Modelling Fluid Soils

Designing Together for the Wadden Sea Landscapes in Transition

Cipriani, Laura; Li, Zhaolei; Tang, Keyan; Wander, Hanneke; Dekker, Madelief; Wah, Wong Yin; Kuo, Suihui; Cobben, Nicolle; Schüll, Martine; More Authors

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Embracing the Future of the Wadden Sea Landscapes

Voices and Imageries from Students and Educators

edited by Laura Cipriani

Colophon

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3.1 | Modelling Fluid Soils

Designing Together for the Wadden Sea Landscapes in Transition

Master thesis lab coordinator | Laura Cipriani

The relationship between soil and water is at the center of interest now more than ever. Like many other littoral areas around the globe, such as lagoons, wetlands, islands, and their inland areas, the Wadden Sea territories struggle between two opposing forces: permanence and transformation. The war between man and nature is waged on various fronts (i.e. geo-morphological, climatic, ecological-environmental, architectural, and landscape) and in urban settlements.

Despite being a UNESCO World Heritage Site of extraordinary environmental value and beauty, the Wadden Sea, its territories, and its people

TU Delft Department of Urbanism
BK Bouwkunde

now face an uncertain future while wrestling with latent climatic, economic-productive, and social crises. Subsidence increased by gas extraction and peat oxidation, soil erosion, saltwater intrusion, eutrophication, and agricultural water pollution testify to a territory in the throes of long-term repossession by the sea. Unlike large coastal conurbations, these areas are marginal territories with low levels of urbanization that are characterized by crises and territorial fragility. Notably, these are predominantly rural regions where the countryside becomes the frame within which cities are located. Lands reclaimed from the sea over the centuries now require the radical transformation of agricultural practices and an urgent response to climate change.

Can we (co)design the Wadden Sea landscapes?

How can we transform this crisis into an opportunity? As designers and educators, can we sow hope through the project in its various scales of intervention, from the regional to the most minute? Based upon applied research work in regional scenario-making and local design projects, the studio attempted to imagine the present and future of the Wadden Sea and its hinterland.

Through accurate and concrete plans, we attempt to give life to renewed economies aimed at proposing ideas to close environmental and economic cycles. Starting from the project, the intention is to promote tiny seeds of hope to trigger change. Peatlands, agriculture, energy, and heritage all intersect to encourage economies and social inclusion projects where

the landscapes of soil and water become the driving force to overcome the crises.

Laura Cipriani

TU Delft
Faculty of Architecture and the Built Environment
Department of Urbanism
Section of Landscape Architecture

The Altitudes of Flatness

No Land is Flat | Territorial Models

Docent | Laura Cipriani
Students | Keyan Tang | Hanneke Wander | Madelief Dekker | Wong Yin Wah | Suihui Kuo

Thinking with Sections and Models Course | Year 2020-21

No land is flat. Every land is dense with bathymetries, topographies, and micro-topographies.

The Wadden Sea is over 500 km long, and 20 km wide and stretches over three countries: the Netherlands, Germany, and Denmark. These countries are experienced as different entities, and crossing a country's border means something. But the Wadden Sea doesn't care about borders; it flows, undefined by the jurisdictions projected by our economic ntional borders.

The continuous tidal flat system of the Wadden Sea is a vast system full of ecological and hydrological processes. It is always changing and houses 39 tidal basins. These intricate interactions facilitate a multitude of habitats.

This 1:500.000 scale level model conveys Waddensea's unbroken system in relation to the contemporary cultural layer added by humans.

Model of the Dutch, German and Danish Waddensea.
Horizontal scale (x) 1:750.000. Vertical scale (y) 1:7500. Model size 500 x 500 mm.

The Wadden Sea landscapes | Bathymetries and elevations

Authors' work

Docent | Laura Cipriani
Students | Nicolle Cobben | Martine Schüll | Fudai Yang | Xulingyun Ji | Aileen Hallie

Thinking with Sections and Models Course | Year 2020-21

Horizontal scale (x) 1:750.000. Vertical scale (y) 1:7500. Model size 500 x 500 mm.
The following model shows the area between the cities Dokkum, Holwerd, and Stiens in the province of Friesland, scale 1:40.000. At first sight, the terps in the dominantly flat landscape, as well as the dike and the bathymetry, will catch the attention. To emphasize the terps, their height is 30 times exaggerated.

When looking at the model in more detail, the water pattern of the polder will provide an extra layer to help us understand the landscape. The bathymetry and the polders' water pattern are shown for two reasons. Firstly, the current condition of the two water directions must be emphasized. Secondly, the location of the model in the landscape must be made more recognizable. The current water pattern of the polder provides insights into the spatial embedment of the terms, such as radial land reclamation patterns.

Model of Dokkum, Holwerd and Stiens in the province of Friesland.
Horizontal scale (x) 1:40.000. Vertical scale (y) 30x. Model size 500 x 500 mm.

The Dutch Wadden Sea landscapes | Dikes, terps and polders

Authors' work

Regression and Progression

Towards a Regenerative Water Landscape in Wadden Coast

Student | Heather Yin Wah Wong
Docents | Laura Cipriani | Mark Voorendt

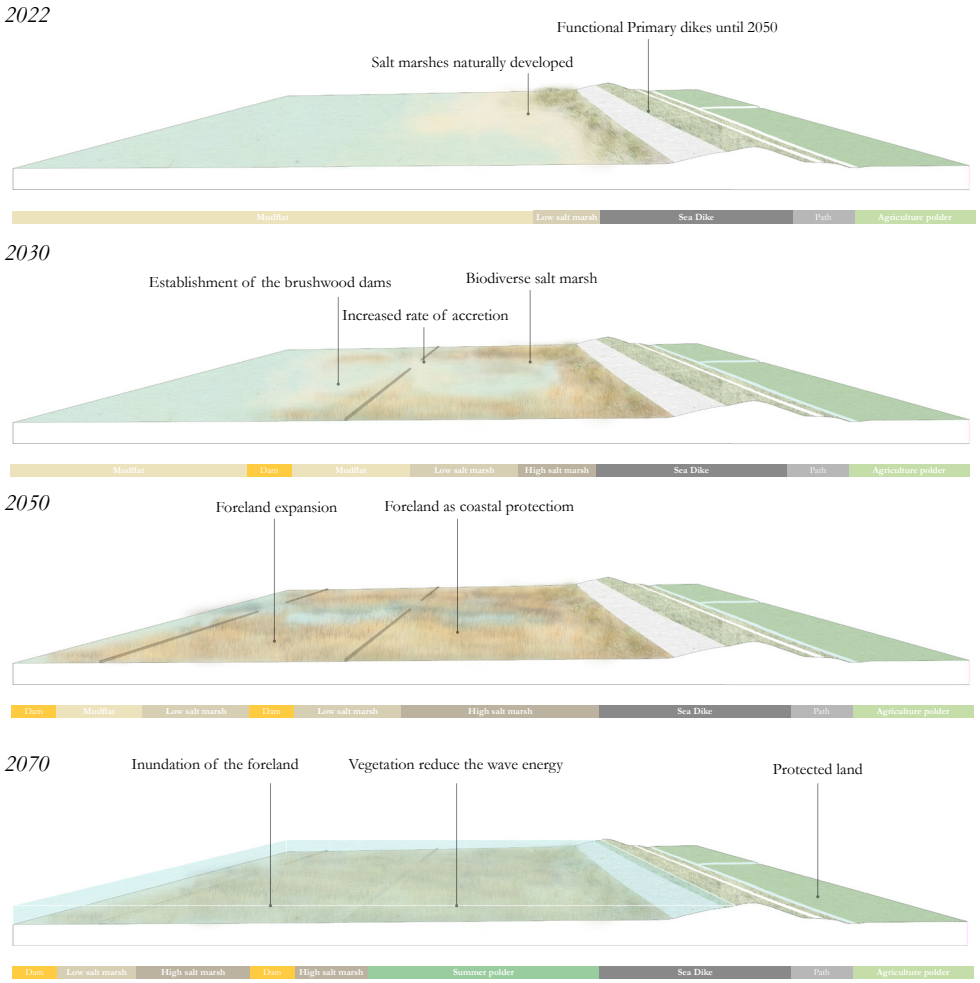
As the world's largest intertidal area, the Wadden Sea Region was recognized as a UNESCO World Heritage site in 2009. In addition to the scenic and ecological values, the Dutch Wadden Sea also serves as an infrastructure to safeguard the coastline of the mainland as a climate buffer, where it is good to live, work, and recreate.

The Dutch Wadden Sea is a dynamic landscape highly vulnerable to future climate change, demographic changes, and increased recreation and tourism. The rising sea level and changing climate will lead to prolonged droughts and flooding, posing a water safety crisis in the area. As an indispensable infrastructure protecting the hinterlands, the Wadden Sea dikes define and fragment the features of the landscape. The Wadden Sea coast is also confronting declining populations and a mono-sector economy.

The graduation project seeks the possible outcomes of the Wadden Sea Coast through in-depth research to analyze, synthesize, and develop a strategic design proposal for a resilient and sustainable landscape infrastructure contributing to the whole system. This project sets up an agenda for exploring the prospective capabilities of design-oriented research and cartography. In-depth research and analysis of the spatial and cultural landscape characteristics identify the spatial dynamics and transformations undertaken on the Wadden Coast. Future scenarios and narratives will be formed based on different climatic conditions.
The design assignment involves an adaptive landscape approach at multiple times and scales and scenarios, making for an integral approach to the climate crisis and small-scale design interventions along the Dutch Wadden Coast.

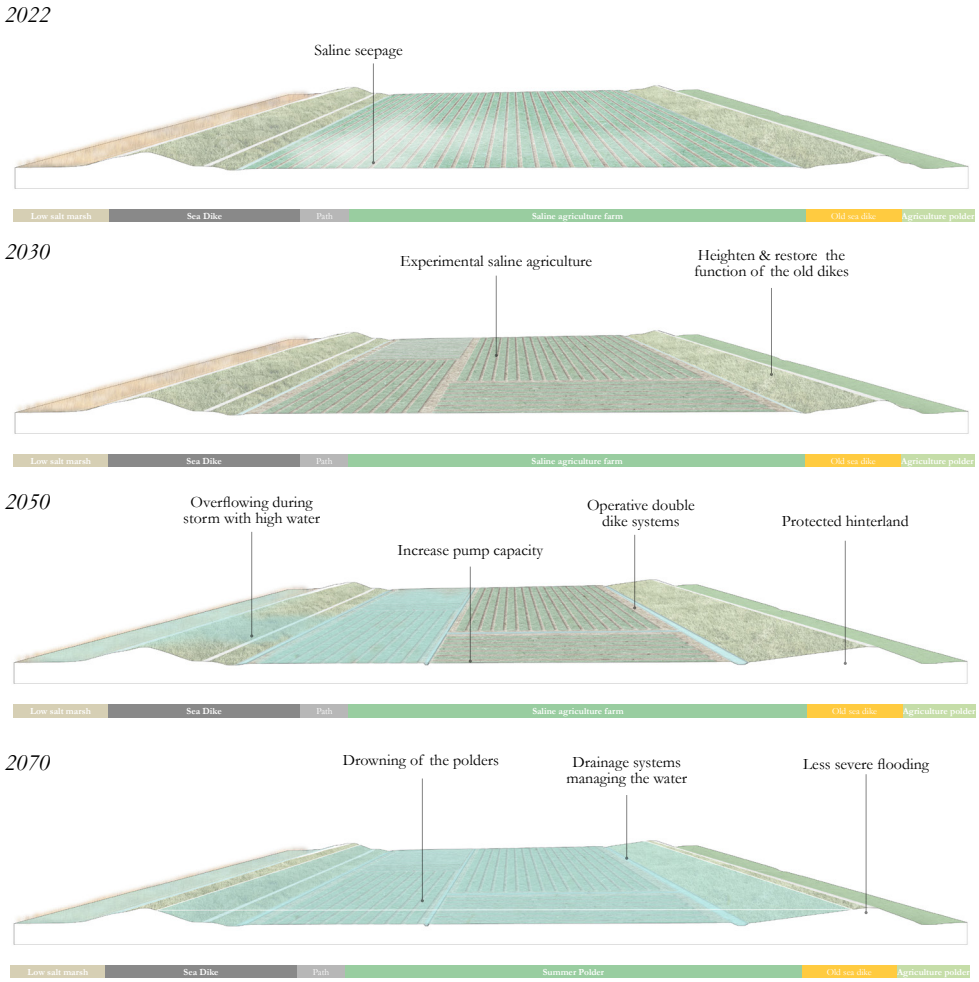
Experiential route of the salt marsh

Author's work



Progression | Salt marsh defense systems

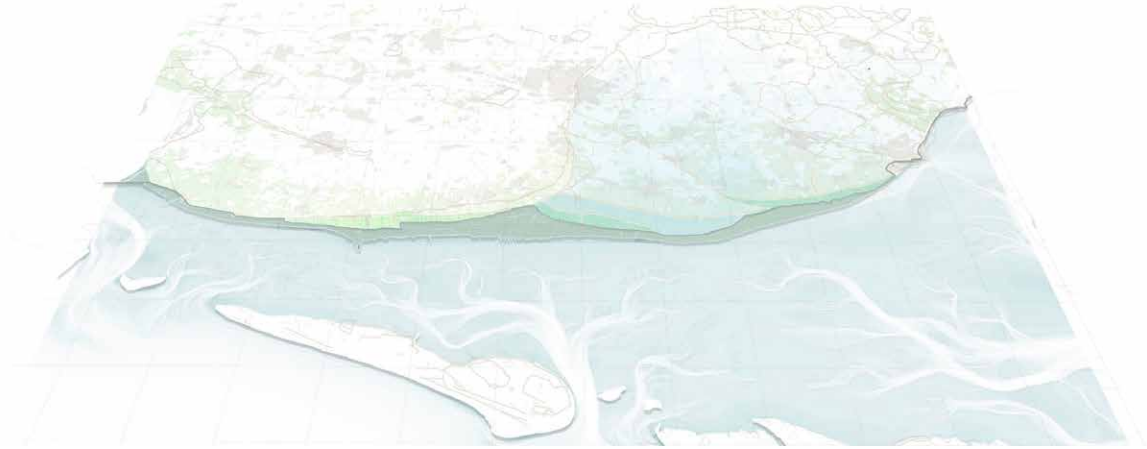
Author's work



Regression | Double dike systems

Author's work

2030



2070

Climate adaptive landscape in the future

Author's work

Mudscapes

Embracing Nature, Feeling Culture in the Ems Estuary

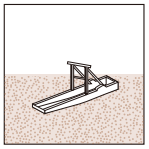
Student | Zhaolei Li
Docents | Laura Cipriani | Bram van Prooijen

External Contributors | Stephan Smeijers | Joca Jansen

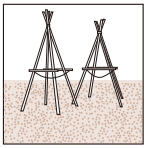
The Wadden Sea region is characterized as a diverse and contradictory area. On the one hand, it is the largest intertidal area globally, supporting a rich and diverse flora and fauna habitat that showcases nature's power and allure. On the other hand, it is a landscape shaped by human habitation and extensive transformations, including establishing numerous polders, reclaimed land, and imposing dikes. The region's history reveals the enduring struggle of its inhabitants against the sea over the past millennium, leaving behind a valuable cultural heritage.

One particular area exemplifying this dichotomy is the Ems estuary, which represents the Wadden Sea's most ecologically compromised section, often referred to as the "yellow river" of Europe. The industrial development occurring along the estuary, including activities like waterway deepening and riverbank embankment, has substantially altered the morphology, hydrology, and ecological composition of the area. Additionally, the area's cultural significance often remains overlooked due to its designation as a natural heritage site. Consequently, the region lacks sufficient allure, resulting in a declining population and an inferior economic state compared to the southern Netherlands and the surrounding islands.

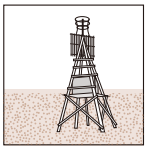
This master's thesis addresses the crisis in the Ems estuary by focusing on the transformative potential of mud as a catalyst. Through a comprehensive study analyzing the status and role of mud and integrating various strategic options, the project explores opportunities for revitalizing the estuary. As the muddiest estuary within the Wadden Sea and the last naturally connected river in the Netherlands, mud plays a vital role in the overall estuarine system. The thesis proposes a spatially dynamic transformation of the Ems estuary through small-scale design interventions and pilot projects by conducting research and analysis in these three domains.



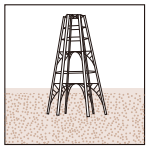
Mud sled



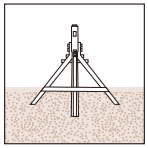
Wad stool ("Wadstoel")



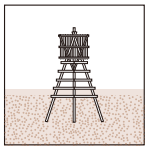
Cape with shelter



Emder kaap van rottumeroog

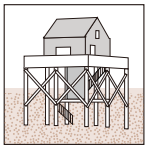


Boundary post

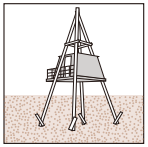


Cape

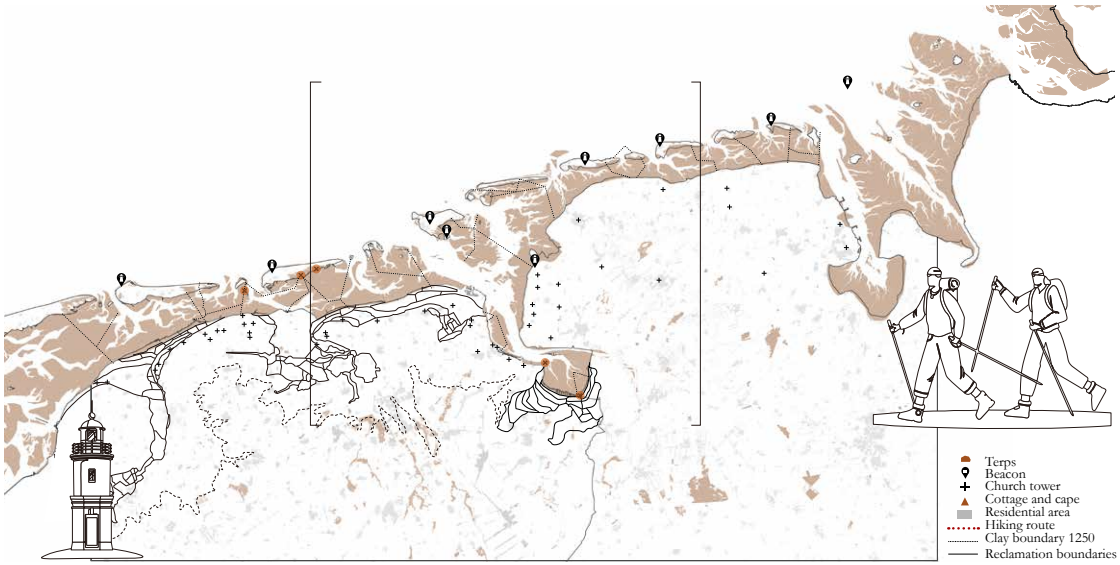
Drowning shelter



Bird watching house

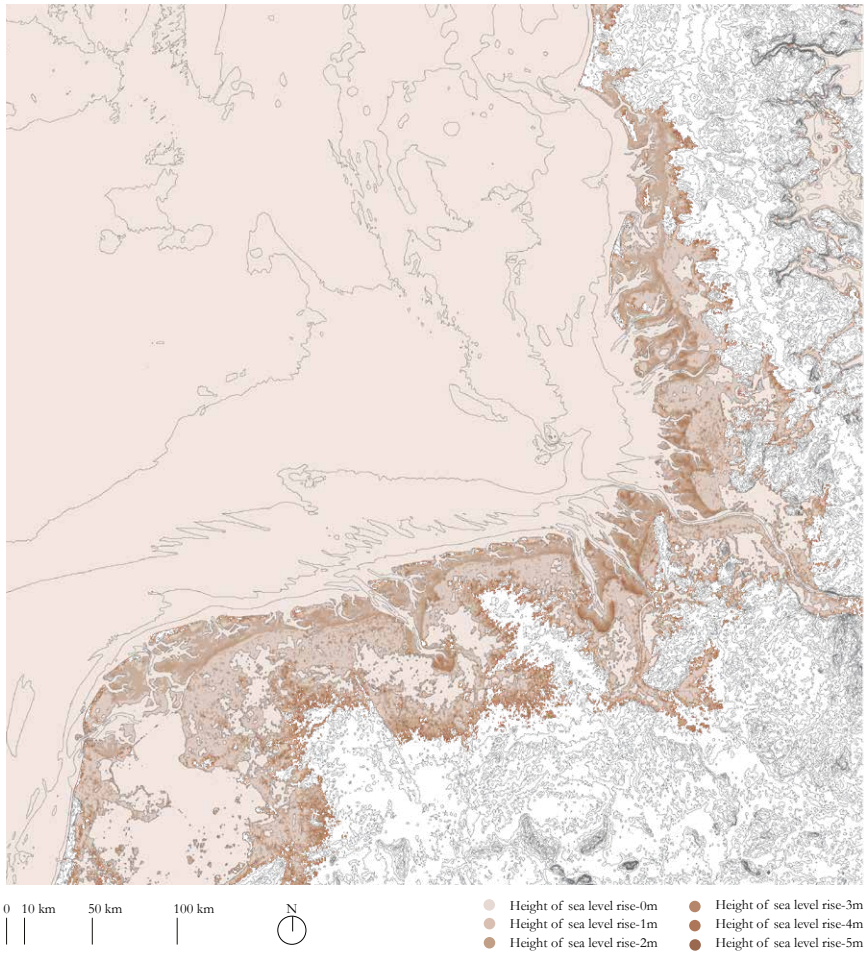


Drowning shelter



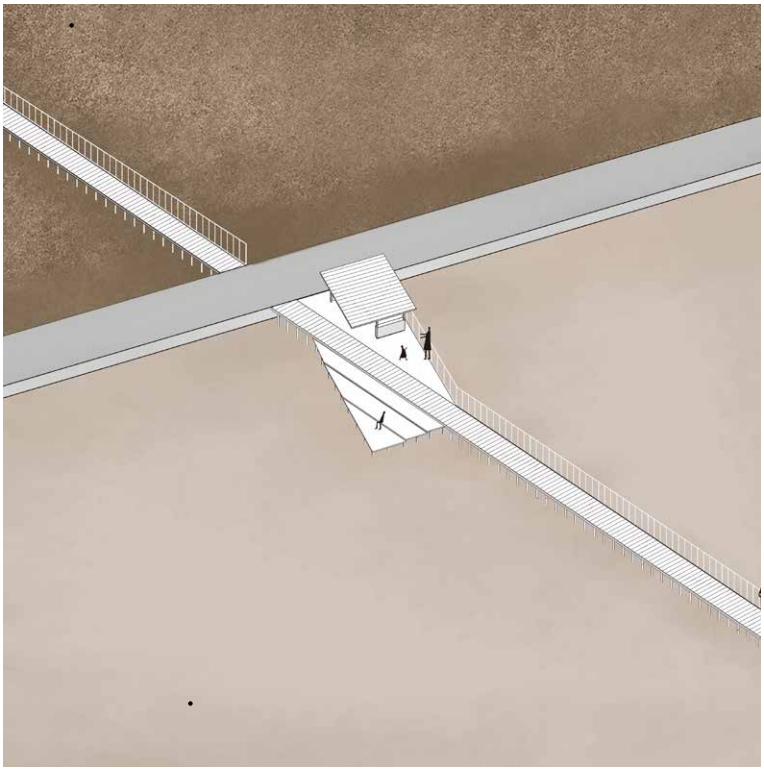
Mud recreation and perception

Author's work



Sea level rise

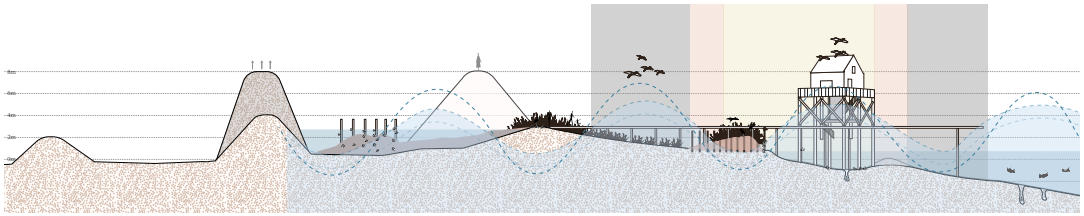
Author's work



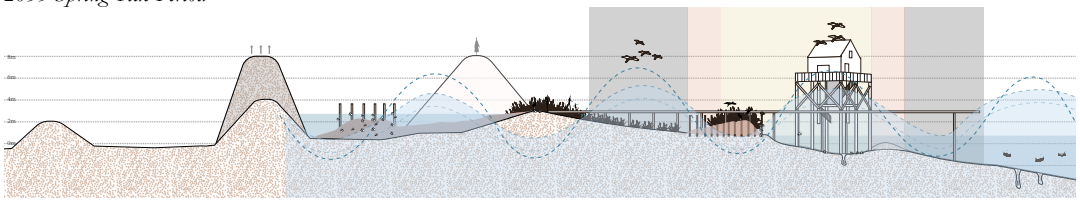
Mud mature pond

Author's work

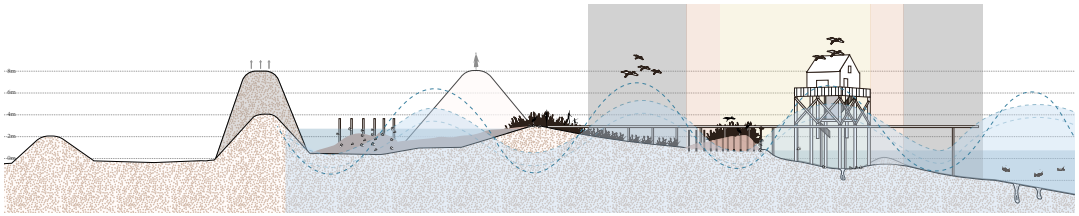
2035 Normal water level



2035 Spring Tide Period



2050



Sections of future scenarios

Author's work

Masterplan 2050

Author's work

Unpaving Nature

Restoring Balance Between Nature and Infrastructure in the Wadden Sea

Student | Xinjian Jiang
Docents | Laura Cipriani | Peter Herman

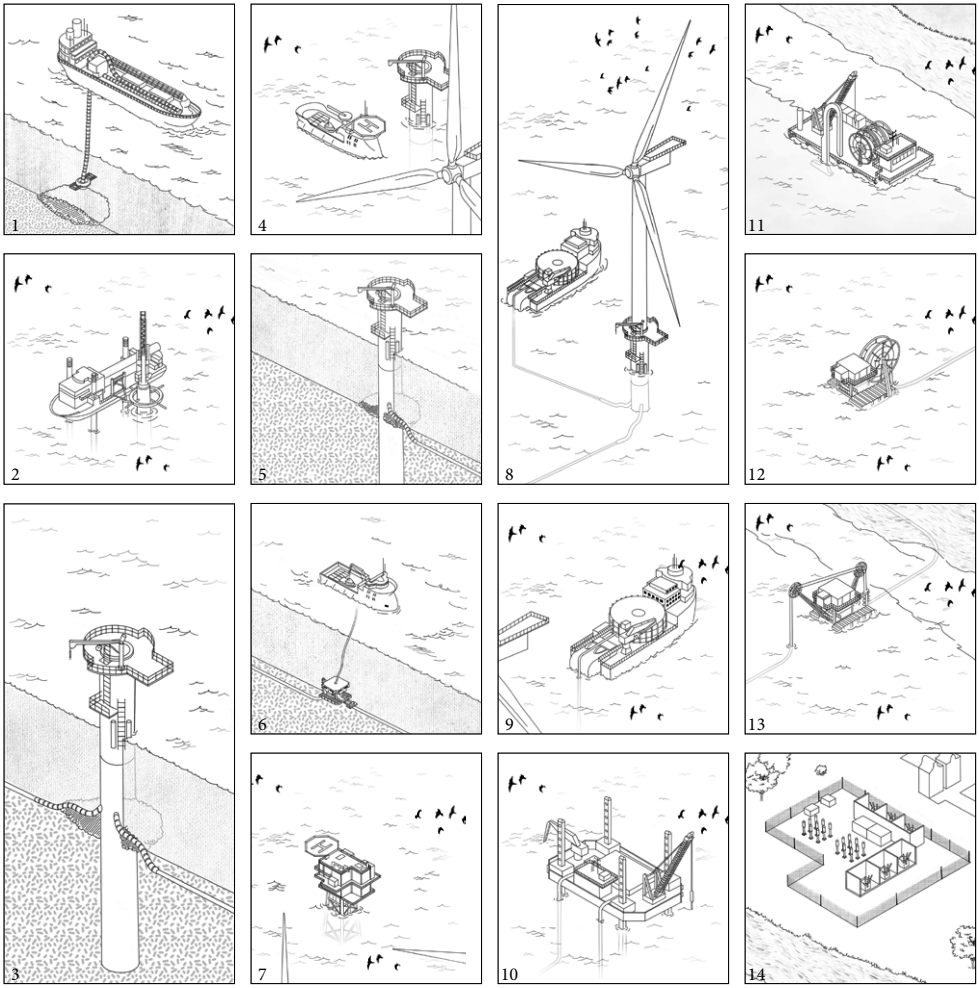
External Contributors | Stephan Smeijers | Joca Jansen

The Wadden Sea is a unique and ecologically important coastal region in the southeastern North Sea, stretching along the coasts of Denmark, Germany, and the Netherlands. It is known for its vast tidal flats, salt marshes, and barrier islands, forming a dynamic and constantly changing landscape and creating rich biodiversity.

The Wadden Sea in the Netherlands comprises the mainland coastal areas and the Wadden Islands (such as Texel, Vlieland, Terschelling, Ameland, and Schiermonnikoog). This area is crucial in protecting the land and supporting the people there. It is a natural defense against storm surges and flooding supports local businesses through fishing and tourism and provides a vital ecosystem for numerous plant and animal species.

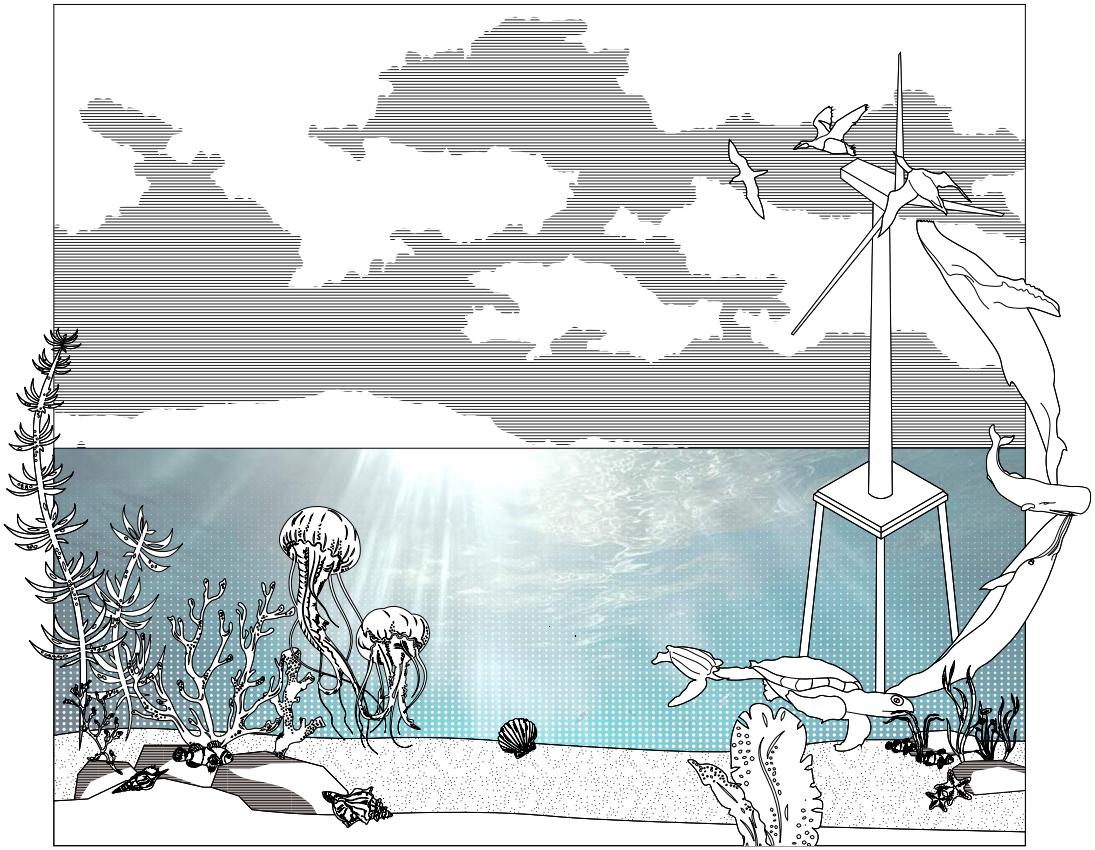
However, infrastructure development in the Wadden Sea area, including offshore wind farms, shipping routes, and coastal engineering, has impacted some ecosystems. The development is necessary for economic growth, such as shipping infrastructure for tourism on the Wadden Islands and offshore wind energy due to the energy crisis. These developments will shape the landscape in the coming years.

In the thesis, data on infrastructure and ecology was collected and analyzed to find conflicts between them and how they affect the landscape. This research formed the basis for the design phase. Then, three strategies were put forward for the territorial scale. Moreover, two sites were chosen to demonstrate how these strategies can be applied to site-specific design. Both sites share the idea of preserving and adapting positive landscape features and restoring the natural process, achieving minimal intervention.



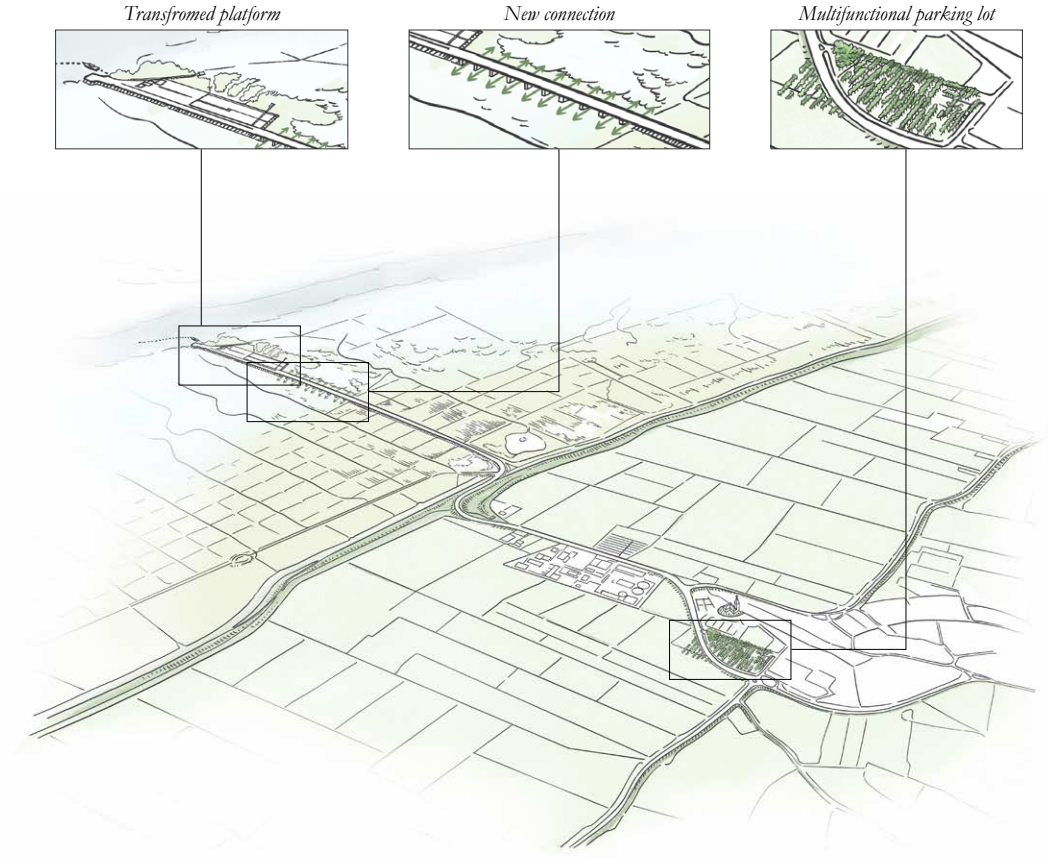
Wind turbine installation steps

Source: The Gemini Offshore Wind Park, 2017. Author's work



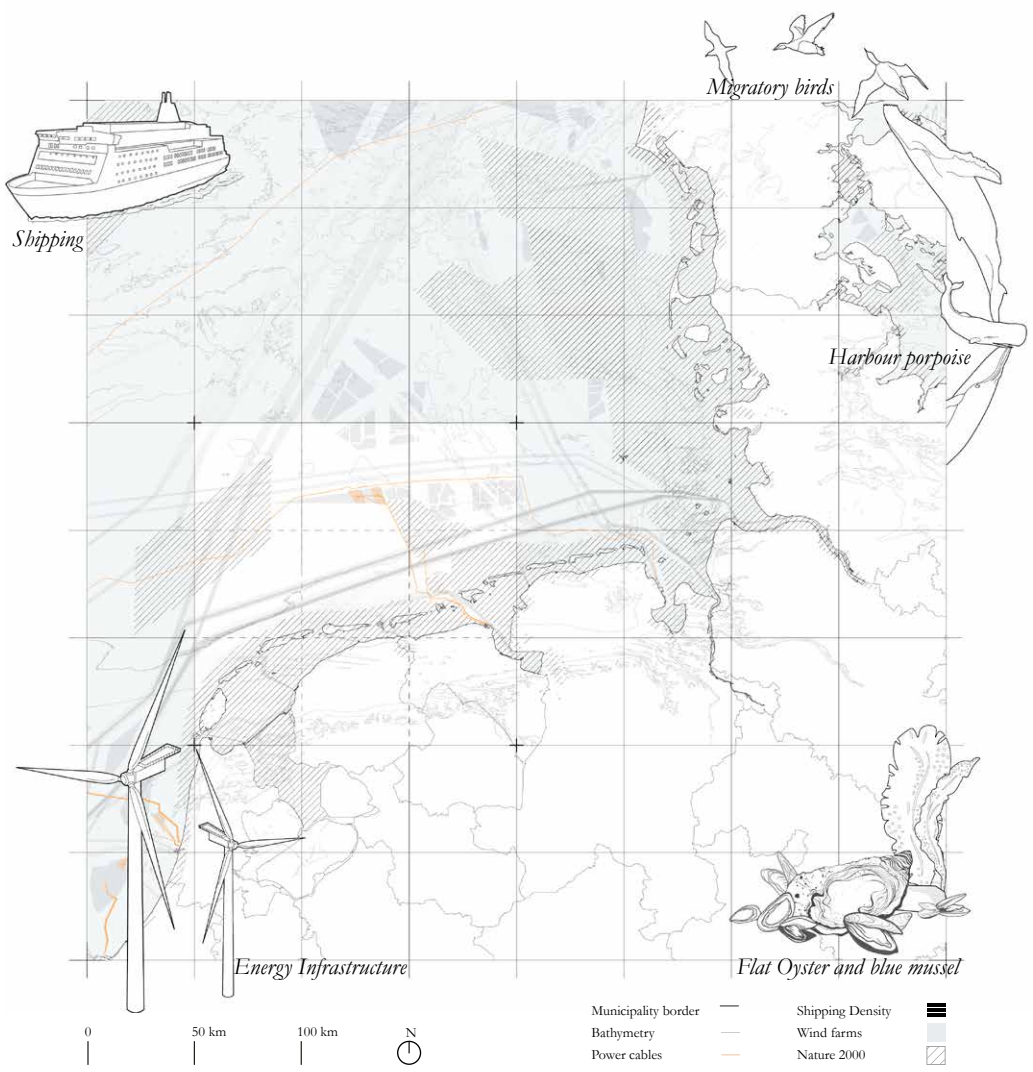
Seabed community

Author's work



Interventions in Holwert

Author's work



Conflict between nature and infrastructure

Data: EMODnet | The European marine observation and data network, 2022. Author's work

Land and Farmers Equilibrium

Restoring Balance Between Land and Humans in Northern Friesland

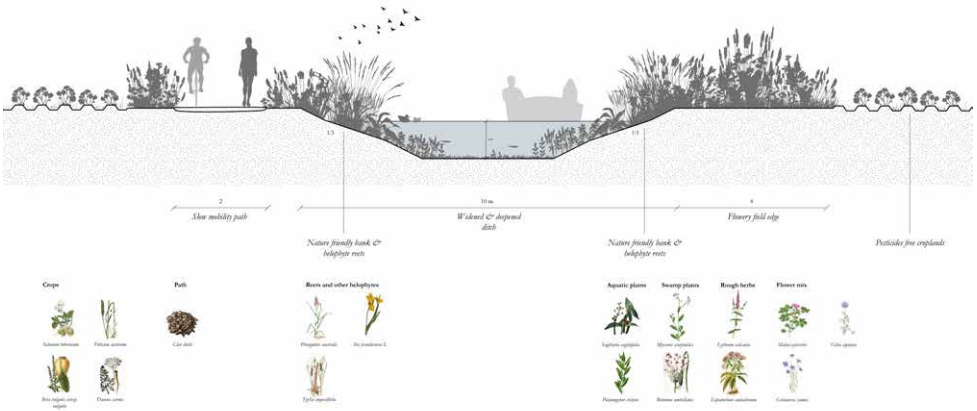
Student | Hanneke Wander
Docents | Laura Cipriani | Luisa Calabrese

External Contributor | Hans Kroodsma

Terps in the Frisian landscape are remnants of the province's rich history and relationship with the sea. With farms on the terps, cattle grazed on the plains when the sea temporarily receded. To this day, Friesland is still characterized by its dairy farming, now guarded by the sea dyke. Agriculture is ingrained in the Frisian landscape. However, it has seen a significant change in the past 70 years. After World War II, government-driven agricultural policies aimed to ensure a steady food supply led to the upscaling of farms, resulting in the loss of small-scale structures and increased agricultural waste in surface water. This change has adversely affected biodiversity, impacting the habitats of animals, including the beloved meadow birds.

The balance between landscape, ecology, and agricultural practice is lost. Nature-inclusive agriculture could be an opportunity. Emphasizing cultural-historical structures, enhancing ecological values, and working with local input and values could promote a better balance between agriculture, ecology, and the topographic landscape. These strategies emerged from multiple conversations with a local farmer transforming his farm into an organic practice.

Introducing nature-friendly riverbanks along waterways strengthens ecological corridors in the area. In addition, flower-rich field edges and farmyards act as stepping stones for biodiversity and create a small-scale farm nature network. A water-purifying helophyte field is constructed on a meadow, which will help filter the runoff of agricultural wastewater. An intertwined recreation network is created on the ecological corridors, which were once an important infrastructure between terps and through the meadows. It lets visitors experience the connection of the present nature-inclusive agricultural practice with the rich cultural history of the Frisian landscape.



Nature-friendly banks along small waterways

An intertwined recreation network is created on secondary ecological corridors which were once an important infrastructure between terps. Author's work

An agricultural nature network

It consists out of flowery field edges along agricultural fields, biodiverse meadows and farms themselves are appointed as stepping stones. Author's work

Build environment
Trees
Historical farmyards
Waterways
Enhanced ecological corridors
Livestock farming
Crop production
Terps
Stinzen, stanzen and churches

0 1 Km 3 km

Main and secondary ecological corridors

Ecological values are enhanced by introducing a network of ecological corridors. Author's work

The Dokkumer Ee as an ecological corridor

Experience the connection of nature-inclusive agriculture with the rich cultural history of Friesland. Author's work

Re-Peating Nature

Ruralities in Transition

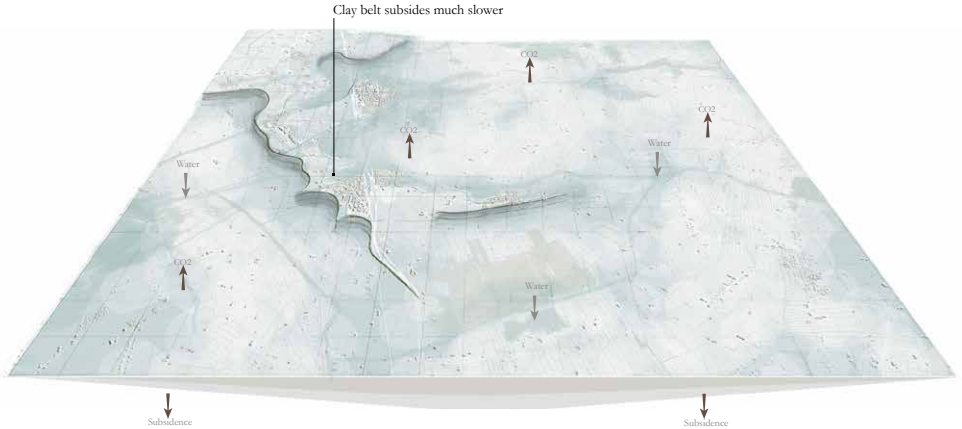
Student | Anna Gorokhova
Docents | Laura Cipriani | Diego Andres Sepulveda Carmona

External Contributors | Stephan Smeijers | Joca Jansen

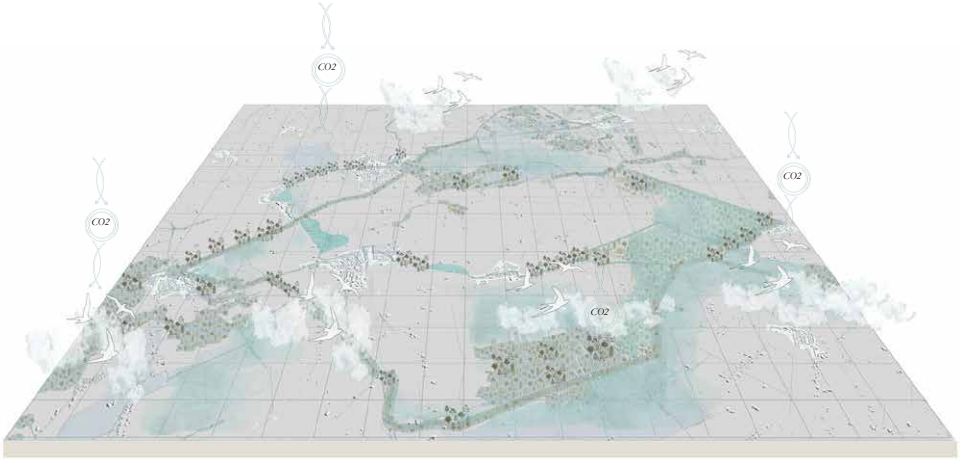
The Wadden Sea Region spans the Dutch, German, and Denmark coasts, creating one of the most culturally and environmentally rich areas. The natural and cultural value of the UNESCO heritage site possesses unique features and characteristics that are important to preserve for future generations. Like many other places in the world, the Wadden Sea region is facing significant uncertainty in the future. Climate change plays a vital role in planning such a vulnerable region. It is a complex landscape that has already been impacted by climate change and is awaiting big decisions and changes for its resilient future.

Years of scaling up and production growth created a situation in which the productive landscape conflicts with Friesland's cultural and natural heritage and contributes to climate change. The Frisian agricultural practice puts immense pressure on the province's peat soils, resulting in significant carbon emissions and likely contributing to water shortages in the future.

The graduation project looks into the past, present, and future of the agricultural landscape of Friesland. It aims to envision an alternative resilient future for its peatscapes, in which the productive properties of Frisian agricultural practices of the landscape are not lost but strengthen the local cultural and natural values. Future scenarios are formed based on different outcomes related to agricultural practices, the most desired of which is explored through design. The thesis results in a strategic design proposal for peat restoration and preservation. The strategies are implemented in close conversation with the local stakeholders on a regional and small-scale design. The alternative scenario involves strategies that strengthen ecological connectivity and cultural heritage while proposing acts for climate mitigation and adaptation. The formation of carbon banks, paludiculture corridors, and people nature is under the proposal for the region's peat restoration, preservation, and long-term carbon sequestration.



What if we do nothing? 2100



What if we develop nature? 2100

Alternative future

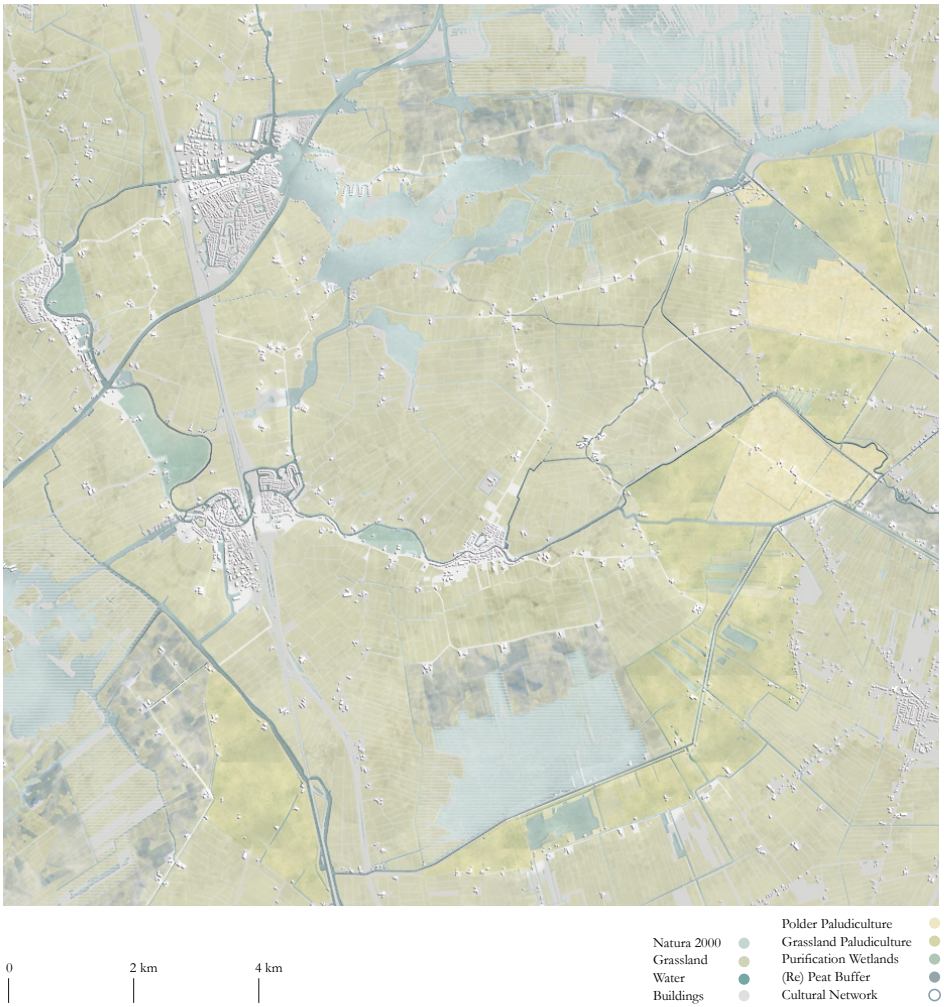
Author's work

Paludiculture

Author's work

People nature

Author's work



What if we develop nature? 2035 vision

Author's work