

Development of the river Aa catchment area to contribute to Mid-Brabant as a National Landscape Park.

Wessel Koolhaas
Landscape architecture
mastertrack Tu Delft

First mentor; Eric Luiten
Second mentor; Marco Lub

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Abstract

The Aa is a channelized stream system with an out-of-balance hydrological system. Being too dry in the summer and having no room for water during the winter. There is also no room for natural processes and the biodiversity is low. This together with the intensively large-scale agricultural landscape makes the Aa an unattractive landscape. To change this in order to make the Aa resilient and attractive component of the Van Gogh National Park, is the landscape studied through three lenses; hydrological, nature, and recreation. In the area three landscape types are identified as having the potential to contribute to a resilient and attractive landscape; these are the stream, the wet areas, and the higher grounds. Looking at the three landscape types through the three lenses yields nine elements which together make an illustrative masterplan which is detailed in zoom-ins. The nine elements are called Meandering, Retention, Infiltration, Beekprik, Boomkikker, Boommarter (BBB), Kano, Boots, and Mountainbike.

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1. Introduction

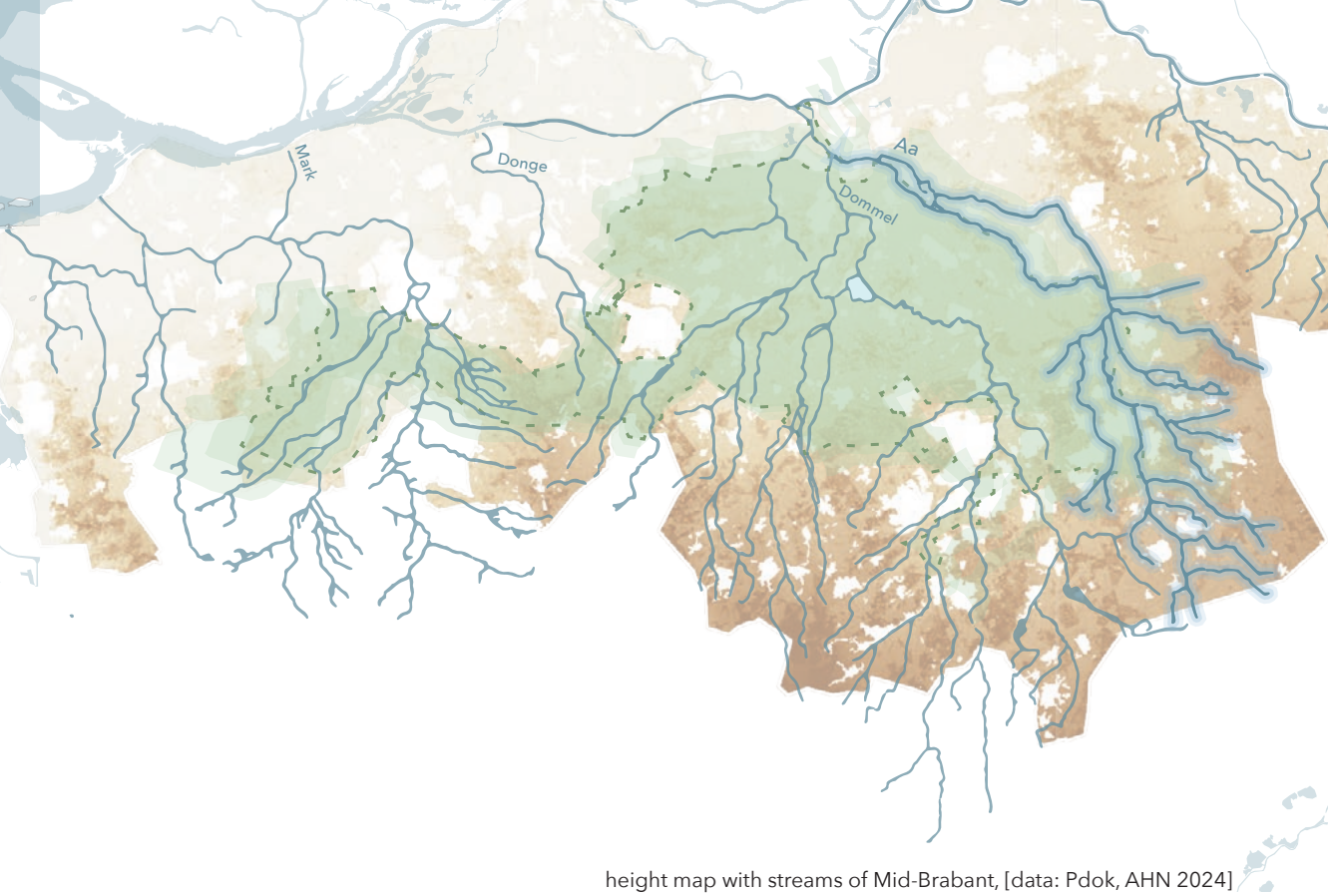




The Aa at castle Heeswijk
Image by author

location





In mid-Brabant we find a stream landscape. Most spring in the higher grounds towards Belgium. Then flow northwards to end up in the Maas, Hollands diep en Volkerak. The eastern most stream before the higher grounds of the Peelhorst is the Aa. It extends from the Grote Peel in the south, through Helmond, along the Peelrandbreuk at the east, towards 's Hertogenbosch. The catchment area of the Aa is the research and design location of this project.

Image left: the position of the Aa in the Netherlands with the Van Gogh National Park.
Image top: height map of North-Brabant with the major streams

Problem statement



Illustration from the masterplan for Van Gogh National Park (West 8 & Overland, 2020)

Van Gogh National Park

Van Gogh National Park defines itself as a new National Park of World class, distinguished by its small-scale stream landscape, which combines nature with the metropolitan knowledge economy of Brainport and Brabantstad and with the tangible heritage of Van Gogh. But in the current landscape nature and biodiversity are under pressure from agriculture, urbanization, infrastructure projects, and more. The aim of the VGNP is to create a future-focused and integrated landscape where there is both room for innovation and economic activities and a strengthened nature, landscape identity and biodiversity.

The Van Gogh National Park came to be

out of a collaboration between the National Park 'De Loonse en Drunense Duinen' and the landscape park 'Het Groene Woud'. VGNP in North-Brabant is the first park embracing the ideas of a National Park 'nieuwe stijl', which are National Parks that includes the surrounding farmland, and small towns and villages.

This makes better cooperation possible between nature conservation and the activities on surrounding land. The surrounding landscape can help protect and strengthen the ecosystem, creating larger areas more resilient to changes and pressures (De Vries, et al. 2017).

For this, a masterplan has been developed by West 8 and Overland for VGNP. It proposes to use the streams of mid-Bra-



The Aa near Koks (image by athor)

bant as a backbone for the landscape design. Trying to look at the entire water system from the infiltration and seepage upstream to the stream mouth at the end. The challenge is to develop the stream to make a connected landscape. Including the many villages and cities the stream passes. Connecting people from their doorstep in urban areas to the wider landscape. (masterplan VGNP, 2020).

But the reality on the ground is in many places much different than the image outlined in the masterplan. The image above shows one of the streams that is supposed to be a backbone of the nature and recreation network. It is the Aa, which flows from the Peel, through Helmond, towards 's Hertogenbosch. The Aa is channelized along almost its entire length,

with intensely used agricultural fields on either side of the stream banks. No path or anything along it, just, with manure-injected, muddy fields. To even get here at the water's edge, you have to follow a dead-end road past some huge pig farms. Where you can hear the pigs scream and smell them, but you cannot see any. Past the farms, the road turns into an unpaved path that ends with a dead-end at the stream. A canalized stream where almost all natural processes are dead. This is not a stream that provides the backbone for a nature or recreation network.

For the entire VGNP the Advisory Commission for National Park was also critical and refused the application of the VGNP with the current masterplan to become a National Park officially. According to

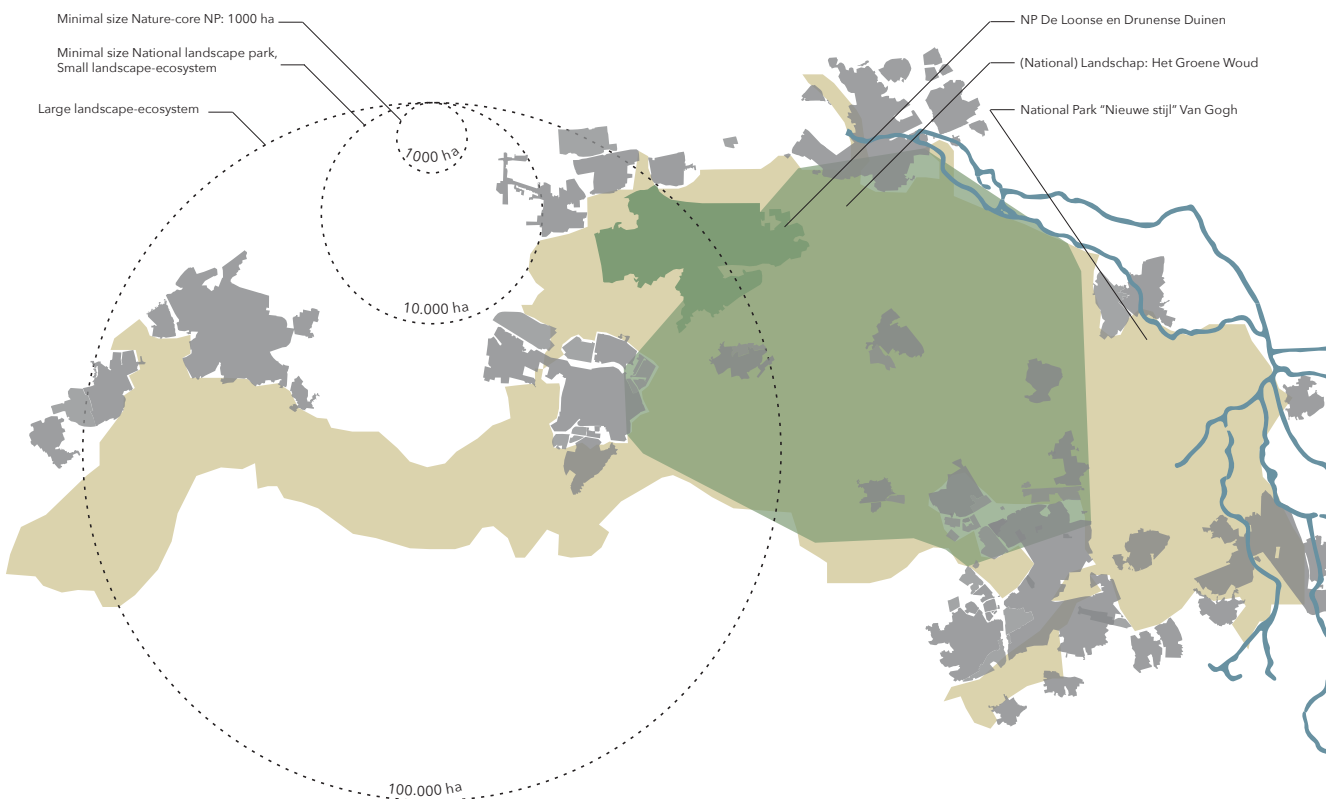
the commission, the streams of mid-Brabant don't have sufficient landscape and ecological quality to grant a National Park status. This is mainly due to pollution by agriculture on the ecosystem and lacking attention given to recreation and biodiversity in the maintenance and development of the streams over the past decades. The current poor state of ecological and landscape quality of the stream would be difficult to address as not all streams of the landscape of mid-Brabant are included and of the included streams large parts fall outside the currently proposed National Park boundary. Causing much of the stream ecosystem to be still outside of the reach of the new National Park (Adviescommissie Nationale Parken, 2021).

The landscape quality is not the only problem, the stream landscape of mid-Brabant is also missing a coherent landscape identity that ties the area of the National Park together. The name 'Van Gogh' is now heavily used as marketing for the VGNP, but outside a couple of hotspots is Van Gogh's legacy not visible in the landscape. Therefore there is the need for a more landscape-based identity throughout the entire landscape, which makes it visible and recognizable in the landscape for visitors and residents.

These problems are in large part due to the ambitious vision of the VGNP. Everyone and everything in the region is allowed to join VGNP, no matter the current state of nature or landscape quality. VGNP then uses their platform to promote and improve the landscape. So even though the currently lacking quality, Van Gogh National Park is the movement that makes improvement possible.

As this model of nature protection was new, a new list of requirements had to be developed for the VGNP. The requirements of National Park 'Nieuwe Stijl' that are relevant in a landscape architecture projects are:

- At least one clearly defined area of a single landscape, landscape ecological, and cultural-historical unity, with at least one natural core of 1000 Ha.
 - The national park has one or multiple coherent ecosystems, with room for widespread natural processes within the natural core.
 - The landscape, ecological, and cultural historical values in the national park are unique national and/or international.
 - The landscape identity is well enclosed by the national park and unique to its surroundings and other areas.
 - A strong cohesion between natural, cultural historical, and landscape values which strengthens the area's identity.
 - The park is recognizable, accessible, and experiential for visitors.
 - The national park is strongly connected with the regional community, making the community proud of the landscape and to care for it, whilst the national park improves the livability in the area.
 - And then follow four points about education, research, governance, and documentation which are not relevant to this landscape architectural project.
- (Nationale parken bureau, 2021)

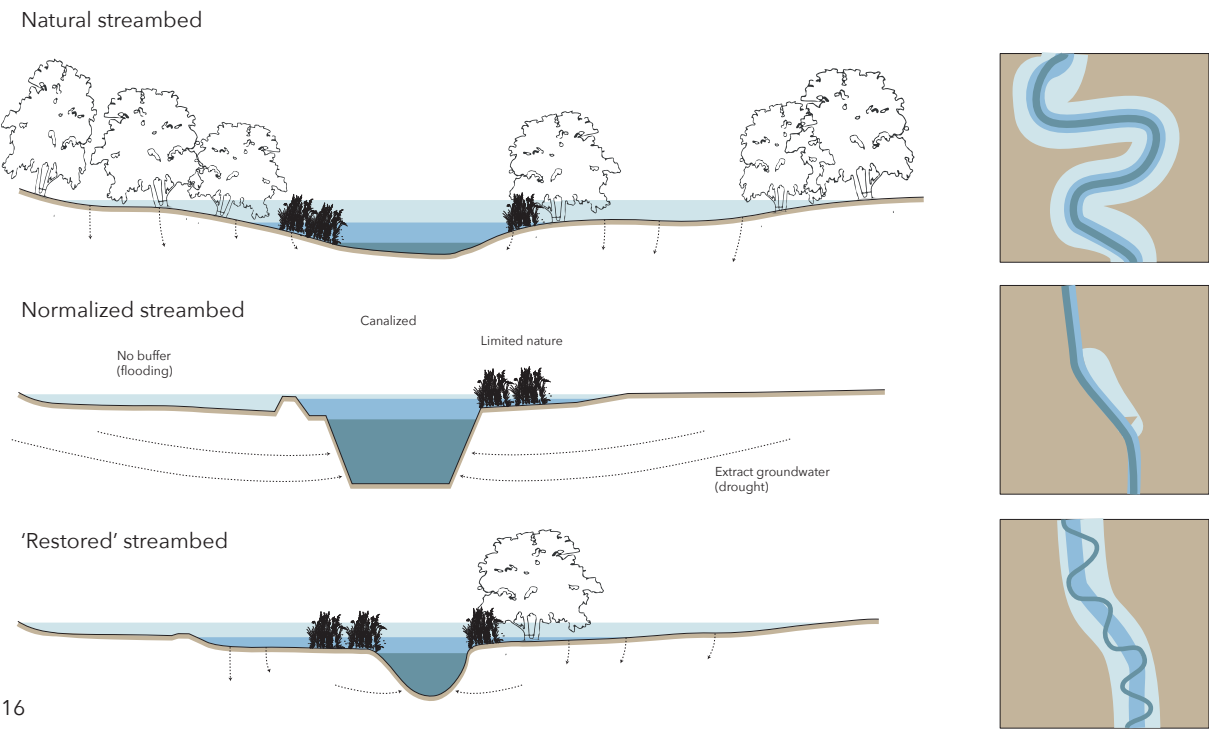


The size the Van Gogh National Park [Data: PDOK, 2024]

Stream normalisation

Streams have been intervened with by humans since the beginning of agriculture, but for most of the time, the interferences were limited, allowing the stream to meander, sediment and erode, and cause flooding regularly. The streams of North-Brabant (including the Aa) were no different. There was often very little and shallow water, but in case of high precipitation, the stream would swell, causing it to widen significantly. The wider stream would have more surface to infiltrate much of its water. The flood plains with their dynamics of regular flooding create unique niches for plants and animals, leading to a more diverse ecosystem. In the nineteen-sixties there came a large-scale movement to ‘normalize’ the streams. This meant straitening the bends and making them deeper and narrower with fixed banks. This had the advantage of quickly getting rid of rainwater during high precipitation. And it made what where previously the floodplains suitable for large-scale agriculture. Without the seasonal floodings, year-round production became possible, and the drier land

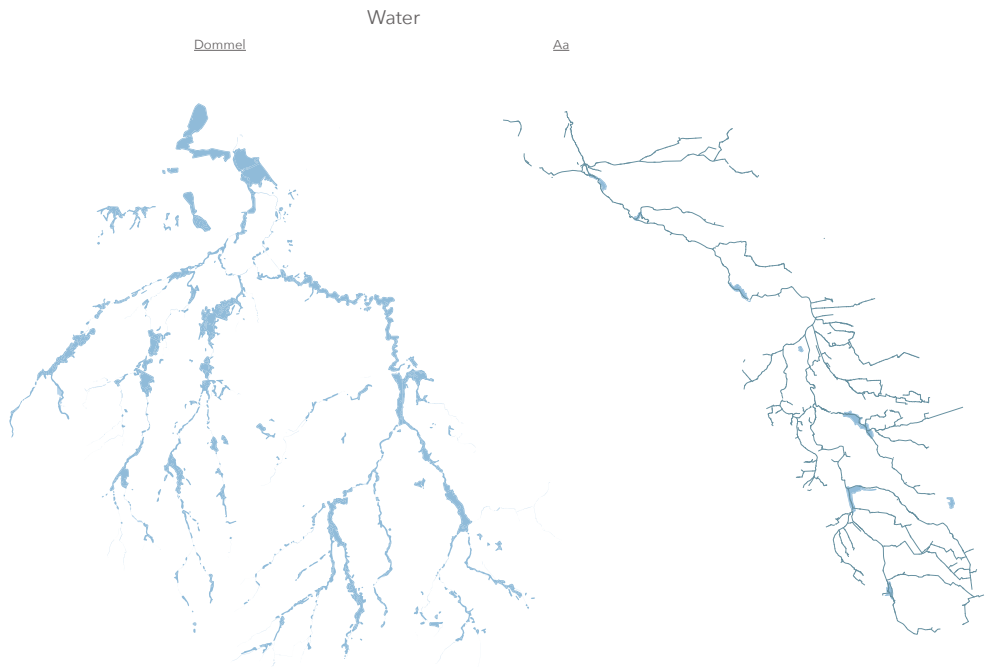
made them better navigable with heavy machinery. But it quickly became apparent that the ‘normalization’ had many negative consequences. All the quickly discharged water must go somewhere. Causing problems downstream. The deeper channels drained much of the groundwater, leading to more severe droughts. And the biodiversity took a big hit with the loss of the floodplains and the dynamics within the stream. The image to the right shows how little space Aa has compared to a not canalized stream like the Dommel. Causing these previously named negative consequences are happening in the Aa. In some places we see stream restoration projects now, that aim to undo the problems caused by ‘normalization’. However, these restoration projects are not always easy to implement, among others because farmers have gotten used to being able to use the floodplains for agricultural use. Resulting in many restoration projects (including those seen at the Aa) being limited in implementation, not completely restoring the natural processes (Makaske et al., 2020).



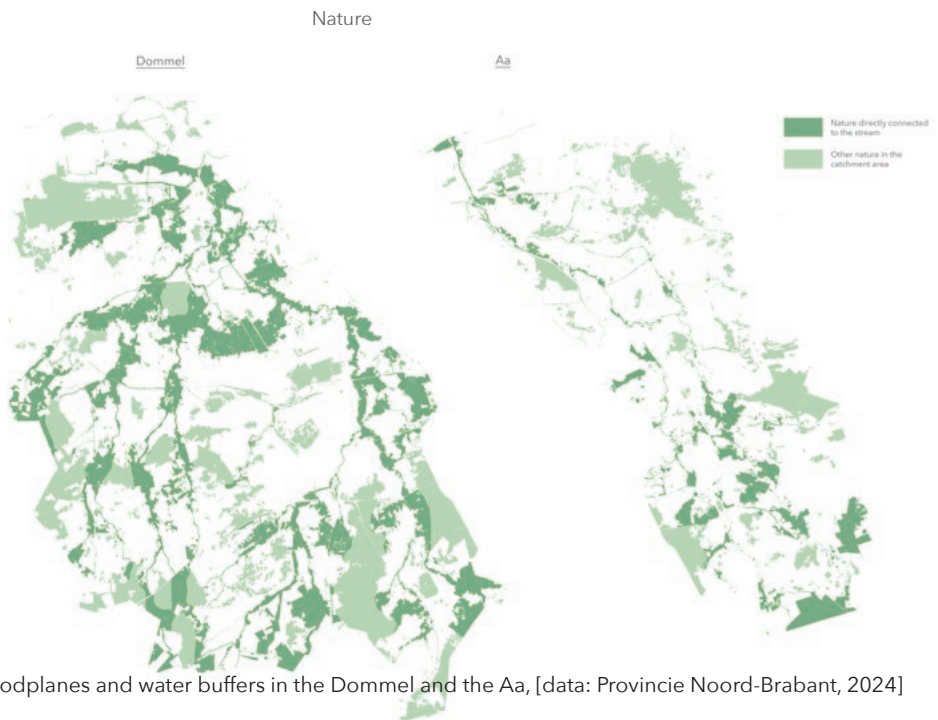
Ecological connections

Natural areas in the Netherlands are on their own often too small to maintain a healthy population of plant and animal species. Connecting habitats enables exchange between populations and spread to new areas, better safeguarding species from extinction (Reijnen & Kooistra,

1997). The use of a stream system would be an effective way of connecting natural areas. The image below shows how this is used at the Dommel but underutilized at the Aa. This limited and fragmented nature around the Aa has severe negative consequences for the biodiversity there.



Floodplanes and water buffers in the Dommel and the Aa, [data: Pdok, 2024]



Floodplanes and water buffers in the Dommel and the Aa, [data: Provincie Noord-Brabant, 2024]

Conclusion

The stream can be seen as a system under severe stress, or better an ecosystem that almost doesn't exist anymore. A patient barley alive.

Over the last decades the sole purpose of the water system has seem to serve the agricultural system with water and to drain as quickly as possible every excess droplet of rainwater. Causing increasingly severe droughts in the summer, whilst having no room to deal with peak water inflow during winter downpours. The focus on agricultural production has also pushed away, fragmented and polluted the natural system. With the loss of biodiversity as a consequence. This has actually a negative consequent on agriculture again with decreasing soil quality and increased threat and vulnerability to diseases and plagues. This all doesn't make for a nice and enjoyable landscape. And without a coherent landscape vision the access to outdoor recreational options and the access to green will only decrease.

Research question

Main Research Question:

How can the landscape of the river Aa be revitalized to become a resilient and attractive component of the Van Gogh National Park?

Sub Research Questions:

Which hydrological measures have to be taken to restore the natural balance of flows?

Which ecological measures have to be taken to enhance plant and animal life?

Which recreational measures have to be taken to support an attractive area for visitors and residents?

Design objective

Design assignment

The Van Gogh National Park shows ambition for working towards a landscape worthy of the title National Park. However, the difference in the vision of the VGNP and the reality on the ground at the Aa regarding water management, ecology, and recreational qualities, as shown in the problem statement, creates the opportunity for a redesign of the Aa catchment area.

The making of a landscape design for the stream Aa and its catchment area in such a way that it regains a living, clean, active, and resilient water system. With strong biodiversity and a healthy ecosystem as part of a larger regional ecological network. And making this accessible, experientable, and enjoyable for citizens and visitors of the area. Connecting people with their landscape. And having a clear design 'language' with landscape elements that illustrate how the different landscape parts like; higher grounds, lower lying grounds, and urban areas partake in the revived stream landscapes and make the entire Aa catchment area recognizable as part of the National Park.

Scope

National Park

This project focuses on the landscape architectural aspects of the creation of a National Park 'Nieuwe Stijl'. These are the protection and restoration of a biodiversity-rich ecosystem, the creation of a healthy living environment, and the facilitation of outdoor recreation within an accessible and recognizable landscape. The governance, economical, and educational aspects of a National Park are not covered in this project. (Nationale parken bureau, 2021)

Emissions

In order to create a healthy ecosystem, there is a very important need to reduce the emissions of nitrogen and phosphorus (Gies et al, 2019). The reduction of emissions would be the first step in creating a healthier ecosystem, but this project focuses on the next steps of designing a new and stronger ecological network. A reduction in emissions will be assumed in this project. Seeing the current political landscape in the Netherlands the reduction in emissions is actually not certain, but the Van Gogh Nationale Park does show local initiative in the positive direction (Brabantse bodem). The assumption of reduced emissions will mostly come from a reduction of livestock in and around the Aa catchment area.

Site boundaries

This project focuses on the stream the Aa. This stream source lies in the peat and groundwater reservoirs of the Peel. However, the Aa is intended to become part of a National Park around the Mid-Brabant stream landscape, of which the Peel is not a part. The water source of the Aa on the Peel will not be part of the design site. The design site will focus on the flowing surface water area of the Aa and its connection towards the streams to the east (the Dommel).

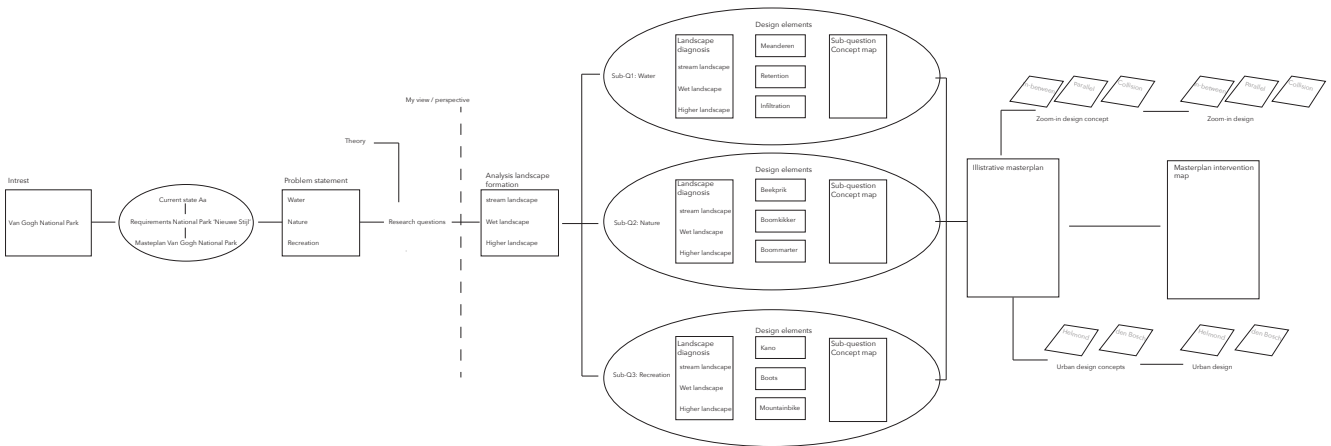
Relevance

The state of nature is deteriorating (WNF, 2022), not only worldwide, but also in the Netherlands. The current nature policy in the Netherlands is falling short (RLI, 2022). One of the causes is a too narrow definition of nature with the focus mainly on protected areas. These protected areas are part of a much larger ecosystem. This caused much of the area of influence on the protected nature area to be outside the area of control of nature conservationists. Nationale Parken 'Nieuwe Stijl' is a proposed solution for this (NPB, 2021). The new parks cover a much larger area than only the core of highly valuable nature. Extending the nature conservation and landscape protection efforts beyond the natural core. Including more of the ecosystem and natural processes in the National Park. Creating larger areas more resilient to changes and pressures (Commissie Verkenning Nationale Parken, 2020).

The ideas and ambition for a Nationaal Park 'Nieuwe Stijl' are there, but how it would look in landscape terms is unclear. Same as the impacts and influence it would have on the larger landscape. The hope is that this project can contribute to the development of design approaches for the integration of the National Park 'Nieuwe Stijl' requirements into the landscape. And that successful integration of new National Landscapes Parks can have an impact on creating a more resilient nature.

2. Research approach

Research framework



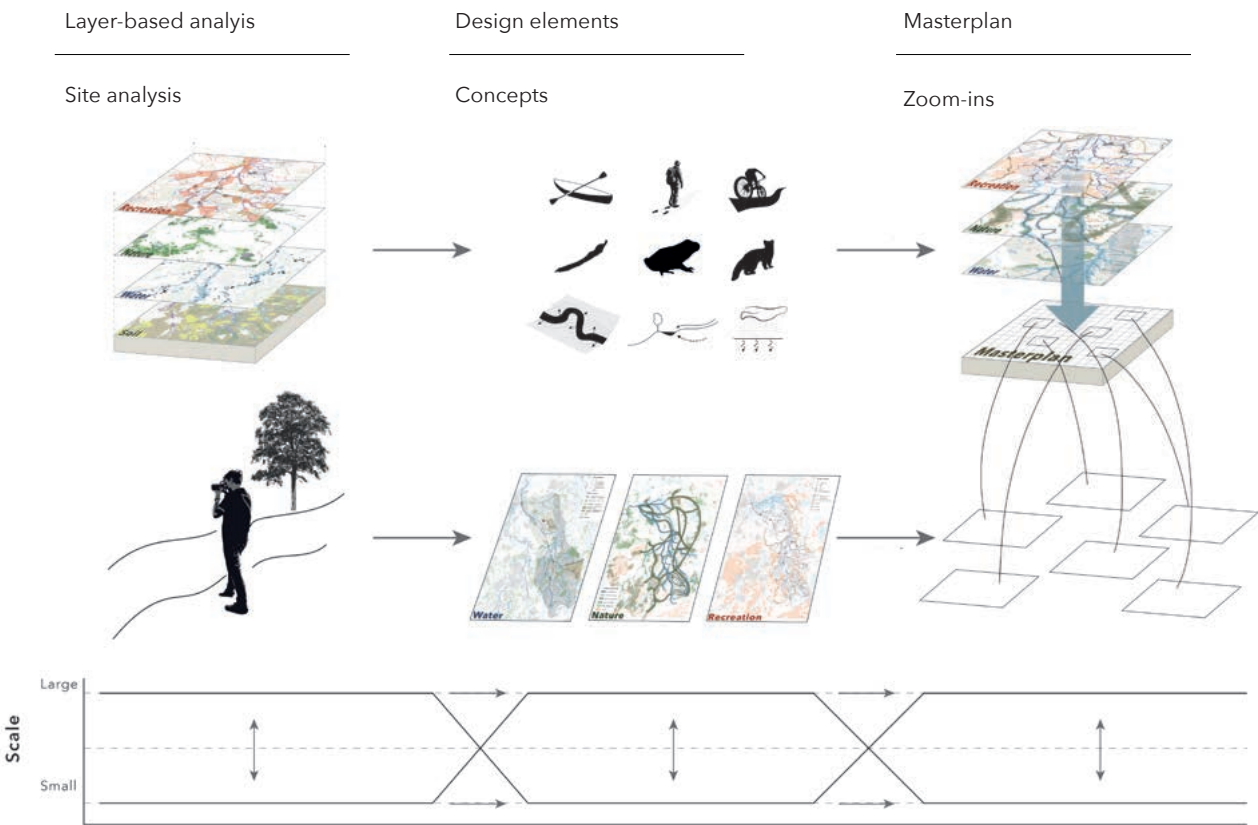
The analysis starts with large-scale mapping to understand the landscape, its layers and function. And field visits to understand the spatial characteristics of the landscape.

As the design goal is the creation of a landscape that is a resilient and attractive part of the Van Gogh National Park, the requirements for a National Park 'Nieuwe Stijl' have been translated into three goals: the protection of the ecosystem with room for natural processes, the restoration of nature with a healthy biodiversity, and the creation of an attractive area for visitors. This led to the elaboration of three layers from analysis to concepts. With the layers being water, nature, and recreation.

Out of the historical analysis came three landscape types which showed an opportunity to design for, these are the stream, the wet landscape and the higher landscape. Overlaying the three layers on the three landscape types gave nine different parts used to create a combined masterplan. The nine parts are meandering, retention, infiltration, beekprik, boompikker, boommarter, kano, boots, and mountainbike.

The masterplan is then detailed with zoom-ins. Three landscape zoom-ins and two urban zoom-ins.

Methodology



Layer analysis approach

Separating the landscape into layers provides a clear way of researching and understanding the different aspects that make up the landscape and how they interact. The layer approach of Frieling et al. (1998) is divided into the three layers substratum, networks, and occupation. The substratum layer sets the conditions for the networks and occupation layers above and has a bigger time scale for transformations. The transformation is based on processes, repetitions, and cycles of natural processes. The network and occupation layers transform quicker and have a more direct interaction with

each other. Where the network layer is organized around social, economic, and cultural dynamics. The occupation layer is based on people and politics, This project has a variation on the layered approach for its research and design. The substratum exists out of a geomorphological and a soil layer which together with the groundwater levels make a 'natural' landscape types layer. On top of this a hydrological and water management layer, an ecological layer, and a recreational layer.

Framework and corridor approach

Three landscape-based regional design approaches have been described by Nijhuis (2019). These are the area approach, framework approach, and corridor approach. The area approach makes a landscape-mosaic of zones. With zones for both long-term low dynamic functions as well as zones with high dynamic functions. The framework approach makes a landscape network to provide a long-term and coherent structure to safeguard resources and spatial coherence and to create conditions for local developments. The corridor approach works as an armature for urban and rural development. It creates lines around which urban areas can grow or develop, while the corridors provide ecological and social connections. This project will mainly work with the framework approach. Providing a network based around water, ecology, and recreation. Occasionally corridors will be used to provide continuous connections through urban areas and connect the urban life with the surrounding landscape.

Hydrological landscape structure

Understanding the hydrological system provides insight into the build-up of the landscape, showing places of conflict and possibilities for development. Van Buuren and Kerkstra (1993) have developed an approach to use the understanding of the water system to find places with opportunities for connections and interaction. The method is developed for spatial planning, but it does provide a good stepping of point to identify areas of opportunity to design further.

Theoretical framework

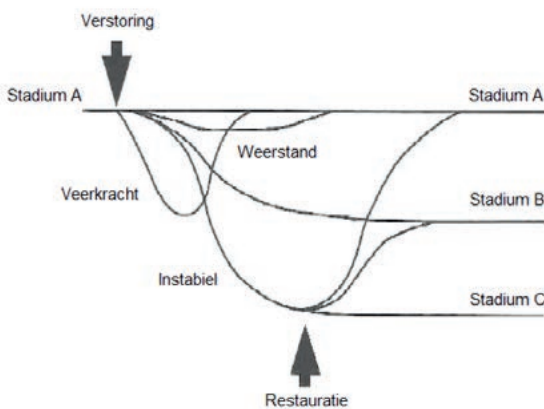
A National Park is about nature protection and making it accessible and recognizable for visitors. But what is nature? And what makes a landscape recognizable as part of something and why do we want people to have access to nature?

Nature

Nature is in this project seen as two things. The first is biodiversity. The diversity in species and genetics. This makes nature measurable. There is a need to keep the biodiversity as high as possible because there is quite likely a tipping point on which the biodiversity has gotten so low that is incapable of recovery and it will start spiraling down (IPBES, 2019). Losing much of what we depend on for nature; ecosystem services and human well-being.

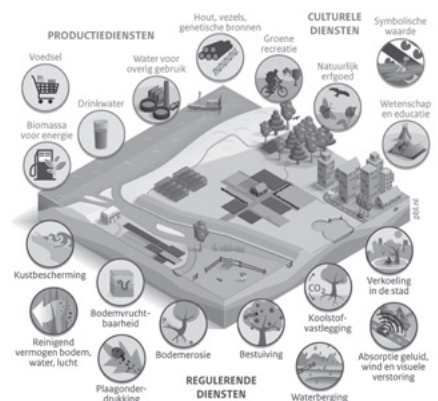
The second way of looking at nature is as a force. The force acts upon the landscape and creates natural processes such as sedimentation and succession. These natural processes provide for us so called 'ecosystem services' (Van Egmond & Ruijs, 2016). These are the things we depend on or gain from nature. This is for example keeping soil live active for good soils or nature's ability to filter pollution out of water. These ecosystem services provide a direct benefit for humans. And are therefore a good argumentation to invest in nature restoration and protection.

Ecological resilient and tippingpoints



van Wierdum, 1979

Ecosystem services



(Van Egmond & Ruijs, 2016 & CBS, 2021)

Landscape identity

landscape identity is the perceived uniqueness of a place. This preceiving has a both social and personal aspect and is based on interaction between spatial and social interactions (Stobbelaar & Pedroli, 2011). The social and spatial aspects can be used during design to create a landscape people recognize and feel connected to.

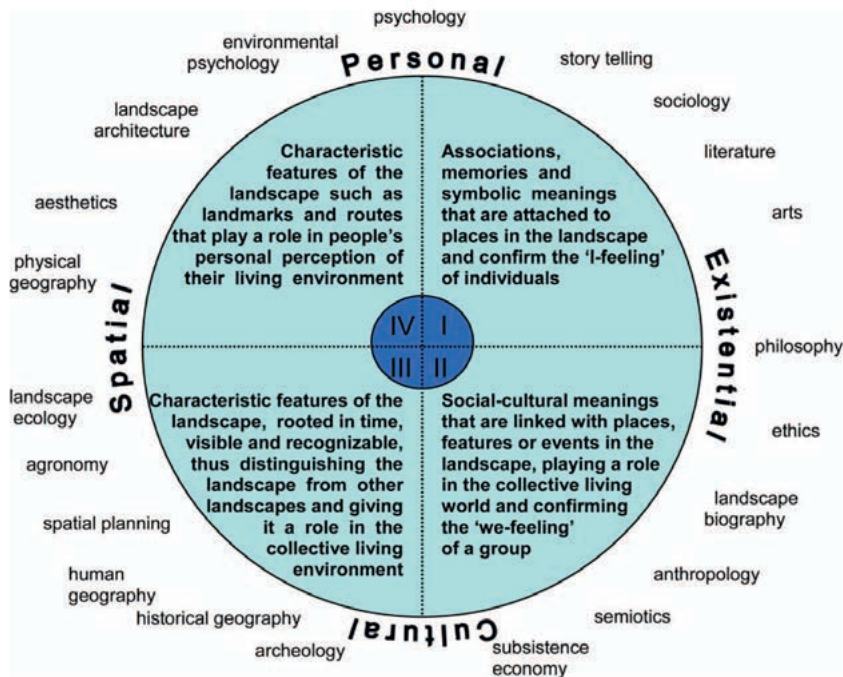
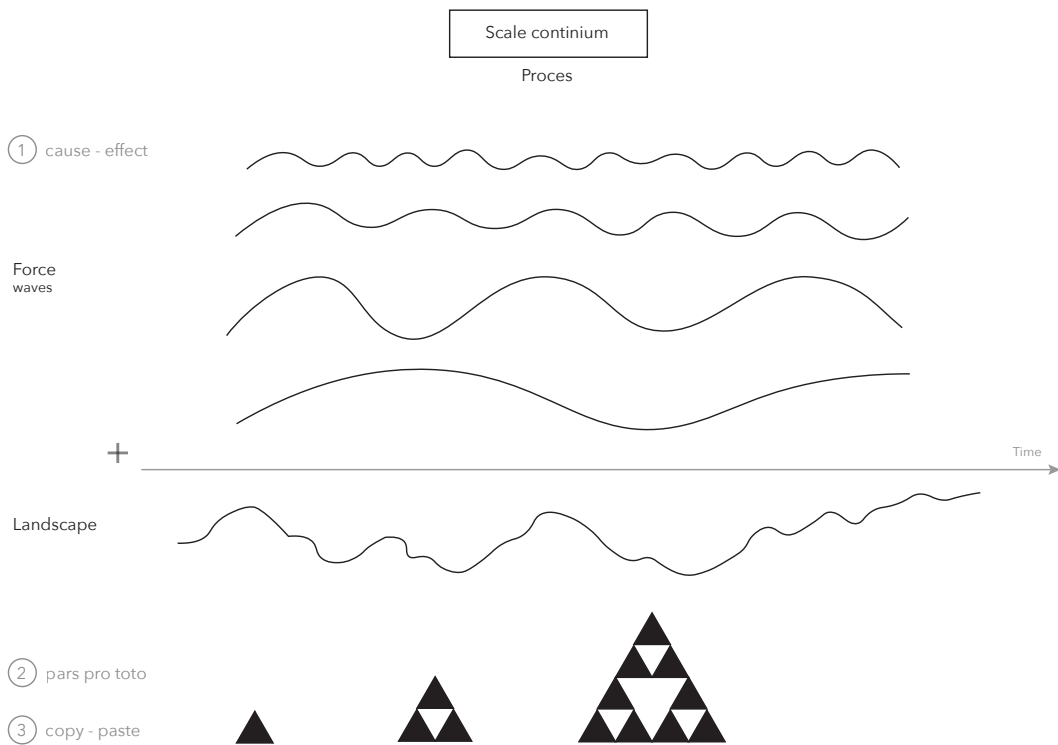


Figure 1. The Landscape Identity Circle: landscape identity laid out on two axes of spatial–existential landscape identity on the one hand and personal–cultural landscape identity on the other (Stobbelaar & Hendriks, 2006). Scientific disciplines involved in landscape studies are placed around (outer sphere).

(Stobbelaar & Pedroli, 2011)



The three parts of scale continuum

The 4 landscape architecture principles

This project is part of the graduation lab: Landscape Architecture Principles. This aims to stake out the four corners of landscape architecture, which are divided as scale continuum, palimpsest, natural processes, and bodily experience. The idea is that each year the graduation project of this lab will focus on one of these four principles whilst keeping the others in mind. The graduation project collected at the end of the four years will together provide a better understanding and an overview of the four lenses. This year the focus is on the scale continuum.

Scale continuum

According to Kahn and Burns (2005), a site has three distinct areas. The area of

control is the area on which the designer has direct influence to create and re-shape. The area of influence is the total area surrounding the site that has influence on the design plot. And the area of effect is the area on which the design will have an impact.

Understanding these areas allows the scale continuum to be used in analysis and design. There are here again three methods. Pars pro toto; whereby a singular site acts as a representation of a large-scale phenomenon. Cause-effect; whereby the intervention on the site has a larger effect on the surrounding landscape. And Copy-paste whereby the repetition of an element or action creates a larger landscape with a coherent identity.



De Grote Peel, which can be seen as the source of the Aa
Image by author

3. analysis





The Leigraaf between Erp and Volkel
Image by author

3.1 Landscape history





A tributary of the Aa near the Peelrandbreuk
Image by author

Landscape formation

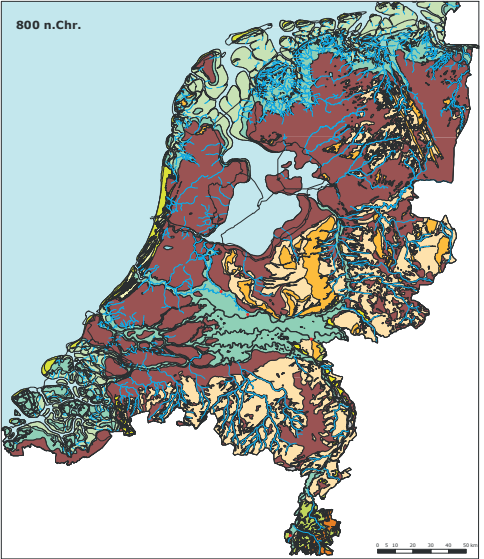
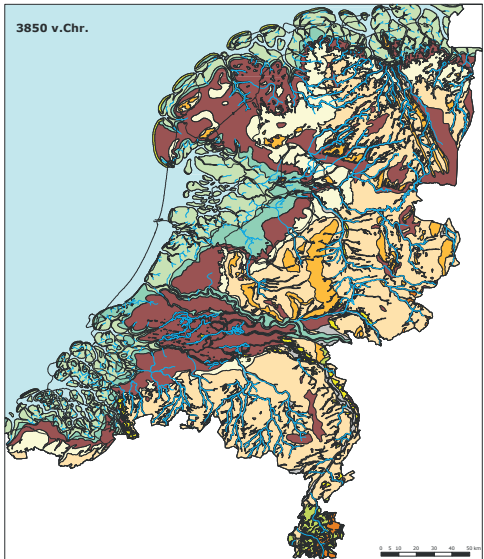
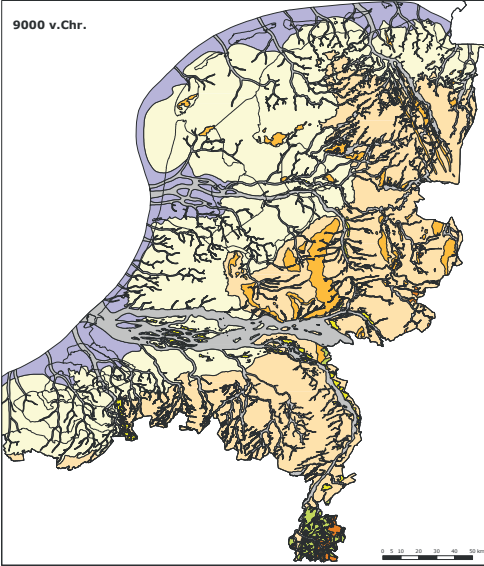
The Aa is situated in the eastern part of the Roerdalslenk flowing south to north with the higher ridge of the Peel horst forming the eastern boundary. This height difference is caused by cracks in the tectonic plates below. Around 150 to 200 million years ago the Peel was being pushed up relative to the sinking Roerdalslenk. Precursors of the Rhine and Meuse which flowed back then through this valley deposited layers of coarse river sand and gravel.

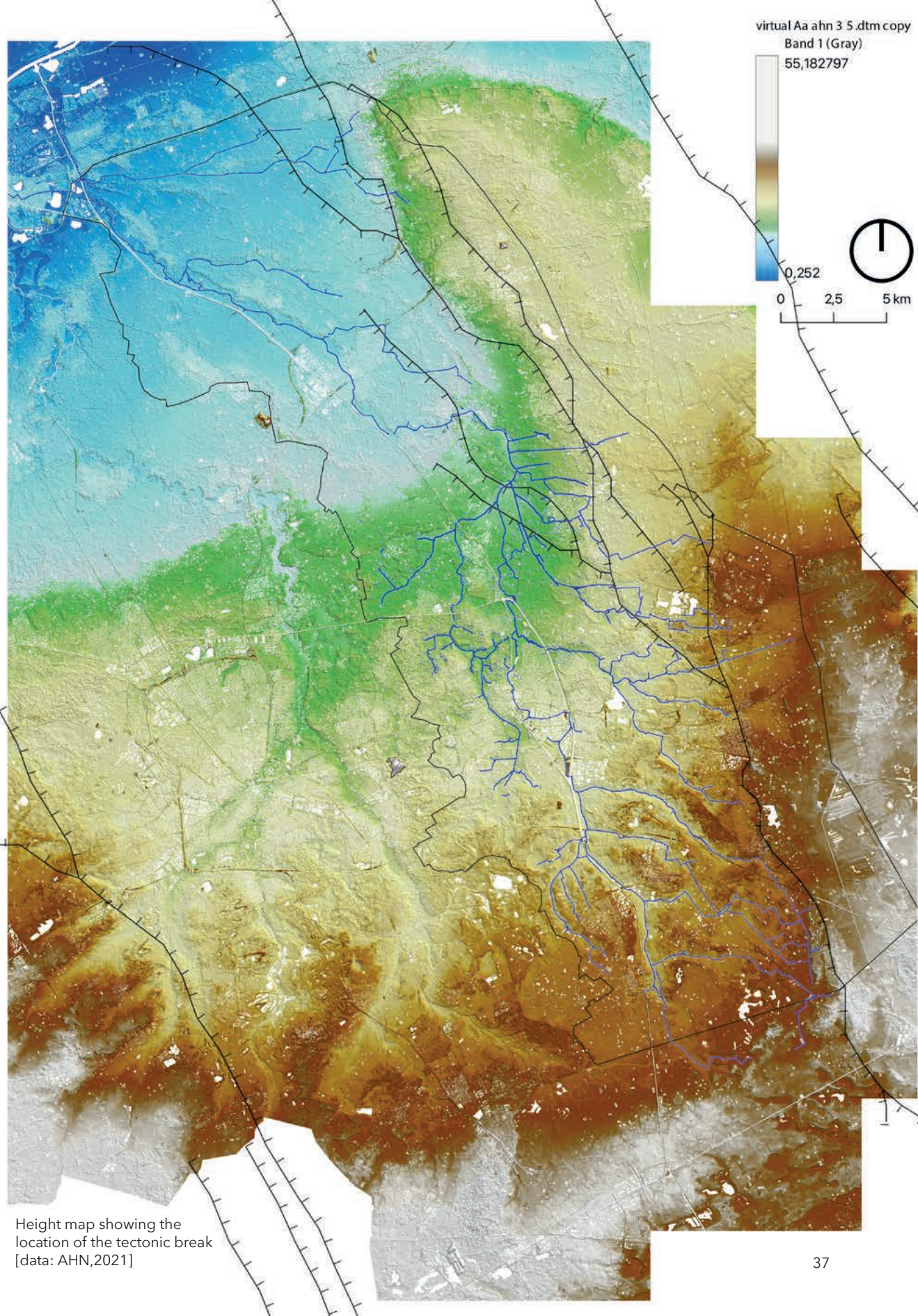
During the Weichselian there was a dry tundra climate in the Netherlands. Causing there to be large open sandy planes from which the wind brought sand and loam sediment to North-Brabant. Where the sediment would be trapped in thermokarst lakes. Creating pockets of loamy soils in the otherwise mostly sandy landscape.

At the end of the glacial period, the predominate north-western wind brought new sand. Creating sand ridges and dunes. These caused several meters of height difference in the landscape forcing diversions and bends in the new streams. Melting water from the higher laying surroundings fed these streams, creating the stream land in Mid-Brabant. (Ecologische Kring Midden-Brabant, 2011)

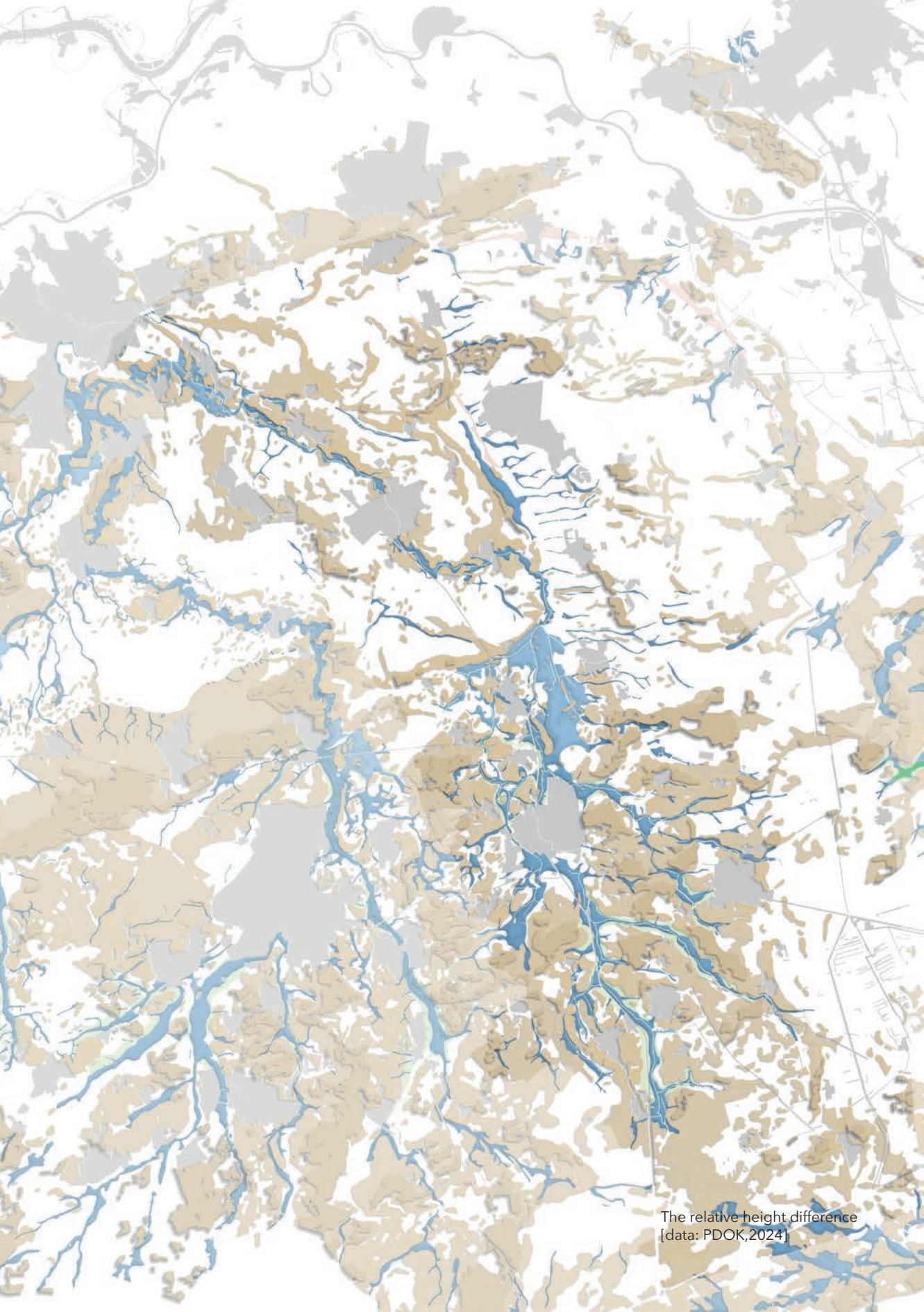
With rising temperatures forests started to develop in the valley. With Black alder, willow, ash, and Elm in the wetter areas and Oak, birch, and beech on the higher sand ridges and dunes. Whilst on the higher laying horst of the Peel a peat landscape developed. Stream dynamics caused erosion on the ridge's edges and formed sedimentation plains with this fine-sanded brook loam in the lower parts. Along the stream, stream following peat was developing. (Visscher, 1975)

Images: Paleographic maps shows the peat growth on the sandy stream landscape (Rijkdsdienst voor cultureel erfgoed,2022).





Height map showing the location of the tectonic break [data: AHN,2021]



The relative height difference
[data: PDOK,2024]

Cultural landscape history

Between 9000 and 5000 years BC. the landscape developed from an open landscape into a forested landscape, flanked by a vast peat landscape on the higher laying Peel horst. Within the valley local peat development along the stream. Permanent settlements in this area started around 4300 BC (Ecologische Kring Midden-Brabant, 2011). The settlers started clearing forests to use the fertile forest soil for agricultural purposes. This started mostly near water, as the stream sedimentation has made the soil more fertile. Around 2000 years BC the landscape was still half open and half forested, but by 500 BC the landscape was a large majority cleared (Arts, 2020). With large open grass and heathlands and dotted with small settlements surrounded by arable land with wooded banks. The forest that was left was mostly on the wettest parts in the landscape. Land to wet for agricultural use.

By the Middle Ages, the land use became more organized. Settlements are concentrated at the flanks on the boundary between the wet stream landscape and the drier sand ridges. This created an organized landscape around natural conditions. With a wide stream down in the valley, which varied in size based on the seasons. The wetland around the stream was used for cattle grazing where and when possible.

On the higher grounds, the peat was drained. Making it temporarily useful for agriculture. But without the peat holding the water, the landscape became increasingly dry. This together with leaching, causing the loss of nutrients in the soil, changed this peat landscape into dry heather. Sheep grazing was introduced on this heather to collect podzol, which is then used as fertilization on the agricultural land around the settlements. These layers of podzol raised this land over time creating 'essen' and 'esdor-

pen' (villages on these raised lands). Settlement mostly grew on the sloped areas between the wet landscape below and the dry heather landscape above. The fields and meadows of farmers were separated by treelanes and hedges. The planting of these was a consequence of the introduced right to plant, own, and sell the trees at one's field edge ('voorpootrecht' in Dutch). This was introduced to combat the wood shortage which arose after all the deforestation. Creating over time a huge network of tree lanes and hedges. Turning much of Brabant into a 'coullissen landscape' (Visscher, 1975). Around this period Castle and watermills started appearing in the landscape. These played an important role in the cultural landscape structures. Thereby shaping the landscape around them (Visscher, 1975).

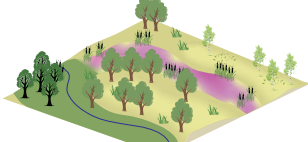
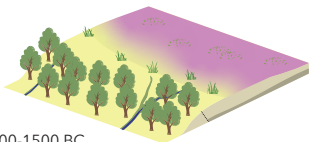
The still existing coulissenlandscape around the Castle of Heeswijk. (Data: openstreetmap and AHN)



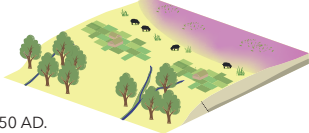
Horst & flank

Stream valley

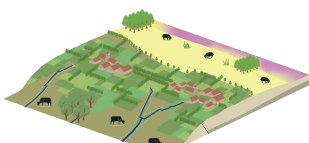
9000 BC.



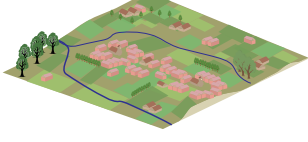
5500-1500 BC.



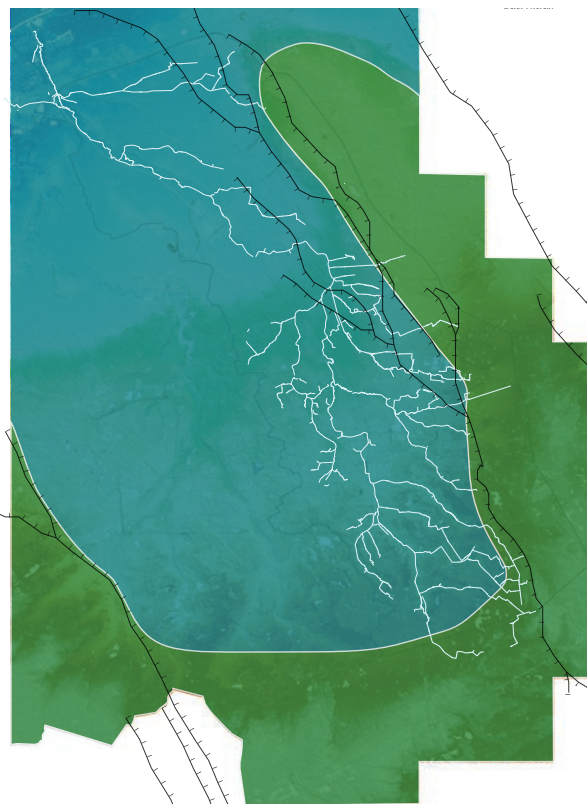
1250 AD.



1500-1800 AD.



2024 AD.



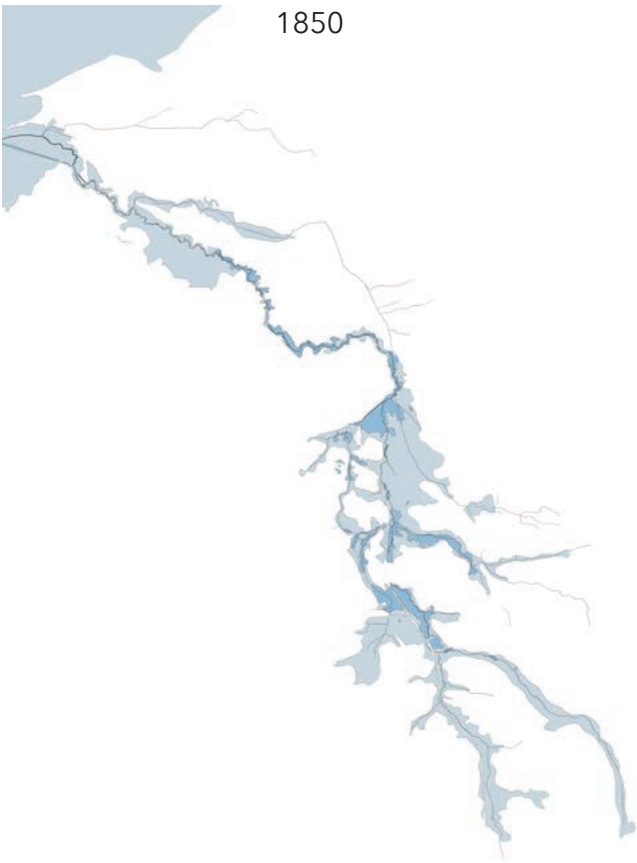
Map from 1900 showing from left to right: the stream, wet meadows, agricultural land, strip with villages and forest, and heather. (Kadaster, 2004)

Conclusion landscape development

Around 1850 human activity is abundant in the landscape but the Aa holds for a large part its natural shape and dynamics. Wet areas are not drained but adapted to. Cattle grazing on the wet fields makes them productive. The use of hedges and tree lanes as field dividers is not only useful for wood production but also provides much ecological and cultural value.

The higher grounds with their pine-production forests disrupt the resupply of groundwater and hold little ecological value, but this can be changed by transitioning this forest back into the original native forests with deciduous tree species.

This historical look shows opportunities where in the landscape there is potential to integrate a restored water management system, with ecological, and recreational value in a human-used landscape. The stream, the wet areas, and the higher dry landscapes hold potential for improvement, leaving the majority of the area in between for more intensive human activities such as agriculture, urbanisation, and infrastructure.



2020



2000



1950



1900



1850



1820



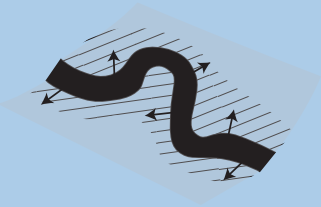
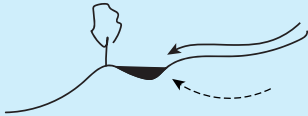
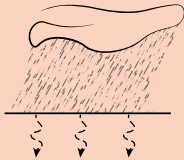






Landscape development from 1820-2020. Form a diverse to a mostly monotonous landscape.
With a schematic section depicting the landscape of 1900. [Data: Kadaster, 2004]

Nine design modules

The three landscapes of the stream, the wet areas, and the higher dry landscapes are taken as locations to make the design. Looking at these three landscapes through the three lenses of the sub-research questions about hydrology, nature, and recreation gives nine different components. These nine later lead to the design modules from which the masterplan will be built up.

Structure of design modules

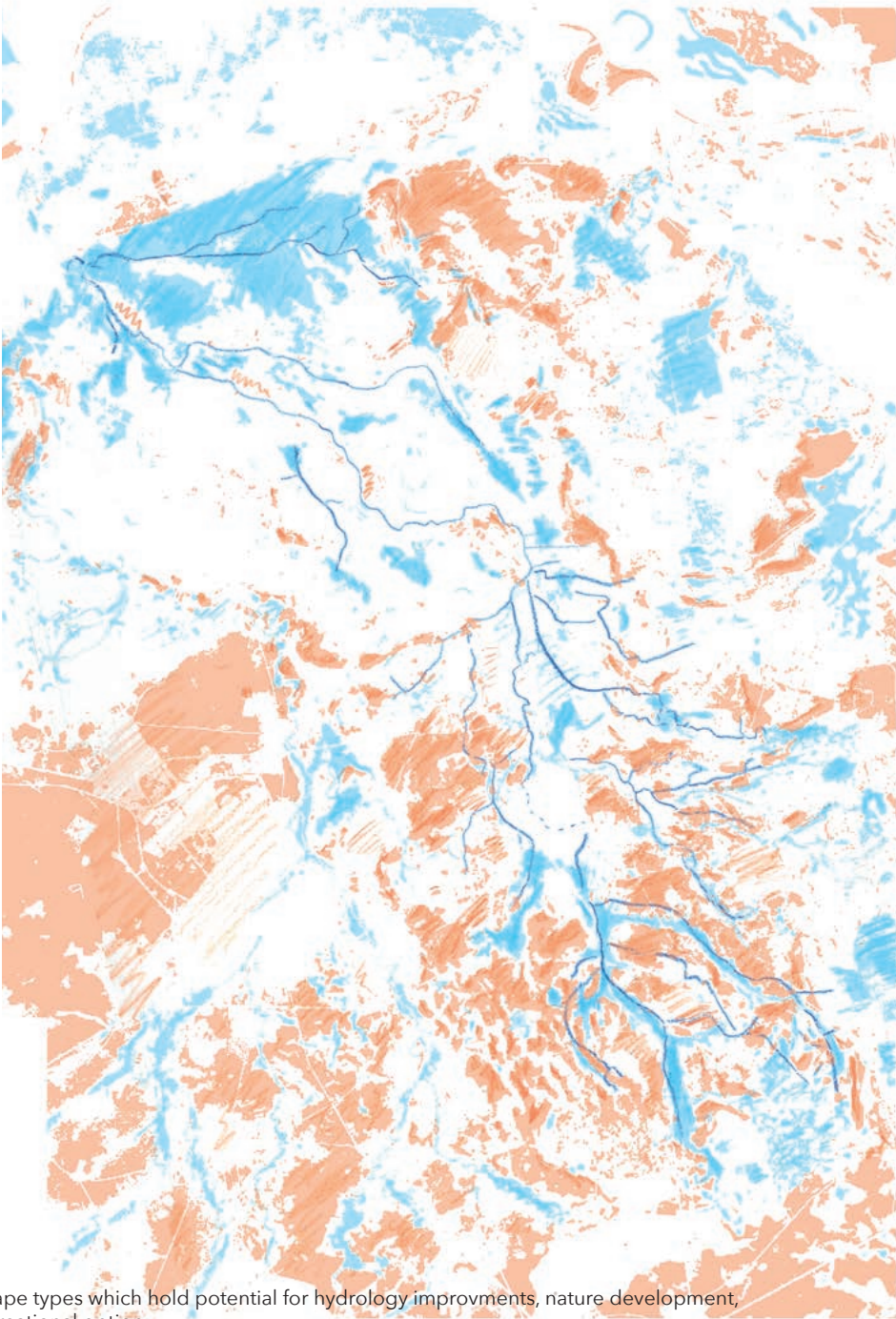
Landscape type

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Stream

Wet areas

Higher areas



Landscape types which hold potential for hydrology improvements, nature development, and recreational option.

3.2 Landscape diagnosis





The Aa near Beek en donk
Image by author

Hydrology

Shortage

The hydrological system of the Aa is under increasing amounts of stress. The map on the next pages shows the increasing water shortages around the Aa. The hedges on the map show the surface water shortage during an average summer. This is only the shortage during an average summer, with increasingly extreme weather and hotter summers because of climate change the likelihood, amount, and duration of water shortage will only increase (Smit & Hoogenraad, 2024).

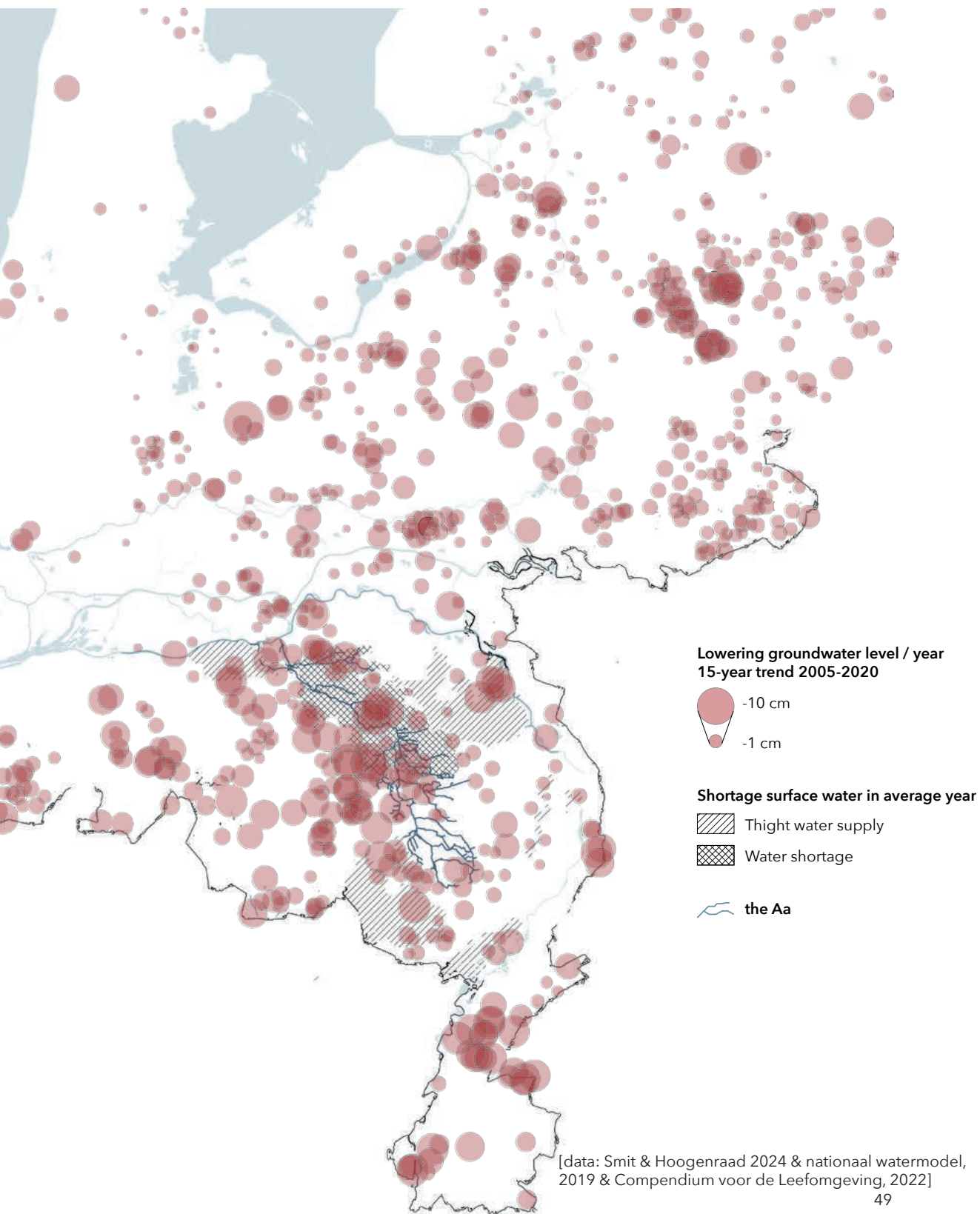
The increasing surface water shortage is caused by a high amount of drainage, a lack of water retention upstream, a loss of surface water to evaporation due to the lack of tree shading over the stream, and increasing water use for drinking water, agriculture, and industry (Verdon-schot, 2000).

The red dots show decreasing groundwater levels at monitoring wells over a duration of 15 years. Many wells around the Aa show a decrease trend of 10 cm a year, meaning a total decrease of groundwater level of 1,5 meters between 2005 and 2020.

The decrease in groundwater level is for a large part caused by increased pumping. But with a decreasing infiltration of surface water to the groundwater, is the groundwater also not being regenerated (Smit & Hoogenraad, 2024).

With both a surface water shortage and the decreasing groundwater level, a complete water shortage around the Aa is more likely.





Surface water

What was once a free-flowing stream, is now canalised, managed to efficiently provide water for agriculture in the summer and to discharge rainwater quickly in the winter (Terra Incognita, 2016). The image on the right page shows the difference in width the stream could take between 1850 and now after the stream has been normalized. A much wider stream allows for more fluctuation in water the stream can store, allowing the stream to catch more water during precipitation. This buffering of water in the stream creates more surface water and causes more water to infiltrate the groundwater (Makaske et al. 2020).

Over time the Aa was transferred in such a way as to maximize control and the ability to consistently supply water for agricultural purposes. This attitude to water management can be shown in the map below. Showing the locations of weirs and closing gates in the Aa and Dommel. At the Dommel, there is the attitude to let the stream flow freely and to only intervene by closing gates in more extreme situations. While at the Aa the weir always maintains a certain water level and flow, therewith limiting stream dynamics, ecological quality, and the stream’s ability to react to and buffer changing situations. This ability to control is also the reason why the Aa has been canalized, ‘normalized’.

The section on the right page below shows the act of stream normalization. During stream normalization, the stream is made narrower and deeper with steeper banks. The higher and flatter water banks made agricultural use all the way to the water edge possible. And the heavily managed and controlled water system made supplying water for agricultural usage easier. Furthermore, did the deeper stream increased the

drainage capacity, but in cases of high water inflow, this can cause problems downstream (Verdonschot, 2000). This can be combatted by holding more water upstream, but a channel with steep banks has little room to hold more water. Therefore, the Aa is too reliant on a couple of large man-made water buffer spaces to store excess water when the throughput gets too high (Terra Incognita, 2016). These water buffers are only built to store excess water during high precipitation, not to keep more water in the system to combat droughts.

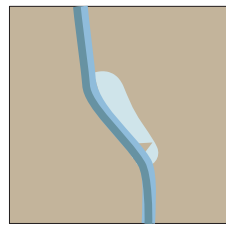
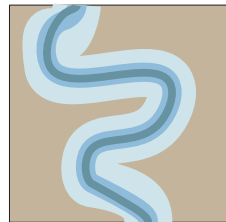
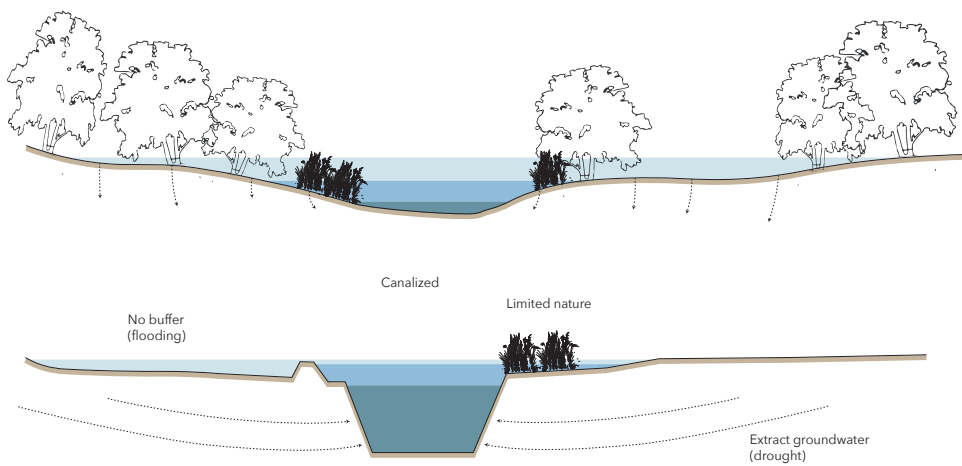
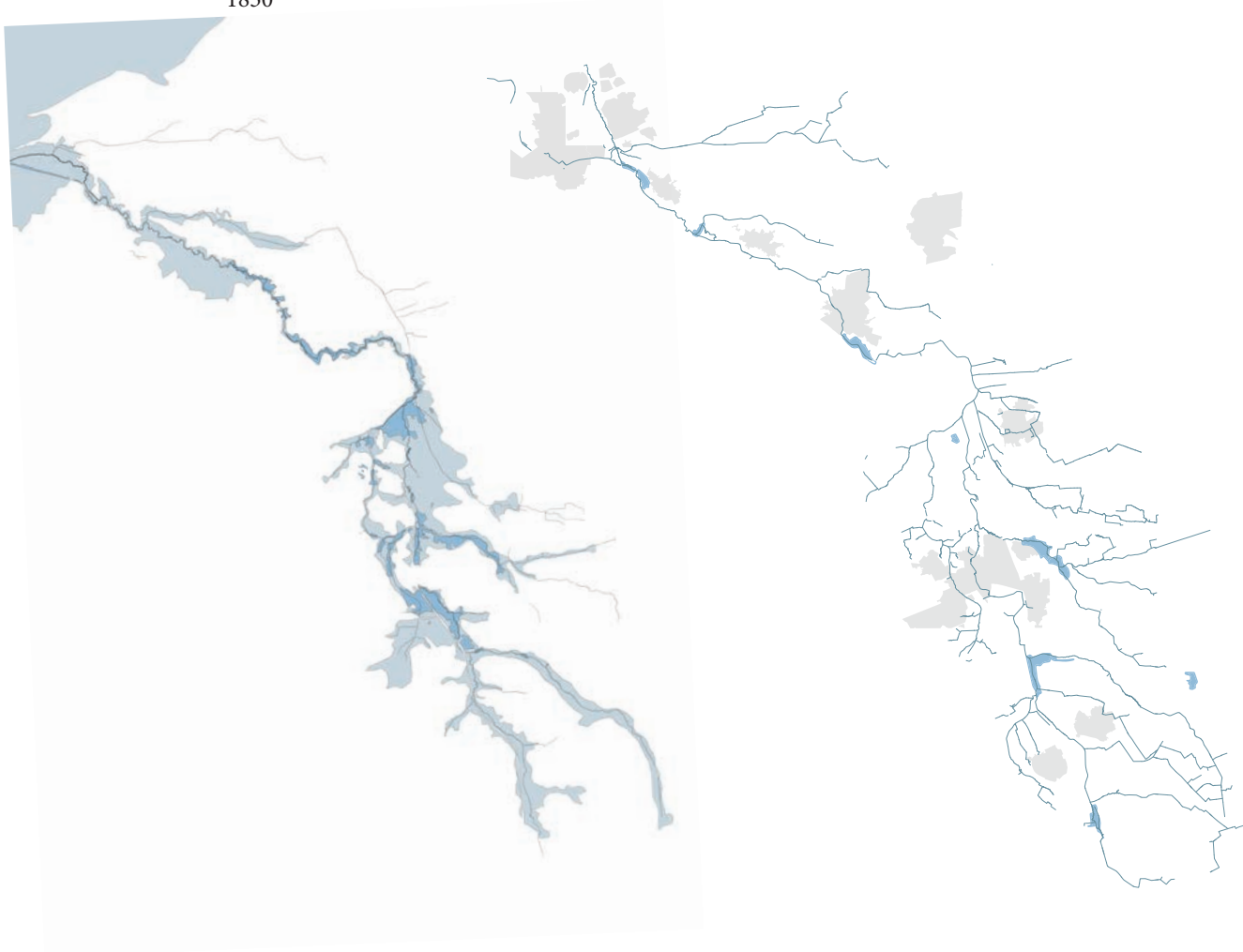
The deepened channel causes the groundwater to be drained into the stream. The draining of the groundwater is catastrophic for vegetation dependent on it. Together with the removal of the floodable areas next to the stream, which represented a dynamic atmosphere on which certain plants and animals have specialized, caused a huge loss of biodiversity around the stream (Makaske et al., 2020).



[Data: Pdok, 2024]

1850

2024



Top: The room for the Aa before and after stream normalization [data: kadaster, 2004 & PDOK, 2024]
Below: Normalization of the streambed

A wide, shallow channel could hold more water in its width, has slower flow rates due to its limited depth, and has more surface for water to infiltrate into the groundwater. But this would require more space around the stream. Space where highly efficient farming would then no longer be possible. Seasonal grazing and mowing would still be possible. The waterboard is currently looking into widening the stream and giving it more space between Helmond and 's Hertogenbosch. But these plans are still in the early stages. They are talking now about 50 meters on either side, but they might need 200 meters on either side (Terra incognita, 2016).

The canalized stream of the Aa with its many weirs holds little opportunity for stream dynamics. If there were stream dynamics, then natural processes such as erosion, sedimentation, and meandering could take place. These processes would create a more natural stream with more ecological and experiential value.

Ground water

The shortage of surface water means an increasing reliance on groundwater both for nature and our drinking water (Smit & Hoogenraad, 2024). A large part of the groundwater should replenish from rainwater on the higher grounds, but this has been too little the past decades

By the beginning of the 19th century, the system of sod fertilization was stretched to its maximum. With the introduction of artificial fertilizers and the dropping of wool prizes the use of sheep grazing on the heather fell into disuse. Removing the interaction between heather and agricultural land. Leaving the heather as a wasteland. This large open landscape came to be dominated by wind and sand drift (Ecolo-





The Aa near Koks with only a strip of grass separating the Aa from agricultural land. Image by author

gische Kring Midden-Brabant, 2011). This was eventually combatted with the planting of monotonous production forests of conifers such as the *Pinus sylvestris*. These grew quickly and were useful as support beams in the mining industry, but these forests hold very little ecological value and disrupted the groundwater supply. Conifers catch much rainwater in their foliage and let it evaporate from there. This rainwater does then not reach the ground to infiltrate. Depriving this water from the groundwater (Jansen & Olsthoorn, 2003). Leading to an eventual groundwater shortage (Van Linge et al., 2020).

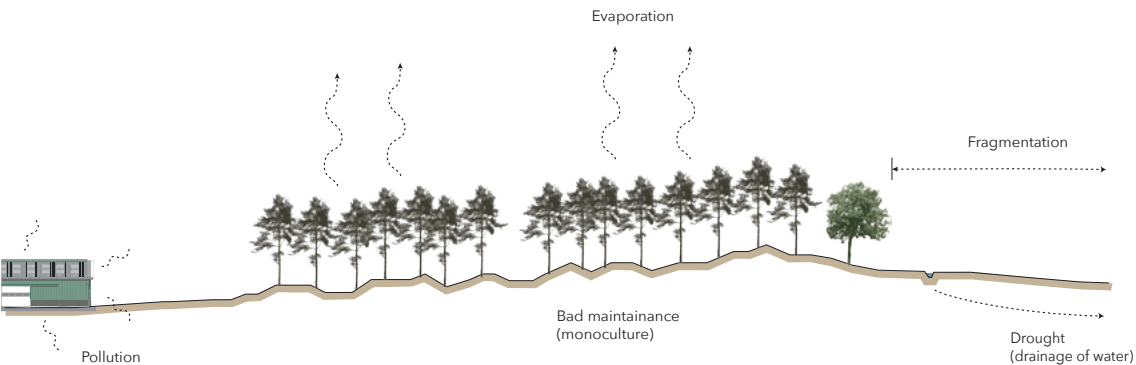
ZuidWillemsvaart & pollution

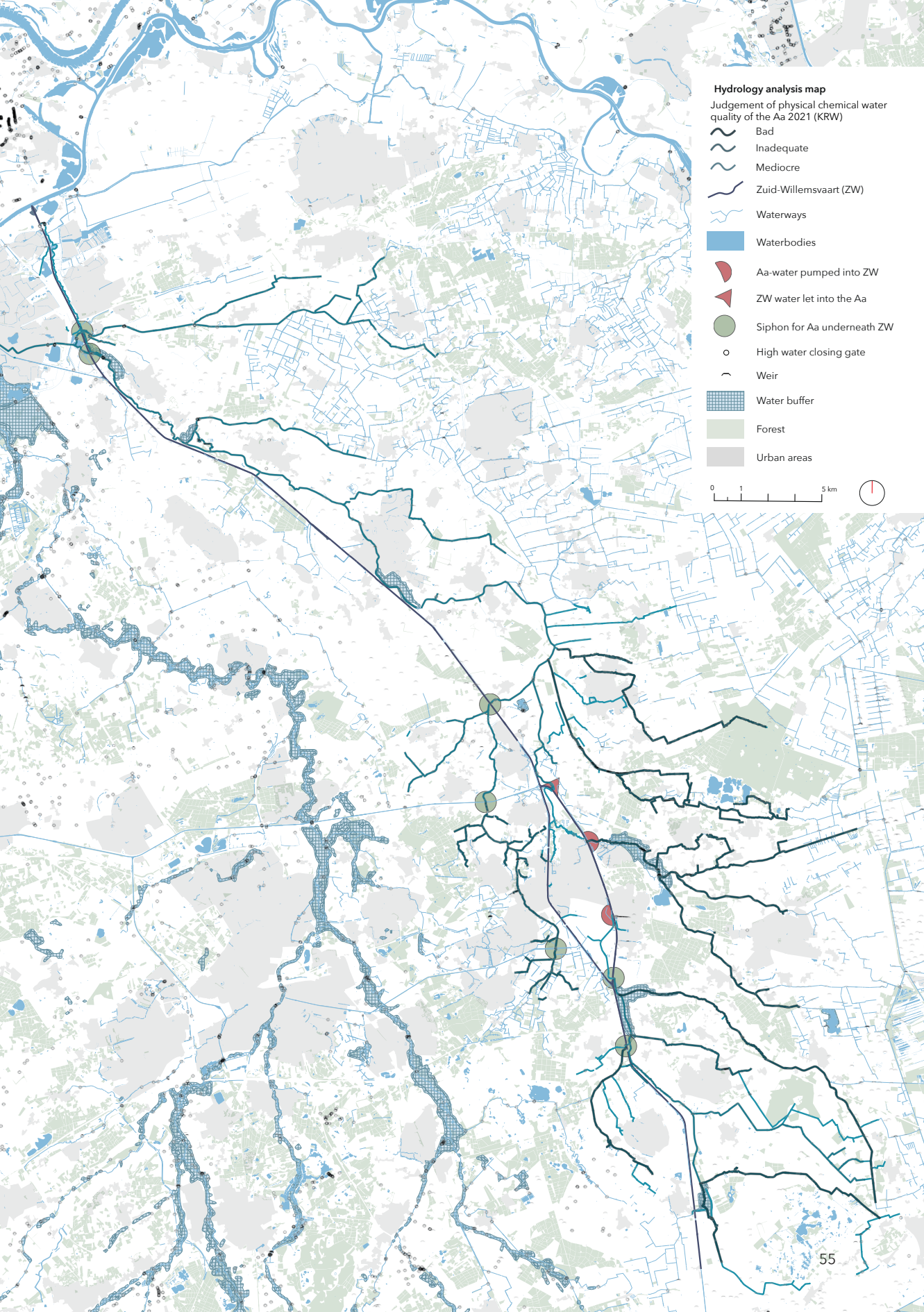
The Zuidwillemsvaart was built in 1826 from 's Hertogenbosch to Dieze (South-Limburg) as a reliable alternative for the Meuse (Bijl, 1988). A channel cutting through Brabant with locks made shipping more reliable. But this channel cuts through the Aa watershed. In multiple places, the Aa stream or side streams are being disrupted by the Zuidwillemsvaart. In most locations, the waters are kept separated with the Aa going underneath the Zuidwillemsvaart via siphon. This preserves the water quality of the Aa, but a siphon does not create much of an ecological and recreational connection. At the east side of Helmond, a new channel was built in 1993 cutting the Aa again. Here, it was chosen to divert the Aa water into the

new channel and mix it with the water from the Zuidwillemsvaart. Then further downstream (on the north side of Helmond) Zuidwillemsvaart water is let back into the Aa stream system. This does not only create a break in the stream, it also allows pollution for the Zuidwillemsvaart into the Aa (Van Linge, 2020).

The Aa is currently not up to the quality guidelines (KRW) (Compendium voor de Leefomgeving, 2022). But even if the water quality in the Aa would be improved, mixing it with Zuidwillemsvaart could still pollute the water from other sources. To improve the water quality in the Aa the most important thing is to reduce emissions at the source. This is mostly from agriculture (Gies et al., 2019). Where surface and groundwater take nutrients and chemicals from the field into the water system. A more natural and wider stream could better buffer and filter the nutrients getting into the water system (Verdonshot, 2000).

This purely functional stream holds almost no cultural or recreational value. Stream restoration of the Aa is necessary to deal with the increasingly dire state of the Aa. Stream restoration means giving the water more space and restoring stream dynamics. Maintaining more surface water upstream, replenishing groundwater, and improving the ecosystem in and around the stream to improve biodiversity.





Nature

It is clear that the current state of nature in the Netherlands is poor (RLi, 2022). With a decreasing amount of area designated for nature protection and a decrease in biodiversity. Populations of vulnerable species are decreasing, and the Netherlands is doing the worst in the EU with nitrogen and phosphor deposition (CBS, 2021 & CBS 2024). There are six main reasons for biodiversity loss in the Netherlands these are: (Adams et al., 2020).

- Fragmentation of habitats as a consequent of the building and expanding of urban areas, infrastructure, and agriculture.
- The spread of milieu dangers chemicals, eutrophication, and acidification caused by industry, agriculture, and traffic.
- Desiccation by increasing droughts, caused by agriculture, drinking water abstraction, and climate change.
- The displacement of native species by invasive exotic species.
- Overexploitation by activities such as fishing and grazing and depletion of the soil by agriculture.
- Bad maintenance of roadsides and waterways.

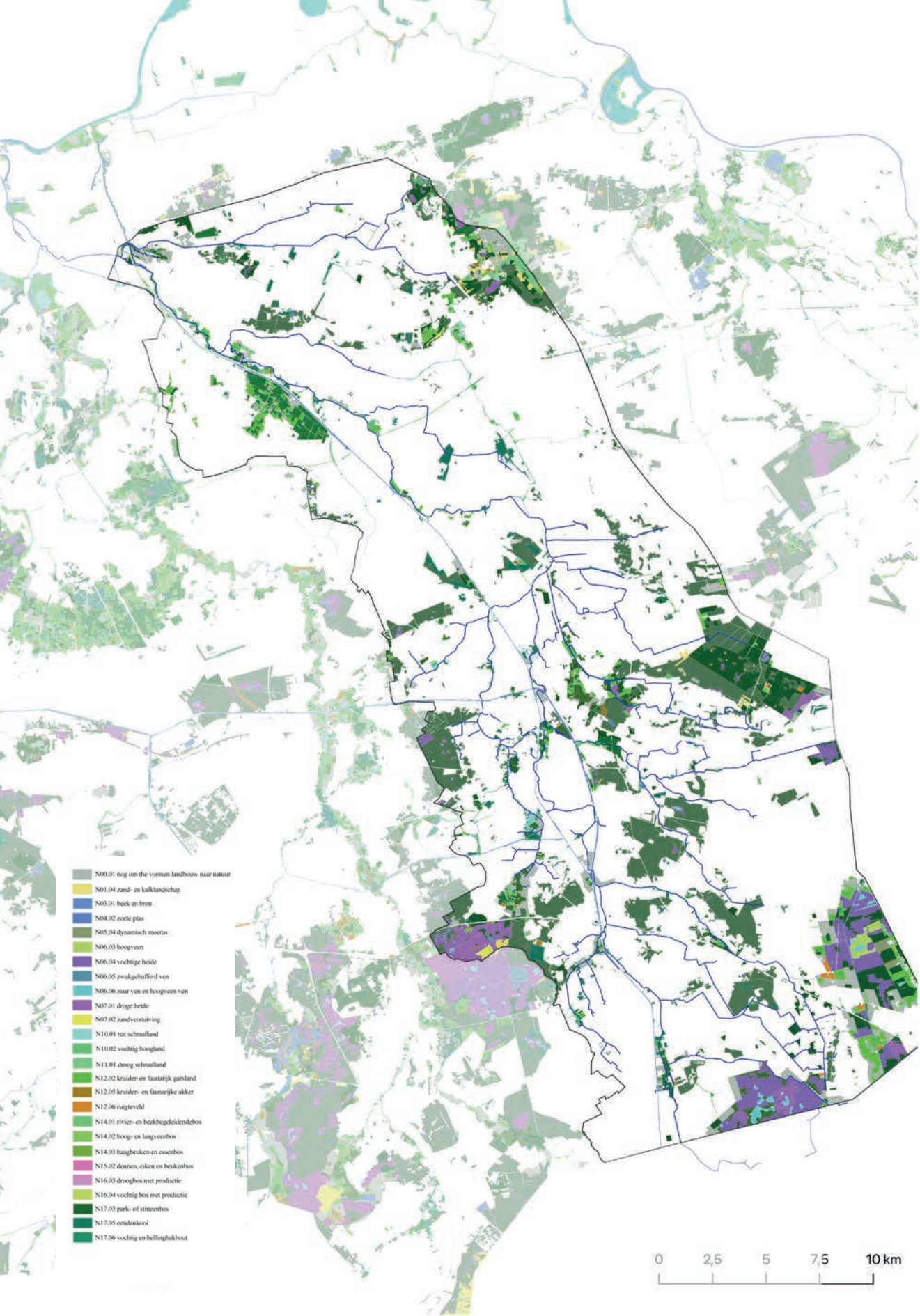
To get an exact look at the state of nature in the catchment area of the Aa is difficult as most published reports are about existing nature areas of which there are too few around the Aa. But there are some nature areas around the Aa as part of the Natuur Netwerk Brabant (Provincie Noord-Brabant, 2024). Most of these nature areas are (former) production forests and nature-inclusive grassland. In the south, there are three larger natural areas of which the eastern two are peat areas as part of the Peel and the one in the west is heather on the higher grounds south of Eindhoven.

Around the Aa itself, nature is lacking compared with the neighbouring Dommel. This is mostly caused by more intensive agricultural use around the Aa pushing way and fragmenting natural areas.

Biodiversity

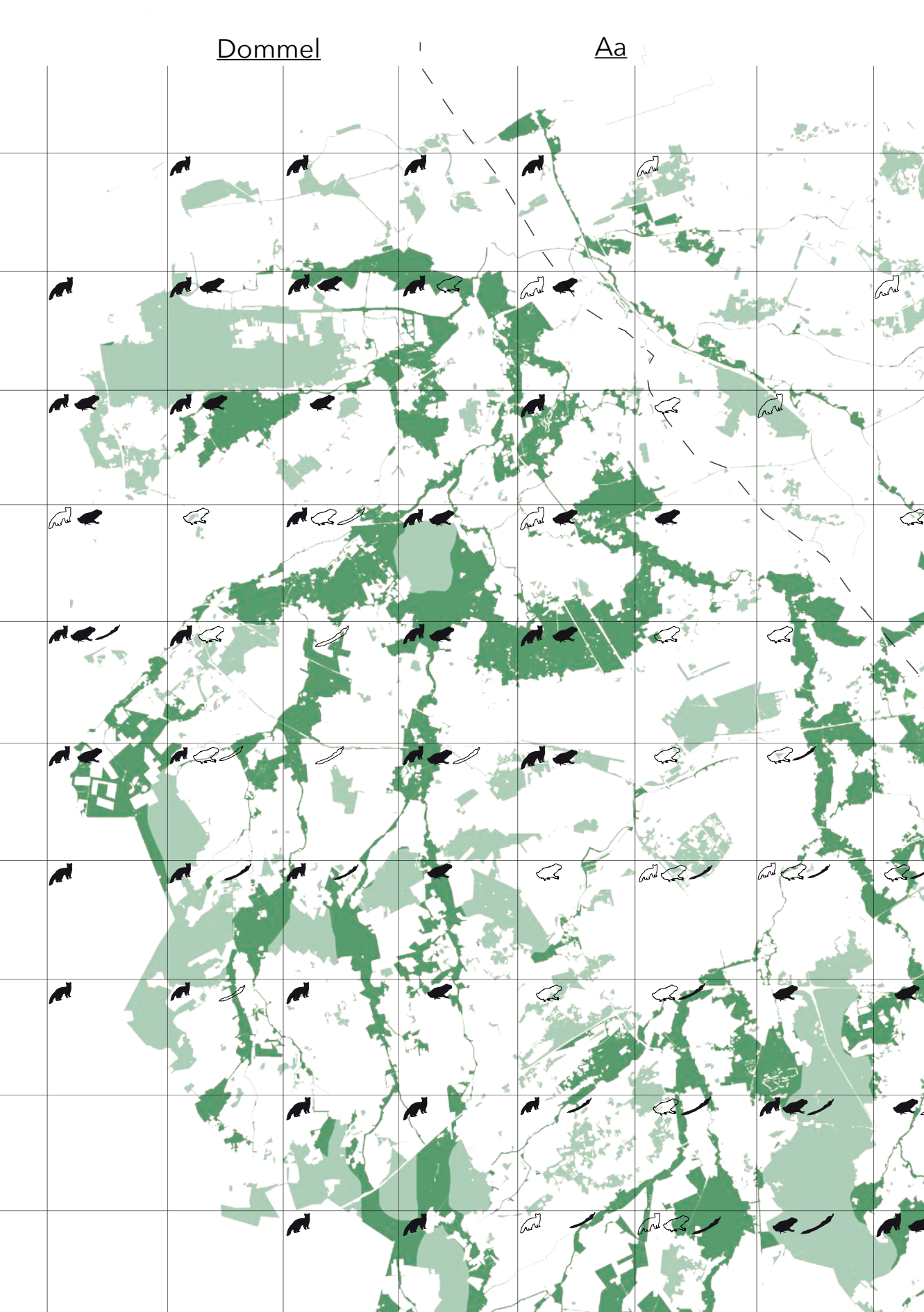
Fragmentation is a major cause for biodiversity loss. A stream could be used as a good connecting corridor between nature areas. But comparing the Dommel and the Aa shows how this opportunity is too often left unused by the Aa. The map on the next pages shows the natural areas in the catchment area of both the Dommel and the Aa, how much of these natural areas are connected via the stream. It also shows the distribution of three indicator species and were they disappeared since 1990.

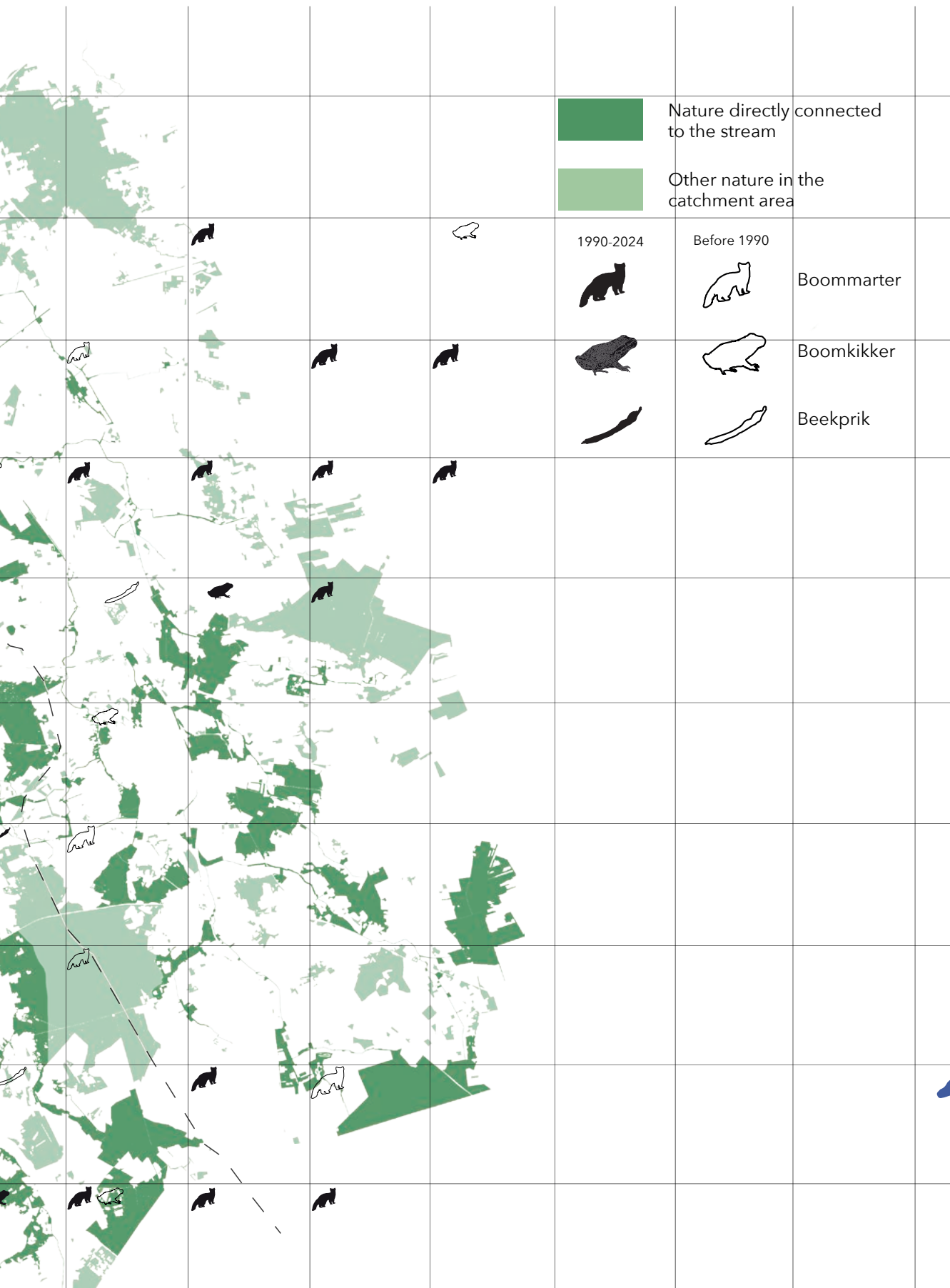
The three indicator species shown are the Boommarter (Pine marten), Boomkikker (European tree frog), and the Beekprik (Brook lamprey). The species each indicate the health of different biotopes. The theory is that if the indicator species are doing well in an area the quality of that niche is good (Reijen & Koolstra, 1997). The Boommarter for the higher and dry sandy areas mostly covered by trees, the Boomkikker for the lower wet areas, and the Beekprik for the stream itself. The map shows separated populations and the mostly missing of populations in the catchment area of the Aa. The populations of Treefrog and Brook lamprey, even though small before 1990, have disappeared from the Aa completely now (Verspreidingsatlas, 2024). Only a population of Pine marten has established on the eastern side of the Aa. A better connected nature network can help species to (re)settle in the Aa catchment area.



Dommel

Aa



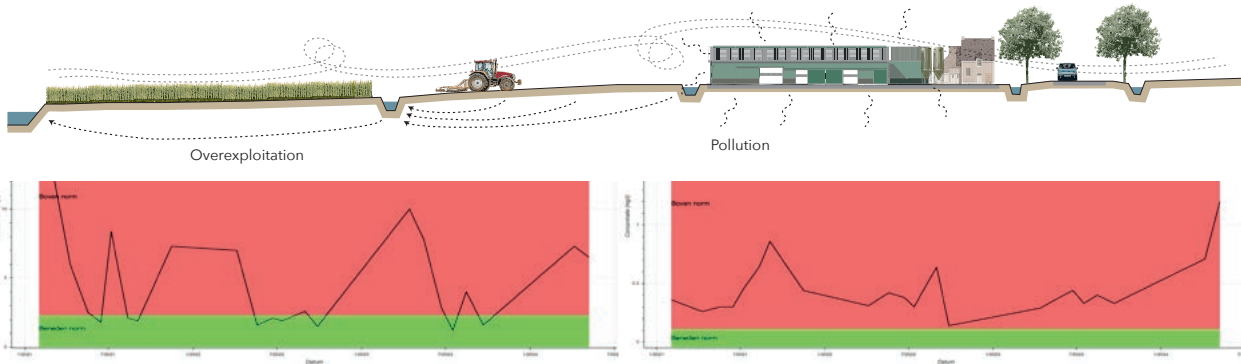


Pollution

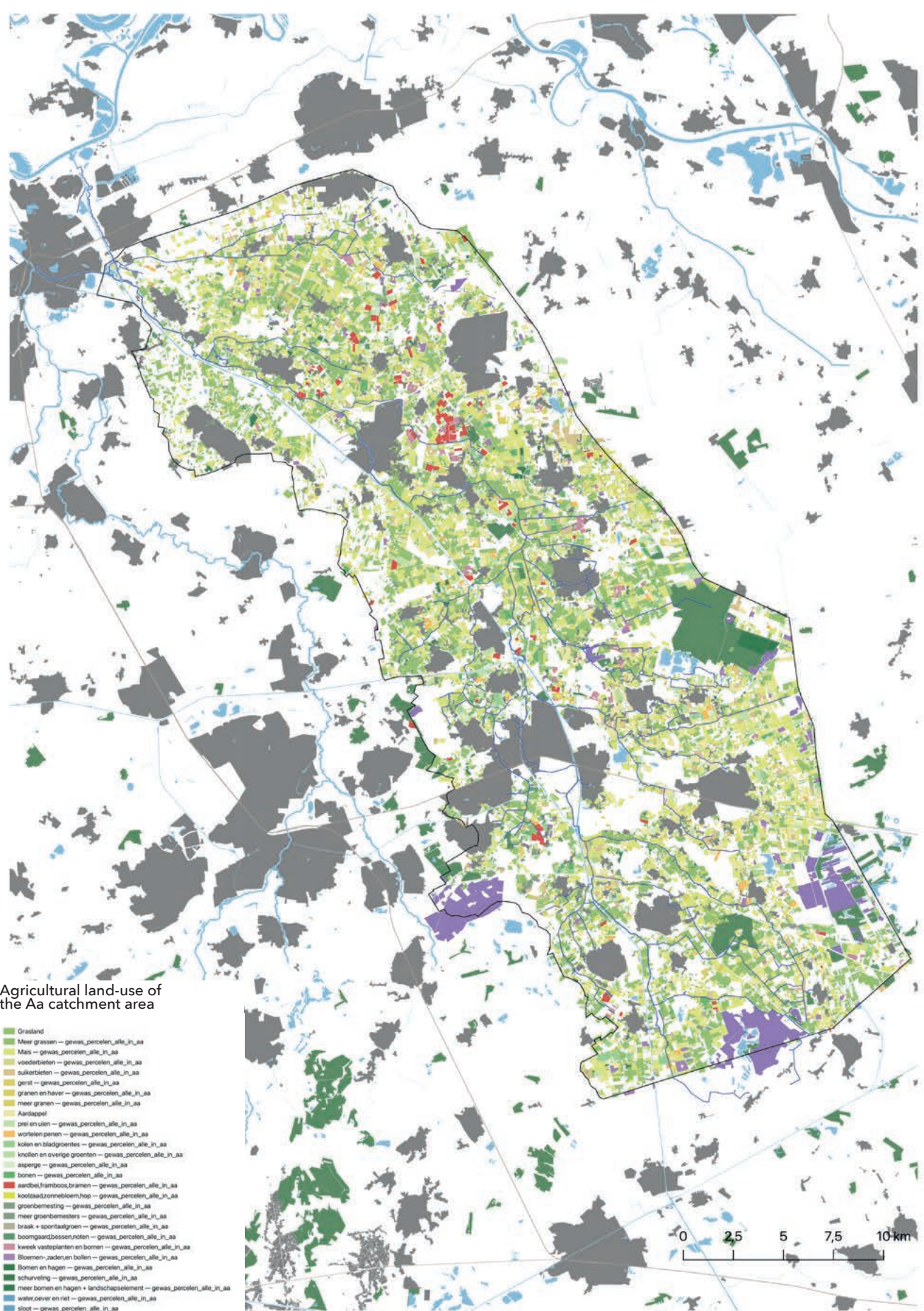
The important causes for nature and biodiversity loss are; pollution, drought, over-exploitation, and fragmentation (WUR,2019). Pollution is rampant around the Aa. To ensure clean ecosystems; KDW (critical deposition value) has been set for nature areas and a KRW for surface water. The Aa far exceeds its KRW (waterschap Aaenmaas, 2024). Most of the pollution comes from agriculture (Gies et al., 2019). The map on the right shows besides the KDW and KRW, the nitrogen deposition. Excess nitrogen deposition causes certain species to thrive, pushing out more vulnerable species thereby decreasing the biodiversity mainly in otherwise nutrient sparse nature areas (Bij12, 2023). The majority of the nitrogen in the Netherlands is produced by livestock. Around the Aa, we find a high concentration of pig farms, but also cattle, poultry, and other livestock (I-GO, 2024). Causing in area around de Aa one of, if not the highest nitrogen deposition of the Netherlands.

The mechanization of agriculture led to the need for scale enlargement. During re-allotment ('ruilverkaveling' in Dutch) many of the existing tree lanes, wooded banks, and hedges were removed. Waterways were removed or canalized (stream normalization) and slopes in fields were flattened (Terra Incognita,

2016). During this time the agricultural output grew massively. But destroying the ecosystem around tree lanes and hedges and around the stream and wet areas. Making the landscape vulnerable to droughts, flooding, pests, and decreasing soil quality (Van Egmond & Ruijs, 2016). There also was a shift in land use by farmers from more grazing livestock to putting livestock on a large scale inside and using the land for crops and animal fodder production. A couple of decades ago most livestock farmers owned their own land around their farm. Allowing the animals to graze outside and the fields to be used to spread much of their manure. However, increasing ground prices made it lucrative for livestock farmers to sell their land to crop producers and use the money to invest in enlarging their livestock (Goodijk et al., 2020). But without any land, these animals spend all their time inside and the farmers must look for ways of getting rid of their manure. Over time the amount of nutrients in the cycle grew. This increasing amount of nutrients in the cycle led to increasing amounts of deposition in the surroundings (Bakker, 2020). The consequence of this increased deposition is increased by taking away nature's ability to filter and buffer nutrients with the removal of landscape elements and gradients such as; hedges, wet areas, ->



Top: pollution of the landscape
Below: levels of nitrogen and phosphorus pollution in the Aa (AaenMaas, 2024)



Agricultural land-use of the Aa catchment area

- Grasland
- Meer grassen — gewas_percelen_alle_in_aa
- Mais — gewas_percelen_alle_in_aa
- voederbieten — gewas_percelen_alle_in_aa
- sukkerbieten — gewas_percelen_alle_in_aa
- gerst — gewas_percelen_alle_in_aa
- grainen en haver — gewas_percelen_alle_in_aa
- meer granen — gewas_percelen_alle_in_aa
- Aardappel
- prei en uien — gewas_percelen_alle_in_aa
- wortelen penen — gewas_percelen_alle_in_aa
- kolen en bladgroentes — gewas_percelen_alle_in_aa
- knollen en overige groenten — gewas_percelen_alle_in_aa
- asperge — gewas_percelen_alle_in_aa
- bonen — gewas_percelen_alle_in_aa
- aardbei,framboos,bramen — gewas_percelen_alle_in_aa
- koolzaad,zonnebloem,hop — gewas_percelen_alle_in_aa
- groenbemesting — gewas_percelen_alle_in_aa
- meer groenbesters — gewas_percelen_alle_in_aa
- braak + sportvelden — gewas_percelen_alle_in_aa
- boomgaard,bessen,noten — gewas_percelen_alle_in_aa
- keek vastplanten en bomen — gewas_percelen_alle_in_aa
- Bloemen-zaden en bollen — gewas_percelen_alle_in_aa
- Bomen en hagen — gewas_percelen_alle_in_aa
- schurveling — gewas_percelen_alle_in_aa
- meer bomen en hagen + landschapselement — gewas_percelen_alle_in_aa
- water,over en niet — gewas_percelen_alle_in_aa
- sloot — gewas_percelen_alle_in_aa
- natuurterreinen — gewas_percelen_alle_in_aa
- Overig

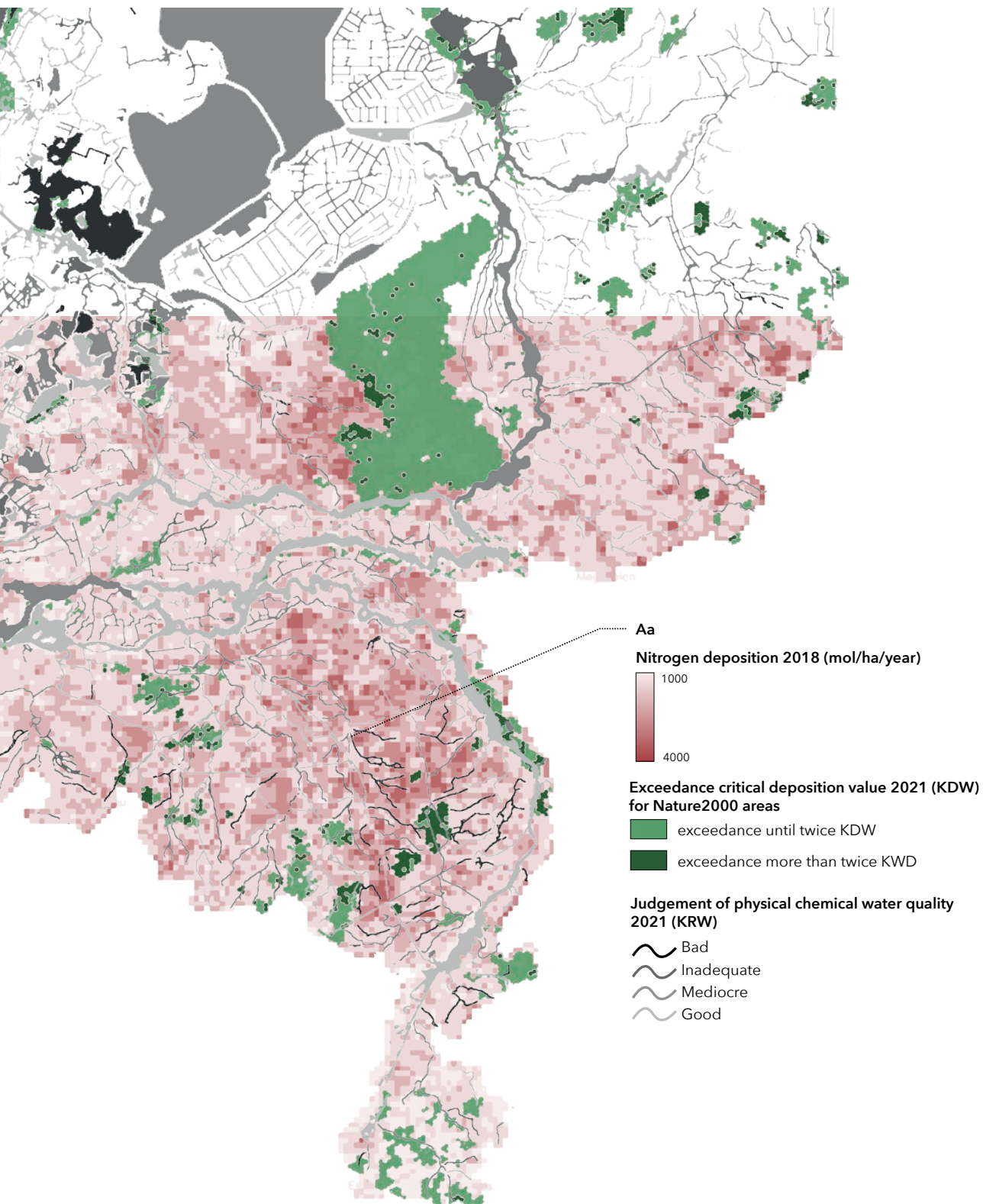
0 2,5 5 7,5 10 km

and green water banks. The pollution of the ecosystem causes a decrease in biodiversity (Gies et al., 2019). This removal of landscape elements also removed a lot of the cultural and recreational value of the landscape. Leaving an open agricultural landscape which is mostly uncomfortable to be in.

To ensure a healthy ecosystem the nitrogen deposition has to be massively decreased.

A healthy ecosystem and strong biodiversity are needed for 'ecosystem services' (PBL, 2014). These are needed for drinking water, food security, and a healthy living environment (RLI, 2022).

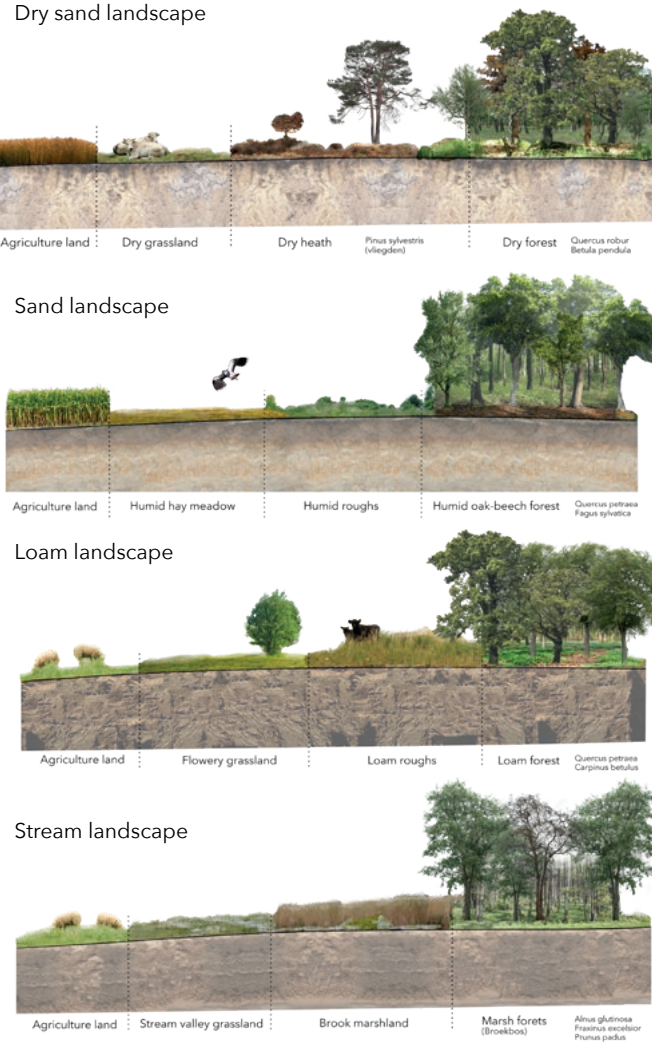




Nature types

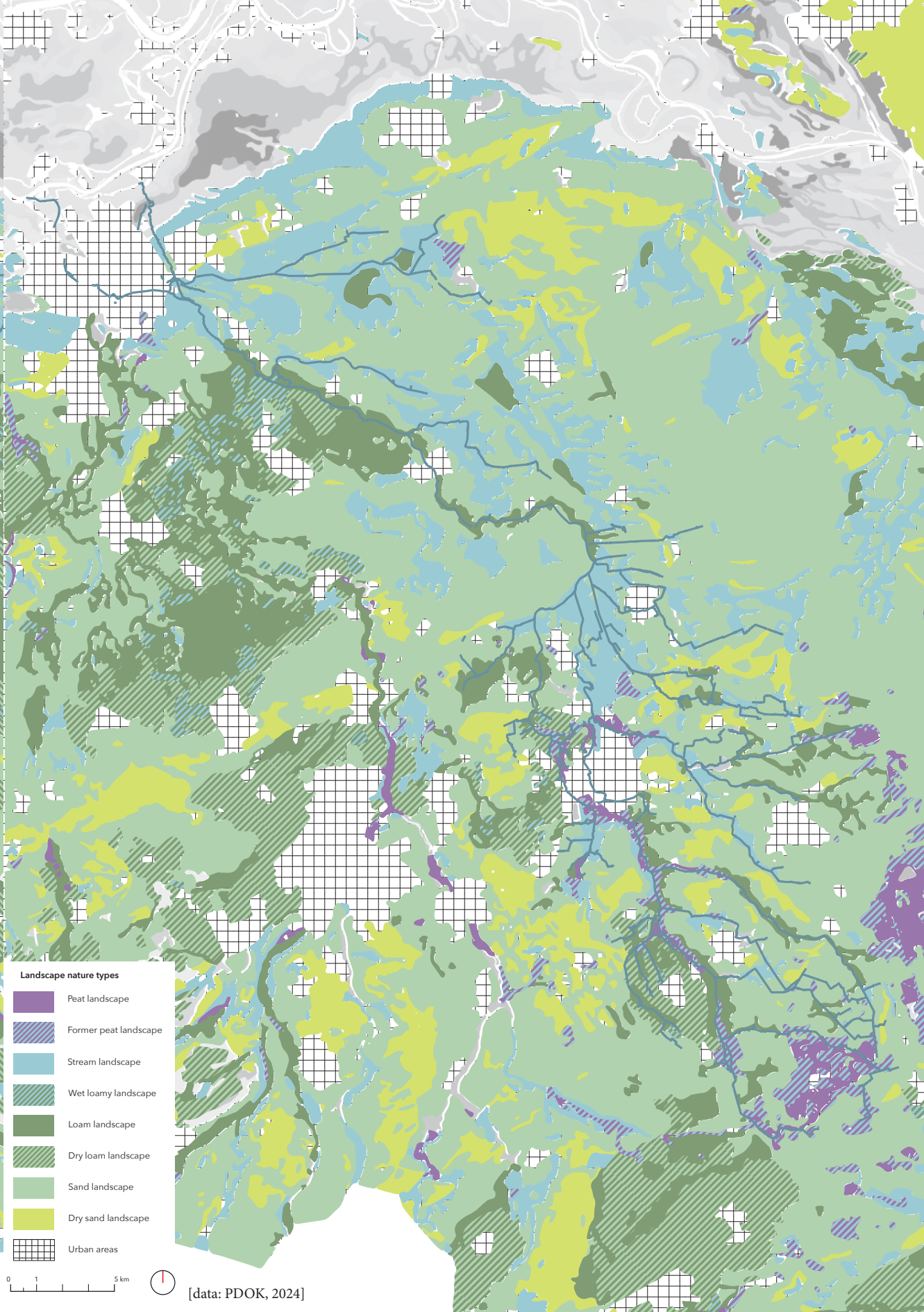
When creating or restoring natural areas it is important to use the right species for the environment. In order to map the potential landscape types the geomorphological conditions, the soil type and the ground water level has been combined. The conditions are then compared with the Nature goal types of the Netherlands (Bal et al., 1995) to find the landscape type and the corresponding tree species. This method gives a different result compared with the potential natural vegetation from the scientific atlas of the Netherlands (Stichting Wetenschappelijke Atlas van Nederland, 1987) as that looks at the longer term geomorphological and climate conditions. While this method here takes the current soil and water levels as influence by human activity into account. The result is a map with five different landscape types: peat, stream, loam, sand, and dry sand landscape. And three transition landscapes. The peat landscape is not detailed in a succession section as the peat landscape is concentrated around the higher areas of the Peel which fall outside the study site of this project.

Natural succession



Occurrence of tree species based on groundwater level





Landscape nature types

- Peat landscape
- Former peat landscape
- Stream landscape
- Wet loamy landscape
- Loam landscape
- Dry loam landscape
- Sand landscape
- Dry sand landscape
- Urban areas

0 1 5 km



[data: PDOK, 2024]

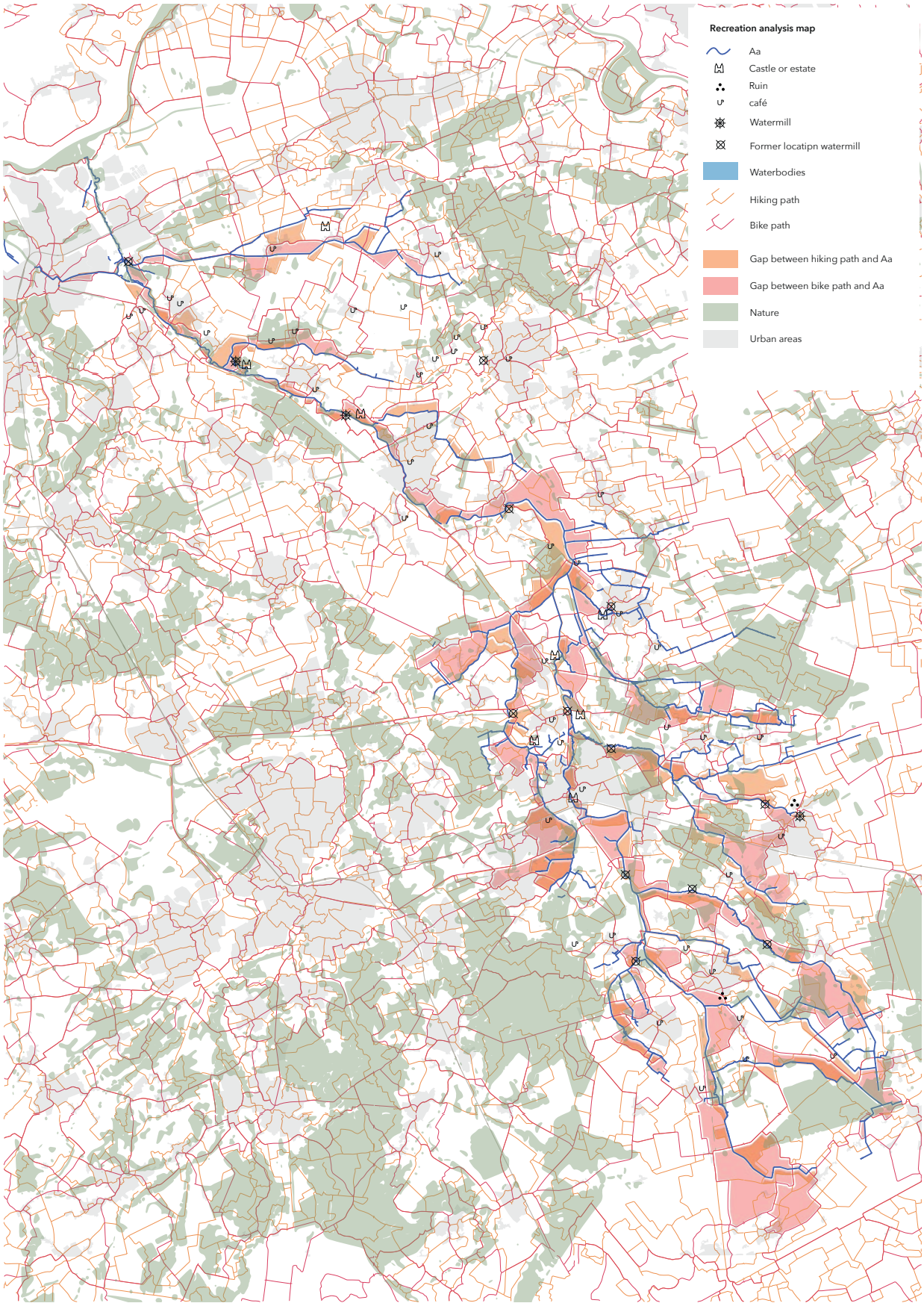
Recreation

An important part of a national park is that it is accessible and that it has a recognizable coherent landscape identity (Nationale parken bureau, 2021). However, according to the Advisory Commission on National Parks the current proposal for the Van Gogh National Park does not show a coherent cultural landscape identity in its current borders (Adviescommissie nationale parken, 2021). As the current border do not contain the complete north south gradient along the entire length of the stream, but only a middle section of this stream landscape. Only when including the entire stream could the National Park encompass a complete landscape and its identity.

Landscape identity

Along the entire length of the stream, there were historically water mills. These formed an important part of the water management system and the local economy (De Vries-Oosterveen et al., 2016). Many of these watermills have disappeared over the years, but a couple remain. The castles in the landscape also hold an important cultural and historical position in the landscape. This includes not only the building but also the often preserved or restored landscape around it. In this landscape there are small scale field structure defined by hedges and tree lanes. The map on the next pages shows the abundance of hedges in Noord-Brabant. The highest concentration is part of Het Groene Woud landscape in the Dommel catchment area, but it does extend a bit into the Aa area. Historically this hedge network was present all around the Aa but is mostly gone now (CBS, 2018). A clear landscape language can be developed around a visible natural stream, a wet landscape with spars meadows and

hedges, and the higher grounds. this can be supplemented with some key points such as watermills and castles. The characteristics of the higher ground and sand dunes and ridges have changed over time. From a natural forested landscape to heather, to open sand landscape and now mostly production forest. This leaves the landscape type which it can be developed into historically looking open. choices can be made depending on what provides the most benefits hydrologically or ecologically.



Recreation analysis map

- Aa
- Castle or estate
- Ruin
- café
- Watermill
- Former locatipn watermill
- Waterbodies
- Hiking path
- Bike path
- Gap between hiking path and Aa
- Gap between bike path and Aa
- Nature
- Urban areas



Top: Hedge desity (Centraal Bureau voor de Statistiek, 2018):
Righ: Fragment of hedge landscape left in the Aa catchment [Data: AHN, 2024, openstreetmap 2024]

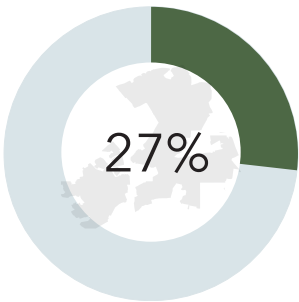


Accessibility

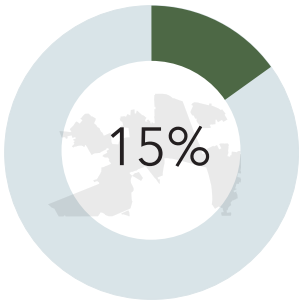
Access to the landscape around the Aa brings its own challenges. It is for people's well-being important to have access to green areas (RLi, 2022). This access can be limited especially for those living in urban environments. The map on the right shows how much of a city's surroundings is connected with the Brabant Nature Network (BNN). The first kilometre from the city's edge is used as this would make nature within this border easily accessible both on foot and bike. The map shows a disparity of city-nature connection between the Dommel cities and the Aa cities. With the Dommel cities scoring an average of 26,8 % compared to the Aa cities with 15,1%. Even though these numbers are hard to qualify, it does indicate a lack in connection between people and nature in the Aa catchment area. But once inside the landscape is the Aa often not visible and out of reach. The canalized stream lies deep in agricultural land without many markers along its banks. Making the stream often not visible from the roadside or paths. Even when the stream can be reached it holds little recreational value. Most of the time there are no paths right along the stream and the channels are visually uninteresting and very monotonous. Making the stream thereby uninteresting to follow in its current state even if it would be possible. When trying to follow the Aa there are also many larger obstacles such as highways and the Zuiwillemsvaart which cuts the stream into parts. On the stream itself, the many weirs in the streambed also make traversing the stream by kano or boat difficult.

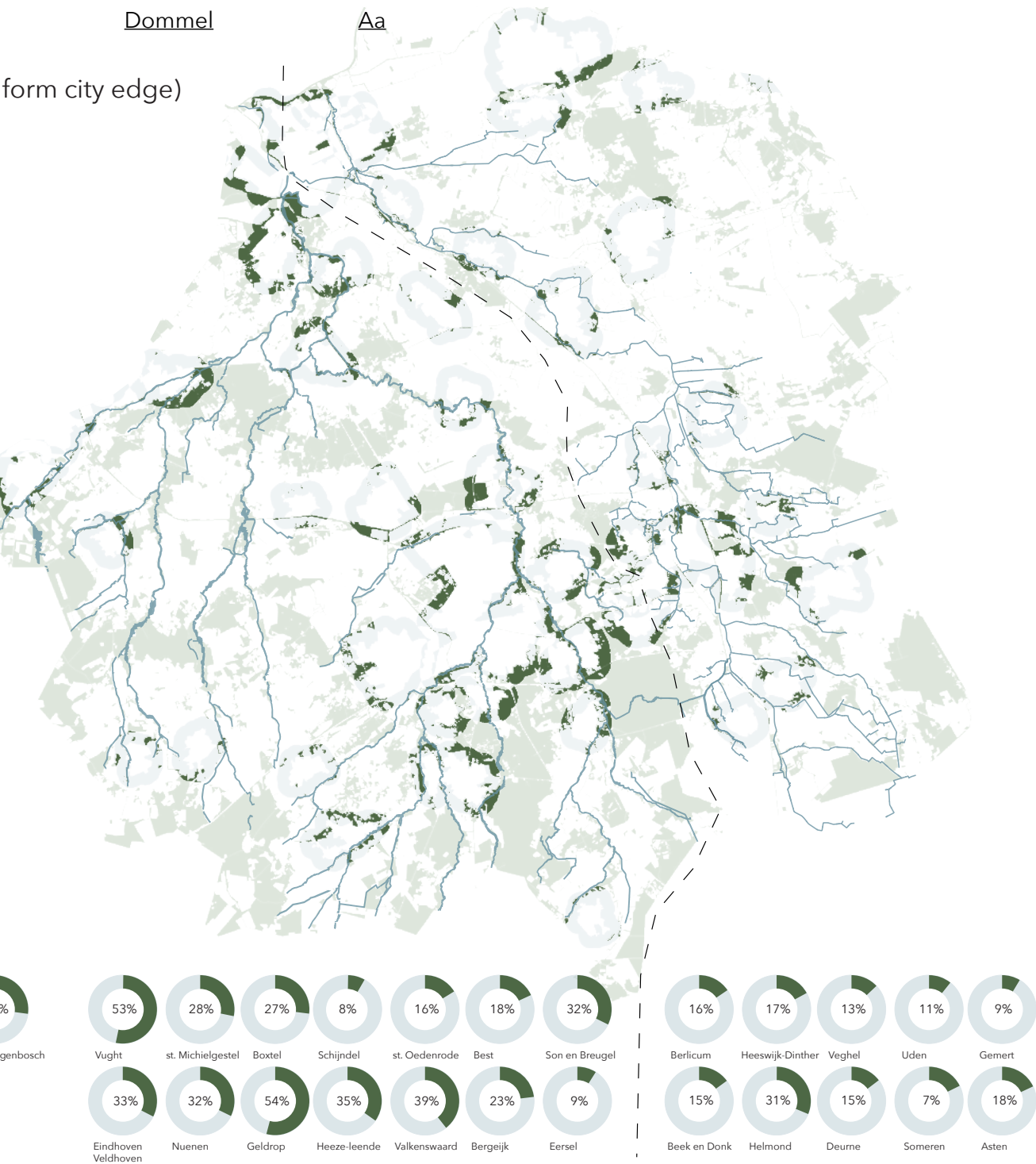
Access to nature from urban cores
percentage of land in the urban vicinity (1km
which is part of the Brabant Nature Network

Average Dommel cities



Average Aa cities









A view towards the Aa
Image by author

4. Design





Astense Aa between Asten and Deurne
Image by author

4.1 Concepts





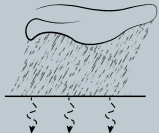








High waterlevel at the Dommel near Nijnsel
Image by author

Design structure

The design is divided into the three sub-research questions. Each contributing to making the landscape a resilient and attractive component of the Van Gogh National Park. The measurements coming from the sub-questions are divided into modules based on the different landscapes they are relevant to. This leads to the nine different modules which together form the basis for the masterplan.

Design modules

Sub- research questions:		Stream	Wet	Higher
Hydrology: Which hydrological measures have to be taken to restore the natural balance of flows?	Hydrology			
Nature: Which ecological measures have to be taken to enhance plant and animal life?	Nature			
Recreation: Which recreational measures have to be taken to support an attractive area for visitors and residents?	Recreation			



Aa tributary which springs at the Peelrandbreuk
Image by author

Problem

Intervention

Surface water shortage

Dropping groundwater level

To much drainage
causing floods downstream

Limited space for stream

No stream dynamics

Limited ecological value
(See Ecology)

Limited spatial quality

Limited recreation options
(See Recreation)

Reduce evaporation

Water retention

Increase infiltration

More inudation

Introduce meanders

Stimulate natural processes

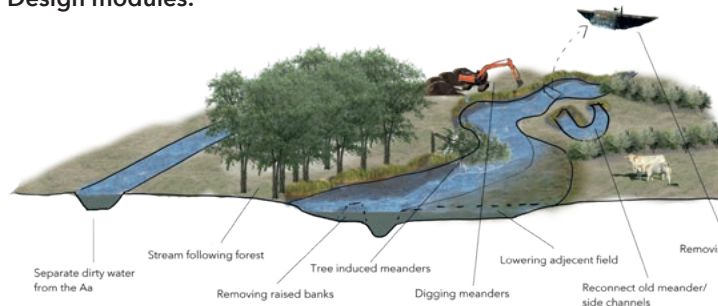
	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Elements

Stream - Meanders

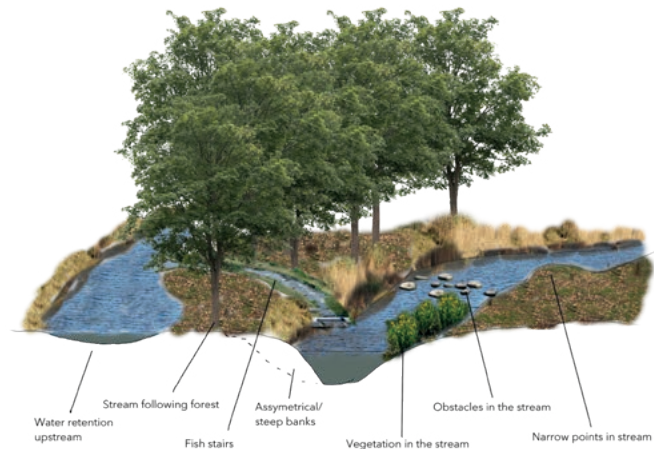
- (re-)opening side channels or old meanders
- Removal of banks
- Lowering adjacent fields
- Digging meanders
- Tree induced meanders
- Remove weirs
- Plant stream following forest
- Separate dirty and clean water flows

Design modules:



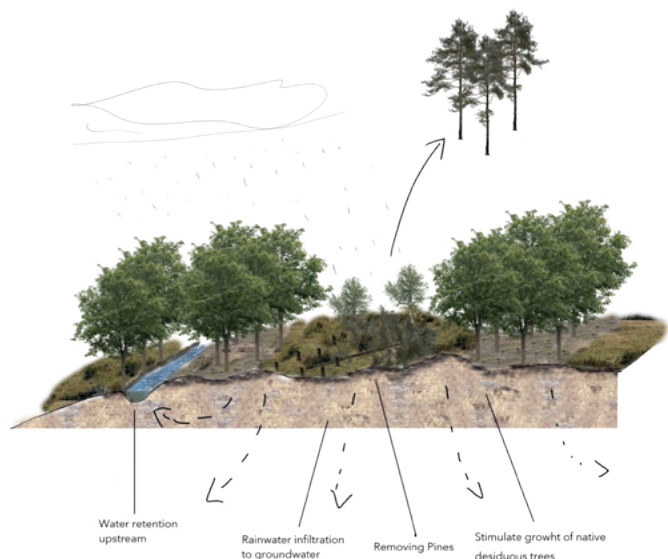
Wet - Retention

- Create water retention
- Narrowing stream at points
- Obstacles in the stream
- Build fishstairs
- Asymmetrical streambanks
- Create steepbanks at points
- Vegetation in the stream
- Crear flowholes and streambanks
- Plant stream following forest



Higher - Infiltration

- Remove pine forest for open sand landscape
- Create water retention
- Replace pine with deciduous trees
- Infiltrate rain water to groundwater



Hydrology

The first step in creating a clean, ecological and recreational continuous stream is to decouple the stream for the Zuidwillemsvaart around Helmond. This way the water from the Aa can stay separated from the water in the Zuidwillemsvaart (Linge et al., 2020). This requires creating new water channels one south-west of Helmond, one north-east of Helmond, and one right through Helmond. These stream redirections are further elaborated in the urban zoom-ins (chapter: 4.4).

Meandering

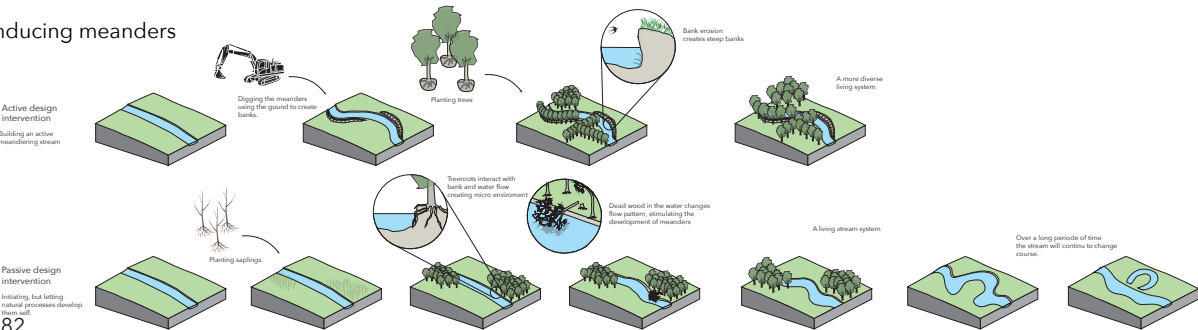
Secondly is looking to create more space around the stream giving the stream space to expand in cases of high-water levels. This also gives the stream room for natural processes, allowing the stream to meander. The image below shows two ways of kick-starting the meandering process. One by actively digging the new meanders, the other by inducing the meanders with trees and dead wood in the stream. A meandering stream flows slower thereby retaining more water upstream and allowing for more infiltration with its wider streambed (Makaske, 2020). Trees along the stream reduce evaporation, reducing the chance of surface water shortages. This all provides also much-needed ecological value. With more differentiation in the stream regarding stream flow, depth, vegetation

in the stream, shadow over the water and water banks. Creating more and gentler gradients and providing more niches for different species (Verdon-schot, 2000). This together also provides visually and spatially a more interesting stream.

Besides inducing meanders around the stream much of the stream banks should be removed to allow the surrounding land to be inundated during high water levels (section bottom right). This way the rainwater during a high precipitation event can be stored locally in the Aa. Allowing more of this rainwater to infiltrate restoring the dropping groundwater level (Linge et al.,2020). These seasonally overflowing lands do require the function of the land to change from intensive agriculture to grazing and/or mowing or to be taken out of its agricultural function. Reducing agriculture intensively around the Aa must be done anyway to achieve the water quality standards (KRW) (Gies et al., 2020). There are two areas where the agricultural transition can take more time. These areas can be used to concentrate livestock farming temporarily while transitioning agriculture (Bakker, 2020). These areas are selected because the water here can be separated from the Aa water system. The water from the southern area can be let into the Zuidwillemsvaart a bit further downstream if the water quality does not suffice. The water from the northern area flows by an existing water cleaning facility, where the polluted water might be cleaned.

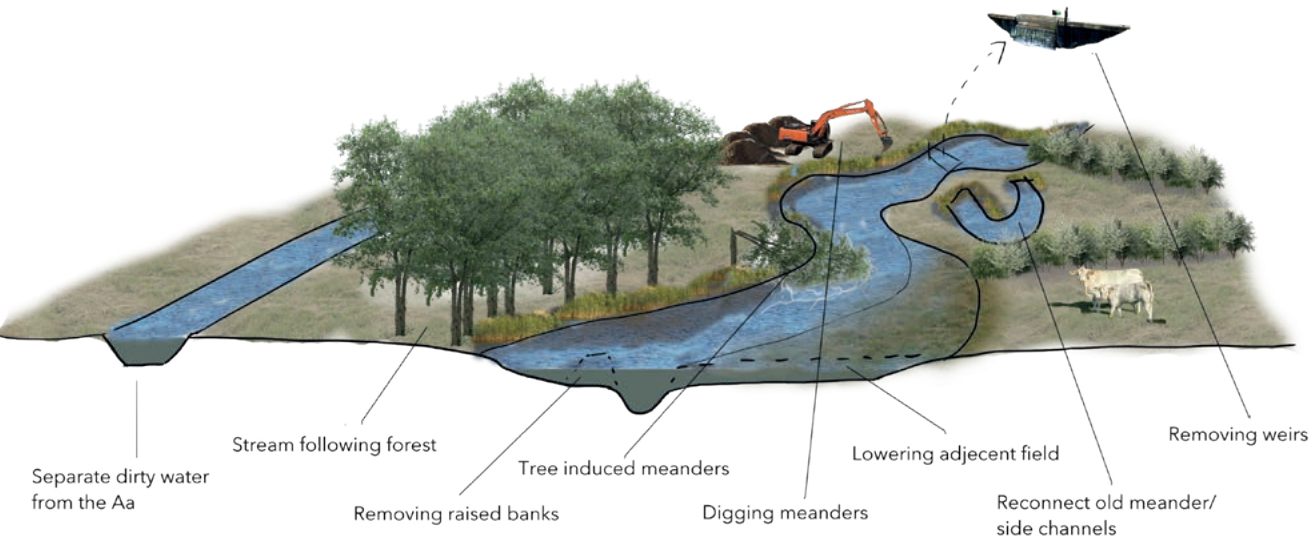


Inducing meanders

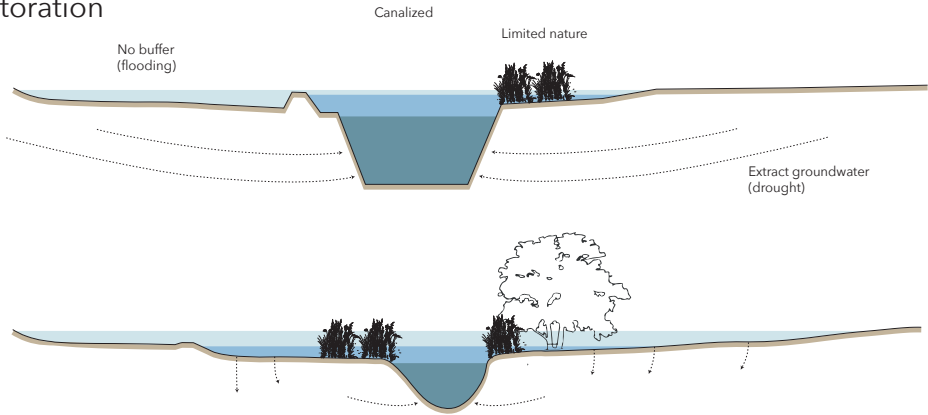


Stream landscape module: Meanders

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			



Streambed restoration

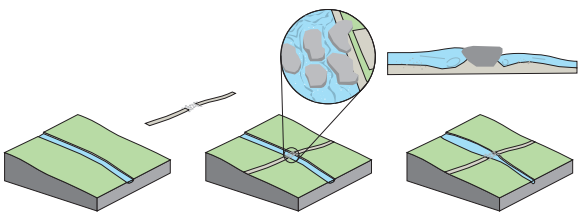


Retention

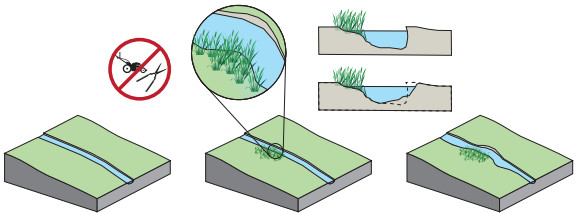
To combat water shortages more water should be retained longer upstream and in the smaller side channels. This is all about slowing down the flow speed. By slowing the flow speed down with obstacles, but without completely blocking water flow are differences created in flow speed through the stream. These differences create dynamics in the stream (Verdonschot, 2000). The image to the right shows ways to induce stream dynamics. One by placing obstacles in the stream, in this case stepping-stones, and the other by allowing vegetation to grow into the stream to change flow speeds. The created difference in flow speed leads to erosion and sedimentation patterns. Which again creates different niches in the stream for ecology and makes the stream more interesting for visitors.

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

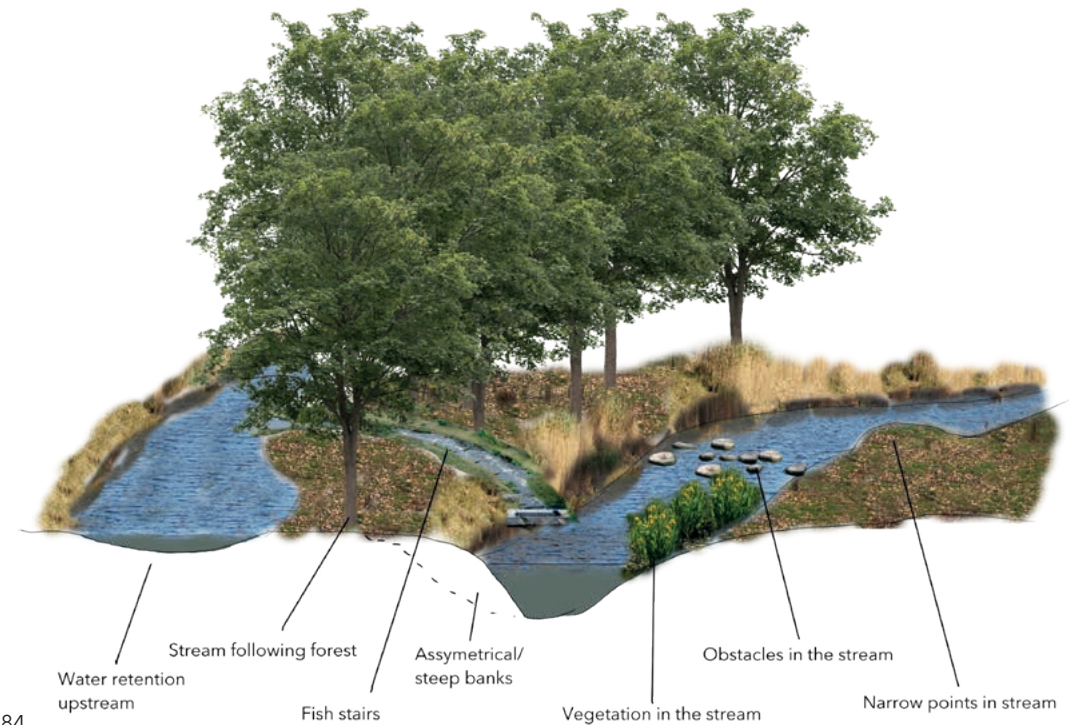
Actively intervening by placing obstacle



Passive, less maintenance



Wet landscape module:
Retention

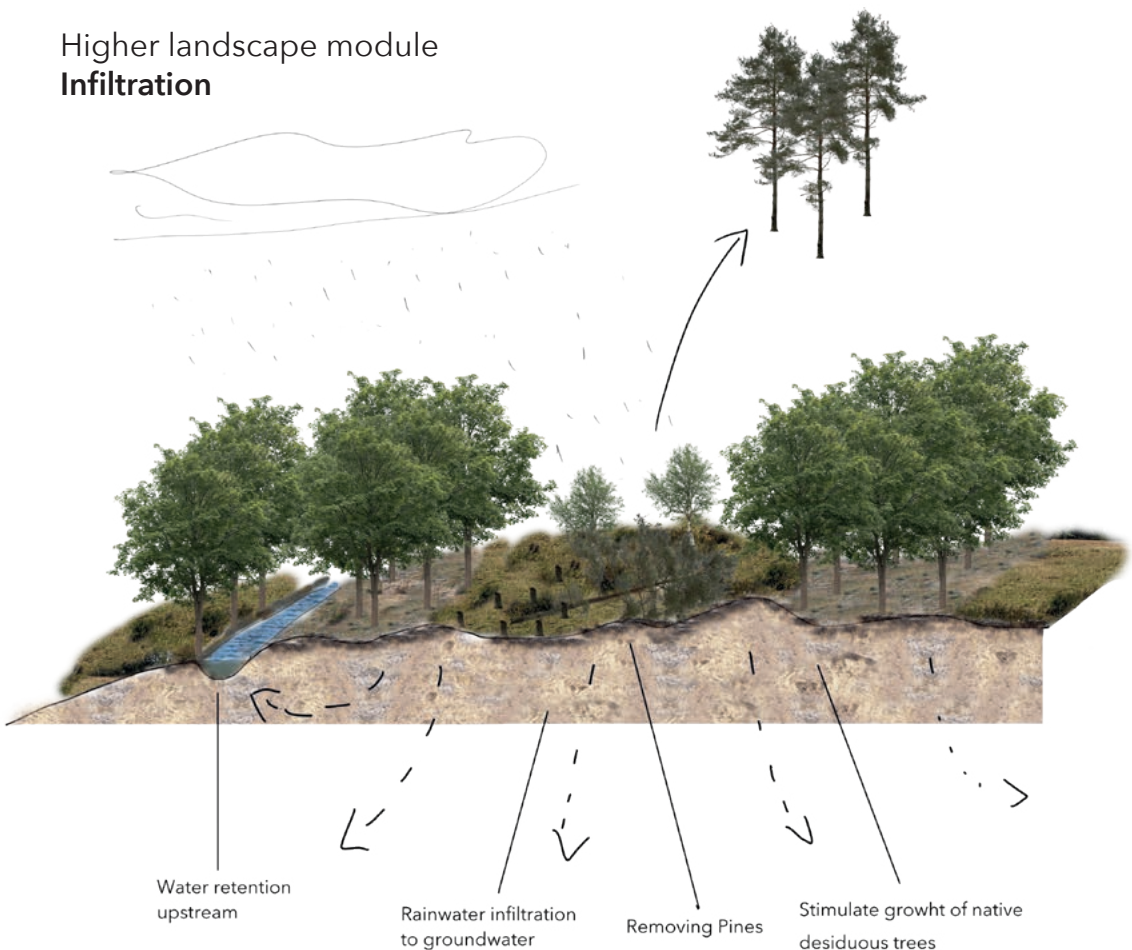


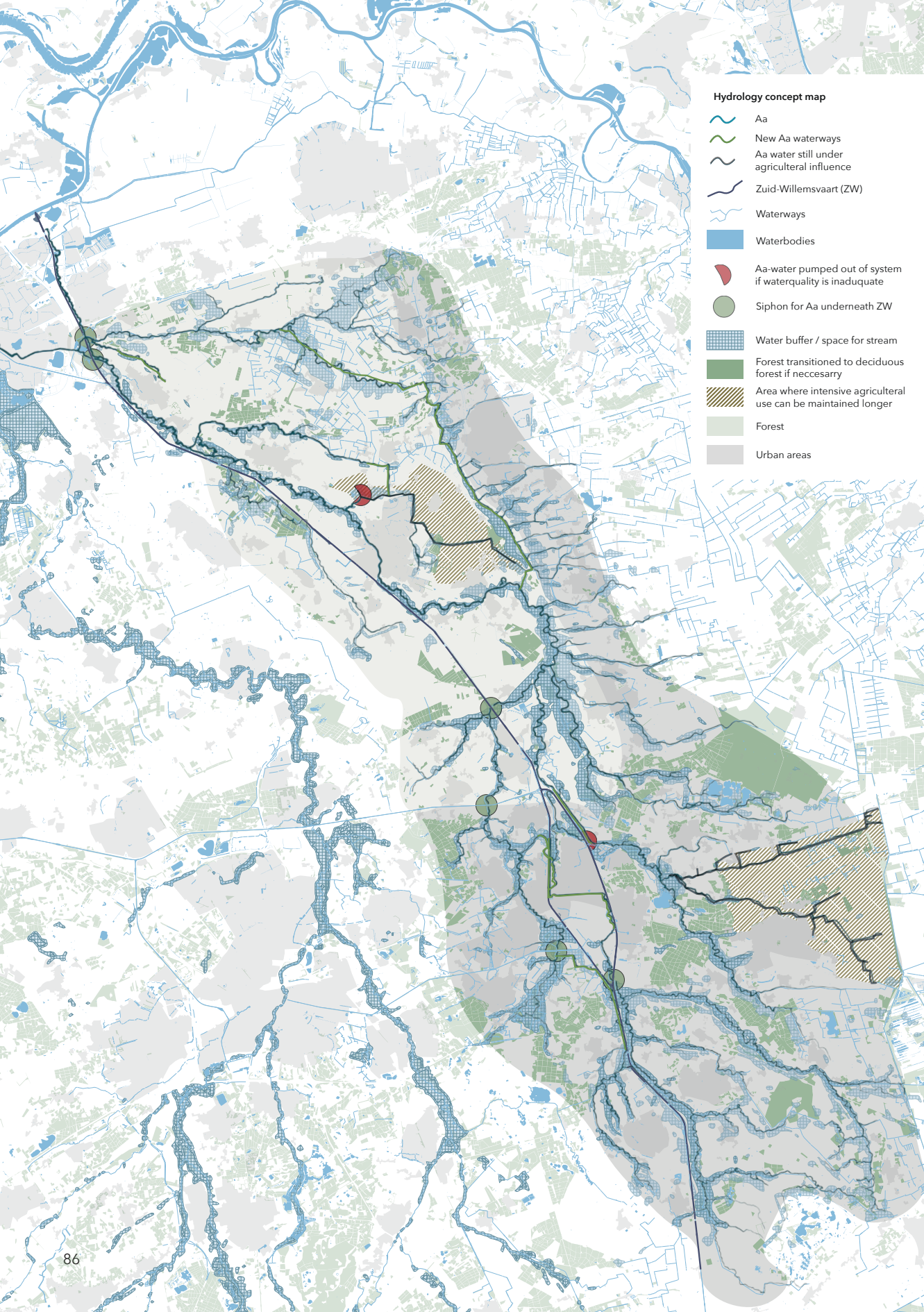
	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Infiltration

In the current hydrological network, too little water infiltrates the groundwater. A large cause of this is the monotonous pine production forest on the higher grounds which catches rainwater away from the water system. Replacing these pine forests with native deciduous forests is therefore required. Deciduous trees catch less rainwater. Allowing more to hit the ground and infiltrate. This forest transition has to be a staged process. Taking out pines in stages, allows deciduous trees to grow and take over.

Higher landscape module Infiltration














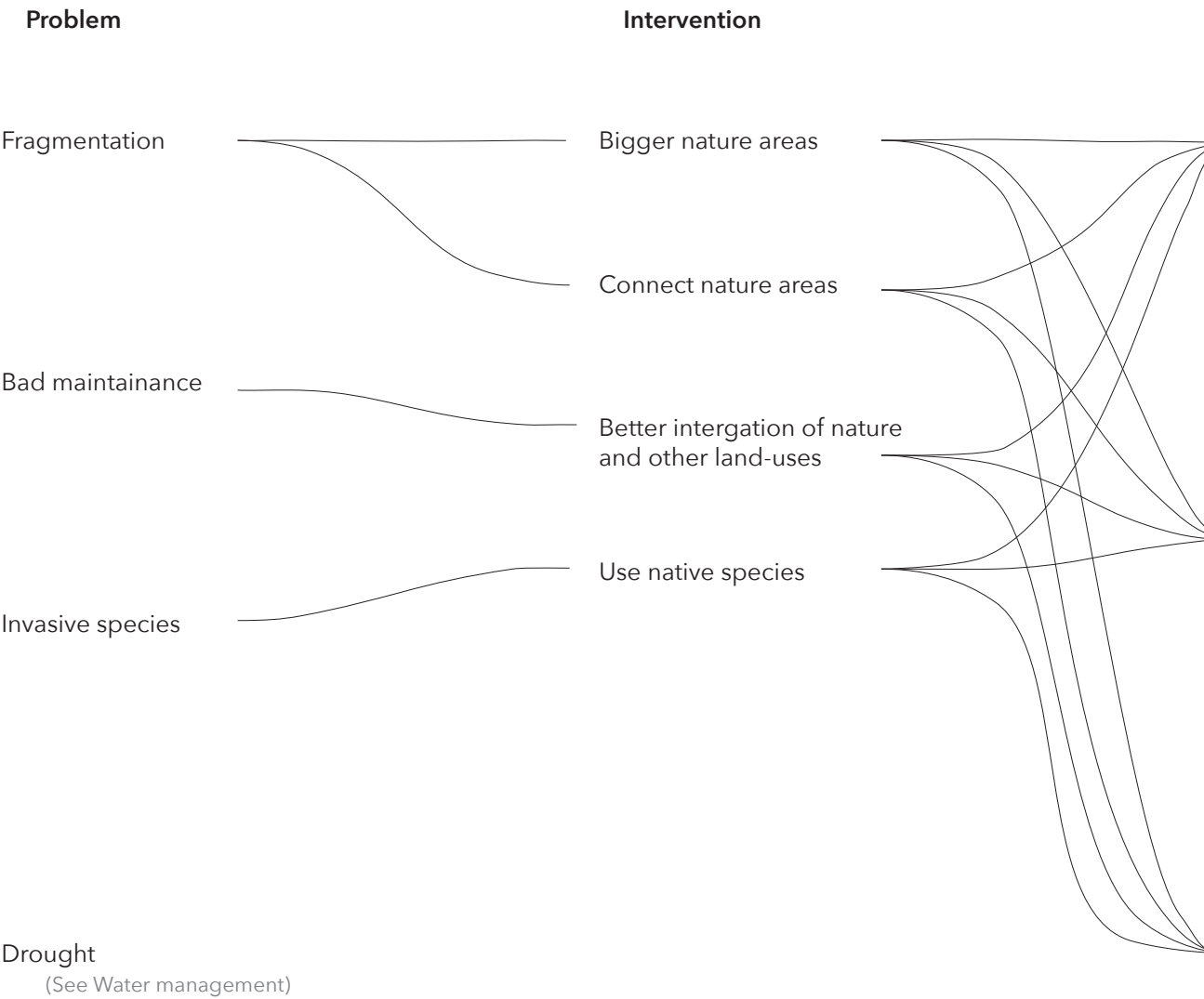
Hydrology concept map

- Aa
- New Aa waterways
- Aa water still under agricultural influence
- Zuid-Willemsvaart (ZW)
- Waterways
- Waterbodies
- Aa-water pumped out of system if waterquality is inaduate
- Siphon for Aa underneath ZW
- Water buffer / space for stream
- Forest transitioned to deciduous forest if neccesarry
- Area where intensive agricultural use can be maintained longer
- Forest
- Urban areas

Schematic intervention map

Showing the interventions in the hydro-logical system needed to be taken to assist the success of implementing the modules.

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			



	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Elements

Stream - Beekprik

Continuis navigable stream

Vegetation in stream

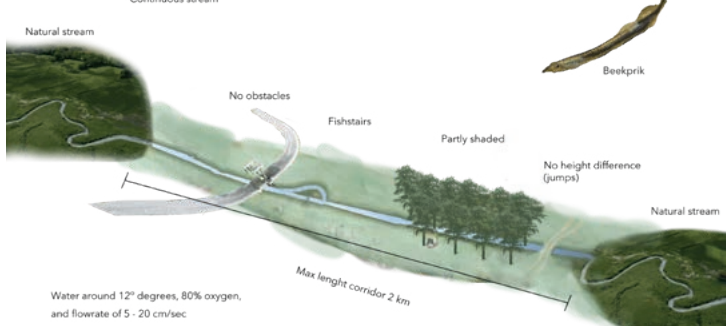
Partly shaded stream

Meanders in stream

Dynamic streambed

Design modules:

Ecological corridor model: Beekprik
Continuous stream



Wet - Boomkikker

Wet roughs (living habitats)

Connecting corridors

Bushes

Roughs

Shallow banks

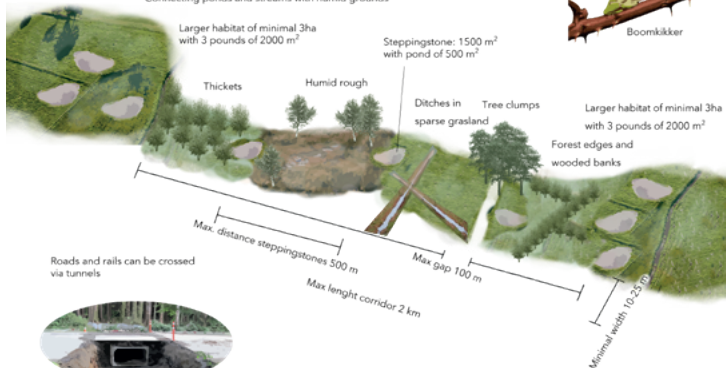
Wood edges

Wooded banks

Eco-tunnels under roads and rail

Less intensive use of agricuteral land

Ecological corridor model: Boomkikker
Connecting ponds and streams with humid grounds



Higher - Boommarker

Forested living habitat

Replace pine with native species

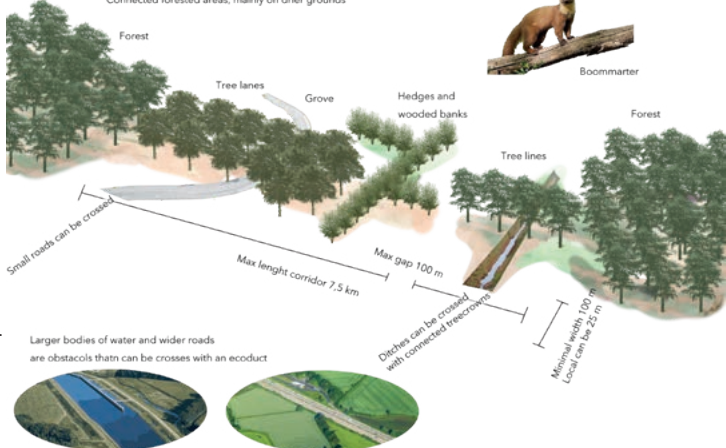
Connecting corridors

Wooded banks

Tree lanes










Ecoducts over larger roads, rail and water

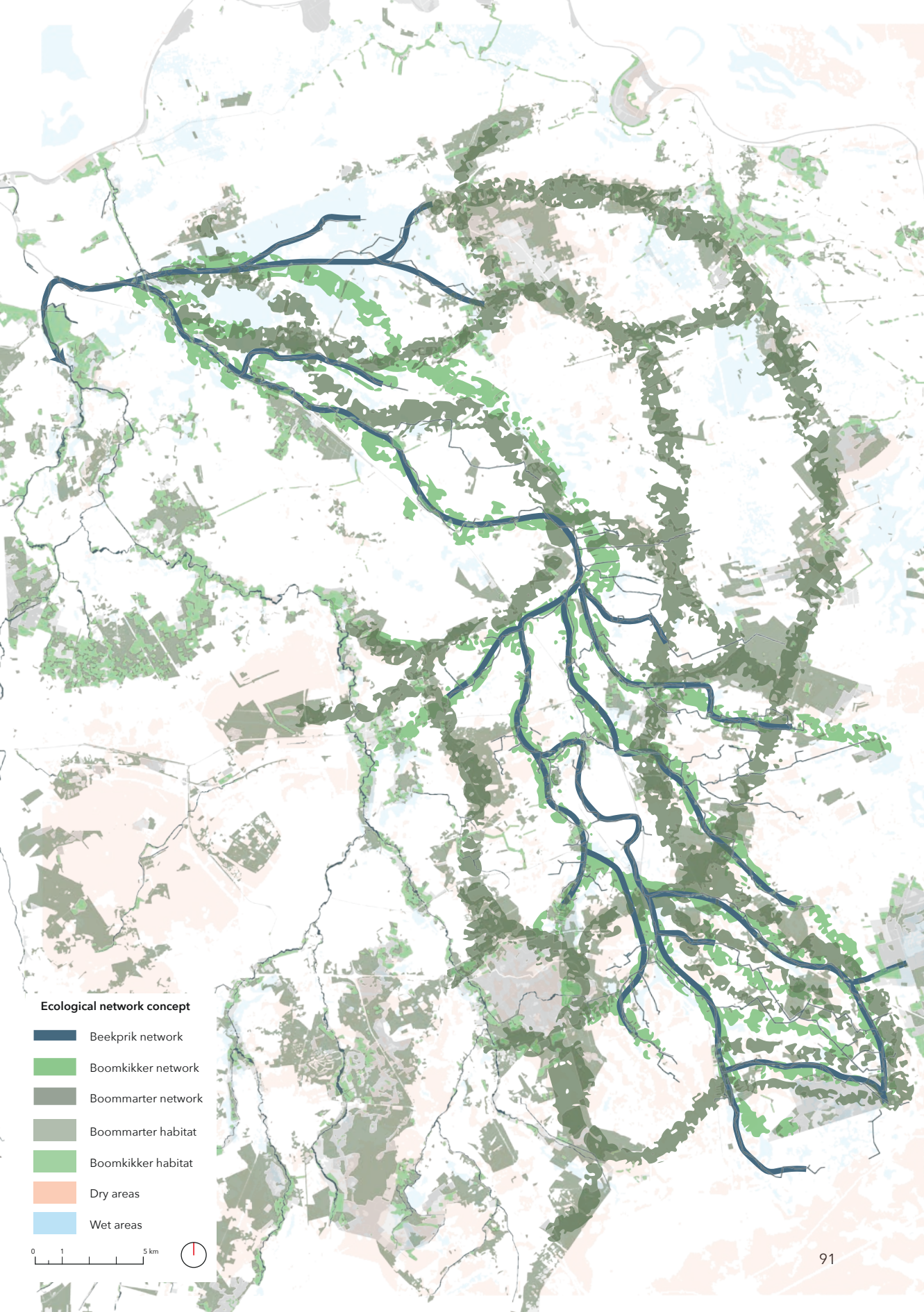
Ecological corridor model: Boommarker
Connected forested areas, mainly on drier grounds



Nature

The ecological network is designed around the three indicator species. Each species represents a different landscape. The pine marten (Boommarter) represents the forested higher grounds, the European tree frog (Boomkikker) represents the wet swampy areas, and the Brook lamprey (Beekprik) represents a natural stream. Each species has its own habitat and corridor requirements. These habitat requirements make the basics for the natural environment created in the different landscape types. Because this Landscape Park is put into an existing landscape, the focus will be on creating a strong natural network with only smaller nature cores. The implementation of this network requires the finding or making of space between existing landscape uses. The stream, wet areas and the higher dry areas are the more extreme landscape types here. Making them (historically) more difficult to culturalize (Ecologische Kring Midden-Brabant, 2011). Causing these areas to have less urbanization and hold less economic value. Making these areas well-suited for the implementation of an ecological network. Because the stream, wet areas and the higher dry areas are the more extreme landscape types they hold the more regional-specific species and together cover most of the ecological niches for this region. The idea is that this network provides a diverse and ecological strong basis implemented in the existing landscape.

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			



Ecological network concept

- Beekprik network
- Boomkikker network
- Boommarter network
- Boommarter habitat
- Boomkikker habitat
- Dry areas
- Wet areas



Beekprik










The most important thing for a Brook lamprey is clean continuous water. This requires the Aa to comply with the water quality requirements (KRW) and the removal of weirs or the installation of fish stairs (Makaske et al., 2020). In the stream itself more diversity is needed in the flow speeds, bank slope, depth, and shadow coverage of the stream (Reijen & Koolstra, 1997). Together with enough objects and vegetation in the stream, it provides habitats for the water species. The required changes to the stream are further described in the previous chapter about water.

Boomkikker

The European tree frog requires wet areas with enough coverage and standing or slow-flowing water for its offspring (Molen et al., z.d.). This can be achieved on location with standing water (ponds), with seepage areas, or at the stream edge where the stream (regularly) inundates the land. The area around the stream forms a large continuous network, which can be the backbone of the network for the Tree frog. Furthermore are there many places of seepage next to higher grounds, connecting the Boomkikker network with the Boomarter network. In the northern part of the Aa catchment (east of 's Hertogenbosch) there is a large area of lower-lying water land. Perfect for the creation of larger Tree frog habitats. For the corridors connecting the different habitats, there need to be ponds at regular intervals which serve as steppingstones. Connected via covers such as hedges, wooded banks, and the banks of waterways and ditches (Reijen & Koolstra, 1997).

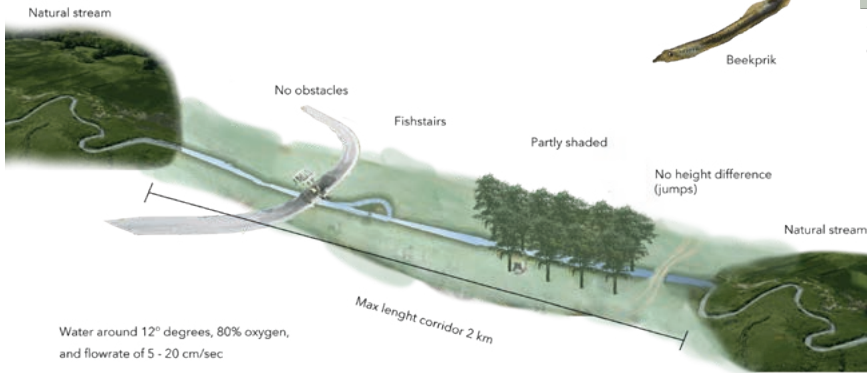
Boomarter

It makes for the Pine marten not much of a difference if the forest is situated on drier or wetter grounds. But historically most forests are situated on higher grounds as they became too sparse and dry for agriculture (Arts, 2020). These forests will be transitioned from pines into deciduous forests. Contrary to what the English name of the Pine marten suggests, the pine marten also lives in none pine forests. The habitat of the Pine marten requires a larger area with continuous tree cover (Molen et al., z.d.). These forests can be connected via tree lanes or wooded banks (Reijen & Koolstra, 1997). The Pine marten can cover small distances over the ground, but it does not like to swim or cross wide roads.

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

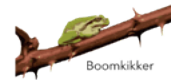
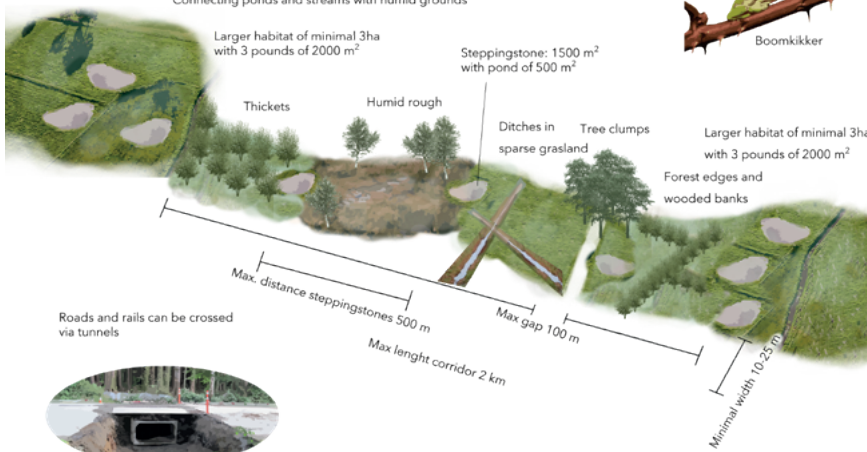
Ecological corridor model: Beekprik

Continuous stream



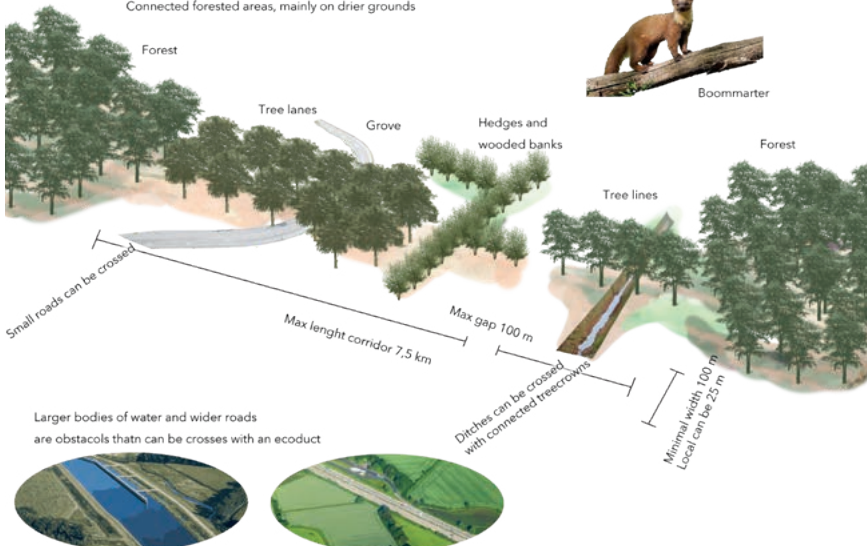
Ecological corridor model: Boomkikker

Connecting ponds and streams with humid grounds



Ecological corridor model: Boomarter

Connected forested areas, mainly on drier grounds



Problem

Intervention

Limited access to nature

Better city - nature connection

To little continious routes

Connected nature-recreation network

To little outside recreation options










More recreation options

Lacking spatial quality

Better spatial/experiential quality

Lacking reconizability of landscape

Creating reconizable landscape

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Design modules:

Elements

Extend the Aa and nature trough urban areas
and connect therewith connect cities to the landscape

Routing

Continuous route along the Aa
Higher landscape routes
Peelrandbreauk route

Stream - Canoe

Trees / forest along stream
Wet fields next to stream
Kano routes
Swimming
Watermill visitors point
Fishing
City hotel

Wet - Boots

Wet forest
Wet roughs
Bird watch hut
Bike paths
Hedges
Castle visitors points
Camping

Higher - Mountainbike

Dry forest
Tree lanes
Forest cabin cafe
Mountainbiking
Horse riding
Bungalo park

National Park

Benches
Signs
Route marking
Roadsigns
Fences / gates
Lantarns (poles)

Trash cans
Bridges

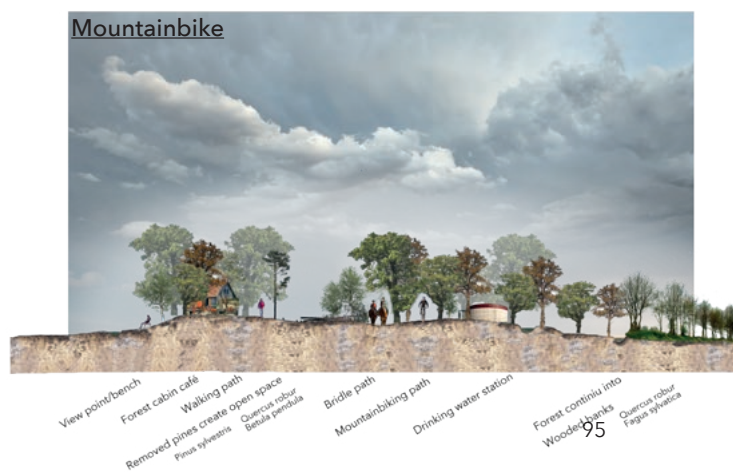
Canoe



Boots












Mountainbike



Recreation

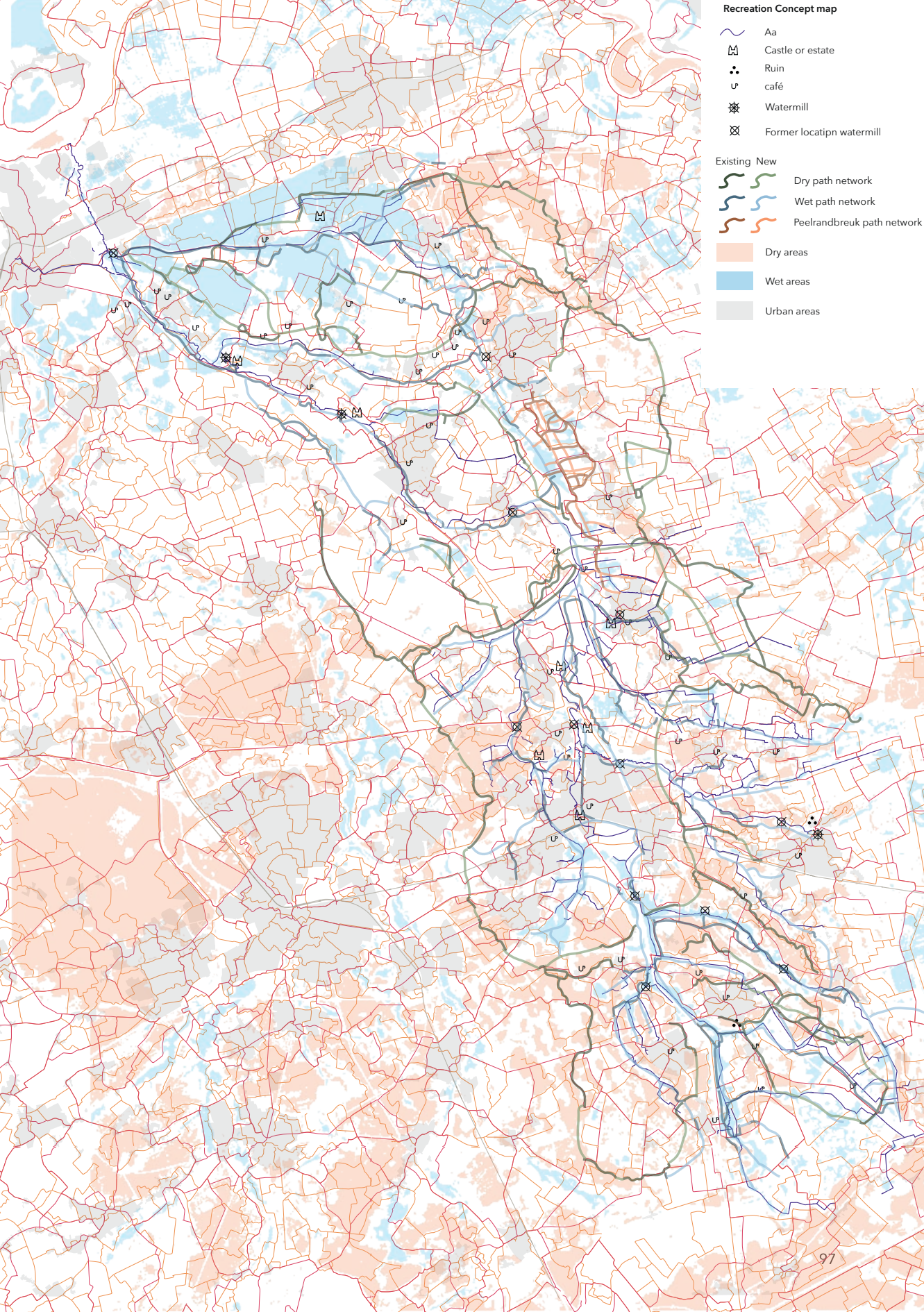
Access to green and outdoor recreation is important for people’s well-being (Raad voor Leefomgeving en Infrastructuur, 2022). This requires a good connection between the place where people live and the landscape around them. This landscape needs then to provide an interesting and enjoyable experience throughout the seasons. Because this landscape will be part of a National Landscape Park it is important that the cultural history and landscape identity becomes apparent to both residents and visitors. Making it a place that people want to visit and a place that builds a connection between residents to their landscape.

	Stream	Wet	Higher
Hydrology			
Nature			
Recreation			

Recreation Concept map

- Aa
- Castle or estate
- Ruin
- café
- Watermill
- Former locatipn watermill

- Existing New
- Dry path network
 - Wet path network
 - Peelrandbreuk path network
 - Dry areas
 - Wet areas
 - Urban areas



Canoe - stream

The water management and ecological changes to the stream will transform the Aa into a more diverse and visually interesting landscape. A meandering stream with its many bends creates changing view lines when on the water, a softer gradient giving access to all different types of nature and a wide variety of species, and trees along the stream make enclosed shadow-rich sections and open up into wide open views from time to time. Making the stream traversable by canoe will be the design driver for this part of the recreation network. The major change for this is to make the stream continuous, removing of interruptions like weirs and disentanglement of the Aa with the Zuidwillemsvaart. These are already requirements for the Beekprik and to create a natural water system. So these elements strengthen each other. Furthermore are there also good connections needed with urban areas, places to get in and out, and resting points. The idea is to use (former) watermills as central points in this network. These provide a cultural-historic importance place in de landscape (De Vries-Oosterveen, 2016). Being the connection point between the stream and the villages and cities around. These watermills can be used as kano renting places, with a café, and as a centre in the routing network. These routes should include a path network following the Aa along its entire length. So, people can follow and experience the Aa by foot or bike from 's Hertogenbosch to the Grote Peel.

Boots - wet network

The wet areas range from wet meadows to roughs and to brook forests. These places might often require high (wellington) boots to walk in. Depending a bit on the seasons. But if you do go out you will be rewarded with beauti-

ful flooded forests or meadows filled with different bird species. In the wet grassland, the cultural historical use of hedges can return and the fields can be used for grazing during the summer. The connection with the farmer can be improved by camping at the farmer's, giving the farmer also an alternative source of income. For the main connection points plentiful of old castles and estates in the area can be used. These often already have a touristic function, and the surrounding lands are some of the best preserved.

Mountainbike - higher network

The higher dry network is a bit of the opposite of the wet network. Where the wet network covers large areas in the north (downstream) and is only sporadic in the south (upstream). The dry network is only a couple of dunes and ridges in the north, while it covers a large area on the higher areas in the south. Also seasonally is the wet area more enjoyable during the summer, when wet feet dry quickly, while the dry forest can become beautiful with autumn colours or covered under snow. These higher areas in the landscape exist out of a thick layer of loose sand with many little height differences. Making these areas perfect for activities like mountainbiking, but also horse riding or trail running. The mountainbiking lens provides a good perspective to design these areas for recreational activities. With a large network of trails, gathering and resting points at a forest cabin-café, and drink water tap points (these sandy areas are often also used as groundwater winning locations (Brabant Water, z.d.)). The accessibility of these areas would be no problem on the bike and because they are forested, they are well recognizable in the landscape.

Canoe- stream



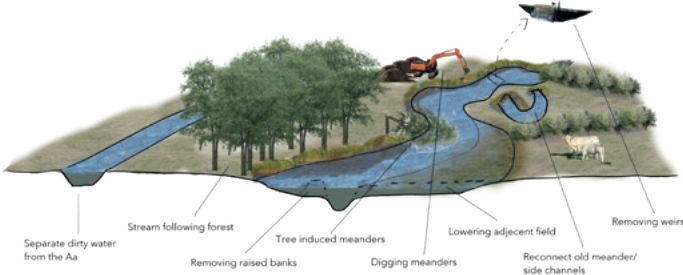

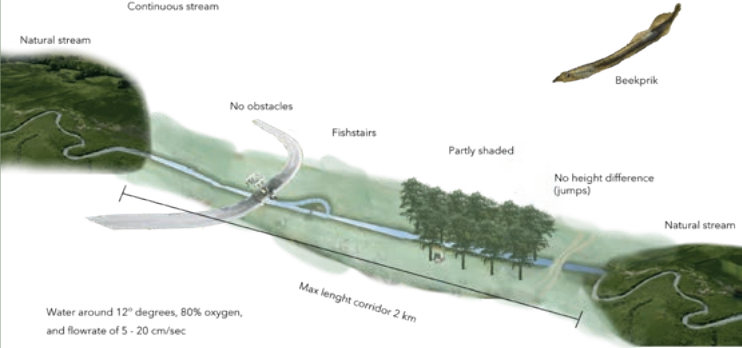
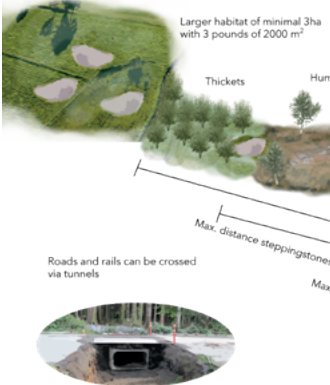
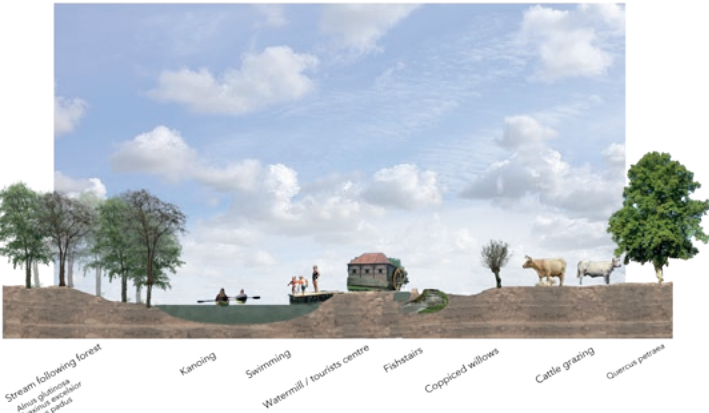

Boots - wet network



Mountainbike - higher network



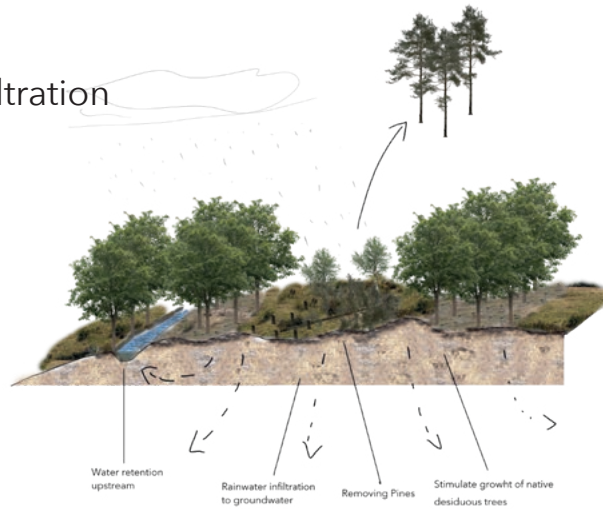
Overview design modules

	Stream landscape	Wet landscape
Hydrology	<p>Meanders</p>  <p>Labels: Separate dirty water from the Aa, Stream following forest, Tree induced meanders, Lowering adjacent field, Removing weirs, Removing raised banks, Digging meanders, Reconnect old meander/ side channels.</p>	<p>Retention</p>  <p>Labels: Water retention upstream, Stream following forest, Fish stairs.</p>
Nature	<p>Ecological corridor model: Beekprik</p> <p>Continuous stream</p>  <p>Labels: Natural stream, No obstacles, Fishstairs, Partly shaded, No height difference (jumps), Natural stream, Max length corridor 2 km, Water around 12° degrees, 80% oxygen, and flowrate of 5 - 20 cm/sec.</p> <p>Beekprik</p>	<p>Ecological corridor model: Bo...</p> <p>Connecting ponds and streams with h...</p>  <p>Labels: Larger habitat of minimal 3ha with 3 pounds of 2000 m², Thickets, Hum..., Max. distance steppingstones, Roads and rails can be crossed via tunnels.</p>
Recreation	<p>Canoe</p>  <p>Labels: Stream following forest, Alnus glutinosa, Fraxinus excelsior, Prunus padus, Canoeing, Swimming, Watermill / tourists centre, Fishstairs, Coppiced willows, Cattle grazing, Quercus petraea.</p>	<p>Boots</p>  <p>Labels: Loamy forest, Quercus petraea, Carpinus betulus, Sparses wet meadow, Birdwatching hut, walking path, bl...</p>

Higher landscape



Infiltration

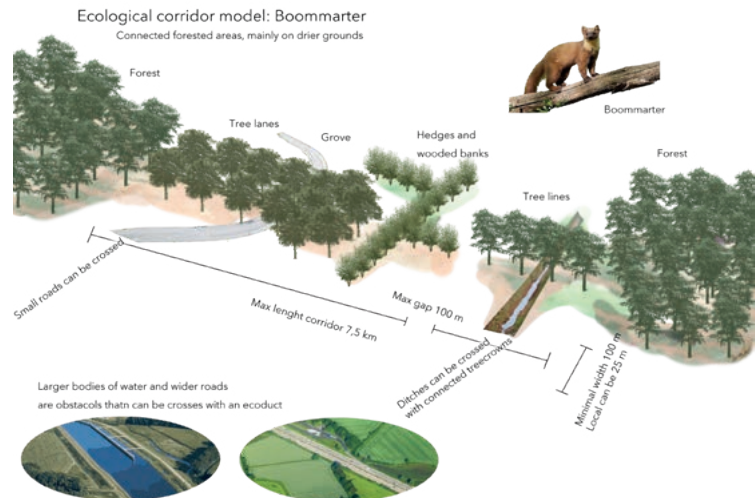


Boommikker
humid grounds



Ecological corridor model: Boommarter

Connected forested areas, mainly on drier grounds



Mountainbike



4.2 Masterplan





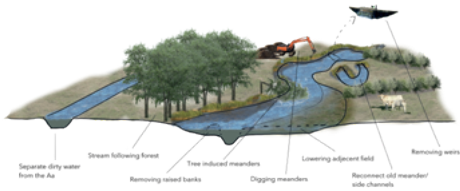
Nature corridor near the Peelrandbreuk
Image by author



The Aa

- Meander
- Beekprik
- Canoe

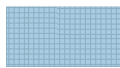
Meanders



Ecological corridor model: Beekprik



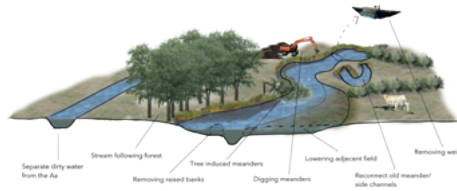
Canoe



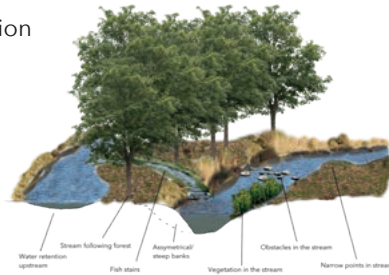
Wet stream landscape

- Room for meandering
- Water retention
- Boomkikker
- Boots

Meanders



Retention



Ecological corridor model: Boomkikker



Boots



Wet

- W
- Int
- Bo
- Bo

Retention



Infiltration



Ecological corridor model: Boomkikker

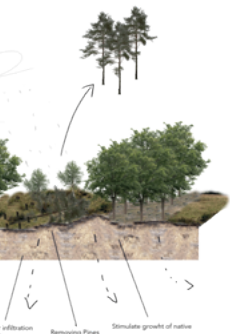
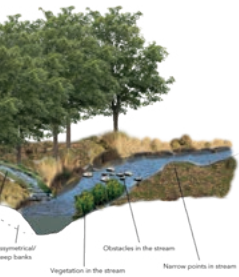


Boots



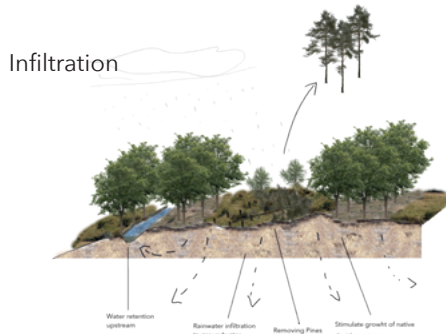
Different combinations of the nine modules can be made based on different landscape characteristics. For example, the higher landscape can be left open to make the dry sand landscape or be forested to make it habitable for the boommarker. These combinations of modules give five landscape types which make the masterplan.

roughs
water retention
infiltration
boomkikker
roots



Dry sand landscape

- Infiltration
- Mountainbike

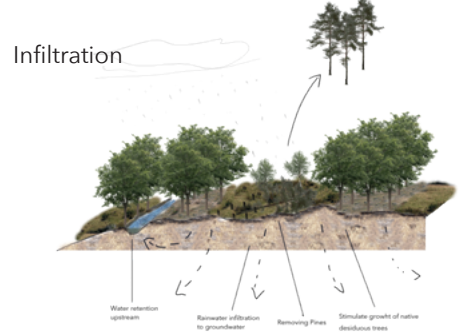


Mountainbike

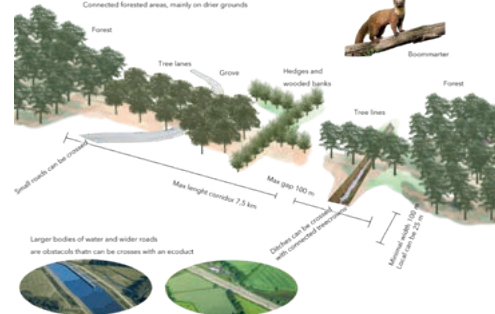


Forest

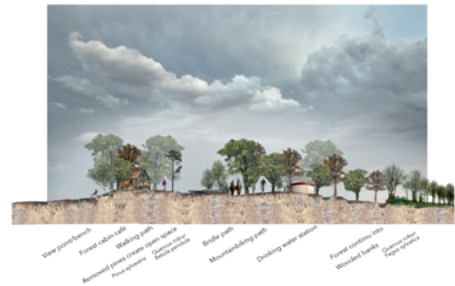
- Infiltration
- Boomarter
- Mountainbike



Ecological corridor model: Boomarter

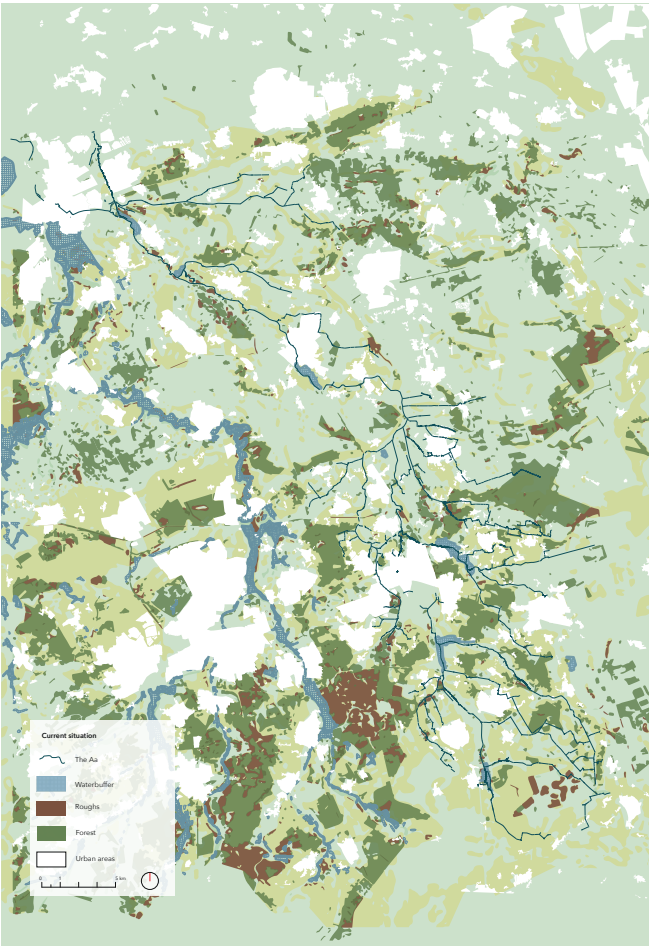


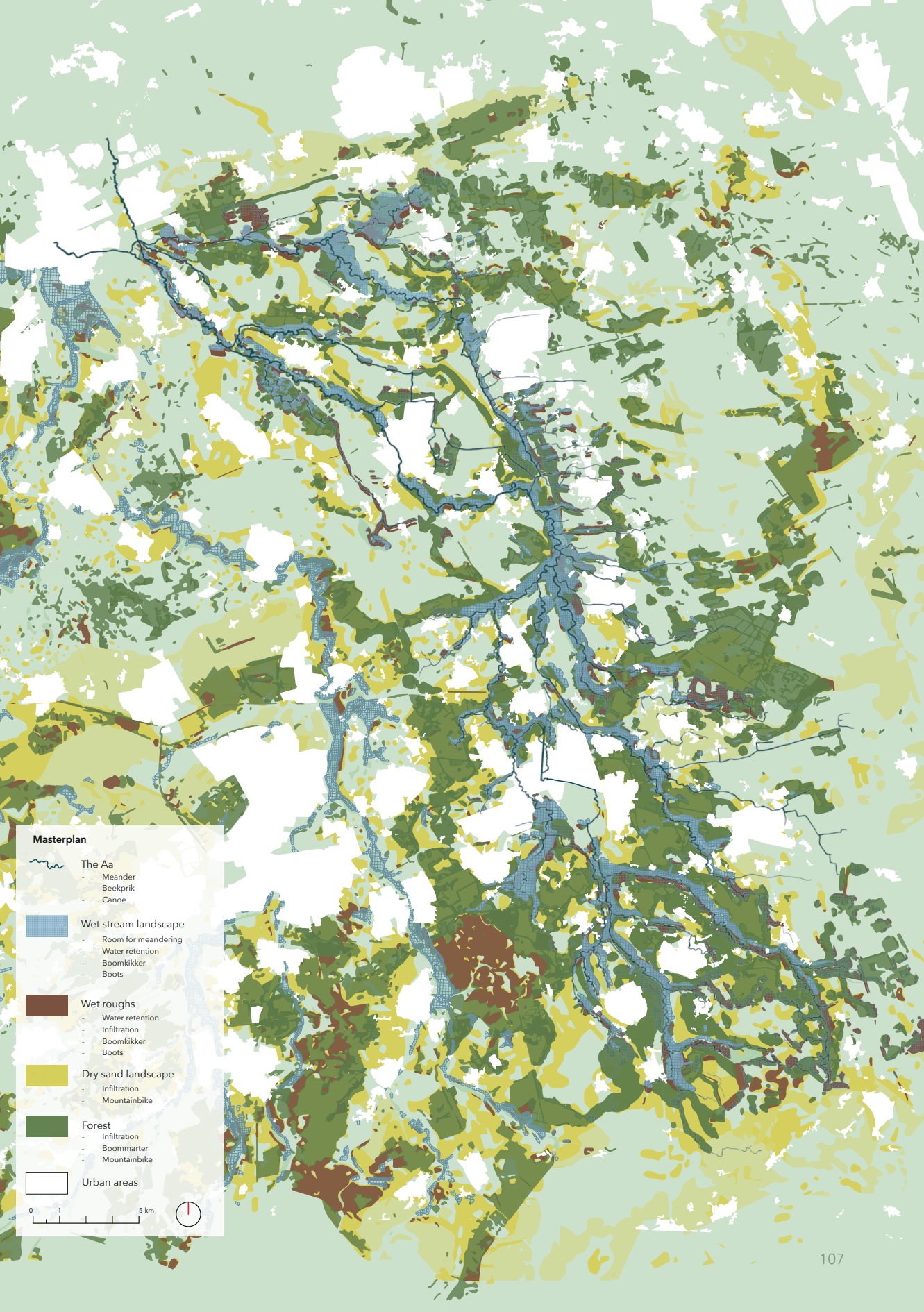
Mountainbike



Masterplan

The masterplan gives an illustrative view of what the landscape could look like when combining the concepts. With the three landscapes of the stream, the wet landscape, and the higher landscape. And for each of these landscapes looking at the different themes of water management, ecology, and recreation. Giving a total combination of the meander, retention, and infiltration measurements, the Beekprik, Boomkikker, and the Boomarter ecological network and the Kano, Boots, Mountainbike network. It gives a spatial view of how the landscape identity of this National Landscape Park can look like, combined with room for the protection of the ecosystem and room for natural processes. The important parts are the continuous stream, with new waterways around Helmond. Providing connections for the Beekprik and the Kano routes. And more space for meandering downstream. The extra space around the stream can be used to inundate the land, creating a habitat for the Boomkikker and making a Boots recreation network. Complemented by an extensive network on the higher areas. With wetter areas for water retention and more Boomkikker habitat. Forested parts by deciduous trees, allowing infiltration of rainwater and providing habitat for the Boomarter. These higher areas are connected with mountainbike routes.





Masterplan



The Aa

- Meander
- Beekprik
- Canoe



Wet stream landscape

- Room for meandering
- Water retention
- Boomkikker
- Boots



Wet roughs

- Water retention
- Infiltration
- Boomkikker
- Boots



Dry sand landscape

- Infiltration
- Mountainbike



Forest

- Infiltration
- Boommarter
- Mountainbike



Urban areas

0 1 5 km

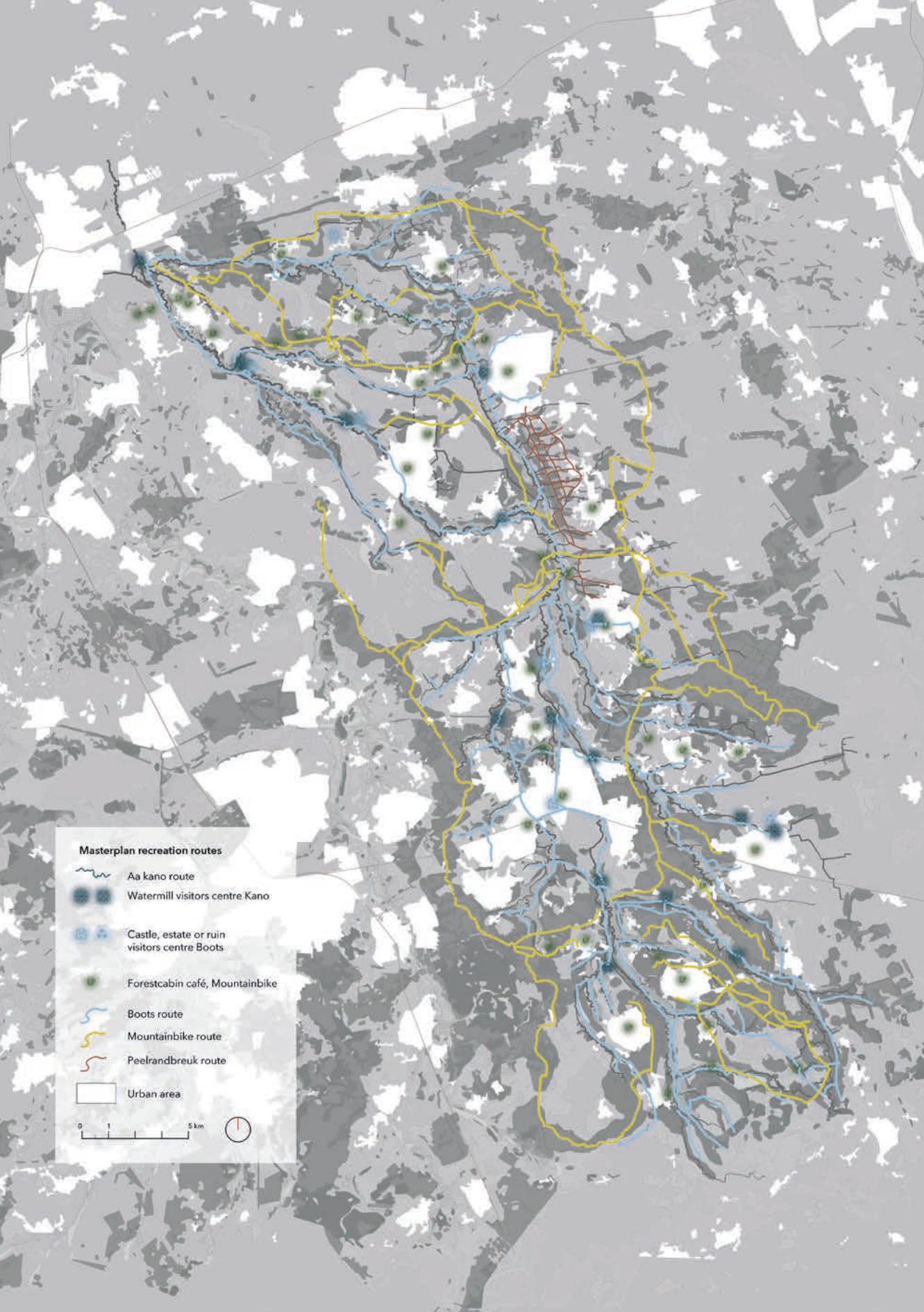


Routes

To better show the recreational network there is a separate map with the recreational networks. The Kano network was two main routes from 's Hertogenbosch to Helmond. One along the Peel horst and one through Veghel. Around Helmond, the stream and there for the Kano routes break up into smaller tributaries going towards the Grote Peel and the Maria Peel. Along the stream, there are Watermill visitor points dotted as a connection between the stream and the Villages and cities.

The Boots routes follow mostly the Aa and its tributaries. Finally making it possible to follow the Aa along its entire length. Along the way, old castles and estates can be found with beautiful cultural landscapes.

The mountainbike routes follow the forested areas. Within one forest a little round can be made, or multiple forests can be strung together on one ride. In the forests or nearby villages, there are cafés to be found. Providing a nice resting point.



Masterplan recreation routes

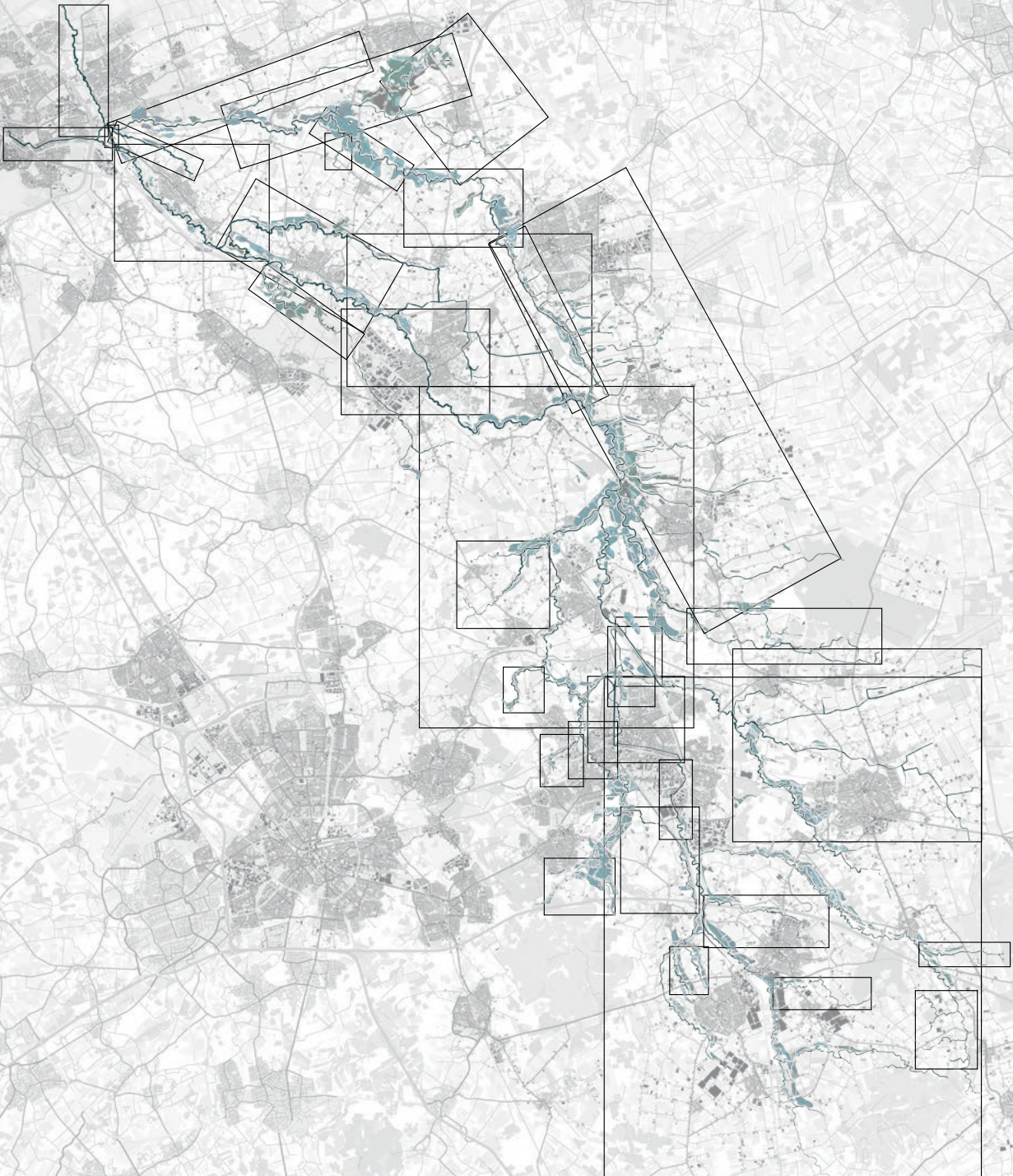
- Aa kano route
- Watermill visitors centre Kano
- Castle, estate or ruin visitors centre Boots
- Forestcabin café, Mountainbike
- Boots route
- Mountainbike route
- Peelrandbreuk route
- Urban area



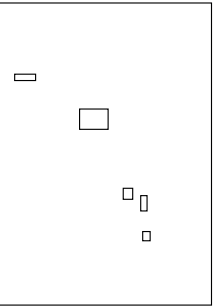


The Aa

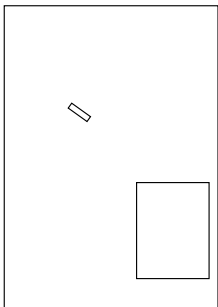
- Meander
- Beekprik
- Canoe



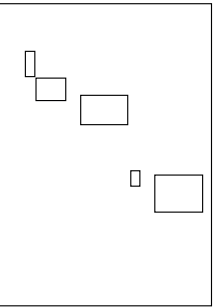
Inside city



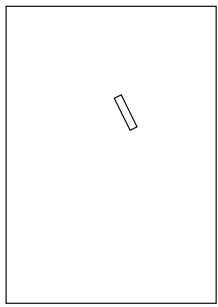
Upstream



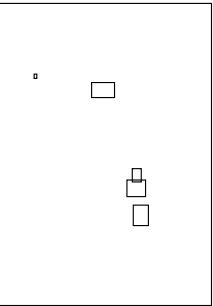
No change needed



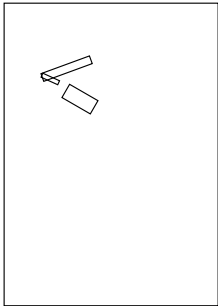
Leigraaf channel



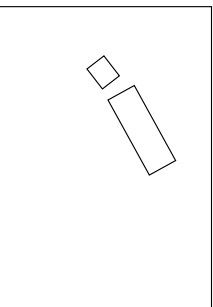
New waterways



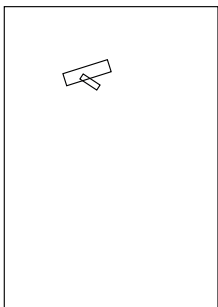
Downstream natural



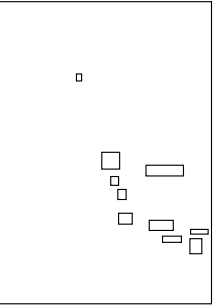
Peelrandbreuk



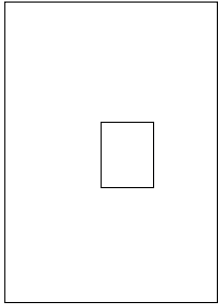
Downstream inudation



Stream spring



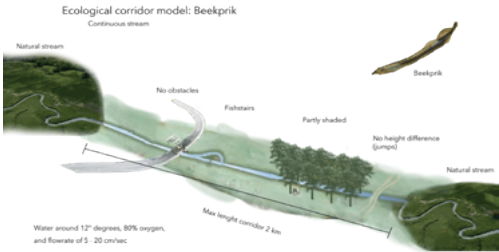
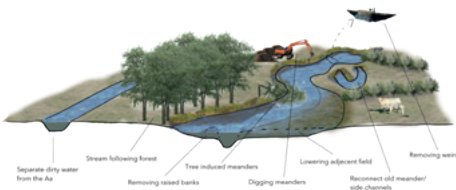
Downstream active



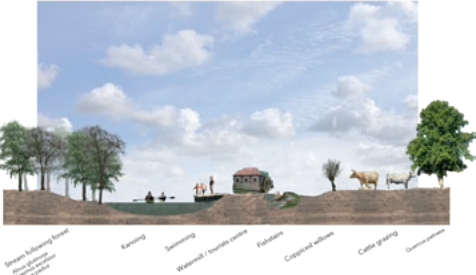
Parts of the Aa

The Aa and its tributaries exist out of many parts with different characteristics. Each of them would require detailing in design to make them a resilient and attractive part of the Van Gogh National Park. A large part of the Aa between 's Hertogenbosch and Helmond is already restored and of higher recreational quality compared to the many tributaries more upstream. This project does not go into further detailing of the individual parts of the Aa, it does show a regional design for the entire Aa catchment area and some zoom-ins showing the implementation of the design modules in a couple of places.

Meanders



Canoe







The Aa north of Veghel
Image by author

Wet stream landscape

- Room for meandering
- Water retention
- Boomkikker
- Boots



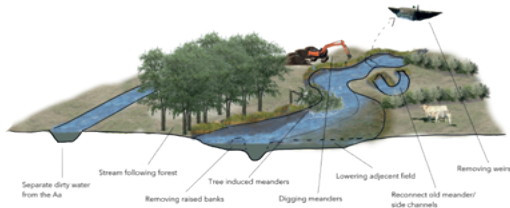
Masterplan stream landscape

- Meadow
- Rough
- Forest

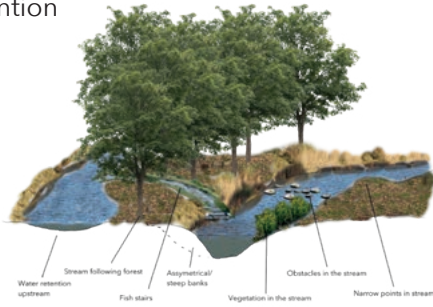
0 1 5 km



Meanders

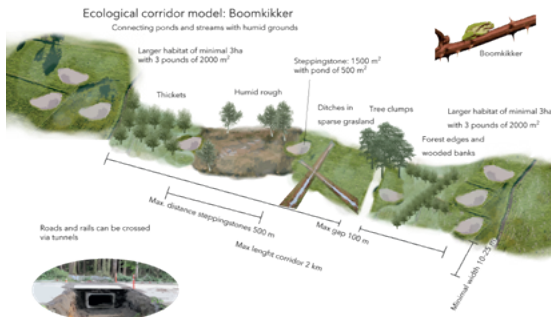


Retention



Wet stream landscape

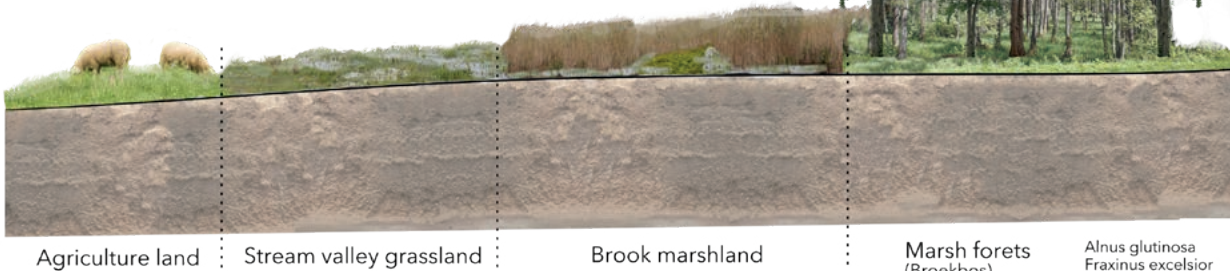
The wet stream landscape is mostly concentrated around the Aa itself. Upstream in the south making linear structures in the valleys, whilst more downstream in the North covering large surfaces. The wet stream landscape is the landscape through which the Aa will meander as well as the landscape in which water will be retained. This makes the landscape the living habitat for the boomkikker. Accessibility depends a bit on the season and weather as it might be too wet. High boots are advised when strolling through the landscape.



Boots



Stream landscape







The Aa near Berlicum
Image by author

Wet roughs

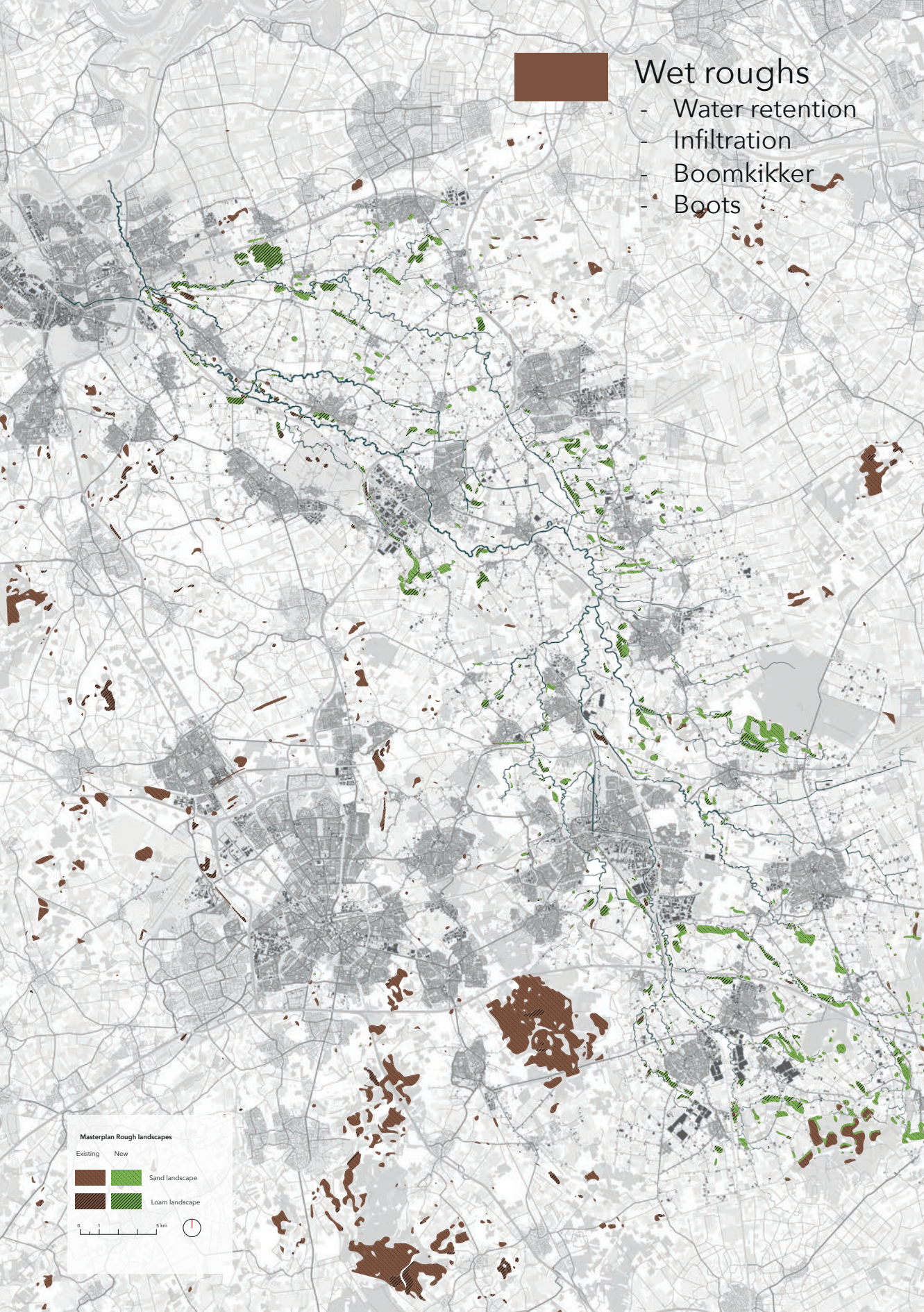
- Water retention
- Infiltration
- Boomkikker
- Boots

Masterplan Rough landscapes

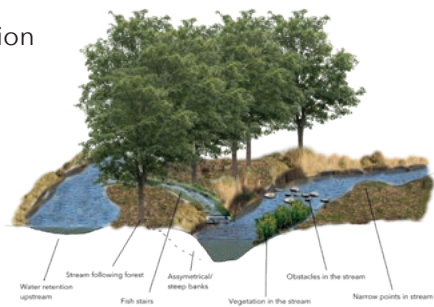
Existing New

Sand landscape
Loam landscape

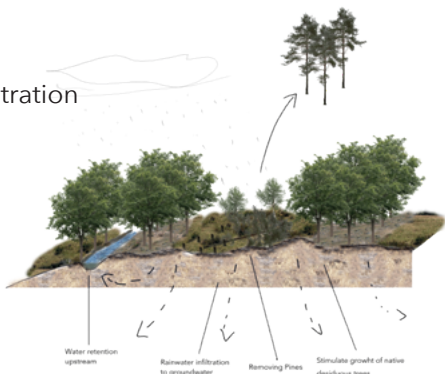
0 1 2 3 km



Retention



Infiltration



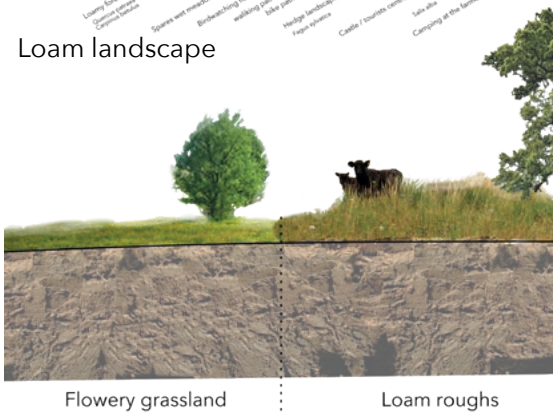
Ecological corridor model: Boomkikker



Boots



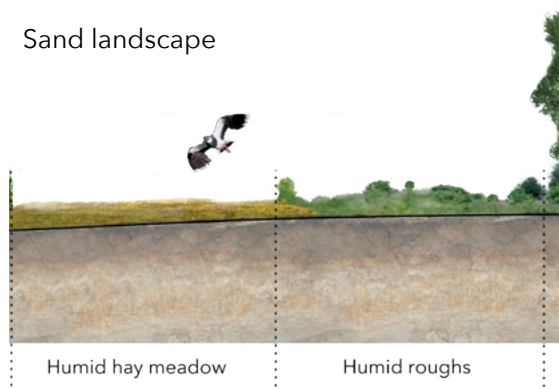
Loam landscape



Wet roughs

The wet roughs form an extension of the wet stream landscape further from the stream itself. Roughs require semi-regular maintenance or grazing to prevent the landscape from becoming forested. The lower grounds can be inundated and thereby retain water. Whilst stored water on the higher ground can be infiltrated. Keeping these landscapes wet makes them suitable for the Boomkikker and seasonal recreation.

Sand landscape







The Aa north of Veghel
Image by author



Dry sand landscape

- Infiltration

- Mountainbike



Masterplan Forest

Existing New



Marsh forest



Loam forest



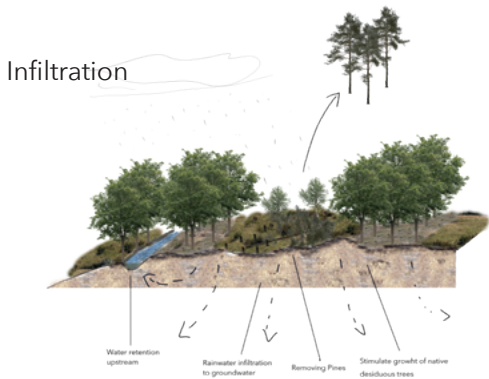
Humid oak beech forest



Dry forest

0 1 5km

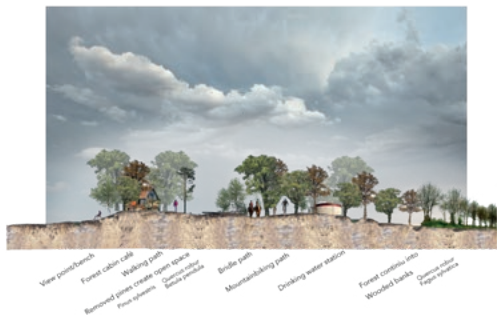




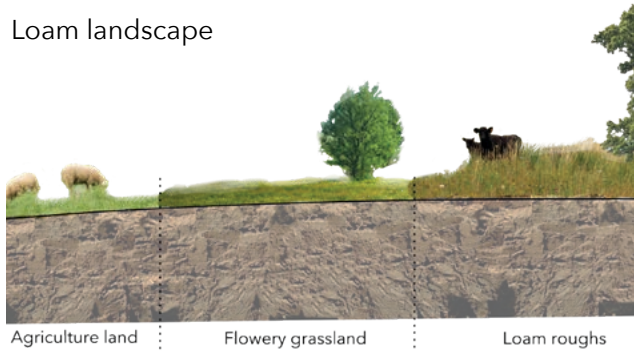
Dry sand landscape

Large parts of the landscape can become part of the dry sand landscape. This can often be combined with agricultural functions, but space needs to be made to store rainwater and allow it to infiltrate. Hedges and tree lanes are planted creating a smaller-scale more diverse landscape suitable as habitat and corridor for the Boommarker. And the addition of paths and routes makes it well enjoyable for recreation.

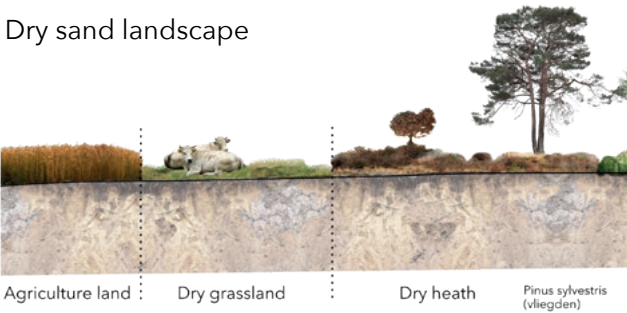
Mountainbike



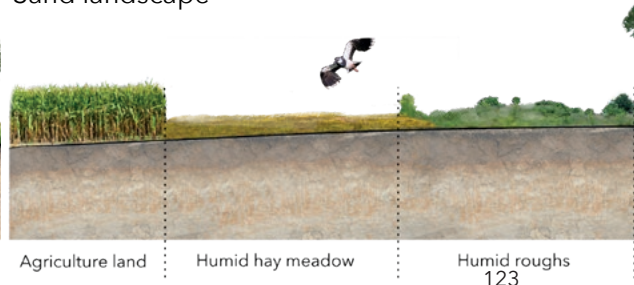
Loam landscape



Dry sand landscape



Sand landscape







Landscape around castle Heeswijk
Image by author









Forest


- Infiltration
- Boomarter
- Mountainbike

Masterplan Dry sand landscape

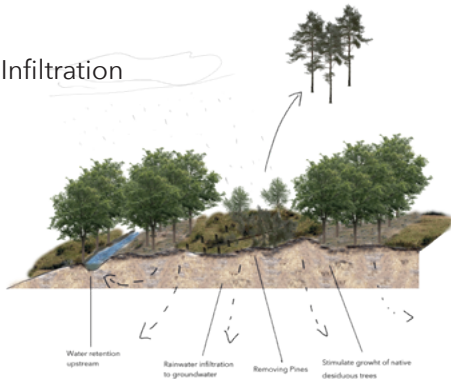
Agriculture / Meadow
/ Meadow

		Dry sand landscape
		Sand landscape
		Loam landscape

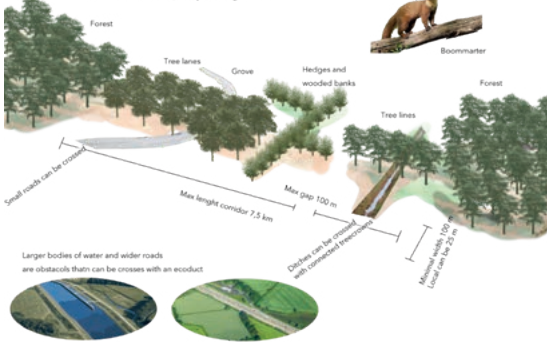
0 1 5 km



Infiltration



Ecological corridor model: Boomarter



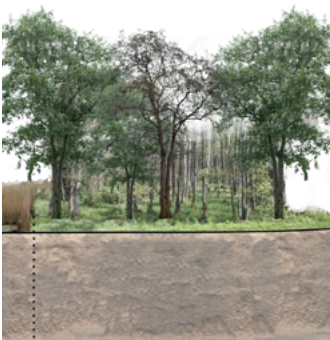
Mountainbike



Forest

The forests around the Aa have a multitude of roles and cross different landscapes. It therefore also exists out of a variety of forest types. With stream following wet forest providing shade over the stream to dry forests on the higher grounds replacing the existing pine forests. All these forests can provide habitat for the Boomarter, but they will most likely concentrate in the larger forests on the higher grounds. The recreational network can go from small rounds inside the forest to a larger network connecting the different forests.

Dry sand landscape



Marsh forests (Broekbos)

Alnus glutinosa
Fraxinus excelsior
Prunus padus

Sand landscape



Loam forest

Quercus petraea
Carpinus betulus

Loam landscape



Humid oak-beech forest

Quercus petraea
Fagus sylvatica

Stream landscape



Dry forest

Quercus robur
Betula pendula





Tree canopy over the stream at castle Heeswijk
Image by author

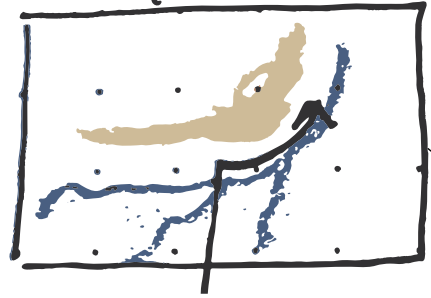
Zoom-ins

The three landscape types of the stream, wet, and higher have different ways of interacting.

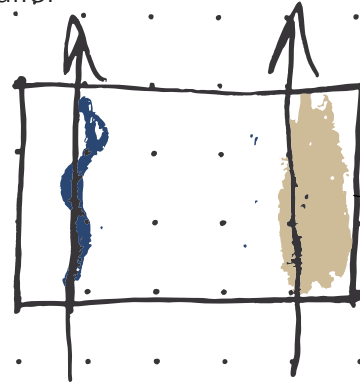
- 'Collision': where the streamflow hits a higher sand dune or ridge and is diverted
- 'In between': where the stream cuts its way through a higher area
- 'Embrace': when streams flow on both sides of a higher sand dune or ridge encompassing it.
- 'Parallel': Where the stream flows parallel to a higher area, often small side streams from the higher area enter the main stream perpendicular.
- 'Spring': a point with much seepage from which a stream arm starts flowing.

Three locations, one with 'Collision', one 'In-between', and one 'Parallel' are used as zoom-in locations showing the detailing of the different networks. Multiple networks are present in each zoom-in, but the focus will be on the networks of one of the landscape types for each zoom-in. This will be the stream networks for the 'Collision' zoom-in, the wet networks for the 'Parallel' zoom-in, and the higher networks for the 'In-between' zoom-in.

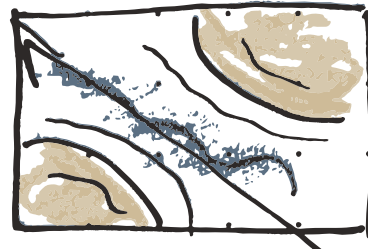
Collision



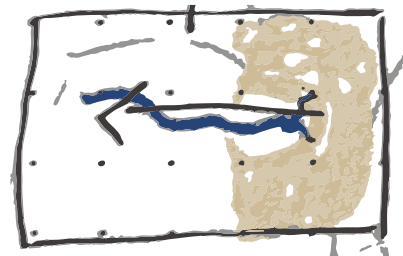
Parallel



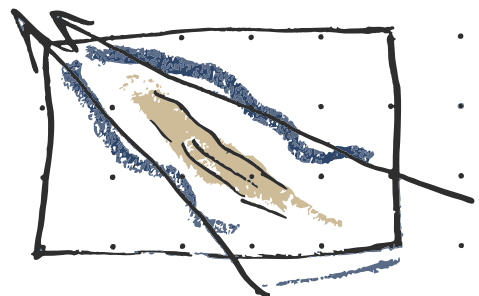
In between

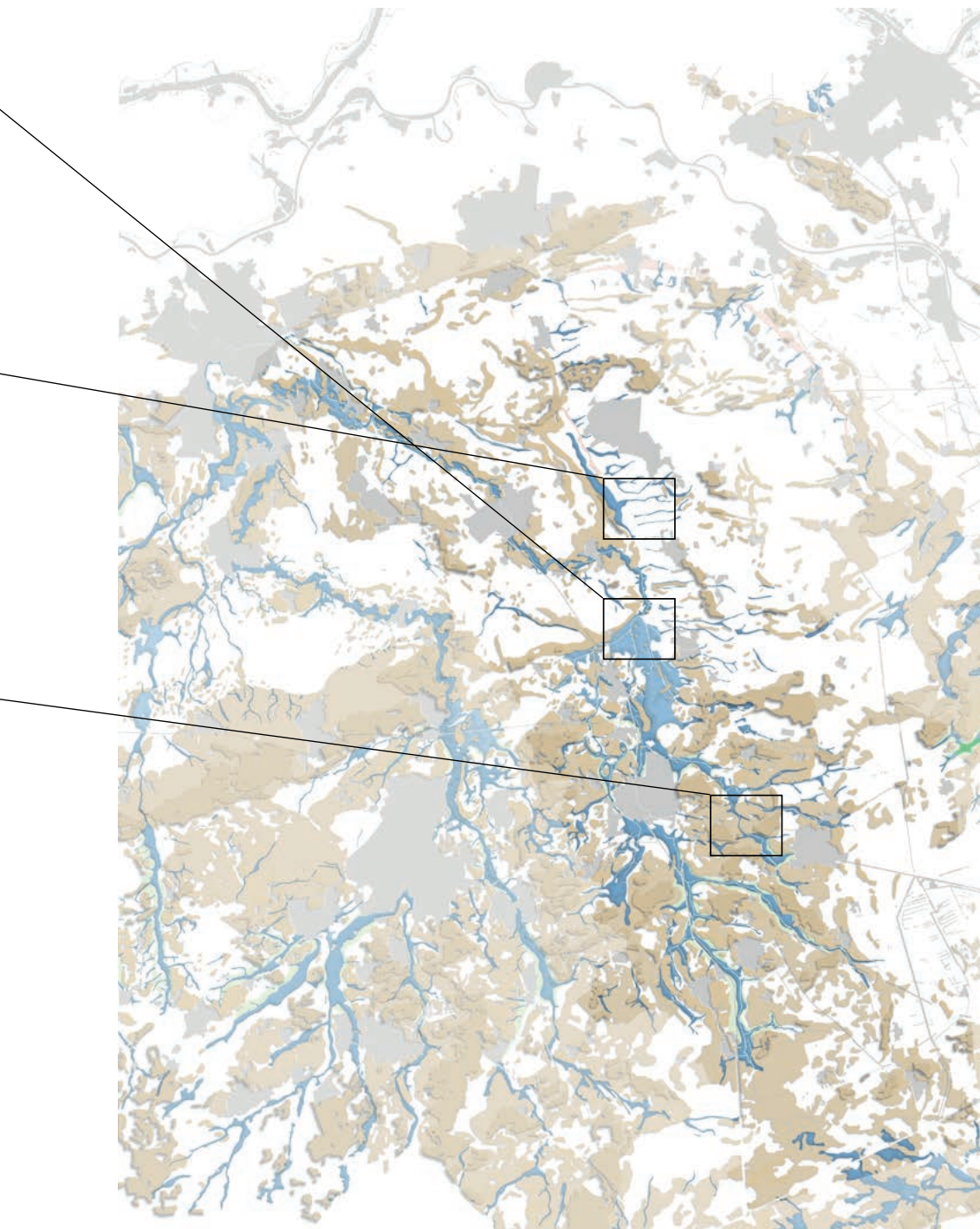


Spring



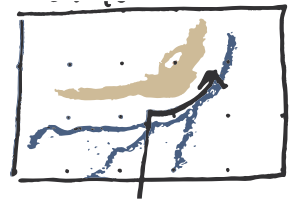
Embrace

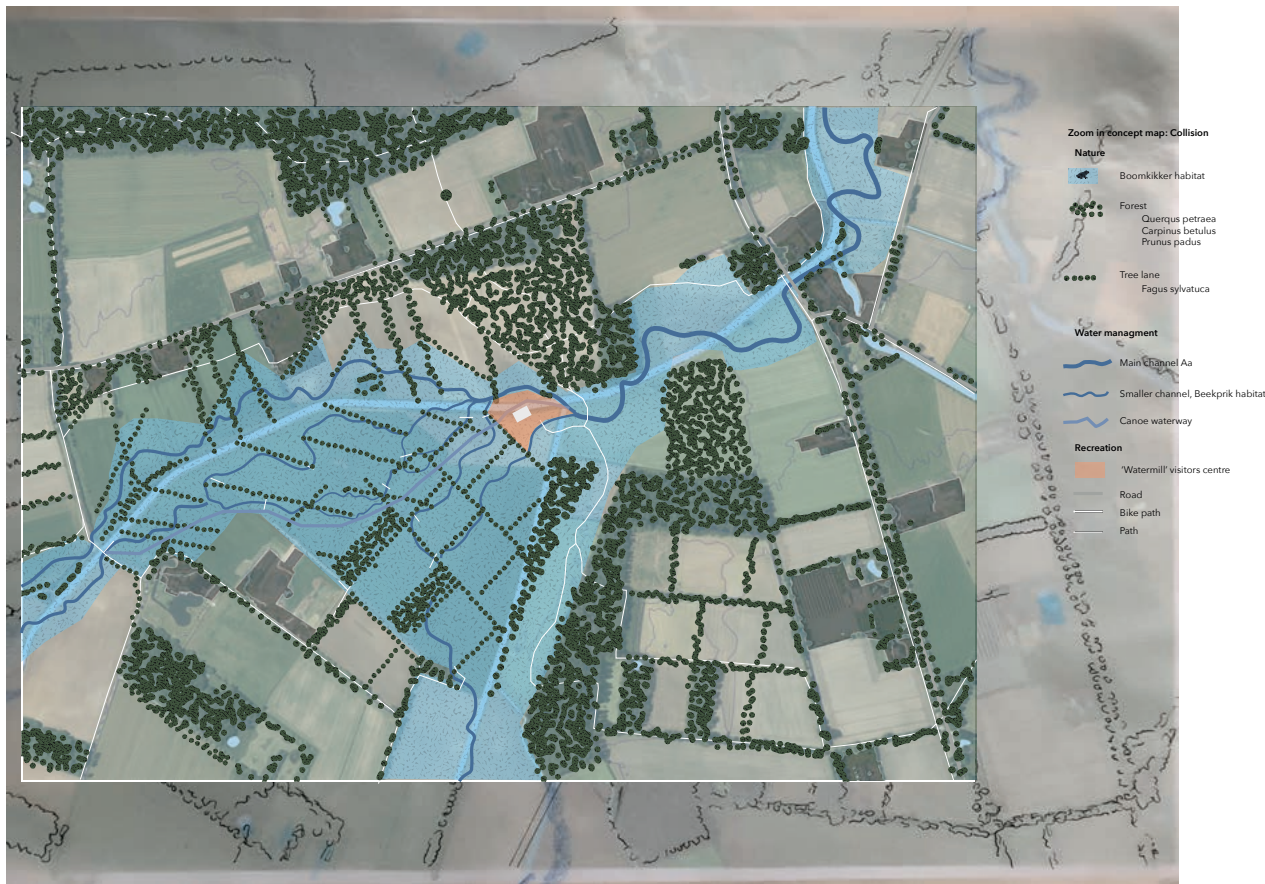




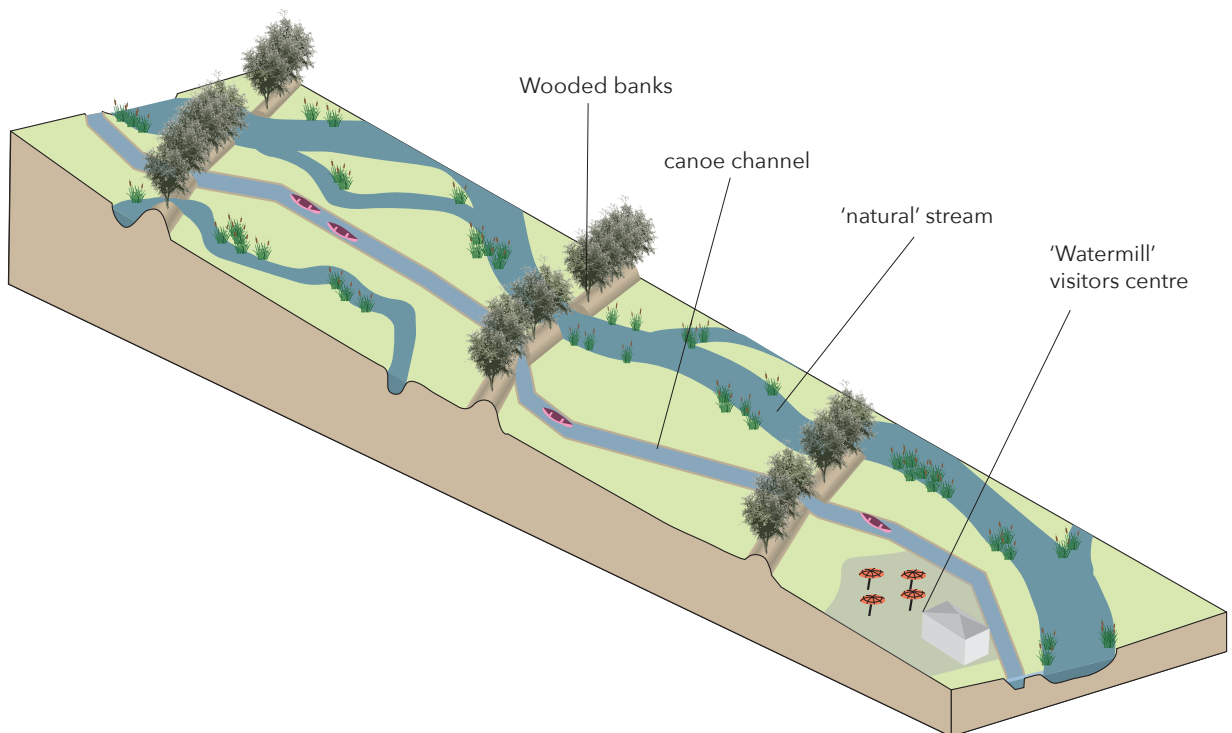
Collision-stream

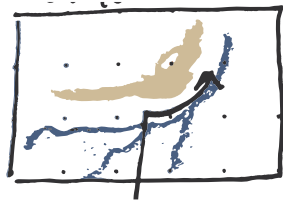
This zoom-in shows the point north of Helmond where the Aa comes from the south hits a sand ridge and is diverted to the east around it. This is also a point where multiple tributaries of the Aa come together. The landscape is characterised here by a low flat valley that quickly rises on the slope of the sand ridge. In the southeast, there are still remnants of an old hedge landscape. While along the stream there used to be fields defined by hedges perpendicular to the stream. At the outer banks of the stream, the hedge landscape is reintroduced, although at a slightly larger scale to accommodate modern machinery. New channels are dug to divert the channels together towards the middle. On this middle plateau, banks are created that mimic the wooded hedge pattern on the sides. The diverted stream will find there way navigating around these bends, kickstarting a meandering process. The new more dynamic stream will provide habitat for the Beekprik. In the short term there will be trees growing on the banks, in the long term the banks will start to disappear as the stream erodes them away. This place will be a crossing of multiple routes. The Kano route between Veghel en Helmond, a Boots route following the stream, and a Mountainbike route crosses the stream here connecting the forests northwest and southeast.



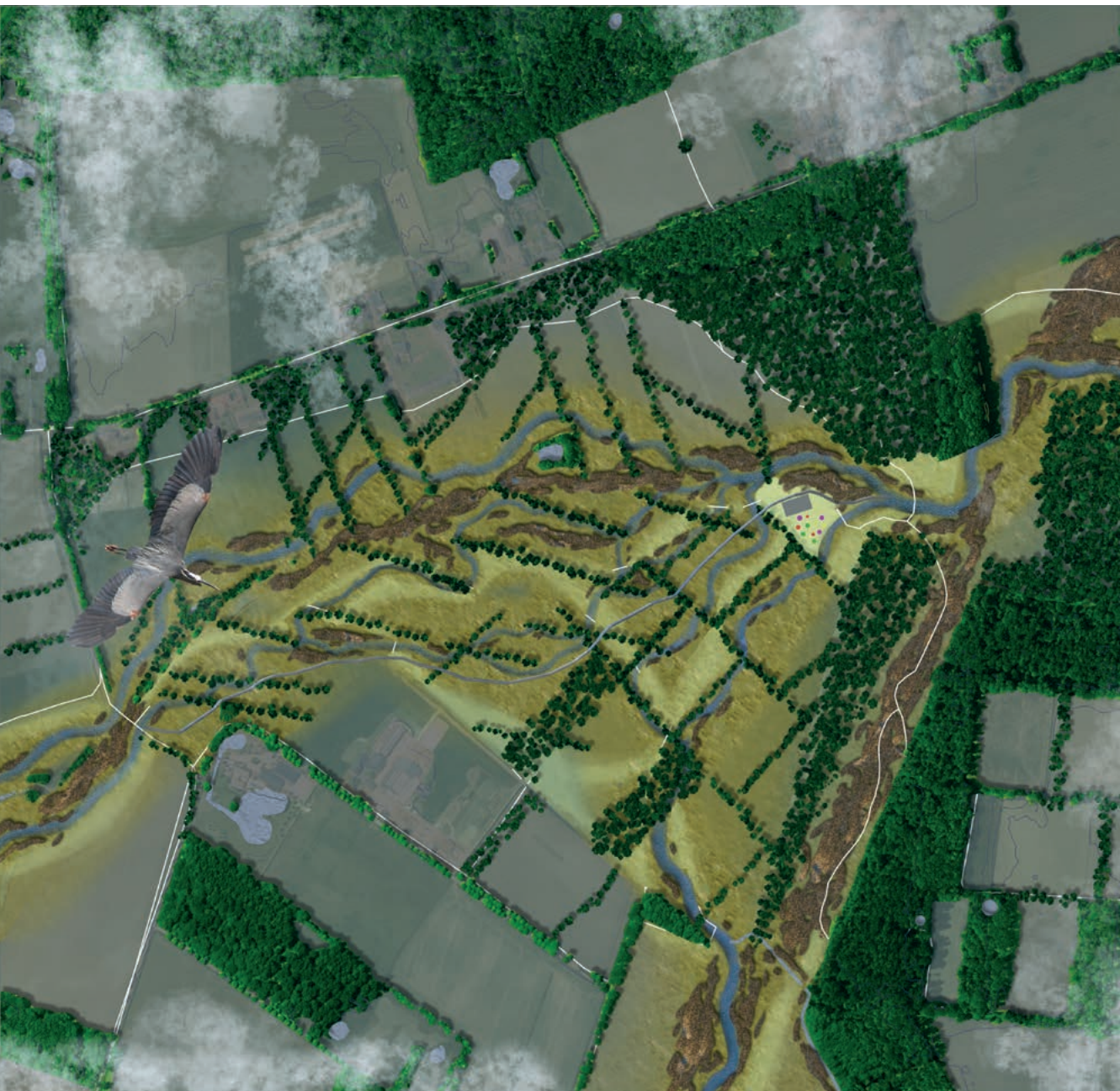


Sketch design



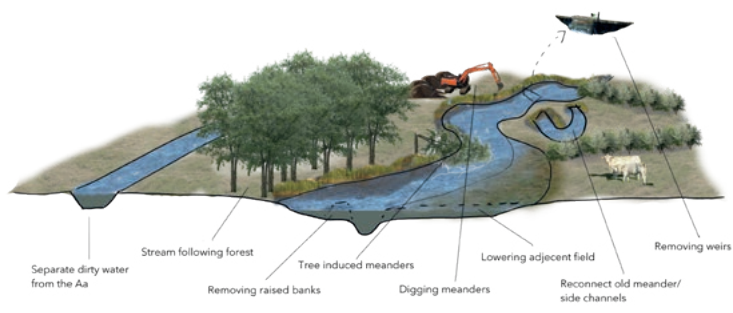
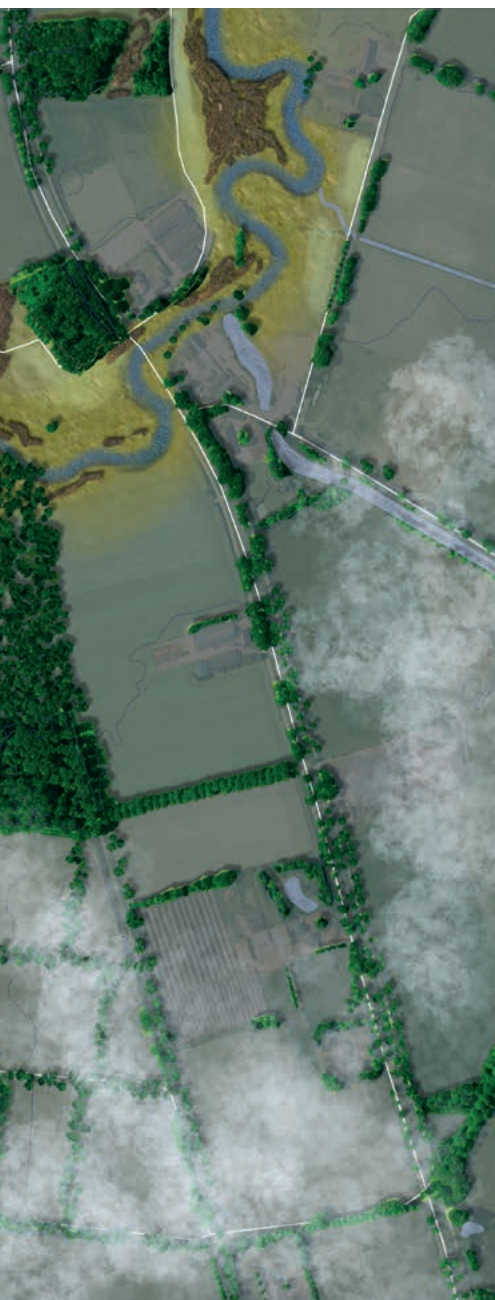


Zoom-in: Collision

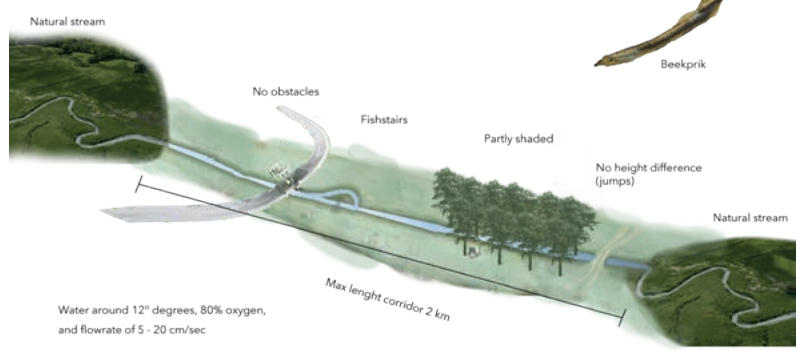


Design zoom-in Collision

Meanders



Ecological corridor model: Beekprik

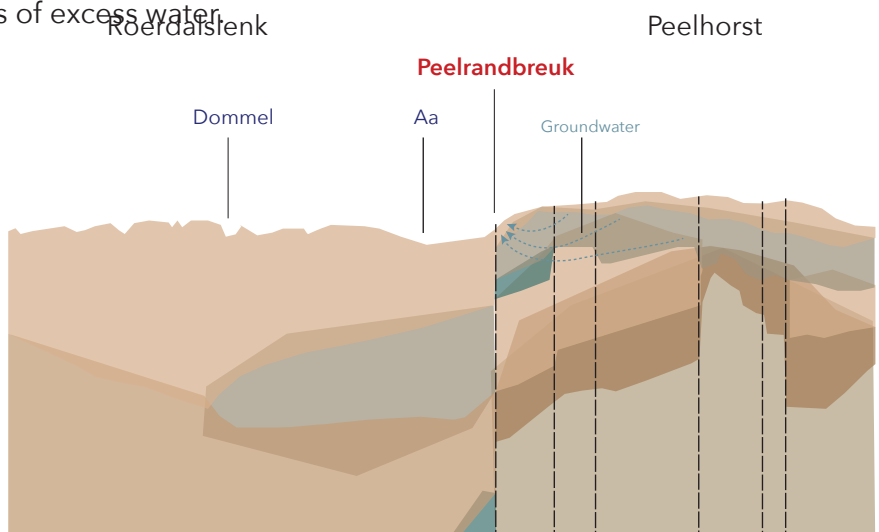
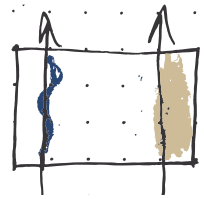


Canoe



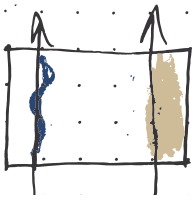
Parallel- wet

Here flows the Leigraaf parallel to the horst on the east. In the slope of the horst lies the Peelrandbreuk. Along this tectonic fracture seepage comes up. If the land is not interfered with the location of the tectonic fracture becomes visible by a couple of meters exactly, caused by the seepage. That is why a protected cultural landscape is introduced along the Peelrandbreuk. With tree lanes creating small fields that can still be used for sheep grazing. Downhill the seepage is collected in wet roughs to retain water upstream for longer while providing habitat for the Boomkikker. The idea is that the landscape makes the Peelrandbreuk visible. Making it possible to follow the fracture through the landscape here between Uden and Boekel. All the seepage causes the area to be wet and therefore part of the Boots network. Eventually, the water is released by smaller streams. Which flow protected by trees towards the Leigraaf. The Leigraaf is a tributary of the Aa, providing water to the northeast part of the catchment area. This requires the Leigraaf to maintain sufficient depth and flow. The tree lanes from east and west are slightly raised and form choke points in the Leigraaf. Allowing enough water through in dry periods, but retaining water upstream in periods of excess water.





Sketch of design from birdseye perspective

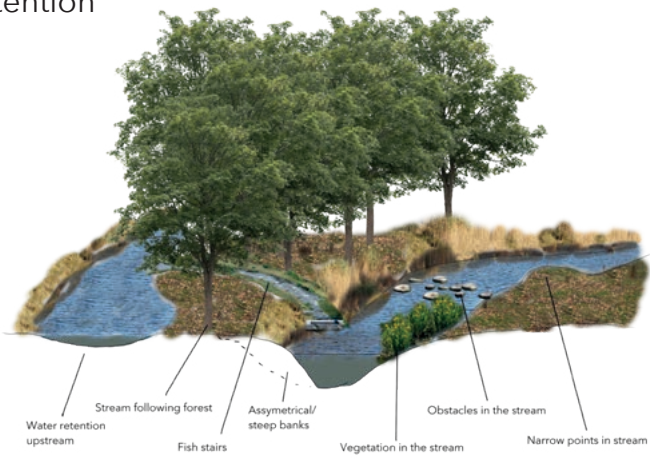


Zoom-in:
Parallel



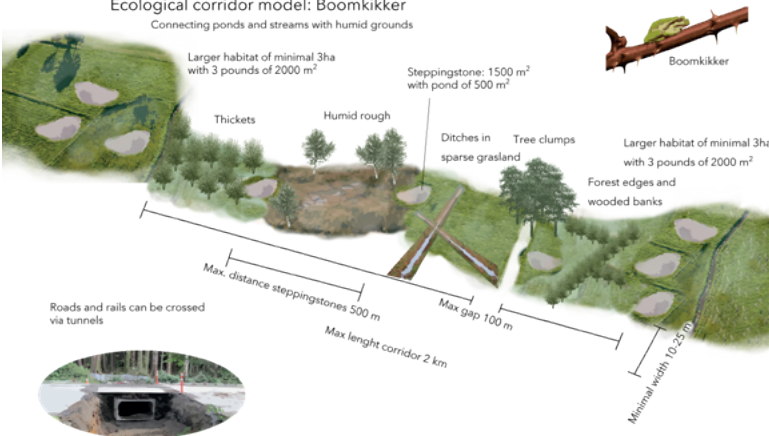
Design zoom-in Parallel

Retention



Ecological corridor model: Boomkikker

Connecting ponds and streams with humid grounds

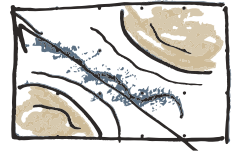


Boots

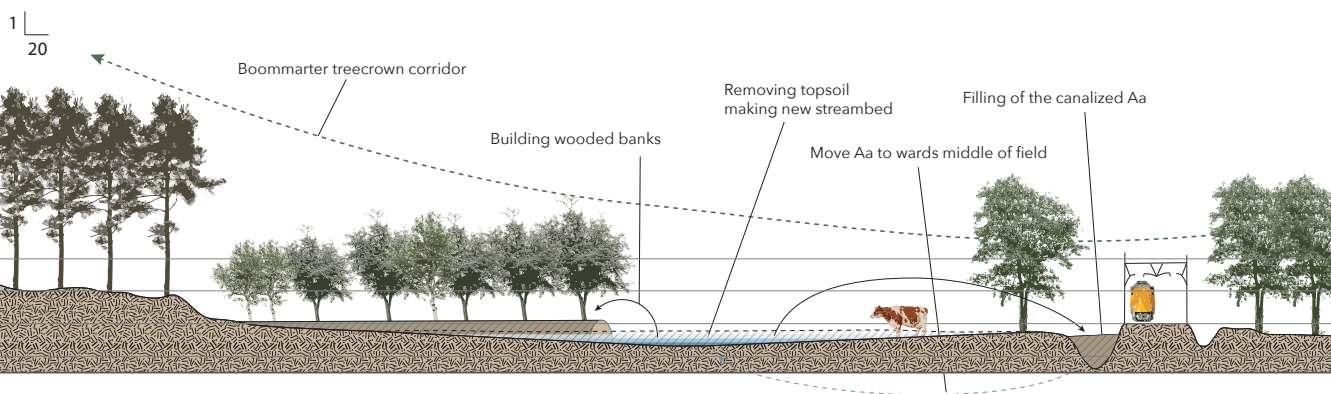
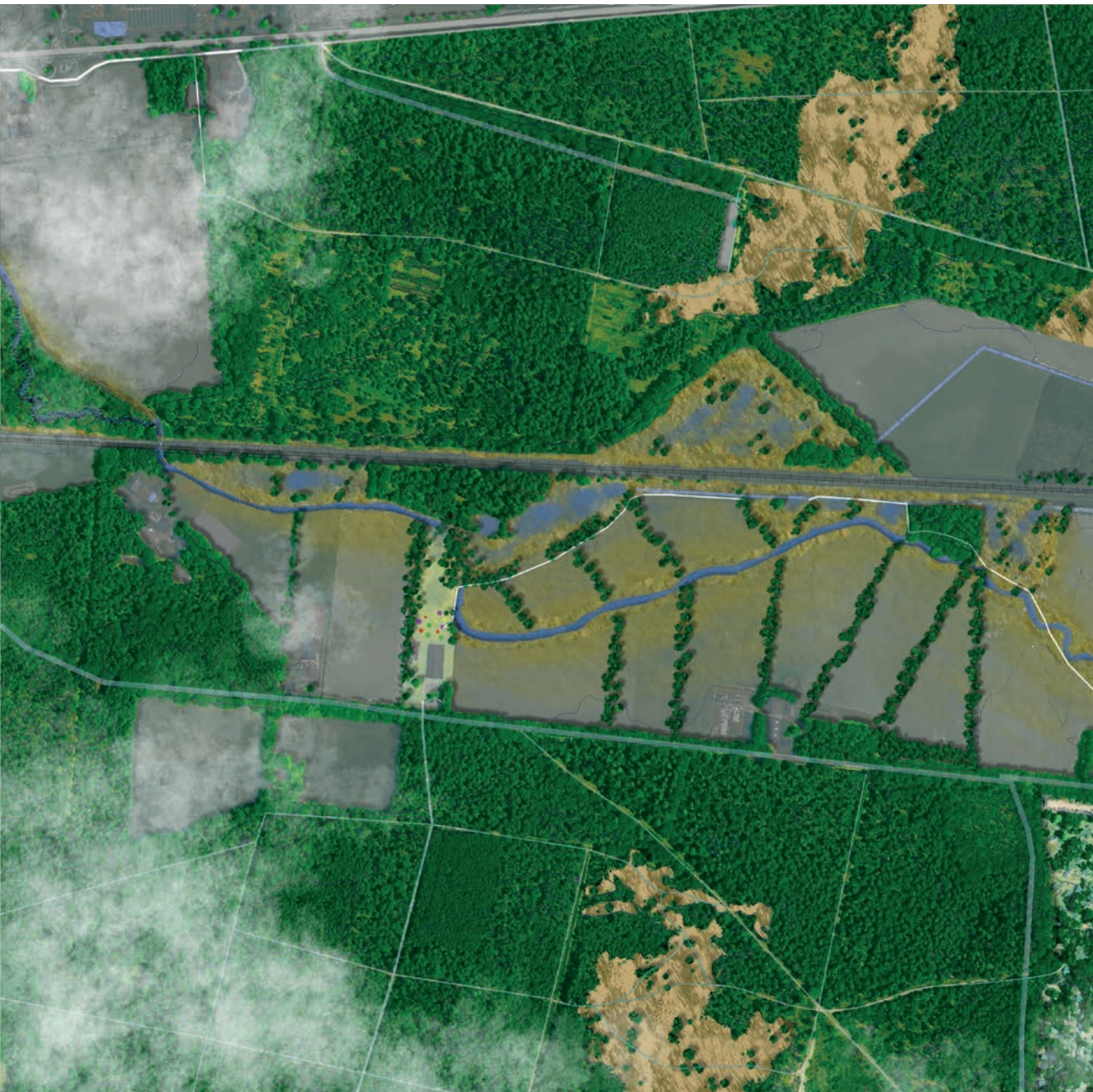


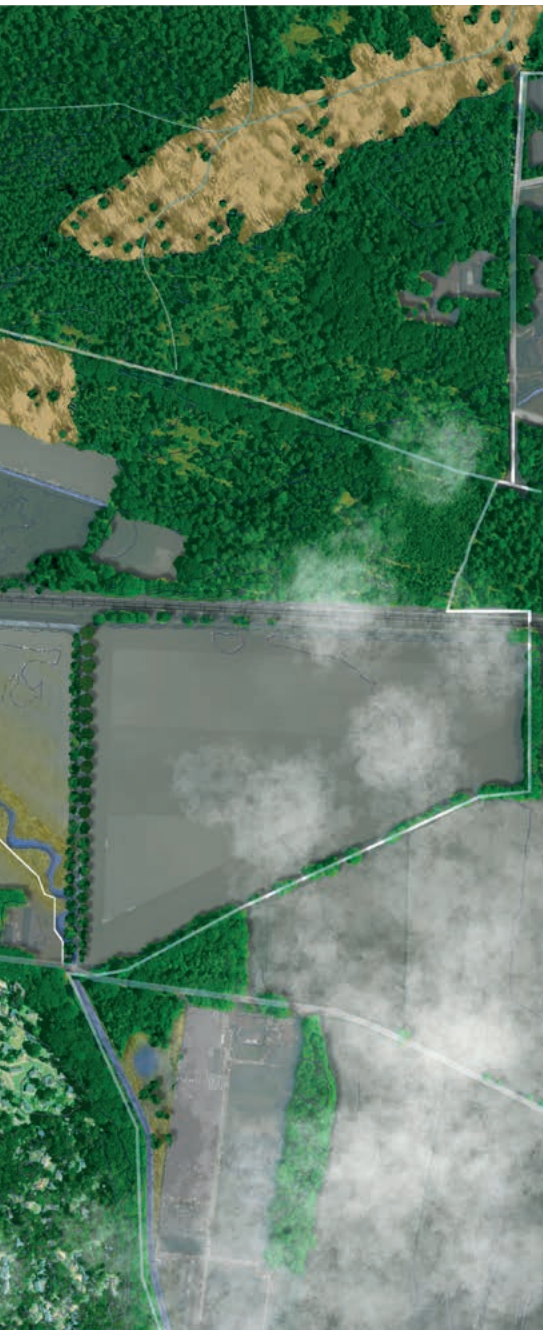
In between- higher

Here between Helmond and Deurne the Aa the oude Aa has carved an opening, cutting between the higher sand ridges. This little valley is also used to run the train tracks. This was the first reason to canalize part of the stream along the train tracks. Later stream was completely canalised to improve the efficiency of the farms. While the land used to be grazed by cattle, around twenty years ago it transitioned to crop production. Mainly maize and potato is produced now. It was not the farms here that made the transition, as all farmers were live-stock farms and all farmers here have already stopped recently or are phasing out their production (I-GO, 2024). In the surrounding forest, clearings are created to remove pine. These clearings allow more rainwater to infiltrate, while over time they will be overgrown with deciduous trees, creating a more diverse forest. The two forests will be connected via tree lanes and wooded banks for the Boomarter. The rail will have to be crossed via a tunnel. The wooded bank will be created with the top layer of soil from the fields. This layer is removed to remove the nutrient-rich layer and allow sparse meadow to develop. The removal will not be done equally, but with its lowest point in the middle of the fields to guide the stream in a new direction. This will cause the fields to be inundated during the winter and available as pasture during the summer. On the east, a restored stream meander will be created from old mapping. Along the stream wet steppingstones are made for the Boomkikker, changing the stream into an ecological corridor. The location of the bungalow park means this location will become a node in the routing

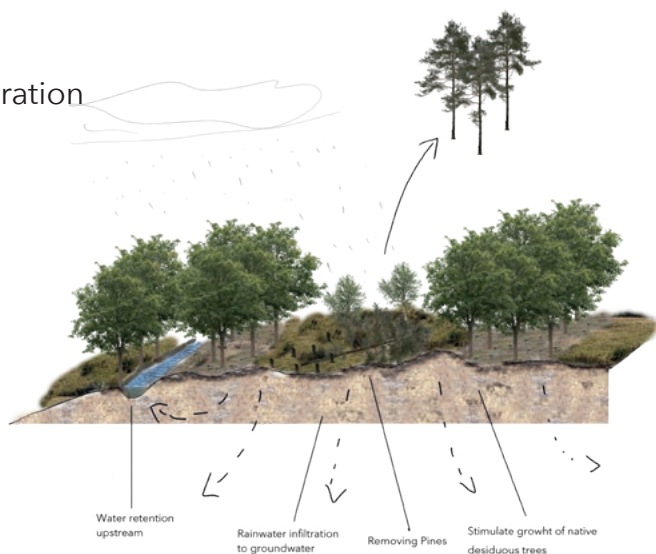


network. With a Boots path following the stream east to west, and mountain-bike routes crossing the stream north to south. One of the former farms can be turned into a café.



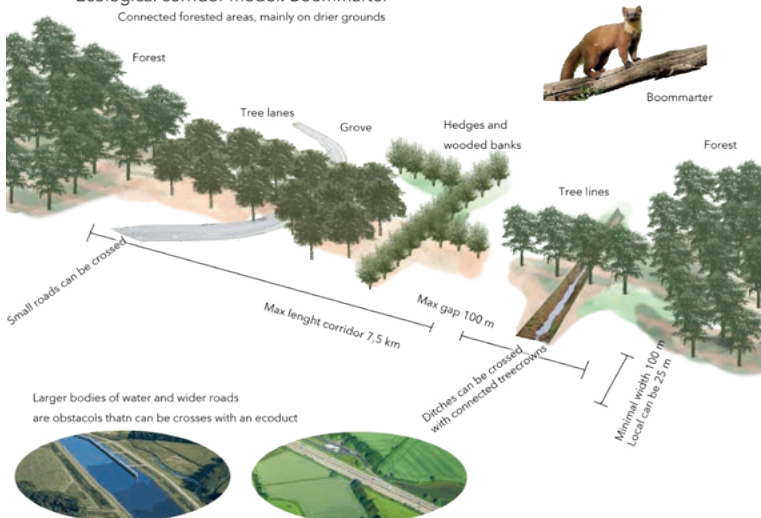


Infiltration

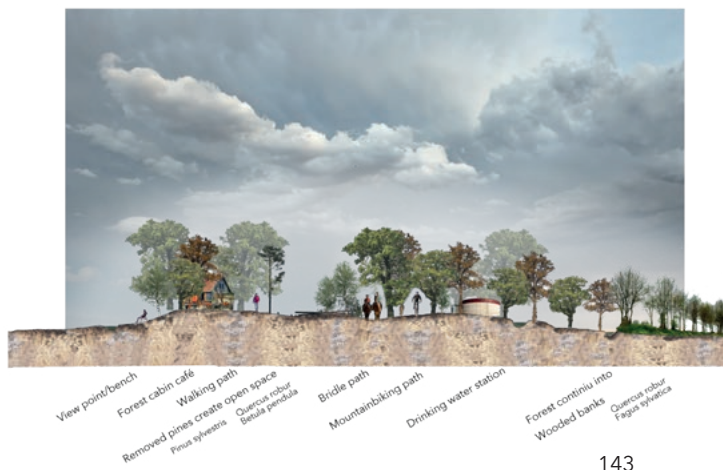
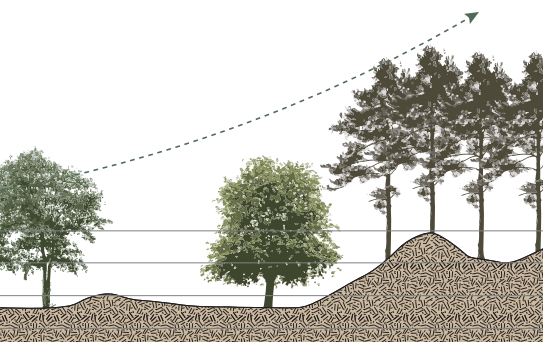


Ecological corridor model: Boommarker

Connected forested areas, mainly on drier grounds



Mountainbike







The Aa flowing through the city of Veghel
Image by author

Urban bottlenecks





Water in Uden
Image by author

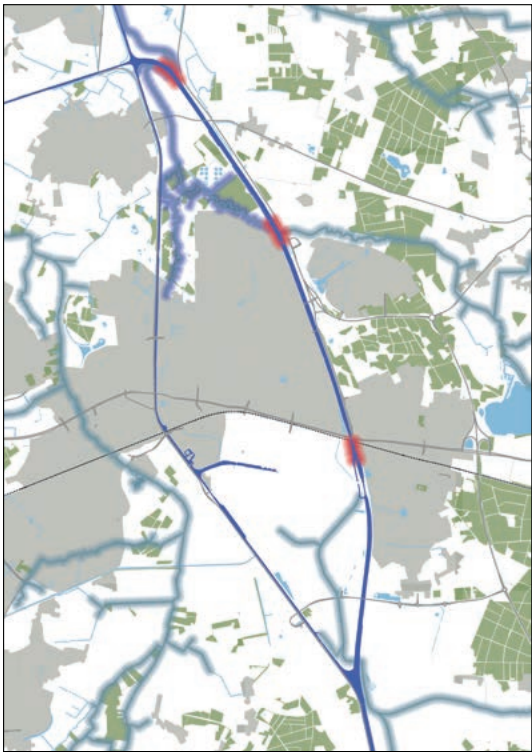
Urban

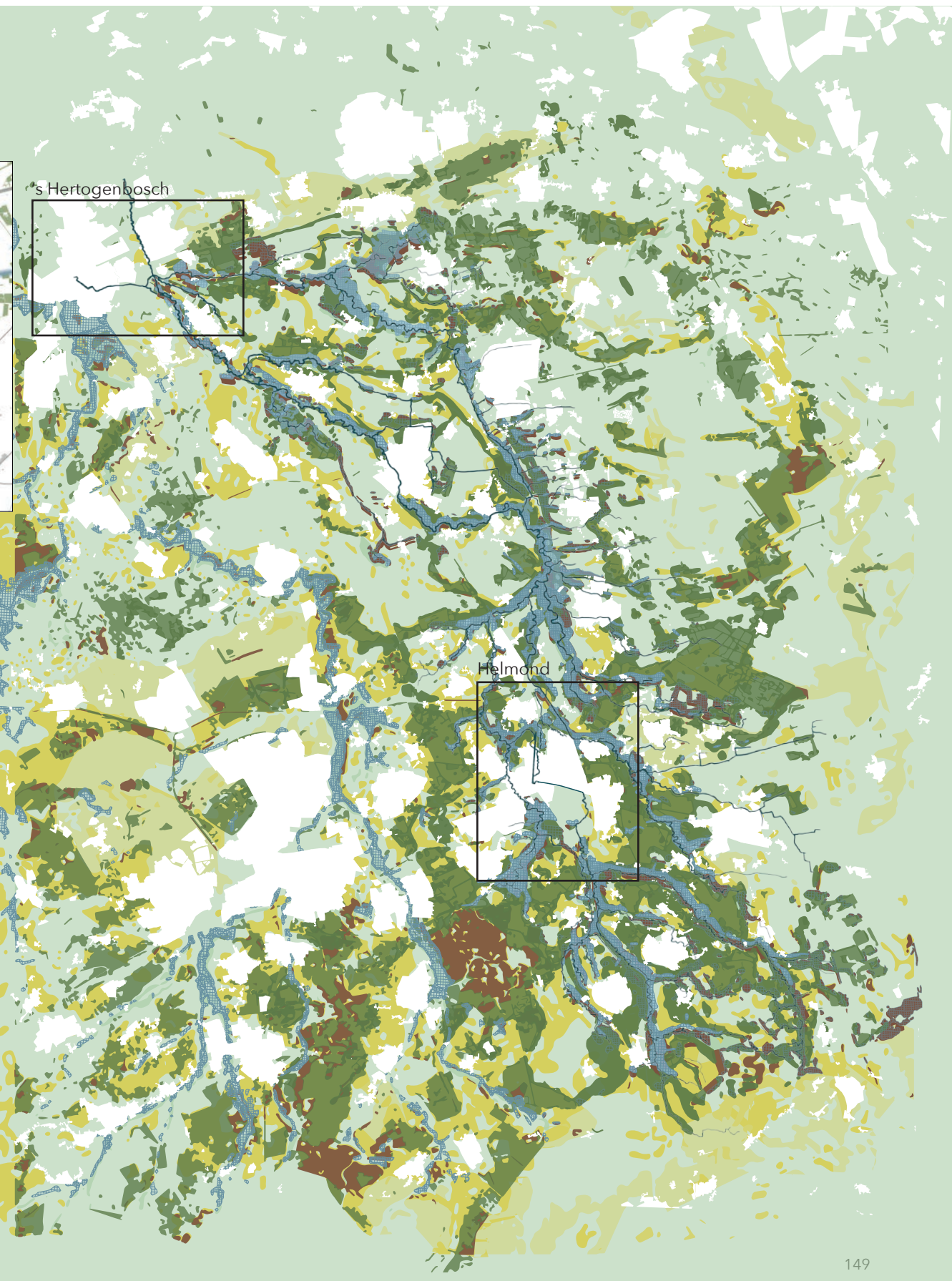
There lays an important in connecting people with their surrounding landscape. Access to green and nature is good for people’s well-being (Rli, 2022) and the interaction between people and the landscape creates the landscape identity. The problem statement showed that urban areas around the Aa are on average less connected to nature compared to the cities around the Dommel. Using a stream that flows through a city is a good way of connecting the urban dwellers with the landscape. For the ecological network an urban area is often an obstacle. Around a stream in a urban environment is most of the time less space, space needed for a undisturbed nature corridor. But a well design bleu-green corridor trough an urban area can be well suited for many species, and it provides green and urban cooling in the city. These challenges and opportunities are why in the two largest urban areas of the Aa a zoom-in designs are made. To see how the networks of the Aa looks like in an urban context and on how people in urban areas can get a good new connection to the wider landscape.

’s-Hertogenbosch



Helmond





Helmond

Analysis

The biggest challenge around Helmond for the a is the many places where the stream is cut by the Zuidwillemsvaart and the new side channel. Disentangling the Aa from the Zuidwillemsvaart requires the building of new channels guiding the Aa water along the Zuidwillemsvaart for a bit. Where crossing is necessary siphons will be used to maintain at least the water quality. Crossing the Zuidwillemsvaart in the south of Helmond with a siphon provides the opportunity to reintroduce this water in the city. Historically the Aa used to flow through the city but was diverted with the building of the Zuidwillemsvaart. Currently, there is a four and at times a 5-lane road through the middle of the city. Removing most of these lanes creates space to have the Aa flow through the middle of the city from east to west. In the west, the Aa can reconnect with the old castle and be diverted into the old channel of the Zuidwillemsvaart. Making this channel part of the Aa water system. From here the Aa can flow up north connecting to the park of the Gulden Aa and divert to the west where the Aa can continue its path. To connect the urban area with the surrounding landscape a couple of new parks are introduced at the places where the Aa hits the urban fabric. These parks are used as transition points between urban and the landscape.



Current situation

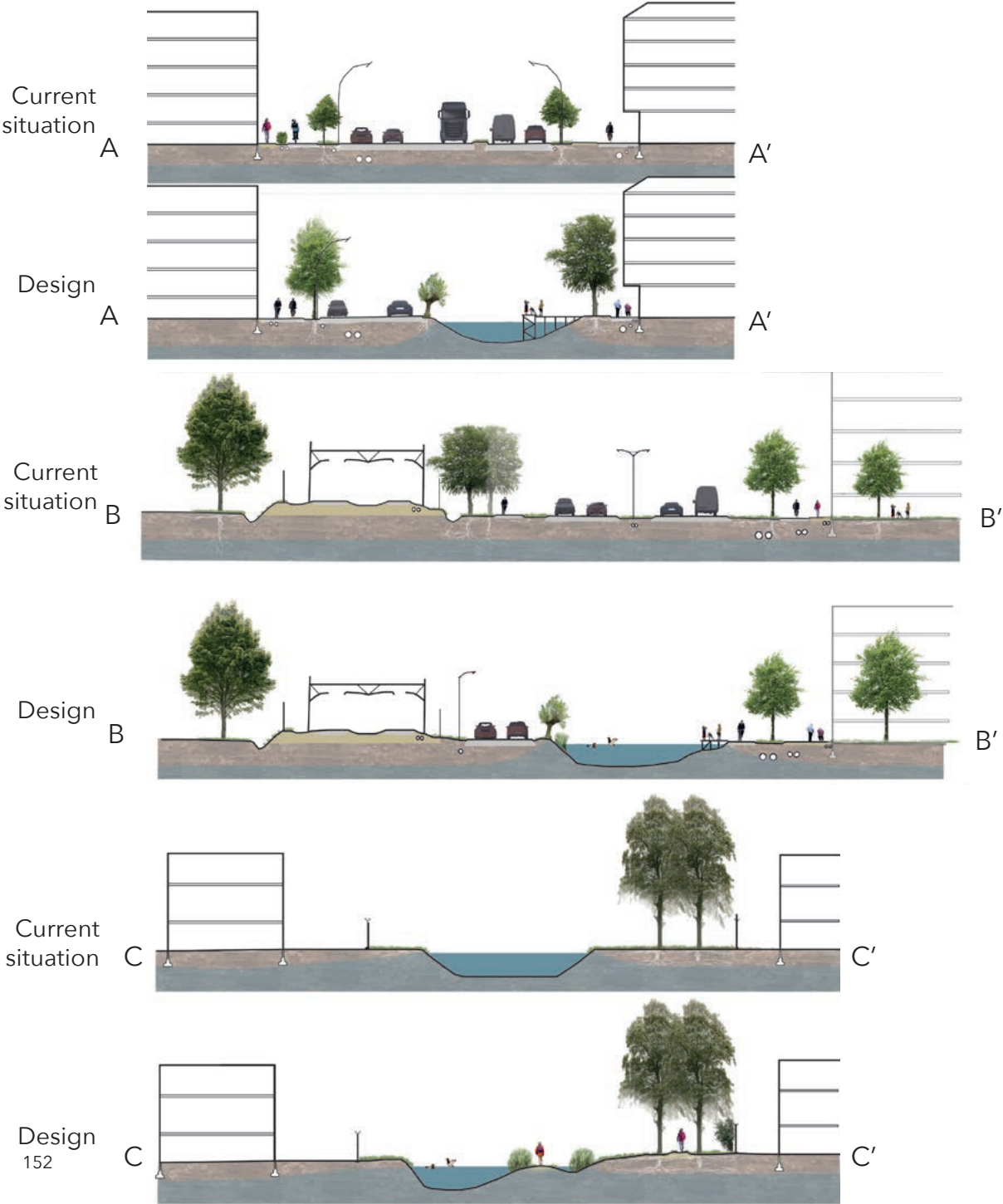


Concept map Helmond

Design Helmond

In the new design the Aa will no longer be diverted into the Zuidwillemsvaart, but cross right through the centre of Helmond. Changing a five-lane road into a green/blue corridor. Giving much-needed green space in the city and countering the urban heat island effect. While making a connection to the

surrounding landscape. At all corners of the city, there is a connection with the Aa. Parks are here created or extended to provide a better gradient between the city and the landscape. The three sections show how the profile will change as the Aa is introduced in the city.







Current
situation

A



A'



Design

A



's Hertogenbosch

Analysis

's Hertogenbosch is famous for its old city centre directly connected to the landscape of the Dommel. The city is faced towards the Dommel, while at the east side of the city the Aa has to enter the city via least pleasant landscape possible. Crossing highways, shipping channels, and commercial centres. The challenge here is how this connection can be improved and made pleasant. It requires the redesigning of the channels through the city and to introduce a

new water way to extend the connection to a larger part of the city. The large infrastructural works of highways and shipping channels cannot be removed, so everything is done to make crossing them as easy and pleasant as possible. With minimal interaction and a pleasant landscape on either side.

In the landscape different networks diverge. These landscapes continue a bit into the urban fabric. Making a strong connection form the urban area with the streams, the higher forested areas, and the wetter landscape.



Current situation

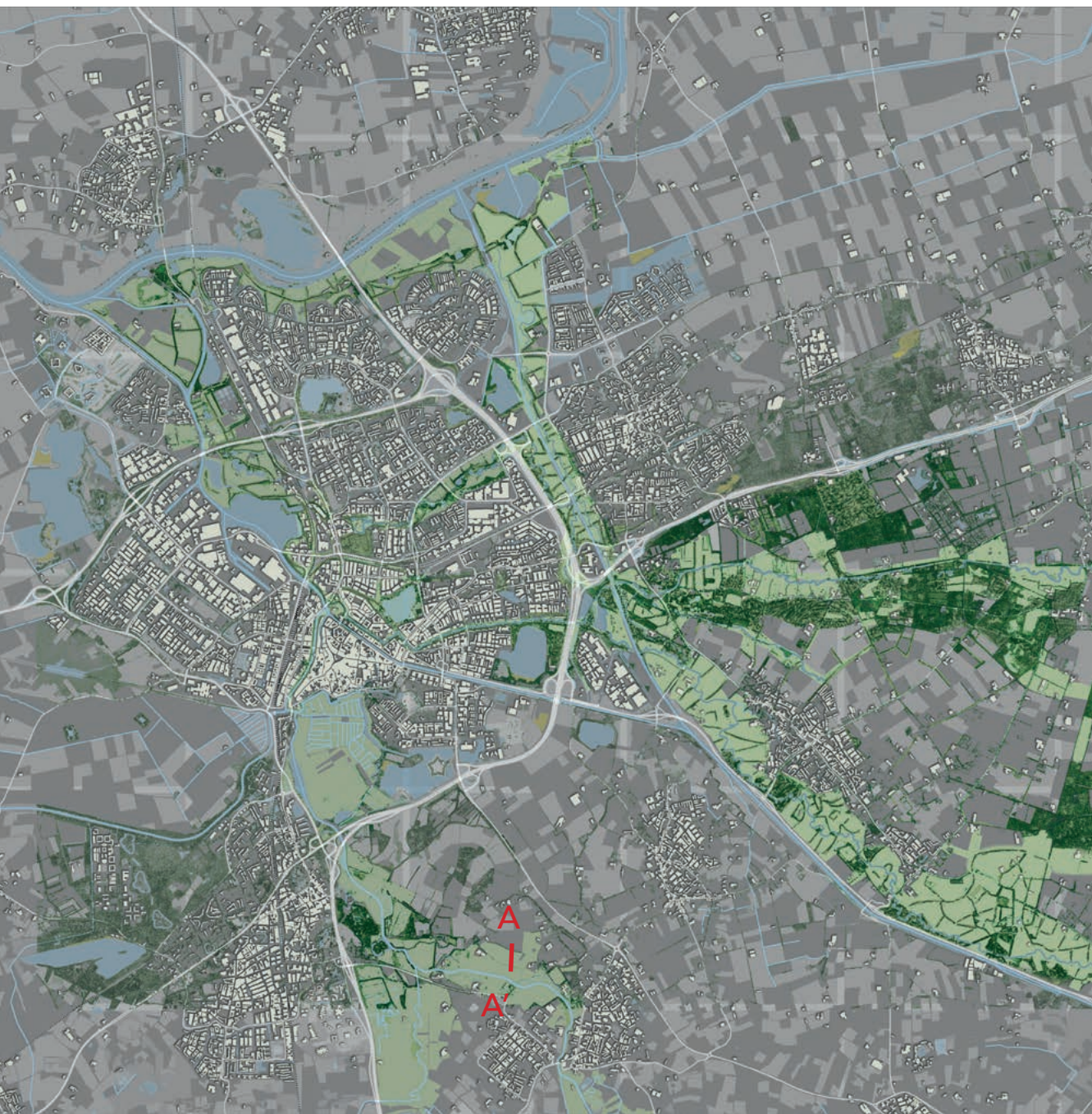


Concept map 's Hertogenbosch

Design 's Hertogenbosch

The southeast corner of the city of 's Hertogenbosch will become a node in a web of streams connecting the city with the landscape. On the landscape side, there is from north to south the Grote Wetering stream, a forested ridge, the Wambergse stream, the sand ridge of Berlicum and then the Aa stream with a cultural landscape towards the castle of Heeswijk. On the city side, there is a stream going north connecting to the Muese, A stream following the A2 for a while before diverting into the heart of the city, and the Aa main channel going towards the old centre, where it connects with the Dommel. For this arm, there is a section made to show how the profile will change to better accommodate the function of connecting the city with the landscape. Around the node itself on the city side, new tunnels will be used to go underneath the highway. And on the other side, there will be pedestrian and cycle bridges to cross the Maximachannel.





Design map 's Hertogenbosch



Current
situation

A









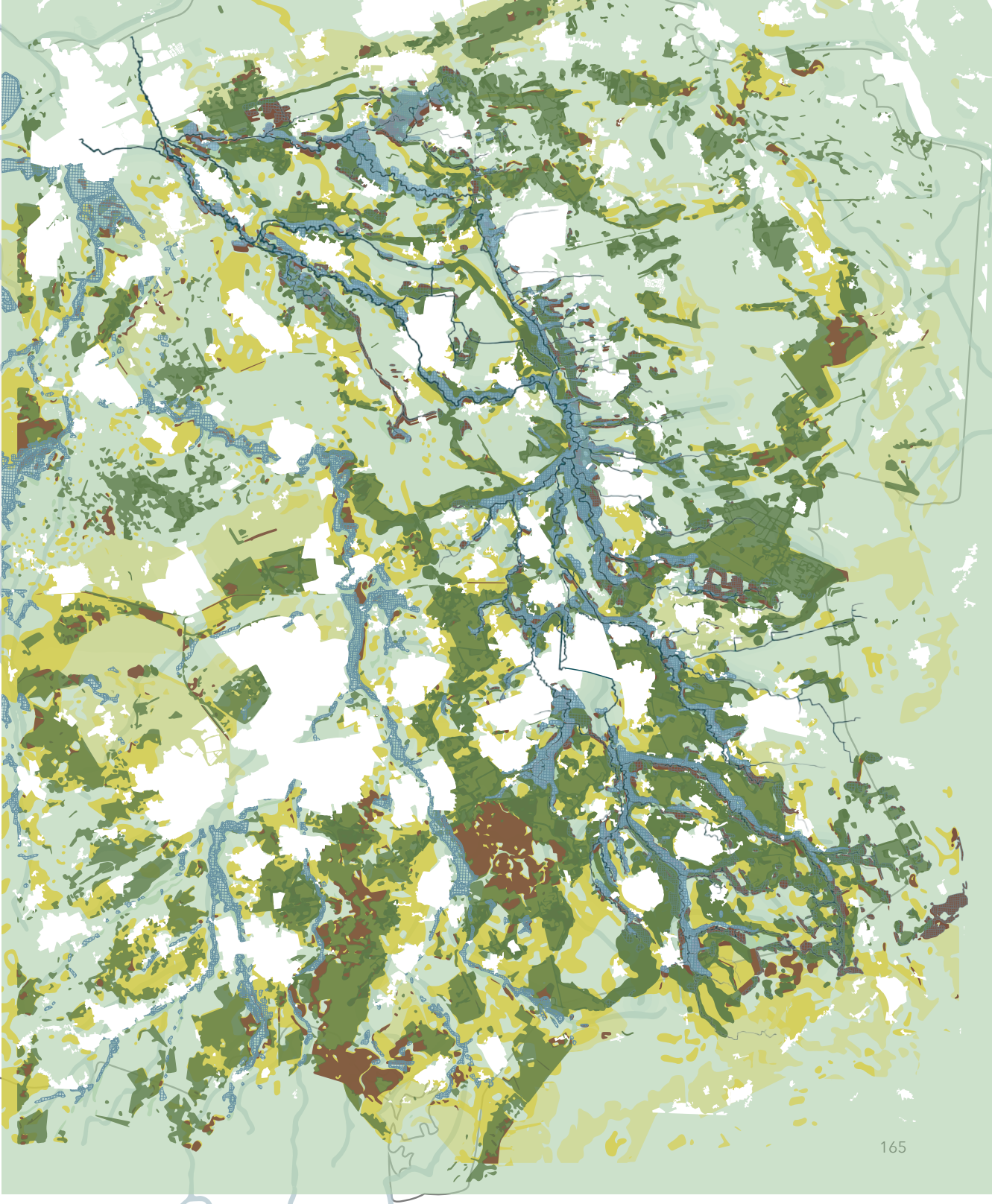
Overflown banks at the Dommel near Eindhoven
Image by author

Conclusion

The advantages of a strong, protected ecosystem and room for natural processes are well-documented and clear. From water security, flood protection, protection of biodiversity, cleaner living environment, space for outdoor recreation and much more. The advantages are widespread but often indirect. Making it often difficult to gain support for investment in ecosystem protection and nature conservation. The best way to take action is with governmental support, but right now we cannot expect too much from our national government on these points. That's why local initiative is so important. That is what makes the Van Gogh National Park movement so great. However, such a movement does require a good landscape vision in order to gain the maximum out of the initiative. Here they should look less at the administrative borders and look at what the landscape requires. The inclusion of the entire stream from the source to the

mouth. This project aims to show what such a vision could look like for one of the streams. And how this can be told with landscape-focused elements like the BBB (Beekprik, Boomkikker, Boomarter), the kano, boots, mountainbike networks and the focus on urgently needed intervention in the hydrological network with more meandering, water retention and infiltration. Instead of the current marketing tool for Van Gogh which is not visible in the landscape, the focus on the landscape characteristics and the moving away from traditional nature protection towards a more integrated approach in a heavily used landscape makes this park deserve a name that distinguishes it from other National Parks. No longer a National Park, but a National Landscape Park;
The streams of mid-Brabant National Landscape Park
De Beken van Midden-Brabant Nationaal Landschapspark

National Landscape Park The Streams of Mid-Brabant



Discussion

As this project focuses on the landscape architectural aspects of the creation of a National Park 'Nieuwe Stijl', the project looks at the protection and restoration of a biodiversity-rich ecosystem, the creation of a healthy living environment, and the facilitation of outdoor recreation within an accessible and recognizable landscape. For the ecosystem, the project focused on the hydrological system as the stream is the backbone of the design. This hydrological perspective helps to focus the project but does leave out large parts of the total ecosystem of the area. For example, the forest ecosystem with its succession is mostly left out of the research. Forest is used in the design, but besides the defining of a couple of tree species, further detailing of the ecosystem is left out.

A similar point can be made about the use of indicator species for biodiversity. These species do give a clear indication of the health of a biotope and have clear guidelines to design with. It is unclear if designing for these species will improve the biodiversity of an entire biotope.

For the creation of an attractive landscape for visitors and residents, an analysis of the landscape identity is used. However, this analysis mostly relies on a cultural-historical look at the landscape, while a social study into people's perspectives on the landscape is missing. Making it for a large part unclear how people would currently recognize or define the landscape. Then again, the design is aiming to create a (new) landscape identity around the streams of Mid-Brabant. So, the landscape identity would change hopefully anyway.



Leuvennumse beek
Image by author

Reflection

The topic of the Van Gogh National Park caught my interest with its clear current relevance in the discussion of nature in the Netherlands and with its seeming contradiction of making a National Park in a landscape better known for its intensive farming and haphazardly spread-out urbanization patterns.

The National Park in Nieuwe Stijl broadens the concept of nature. Focusing on the wider landscape, better combining it with other landscape functions. Any success of these efforts will be difficult as previous decades of nature conservation have been unable to stop the decline of surface dedicated to nature and to halt the decreasing biodiversity. But new efforts are needed to reverse the trend. Which would require designs like these to give direction. This design stays on a higher more abstract level, illustrating how the Aa could look like, but the design gives little in detailing. It gives some elements and modules to implement, but the exact locations and how to implement them are not elaborated. This would require further detailed designs on a smaller scale as illustrated on page 110. The inclusion of urban bottlenecks is a nice addition to the design, but it should probably not have been part of this project. Using that spend time instead on better detailing the implementation of the nine components in the landscape. As the urban zoom ins are not in line with the concepts worked out in the rest of the project.

Streams as used in this project provide a good landscape basis for making an extended nature network. Hydrology is often used as a base layer in landscape design. Combining this with soil data gives the proposed landscape and nature types in this project. But this ap-

proach does simplify reality. Succession is mentioned but time is little used in the design. And the influences of people or the effect climate change might have, has not been studied for this design. This makes the implementation and further development of the design unclear. Designing for future recreation is well possible. When recreation opportunities are given, people will use it. Use might change over time, but flexibility can easily be accounted for in design. Designing for natural processes has a bit more uncertainty. Giving it room, and maybe a bit of a kick start will develop in natural processes, but the effects or consequences might be unexpected. Whilst designing for biodiversity is more difficult. Designing for ambassador species might have a positive effect on that species and species from the same biotope. But lessons from past decades of nature conservation have shown despite some success, that reversing the trend of biodiversity loss is difficult. But as this design focuses on making a regional nature network connected to the similar landscape to the east of the Dommel with that of the Aa, local success here is well possible.

Using the three landscapes of stream-, wet-, and higher landscape as the locations to design for is based on a historical perspective on land use. Because historically these three landscapes show how human usage and giving room to nature can be combined. But this is cherry-picking moments in history and subjective why this had a good nature-human balance. For example, the hedges in the wet meadow landscape did hold an important ecological and cultural value, But they are gone now for a reason. These hedges might be restored, but they do not fit the modern land use. These hedges need to be updated to fit the modern requirements,

with mechanised agriculture and the changing climate. This makes it unclear in the project how much is, restoration and how much innovation to make the landscape future-proof.

The overall design uses the nine modules to craft a coherent and clear story. The idea of then combining and repeating these modules throughout the landscape uses the concept of scale continuum. Both in repetition to create a consistent, recognizable landscape for a National Park and in cause-effect to bring the landscape and natural processes back to life.

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Colophon

Development of the river Aa catchment area to contribute to
Mid-Brabant as a National Landscape Park.

Master Thesis Report
MSc Architecture, Urbanism and the Built Environment
Landscape Architecture Track

Author:	Wessel Koolhaas
Research Studio:	Landscape architecture principles (LAP)
First Mentor:	Prof.ir. E.A.J. Luiten Professor of Landscape Architecture
Second mentor:	Ir. M. Lub Lecturer in architecture and urban design
Examination committee:	Ir. H.J.M. Vande Putte Assistant professor MBE



Department of Landscape Architecture
Faculty of Architecture and the Built Environment
Delft University of Technology
Delft, The Netherlands

P5 report
June the 16 2024

Unless stated otherwise all the graphics and pictures present
in this graduation report are made by the author.



Reed growing in wet meadow due to
Peelrandbreuk seepage
Image by author