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Urban Ecosystem Participation in Extraction Landscapes

'Extraction Ecologies'

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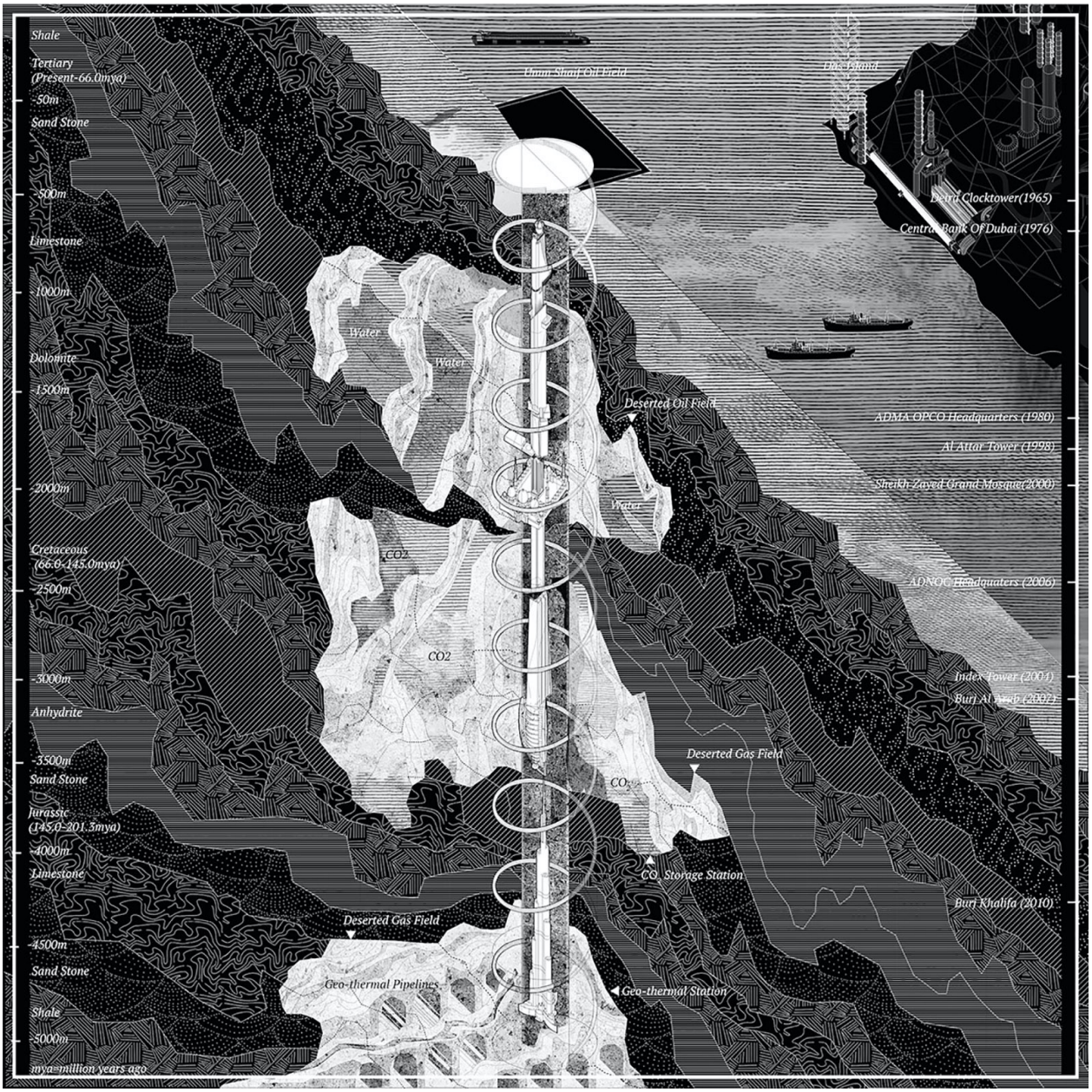
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Urban Ecosystem Participation in Extraction Landscapes

‘Extraction Ecologies’

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Drawing what is beneath the surface reveals the unseen despoliation of the Earth in the pursuit of extraction and settlement, write Rania Ghosn and El Hadi Jazairy of Design Earth

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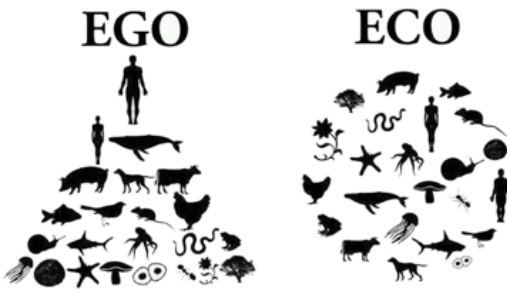
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Index

Chapter 1 Introduction

§ 1.1 The main research question, relevance, theoretical background & methodology

- Theory
- Critical cartography
- Systems description and synthesis
- Scenario development and application
- System intervention – guidelines, manifesto and design experiment

§ 1.2 Mobility & transport and ecosystem participation
§ 1.3 The cases

Chapter 2 - 7 Drink, Drink, Hot, Systems, Flows, Flows

§ 2-7.1 Introduction to the case
- Environmental risks
- Human response to the risk
- Project scales & actors

§ 2-7.2 Research question and theoretical framework
§ 2-7.3 Critical cartography
- Anthropology
- Landscape morphology and ecology analysis
- Urban morphology
- Mobility and transport

§ 2-7.4 Systems description and synthesis
- Hybrid system drawing (bringing together the domains)
- Assemblage of assemblage ecologies
- Problem analysis map

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§ 2-7.5 Scenario application
Nature first
No technology
No humans
§ 2-7.6 System intervention
Performance bases urban design guidelines
Guidelines map
Manifesto
Design experiment

Chater 8 Cross analyses

Chapter 9 Conclusions

Refrences

1.
Introduction

§ 1.1

The main research question, relevance, theoretical background & methodology

Environmental crisis

The environmental crisis is composed out of direct and indirect impact of human action on the ecosystem. The direct impact is: biodiversity loss, pollution, conservation, landscape use and exploitation of natural resources; with focus on terrestrial, freshwater and marine realms (Domingues, 2017). The indirect impact is the human impact on the climate inducing climate change that impacts the ecosystem in: timing of seasonal life-cycle events, range shifts of species territories, food web disruptions, buffers and threshold effects for wildfires, flooding and drought, spread of pathogens, parasites, and disease: shifts in ecological conditions could support the spread of pathogens, parasites, and diseases and plant and animal extinction risks (EPA, 2017)

With this urgent challenge to respond to the environmental crisis with strategies like climate adaptation, energy transition, and continued but sustainable urbanisation, the urgency of integrating planning and design with urban engineering increases. The implementation of new technological interventions and the utilisation of the natural system in urban development is hampered by the lack of an integrated approach incorporating urban planning and design decisions. This can be illustrated in decision making concerning changing to decentralized systems of water and energy. Meanwhile, urban and economic growth increasingly competes for infrastructure and environment, affecting the success or failure of the daily operating systems of cities and regions and thereby affecting urban competitiveness (Kresl & Ietri, 2014). In light of new technologies, the challenge is to fundamentally re-think the urban landscapes material and ecological practices. In this sense, the question is how to renew existing urbanized areas by integrating parameters of the natural system and technological innovations directly into urban development opportunities arising from spatial planning and design.

The ecological, climate and urban crisis globally takes place in anthropocene landscapes. Events like tsunamis', hurricanes, extreme drought and cold, or extreme urbanizations take place in 'used' landscapes, anthropocene exploitation of resources. This book exposes explorative research into 4 landscapes of extraction in which different forms of critical relationship between nature (biotic/abiotic) and culture exist. By reading and mapping ongoing trends and projecting future change, the course will engage with a main research question which has the purpose to turn the negative effects of extreme ecologies around:

How can ecosystem participation perform as a design catalyst for healthy and climate proof urban extraction landscapes?

It should guide us in answering how to move from considering ecosystems as a service towards going back into the system as a participant. Next result is then how does this affect the living in these landscapes. By working on different situations we can get a methodological understanding of how this affects our field of urban design.

The working hypothesis moves away from the notion of ecosystems as services to be deployed in a human-nature dichotomy, and instead, it acknowledges the fact that people and urban systems are part of the ecosystem and stipulates on the fact that we need to engage with nature as nature, thus participate. Furthermore, the notion of participa-

tion purposefully engages with local sensitivities and culture, re-establishing a new harmonious relation between traditional/indigenous practices and technology. This is an important new perspective that not only gives natural systems a better position as a stakeholder in urban development, but it also acknowledges the fact that extreme landscapes are complex ecosystems that need to be contextually understood, demanding tailor made solutions. In this regard, terms like 'nature based solutions', 'building with nature', 'green blue infrastructure' or 'landscape infrastructure' are solutions that can be re-defined for each context.

Finally, the research investigates how ecosystem participation affects the living in the proposed extraction landscapes. By studying the mechanisms, a fundamental and meth-odological understanding of how this affects the field of urban design is generated. The cases for extraction landscapes are:

DRINK
Zeist Netherlands/ drinking water

HOT
Rotterdam Waalhaven Netherlands / geothermal water

SYSTEMS
Brazil, Amazon, Transamazonica/ mining

FLOWS
Norway, Oslo, Great Metropolitan Area / wood

Methodology

The research methodological steps were designed to organize theory, information and ideas from the general question into ecosystem participation in extraction landscapes toward application to the specific cases.
The first step was the theoretical framing which is described in the former paragraph. This was important to bring focus into the research and to feed the second step of critical cartography. Each member of the case team took a domain and cooperated with the team members of the other groups in this domain. This was the analysis were tuned and cross learning took place.

The perspectives were:
Anthropology (guided by Baukje Kothuis and Anita van Stel)
Landscape morphology and ecology (guided by Taneha Kuzniecow Bacchin)
Urban morphology (guided by Fransje Hooimeijer)
Mobility and Transport (guided by Fransje Hooimeijer)

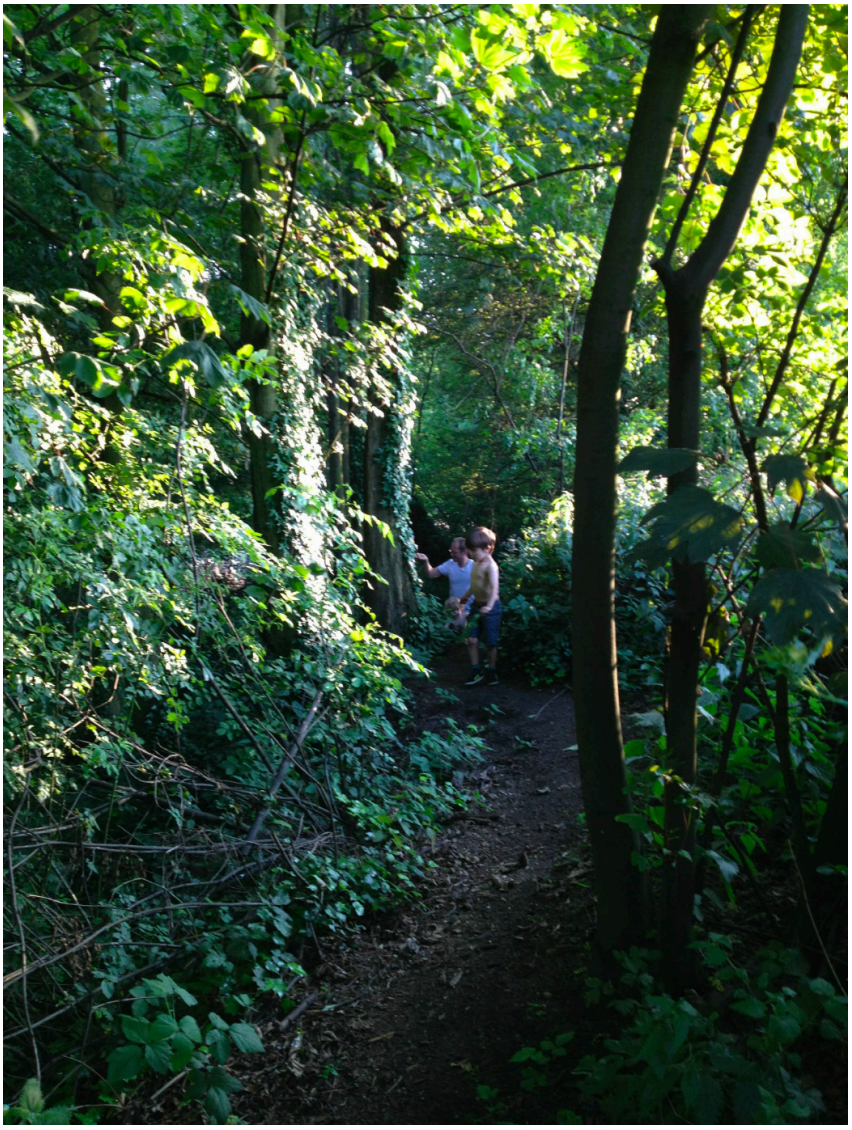
The results of these analyses were brought together for the selected cases in a Systems description and synthesis. By applying four scenarios, boundaries and qualities were explored and ideas generated for the System intervention that followed later, in the case level as general guidelines and on the individual level in the design experiment.

The first step was the theoretical framing from the main research question and a sketchy environment which is described in the former paragraph. The main research question:

How can ecosystem participation perform as a design catalyst for healthy and climate proof urban extraction landscapes?

was divided in three domains: ecosystem participation, catalyst for health and climate proofing and extraction landscapes. The students needed to take one or two domains and formulate a sub-question to the main question. For that question they needed to perform a literature review by defining concept and their keywords that defined the direction of their search. This resulted in a collection of literature review papers describing literature to form the theoretical base for the research that continued.

The table on the next pages is the overview of the sub-questions, concepts (C) and keywords (KW). The review papers offer the base for the theoretical framework and group question per team.



Urban Forrest Rotterdam, coexistence of forrest and city, in which humans both participate

Critical cartography

The critical cartography started with formulation the base-line information by the case group identifying the answers to the following questions:

1. What is/are the environmental risk(s) to be tackled?
   - e.g. polution risk / degration risk / climate change / a combination of ...

2. How does the population of the case study experience the risk?
   - risk preparedness / response (planning) framework in place, system's robustness (and resilience) by design
   - non or little preparedness / response framework in place
   - based on individual responses /social resilience

3. What are the project scales and who are the actors to be involved at each scale:
- Macro-scale: Regional level
  What is the larger spatial (aggregative) unit at ecological/water processes level of importance? e.g. river catchment area / eco-region / etc.
  Who are the actors at this scale?
- Meso-scale: Urban level
  What is the urban scale (metropolitan area / entire city / portion of a city) to be considered?
  Who are the actors at this scale?
- Micro-scale: Urban fragment level
  What could be potentially the smaller spatial unit to be used as test site for a design experiment? e.g. neighbourhood / urban or ecological corridor / parcel (patch of land) / street / household level (plot)
  Who are the actors at this scale?

After defining the problem and the scales of action each group member of the case group took a perspective in the study and cooperated with the members of the other case groups with the same perspective in the investigation. This way the research was tuned between the different cases and the analysis could become comparable. Each perspective had clear goals and products.

<u>Anthropology analysis</u>

The results of the study into anthropology for this research are insight in local time, cultural, and social systems to be able to map out an impression and overview of typical local human behavior in the diverse local extreme environments and local natural hazards.

1 Time systems:
How have people coexisted with their local extreme environment(s)/events?
Products:
- Linear and/or circular timelines, showing Time * Social Dynamics, including
  - General and local historically relevant events and changes
  - Local decisive events, disasters and changes concerning living in and coping with the extreme environment

By including imagery in the timeline(s) both cognitive and visual impressions are created. Additionally, this implies a more diverse contextual approach by the researcher and adds a broader frame of reference to the communication of time systems. Guiding principle is a quote from Donella Meadows's essay
'Dancing with Systems' (2001):

'In a strict systems sense, there is no long-term, short-term distinction. Phenomena at different time-scales are nested within each other. Actions taken now have some immediate effects and some that radiate out for decades to come. We experience now the consequences of actions set in motion yesterday and decades ago and centuries ago. The couplings between very fast processes and very slow ones are sometimes strong, sometimes weak. When the slow ones dominate, nothing seems to be happening; when the fast ones take over, things happen with breath-taking speed. Systems are always coupling and uncoupling the large and the small, the fast and the slow. When you're walking along a tricky, curving, unknown, surprising, obstacle-strewn path, you'd be a fool to keep your head down and look just at the next step in front of you. You'd be equally a fool just to peer far ahead and never notice what's immediately under your feet. You need to be watching both the short and the long term - the whole system.'

2 Human Cultural Perspectives:
How do people perceive their extreme environment(s)/events?
Products:
- A series of window-scapes including representations of typical local interior and exterior surroundings during 'normal' daily life and during life in the extreme environment and/or during the extreme natural event.
- Each window scape explained by 'perception of nature'-concepts based on the 'A Credible Biosphere' (Douglas, 1992), a well known and practicable anthropological perspective on how humans cope with nature and hereto related 'myths' (or 'the socialized perceptions'), using the following legend:

'Nature is Capricious' – This perception implies uncertainty for humans towards extreme environments and natural disasters; the ball can roll anywhere on a flat plane, we don't know what it will do next.


'Nature is Fragile' – This perception implies vulnerability for humans towards extreme environments and natural disasters; there is only one possibility of equilibrium, with the ball on top of the mound, every disturbance creates major changes.

'Nature is Robust' – This perception implies a resilient situation for humans towards extreme environments and natural disasters; there will be return to the original state no matter what the disturbance is.

'Nature is Robust within limits' – This perception implies a resilient situation for humans until the extreme environment or natural disasters reaches a

tipping point, from where there is no return to the current safety; the ball will roll over the edge and never come back to the original state.

Taking human agency as a starting point, some of the following notions could be leading for research:

- How do people perceive the extreme natural hazard in the specific local environment and culture?
- Before, during, after extreme events?
- What conflicts/opportunities/actions have sprouted from these perspectives?
- Or could be developed based on these perspectives?

3 Extremes and vulnerabilities:

Which strategies for coping with the local hazards and which aspects relevant for developing local social resilience are in place or can be developed to deal with vulnerability in this extreme environment?

Product(s):

- Deep map/Heat map: showing structures, infrastructure, and other strategically aspects (potentially) relevant for coping with hazard and developing social resilience on the urban scale. Using images, layers, text, drawings, in overlapping layers to demonstrate aspects of (potential) mitigation (minimizing devastating impacts of hazard/extreme environment) and adaptation (adjusting circumstances to live with hazard/extreme environment).
- Mind-map: Communicating an array of connections related to 'resilience to vulnerability' that are hard to explain with a linear story. Make use of pictures, words, drawings, etc. 'Vulnerability is the extent of harm, which can be expected under certain conditions of exposure, susceptibility and resilience'.

Taking the' formal and informal' as starting points for the anthropological perspective on extremes and vulnerability, some of the following notions can be leading

- How is vulnerability shared/distributed in the extreme environment?
- Who is formally responsible for coping with the extreme environment/hazard and how is that responsibility enacted? (Think of policies, institutions, etc)
- Who takes responsibility for coping with the extreme environment/hazard informally and how is that responsibility enacted? (e.g.; local initiatives; objection against formal rules, etc)
- How do people individually prepare for extremes?

<u>Landscape morphology and ecology analysis</u>

This perspective aimed at analysis of the larger scale natural landscape and bringing it to the urban scale in three parts: Palimpsest, the analysis ecosystems' profiles and series, processes and synthesis.

The first part of analysis is named Palimpsest, a term which originally describes the scraping of a manuscript page to be used again. In geology, a palimpsest is a geographical feature composed of superimposed structures created at different times. Palimpsest is beginning to be used by glaciologists to describe contradicting glacial flow indicators,

usually consisting of smaller indicators overprinted upon larger features. The Palimpsest thus is the natural layer, the cultural layer and the urban layer connected through scales. The natural layer is the landscape typology like forest, desert, tropical forest, the geomorphology like topographic contour lines, elevation and landform and the soil type. The cultural layer are the settlements, settlement typologies and land use based on the possibilities of the natural layer with relatively small impact. The urban layer are on the larger scale the energy landscapes like windmill and solar parks, understanding of the larger scale of the landscape morphology and composition.

The first level of ecosystems' profiles and series is about defining which systems (biomes) and how they relate (ecotone), their flora and fauna and soil conditions. The biomes and ecotones are first found in their larger scale positioning in the landscape of the site. An ecotone is a transition area between two biological communities or biomes. They are then described in their Flora, the natural (possible) vegetations and Fauna, the natural (possible) habitat and the present habitat of species. The soil typology is defined and seen for its life and fertility.

The Processes are pollution, climate and dynamics. The pollution is studied in the soil, air and noise on the urban scale. The climate is studied in the categories wind, direction and intensity, temperature, deviation and seasonal, and dynamics is studied in tidal sea, flash flood, erosion, fluvial and pluvial flooding.

The concluding part is synthesis in which the assessment of the habitat and quality of life is done.

Urban morphology analysis

The perspective of urban morphology is the base line study for the urban design field and for this research focussed on the two scales: urban and architecture. The constructions analysis is the connection between the scales.

The first part of urban morphology looks into the urban typology and vital infrastructure. The urban typology is taking the logic from building ensembles (year of construction, materialization), Public spaces (spaces of collective gathering), Green open spaces (parks / vegetated areas) and draws sections of the most characteristic typologies of spaces, and masses. The study of vital infrastructure is aimed at health and utilities.

The second part of architectural morphology is important to make the step to the human scale and continued with the vernacular architecture, building typology and construction and materials. This scale is clearly connected to the anthropology study that also entered the house with interior drawings like the window-scape. It also connected to the scale of ecology in studying the natural habitat.

The last part of extreme constructions investigates the relation between landscape alterations, hazard protection and draws the conclusion to extreme situation on the urban scale as a collection of buildings.

Mobility and Infrastructure and eco system participation

The Transport Infrastructure and Logistics (TIL) students took the additional general perspective from their disciplines which is presented in the paragraph named 'Mobility & transport and ecosystem participation'. Herein they developed a framework how to understand the this concept in mobility and transport systems.

Systems description and synthesis

After concluding the critical cartography per perspective, all perspectives are, coming from the problem statement, brought into one hybrid system drawing and problem analysis map. The representation of the case in its complex relations is done on the lowest scale of analysis to be able to connect to the human scale and design directly.

Inspiration for the hybrid system drawing was the exploded view of a machine. Among those involved in the Landscape Urbanism discourse, Gray (2011) states in relation to the concepts of 'the machine landscape mode' as defined by Mohsen Mostafavi (2003) and the 'field operations mode' as set out by James Corner (2006) 'In pairing landscape with urbanism, landscape urbanism seeks to reintroduce critical connections with natural and hidden systems and proposes the use of such systems as a flexible approach to the current concerns and problems of the urban condition.' The machine landscape mode considers landscape as a cybernetic universe with its own laws.

The method applies dynamic systems in mapping to the study of the fluxes and processes that are inherent to the constant time-space evolution of the landscape. It comprises the gathering of information, its decoding, synthesis and systematic processing towards a design that accommodates change and indeterminacy. This approach puts this knowledge in the centre to steer infrastructure and ecological systems as guiding mechanism in urban design, thus to make the step to intervention the decoding and problem analysis offer the base. This base is tested in the next step of scenario development and
application.

Scenario development and application

When the location was studied, described and analysed, the synthesis between spatial elements of the site understood, the next step of scenario application was done to test the potentials of the location. Three scenarios were proposed that the students developed further (see table on next pages):

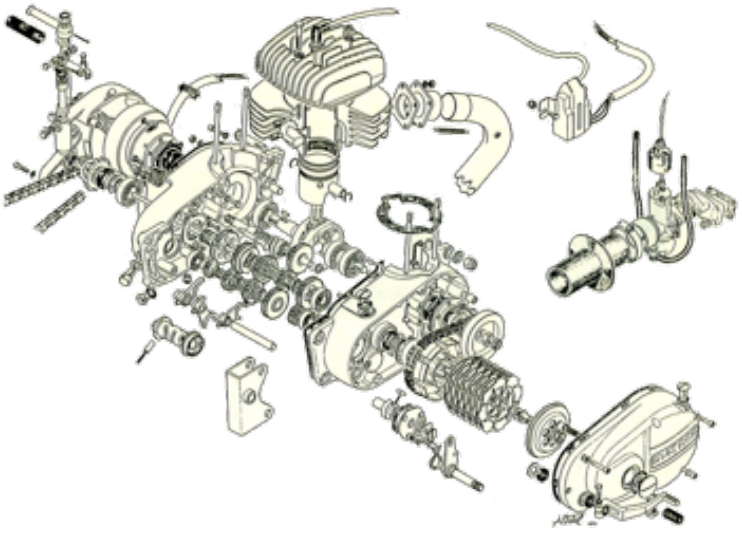
Nature first: situation of no further urban development and nature is prioritized.
No technology: situation of growth in which technological solutions are avoided.
No humans:the location is left to nature.

The base that was developed was used as a paper doll that could be dressed up with different outfits, the four different scenarios. The image to the right shows the main conclusions and directions within the three scenarios.

System intervention – guidelines, manifesto and design experiment

The last part of the project was the system intervention, proposing guidelines for the case as a group and developing a manifesto and design experiment individually. Continuing on the conclusions of the research the group develops a vision for the future of the area and formulates Performance based urban design guidelines as a group. These guidelines are presented in a map and in a flow chart in which the relations between the vision, the goals and the proposed development rules become clear.

The final part is individually drawing up a manifesto which connects the urban design guidelines for the area to the personal fascination. This is tested in a design experiment on a smaller scale and more specific topic as an elaboration of the guidelines.

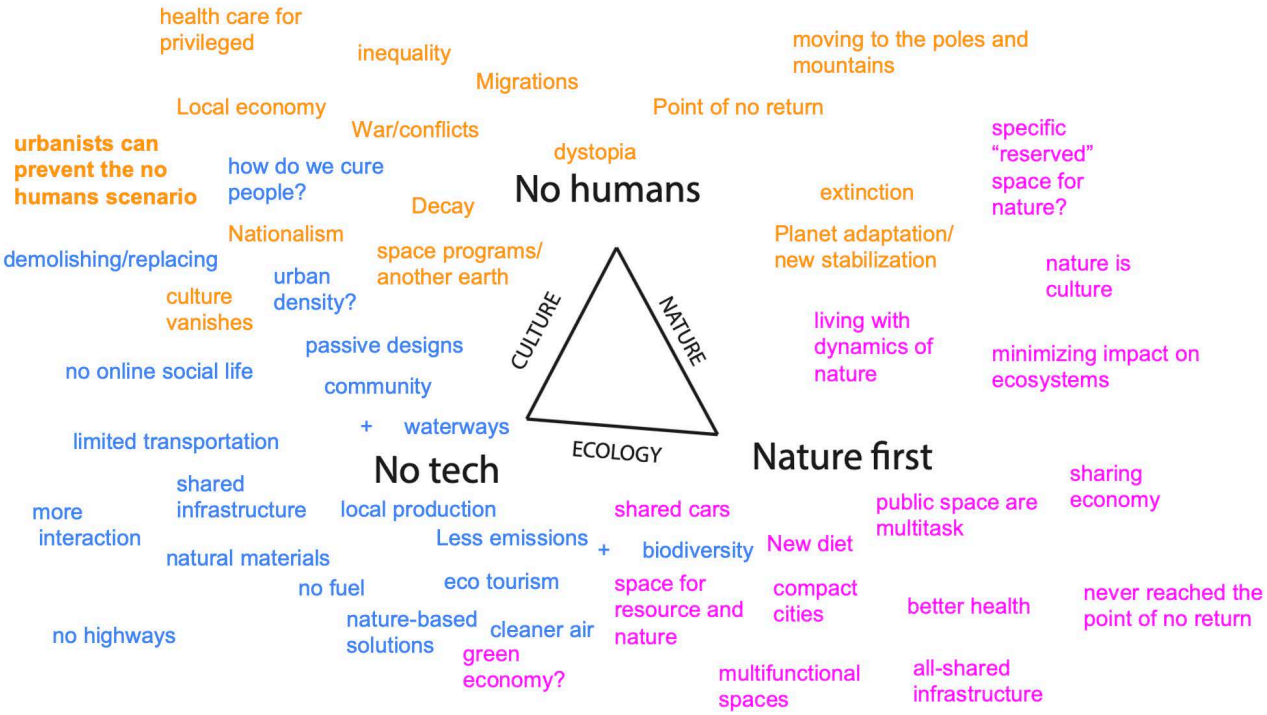




	No Humans	Nature first	No technology
	This scenario is part of a retreat strategy over a long time, where it is assumed that people will gradually leave the area, leaving nature to re-colonize the place.	This scenario assumes a de-growth context where nature is put at the centre of the design decisions.	This scenario excludes heavy engineering and tech-based solutions from design. It integrates a radical design with nature or "deep ecology" approach to design.
What is the effect of this scenario on:	We keep going like we're going now, the world starts to become inhabitable, so at first we start migrating to specific places, which will lead to an increase in conflicts and wars. Next a few test subjects will be sent to Mars (or another planet) and when everything is safe there the most privileged will migrate. There will be people left on earth, because they choose to or because they can't afford to go. The conditions will become so harsh on earth that they will all die eventually.		Technology: man-made, no fuel/energy needed, facilitated by nature .
Impact on resources	The pressure on resources will keep increasing which will lead to wars and conflicts and only the privileged will have access to resources in the end. After our departure, or extinction, the only resources left are biobased ones. All mineral and fossil fuels will not be found anymore because we used them all.	We only take resources out of nature which we can give back to nature. We will do this gradually so that we do not cause shocks to existing ecosystems. We won't cut down the whole forest and then plant it back. We try to take it little by little and plant it back in the meantime.	- Transportation of resources is limited - More pressure on local production - Economic restructuring - Less possibilities
Mitigating or adaptive impact on environmental risks	Humans tried to adapt but it was not sufficient because it was already too late. When we leave we also leave a lot of evidence of our efforts in the form of infrastructural works and such. Only after we have left will the planet be able to stabilize again.	We will live with the flows of nature, for example letting the rivers choose their own path, and letting it change over time. An example for this is could be 'ruimte voor de rivier'.	- Less emissions due to less polluting technology - More difficulty using passive techniques on extreme situations (adaptiveness is slowed down)
Eco life in this scenario	Before we left eco life had a hard time as well, species went extinct and ecosystems were highly disrupted. After we leave the eco life will slowly start adapting and evolving again and will end in new types of ecosystems.	Nature is seen as an equal actor. Cities are very compact with nature as public space. In between the compact cities there is a lot of space for nature.	- Less emissions: beneficial for eco life - Biodiversity due to nature-based solutions - Bigger incentive to improve the local environment (due to sourcing/exploiting from that environment)
Social life in this scenario	As conflicts arise people will become more individualistic, and countries will become more nationalistic (or countries' futures of power will be taken over by companies) and will be putting more walls to keep resources in and people and the forces of nature out. When moving to another planet the division between the privileged and the poor will become bigger. There will be more refugees and homeless people because of migration to areas that are more liveable.	With less resources we should evolve towards a sharing economy in which we use the scarce resources as efficiently as possible and decrease the impact of humans on the natural environment. This sharing society is also a change to increase the social cohesion and the sense of community. As working together becomes more important.	- More community and human-nature interaction due to common goals and responsibility to sustain your surroundings (coexistence) - Anonymity caused by technology is reversed

	No Humans	Nature first	No technology
	This scenario is part of a retreat strategy over a long time, where it is assumed that people will gradually leave the area, leaving nature to re-colonize the place.	This scenario assumes a de-growth context where nature is put at the centre of the design decisions.	This scenario excludes heavy engineering and tech-based solutions from design. It integrates a radical design with nature or "deep ecology" approach to design.
Economy	The economy becomes more global because of scarcity of resources. The world needs to share or trade in order to supply for everyone. Common people will not have a say, or a choice, in what there is to buy. Whatever food is available will just be distributed to them.	We will focus on using local resources. The final goal will no longer be to make the largest monetary profit, but to make the biggest gain in nature and our surroundings. Effects on nature will be central in the new economic model. Free market forces	- More locally run economics (local export and import) - Less exploitative of the natural environment / focus on regenerating the environment - Eco-forms of economies (eco-tourism, nature-based solutions...)
Public Space	When migrating to a few areas on earth the public space will become scarce as well which will lead to the fact that the public space won't be public anymore, only the privileged will have access and the social division will only increase by this. Maybe a few public spaces (with lower quality) will be left for the poorer people to live and interact in.	Space limitation in these compact cities will make sure there are no surplus capacities in the city. Every place is used intensively and for multiple functions.	- Usage of materials: locally produced/ natural materials - Social life requires communal space - Less nuisance from surroundings (sound, air pollution) - Public space becomes more important (less technology means more outdoor activity > Distance to public space? Size of public space? Function of public space (per product/service)?) - What is needed in the physical world (vs. digital world)? A new typology?
Infrastructure/mobility	At first we keep creating more technologic ways of transport (hyperloop) until we really have no resources anymore, then we go back to more traditional ways of movement which don't need the same amount of fossil resources, such as using wind again to transport over water. The fossil fuels that we have will be reserved for the space programs so that the privileged can leave the earth when the time has come.	Shared public transport (No cars) and no import/export transport (except for necessary goods). Limited access to vital infrastructure, because of local production. When energy or clean water runs out, it's out. Vital infrastructure is taken care of by one provider, diminishing the material and space needed.	- More local infrastructure: Less regional/ international infrastructure - Improved shared infrastructure (heat networks, energy networks, water networks) - Increased usage of waterway network - Less public transport - Other use of infrastructure (walking, cycling, boats, gliders, hot-air balloons) no highways etc
Buildings	During the conflicts more buildings like bunkers and walls around cities will arise to keep other people and forces of nature out. As an elite countermovement big greenhouses-like buildings will arise which will have a nicer living climate than the underground bunkers, but will also be more difficult to build and maintain.	Extreme adaptive (changing function + climate conditions) and circular. Moveable houses. Smaller houses so there is more space for nature. More common areas for saving space.	- There is a pop/m2 / densification limitation (no high-rise possible) - Passive energy production (wind, thermal mass, water > circular, closed loop) - New typology based on local economies - Context-specific building forms and solutions (vernacular architecture/passive design)
Culture/Heritage	Because being able to take care of culture and heritage is seen as non-essential for western culture, it will soon start to decline when other issues become more prominent. A lot of cultures will vanish when groups of people are not able to go to the other planet. There will be people that want to record everything that was here, but this will not come from one of the parties with power, so it will be the question if these recordings will actually survive. During the transition cultures will slowly start to vanish as well because	Nature will also be seen as heritage as well as being an active living part of our culture. So not only man made artifacts/ buildings/cultural activities play a part in what we conceive as culture but also the natural environment.	- Because of the amount of time and effort put into the buildings/public spaces/ products, demolishing/replacing is less attractive - Culture and heritage, as physical meeting moments, are of greater importance/ higher valued

	No Humans	Nature first	No technology
	This scenario is part of a retreat strategy over a long time, where it is assumed that people will gradually leave the area, leaving nature to re-colonize the place.	This scenario assumes a de-growth context where nature is put at the centre of the design decisions.	This scenario excludes heavy engineering and tech-based solutions from design. It integrates a radical design with nature or "deep ecology" approach to design.
Culture/Heritage	resources will diminish and change so people will have to adapt what they eat and make. With this a lot of cultural traditions will change then as well and will only exist as stories.		
Health	With resources becoming scarce, health care will become for the privileged (again). Having access to non processed food will be limited to people with money, diets will become less varied and it will become more difficult to maintain a healthy diet.	Improved significantly: more local, more green, less air pollution, more exercising. Changing diet: no more export and import, which means more local agriculture (for example agroforestry), this translates into a more sober diet of seasonal and local produce.	- Less diverse diet, only locally produced products, also more fresh products - No hospitals with technology: less diseases, health issues can be cured - Less environmental pollution: clean air - More physical activity
Impact on resilience	Humans will not be resilient enough to keep living on the earth, that's why a part will leave and a part will die. The planet turns out to be resilient when we're not there anymore and will evolve into a world with life again.	The term "resilience" no longer applies, since it is so human-centered. People are so much closer to the dynamics of nature and live together. Society is resilient in its core.	- Resilience is based on the prosperity of the local economy and people: self-sustainability
Influence on climate/climate change	We were too late to stop climate change so a part left when they still could. When humans were gone the climate kept changing but without our influence it stabilized again, in a different form.	People no longer have a significant impact on large geological processes, as currently is seen in the Anthropocene.	- Less climate change due to less emissions, local economies/communities and a bigger incentive to improve the local environment.
Level of ecosystem participation	There is no level of ecosystem participation. Humans drained the earth of its resources and when there was nothing left, they tried to live with the ecosystems for a minute but it was already way too late, so then they just decided to leave the earth in the state they left it in.	Spatially we are more separated from nature, while our systems will be more dependent on the local natural systems. This will allow nature to have a fair opportunity to heal and to be.	- Natural solutions are preferred over technical solutions, so there is more ecosystem participation - Local communities, so dependent on the environment



Summay of the scenarios

§ 1.2

Mobility & transport and ecosystem participation

1.2.1 Transport network introduction

Characteristics
The transport network was described early on by Jones in 1977 from the traveller's perspective, as consisting of several dimensions: Mode, Time of Travel and Journey purpose. The mode tells us something about the possibilities that a traveller or a good has in a transport network. For example, an urban environment in which the traveller has four different mode choices: private car, bus, tramline or metro. Each mode has a certain time and cost component that results in an equilibrium which prefers one mode above the other in different situations. Quandt expanded on this in 1992 by stating that each transport mode also bears a frequency of service and a comfort component. Time of day is a dimension that makes certain modes attractive or unattractive. The metro line, for example, will be attractive during morning peak hours due to its low cost and low travel time component. Since the demand of transport is a derived demand, the journey purpose plays a significant role. Being a derived demand means that the amount of transportation depends on the goal that it serves (Holmgren, 2007). Replacing shopping facilities from the city centre to a surrounding neighbourhood will decrease the level of transport in the inner city and increase the level of transport outwards the city. Finally, the route plays an important role in transportation networks. Routes are made up by activity nodes and links. Activity nodes are access and exit points (Knöll & Mezini, 1977). Examples of activity nodes are train stations, airport hubs or highway junctions. They are characterised as spatial points where multiple transportation links come together and passengers are able to switch from one link to another link. Transportation between these activity nodes is only possible if they are connected by links that serve mobility or logistic flows and therefore provide a certain degree of accessibility. Examples of links are highways, railways or waterways.

However, over the years transportation systems have become more complex, consisting of more components and influence on the outside world. Several bad externalities have arised, of which one is a higher degree of carbon pollution. In terms of the decarbonisation of transport infrastructure, from a systems perspective; Schwanen, Banister & Anable suggested in 2011 that four different sets of elements should be targeted: transport technologies, the price or commodity value of carbon, the 'hard infrastructure', the behavior of users, and the institutions governing transport systems. From a governmental perspective certain routing policies can be implemented to distribute travellers in a more efficient way to motivate or relieve transport modes, destinations and areas. It would be wise to use the identified sets of elements in designing new policies.

To be able to analyse the urban network and identify potential opportunities, a theoretical framework is developed. The mode and route characteristics are regarded as most important in decarbonisation and ecosystem reservation, since they consist of the building blocks that bear the biggest influence on ecosystems. The framework serves as a handy tool to identify critical components in spatial planning and urban design to contribute by means of ecosystem participation instead of the disruption of ecosystems. By making use of the framework, urban planners and designers can develop guidelines to make sure that mobility becomes part of the city's ecosystems instead of exhausting them.

Effects on ecosystems
The main function transportation infrastructure serves is to enable travel activities for both humans and resources. Transportation relates to the movement of goods and people and the undertaking of this activity has several benefits and has been a major human pursuit throughout history. Human travel is done for a variety of reasons, for example work, leisure, research, trade as well as governmental, due to the spatial spread of activities and resources. Therefore, transportation is mainly concerned with either moving resources to more useful locations or people to areas where certain activities can take place. A key measure of transportation potential is accessibility. Transportation infrastructure serves to allow goods and people to reach certain areas which leads to social and economic welfare. Accessibility can be defined as "the potential of opportunities for interaction" (Hansen, 1959). According to El-Geneidy and Levinson (2006) accessibility measures "the collective performance of land use and transportation systems and determines how well that complex system serves its residents". Common examples include visiting distant relatives, discovery of previously unknown territory, travelling to undertake leisure activities, exchange with other human cultures, visiting religious sites as well as practicing medicine and delivering medical supplies. Economic welfare is generated through gaining access to jobs, spending of money on leisure activities, trade and resource extraction. All these activities constitute a need for transport.

The impact transport systems have on development and welfare is directly related to the ability to take social and economic opportunities, for example gaining access to markets, employment as well as resulting in further investments in the region (Rodrigue, 2020). According to the author, transport accounts for 6%-12% of a country's GDP, and logistics costs can constitute up to 25% of the gross national product at the macroeconomic level. Furthermore, the effects of transportation activities have more widespread effects as the level of activity and monetary expenditure triggers more activity and more expenditure. These benefits are even more prevalent in peripheral regions and "reduced spatial friction" can result in vast improvements in economic welfare (Leck et. al., 2008). Finally, transportation is a derived demand. People travel, because they need to. The benefits of good transport infrastructure stem fundamentally from this aspect: On one hand costs arising due the need to overcome a distance can be reduced with good infrastructure, secondly benefits that arise due transport improvements directly benefit the activities from which this demand is derived in the first place (Blum et. al. 1998). Examples of direct benefits of improved transportation regimes are decreased travel times, decreased travel costs, increased real estate evaluation as well as increased production and commerce (Rabello Quadros et. al., 2015).

1.2.2 Ecosystem - Transport influences

Effects on ecosystems
For every kind of transport infrastructure it is important to identify what the effects on the ecosystem in the surrounding area will be. In this research the effects on ecosystems related to four different cases will be described. The needed infrastructure for each of the cases will certainly have different effects on the ecosystems in the surrounding area. However, the construction of transport infrastructure will always include the build-

ing of new roads, waterways and pipelines (Hossain, 2019). For example, research has shown that the road infrastructure will increase by 60 percent in 2050 compared to 2010 (Asher et al., 2020). Especially in developing countries, there will be a huge increase in road infrastructure, up to 90 percent compared to the current situation (Laurance et al., 2014). The tropical forests in these countries are currently facing a lot of threats because of industrial activities and in the future these threats will even become bigger.(Laurance, 2013). Forests in general fulfil an important function in their surrounding environment providing global carbon benefits and providing good quality of local ecosystems which supports biodiversity in related areas (Barrett et al., 2016).

Besides the threats for tropical forests, transport infrastructure affects nature in other direct and indirect ways. The physical presence of new transport infrastructure in a landscape leads to new habitat edges, alters hydrological dynamics and disrupts natural processes and habitats. The main effects of transport infrastructure are considered in five categories; habitat loss, disturbance, corridor, mortality and barrier. Habitat loss is a consequence of landscape fragmentation because of new infrastructure. Disturbance is a consequence of the fact that new infrastructure disturbs and pollutes the physical, chemical and biological environment. Movement corridors could be a benefit as a consequence of new infrastructure as they provide connection between different natural areas for wildlife. Mortality is a consequence of new infrastructure, transport mortality has been growing over the last few decades. Lastly, new infrastructure can create barriers in ecosystems resulting in less accessible areas and even isolated areas.(Seiler, 2001). In the future there is a need to find a way in balancing human needs and ecosystem needs in order to realize a sustainable environment. To mitigate the negative effects of transport infrastructure, it is important to focus on the use of green infrastructure to maintain and support the ecosystem services provided by specific ecosystems.(Ghent, 2018)

Ecosystem participation

Ecosystem participation is an important factor in ecosystem management. The past decades, the call for more stakeholder participation in local land-use planning has been increasing. Critical natural resources are decreasing and ecosystem approaches are being embraced more often. Ecosystem management requires an approach that goes beyond existing jurisdictions and requires broader scales (Grumbine 1994; Christensen et al. 1996). Current ecosystem approaches are bounded to administrative or political lines, rather than the ecological boundaries (Brody, 2003). There have been many claims that local ecosystem participation will benefit the quality of the local land-use. It is argued that this interference is a democratic right, a right constantly being used by environmentalists and activist groups. However, different stakeholders such as resource managers, ecologists and social scientists disagree about the possibility of balancing out the social and ecological goals (Keough & Blahna, 2006). The participation in the ecosystem is very much influenced by the need for transport. A higher need for transport calls for more ecosystem participation to limit damages. Road networks for example have a direct influence on ecosystem change (Liu et al., 2008). Loyd, Lohse and Ferré (2013) however found that with active participation in constructing these road networks, ecosystems can recover. This shows that active ecosystem participation can have an influence. The framework describes through what ways, participation can

be beneficial to the ecosystem in each specific situation. Each situation is different and requires different ways of required influence by mankind. Lumber transport is different from geothermal transport in terms of transport modes and required land-use. We as humans need to find a way to optimally distribute those goods with regards to reducing ecosystem damage.

Critical transport evaluation
For the efficiency of transportation it is crucial to map the network and identify the critical points in the system. To identify which parts of a transportation system are critical, the system needs to be viewed as a whole; a transportation network. Being able to map the critical points (nodes) and links (flows) in the network, will lead to immediate benefits. These benefits stem from the ability to plan for and manage the impacts of transport network degradation to minimise further consequences on economic, employment, trade and social activities in cities and regions (Taylor, 2003).
For the transportation of goods and people there is a wide range of short-term disruptive events, such as partial flooding, visibility reductions, traction hazards due to weather, and pavement deterioration occur on transportation networks on a daily basis (Sullivan et al., 2010). These impacts have a very relevant impact on the overall flow, for mobility but also for other networks of flows. To be analysed, transportation networks can be represented by an undirected graph; a set of nodes that are connected where all the edges are bidirectional. The nodes represent for example train stations and airports where the links represent traffic roads, railways, bicycle paths or waterways.

There are multiple ways of evaluating, analysing and optimising transportation networks. Ip and Wang (2011) first identify the survivability of transportation of a pair of nodes. The survivability of a pair of nodes depends on the number of passageways between them. This is then used to get to the resilience with which the friability can be calculated. The resilience of a city node can be evaluated by the weighted average number of reliable passageways with all other city nodes in the network. The network resilience can then be calculated by the weighted sum of the resilience of all nodes. The friability is defined as the reduction in total resilience upon removing a link or node. It thus determines the critical nodes and flows in a transportation network as it can expose the pain points for any form of transport (human or goods).
Scott et al. (2006) present a new, comprehensive, system-wide approach to identifying critical links and evaluating network performance; the Network Robustness Index. Their aim is to generate not only local solutions but a system that considers larger scale, system-wide impacts. The approach considers network flows, link capacity and network topology. They rely on existing sources of data and yield different highway planning solutions than traditional methods.

1.2.3 Framework assessment

Framework structure
In the table below on th enext page, the framework is displayed. The three effects on the ecosystem, as described in paragraph 1.2.2, are further subdivided in mobility and infrastructure characteristics. The reason these two are separated is the key difference

in definition. Infrastructure relates to the static spatial areas that enable mobility to happen (roads, rivers etc.), where mobility is defined as the components that make use of the infrastructure (cars/trains/boats etc.). Without one or the other transport would not be possible. The mobility and infrastructure characteristics are subsequently divided into two categories. The mobility characteristics are divided into mobility flows and logistic flows. The first captures the effects of the transport of people necessary for the mobility system and the latter for the effects of transport of goods. The infrastructure characteristics are subdivided into activity nodes and transport links. The difference in these two has already been illustrated in the paragraphs before, and is important as they are two distinctively different elements in the network.

Green vs grey infrastructure
Within the infrastructure characteristics, there is a differentiation between green and grey infrastructure. Green infrastructure is natural infrastructure or infrastructure integrated in nature, whilst grey infrastructure is man-made infrastructure. The natural flows of a river for example can just as well be used to guide human transport or transport of goods as man-made roads or railways. Whilst infrastructure made by man is certainly necessary for humanity to develop and prosper, the natural aspects of infrastructure are often forgotten. Not only is it important to include nature in the planning and development of infrastructure, ecosystems themselves can be regarded as infrastructure (Silva & Wheeler, 2017). In a way, natural infrastructure is more enduring and resilient than man-made infrastructure, which usually only lasts for 50 years and leaves considerable damage to the environment behind (Doyle et al., 2009). One of the most prime examples of natural infrastructure are water flows, which follow the laws of nature and can only be managed by mankind, but not stopped. However, at the same time these are used as a primary means of transportation across the world, carrying both freight and passengers.
The use of natural infrastructure can become one of the cornerstones of ecosystem participation. Not only in the field of physical transportation of people or goods, but also in the field of supplying people with proper drinking water (Tellman et al., 2018). Despite the historic value of natural infrastructure in humanity's development, its use is still underappreciated in current times. Changing such a stunted view in many countries takes considerable effort, however will result in payoff of environmentally sustainable infrastructure and a better living environment for people across the world.

Notes on Framework
The framework aims to map the effects on the ecosystem, the participation of mankind, the effects on society and economy and the evaluation on critical transport evaluation. The characteristics of the network are split up in the mobility flows, activity nodes, logistics flow and transport links.

Effects on ecosystem: This part of the framework describes the effect of mobility services (mobility flows/logistic flows) on the transport related areas related for each specific case (activity nodes/transport links)

Ecosystem participation: The ecosystem participation describes to what extent the ecosystem participation has an influence on different transportation modes for different transportation purposes.

A framework on ecosystem participation and mobility systems			**Transportation of lumber, gravel and sand (Flows, Norway)**	**Minerals and soy beans (Flows, Brazil)**	**Geothermal and public transport (Hot, Netherlands)**	**Drink water (Cold, Netherlands)**
Effects on ecosystem (ecosystem services)	Mobility characteristics	Mobility flows (Human transport):				
		Logistics flows (Goods transport):				
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
		Transport links:	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
Socio economic effects	Mobility characteristics	Mobility flows (Human transport):				
		Logistics flows (Goods transport):				
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
		Transport links:	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
Critical transport evaluation	Mobility characteristics	Mobility flows (Human transport):				
		Logistics flows (Goods transport):				
	Infrastructure characteristics	Activity nodes:	*Green infrastructure* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
		Transport links:	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
Guidelines						
Ecosystem participation	*Guidelines*	Mobility characteristics				
		Infrastructure characteristics				

Critical transport evaluation: This describes the most important facilities and parts of the infrastructure related to the different mobility services (mobility flows/logistic flows) and the transport related areas related for each specific case (activity nodes/ transport links)

1.2.5 Reflection on the framework

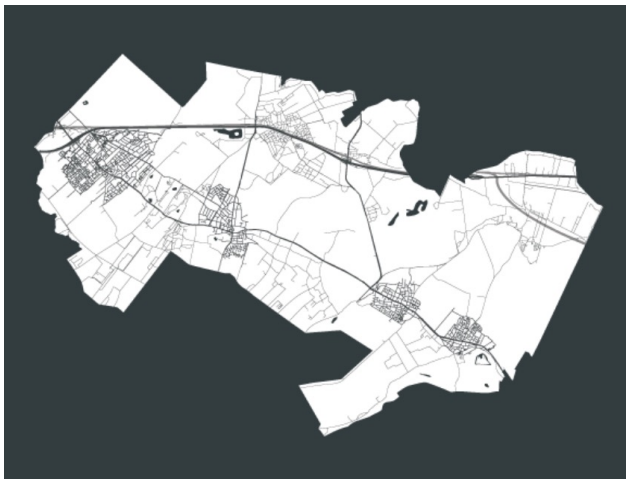
In this paragraph, the framework is shortly reflected based on the applications of the framework for the different cases. The framework tends to dissect the model into different subsystems that are the building blocks of the transportation infrastructure. By doing so, each part can be evaluated on ecosystem participation, socio economic effects and critical transport evaluation to produce guidelines that should be taken into account when developing/modifying transport infrastructure. The distinction between grey and green infrastructure helps analyzing what part of the current infrastructure is grey or green and what green alternatives are present. The current situation could be analysed and new green solutions could create guidelines to design a landscape where human and ecosystem are integrated more. Although the framework incorporates the current situation and the green solutions, it does not explicitly define this distinction. This makes it harder to interpret what system is present and what options are available for a more green integrated system.

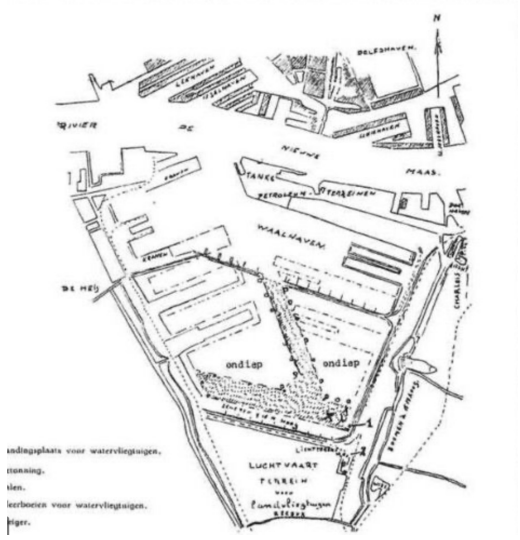
For the hot water case of Rotterdam south, transportation infrastructure is built underground (metro lines), above ground (rail and highways) and makes use of natural (green) infrastructure: waterways. In the filled-in framework, the guidelines can be interpreted from itself since quite some text is added. These guidelines should be taken into account by urban planners since economic, social benefits and also ecosystem preservation are often dependent on the transportation infrastructure in the area. By taking the guidelines into account, all of these factors can be included in the planning process to provide sustainable growth in the future.

For the drink water case, the framework was sufficient and complete to include all required elements in the analysis. All current infrastructure, either grey or green, could be taken up and more ecosystem-friendly alternatives could be given. This made formulating the guidelines more easy. During the analysis of elements in the waterwinpark and the Zeist area, there was sometimes an overlap between logistic flows and transport links. However, this is of course a logical consequence since the logistic flows are moved over the transport links. No specific transport mode is used in this case. The element of transportation modes could have been added to the framework to specify what modes are used, if any.

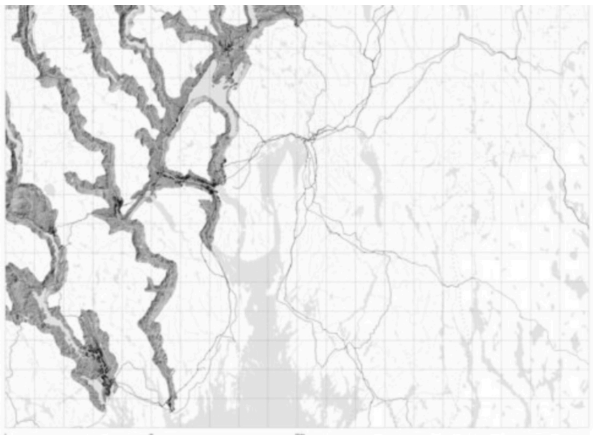
For the flows case, the impacts on ecosystem services were useful as they helped to identify crucial areas that need to be taken into consideration in the planning process of infrastructure systems (for example floodplains). The division between green and grey infrastructure was a useful distinction and helped to easily communicate the core aspects under focus during the course. The mobility flows category, which is very important in transport planning, was not of much added value. Whilst they did help with the critical evaluation of transport activities in the first place, they were not very useful to issue guidelines.

For the lumber case, the division of mobility and infrastructure was of use and helped with formulating the guidelines. Especially for the guidelines that steered towards social acceptance and that took infrastructural perspective into account. It could have given more insight into effects on people behaviour and the ecosystem participation. The framework sometimes poses a dilemma between slower transport (good for bio-diversity and connecting wildlife habitat) and faster transport (economics, transport capacity and logistics).





DRINK in Zeist and HOT in Waalhaven, Rotterdam





FLOWS in Sweden and SYSTEMS in Brazil

§ 1.3

The Cases

IDRINK
Urban landscape in sync with drinking water resources
VITENS, Deltares and Ruimtevolk are cooperating in a project that connects the challenge of drinking water to urban development over the coming 100 years. The question is how the urban landscape can accommodate archetypal drinking water abstractions that are more flexible so that the drinking water extraction can deal with external shocks, while also avoiding damage.
The aim of the project is to be able to respond quickly to the challenges of the future with regard to drinking water security. In this assignment, the teams are asked to design flexible extraction (urban) landscapes of the future for one or more archetypes. These extractions can adapt quickly to the changed situation if a disruption or change occurs and preferably cause no or as little damage as possible to the environment.

HOT
Urban landscape in sync with energy resources
The city Rotterdam has a long-term ambition to transfer to environmentally neutral energy resources, sustainable densification and transformation supported by public mobility. More specifically, this includes the transformation of port areas such as the Waalhaven from cargo to green industry and housing, supported by the construction of the subway Circle-line which is a new public transport line encircling the city of Rotterdam.
To support the ambition for energy neutrality there is the opportunity to develop a plan for geothermal energy extraction at different depths in the Waalhaven area. This should be linked to the new urban program and ecological rehabilitation of the Waalhaven area.

FLOWS
Urban landscape in sync with resource extraction and transport: 'Oslo Hydropolis'
Norway, Oslo, Great Metropolitan Area. Small-medium size settlements, fast transport networks and the hydronetwork in relation to natural topography and site. The new/fast regional mobility does not follow the logic of surface topography and hydrology, evolving as separate systems. The case looks for indigenous ways of working together and living with the landscape, from small-scale (object) to large-scale (regional) design practices. Reading of different types of inhabitation and its landscape and the major infrastructure. In partnership with Oslo School of Architecture (AHO).

SYSTEMS
Urban landscape in sync with resource exploitation: 'Post-infrastructure'
Brazil, Amazon, Transamazonica. Post mining in the amazon, superposition of mega-scale and micro-scale infrastructures on the amazon by mining, deforestation, deviation of rivers and transposition of hydrolnogical basins. In partnership with University of Sao Paulo, Faculty of Architecture and Urbanism (FAU-USP).

Drink

Drink water extraction in Zeist

Boris Bakker
Rosemarijne Bouma
Madelief Dekker
Tom Savalle

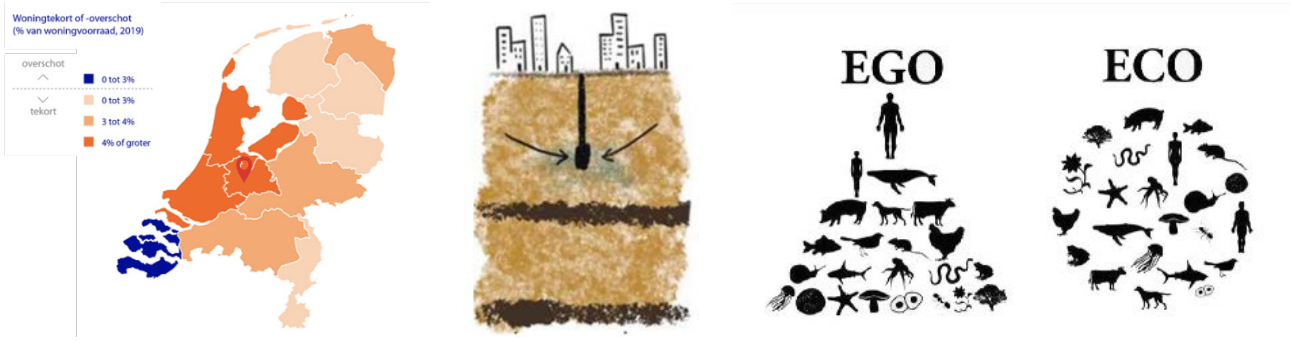
2020—2021 IED
Infrastructure and Environment Design
July 2021

1.

Introduction

Context and Challenge

The project is set in the urban area of Zeist. Zeist is located close to Utrecht, and is therefore a popular place to live, dealing with a housing shortage. Adding to this is the housing shortage in Utrecht, resulting in more and more people looking for a home in the surrounding cities and villages. Within the urban area of Zeist, large differences in quality of the neighborhoods are visible, partly due to the large number of villa neighborhoods in contrast to social rent apartments. This has led to a strong division between different groups of inhabitants within Zeist. Other challenges can be found in the landscape surrounding Zeist. Zeist is located at the boundary of two landscapes, the Kromme Rijn landscape and the Utrechtse Heuvelrug, both having their own characteristics and needs. The area also functions as a water extraction site, resulting in rather strict regulations to ensure proper water quality. Furthermore this water extraction should be made flexible to comply with future demands. Finally, on a larger scale one can see how the relationship between humans and nature has become more distant, while simultaneously humans are having a bigger impact than ever before on nature. A new, more balanced relation should be found to ensure long term livability for humans as well as other species. This new relation could be in the form of ecosystem participation, where humans add value to nature, as does nature to our lives.



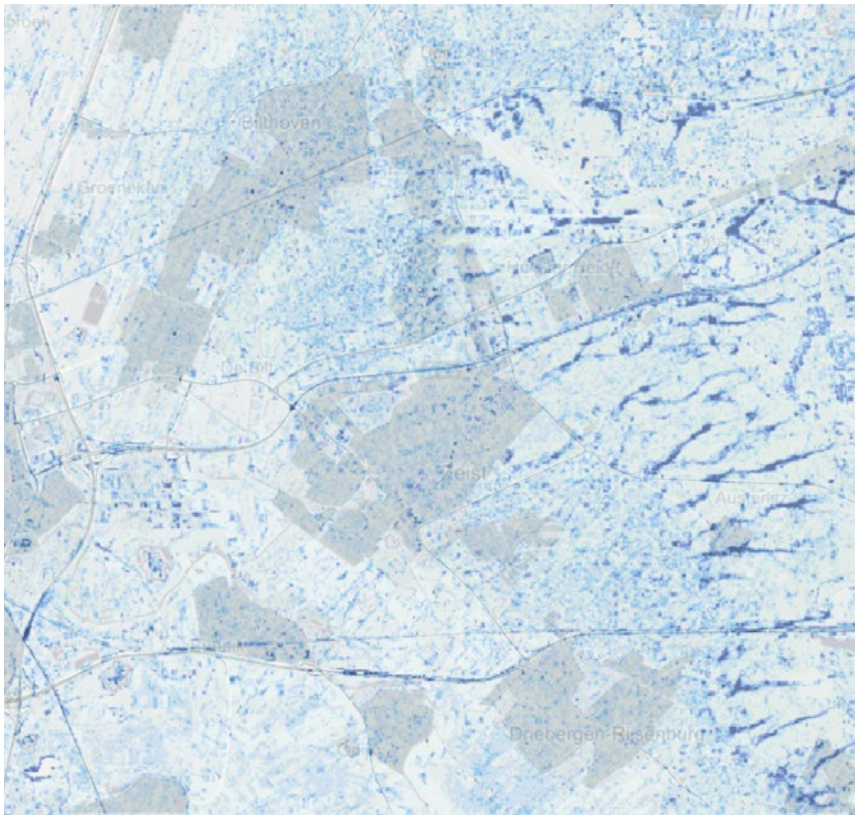
Context

The housing shortage, the flexible drink water extraction and ecosystem participation.

Environmental Risks and Human Response

Drought, extreme rainfall and seasonal drink water shortage are the main environmental risks in and around Zeist. Events of extreme rainfall are seen more often in recent years, and this trend is expected to continue. The extreme rainfall leads to local floodings and to overflows of the sewage system, decreasing the water quality in surface water. This not only has negative consequences for organisms using the water as a habitat, but is also undesirable in a water extraction area. At the other extreme, in summer we see an increase in droughts due to prolonged periods of no rain. The Kromme Rijn landscape is especially vulnerable for droughts and this has already resulted in a loss of biodiversity. The droughts also impact the vegetation inside the city, and lead to seasonal drink water shortages. In a dry summer people use more water, leading to a peak demand, yet pumping the water is less desirable for the water level. Furthermore the system is not designed for peak demands, making it challenging for Vitens to suddenly change the amount of water they extract.

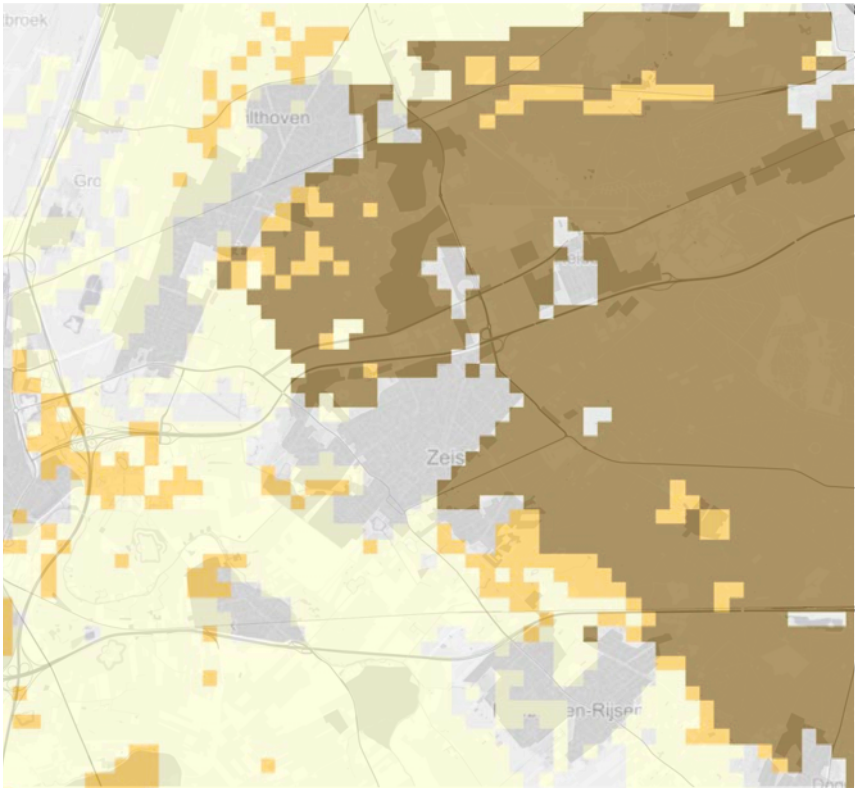
Human response to these environmental risks vary greatly depending on the scale one looks at. On an individual scale, people tend to use a lot of water in summer, even when we are experiencing a drought. Furthermore, to have a low maintenance backyard, grass is often replaced by a tiled terrace. The individual responses thus often are counterproductive, which is in contrast to our communal response. As a society, more greenery and water is realised in cities, as well as wadis, water squares and other measures to delay water and create better infiltration opportunities. As to reduce droughts and water shortages in summer, buildings are more often designed to use less (drinking) water. Simultaneously, organisations as Vitens are investing in making the drink water extraction more flexible, as well as looking into buffer systems to increase the water availability in dry periods. The differentiation in response can be explained as in the individual case, the costs to adapt do not outweigh the benefits, but for society as a whole the benefits are greater than the investments needed.



Water depth after heavy rainfall (70 mm/2 hr)

The map shows the amount of rain in the streets after a rain shower.

- 5 - 10 cm
- 10 - 15 cm
- 15 - 20 cm
- 20 - 30 cm
- > 30 cm



Risk of drought stress

The map shows the amount of drought stress in summer.

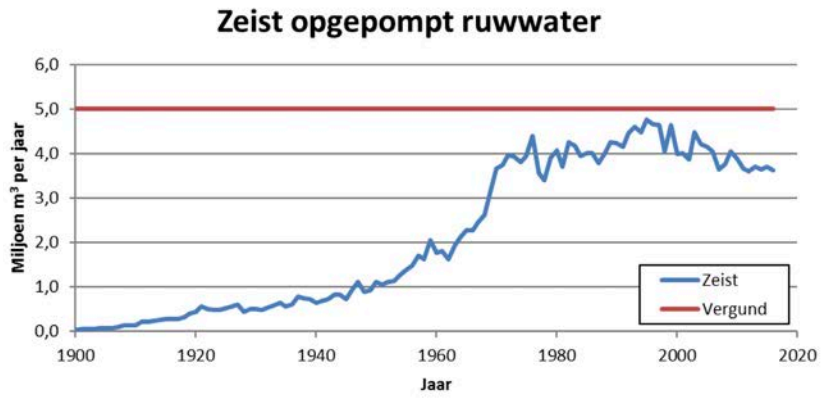
- Low
- Intermediate
- High

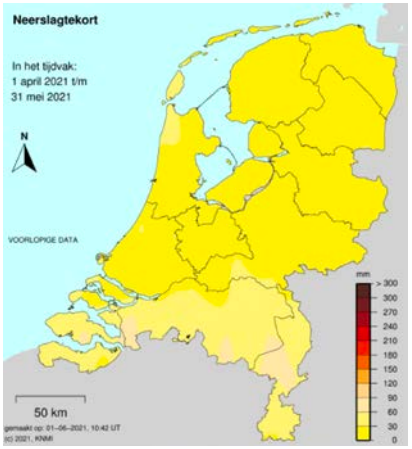
N

0 2 km

Drinking water shortage

The diagram shows that the water extraction is almost at his maximum. The maps show that a rain water shortage leads to a drinking water shortage.









The human response to these environmental risks

First image: scenario's of Vitens and Deltares
Second image: using drinking water to 'clean' your garden



Scales & actors

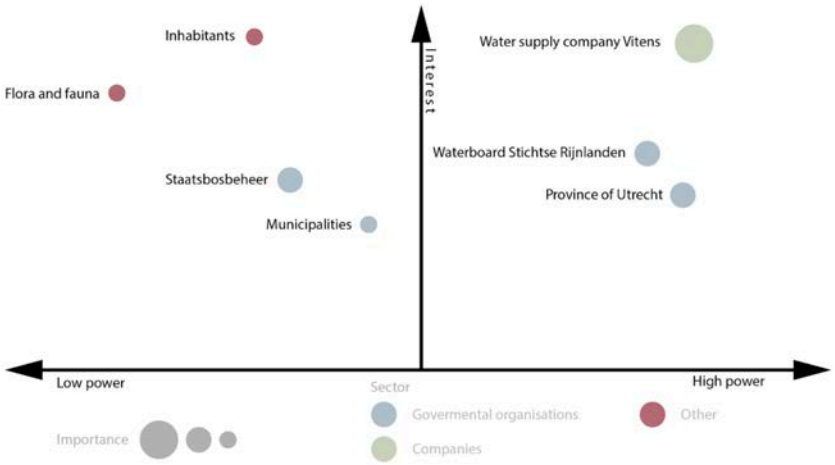
To get a better understanding of the different parties that are in the playing field, the various actors have been defined per scale in a power versus interest matrix. Starting with the macro scale, which has been defined as the scale of the landscape, we see that the largest power resides with governmental organisations like the province and the waterboard. The Drinkingwater supply company Vitens' interest and power are clearly high as they facilitate the drinking water throughout the whole area and further. On a contrast to that, we see inhabitants and flora and fauna who do have high interests, but have hardly any notable power.

Moving to the meso scale, which has been defined as the scale of the city, we see Vitens power decrease as the municipality enters the playing field, possessing both high power and interest. Citizens have increased power on scale of the city and research related initiatives from dutch Universities (like this project) have high interest. Again though, on this scale as well do the flora and fauna have unremarkable power.

On the micro scale, which is the scale of the neighbourhood, the most power resides with the municipality. Local environmental organizations have high interest due to the high ecological value of the surrounding environment and moderate power. Quite specifically we see the Asylum seekers centre, who's refugees have very little opportunities overall and therefore little power.

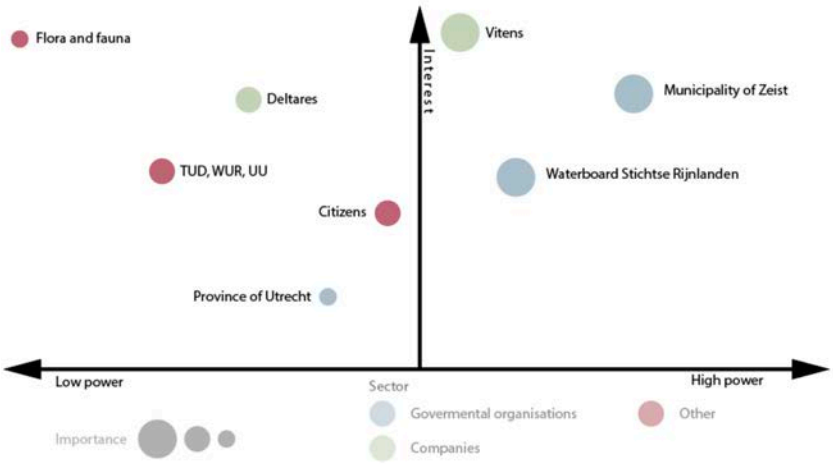
Actoren on the macro scale

Scale of the landscape



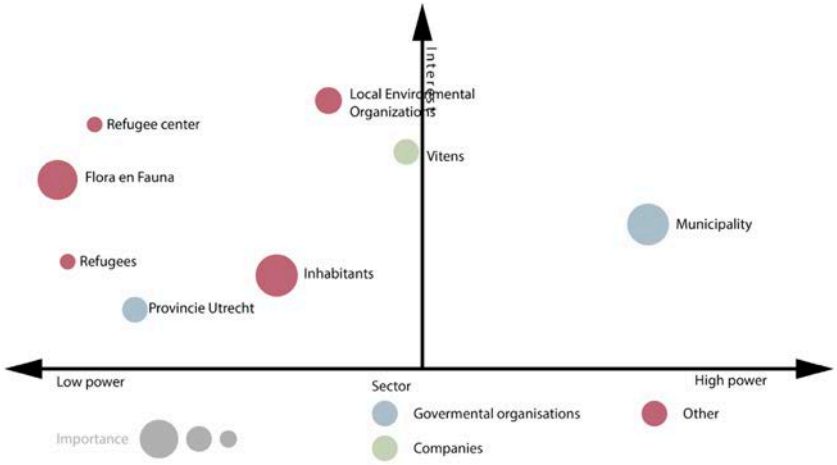
Actoren on the meso scale

Scale of the city



Actoren on the micro scale

Scale of the neighbourhood



Theoretical framework/ concept & vision

To base our scope of interest in existing theories and concepts, we have created a theoretical framework. The illustration relates to “The Doughnut of social and planetary boundaries” (Raworth, 2017). The Doughnut is a visual framework for sustainable development that indicates our challenge of meeting the needs of the world within the means of the planet. In other words, it dictates how we cannot fall short on the essentials of life but can neither put to much pressure on the environmental systems that provide for us.

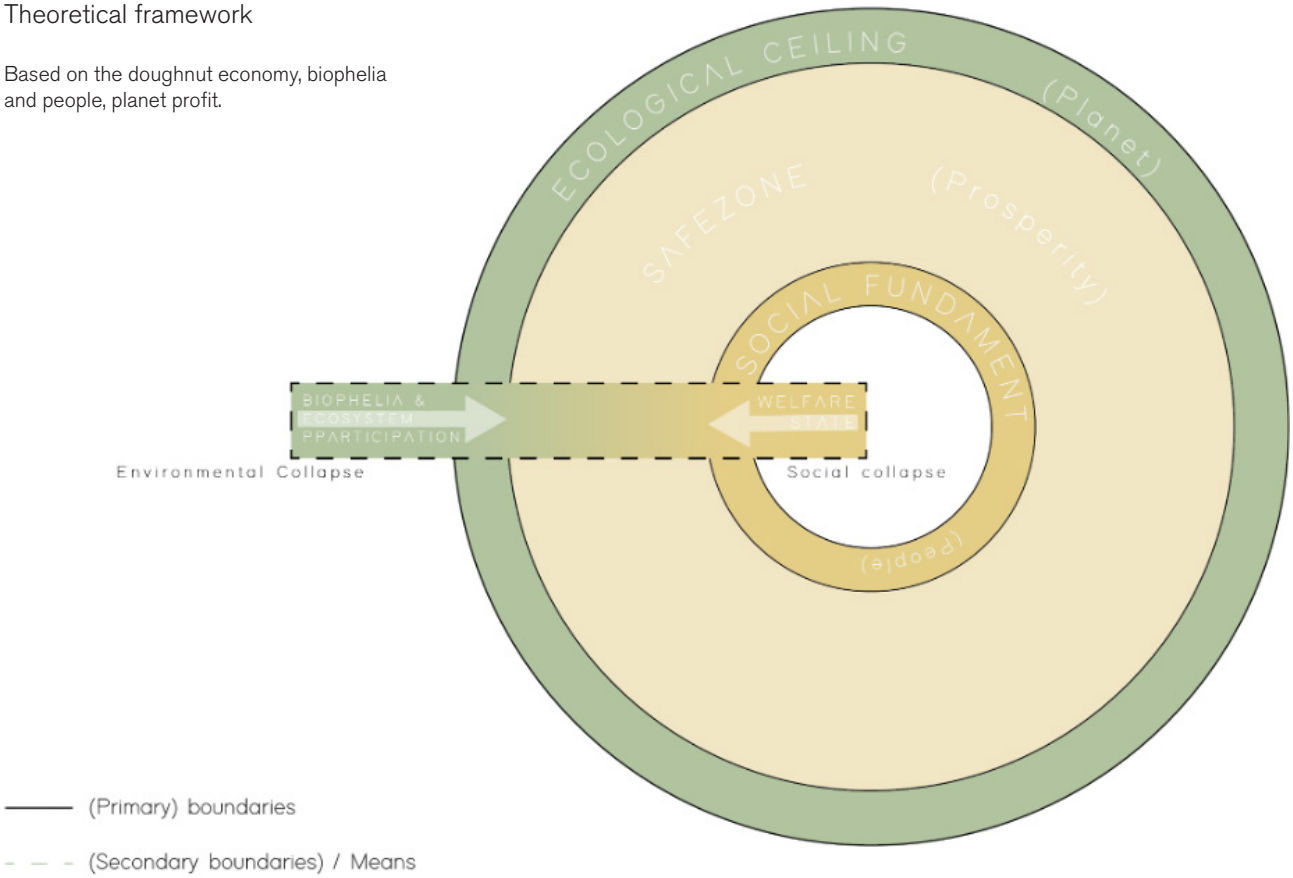
In our theoretical framework it has been combined with the triple bottom line of sustainability; People, Planet and Profit. The diagram illustrates how our safe zone, the prosperity zone, is protected by two layers; the ecological ceiling (our planet) and our social fundament (people). If we would break through these by putting too much pressure on our environmental or social systems, we would end up with either environmental or social collapse. As these are disastrous scenarios, our vision proposes supporting concepts that might help us prevent from falling through these barriers.

Due to our current trends of behaviour surrounding consumerism, we are putting very large pressure on the environmental systems. Wilson’s Biophelia hypothesis suggests that we as human possess an “innate tendency to focus on life and lifelike processes” (Gullone, 2000), something we seem to have been losing over the years regarding nature. Stimulating this loving and caring relationship for nature, combined with ecosystem participation can help to prevent us from breaking through the ecological ceiling by countering the indifference regarding nature that has built up amongst many of us. On the other end of the diagram we see the welfare state which, comparable to the Netherlands’, strives to keep our social fundament intact.

The theoretical framework functions as a viewpoint from which we develop our vision and has urged us in developing specific goals, such as aiming at citizen involvement, stimulating specific behaviour and possible behaviour change and finally the landscape appreciation and value recognition of nature. With the vision we aspire to create a framework of design interventions that might lay the foundations for a new way of thinking and acting, one that is more related to the scale of the long term rather than the short term. It should combine concepts of environmental responsibility and sustainable resource management.

Theoretical framework

Based on the doughnut economy, biophelia and people, planet profit.



2.

Critical Cartography

Process of collecting data

The research process began in early gatherings of broad context reports from various organisations about the location of Zeist to build the theoretical and technical background. To support this matter, three review papers have been developed on the subject of ecosystem participation in urban extraction landscapes to obtain a better understanding of the concept and existing research that might support it. Next to that, in collaboration with civil engineering students, research was carried out for the location of Zeist and it's drinking water extracting properties. In this process, a first concept for the location was developed by us containing questions and ideas, which were further analysed by the civil engineering students after which a conclusion was derived about the proposed concept. Next, research was divided into four subjects; anthropology, urban morphology, ecology and TIL (Transport, Infrastructure and Logistics). By use of critical cartography, information on these subjects was put together and synthesized. This was later used as a foundation for strategy building and vision development.

Drips of time

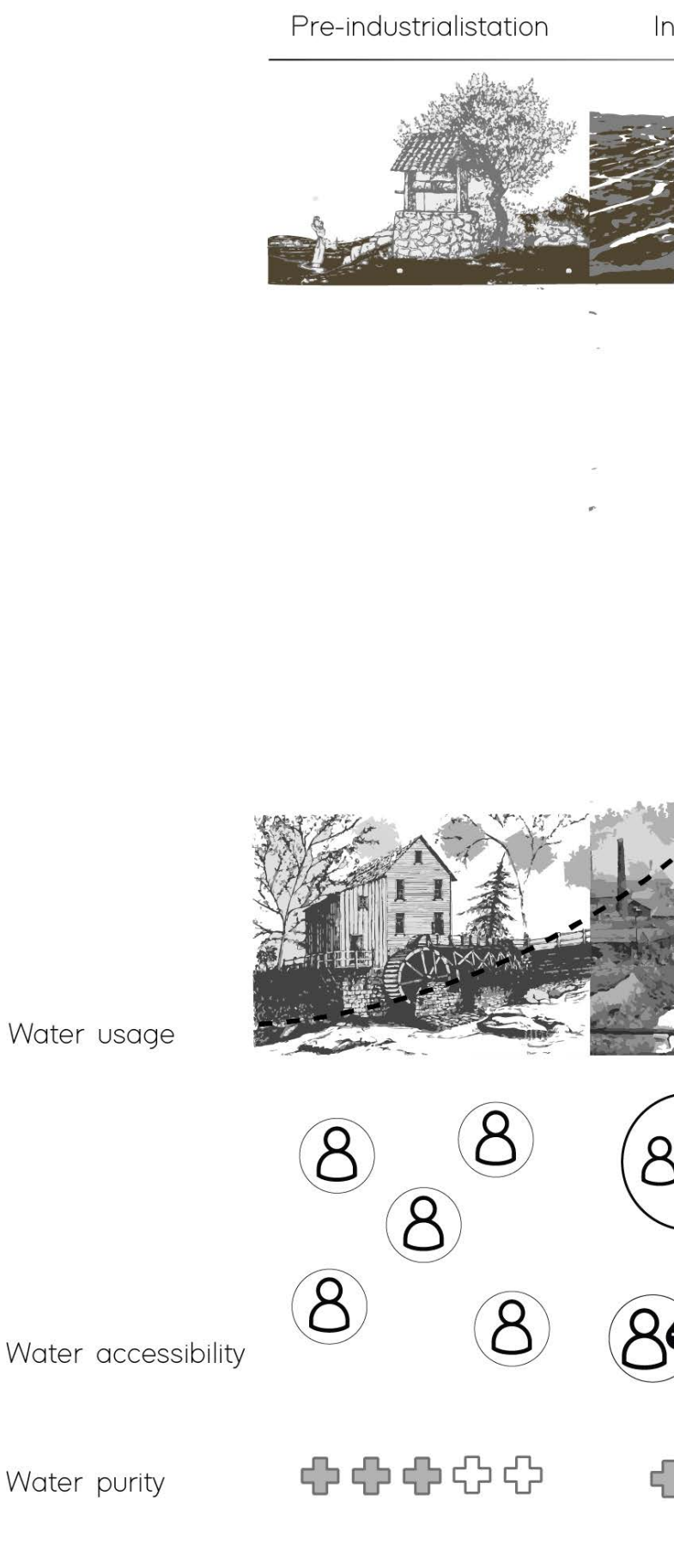
As anthropology studies the human aspect and its cultural elements, a convenient way to obtain a better understanding of the human perspective of the project area is by taking a big leap back in time. As the subject at hand is about drinking water extraction, the followig timeline illustrates how during the course of time, people handled drinking water in the area.

In early days, after the fall of the Roman empire and disappearance of their great water transporting infrastructure, water extraction was mostly done individually through waterwells or rivers. These sources were relatively clean. During the industrialisation we see a steep increase in water usage since the invention of the steam engine. These industries used large amounts of water and were heavily polluting to nearby water sources. Population growth of cities combined with lack of knowledge lead to more pollution, which meant that only the rich were able to get clean drinking water.

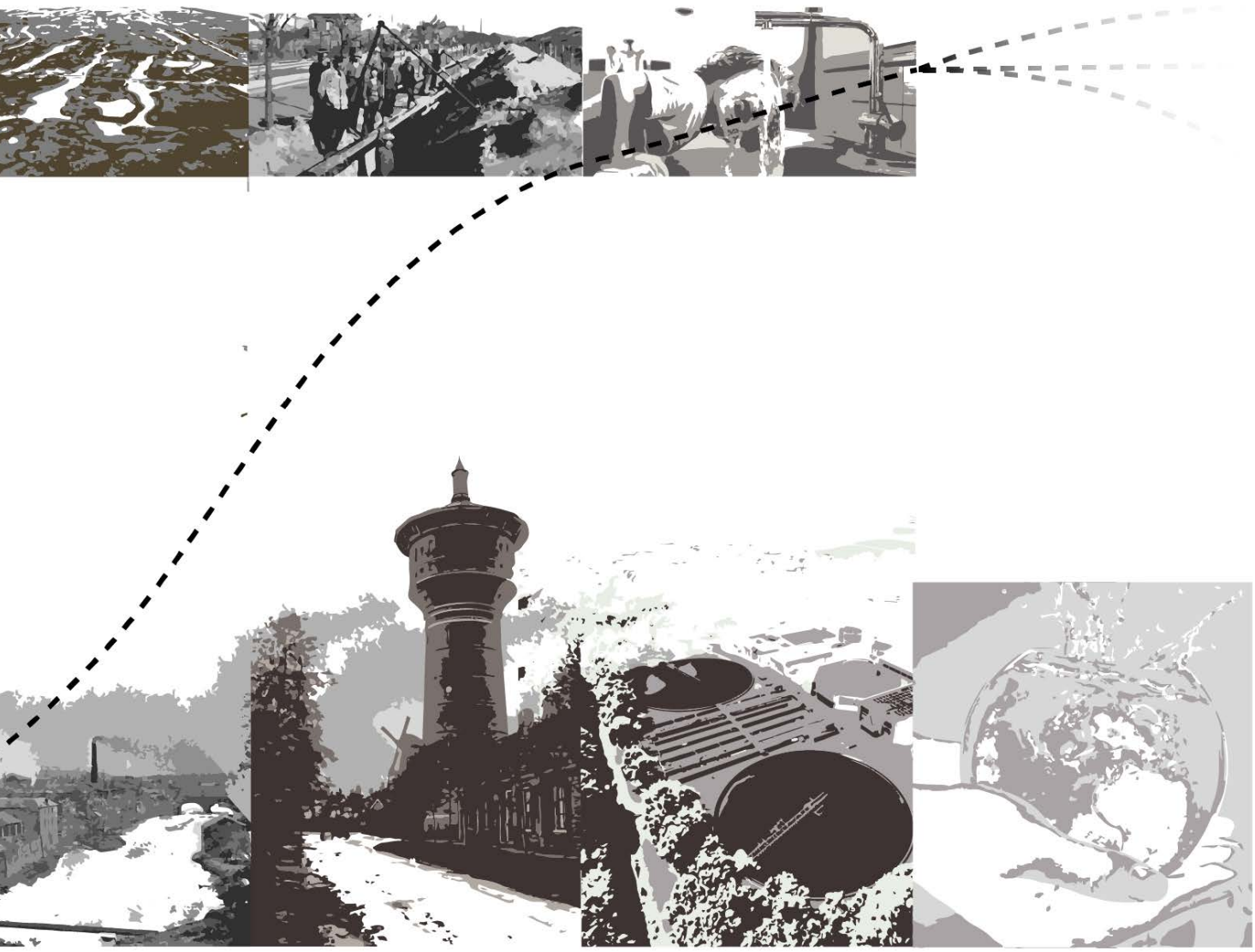
As reaction to the cholera epedemics, the Dutch-English Dunewatercompany started extracting and transporting clean water to the inner city of Amsterdam. This started an increasing trend of clean water distribution by private companies and clean drinking water became an increasingly popular product.

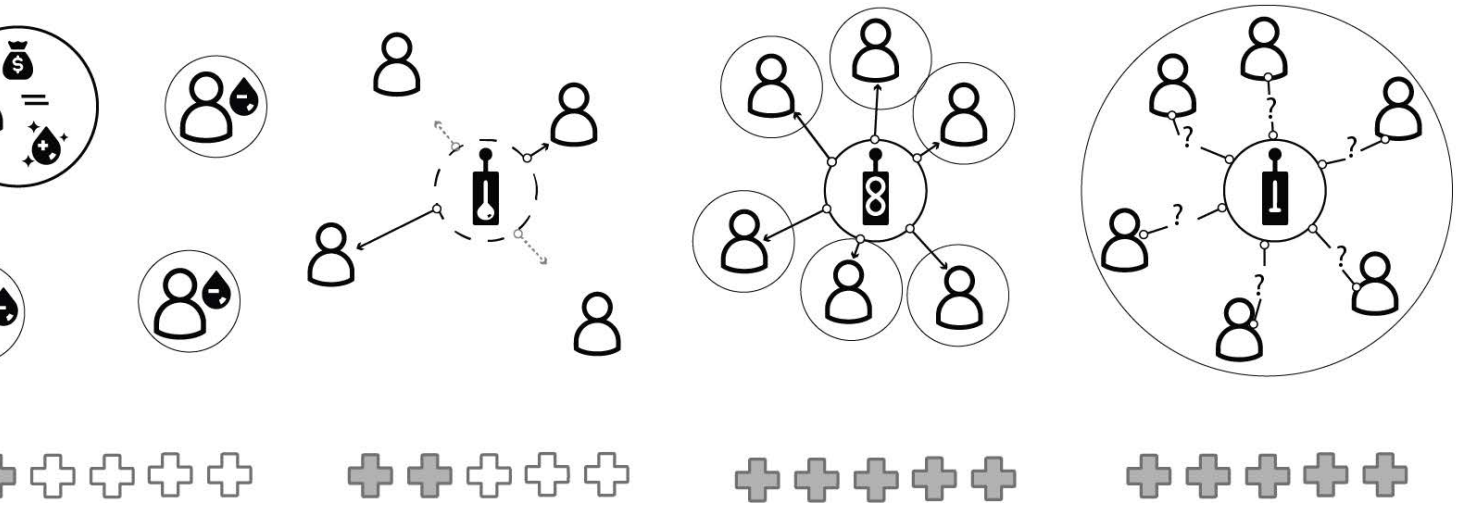
Soon local governments joined the playing field and started working together with companies to provide drinking water for inhabitants. Restrictions and measures for the prevention of contamination were defined. During the last part of the 20th century, all Dutch dwellings were connected to clean drinking water supply (Brederveld & Sloots, 1997).

In current times, it is almost unimaginable not to have near unlimited access to clean drinking water. However, as the negative externalities of our consumption and pollution trends are become more and more visible, we might wonder if we are true to think so. As we are experiencing events of drought more often and as the landscape of Zeist is highly vulnerable to these, we need to aspire to a different relationship with water that is much more conserving and sustainable than our consumerist ways now allow.



dustrialisation Identity Search New order Future





The human perspective

Mary Douglas' theory surrounding human behaviour illustrates four different rationalities. As part of the problems that arise in water extraction landscapes are due to human behaviour, these rationalities are applied to the behaviour of the inhabitants of Zeist and thus their view on water usage. These views give an indication of the inhabitants behaviour towards nature overall, which is necessary information in the scope of a transition t ecosystem participation.

The first rationality is that of the Egalitarian who views nature as fragile. As the source from which drinking water is extracted lies underneath the city, pollution cannot be risked. This is even more critical in the landscape that Zeist is located on as rainwater infiltrates rather quickly into its sandy soil. Also, as the layer that normally prevents water from seeping through (often a layer of clay) is very thin and at some places even breached, pollutans can seep through the layer and contaminate the drinkingwater source. For this reason, the municipality of Zeist has defined rules to prevent contamination, such as prohibition to wash cars and use of pesticides, and it is in these that we see the rationality of the Egalitarian. Nature is fragile and therefore we need to act carefully.

The rationallity of the hierarchist lies in the conviction that nature is robust, but within limits. We can see this the in how the municipality attempt to tackle climate change by intervening in the urban environment.

In the rationality of the individualist, nature is infinitely robust and therefore is resilient to such an extent that it will endure. We can recognise this in the past development that has ensured the privatization of water.

Finally there is the fatalist, who's rationality is that nature is capricious; it does not matter what you do. They are convinced that nature does not have a voice, and we can see this in many places of course but also in Zeist, where valuable drinkingwater is carelessly used for the flushing of toilets and to wash our clothes with.



NATURE IS FRAGILE



NATURE IS ROB



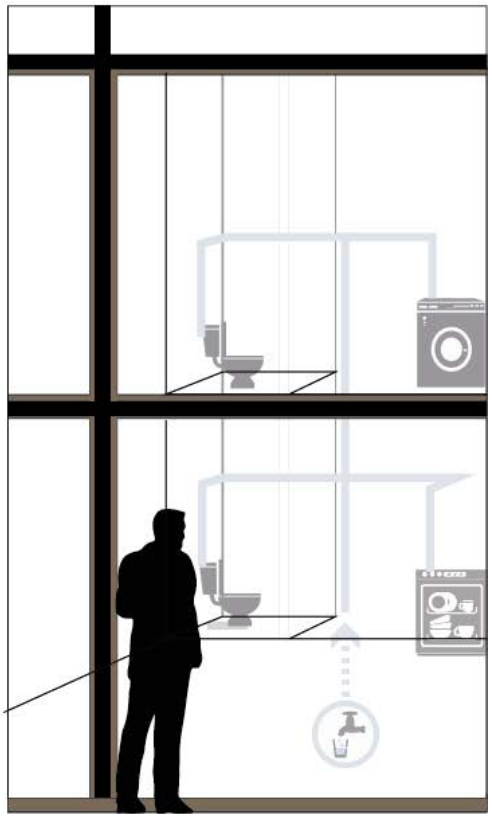


UST WITHIN LIMITS





NATURE IS ROBUST

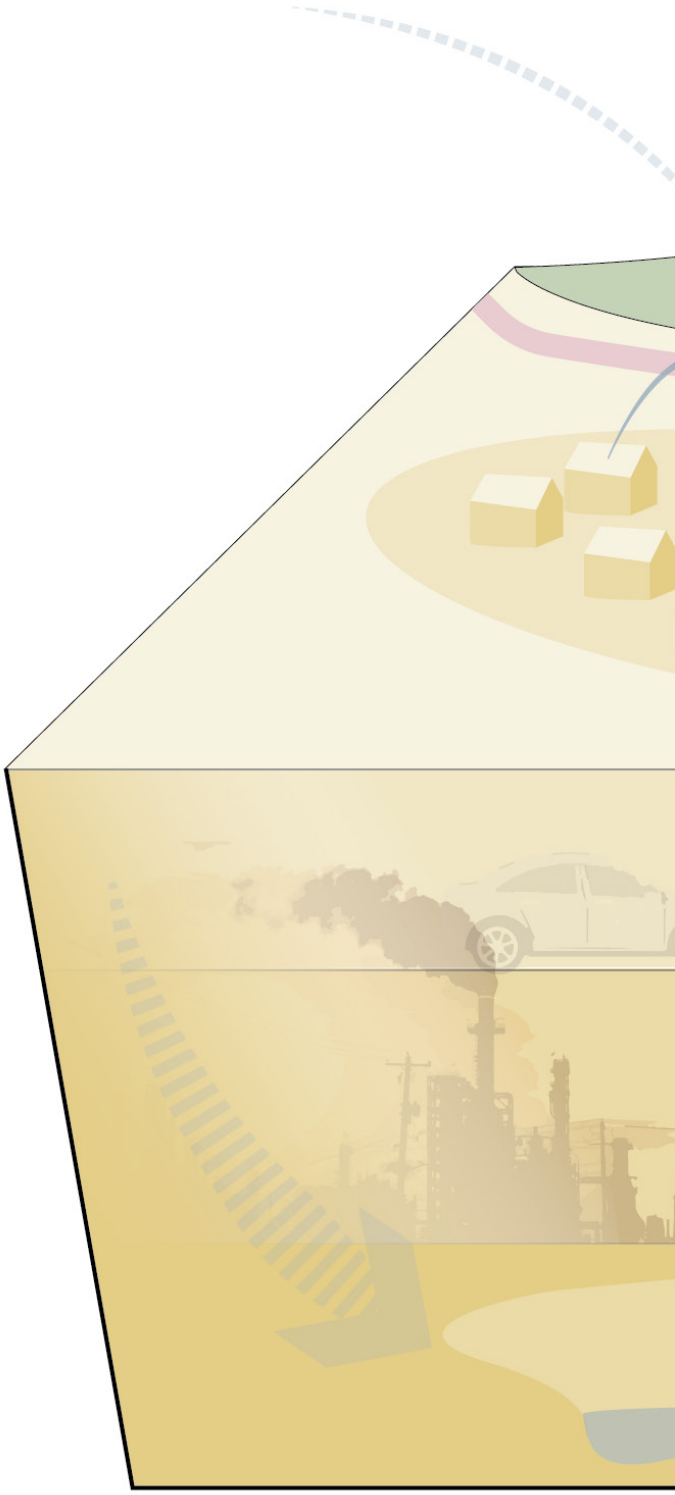


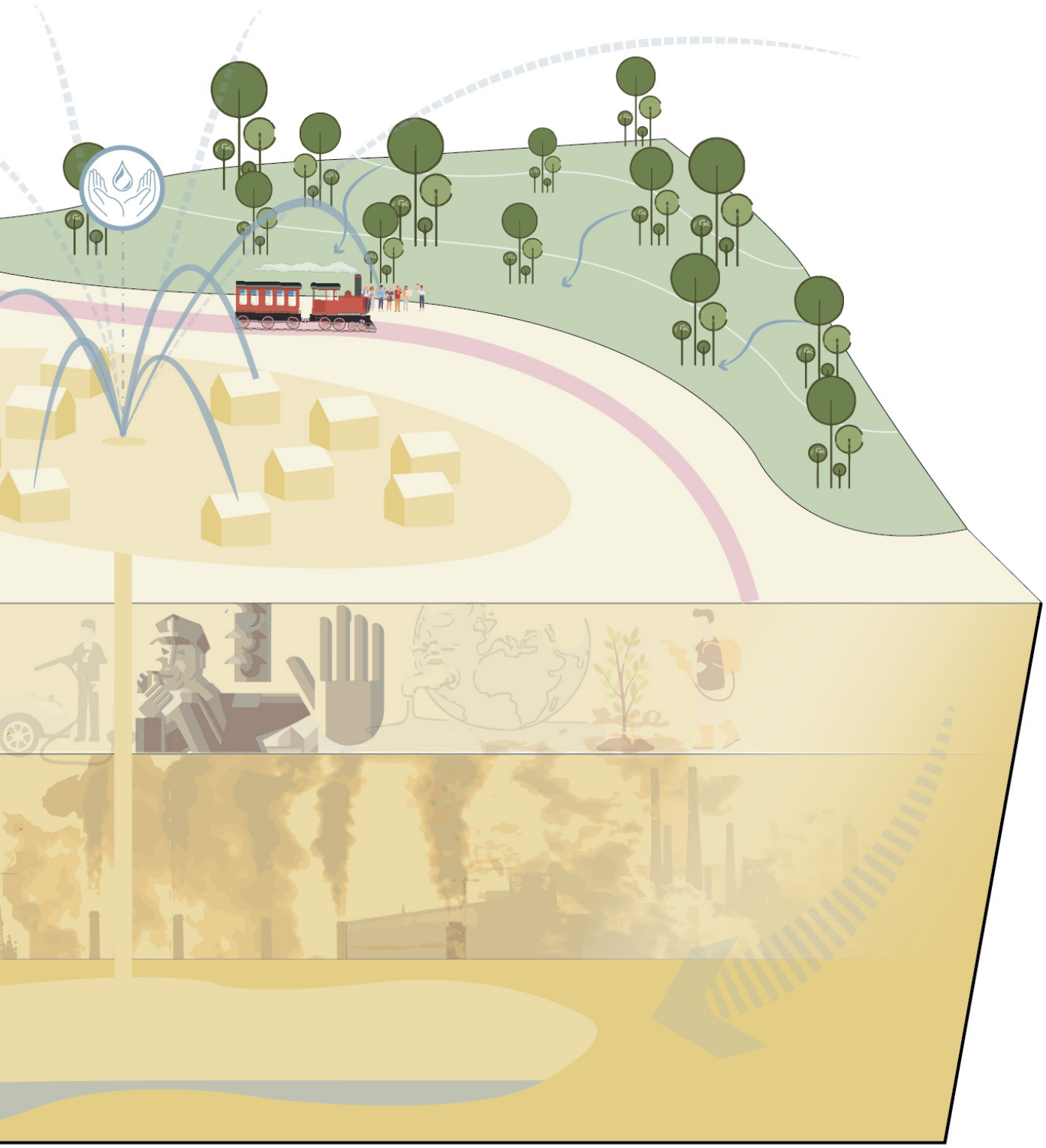


NATURE IS CAPRICIOUS

Synthesis

Although Zeist has taken measures to prevent polluting of the drinking water source, these measures came into realisation only after these risks were taken into serious consideration. Before that time, the industries that settled in Zeist like the silver and medicine industry and large scale use of pesticides polluted the soil quite heavily. It was only at the end of 20th century that these these industries, although for other reasons, disappeared and regulations for the prevention of contamination were imposed. The pollutands infiltrated near immediately but for them to reach the source takes a much longer time. These pollutants may eventually partly indeed reach the source still and therefore teaches us an important lesson about behaviour in extraction landscapes



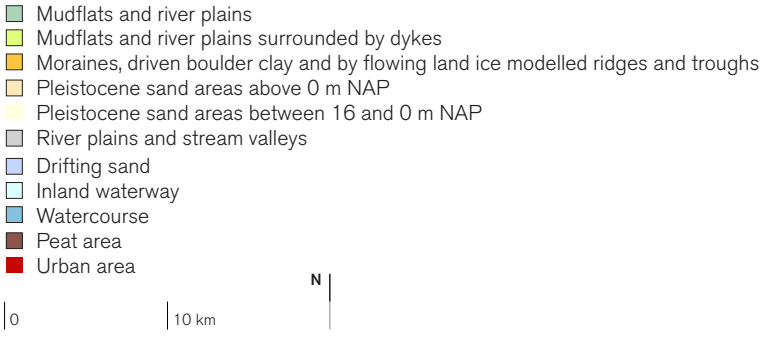


The history of the landscape

The current location of the urban area of Zeist used to exist out of Pleistocene sand around 9000 BC with on the east side the ridges and throughs of the Utrechtse Heuvelrug. Around 3850 BC an inland waterway is moving towards the area of Zeist and brings with it the mudflats, river plains and surrounding peat areas. These areas shrink and grow over the centuries but stay approximately on the same place. Around 1250 BC settlements start to grow and the riverplains are dyked. Around 2000 more and more settlements have arised and almost have of the area becomes urbanized.

Paleogeographic Maps

With the dashed line as the contour of Zeist

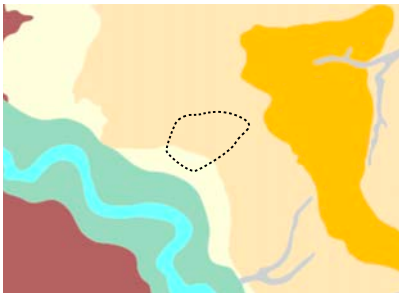




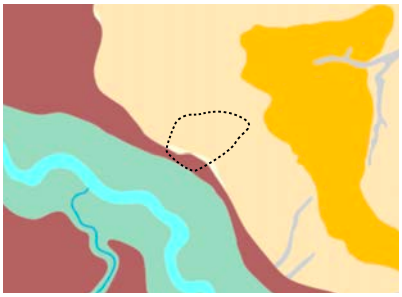
9000 BC - The area consists of Pleistocene sand areas which are mostly above 0 m NAP



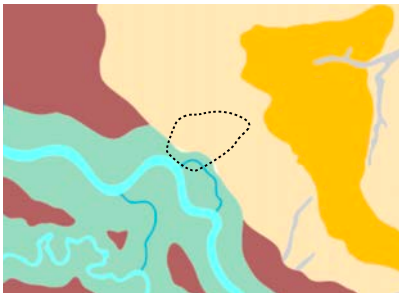
5500 BC - The area stays the same and mudflats and river plains are forming in the south-west



3850 BC - The mudflats and river plains move to the north-east, followed by an inland waterway and a peat area



2750 BC - The peat area expands into the area and leaves only a small strip of pleistocene sand area thats between 16 and 0 NAP



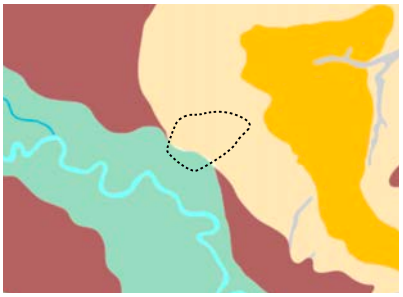
1500 BC - The mudflats and river plains take over part of the peat area and more inland waterways form



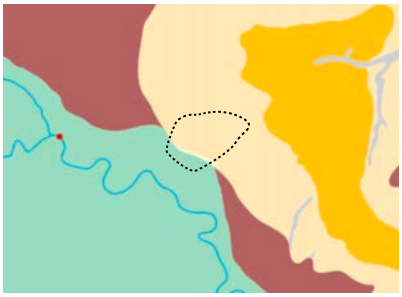
500 BC - The inland waterways keep changing their shape and the peat area increases again



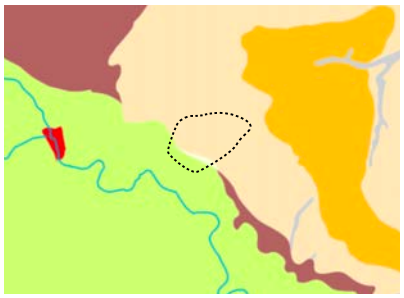
250 BC - Nothing really changes



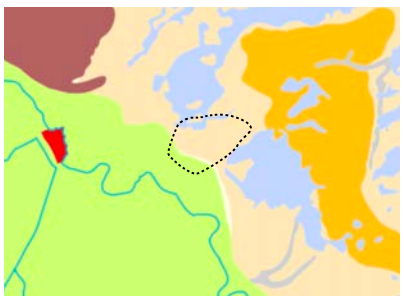
100 - The inland waterway has become smaller and a small strip of peat has been dissolved in the area



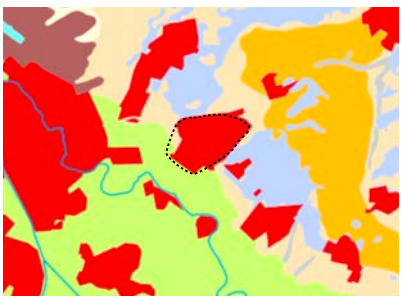
800 - A small settlement arises in the west



1250 - The settlement has grown and the mudflats and river plains are surrouned by dykes



1850 - The watercourse changes form and drifting sand appears around the Utrechtse Heuvelrug



2000 - Utrecht has grown and other urban areas appeared

On the meeting point of two different landscapes

The history of the landscape and the current use of the landscape created three different landscapes around Zeist:

On the east:the high and dryer Utrechtse Heuvelrug with heath and pine forest

On the west: the lower Kromme Rijn area with dryer and wetter areas with meadows, grienden, swamps and orchards

Between the landscapes you have the smaller scale estates with forests at the transition areas between dry and wet.



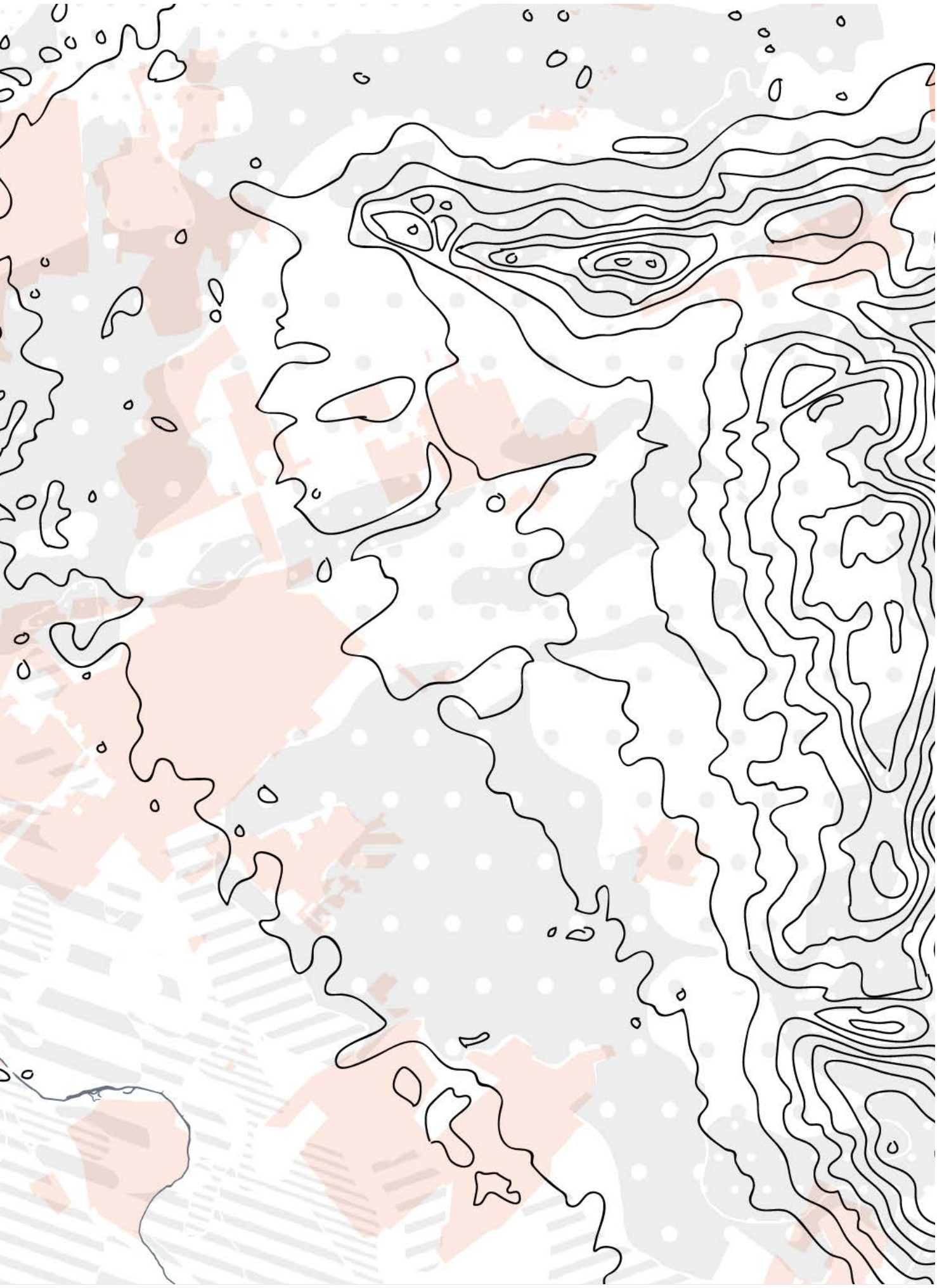
Settlements - Contour lines - Soil

On the map you see in the middle the settlement of Zeist and on the right a small part of the city of Utrect. The contour lines of the Utrechtse Heuvelrug show how Zeist is located on the border of the two landscapes. The Kromme Rijn inself flows around two small settlements but the landscape around it stretches onto the borders of Zeist. The two landscapes differ in soil type, the Kromme Rijn landscape has thte wetter clay soil and the Utrechtse Heuvelrug the dryer sandy soil.

- Kromme Rijn
- Duinvaaggronden
- Potzolgronden
- Hoge zwarte enkeerdgronden
- Poldervaaggronden
- City
- Town

N

0 1 km



A drop in biodiversity in the Kromme Rijn Landscape

The Kromme Rijn Landscape used to be really wet but with human interference and the current climate change the area has become dryer and thus lost a lot of it's biodiversity. That's why a lot of the previaling animals are now located in the cities itself and the Utrechtse Heuvelrug Landscape.



Prevailing (present) animals

The map shows the approximate location of the current prevailing animals in relation to the type of landscape.

- Green Heart Landscape
- Kromme Rijn Landscape
- Utrechtse Heuvelrug Landscape

N

0 1 km

Great spotted woodpecker



Mouse



Barn owl



Wild boar



Hawk



Deer



Squirrel



Possibilities to increase the biodiversity in the Kromme Rijn Landscape

Since the Kromme Rijn Landscape got dryer it has a lot of possibilities to increase the biodiversity by making the area wetter again. When this will be done a lot of animals will once again be attracted to the landscape that can thrive in the wetter area.



Natural (possible) animals

The map shows the approximate location of the possible animals in relation to the type of landscape.

- Green Heart Landscape
- Kromme Rijn Landscape
- Utrechtse Heuvelrug Landscape

N

0 1 km

Tawny owl



Badger



ach



Grass snake



Dark clover sand bee



Great bittern



Great range of trees

Since Zeist is located on the border of two landscapes it also has a great range of different kind of trees, due to the big gradient from the wetter clay to the dryer sand a lot of different trees can thrive within the area.



Alnus glutinosa



Castanea sativa



Fraxinus excelsior



Malus



Salix alba



Tilia platyphyllos



Carp

Trees

With their scientific names





Acer pseudoplatanus



Crataegus monogyna





Pinus nigra



Fagus sylvatica



Populus tremula



pinus betulus



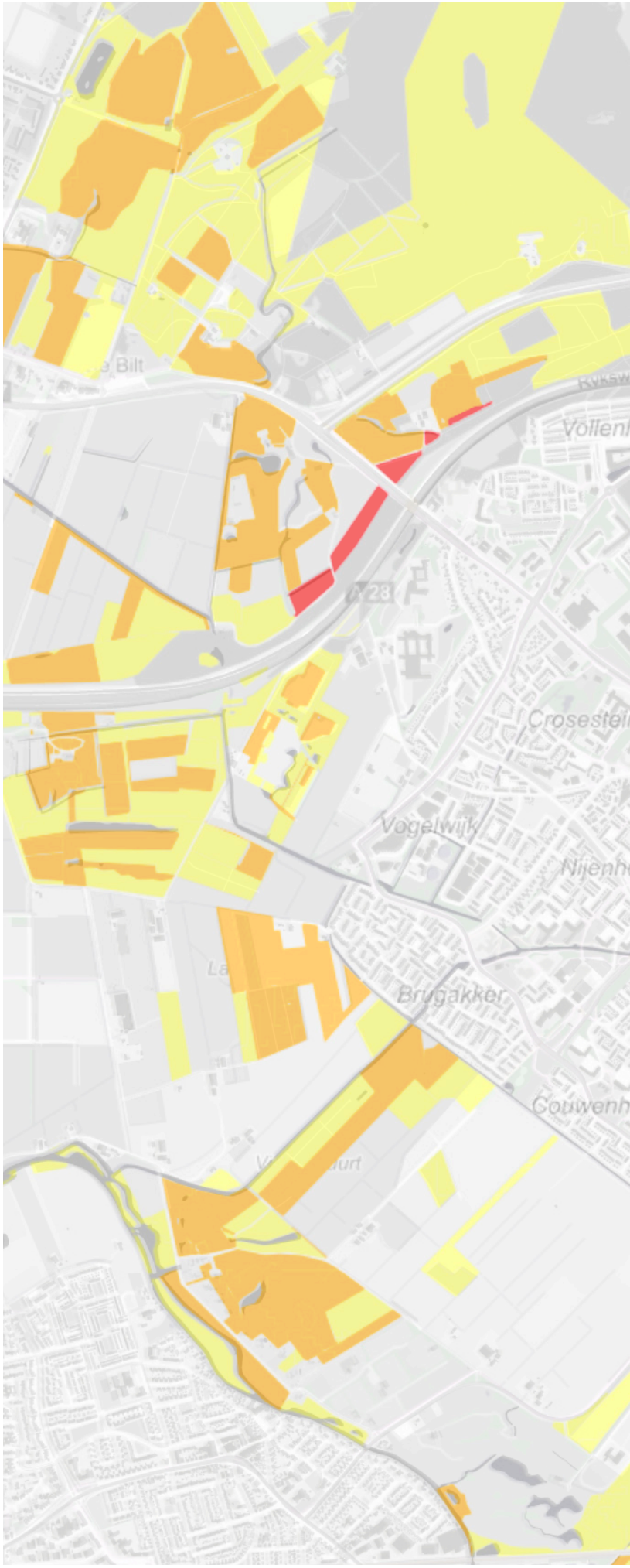
Juglans regia



Quercus

Nature areas are suffering due to the drought

Around Zeist are multiple nature areas that are dependent on the ground water which are thus sensitive to the possibility of droughts. These nature areas are mostly located in the Kromme Rijn Landscape that used to be very wet but is now suffering because of the droughts.

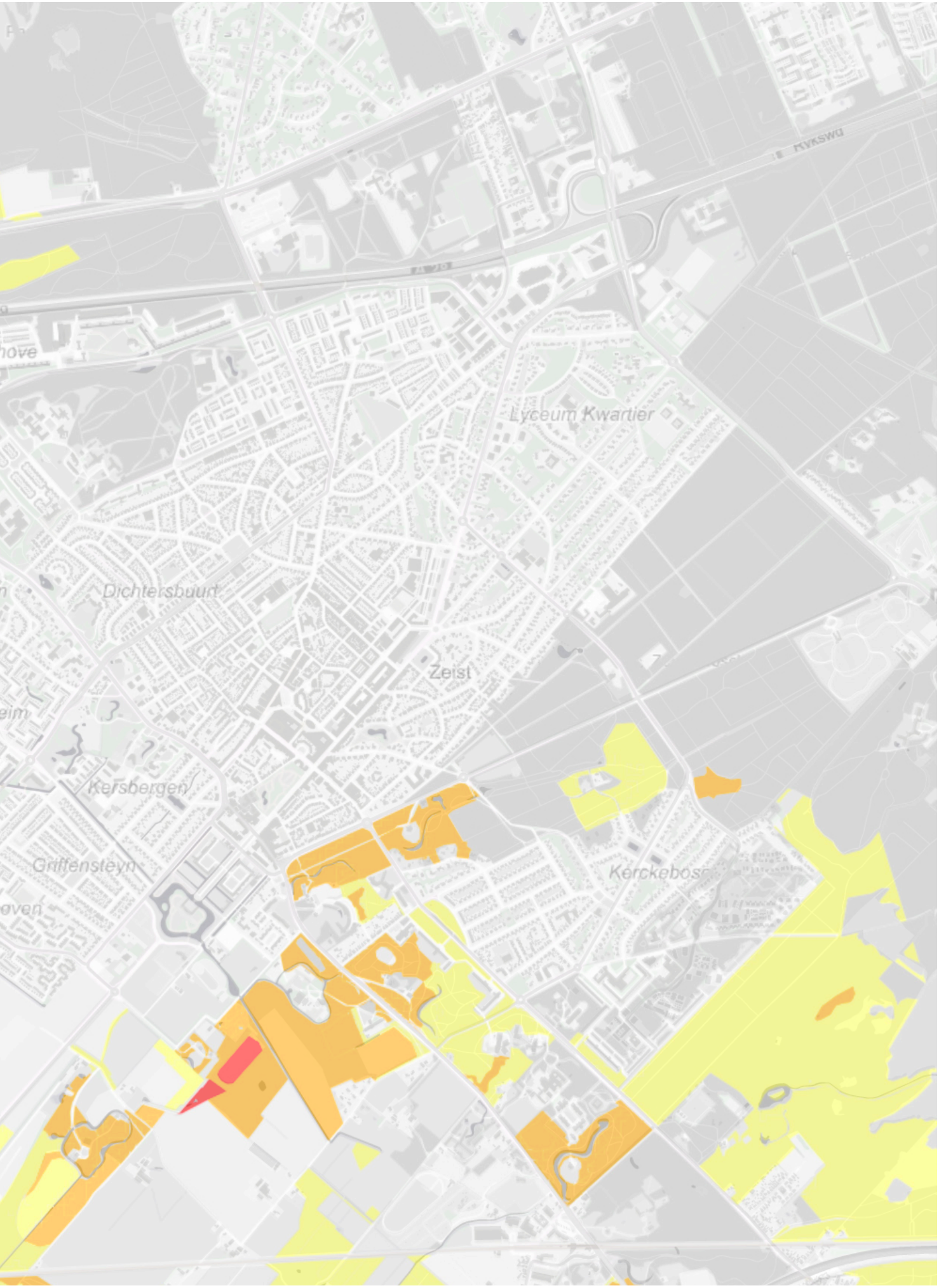


Drought sensitivity ground water dependent nature

- Not ground water dependent
- Not very sensitive
- Sensitive
- Very sensitive

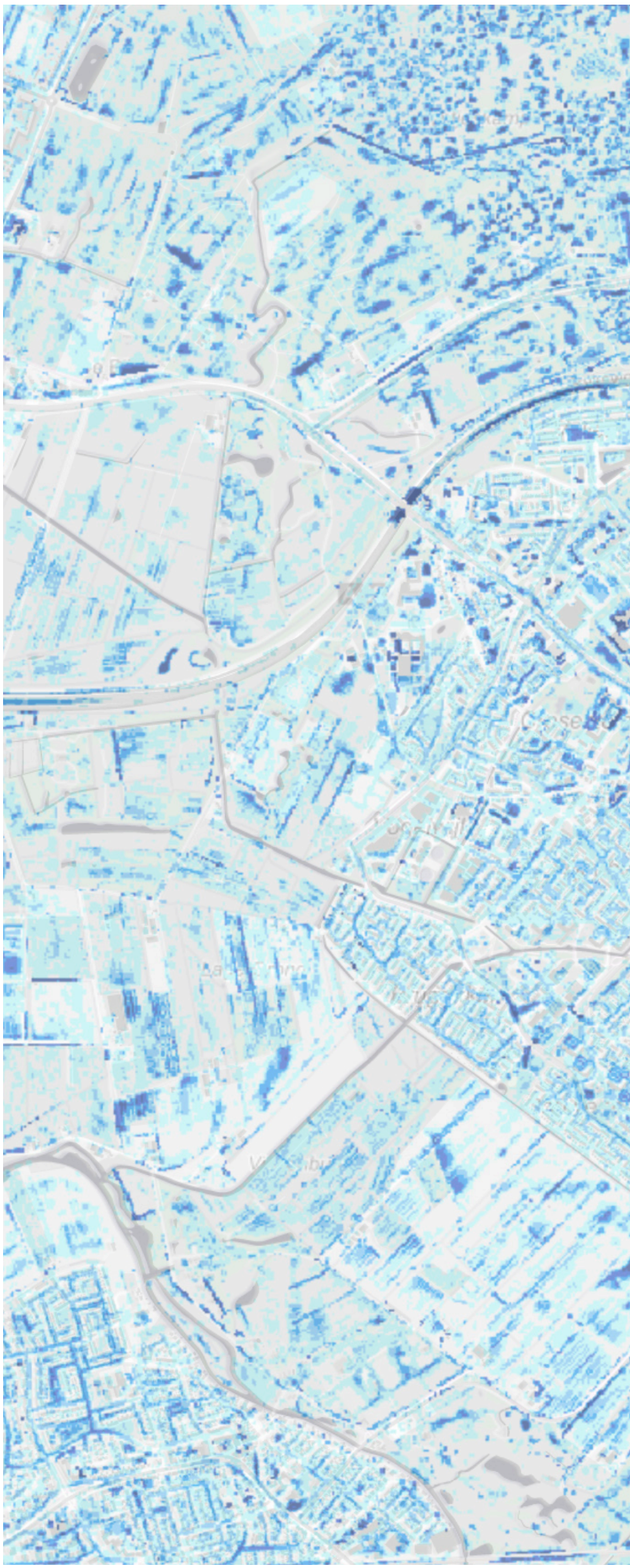
N

0 500 m


Lyceum Kwartier
Dichtersbuurt
Zeist
Kersbergen
Griffensteyn

Wet streets due to heavy rainfall

Next to the periods of drought there's also the environmental risk of the heavy rainfall. During these rain showers the water has no place to go and the streets become wet.



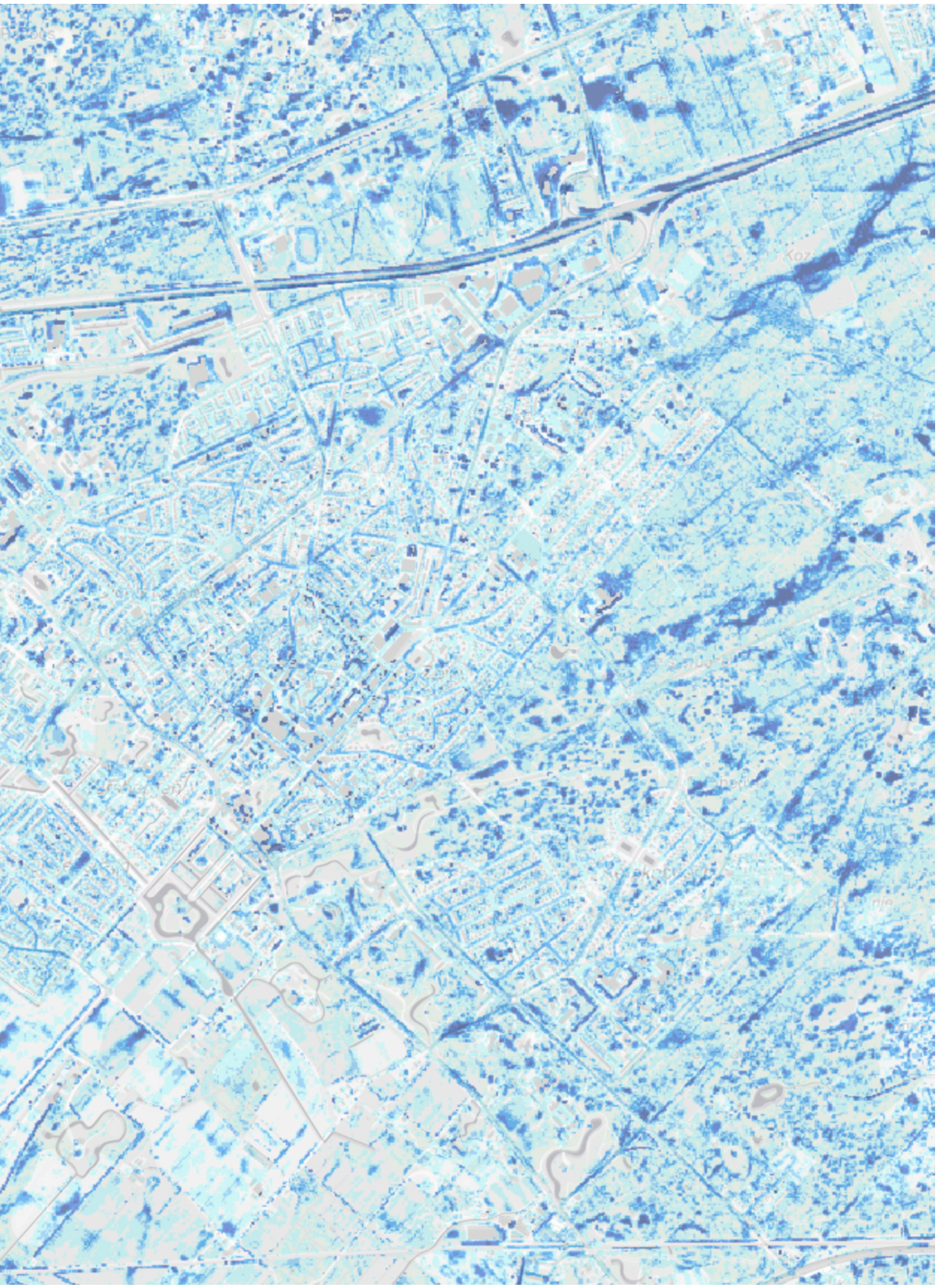
Water depth after heavy rainfall (70 mm/2 hr)

The map shows the amount of rain in the streets after a rain shower.

- 5 - 10 cm
- 10 - 15 cm
- 15 - 20 cm
- 20 - 30 cm
- > 30 cm

N

0 500 m



Groundwater pollution

In and around Zeist there are multiple ground water extraction zones. These zones come with different regulations to keep the groundwater clean, nevertheless there are still some pollution sources: the agricultural areas around the urban area, some old industries and a hospital. Next to that there some area where the ground is extra sensitive due to high infiltration.



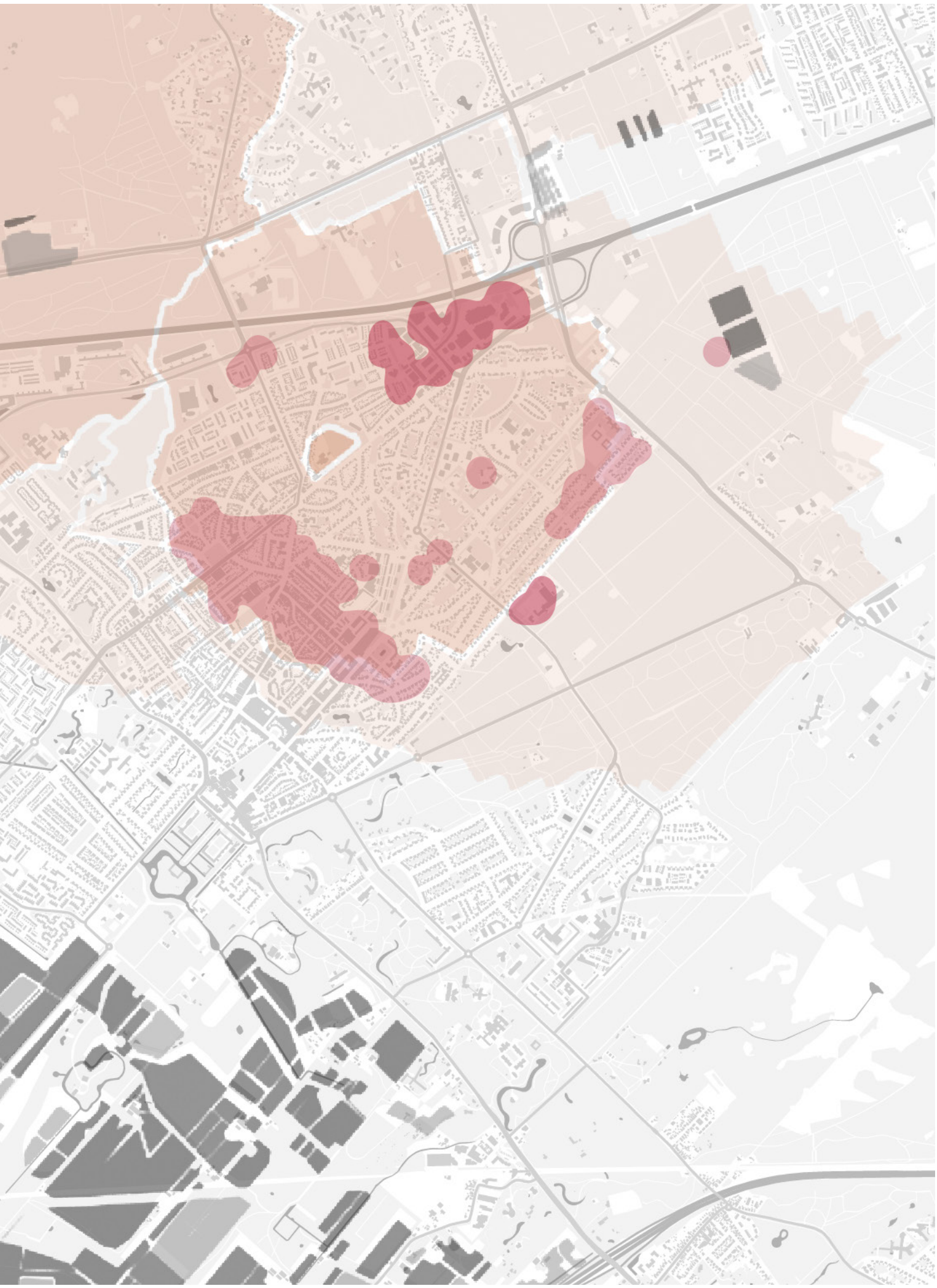
Agriculture and Water win areas

Soil sensitive for pollution due to:

- Industry/hospital
- High infiltration
- Agriculture
- Meadow
- Water win area
- Ground water protection area
- 100 years zone

N

0 500 m

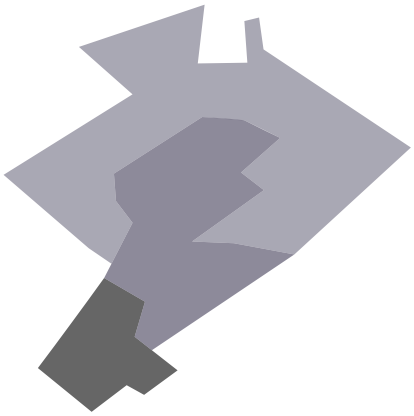


Historical development of Zeist

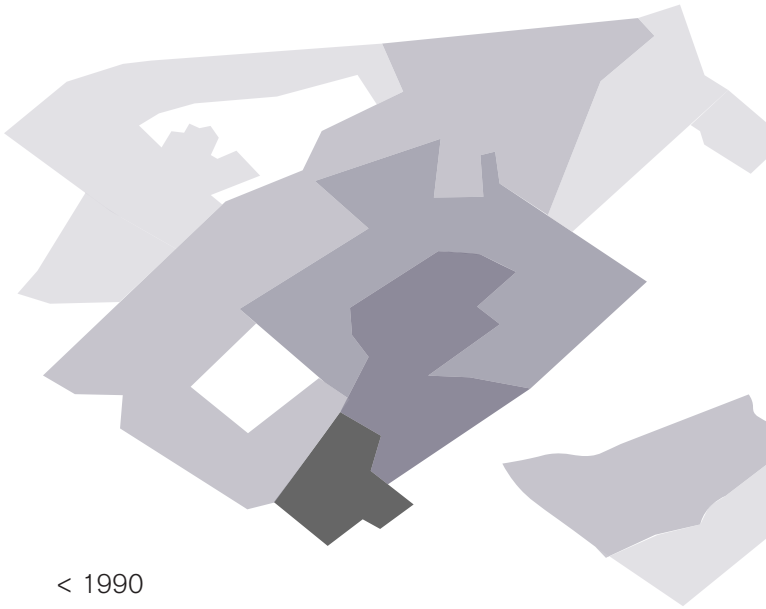
The historical development of Zeist is shown in the maps on the right. Zeist started out rather small, as a place where rich people had their second home, and started to grow rapidly when more and more middle and working class families made it their permanent living place. Today it is appreciated for the surrounding landscape as well as its closeness to Utrecht.



< 1850



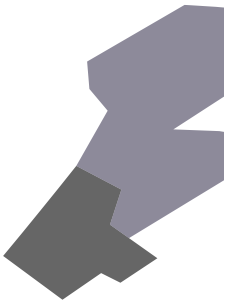
< 1950



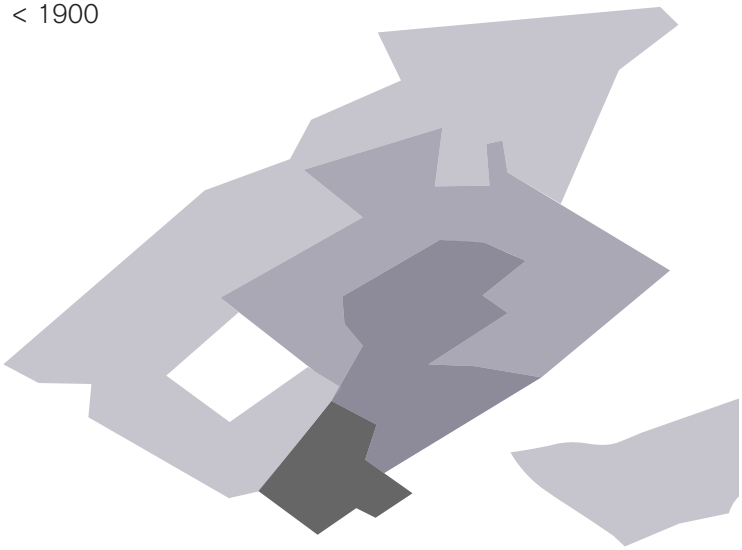
< 1990

Historical development of Zeist

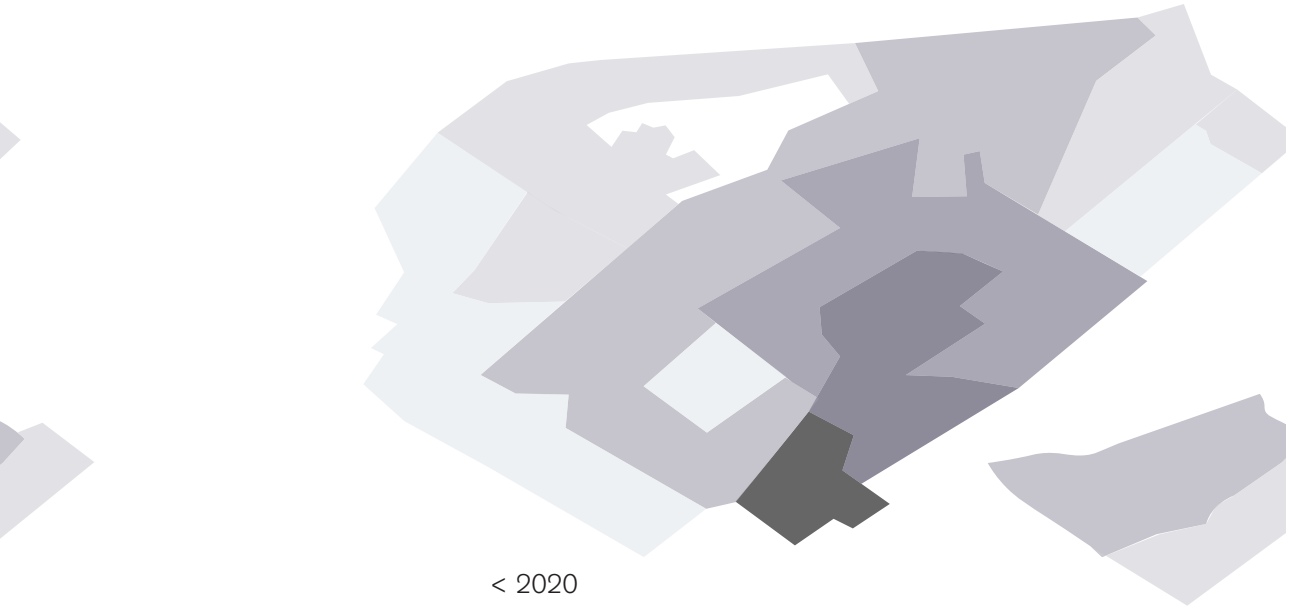
- < 1850
- 1850 - 1900
- 1900 - 1950
- 1950 - 1975
- 1975 - 1990
- > 1990



< 1900



< 1975



< 2020

Built environment, Infrastructure, water and Greenery

Zeist has a variety in typology as is clearly visible in the figure ground. The infrastructure network is dense, as is to be expected from a city. Remarkable is the large amount of greenery in Zeist. This is partly due to the relatively low density in combination with a high income in the villa neighboorhoods of Zeist. It however can also be explained by the closeness of the Utrechtse Heuvelrug, a great quality of zeist which therefore is intergrated in the city. Evenly remarkable is the lack of surface water. In the east of Zeist this is partly due to its sandy grounds, in which water infiltrates quickly.

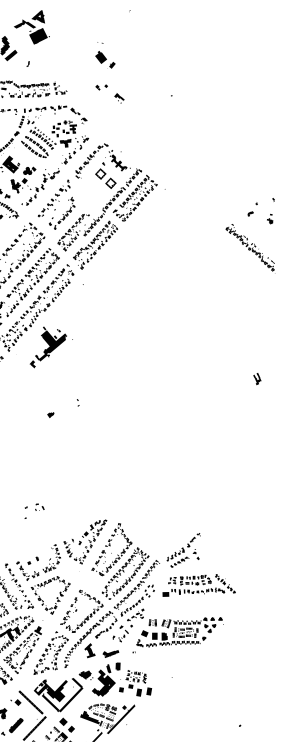


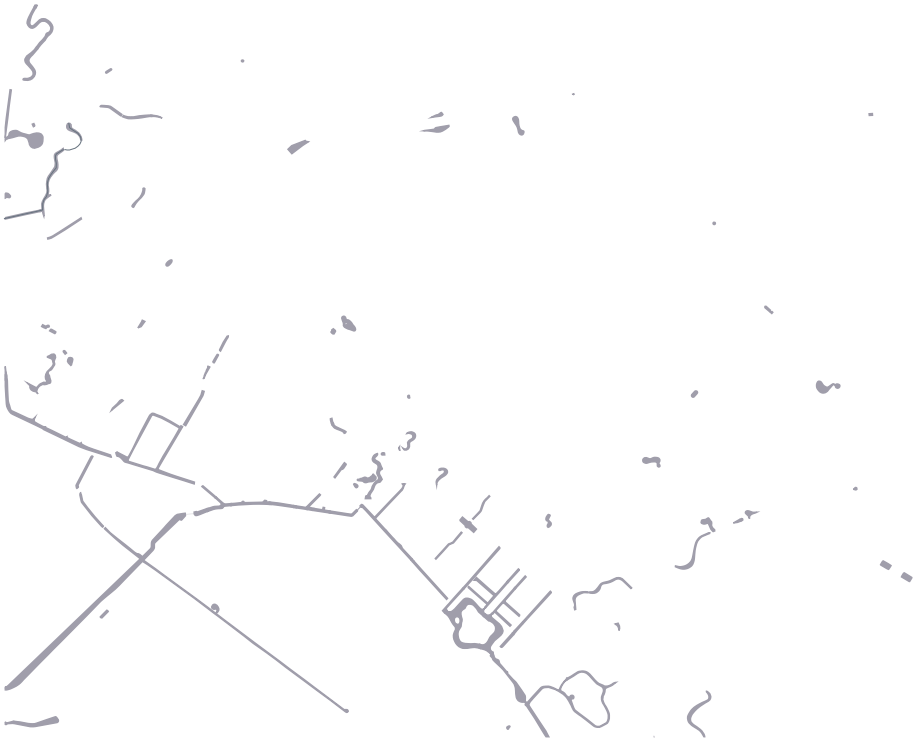
Figure ground

Roads

N

0 500 m





Water



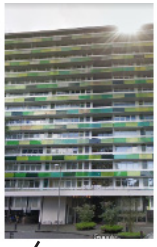
Green

Neighbourhoods in Zeist

Zeist has a large variety in neighbourhood typology. In the North east, several villa neighbourhoods for higher incomes are present. Here houses vary in style, typically have a spacious backyard and the streets are green. Neighboors have little interaction, but are happy with their living arangments (Kars advies, 2011). In the North and West corners of Zeist, neighboorhoods for lower incomes are present. Many one person households as well as families are living here. The neighbourhoods are less green than is average in Zeist and consist of mainly flats and row houses. In the center of Zeist, houses for middle incomes are mainly found.

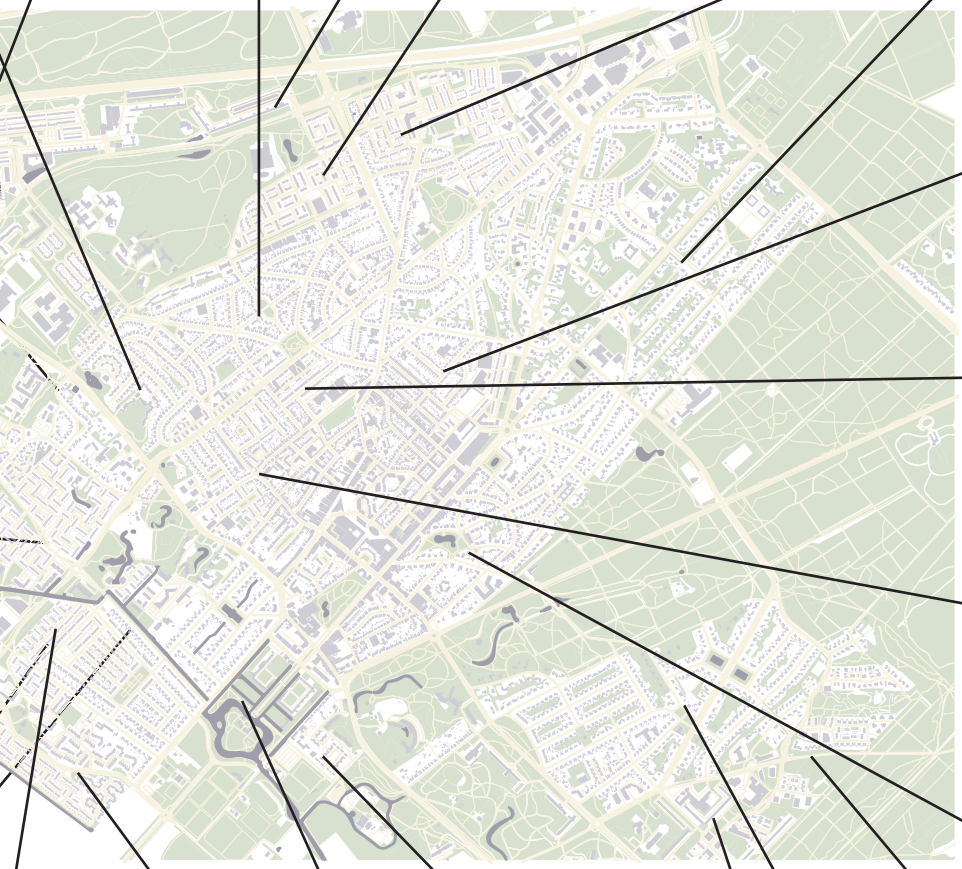






















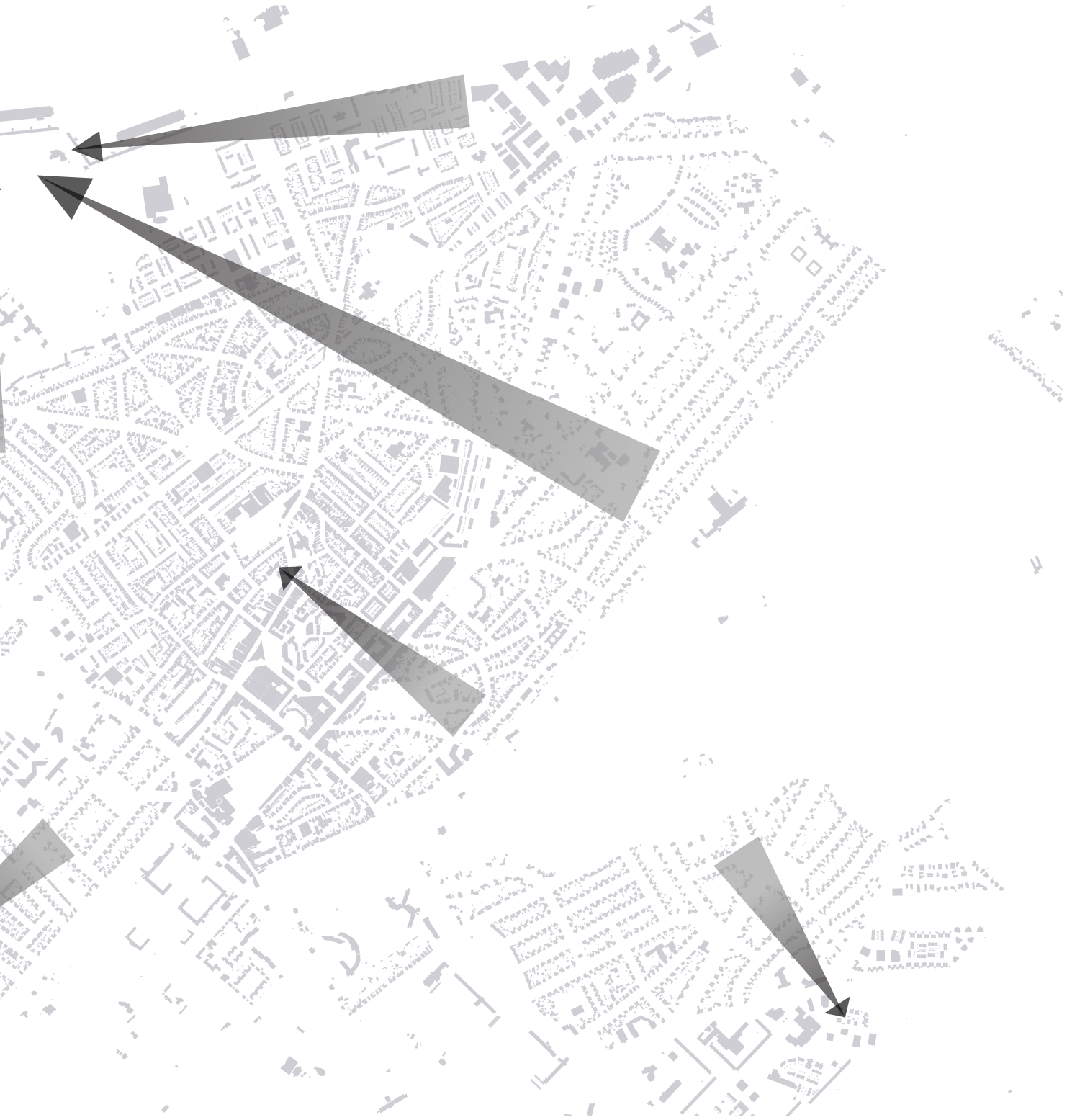

Social economical gradient Zeist

In Zeist there is a large variety in social economical classes between neighbourhoods. Lesser neighbourhoods tend to be located at the edges of Zeist, especially along the north west edges. The neighbourhoods transition in most cases smoothly from high quality neighbourhoods to middle, and then to lower quality neighbourhoods. This also makes that people form high and low social economical status rarely meet.



Social economical gradient Zeist

Gradient (high quality to lower quality neighboorhood)

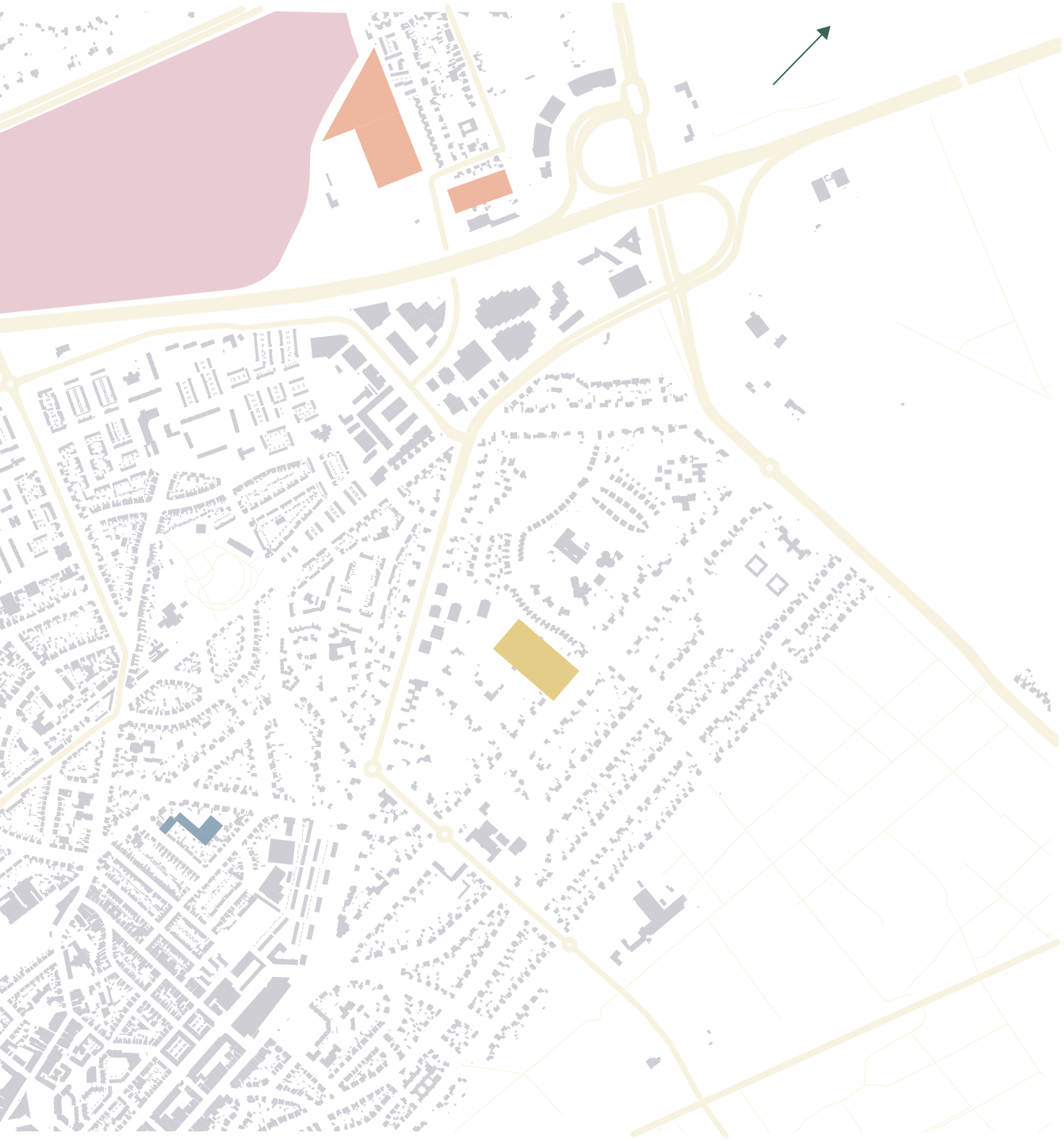


Densification locations

On the map planned densification locations by the municipality are shown (Gemeente Zeist, 2021), (Projectenoverzicht, z.d.). Each colour represents one of the densification locations. With these plans around 1200 homes are realised of which 75% is for rent, and 25% is for sale. The homes are mainly small homes for one person households, including divorced people and young professionals. Furthermore, at least 100 homes are realised where extra care is provided for its inhabitants, mainly elderly. However, due to the housing shortage, more homes are still needed in the near future, maintaining the challenge of furter densification.



N



Built environment, Infrastructure, water and Greenery

Mainly interesting is the amount of green in and surrounding the Vollenhove area. Furthermore it is enclosed by rather large roads.

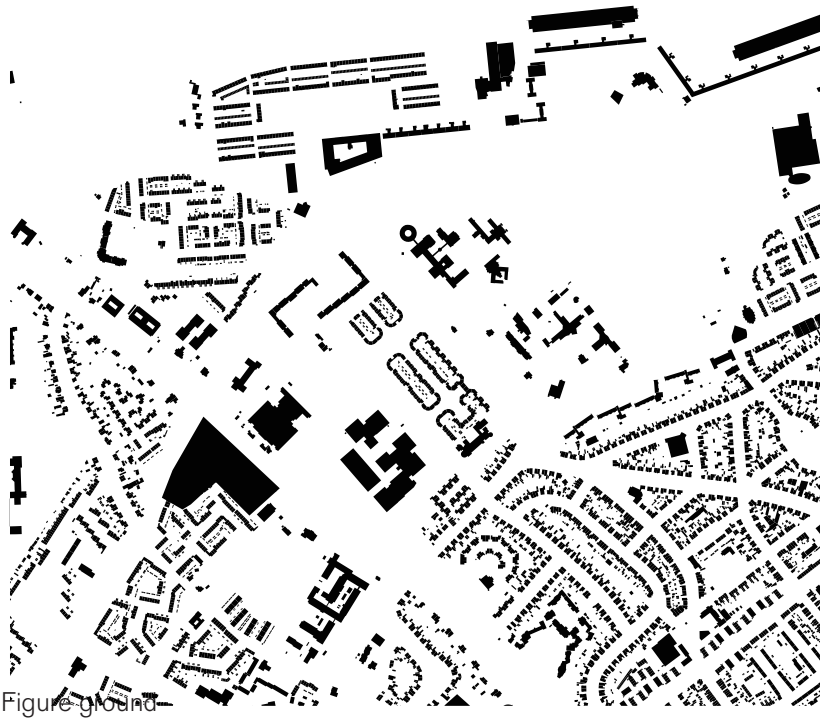


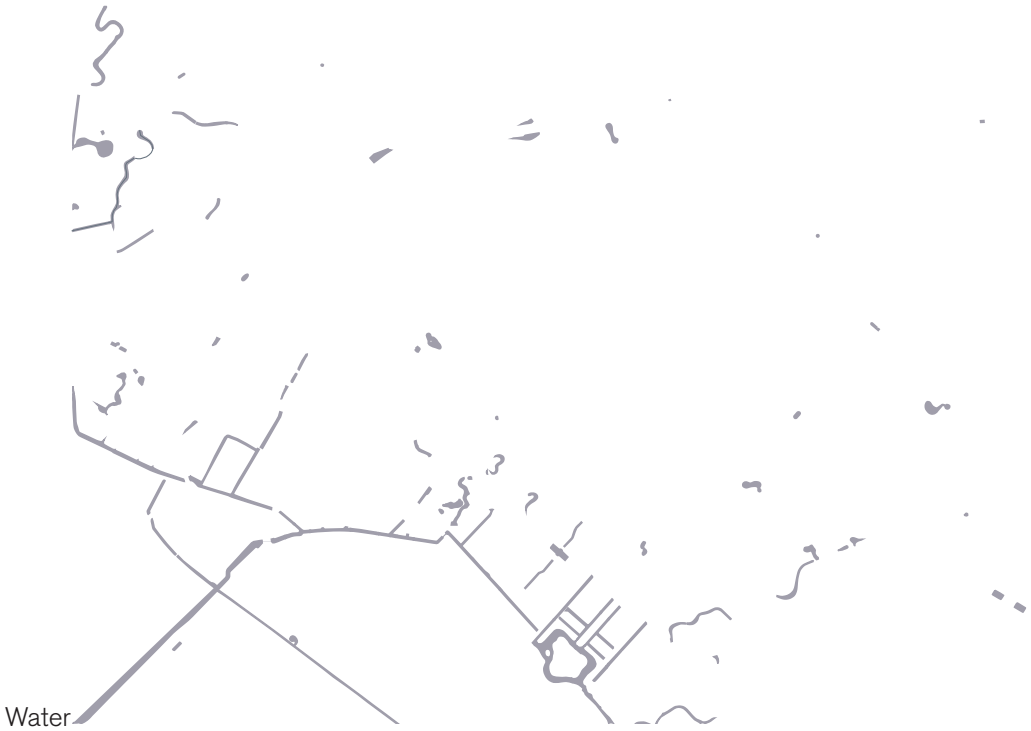
Figure ground

Infrastructure

N

0 265 m





Water



Greenery

Boundaries and Utilities

The Vollenhove area has many internal and external boundaries, distancing the neighbourhood and it's inhabitants from other parts of Zeist. the first major boundary is the big road and sound screen in the north. This creates distance between Vollenhove and the recreational forest at the other side of the road. The other big boundaries are boundaries of greenery, where too little paths are present, which both visually and physically disconnect parts of the Vollenhove area form one another and the surrounding neighbourhoods.

The second analysis maps the utilities to see whether or not inhabitants of different neighboorhoods cross paths while doing groceries. It seems as if some cross overs are made, but mainly the richer and poorer neighboorhoods remain segregated.

Boundary map Vollenhove

- Sound wall
- Infrastructural boundary
- Boundary of greenery
- Area functioning as boundary

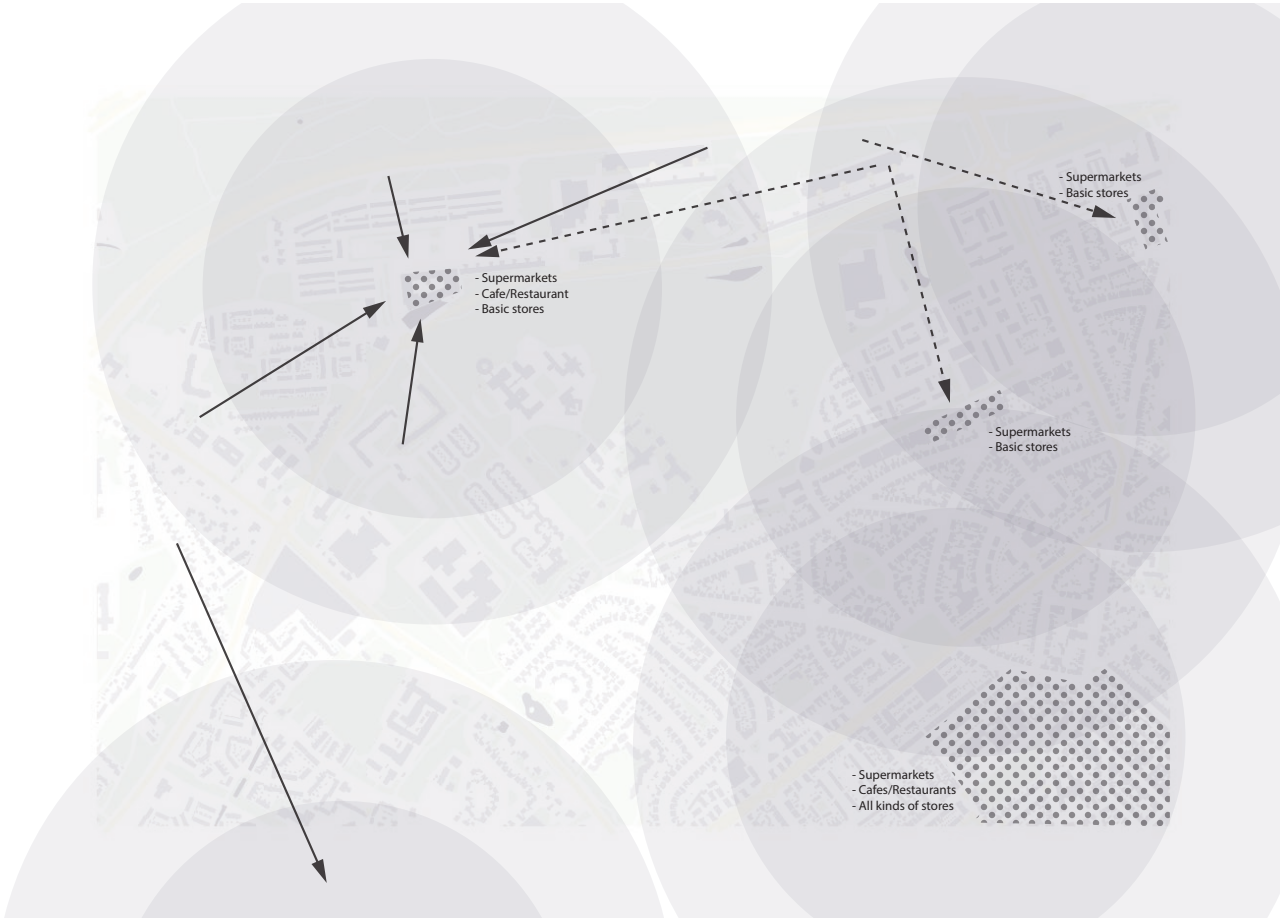
Distance to utilities

- r = 375 m
- r = 750 m
- Utilities

N



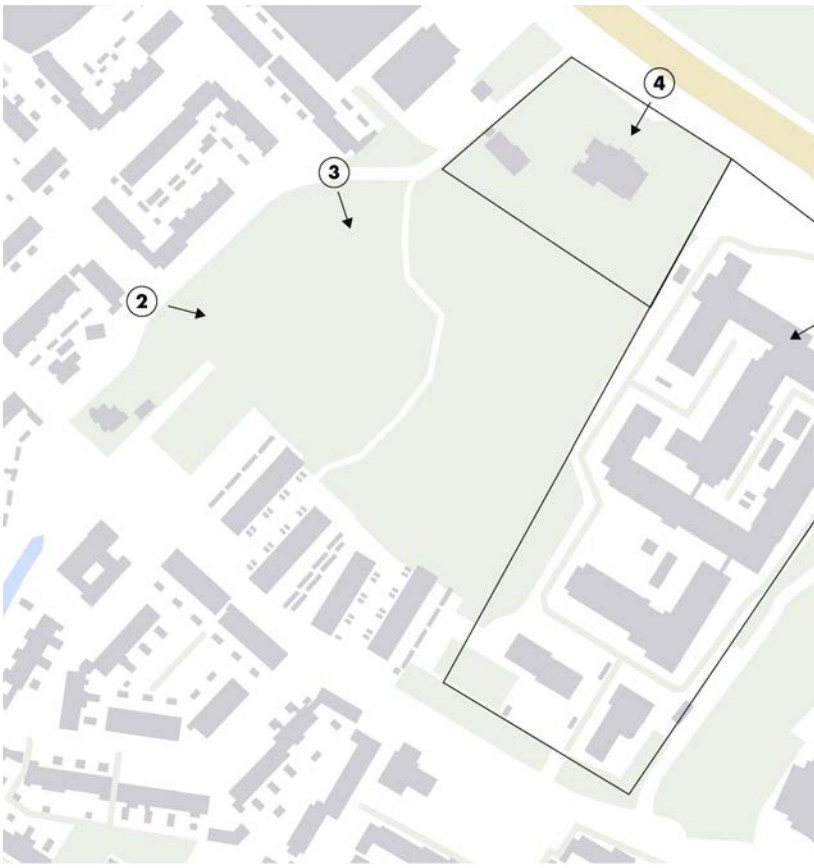
Boundary map of the Vollenhove area



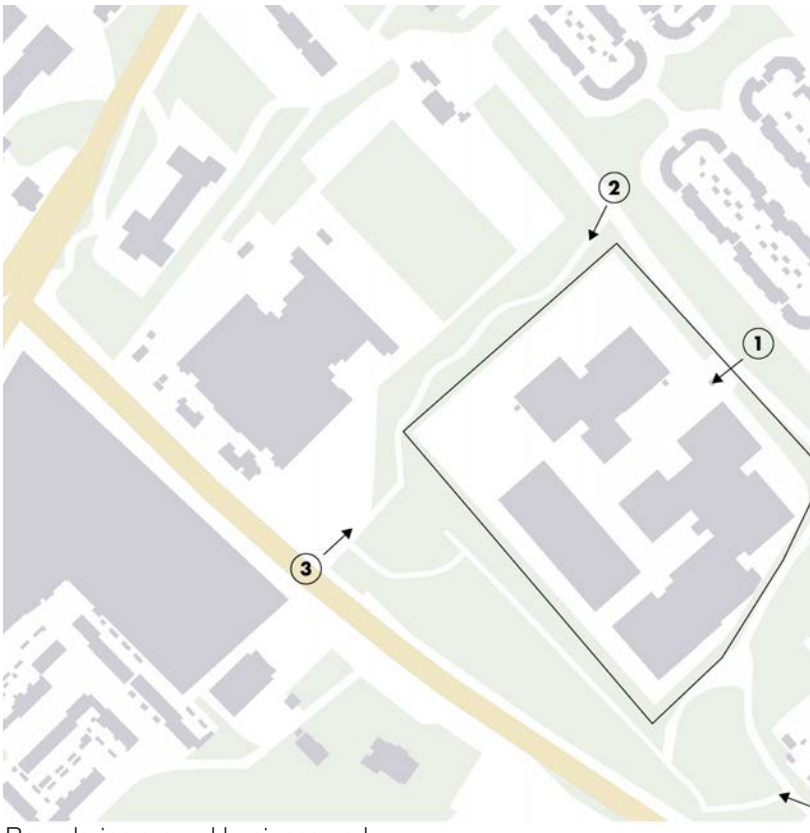
Utilities and their reach of the Vollenhove area

Business enclaves

Businesses are found in huge buildings, often old landhouses in Zeist and are surrounded by a spacious private green area. This all but creates business enclaves in neighbourhoods of Zeist. Here the entrances were investigated to determine what kind of boundary they impose. One can enter the terrain but often it is made unattractive and hardly visible from the surrounding neighbourhoods.



Boundaries around business park



Boundaries around business park

Business enclaves

N


5
6
1


1


2


3


4


5


6


6
5
4


1


2


3


4


5


6

Conclusion

Zeist is a relatively green city, with a limited amount of surface water. This can be explained by the two landscape types. The Utrechtse Heuvelrug landscape has a sandy soil in which water infiltrates quickly, meaning surface water is difficult to sustain here. Although the lack of water is in compliance with the landscape, it is visually in constrast to a water extraction area. This connection could be made stonger to make inhabitants more aware of the water extraction. The arrows indicate the gardient in livability and social economical circumstances in the neighbourhoods. One can see the less disarable neighbourhoods being located in the north and west corners of Zeist. The green neighbourhoods of different quality are rather isolated leading to less interactions between people form different social ecnomical backgrounds.

Many boundaries are present around Vollenhove, causing the neighbourhood to be rather isolated. The first boundaries are found to be infrastructural boundaries. Secondly greenery functions both as a visual and a physical boundary. Areas functioning as a boundary in itself can be found in the forest and large business terains, in which little possibilities to cross the area are present. Given the locations of utlilities, little interaction is expected to take place between the different neighbourhoods.



Conclusion map: Social economical gradient in relation to the water and greenery

- Water
- Forest
- Fence (with opening)
- Area functioning as boundary
- Shopping area
- Area within 375m of a store
- Indicating where people go for groceries
- Planned new housing by municipality

N

0 230 m

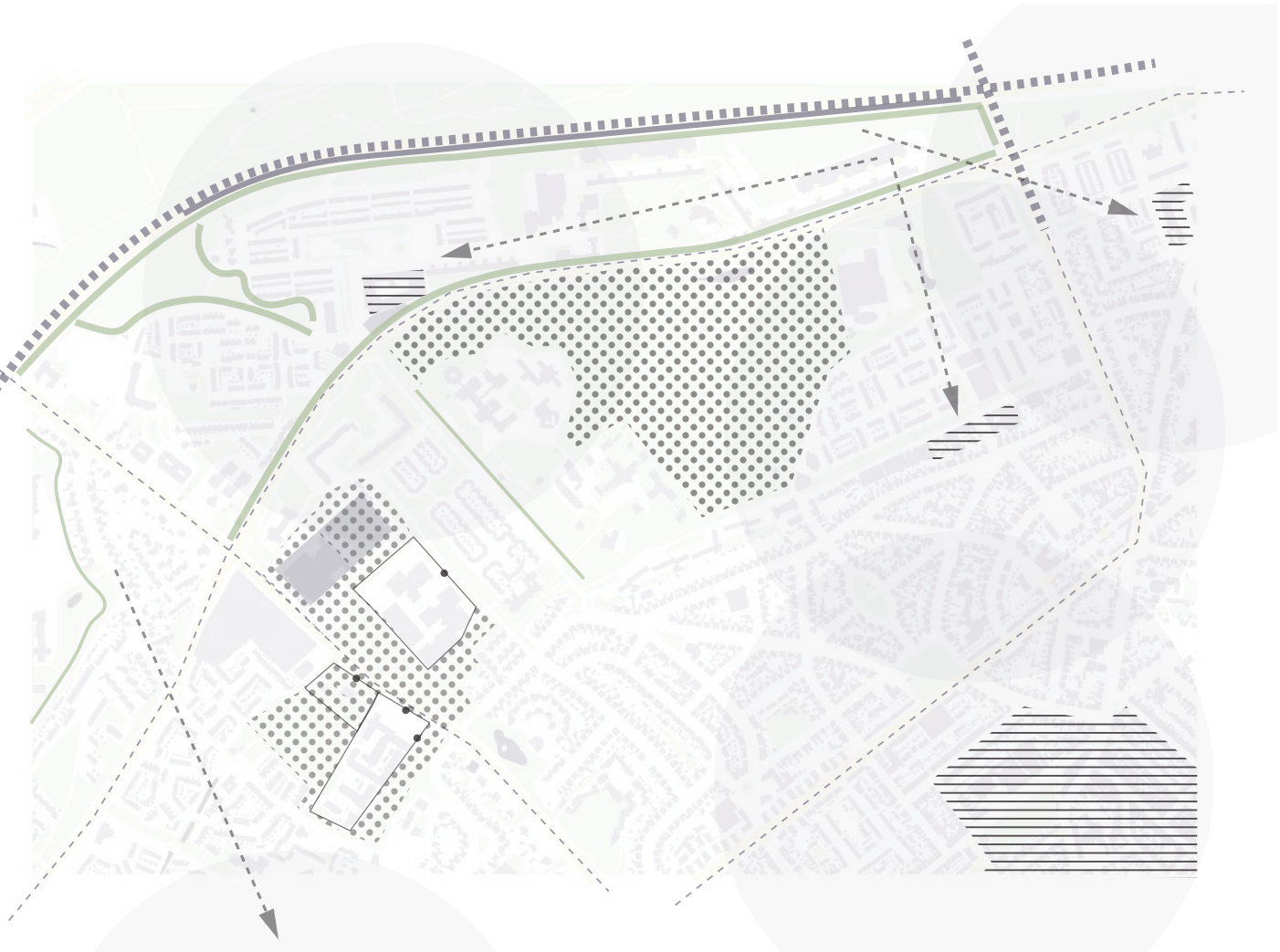
Conclusion map: Boundaries and interaction in and around Vollenhove

- Greenery
- Water
- Gradient (high quality to lower quality neighboorhood)

N

0 375





A framework on ecosystem participation and mobility systems		**Drink water (Cold, Netherlands)**	
Effects on ecosystem (ecosystem services)	Mobility characteristics	Mobility flows (Human transport):	Mobility flow effec from and to this w Other visitors of th area contaminate and microplastics this area should o winning site. Esse green road filtering
		Logistics flows (Goods transport):	The effect of the w direct ecosystem i extracted from the drainage which, ac other distribution n
	Infrastructure characteristics	Activity nodes:	Green infrastructu Green infrastructu hardly any infrastru green ways as we Grey infrastructure The grey infrastruc environmental frien water purifications 'living machine' co
		Transport links:	Green infrastructu Shell or gravel biki materials adds to filled with helophy Grey infrastructure The flow of the dri that structure and (Smith & Cameron 2013) and damag forgotten that com
Socio economic effects	Mobility characteristics	Mobility flows (Human transport):	The human transp
		Logistics flows (Goods transport):	The socio econom water leads to a hi lead to less health

TIL Framework (1/2)

A framework of the transport, infrastructure and logistics in Zeist.

ts for drinking water purposes are limited in the area of Zeist. The ‘waterwinpark’ in Zeist is located underground and mobility inpark regarding the drinking water is scarce because only inspectors or mechanics enter this area for drinking water purposes. his park come for recreative purposes. This makes that this area is well visited and well accessible. The road network around this the ground water. Water flowing from the streets into the ground is contaminated and consist of oils, sediments, heavy metals (State of Green, 2020). Also the Co2 emission of cars in the area causes poor soil condition. (Zhang et al., 2012). Therefore nly be accessible by active modes such as walking and cycling. The car network should be as far as possible from the water ntial roads for human transport should be equipped with filtering solutions. In Denmark, roads in dense areas already consist of g solutions that directly filter water before entering the ground water (State of Green, 2020).

vater on the ecosystem is limited. The pipes that distribute the water are located underground. The effect of this good on the is therefore not existing. In the case of a leak, pure clean drinking water will enter the ecosystem. This water was originally also ground and will therefore do not much damage. In case of a big leak and a quick loss of water into the ground might lead to ccording to Poschlod et al. (2005), affect the performance of species and can lead to a decrease in their richness. In case of networks such as canals, flooding can has the same influence.

re:

re is now being seen in the ‘waterwinpark’ where the entire water distribution system is located underground and above ground ucture is visible. This makes a connected, multifunctional and integrated ecosystem still possible. Purification can be done in ll, for instance by using nature in the form of helophyte plants, living machines or dunes to filter water.

e:

cture on activity nodes is the water infrastructure needed to pump the drinking water from the pipelines out of the tap. No ndly or green infrastructural solutions have yet been provided in Zeist. Before entering the houses, the water flows through a system. This system is crucial for the safety of the drinking water. It is yet built as grey infrastructure but new techniques like the uld in the future make this infrastructure green (Blersch et al., 2002)

re:

ing/foot paths lead to a more green infrastructure as natural materials are used. Increasing road networks with water filtering making the system more green (State of Green, 2020). The flow of the water could be more distributed by little channels that are te to enhance water quality (Gacia et al., 2019).

e:

nking water is distributed through pipes. Studies show that construction of pipes kill plants (Agbagwa & Ndukwu, 2014) and composition changes after construction (Dunne & Quinn, 2009). For animals the pipelines act as a physical or visual barrier n, 1985). Other impacts on animals were mortality of worm species (van Praagh, 2014), loss of bird nests (van Wilgenburg et al., e to benthic communities (Lewis et al., 2002). Although pipelines have some negative effects on the ecosystem, it must not be npared to alternatives like truck distribution, these pipelines are less harmful.

ort in the area has a socio economic benefit as accessibility increases that (Doi et al., 2008).

ic effects of the water transport are high. This is because safe drinking water is an essential provision. Safe and healthy drinking igher quality of life (Kim & Kim, 2016). This has not only social but also economical effects as healthier and cleaner water will costs.

	Infrastructure characteristics	Activity nodes:	Green infrastructu The green infrastru an advantage as le educational(social Grey infrastructure The grey infrastruc
		Transport links:	Green infrastructu New green infrastr significant addition Grey infrastructure The biggest socio several days/week effects. Fortunatel the economy.
Critical transport evaluation	Mobility characteristics	Mobility flows (Human transport):	Water supply is se water source is ea In the case of dam through a cycling
		Logistics flows (Goods transport):	The water is a criti
	Infrastructure characteristics	Activity nodes:	Green infrastructu The criticality of th be influenced by n Grey infrastructure Grey infrastructure purification can no
		Transport links:	Green infrastructu No green transpor maintained more e Grey infrastructure The grey infrastruc is less critical than
Guidelines			
Ecosystem participation	Guidelines	Mobility characteristics	▪ Increase u ▪ Remove p
		Infrastructure characteristics	▪ Replace u ▪ Apply mo ▪ Increase u

TIL Framework (2/2)

A framework of the transport, infrastructure and logistics in Zeist.

re:

uctural ‘waterwinpark’ now acts as a recreative area as the entire park is located under ground. Economically this has ess surface space is used and can be used for other purposes. Potentially the ‘waterwinpark’ area can also have a) effect if water catchment and distribution could be educated through means of mounted signs/boards.

e:

cture on activity nodes could lead to less space to be used in the middle of the city.

re:

ructure to transfer the water have a social benefit of more surface water. Whyte et al. (1974) describes open water as a n to the quality of public space. A higher quality of public space leads to a higher quality of public life (Gehl, 2007).

e:

economic effect of this drink water system is the construction and the laying of the pipelines. These construction jobs can take ks and open up the entire ground causing detours, delays and also nuisance. These effects are all negative socio economic y this is only during construction. On a daily basis the transport links, thus the pipelines, have no effects on either the society or

een by governments as a critical infrastructure and human transport to this facility must therefore be fast (Janke et al., 2014). The asy reachable with the car and located very central in the city Zeist. Human transport towards this area is thus well taken care of. nage at the ‘waterwinpark’ the mechanics can be present soon. A car must always be able to reach the place, this can be done path as well but as long as there are no obstacles present that hinder a vehicle from reaching the ‘waterwinpark’.

ical element and can not be contaminated. Contamination can lead to serious damage on human health (Sankhla et al., 2016).

re:

e purification system can be resolved by implementing natural purification systems that are not dependent on electricity nor can natural disasters such as earthquakes.

e:

e that is more dependant on external sources or are more exposed to possible natural disasters are more likely to fail. The water ot fail, when it does people will drink contaminated water.

ure:

rting infrastructure present in the current system. Pipelines could be replaced by natural channels that can be reached and easily as they are above the ground.

e:

cture pipelines are installed under the surface making it difficult to repair any damages caused by e.g. earthquakes. This system n the purification as not having water is less dangerous than having contaminated water.

usage of green modes of transportation in the area of the groundwater extraction

polluting transportation networks on the sites where water is extracted for drinking water purposes

underground pipelines with open surface water for water distribution in the Kromme Rijn area

re green filtering solutions to the water distribution system

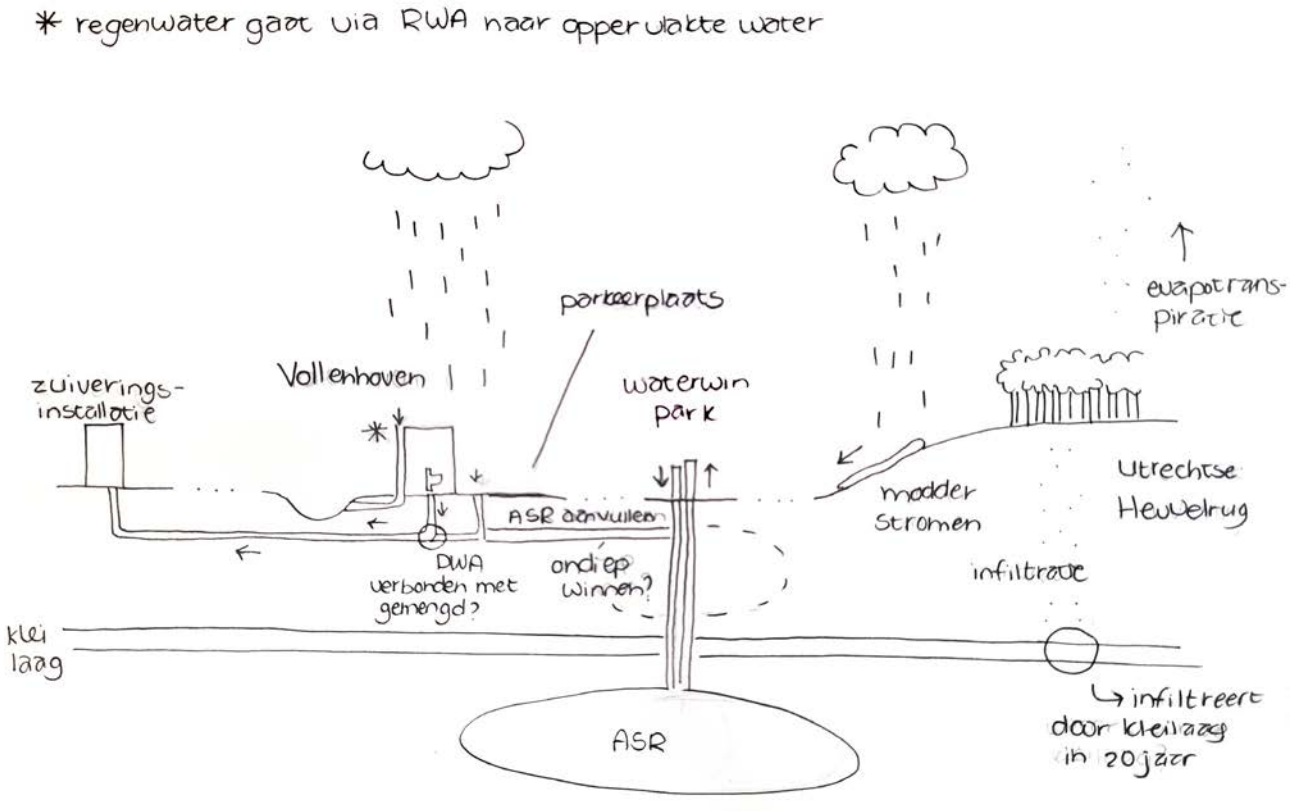
usage of green filtering solutions for water derived of polluted roads in the area of the groundwater extraction

3.

Systems description and synthesis

Water system

The water system in Zeist functions on different scales. The scale of the region/ city is interesting as it shows how the water infiltrates into the aquifer. This is a slow process, as water easily moves through the sand layers, but only very slowly through the clay layer. On the smaller scale a rainwater sewage system as well as other forms of water storage can be used to realise an ASR solution. For the ASR to work, one needs relatively clean water, which needs to be filtered before it can be pumped into the ground.



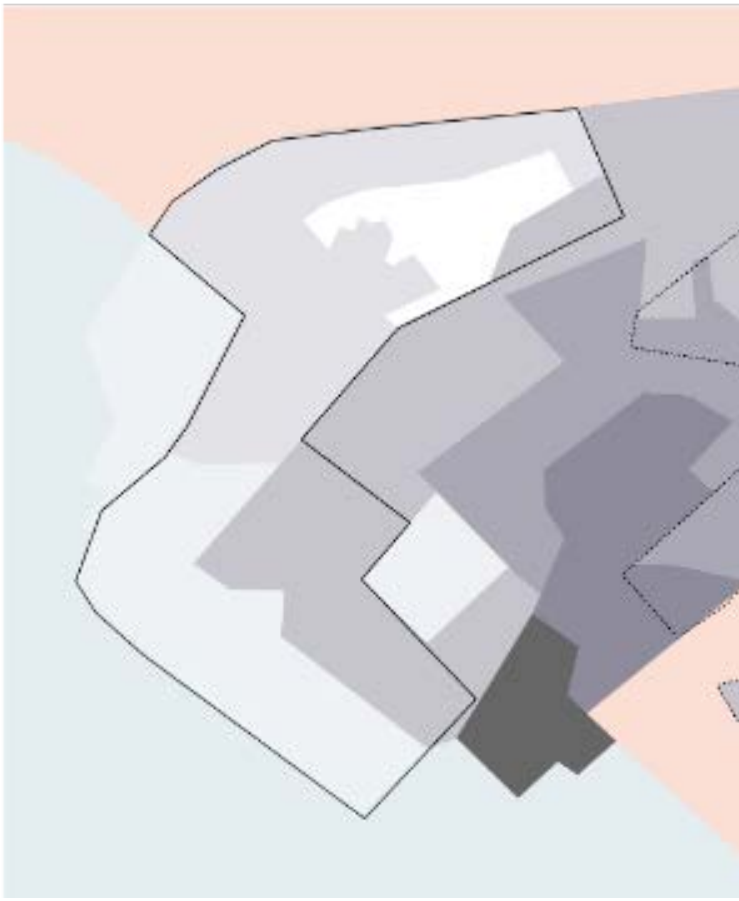
Sketch of the water system

Districts and historical linkage

When we investigate the different districts and the overall historical linkage of Zeist we notice interesting overlap. In figure (...) the different districts are shown rated to their liveability.

Two districts really stand out, one of which being the district 'Hoge Dennen' in the South-East of Zeist. In earlier days, we see how the landscape contained traditional french landscape gardens, villa's and estates that stretched out in and along the Utrechtse Heuvelrug as the nature here was remarkable and unique (also one of the reasons for very early signs of tourism). The district that emerged here in the 1960's was built for the well-earning and contained large (semi) detached dwellings and gardens that continued in the striking style of the historical estates. Decades later, when urban expansion saw to the realisation of the district Kerckebosch, this villa style with a high integration of nature was continued.

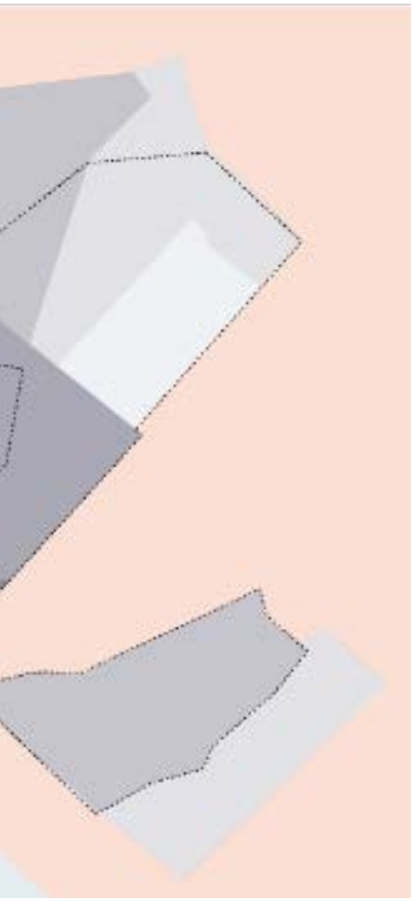
The other district that stands out due to its liveability, though much lower compared to 'Hoge Denne', is the district Vollenhoven. It's first historical mention started with the Sanatorium Zeist located in the woods next to Zeist in 1910. In 1968, an area caught between the highway and the forest was designated for the realisation of a new district containing housing for local industry workers, thus being working-class neighbourhoods. However, in the years to come we see a steep decline in Zeists industries, as they are all leaving due to the popularity increase of low income countries. After years of further urban in- and expansion, Vollenhoven has become a secluded fragment of Zeist by the highway and Sanatorium woods, and these aspects compared with the previous mentioned events might have been the driving force behind the low liveability of the district.



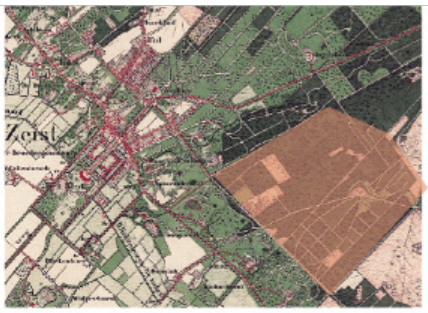
Schematic view of Zeist

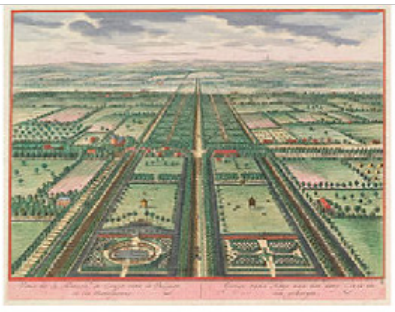
With highlighted districts in the surrounding landscapes

- < 1850
- 1850 - 1900
- 1900 - 1950
- 1950 - 1975
- 1975 - 1990
- > 1990
- High livability
- Low livability
- Kromme Rijn Landscape
- Utrechtse Heuvelrug Landscape



1873



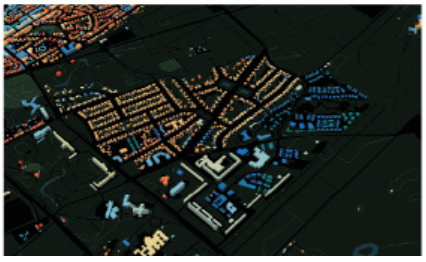


1960





2020



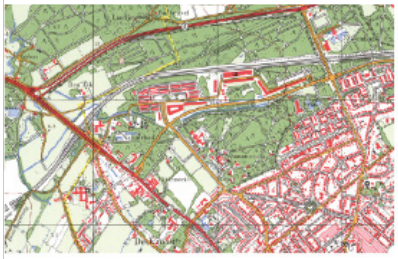


1910



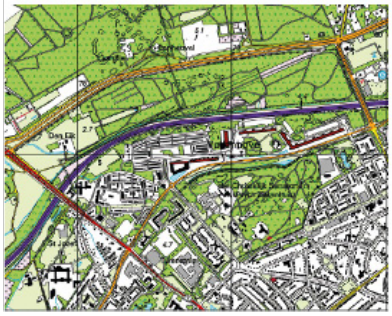


1960





2020





The function of green in the urban area of Zeist

In most cities greenery within the city is used as a binding element and only as a boundary when it is placed inbetween neighboorhoods and large roards. In zeist however the greenery also forms a boundary between neighboorhoods where people from different social economical background live as well as a boundary between private areas of buisinesses and neighboorhoods. This increases the division between neighboorhoods and is therefore not always desirable. Private green in the form of gardens can be directly related to the neighboorhoods for higher income citizens. The remaining greenery in zeist has a social or recreational function. This is also needed as not many public spaces in the form of squares are present.

The function of greenery in the urban area of Zeist

- Social/ recreational green
- Greenery which is mainly nice to look at Private (garden)
- Greenery that functions as border
- Greenery outside of Zeist

N

0 250 m

Disconnected green elements in the Kromme Rijn Landscape

There's a big difference in the amount of connection between the green elements in Zeist and it's surrounding landscapes. In the more wealthy areas in the Utrechtse Heuvelrug Landscape the green elements are pretty well connected to the landscape but if you move to districts with a lower livability in the Kromme Rijn Landscape it shows less connection.



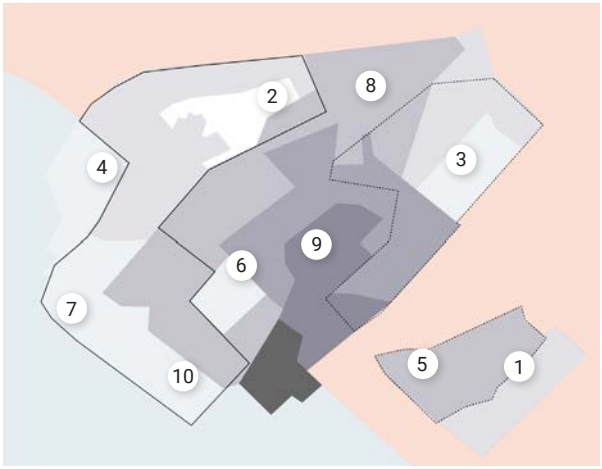


Amount of connection of the green elements to the surrounding landscape

Ranked from a lot (1) to not really (10)



☐ Kromme Rijn Landscape
☐ Utrechtse Heuvelrug Landscape


2
8
4
3
9
6
7
10
5
1


1


3


4




6


7




9


10

A synthesis between the domains throughout the scales

Here you see how the analysis of the landscape, urban morphology and antropology relate to each other throughout the scales.

Ot the landscape scale where you can see that Zeist is located on the place where two landscapes meet. In the west you have the wet and lower Kromme Rijn landscape and on the east the dry and higher Utrechtse Heuvelrug landscape. Next to the images of the landscapes you can see the current prevailing animals in which it stands out that in the Kromme Rijn landscape there are not at lot of. This can be explained by the increase of periods of drought that Boris mentioned before, these periods made the landscape dryer than it was and a lot animals lost their habitat when this happened.

Zooming in into the scale of Zeist we see a big contrast between the livability of the districts and it becomes clear that the districts with a high livability are situated in the Utrechtse Heuvelrug landscape and that the green elements in these districts themselves are also based on the landscape around it. Most of the districts with a lower livability are located in the Kromme Rijn landscape and the green elements also happen to have less of a connection to the landscape.

And lastly zooming in to the district Vollenhove. In this low livability district there are a lot of boundaries, which can differ from very thick tree lines to the buildings themselves. In this district there are multiple perspectives on water use happening at once which can be somewhere between protecting the groundwater against pollutions to carelessly using drink water to flush the toilets.

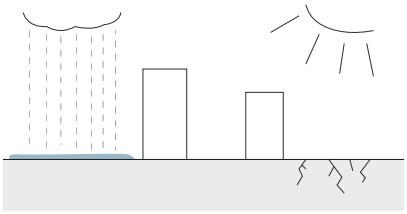
If we then zoom out again and look at the complete picture we can see the connections between the scales. You have for instance the degradation of the Kromme Rijn landscape which has resulted in the fact that the green elements in the surrounding districts are less connected to this landscape. We can also see that the huge contrast in landscapes is being reflected in the big contrasts in livability between the districts and the boundaries that enhance these contrasts. And lastly there's the internal individual contrast of the inhabitants when it comes to their perspective on water use.

Hybrid system drawing

The relation between the analysis is shown.



L-flat as a boundary in itself



Periods of heavy rainfall and drought

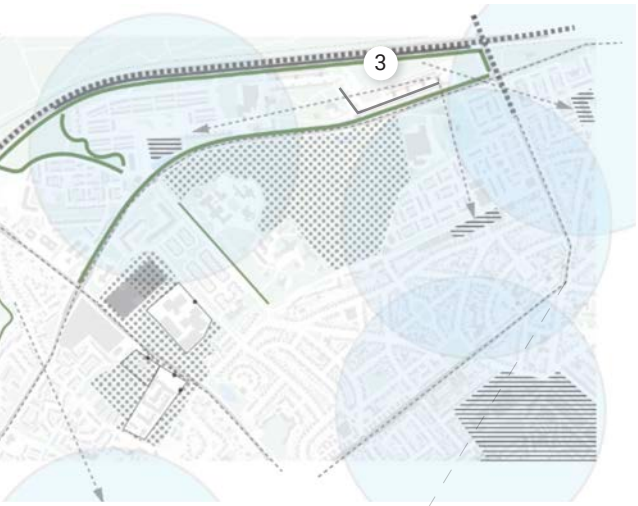


Low livability districts on clay
+ not integrated in the landscape

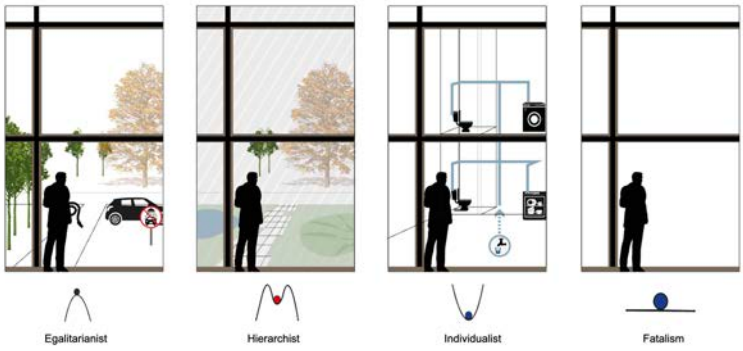
Kromme Rijn landscape



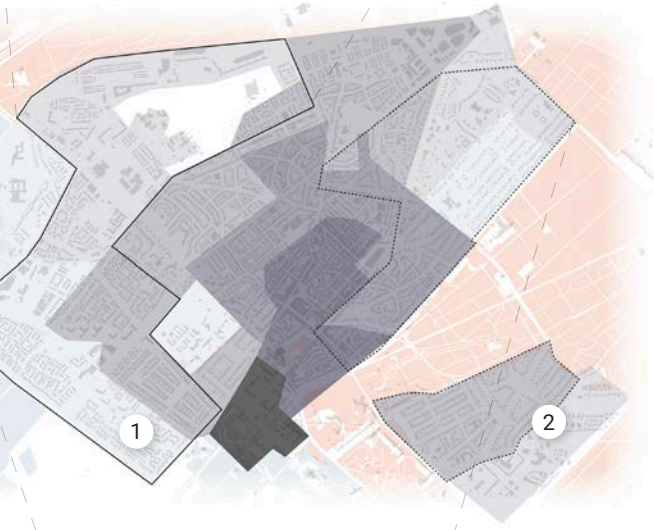
A few prevailing Animals



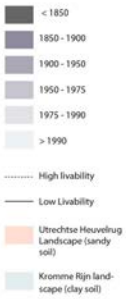
Boundaries in Vollenhove



Perspectives on water use

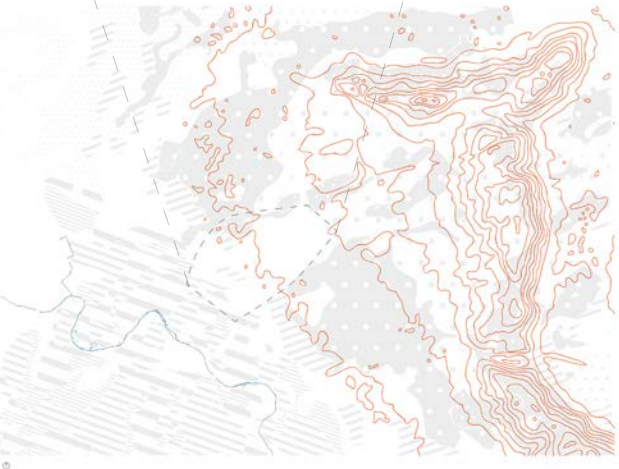


Division in districts





High livability districts on sandy soil
+ integrated in the landscape



Two landscapes

Utrechtse Heuvelrug



Many prevailing Animals

4.

Scenario making

Introduction and conclusion

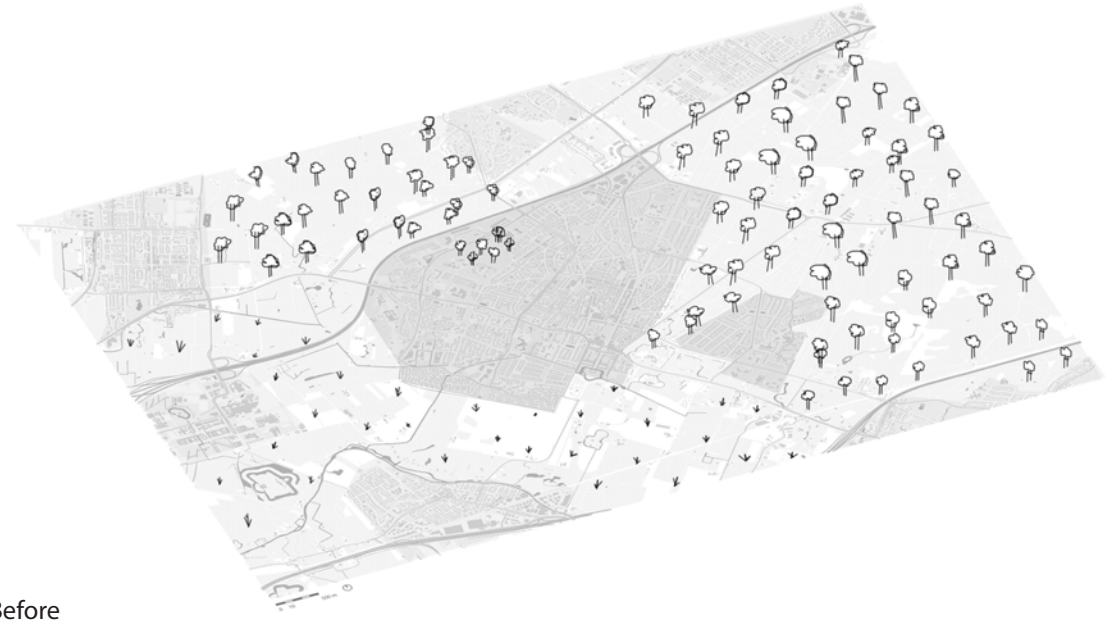
Three scenarios were investigated to explore what would be the consequences for Zeist in these extreme cases. When one can see the consequences of an extreme scenario, it is possible to give an indication of what would happen in a more realistic case and what we can learn from the extremes. The three scenarios chosen are: Nature first, No humans and no technology. Based on the outcomes of the nature first scenario, it was realised one needs to think more carefully about nature and it's intended function and long term relation to humans while designing. We should realise when we are designing nature for ourselves, and when we design it for nature and all species living in nature and make a conscious choice. From the no humans scenario came the realisation that nature can function very well without humans being present, raising the question how and if we could have a relationship with nature that is actually mutually beneficial. Lastly, the no technology scenario showed how every site has a very specific quality, and that small scale trade is necessary to function optimally, as in this scenario a quick realisation of the unsustainability of our consumerist trends would be forced. Three scenarios were investigated to explore what would be the consequences for Zeist in these extreme cases. When one can see the consequences of an extreme scenario, it is possible to give an indication of what would happen in a more realistic case and what we can learn from the extremes. The three scenarios chosen are: Nature first, No humans and no technology. Based on the outcomes of the nature first scenario, it was realised one needs to think more carefully about nature and it's intended function and long term relation to humans while designing. We should realise when we are designing nature for ourselves, and when we design it for nature and all species living in nature and make a conscious choice. From the no humans scenario came the realisation that nature can function very well without humans being present, raising the question how and if we could have a relationship with nature that is actually mutually beneficial. Lastly, the no technology scenario showed how every site has a very specific quality, and that small scale trade is necessary to function optimally, as in this scenario a quick realisation of the unsustainability of our consumerist trends would be forced.

Scenario 1 . Nature First

‘Nature First’

In the nature first scenario, humans will truly become a part of the ecosystem and live with it without having more influence on it than other species. This living with the dynamics of nature will result in less humans, living more compact with shared facilities and at a physical distance from nature, as not to harm it. Simultaneously nature will feel closer as it will be part of our everyday life, of our culture. Society will be less materialistic, the economy will be more local and making monetary profit will no longer be the main goal.

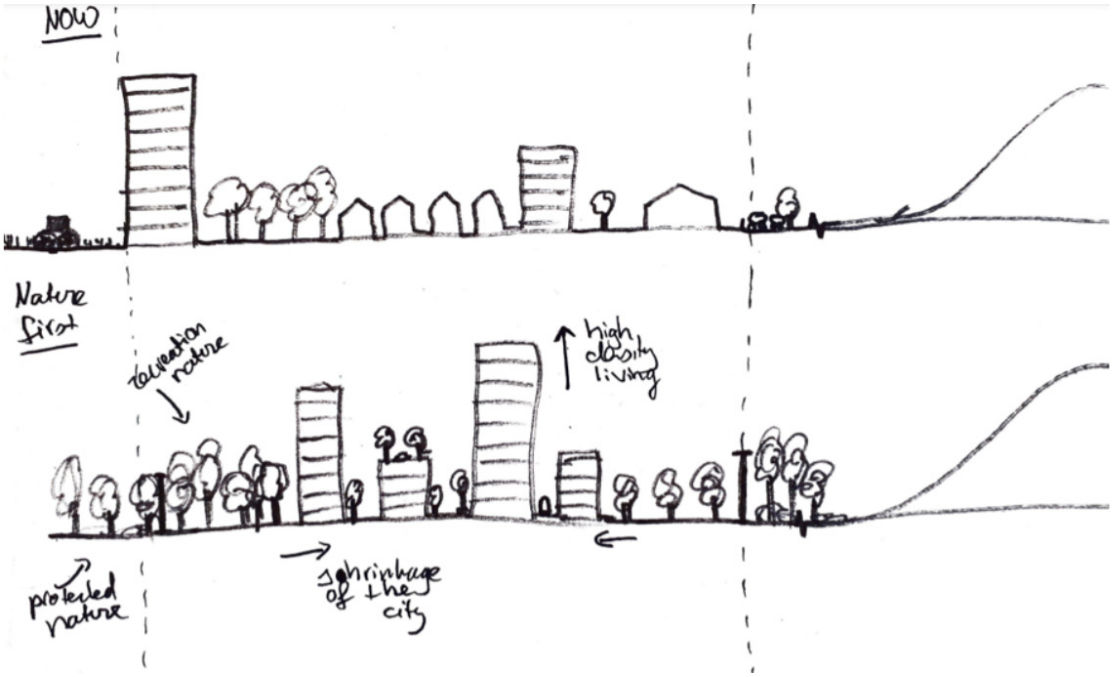
What can we take from this scenario? The following questions where asked based on the findings: What is nature and who’s is it? Can we call something nature if we decided for which species we make it attracktive? and, do we even have the right to decide on that? till what extend schould we intervere in nature? From this it was taken to think more carefully about nature and it’s intended fucntion and long term relation to humans while designing.



Before



After



Scenario 2 . No Humans

‘No Humans’

How we reach phase 1: We keep going like we’re doing now, so we keep developing new technology and keep using the earth the way we’re used to do. Eventually the climate change will become so prominent that people start migrating to areas that are most suitable.

Phase 1: Communities will build walls around their living area to keep everything that’s valuable inside and to themselves. Every area has it’s own value: the southern area has fertile soil, the middle area has the drink water well and the northern area is situated high and dry, so they will have to trade to survive. This areas are only for the wealthy and favelas begin to appear in the poorer areas.

Phase 2: The richest people have already left, their areas are abandoned, the favelas have grown, more traditional ways of mobility are in use, resources are gone.

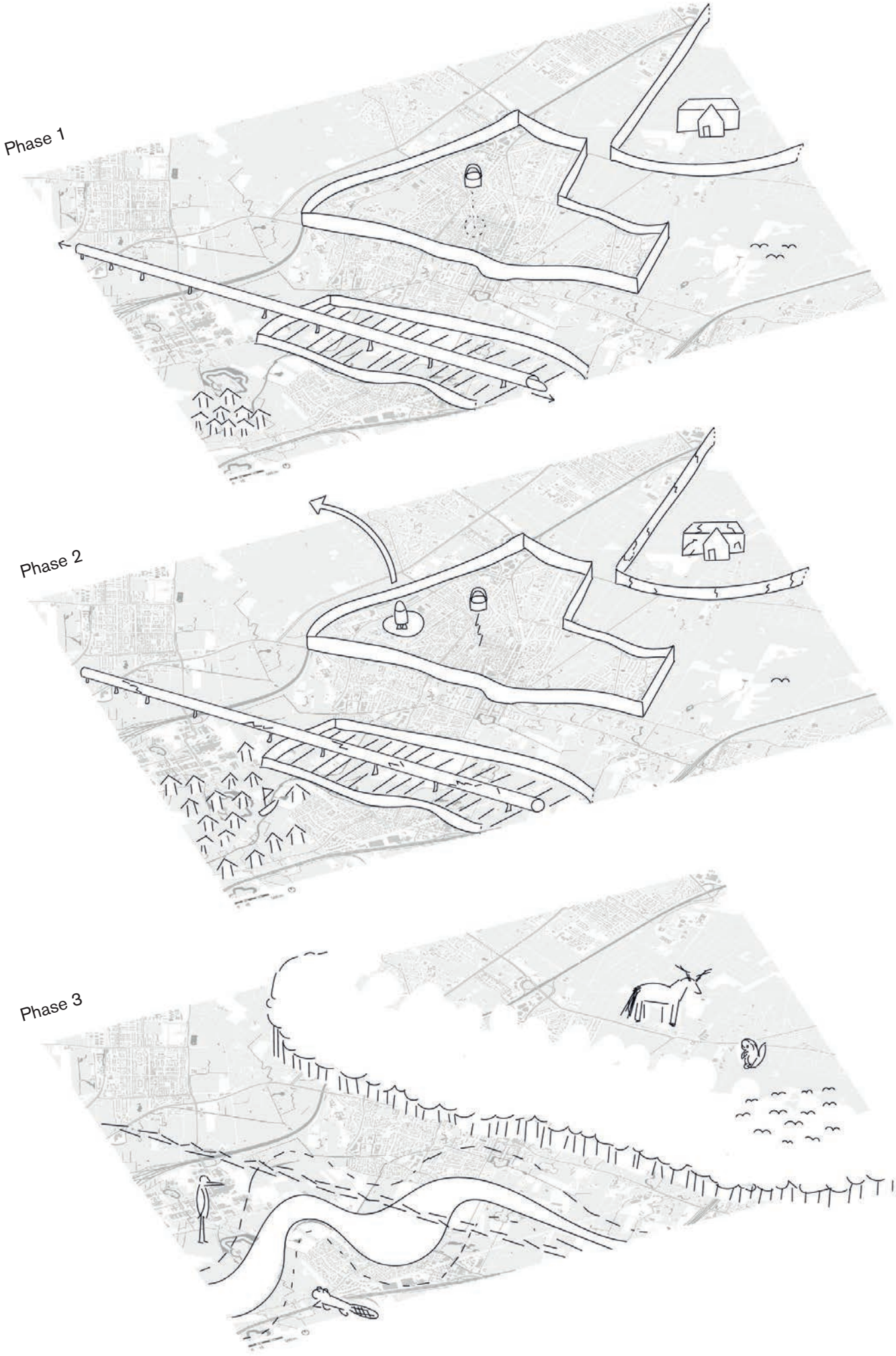
Phase 3: Some remnants of infrastructure will maybe remain, but the people are gone, the planet is starting to stabilize again and biodiversity is increasing again.

Conclusions:

- Look at the site specifics to see the areas big potential
- Trading and working together is needed
- Combine the human landscape with the natural one?

Rough 3D sketches

For every phase of the scenario


Phase 1
Phase 2
Phase 3

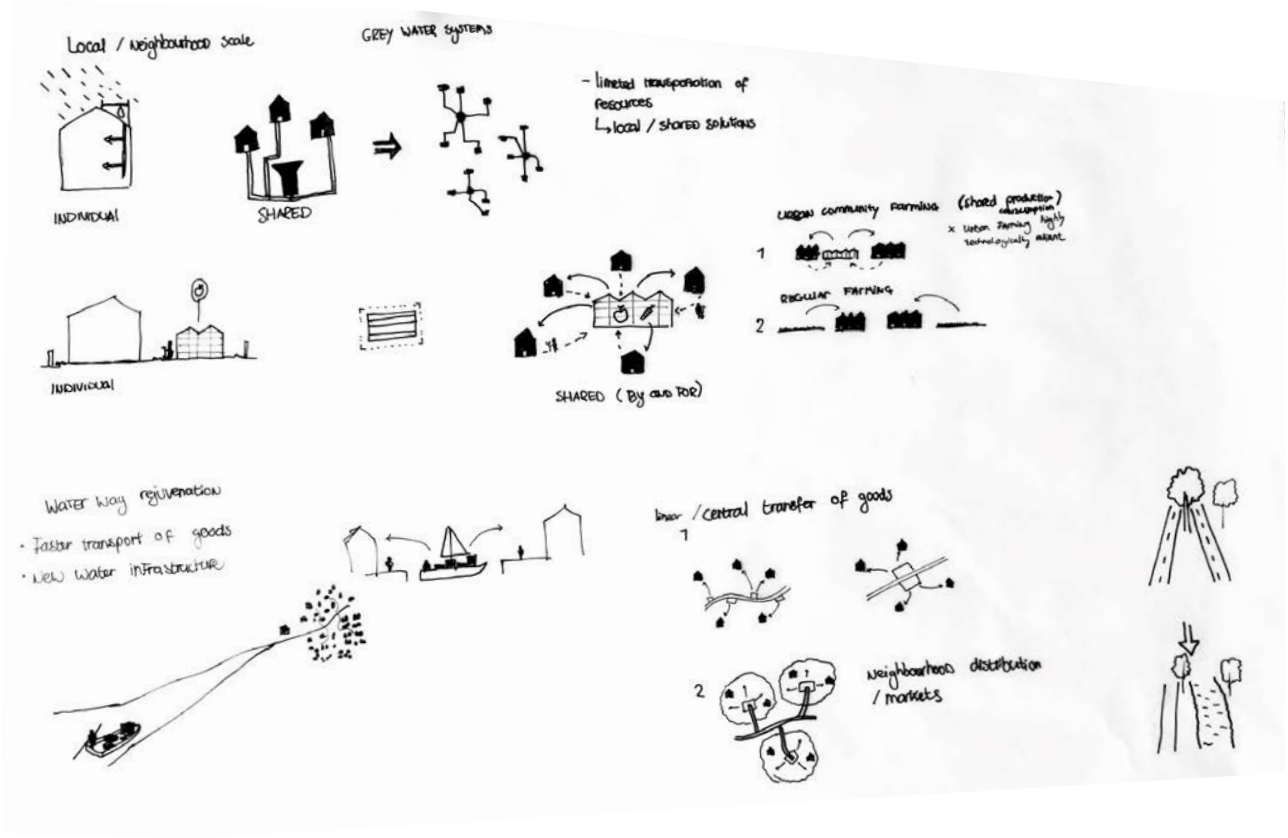
Scenario 2 . No Technology

What we can learn from ‘No Technology’

- In the scenario no technology, it is imagined that there is still growth and densification but overall natural solutions are preferred over technological solutions. Solutions that do not need fuel or energy and are mostly facilitated by nature.
- Firstly, as cars are completely out of the question in this scenario, the large infrastructural bodies we are used to become rather underused. The most convenient mode of infrastructure that is then available is mobility over water. Therefore, in this scenario, waterway rejuvenation is envisioned in which the system of waterbodies is increased to provide connections between the different locations and facilitate water as the main body for transportation.
- Secondly, as we do not possess the technology for mid- or highrise any longer, urban densification becomes much harder as the urban environment will then be fully occupied in no time. Therefore urban expansion is chosen over densification.
- Thirdly, transportation of provisions over long distance is neither an option anymore, which leaves us to strive for more local production of location specific foods.
- These three aspects come together in a scenario where the city will be expended with self-producing communities that rely on many shared facilities and transport by boat via the rejuvenated infrastructure of waterbodies. The old infrastructural bodies that are now out of use can be used for material harvesting, whereby the decrease in impervious surface will allow nature to regrow back into the urban environment. This scenario shows us the incredible disproportionality of our current ways as we would soon realise how unsustainable our current trends of consuming are, therefore it encourages us to already look for behaviour changing concepts regarding consumption and resource management.

Rough 3D sketches

For every phase of the scenario


Local / neighbourhood scale
GREY WATER SYSTEMS
- limited transportation of resources
↳ local / shared solutions
INDIVIDUAL
SHARED
urban community farming (shared production consumption)
x urban farming highly technologically aware
1
REGULAR FARMING
2
INDIVIDUAL
SHARED (By and for)
Water way rejuvenation
- faster transport of goods
- new water infrastructure
Inner / central transfer of goods
1
2
Neighbourhood distribution / markets

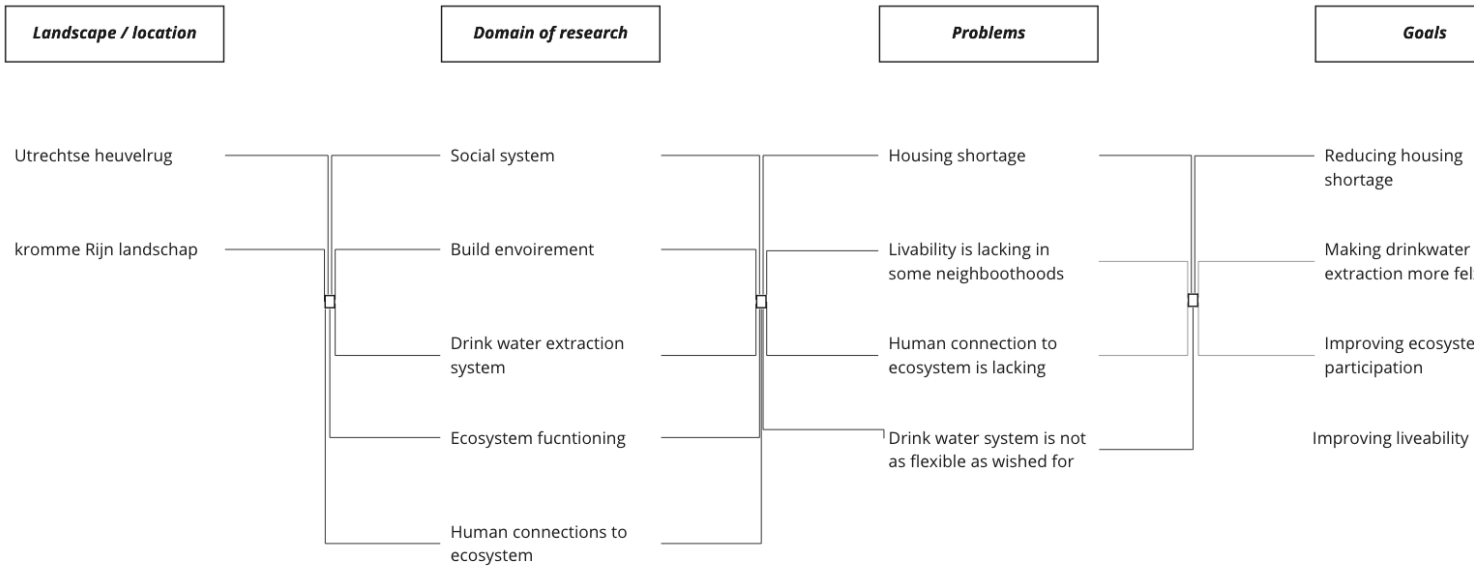


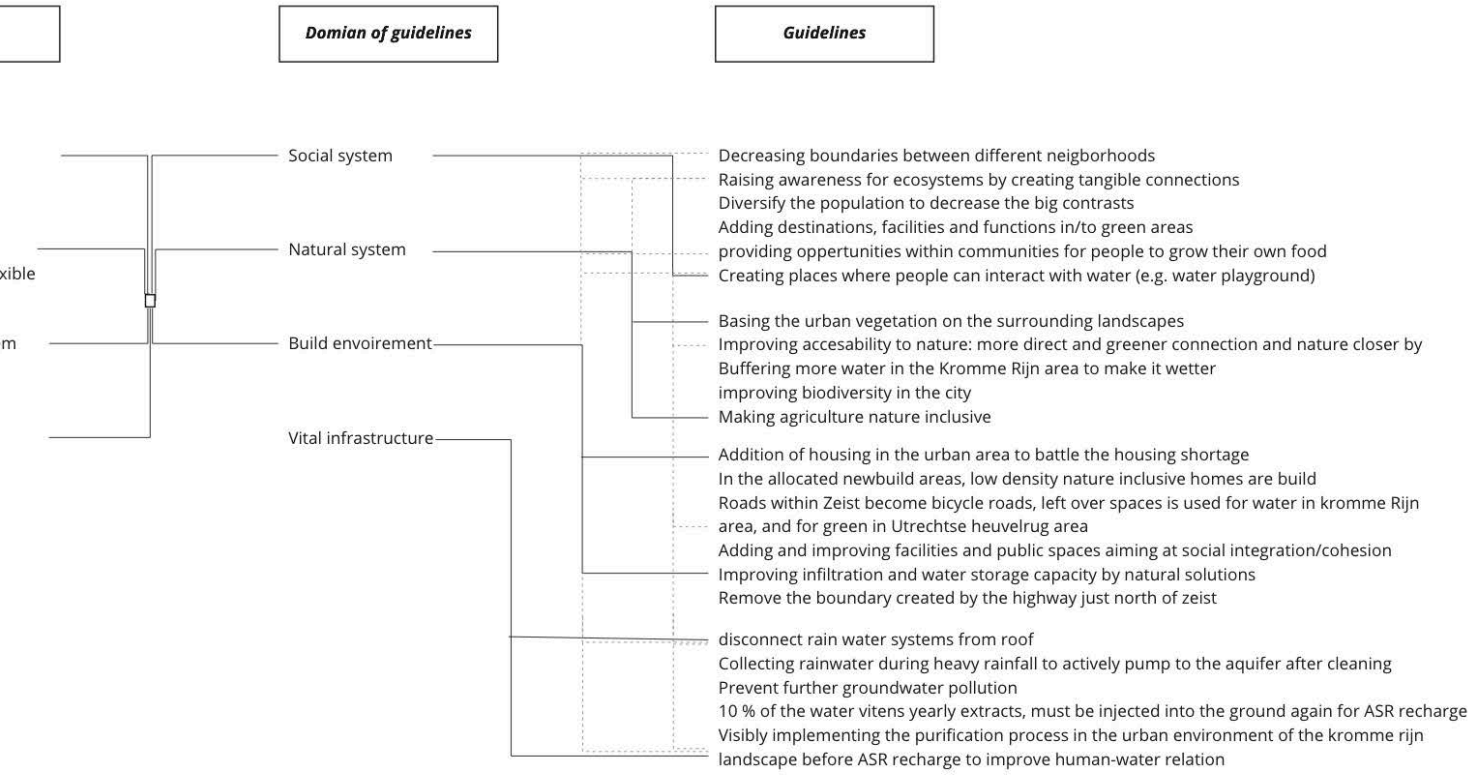
5.

System intervention

Guidelines taxonomy

The guideline taxonomy is structured as follows: First, a distinction is made between the different landscapes, followed by the domains of research. From the location and the relevant domains of research, a set of problems is defined, which where then translated into a set of goals. From these goals, guidelines could be defined. However, to order the guidelines properly, first domains of guidelines were determined. As the guidelines often could not be allocated to one single domain, the relation is shown by the dotted lines. The guidelines itself would have to be enforced and lived by by a variety of actors, making the implementation complex. Collaboration between the different stakeholders, especially: the municipality, housing developers, waterschappen, Vitens and Inhabitants of Zeist is desirable to achieve the intended outcome. However if collaboration is challenging, the majority of the guidelines can either be enforced or implemented by the municipality itself yielding a less than optimal, but still acceptable result.




Domian of guidelines
Guidelines
Social system
Natural system
Build envoirement
Vital infrastructure
Decreasing boundaries between different neigborhoods
Raising awareness for ecosystems by creating tangible connections
Diversify the population to decrease the big contrasts
Adding destinations, facilities and functions in/to green areas
providing oppertunities within communities for people to grow their own food
Creating places where people can interact with water (e.g. water playground)
Basing the urban vegetation on the surrounding landscapes
Improving accesability to nature: more direct and greener connection and nature closer by
Buffering more water in the Kromme Rijn area to make it wetter
improving biodiversity in the city
Making agriculture nature inclusive
Addition of housing in the urban area to battle the housing shortage
In the allocated newbuild areas, low density nature inclusive homes are build
Roads within Zeist become bicycle roads, left over spaces is used for water in kromme Rijn
area, and for green in Utrechtse heuvelrug area
Adding and improving facilities and public spaces aiming at social integration/cohesion
Improving infiltration and water storage capacity by natural solutions
Remove the boundary created by the highway just north of zeist
disconnect rain water systems from roof
Collecting rainwater during heavy rainfall to actively pump to the aquifer after cleaning
Prevent further groundwater pollution
10 % of the water vitens yearly extracts, must be injected into the ground again for ASR recharge
Visibly implementing the purification process in the urban environment of the kromme rijn
landscape before ASR recharge to improve human-water relation

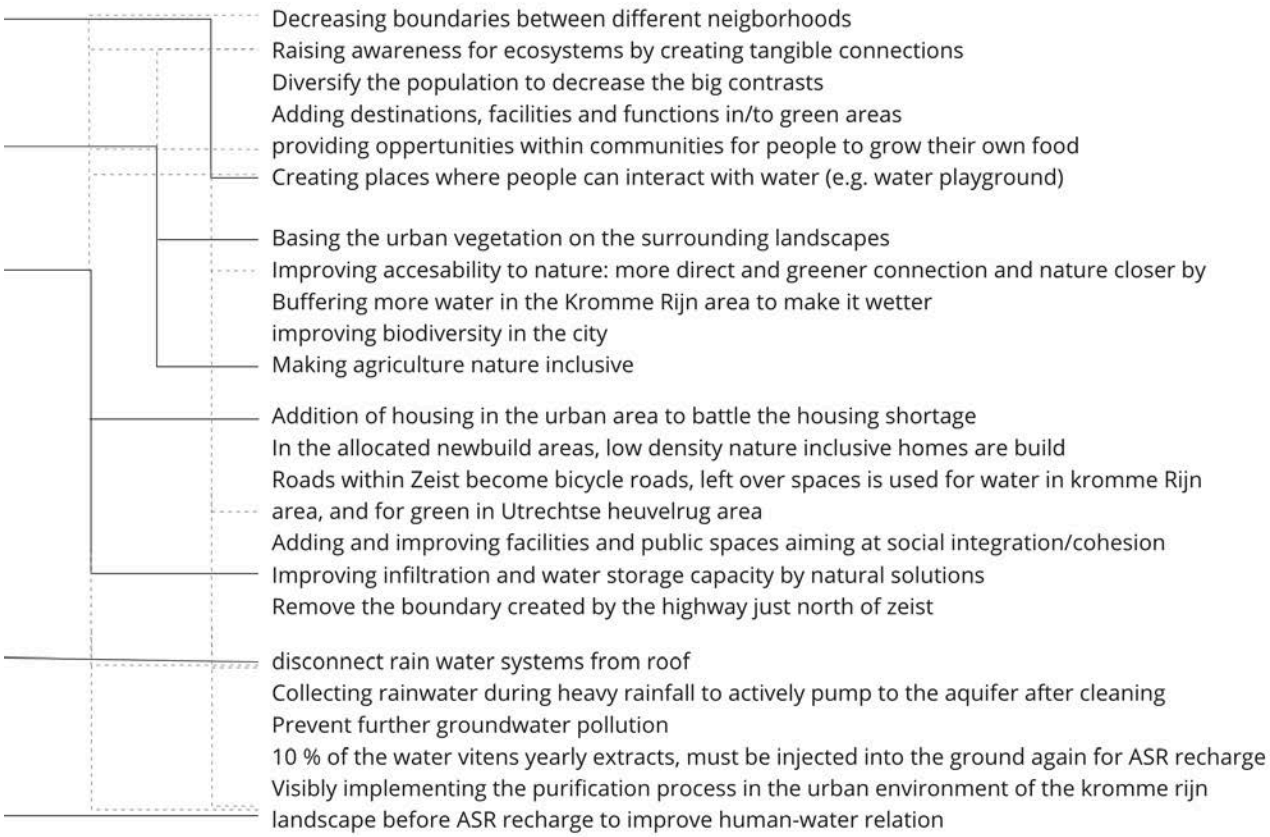
Performance based urban design guidelines

We are looking at the scope of nature inclusivity and the creation of tangible connections to stimulate biophelia & ecosystem participation. These two concepts can be of help to prevent us breaking the ecological ceiling or falling through through our social fundaments. In the new landscape, this is characterised by green and blue inclusivity. From scenario planning followed as guidelines more local production and self sustainability & integration of dwellings with production zones, of which the latter is to improve the human-nature relation to make men nurture nature again.

To achieve this in a way where nature gets as much free play as possible, there has been looked at the option of food forrestry combined with housing. A viable option for this is the northern area, which will become a natureinclusive foodforrest with recreational options and low density communities that care for the food produced. To connect this area more to Zeist and act as a green (corridor?) a solution has to be found for improving north-south connectivity, which will be done by removal or tunneing of the highway. This will also decrease the fracturedness of the district Vollenhoven, and connect it to nature. The second area for natureinclusive design is on the edge of the Utrechtse Heuvelrug.

In the Kromme Rijn landscape, the main scope of focus is waterinclusivity to increase awareness responsibility about the water task that we are currently facing. To increase waterstorage capacity, a waterstructure throughout the district will be realised to secondly provide a more tangible connection to the water. Along these waterbodies, drinking water treatments will be visibly implemented in the urban land to add to this effect. In the North part of this, a densification area has been chosen in which a natureinclusive district will be added in a comparable density to Kerckebosch, but in style of the Kromme Rijn landscape.

Guidelines


Decreasing boundaries between different neigborhoods
Raising awareness for ecosystems by creating tangible connections
Diversify the population to decrease the big contrasts
Adding destinations, facilities and functions in/to green areas
providing oppertunities within communities for people to grow their own food
Creating places where people can interact with water (e.g. water playground)
Basing the urban vegetation on the surrounding landscapes
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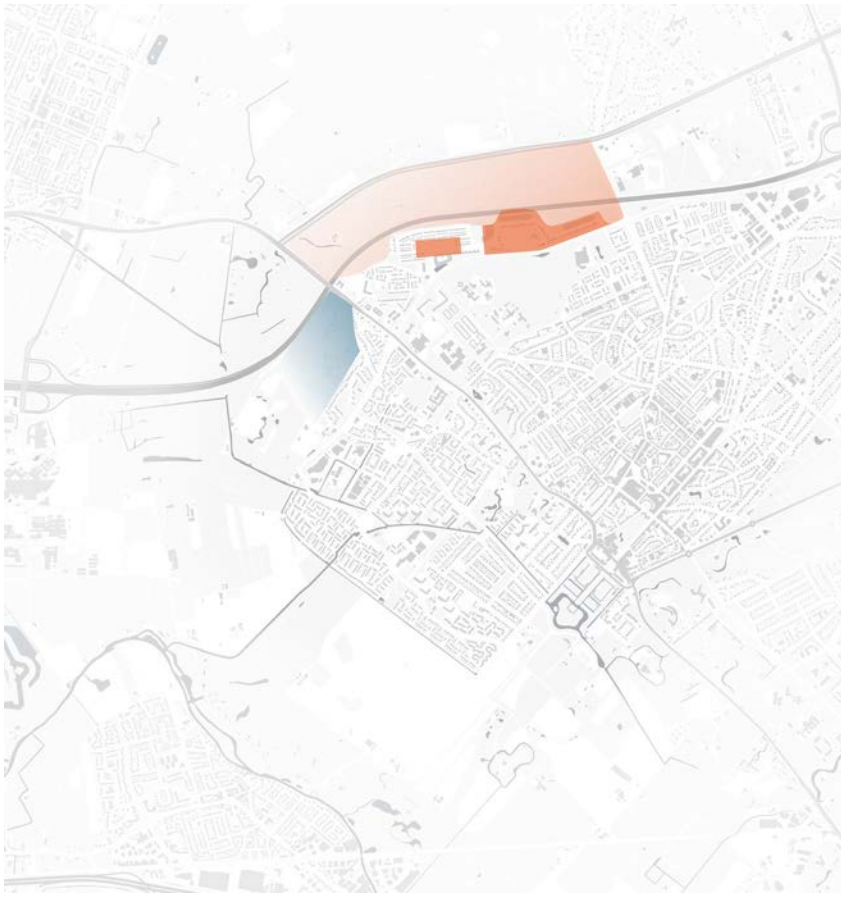
Our vision

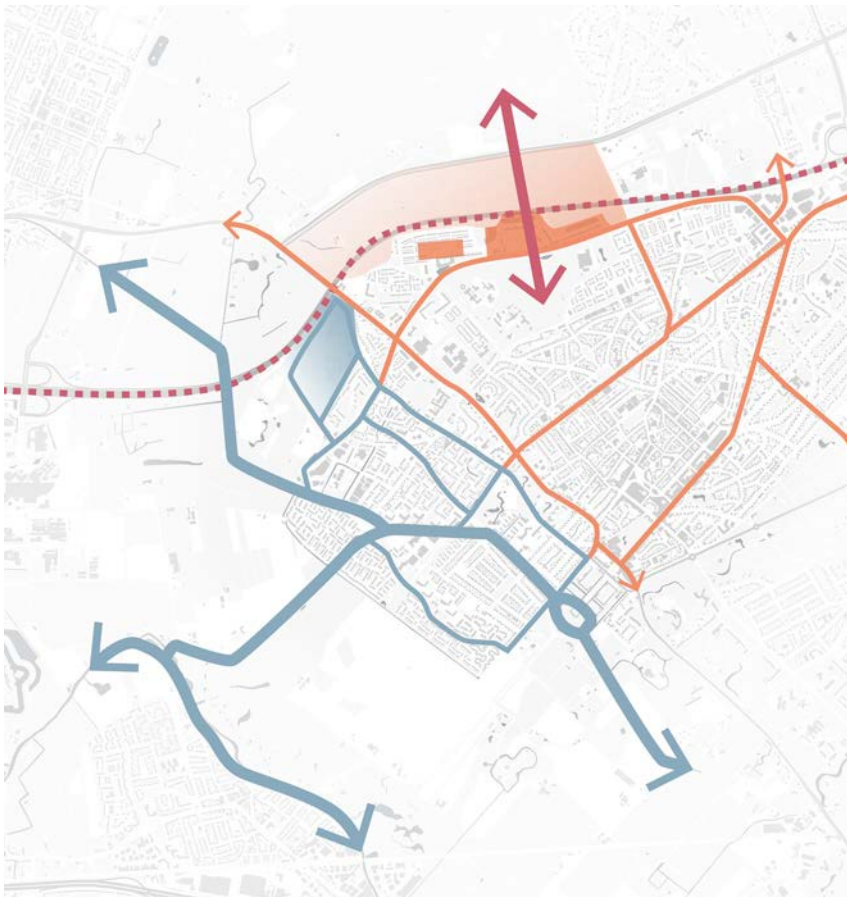
Densification locations are allocated in the urban area of Zeist as well as around the edges. These areas are chosen based on their potential to add value to the existing neighborhoods, as well as providing a more soft transition towards nature. Therefore the areas at the edges will have a gradient in building density, to transition from nature inclusive living towards recreational nature.

To make this soft transition possible, the boundary of the A28 needs to be decreased. This is also possible, as in the future it is expected for the city to become less car dominated.

Adding to this, roads will be transformed into bicycle roads, meaning the roads will be made smaller, allowing the extra space to be used for greenery or water, depending on the landscape type. This will also form a more visible connection to nature for the inhabitants of Zeist as well as providing a more optimal network for other species to move around the city.

To further improve on the habitat for the species currently living there, agriculture will be made more nature inclusive by adding for example crop rotation and inter cropping. Lastly, recreational nature is cherished, and made more accessible to enable it to be used to its full potential.





Strategic map

Connecting to the Utrechtse Heuvelrug Landscape:
- Renovating and densifying the existing district
- Opportunities for nature inclusive densification
- Keeping the existing recreational areas
- Transforming roads into bicycle streets and adding vegetation

Connecting to the Kromme Rijn Landscape:
- Opportunitities for nature inclusive densification
- Transforming the agriculture into nature inclusive agriculture
- Transforming roads into bicycle and adding water
- Creating a connection between Zeist and the recreational area
- Decreasing the boundary of the A28

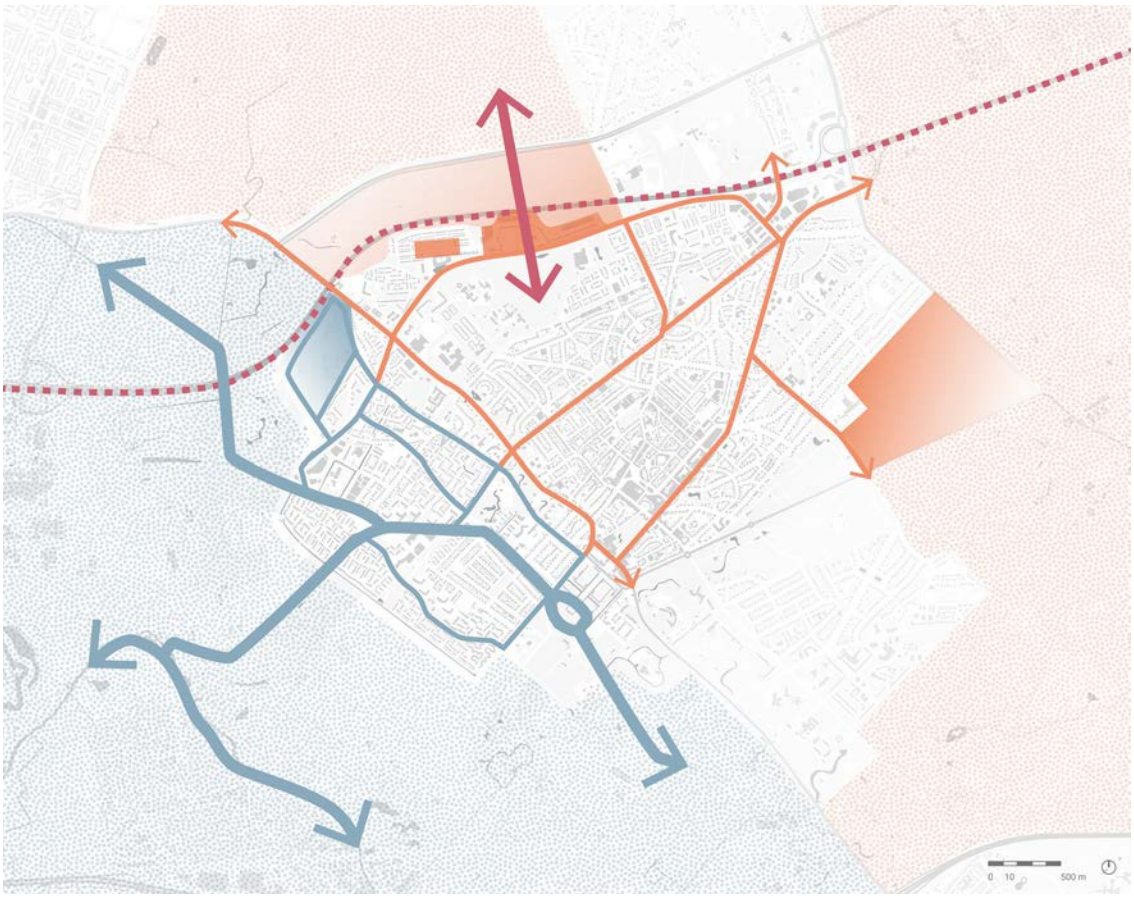
N

0 500 m









INDIVIDUAL PART

6.

Design Experiments

Boris Bakker
‘Grow to care’

Rosemarijne Bouma
‘Towards new connections’

Madelief Dekker
‘Rerooting the landscape’

6.1 Boris Bakker

Manifesto

The city of Zeist is for a large portion located on the landscape of the Utrechtse Heuvelrug, which mostly consists of a sandy soil. This means most water immediately disappears after falling onto the ground, and as quite a stark contrast to a large portion of the Netherlands leaves a barren landscape behind. Especially in times of drought, this makes nature here even more unforgiving. These properties are particularly important as Zeist is a drinking water extraction location, which means that the water that infiltrates eventually reaches the source from which we indirectly drink. As climate change is leaving us experiencing extreme events like drought or stormwater surge more often, we cannot sit back and carelessly do whatever we want. Here. by damaging nature, we damage ourselves quite directly.

As the negative effects of our consumerist ways are showing more frequently, steps should be taken to reduce our destructive methods of growing, selling and shipping that come with our consumerism. As we have become disconnected from nature through our comfort and ease, a first step can be to start producing more by and for ourselves. By nurturing nature again, we can aim at adopting a caring manner of behaviour towards nature, in a similar way as the theory of biophelia. Stimulating this loving kind of human-nature relation can help us move away from the ecological degradation and perhaps disaster we are calling down upon ourselves.

In this way, to literally place ourselves back into the system, dwellings are realised in a food producing and nature-responsible environment. This environment will provide different typologies for dwelling, all focussed on food production by forestry but with varying production intensity rates. Not everyone dares to jump in at the deep end, therefore the typologies range from more privately, productive and responsible communities to dwellings that emphasize on facilitating and stimulating environmental, productive and resource responsibility. Participation and education are of high importance as we cannot succeed with short term processes, but need to aspire to the long term. Inhabitants from surrounding neighbourhoods are encouraged to take part in the nature conserving and agricultural processes and educative practices help inspire both older, current and new generations to a more sustainable behaviour. Adopting this ‘caring for nature’ and actively taking part in the ecosystem can make people realise how incredibly disproportionate our current trends of behaviour actually are and guide them in the necessary direction of change.

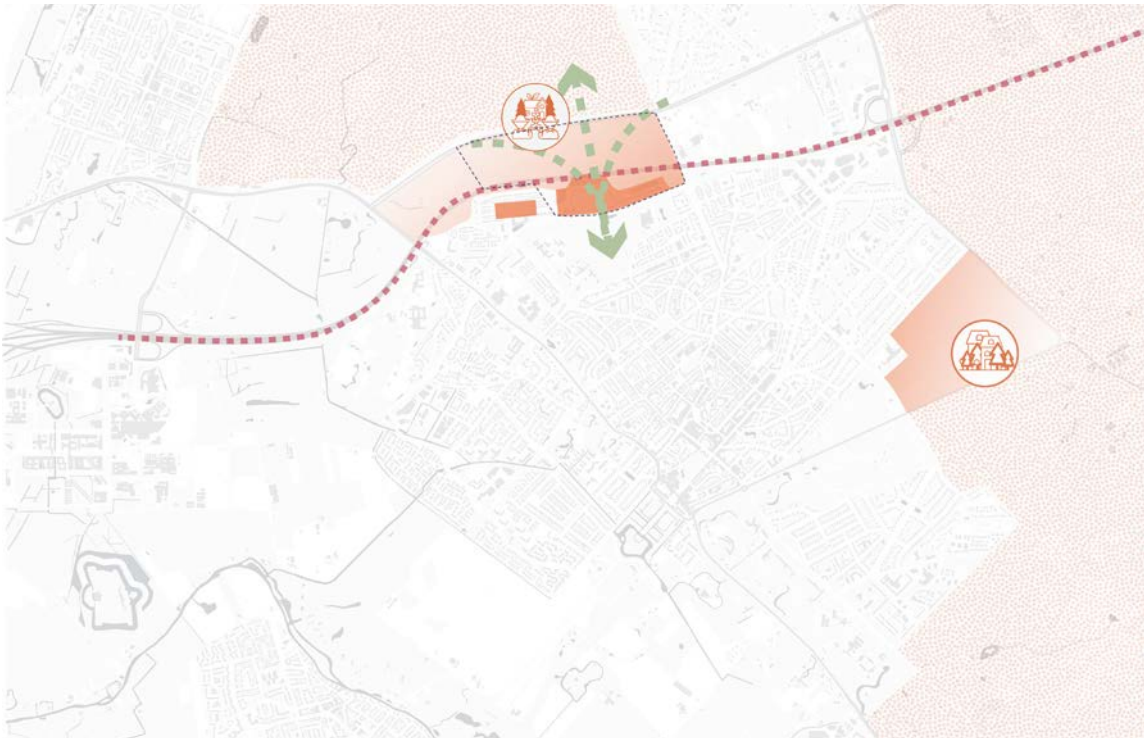


Design Experiment

When searching for locations that might prove to be a suitable start for this new human-nature relation, two come to mind, both of which are close to existing forest area, but one being heavily influenced by the highway separating that area. In line with our vision, breaking through this barrier can help to open up the city and especially this district to it's surrounding environment, and opens up chances for nature to flow inwards into the city. Due to these potentials, this location (the district Vollenhoven) has been chosen for the design experiment.

To literally place ourselves back into the natural system and change and enhance our human-nature relationship, dwellings are realised in a food producing and nature-responsible environment. This environment will provide different typologies for dwelling, all focussed on food production by forestry but with varying production intensity rates. To keep biodiversity intact, the method of production is by food forestry, as a contrast to the ecologically destructive monocultures that we are used to in the Netherlands.

The area in green will feature private communities consistent of vernacular tiny houses where the human nature relationship is lived to the fullest, and which possesses the highest production rate of the three. The second area (in yellow) will be semi public and contains medium rise apartment buildings with a lower production environment. The emphasis here lies on stimulating environmental responsibility first, as not everyone dares to jump in at the deep end and start committing themselves to food forestry. The third area will be a public food forest aiming at social integration, participation and education. The dwellers here aim at educating people about the forestry processes. It strives to include various groups of people, across all generation and groups, for example also people from the refugee center and others for whom this involvement and participation in nature conserving and food producing processes might provide outcomes on a social level. A combined marketplace and watersquare will function as "get together" place and periodically function as market for locally produced foods.



Connecting to the Utrechtse Heuvelrug

Renovating and densifying the existing neighbourhood

Opportunities for nature inclusive densification

Creating a connection between Zeist and the recreational area

Decreasing the boundary of the A28



Semi public

Medium high rise

Low production

Environmental responsibility

Private communities

Vernecular tiny houses

High production

Public

Vernecular tiny houses

High production

Focussed on education,

social integration and participation

Marketplace / Watersquare

Primary school

Vision

To open up the district to the Northern forest area 'Het Panbos', the highway will be partly lowered and covered like a long ecoduct. This also opens up the district Vollenhove and can help to counter the secludedness it currently possesses. To improve this even further, the large L-flat will be cut through at a section to provide a direct connection with the inner park of Zeist.

Different relationships are visible between the dwelling typologies and their environment, which links back to their production rate. The two typologies with a higher production rate will contain more dense ecology as the food forestry is more intense here.

The school, here in yellow, has it's own food forest in the integration zone on the right and the kids that go to school here can playfully use the watersquare marketplace as well as learn about smart water management The market place is centrally located between the existing and new part of Vollenhove to allow for social integration between the different groups in this 'get together' space. The market place is located on top of a lowered parking space that provides for the surrounding dwellings.





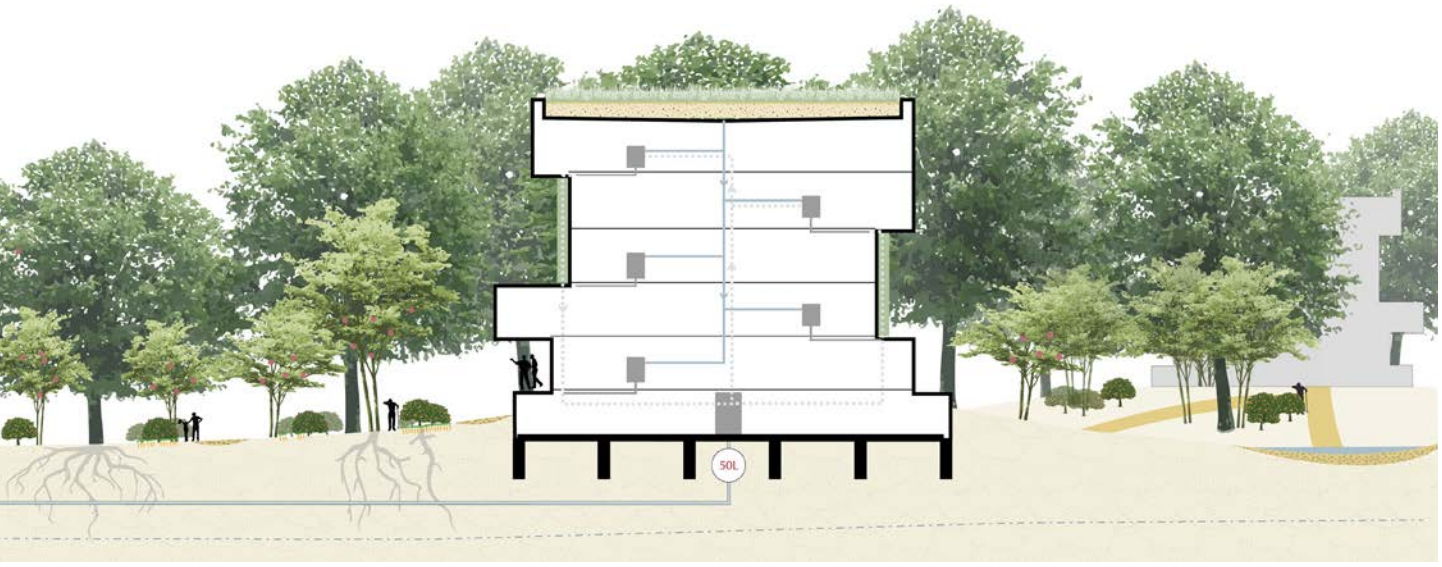
Typologies

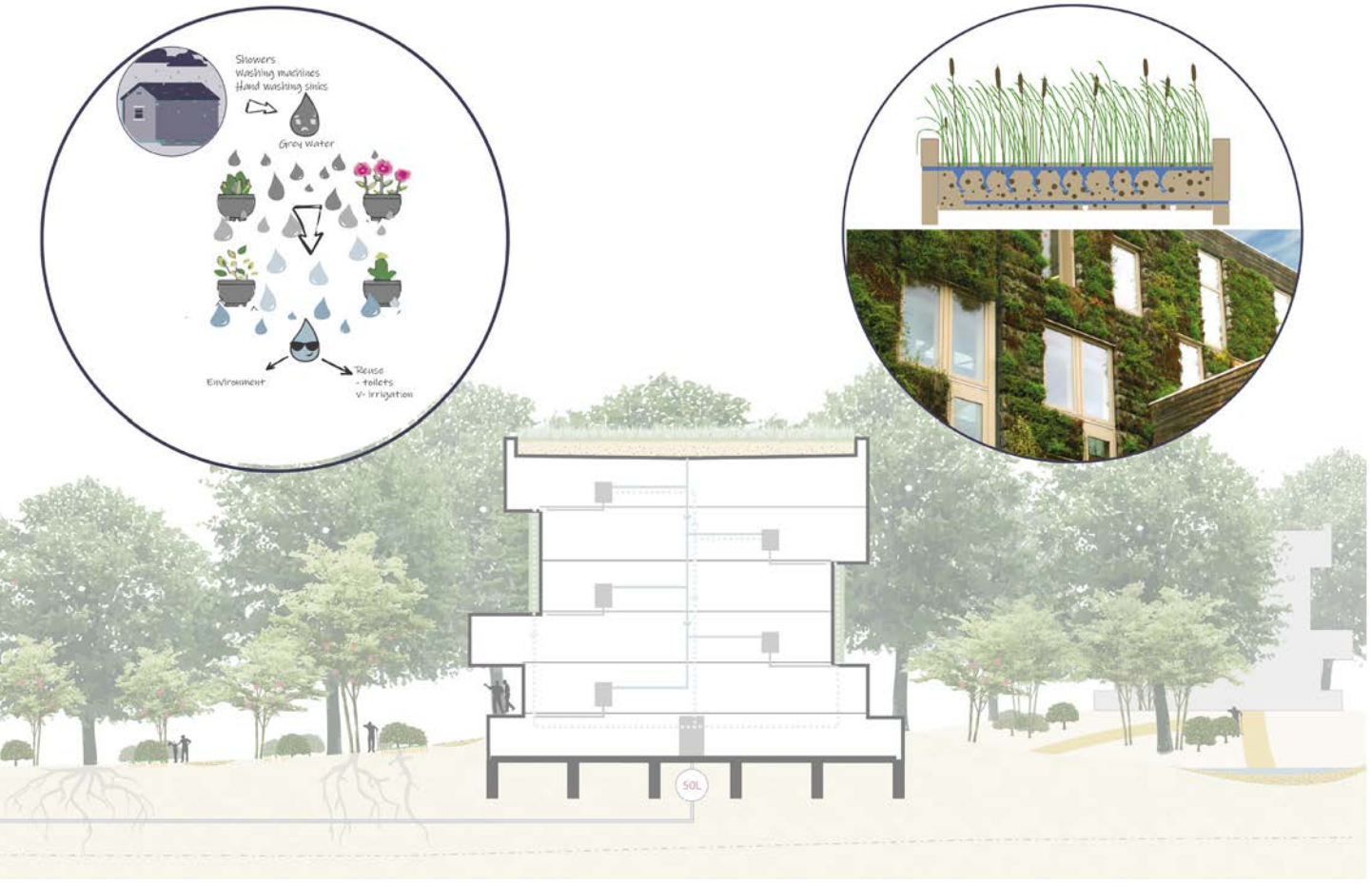
As not everybody dares to jump in at the deep end and immediately fully dedicate themselves to agroforestry, this typology functions as a stepping stone. The surrounding environment of the mid rise appartment blocks still contains food forestry and dwellers have a responsibility to the nature here, but do not have to be as fully commited to the production as in the following typology.

Growing a greaet sense of responsibility for nature is aspired to here and dwellers are educated about how to deal with food forestry and smart resource management. For this reason, the building itself strives to be as water conserving as possible by binding the dwellers to a maximum of 50L of water per day and collecting its own water.

The roof is designed to function as a helophyte filter that cleanses the collected rainwater for use of showers, washing machines and hand washing sinks. After these processes the grey water is pumped back up again to infiltrate through the green facades, after which it is clean enough to be used again for flushing of toilets and necessary irrigation of the surrounding productive landscape.




SOL


Showers
Washing machines
Hand washing sinks
Grey water
Environment
Reuse
- toilets
v- irrigation
SOL

Typologies

In this area the possibility is provided for people to design and build their own vernacular tiny houses, living in a community that deeply cares for the dense productive nature that is all around. Vernecular in this sense does not particularly mean traditionally dutch, but emphasizes on the awareness for and adaptation to the related context and specific geographical features

Comparably to the first typology, the tiny houses need to collect water for their own use but can fall back on water facilities, albeit at a max of 50L as well. The houses can individually adopt methods for watercollection, for example like the roofs on the island Bermuda, where every roof is mandated by law to collect and store rainwater as drinkingwater source, which is done through slanted roofs and storage spaces.

As Zeist is located on relatively nutrient poor sandy soil, specific plants and trees need to be chosen to establish the food forest in a manner that it produces edible foods. The canope layer functions as a protective layer for smaller and younger trees, but has productive capabilities as well. The canope protects the fruit trees underneath, which themselves provide shelter for the shrubs underneath, and so on and so forth. The different layers benefit from each other, providing shade or support to the other species underneath and around them (Eshuis, 2019).



FOOD FOREST

Hierarchy

Canope layer


Rowan


Common Hackberry


Korean pine tree


Black cherry

Fruit trees


Decaisnea insignis


Hazel

Shrubs


Zucchini plant


Red chokeberry


Barberry


Tomato plant

Herbs


Rosemary


Thime

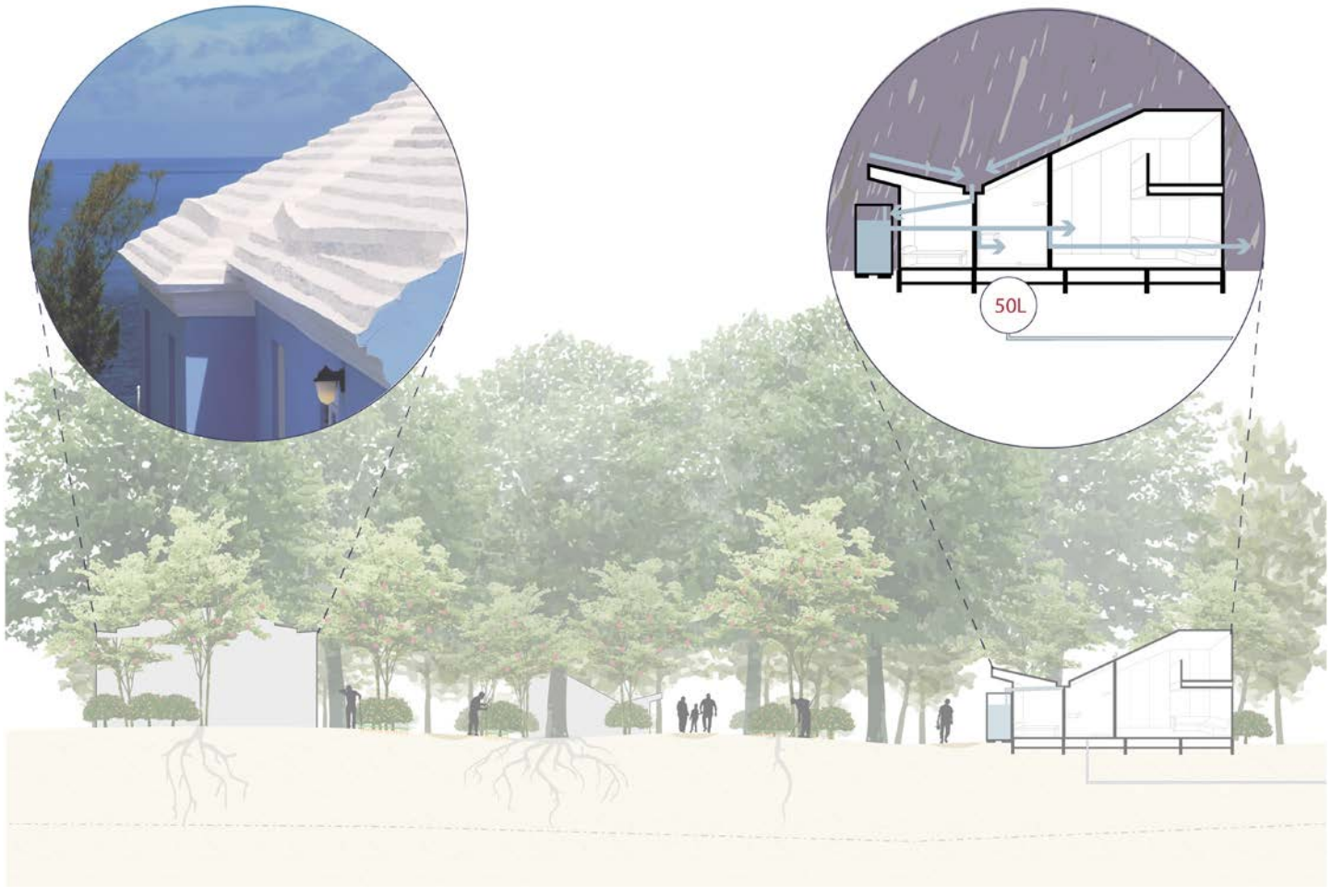
Root vegetables


Radish


Potatoes


Carrots



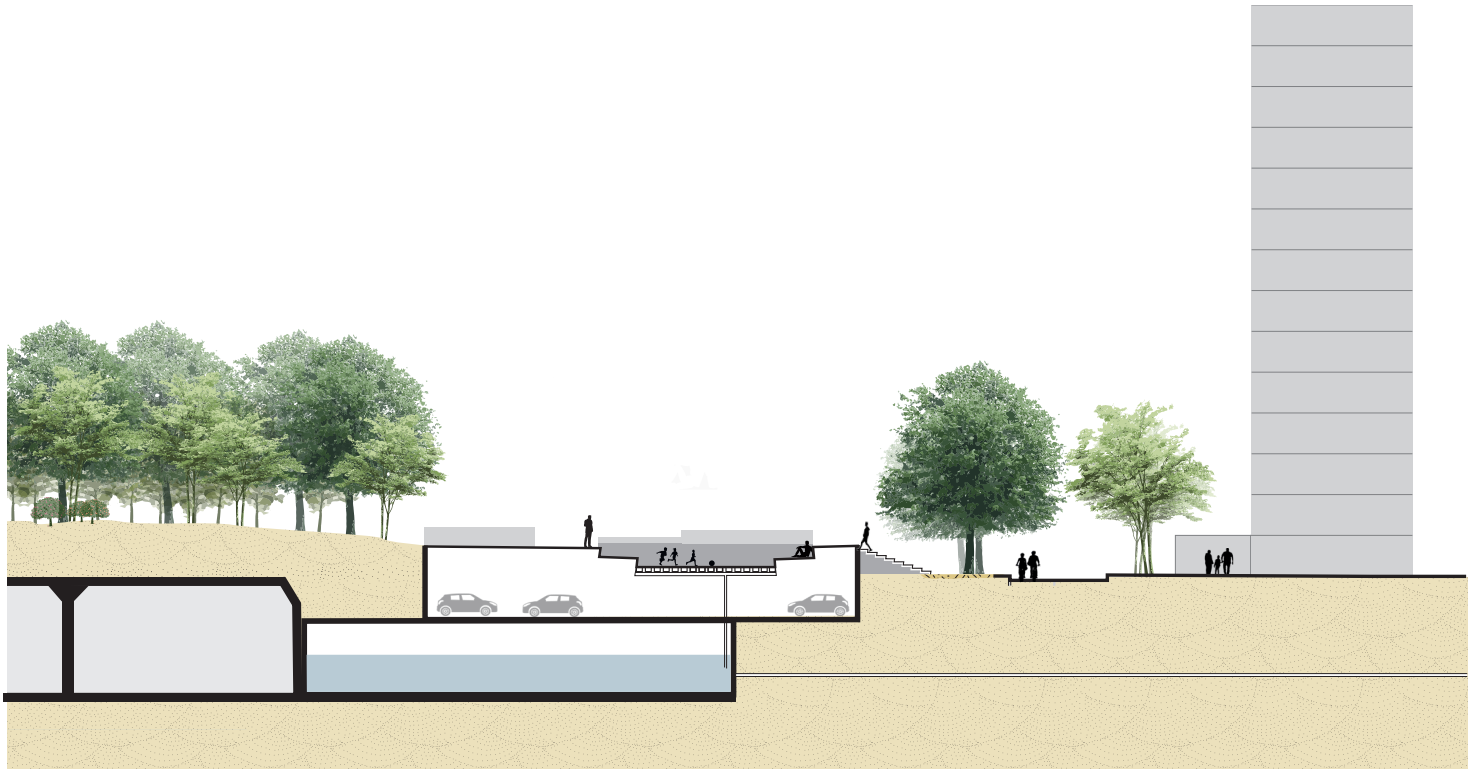

50L

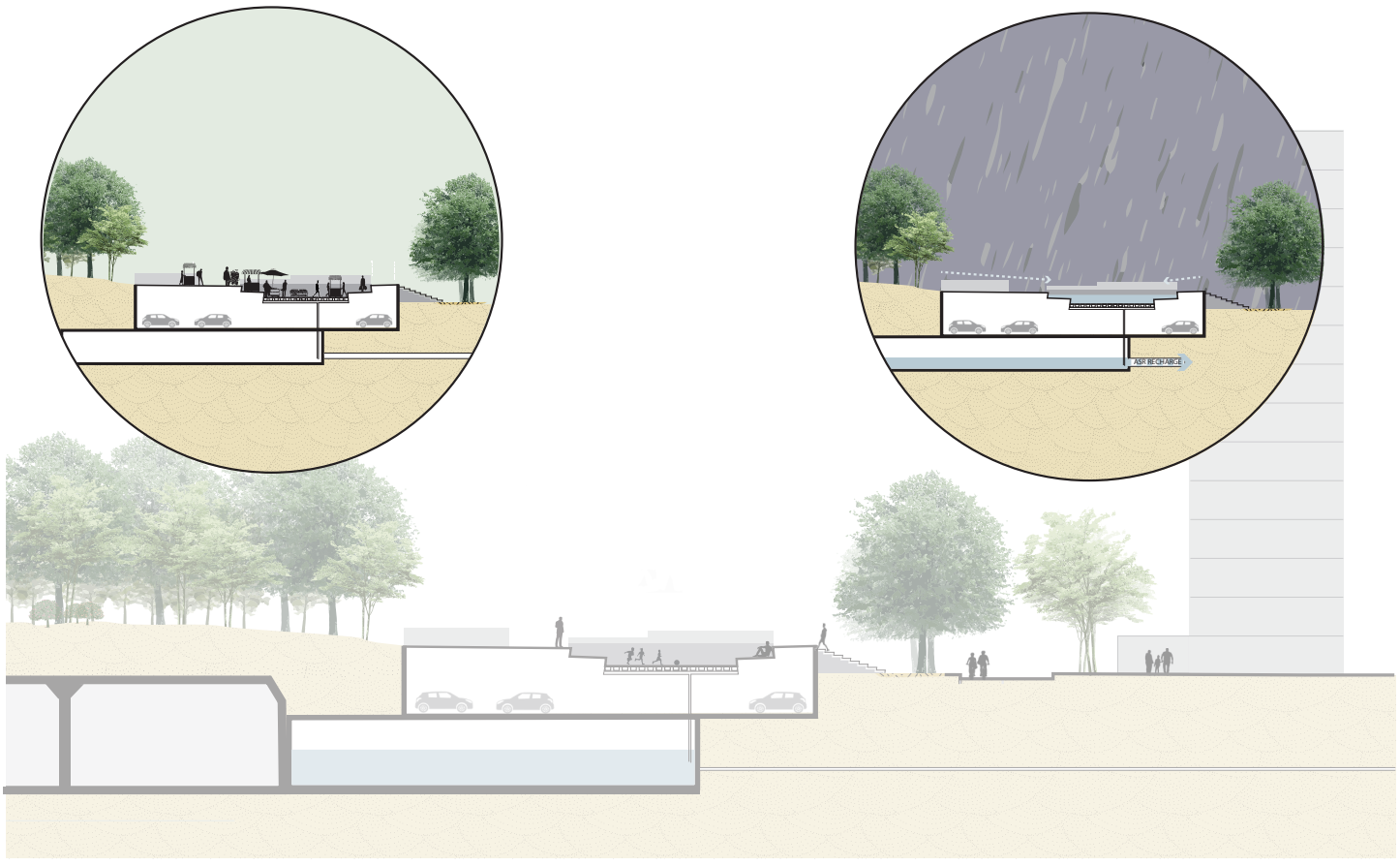
Section

Tunneling the highway opens up possiblities for the integration of infrastructural bodies. As parking spaces are realised next to the tunneled highway and as its roof functions as watersquare, these infrastructures can be integrated by using space for water storage as well.

The space on top thus multifunctions as market area for locally produced foods and other initiatives, waterplayground for kids and watercollection and storage facility during events of heavy rain. The collected water is afterwards pumped to a low intensity purification facility and used to directly recharge the drinking water source of which Zeist extracts. As local infiltration would take too long for the water to reach the source and extreme events like drought ask for flexible solutions, the collected water is used to directly recharge the drinking water source.






ASR RECHARGE

Let us grow to care

In the end, this design experiment of course does not illustrate the most , perfect solution, as there most probably is none. However, it shows a possible means to guide into a direction of necessary change and in its implementation helps to show people how incredibly disproportionate and unsustainable our current trends of behaviour actually are. The design interventions in this experiment attempt to inspire a movement to an improved human-nature relation. Through education and participation it strives to make people grow to care for nature, by nurturing it like it has nurtured us for thousands of years.



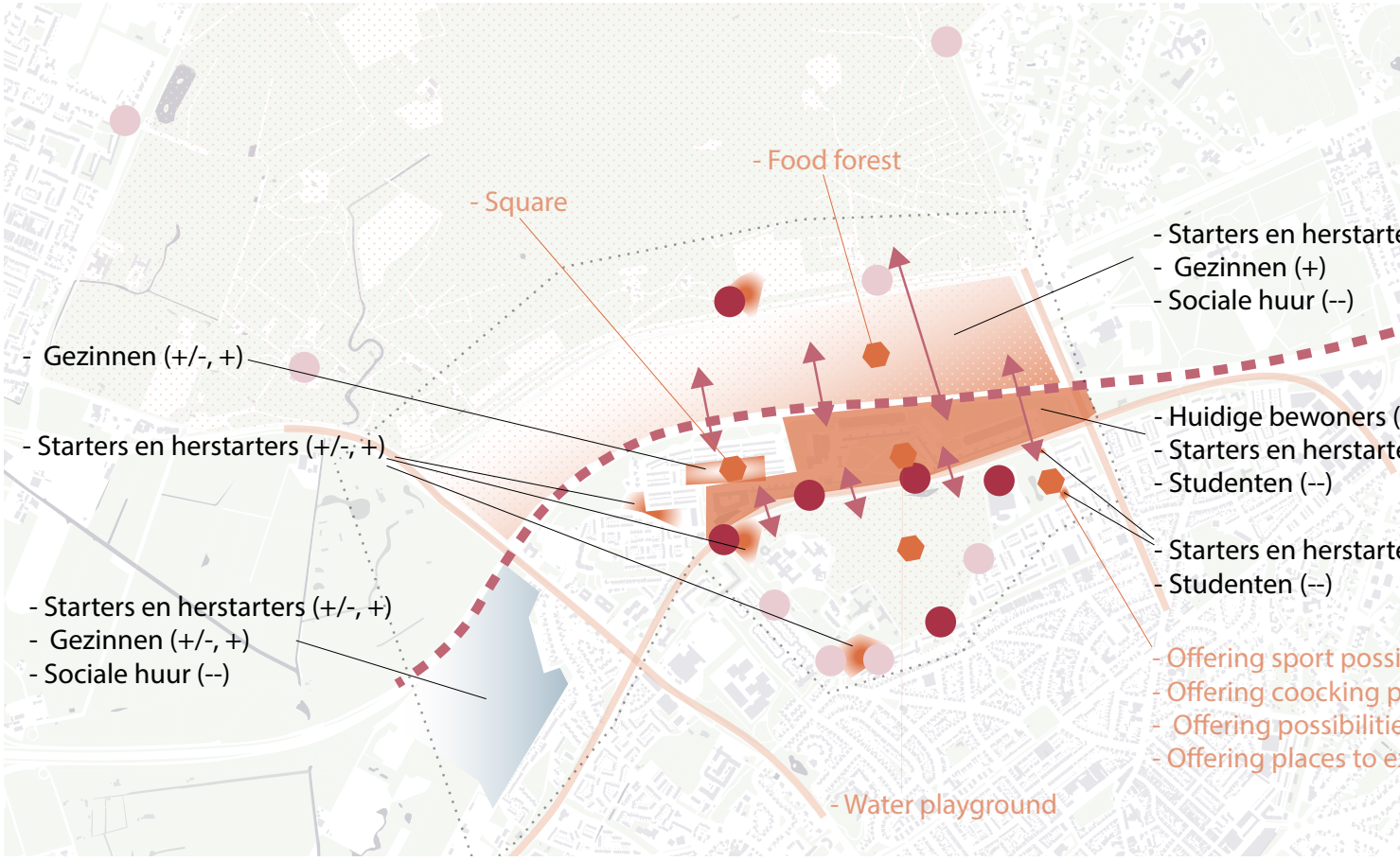


6.2 Rosemarijne Bouma





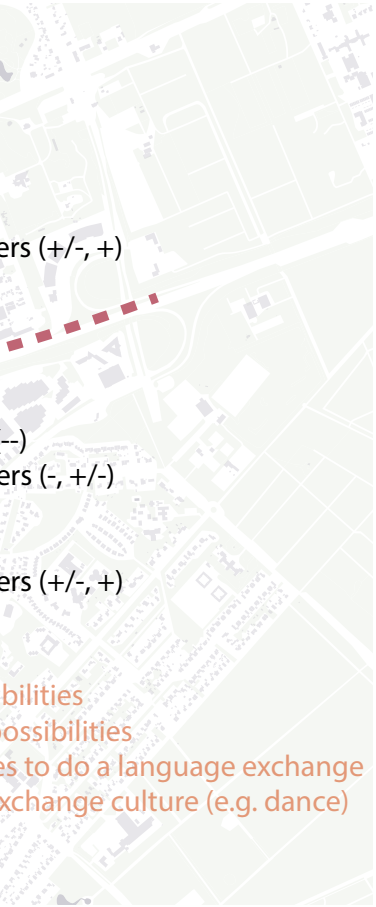

NO JUSTICE
NO PEACE
AZC NEE
WEG ERMEE!!





Densification map

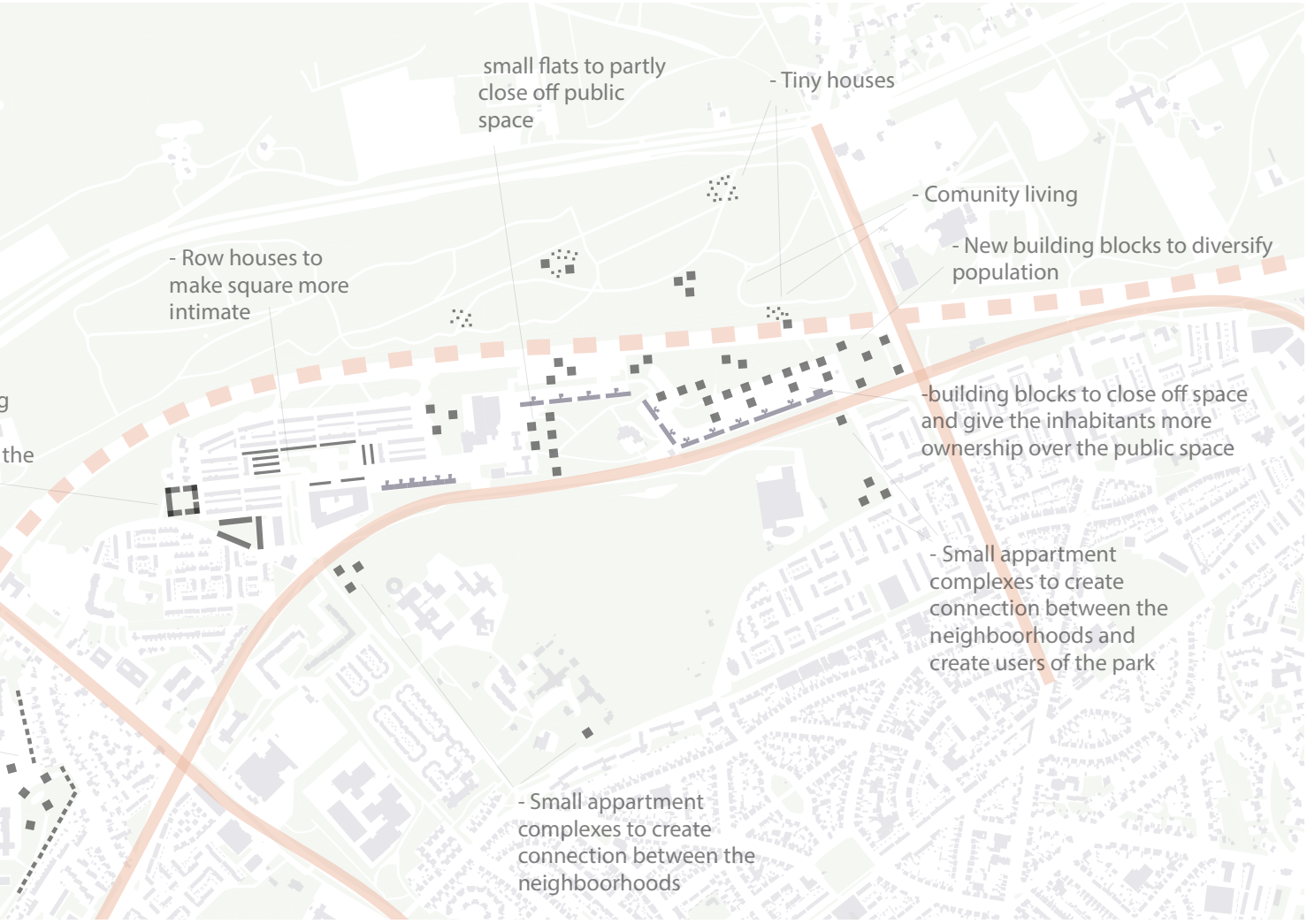
New places need to be created. This is done by adding masses, to create more enclosed space, but simultaneously new flows of movement. It gives people ownership over the spaces around, and a sense of security. Simultaneously the population is diversified ending the strict division of social economical classes per neighborhood.



Vision map

The map shows how the A28 will be placed underground, housing will be added to diversify the population and to decrease boundaries between neighbourhoods. New functions are introduced so the different inhabitants of the area will meet each other, as well as providing oppertunities to connect to nature.

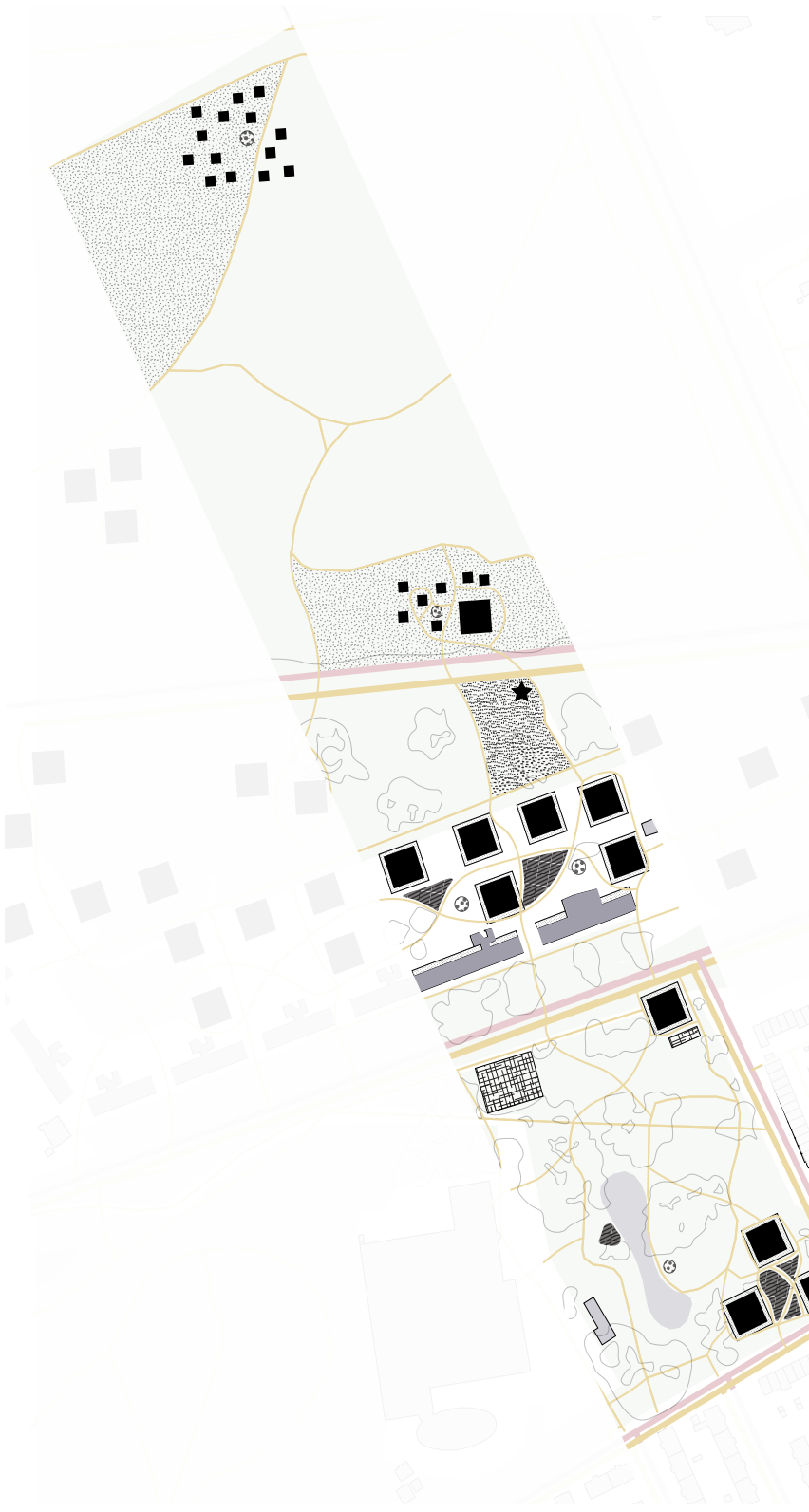
- Bicycle road and green coridor
- Tunnel
- Connection
- Activity
- Current entrances
- New entrances
- Renovation area
- Super low density newbuild eco sttelmentsts
- Middle density newbuild
- Area of interest/ deisgn area



Public space design and social relations

The food forest extends itself all the way to Vollenhove. At the “border area” a visitor center is build. The public space in between the L flat and the new buildings are a combination of grass with a slightly sunken square and some playground objects for the children living closeby. In the current park, a basketball field as well as a petanque field is added, plus a small BBQ place and small squares in-between the new buildings. The roads have become bicycle roads.

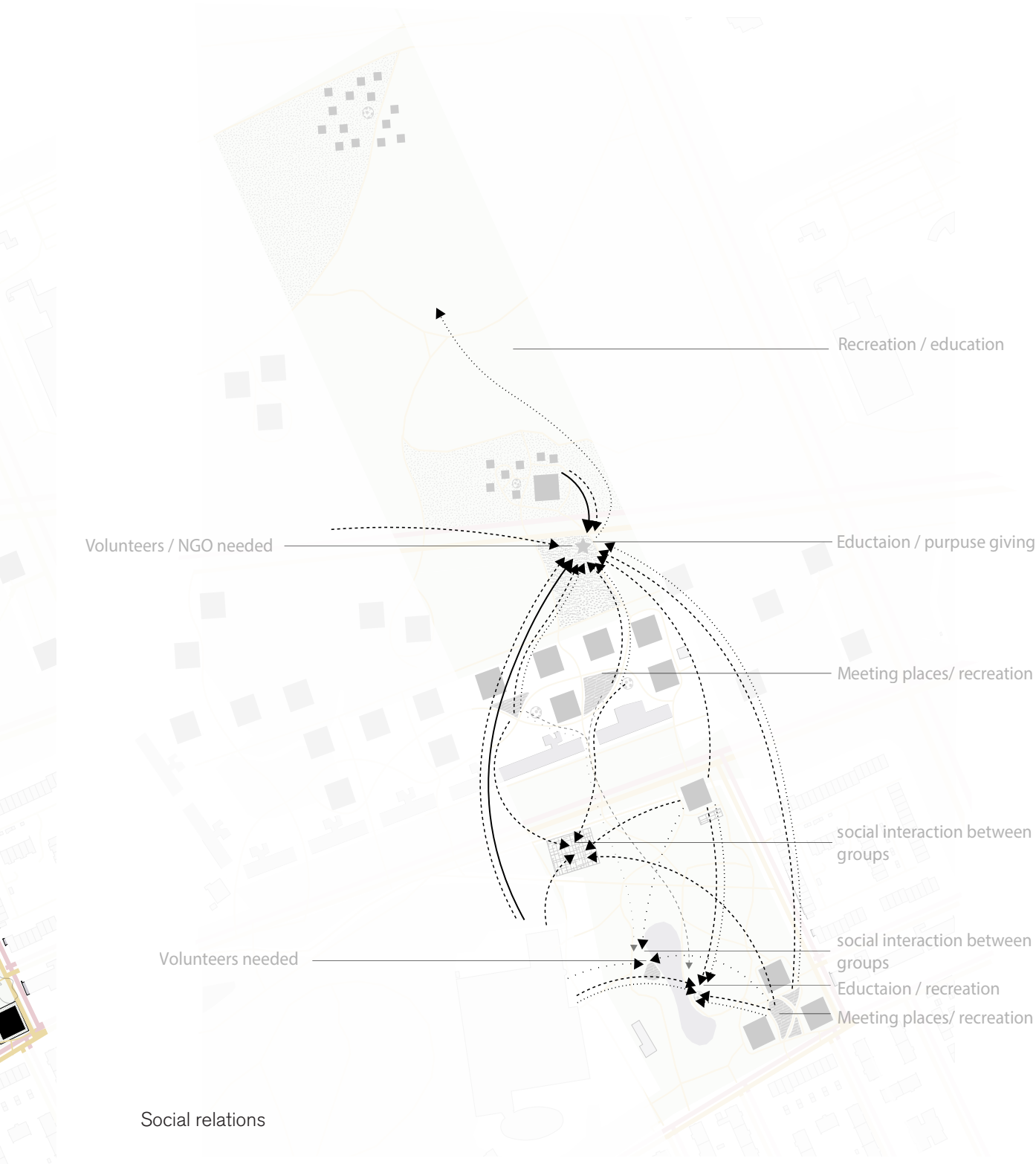
Why the public space is designed like this can be best explained when looking at the social relations within the neighbourhood. Asylum seekers are allowed to work, but to a very minimum standard leading to them having loads of free time and being in the neighbourhood. This can cause tensions for both asylum seekers who would prefer to do something with their time, as well as residents seeing them doing little. By introducing the food forest with the educational experience center, asylum seekers can do volunteer work here by managing the land, as well as preparing meals for visitors. This gives them a purpose and a way to integrate in society, something to be proud of as well as providing other residents opportunities to explore and interact with nature. Furthermore the BBQ place in the park attracts different people, who could bond over cooking together, as is done in many cultures around the world. The sport and playground facilities are aimed at attracting children from different families. By letting the children interact the parents will follow.



Public space design

Food forrest
Intensive food forest
Garden
Square
Sports facilities
Playing area
Visitors center
Foot path
Bicycle path
Tree contours

N

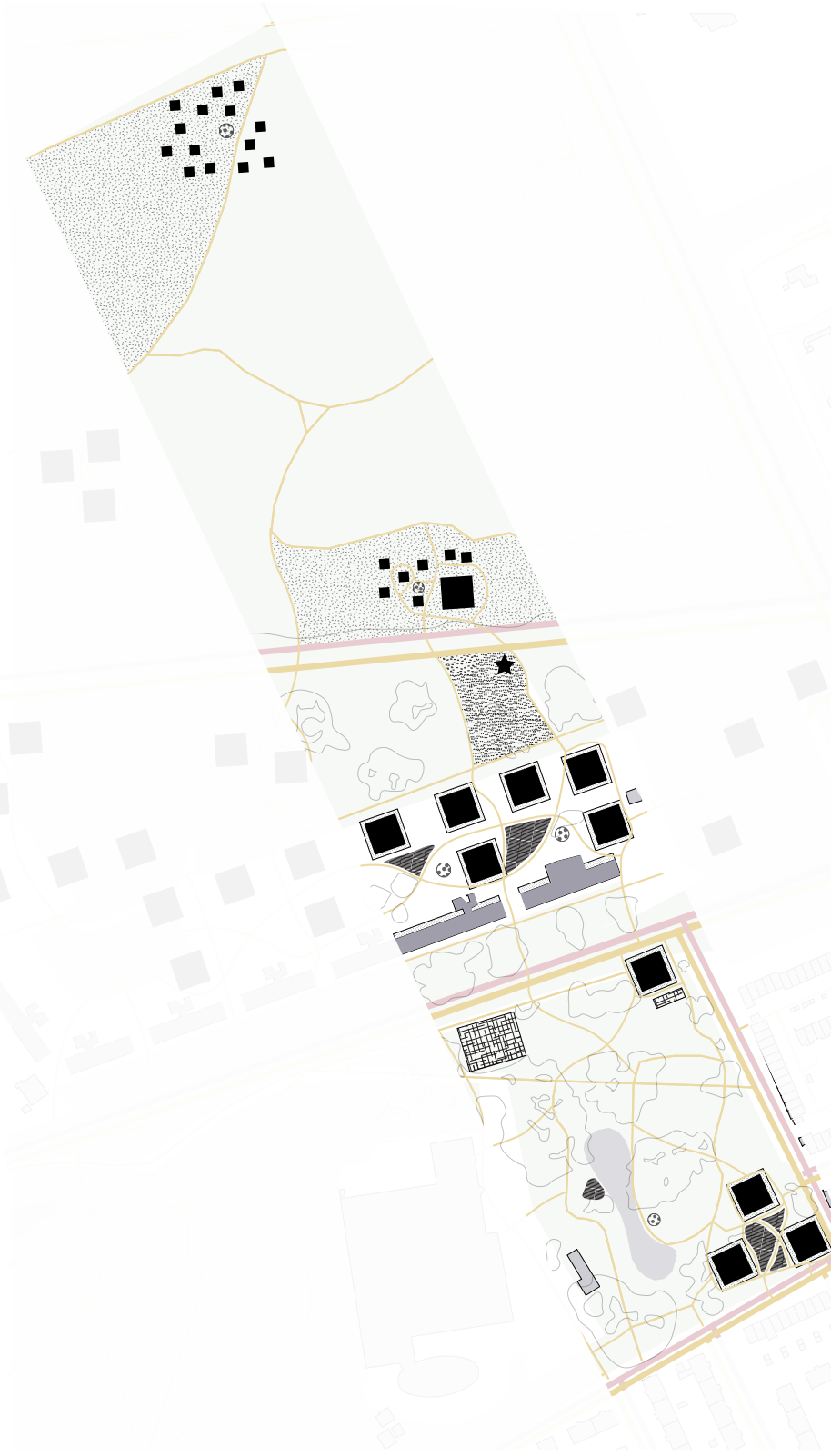


Social relations

Volunteers
Families
Grown ups
Childeren

Public space design and water managment

The water management consists of three different principles. The tiny houses will be self sufficient when it comes to water. The new apartment complexes in the park and food forest will re-use rain water in the gardens, but apart from that will be rather traditional. The renovated L flat and surrounding buildings will have a rain water collection system, collecting the water and by pipes getting it to the central square in front of the L flat to clean it there, and pump it to the aquifer as an ASR solution. In the area, several wadi's will be places as well as slightly deepened squares aiding in collecting rain in periods of heavy rainfall.



Water system design

- Rain barrel for own ussage
- Rain barrel
- Water flow
- Slightly deeper square
- Water playground
- Rain water sewer to ASR

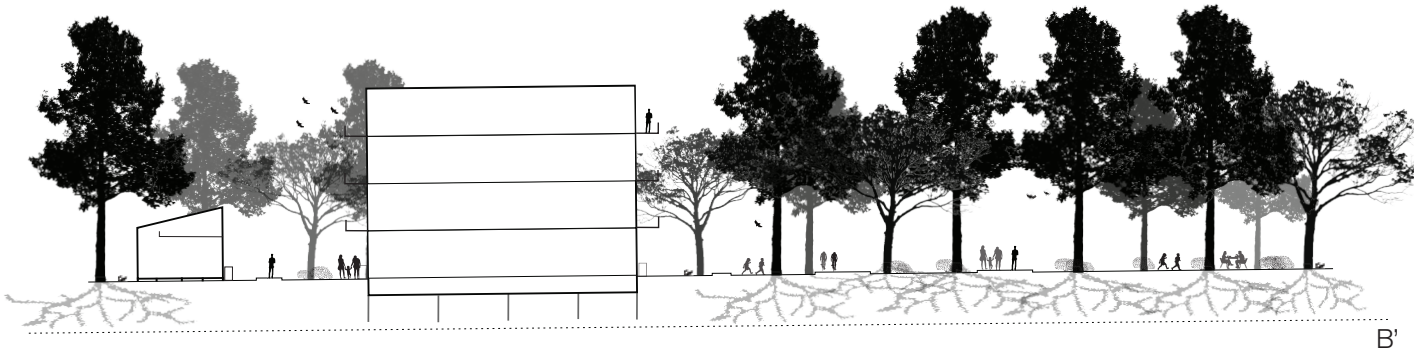
N





A

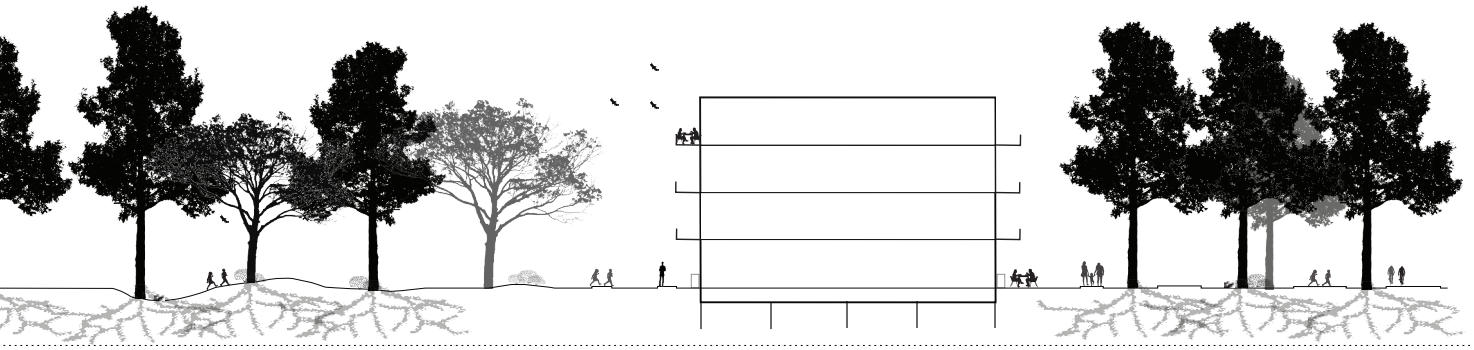
Section in the park: shows the new more multifunctional public space, which will attract more visitors due to the new functions as well as the added densification also providing social control at night.



B

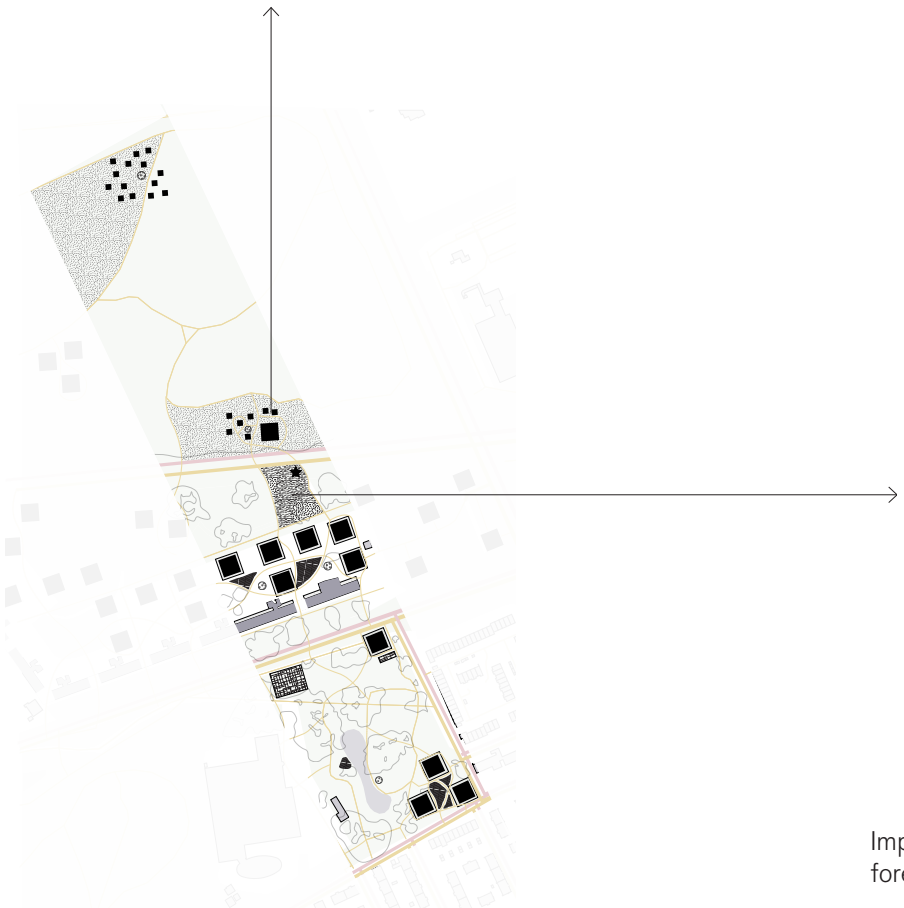
B'

Section in the food forest: Shows the new dynamics in the food forest and the scales of the different building masses. Also the new bicycle road is visible.


A'


B
B'
A
A'







Impression: Visitor center food forest



Impression: Eco community in the food forest



6.3 Madelief Dekker

Manifesto ‘Rerooting the landscape’

Zeist is located on border of two landscapes: on the west you have the wet Kromme Rijn landscape that’s grown around a river and on the east you have the dry Utrechtse Heuvelrug landscape that’s located on a ridge of low sandhills. The town of Zeist is located on the meeting point of these contrasting landscapes but this doesn’t easily catch your eye when you’re in the urban area itself. This really is a shame because with these two contrasting landscapes next to each other it could be a really fascinating place so this is in my opinion a major potential when redeveloping this area.

Next to the context of the landscapes there’s another big theme that needs attention in this area and that’s water. Due to climate change there are problems of periods of drought and heavy rainfall and on top of that there are also multiple ground water extraction points in the area for the extraction of drinking water. In the current climate drinking water is seen as something that’s infinite but to cope with the problems of climate change this point of view of water needs to change.

To change peoples mindset about the scarcity of water we can use the contrasting landscapes to hit two birds with one stone: if we want to work together with the landscapes in a form of ecosystem participation the water management should be different for both of the landscapes due to their difference in characteristics. So when we apply this more tangible way of water management the two different landscapes will also become more clear in the urban area and their legacy will become more prominent again.



Design experiment

In my design experiment I've worked with these characteristics of the two landscapes so I've chosen an area where the two landscapes meet. Here you can see a zoomed in version of the vision map of the area north-east of Zeist. The main goal for this area is the transformation of the roads into bicycle streets to make them greener and bluer so that's why I will be focusing on these avenues.

On the map you can see the locations I focused on which are two avenues, one located on clay and one on soil and a meeting point of these two avenues to show how they come together. At number 4 you can see the pump to the aquifer which is where the water needs to be transported to so that it can be used as drinking water in the future.

Due to the contrasting characteristics of the landscapes they have a really different take on rainwater management so I will use this to show the difference in the landscapes on ground level. The soil types of the landscapes aren't really visible on ground level but the trees they create the right conditions for are, so I will use the different type of trees to show the difference in landscape types as well.

When you'll drive, bike or walk on the meeting point of the two landscapes you will see and feel the landscape around you changing which will make you more aware of the landscapes and how they deal with water so hopefully this will make you think of your own water usage as well.

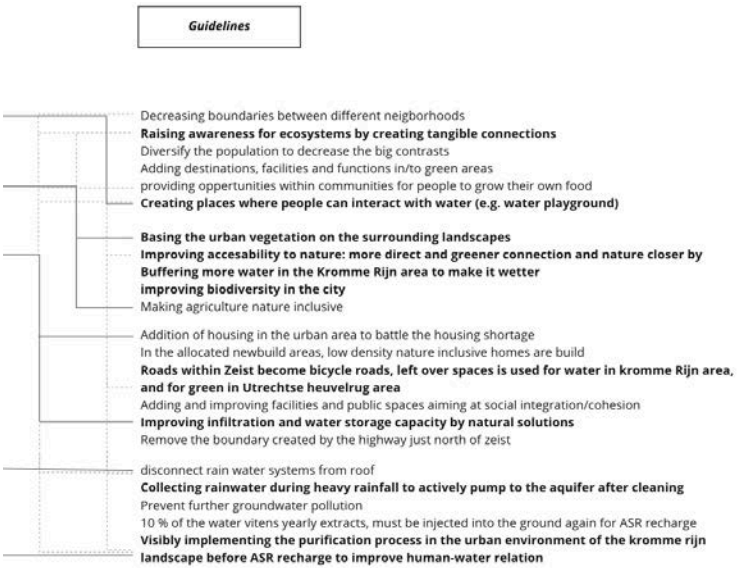
Used guidelines

Bold guidelines are the ones that are used in the design experiment.

Maps of the chosen area

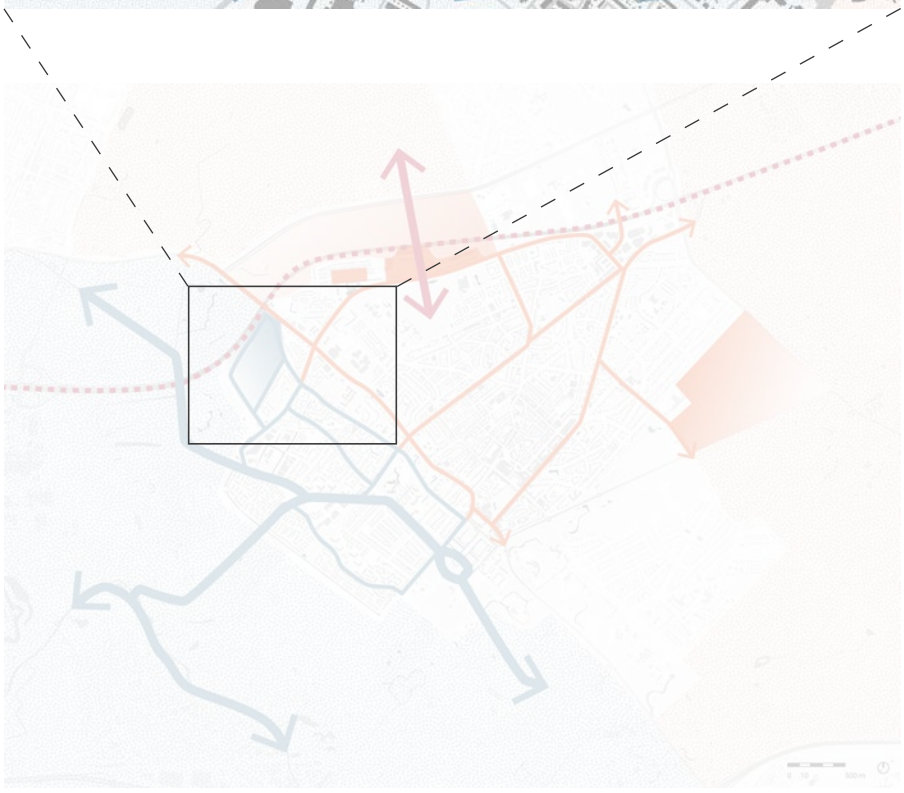
You can see the zoomed in part of the vision map that I've worked on with above that a map of the locations that I've chosen to focus on in this area.






Avenue on clay 1
Avenue on sand 2
Meeting point 3
Aquifer pump 4
1
2
3
4



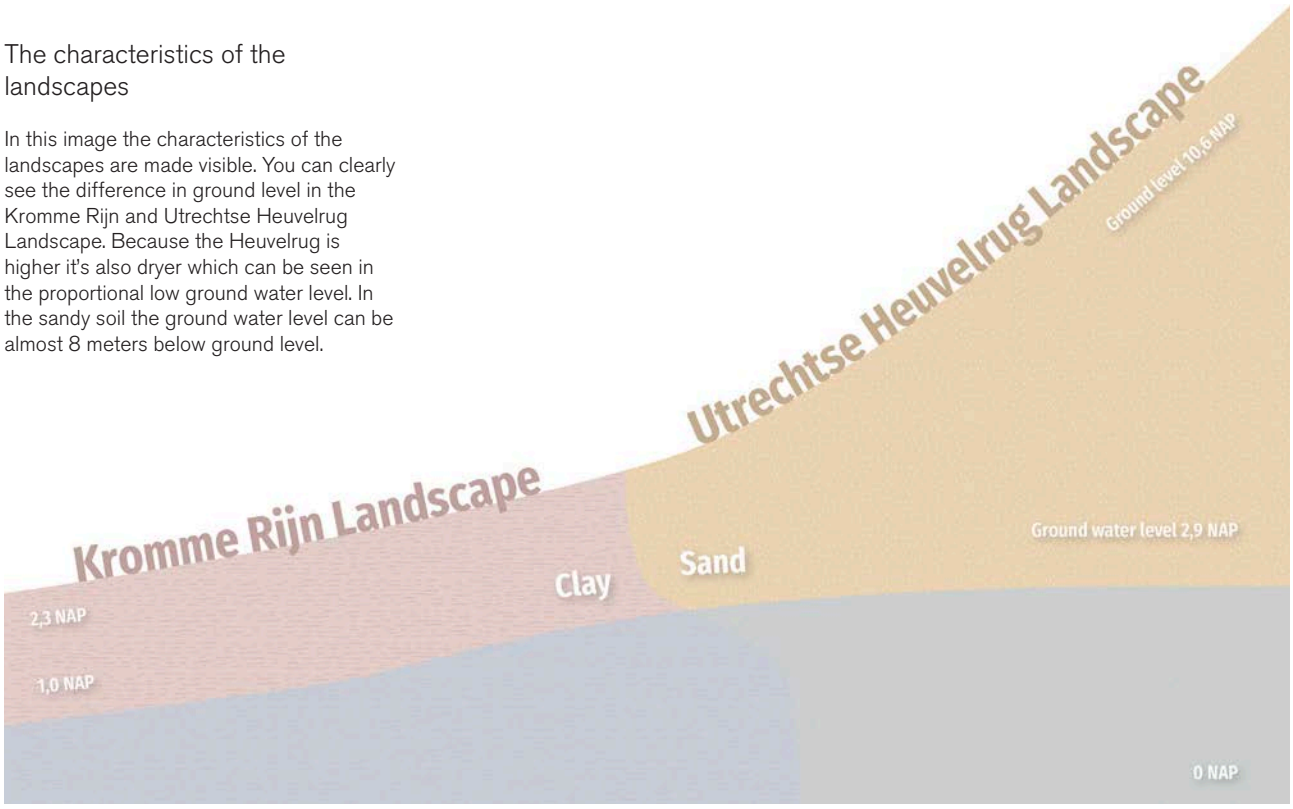


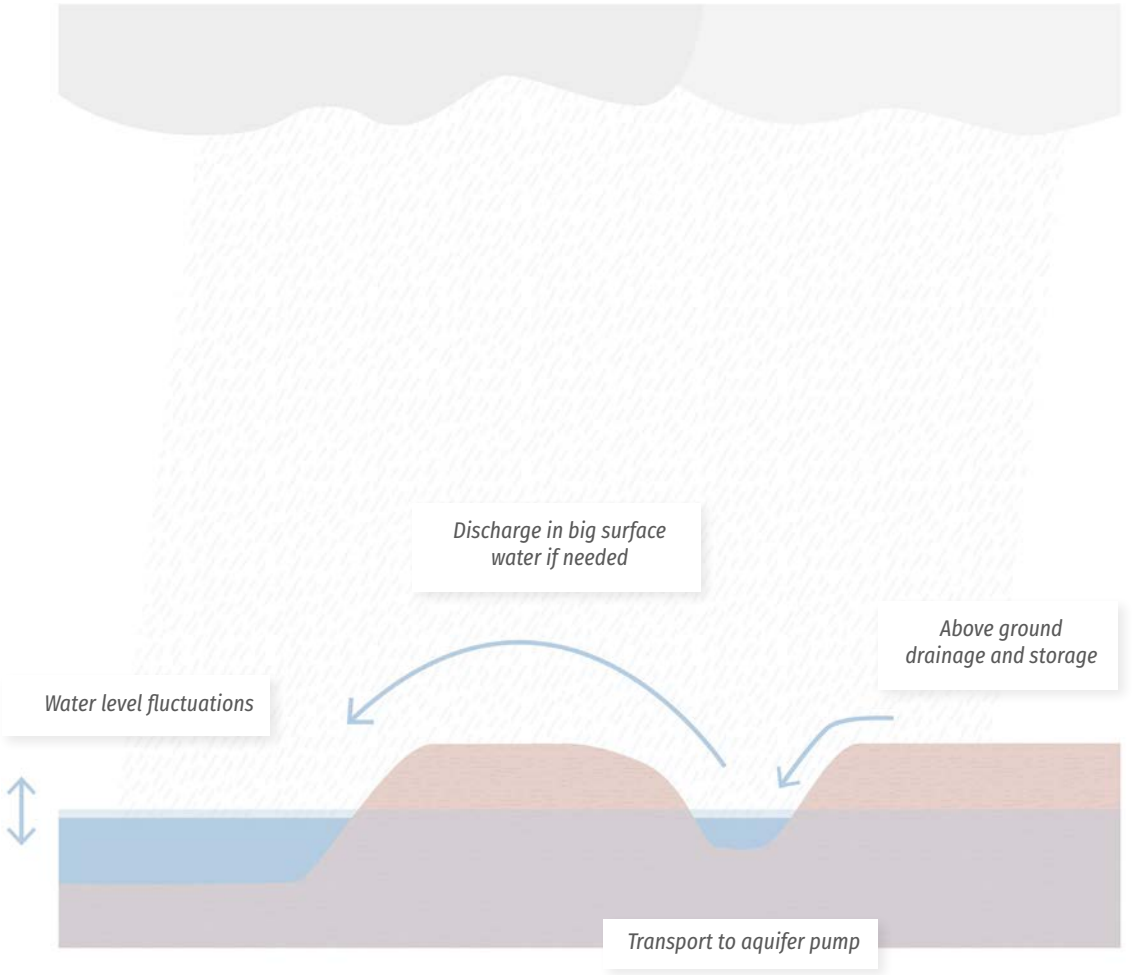
The differences in rainwater management

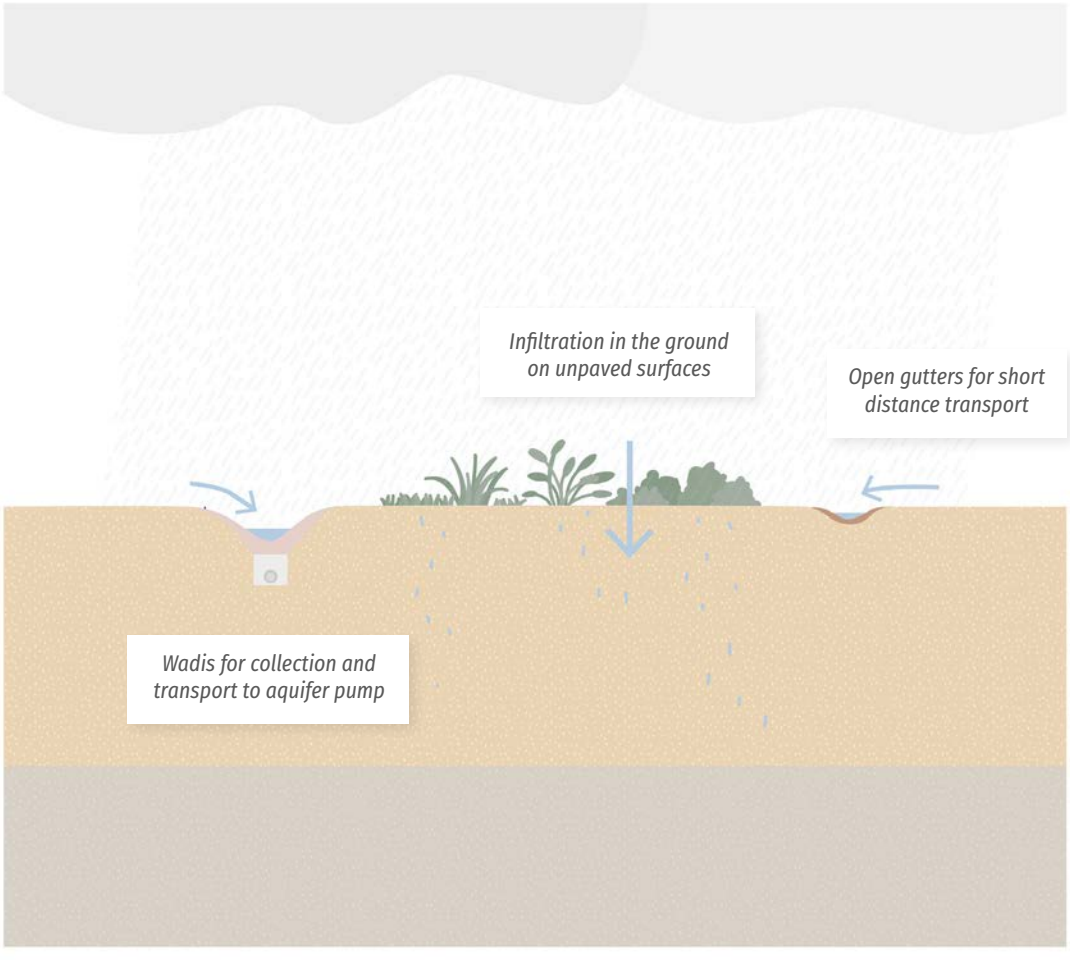
Before diving into the avenues it's good to show the difference in rainwater management in the two landscapes. Because of the high ground water level and the low permeability of the clay the main focus in the Kromme Rijn Landscape is above ground drainage and storage. The ditches will be used for transport to the aquifer pump and they need to be designed for water fluctuations as well. Due to the low ground water level and high permeability of the sandy soil in the Utrechtse Heuvelrug landscape here the focus lies mainly on the infiltration in the ground on unpaved surfaces. Only a small part of the water will be collected in a wadi to be transported to the aquifer pump.

The characteristics of the landscapes

In this image the characteristics of the landscapes are made visible. You can clearly see the difference in ground level in the Kromme Rijn and Utrechtse Heuvelrug Landscape. Because the Heuvelrug is higher it's also dryer which can be seen in the proportional low ground water level. In the sandy soil the ground water level can be almost 8 meters below ground level.




Discharge in big surface water if needed
Above ground drainage and storage
Water level fluctuations
Transport to aquifer pump


Infiltration in the ground on unpaved surfaces
Open gutters for short distance transport
Wadis for collection and transport to aquifer pump

Avenue on clay

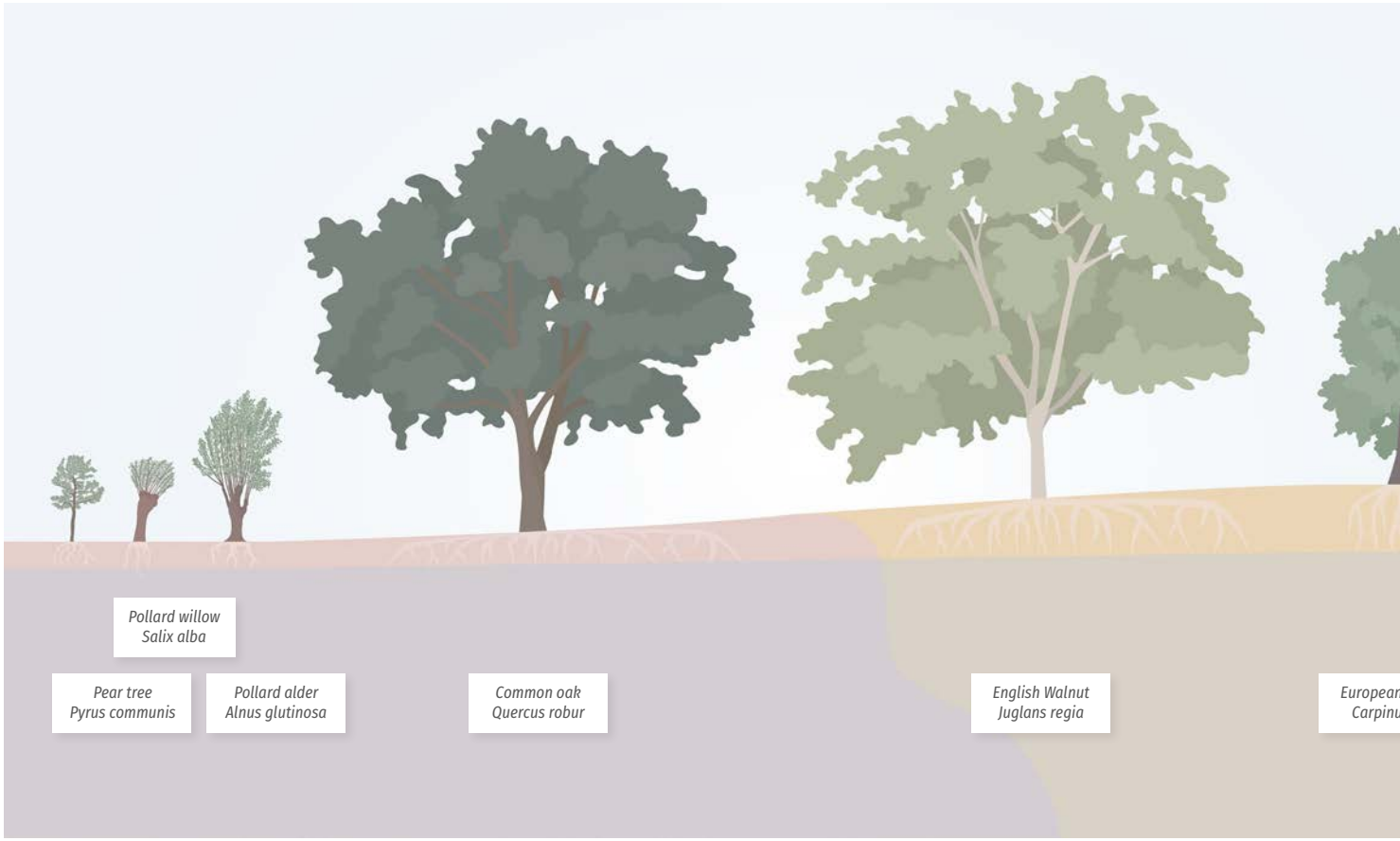
This is how an avenue on clay could look like: with in the middle the two way bicycle street with on both sides the ditches and then a pedestrian path. You can see how the pollard willow, pollard alder and the pear tree create an atmosphere that suits the Kromme Rijn Landscape. The ditches can differ in size but it's important that they have nature friendly banks to be able to add helophyte filters and to increase biodiversity.

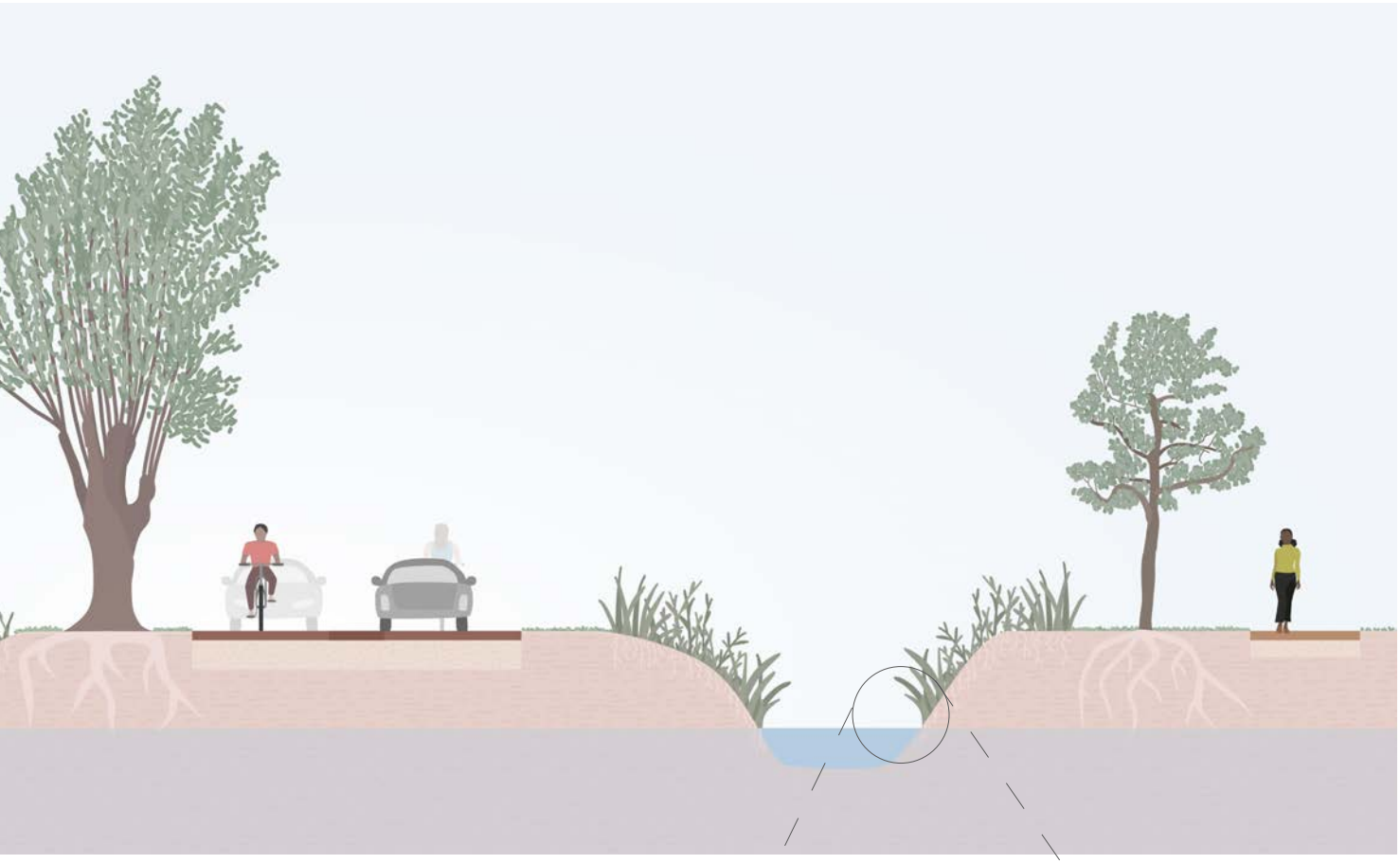
With this increase in biodiversity there's also place for new species that do well in wet areas such as a root vole, the great reed warbler, the moor frog and the great loach. These are species that have lost a lot of their habitat because of the increase in drought in the Kromme Rijn landscape so by adding this nature friendly banks their habitat would increase again.

Trees corresponding to the landscapes

In this image you can see that the trees in the Kromme Rijn Landscape are smaller than the other ones and that a few of them are also pollard ones which is more of a cultural thing that is connected to the landscape. The two trees that I've chosen that do really wel in the transition zone between wet and dry are the biggest trees of the two landscapes because they live in the less extreme conditions. And lastly we have the trees in the Utrechtse Heuvelrug landscape that have pretty dense crowns and have a height that's in between the other two landscape types.





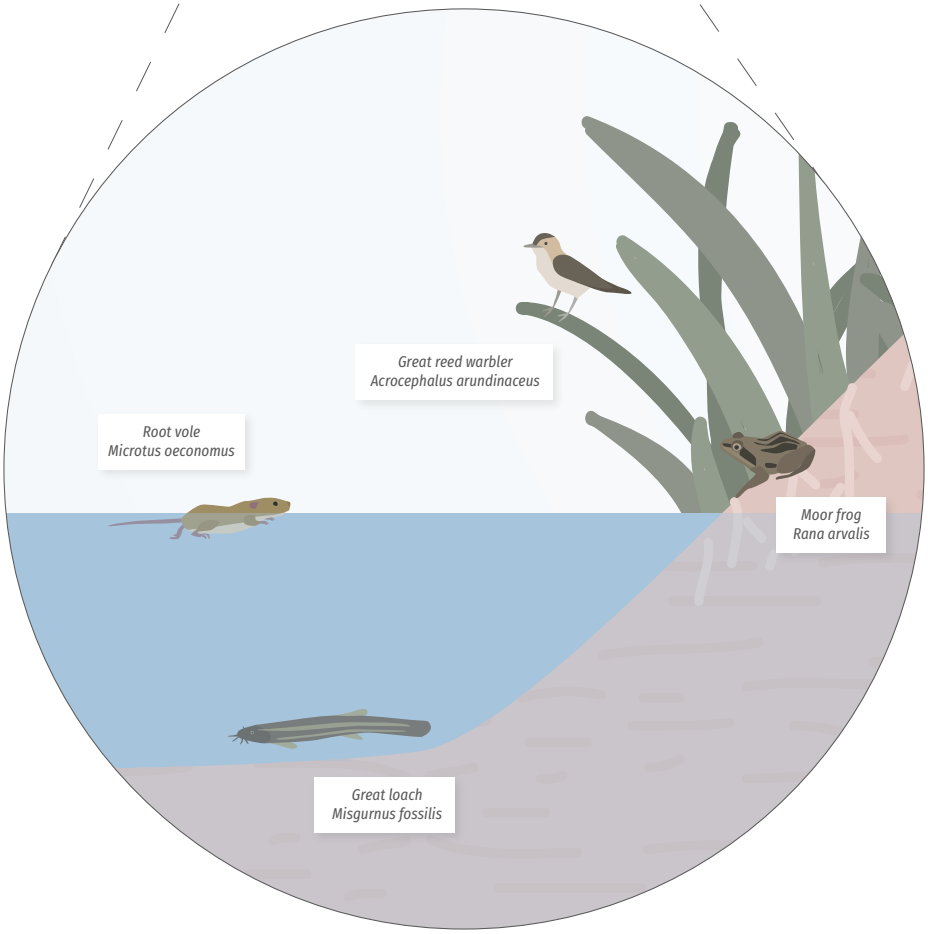


Pollard Alder | Bicycle street 6 m | 3 m | Pear tree | Pedestrian path 2 m



n hornbeam
us betulus

Large-leaved linden
Tilia platyphyllos



Great reed warbler
Acrocephalus arundinaceus

Root vole
Microtus oeconomus

Moor frog
Rana arvalis

Great loach
Misgurnus fossilis

Avenue on sand

Then we'll move to the avenue on sand. It immediately stands out how different the atmosphere is in this avenue due to it's lack of surface water and the denser and bigger trees such as the European hornbeam and the Large-leaved linden. The only bit of surface water you'll see is in the wadi, but this will only be a small strip after it has rained and during dry periods it will be dry as well. So it's important to pick the right plant species in the wadi such as the Siberian iris, the purple loosetrife and the lady's mantles which can withstand these fluctuations.

Around the trees there is also some higher vegetation added to increase biodiversity and to make the ground even more permeable for rainwater infiltration. These plants can also attract insects like the tree bumblebee and the meadow brown. And with the bigger denser trees come small mammal and bird species as well such as the squirrel and the great spotted woodpecker.



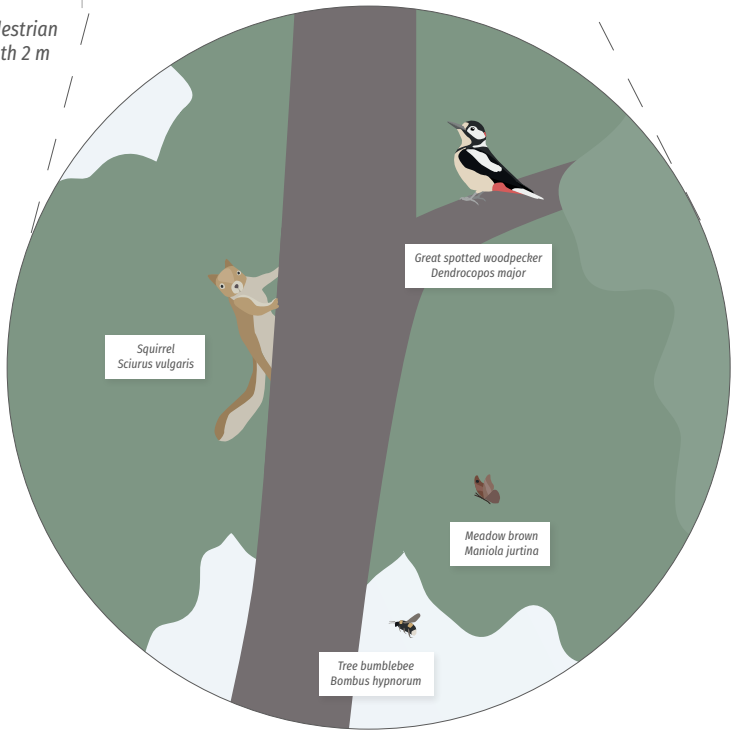
European Hornbeam

Pedestrian path 2 m



Large-leaved Linden | *Bicycle street 6 m* | *Wadi 4 m* | *Pedestrian path 2 m*

Plants in wadi: Siberian iris, Purple loostrife and Lady's mantles



Meeting point

And then lastly I want to show you how these two avenues would come together in the meeting point. I've created a bicycle street roundabout where the pedestrians can easily cross to go to the other avenues with the different landscapes. The avenue on clay is currently called the Kromme-Rijn laan so the the avenue on clay will be named the Utrechtse Heuvelrug laan as well. The avenues that are perpendicular to these two are a transition zone and will have the big trees that fit this soil type. The ditch of the Kromme-Rijn laan will be connected with a pipe to the wadi of the Utrechtse Heuvelrug laan so that they'll both be connected to the aquifer pump. When you'll drive, bike or walk on this meeting point you will see and feel the landscape around you changing which will make you more aware of the landscapes and how they deal with water so hopefully this will make you think of your own water usage as well.




Utrechtse Heuvelrug laan
(Avenue on sand)
Utrechtse weg to the south
(transition zone)

Hot - Waalhaven

Geothermal extraction in the Waalhaven

Froukje Ottema
Lisanne den Held

2020—2021 IED
Infrastructure and Environment Design
July 2021





Port of Rottedam
(ROTTERDAM - TOWARDS A CIRCULAR PORT, n.d.)

1.

Introduction

Context and Challenge

The Waalhaven is a harbor situated in the city of Rotterdam in the Netherlands. The waalhaven was designed by G.J de Jongh and the exavation started in 1907. The Robbenoord en Plompert polder needed to be expropriated. The polders where poorly populated and most of the ground was agricultural land that made the expropriation relatively cheap. (Kamphuis et al., 1998)

With a sufrace of 310 Ha, the Waalhaven is the biggest artificial harbour basin in the world. Throughout the years, the Waalhaven has changed shape and is often seen as a failure because the design had to be changed often. But what only a few people know is that G.J. de Jongh designed the harbour basin with an eye on its adaptability. The port should be able to develop according to the changing needs of the port. (Kamphuis et al., 1998)

The challenges we are dealing with in the Waalhaven are biodiversity loss, a housing shortage and the enrergy transition.

Biodiversity is important for the overall human wellbeing, it supports human and societial needs. For good health we need biodiversity, it provides us of food, energy, devolopment of medicines, nutrition security and freshwater. (WHO, 2015) So the loss of biodiversity will be a disaster for human kind.

The housing and rent prices are sky high at the moment. That's why there is a national pressure on the cities to build more houses. The vision of Rotterdam is to build these new houses inside its city boundaries, so the city won't grow bigger. But this asks of innovated solutions. This is why we want to show that there is space inside the city where a lot of densification can be executed. Like in the Waalhaven. (Archined, 2020)

The city of Rotterdam has the ambition to be energy neutral by 2050. (Rotterdam Innovation City | Energy, n.d.) To fulfill this ambition every solution needs to be looked at. The solution we are looking at in this project is Geothermal energy.



Biodiveristy loss



Housing shortage



Energy transistation

Environmental Risks and Human Response

This case touches 2 main subjects concerning Environmental Risks, the rising water level and the extraction of oil within the area. Loosing the extraction of oil will mean that the pumps will lose their function. However, the current use of the oil pumps can with some work be exchanged for extracting hot water. This water can then be used to heat buildings and can even be connected to the heat roundabout already existing in Rotterdam.

The harbor area is not protected by dikes, this means that the risk of flood is higher compared to the adjacent neighborhoods. This results in a less suitable area in for example living. Different projects have shown ways to create safe neighborhoods within such lower area's. These examples are used within the project in order to avoid risky situations. And to show, just like in those references that there are multiple possibilities to deal with tidal change.

Scales & actors

Because of its function the harbor of Waalhaven has lots of actors involved. These actors differ in scale. The next paragraphs explain who's involved trough out the different scales.

Macro-scale - South Holland
The Waalhaven forms a small part of the harbor industry of Rotterdam called the port of Rotterdam. The port of Rotterdam is the biggest seaharbor of Europe due to its close connection to the sea and other countries.
The harbor facilitates 385.000 jobs throughout the whole country. This means that on this macro scale the harbor has a lot of actors such as large companies who use ships as main transport, shippers etc.

Meso-scale - The city of Rotterdam
The Waalhaven is one of the most eastern located harbors of the port of Rotterdam. The harbor touches different neighborhoods such as Charlois and Heijplaat. Heijplaat was meant as a neighborhood for the workers of the harbor to live in. The harbor is located near the city center and therefore easy reachable through the watertaxi. This means that the inhabitant of Rotterdam is closely connected to the harbor and therefore one of the main actors within this scale.

Micro-scale - The Waalhaven
The people who live in Charlois and Heijplaat and the workers of the boats of the Waalhaven form the main actors of the micro scale. Because of its clear function the differentiation of actors on this scale is quite narrow.

Theoretical framework/concept & vision

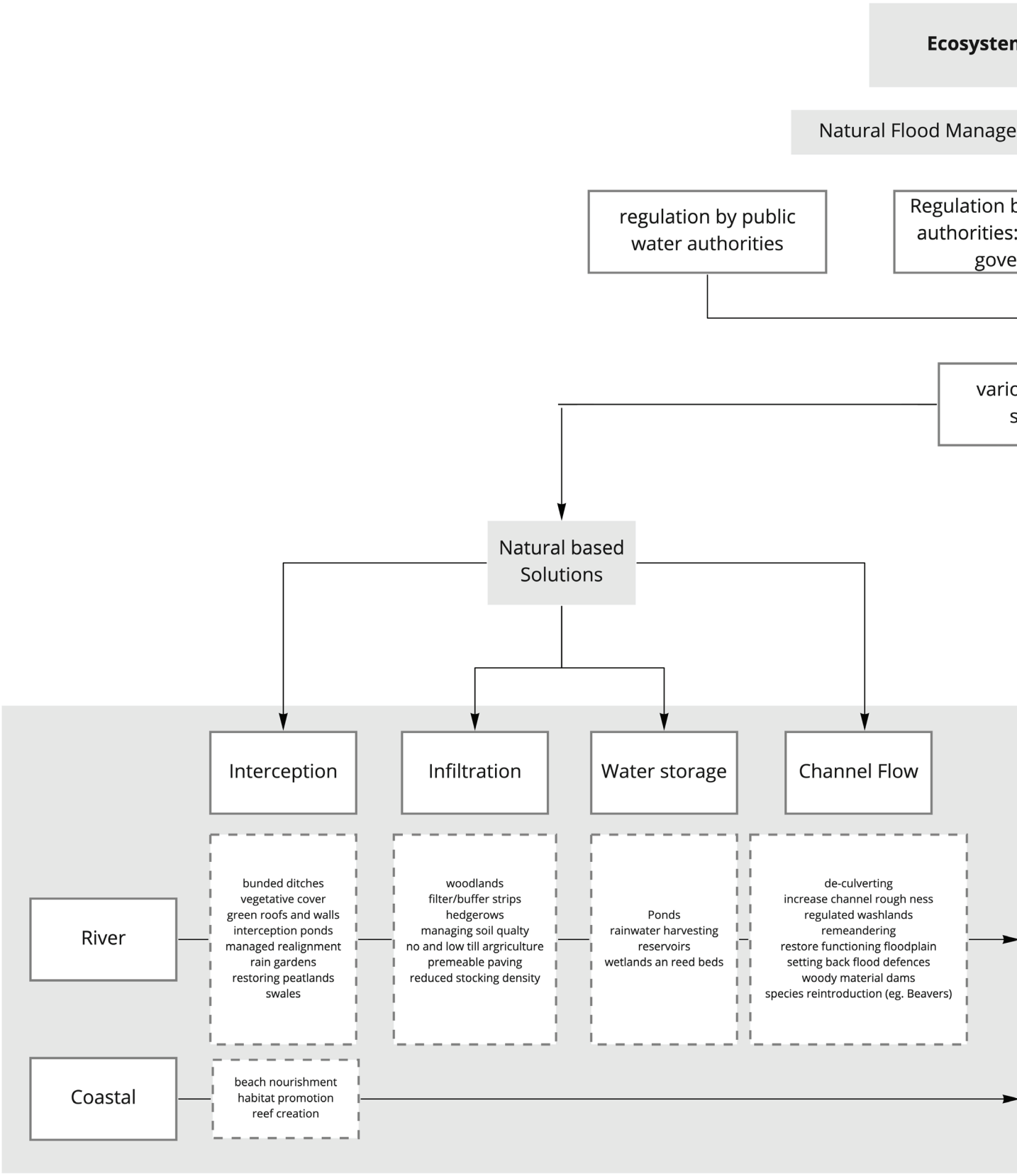
Theoretical framework

The theoretical framework is made to make a clear visualization of the thinking process of the project. The framework mainly focuses on ecosystem participation using the layer approach. Each layer stands for an aspect of importance for urban and regional planning and design. Three layers are distinguished: the layer of the substratum, the layer of the networks an the layer of the occupation pattern. The physical transformation of the layers doesn't all happen at the same rate. The substratum layers transforms the slowest then the networks layer and the occupation layer transforms the fastest. This leads from bottom to top fixed conditions and priorities for the layers above. (van Schaick & Klaasen, 2011)

The framework starts with the different types of flood management, depending on the type of management, different strategies can be chosen. The different measurements can be divided into two categories, nature based solutions or technical solutions. The nature based solutions for floodrisk are divided in four main groups. Interception, infiltration, waterstorage and waterflow. This four groups cover all the nature based solutions for the whole watersytem. It's important to look to the entire river and costal zone, because they all effect each other (Wingfield et al., 2019). the technical solutions are for example building dikes or working with floating houses. This Clear framework helps the designer see what is possible and what does fit within a plan.

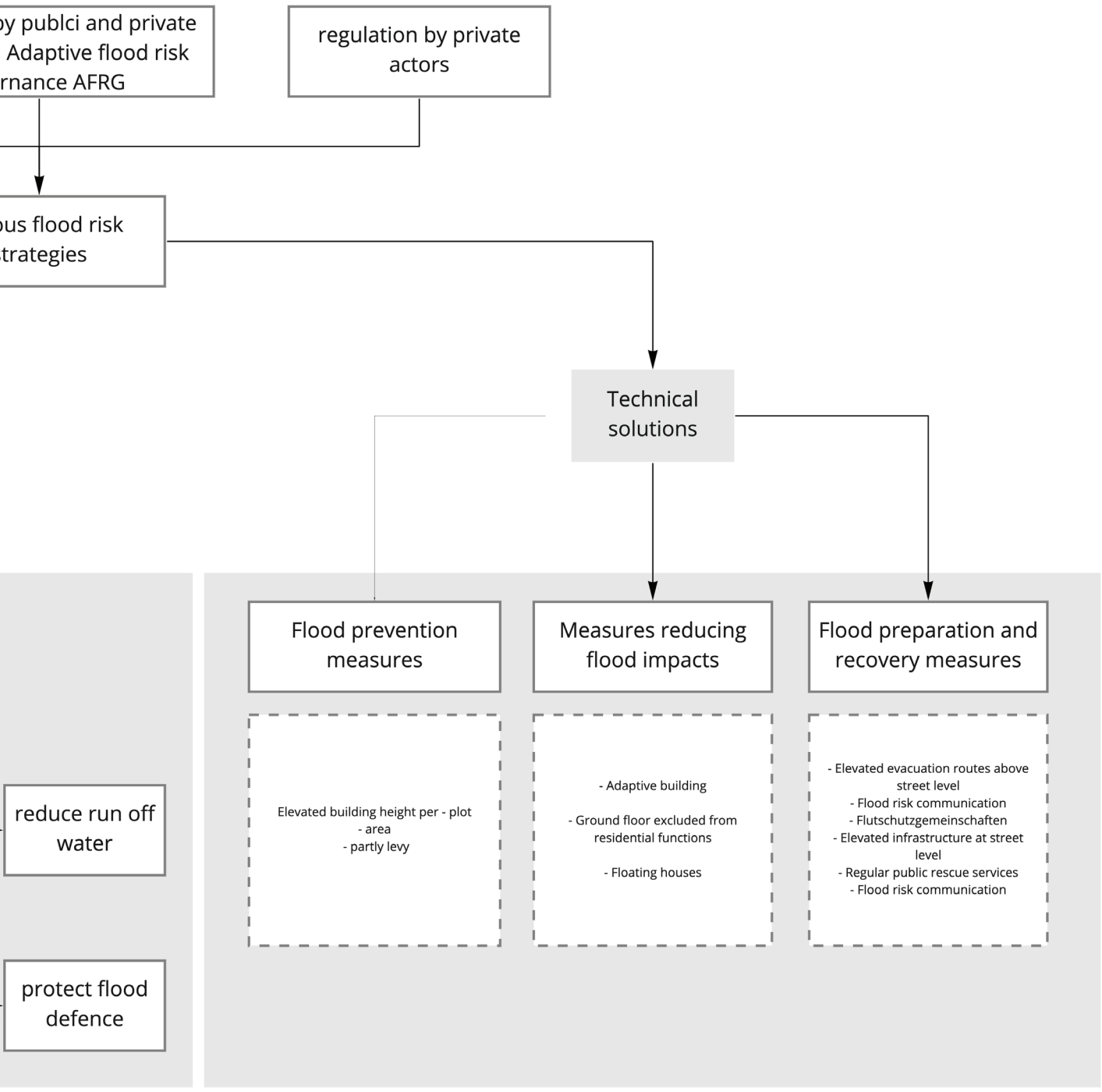
The vision

In this project we want to give an inside look in how ecosystem participation can be achieved by using both nature based solutions and technical solutions. With nature based solution we mean "actions to protect, sustainable manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptable, simultaneously providing human well-being and biodiversity benefits" (IUCN, 2020)


Ecosysten
Natural Flood Manage
regulation by public water authorities
Regulation b authorities: gove
varic s
Natural based Solutions
Interception
Infiltration
Water storage
Channel Flow
River
bunded ditches
vegetative cover
green roofs and walls
interception ponds
managed realignment
rain gardens
restoring peatlands
swales
woodlands
filter/buffer strips
hedgerows
managing soil qualty
no and low till agriculture
premeable paving
reduced stocking density
Ponds
rainwater harvesting
reservoirs
wetlands an reed beds
de-culverting
increase channel rough ness
regulated washlands
remeandering
restore functioning floodplain
setting back flood defences
woody material dams
species reintroduction (eg. Beavers)
Coastal
beach nourishment
habitat promotion
reef creation

n participation

ment - flood risk prevention



2.

Critical Cartography

Process of collecting data

In this group research project we have collected information from data that was provided by open source GIS data, recent scientific literature with related topics, vision reports of the municipality of Rotterdam and previous design researches that are done in this spectrum.

2.1

Landscape

Froukje Ottema

Networks

This map shows three important asepcts. The first one is that the Waalhaven is located in an outer dike area. This means that this area is not protected against the high water. But it also means that this area is higher. And there is no risk of a big flood but only a water nuisance.
The second important aspect of this map is the watersystem in Charlois, the watersystem is now a incomprehensible system. And the excess water is pomped in the river through invisble pipes.
The last important aspect is the acknowledgement of the gap in the roadsystem. Where the port begins the regional infrastructure ends.

- River (de Maas)
- Train
- Dike
- Connection polderwater - riverwater




A13
A20
Dike Ring 17
A13

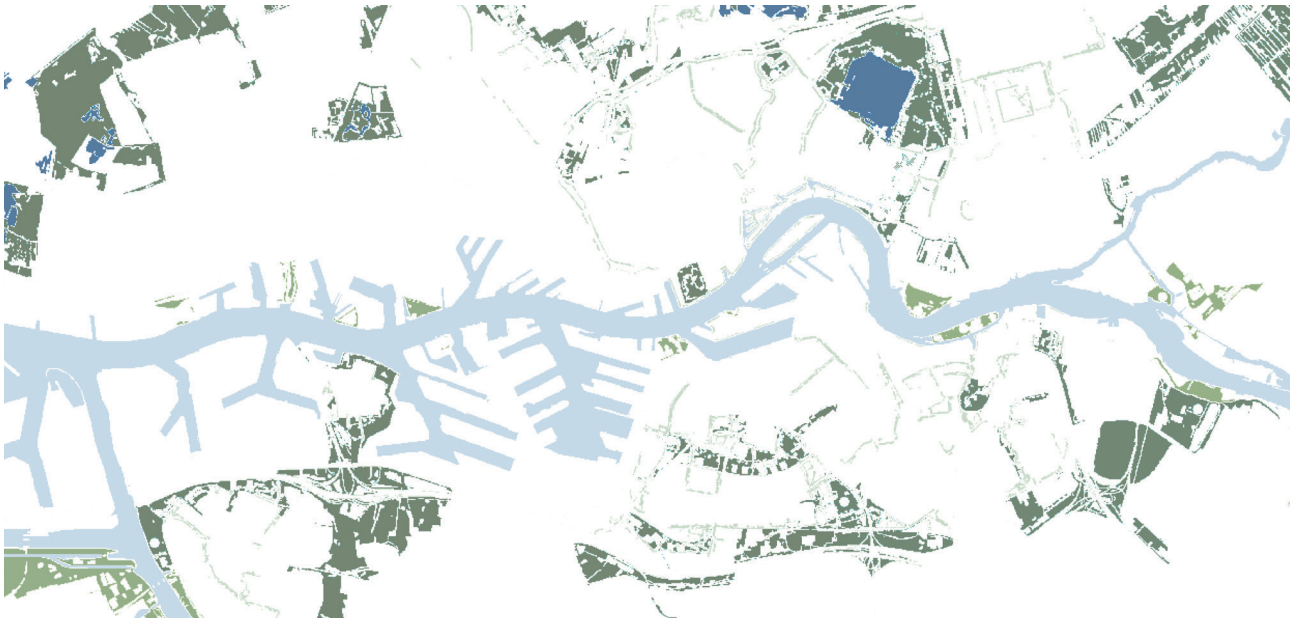
Green structure

This map shows the missing green along the river Maas. And shows that thw river is not recognized by the municipality as a potential green structure.

- River (de Maas)
- Park forest: landscape parks and recreation areas that have great significance for the ecological structure of the city.
- Tidal nature
- Green neigbourhood network
- Lake: large bodies of water with generous banks.

N

0 2 km



Polder types

The Maas river in Rotterdam is the border between two landscape types. On the North side of the river lays the peat landscape and on the south side the clay landscape.

- River (de Maas)
- Clay Landscape
- Peat landscape



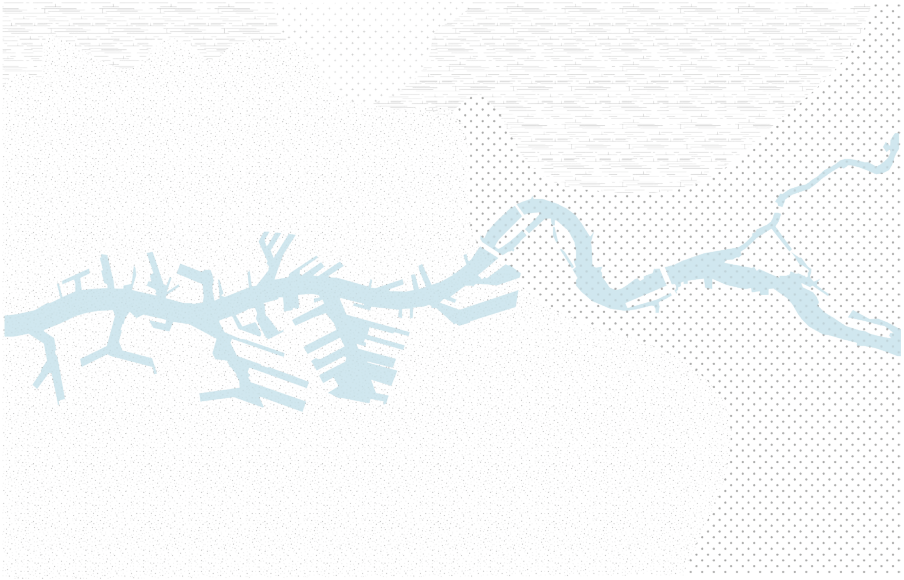
N

0 2 km

Soiltype

The common soiltype of the Waalhaven is clay due to the former sedimentation of the river.

- River (de Maas)
- Marine Clay
- Clay, Riverbasins
- Peat
- Clay, Droogmakerij



N

0 2 km

Rainwater depht

Rainwater depth in the extreme scenario 2050
The rainwater depth is probably high because of the high percentage of paved surface. How darker the color how deeper the rainwater.

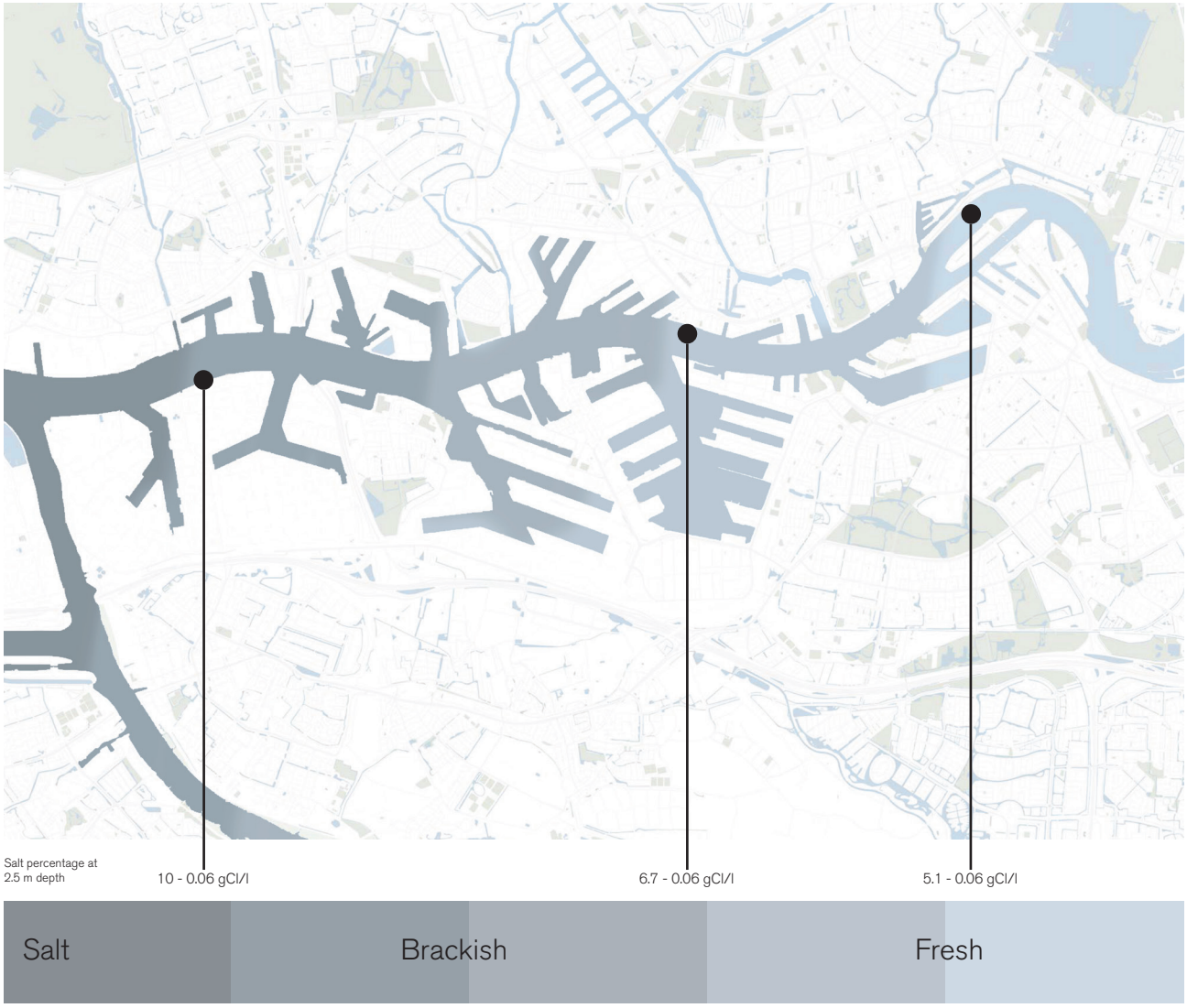
Salinity of the Maas river

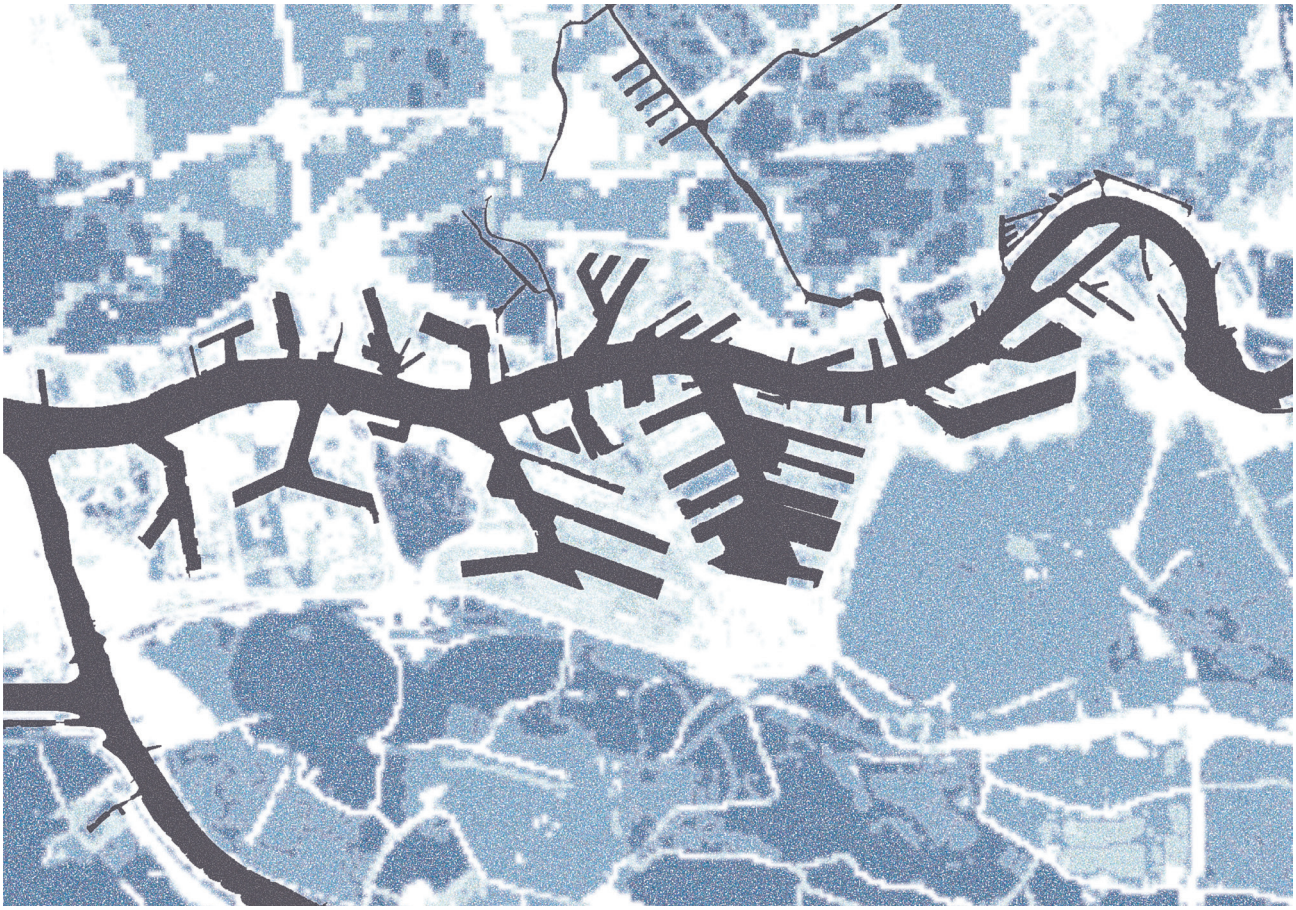
The salinity of the Maas river is here illustrated. Land inwards the river is less salty. In the future due to sealevel rises. The salt will move more land inwards and the Waalhaven wil get a higher salinity percentage.

Flooding depth

Flooding depth in the extreme senario 2050
The flooding depth in the Waalhaven is relative low, if you compare it with the surrouding areas due to its higher position. This makes it strategically more logical to build in the Waalhaven than in the lower-lying areas
How darker the color how deeper the flooding.

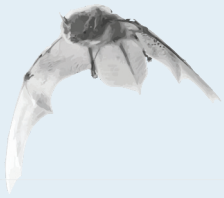



Salt percentage at
2.5 m depth
10 - 0.06 gCl/l
6.7 - 0.06 gCl/l
5.1 - 0.06 gCl/l
Salt
Brackish
Fresh

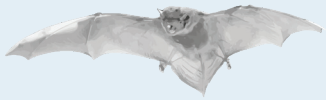




The common pipistrelle
Pipistrellus Pipistrellus



The rough pipistrelle
Pipistrellus nathusii



The common noctule
Nyctalus noctula



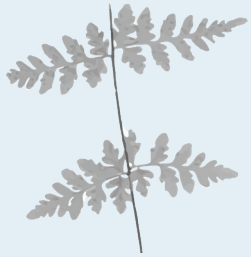
House sparrow
Passer domesticus



The Rook
Corvus frugilegus



The Eurasian hobby
Falco subbuteo



Brittle bladder-fern
Cystopteris fragilis





2.2

Urban morphology

Lisanne den Held



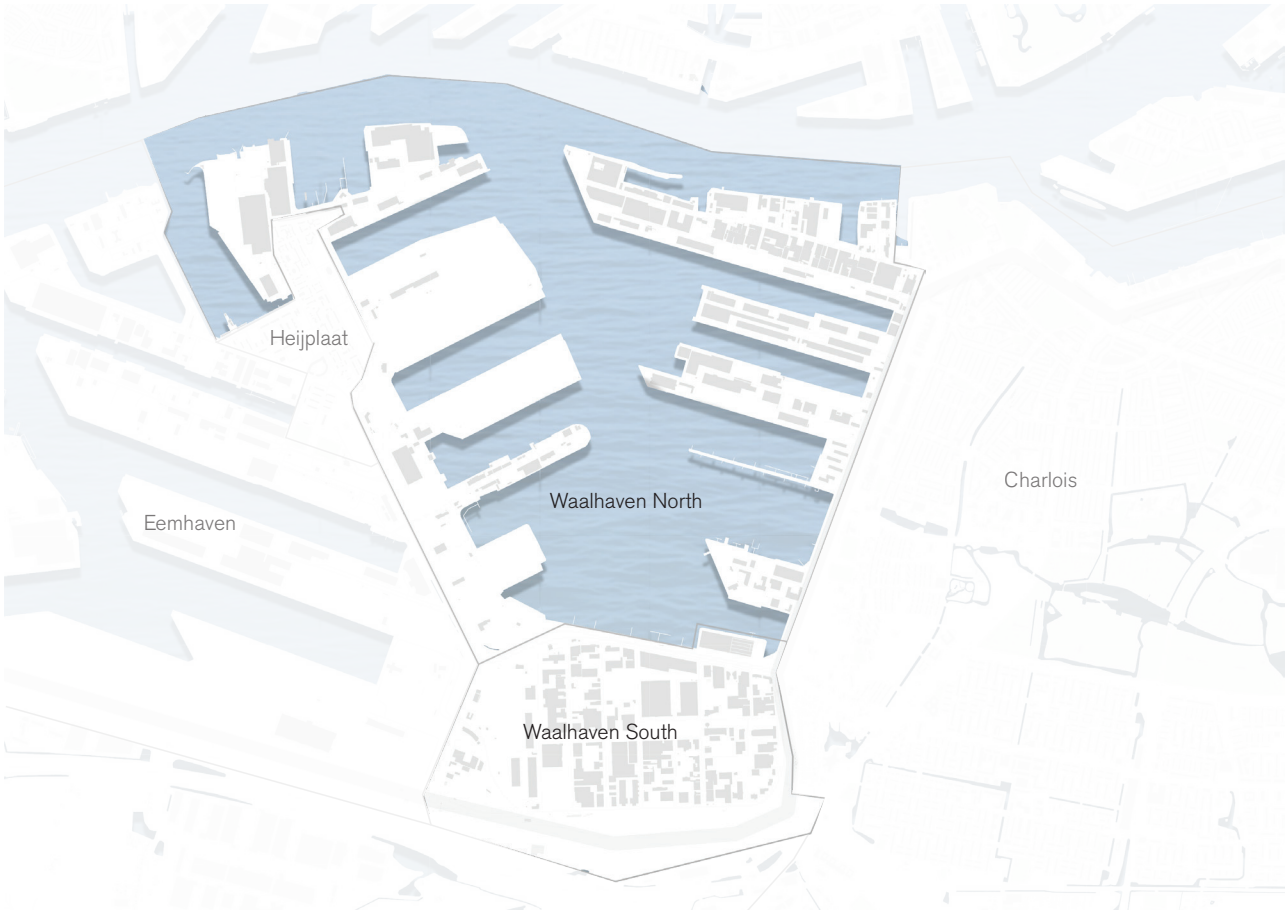
The City of Rotterdam

City of Rotterdam
Neighborhoods
City center
Waalhaven

The Waalhaven

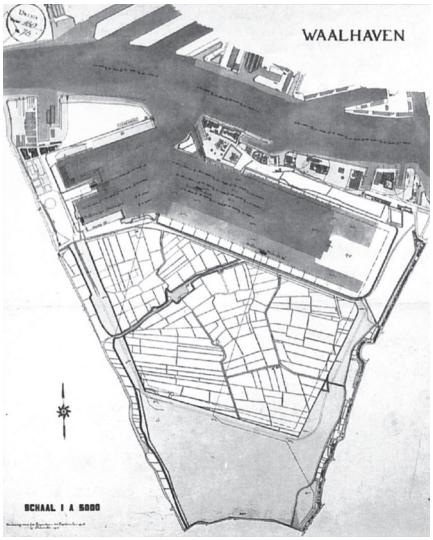
N

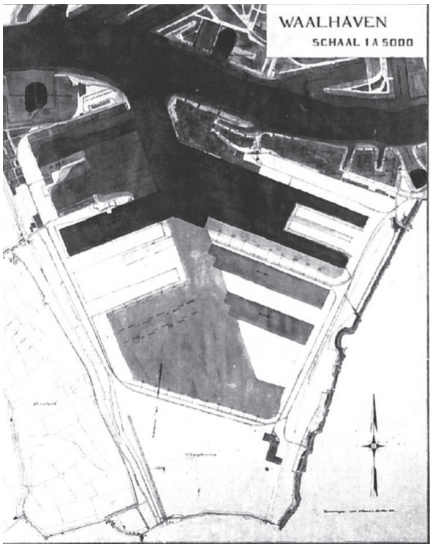
0 1 Km

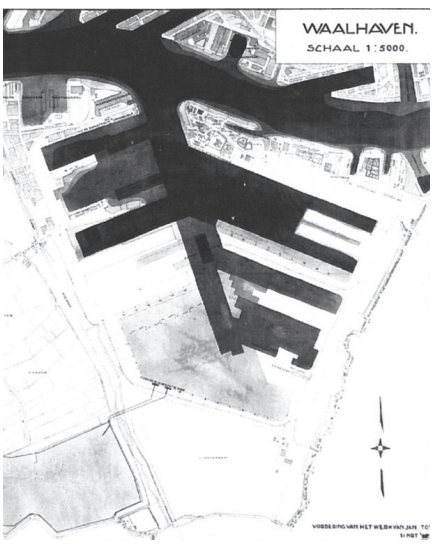


The Waalhaven

The Waalhaven forms a part of the Port of Rotterdam. The Waalhaven which is located near the east reaches to the city center. The Waalhaven is separated with the neighborhood Charlois by dikes, which makes the separation of both functions though physical near respectively quite large.







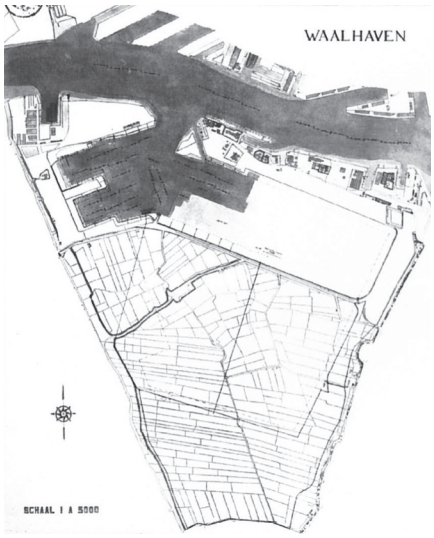
The history of the Waalhaven
The Waalhaven is one of the excavated harbors on the left bank of the Maas in Rotterdam. With its area of 310 ha. the Waalhaven is the largest excavated harbor basin in the world. The Waalhaven flows into the Nieuwe Maas and is therefore directly connected to the sea.

In 1907, the city council of Rotterdam took the decision to construct the Waalhaven, The expropriated soil is partly used to transform the polders Robbenoord en Plompert to the Waalhaven South. The rest of the soil was used to create parts of the Kralingse bos.

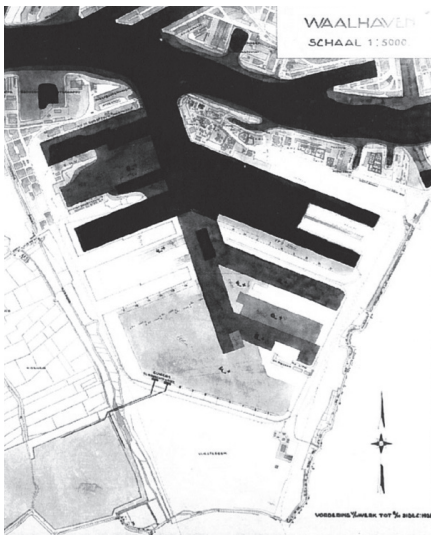
In 1919 it was decided to build an airport in Waalhaven South. An air freight service with England was set up and named Waalhaven Airport. In the May days of 1940 the airfield was raided by German paratroopers. The airfield was put into use by the Germans for a short time, but they found it impractical because it was too close to the coast. The Germans would eventually make the terrain unsuitable for landing. After the war it was soon incorporated into the port industry.

On the west side of Waalhaven, next to the sheds of the Rotterdamse Droogdok Maatschappij, the village of Heijplaat arose. It was Built to house employees of the yard. The village had 315 single-family homes, later about 40 more homes were added

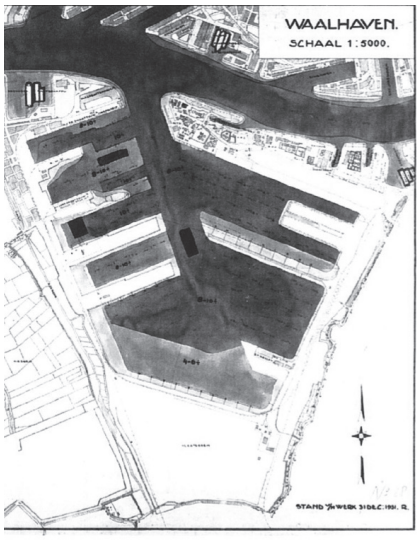
Until the 1990s, the Waalhaven served as a transhipment port for bulk goods and containers in particular. At the time, it was a transshipment point for Lash ships. The bins that are still there are mainly used for storage. (Redactie in Havens).


WAALHAVEN
SCHAAL 1 A 5000

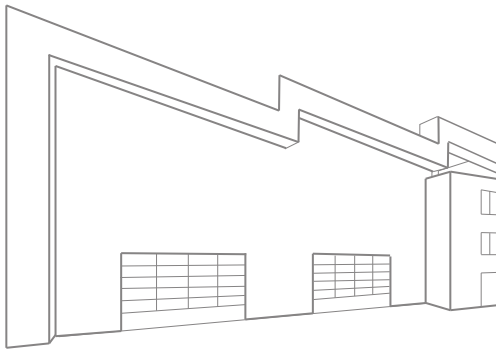

WAALHAVEN


WAALHAVEN
SCHAAL 1:5000

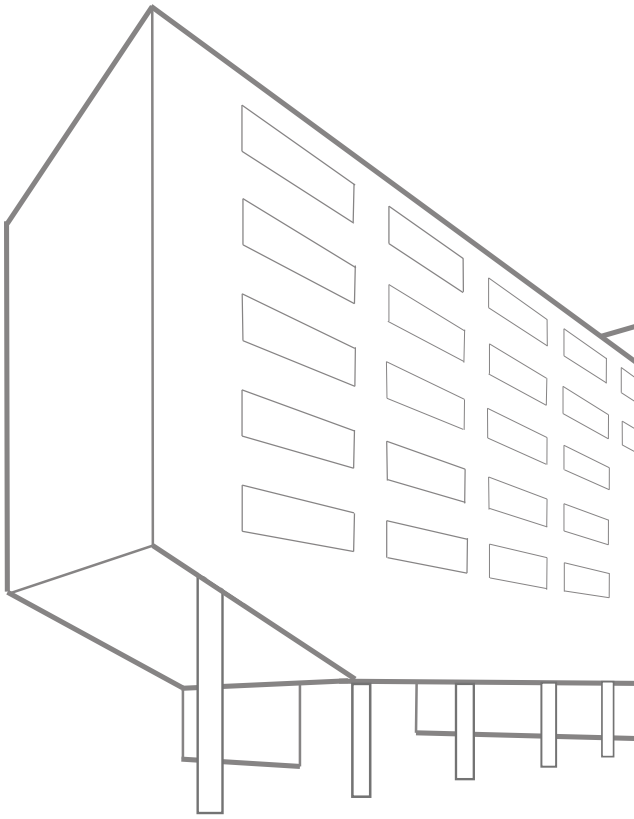



WAALHAVEN.
SCHAAL 1:5000.





Hardwarestore



Office building

The Elastical Harbor

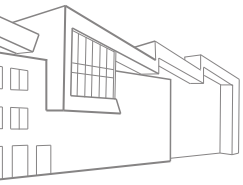
The Waalhaven has many times been transformed and is therefore called the Elastical Harbor. The word Elastical illustrates the capacity of change the Waalhaven can Offer. Its forms follows the function. These changes are shown in the image underneath

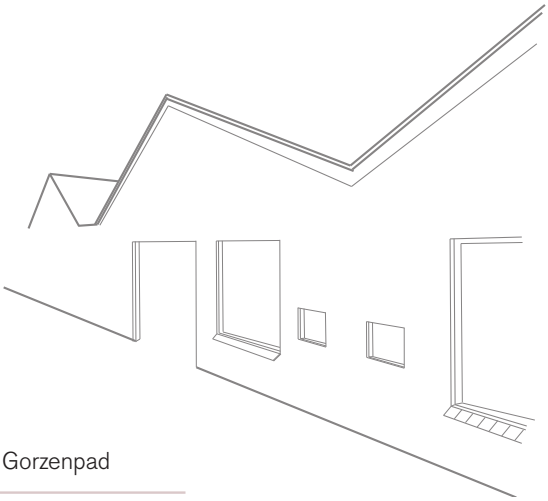
Building Typologies

Within the area multiple Building typologies can be found. The area only offers small amounts of housing, offices and public buildings in contrast of the large amounts of harbor facilities. The sketches show these main Typologies.

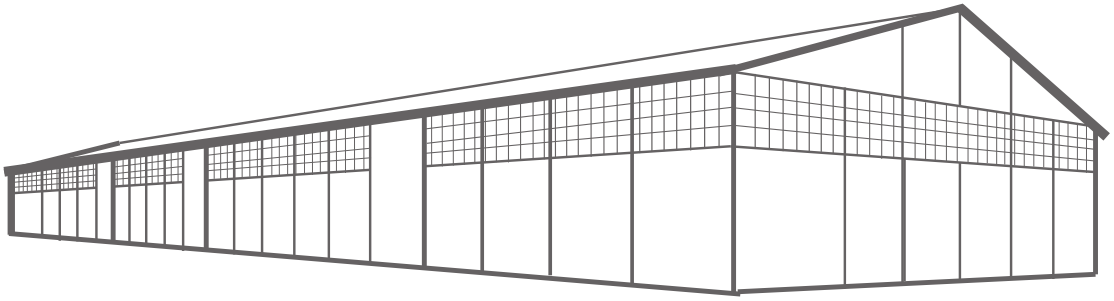


1815 1911 1920

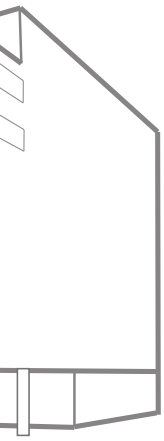


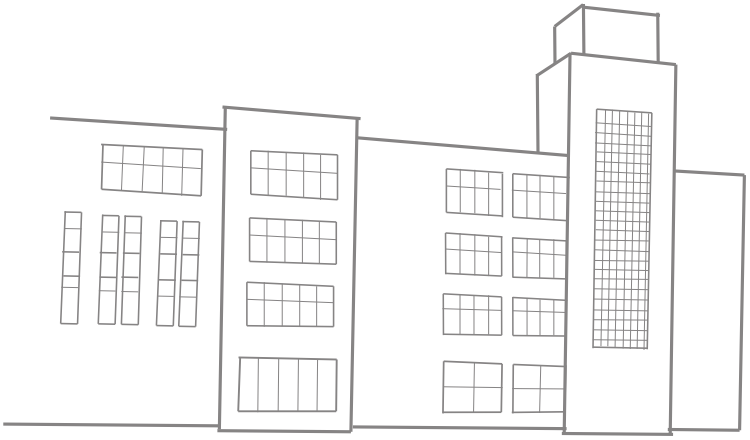


Gorzenpad

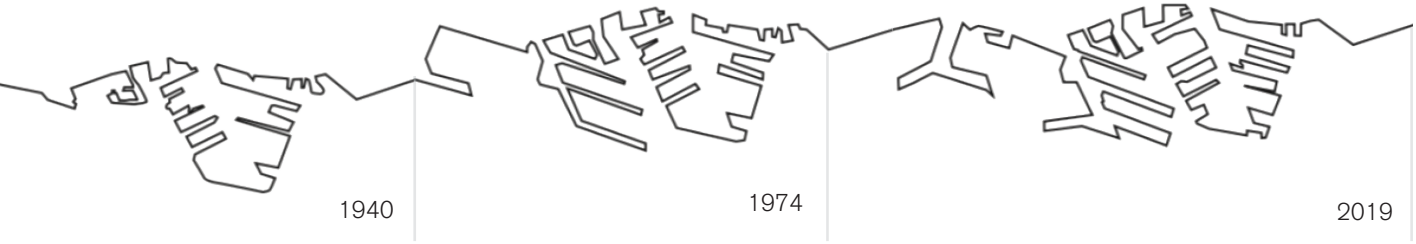


Warehouse





old RDM headquarter



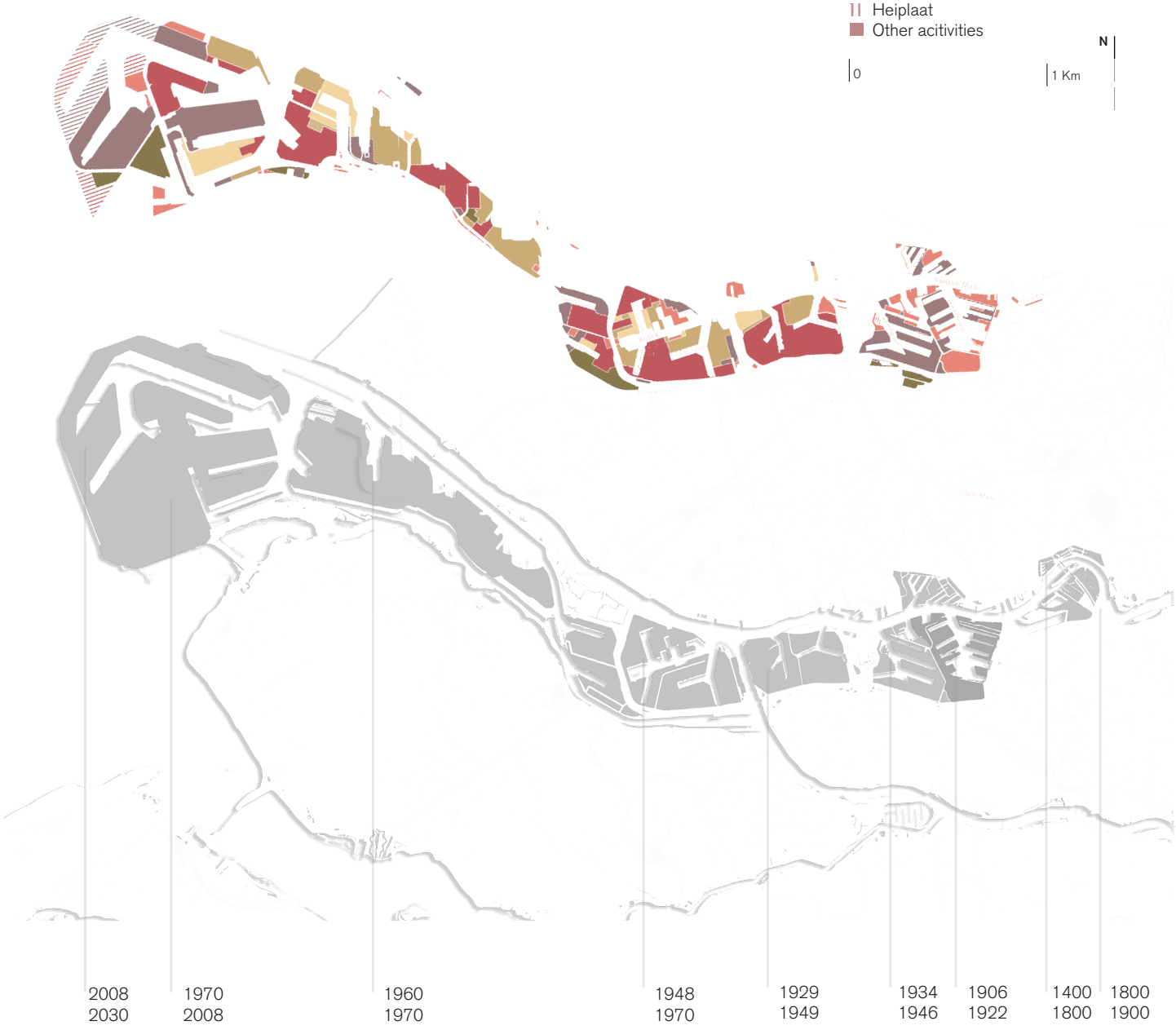
1940

1974

2019

Harbor Functions

The Waalhaven forms a part of the Port of Rotterdam reaching from Hoek van Holland till the center of the city. The maps show the division of the different functions of the harbor in two scales. Together with the timelime the maps show how the harbor grew in length and function over the years. Compared to other parts of the port of Rotterdam, the Waalhaven mainly focusses on containers and loose activities.

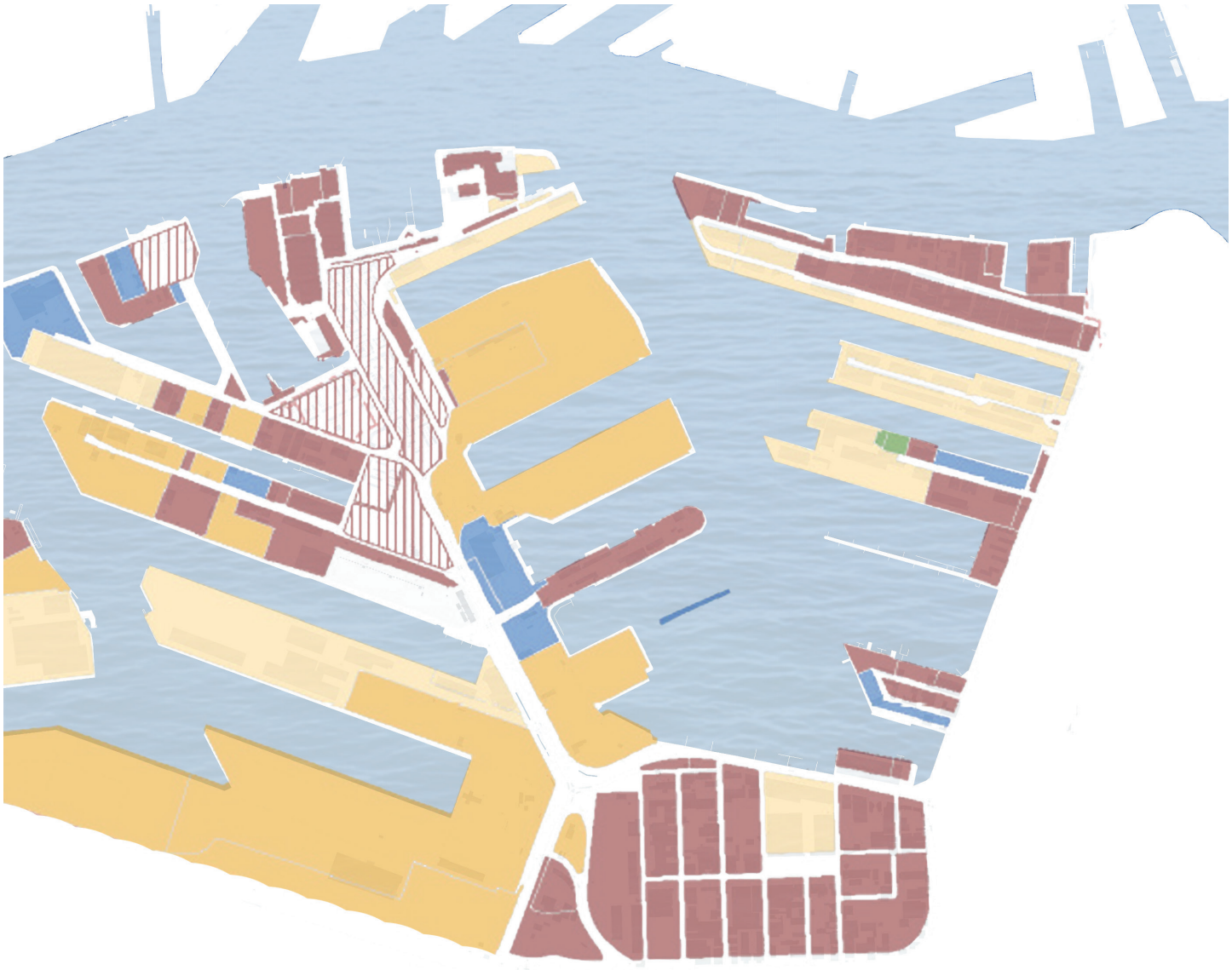


Urbanization of the Waalhaven

The image on the right illustrates the urbanization of the Harbor dating back from 1950 till 2010 in building stamps.

- 1950
- 1980
- 2010



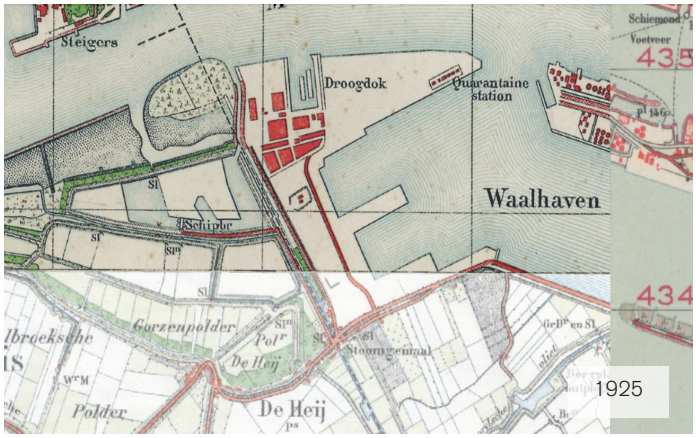


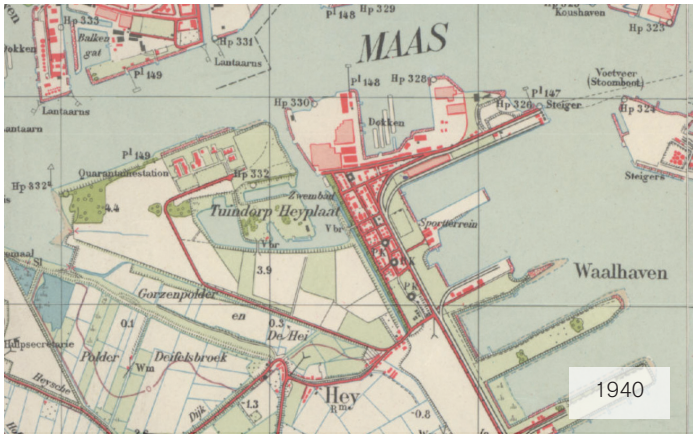
RDM and Tuindorp Heijplaat

The Rotterdamsche Droogdok Maatschappij N.V. (RDM) was founded in 1902 by a consortium of almost all Rotterdam shipowners and played a big role in the creating of the Waalhaven. Due to the remoteness of the company, including the digging of the Waalhaven, the RDM had its own village built to accommodate some of its employees right next to the Waalhaven area. The starting point for the houses in Tuindorp Heijplaat in 1914 was a single-family house with five rooms and a small garden. In addition, the RDM took care of all other public buildings, such as the shops, a library, a meeting room, three churches, the Courzand party building, a bathing facility with a laundry for clothes, a music pavilion, swimming pool, sports fields and a school. Only the public school was realized by the municipality. In the early 1950s, a retirement

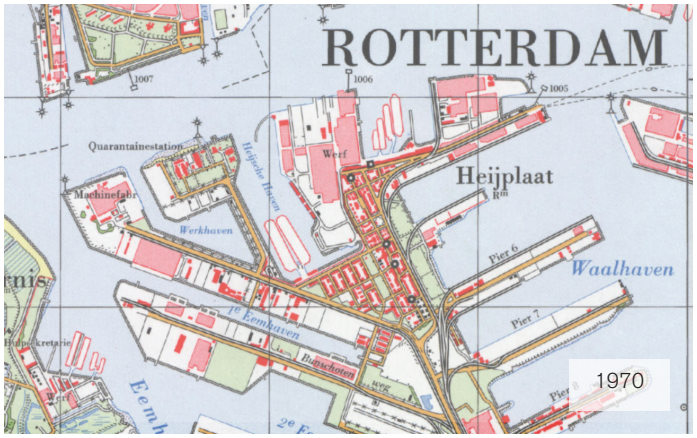








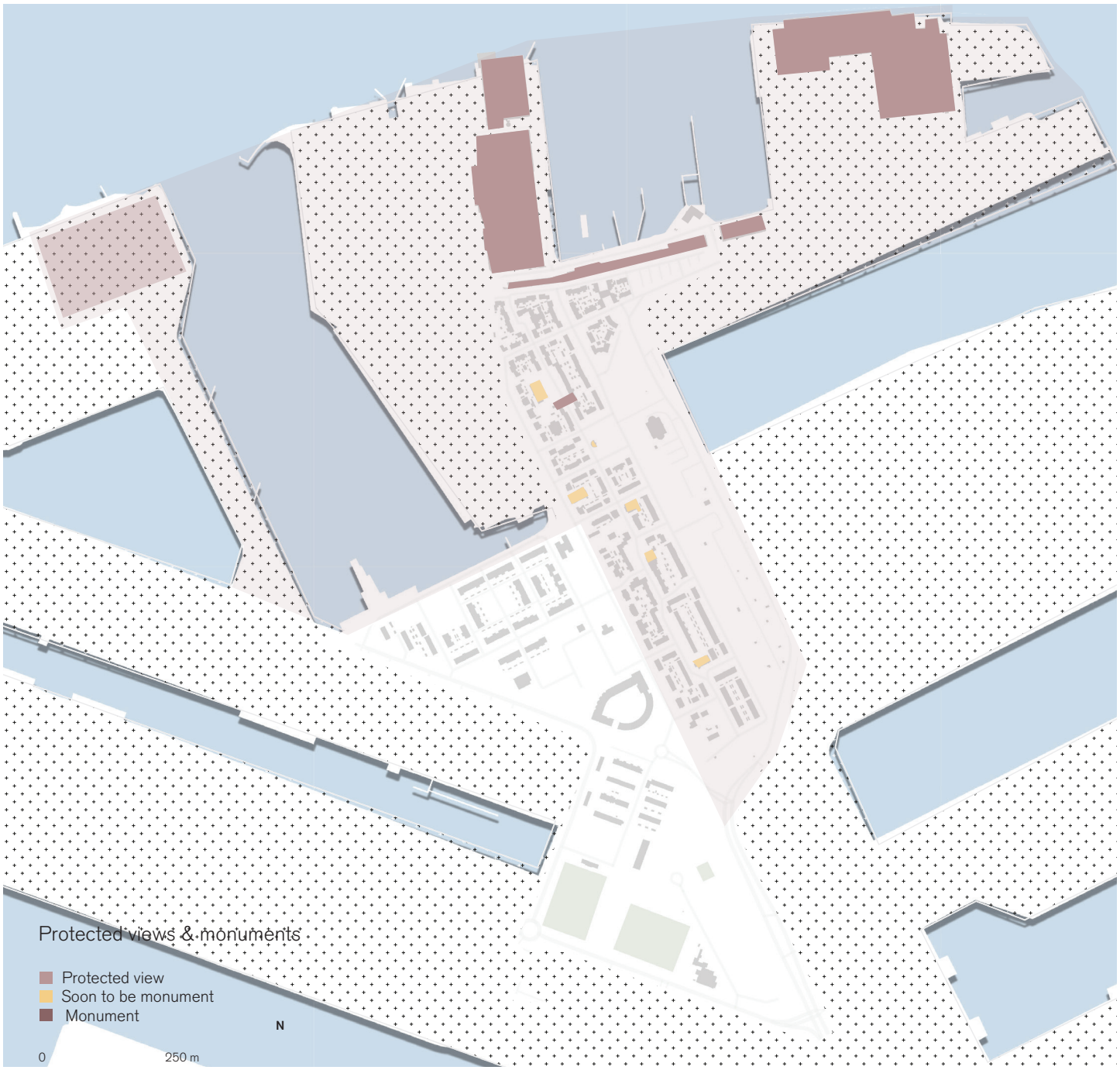




home was also built, one of the first housing facilities for retired employees in the Netherlands. The architect of the first construction phase was Baanders who not only designed the houses but also did the urban planning. Baanders was also the designer of the RDM headquarters. Heijplaat has not been transformed anymore over the years and is still surrounded by only harbor facilities.

Monumental value

The area of both the waalhaven and Heijplaat, indicated by the red color is a protected view. The old company buildings of the RDM by Baanders are also indicated as monuments. Different building of the neighborhood Heijplaat colored in yellow will in the future be added to the list of monuments of Rotterdam as well.



Heat roundabout of South Holland

These maps illustrate the heat roundabout of South Holland. The Roundabout provides sustainable heat for 350.000 houses and 1000 hectares of greenhouse facilities mainly by using residual heat from the port of Rotterdam. This approach results in a million tons less CO2 emissions and 5% less nitrogen deposition (COB).

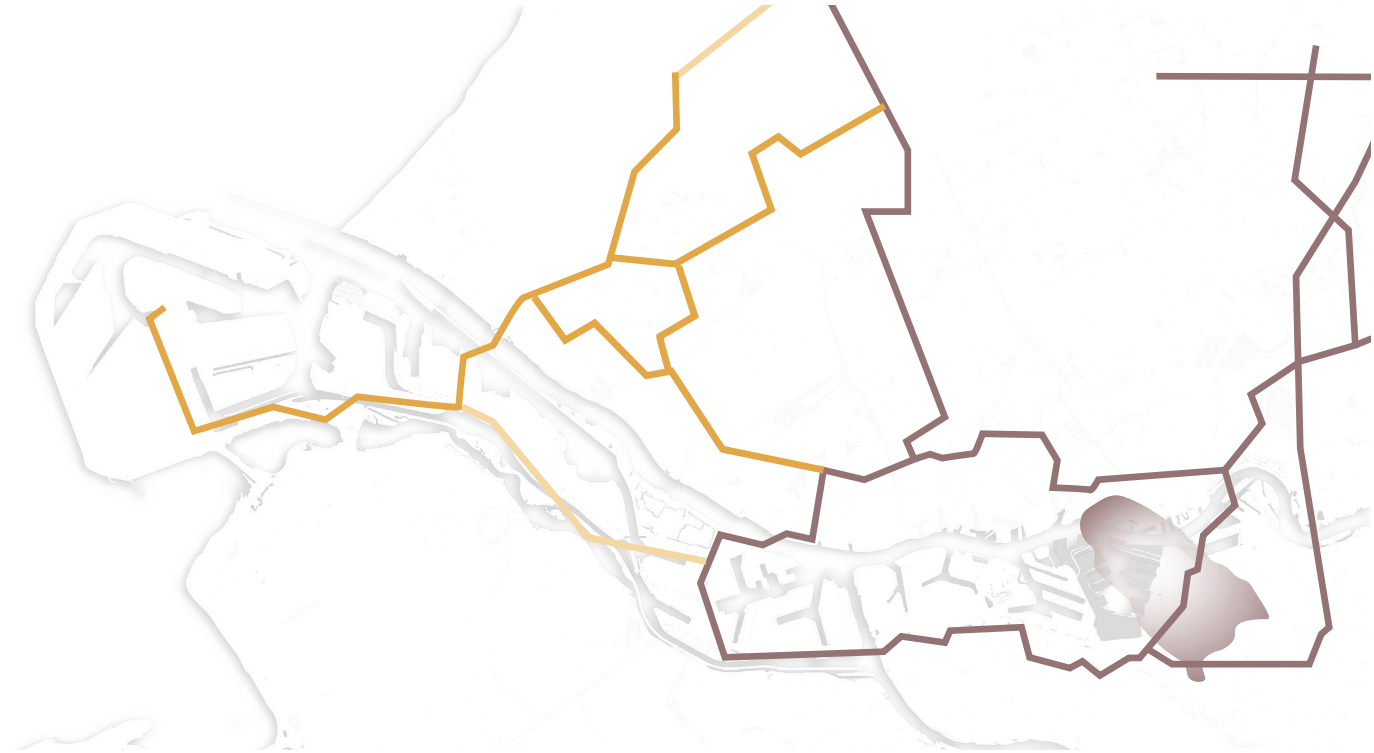


Heat Roundabout

First future extensions
Second future extensions
Current system
Oil

N

0 2.5 km





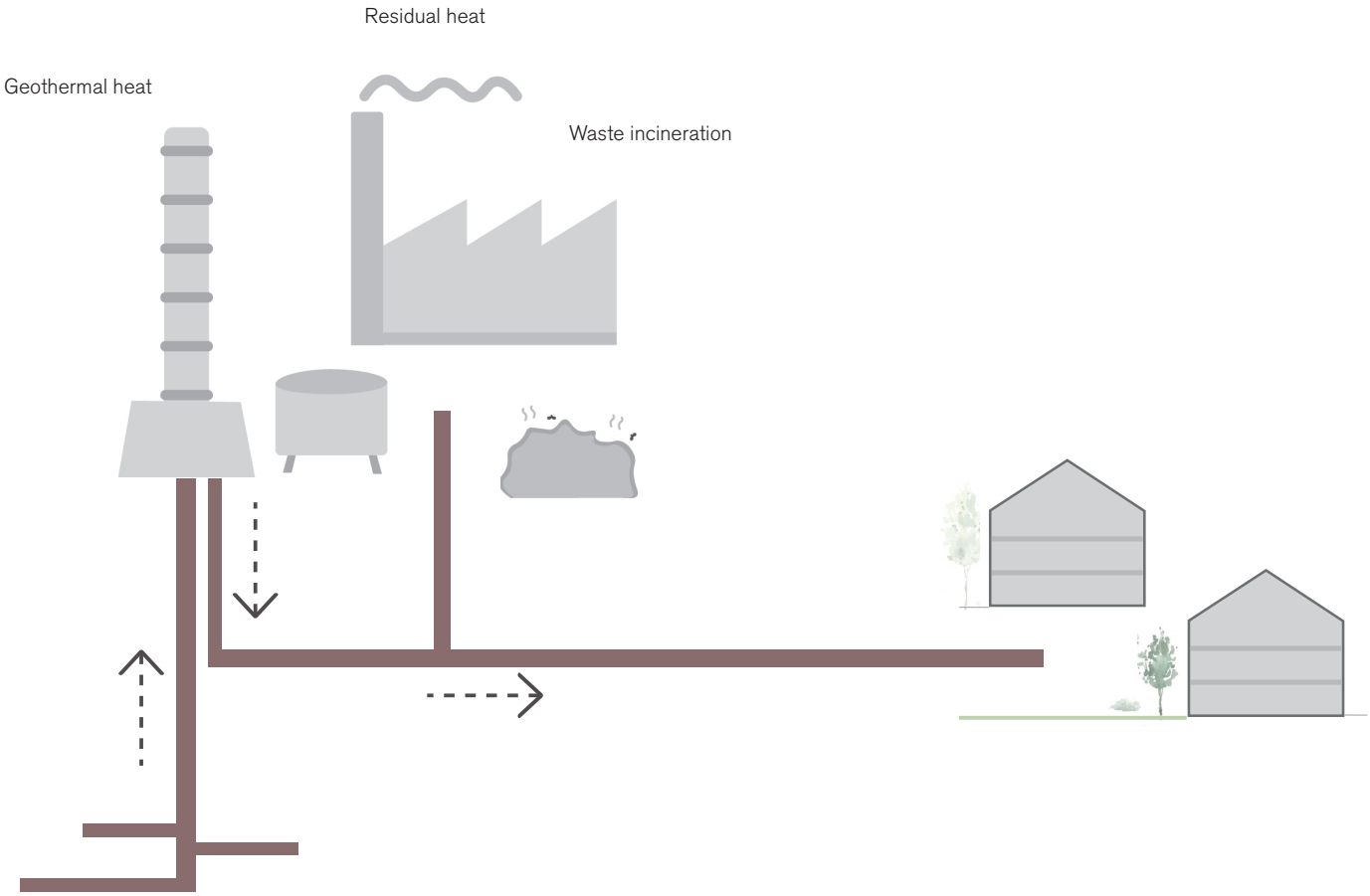
Geothermal Options

There is a possibility to exchange the current use of the oil pumps to the extraction of hot water. There are multiple options on how to deal with the heat that has been extracted:

- Create a new neighborhood with a heat system underneath the new roads. In order to be profitable this new neighborhood needs to have at least 3000 houses.

- Add a Geothermal heating system to the current infrastructure in nearby neighborhoods. This is not always possible if the infrastructure is too narrow and is expansive.

- Connecting the new system with the heat roundabout and providing the roundabout with more heat.



Connectivity

Harborconnectivity
The yellow line on the right page illustrates the transfer from Water to land. Because of the location of the Waalhaven right next to the A15 and the multiple train tracks the containers can be transferred very easily.

Public transport
The Waalhaven is accessible by bus. Different bus lines make various stops within the area. The nearest metro station, Slinge, is still quite far away to be considered at walking distance but still makes the area very accessible trough out the public transportation system. Furthermore, the Waalhaven is accessible by water taxi.

Public transport (Left)

- Stop watertaxi
- Busline
- Tramline
- Metro line

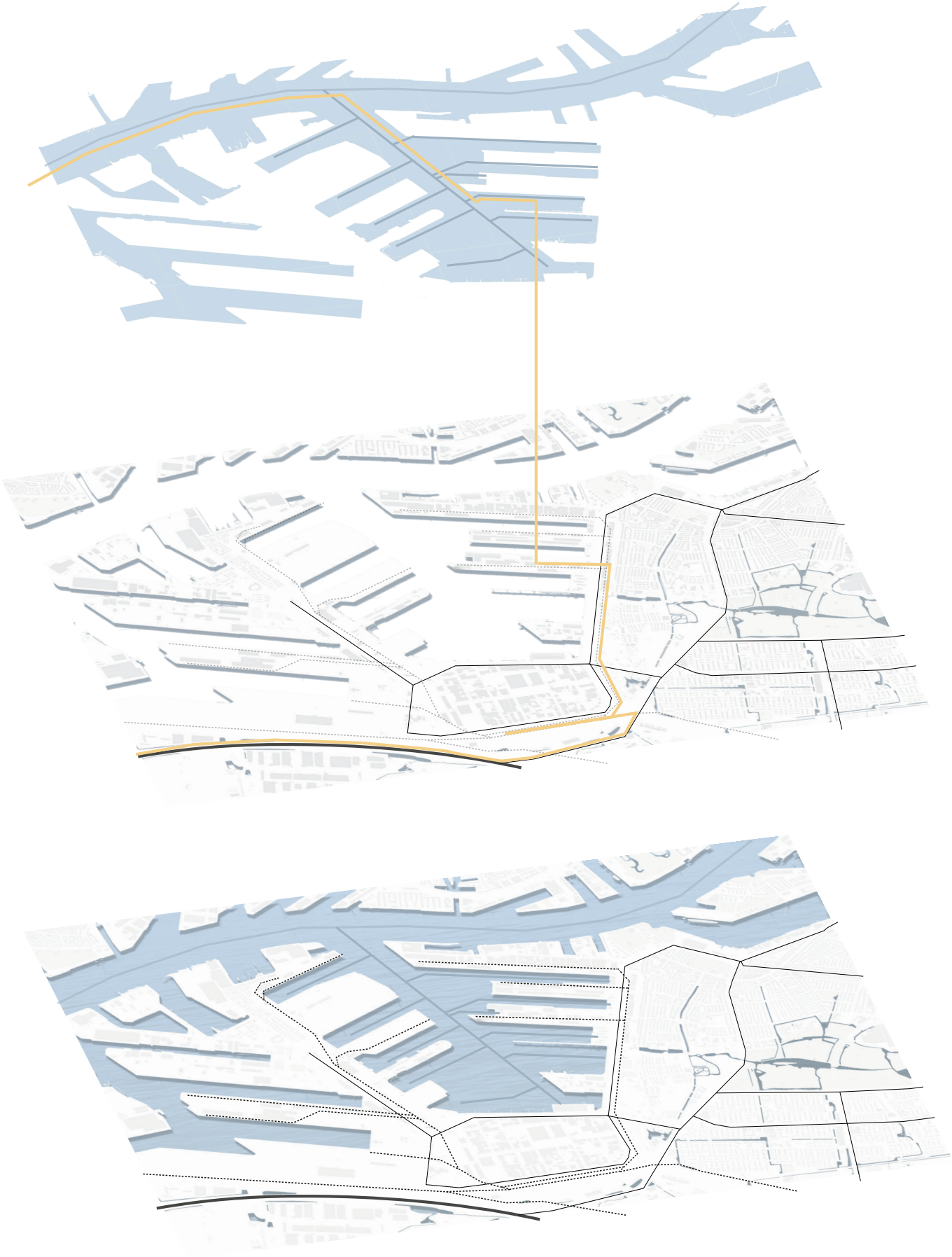
0 1 km

N

Main transport (Right)

- Traintrack
- Main road
- Sea routes



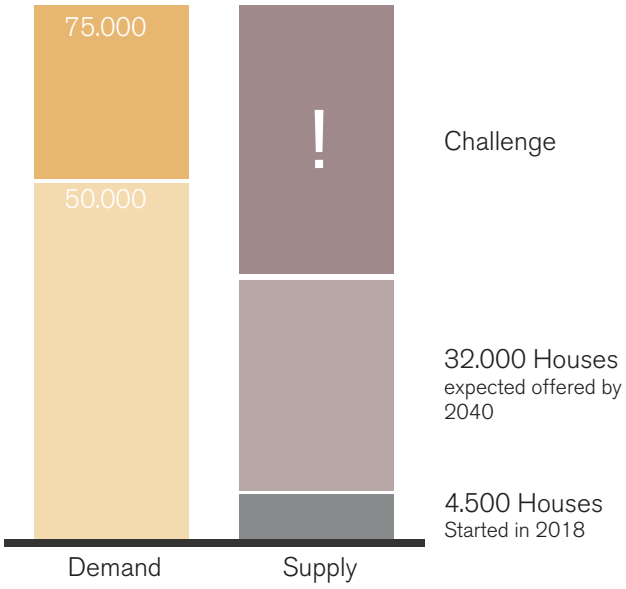


Vision of Rotterdam

This page shortly introduces the vision of Rotterdam. The Strategic exploration for urbanization (Strategische verkenning verstedelijking) of June 2019 is mainly used.

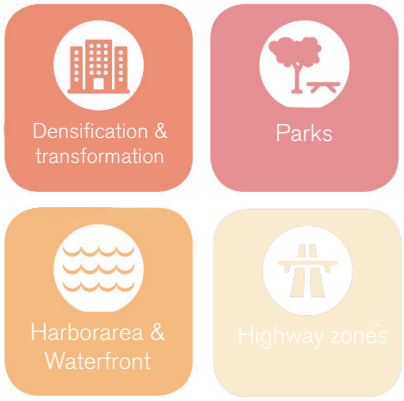
Housing demand and supply

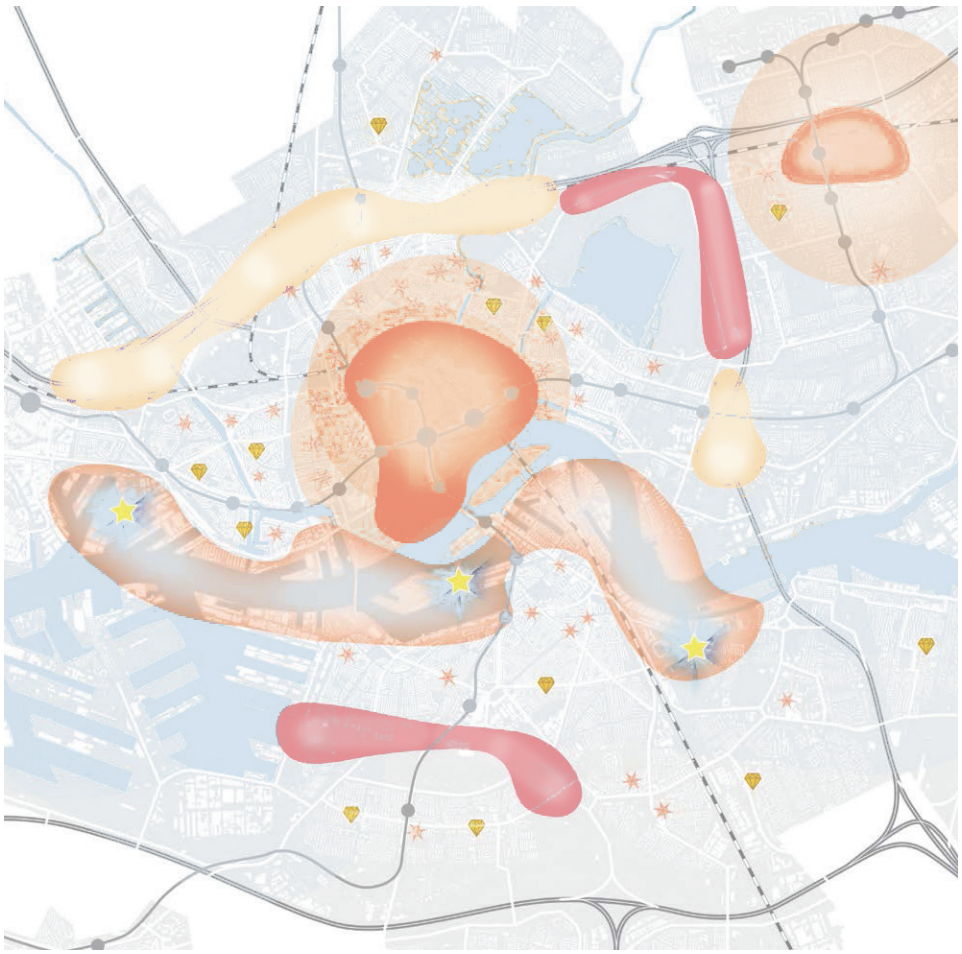
The Netherlands currently deals with a housing shortage. Most cities therefore need to increase its amount of housing. The demand and supply is shown in the image on the right. Due to the current high construction output of 18,000 homes, the expectation is that the build of 50,000 homes in 2040 will be reached. But, due to a possible higher demand the municipality aims to increase the construction output till its reaches a demand of 75.000 houses ((Strategische verkenning verstelijking).



Possible densification zones

In a first exploration from 2017, some large plots for possible densification are looked at. These plots have opportunities for densification because of public transport lines and nodes, possible transformation of old harbor areas and riverbanks, or have under used locations along highways and park edges. Parts of the Waalhaven, the Sluisjesdijk for example, forms a part of such a plot (Strategische verkenning verstelijking).



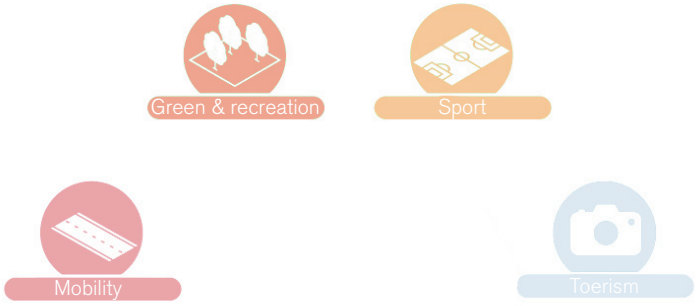


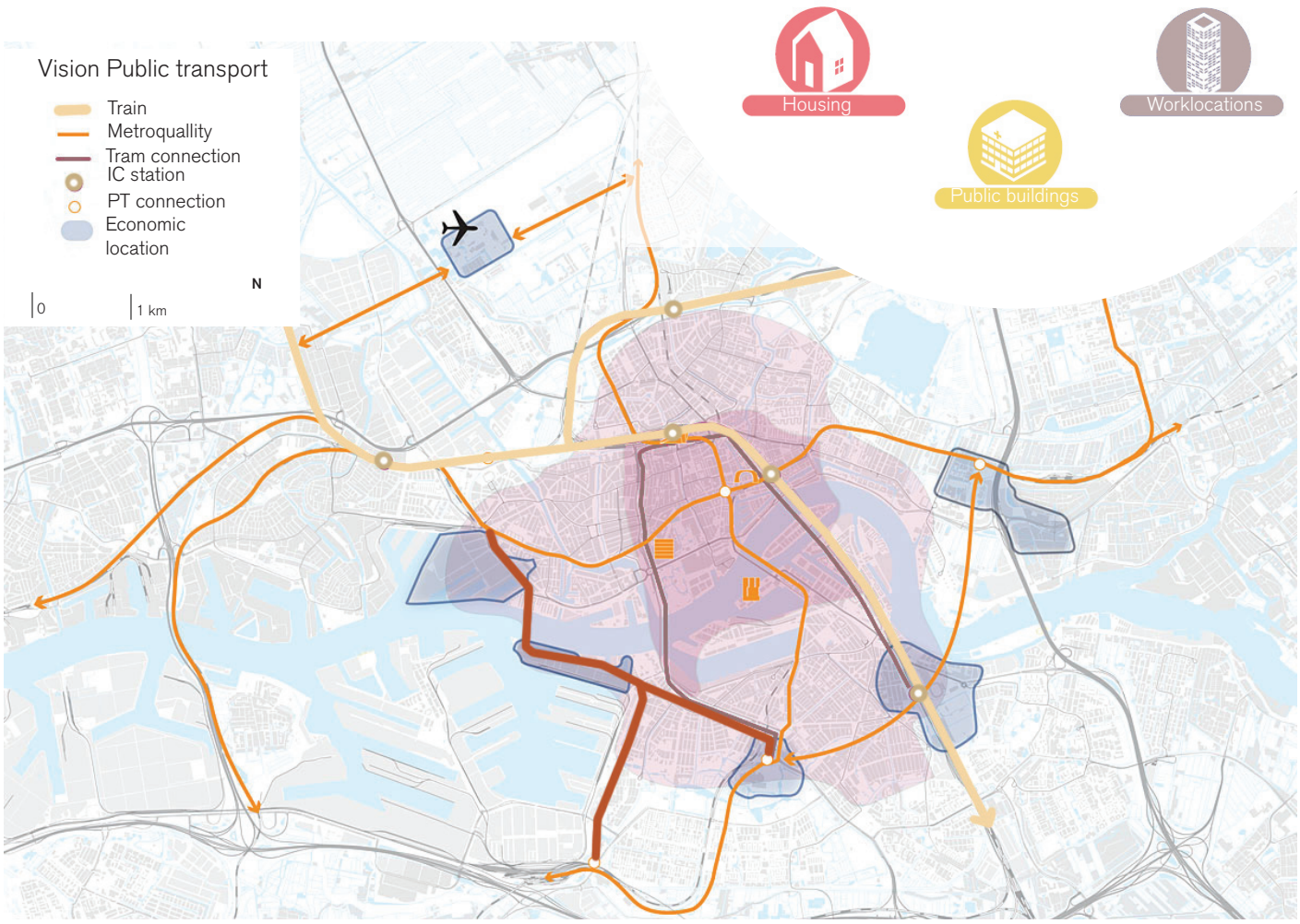
A complete city

The growth of the city is about more than just housing. A complete and attractive city also requires sufficient and good quality schools, sports fields, greenery, work locations, cultural facilities, primary care, public transport, etc. These main interventions that are stated to be important to the city of Rotteram are illustrated in the image on the right. (Strategische verkenning verstedelijking)

Vision Public transport

The municipality stated to want a new bridge connecting The Waalhaven and Merwe Vierhaven. This bridge will connect both sides for cars, pedestrians, cyclists and a new metro line. The city plans to build a new metro line connecting Rotterdam south with Schiedam centrum. This new metro line (shown in red) will decrease the pressure on the now only transfer station Beurs. (RotterdamOV)





2.3

TIL Framework

Joost Smeets

A framework on ecosystem participation and mobility systems			Geothermal and public transport (Hot, Netherlands)
Effects on ecosystem (ecosystem services)	Mobility characteristics	Mobility flows (Human transport):	Existing metro lines: 1. Centraal – Blaak – Rotterdam Zuid - Feijenoord – Lomba 2. Centraal – Beurs – Maashaven - Slinge no effects on ecosystem. Metro uses electric energy with few e Highways: A20 (north), A15 (south), A16 (east), A4 (west) forms a barrier to ecosystems outside the Rotterdam south area New metro line: Schiedam – Waalhaven – Hart van Zuid – Stadio no effects on ecosystem. Metro uses electric energy with no em Watertaxi/ ferry's: connection of north and south by crossing the could potentially have an effect on the ecosystem by pollution o C
		Logistics flows (Goods transport):	Waterway (Maas river) towards Waalhaven from the North sea, po water pollution, noise pollution. Degrading water quality of the W Railway lines in Waalhaven for container distribution, transshipme no ecosystem effects Railway line Waalhaven south connecting area to the inland wher railway alongside southern highway A15. Additional barrier to c Geothermal energy potential for house heating. Heat coming from existing oil drilling facilities can be used for geothermal extracti

ardijen missions and operates below ground. a. So could be problem in connecting ecosystems npark – Kralingen issions and operates below ground Maas f water and noise production that scare off animals/ fish
ssibility for cargo transshipment Waalhaven, could potentially conflict with making the Waalhaven more green. nt from the Maas e goods are transported to northern & southern parts of the Netherlands and Europe onnecting ecosystems in and outside Rotterdam south m hot water source on the sides of oil bedding underneath Waalhven & Charlois area. No potential conflicts with other networks on. This substitution provides less emissions and has little effect on ecosystems since it is below surface.

	Infrastructure characteristics	Activity nodes:	Green infrastructure: Grey infrastructure: Existing metro line stations, access & egress points where people little effect on ecosystems because stations are located in the i Port Waalhaven, distribution area where transshipments of cargo noise pollution, might conflict with Maas' ecosystems present in Watertaxi/ferry stations, access and egress points for people to g little effect on ecosystems since activity is centralized in a single Oil drilling facilities in the Waalhaven area. NAM extracts oil here noise pollution, light pollution
		Transport links:	Green infrastructure: Grey infrastructure: Metro lines, partially located subsurface and connect different act above ground could potentially affect city ecosystems since the Highways surrounding the area potential barrier between inner and outer city ecosystems, especially for crossing animals. Waterways connecting Rotterdam north and south water pollution, noise pollution could influence birds, fish in the Waterway connection North sea with Waalhaven and connection heavy cargo ships, produce emissions and affect quality of wate
Socio economic effects	Mobility characteristics	Mobility flows (Human transport):	Existing metro line & highways human transport, social benefits due to movability serving transp Watertaxi/ ferry's: human transport, connecting north to south. Provide recreationa
		Logistics flows (Goods transport):	North sea to Waalhaven cargo shipments biggest import area for cargo in the Netherlands. Huge econom Waalhaven, but disbenefits in disrupting livability because of exce Railways from Waalhaven area to inland of the Netherlands and E Economic benefits by distributing and transporting goods which landscape pollution

e get on and off the network.
nner city

onto trains takes place.
that area. Could become a bigger conflict if Waalhaven area would be made more green.

get on and off transportation waterway between north and south
e point surrounded by industrial area

from a subsurface bed. Daily oil production: 2800 barrels

---

tivity nodes.
network crosses the entire city

area and quality of water

to inner land
er. Therefore also ecosystem quality

---

port needs. Economic benefits by generating revenue for the city and connecting economic areas

al pleasure with watertaxi for social benefits. Also create revenue for the city and connecting economic areas

---

nic benefits for the country and pass on distribution area to the rest of Europe. Social benefits in creating jobs in the port and
ssive noise and emissions of industrial plants

Europe
creates revenue and jobs in the Waalhaven area. Social disbenefits by railways disrupting natural areas inland which can lead to

	Infrastructure characteristics	Activity nodes:	Green infrastructure: Grey infrastructure: Existing metro line stations, access & egress points where people economic benefits by offering access to metro network in return around the station, attraction of new stores and other facilities. So Port Waalhaven, distribution area where transshipments of cargo economic benefits by creation of industrial activity alongside job Watertaxi/ferry stations, access and egress points for people to g economic benefits by offering north – south connection for both transport means connecting north to south Oil drilling facilities in the Waalhaven area. NAM extracts oil here economic benefits of winning oil that can be used in the industr
		Transport links:	Green infrastructure: Grey infrastructure: Metro lines, partially located subsurface and connect different activity nodes connecting metro stations, necessary to provide economic bene Highways surrounding the area connection of Rotterdam to highway network and surrounding c inner neighborhoods to the outer neighborhoods of the city. This increasing mobility on city level. Waterways connecting Rotterdam north and south link itself facilitates the connection between watertaxi/ferry sta tourists Waterway connection North Sea with Waalhaven and connection connection of North Sea and Waalhaven. Facilitates transport o

e get on and off the network.
n for financial transactions which is an incoming revenue for the city. Also creates economic benefits by improving the public area
ocial benefits in increasing mobility of residents and tourists.

onto trains takes place.
os. Social benefits of jobs created and disbenefit of noise and air pollution.

get on and off transportation waterway between north and south
n inhabitants and tourists in return for transactions. Social benefits by offering recreational trips over the Maas and offering a

from a subsurface bed. Daily oil production: 2800 barrels
ial plants of Waalhaven, or exported to other areas inland. Social disbenefit of noise, light pollution and usage of fossil fuels (oil)

efits. Provide social benefit by increasing mobility throughout the city

cities. Benefit of linking economic areas and thus increasing activity. Economic disbenefit in being an obstacle for linking the
could also be a social disbenefit, outer neighborhoods might lose their connection to the city. However, there is a social benefit of

tions, and in bigger sense two economic areas. Social benefit by providing a recreational mode of transport for inhabitants and

to inner land
f tons of cargo that generate revenue. Social disbenefit of overcrowding the Maas river and hold back sustainable deveopment

Critical transport evaluation	Mobility characteristics	Mobility flows (Human transport):	Existing metro lines Quickest connection between the northern and southern part o Highways Connections out of the city to surrounding areas and cities. Reg Watertaxi/ ferry's Connection north – south, however, due to Erasmusbrug, Maast
		Logistics flows (Goods transport):	North Sea to Waalhaven cargo shipments Flow of cargo towards the Waalhaven for further distribution inl Railways from Waalhaven area to inland of the Netherlands and E Flow of cargo the inlands of the Netherlands and Europe from t
		Activity nodes:	Green infrastructure: Grey infrastructure: Port area Waalhaven critical due to throughput from the Rotterdam port area Metro stations critical due to accessibility to subway system
		Transport links:	Green infrastructure: Grey infrastructure: North sea – Waalhaven link – inner land: critical due to throughput from the North Sea towards the Neth Highways: critical for facilitating passenger streams and increasing mobilit Metro lines: critical for facilitating passenger streams and increasing mobilit
Guidelines			

f Rotterdam with access into the heart of the city. Regarded as critical transport line garded as critical transport tunnel, Willemsbrug & Koninginnebrug connections not regarded as critical
ands. Regarded as critical transport Europe the Waalhaven. Regarded as critical transport
erlands and the rest of Europe y y

Guideliness Till

Ecosystem participation	Natural Structures	Characteristics	The Maas river is a natural structure that facilitates a transport co Metro lines operate mostly above ground in the inner parts of the Railways operate mostly alongside the industrial area in the Waal structures. Besides that, the railways form a barrier for the conne Geothermal energy has the potential to become a natural heating substituting what is now an oil pumping station for geothermal he
		Benefits and Drawbacks	
	Guidelines	Mobility characteristics	Maintain the capacity of current mobility patterns for economic Facilitate and promote transport by metro as much as possible that as much as possible green energy is provided for Metro lines Watertaxi and ferries are an important transport means to move degrade. Pollution and noise levels from transportation equipmen (and thus affect ecosystems negatively); alternative fuels like biof If this is not possible, these transport lines should be replaced by Rail- and highways are very important not only for passenger st port of Rotterdam can act as a hatch for the rest of the Netherlan be assured that important ecosystems in the inner and outer parts outer city neighborhoods Promote Geothermal project to ultimately banish the use of nat natural resource
		Infrastructure characteristics	Assess the stationary facilities of the metro and watertaxi & fer Make use of natural lighting and ad surface vegetation. For transp Boats (watertaxis & ferrys) and metrolines that transport people green energy in the longer term. Metrolines should make use of g As little maintenance as possible on newly constructed transpo

nnection between north and south Rotterdam by watertaxi's and ferries.

city and do not consist of any natural structures.

haven, where ecosystem presence is very low, and alongside the highways A15 & A16. They do not consist out of any natural ction of ecosystems in the inner and outer part of the city of Rotterdam.

source that would replace natural gas supply to the city in the near future. Hot water sources will be pumped to the surface by eat.

and social benefits, without degrading ecosystems in the area

since it consumes low energy and affects natural ecosystems in the inner city to a very low extent. Besides that, it must be assured

people between north and south. However it shouldn't be the case that the river gets neglected and because of that its ecosystems t (e.g. boats) should be measured and reflected onto the living ecosystems in terms of harmfulness. If values are above acceptance fuel of green electricity should be considered and implemented.
metro lines underneath the Maas or additional bridges to sustain the North – South connection of the city

reams but also for logistical movements. They provide huge economic benefits for the city and its inhabitants and make sure that the nds and Europe. However, in terms of ecosystem connectivity, barriers are formed by these transport lines. Because of that, it must s of the city stay or get connected. Besides that, social connectivity must also be sustained in connecting inner city neighborhoods to

ural gas in the city. Current subsurface pipelines and the NAM oil drilling facility can serve as a mean to achieve this by using a

ries in terms of their influence on ecosystems in adjacent space. Try to transform stations into natural structures as much as possible. port metro lines, make sure that no ecosystems are harmed and no barriers are formed between ecosystems.

e over links between the stationary facilities should make use of sustainable sources of energy. For boats these could be biofuel or green energy as much as possible.

rt facilities (links and nodes) while making use of circular materials in construction.

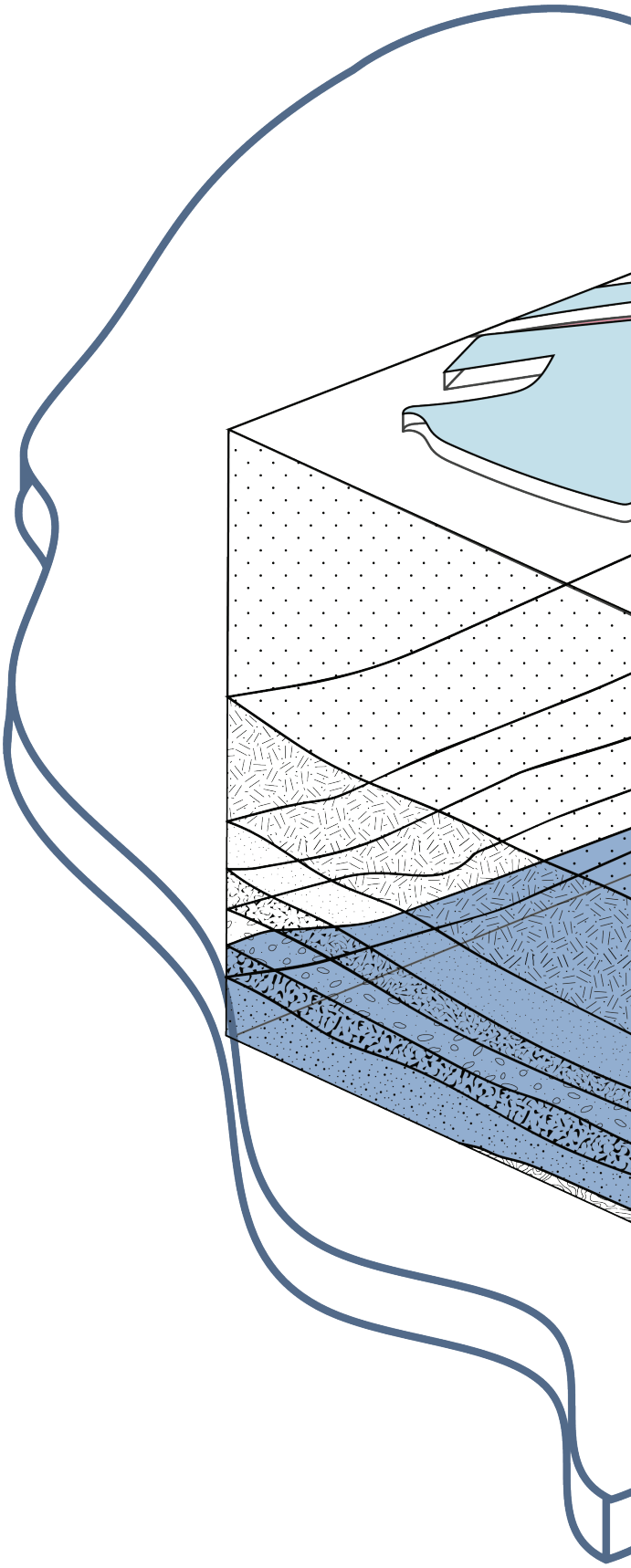
3.

Systems description and synthesis

3.1

Landscape

Froukje Ottema

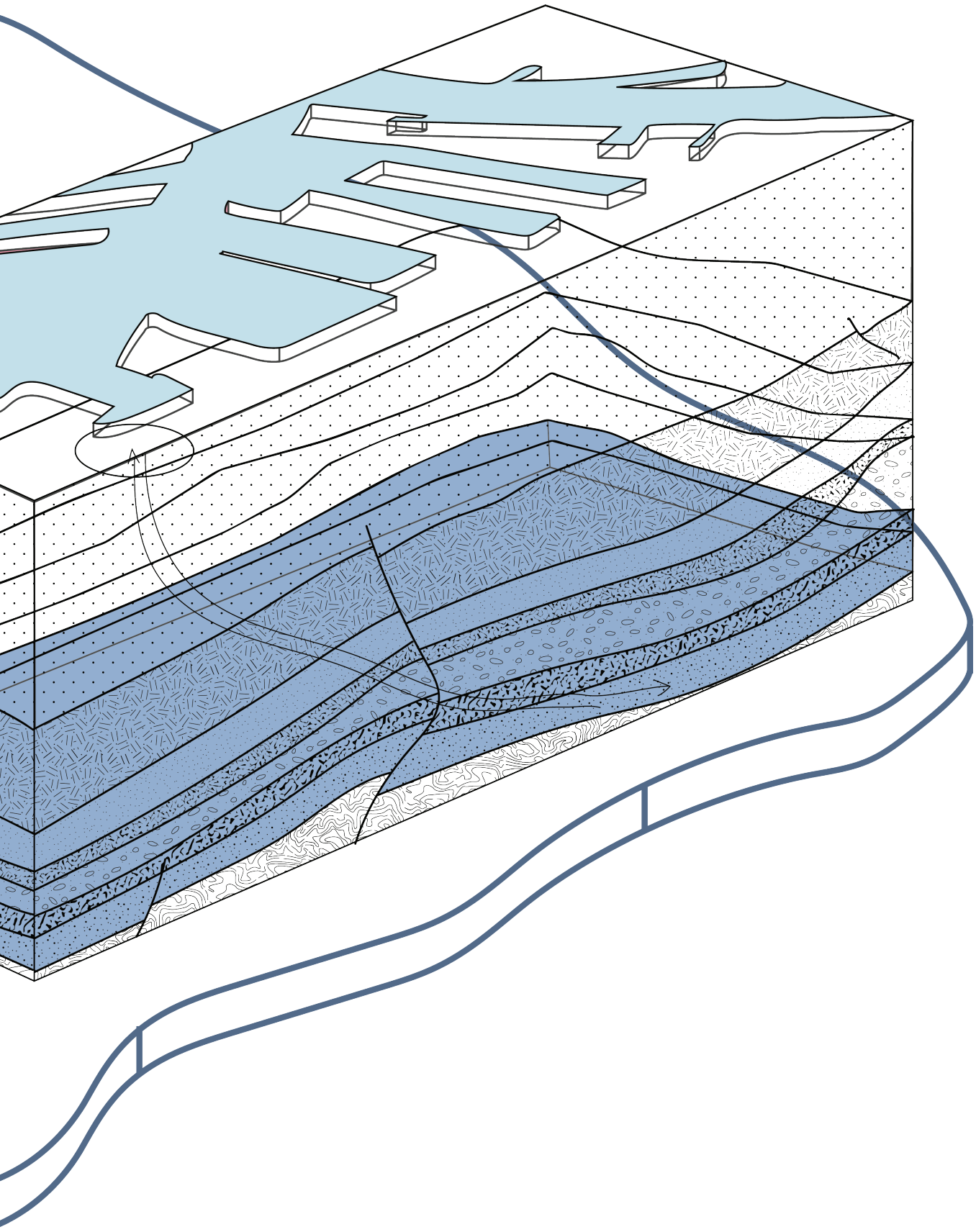


Synthesis morphology and Soil

This image shows the synthesis map of the soil composition in the Waalhaven. The dark blue layer is the layer where the hot water is situated. On the higher point of this layer are the gas and oilfields and at the lower point is the water located. This because water is heavier then gas and oil and will therefore be on the bottom.
The dark blue outline illustrates the form of the geothermal field in the substratum.

On top the exavated Waalhaven is drawn.

- North Sea group
- Chalk group
- Upper Holland formation
- Holland Greensand
- Lower Holland Mari
- De Lier Sand-shale
- IJselmonde Sandstone

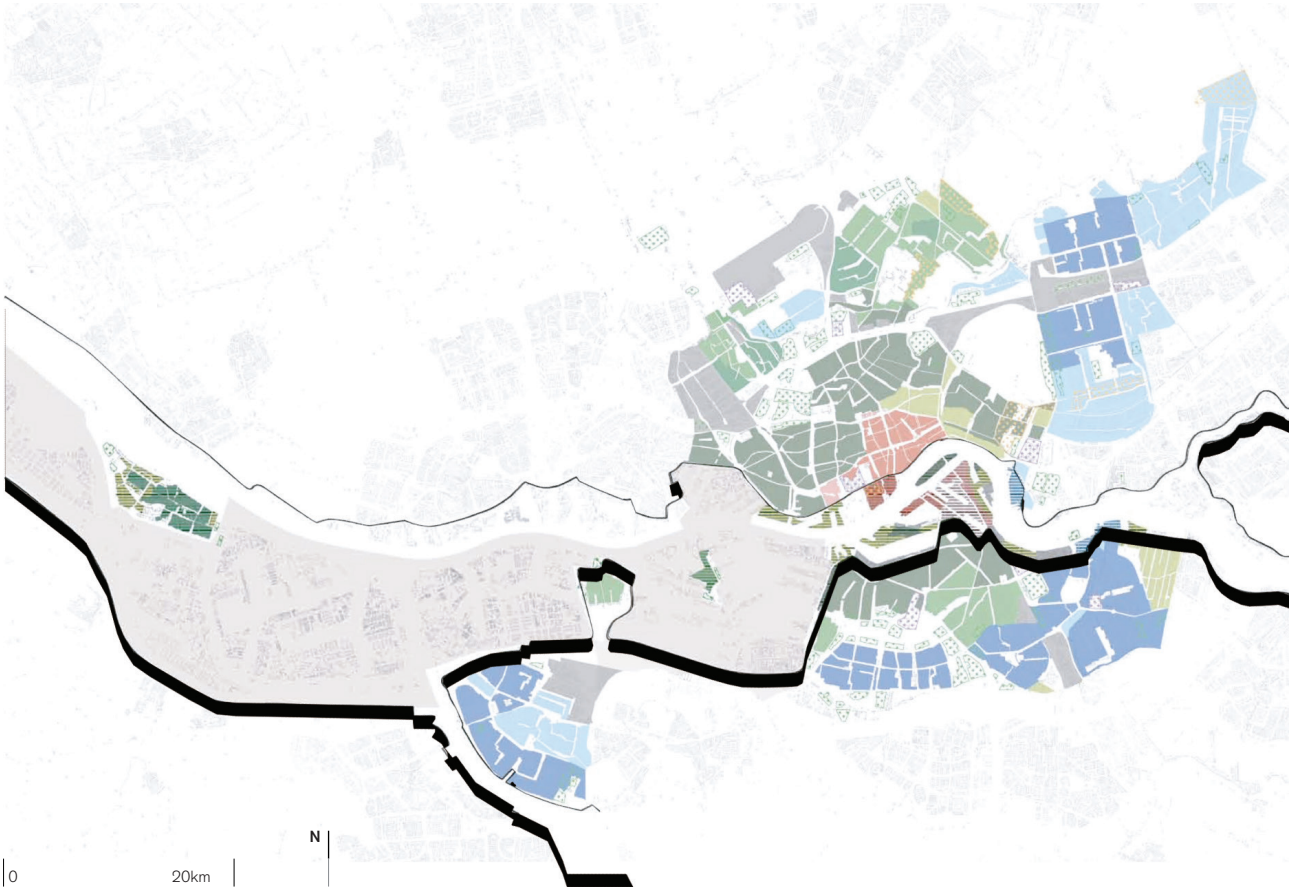


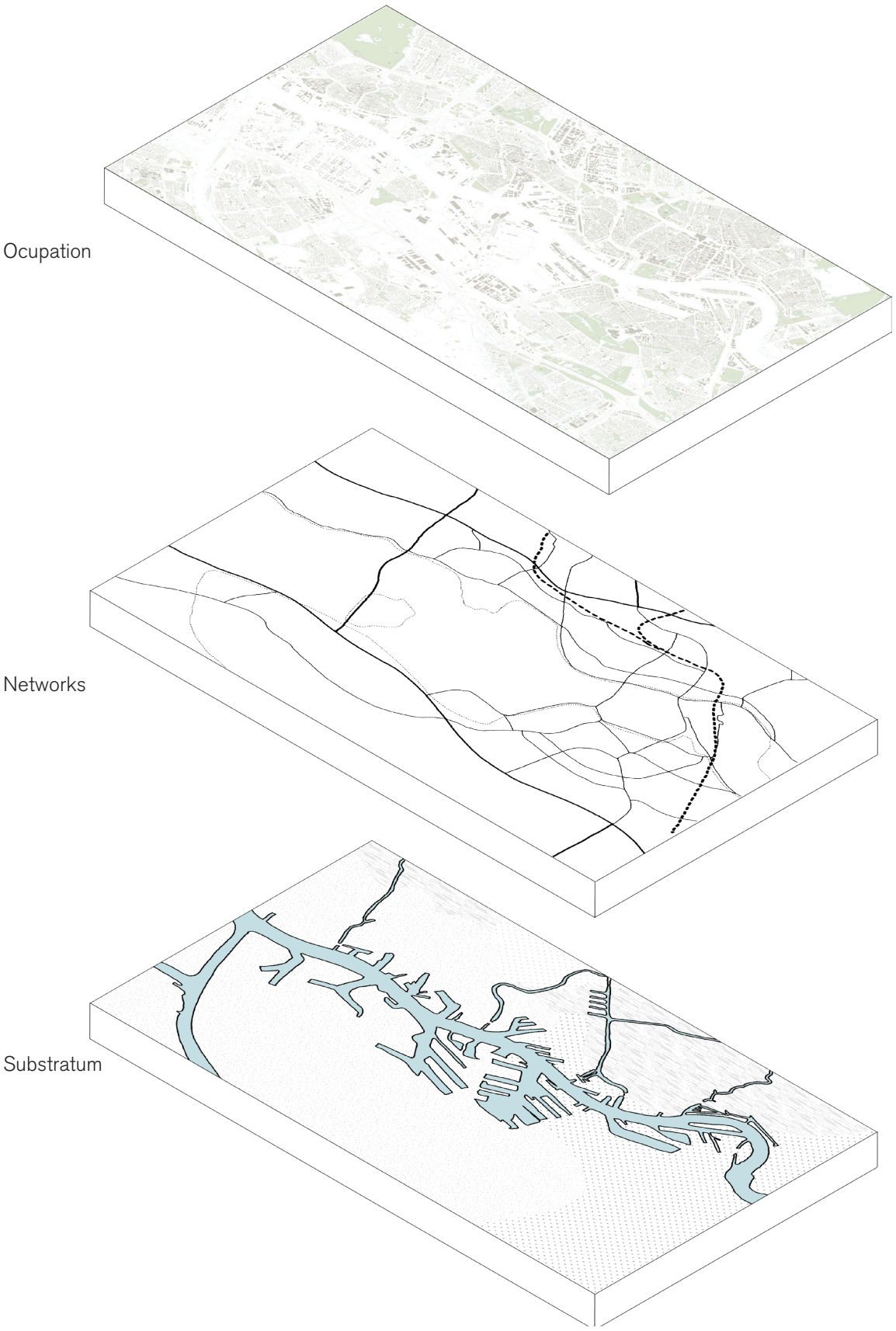
Synthesis city structure and altitude

This synthesis map shows the relation between the altitude and the city structure. The area around the Maas river is situated higher. Former harbors in the center of the city are already part of the city. What is also clearly visible in this map is that the Waalhaven is embedded in the city structure but is not yet part of the city. On the north and east part of the harbor, the city already grew around and against it.

Synthesis layer aproach

This synthesis maps shows the dutch layer approach of Rotterdam. The subratum layer contains the watersytem en soil, the networks layer shows the manmade infransturcture and the occupation layer shows the traces of habitation.




Ocupation
Networks
Substratum

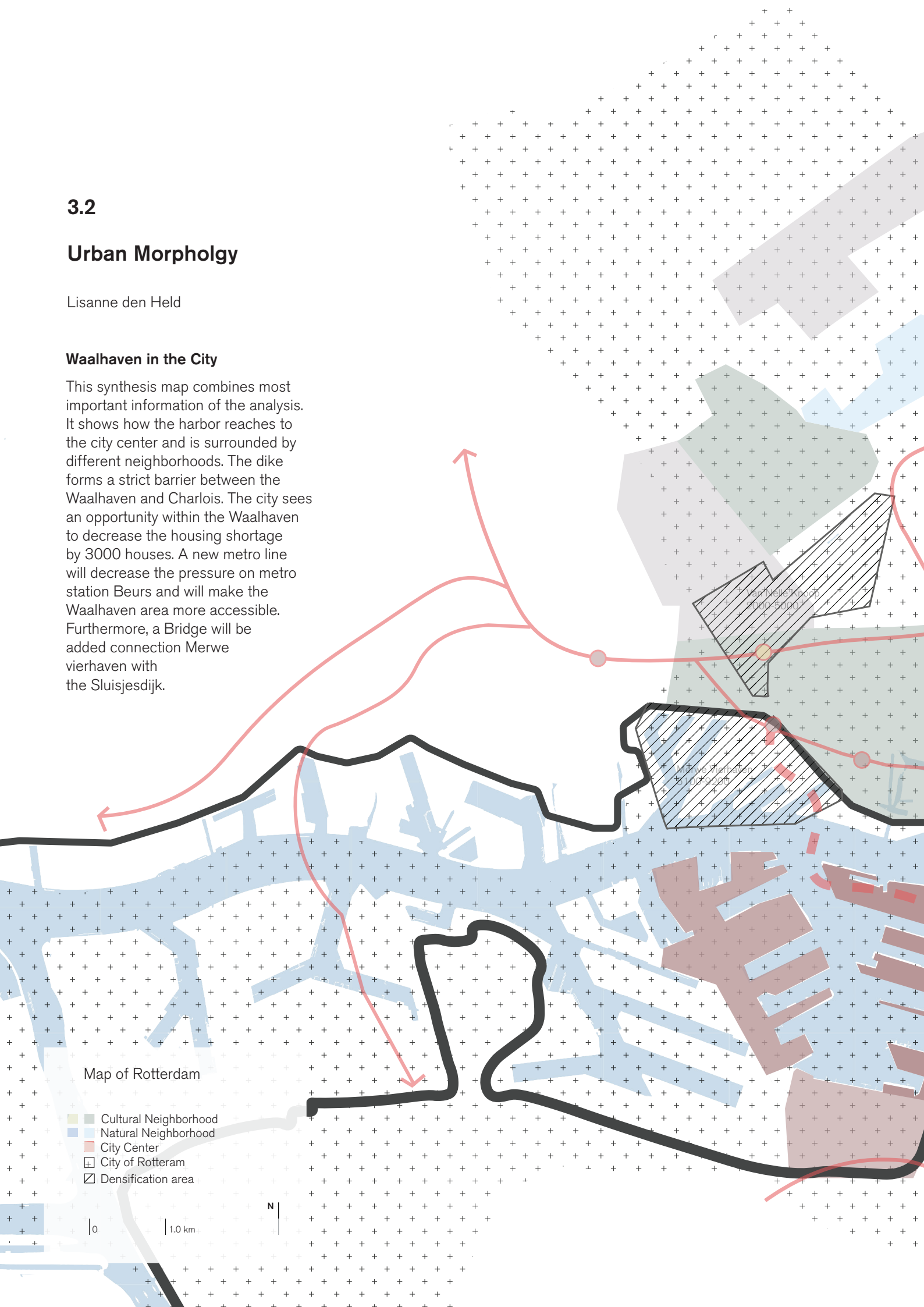
3.2

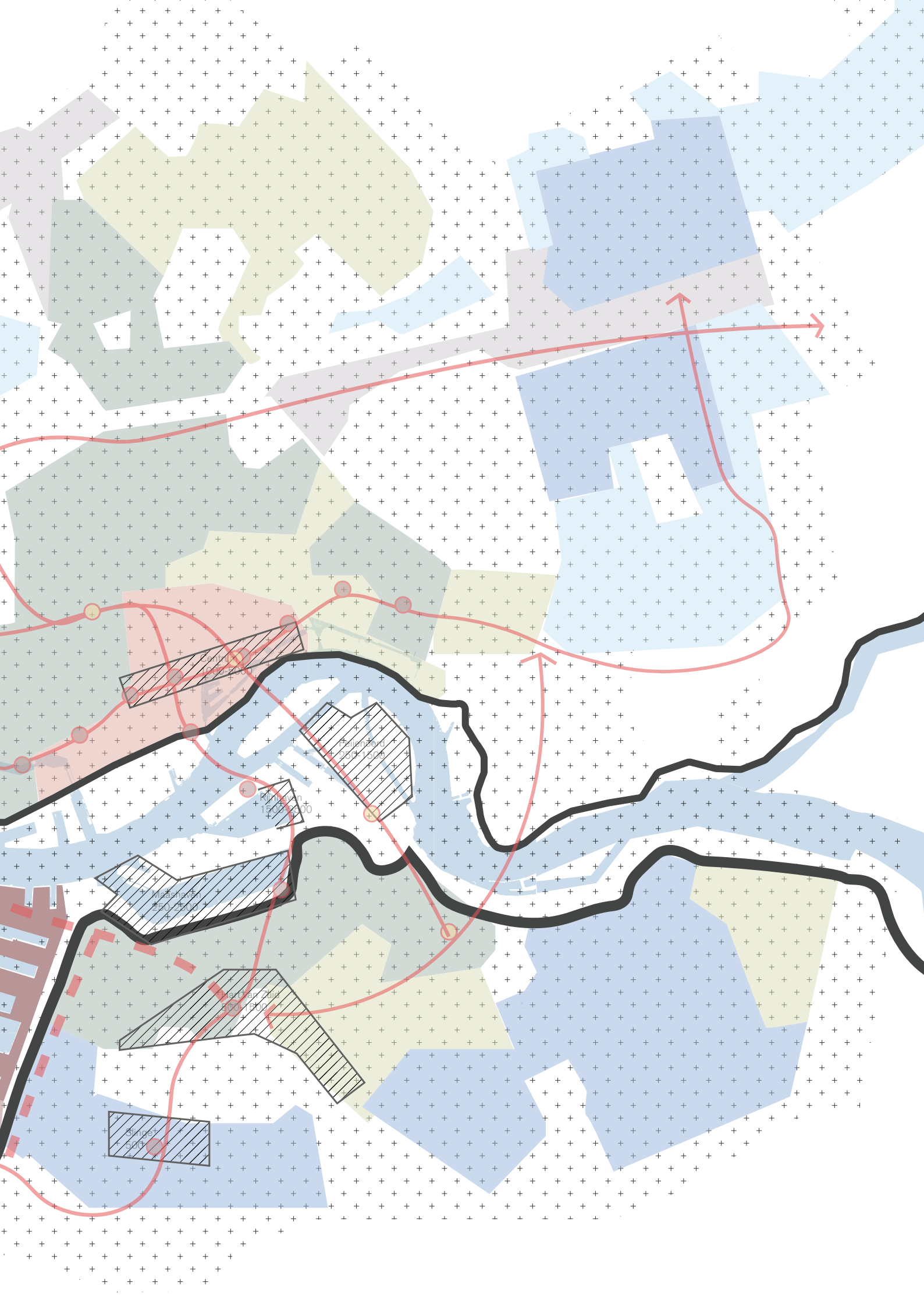
Urban Morpholgy

Lisanne den Held

Waalhaven in the City

This synthesis map combines most important information of the analysis. It shows how the harbor reaches to the city center and is surrounded by different neighborhoods. The dike forms a strict barrier between the Waalhaven and Charlois. The city sees an opportunity within the Waalhaven to decrease the housing shortage by 3000 houses. A new metro line will decrease the pressure on metro station Beurs and will make the Waalhaven area more accessible. Furthermore, a Bridge will be added connection Merwe vierhaven with the Sluisjesdijk.




Centrum
1000-2000
Feijenoord
250-1500
Kop van
1500-3000
Maashaven
250-2000
Katendrecht
500-1000
Stieltjesplein
500

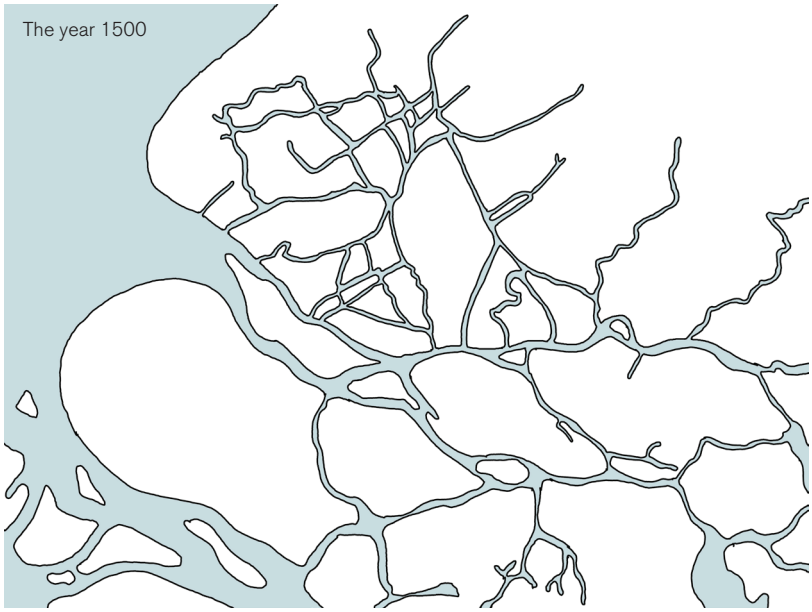
4.

Scenario making

Introduction and conclusion

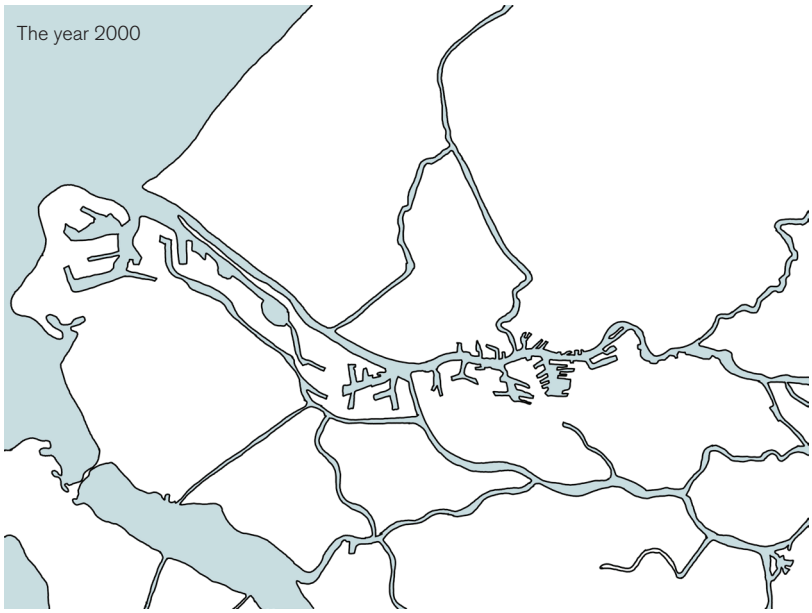
Introduction and conclusion

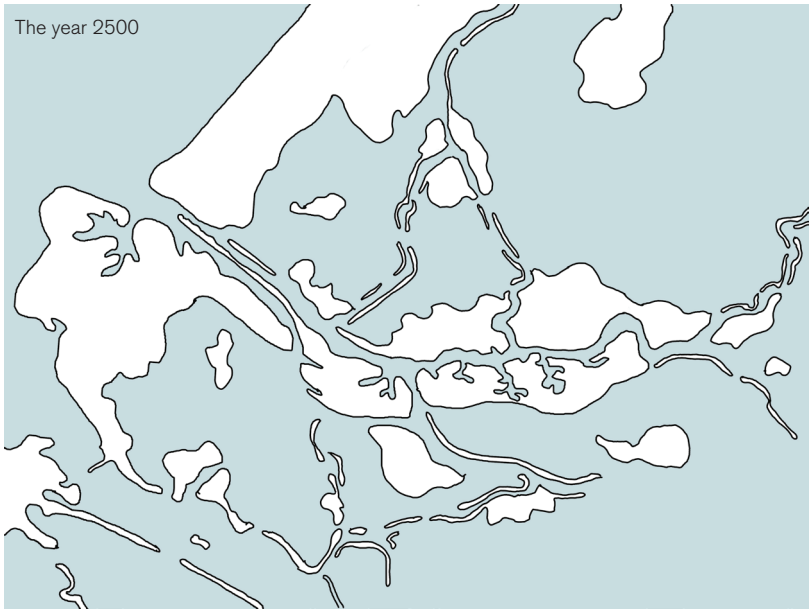
To think more in the extreme, two scenarios are implemented in the location Waalhaven. These scenarios were made to learn from. The good ideas that came out of scenarios can be used in the design experiments. Two scenarios where made no technology and no human. The no technology scenario describes a world where no technology can be used anymore. This means changes in possible ways of transportation and information exchange. The no human scenario describes a future where all humans have left this planet. The depletion of the earth is what finally caused mankind to become extinct. Some of the few elite has survived by leaving the earth. After all humans have left, the earth came back alive. The conclusion that could be drawn from the no technology scenario is that Public buildings and infrastructure become more or less important depending on the amount of technology available. From the no human scenario we realized that the form and function of the river are nowadays totally artificial. The idea arose to make the river more natural. Also in the scenario the water system in the polder would change, this gave the idea to make the water system more comprehensible and connect the polder with the river.



Scenario 2 . No human

If human kind left this earth and left the area where the Waalhaven is situated, a lot will probably change. As you can see in this range of maps from 1500 till 2500, the water will be dominated again in this landscape. Due to the lack of maintainance dikes will break and the low laying parts of the Netherlands will fill with water. The higher parts like the dunes, dikes and the elevated harbor parts will stay dry. Sediment will accumulate around these higher areas and former villages and towns.





Morphology of the Neterhlands

The morphology of the Netherlands from the year 1500 till 2500

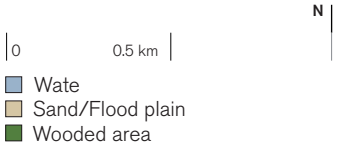
Land
Water

N

0 100 km



The waalhaven in 2500
This map shows the more zoomed-in senario of the Waalhaven. The sedimentation of the river will take over and the hard harboredges will gradualy be softed. The pomps that used to pomp the water out of the polder into the river, will no longer funtion. Eventually the water in this polders will find their own way to the sea.
The remains of civilisation will still be visible but nature has taken over.





Scenario 2 No technology

No technology

The change to no technology brings quite a lot practical changes. For example, getting information can longer be fulfilled by internet this means, that public buildings such as a library become more important. Local Shops will be needed in order to can purchase what is wanted. Other examples of changes by the lack of technology are shown in the table on the right

Change in transportation

Because technology is no longer possible lots of transportation is also not possible anymore. This means that old ways of transportation such as hot air balloons and boats will get popular again. This change is shown in the image underneath



Possible



Impossible

No Technology

Man-made, no fuel/energy needed, facilitated by nature

Change in The way of living	Limited transportation	Climate Adaption
- Anonymity caused by technology is reversed - Public space becomes more important (less technology means more outdoor activity public space) and is needed in order to gain information, for example a library - A densification limitation (no high-rise possible)	- Different types of transportation are no longer possible, such as the train large boats and cars. Those must be replaced by walking, cycling, gliders, hot-air baloons etc) - Focus on local infrastructure, Less regional/international infrastructure - Expected increase in the use of waterway networks due to the possibility to traver far - Less diverse diet, only locally produced products, also more fresh products	- Less emissions due to less polluting technology - More difficulty using passive techniques on extreme situations (adaptiveness is slowed down) - Passive energy production (wind, thermal mass etc) - Re-use of products and buildings becomes more attrative due to the effort needed when building something new

Waalhaven Rotterdam

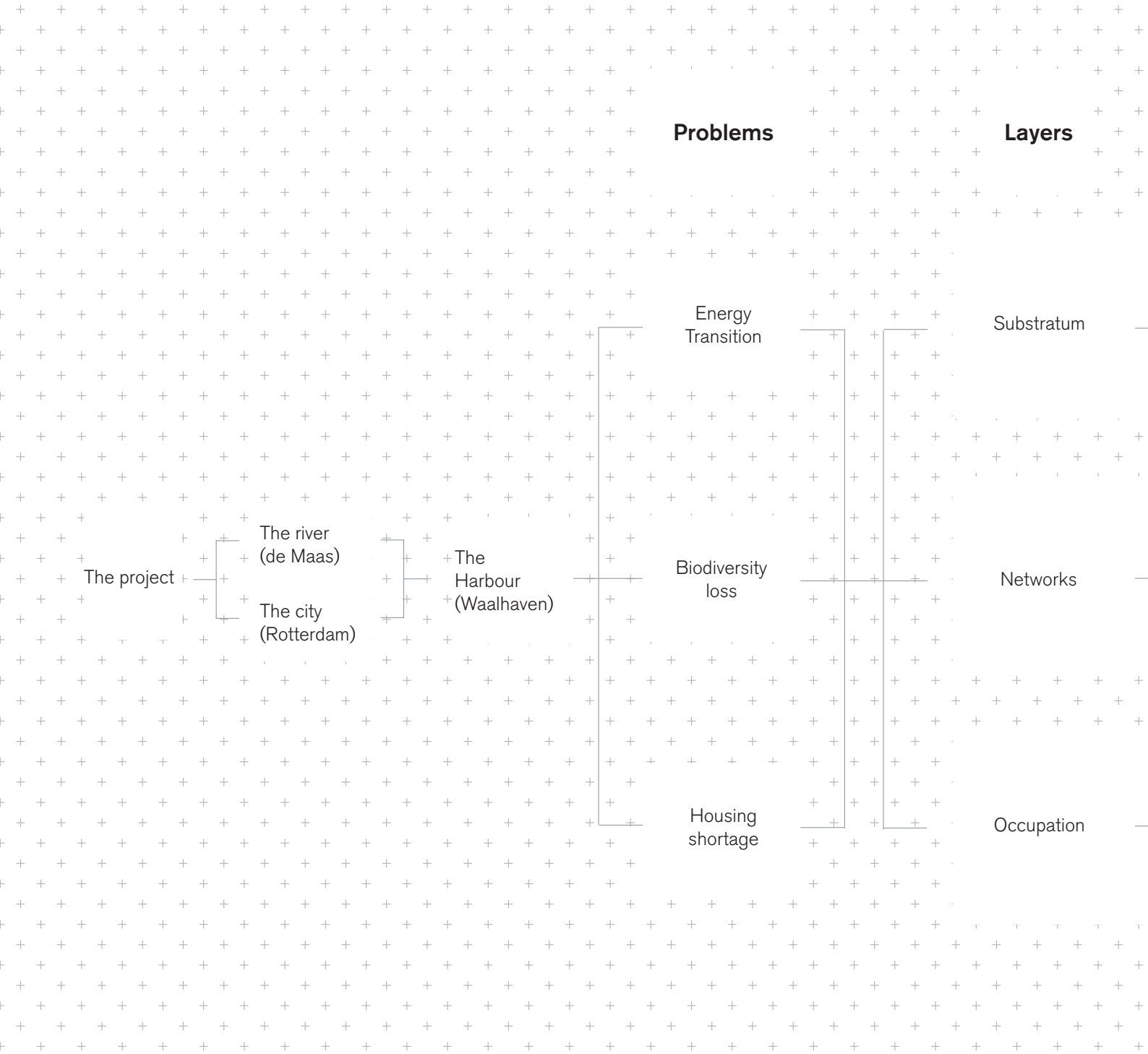
Different functions of the harbor are nog longer possible. This can possibly be exchanged to more public space and other harbor functions, such as a facilitation for small boats and fishing	The different train tracks and the highway close to the area are no longer in use. The harbor can offer transportation trough small boats	Due to less technology emissions will be reduced. Hence, flood risks are still present.

5.

System intervention

Guideliness taxonomy

The flow scheme is structured as follows, first a distinction is made between the territories the Waalhaven lays in. The Waalhaven is situated between the territory of the Maas and the city.Then the scheme implement that there are 3 different problems in the Waalhaven. The energy transition, biodiversity loss and the housing shortage. Each problem can be divided with the Dutch layer approach. The occupation, networks and substratum layer. In each of this layer the domains given that are relevant for that layer and the guidelines we that we have established.



Domains	Guideliness
New mobility Nature based	- From oil production to Geothermal heat - Making the Maas area a nature friendly estuarium - Less dredging in the harbours and sides of the river - Nature is flood resilient - Using the tide for flood protection and nature
New mobility Geothermal heat	- Active transportation such as walking and cycling - Close connection to the city through the new metroline and new bridges - Geothermal heat as the main heating system
Flood management Building Public space	- More infiltration, less closed pavement - Building typologies according to the shortage of nearby neighborhoods - Connecting human and river by contact and views - Housing reacts to tidal changes and flood risks

vision

Mirco - Waalhaven

Actors

Workers of the Waalhaven harbor - New inhabitants - Officeman - shop owners

Substratum

Networks

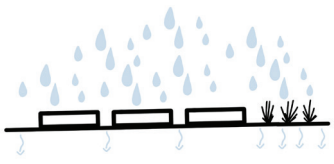


Active transportation such as walking and cycling



Close connection to the city through the new metroline and new bridges

Occupation



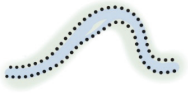
More infiltration, less closed pavement



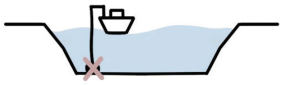
Housing reacts to tidal changes and flood risks

Meso - Rotterdam

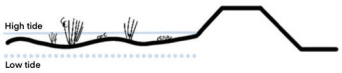
Workers of the port of Rotterdam - Inhabitants of the city of Rotterdam



Making the Maas area a nature friendly estuarium



Less dredging in the harbours and sides of the river



Nature is flood resilient



Using the tide for flood protection and nature



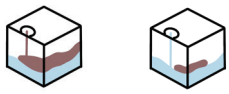
Reduced heat island effect



Building typologies according to the shortage of nearby neighborhoods

Macro - South Holland

Traders - Inhabitants of the province - Heat roundabout - The Maas



From oil production to Geo-thermal heat



Geothermal heat as the main heating system



Connecting human and river by contact and views

Vision Map 1

This vision map shows on the regional scale of Rotterdam what our guidelines will spacial mean.

Along the river, sofbanks will be created to enhance biodiversity, as well as the tidal parks in the former harbor fingers.

Three spots are indificated for densification in the Waalhaven.

The new metroline and the new bridge will connect the new created city with the other side of the river.

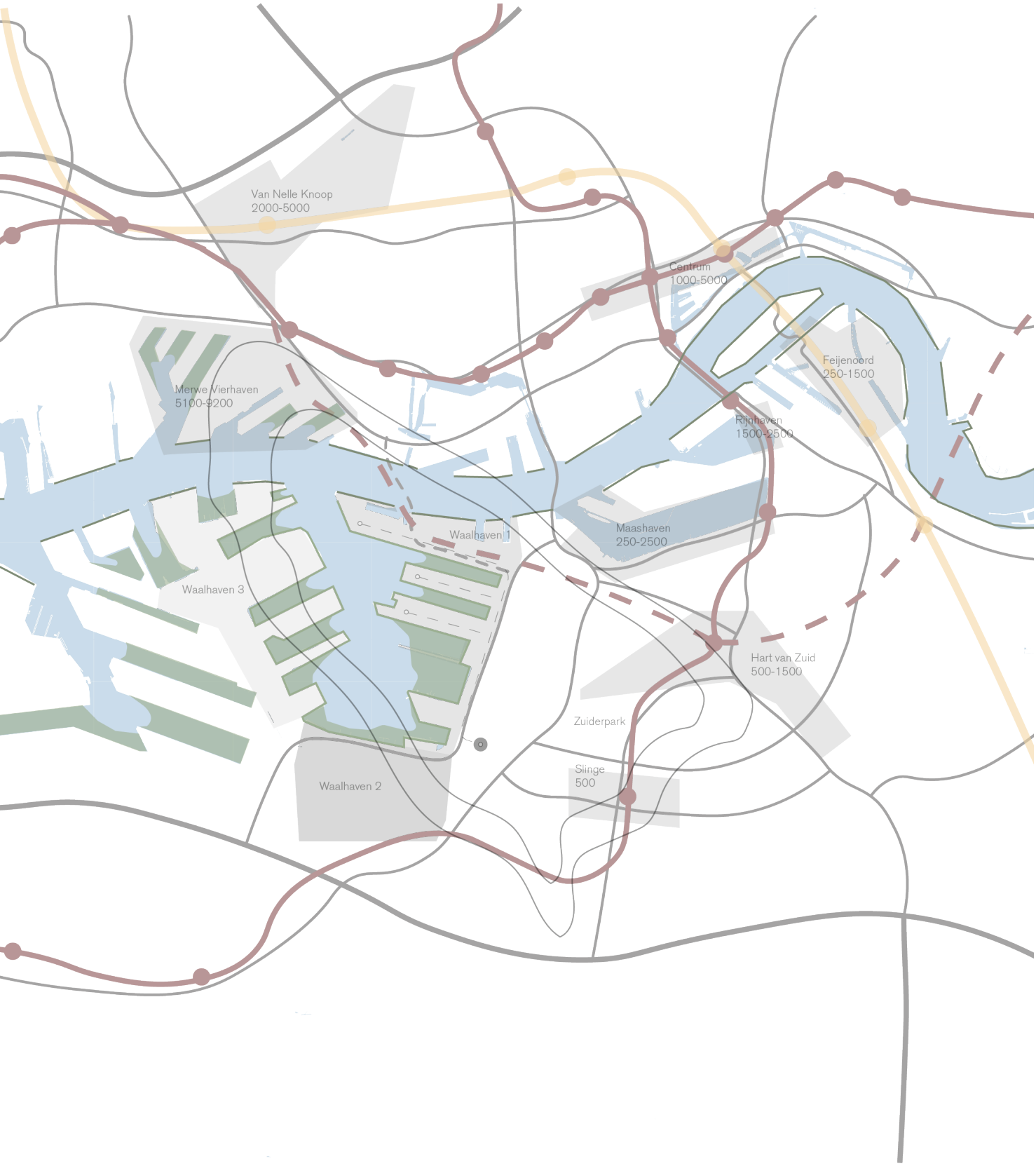


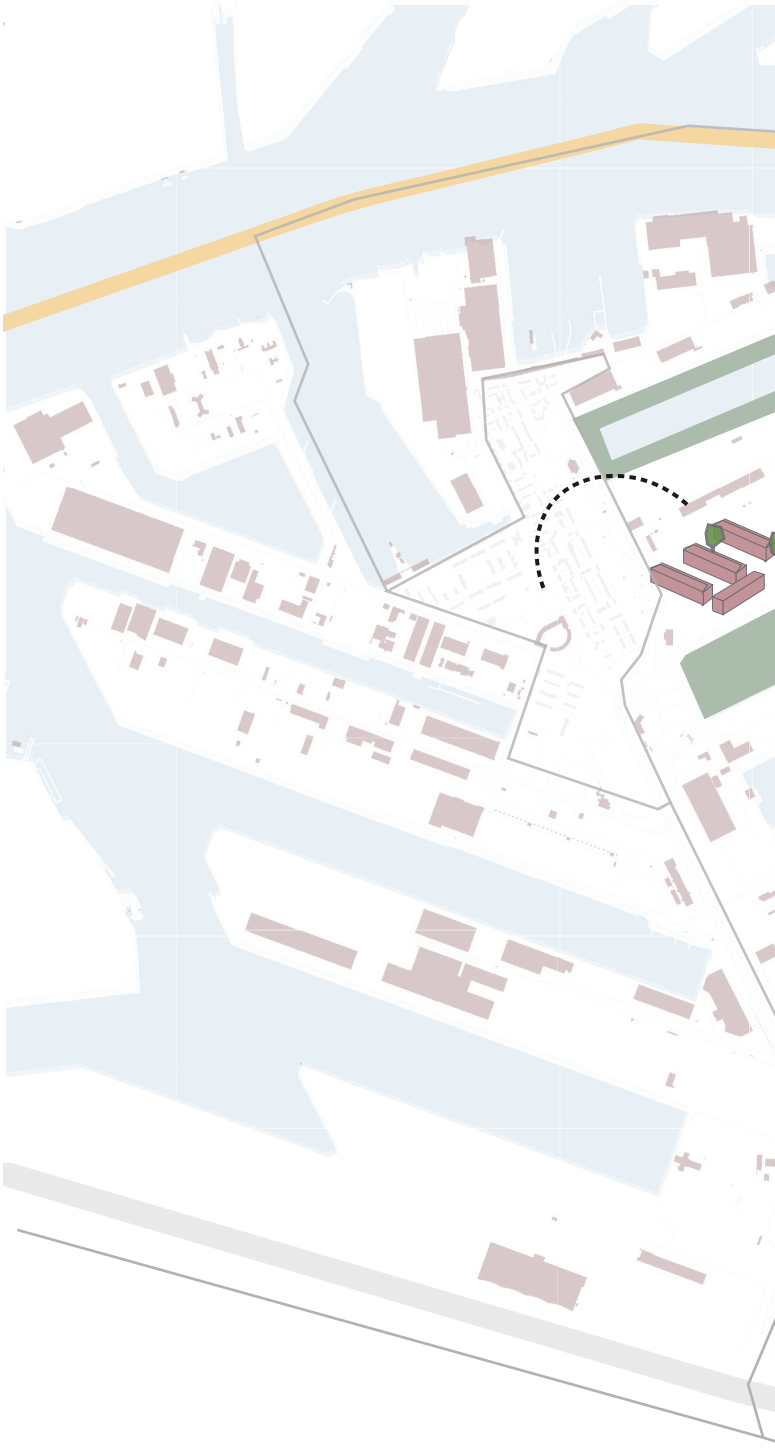
Vision map 1 regional scale

- Water
- Tidal parks
- Sealevel rise
- Metro line
- Soft banks
- Road
- Train

N

0 100 km


Van Nelle Knoop
2000-5000
Centrum
1000-5000
Feijenoord
250-1500
Merwe Vierhaven
5100-9200
Rijnhaven
1500-2500
Waalhaven 1
Maashaven
250-2500
Waalhaven 3
Hart van Zuid
500-1500
Zuiderpark
Slinge
500
Waalhaven 2

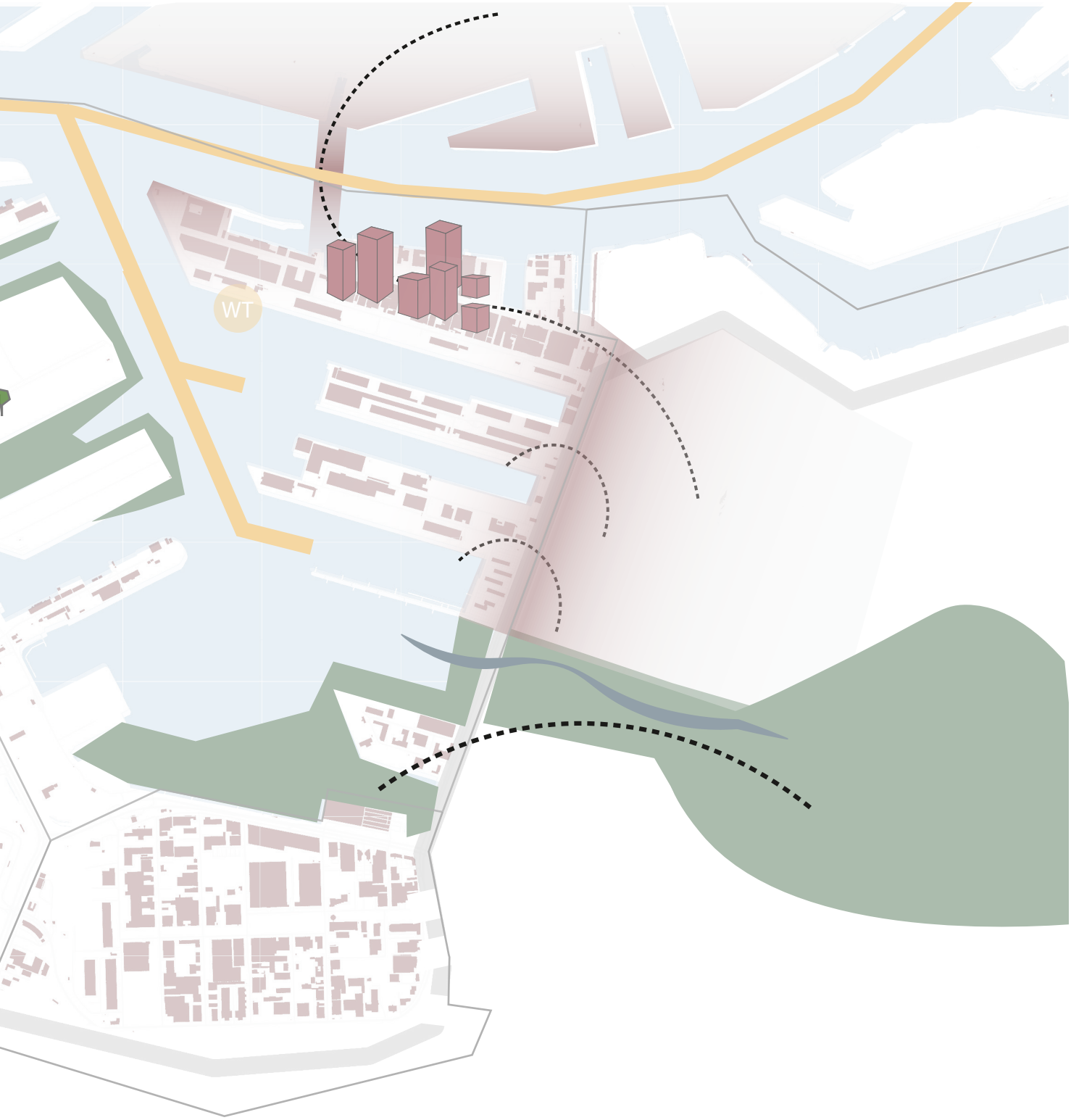


Vision Map 2

This map shows the vision on the smaller scale. It illustrates how different neighborhoods ask for different types of densification typologies. It shows the possible connection with the city center and Charlois by transforming the Sluisjesdijk. The green space of Rotterdam South can ben connected to the harbor. The watertaxi will decrease the boundry between Rotterdam North and South together with the new bridge facilitating cars, pedestrians, cyclists and the new metroline.

N

0 500 m


WT

6.

Design Experiments

Froukje Ottema
Lisanne den Held



Froukje Ottema

Manifesto

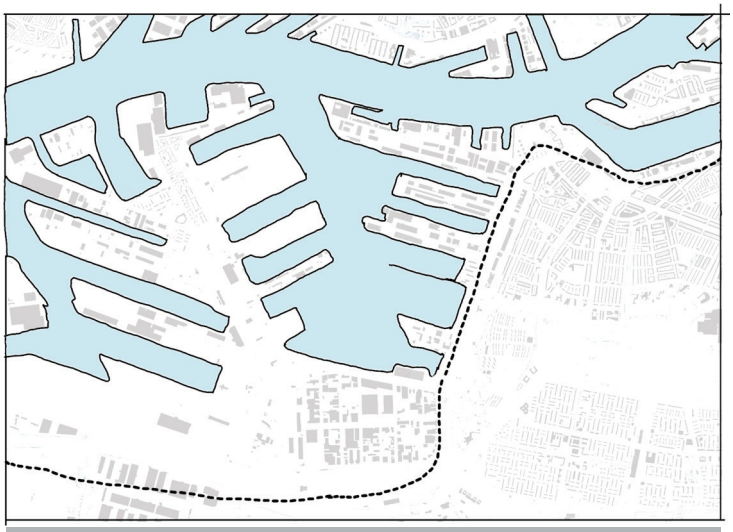
Dutch people are landformers. From water they create land. It's fascinating to see the immens part of land, the ancestors took from the sea. It's in the culture, they fought the water and concured the water! But now the reality is that the water will eventually always win. Climate change directs the need to work with the water instead of against it. This is a cultural change that will take time.

Rotterdam is a city situated in an estuarium. In the development of the harbor of Rotterdam the river estuarium is transformed in a man made, closely regulated channel to the sea with on the sides excavated harbor fingers. The river is pushed back to its narrowest form. The river is treated as a subordinated slave. It should always work for humans without getting anything in return. But this needs to change towards a cooperation and acknowledgement of the river as an entity. This is how ecosystem participation will be achieved in the Waalhaven.

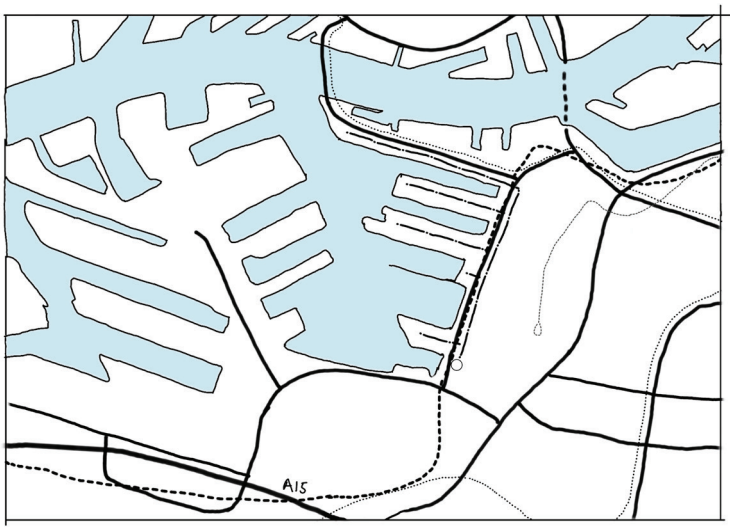
In the image on the left, the Waalhaven is illustrated. The current silhouet of the harbor is drawn and in the reflection of the water you see the desired future. A hard industrial place is being transformed into a green livable area, where the natural form of the river Maas is brought back into the heart of the city and its people. Where the tidal changes of the river are daily visible and where people live hand in hand with the water and nature that surrounds them.

Design experiment

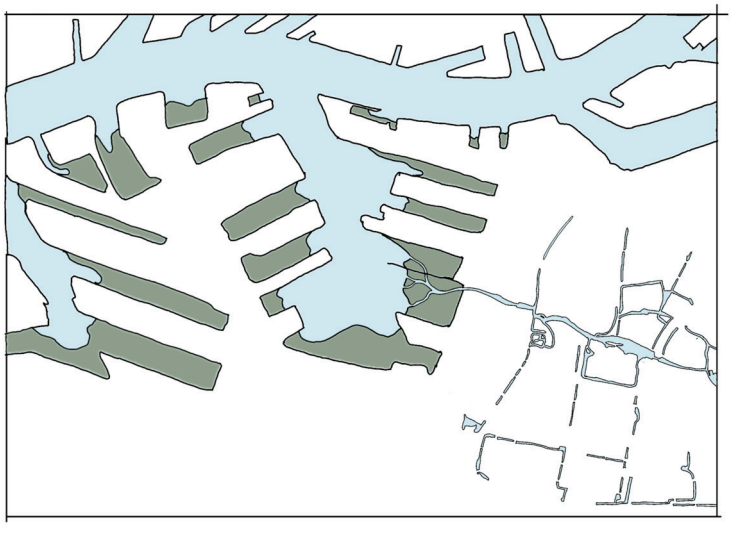
The Waalhaven in the images, here on the right, are drawn in the model of the dutch layer aproach. The substratum, the networks and the occupation layer. The substratum shows the watersystem in the polder of Charlois what will be transformed to a more visible and understandable whole system. And it shows the new tidal nature that will be added in the Waalhaven. The networks layer shows the current connection of the Waalhaven with the city and its surroundings, but also the new added infrastructure. This new infrastructure contains a bridge to cross the Maas and a new metroline along it. The occupation layer shows the existing housing in Charlois and also the added housing.



OCCUPATION



NETWORKS



SUBSTRATUM



Map Tidal Waalhaven

In this map a few things are important. The new green connection that is made between the zuiderpark and the tidal Waalhaven. This is a connection that connects not only green but also blue and people. By making this connection not only people who live in the Waalhaven will reap the benefits but also the people living in Charlois can benefit from the new public good that will be created. Another thing to point out is the geothermal station that will be created. This geothermal station will provide the new residence of heat and warm water. The station will be located on the former oil extraction point. And will be distributed to the new neighbourhoods.

- Water
- Tidal park
- Public space
- Buildings
- Zuiderpark
- Pathways
- Geothermal Extraction point



The layer aproach

To understand the design better the Waalhaven can be divided in 5 different layers. This layers are shown in these images. So on the bottom we have the tidal park layer. This layer contains the new watersystem, the tidal parks, and the trees. The geothermal level shows the distribution of the hot water. The pathways layer shows the new connection and routes that lay in the tidal parks. These pathways will be elevated from the underlaying nature so this can be flooded and will not be disturbed by the people living here. But the nature can still be appreciated and used. The public space layer shows the new public squares, these squares are a place to meet the neighbors and socialize. And then at last we have the occupation layer that contains the new housing.

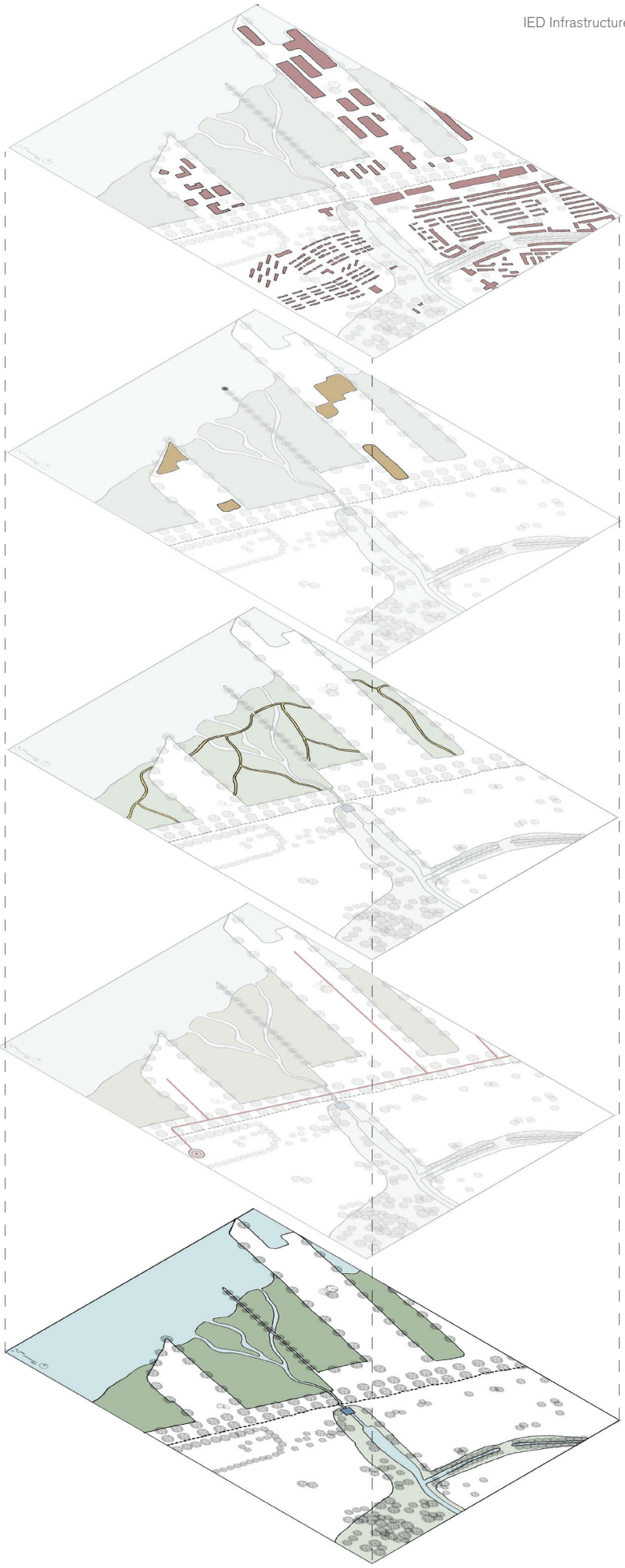
Occupation

Public space

Pathways

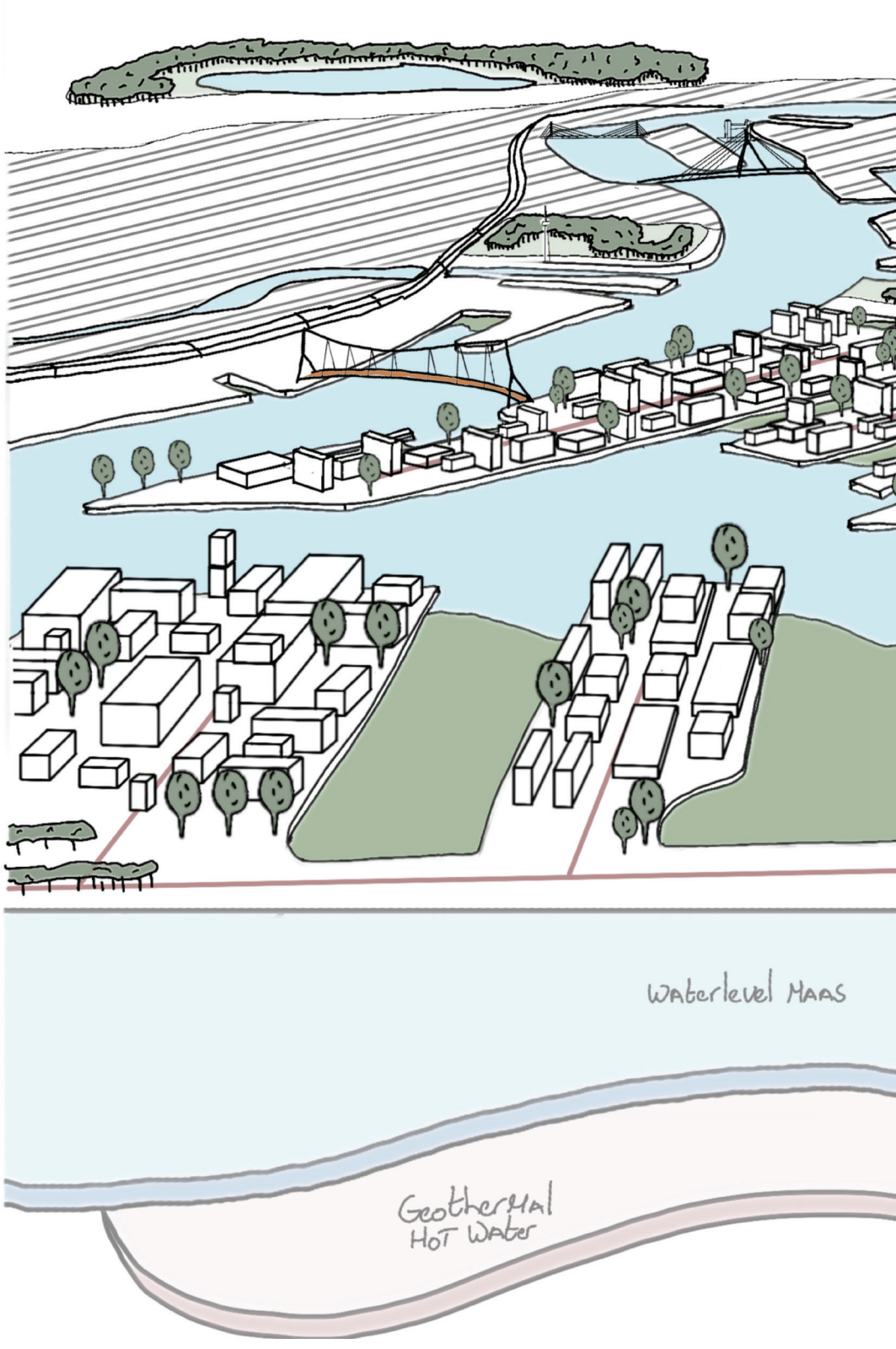
Geothermal network

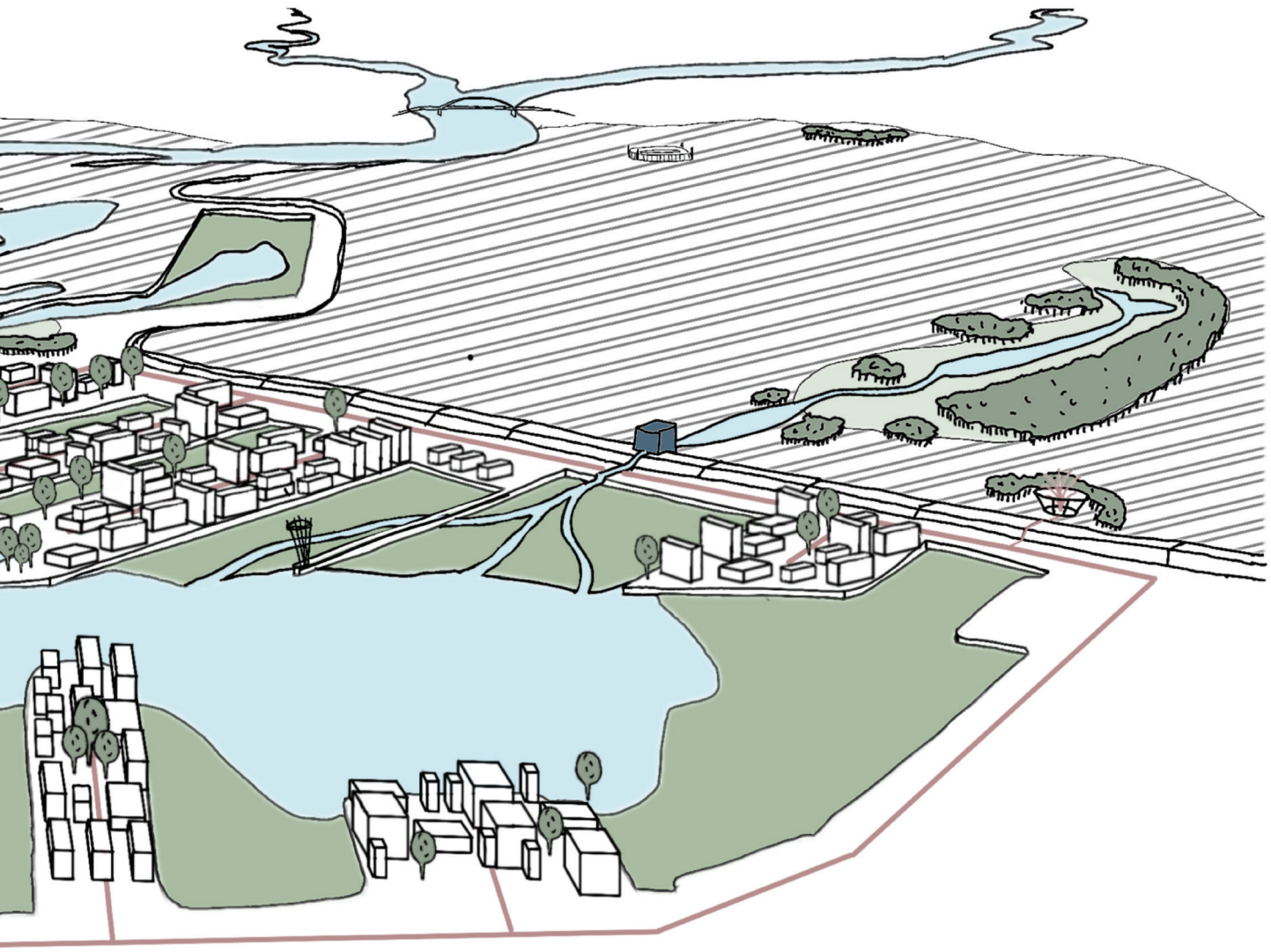
Nature

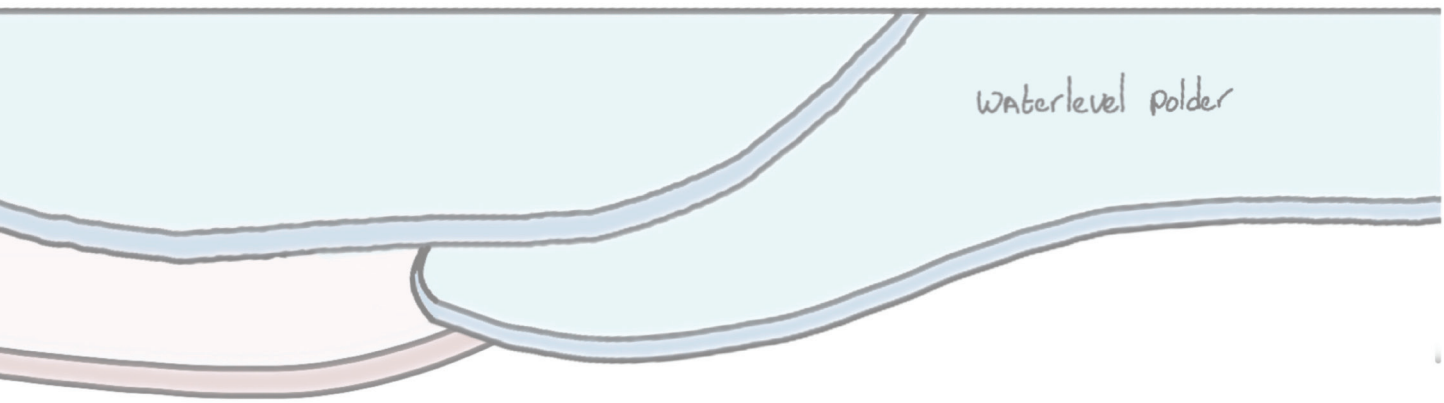


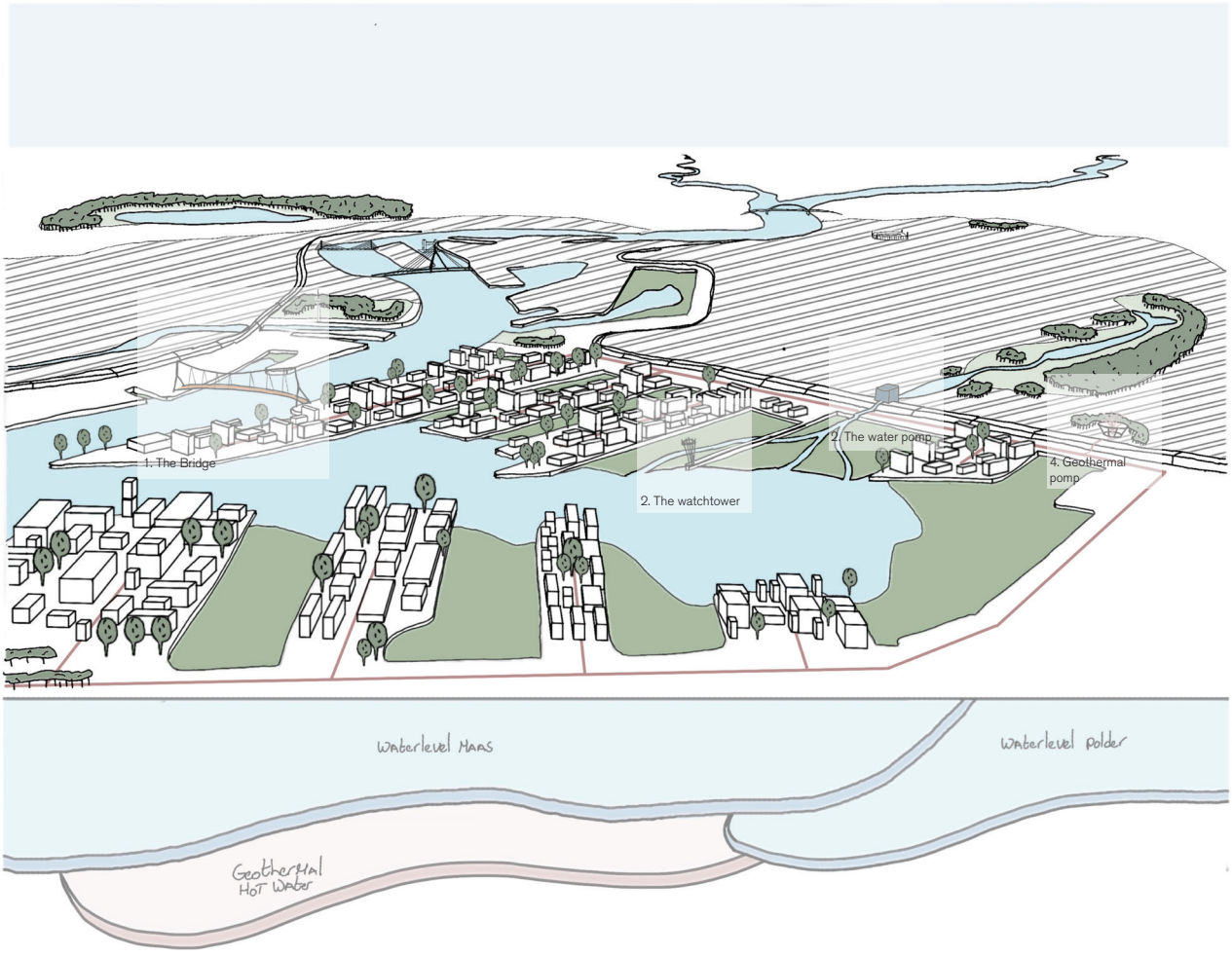
Birds eye view

This birdseyeview gives a overview of all the interventions I designed for the Waalhaven. Underneath the surface of the waalhaven are three layers drawn, these layers illustrated the important fields in the substratum. In red the geothermal field is drawn. And in blue are the water levels drawn. What is illustrated in this map is that the waterlevel of the Maas lays higher then the surrounding polder.





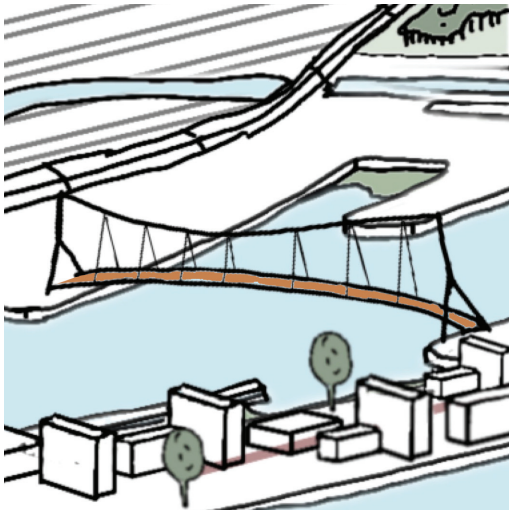

waterlevel polder



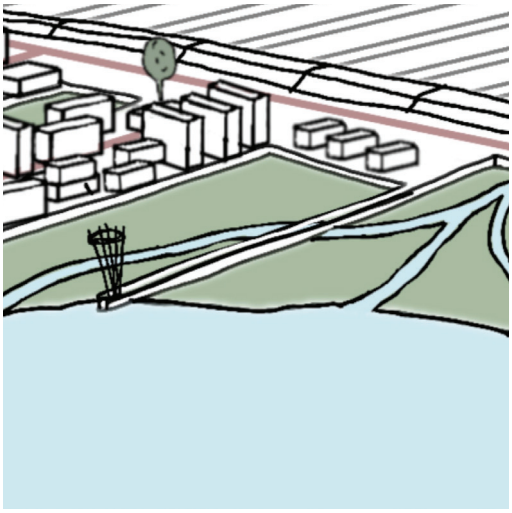
Four artefacts

This birdseyeview of the Waalhaven gives you a feeling of the scale of this harbor but also points out how close this harbor lays to the inner city of Rotterdam. Four artifacts will be created, one is the new bridge across the river. This new bridge connects the new residents, living in this neighborhood, with the North side of the river. The watchtower is situated on the fingerpier and moves people from Charlois over the dike towards the water. The geothermal station and the new pumping station connects the substratum with the public.

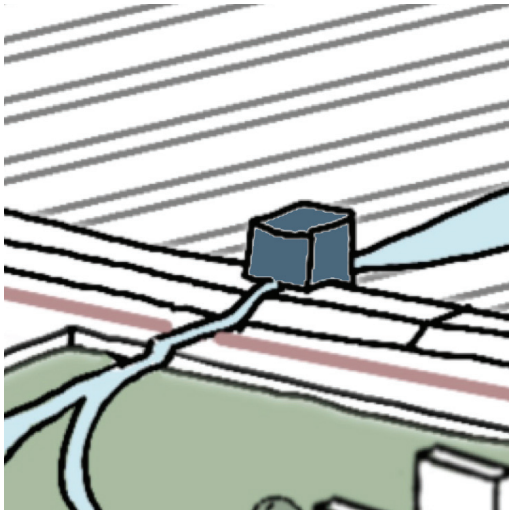
1. The Brige



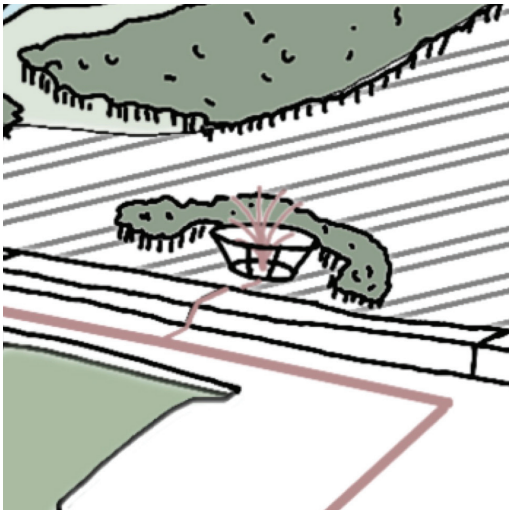
2. The Watchtower



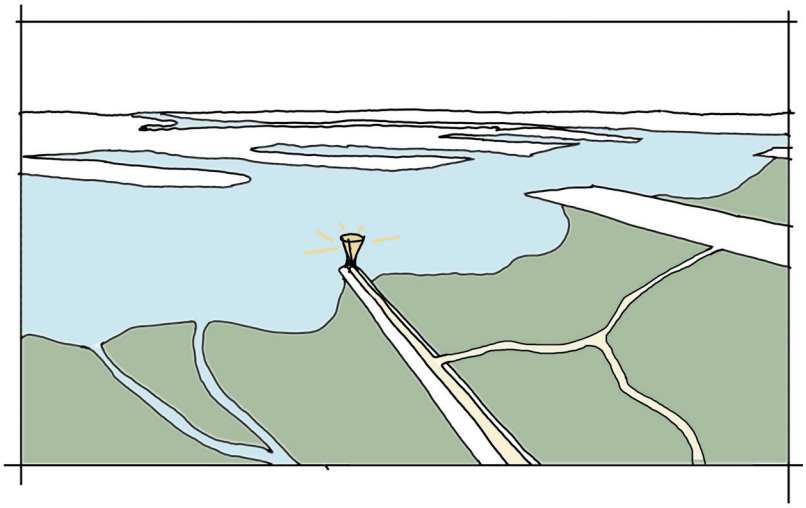
3. The water pomp



4. Geothermal pomp



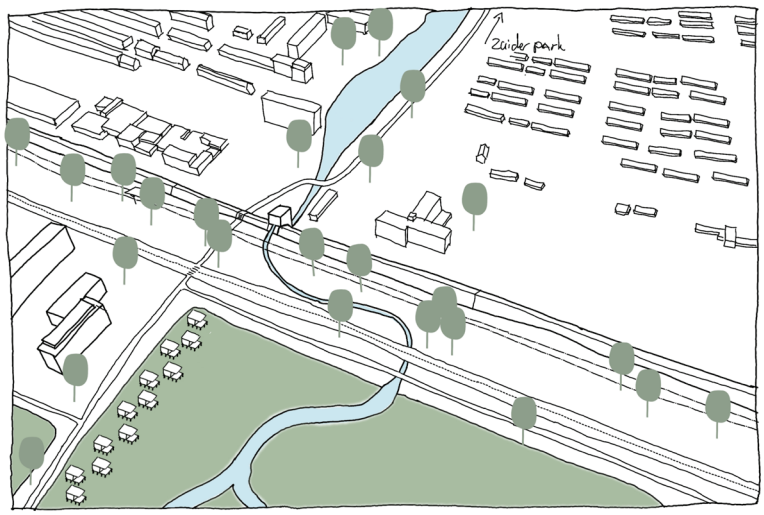
This image shows how the Maas is transformed in a nature friendly estuarium. The former harborfingers are transformed. The natural sedimentation is brought back



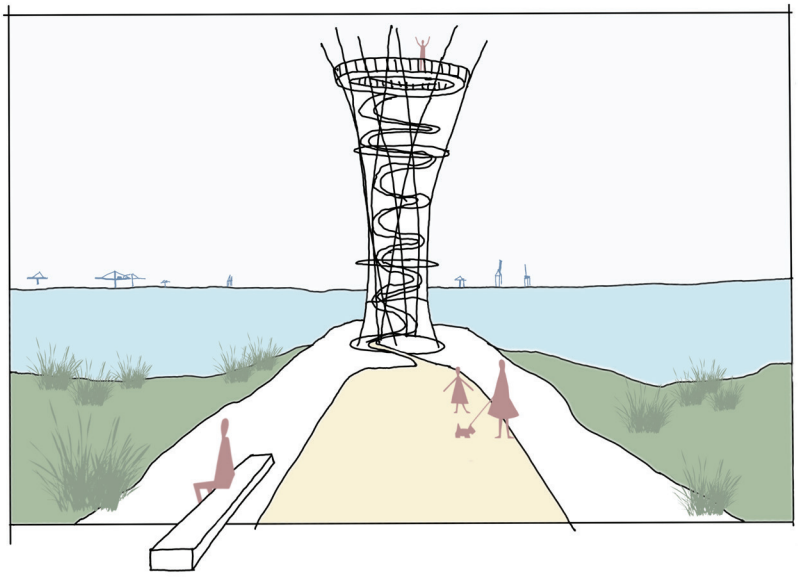
On the left side, an image of an example is given on how the housing reacts to tidal changes and flood risks. Instead building a dike around the area, we adapt to the climate changes. The four strategies we use are:

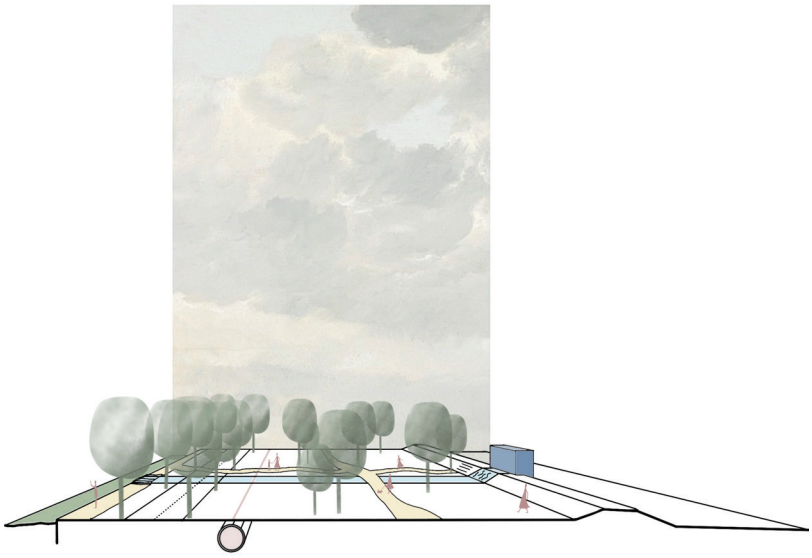
1. Hightening
2. Floating
3. On piles
4. Non essential first flour

In this image strategy number three is used.

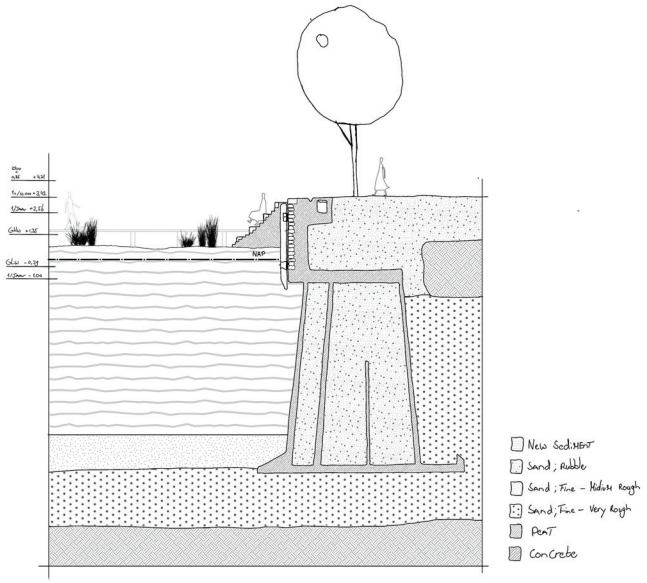


In this image the watchtower is shown. This artefact moves people towards the river and in that way connects human and river by contacts and views. Along this path plenty of benches will be created, this allows people to recreate along the entire pier.



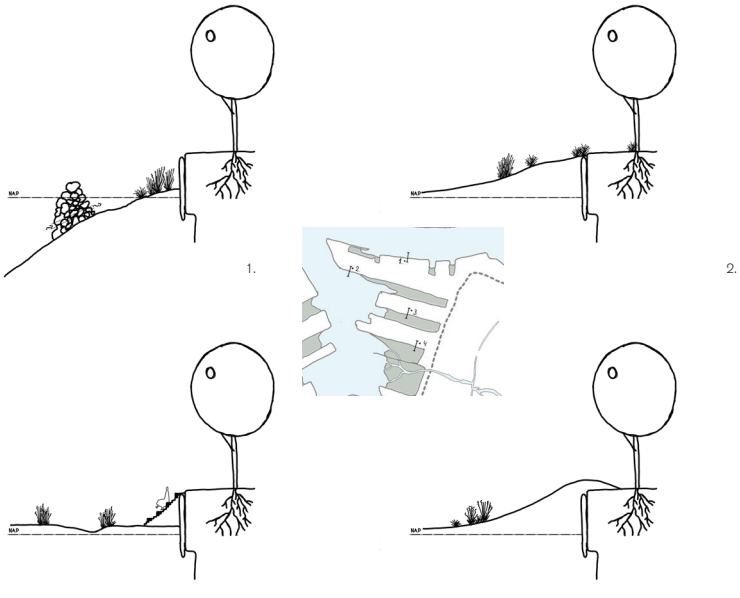


The geothermal heath system is drawn in this image. Underneath the park will be created along the dike the pipesytem is situated. The piping system will be visible on the surface.



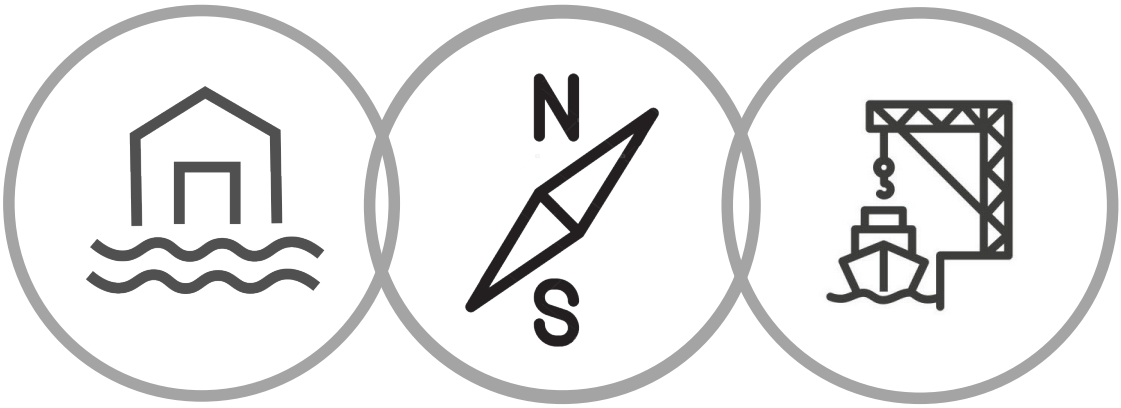
In this section, two guidelines are drawn. The first one is that nature is flood resilient. On the left side of the image the different water heigts are given.
As you can see, the tidal park will be flooded every six hours with high water, with low water it wil be dry.

The second guideline that is shown here is the less dredging of the harbors and sides of the river. In the harborfingers the dredging will completely stop and sedimentation will take over. To speed up this proces dredge that is still dredged out of the Maas can be put here instead of dumping in the sea.



The guideline ‘nature friendly banks’ is made clear in four types. In this way there is always a solution to find for the right spots and all the banks along the river and harbors can be made nature friendly.

Lisnne den Held



Flood resistant Living

- Creative food risk protection
- Future proof
- Ad more densification to degrese the housing shortage

North South connection

- Provide a better North South
- connection within the city
- Mix of functions
- Better public transport connections

Green Harbor

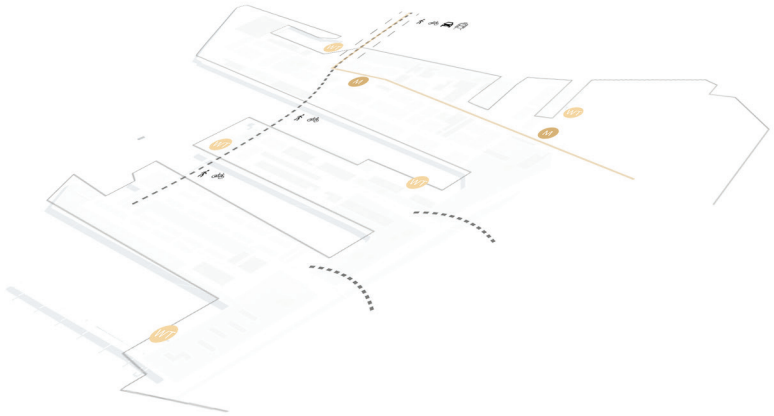
- Staying close to the water Protect
- harbor heritage
- Keep the harbor function
- Create nature friendly banks

The Vision

Based on the guidelines a vision for the Waalhaven has been created. The vision is based on three main points: Flood resistant living, North South connections, and a Green harbor. The next few pages will further explain the vision based on these three points and the layer approach.

The Story

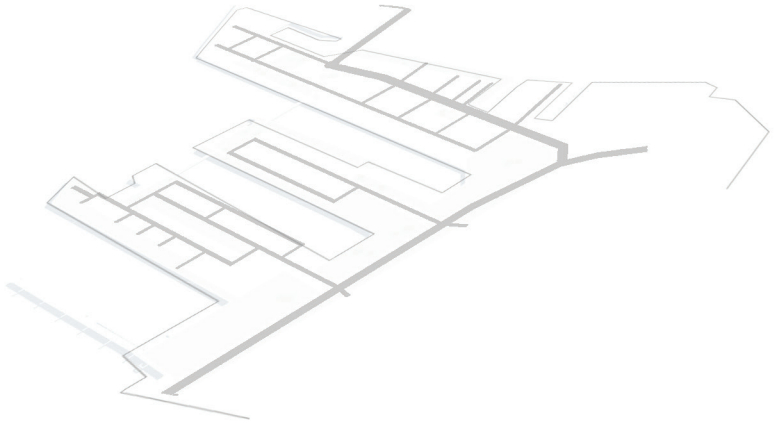
Rotterdam, just like most cities within the Netherlands deals with a future housing shortage. Because of the limited amount of space Rotterdam tries to take an innovative perspective on how to create these new homes. Rotterdam believes that parts of the Waalhaven surrounding the Sluisjesdijk can create those opportunities needed by also creating a new bridge and metro connection. The harbor function must be mixed with housing. This will then create more challenges on how to deal with tidal change, but also create more opportunities to make Rotterdam greener, create a closer connection to the water which fits the Watercity character and create new facilities for those living in nearby neighborhoods such as Charlois and Merwe Vierhaven.



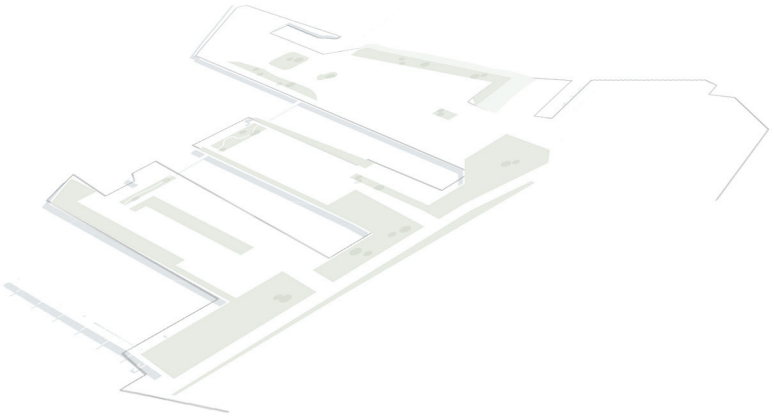
Layer 4:
Connections



Layer 3:
Urban Structure



Layer 2:
Infrastructure



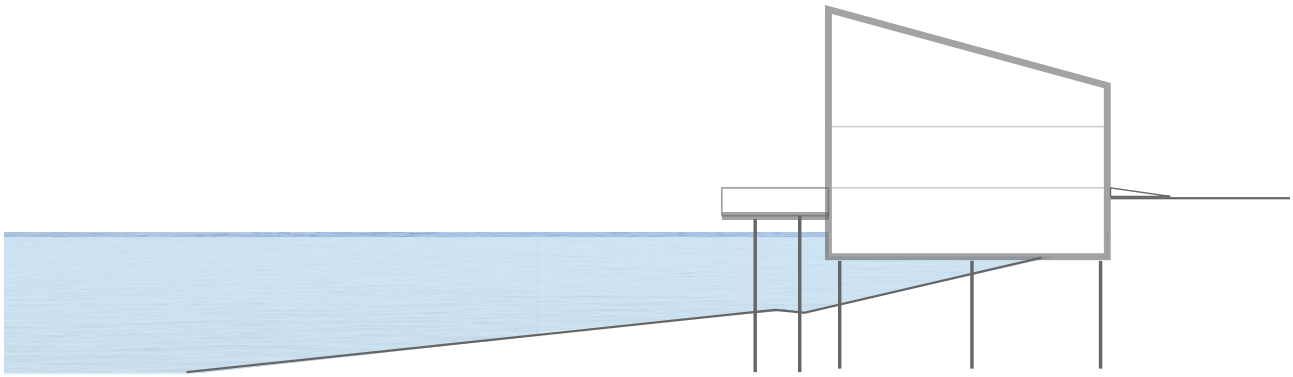
Layer 1:
Green structure

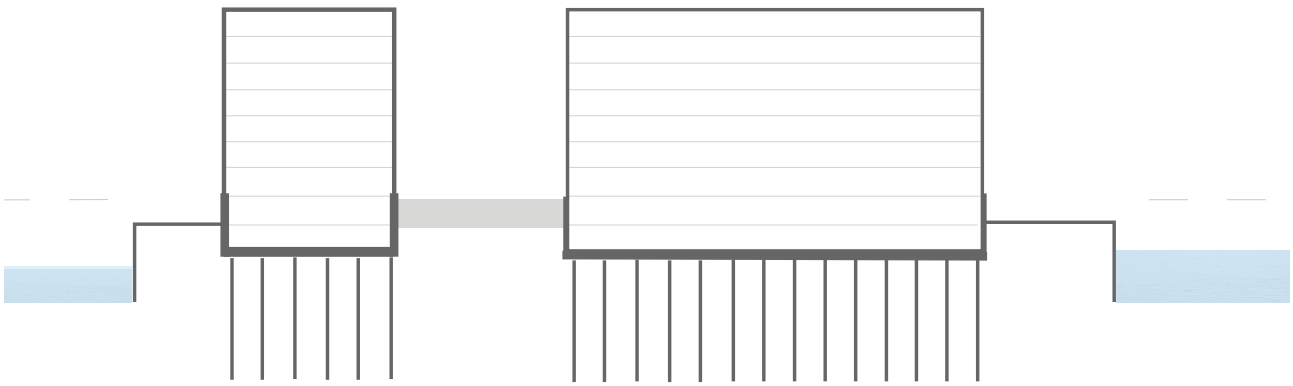
Layer approach

On the left page the Layer approach of this design is shown. Apart from the 3 layers earlier spoken of in this chapter another layer has been added, the Connection Layer. The connection layer shows the invisible artefacts that connect the Waalhaven to nearby neighborhoods and the city of Rottterdam. The forth layer is important in order to make the story possible, the connection form the basis of the opportunites.

Building typologies Waalhaven North

Within this design experiment the focus lies on the northern part of the Waalhaven, called Waalhaven North. Here two main typologies will be used. Which are Floating houses and Buildings which have a parkinggarage at the ground floor level and are mostly accessible from two levels. The sections on the right show how these two typologies work. The bottom section is based on the HavenCity of Hamburg.



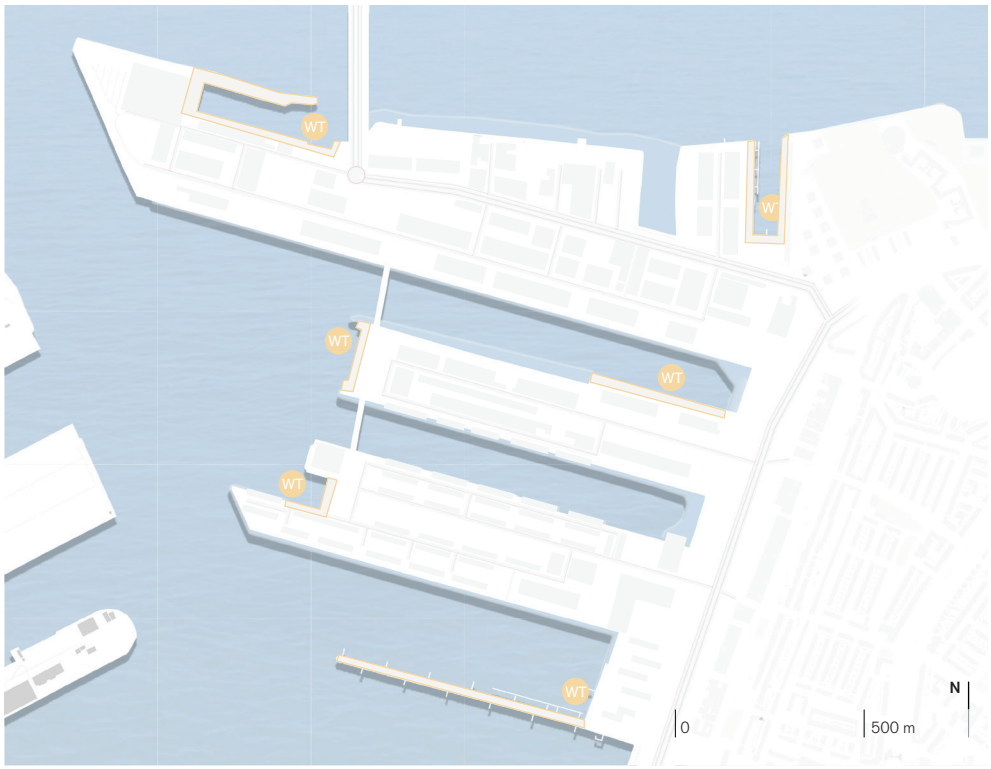




Green Harbor

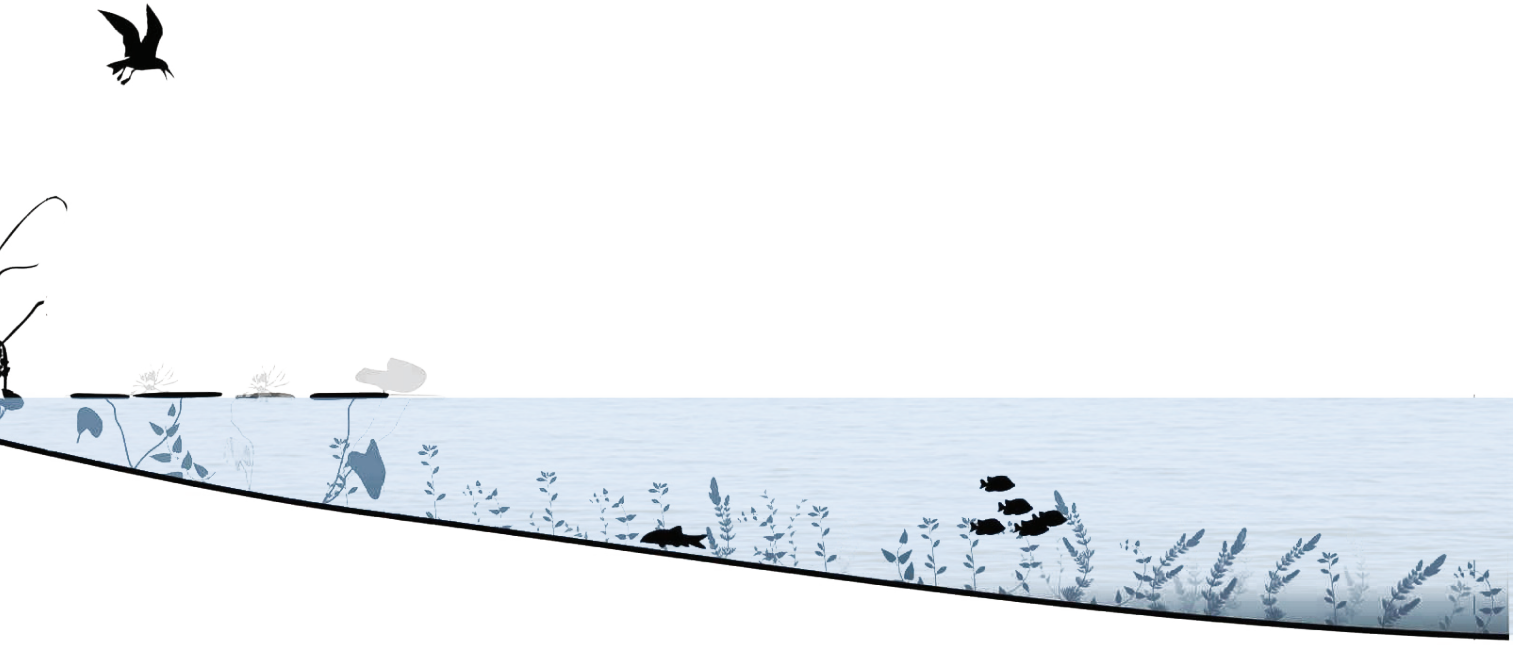
One of the aspects of the Green Harbor is the maintaining of the harbor function, however small scaled. This has been done by creating small stops for the upcoming Watertaxi in Rotterdam, shown in the first map. A second aspect of the Green Harbor is the preserving of the harbor ambiance created by the old building typologies. These buildings are shown in the map in grey. Because of the change in function these buildings must be transformed into other building types such as housing. The last aspect of the Green Harbor shown on this page contains the close connection to the water and the nature friendly banks. The placement of these naturefriendly banks are shown in the last image. The dike, and the road Waalhaven oostzijde will fluently be connected to this nature friendly bank in order to make the height difference smoother to be able to connect both area's Charlois and Waalhaven North in a better way.

Harbor function



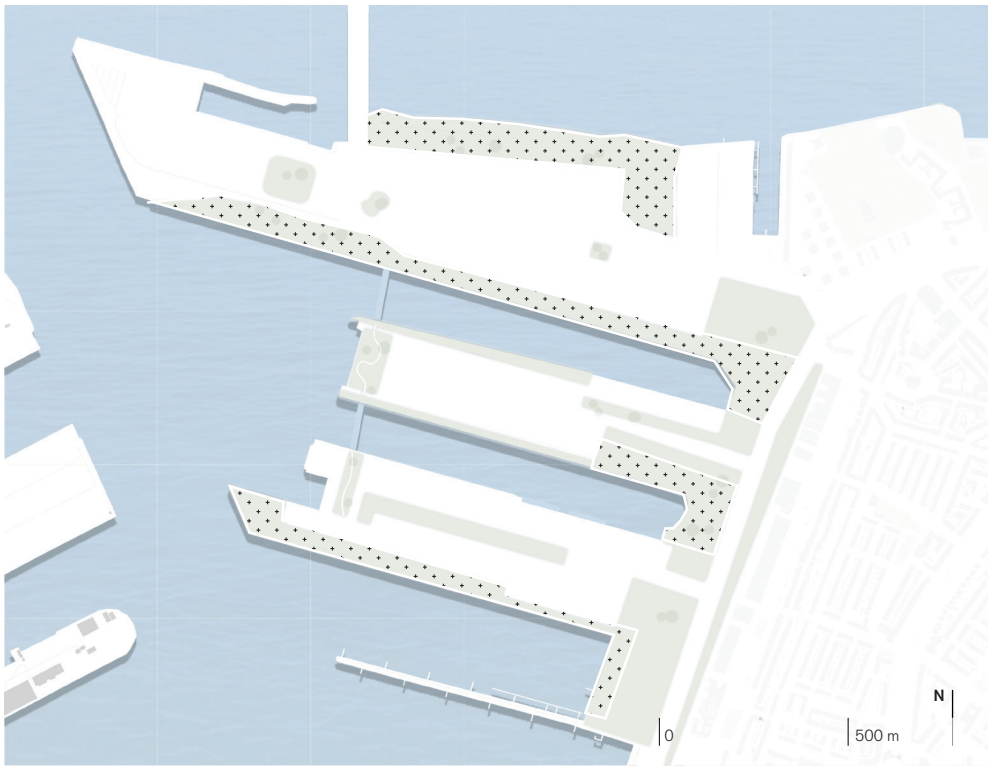
Harbor Heritage





Nature friendly banks





North South Connection

The second part of the vision contains the North South connection. Within the plans of the municipality a new bridge will be created between the sluisjesdijk and Delftshaven. The precise location however is not yet indicated. The location of the new bridge within this design experiment is based on a rectangular connection with the Westzeedijk and is therefore well connected with the city's infrastructure. The new metro line (also within the vision of the municipality) will make use of this bridge as well. Within the area two metro stops will be added in order to include the area well within the public transportation system. As spoken of, the area will offer lots of opportunities to make use of the watertaxi in order to make this North South connection even more easy.

The different fingers of the harbor will be connected by two small bridges for pedestrians and cyclists, This will make sure that different facilities such as shops can easily be reached from all places.

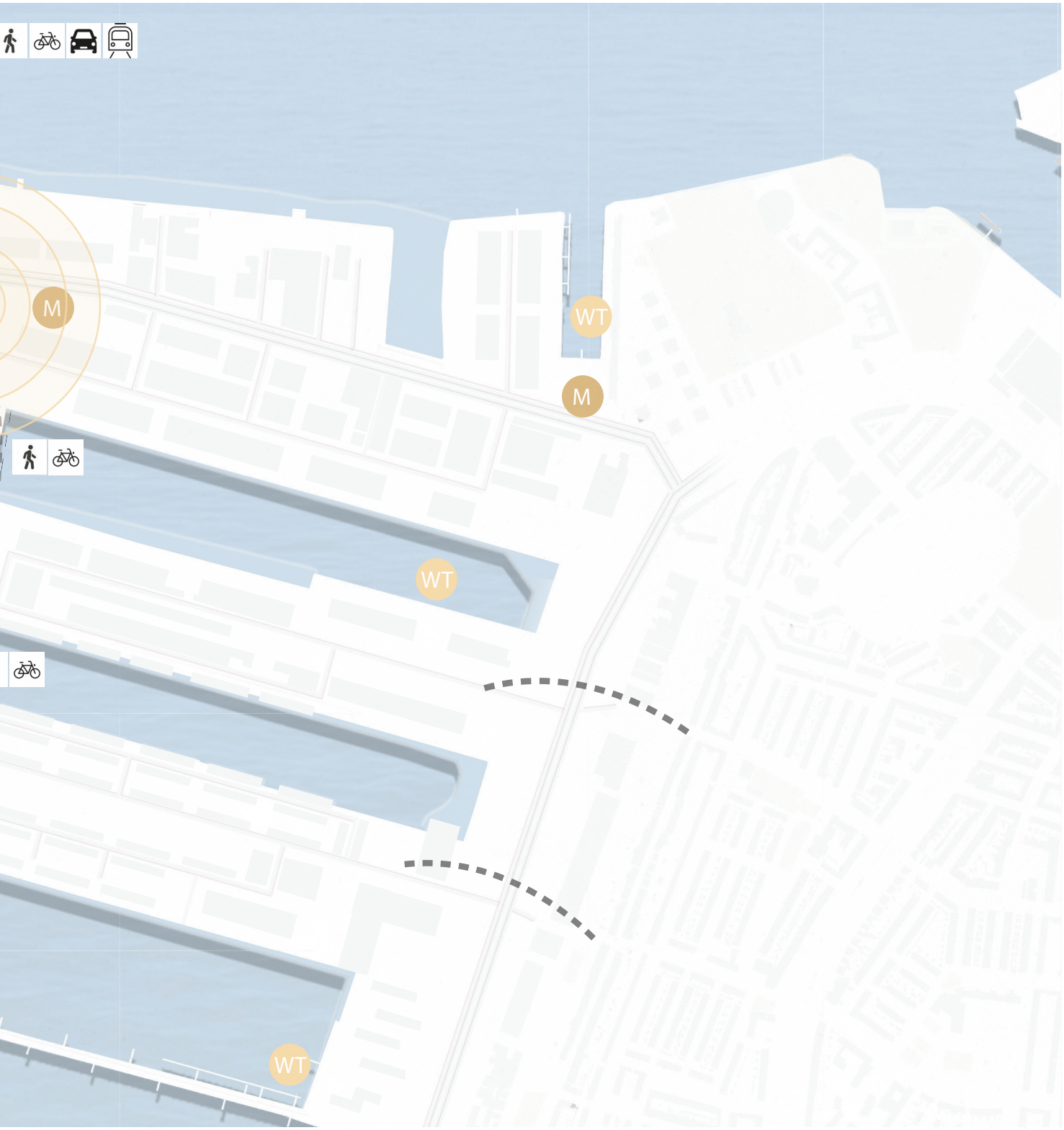


North South connections

Car connection
Pedestrian connection
Metro connection
Bike connection
WT Watertaxi stop
M Metro station

N

0 200 m


N
S
M
WT
M
WT
WT



Flood prevention

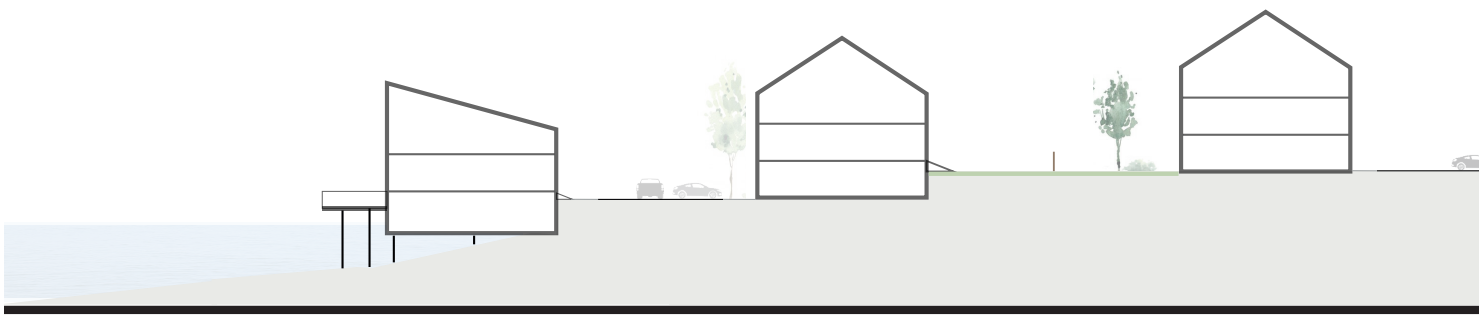
On the map the parts that will rise in height are indicated. The second ‘finger’ will not be risen because of the preservation of most of the buildings. This means that this area will be less future proof, however, neither many changes have to be made within this fingerarea. The section on the bottem shows how the rising of the last fingers has been created.

Risen Parts

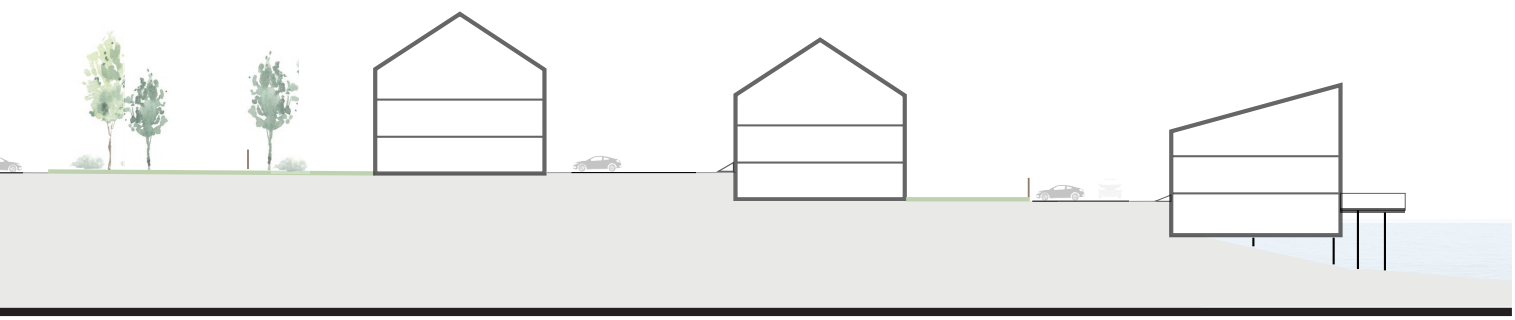
Risen part

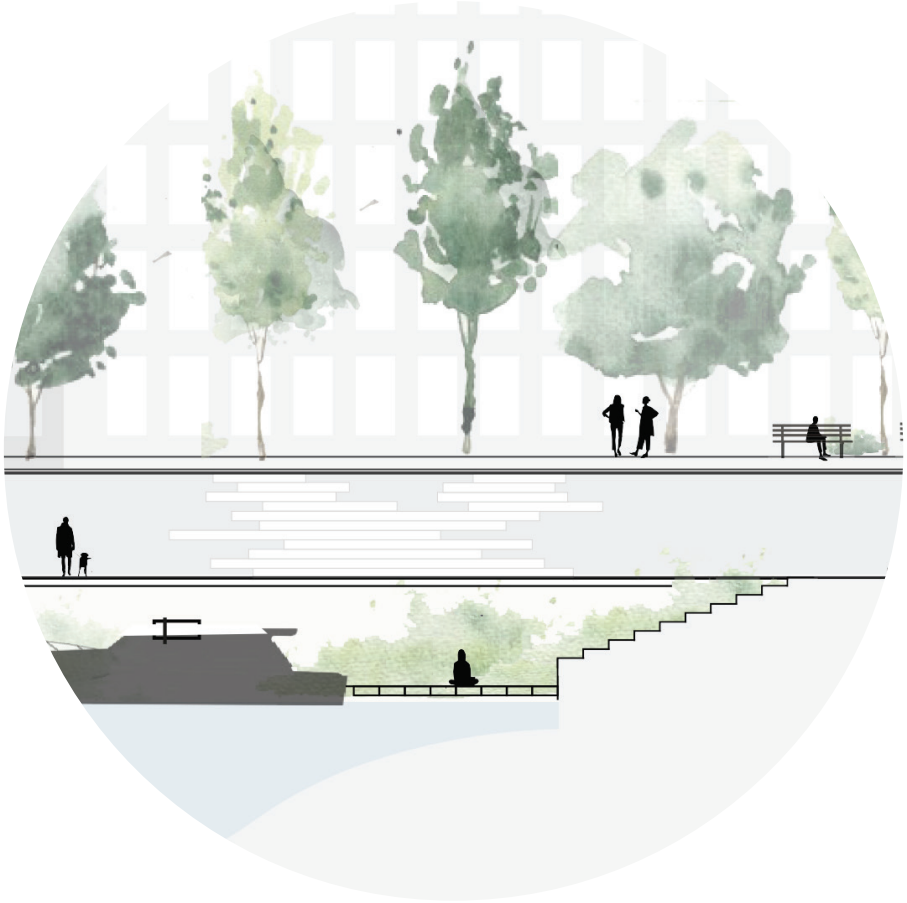
N

0 200 m









Connection with water

In order to keep close connection with the water, nature friendly banks are alternated with recreational area's with some small stops for boats.

Main Section

These images show crossections of the streets Sluisjesdijk and the Waalhaven Noordzijde. The section shows different buildings of the Gorzenpad dating from around 1930 til 1945. Because of de preservation of the gorzenpad only the Sluisjesdijk has been raised. This raising is partly created by the new metroline.





Parking and Floodmanagement

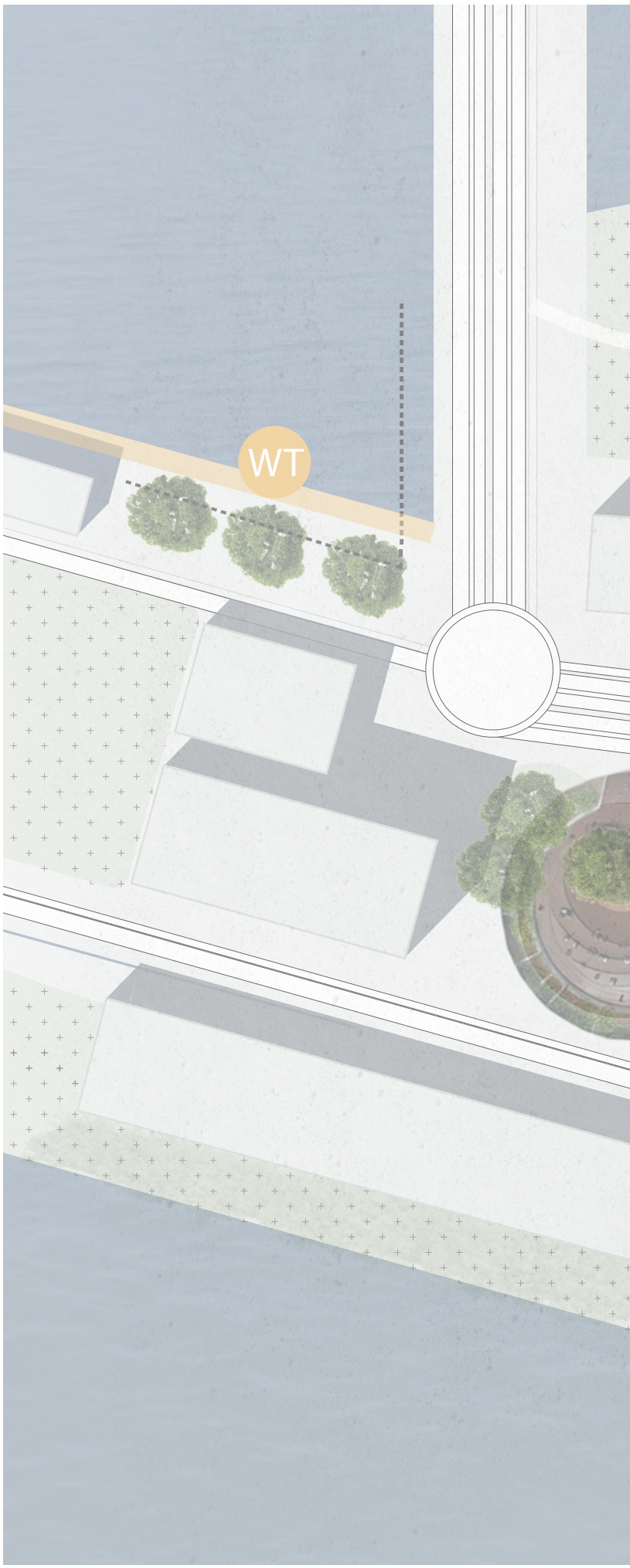
In the area's that will not be risen, the main floor of buildings will be contributed to parking. This also means that the current streets will not be overloaded with parked cars and able to keep a green allure



Preservation of the Gorzenpad

In order to keep the harbor ambiance alive in this area buildings such as the buildings of the gorzenpad should be preserved. These buildings could be transformed into a recreational area with for example restaurants, shops and musea. In order to attract people to this street and show it's history





Connectivity Square

In order to create enough facilities within the new neighborhood a square has been added. The square offers the new inhabitants shops, restaurants etc. The deepened structure creates a close connection to the new underground metro. The large bridge, the square and the smaller bridges which reaches to the next finger form a whole.

Connectivity Square

N

0 50 m


M


華興路
西大堡路
XIDABAO RD
出口
EXIT

Manifesto

Two gentleman crossing a dike and leaving the overcrowded city behind. An illustration on what the Waalhaven can be. When daring to cross the dike, the Waalhaven can offer opportunites for different challenges. Depaving an area full of concrete will have large effects on the physical environment and can offer an green escape from the overpopulated city. Instead of overpopulating even more, the Waalhaven can offer space for new neighborhoods which are too close to the city center to be considered an outskirt. The absence of the protection by a dike will bring the inhabitant closer to the water, and the city closer to its ambition to be called a watercity.

Systems - Amazon

A bird's-eye view over the Amazon

Jin-Ah Duijghuisen
Luiz Felipe do Nascimento
Paul Simon Schön
Sanne Francissen

2021—2022 IED
Infrastructure and Environment Design
July 2021



Satellite view over the Madeira River, 1980s
On the left bottom corner of the image, Bolivia. On the right side, Brazil
Google Earth



Satellite view over the Madeira River, 2020
On the left bottom corner of the image, Bolivia. On the right side, Brazil
Google Earth

1.

Introduction

Context and Challenge

The Amazonian region studied in this report is located between the Brazilian states of Rondônia, Mato Grosso, and Mato Grosso do Sul, as well as neighboring countries of Bolivia and Paraguay. Of hard access due to the natural conditions of the land and distance to the main populational centers of the three countries, the region is fairly detached from the main capitals and economic centers of the continent.

However, despite its remote location, the region finds itself at the center of a political, ethical, and environmental dispute between the forest, indigenous peoples, locals and the interests of giant corporations in the fields of soybeans, cattle ranching, energy, and mining.

The relevance and choosing of this location can be explained by the proposal by the late Brazilian architect Paulo Mendes da Rocha, put forward by fellow researchers from the Design Lab at the Faculty of Architecture and Urbanism, from the University of São Paulo. An ambitious plan to connect two of the largest basins in the continent forming, therefore, a complex system of navigable waterways that go from the villages along the margins of the Amazon basin rivers to the economic centers of the south of the continent, such as São Paulo and Buenos Aires, both located on the basin of the La Plata River.

As much as the proposal by Paulo Mendes da Rocha seems unattainable and detached from the Latin-American reality, it is a very much needed one. It is a statement and a way out of the predatory forms of construction of transport infrastructures to manage the flows of goods being shipped from the hinterland of the continent towards the outside world: a transportation system that pays respect to the natural shape of the landscape and its dynamics.

For five centuries the region has been developed with the interests of foreign markets and capitalist society over those of nature and the original dwellers of this land: indigenous peoples that have lived harmoniously with the land for as long as history can tell us. This research and further individual design proposals briefly present a special opportunity to discuss the options for more sustainable development of the region, following the implementation of the system of waterways of the Amazon-La Plata basins.

Environmental Risks and Human Response

The ongoing extractive practices found in this region of the Amazon, commonly the plantation of soybeans for further exporting, cattle farming for production of meat for consumption by China, the EU and the United States and lastly, mining for precious metals are very disruptive and detrimental to the ecological balance of the ecosystems. Also, to the people living in the villages and big cities of the Amazon, not to mention the right to the land by indigenous peoples, who are at the forefront of the confront between the expansion of farms and the protection of the forest.

The environmental risk on a larger scale caused by extraction to be tackled is the eventual transition of the region from a moist dense tropical forest into a savanna. It is believed that the region can begin an irreversible process of desertification that would harm not only those living in the Amazon, both humans and animals, but the entire continent, should deforestation continue at its current rates. The Amazon is the source of much of the moisture and rainfall that is distributed throughout the continent by a set of currents, low and high-pressure systems associated with the high temperatures of this tropical region.

To expand the areas suitable for farming, people cut down large portions of the forest, which then are set on fire to clear out the region of animals, vegetation remainings, and, ultimately, indigenous peoples.

During recent years it has become evident that citizens of Brazil and other Latin-American states cannot ignore what happens in the forest, away from the public eye at large urban centers. The arrival of a huge smoke cloud from forest fires in the Amazon to São Paulo (2500 km away) in 2019 was the ultimate proof that the Amazon is vital to the survival of the entire planet.

All is connected.

The response from the Brazillian society has been fierce, as well as from the global community and political leaders worldwide. The discussions for an economic treaty between the European Union and the Mercosul even have been put to a halt due to the pressure by Europeans against the environmental policies of Latin-American governments. However, it seems that all efforts are still insufficient to prompt a response from the local government. Deforestation rates continue to increase and the lives of those living in the forest, who depend on it for its survival, is increasingly in danger.

Unfortunately, it is fair to say that for as long as the economy of the region is dependant on this sort of extraction and that short-term economical profit is of more relevance than the well-being of the ecosystem this dynamic will continue to take place. The need for an alternative reality is urgent.

Connecting the two largest basins of South America

The waterways connection proposal, put forward by the late Brazilian architect Paulo Mendes da Rocha is a design statement of how an infrastructural project could reshape the territory of the whole continent.

In the South of the country, in regions forming the La Plata Basin, waterways already are used as a prominent way of transportation of goods, along with a system of railways and good connection to highways.

The Tietê-Paraná waterway, which goes from the state of São Paulo through the Tietê River, until it reaches the Paraná/Paraguay/La Plata rivers is a prime example of the implementation of such a project in the Latin-American context. On the Amazon basin, however, different challenges to those of the La Plata can be found: a fairly preserved and untouched natural territory, where free-flowing rivers are key to the maintenance of life for the forest, animals, and locals that live along the waterways. This is a major point of attention when thinking of using the rivers as a more robust way of transport, adding to the vernacular ways in which the fluvial waterscapes are used by locals and indigenous peoples.

Basins of relevance to the project

The proposed waterway is divided between the basins of the Amazon and La Plata rivers

+ Selected locations
Amazon River Basin
La Plata River Basin
Hydrography
Political/Administrative borders



N

0 250 500 km

A transnational matter

Brazilian, and to a certain extent, South American infrastructures have been constructed throughout the centuries with the ultimate goal of shipping goods to the colonial powers of the North, and more recently, as part of the globalized economy, shipping commodities towards consuming markets in the global North and China.

Being two of the largest basins in the world, the Amazon and La Plata basins are shared by many countries in the continent (Brazil, Bolivia, Argentina, and Paraguay, only to name a few). Therefore, any project that aims to connect and transform the waterways from the perspective of a transportation system would have an enormous impact in a transnational scale.

As described by Luiz Azevedo, a researcher at the Design Lab at the Faculty of Architecture and Urbanism from the University of São Paulo, the conclusion of such a project would be extremely impactful, as if a new inland sealine would be opened, connecting the Brazilian lands with the neighboring countries in a North-South axis. On the East-West axis, railways, highways, and other smaller waterways would facilitate the connection between the Atlantic and Pacific oceans, through the Amazon and the Andes.

Administrative divisions

The project of the waterway sits at the border between Brazil, Bolivia and Paraguay

+ Selected locations
■ Urban settlements
□ National Administrative borders
□ Subnational Administrative borders



N

0 250 500 km

Remote locations, local centralities

As a fundamental part of the connection of both basins, year-round navigation along the Madeira/Guaporé/Alegre rivers must be enabled, establishing a direct connection between the Amazon and the Paraguay rivers, two of the most important bodies of water of the continent in terms of water volume, but also flows of passengers and goods.

Along the way, three cities stand out for their symbolic value as examples either of different types of urban settlements, periods in which their growth took place, or their strategic position for the handling of cargo between land and water: Porto Velho, Vila Bella da Santíssima Trindade, and Corumbá.

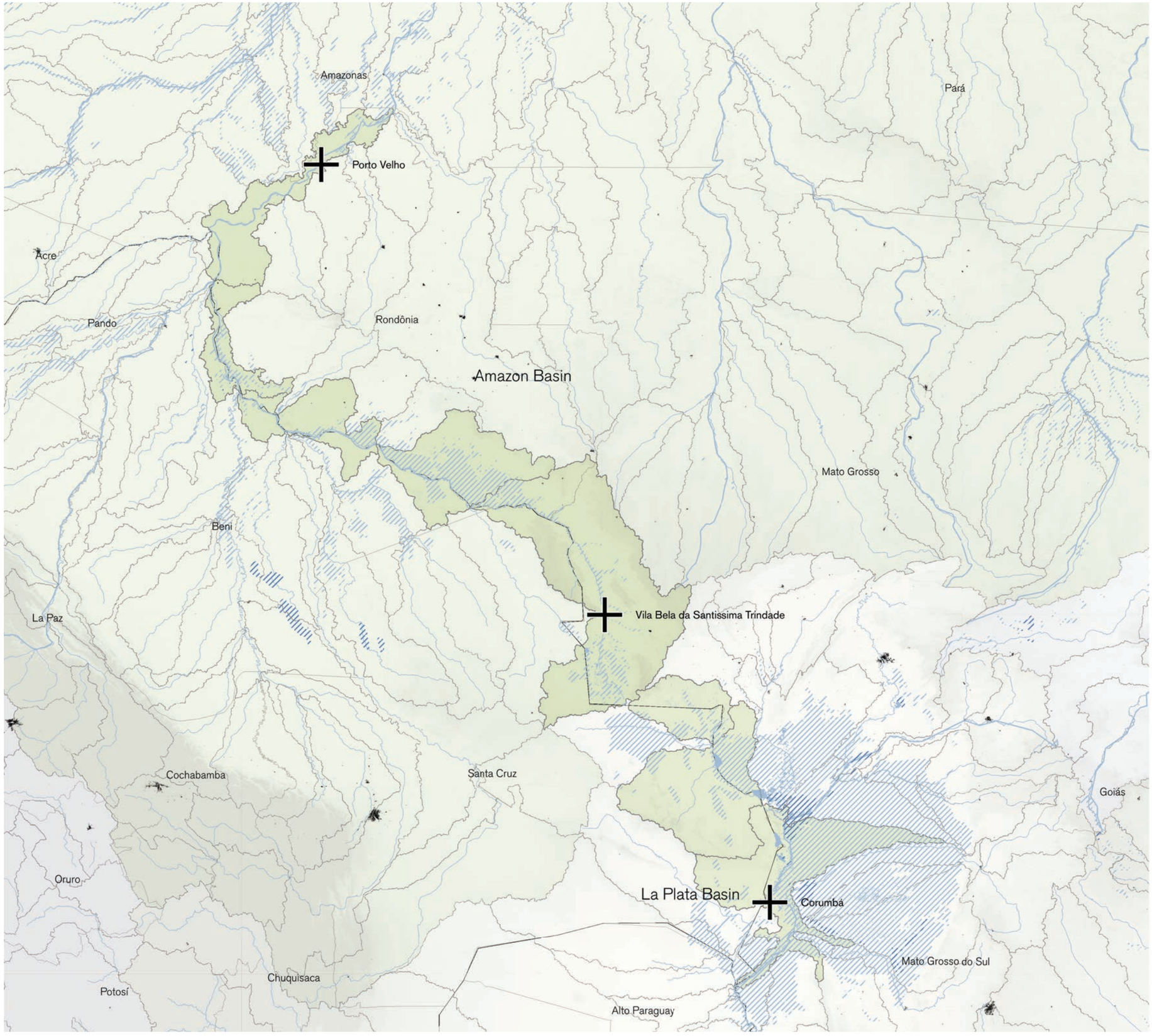
Porto Velho is one of the capitals of the Brazilian Amazon, a large city with relevant connections to hard-to-reach villages along the waterways, hidden in the middle of the forest.

Vila Bella is a testimony of European colonization of the continent and opening of the frontier against the jungle, due to its role as a former capital of one of the Brazilian territories under Portuguese rule.

Corumbá is a point of exchange between land and water, via a system of dry ports, railways, highways, and waterways, as well as its key location at the border with Bolivia.

Basins of the main stretch of the waterway

Depiciting the aproximatlely1400 km that separate Porto Velho from Corumbá



Scales & actors

Overwhelmingly large, the scale of the project of connecting the two basins at first seemed like a challenge. The stretch between Porto Velho and Corumbá alone has more than 1500 km, passing through several different Brazilian states, biomes, ecoregions, climates, and cultures (for a matter of comparison, fairly the same distance between the cities of Amsterdam and Madrid).

As mentioned previously, the three cities have been selected as study cases for their relevance to the history of the place, as well as the functioning of the waterway. Porto Velho, Vila Bella da Santíssima Trindade, and Corumbá together were capable of providing the research with insightful input on the challenges and realities of the place, although, due to the vastness of the region and difficulty in accessing high-quality data from such a long distance, it is impossible to say that the dynamics on ground-level have been completely examined.

On a macro-scale, the entire region sits at the intersection between two very distinct biomes, the Amazon and Pantanal, as well as an ecotone, the Chiquitano dry forest. At this aggregative unit, the main anthropogenic processes are the gradual transformation of forests and natural areas into cattle ranching pastures, planting of vast areas of monocultures such as soy fields and, on a smaller scale, mining activity. From this region, moisture and rainfall from the Atlantic Ocean are recycled to the air and further directed to southern parts of Brazil, a process that will be further explored later on this report. This phenomenon is key to the economical prosperity of Southern Brazil and is in jeopardy by the extractive activities taking the place of the forest through deforestation. Cattle ranchers, farmers, indigenous peoples, locals, and governmental institutions are the main identified actors on this level.

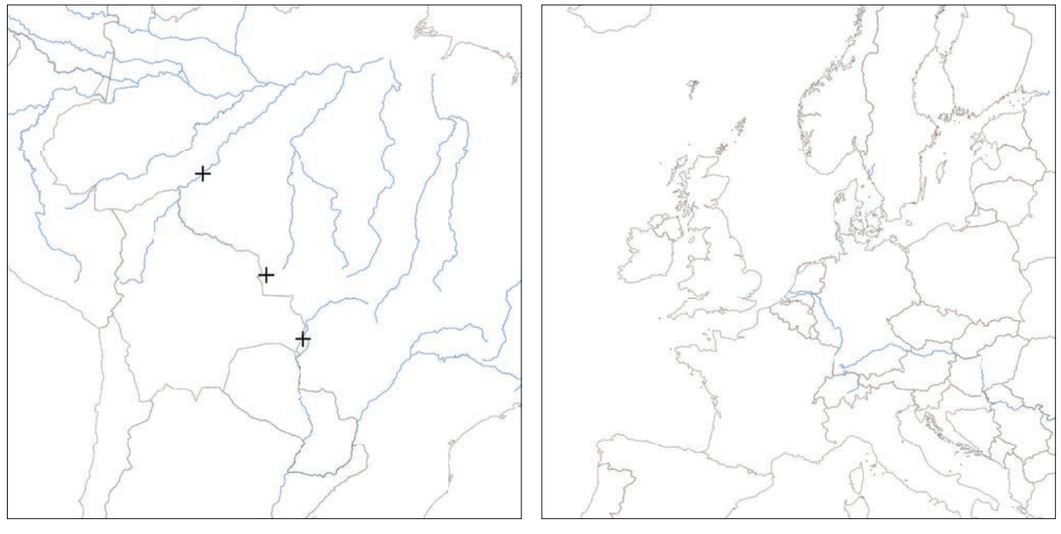
On a meso-scale, Porto Velho and Vila Bella da Santíssima Trindade have been chosen as subjects of more profound analysis, as both are representatives of a large capital city in the Amazon, and a small village which although fairly disconnected from the larger economic/social dynamics that play in the macro-scale, is a regional centrality and carries a heavy historical value for this region of the continent, respectively.

In Porto Velho, many public and private institutions and companies play an important role in the city, as it is a point of exchange between land and water: soybeans that are planted in the hinterlands of Rondônia and Mato Grosso (Northern and Mid-western Brazilian states) are shipped to international markets from the private and public ports of Porto Velho built along the Madeira River. On the other hand, the city and the riverine area are of extreme importance to the *ribeirinhos*, or inhabitants of small villages and settlements that live along the waters of the Madeira River and its affluents, which use the city as a regional center for health, retail and leisure.

On a micro-scale, embedded in the urban settlements of the cities smaller units that can be used as test sites for design experiments are the urban systems of public open spaces, as well as urban catchment areas and, due to the nature of the background project (the connection between the Amazon and the La Plata basins via a robust system of waterways), the waterfronts and urban waterscapes.

Therefore, making justice to the scale of the overarching project, it is important to keep in mind that the individual designs should respond, at this stage of development, to concepts and dynamics elaborated for the regional scale: those of the functioning of the waterways systems, e.g. ports, those of the protection of natural environments against anthropogenic intervention, e.g. restoration of riverine ecosystems and those of strategic relevance to the well-being of citizens in urban environments, such as the maintenance or creation of a system of rainwater collection and other basic infrastructures such as sewage systems.

On a general note, actors at all scales are very distinct, and it can be said that their interests are not always in synch, especially with the interests of the forest and of the indigenous peoples. This is why the ecosystem participation perspective is of such relevance to this case. By reframing our place and our part as humans in such a robust yet fragile ecosystem, it is expected that insights on how our role as designers can contribute to the solving of some of the issues identified.

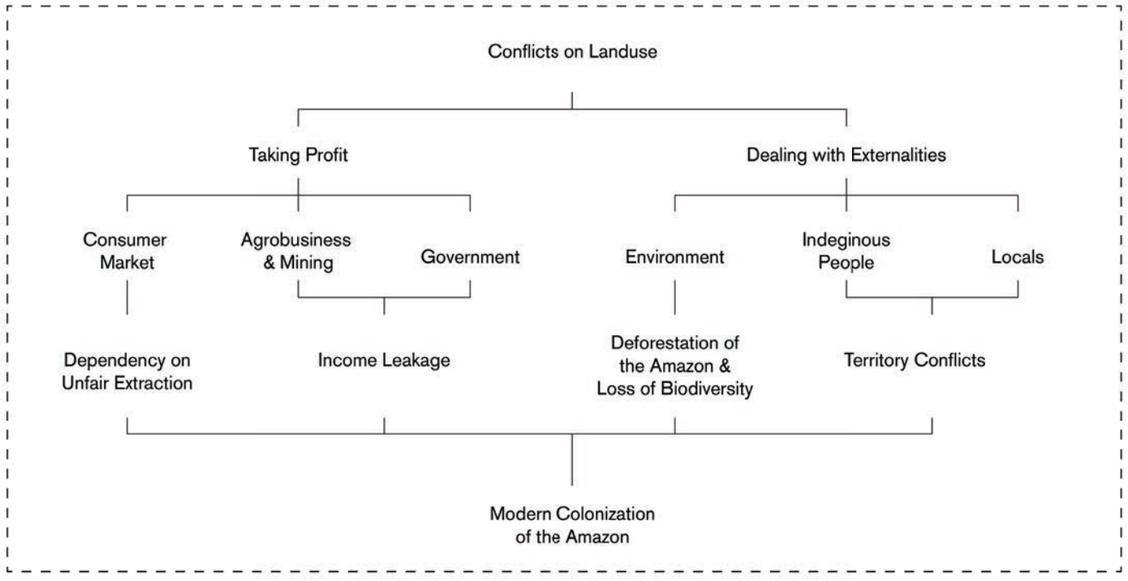


Compasion of scales between the analysed stretch of the waterway between Porto Velho, Vila Bella da Santíssima Trindade and Corumbá in South America (left) and Europe (right). Both maps are shown in the same scale.

Problem Statement

Brazil has an export focussed economy that provides the whole world with products such as soy, minerals and meat. In the Amazonian region a lot of land is used for the extraction of commodities. This causes conflicts on landuse, as there are two groups that are diametrically opposed. On one side there is a group taking profit from the export focussed economy, while on the other side there is a group that has to deal with the externalities of it. This group, consisting of the environment, indigenous people and locals, suffer from the burdens of deforestation, pollution and water scarcity due to extraction.

This conflict on landuse can be described as modern colonization of the Amazon rainforest.



Research Questions

The main research question set for the project is:

How can ecosystem participations perform as a design catalyst for healthy and climate proof urban extraction landscape?

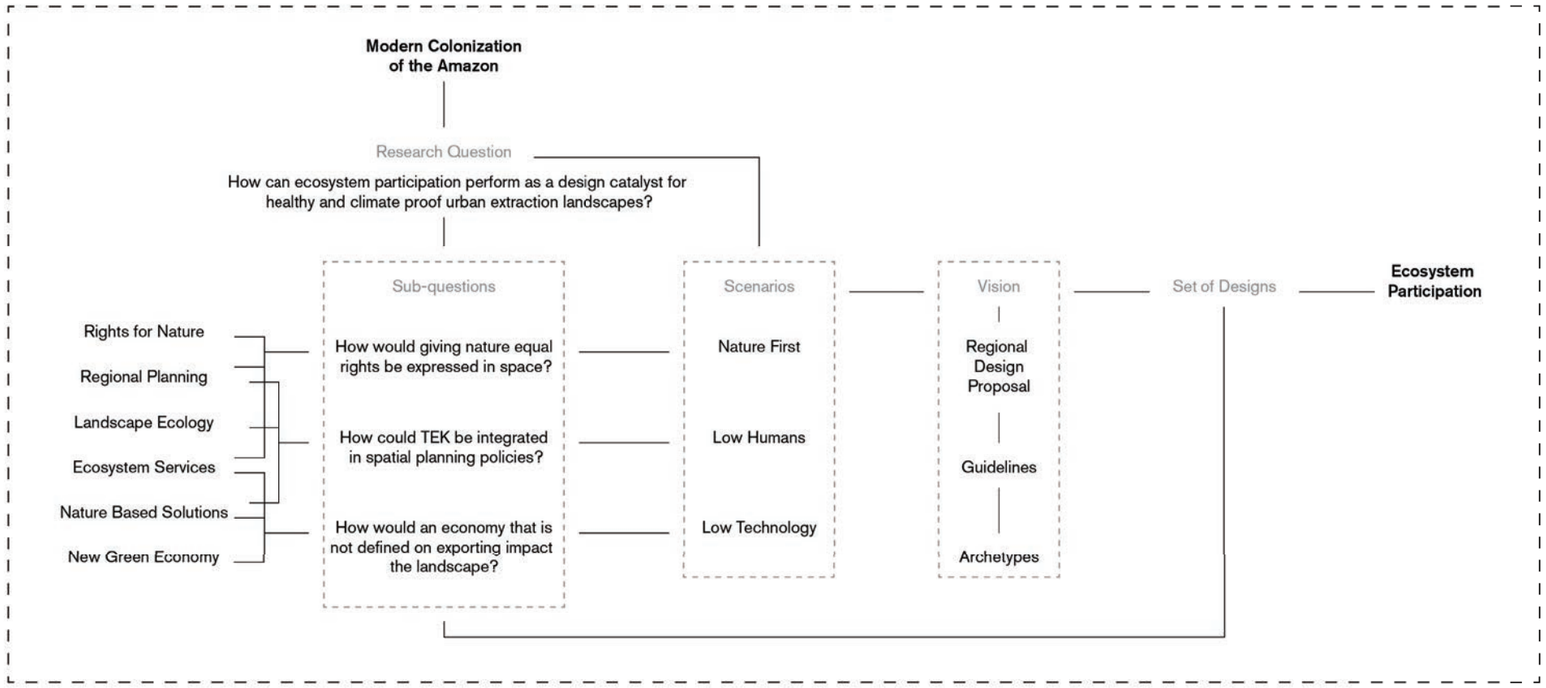
In order to specify this for the specific context of the Amazon in Brazil, a few subquestion are formulated:

- How would giving nature equal rights be expressed in space?
- How could TEK be integrated in spatial planning policies?
- How would an economy that is not defined on exporting impact the landscape?

Theoretical framework

Based on the problem statement and research questions, a theoretical framework is defined as a guideline for the project. With this theoretical framework, we aim to answer the main research question of the project.

The sub-questions are linked to the scenarios and to different theories. These theories are selected to support the development of the vision and set of designs.



Rights for Nature

Most definitions of “stakeholder” only consider human entities and non-human nature is not included. However the natural environment affects or is affected by all organizions using stakeholders (Starik, 1995). Three reasons for including the natural environment as a stakeholder are researched by Starik (1995): “the natural environment is an important business environment; that the stakeholder concept can include non-human entities, if ethical, socio-emotional, legal, and physical characteristics are contained in this concept; and, that those human entities that are currently recognized as natural environment-related stakeholders can be supplemented by direct recognition of non-human nature as one or more stakeholders.”

As the natural environment in this project is suffering, the approach of rights for nature is crucial in order to ensure that the vision is in nature’s best interest and preserves the values of the indigenous people.

Regional Planning

Regional Planning is a concept that has different interpretations in different contexts. In Brazil, spatial planning is a responsisbility that the local governments, the 26 states and the federal government share (Farret, 2001).

Regional planning is a tool to organize the spatial developments and make sure that all the different stakeholders are in syncronization and are heading into the same direction. Besides this, not only the country of Brazil should be involved in the developments concerning the export of commodities, but also other bodies of power such as the United Nations, Mercosur and the World Wide Fund for Nature should be involved to accomplish transnational goals.

Ecosystem Services

Costanza et al. (1997) have defined ecosystem services as ‘‘the benefits human populations derive, directly or indirectly, from ecosystem functions’’. Multiple ecosystem services are distinguished and they can be available on local and globale scale (Bolund, & Hunhammar, 1999).

The ecosystem services provided by agriculture have negative impacts on the natural environment and play a big role in the case of the Amazon. Therefore, considering the different ecosystem services in the specific area is imporant in order to develop a vision and design that includes ecosystem participation.

Landscape Ecology

Landscape Ecology can be defined as “spatial mosaics of interacting biophysical and socioeconomic components” (Wu, 2008). It is about understanding the landscape as a system of components that has multiple layers.

Within this project there is a gap between the landscape ecology and the ecosystem services, which causes the conflict on landuse in the area. The approach of ecosystem participation links the two concepts and could be introduced to bridge this gap.

Nature Based Solutions

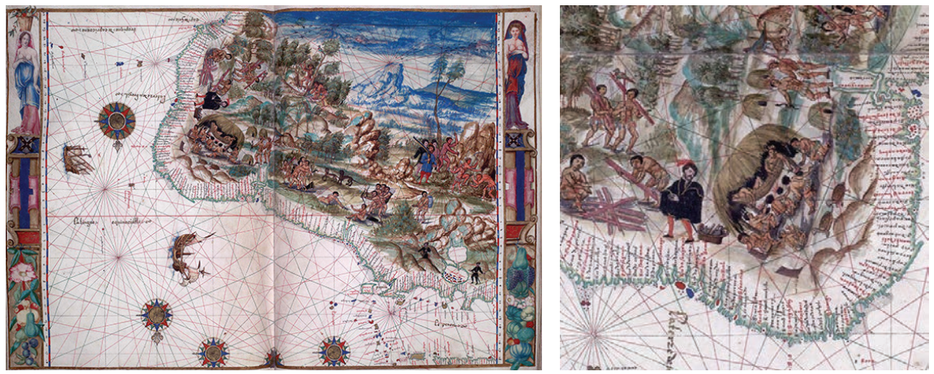
The concept of Nature Based Solutions can be defined as “actions to protect, sustainably manage and restore natural or modified ecosystems, which address societal challenges (e.g. climate change, food and water security or natural disasters) effectively and adaptively, while simultaneously providing human well-being and biodiversity benefits” (Cohen-Shacham et al., 2019).

This approach is recommended for this project as it provides possible solutions for deforestation and loss of biodiversity that support the concept of ecosystem participation. However, there is also a social componend to Nature Based Solutions and the feasibility of the solutions depend on the social aspect. The solutions are only Nature Based Solutions if there is a human componend involved. Otherwise they are just pieces of infrastructure.

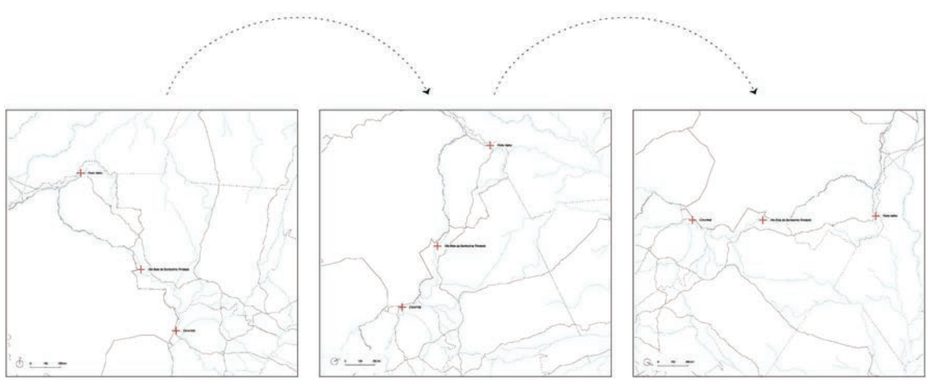
New Green Economy

In the current situation Brazil has an export focussed economy, which obviously is harming the natural environment. In order to reduce the impact of exporting commodities a transition to a new green economy should be made.

Examples of green economies are the circular economy, which is “an economic model wherein planning, resourcing, procurement, production and reprocessing are designed and managed, as both process and output, to maximize ecosystem functioning and human well-being” (Murray et al., 2015), and the biobased economy, which is a “major new opportunity for agriculture—providing the opportunity to take it from its recurring overproduction for limited food, feed, and fiber markets to a more sustainable and profitable balance of production and markets” (Hardey, 2002).



This atlas shows native Brazilians bringing brazilwood to a French merchant dressed in black. "Northeastern South America," detail of French merchantâ in the Vallard Atlas, c. 1547, folio 11 (Huntington Library; photo UC Berkeley Library, www.digital-scriptorium.org, CC BY-NC 4.0).



Map rotation

2.

Critical Cartography

Process of collecting data

In oder to form an understanding of context and a solid theoretical base for our design proposals different ways of collecting data were used. To start the proces literature was used to gain a understanding of Ecosystem participation in relation the the context.

Later the different domains focused on different techiques of research:

For the landscape morphology analyses GIS data formed the bases for the analyses. For the urban morphology analyses there was a lack of GIS data therefore aternative sources as Google Earth were used to form a understanding of the local context. Lastly the anthropology analyses mostly relayed on quatative data, such as papers and articles.

Map Rotation

The critical cartography analyses formed the basis of the proposed map rotation. It is a way to explore what an alternative future for Brazil holds in store, a future that is not so much focused on the Western world but more on in land connections. Therefore the map is rotated to be focused more towards the Andes and the inland of the continent.

2.1

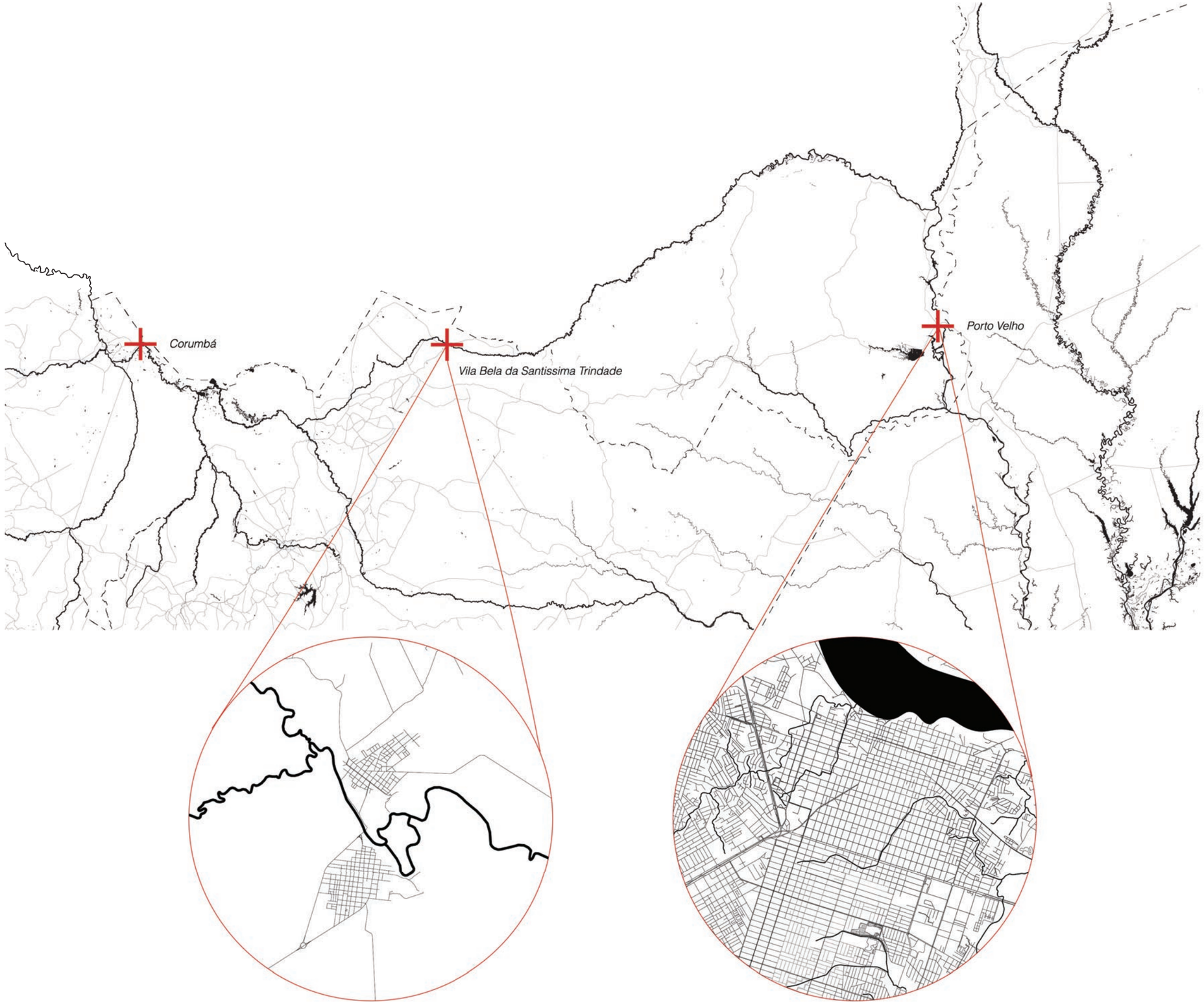
Critical Cartography | Urban Morphology

Sanne Francissen

The critical cartography for the urban morphology covers the smallest of the three defined scales. It studies the dynamics of two different settlements: Porto Velho, one of the largest cities of Brazil and the captial of the state Rondônia, and Vila Bela da Santissima Trinade, a small village descended from colonial times. Two very different settlements which both play or have played an important role in the transport of commodities.

The settlements will be analysed and compared by looking into the urban tissue, building ensembles and public spaces. Furthermore, this cartography contains analysis on different scales. From the vernacular architecture to their position within the country of Brazil and everything in between.

All finding will be combined and concluded in the synthesis drawings.



Urban Morphology

Vila Bela da Santissima Trinade is located in the state of Mato Grosso and has about 16,000 inhabitants. Porto Velho, the captial of the state of Rondônia, is located more up north and has a little less than 540,000 inhabitants.

The two settlements are connected by both roads an waterways.

- Waterway
- Waterbody
- Structural Highway
- National Border
- Selected Locations

0 100 km N



An impression of the calm and well-arranged colonial town of Vila Bela da Santissima Trinade.

Urban Morphology

Urban Tissue
Vila Bela da Santissima Trinade

Waterway
Waterbody
Roads
Main Roads



0 1 km N





1. The busy and fully paved city centre of Porto Velho.



2. Smaller residential area formed by its landscape.



3. Average neighbourhood defined by the city its strong grid.

Urban Morphology

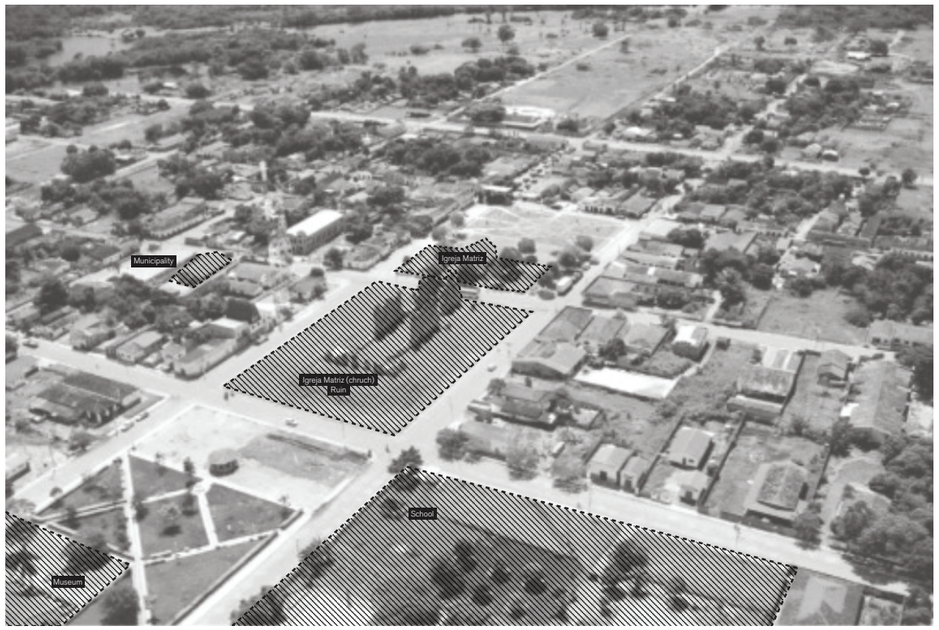
Urban Tissue
Porto Velho



Waterway
Waterbody
Roads
Main Roads

0 | 1 km | N





The buildings are well maintained and the public buildings are centred around the historic ruine which is built in colonial times.



Urban Morphology

Urban Typology
Building Ensembles

Vila Bela da Santissima Trinade

- Waterway
- Waterbody
- Roads
- Residential Building
- Industry
- Church/Museum
- School
- Public Service
- Municipal Building



0 100 m N



1. Poorly maintained buildings in a residential district.



2. Settlement formed by its landscape.

Urban Morphology

Urban Typology
Building Ensembles

Porto Velho



- Waterway
- Waterbody
- Roads
- Residential Building
- Townhouse Complex
- Gated Community
- Port
- Church
- School
- Public Service
- Governmental Building

0 | 100 m | N





1. Huge, well-maintained, modern style governmental building next to the smaller traditional educational building.



2. Well maintained residential communities.

Urban Morphology

Urban Typology
Building Ensembles

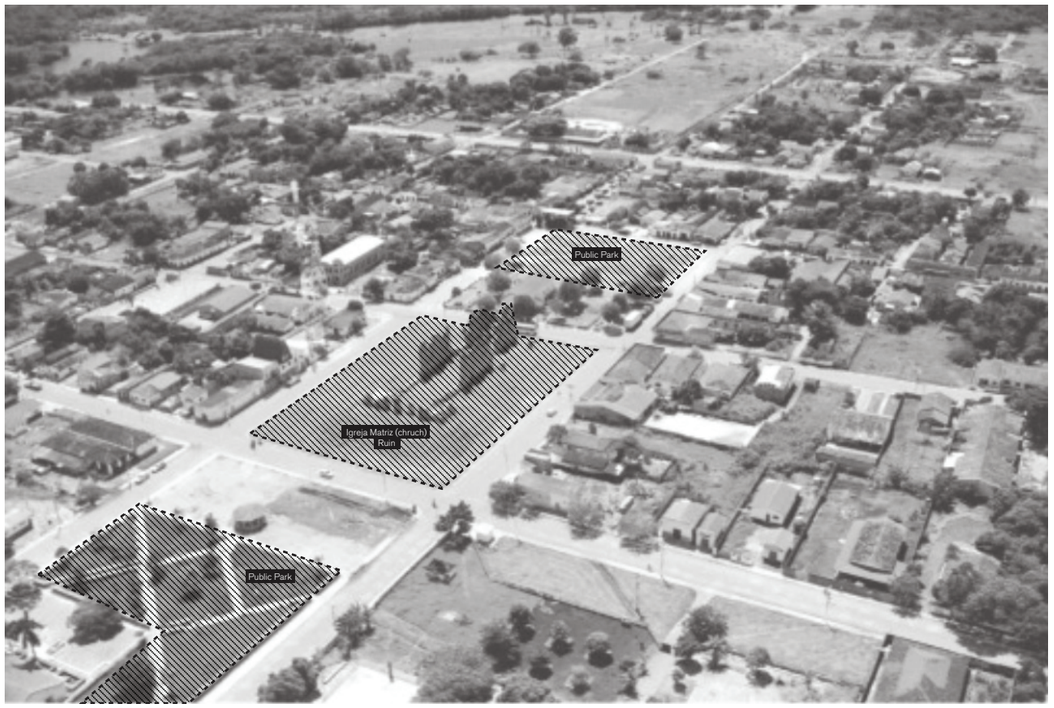
Porto Velho

- Waterway
- Waterbody
- Roads
- Residential Building
- Townhouse Complex
- Gated Community
- Port
- Church
- School
- Public Service
- Governmental Building

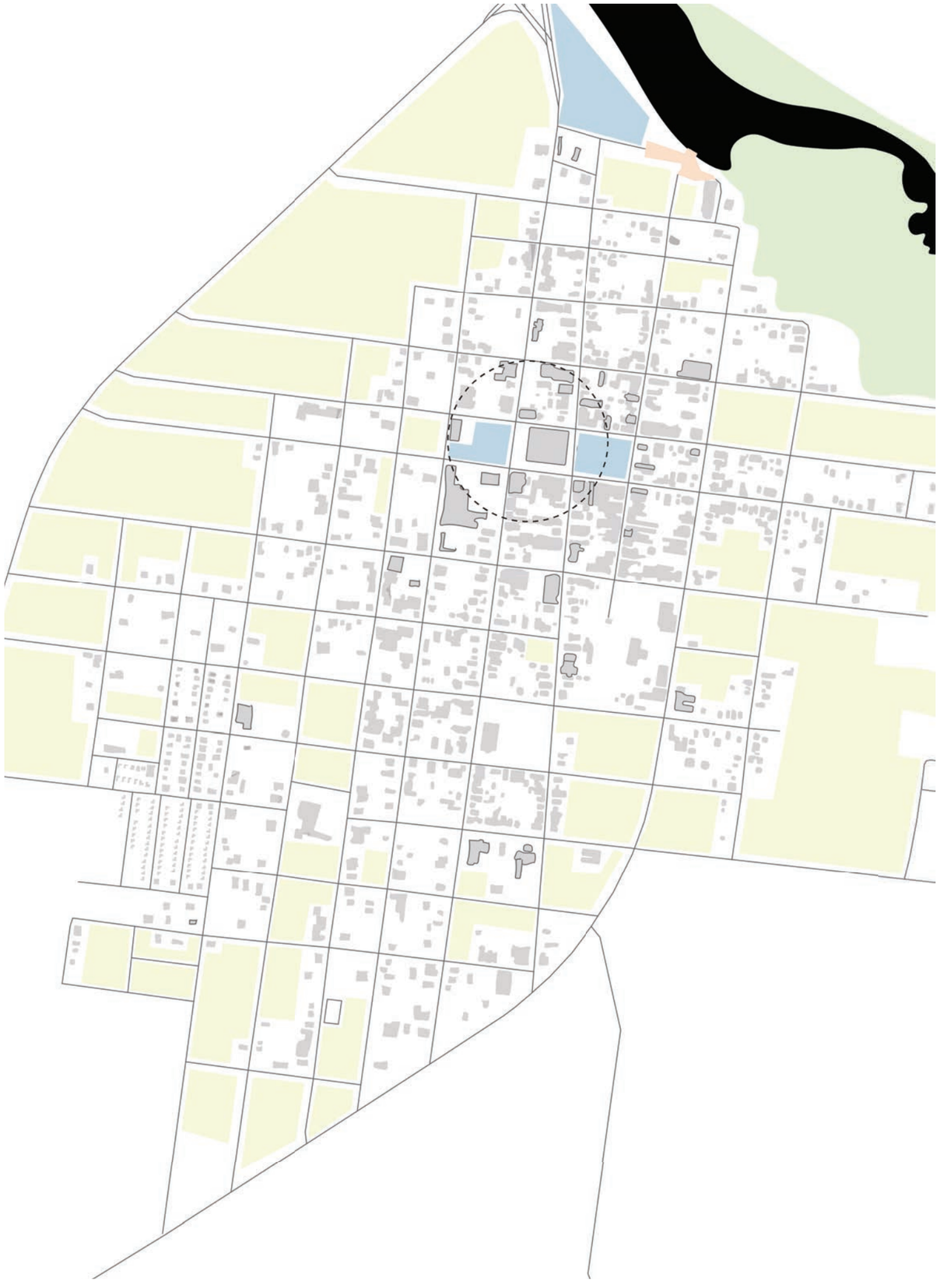
0 | 100 m | N







The plots are strictly divided along the grid. The public space is centred around the historic ruine.



Urban Morphology

Urban Typology
Public Space

Vila Bela da Santissima Trinade



- Waterway
- Waterbody
- Roads
- Residential Building
- Public Buildings
- Port
- Empty (Green) Lot
- Nature
- Public Park

0 100 m N



1. Closed gates around the public port of Porto Velho.



2. Huge parking lot for a car rental service.

Urban Morphology

Urban Typology
Public Space

Porto Velho

- Waterway
- Waterbody
- Roads
- Buildings/Urban Area
- Public Buildings
- Port
- Parking Lot
- Nature
- Public Park

0 100 m N







1. Small soccer fiels enclosed by residential buildings.



2. One of the rare open spaces in the densely popluated city.

Urban Morphology

Urban Typology
Public Space

Porto Velho

Waterway
Waterbody
Roads
Buildings/Urban Area
Public Buildings
Port
Parking Lot
Nature
Public Park

0 100 m N









Urban Morphology

Urban Typology
Section

Vila Bela da Santissima Trinade

0 100 m





Urban Morphology

Urban Typology
Section

Porto Velho

0 100 m

The town of Vila Bela da Santissima Trinade contains multiple supermarkets in both districts. Only in the old district, a medical centre in the form of a small hospital can be found.

Besides this, the settlement is accesible by a few roads in both districts. However, a car is requierd to travel, because the closest city is located 75 km away and there is no public transport in this area.

Urban Morphology

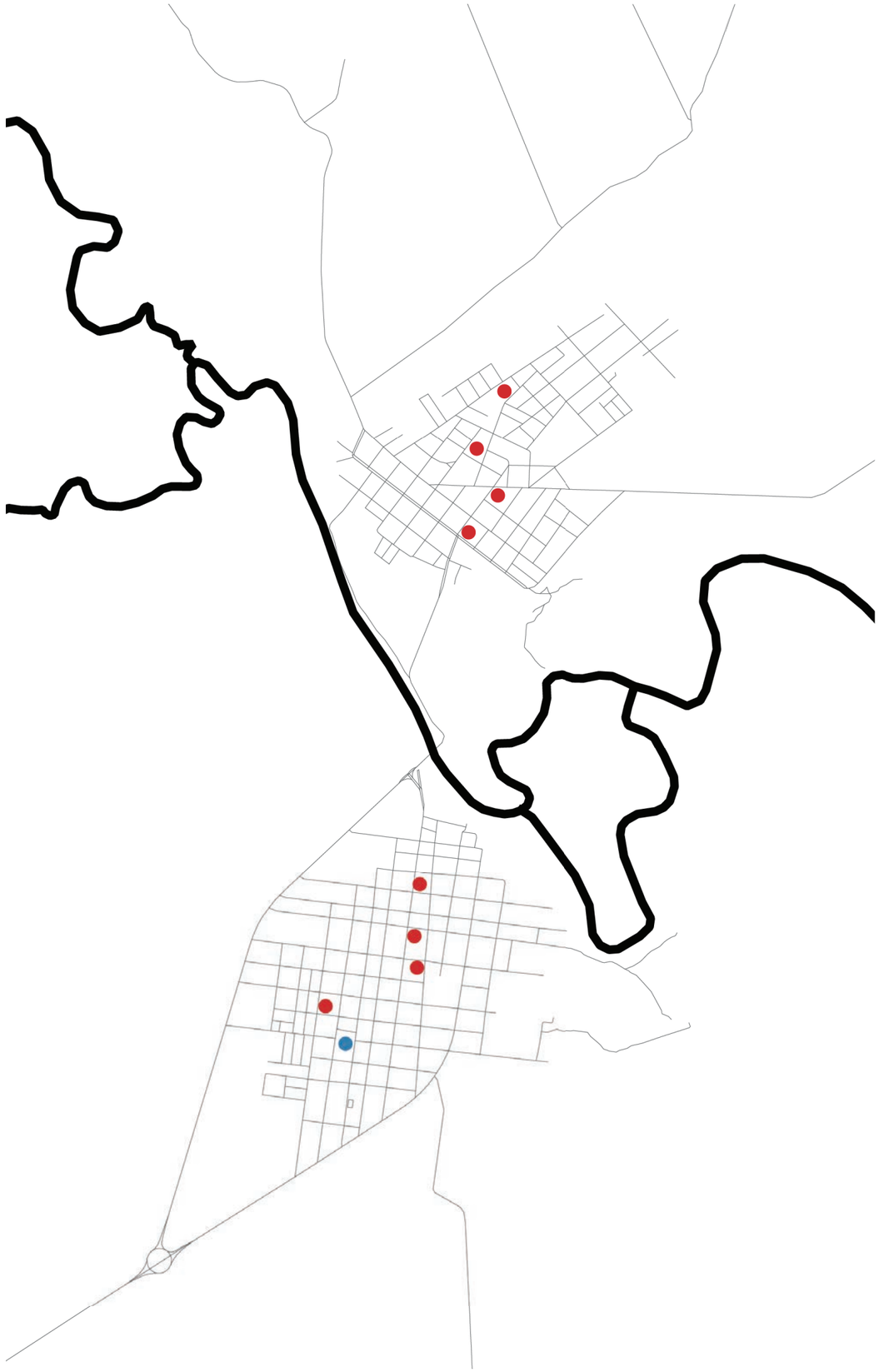
Vital Infrastructure
Health & Utilities

Vila Bela da Santissima Trinade

- Waterway
- Waterbody
- Road
- Hospital/Medical Centre
- Supermarket

0

1 km



As Porto Velho is a large city in the Amazonian region, there are multiple supermarkets and medical centres available in each district, as well as a very extensive bus network.

Also, one can enter the city from all directions and there is an international airport located in Porto Velho.

Urban Morphology

Vital Infrastructure
Health & Utilities

Porto Velho

- Waterway
- Waterbody
- Roads
- Hospital/Medical Centre
- Supermarket

0 1 km N

These photographs show a few of the vernacular achitecture typologies that can be found in the project region. The stilt houses can still be found in small numbers while a comination of the other three typologies can be found in large numbers. This is called the taipa de pilão and is made of mainly dirt.

Urban Morphology

Architectural Morphology
Vernacular Architecture

Source: Daudén, 2014.



Stilt Houses: can be found in areas with lots of rainfall.



Shack: masonry without plaster.



Rammed Earth House: developed in the colonial era. The wooden frame is removed after the mixture of clay, lime and gravel, which fills it, is mechanically compacted.

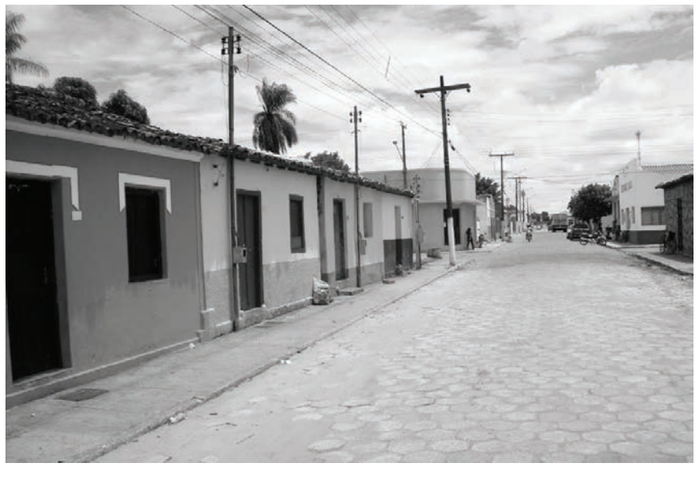


Quilombo: resistance settlements of African Slaves.

Tradtional way of building contructions made up of concrete blocks covered by plaster. Rooftop are covered with tiles or corrugated iron. This building type can be found a lot in both Porto Velho as Vila Bela da Santissima Trinade.







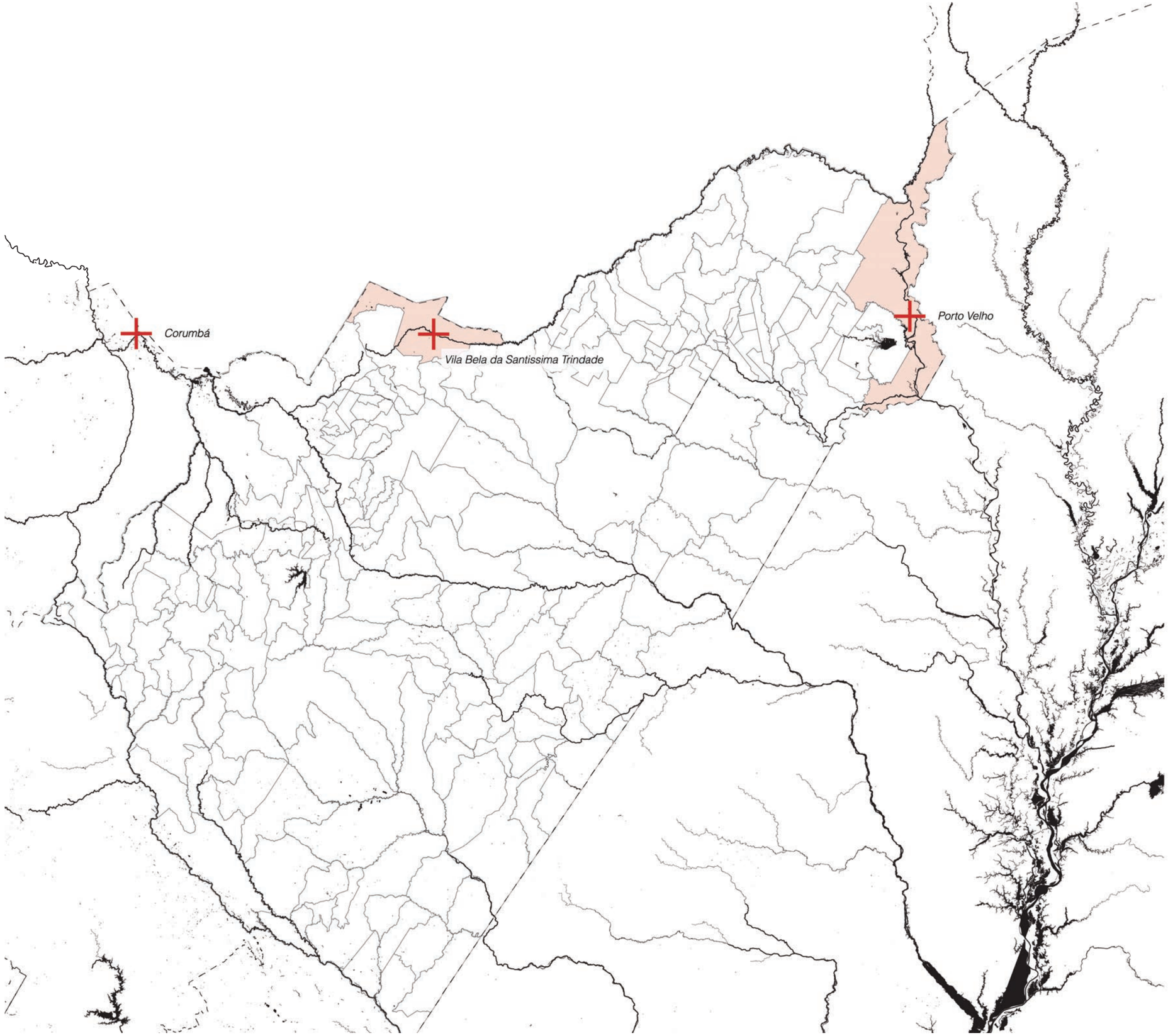
The tilted house is a traditional building typology in Brazil, and can be found in areas that have a high risk of flooding. However these houses are not built often anymore. This photo was taken in Vila Bela da Santissima Trinade and is made up of wood.





Urban Morphology

Architectural Morphology
Building Typology



Brazil is divided into 26 states, which are based on the historical borders that have been established since the colonial times. The municipality of Porto Velho is the capital of the state of Rondônia and the municipality of Vila Bela da Santissima is located in the state of Mato Grosso. Remarkeble here is the size of the municipality, which is huge, compared to the outreach of the urban settlement itself.

Urban Morphology

Governance & Relations

Waterway
Waterbody
Municipal Border
National Border
Selected Locations

0 100 km N

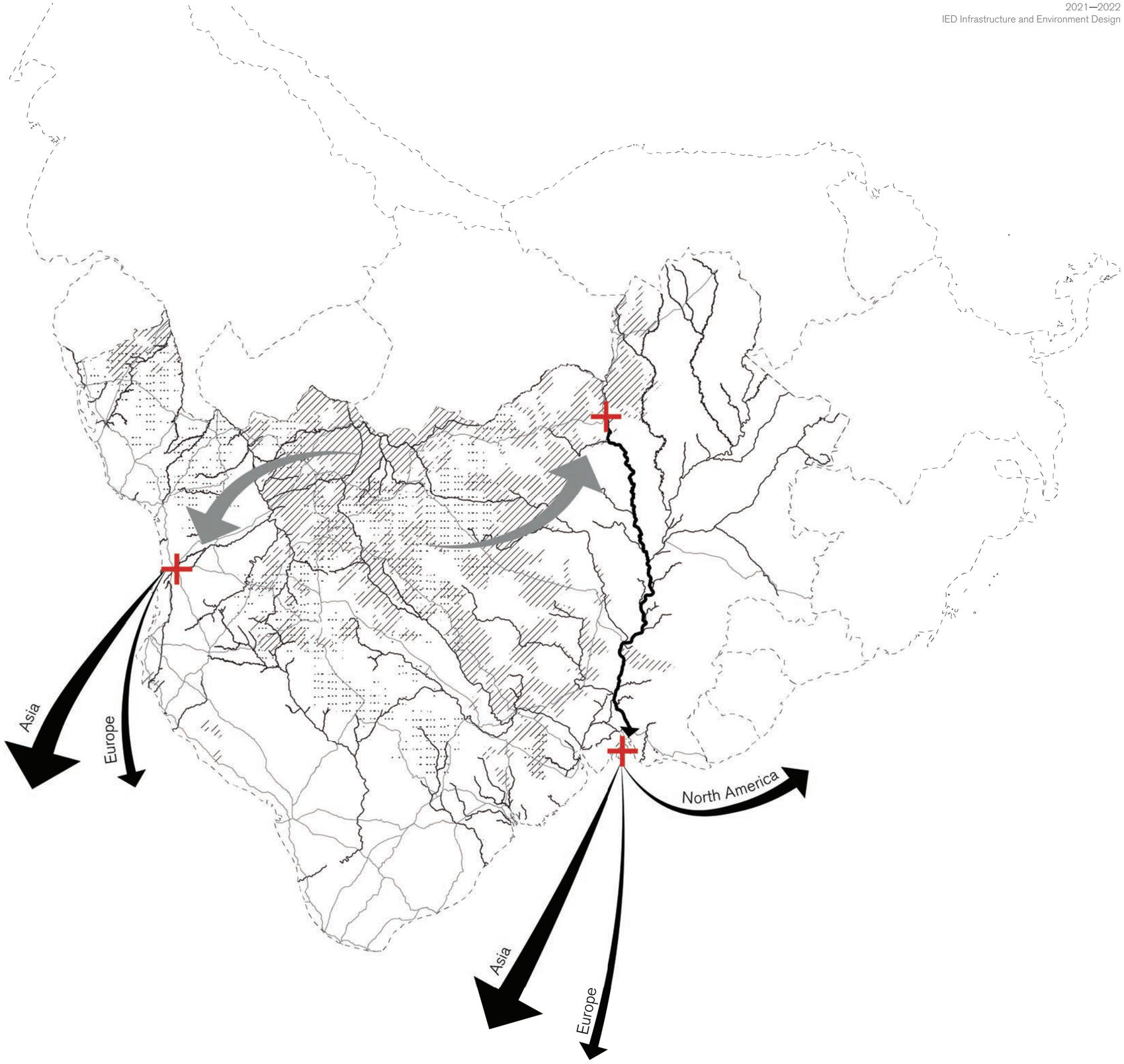
The infrastructure in Brazil is important for the outflow of commodities is. Soy extraction and cattle farming cover the majority of the surroundings of Porto Velho and Vila Bela da Santissima Trinade. These commodities are transported to Porto Velho, from where it goes to the coast and overseas. Both towns are located along a waterway and play or have played an important role in the export of Brazil.

Urban Morphology

Extraction Flows

- National Border
- Waterbody
- Roads
- Important Nodes
- Soy Extraction
- Cattle Farming
- Water Transport
- Road Transport
- Transnational Transport

0 250 km N





For the urban morphology, the focus lies with the outflow of commodities. Soy extraction and cattle farming cover the majority of the surroundings of the Vila Bela da Santissima Trinade. These commodities are transported to Porto Velho by road, from where it goes to the coast and overseas. Both settlements are located along a waterway and play or have played an important role in the export of Brazil. However when zooming in we can see the neither of them have strong connection with the water. Vila Bela da Santissima Trinade, which is way smaller then Porto Velho, consists of two districts separated by water, but along the shore hardly anything happens. In Porto Velho, there is no connection with the water either, except from the relatively small port that is there.

Furthermore, there a multiple differences and similarities between the two places. Both have a strong grid as a result of the colonial times, but Porto Velho is way more dense. There is much more open space in Vila Bela and this is also of higher quality compared to Porto Velho. Besides this, both places have the same building typology, but ther is a clear difference in maintenance.

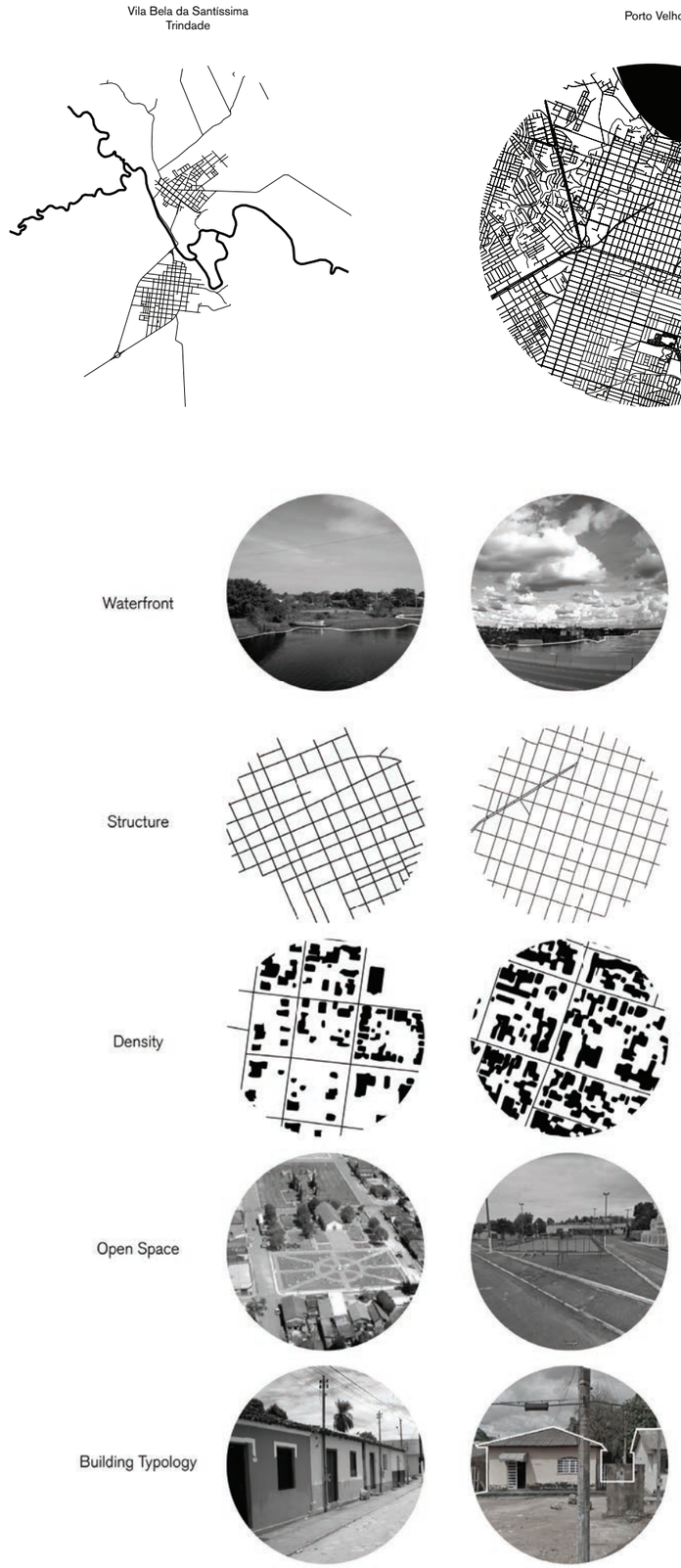
In conlcusion Vila Bela is a well maintained and calm village with a lot of open space, and Porto Velho is a more dense and chaotic city with a strong difference between governmental and residential buildings. As a result Vila Bela would be more adaptable compared to Porto Velho in finding the middle ground.

Urban Morphology

Synthesis

- Municipal Border
- Waterbody
- Roads
- Selected Locations
- Soy Extraction
- Cattle Farming
- Water Transport
- Road Transport

0 | 100 km | N



2.3

Critical Cartography | Anthropology

political systems & technical posibilities

Jin-Ah Duijghuisen

“What human systems influenced the deforestation rate of the Amazon?”

These human systems are split up in to three subdomains exploring the following subquestions:

- A01 | Cultural Systems: How do people perceive the extraction environment and coexist?
- A02 | Time Systems: How did technology change the notion of time and therefore the extraction pace and the relation to nature? What are the implications for the future?
- A02a | Time Systems: How did political regimes changed extraction?
- A02b | A02b - Political regimes and conflicts of territory
  How economic growth on global scale led to territory conflict on local scale?
- A03 | Extraction and Scale: How did different political regimes influence the notion of scale and therefore the extraction pace and the relation to nature?

A01 - Cultural Systems

A01 | Cultural Systems:

How do people perceive the extraction environment and coexist?

In trying to answer this subquestion the grids and groups diagram (figure 1.) of Mary Douglas was used.

In formulating an understanding on how these four groups could be used to depic mens view on the extraction landscape the paper: “Clumsy solutions for a complex world: The case of Climate Change” frome Verwij et al. (2006) was used.

In their paper Verwij et al (2006) use the four groups as perspective to the climate change debate. The formulated that each group as a different position in the debate. Verwij et al. translated these positions in to policy stories that consist out of: a setting (the basic assumptions), a villain (the policy problem), heroes (policyprotagonists), and a moral (the policy solution). This format was used to also create an position in relation to extraction environment of the different actors in the amazon.

Window Scapes

Three different actors were chosen to represent the different positions of actors to the Amazon forest. 1) The indigenous people (Wari’). This group decends from to the orginonal inhabitants of the area around the chosen location. This group is also strongly depended and connected to the forest and the river. 2) The soy producers, this group represents the capitalistic and anthropogenic forces on the amazon forest the river. 3) The cattlefarmers represent the local population. Although they really harm the natural environment, they feel a close relationship to their living environment and feel that fate is closely connected to the coditions of the land. Due to their depenency on land and the economical forces they are caught in a down ward spiral of income leakage.
4)The forest and the river it self. In the growing debate if nature should have legal right, an exploration was made of where these ideas find their origan and what is the corresponding policy story.

Soy Producers





THE INDUVIDUALIST

The setting: Nature is robust and bountiful.
The villains: Those who try to protect the Amazon Forest: idealistic, naive bureaucrats looking to expand their budget and power over the forest.
The heroes: Are both decision makers who are not intimidated by social democratic ideals and the idea of the transitoriness of the amazon forest, as well as risk-taking entrepreneurs who make sustainable technologies compatible.
Moral: Innovative business as usual.

This policy story translates into behavior of the individualist on the micro scale:
The soy producer sees nature as robust and is conflict with those who try to protect the forest from the mass production of soy. The soy producer sees this protection as nonsenses and is mostly driven by economic growth. He sees technological innovations as a way to extract more of the environment for his own gain. The window scape of the soy producer mainly consists out of his own created landscape that centers around production of soy. This meaning, tractors and other highly advanced agricultural equipment that make mass production possible.

The Amazon





THE EGALITARIAN

The setting: Nature is fragile. The world is ecocentric in which everything is connected and Planet Earth is a single living entity. Environmental degradation is an attack on human wellbeing.
The villains: The advanced industrial society, more specific those who are obsessed with economic growth.
The heroes: Those who understand that nature and humans are closely interrelated, and in order to halt environmental degradation we must address the global inequities.
Moral: Deep Ecology, wilderness for its own sake. This could also be translated into equal rights for nature.

This policy story translates into behavior of the individualist on the micro scale:
This position is, form a modern perspective, is yet to be integrated into local behavior. Although on a global and national scale the concept and movements are growing to give nature right for the Brazilian Amazon Forest is concept is not yet implemented.

The Cattle Farmer





THE HIERACHIST

The setting: Nature is robust
The consequences of our existence and nature lay far in the future. The role of a single household or individual is minimal.
The villains: The villains is not specified in a who rather than the lack of governance, protecting the global commons.
The heroes: Big organizations and GNO’s that could play a role in redividing the global commons. Think about governing parties as the United Nations.
Moral: It is the responsibility of strong and powerful parties to fight climate change and the damage humans pose on the natural environment.

This policy story translates into behavior of the individualist on the micro scale:
The local cattle farmer can be seen as a hierachist. They see nature as a very valuable resource from which they can take (with limits). They acknowledge its limits but, due to economical circumstances, can’t always guarantee these limits. They feel like the consequences of overstepping these limits are not their problem but belong to those who can carry that responsibility (national government).
The setting: Nature is robust and bountiful

Indigenous People





THE HIERARCHIST
&
THE EGALITARIAN

The setting: Nature is robust and bountiful

The indigenous tribes of the Amazon see the forest and the natural environment both through the lenses of hierarchist and the egalitarian. Meaning that they found a way in which they can still interfere in the natural environment (hierarchist) but also still see nature as a subject and value and take care of nature for natures sake (indivualist). Their way of living can be seen as a way of breaking the grid model of Douglas and move to a middle ground solution to live with the natural environment.

A02 - Time Systems (technnology)

How did technology change the notion of time and therefore also change the extraction pace and the relation to nature? What are the implications for the future?

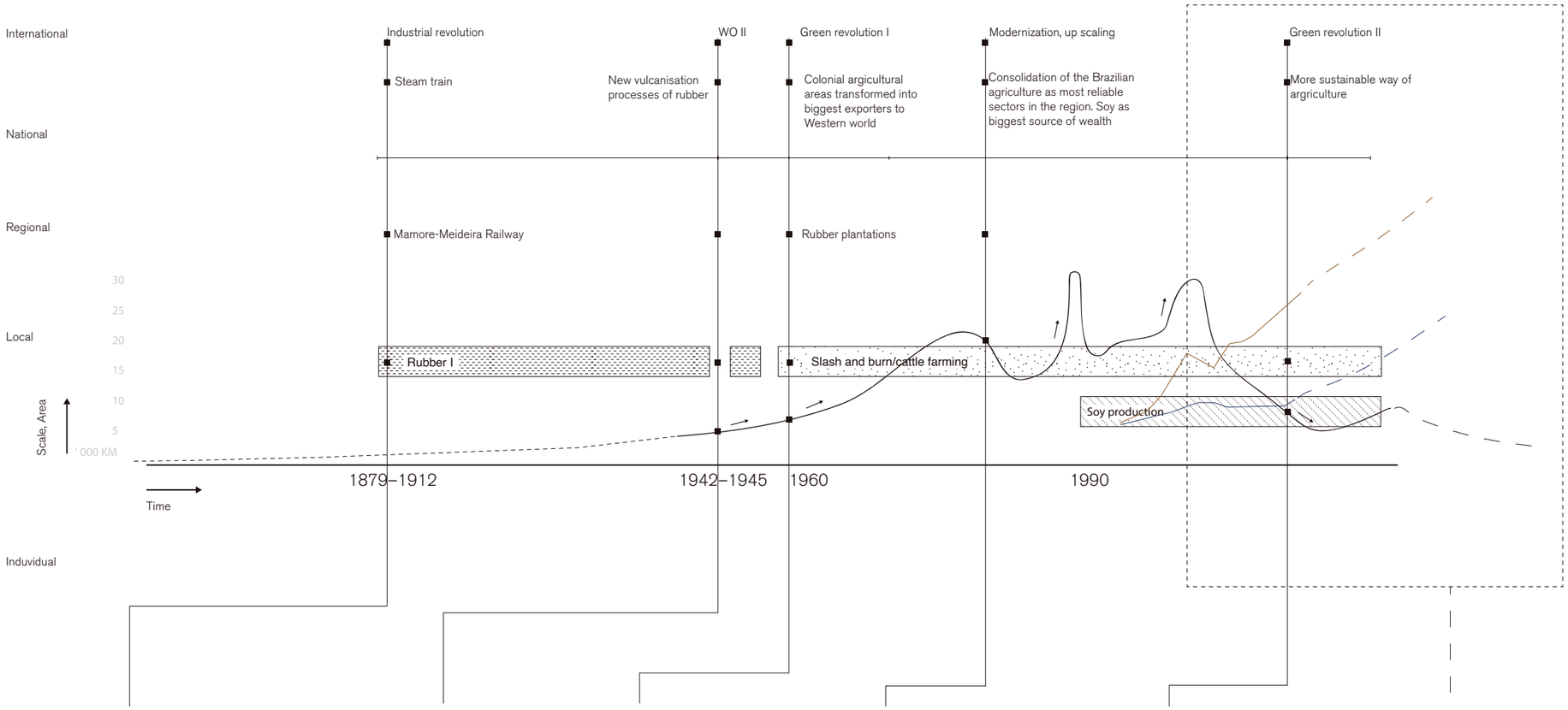
The graph on this page explains the relation between big political event (international scale) technical inventions/infrastructure (national, regional scale), extraction (local scale) and deforestation.

Lastly the graph shows how these systems influenced the way and the pace of extraction and the individual level.

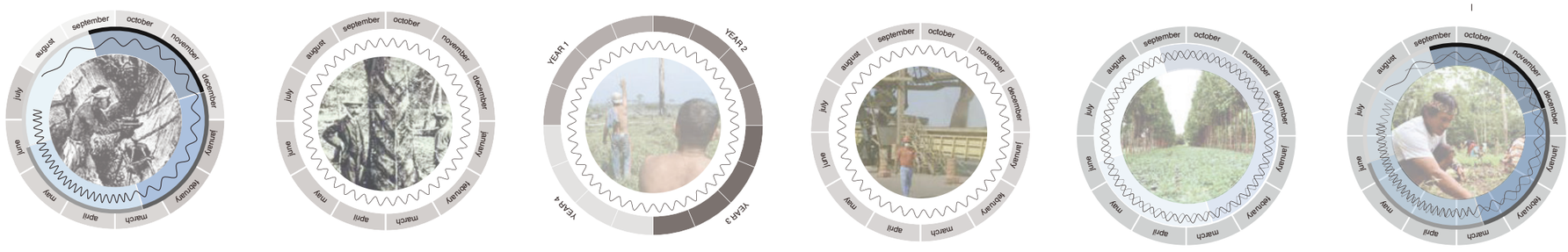
Overall, the conclusion is that technological inventions can be seen as the groundwork of modernization that speed up the way and the pace of extraction on individual scale. A lot of times these technical inventions lead to an increase of deforestation, but sometimes new technical inventions also lead to decrease in deforestation.

Implication for the future

The second green revolution showed that technical innovations can have a positive effect on the deforestation rates, whilst also positively influencing soy and cattle production. Hopefully, technical innovations help to bring extraction way and pace back to a way in which we can listen more carefully to the natural environment. Meaning bringing back seasonality and slowing down extraction rates.



Extraction pace



Timeline

- Deforestation rate
- Soy production
- Cattle production
- Implication for the future
- Extraction pace
- Seasonality
- Rubber
- Cattle farming
- Soy production

A02a - Scale and extraction (Timeline)

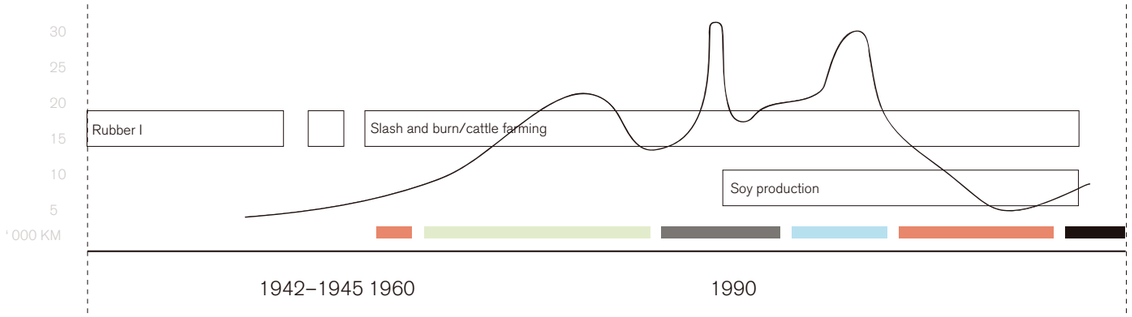
How did political regimes changed extraction?

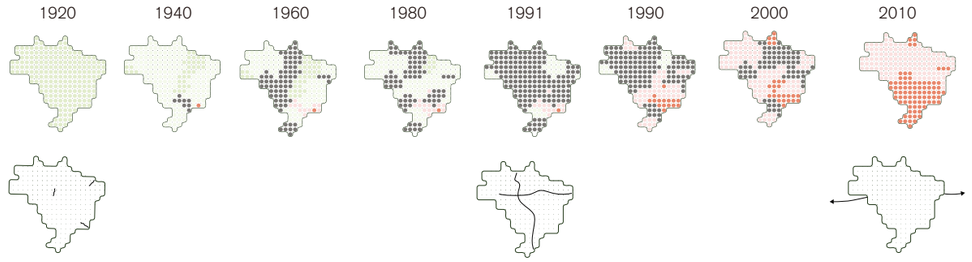
Apart from technical innovations political systems were of big influence of the deforestation rates. Showing big peaks of deforestation under the military regime, liberal and conservative political regimes. These political perspectives are a way to frame the Brazils relation to the global market and the relation of these political regimes and the Amazon forest. A spatial manifestation of this relationship with the Amazon Forest is the infrastructure that is built in the Forest.

Colonial regime: These times can be seen as the first attempt to colonize the Amazon. The physical manifestation of this hunger to try and take as much as possible is the local infrastructures. Such as the Meidera-Mamore Railroad.

The military regime: After the colonial time the military regime saw the Amazon as land to be conquered, full of resources that could bring the nation wealth. The first national and big infrastructural project was accomplished in this time, the trans-Amazonian highway.

This modern time the forest is again or still a object that is used for exploitation and a resource of wealth. The modern infrastructural projects are more focused on making intercontinental export possible. An example of these kind of projects is the The Manaus-Iranduba Bridge that makes crossing the continent possible and is a big investment from the Chinese.





Timeline

- Conservative
- Social democratic
- Liberal
- Populistic
- Military regime
- Deforestation
- Western socities and China
- Brazils consilidation as participant to the global economy
- Outgoing commodities
- Incoming economic wealth

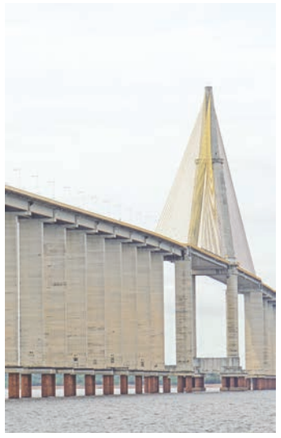
Madeira-Mamoré Railroad



Transamazonian highway



Manaus-Iranduba Bridge

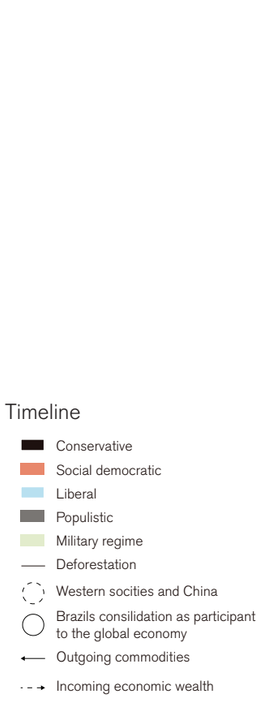


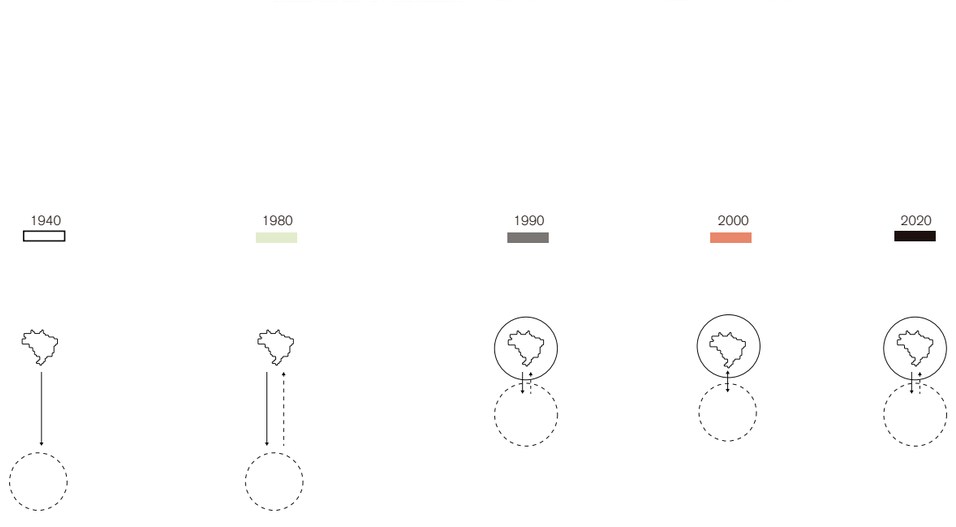
A03a - Political regimes and conflicts of territory
How economic growth on global scale led to territory conflict on local scale?

As said on the previous page the role of the Amazon changed per political regime. This shifting role had an immense influence on the local population in the Amazon. Every political regime had their own reason and resources to invade the forest. These invasions led time and time again to conflicts with the indigenous people of the Amazon. These conflicts growing more and more complicated over the years as the number of actors involved only grew and the duration of the territory conflicts only grew longer.

The visuals on the right page is an afford to show the main actors in the territory conflict per political regime and on a global scale how the relation of Brazil to the global market changed.







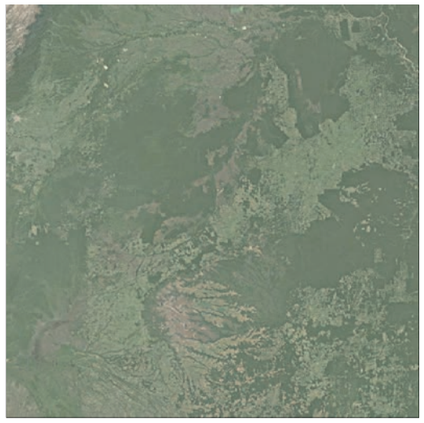
A03b - Scale and extraction (deepmap)

How did different political regimes influence the notion of scale and therefore the extraction pace and the relation to nature?

Every political regime sees the Amazon rainforest in its own way, but also on the individual scale the amazon the territory of the forest isn't a static thing. On the individual level different actors preserve the territory of the Amazon Rainforest different. The maps on this page are an afford to depict the objects that form the territory of the forest, through the lenses of different actors.

The maps are the main conlusion of the anthropology analyses. They depict the landscapes of extractions for the different actors, therefore they are the spatial implication on how different systems (political, time, technical) shaped the perception on the extractionlandscapes.

The context



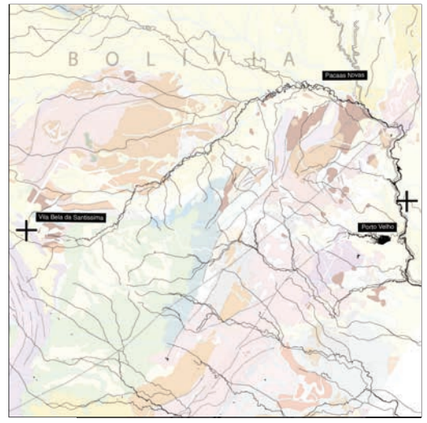
A picture from Google Earths forms the most neutral understanding of the territory.

Soy Producer & The Cattle Farmer



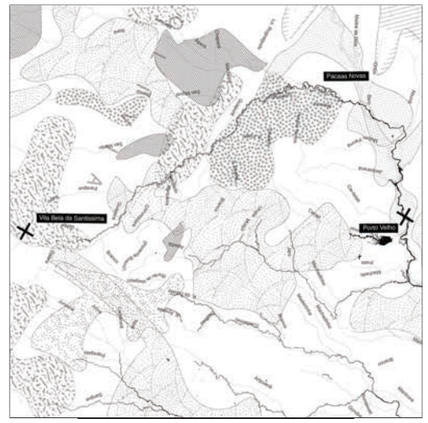
The Soy producer and the Cattle Farmer are both actors that are strongly guided by the modern regimes. These modern regimes view territory moslty through the administrative borders. Therefore this map shows the state and country borders and the borders of the natural en indigenous reserves. For these actors these borders are the most guiding in understanding their living environment.

The Amazon



The rich variety of soil type and climate conditions can be seen as the main reason for the rich biodiversity of the rainforest. This map therefore shows the diversity of soil types that shaped the natural environment.

Indigenous People



The indigenous tribes see territory as something les static and more fluid. They view their territory as places where they can closely follow what the natural environment can give them. This maps shows the shifting territory of indigenous tribes and the indigenous names of the rivers which are leading in choosing a place to settle.

2.4

Critical Cartography | TIL

Paul Simon Schön

Chapter 1. Transport network introduction

1.1 Characteristics

The transport network was described early on by Jones in 1977 from the traveller's perspective, as consisting of several dimensions: Mode, Time of Travel and Journey purpose. The mode tells us something about the possibilities that a traveller or a good has in a transport network. For example, an urban environment in which the traveller has four different mode choices: private car, bus, tramline or metro. Each mode has a certain time and cost component that results in an equilibrium which prefers one mode above the other in different situations. Quandt expanded on this in 1992 by stating that each transport mode also bears a frequency of service and a comfort component. Time of day is a dimension that makes certain modes attractive or unattractive. The metro line, for example, will be attractive during morning peak hours due to its low cost and low travel time component. Since the demand of transport is a derived demand, the journey purpose plays a significant role. Being a derived demand means that the amount of transportation depends on the goal that it serves (Holmgren, 2007). Replacing shopping facilities from the city centre to a surrounding neighbourhood will decrease the level of transport in the inner city and increase the level of transport outwards the city. Finally, the route plays an important role in transportation networks. Routes are made up by activity nodes and links. Activity nodes are access and exit points (Knöll & Mezini, 1977). Examples of activity nodes are train stations, airport hubs or highway junctions. They are characterised as spatial points where multiple transportation links come together and passengers are able to switch from one link to another link. Transportation between these activity nodes is only possible if they are connected by links that serve mobility or logistic flows and therefore provide a certain degree of accessibility. Examples of links are highways, railways or waterways.

However, over the years transportation systems have become more complex, consisting of more components and influence on the outside world. Several bad externalities have arised, of which one is a higher degree of carbon pollution. In terms of the decarbonisation of transport infrastructure, from a systems perspective; Schwanen, Banister & Anable suggested in 2011 that four different sets of elements should be targeted: transport technologies, the price or commodity value of carbon, the 'hard infrastructure', the behavior of users, and the institutions governing transport systems. From a governmental perspective certain routing policies can be implemented to distribute travellers in a more efficient way to motivate or relieve transport modes, destinations and areas. It would be wise to use the identified sets of elements in designing new policies.

To be able to analyse the urban network and identify potential opportunities, a theoretical framework is developed. The mode and route characteristics are regarded as most important in decarbonisation and ecosystem reservation, since they consist of the building blocks that bear the biggest influence on ecosystems. The framework serves as a handy tool to identify critical components in spatial planning and urban design to contribute by means of ecosystem participation instead of the disruption of ecosystems. By making use of the framework, urban planners and designers can develop guidelines to make sure that mobility becomes part of the city's ecosystems instead of exhausting them.

1.2 Benefits

The main function transportation infrastructure serves, is to enable travel activities for both humans and resources. Transportation relates to the movement of goods and people and the undertaking of this activity has several benefits and has been a major human pursuit throughout history. Human travel is done for a variety of reasons, for example work, leisure, research, trade as well as governmental, due to the spatial spread of activities and resources. Therefore, transportation is mainly concerned with either moving resources to more useful locations or people to areas where certain activities can take place. A key measure of transportation potential is accessibility. Transportation infrastructure serves to allow goods and people to reach certain areas which leads to social and economic welfare. Accessibility can be defined as “the potential of opportunities for interaction” (Hansen, 1959). According to El-Geneidy and Levinson (2006) accessibility measures “the collective performance of land use and transportation systems and determines how well that complex system serves its residents”. Common examples include visiting distant relatives, discovery of previously unknown territory, travelling to undertake leisure activities, exchange with other human cultures, visiting religious sites as well as practicing medicine and delivering medical supplies. Economic welfare is generated through gaining access to jobs, spending of money on leisure activities, trade and resource extraction. All these activities constitute a need for transport.

The impact transport systems have on development and welfare is directly related to the ability to take social and economic opportunities, for example gaining access to markets, employment as well as resulting in further investments in the region (Rodrigue, 2020). According to the author, transport accounts for 6%-12% of a country’s GDP, and logistics costs can constitute up to 25% of the gross national product at the macroeconomic level. Furthermore, the effects of transportation activities have more widespread effects as the level of activity and monetary expenditure triggers more activity and more expenditure. These benefits are even more prevalent in peripheral regions and “reduced spatial friction” can result in vast improvements in economic welfare (Leck et. al., 2008). Finally, transportation is a derived demand. People travel, because they need to. The benefits of good transport infrastructure stem fundamentally from this aspect: On one hand costs arising due the need to overcome a distance can be reduced with good infrastructure, secondly benefits that arise due transport improvements directly benefit the activities from which this demand is derived in the first place (Blum et. al. 1998). Examples of direct benefits of improved transportation regimes are decreased travel times, decreased travel costs, increased real estate evaluation as well as increased production and commerce (Rabello Quadros et. al., 2015).

Chapter 2. Ecosystem - Transport influences

2.1 Effects on ecosystems

For every kind of transport infrastructure it is important to identify what the effects on the ecosystem in the surrounding area will be. In this research the effects on ecosystems related to four different cases will be described. The needed infrastructure for each of the cases will certainly have different effects on the ecosystems in the surrounding area. However, the construction of transport infrastructure will always include the building of new roads, waterways and pipelines (Hossain, 2019). For example, research has shown that the road infrastructure will increase by 60 percent in 2050 compared to 2010 (Asher et al., 2020). Especially in developing countries, there will be a huge increase in road infrastructure, up to 90 percent compared to the current situation (Laurance et al., 2014). The tropical forests in these countries are currently facing a lot of threats because of industrial activities and in the future these threats will even become bigger.(Laurance, 2013). Forests in general fulfil an important function in their surrounding environment providing global carbon benefits and providing good quality of local ecosystems which supports biodiversity in related areas (Barrett et al., 2016). Besides the threats for tropical forests, transport infrastructure affects nature in other direct and indirect ways. The physical presence of new transport infrastructure in a landscape leads to new habitat edges, alters hydrological dynamics and disrupts natural processes and habitats. The main effects of transport infrastructure are considered in five categories; habitat loss, disturbance, corridor, mortality and barrier. Habitat loss is a consequence of landscape fragmentation because of new infrastructure. Disturbance is a consequence of the fact that new infrastructure disturbs and pollutes the physical, chemical and biological environment. Movement corridors could be a benefit as a consequence of new infrastructure as they provide connection between different natural areas for wildlife. Mortality is a consequence of new infrastructure, transport mortality has been growing over the last few decades. Lastly, new infrastructure can create barriers in ecosystems resulting in less accessible areas and even isolated areas.(Seiler, 2001). In the future there is a need to find a way in balancing human needs and ecosystem needs in order to realize a sustainable environment. To mitigate the negative effects of transport infrastructure, it is important to focus on the use of green infrastructure to maintain and support the ecosystem services provided by specific ecosystems.(Ghent, 2018)

2.2 Ecosystem participation

Ecosystem participation is an important factor in ecosystem management. The past decades, the call for more stakeholder participation in local land-use planning has been increasing. Critical natural resources are decreasing and ecosystem approaches are being embraced more often. Ecosystem management requires an approach that goes beyond existing jurisdictions and requires broader scales (Grumbine 1994; Christensen et al. 1996). Current ecosystem approaches are bounded to administrative or political lines, rather than the ecological boundaries (Brody, 2003). There have been many claims that local ecosystem participation will benefit the quality of the local land-use. It is argued that this interference is a democratic right, a right constantly being used by environmentalists and activist groups. However, different stakeholders such as resource managers, ecologists and social scientists disagree about the possibility of balancing out the social and ecological goals (Keough & Blahna, 2006). The participation in the ecosystem is very much influenced by the need for transport. A higher need for transport calls for more ecosystem participation to limit damages. Road networks for example have a direct influence on ecosystem change (Liu et al., 2008). Loyd, Lohse and Ferré (2013) however found that with active participation in constructing these road networks, ecosystems can recover. This shows that active ecosystem participation can have an influence. The framework describes through what ways, participation can be beneficial to the ecosystem in each specific situation. Each situation is different and requires different ways of required influence by mankind. Lumber transport is different from geothermal transport in terms of transport modes and required land-use. We as humans need to find a way to optimally distribute those goods with regards to reducing ecosystem damage.

2.3 Critical transport evaluation

For the efficiency of transportation it is crucial to map the network and identify the critical points in the system. To identify which parts of a transportation system are critical, the system needs to be viewed as a whole; a transportation network. Being able to map the critical points (nodes) and links (flows) in the network, will lead to immediate benefits. These benefits stem from the ability to plan for and manage the impacts of transport network degradation to minimise further consequences on economic, employment, trade and social activities in cities and regions (Taylor, 2003).

For the transportation of goods and people there is a wide range of short-term disruptive events, such as partial flooding, visibility reductions, traction hazards due to weather, and pavement deterioration occur on transportation networks on a daily basis (Sullivan et al., 2010). These impacts have a very relevant impact on the overall flow, for mobility but also for other networks of flows. To be analysed, transportation networks can be represented by an undirected graph; a set of nodes that are connected where all the edges are bidirectional. The nodes represent for example train stations and airports where the links represent traffic roads, railways, bicycle paths or waterways.

There are multiple ways of evaluating, analysing and optimising transportation networks. Ip and Wang (2011) first identify the survivability of transportation of a pair of nodes. The survivability of a pair of nodes depends on the number of passageways between them. This is then used to get to the resilience with which the friability can be calculated. The resilience of a city node can be evaluated by the weighted average number of reliable passageways with all other city nodes in the network. The network resilience can then be calculated by the weighted sum of the resilience of all nodes. The friability is defined as the reduction in total resilience upon removing a link or node. It thus determines the critical nodes and flows in a transportation network as it can expose the pain points for any form of transport (human or goods).

Scott et al. (2006) present a new, comprehensive, system-wide approach to identifying critical links and evaluating network performance; the Network Robustness Index. Their aim is to generate not only local solutions but a system that considers larger scale, system-wide impacts. The approach considers network flows, link capacity and network topology. They rely on existing sources of data and yield different highway planning solutions than traditional methods.

Chapter 3. Framework assessment

3.1 Framework structure

3.1.1 Green vs grey infrastructure

Green infrastructure is natural infrastructure, whilst grey infrastructure is man-made infrastructure. The natural flows of a river for example can just as well be used to guide human transport or transport of goods as man-made roads or railways. Whilst infrastructure made by man is certainly necessary for humanity to develop and prosper, the natural aspects of infrastructure are often forgotten. Not only is it important to include nature in the planning and development of infrastructure, ecosystems themselves can be regarded as infrastructure (Silva & Wheeler, 2017). In a way, natural infrastructure is more enduring and resilient than man-made infrastructure, which usually only lasts for 50 years and leaves considerable damage to the environment behind (Doyle et al., 2009). One of the most prime examples of natural infrastructure are water flows, which follow the laws of nature and can only be managed by mankind, but not stopped. However, at the same time these are used as a primary means of transportation across the world, carrying both freight and passengers.

The use of natural infrastructure can become one of the cornerstones of ecosystem participation. Not only in the field of physical transportation of people or goods, but also in the field of supplying people with proper drinking water (Tellman et al., 2018). Despite the historic value of natural infrastructure in humanity’s development, its use is still underappreciated in current times. Changing such a stunted view in many countries takes considerable effort, however will result in payoff of environmentally sustainable infrastructure and a better living environment for people across the world.

3.2 Notes on Framework

The framework aims to map the effects on the ecosystem, the participation of mankind, the effects on society and economy and the evaluation on critical transport evaluation. The characteristics of the network are split up in the mobility flows, activity nodes, logistics flow and transfer nodes.

Effects on ecosystem: This part of the framework describes the effect of mobility services (mobility flows/logistic flows) on the transport related areas related for each specific case (activity nodes/transfer nodes)

Ecosystem participation: The ecosystem participation describes to what extent the ecosystem participation has an influence on different transportation modes for different transportation purposes.

Natural infrastructure usage (green infrastructure): This describes the extent to which natural infrastructure, like water flows or a natural focal point, are being used by man-made infrastructure for each of the cases

Critical transport evaluation: This describes the most important facilities and parts of the infrastructure related to the different mobility services (mobility flows/logistic flows) and the transport related areas related for each specific case (activity nodes/transfer nodes)

A framework on ecosystem participation and mobility systems			**Transportation of lumber, gravel and sand (Flows, Norway)**	**Minerals and soy beans (Flows, Brazil)**	**Geothermal and public transport (Hot, Netherlands)**	**Drink water (Cold, Netherlands)**
Effects on ecosystem (ecosystem services)	Mobility characteristics	Mobility flows (Human transport):	current (trucks): • High speed vehicles intervene with forest new (boats): • Intervening with life under water	• More people, higher strain on the environment as it needs to carry more human activity • Higher need for ecosystem services due to more human activity as well as dissolution of natural infrastructure		
		Logistics flows (Goods transport):	current (trucks): • High level of emissions • Congestion new (boats): • Relative low emissions	• Vast amounts of extraction of resources used by other parts of the ecosystem • Change in the face of the landscape, thereby reducing ecosystem services • Negative externalities due to logistics activities		
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* new (river network): • Mining areas stay as is • Potential change of harbor function • Loss of dams *Grey infrastructure:* current (road network): • Deforestation • Excavation of the soil	*Green infrastructure:* • Space required for port access • Space required for transhipment • Externalities due to construction activities and waterway alterations *Grey infrastructure:* • Space required for transhipment • Externalities due to construction activities	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
		Transport links:	*Green infrastructure:* new (river network): • Potential need for broadened river • Removal of dams on the river *Grey infrastructure:* current (road network): • Environmentally burdenful maintenance	*Green infrastructure:* • Clearing and widening of river network to gain accessiblity for ships and barges • Alteration of waterways *Grey infrastructure:* • Deforestation for road network to gain access for trucks and rail • Artificial dissection of landscape	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
Socio economic effects	Mobility characteristics	Mobility flows (Human transport):	current (trucks): • Relatively large amount of truck drivers new (boats): • Loss of trucker jobs • Rearrangement of supply chain	• People need to gain access to their work place • People need to gain access to their homes • People need to gain access to their families • People and local community benefits of jobs and income		
		Logistics flows (Goods transport):	current (trucks): • Driver of national economy new (boats): • Driver of local economy	• Access to raw materials • Driver of wider national/regional economy		
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* new (river network): • Stay as is, the nodes do not change *Grey infrastructure:* current (road network): • Mining jobs and logging economy	*Green infrastructure:* • Provides jobs and growth in port areas and local communities • Grants access to river communities via the river *Grey infrastructure:* • Grants access to the wider region due to road or rail network • Allows regions away from the river to develop	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
		Transport links:	*Green infrastructure:* new (river network): • Less floadings • More boats that interfere with life on water *Grey infrastructure:* current (road network): • Construction of additional lanes lead to bigger barriers for locals/animals • More houses near highways lessen in value	*Green infrastructure:* • Bulk transport via barge/or ship allows for slower but potentially cheaper movement of large volumes • Establishes access to the amazon river *Grey infrastructure:* • Bulk transport via road allow for more frequent and faster shipments • Establishes access to the hinterlands	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
Critical transport evaluation	Mobility characteristics	Mobility flows (Human transport):	current (trucks): • Road netwok new (boats): • River flows • Rail network • Transfer points	The more people migrate to the area the more people will migrate in the future. Greater access for people results in more people overall in the area, which places an even greater strain on the environment.		
		Logistics flows (Goods transport):	current (trucks): • High speed new (boats): • Large capacity • No congestion due to external traffic	Generating wealth in the area will act as a driver for migration. Extracting material from the environment and local ecosystem will result in its degredation if environmental concerns are not strongly incorporated in human activites. Extraction leaves the landscape bare.		

	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* new (river network): • Small distance towards river network *Grey infrastructure:* current (road network): • Immediate access to road network	*Green infrastructure:* • Only changes aspects of the natural landscape in specific access points (port regions) • Industrializes regions close to the river • Results in more artificial structures around the river that provide human services • Can have negative impact on floodplains • Annual flooding may lead to frequent restoration/maintenance activities *Grey infrastructure:* • Facilitates development of the entire region (more towns and settlements), results in transshipment centers wherever most feasible/affordable, thereby resulting in a larger environmental impact due to increased access • Industrializes the region and replaces nature with structures that provide human services	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
		Transport links:	*Green infrastructure:* new (river network): • Weather-dependent links *Grey infrastructure:* current (road network): • Need for periodical maintenance	*Green infrastructure:* Makes use of already existing infrastructure, thereby easing the need for new man made infrastructure. However if not managed properly may give rights of natural infrastructure into private hands, thereby monopolizing nature and barring access to local communities. *Grey infrastructure:* Removes nature by replacing it with man made structures. Can cut off migration paths, divides the landscape, destroys habitats, grants more access to for future human activity	*Green infrastructure:* *Grey infrastructure:*	*Green infrastructure:* *Grey infrastructure:*
Guidelines						
Ecosystem participation	*Natural Structures*	Characteristics	• Make use of intermodal transport, following natural flows	Rivers network can be used to transport goods and people. The smaller the vessels the less alterations are required to transport. Preservation of the forrest is important as they act as a global sink for CO2 as well as having important hydrological function for the south american continent.		
		Benefits and Drawbacks	•	*Benefits:* Use of natural resources can prove to be less straining than building man made structures, for example roads, that endager the forest. *Drawbacks:* Altering rivers and creating port structures can interfere with local river fauna, sediment movement as well as drainage and floodplains		
	Guidelines	Mobility characteristics	• Little intervention with nature • Low level of emissions • High transport capacity • High transport speed	Make use of rivers as much as possible, design to provide as many services as possible with as little alteration of the natural environment as possible to limit the need for additional road/rail networks. Preserve floodplains, migrational patterns and natural infrastructure to preserve ecosystem services.		
		Infrastructure characteristics	• As little maintenance as possible • Easy to access network • As little influence on residents as possible	Choose port and transshipment locations such that their impact is minimized. Also beware of flood plains to avoid routine maintenance and restoration activities, that results in periodic extensive costs. Design for barges, rather than ships as barges rely on less river alteration than ships. Concentrate human structures, to provide services at one node, rather than encouraging sprawl and growth outwards to limit human impacts.		

2.5

Critical Cartography

Landscape morphology & Ecology

Luiz Felipe do Nascimento

The critical cartography for the landscape morphology & ecology domains aims to provide a glimpse over the complexity of this vast region which is home to the most biodiverse area in the world, the Amazon Forest.

Starting with the composition of the land by its biomes, mainly the Amazon, Pantanal, and Chiquitano dry forests, continuing on analyzing the form of the natural terrain and soil.

The cultural layer and ways in which the landscape is structured by indigenous lands, farms, and urban areas are presented in a set of two maps depicting the conflicts that define this landscape. As mentioned previously, the region is responsible for the distribution of moisture and rainfall throughout the continent.

In the Climate section of this chapter, a map is presented to express this dynamic graphically.

Ultimately a synthesis section is presented, aiming at showing the most important characteristics of the landscape and the factors that make this one of the richest areas of the world, from the point of view of natural resources, and biodiversity.

The natural layer

The stretch between Porto Velho and Corumbá is a strategic location from the logistics and transportation point of view, but also due to the natural environment around it.

The river valleys go through several different biomes and ecotones and are subjected to many climates, micro-climates, reliefs, and cultures.

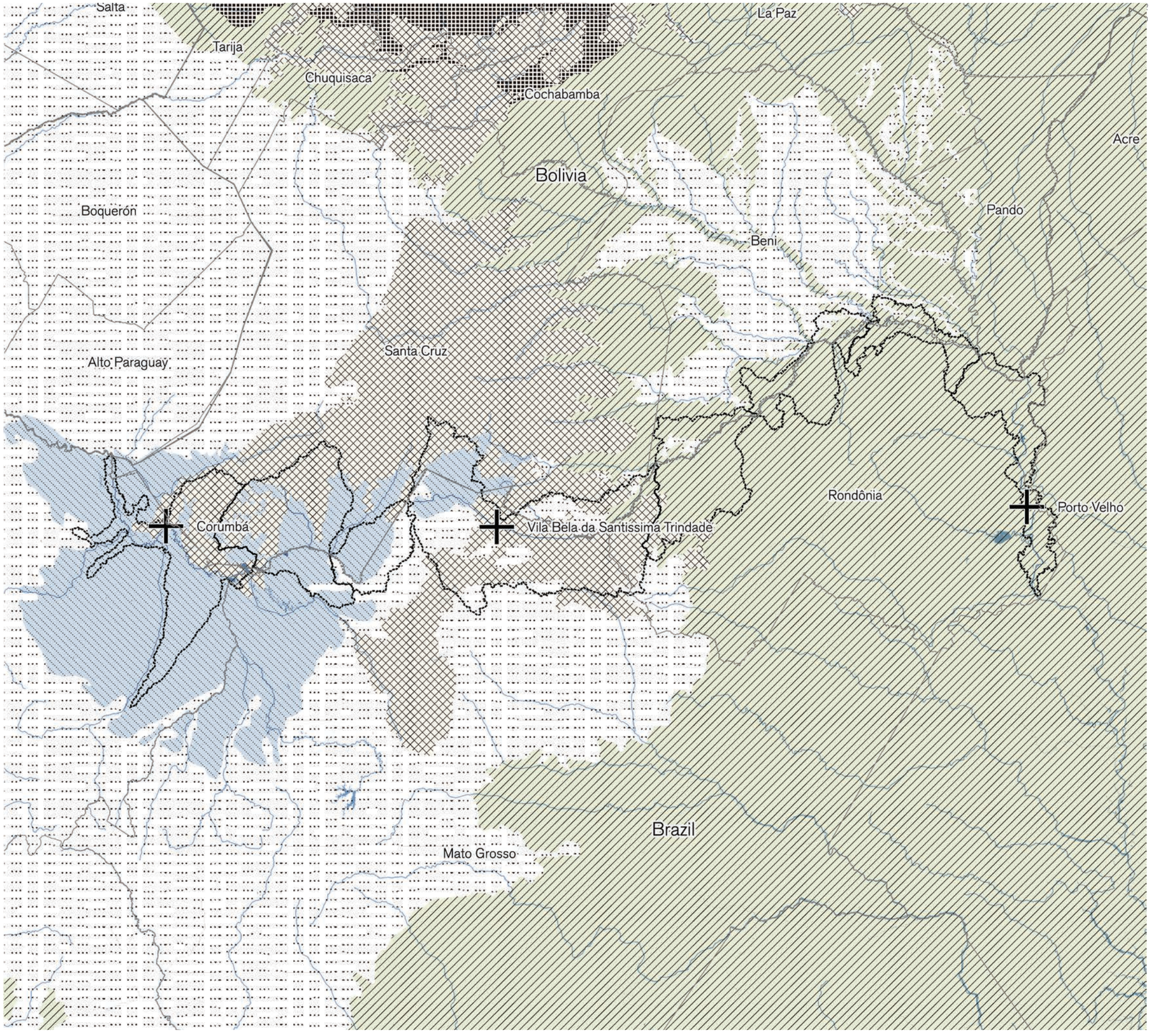
On the northern part, the Amazon is the predominant biome, with its moist dense forests, home to an infinity of animal and vegetal species.

On the southern part, the Pantanal, the largest natural tropical wetland of the world, extends over an immense area that is prone to flooding by the rivers that descend from the highlands.

In-between the two biomes, the Chiquitano dry forest is located. Shared between Brazil and Bolivia, this ecotone is an area of transition between the two aforementioned biomes, containing characteristics of both.

Composition map

Biomes and ecotones of the region



- Selected locations
- Tropical and subtropical moist broadleaf forests - Amazon
- Tropical and subtropical dry broadleaf forests - Bosque Chiquitano
- Tropical and subtropical grasslands - Cerrado
- Flooded grasslands - Pantanal
- Montane grasslands
- Hydrography
- National Administrative borders
- Subnational Administrative borders

0 100 200 km

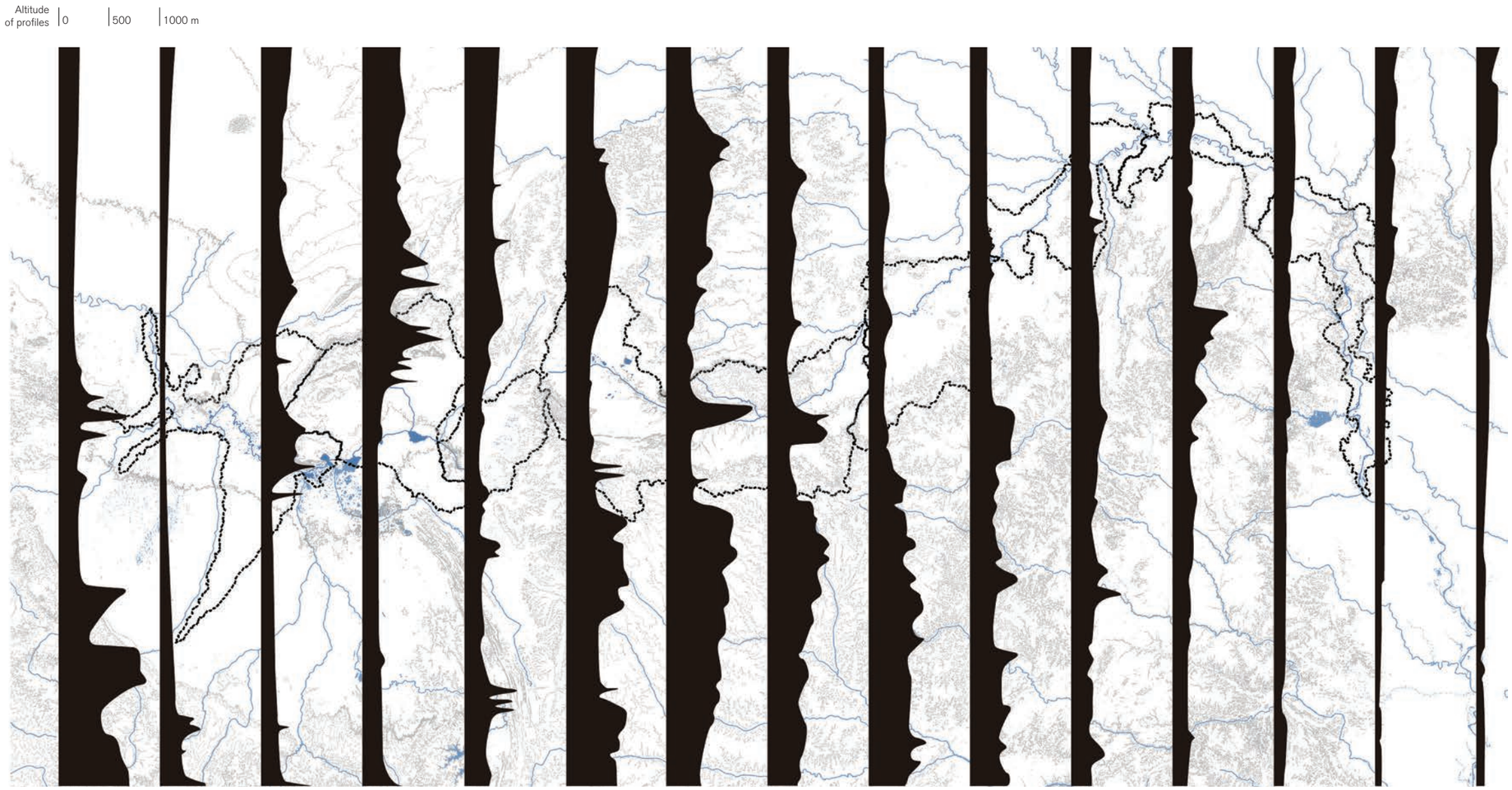
N

Mapped form

Along the valleys of the Guaporé and Madeira rivers, many different types of landscapes and rock formations are found. Going from south to north, or from the left to the right side of the drawing on this page, the rivers flow through the Pantanal region, a massive tropical wetland that is characterized by how flat the land is.

Moving on towards the north, the rivers encounter a region of Chapadas, or plateaus, formed by singular rock types. These environments are naturally home to different species as of those of the Pantanal and the Amazon, therefore forming the Chiquitano ecotone.

As the rivers go downstream, descending towards the Madeira, and further along, the Amazon rivers, the land becomes very flat again. This causes the forest to have a constant rhythm of drought and floods, that accentuate the biodiversity of the region.



Elevation crossection

Elevation map and sections along the Madeira/Guaporé valley between Porto Velho and Corumbá

+ Selected locations
Contour lines (100m)
Hydrography
Madeira/Guaporé River Basins

0 100 200 km

N

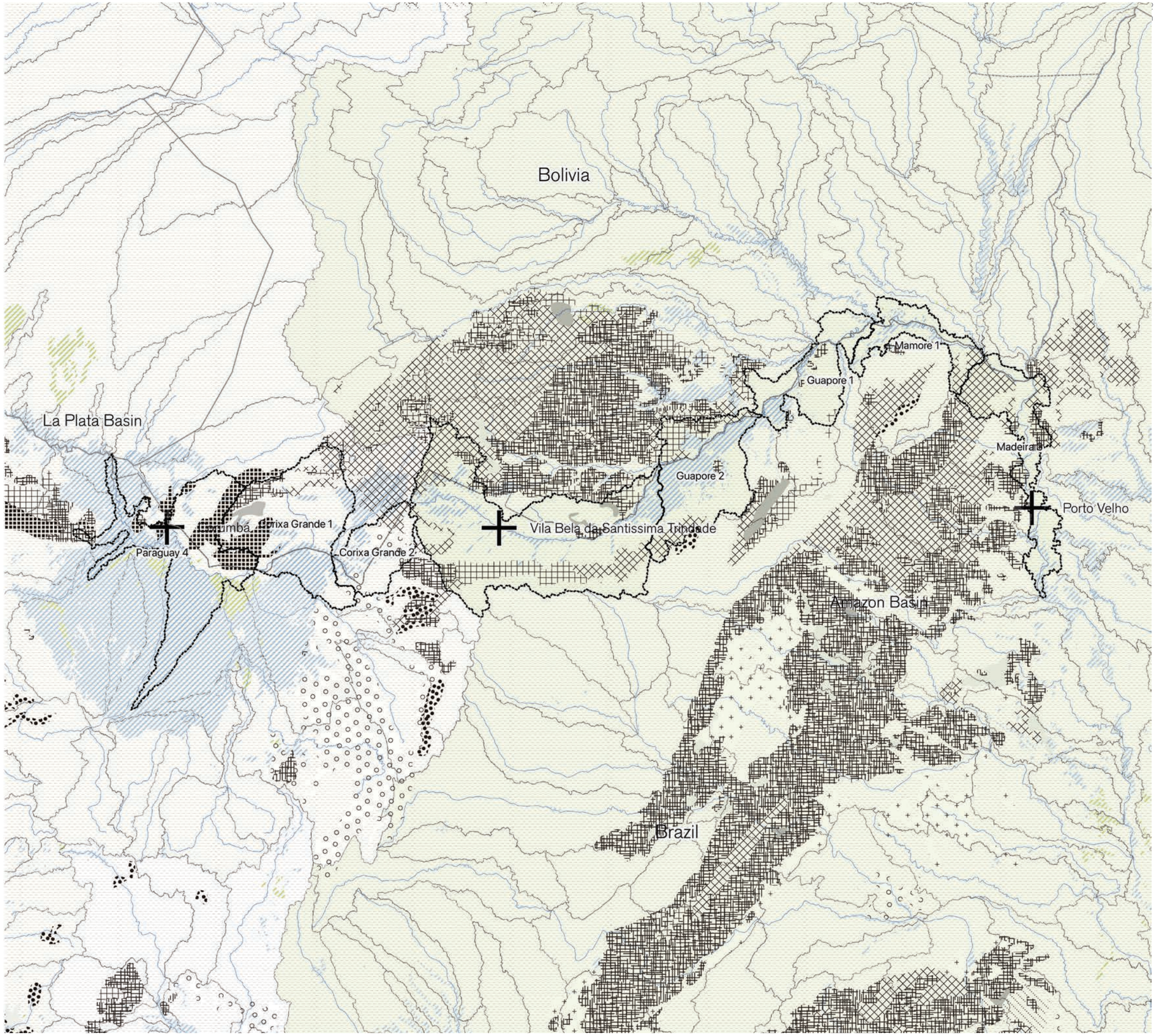
Mapped structure

The region is vastelly shaped by the rivers that run down from the Andes and the higher lands of Brazil towards the Amazon valley.

On the left side of the map, more to the south, the Pantanal acts as a giant sponge, collecting water from basins around it during flood season. Along the Guaporé and Madeira rivers several areas of large extension that are prone to floods can be found.

Heavily formed by Siliciclastic rocks, or non-carbonate sedimentary rocks, such as quartz or silicate minerals. These have been deposited through the millenia by the streams and rivers that flow through the region.

Another important type of soil commonly found in the region are Granitic rocks, originally formed by magma that eventually cools down and solidifies.



Natural water systems

Network of waterways in the region, divided by macro basins

- Selected locations
- Amazon River Basin
- La Plata River Basin
- Madeira/Guaporé River Basins
- Other basins
- Hydrography
- Floodplains
- Floodplains
- Administrative/Political borders

Types of soil

- Alkaline
- Basaltic
- Carbonatic
- Gabbroic
- Granitic
- Low to medium grade
- Medium to high grade
- Rhyolitic
- Siliciclastic
- Volcanic/sedimentary
- Other

0 100 200 km

N

The cultural layer

This regional landscape is perceived in different ways, by different actors and views of the world.

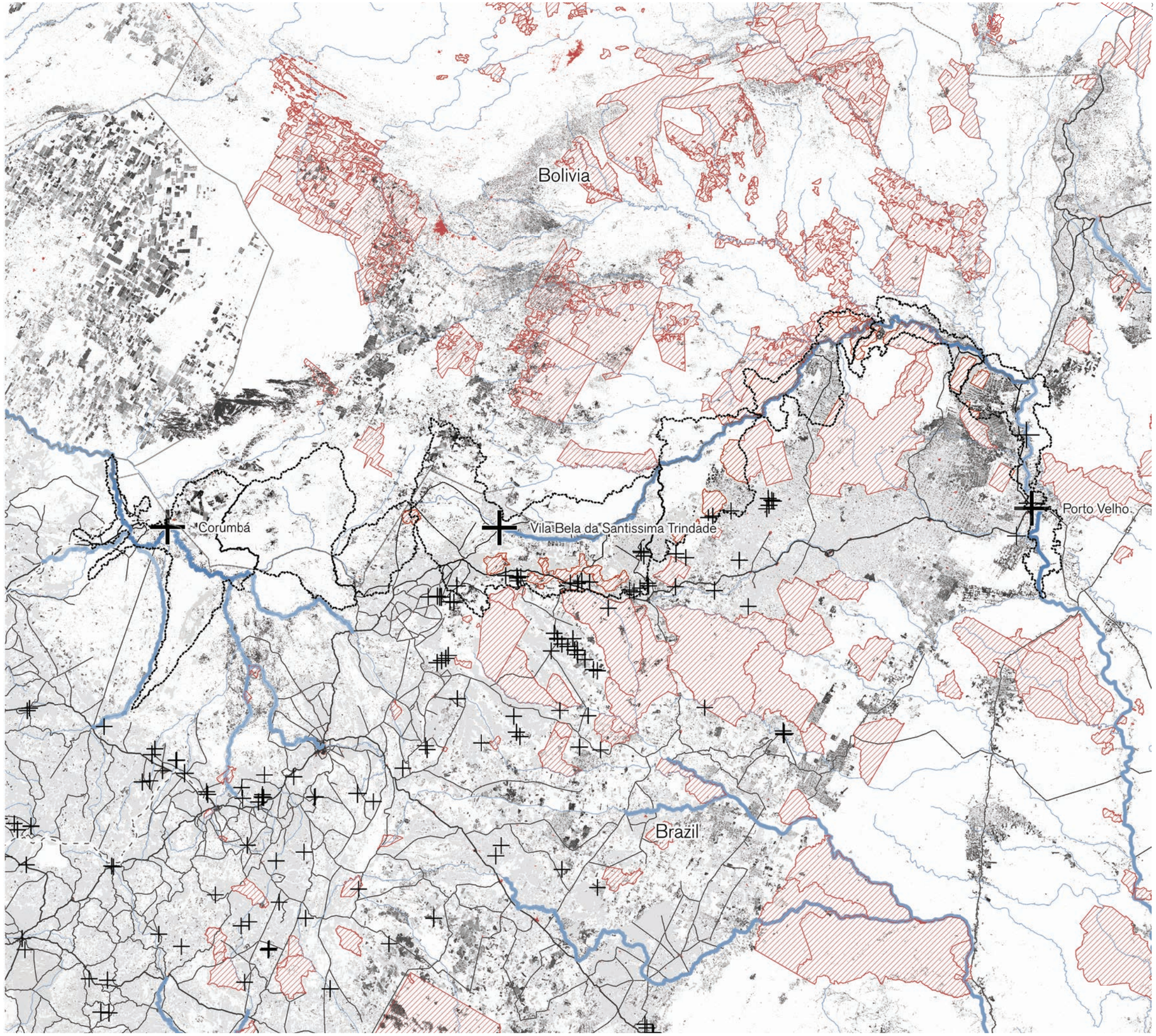
The ancient dwellers of the forest, the indigenous people who have survived to years to European invasion, colonization, and eventual transformation of its territories into independent nations are still very present in the area and keep to resist the pressure from contemporary capitalism.

Large portions of the land are marked as indigenous reserves or have been claimed to be such by the indigenous themselves. On the other side of the front stand farmers and cattle ranchers, which aim at expanding their productions towards the forest.

Natural water systems, although fairly untouched, especially if compared to those of other parts of the continent, have been altered by the construction of several hydropower plants and dams. Many of the waterways are prone to navigation by small to medium-sized vessels and have served as entry gates to the forest from the Atlantic coast since colonial times.

Human intervention

Anthropogenic use and transformation of the landscape

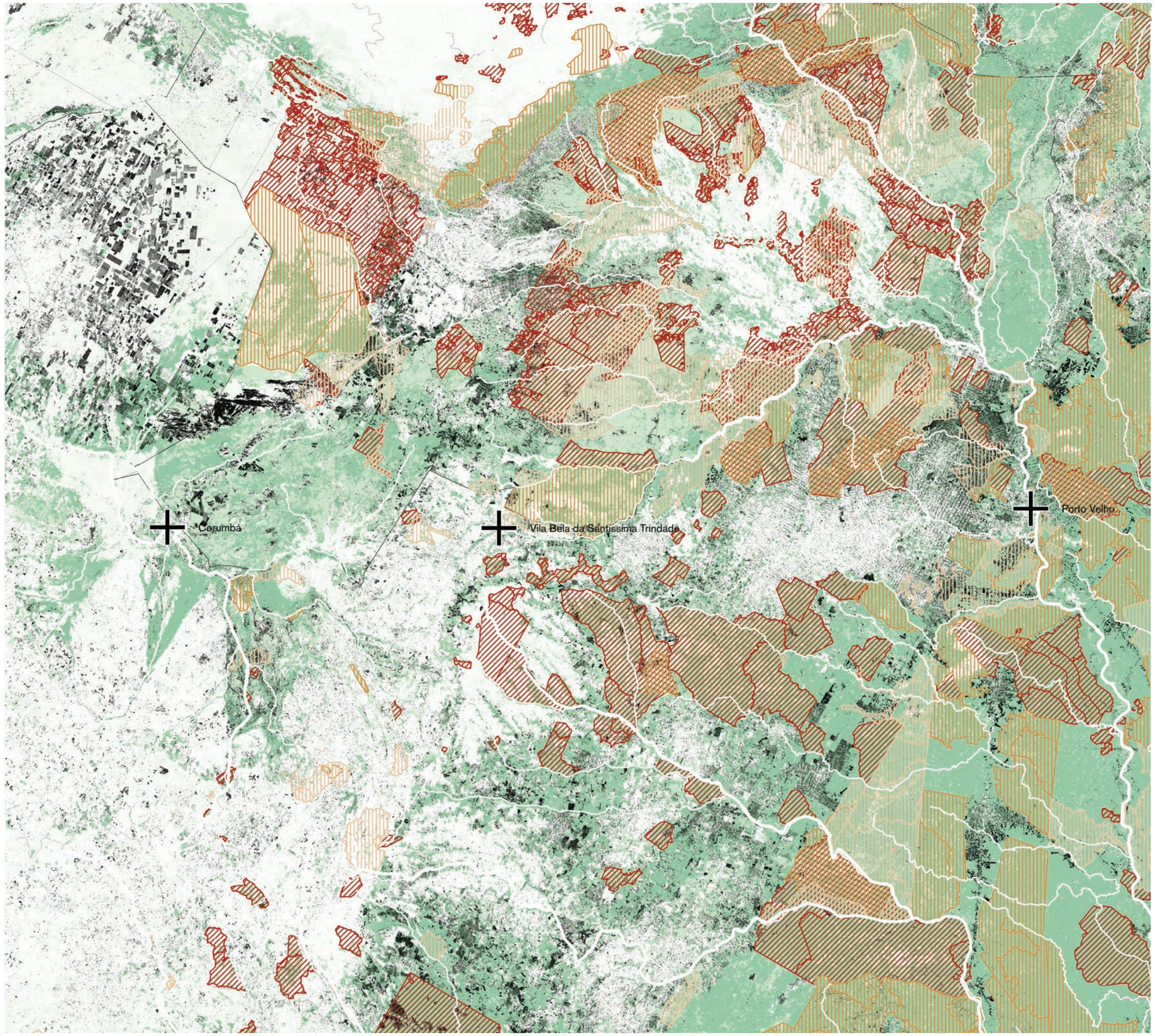


Territory in dispute

At the ground level, a dispute is endured by indigenous, farmers, ranchers, locals, and politicians. As it is visible from the map, an extensive part of the forest in the region has already been altered by anthropogenic activity. During the last couple of decades, deforestation increased in countries such as Paraguay and Bolivia, but also in Brazil.

It is fair to notice that many of the indigenous reserves marked are holding to fort against deforestation and destruction of the ecosystems.

Apart from the indigenous reserves, many protected natural areas are found throughout the different national states, although some of them allow for contained (theoretically) sustainable extraction of resources, such as wood or minerals.



Conflicting land uses

Demand for land by indigenous peoples, ranchers and farmers and environmentalists

- Selected locations
- Area covered by tree canopy
- Deforested areas between 2000 and 2018
- Indigenous reserves
- Protected natural areas

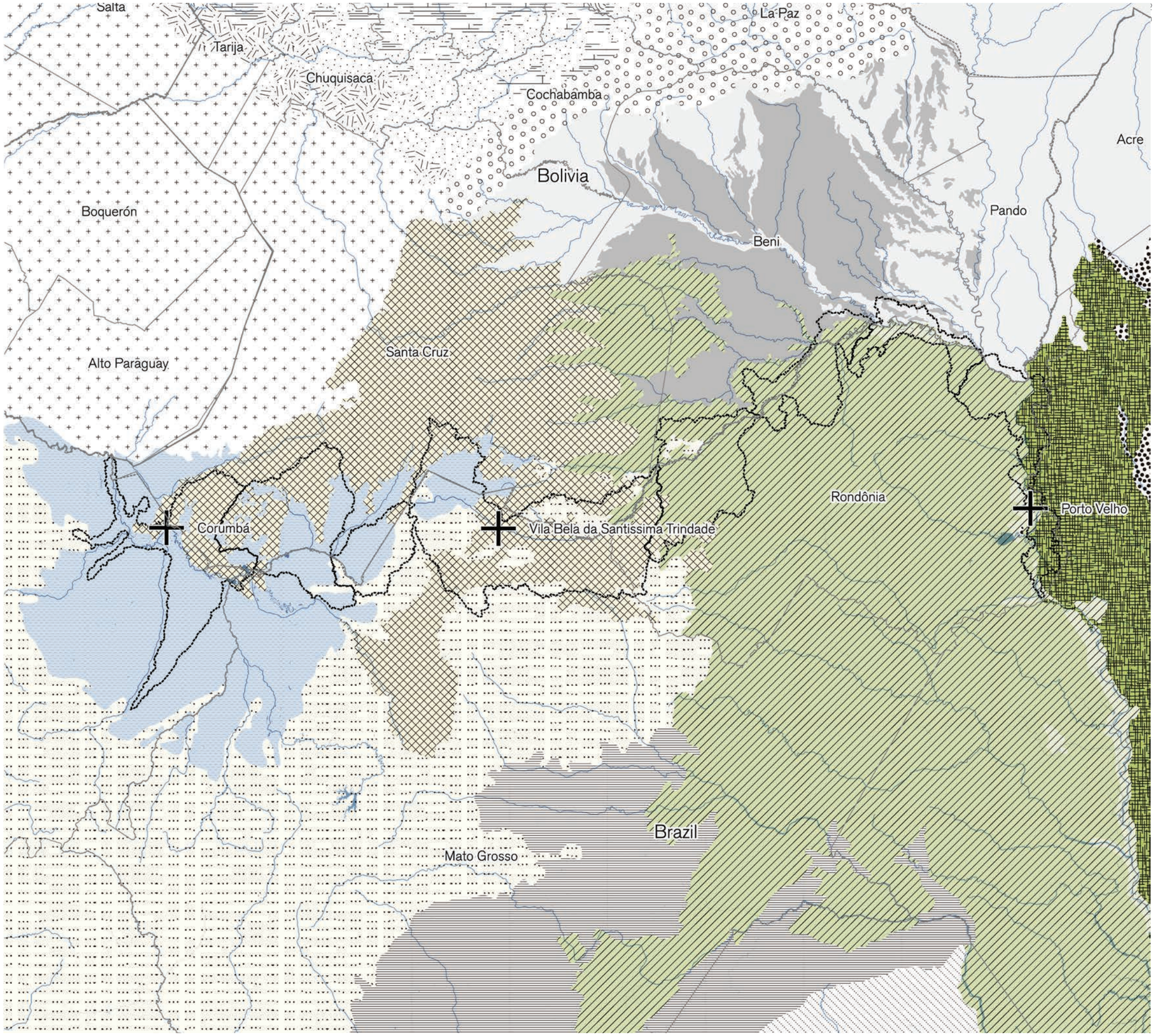
0 100 200 km

N

Flora and fauna

Beyond the classification of the region between different biomes, many other smaller ecological units can be found in the area.

In the Amazon biome, for instance, different types of evergreen forests can be found, as they react to varied conditions of the landscape, such as the possibility of being flooded and under the water for months, during the rainy season, as well as higher altitudes and different levels of radiation and moisture, especially on top of the chapadas, or plateaus.



Ecoregions

Within the Amazon, Cerrado, Pantanal and Bosque Chiquitano biomes, several different ecoregions exist

- Selected locations
- Madeira-Tapajós moist forests
- Mato Grosso seasonal forests
- Tapajós-Xingu moist forests
- Amazon river flooded forests
- Southwestern Amazonian moist forests
- Purus floodplain
- Cerrado
- Chiquitano dry forests
- Pantanal
- Dry Chaco
- Bolivian Yungas
- Southern Andean Yungas
- Bolivian montane dry forests
- Southwestern Amazon moist forests
- Beni Savanna
- Hydrography
- National Administrative borders
- Subnational Administrative borders

0 | 100 | 200 km

N

Fauna

Being the largest biodiverse hotspot in the world, the Amazon and the Pantanal regions are home to a series of species that have adapted to the conditions of the land, such as the high temperatures and levels of moisture, drought, flood, and abundance in organic matter and other animals.

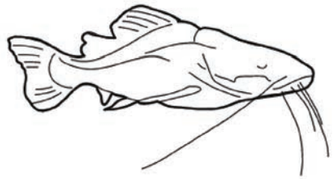
The region comprises some of the largest sweet water rivers in the world and, therefore, also a large number of fish and mammals that live in the water. One of the most singular examples is the *Boto-cor-de-rosa*, or the amazonian river dolphin *(Inia geoffrensis)*, a species of toothed whale that lives in the Amazon basin. These are widely spread throughout the region and can be found in six different countries.

It is worth mentioning that many of these species are also very relevant and present in the imagination and culture of the Latin people, with many being characters and subjects of urban legends and folklore/ mythology stories.

However, at the heart of a large part of the population, many of these species are also endangered and run the risk of being extinct, either by predatory hunting or destruction of their natural environments.

Water

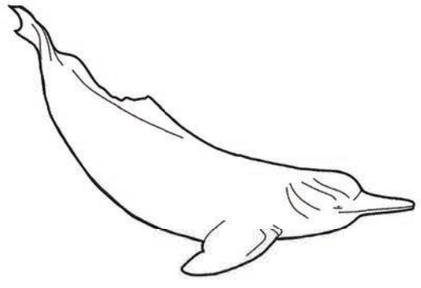
Phractocephalus hemioliopterus
Popular name: Pirarara
Habitat: Araguaia, Tocantins and Amazon river basins



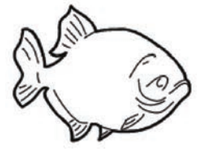
Araipama gigas
Popular name: Pirarucu
Habitat: Amazon river basin



Inia geoffrensis
Popular name: Boto-cor-de-rosa
Habitat: Amazon, Solimões, Araguaia and Bolivian river basins

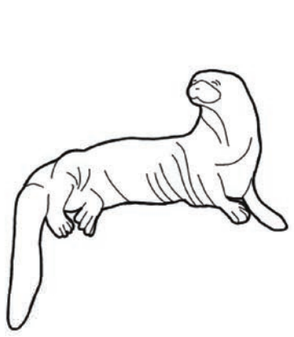


Pygocentrus nattereri
Popular name: Piranha Vermelha
Habitat: Araguaia, Tocantins, Paraguay, Paraná and Amazon river basins

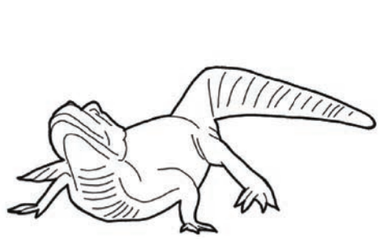


Land and water

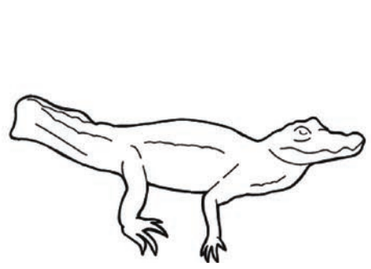
Pteronura brasiliensis
Popular name: Ariranha
Habitat: Amazon basin and Pantanal



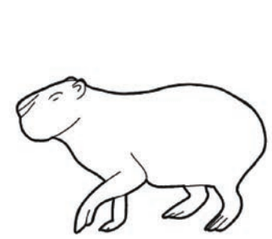
Cayman yacare
Popular name: Jacaré-do-Pantanal
Habitat: Pantanal and Paraguay river basins



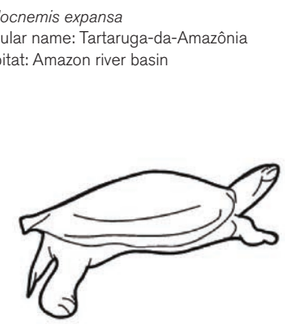
Caiman crocodilus
Popular name: Jacaretinga
Habitat: Commonly found in the americas



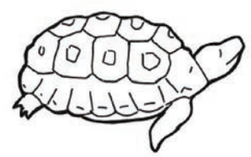
Hydrochoerus hydrochaeris
Popular name: Capivara
Habitat: Commonly found in South American regions to the east of the Andes mountains



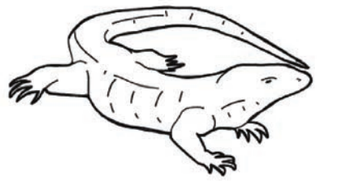
Podocnemis expansa
Popular name: Tartaruga-da-Amazônia
Habitat: Amazon river basin



Chelonoidis carbonaria
Popular name: Jabuti-Piranga
Habitat: Commonly found in South American regions to the east of the Andes mountains



Tupinambis teguixin
Popular name: Teiú-branco
Habitat: Commonly found in Brazil

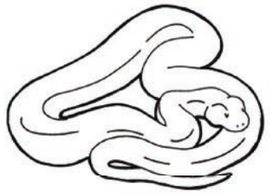


Rhinella marina
Popular name: Sapo-cururu
Habitat: Commonly found in the americas



Land

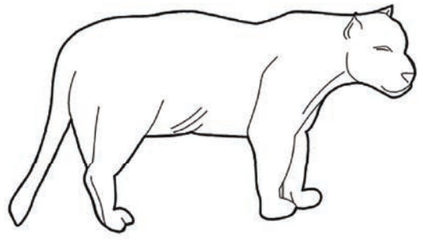
Eunectes murinus
Popular name: Sucuri-verde
Habitat: Commonly found in Brazil



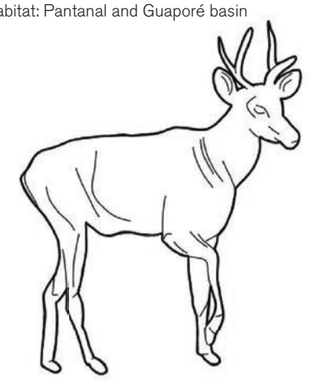
Corallus caninus
Popular name: Jibóia-verde
Habitat: Amazon river basin



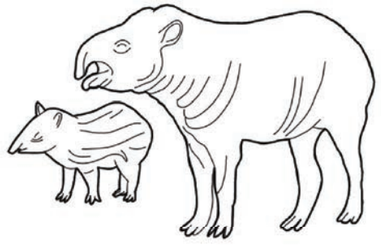
Panthera onca
Popular name: Onça-pintada
Habitat: Commonly found in the americas



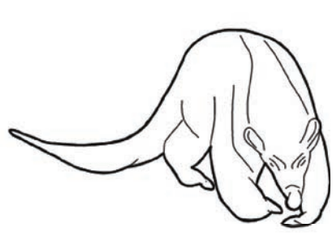
Blastocerus dichotomus
Popular name: Cervo-do-Pantanal
Habitat: Pantanal and Guaporé basin



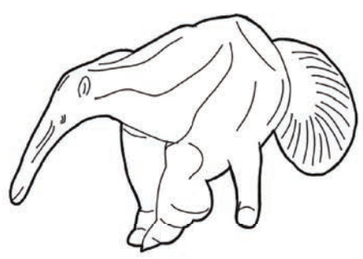
Tapirus terrestris
Popular name: Anta brasileira
Habitat: Commonly found in the americas



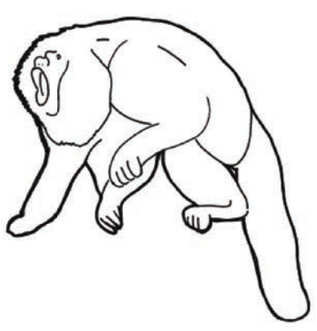
Tamandua tetradactyla
Popular name: Tamanduá-mirim
Habitat: Commonly found in the americas



Myrmecophaga tridactyla
Popular name: Tamanduá-bandeira
Habitat: Commonly found in the americas

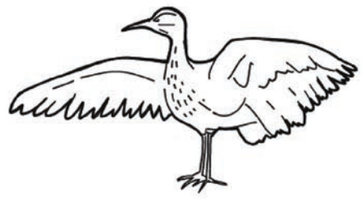


Alouatta seniculus
Popular name: Bugio-ruivo
Habitat: Amazon and Atlantic forest



Air

Eurypyga helias
Popular name: Pavão-do-Pará
Habitat: Commonly found in the americas



Anodorhynchus hyacinthinus
Popular name: Arara-azul-grande
Habitat: Amazon forest, Cerrado and Pantanal

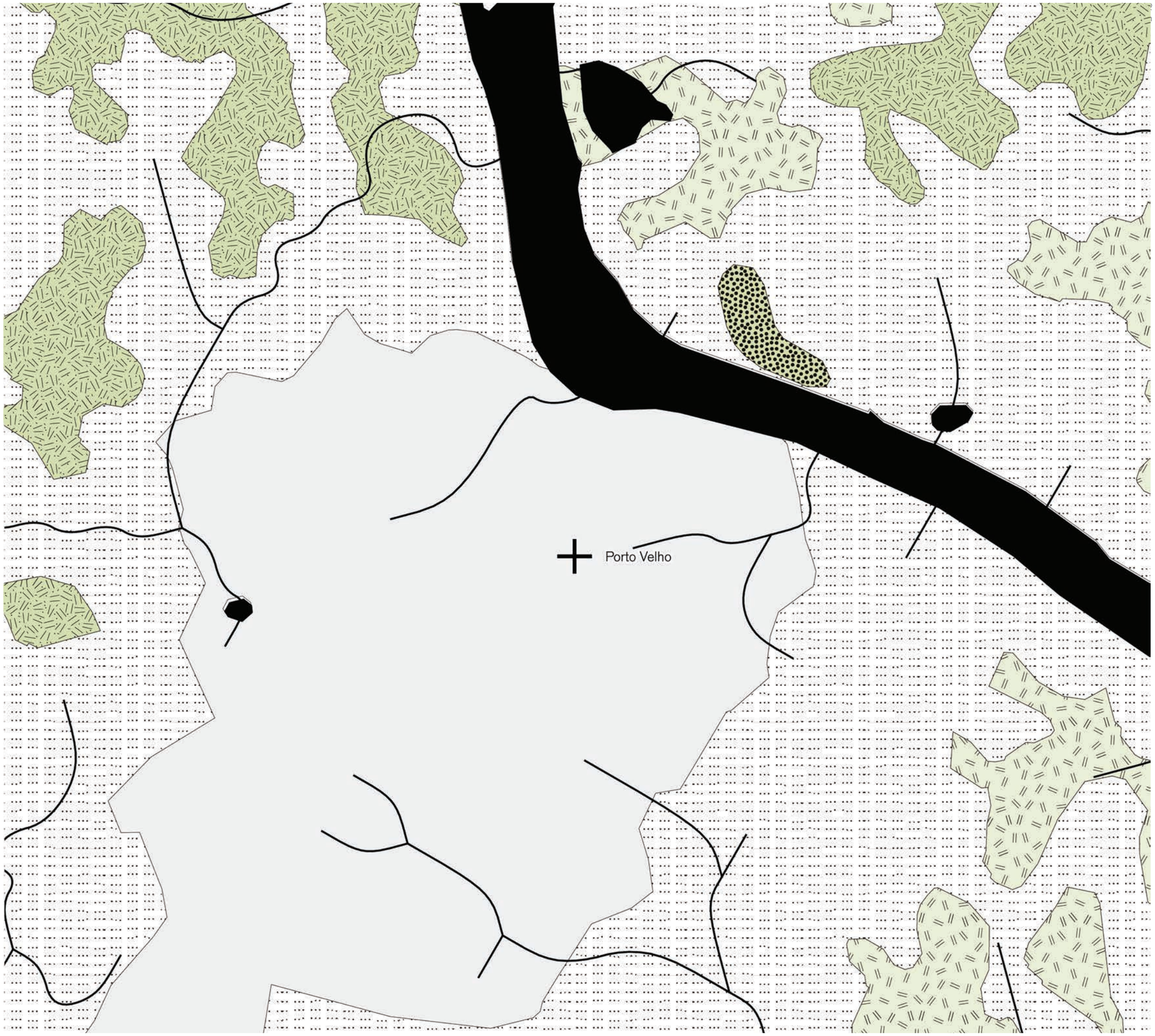


Flora

Porto Velho

Despite being located in the middle of the Amazon forest, not much of the natural vegetation is left around the city of Porto Velho. The urban footprint was responsible for a large-scale deforestation forested, associated with agriculture production, e.g. cattle ranching around the urban core.

A few remainings of natural vegetation patches can be found, however, such as open forest areas dotted by palm trees.



Types of vegetation

Vegetation, or lack of, around the city of Porto Velho

- Selected locations
- Urban Settlements
- Agriculture/Cattle ranching
- Submontane open rainforest with palm trees
- Lowland open rainforest with palm trees
- Secondary vegetation with palm trees
- Hydrography
- National Administrative borders
- Subnational Administrative borders

0 1 2 km

N

Flora

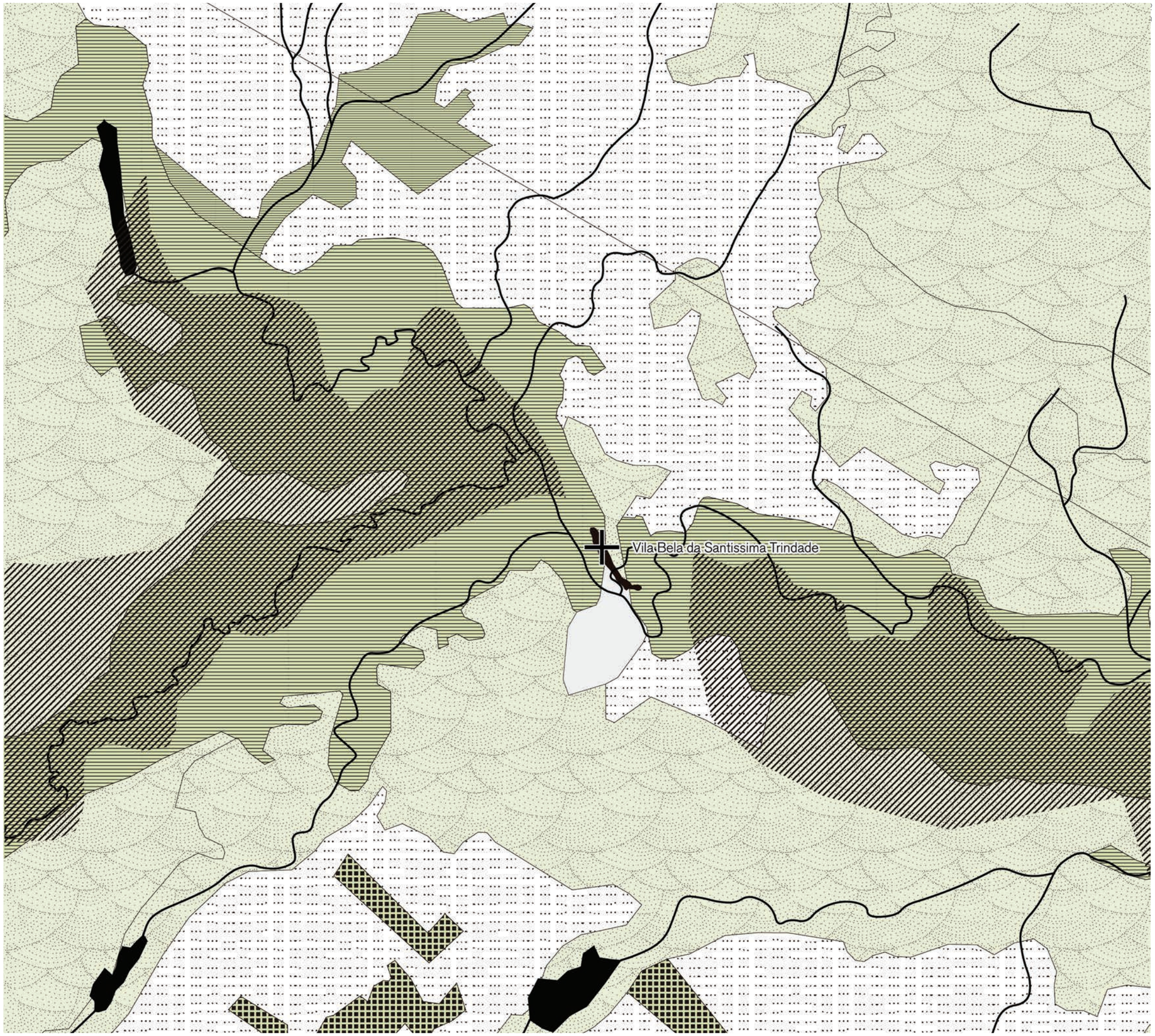
Vila Bella da Santíssima Trindade

Due to its small urban footprint, Vila Bella counts with a robust green belt around its core, with more variety in remaining vegetation than its counterpart, Porto Velho.

Some areas of plateaus that have been transformed into natural parks due to their landscape value helped to preserve much of the original vegetation.

However, as in other areas of the region, agriculture and cattle ranching have been responsible for most of the deforestation in the region.

Another important aspect of the natural vegetation in Vila Bella is the immense floodplains along the Guaporé river, which subject the areas along the water to be flooded from time to time.



Types of vegetation

Vegetation, or lack of, around the city of
Vila Bella da Santíssima Trindade

- Selected locations
- Urban Settlements
- Agriculture/Cattle ranching
- Alluvial evergreen seasonal forest with emergent canopy
- Savannah park with gallery forest
- Evergreen lowland seasonal forest
- Hydrography
- Floodplains
- National Administrative borders
- Subnational Administrative borders

0 1 2 km

N

Climate

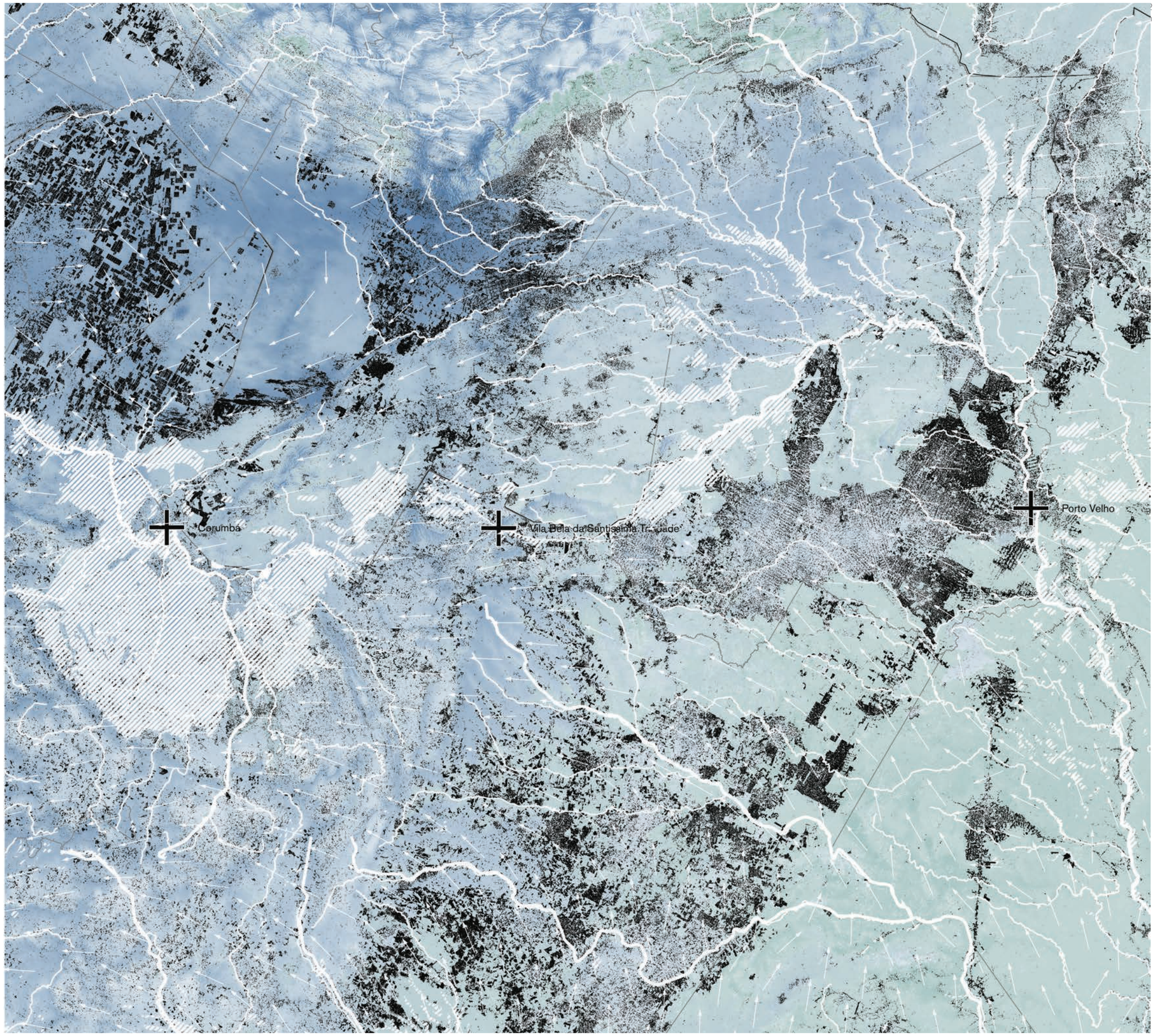
However varied due to the extension of the region and diversity in landform and vegetation cover, one main climate phenomenon can be observed in the region. Moisture and rainfall that travels from the Atlantic Ocean towards the west encounter in the Andes mountain range a barrier, and cannot cross the continent, eventually reaching the Pacific ocean.

This moisture is then liberated over the Amazon region, through intense rainfall during the summer season. The water is then absorbed by the vegetation and the soil, and eventually is liberated to the air again, this time traveling south. This is the ultimate reason why the Amazon is so sought-after by cattle ranchers and soybean plantations. Not only does its vastness in size allow for the creation of huge monoculture fields, but also it provides agriculture businesses with large amounts of water.

Nevertheless, the expansion of agricultural production towards this forest already altered the rainfall patterns not only in the region but also in the South of the country.

Endangered rivers of air

Rainfall and moisture recycling in the Amazon



+ Selected locations
Wind speed intensity
Area covered by tree canopy
Deforested areas between 2000 and 2018
Floodplains

0 100 200 km

N

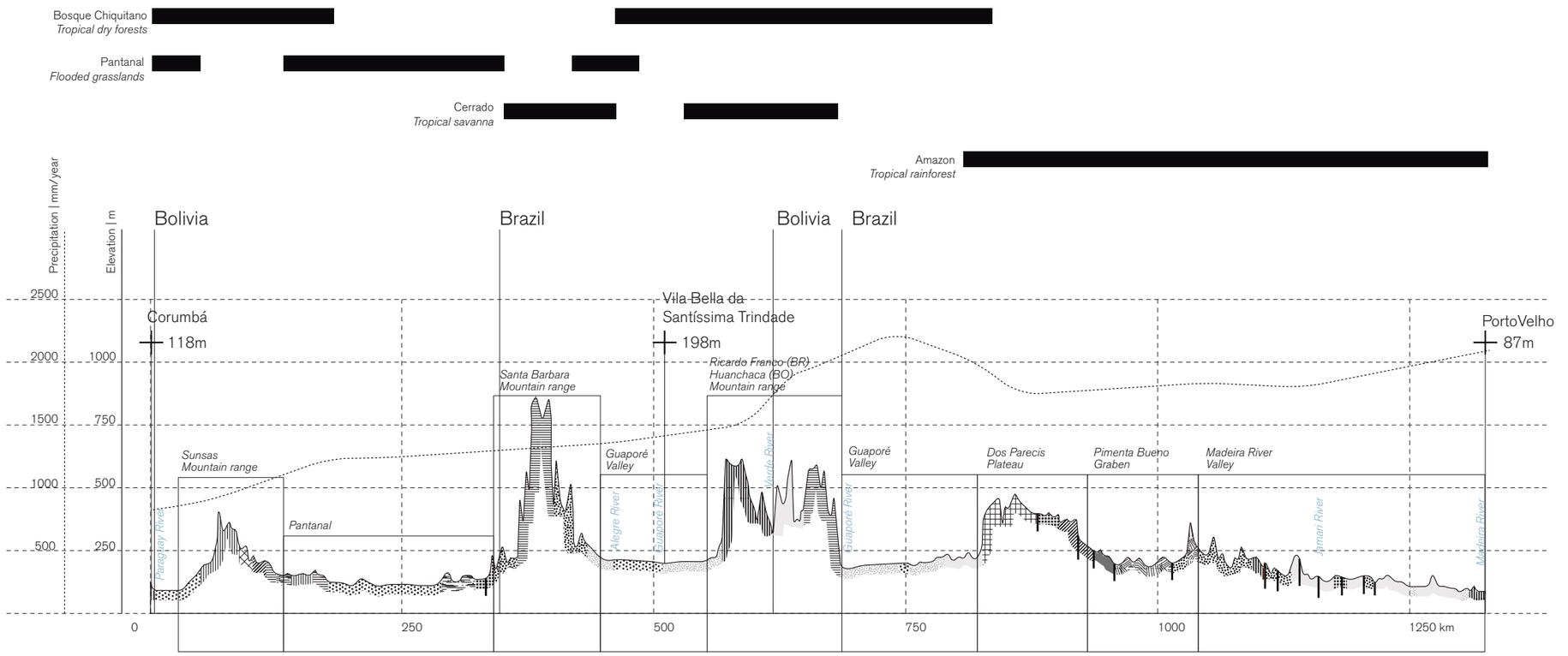
Synthesis

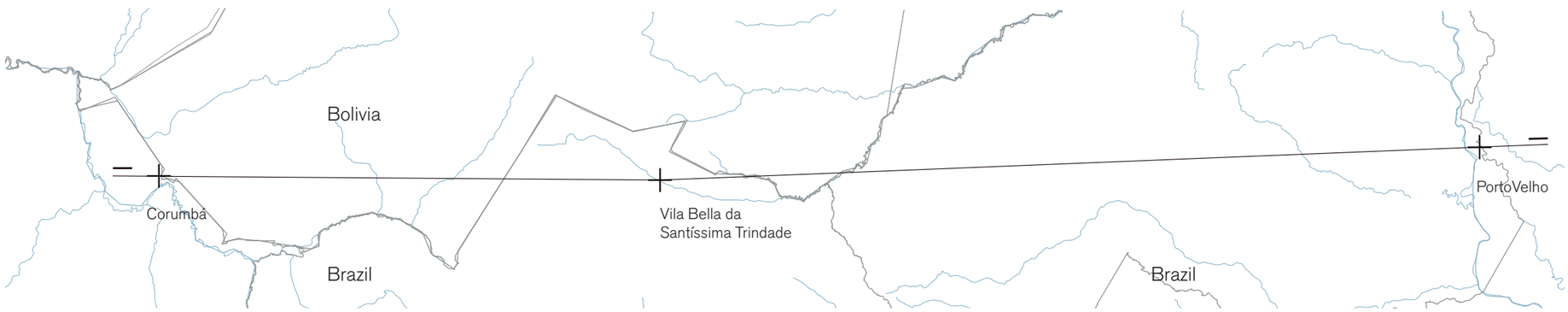
As a synthesis of the landscape morphology and ecology studies on this region of the Amazon, a schematic section was chosen as a way of depicting the complexity of the natural systems in place, as well as the variants that make this of the hotspots for biodiversity in the world.

This section goes in a sraight line, from Corumbá to Porto Velho, passing through the village of Vila Bella da Santíssima Trindade and crossing the border between Brazil and Bolivia several times.

An immense variety in soil types, microclimates, altitude and abundance of water, both in the form of rainfall and water bodies make this area extremelly rich in natural resources.

Some of the aforementioned landscapes are visible in the section, such as the river valleys of the Guaporé and Madeira, the low-lands of the Pantanal, as well as the granite plateaus that form the *chapadas*.





3.

Systems description and synthesis

Hybrid system drawing

The layered image shows the combined synthesis of the critical cartography of each domain. Three different layers are distinguished to elaborate upon the main findings on each scale.

Local Scale

The cities of Vila Bela da Santissima Trinade and Porto Velho.

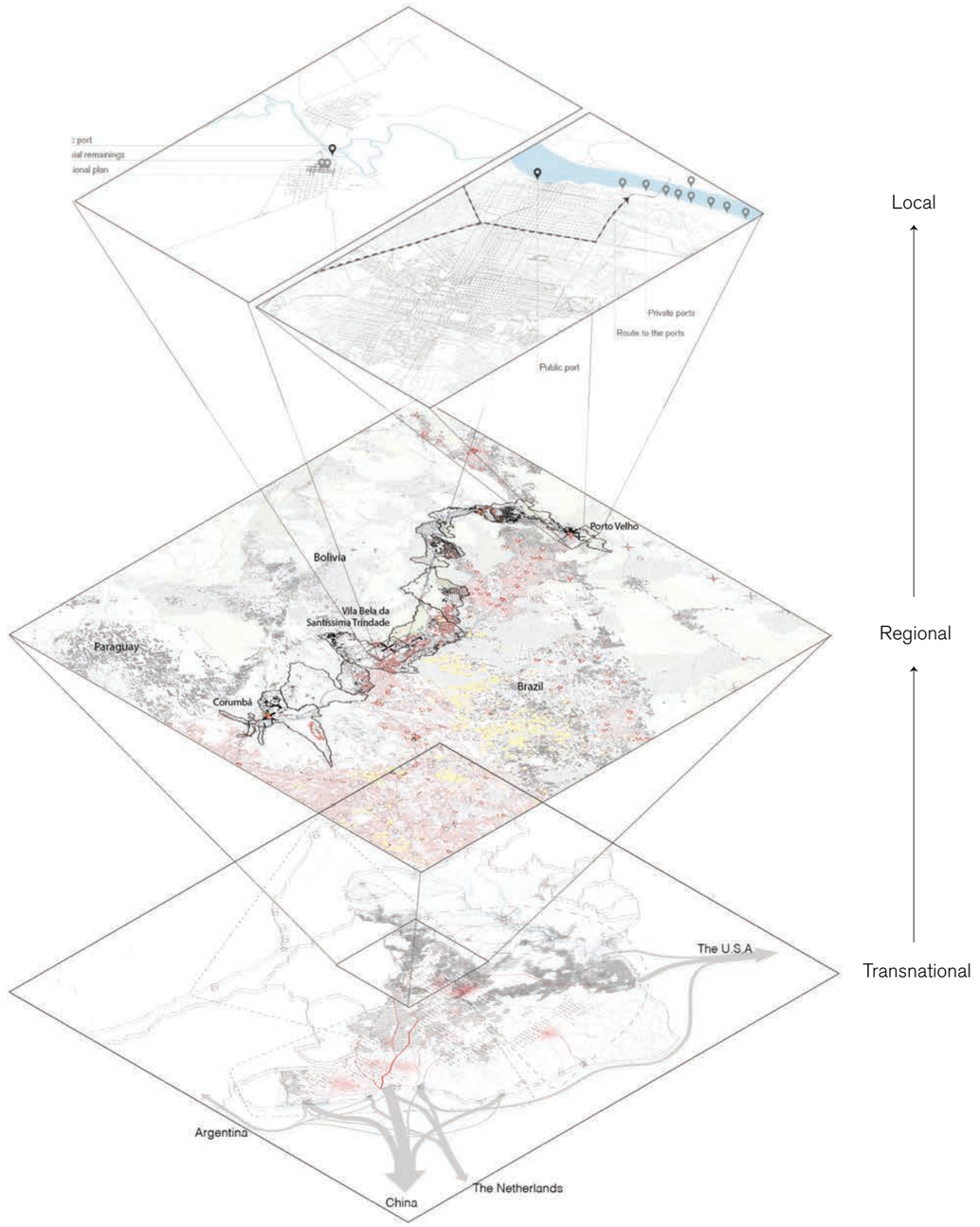
Regional Scale

The stretch between the two river basins between Corumba and Porto Velho.

Transnational Scale

Brazil's position in the continent of South America and the rest of the world.

In the following pages, each scale will be elaborated upon. The main conclusion of the systhesis shows that extraction and export not only demaged the landscape but also influenced the urban morphology, landscape morphology and human relationship to nature. Spatially this means that the national scale has always played a dominant role in the spatial development on local scale.



As mentioned before, Brazil is an export focussed country. This can be seen in the spatial strucutre of the infrastructure, which is focussed on transporting the commodities. The map shows the places of deforestation as a result of soy extraction and cattle farming. The commodities that are extracted here, will have to be transported by road and waterway towards the ports along the coast, from where they will be exported overseas.

Systems description and synthesis

Transnational

Brazil's position in the continent of South America and the rest of the world.

- Country Borders
- Waterways
- Roads (export agriculture)
- Ports
- Soy Extraction
- Cattle Farming
- Road Transport
- Water Transport
- Deforestation

0 250 km N

On regional scale it is visisble that the extraction landscape covers most of the surrounding land of Vila Bela da Santissima Trinade and Porto Velho which is in conflict with other landuse, mainly with the indigenous lands. Vila Bela da Santissima Trinade used to be an important node of transport over waterways during the colonial times. These days a lot of inland transport is done via the road network which go up north to Porto Velho, or south to Corumba.

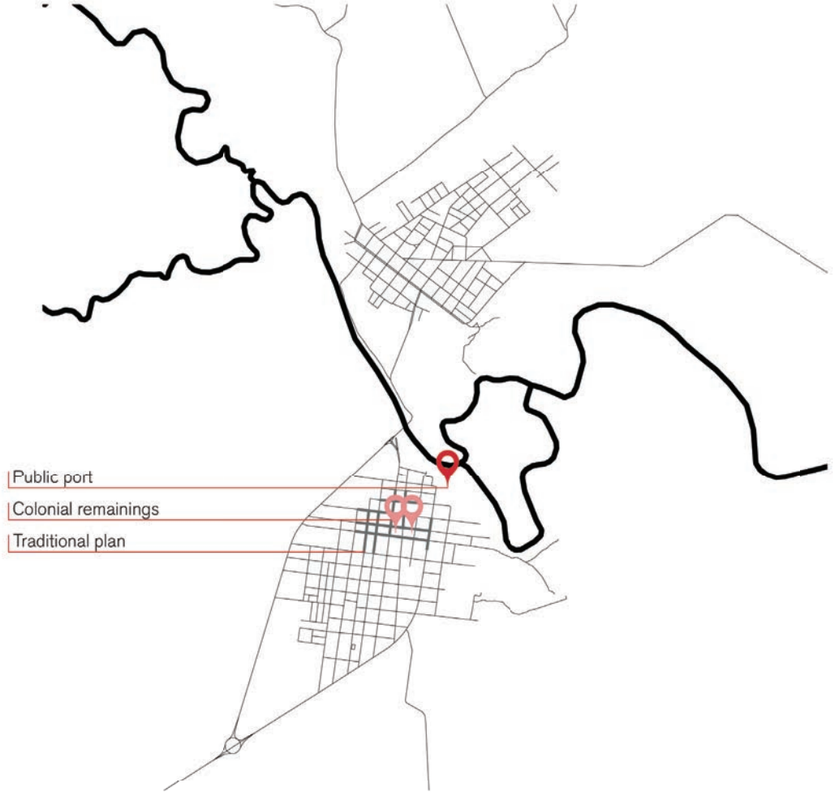
Systems description and synthesis

Regional

The stretch between the two river basins between Corumba and Porto Velho.

- Country Borders
- Basin of the Guaporé-Madeira rivers
- Hidrography
- Selected locations
- Cattle farming and soy plantations
- Indigenous territories
- Natural protection zones
- Storage facilities
- Crushing facilities
- Slaughterhouses
- Warehouses

0 100 km N





On local scale the position of the two settlements in the export economy is visible. Vila Bela da Santissima Trinade has been an important node during colonial times and is not used much for transport these days. Port Velho on the other hand still is an important node in the export of commodities. The extracted product are transported by road towards the city, where many agriculture companies have their own port from which commodities are transported over water to the seaports.

Systems description and synthesis

Local

The cities of Vila Bela da Santissima Trinade and Porto Velho.

Waterbody
Roads

0 1 km N 0 1 km

4.

Scenario making

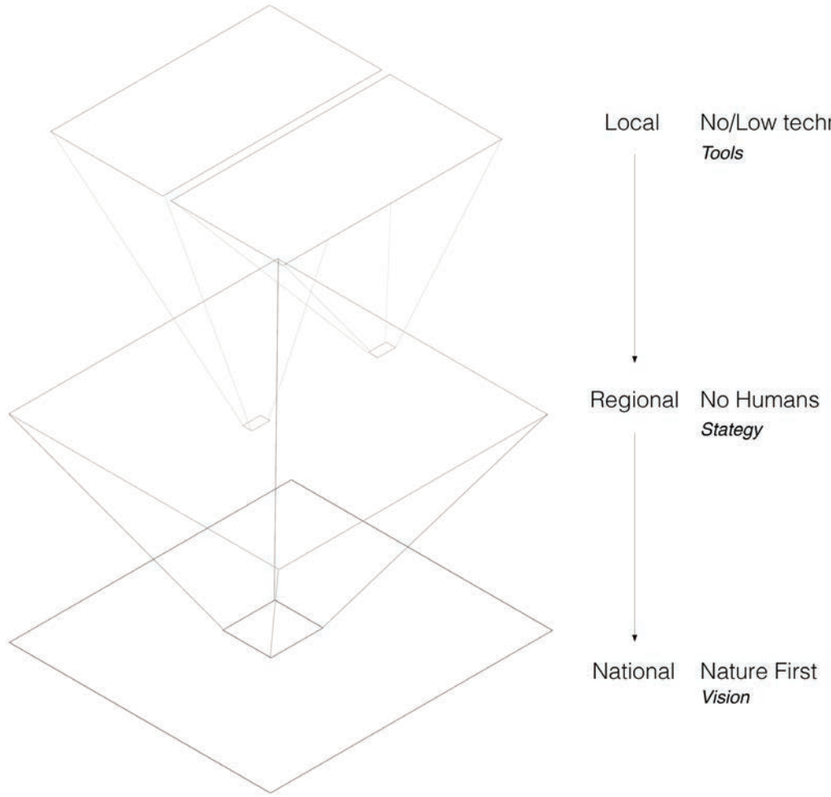
The scenario's are an afford to see how dominant role of the national scale can be undermind and how the local conditions can become more important in future development.

In doing so the scenario's will be used in different ways.

Nature First will serve as a vision.

No Humans will serve as a strategy.

No/Low technology will serve as tools.



Scenario 1 . Nature first

Nature First

This scenario forms the vision the desired new development of Brazil and the continent.

In developing this scenario, firstly the current situation will be examined using time-space maps. This cartographic technique shows how infrastructural project, that don't follow the landscape morphology, distorted the proportions of the country.

The second part of the scenario making will use the same time-space technique as to experiment how a alternative infrastructural project (waterways) can de-distort the proportions of the country.

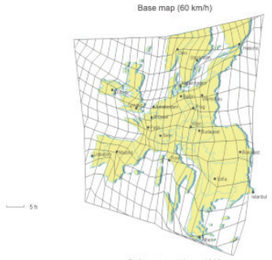
Current infrastructural projects

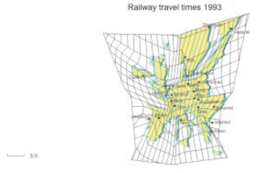




Time-space maps:







Source: Spierman (2020)

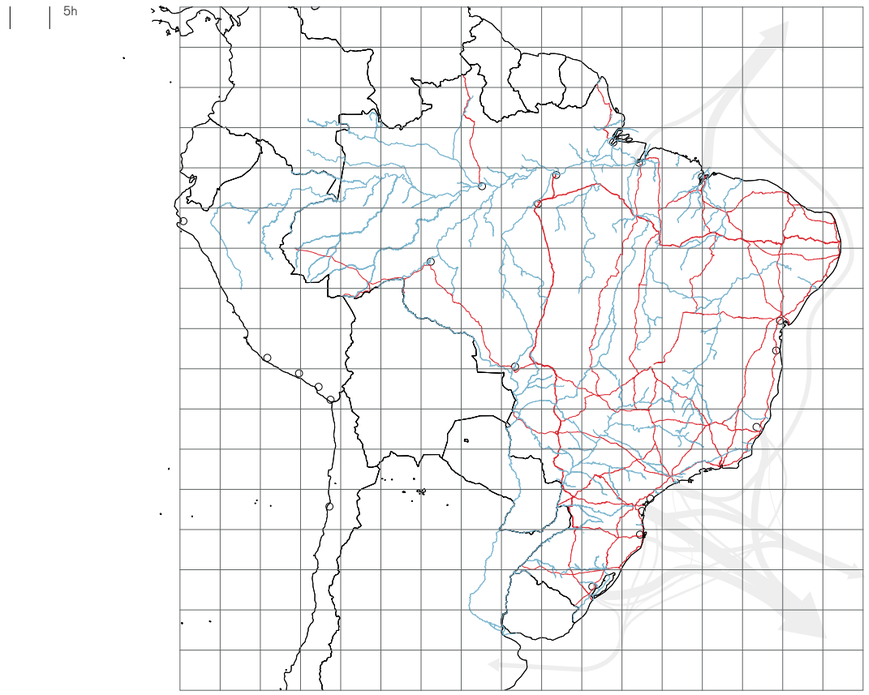
Nature First: infrastructural projects

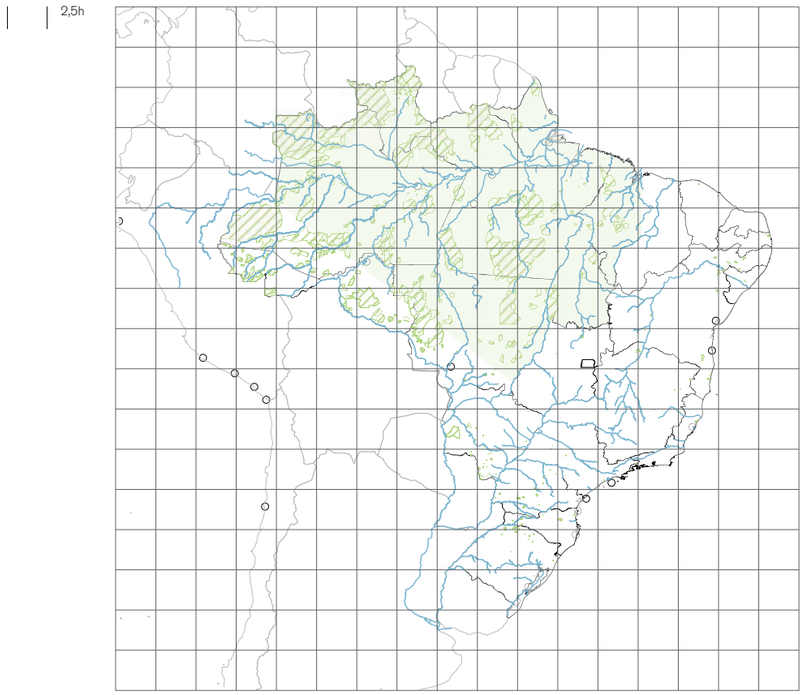


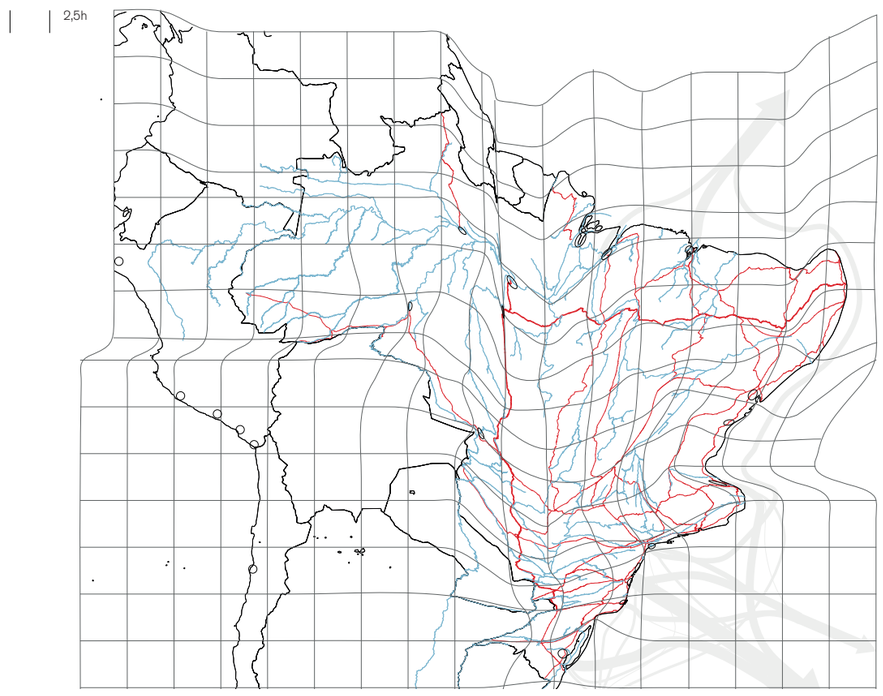


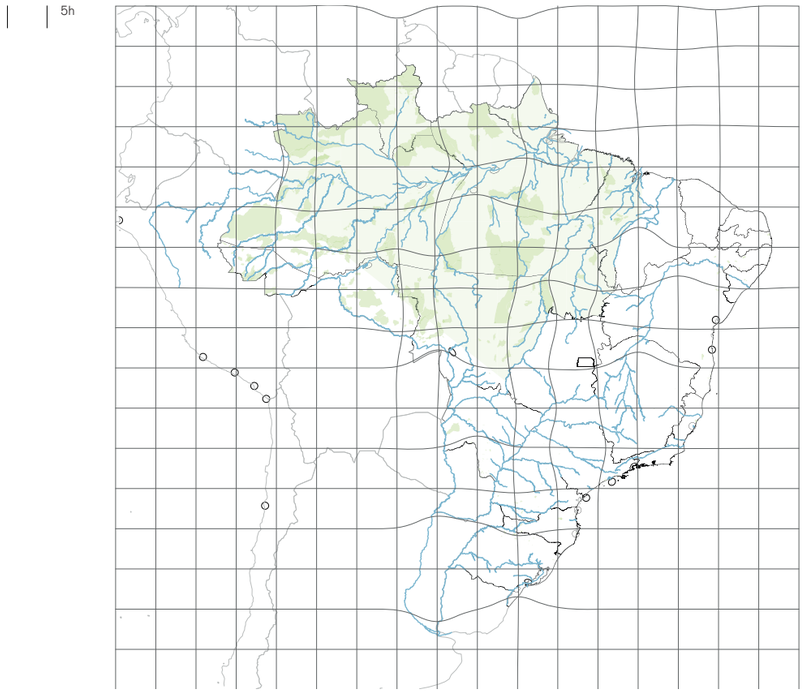
Time-space maps

The time-space maps show how seeing the waterways as alternative ways of transport can de-destort the proportions of the country









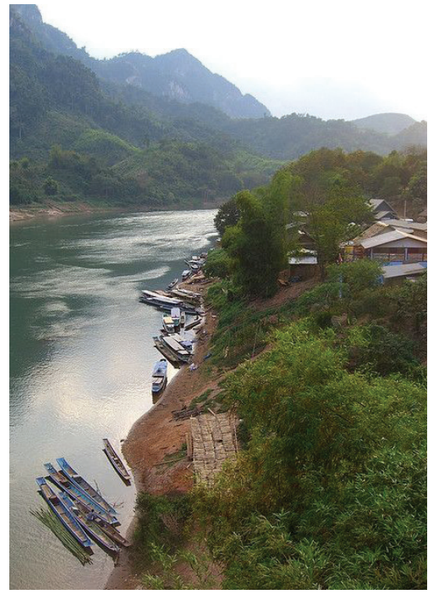
N

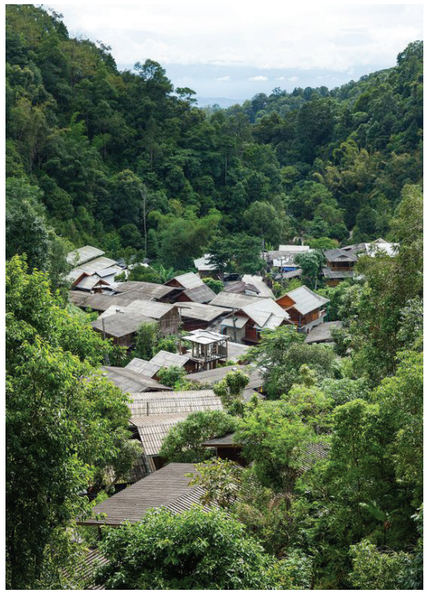
0 | 250 km

Scenario 2 . No Technology









Low Technology

The title of this scenario is changed from ‘No Technology’ to ‘Low Technology’ as there is limited use of technological developments.

This scenario is part of the multi-scalar scenario project, where it functions as a tool to accomplish the strategy and vision of the region and country. Therfore, the scenario is developed on local scale.

In the case of low technology, self sustainability would be necesary on local scale. This results in the nature taking making its way back into the settlements as well as waterways in order to transport goods and people.

The original road structure remains visible, but some of them have been replaced by waterways. Furthermore the inhabitants of the settlements live in small communities that provide for themselves by growing food that is able to grow there in the natural circumstances.





Low Technology

Maps of Vila Bela da Santissima Trinade and Porto Velho in the scenario of low technology.

Waterbody
Roads
Nature
Agricultural Land

0 1 km N 0 1 km

Scenario 3 . No Humans

Low Humans

The title of this scenario is changed from ‘No Humans’ to ‘Low humans’ as there are still a few groups of humans who inhabit the earth.

Departing from a situation where most humans would be forced to leave the earth for undefined reasons, the Amazon is transformed into a natural sanctuary for endangered animal and vegetation species. Ultimately, the gatekeepers of these sanctuaries are the indigenous peoples, who gain back their ownership over the land.

In this sense, indigenous reserves are extinct, as the tribes no longer have to be confined to a piece of land and can wander freely by the continent, as they used to do before European invasion.

Areas that had been previously deforested are reforested. Not to their original state, but as testimonies of human activity on the planet, therefore being called anthropogenic forests.

Areas that once were over-exploited for agriculture, for example by soybeans plantation or cattle ranching undergo processes of soil remediation and enrichment.

Finally, the current “arch of deforestation” is reinterpreted as an arch of ecosystem remediation.



Low Humans

Map depicting the spatial implications of the Low-Humans scenario

- Hydrography
- Floodplains
- Anthropogenic forests
- Soil remediation areas
- Natural sanctuaries
- Former indigenous reserves
- Ecosystem remediation arch

5.

System intervention

Performance bases urban design guidelines

The previous part of the report is an analysis (critical cartography) and an exploration of the possible outcomes for the future (scenarios). In this chapter, the synthesis and the scenarios will be used to formulate a vision. To do so the vision will be defined by the same three scales as the synthesis.

The concept explained in the scenarios will be used

- Nature first: Vision
- No humans: Strategy
- No/low technology: Tools

This chapter is mainly intended to formulate project the ideas and ideals of the scenario's in on a realistic manner.

In the second part of the chapter, the visions of the different scales will be converted into a set of guidelines and actions. The guidelines operate on different scales can therefore be translated into specific actions for each specific scale.

Alternative ways of transport

This map show the new connection of the two basins forming the alternative navigation route. This route will be the ground work for a more sustainable and biobased future for the continent. A future that is not focused on export but on being selfsufficient and taking care of the natural landscape.



Vision map: Continental scale

Floodplains
Amazon Basin
Indigenous resevers
New connections
Locations
Waterways

N

0 500 km

Reinventing the natural landscape

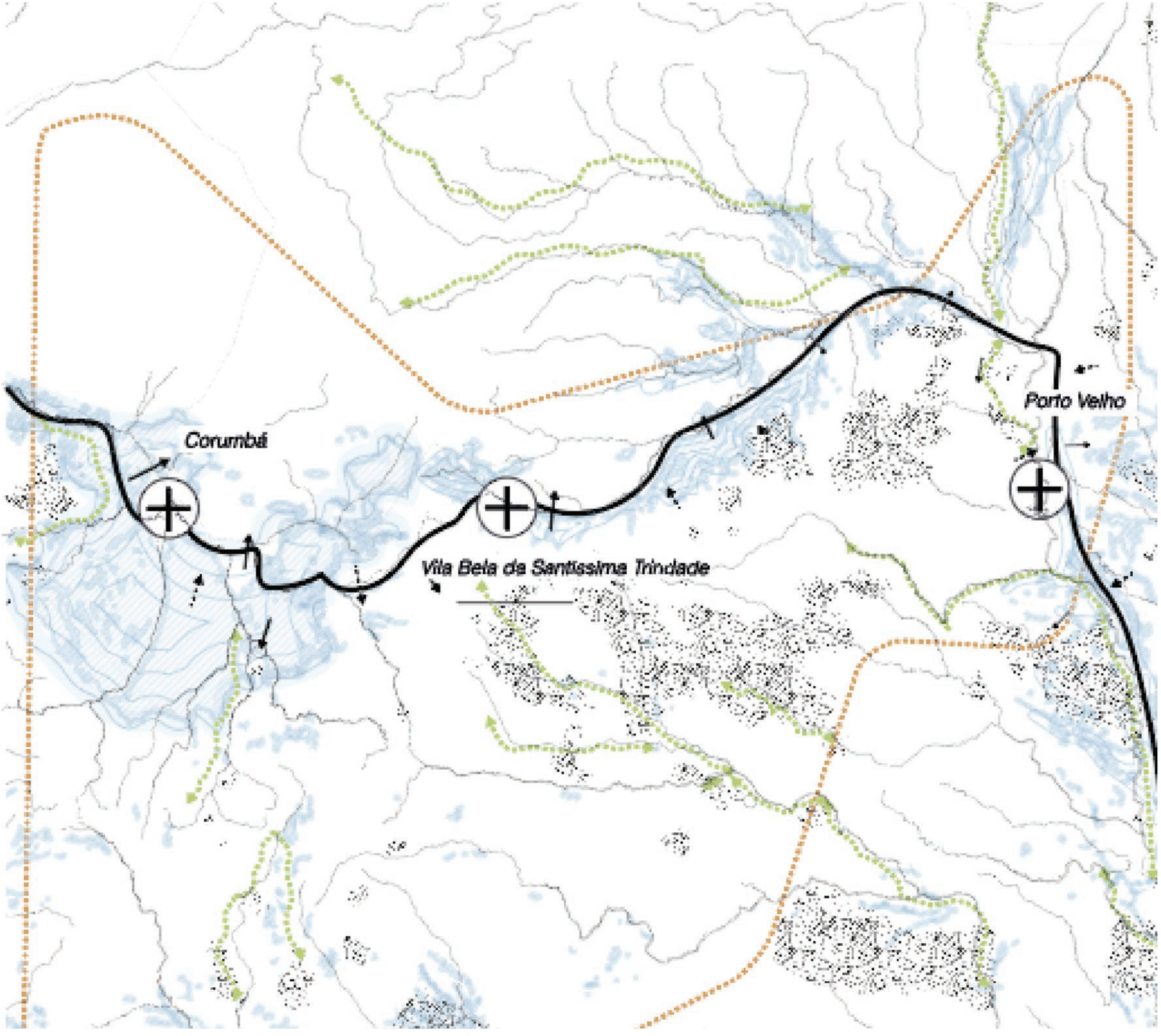
The vision for the regional scale would mainly be about reinventing and reconnecting to the natural landscape.

New land occupations and land-use allow also new physical and social connections to be made.

For new land occupations and land-use think about regenerative agriculture on the floodplains. This allows the region to become more self-sustainable and independent of export.

new physical connections, green corridors that follow the river, will form the connections between the indigenous reserves.

Letting the indigenous population play a dominant role in the new land-use, a lot can be learned in how to live more in synch with the natural landscape and remediate the environment instead of exploiting it.



Vision map: regional

Vision map : Porto Velho

The vision for Porto Velho is mainly about reconnecting the city to the natural environment, whilst increasing the livability of the city. To achieve this goal the main three interventions on this scale will be the green blue network, a redesign of the ports and softening the relation between the city and the river.



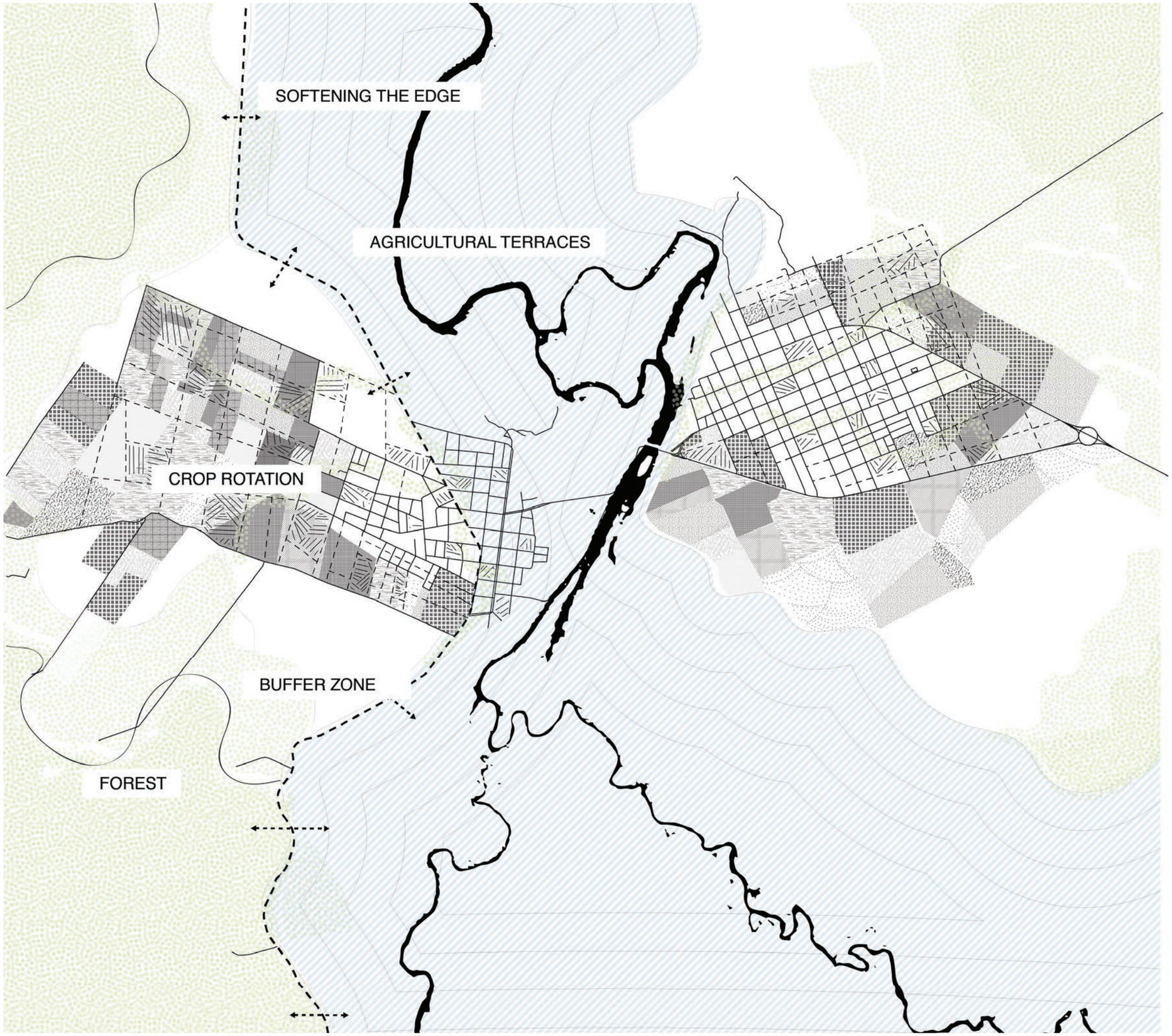
Vison map: Porto Velho

Regenerative Agriculture

The vision for Vila Bella is a way to contextualize the idea of regenerative agriculture to a specific city.

In this location the strong urban grid forms the basis for crop rotation and expension of the urban fabric.

There was also an afford made to soften the edges and barriers and create bufferzones between athropogenic forces and the natural environment.



Vison map: Vila Bela

- Floodplains as productive landscapes
- Low intens agroforestry
- Crop rotatation
- Anthropogenic Forest
- Indigenous lands
- softening the edges
- Extension urban grid

N

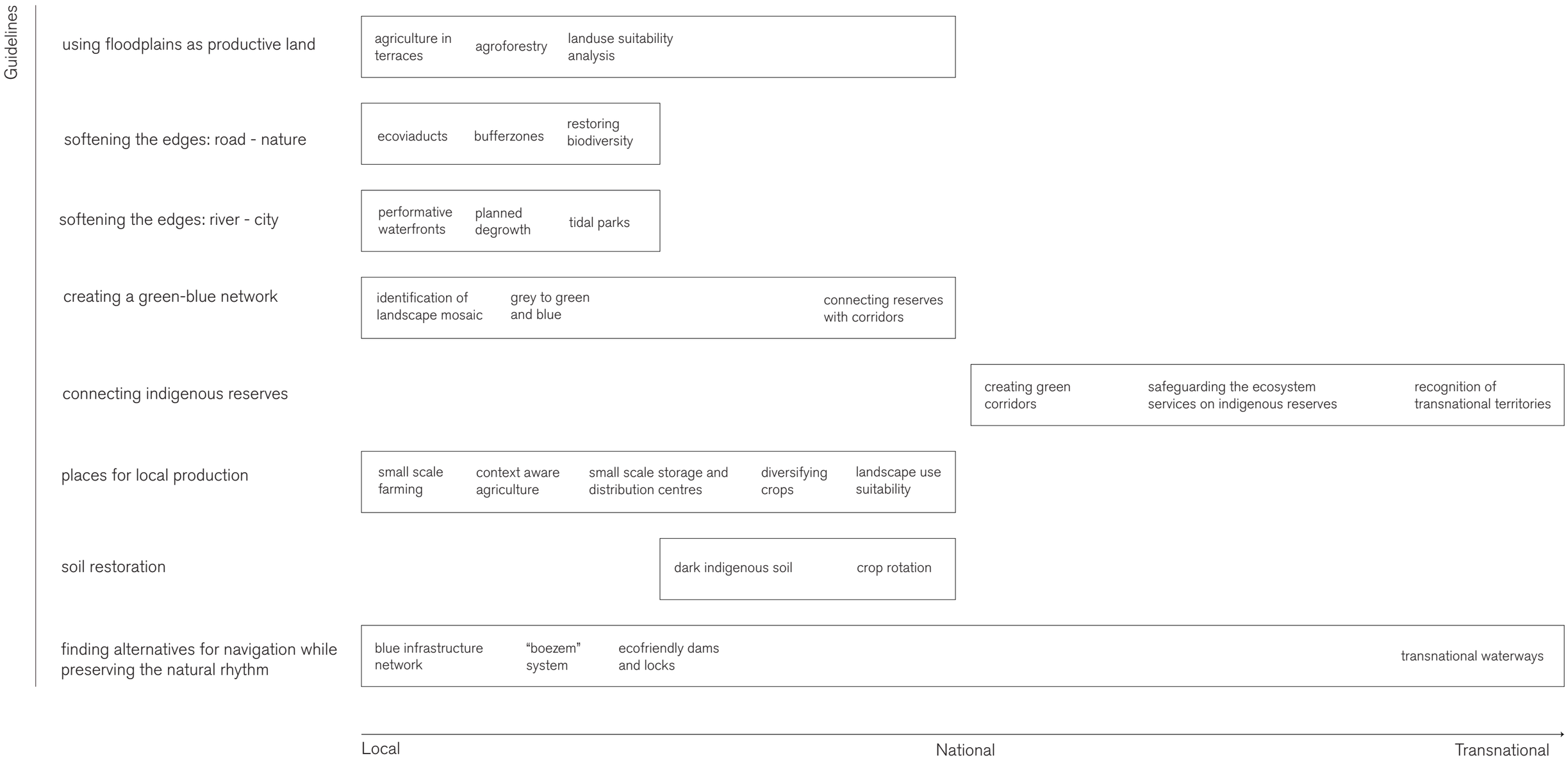
0 — 1 km

Guidelines taxonomy

The visions on different scales translate into a set of guidelines and interventions/actions that are suposed to guarantee the vision.

The guidelines are multi-scalar and translate to different actions on each specific scale and location.

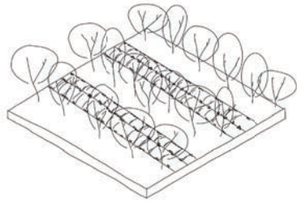
On the following spread some of the different actions will be illustrated.





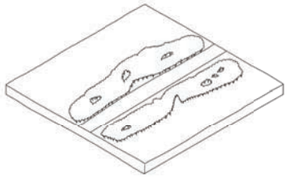
Archicultural Terraces

Archicultural terraces will transform the floodplains into productive landscapes. With carefully selected crops and the right techniques these agricultural terraces can regenerate the soil.



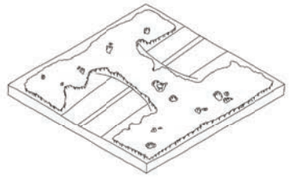
Agroforestry

Agroforsty is an alternative for the monocrops, slash and burn and the cattle farming. Agroforestry is sustainable way of agroculture thats also highly productive.



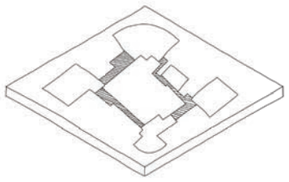
Bufferzones

Bufferzones are intented protect the natural environment form antroprogenic forces.



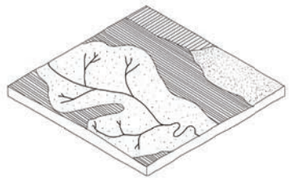
Ecoviaduct

Ecoviaducts is a piece of infrastructure that should secure biodiversity and reconnect fauna. They are an afford to create a landscape mosaic.



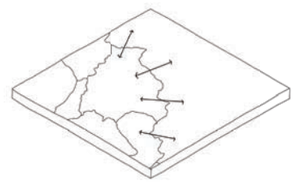
Green corridors

The green corridors are connection on a regional scale between idigenous and natural reserves. They bring back fluidity of the landscape as the indigenous people preseve it.



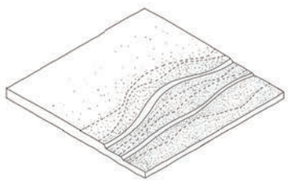
Land use suitability

Land use suitability maps is a techique used by the military regime to see how and where they could exploit resources. However, this technique can also be used for examine sustainable landuse



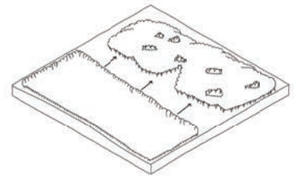
Transnational territories

A lot of the current administrative borders do not follow the landscape morphology or the indiginous territories. For a more inclusive future transnational territories become more important.



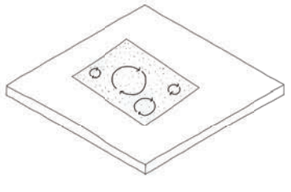
Tidel parks

Tidel parks are a way to soften the transition between urban and natural territory. Besides that they also form a Nature Based Solution to counter act erosion and create a valuable public space.



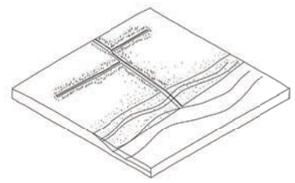
Restoring biodiversity

In finding new ways of using the land emphasis should lay on the restoration of biodiversity.



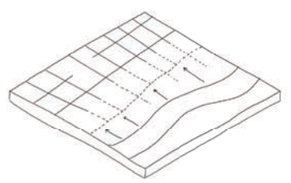
Safe garding Ecosystem services

In finding new relations between human and nature emphasis should lay on safe garding Ecosystem services.



Performative waterfronts

The performative waterfront way to both ensure the proditivity of the waterfronts meanwhile also garentuee the natural conditions of the waterfronts.



Planned degrowth

Areas along the shorelines that must give room to the river or riverine vegatations and need to go under a process of planned degrowth of urban activities

6.

Design Experiments

Jin-Ah Duijghuisen
4461401
Urban by nature

Luiz Felipe do Nascimento
5255082
The civic urban forest waterfront

Sanne Francisen
4563506
Soft Transition

Urban by nature

Retrofitting the urban igarapés

Jin-Ah Duijghuisen
4461401



Jin-Ah Duijghuisen

Manifesto

Urban by nature

Giving nature equal rights

In this anthropogenic epos the damage we as humans pose on the earth has become more and more evident. To change this, our understanding of what nature is and how we relate to the natural environment needs a radical change. A possibility for the reinvention of our relation to nature could be expressed in giving nature equal rights.

The legal quest of how we can give nature equal rights has a lot to do with what we as humans value and what we think constructs our living environment. In that perspective this legal question becomes even bigger and more fundamental, it could also describe as a paradigm shift to perceiving nature as a subject rather than an object.

The designer is the mediator between the humans and the natural environment. Instead of designing with nature for humans the designer becomes the guide in a new dialog.

Translating that to the context of The Amazon and Porto Velho the natural environment has always been a source to be exploited. The city was founded to make the transport of natural rubber possible and has ever since grown due to the transport of soja and the development of two hydro power dams. Extraction and export are part of the DNA of the city, as it is the reason for its existence in the past (rubber) but also in the current (soja, electricity). Due to the strongly export focused activities and mindset, the city has lost its connection to the local context. In the case of Porto Velho this means to things; 1) Disconnect to the physical context, there is no notion that you're in The Amazon Forest. The biggest and most biodiverse forest of the world. 2) Disconnect to the local urban population. There is little to no investment in the local urban environment. Which leads to poor public health in the city.

A specific element within the urban tissue that shows this disconnect to the context are the urban Igrapares (the urban streams) that are highly polluted. Nowadays, these streams a clear illustration on how people and nature live of each other's trade-offs.

This design experiment is an exploration on how this paradigm shift of nature as subject would be projected in space. It is meant to establish the role of the designer in this new dialog and to reconnect with the local context. To explore this the urban stream will be the most important new actor.

Design Experiment

As stated in the manifesto is the design experiment an exploration on how giving nature equal rights could be expressed in space and be projected on the urban igarapés. To be more to the point the design will be to retrofit the urban streams with the scenarios in the back of the mind of nature first as vision, no humans as strategy and low/no technology as tools.

In retrofitting the urban stream there are two main goals

1. Ensure the continuation and the space of the stream
2. Decrease pollution

In trying to achieve these goals on local scale will refer to the guidelines that are formulated in the vision part (Archetypes Vision).

The relation between human and nature right now exists as a dichotomy to change this the design exists out of a set of three layers.

1. Confinement re-establishing the territory of the urban igarapés.
2. Optimalisation Nature Based Solutions
3. Participation Giving back, taking care

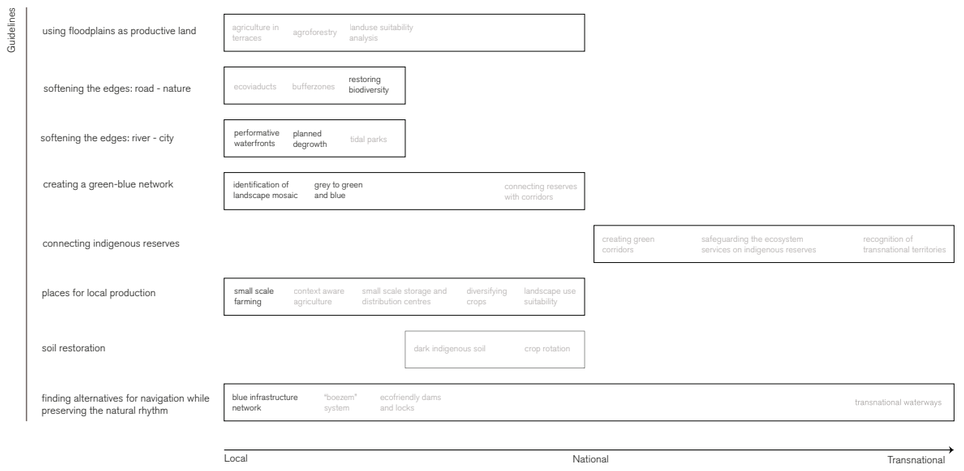
Layer 1. The first step entails providing room for urban igarapés. In practice, this meant determining what kind of infrastructure could ensure space for nature. It could be seen as the first layer of the design. This layer will mostly consist out of hard(er) infrastructure, which should be robust and low-maintenance.

Layer 2. entails optimizing the existing local systems. This stage is mostly an attempt to bring human activities more in-sync with the natural world. It's also about demonstrating to the urban population that ecosystems can help them deal with their daily problems, such as polluted environment

Layer 3. Layer 2 made humanity more reliant on Nature Based Solutions and created a holistic system that brought human activities closer to nature. Layer 3 develops that concept further; the system of Nature Based Solutions cannot exist without maintenance of humans. Layer 3 shows where the place of humans is within the ecosystem established in layer 1 and 2.

The three layers together are codependent one cannot exist without the other. This codependency at one hand give humans the control back over their living environment and on the other hand it ensures that they give back at take care of the natural environment.

Archetypes Vision



Vision Map Porto Velho



Locations

Porto Velho's basic sanitation is, among the 100 biggest cities of brazil, the worst. A comparison of the ranking of sanitation to the development of the Gross Domestic Product (GDP) ranking from 2003 to 2016 shows that although the GDP and the population has grown over the past decades the basic sanitation have not evolved with the economic and population growth. Leaving big consequences for the urban climate, biodiversity, and the status of nature within the urban fabric (Borges, 2019).

Basic sanitation is defined by law and is subdivided by drinking water supply, sewage, urban cleaning, waste management drainage and storm water management. Since 1970 the investment of the universal and public basic sanitation of Porto Velho has stagnated (Borges, 2019). Leaving only 36,7% receiving treated water from the piped supply system and only 4,8% of the population of the city is served by a public sewage system (Vargas. 2021)

In previous times the urban igarapés used to an important part of the basic sanitation of the city (storm water management) but due to the lack of investment in universal and public sewage systems, waste management and urban cleaning the urban stream transformed to a collection place for liquid and solid waste.

To land the design-experiment the urban igarapés running through the heart of the center is chosen as a subject. The stream runs from the city center to the more 'informal' part of the city. Showing an increase territory conflict with the urban fabric. Eventually the urban stream devolves in the urban fabric (shown in both the picture and the diagram).

The diagram shows the two spatial problems that form the basis for the interruption of the urban igarapés:

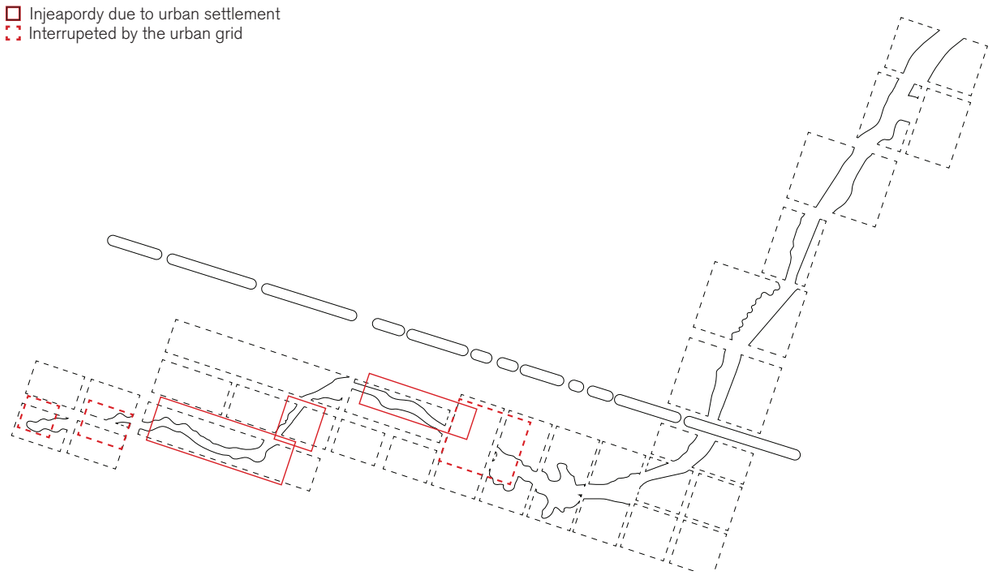
1. Urban settlements
2. The urban grid

Localizing the problem





Diagram: Interuption of the Urban stream



Problems | pollution

1. Urban settlements growing closer and closer to the urban stream

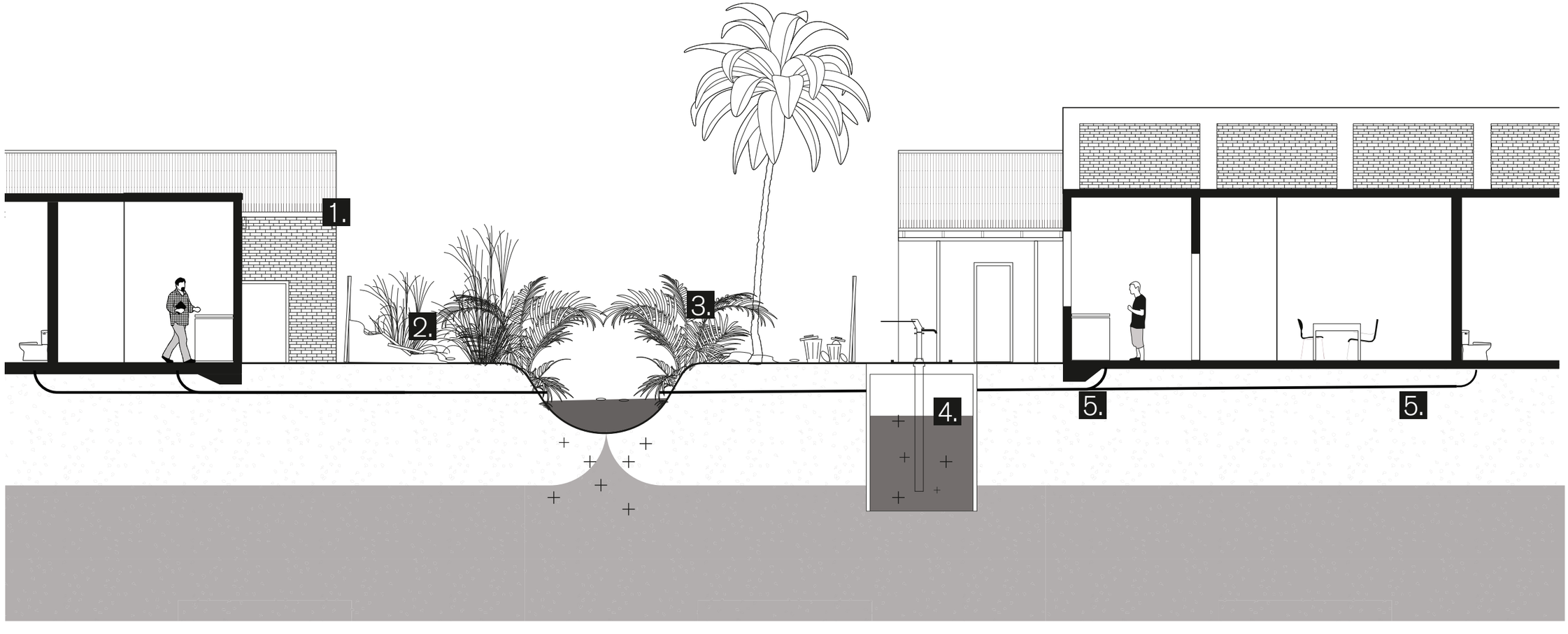
2. The urban stream as dump for solid waste

3. The urban stream is overgrown by plants that grow well on polluted soil. This leads to a lot of the same species and is bad for the biodiversity

4. The polluted soil and groundwater is used for domestic consumption. This leads to health hazards such as diarrhea and infectious diseases.

5. The urban stream serves as open sewage system

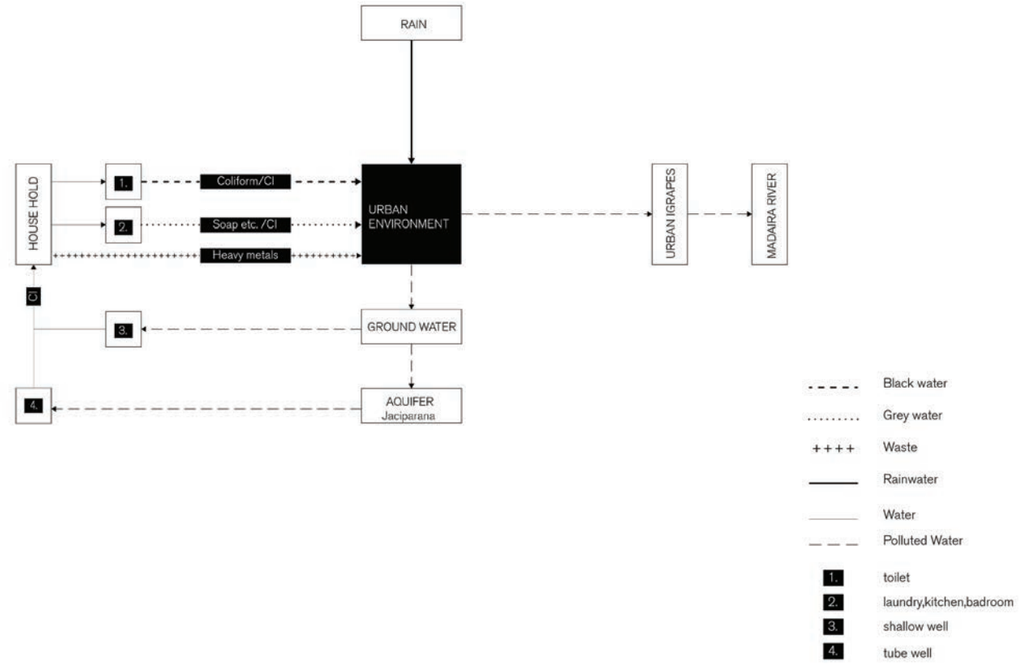




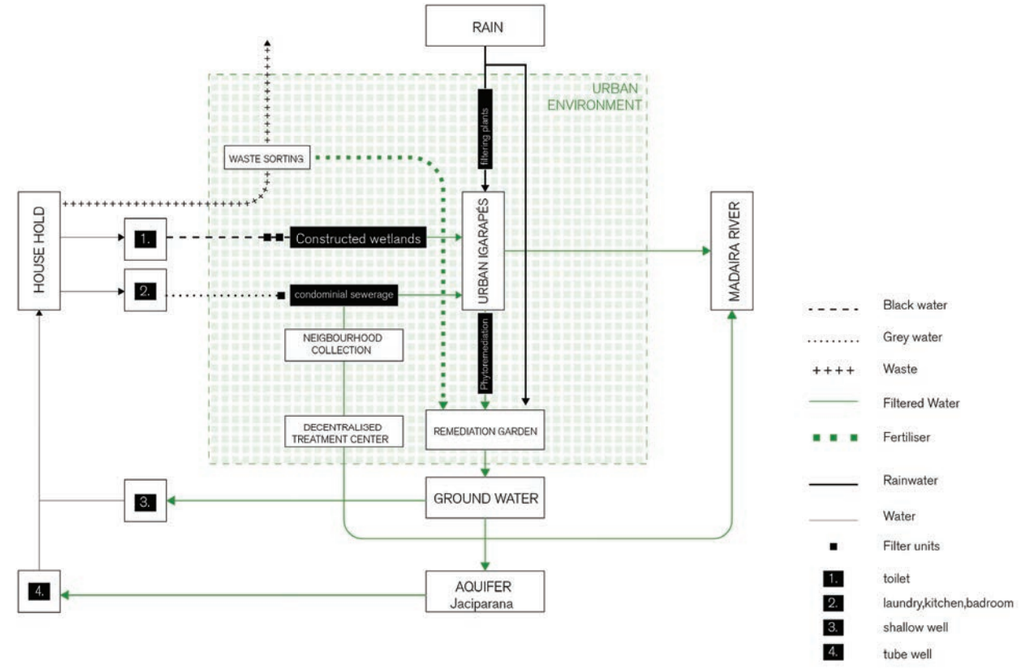
System interventions

An important part of the design is turning the current opposite systems of the human and the natural into an holistic system, in which both entities can exist and can use each other's benefits. To reach this goal Nature Based Solutions are used (mostly in situ). These Nature Based Solutions willshow a decentralized way of treating solid and liquid waste and grey water, whilst also increasing biodiversity and remediate the soil and ground water. The solutions will, as far as possible, be in situ to give the urban population the control over their environment. In doing so this design hopes to catalyze human participation within this system.

System-diagram: Current-situation



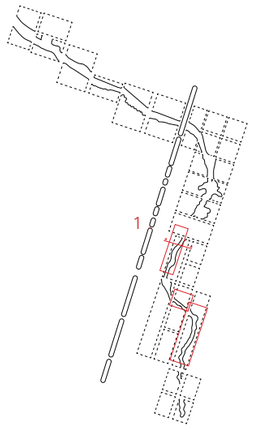
System-diagram: Improved conditions (Nature Based Solutions)



Case study 1:
Continuation and space for Igrapes

Due to urban settlements the urban Igarapés lost territory and were transformed into trash dump place. Adjacent backyard of many houses the urban stream was a place of neclect. This section shows how the urban stream could be transformed into a continues landscape line in the city, while at the same time garentuee a clean and biodiverse living environment for human and nature.

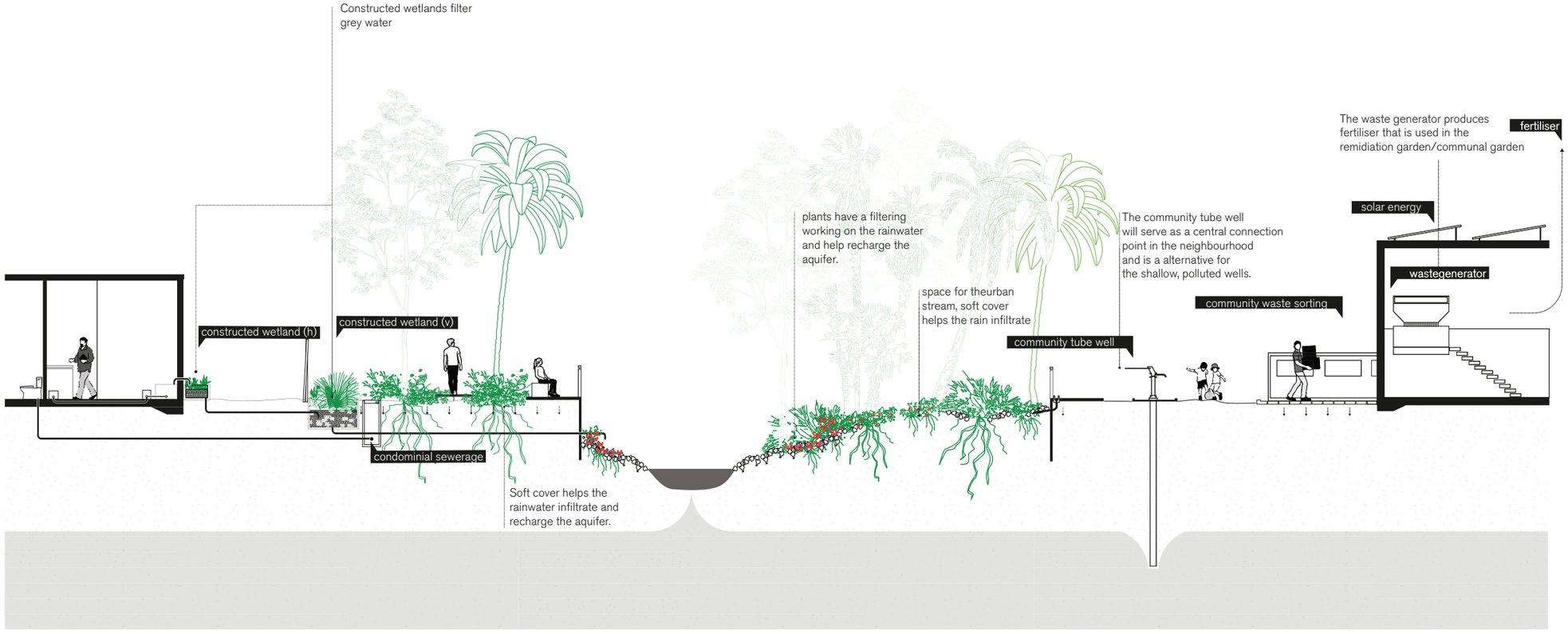
Locactions



1. Confinement | re-establishing territory

2. Multifunctional |Ecosystem Services





Section 1: Retrofitting the urban igrapes

The section shows how humans would interacht with nature in the changed territory of the stream and the ecosytem services.

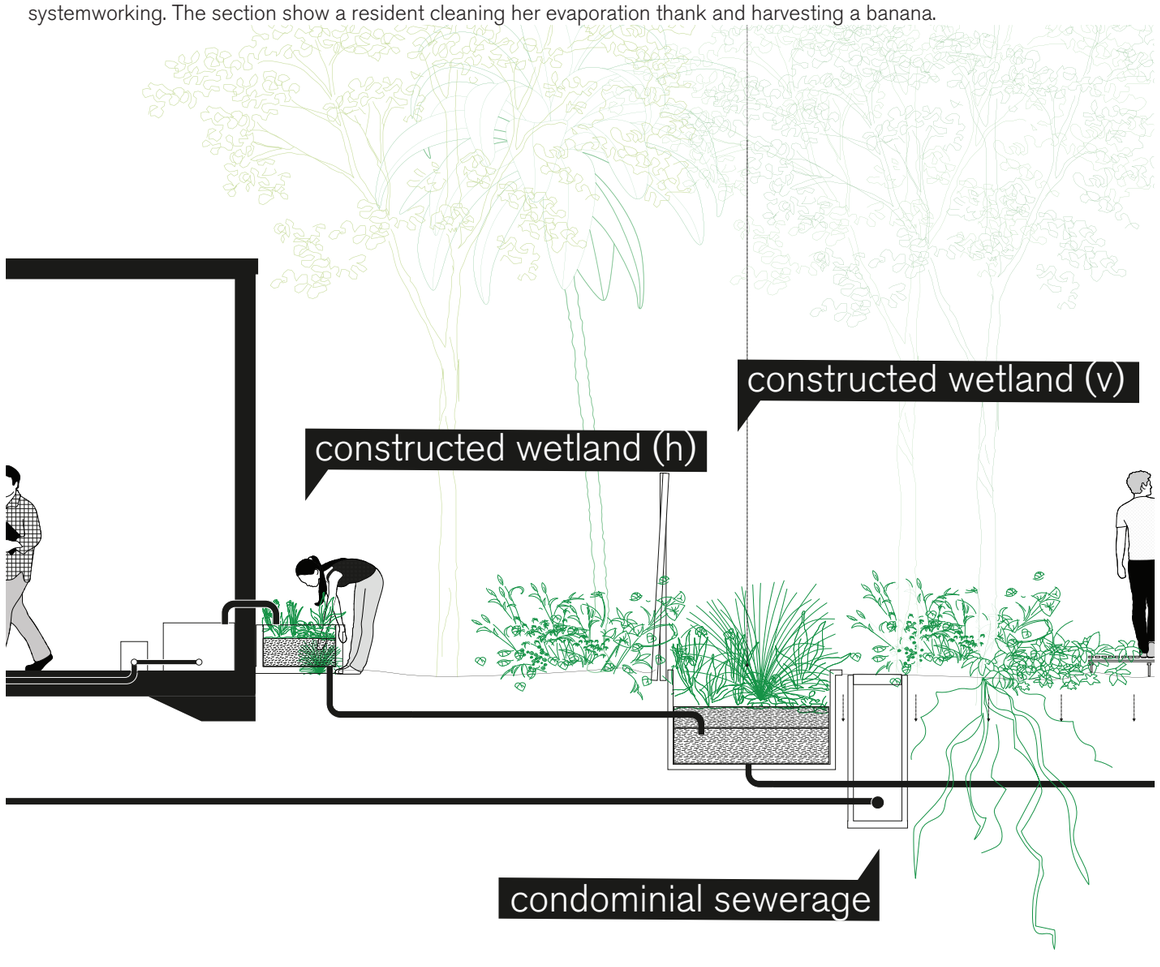
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Continuation and space for the stream

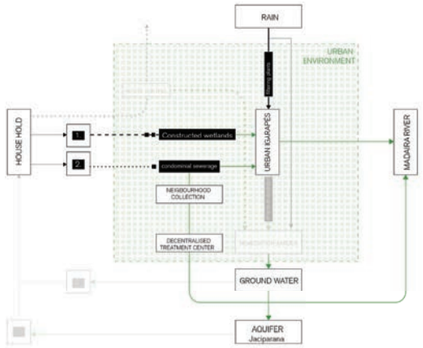
As stated before the first two layers of the design (Confinement and re-territorialize) can not exist without the maintance of humans. The zoom in show how humans should interact with the system to make holistic system work. In letting people act in the system they are taking care and giving back to nature, whilst also directly profiting form the system.

System-diagram 1 shows where in the overall system the section is situated.
System-diagram 2 shows how the system on the smaller scale works and where humans are interacting in the system.

Zoom-in section:Humans should clean the constructed wetlands and the evaporation thank to keep the systemworking. The section show a resident cleaning her evaporation thank and harvesting a banana.

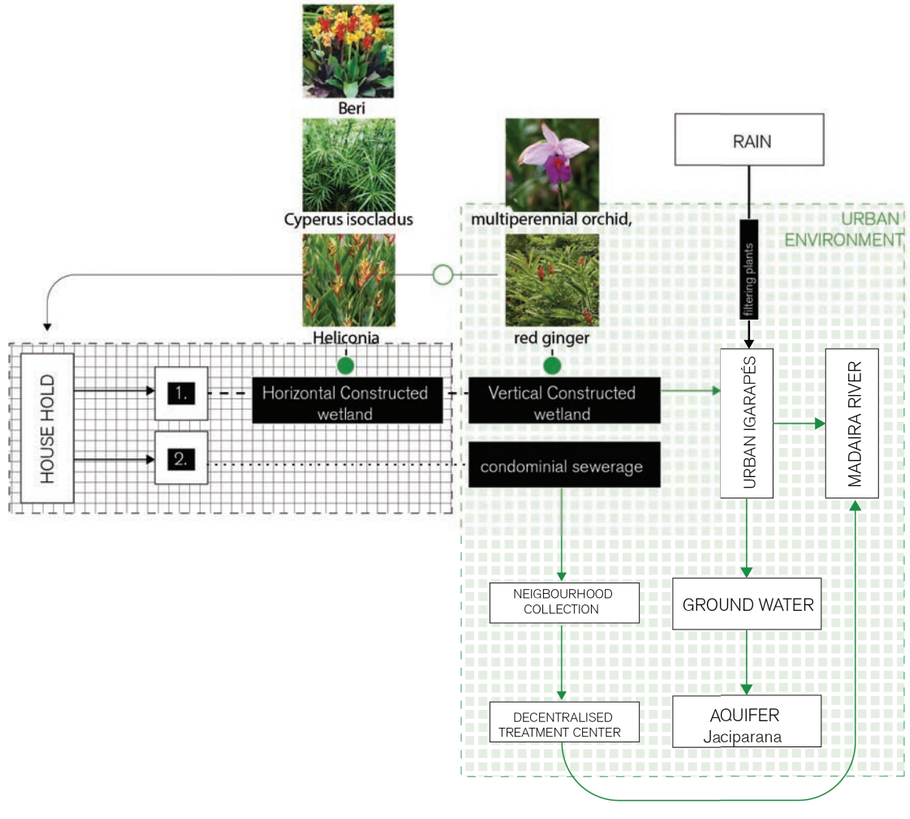


System-diagram 1: Improved conditions (Nature Based Solutions)





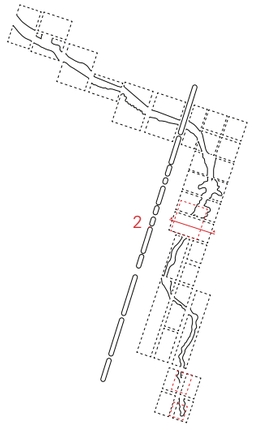
System-diagram 2: Improved conditions (sewage and grey-water treatment)



Case studuyBreaking the Grid

Apart the decreasing space around the Igarapes the stream also dissappeared completly within the urban grid. This spread is an exploration on how a whole block in the urban grid could be tranformed into a public sapce. containing a park and the remediation/ communal garden. Giving the public space a multifunctional usage.

Locactions

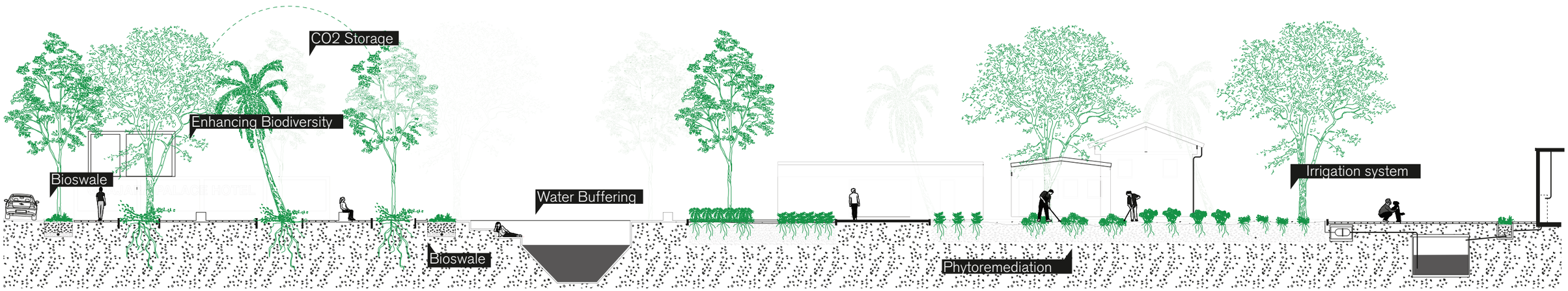


Plan remediation garden

- Remediation garden
- Bioswale/horizontal constructed wetland
- Territory of the urban igrapes



0 28m N

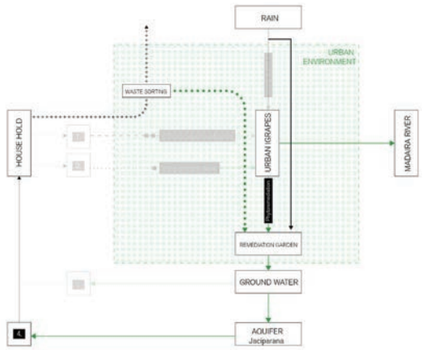


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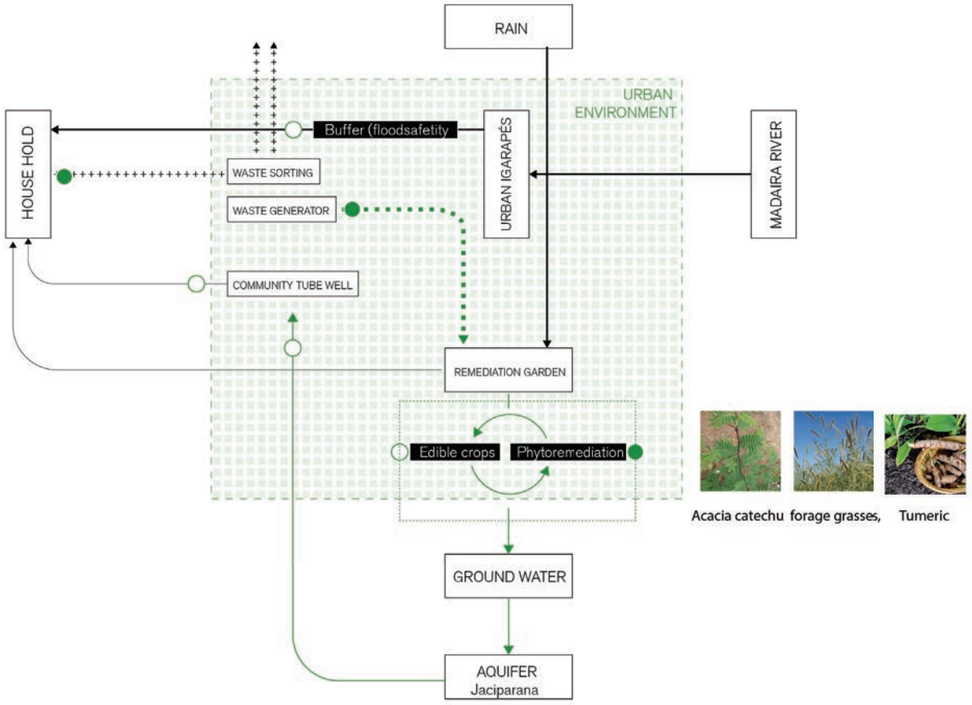
Nature Based Solutions

This spread shows how the system of Nature Based Solutions works together with human activity.

System-diagram 1: Improved conditions (Nature Based Solutions)

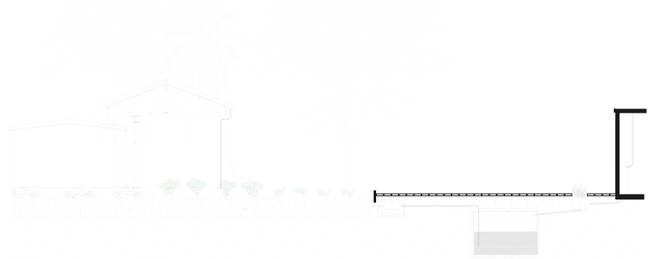


System-diagram 2: Improved conditions (remediation of the soil)

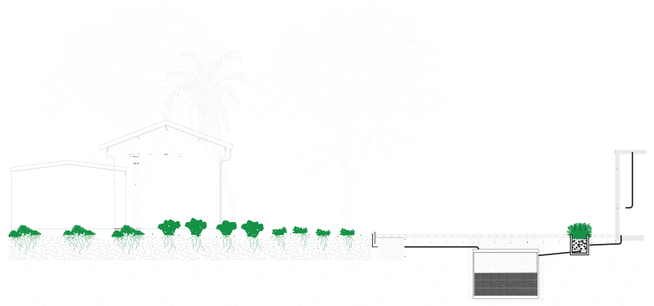


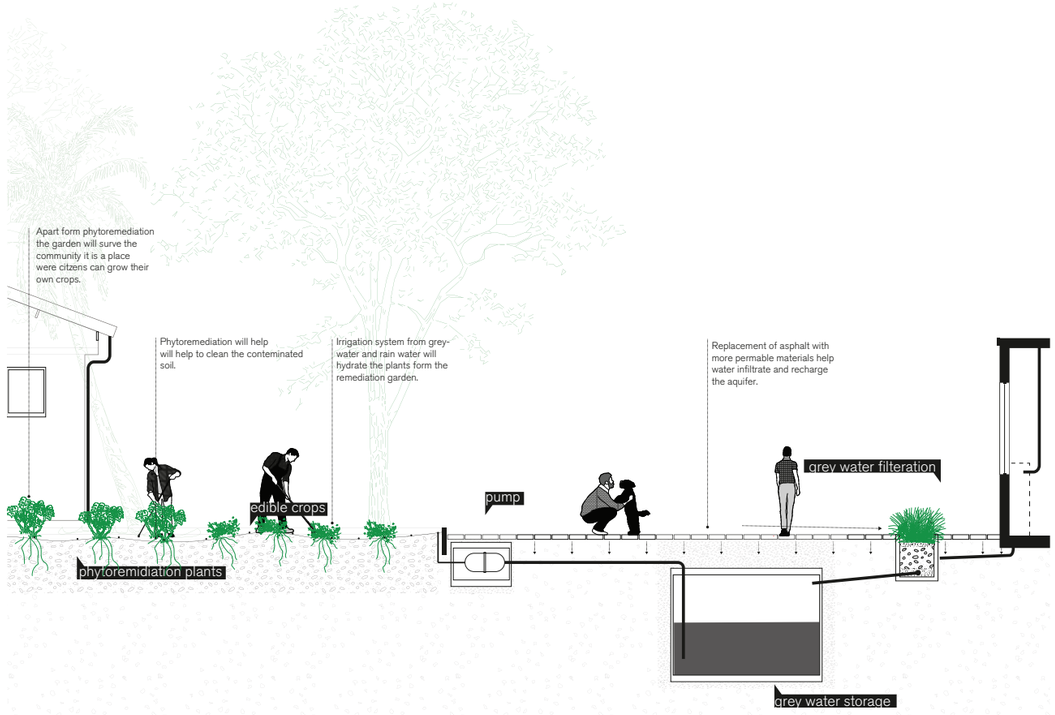
Acacia catechu forage grasses, Tumeric

1. Confinement | re-establishing territory



2. Multifunctional |Ecosystem Services





Conclusion

The design experiment was an afford to see how giving nature equal rights to human could be expressed in space. In trying to do so the subject of the design were the urban Igarapés. The design consisted out of three layers.

1. Confinement | re-territorialize the space for the urban stream
2. Optimize | Nature-Based Solutions
3. Participate | Giving back, taking care

As said in the introduction these three layers of the design are codependent layer 2 and 3 can be seen as boundary conditions to let layer 2 work at its full extent. In implementing very small scale and in situ Nature Based Solutions the residents and overall urban population experience more control over their environment and how it influences their health. Giving this control back on a very small and clear area should stir up a feeling of responsibility and wanting to give back and take care of the natural environment.

Concluding, the idea of giving nature equal rights seems very abstract and conceptual but as designers we should not think about the legal question but more how does this question change the tools of our work field. This design experiment showed that this question translates a static design assignment into creating conditions in which public space and the urban environment can develop and evolve.

Discussion

The design experiment is focused on a very small part of Porto Velho the improvements that were suggested were mostly related and connected to the urban igrapares. It would be interesting to explore what this system could look like on a bigger scale and if it can exist further a way from the urban stream. Solutions such as the waste generator and the remediation garden are solutions that could be implemented without the urban igrapares. The implementation of the water treatment system could be combined with condominial sewerage system. This system provides a local and decentral sewage system. Nevertheless these assumption need further research.



Discussion

The design experiment is focused on a very small part of Porto Velho the improvements that were suggested were mostly related and connected to the urban igrapares. This very local intervention is a systemic design that could be an incentive for developments on bigger scale. In trying to achieve the the vision for the city in this decentralised way it is also an afford to try and make what should happen comprehensible and give control back to the induvidual.

The sectiong and plans show how the connections and the retrofitting of the urban igarapes could create new public spaces with communal functions. In trying to set up this systemic network it is quite easy to image how the design could spread to the whole city. Public space can become communal well and trash collectionpoints and the urban igarapes could become the backbone of a new green blue network in the city.

Leaving a city in which the district scale becomes dominant and the urban commons such as basic sanitation a way to connect the communities within the districts.

Vision map Porto Velho



Possible communal well and trash collection locations



Revisioned basic sanitation system Porto Velho



Map produced by Sanne Francissen

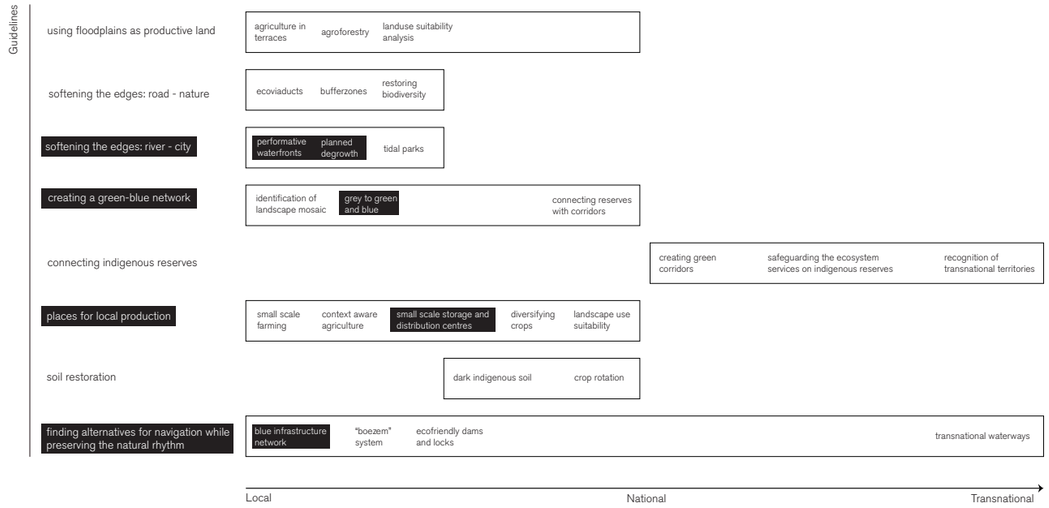
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The civic urban forest waterfront

Infrastructure for fluvial passenger transportation and flood protection in Porto Velho

Luiz Felipe do Nascimento
5255082

Taxonomy



Manifesto

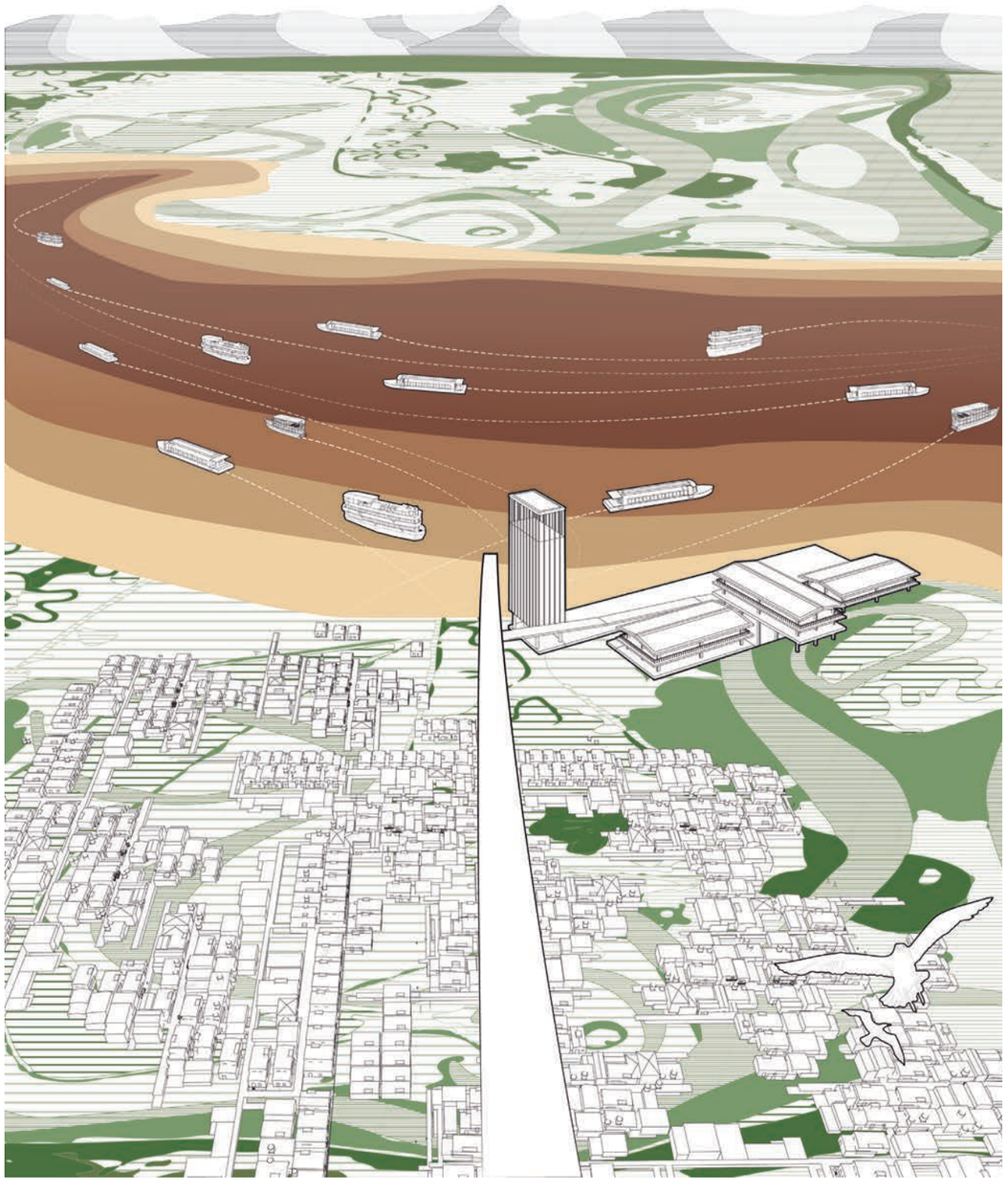
The civic urban forest waterfront

The Amazon is a stage of the current dynamics of our times, with our entire global community as actors and spectators. As climate change and global warming threaten millions of people around the globe the inhabitants of the forest, both humans and animals, struggle to survive despite the most disruptive events. Once rare, the disasters now do not provoke as much astonishment and have become part of the routine of those living in the forest or the capital cities of the Amazon. Floods, fires, loss of biodiversity, income, and erasure of indigenous lifeways are just some of the urgent risks that any design developed in the region must be aware of.

A tale going on for 500 years and counting, a story of a world that seized existence: man and nature living in symbiosis, one providing the other with the tools needed for survival and thrive. The colonization of the forest, a process that started with the invasion of the Europeans in the 16th century, continued with the military investments and expansions in the Brazilian Amazon during the 20th century, and now take a new turn, provoking even more damage by the expansion of cattle ranching, mining and exploitative farming of soy and sugar cane, among others, under the only driven-by-profit governments of South America.

The image of the Amazon, which used to be associated with nature and traditional ways of living, now is more than ever linked to the reckless extraction of natural resources. A reinforcement of the role that the continent was assigned to play in the world: a provider of goods, of commodities, at the expense of its own financial, technological and social independence.

As a design experiment developed during only a few weeks, this work makes an effort to provide an image, a mere glimpse, of what a future of post-extraction means in the urban landscape. A set of tools and objects needed for a more sustainable and synchronized natural way of transportation. Transportation of humans, real food, medicines, and prosperity, not of grains, beef and oil. Civic spaces that reenable citizens and forest to dialogue. A design catalyst for ecosystem participation in the context of the Brazilian Amazon.



Conceptual vision

How to reconnect the city and the forest via a new waterfront that acts as a novel civic public space, as a high-performance passenger port, and as flood defense against the waters of the Madeira River?

In this depiction, the Madeira River is the main character of the vision. As a thoroughfare for watercraft, with high-speed services connecting the Amazonian capitals, as well as the smaller cities along the rivers.

Furthermore, on the background of the picture seats the Andes. Although in reality the mountain range is located much further from Porto Velho, it is brought to the illustration as a symbol of the union of the Latin-American countries via a system of connected waterways that allow for navigation from The Caribbean to the Tierra del Fuego, From the Atlantic to the Pacific Ocean.

Design experiment

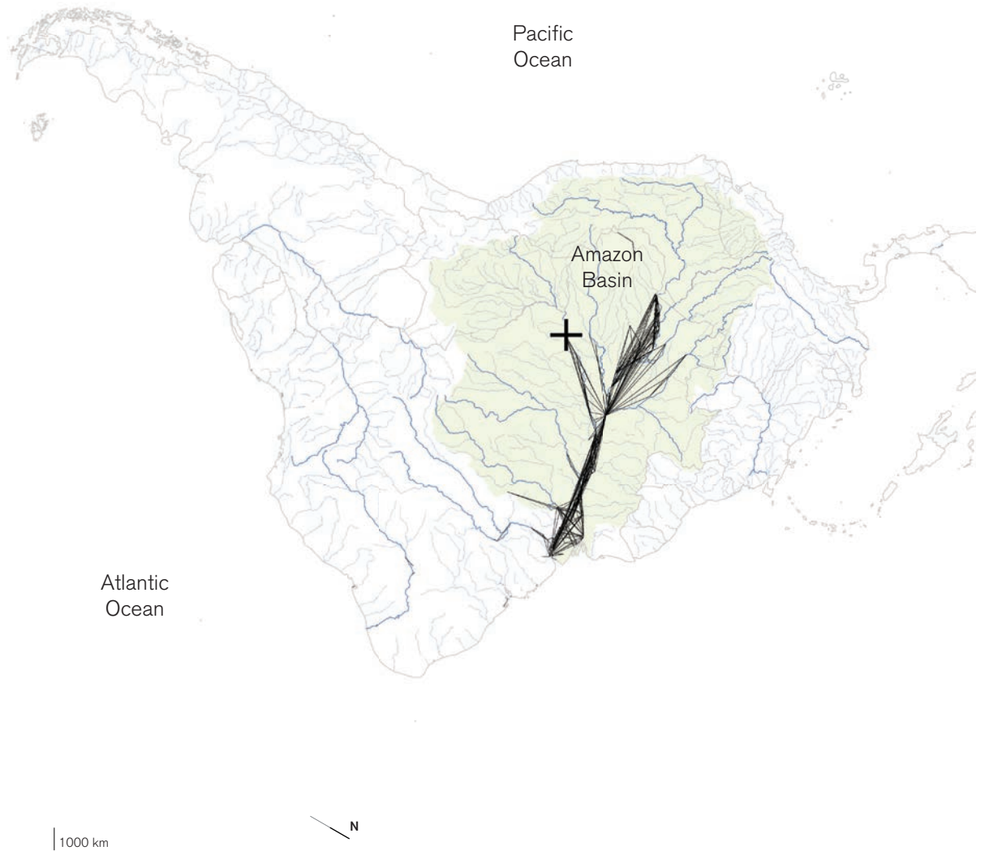
Connecting small and large cities, hinterland and abroad, the city is nowadays an important point of exchange for soybeans and other products of the agricultural expansion towards the Amazon forest. The civic urban forest waterfront design experiment revolves around the idea of having Porto Velho as a consolidated center for passenger transportation along the waters of the Madeira River.

This project aims to provide the city with a new basic set of infrastructures for the implementation of more formal, structured fluvial passenger services in the Amazon, as well as to offer a new entry point for produce harvested by local farmers (in line with the group vision for Porto Velho) artisans and finally, a new departure point for touristic vessels that navigate through the waters of the Madeira.

Analysis has been carried out to understand what is the presence of this type of infrastructure in the city, as well as other eventual urban and environmental issues that could be tackled by the design.

Porto Velho demonstrated to have a prominent but scattered set of port infrastructures built both by the public and private sectors. As to the articulation between water and the city, the renewal of the waterfront seemed to be of extreme importance to the resilience of the city. Due to the considerable fluctuation of the level of the Madeira River between drought and flood periods, the riverbanks of the city are naturally prone to erosion, a phenomenon that has been accentuated by the uninhibited occupation of the shores, as well as to the deforestation of the riparian forest.

Embedded in the main overarching question of the studio "*How can ecosystem participation perform as a design catalyst for healthy and climate-proof urban extraction landscapes?"* and also referring to one of the subquestions formulated by the group along with the research *"How would an economy that is not defined on exporting impact the landscape?"* the design attempts to provide an insight on other types of infrastructural and civic spaces needed for the emancipation of the region from fossil-fuel transportation systems, from beans and beef exports.



Systematic proposal

The Amazon region is already connected not by its roads, railways, or airports, but by its rivers. Informal and unreliable passenger service lines operate the long stretches between the capitals, whereas smaller boats connect the riverine villages to the regional centers.

Currently, the ferry from Porto Velho up north to Manaus, the capital of the Amazonas state, takes no less than 7 days to complete the route. Another important ferry service of the region, from Manaus to Belém, capital of the state of Pará takes 6 days. Although both services sound inconvenient and slow, they have severe importance to the integration and exchange within the Amazon, and also act as a relevant touristic attraction.

The Brazilian Amazon counts with approximately 175 locations that are classified by the IBGE as regional centers for the neighboring villages. Many of these locations are found by the water and can be accessed by boats and passenger lines. The state of the infrastructure (when existent) that supports these activities are, however, precarious.

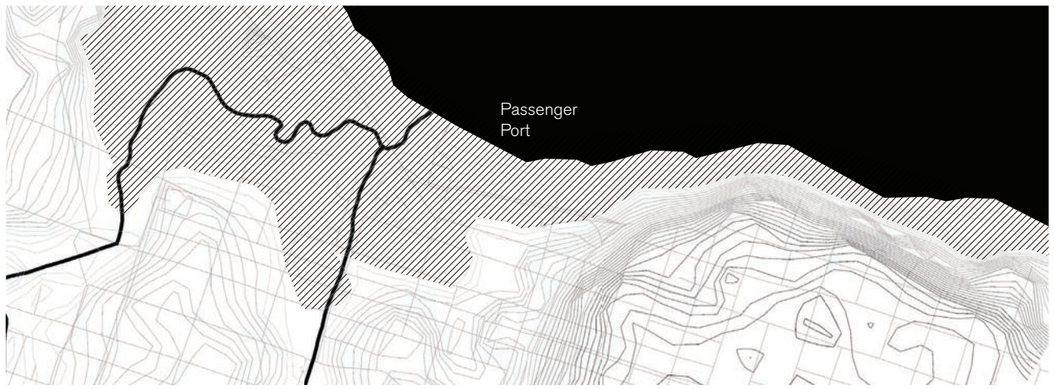
Should the connection between the La Plata and Amazon basins be carried through, the opportunity for using the waterbodies as waterways and implementing a structured system of navigation in the region increases enormously.

This design experiment is, therefore, embedded in the vision of reinforcing the connection of the Amazon, both in Brazilian and neighboring countries' territories via its waterways.



< Location of ports in Porto Velho

1. Passenger port
2. Oil/Gas
3. Soybeans/grains
4. Mining
5. Container shipment



< Location of the Cai n'água passenger port in the city center

Hatched is the aproximate area at risk of flooding

Context analysis

Along the shoreline of the Madeira several ports are located, both private and public. Lately, private parties, especially big names in the soy and beef sectors have built their own sets of infrastructures along the river, financed by Chinese investments. This poses a problem to the articulation of such pieces of infrastructure within the city, as the flows of trucks coming and going are now more spread out throughout the city, and the riverbanks are altered more by the construction of a large number of docks. A common trait of these private ports is that the quality of the construction and its relation to the open space are oftentimes neglected, as well as the aesthetical and cultural values of the waterfront.

The passenger port of Porto Velho is located close to the old city center. Entitled Cai n'água, or "falls into the water", the port is the gateway towards other cities and villages of the Amazon, as well as to *corredeiras*, or smaller speedboats that facilitate the connection between both margins of the river (in the section facing the port, the Madeira River is 1,5km wide, presenting no bridges or pedestrian crossings).

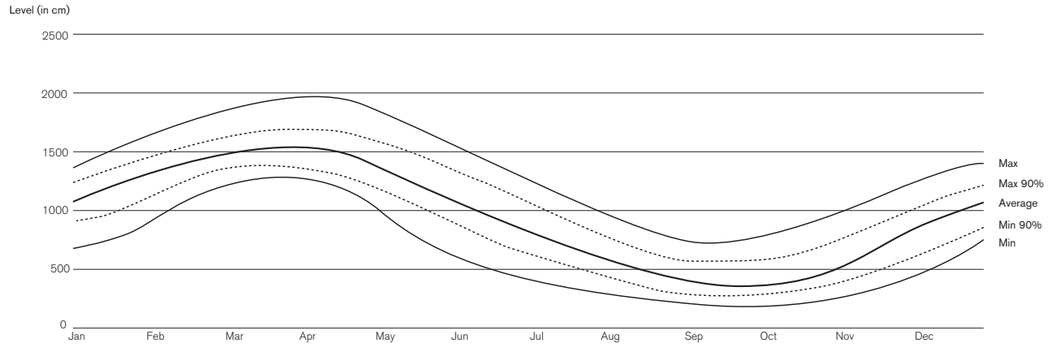
The port seems to be too small to dock the number of boats present at the shores of the Madeira, and most definitely do not offer its passengers and users a safe or pleasant start to their journeys. A lack of appropriate docks and piers was noticed, with many of the services destined for the transportation of locals having to operate using the eroded riverbanks as support for the docks.



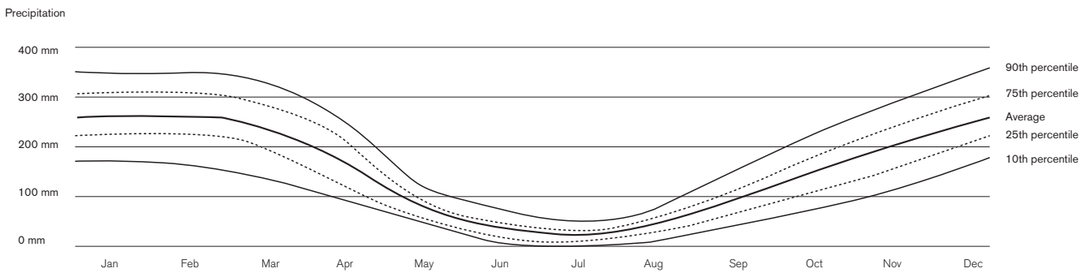
< Passenger boats docked at the Madeira shores



< Passenger boats docked at the floating platform of the port



< Water level of the Madeira River throughout the year



< Mean precipitation in Porto Velho throughout the year

The passenger port is located next to a set of different public markets, that serve both locals and tourists, selling local produce, medicines, craftsmanship, and fresh fish. However of extreme importance to the city, this ensemble of markets and port is frequently subject to the floods of the Madeira River, which occurs every other year, during flood season. By reason of the old city center being erected on low-lying land, at the mouth of two streams that flow into the Madeira, this area is naturally prone to floods.

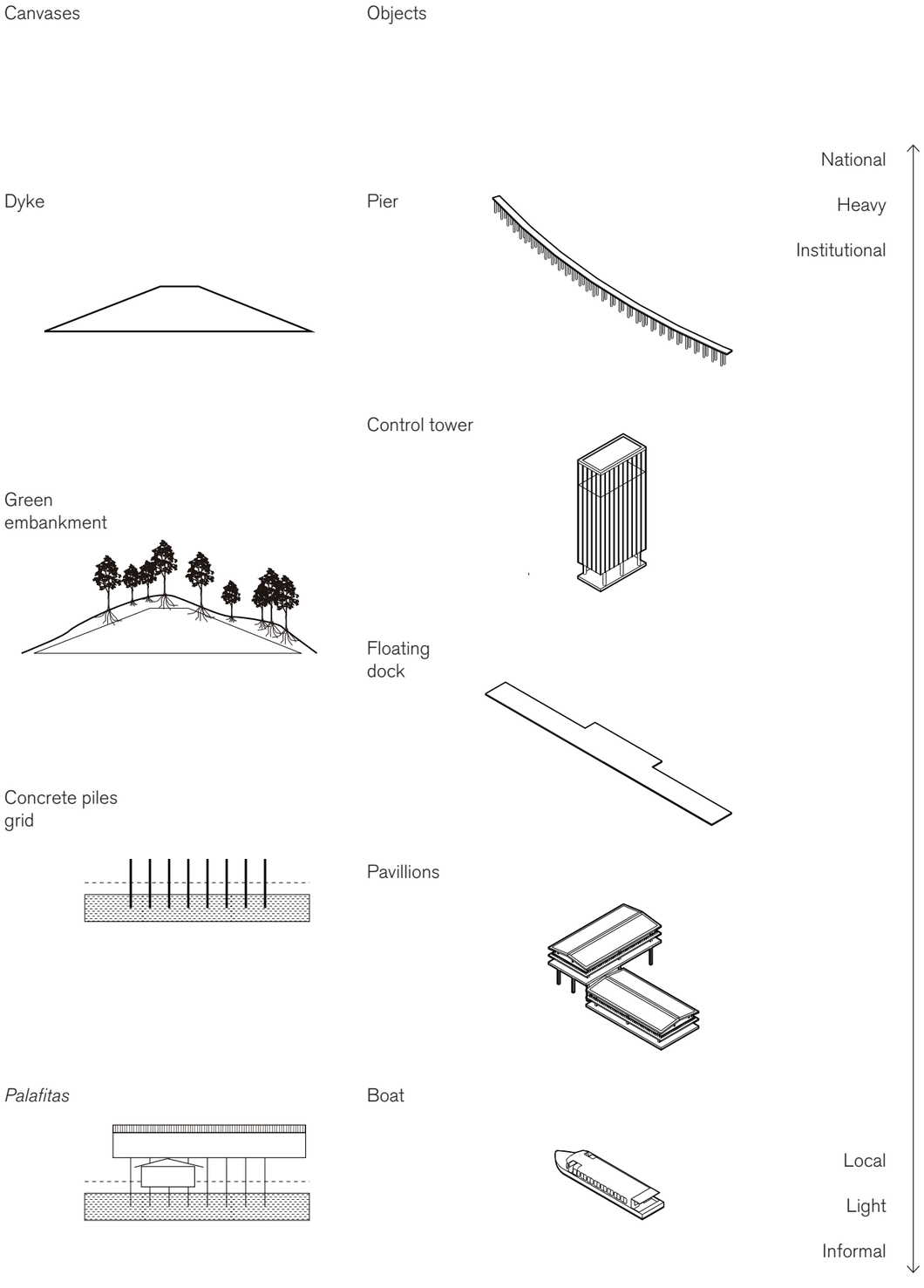
Another important issue is the erosion of the river banks of the Madeira along the shoreline of Porto Velho. Especially along the Madeira-Mamoré old train station, a listed monument evidence of the ancient railway, this presents a hazard to the resilience of the city. More recently construction works have been carried through in the area, with the reinforcing of the shoreline with gravel and concrete. However, these works present no gains in terms of landscape and aesthetic values to the scenery, as well as to the resilience against floods, waves provoked by the boats, or tides.



< Overview of the area adjacent to the port under flood



< Construction works to secure the shoreline of the Madeira-Mamoré complex, with the Cai n'água port on the right upper corner of the image



Urbanization model

Serving as the backbone for the construction of the new port and supporting a set of public civic spaces along the waterfront of the river, a framework of urbanization is put forward.

The framework consists of a set of canvases or heavier structures that serve as the backbone for the construction of the new riverfront and are, in general, constructed and maintained by the public sectors. Considering that the project's benefits to the city are manyfold, several different departments of both national, regional, and local governments could allocate funds for this construction. For instance, infrastructure and development, health and environment, culture, and commercial secretariats.

These heavier structures are named Canvases, or the clean background on which the project relies upon. Dykes against flood protection, green embankments (or on top of the new dykes), a grid of concrete piles for support of the port structures and *palafitas*, or vernacular ways of constructing on water from the Amazon are some of the canvases proposed.

Lighter pieces, or Objects, are those that complement the construction works and fill out the canvas: piers that connect water and land, a set of floating docks that fluctuate following the level of the Madeira, pavilions (either floating or on top of *palafitas*), a control tower for the port and new, modern and low-emissions boats. These are governed and maintained by smaller institutions or the civil society, such as the city hall, shop owners, locals, and the passenger service companies.

Ultimately all the aforementioned components are adapted to local contexts and necessities.

The rationale of the waterfront

The spatialization of the aforementioned systematic proposal, context, and urbanization models is illustrated by the axonometry on the right.

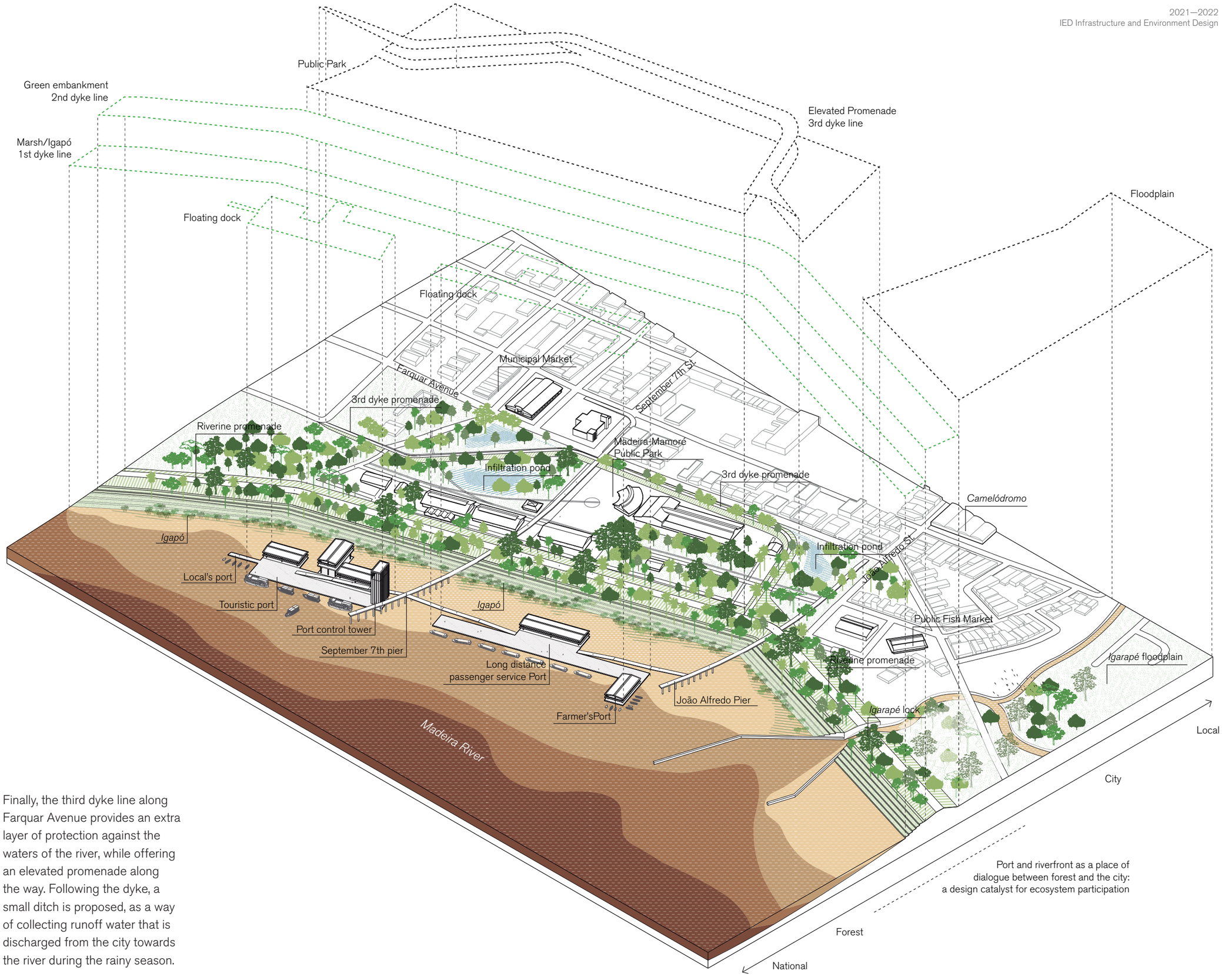
On top of the water the floating port is located, consisting of docks, piers, ramps that facilitate the transition of levels between pier and dock, and pavilions that support port activities. Boats are docked on the floating platforms, which fluctuate following the level of the water and aim at maintaining the functioning of the port should the water level rise or decrease too much.

In the immediate shoreline a set of a line of *igapós*, or sweet water flooded forests, followed by lines of terraces on top of which endemic species, resistant to flood are planted. Both elements are entitled as the first dyke line against the Madeira waters.

A dyke covered by a green embankment is the second dyke line. This band act as a linear park along the River, and also as an accessible waterfront for the city of Porto Velho.

Continuing in the direction of the city, the listed Madeira-Mamoré complex is transformed into a park, a public and open for all equipment that aims to reconnect the city to the forest (Porto Velho is very deficient in terms of green infrastructure and parks within the urban grid).

Finally, the third dyke line along Farquar Avenue provides an extra layer of protection against the waters of the river, while offering an elevated promenade along the way. Following the dyke, a small ditch is proposed, as a way of collecting runoff water that is discharged from the city towards the river during the rainy season.



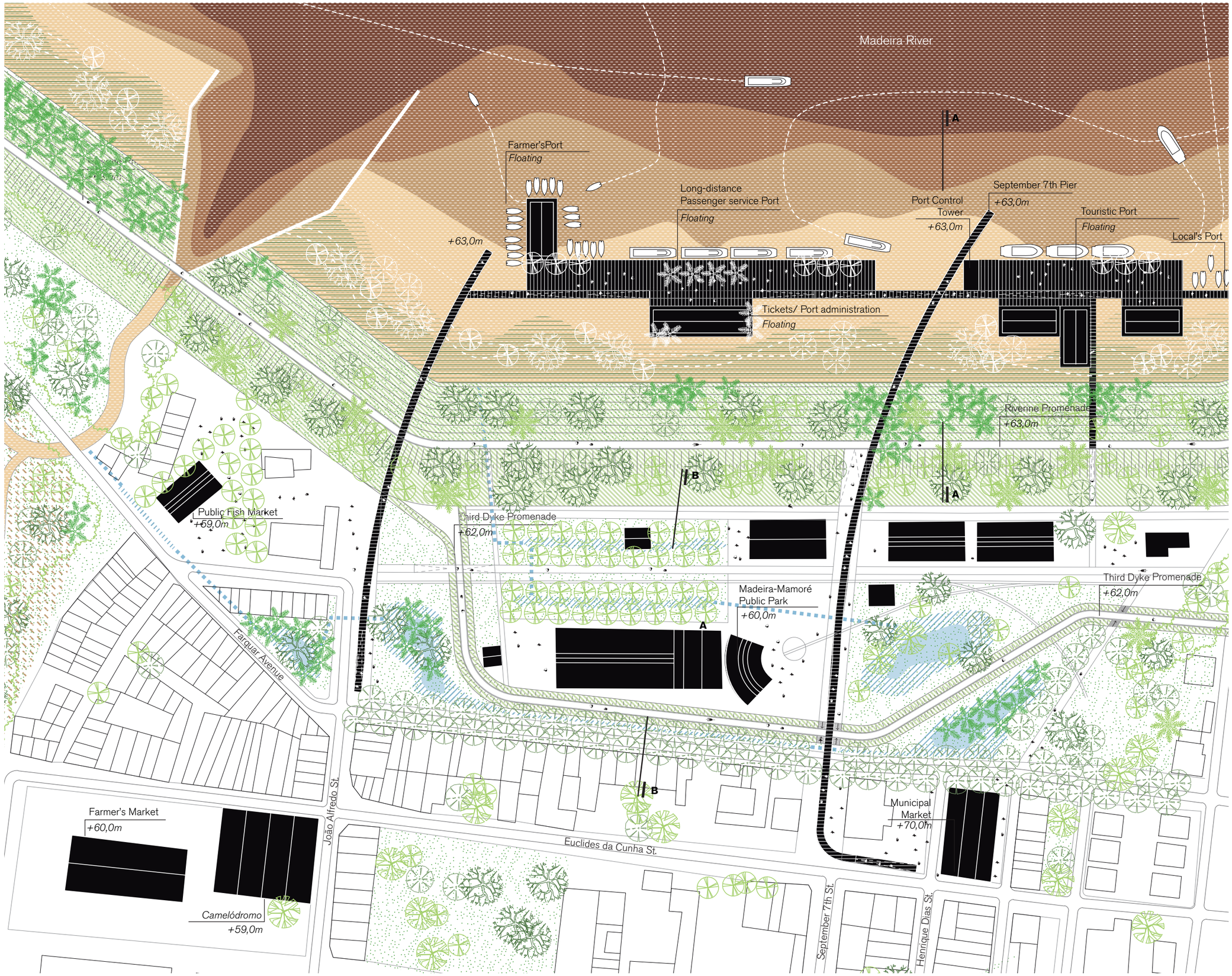
Port and riverfront as a place of dialogue between forest and the city: a design catalyst for ecosystem participation

General Masterplan

The port is proposed along the shoreline of the Madeira-Mamoré complex, as a way of rehabilitating this listed monument and offering enough space for the activities of the port, as opposed to the very humble current facilities.

The nearby public markets are connected to the port via a set of two elevated walkways, built on a higher level than that of the maximum flood risk level of the river.

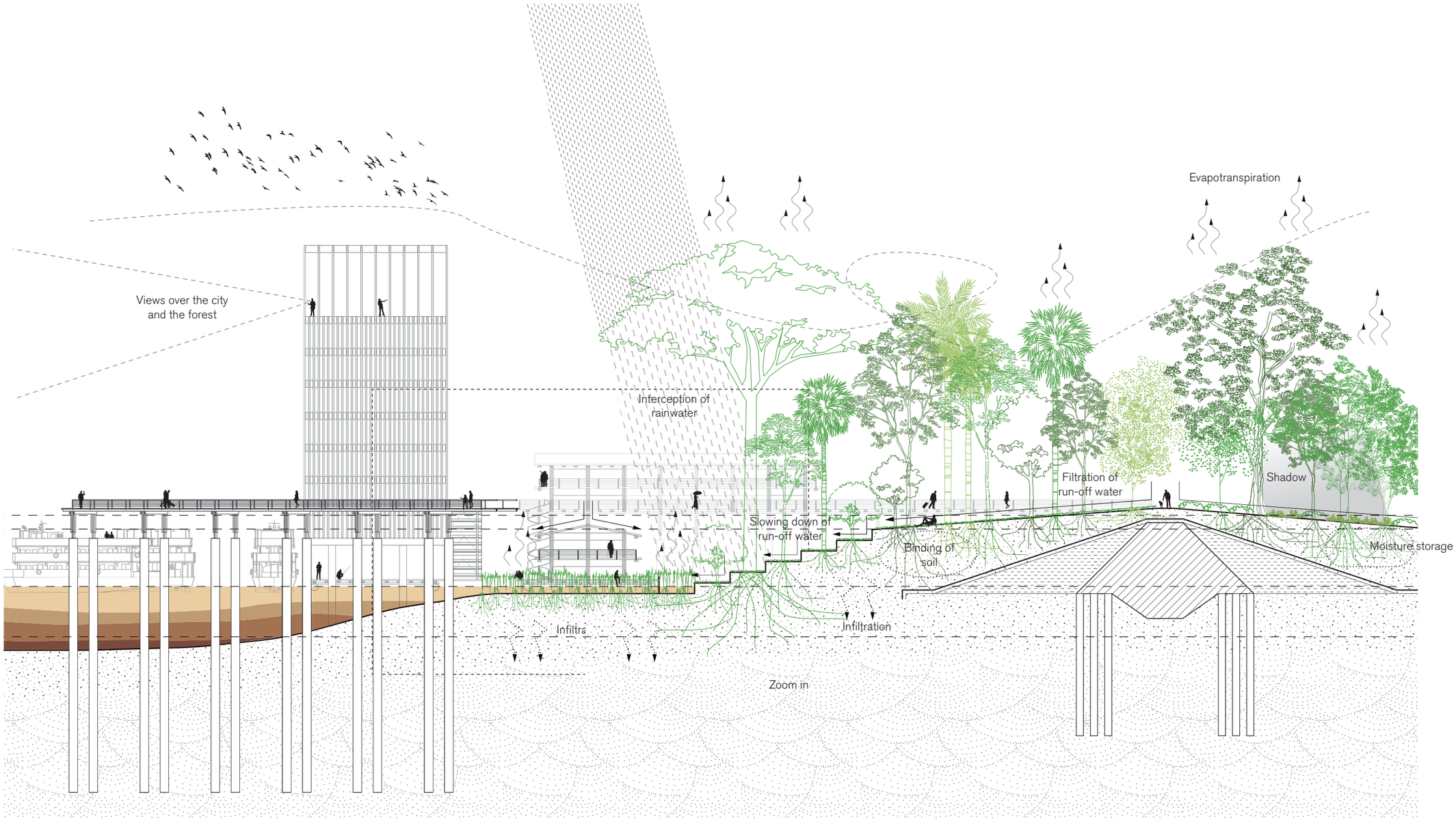
In case of flood, the walkways assure that goods can travel between the city and the river without interruption. Furthermore, the markets and the riverine neighborhood are protected against the water by the 3-dyke lines proposed.



AA Section

Immediately at the encounter between water and land, an *igapó* is planted to help reduce the power of waves caused by the boats, that have an impact on the shoreline, currently leading to erosion. Also as a way of protecting the shore against erosion, a system of terraces is built along the waterline, with species that are typical of the flooded parts of the forest, that are resilient to flood and drought.

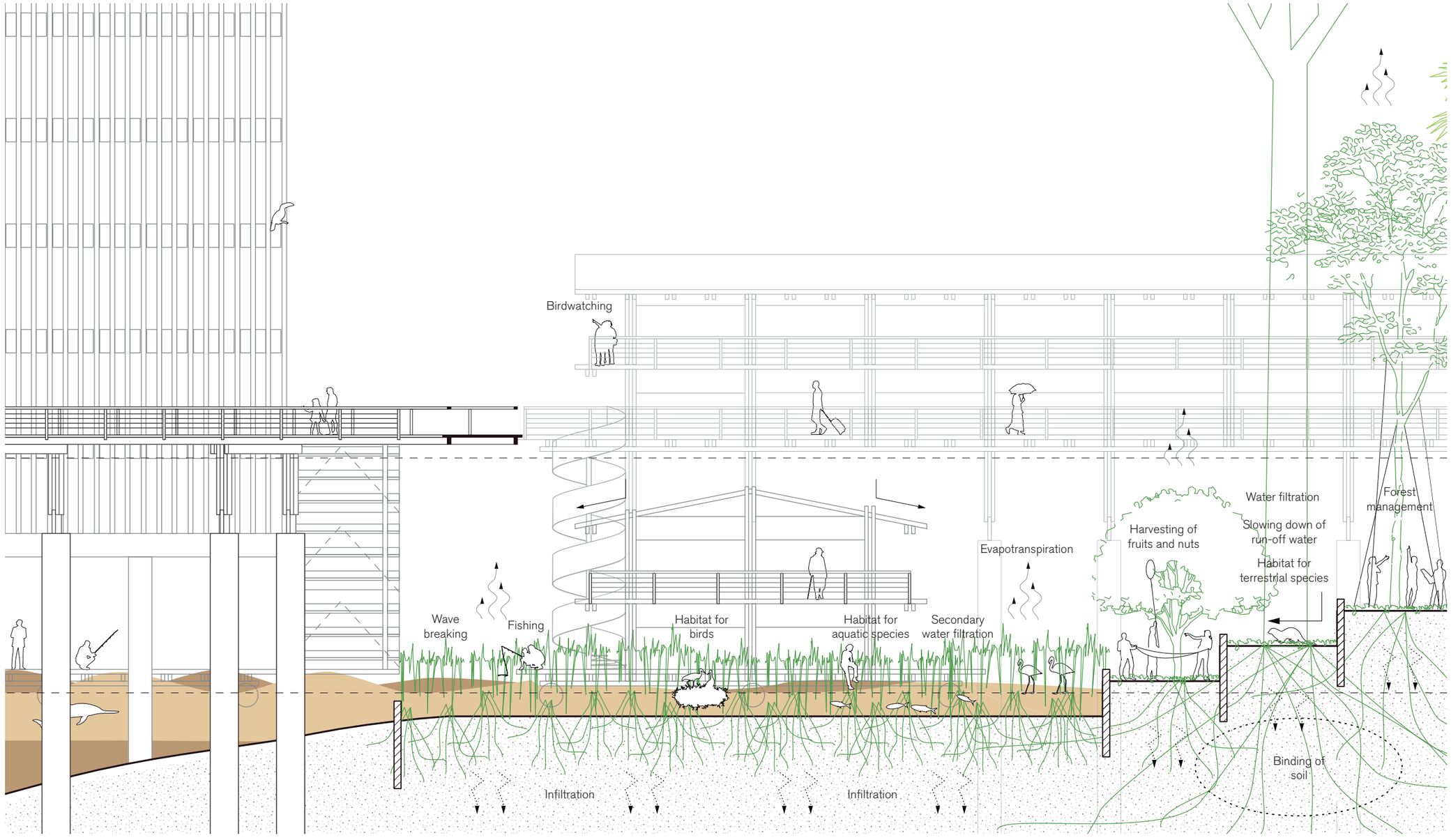
Lastly, an engineered dyke secures the land against the water, but also holds the shoreline in place against erosion, whilst being covered by a green embankment that serves as a linear park.



AA Section Zoom-In

From water to land, a closer look at the transition from the brown waters of the Madeira River to the Madeira-Mamoré Public Park (proposed) via a series of systems of embankments, boarding docks, and elevated piers, or *palafitas*.

In the area of the *igapós*, many different species find a new habitat. Fish, turtles, and birds can create nests among the plants and roots of the vegetation. Going up on the shore, the terraces are used by locals for harvesting fruits and nuts typical of the Amazon forest, which then can be turned into products of higher aggregated value. Also, the park can be turned into an experiment of sustainable agroforestry, or in case a tree falls during a storm or has to be cut down, its wood can be transformed by local artisans into crafts that could be sold in one of the nearby public markets.



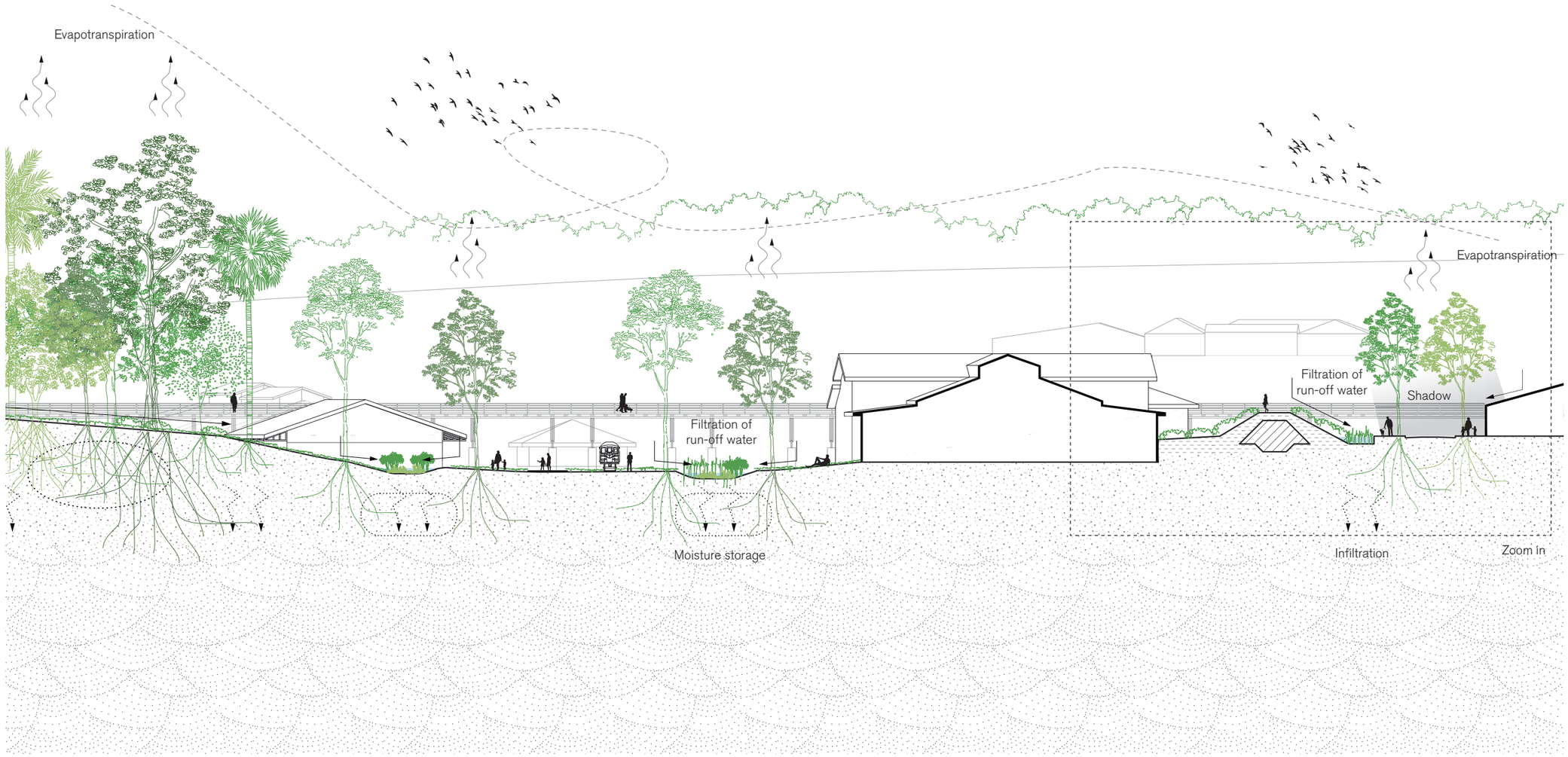
Green embankment | Small infiltration pond | Remainings of ancient train line | Small infiltration pond | Old Madeira-Mamoré Station workshops | 3rd dyke | Filtrating ditch | Calm street

BB Section

In between the second and third dykes lines lays the Madeira-Mamoré public park, at the site of the listed monument. Its lawns and gardens covered by the shadow of trees can be used by locals and visitors as a place for leisure, relaxation, and connection to the forest.

Due to the enclosure of this space by the two dyke lines, a system of infiltration ponds is proposed that aims to solve the issue of water discharge in this area.

At the edge of the park, facing the old warehouses and workshops of the ancient station, the third dyke frames the space, separating it from Farquar Avenue.



Embankments

Park - Dry land forest

Elevated Promenade

City

0 | 10 | 25 m

2nd dyke line

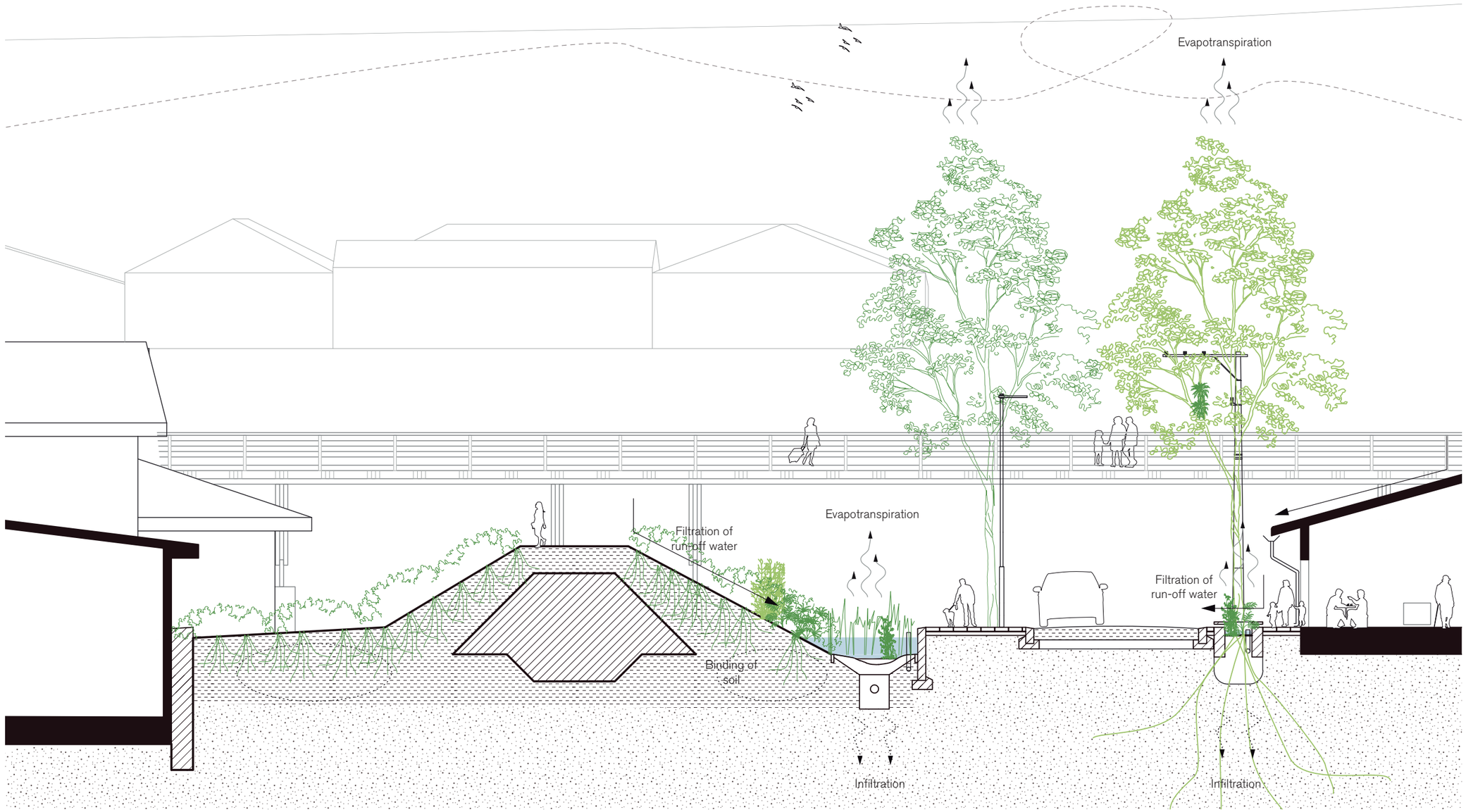
3rd dyke line

Old Madeira-Mamoré Station workshops | 3rd dyke | Filtrating ditch | Sidewalk with infiltration planters | Calm street | Sidewalk with infiltration planters | Proximity establishments

BB Section Zoom in

Along the dyke line a small ditch accounts for collecting runoff water from one side of the dyke, as well as from Farquar Avenue. On top of the dyke an elevated promenade is proposed, offering views over the city and towards the water, in-between the ancient constructions of the station.

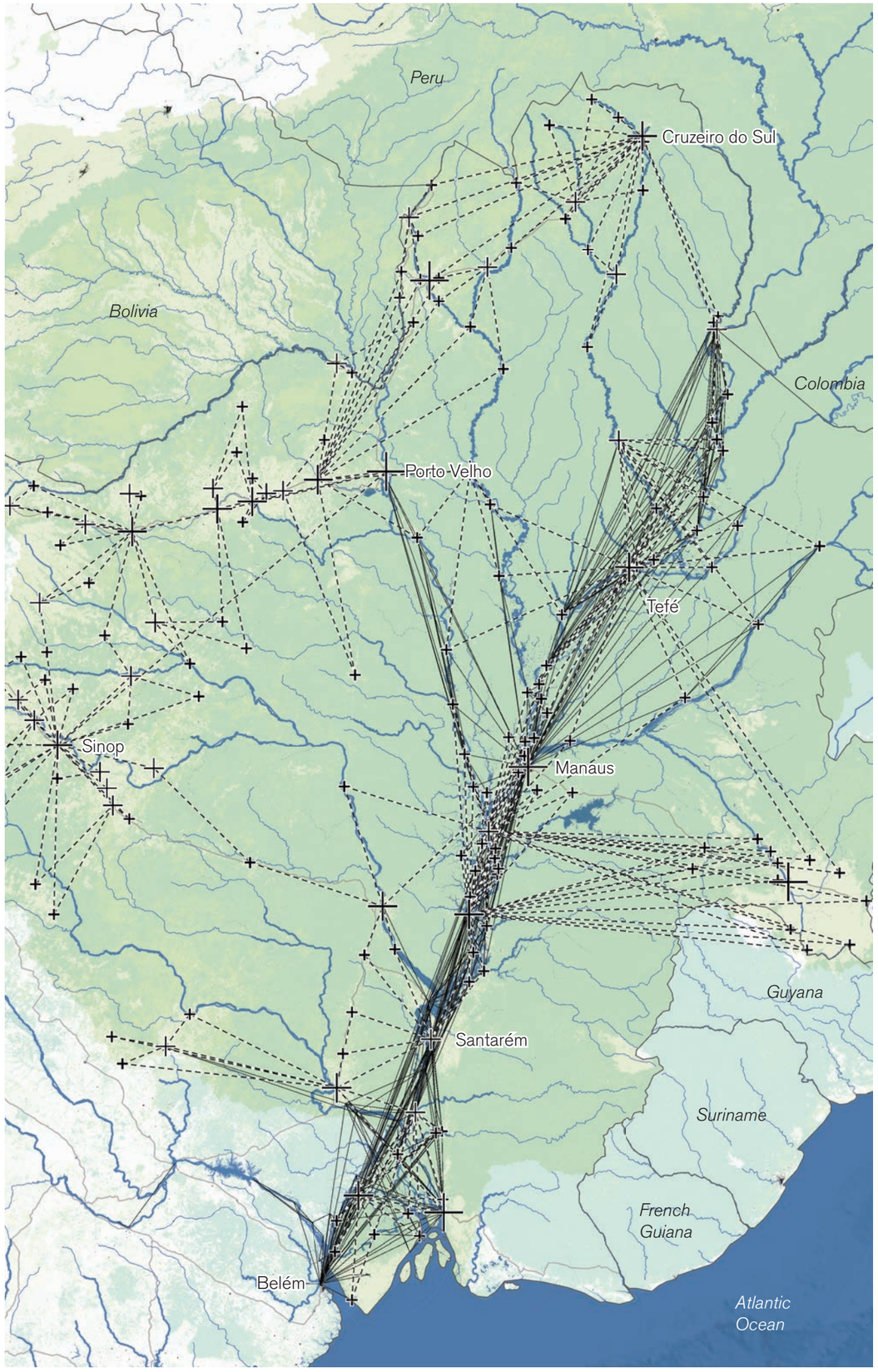
Accompanying the avenue, trees are placed on planters that help runoff water to be absorbed by the soil, as well as providing shade to pedestrians and the homes along the road.

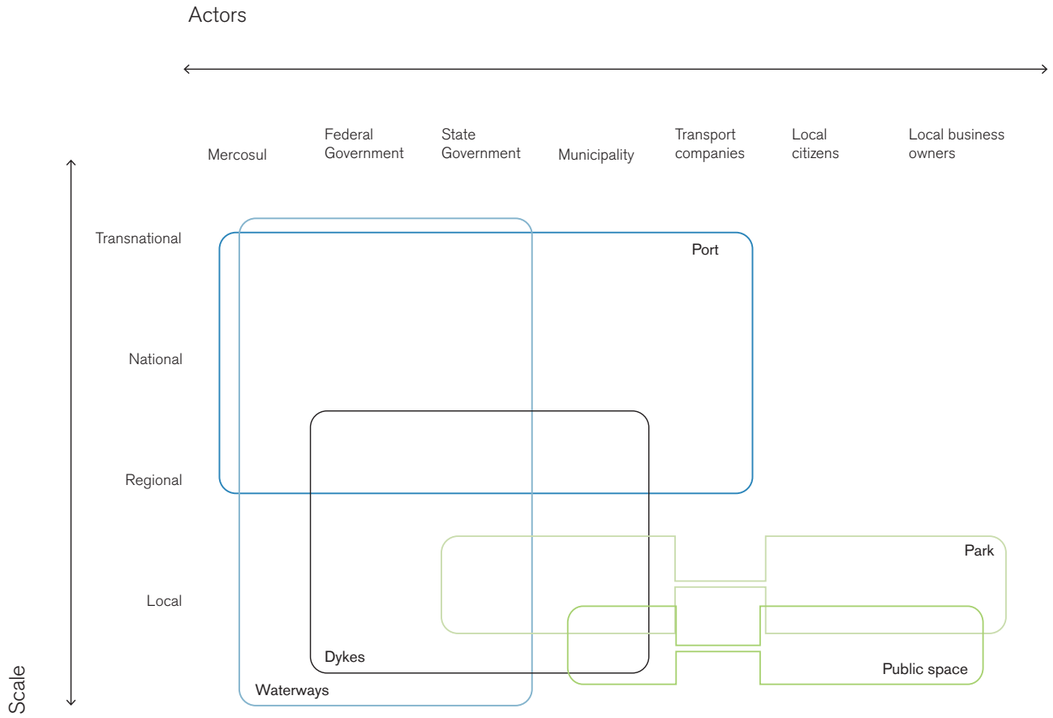


Park - Dry land forest | Elevated Promenade | City

3rd dyke line

0 | 5 | 10 m





<

Potential for consolidation of fluvial transportation in the Amazon basin

Urban nodes apt to be connected to a larger transportation system

- Regional centralities
- Amazon River Basin
- Tree canopy cover
- Existing fluvial connections
- Possible fluvial connections
- Hydrography
- Political/Administrative borders

0 250 km N

Conclusion

Ways in which the experiment deals with the local context and how it present solutions to the challenges are as follows:

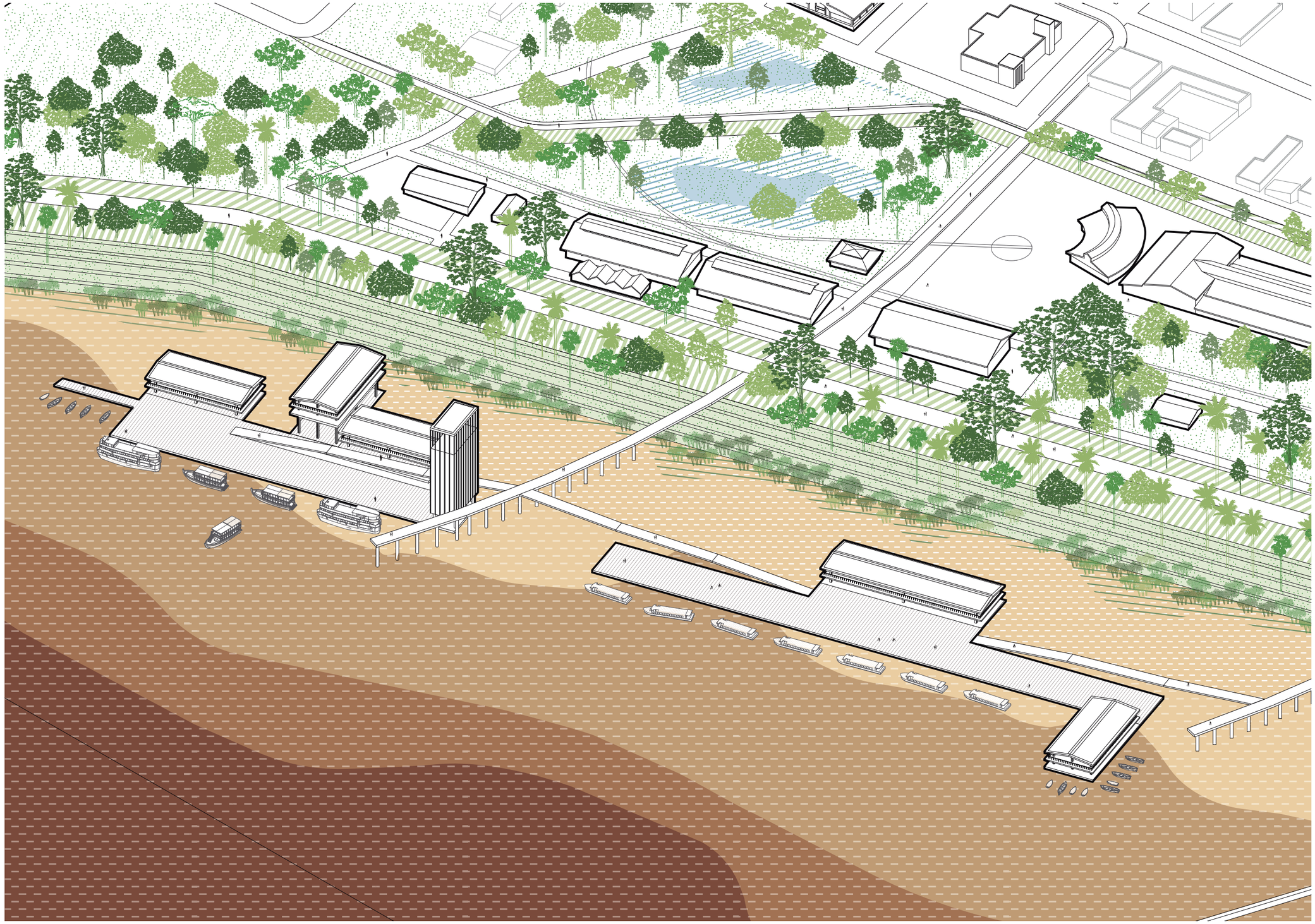
1. It is a port for non-extractive activities
2. It is a flood defense mechanism, based on heavy engineering and nature-based solutions
3. It is a place for dialogue between forest and people
4. It is a place for ecosystem restoration along urban stretches of Amazonian rivers.
5. It is a place for dialogue between the city and the forest.

Reflection

Studying this location in the Brazilian Amazon has been such a special way to conclude the first year of the Masters. After three quarters focusing on Dutch cases, “going back” to a Latin-American case has been very pleasant and enriching, especially right before the commencement of the thesis year, in which I expect to develop a research and project in Brazil as well.

However closer to home, the study case could not have put me out of my comfort zone more. The approximate distance from my hometown, in São Paulo, to Porto Velho is none less than 2500km, roughly the same as from Amsterdam to Marrakesh. It goes without saying that my previous knowledge on the region was very limited, and however difficult it has been to study the location from a distance, and being unable to travel to the site due to the ongoing pandemic, I believe that we, as a group, have managed to grasp a small piece of the challenges of the place, as well as envision possible solutions to some of them.

Working in the Amazon is not possible without acquiring a deep understanding of its politics and dynamics, and the brief time which we have spent studying the case was enough to leave us all with a desire to go back and dive further into the matter, I believe.



The Soft Transition

Sanne Francissen
4563506



Sanne Francissen

Manifesto

Porto Velho, the capital of the state of Rondônia, is a huge city with more than half a million inhabitants. A busy place along the Maindeira River, in the middle of the Amazon and an important node for distribution of export products. With its strong grid and extensive road structure, chaotic and dense. Shut off from its surrounding context.

As a crucial element of the export culture of Brazil, Porto Velho is a productive city focussed on this economic perspective. The infrastructure is dominant within this urbanized area resulting in mainly places to pass through rather than places to stay. Besides this, the city is densely built and lacking open space.

Porto Velho is located along the river, but this is hardly experienced from within the city. Ports make up the majority of the riverfront.

The lack of open space and the lack of connection with the Mandeira River go hand in hand with the absence of nature in the city. Even though Porto Velho is located in the largest tropical rainforest of the Earth, the Amazon, one would not experience this. Any connection with the Amazon Basin in missing.

From the perspective of Ecosystem Participation, nature will be brought back to the city of Porto Velho. Porto Velho will become part of the nature again. Starting with the waterfront.

A soft transition from the Mandeira River towards the urbanized area will create a connection with nature. Green corridors will make their way through the city from the riverfront. Awareness of the impressive and extraordinary rainforest will be raised among the inhabitants. Besides this, the preformative waterfront will function as a place where biodiversity can be restored and urban waste water can be treated within a natural process. And last, but not least, open space for collective gathering will be creted for the inhabitants of Porto Velho.

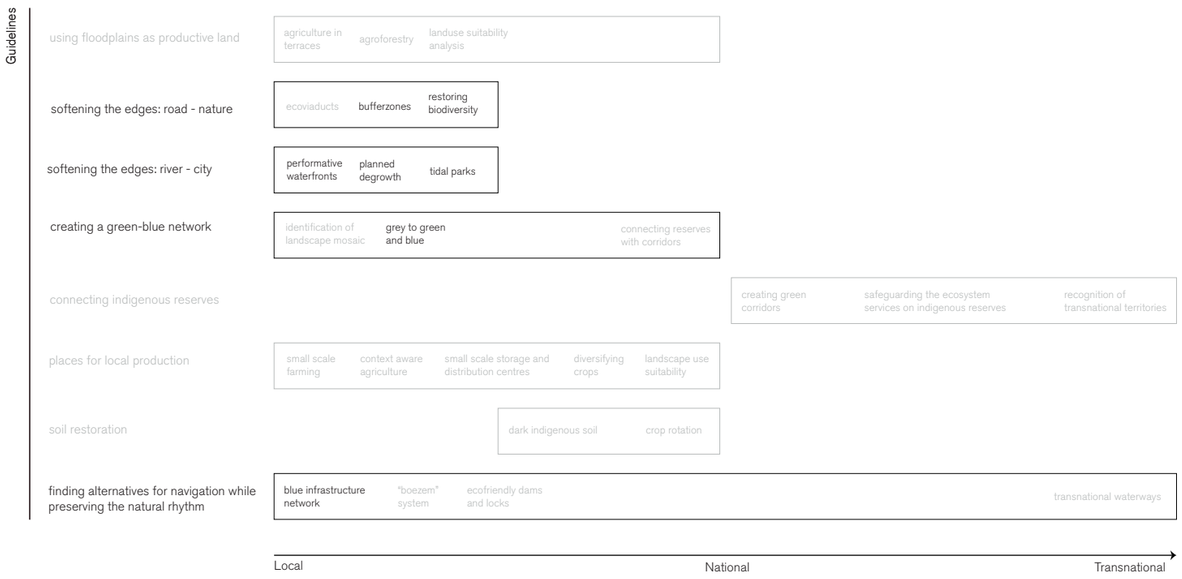
Design experiment

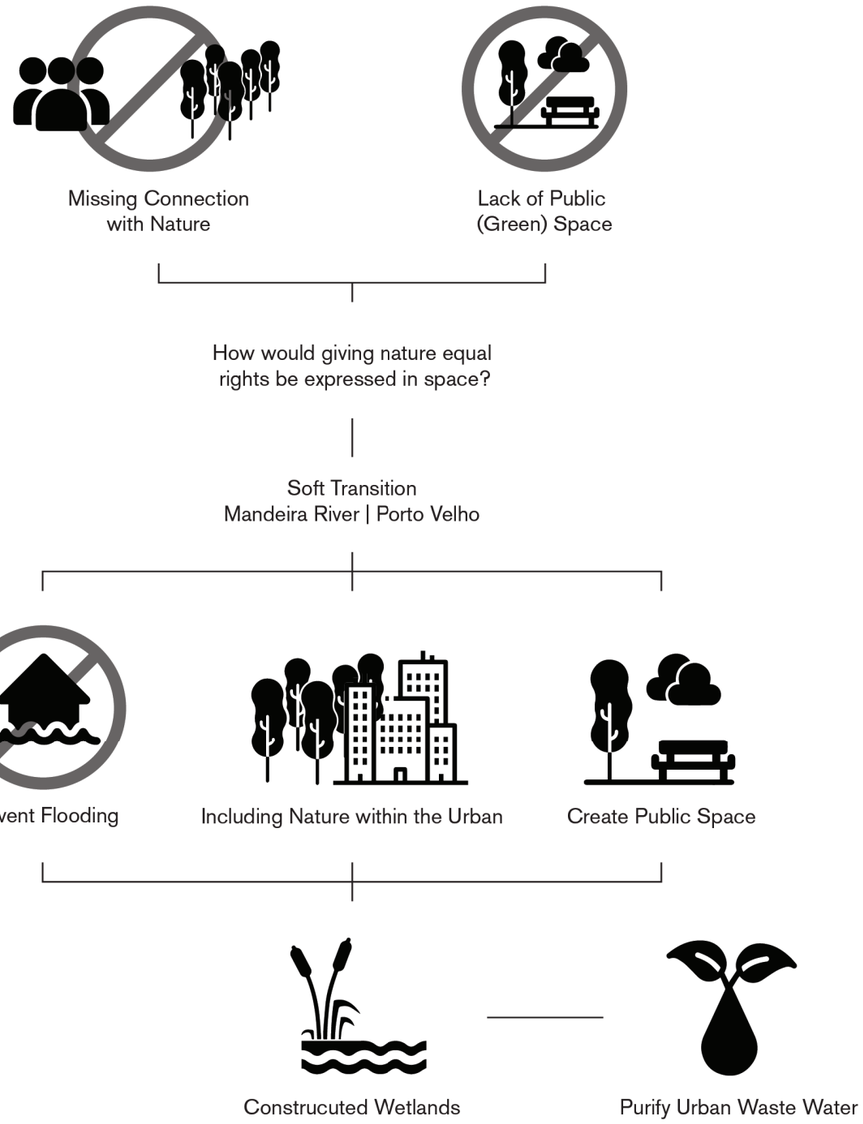
Within this design experiment, the focus is on the city of Porto Velho and its relationship with the Mandeira River. As the other two design experiments focus on the hard transition and the gradient between the city and the river, this design concerns the soft transition.

In the current situation of Porto Velho, there is no link with the surrounding nature whatsoever. One would not even notice that this city is located in the Amazon rainforest. Additional to this there is hardly any open green space within the city. In fact there is barely any open space at all.

This design experiment focusses on bringing back nature in the city, creating open green spaces and giving the river more space to limit the risk of flooding. This will be done by creating a soft transition from the river to the city and transforming the waterfront into constructed wetlands. Besides this, the constructed wetlands contribute to urban wastewater treatment in Porto Velho, to preserve the quality of water.

The digram below shows which guidelines form the backbone of the design experiment and which archetypes could be included.







Current Situation



Extending green/blue network and planned degrowth takes place along the riverfront.



Proposed situation with an exstensive green/blue network and constructed wetlands along the riverfront.

Green/blue infrastructure

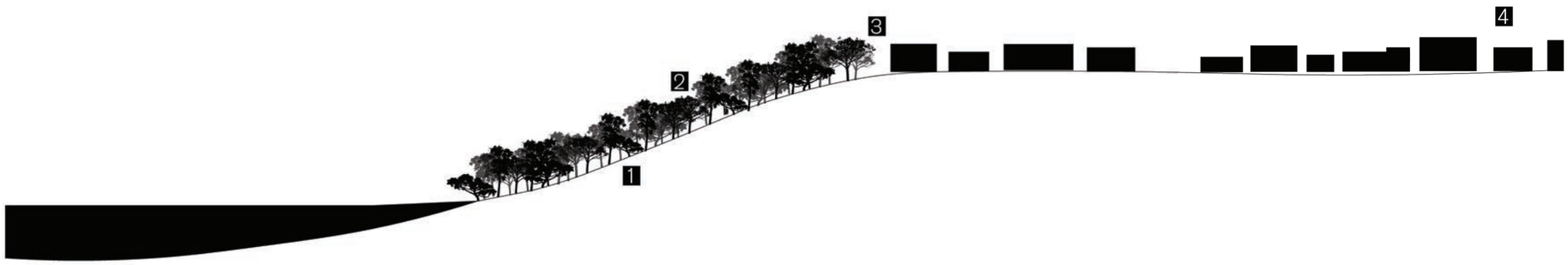
The three maps show the transition from the current situation towards the proposed situation. The limited green/blue network of Porto Velho will be extended within the city and space along the river will be cleared from housing and also the public port will be moved. This is where the constructed wetlands will be created.

Water
Roads
Urban Green
Planned Degrowth

0 500 m N

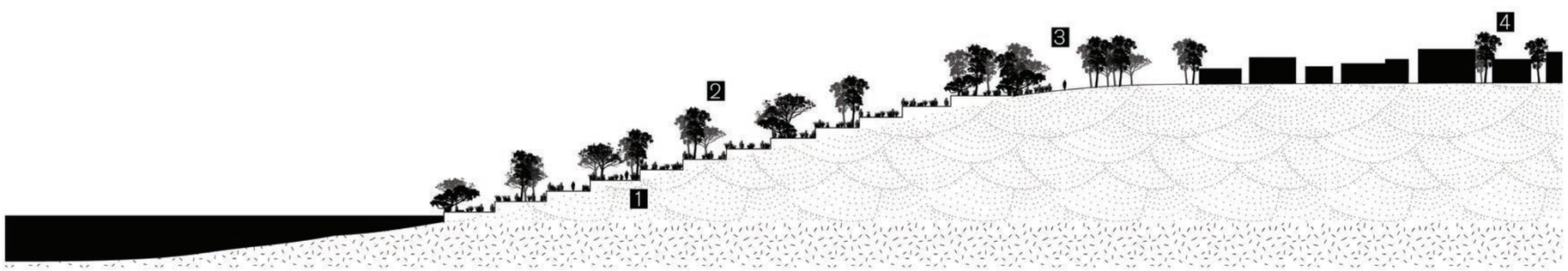
Current Situation

1. Steep slope and little space for the Mandeira River.
2. Unaccessible nature covers the transitional area.
3. Hard transition between nature and the urban.
4. No natuere included in the urbanized area and no view on the Mandeira River.



Proposed Situation

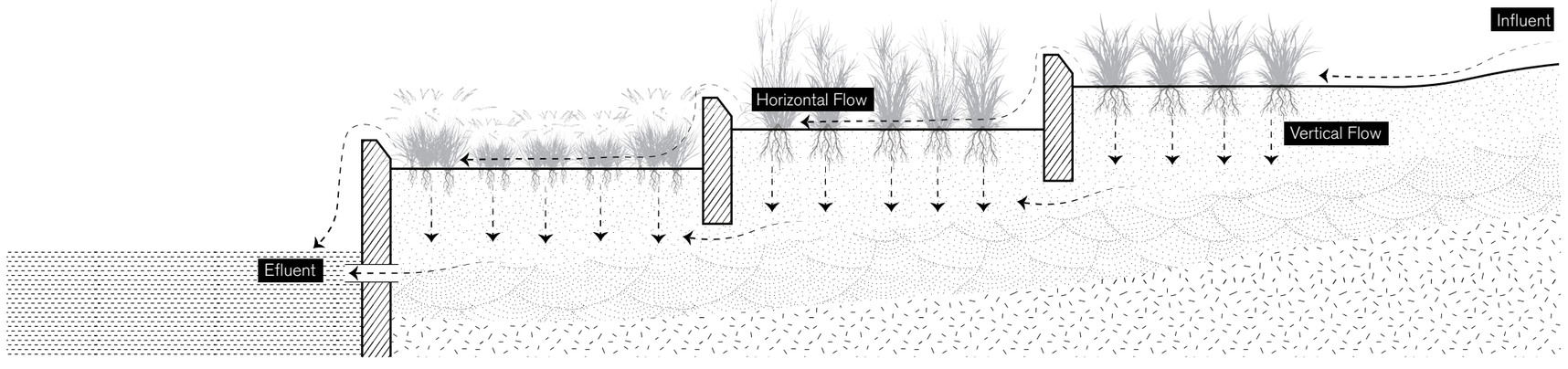
1. Flatter slope and more space for the Mandeira River.
2. Terraced wetlands to perserve nature and water.
3. Soft transition between nature and the urban.
4. Nature inlcuded within the urbanized area and a connection with the Mandeira River.

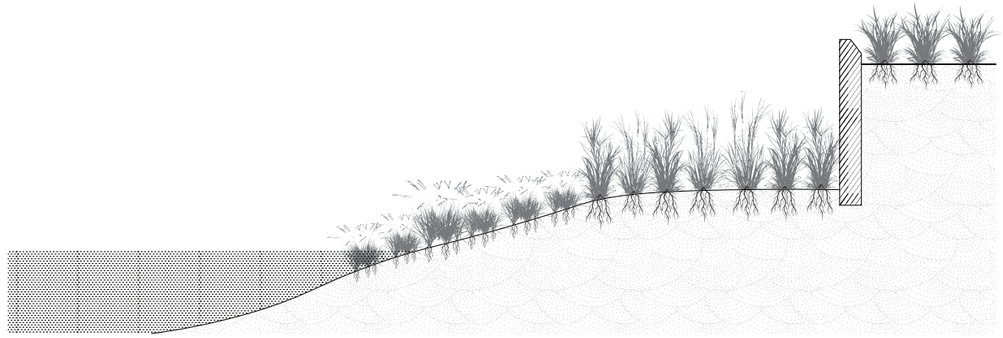


0 25 m

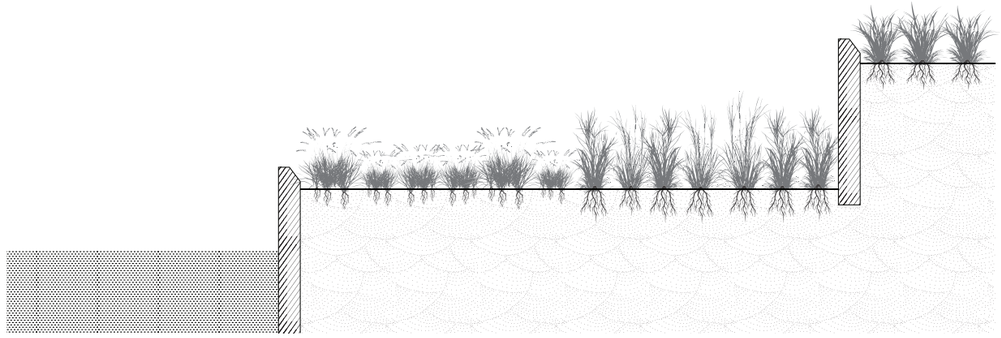
Constrcuted Wetlands

Constructed Wetlands are wastewater treatment systems designed and constructed to operate as a natural system. They utilize the natural functions of wetland vegetation, soil media and their associate microbial for wastewater treatment within a more controlled environment. Within tropical conditions, the pollutant removal efficiency increases compared to cold regions, due to the consistent warm climate which increases the performance of Constructed Wetlands. Besides this, Constructed Wetlands have multiple other benefits such as easy operation and maintenance, low costs, good potential for water and nutrient reuse, and restoration of some biodiversity that has been lost due to destruction of natural wetlands (Bojcevska, & Tonderski, 2007; de Ceballos et al., 2001; Kaseva, 2004; Varma et al., 2021; Yeh & Wu, 2009; Zhang et al., 2015).



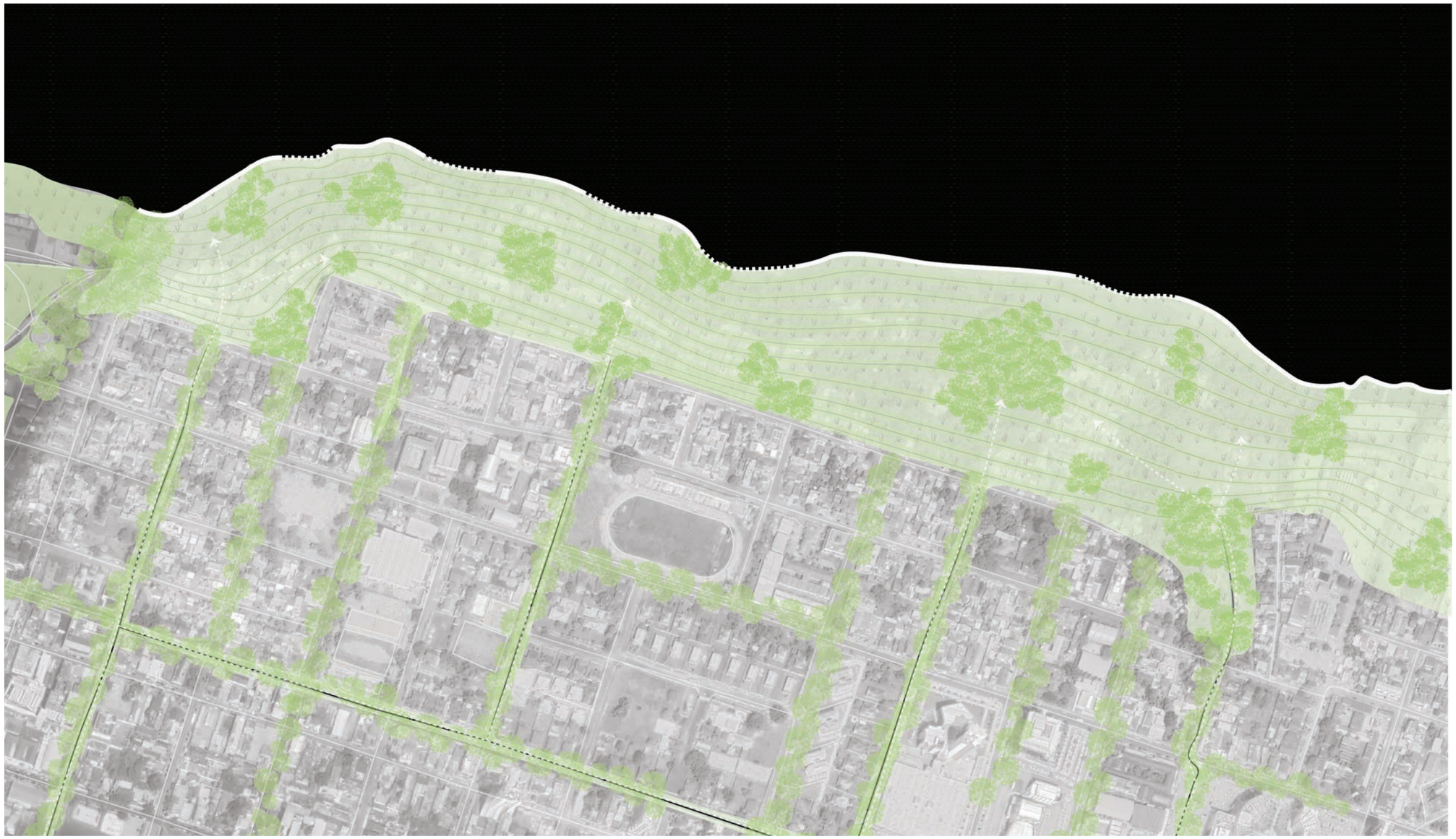


Soft Edge



Hard Edge



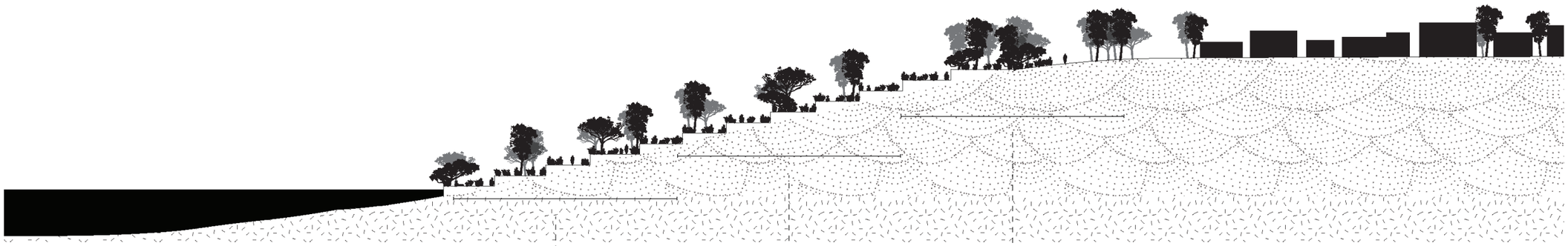


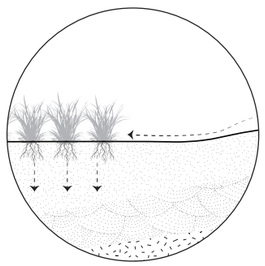
Map Riverfront

The Riverfront will be transformed into constructed wetlands. The wastewater stream comes from within the city and flows into the Mandeira River. There are two types of edges along the water, a soft edge and a hard edge.

- Water
- Water
- Roads
- Constructed Wetlands
- Excisting Green Space
- Trees
- Soft Edge
- Hard Edge
- Water Flow

0 100 m N





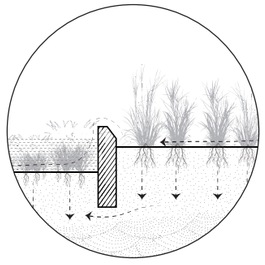
urban waste water



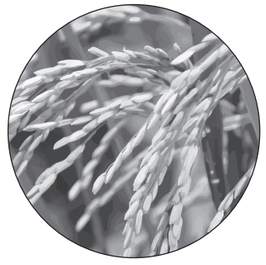
dry marsh plants



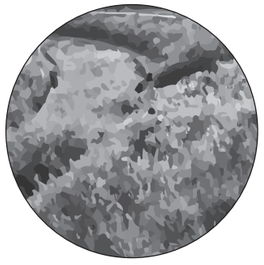
urban park



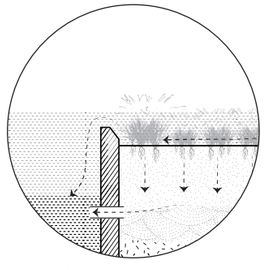
brakish and semi-purified water



wet crops



communal garden



changing water level
brackish water



aquatic plants

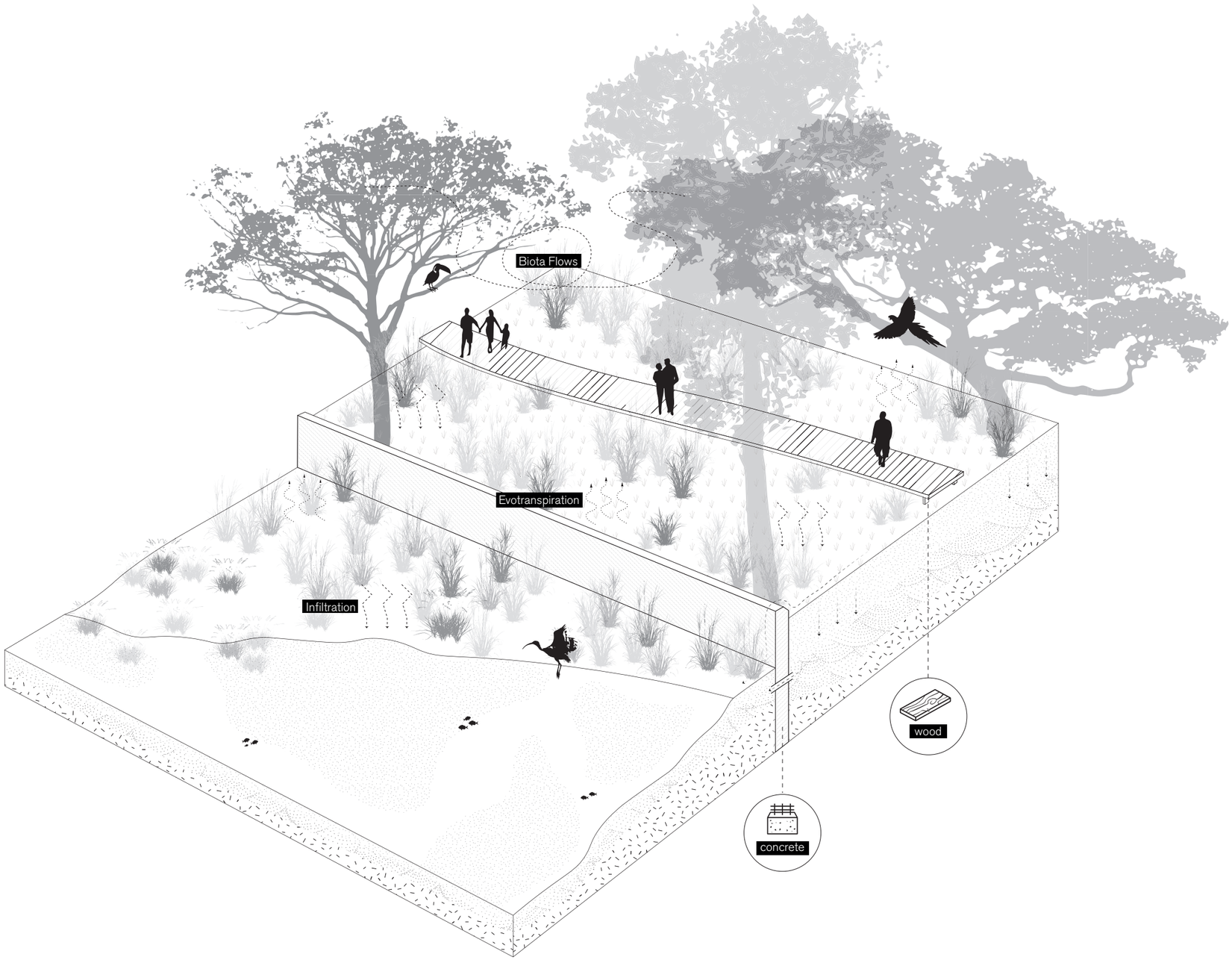


fishing

Quialities of Life

The constructed wetlands consist of multiple terraces and each level has different qualities.

1. The lowest levels of the constructed wetlands are dealing with a changing waterlevel and are flooded regularly by the Mandeira River. This means aquatic plants will grow here and the public space can be used for recreational fishing.
2. Moving up the slope, the land is flooded less often by the river, and semi purified water flows through. These levels can be used as for growing wet crops, such as rice, in a communal garden. The community then could also make sure that it is well maintained.
3. The upper levels rarely deal with floods from the river and are in the first stage of wastewater treatment. Dry marsh plants cover this land and the public space is experienced as an urban park for recreational purposes.



The New Riverfront

Where one can relax.
Where there is space for collective gathering.
Where communities can grow crops.
Where wastewater will be treated.
Where the Mandeira River can flood.
Where biodiversity will be restored.
And where one would be part of nature again.

Flows - Norway

Drammen

Connecting Flows through and with water

Dennis Groen
Jamie Taal
Hidde van Beek

2020—2021 IED
Infrastructure and Environment Design
July 2021

1.

Introduction

Context and Challange

Drammen is a city in Norway with around 66.000 inhabitants, 42 kilometres away from Oslo. Currently, Drammen is a link in the system, where all villages and towns are linked to Oslo. Also, Drammen does not currently have a very attractive and good reputation. Currently, various forms of extraction are taking place in the region of Drammen: wood, aggregate, sand and gravel. However, the method and transport of extraction is not very sustainable at present. Next to that, there is a high risk of flooding in the area.
This project will focus on the concept of ecosystem participation. It will try to make the way and transport of extraction in the area more sustainable. In addition, an attempt will be made to reduce the risk of flooding in the area. It will also try to give Drammen a greater role in the region and make Drammen more attractive as a whole.

Environmental Risks and Human Response

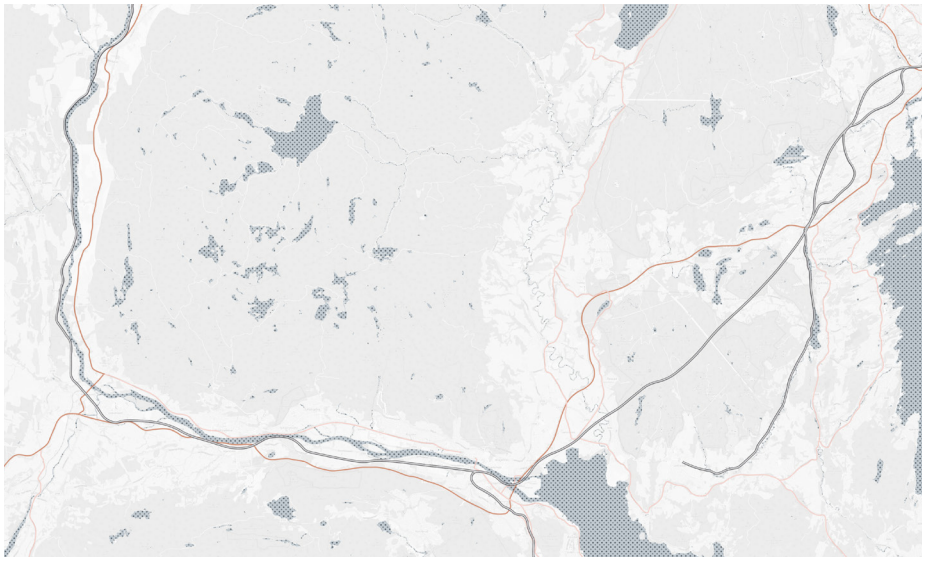
There are several environmental risks in the area which will be tackled in this research. First of all, there is a risk of flooding along the rivers. This is dangerous for the buildings that are mostly located along these rivers while also hindering the use of the surrounding landscape. Next to this, there are many dams along the rivers which generate hydropower. However, these dams are not beneficial for the biodiversity in the area, as they will affect the distribution of fauna. Another obstacle to the spread of biodiversity are the urban settlements that form a barrier to the surrounding green areas as there is little green inside this urban fabric. In addition, there are many flows in the area in the form of transport that are not beneficial for the environment. A lot of transport takes place via motorised vehicles which emit greenhouse gasses. The port of Drammen is also currently causing environmental risks. The port is polluted in some places and is currently far from being circular. There is also a high pressure on resources, due to the many extractions in the area, of various stones, sand, gravel and lumber.

To tackle these environmental risks, there have been some responses in the area. The creation of dams has resulted in the generation of hydropower, however, these dams can also regulate the water level in the river. This regulation of the river decreases the risk of flooding. There have also been incentives to increase the amount of open water. In the area in and around Oslo, waterways have been opened to increase the storage capacity after heavy rainfall. Next to this, there have been plans to increase the amount of green inside the cities, however, these are not yet realised and need further research and planning to make sure they are implemented correctly. In terms of circularity, the country and province has room for a lot of improvement, as most resources are not re-used. This re-use of materials has a high potential in this area.

Scales

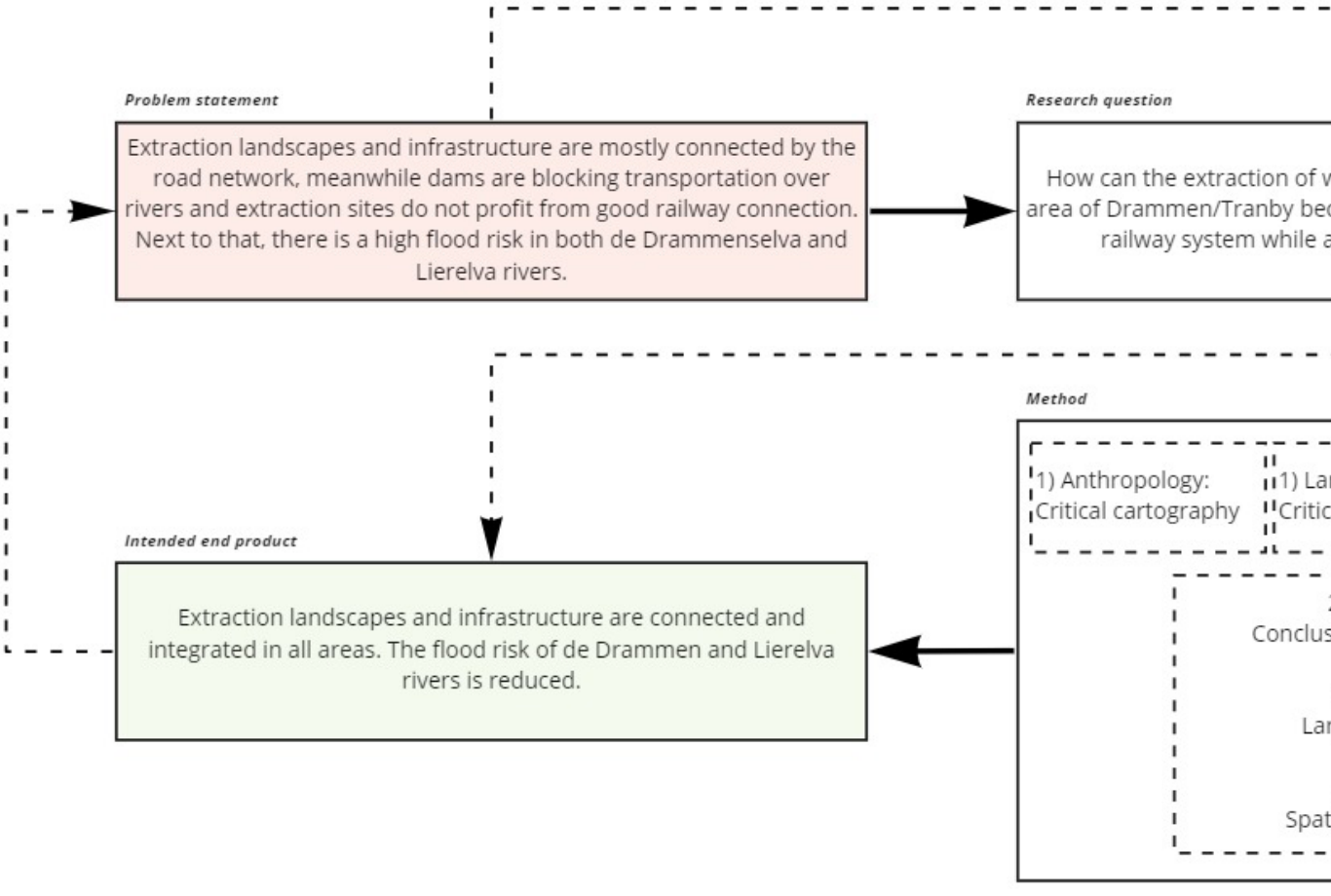
In this research book, different scales will be used. The largest scale will mainly be used in the anthropology section. In this section, systems and relationships on the larger scale are discussed. The next scale is also on a relatively large scale. On this scale you can see the water system, where the Drammenselva connects both fjords on the north and south side. In addition, Oslo can be seen on this scale, so that the relationship of the area with Oslo can be shown. This scale will mainly return in the landscape and urban morphology part of the critical cartography, but also in the regional vision. The next scale will zoom in even further towards Drammen. On this scale, a large part of the Drammenselva River can still be seen, as well as the Lierelva River. This scale also shows the relationship between Drammmen and its close surroundings. This scale is mainly used in the landscape part of the critical cartography. The most zoomed in scale zooms in on Drammen even more. This scale mainly shows the harbour of Drammen and will be used in the urban morphology part of the critical cartography. The individual design experiments will then zoom in even further on parts that are relevant to that experiment.





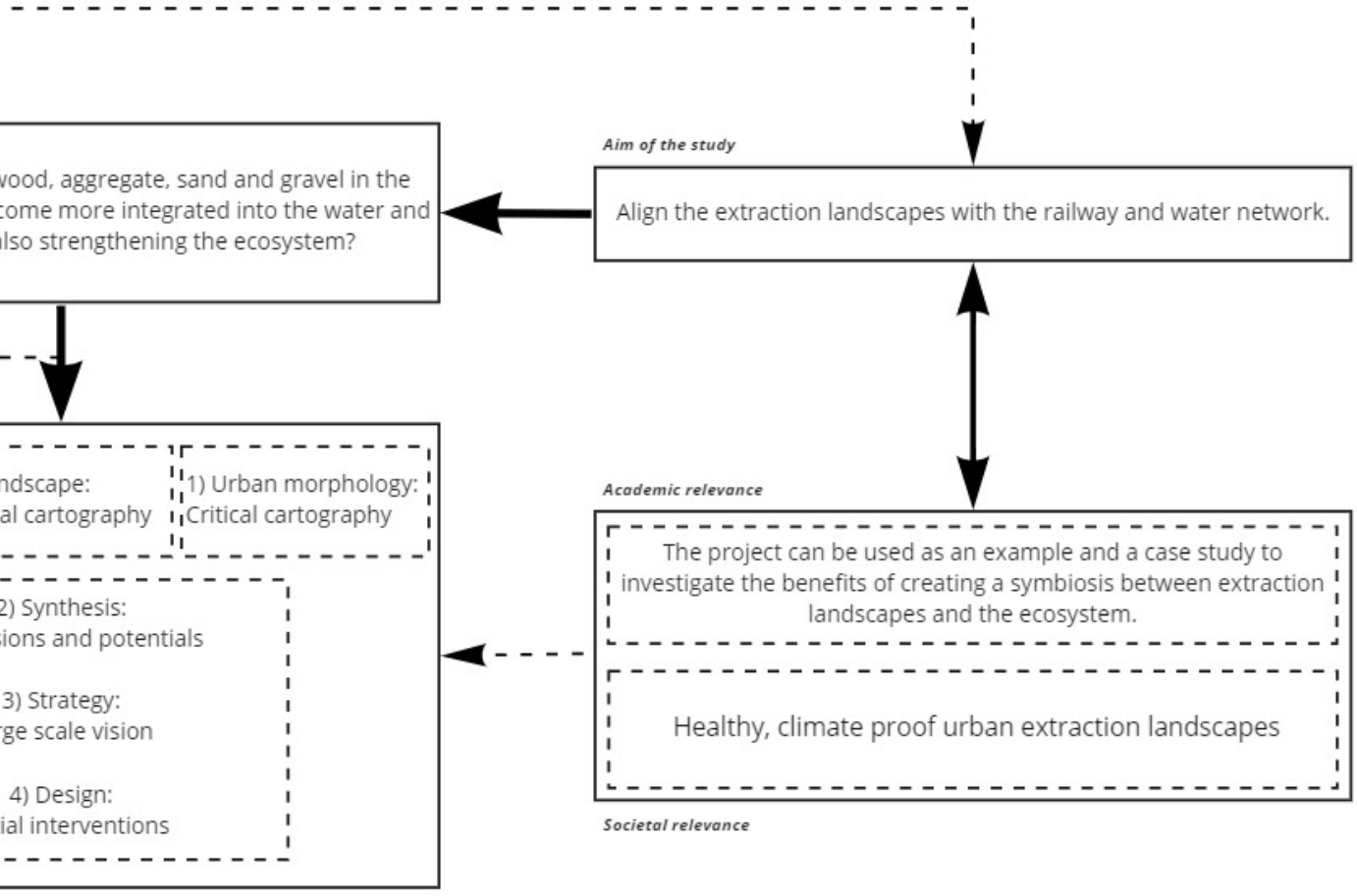





Problem statement
Extraction landscapes and infrastructure are mostly connected by the road network, meanwhile dams are blocking transportation over rivers and extraction sites do not profit from good railway connection. Next to that, there is a high flood risk in both de Drammenselva and Lierelva rivers.
Research question
How can the extraction of w
area of Drammen/Tranby bec
railway system while a
Method
1) Anthropology:
Critical cartography
1) La
Critic
Conclus
Lar
Spat
Intended end product
Extraction landscapes and infrastructure are connected and integrated in all areas. The flood risk of de Drammen and Lierelva rivers is reduced.

Conceptual framework

This conceptual framework shows the structure and relationships of this project. The start was made by drawing up a problem statement. Based on this problem statement, a main research question was formulated. This research question is the beginning of the method, which consists of the critical cartography, synthesis, strategy and design. In this way, the intended end product can be achieved. The acedemic relevance of the project lies in the fact that it can be used as an example and case study of how extraction landscapes and ecosystem participation can be applied.



2.

Critical Cartography

Process of collecting data

This chapter, the critical cartography, contains all the analysis of the area on the different scale levels. This critical cartography is devided into three domains: anthropology, landscape and urban morphology.

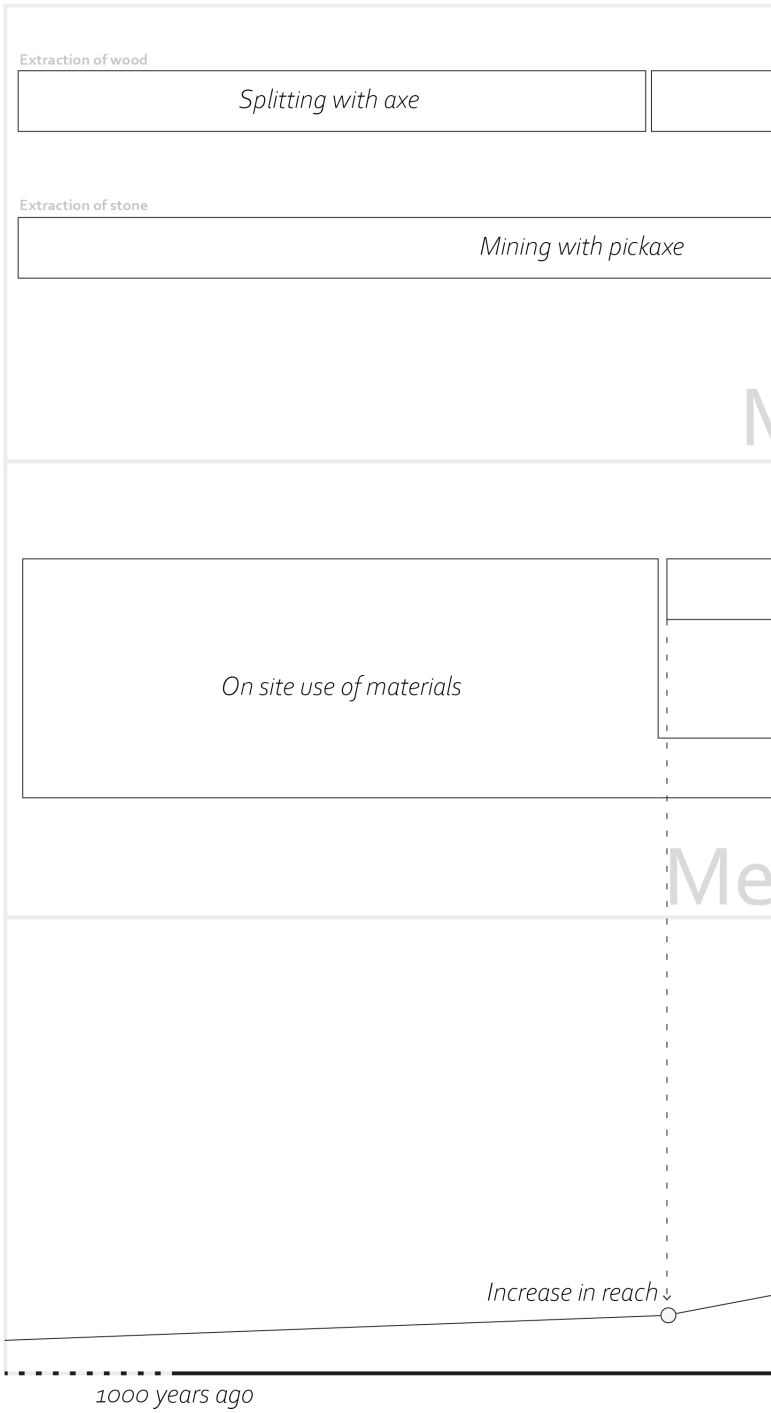
For the anthropology part, there will be looked at time, culture, behaviour and social aspects. This will be done using timelines, windowscapes and maps.

The landscape domain will look at the natural aspects like for example landscape types and soil types. The cultural layer will also be investegated, even as the climate, pollution and dynamics. This will be done by using different scale levels.

The urban morphology part will zoom in on the city of Drammen. The building typologies, green and functions will be investigated. After this, there will be zoomed out to the bigger scale. In this scale the infrastructure nodes will be investegated

2.1 Anthropology

Timeline

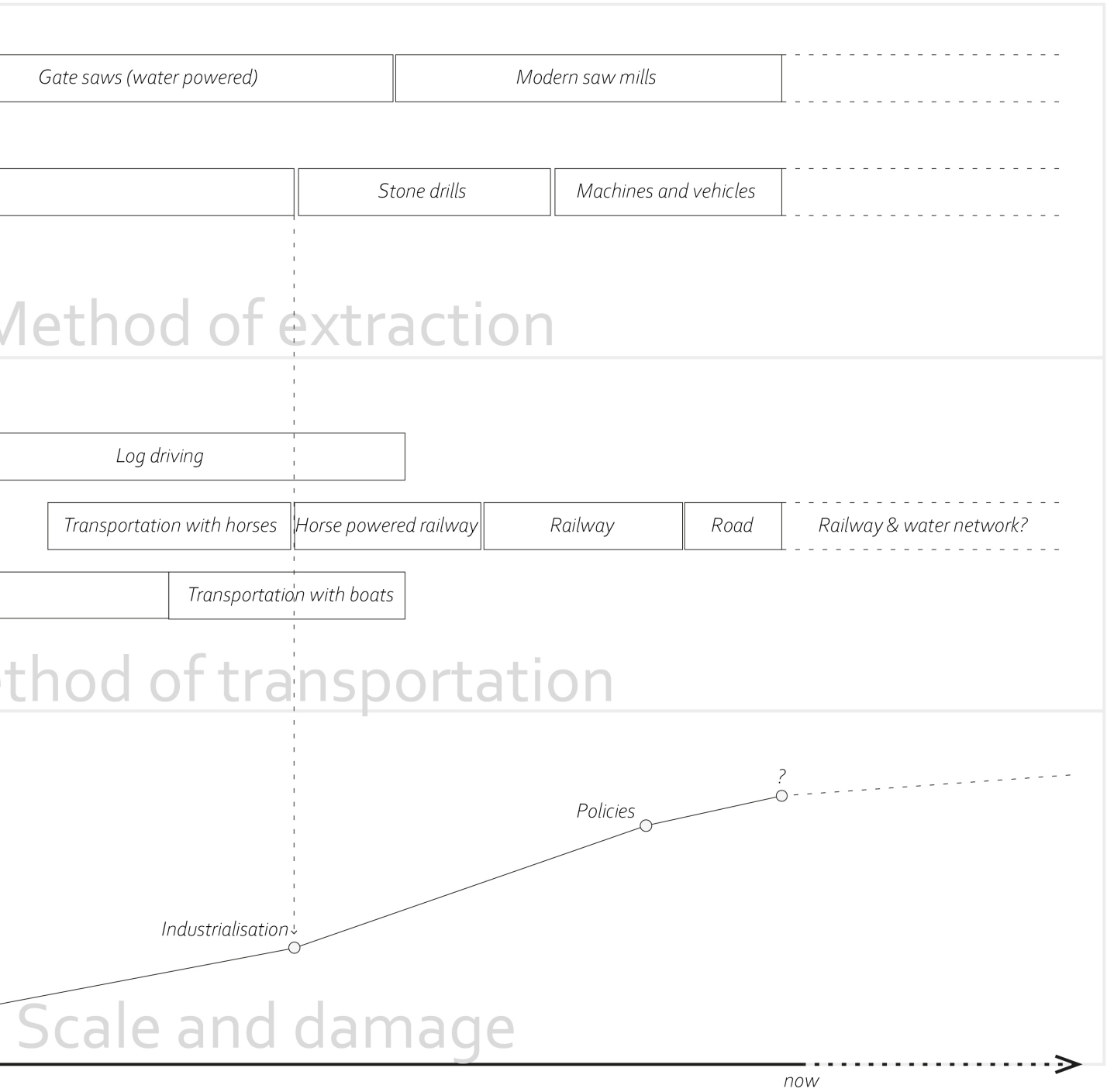


Time systems

There are two main resources that are extracted in this area throughout time which are the extraction of wood and stone. Wood has always been an important resource and people were extracting this resource way before this timeline has started (Eydelman, 2019). The extraction of stone started when people were using millstones to grind wheat, other grains and nuts (Heldal et al, 2013). This extraction was mostly done by pickaxe. While the extraction of wood improved by the development of water powered saws (Hoen et al., 2019), the extraction of stone remained to be done by pickaxe until the industrialisation. By then, drills and saw mills were developed to increase this extraction (Seelow, 2017). Around a century ago, this again changed. The extraction of stone is now done by large machines and vehicles which have increased the output again while the extraction of wood remains to be done by mostly saw mills.

The method of transportation has changed a lot through time. A long time ago, the use of materials was mainly on site. There was no large transportation possible until people started to drive their extracted logs on the water. Because of this, the reach of the lumber extraction increased a lot. Before and during industrialisation, the importance of horses and boats started to increase up until the development of the railway network. The first railway in Norway was constructed to move stone and wood from mountainous areas to the river where they could be moved further by boat. Due to the construction of dams during the 19th century, the importance of the railway network grew. Rivers were no longer used as network for transportation. This dependence of the railway system changed from 1970, when the cargo traffic was taken over by a company which mainly used cars and trucks. Currently, cargo trains are mostly used to transport from ship containers.

There are a few moments in time where the scale and damage of this extraction increased noticeably. The first moment was the use of the log driving technique, this increased the scale of the wood extraction a lot. The next point is the process of industrialisation, where railways were constructed to connect rural areas to the cities where new and more resources were needed. Not only did this process increase the scale, it also started the development of new extraction methods such as industrial saw mills and stone drills. Early in the 20th century policies were put into place to decrease the wood extraction. This halted the extensive wood cutting and made sure some vulnerable forests were protected (Eydelman, 2019).


Gate saws (water powered)
Modern saw mills
Stone drills
Machines and vehicles
Method of extraction
Log driving
Transportation with horses
Horse powered railway
Railway
Road
Railway & water network?
Transportation with boats
thod of transportation
?
Policies
Industrialisation
Scale and damage
now

Windowscapes

Four windowscapes will be tied to the theory of Mary Douglas. These windowscapes all represent a point in time (as discussed on the previous page) in order to understand the time and cultural systems better. In this theory, Mary Douglas mentions four main rationalities which describe views on nature. These four are the following:

The Fatalist

Nature does not have a voice



The Hierarchist

Nature is very powerful up to a point of no return



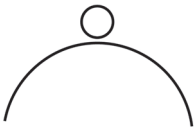
The Individualist

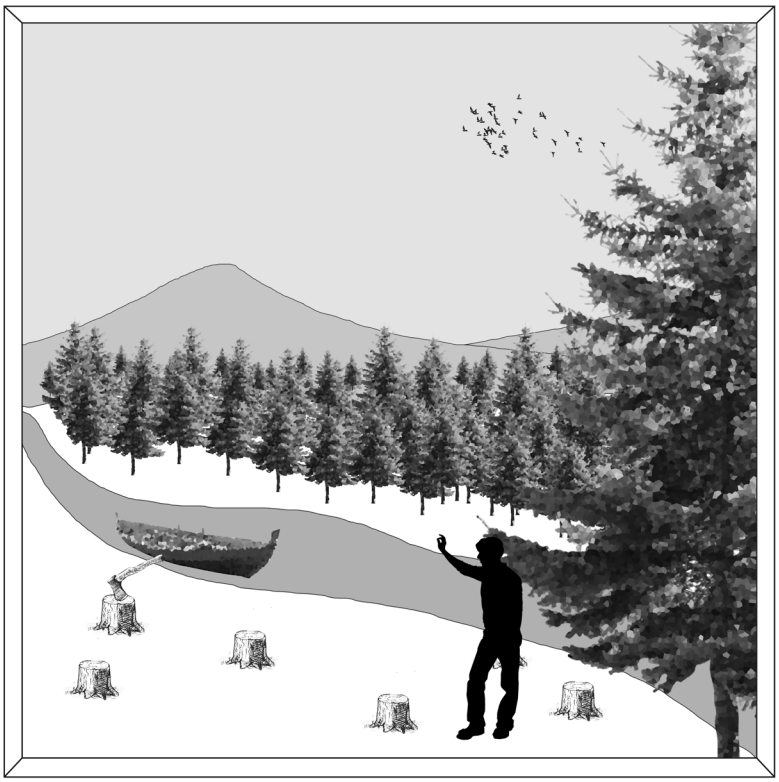
Nature is powerful and cannot be changed



The Egalitarian

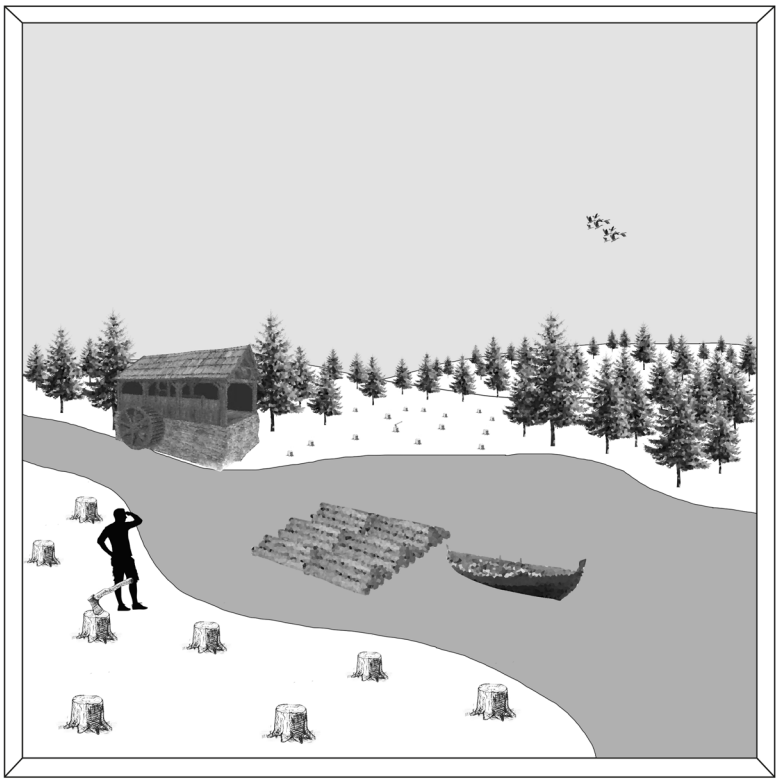
Nature is vulnerable





1. Early medieval

People and nature live in harmony. Wood and stone are extracted by hand and only small areas are influenced by people.



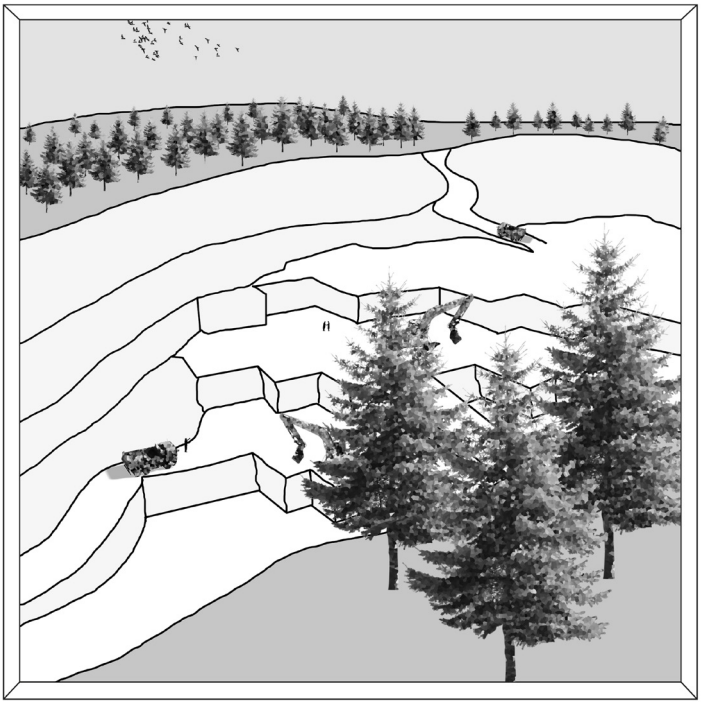
2. Late medieval

Log driving increased the reach of the extraction of wood. People were able to transport wood for hundreds of kilometres by floating them on the rivers. Small settlements along the river started to increase in size and cities started to appear. People were starting to use the water for energy as well. The first water powered saw mills were constructed which allowed people to process the wood faster.



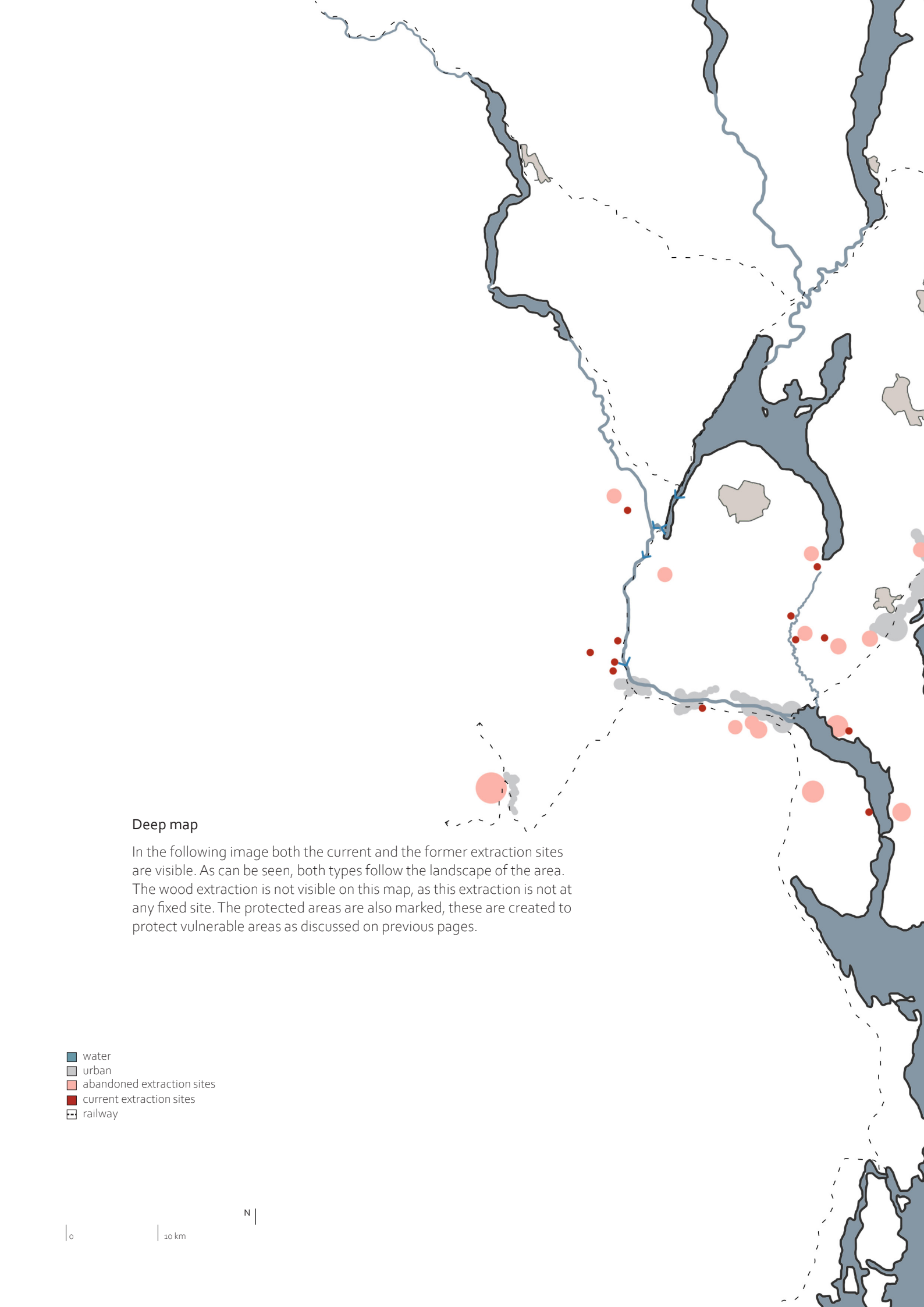
3. Industrial

The process of industrialisation changed a lot for the extraction of both wood and stone. First people were bound to use the river, while after the construction of the first railways the reach extended even further. Cities started to grow and around the rivers the first industrial hubs starter to appear. Rails were constructed along the river as well, to make up for the loss of connectivity along the river because of the construction of dams. These dams regulated the water and made people have more control on nature.



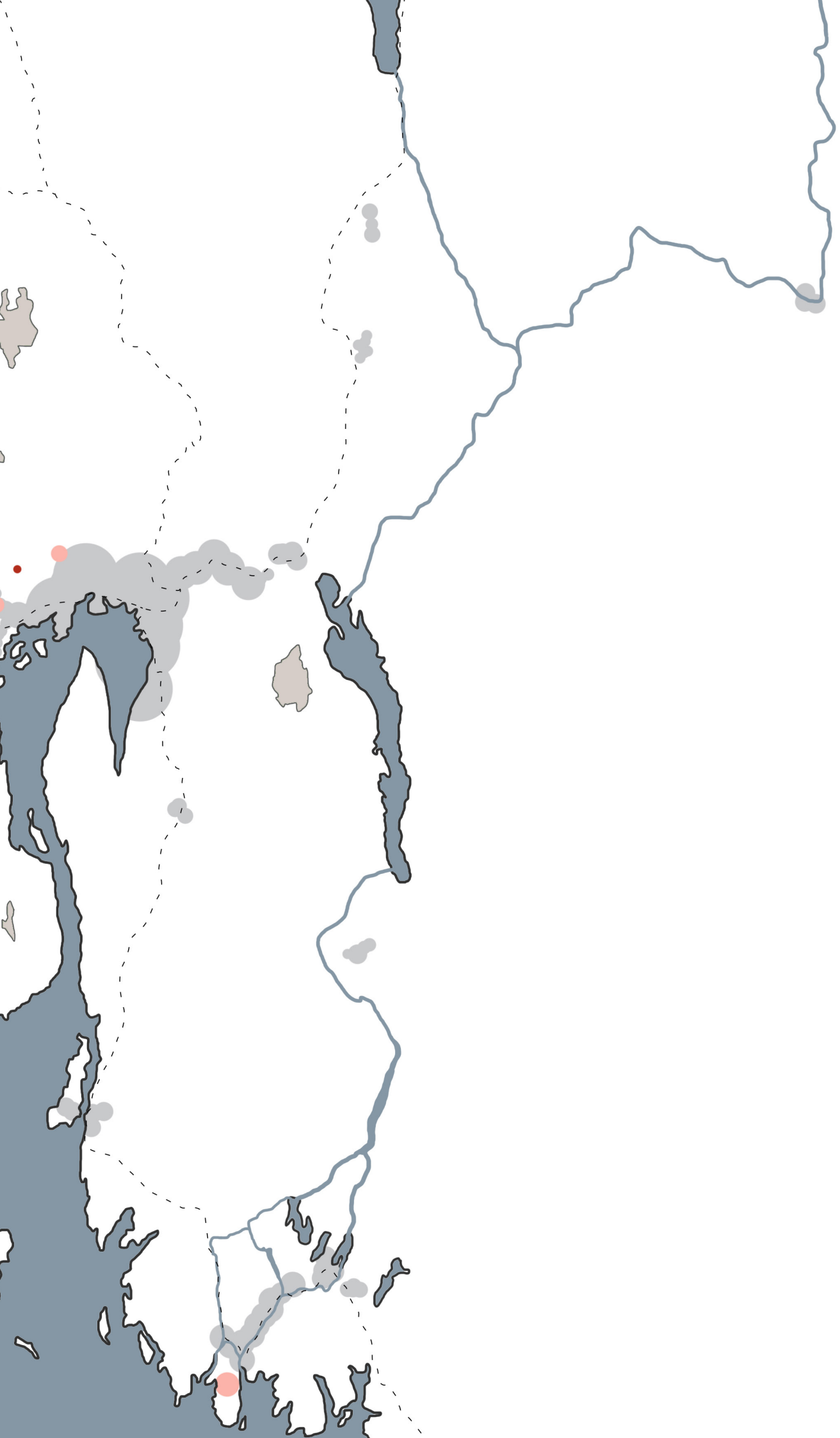
4. Modern

Large machines and trucks are used to extract large amounts of stone, sand and gravel. This is done in large quarries. Meanwhile the extraction of wood has been regulated. Important and vulnerable landscapes have been protected and replanting of forests is mandatory. While nature will be protected more in some areas, the influence of humans grows in others, such as urban areas where nature is not seen of main importance.



Deep map

In the following image both the current and the former extraction sites are visible. As can be seen, both types follow the landscape of the area. The wood extraction is not visible on this map, as this extraction is not at any fixed site. The protected areas are also marked, these are created to protect vulnerable areas as discussed on previous pages.



2.2 Landscape

Landscape types

At the largest scale level, we can see that the forest landscape is the most prevalent. Next to the forest landscape there is also some meadow landscape present in the area.

In terms of water, the Drammenselva river is very important. It connects the fjords on the north and south sides of the area. The Drammenselva river is with 318 kilometers one of the longest rivers in Norway. Next to that, there is the Lierelva river, a smaller river, with a length of 46 kilometres.



Forest
Meadows
Water

N

0 5 km



Forest landscape



Meadow landscape





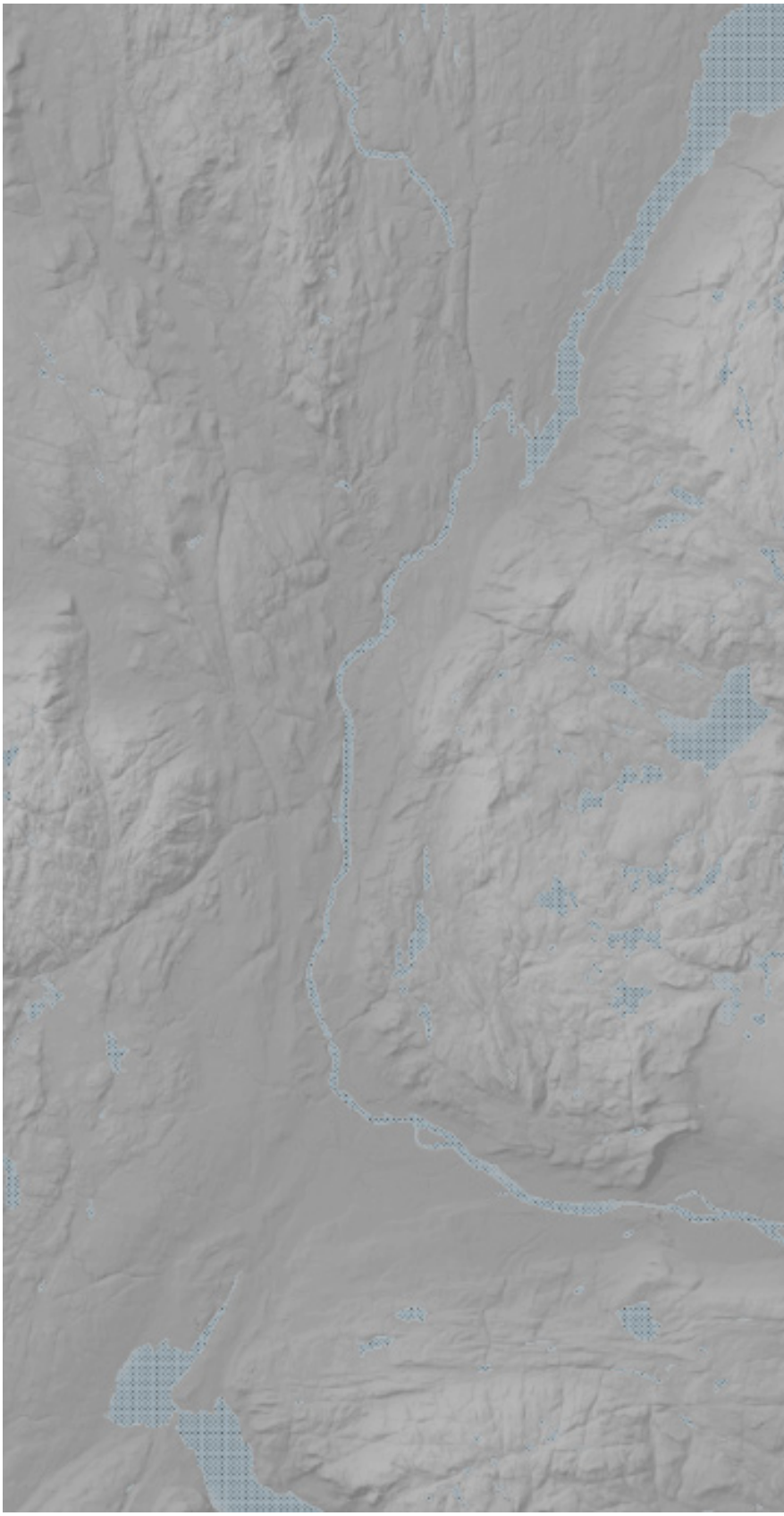
Drammenselva



Lierelva

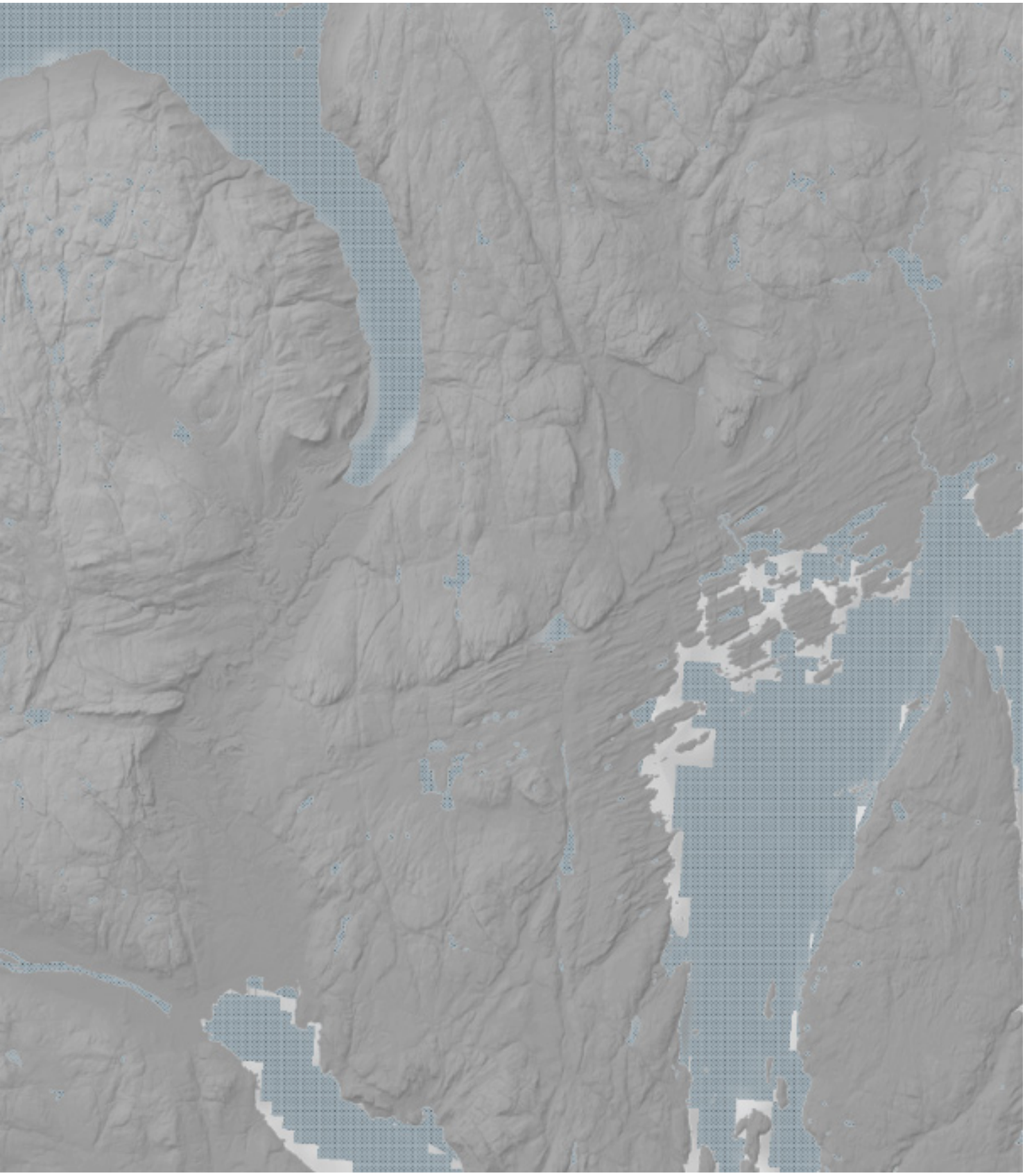
Elevation

The elevation map shows that the areas alongside the Drammenselva are the the lowest elevated areas. The areas with the meadow landscapes are also lower elevated areas. The higher parts of the area consist of forest landscape.



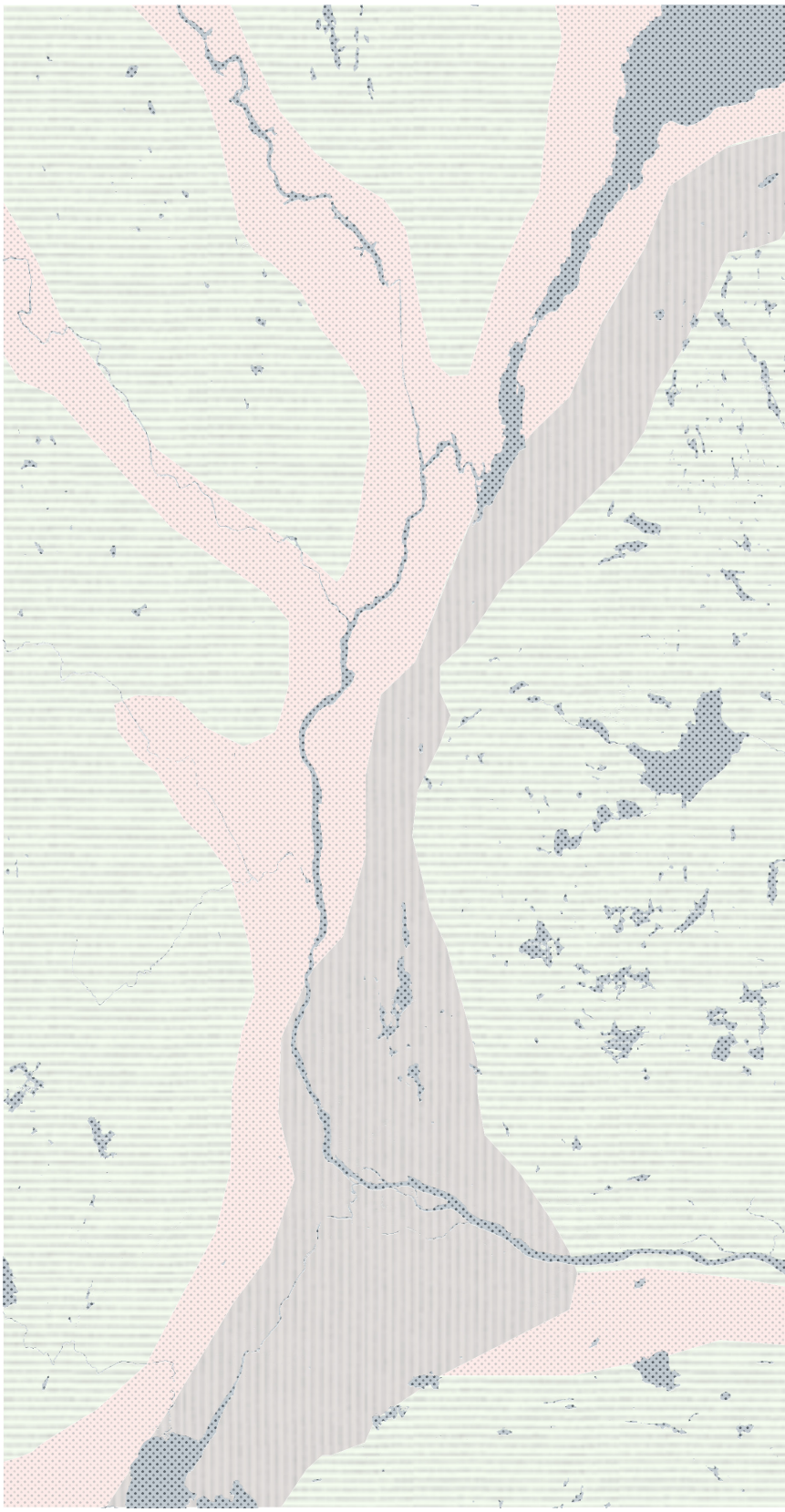
N

0 5 km



Soil types

There are 3 types of soil types present in the area. The most common soil type present is podzol. Podzol is common in northern Europe, in places with high precipitation (Geologie van Nederland, z.d.). In addition, brown soil and clay soils are also present in the area.



Brown soil
Podzol
Clay

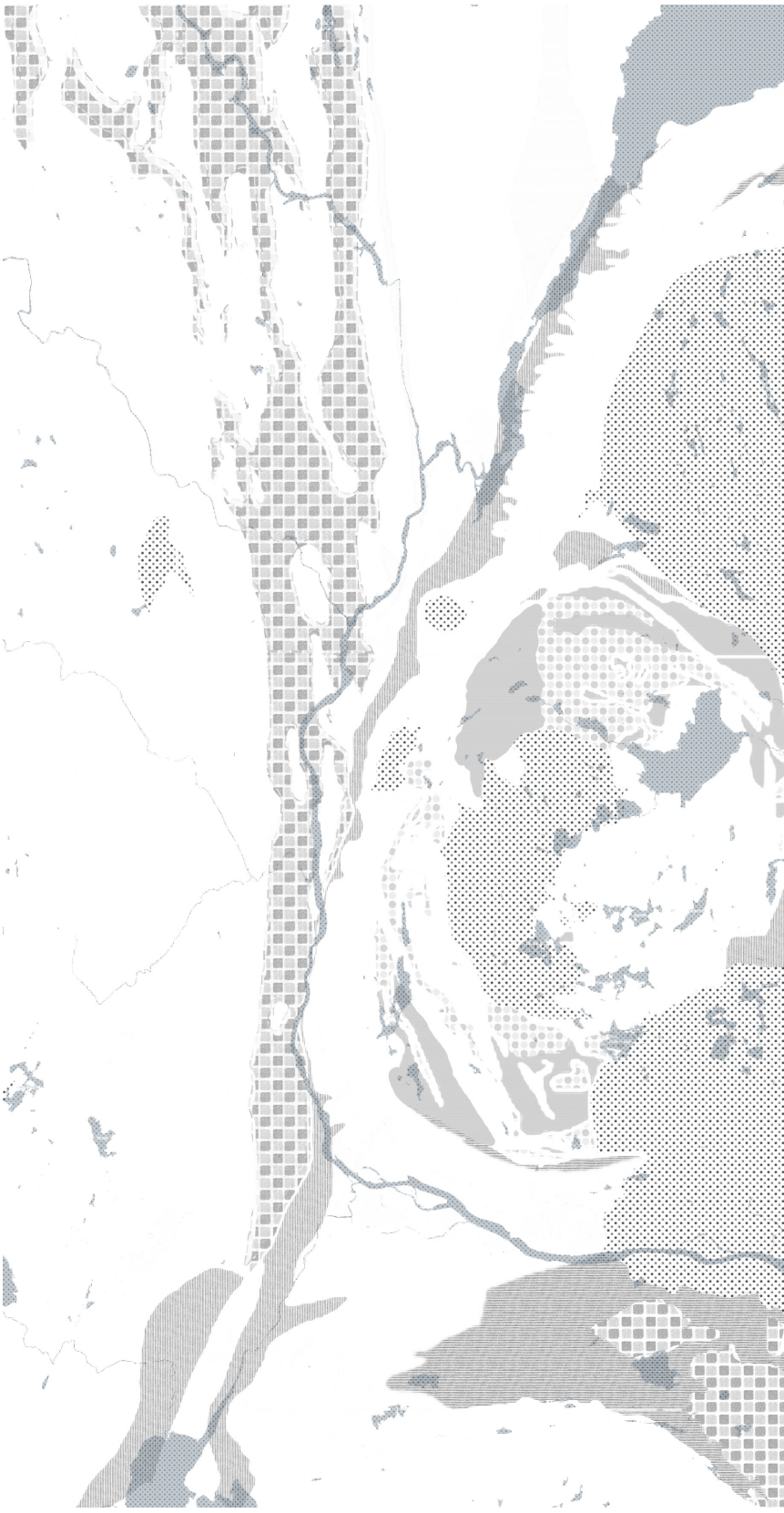
N

0 5 km



Bedrock

This map shows the most prevalent bedrock types located below the top soil layer. There is a lot of granite bedrock present in the area. Next to that, there is also latite, sandstone, limestone, basalt and shale.



Granite
Latite
Sandstone
Limestone
Basalt
Shale

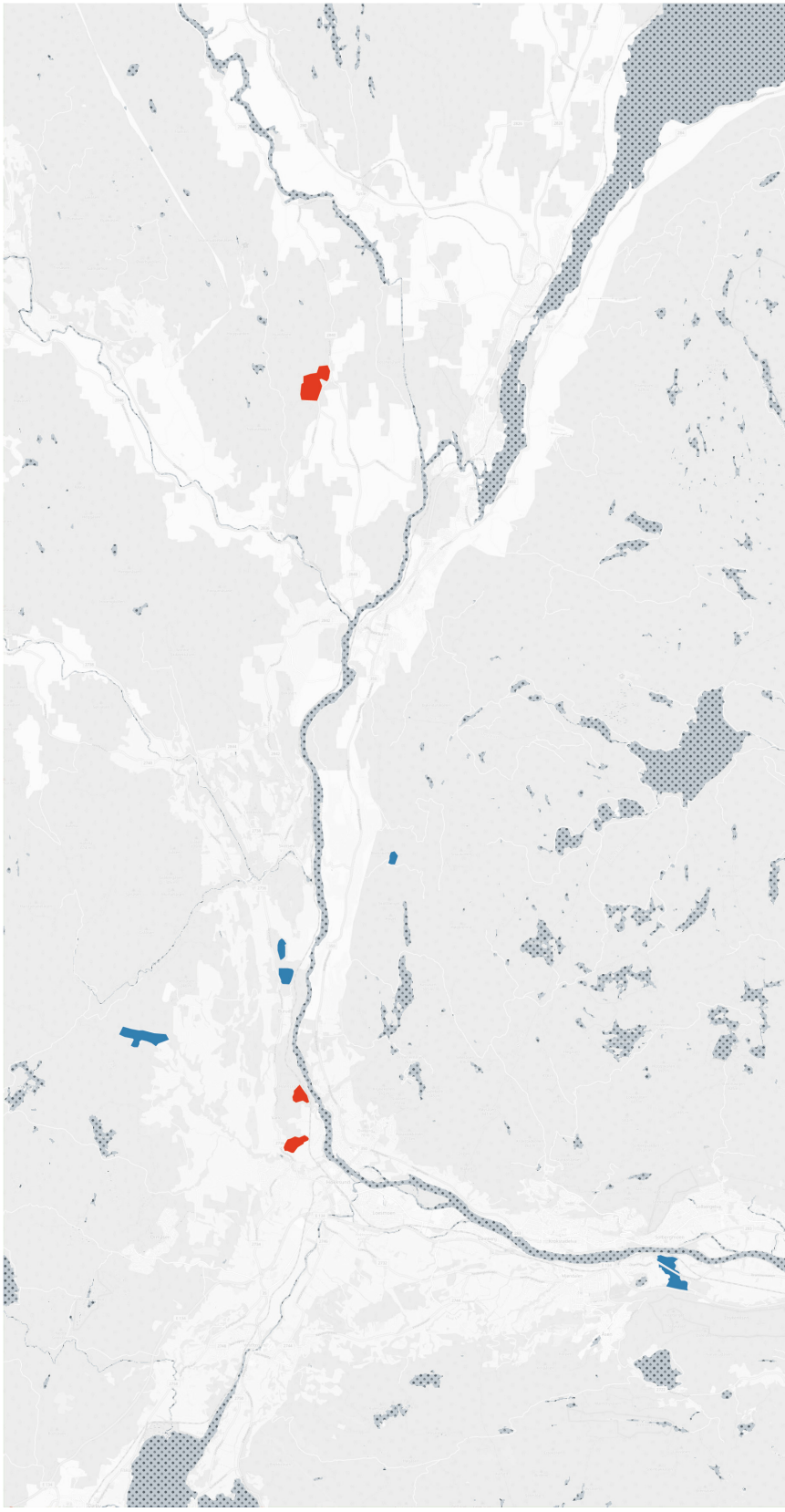
N

0 5 km



Extraction sites

There are a number of extraction sites in the region. At these sites, material is extracted from nature. This is mainly sand and gravel, but also basalt and other stones. Many of the extraction sites in the region are conveniently located along a river or train track.



Image/ Map/ Diagram Title

Here you can write a brief explanation.
Use as much text space as needed.

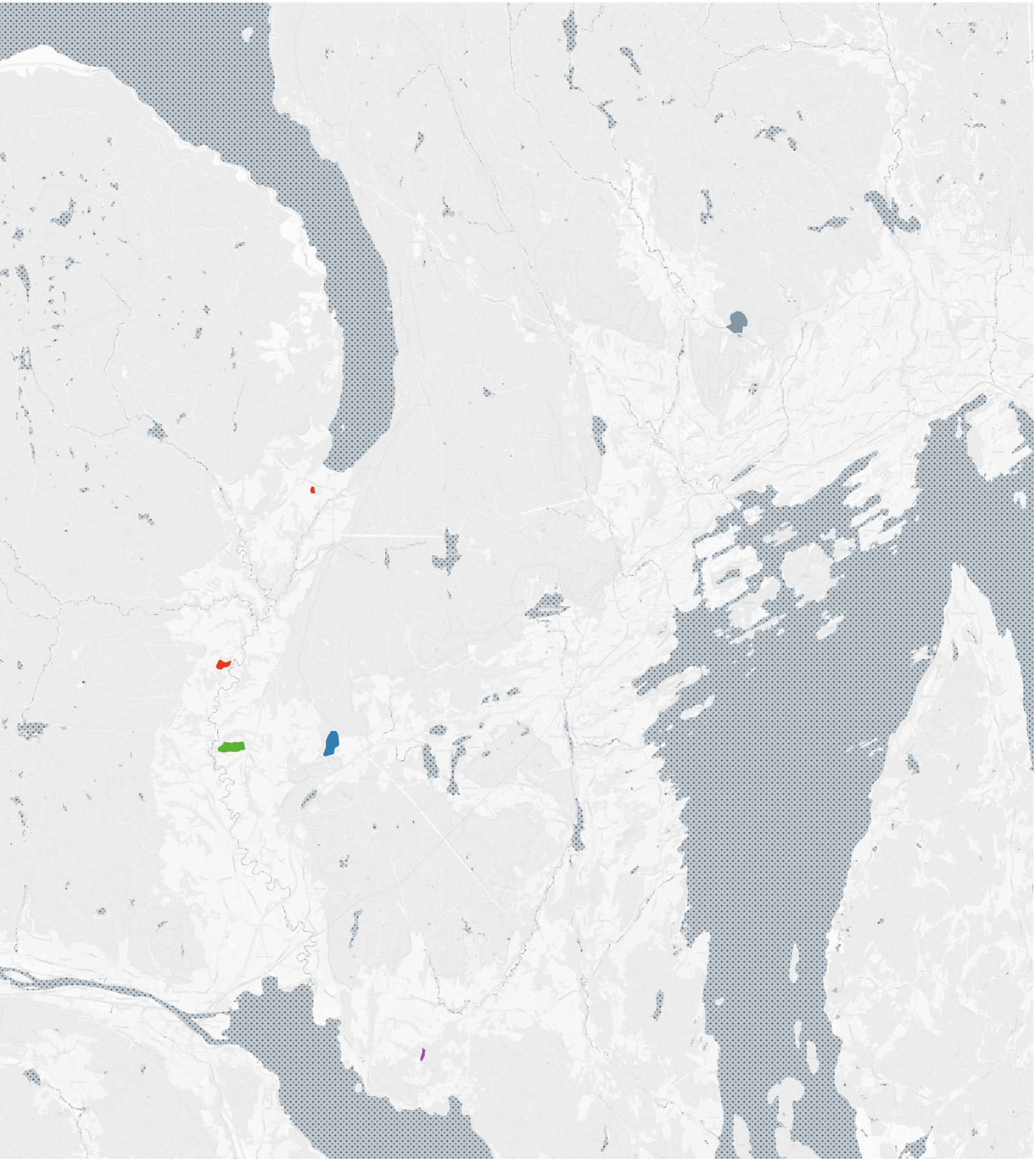
- Sand
- Gravel
- Gravel & Sand
- Basalt
- Stone

N

0 5 km





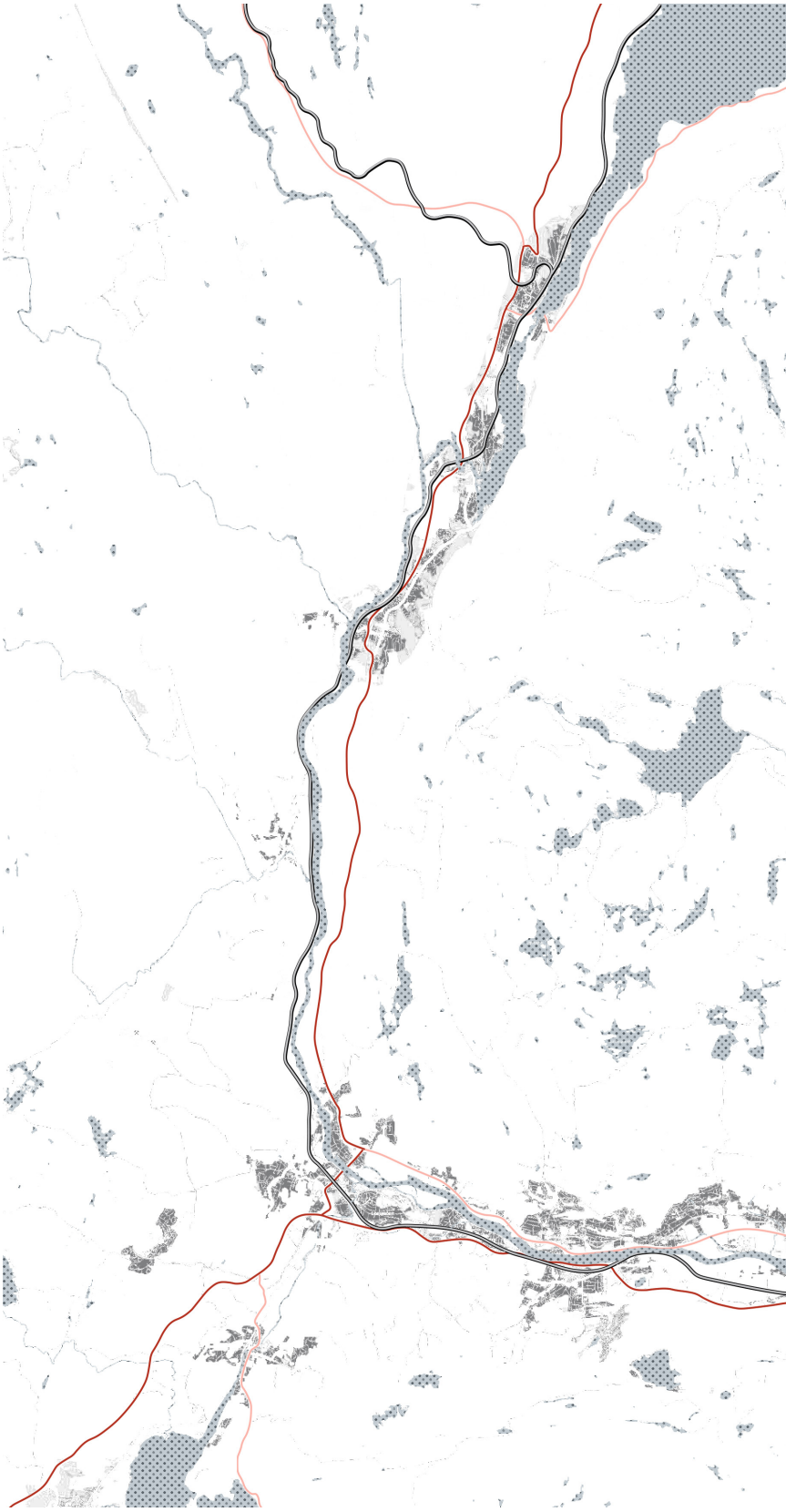






Cultural layer

The cultural layer shows all the interventions and settlements made by human in the region. It shows that almost all the urban fabric is concentrated along the rivers in the lower-lying landscape. Also the main infrastructure is mostly situated along the urban fabric and thus the rivers.



Urban
Main road
Secondary road
Railway

N

0 5 km



Pollution

On this, more zoomed in scale, the polluted soils are shown. This can be suspected pollution or unacceptable pollution that requires immediate intervention. It can be seen that there are some locations in drams where there is unacceptable pollution. This is mainly in the port of Drammen.



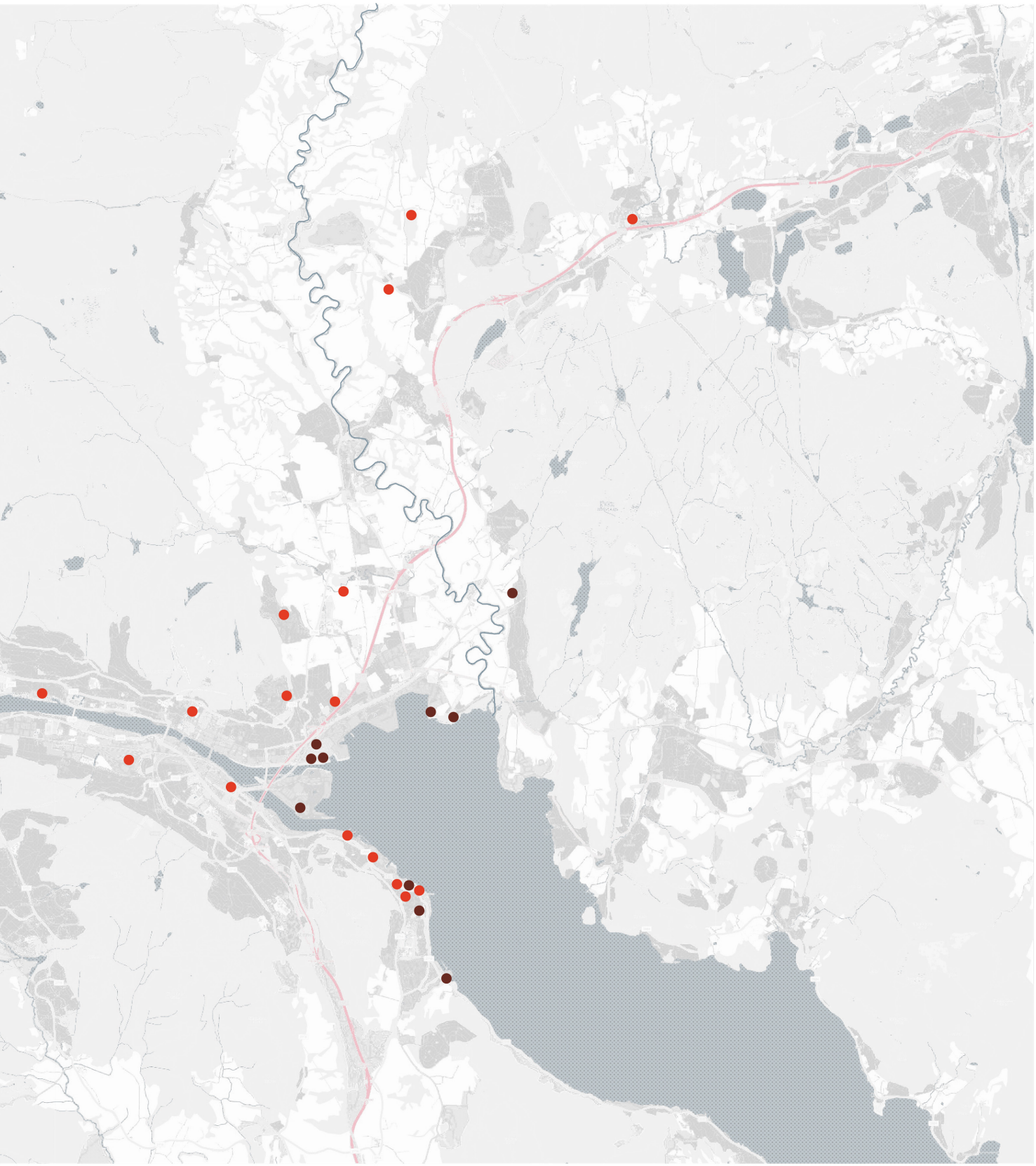
Image/ Map/ Diagram Title

Here you can write a brief explanation.
Use as much text space as needed.

- Suspected pollution
- Unacceptable pollution and need for action

N

0 2 km

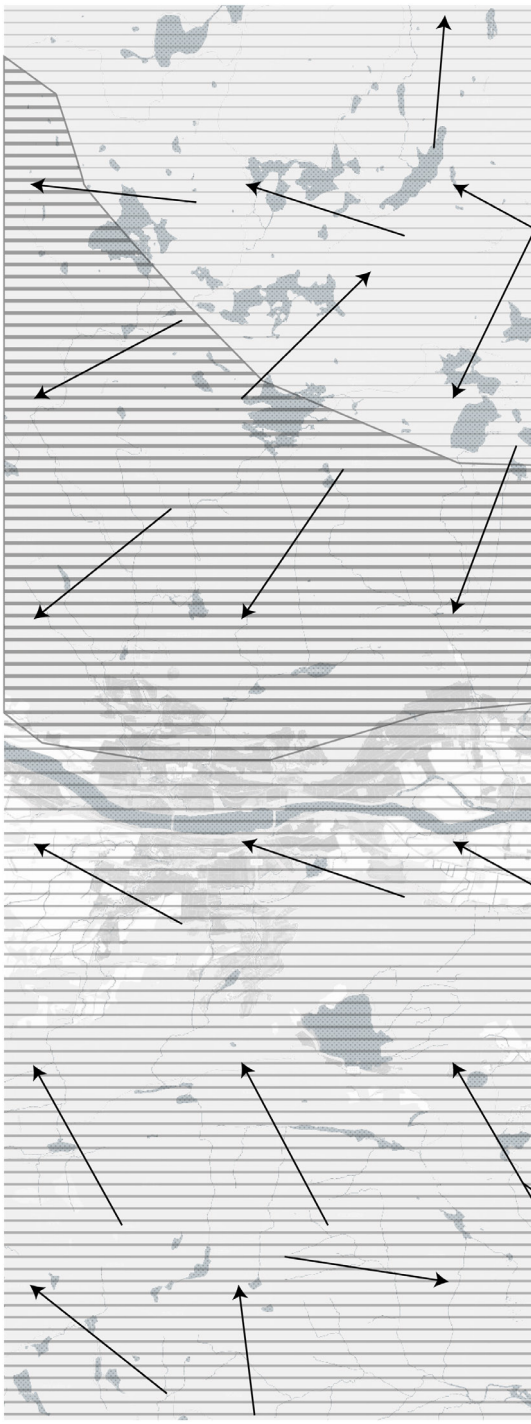


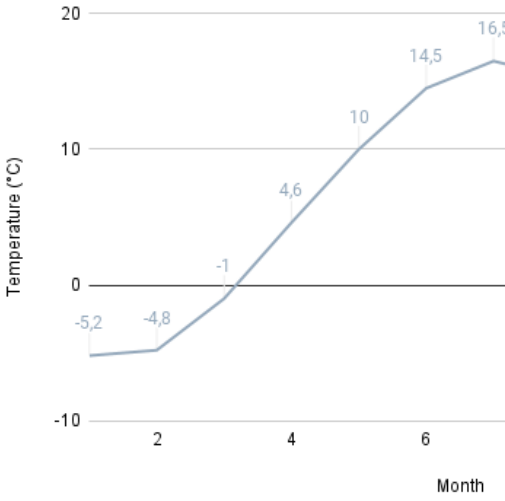
Climate

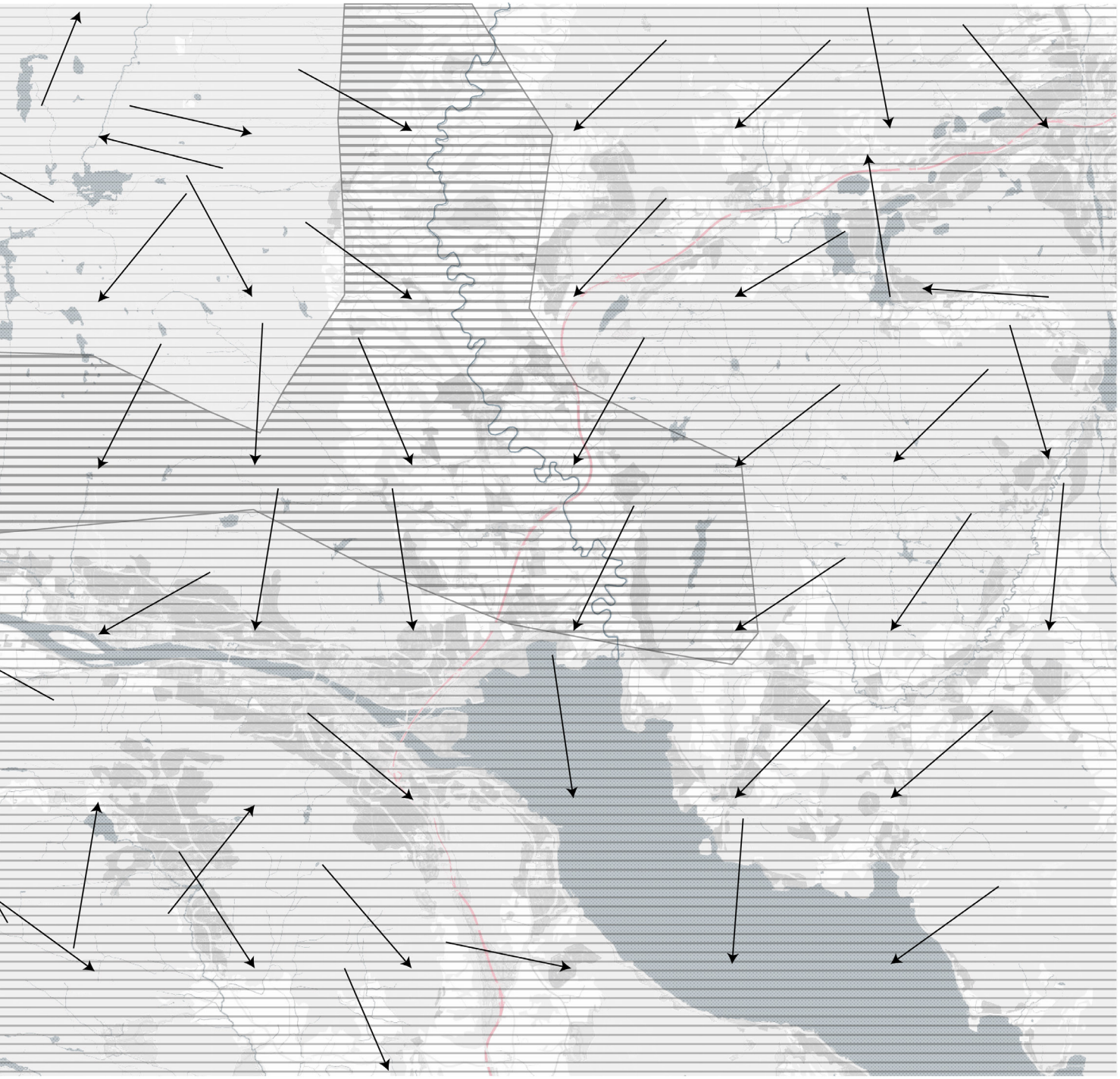
Drammen has a continental climate. It is warm in the summer and cold in the winter. The average annual temperature for Drammen is 8°C and 527 mm of rain falls in a year. The graphs on the right show the average temperature per month and the average rainfall per month. The average temperature ranges from -5.2 degrees Celsius in January to +16.5 degrees Celsius in July. The most precipitation, 110 millimeters, falls in August and the least precipitation, 58 millimeters, in March.

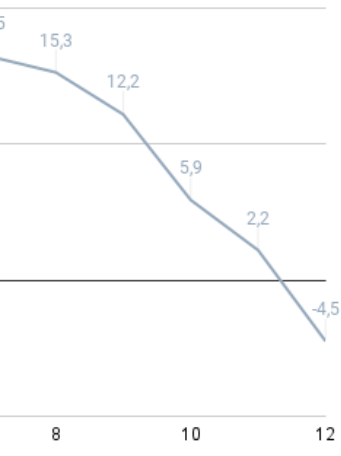
Wind

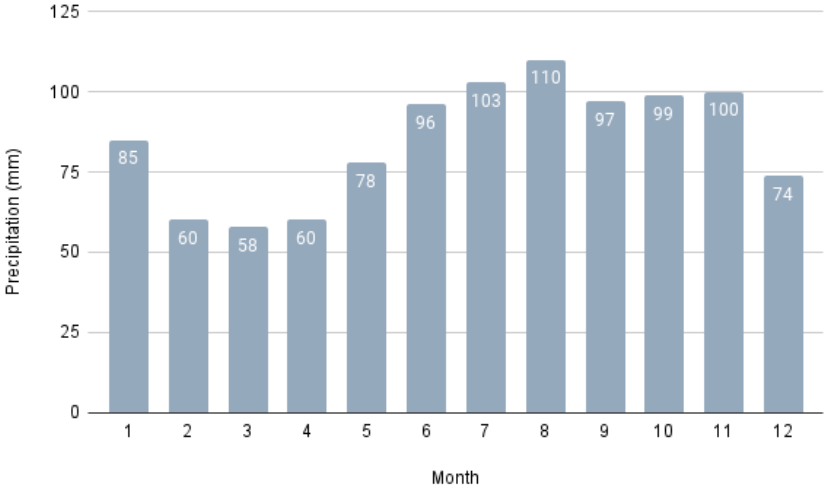
The highest wind speeds are found in the lower lying meadow landscape along the Lierelva River. The main wind direction is largely in the direction of the lower lying areas and thus along the urban fabric, from east to west.








15,3
12,2
5,9
2,2
-4,5
8
10
12


125
100
75
50
25
0
Precipitation (mm)
85
60
58
60
78
96
103
110
97
99
100
74
1
2
3
4
5
6
7
8
9
10
11
12
Month

Dynamics

There is a relatively high flood risk in Drammen and the surrounding area. In the town of Drammen, along the quays of the Drammenselva, there is a 10-year flood risk. Towards the east, near the smaller Lierelva River, there is a 20 year flood risk.



10 Year flood
20 Year flood

N

0 2 km



Flood Drammenselva



Floo



od Drammenselva



Flood Lierelva

2.3 Urban morphology

Buildings

For the urban morphology part of the critical cartography the focus is on the city of Drammen. In this drawing, the morphology of Drammen is compared to de Drammenselva river, to explain the structure of Drammen. There is a clear difference between the more orthogonal orientation of the buildings blocks along the river, and the more organic orientation along the higher landscape on the edge of the city. These smaller residential buildings are following the hilly landscape. The morphological structure can also be explained by looking at the functions, which will be shown later.



Buildings

Inventarisation of the morpholigal structure of Drammen

Buildings
Water

N

0 200 m



Green

Looking at the green elements in Drammen and its surroundings, there is a clear division between three different kinds of green. On the higher areas outside the city there is mostly afforestation and in the valley areas there are mostly meadows. The contrast between the city and its surroundings is clearly visible. WIthin the city of Drammen there are some fragmented green areas which are barely connected with each other and the surrounding green areas. Especially along the Drammenselva, there is a lack of quality green spaces.



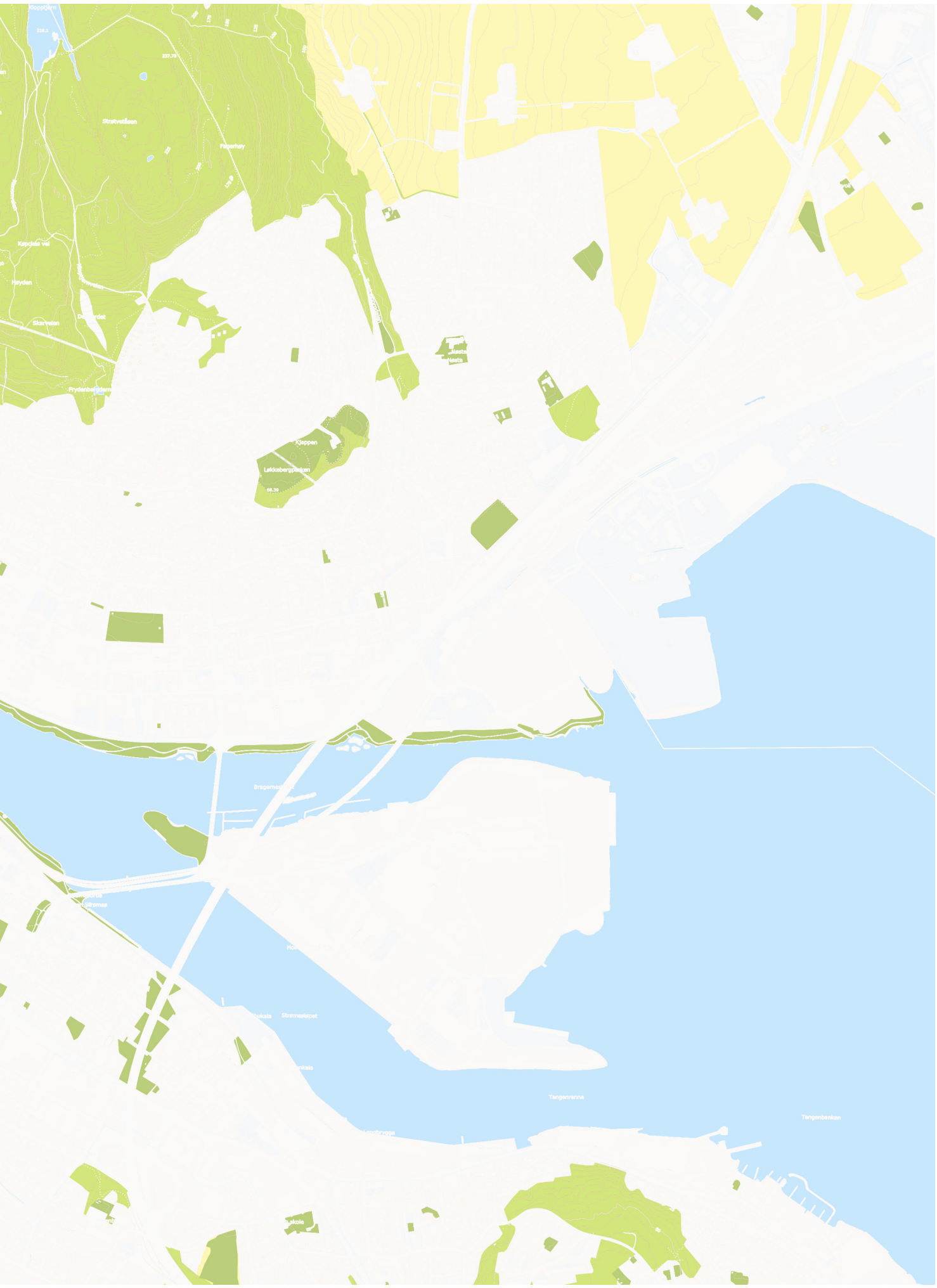
Green

Inventarisation of green elements in Drammen

- Urban green
- Forest
- Meadows

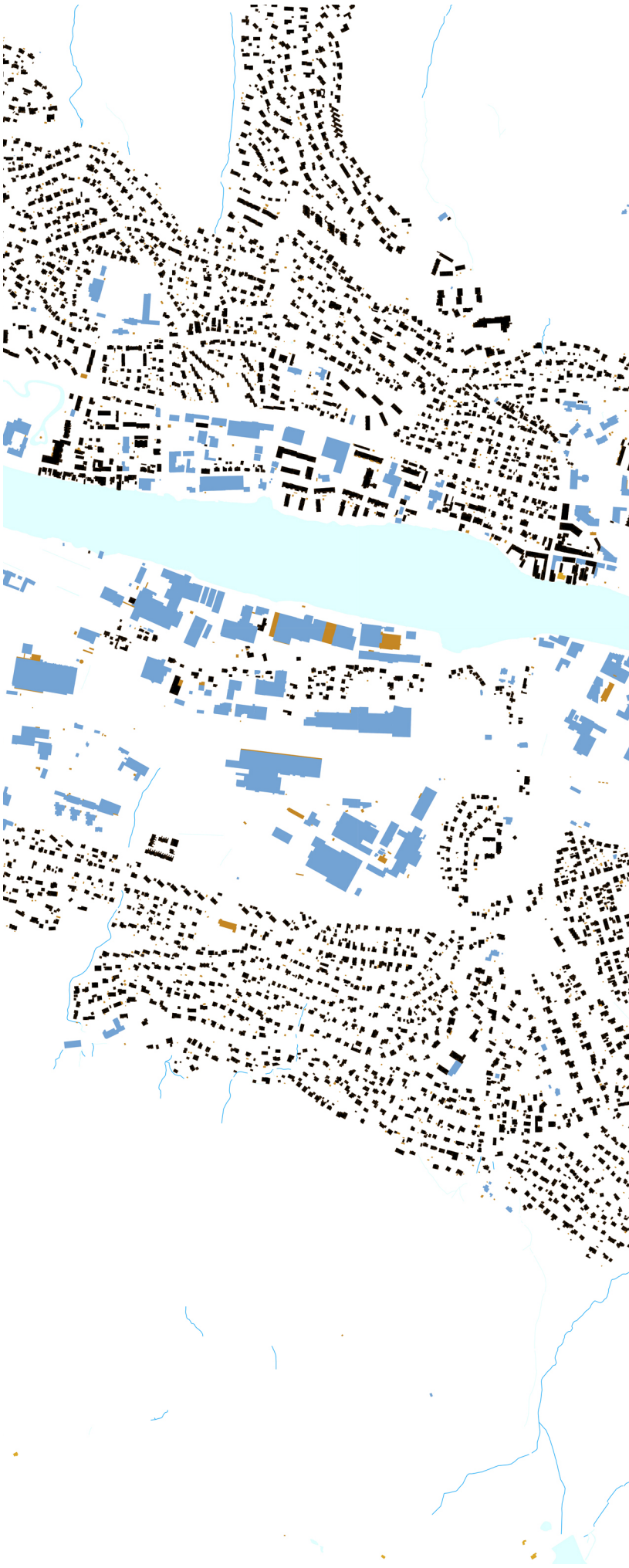
N

0 200 m


Stratvatnåsen
Petterhøy
Kapdalsvei
Høyden
Skarvheia
Prydenberghaugen
Kjeppen
Lekkebergplassen
Tangenranna
Tangenbanken

Functions

As explained before, the morphological structure of Drammen can partly declared by looking at the most important main functions. Important to notice is that Drammen is an important harbour city in the region, which declares the various industrial areas alongside the river. In blue the several industrial buildings are highlighted. The exact functions of these buildings are unknown. In black the residential buildings are shown. What strikes is that these residential buildings are mostly located in the higher areas.



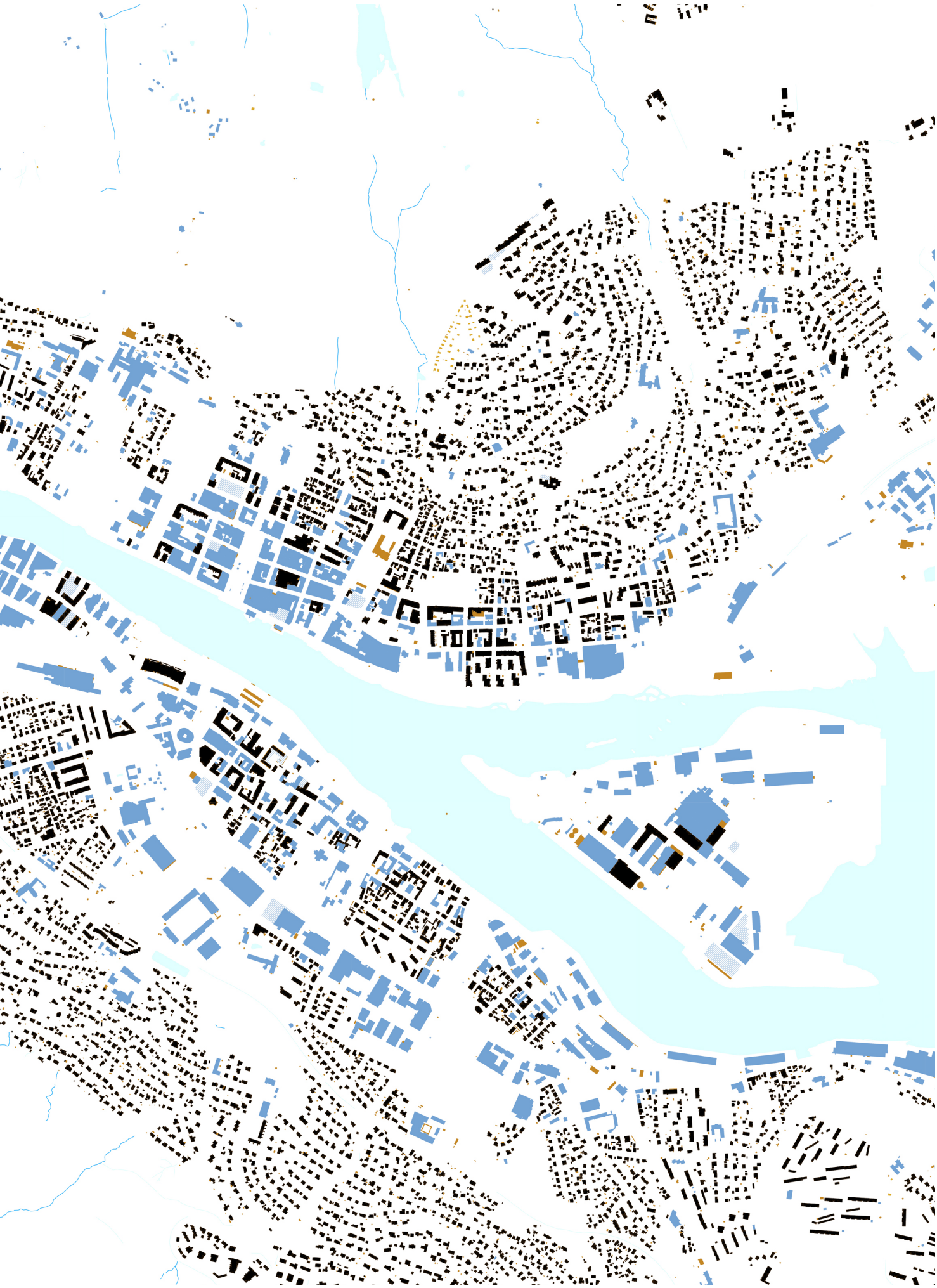
Functions

Inventarisation of different important functions in Drammen

Industry
Residential
Other

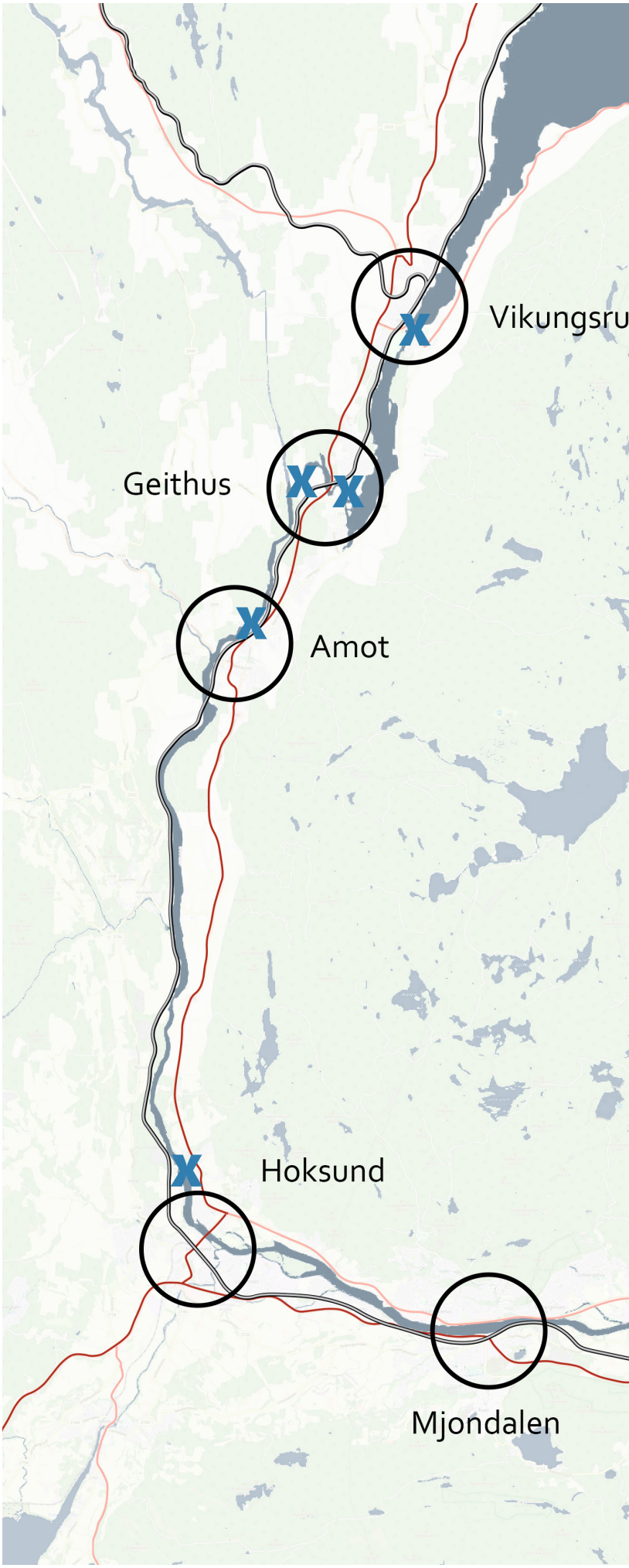
N

0 200 m



Infrastructure nodes

One of the most important analysis within the theme of urban morphology, which contributes to the group vision, was the inventarisation and explanation of the infrastructure nodes and centralities in the Drammen region. As discussed in the landscape part, the urban settlements and the infrastructure networks are following the landscape (alongside the river and between the higher areas). In this analysis an inventarisation was made on the locations where the railway, road and waterway networks are crossing. On the next pages there will be zoomed in on three of these locations: Tranby (extraction sites), Hoksund (extraction sites) and Drammen (port).



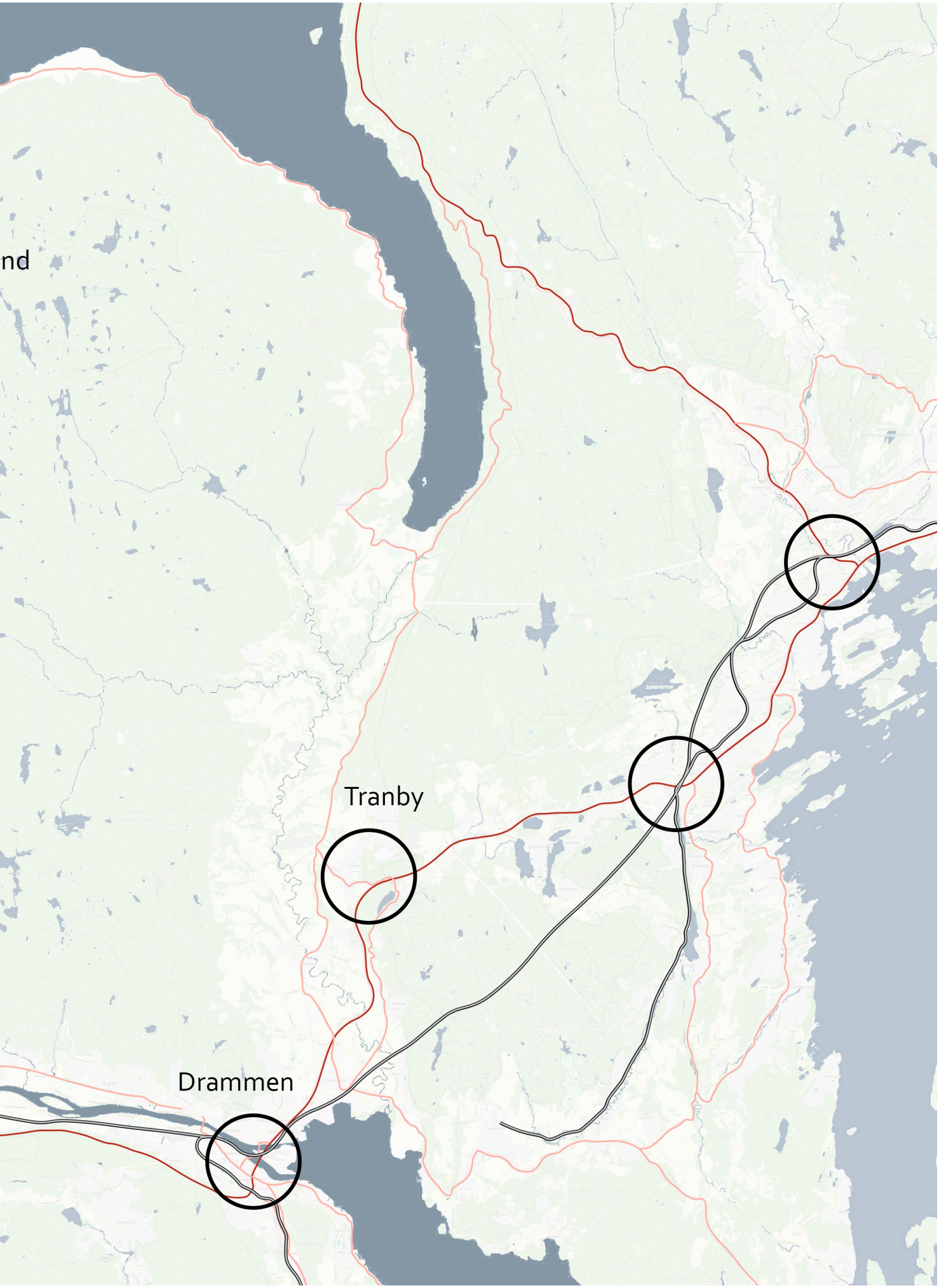
Infrastructure nodes

Map of infrastructure nodes in the Drammen region

Roads
Water
Dams
Railway

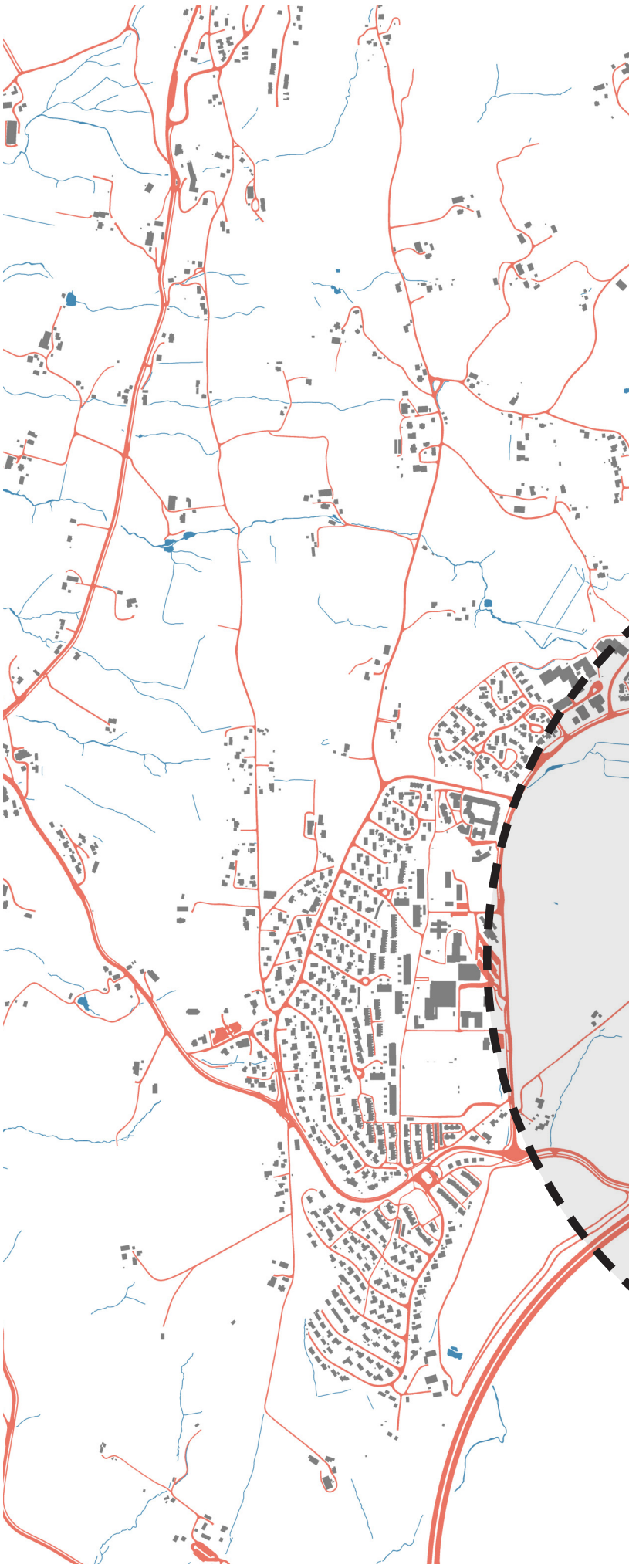
N

0 1 km

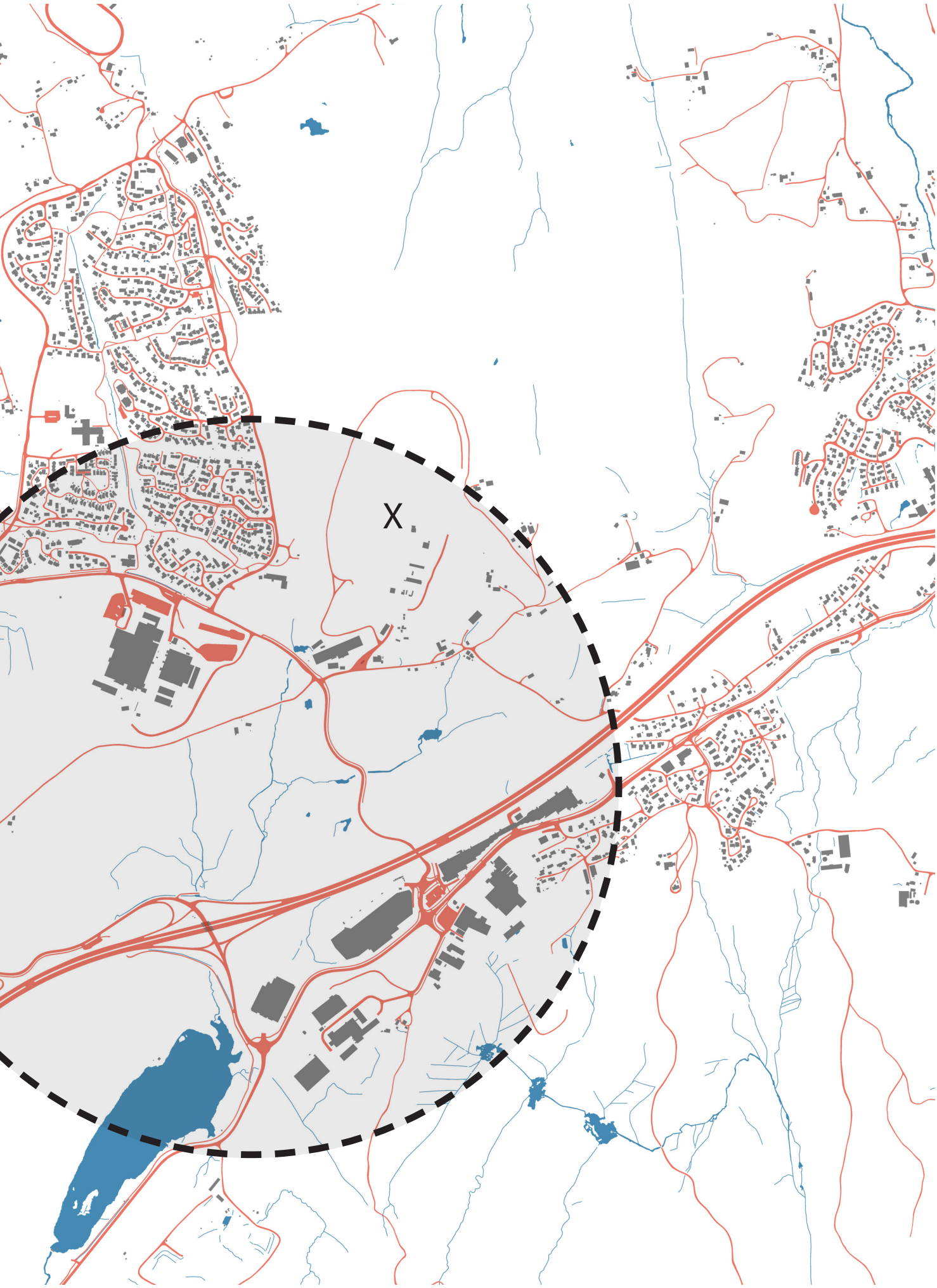

nd
Tranby
Drammen

Tranby

Tranby is located north of Drammen and is mostly connected through the road network. The railway is not crossing Tranby even as the water network. Tranby is an important chain in these region because of its extraction sites (). However, the lack of infrastructure could be a problem for transporting the extraction materials on an efficient and sustainable way.



Tranby - infrastructure


X

Hoksund

Hoksund is an urban settlement which is located in the bend of the Drammenselva river west of Drammen. In Hoksund, the three different infrastructure elements are present. Hoksund is therefore spatially acting like an infrastructure node. This map is clearly showing the strong connection between the organisation of the urban morphology, infrastructure and landscape. Hoksund is an important chain withtin the extraction cycle, because of the two extraction sites (sand), which are located in the north. However, same as for the whole region, the transport is mainly taking place by road. Hoksund could be a more efficient, sustainable and important node if the water and railway system would be used more for the transportation of these extraction materials.



Hoksund - infrastructure



Drammen

Drammen is strongly characterized by the presence of the port. As explained before the infrastructure and the urban morphology are strongly following the river and the surrounding higher areas. The most important part in the port of Drammen is the island Holmen, where the infrastructure node is clearly visible. On this island the river, road network and railway network are all coming together. This makes Drammen the most important chain in this network.

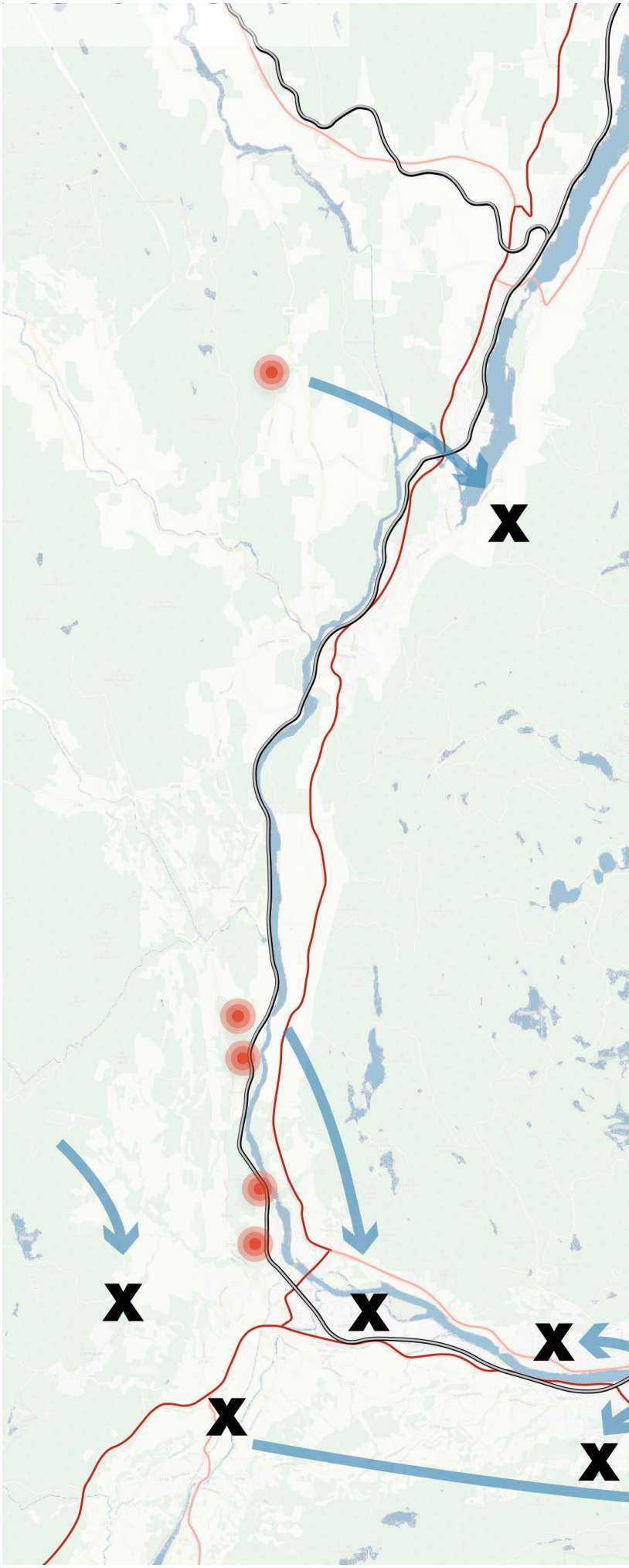


Drammen - infrastructure



Flows

After investigating the infrastructure networks and the nodes, several important flows are drawn in the map on this page. In red the extraction sites are hightlited and the black crosses are representing several present material suppliers (mostly concrete). It is assumed in this investigation that the extraction materials (sand and gravel) are used for producing concrete. This materials are therefore transported (mostly by road) to the material suppliers. It is assumed that the produced concrete is partly used for construction.



Flows

Global investigation of important flows

- Extraction sites
- Roads
- Railway
- Water
- X Material suppliers (concrete)
- X Material suppliers (timber)
- Flows

N

0 1 km

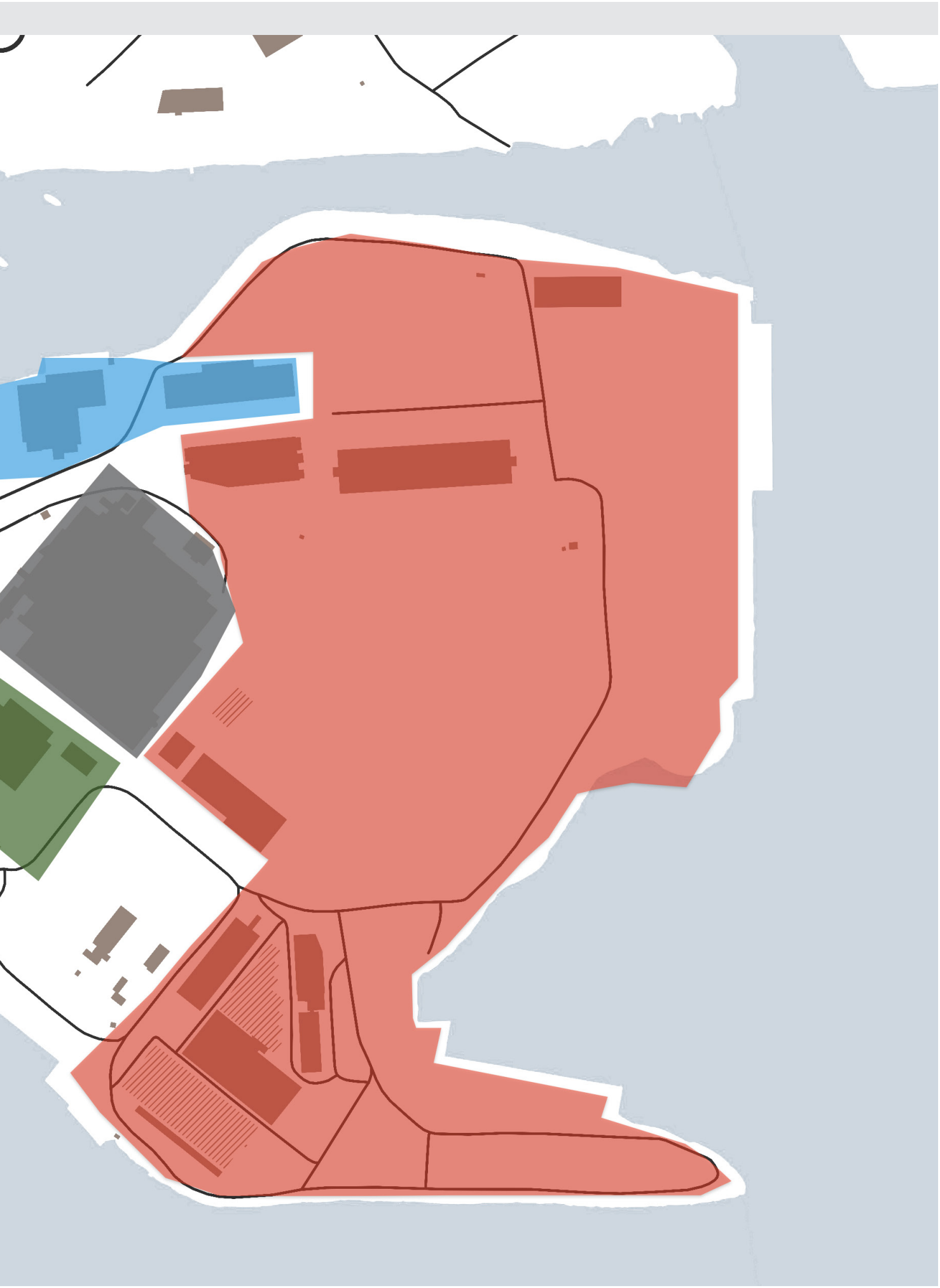


Holmen

As explained before, the most important infrastructure node in the Drammen region is the node in the port of Drammen. This infrastructure node is located on Holmen, which is an important hub in the port of Drammen. In this map an inventarisation of the functions and landuse on Holmen is made. What strikes is that most of the surface of Holmen is used for storing cars. The port of Drammen is therefore an important port for importing cars. In 2017 a import record of 111547 was broken (Drammen havn, 2021). Other present functions on Holmen are manufacturers, shipping companies, material suppliers and transport companies.



Holmen - landuse



3.

Systems description and synthesis

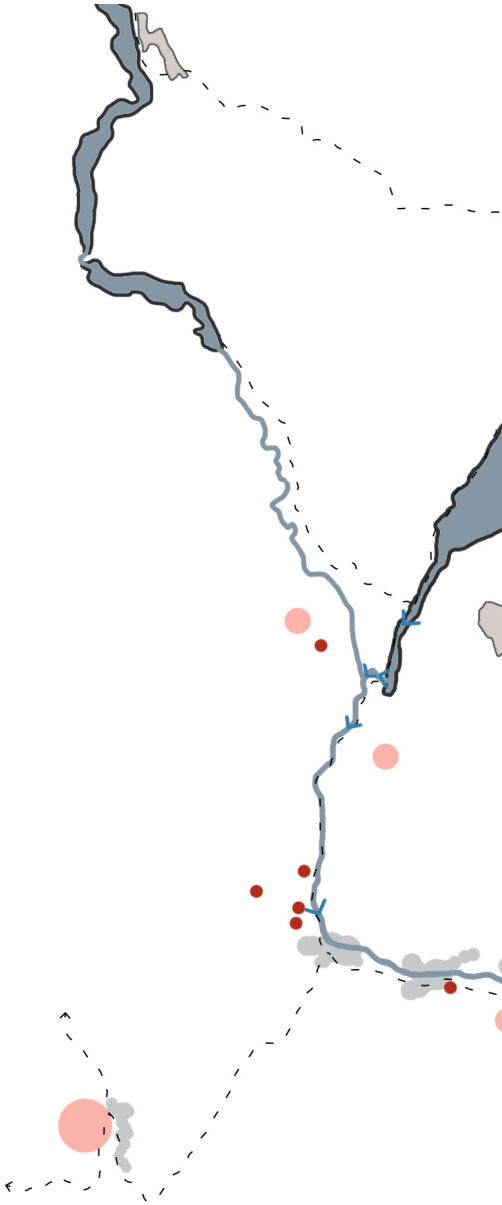
This chapter will show the main conclusions of the critical cartography. A synthesis map for each domain will be displayed at a scale relevant to that domain. For anthropology this will be at the largest scale level, for landscape at the regional scale, and for urban morphology it will zoom in on Drammen.

After the synthesis maps from the three domains, a general conclusion map will be displayed. This map is a combination of the three domains and shows the relationships between them. It will show the most important flows in the area. Finally, the potentials in the area will be explored, which will be used in the vision and the individual design experiments.

Anthropology

In the previous chapter the anthropology of the area has been analysed and investigated. To better connect this aspect with the rest of the group, there was chosen to use a map as a means of communication. This map is the same as the deep map discussed before.

It shows the relation between the landscapes and the extraction sites and a strong correlation between the location of extraction and the railway and water network can be seen.

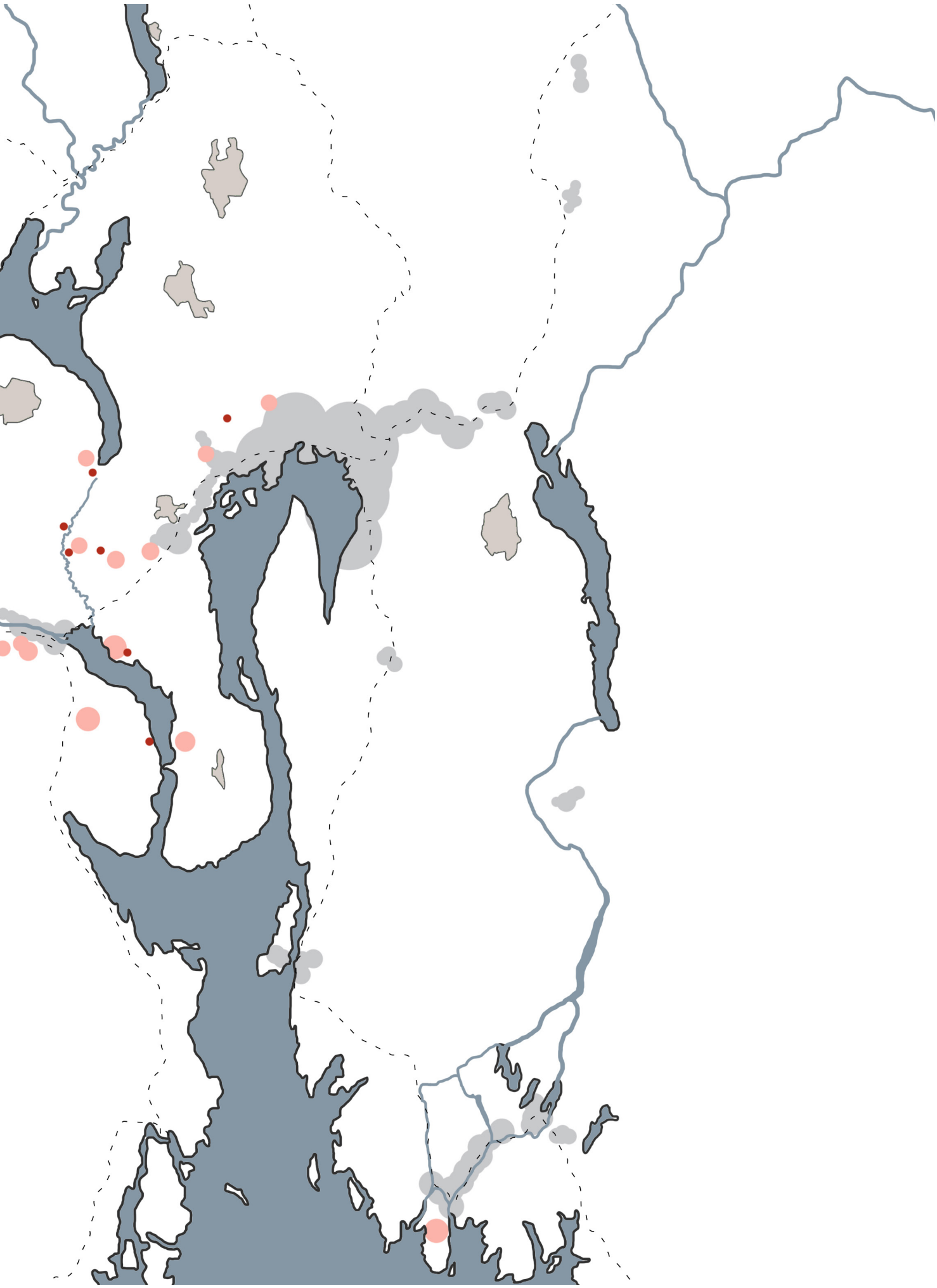


Anthropology synthesis

water
urban
abandoned extraction sites
current extraction sites
railway

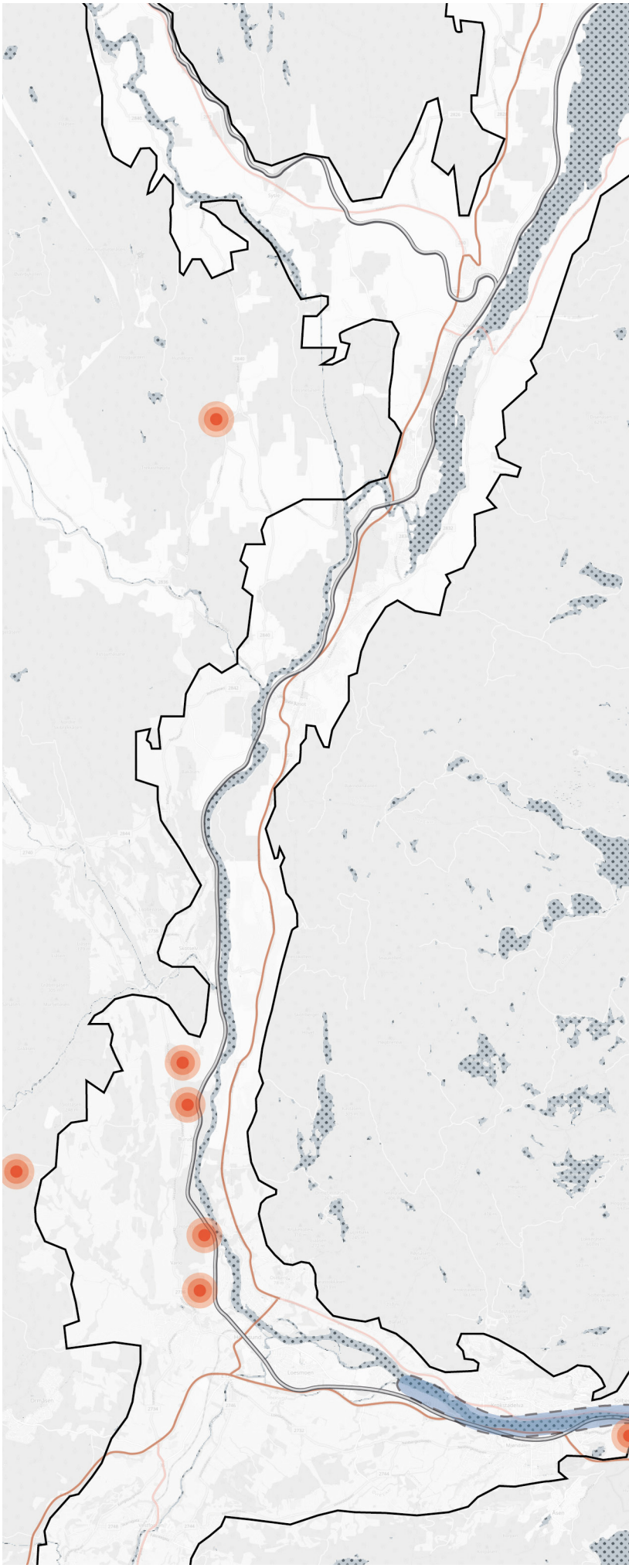
N

0 10 km

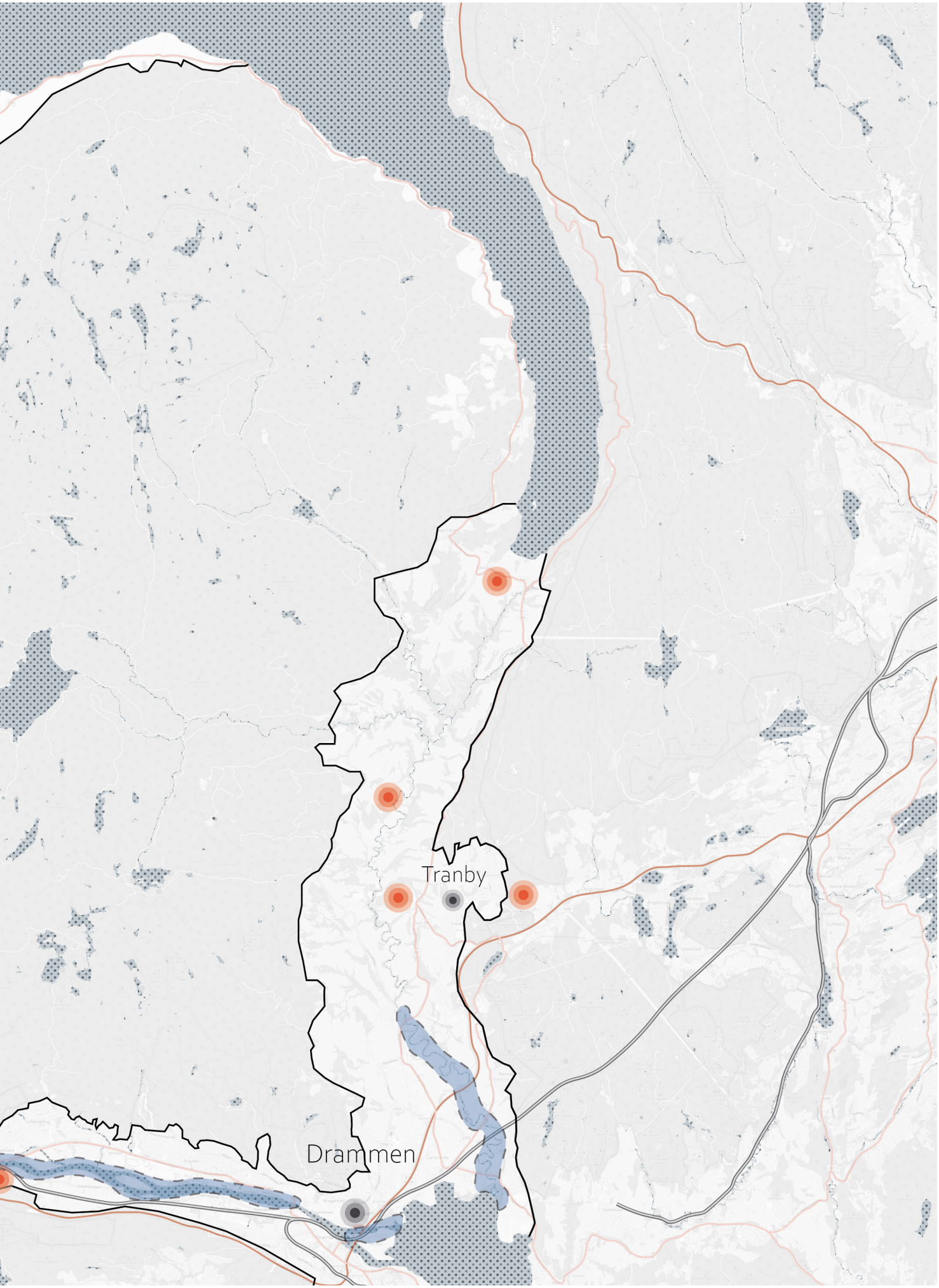


Landscape

The most important conclusion of the landscape analysis is that the urban settlements have followed the landscape. The urban settlements in the area are mostly located along the Drammenselva River, near the fjords and along the smaller Lierelva River. These parts of the area are lower elevated. In the more elevated forest landscape areas there are hardly any urban settlements. In addition, there are a number of extraction sites in the area. Many of these extraction sites have a very favourable location, either along water or along railways. Finally, a problem in the area is the risk of flooding. Along the Drammenselva river there is a 10 year flood risk and along the Lierelva river a 20 year flood risk.



Landscape synthesis


Tranby
Drammen

Urban morphology

The synthesis of the urban morphology analysis consists of several important findings. First, the infrastructure on regional and urban scale have been investigated. By doing this, several important infrastructure nodes have been discovered. On the big and the small scale it is clear that the infrastructure is following the Drammenselva river. The infrastructure nodes have been analysed on the small scale to compare this with the urban morphology and urban functions. Also, the positioning of the extraction landscapes are investigated. To conclude, the infrastructure node in Drammen the one with the biggest potential, regionally and on the urban scale.



Urban morphology synthesis

Roads
Water
Urban area
Railway
Dams

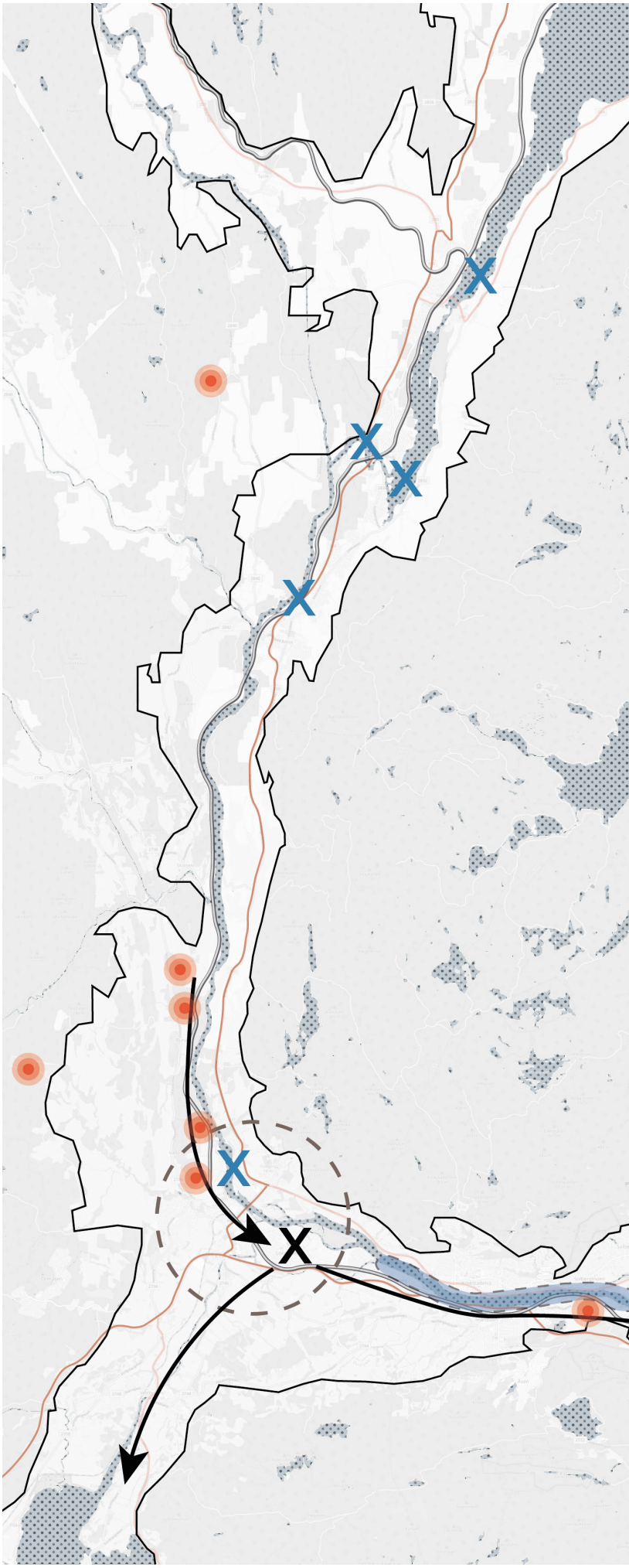
N

0 5 km

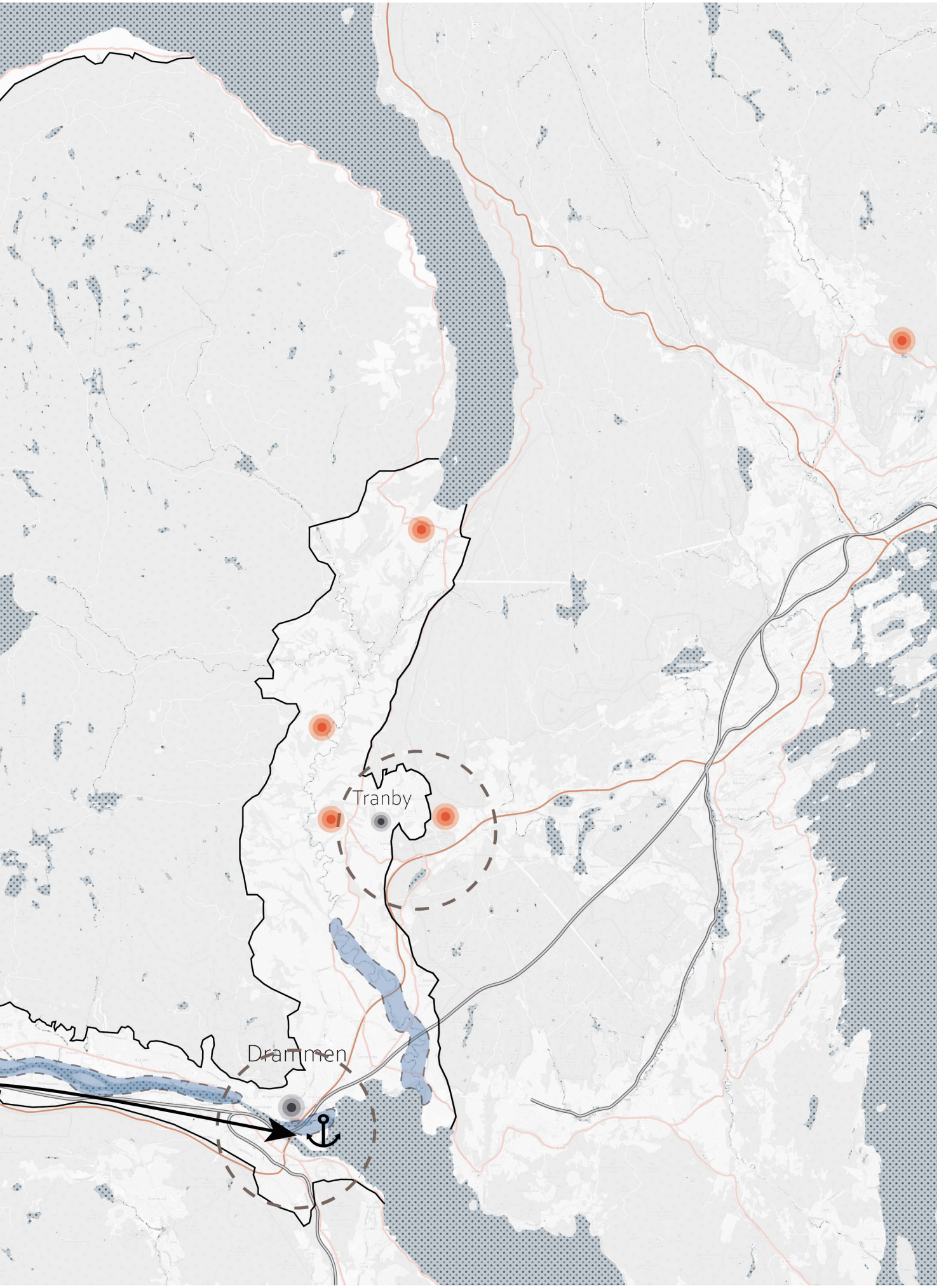

Drammen
Tranby
men

Conclusion

This conclusion map summarises the analysis of the three different domains. The urban fabric follows the landscape, being mainly located along the rivers in the lower areas. A number of dams have been built along the Drammenselva River to reduce the risk of flooding. However, there is still a flood risk along the Drammenselva and Lierelva rivers. There are a number of extraction sites in the area. The flows of goods from these extraction sites are mainly by highway, to the concrete contractors and to the rest of the region or to the port of Drammen. In addition, there are some important urban and infrastructural nodes in the area, at Tranby, Drammen and Hokksund.

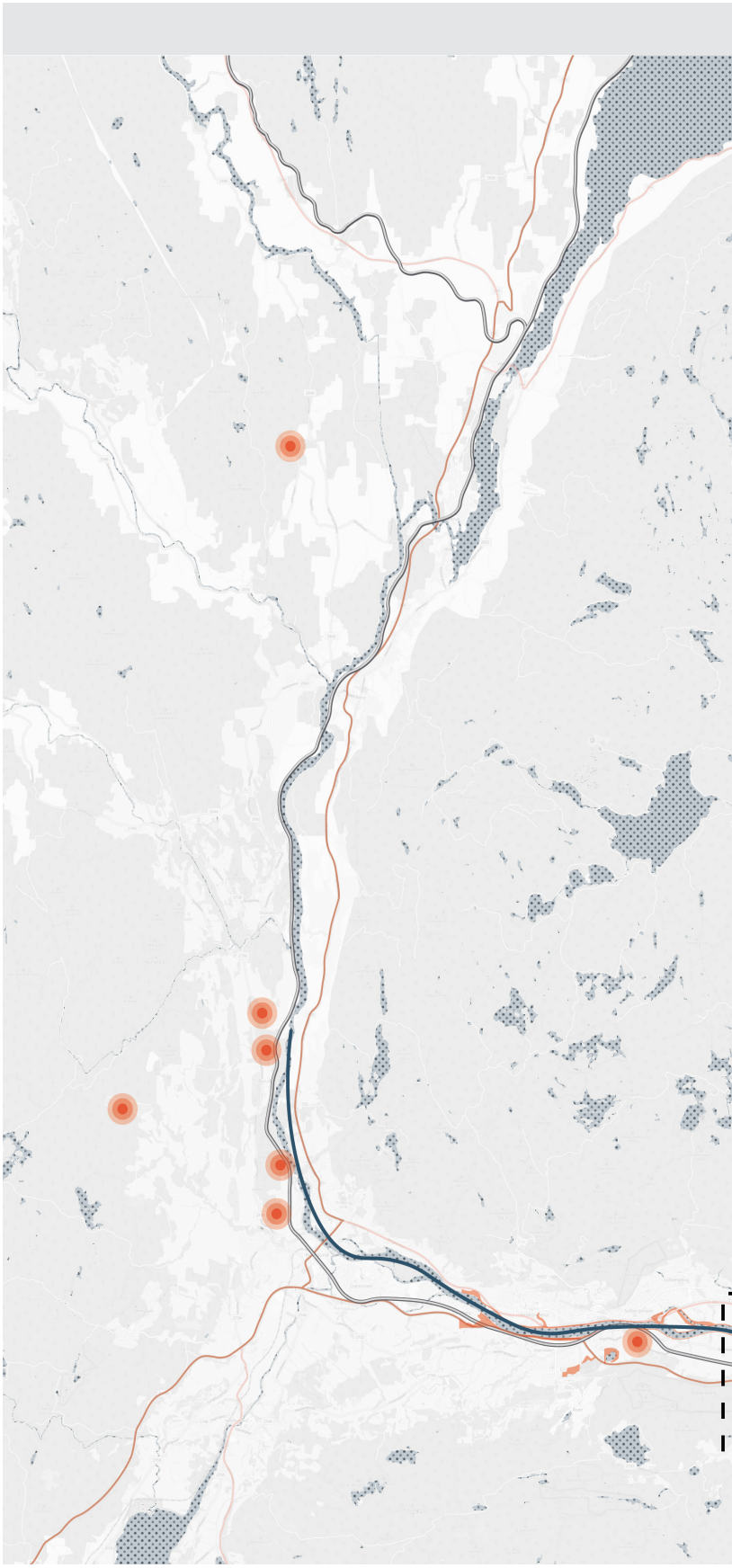


Conclusion map


Tranby
Drammen

Potentials

A number of potentials can be identified in the area. One of the greatest potentials is the prevention of flooding at the Drammenselva and Lierelva rivers. This can be done by giving the river more space. In addition, many extraction sites in the area have a high potential, situated along the river and the railway. This provides an opportunity to transport the materials from the extraction sites in a more sustainable way.

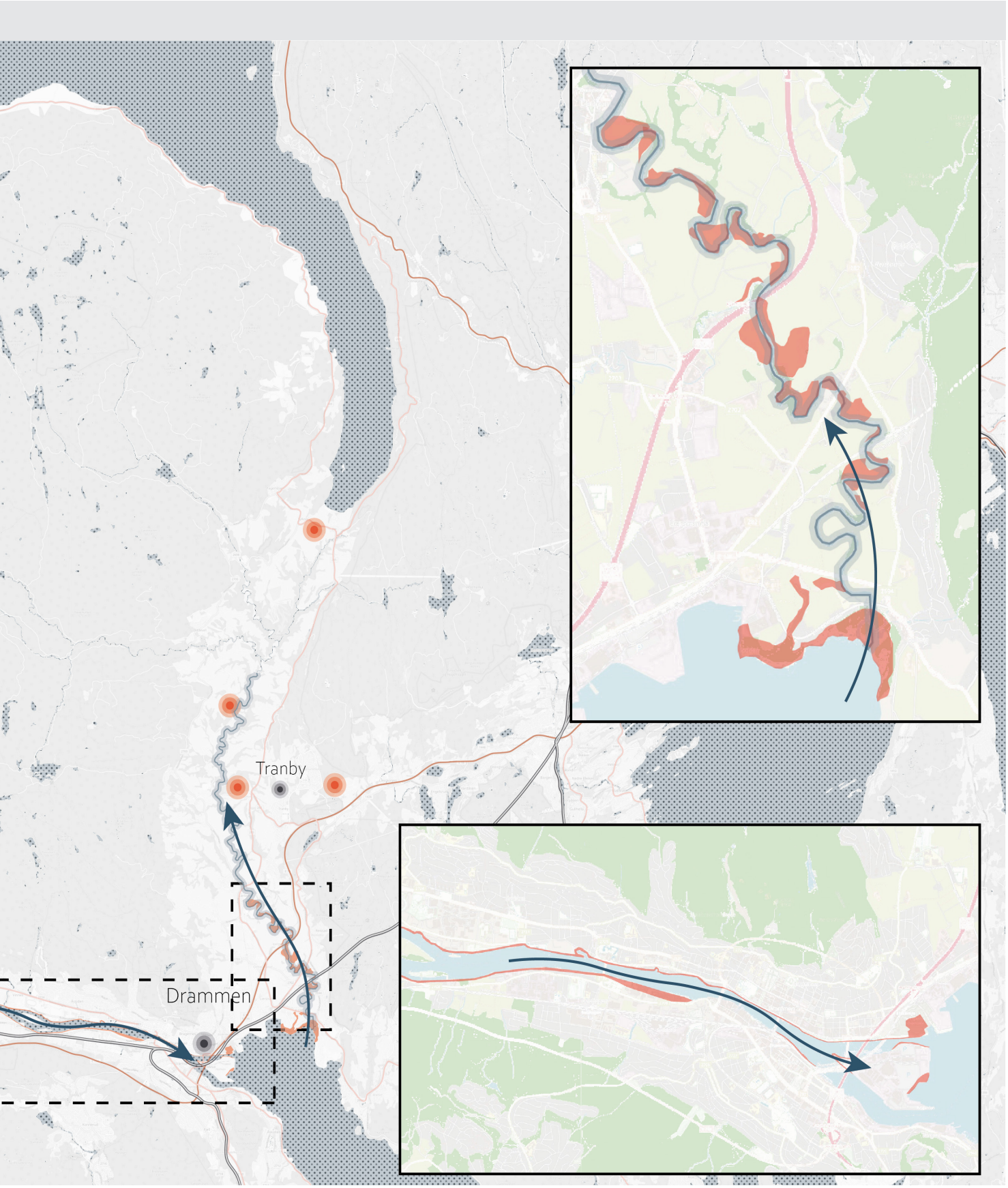


Potential map

- Water
- Floodrisk
- Roads
- Railway
- Forest
- Meadows
- Extraction sites
- Reducing flood risk
- Potential new / more use of shipping routes

N

0 2 km


Tranby
Drammen

4.

Scenario making

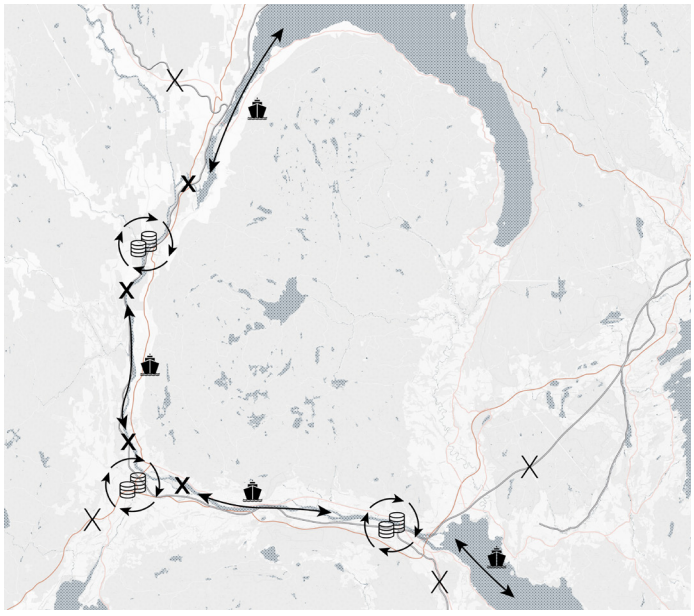
Introduction

In this chapter, different scenarios will be tested on a regional scale. These scenarios are very extreme; nature first, no humans and no tech. These extreme examples can ultimately provide input for a regional vision and individual design experiments.

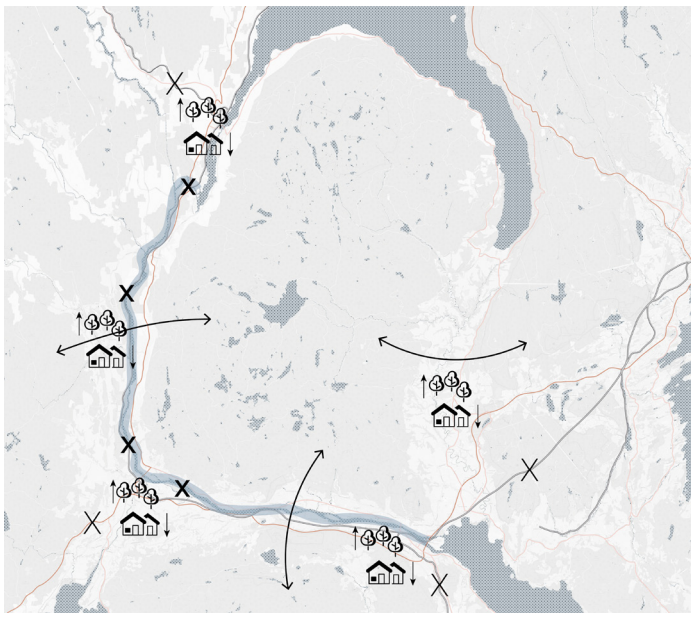
Nature first



No tech



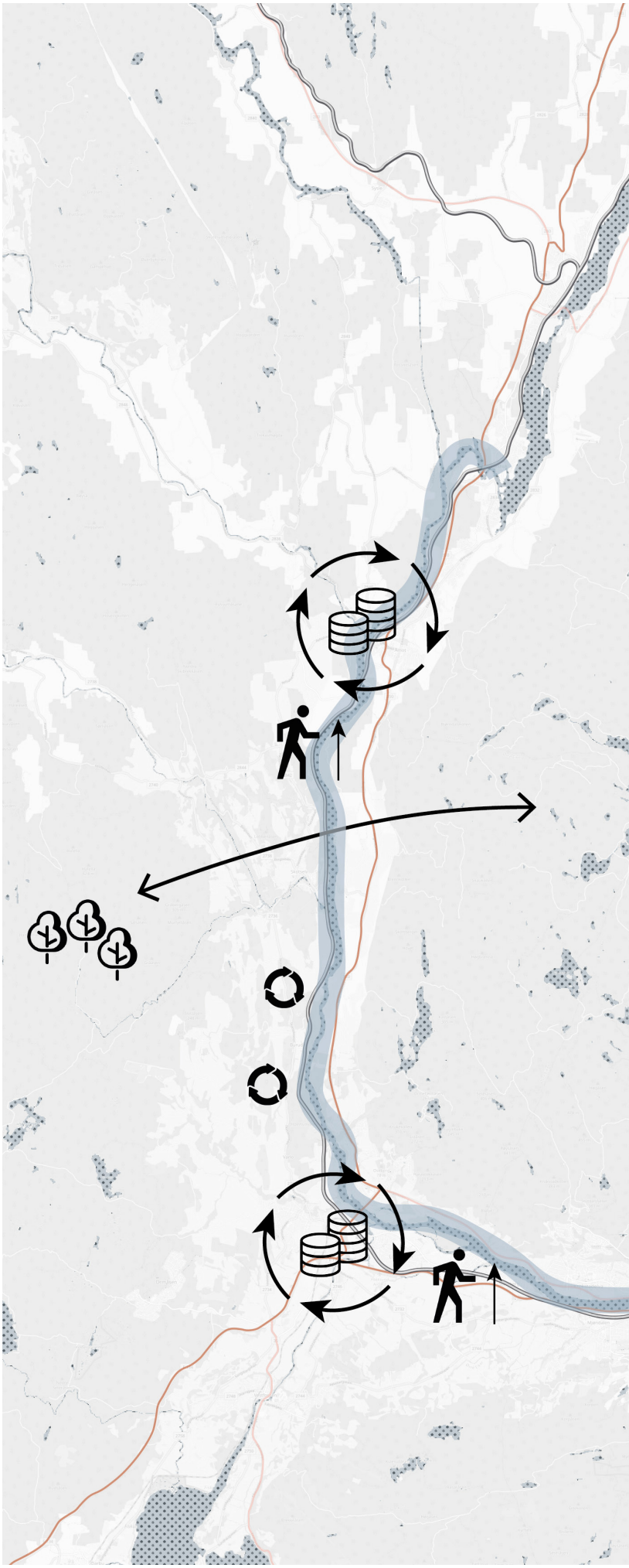
No humans

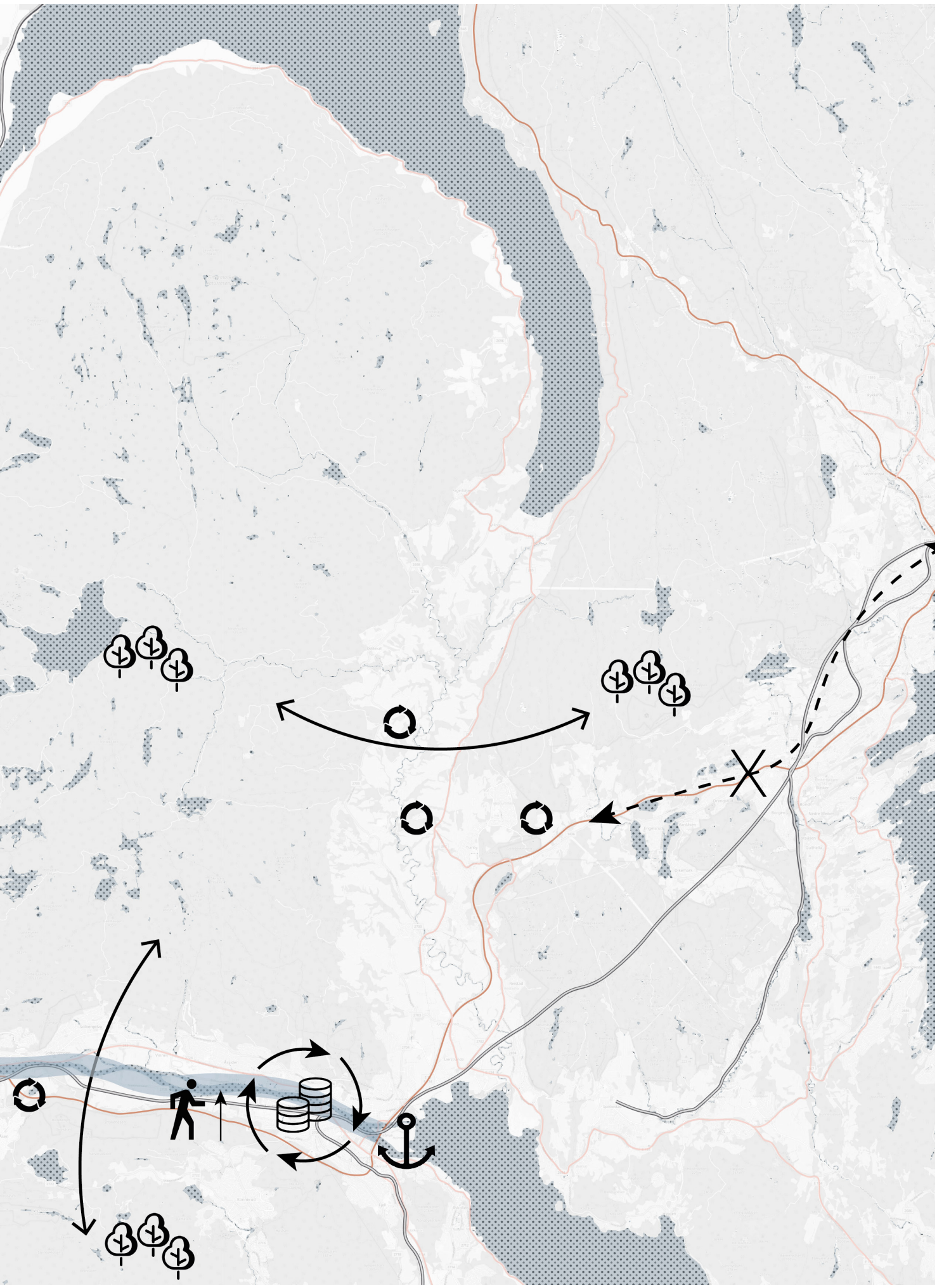


Scenario 1 . Nature First

Nature first

In this scenario, nature is considered as the most important. Therefore, less use will be made of environmentally harmful transport methods, such as highways. As a result, the economy will be more local and circular and less dependent on Oslo. Next to that, the port of Drammen wil become less important. In addition, the various extraction sites in the area will also make the transition to become more circular and local. The traffic in the urban fabric will focus more on slow traffic. In addition, there will be more green connections in the urban areas to the surrounding nature.

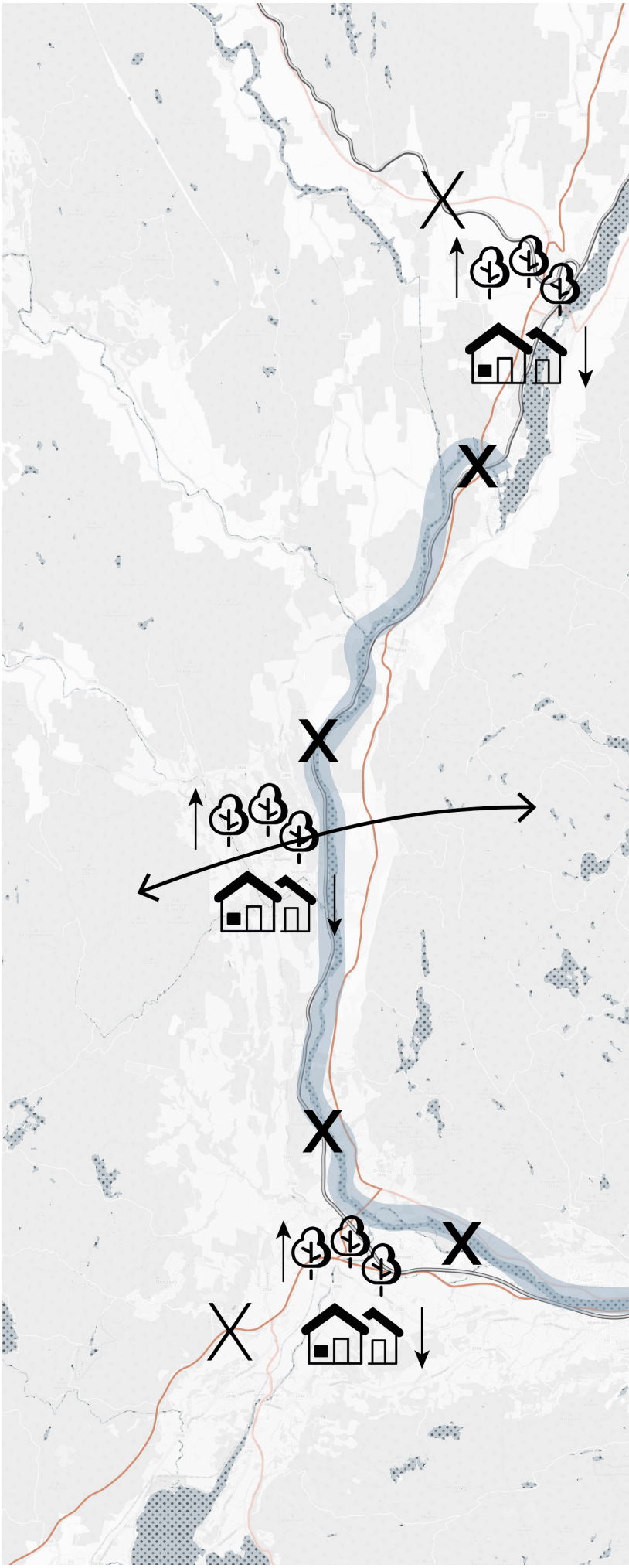




Scenario 2 . No humans

No humans

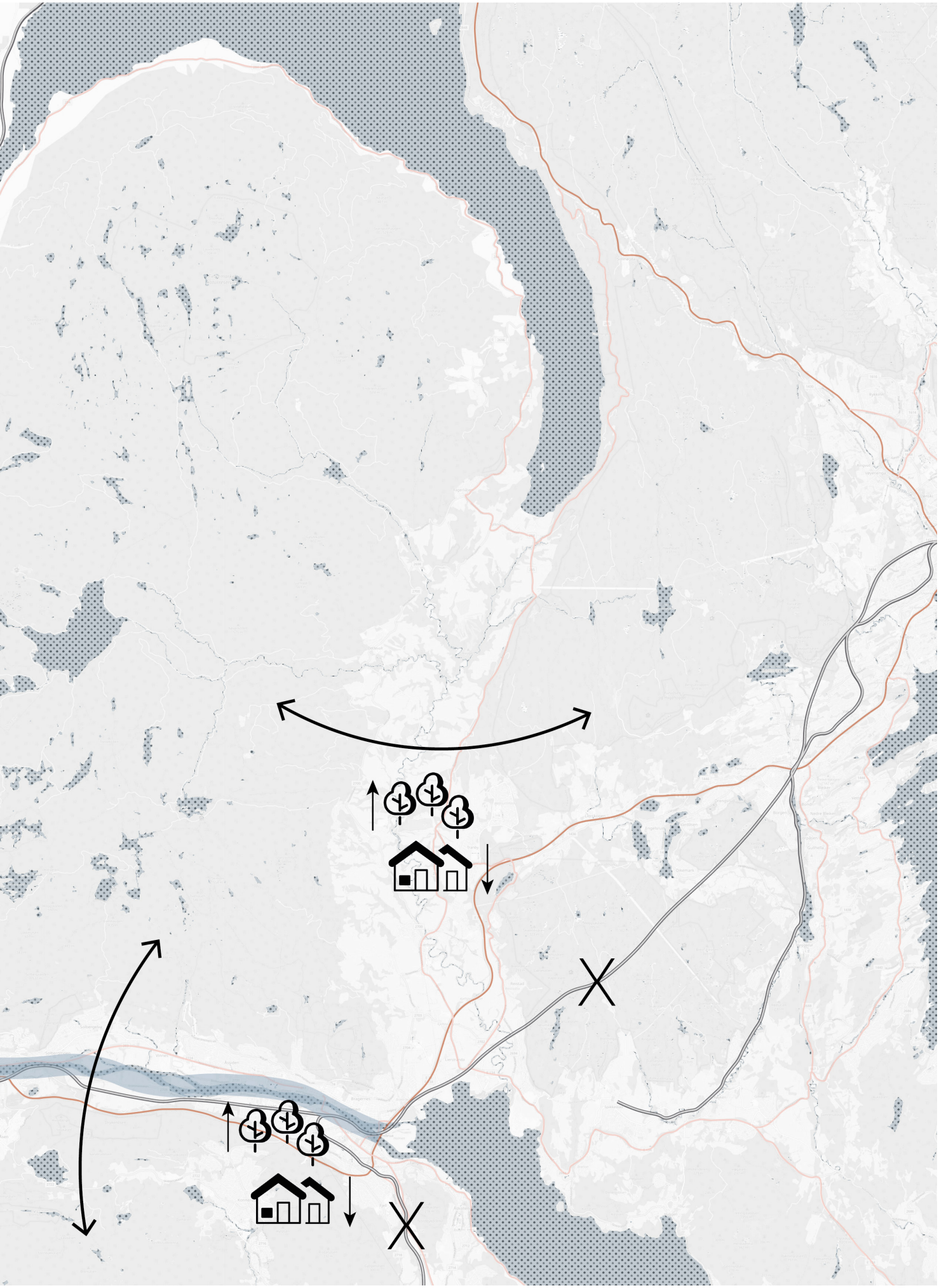
In this scenario, humans and human intervention will disappear completely. The urban areas will disappear and make room for nature. This will connect the surrounding green areas and create a large nature reserve. The infrastructure in the region will disappear. In addition, the dams constructed by human will also disappear. As a result, the river will become wider and break its banks.



N

0

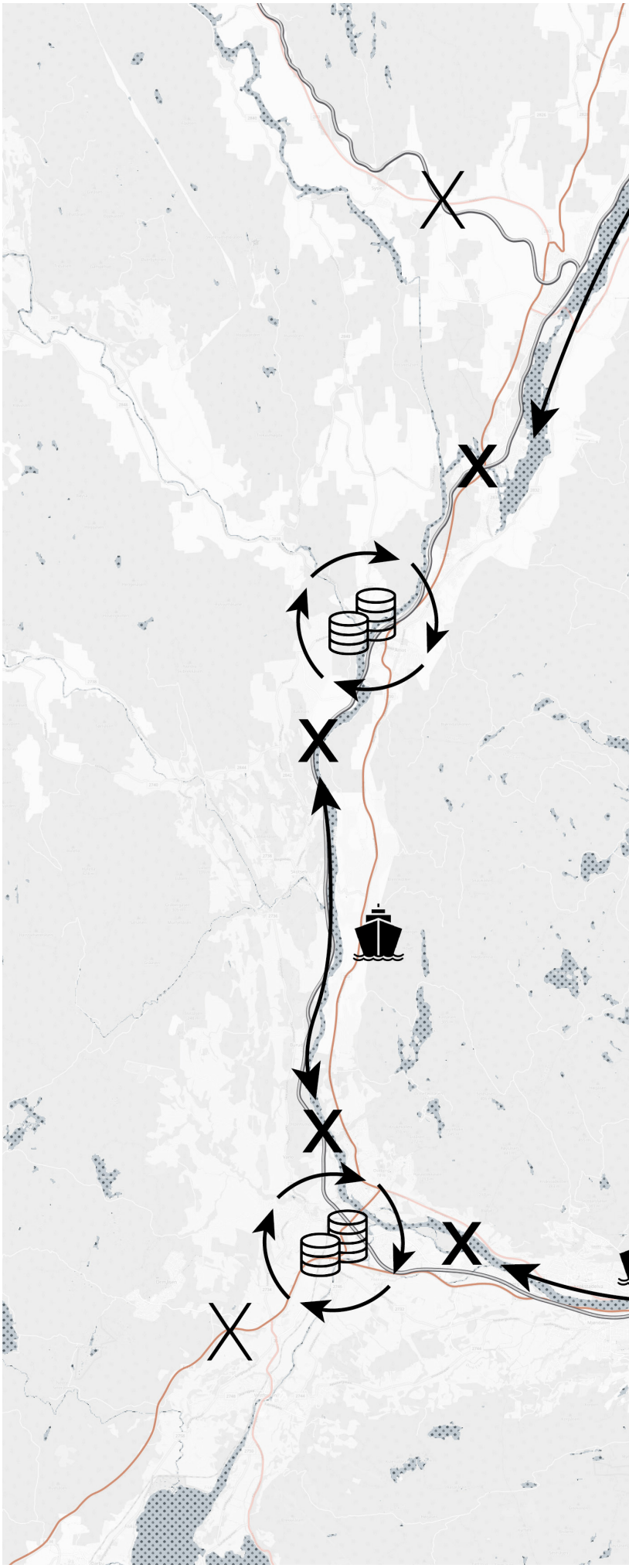
2 km

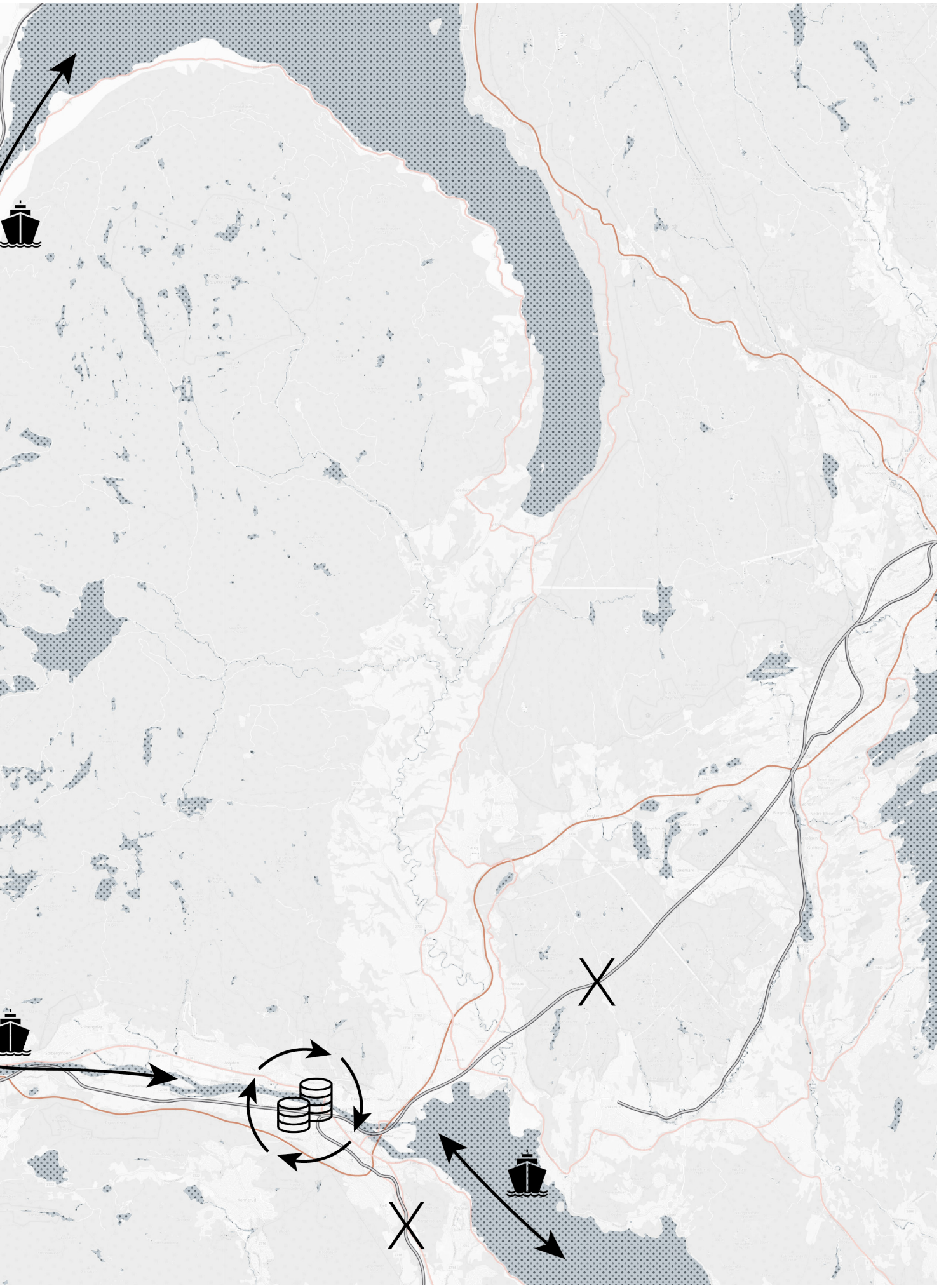


Scenario 3 . No tech

No tech

In this scenario, there will be no more talk of technology and everything related to it. There will be no more use of transportation via automobiles. Instead, more use will be made of water transport. The dams in the area will also disappear. The economy will become more local because there will be less possibilities for transport. Next to that, the extraction sites will decrease because there can no longer made use of machines.



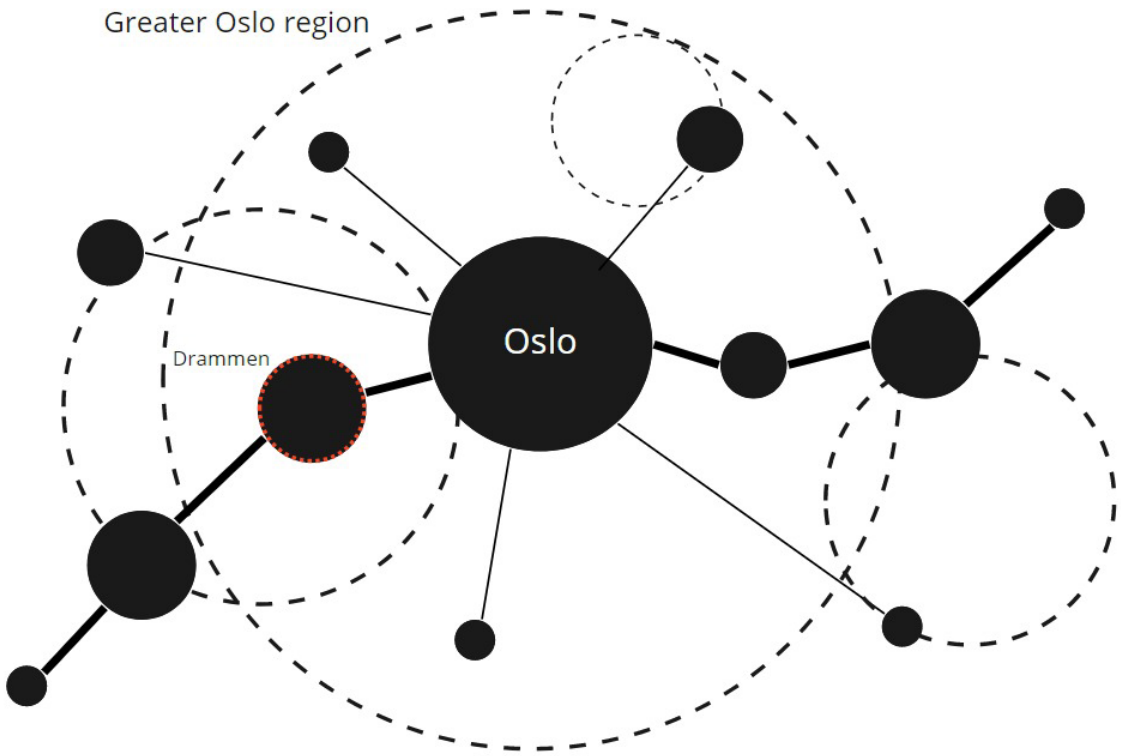


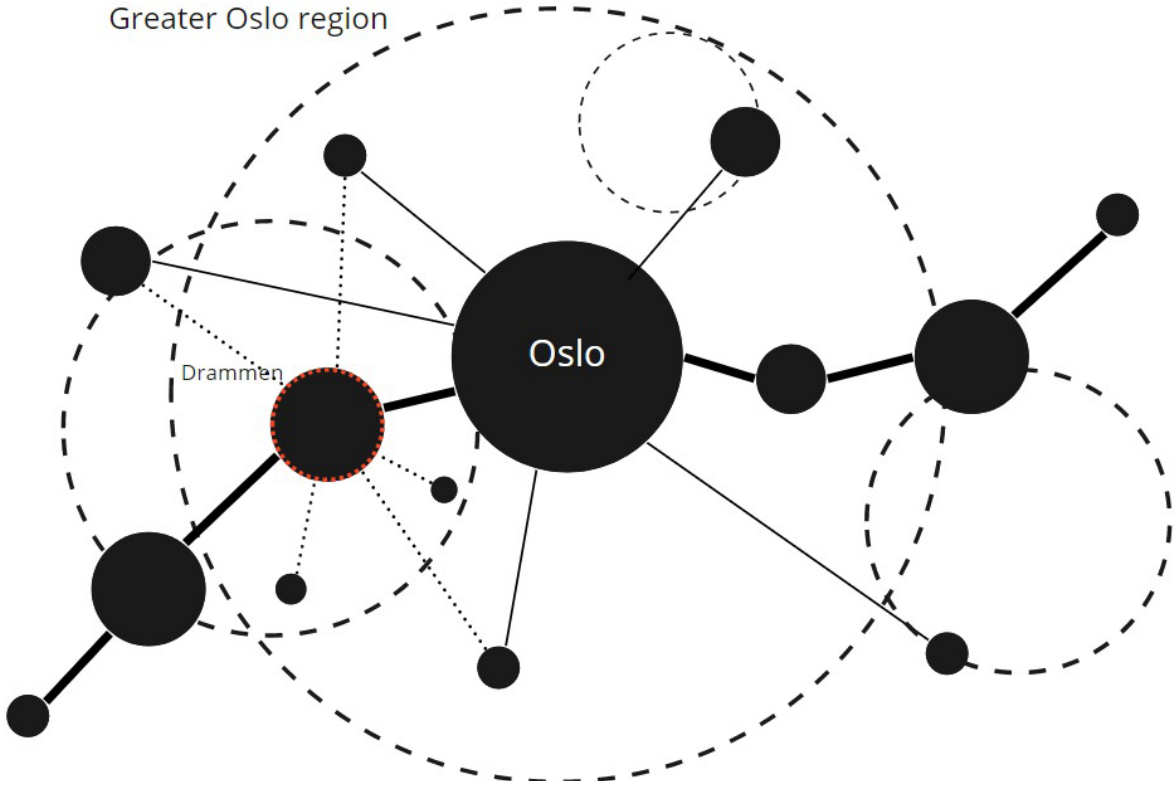
5.

System intervention

Oslo region

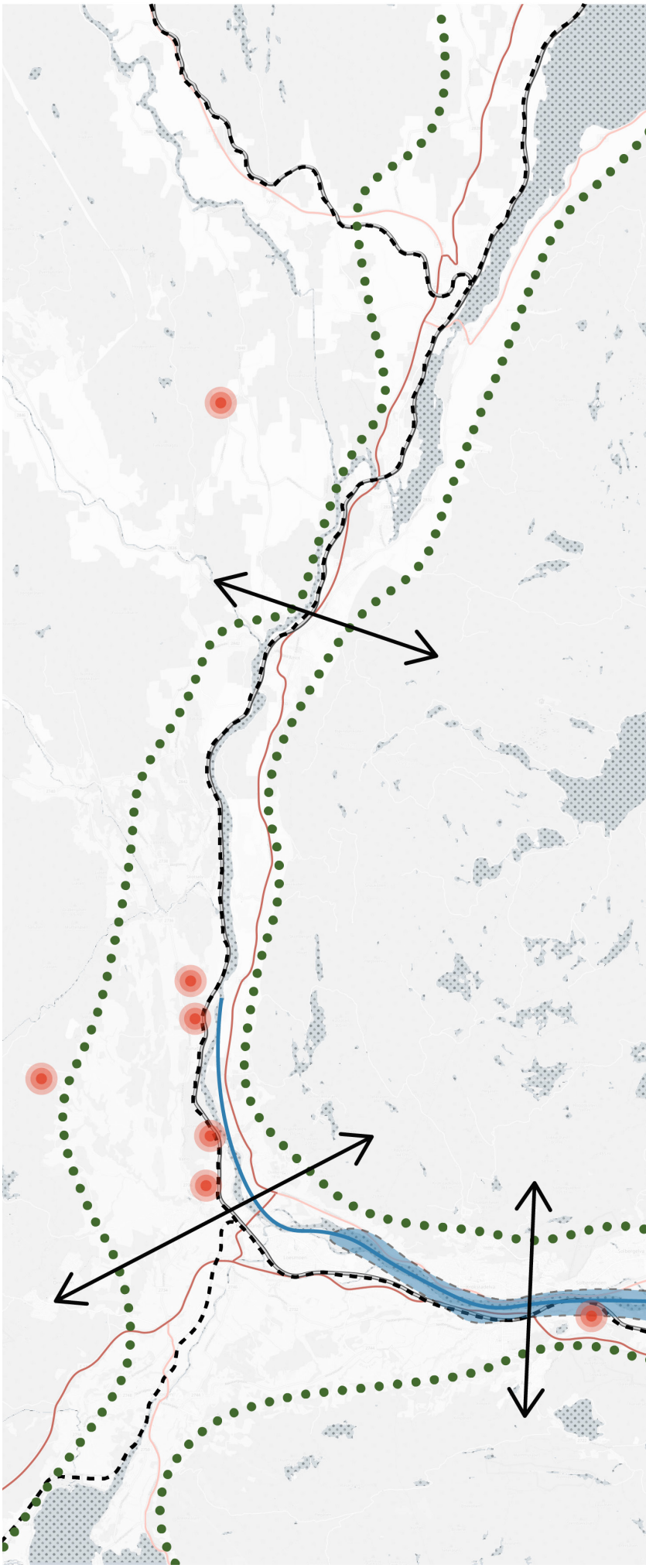
Currently, Drammen is only a link in the system. In this system, every village and smaller town is a link that leads to Oslo. In the new situation, Drammen will have a more important role in the region. Surrounding villages and smaller towns will connect to Drammen in addition to the connection to oslo. This will lead to more flows from the region to Drammen and Drammen will no longer be just a link in the system to Oslo. Drammen will therefore become more important in the region, but its relationship with Oslo will remain the same.

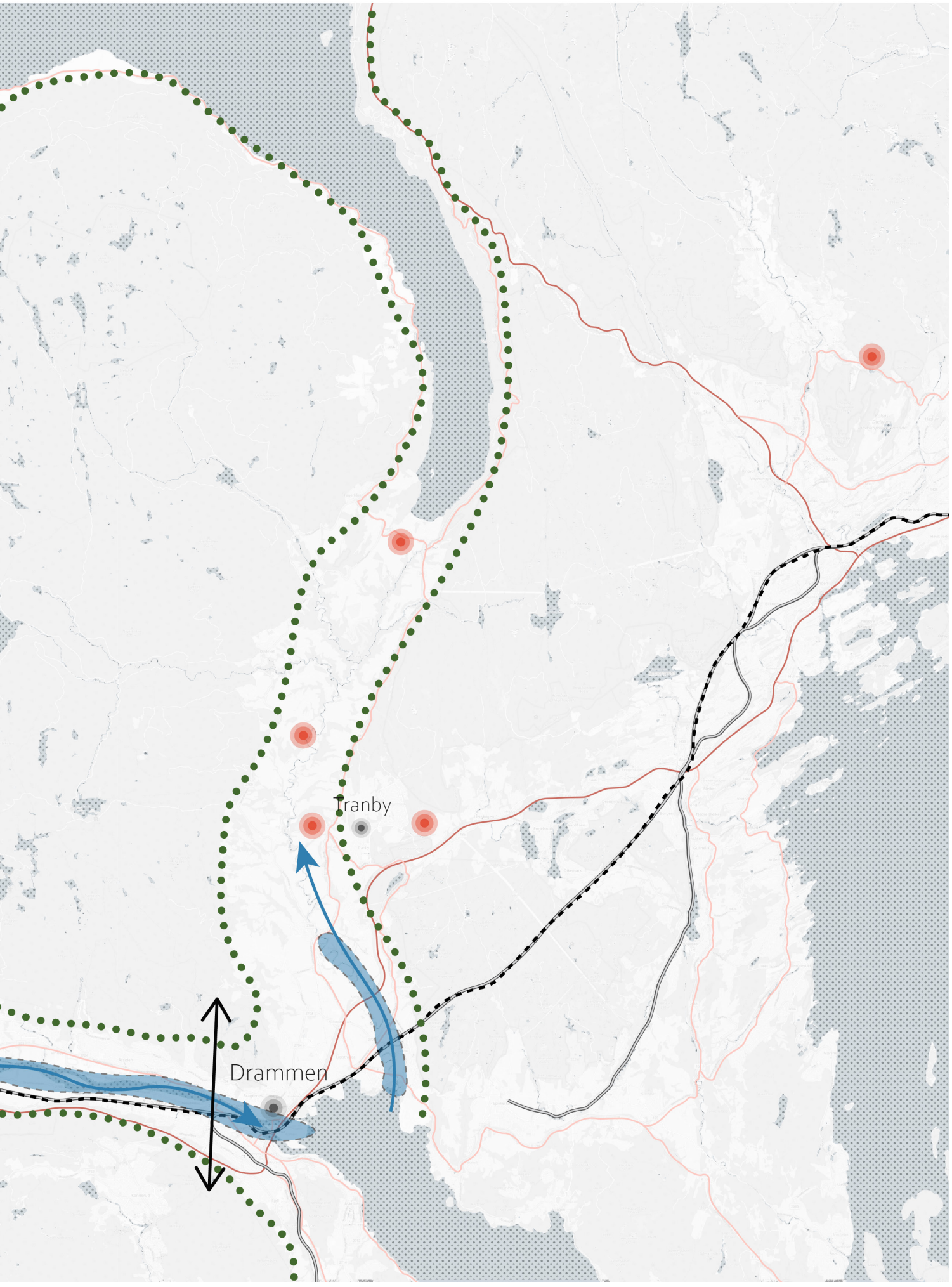

Greater Oslo region
Oslo
Drammen


Greater Oslo region
Oslo
Drammen

Vision - regional scale

On the regional scale, the surrounding green nature areas will be connected. This will be done by applying green connections in the urban areas. In addition, use will be made of the favourable locations of the extraction sites. The transport of goods from the extraction sites will be made more sustainable. This will be done by reducing transport via highways and transporting the goods more via railways and waterways. In addition, the risk of flooding along the Drammenselva and Lierelva river will be reduced.




Tranby
Drammen

Vision - Drammen

For the zoomed-in view, we focus on Drammen and the port of Drammen. At this scale, we can see the green link in the city that should connect the surrounding nature. The port of Drammen will be reprogrammed. Currently, the car industry dominates here. In the new vision, the port will focus on circularity. In addition, the quays in the city of Drammen along the Drammenselva river will be redesigned to reduce the risk of flooding. The flood risk of the Lierelva River will also be reduced.





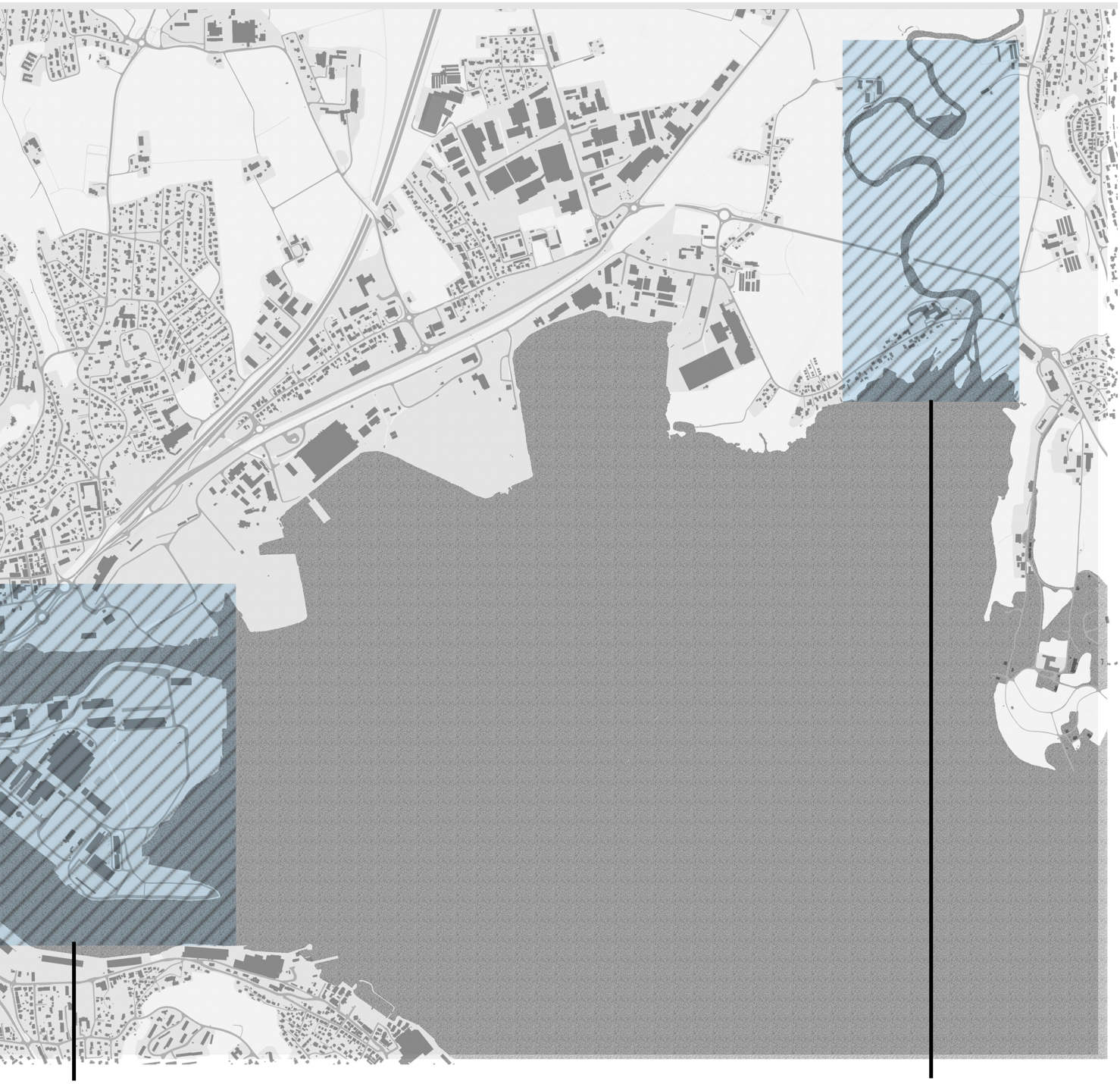
Locations

The following three areas were chosen for the individual design locations. The first design location is at the quays of the Drammenselva River in Drammen. This project will redesign the quays and reduce the flood risk at this location. The second design location is on Holmen Island, part of Drammen Harbor. This design will redesign this island and make the port more circular. The third design location is more to the east, at the mouth of the Lierelva River in the fjord. Here a design will be made to reduce the flood risk of the buildings. The accessibility of the recreational area will also be strengthened here.



Hidde:
Dealing with floods and flows

Dramm

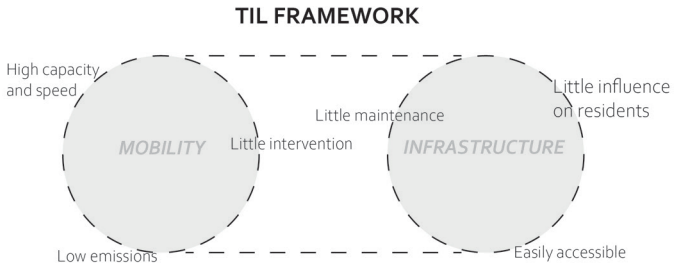


Jamie:
nen: Port in transition

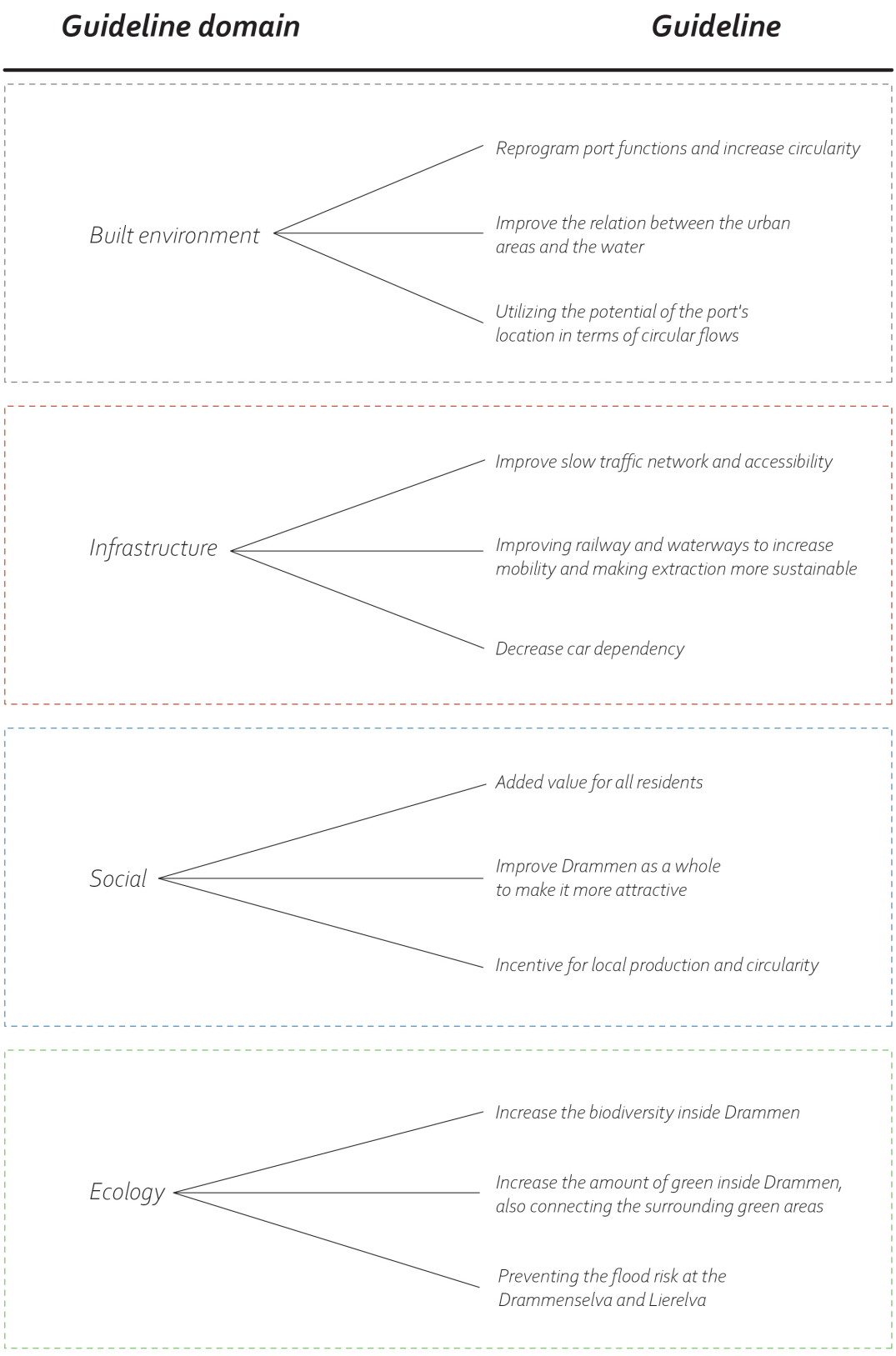
Dennis:
Accepting and adapting

Guidelines taxonomy

To add the perspective from transport, infrastructure and logistics, a framework has been created. This framework has been translated into guidelines to fit into this research, the translated framework with the guidelines can be seen in the image below. There are two main perspectives; mobility and infrastructure. Each perspective has three main guidelines which will be taken into account when creating guidelines for the project itself.



The guidelines are divided into four domains: built environment, infrastructure, social and ecology. Three guidelines have been drawn up for each domain, which are reflected in the group vision. The guidelines incorporate the guidelines drawn up by the TIL student. For the individual design experiments, the focus was on a number of guidelines per experiment and not on all of them.


Guideline domain
Guideline
Built environment
Reprogram port functions and increase circularity
Improve the relation between the urban areas and the water
Utilizing the potential of the port's location in terms of circular flows
Infrastructure
Improve slow traffic network and accessibility
Improving railway and waterways to increase mobility and making extraction more sustainable
Decrease car dependency
Social
Added value for all residents
Improve Drammen as a whole to make it more attractive
Incentive for local production and circularity
Ecology
Increase the biodiversity inside Drammen
Increase the amount of green inside Drammen, also connecting the surrounding green areas
Preventing the flood risk at the Drammenselva and Lierelva

6.

Design Experiments

Jamie Taal - Port in transition



Dennis Groen - Accepting and adapting



Hidde van Beek - Dealing with flows and floods



Jamie Taal - Port in Transition

Manifesto

The port of Drammen is an important chain within the economy of Drammen and the Viken region. The main function of the port is the import of cars. In 2017 the port of Drammen broke an import record with the import of 111.547 cars in a year. Although the port of Drammen is important for the economy of Drammen and the city as a whole, the aim of this manifesto is to discuss the potential of this harbor to be an important chain within a shift towards a more sustainable and circular region. Also, this is an attempt to positively change the appearance of the city of Drammen and to give parts of the city back to the residents.

The focus of this manifesto is on the Holmen Island, which is a central infrastructure node in the port of Drammen. The largest part of the surface of Holmen is used to store cars, which are transported from Drammen to the rest of Norway. As told before, Holmen is an important infrastructure node in the Viken region. Holmen is located in the Drammenselva river, connected with several (relatively new) railways, and connected with the regional road network. The aim for the vision of the Drammen region is to improve the railway and waterway network in combination with increasing circular flows. The infrastructure node which Holmen is, would be the most important chain in this new way of transporting, extracting, and increasing sustainability. To achieve this shift towards increasing circularity, there is a strong need to reprogram the port of Drammen to hit its full potential.

The shift towards a new regional circularity hub that Holmen could be, needs to go through some crucial phases which are discussed in detail in the project. Phase 1) is about starting this project in a strategic way, on a strategic place. Free spaces on Holmen are potential locations to kick-start new circular and sustainable projects, by giving new entrepreneurs the chance to develop their ideas that could contribute to this shift. Phase 2) is about integrating these new projects within the fabric of Holmen and connecting these new projects with ongoing sustainable and circular projects and companies. Phase 3) is about upscaling and phase 4) is the last but not the final phase of this shift towards circularity, where scaled up developments still go on in a shifting regional economy.

Finally, next to this shift towards a program based on circularity and sustainability, the implementation of green solutions and making connections with the city of Drammen will be important. Freed up spaces on Holmen offers opportunities to prevent parts of Drammen for occurring flood risks. Using green solutions like tidal parks and recreational areas to give room to the river, also offers a chance to give something of the port back to the residents.

Guidelines

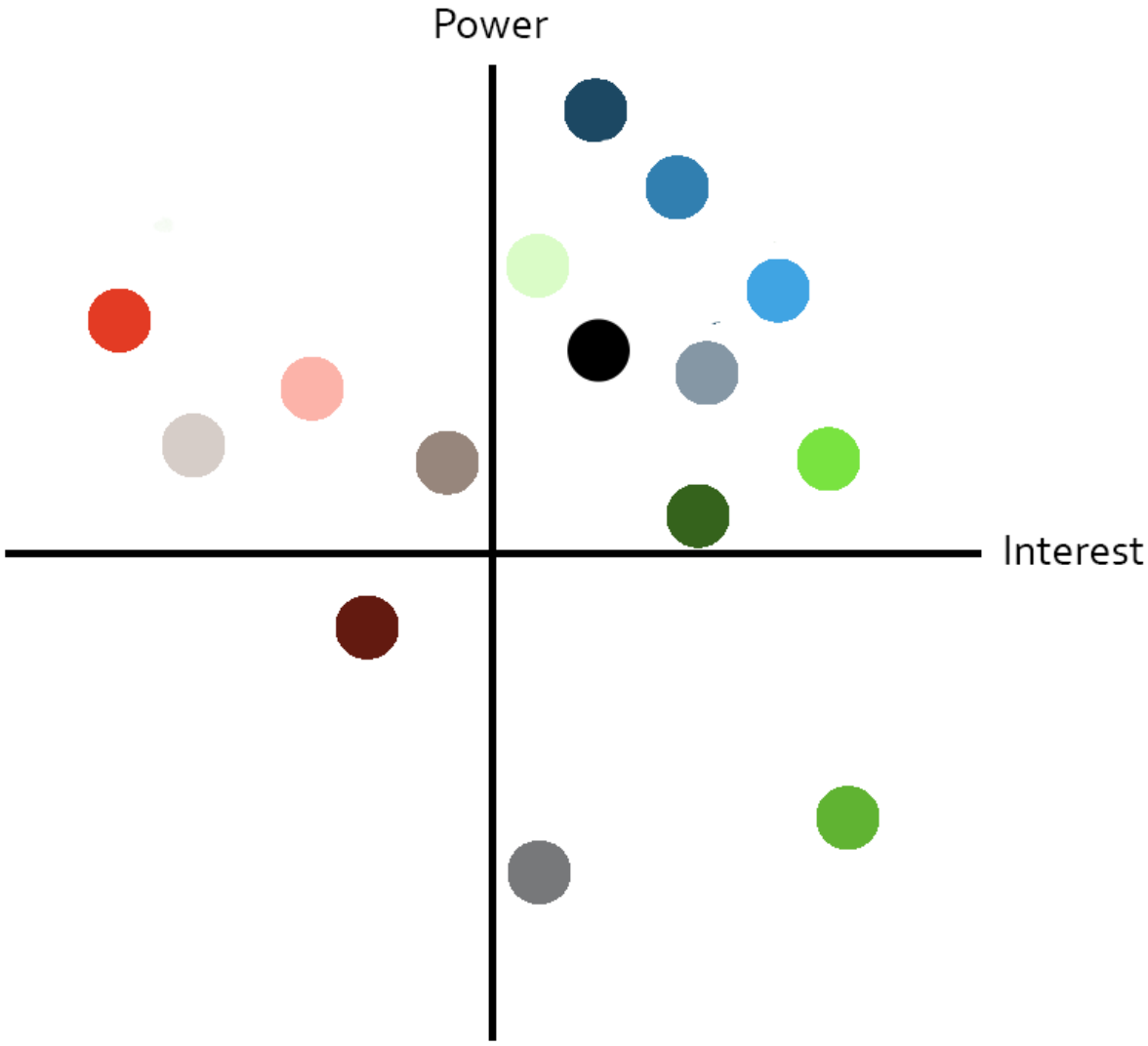
On the right the guideline diagram for the group vision is shown. These guidelines are divided into four domains: built environment, infrastructure, social and ecology. The guidelines that recur in this design experiment are highlighted. Each of the domains contains at least one guideline which returns in the design experiment, in order to have a versatile design.

Guideline domain	Guideline
Built environment	Reprogram port functions and increase circularity
	Improve the relation between the urban areas and the water
	Utilizing the potential of the port's location in terms of circular flows
Infrastructure	Improve slow traffic network and accessibility
	Improving railway and waterways to increase mobility and making extraction more sustainable
	Decrease car dependency
Social	Added value for all residents
	Improve Drammen as a whole to make it more attractive
	Incentive for local production and circularity
Ecology	Increase the biodiversity inside Drammen
	Increase the amount of green inside Drammen, also connecting the surrounding green areas
	Preventing the flood risk at the Drammenselva and Lierelva

Stakeholders

Important is, in this vision, that an inventarisation is made of the actors and stakeholders in Drammen and its region. In the stakeholder analysis on this page different important stakeholders are analysed and displayed in a power/interest diagram. There can be made a clear division between negative oriented stakeholders and positive oriented stakeholders, regarding reprogramming the harbour. The stakeholders with low interest may be the car industry , manufacturers, transport companies and shipping companies. The project of shifting towards a more circular and local approach, will have a direct impact on the way these companies work nowadays. Also, some stakeholders will have more power than other stakeholders. For example the car import, which is one of the main functions of the port. Stakeholders with high interest may be the Drammen municipality, residents and sustainable logistic and transport servic

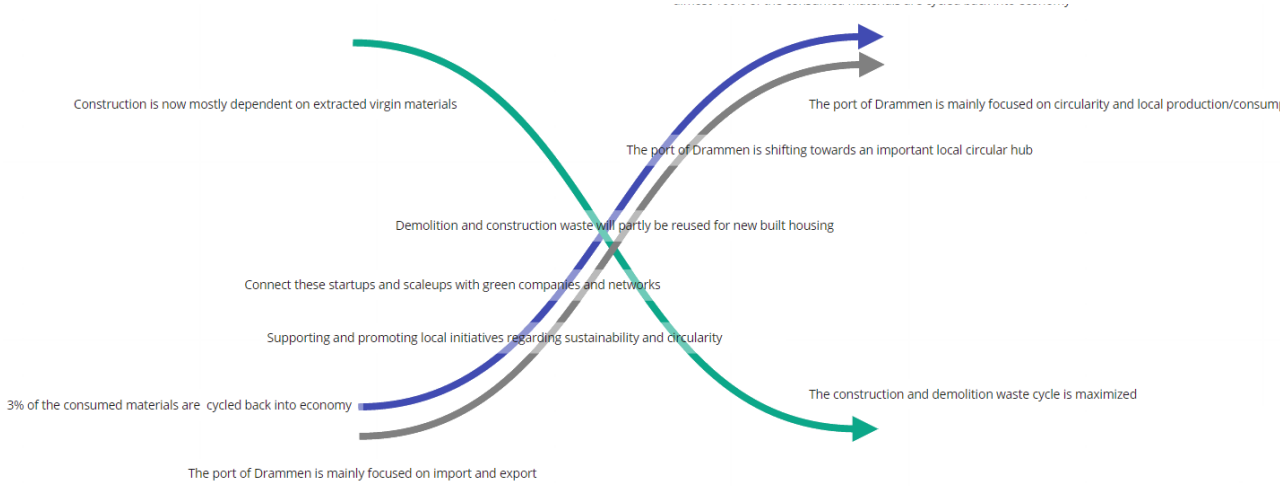


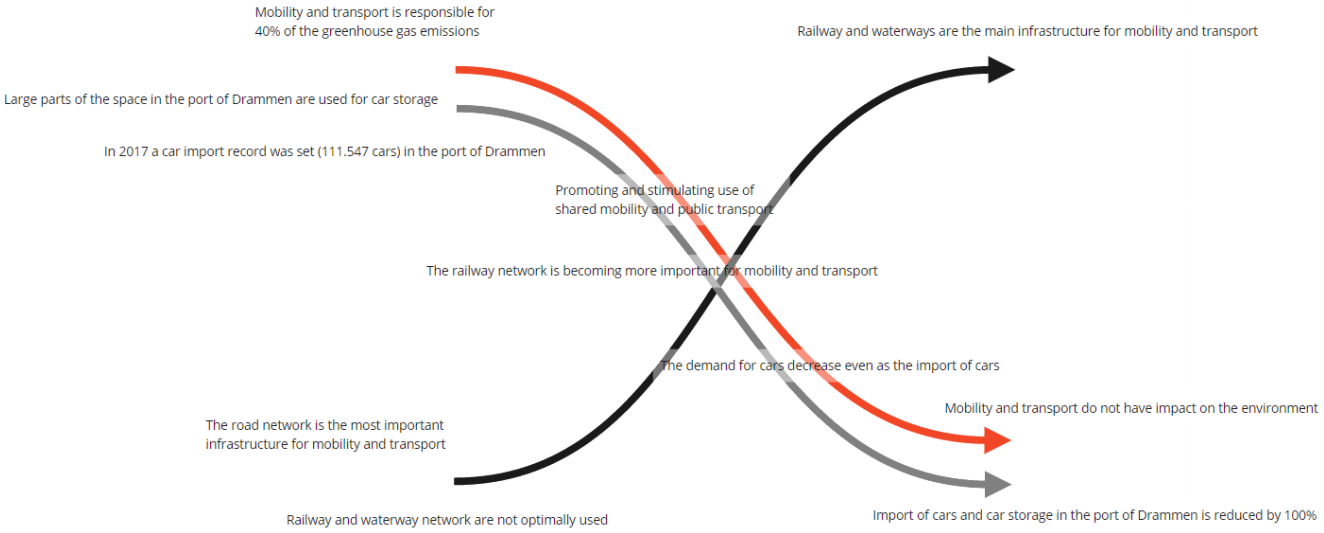

Power
Interest

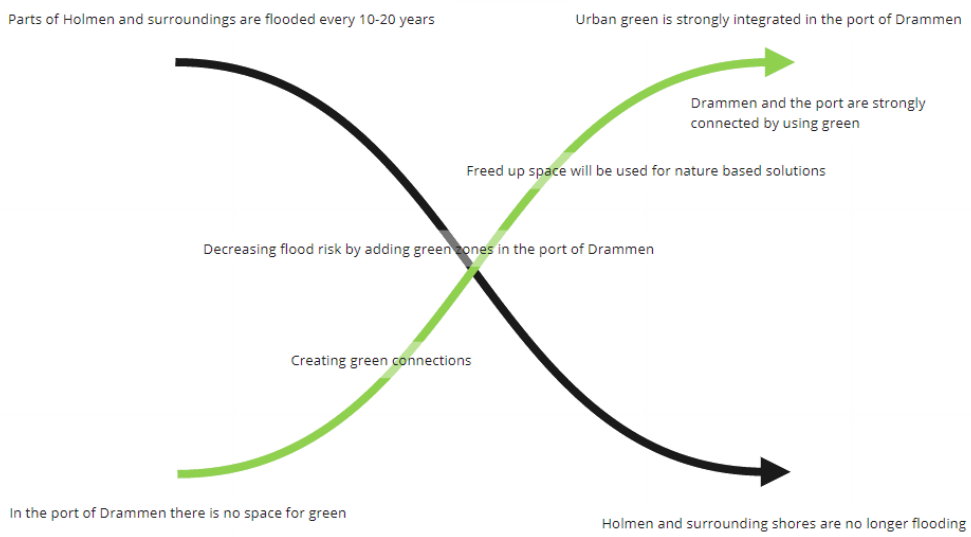
Shifting

The vision for the port of Drammen is based on guidelines and goals. These goals and guidelines can be achieved by shifting towards these in phases. In the X-diagrams on the next page, three different themes (Extraction, mobility and environment) and their expected changes are illustrated, based on the aforementioned goals and guidelines.

These X-diagrams are used to set up a global phasing for the port of Drammen, especially Holmen. On the next pages this phasing and corresponding strategy maps are shown, arranged in crucial phases.


Construction is now mostly dependent on extracted virgin materials
The port of Drammen is mainly focused on circularity and local production/consum
The port of Drammen is shifting towards an important local circular hub
Demolition and construction waste will partly be reused for new built housing
Connect these startups and scaleups with green companies and networks
Supporting and promoting local initiatives regarding sustainability and circularity
3% of the consumed materials are cycled back into economy
The construction and demolition waste cycle is maximized
The port of Drammen is mainly focused on import and export


Mobility and transport is responsible for
40% of the greenhouse gas emissions
Railway and waterways are the main infrastructure for mobility and transport
Large parts of the space in the port of Drammen are used for car storage
In 2017 a car import record was set (111.547 cars) in the port of Drammen
Promoting and stimulating use of
shared mobility and public transport
The railway network is becoming more important for mobility and transport
The demand for cars decrease even as the import of cars
Mobility and transport do not have impact on the environment
The road network is the most important
infrastructure for mobility and transport
Railway and waterway network are not optimally used
Import of cars and car storage in the port of Drammen is reduced by 100%


Parts of Holmen and surroundings are flooded every 10-20 years
Urban green is strongly integrated in the port of Drammen
Drammen and the port are strongly
connected by using green
Freed up space will be used for nature based solutions
Decreasing flood risk by adding green zones in the port of Drammen
Creating green connections
In the port of Drammen there is no space for green
Holmen and surrounding shores are no longer flooding

Phase 1

Foundation & motivation

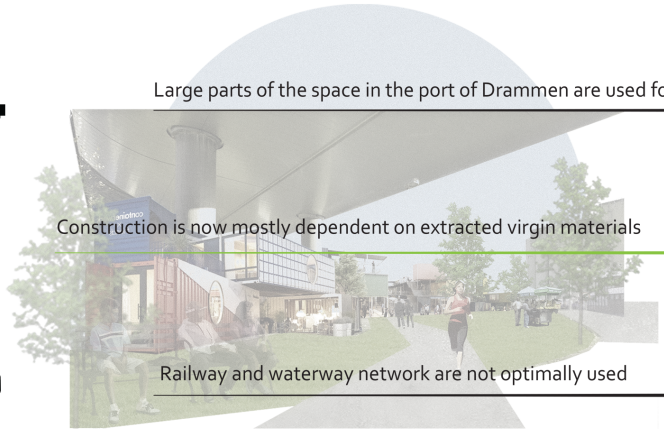
Phase 2

Upscaling

Mobility and transport is responsible for 40% of the greenhouse gas emissions

Promoting and stimulating use of shared mobility and public transport

Large parts of the space in the port of Drammen are used for car storage



Construction is now mostly dependent on extracted virgin materials

Demolition and construction

Railway and waterway network are not optimally used

The railway network is becoming m



Supporting and promoting local initiatives regarding sustainability and circularity

Connect these startups and scaleups with green compan

The port of Drammen is mainly focused on import and export

Decreasing flood risk by adding green zon

Parts of Holmen and surroundings are flooded every 10-20 years

Phase 3

Shifting

The demand for cars decrease even as the import of cars

Import of cars and car storage in the port of Drammen is reduced by 100%

waste will partly be reused for new built housing



ore important for mobility and transport

ies and networks

The port of Drammen is shifting towards an important local circular hub

es in the port of Drammen

Freed up space will be used for nature based solutions

Phase 4

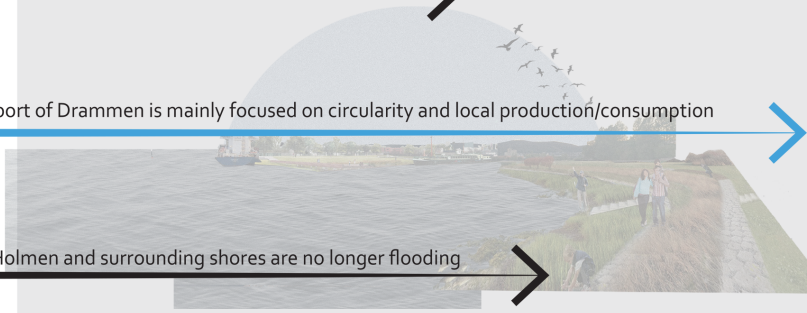
Finalizing

Mobility and transport do not have impact on the environment

The construction and demolition waste cycle is maximized

Railway and waterways are the main infrastructure for mobility and transport

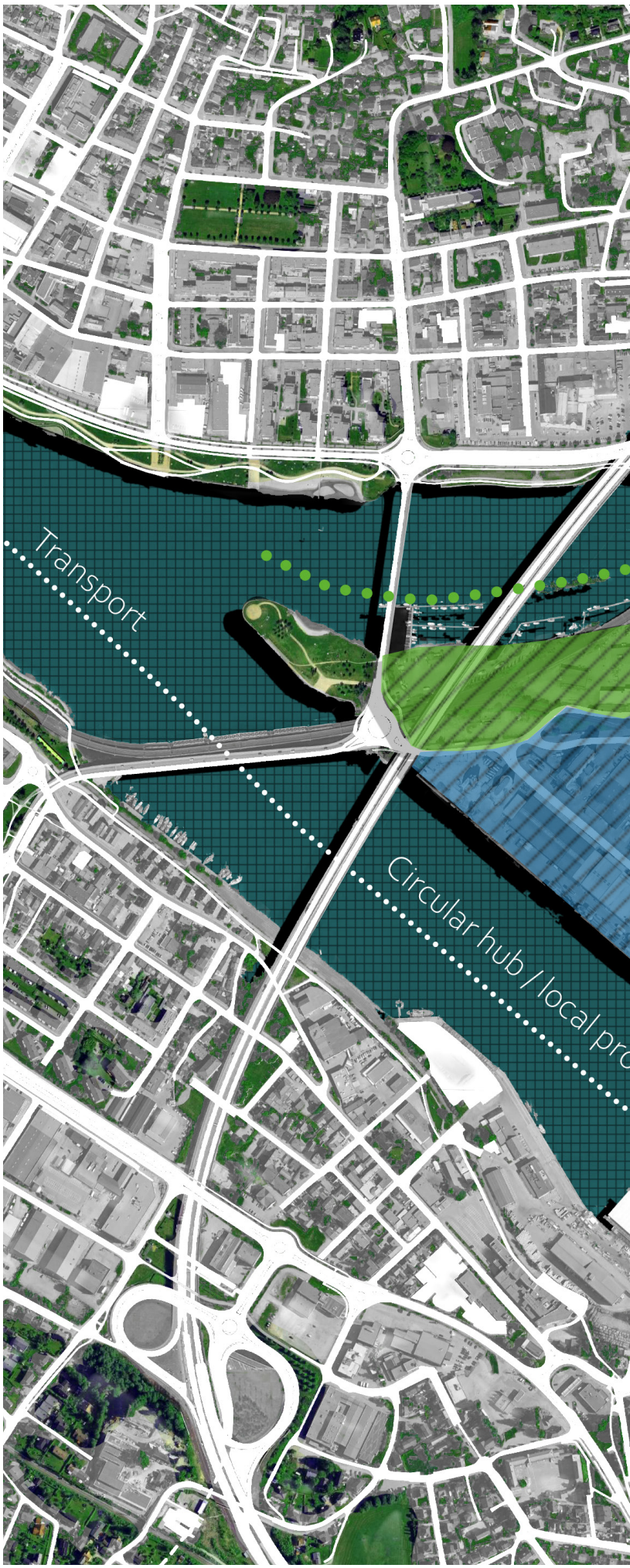
The port of Drammen is mainly focused on circularity and local production/consumption



Holmen and surrounding shores are no longer flooding

Vision

The vision for Holmen is really about rethinking the program of especially this part of the port. In this map, a statement is made to show in which direction the vision is shifting. In our vision the port of Drammen is shifting towards an important infrastructure node where ideas of circularity and sustainability are forming the main program. On the other side, freed up space will be given back to the residents of Drammen by using these space to implement green solution for floodrisk and creating recreational areas which are connected with Drammen. On the next pages the strategy for shifting towards . this circular, sustainable and green hub is shown.




Green corridor / More space for Drammenselva
duction
Transport

Phase 1

In phase one there is a need to kick-start this shift towards cirularity and sustainability. For achieving this, an investigation is made on where on Holmen there is space to start inititiatives regarding circularity and local production. Chosen is an area on the north side of the island. This area is next to the main infrastructure node. Most of the surface of this area is used for parking. Also, several material suppliers are located there, which could be important for collaboration between new initiatives and start-ups and existing material suppliers in the next phases.



N

0 200 m


frastructure node
Starting point

Phase 2

Phase 2 is about connecting new ideas and startups with ongoing sustainable and circular projects in Drammen. Knowledge centers such as the university of south-eastern Norway, which is located in Drammen, could help with doing research. Sustainable transport companies could be helpful in developing new strategies for sustainable and circular transport, and another transformed port-areas in the city can connect with each other to develop an integrated network within the port.

On the other side, new first developments on the islan can be accompanied by implementing green spaces and solutions.




Implementing green
Connect with ongoing
sustainable projects

Phase 3

Phase 3 is about upscaling. The foundation for the shift towards circularity, sustainability and focus on local production is laid in phase 1 and 2. The demand for cars is decreasing, even as the import of cars. This will phase out the main function of the island, which will result in the release of spaces and buildings. New ideas that are developed in phase 1 and 2 can now integrate within the fabric of the Island. Also, freed up spaces can be used for upscaling and implementing green elements and connections with the city.




Upscaling green /
prevend floodrisk
Connect
Decrease import
Integration

Phase 4 >

Phase 4 is about further up scaling and finalizing the shift towards a local, circular and sustainable hub. The ideas that were developed in phase 1-3 are now in the process of full integration into the fabric of Holmen.

On the next pages, a desing proposal is presented. This design is based on the elaborated starting area, shown in the strategy maps. The design is presented by a plan and a section on how this starting area could be developed in the first phase. There will be room for small improvised and temporary building units, using old freight containers, to give space to start-ups and new developers of ideas regarding circularity and sustainability. Also, this new developments may be accompanied by implementing green on the small scale, which could be further developed in later phases. In addition, a plan and a section are made for phase 3-4. These drawings show globally how the ideas from the first map and section can be upscaled in later phases.

Finally, the impressions show how the different developments in different phases could be implemented on Holmen. Starting with phase 1 and ending with phase 4.



0 200 m N


Green corridor
Upscaling
Circular Axis

Plan map - Phase 1-2

Plan map of the design proposal/experiment on the area where a kick-start could be made for reprogramming Holmen.

N

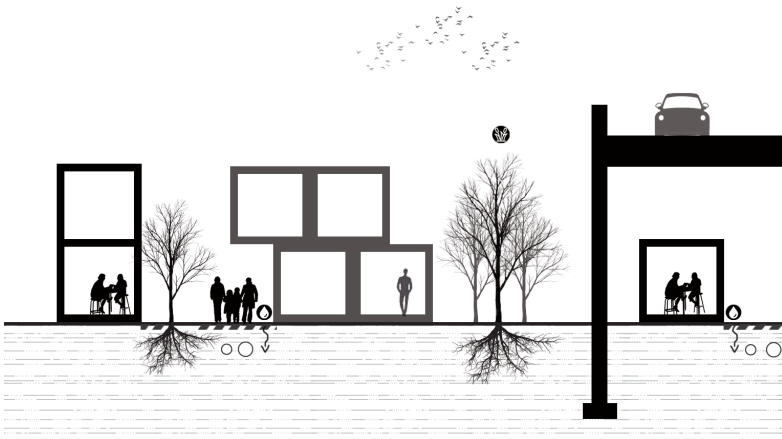
0 200 m



Section AA' - Phase 1-2

Section of the design proposal/experiment on the area where a kick-start could be made for reprogramming Holmen.

0 10 m

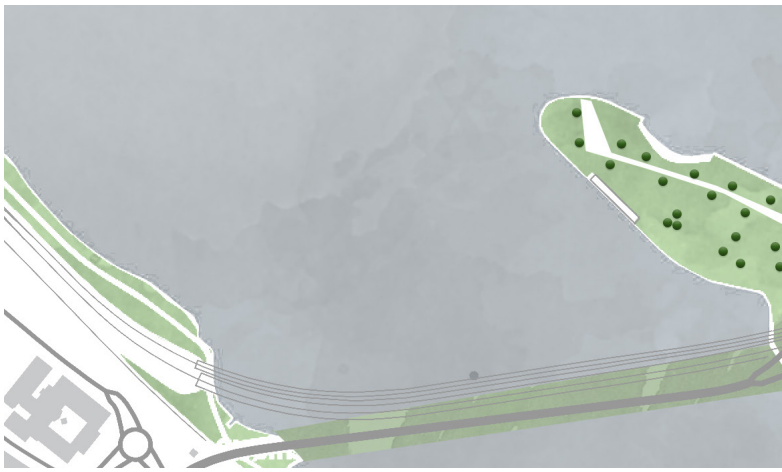


Plan map - Phase 3-4

Plan map of the possible further development of the design proposal/experiment .

N

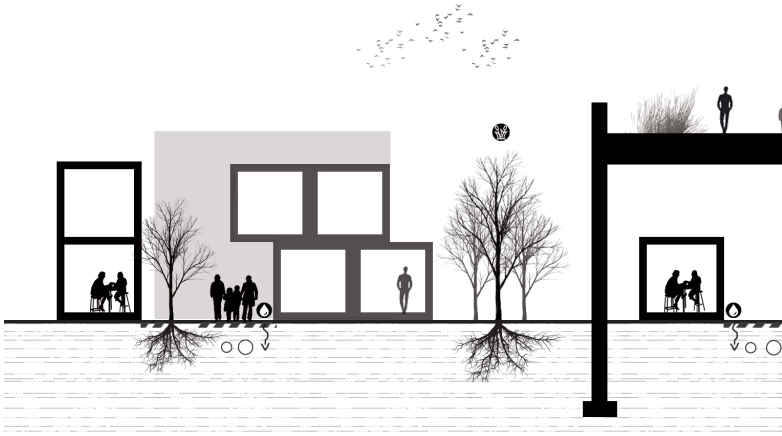
0 200 m



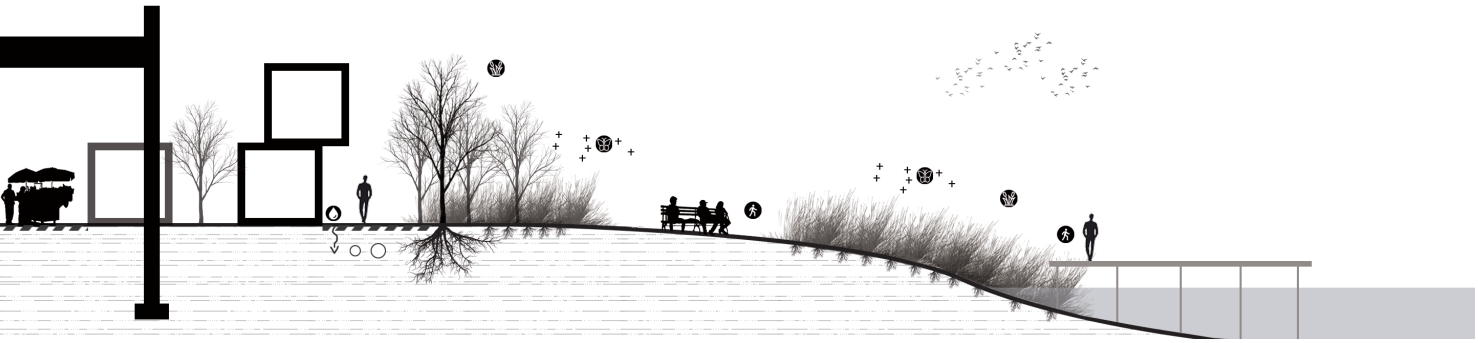
Section AA' - Phase 3-4

Section of the possible further development of the design proposal/experiment .

0 10 m




A′
A




A′
A





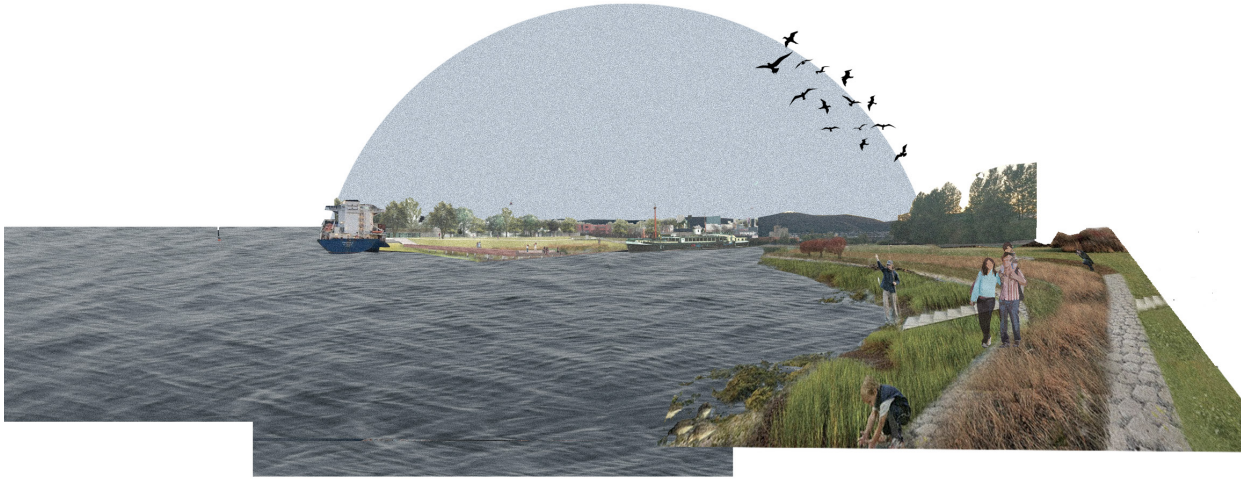
Impression - Starting point



Impression - Integration



Impression - Implementing green



Impression - Connecting

Dennis Groen - Accepting & Adapting

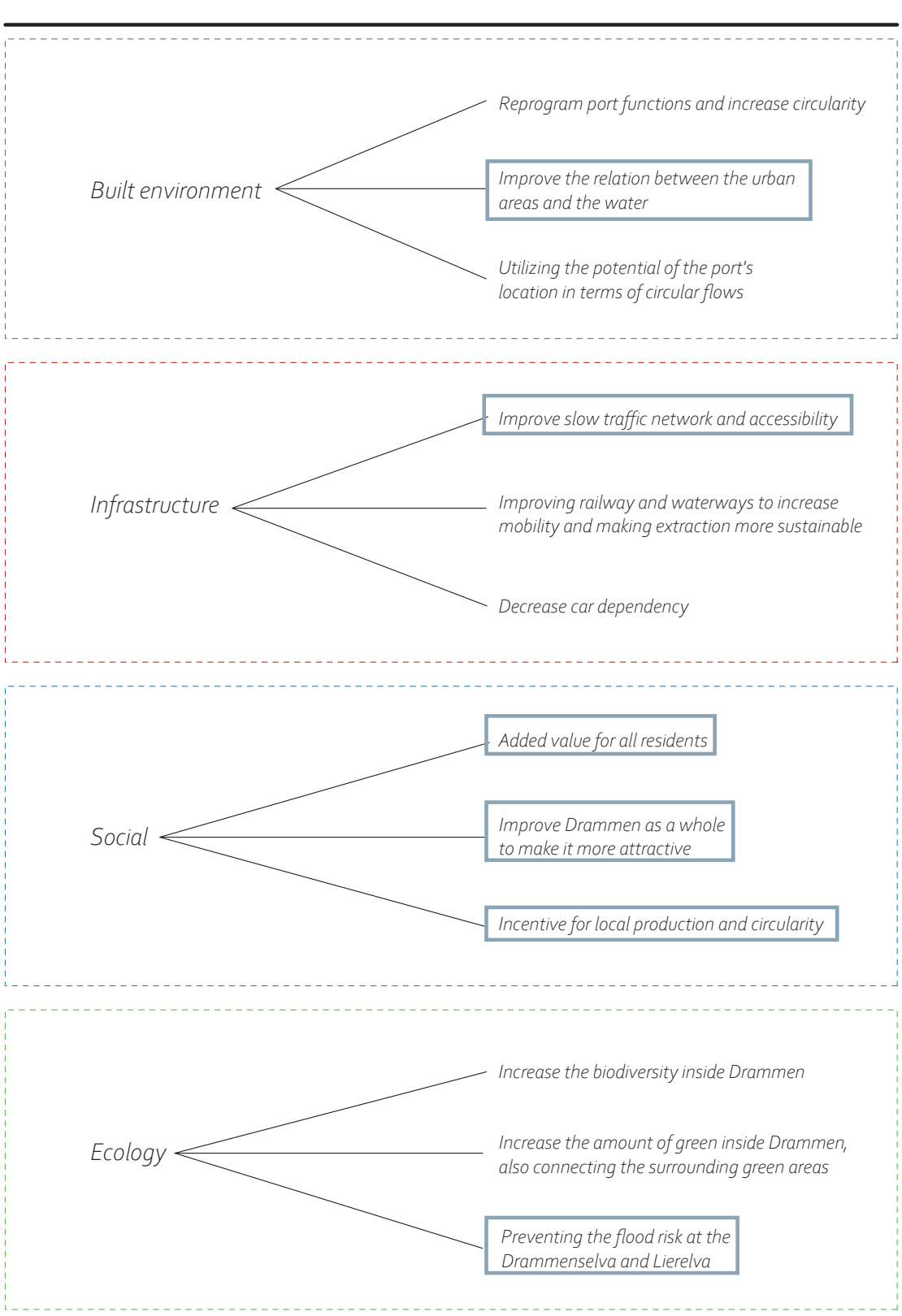
Manifesto

Rising groundwater levels, more rain and a higher risk of storms and flooding. Along
Norway's coast, there is a concern about the increase of frequency and magnitude of storms. Norway has an extensive coastline, where about 40% of the entire population lives. Along this coast, near Oslo, the city of Drammen is situated. Drammen also has a risk of flooding along the Drammenselva that runs through the city, but also just to the east outside the city. Here, the smaller Lierelva River is situated, which flows into the Drammenfjord. This project will zoom in on this location at the mouth of the Lierelva river. This location at the mouth of the river is a location with great potential, as there is a large habitat in terms of birds. In the area, there already is a bird watching tower. However, the infrastructure for slow-moving traffic leaves much to be desired: at high tide, the area is difficult to access.

This project will try to provide a solution to the problem of flooding. It will try to form a vision of flood risk management that sets an example for the region. Next to that, it will be a model project for homes that adapt against the flood. In addition, it will try to exploit the cultural potential of the area in terms of bird watching, without compromising the ecosystem. This will all be done by *accepting* the river & *adapting* to the river.

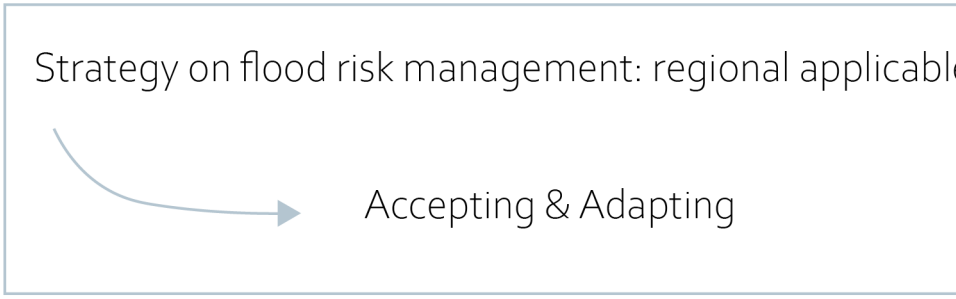
Accepting
In this project, it is important to accept the river. It is part of the ecology of the area, so instead of building up resistance, for example with a dyke, more space will be given to the river. This will be done by allowing the water to enter the area, by means of side channels and more variation in the height of the landscape.

Adapting
In addition, new housing will be adapting to the water. A neighbourhood will be built in the area on a small scale with houses on poles. So when there is high tide, these houses will not be flooded. The infrastructure for pedestrians will also be raised, so that the entire area will be accessible during high tide. More bird watching towers will also be added.



Guidelines

On the right the guideline diagram for the group vision is shown. These guidelines are divided into four domains: built environment, infrastructure, social and ecology. The guidelines that recur in this design experiment are highlighted. Each of the domains contains at least one guideline which returns in the design experiment, in order to have a versatile design.

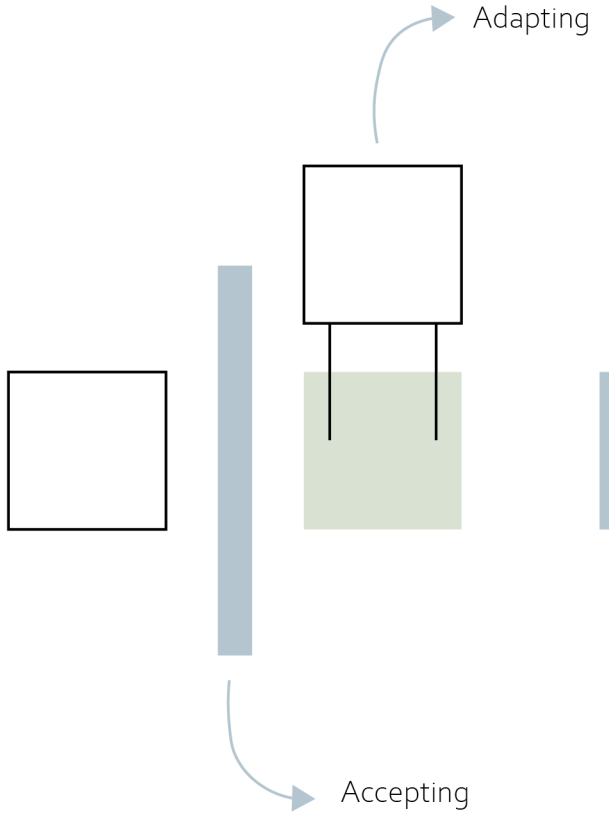


Positioning

This diagram represents the concept of the design experiment and its position. This design is a strategy on flood risk management which is regional applicable. This design will accept the river and adapt to the river. In the normal situation urban, nature and green coexist. However, when there is a high flood, the water takes over all. In the new situation in this design experiment, the river and the water will be accepted and given more space. Next to that, the housing and infrastructure will adapt to the water. In this way, when there is high flood, the water will not take over all anymore.



Normal situation



New situation

e

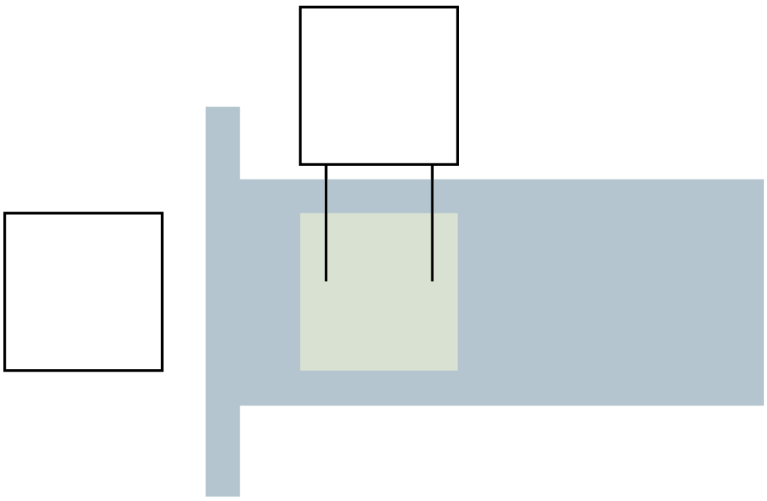
Water



Flood







Flood

Plan map

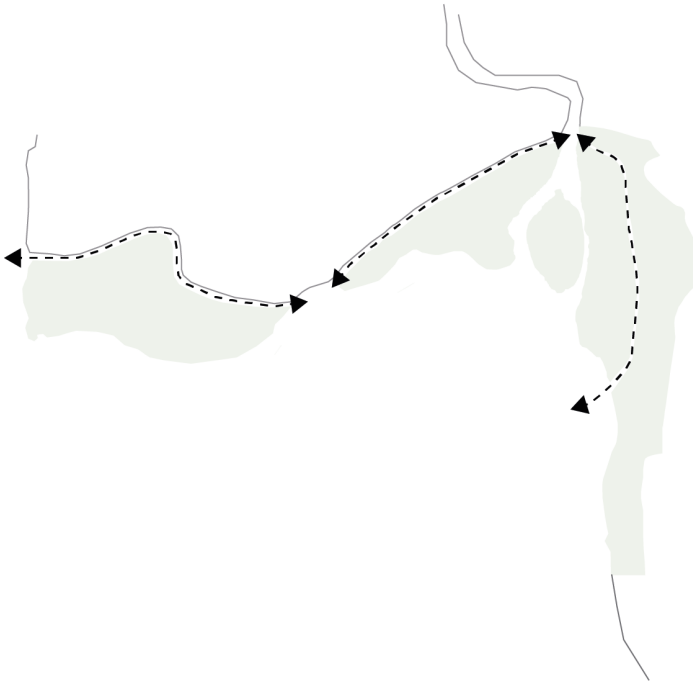
The plan map of the area contains several zones. The right part of the area focuses largely on wildlife habitat. Here, only the main pedestrian infrastructure leading to the bird watching towers is present. These bird watching towers are strategically placed so that they have long sightlines and have a visual connection to eachother. The main pedestrian infrastructure has been lifted up so that the entire area can be accessed even at high tide or flood. The left part of the area has more room for recreation. Here there are also secondary pedestrian paths that are accessible only at low tide. There is a beach and a jetty for small recreational boats. There is also a section where there is room for a new flood-adaptive neighbourhood. These are houses on stilts with space for agriculture in between. This makes the neighbourhood self-sustaining. Finally, there is a zone with the existing housing.



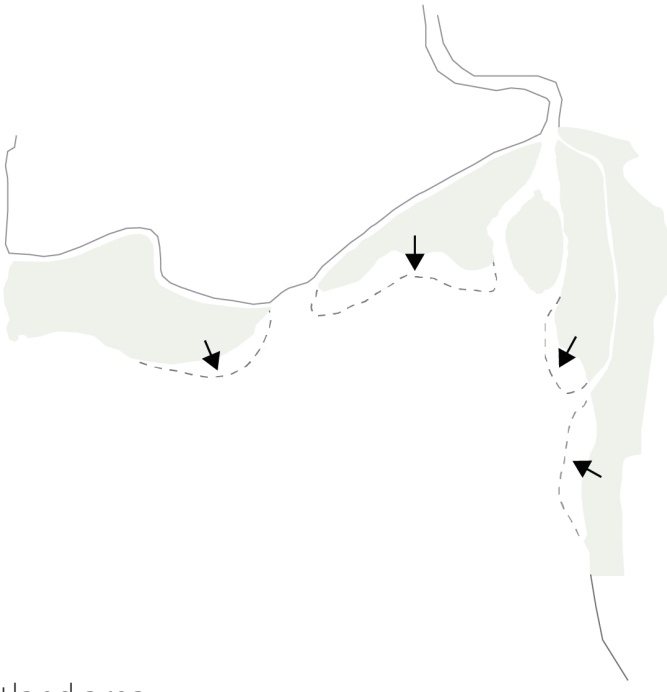

4
3
3
4
4
3
3
50 m



Water depth variation



Creating side channels for the river



Extanding wetland area

Flood concept

The current area contains little variation in elevation. In the new design, this variation in height will be applied. This will allow the water to flow into the area more easily at the lower elevations. In addition, large side channels for the river will be used. These side channels can collect a lot of water and will ensure faster drainage of the water. This reduces the risk of flooding for the current buildings. Finally, the current wetlands have been expanded so there is even more room for wildlife habitat.

At the right the different water levels in the area at the new situation are shown. In a normal situation, a limited amount of water will flow into the area. However, at high tide a lot more water flows into the area, thanks to the applied height variation in the area. In case of a 200 year flood, almost the entire area will be under water. However, there are small raised islands scattered throughout the area, so that even in an extreme flood not everything is under water.





Normal situation



Flow

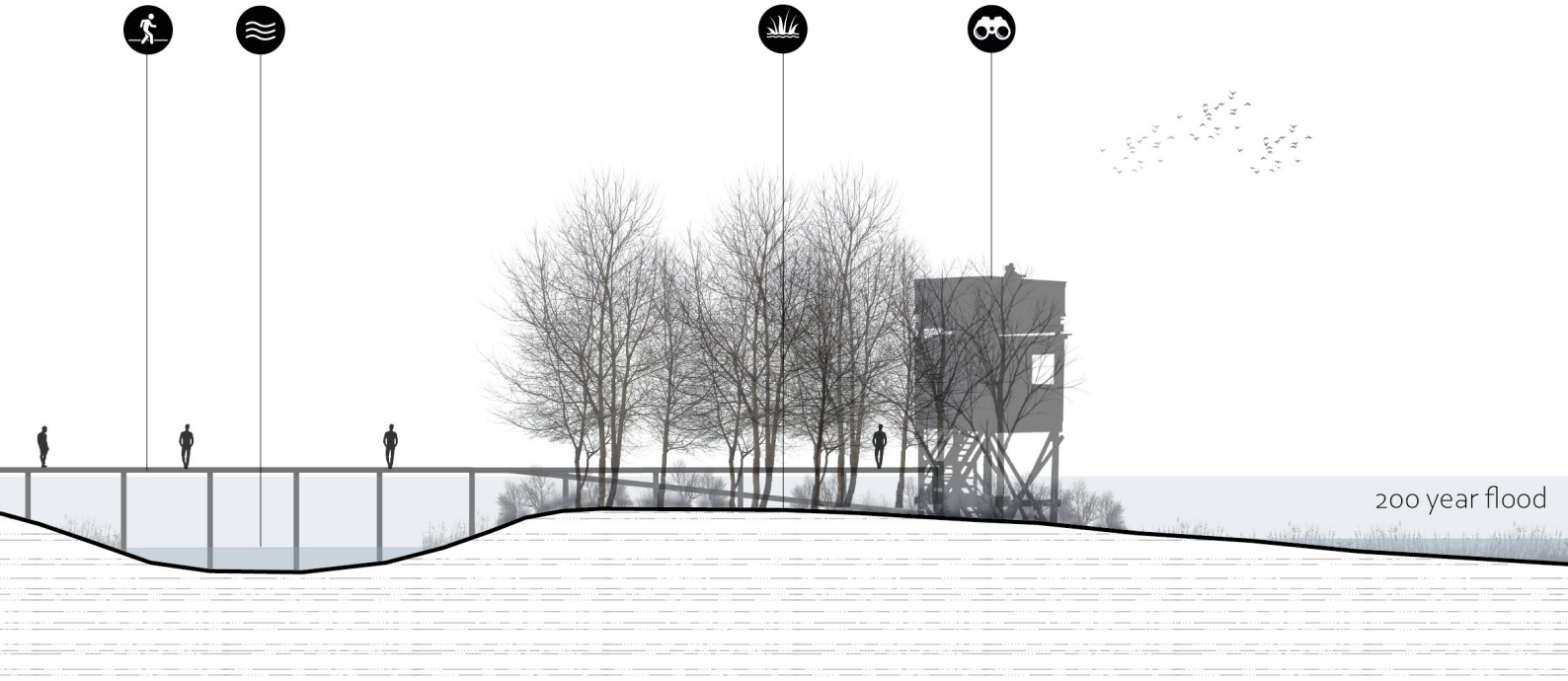


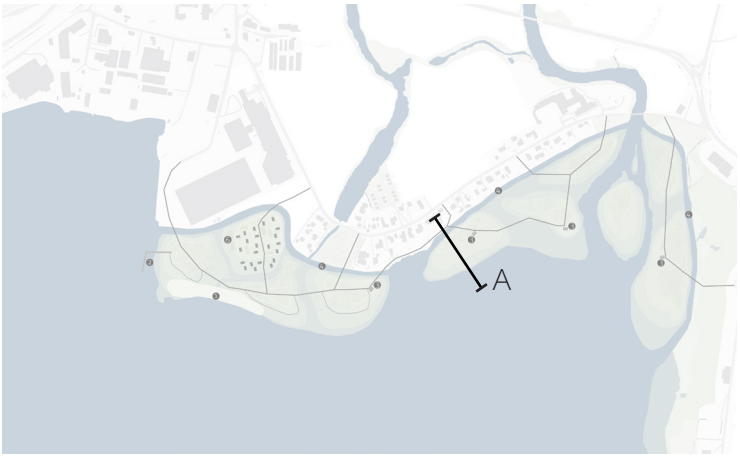
200 years flood

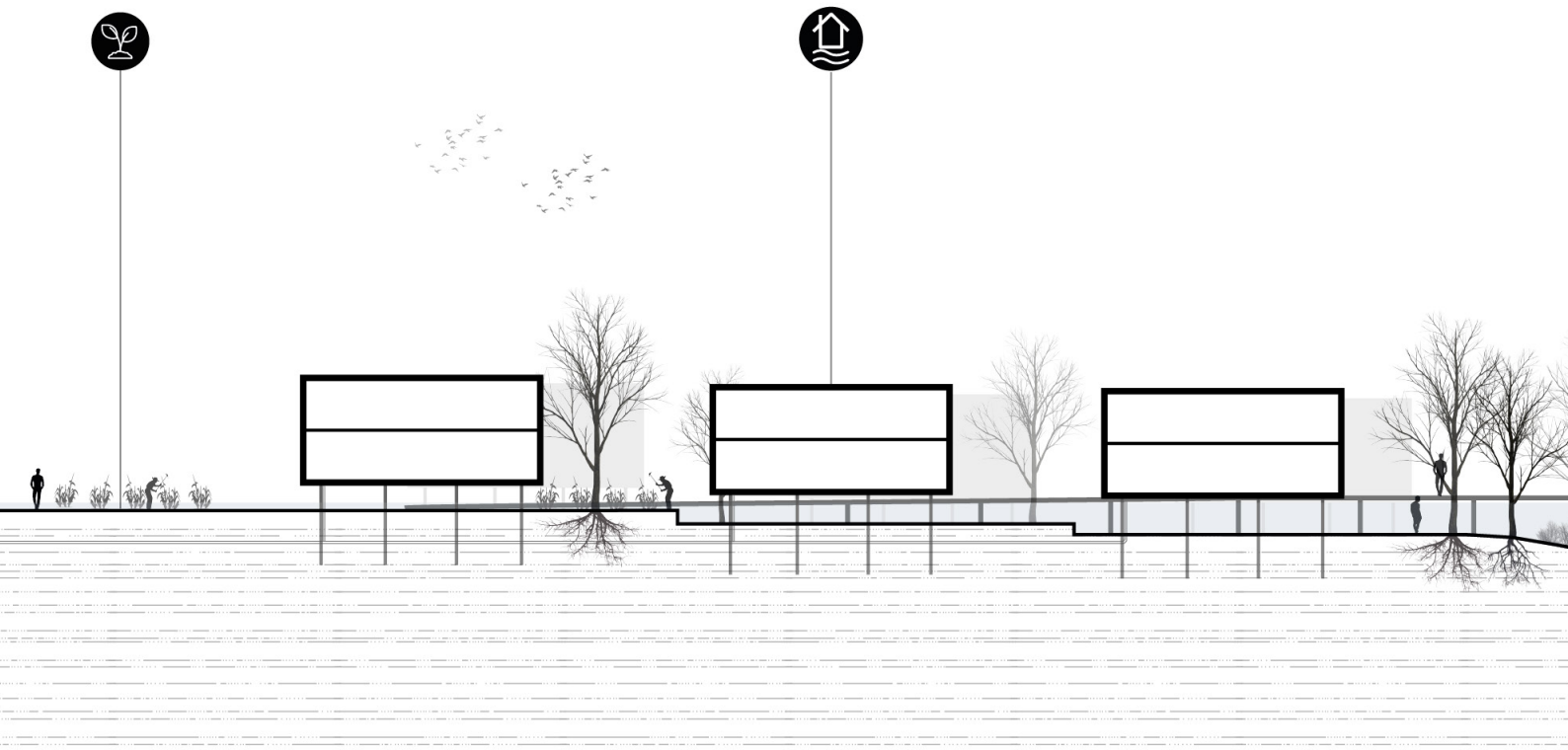


Section A

This section is located at the existing housing. The raised pedestrian bridges stand above the highest water level, so that the area is always accessible. The section also shows a large side channel of the river that can hold a lot of water. The bird watching tower is placed at the edge of the area with lots of views.


200 year flood


A



Section B

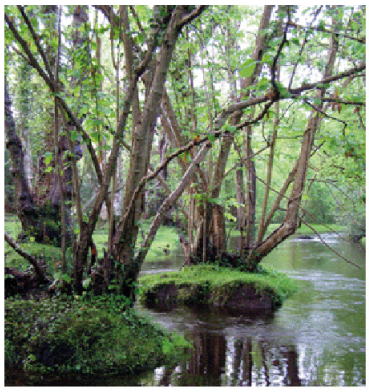
Section B is located at the new flood adaptive neighbourhood. Terraces are applied to these houses on stilts. These terraces provide a build up in height, so that the higher areas are less likely to be flooded. Between the houses, agriculture is added. The type and amount of agriculture can be adjusted to the different heights of the terraces.


200 year flood
Normal level

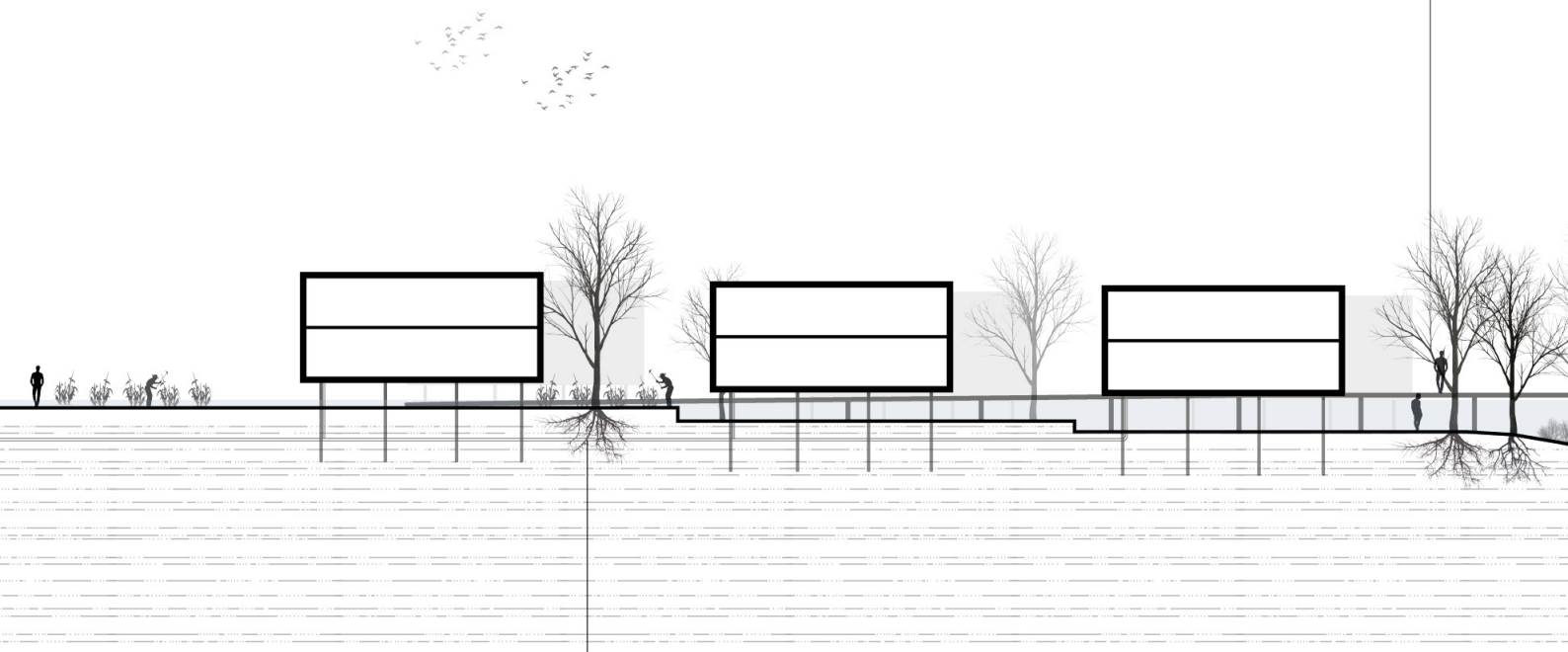

B

Vegetation

The area has vegetation that is water resistant. In terms of trees, this is mainly willows and alders. These trees can be exposed to high water levels for a long time. In the lower parts of the wetlands that are almost always under water, there is under water vegetation applied such as eelgrasses. This will benefit the underwater wildlife. Finally, a lot of reed has been applied, especially near the edge of the wetlands towards the fjord.



Black alder
Alnus glutinosa

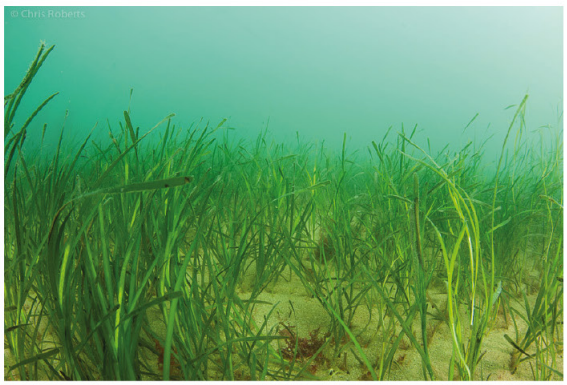




Grey alder
Alnus incana



Goat willow
Salix caprea



Eelgrass
Zostera



Reed
Phragmites australis





Impression

In this impression the elevated pedestrian infrastructure in the bird spotting area is shown. The main pedestrian infrastructure is connected to the bird spotting towers.





Impression flood adaptive neighbourhood

In this impression the flood adaptive neighbourhood in a dry situation is shown.
In this situation there is room foor agriculture between the pole housing.





Impression flood adaptive neighbourhood

In this impression, the flood adaptive neighbourhood in a flood situation is shown. In this situation, the main pedestrian infrastructure is still accessible. Because of the terrace structure in the neighbourhood, some agriculture will not go under water.





Hidde van Beek - Dealing with flows and floods

Manifesto

[Drammen]

The city of Drammen originates from three smaller towns which have been developed separately alongside the Drammenselva. This can be seen in the structure of the city, where there are multiple smaller centres. These centres have lost connection towards each other. Moreover, they lack a connection to the water, something that was important to the area, its villages and cities since its origin. How will the city of Drammen restore that connection between city and water in the future?

[Floods]

The largest centre of Drammen is located north of the river. Alongside the north bank of the river, floods cause disruptions. These floods are both causes by rainfall and the Drammenselva. By giving this river more space and improving the drainage of rainwater, these spaces alongside the waterfront can become of value again. This improvement of space will be done through various methods. First the walking routes will be improved by increasing the number of pedestrian crossings and decreasing the speed for cars. These walking routes will in some parts be raised to be walkable after both heavy rainfall and river floods. Because the Drammenselva often floods near parks and other large open areas, these spaces will become usable when the river floods. By creating tidal parks, the waterfront will become usable at all times, besides, it will increase the areas' biodiversity while also improving the quality of the city.

[Flows]

However, currently cars use a lot of this space alongside the waterfront, resulting in a decrease in space for pedestrians and cyclists. By downscaling these roads and improving the crossings as mentioned before, the car will no longer be the priority. Instead, the waterfront will become an extension of the city centre. Streets connecting the waterfront to the centre will house more restaurants and bars, resulting in a more vibrant space for both residents and visitors. The waterfront of Drammen will again become a major part in the future of the city.



The city lacks connection towards the water
and
floods cause disruptions along the waterfront.



Design experiment

This design experiment will tackle the northern waterfront inside the city of Drammen. This area is vulnerable to flooding from both heavy rainfall and the river, as mentioned in the manifesto. In this experiment, there will be investigated if this vulnerability can be resolved while also strengthening the centre of the city and improving the quality for people living in Drammen.

On the following pages, first the structure of the city and waterfront will be explained to give a better understanding of the context of this experiment. Next, the guidelines formed by the group project, will be matched with this experiment to make sure that this experiment follows group guidelines. After this, the design experiment itself will be explained through sections, elevations, plans and impressions.

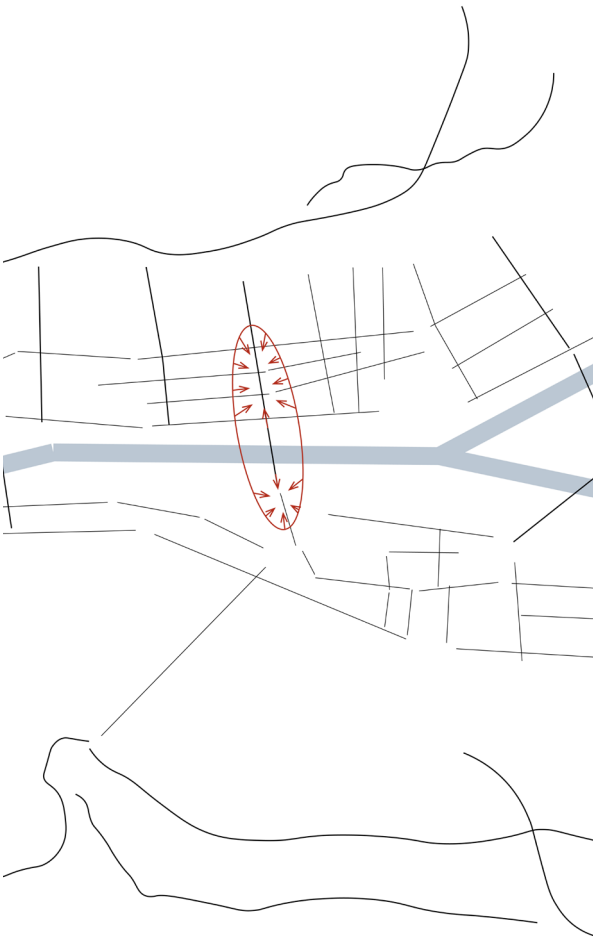
Design experiment

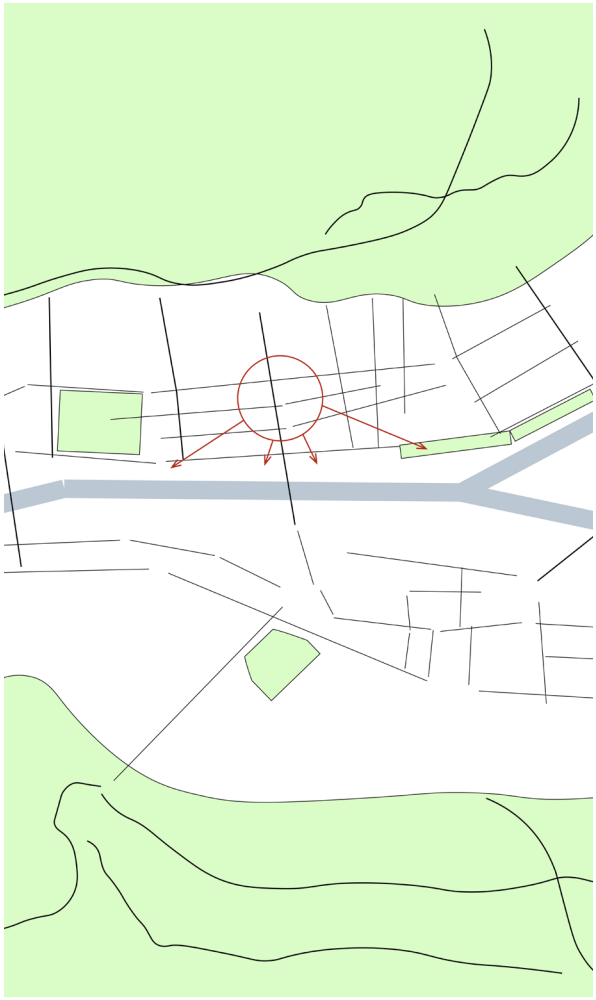
On the right the structure analysis of the inner city is visible. The inner city consist of a mainly orthogonal road structure. More towards the north and south of the city, the roads start to follow the landscapes as the elevations become larger. Next to the Drammenselva, from which the city has got its name from, two main centres of the city are located. One larger centre on the north bank which originates from the small historical town of Bragernes, and one on the south bank which was formed alongside the train station. This design experiment will focus on the northern and larger centre, as it is of greater importance. However, future investigations and experiments can certainly be valuable for the southern part of the city.

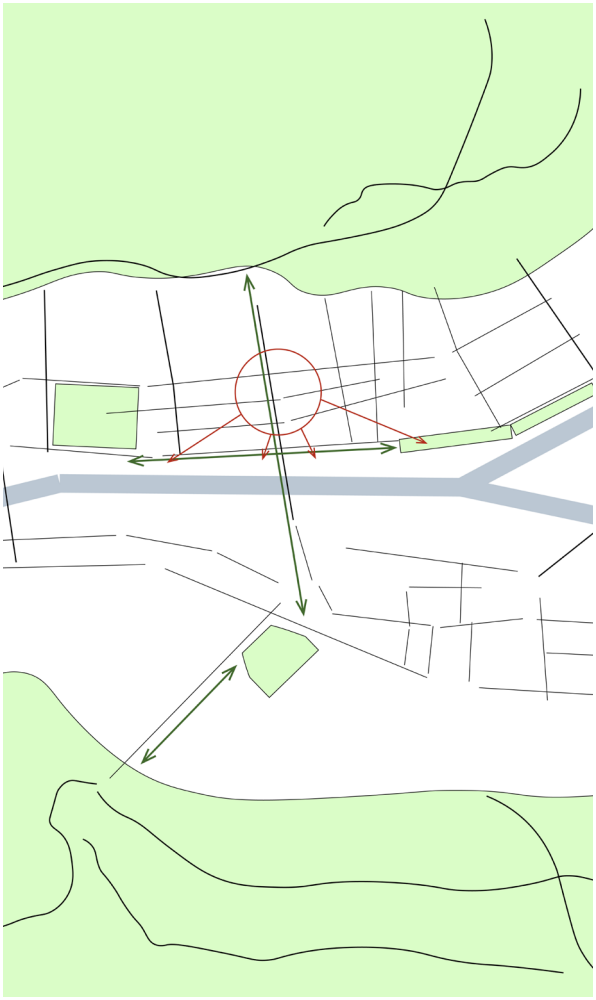
The Bragernes city centre lacks a connection to the water. It is centred around a square with shops on the eastern and restaurants on the western side. Along the water, a road connects the eastern and western side of the north bank and this road creates a barrier from the centre towards the water. There is a lack of crossings and moreover, this road and other green areas alongside the water are prone to flooding.











Guidelines

These guidelines shown on the right should be familiar as there were explained in the group section. For this individual design experiment a couple of guidelines were of main importance, these are marked on the right.

Guideline domain	Guideline
Built environment	Reprogram port functions and increase circularity
	Improve the relation between the urban areas and the water
	Utilizing the potential of the port's location in terms of circular flows
Infrastructure	Improve slow traffic network and accessibility
	Improving railway and waterways to increase mobility and making extraction more sustainable
	Decrease car dependency
Social	Added value for all residents
	Improve Drammen as a whole to make it more attractive
	Incentive for local production and circularity
Ecology	Increase the biodiversity inside Drammen
	Increase the amount of green inside Drammen, also connecting the surrounding green areas
	Preventing the flood risk at the Drammenselva and Lierelva

Strategy

The goal is to connect the centre to the waterfront, decrease the flood risk and improve the waterfront on its own as well. To better explain the interventions that will be done alongside this waterfront, four main points will be explained, whereafter two (/three) will be highlighted and elaborated in more detail.

1 On the western side of the centre, the green in the streets will be increased and improved, creating more biodiversity. The pavement along the road will become more permeable so heavy rainfall will no longer flood these streets. The street connecting it to the centre will house have a more public plinth with cafés and restaurant, generating more life on the streets. This part will be elaborated later in this report.

2 More towards the east, a indoor shopping street is located. By connecting this more towards the waterfront and improving the crossings, people will again use this water front to hang out and have a drink. Next to that, the level of green will increase and asphalt will be decreased.

3 This intersection will decrease in importance for cars. Because the road along the waterfront will be less used, this intersection becomes greener and the number of crossings will be increased. This part will be elaborated in a later part as well.

4 This area is now one of the most prone areas along the waterfront to flooding. By creating a tidal park which can partially flood (more on this in a later chapter), the issue of flooding will no longer be. Elevated wooden paths will be created to make sure people can still use this space when the tide is higher.

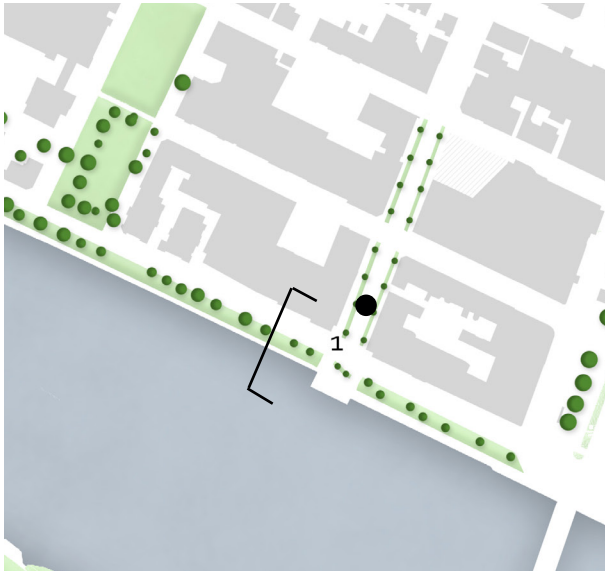


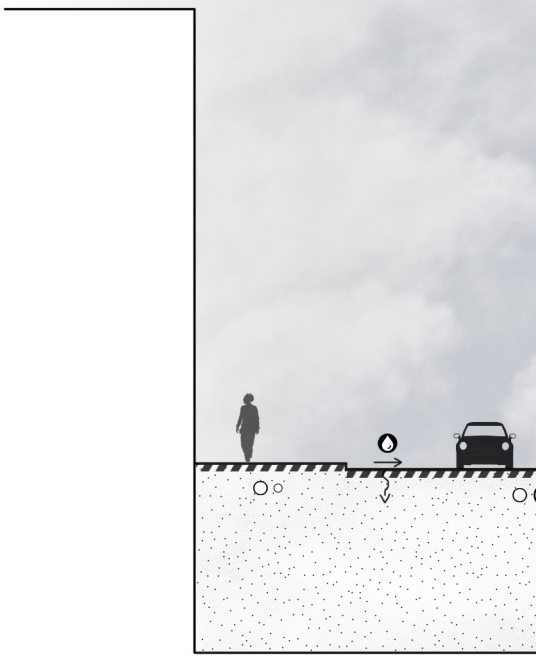

2
3
4



Design experiment

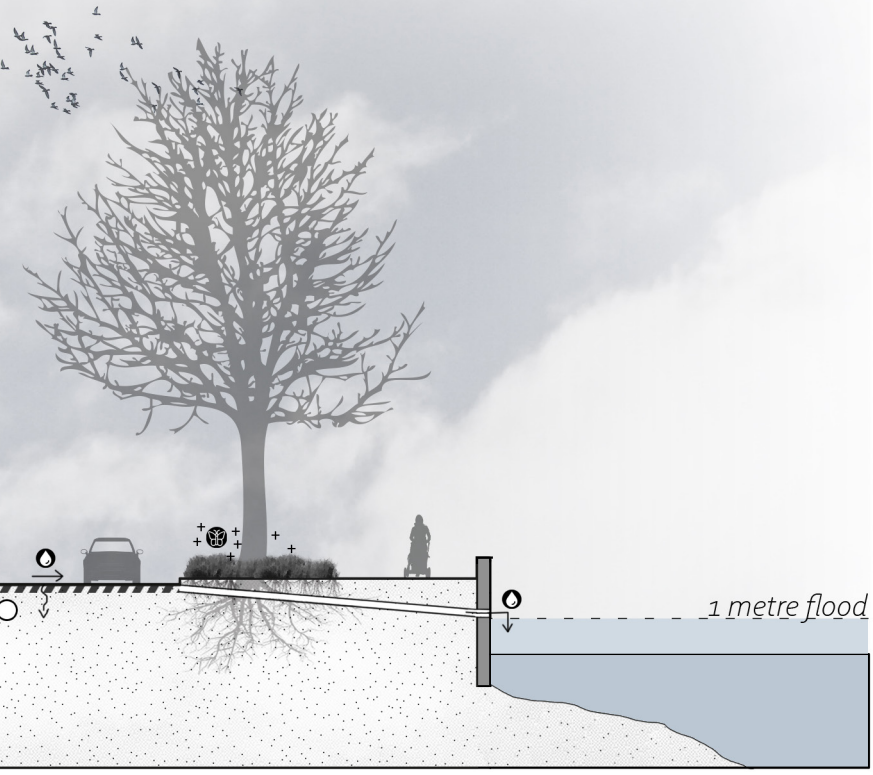
On the right, both the current and the proposed situation are visible. Below is a section of this street with several changes to the profile.
The main problem in this area was the lack of connection to the water and the risk of flood after heavy rainfall. The first problem will be solved by increasing the amount of crossings and adding a public plinth on the street connecting this area to the centre. Asphalt will be removed and replaced with bricks to increase the permeability but to also feel like less of a barrier when walking across. Next to the permeability of the road, the drainages will be improved and increased to make sure excess water can flow into the river.





0 4 m

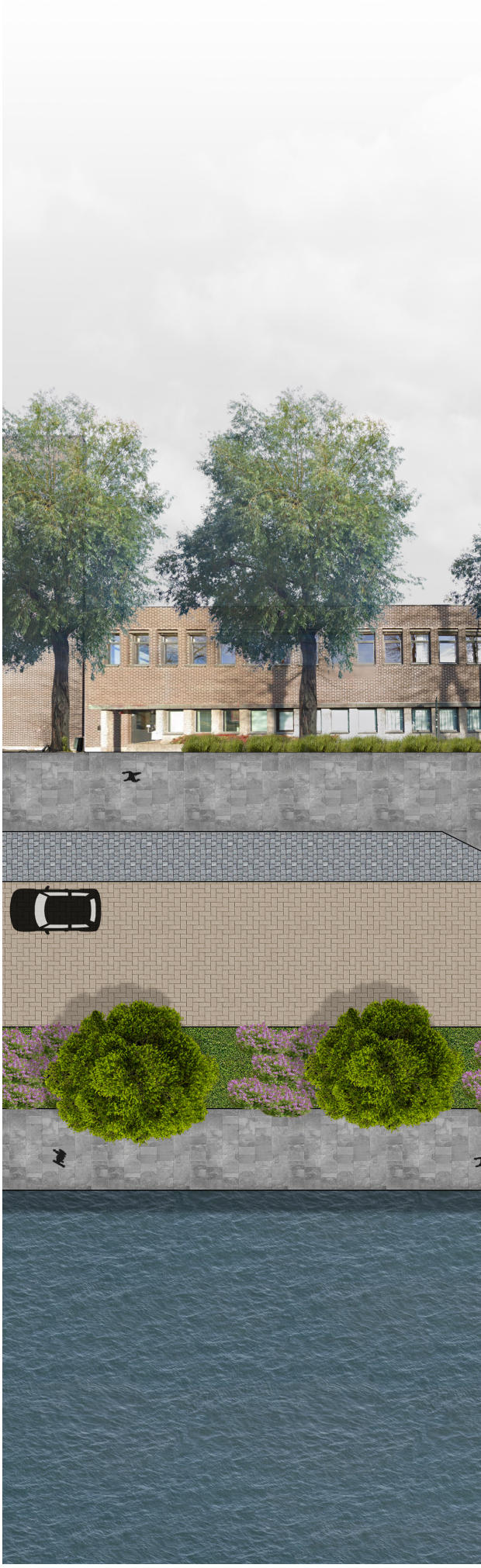



1 metre flood

Design experiment

A plan combined with an elevation is shown on the right. As discussed on the previous page, it visualises the connection of both sides of the street.





0 5 m





Design experiment

Towards the west, a tidal park will be created to solve the issue of floods. This park will have three main levels, the first one being the direct connection with water. This area has a lot of water plants and will flood when the water level of the Drammenselva rises. Alongside the street more flowers and trees will be planted to increase the biodiversity and attraction of the area. Between these two main levels (the upper and lower), an elevated wooden path will be created so people can walk through this tidal park at all times. On the street itself, a brick road will replace the asphalt and crossings will be added.





0 4 m


Strandveien


1 metre flood

Design experiment

To give a better illustration of the connection between the street, park and urban area, an elevation is created. The quay will remain paved towards the east. The wooden path will start off more structured to connect the straight lines of the quay to the more fluent structure of the park as shown in the impressions and sections of the previous page. Extra crossings will be created to improve the connection of both sides of the road and plants will be added to replace the grass. This also increases the quality of green towards the city centre.





0 | 3 m


AA88
MIKKELSEN

FLOWS

The Glomma and Årnes

Douwe Douma
Paul van Eeden
Floor Mulder

2020—2021 IED
Infrastructure and Environment Design
July 2021





Glomma trajectory,
Bjørnar Hansen, Fishspot.no

1.

Introduction

Context and Challenge

The Glomma is the largest river in Norway and has been of historical importance for extracting electricity (hydropower), industrial products (water as primary resource or cooling agent), drinking water and food (agriculture and fish). Low-lying areas along the river are under cultivation thanks to fertility brought by the water. These lands are mainly used to grow corn and potato, or as animal grazing grounds. Besides strategic opportunities, the river can threaten lives and properties during extreme weather, by causing floods or landslides (occurring more frequently with climate change).

Houses and farm buildings are scattered between cultivated fields, with the occasional village popping up along the river. One of these small villages located at the shore of the Glomma is our project location, Årnes. From the total number of 4688 inhabitants, more than a quarter commutes to work in Oslo (NorwayStatistics, 2021) about an hour drive away.

Perhaps the biggest extraction product of the capital today is knowledge. Because the historic harbour has left the city centre (similar to what has been and still is happening in Rotterdam) logistics services are largely carried out over roads. These lorries and cars must pass through the city since there is no ring road available. Larger (and more elongated) flows between extraction and consumption in the future can further increase externalities by this unsustainable traffic. Despite taking pride in producing electricity in a sustainable manner, oil is still the dominant fuel for transportation and is exported out of the country in vast amounts.

The main issue we identified regarding flows in the area is their disconnection from nature. Humans no longer rely on surrounding nature for their food supply, but on the supermarket with processed food from all over the world instead. Similarly, daylight is no longer spent in the village or fields, but working in office towers instead. Even while traveling to the job, people exclude themselves from sensory experiences of nature by taking the car, on roads carving through (or underneath) the landscape. How we want to bring people closer to nature again, putting emphasis on (experiencing and enjoying) water, will be discussed more in depth in the chapters of design and vision.

Environmental Risks and Human Response

Leonardo da Vinci stated 500 years ago that ruinous floods of the river are paramount compared to damage caused by fire (Macagno, 1989). He argued that fire consumes that which feeds it and eventually consumes itself by having no available material left to burn: The fuel of fire is discontinuous and the damage separated. On the contrary, flooding is maintained by the sloping of valleys and only ends when the sea has been reached. The inclination of the valley is continuous and so is the damage. The water can cut through mountains, tear down the strongest banks and uproots well-established plants. Utmost effort of poor and overworked farmers is undone and the cultivated valleys are left miserable in poverty.

The largest flooding of the Glomma ever recorded occurred in 1789 (Wold, 1998). In the current age, flooding of the river continues to be an environmental risk to life and property in South-Eastern Norway. As recently as the spring of 1995, the snow unusually remained and even built up to 150% percent of the normal situation (Gisgeo, 2021). Suddenly, the temperature rose 10 degrees Celsius and the water started rising fast in succession. At this point, low-lying areas along the Glomma already had been flooded, many thousands of hectares of land were under water and many households had to evacuate their homes.

Historically, Norway was the most prone to flooding during cold periods (Kvittingen, 2021). Today however, flood-rich periods are 1.4 degrees Celsius warmer than flood-poor periods. Climate change has caused the weather to be warmer and wetter, elongating the flooding season. In addition, previous floods caused by melting snow are more predictable (and thus safer) than modern floods or landslides caused by heavy rain.

During the 1995 flood (Wold, 1998), the river formed new or returned to previous beds (that had long been dried out and already cultivated). Crops were destroyed, whole houses were carried downstream and critical infrastructure was impaired for a short period of time.

Humans reacted by building (temporary) protection dams, water was pre-released from hydropower reservoirs, the mouth of the river was enlarged by blasting away safeguards at Øyeren and two old bypass tunnels were reconditioned with floodgates to facilitate greater flow rates.

In the future, it would be wise to avoid building in places that are susceptible to flooding and landslides, such as the floodplains on the western bank. Preventing danger is still better than responding to it. Another lesson from previous floods is that natural vegetation, such as forest, brushwood and grassland are resilient against flooding damage, returning to thrive within years after being swept away.

Scales & actors

To properly assess the project and its reach on these scales, an overview has been made of the various actors at these scales, with a description of their importance.

Macro-scale

On the regional level there are two main influential spatial units, namely: the reach of the metropolitan area of Oslo and the river catchment area of the river Glomma. These are separate entities with great influence over the region. The Oslo metropolitan area has a major attractive factor on the anthropological level, it is the de facto center of the entire (southern part) of Norway for any higher-level activity, such as technology, health or government. The Glomma catchment area encompasses the entire valley wherein Arnes lies, the downstream from Arnes (and upstream) and is therefore the relevant natural spatial unit.

Actors on this scale include: the city of Oslo, the government agency managing water and harnessing power from the hydroplants (NVE), the government agency managing nature (Ministry of Climate and Environment), the environment of the Glomma catchment area.

Meso-scale

The “urban” level consists of the Nes municipality, wherein Arnes is the largest (most central) town with many smaller population cores, as well as the landscape in between these population centers. This encompasses the agricultural fields, forests, natural areas and river/waters within this landscape.

Actors on this scale include: the municipality of Nes (administering the area, managing the environment and infrastructure), inhabitants of the various towns, farmers (of the fields), the environment, the river Glomma (and Vorma).

Micro-scale

The precise scale of the micro-scale may vary, however the scales that were chosen for the individual design experiments were: “street” scale (bridge), block scale and the extent of one stream that flows into the Glomma (landscape corridor scale).

Actors on these scales include: local inhabitants or users (all scales), local entrepreneurs and companies (block/bridge scale), farmers (landscape corridor scale), the municipality of Nes, the local flora & fauna and the Glomma river (and streams).

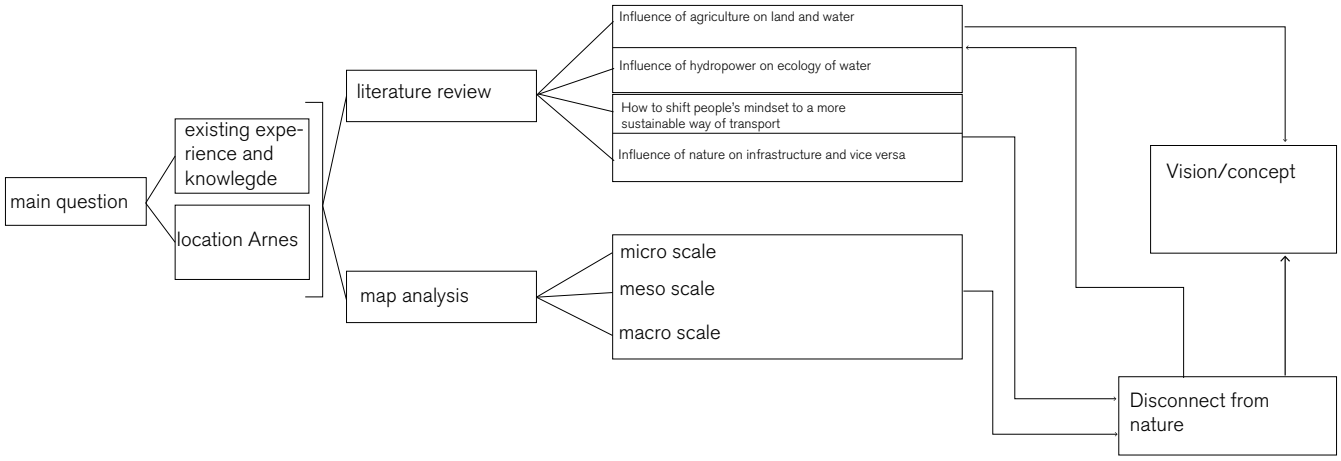
Theoretical framework

To start a project in another country, it first takes a while to understand the ideology of that place. With help of the literature review in the first weeks, we found our basis for starting the research. Together with an extensive walk through in Google Maps, menus from local restaurants and branches that are established there, but also here, we could find the differences and similarities between what we know and Arnes.

Our literature review was very complementary of each other. Whilst more objective information came from the hydropower and agriculture research, changing the mindset and the influence of nature on infrastructure took a more humanistic approach. The latter was more influencial in the forming of a conclusion, but both helped to build a strong basis for our design.

We then all three looked into different scales, lead by the different topics that we had for the critical cartograpny. This lead to our conclusion of disconnect from nature.

The conclusion lead to the vision: we want to re-embed functions into nature, about the vision we will tell more later.



Concept & vision

Concept

From the critical cartography it becomes apparent that there is a disconnect from nature and the landscape on multiple levels.

Transportation infrastructure does not rely on the landscape (river, mountains) anymore, but is based on cars and trucks (roads, tunnels and bridges). In the past this landscape was conquered by the rivers, which provided natural corridors to transport a variety of goods, mainly wood downriver, and allowed people to go inland from coastal settlements.

The daily rhythm of inhabitants of Arnes is not connected with the landscape anymore, instead (for the most part) they commute to Oslo in the morning and come back in the evening. Disconnected from Arnes and its surrounding landscape, passing it by for a reason not raised by the landscape, but instead by human factors (type and location of jobs). Which also affects what Arnes has, and needs to offer its inhabitants. If most people commute to Oslo, more services will be located there and more jobs will move there to provide these services. In turn diminishing the role of Arnes and its surrounding landscape even further from the day to day life of inhabitants, other than to sleep.

The landscape itself has been reshaped for the benefit of humans, thereby disconnecting the landscape from its natural state. This is well-expressed in the many dams located in the river Glomma, harnessing the water for power generation. Several streams have been dammed as well, mostly to protect against flood risk. Not to mention the “natural state” would be forest with occasional clearings, where a lot of forested land has been cleared for the wood and to establish fields for agriculture. This has been a slow process, however, where nature could better adapt, whereas the dams were quite sudden and big interventions upon the natural state.

Food production has also been disconnected from nature and the landscape, where in the past people would eat off the (nearby) land, this is not “required” anymore. Hence, the fields around Arnes may not even supply food for Arnes, and the river is not used to catch fish anymore and instead this is imported. As are tropical fruits and other non-native food, and food items such as vegetables are often grown in hydroponic greenhouses.

The disconnection from nature and the landscape manifests itself in so many ways within our critical cartography, that it is a clear conclusion that can be drawn and one we will try to tackle. The concept is easily described in IMAGE, where the shift from “people-based” (the city) to “nature-based” (personified by the river) is shown. Instead of superimposing human-made solutions onto nature and the landscape, a way of living with the river as center should be strived towards. Back to living off of the river Glomma, taking into account all of the innovation and knowledge of today. This sets the concept apart from simply going back 100 years in time.

Vision

The vision is based on four functions within the landscape, that all connect to shifting towards a more nature-based society living in closer connection to the landscape: transportation, recreation, extraction and urbanisation. These in turn consist of many smaller parts.

Transportation, re-activating the river for transport of goods. This means retrofitting dams with the required infrastructure to do so. Many towns along the river have an adjacent, or nearby, bridge crossing the dam. These bridges can act as a transportation node, from which the connection between the river and the land can be established. These nodes can feature goods transhipment, local distribution (for the town), a multimodal passenger transport center as well as acting as centers on the water.

Recreation, a big part of the recreational aspect of the vision is raising awareness of the landscape for inhabitants, by opening the landscape up in various ways. Slow routes along the river can be established as (functional) long-distance walk and bike trails, with various points to connect with the river. Areas with specific recreation biospheres (such as forest, fields and the river) can give more understanding of flora and fauna species.

Extraction, utilising more differing methods of extraction may greatly benefit the landscape. By utilising silviculture and food forests, greater areas can return to the way they were naturally (as forested area) while still being productive. Communal garden areas per city can create awareness in growing food, as well as provide areas for social connections within the realm of shifting towards a more nature-based society. Dams can be retrofitted to decrease their negative influence on fauna, water level and flood control.

Urbanisation, there is an expected increase in population within the Nes municipality. To achieve this, two ways of urbanisation may be utilised. Densifying already existing urban areas will minimise the (spatial) impact of a large number of new residents to Arnes and the surrounding towns. While expanding along currently existing roads, which are often historic connections, will limit the spatial impact of urbanisation along corridors. By mandating that these expansions are single-line along the road, that is to say “one building deep”, the residents of these expansions will have a visual (and direct) connection with the landscape which surrounds them.



Visualization of vision

Diagram showing the shift from human centered to nature centered based desgin

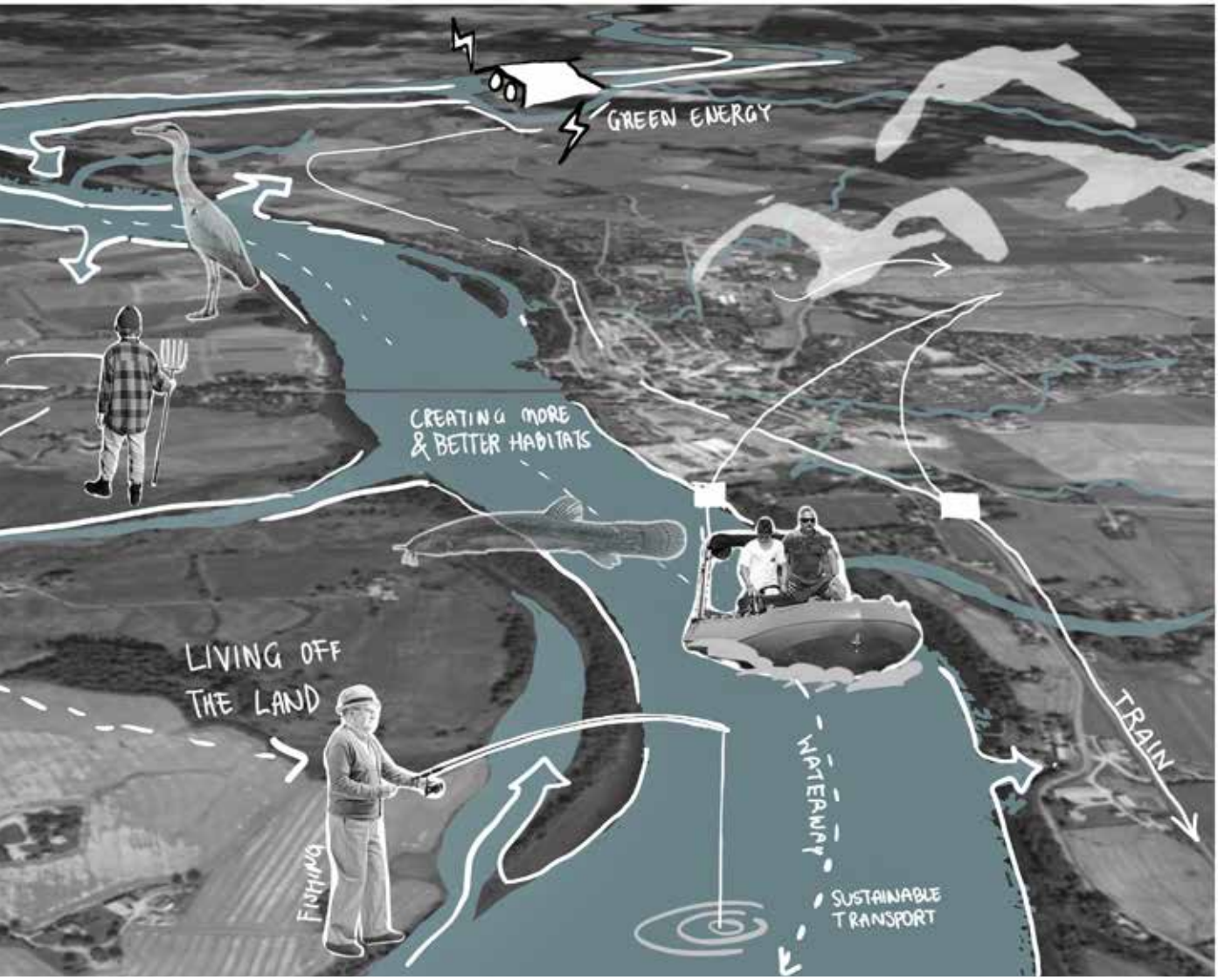


Visualization of vision

A 3D sketch of the flows and functions we want to give back to the town of Arnes






GREEN ENERGY
CREATING MORE & BETTER HABITATS
LIVING OFF THE LAND
FISHING
WATERWAY
SUSTAINABLE TRANSPORT
TRAIN

2.

Critical Cartography

Process of collecting data

When doing a project in the Netherlands, we all have our standard sources of information. We could not rely on those when searching in Arnes. At first, we had a hard time finding the correct data; sketchy sites, Google Translate and a lot of Norwegian advertisements (because, cookies) were our friends.

Later on, when we learned a Norwegion word or two, we found some really helpful data banks (like https://temakart.nve.no/).

First steps in this process was a lot of Google Street View, the occasional photo spot of a tourist or visitor and trying to find general maps, like contour lines.

The lecture by Dag Tvilde was also very helpful. He gave us a strong basis for the general history of Norway and the different landscapes that are present.

Eventually we found sites that are very similar to the Dutch PDOK. This was really helpful in a sense that information was already made visual. Paul did a lot of work with help of QGIS.

At the end, we have found a good summary of everything that we felt we needed to know to come up with a good vision and design experiment.

Firstly, we'll go through the critical cartography of landscape & ecology (Floor). Then urban morphology (Paul), and then last but not least, anthropology (Douwe).

Anthropology - Extraction landscape of the past

Only around a century ago, people gathered everything they needed for survival out of their nearby environment. Nature provided wood to burn and built with, as well as food to hunt and gather. Extracting these resources took all day and sometimes had to be done in harsh climate conditions. This dependency on what nature had to offer meant that harvests varied each year (as animal populations and foraging yields fluctuate over time). In winter, little to no food was available.

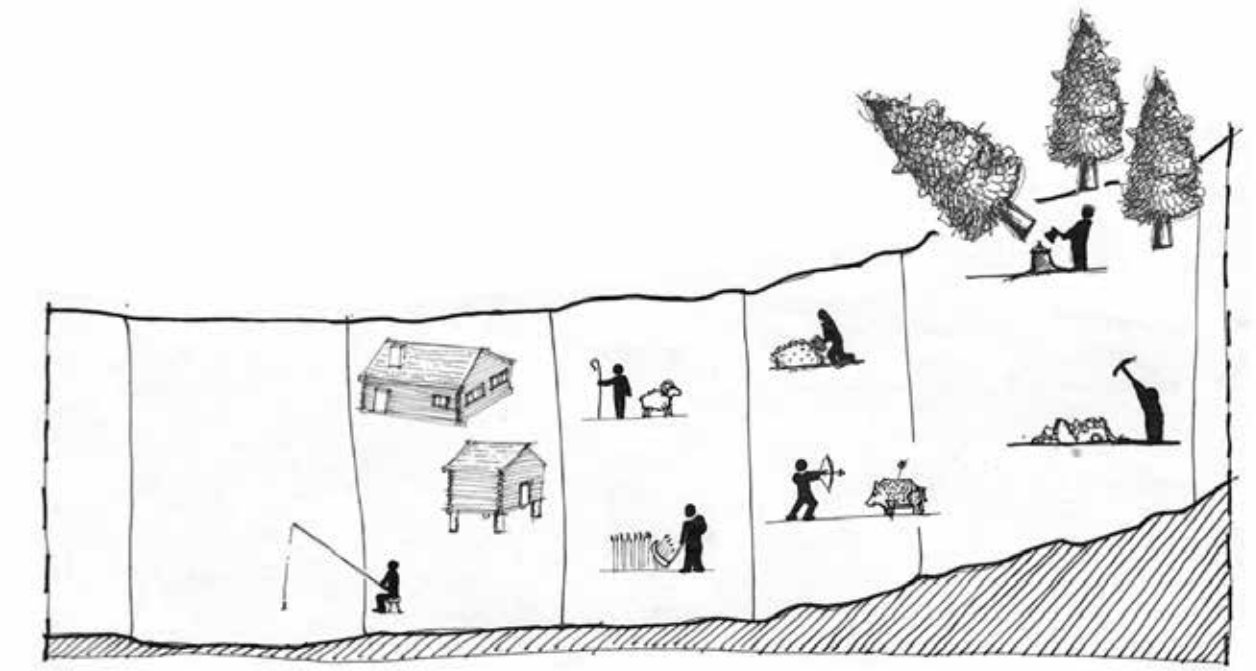
For a more stable (and predictable) food supply, people started cultivating the land and domesticating animals. These animals not only provided meat, but also (continuously) produced eggs, milk, bones (for tools and weapons), wool and leather (for clothes). Wheat could be stored for several years, with the introduction of storage huts raised on poles (above the freezing ground).

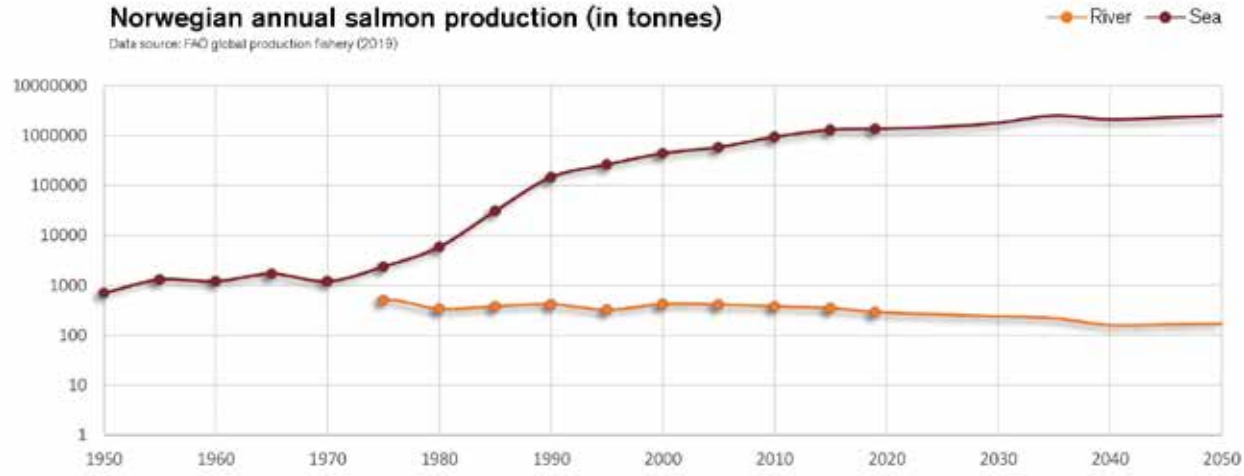
On the next page, an abstract diagram shows how people once lived with nature (for their extraction) in the village of Arnes, and how this translated spatially.

Anthropology - Salmon fishing through the years

Before finding huge oil reserves offshore in the sixties, Norway's economy was driven by fishing. In the following timeline, yearly capture rates for salmon show an exponential growth. This is illustrated by the required logarithmic scale (with step sizes of x10) to make present capture rates fit with those of fifty years ago in the same graph. There is a clear pattern between timeframes 1918, 1968 and 2018. In 1918, fishing was done small scale with the intention to provide yourself or family with food. In 1968, the sector was industrialized and bigger boats, propelled by engines had bigger nets. The intention now was to sell the fish locally. Jumping to the present, humans are less and less involved in the fishing chain, which is now automated by machinery. Millions of fish are bred inside underwater cages, so we do not even have to catch them anymore. Being packed together, diseases can spread easily which gives two serious concerns to the environment: 1) Infected (or mutated) salmon can escape the cages and end up in the wild, and 2) Pesticides are sprayed over the fish in huge amounts, polluting the sea (floor).

There is no (found) academic consensus over whether these pesticides end up in the food, as well as leftover toxic chemicals from the food pallets the growing salmon get served. However, some sources say farmed salmon is among the most toxic foods consumers can buy in the EU.







1918:
Small scale
Own source of food
Labour intensive

1968:
Industralization
Feeding the nation
Machinery lightens labour

2018:
Automatization
Feeding the world
Machinery takes over labour

Anthropology - Human perspectives

Natives - Nature is fragile

Fishing as recreation or small-scale food production. Is patient and respectful towards the fish to ensure healthy populations, now and in the future. Believe they have more right to fish than others, distrusting all other groups.

Tourists - Nature is robust

Wants to catch as many fish within their vacation, with little to no regard to fish populations long term. Fishing for recreational purposes only, in scenic environments.

Scientists - Nature is robust within limits

Scientific approach, testing the environmental quality of water and fish populations. Often employed by the government, can be fired if too critical (whistle-blower).

Politicians - Nature is robust within limits

Bureaucratic, makes policies balancing sustainability with competitiveness of the industry. Fishing is embedded in the culture, and thus has a special protective status. Intertwined interests (having shares in the industry) can lead to corruption.

Entrepreneurs - Nature is robust

Yields above everything. Uses chemicals and pesticides, sometimes without knowing their effect. If the industry becomes too regulated (read expensive) in the country, threatens to move out.





















Landscape morphology & ecology analysis

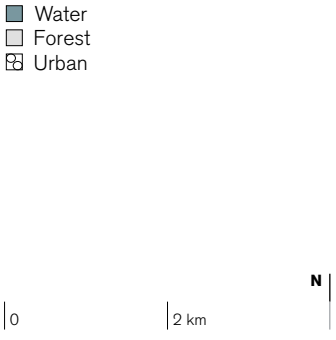
In this chapter the critical cartography of the landscape will be discussed. Started with is the typology of the landscape. The river shaped the landscape and Arnes is situated in the valley of the Glomma.

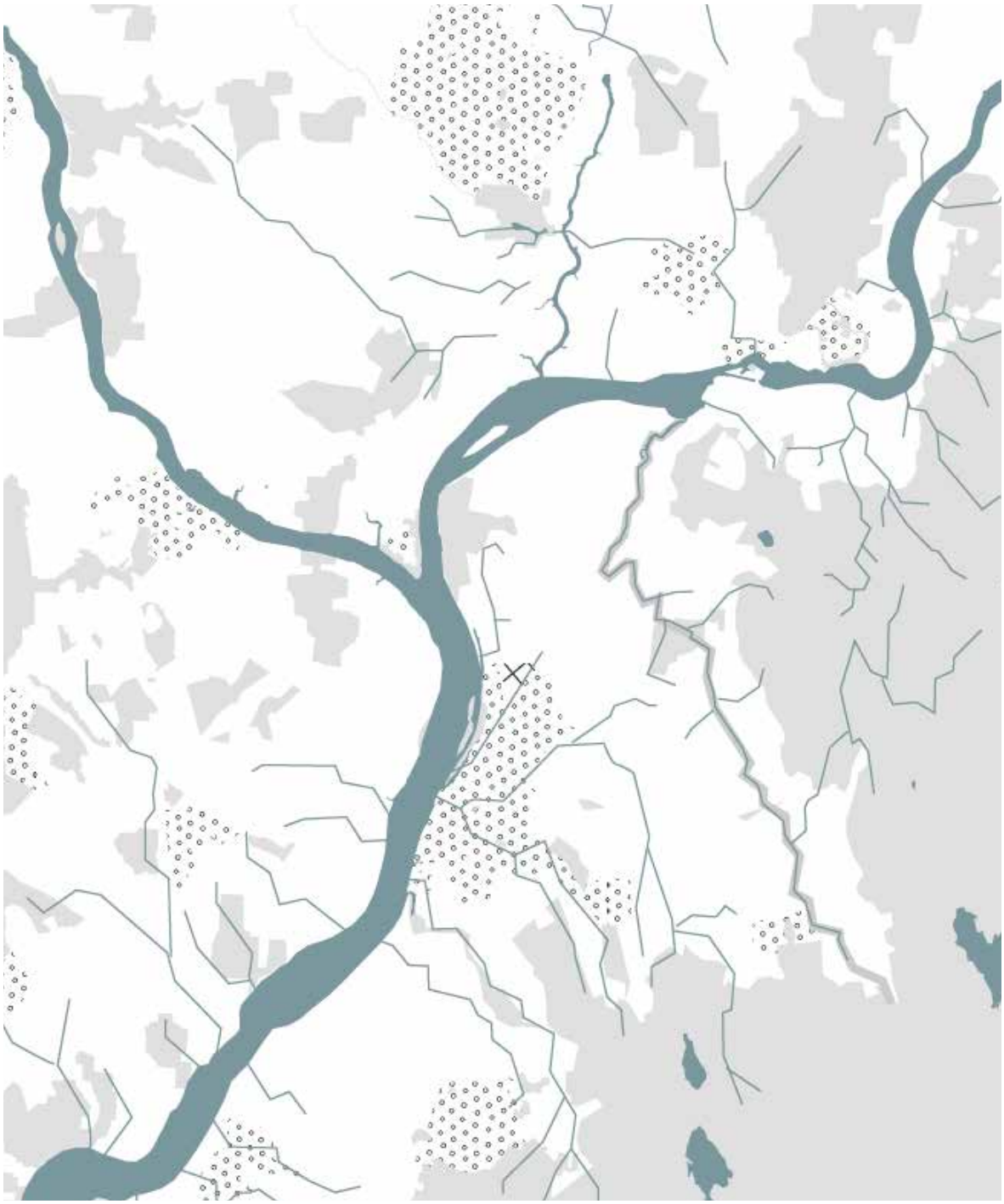
The surrounding land is very fertile and is mostly agriculture with patches of forest. The higher lying grounds are conifere forests.

Striking are the clear edges between all three landscaped and the rigid forms that build up the landscape, as can be seen in the bottom pictures. The rigid lines of the fields, with the lines of the forests make up the view.

Landscape typology

The landscape consists of the river, a band of agriculture and higher lying forest.








Source: Google maps

Landscape - Geomorphology

The landscape surrounding Arnes is hilly. In orange you can see the contour lines. This is caused by erosion from all the years the Glomma flowed through, one can say that the Glomma cut itself out in the landscape.

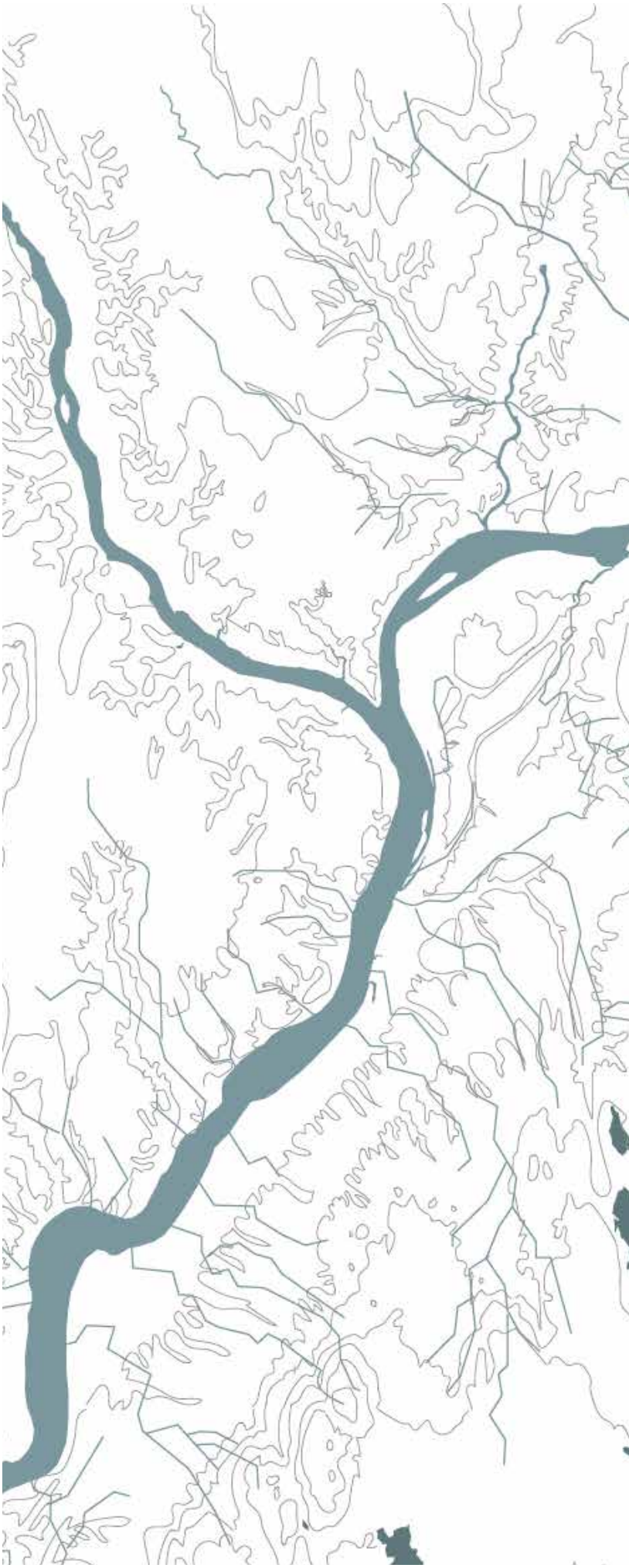
The very wiggly contour lines point out the streams that are there now or in the past.

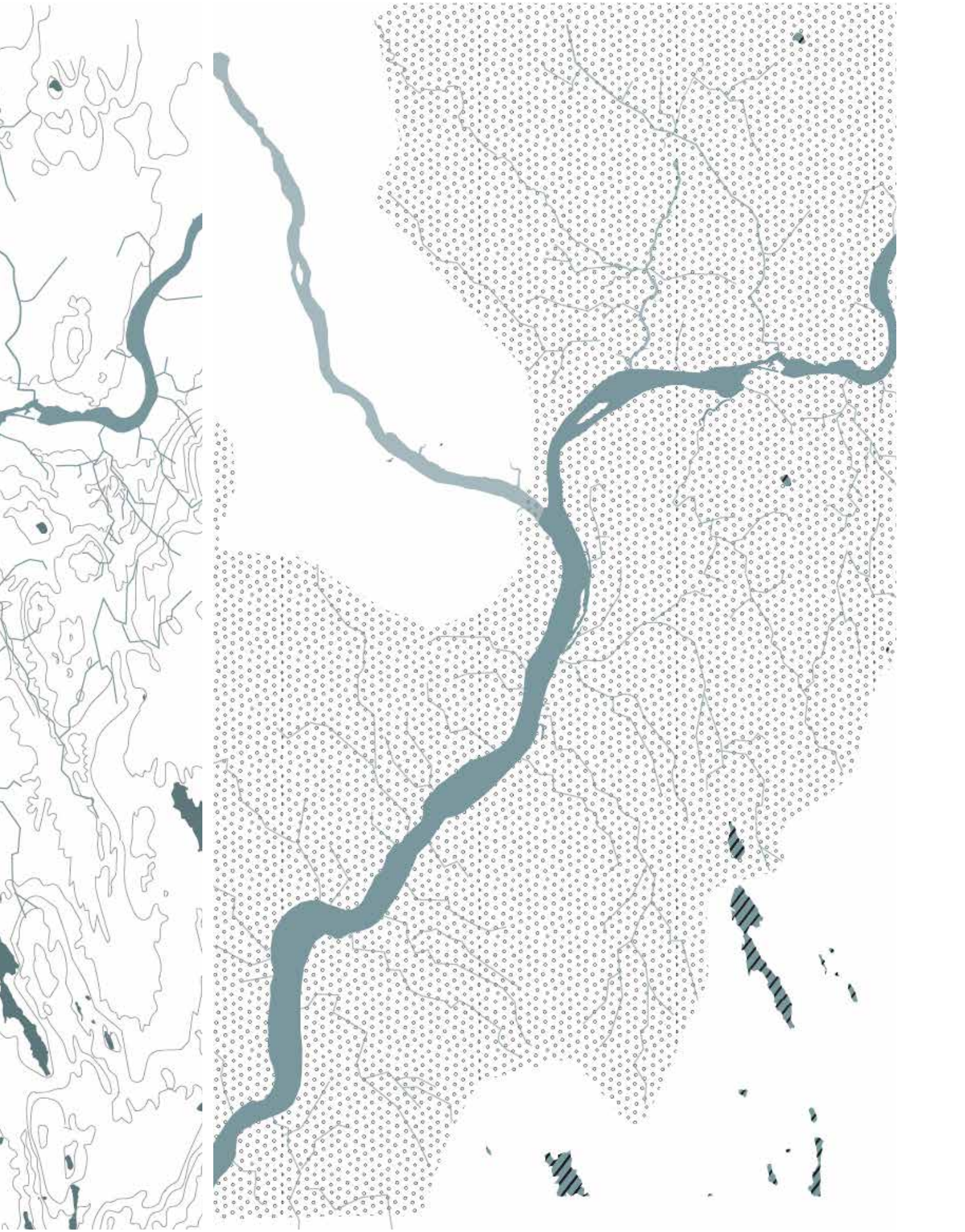
Landscape - Natural water system

Water plays a very large role in Norway - it is everywhere. From the world famous fjords to their main source of sustainable energy.

In this page the natural water system is shown. The Glomma has a catchment area of 41 000 m2. Not counting the catchment area of the Vorma, which as we can see on the right, flows into the Glomma.

In higher laying grounds there are some lakes.





Landscape - Human intervention

As the main environmental risk is flooding, most human interventions are with the purpose of protecting humans against these waters. Dams are in the main river, as well as smaller streams.

Flood plains can be found along the shore on some places and river inlets can also take up amounts of water.

Pictures (source: Google Maps) show the objects that are actually there.

Water is part of the Norwegian culture, as can be seen in the flooding stone that shows the height of the Glomma in the most extreme situatiosn, as to remind people what can happen.











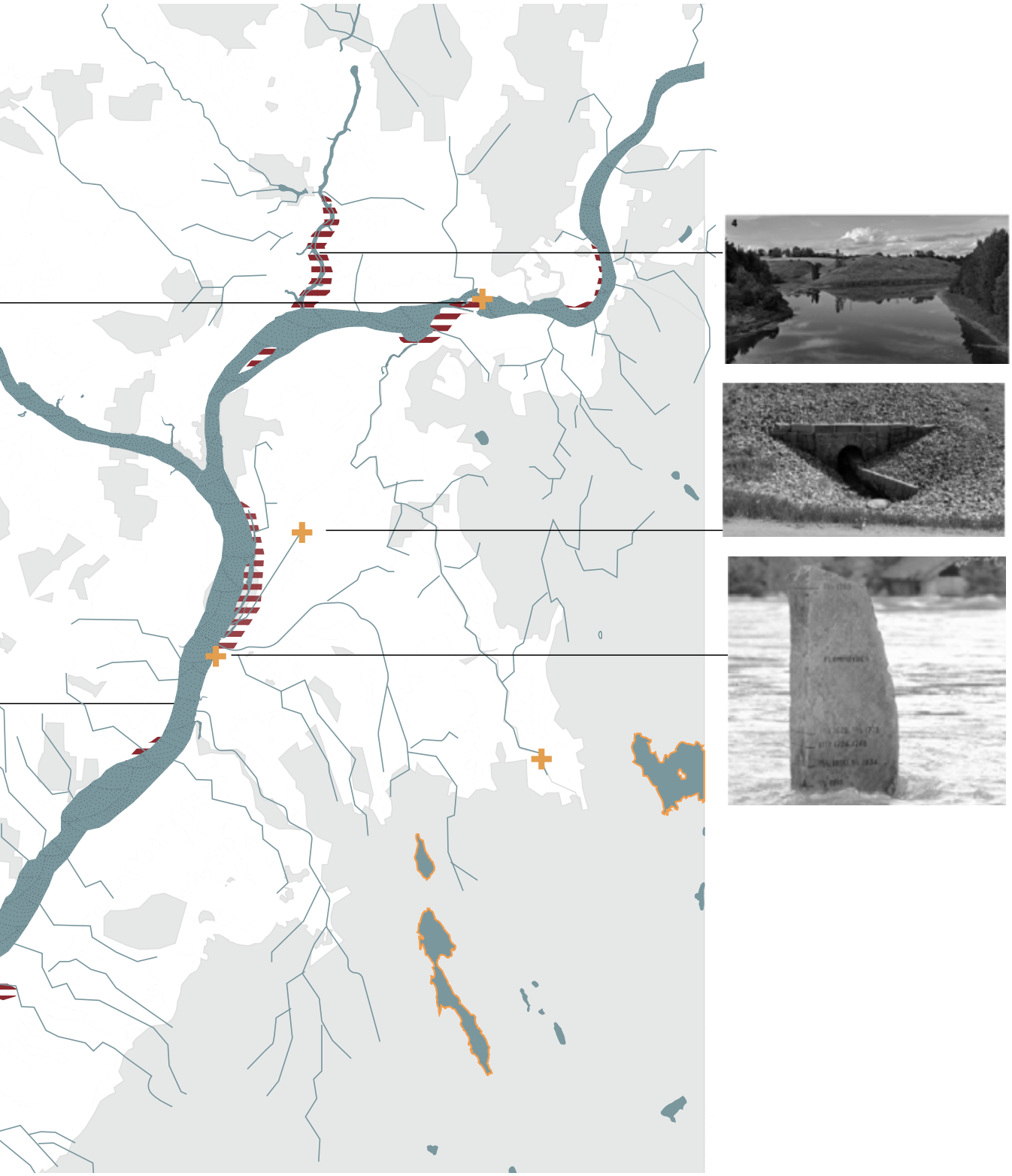


Human reaction

Wate
Dammed lake
Reactional object
Flood plain

N

0 2,5 km



Landscape - Biotopes & ecotopes

Characteristic of this landscape are the edges of the different spaces. As can be seen on the map, there is a clear distinction between the typologies of the different areas.

There are four main ecotopes; the forest, agriculture land (fields), riparian zone and the river itself. On the edge of these landscapes, there can be another type of ecotope.

Landscape - Soil

The soil everywhere is made up of clay. It is most fertile land of Norway, and therefore the function of this land is mostly agriculture.

The soil here in Norway is very young, because of the ice that had been here. Therefore nutrients are very different from the rest of Europe.

Disadvantages are that there is not a lot of infiltration, and landslides can occur when it is too wet. This is quite dangerous.

Ecotopes

Here you can write a brief explanation.
Use as much text space as needed.

- Water
- Urban
- Forest

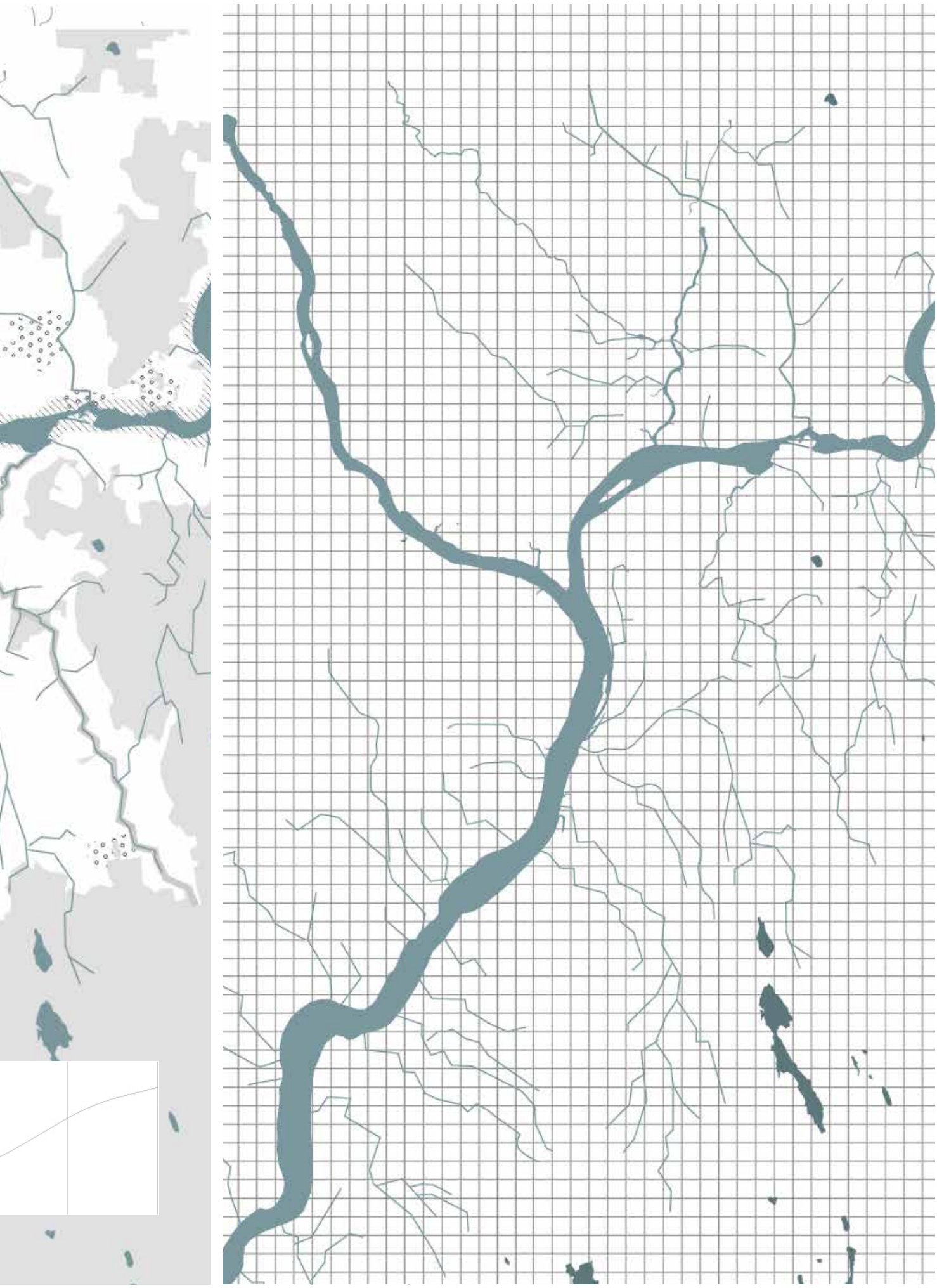
Soil

- Clay



N

0 2 km

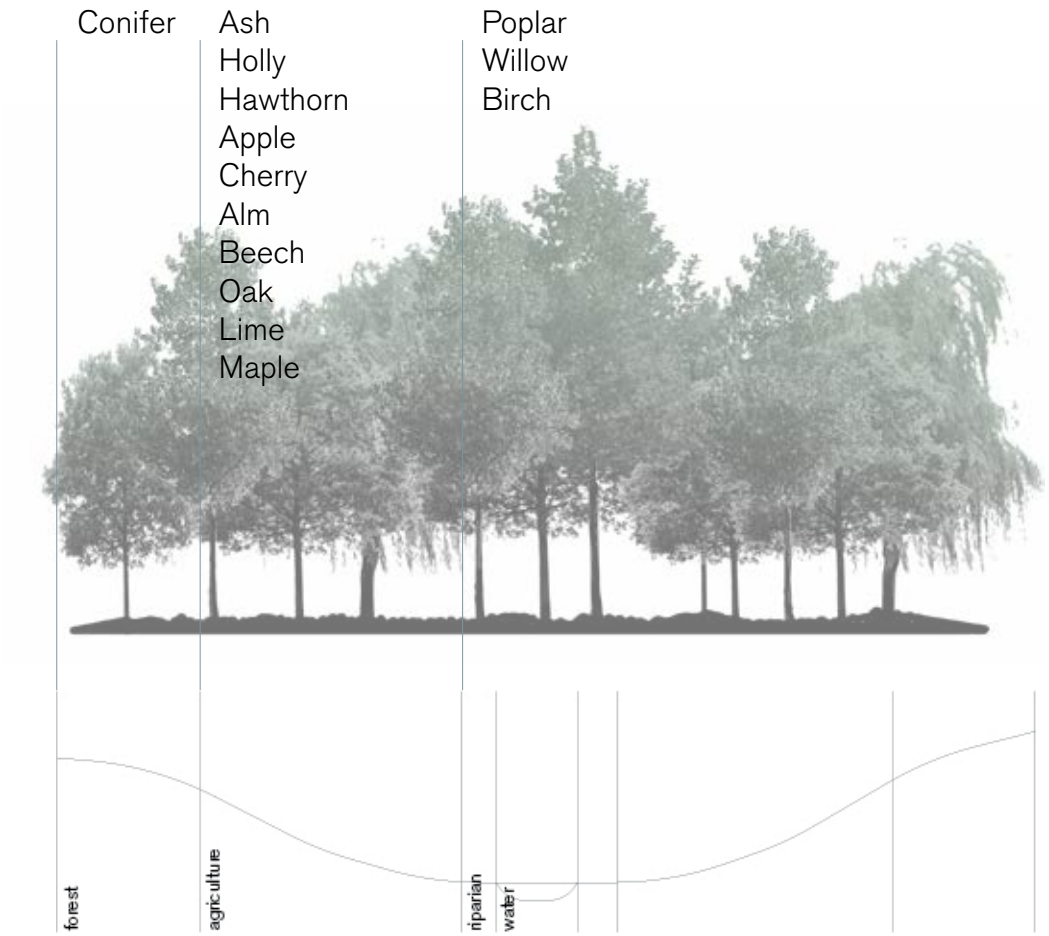


Landscape - Flora

Because the clay ground is very fertile for many trees, there is a broad range of trees and plants to be found in Norway.

Along the river, the trees that can live on wetter grounds, such as birch, poplar and willow, on higher grounds are trees that live with less water, such as different kinds of conifer trees.

Plants have to be winter proof. As the winters here can be long and hard, roots can freeze easily.



Landscape - Fauna

In this very green zone, there are a lot of animals to be found. Firstly, a list of species that can be hunted and fished. This is also Norwegian culture and therefore important to know.

Fish: pike, grayling, trout, whitefish, perch, roach, bream, halibut, redfish, rainbow trout and lake are species that can be fished here.

Mammals (hunt): reindeer, moose, regular deer, rabbits.

Even though the province is very green, there are a lot of species red-listed. Here is a list of the most well known, red-listed species for this area:

two-colored hoverfly, brown bear, stink wreath, dwarf smooth wreath, southern metal water nymph, large blue dragonfly, fragile wreath, spike smooth wreath, barkless wreath, two-spot eye sticks, moon blue water nymph, bryozoan, rigid ring, seaweed river dragonfly, club river dragonfly, river mussel.



Landscape - Pollution

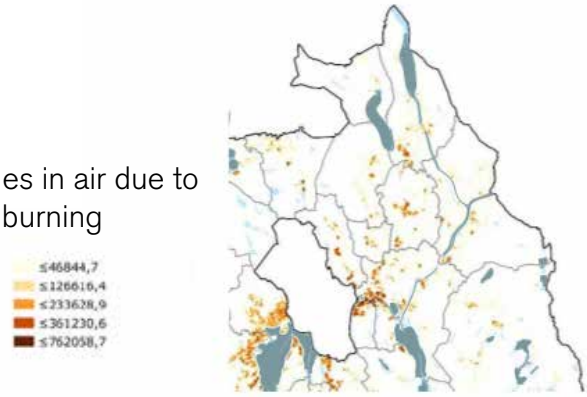
The general pollution level in Årnes is low. It is situated in a forested area and a high amount of clean water flows through. Noise pollution is only calculated along train and larger roads. This does not affect a very large area, but only the surrounding area a little bit.

You can see in the province there is a higher number of polluting particles in the air, due to wood burning. However, this is not too high legally.

Landscape - Climate and temperature

Arnes knows an inland climate, with warm summers, cold winters and not too much of precipitation. This is caused by the mountains on the west side. As you can see in the wind map, they provide shelter for a lot of wind that comes from the sea.

particles in air due to wood burning

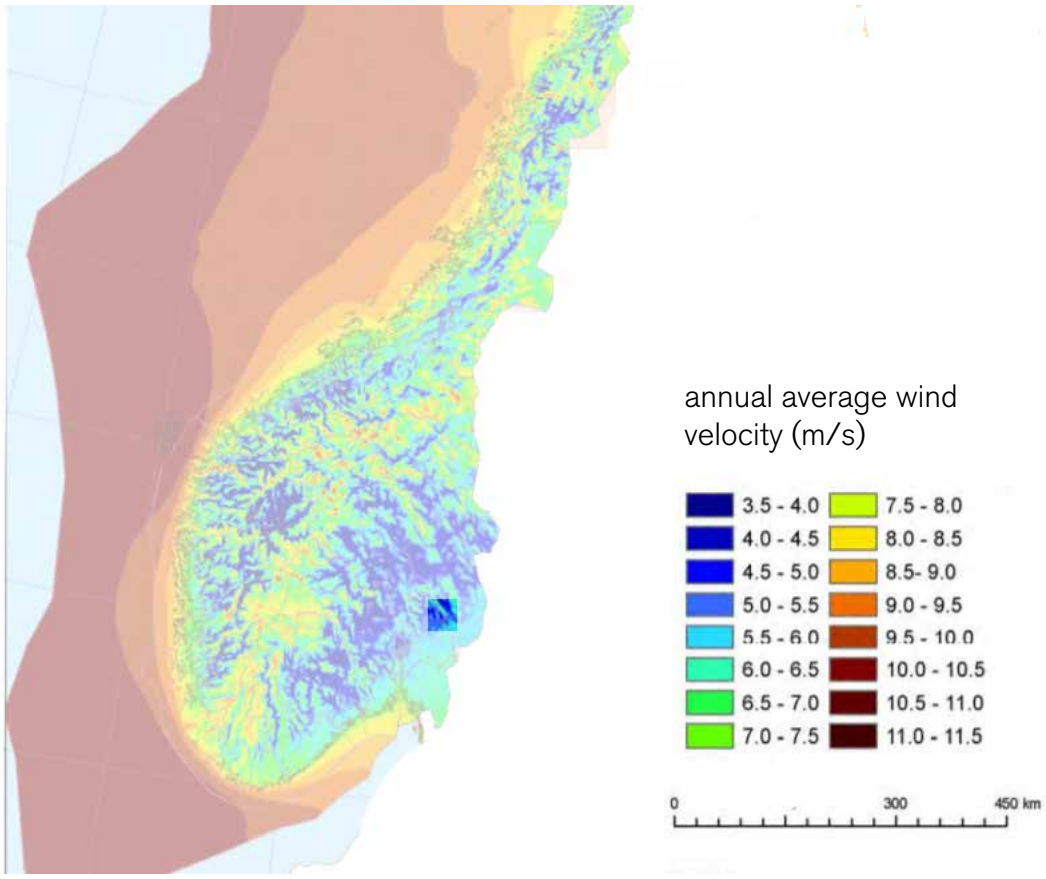


Pollution

Maps of respectively sound, air and water pollution

water Glomma	measurement	condition 1(bad)-4 (very good)
periphyton	7	4
fouling algae	13	3
ground fauna	5,6	2
fish	n.a.	1
acidification	0,25 mmol/l	4
nitrogen	439 mmol/l	4
phosphorus	9,5 mmol/l	4
lead	0,12	3
nickel	0,62	3
cadmium	0,01	3

	Jan	Feb	maart	Apr	mei	juni-	juli-	Aug	Sep	Is gestegen	Nov	Des
Dag	-3 °C	-2 °C	2 °C	9 °C	15 °C	18 °C	22 °C	20 °C	15 °C	8 °C	3 °C	-1 °C
Nacht	-7 °C	-7 °C	-4 °C	1 °C	6 °C	9 °C	12 °C	11 °C	8 °C	3 °C	0 °C	-5 °C
Regenval	14 mm	15 mm	16 mm	16 mm	29 mm	30 mm	32 mm	28 mm	16 mm	22 mm	17 mm	15 mm
Dagen van regen	2	2	4	9	12	12	14	14	8	8	7	3
Dagen van sneeuw	12	13	10	4	0	0	0	0	0	1	5	12
Dagen blijven weer	17	13	17	17	19	18	17	17	22	22	18	16
Zon uren per dag	3	3	5	8	9	12	11	9	8	4	3	2
Windsnelheid in Bft	2	2	2	2	2	2	2	2	2	2	2	2
UV-index	1	1	2	3	4	5	5	4	3	2	2	1

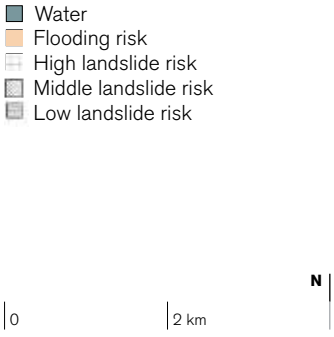


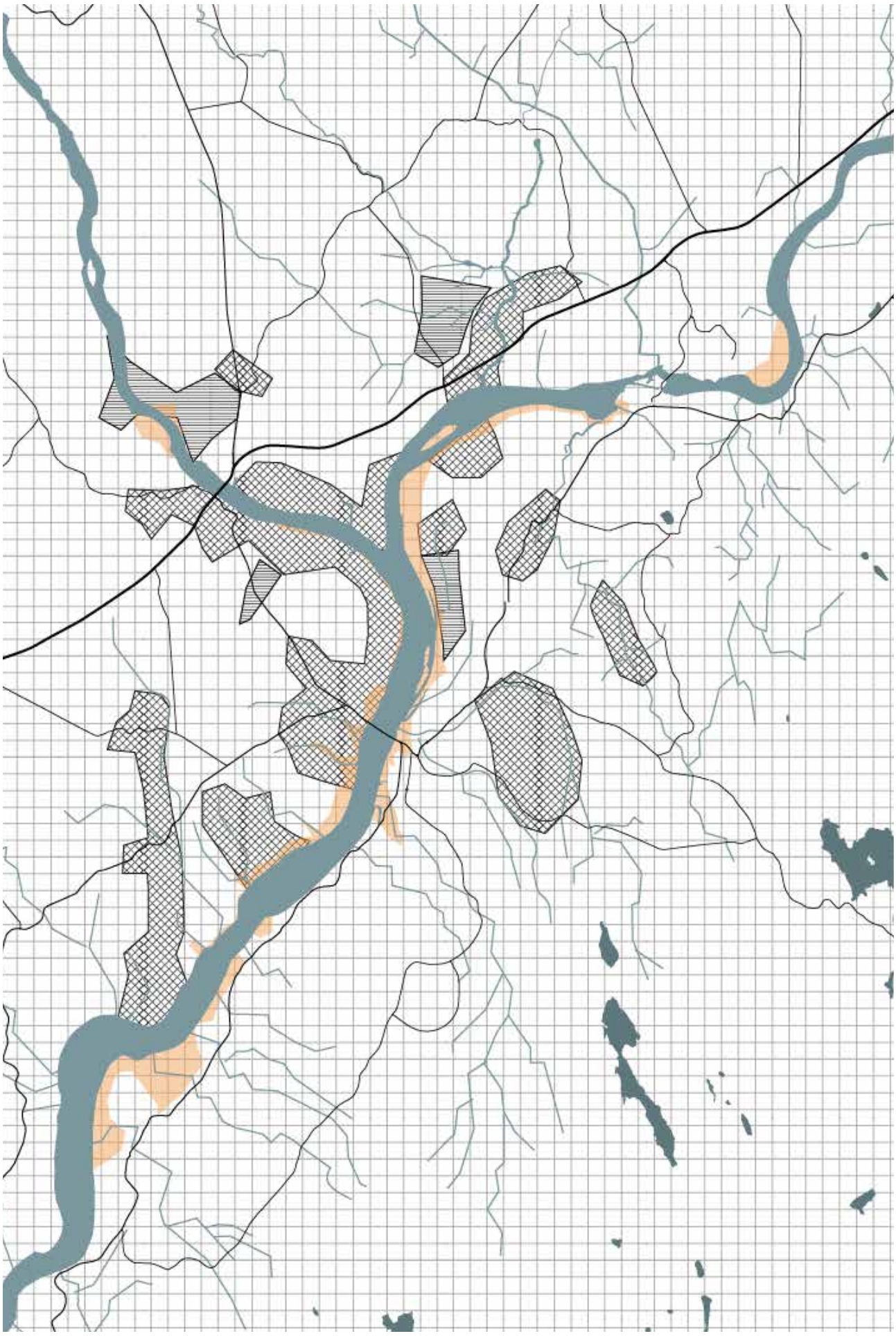
Landscape - Dynamics

The dynamics of the site are also the ecological risks that Arnes has to deal with. Flooding can occur every so years, like the big flood in 1995.

As said before, the soil is made entirely of clay. Next to this being extremely fertile, it is also very dangerous. When there is a lot of precipitation, it can cause the clay to slide and destroy entire houses.

Flooding and landslides





Landscape - Synthesis landscape & ecology

Arnes is located at a special place, where the Vorma & Glomma collide and move further south together. The river banks are very green, and almost everywhere completely natural. There are not a lot of flooding areas as terrain quickly rises.

Higher up you can see the forest with a stark line. This line does not change over the years. Agriculture makes up for most of the rest of het land.

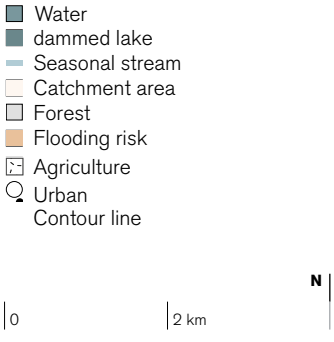
The lakes in the forested area are dammed - and are used to save up for energy generating and also for drinking water of the entire province of Viken.

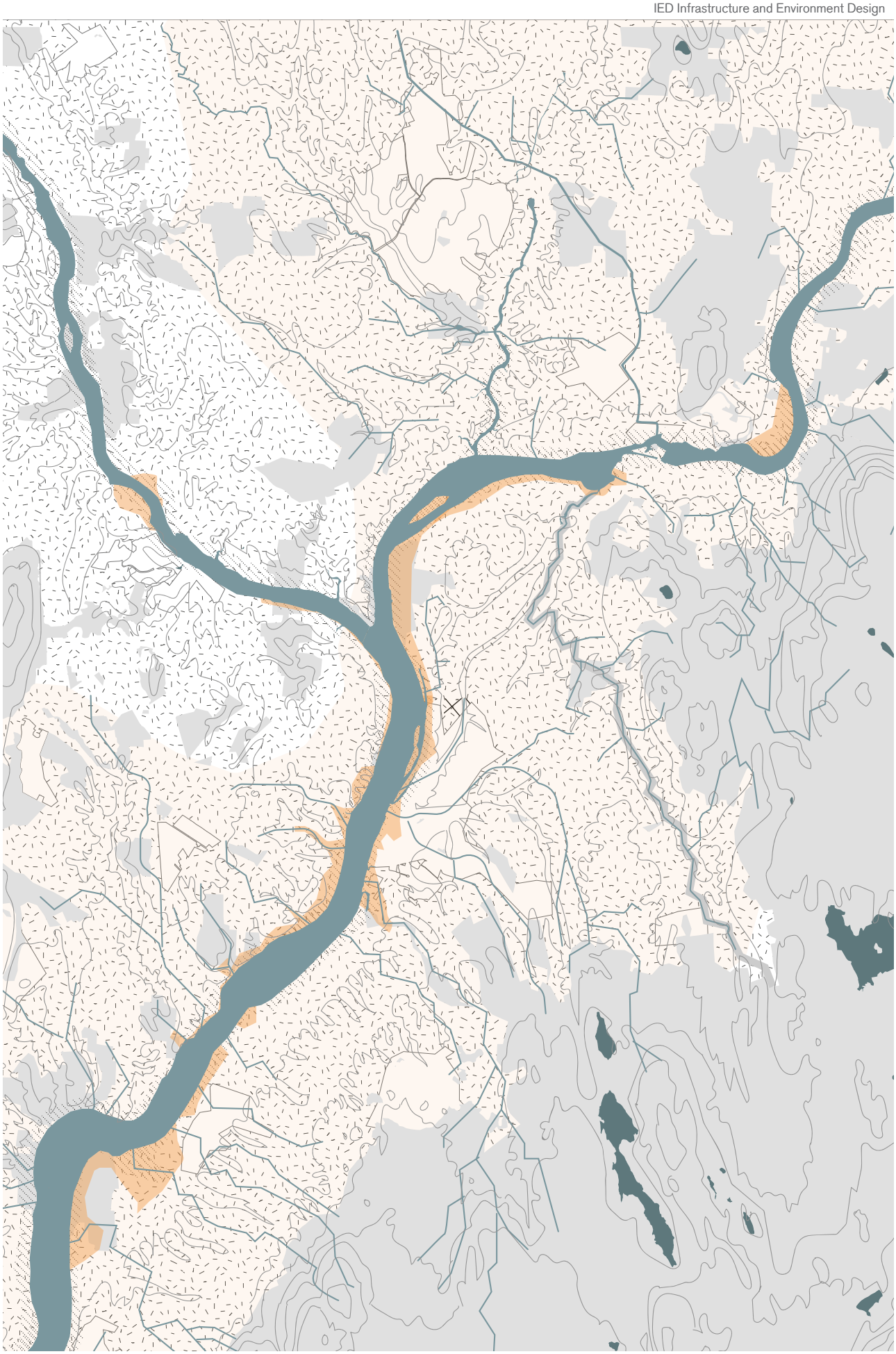
The catchment area of the glomma is put in orange - you can see very clearly that this one river has a huge impact. The catchment area of the Glomma consist of 13% of Norway. All the streams bring this water into the river.

The towns are scattered along this terrain - most of them along the river but with the coming of the highway etc, they become even mroe scattered.

Synthesis

A summary of most important finds



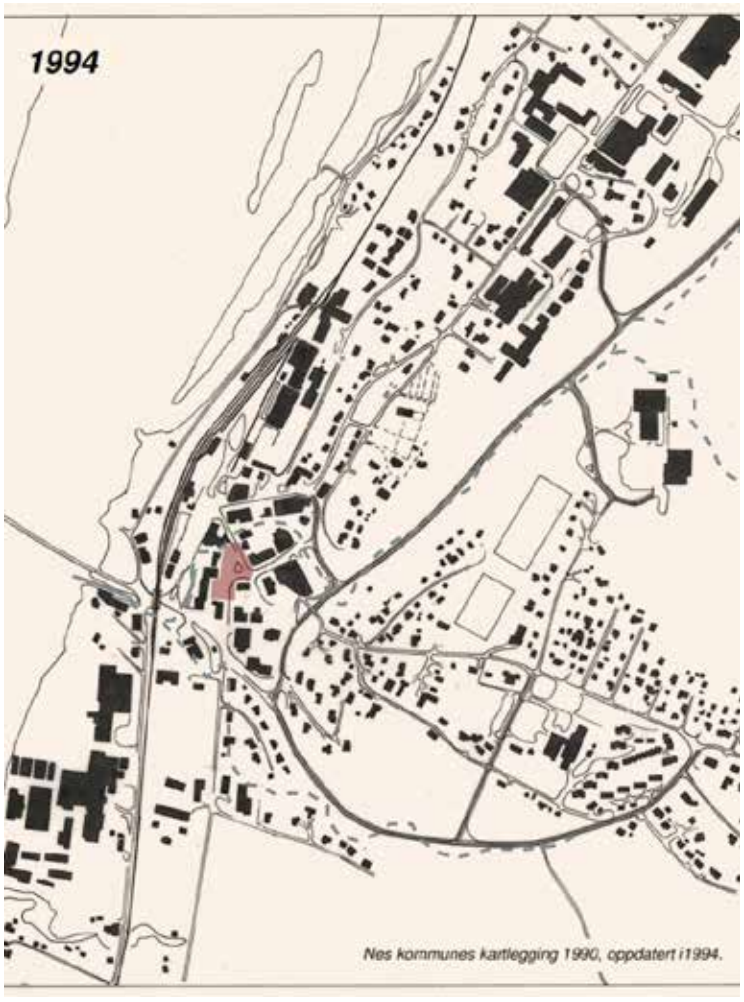


Urbanism - Historical

The historic town of Arnes grew around the coming of the railroad, with the center of town around the railway station. The town consisted of several streets that connected with other towns (historical routes), as well as a bridge over the river Glomma. These roads connected at a square in front of the railway station. Noticable in the historic maps is two streams, one of which goes right through the center, both connecting to the river Glomma in a small inlet.

Over time, as Arnes grew, the central square shifted away from the railway station and more towards the middle of the old town, where the town hall was built. During this time, the disappearance of the two streams becomes apparent. While in 1936 the streams are clearly visible, by 1973 the southern stream has gone and by 1994 both streams are replaced with major roads and built up area. While the stream remains underground, canalised, the switch from open stream to major road is quite telling. The present day situation shows the underground, canalised streams, with two open parts: past the town hall and to go underneath the train tracks.





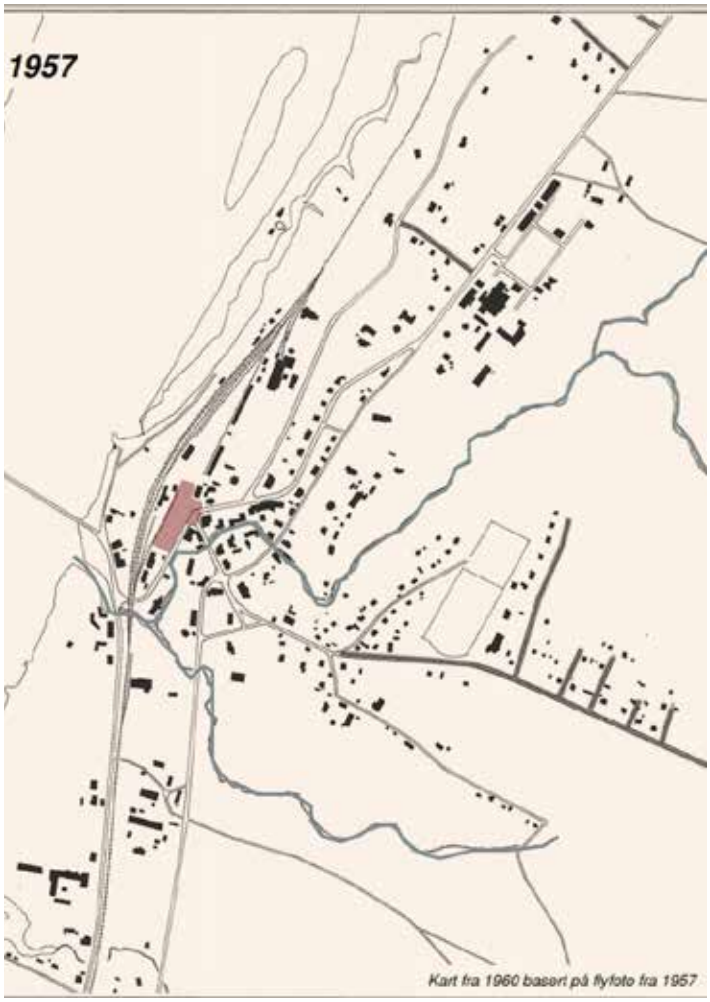
Arnes - progression through time

Disappearance of streams and moved town center on the map.

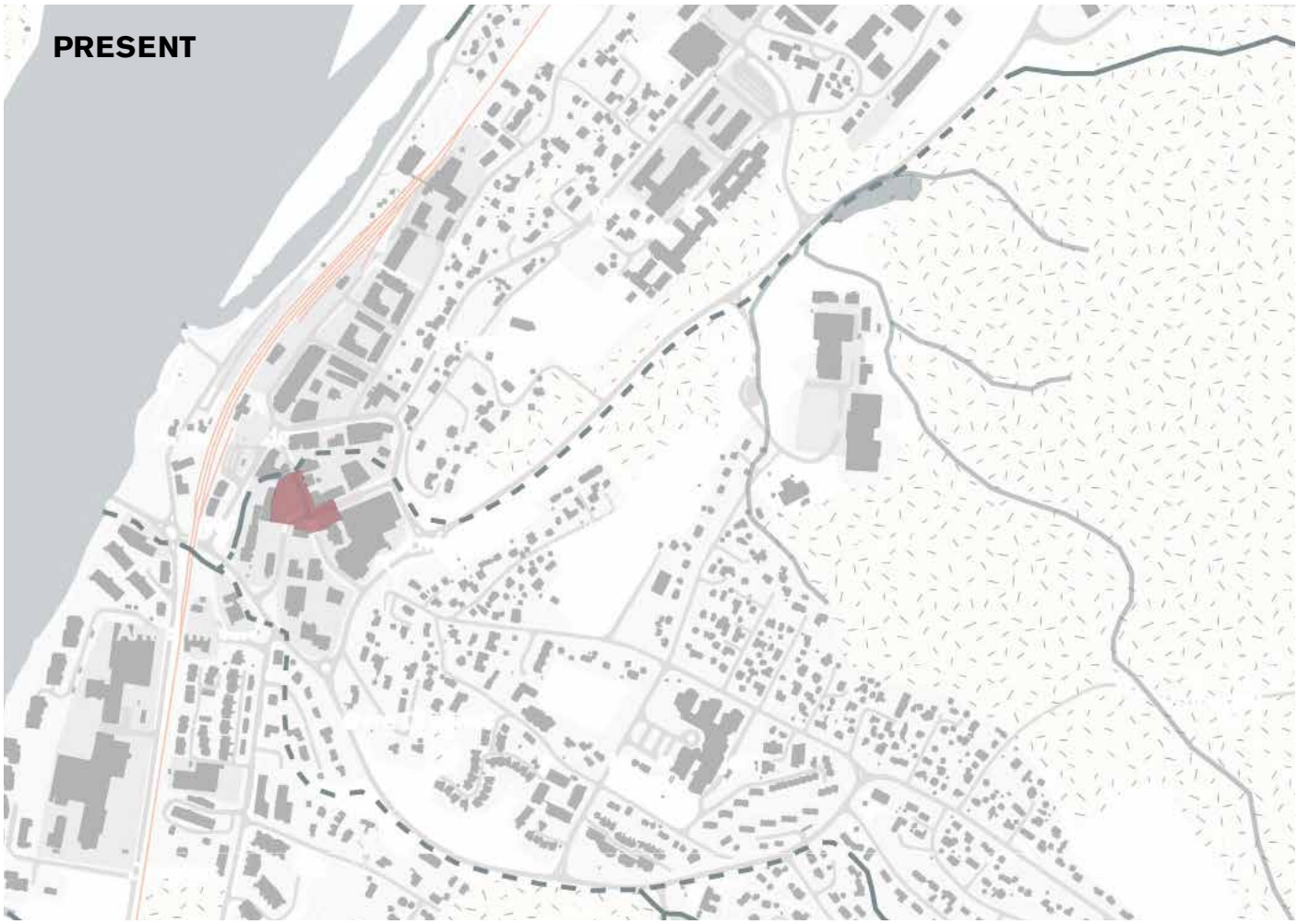
- Open water
- Underground water
- Central Square

N

0 200 m


1957
Kart fra 1960 basert på flyfoto fra 1957


1973
Økonomisk kartverk 1976, basert på flyfoto fra 19


PRESENT

Urbanism - Historical

There are many historical elements remaining in the town of Arnes. These are mainly buildings that are present in the center or its surrounding. Historical routes between towns are akso still quite evident, mostly remaining untouched since they were made. The historic town center near the train station is also still an important point in town.







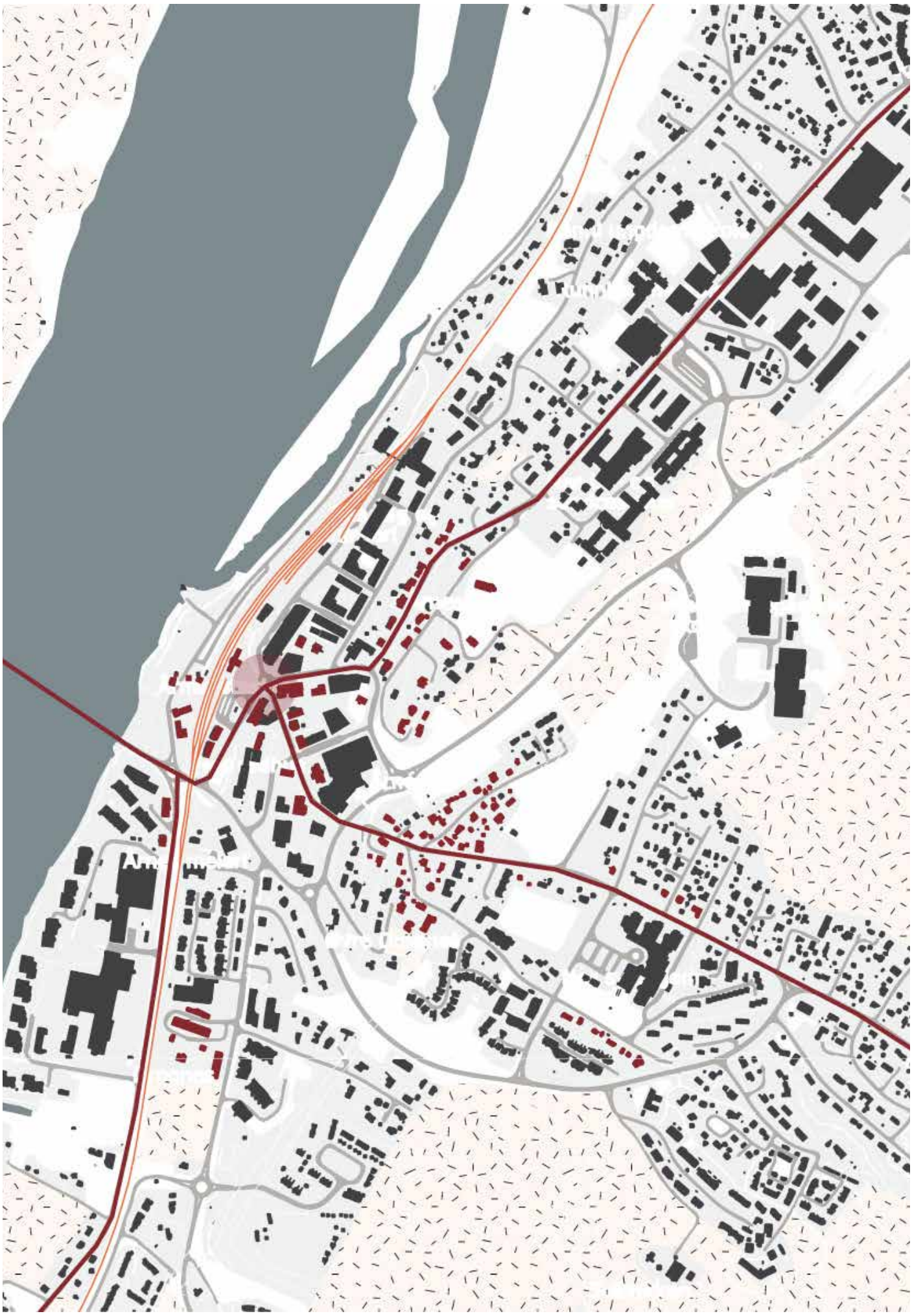
Arnes - historic elements

Remaining historic elements, like buildings and connections

- Historic buildings
- Historical center of town
- Historical routes

N

0 200 m





Urbanism - Housing

Housing programme in Arnes mainly exists in three typologies: small green, medium green and medium gray.

The small green typology is the most occuring, and can be described as a one to two story, family house surrounded by a green yard - usually grass.

The medium green typology is similar, except in apartment form. This consists of a three to four story building surrounded by greenery, with a shared entrance and surface parking nearby.

Medium gray is slightly different, as this only occurs in the town center and there are only a few examples. This typology consists of a three to five story building, in a block formation, surrounded by sidewalk, a street and surface parking. The interior of the block is often green. This typology can be seen as a more “urban” form of housing, more commonly found in larger cities.





Arnes - housing programme

An overview of housing programme in its different forms, with examples on the ground and on the map.







Urbanism - Non-housing

Non-housing programme in Arnes mainly exists in two forms: small and large. Large non-housing programme has a recurring form of a large building surrounded by a large amount of ashpalt, for parking or other reasons. the small non-housing programme mainly consists of stores or small offices and is often located in the center and specifically the historical buildings.

Due to the small non-housing programme being in the center and the large non-housing programme containing a large amount of asphalt surrounding the buildings, non-housing programme in general is correlated in Arnes with a large amount of impervious surface, creating a barrier between the landscape and fields in the east and the river in the west.







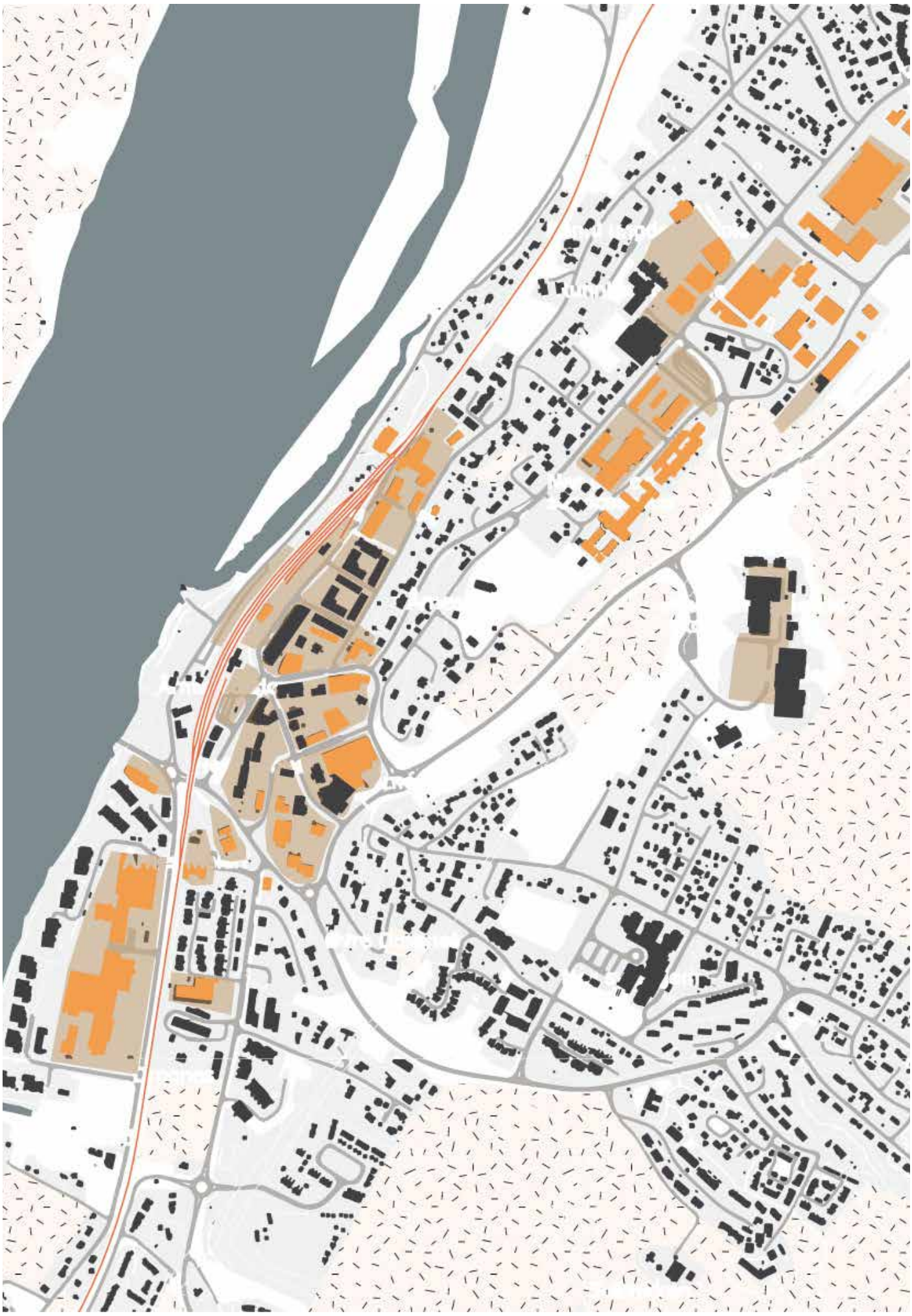
Arnes - non-housing programme

Non-housing programme and impervious surface on the map

- Non-housing programme
- Impervious surface
- Buildings
- River
- Fields

N

0 200 m









Urbanism - Centralities

Within the town of Arnes are several public spaces where people come together. These places are the historical center in front of the train station, the (new) town center in the middle of the old town and in front of the town hall, and a particular area along the waterfront.

The historical center in front of the train station has been the place where the town grew around and is still an important area for people, as the central area where the public transport modalities come together, as well as the main entrance to the city when coming by train.

The (new) town center is a square in front of the town hall, in the middle of the old town and surrounded by many historic buildings. This is the de facto “center” of town, when it comes to public space

Along the waterfront, behind the station, is a central area for people to congregate for river-based recreation. It features a harbour, park, the start of a walking route along the river, as well as parking facilities.

The AMFI shopping center could be seen as a central area of the town, however it is not a public space, rather just a large building, and therefore is not included.

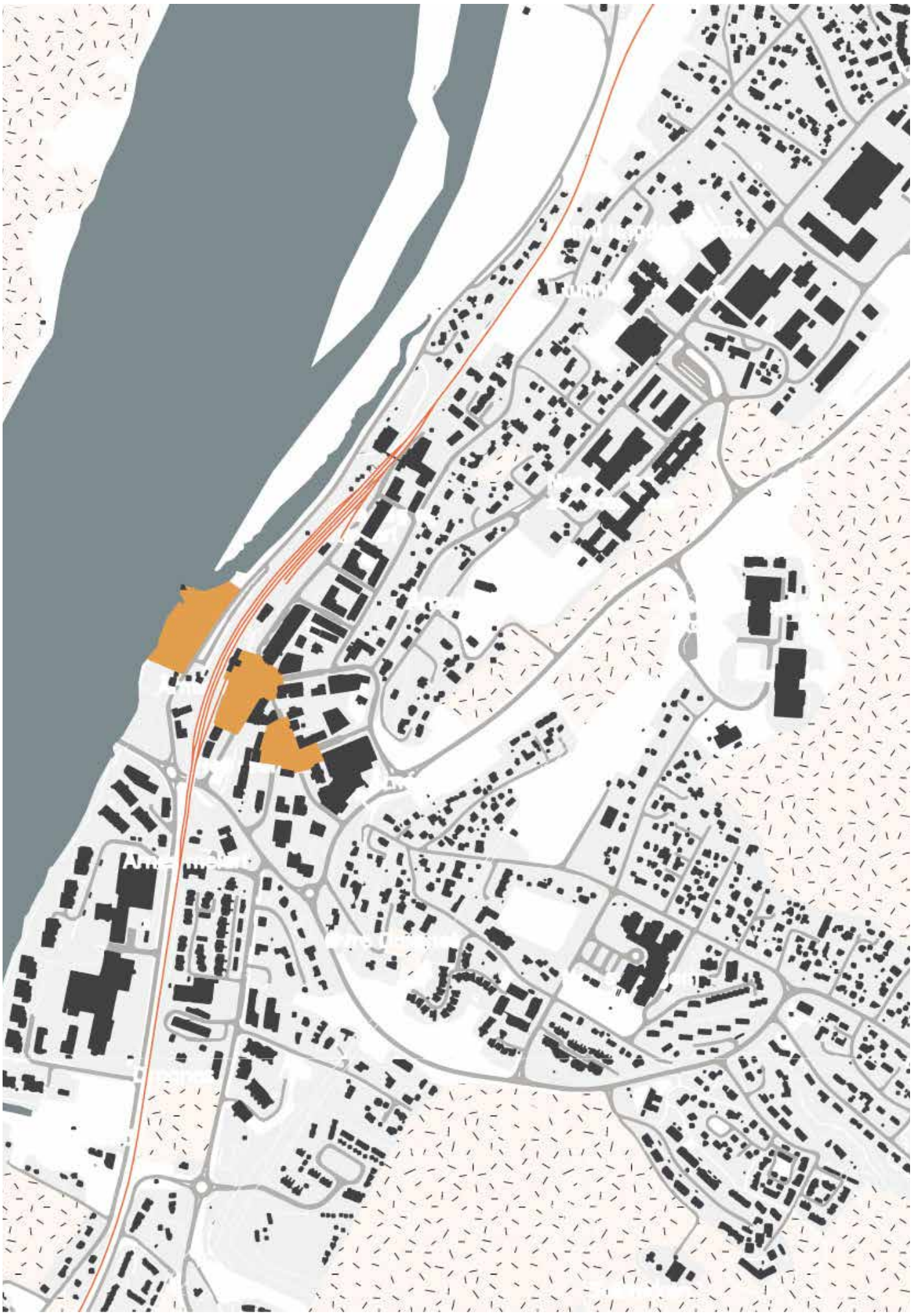
Arnes - centralities

Public spaces for congregation on the map

- Central area
- Buildings
- River
- Fields

N

0 200 m





Urbanism - Population increase

There are several big building sites within Arnes, these are mostly for building medium-density housing. Consisting of typologies similar to the “medium green” or “medium grey” typologies mentioned in the housing section.

Arnes is a town with a large expected increase in population from people leaving Oslo in search for cheaper housing. As the town is quite rural, it is a good location to enjoy the landscape as well.

The town lies about 45 minutes away from the center of Oslo by train. Because of its interesting surrounding, cheap(er) housing costs and relative distance from Oslo, many people commute to work daily to Oslo from Arnes. Causing Arnes to become more of a sleeper town of Oslo, where many people are away during daytime on weekdays, looking for local leisure activities during the weekend.





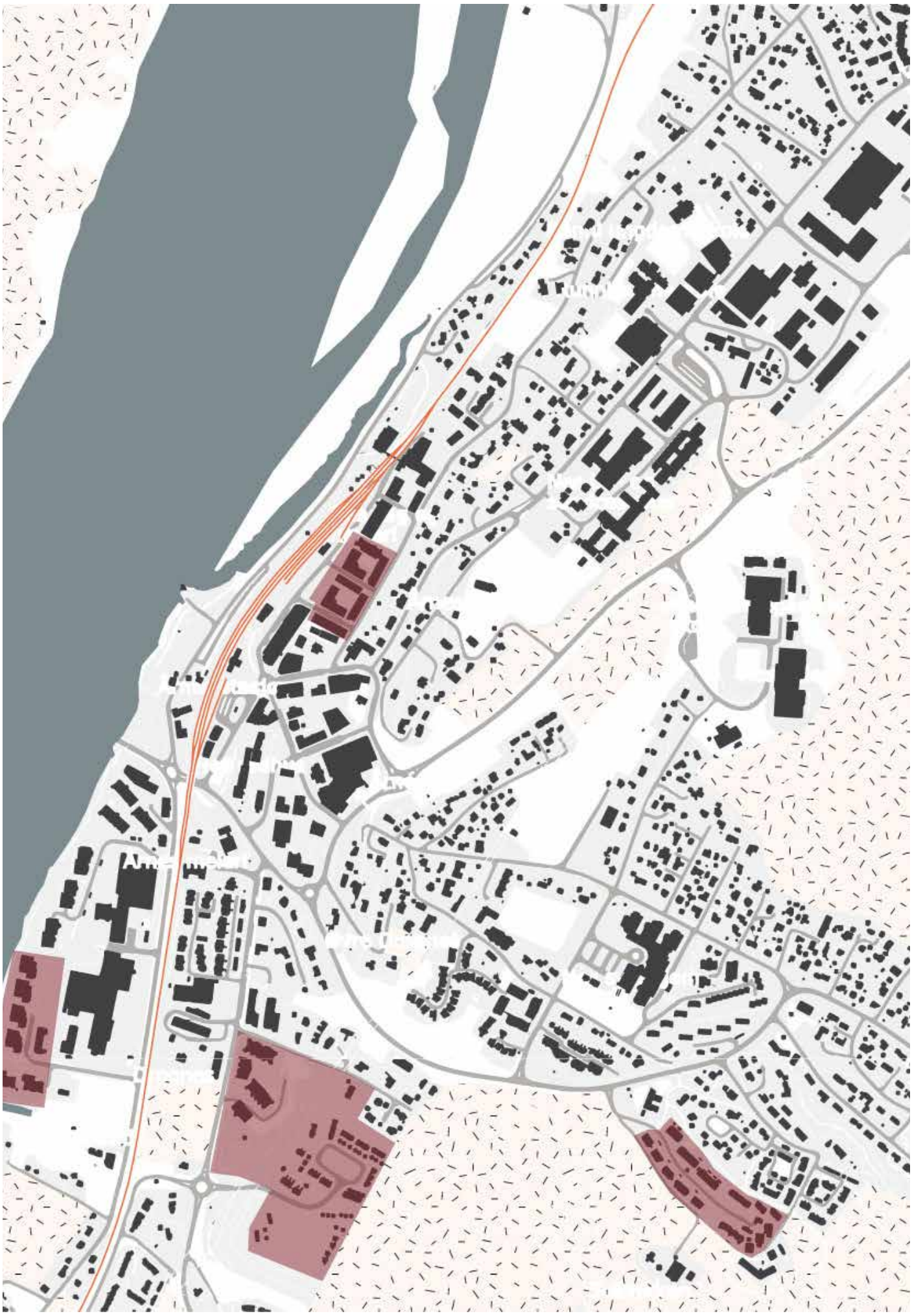
Arnes - building sites

Current sites in Arnes where new housing is being developed on the map

- Building site
- Buildings
- River
- Fields

N

0 200 m



Urbanism - Synergy

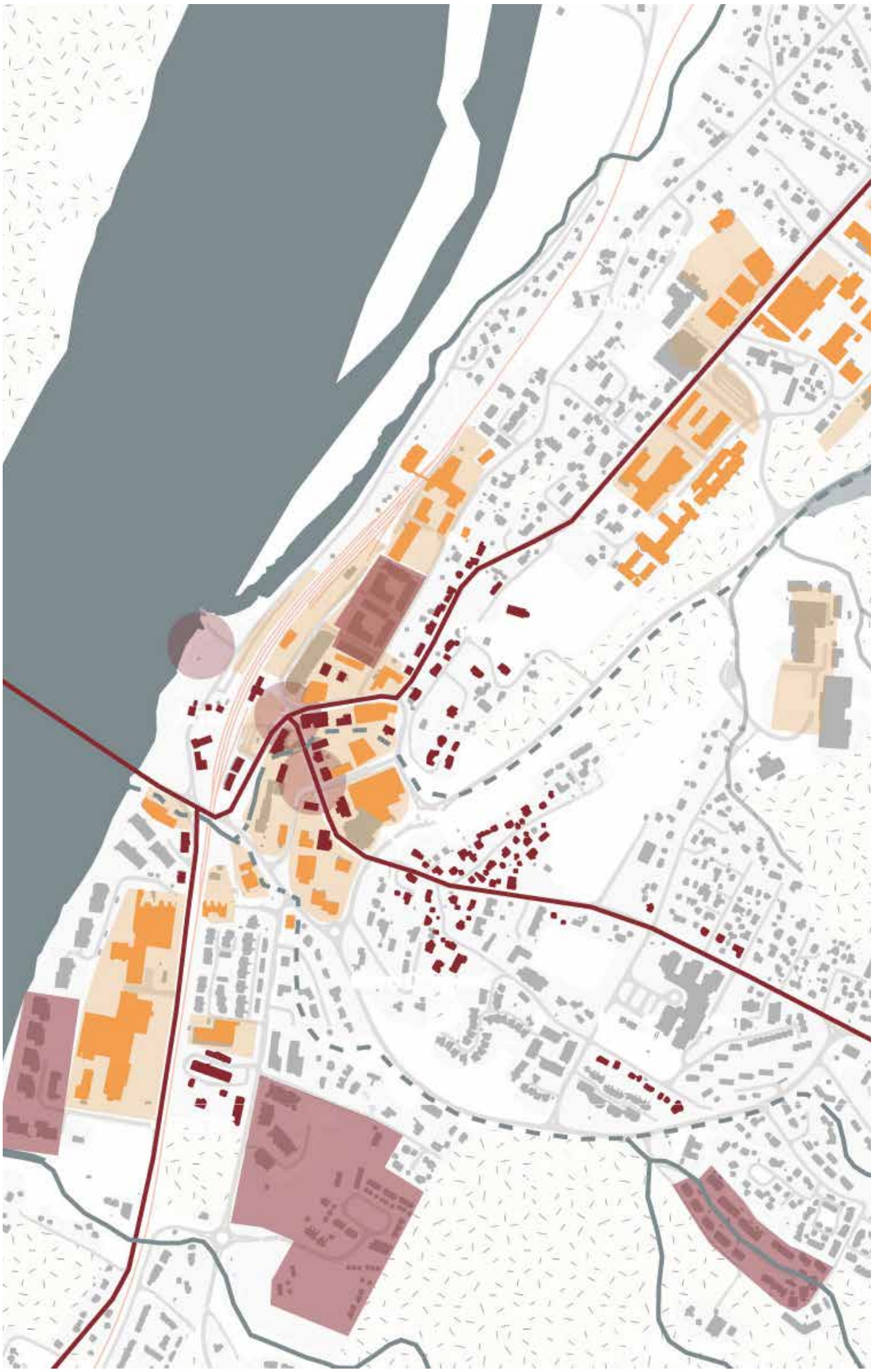
The synergy map brings together aforementioned topics into one map, and makes visible where different topics' area of effect is in accordance to one another. This is valuable, as it shows which areas may be influenced by multiple topics and it can therefore be used as a map of complexity of sorts.

While most areas are limited to one topic's effect, such as the large development areas in the south, the various swaths of impervious surface along the middle and the centrality on the river's coast. There is one big area where quite a few area of effects overlap: the center. The center of Arnes is an area that has contains many of the identified topics, and the assumption can be made that any developments within this area per topic would have externalities in other topics. In other words, the area has been identified as having a big potential for interventions which may create an overall synergetic effect.

Arnes - synergy

Combination of aforementioned topics on the map





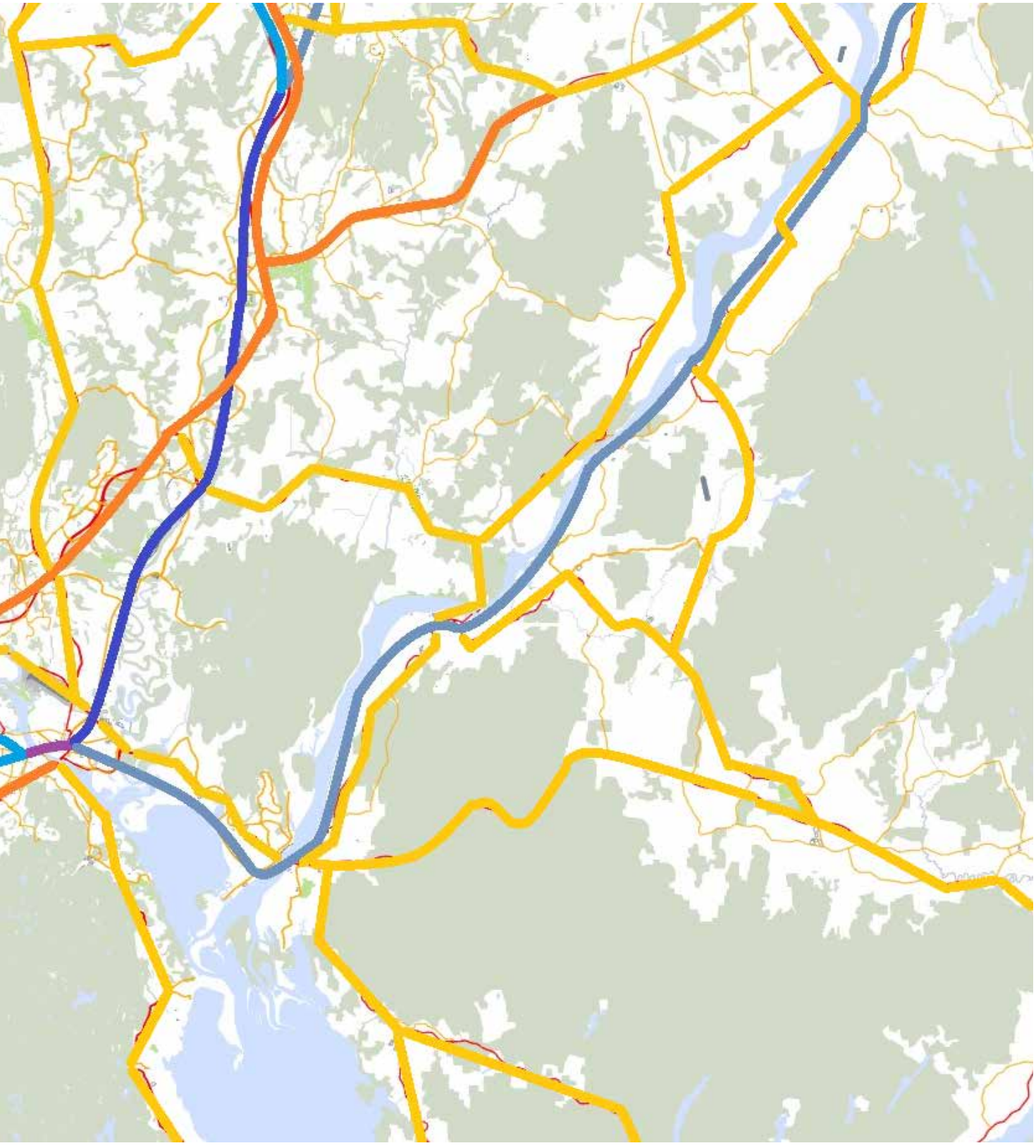
TIL critical cartography

From carrying capacity:
There are several infrastructural arteries reaching out from Oslo towards the eastern countryside. These serve as the supporters of the flows of commuters during morning and evening peak hours. Both for the rail and road arteries, a tree network can be seen, with the closer one gets to Oslo, the more compacted and higher capacity the infrastructure becomes. The branches get increasingly less capacity and are more following natural flows such as the Glomma river, especially the railway line towards Arnes. Arnes itself is relatively accessible in relation to Oslo, but certainly not as much as other main lines. Especially the infrastructural arteries towards Hamar, Lillehammer and Ski, Fredrikstad, Halden seem to have a bigger priority, which makes sense as these are far greater urban centers.

From logistics:
The railway station of Arnes is in extremely close proximity to the river and could be used to transfer wood from river to rail or vice versa. Historically, this will have been done as well, however in modern times the railway lines and passenger schedule might not allow for such a hold-up. Arnes station has 2 tracks with platform accessibility and 2 additional tracks without. There is certainly opportunities for increasing water-rail transport connection in the vicinity of Arnes. This goes especially for the station area. For the commuter network, Arnes is relatively quietly placed in the tree of infrastructure leading towards downtown Oslo. Because of this, both the road and rail infrastructure still have access to the waterfront and follow natural flows.

(rail)road network





TIL Framework

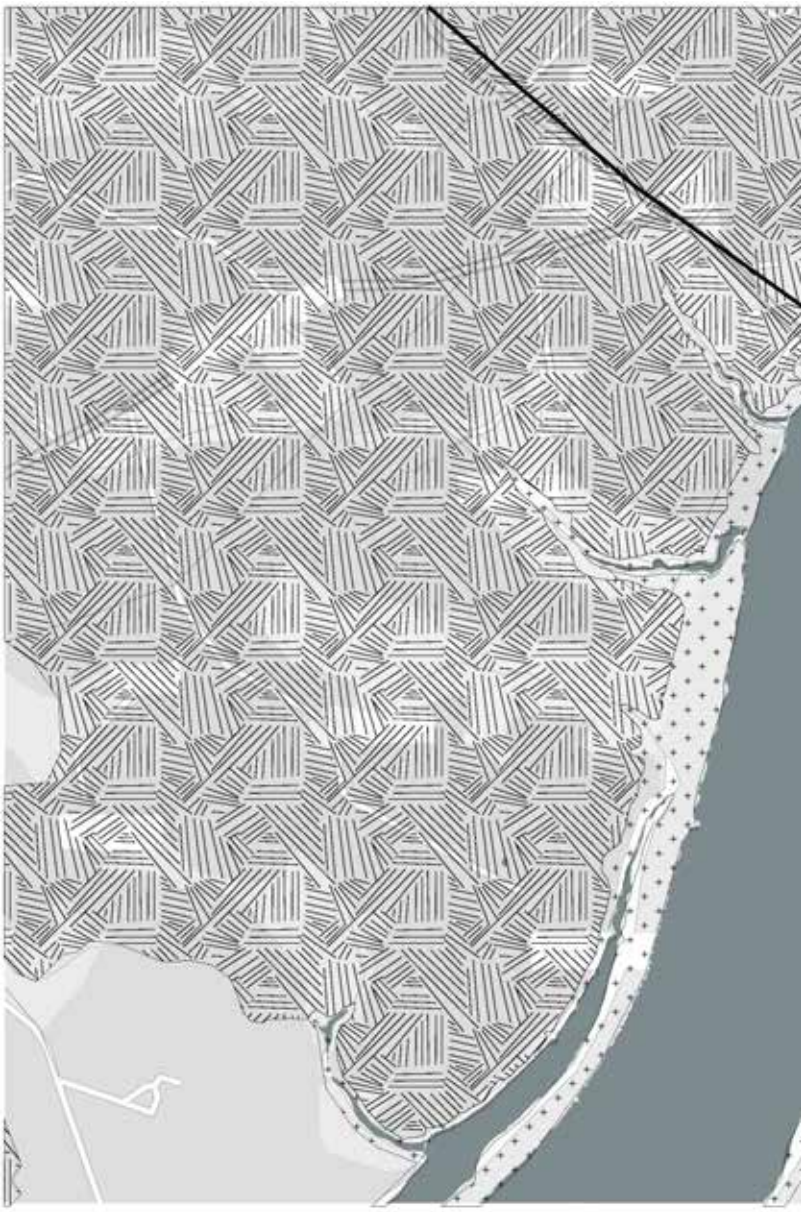
A framework on ecosystem participation and mobility systems			**Transportation of lumber, gravel and sand (Flows, Norway)**
Effects on ecosystem (ecosystem services)	Mobility characteristics	Mobility flows (human transport)	current (trucks) ▪ High speed vehicles intervene with forest new (boats) ▪ Intervening with life under water
		Logistics flows (goods transport)	current (trucks) ▪ High level of emissions ▪ Congestion new (boats) ▪ Relatively low emissions
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* new (river network): ▪ Mining areas stay as is ▪ Potential change of harbour function ▪ Loss of dams *Grey infrastructure:* current (road network): ▪ Deforestation ▪ Excavation of the soil
		Transport links:	*Green infrastructure:* new (river network): ▪ Potential need for broadened river ▪ Removal of dams in the river *Grey infrastructure:* current (road network): ▪ Environmentally burdenful maintenance
Socio economic effects	Mobility characteristics	Mobility flows (human transport)	current (trucks) ▪ Relatively large amount of truck drivers new (boats) ▪ Loss of trucker jobs ▪ Rearrangement of supply chain
		Logistics flows (goods transport)	current (trucks) ▪ Driver of national economy new (boats) ▪ Driver of local economy
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* new (river network): ▪ Stay as is, nodes do not change *Grey infrastructure:* current (road network): ▪ Mining jobs and logging economy

			Transportation of lumber, gravel and sand (Flows, Norway)
Socio economic effects	Infrastructure characteristics	Transport links:	*Green infrastructure:* new (river network): ▪ Less floodings ▪ More boats that interfere with life on water *Grey infrastructure:* current (road network): ▪ Construction of additional lanes need to bigger barriers for locals/animals ▪ More houses near highways lessen in value
Critical transport evaluation	Mobility characteristics	Mobility flows (human transport)	current (trucks) ▪ Road network new (boats) ▪ River flows ▪ Rail network ▪ Transfer points
		Logistics flows (goods transport)	current (trucks) ▪ High speed new (boats) ▪ Large capacity ▪ No congestion due to external traffic
	Infrastructure characteristics	Activity nodes:	*Green infrastructure:* new (river network): ▪ Small distrance towards river network *Grey infrastructure:* current (road network): ▪ Immediate access to road network
		Transport links:	*Green infrastructure:* new (river network): ▪ Weather-dependant links *Grey infrastructure:* current (road network): ▪ Need for periodical maintenance
Guidelines			
Ecosystem participation	Natural structures	Characteristics	▪ Make use of intermodal transport, following natural flows
	Guidelines	Mobility characteristics	▪ Little intervention with nature ▪ Low level of emissions ▪ High transport capacity ▪ High transport speed
		Infrastructure characteristics	▪ As little maintenance as possible ▪ Easy to access network ▪ As little influence on residents as possible

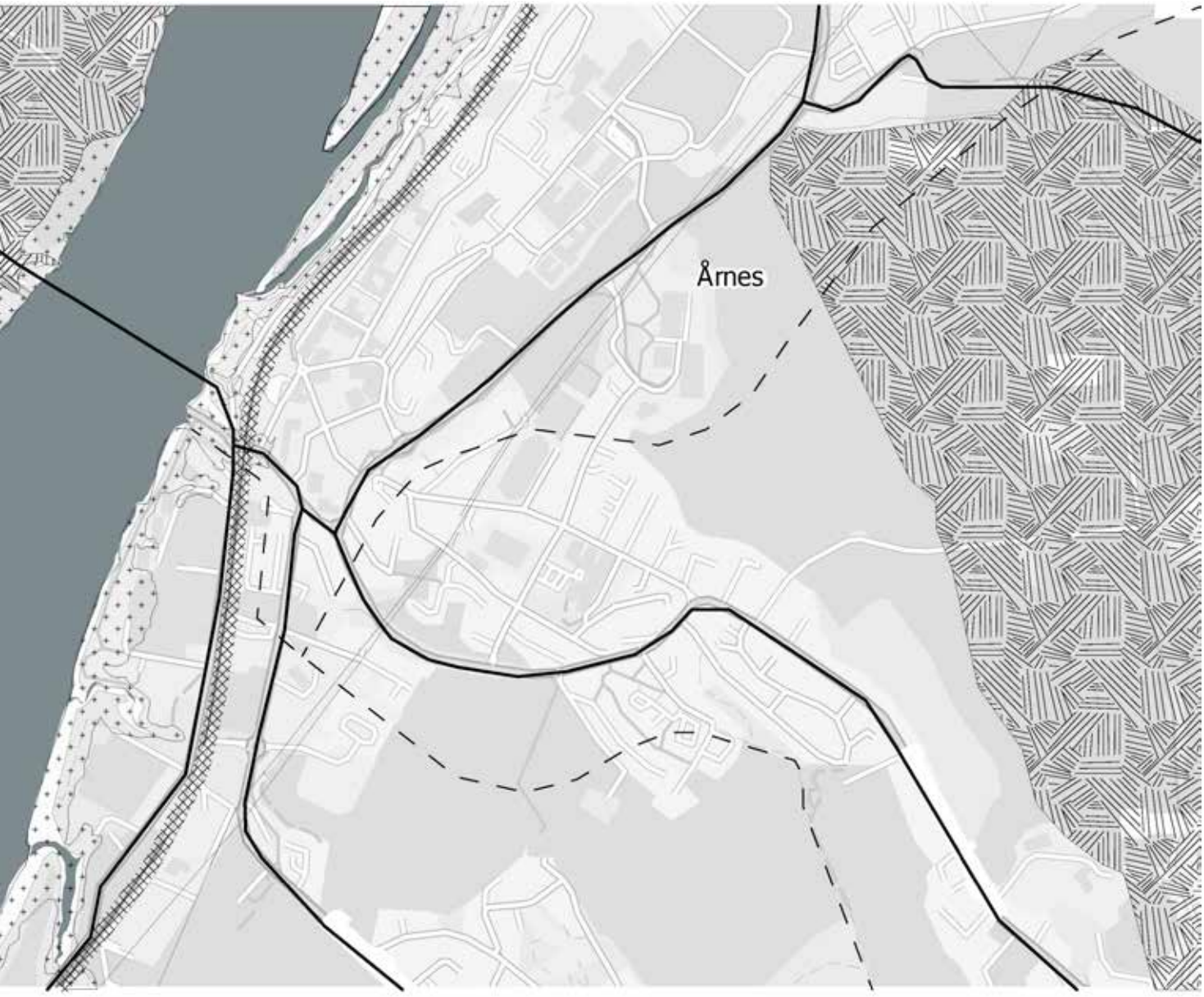
3. Hybrid systems

Hybrid systems

Infrastructure, such as railway, road and (hydro-power) dam hinder the national flows of migratory animals. Inside unsustainable ways of transportation, such as motorised boats, cars and trains nature is experienced differently than when you have to propel yourself out in the open. Former waterways through the urbanized areas are no longer visible since they have been put underground or dampened. Some areas are prone to flooding and landslides and should be avoided when building homes.



Flood plain
Landslide risk > medium
Flow obstruction rail
Flow obstruction road
Dampened waterway
Glomma



1:10 000

0 0,13 0,25 0,5 mi

0 0,2 0,4 0,8 km

Kartverket, Geovekst, kommuner og OSM - Geodata AS; None

4. Scenario building

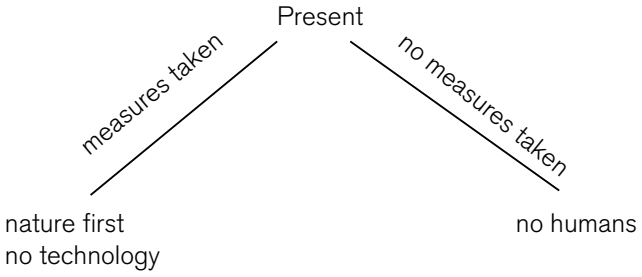
Introduction and conclusion

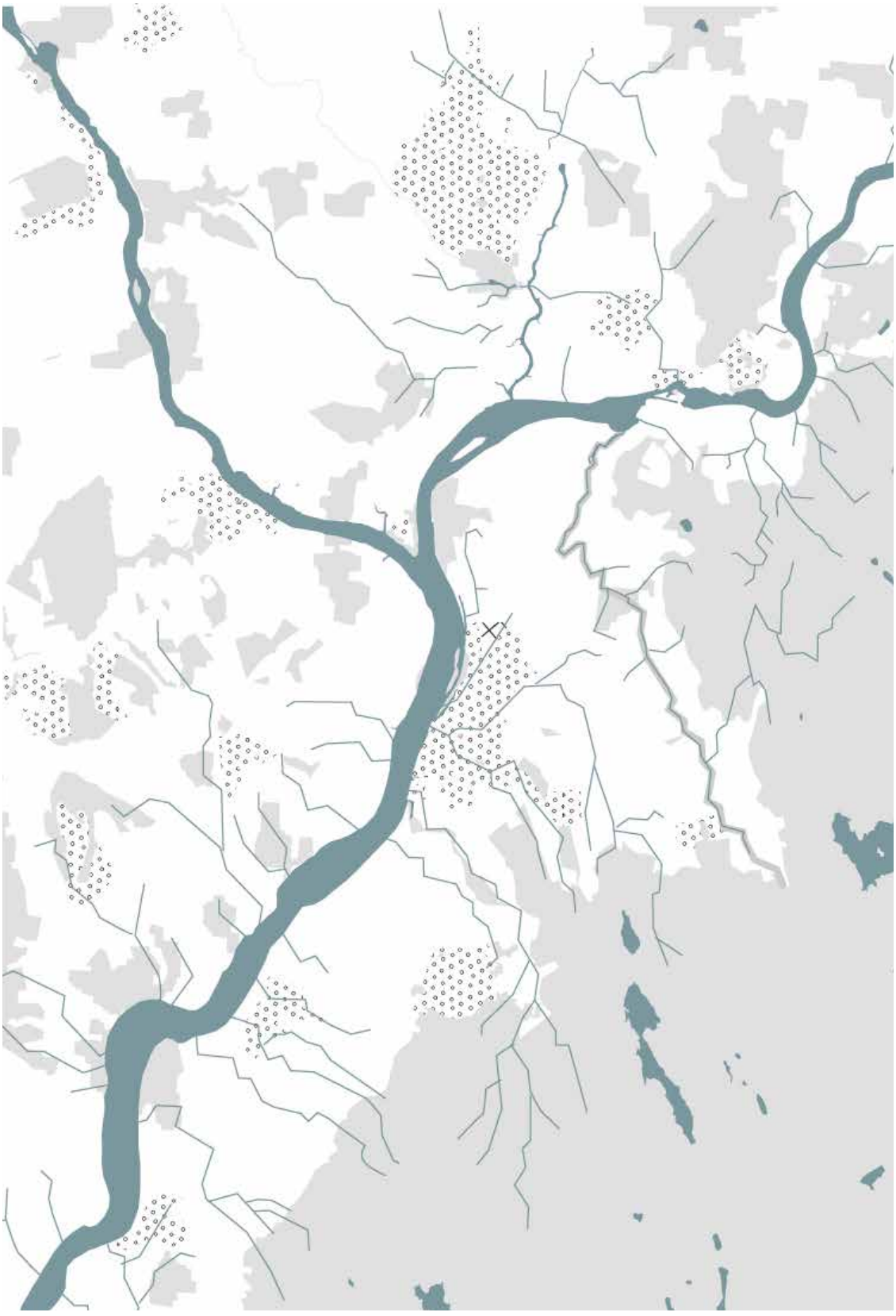
We got three scenarios to find a world view for: nature first, no humans and no technology. Very extreme situations, asking for extreme measures. After spending a morning to figure out how each theme would affect the world, we were asked to implement this in our design area.

It was a fun assignment, but also a very useful one. When looking into extremes, one can also find sort of a perfect solution for something. After which it is easier to find the correct compromizing.

When looking into these three scenarios, we concluded that it is good to connect the habitats (no humans), get shorter production flows (nature first/no technology) and really embed functions into the landscape. By embedding the functions so drastically, we could see that this (or a part of) was the right way to go.

It was a good way to further sharpen our vision, and the terrminology “embed functions into nature”, became the focal point for our vision even.





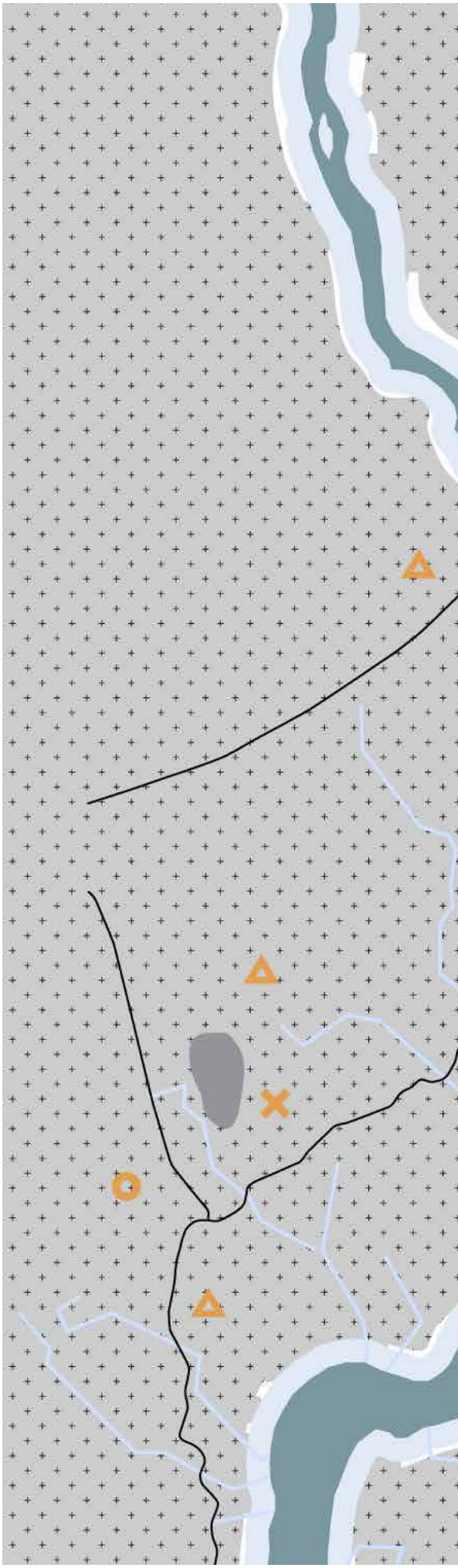
Scenario 1 - Nature First

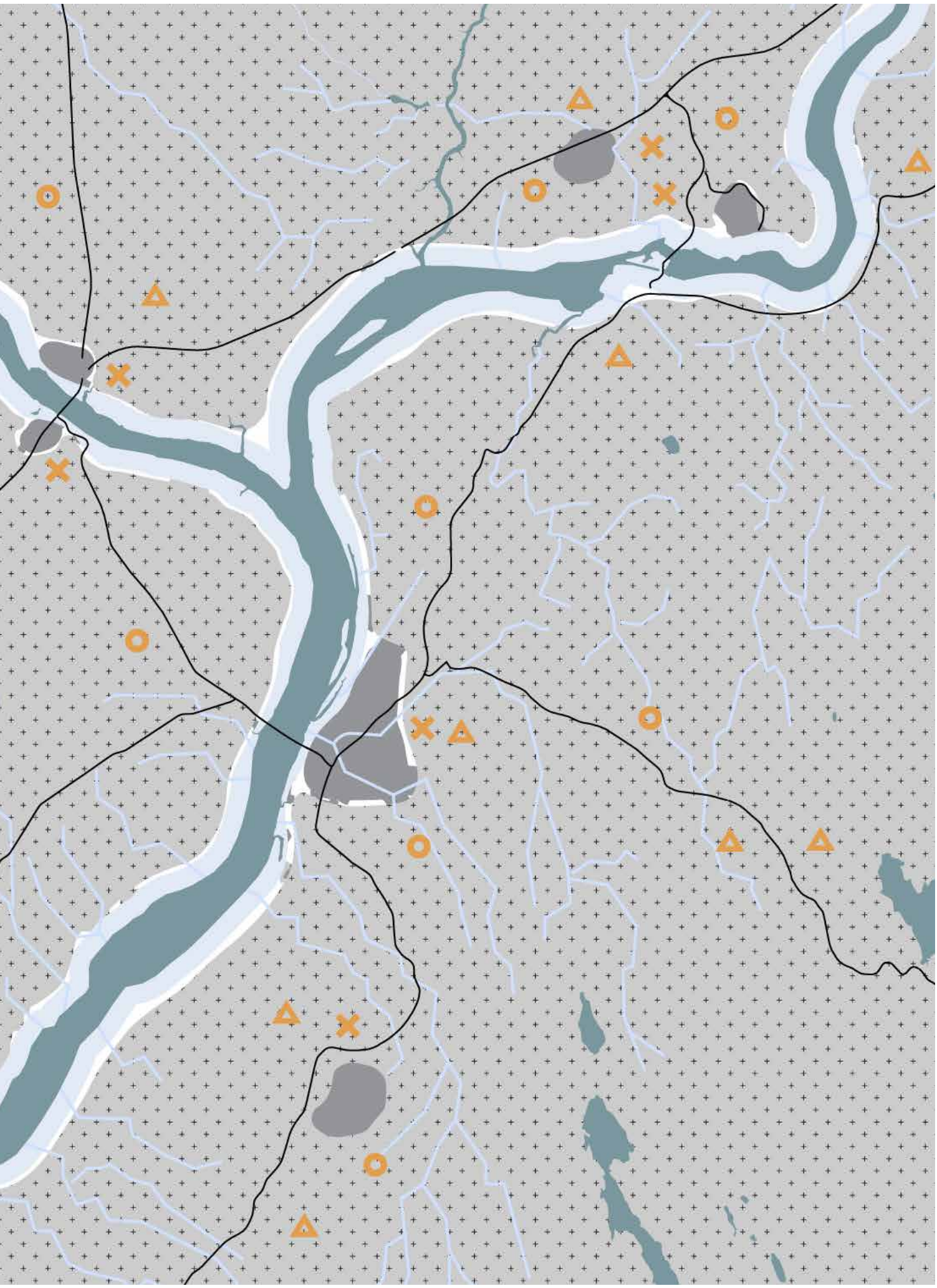
The nature first scenario is an amalgamation of several choices, focused on spatial decisions, ways of extraction and an idea of how the city should be. It does not necessarily mean going back to a “simpler” time, with no technology or doing everything by hand. Instead, it is about creating the most space and least burden on nature by humanity’s actions. This includes actions now, such as building with sustainable materials, but also actions later, such as how those materials can be recycled/repurposed. Using materials that store CO2 now (such as wood) is a positive development, but if it can only be burnt at the building’s end-of-life, it may still not be the best solution.

The space for nature is maximised, drawn as forest, by densifying and minimising the size of the urban cores. The agricultural fields would be exchanged for food forests or hydroponic farming in the dense urban core. Building materials would be sourced by utilising silviculture, and should thus be mostly wood (which with current technology can mean quite large buildings). Food forests and silviculture harness the forest in a way that is more friendly for nature, while still providing for humanity. Technological solutions does not necessarily mean high-tech, which would still rely on rare earth minerals (not-nature friendly).

Nature First map

The future situation as the conclusion of the nature first scenario.





Scenario 2 - No humans

“Doomsday will come”

When humans don’t stop exhausting nature, they will eventually win. But winning means actually losing. They won’t survive. A fight will come over the last resources; a war will start. Gated communities fight over left over fertile land and clean water. The rich will fly to Mars to live there and the poor will die.

After a while, nature will restore. This will take many many years, but eventually earth will cool down, water will be purified and plants will grow back.

New discoverers will return. This is a generation who have never seen the earth.



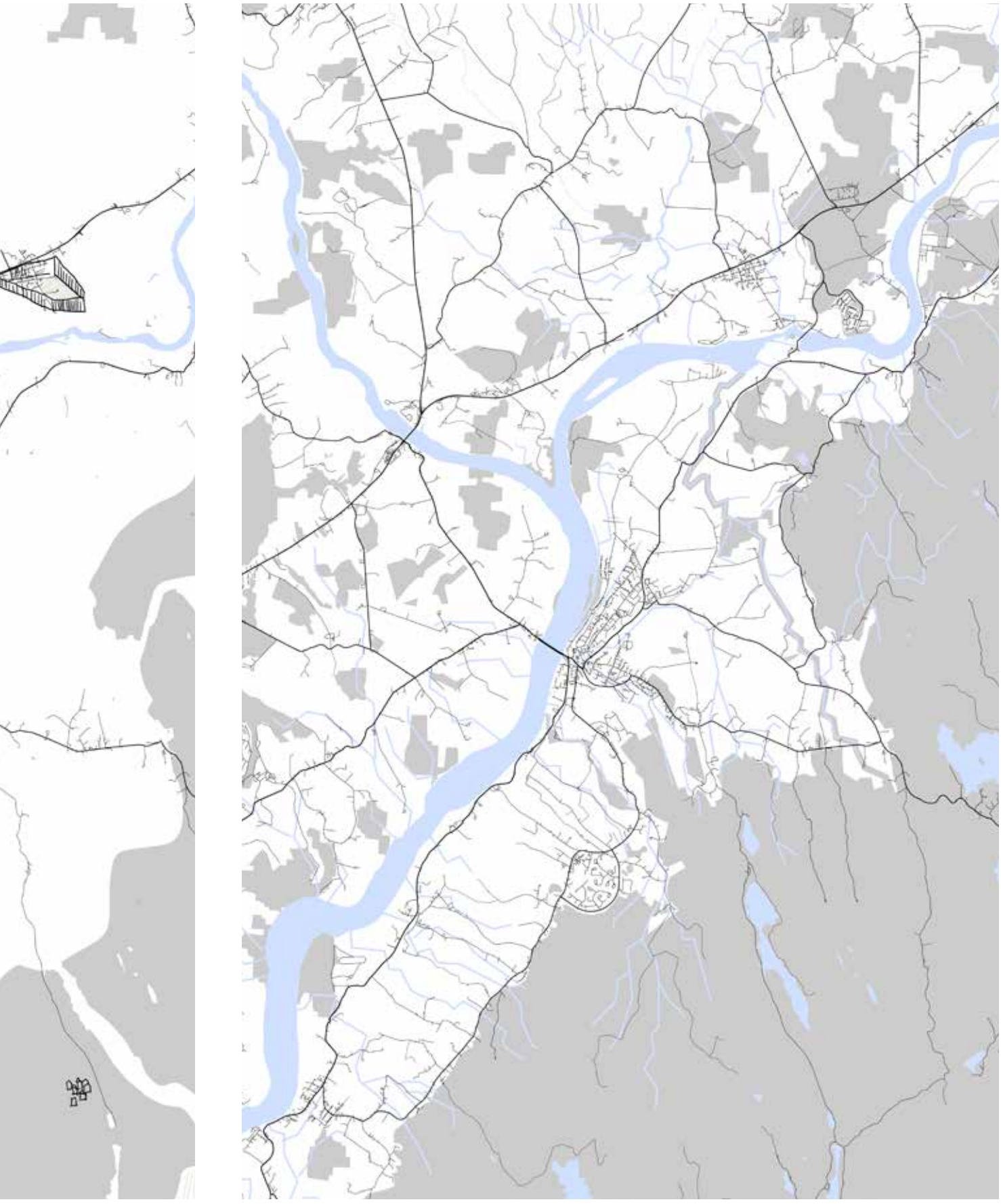
No humans scenario through time

2030 (left) and 2180 (right)

- Water
- Forest
- Road
- Farming

N

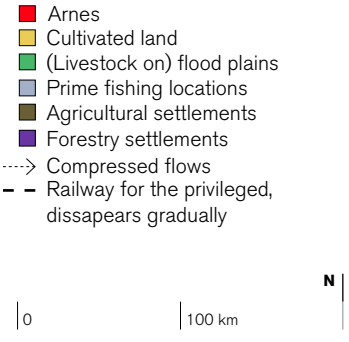
0 100 km

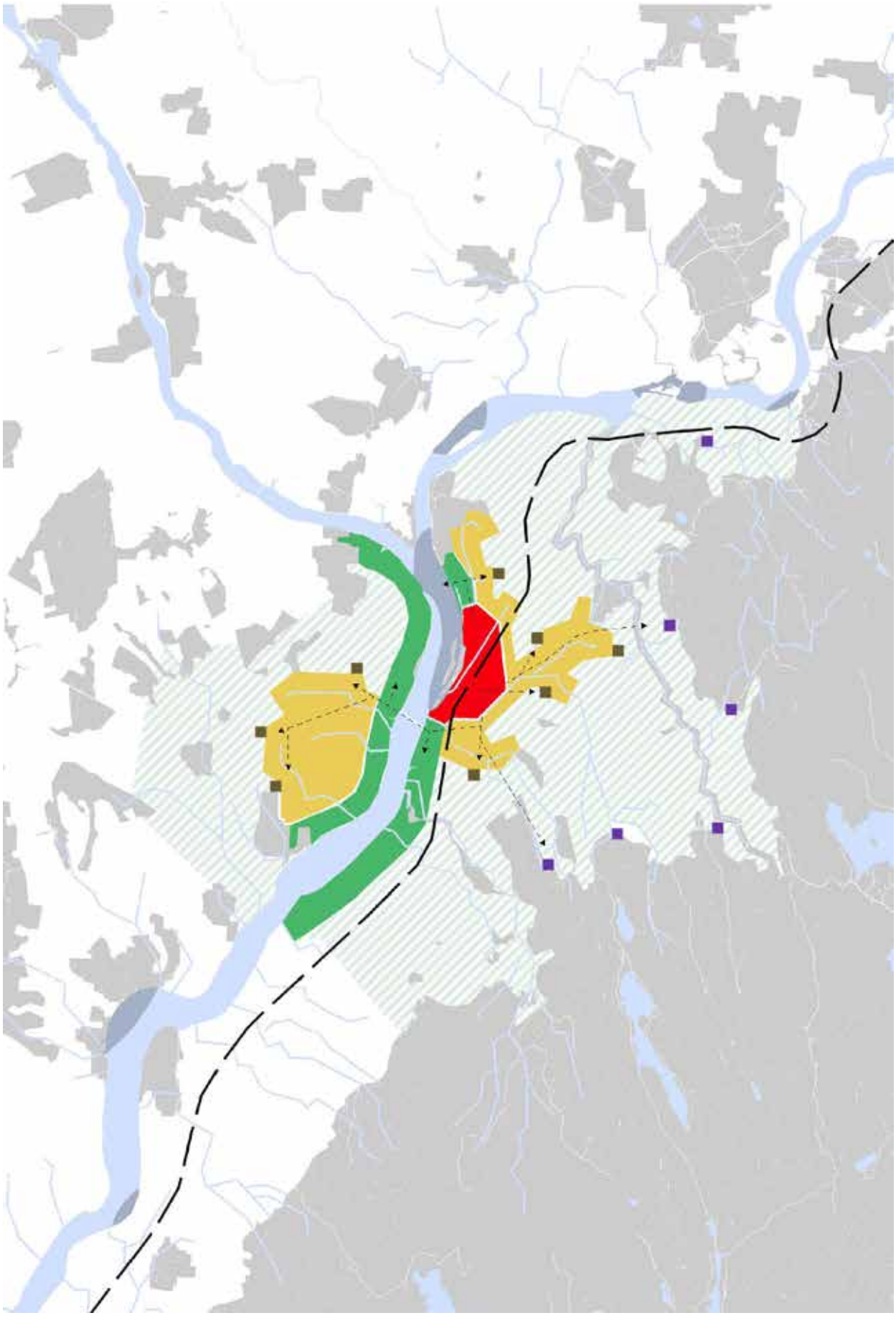


Scenario 3 - No technology

“Back in time”

This scenario is defined by no longer having access to fossil fuel and electricity. What would this mean for people and the landscape? For starters, transportation will no longer be running on engines. Global trade would diminish and once again people would turn to their surroundings for (food and material) extraction. Chemically refining artificial fertilizer requires enormous amounts of energy (electricity) and is no longer viable. More land needs to be cultivated to keep up with production, nutrients in the ground need to be balanced by applying crop rotation, intercropping and polyculture. Synergies with domesticating animals, as facies can be turned into fertilizer. Jobs will disappear from the city and people will work on the land again, creating settlements near extraction sites.





5. System intervention

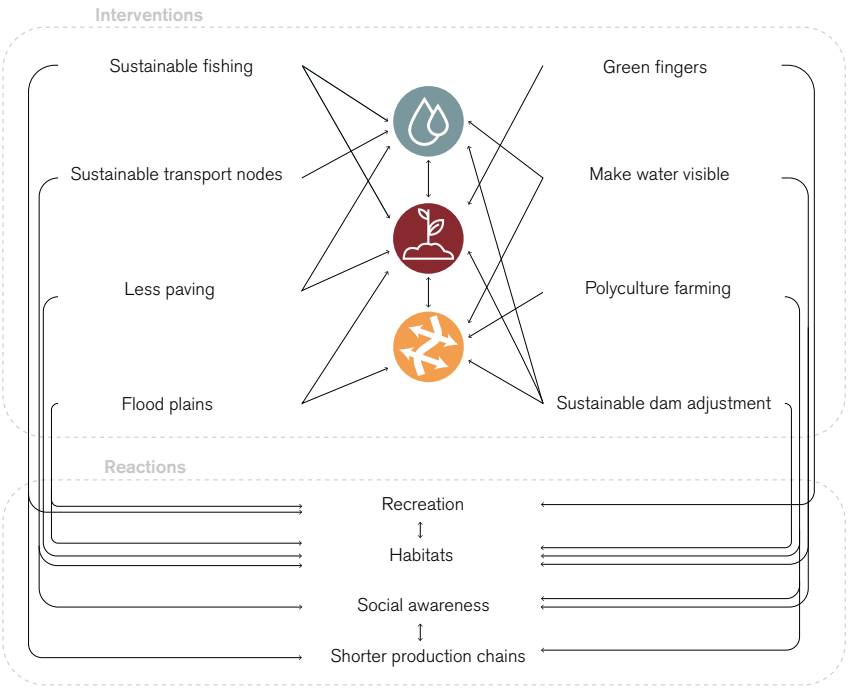
Performance bases urban design guidelines

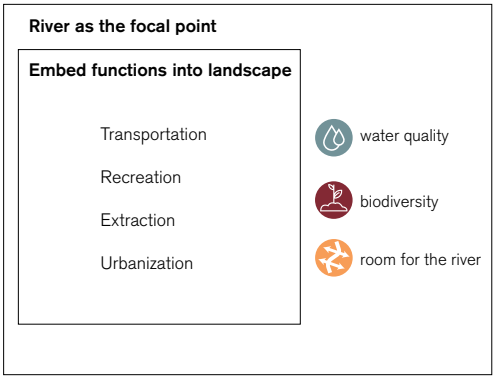
The guidelines set forth to reach our vision are based on the principle of turning the river into the focal point in the story. To achieve this, three markers were identified. These three represent a variety of positive influences which, when reached, would make the river and its biosphere “central” again. As the considerations made to reach high levels in these three markers, de facto result in the main consideration being the river.

These three subjects are: water quality, biodiversity and room for the river. These are further quantified by perceived goals.

Water quality entails no fertiliser run-off, heavy metals or other kinds of pollution. Biodiversity includes: amount of species, prevalence of local species, protection of habitats and the like. Room for the river is mainly focused on flood mitigation in a natural way, i.e. more room for the river rather than dykes or dams to control the river.

Based on these three markers, guidelines were created depending on four functions embedded in the landscape: transportation, recreation, extraction and urbanisation. The chosen functions are meant to signify humanity’s general influence on the landscape, broken down into four categories. By stating these functions, there’s an aim to cross-reference function and subject. Thereby creating a coherent set of guidelines per function, per subject. Some of these may overlap.





Transportation

Sustainable ways of transportation on the river

Railway does not form a barrier for animals.
Forest pierces through the open land - habitats are connected.

Stimulate only slow movement directly next to the river

Recreation

Recreational areas are multifunctional to also purify water and create habitats.

Only sustainable fishing is allowed.
Recreational areas are allocated in the forest.

Added recreation does not hinder river

Extraction

No artificial fertilizer
Vegetation around the river blocks left over nutrients from going in.
Dam is adjusted to keep enough oxygen and sediment in the water.

Only small-scale fishing is allowed, with recycled polyester nets.
Extraction and biodiversity is harmonized by polycultures such as silviculture and food forestry.

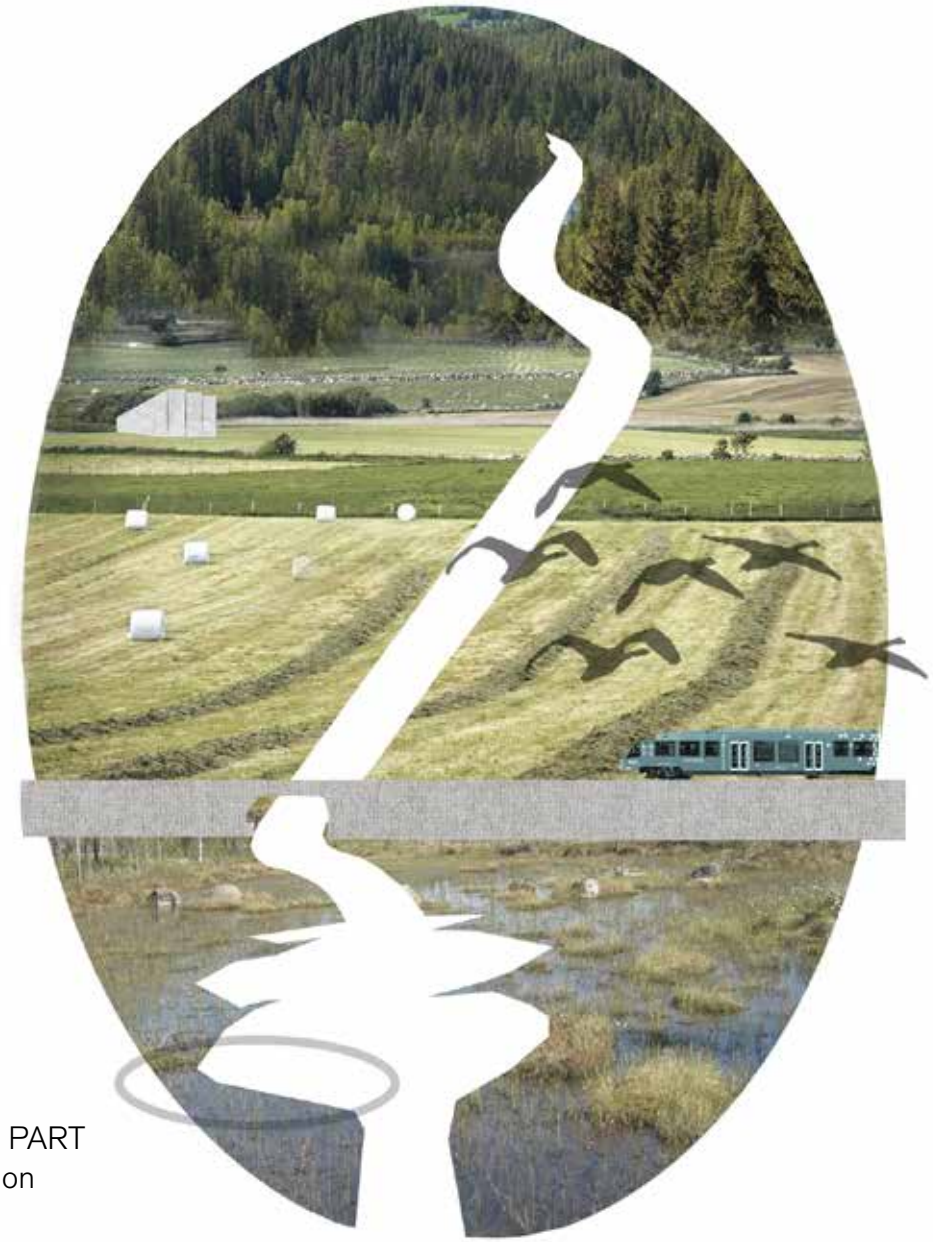
Flow fluctuation is re-introduced by adjusting the dams

Urbanization

Hardened surfaces are diminished to a minimum.

Landscape stretches into the town by using fingers.

Water awareness is created by making the water more visible.



INDIVIDUAL PART
a new direction

Floor Mulder
4481313

Floor Mulder

Manifesto

Along the Glomma are these forgotten towns. Their function has been lost during modern times where Oslo is the center of the region now.

Årnes is one of these towns. People work away from the town, travel by train or car to Oslo and come back to sleep.

But what if Årnes becomes a place where people want to work, sleep and reside all day. A growing appreciation for the landscape, the calmness and the pace of the town.

My proposal focuses on one of these; a growing appreciation for the landscape. A recreational route that follows one of the biggest brooks upstream, into the forest.

Objects and places that are carefully placed along this route emphasize the landscape on certain places.

A barrier is taken away to give and allow the Glomma to have more space to fluctuate. Leaving the land fertile and healthy for productive agriculture.

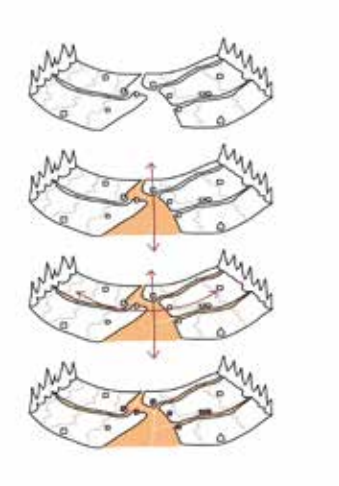
Shock	**Landscape**	**Potential**	**River central**	**Infrastructure**	**Environment**	**Space**
Flooding	Forest	Extraction	Biodiversity	Logistics	Intensification	Functional
Landslides	Fields	Recreation	Water quality	Social	Conservation	Natural
	River	Urbanisation	Room for the river	Water	Regeneration	Recreational
	Urban	Transportation		Green network		

Taxonomy

Chosen direction for my design experiment: flooding, but mostly recreational and social awareness concerning this topic

Route proposal

Recreational routes are mainly focused on the riverside and in the forest, neglecting the beautiful landscape, the farmland, in the middle. The proposal for this route is to connect the two recreational zones and to celebrate the different landscapes that can be found here. The stark contrast between the landscape and the clear edges make it very pleasant to walk through.

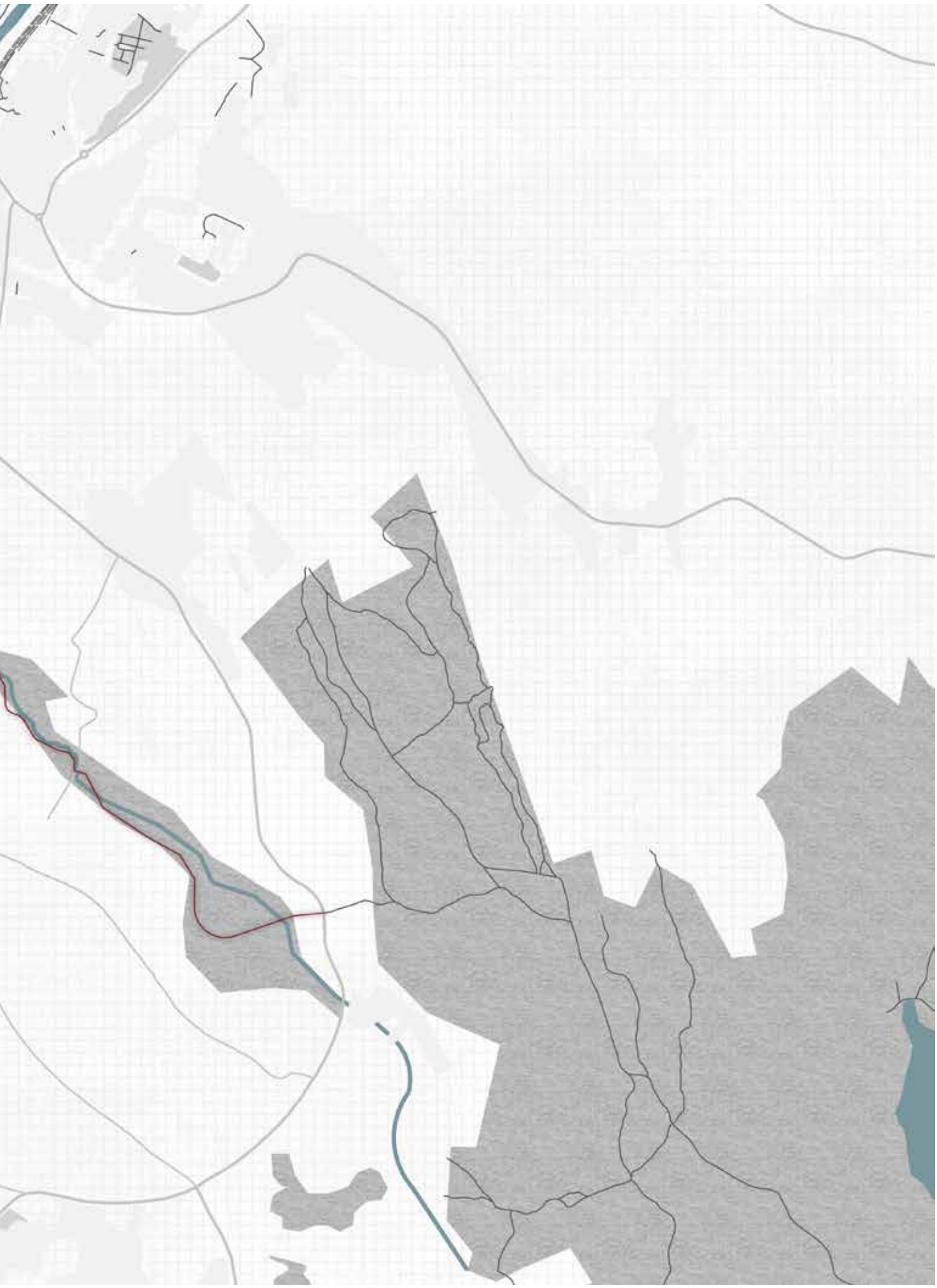


Map of Arnes with proposed route

- Water
- Urban
- Forest
- Road
- Pedestrian
- Route proposal

N

0 600 m



Places and spaces along route

In this zoomed in map you can see the places I thought out to be points to stand still and really take in the landscape. This can be done by feeling, touching, seeing, but also listening and playing.

Spaces along route

1. seating area “wide”
2. walk through farmland
3. seating area “burden”
4. swampy playing area
5. viewing point
6. seating area “direction”

N

0 120 m


1
2
3
4
5
4
6
N
0
120 m

The three seating areas

For the design experiment I worked out three seating areas. These seating areas are all designed by using the same framework: see below for the four concept I thought of.

The names are: Wide, Burden and Direction. This refers to the view one has from this object.



surrounding is taken into the object



take in of the view



appreciation of the landscape



awareness of flora & fauna

N

0 100 km



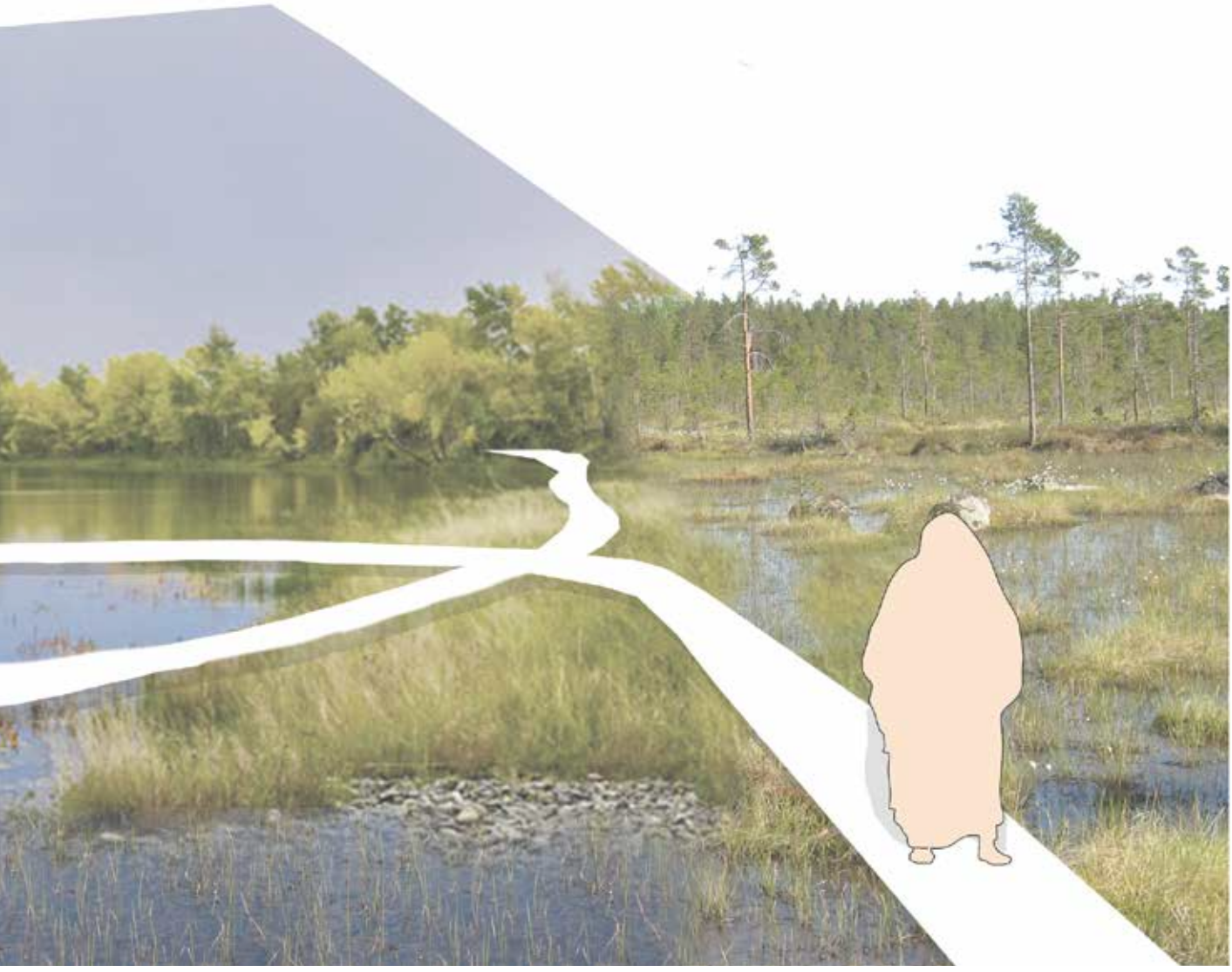
Wide

Wide is a floating concrete loop at the edge of the Glomma. When one walks around, all different angles of the Glomma are taken in. At the end there are seats to look over, captured by the landscape.

The swampy floor below the path is really dynamic to the water level and change of seasons, making it an exciting place to walk.









The wide circle symbolizes the vastness of the river and the catchment area of 42 000 km^2



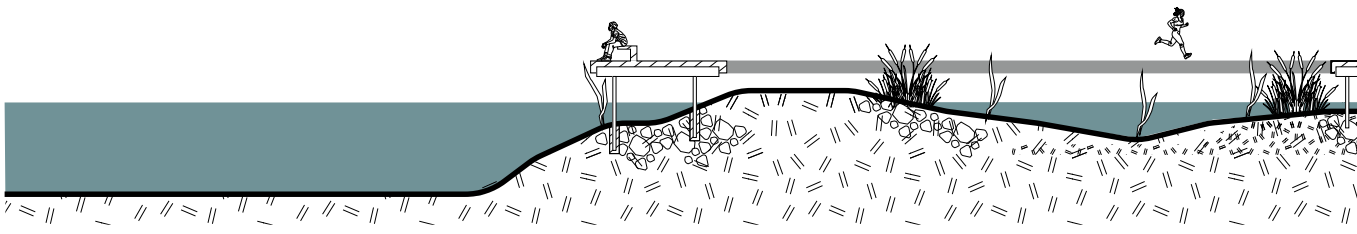
The direction changes as you're walking around - taking in the huge quantity of water from all directions

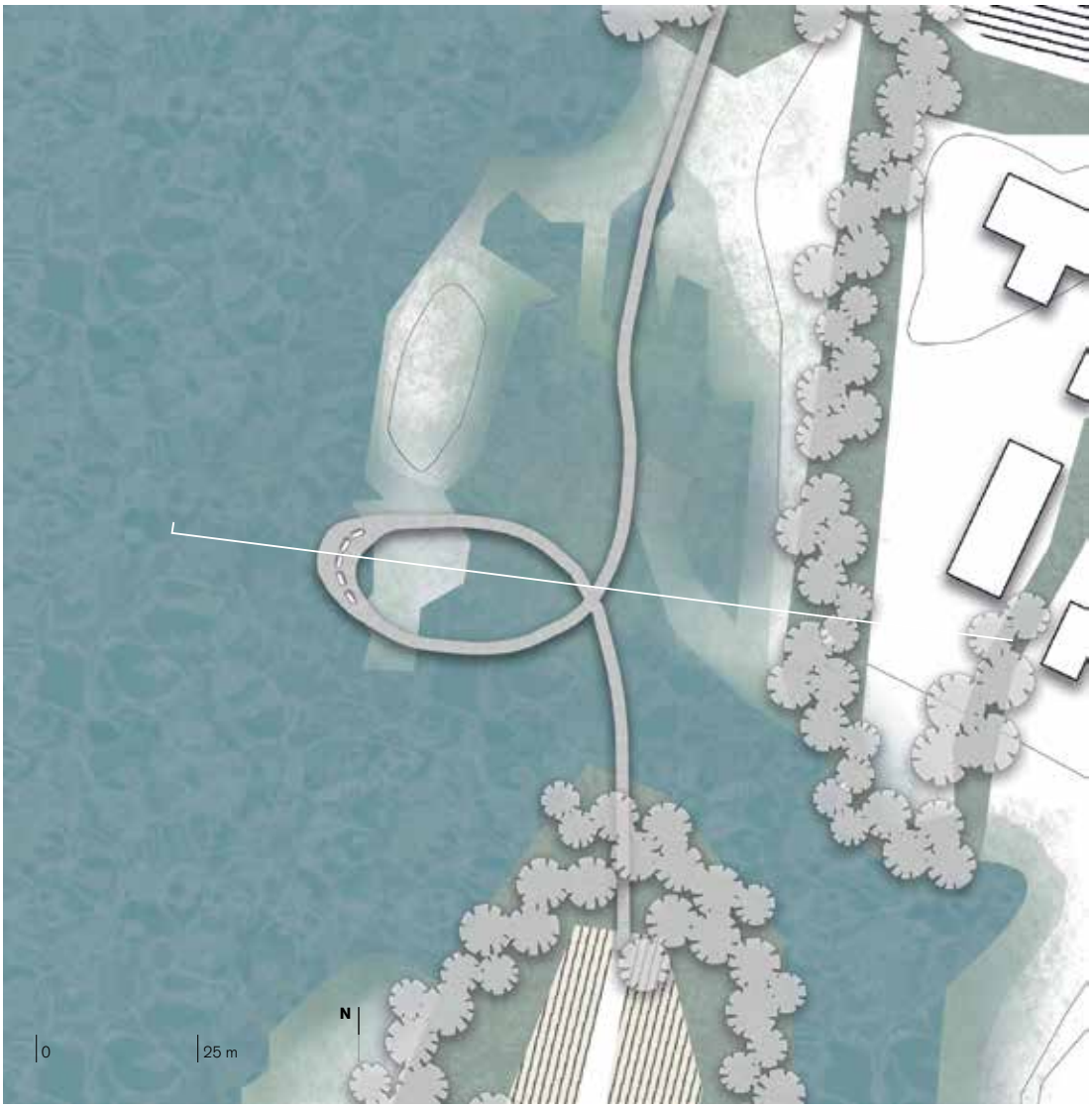


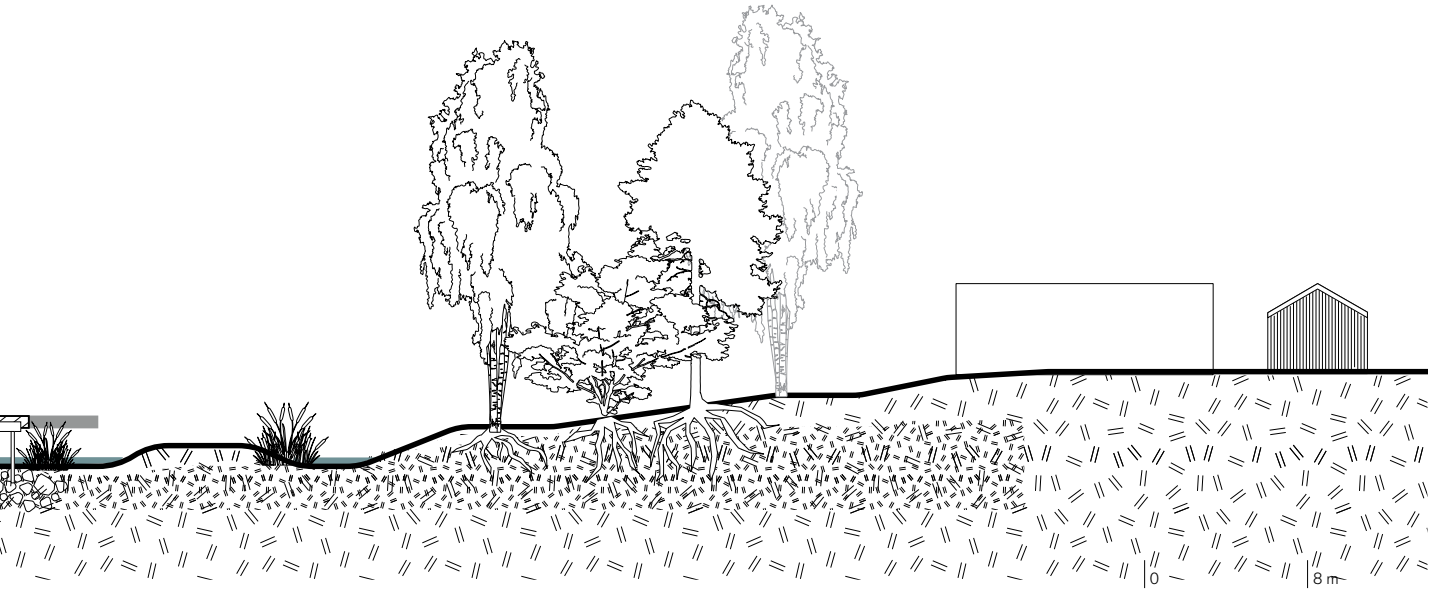
The floating path above the water



Flora and fauna can be seen from up close without destroying it - the path creates a new microclimate for river mussels and shelter for small fish




N
0
25 m

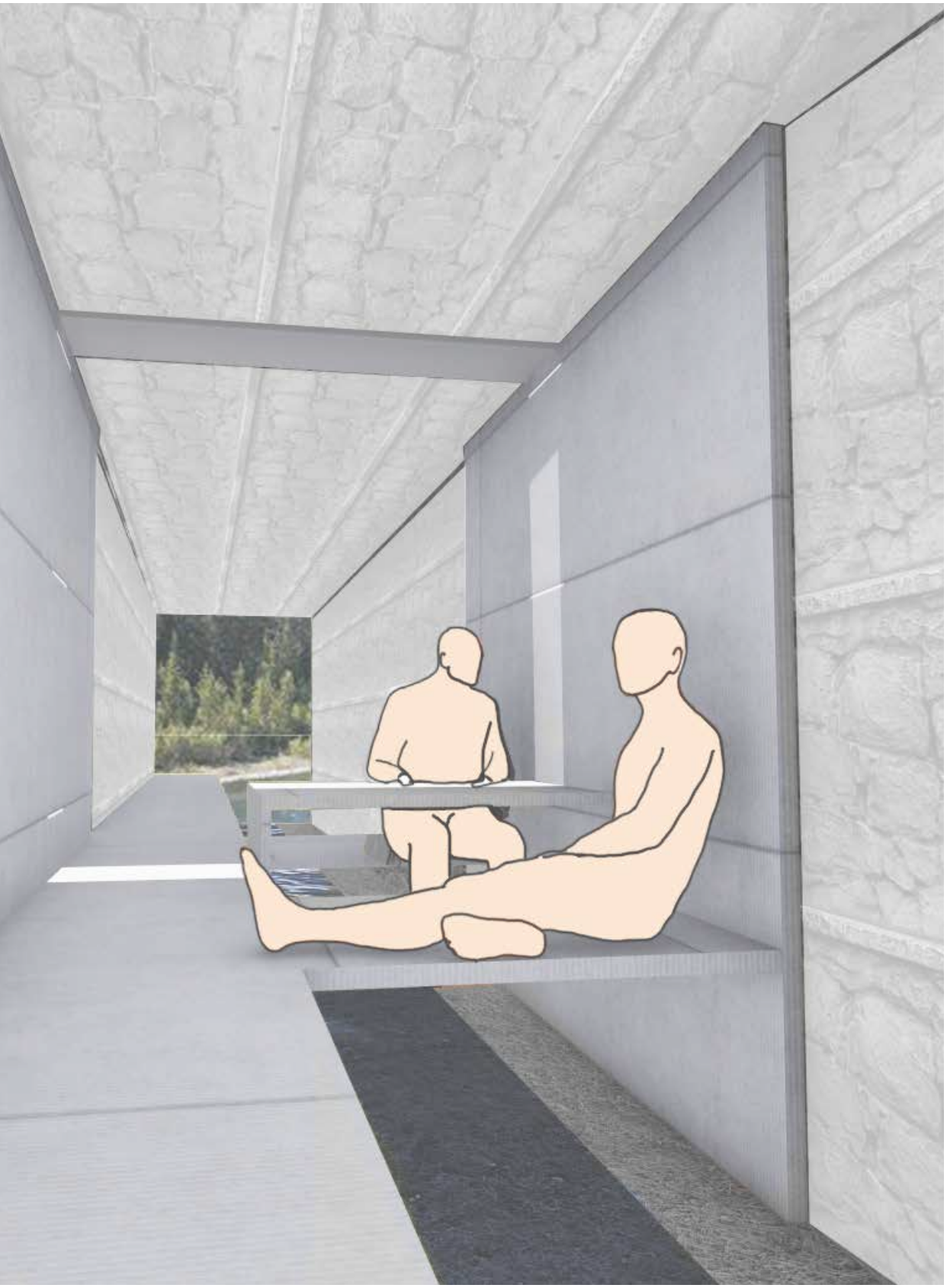

0
8 m

Burden

Burden is the place where nature meets human. This is a place that works as a palate cleanser - visitors are thrown back into the sense for hearing. A concrete addition in the tunnel refers to the people being guest here, instead of the water. A picknick bench is located in the center.









The object is made to be focused on sound - the of the kabbling water versus infrastructure



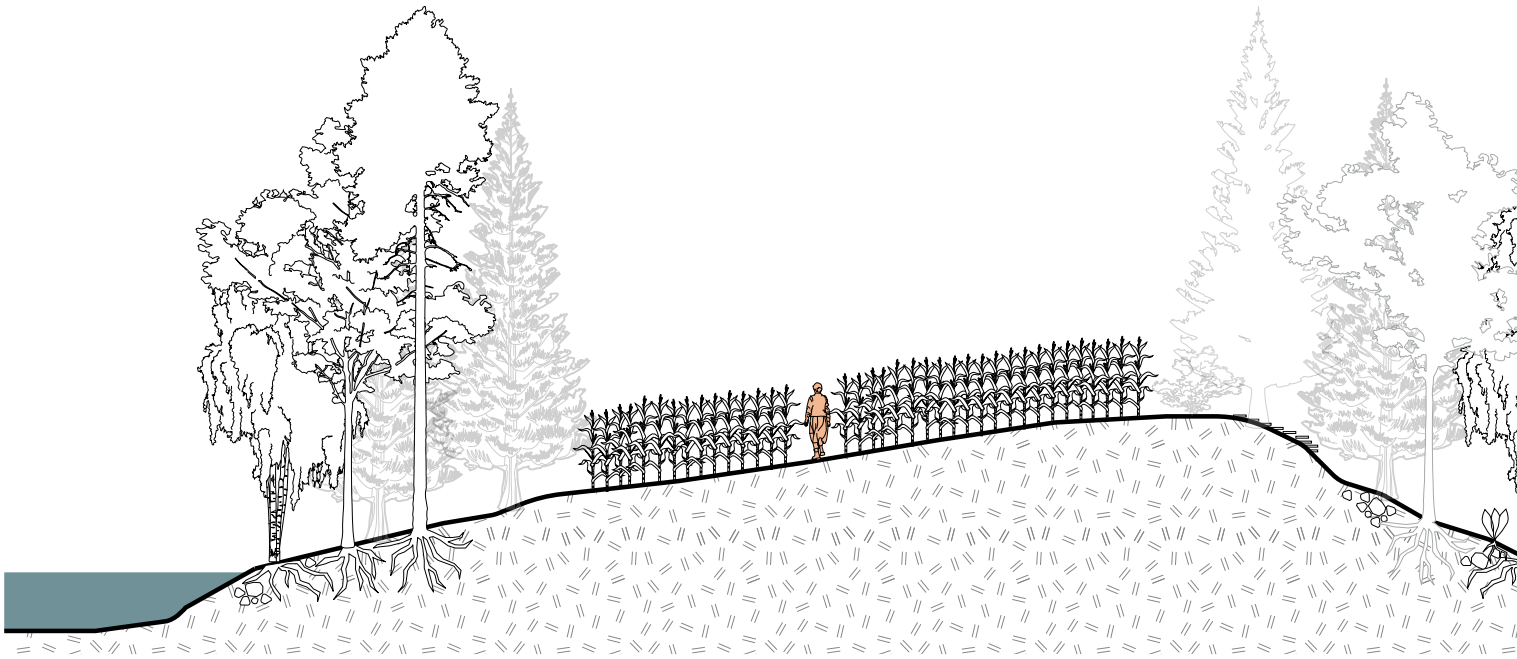
The passing through of the stream is the main direction of the view

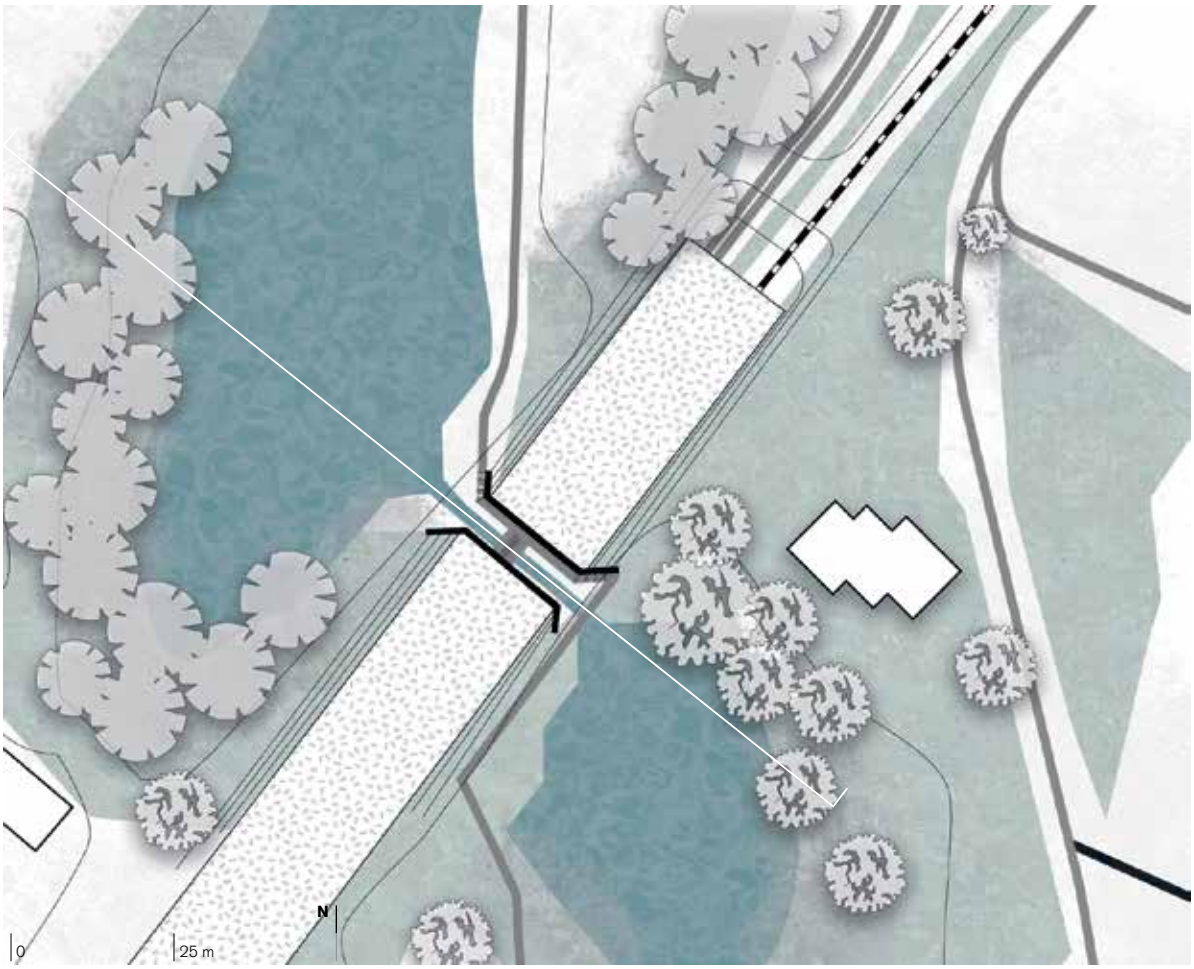


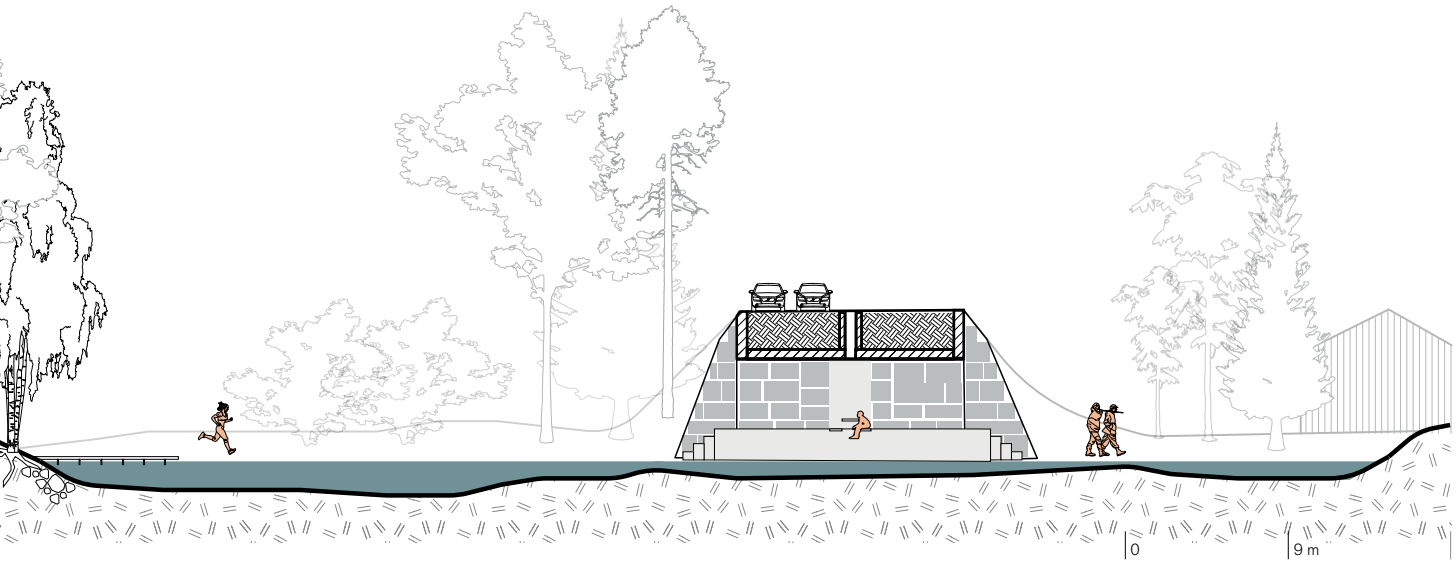
The way in which nature is closed off for humans convenience, the seats are closed off from surrounding



Flora and fauna cannot survive in a tunnel, shows a reasoning for detunneling in other places




N
0
25 m


0
9 m

Direction

In the more hilly agriculture, you can find the object direction. This links to the very rigid feel the fields have because of the way it is planted. There is refered to the contrast between the flowy hills and the direction by the stairs towards the three blocks.

From the top of the hill, one finds a spectacular view of the fields and the Glomma, but also you are standing directly in it. The corn and grain are really inside the blocks. The visitor is standing IN the landscape, instead of looking at it.









The sharp direction of the farm fields are very dominant against the soft flowy hills. This object has the same flowy ramp, with rigid seating area



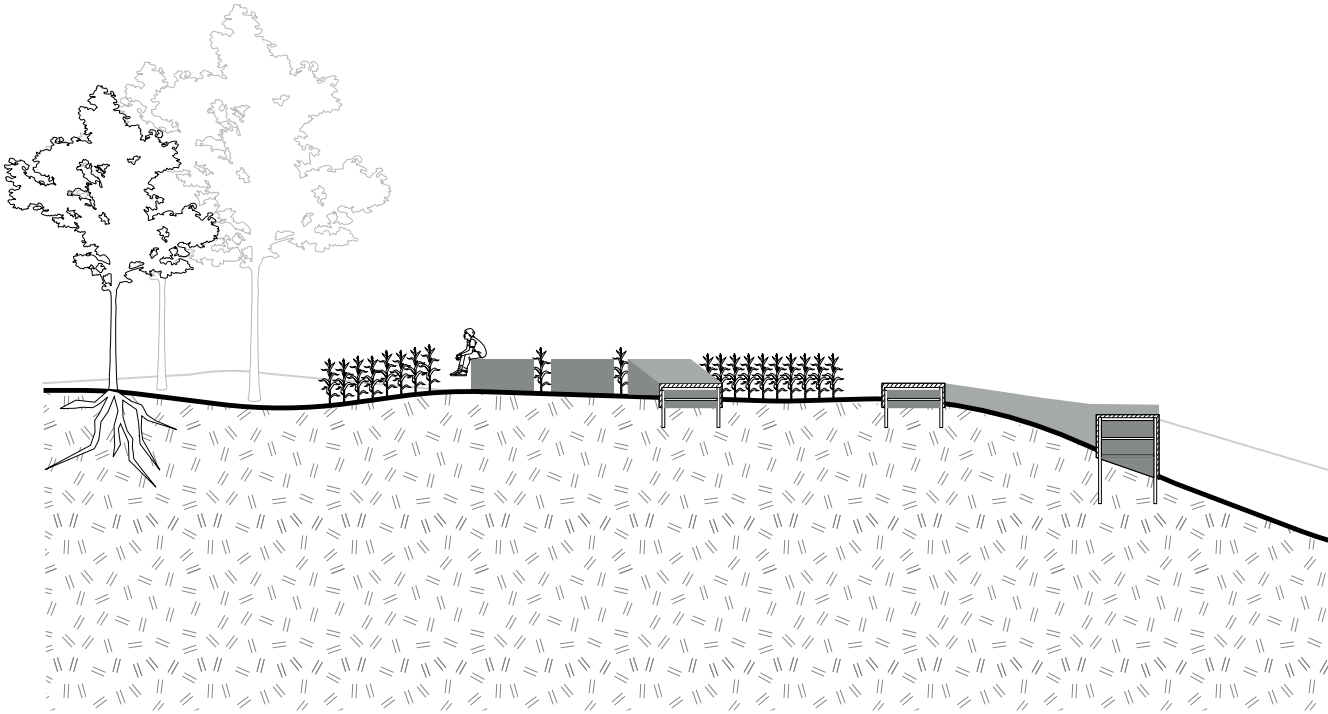
Located on the edge of a steep slope, the concrete blocks offer a wonderful overlook over the fields and river

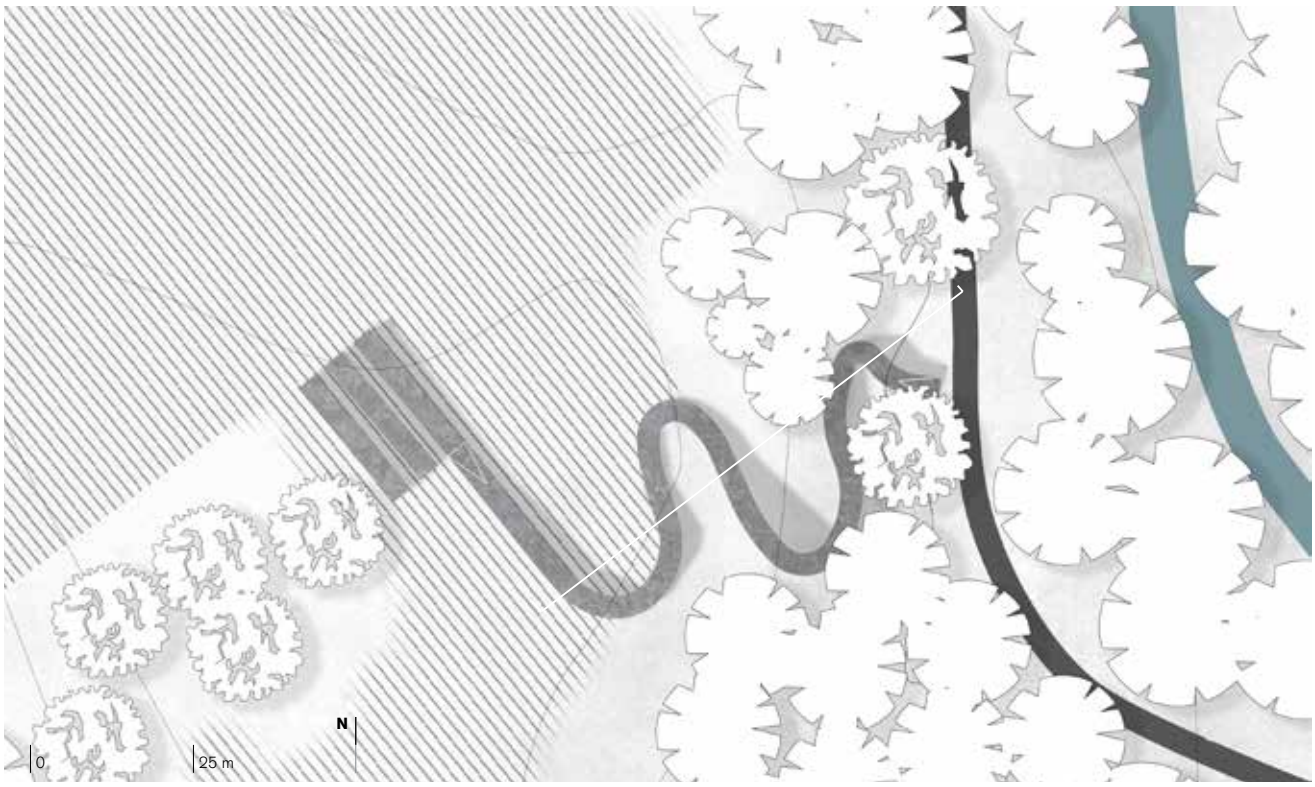


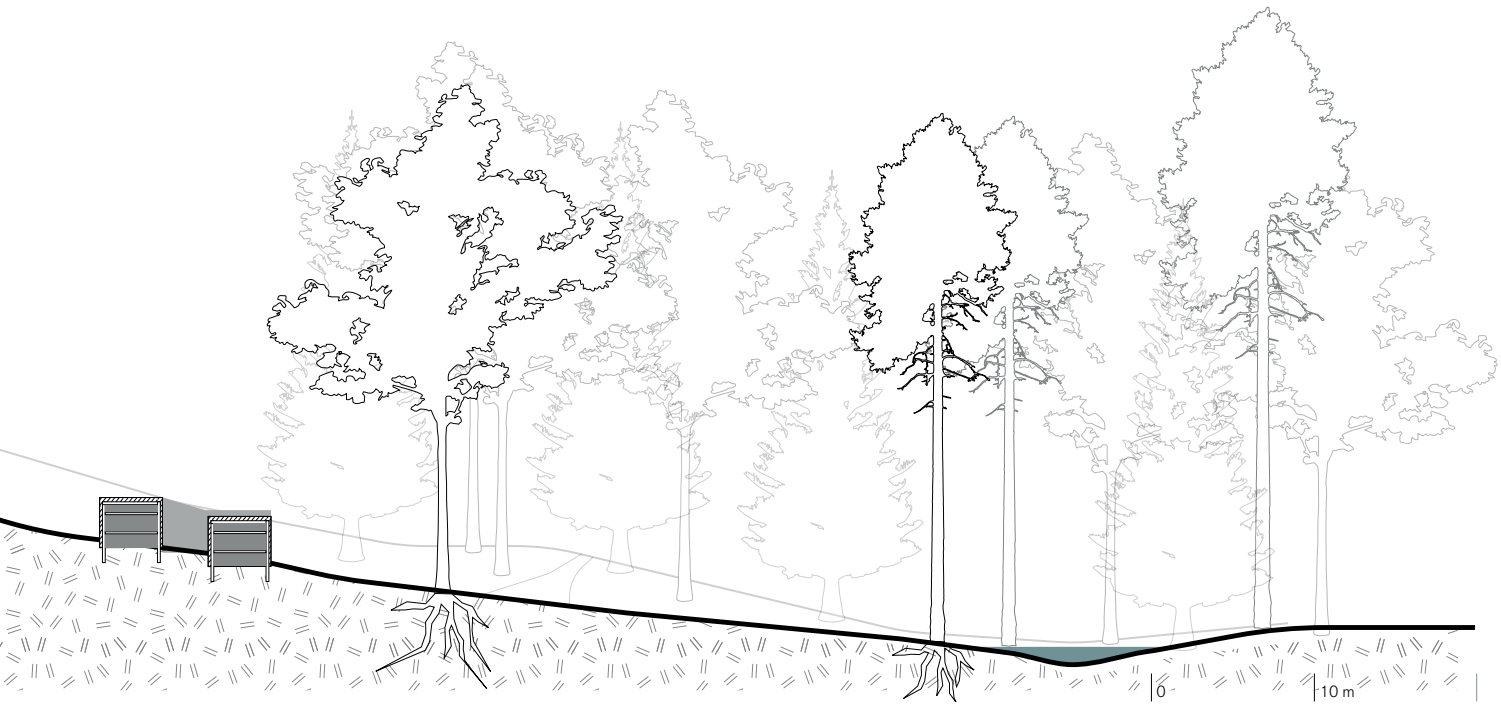
By pulling in the rows of crops, one is not only watching a landscape, but is pulled into it



Small holes in the concrete give the opportunity for small animals to find shelter - increasing biodiversity in the fields.




N
0
25 m


0
10 m



INDIVIDUAL PART
Green core

Paul van Eeden
4649257

Paul van Eeden

Manifesto

The town of Arnes is like a big boulder. A large, hard, immovable object (without great force) that lies in the landscape, superimposed like a landed meteor. The river flows past it, streams flowing to the river from the landscape have been altered in their course, nature flows around the object. With an emanating force seemingly felling trees in its radius. Humankind live on this boulder, feeling arisen from the landscape beneath, viewing nature as their inferior. Why shouldn't nature flow around what we have built? Haven't we conquered nature? Isn't our superimposed boulder just a wicked flex to be expected after such a victory?

While it may be unrealistic to propose the demolition of the boulder in its entirety, a slow progression from a unilateral to a multilateral way of life is in order. Humankind must live on the same level of nature, as part of nature, to flourish into the future. Rescinding the idea of supremacy over nature.

The way to reach this goal is to show, physically, how natural systems pushed out by this boulder can be reintroduced. Creating a natural solution for a natural system while creating new ways of interacting with nature at the core of the boulder. This will not only achieve a long term solution for this natural system, rather than its diverted state now, it will also showcase what natural systems can improve for humans. Awareness is crucial to start rebuilding back better. By rebuilding in a way that provides opportunities for physical connection between nature and humans, awareness is not only raised in a more direct way, it also immediately shows the positive aspects rather than "just being aware". Awareness as a goal on its own is meaningless - what does awareness achieve when it is not brought with clear benefits or a showcase of the concept for which awareness is raised and what it can achieve? Physical changes increasing human-to-nature (and vice versa) connection will improve ecosystem participation.

Taxonomy

Chosen direction for my design experiment: flooding, but mostly recreational, social awareness and functionality (for water) concerning this topic

Shock	Landscape	Potential	River central	Infrastructure	Environment	Space
Flooding	Forest	Extraction	Biodiversity	Logistics	Intensification	Functional
Landslides	Fields	Recreation	Water quality	Social	Conservation	Natural
	River	Urbanisation	Room for the river	Water	Regeneration	Recreational
	Urban	Transportation		Green network		

Design experiment

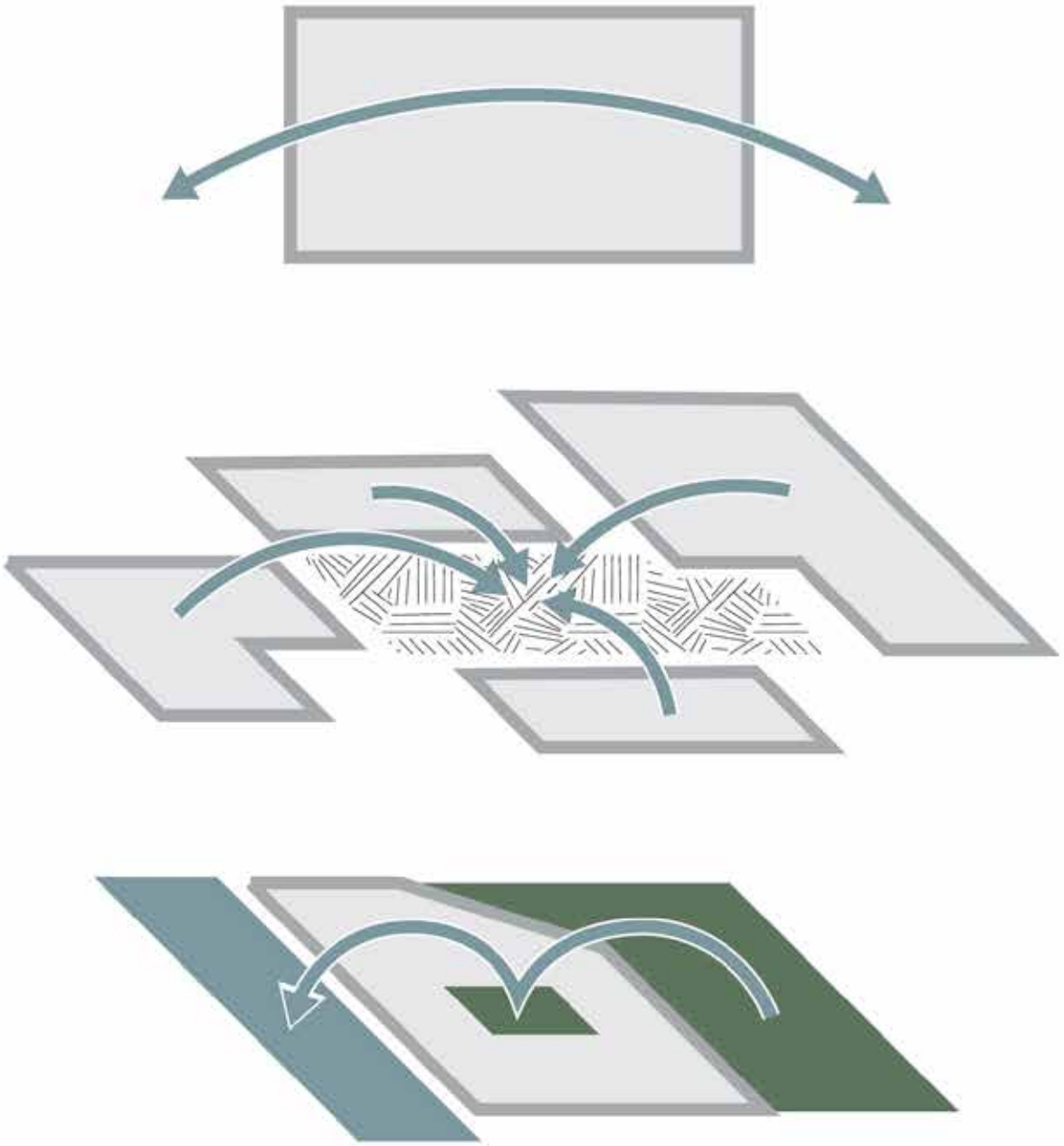
The “green core” design experiment in Arnes is based on four goals:

Re-opening the stream - within the chosen urban block a stream used to flow. It’s possible to retrace this stream based on the historical analysis in the urbanism critical cartography. This stream now exists as an underground engineered solution, however, this may prove flood-prone as a large area of fields outside the city drain into it, as well as large parts of impervious surface within the urban core. Re-opening the stream may alleviate this concern.

Reduce impervious surface - the urban core consists primarily of large pieces of impervious surface such as asphalt or pavement, blocking rainwater from infiltrating into the ground, causing local heat island effect, reducing the opportunity for greenery and causing potential flooding. Re-opening the stream comes with reducing a part of the impervious surface in the center (creating a green space) while also being able to drain rainwater from retained impervious surface towards it.

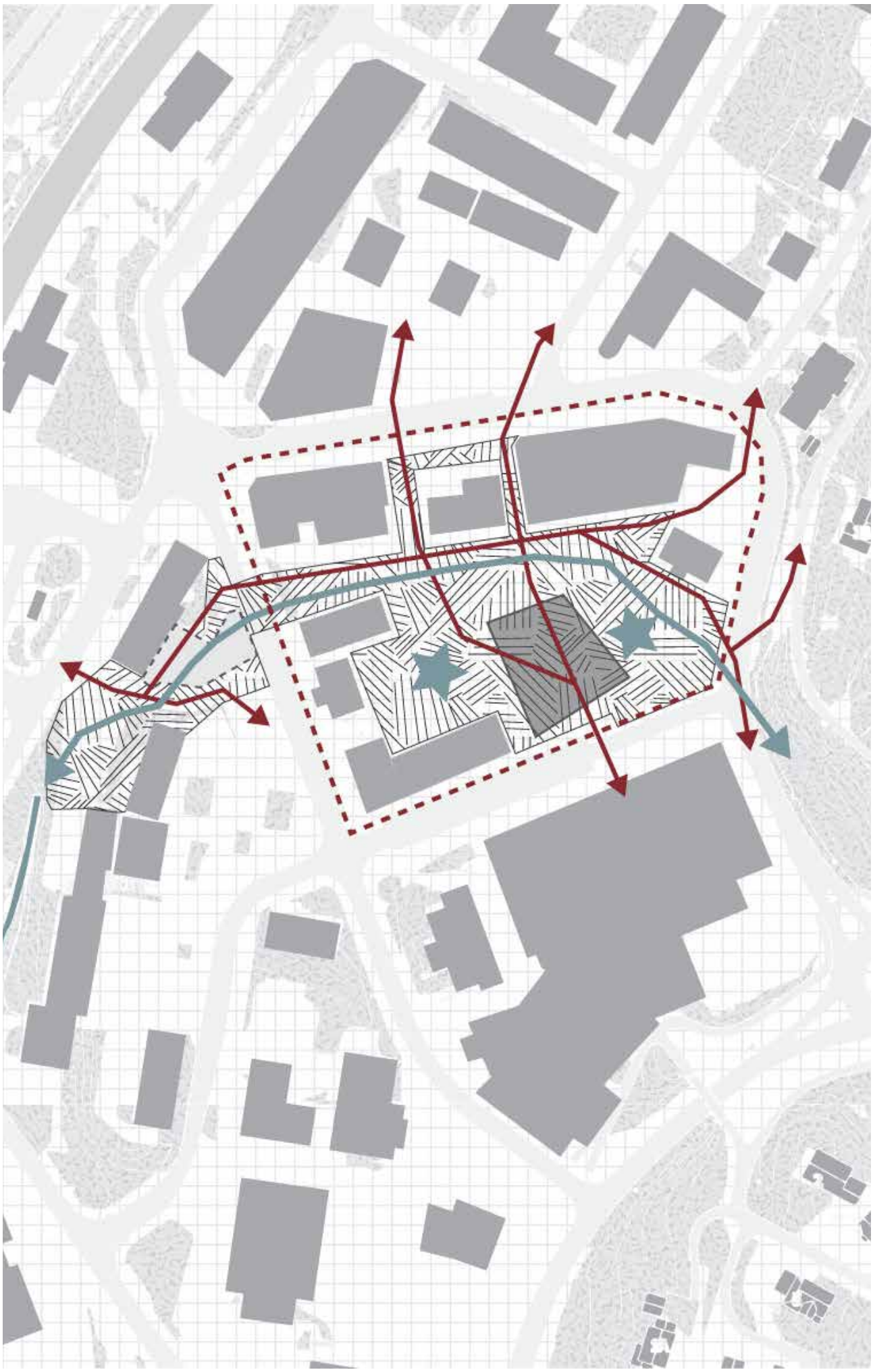
Create a stepping stone - the stream used to flow from the fields to the river, with it following a natural route for flora and fauna. With the stream gone and the surface paved, this natural route is cut off. By reintroducing the stream as well as greenery, a stepping stone can be created from the fields to the river through the city. Thereby better uniting the natural world with the human world and garnering better support for one another.

Quality green space - to not only provide a stepping stone and space for greenery and water, but also a qualitative space for humans to recreate. This way, a bond can be formed between the two, better understanding can be created and this may help inhabitants to participate in the ecosystem they live in, rather than feel disconnected or elevated above it.



The green core involves a block in the center of Arnes where a stream used to flow through - now underground. At current, this is a massive parking lot that is asphalted wall-to-wall in between the buildings that exist in the block. The first course of action is to find the alignment of the stream and possibility of re-opening it. As the stream is reopened the area is transformed into a large green space for water to flow into (from the surrounding asphalted or paved areas) and infiltrate into the ground. This only happens in part of the area, where the current soil (clay) is replaced with a sand/clay mix, during peak rain (such as a big storm), so as to not interrupt the entire stream and cut off the downstream from water. Other areas will have space for flooding on native soil (clay) which will keep the water flowing. The surrounding green space will retain its soil type, so native flora and fauna can reclaim the lost, previously asphalted space.

With the return of the water and greenery to the center of Arnes, a park is created for people to recreate and be physically close to their native habitat. Seeing and hearing the water, seeing and smelling the native flora, having the ability to be in touch. The park is incorporated into the area with walking paths between different places, so it can function as a destination and a route. Within the park, two located are designated as “experience” centers. This consists of two water areas, one based on functionality (retention/infiltration of water) and one based on native species. As the differences in soil type (and thus flora) and landscape design can be shown off. Two adjacent pavilions will provide space to stop and connect with the surrounding. As a symbolic action, one of the former buildings in between these two areas will be stripped, with the construction beams and columns remaining, to be “taken over” by water flowing underneath, greenery growing through and in between the colums, and a path through. The area designated for water can become dry during periods of low rain, essentially acting as a flood plain, offering an interesting dynamic to the area depending on the time of year.





Green core plan

Overview of paths, buildings, greenery and water areas on the map.

- Water
- Water (flood)
- Greenery (wet, helophytes)
- Greenery (wet, native)
- Greenery (wild, field)
- Platform (water level)
- Green roof

N

0 50 m







Green core plan

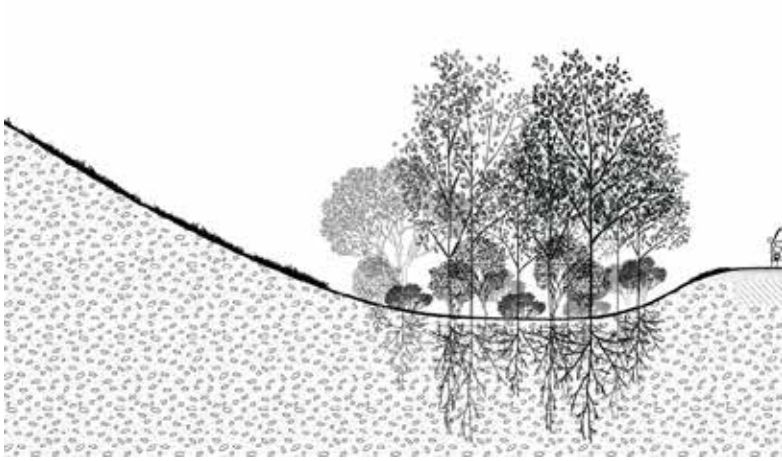
The area can dry up or swell to give maximum flexibility for potential future severe flooding events from rain.





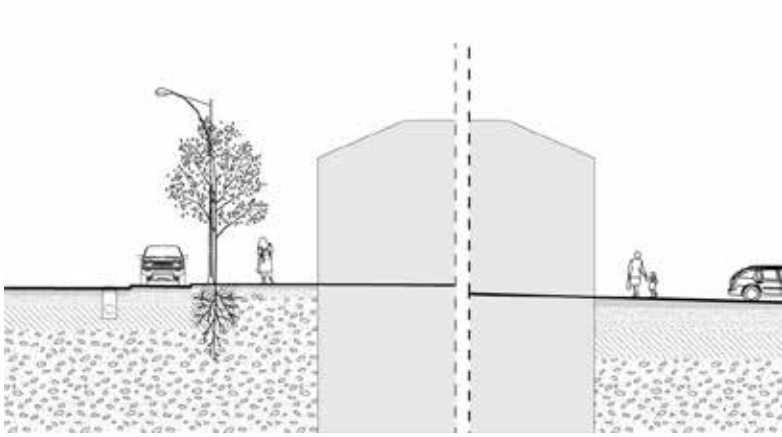
A-A

Section upstream, stream to open exists as swale with underground drainage



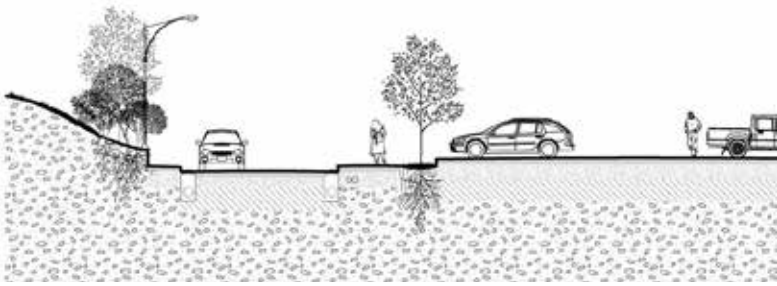
B-B

Existing situation in project area, wall-to-wall asphalt parking lot, stream to open exists as large underground drainage



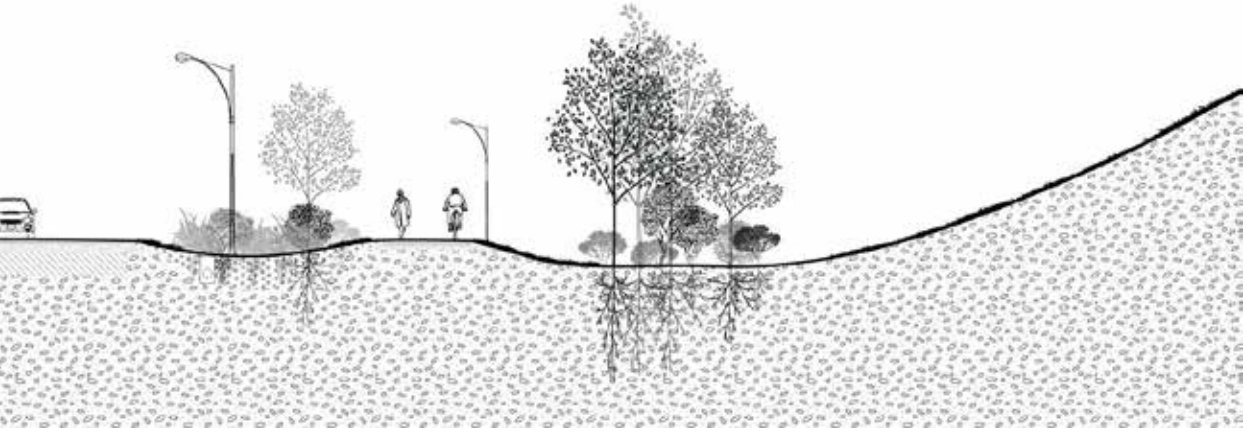
C-C

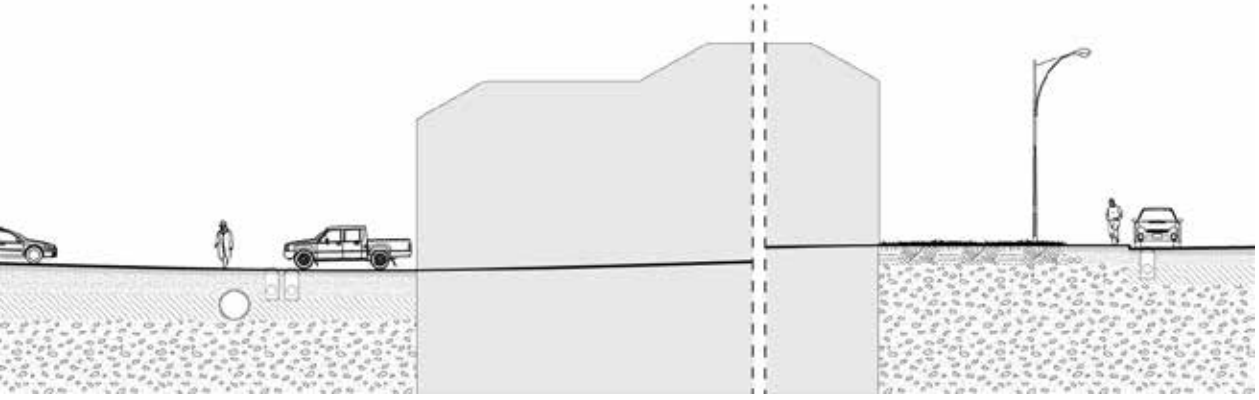
Section downstream, stream exists as open stream

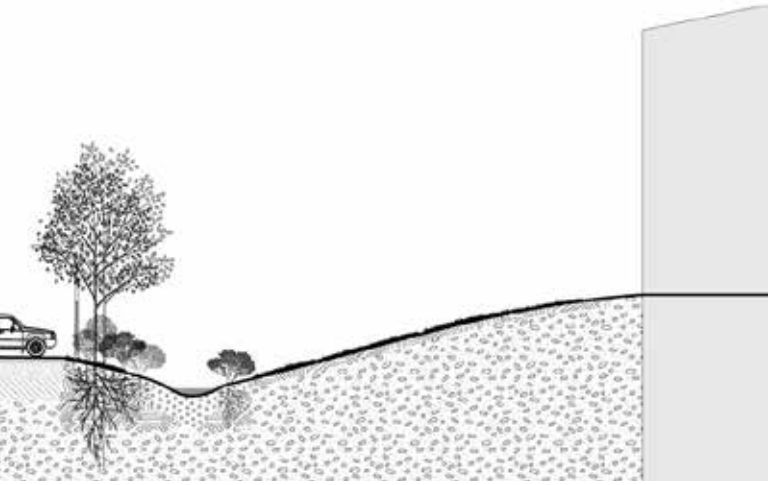




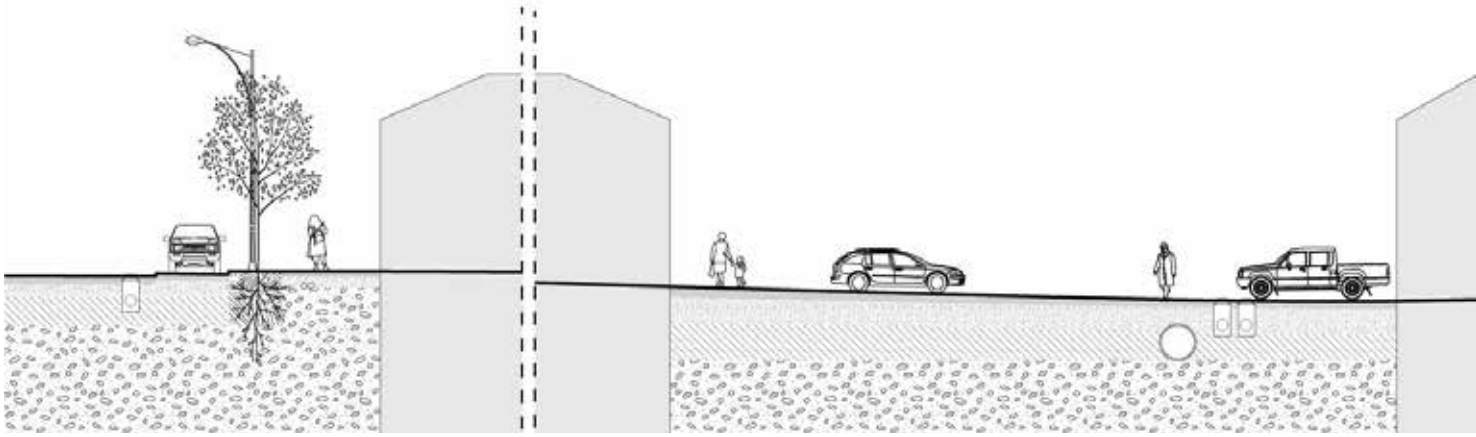
- Hard surface (asphalt/pavement)
- Hard surface base (sand/gravel)
- Hard surface subbase (crushed rock)
- Infiltration layer (sand/gravel)
- Vegetation (soil)
- Subsurface (clay)
- Drainage (road)
- Drainage
- (Electricity) cables



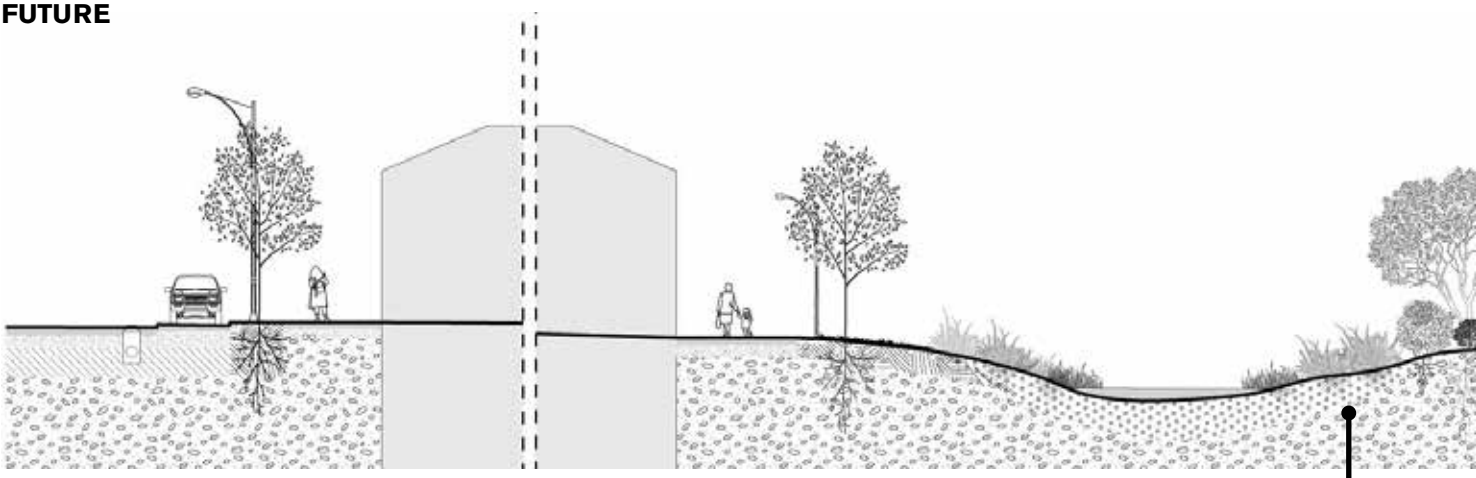




PRESENT



FUTURE



B-B

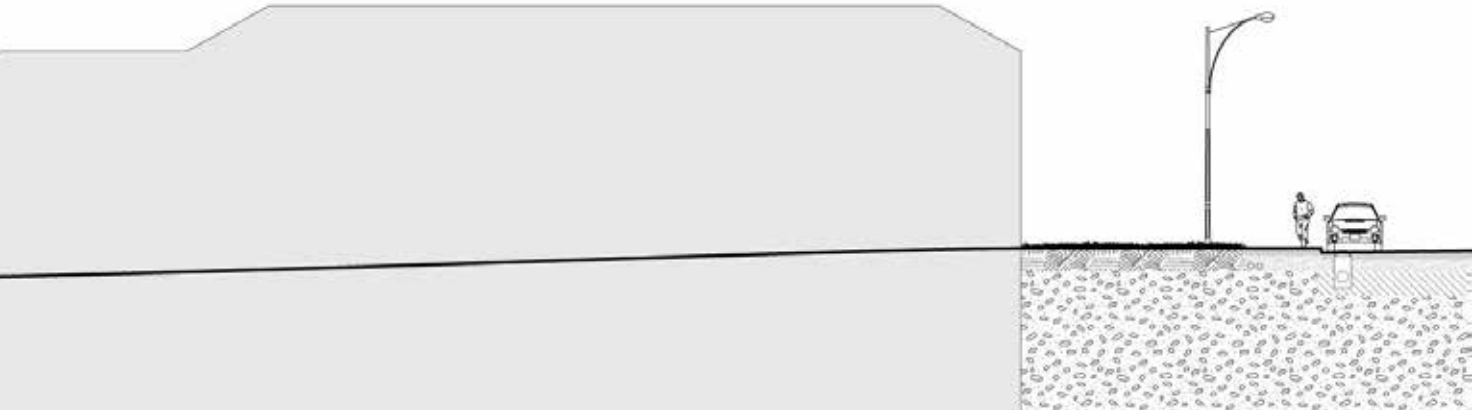
Existing situation in project area, wall-to-wall asphalt parking lot, stream to open exists as large underground drainage
Future situation in project area, wall-to-wall green area with water infiltration, room for water, greenery (bushes, trees)

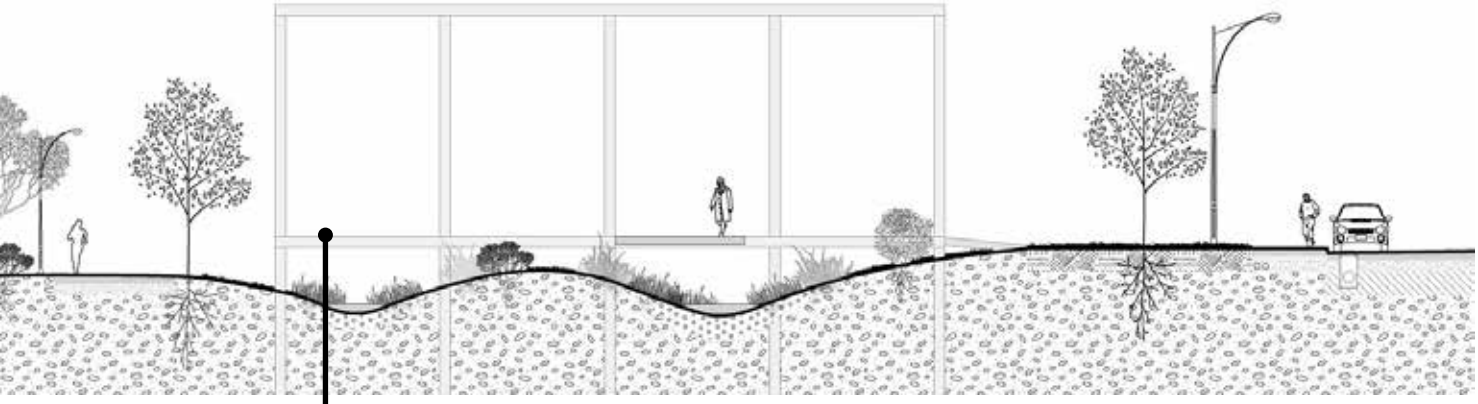
By going from asphalt parking lot in the center of an urban block to a large green area, with a re-opening of the stream that used to flow here. The idea of a "stepping stone" for greenery from the outer fields to the river is created.

One part of the added water is designed for maximum funcitonality in terms of water infiltration and retention. Water falling onto nearby hard surfaces can be diverted water into this area, rather than into the sewer when it rains. The soil would be replaced with mainly sand or peat, depending on whether retention or infiltration is desired (or both.)

This is not done everywhere so as to not completely remove the native flora (and fauna), which is based on clay soil.

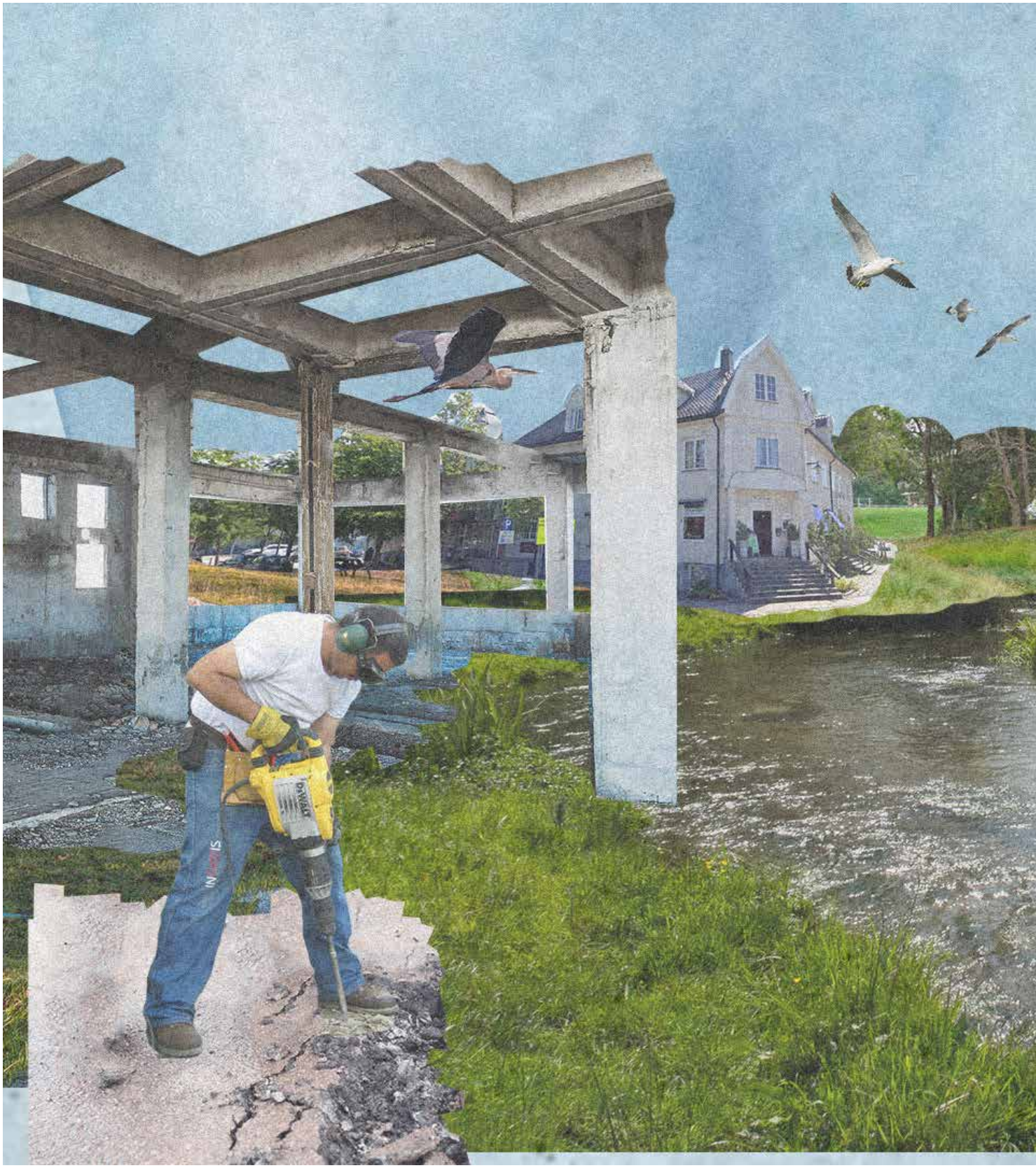
- Hard surface (asphalt/pavement)
- Hard surface base (sand/gravel)
- Hard surface subbase (crushed rock)
- Infiltration layer (sand/gravel)
- Vegetation (soil)
- Subsurface (clay)
- Drainage (road)
- Drainage
- (Electricity) cables

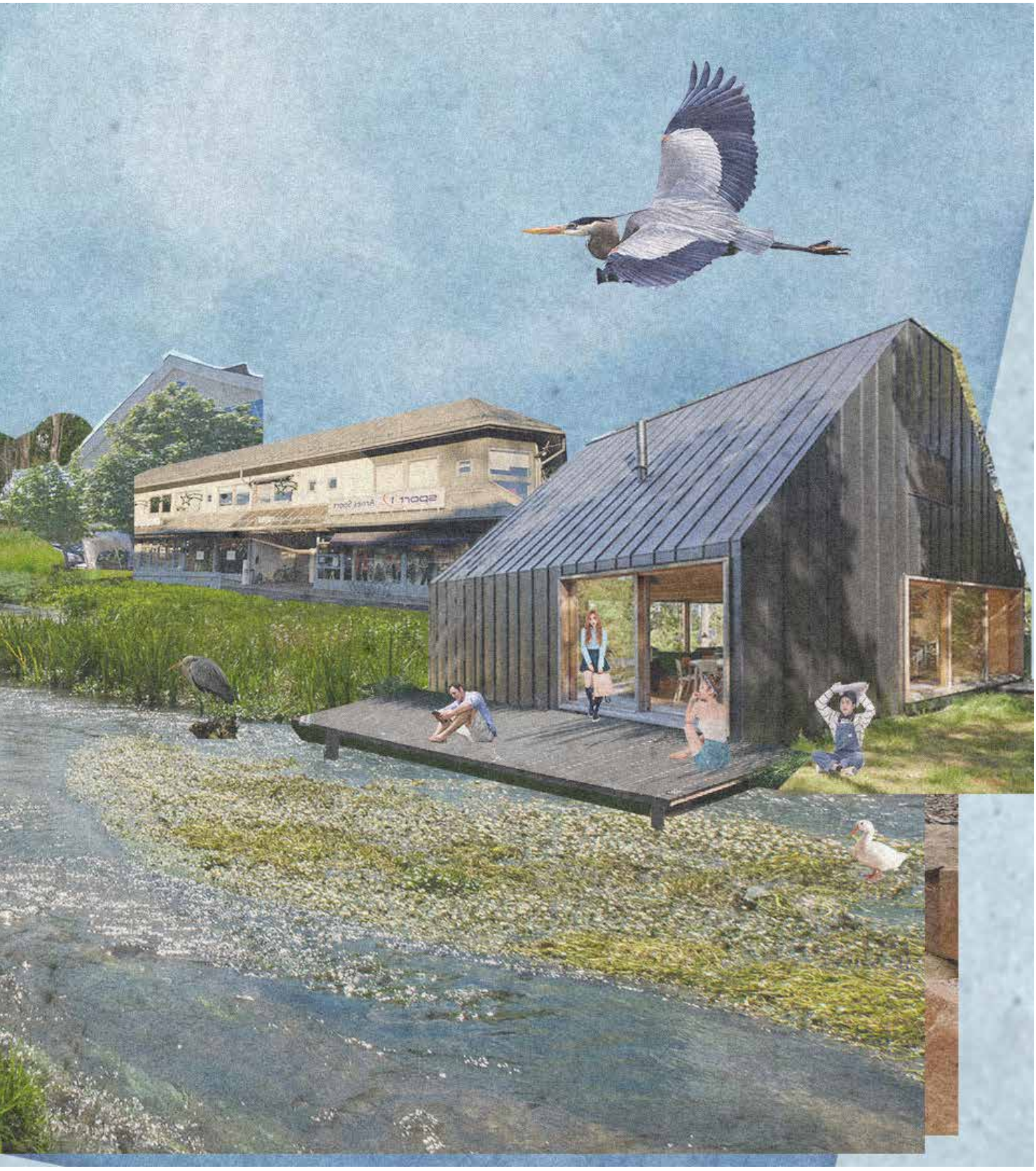


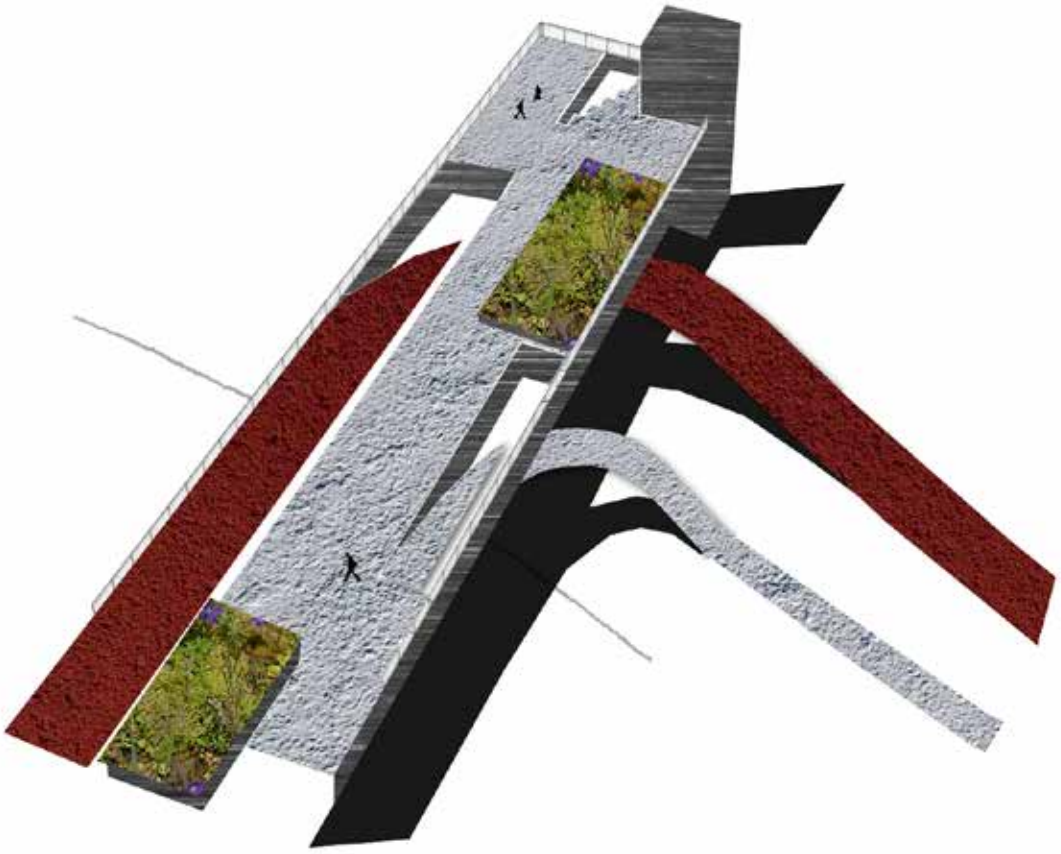


The construction of one of the former buildings is retained and transformed, by stripping it to only columns and beams, to make it possible for the water and greenery penetrate it. This is symbolism for the blue-green network being interwoven with the city (and in part superceding it), as well as creating something interesting to visit in this newly created central green area.

Certain paths through the park follow the water level, which is 1,5m lower than the city level. The path would be 0,5m above water level, to be close to the water. This path crosses the water several times, providing a dry crossing just slightly above water level during normal circumstances. This means the crossings may flood during large rains.


DEWALT





Redesigning the Arnes bridge,
putting emphasis on slow traffic

Douwe Douma
4451708

Equilibridge

Manifesto

After concluding that flows are disconnected from nature, this design experiment targets the bridge leading out of Arnes: How can we bring the daily commuters closer to nature (and especially the river), before they spent their daylight in the office?

Letting people experience nature inevidently means slowing them down. To make the crossing more enjoyable (that is more accessible, democratic and peaceful) cars are left out altogether. This way, the bridge becomes like a serene portal between work and home (or between home and recreation).

Instead of driving out in a hurry, commuters now start their day walking a couple of minutes, getting some exercise in, bor going for a stroll to lower heartbeat while having a moment to enjoy the scenic environment.

The bridge is embedded in a slow traffic network, where it can be used as elongated public space (a place not just for flowing, but with opportunities to stand still too). On the smallest scale (diagrams and sections) effort is put in to break the linear monotony (varying perspectives while walking across). The landing points not only connect to the proposed slow traffic network (continuing over the shores), but also to the train station of Arnes and the shared car parking in the north (specifically for use by commuters working in Oslo).

Rather than keeping the slopes in place at both ends, the bridge halts abruptly while traffic spirals down. These dead-ends make for natural observation (and meeting) points, while also symbolizing the dead-end society has reached with its consuming lifestyle. Rather than continuing what we have been doing for centuries (becoming increasingly polluting and disconnected with nature) it is time to take a new direction, using sustainably ways of transportation. Coming from an island myself, this is nothing to be afraid of, as it seems to be that the more isolated a village is, the stronger the feel community gets.

Analysis

Bicycle flows

To own surprise, cyclist currently do not avoid the bridge despite having no dedicated bicycle lane. This is presumably because there are not many crosses over the river (it is hundreds of meters wide after all) and we conclude the bridge is already part of a cycle network. Redesigning the bridge, putting emphasis on slow traffic can make this ride more enjoyable and thus stimulate bicycle use even more.

Pedestrian flows

When on foot, people take different routes. Detours (through nature) are more common and people flow less far from home. The bridge is not often used, presumably because on the opposite side of the water from Arnes there is little attraction (only a couple of houses in the vicinity). The kind of road where you walk besides speeding cars makes hikers uncomfortable.

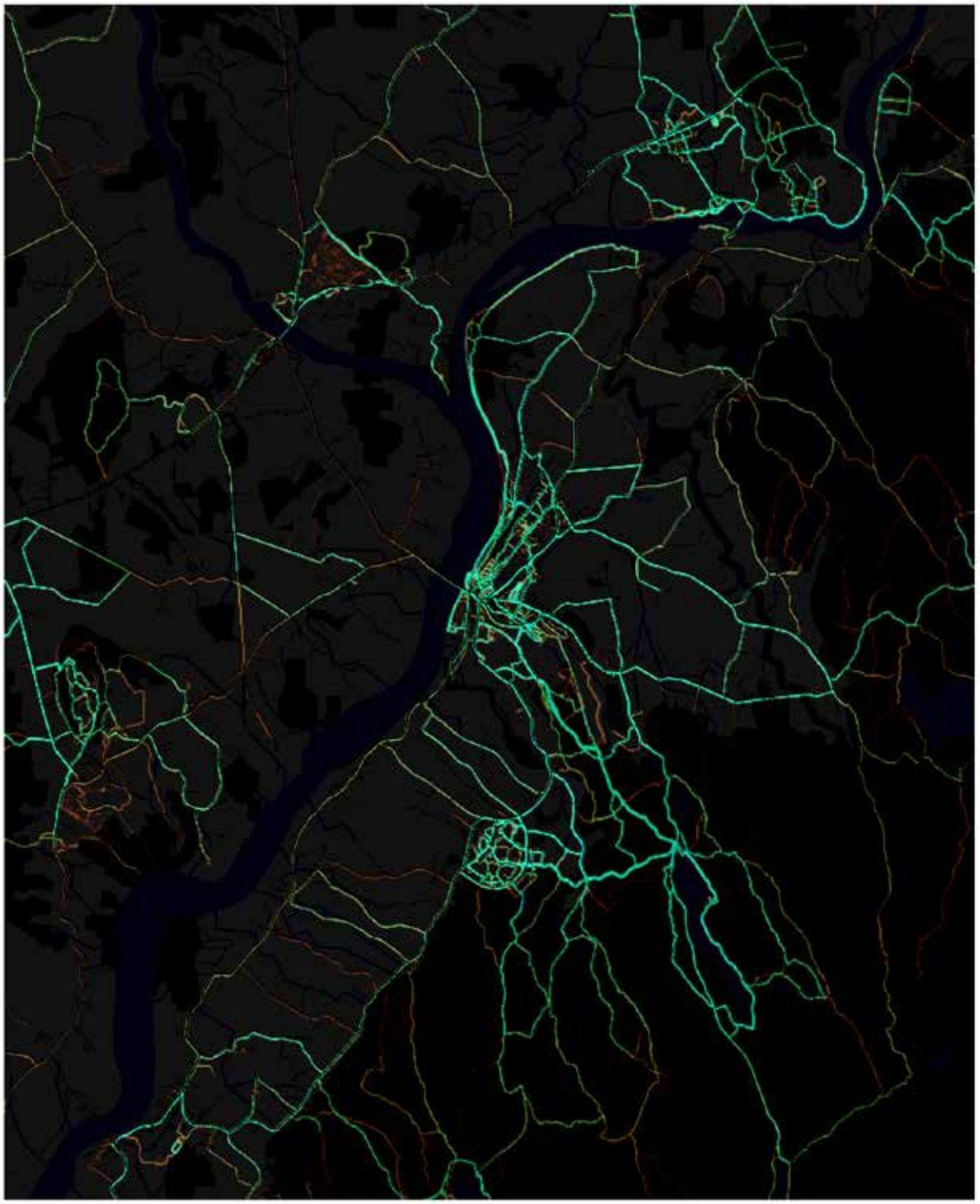




Bicycle flows (imported from strava)
- High intensity
- Low intensity
- Water



0 100 km



Pedestrian flows (imported from strava)
High intensity
Low intensity
Water

0 100 km

Slow traffic can be stimulated by embedding the bridge into a network. For this, five points of interest have been identified that we want to connect. Numbers one to three are village centres, while number four and five are landmarks: a church ruin and hydropower dam. Connecting the dots was done in such a way that different routes are possible with different lengths (5km, 10km and 20km). The colour of the line indicates if the path needs to be built altogether, redesigned or is already of good spatial quality. In this context, quality is determined by the speed of cars (on the same road) and the views provided (by google street view).



4. Church ruins Nes. Source: Remi Presttun

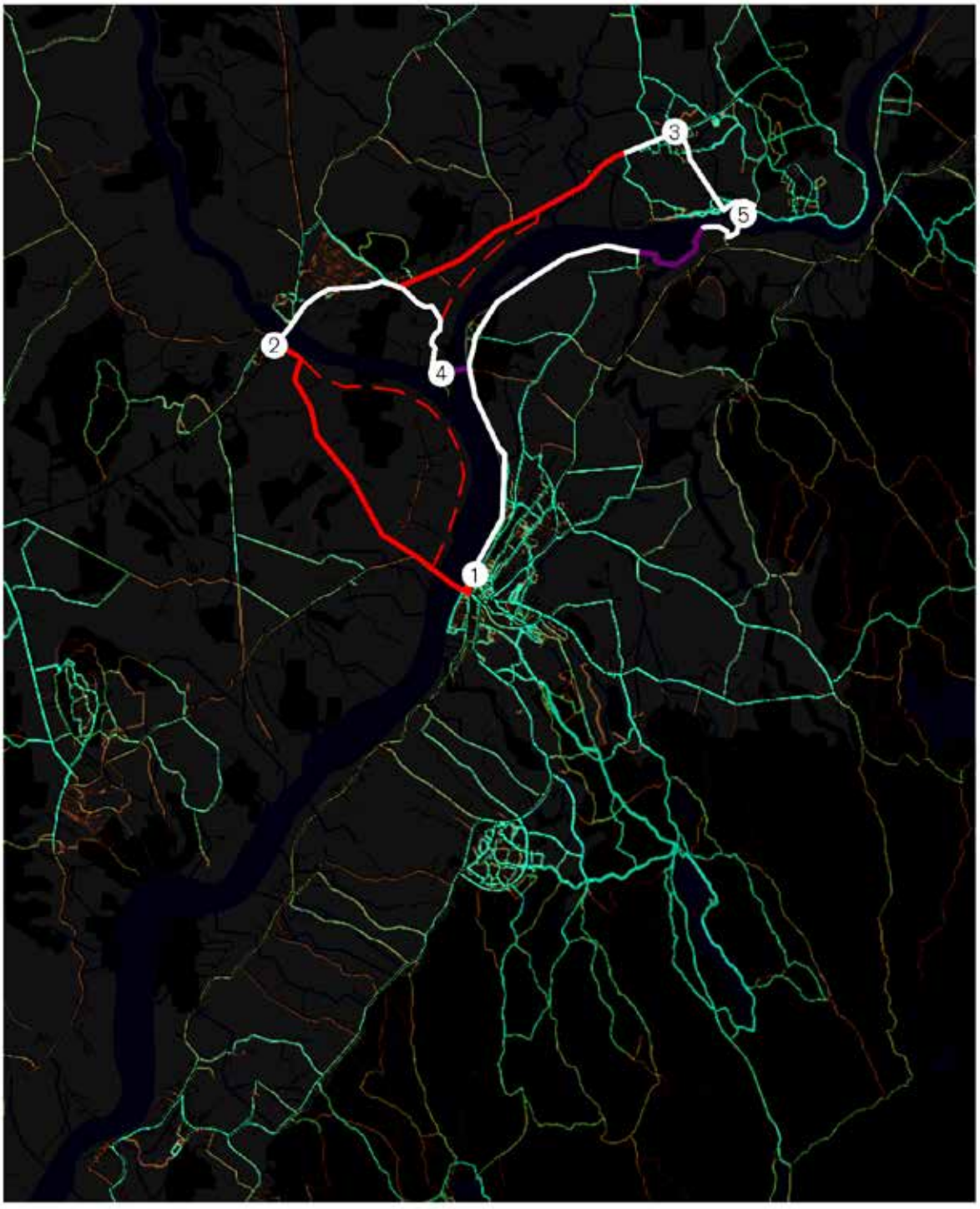




5. Hydropower plant. Source: TV2 Nyheter







Slow traffic network
- New connection
- Improving quality
- Fine as is

0 100 km

Situation

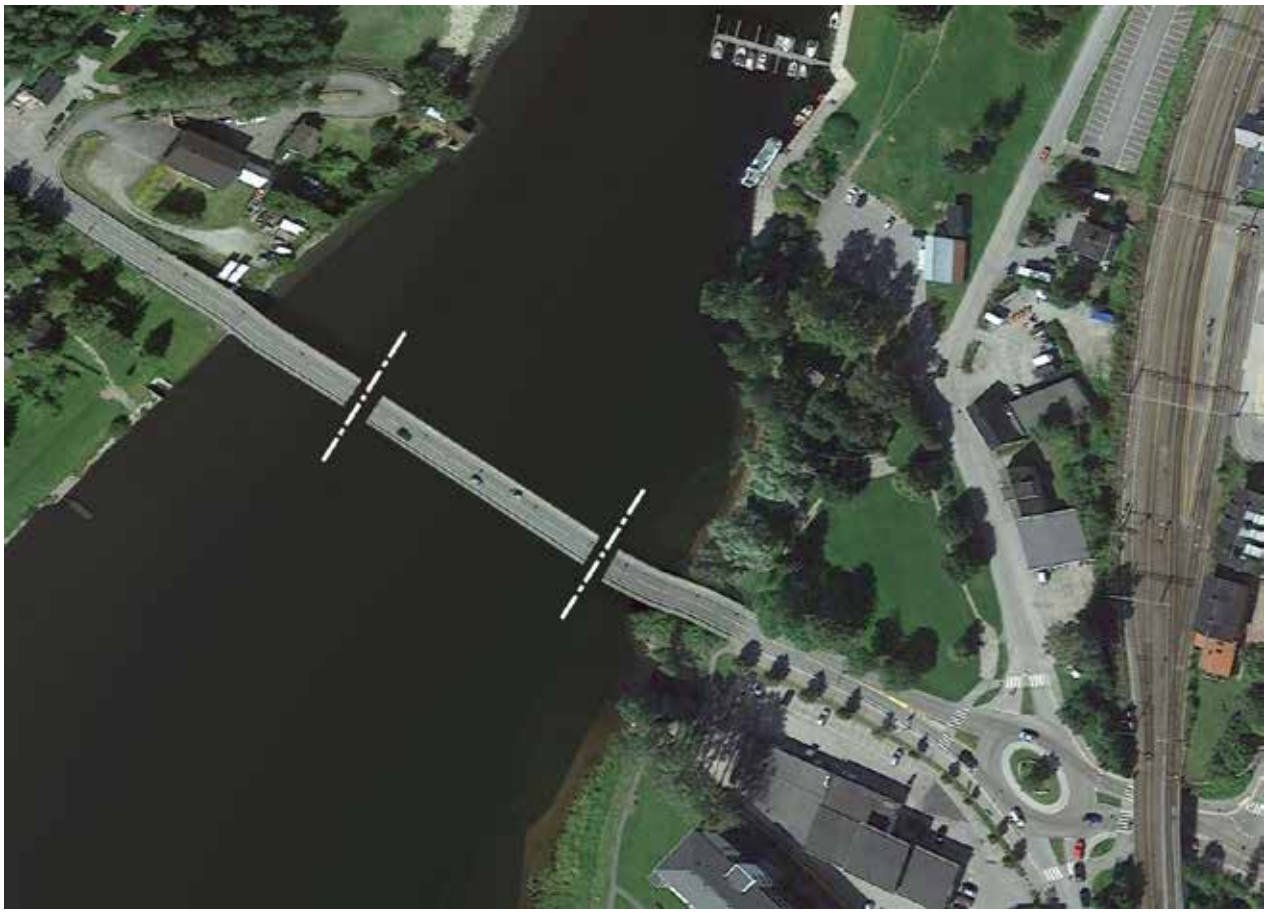
As indicated by the red line in the previous map, the bridge crossing the Glomma out of Arnes is made for - and claimed by cars.

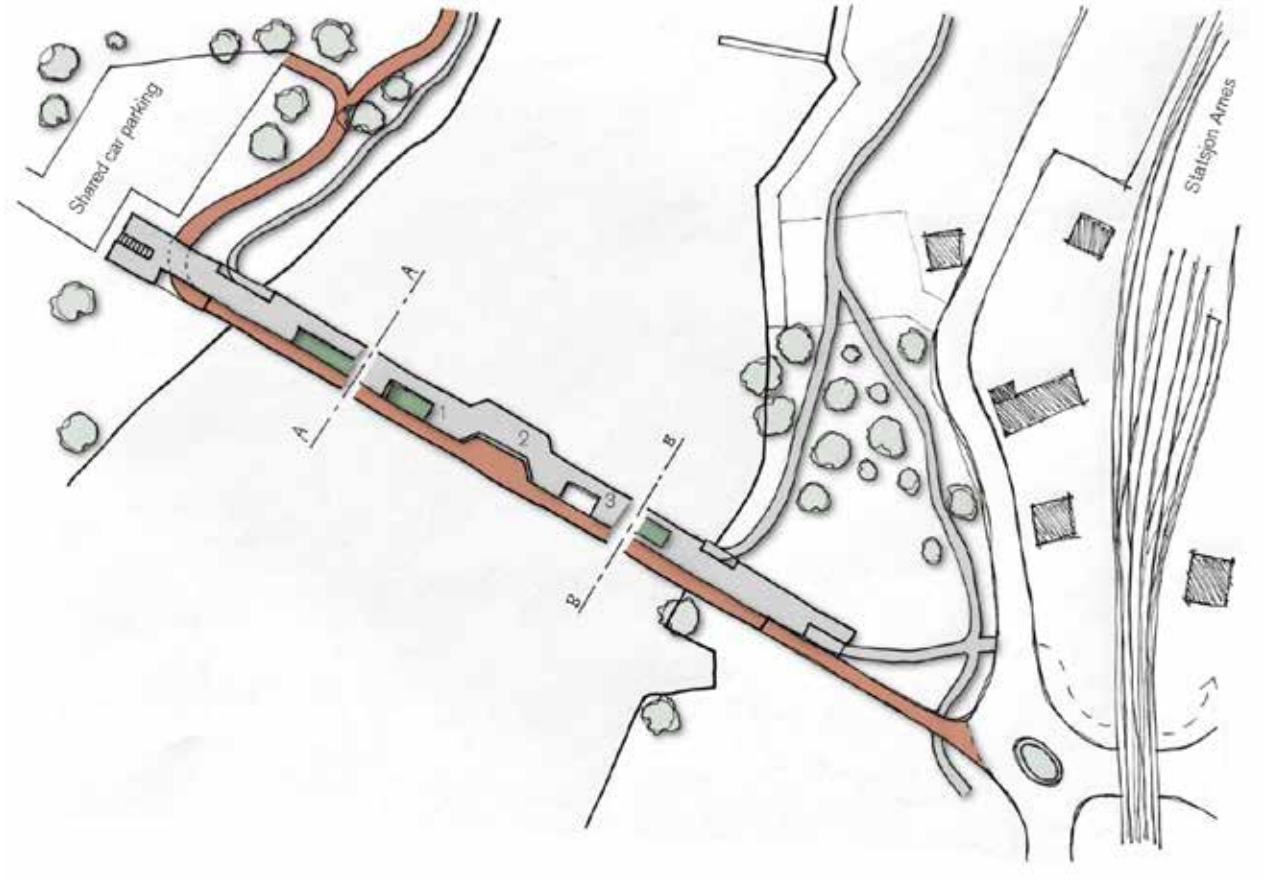
Commuters use the 400m wide bridge (the drawings on the right are cut up so they can fit the screen at an appropriate scale) to get to work as fast as possible, with little oppurtunities to change this urban perspective.

People keep their eyes on the road, there are no possiblities to slow down and appreciate the environment.

Landing points connect to the proposed slow traffic network (along the shores). On the side of Arnes, the connection to the station is important, while on the opposite side the shared car park needs to be accesssible.

The bike lane is made extra wide (5m) so people are able to look around without colliding with eachother. In addition, this path can be used for emergency vehicles (hence the connections to the road).




Shared car parking
A
A
1
2
3
B
B
Station Arnes

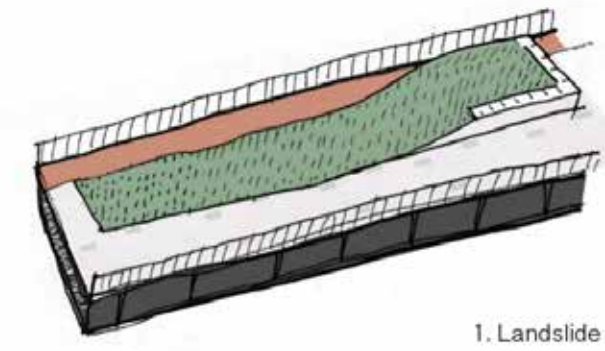
Sections and diagrams

The purpose of the following diagrams and sections is making sure the bridge is not a monotone (elongated) public space.

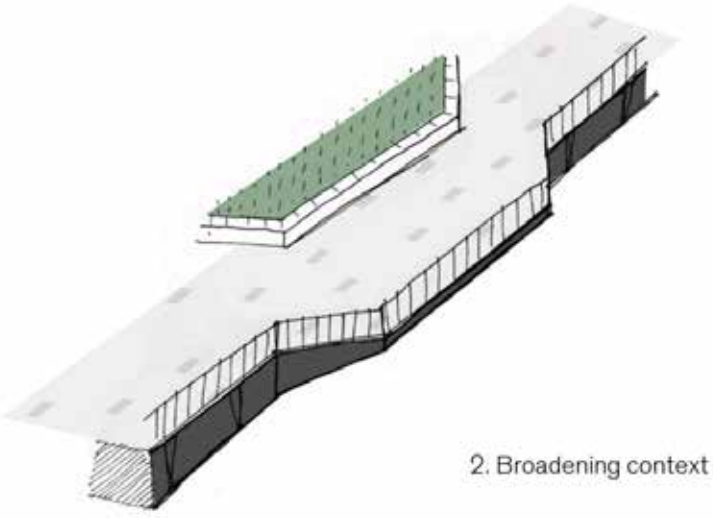
The diagrams on the right show how we can change the perspective of people walking over the bridge. Rather than walking in a straight line, people can move around (or over) obstacles, providing different views at different paces.

The sections divide the bridge into chapters. In the North (AA), we find a winterhard meadow consisting of local plants (able to survive the winters in Norway). Examples are Salvia, Artemesia and Heucheria. The pedestrian path meanders from the edge of the bridge to being in the middle of colorful (and smelly) plants, ensuring people feel part of nature.

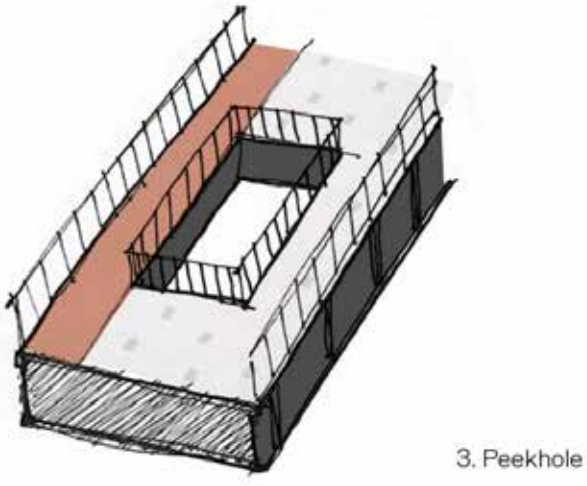
Closer to Arnes (BB), flowers and grass is replaced by edible plants. Traditionally, people in Norway have been eating what nature had to offer in the region. These need to be easy to cultivate (also withstanding cold). Examples here are berries, winter peas and cauliflower.



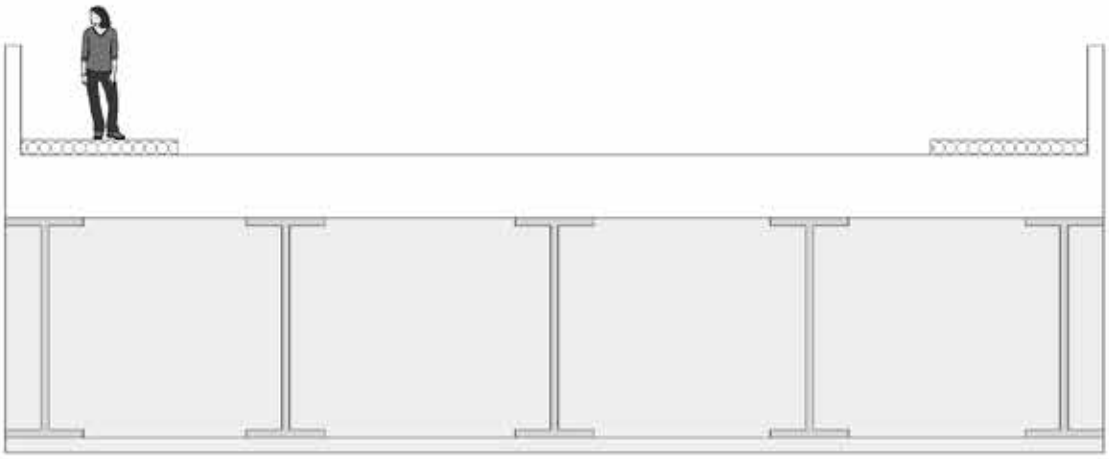
1. Landslide



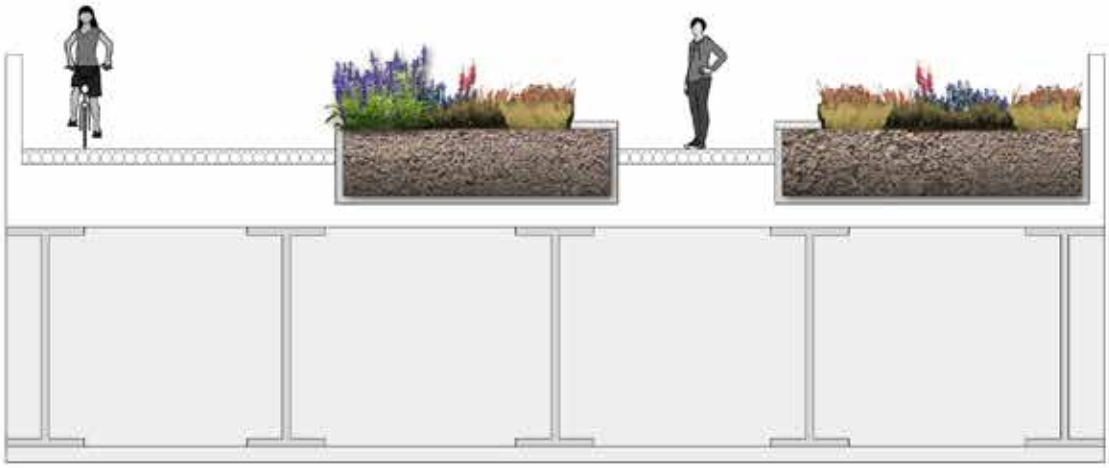
2. Broadening context



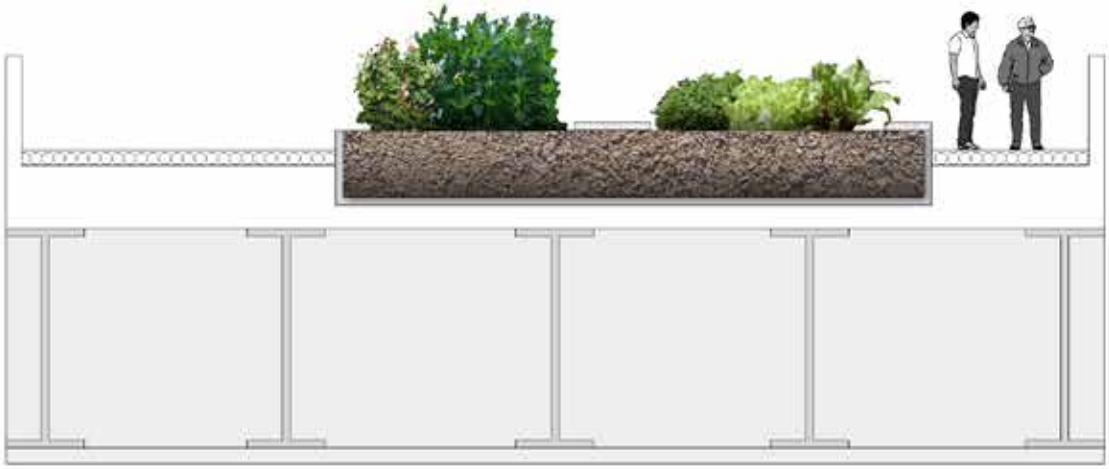
3. Peekhole



Section 00
current situation



Section AA
Winterhard meadow



Section BB
Edibles

DRINK

Ecosystem participation for drinkwater extraction

Jolt Wiersma
Carmen Jansen op de Haar
Esmee Kuit
Daan Emmerig

2020—2021 IED
Infrastructure and Environment Design
July 2021



Utrechtse Heuvelrug
MartinD

1.

Introduction

Context and Challenge

Zeist is a municipality in the province of Utrecht and is located in the Utrechtse Heuvelrug. The Utrechtse Heuvelrug is, after the Veluwe, the largest contiguous forest area of The Netherlands. In the heart of this nature reserve forests alternate with drifting sands and moors. The project scope consists of the hill landscape, the urban landscape and the river landscape. The urban landscape is linked to the municipality of Zeist and has a total area of 4.865 hectares, of which 4.851 land and 14 water. The average density is 1.590 households per km2. The municipality has 5 residential areas, 5 districts and 35 neighbourhoods.



The territory of Zeist has undergone a major transformation in recent centuries. In the 19th century, cities were seen as unhealthy places. People wanted to move to nature outside the city with fresh air, especially on the sandy soils. The rich people built in the period 1800-1920 new country estates, just outside the city. From the late 19th-century income growth made it possible for more people to move to villas outside the city. The enormous densification and expansion changed the original small farming village Zeist into an urban area.



This densification is still going on because 1 million houses should be built in The Netherlands and, especially in Zeist, this increases the pressure on the drinking water capacity. In 1896 they built the first drinking water extraction in Zeist. Zeist has been designated as a water extraction area, groundwater protection area and 100-year focus area. Due to this densification, drinking water becomes scarce. Besides that, climate change causes more droughts and increased rainfalls, which makes drinking water extraction more difficult. Therefore, the main issue is the drinking water extraction that needs to deal with external shocks. The question is how the urban landscape can accommodate archetypal drinking water abstractions that are more flexible so that the drinking water extraction can deal with external shocks, while also avoiding damage. The aim of the project is to be able to respond quickly to the challenges of the future concerning drinking water security.



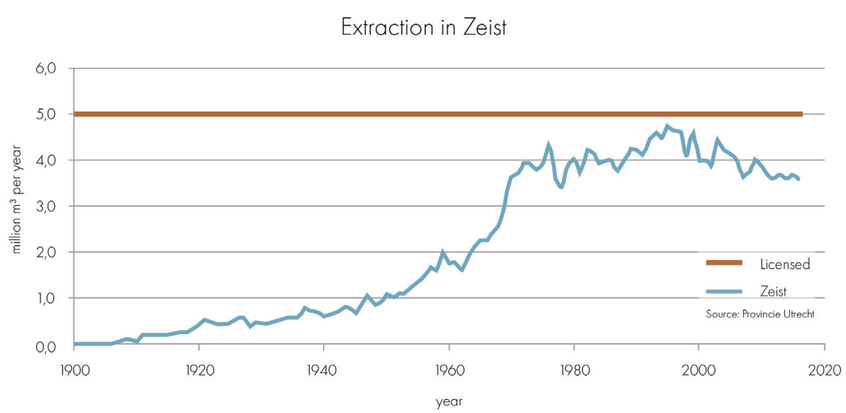
Environmental Risks and Human Response

There are several environmental risks caused by drinking water extraction. At all locations in the Netherlands where drinking water is extracted from surface water, the water quality is under pressure as a result of climate change. Measures are needed to keep the water suitable in the future for drinking water preparation (Wuijts et al., 2013). The quality of water deteriorates if the amount of water flowing through the rivers decreases. The influence of discharges on water quality is then much bigger because the concentrations of polluting substances from the discharges are less diluted. The population experiences problems during extreme droughts, because there is not enough water available for, for example, irrigating gardens (Wuijts et al., 2013). It is even possible that Zeist will have to deal with a drinking water shortage because of extreme droughts.

Besides the problem of water shortage, Zeist is facing more challenges. During winter the environmental risks are habitat loss and low soil permeability. The water quality in the Kromme Rijn area has strongly deteriorated over the past 50 years. Causes are the reduction of seepage through water extraction, supply of water with lower quality, sewage overflows and fertilization in agricultural areas. Nitrogen deposition and drought also have a negative effect on species such as the butterfly (Buizer et al., 2021).

All this results in biodiversity loss. If the soil compaction is too strong, the permeability and moisture storage capacity of the soil will decrease. This can lead to flooding and superficial runoff. There is also a greater chance of nutrients and crop protection products being runoff into the surface water (SkyGeo Explorer, 2020).

During summer the well-known phenomenon of the heat island will occur (Catsburg, 2021). Because of this urban heat island effect, inhabitants will use more water which will lead again to more water shortage. In order to be able to live, work, and recreate pleasantly in the future, certain strategies should be used. These strategies are connectivity, awareness, adaptivity, circularity, efficiency and social vitality. The strategies will stimulate conservation, regeneration and integration. In the end, it is all about humans who need to know how to respond to climate change. They need to interact with nature instead of only using it.



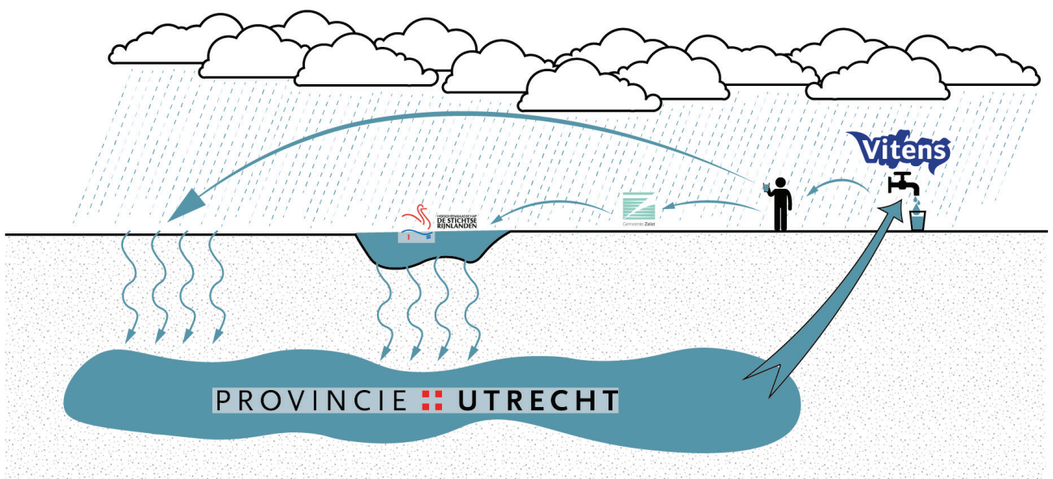
Scales & actors

The project acts at various scales because interventions even at the smallest level have larger-scale effects. The three scales that are worked with are macro-scale (regional level), mesoscale (urban level), and micro-scale (urban fragment level).

The regional level consists of the junction of the three landscapes (river, urban, hill) around Zeist. Because of this, the actors involved are cities (Utrecht, Heuvelrug Town) and municipalities (Utrecht, Utrechtse Heuvelrug) as well as government (Rijkswaterstaat) and water boards and suppliers (Hoogheemraadschap de Stichtse Rijnlanden, Vitens). These landscapes are also home to various flora and fauna that migrates between them. They will be affected strongly by interventions at a regional scale.

The urban level consists of the city limits of Zeist as it sits on the hillside as one of many villa towns of the Utrechtse Heuvelrug. Because of this, the actors involved are also the other hillside villa towns that use infrastructure provided by Zeist. The city council of Zeist is the main stakeholder but Vitens has a large role here as well due to the water extraction zone that sits atop the city. The inhabitants of Zeist (humans, flora, and fauna) are significant stakeholders as well as they use the public facilities provided in the urban fabric.

The urban fragment level consists of separate urban districts. Here the actors are individual homeowners or community organizations. At this level, ecological habitats also have form and so flora and fauna are stakeholders here as well.



Theoretical framework/ concept & vision

As an underlying ideological standpoint, a theoretical framework will be applied in this project that will help in guiding design decisions in the design experiment phase. These underlying ideas and principles are the ethical backbone of the concept, vision, and ultimately the design experiments. The theoretical framework as presented here is a result of the combination of three existing theoretical frameworks that have in the past been applied to existing urban and landscape architectural interventions.

Researcher Klemm et al (2017) devised a framework that concluded that participatory approaches helped to link knowledge about people, planet and prosperity to projects. In a studio session, researchers defined guidelines based on human-landscape issues (drought, heat, rainfall) while landscape architects tested evidence-based design guidelines in practice. The result was a climate-responsive design framework involving stakeholder participation and interaction (socio-economic prosperity).

Research by TKI Watertechnologie (2019) devised a framework that concluded that the aspects of people, planet, prosperity, and project, which inherently come from the four-p's tetraeder by Van Dorst & Duijvestein (2004), manifest themselves in different aspects of an intervention, especially if they are for climate adaptation. Project and planet come forth from interventions that work toward a spatial fit of a design (functionality). People and prosperity come forth from interventions that work toward public awareness of a design (tangibility). This research was a result of a pilot project aimed at reducing water stress at street level, the Urban Water Buffer project.

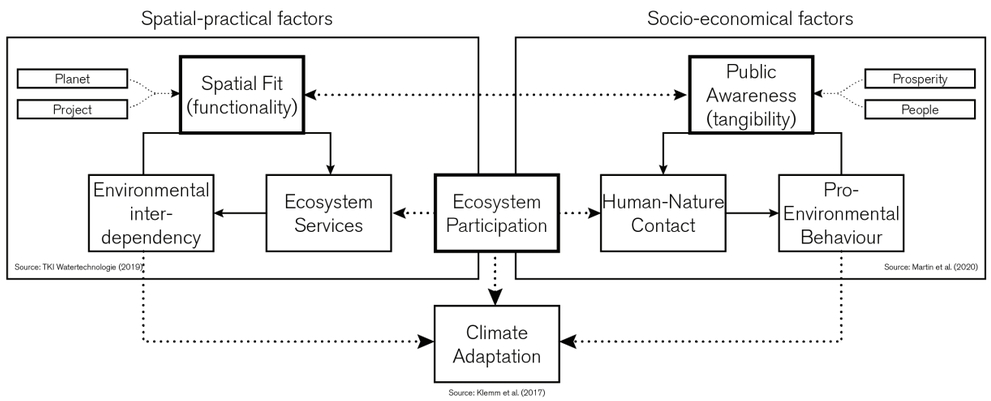
The public awareness that was researched in the previously mentioned study can be connected to a study by Martin and colleagues (2020) that links nature connectedness and nature contact to pro-environmental behaviour (PEB). Pro-environmental behaviour can be both public and private, and can therefore range from participating in demonstrations to separating waste or implementing a rain barrel. Pro-environmental behaviour in the private sphere can thus be imposed. If it is, it will act as a self-fulfilling prophecy. Nature connectedness is 'an individual's subjective sense of their relationship with the natural world'

(Martin et al., 2020).

Studies conclusively show that there is a direct relationship between nature-connectedness and PEB. However, the same research also shows that contact with nature can influence a person's nature connectedness. Therefore, an increased amount of time that a person is in contact with nature can increase the willingness to participate in PEB. This can be achieved by small changes, such as implementing more green and water.

This project in Zeist, in which climate adaptivity and future-proofing is a major potential, has a theoretical framework in which the guidelines of Klemm et al (2017), TKI Watertechnologie (2019), and Martin et al (2020) are combined. Future-proofing requires two underlying ambitions for adapting to the circumstances of the future. First, there is the sphere of spatial-practical factors in which planet and project are most influential and affected. Herein the offer of functionality in interventions (spatial fit) will automatically lead to human and nature benefits (ecosystem services) and eventually the need for environmental interdependence which stimulates new optimally fitting interventions. Second, there is the sphere of socio-economical factors in which prosperity and people are most influential and affected. Herein the offer of tangibility (public awareness) in interventions will automatically lead to a bettered human and nature relation (contact) and eventually the outcome of pro-environmental behaviour which stimulates new public awareness of interventions. The concept that links the two spheres is ecosystem participation which alongside the spatial-practical and socio-economical factors, has a direct effect on climate adaptation and therefore future-proofing.

Applying this theoretical framework in the future-proofing of the drinking water extraction landscape of Zeist will lead to the most optimal and resilient design.



2.

Critical Cartography

Process of collecting data

The process of investigating the different domains started by dividing the three topics. The division is as follows:

- Landscape and ecology: Jolt Wiersma
- Urban Morphology: Carmen Jansen op de Haar
- Antrhopology: Esmee Kuit
- Transport Infrastructure and Logistics: Daan Emmerig

The process was set off by a presentation of the problem description for this location as proposed by Vitens. This presentation and additional documentation provided a considerable amount of information to get the process started.

However, a vast component of the location was to deal with the drinking water supply. This proved to be delicate subject, so over the course of the research there were various moments that input was delivered on this topic. There was a team of water management students that provided information regarding the recharge of the water supply. In addition, the team provided practical solutions to make water more tangible in the location, which will prove very applicable for the individual designs in a later stage. The fact that this workshop came very early in the process ensured that there was a critical basic understanding of the water management in the area.

Later in the process, there was the chance to meet with a hydrologist to retrieve information that was more in-depth on the questions that were still unanswered. During the whole process, the different teams and profesionals were at a stand-by for all questions water related.

Most of the data was retreived online via governmental sources and personal stories as well as documents created by private organisations such as Vitens. However, it was also possible to visit the location to experience hands-on what was read in documents.

An important part of the process was collaborating on the different domains. Early on in the process, there were meetings to see what possible synergies were. These meetings informed the individual processes and lead to more well defined critical cartographies, which facilitated the creation of the synthesis.

2.1

Landscape and Ecology

Jolt Wiersma

L01A - Natural Layer

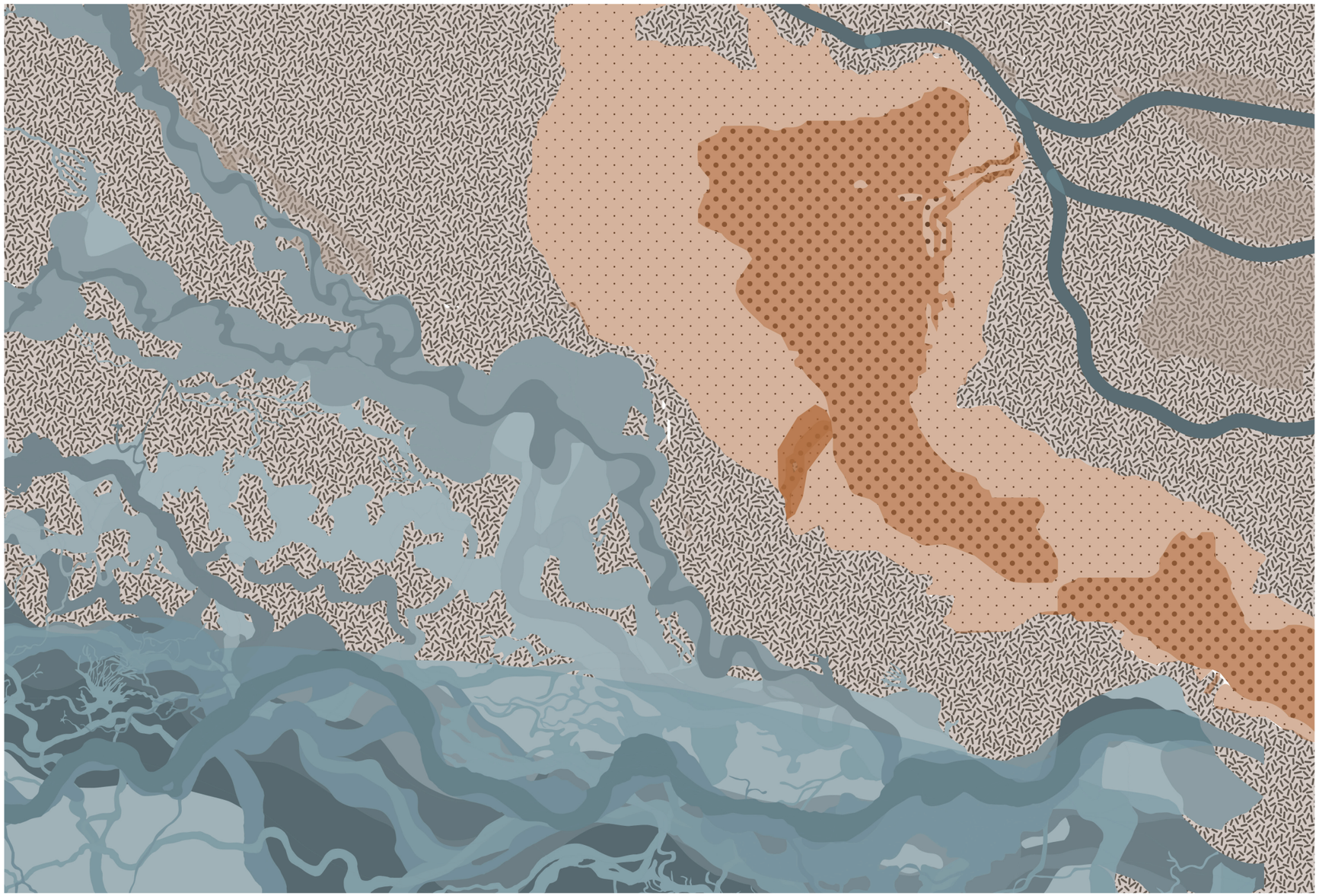
Typology & Soil

The natural layer is comprised of three main landscape typologies. Each of these has deposited a specific soil type.

The river landscape has meandered through the area since prehistoric times. Nevertheless, its precise course and volume has varied over time, depositing clay soil in a meandering pattern. New deposits come to sit upon older deposits.

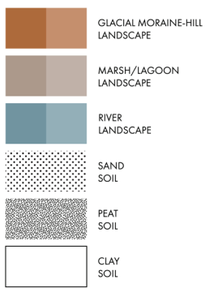
The glacial moraine-hill landscape developed during the last ice age as an ice-sheet pushed sediments southward as the glacier grew from the north. At the end of this glacial period, the retreat of the ice-sheet meant that the sediments remained in place, forming a ridge called a moraine. It is essentially a hill with sediments ranging from sandy soil to silty soil.

The marsh/lagoon landscape is a side effect of the river landscape. Terrain on which water had difficulties in draining toward the rivers formed into wetlands and bogs. As the water level fluctuated, flora and fauna generations also succeeded each other. The layering of these organic materials formed peat soil.



Map of natural landscapes and soils in the area of Zeist

Three landscape typologies interact to form three soil types



L01B - Natural Layer

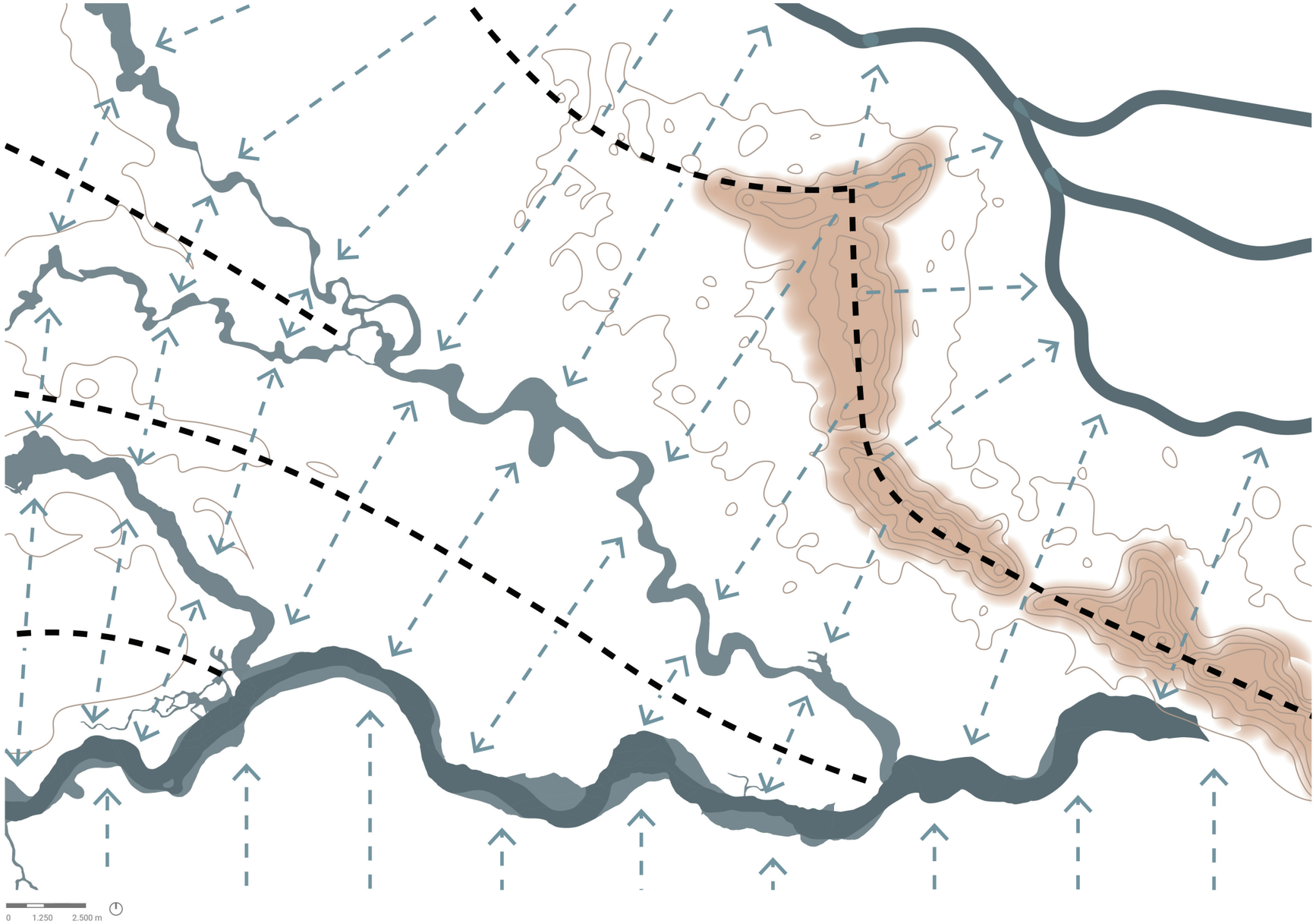
Morphology & Structure

The natural layer has a morphology and structure based most prominently on the drainage possibility of water.

The most recent river system in the river landscape indicates that the area has multiple catchment basins. The topography of the glacial moraine-hill landscape acts as the highest of these watershed ridges. The other watersheds also sit on ridges formed from the topography. Perpendicular from these watersheds is the rainwater run-off.

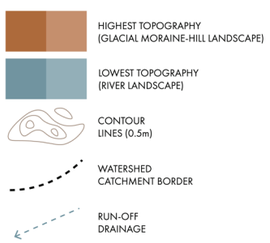
The main rivers that drained away the water run-off are the Neder Rijn, Lek, Hollandse IJssel, Kromme Rijn, Leidsche Rijn, and Vecht rivers. The meandering course of these rivers froze in time as the land became cultivated and the cultural layer formed.

For prehistoric settler's, such as the Romans, these rivers acted as the main infrastructure network for movement of people and goods.



Map of natural morphology and structures in the area of Zeist

The topography interacts with run-off to form catchment basins for draining rainwater



L01C - Cultural Layer

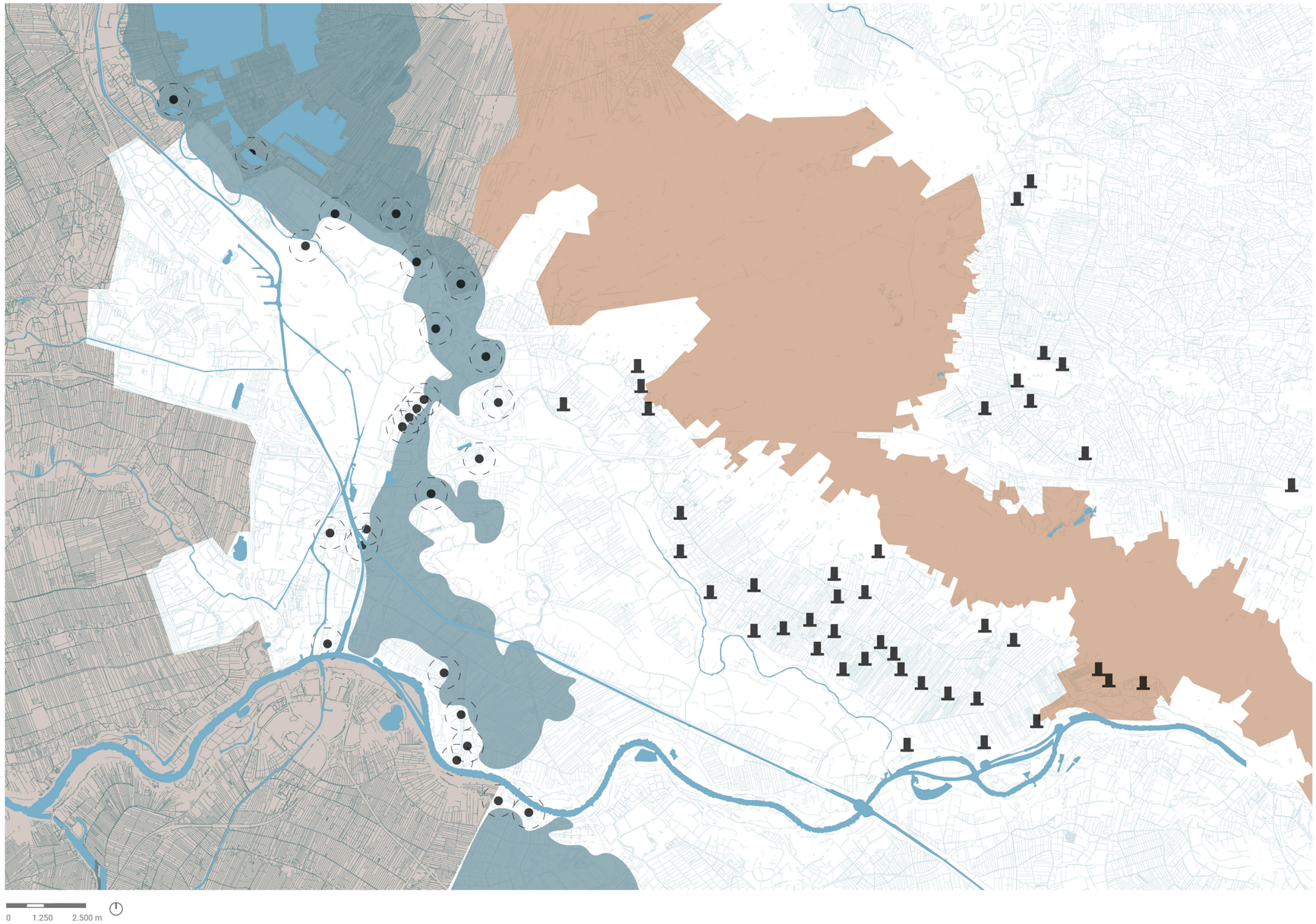
Typology & Land Use

The cultural layer is comprised of three recognized cultural landscape typologies. Each of these has a land use that is based on the typology and soil there from the natural layer.

The Greenheart Landscape is a polder landscape situated most prominently in the natural marsh/lagoon landscape. The abundance of peat, which was exploited as a fuel, meant that the land had to be drained from water as the soil was excavated away. This results in the typical grid structure of ditches.

The Nieuwe Hollandse Waterlinie Landscape is a military defence landscape situated along the eastern edge of the Greenheart Landscape. It makes use of low lying land (exploited for peat) as inundation fields. Along with various fortification camps, enemy troops from the west could not cross into the Greenheart Landscape.

The Utrechtse Heuvelrug Landscape is the natural glacial moraine-hill landscape as a culturally-valuable national park. The many estates on the hillside are characteristic of it.



Map of cultural landscapes and land use in the area of Zeist

Three landscape typologies interact to form three different land uses

GREENHEART POLDER LANDSCAPE

DITCH STRUCTURES

NIEUWE HOLLANDSE WATERLINIE LANDSCAPE

FORTIFICATION STRUCTURES

NATIONAL PARK UTRECHTSE HEUVELRUG LANDSCAPE

ESTATE AND CASTLE STRUCTURES

L01D - Cultural Layer

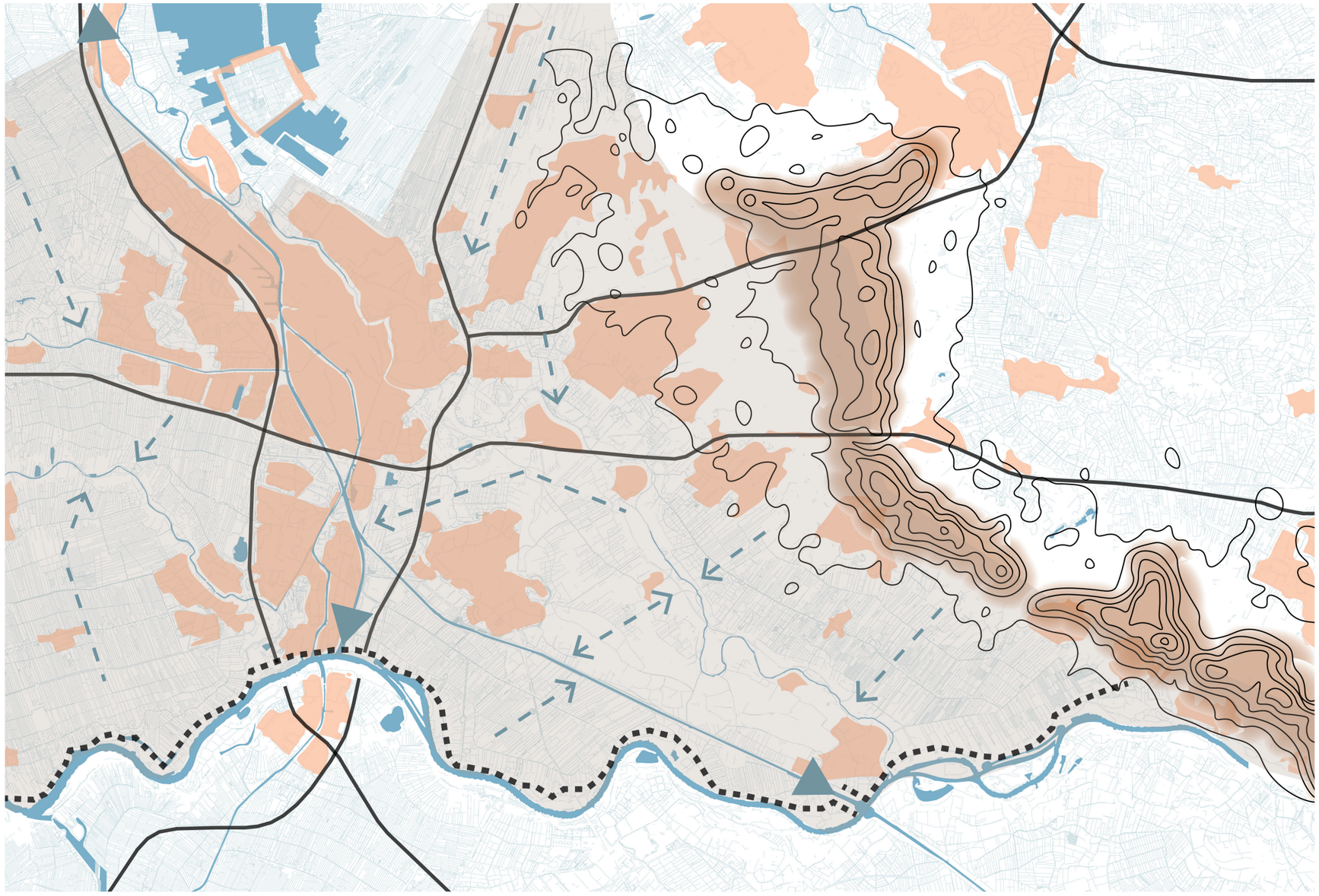
Morphology & Structure

The cultural layer has a morphology and structure based most prominently on the regulation of water drainage.

Due to increasing settlement of humans and the slow subsidence of the land, much of the natural layer river landscape was transformed into canals, diked for protection, or made dry for new land. The consequence was that specific policies were put into place to regulate the drainage and discharge of water.

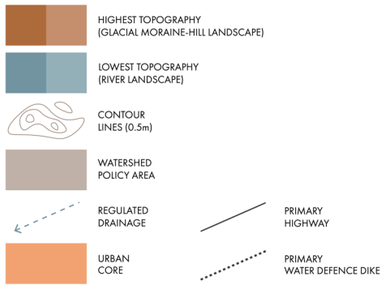
The topography of the Utrechtse Heuvelrug stilll acts as the most influential watershed ridge. In the current policies of the watershed, the water run-off is discharged into the Lek river on the south edge of the policy area and into the Vecht river on the north edge of the policy area.

For current settler's, such as the inhabitants of Utrecht, a network of highways and canals act as the main infrastructure for movement of people and goods. They intercept the landscape at strategic points such as breaks in the hillside or floodplains along the river.



Map of cultural morphology and structures in the area of Zeist

The watershed policy area regulates the drainage of water, allowing development



L02A / L02B - Biomes and Ecotones

Flora and Fauna

The shift from natural landscape to cultural landscape has affected the biomes and ecotones, specifically the types of flora and fauna that are found in the area. Much of the flora and fauna lost their habitat as the landscape changed its performance. Nevertheless, a lot of new flora and fauna could benefit from the new landscape performance.

For flora, all trees and plants that existed in the natural landscape continue to thrive to this day. The cultural landscape has offered habitat for newcomers such as the maple tree and daisy plants in the cities. These offer habitat to a variety of fauna as well.

For fauna, not all wildlife that existed in the natural landscape still continues to thrive until today. The cultural landscape has changed in performance so much that many animals that were once natural to the area have moved on. This is mainly due to the water management in the area surrounding the Kromme Rijn river. The loss of this wet habitat meant the loss of, for example, the great reed warbler and the eurasian bittern. Wildlife that lived higher up on the hill landscape mainly continues to thrive until this day since the landscape performance has changed to a less extent. With new cities, however, new habitats are established and new animals prevail. The squirrel and butterfly are good examples of this.

Images flora courtesy of NDFF Verspreidingsatlas (2021).

Images fauna courtesy of Animal Diversity Web (2021).

Tables of Flora and Fauna found in Zeist

Most natural flora continues to exist until today. Fauna, however, has seen large scale changes, mostly in wildlife used to wet habitats.

Flora

Trees



Acer pseudoplatanus
maple tree



Alnus glutinosa
alder tree



Castanea sativa
chestnut tree



Corylus avellana
hazelnut tree



Crataegus monogyna
hawthorn tree

Plants



Alisma plantago-aquatica
plantain



Allium ursinum
ramson



Anthoxanthum odoratum
sweet vernal grass



Anthriscus sylvestris
parsley



Bellis perennis
daisy

Fauna

Natural (possible) fauna



Acrocephalus arundinaceus
great reed warbler
reed areas in fluctuating water landscapes
STRONG DECREASE



Microtus oeconomus
tundra vole
swamps, marshes, wetlands
STRONG DECREASE



Botaurus stellaris
Eurasian bittern
swamps, marshes, wetlands
STRONG DECREASE



Strix aluco
tawny owl
thick covered forests with aged trees
SLIGHT DECREASE



Natrix natrix
grass snake
moor / heather terrain along river landscape
SLIGHT DECREASE

Prevailing (existing) fauna



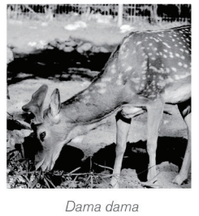
Sciurus vulgaris
squirrel
mixed species forests and cities
STRONG INCREASE



Thecla betulae
brown hairstreak butterfly
city parks and private gardens
STRONG INCREASE



Accipiter gentilis
northern goshawk
tall, quiet forests
REMAINING



Dama dama
fallow deer
remaining moor / heather terrain, forests
REMAINING



Sus scrofa
wild boar
remaining moor / heather terrain, forests
REMAINING

L03A - Pollution and Vulnerability

Fragility of the Water Zones

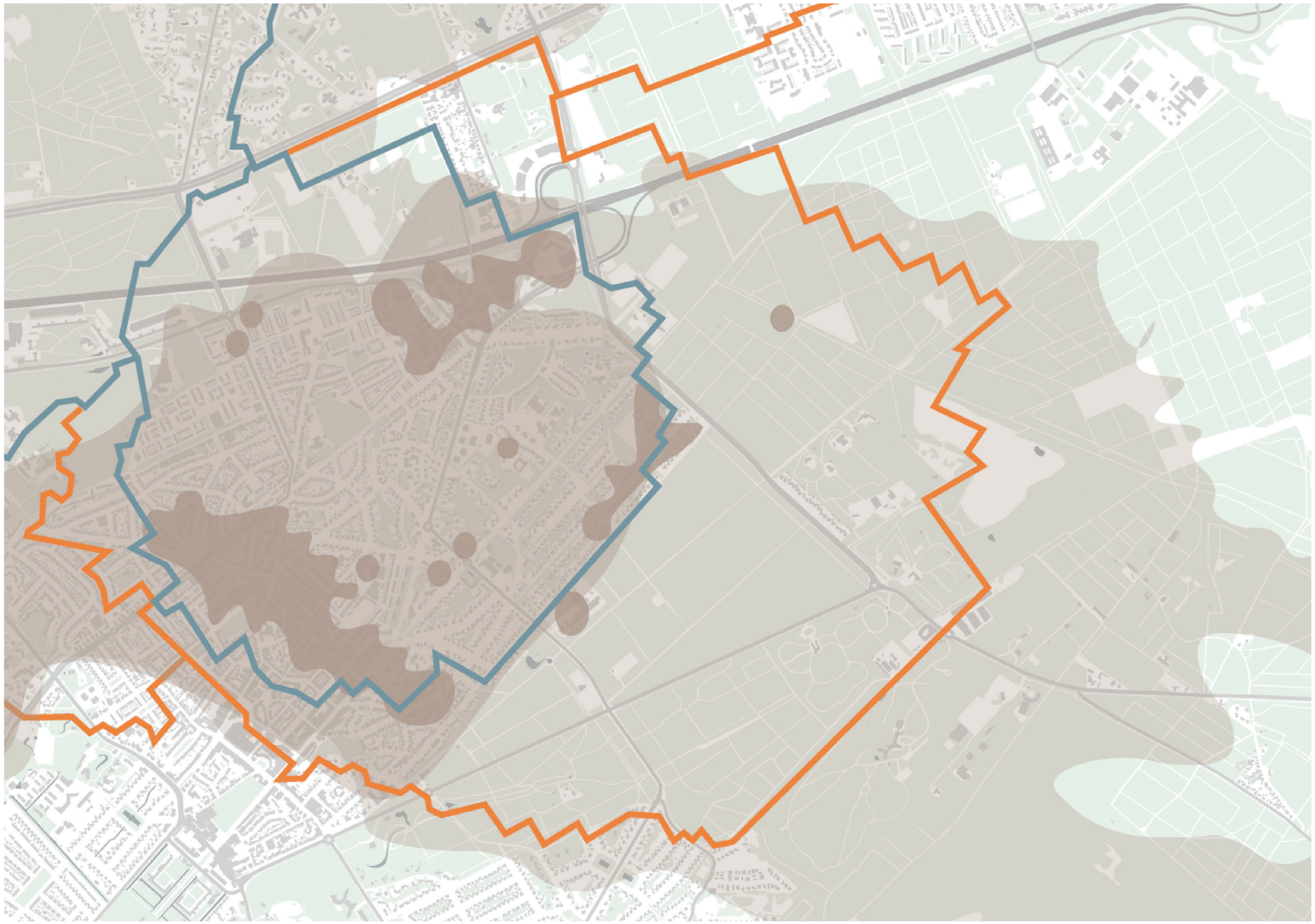
The drinking water zones at Zeist has been put into place by the company Vitens who is the drinking water provider for Zeist and other cities in the area.

Vitens extracts water from an underground aquifer source in the middle of the city. On the surface the space is designated as a regular public park. Surrounding the park is a zone designated as the catchment area to recharge the underground aquifer by means of infiltration of water that falls on the surface. Outside of that is another zone, the 100-year zone. A waterdroplet that falls here will take 100 years to reach the drinking water extraction source. Therefore, this zone has also been designated as a focus area.

Nevertheless, all these zones have a certain fragility. The soil is vulnerable to actions that are being or have been undertaken at the surface. Most of the built core of Zeist, for example, is covered by a 2nd degree vulnerability zone. The hard surfaces of the built environment are decreasing the infiltration possibility. There are also patches with 3rd degree vulnerability. These are areas in which the soil contains remnants of historic industrial pollution. Water that infiltrates in these areas risk contaminating the aquifer.

Map of the Fragility of the Zeist Drink Water Zones

The drink water extraction zone in Zeist is vulnerable to pollutions in the landscape.



L03B / L03C - Climate Change

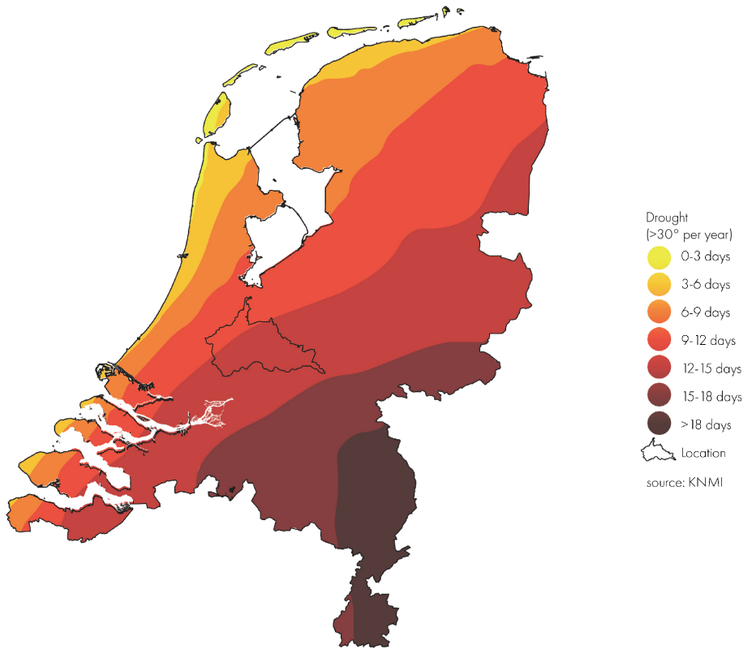
Summer Drought & Winter Rainfall

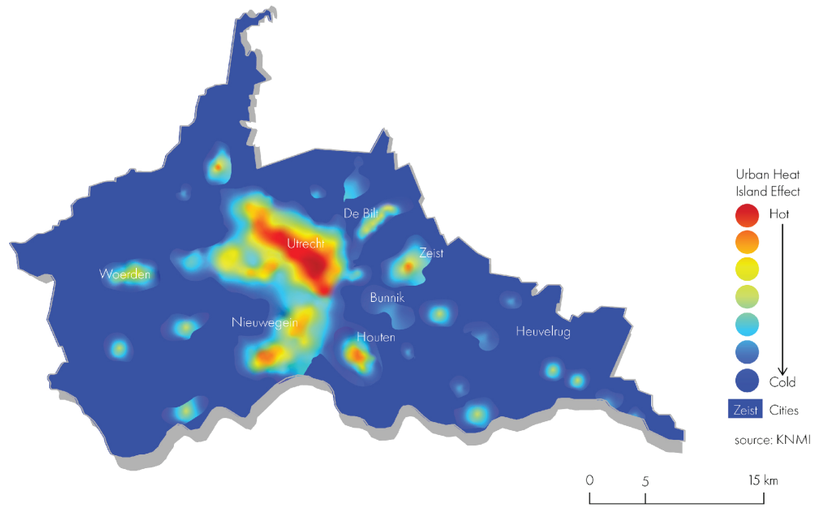
Climate change is causing two main seasonal things. The increased warm temperatures lead to droughts during summer seasons and the increased rainfall periods lead to water excess during the winter seasons.

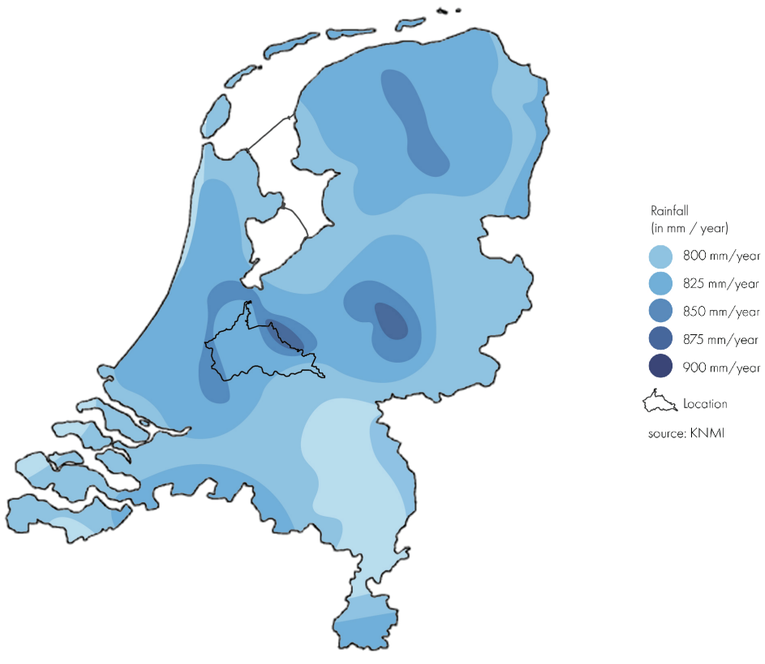
At the scale of the country of the Netherlands, the drought climate increases toward the southeast and the rainfall climate is focussed around the highest topographic areas.

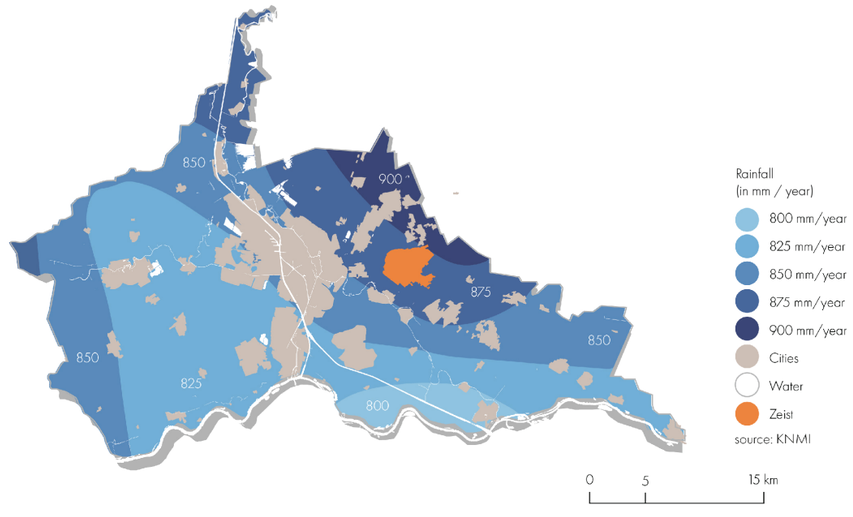
At the scale of the province of Utrecht, the drought climate is approximately at its average. However, the abundance of built up area means that the heat capacity is increased and warm temperatures are less likely to quickly dissipate. The urban heat island effect is therefore very large. The rainfall climate is nearly at its most extreme as the Utrechtse Heuvelrug, a topographic high, is present in the area.

The city of Zeist is next to Utrecht one of the largest cores that produces urban heat. Next to this, it is the largest built up area within the area that sees the most rainfall. The seasonal extremes in Zeist are significant.









Maps of Summer Drought & Winter Rainfall on Two Scales

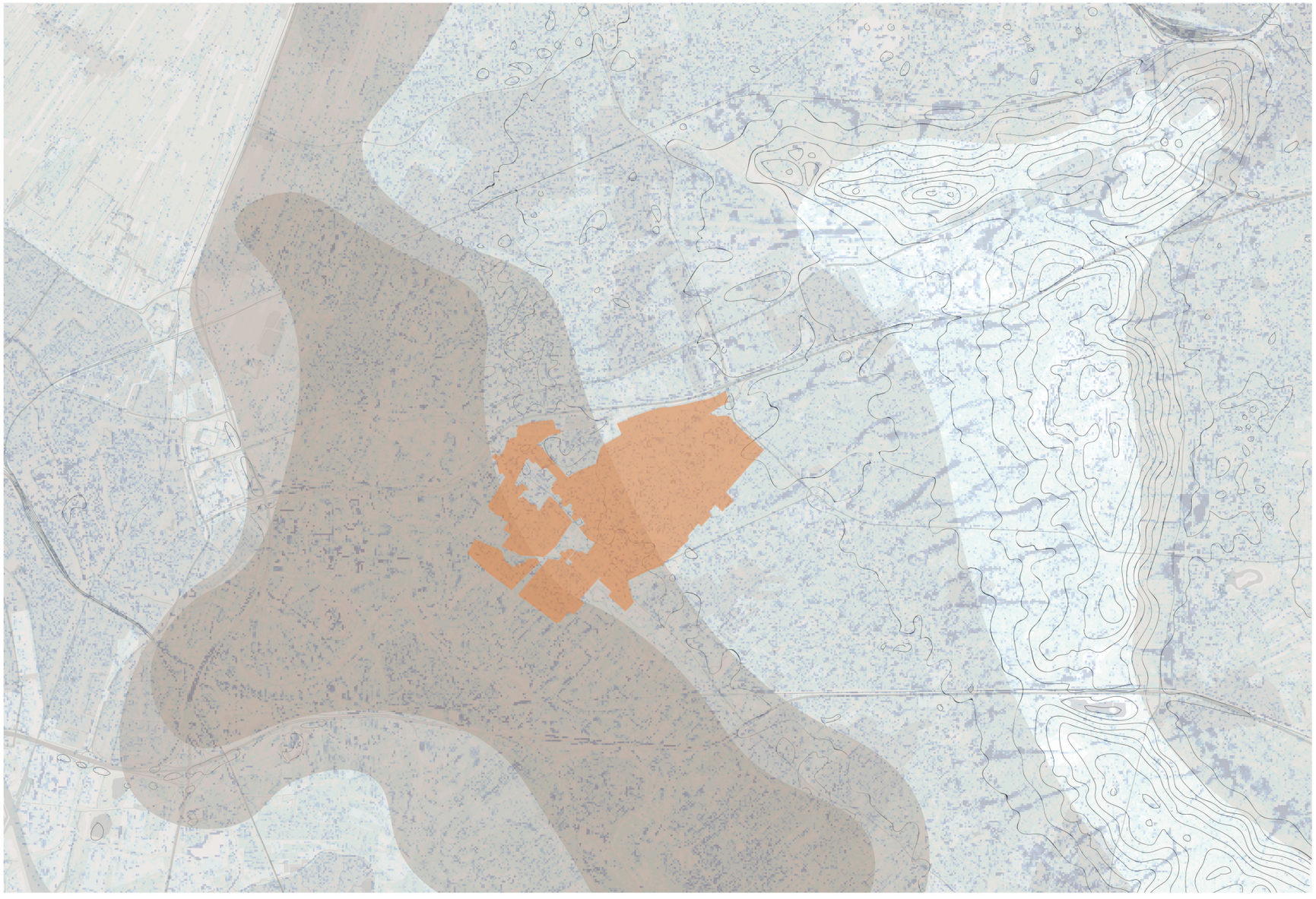
At both the scale of the Netherlands and the province of Utrecht the imminent effects of climate change are visible.

L03D - Process & Dynamics

Soil Compaction and Water Excesses

The landscape is a dynamic landscape in which the processes surrounding water run-off are most influential. From the high points of the Utrechtse Heuvelrug, excess water that cannot infiltrate into the sandy soil flows downhill as mudstreams. Although the hill landscape is mostly made up of non-compacted permeable sandy soil, going downhill, the soil becomes more compacted and therefore impermeable. Due to this, water and mudstreams have increasing difficulty infiltrating into the soil going downhill. This is accentuated due to the clay soils surrounding the Kromme Rijn. Even these clay soils have an extreme risk of compacting even more since the river cannot effectively discharge its content.

Overall, the pore volume decreases with soil compaction. If the soil compaction is too strong, the permeability and moisture storage capacity of the soil will decrease. This will lead to flooding. The accumulation of soil compaction is most notable at the foot of the heuvelrug due to pressure of the ridge and mudflows and water erosion downward. Zeist sits on the gradient.



Map of Soil Compaction Risk due to Topography and Rainfall

The topography causes mud and water run-off which causes soil compaction around the Kromme Riin river.

L05 - Synthesis

Past: Living off the Land

The glacial moraine-hill landscape (Utrechtse Heuvelrug) tapers level toward the Kromme Rijn river which is part of the larger river drainage network. The mudflow and waterflow run-off from the hillside is caught in the Kromme Rijn and can be easily discharged via the river system toward the North Sea.

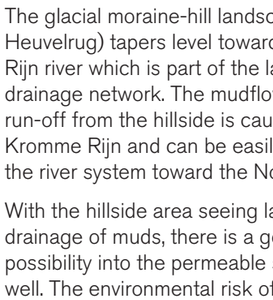
With the hillside area seeing large scale drainage of muds, there is a good infiltration possibility into the permeable sandy soil as well. The environmental risk of surface water flooding is therefore low and this performance results in a landscape that is stable enough for the habitation of a wide variety of floras and faunas.

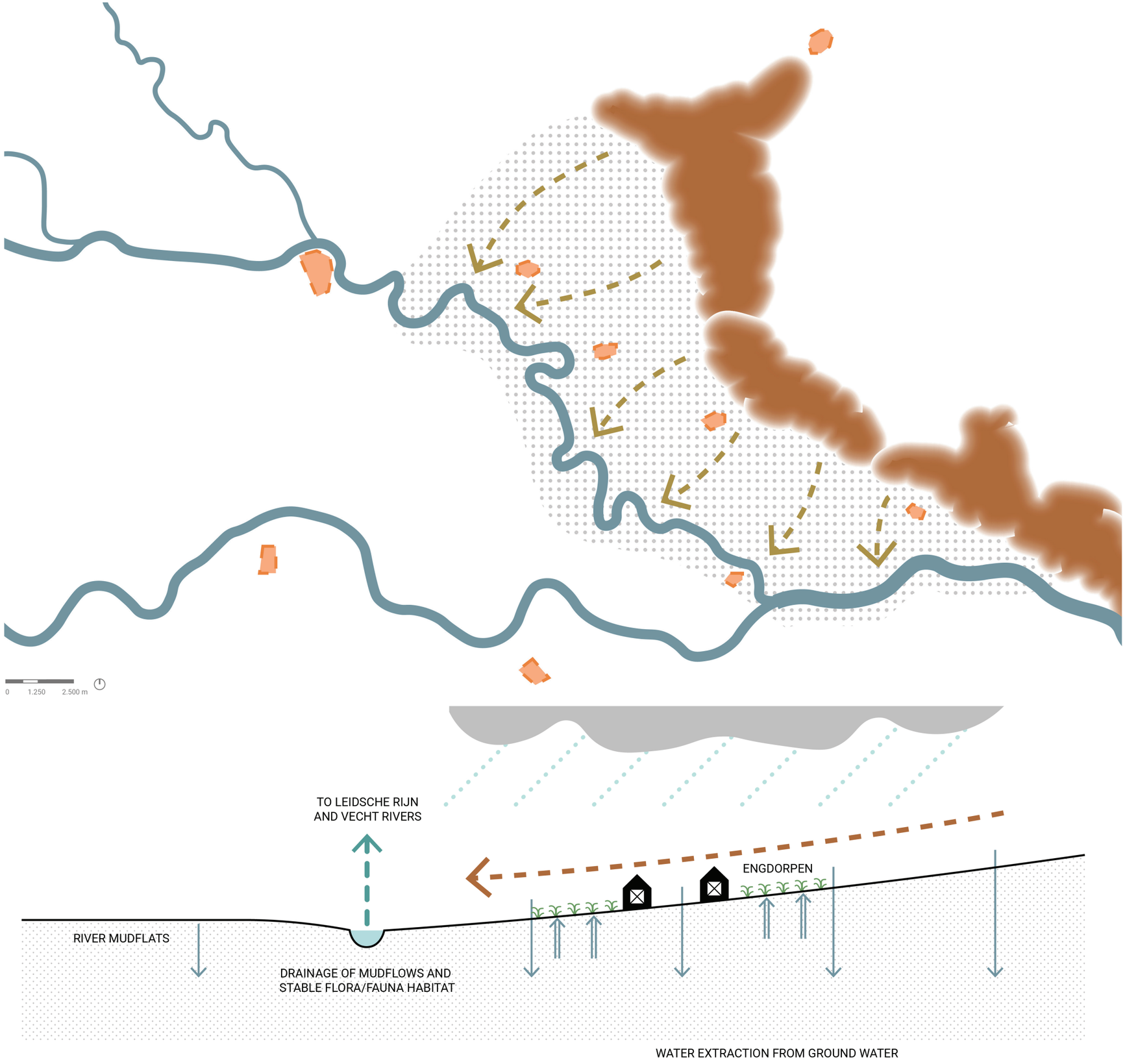
With the introduction of human settlers, small farm-towns called Engdorpen emerged on the stable sands of the hillside. They are reliant local resources, like the shallow subsurface groundwater for drinking.

The landscape morphology (certainty for infiltration) shapes the extraction landscape (groundwater usage). In turn, the urban landscape gets a particular form (Engdorpen).

Schematic map and section of the past relation of Zeist to its surrounding landscapes

The river landscape, glacial moraine-hill landscape, and urban landscape interact to define each other.





L05 - Synthesis

Present: Land of the Living

The tapering of the Utrechtse Heuvelrug toward the Kromme Rijn river still allows it to catch mudflow and waterflow run-off from the hillside. Nevertheless, due to urbanisation to the north and dike infrastructure to the south, the discharge cannot be drained into the main river system leading toward the North sea.

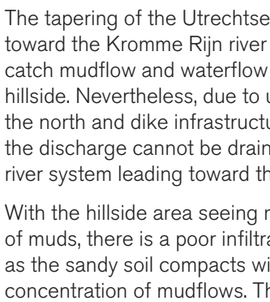
With the hillside area seeing minimal drainage of muds, there is a poor infiltration possibility as the sandy soil compacts with the increasing concentration of mudflows. The environmental risk of surface water flooding is therefore high and this performance results in a landscape that is regulated to the degree that stable habitation of floras and faunas is impossible.

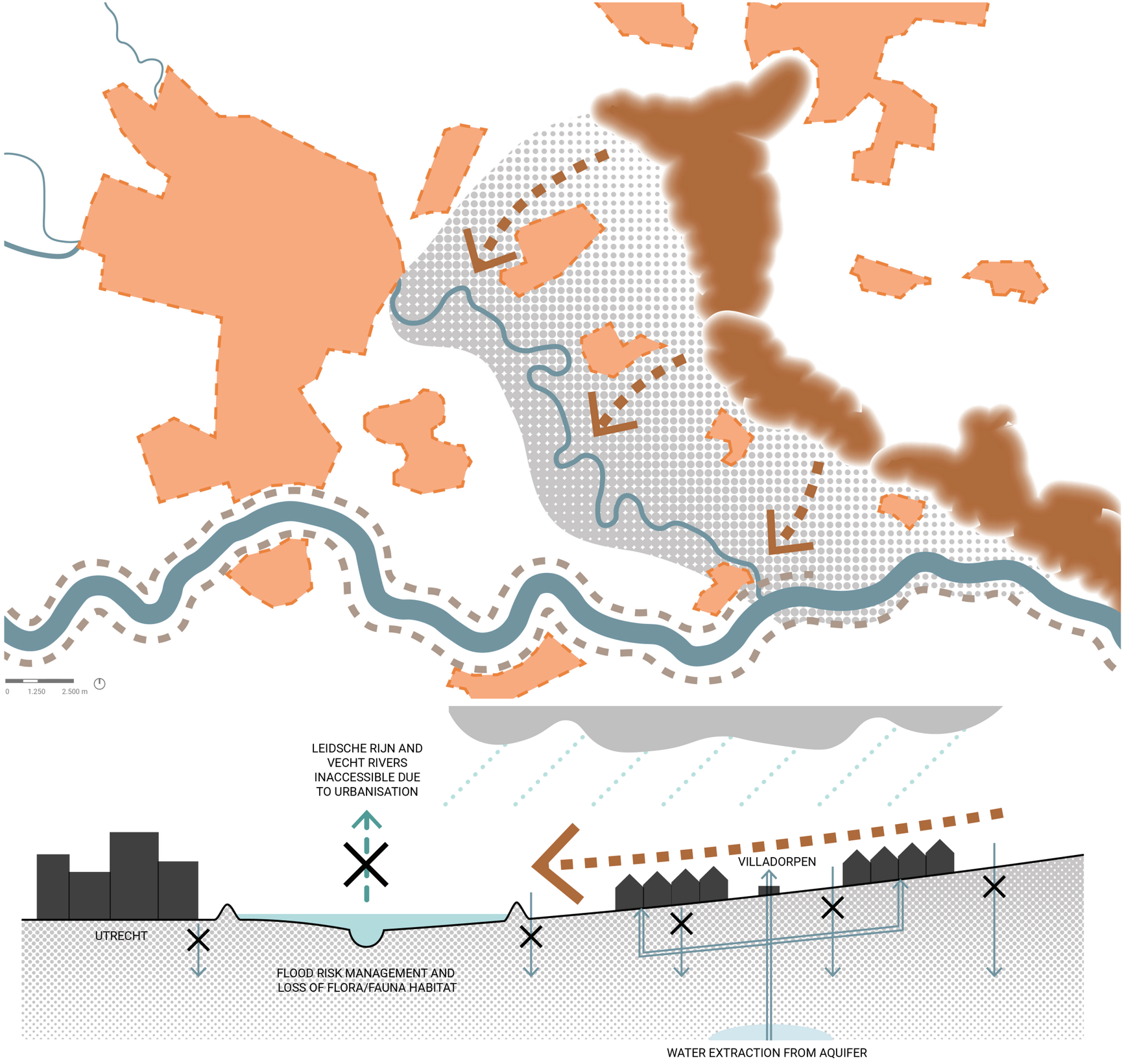
With more human settlers occupying the hillside, large villa-towns and an estate landscape emerged. They are reliant on centralised resources, like drinking water from aquifers due to the low groundwater levels.

The landscape morphology (uncertainty for infiltration) shapes the urban landscape (Villadorpen). In turn, the extraction landscape gets a particular form (aquifer usage).

Schematic map and section of the present relation of Zeist to its surrounding landscapes

The river landscape, glacial moraine-hill landscape, and urban landscape interact to define each other.





Future: New urban extraction landscape?

The future is seeing increased winter rainfall and increased summer drought. The rainfall will result in increased run-off quantities while the drought will result in increased water demand. Inititally, it may seem that the two can counter and balance each other out. However, the landscape performance of the present as influenced by the past does not make that possible. This is because the drinking water extraction landscape would be put into distress:

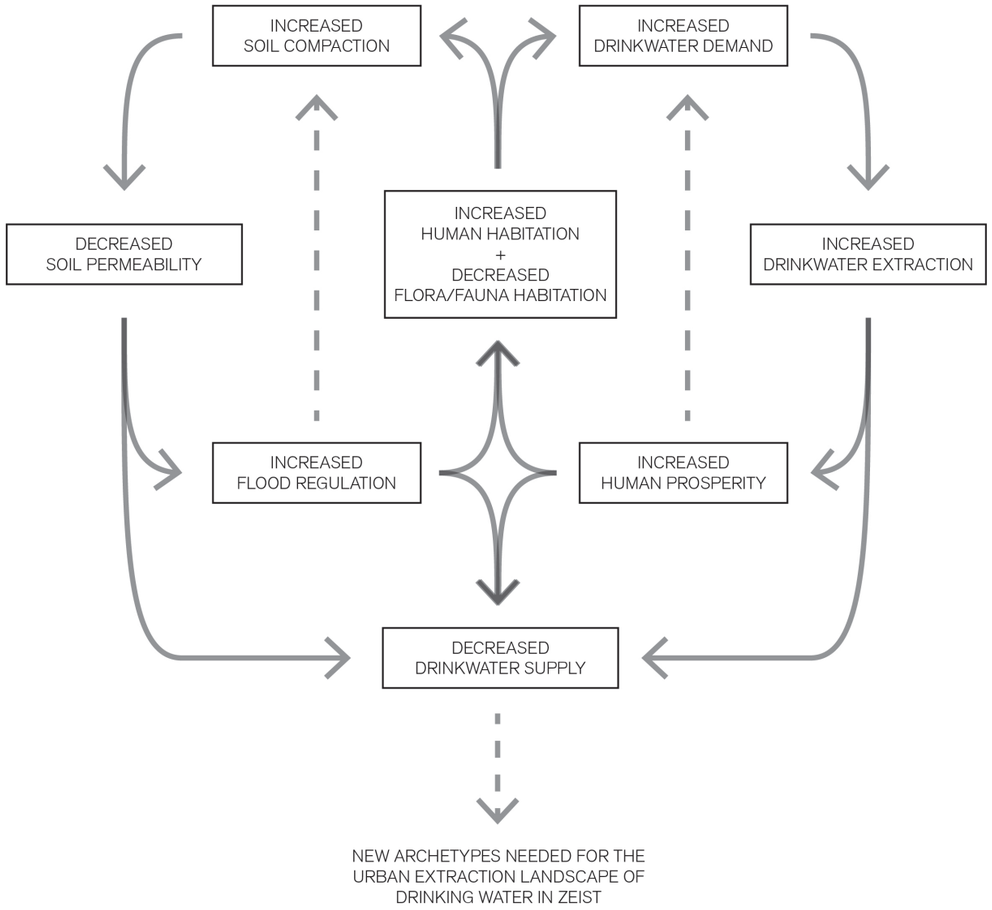
The winter run-off results in INCREASED SOIL COMPACTION which results in DECREASED SOIL PERMEABILITY which results in DECREASED DRINKWATER SUPPLY due to less water recharge for the aquifer. It also results in INCREASED FLOOD REGULATION which makes the land more susceptibleto both INCREASED SOILD COMPACTION (again) and INCREASED HUMAN HABITATION + DECREASED FLORA/FAUNA HABITATION. The cycle would continue.

The summer water demand results especially in INCREASED DRINKWATER DEMAND which results in INCREASED DRINKWATER EXTRACTION which results in DECREASED DRINKWATER SUPPLY due to depletion in the aquifer. It also results in INCREASED HUMAN PROSPERITY which makes the society more susceptible to both INCREASED DRINKWATER DEMAND (again) and INCREASED HUMAN HABITATION + DECREASED FLORA/FAUNA HABITATION. The cycle would continue.

Overall, both the winter and summer cycles result in DECREASED DRINKWATER SUPPLY in the aquifer used to extract the resource. They can therefore not be used to fulfil each other's needs. Utlimately then, in order to future-proof the landscape performance in Zeist, new archetypes are needed for the urban extraction landscape of its drinking water.

Flowchart of the future relation of Zeist
to the landscape performance

The landscape performance as established by past and present processes requires changes for the future in order to remain resilient.



2.2

Urban Morphology

Carmen Jansen op de Haar

Densely populated

Zeist is becoming densely populated. The population increased from 347 inhabitants in 1663 and 1674 inhabitants in 1800 via 8720 inhabitants in 1900 to approximately 60,000 inhabitants in 1980. The construction of various villa parks and residential areas is closely related to this. Huis ter Heide and Bosch en Duin then emerged as villa parks. The name Huis ter Heide originally comes from an inn with the same name (Het verhaal van Zeist en het Zeister erfgoed, 2018). As can be seen on this map, also the villages around Zeist are expanding. Zeist is located in the National Park Utrechtse Heuvelrug. The park currently needs to be protected against the pressure of urban development and extensive fragmentation. Densification must therefore be done as carefully as possible without affecting the protected nature area.



Zeist figure ground

A basic map of Zeist, Bunnik, De Bilt, Soesterberg and Driebergen-Rijsenburg.

Connection

Between Utrecht and Zeist, the A28 cuts through the estate zone and the Utrechtse Heuvelrug. The road user experiences the wooded landscape despite the high population density in this area. Core qualities of the area are the higher sandy landscapes with relief, heath and large forests. Most places in Zeist can be reached by public transport. The train station is located between Zeist and Driebergen and is called Driebergen-Zeist station. There are many bus stops in Zeist, except from the south side of the Sanatorium forest, this could be improved.



Infrastructure map

Here you can see how well Zeist is connected with roads and public transport routes.

Roads
- Highway
- Main road

Public transport
- Bus (fast lane)
- Bus (city lane)
- Busstop

N

0 1000 m

Recreation

In this map, the atmosphere of different areas is shown. Because of the place of Zeist in the national park Utrechtse Heuvelrug, the region around Zeist can be considered as quiet and peaceful. It is remarkable that the vibrant places can be found more outside the city center than inside. This is something that could be improved during a new design plan.



Image/ Map/ Diagram Title

Here you can write a brief explanation.
Use as much text space as needed.

- Calm
- Quiet
- Vibrant
- Peaceful

N

0 1000 m

Typologies

The municipality of Zeist is divided into 5 districts: Zeist-East, Zeist-West, Zeist-North, Zeist-Centre, and Den Dolder and surroundings. Each district in turn consists of neighborhoods and/or villages. The territory of the current municipality of Zeist has undergone a major transformation in recent centuries. The main theme is the enormous densification and expansion of the origin small farming village Zeist. At the beginning of the 20th century, Zeist was a patchwork of districts and neighbourhoods, in which the different social classes are spatially strong separately from each other. People with higher incomes are living in residential ares on the old gardens of Slot Zeist and the country estates. Also on the high sandy soils, north of the Amersfoortseweg, luxury residential areas are built.

Because of the difference in income classes there is a large contrast between housing typologies. The image on the right side shows three different neighborhoods: Lyceumkwartier, Griffensteyn and Vollenhove. It is immediately noticeable that Lyceumkwartier is the most spacious district with wide streets and large houses, all detached houses. Next is the district Griffensteyn, which has many more houses close together, mostly rowhouses. The houses are mainly cheap and duplex. The maintenance of roads and footpaths is substandard. The abundance of greenery in some places causes obscure and unsafe places. This is most likely because there is no high-quality green present. The third district is Vollenhove, the area with the highest flats and the worst name. There are four high-rise flats on Laan van Vollenhove. Their reputation is different. Vollenhove is strongly segregated from Zeist, among other things by the Sanatoriumforest.



Lack of a vibrant society

The main difference between a neighbourhood such as Vollenhove and the Lyceumkwartier is the character and the housing typologies. In places where it is more densely populated, more houses resemble each other. Many houses are identical and there is little distinction. However, the Lyceumkwartier has a much lower density and the houses there are all different. It is remarkable that in the places where there is less diversity in social classes the diversity in houses is greatest. On the images on the right, it is visible that the flat and the row houses consist mainly of straight lines, almost block-shaped. While the villa is designed more playful with lines in different directions.

The different types of society in the fragmented, partly planned space, make Zeist a special municipality with a great diversity of gems. These gems become visible when you zoom in on the urban planning and social skin of the concrete complexes, neighbourhoods and villages. By accentuating them, these extraordinary buildings become more visible. As mentioned, the vibrant society is limited presented in Zeist. This type of society comes in Zeist especially in complexes where there is a high mutation rate. The lack of a vibrant society would indicate a relatively limited presence of the lower middle class/students who often belong to this type of society.

The pattern of cohabitation types in the spatial structure is striking. In the southwestern part of Zeist, you will find more predominantly informal and pleasant societies, while in the north/northeast part there are more exclusive and closed societies. This also follows the pattern of the clay to the sandy soils. Ont he sandy soil the high quality societies and on the clay soil more low quality societies. Also, the location of the different types of society in the relation to each other is often special, as in the case of Hoge Dennen and Kerckebosch. It concerns two different types of society, consciously connected and separated by Hoog Kanje, forest, schools and a shopping centre. When interpreting the results, the ratio between the number of residents per neighbourhood and the established type of society is important. The space requirement of the exclusive society is concerning the number of residents who live there much greater than in other societies.









Gradient map
This map shows the different districts in Zeist, the arrows make the gradient visible.

Neighbourhoods
Gradient (low vs. high income)



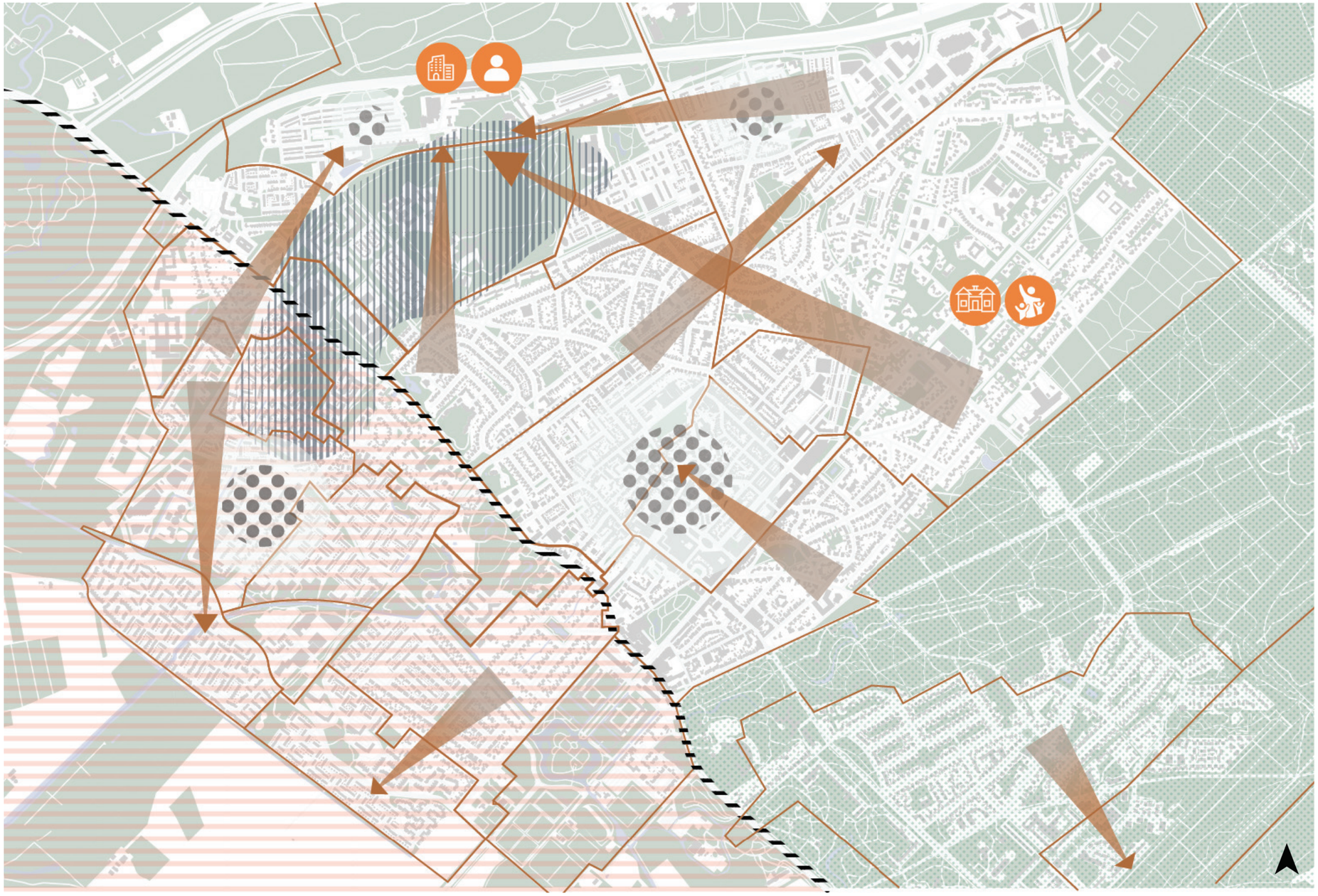
Excursion

During the excursion, photos were taken throughout the whole route. The starting point was in Kerckebosch where it starts with flats and small houses, and when you move on you will see more and more villa's. You can see very clearly how the houses change during the route. From the big villa's in Lyceumkwartier to the rowhouses in Dijnselburg to the park in the Staatsliedenkwartier. What was very striking was the fact that there is so much greenery in Zeist. In many neighbourhoods, it still seems like you are in the forest. In the Lyceumkwartier there is a presence feeling of being in the forest. This feeling of being in the forest is the strongest in the Lyceumkwartier. However, even in Dijnselburg the avenues feel like forest because they are very wide and there are a lot of trees.What also stood out during the bike ride was that you hardly saw any people on the street, no local residents chatting with each other or children playing in the street. The excursion confirmed the conclusions drawn from the analyses. Unfortunately there wasn't any more time for visiting the south-west of Zeist. Crosestein, Nijenheim and Griffensteyn were visited via google maps.



Synthesis

On the right the urban morphology synthesis map is visible. The brown lines show the different neighbourhoods in the different districts. The dots are the most visited places where people go shopping or do groceries. The green dots shows the national park Utrechtse Heuvelrug where it is not allow to build because it is a protected area. The stripes show the place with most potential for future housing. This area mainly consists of business areas that take up a lot of space without even using it. Currently, the municipality of Zeist is making plans in this area, but only for a small part. In this specific area there is enough space to built 1200 new dwellings and at the same time the opportunity to resolve the lack of a vibrant society. Then there is the clear dividing line of soil type that runs right through Zeist.



Urban Morphology synthesis map

This map shows the main points that emerged in the analyses.

- Neighbourhoods
- Grow Zeist
- Gradient (high vs. low income)
- Center facilities
- Boundary soil type
- Flat
- Familiy
- Villa

N

0 | 1000 m

2.3

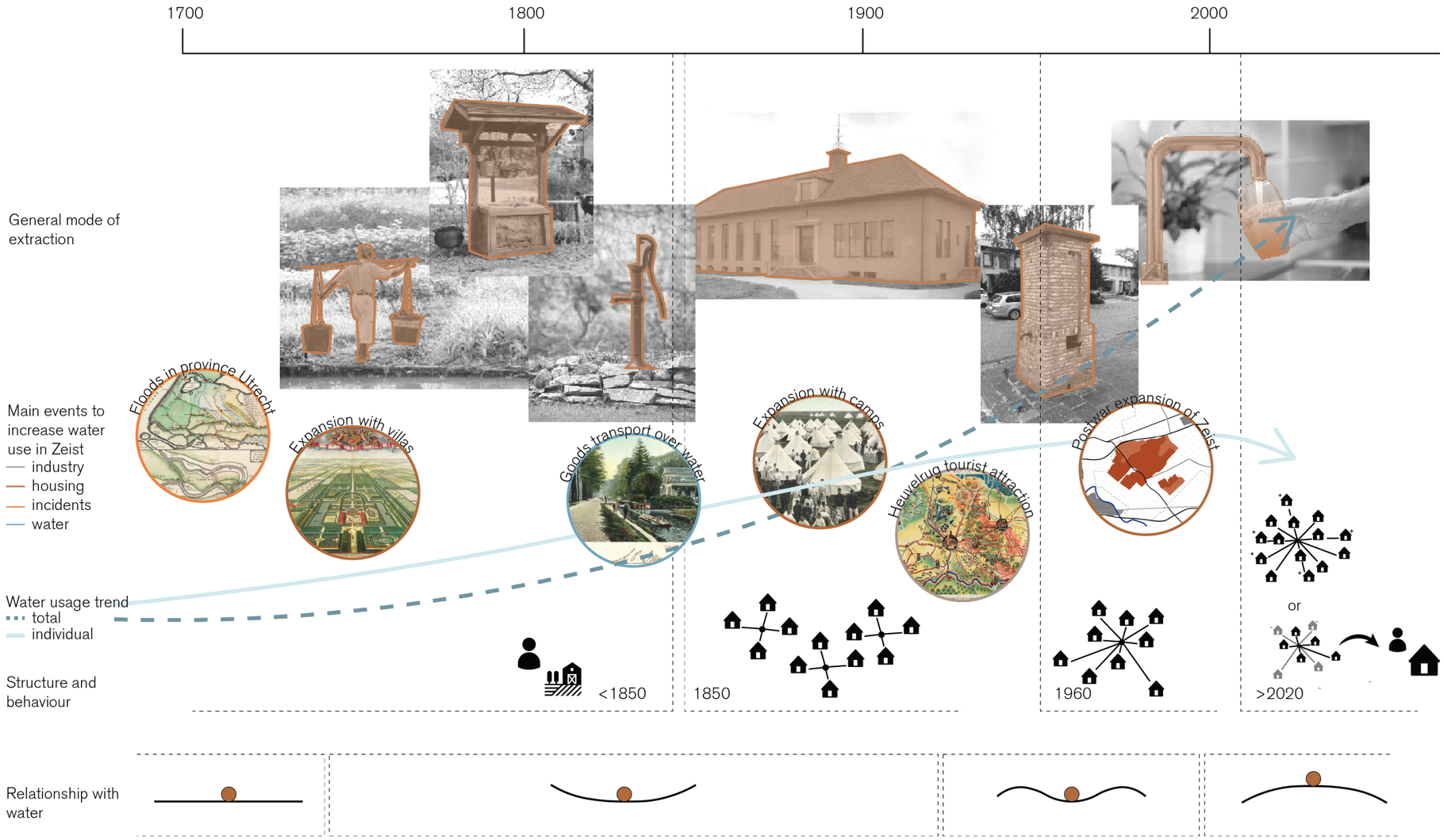
Anthropology

Esmee Kuit



Time systems

The timeline makes use of various subjects to try and tell the story of the relationship between people and the modes of water extraction. It discusses general modes of water extraction that were not limited to Zeist but were present there. Furthermore, it shows events that have changed the way people thought about water, be it water from the river, or the division of drinking water. The lines represent the trends in drinking water, both the total amount and the individual amount. In the coming years, individuals are expected to start using less water. However, the grand total will increase as population growth is expected. The structure is the system in which water was extracted and then distributed during different times in different ages. As can be seen, the change of the societal system goes hand in hand with more large-scale technological progressions.



Timeline

Chronological timeline on the situation of Zeist with regars to extraction, events, water usage, control, and behaviour.

images for main events retrieved from: Blijdenstijn, R. K. (2015). Tastbare tijd 2.0: cultuurhistorische atlas van de provincie Utrecht. Provincie Utrecht.

Windowscapes

Over time, the relationships between humans and water have changed significantly. The way that water became available to them has changed significantly over the past. Each windowscape shows how people can access their drinking water. The signs of Mary Douglas with the brown bubble show how humans looked at nature. Alternatively, figures with the blue bubbles explain how nature could have looked to people during that same period of time, should we imagine that nature has an opinion.



||1850 ||
Wells provide water for individual farms. These farms have a lot of land for agriculture, which makes the farmers very influential.



nature is capricious



humans are capricious



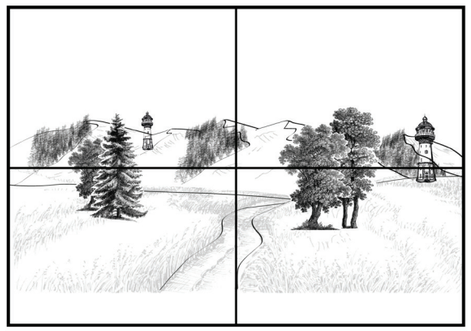
||1920 ||
Camps for soldiers are set up. Large amounts of wells are placed on these sites



nature is robust



humans are tolerant



||1930 ||
Water towers are providing water for houses as well as hotels. Tourism has increased the water demand



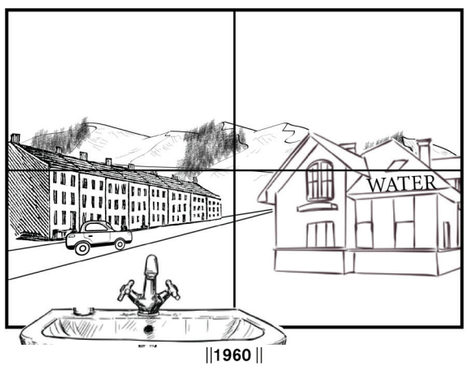
nature is robust



humans are tolerant

Windowscapes
What do people from different time periods experience?

- Human perspective
- Nature perspective



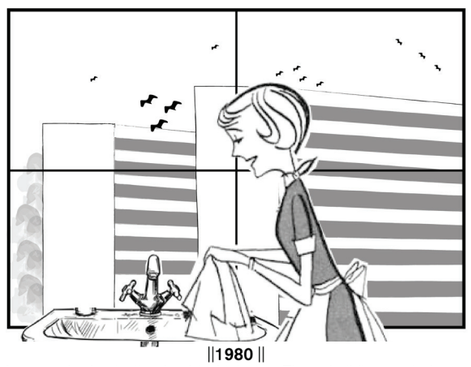
||1960 ||
Increased urbanisation, people get water from a centralised system. Water is available from the tap.



nature is tolerant



humans are robust



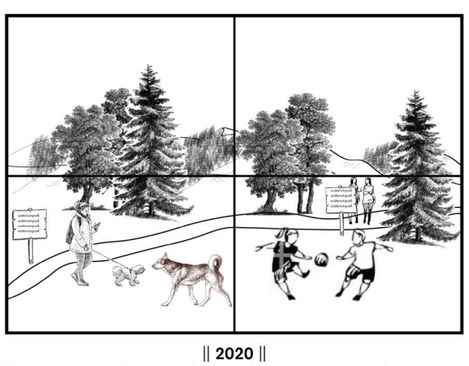
||1980 ||
Increased urbanisation lead to high-rise. These buildings not always had a shower, so people used the sink for laundry and showering.



nature is tolerant



humans are robust



|| 2020 ||
The integration of water and nature becomes increasingly important, also in creating awareness. The waterwinpark is an example of this.



nature is ephemeral



humans are robust



|| 2050 ||
The extraction of water becomes more decentralised as individual households take more measures to collect their own water.



nature is tolerant

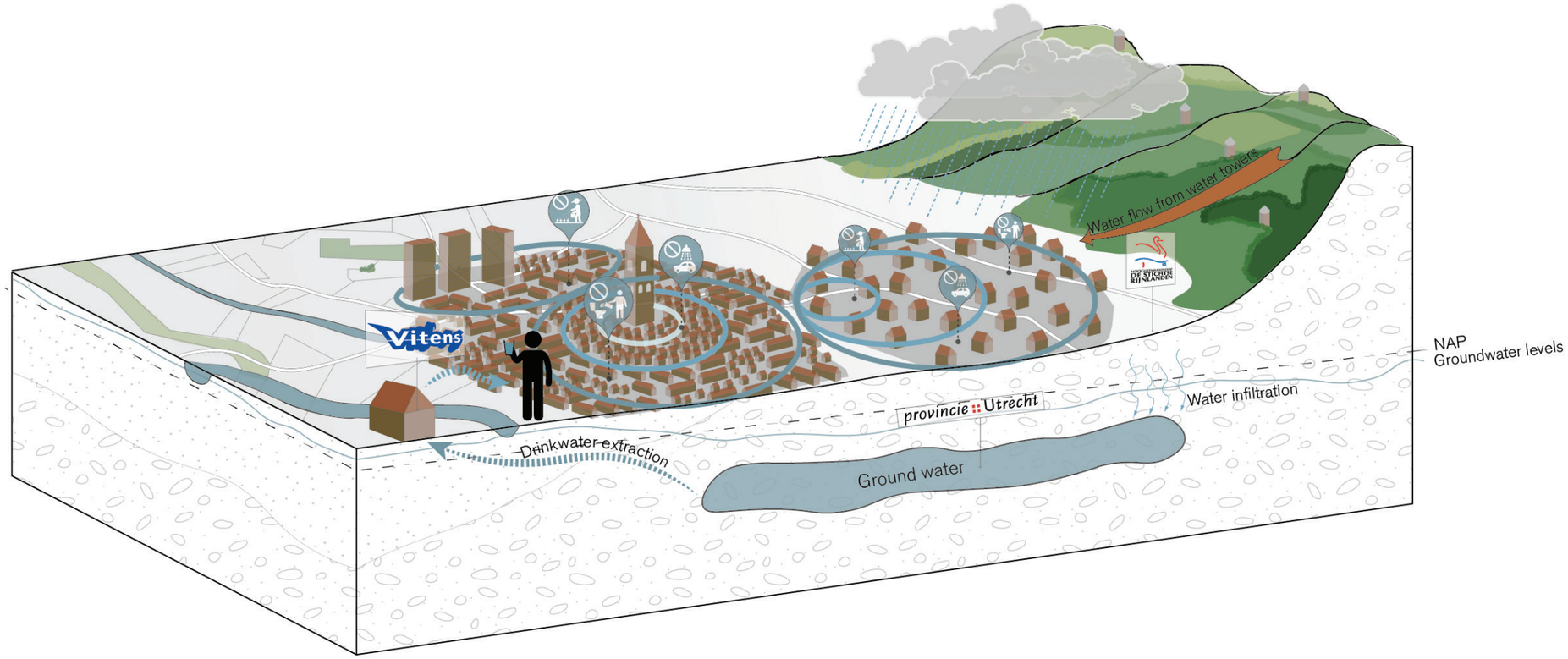


humans are tolerant

Deepmap

For the deep map, a pie slice was taken as the basis. This is because the ground level is important in understanding the relationship between humans and the water system, but the sub-surface is of significance as well. In addition, the section like nature of the map gives a perspective that achieves the effect of the relationship

On the map, there are several important aspects. The first is the growth of the city on the different types of soil. The second elements that are important are the old water towers that are still in the landscape. Their function in the provision of water is redundant, but they are still points of navigation in the surrounding. Thirdly, there are rules by which people have to obey because their actions can have a direct influence on the groundwater quality. Lastly, there is the almost incomprehensible system of institutions that are all responsible for a different type of water: the water board is responsible for the quality of the surface water, the province for the quality of the subsurface water and Vitens is responsible for the quality of the drinking water. The municipality enforces all the rules that are involved in this system. These differences make it hard for people to grasp to who to address their problem.



Deepmap

Interpretation map of Zeist

Legend

- Water
- Rules
- Water tower
- City
- Old growth
- Newer growth
- Newest growth
- Clay ground
- Sand ground
- NAP
- Groundwater level

2.4

Transport Infrastructure and Logistics

Daan Emmerig

Effects on ecosystem (ecosystem services)

The text that is on these pages could originally be found in the framework. To condens the framework, the text has been copied to the pages. The summarised version of the framwork can be found on the last pages of this chapter.

Mobility flows

Waterwinpark 'de waterbron' is operated by Vitens and located in the northern residential area of Zeist. Since 2010 the mobility flows have changed in the area because the area was transformed from a dog walking area into a recreative park for all kinds of people. This change has led to an increase in mobility flows because of the recreative purpose of the design and the routes that are added. The designers of the park did take into account the fact that the ecosystem should not be affected and maintained. With the new design, it is still possible to keep the main function of the area which is still water extraction. Furthermore, the existing greenery was still preserved and more spaces were created for growing new kinds of vegetation that could be of value for realizing an attractive atmosphere. (Rod'or Advies, 2018) Because the park has offered a more attractive area for bike transport, people will choose more often for using their bikes which lead to a reduction in the CO2 emission in the city (Nello-Deakin & Nikolaeva, 2020).

Logistic flows

The goods transport in this case is the transport of water through pipelines to residential areas. This network of pipelines is located underground, so above the ground, there will be no effects on the ecosystem. The construction or repair of the pipelines underground have social and environmental effects, but the extent of these effects depends on the site where the construction takes place (Zayed et al., 2011). Because the waterwinpark is located in a very crowded area, the extent of these effects will be relatively higher. These effects will be explained in the transport links bracket.

Activity nodes

Green infrastructure | In Zeist, important activity nodes related to green infrastructure are the parks that are used for nature and recreational purposes. For example, Wilhelminapark, Natuurpark De Brink and Bisonpark are areas where green infrastructure is located. The waterwinpark where the water distribution system is located is also an example of an area with green infrastructure because all the grey infrastructure (pipelines) of the water distribution system is located underground. All these areas make it possible to create a healthy and connected ecosystem in the city of Zeist, so the green infrastructure will definitely not have any negative effects on the ecosystems.

Grey infrastructure | In Zeist, important activity nodes related to grey infrastructure are the bus stations and the train station for the use of public transport. These kinds of grey infrastructure cause negative effects on the ecosystem, because of CO2 emissions. However, the use of public transport leads to relatively fewer negative effects compared to private transport. In the waterwinpark there is almost no grey infrastructure., because all the pipelines are underground. In the park, there are five water sources available with double covers, which could be seen as grey infrastructure. (Waterwinpark, 2018) However, this grey infrastructure will not have any negative effects on the ecosystem.

Transport links

Green infrastructure | At this moment there are no transport links in Zeist related to green infrastructure.

Grey infrastructure | The transport links that are related to grey infrastructure are the pipelines underground. The construction of pipelines has some negative effects on the ecosystem and causes disturbance in the area. The bigger the number of pipelines being constructed, the higher the intensity of construction and the more frequent disturbance is occurring. Furthermore, research has shown that after pipeline construction the impacts are still remarkable after a 4-year recovery period in the nearby eco-environment. These impacts include negative effects on the soil quality and vegetation. The effects on vegetation reach 300 meters beyond the construction area and the effects on soil reach 30 meters on each side of the pipeline (Xiao et al., 2014).

In Zeist, other important transport links related to grey infrastructure are highway A28 and the Utrechtseweg. The Utrechtseweg crosses the centre of Zeist and fulfils an important function in the mobility of the city. Research has shown that highways and main roads like the Utrechtseweg have a negative effect on the groundwater quality., which leads to negative consequences for the quality of drinking water (Wang et al., 2018). Compared to the grey infrastructure of the water system, the highway and the Utrechtseweg have a bigger impact on the ecosystem, because of the CO2 emissions caused by cars and trucks.

Socio economic effects

Mobility flows

There are few socio-economic effects related to the mobility flows in the water-winpark, because there are more mobility flows after the redesign since 2010. However, it will hardly have an effect on economic activity. The reason, therefore, is that there are no shops for example in the waterwinpark.

Logistic flows

The water transport through the pipelines to the residential areas has big socio-economic effects. The building of the water distribution system by Vitens has led to the provision of safe drinking water for a lot of residential areas in different provinces including Utrecht. For society, it is very important that everybody has access to safe and healthy drinking water because it increases the liveability of the area and enhances the quality of life (Tahir & Majeed, 2020). Besides that, areas with access to healthy and safe water will reduce health costs for the people living there, because fewer people will face illnesses caused by bad water quality (El-Fadel et al., 2003).

Activity nodes

Green infrastructure | In Zeist, important activity nodes related to green infrastructure are the parks that are the parks that are used for nature and recreational purposes. For example, Wilhelminapark, Natuurpark De Brink and Bisonpark are areas where green infrastructure is located. The waterwinpark where the water system is located is also an example of an area with green infrastructure because all the grey infrastructure (pipelines) of the water system is located underground. The green infrastructure causes positive socio-economic effects as well because the building of these parks enhances the well-being of society (Li, 2020). The parks offer people a nice area for recreational purposes (Rod'or Advies, 2018). Furthermore, the waterwinpark has educational and cultural purposes as well. In the redesign of the park school gardens, meeting places for youth and educational art are placed. (Rod'or Advies, 2018). The educational art is placed to make people aware of drinking water usage and the protection of maintaining a good water quality (Gemeente Utrecht, 2020).

Grey infrastructure | Because the pipelines of the water supply system are built underneath, there is more space available for building above ground. This available space can be used for economic or social purposes. Other important activity nodes related to grey infrastructure are the bus stations and the train station for the use of public transport. These nodes have socioeconomic benefits because it improves the mobility of people, which makes it easier to do economic activities (Ng et al., 2017).

Transport links

Green infrastructure | At this moment there are no transport links in Zeist related to green infrastructure.

Grey infrastructure | The transport links that are related to grey infrastructure are the pipelines underground. The construction of pipelines of the water supply network has negative socio-economic effects. The reason, therefore, is that the construction of these networks take a lot of time and leads to certain consequences people have to deal with. These consequences include delays, nuisance and disturbance in the area where the network is being built (Batey, 2015). From an economic perspective, the construction of a water supply network offers jobs for people in the construction sector. After the construction of the water supply network, there are no further socio-economic effects caused by the pipelines, only when maintenance is needed for repairing pipelines.

In Zeist, other important transport links related to grey infrastructure are highway A28 and the Utrechtseweg. The Utrechtseweg crosses the centre of Zeist and fulfils an important function in the mobility of the city. These transport links have socioeconomic benefits because it improves the mobility of people, which makes it easier to do economic activities (Ng et al., 2017).

Critical transport evaluation

Mobility flows

Related to mobility flows it is critical that there is enough infrastructure available for human transport to create accessible areas. More details about the level of mobility in the city of Zeist will be given in the activity nodes bracket and transport links bracket.

Logistic flows

Governments are needed to protect the water supply systems. The water supply infrastructure is critical because it is essential for the health of people. Research has shown there are five issues related to protecting water systems. These are direct threats to water systems, water resource availability, threats due to ecosystem impacts, threats due to climate change and integrated total water management (Clark & Hakim, 2016). For Zeist in the future, there will be relatively enough water available compared to other provinces in the Netherlands (Vitens, 2012).

Activity nodes

Green infrastructure | In Zeist, important activity nodes related to green infrastructure are the parks that are the parks that are used for nature and recreational purposes. For example, Wilhelminapark, Natuurpark De Brink and Bisonpark are areas where green infrastructure is located. These parks are essential infrastructure in the design of a city like Zeist. Research has shown that urban green space leads to important social benefits. These benefits include recreational opportunities, aesthetic enjoyments, psychological well-being, physical health and providing educational opportunities (Zhou & Parves Rana, 2012).

Grey infrastructure | To make use of the waterwinpark, it has to be accessible for people. Currently, there are four bus stations within a 6-13 minutes walk from the park. These bus stations have connections with other bus stations in cities close by like Utrecht, Niewegein and Houten. Furthermore, the train station Driebergen-Zeist is located within a 60-minute walk from the waterwinpark. However, the train station is connected to the bus stations which are close to the park (MOOVIT, 2021). In the future, the municipality of Zeist gives high priority to make transport modes like cycling and walking more attractive in order to realize a reduction in CO2 emissions. Grey infrastructure related to the stimulation of these transport modes will become critical infrastructure in the future vision (Weijers, 2021).

Related to the water distribution system, water purification installations are critical infrastructure, because people have to be sure that the drinking water is healthy and safe.

Transport links

Green infrastructure | At this moment there are no transport links in Zeist related to green infrastructure.

Grey infrastructure | Highways that are connected to cities increase the accessibility of the area and therefore assigned as critical infrastructure. However, research has shown that removing highways could lead to positive impacts. When traffic is slowed down by removing highways, cities get more value, because there is more space for better urban design, more mobility choices and greater investments. When highways are removed, they have to be replaced by streets networks that improve urban vitality and liveability. Furthermore, these new street networks are also needed for the preservation of the accessibility and mobility of a city (McCormick, 2020).

Related to the water distribution system, the pipelines are critical infrastructure, because the pipelines are needed to transport the water to the houses in residential areas.

Ecosystem participation - Guidelines

From the analysis, the following guidelines follow:

Mobility characteristics

- Enhancement social connections with physical spaces to reduce mobility flows – causes CO2 emission reduction
- Stimulate the usage of public transport instead of private transport - causes CO2 emission reduction
- Stimulate the usage of green transport modes by making them more attractive to use - causes CO2 emission reduction

Infrastructure characteristics

- Maintain the recreational function of the waterwinpark
- Remove highways, but maintain the same level of accessibility and mobility in the Zeist by adapting the current street network
- Apply more green solutions to water supply system – (The usage of a living machine as a replacement for grey infrastructure)
- Change water distribution via pipelines in a more natural way through filtering canals to different part of the city – The usage of an irrigation system could be a solution.

Table

The table on the right shows the summarised results of the Transport, Infrastructure and Logistics perspective

A framework on ecosystem participation and mobility systems		**Drinking water in Zeist, the Netherlands**	
Effect on ecosystem (ecosystem services)	Mobility chacteristics	Mobility flows (human transport)	Because the park has offered a more attractive area for bike transport, people will choose more often for using their bikes which lead to a reduction in the CO2 emission in the city (Nello-Deakin & Nikolaeva, 2020).
		Mobility flows (goods transport)	The network of pipelines is located underground, so above the ground there will be no effects on the ecosystem, except for construction or repair.
	Infrastructure characteristics	Activity nodes (green and grey infrastructures)	In Zeist important activity nodes related to green infrastructure are the parks that are used for nature and recreational purposes
			In Zeist important activity nodes related to grey infrastructure are the bus stations and the train station for the use of public transport.
		Transport links (green and grey infrastructures)	There are no transport links related to green infrastructure.
			The transport links that are related to grey infrastructure are the pipelines underground. Others are the A28 and Utrechtseweg.
Socio economic effects	Mobility characteristics	Mobility flows (human transport)	No effect on the economic activity, as there are no shops for example in the waterwinpark.
		Mobility flows (goods transport)	The water transport through the pipelines to the residential areas has big socio economic effects
	Infrastructure characteristics	Activity nodes (green and grey infrastructures)	The green infrastructure causes positive socioeconomics effects as well, because the building of these parks enhances the well-being of society (Li, 2020).
			Important activity nodes are those for the use of public transport. These nodes have socioeconomic benefits because it improves the mobility of people, which makes it more easy to do economic activities (Ng et al., 2017).
		Transport links (green and grey infrastructures)	At this moment there are no transport links in Zeist related to green infrastructure.
			The construction of pipelines of the water supply network have negative socio economic effects. The highway and Utrechsteweg have socio economic benefits because it improves the mobility of people, which makes it more easy to do economic activities (Ng et al., 2017).
Critical transport evaluation	Mobility characteristics	Mobility flows (human transport)	It is critical that there is enough infrastructure available for human transport to create accessible areas.
		Mobility flows (goods transport)	The water supply infrastructure is critical because it is essential for the health of people. There are also threats to the total water availablity, but for Zeist there will be relatively enough water available (Vitens, 2012).
	Infrastructure characteristics	Activity nodes (green and grey infrastructures)	These parks are essential infrastructure in the design of a city like Zeist. Urban green space leads to important social benefits (Zhou & Parves Rana, 2012).
			Grey infrastructure related to the stimulation of walking and cycling will become critical infrastructure in the future vision (Weijers, 2021)
		Transport links (green and grey infrastructures)	At this moment there are no transport links in Zeist related to green infrastructure.
			The highway A28 can be removed, which will create more value to the city.

3.

Systems description and synthesis

Hybrid system drawing

To summarize the critical cartographies, the overall critical cartography synthesis maps have been made. These maps are all about landscape & ecology, urban morphology, anthropology and infrastructure. They are described at two scale levels: regional and urban. The main elements that can be seen on the regional level map are the building environment that increasingly encloses the nature of the Utrechtse Heuvelrug. Villages such as Zeist, Austerlitz, Doorn, Soesterberg and Den Dolder keep on expanding. Besides the villages, there are the cities that keep increasing in size, mainly Utrecht. The increase of the urban area puts a lot of pressure on the surrounding nature.

Another effect of the increased urbanisation is that the mud streams from the Utrechtse Heuvelrug will become more concentrated in the future and eventually cause more damage than they do now since the soil will compact more. When heavy rainfall increases, the Kromme Rijn will flood more often and the water that is collected in the Kromme Rijn can not flow away because of Utrecht's expansion, where the river has been dammed, blocks it on one side. On the other side of the Kromme Rijn, the dike blocks the outflow of water along the Lek. The excess water can go nowhere.

The smaller overall critical cartography synthesis map shows the different gradients from neighbourhood to neighbourhood. The East and South of Zeist consist of the socio-economic strong neighbourhoods, while the districts in the north-west and west are socio-economically weaker. In the past, people with more money built their houses on the sand while people with less income had to live in the clay area. There is a relationship between elements in the landscape and elements in urban morphology. Furthermore, the most visited places are shown, these are mostly the places where people do their groceries or go shopping. The National Park the Utrechtse Heuvelrug is a place where the building of new houses is not allowed.

That Zeist expanded on the edge of clay and sand soil can be seen from the location of the historic town and the two main roads that lead to it. The Utrechtseweg and the Driebergseweg are the first roads that connected Zeist with its surroundings. Other old structures still exist, one of which is the grift. This water was used to ship sand and wood from the Heuvelrug to Utrecht, and city waste from Utrecht back into the Heuvelrug. This waste was likely used to fill in the holes that sand was dug out of, which polluted the soil of the Heuvelrug in the same action.

Nowadays, there are measures that prevent humans from polluting Zeist and the Heuvelrug and, therefore, the drinking water. Humans are not allowed to flush pollutants through the toilet or wash their cars on the street, as they respectively influence surface water and subsurface water. Both those types of water have a high influence on the drinking water quality.

To make people more aware of the water extraction in Zeist, waterwinpark 'de Waterbron' was designed. This park aimed to educate people about the way water is extracted while also providing a place for recreation.

Assemblage of ecologies

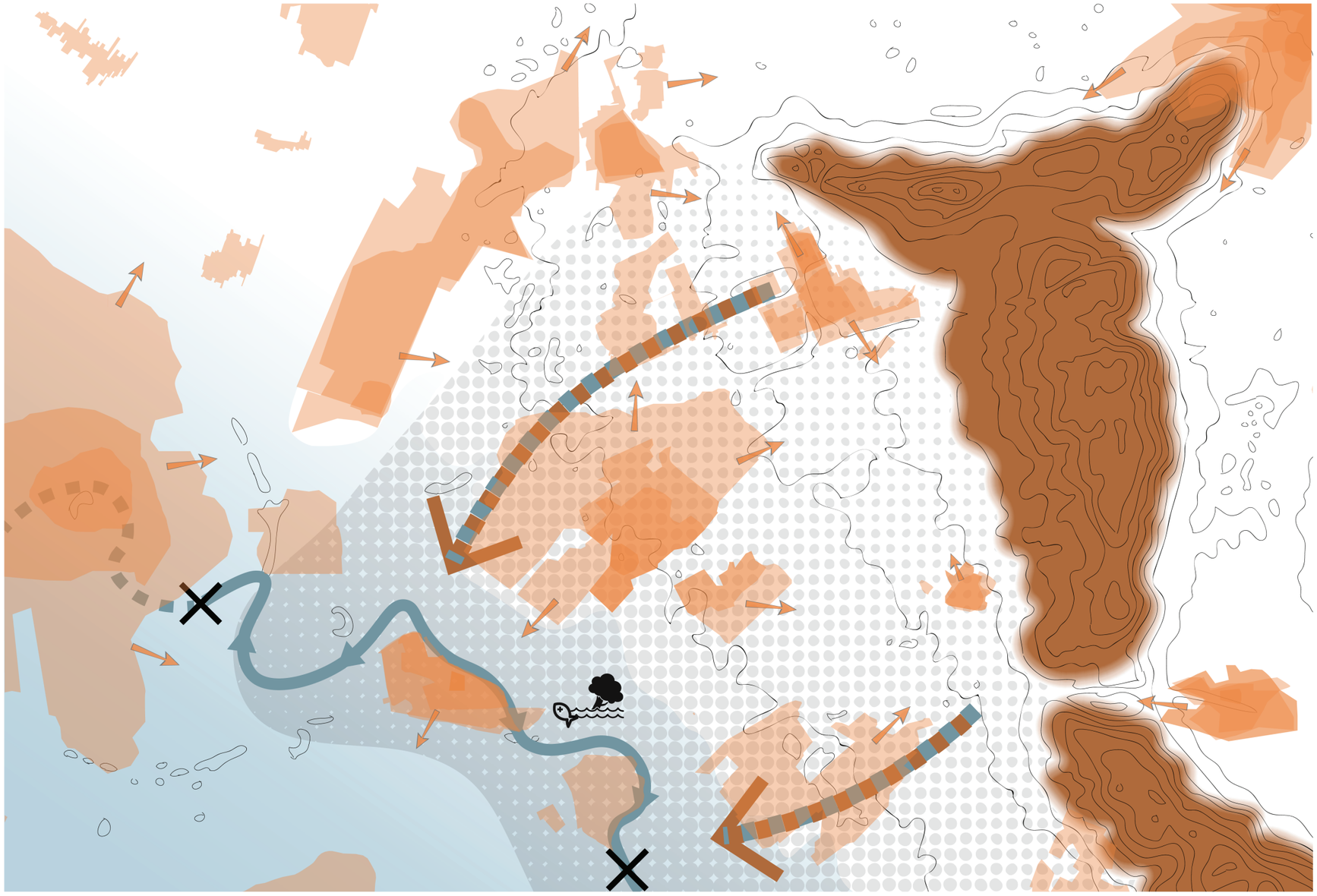
The extraction of Zeist is located in the urban area of Zeist and lies entirely within this municipality. The area is located on the flank of the Utrechtse heuvelrug in a wooded area and partly in an urban area. The groundlevel in the entire area is +4m to +13 m NAP. The extraction withdraws groundwater from the second aquifer. The filters are located at a depth of -50m to -70m NAP. The 'Zeist extraction' has been classified as very vulnerable by the Province of Utrecht. As the separating layer is relatively permeable and thus contaminants relatively easily in the second water-bearing package.

Above the separating layer the flow is directed to the west and in the abstraction package there is a circular flow towards the extraction. The winpackage is supplemented by water from the phreatic package originating from the area east of the Heuvelrug (Engel et al., 2021). There is hardly any surface water in the extraction area of Zeist. There are a few ponds and ditches in the extreme south. Next to the main roads the ditches are almost always dry. Along the highway infiltration runoff rainwater into the soil. Water therefore must be used more frugally and attention should be paid to potential pollution.

It is very important to make people aware of economical use of water. The municipality alone will not solve the water problem, residents should help with that. Especially with the arrival of 1200 new homes, people should be helping with specific implementations in their neighbourhood to store water for example.

Regional scale

The main elements that can be seen on the regional level map are the building environment that increasingly encloses the nature of the Utrechtse Heuvelrug. The increase of the urban area puts a lot of pressure on the surrounding nature. Another effect of the increased urbanisation is that the mud streams from the Utrechtse Heuvelrug will become more concentrated in the future and eventually cause more damage than they do now since the soil will compact more. In additinon, the Lek can overflow as the excess water can go nowhere because of the dams.



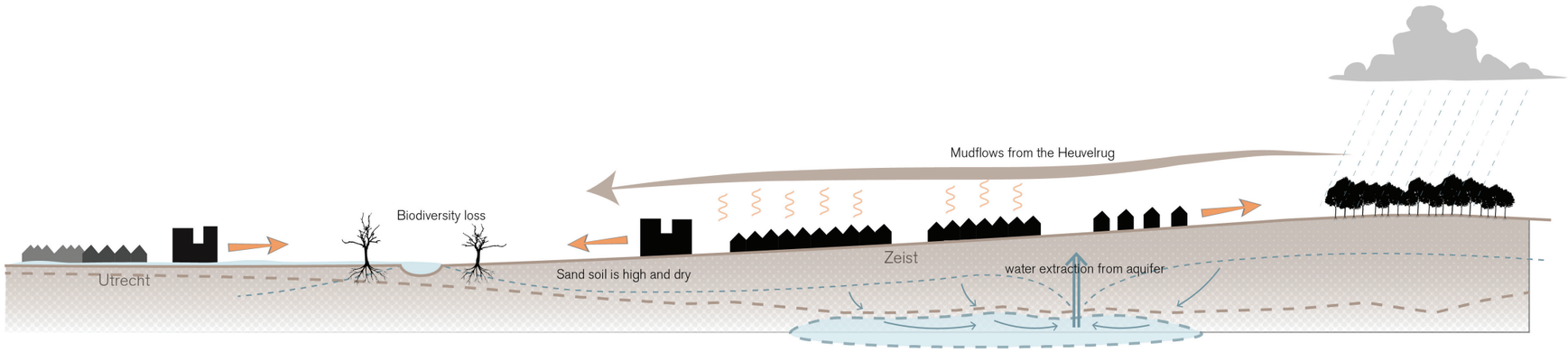
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Image/ Map/ Diagram Title

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Use as much text space as needed.

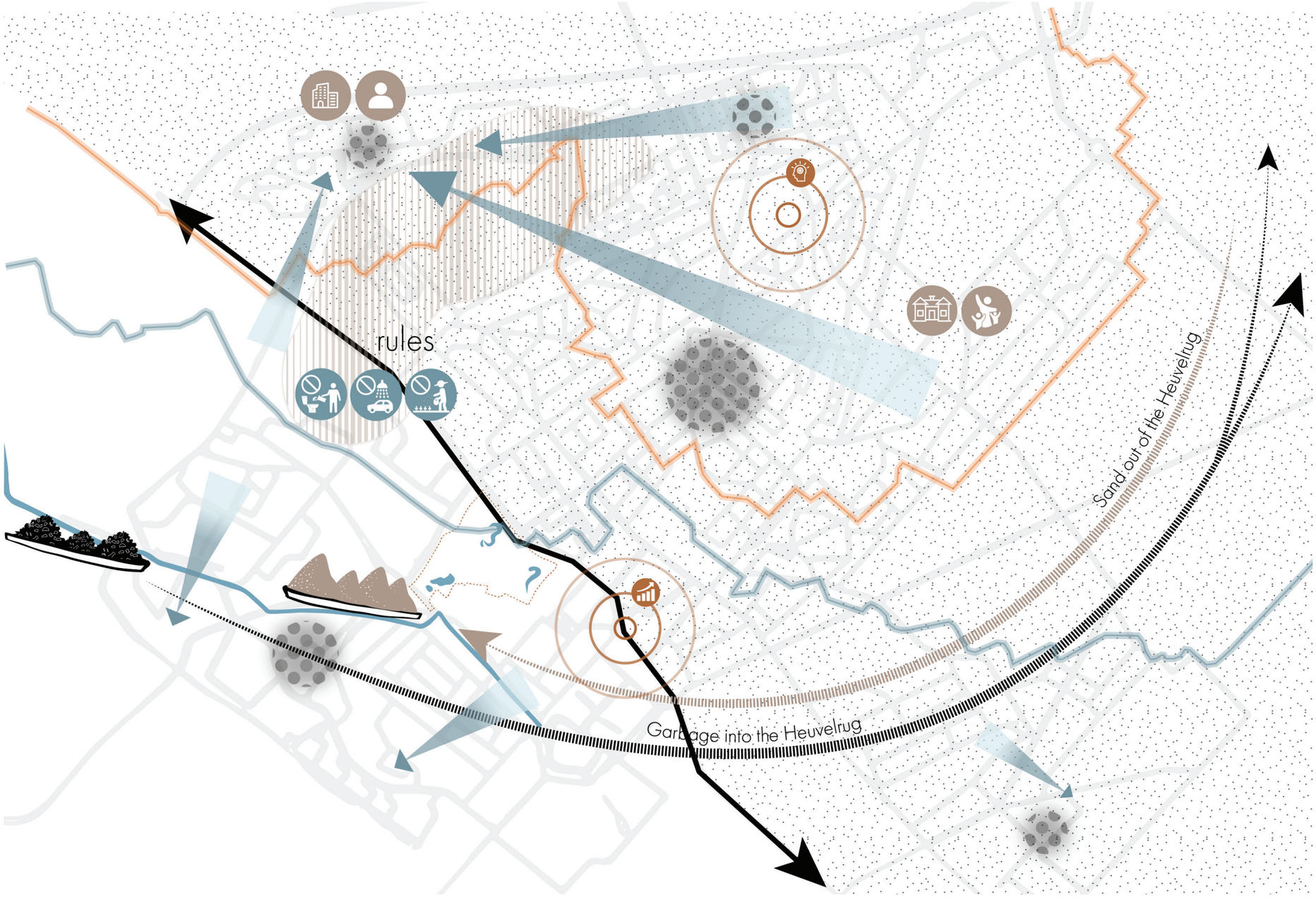
Legend

- Biodiversity loss
- Soil compaction
- Heuvelrug
- Kromme Rijn
- Dammed river
- Mudstreams
- Flood area
- City
- City expansion



Urban scale

In the past, people with more money built their houses on the sand while people with less income had to live in the clay area. There is a relationship between elements in the landscape and elements in urban morphology. That Zeist expanded on the edge of clay and sand soil can be seen from the location of the historic town and the two main roads that lead to it. The Utrechtseweg and the Driebergseweg are the first roads that connected Zeist with its surroundings.



Image/ Map/ Diagram Title

Here you can write a brief explanation.
Use as much text space as needed.

Legend

- Villa
- Flat
- Family
- Single person household
- Centre
- Socio economic strong to weak
- Water catchment area
- 100 year focus area
- Awareness
- Growth old city center
- Rules
- Possible area of densification
- Main road
- Sand soil
- Clay soil

4.

Scenario making

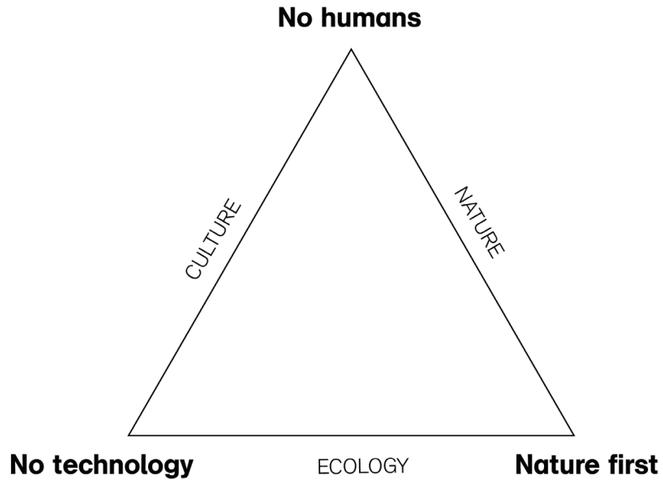
Introduction and conclusion

The next step in the process is the application of three scenarios. In this way, the potentials of the location can be deduced and later used. The three proposed scenarios are

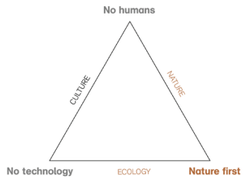
- Nature first: situation of no further urban development and nature is prioritized;
- No technology: situation of growth in which technological solutions are avoided;
- No humans: the location is left to nature.

The specifics of the scenarios and their consequences for Zeist can be found on the following pages.

The result of scenario-making is a greater understanding of the location and its potentials. With the help of this, it is now possible to find synergies between the three different scenarios and the case of Zeist that can be used to the advantage when creating the guidelines.



Scenario 1. Nature First



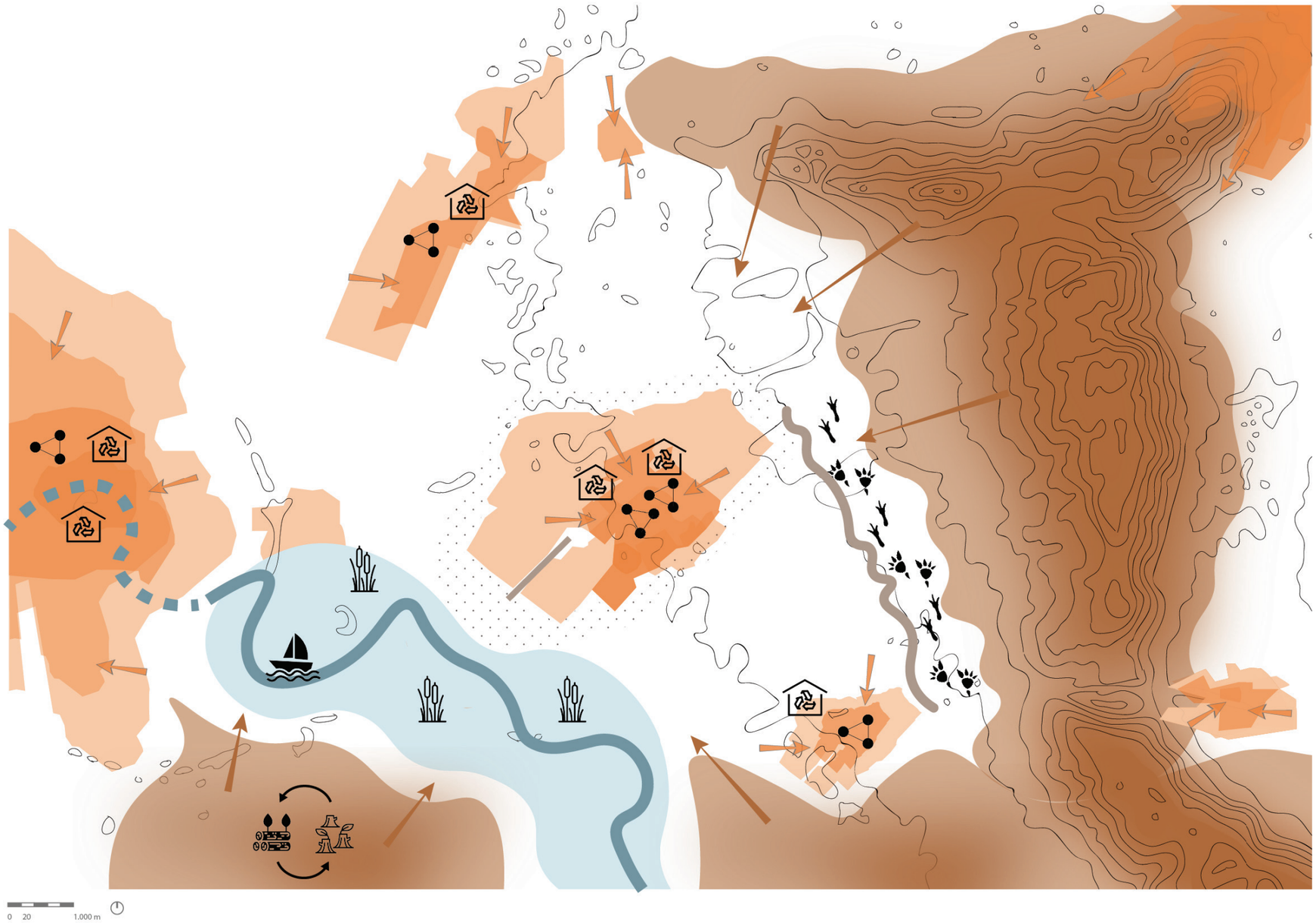
National Park Zeist

In the redesign of the city, nature is put central as part of a 'give back to nature' strategy. Which means living with the flows of nature. Using only materials which can be given back.

In this scenario, people will be producing more locally to reduce exports to achieve a sharing society and economy.

In the specific case of Zeist, this will mean that people will start treating the Heuvelrug as a real heritage. Nature will be protected and will be allowed to run its course. The Kromme Rijn will be allowed to run its course and nature and urban areas will be separated by a green belt. This belt protects nature from human extraction and intervention. In the belt, this extraction is allowed.

In the city, houses will become extremely adaptive, circular and movable to allow nature to run its course. Furthermore, the city is not allowed to grow and will potentially shrink, resulting in a more compact city with nature as a public space.



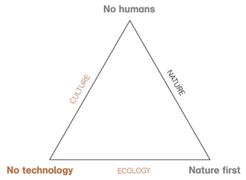
National Park Zeist

Map to explain scenario 1: nature first

Legend

- Sharing society and economy
- Adaptive, circular and movable house.
- Space for the river
- Floodplains
- Species as heritage
- City shrinking
- Nature expanding
- Using materials which can be given back

Scenario 2. No technology

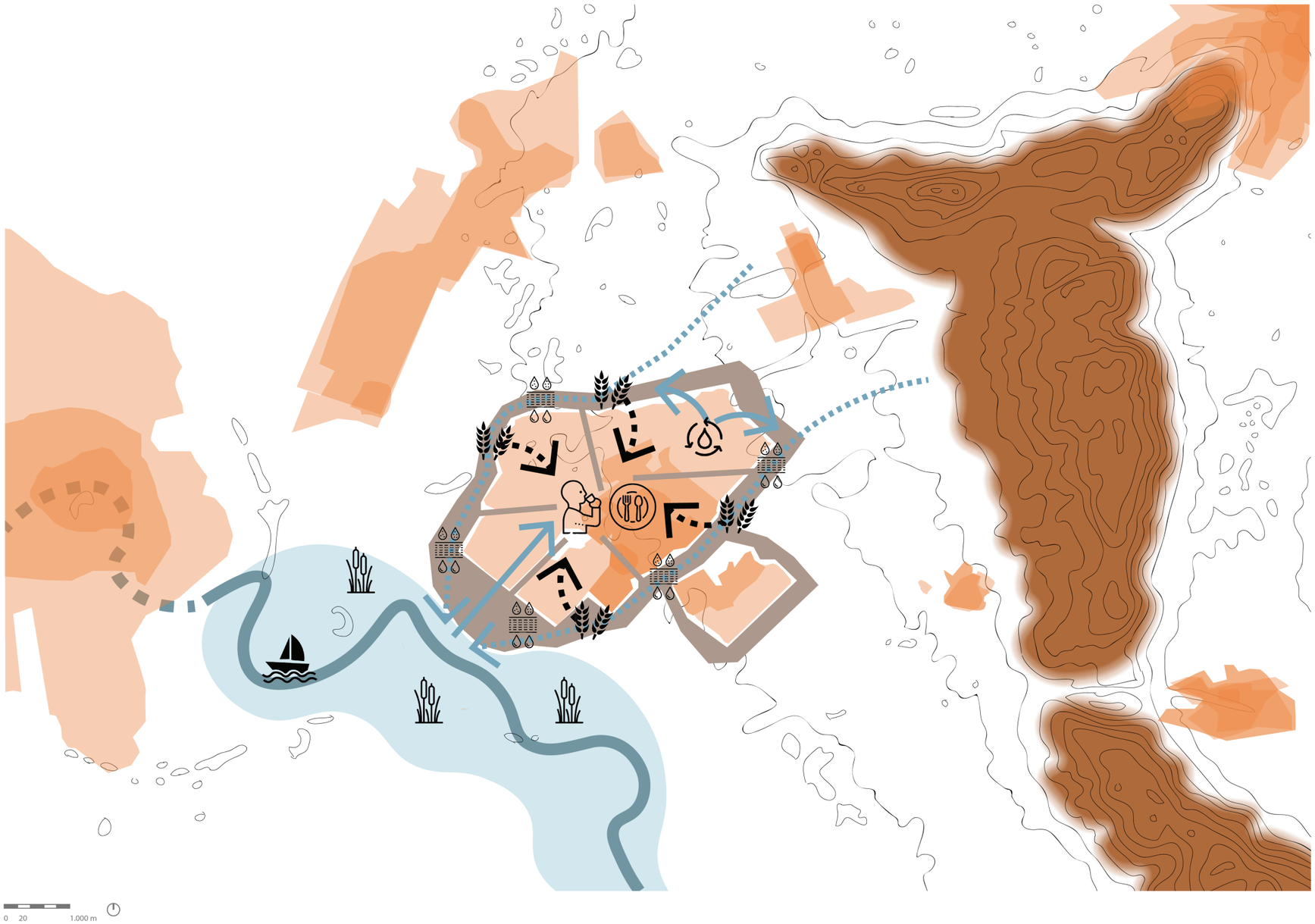


Production City Zeist

In this scenario, there is still growth and densification by humans. However, in the design of cities, issues are approached with natural solutions instead of technological solutions. Technology here is defined as man-made interventions that use cheap fuel/ energy instead of being facilitated by natural processes.

The main spatial effect is the disappearance of roadway infrastructure, leading to the need for self-reliant town centres and local economies (decentralisation) based on the workings of natural processes.

For Zeist, this means that the Kromme Rijn becomes part of a possible trade infrastructure network. Furthermore, there will be a production belt surrounding the city to ensure self-reliance. In this belt, food can be produced as well as clean water. In addition, this belt is part of the circular water system. In this system, buildings use greywater and rainwater harvesting for indoor re-use. Blackwater is filtered through the green belt.



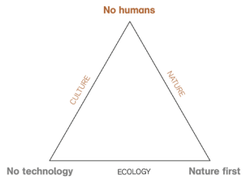
Production City Zeist

Map to explain scenario 2: no technology

Legend

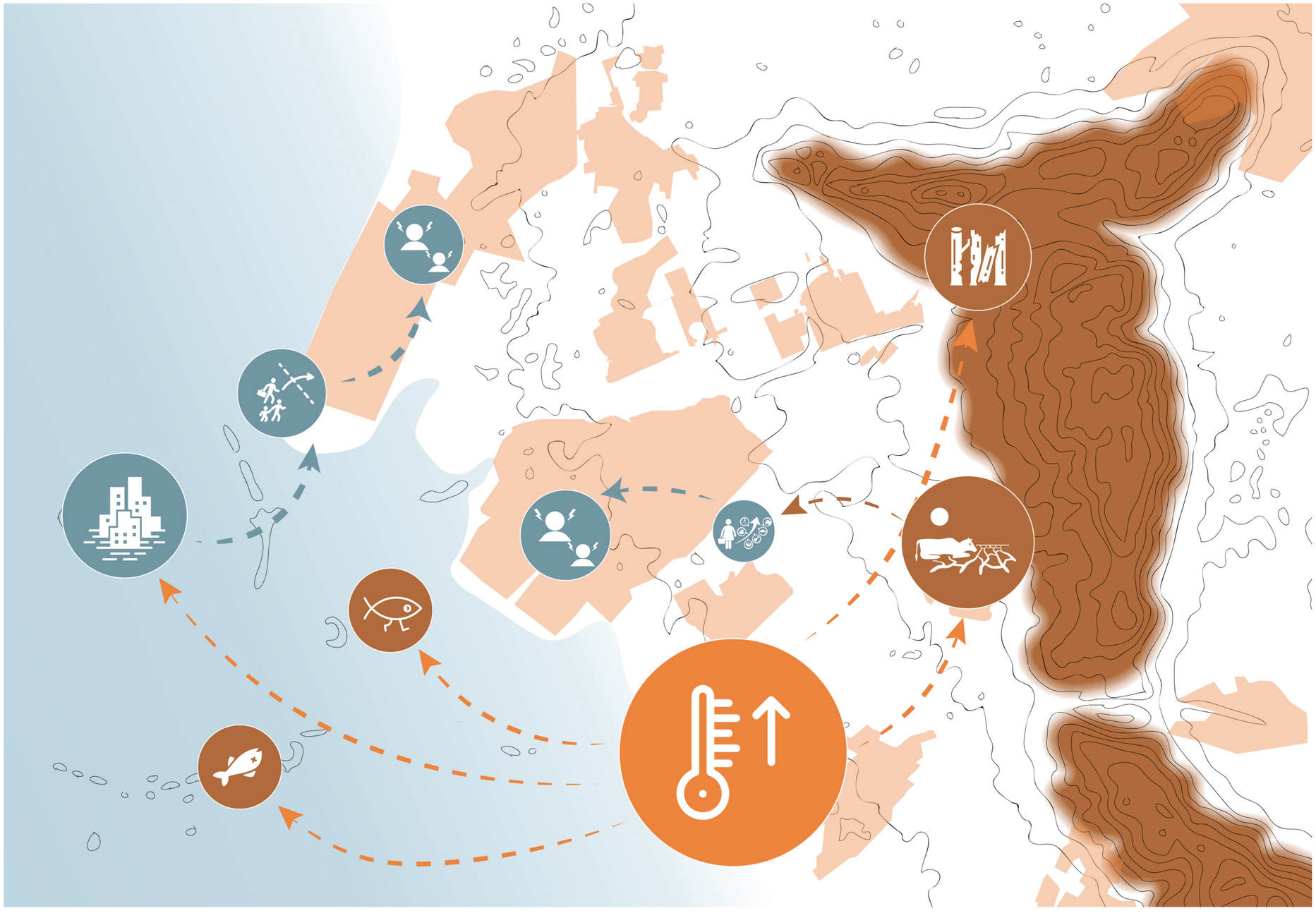
- Kromme Rijn transport river
- Kromme Rijn floodplains
- Water infiltration
- Drinking water supply
- Farming and production
- Food supply
- Water recycling
- Food flow
- Water flow

Scenario 3. No humans



Zeist at Sea

In this scenario, humans keep treating the world as they do now until the point of no return is reached. The world has become uninhabitable and humans migrate to specific places. In the Netherlands, this will be Zeist, as this is the first point that the seawater will not reach. It has become evident that specific locations can have solely one or two functions. The increase of people in one space and the scarcity of resources will lead to conflicts and wars. This results in migration from the earth to another location in our universe. Conditions on earth start to become so harsh that everyone that has not evacuated the earth will be dead.



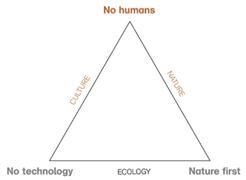
Zeist at Sea

Map to explain scenario 3: no humans

Legend

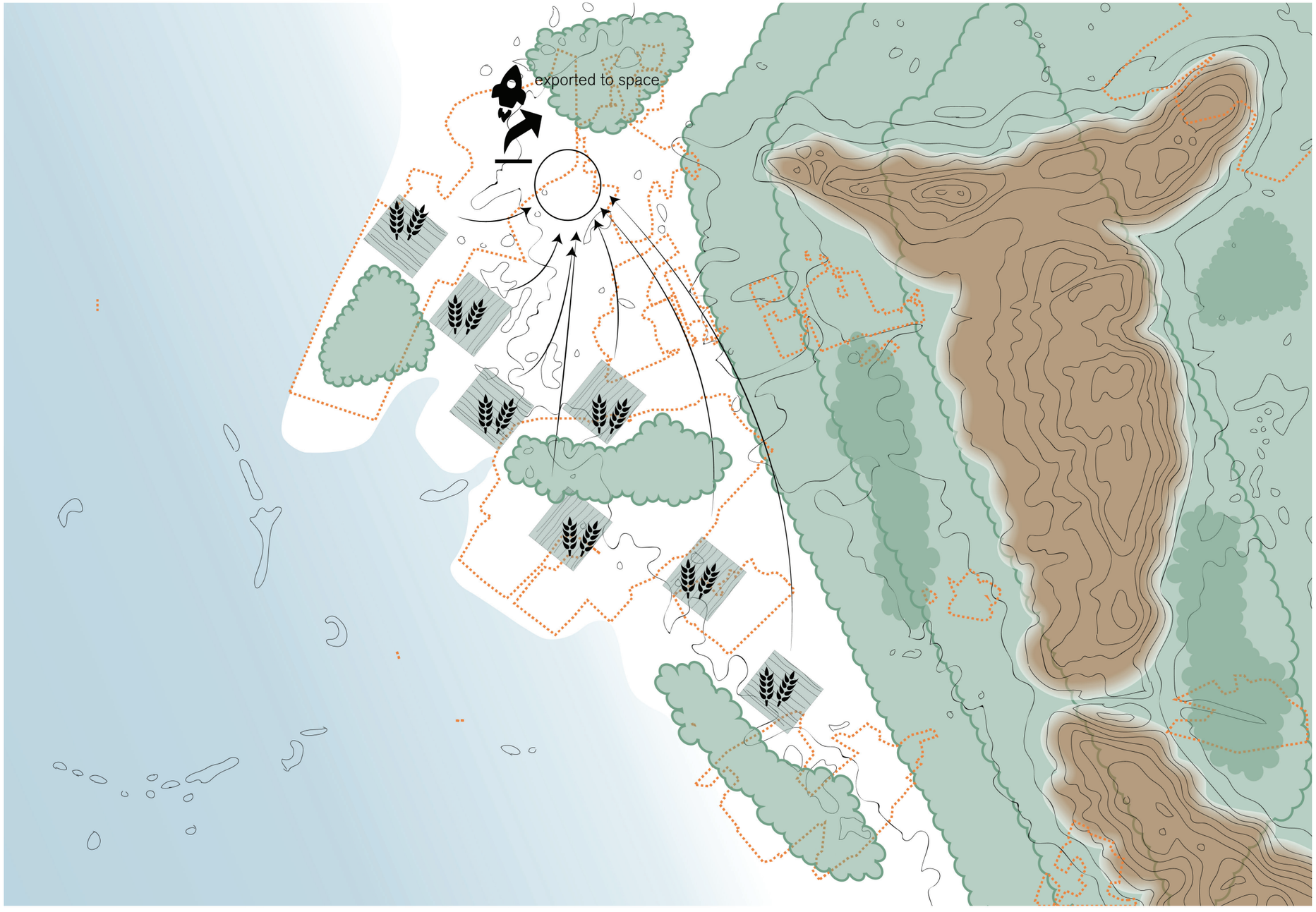
- Increase in temperature
- Loss of plants
- Loss of animals
- Evolution of animals
- Extreme droughts
- Migration
- Sealevel rise
- Inflation
- Friction between people
- Old cities
- Heuvelrug
- Forest
- Sea

Scenario 3. No humans



Zeist at Sea

However, nature can find a new balance in this new climate. New species will evolve to withstand the increased heat. Because of the elimination of humans, nature can flourish and regenerate. When humans find out, they will not commence inhabiting the planet, as they are now aware that it was the human race that caused all the problems on earth. They do see opportunities to start to extract from the earth again. The earth will provide them with food while they leave it alone for other resources. In this way, humans start to live of the earth again but only in very specific locations and while keeping the balance in what they take and what nature can provide.



Zeist at Sea

Map to explain scenario 3: no humans

Legend

- Space port
- Heuvelrug
- Forest
- Agriculture
- Sea
- Old cities

5.

System intervention

Performance based urban design guidelines

The project's primary goal is essentially to connect the challenge of drinking water to urban development over the coming 100 years. The question is how the urban landscape can accommodate archetypal drinking water abstractions that are more flexible so that the drinking water extraction can deal with external shocks, while also avoiding damage.

The main vision for this challenge is to develop a green belt around the city that will protect the city from externalities from the heuvelrug and river landscape, as well as protect outside nature from the negative impacts of increased densification. In this way, a better balance between humans and nature can be initiated.

From the perspective of landscape & ecology, the green belt will protect the densely built interior from hillside run-off, catching rainwater and filtering it on its way toward an inundated river landscape along the Kromme Rijn. Inner-city wadi landscapes recharge the existing subsurface aquifer used for drinking water extraction. The green belt and inundated river landscape further provide cooling in benefit of the urban heat island effect within the city.

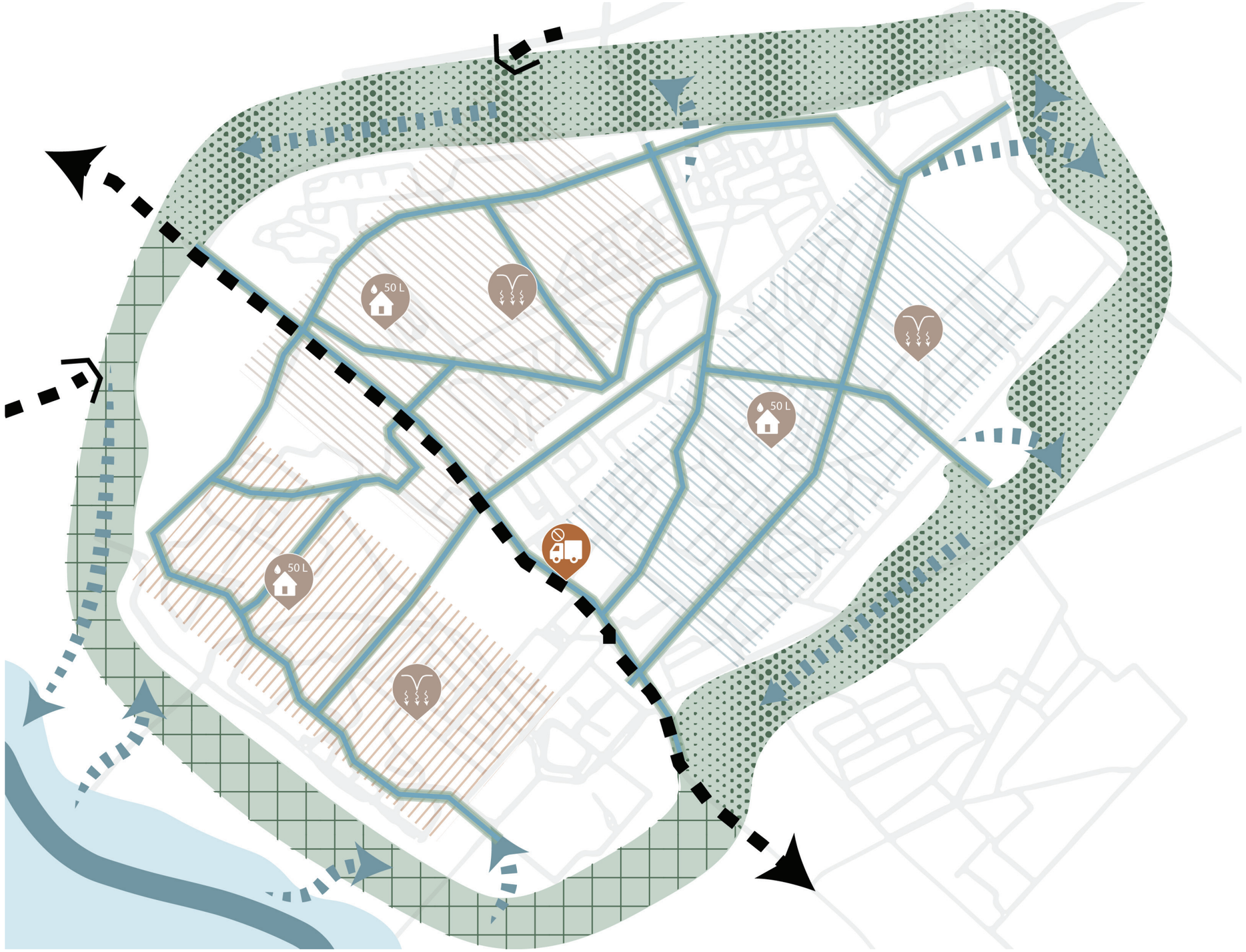
From the perspective of urban morphology, the most important aspect is reconnecting the different neighbourhoods again. The relation between different social-income groups should be improved by creating new public spaces, implementing more green-blue infrastructure and building new shared homes. To ensure that the densification has no negative impact on the environment, new houses and public space should be made circular and adaptive to nature. The green belt helps to confine densification from nature reserves outside the city.

From the perspective of anthropology, the green belt, new wadi structures, and the green-blue network that are implemented in the vision will help to create increased resource and space awareness. In addition, new rules and policies for water usage, such as the 50L-homes and the decrease in mobility types that contaminate water, will help to develop consciousness as well as trigger pro-environmental behaviour.

Vision map

The map shows what has been explained on the previous page. Because of the implementaton of the green belt, the A28 is tunneled.

There are three zones in which inner-city transformation will take place. The first one will be the densification of the district of Vollenhove. The second will be the transformation of houses and public space in the districts with villa houses. The last area is the transformation of green spaces in the dense rowhouse districts in the southwest of Zeist. These will also be the locations for the individual design exercises.



Vision map

Legend

- Green belt (productive function)
- Green belt (recreational function)
- Wadis
- 50 liter homes
- Green-Blue structures
- Kromme Rijn and floodplain
- Tunnel
- Main road
- No trucks
- High densification area
- Transformation area 1
- Transformation area 2

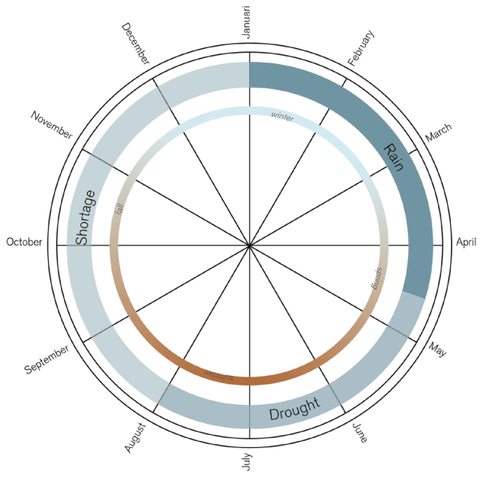
Seasonal changes

The vision for Zeist transforms the urban and landscape metabolisms for water and wastewater into closed-loop systems and flows. Both in the winter season and summer season, a new approach is implemented.

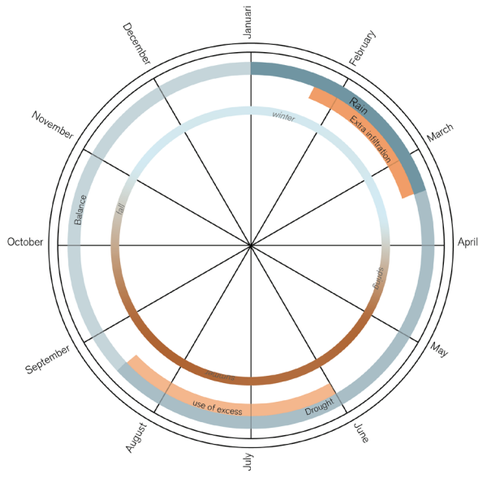
Currently, during the winter season, rainfall cannot infiltrate everywhere due to low soil permeability and wastewater is discharged into flood controlled surface water bodies. In the vision, the aquifer is recharged in two ways. First, water naturally infiltrates where it is still possible with excess water from the Kromme Rijn pumped uphill to naturally infiltrate to the groundwater. Second, wadis with pumps to the aquifer are used where the soil is too compacted and polluted to allow for natural infiltration. In addition, the green belt catches rainwater and mudflow run-off and discharges it into the Kromme Rijn while rainwater and grey/blackwater from within the city is recycled to households.

Currently, during the summer season, the aquifer used for water extraction drains to critical levels as drinking water shortages are confronted. In the vision, the green belt and surface water bodies are irrigated and recharged from the Kromme Rijn, lessening the extraction load for the subsurface aquifer as well as confronting the urban heat island effect. Since the winter offered water storage for households, they will require less during the summer.

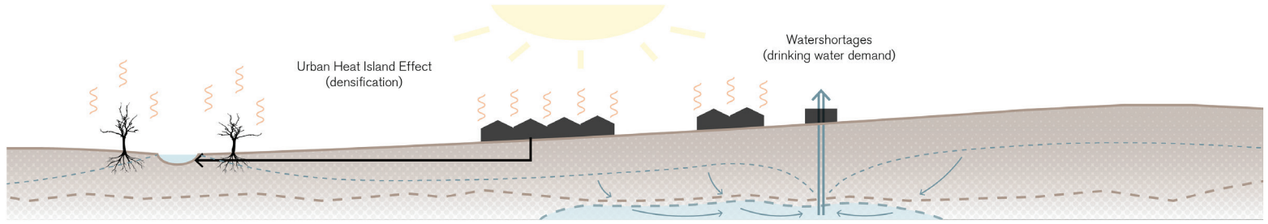
One year
The time circles represent the timeframe of one year.

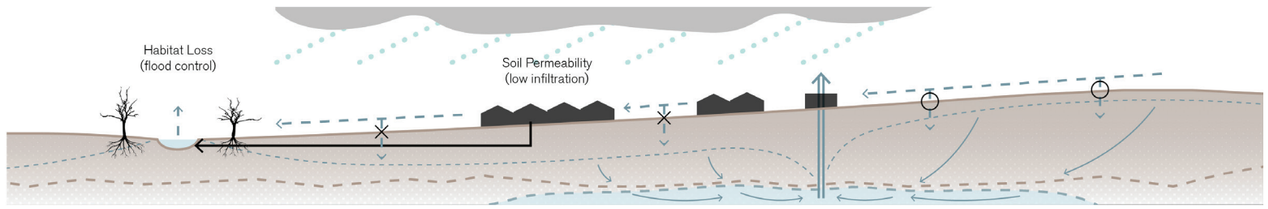


Current situation

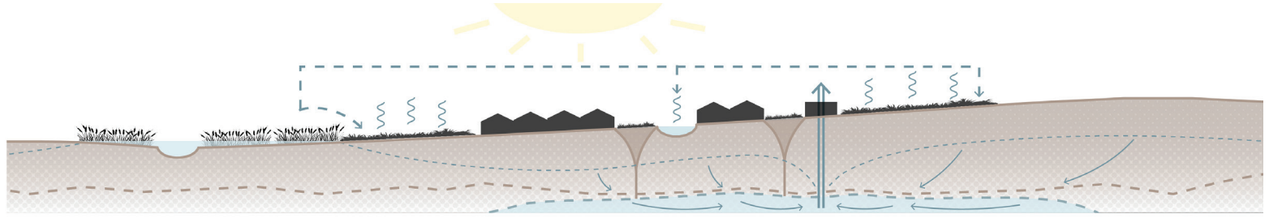


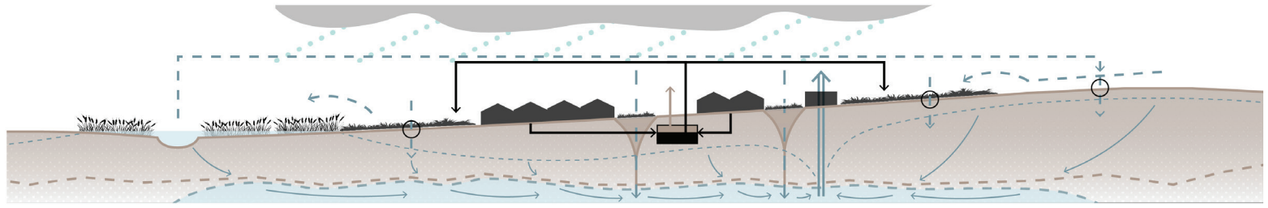
New situation



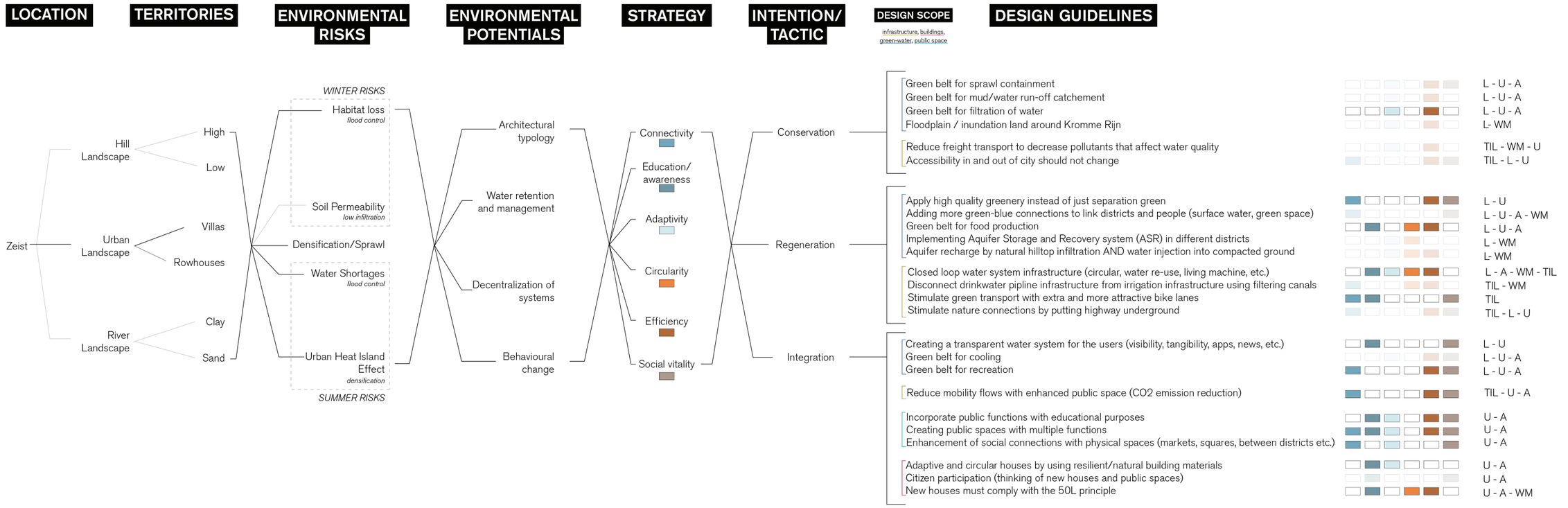


Sections current
The sections explain the current summer (top) and winter (bottom) situation.





Sections vision
The sections explain the new summer (top) and winter (bottom) situation.



Guidelines taxonomy

The guidelines are informed by the whole process up until now. Of course, the area of Zeist is the starting point for the framework. In this location, three territories can be distinguished: the urban landscape (Zeist), the hill landscape (Heuvelrug), and the river landscape (Kromme Rijn). Within these landscapes, there are certain risks. These can be divided into winter risks and summer risks, as the water system is highly influenced by the seasons. Other risks, such as densification, do not conform to one season and are therefore separate.

In order to resolve these risks, four potentials are determined that can help alter the course of the current situation. These are the potentials in architectural typology, water retention and management, decentralisation of systems and behavioural changes.

Informed by the theoretical framework, there are six points in which strategic action can be taken. The concepts that are distinguished are broad terms. To be specific about the way they are used, the following definitions are drawn up:

- Connectivity - The directness of links and the density of connections in a network (Heart Foundation et al., 2009).
- Education/awareness - knowledge that something exists, or understanding of a situation or subject at the present time based on information or experience (Cambridge dictionary, 2021)
- Adaptivity - ‘urban design as a process of perpetual engagement and reiteration. Cities as ecologies that take immersion and collaboration to re-shape from within’ (Artibise, 2010).
- Circularity - close resource loops, eliminating the concept of waste, This will be done in partnership with the city’s stakeholders to realize its vision of a future-proof city (Stockholm Environment Institute, 2020).
- Efficiency - “the performance of each system is optimized, but also that these systems are managed in an integrated way to better prioritize investment and maximize value” (Tawil et al., 2016)
- Social Vitality - “strong, active and inclusive relationships between residents, private sector, public sector and civil society organizations that work to foster individual and collective wellbeing” (Scott, 2010)

These strategic points can all be implemented in different manners. In order to be explicit about this, three tactics are drawn up to inform the spatial way the strategic points were handled. These are:

- Conservation - parameters in the system remain constant. (Conservation International, 2021)
- Regeneration - the action which leads to the resolution of urban problems to bring improvement in a resilient and equitable way, integrating societal needs with nature (Huston & Darchen, 2014)
- Integration - an approach to design that brings together specialisms that are usually considered separate (Axis, 2020)

The design guidelines are connected to this. Behind each tactic, the guidelines that are formulated according to that intention are mentioned. The guidelines are also divided into four main elements to show the scope that they are working on. Furthermore, the guidelines are connected to elements of the strategy by the coloured blocks. Altogether, this can be seen exactly in what way the guidelines will alter the project location.

This framework can be used in the individual designs to make explicit how and why certain design guidelines were chosen.

Overall, the guidelines that come out of the conceptual framework are in line with the strategy of the two networks (S2N) framework by researcher Tjallingii (2013) stating that water and transport networks are the supporting elements for spatial planning. Specifically in line are the points about viewing the spatial system as flows with inputs and outputs and that the water network plays into multifunctionality incorporating water extraction, nature, recreation and ecological quality. The guidelines are about flow regulation.

6.

Design Experiments

Jolt Wiersma
Carmen Jansen op de Haar
Esmee Kuit

Do-it-Yourself Wadi
Inclusiveness
Spaces and Places

Do-it-Yourself Wadi

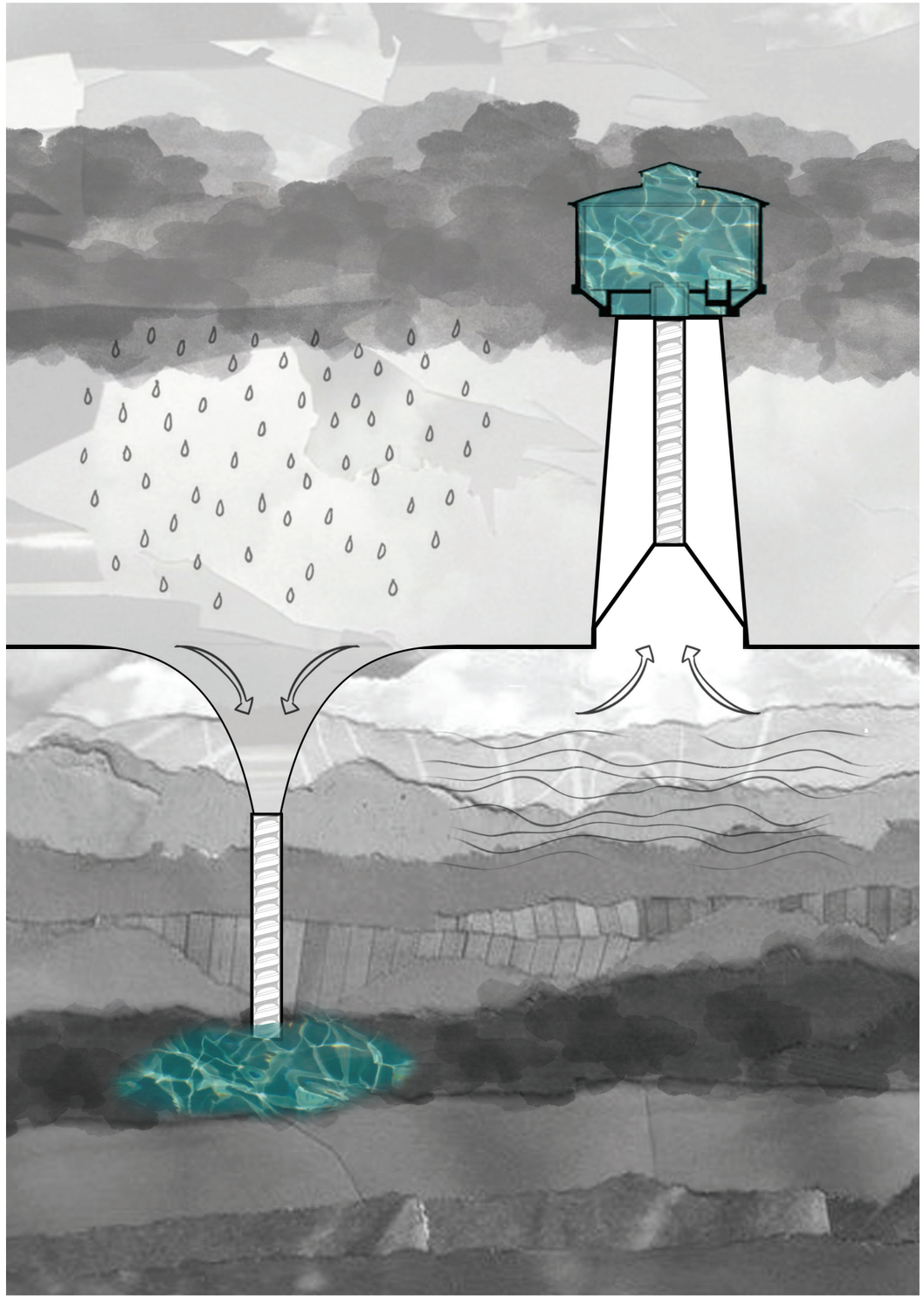
Jolt Wiersma

Manifesto

Zeist is the first city in the world that, in terms of water-use, is entirely off the grid. This is ensured by a practical system of interconnected wadi landscapes. Wadi's at private-scale, communal-scale, and public-scale levels work together to evoke water-circular households, to spawn surfacewater urban-cooling, and to initiate aquifer waterstorage & recharge. While in the past abundant groundwater was stored in basins atop of watertowers, in the future the rainwater abundance will be stored in sand-layers of the subsurface. The past is literally and figuratively upturned. Like this, Zeist is future-proofed for imminent climate change.

But this off the grid wadi infrastructure, these triple-scale interventions... What will the spatial environment in Zeist be like? What space belongs to who? This is where the user comes in: the Do-it-Yourself Wadi. Available at GAMMA, Intratuin, and HORNBACH, the DIY Wadi provides an assortment of components that can be implemented to design a wadi to a personal taste. Planning at household, district, and city levels will then lead to the most optimal wadi archetype: both in spatial function and spatial tangibility. The DIY design opportunity of the wadi infrastructure is essential since the human connection that materializes will stimulate water awareness.

Like the architecturally articulated watertower infrastructure of the past, the future is a landscape dotted by the DIY Wadi. This future, however, requires an intense adaption to the traditional societal ways of thinking. As Zeist takes the lead in this pilot project, the rest of the world will soon follow. The design experiment is a testament to its performance and the will of people to change the world.



Design experiment

There are three scale levels in which the DIY Wadi works at:

1. The private scale level, such as dwellings.
2. The communal scale level, such as district blocks.
3. The public scale level, which is the entire city.

The public scale level that is the mediator to the private and communal levels.

Each scale level has its own priority based on the manifesto for Zeist:

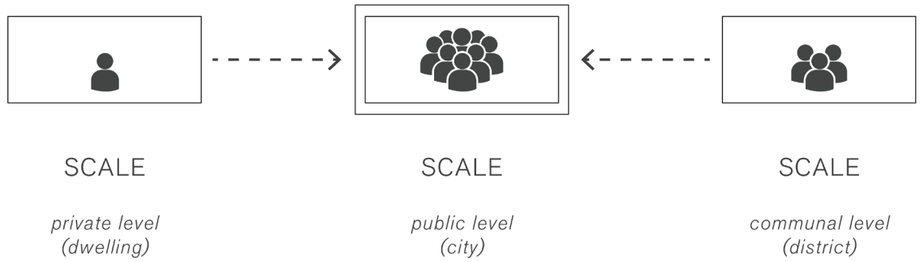
1. At private level, this is household water reuse.
2. At communal level, this is surfacewater distribution.
3. At public level, this is aquifer storage & recharge.

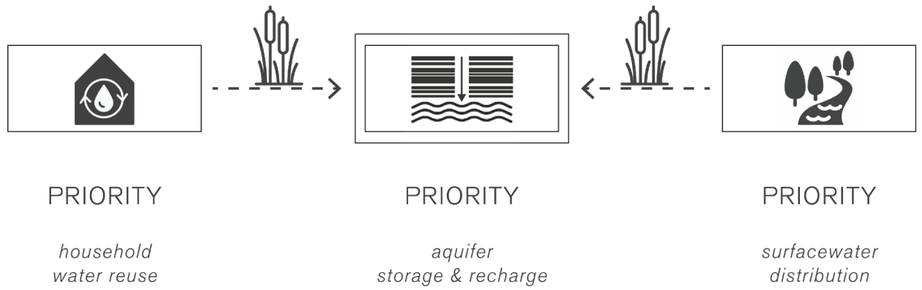
Water is the resource that is transported between the different levels in order to fulfill their individual priorities. The priority of the mediator flows (arrows) to the public scale level is to keep the water quality to a clean enough standard.

As a consequence, the three scale levels have different societal impacts:

1. At private level, the biggest impact is water cost savings.
2. At communal level, the biggest impact is cooling of urban heat.
3. At public level, the biggest impact is the supply of clean drinking water.

The next schematic shows how this triple-scale infrastructure network looks like spatially. It is the most optimal design scheme for the needs of Zeist. However, each scale level implements a different wadi typology in order to be most effective at carrying out their individual priorities. That is the DIY Wadi.







PRIVATE LEVEL

PUBLIC LEVEL

COMMUNAL LEVEL

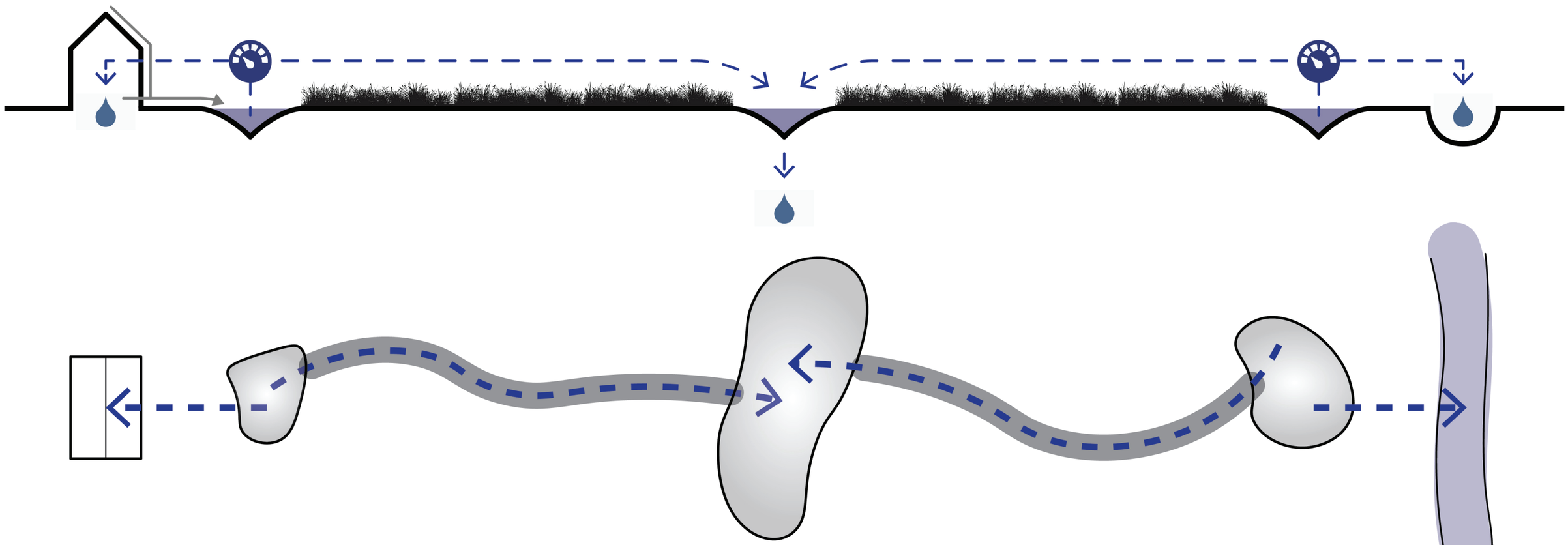
giving back to the grid (household water)

filtering channel (purification)

giving back to the grid (aquifer water)

filtering channel (purification)

giving back to the grid (surface water)



D-I-Y Wadi (optimal design)

filtering channel (purification)

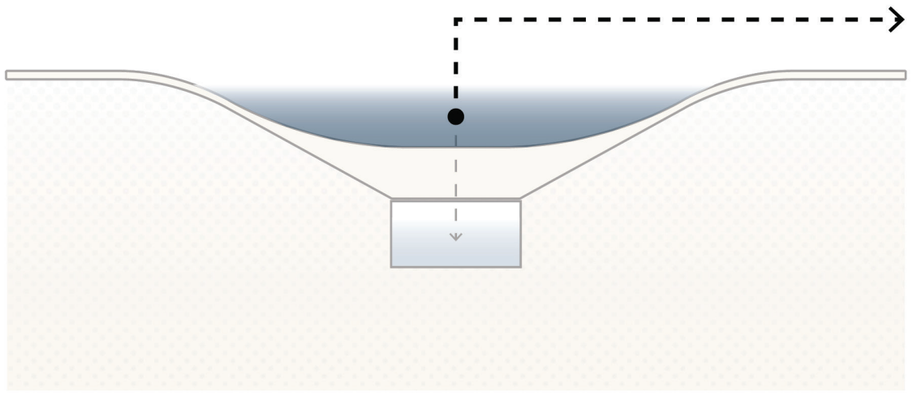
D-I-Y Wadi (optimal design)

filtering channel (purification)

D-I-Y Wadi (optimal design)

Typical Wadi - Overflow Discharge

The first component of a typical wadi is the overflow discharge. This is the method in which excess water that enters the wadi is taken care of.



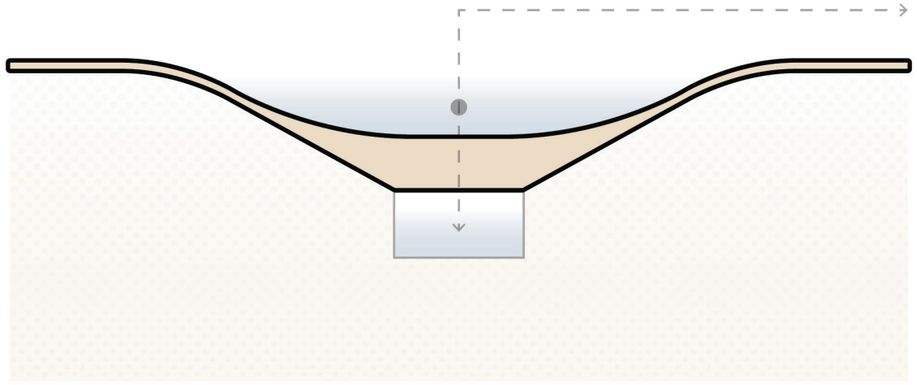
OVERFLOW DISCHARGE

TOPSOIL LAYER

COLLECTION BASIN

Typical Wadi - Topsoil Layer

The second component of a typical wadi is the tposoil layer. This is the method in which water in the wadi is buffered an shaped (altered).



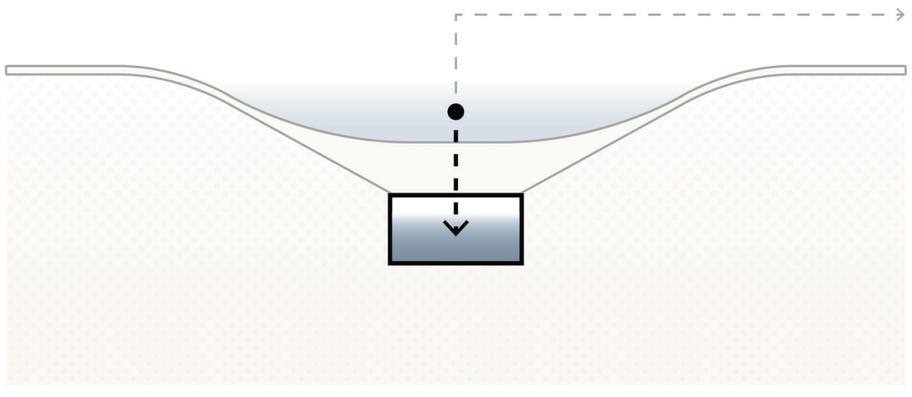
OVERFLOW DISCHARGE

TOPSOIL LAYER

COLLECTION BASIN

Typical Wadi - Collection Basin

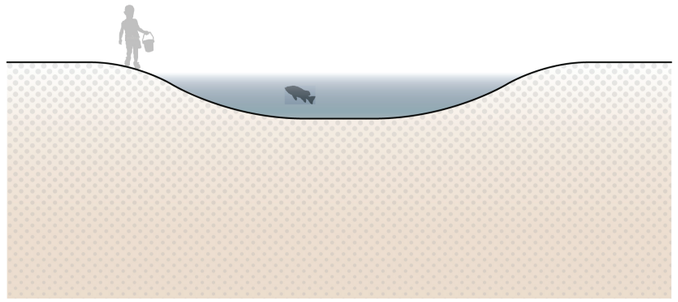
The third component of a typical wadi is the collection basin. This is the method in which water in the wadi is retained and kept during its buffer period.

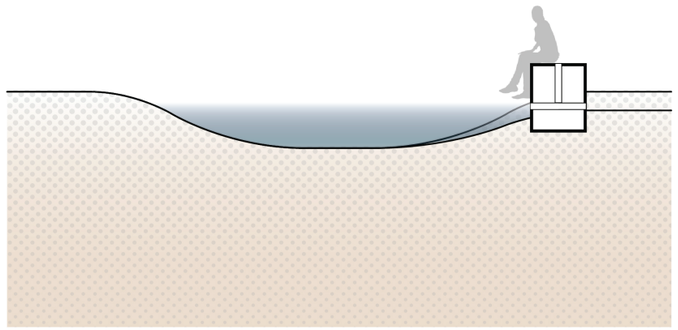


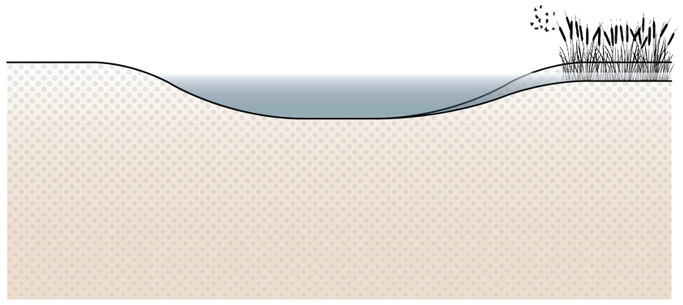
OVERFLOW DISCHARGE

TOPSOIL LAYER

COLLECTION BASIN







Configuration Options of the Overflow Discharge

The overflow discharge comes in three configurations:

1. applying no discharge provision
2. applying self-regulated discharge
3. applying direct discharge

Each option has certain advantages and disadvantages that can be taken into account when designing a wadi that should carry out a certain task. For the best wadi typology at private, communal, and public level, care should be taken when looking at the spatial-practical performance and the socio-economical performance.

A. NO DISCHARGE PROVISION

spatial-practical performance — space/room savings; water pond/garden capability

socio-economical performance — decentralized; citizen participation/tangibility

B. SELF-REGULATED DISCHARGE (BUFFER)

spatial-practical performance — space/room savings; water pond/garden capability

socio-economical performance — decentralized; citizen participation/tangibility

C. DIRECT DISCHARGE

spatial-practical performance — space/room savings; water pond/garden capability

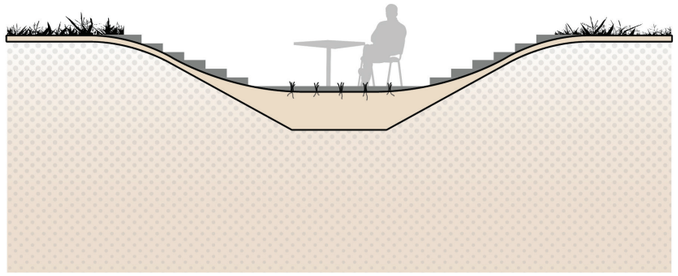
socio-economical performance — decentralized; citizen participation/tangibility

Configuration Options of the Topsoil Layer

The topsoil layer comes in three configurations:

1. applying semi-permeable tiling
2. applying grass on a humus bed
3. applying helophyte plant beds

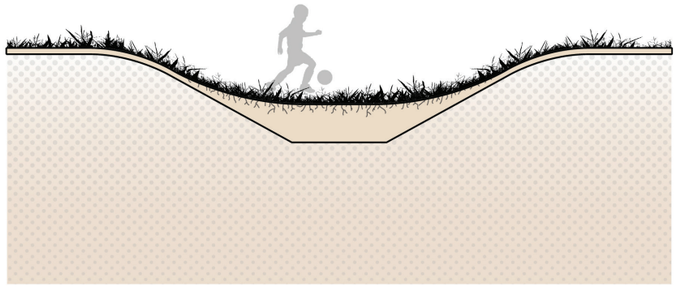
Each option has certain advantages and disadvantages that can be taken into account when designing a wadi that should carry out a certain task. For the best wadi typology at private, communal, and public level, care should be taken when looking at the spatial-practical performance and the socio-economical performance.



A. SEMI-PERMEABLE TILING

spatial-practical performance
infiltration opportunity
purification opportunity

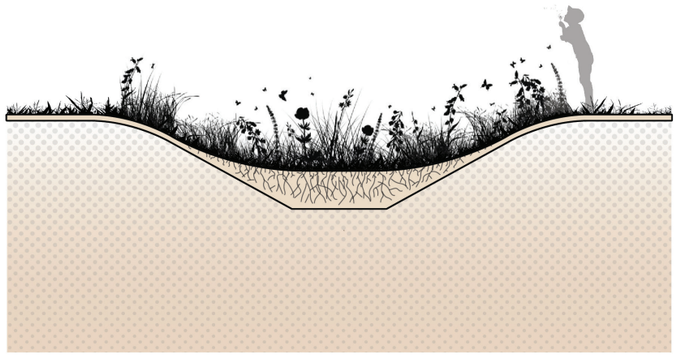
socio-economical performance
flora-fauna interaction
leisure accommodation



B. GRASS ON HUMUS BED

spatial-practical performance
infiltration opportunity
purification opportunity

socio-economical performance
flora-fauna interaction
leisure accommodation



C. HELOPHYTE PLANT BED

spatial-practical performance
infiltration opportunity
purification opportunity

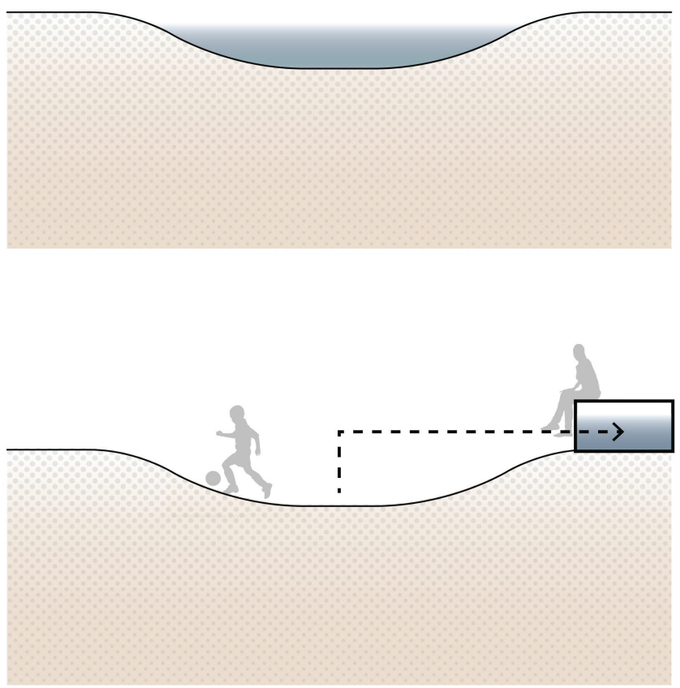
socio-economical performance
flora-fauna interaction
leisure accommodation

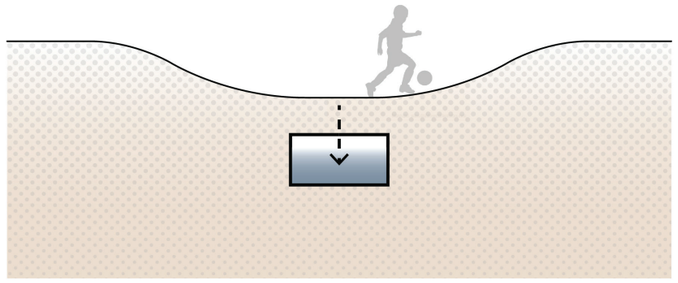
Configuration Options of the Collection Basin

The collection basin comes in three configurations:

1. applying no basin
2. applying an above ground basin
3. applying a below ground basin

Each option has certain advantages and disadvantages that can be taken into account when designing a wadi that should carry out a certain task. For the best wadi typology at private, communal, and public level, care should be taken when looking at the spatial-practical performance and the socio-economical performance.





A. NO BASIN USE

spatial-practical performance — space/room savings, multifcuntionality

socio-economical performance — water contamination chance, ease of water access

B. ABOVE GROUND BASIN

spatial-practical performance — space/room savings, multifunctionality

socio-economical performance — water contamination chance, ease of water access

C. BELOW GROUND BASIN

spatial-practical performance — space/room savings, multifunctionality

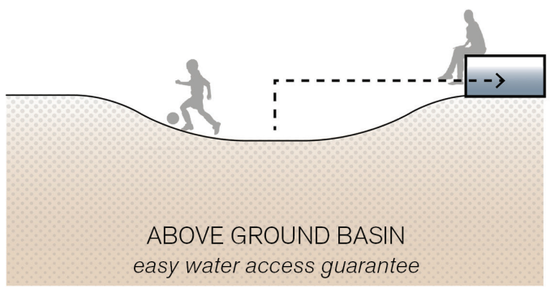
socio-economical performance — water contamination chance, ease of water access

The next schematic shows that in order to fulfill to priorities for each scale level, an optimum wadi typology should be implemented. The combination of configuration options for the wadi components guarantee that the wadi is most effective at achieving the desired societal impacts.

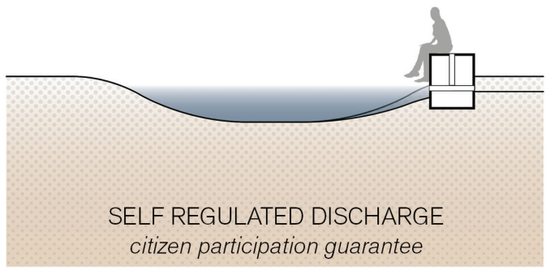
PRIVATE LEVEL



HELOPHYTE PLANT BED
purification guarantee



ABOVE GROUND BASIN
easy water access guarantee

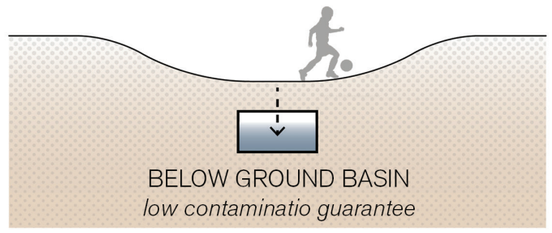


SELF REGULATED DISCHARGE
citizen participation guarantee

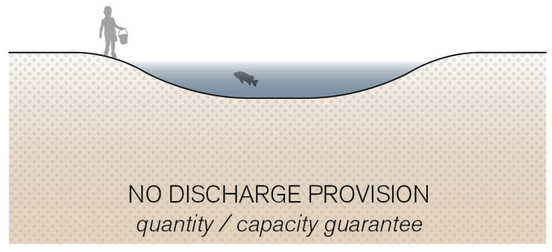
PUBLIC LEVEL



GRASS ON HUMUS BED
infiltration guarantee

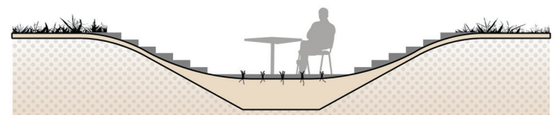


BELOW GROUND BASIN
low contaminatio guarantee

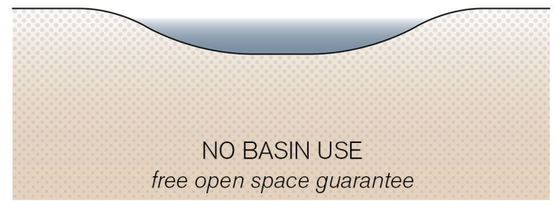


NO DISCHARGE PROVISION
quantity / capacity guarantee

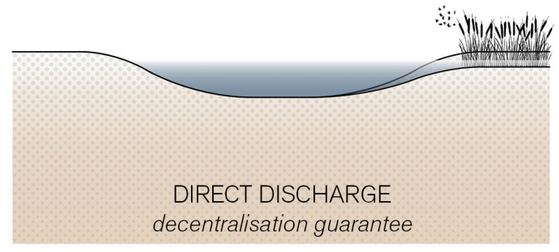
COMMUNAL LEVEL



SEMI-PERMEABLE TILING
leisure space guarantee



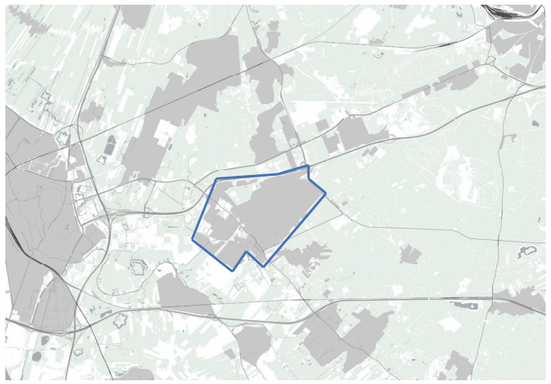
NO BASIN USE
free open space guarantee



DIRECT DISCHARGE
decentralisation guarantee

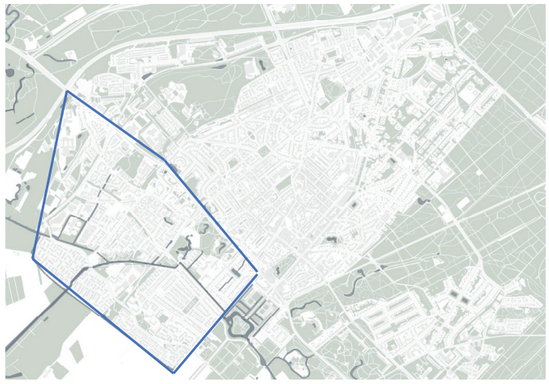
Regional Scale

The city of Zeist sits on the flank of the Utrechtse Heuvelrug, partly on sandy soil of the moraine hill and partly on clay soil of the river landscape.



Urban Scale

Since the infiltration of excess water is most difficult on clay soil, the districts on the south and southwest of Zeist are most promising for DIY Wadis.



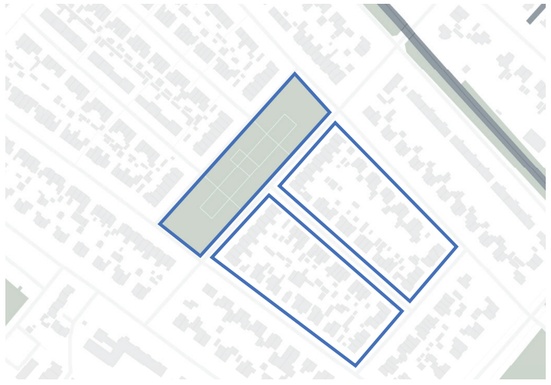
District Scale

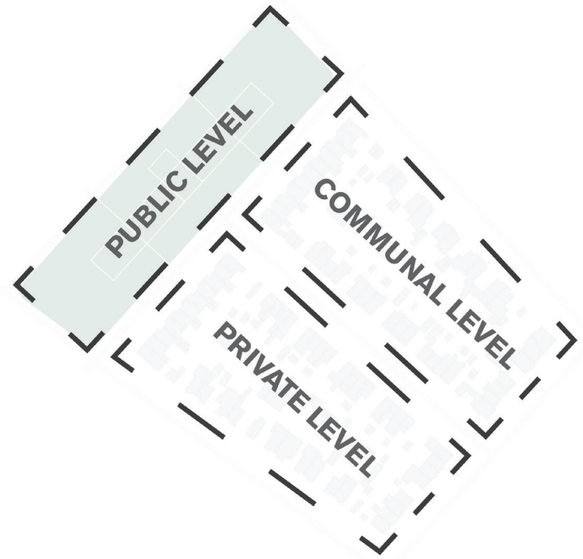
There are various urban blocks that vary in form and housing, with space ranging from urban park to city-block with rowhousing, duplex-dwellings, and individual homes. Griffensteyn is representative.

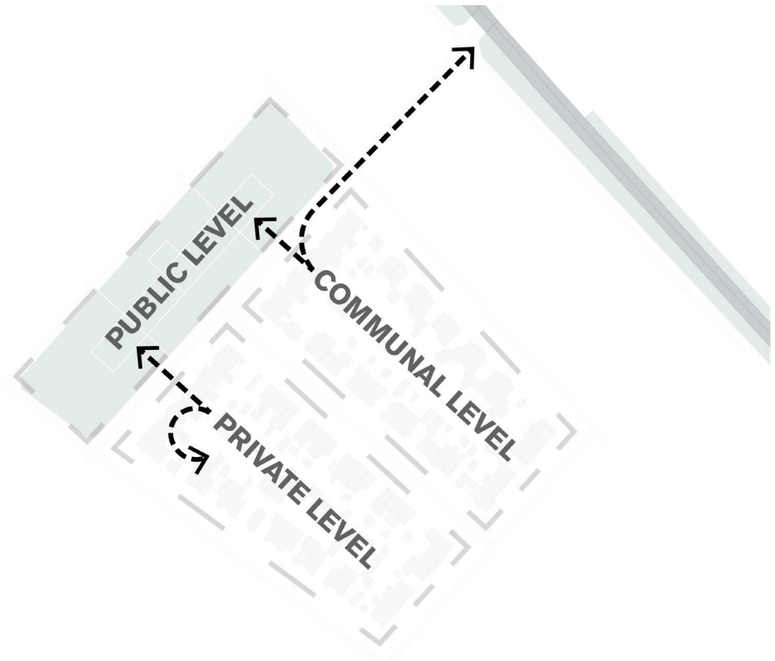


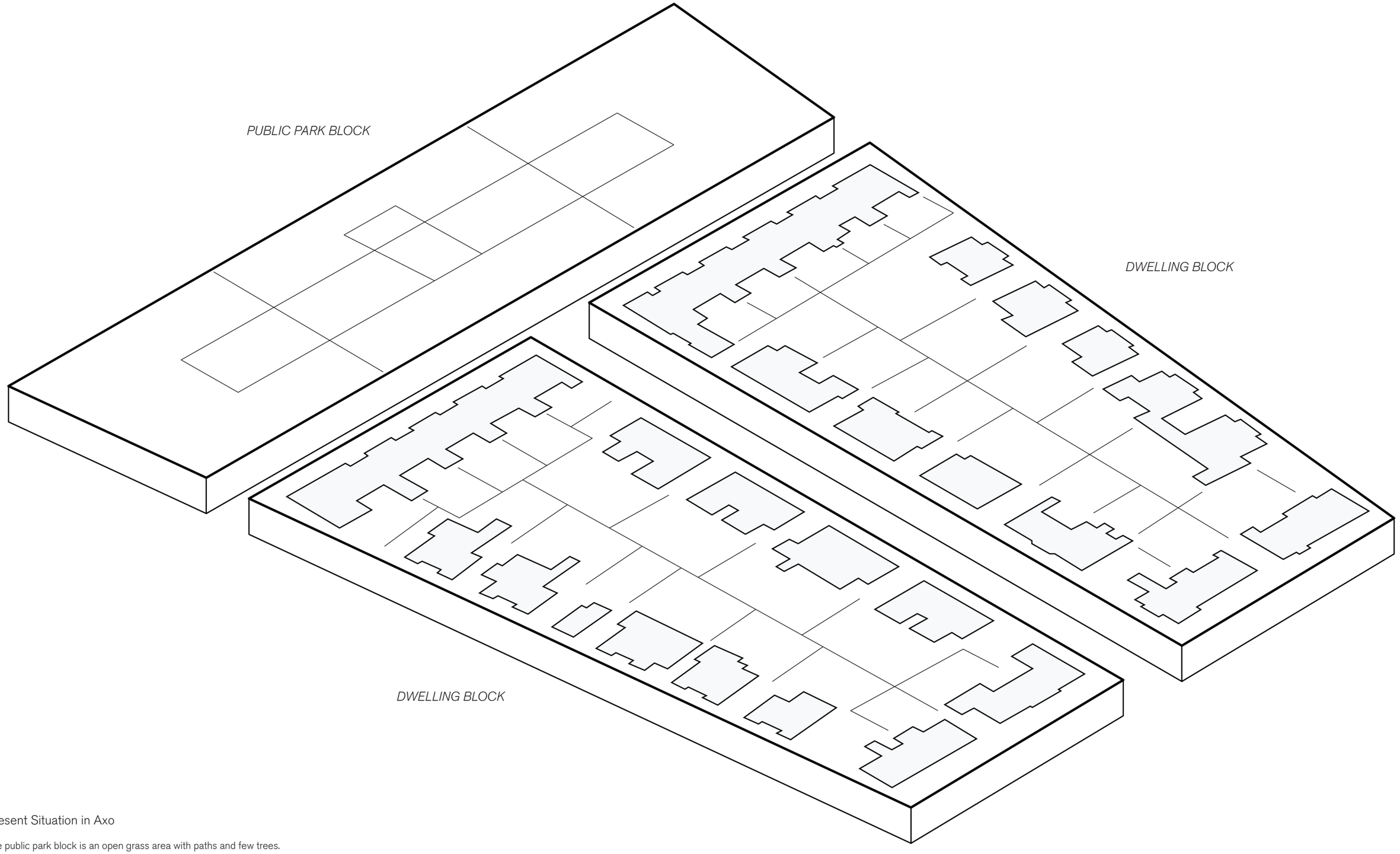
Block Scale

The urban blocks are taken as the backbone for the three scale level design scheme (private, communal, and public levels). The existing infrastructural fabric is used for the filtration channels of the scheme.





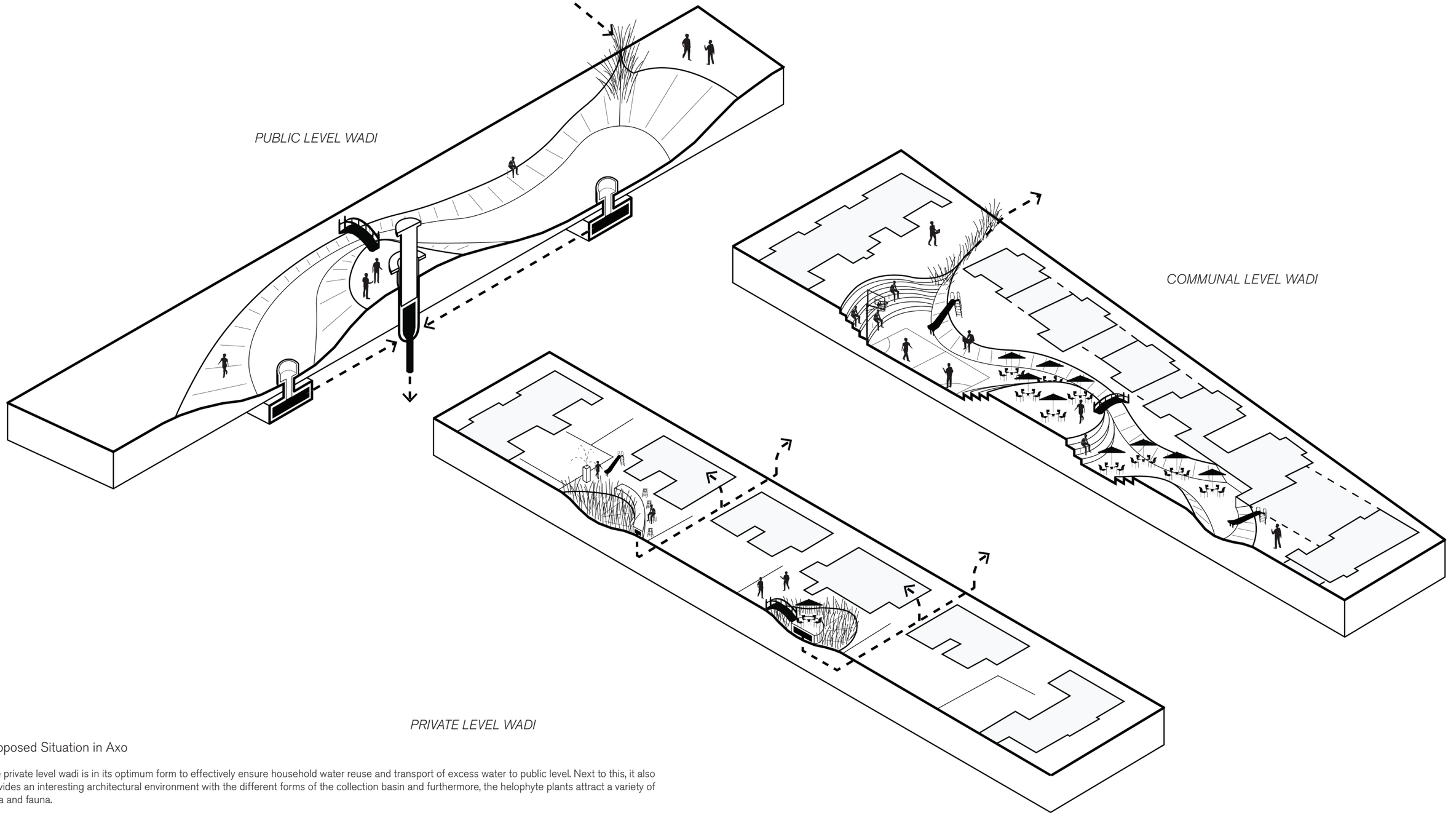




Present Situation in Axo

The public park block is an open grass area with paths and few trees.

The dwelling blocks are made up of rowhousing, duplex-dwellings, and individual homes and they all have backyards on their interiors.



Proposed Situation in Axo

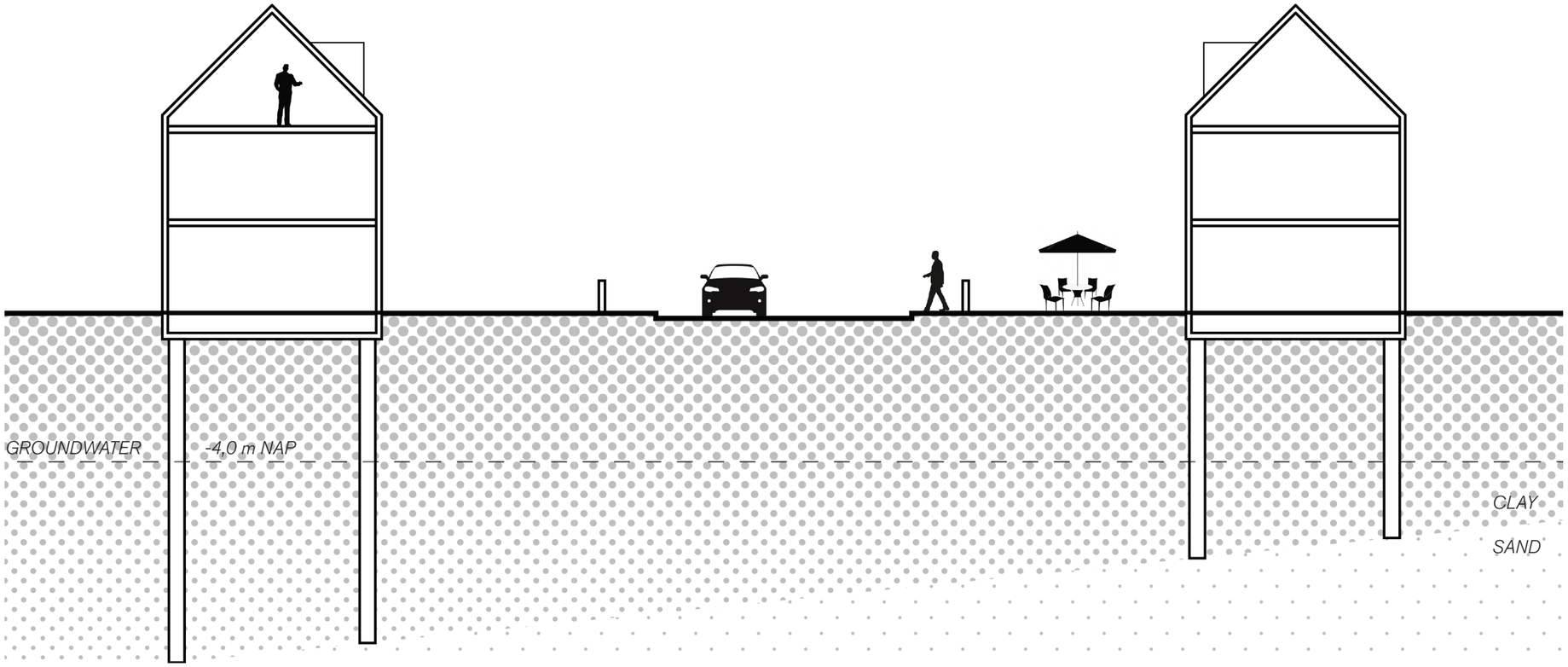
The private level wadi is in its optimum form to effectively ensure household water reuse and transport of excess water to public level. Next to this, it also provides an interesting architectural environment with the different forms of the collection basin and furthermore, the helophyte plants attract a variety of flora and fauna.

The communal level wadi is in its optimum form to effectively ensure surface water distribution and transport of excess water to public level. Next to this, it also provides a resilient communal environment with the ability to realise sport courts, patios, terrasses, and stairs along the edges that people can sit on.

The public level wadi is in its optimum form to effectively ensure aquifer storage & recharge and therefore increase drinking water supply. Next to this, the water artefacts that are needed to drain and pump water to the aquifer stimulate water awareness. By making this aspect play at this most public scale level, a trickle down effect will result that stimulates water awareness at the lower communal and private levels. This perhaps encourages more building blocks in the urban fabric to transform their open spaces into private or communal wadis and the city as a whole can work toward becoming even more future-proof.

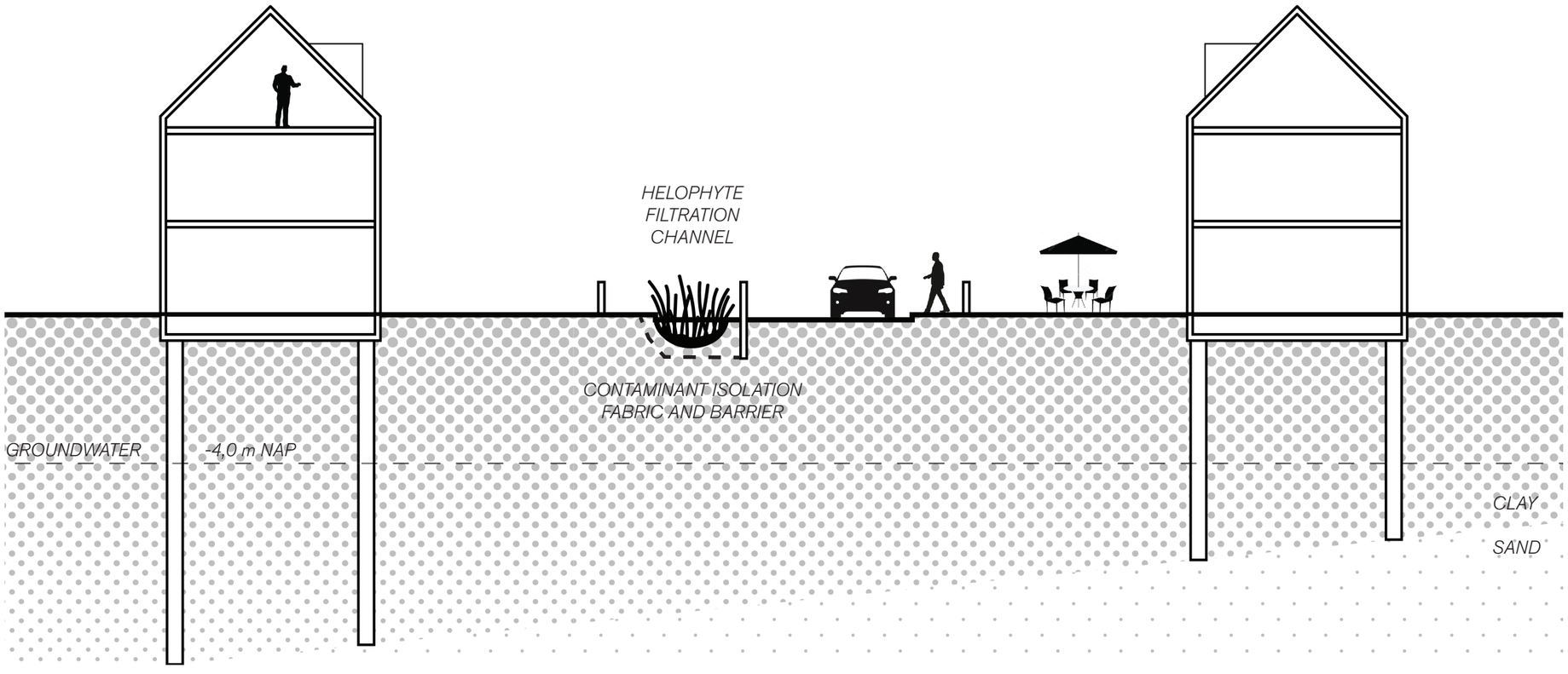
Present Situation - Street-profile

The current street profile between the urban blocks is wide and contains a small front garden on both sides of a central street. The street itself is wide enough to allow on-street parking but each home also has its own garage. Along the street, on both sides, are sidewalks for pedestrians.



Proposed Situation - Street-profile

The filtration channels that are used in the design scheme to transport water from the private and communal levels to the public level, can become part of the current infrastructure fabric. A shallow and narrow gutter with helophyte plant beds ensures that not too much room is taken and also that outside pollutants have little chance in contaminating the water while it flows on its way to the public wadi. Next to this, the helophytes add greenery and various planting to the street-profile, increasing its attractiveness for humans, as well as flora and fauna.



Implemented Design Guidelines

From the vision, several design guidelines were established. In the design experiment, many of the guidelines were realised. All of them come from two design intentions or tactis: regeneration and integration. This is to be expected since the DIY Wadi infrastructure involves both the regeneration and integration of the existing urban fabric. Conservation intentions are not applicable since the DIY Wadi is a quite intense intervention that requires thorough adaptation. Nevertheless, the resource of water is conserved in this urban extraction landscape.





Inclusiveness

Carmen Jansen op de Haar

Manifesto

Creating synergy between different demographics

The aim is to create a place for a diverse group of people who are not afraid of sharing and are willing to save more water. A place with sustainable homes is surrounded by green and the most important aspect: shared facilities that create space for the individual and the community. We must ensure that we create a general feeling of being one with nature. If we can fill moments with learning and observing, people will also become one with water. If the Dutch people become one with water, they will not try to fight against the water anymore.

In the late 50s, Zeist had to build more and more new dwellings in a short amount of time. There became a clear separation between the neighbourhoods of different social income groups. They wanted to build as many houses as possible on as little land available. This clashed with the housing typology that was common to Zeist villas. At the same time- today, the problem of drinking water shortage arose. Because of climate change, more droughts appear and drinking water becomes scarcer. The increase in the population and the number of new houses that need to be supplied with water is a growing problem. Humans need to participate in the ecosystems instead of extracting resources.

In the case of Zeist, the urbanized area of Vollenhove needs to become a more staggered district connected to the Sanatoriumbos and the green belt. An integrated water system is needed to create a new communal neighbourhood where water and green are the central connection. The residents need to work together as a team and become aware of their water usage by learning spaces in the public area. By implementing more facilities, spaces are used efficiently and also water usage will decrease. People need to believe in the power of sharing, this creates a neighbourhood in which residents are involved with each other and with their environment. In this way, residents will talk to each other more often and will help each other easier. The goal is to pursue the balance between human and nature by establishing more structures that connect them.

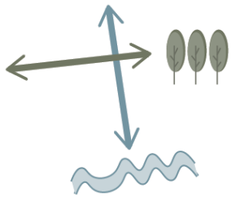
Design experiment - 900 new homes

There are three different transformation areas whereof one is called the densification area. The densification area lays in northwest of Zeist. The analyses have shown that this area has the most potential for densification. A total of 900 new homes will be built in this area. In addition, there are certain problems in this area that need to be solved. The neighbourhood is starting to look more like a deprived neighbourhood and this creates a lot of social problems. The main troubles are poverty, loneliness and language deficiency. Besides these social difficulties, more attention should be paid to water extraction and especially how we can use water more efficiently.

Business areas will turn into residential areas with shared homes. The region around the L-flat will get more luxurious homes to improve the district. Urban geographer Cody Hochstenabck of the Amsterdam University said: 'Not the demolition of cheap houses in exchange for the construction of more expensive houses but the construction of cheap houses in high-quality neighbourhoods'. The L-flat itself will be broken up into several parts to personalize the neighbourhood. To connect the neighbourhood more with the forest around Zeist, the highway will be constructed underground. In this way, residents will visit the green belt more often. The green belt will serve here as a food forest where people can harvest their food together. The green belt also ensures better infiltration of water. On a smaller scale, the many plants, orchards, wadis and new water structures will ensure that the soil can absorb and keep the water. The new interventions have merged from the design guidelines from the conceptual framework. The three most important interventions are adding green & water infrastructure, creating a shared community and stimulating diversity.

Furtermore, existing water structures are used to make new ones (vertical). Orchards are implemented to improve high quality green and to create different public spaces. The shared community is created by the implementation of communal housing and shared facilities. Diversity will be stimulating by creating different public spaces and the enhancement of social connections.

1. Private homes and shared facilities
2. Village-sized development
3. Intentional neighbourhood design
4. Neighbourhood managed by resident



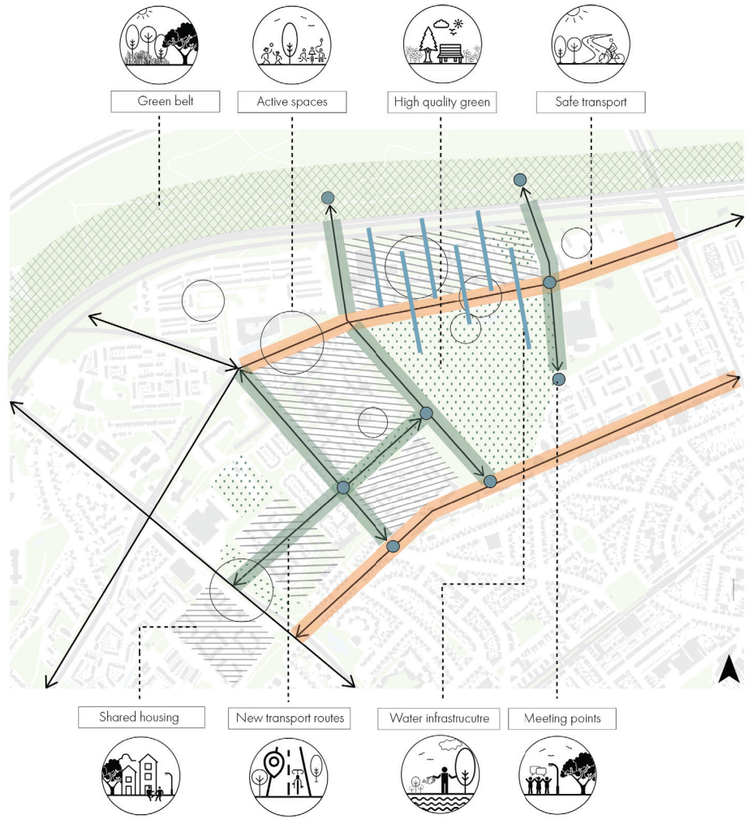
Green & water infrastructure



Shared community



Stimulating diversity





N

0

1000 m

Vollenhave, a vibrant design for all people

Vollenhove will change into Vollehave, a vibrant design for all people where share and care is the main theme. The Dreef is diverted next to the highway to create better and safer bike lanes. The existing water structure has been used to create a new water structure. In this way there is an extra place to store water and residents will become more aware of the importance of water. To enhance the social connection between inhabitants there are new facilities placed in this area. For example, the small farm, the flower garden, the tea house, the playground and there is a market. On this market, people can sell the food they produced by themselves in the green belt.

The green belt is the place behind the highway and it is a food forest where people can grow their food. A food forest is a form of agroforestry characterized by low-maintenance, sustainable, plant-based food production based on forest ecosystems, integrating fruit and nut trees, shrubs, perennials and climbers.

The green belt around the city can be used to store water and as a reacreation and nature park. Different gradients and biotopes for humans and animals are used. In the Vollenhove district, climate trees have been chosen that can withstand both drought and dehydration, and this vegetation is climate-resistant. The advantage of drinking water extraction in the city, compared to nature reserves or agricultural areas, is that it can adapt to the environment, within the constraints of the natural system.



Legend: Site plan (zoomed out)

- Road for cars
- Bike path
- Parking
- Pedestrian path
- Water structures
- Sport field
- Food forest
- Water museum
- Market
- Little farm
- Flowergarden
- Playground
- Tea house

N

0 — 100 m



Legend: Site plan (zoomed in)

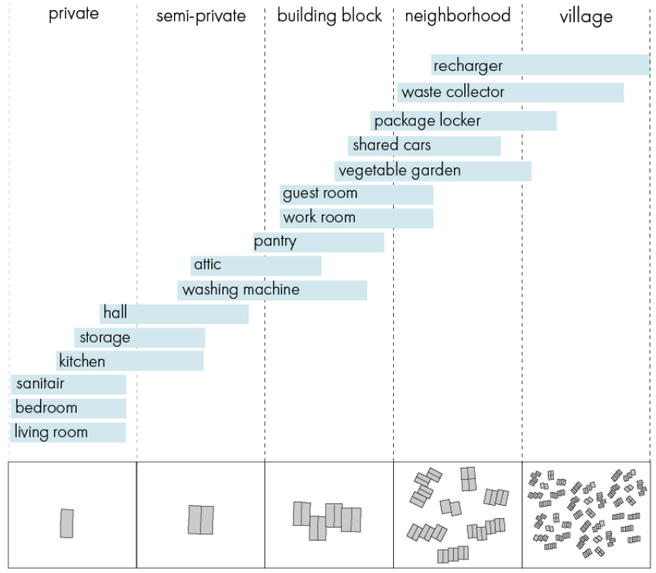
- Relocated existing buildings
- New dwellings
- Guesthouse, package locker, waste collector
- Workspace & shed
- Wadi
- Bike parking
- Playground
- Orchard (fruit trees)
- Flowergarden

N

0 — 20 m

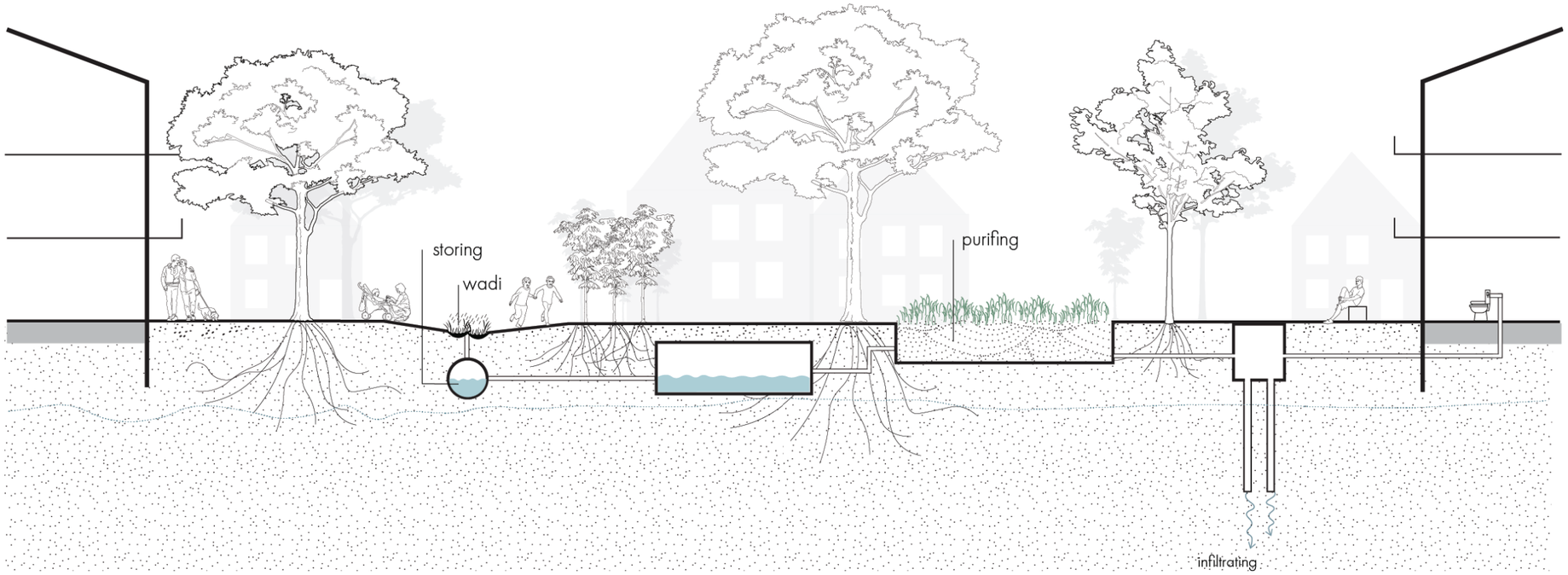
Share & Care

The map on the left shows the site plan on a smaller scale. The gray flats have been taken apart to create more space in between, for more luxurious living. This more luxurious living is made possible by the concept ‘shared community’. A shared community is more sustainable, creates more connections between inhabitants and encourages the most efficient use of spaces. There is still a distinction to be made between private and public spaces. There will be a difference between homes that have more common areas than others. Some people find it less pleasant to share the hall and kitchen, while other people do not find this a problem. The sanitairy, bedroom and living room will be private for everyone. The waste collector package lockers and shared cars will be for the neighborhood. The pantry, guestroom and workroom will be shared within the building blocks.



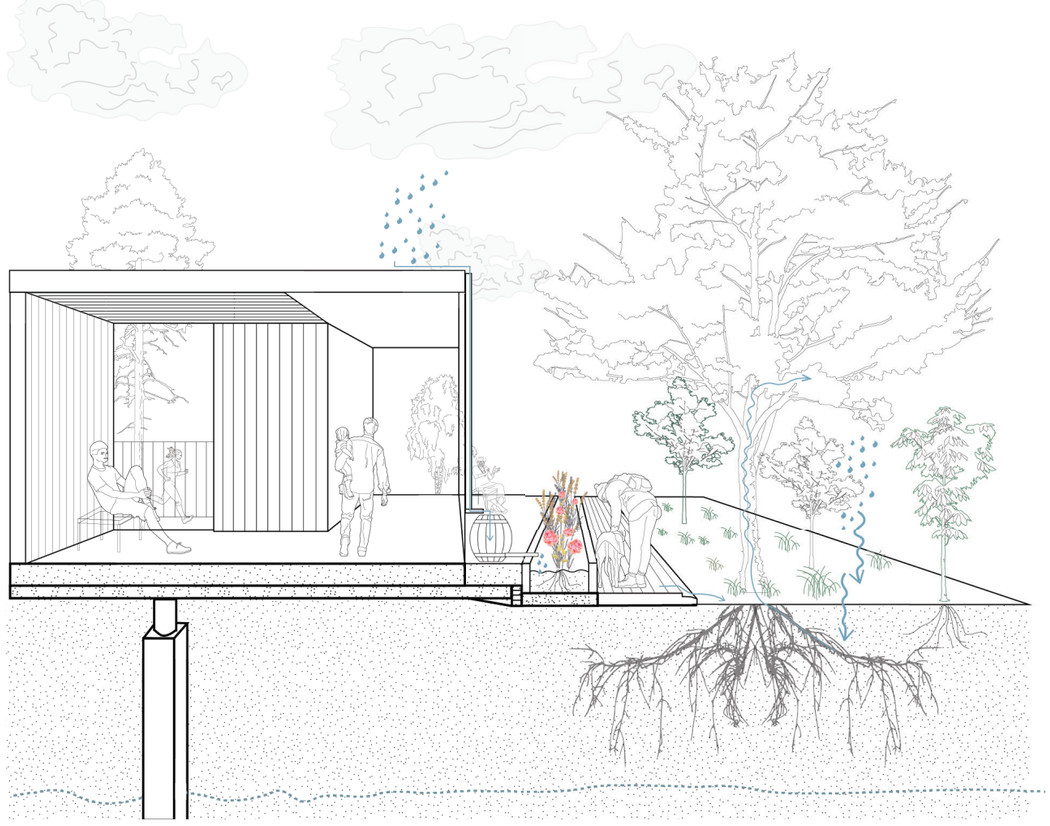
Section 1 - wadi's

Here you will see how the water from the wadi's can be stored in the ground. The water will be purified by specific plants and the water which comes out can be used for flushing the toilet. The remaining water will infiltrate into the soil and run towards the green belt.



Section 2 - orchards

Here you see the orchards and the unpaved ground to stimulate the infiltration of rainwater. Also rainwater form the roof is collet in a rain barrel to water the planters.



Section 3 - impression

As you can see on this image a new environment is created where all kinds of people will have a place to interact with each other. You see the high quality green instead of the separation green and the enhancement of social connections with physical spaces. The shared homes and difference between building blocks.



Inclusivenss

So to conclude we can say that with all these implementations we will create inclusiveness, where people form all different social groups come together, green and blue connections will be stimulated and public spaces will have different functions. A creative place for a diverse group of people who are not afraid of sharing and are willing to save more water at the same time. Vollenhave, a virbrant design for all people.



Enhancement of social connections



More green blue connections



Public space with multiple functions

Space and Place

Esmee Kuit

Manifesto

Spaces can be explained as locations that have no social connections for a human being. It is an open space that does not invite or encourage creativity to fill the space. On the other hand, a place is more than just a location and can be described as a location that is created by human experiences. A place exists of a space that is filled with meaning and aspirations by experiences of humans. - Tuan, Y. (1977)

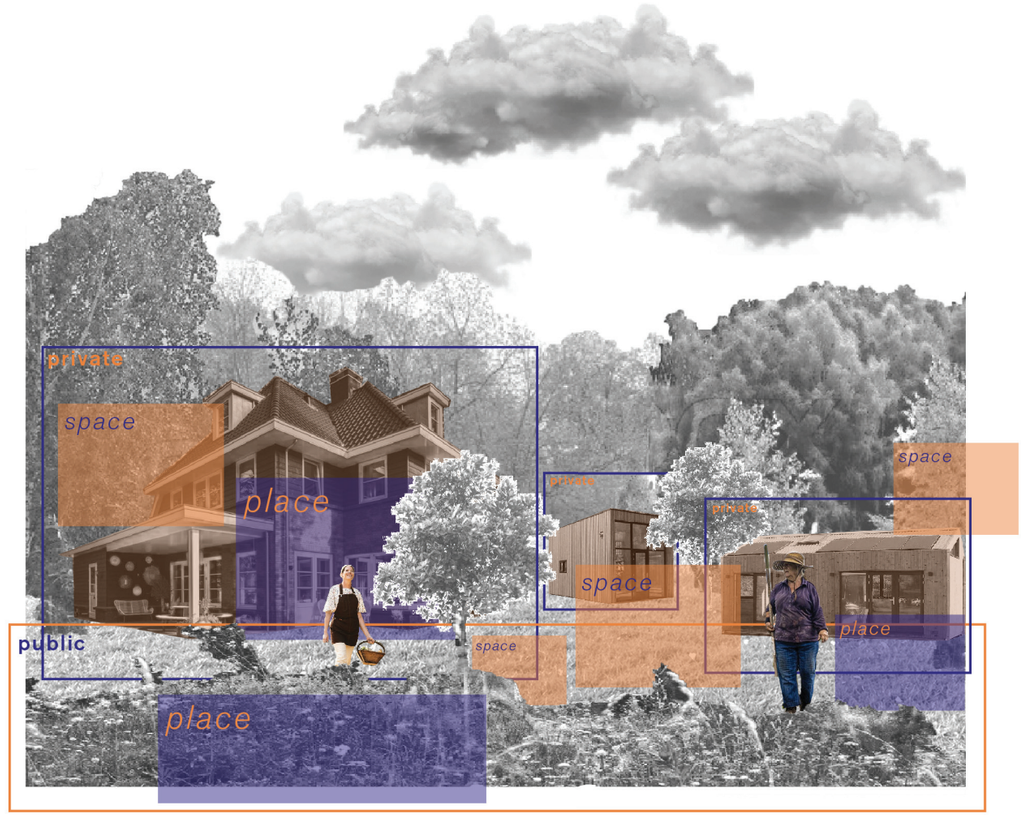
What is a space for some people, might be a place for others. It is therefore necessary to look critically into the functions that you harbour in vacant spots. In addition, when people have a lot of private place, they will not try to make those vacant spaces their own, through activities or change. This is what has happened and Is still happening in the Lyceumkwartier. However, this system is an old one, it dates from the 1800s.

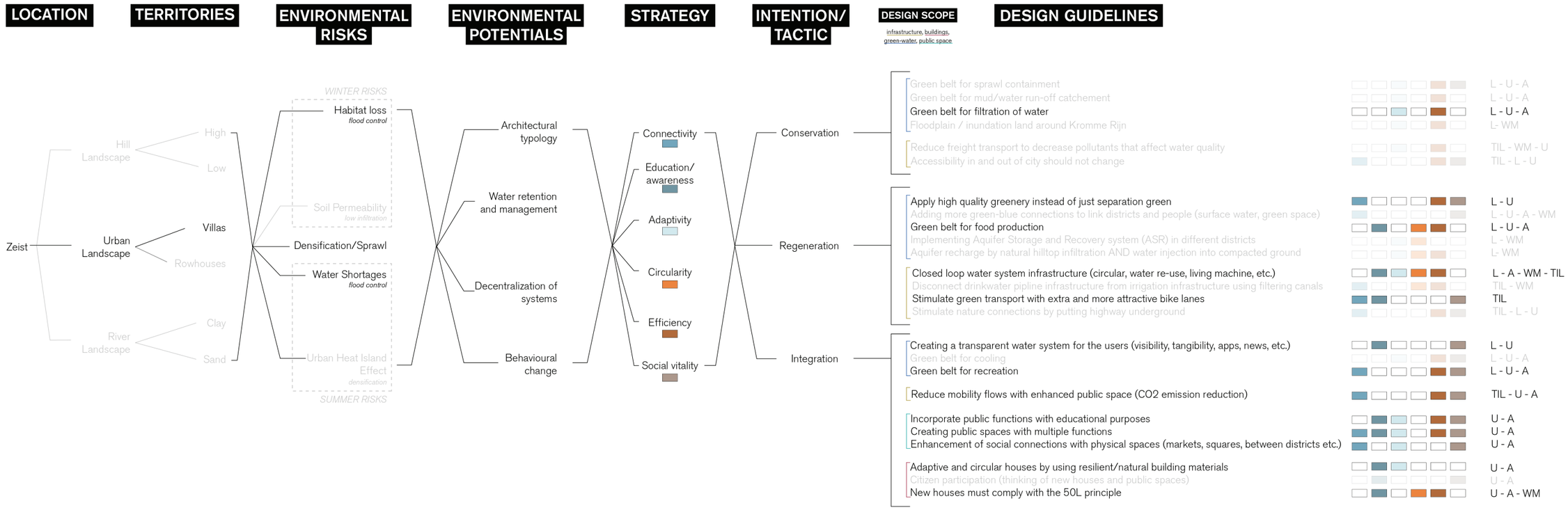
But communities change; values and aspirations change, and individuals change, so the sense of place changes as well - Jivén, G. and Larkham, P. J. (2003)

This is a story about the change of the historic villa neighbourhoods of Zeist. The historic lanes date from the late 1800s and area a core part of the identity of the city of Zeist. However wide and spacious they are, their public and social value is not so high. There are no communal outside spaces that are in use. So why can't these spaces and places be changed?

Spaces in the lanes can be identified the greenspaces in front of the gardens. In combination with the large gardens that the inhabitants currently have, the lanes do not invite inhabitants to fill the space with new purposes. These spaces are widespread and all entail the same main funtion: traffic. Their main typology can change to house a more communal function and add biodiversity.

Places are green spaces with a function, which is currently limited to the houses and gardens of the inhabitants. Because these places are so large, there is no need for the spaces. By putting a limit to the vastness of the private places, the public spaces can turn into places as well.In addition, there are functions that can be placed elsewhere to re-value that place for a few individuals into a place for the whole neighbourhood. The plan will include more attractive public spaces in which children can play and people can meet. This can be in the form of playgrounds, food forests or (vegetable) gardens. These places will be communal. All this asks for a change in perspective of the current residents.





Framework

This project is within the limits of the communal vision. But because it is a little more zoomed in, not all guidelines that were set up apply to this location.

This project is solely about the villas in Zeist and tackles the risks of habitat loss, densification, and water shortages through all the environmental potentials. In the plan, new typologies are created and water management is altered by the decentralisation of systems. All this asks of a behavioural change in the inhabitants.

The guidelines that are used as a framework for this plan are mostly to do with the creation of better public place, changing the houses to a decentralised system, stimulating the use of bikes and foot, and creating awareness for users.

The use of the various guidelines translates into the following key principles for the new design of the Lyceumkwartier in Zeist.



smaller gardens



space becomes place through activity



new, smaller housing



more bicycle traffic



autarkic houses

Tile interventions

These key points translate in several special interventions. The nine interventions that are portrayed here are all marked with public/ privateness and whether they are space or place, or both.

The villas are a place, as the people that live there have an emotional connection to it. In addition, the place is private.

The playground is a place for some, and a space for others. This depends on whether you use it or not.

The same is true for the paddock. However, this is not solely a public space. This place is private but can be enjoyed by others, if permission has been granted.

The tiny houses are of course a place, that is private. However, the surrounding green is not completely private as people are allowed to walk there.

The vegetable gardens are space for some, a place for others. The area is public, but you cannot just start to help out.

The forest is public. Not everyone will feel attached to it to the same degree so it is a place and a space.

The three traffic situations are most likely to be a space for everyone. These are public areas.

- Places
- Spaces



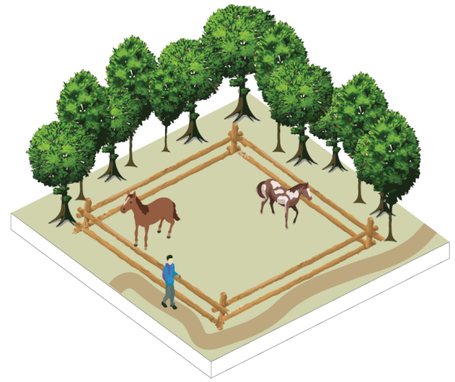
villas and gardens

public — private



playground

public — private



horse paddock

public — private



tiny houses

public — private



vegetable gardens

public — private



forest

public — private



basic traffic situation

public — private



crossing

public — private



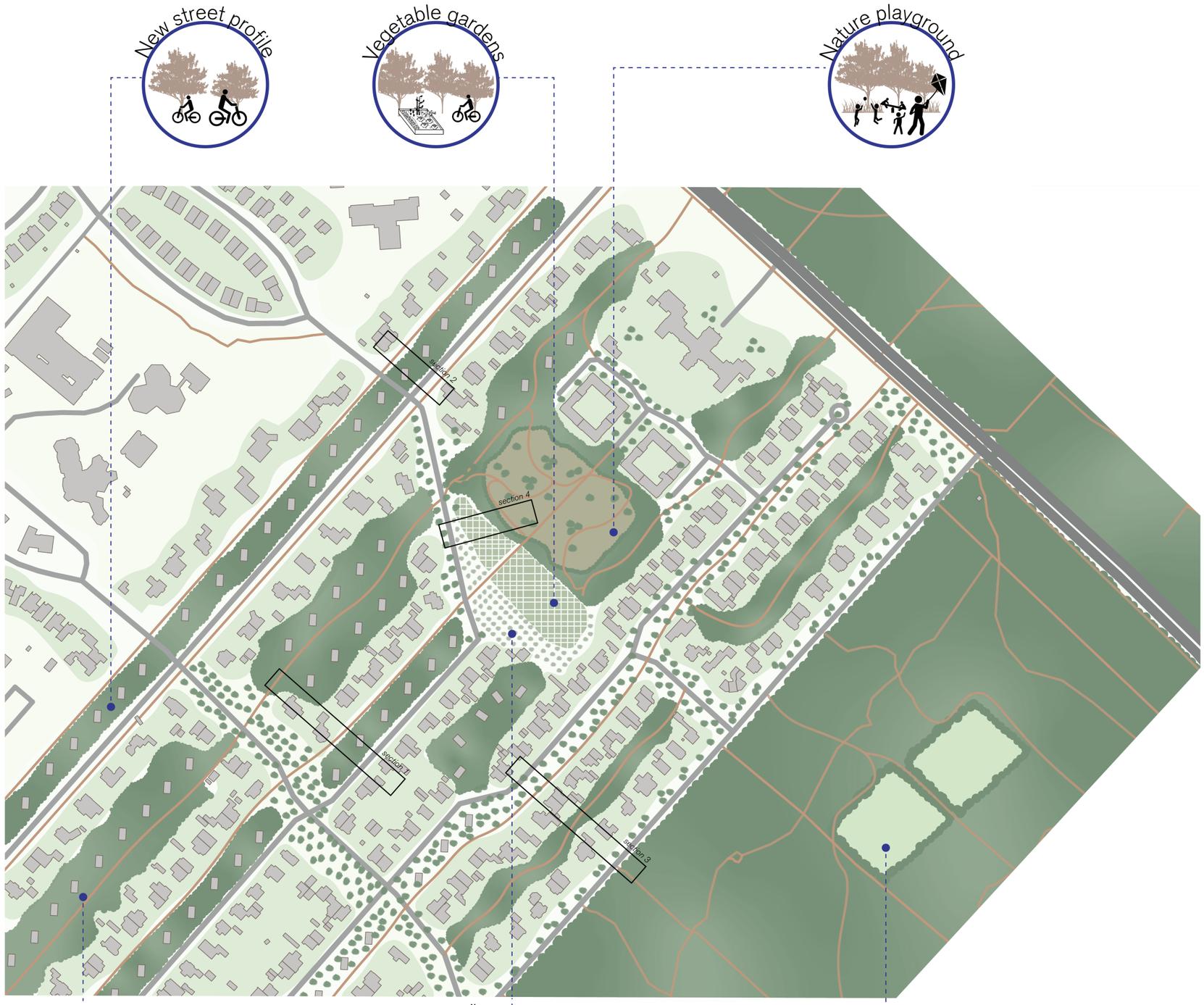
dead end

public — private

New situation of Lyceumkwartier

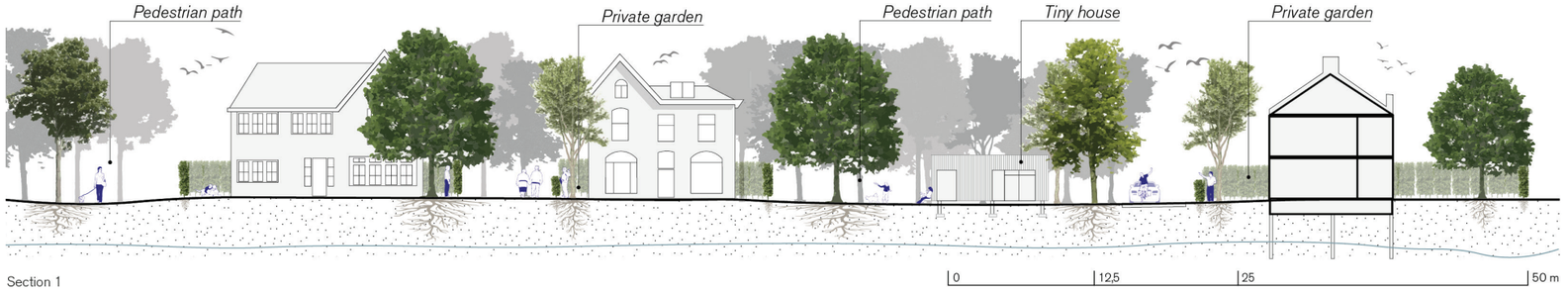
On the map, these spatial interventions look the following. What is evident from the map is the increase in buildings. As the gardens of the villas on the lanes become smaller, more space becomes vacant. However, vacant spaces will not be used, as people are not attached to that. The spaces are so large that room is available to add a new typology of houses in this area.

Furthermore, the map shows the location of the playground, which is on the location of the old paddock. However, this place is so central that it would suit this function better. The field for the horses has now been moved to the forest, so people can just directly ride into the forest. In addition, this eliminates that function from the neighbourhood, as this was a space for most people, not a place.



Section 1

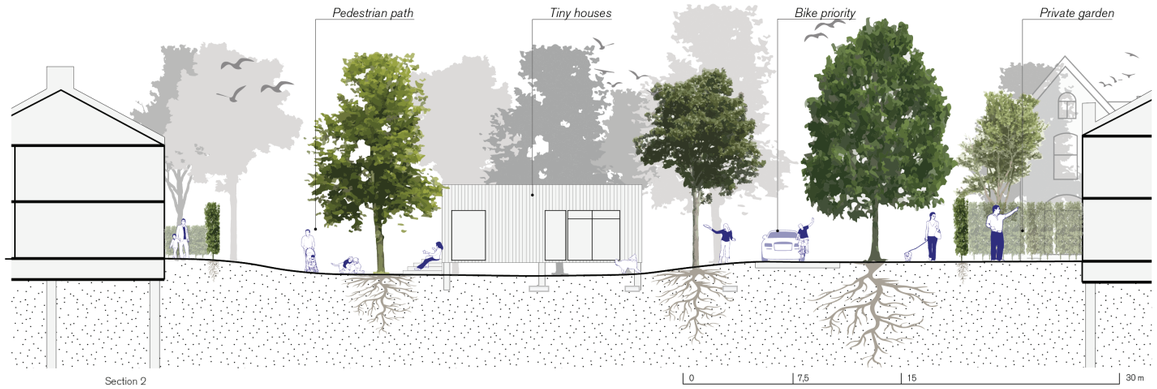
On the first section, the relationship between the new and old typologies becomes clear. The tiny houses that are added will be in a green area, but the houses will not have a large private green area. In this way, the greenery can kind of start to take its own shape, increasing the local biodiversity. This is in contrast with the villas, with mowed lawns and where bushes are grown high.



Section 1

Section 2

What can be seen on this section, is that the tiny houses are elevated a little. In this way, nature can run its course under and around these houses. In addition, they are built on steel so they can better withstand altercations to the landscape.

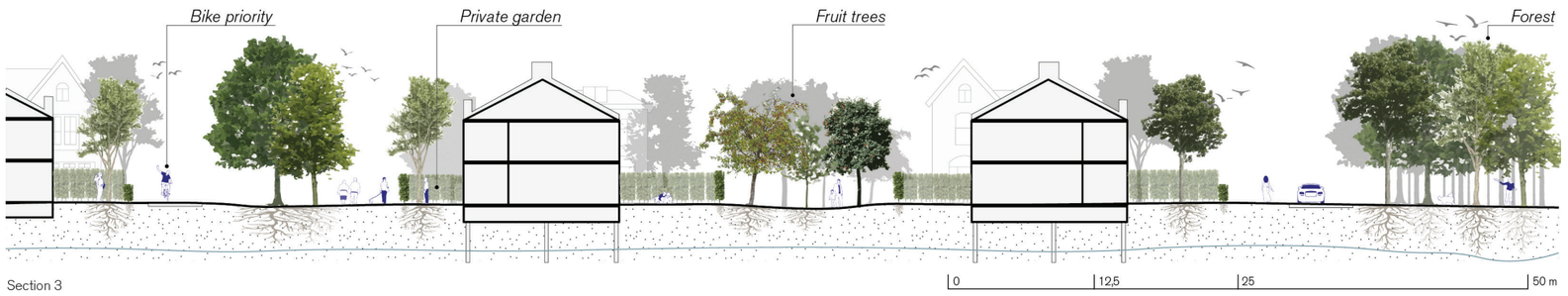


Section 2

Section 3

The relationship with the forest can be seen on this section. It still just starts, without any transition zone. This is because there is a certain charm in living next to the dense forest.

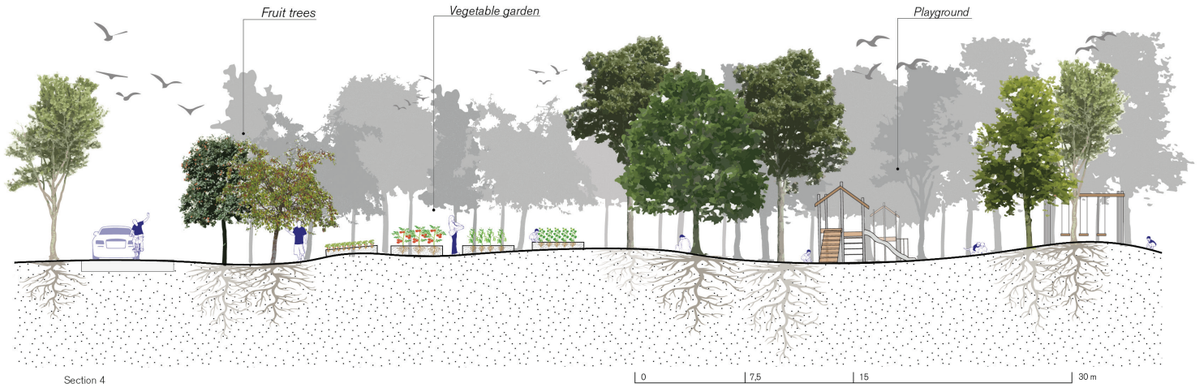
In this section there is also a fruit forest between the private gardens of the villas. This will attract people, while also providing more biodiversity.



Section 3

Section 4

The open inviting atmosphere of the vegetable garden and the playground can be seen on the fourth and last section. The landscape is flowing here, and it will be allowed to do so as well. In the playground there will thus be places that are more low and wet or high and dry, providing varied places for children to play in.

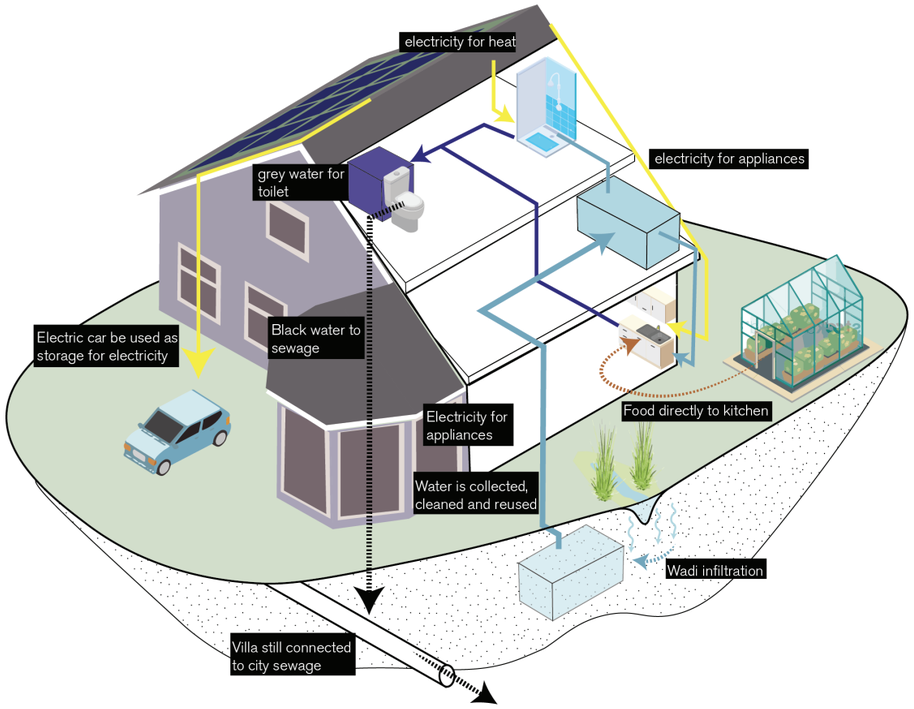


Section 4

Diagram of autarkic houses

On the scale of the dwelling, changes will be made as well. there is the alteration of the villa to be made almost autarkic. The villas will be provided with a wadi, from which the water can be filtered and reused in the homes. Grey water is then also reused, to flush the toilet. The houses are still attached to the current sewage system, so blackwater is still runoff and cleaned. Energy is generated from the solar panels and can be used for appliances. Whenever there is too much it can be stored in electric cars.

The tiny houses will be fully self-sufficient. They will collect rainwater to use in the house, reuse greywater and then compost toilet waste. This can then be used in the gardens to provide food.





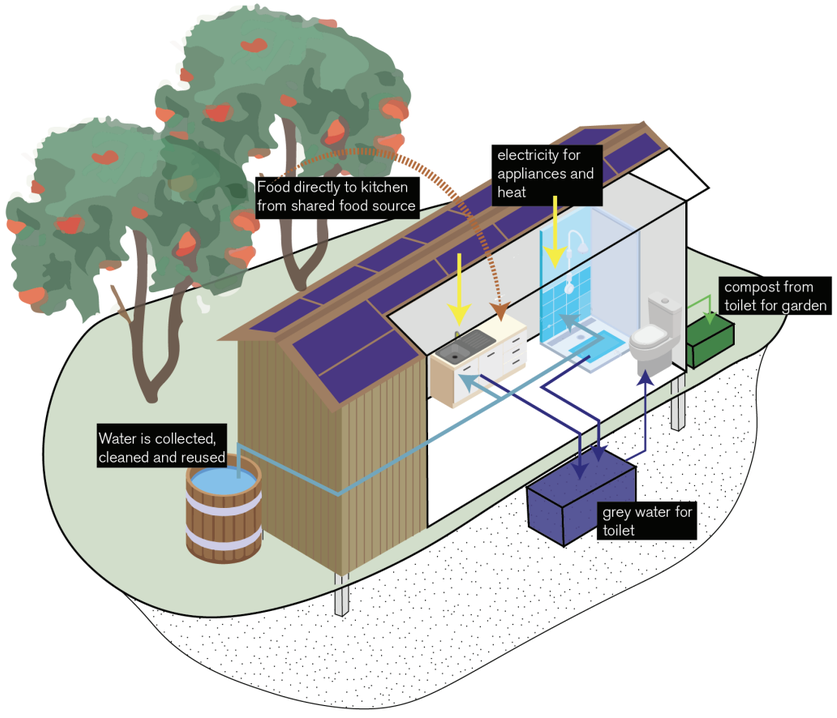
Collages of houses (right)

Furthermore, the change was made for the houses to have a smaller garden. This does not mean that activities are no longer possible, as can be seen from the top collage. It just means that the welfare that is absorbed by private owned property is limited to a certain extent.

The tiny houses will have a more forest-like atmosphere. There will be trees surrounding the house, as well as a more natural flow of the landscape.

There is a large difference between the green at the villas and the green with at the tiny houses. This is because the green at the villas is still the people's choice. These gardens that are filled with cleanly mowed grass are not so good for the biodiversity. In that sense it is also positive that the room that private gardens take up is limited.

- Rain water
- Clean water
- Grey water
- Black water
- Electricity
- Food
- Compost





8.
Cross case analysis

	Flows 1	Flows 2	Systems
Typology of landscape	Hill River Urban	Forest River Agriculture	Flat Tropical rainforest
Level of interaction with nature?	Medium level of interaction with nature. The level of interaction with nature is very low in urban areas but significantly higher in rural areas.	There is a medium level of interaction, the proximity of the river (and a harbour) make recreation in the river's sphere the most interaction inhabitants get. Some inhabitants may interact with fauna that lives in the fields, however if this can be really called nature.	High positive level of interaction with nature by the locals and indigenous, lower, negative interaction in larger urban settings and on farmlands.
Typology of extraction	Timber, stone, sand, gravel	agriculture, electricity	Commodities agriculture and mining
Level of interaction with extraction	Low level of interaction with the extraction of stone, sand and gravel as this is completely isolated from humans, only people working in the industry have interaction with this extraction. Timber extraction however, is more small and local.	Agriculture plays a big role spatially, but a lot of people work elsewhere. There is no interaction with the hydropower plants at all.	In urban settings ports, warehouses and silos organize and distribute the production. In the hinterland interaction via conflicts between farmers, large mining companies, locals and indigenous.
Vernacular or traditional interaction with landscape and extraction	Modern interaction with the landscape as new technology shapes the forms of extraction.	Agriculture nowadays is a modern variant of vernacular extraction.	In urban settings ports, warehouses and silos organize and distribute the production. In the hinterland interaction via conflicts between farmers, large mining companies, locals and indigenous.
Modernist approach?	Highly modernised.	Big fields, extraction by tractors. Big dams extracting (hydro)power.	The highly modern Soy-plantations and the high intensive cattle farms
How do the different topics of analysis interact among each other?	The sites of extractions were created on locations where the landscape could aid the transportation. This same landscape also structured the urban areas which also follow the river.	\ The past of extraction is the basis for the way the town is formed. It does not have this same function anymore.	There is a strong conflict between urban dwellers, indigenous people, farmers and large mining and grains companies. The ultimate battle field is the forest.

	Drink 1	Drink 2	Hot
Typology of landscape	Kromme Rijn landscape (river) Utrechtse Heuvelrug landscape (hill) Urban landscape	Junction of three landscapes Hill River Urban	River Clay polder Peat polder
Level of interaction with nature?	Not a lot of interaction with nature due to modern urbanization but the forests around the city are used for recreational purposes so that's the most interaction they have.	In the past, high interaction with nature due to connection with the land. Today, less interaction due to increased densification.	Low level of interaction with nature. River is seen as transport machine.
Typology of extraction	Drink water extraction	Drinking water extraction	Geothermal heat extraction
Level of interaction with extraction	Not a lot of interaction with the extraction: it's a centralized system that's controlled by a company so as a inhabitant you don't really interact with it. Except for the fact that there are rules for the extraction areas to prevent pollution of the water.	Centralized system means everyone exploits from one source: high level interaction	Today no interactions with extraction. Extraction is a future plan. When realized. Medium level of interaction with extraction can be achieved. The morphology of the geothermal heath needs to be brought to the surface.
Vernacular or traditional interaction with landscape and extraction	No vernacular of traditional interaction because it's a modern system that's based on technologies and not on the landscape	Centralized system means everyone exploits from one source: high level interaction	Today no interactions with extraction. Extraction is a future plan. When realized. Medium level of interaction with extraction can be achieved. The morphology of the geothermal heath needs to be brought to the surface.
Modernist approach?	The way of extraction is modern	Yes, extraction from subsurface aquifer	Yes, the extract heat from the subsurface, a modernist approach is needed
How do the different topics of analysis interact among each other?	The landscape and ecology influences where people decided to built homes (urban morphology) and the way they interacted with water (anthropology)	People living on the sandy hillside (landscape & ecology) means densification (urban morphology) is increasing and water use as well (anthropology)	The landscape of the harbor and the city interact with each other. Over time the harbor is moving away from the city and the city is growing around the harbor.

	Flows 1	Flows 2	Systems
Which criteria have been chosen for elaborating the Vision map?	The vision map is structured around the potentials of each of the three themes. The vision map aims to illustrate the future green connections, the relation between extraction landscapes and urban areas, and reducing environmental (flood) risks.	Surrounding four functions: recreation, transportation, urbanisation and extraction. These themes were tested with: room for the river, water quality and biodiversity. Increased interaction between humans and nature. Social aspect of interventions. Looking for more "nature-friendly" methods of extraction.	National: alternative ways of navigation Regional Resolve the conflict of territory, redefine and connect the indigenous reserves Local regenerative agriculture (sustainable land-use), green blue networks
Concept of Participation?	Creating a deeper connection between the extraction sites and the mouth of the river and its surrounding urban fabric.	A greater appreciation and understanding of the surrounding landscape.	Creating awareness of the surrounding environment by including it within the urban settlements.

	Drink 1	Drink 2	Hot
Which criteria have been chosen for elaborating the Vision map?	Decreasing car usage, adding densification in low livability areas, decreasing boundaries and using the landscape as a basis	Solutions to problems in infiltration performance (landscape & ecology), transparent water systems for human interaction (anthropology), different neighbourhoods (urban morphology). This all comes together in a vision that includes a green belt, new housing typologies, and wadis.	Densification in the waalhaven, nature friendly banks along the river,giving space back to the river (through tidal parks), new connections by metro, new river connection, geothermal heat.
Concept of Participation?	Creating a new and more loving relationship with nature and thus creating awareness with tangible connections	Making people aware of the water system and their water use, through housing typologies, wadis, and the green belt.	Cooperation and acknowledgement of the river as an entity, through new housing typologies, tidal parks, and interaction with the river

9.
Conclusions

	Flows 1	Flows 2	Systems
What does eco system participation for the particular case mean	For the region and city of Drammen, ecosystem participation means that people can benefit from nature and meanwhile nature is strengthened. Local and circular flows will strengthen the economy of the area while also decreasing the damage on nature itself.	For Arnes, it means that people could be reliant on their surroundings again - shortening production flows and therefore creating awareness.	In the Amazonian case, it means taking note of indigenous, vernacular ways of living with the natural environment, instead of seeing the vast amount of land as an infinite source of economic prosperity.
How does it relate to extraction	An increase in circularity means that less extraction will be needed, which in turn will decrease the damage on nature and the ecosystem.	Having more "nature-Friendly" methods of extraction. I.e. silviculture for wood extraction. And/or mitigating negative externalities as much as possible. I.e. retrofitting dams to allow fish passage and boat passage (thereby relating to the extraction of power from these dams)	Reduce the amount of land used for extraction.
Is there a way to make the negative effects of extraction be beneficial?	The way is to decrease the demand for extracted resources. This can be done by re-using more materials and increasing circular flows.	Agriculture is mostly monofunctional, for a better ecology it could be switched to polycultures. The spatial influence of the agriculture is not necessarily bad.	The present types of extraction and the way in which the activities are organized make it very difficult for the profits to be shared amongst those who suffer from the burdens of deforestation, pollution and water scarcity due to extraction. Should the economy of the region transition towards a more nature-based green economy, local communities and the safeguard of indigenous peoples and land could be taken into consideration.
How can the project be considered phase able?	To reach circularity in the area of Drammen is a big challenge which cannot be done overnight. This can be done step by step by creating a phasing that increases circularity little by little. First small circular initiatives need to start in the port area. These can then be expanded to transform this entire port area.	The interventions to be taken are all focused on a different scale. There are some town level interventions, but also ecological measures that will take longer. Such as the growing of silviculture forest and connecting habitats. Some small regulatory actions can be taken immediately.	The first phase would be to lay out the basis of the regional vision that would mean restoring the natural landscape. Connecting the indigenous reserves, preparing the river for navigation and preparing the landscape for an alternative way of more sustainable land-use. The second would focus more on the urban context, introducing local solutions that would add up to the groundwork that was developed in phase 1. This would mean transforming the harbour, softening the edges

	Drink 1	Drink 2	Hot
What does eco system participation for the particular case mean	In the case of Zeist ecosystem participation means that the water management is again based on the landscapes and their characteristics and that people will have a more loving relationship with nature because their surroundings stimulate this.	The ecosystem participation (water awareness) means that Zeist is adaptive to future climate change (increased winter rainfall, increased summer droughts)	In the Waalhaven case the ecosystem participation means that Rotterdam is more climate adaptive and more aware of their river.
How does it relate to extraction	Because the rainwater management changes it will be connected to the extraction and this one will become more flexible because there is more of a buffer created during periods of heavy rainfall which then can be used in dry periods. Because peoples relation with nature will change they will also use less water during dry periods so the peak will be less high then as well.	Less water extraction because of decentralisation (more reuse of water, more water supply)	This relates to extraction because of the same goal that the extraction and ecosystem participation tries to achieve. Both solutions try to make the city more climate adaptive and green.
Is there a way to make the negative effects of extraction be beneficial?	No the negative effects of the extraction cannot be made beneficial because your taking water from the earth that it can better use it itself, but what you can do is making the negative effects smaller or even neutral.	The present day water extraction from the aquifer makes the sand-layer unstable, the aquifer should be more effectively recharged meaning more surface level green space for water infiltration is needed which is beneficial to humans, flora, and fauna.	The negative effects of the extraction can not be beneficial, we are taking hot water out and putting cold water back. Eventually this source will be depleted. But this will take a long time but this solutions gives us time to come up innovative renewable energy sources.
How can the project be considered phase able?	The project can be considered phaseable because the new densification areas, the renovated houses and streets cannot be done at once so some priority place should be chosen to start with and then the rest can follow.	It can be considered phasable because the green belt needs time to grow. Then, people need to adapt to new systems and ways of transport in the first place. As soon as new behaviour is acquired then inner city transformations can take place (new housing typologies, wadis)	This project can be considered phaseable, it takes time to develop the new neighbourhood, the new infrastructure, like the bridge and the metro line and the nature based underlay needs to develop as well. All these interventions can't be realised all at once. So a phasing these intervention is desired

	Flows 1	Flows 2	Systems
			and connecting the urban streams. The 3rd phase would focus on developing the social system that would maintain these interventions.
Are the inhabitant's part of the development of the project or only beneficial?	The inhabitants are mostly beneficial as the largest and most important intervention happens at the port. However, people working here will be part of the development.	A lot of addition we've made have come with the idea of more inhabitant interaction (as in jobs), being closer to home. I.e. silviculture nearby would have more people working on the nearby land, extracting resources in a way where more local people understand the local environemnt.	The level of engagement of the local inhabitants varies from design experiment to design experiment, as well as from local to regional. In larger interventions locals benefit largely from the proposals, as they are put forward by larger institutions, and require heavier engineering and infrastructure works. In smaller interventions, locals are part of the development of the project, as co-creators of the interventions and actors in the maintenance and governance.

	Drink 1	Drink 2	Hot
Are the inhabitant's part of the development of the project or only beneficial?	The inhabitants play an important role in the development in the project because the more they are in involved the bigger the chance is that is will be a success because they are the ones that need to gain the new relationship with nature in the end	People are of importance in the plan as they have to interact with nature in their own way, so they will have to voice their design wants and needs. This asks for an adaptable stance and cooperation with the community. People will help with the development of the green belt, by designing their own wadi's at different scale levels, farming communities, changing their gardens, etc.	The inhabitants are at some interventions part of the development and with some they are only beneficial. With the new metro and bridge and the newly developed housing the inhabitants are only beneficial. With nature based underlay the inhabitant should be more part of the development because people need to interact with nature more.

10.
Refrences

Animal Diversity Web. (2021). Retrieved July 1, 2021, from https://animaldiversity.org/
Artibise, Y. (2010, 22 December). Adaptive Urbanism: A Process of Perpetual Engagement - Yurban-ism. Yuri Artibise. http://yuriartibise.com/adaptive-urban-ism/#:%7E:text=Adaptive%20urbanism%20takes%20a%20contrary,or%20above%2C%20but%20from%20within.

Asher, S., Garg, T., & Novosad, P. (2020). The Ecological Impact of Transportation Infrastructure. The Economic Journal, 130(629), 1173–1199. https://doi.org/10.1093/ej/ueaa013

Axis, Y. (2020, 4 juni). Master of Science in Integrated Design and Management in USA. Y-Axis Foundation Blog. https://www.yaxisfoundation.org/blog/master-of-science-in-integrated-design-and-management-in-usa/#:%7E:text=Integrated%20design%20is%20a%20comprehensive,system%20that%20will%20produce%20it.
Barrett, C. B., Garg, T., & McBride, L. (2016). Well-Being Dynamics and Poverty Traps. Annual Review of Resource Economics, 8(1), 303–327. https://doi.org/10.1146/annurev-resource-100815-095235

Batey, T. (2015). The installation of underground pipelines: effects on soil properties. Soil Use and Management, 31(1), 60–66. https://doi.org/10.1111/sum.12163

Bialasiewicz, L. (2006). Geographies of production and the contexts of politics: dis-location and new ecologies of fear in the Veneto città diffusa. Environment and Planning D: Society and Space, 24(1), 41-67.

Blijdenstijn, R. K. (2015). Tastbare tijd 2.0: cultuurhistorische atlas van de provincie Utrecht. Provincie Utrecht.
BNNVARA. (2020, 4 februari). Hoe verbeteren we de situatie in arme wijken? https://www.bnnvara.nl/artikelen/hoe-verbeteren-we-de-situatie-in-arme-wijken

Brederveld, L., Sloots, K. (1997). Waterwinning en -distributie. Zeist, Stichting Project Bureau Industri-eel Erfgoed

Brody, S. D. (2003). Measuring the effects of stakeholder participation on the quality of local plans based on the principles of collaborative ecosystem management. Journal of planning education and research, 22(4), 407-419

Buizer, J. D., Bureau Waardenburg, & van Helsdingen, A. A. (2021, februari). Samen voor meer bio-diversiteit in Zeist! Gemeente Zeist. https://www.zeist.nl/fileadmin/bestanden/Open_gemeenten_nieuwe_bestandenboom/Afval__groen_en_water/Bomen/20-0210_Samen_voor_meer_biodiversiteit_in_Zeist_Eindrapport.pdf

Cambridge Dictionary. (2021, 30 juni). Awareness definition. https://dictionary.cambridge.org/dictionary/english/awareness
Catsburg, W. (2021, januari). Route naar een klimaatbestendige gemeente. Gemeente Zeist. https://www.zeist.nl/fileadmin/bestanden/Open_gemeenten_nieuwe_bestandenboom/Afval__groen_en_water/Water/Klimaatbestendig_gemeente_Zeist.pdf

Christensen, Norman, Ann Bartuska, James Brown, Stephen Carpenter, Carla D'Antonio, Robert Francis, Jerry Franklin, James MacMahon, Reed Noss, David Parsons, Charles Petterson,Monica Turner, and Robert Woodmansee. (1996). The report ofthe Ecological Society of America Committee on the Scientific Basis for Ecosystem Management. Ecological Applications 6 (3):665-91

Clark, R. M., & Hakim, S. (2016). Securing Water and Wastewater Systems: Global Experiences (Pro-tecting Critical Infrastructure, 2) (Softcover reprint of the original 1st ed. 2014 ed.). Springer.

Conservation International. (2021). Conservation International. https://www.conservation.org/
Design Earth (2020) Geostories: Another Architecture for the EnvironmentPaperback. Actor: Boston

Domingues V (2017) Human impact on ecosystems. Ecology & Evolution https://natureecoevocommunity.nature.com/users/17998-vera-domingues/posts/16301-human-impact-on-ecosystems

Meadows, Donella H. (2001). 'Dancing with Systems.' In: Whole Earth, Winter, Issue 106: 58-63.(also to be retrieved from http://donellameadows.org/archives/dancing-with-systems/)

Douglas, Mary (1992). 'A Credible Biosphere.' In: Douglas, M. Risk & Blame. Essays in cultural theory. London and New York, Routledge. Pp. 255-270.

Doyle, Martin W. and Havlick, David G. Infrastructure and the Environment Annual Review of Environ-ment and Resources volume 34 number 1 pages 349-373, 2009 doi: 10.1146/annurev.environ.022108.180216

El-Geneidy and Levinson (2006), Access to Destinations: Development of Accessibility Measures, Access to Destinations Study, Report # 2006-16 , https://conservancy.umn.edu/bitstream/handle/11299/638/200616.pdf?sequence=1&isAllowed=y

El-Fadel, M., Maroun, R., Semerjian, L., & Harajli, H. (2003). A health-based socio-economic assess-ment of drinking water quality: the case of Lebanon. Management of Environmental Quality: An International Journal, 14(3), 353–368. https://doi.org/10.1108/14777830310479441

Engel, W., Phernambucq, I., Van Wee, L., & Jensen, I. (2021). GEBIEDSDOSSIER WATERWINNING ZEIST. Provincie Utrecht. https://www.provincie-utrecht.nl/sites/default/files/2021-01/Gebiedsdossiers%20%20Zeist.pdf

EPA (2017). Climate Impacts on ecosystems. https://19january2017snapshot.epa.gov/climate-impacts/climate-impacts-ecosystems_.html

F. (2021). Arealbruk i kommunene. Statistisk sentralbyrå. https://www.ssb.no/kommuneareal/nes
Gemeente Utrecht. (2020). Kunst in het Waterwinpark | Gemeente Utrecht. https://www.utrecht.nl/wonen-en-leven/parken-en-groen/parken-en-plantsoenen/waterwinpark/

Ghent, C. (2018). Mitigating the Effects of Transport Infrastructure Development on Ecosystems (Nr. 19). Columbia University. https://www.jstor.org/stable/26427712

Gisgeo. (2021, 7 5). The Background of the Glomma and Lågen Floods in June 1995. Retrieved from Flommen: http://www.gisgeo.dk/flommen/01back.htm

Google. (n.d.). [Google Maps location of Arnes and Glomma, Norway]. from https://www.google.com/maps/place/2150+%C3%85rnes,+Norway/@60.1206183,11.443074 2,13z/data=!3m1!4b1!4m5!3m4!1s0x46422cf253cfb599:0xccf0a47e96ffcc5a!8m2!3d60.1209 872!4d11.4662933

Grey C. (2011) Landscape Urbanism: Definitions & Trajectory. Scenario Journal Volume 1.

Grumbine, Edward. (1994). What is ecosystem management? Conservation Biology 8 (1): 27-38

Hajer, M., & Dassen, T. (2014). Slimme Steden. nai010.

Heart Foundation, Planning Institute Australia, & Australian Local Government Association. (2009, June). Design Principle – Connectivity and Permeability. https://www.healthyplaces.org.au/userfiles/file/Connectivity%20June09.pdf

Het verhaal van Zeist en het Zeister erfgoed. (2018, 17 januari). Geheugen van Zeist. https://www.geheugenvanzeist.nl/artikles/het-verhaal-van-zeist-en-het-zeister-erfgoed/

Holmgren, J. (2007). Meta-analysis of public transport demand. Transportation Research Part A: Policy and Practice, 41(10), 1021–1035. https://doi.org/10.1016/j.tra.2007.06.003

Hossain, M. F. (2019). Best Management Practices. Sustainable Design and Build, 419–431. https://doi.org/10.1016/b978-0-12-816722-9.00007-0

Huston, S., & Darchen, S. (2014). Urban regeneration. International Journal of Housing Markets and Analysis.

Ip, W. H., & Wang, D. (2011). Resilience and Friability of Transportation Networks: Evaluation, Analysis and Optimization. IEEE Systems Journal, 5(2), 189–198. https://doi.org/10.1109/jsyst.2010.2096670

Jean-Paul Rodrigue (2020), The Geography of Transport Systems, FIFTH EDITION, New York: Routledge, 456 pages. ISBN 978-0-367-36463-2

Jones, I. S. (1977). Urban Transport Appraisal. Macmillan Publishers.

José Maria Cardoso da Silva, Emily Wheeler (2017) Ecosystems as infrastructure, Perspectives in Ecology and Conservation, Volume 15, Issue 1, 2017, Pages 32-35, ISSN 2530-0644, https://doi.org/10.1016/j.pecon.2016.11.005.

Karimizade, A. S., Nazari, J., & Rezai, A. H. (2009). Explaining The Social Vitality And Its Relationship With Collective Identity Case Study Of (Azeri, Kurd And Lur) Tribes
.
Kartkatalogen. (2021). Geonorge. https://kartkatalog.geonorge.no/metadata/n20- bygning/b187c449-04ac-42fe-9eab-83d81bf338bc

Kartportal Nes. (2021). Nes Kommune https://kommunekart.com/klient/nesak/kartportal NVE Temakart. (2021). NVE Temakart. https://temakart.nve.no/tema/elvenett

Keough, H. L., & Blahna, D. J. (2006). Achieving integrative, collaborative ecosystem management. Conservation biology, 20(5), 1373-1382.

Knöll, R., & Mezini, M. (1977). A pattern language. Proceedings of the Conference on Object-Oriented Programming Systems, Languages, and Applications, OOPSLA, 503–521. https://doi.org/10.1145/1640089.1640128

Kresl, P., & Ietri, D. (2014). Urban competitiveness: Theory and practice. Routledge.

Kvittingen, I. (2021, 7 5). Historic amount of flooding in Europe during the last 30 years. Retrieved from Sciencenorway: https://sciencenorway.no/climate-change-environment/historic-amount-of flooding-in-europe-during-the-last-30-years/1734997

Laurance, W. F. (2013). Emerging Threats to Tropical Forests. Treetops at Risk, 71–79. https://doi.org/10.1007/978-1-4614-7161-5_5

Laurance, W. F., Clements, G. R., Sloan, S., O'Connell, C. S., Mueller, N. D., Goosem, M., Venter, O., Edwards, D. P., Phalan, B., Balmford, A., Van Der Ree, R., & Arrea, I. B. (2014). Erratum: Corrigendum: A global strategy for road building. Nature, 514(7521), 262. https://doi.org/10.1038/nature13876

Leck, Eran & Bekhor, Shlomo & Gat, Daniel. (2008). Welfare economic impacts of transportation im-provements in a peripheral region. European Transport \ Trasporti Europei. 88-105.

Li, C. L. (2020). Quality of life: The perspective of urban park recreation in three Asian cities. Journal of Outdoor Recreation and Tourism, 29, 100260. https://doi.org/10.1016/j.jort.2019.100260

Liu, S. L., Cui, B. S., Dong, S. K., Yang, Z. F., Yang, M., & Holt, K. (2008). Evaluating the influence of road networks on landscape and regional ecological risk—A case study in Lancang River Valley of Southwest China. Ecological Engineering, 34(2), 91-99.

Lloyd, R. A., Lohse, K. A., & Ferré, T. P. A. (2013). Influence of road reclamation techniques on forest ecosystem recovery. Frontiers in Ecology and the Environment, 11(2), 75-81.

Macagno, E. (1989). LEONARDIAN FLUID MECHANICS IN THE CODEX ATLANTICUS IV-V. Iowa: Iowa Institute of Hydraulic Research .

Mamadouh, V. (1999). Grid-group cultural theory: an introduction. GeoJournal, 47(3), 395-409.

Martin, L., White, M. P., Hunt, A., Richardson, M., Pahl, S., & Burt, J. (2020). Nature contact, nature connectedness and associations with health, wellbeing and pro-environmental behaviours. Journal of Envi-ronmental Psychology, 68, 101389. https://doi.org/10.1016/j.jenvp.2020.101389Rabani, R.,

MartinD. (n.d.) Own work [JPEG], Wikipedia. https://commons.wikimedia.org/w/index.php?curid=3931149 McCormick, K. (2020). How Urban Highway Removal Is Changing Our Cities. LILP. https://www.lincolninst.edu/publications/articles/2020-03-deconstruction-ahead-urban-highway-removal-changing-cities

Mostafavi M and Najle C (eds.) (2003) Landscape Urbanism: A Manual for the Machinic Landscape. London: Architectural Association.

MOOVIT. (2021, 30 mei). Hoe gaan naar Waterwinpark De Waterbron in Zeist via Bus of Sneltram | Moovit. https://moovitapp.com/index/nl/openbaar_vervoer-Waterwinpark_De_Waterbron-Netherlands-site_56837393-101

NDFF Verspreidingsatlas. (2021). Retrieved July 1, 2021, from https://www.verspreidingsatlas.nl/

Nello-Deakin, S., & Nikolaeva, A. (2020). The human infrastructure of a cycling city: Amsterdam through the eyes of international newcomers. Urban Geography, 1–23. https://doi.org/10.1080/02723638.2019.1709757

Ng, C. P., Law, T. H., Wong, S. V., & Kulanthayan, S. (2017). Relative improvements in road mobility as compared to improvements in road accessibility and economic growth: A cross-country analysis. Transport Policy, 60, 24–33. https://doi.org/10.1016/j.tranpol.2017.08.004

NorwayStatistics. (2021, 7 5). Area and population of urban settlements (US) 2000 - 2020. Retrieved from Land use in urban settlements: https://www.ssb.no/en/statbank/table/04859/

Østdahl, T., Skurdal, J., Kaltenborn, B. P., & Sandlund, O. T. (2002). Possibilities and constraints in the management of the Glomma and Lägen river basin in Norway. Large Rivers, 471-490.

Quadros, Saul & Nassi, Carlos. (2015). An evaluation on the criteria to prioritize transportation infrastruc-ture investments in Brazil. Transport Policy. 40. 10.1016/j.tranpol.2015.02.002.

Quandt, R. E. (1992). The Collected Essays of Richard E. Quandt. Edward Elgar Publishing.

Rod'or Advies. (2018, 27 oktober). Rod'or Advies. HERINRICHTING WATERWINPARK 'DE WATERBRON' TE ZEIST https://rodoradvies.nl/project/herinrichting-waterwinpark-de-waterbron-te-zeist/

Schwanen, T., Banister, D., & Anable, J. (2011). Scientific research about climate change mitigation in transport: A critical review. Transportation Research Part A: Policy and Practice, 45(10), 993–1006. https://doi.org/10.1016/j.tra.2011.09.005

Scott, D. M., Novak, D. C., Aultman-Hall, L., & Guo, F. (2006). Network Robustness Index: A new method for identifying critical links and evaluating the performance of transportation networks. Journal of Transport Geography, 14(3), 215–227. https://doi.org/10.1016/j.jtrangeo.2005.10.00

Scott, K. (2010). Community vitality. Waterloo, ON: Canadian Index of Wellbeing and University of Wa-terloo, 84.

Seiler, A. (2001). Ecological Effects of Roads: A review (Vol. 9). Uppsala
Silviculture. (2021). U.S. FOREST SERVICE. https://www.fs.fed.us/forestmanagement/vegetation management/silviculture/index.shtml

SkyGeo Explorer. (2020). NCG. https://bodemdalingskaart.portal.skygeo.com/portal/bodemdalingskaart/u2/viewers/basic/

Smedley, T. (2019). Could wooden buildings be a solution to climate change? BBC Future. https://www.bbc.com/future/article/20190717-climate-change-wooden-architecture-concrete global-warming

Steiner, F. R., Weller, R., M'Closkey, K., & Fleming, B. (2019). Design with Nature Now. Lincoln Institute of Land Policy.

Stockholm Environment Institute. (2020, 22 juli). Cities can lead the way to circularity – what do they need? SEI. https://www.sei.org/featured/cities-can-lead-the-way-to-circularity-what-do-they-need/

Sullivan, J., Novak, D., Aultman-Hall, L., & Scott, D. (2010). Identifying critical road segments and measuring system-wide robustness in transportation networks with isolating links: A link-based capacity-reduction approach. Transportation Research Part A: Policy and Practice, 44(5), 323–336. https://doi.org/10.1016/j.tra.2010.02.00

Tahir, T., & Majeed, M. T. (2020). An Empirical Analysis of Safe Drinking Water and Quality of Life. Pakistan Journal of Economic Studies, 3(1), 1–23.

Tawil, M., Reicher, C., Jafari, M., & Baeumer, K. (2016). Assessment of public space efficiency in rela-tion to spatial development in Amman: Exploring indicators to sustainable models of future city life. Sustaina-ble Development, 9(3).

Taylor, M. A. P., (2003). Concepts of network vulnerability and applications to the identification of criti-cal elements of transport infrastructure

Tellman B, McDonald RI, Goldstein JH, Vogl AL, Flörke M, Shemie D, et al. (2018) Opportunities for nat-ural infrastructure to improve urban water security in Latin America. PLoS ONE 13(12): e0209470. https://doi.org/10.1371/journal.pone.020947

Tjallingii, S. (2013). Ruimte met Toekomst - Strategie van de 2 netwerken. Retrieved July 2, 2021, from http://www.ruimtexmilieu.nl/wiki/ontwikkelconcepten/strategie-van-de-2-netwerken

Ulrich Blum (1998), Positive Externalities of Transportation and the Allocation of Infrastructure – an Evo-lutionary Perspective, JOURNAL OF TRANSPORTATION AND STATISTICS VOL. I, NO. 3, 199

Van Dorst, M.J. & Duijvestein, C.A.J. (2004). Concepts of sustainable development - The 2004 Interna-tional Sustainable Development research conference – Conference proceedings 29-30 march University of Manchester, UK.
Vitens, Provincie Utrecht. (n.d.) Drinkwaterstrategie 2040.

*Vitens. (2012). Visie van Vitens op waterinfrastructuur voor de lange termijn. *thema achtergrond. https://edepot.wur.nl/339098*

Walter G. Hansen (1959), How Accessibility Shapes Land Use, Journal of the American Institute of Plan-ners, 25:2, 73-76, DOI: 10.1080/01944365908978307

Wang, H., Nie, L., Xu, Y., Du, C., Zhang, T., & Wang, Y. (2018). Effects of Highway-Related Pollutant on the Groundwater Quality of Turfy Swamps in the Changbai Mountain Area. International Journal of Environ-mental Research and Public Health, 15(8), 1652. https://doi.org/10.3390/ijerph15081652

Waterwinpark. (2018, 22 januari). Geheugen van Zeist. https://www.geheugenvanzeist.nl/articles/waterwinpark/

Weijers, W. (2021, 19 maart). Zeist zet in op de fiets, verkeersveiligheid en duurzame mobiliteit. Regio Online. https://regioonline.nl/regio-utrecht/zeist-zet-in-op-de-fiets/

What is a Food Forest? (2021). Project Food Forest. https://projectfoodforest.org/what-is-a-food forest/

Wold, B. (1998). THE NORWEGIAN SPRING FLOOD DISASTER 1995: EXPERIENCE AND CONSEQUENCES. NVE, 192-195.

Wong, W. K., Beldring, S., Engen-Skaugen, T., Haddeland, I., & Hisdal, H. (2011). Climate change effects on spatiotemporal patterns of hydroclimatological summer droughts in Norway. Journal of Hydrometeorology, 12(6), 1205-1220.

Wuijts, S., van der Grinten, E., Meijers, E., Bak-Eijsberg, C. I., & Zwolsman, J. J. G. (2013). Impact klimaat op oppervlaktewater als bron voor drinkwater Van knelpunten naar maatregelen. Rijksinsti-tuut voor volksgezondheid en milieu. https://www.rivm.nl/bibliotheek/rapporten/609716007.pdf

Xiao, J., Wang, Y. F., Shi, P., Yang, L., & Chen, L. D. (2014). Potential effects of large linear pipeline construction on soil and vegetation in ecologically fragile regions. Environmental Monitoring and Assessment, 186(11), 8037–8048. https://doi.org/10.1007/s10661-014-3986-0

Zayed, T., Salman, A., & Basha, I. (2011). The impact on environment of underground infrastructure utility work. Structure and Infrastructure Engineering, 7(3), 199–210. https://doi.org/10.1080/15732470802445310

Zhou, X., & Parves Rana, M. (2012). Social benefits of urban green space. Management of Environ-mental Quality: An International Journal, 23(2), 173–189. https://doi.org/10.1108/14777831211204921