

urban climate in TIEL

february 2012

Colophon

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This project was partly funded through the Interreg IVB programme Future Cities: 'Urban networks to face climate change'. The Future Cities project promotes knowledge exchange between north-western European cities about adaptation to the predicted climate changes. Besides the municipality of Tiel, the municipalities of Arnhem, Nijmegen (NL), the West Vlaamse Intercommunale (BE), Rouen (F), Hastings (UK), Bottrop (DE) and the EmscherGenossenschaft (DE) participate in Future Cities.



Introduction

Through its involvement in several projects on water policy focused on climate change, the municipality of Tiel is a Dutch pioneer when it comes to climate adaptation. Tiel wanted to have a complete overview of the issues of climate adaptation concerning the city's climate, and their design solutions.

The Landscape Architecture Group of Wageningen University and the expert dr. S. Lenzholzer was asked to make these analyses and recommendations together with a group of 5th year students.

This book is the result of the project. We hope it is both informative and inspirational; and that it helps the municipality of Tiel to implement climate policy for the urban climate.

The project was executed in two phases. In the first phase extensive analyses were made of the urban climate. These are based on various types of geographical data of Tiel and recordings of weather station Heerwijnen. Conclusions could be drawn from these data concerning the urban climate. These conclusions focus on the thermal aspect, through a classification into so-called 'climatopes'. They also focus on the 'dynamic' aspect of wind. Together, these two analyses form the urban climate maps for the whole city. Based on these maps, general recommendations for improving the city's climate were made, indicated on a map of the whole municipality of Tiel. On the evening of 12 October 2011, the findings were presented in the council chamber of Tiel.

In the second phase, a number of areas were identified where special urban climate conditions were expected. For these areas of interest the students first analysed the microclimate on a small scale. Based on their findings, they designed various adaptation measures. Their main focus was on solv-

ing heat- and urban climate problems, but other issues in the chosen area also had to be integrated in the design. On 3 November 2011, the students hosted a workshop in the council chamber of Tiel to discuss their first designs with staff members of several departments of the city of Tiel. The students then adjusted and finished their designs. The results of the whole project were presented on the evening of 12 January 2012 in the Agnietenhof in Tiel to the mayor, councillors and citizens, who were very enthusiastic about the work. We thoroughly enjoyed working on this project and would like again to express our gratitude to our project partner of the municipality of Tiel, Annemieke Spit.

The book has two parts. The first part consists of the city's climate analysis and the recommendations for planning and design. These can be directly implemented in policy. The margins of the pages in this part are coloured to distinguish them from those in part two. The second part contains all student projects to illustrate the possibilities for small-scale adaptation.



students conduct site research in Tiel

september 2011

2011



results of the analysis phase are presented to the council of Tiel

october, 12th 2011



workshop in the town hall of Tiel: discussing first results with members of the municipality administration

november, 3rd 2011



presentation of the whole project to mayor, council and citizens in the Agnietenhof theatre

january, 12th 2012

article in 'de Gelderlander' newspaper about climate adaptive Tiel

january, 23rd 2012

2012

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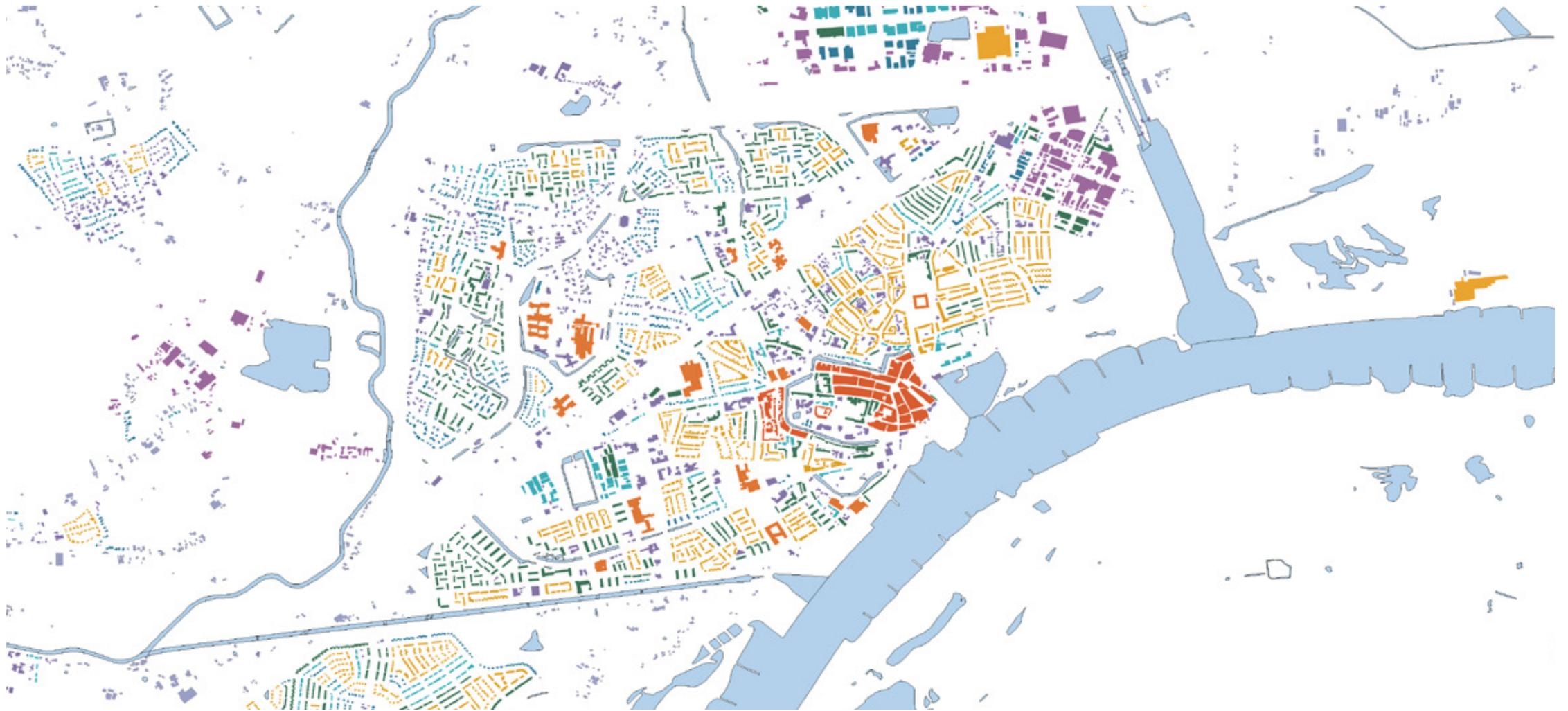
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PART I

Analysis and recommendations
for the entire city



spatial analyses with relevance
for thermal potential

1

Urban morphology

The urban morphology is of great influence on the thermal effects. A high density and closed structure can result in strong heat absorption and low ventilation.

Based on the building density and the morphology of the buildings, the development in Tiel can be classified into various types. We identified three main types: block structure, row structure and scattered structure.

'Block' structure is characterised by a relatively large volume or combination of volumes with an open inner court. This type of structure can be divided into four subtypes:

verdelen in verschillende types, namelijk:

- High density structures in the old/historic centre of Tiel;
- Large solitary building volumes in the urban surroundings;
- Block perimeter structure;
- Large solitary building volumes at for instance industrial estates.

These types often have a high potential for heat absorption.

'Row' structures are usually parallel to the street and can be divided into three subtypes:

- Continuous row structure with a considerable length;
- Interrupted row structure, often consisting of shorter rows or alternating with buildings at right angles to it;
- Row structure with big intervals between the individual building volumes, but parallel to the street.

These types have a medium potential for heat absorption.

'Scattered' development can be divided into three subtypes:

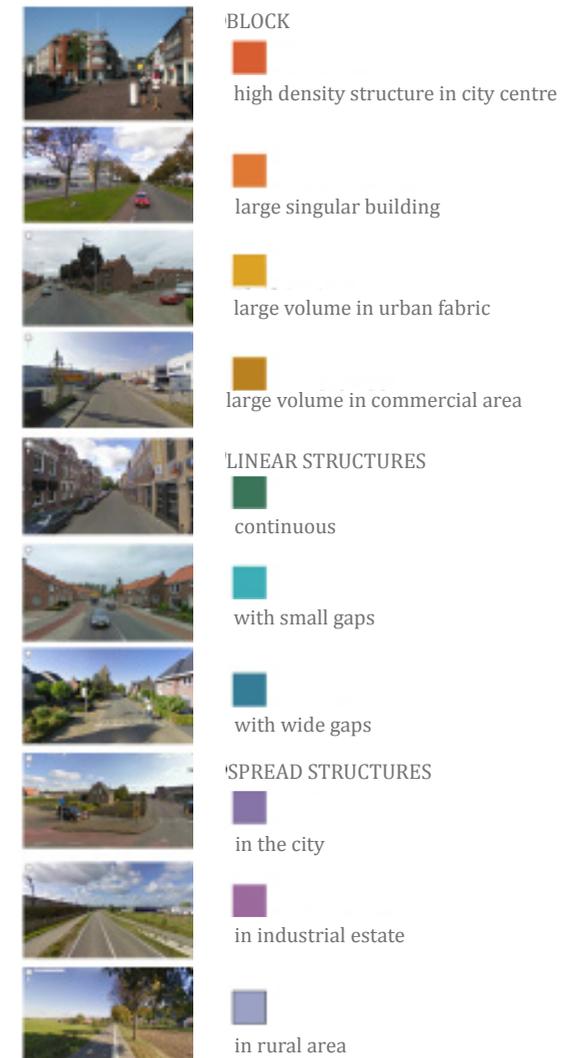
- Scattered structure in an urban environment;
- Scattered structure at an industrial estate;
- Scattered structure in the rural surroundings where the buildings are often spread far apart and scattered over the landscape.

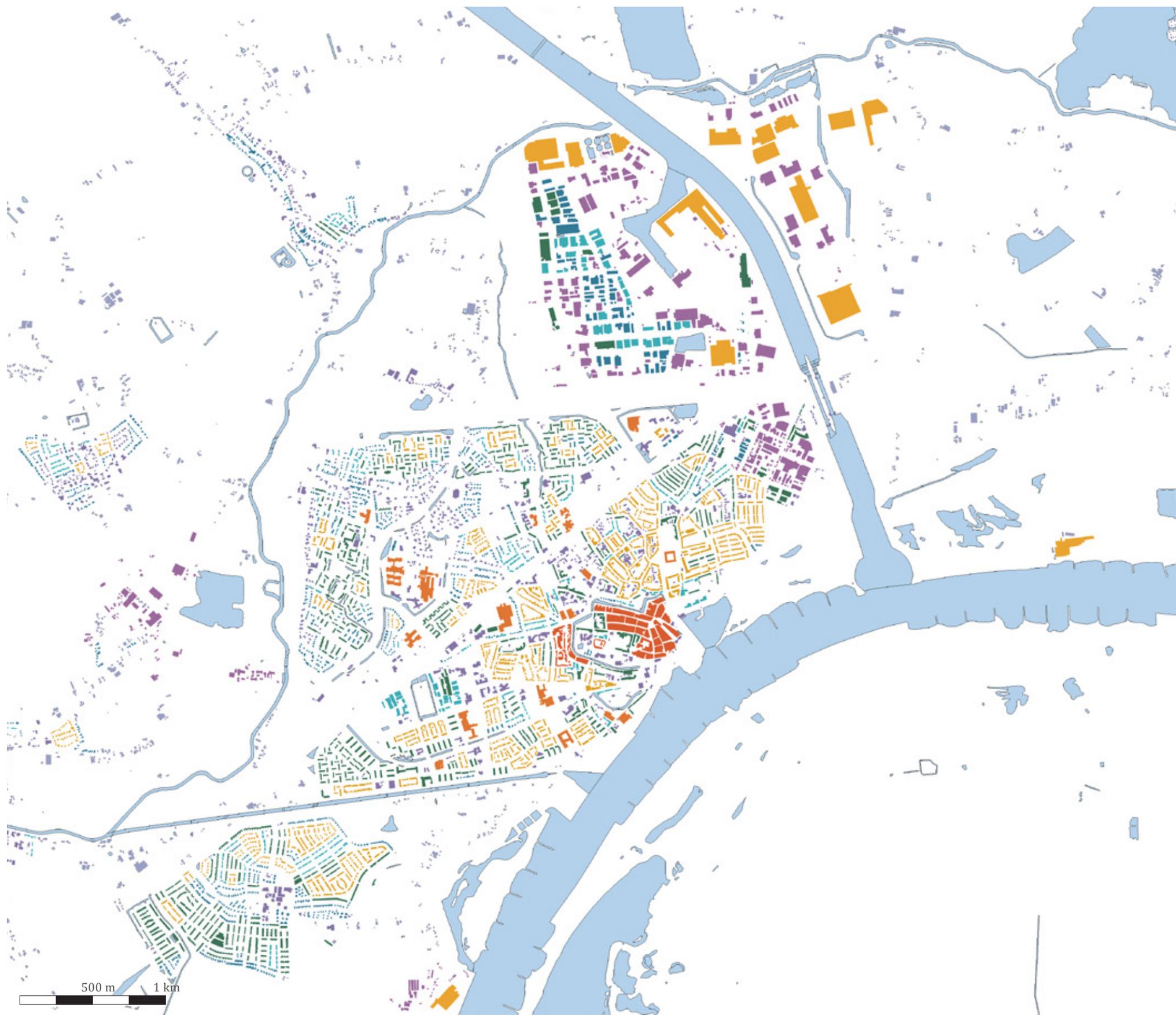
These types usually have a lower potential for heat absorption.

urban morphology

scale 1 : 30 000

LEGEND





Vegetation

Vegetation can have a cooling effect on a city's climate. Because of their dense foliage, all trees and shrubs have a strong cooling effect, due to evaporation and the shade they offer.

Based on its height, the vegetation in Tiel can be classified into three types.

The first type is tree vegetation with a large volume, such as woods, (fruit) orchards and nurseries. Most vegetation of this type can be found in the suburban surroundings, especially in the southwest of Tiel. A few lots are in residential areas or at industrial estates. This type of vegetation is the most efficient when it comes to cooling.

The second type consists of tall, linear elements like hedgerows, groves, wooded banks and trees. These have often been planted next to access roads and waterways, and around residential areas. This type of vegetation can be found a lot in the urban surroundings of Tiel. It has a medium cooling effect.

The third type consists of flat, green areas like meadows and arable lands. For the great part the environs of the municipality of Tiel consist of this type of vegetation, as do many of the private gardens in the suburban areas. Low, flat vegetation is less effective when it comes to cooling.

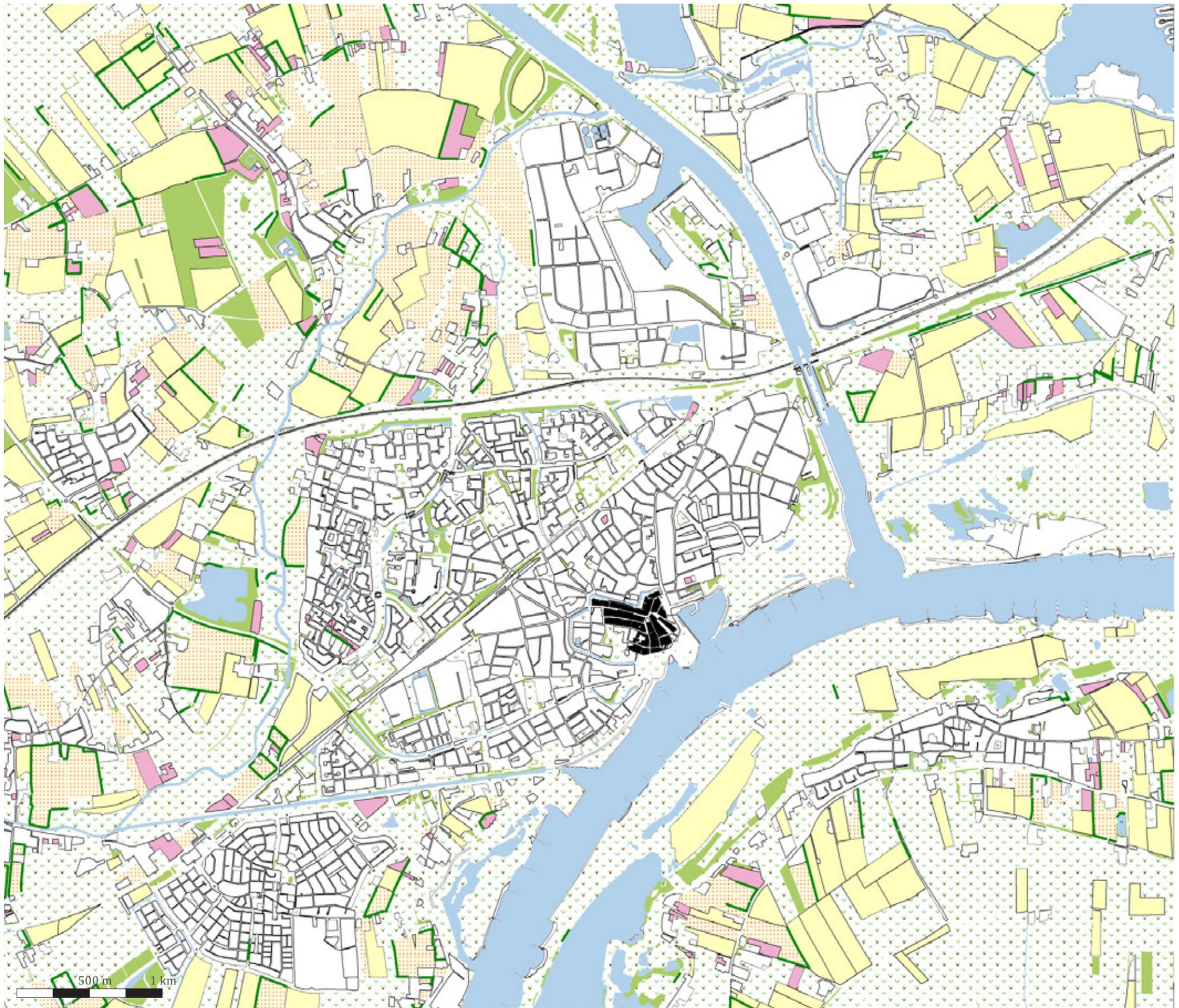
The most 'cooling' vegetation in Tiel can be found in the suburban areas, in some of the areas in the environs of Tiel and along the river. The areas with little vegetation, such as the densely built city centre, some residential areas and industrial estates, have less potential for cooling.

vegetation

scale 1 : 30 000

LEGEND

-  hedgerow/ shelterbelt
-  forest
-  arable land
-  meadow
-  nursery
-  orchard



Land use

The various kinds of land use influence the thermal balance of the urban climate through various types of built structure, the amount of pavement and human activity in and around the buildings. The classic classification of urban climate types in 'climatopes' is therefore primarily based on the land use.

The historical centre of Tiel originated next to the river, expanding through the years. Around this centre, older residential areas and mixed areas with small-scale economic activity are situated. To the north and the west, Tiel has mostly expanded with residential areas. In and in between different residential areas are green areas, such as parks. On its eastern side, the city has mostly expanded with businesses and offices. Quite recently, the city has 'jumped' over the Amsterdam-Rhine Canal with the development of a large-scale commercial and industrial estate.

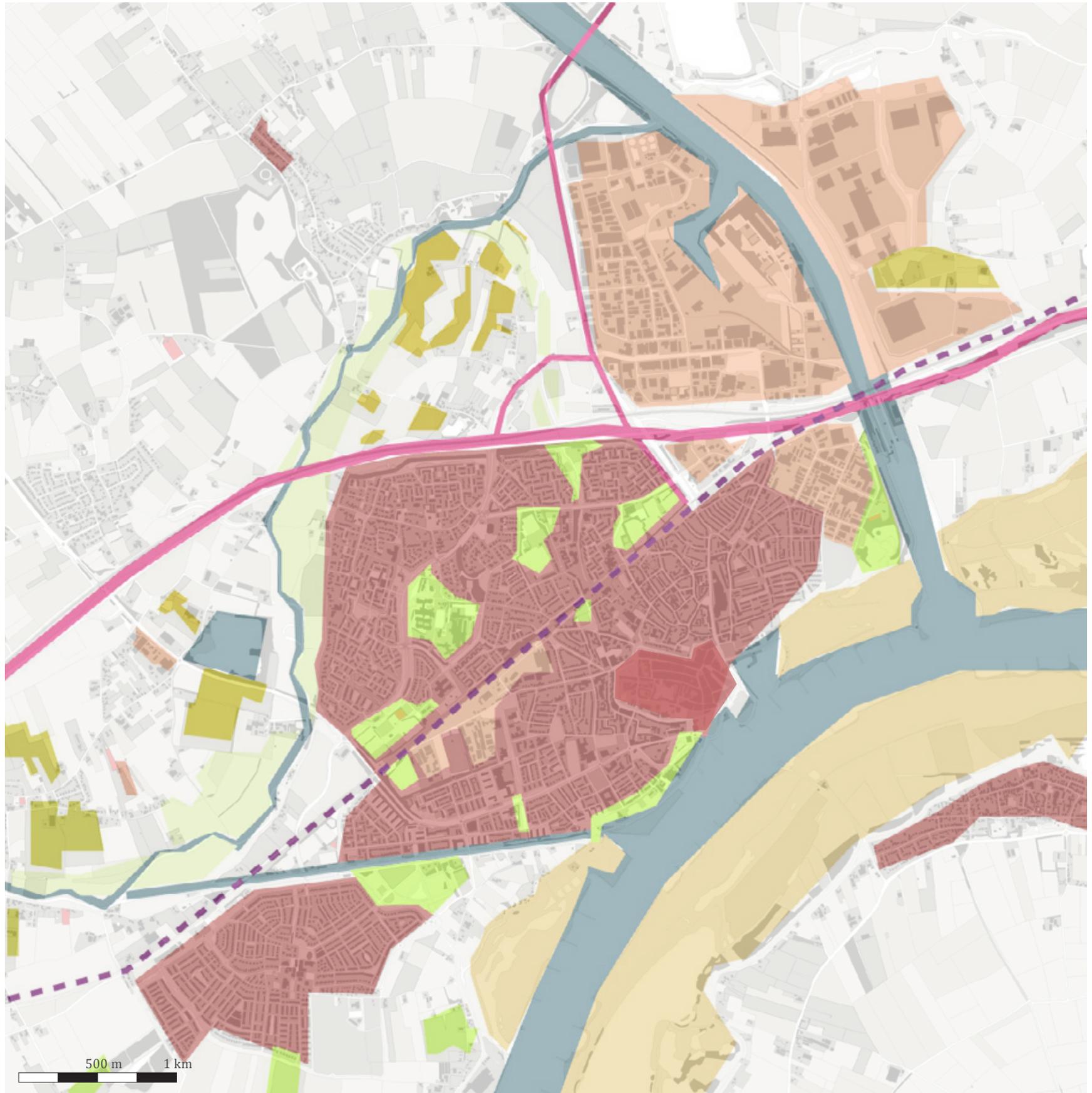
The Lingezone and its surrounding farmlands form a boundary in the northwest. Around the River Linge recreational areas are situated, which are of value to water and nature conservation. Naturally, the River Waal is an important area to the south of the city. The Waal is bordered with riverbanks with an important function as water buffers.

land use

scale 1 : 30 000

LEGEND

- centre
- residential
- commercial/industrial
- park
- recreation
- agriculture
- floodplains
- water
- railway
- major roads



Surfaces and enclosure

The outdoor materials have a big impact on the heat conditions in the city, due to their different radiation properties. Sealing of soils due to paving and built vertical structures can lead to the accumulation of heat, especially when this heat is unable to spread out into the environment. So it is important to analyse the properties of the vertical materials, such as walls, hedges and trees, as well. The vacant or open space in Tiel can be divided into different types, namely:

- Surfacing, such as concrete, asphalt or bricks;
- Permeable surfaces, such as grass, vegetation, crops and water;
- A combination of paved and permeable surfaces, like in gardens.

These types can then be subdivided according to the type of border (built up or green) and to what extent an area is enclosed: open, completely enclosed or partially enclosed.

Open surfaces are typically situated outside of the developed areas, but some of them can be found within these areas. Think of parks, allotments, sports fields and urban greens. These surfaces are frequently surrounded with areas with hard or combined surfaces. These open types generally have a cooling effect on the urban climate.

The paved surfaces oftentimes can be found in the developed areas, especially at industrial estates. A number of important paved surfaces are situated in the historical centre of the city, such as parking spaces and squares, small and large, public and private. Most paved surfaces in the centre are small, enclosed spaces, while the hardened surfaces at industrial estates are relatively large and only partially enclosed. These types often have a heating effect on the urban climate, especially when it involves very stony and small spaces.

The combined surfaces can generally be found within the urban environment or around buildings. Different materials border many of the combined surfaces, as is the case with most gardens in the city. The effect of these types on the urban climate is usually neutral.

surfaces and enclosure

scale 1 : 30 000

LEGEND

HARD SURFACES - concrete/asfalt, etc.

-  hard surface - hard boundary - enclosed
-  hard surface - hard boundary - partly enclosed
-  hard surface - green boundary - enclosed
-  hard surface - varied boundary - partly enclosed

GREEN SURFACES - grass/arable, etc.

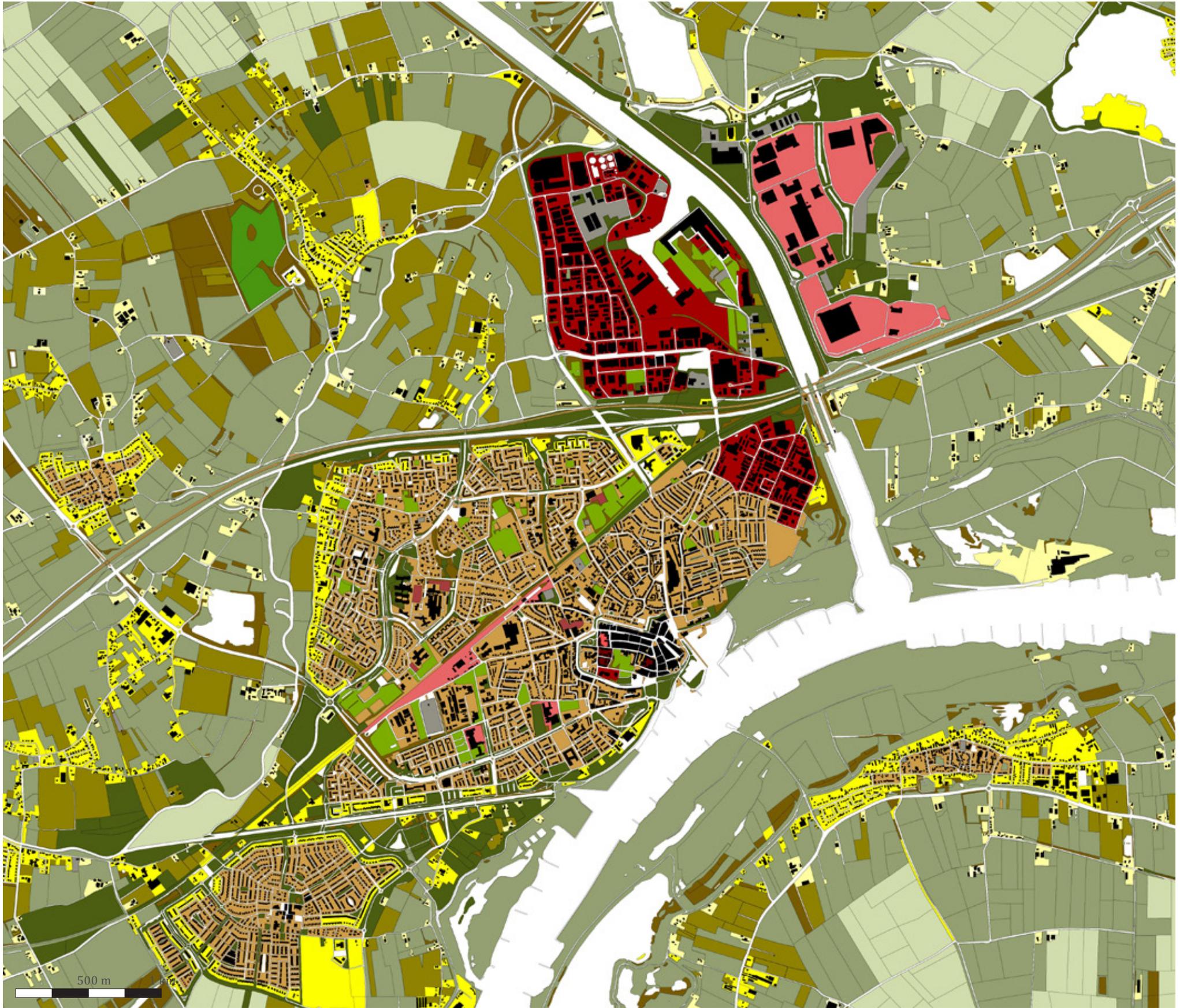
-  green surface - varied boundary - partly enclosed
-  green surface - varied boundary - enclosed
-  green surface - green boundary - partly enclosed
-  green surface - green boundary - enclosed
-  green surface - hard boundary - partly enclosed
-  green surface - open

COMBINED SURFACES - outdoor spaces in commercial areas, villages, etc.

-  varied surface - green boundary - partly enclosed
-  varied surface - varied boundary - enclosed
-  varied surface - varied boundary - partly enclosed

BOUNDARIES/BARRIERS

-  building
-  forest
-  orchard



Anthropogenic heat

Human activities can generate a lot of heat in the environment, for example through driving cars, central heating, air conditioners and industry.

The map shows sources of heat in areas around infrastructure, production facilities at industrial estates, large supermarkets, hospitals, hotels and historic buildings with little isolation.

The areas that are most influenced by anthropogenic heat are situated around roads with a lot of traffic, especially lorries. On the industrial estate northeast of Tiel, the large factories generate much residual heat. To keep products fresh, supermarkets also produce residual heat through air conditioning and cooling. This is also the case for buildings with continuous activity throughout the day, using a central air conditioning system, such as hospitals and hotels. Another important source of residual heat are poorly isolated houses like some of the historical buildings mostly situated in the centre of Tiel.

anthropogenic heat

scale 1 : 30 000

LEGEND

-  main roads
-  industry
-  supermarkets or logistic companies
-  hospital or hotel
-  accumulation of badly insulated historical buildings



Time distribution of human activities

Effects of the urban climate change with time and space. Human activity patterns also change spatially and in time, per day and with the seasons. This leads to the question: where and when do we have a potential or a problem with the urban climate? Thus, it is important to take these aspects into account in the analysis of the city's climate and especially in the recommendations for climate adaptation.

Tiel can be divided into different districts characterised by the activities that take place in it. The time on which people use these locations can differ: which areas are used during the day, which in the evening and which are in use day and night? Sometimes the use is limited to the summer season, like at the event site next to the Waal. Heat islands are especially prominent at night. This can have a great influence on the heat exposure of people in densely populated residential areas or mixed zones. The influence is considerably smaller in industrial areas; since people normally don't stay there at night.

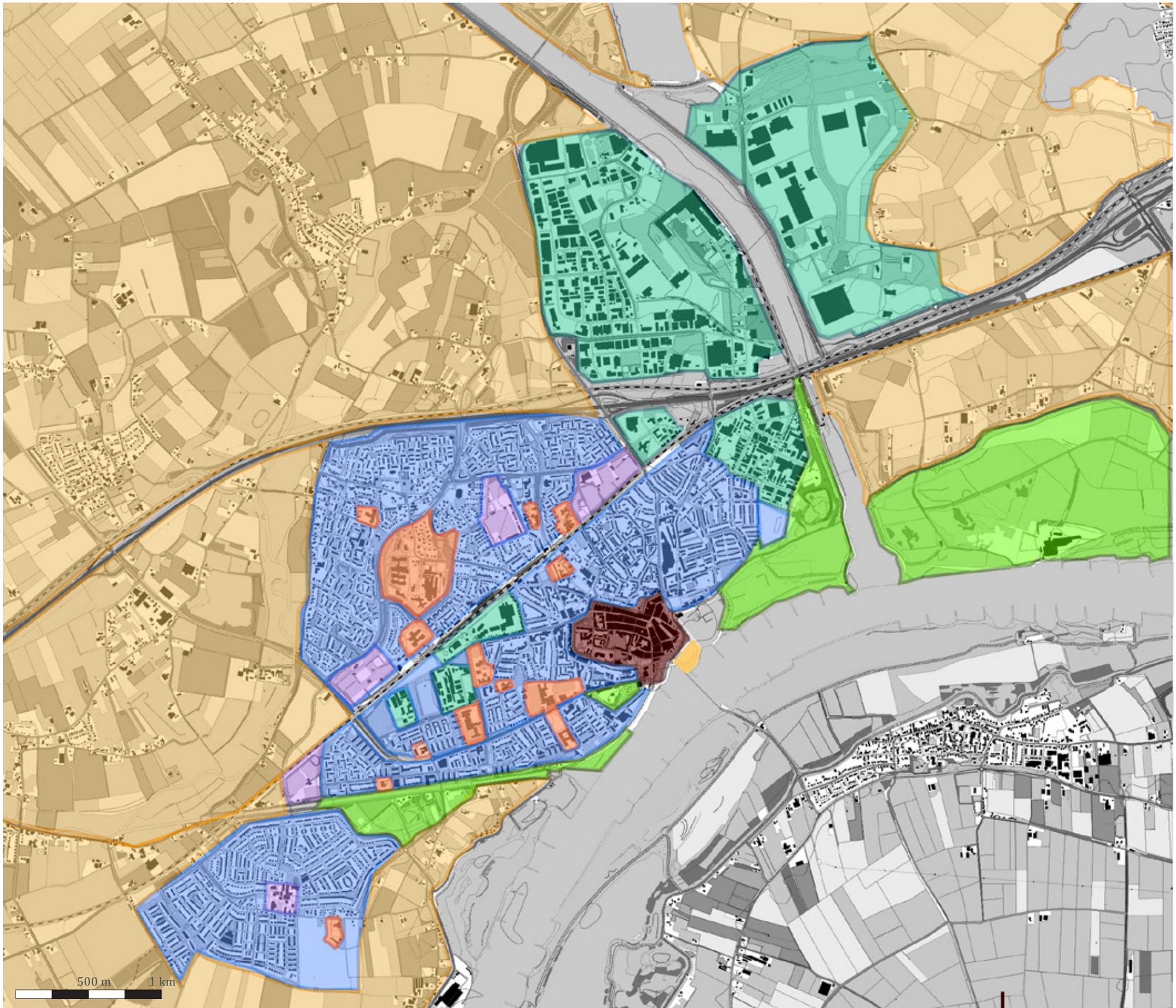
The pattern of use of public spaces per season can be equally important, particularly when it comes to wind nuisance, which is mostly a problem in spring and autumn.

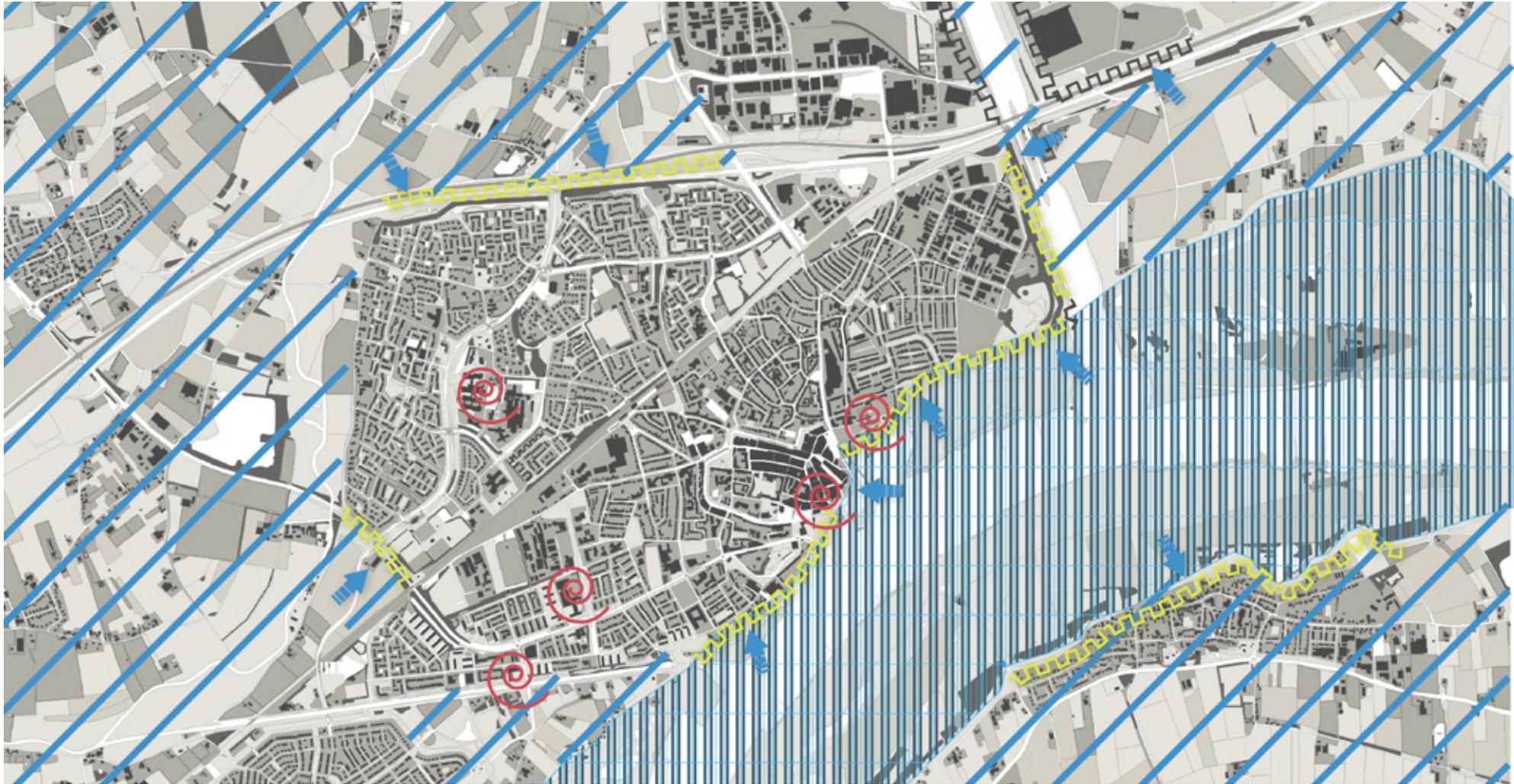
time distribution of human activities

scale 1 : 30 000

LEGEND

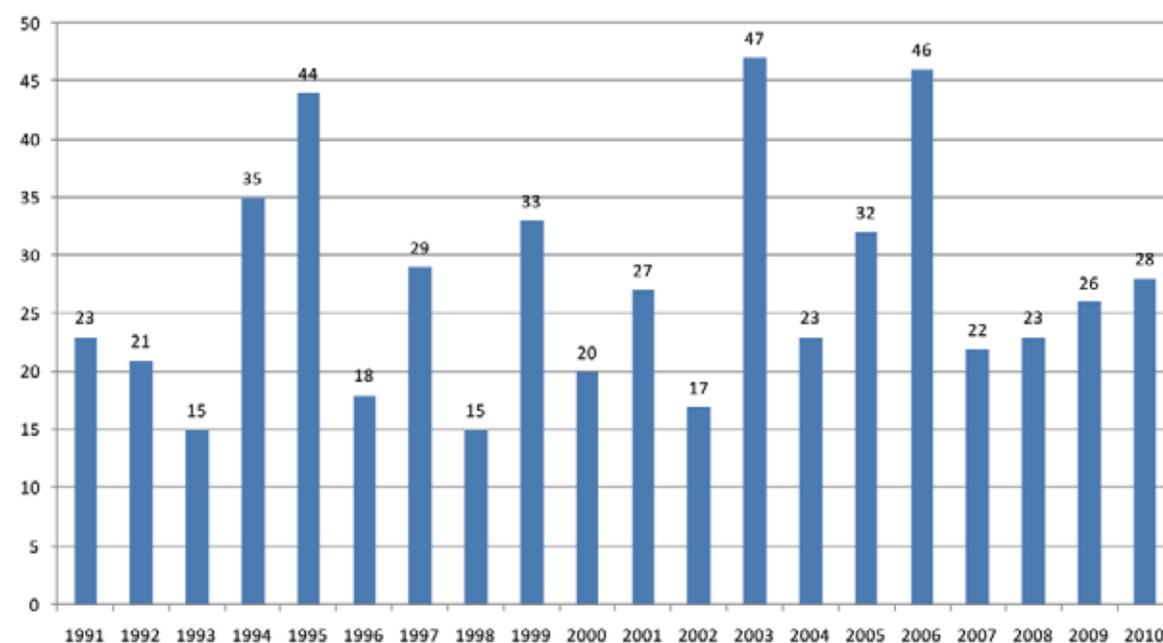
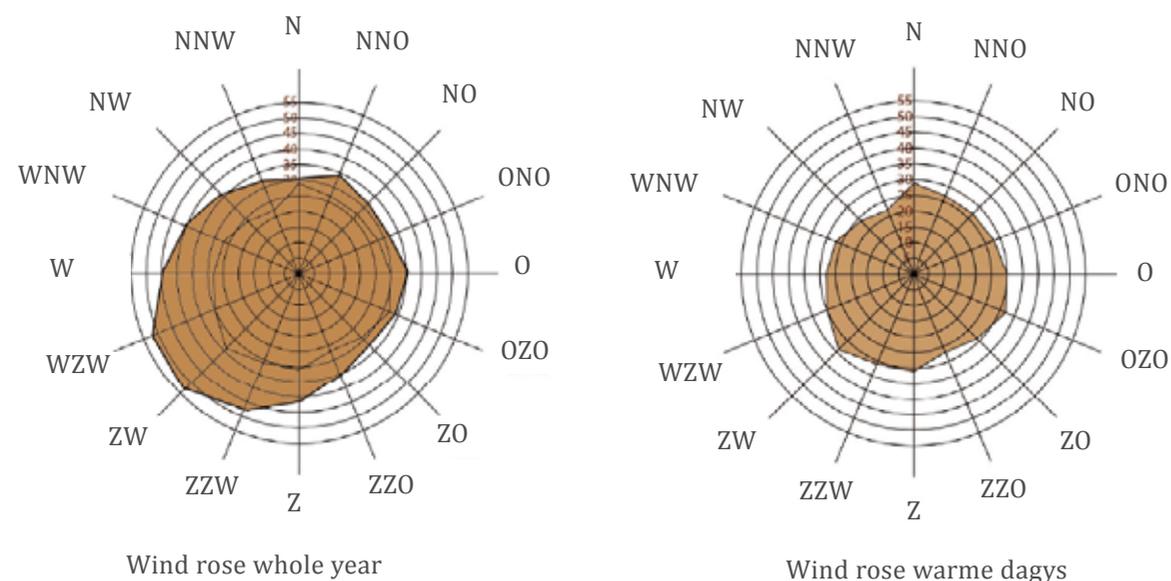
-  residential area, permanent human presence
-  sport fields - evening activities
-  rural areas with few inhabitants, little activity
-  recreational area, human presence overday
-  historical centre, permanent human presence
-  industrial area - activity overday
-  hospitals, schools, permanent human presence
-  event area, few summer activities





spatial analyses
with relevance for dynamic
wind potential 2

Wind rose



yearly number of warm days with max. temperatures above 25 °C (1991 - 2010)

Two main aspects are featured on the map in order to chart the 'dynamic' or wind potentials: the most predominant wind forces to identify wind nuisance, and warm 'tropical' days to identify the potential for cooling breezes.

Wind roses were made based on the 1991-2010 weather data from Herwijnen, the nearest weather station. These wind roses show the dominant wind directions over the last years both for the whole year and for the warm days with temperatures rising above 25 °C.

Throughout the year, south-western winds are the most predominant. Wind speeds are often so high that outdoor areas can become uncomfortable. Extra measures can be taken to prevent this from happening.

On warm days, however, the wind speeds are much lower, and the wind does not come from one direction. Hence, these winds are not very effective when it comes to cooling the city. Convective winds, caused by temperature gradients between warmer and cooler areas, offer more opportunities for cooling.

Dynamic potential

The dynamic potential refers to the problematic wind nuisances in Tiel caused by the south-western winds, and to the potential for convective breezes. The 'dynamic potential' map features both potentials. That occur between warmer and cooler areas.

On warm days, the River Waal and the riverbank areas have a high potential for producing cool air. The Amsterdam-Rhine Canal, large ponds and the agricultural areas have a low potential for cooling. The residential areas close to the centre and the industrial estates are the warmest places in Tiel, but areas with a potential for cooling surround these areas. The big difference in temperature cause a light breeze on the borders of these areas. Unfortunately, the dike and the highway form impenetrable barriers for these breezes. Thus, we can only expect marginal convective air currents between the areas with a low potential for cooling and the urban areas.

A south-western wind prevails most other days. When the wind is strong, especially the southern and western borders of the residential areas and the open areas feel unpleasant. Another point of attention is the wind turbulence around high-rise buildings. A smaller problem is the wind nuisance in the public areas in the city.

dynamic potential

scale 1 : 30 000

LEGEND

LOW DYNAMICS

 area with high potential

 area with low potential

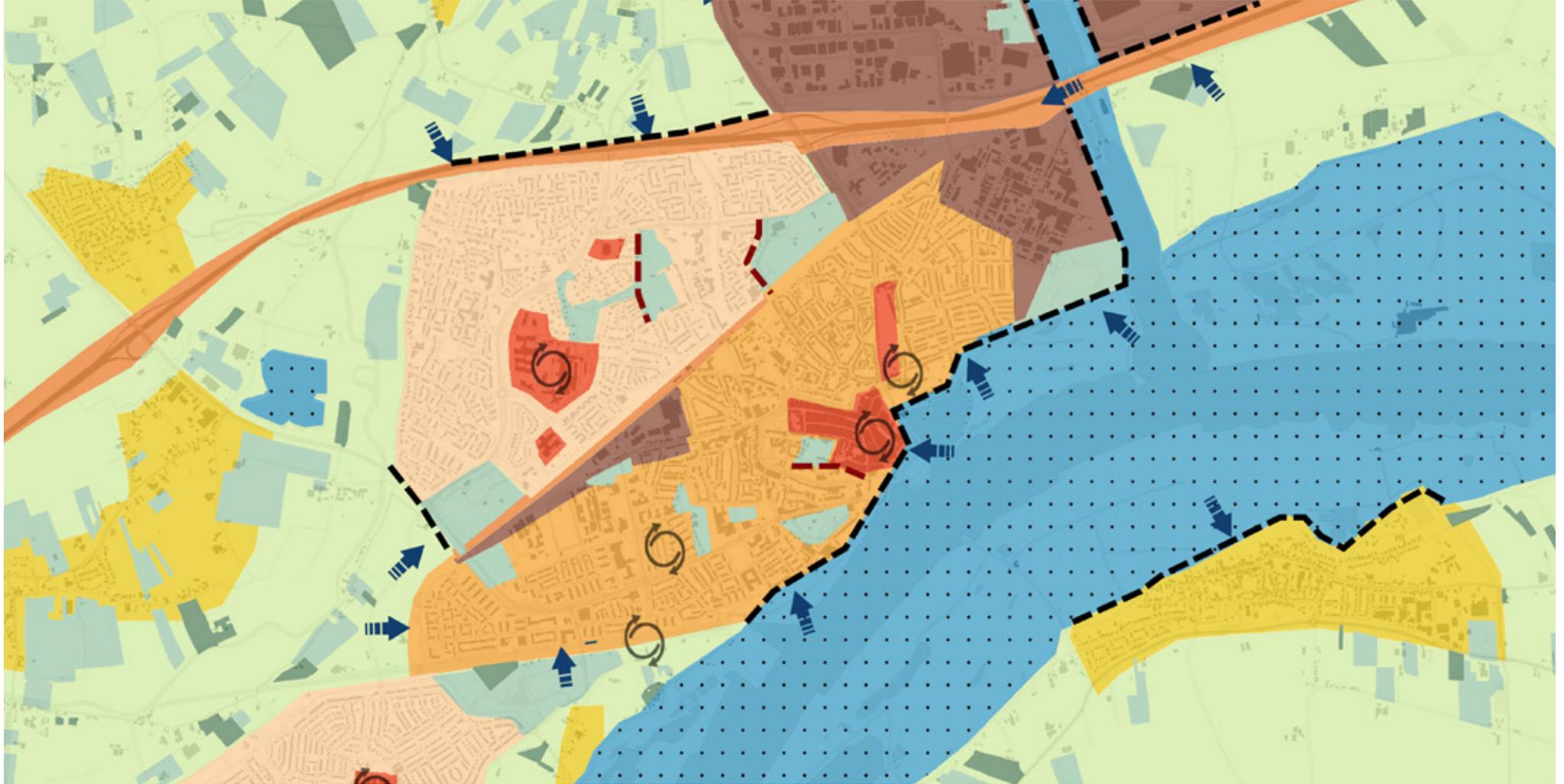
 wind blockers

 wind on warm days

HIGH DYNAMICS

 turbulence





urban climate analysis map 3

Urban climate analysis map

The analysis of the city's climate consists of a description of climatopes, summarising the thermal characteristics and the most important conclusions from the wind maps. The division in climatopes is based on several criteria influencing the climate, such as building density and structure, the function of buildings, and land use.

The climatope 'city centre' with its many high-rise buildings has the highest building density with 45% of the surface occupied by buildings. The building structure consists of closed building surfaces facing the streets and small, enclosed green areas, covering a mere 5% of the centre. On top of that, there is no water here, so the atmospheric humidity in the city's centre is low and it's microclimate is warm.

The climatope 'city' is situated in the central-western part of Tiel. It has a building density of 35% of the surface occupied by buildings and an average Floor Space Index (FSI) of 0,5. This means that this area has a fairly compact building structure, but that the buildings themselves are low. The vegetation here consists mostly of private gardens. The public greens are limited to a network of trees lining the streets.

The climatope 'garden city' differs from the climatope 'city' in that it has more high-quality green spaces and more small watercourses. Consequently, its built up surface is lower: 25%.

Most of the surfaces in the climatope 'businesses and commerce' are made of hard, impermeable materials. 25% of the surface is occupied by buildings and the area's FSI is 1. This climatope is thus characterised by low atmospheric humidity and a warm microclimate.

The climatope 'periphery' consists of various closed building types (10-15%) with a maximum of five building levels and various vegetation types. Green areas with an open surface are indicated by the climatope 'parks and orchards'. These areas are permeable to water and have a cooling effect, resulting in a considerably lower temperature.

The 'woods and old orchards' areas have an even stronger cooling effect. Since the vegetation is taller, these areas can also function as windbreakers. The climatope 'open areas' consists of open farm and grasslands and open areas with grass and trees outside of the built-up area. These areas are cooler and windier than the built-up areas.

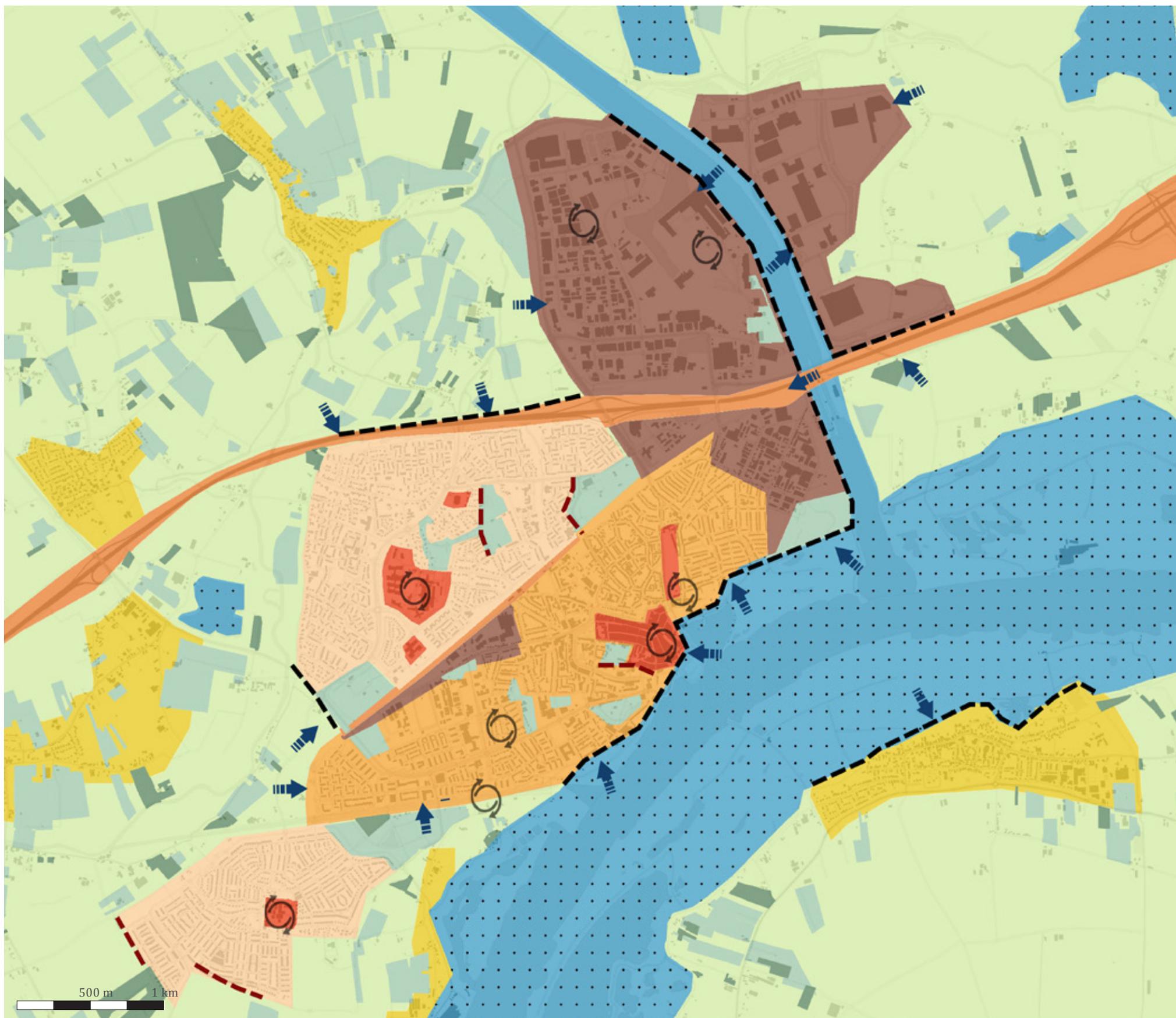
The Amsterdam-Rhine Channel, the River Waal and their surroundings are all part of the climatope 'water'. These areas have the highest atmospheric humidity. There are no buildings here and the vegetation can mostly be found on the riverbanks. During the day, the temperature is lower than in the surrounding areas, at night, it's the other way around. The wind has a big influence on the climate of these areas. In many places convection is hindered by high dikes during warm nights. There are also places where wind can be a nuisance in the windy seasons.

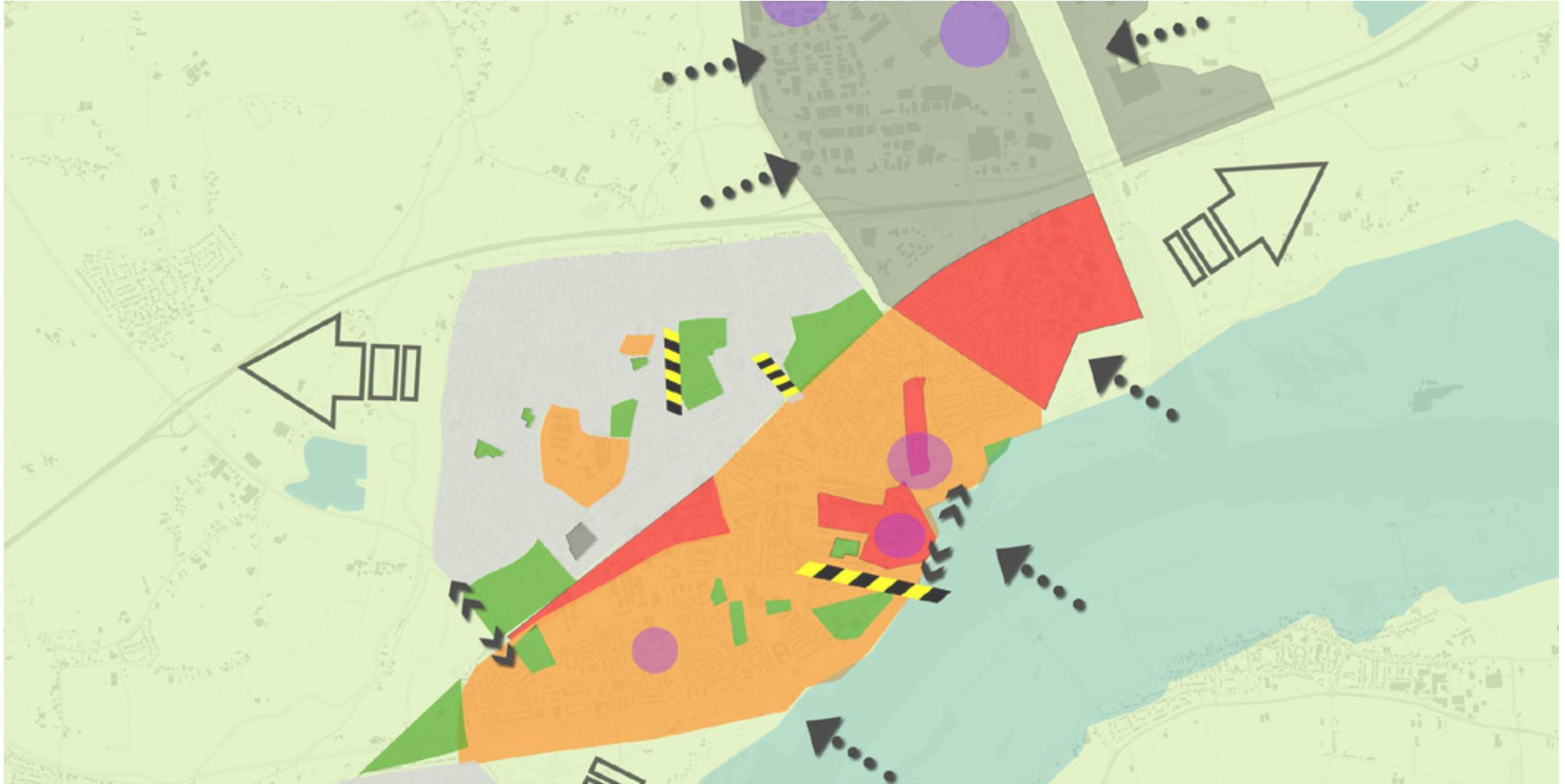
climatopes

scale 1 : 30 000

LEGEND

-  urban centres
-  traffic infrastructure
-  industry/commercial area
-  urban
-  garden city
-  periphery
-  parks and orchards
-  open agricultural areas
-  forest and old orchards
-  water
-  high ventilation potential
-  turbulence
-  problems with southwestern wind
-  ventilation blockage
-  convective wind on warm days





adaptation recommendations 4

Recommendations

We formulated general recommendations for the microclimate regarding heat and wind, based on the synthesis of the maps.

HEAT

Work on current problems

We identified three areas with problems concerning heat-stress where measures should be taken. The city centre and its immediate surroundings (climatopes 'city centre' and 'city') have the highest priority. These areas are in constant use and people's exposure to heat is highest here. Latenstein within the climatope 'businesses and commerce' has similar problems, especially since many people live here as well. Possible general measures are adding vegetation in all ways possible, shading the streets, sprinkling on hot days and using permeable materials for surfaces between the buildings. In the northern commercial and industrial estates, there is a different problem. There are no people suffering from heat here at night. During the day, however, the employees working here do not have an outside space where it is pleasant for them to take their breaks. Small places with a pleasant microclimate should be created here, protected from the sun especially, but also from the wind. Using the difference in temperature with the open areas, convective winds can be brought deeper into the industrial estates to cool them.

Making use of current potentials

Fewer problems are to be expected for the other climatope types in the city. Nonetheless, to ensure a 'climate proof' future for the city, it is important to prevent further warming. Vegetation can be added through green roofs and facades. It would help if streets and gardens were more permeable, and existing green areas were conserved and new ones developed. The open, and potentially green, areas should be protected, so they can keep cool-

ing the city. Besides, more use could be made of the cooling effect of the river on hot summer days by making the banks more attractive for people to go there.

Creating future potentials

Insofar as this is possible, more green places should be created in order to cool the city's centre. A first step could be the 'greening' of the former fruit auction terrain. With the expansion of Tiel, green fingers should be created, offering sufficient interfaces between cooler green and warmer urban areas, guaranteeing the occurrence of convective winds. This is also important to compensate for the fact that airflows from the river are, and will be, blocked by the dikes (which will probably be even higher in the future). Where possible, ventilation corridors between the city and its environs should be kept open or be created at the edges of the city.

WIND

The identified places with turbulence around large buildings should either be fitted with wind protection or these places should not be appointed as sojourn areas. The residential areas influenced by the southwestern wind are in need of wind protection, for instance in the form of windbreaks. Some areas in Tiel even need extra wind protection, like the event site next to the river, and very open spaces in the parks or open squares in the city.

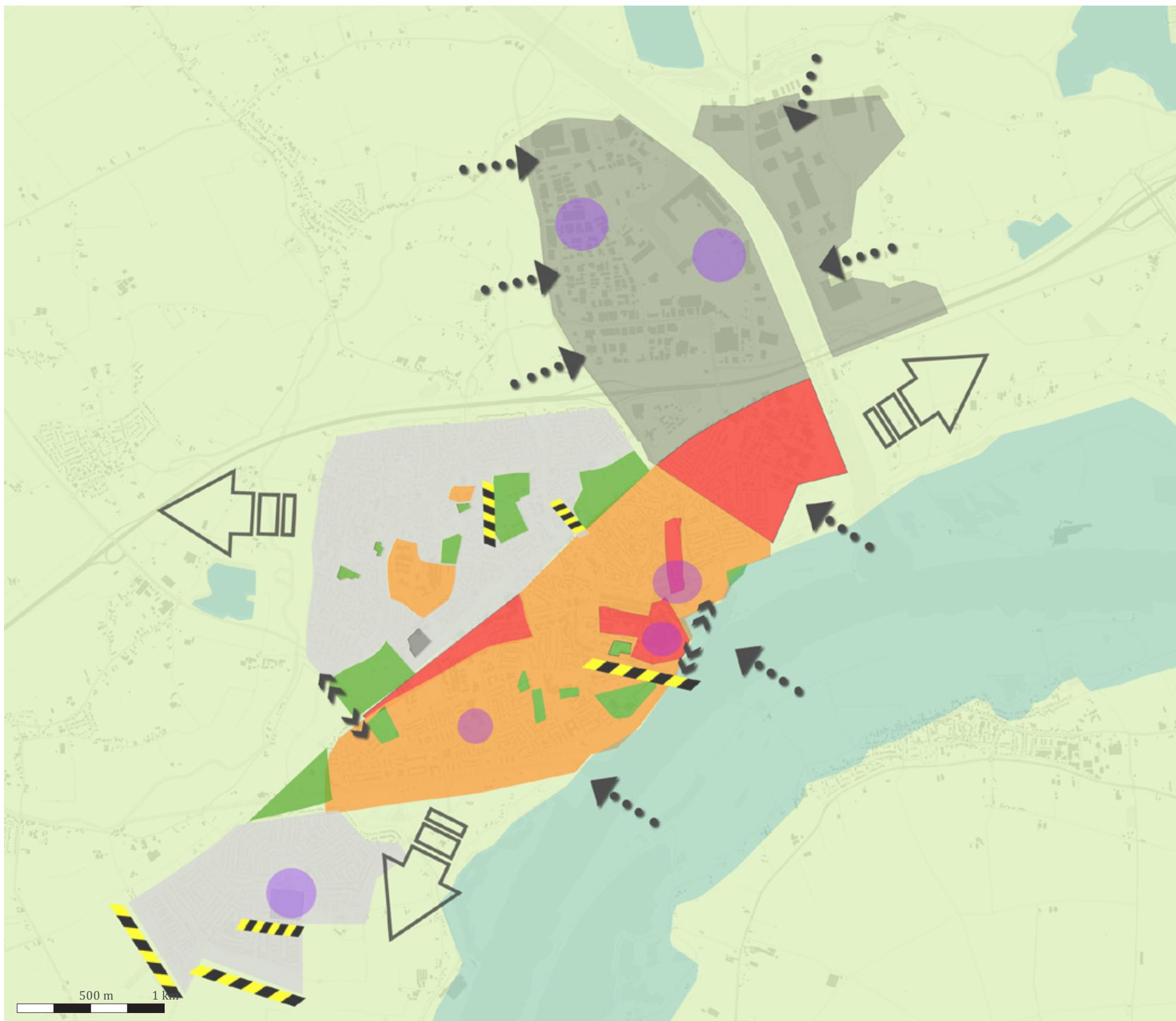
Besides these concise recommendations, we found it was necessary to study the local microclimate more specifically for certain problem areas and offer specific solutions for these locations. Consequently, we studied areas with particular potentials and came up with recommendations for these as well. The second part of this book focuses on specific areas studied by ten students.

Recommendations

scale 1 : 30 000

LEGEND

-  high urgency to prevent heat accumulation
-  high urgency to prevent heat accumulation
-  low urgency to prevent heat accumulation
-  protect green areas
-  high cooling potential through convective winds
-  lower cooling potential through convective winds
-  keep existing situation
-  avoid sojourn functions because of turbulences
-  create local wind protection
-  reserve 'green fingers' in case of urban extension
-  allow convective winds
-  open ventilation barriers





PART II

microanalyses and design
proposals for selected areas



*Down to
the River*



relation city and harbour
Ziyi Liu

Location

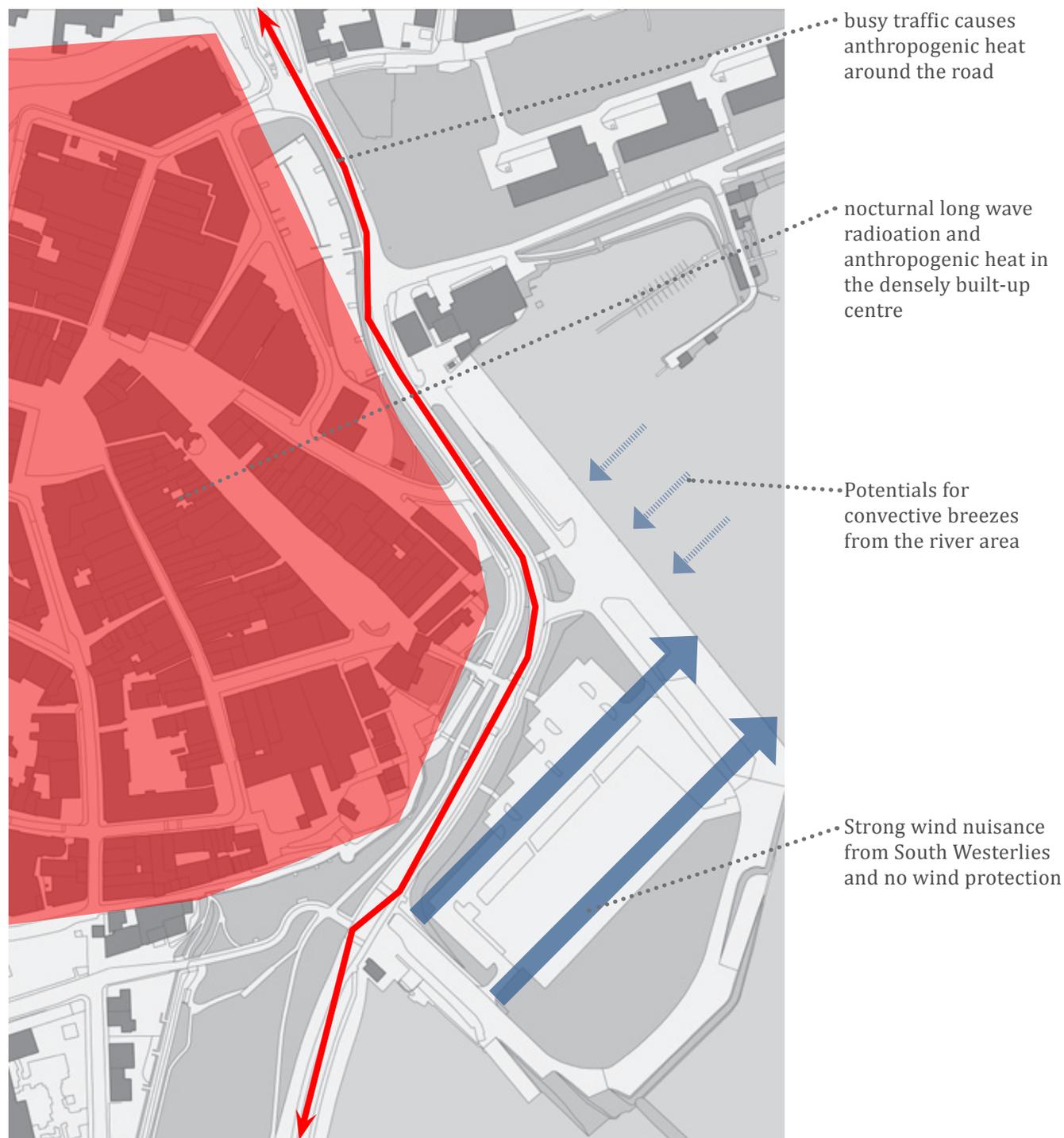
The project area is in the centre of Tiel. The focus is on the square Plein in the old heart of the city, the waterfront around the Vluchthaven harbour, and the relation between these two areas.



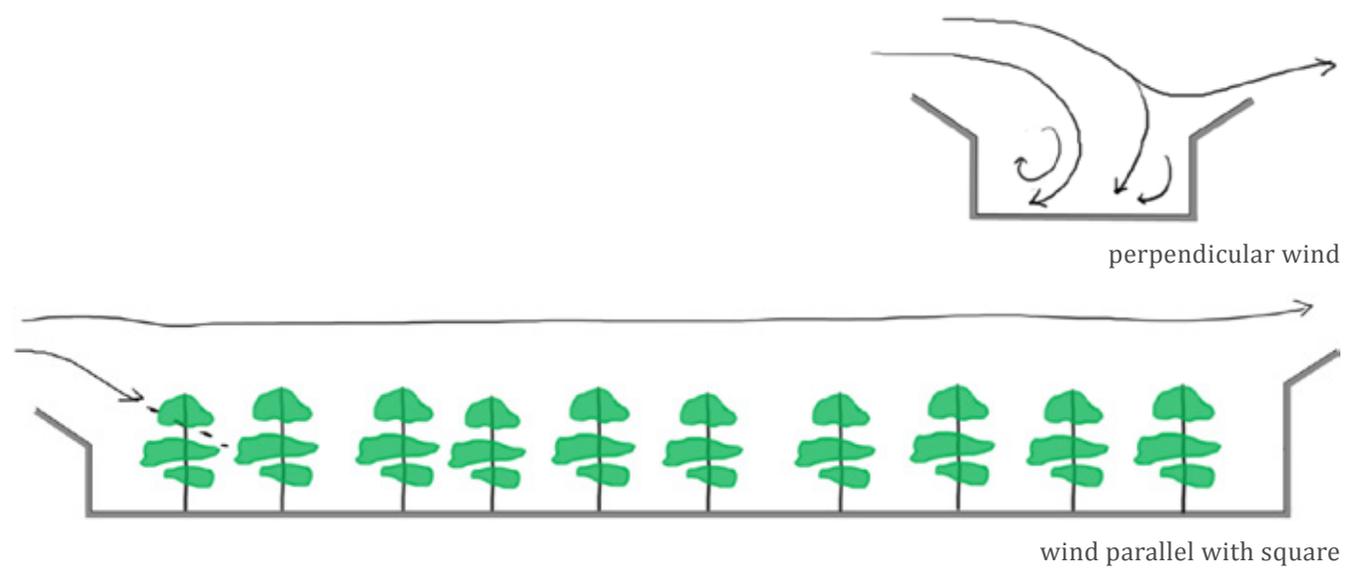
the 'Plein'



waterfront 'Vluchthaven'



Analysis - Plein

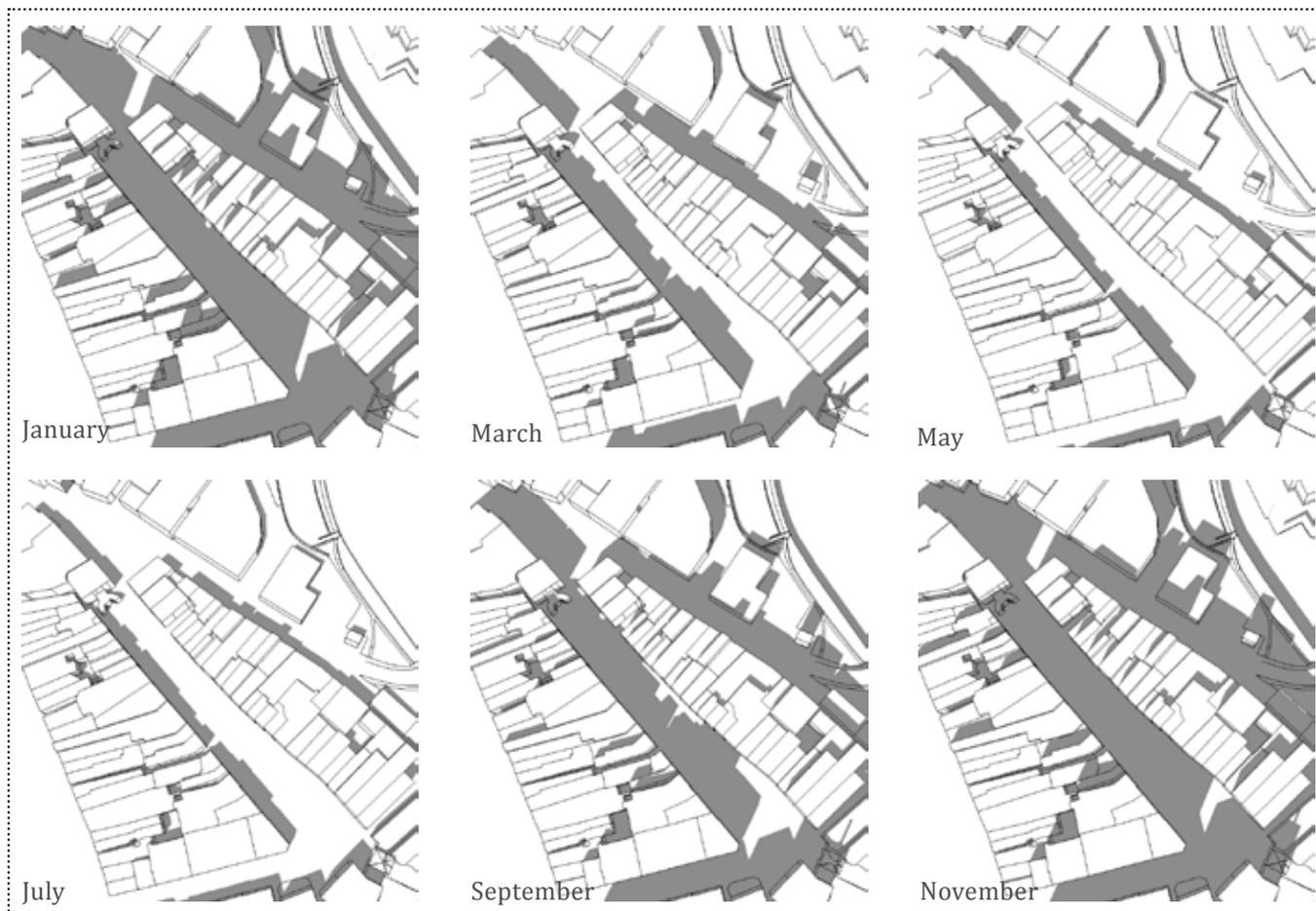


Wind analysis

The Plein is a long, narrow square, which can be seen as a sort of 'canyon'. Still, the analysis shows there are eddies or high wind speeds on the square during the prevailing south-western wind. Because the length of the square is at right angles to this wind, the Plein is sheltered from it and there is no wind nuisance on cold days. On warm days, however, the line of trees prevents sufficient ventilation.

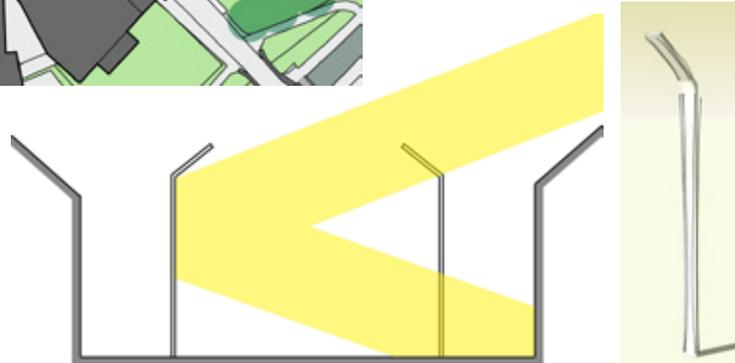
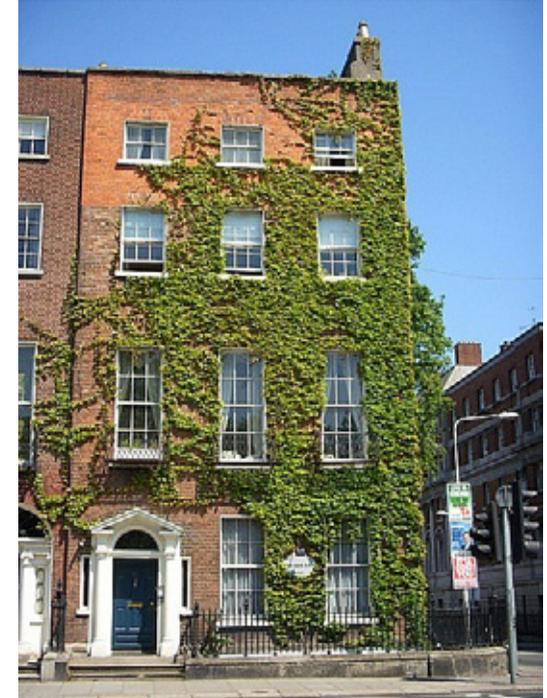
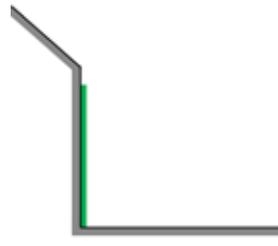
Shade analysis

These images show the shading at 2 p.m. over six months. Almost half of the year, the Plein is completely or partly shaded.

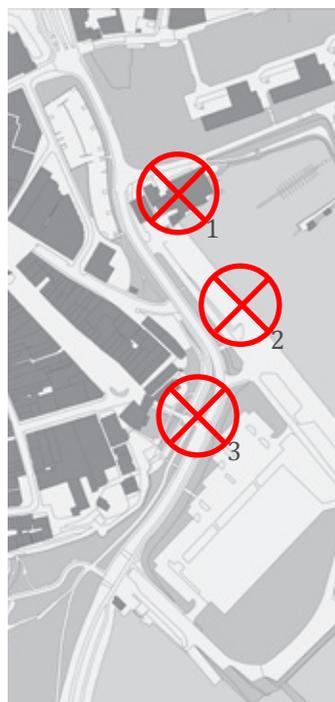


Design interventions - Plein

1. Reduce the number of trees so they do not block the wind as much.
2. Introduce vegetation for the facades to compensate for the loss of trees and to improve the buildings' isolation.
3. Street lamps with reflectors help reflect the sunlight on the square.



Concepts Vluchthaven



Analysis of the relation between the harbour and its surroundings

1. There is no direct footpath between the climate dike and the waterfront.
2. The waterfront is now being used for parking and as a landing stage. The land is considerably higher than the average water level in the river, so the quay is like a wall blocking the wind.
3. There is little relationship between the Plein and the waterfront plus the River Waal. When people pass the old entrance to the city and the dike, they see a large parking area, not the river.

Recommendations for the climate at Vluchthaven harbour

- Create a green zone as a buffer against anthropogenic heat.
- Remove the barrier blocking the cool wind on warm days.
- Create a barrier against the south-western wind.

Future plans for the climate dike

In the future, the current dike will be broadened into a climate dike, and the area next to the Vluchthaven will be developed into a residential area with terraces and floating houses.

MAIN ELEMENT: TERRACES

quai with sharp corner



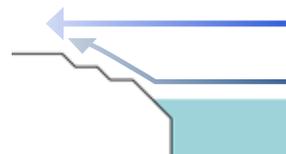
prevents breeze flow

slope

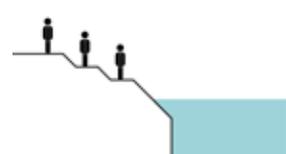


allows breeze flow

terraces with small slopes



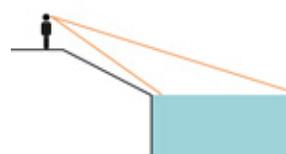
allows breeze flow



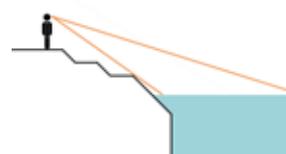
more space for activities



blocks water views



gives water views

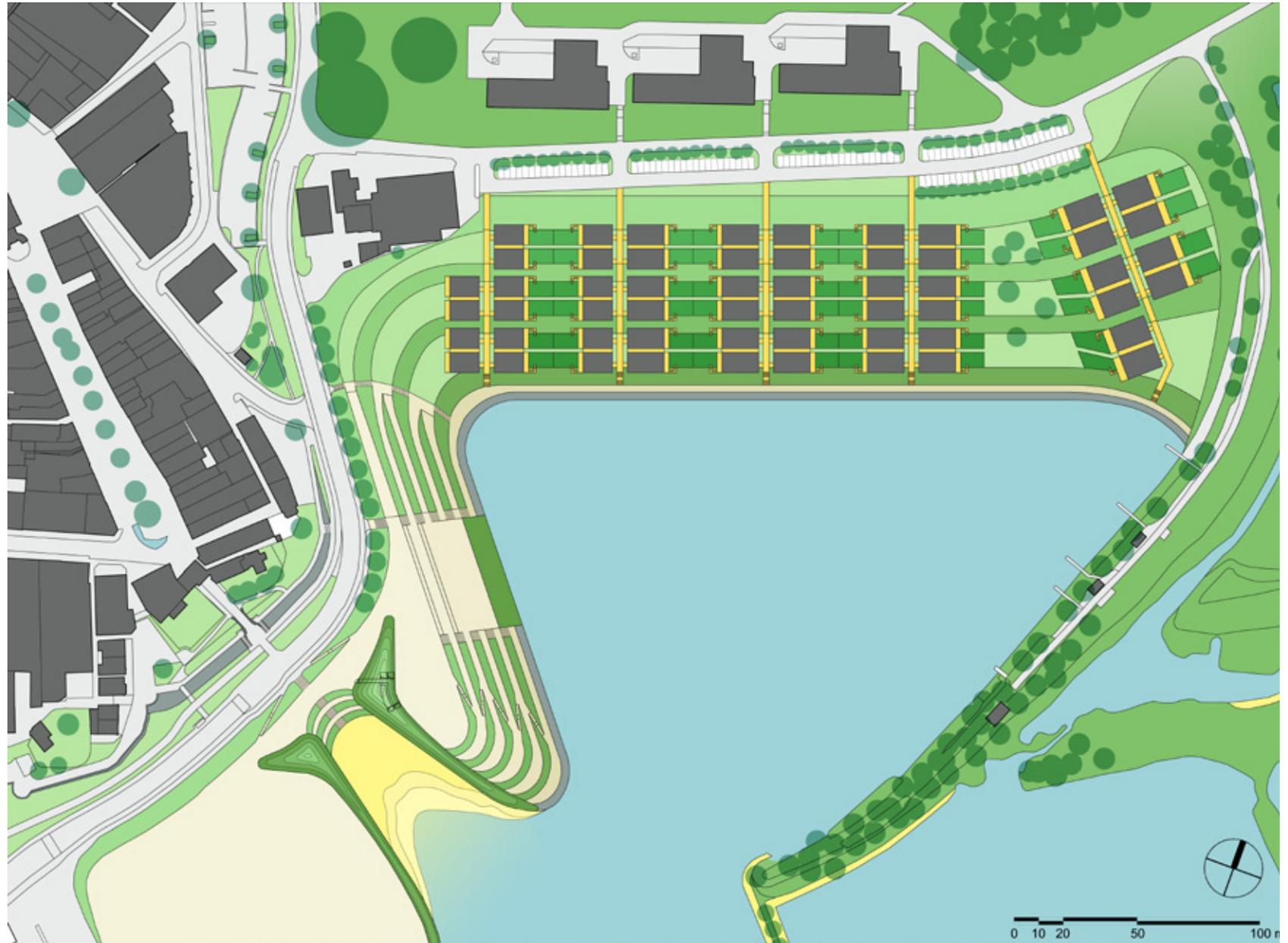


gives water views

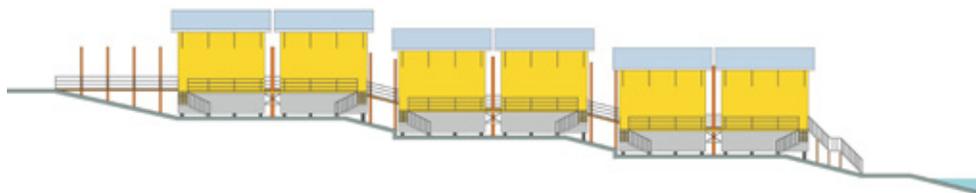


better water experience

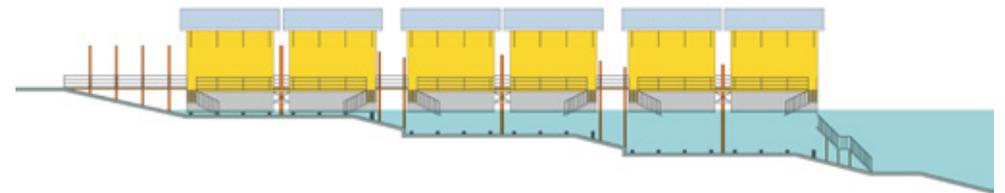
Vluchthaven plan



LOW AND HIGH
WATER LEVELS



houses are situated on stepped terraces that also contain the gardens



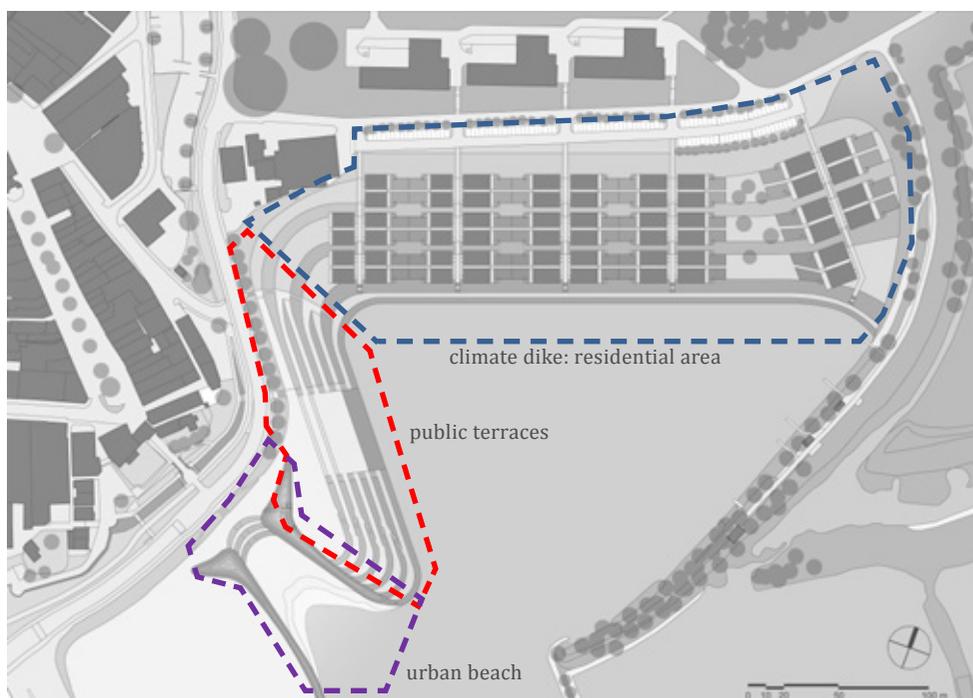
houses and access deck float on the same height and gardens are flooded

Vluchthaven plan

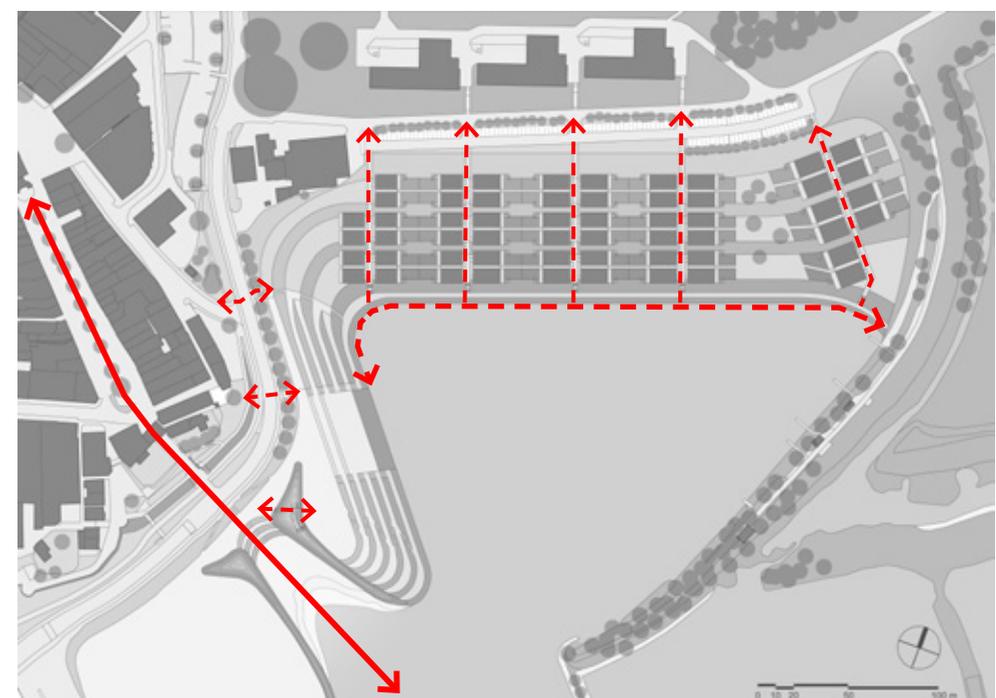


Climate dike as a residential area

Based on the vision for this area, five groups of houses area situated on the broadened climate dike. There is place for parking on top of the dike. Each group of houses can be reached through wooden decks consisting of several connected parts floating together with the houses as the water level changes. The terraces are used as private spaces for the residents. The wooden decks are accessible, so people can go to the terrace at the lowest level, which is connected to the public terraces.



PLAN AREAS

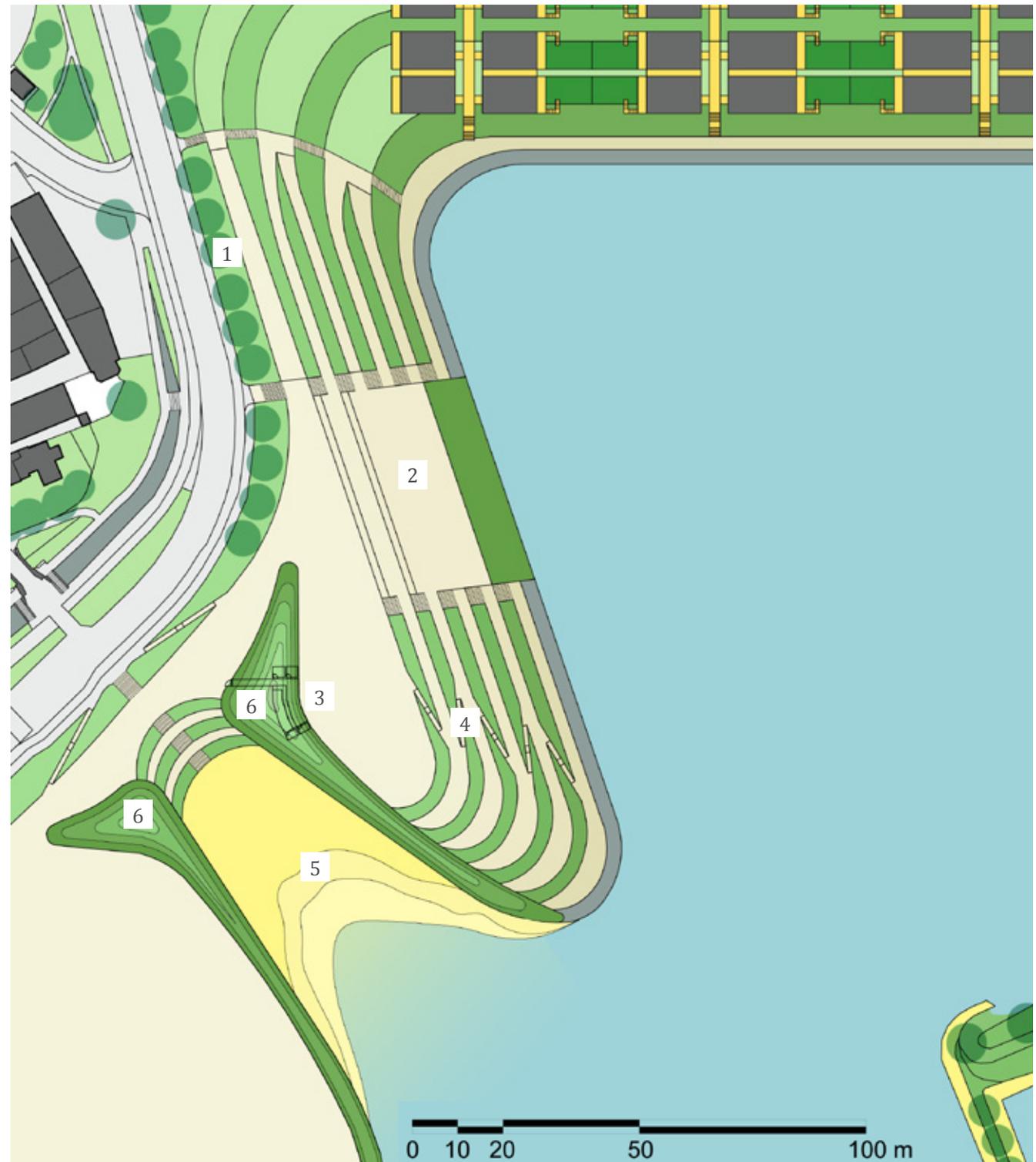


CONNECTIONS: better relation of Vluchthaven and surroundings and open view and walking connection from Plein to River Waal

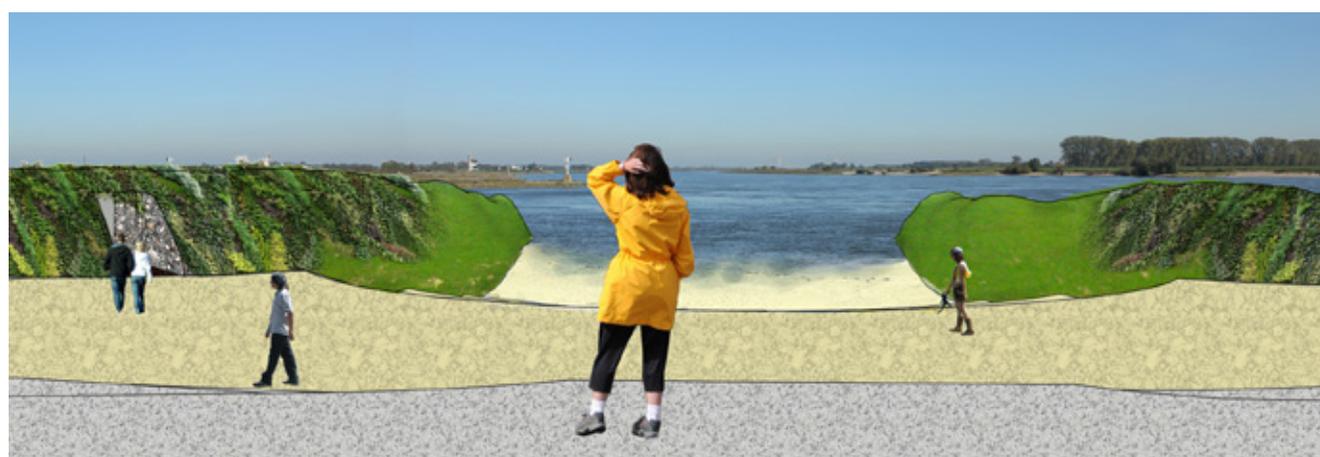
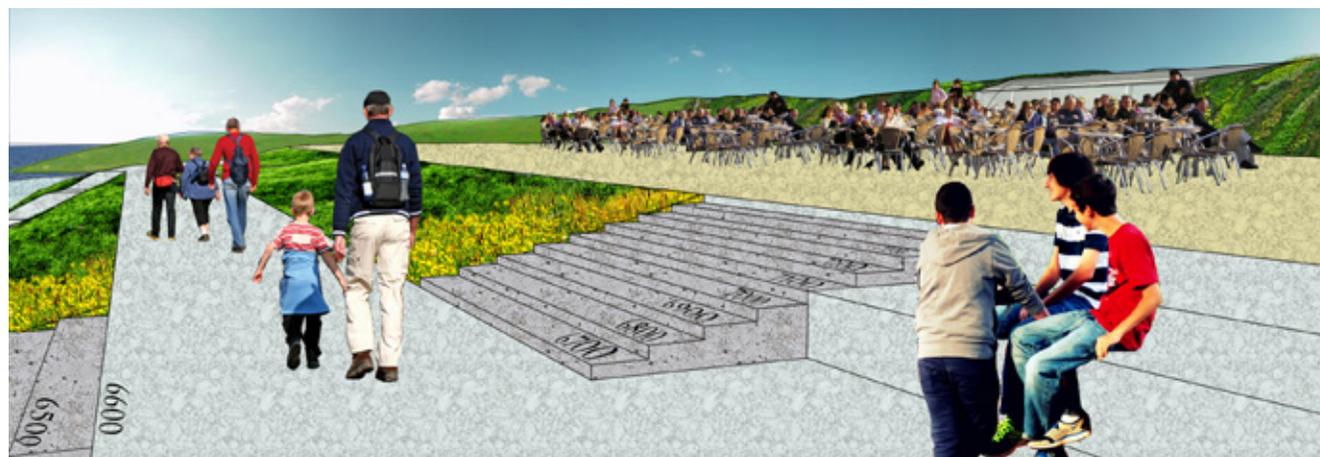
Vluchthaven plan

These two areas vary a lot in terms of heights and flexible sojourn spaces. The area brings people closer to the water and offers several possibilities for recreation.

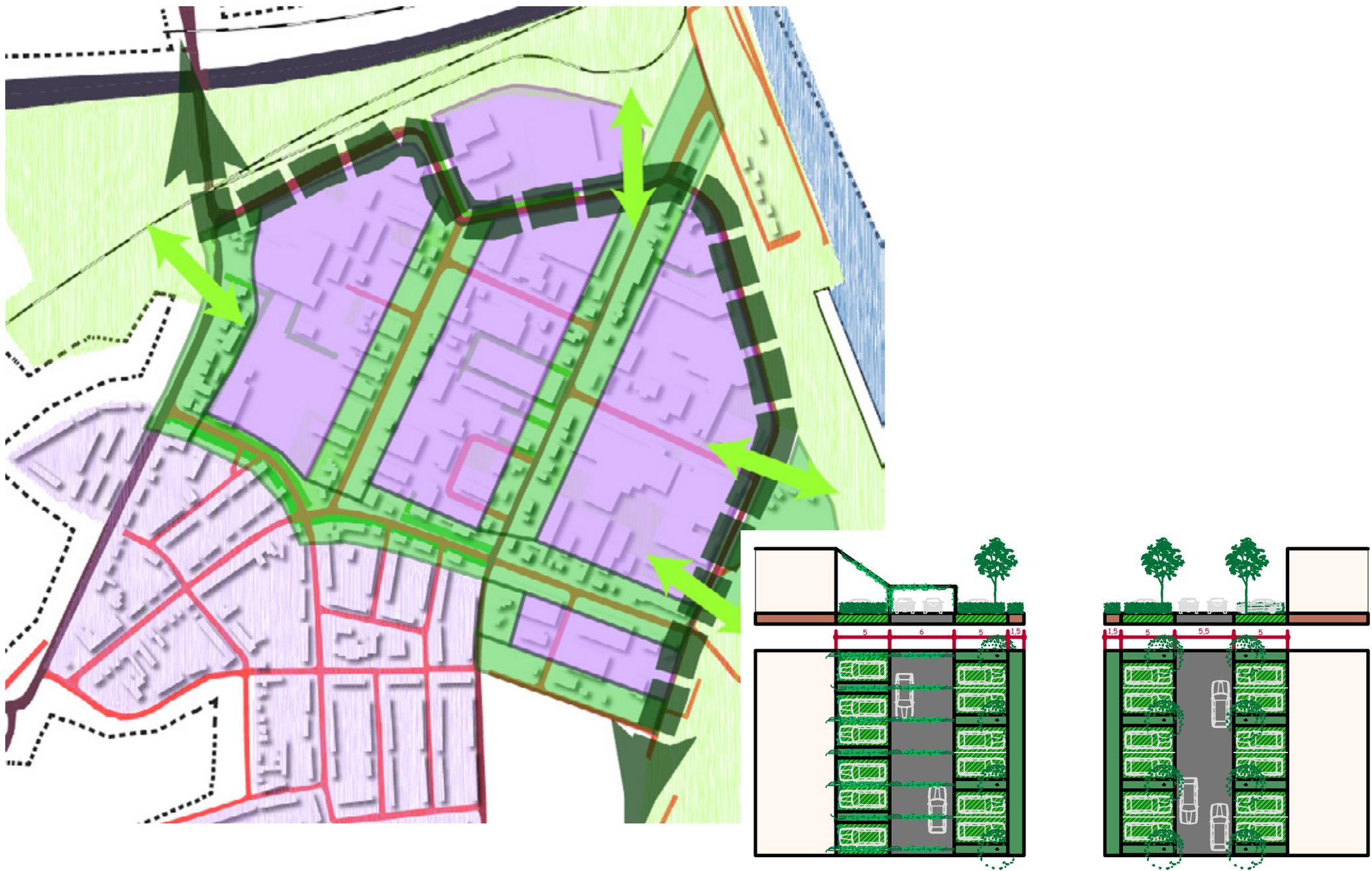
1. Green ring: forms a buffer against the heat of the major road as well as the south-western wind.
2. 'Water theatre': a large space for various activities.
3. A green hill with a café and terraces.
4. Wheelchair accesses.
5. Beach: access through stairs to the beach and the water. Because of the slower current, sand is deposited naturally at the beach.
6. 'Small dunes': block the south-western wind and offer a visual frame from the old city entrance to the water.



Impressions





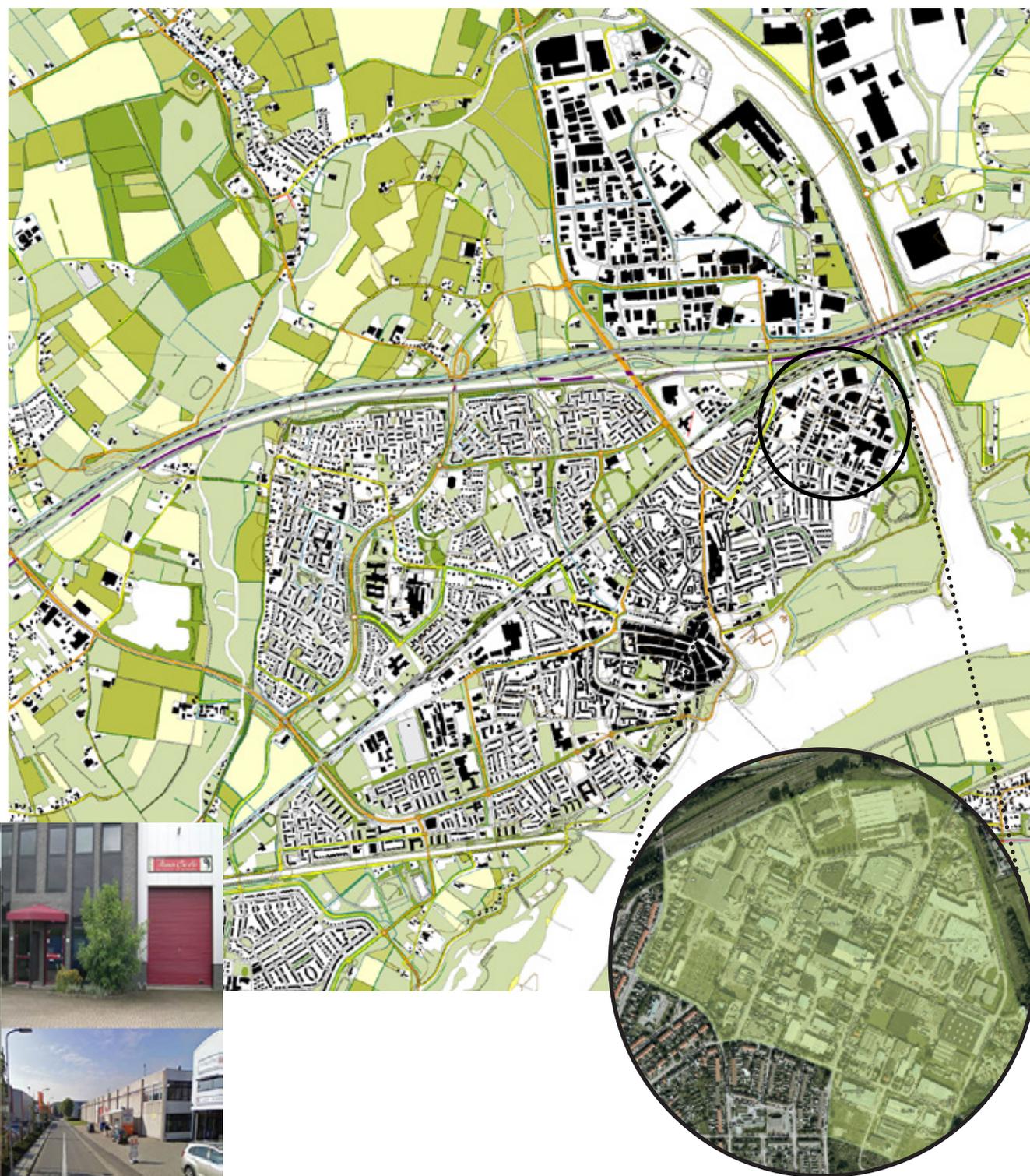


Latenstein's green
street profiles
Irina Hotkevica

Location

Latenstein is located at the eastern part of Tiel. The area is very diverse with residential, commercial and industrial buildings. Many people work and live here. The main streets are lined with houses, while businesses are located farther off.

Districts like Latenstein were common in the 19th and 20th century when people did not want to spend much time travelling to work. Nowadays, the businesses are scaling up and often move to other locations with bigger buildings. Besides the ones in use for industry and shops, relatively many buildings are vacant. People that don't want to leave the area occupy the houses, but there are no newcomers. There is little cohesion and a proper infrastructural organisation is lacking. Furthermore, the atmosphere seems somewhat deserted and unsafe. Latenstein thus knows many problems, a bad microclimate being one of them.



diverse and chaotic

Microclimatic analysis of the location



The microclimatic conditions of Latenstein are usually characterised by long-wave radiation, caused by the high building density and the large, paved surfaces of the streets. The influence of the wind is limited, as dikes and residential areas surround Latenstein, forming a wind barrier. The houses and direct surroundings suffer the most from negative microclimatic effects. In front of the houses there are streets; and behind them there are buildings and more streets. The situation is in urgent need of change. People live and work here. A possible solution is to make use of the cooling potentials of Latenstein, namely the green surroundings and the green areas between the buildings.

LEGEND

-  main wind direction
-  windbarrier
-  heat accumulation areas
-  heat stress areas
-  heat exchange

Functional principles

The microclimatic organisation principles are based on the use of the cooling potentials – the green surroundings and the green areas in the district itself. It is essential to preserve these greens and make them easily accessible to the residents. Entrances to green areas should also be preserved or created, so cool wind from these areas can enter Latenstein. The residential areas should be in the midst of green elements, such as green streets, trees and shrubs. These can reduce heat stress, by preventing long-wave radiation and anthropogenic heat.

Functionally, it is important to separate large commercial businesses and areas from small-scale businesses and houses. The map of the functional organisation of the area shows an example. It is also important for large transportation to gain easier access to the district, seeing to it that the access to the residential areas is limited (the green zone around Latenstein).



organisation concept

Street profile analysis

LEGEND

SUN/SHADOW

- built up
- summer shadow
- spring/autumn shadow
- winter shadow
- sunny areas

THERMAL ANALYSIS

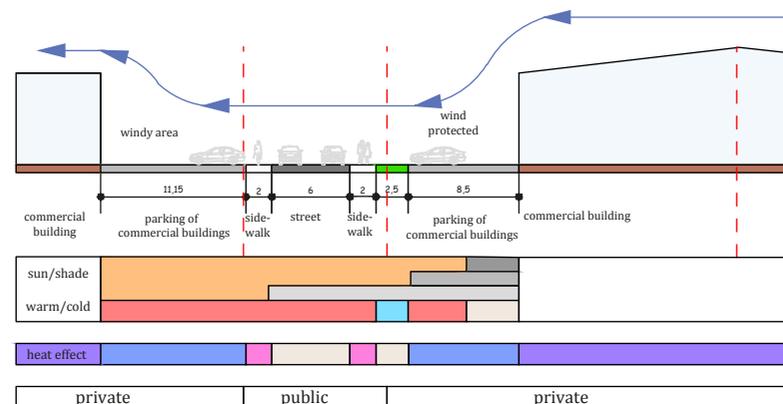
- built up
- cooling potential
- long wave radiation
- neutral areas

HEAT-EFFECT ANALYSIS

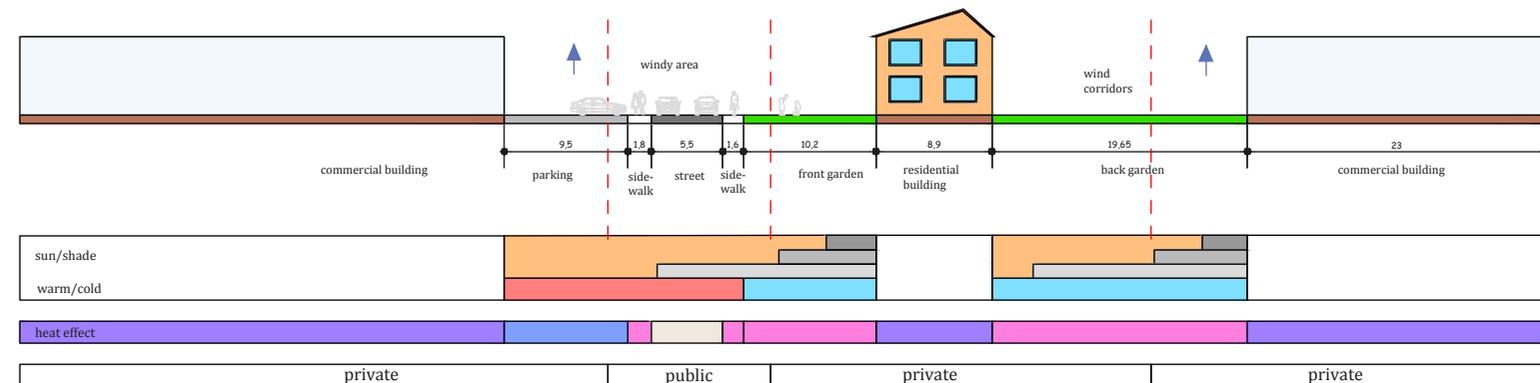
- built up
- recreation area with heat problems
- air pollution problems from car traffic
- neutral

OTHER

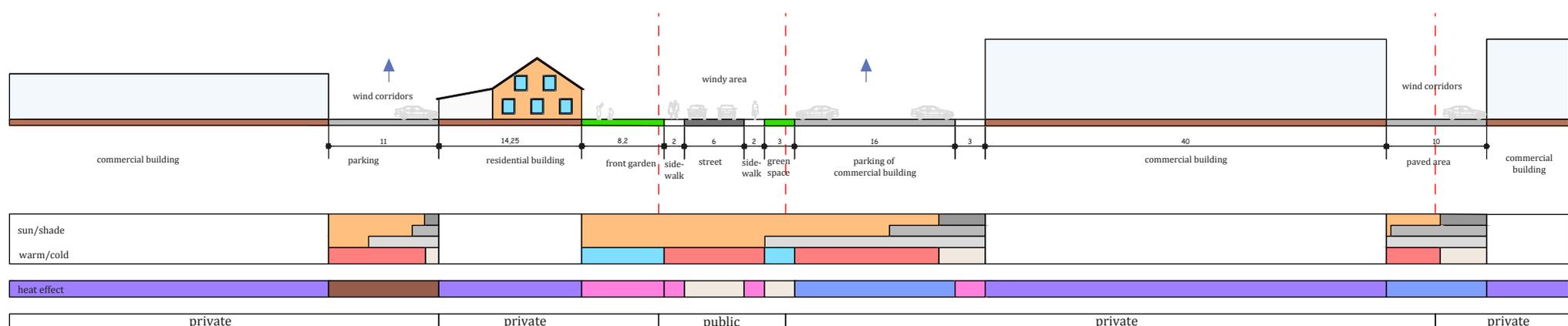
- prevailing wind direction
- plot boundary



NW/SE oriented street



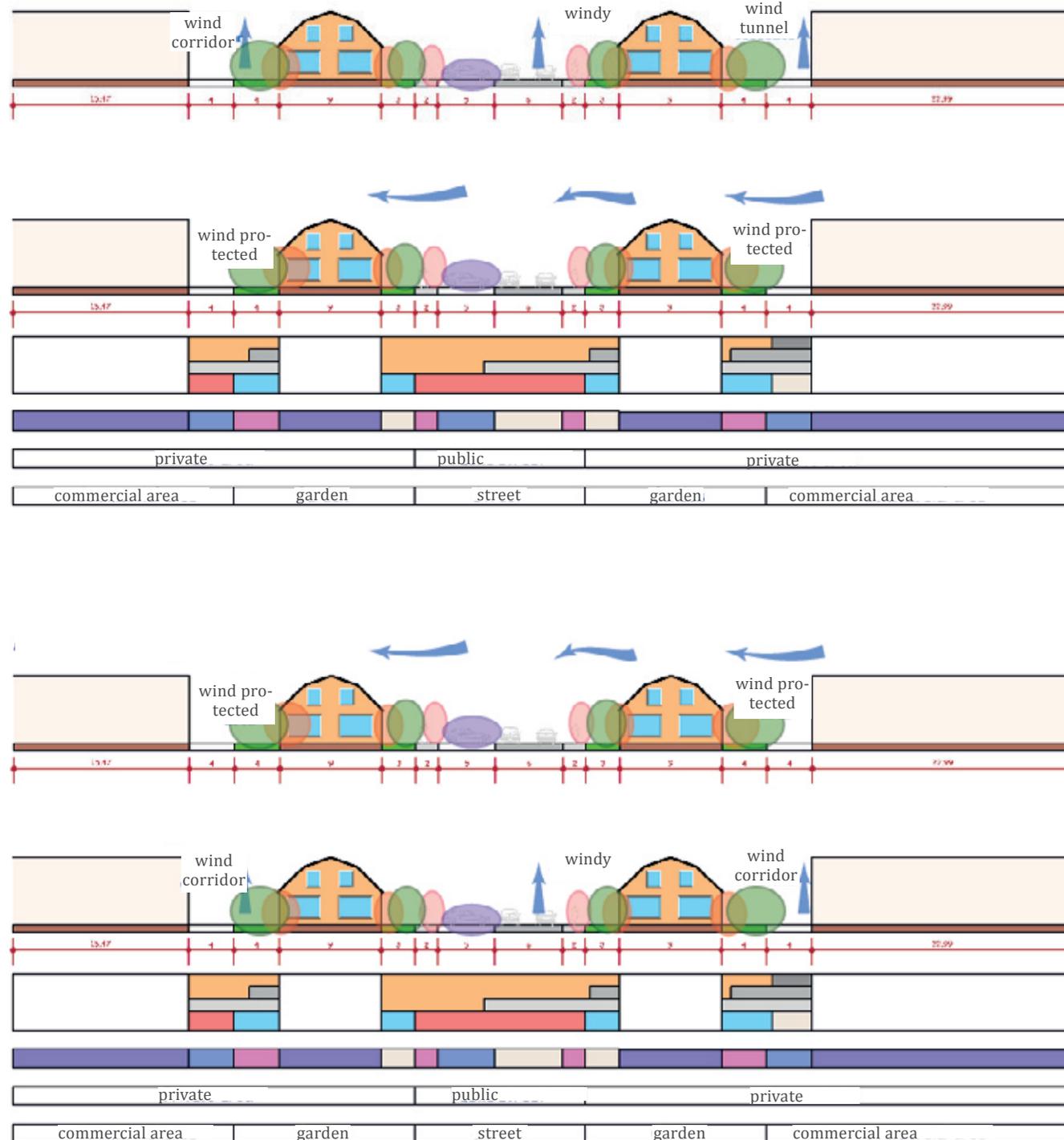
SW/NE oriented street without parking



SW/NE oriented street with parking

In order to make specific recommendations for improving the microclimate in Latenstein, we analysed the street profiles. We looked at street profiles of several locations in the district from different perspectives: sun and shadow; heat accumulation and potential for cooling; and who (or what) suffers from the produced heat and on what location. This analysis helps to gain a better understanding of the situation in Latenstein and ways to improve its microclimate. A few examples of analyses are shown here.

Microclimatological conclusions



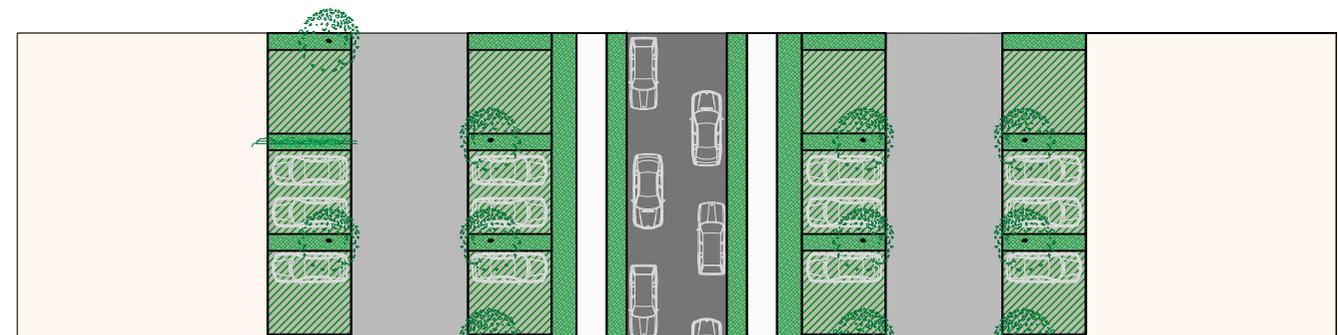
To offer relevant solutions, we looked at two common street profiles in Latenstein: a street with large parking spaces for large-scale commercial locations, and a street with houses and businesses at the back of the parcels. For two of these, conclusions were based on the direction of the wind.

LEGEND

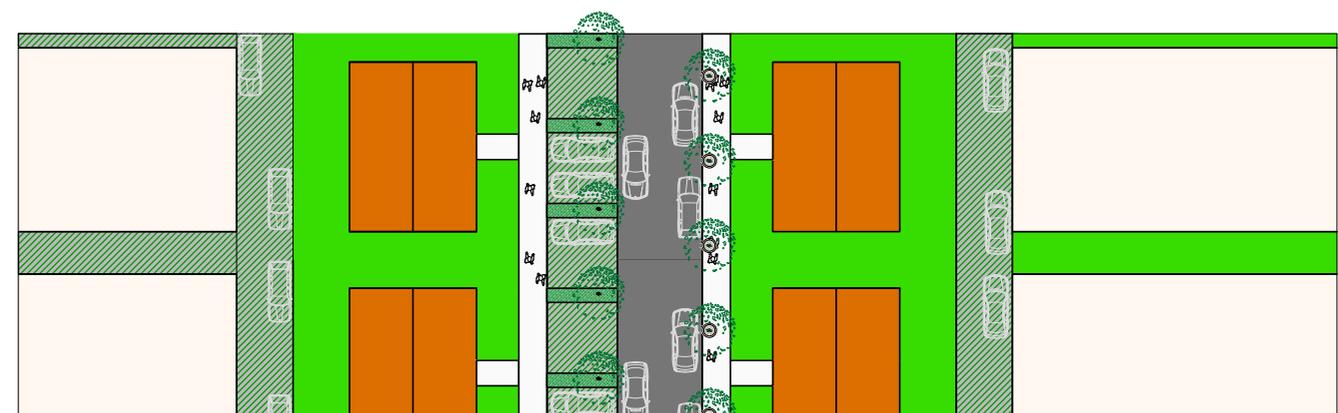
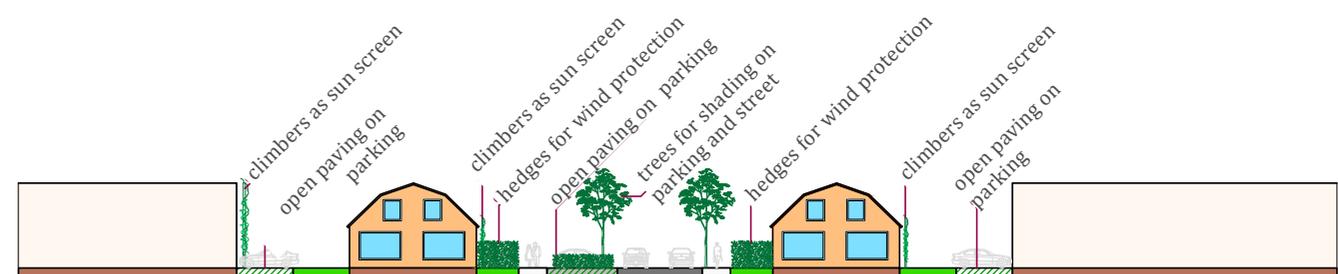
-  main wind direction
-  locations with heat stress indoors
-  locations with heat stress for pedestrians
-  locations with heat problems for parked cars
-  locations with cooling potential

Ideal street profiles

Based on the conclusions from the street profile analyses, ideal street profiles were designed. In these profiles the pedestrian paths are separated from other traffic, solutions are given for parking, and locations for planting are indicated. Trees, hedges and awnings provide shade in the streets and for houses, thus reducing urban heat.

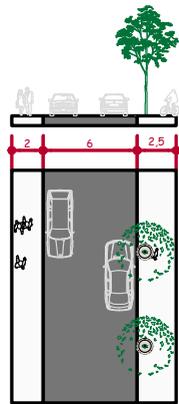


Ideal street profile

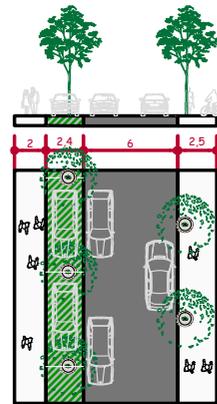


Ideal street profile

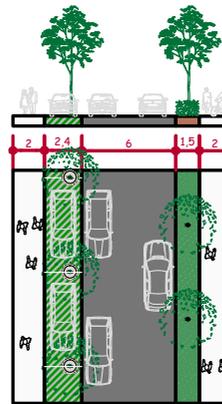
Solutions for various street widths



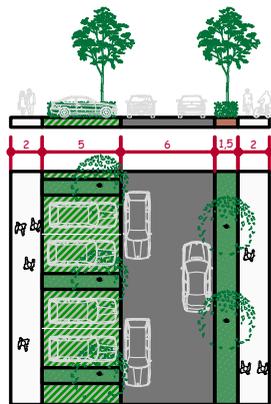
10.5m width



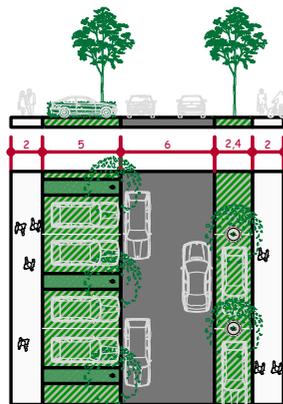
12.9m width



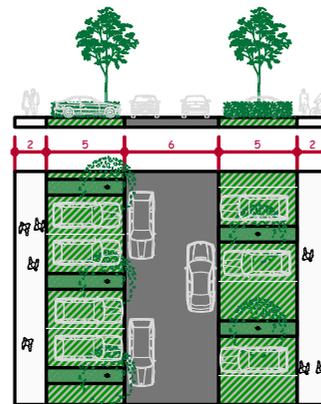
13.9m width



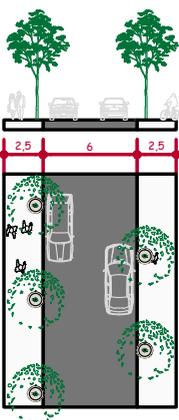
16.5m width



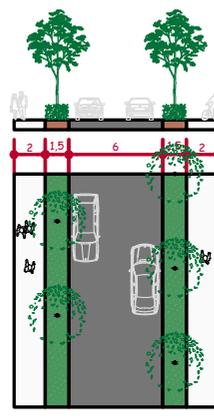
17.4m width



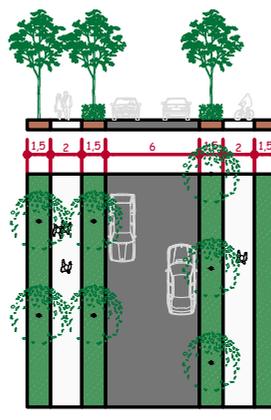
20m width



11m width



13m width



16m width

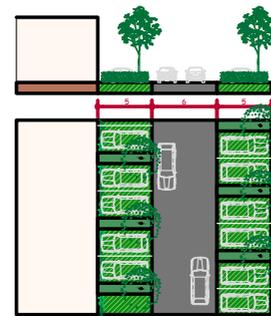
ideal street profiles
private/street/private

ideal street profiles
commercial/street/commercial

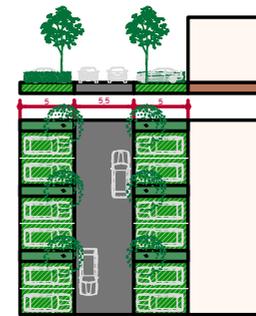
Unfortunately, not all streets offer sufficient space to construct an ideal street profile. To optimise the circumstances in existing situations, various solutions were offered for different street widths. In all street profiles provision of shade and the separation between pedestrians and other traffic are required.

Parking solutions

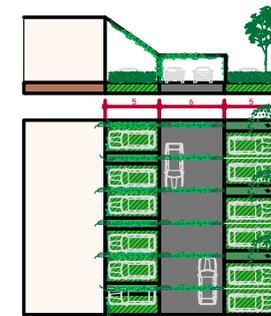
Not only the street widths can differ- also the size of the parking lots can differ. The most important requirements in this respect are the realization of proper separations between parking space and the road, the use of open pavement and shadow casting elements. Shelterbelts are planted in areas where wind can cause nuisance on large parking lots.



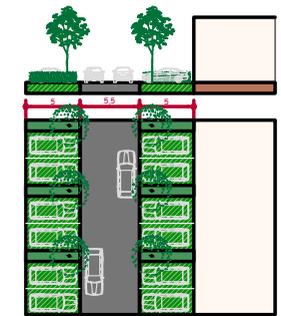
16m parking on sunny side



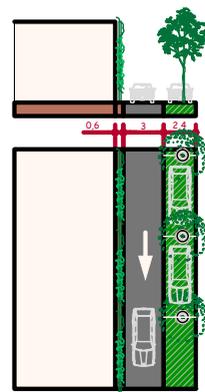
16m parking on shady side



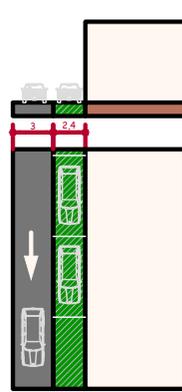
16m parking on sunny side



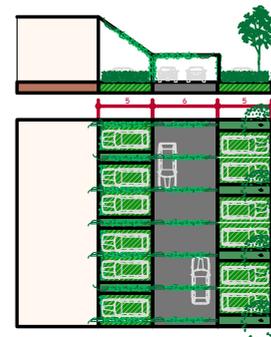
16m parking on shady side



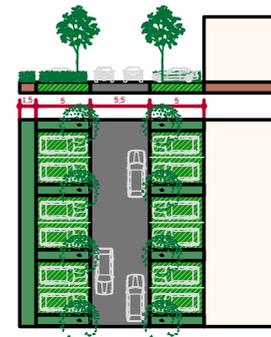
6m parking on sunny side



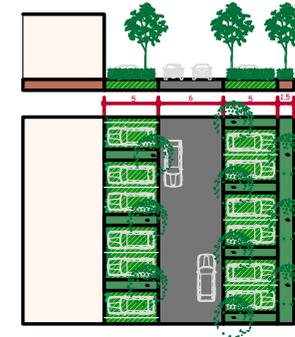
5.4m parking on shady side



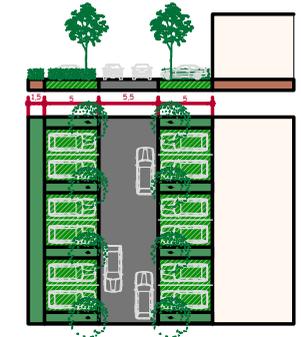
17.5m parking on sunny side



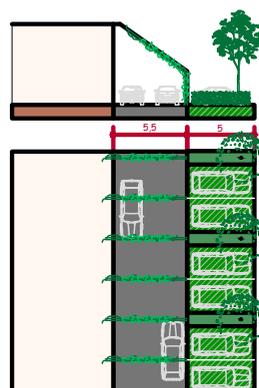
17.5m parking on shady side



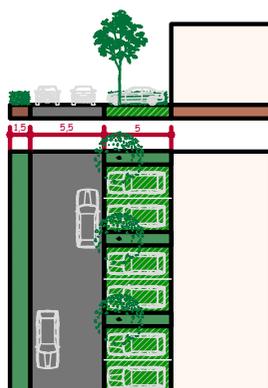
17.5m parking on sunny side



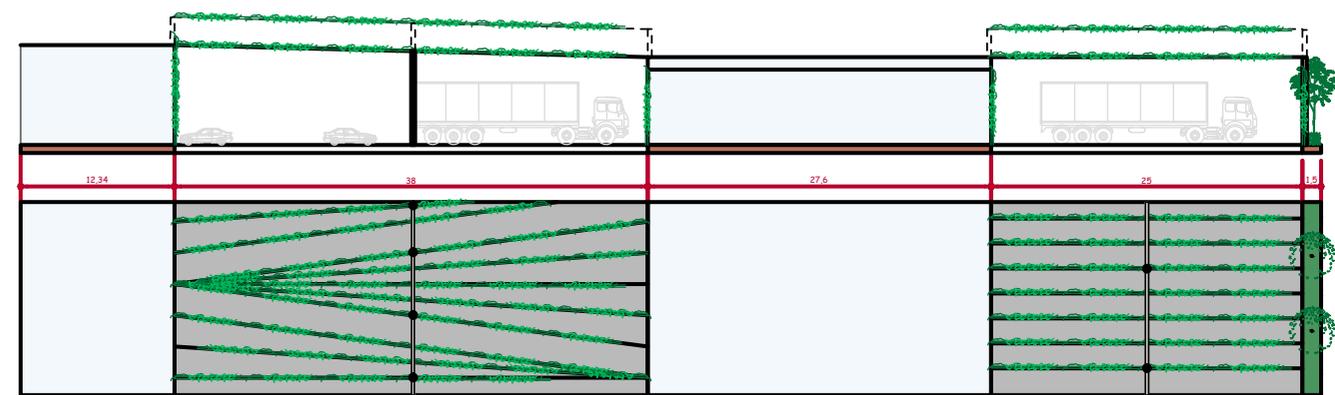
17.5m parking on shady side



10.5m parking on sunny side



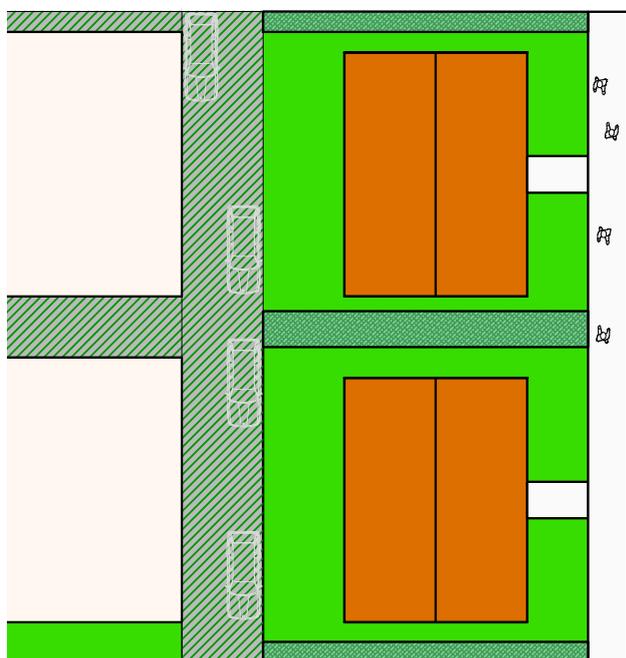
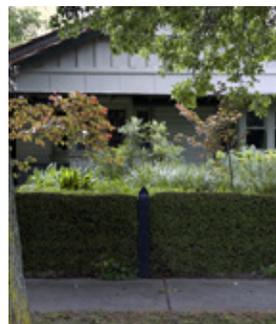
12m parking on shady side

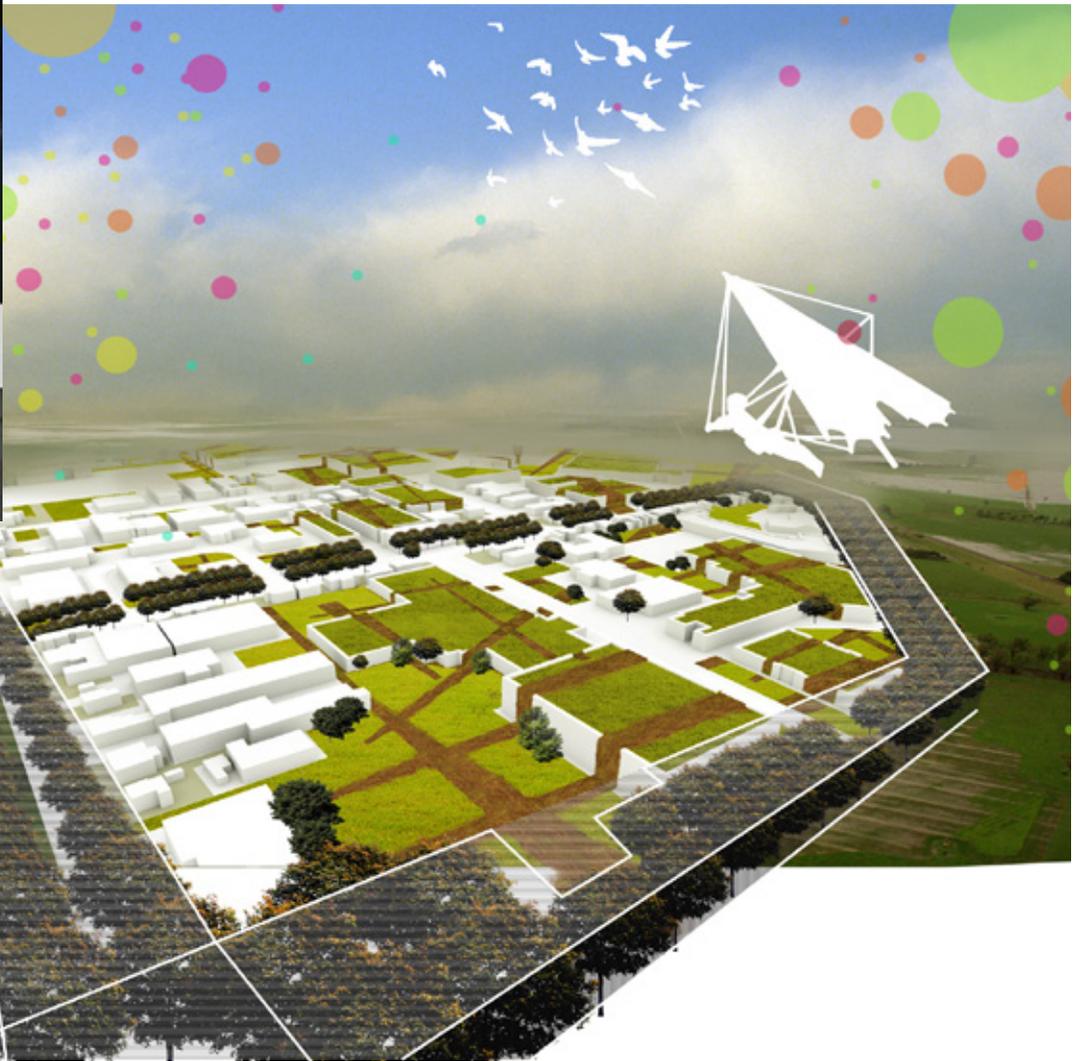


green canopy above commercial logistics areas

Recommendations for houses and gardens

The residential areas in Latenstein have no specific design guidelines for improving the urban climate. These areas do, however, need guidelines for the public spaces in order to create a stronger coherence in the area. The illustrations show reference images of which types of hedges and wind barriers, shade constructions and sunshades, and green paving are suitable for Latenstein.





green and water in Latenstein
Darius Reznek

Introduction

The chosen area is in the Latenstein district (fig. 1). This neighbourhood is interesting for several reasons. It is a unique mix of light industry, commercial areas and residential areas, in an intricate pattern developed over decades (Fig. 2). The area suffers from several climate issues. There is a high risk of seepage nuisance and the area suffers from the 'urban heat island effect'.

The area is dominated by commercial and light industrial activities, combined with residential areas and storage buildings along the main routes (Fig. 2). There is not enough green space, resulting in problems with the microclimate (Fig. 3).



Fig. 1 Location



Fig. 2 Land use



Fig. 3 existing green plots



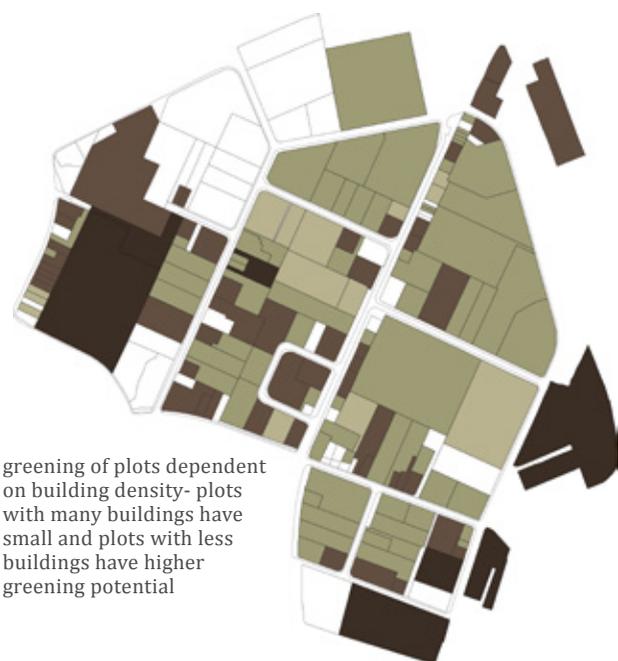
changing into green plots as soon as possible and no further paving

Fig 4.1 open plots



Plots that are for sale or developments are planned need to be greened more in the future

Fig. 4.2 Plots in transition



greening of plots dependent on building density- plots with many buildings have small and plots with less buildings have higher greening potential

Fig. 4.3 occupied plots



Fig. 4.3.1 Built-up area

What also makes this area so interesting, apart from the climate issues, are the transitions taking place here. From this viewpoint, different types of parcels can be identified (Fig. 4). First, there are the free parcels (Fig. 4.1), with a large potential for change. Second, there are the parcels that are in transition. These offer chances, for example because they're on sale or new developments are planned for them (Fig. 4.2). Finally, there are the occupied parcels (Fig. 4,3), which in their turn can be subdivided according to building density (Fig. 4.3.1). This division is necessary to be able to determine where chances lie for developments and measures, and which areas can be the backbone for future development strategies.

Process of change

Cooling potentials

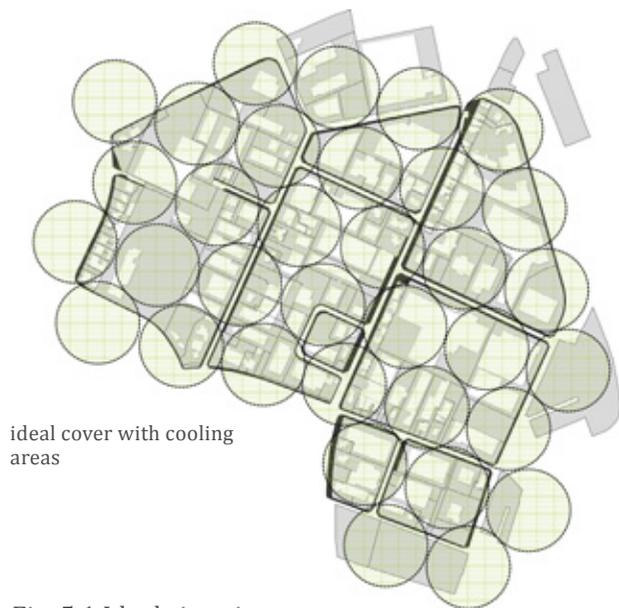


Fig. 5.1 Ideal situation

warmest areas

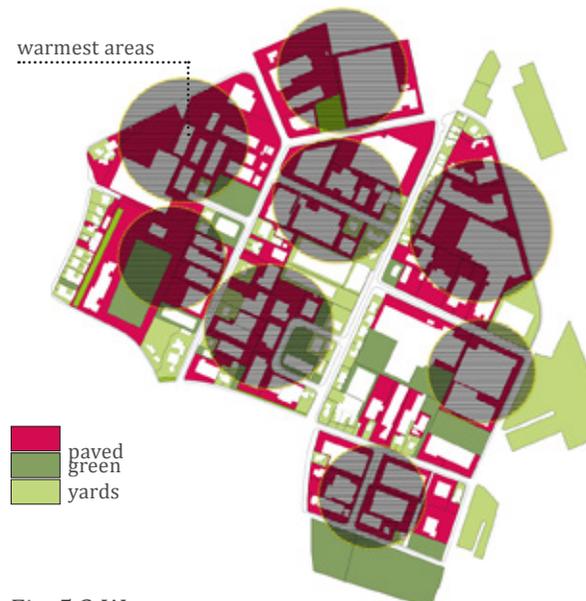


Fig. 5.2 Warmest areas

Water problems

problem areas stormwater

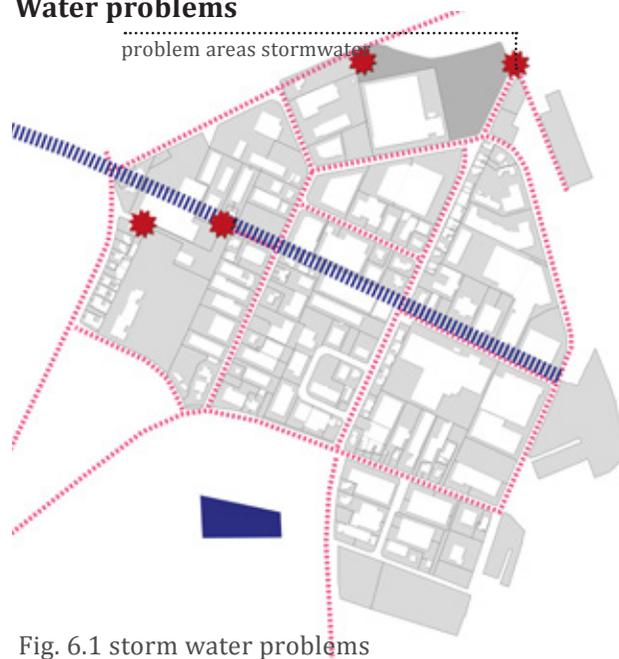


Fig. 6.1 storm water problems

high ground water

sandy soils

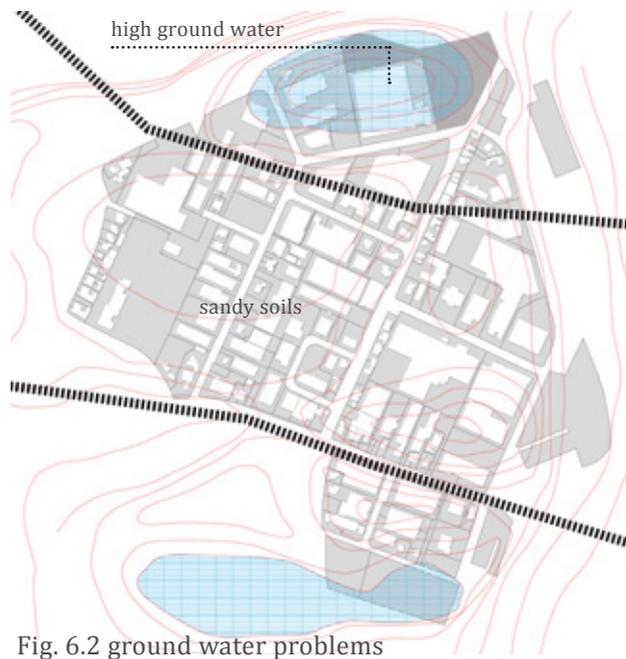


Fig. 6.2 ground water problems

interventions



Fig. 6.3 problem areas

Problems

As described in the introduction, the area has two large problems, each in need of specific solutions. I target these problems simultaneously, to offer robust solutions.

To cool the urban climate, you need green areas to be spread evenly (Fig. 5.1). The areas with the highest demand for cooling can mostly be found in the commercial zones (Fig. 5.2).

The water problem in this area is twofold (Fig. 6). Firstly, there is an issue of peak precipitation (Fig. 6.1). Secondly, there are problems with the groundwater (FIG. 6.2).

These problems are dealt with gradually (Fig. 7). In the first phase, the free parcels are transformed into green areas. The same happens to the transitional parcels when the opportunity arises. The parcels with a low building density are transformed in the next phase.

Then retention basins are created within the network of greens in the areas with ground water problems. In those areas where the potential for cooling through greens on ground level is low, green roofs and facades are used.



Fig. 7

Masterplan

With the right management, the area can become a 'patchwork' of green spaces, spread over the area and connected through clear lines over the landscape. These lines are meant to evoke images of drainage in the polders, and to connect elements on the surface level with those on the roofs and facades. In this way, all parts of the 'patchwork' are connected (Fig. 8).

Linear retention basins are integrated in the green line structure. This turns these areas into dynamic landscapes integrating the water, instead of keeping it at bay (Fig. 8.1).

This combination of green areas, roofs and facades offers a solution to the current heat problems, and also to future global warming. The network ensures a cool and comfortable area.

The water problem is dealt with a system that accommodates both current surpluses as well as predicted future precipitation levels. When necessary, the system can be adjusted and expanded throughout the area, to create a robust water system.



Fig. 8 Normal situation

Energy opportunities



Fig. 8.1 Peak rain situation

The changes in the area offer a chance for the urban climate, but also for new forms of energy use – especially with the current political policy of the municipality of Tiel, where this theme is highly prioritised. There is potential for production as well as savings. The large roof surfaces in the commercial areas can be used for solar panels. In combination with a green roof, an even higher energy production of the solar panels can be realised.

Energy can be saved through the introduction of new functions that can add to integrated energy systems. The planned supermarket in the north of the area, for instance, will produce excess heat in the summer, which can be used to heat a swimming pool in the neighbourhood. This won't just contribute to a more efficient use of energy, but will also make the area livelier. In winter, the swimming pool can serve as a skating rink, and in its turn the excess heat produced with the freezing can be used to heat the supermarket. (Fig. 9).



Fig. 9

Thermal comfort

The patchwork of green spaces combined with the water retention basins will solve the water and heat issues in the area (Fig. 10). But to make the area more pleasurable for the users of the public spaces, another problem needs to be solved: the lack of spaces for employees to recreate or have their breaks.

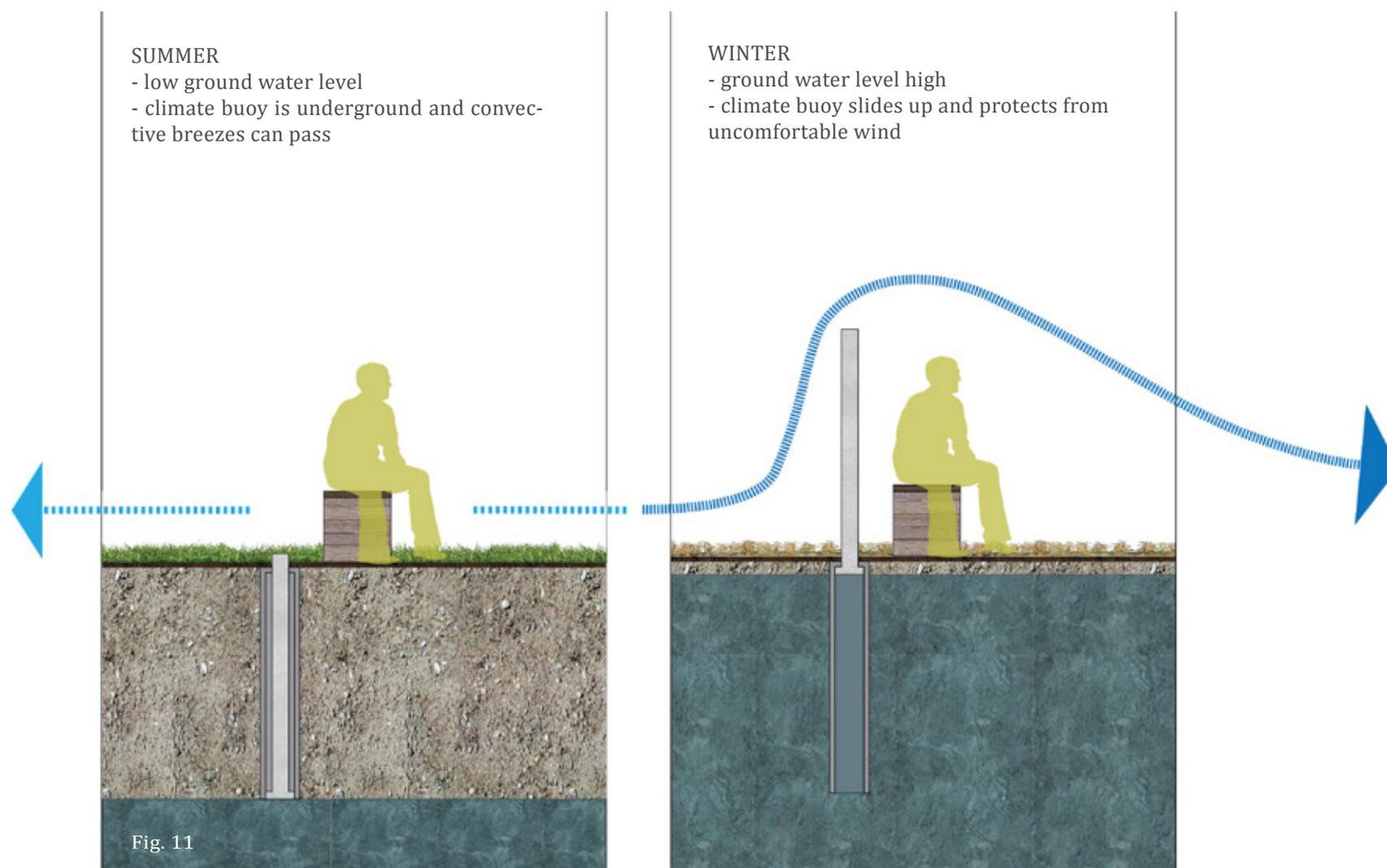
To this end, parts of the hard surfaces are transformed into green recreation areas.



Fig. 10 Bird's eye view

Climate buoy

To ensure a pleasant microclimate in these recreation areas during the cooler seasons with more south-western winds, the 'climate buoy' was conceived of. This 'climate buoy' 'floats' on the ground water and rises in the cooler seasons, when there is a lot of unpleasant wind. The 'buoy' consists of a light pillar slid in a cylinder. Groups of lines of these 'climate buoys' then form a wall offering shelter from the wind (Fig. 11).



Opportunities

The concept of the 'climate buoy' makes use of these predictable variations, and allows a flexible design approach for public greens.

Adding small clusters of pillars showing the daily and seasonal variations of the ground water level would add to the educational values of the climate buoys. The concept can also have a day/night dynamic, if you let it function as a light feature in the public space (for instance at the proposed swimming pool or skating rink).



Situation during a summer night

- Ground water level is low.
- Climate buoy is hidden and allows ventilation.
- Option to incorporate light features in the buoys, thus having them be a part of the outdoor furniture or as possible objects of art.



Situation during a winter day

- Ground water level is high.
- The climate buoy comes up and offers shelter from the cold south-western winds.
- Possibility to show educational elements explaining the water level.



Bleekveld in 2011



Bleekveld in 1900

Bleekveld in the future

alternative design Bleekveld
Xiaolu Hu

Context

Bleekveld is in the southern part of the old city centre of Tiel. It is predominantly used for parking. There nothing special here and there aren't any activities. The area has a lot of wind nuisance and average heat stress. The microclimate on this location is thus open to improvement. The area also shows a lot of potential for recreational functions. It is located next to the old city canal and there are plans for the realisation of a centre for culture and living, the Westluidense Poort (WLP) plan.

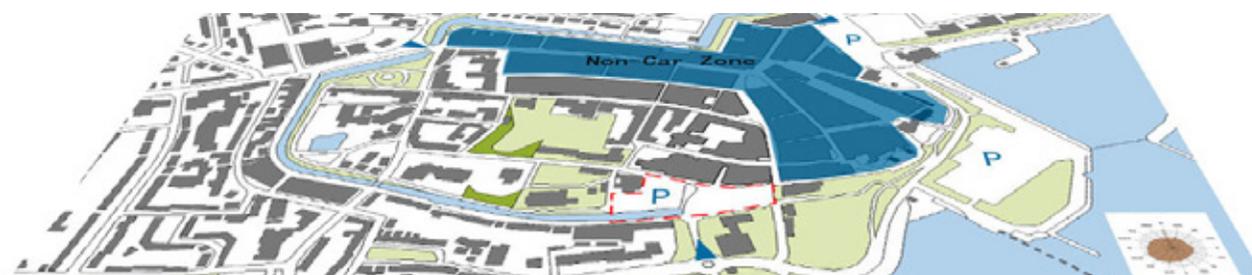
In this WLP plan, Bleekveld changes into a residential area with 8087 m² of apartments in six buildings of 12 to 18 meters height. In the south of the area a cultural cluster will arise, enhancing the cultural and public services in Tiel. On the down side, the new constructions will entail shade problems. Therefore, an alternative plan was made.



Location in Tiel



Location on climate map



Bleekveld within the traffic system



Bleekveld within the green structure



Collage of WLP Plan (Vrolijk, JM. 2010)



prevailing wind in the area



Wind- and shadow analysis



climate responsive interventions

According to the climate map and the analysis of the location, Bleekveld has climatic problems. In summer, the cooling breeze from the river can only enter the area through the small gap in the dike. While in the winter, people stay indoors due to the south-western winds and the fact that there are no outside activities.

Recommendations:

1. Make a 'green canal' in line with the existing canal, which can form a wind corridor.
2. Use water fountains in the grass to cool the warm summer air.
3. Build 'sun terraced' apartment buildings that also act as wind barriers to create wind-free areas for activities.



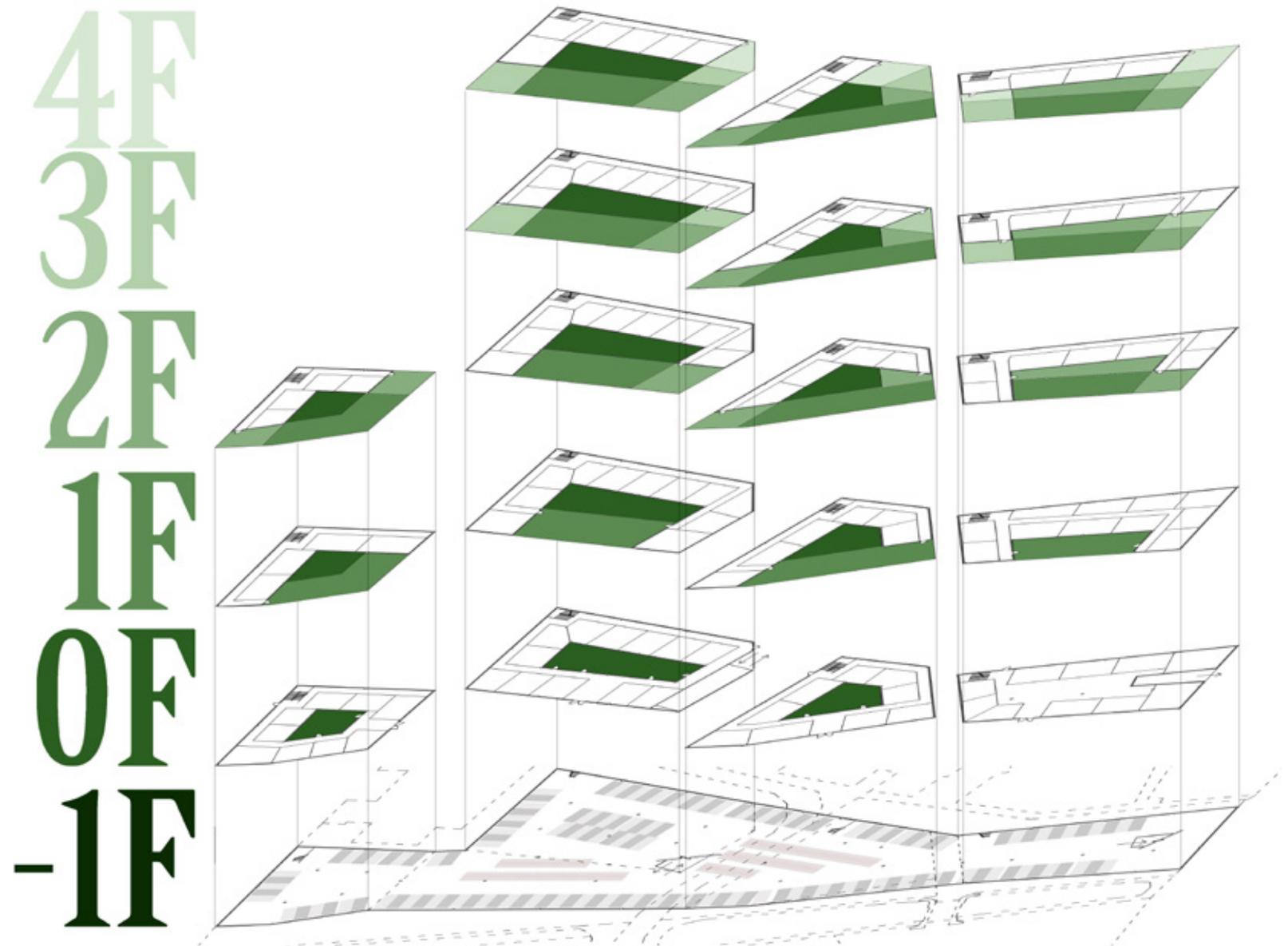
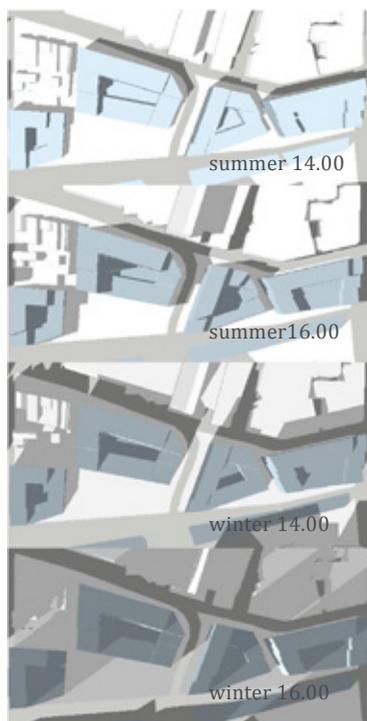
Climate proof

Design Concepts

Open to sunlight
Block the winter wind
Green roof for cooling

Design Programme

Roof gardens: 2211m²
Apartments: 8502 m²
Underground parking: 182 cars
& 309 bicycles



design apartment buildings



LIVABILITY CONCEPTS: Place Diagram (PPS, 2011)

How can Bleekveld be transformed from an empty space without an identity into a place full of life? We use the 'Place Diagram' of PPS (2011) to consider four aspects for this location.

Based on the 'Place Diagram' the following aspects are incorporated in the climate-proof design:

1. Ensure proper accessibility.
2. Introduce different recreational activities.
3. Combine historical and future images into new pleasant visions.
4. Based on the climate-improving concepts and other functions on the location, create some inviting places with seating for people to repose, and to make Bleekveld nicer.



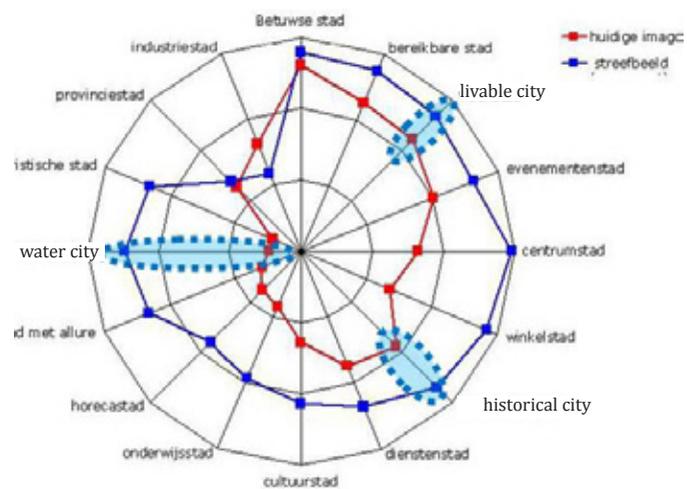
access and entrances



connections

Livability

Based on the ideal image of the municipality of Tiel, we combined the image of the water city, the liveable city and the historic city of Tiel for Bleekveld. The design therefore provides for: fountains in the grass where children can play; floating tree-trunks to tell the history of the transport on the canal; and allotment gardens for the inhabitants.



strengths and weaknesses in development vision (Gemeente Tiel, 2007)



Recreation along the canal



In the past, the canal was used for floating timber (Gemeente Tiel, 2009)

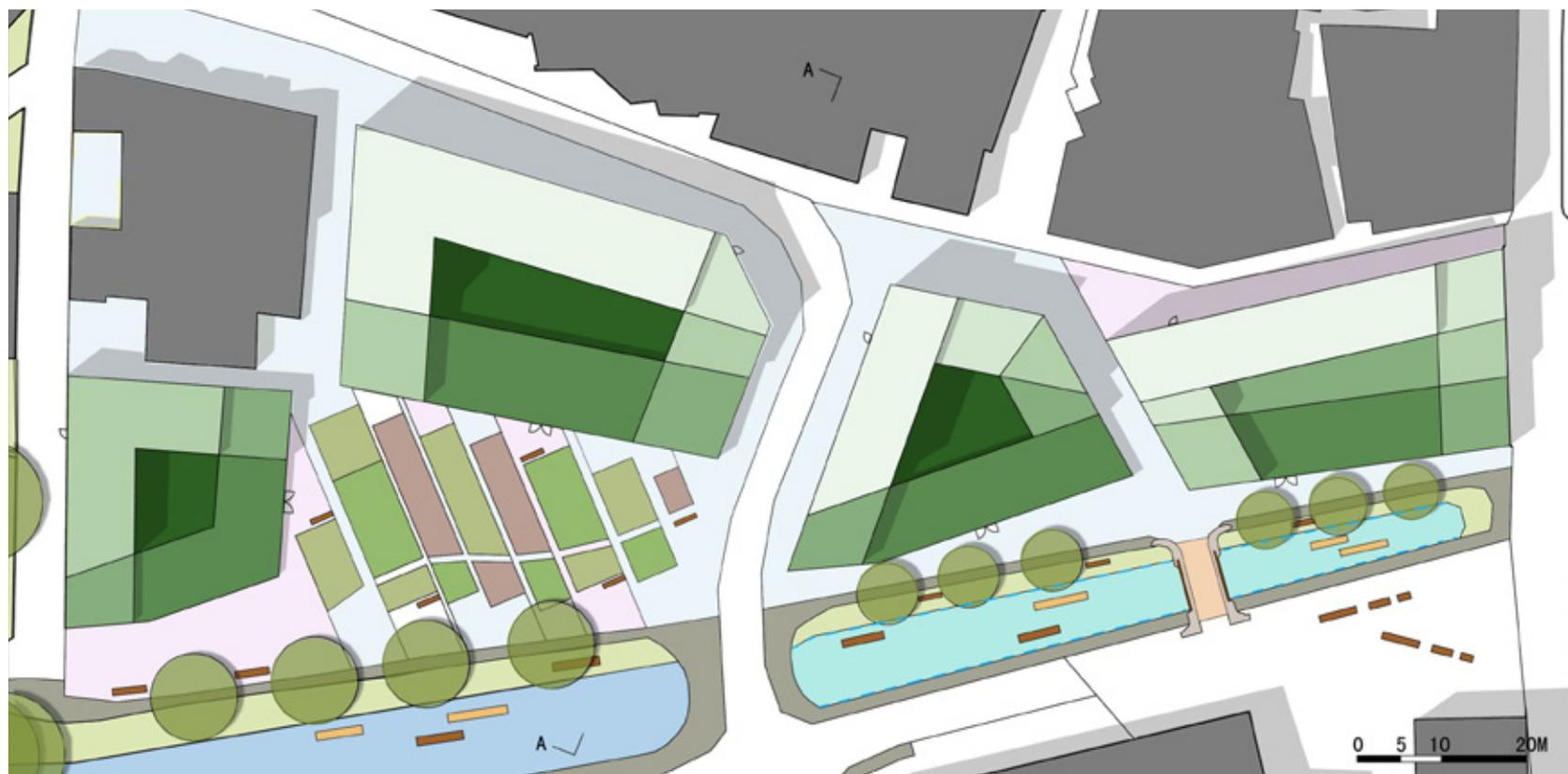


playing with water



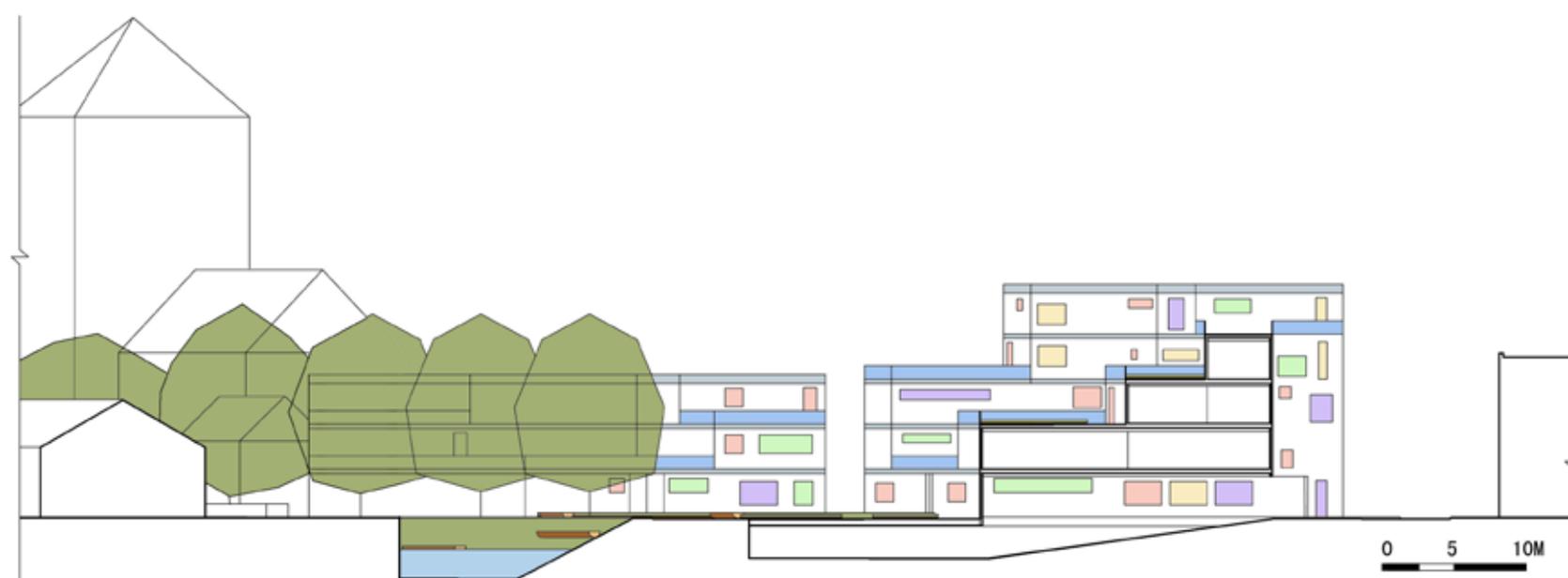
urban agriculture

Masterplan



LEGEND MASTERPLAN

- allotment gardens
- tree trunk benches
- bridge
- water nozzles
- roof gardens



section A-A



green interventions
'Hovenierstraat' and environs
Yi Shan

Analysis

STUDY AREA

The chosen location is a residential area. The centre is south of it.



LEGEND

- main access
- local access
- canal

WIND ANALYSIS

Many buildings at the edge of the study area are blocking the wind.



SHADE ANALYSIS



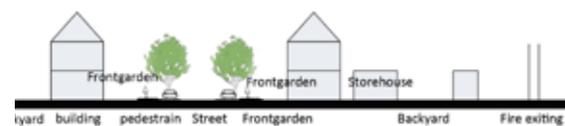
Neighbourhood types

CATEGORY 1: HOUSE WITH FRONT AND BACKGARDEN



Advantages:

1. "green cooling" due to front- and backyard gardens
2. proper ventilation because of large distance between houses



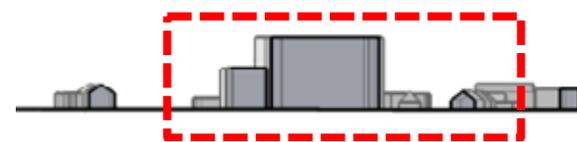
The apartment blocks are categorised into five types according to their shape and location. Some climate issues were observed in categories 2 and 3.

CATEGORY 2: APARTMENT FLATS



Problems:

1. high apartment flats hinder sun access for surroundings
2. much anthropogenic heat
3. apartments are inhabited by elderly people with vulnerable health conditions



CATEGORY 4: BACKYARDS AND PARKING LOTS



- parking
- rear garden
- buildings



CATEGORY 3: TERRACE HOUSES WITH PARKING



Problems

1. building density too high
2. no green in the area
3. parking lots occupy too much space

- yards with garage boxes
- Terrace houses



CATEGORY 5: AT THE CANAL



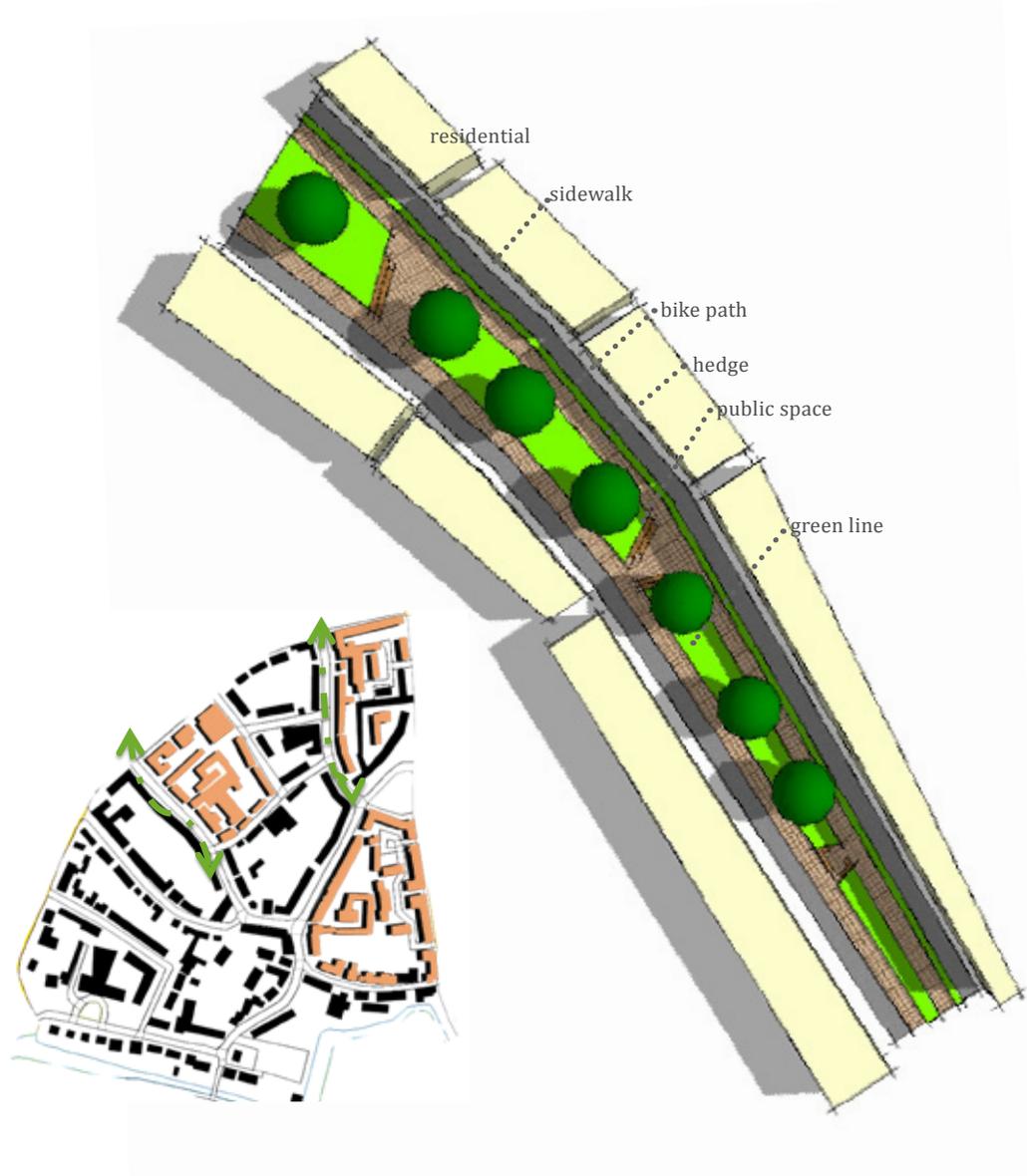
Advantage:

houses at the canal have large front and rear gardens

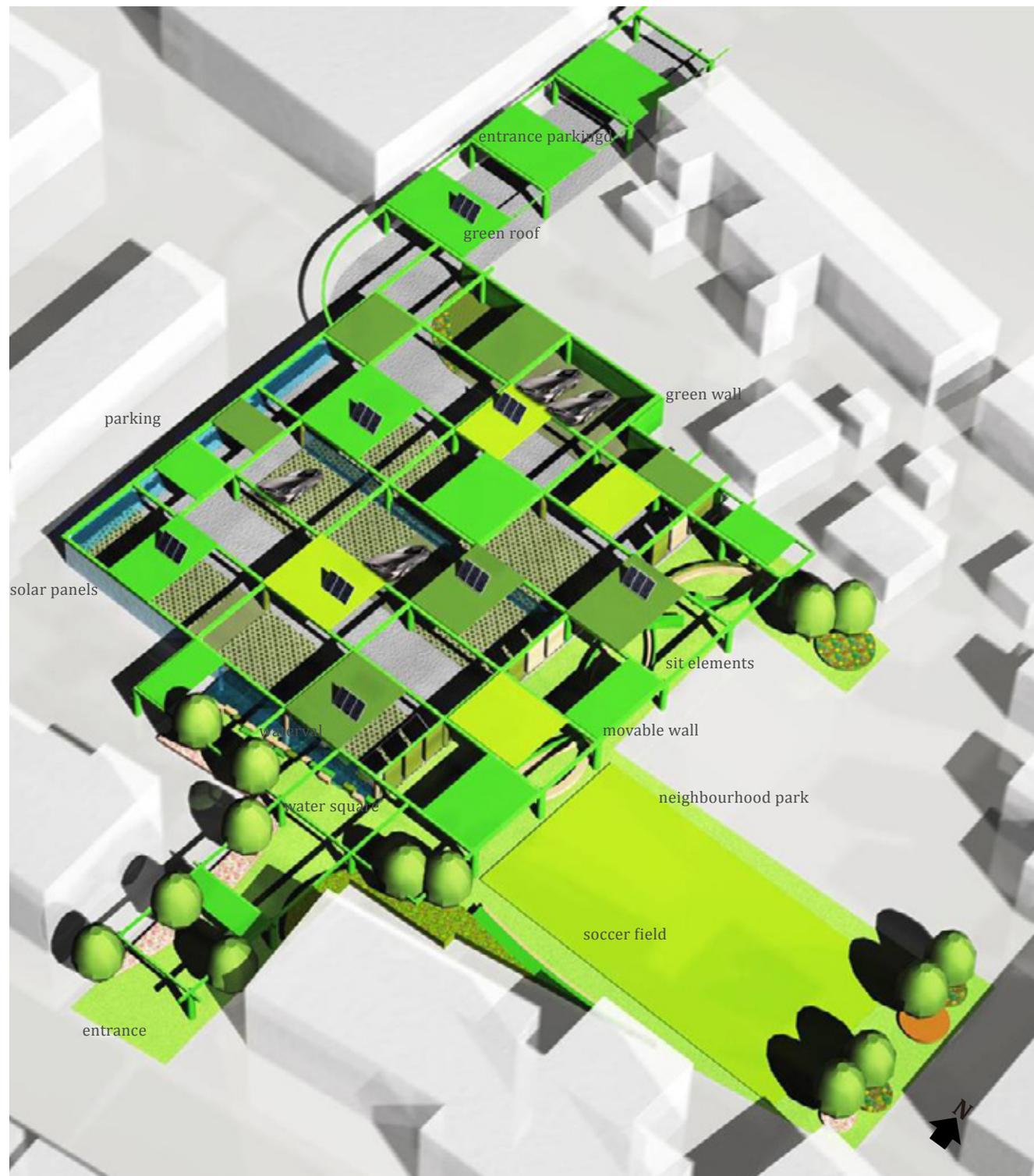


Car-free access

In some places, the combination of green in the streets and barring motorised vehicles can result in a cooler environment and an improved liveability. Therefore, a few streets will be accessible for pedestrians and cyclists only. This intervention has relatively small consequences for the flow of traffic, as shown on the map below left. With these measures, green spaces in the neighbourhood increase. On top of that, it will be a safer environment for the residents.



Cool parking



The photographs below show the current situation. These days, there are no gardens behind the houses, only garages. In the design, a combination of a neighbourhood park and a green, cooling parking zone is suggested.



Location existing parking lots

Cool parking

The current space available for parking will probably have to be expanded in the future. If this situation occurs, part of the neighbourhood park can be transformed into green parking spaces.

This would not interfere with the existing infrastructure and planting, as can be seen in the phasing maps on the left.

Were the number of cars to be reduced, the parking spaces could also be transformed into a neighbourhood park.



phase 1



phase 2



phase 3



Sitting areas

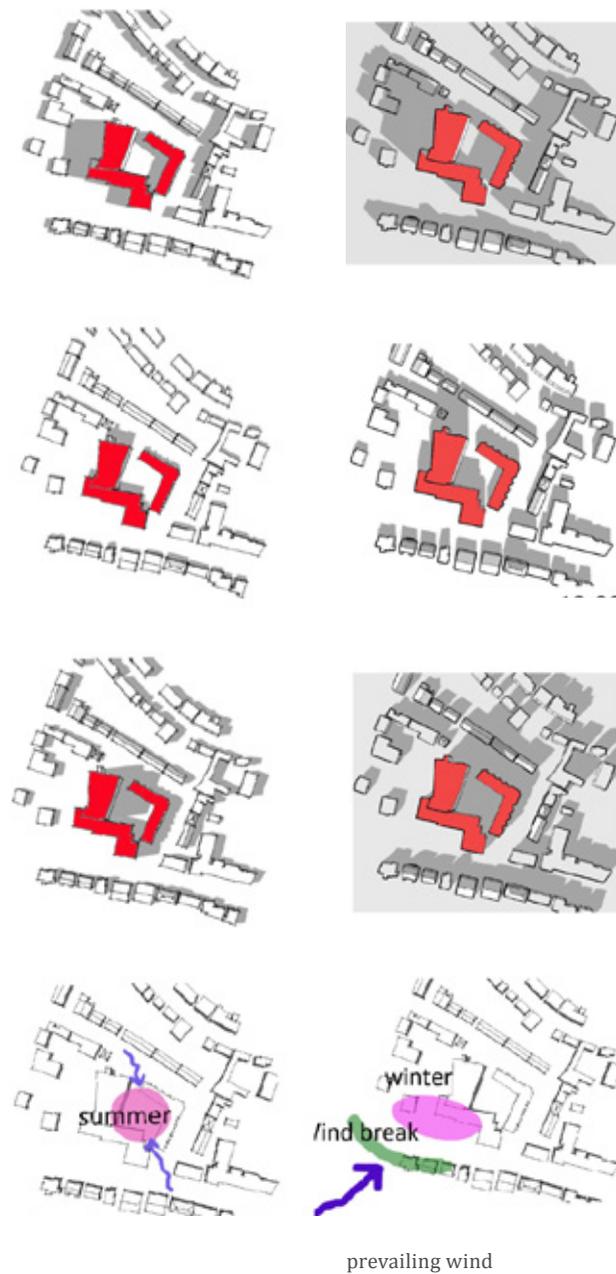


Water wall

Apartment complex

SHADOW IN SUMMER

SHADOW IN WINTER



1. Change the roofs of the high-rise blocks of flats into stepped roofs, so they don't cast too much shadow.
2. Add a storey in the east to compensate for the loss of housing space.
3. Create a wind barrier against the south-western wind.
4. Raise the ground level to create more wind in the summer outdoor areas.



Bird's eye view

Apartment complex

Outdoor areas in summer

A large surface of grass and trees will provide for cooling in the summer. Trees are planted next to benches to provide shade. Next to the path, I propose a pergola for extra shading. The seating elements have a curved shape to offer space for people in wheelchairs or with rollators.



Area for outdoor sports in winter

Behind the seating units, tall vegetation is planted to block the wind in the winter. Gymnastic equipment and badminton courts are planned for this area. Elderly people can enjoy the sun in the sun lounge, even on the coldest days.





restructuring Hertogenwijk
Ioana Nica

Location and characteristics

Introduction

In this part I give a concise explanation of the ideas behind the design for restructuring the Hertogenwijk. What are the district's climatic problems, and how can restructuring improve the thermal comfort in this area? The importance of urban climate in design is explained. The design itself demonstrates that it is possible to incorporate both the climatic and the functional demands of this area.

The Hertogenwijk lies south of the historic city centre, next to the River Waal. The area features mostly housing for the lower middle class, with small terraced houses and blocks of flats with three to five storeys.

The district has an appearance of disrepair, because many locations are being redeveloped or waiting to be. The liveability is mediocre and there is not much green. Private greens are limited to the small gardens behind the terraced houses.

The municipality of Tiel wants to improve the quality of the area to improve the living conditions. I will now expand on how these goals can be realised, while simultaneously attending to the climatic issues.



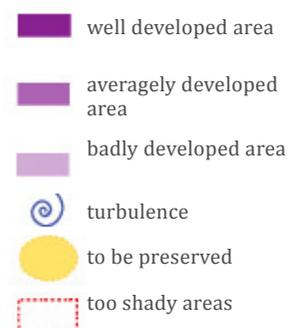
Location



Land use

Existing green plots

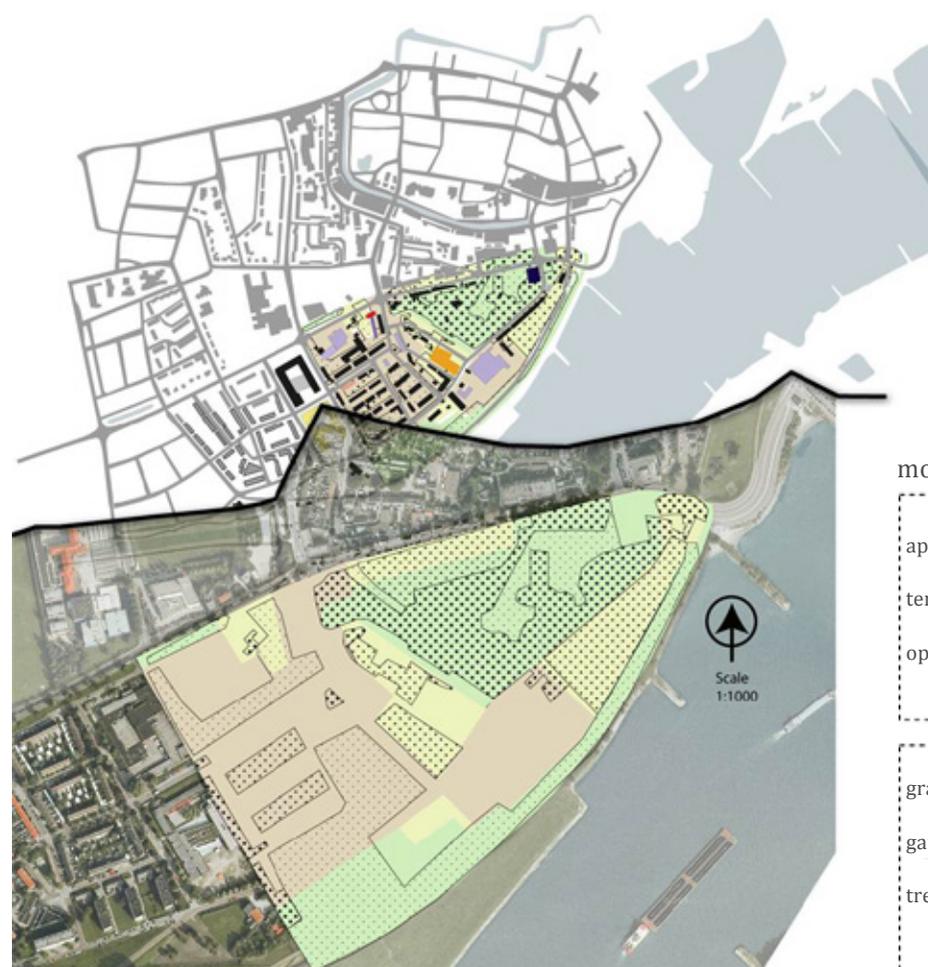
Local analyses



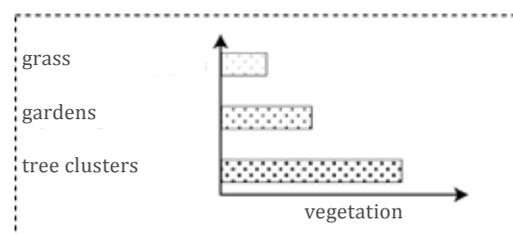
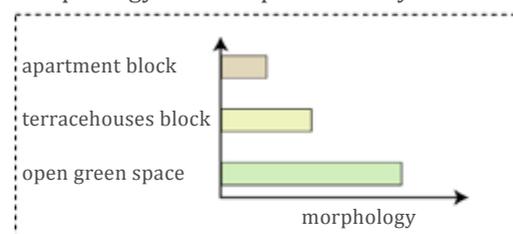
The choice for the eastern part of the Hertogenwijk follows from an inventory of the whole study area. From a socio-economic point of view, the district can be divided in three clearly distinguishable parts, with prosperity declining from west to east. This is directly connected to the urban structure of the houses. Closely related are their microclimatic properties. The prevailing south-western wind affects the outdoor structures of the eastern part most.

The analysis of the degree of pavement gives a clear view on the built-up/green space ratio. The area has blocks of flats of three to five storeys and houses of one to two. The open spaces in the area consist mainly of grass, grass with groups of trees and private gardens connected to the terraced houses.

There are also some avenues with trees. These data are also important for the analysis of shading and wind patterns.



morphology and soil permeability



Existing shading

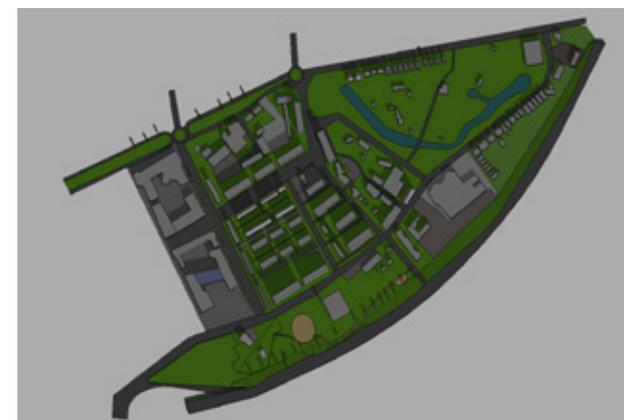
Analysis reveals what areas are often shaded. The spatial structure and the position of the relatively high housing blocks cause large parts of the areas around the buildings to be shaded. Since shade patterns change with the seasons, I indicate these for summer and winter with exact points in time. On summer mornings, the spaces in front of the blocks of flats are in the shade, but notably less so than on winter mornings. In the winter, these areas are completely shaded around noon and in the afternoon. In the summer, these are the hours with the least shade. This raises new issues concerning thermal comfort.

The greens in front of the blocks of flats are often shaded. This could be one of the reasons why these areas are not being used.

To get a good overview of the issues in the area, these results are combined with the wind analysis. Later, these results are used to come up with ways to increase thermal comfort.



summer 10:00



winter 10:00



summer 12:00



winter 12:00



summer 16:00



winter 16:00

Recommendations



This map shows the problems and potentials from a climatic point of view. The shade analysis showed that the structure and position of the buildings influences the use and the thermal comfort of the green areas around them. In view of the prevailing south-western wind in the cooler seasons, the orientation of the buildings is not optimal. The position of these complexes should thus be changed.

The suggested orientation of the buildings perpendicular to the south-western direction of the wind. This way, the buildings block the winds, while southern winds can come into the area in summer and cool it. The valued cultural centre is preserved. In the municipality's vision, the supermarket, now causing heat problems because of the large share of paved surfaces and the air condition excess heat, is moved. In its place, blocks of flats should be built.

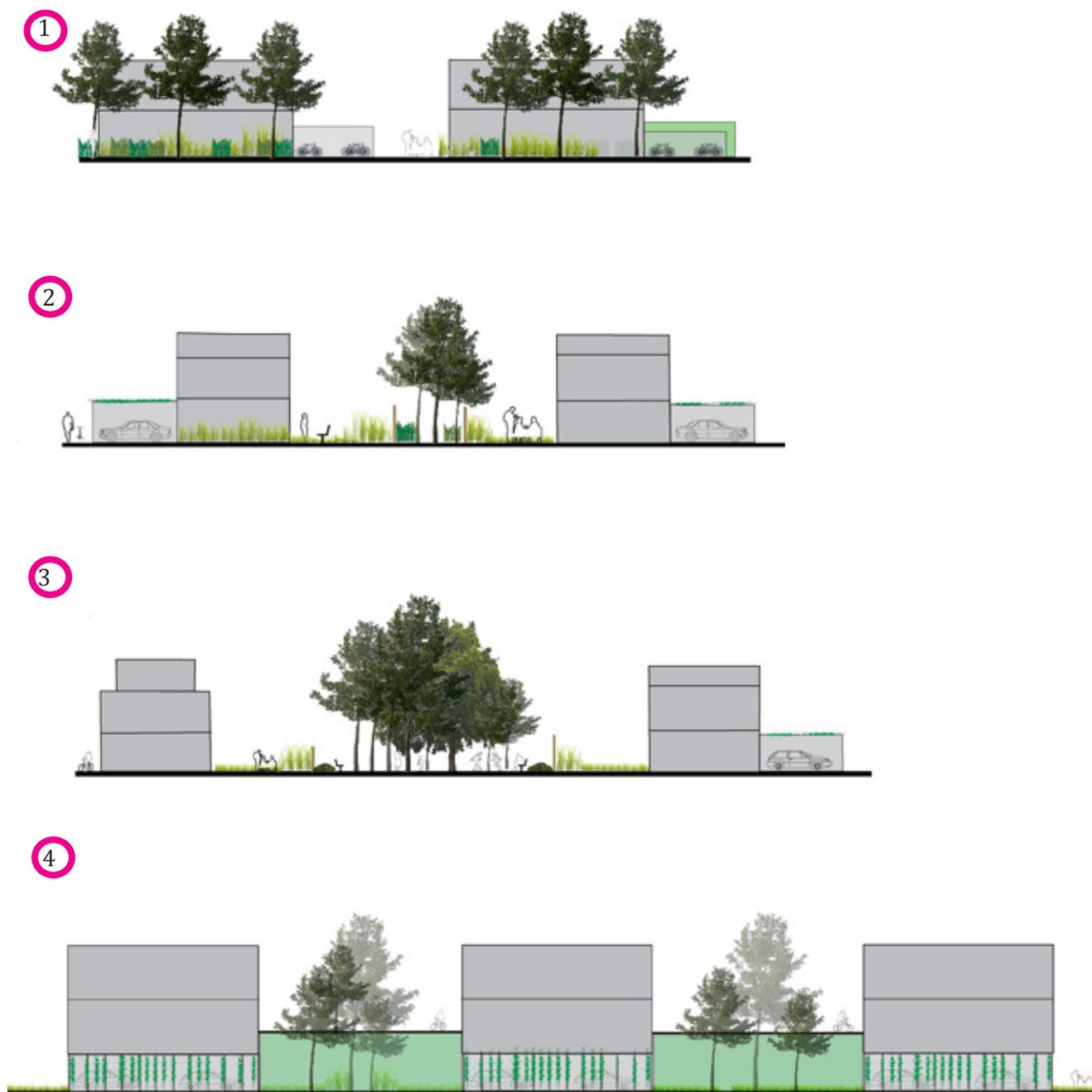
Masterplan

The most important concept for the design is based on the climate. The blocks of houses are replaced with two-storey terraced houses, in a high density and with a perpendicular orientation to the wind. In this way, optimal use can be made of the greens next to each house, as will be shown in the shade analysis of the master plan.

The proposed terraced houses will have comparable sizes, with some of them having a roof-terrace. The main idea behind this setup is shelter from the wind as well. Private gardens are placed in such a way that they get a lot of light, while public spaces can be used for cooling. The aim of the concept is to improve the quality of living and the share of greens in the neighbourhood.



House types



There are four types of houses. The northern part of the district features low-rise blocks of houses with clearly separated gardens, very similar to the concept of the urban villa (1). The most northern point of this area will still be a commercial zone, with the eastern corner as a possible new location for the supermarket of the Hertogenwijk.

The central housing area (2) is mainly accessible by cycle tracks, with limited motorised traffic. The houses have a garage close to the road, and the back garden is usually in the sun. The first group of terraced houses has limited space between the back gardens compared to the next group (3). The functionality is identical to that of the first group, with the exception that the green spaces between the gardens provide cooling. The central eastern part features a row of houses bordering the square around the cultural centre, the café and the terraces. This square is the sunniest place in the area, sheltered by buildings on the west side and a green buffer to the south.

The south-eastern part of the Hertogenwijk, where the supermarket is now located, will have low-rise single houses (4). The wind orientation principle is used here as well, to prevent the south-western wind from coming into the neighbourhood. The houses will have an open garage overgrown with climbers. This type of houses of three storeys will offer a beautiful view over the dike on the top storey. The thermal comfort in this area is achieved through a good orientation of the buildings and sheltering from the wind by the dike.

Shadows new situation

The shade analysis proves that the new orientation of the buildings is a good choice. First of all, the buildings form a wind barrier due to their orientation at right angles to the wind. Secondly, the gardens of the terraced houses will receive more sun.

The same goes for the blocks of houses in the north and the south of the district, where the thermal comfort improves compared to the current situation.



summer 10:00



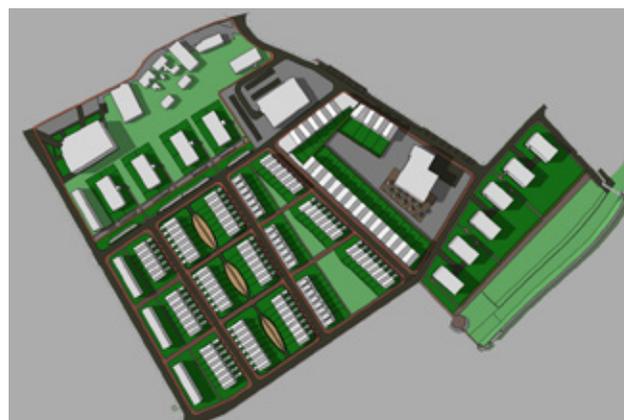
winter 10:00



summer 12:00



winter 12:00

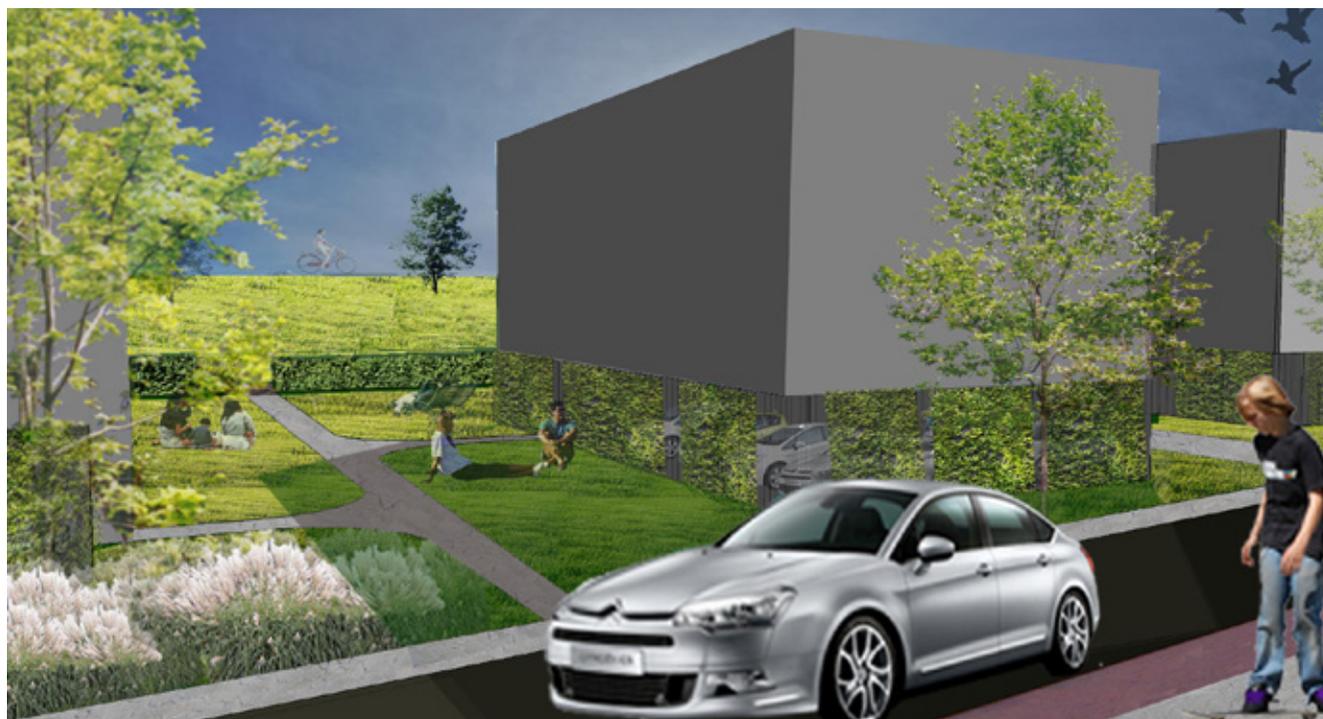


summer 16:00



winter 16:00

Impressions

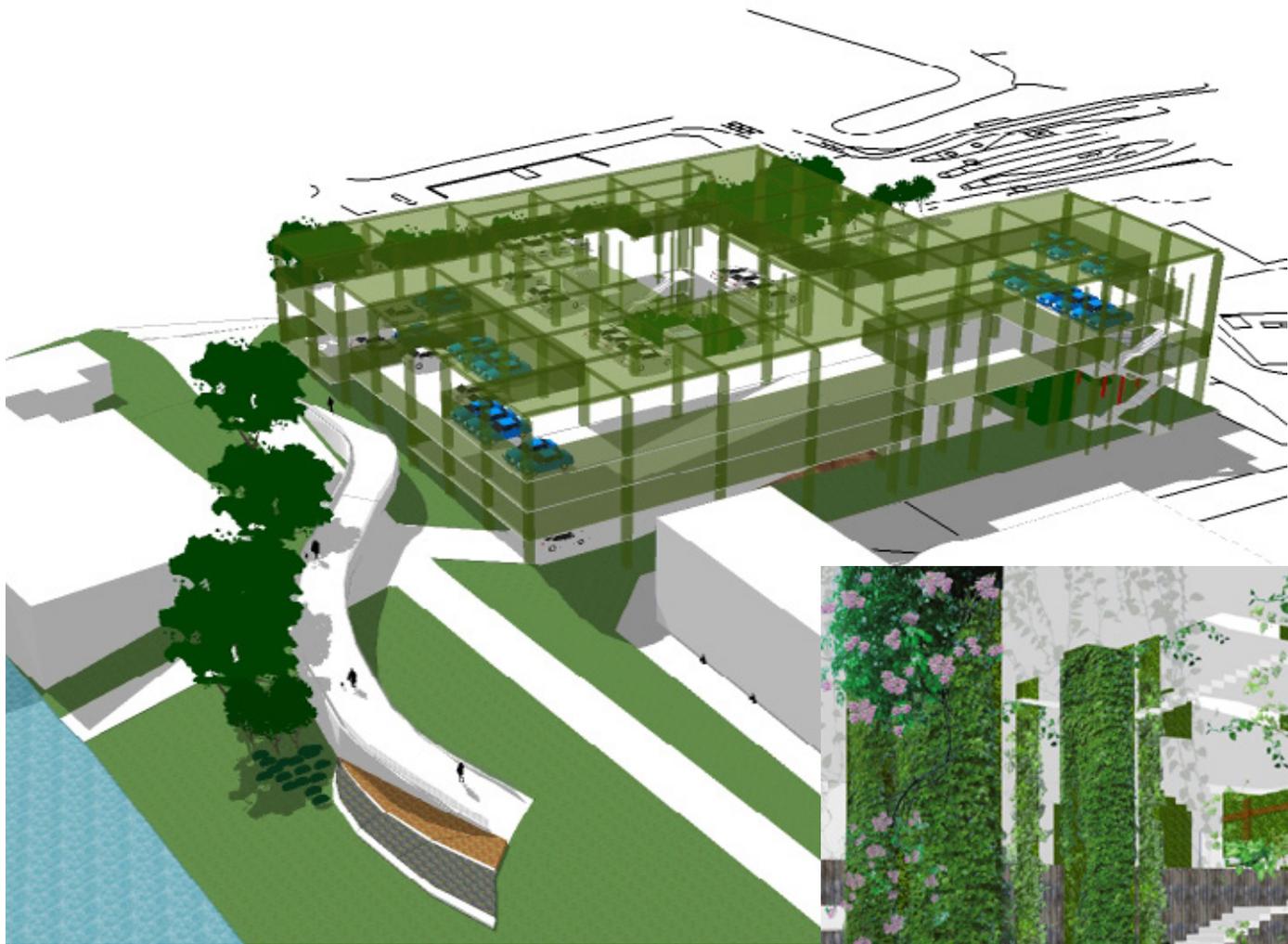


The first illustration is a visualisation of the blocks of houses with a panorama-view close to the dike. Climbers mask the 'green' garages, so as not to cause visual disruption. The blocks have a main entrance for the residents on one side and one for cars on the other. The atmosphere of this neighbourhood is green and lively. People enjoy being here: they are outside in the public areas or ride their bicycles on the dike.

The second illustration is an impression of a block of houses in the north, close to the commercial district. The prominent feature of this area is a low building density with 'urban villas'. Residents have clearly separated, small gardens to improve the quality of living. To make it easier for the residents to enter the gardens, stairs are placed against the outside facades.





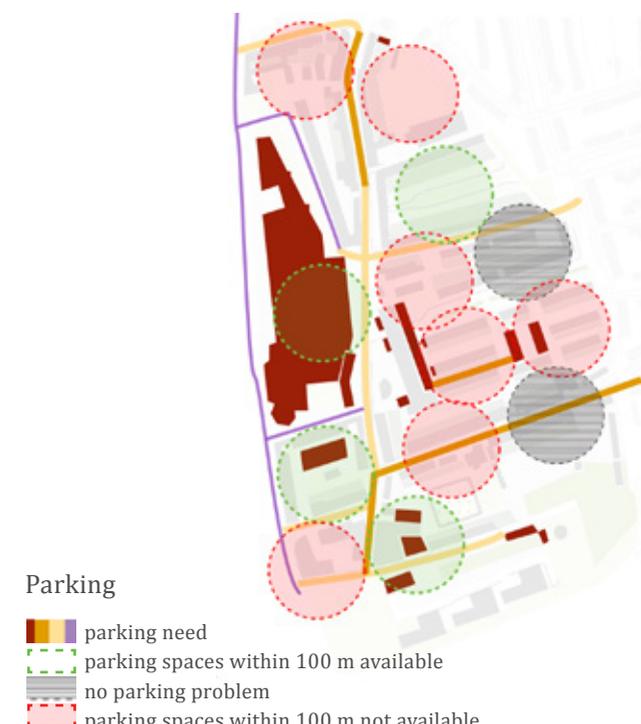
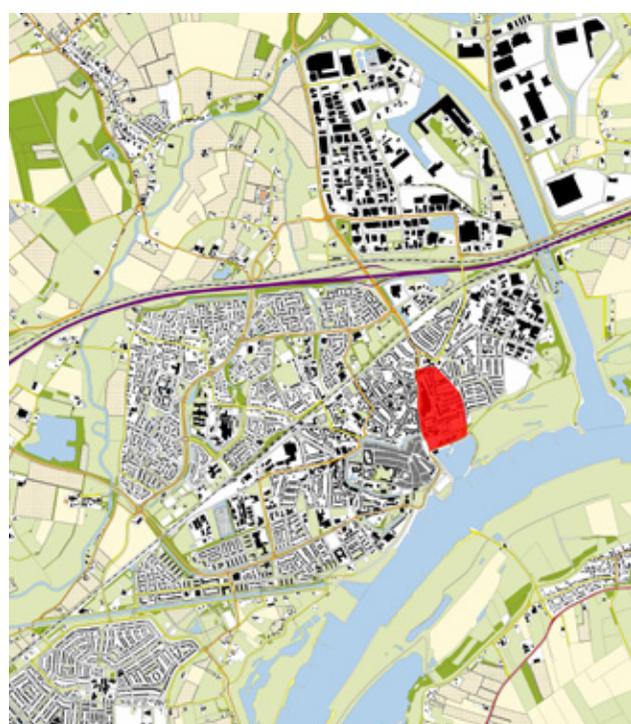
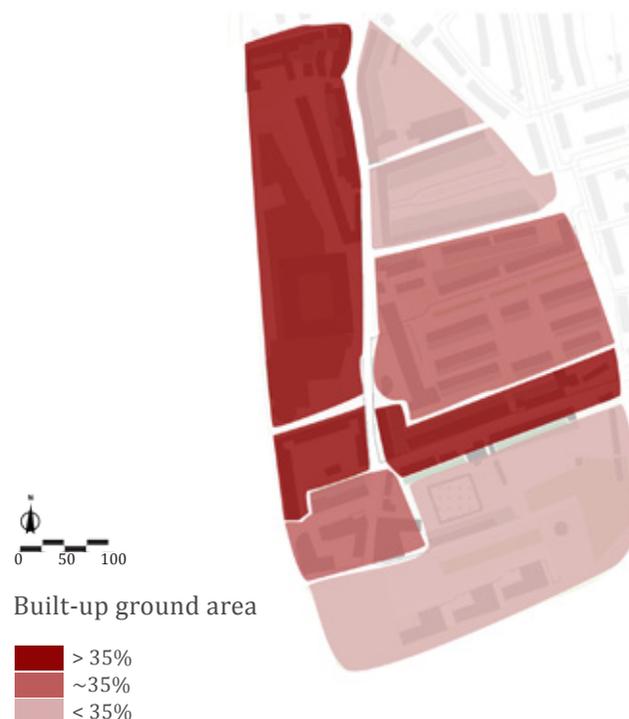


green interventions
'de Kranshof' and environs
Yuqiao Liu

Location analysis

The area around the 'Kranshof' lies north-east of Tiel's city centre. This area is part of the climatopes 'city' and 'city centre'. Despite the fact that the area is right next to the climatope 'water', wind from the river does not cool it, because the dike and high-rise buildings block convective wind.

The main concerns in the area are the parking pressure, the lack of green (especially at locations with a high building density and a high height/width ratio), and the unpleasant living environment due to heating resulting from the high density of houses.



Neighbourhood plan



Because the dike blocks convective breezes from the water, the addition of more green within the neighbourhood is the most efficient solution.

The aims are to add green to the area so as to limit the accumulated heat; to increase the number of parking spaces (mostly concentrated in small-scale green car parks); and to improve the quality of the living environment for the residents.

This area is in need of both parking and green. By combining the two, we make optimal use of the limited space available.

Some locations are fitted with solar panels. Green facades are applied to streets with a high height/width ratio, since space is limited.

By concentrating parking on parking lots, there is more space for green and pedestrians.

* cooling range of greens between 75 en 100 m

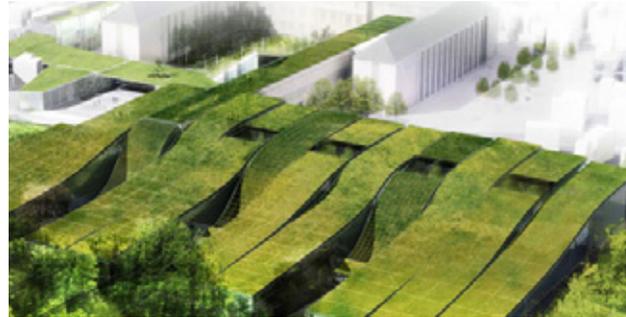
** range for small parking accessibility is 100 meter.

Design for green streets



precedent images of green walls

(source: http://www.turismoenfotos.com/items/francia/paris/3598_museo-de-quai-branly/full/2/, foto 2: <http://inspirationgreen.com/the-green-wall.html>)



green roofs

(source: <http://www.worldbuildingsdirectory.com/project.cfm?id=1451>)



solar panels on roofs

(source: <http://www.residentialsolarpower.org/> + personal photograph taken in Tiel)



photocollages of green streets in the neighbourhood



Design for cool parkings



- green roofs
- effective distance to parking
- solar panels
- parking
- range parking garage
- parking on private lots



Design - 'Parking Park'

The conflict between parking and green in the area results in problems concerning the accumulation of urban heat and the liveability. The idea of the 'Parking Park' addresses both issues at once. The plan provides for more parking spaces, cooling the environment, and a city jungle at ground level connected to the recreational functions of the dike zone through a footbridge.



Parking Park

- green roofs
- effective distance to parking
- solar panels
- parking
- range parking garage
- parking on private lots



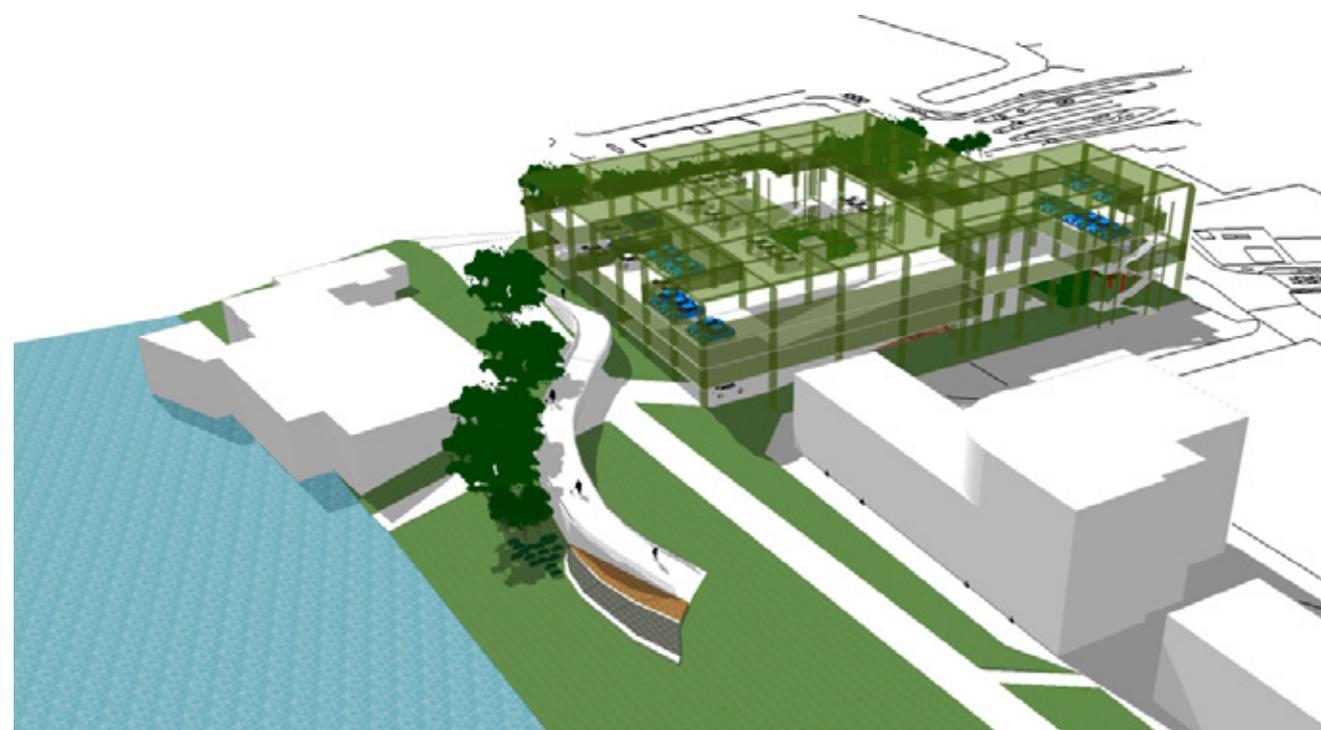
Evolution of design concept



entrance for cars via 1st floor



entrance for pedestians via ground floor



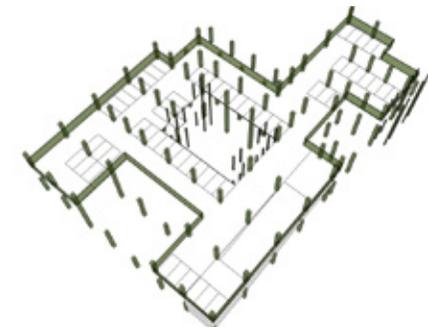
Design - 'Parking Park'



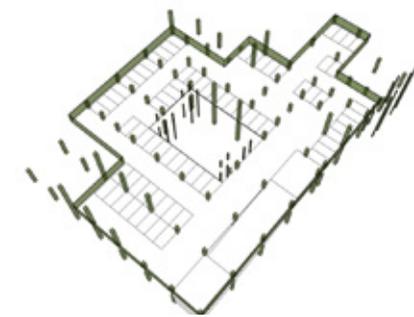
Entrance from the climate dike zone via new bridge



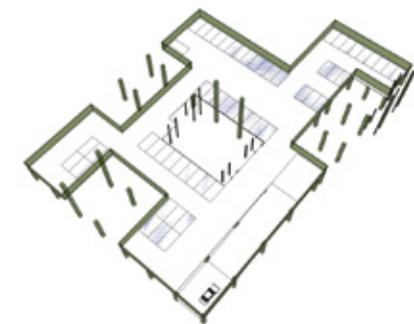
Parking



3rd storey



2nd storey

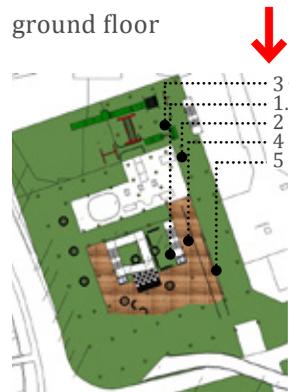
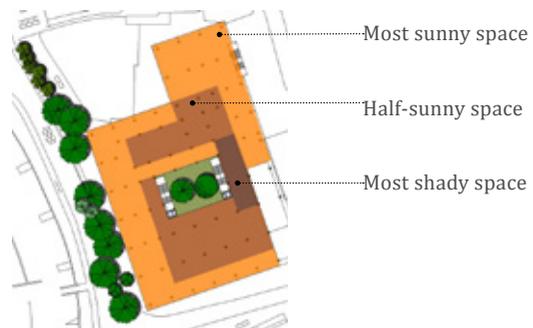


1st storey



ground floor

Impressions - 'Parking Park'



1. Internal air walk



4. Interior garden



2. Skate Pool



3. Climbing playground



5. Recreation Plaza



*We'd go down to the river
And into the river we'd dive
Oh down to the river we'd ride*

Bruce Springsteen, the River



‘cool’ waterfront
Yinyi Chen

Land use analysis and concept

Landscape analysis

Current situation:

- Room for the river at high water
- Space for big events
- Parking spaces

Monotonous and paved landscape:

- Empty grassland without an identity
- Large parking areas with closed pavement

Potential recreational areas:

- A beautiful view along the water and the historic city wall
- A variety of special locations along the water

Design goals

- Flexible approach due to changing demands
- Introducing recreational functions
- Creating a 'softer' landscape with a stronger identity

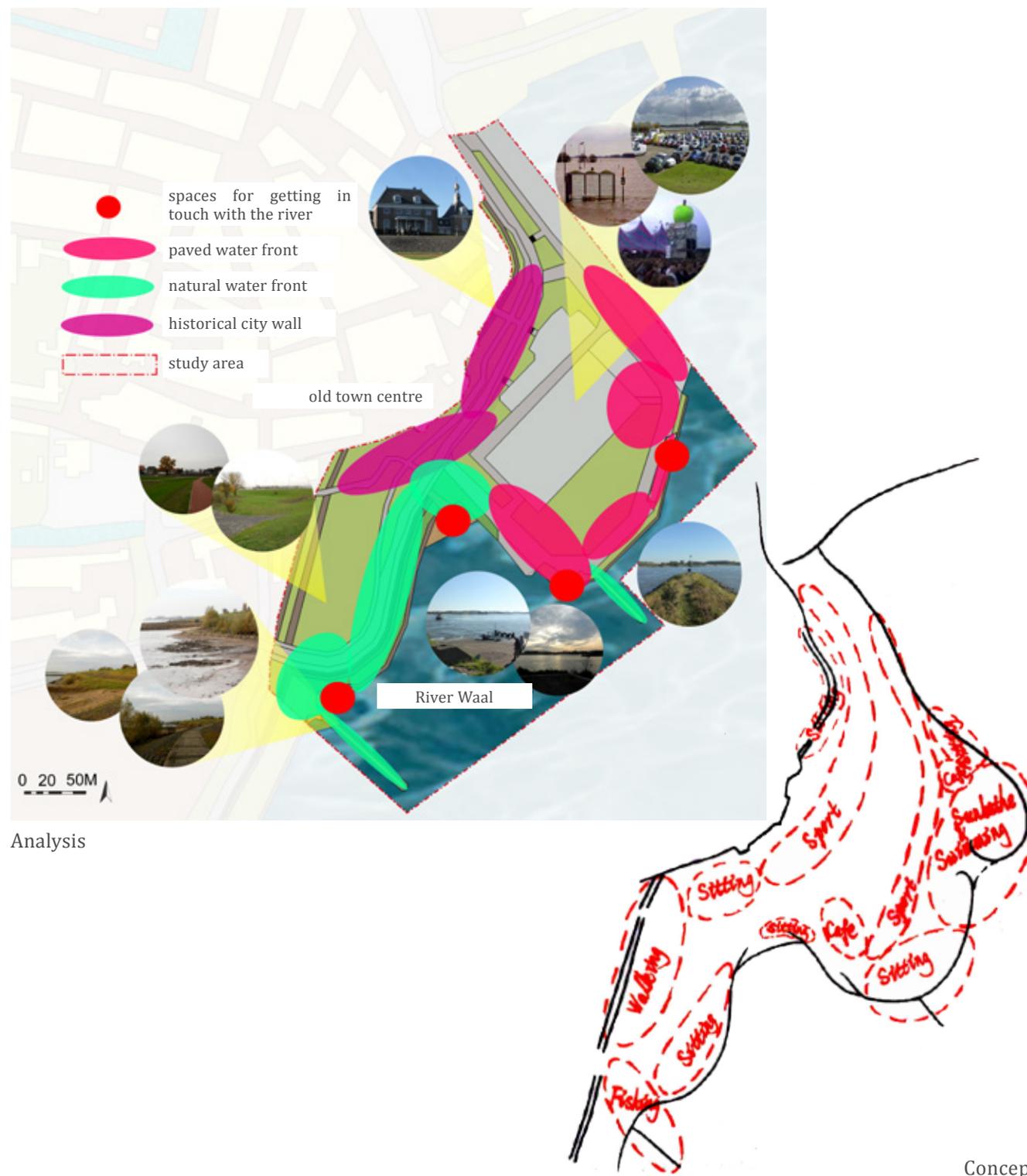
Design concept

Dynamic landscape:

- Places to swim, fly kites, skate, cycle and run

Tranquil landscape:

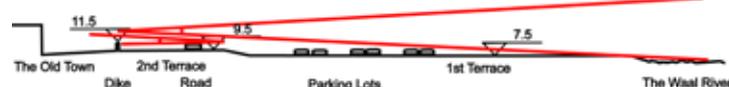
- Places to sunbathe, fish, repose and chat



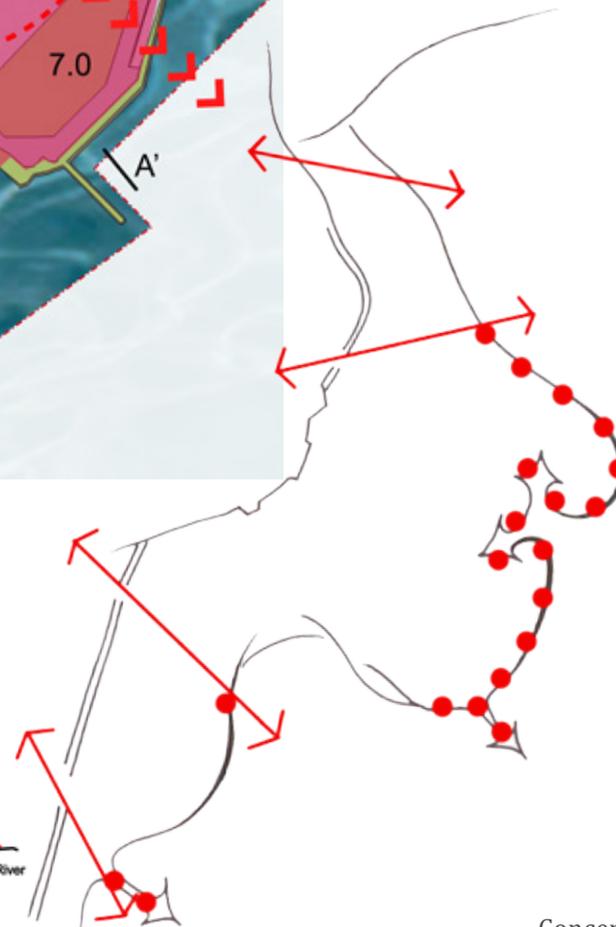
Spatial analysis and concept



Analysis



Section A-A'



Concept

Spatial analysis

Potentials public space:

- River: open towards the flood terraces
- Two flood plains
- Dike: partially surrounds the terraces

Blocked connections between the old river and the river:

- Buildings and dikes with narrow entrances
- Roads and parking areas with many cars

Design goals

Introduction of connections between the old city and the river

Design concepts

Go to the River Waal:

- Activities at the border between the city and the river

Touch the River Waal:

- Gradual slope and steps

Play with the River Waal:

- New harbour

Traffic analysis and concept

Traffic analysis

- Heavy traffic
- Much pollution, heat and noise
- Two dangerous crossings for pedestrians
- Two planned new garages elsewhere, halving the demand for parking near the Waal

Design goals

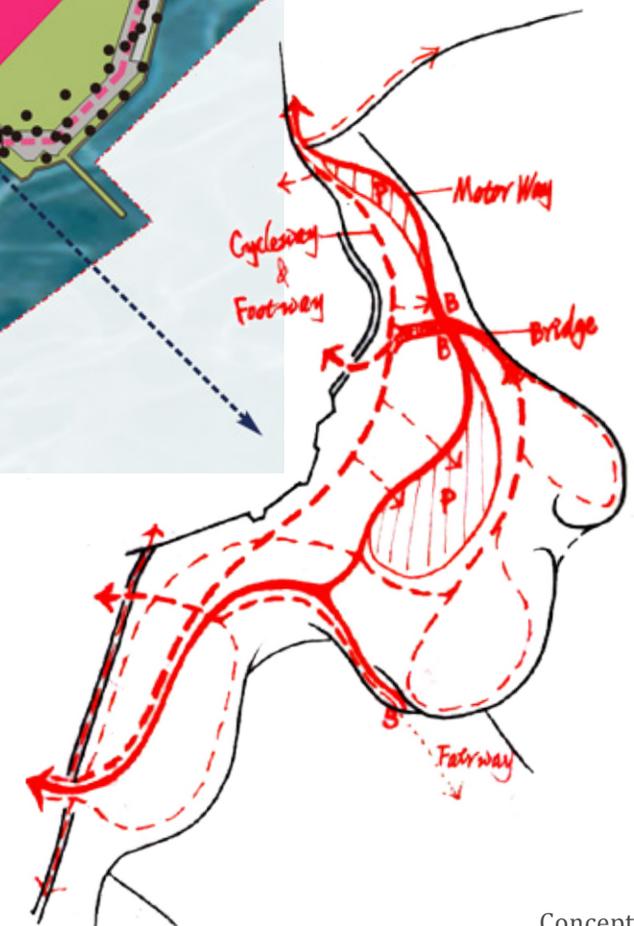
- Flexible design for changing demands
- Reduce the impact of pollution, heat and noise

Design concept

- Car parks in the less attractive areas, so the quality of the surroundings is least affected
- A road through the lower lying part, offering more space for the historic city wall
- Flyover across the road
- Facilitating pedestrian's access to the river

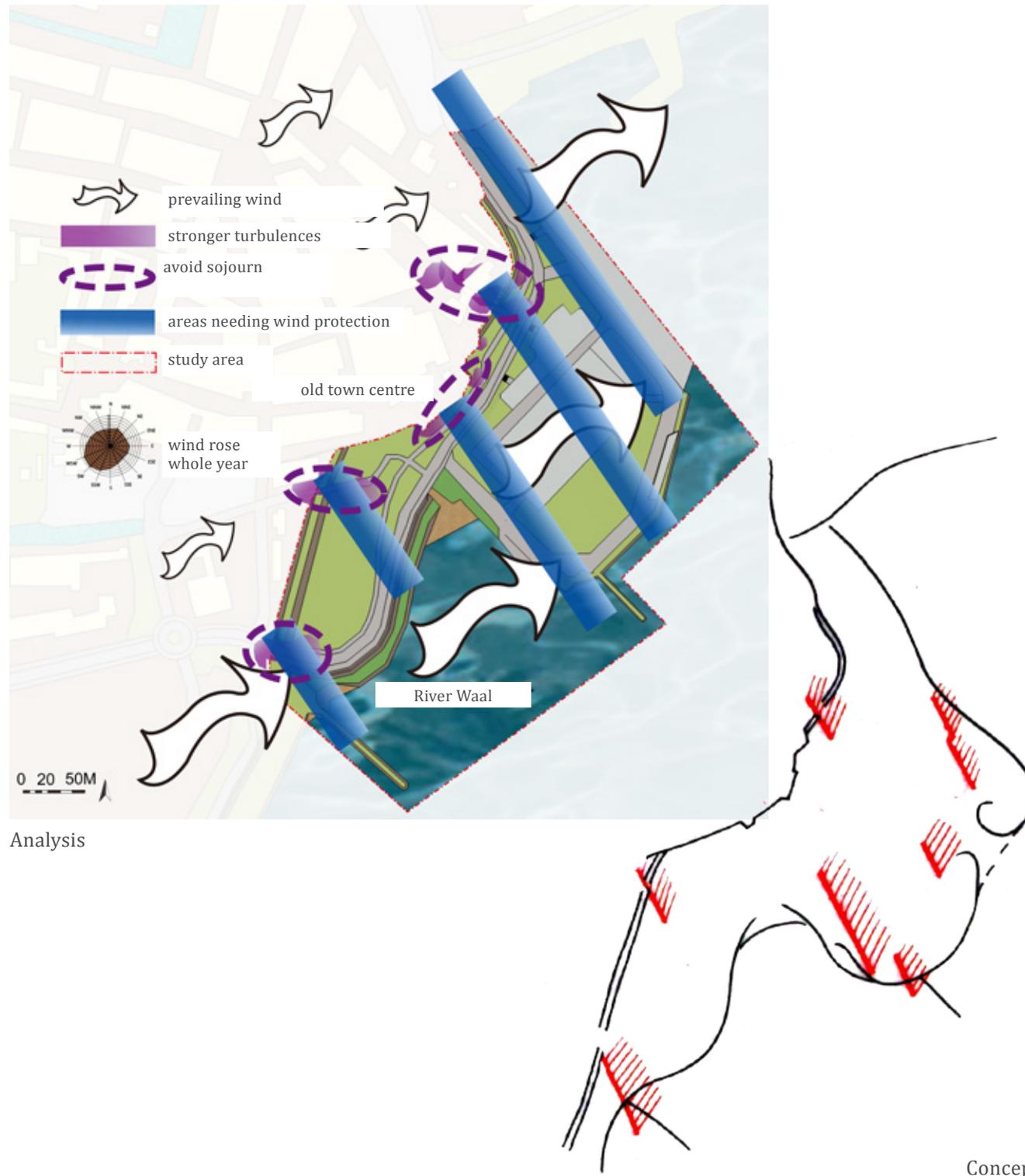


Analysis



Concept

Wind analysis cold days and concept



Climate analysis cold days

- Lower thermal comfort
- Higher and variable wind speed on the flood plain
- Enhanced winds on crucial draughty places
- Lack of shelter from the south-western wind

Design goals

- Shelter from the prevailing winds
- A versatile design adjusting to the variable wind conditions

Design concepts

- Gently rising slopes and steps
- Trees and walls in the recreation zones
- Higher paths for better protection against the wind. Thus stimulating activities on cold, windy days.

Analysis warm days with low wind

Climate analysis on warm days without wind

- Low wind speeds
- Light, cool breezes from the Waal
- Little wind on the flood plain
- No wind in the old city
- Cooler waterfront

Design goals

- Enhancing the cool winds
- Making use of the waterfront

Design concepts

- Several cool places along the water for reposing on warm, wind-still summer days
- A grid of grass surfaces on the car parks
- Trees and shrubs in mobile boxes lead to a higher production of cool air

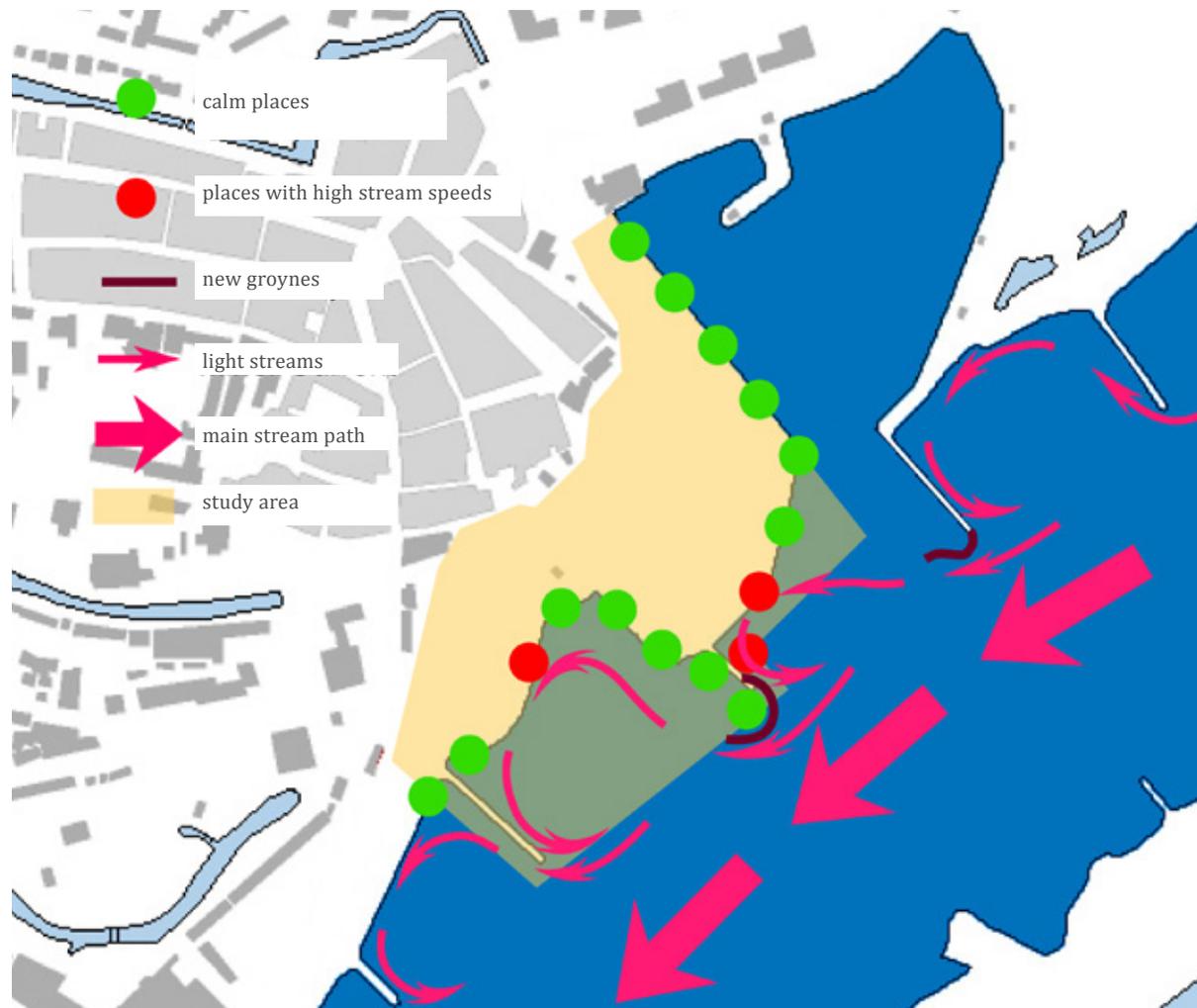


Analysis



Concept

Hydrological analysis



Analysis river streams and concept

Hydrological analysis

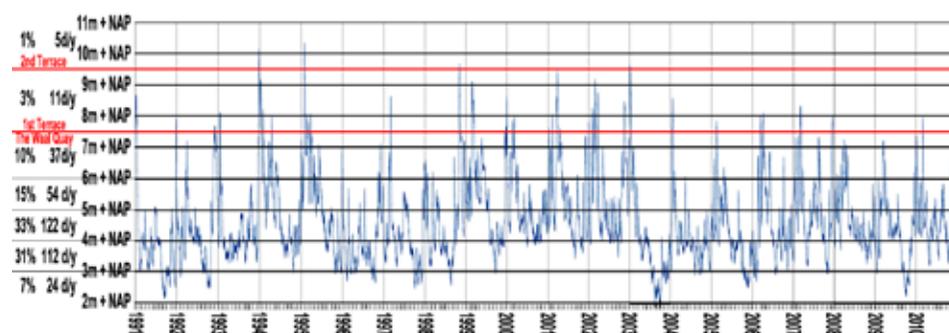
- Insufficient protection through groynes for recreational swimming or paddling
- Few locations suitable for creating sandy beaches
- Water level fluctuates from 2 meters above Normal Amsterdam Water Level (NAP) to 10 meters above NAP

Design goals

- Increase the number of quiet, tranquil locations along the Waal
- Experiencing the changing waterfront and the dynamic of the river

Design concept

- Two new groynes
- More calm locations for the occurrence of sandy beaches
- Stone steps at the flood points
- Experiencing the waves
- Different heights and slopes along the Waal front
- Different waterfront lines occur at different water levels

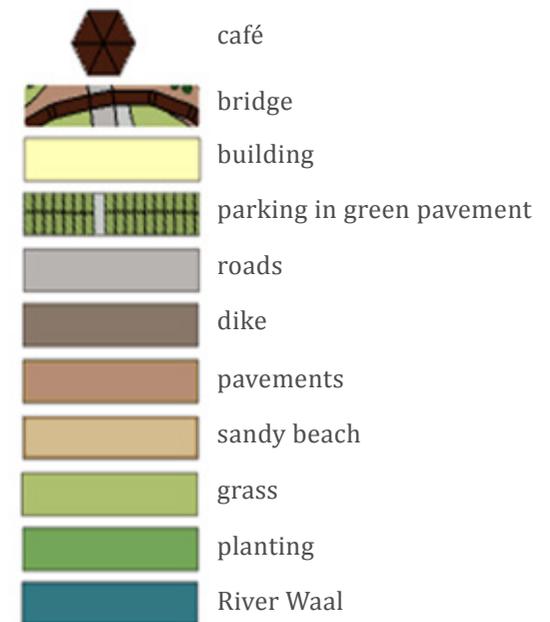
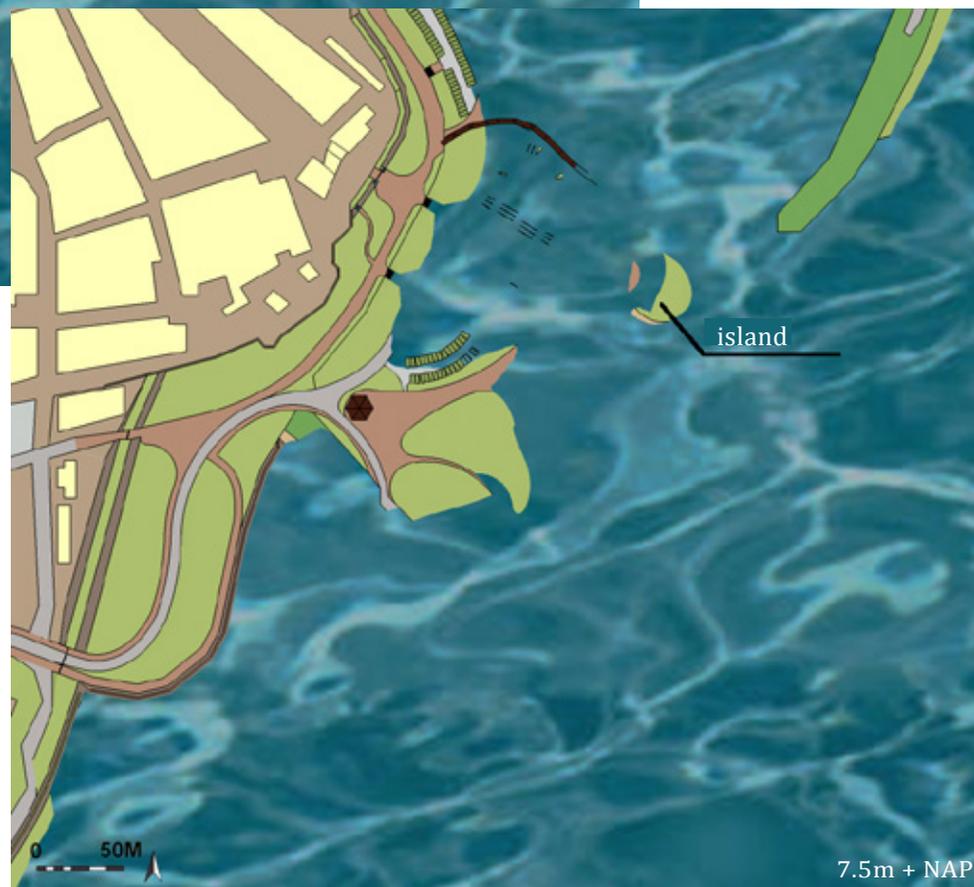
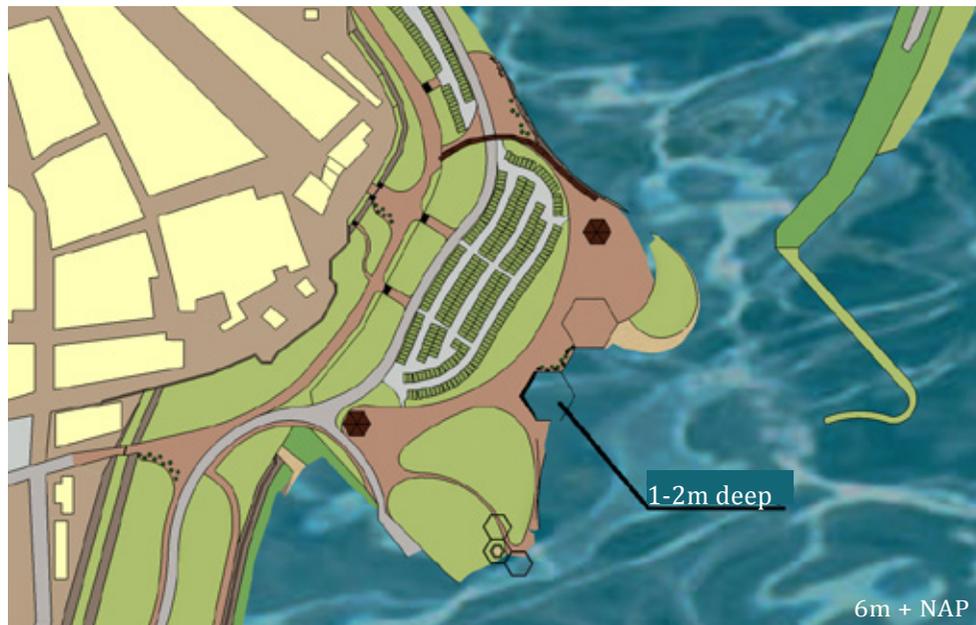


Water levels River Waal

Masterplan at different water levels

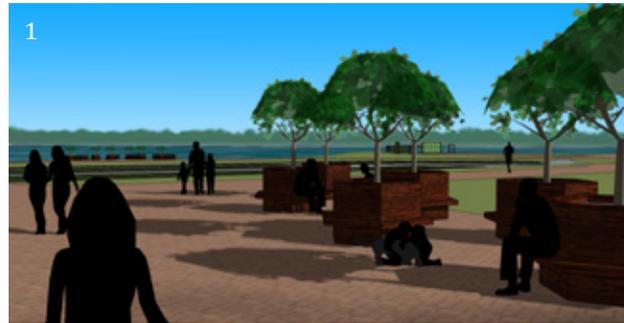
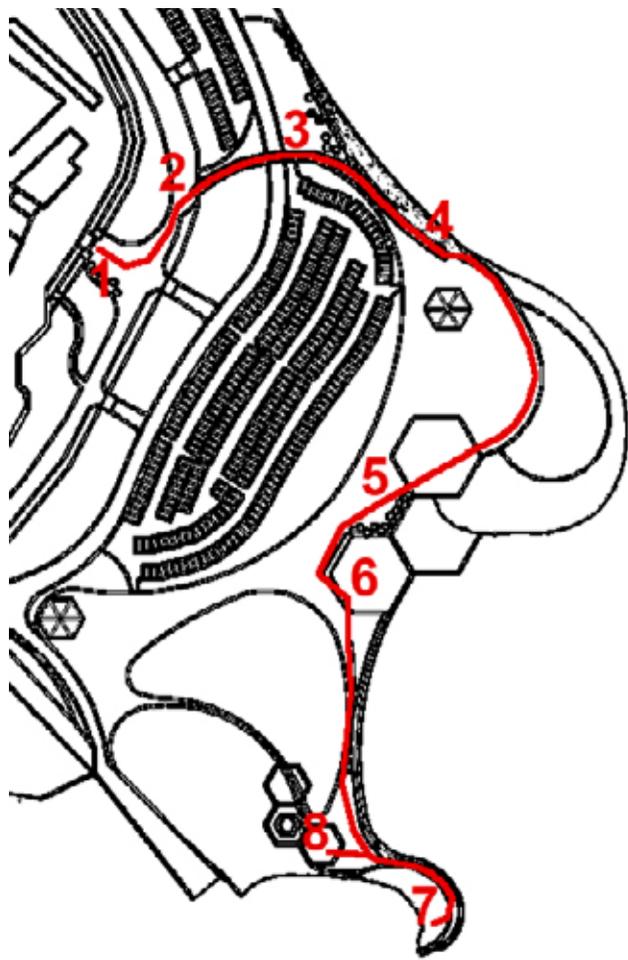


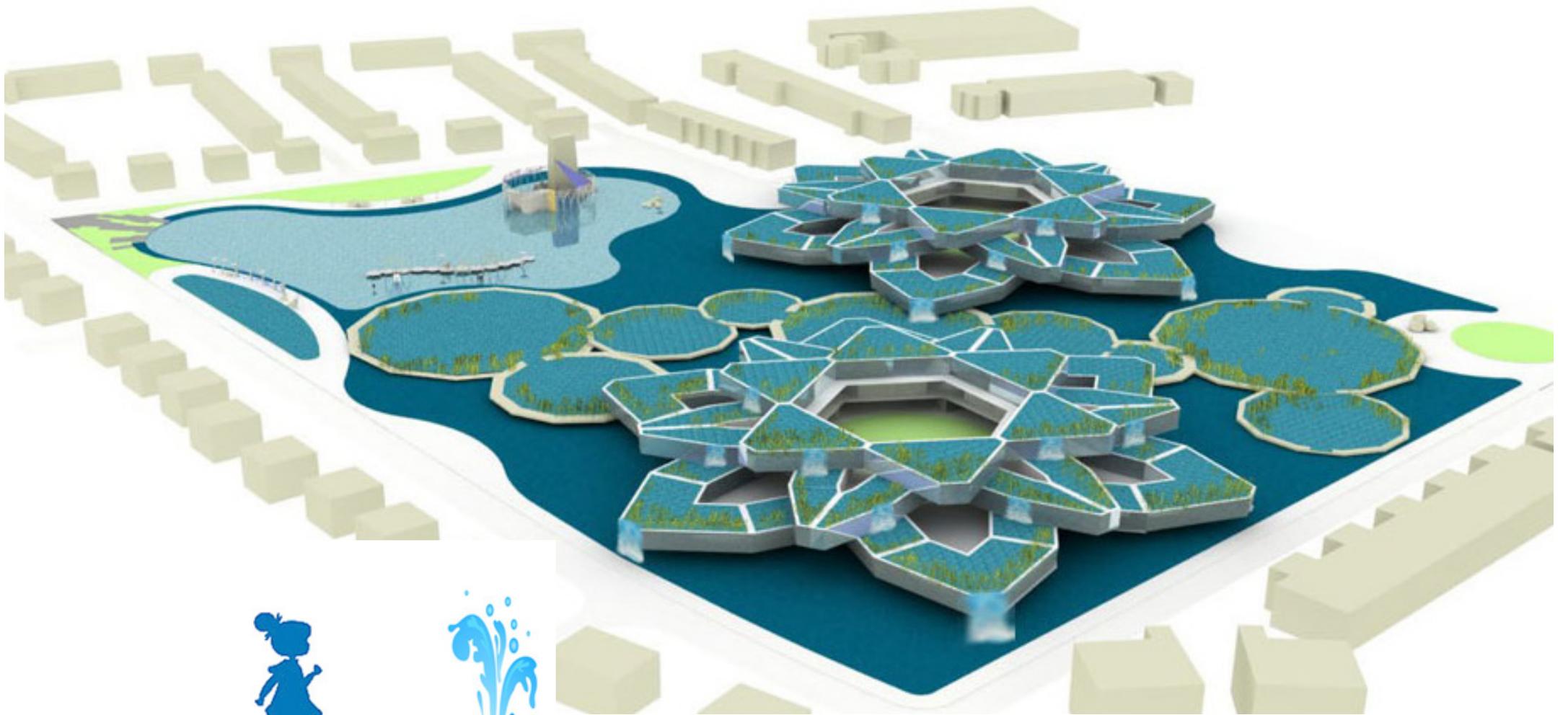
Masterplan at different water levels



Impressions with water level 4m+ NAP

1. Square in front of the entrance of the city wall
2. Flyover across the road, forming a connection between the city and the Waal
3. River view from the bridge
4. Stone stairs along the harbour
5. Water square and skate track
6. City beach and swimming pool
7. City beach along the groyne
8. Wind barrier and playground for children





Livin' water

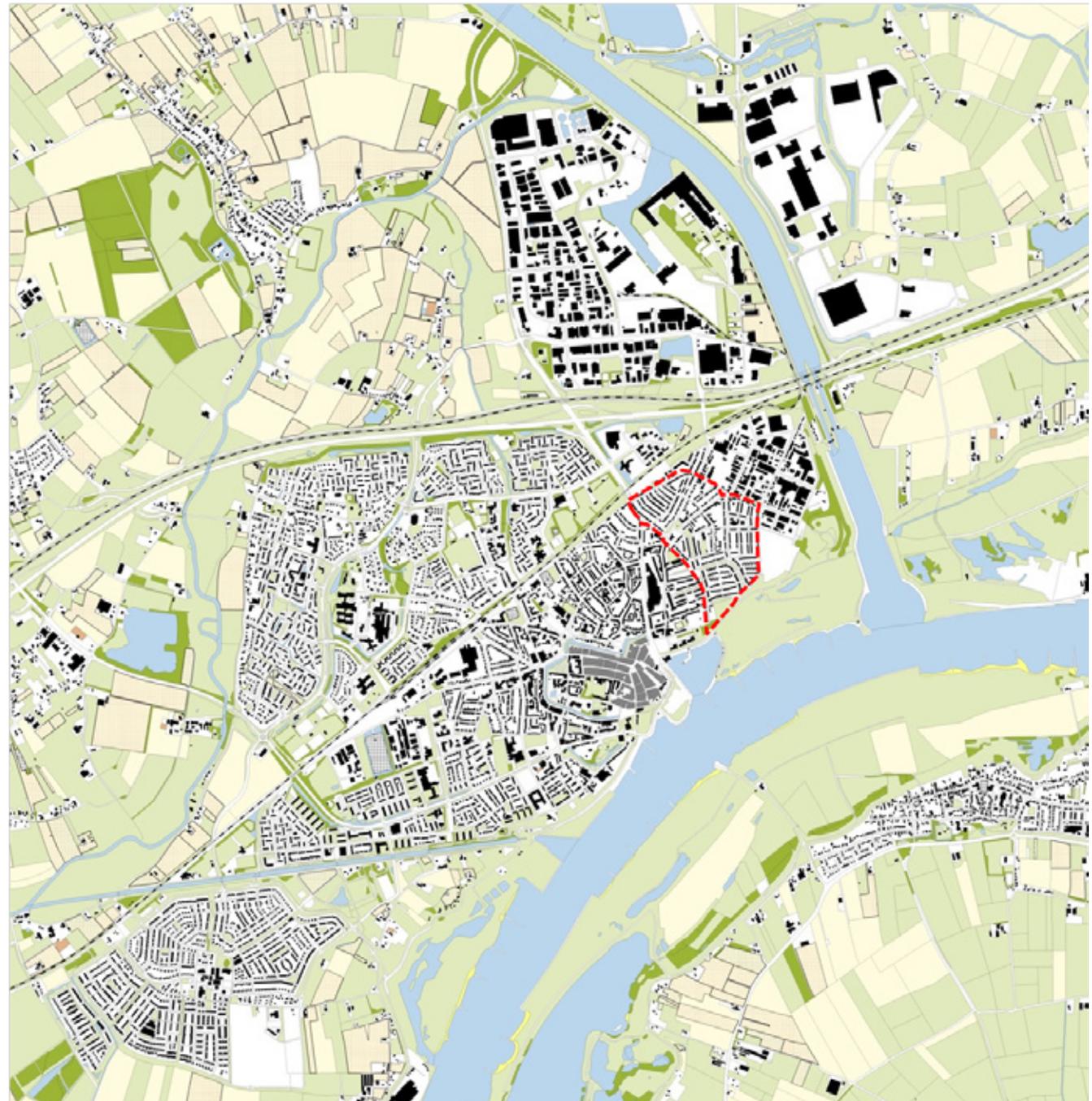
climate adaptive Tiel Oost
Ya-Ping Chang

Introduction

Current world problems like climate change and urbanisation play a crucial part in the growing problems with the urban climate. This causes further pressure on the well-being of people in urban environments. To ensure a more sustainable and liveable environment, greater awareness of the importance of measures concerning climate adaptation is needed for design and planning questions.

Tiel East is the focus of this study. It is a residential area between the centre and the businesses in the west. In the south, the area borders the River Waal and its high dike. It is an attractive living environment because there are many facilities and the river is not far. However, the area is also faced with problems with ground water and heat stress. This study aims to find solutions to those problems of which we can expect that these will only increase with time due to climate change. One can also look at water as an opportunity. Water can be retained seasonally and it can be used to cool the air, thus reducing the problems with heat stress.

I first give a concise overview of the problems in Tiel East and then focus on the opportunities for this residential area and show design suggestions.





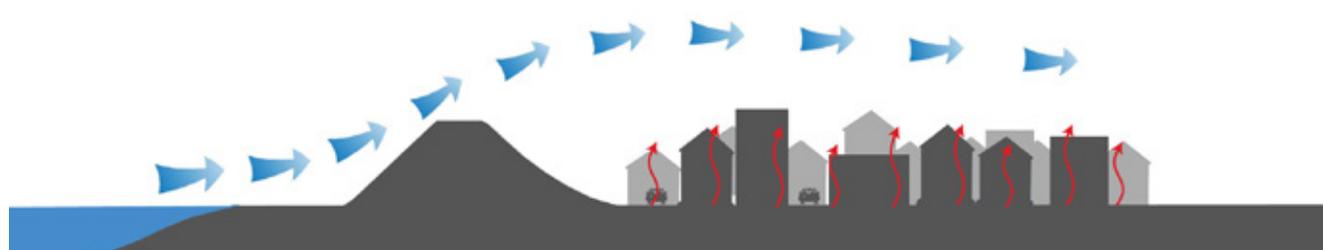
The residents and municipality are well acquainted with the water problems in Tiel East and have wrestled with solutions for a more liveable environment. There is also a problem with heat, due to a high building density, paved surfaces and little wind. To try and find solutions to these problems, it is very important to use the existing knowledge in and about the area.

Problems with seepage

As shown on the map 's right part, the north-east of the area has the most problems concerning water. At high water levels, the water sometimes raises to street level, especially in winter. There is no drainage and no system for water outlet. This causes seepage, resulting in mouldy houses and gardens that are too wet to be planted.

Problems with heat stress

Seasonal airflows in Tiel East mostly come from the south-east and from the river. Unfortunately, the dike forms a windshield, stopping the wind from coming into the residential area. In the future, this dike will be even higher and broader, to withstand the higher water levels caused by climate change. Another source of cool airflows, the Amsterdam-Rhine Canal, is blocked because of the high building density of the industrial estate. The heat generated is not reduced through cooling effects such as sufficient green structures, wind and water. As a result, there is a problem with heat stress, which could affect the health of the population.



Dike blocks cooling breezes from River Waal



Situation low ground water level (summer)



Situation high ground water level (up to 3 meter higher than in summer)

Opportunities

Restructuring area

For the area suffering the most from seepage, a project has been set up by now to deal with the problem. This area is restructured in two phases. The work for the first phase has already started. For the second phase I suggest large retention spaces. This water can be used for cooling in summer.

The buildings in this location are now placed in such a way that they prevent ventilation. It is therefore important to open these buildings, so the evaporation of the water can be used to more effect. The map shows the adjusted buildings in red.

Topography

Flowing water is more effective in cooling the air than stagnant water is. The differences in height on the terrain offer a chance to let the water flow without having to use energy. The fall is about 2%; enough to create a slow flow.

With this information, retaining excess seepage water in the winter, and using it for cooling in the summer, is the best basis for climate adaptive design in Tiel East. I will describe these cooling strategies below.



Guiding concepts

The key idea of this project is to retain enough excess water in winter to satisfy the needs in summer, without negative consequences for the surroundings and CO2-neutral. On this basis, three design concepts were developed:

1. Problems as opportunities
2. Human activity as a cooling force
3. Nature's student: Biomimetic Architecture



Bird's eye view of planned water features in Tiel Oost

Design framework water

Problems as opportunities

The restructuring area offers room for water retention in the winter, when the ground water level is high. A natural way to retain water is to cover the soil with an impermeable layer like clay or loam instead of concrete. The clay can be harvested from the riverbanks when the climate dike is constructed. From the restructuring area, water flows to the western part of the district. This part suffers from heat stress and does not have any open sources of water. One area can be remodelled into a large pond with water plants. As we can see from the literature, this offers a more effective way of evaporation. Consequently, this pond can reduce heat stress. The bottom of this pond is also covered with clay. The pond is connected to a drainage system to be able to deal with extreme rain peaks or when the ground water level is very high.

To find out how much water is needed in summer, the surplus evaporation was measured, taking in the extra evaporation through plants and cooling activities in summer. The calculation for the demand for water in the summer is shown on the right.



ground water in climate ponds, winter

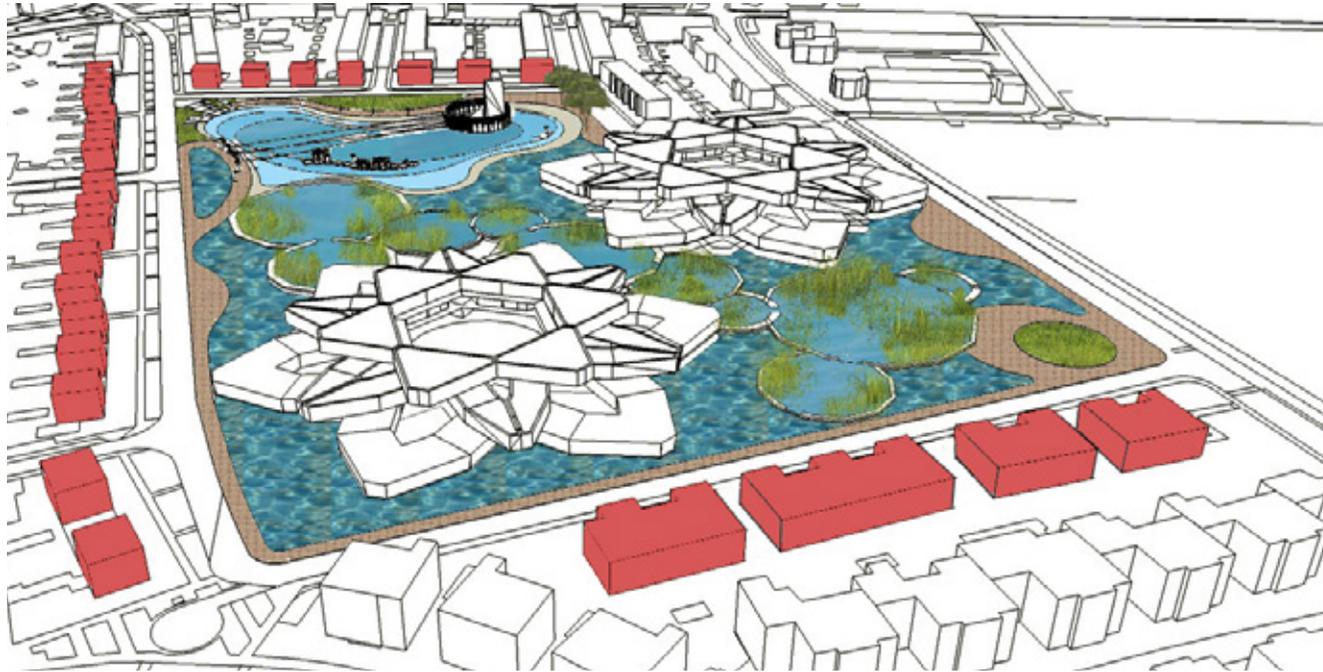
ground water in climate ponds, summer



Water need in summer

Measure of all area	41872.4 m ² = 325751.6+41872.4 (water area)	
Summer water demand	Precipitation surplus	66 mm (for whole area)
	Extra evaporation by plant	5% (for water area)
	Extra evaporation by cooling activity	20% (for water area)
	(3454.5+21499.6)m ² x 66mm x 125% = 24954m³	
Q _s : summer water demand; A _w : water area; D _p : depth of water area; Q _s (< 24954m ³) = A _w x D _p		
D _p	A _w	Q _s (after design)
1 m	31146 m ²	31146.0 m ³
0.5 m	9421 m ²	4710.5 m ³
	1304 m ²	625.0 m ³
Total Q_s (after design)		36481.5 m³
36481.5m³ > 24954m³		
Extra 46% water can remain until winter season		

Design concepts evaporation

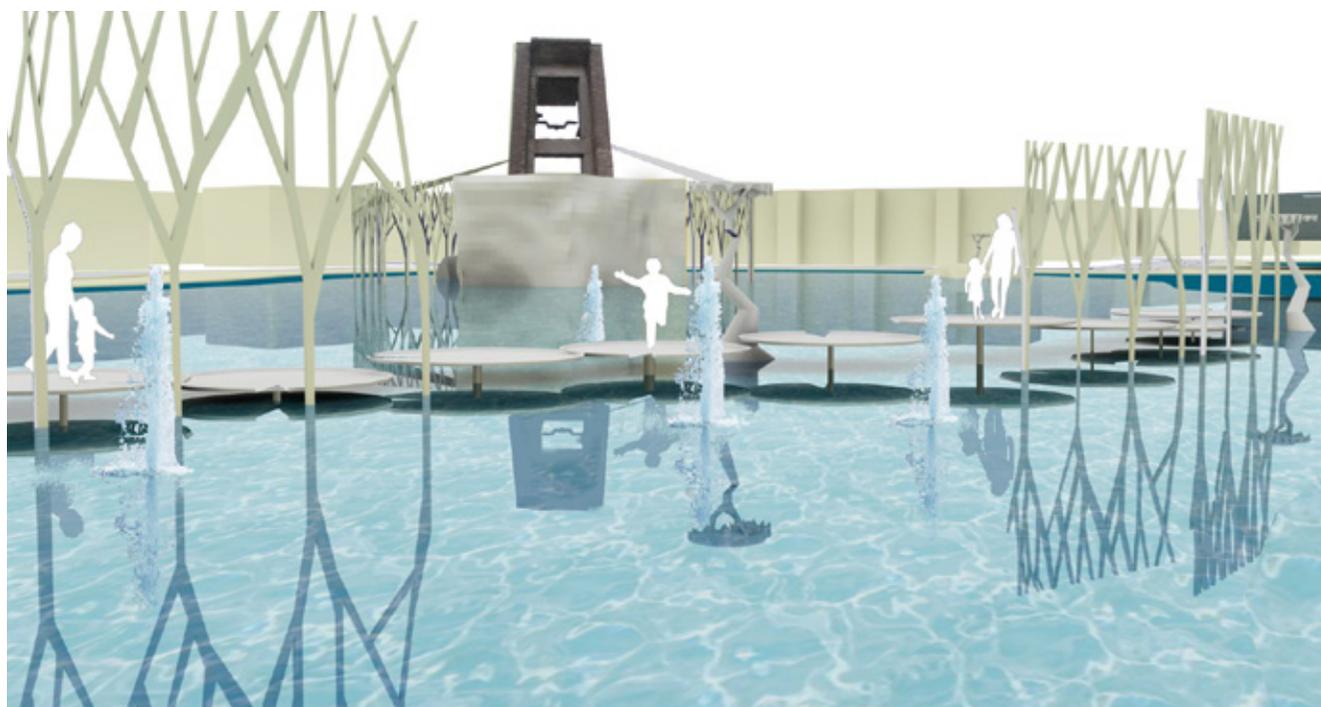


bird's eye view of water square and new building orientations in surroundings

Human activity as a cooling force

According to urban climate studies, an efficient evaporation is essential for cooling the air temperature. Within this design concept, I looked at how people's daily activities and behaviour can be used as a cooling force, without using electric facilities.

On the water square, for example, there are plateaus in the shape of the leaves of water lilies for children to jump on. This action causes air pressure, making water gush from a spout. These fountains can be integrated in street furniture or the design of the outdoor space. The water square offers various activities for children, such as tug-of-war and climbing walls. The use of this square can change with the seasons. In the winter it can be a skating rink, and in the summer, when the water level is low, concerts can be held here.



smart generation of air pressure to drive water nozzles



water nozzles driven by children's activity

Design elements for evaporation verdamping

The idea of air pressure is also used at the climate pond. To reduce car speed, speed bumps were placed. These will be replaced with so-called air bumpers. When a car passes an air bumper, water is forced towards the pond, creating fountains.



smart use of cars that drive over bumpers that generate pressure for water nozzles

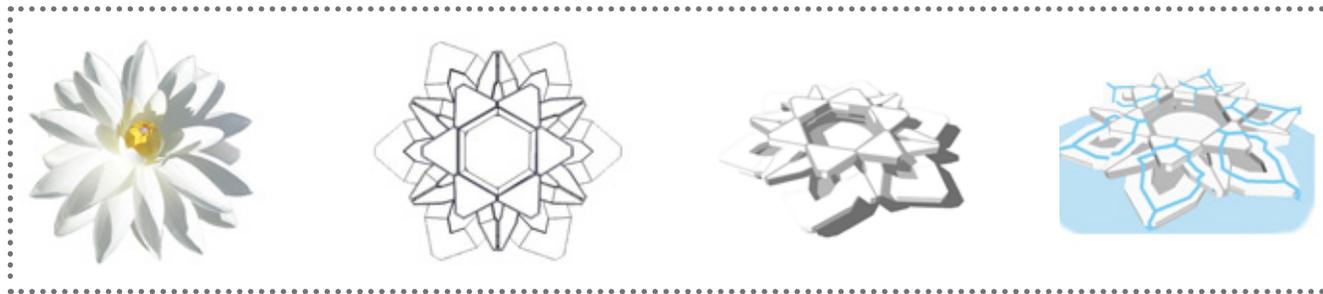


the climate ponds, pedestrian perspective



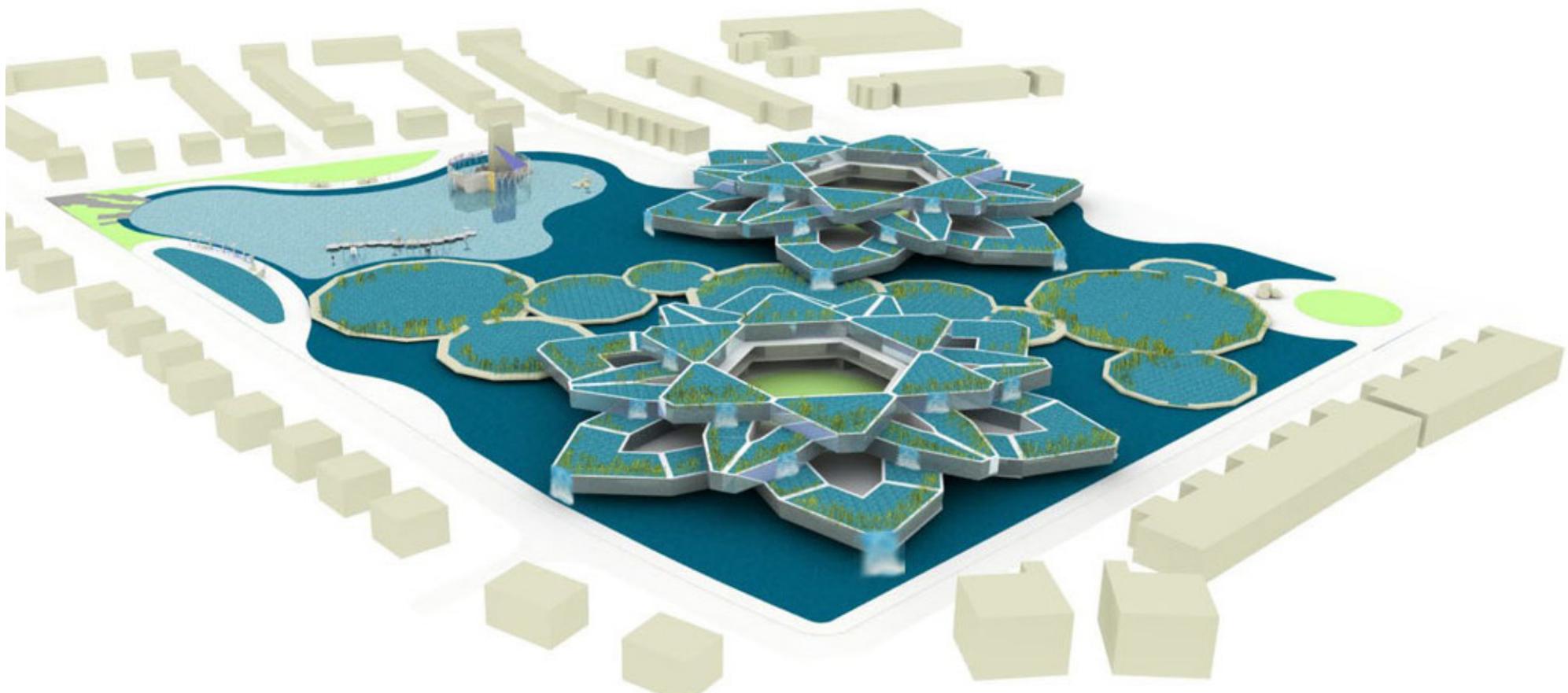
bird's eye view of climate ponds

Concept 'Water lily house'



Nature's student: Biomimetic Architecture

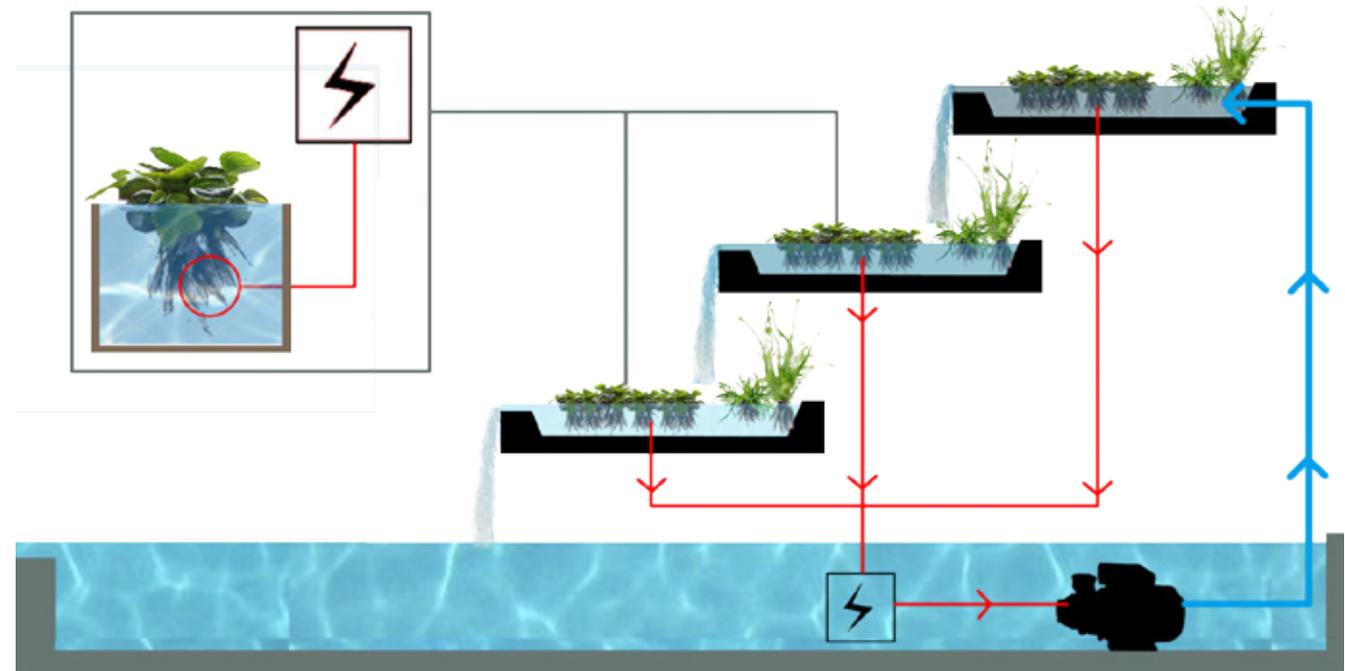
The restructuring area should not only function as water storage, but should also offer space for new housing for current and future residents. The new planning of this area for retaining water does ask for a new mentality towards water. People should not fear water, but rather enjoy it. Water is the main theme for the restructuring area, with the water square for living and recreation. Biomimetic architecture and water are starting points for the design; the water lily, symbol of both nature and water, is an inspiration. The characteristics of the water lily have thus been the basis for biomimicry architecture in this study.



learning from nature- the lotus houses

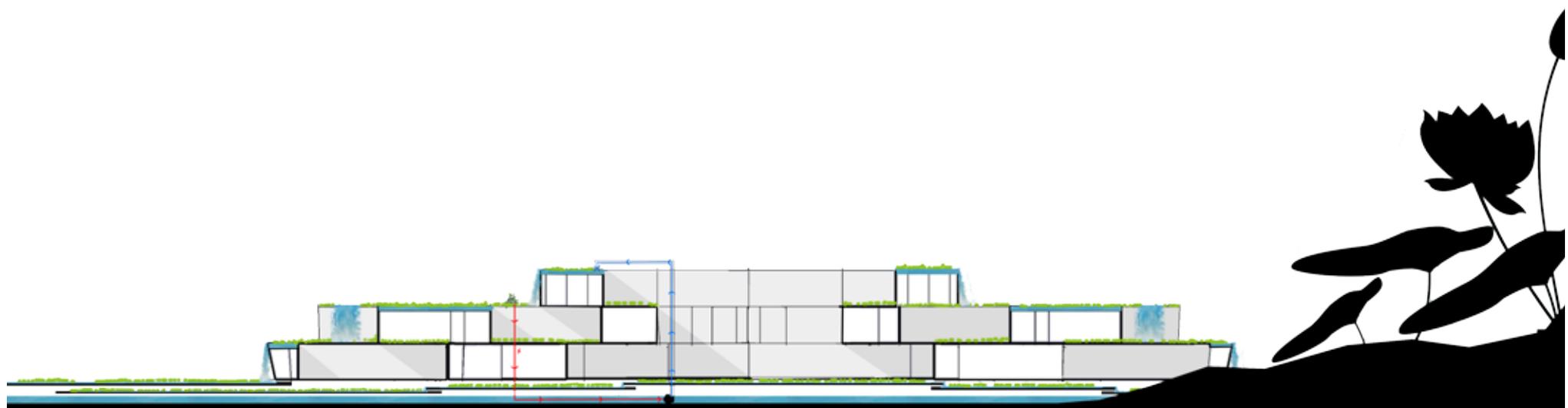
Energy in the 'lotus houses'

The closed water system within this restructuring area is sustainable and CO2-neutral. The water flows over several terraces on different levels to generate more evaporation to cool the air. Plants in the water storage area and the water square purify the water naturally. The energy needed to pump the water to the roof of the water lily houses is green energy coming from the area for water storage and water plants. So there is no need for fossil energy.



closed water circulation with electricity generation

-  water pump
-  energy generation
-  stream direction
-  electricity cable



Section of water square and lotus house



comfortable outdoor
spaces in Medel
Chunhui Zhou

Analyses

The industrial estate Medel lies in the north-east of Tiel. The area has easy access, because of its location next to the Waal, the Amsterdam-Rhine Canal and the A15 highway. Increasingly more industrial businesses want to move here from outdated industrial estates, and the government will invest more money in this area.



strong wind is a big problem



heat problems in summer

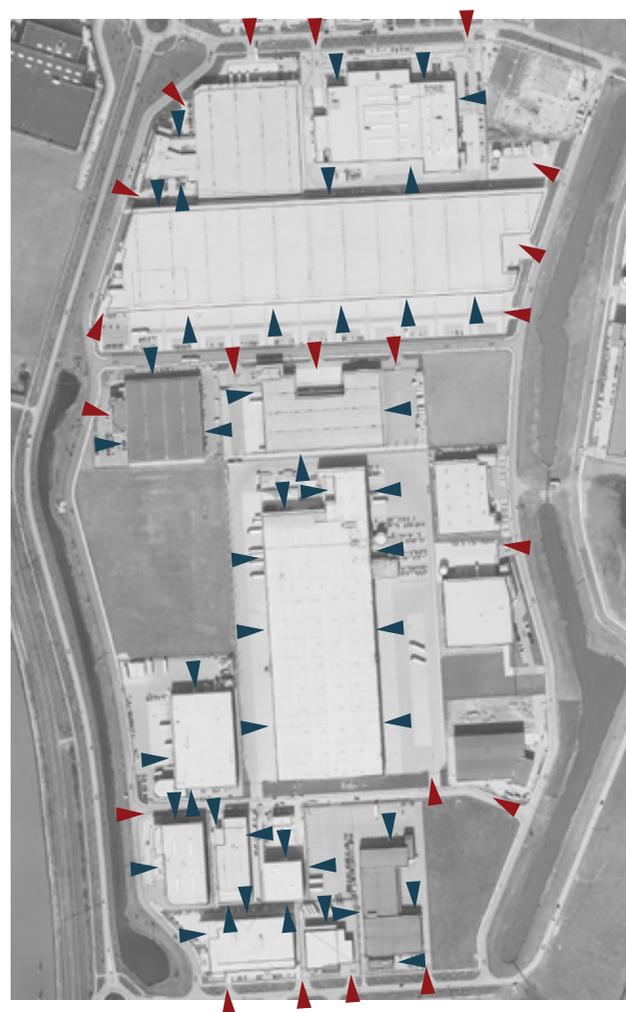


no recreation facilities for employees



ENTRANCES

This maps shows the entrances for motorised and pedestrian traffic, and shows which entrances are used most and from what direction the people come into the area.



- ▶ pedestrian entrances
- ▶ car access

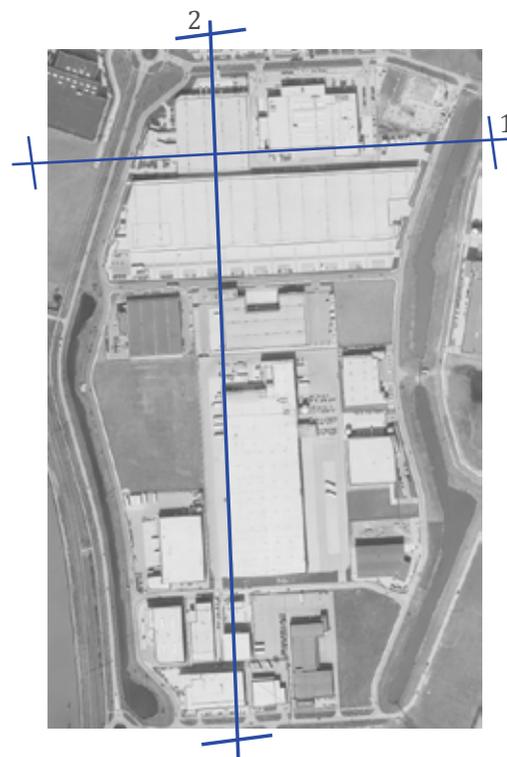
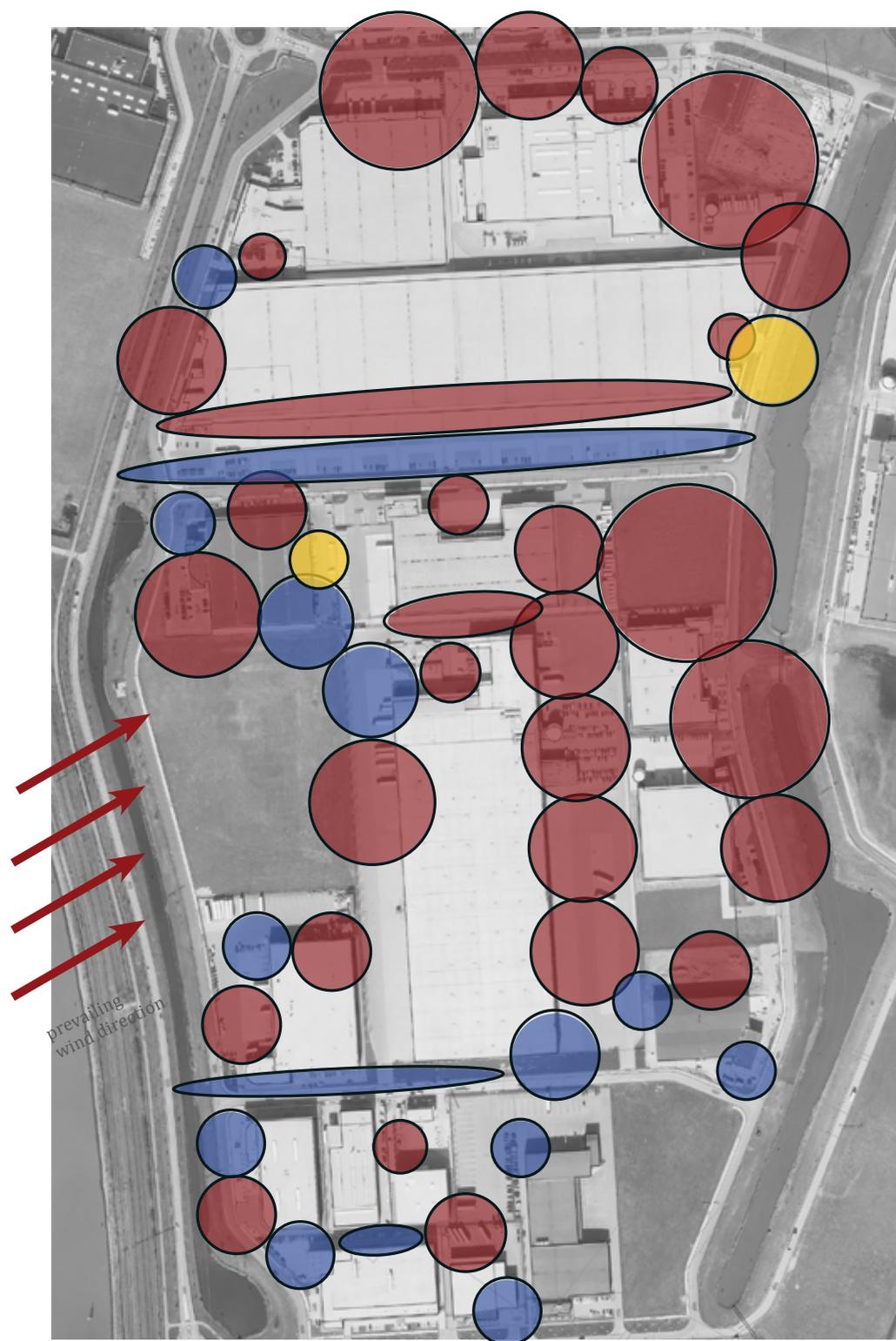
LAND USE ANALYSIS

The function of each paved surface is shown here.

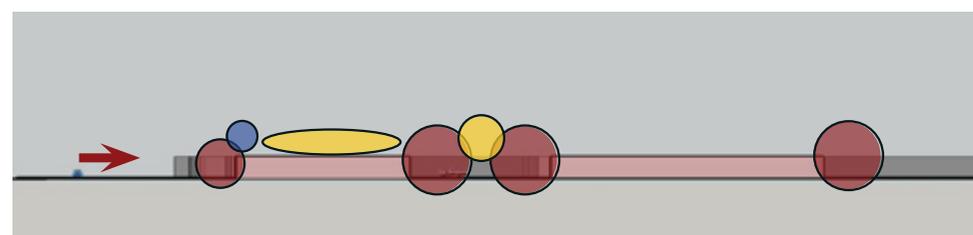


- loading and unloading
- reserved grounds
- parking lots

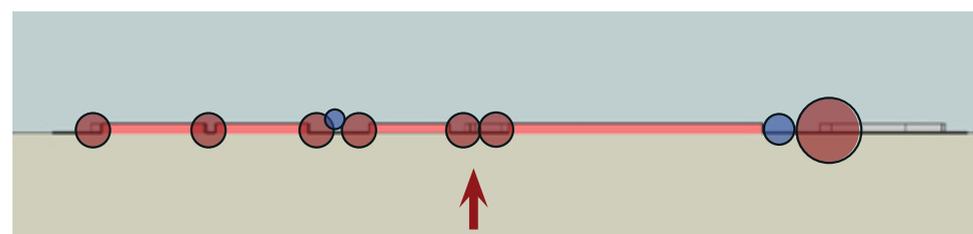
Analyses



The prevailing wind is from the south-west. Places with high wind speeds are mostly in the west of the area or between two buildings. The most comfortable places for people to take their breaks outside are in the north and in the east.



section 1



section 2

- area with high wind speeds
- area with average wind speeds
- area with low wind speeds

Zoom- in areas

Locations with good conditions for reposing and locations with bad conditions can be determined based on the wind and shading analyses.

Five locations within Medel were eventually chosen that score badly in terms of wind and shade conditions. For three of these locations, designs were made, which can serve as an example for the further development of the industrial estate.



activities are affected by wind



activities are affected by shadow



bad sojourn conditions

good sojourn conditions

spaces that have potential as good sojourn places

problem areas that need adjustment



Plan 1



The first design is for a location that is completely paved and enclosed from three sides. In the summer, the location has a heat problem and in the winter it is very windy. The design features a lowered square with a fountain in the middle. The fountain provides cooling for the people on the square. Around the square, trees are planted to block the wind. This creates a small space for people to take a break.



Plan 2

The location of the second design proposal is on a junction. In front of the building next to the junction, there is wind turbulence and also a problem with heat. The climate responsive design features a fountain with an opening in the middle, directed towards the building.

Behind the fountain there will be a wall with company logos visible to people passing by. Trees will be planted between the roads and the building to block the wind. These will also create a small space around the entrance.



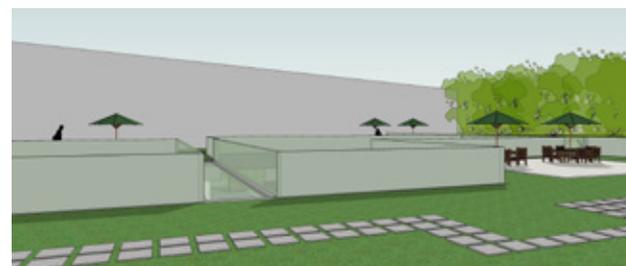


Masterplan roof garden

The third design is for an enclosed car park. The heat is the main issue here in the summer. I propose a roof garden is above this car park. This roof will provide shade and can be a recreational space at the same time. The design shows how functional and recreational spaces can be combined.



Layout of parking lot



The first part of this report consists of analyses and recommendations for planning and design, resumed in the recommendations map for urban planning and design. These can help the municipality of Tiel to address the developments of the city with the urban climate in mind. On a larger scale, structural plans of the municipality can ensure that certain areas (for example green wedges) stay open for sufficient ventilation, or that new parks are planned in areas with heat stress. On a smaller scale, recommendations for locations with wind or heat problems can be taken up in the plans (adjusting current zoning plans or making new ones). When it comes to the planning of public spaces, measures can be taken up in plans for redevelopment or in the maintenance management. For small-scale measures on private terrains, stimulation programmes and subsidies can be used as instruments to further the development of a climate-responsive environment.

Recommendations from urban climate analyses often do not hold much appeal yet and do not stimulate people's imagination. This is why we have chosen to show what adaptation measures can look like, through projects for specific locations by the international MSc landscape architecture students from Wageningen University. Each project was based on analyses of the location, especially with analyses of the local microclimate and then responding to the microclimate and other local factors. The results are diverse, and can sometimes be implemented easily. First and foremost, they are meant to visualize the possibilities, and to make people enthusiastic about the potentials that designing with the urban climate offers.

All those involved – the students, the tutor from Wageningen University and the project partners from the municipality of Tiel – have thoroughly enjoyed working on this project. Together, they hope to have made a considerable contribution to 'climate proofing' Tiel.

urban climate in Tiel

Wageningen University, chair group Landscape Architecture

