



# SUSTAINABLE DENSIFICATION IN UTRECHT

*Testing the Open Space Strategy in Riverenwijk*

*Jelle Dekker - 4978110 - P5 Report, June, 2021*

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## Colofon

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All image and figure sources not made by the author can be found in the Epilogue (Reference list images)



## Acknowledgement

This thesis marks a final point in my years as a student. While the road has known many challenges along the way, I am very proud to finish the master Urbanism in the end. However, this would not be possible with the help from many close people around me. Especially in writing the thesis I had much support, for which I am grateful and who I would like to mention before presenting the final report.

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Finally I would like to thank my friends and family who supported me along the way and provided the needed distraction to create a good balance between work and relaxation. Finally I want to thank my girlfriend Noor who has always believed in me, even if I lost all sight in a successful ending.

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# PROLOGUE

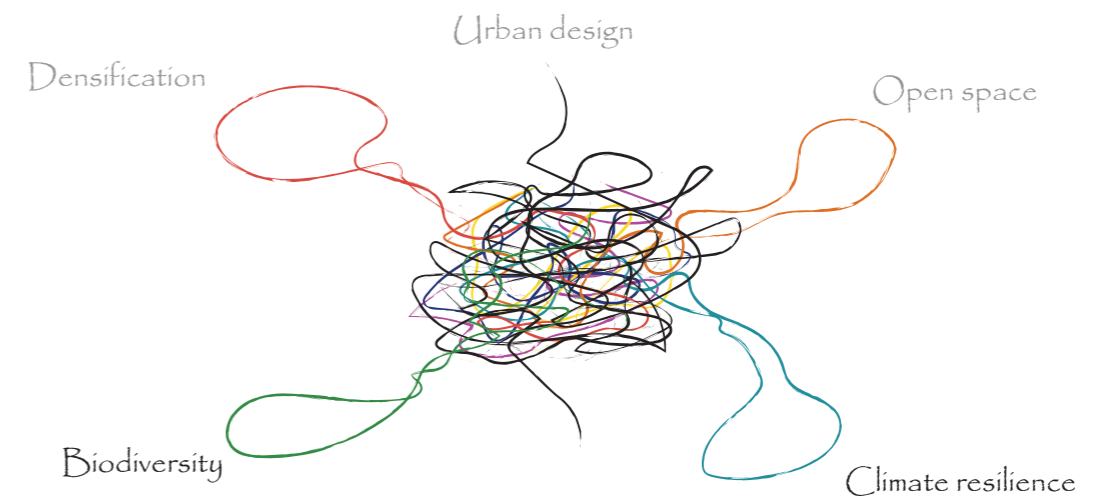
## Vision on urban design

Urban design is a complex thing. The combination of all the actors, processes, conditions, functions, actions and many more things, result in one big tangle which we call 'The City'.

I believe that as urban designers it is not our job to solve or untangle this black box, simply because that is never completely possible. What we can do however, is decompose certain layers and study them in regard to our design interventions. Trying to understand how the city works and how we can intervene in its course is a lifelong learning process and from reading the inspiring book 'Metropolis' from Ben Wilson, the city appears to be something we will never fully understand. Yet the city has been there for most of humanity and will continue to do so in the future.

In this graduation thesis I make an attempt to study some of the layers of the city. First of all, I focus on the process of 'densification' and the concept of 'open space'. Where in contrast, one strives for more built space, while the other one represents unbuilt space.

In addition, the topics of biodiversity and climate resilience in the urban environment are studied. While acknowledging there are many more interesting topics in our field of profession, the following thesis will have these four topics as a main focus.



## Personal Motivation

I often had the feedback that I am a pragmatic person. When there appears to be a problem I tend to dissect it to its origin and find the most efficient way to solve this. Practical, rational and analytical are also terms used by fellow students, friends and family to describe me as a person. This is also how I started the graduation process in September. By asking myself three reflective questions I could determine a starting point for the graduation thesis (figure 1):

Who I am?  
Who do I want to be?  
What do I like?

By firstly looking at my own personal interests and goals, I want to use the thesis project as a final step in my study in which I position myself as an urban designer and demonstrate my skills in the profession. At the same time, I want to use this last phase of my education to teach myself new things and strengthen myself in topics I am currently less experienced in. In other words, it should be the final highlight of my studies.

I should be aware that such a perspective on the graduation thesis is putting more pressure on the process. From personal experience I know that I should constantly have a reality-check in which I maintain a realistic perspective on the project, otherwise I tend to be paralysed by the pressure and lack the ability to actually work on it. By being aware of this personal pitfall and defining small steps within the process I tend to work my way through the graduation and establish a project which I can proudly call a highlight of my studies.



Fig. 1 Orientation proces

After reflecting on the three questions, described in the previous paragraph, I defined some guidelines for choosing a topic for the graduation thesis (figure 2). With a background in Landscape Architecture, studied at Wageningen University, I obtained various practical knowledge about the Dutch landscape, such as its geomorphology, vegetation and water systems. I want to **integrate this already obtained knowledge** in the thesis to demonstrate my wider perspective on urban design and planning and how this distinguishes me within the profession.

At the same time a defined **topics in which I am currently less experienced**, but are, from my perspective, essential for a skilled urbanist and should therefore be central in the graduation thesis. By putting a focus on the process of densification and urban public space, I want to become a more confident urbanist and prepare myself to face real life challenges, experienced in the Dutch urban context.

Finally, I want the scope of the thesis to be relevant, by building upon knowledge and challenges that are present in the practice of today. By researching **relevant challenges in a realistic context** I want to provide a result that illustrates my skills in the contemporary field of urbanism, while also educating myself with knowledge of topics I probably will also work on after my graduation. Providing myself, hopefully, with a favourable position in the professional world.

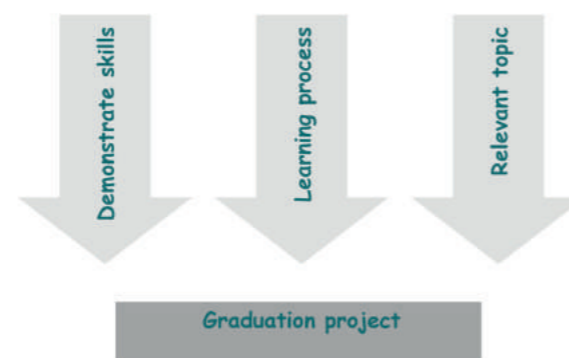


Fig. 2 Personal guidelines for the thesis

## Clarification of terms

### Compact city

The Compact city refers to a dense city, characterised by proximate development patterns, built-up areas linked by public transport systems, and accessibility to local services and jobs. All the needs of citizens (housing, work, services) are brought together in the same place. This intense use of space aims to limit the city's encroachment on agricultural and natural spaces, account for residents' transportation needs and optimize energy consumption (OECD, 2012).

### Urban liveability

The extent to which a city can satisfy the physical and psychological needs of its residents. Reflecting the quality of life within the urban context (R. Chiu, 2019).

### Open space

The term Open space covers all unbuilt surfaces in urban context which contributes to a better quality of life. Therefore, any place that makes people feel comfortable and can look into a wider space, can be called an open space.

### Biodiversity

The variety among living organisms (animals, plants, insects) in a specific place. Their existence and interrelations with each other and the physical environment represent the ecological systems.

### Climate resilient

Climate resilience is the ability to anticipate, prepare for, and respond to hazardous events, trends, or disturbances related to climate. In this research the term is applied in the urban context and the ability of the urban fabric to mitigate the effects of climate change on the urban climate.



## 1.1 Context

According to the PBL, the Netherlands Environmental Assessment Agency, three typologies can be distinguished in the context of urbanization. The rural area, which consists of small villages and mostly an agricultural landscape. The cities, these clusters of human and economical activity form important hubs in the highly urbanized landscape of the Netherlands. Finally, the commuting areas, which are dispersed urban regions around cities, connecting different cities and municipalities with each other. This results in a polycentric network of multiple well connected urban areas where almost three quarters of the Dutch population lives. This makes the Netherlands one of the most urbanized countries in Europe (PBL *Cities in the Netherlands*, 2016).

Research of the past decades shows a decrease of population in the rural areas. At the same time cities are growing and projections for the near future predict a continuous growth (figure 1.1). Most of the growth is, and will be happening, in the polycentric network of the Randstad consisting of the four largest cities of the Netherlands: Amsterdam, Rotterdam, The Hague and Utrecht (figure 1.2).

### Population

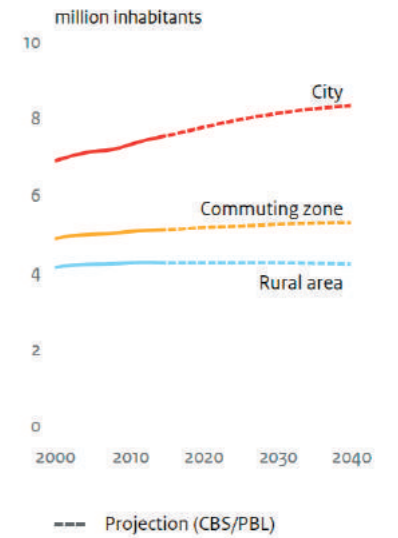
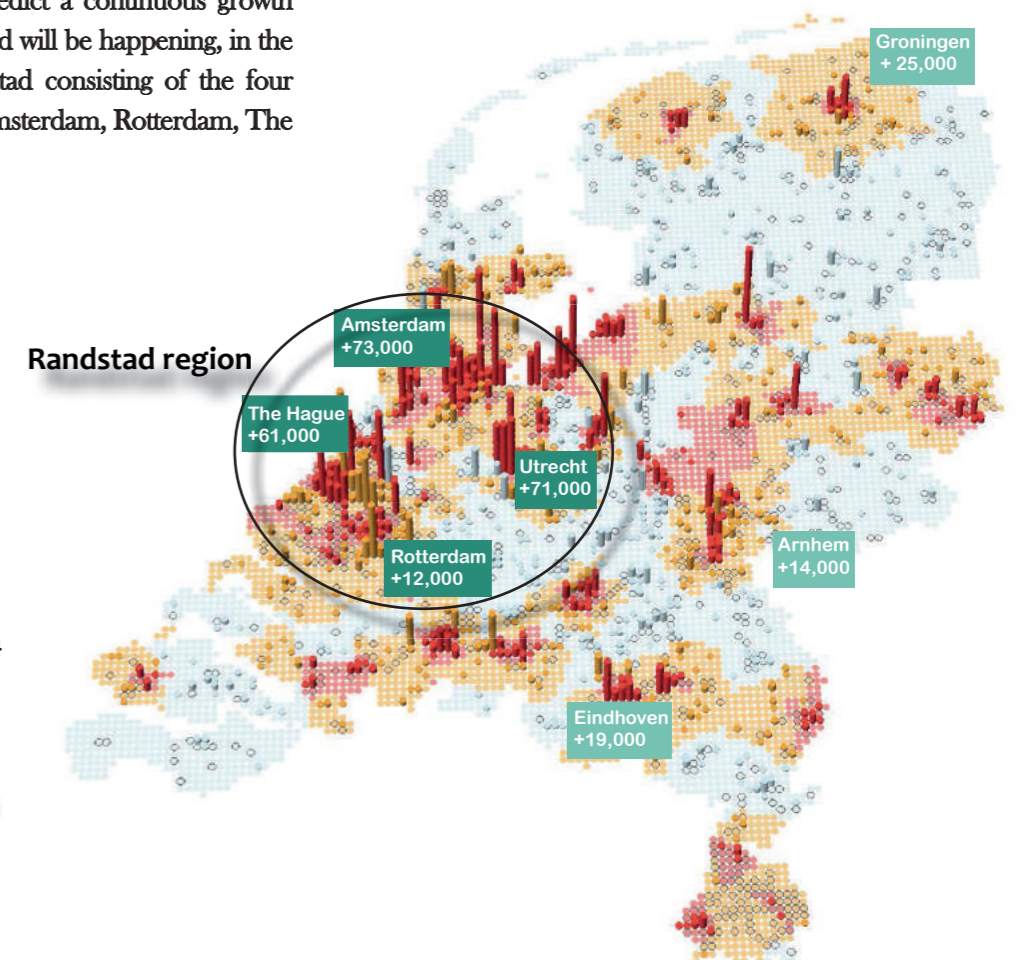


Fig. 1.1 Population development - Source: PBL (2016), *Cities in the Netherlands*



#### Population change, 2000–2014

On a grid of 2x2 kilometres  
Source: CBS, adaptation by PBL

- City
- Commuting zone
- Rural area
- Population growth in the city
- Population growth in the commuting zone
- Population growth in the rural area
- Population decline

Growth and decline smaller than 100 persons per grid cell are not shown on the map

Fig. 1.2 Population change in the largest cities in the Netherlands - Source: PBL (2016), *Cities in the Netherlands*

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- 1.1 Context
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- 1.4 Location analysis

# 1. PROBLEM DEFINITION

## Urban growth in Utrecht

While all four cities are increasing in inhabitants, there are differences in growth rate and size. The city of Utrecht has become an extremely popular settling place in the past decade. Its relative growth is the largest within the Randstad, with a growth rate of 16% over the last ten years (CBS, 2020 & figure 1.3). Looking more into the past, Utrecht experienced a steady pattern of population growth, while the other large cities had periods of shrinkage as well (P.R. Thomas, 1980).

### Growth in Utrecht

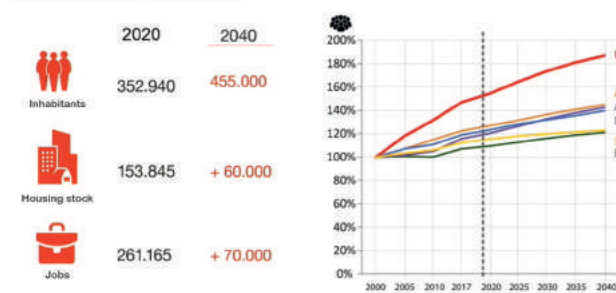


Fig 1.3 Urban growth in Utrecht - Source: RSU 2040 (2021)

In addition to the original pulling force of a city in the Randstad, the city of Utrecht has many other qualities to offer its citizens, explaining its popularity among new settlers. Its central position within the country and high accessibility with both public and private transport makes Utrecht the true turntable of the Netherlands (figure 1.4). The almost nine hundred year old city has a rich cultural heritage, manifesting in the historic city center and the many monumental buildings and parks. Together with important scenic structures like the Limes, the former border of the Roman empire, and the 'Nieuwe Hollandse Waterlinie', a sequence of fortifications and water barriers, Utrecht has a prominent place in Dutch history (figure 1.5). Finally, the city is built amidst four different landscapes, each with their own characteristics and values. The open, natural landscapes are easily accessible to escape the busy urban life, therefore boosting the recreational potential of the city (figure 1.6).

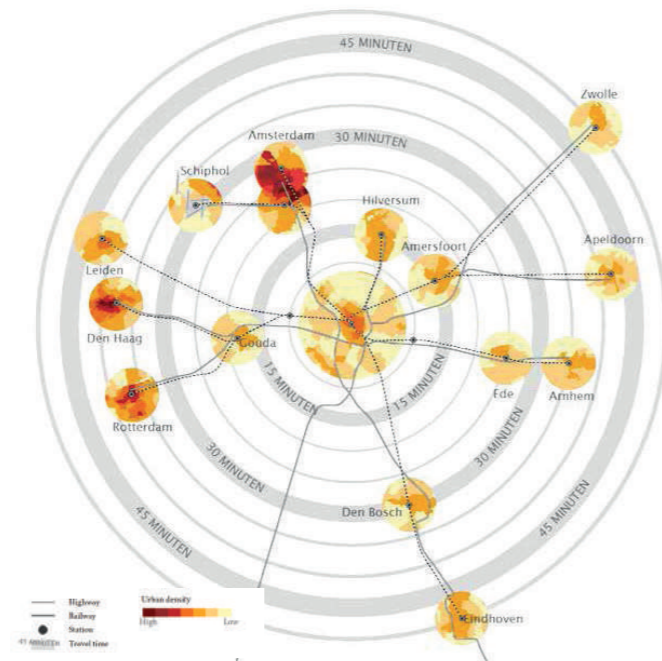


Fig 1.4 The turntable of the Netherlands

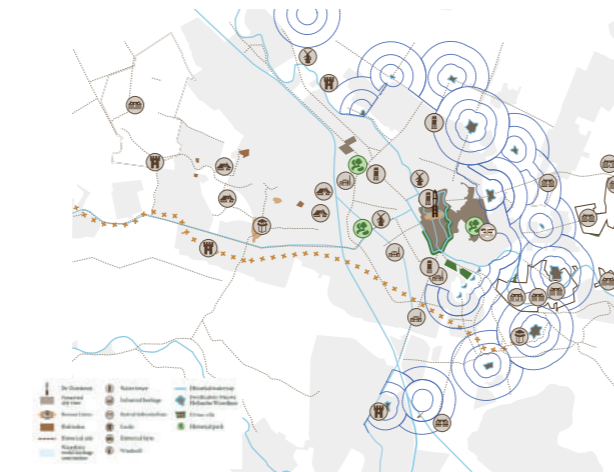


Fig 1.5 Rich history and heritage

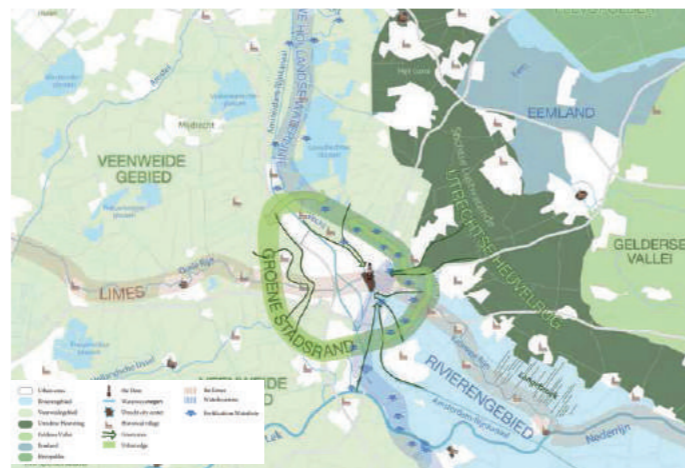


Fig 1.6 Amidst four landscapes

Images retrieved and adapted from: RSU 2040 (2021)

The popularity of the city leads to the high growth rate as shown before. The increased demand on the housing market, which was already under pressure, results in a continuous increase of housing prices. To avoid that the city becomes a privileged place for the wealthy only, the municipality of Utrecht aims to increase its housing stock ambitiously. By increasing the availability of dwellings in all price categories, people from different economic and social classes would have a chance to live in the city, keeping Utrecht the diverse city it always has been (Ruimtelijke Strategie Utrecht 2040, 2019). To provide sufficient dwellings in the nearby future, the province has planned to build between 83.000 and 108.000 new homes before 2040 in the city region of Utrecht (Provincie Utrecht, 2020). With currently containing a little over 182.000 dwellings, the city will face a huge challenge in building the additional homes (BAG, 2020). This raises the question on where and how the new citizens of Utrecht will live (figure 1.7).

Until recently, the answer to this question was to build new neighborhoods in the surrounding open landscape. The enormous housing project of Leidsche Rijn, the largest Vinex neighborhood of the Netherlands and currently housing over 41.000 inhabitants, is the most recent example of how the city deals with the growing urban population (figure 1.8). However, to preserve the vulnerable open polder landscape surrounding the city and obtaining compactness benefits, the province has shifted its focus to develop more dwellings within the existing urban boundaries (Provincie Utrecht, 2020). Hereby following the concept of the compact city, where densification within the urban boundaries is the most important strategy to deal with the housing challenge.



Fig 1.7 News article about the urban population growth and how to deal with it in Utrecht - Source: DUIC (2020)

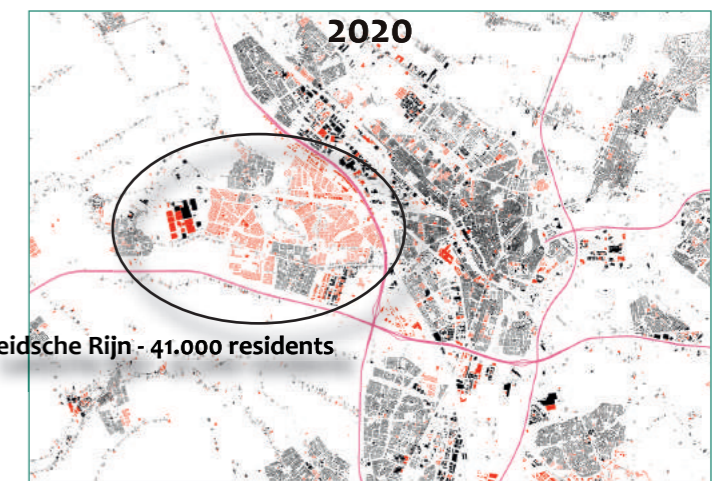


Fig 1.8 Analysis of buildings built before and after 2000 Source: BAG (2020)

## The Built Space strategy

By applying the strategy of the compact city, Utrecht needs to critically reflect on the available space within the city in search for densification potentials. Where is space for more built space? The current primary focus relies on infill development of open spaces and the redevelopment of former industrial sites. These open or outdated areas are perceived as ‘wasted space’ and offer great potential for densification. In a short period of time the municipality aims to fill these areas with large building volumes to take big steps in meeting the enormous housing challenge. The map on the right shows the calculated densification potential in red and the probable potential in brown (figure 1.9). For most of the red areas there are already plans and visions created to implement large buildings which will add many citizens to the area.

As a result of densifying other parts of the urban fabric the municipality aims to create multiple cores besides the traditional city centre. Therefore transforming from a monocentric city to a polycentric city, where multiple hotspots can take some pressure off the historical city centre away.

Monocentric city



Polycentric city



In conclusion, the city of Utrecht is facing an incredible challenge to provide enough dwellings for its growing urban population. By filling up existing open or unused spaces, the city can use its densification potentials which results in a compact city while protecting the surrounding open landscape from reckless urban sprawl. This strategy could be called the **Built Space Strategy**, where open space is filled up with as much built volume as possible.

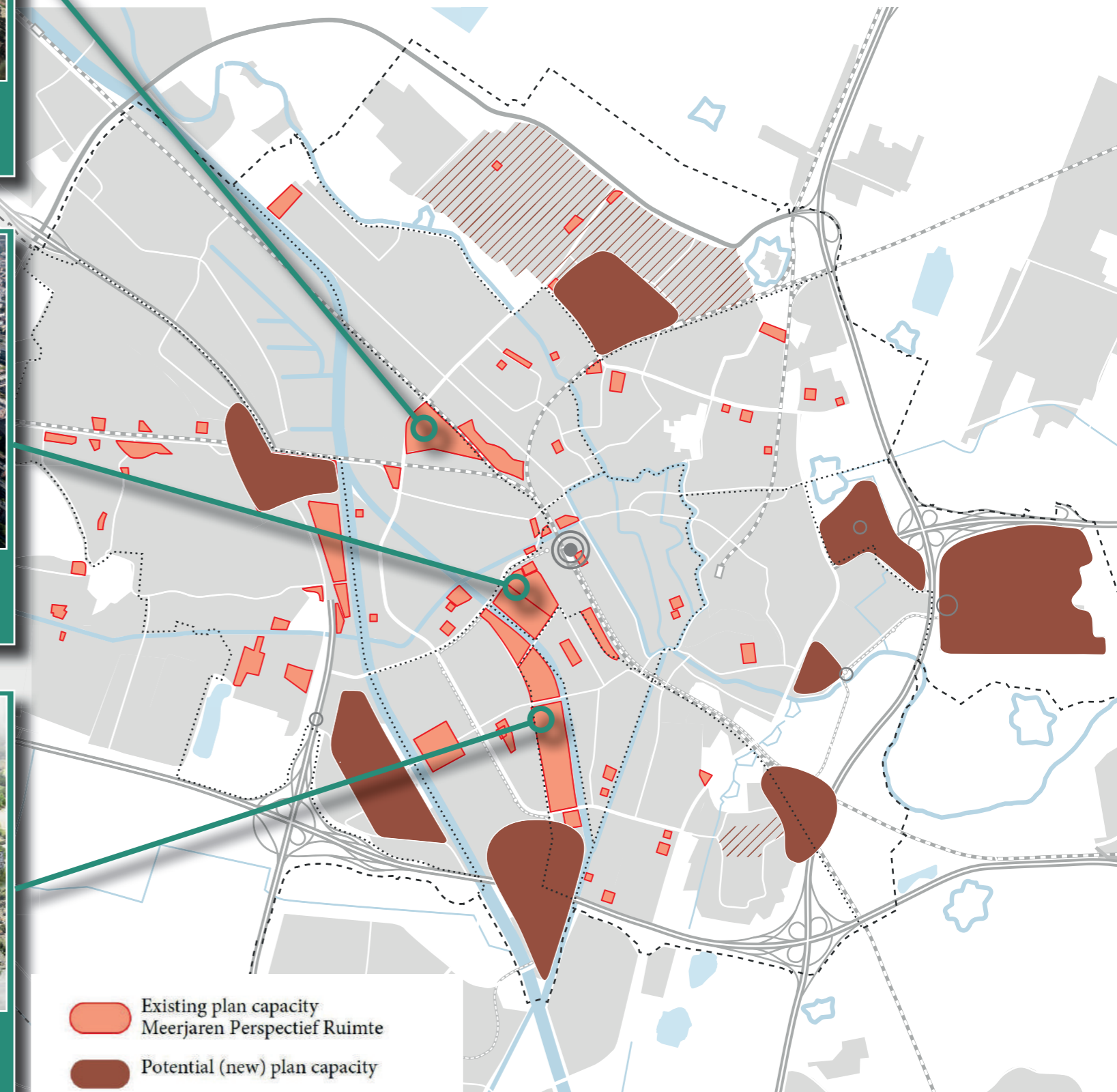


Fig 1.9 Possible densification potentials within the city boundaries - Adapted from: RSU 2040 (2021)



## 1.2 Problem analysis

As a direct consequence of the previously explained built space strategy, more people will live in the same urban area. These new citizens are obviously not limited to the new redevelopment alone, but will move around the whole city making use of the existing infrastructure, facilities and parks. How this additional pressure will affect its surroundings is often difficult to determine beforehand. Infill developments are therefore regularly seen as isolated projects, unattached from their spatial surroundings. As a result, on-controlled pressure is added to existing urban areas, changing the atmosphere of living in the city. Only if the pressure appears to suffocate the existing area, and for example obstruct its infrastructure or overcrowd its public spaces, redesigns are done in the surrounding areas to improve the integration of the infill development. With the enormous densification challenge in prospect for the coming decades, a critical reflection is needed on this **Built Space Strategy**. Is the approach of isolated infill development and its patching up redesign, the best way to implement further densification?

The interpretation that infill developments are isolated projects with no relation to their spatial surroundings is naive. These new developments consist often of new residential blocks, providing homes to live. However, cities are not only its homes, but comprehends its communities and all their spatial needs. The new citizens will therefore not only require a **home** to live in, but also **space** to live. Children need a school for their education, health centers are required to secure accessible healthcare, sport fields need to be present to fulfill the opportunity to exercise and parks are necessary to provide sufficient space to relax and escape the busy urban life. The Province of Utrecht has done elaborate research into the 'true' spatial footprint of new residential blocks, visualized in the image below (Gemeente Utrecht, 2019; figure 1.10). Adding 10.000 dwellings requires for example 5 elementary schools. Most of this spatial claim regarding facilities can often be absorbed within the new redevelopment or within its surroundings. By determining the maximum capacity of schools in the surrounding area of the infill development, it can be decided if new schools are needed, or if the additional pressure can be absorbed by the existing schools.

The largest spatial claim represented in figure 1.10 is the demand for open space. This unbuilt category consists of the green areas in the city and the water surfaces. For 10.000 new dwellings a total of 127 hectare of open space is required, which is almost never included in the infill development because here the focus is to implement as much built space as possible to meet the housing challenge. According to the research of the municipality, one additional dwelling would require 117m<sup>2</sup> of green space and 5-10m<sup>2</sup> of water surface (Gemeente Utrecht, 2019). Other research shows a similar demand for open space, like the World Health Organisation's ideal recommendation of 50m<sup>2</sup> urban green space per individual (WHO, 2012). Because this claim for open space is not met within the new redevelopment, the demand will put more pressure on other nearby existing open spaces. Infill developments, carried out in the described Built Space Strategy, will therefore mostly act in a parasitic way on its surroundings. This results in additional pressure on nearby parks, waterfronts and other open spaces for mostly recreational use. In other words, the places to escape the urban crowd will become more crowded (figure 1.11).

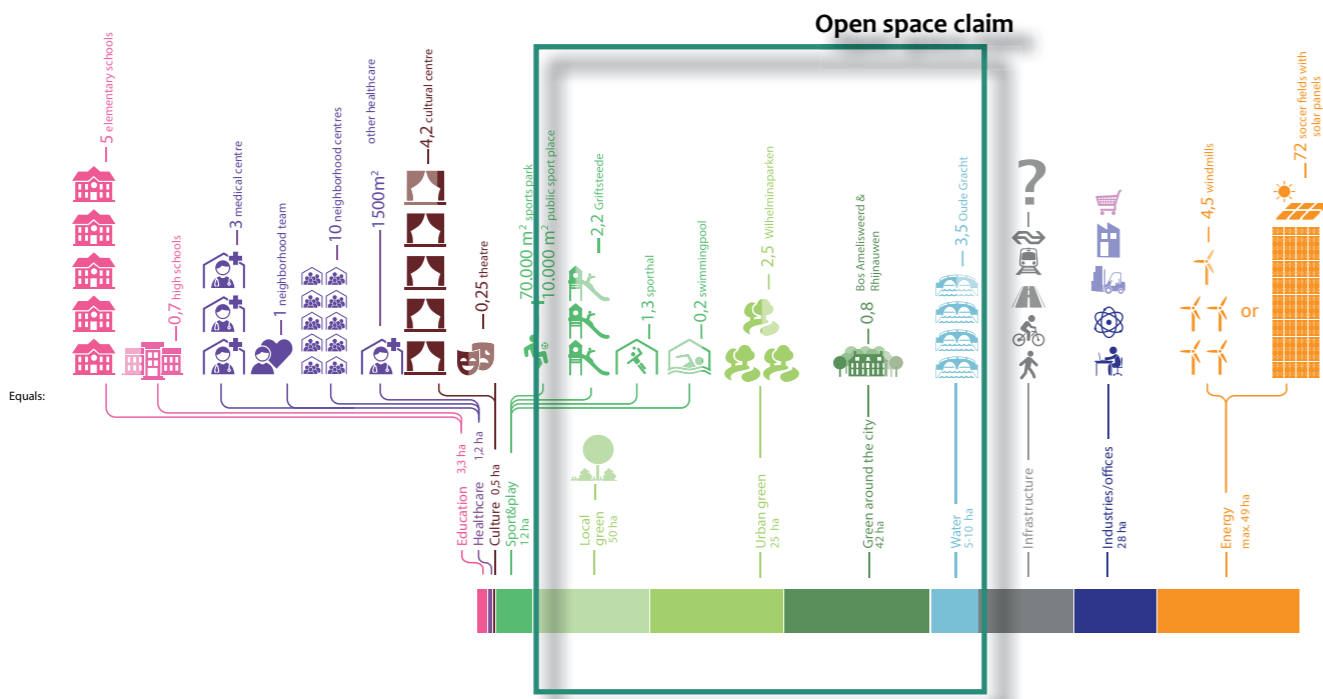


Fig 1.10 Spatial foot print of 10.000 additional homes - Adapted from: RSU 2040 (2021)



Fig 1.11 Overcrowded open spaces within the city of Utrecht  
Images retrieved and adapted from: inebuurt.nl/utrecht (2020)

## Urban liveability

How will this development affect living in the city? Therefore it is necessary to examine what role open space has within the urban context. The diagram below shows the main components of the city (figure 1.12). Inhabitants make use of both the built and open space while living in the city, both containing essential values for urban life. Like shops offer accessible goods and museums provide cultural services. While open spaces contribute to human health and well-being by creating recreational space. Therefore, both built- and open space are required for a high level of urban liveability. Urban liveability can be defined as the extent to which a city can satisfy the physical and psychological needs of its residents (R. Chiu, 2019). The role of open space is essential for urban liveability and is endorsed by many researchers. This theoretical underpinning is discussed in more depth later on, in the third chapter of the thesis (J. Yang et al 2019; A. Russo 2018; P. Balogh 2011). However, it can be concluded that insufficient available open space, as a consequence of increasing pressure, will result in a lower quality of urban life.

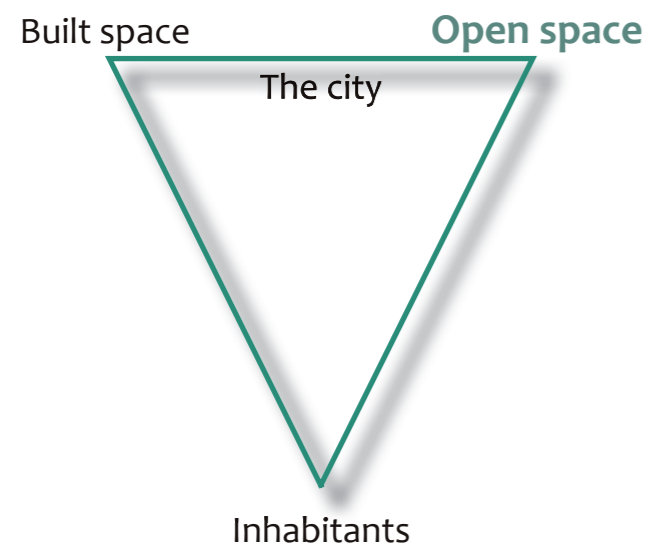


Fig 1.12 Diagram with the main components of the city

The necessity for nearby open spaces has been highlighted in the recent Covid-19 pandemic. With most countries in lockdown, our living radius has largely decreased. For many citizens the only time outside is spent in nearby open spaces, parks and playgrounds (figure 1.13). The quality of life is now magnified by the amount, size and proximity of such spaces. Urban citizens often have no, or barely access to private open space, such as gardens and balconies. Relying therefore even more on nearby open spaces for recreation and getting a breather from the quarantine. Unequal distribution of open spaces over the city is therefore in direct relation with how a city deals with spatial justice. Urban designers are greatly responsible in the process to ensure that urban living is healthy and attractive for all citizens and not only for those who can afford the best spots. A key conclusion from the problem analysis is therefore to design sufficient quantity and well distributed local open spaces within the city, to sustain a high level of urban liveability for all its inhabitants.

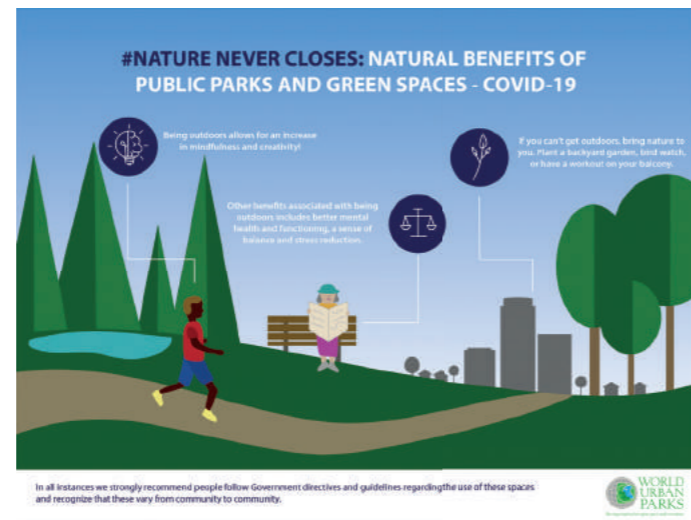


Fig 1.13 Open space in Covid-19 times

## Open space quality

A second aspect is the quality of urban open spaces. It would be naive to assume that adding sufficient quantity of open space will result in a high level of urban liveability. The way how these open spaces are designed and integrated in the urban fabric are key in contributing to more liveability. Aspects like the program, function and materialization of the open spaces determine if an actual contribution to urban liveability is made. In the history of Dutch urbanism there are many examples where this attention was lacking or wrongly executed, resulting in a poor urban living quality. Kanaleneiland in Utrecht, or the Bijlmermeer in Amsterdam are examples where there are many green open areas (figure 1.14/15). However, these neighborhoods are known for their poor living conditions. There are of course more problems in these neighborhood that harm the living conditions, but the way on how open space is designed is of great influence. It can be concluded that the role of open space regarding urban liveability should be examined from both the perspective of quantity as quality.



Fig 1.14 Open space in Kanaleneiland, Utrecht  
Source: Google Maps



Fig 1.15 Open space in the former Bijlmermeer, Amsterdam  
Source: Google Maps

## Environmental qualities

Green open spaces can have many qualities, however in the paved and artificial urban context their environmental qualities are of great importance. Providing a natural environment, clean air and a comfortable urban climate are examples of such qualities. Current trends, like biodiversity loss and climate change highlight the importance of these environmental qualities even more. A sharp decrease in global biodiversity demands action in how we live together with nature (figure 1.16/17/18). The current way of how open spaces are designed result in a poor urban liveability for the plants, animals and insects living in the city.

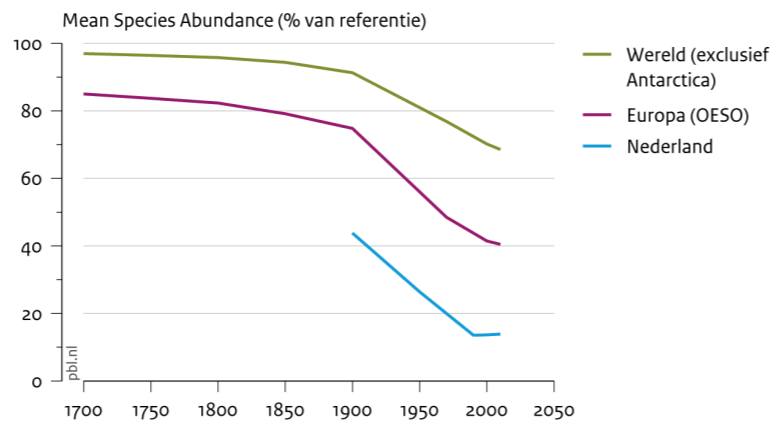


Fig 1.16 The Netherlands in the lead regarding biodiversity loss  
Source: PBL (2020)

At the same time the effects of climate change will be more common in the future (figure 1.19/20/21). More extreme weather will affect the urban climate negatively, decreasing the urban liveability for all inhabitants of the city. Mitigating these effects will become more and more a priority for urban life. Open spaces have a key role in transforming the city into more climate resilient.

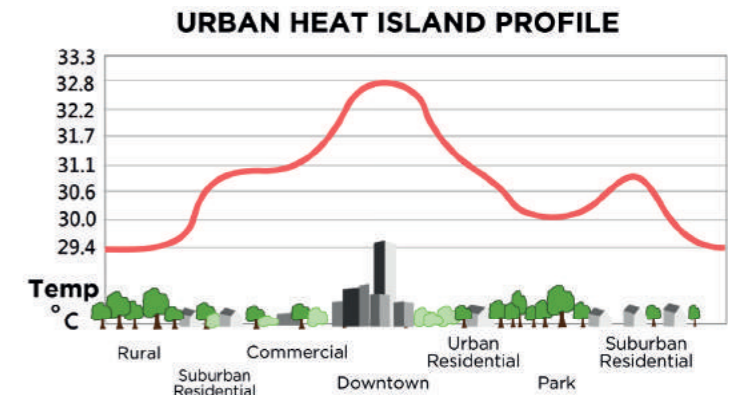


Fig 1.19 The aggravating effects of urban fabric on temperature  
Source: hitte-eilanden.nl



Fig 1.17 The abundant amount of pavement and the lack of green

## Nature inclusive open space

From the origin the city is made for humans, while the rural landscape belongs to nature. However, with the ongoing global urban expansion and the diminishing of the natural landscape, such paradigm is devastating for biodiversity. By including ecological systems within our cities, nature has a chance to restore in these new habitats. Open spaces are of great importance in this transformation towards a nature inclusive city.

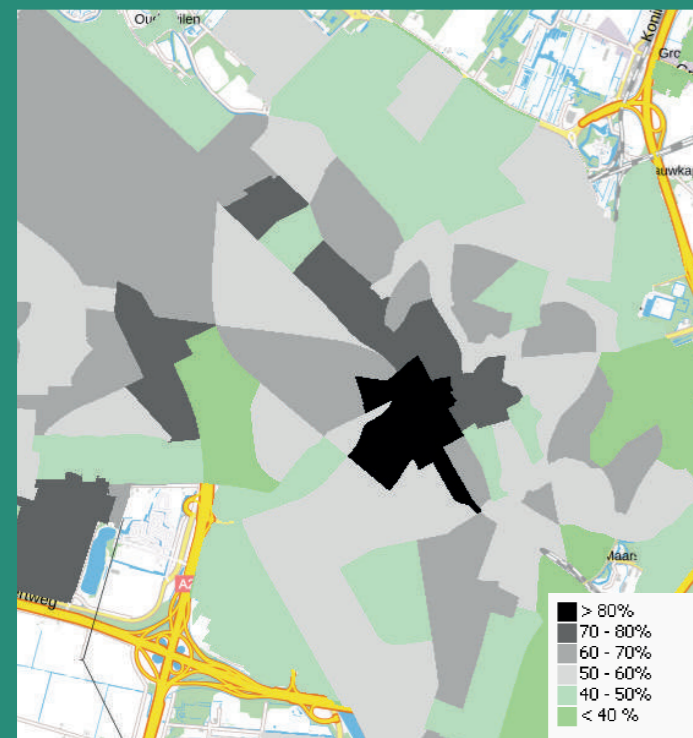


Fig 1.18 The percentage of paved surface and green in the city of Utrecht - Source: klimateffectatlas.nl

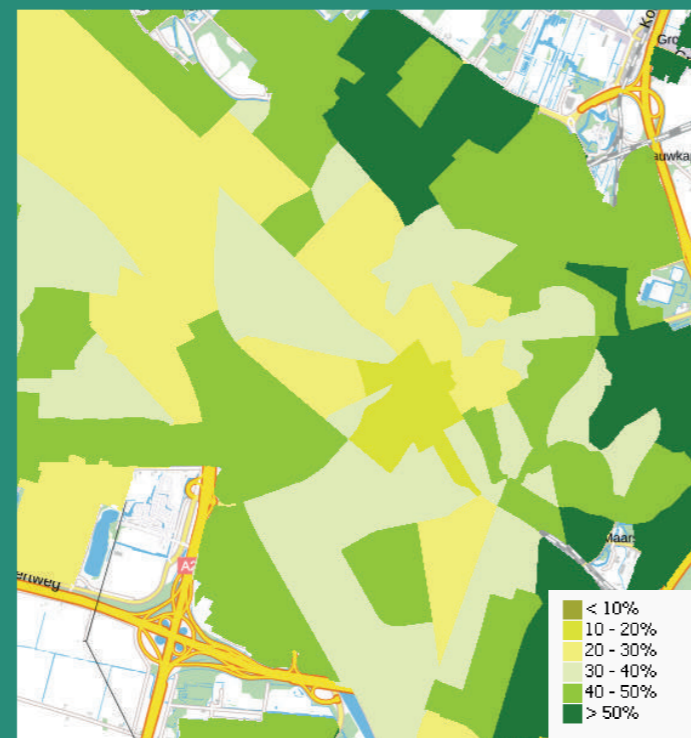


Fig 1.20 The effects of heavy precipitation in the city of Utrecht

## Climate resilient open space

The bundant amount of hard surface in cities is reducing the flexibility for current and future effects of weather extremes like droughts, the heat island effect and peak precipitation. Cities need to transform their urban fabric to become more resilient for these effects. Flexible open spaces, like parks and surface water, have a great positive effect in mitigating these effects, representing therefore a key instrument in creating climate resilient cities.

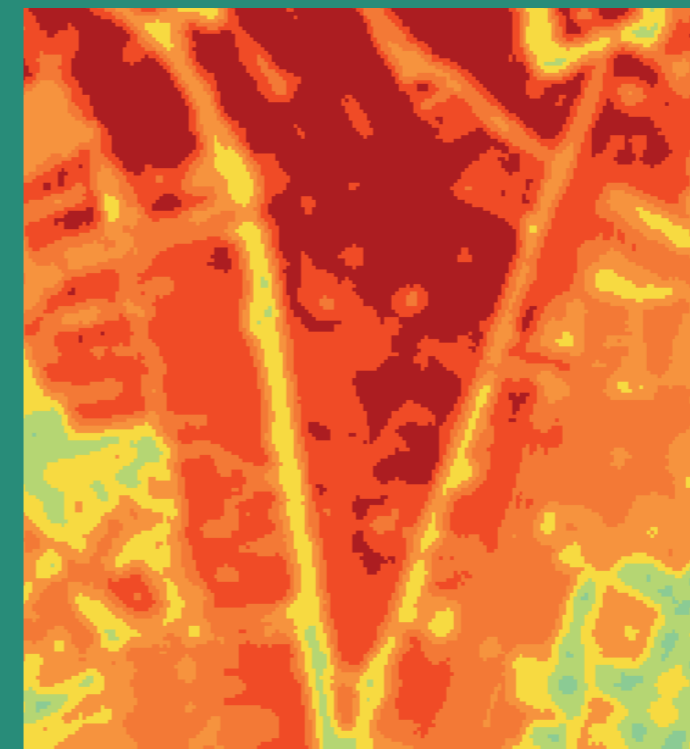


Fig 1.21 The heat island effect and the potential floodings in the city of Utrecht - Source: klimateffectatlas.nl



## 1.3 Problem statement

In securing urban liveability, the problem analysis concludes that the concept of urban open space should be approached from both the quantitative- as well as the qualitative perspective. Where in this thesis the integration of environmental qualities are highlighted.



## 1.4 Location analysis

To test the hypothesis of the Open Space Strategy a more specific location in the city of Utrecht is selected. Suitable is the neighborhood of Rivierenwijk. This post-war neighborhood has a central location in Utrecht, in close proximity to the popular historical city centre. However, there is a great orientation for car mobility with many asphalt roads and parking lots. While the area has a low dense character, with mainly row housing, adjacent are plans for a large-scale infill development. On the former industrial site of the Merwedekanaalzone a densification project is planned for approximately 10.000 new homes. While Rivierenwijk is protected by its artificial water barriers of the Merwedekanaal and Vaartsche Rijn, acquiring the character of an island, this new dense neighbor will cause much additional pressure on the available open spaces in the neighborhood.

In terms of living quality, the figure below shows the performance score of Rivierenwijk compared to other neighborhoods in Utrecht (figure 1.22). It can be concluded that in terms of sustainability Rivierenwijk is performing very poorly. Redesign of the urban fabric is needed to improve sustainability standards like micro climate, amount of green and sustainable mobility. The new planned infill development of the Merwedekanaalzone is very ambitious regarding both density and sustainability. When carried out well integrated, the redevelopment could contribute to the living standards of Rivierenwijk. It is promising that the municipality acknowledges this potential and has the ambition to include Rivierenwijk in the upgrading of the area (neighborhood conversations, utrecht.nl).

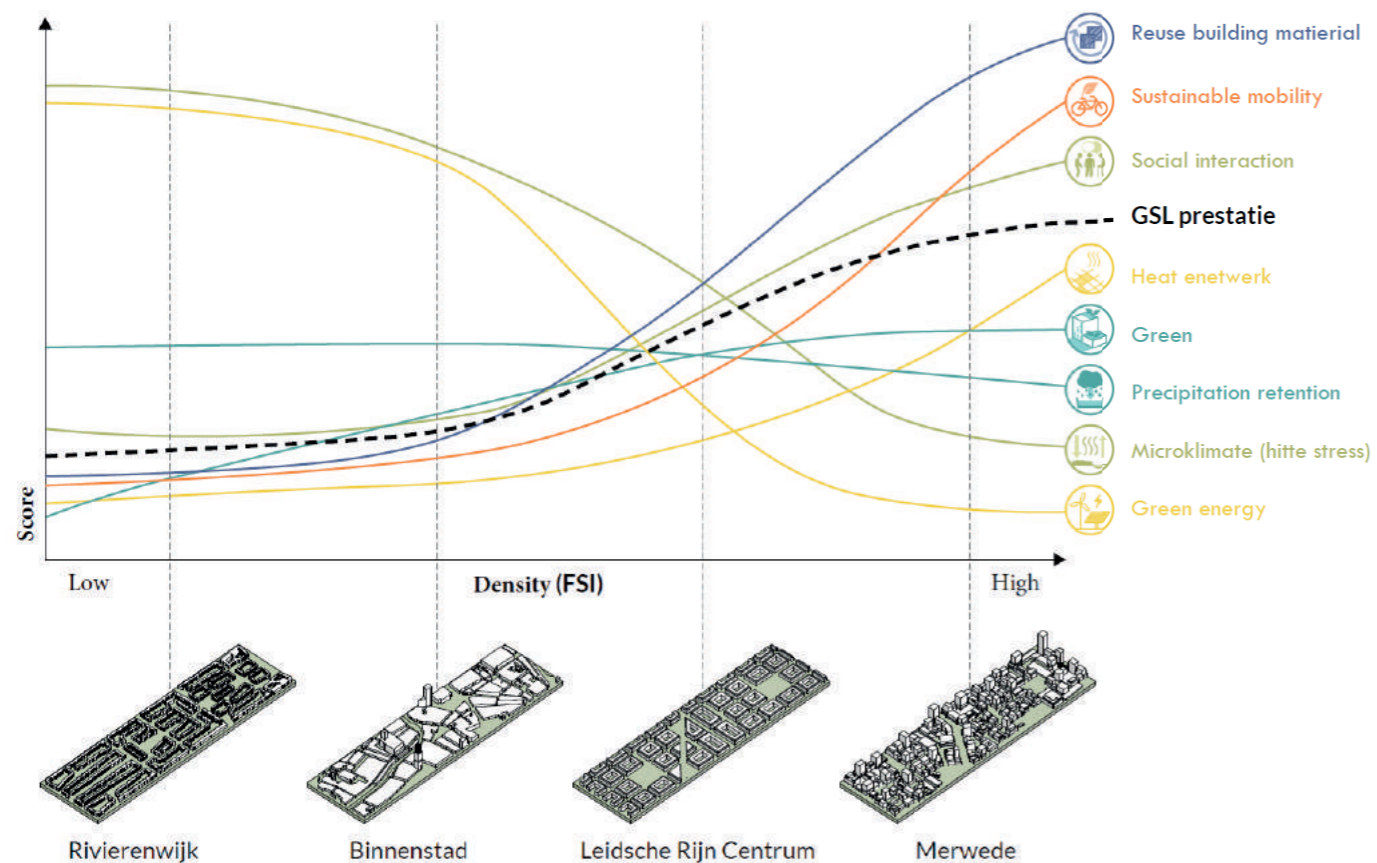


Fig 1.22 Performance score of Rivierenwijk compared to other neighborhoods in Utrecht - Source: Stedenbouwkundig Plan MERWEDE (2019)



Fig 1.23 Overview of Rivierenwijk in the context of Utrecht - Source: Google Maps

The historical analysis shows the development of the triangular neighborhood over time. Starting as a ribbon village along the Vaartsche Rijn, until becoming an integral part of the city of Utrecht.

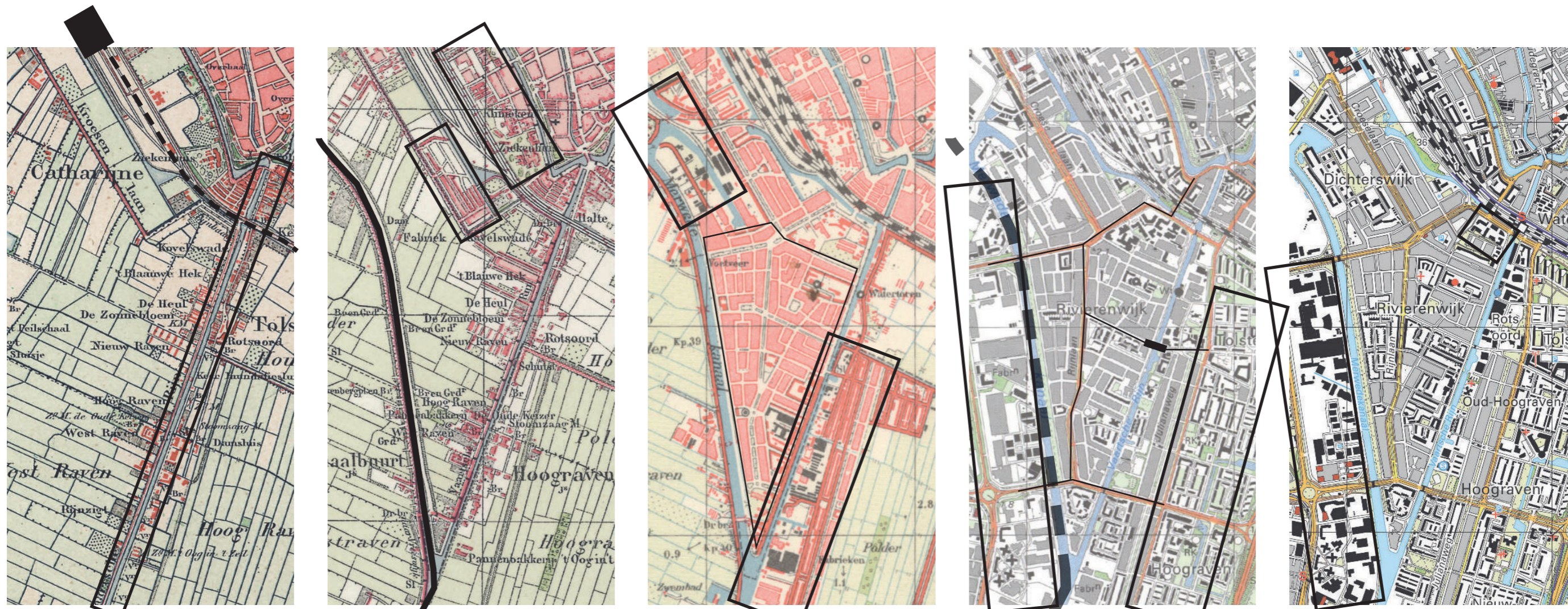


Fig 1.24 Development of Rivierenwijk over time - Source: topotijdreis.nl



View on the Vaartsche Rijn, where the straight line of the canal is accentuated with a large tree line



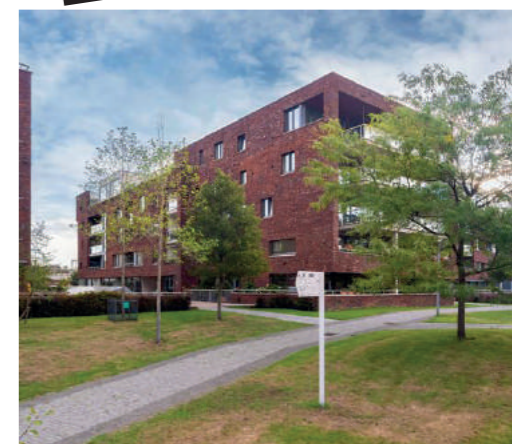
New city expansion in the North of Rivierenwijk, along the Croeselaan



The industries of Hoograven, developing across the Vaartsche Rijn



The Merwedekanaal became because of the redirection of cargo ships a popular location for rowing



Redeveloped facilities of the university of Utrecht, into a car free compact neighborhood

Fig 1.24 Historical pictures of Rivierenwijk Source: SERC foto's

**1890**

- Central station + railway network
- Vaartsche Rijn (1850), connecting Utrecht with the Lek river
- Ribbon development (lintbebouwing) along the canal

**1930**

- City expansion outside of the singels
- Merwedekanaal (1892) leading cargo ships around the city

**1950**

- City expansion on the 'island'
- Developing industries along the canals with the required infrastructure

**1995**

- Amsterdam Rijn canal (1952) making the Merwedekanaal obsolete
- Building of the Oranjebrug (1957) across the Vaartsche Rijn
- Further city development, Kanaleneiland (left) and Hoograven (right)

**2019**

- Redevelopment of industries and large facilities into compact mixed-use neighborhoods



This chapter explains in detail the research framework of the thesis project and will present the base structure on how the research is executed. First an overview of the research approach is given, which functions as a roadmap for the project. Hereafter, the research questions are posed, where answering the main research question provides input to reach the research goal. More detailed are the sub research questions, these specific questions form the building blocks to answer the main research question. For each sub research question methods are allocated to provide a strategy on how to answer the questions. To conclude the methodology chapter, the conceptual framework is constructed to provide a clear and legible overview of the research.

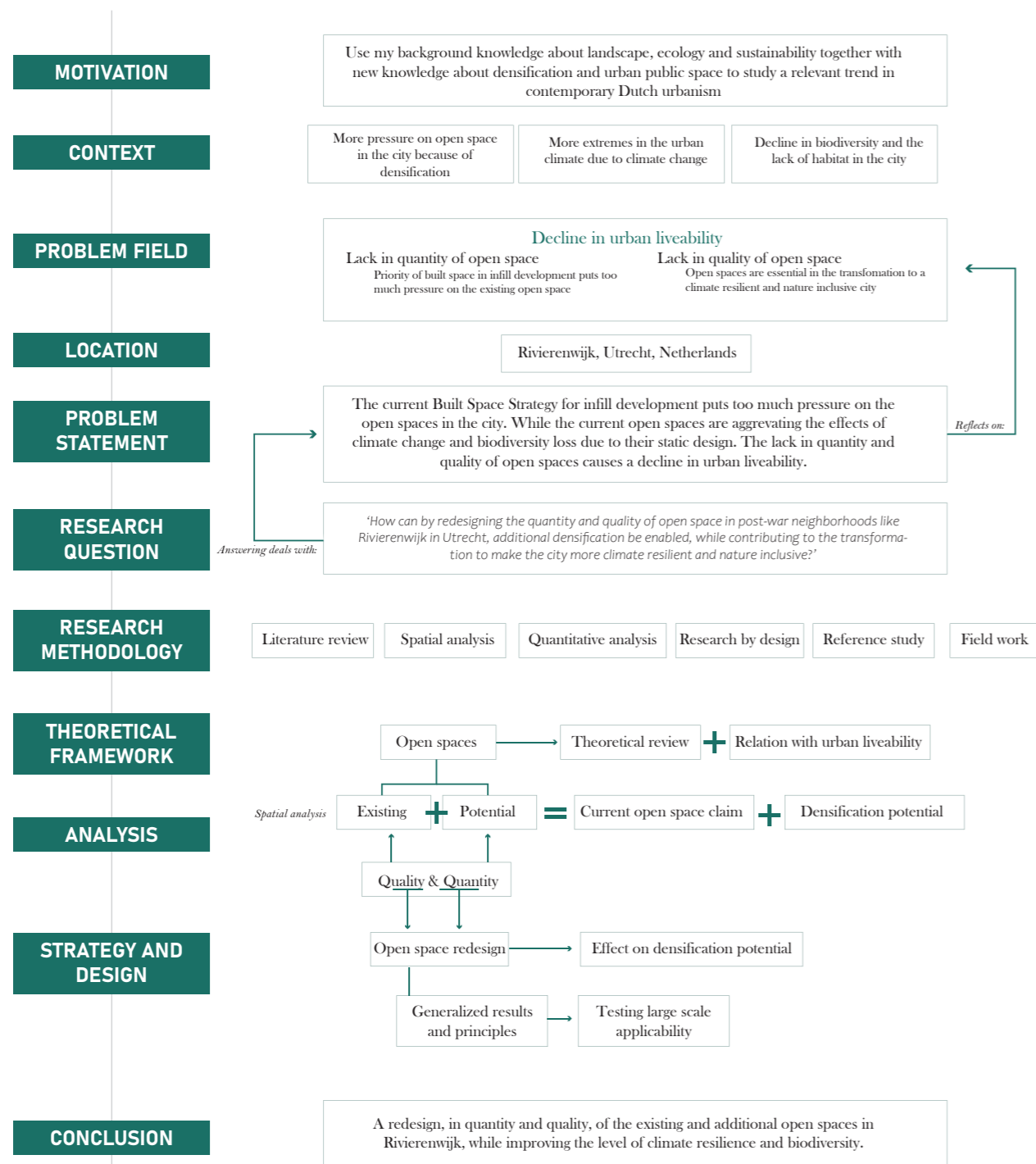
#### Contents:

- 2.1 Research framework
- 2.2 Research questions
- 2.3 Research methods
- 2.4 Conceptual framework
- 2.5 Timeline
- 2.6 Limitations & considerations

## 2. METHODOLOGY

## 2.1 Research framework

To provide a clear overview on the process of the research a framework has been created. Here, the steps from context and problem to analysis, design and conclusion is legible visible.



## 2.2 Research questions

Central in the research is the main research question, which is defined as:

### Main research question

How can by redesigning the quantity and quality of open space in post-war neighborhoods like Rivierenwijk in Utrecht, additional densification be enabled, while contributing to the transformation to make the city more climate resilient and nature inclusive?

The result of this research project is to meet the research goal, which is defined as follows:

### Research goal

A redesign, in quantity and quality, of the existing and additional open spaces in Rivierenwijk, while improving the level of climate resilience and biodiversity.

To answer the main research questions the following sub research questions are defined:

### Sub research questions

#### SRQ1

What is the qualitative and quantitative condition of available open space in Rivierenwijk and how does it relate with densification?

#### SRQ2

What are the opportunities to improve the quality and quantity of both available and potential open space in Rivierenwijk to enable densification potential?

#### SRQ3

How can a redesign of available and potential open space improve the conditions for balanced densification?

#### SRQ4

Which elements of open space redesign can be upscaled into generalized design principles for implementation in similar neighborhoods in Utrecht?



## 2.3 Research methods

### Main research question

How can by redesigning the quantity and quality of open space in post-war neighborhoods like Rivierenwijk in Utrecht, additional densification be enabled, while contributing to the transformation to make the city more climate resilient and nature inclusive?

Research Outcome	Sub Research Questions	Description	Diagram
<b>PART 1</b> An assessment of the available and potential open space in the Rivierenwijk and how it relates with the spatial claim carried out by current and future residents.	<b>SRQ 1.</b> What is the qualitative and quantitative condition of available open space in Rivierenwijk and how does it relate with densification?	This question looks at the concept of available open space in Rivierenwijk. What are the specific criteria for available open space and what is the quantity and quality of these spaces. Also, how does the quantity relates to the built space and a possible densification potential.	
	<b>SRQ 2.</b> What are the opportunities to improve the quality and quantity of both available and potential open space in Rivierenwijk to enable densification potential?	This question looks at the concept of potential open space in Rivierenwijk. What are the specific criteria for potential open space and what is the quantity and quality of these spaces. Also how does the quantity relates to the built space and densification potential.	
<b>PART 2</b> Design proposals of three locations within Rivierenwijk where according to the different criteria of available open space a set of design interventions are presented.	<b>SRQ 3.</b> How can a redesign of available and potential open space improve the conditions for balanced densification?	This question looks at how a redesign of available and potential open space can work out in three practical locations in Rivierenwijk. Also how do the design interventions affect a balanced densification potential.	
<b>PART 3</b> A strategy combined with a set of generalized design principles to implement the Open Space strategy on similar locations in Utrecht and scale up the effect of open space redesign.	<b>SRQ 4.</b> Which elements of open space redesign can be upscaled into generalized design principles for implementation in similar neighborhoods in Utrecht?	This question looks till to what extent results of the research can be generalized for implementation on similar locations in Utrecht. What principles or tools can be defined to also have sustainable densification in other parts of Utrecht and what is the potential of upscaling the strategy.	

### Main research question

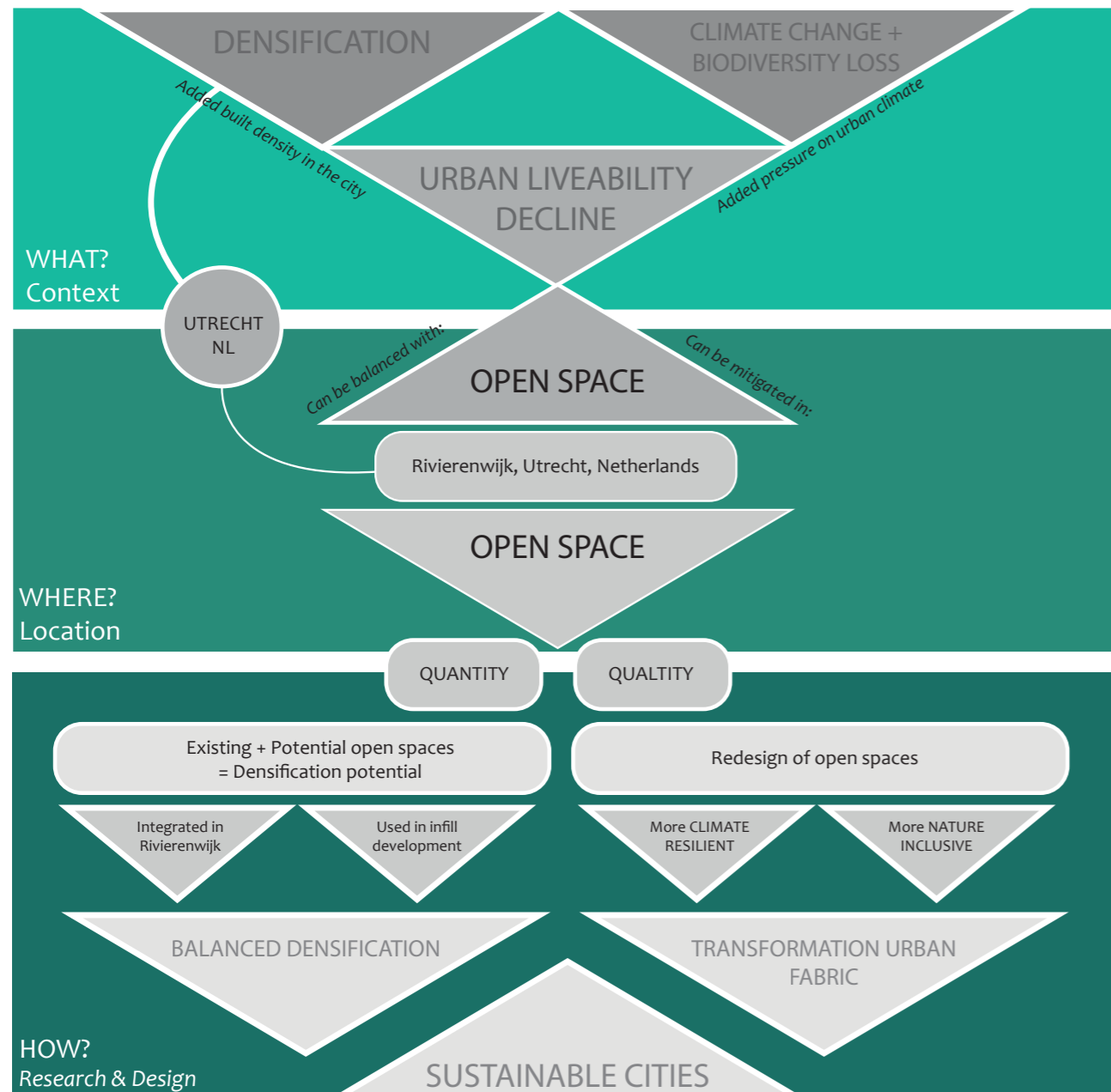
How can by redesigning the quantity and quality of open space in post-war neighborhoods like Rivierenwijk in Utrecht, additional densification be enabled, while contributing to the transformation to make the city more climate resilient and nature inclusive?

Research Outcome	Sub Research Questions	Research Methods	Specific Research Outcome
<b>PART 1</b> Design proposals of three locations within Rivierenwijk where according to the different criteria of available open space a set of design interventions are presented.	<b>SRQ 1.</b> What is the qualitative and quantitative condition of available open space in Rivierenwijk and how does it relate with densification?	<ul style="list-style-type: none"> <li>- A <b>Literature review</b> of the conditions and requirements of open space in the urban context.</li> <li>- <b>Open Space analysis</b> with Qgis software to create an overview of existing open spaces.</li> <li>- <b>Fieldwork</b> to research the qualities of the existing open spaces.</li> </ul>	<ul style="list-style-type: none"> <li>- <b>Qualitative analysis</b> on the performance of open space regarding climate resilience and biodiversity.</li> <li>- A <b>Densification analysis</b> in Qgis to determine the current level of built space and the amount of residents.</li> </ul> <p>By answering this question it should be clear what the existing amount of open space is in Rivierenwijk and what kind of qualities they got. In addition, more insight is required on how built space relates to the pressure on open space.</p>
	<b>SRQ 2.</b> What are the opportunities to improve the quality and quantity of both available and potential open space in Rivierenwijk to enable densification potential?	<ul style="list-style-type: none"> <li>- A <b>Literature review</b> of the concepts of the urban climate and the nature inclusive city.</li> <li>- <b>Reference study</b> on nature based solutions to mitigate the effects of climate change and stimulate urban ecology.</li> <li>- A <b>Typology study</b> to define the different spatial types in the area.</li> </ul>	<p>By answering this question more it should be clear how open space can be redesigned to obtain more quantity and quality. In addition, it should be clear how an increasement in quantity affects the densificaton potential.</p>
<b>PART 2</b> An assessment of the available and potential open space in the Rivierenwijk and how it relates with the spatial claim carried out by current and future residents.	<b>SRQ 3.</b> How can a redesign of available and potential open space improve the conditions for balanced densification?	<ul style="list-style-type: none"> <li>- <b>Scale comparisation</b> to get a better understanding on the size of the design locations.</li> <li>- <b>Fieldwork</b> is done to percieve the lived space of the design locations.</li> <li>- <b>Qualitative analysis</b> on the performance of the design locations regarding climate resilience and biodiversity.</li> <li>- <b>Research by design</b> is used to translate solutions and strategies to the Rivierenwijk.</li> </ul>	<p>By answering this question will become clear how the Open Space strategy will apply on several practical design locations. It is explored by redesign how open space quality an quantity enables a sustainable densificaton potential.</p>
<b>PART 3</b> A strategy combined with a set of generalized design principles to implement the Open Space strategy on similar locations in Utrecht and scale up the effect of open space redesign.	<b>SRQ 4.</b> Which elements of open space redesign can be upscaled into generalized design principles for implementation in similar neighborhoods in Utrecht?	<ul style="list-style-type: none"> <li>- By creating a set of generalized principles and interventions a <b>strategy</b> can be created to implement results of the project on the larger scale.</li> <li>- <b>Morpho-typological analysis</b> of neighborhoods in Utrecht to determine its applicability on the larger scale by collecting similar situations.</li> </ul>	<p>By answering this question it will become clear how the strategy of defining the densification potential from the perspective of open space can be generalized to be applied on similar locations in Utrecht.</p>

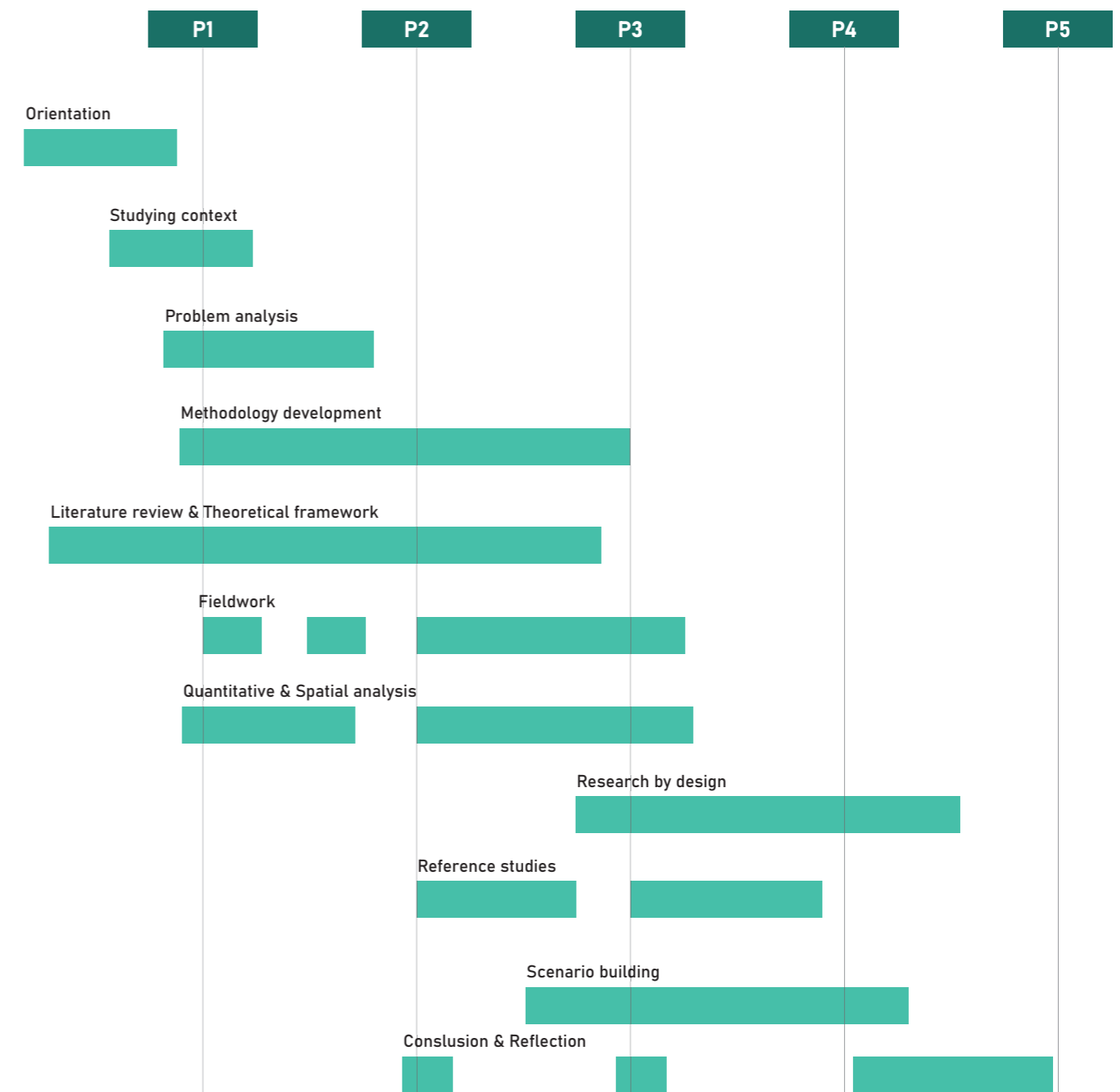
## 2.4 Conceptual framework

The conceptual framework combines large, general trends of densification, climate change and biodiversity loss as a starting point for the research. These trends have a negative effect on the quality of life in the city. To mitigate and balance the effects, which decrease urban liveability, open spaces are essential and therefore the central element of this project. By intervening in the quantity and quality of the open spaces desirable results can

be achieved. Aligning the amount of added built space with the carrying capacity of open space will lead to well balanced densification. Redesigning the quality of open spaces will contribute to the city's transformation to become more climate resilient and nature inclusive. Resulting in more sustainable cities with a high quality of urban life.



## 2.5 Timeline



## 2.6 Limitations & considerations

In conclusion, this research will research the hypothesis of the Open Space strategy, where trends of densification, climate resilience and biodiversity are assessed from the quality and quantity of open space. The project is structured to first understand the relation between open space and densification and how the bandwidth of both topics can and should be adjusted. Hereafter, the relation between open space and climate adaptation and biodiversity is addressed to provide also a design of qualitative sufficient open spaces. Finally, the results are generalized and researched if and how they are applicable on other similar situations in Utrecht.

### *Research limitations*

This research will focus on the quantity and quality of open space in the urban context. While both sides are of great importance they both have research limitations which have to be taken into account. Determining the quantity of open space is done by a quantitative analysis. This can be an endless process, attempting to map every square meter which can be found in the neighborhood, while this is not also contributing to better import for the research. It is important during this process to find the balance between preciseness and usefulness. Assessing quality of open space is a diverse topic. By using the perspective of climate resilience and biodiversity a certain point is taken on how open spaces do and should perform. Although acknowledging other qualities of open space, like stimulating social cohesion, active behaviour or identity, they are not addressed in this research.

### *Ethical considerations*

In proceeding with the research for the thesis, field work will be an essential part on how to collect information. During observations on location the anonymity of the users of the urban space must be conserved to preserve their privacy. This applies for activities like photographing, behavior observations, interviews and other undertaken research methods that include humans.

While conducting research to create better cities for its (new) inhabitants, the perception of the researcher on the topic of liveability should be taken into account. By analyzing from both the perspective of the inhabitants and science, a design can be made that will limit the objective reasoning of the researcher.

### *Scientifical/Societal relevance*

The challenge of providing sufficient affordable dwellings to all the new inhabitants, is heavily influencing both the living conditions within the city as its accessibility. By only focusing on densification the city can become an overcrowded place with no space to breath and relax. While the importance of open space for liveability is clear, the lack of direct financial benefits can be an incentive to only focus on adding as much dwellings as possible. By creating a framework where sufficient open space is included and as important as build space, the quality of life of the new inhabitants is more secure. Simultaneously, the housing shortage in Utrecht is enormous, causing a sharp increase of rental- and housing prices. This results in reducing the accessibility of living in the city for many people. If this trend is continued the city will become only a place for wealthy people, while all that cannot afford will be pushed out and doomed to long commuting. Adding more dwellings for all income groups in the nearby future will release tension on the housing market and keep the city accessible for all.



#### Contents:

3.1 Urban liveability

3.2 Open space

3.3 Open space & urban liveability

3.4 Conclusion

## 3. THE CONCEPT OF OPEN SPACE

### 3.1 Urban liveability

In a liveable city there is a delicate balance between built space and unbuilt, open space. Public open spaces, like parks, squares, waterfronts and green areas are valuable for recreational purposes and to ‘decompact’ in the compact city (Mouratidis, 2019). With an increase in built space, due to densification projects, more open spaces will be filled in. At the same time new residents will create additional pressure on the existing open public spaces. As a result, remaining public open spaces could become more scarce, while at the same time facing the risk of overcrowding by the larger growing urban population. The prospect of no place nearby to escape the busy city life is not a pleasant one and will most certainly negatively affect the quality of living in the city. With much attention to the housing shortage and the need to create more built space in the city, the importance of open spaces are often disappearing into the background. At the same time, built space has a strong financial incentive, while public space is rather perceived as an expense (Ring et al., 2020). To construct a stronger argument for the importance of open spaces in contrast to built space, this chapter looks at the relation between open space and urban liveability. By reviewing what the most important qualities are of open spaces and why they contribute to a higher quality of urban living, the fragile balance between built space and open space can be more equally weighed.

In the first part the concept of urban liveability is discussed. How is the quality of life in the city assessed and what spatial factors are important. Hereafter the concept of open space is explored. By researching different definitions and perspectives of open space in the urban context, a better theoretical understanding of the spatial construct is composed. After elaborating on the two concepts, a more direct relation between them is established. By answering why open space contributes to a higher urban liveability and what spatial characteristics play an important role, a strong tangible argument can be created for the importance of open space in the densifying urban fabric.

The aim of this first part is to provide more insight in the concept of urban liveability. Dissecting the term results in the words ‘urban’ and ‘liveability’. Here liveability refers, according to the Cambridge Dictionary, to “the degree to which a place is suitable or good for living in” (Liveability, n.d.). While this definition does not imply human living specifically, the general debate about liveability is from the human perspective. The concept is therefore concerned with maximizing the performance and the integrity of human life in any living environment (Ellis & Roberts, 2016; Hagerty et al., 2001). Especially when the combination is made with the urban context. The same dictionary describes urban as “in a city or town” (Urban, n.d.). This artificial type of living environment is constructed by and for humans, and therefore reflects a certain adjustability in any direction desired. This could explain some of the wide interest in the concept, because it implies that we as humans are both able and responsible to create a living environment that maximises human performance regarding quality of life. It has to be acknowledged that this is yet a broad definition which, because of the heterogeneous nature of cities, crosses multiple disciplines. This essay will research the concept into more depth from the perspective of urban planning and urban design. This, with the intention to create more insights in the theoretical understanding of what the spatial characteristics are of quality of life in the city. Hereby providing input on how to improve the quality of life in the city by (re)designing the physical urban environment.

According to Rebecca Chiu urban liveability can be defined as “the extent to which a city can satisfy the physical and psychological needs and demands of its residents” (Chiu, 2019). Therefore, performing an assessment with the focus on human behaviour-environment relationships. Here it is argued that urban planners and designers have a main objective to enable a physical environment so it can serve its human inhabitants, satisfying their needs to the best possible. More specifically, liveability is achieved by making cities vital, accessible, controllable, attract continuing investment and stimulate human activities.

A more interdisciplinary definition of urban liveability is discussed by Enrique Aliste, who argues that the perceived notion of liveability is more complex. From this perspective, the well-being and social cohesion of residents is a result of the material conditions of architecture and urban design in combination with the access to goods and services (Aliste, 2019). Liveability is therefore not only something that can be achieved from designing the physical conditions, but is also a confluence from the more intangible aspects like available services and goods. With services in the broadest sense, like accessible health care or environmental services like clean air. Taking this into account, urban design and planning should pursue a holistic view of liveability, where it is acknowledged that not everything can be achieved by design and that interdisciplinary collaboration is necessary. Finally, Aliste argues that all the aspects of liveability should support a healthy and sustainable lifestyle, giving more depth on the practical completion of what liveability is.

This perception that urban liveability means a healthy and sustainable lifestyle is also argued by Noah Quastel. Here, the degree of meeting the needs and demands of its human residents is, as with Chiu, still the core of urban liveability. However, a stronger stand is taken on how these needs should be fulfilled. Promoting for example a compact walkable city reflects on how urban design can contribute to a more healthy city with a sustainable transportation mode (Quastel, 2017). By designing the urban environment urban designers and planners have a large influence on how the inhabitants live their life. Taking a responsible stand on how these topics of health and sustainability are integrated within the profession should therefore be clear. Quastel also makes the interesting notion that urban liveability is not only about the needs and demands of humans, but of nature as well. By acknowledging that the city is also a place for living things, other than humans, a less human-centric perspective is constructed. The more developing and popular concept of a nature-inclusive city is in a similar line, where designing the city should also provide a suitable living environment for natural ecosystems (Stiphout, 2019; Vink & Vollaard, 2017).

With various definitions of urban liveability explored, the second aspect to elaborate on is the practical use of the concept. In the process to design healthy and liveable cities various indices have been developed to rate cities on how well they perform regarding liveability. Such complex grading systems attempt to approach cities in a holistic way and rate the performance of different domains of urban life. Exploring such indices reveals the complexity of rating the intangible concept of 'liveability'. The index of Higgs et al. for example, describes in an extensive way the domains of transport, social infrastructure, employment, walkability, housing, green infrastructure and environment and provides a methodology on how to rate each aspect (Higgs et al., 2019). The indicators of how urban liveability is assessed is, because of the heterogeneous nature of cities, under constant debate. The work of Khorrami et al. provides a comprehensive review on how the parameters of assessing liveability can vary in time and between countries. They conclude that, while there is a lot of similarity among the indicators used for evaluation, there are 'no simple techniques that can be used to compare liveability across countries and time periods' (Khorrami, et al., 2020). While acknowledging the practical purpose of the concept of urban liveability to assess city performance, this essay will not go into depth on how rating the specific domains of liveability is done. Instead, a review will be done about how urban liveability relates to the physical environment and therefore to urban design and planning.

Going back to the general definition of urban liveability, it is about how the urban environment can fulfill the needs and demands of its human residents. Here the urban context is built up from different components that all contribute to achieve liveability. This is well explained in the conceptual diagram in the work of Mohamad Kashef (figure 3.1). Visualized is how different components, like economic development, infrastructure and biodiversity play a role in the conceptualization of liveability (Kashef, 2016). Interesting is that there is a clear distinction between natural systems and built systems, which both are of equal importance in providing liveability. Similar conclusions can be taken from the diagram from the work of Valcarcel-Aguiar and colleagues (figure 3.2). With this simplified diagram

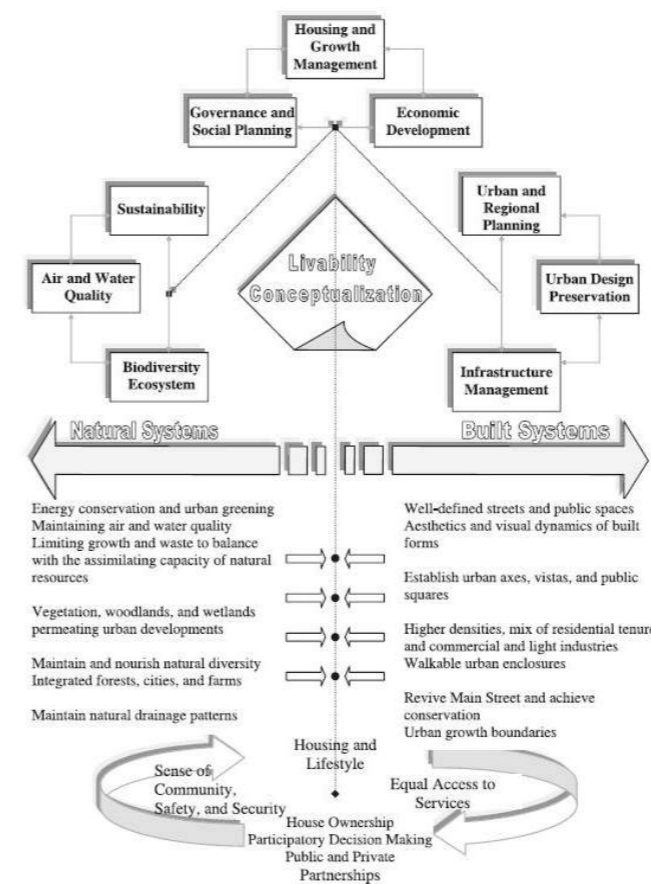


Fig 3.1 Conceptualization of urban liveability, by Mohamad 2016

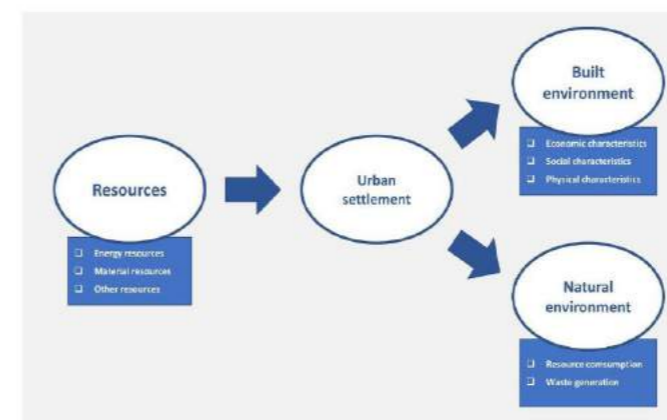


Fig 3.2 Conceptualization of urban liveability, by Valcarcel-Aguiar et al., 2019

it is explained that urban settlements, and sustainable liveability within them, is dependent on both the built environment as the natural environment (Valcarcel-Aguiar et al., 2018). Here the built environment refers to 'those elements created by humans', like buildings and infrastructure. While the natural system includes the 'biological characteristics of nature', which can be described as ecosystems and their ecoservices.

With these notions about the two systems and their importance for urban liveability, some conclusions can be taken regarding urban design and planning. The main task of urban designers and planners is to maximize the urban liveability for the human residents. By doing this, the focus is often much on designing the built environment. Where buildings are needed to provide homes and space to work and designing safe walkable infrastructure makes the city easily accessible. However, from the literature review it is clear that an integration of both the built system as the natural system is required. In other words, space for ecosystems and natural processes should be included as much as the built environment to achieve urban liveability. Trees can for example improve the air quality, while providing shade and a comfortable urban climate. Green areas have a positive effect on human health, and offer space to exercise or for recreation. While surface water can store extreme precipitation and prevent floods in the mostly paved urban environment. By acknowledging the two sides, built and natural, in the concept of urban liveability urban designers and planners have to design for both these systems in an equal manner, if to maximize the quality of urban life.

## 3.2 Open space

In this second part the concept of open space in the urban context is discussed. Over time and between different scholars the concept of open space has known many definitions. This is well analysed by Yang and colleagues in their analysis of open space types in urban context (Yang et al., 2018). Their collection of open space definitions is interesting to understand the concept from different perspectives. In the US 1961 Housing Act for example, open space is defined as any undeveloped land within an urban area. While framing these spaces as undeveloped, it is acknowledged that these spaces have value of recreation and entertainment, as well of history and landscape (Greenwood et al., 1987). A more detailed is the definition of Alexander who defines open space as ‘any place that makes people feel comfortable, has a natural basis, and can look into a wider space, can be called an open space’ (Alexander et al., 2002). Hereby not only addressing the physical conditions, like unbuilt and with natural elements, but also referring to a certain atmosphere that is carried out in the space. Following the thought of a natural basis is the definition of Takahara, who argues that open space are all the green areas in the city. Hereby making a distinction between public green space and private green space (Takahara et al., 1983). Opposing this statement is the work of Heckscher who believes that open space is not only the natural environment in the urban context, like green and water surfaces, but includes artificial grounds such as squares and roads as well (Heckscher & Robinson, 1977). There is also the definition that open space refers to relatively open, less closed space, while being accessible and open to the masses for the majority of people. Therefore including not only the landscapes like parks and green spaces, but also the squares, streets and alleys (Wang, 2004). Interesting in these last two definitions is the addition of roads and streets, which represent the infrastructural layer of the city. With the main purpose to provide a network to move through, roads and streets have a different function than parks, which have the main purpose to let people reside for a longer period of time. However, the well-known work of Jan Gehl, who highlights the importance of the street as a public space, makes this difference in function,

move through or reside, more diffuse (Gehl, 1987). After this introduction to the multilateral definition of open space, the different characteristics of the concept are discussed in more detail. Hereby providing more insights to formulate in the end a comprehensive and logic definition. The last part of the essay will examine this definition of open space in relation to the concept of urban liveability.

The first characteristic of open space is that there is a certain ‘openness’ in the area, or as Alexander frames in its definition: ‘in which you can look into a wider space’. This would mean that there are no objects blocking the view, leaving a wide open space. In the urban context this would mean that an open space is unbuilt, or at least that buildings are scattered, with enough space in between them to create a diffuse open atmosphere. Taking the natural elements, like trees or high scrubs, as objects that can block a wider view is more complex. Most given definitions refer to parks, green or natural areas as open spaces, but an open view is not self-evident. Especially when there is older and more dense vegetation, as in parks with a forest-like character. Although in many parks there is a variety between open- and enclosed spaces, the criteria of ‘an open view’ will not always include parks as an open space. Naturally there is a difference between dense vegetation and a building block, because vegetation is still porous in terms of light, sound and wind permeability, stimulating an open atmosphere. Therefore to be more specific, the criteria of openness for an open space could be interpreted more in a holistic way, including also other senses than vision, while judging a space more on the openness of the palpable atmosphere.

A second aspect of open space is the criteria of accessibility by the urban residents. Therefore discussing if the space is open to the general public, or if there are more restraints in entering the space. Takahara makes for example the distinction between public- and private green open space. Here the focus is on the green character of the space, which makes private gardens still an open space while this is not accessible for the general public.

Public green are for example parks or waterfronts which are for all residents open to visit. The definition of Wang argues that open spaces have to be open for the majority of people, hereby including non-green spaces like streets and roads and excluding private green spaces like front- and back yards. The criteria of accessibility is intertwined with the function of the open space. How and by who the open space is used, relates to the question if the space is actually usable. Giving open space a specific function, like for recreational purposes, is also described by Stevens with the term ‘open space amenity’. Hereby defining open space as an amenity which is ‘desirable or useful for the community’, referring to parks, sports areas or promenade (Stevens, 2009). This raises the interesting issue if open space needs to be accessible as a public space to be useful for the community. If there is, for example, an enclosed natural space in the city which can store extreme precipitation and prevent floods elsewhere in the city, while the trees in the area provide clean air, this non-accessible space is still useful for the community. However, from the perspective of urban design and planning, space in the city also tends to be a scarcity. Therefore designing multifunctionality in space, like a green area which buffers water, provides clean air but also is accessible for recreational purposes, makes much more sense. Finally, public space is susceptible for (re)design, because of the common ownership of the space. Where private space is owned by individuals, who can deny a design intervention. Open space from the perspective of urban design and planning has therefore often a public character.

A last interesting aspect of open space is the topic of walkability. If stating that all unbuilt, public spaces in the city are open space, then this will also include roads, streets and parking lots. However, these spaces have a main function for transportation in the infrastructural network. Here the definition of Alexander is once again interesting, claiming that open spaces are spaces that ‘make people feel comfortable’. A main function for transportation infrastructure is to provide space to get somewhere else, to move through. Especially with motorized

traffic there is a main focus on moving quickly through the network, without paying much attention to the surroundings and experiencing comfort. By claiming space for fast mobility, other users are automatically excluded from using the space due to safety issues. Slow mobility however, like cycling and walking, offers possibility for more experiencing of the surroundings. It could be said that the slower the mobility the more awareness of the surroundings is experienced. Hereby blurring the line between space for movement and space to reside. This follows the work of Jan Gehl where streets are also important public spaces to meet, socialize and play. Looking again from the perspective of urban design and planning, where space should be multifunctional, space for motorized traffic is much less useful. Where walking paths, streets or even bicycle roads can be of much more value for the urban community due to their allowance for other functions than movement. The concept of walkable open space is therefore interesting to highlight in the discussion of what makes open space.

In preparation for the final part, where the contribution of open space to urban liveability is researched, an attempt is made to construct a comprehensive definition of open space from the perspective of urban design and planning.

### Open space definition:

The concept of open space covers all the unbuilt surfaces in the urban context, which are publicly accessible and provide a comfortable walkable condition. Therefore, any place that makes people feel comfortable and can look in a wider space can be called an open space.

### 3.3 Open space & urban liveability

From the literature review the concept of urban liveability can be defined as the extent to which a city can satisfy the physical and psychological needs of its residents. Designing the physical urban environment, urban designers and planners have a great influence on how these needs and demands can be met. The main concern of the profession should therefore be to achieve high standards of urban liveability, by providing as much spatial quality as possible. It is discussed that this can be done by working with built systems as natural systems, both of equal importance. The concept of open space covers mainly the unbuilt, public and walkable space in the urban context. In practice, this concerns spatial elements like parks, streets, squares and waterfronts. Open space is therefore a key element in working with the natural system. It is in these spaces where ecosystems can exist and ecoservices, that contribute to urban liveability, can be integrated. While there is a strong link between open space and the natural system, this is always the case. Often open spaces are designed in an artificial way, functioning more as an extension to the built system. Large paved squares with only a few trees, or the sidewalks in streets dominated by car parking are perceived as open space, but contribute little to the values provided by the natural system. In a city where space is scarce most of the time, open spaces should pursue as much quality as possible. Especially with urgent environmental trends as climate change and biodiversity loss, more should be expected from urban open spaces. Making smarter combinations in function, or shifting priorities to enable more multifunctionality should be of great concern for urban designers and planners.

Integrating more space for natural ecosystems in open spaces is a way to mitigate the effect of climate change and make the urban fabric more climate resilient. Open soil and wadis can buffer extreme precipitation, while trees provide shade and surface water can cool down its surroundings. Working more in an integral way with the natural system will also make the city more a suitable living environment for other organisms than humans, creating a nature-inclusive city where biodiversity can

recover. Many discussed definitions of open space have the criteria that only spaces with a natural bias should be referred to as open space. In the paved and stony urban environment only few spaces, like parks, have such a natural bias, therefore excluding enormous amounts of space as 'not open space'. This space is then easily adopted as an extension of the built system. What if it could be the other way around, where all the unbuilt, public and walkable space is defined as open space, but at the same time there is a requirement that open space should have a strong integration with the natural system to provide urban liveability? The result would be that much more environmental qualities will exist and be intertwined in the city. Enriching the city in many ways.

In the context of a densifying urban fabric more people will live in the same area, putting more pressure on available open space for recreational purposes. The risk of overcrowded open spaces will improve the level of stress for the residents looking for a place to escape busy urban life, with different negative health issues as a result. Therefore it is urgent to not only look at the quality of urban open space but to the quantity as well. Redesigning existing monofunctional space to serve as open space will be an important objective for urban designers and planners. A shift in function could be by reducing the space for motorized traffic, as roads and parking lots. In most urban environments enormous amounts of space is dedicated to the single function of parking and moving motorized vehicles, leaving no possibility for multifunctionality. Degrading the dominant role of the car in the city can open up large amounts of space, which can be redesigned as public, walkable open space within the natural system, to improve the level of urban liveability.

### 3.4 Conclusion

By discussing different definitions and practical uses of urban liveability from existing literature, it becomes clear that it is a complex concept. The definition of quality of urban life crosses multiple disciplines and it can be intensely debated on what 'quality' actually is. However, some common ground can be found from the perspective of urban design and planning regarding designing an environment which meets the needs and demands of the residents as much as possible. This means including both the built system as the natural system, where in the second system open space is a key element. While in this essay a definition of open space is constructed, based on other literature regarding the concept, it should be understood from the context of this research.

Placing the concept of open space in the context of urban liveability much is discussed about how the natural system can and should be intertwined in open spaces. In these unbuilt areas ecosystems have a chance to exist, in contrast to the built system where artificial elements like building and infrastructure creates a barrier with the natural layer. Following this reasoning environmental qualities regarding liveability are more highlighted and while important, it should be acknowledged that many qualities of open space are therefore not discussed. Public open spaces have many social benefits in stimulating social interaction and community building. Community gardens are for example green open spaces that offer a change for social meetings and collective activities.

However, with urgent environmental trends, like climate change and biodiversity loss, it is in these open spaces that great improvements can be done to make the urban fabric more climate resilient and nature-inclusive. A first step would be to acknowledge that to create urban liveability we need the natural system just as much as our artificial constructed built environment. If we want an attractive urban climate we need water and vegetation to provide cooling and shade. If we want plants and flowers to decorate the city and the sound of birds, we need to dedicate space for ecological processes and for

nature to develop. Therefore a less human centric attitude, like already proposed by Noah Quastel, is needed when designing the urban fabric. By acknowledging that we, humans, are not the only inhabitants that live in the city, we can approach the city as a much richer habitat where there is also space for other organisms contributing to a high quality of urban life in the city.





- Contents:
- 4.1 Open space scale & definition
  - 4.2 Open space quantity
  - 4.3 Relation with built space
  - 4.4 Open space quality

# 4. AVAILABLE OPEN SPACE

This chapter consists of the analysis of open space in Rivierenwijk, therefore providing input for the first sub research question. In contrast to the current Built Space strategy, where there is a focus on adding built volume, this thesis examines the hypothesis of the Open space strategy. In this approach, the densification challenge is examined from the perspective of existing, or available, open space and its 'carrying capacity' for taking in more users as a result of densification. In the chapter a basic understanding is provided about which

spaces can be defined as 'available' open space. By creating a set of specific criteria, the actual quantity of available open space can be established. Hereafter, the relation between this quantity of open space and the built space is discussed, to see how the current pressure on open space is and if there is a potential to densify. Besides the quantity, the quality of the available open space is researched, with a focus on climate resilience and biodiversity performance.

**SRQ 1**

What is the qualitative and quantitative condition of the available open space in Rivierenwijk?

<b>Topic</b>	<p style="text-align: center;"><b>Scale and definition</b></p> <ul style="list-style-type: none"> <li>- Defining the scale of open space</li> <li>- Establishing a specific definition with clear criteria</li> </ul>
<b>Quantity</b>	<p style="text-align: center;"><b>Quantitative research</b></p> <ul style="list-style-type: none"> <li>- Quantitative analysis</li> <li>- Analysis of the built space</li> <li>- Determining pressure on open space</li> </ul>
<b>Quality</b>	<p style="text-align: center;"><b>Qualitative research</b></p> <ul style="list-style-type: none"> <li>- Review existing sources on liveability in Rivierenwijk</li> <li>- Conducting interviews</li> <li>- Environmental qualities</li> </ul>

## 4.1 Open space scale & definition

Open spaces exist in many sizes, varying from large public parks to small local playgrounds. Research shows that open spaces larger than 1,5 hectare can contribute greatly to urban liveability, even if they are in a larger radius. Smaller open spaces are often only valuable to those who live in a close proximity. Therefore this research makes a distinction between urban and local open spaces. Where urban open spaces should be larger than 1,5 hectare, while local open spaces should be in a 500 meter walk. With these distinctions a diagram can be made on how to analyse the open spaces (figure 4.1).

This distinction is similar to the spatial requirements provided by the municipality. Here too open space is subdivided in local green, urban green and green around the city (figure 4.2). In this research the focus will be on the availability of local open space, so the fine network of nearby open spaces. However, before addressing the definition and criteria for local open space, first an analysis is presented about the urban open spaces around Rivierenwijk. Such large open spaces are of great importance and it should be studied how this network performs from the perspective of Rivierenwijk.

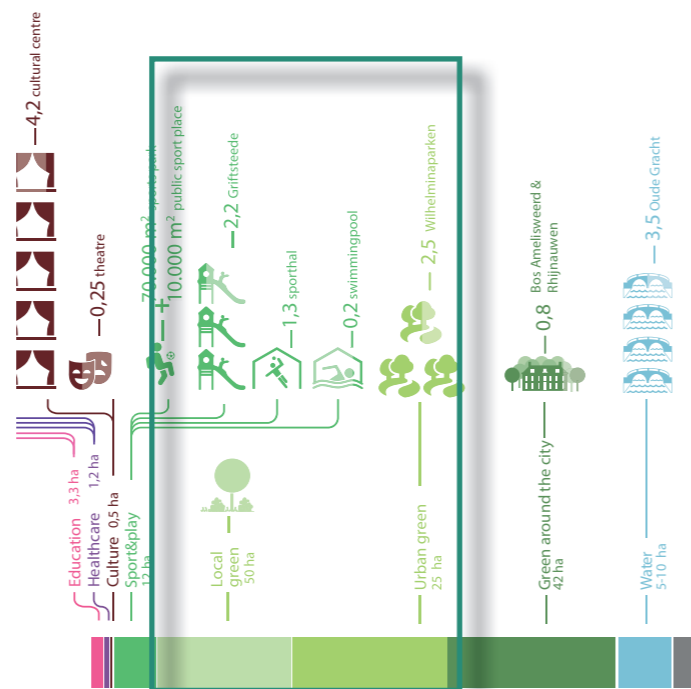


Fig 4.2 Open space claim of 10,000 dwellings  
Source: RSU 2040 (2021)

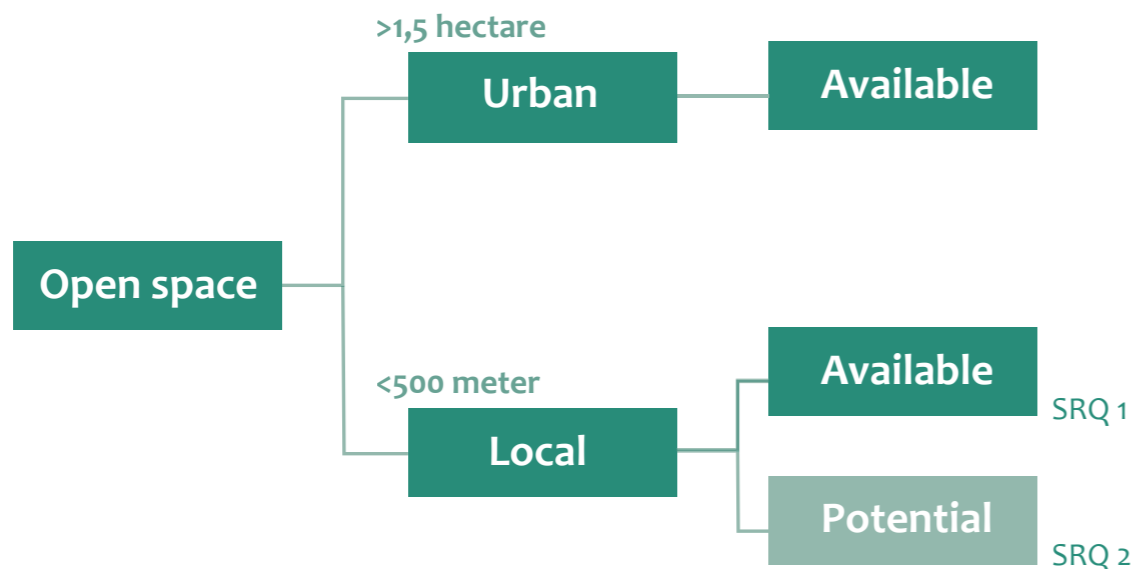


Fig 4.1 Strategy for the quantitative open space analysis

### Park Transwijk

Area **175.000 m<sup>2</sup>**  
Distance **1.700 m**

### Wielingenplein

Area **3.000 m<sup>2</sup>**  
Distance **400 m**

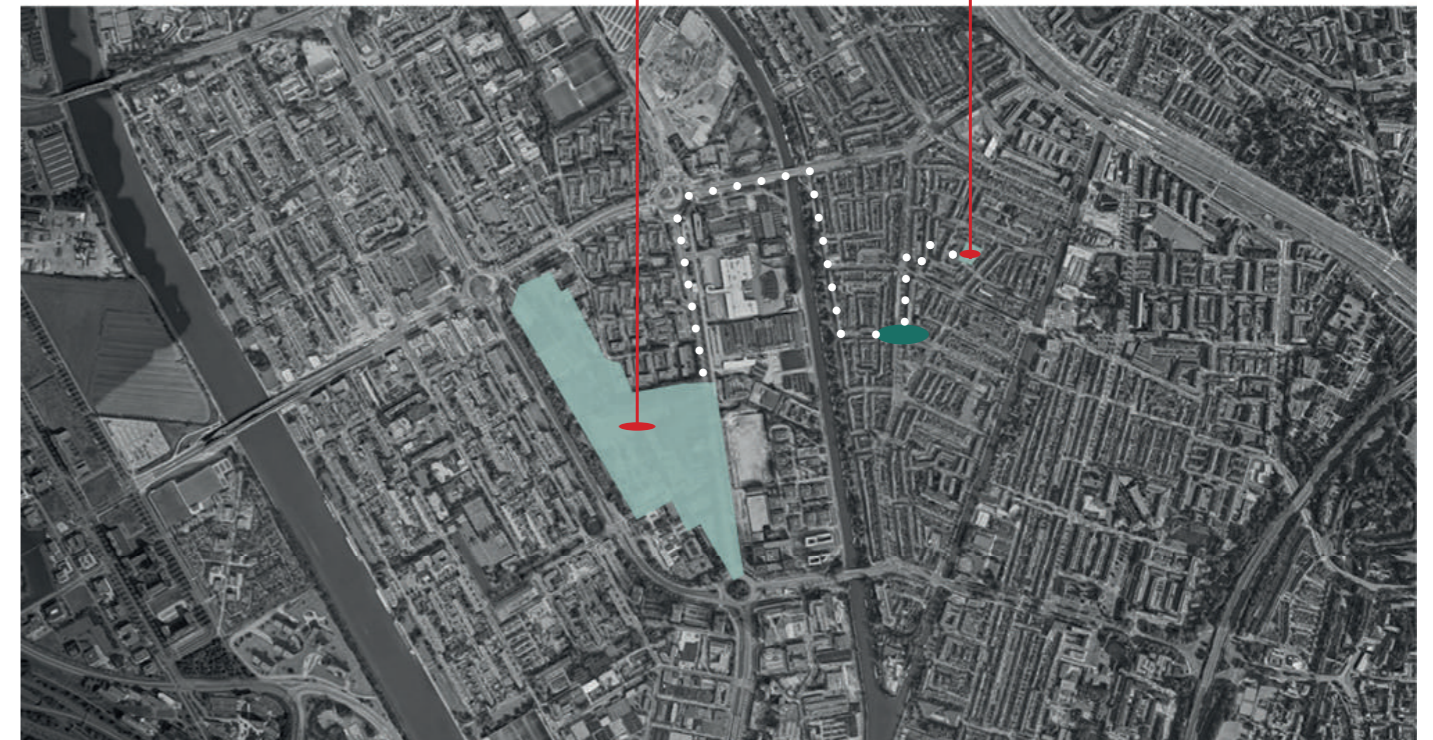
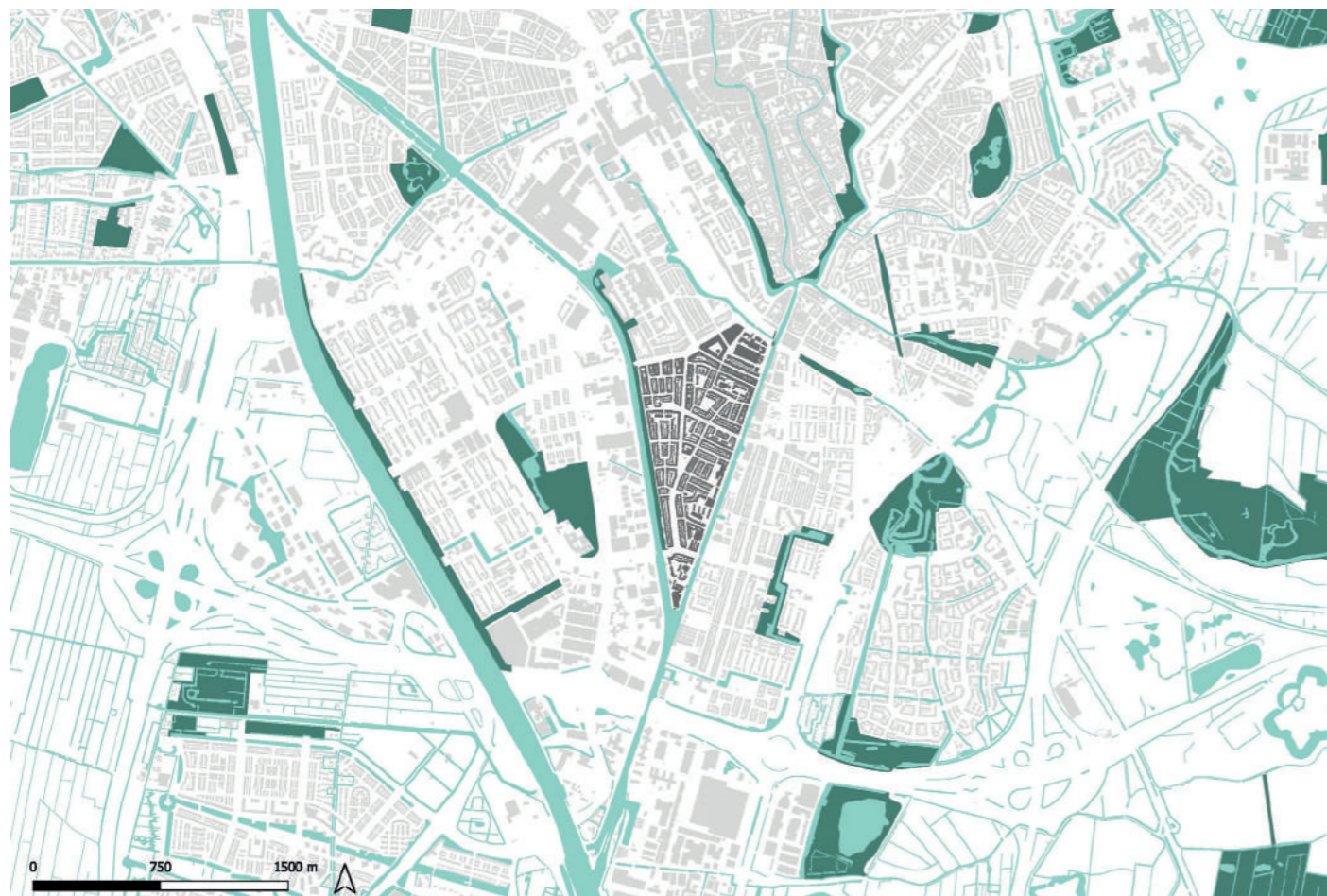


Fig 4.3 Open spaces in different size and distance - Adapted from Google Maps

Urban open space larger than 1,5 ha around Rivierenwijk



Urban open space within 40 minutes walking distance from Rivierenwijk



### Urban open space

The neighborhood relies on the larger parks in the surroundings to secure a high level of urban liveability. Research claims that sufficiently large open spaces, with a minimum of 1,5 hectare, should be at a walkable distance of 500 meter, approximately a 5 minute walk (C Higgs, 2019). Analysis shows that from a central point in the Rivierenwijk only the Merwedepantsoen is accessible for its residents within these parameters. It can be concluded that the small strip of the Merwedepantsoen is the only urban open space that is within a decent walkability. Most

significant parks, like Park Transwijk, the Singelpark or the Beatrixpark, are only contributing in a moderate way in terms of open space, because of their distant location. However, by improving the connectivity from the neighborhood to these larger open spaces the relative distance can be reduced. This is most applicable for Park Transwijk, where the Merwedekanaal acts as a barrier. However, by adding strategic placed pedestrian bridges the park can become more accessible.

Walkability of open spaces >1,5 ha from Rivierenwijk

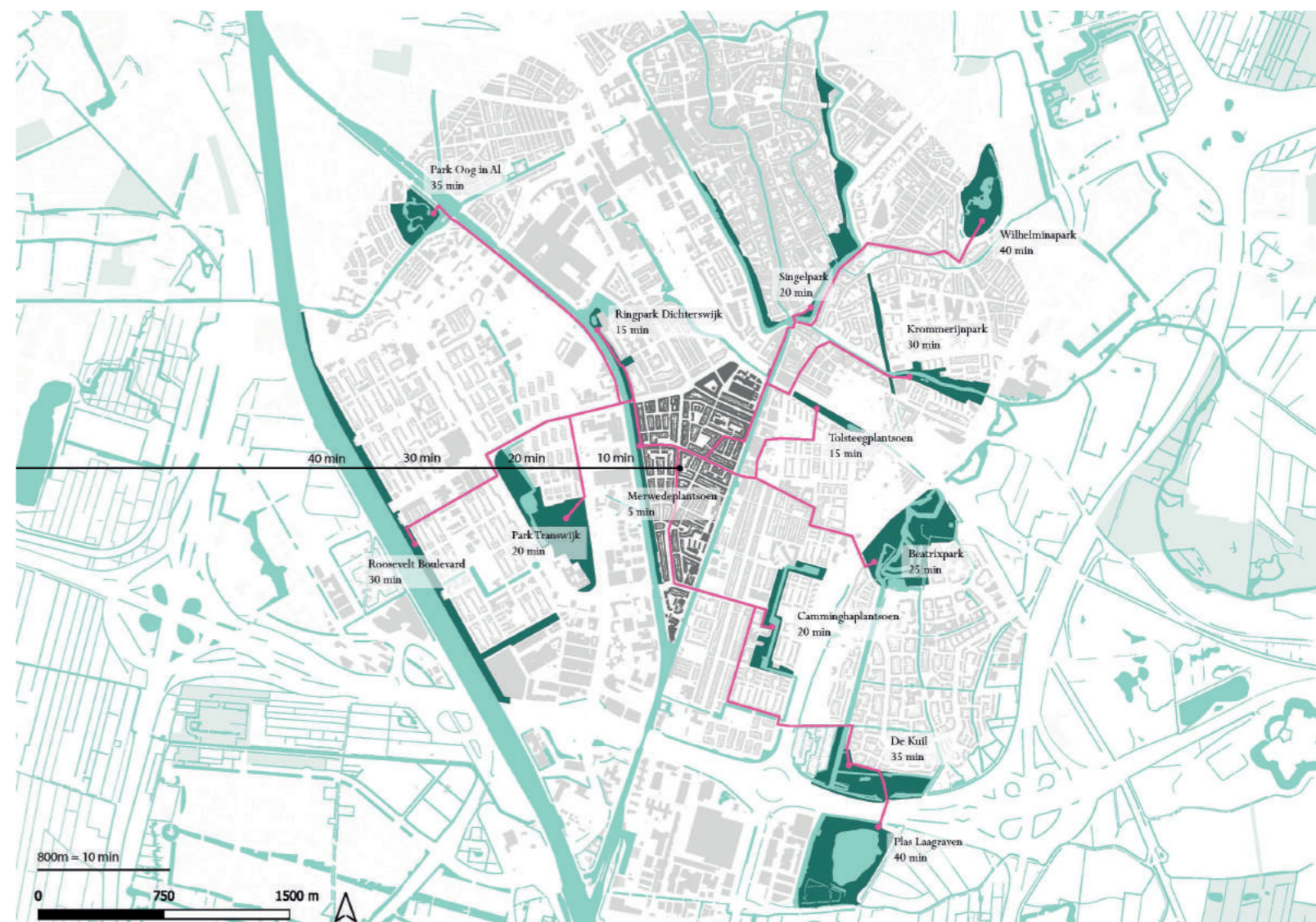


Fig 4.4 Walkability analysis based on data from Google Maps and OSM

# OPEN SPACE QUANTITY

## 4.2 Open space quantity

Based on the theoretical review about the concept of open space, discussed in chapter three, a specific definition can be established on what available open space is. Within this description there is a set of clear criteria which a space needs to meet before it will fit in the definition. The criteria are tested on a local scale of project location of Rivierenwijk in a quantitative analysis, visualized in the diagram on this page. The results are spatially represented in explanatory maps below.

### What is AVAILABLE open space?

**Definition:** 'Available open space' covers all unbuilt surfaces in the urban context, which are publicly accessible and provide a comfortable walkable condition. Therefore, any public place that makes people feel comfortable and can look into a wider space, can be called an open space.

Criteria	Description	Amount ha	Method
	Surface Rivierenwijk 82,4 ha		
'Total surface Rivierenwijk'	The total surface of the project area	82,4 ha	Quantitative analysis How much available space is there in Rivierenwijk?
'Open space is on land'	The total land surface of the project area	71,5 ha	
'Open space is unbuilt'	The total unbuilt surface on land	47,1 ha	
'Open space is public'	The total unbuilt surface on land which is publicly accessible	32 ha	
'Open space is walkable'	The total unbuilt surface on land which is publicly accessible and not car dominated	17,5 ha	
<b>Available open space</b>	All unbuilt surfaces in the urban context which are publicly accessible and contribute to a better quality of urban life	17,5 ha	

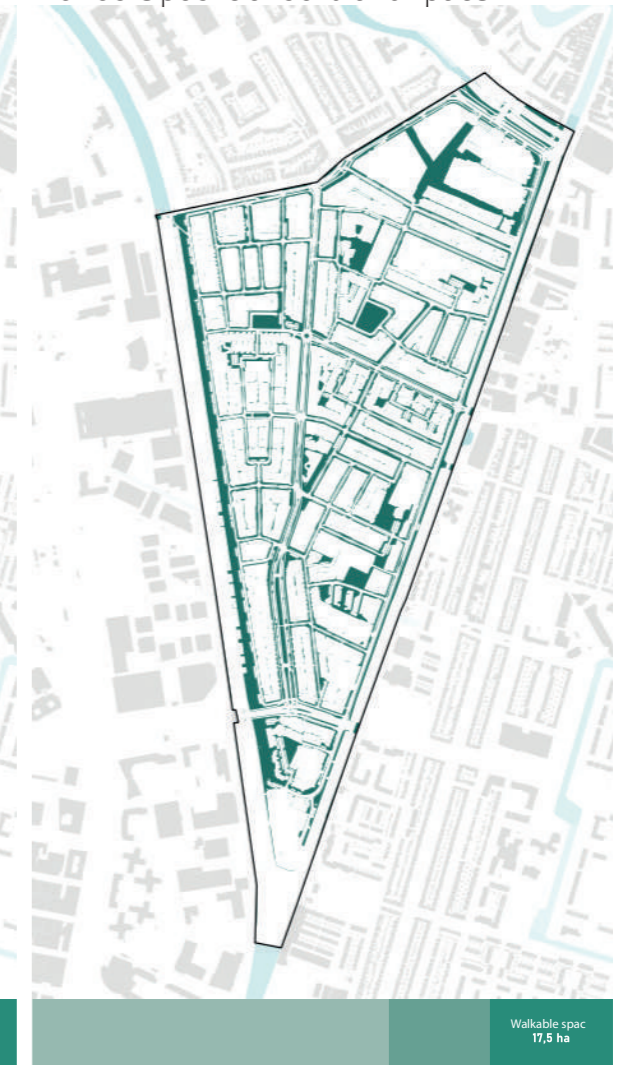
Space

Land space

Unbuilt land space

Public unbuilt land space

Walkable public unbuilt land space



# OPEN SPACE QUANTITY

## Available open space

The space that meets all the criteria, presented on the previous pages, is in this research defined as available open space. These are the spaces that are unbuilt, public accessible and safely walkable for pedestrians. The photos below show what types of spaces fit in the category of available open space. It is remarkable that only about a fifth of the total surface of Rivierenwijk meets the criteria, which is not that much if you acknowledge the importance of open space. It is these outdoor spaces that we use to relax, play, sport informally, walk in

the sun, and meet other people. A closer look to the result of the analysis and a distinction can be made between paved and unpaved, or green open space. In the third chapter the environmental qualities of open space have been discussed and it is explained how important nearby public green open space is, in providing for example a comfortable urban climate. The fact that in Rivierenwijk not even half of the available open space is green open space indicates poor open space quality, but leaves on the other hand much opportunity for improvement.

Footpaths



Squares



Sidewalks



Parks & green areas



Available open space



# OPEN SPACE QUANTITY

## 4.3 Relation with built space

After the open space analysis it is more clear how open space is defined and how much, and what kind of spaces, fit this description. The second step is to examine the relation between this quantity of open space and the built space, with a focus on dwellings. The built space represents the inhabitants and therefore the current pressure on open space. By establishing a more clear relation between the amount of dwellings and available square meters of open space, it can be estimated if there is enough capacity to take in more residents by densification. The maps below show an analysis of the built space in Rivierenwijk. With a density analysis

based on the Spacematrix of Berghauer Pont and Haupt, the FSI and GSI data can be translated to a categorization of Rivierenwijk regarding density (figure 4.6). It can be concluded that Rivierenwijk is a typical post-war neighborhood, with mostly low-dense row houses, with their own private gardens. Fitting in type C, block type - low rise, the area is characterised by smaller blocks with a fine grid of streets. With a large focus on car mobility, which relatively claims much of the available space. With a total of 4.571 dwellings in the area a theoretical estimation can be done about how much pressure is expressed on the available open space by its local residents.

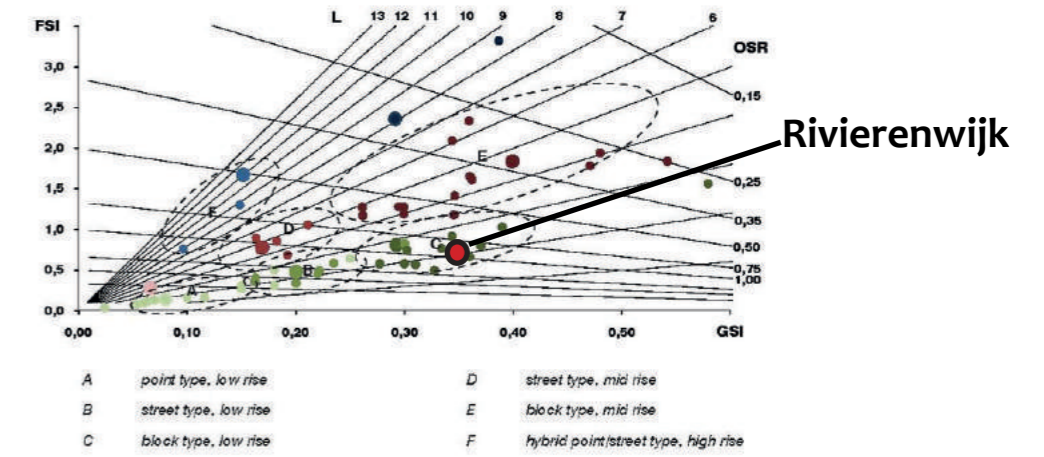
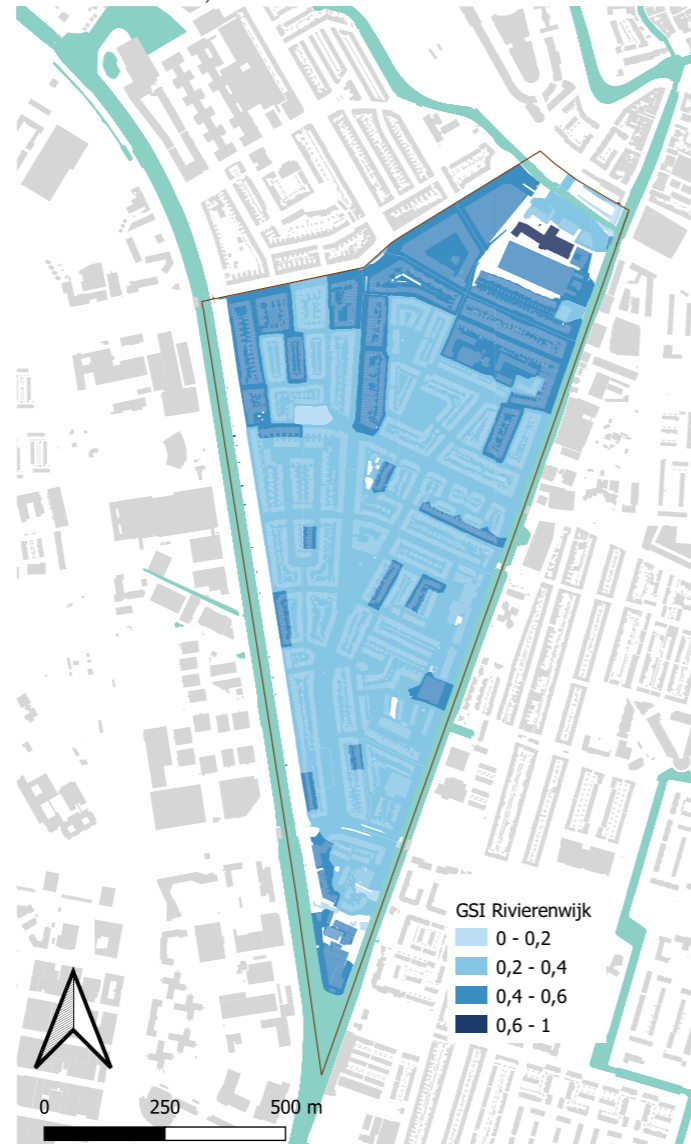


Fig 4.6 The various types of urban areas in the FSI-GSI plane of the Spacematrix - Source: Berghauer Pont and Haupt (2010)

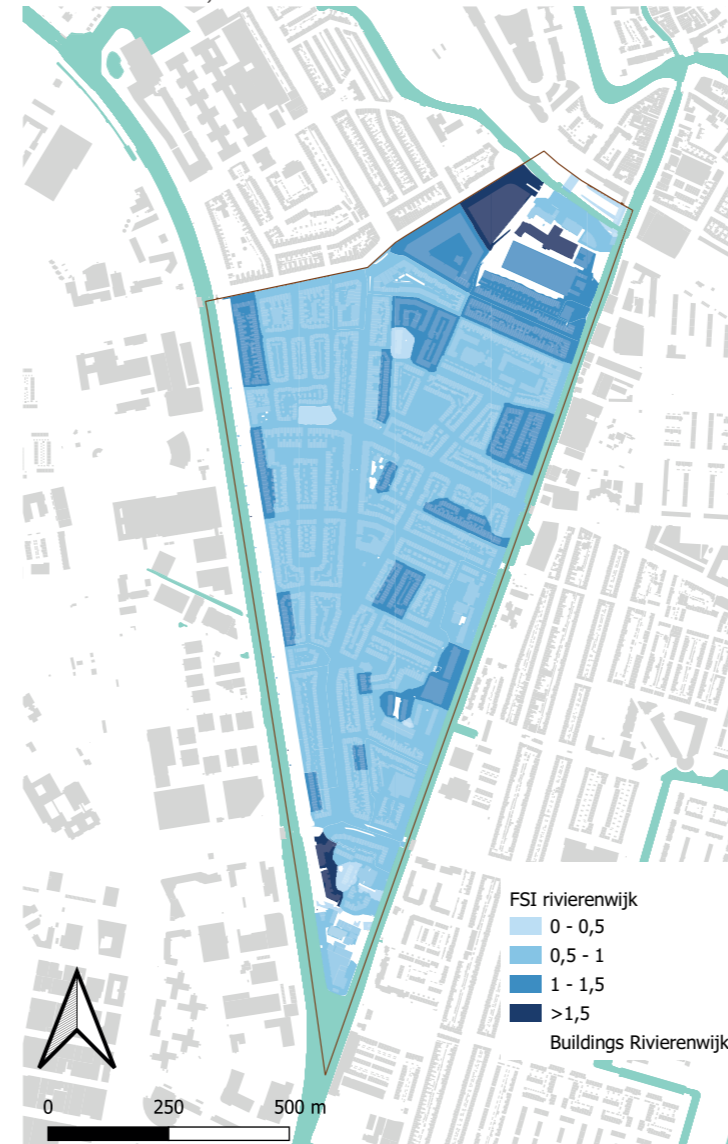
Residential buildings



GSI Rivierenwijk



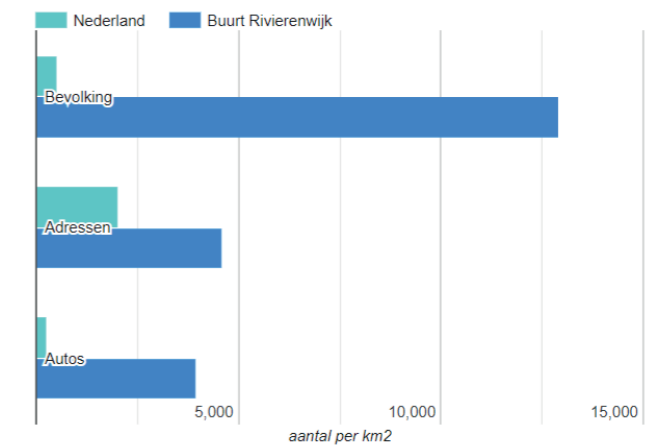
FSI Rivierenwijk



Data Rivierenwijk



Density per km2 of residents, buildings, cars

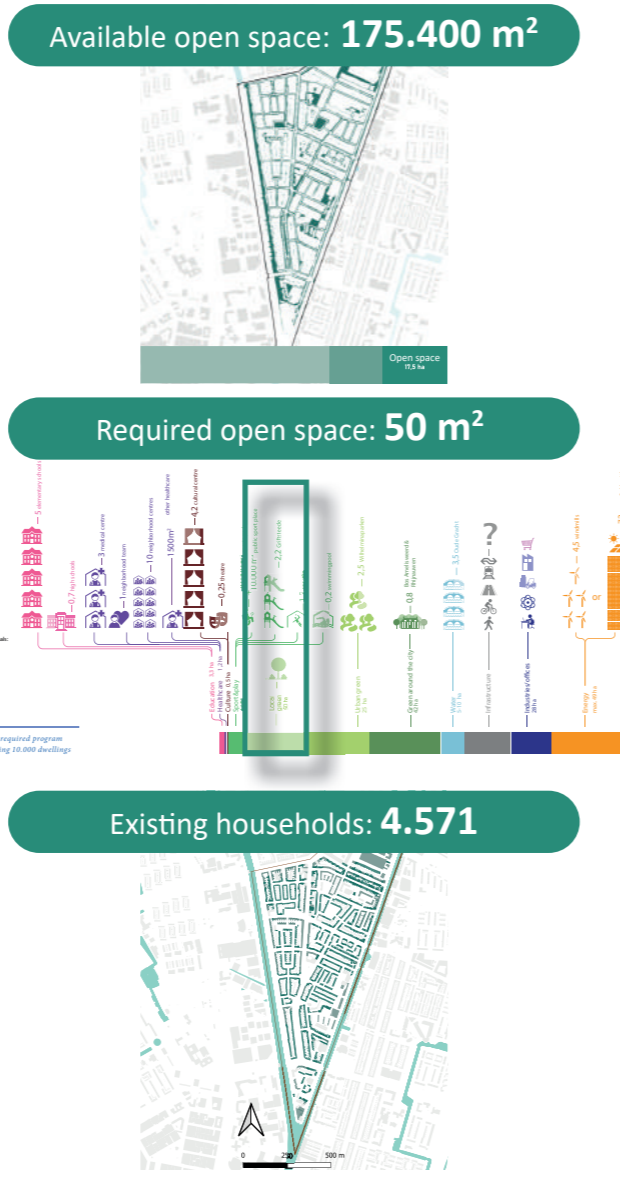


Source: allecijfer.nl, November 2021

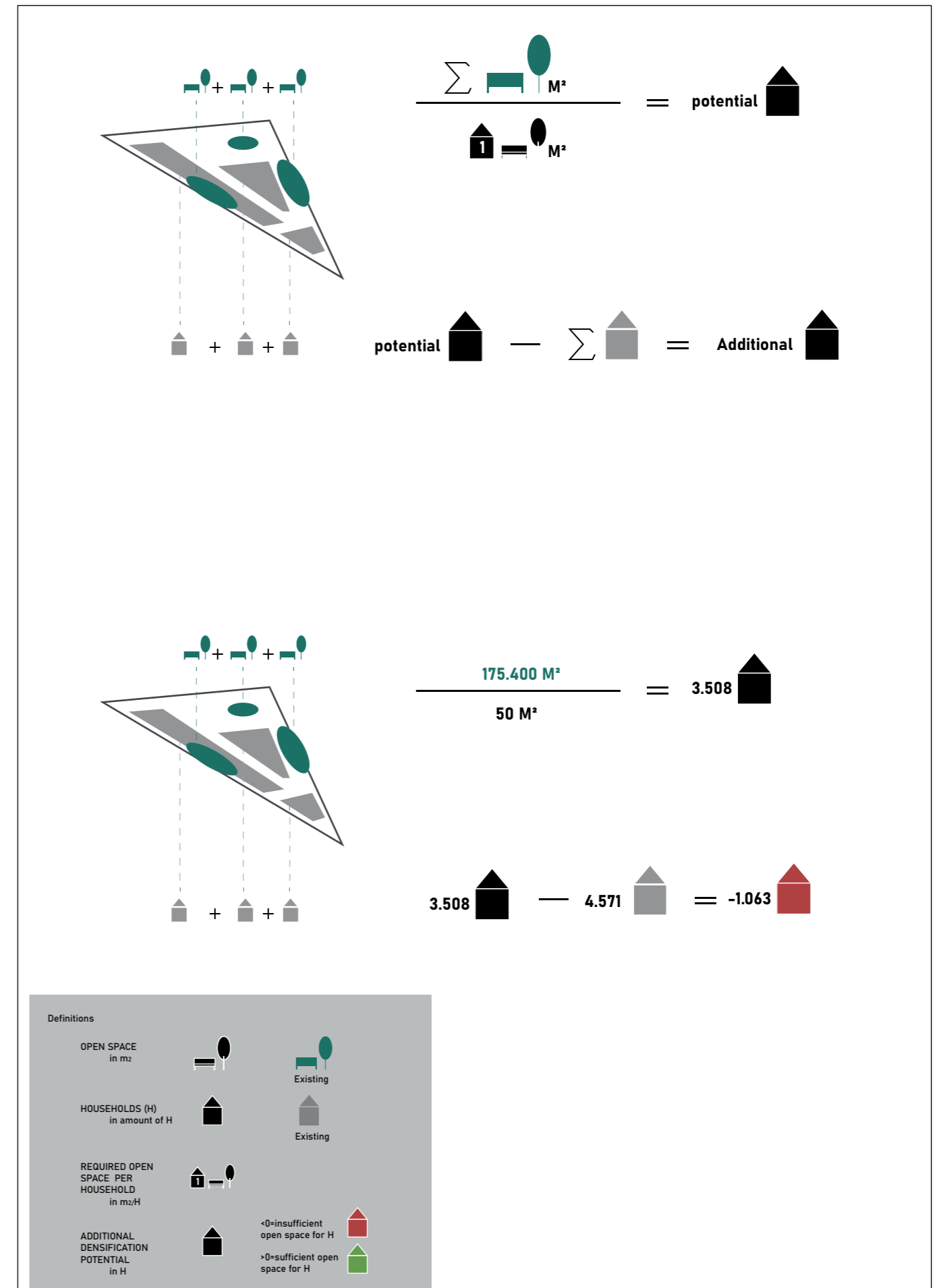
## Pressure on open space

To study the relation between open space and built space a framework is established for sustainable densification with high urban liveability. Here, the starting point is that the amount of available open space determines how much dwellings and densification potential is supported. The framework is explained below, where the amount of available open space is divided by the required amount of open space per household. The result is a theoretical estimation of the potential households that could exist in the area without putting too much pressure on the available open space. Extracting the existing households from this amount concludes the densification potential, or in other words how much dwellings could be added in Rivierenwijk.

With the input from the previous analysis on available open space and built space, and the data from the research of the municipality of Utrecht, the calculation in the framework can be worked out. From this purely theoretical and quantitative perspective the available amount of open space can support 3.508 households. With 4.571 existing households in Rivierenwijk there is currently too much pressure on existing open spaces. Additional densification, with for example the adjacent Merwerdekanaalzone development, will only enlarge this pressure on available open spaces like the Merwedeplantsoen along the canal and further lower the urban liveability in the neighborhood.



## DEFINING ADDITIONAL DENSIFICATION POTENTIAL



**Framework sustainable densification**

$$\frac{\text{Available open space [m}^2\text{]}}{\text{Required open space per household [m}^2\text{]}} = \text{Potential households [H]}$$

Potential households [H] - Existing households [H] = Potential additional households

# OPEN SPACE QUALITY

## 4.4 Open space quality

After the quantitative analysis on open space this next part looks at the quality of these spaces. Only after an equivalent analysis on both quantity and quality a holistic understanding of the available open space in Rivierenwijk can be established. The city of Utrecht has many uptodate sources which research the liveability according from the perspective of its residents. A first step is to analyze two most recent and relevant sources, a 'nulmeting' and the 'Buurtaanpak', whereafter in addition an own qualitative research is performed (figure 4.7 & 4.8).

Conclusions from the review of the two existing sources are presented on the next page. These results provide basic understanding on how most residents of Rivierenwijk perceive their living environment. However, to get more specific feedback regarding open space use and quality, additional interviews have been conducted. The results are discussed in the following pages, which can be divided in two topics: a spatial analysis on which routes are most popular and personal opinions towards the living conditions in the neighborhood.

### Conclusions 1 & 2

- People like to live in Rivierenwijk
- Many people are content and do not have any points of improvement
- There is in most parts a strong community feeling between the residents
- There is a good connection to the city center by bike or walking
- There is too little green and trees in the neighborhood
- Insufficient quality of green
- Insufficient quality of playgrounds
- Facilities, like shops or cafes, are lacking in the neighborhood, which could be added along the Rijnlaan

1

### Nulmeting 2020 Leefbaarheid in Rivierenwijk/transwijk/Dichterswijk

Gemeente Utrecht  
May, 2020

Indicator	Buurt Dichterswijk	Buurt Rivierenwijk	Buurt Transwijk-Zuid	Buurt Transwijk-Noord	Utrecht
<b>kwaliteit woonomgeving</b>					
algemeen buurtbeeld	7,0	7,5	5,8	5,7	7,3
prettig wonen in de buurt	92%	99%	80%	75%	91%
sociaal toezicht	6%	4%	13%	18%	8%
sociale cohesie	8,0	8,0	4,7	4,8	5,8
<b>mobiliteit</b>					
tevredenheid over verkeersveiligheid in de buurt	41%	44%	48%	41%	40%
tevredenheid bereikbaarheid centrum met de fiets	64%	91%	87%	91%	87%
tevredenheid over parkeerplaatsen voor fietsen	32%	43%	55%	50%	51%
tevredenheid over parkeerplaatsen voor auto's	30%	53%	35%	61%	51%
<b>groen en openbare ruimte</b>					
m <sup>2</sup> groen per huishouden in het stedelijk gebied	18m <sup>2</sup>	9m <sup>2</sup>	97m <sup>2</sup>	36m <sup>2</sup>	68m <sup>2</sup>
aantal bomen per huishouden in het stedelijk gebied	0,3	0,3	0,7	0,6	0,8
tevreden over groen in de buurt	41%	43%	72%	62%	66%
tevreden over park in de buurt	30%	45%	32%	73%	72%
zetheld openbare ruimte	7,0	6,5	6,8	6,6	6,7
vaak last van spuiten op de stoep	9%	10%	11%	8%	12%
vaak last van slecht toegankelijke oversteekplekken	19%	8%	11%	9%	10%
<b>veiligheid</b>					
totale criminaliteit*	47,6	36,8	40,8	40,8	43,0
voelt zich wel eens onveilig in de buurt	28%	26%	46%	46%	30%
vaak last van jongeren op straat	28%	19%	22%	32%	19%
<b>luchtkwaliteit &amp; geluid</b>					
last van luchtvervuiling	11%	12%	31%	22%	18%
last van verkeerslawaai	20%	21%	40%	28%	26%
last van bouwwerkzaamheden	20%	0%	32%	18%	14%
<b>voorzieningen</b>					
huisartspraktijken*	1,7	2,1	0,0	0,0	0,9
voorzieningen maatschappelijke dienstverlening**	3,4	2,3	3,5	6,5	3,4
onderwijsvoorzieningen**	0,6	0,8	0,3	2,0	0,7
winkels**	2,1	2,8	2,5	2,2	5,1
tevredenheid over culturele voorzieningen in de buurt***	29%	49%	30%	21%	49%
tevredenheid over sportvoorzieningen in de buurt	46%	51%	87%	72%	86%
tevredenheid over openbaar vervoer in de buurt	70%	88%	82%	82%	80%
tevredenheid over speelplaatsen in de buurt	49%	49%	52%	48%	58%
tevredenheid over winkels in de buurt	60%	70%	81%	68%	74%

Fig 4.7 Results of the nulmeting in Rivierenwijk and surrounding neighborhoods - Source: Gemeente Utrecht (2020)

2

### Buurtaanpak Rivierenwijk en Transwijk Zuid

URBANOS  
October, 2020

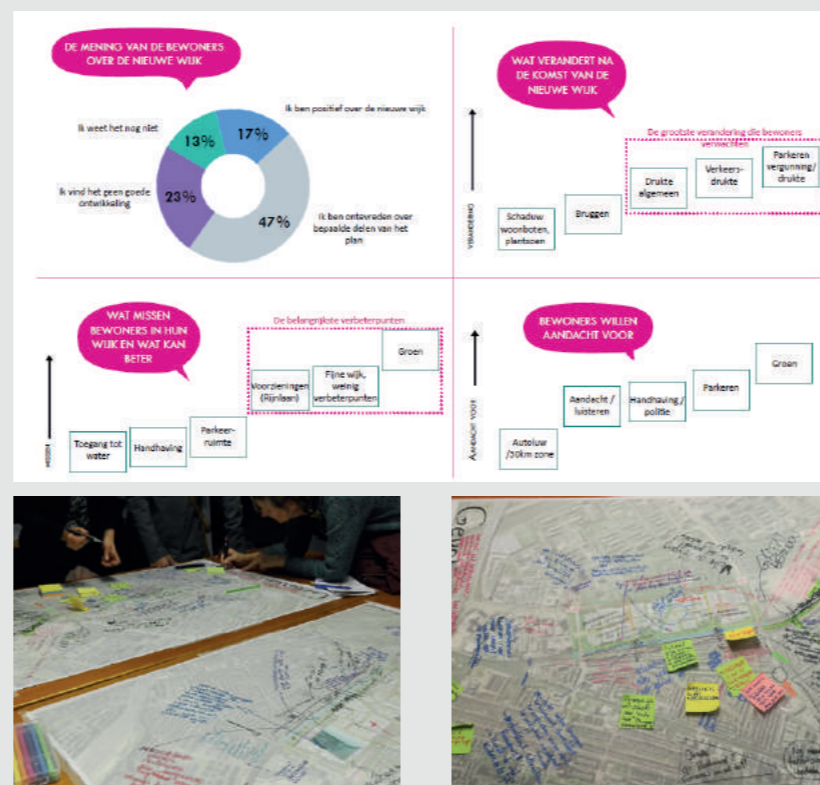


Fig 4.8 Results of the 'Buurtaanpak in Rivierenwijk' with citizen participation - Source: Gemeente Utrecht (2020)

3

### Interviews & Spatial analysis Sample group of 59 residents

Jelle Dekker  
April, 2021

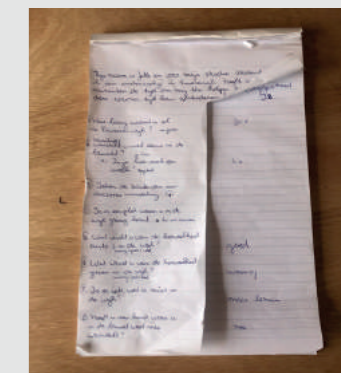
#### 1. Which spaces are used?

Draw on a map where people like to be and move through



#### 2. Improvements & opinions

Set of specific questions regarding liveability in Rivierenwijk





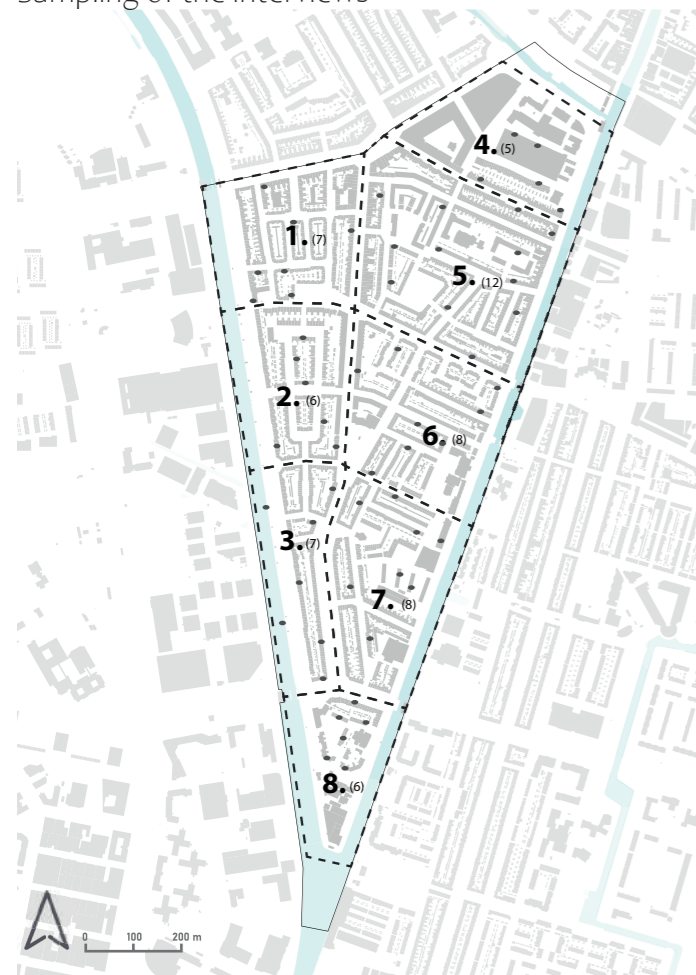
# OPEN SPACE QUALITY

## Fieldwork

The fieldwork performed in Rivierenwijk has been done over the period of one week, where on different moments during the day residents have been interviewed by the author. To get a clear spatial representation of respondents, the neighborhood is divided in eight blocks, from which interviews have been conducted (figure 4.9). The interview consists of two parts, a spatial analysis on how people use the open space in the neighborhood for a recreational purpose and a set of questions to obtain opinions of different subjects. By visualizing popular open spaces to recreate and overlaying the individual walking routes that people take frequently, clear results can be obtained from the fieldwork. Results of this first part are visualized in the maps below and to the right. Research has been done on

which open spaces people like to be and which open spaces they frequently move through, both for recreational purposes (figure 4.10). While a frequent response is that people do not have a favourite outdoor public space, most responses mention the picnic tables in the Merwedepantsoen along the left waterfront. Regarding moving through the space, many respond with 'a walk around the Merwedekanaal', or even go 'up and down' across the Merwedepantsoen. The other waterfront along the Vaartsche Rijn is mostly used to get out of the neighborhood. The most common destinations are present on the map as well, with the historic city center as the most mentioned destination (figure 4.11).

Sampling of the interviews



Favourite outdoor spaces



64 Fig 4.9 Sampling of the interviews in Rivierenwijk - Source: by author

Fig 4.10 Favourite places of the inhabitants to be within Rivierenwijk Source: by author

Popular destinations and walking routes

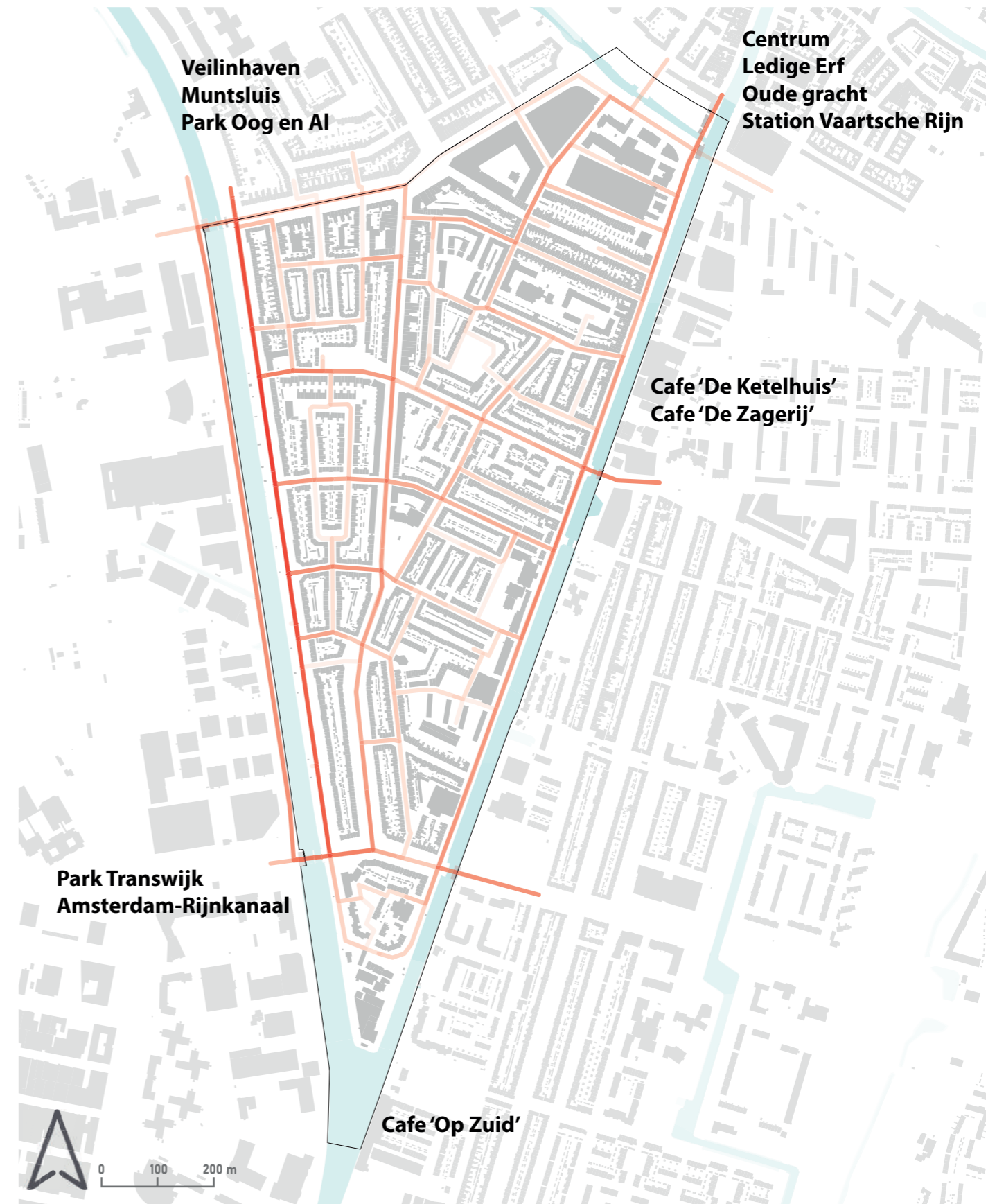


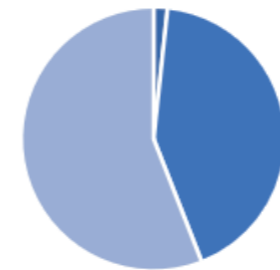
Fig 4.11 Visualization of which walking routes are most popular among the residents of Rivierenwijk - Source: by author

# OPEN SPACE QUALITY

The second part reflects on the availability of green, the presence of cars and what the residents would like to add to the neighborhood. It can be concluded that the highly car-oriented infrastructure is also experienced by the residents. While at the same time almost three-quarter of the respondents think that there is too little green in the neighborhood (figure 4.12). Confirming results of the other qualitative sources, many people do not have specific things to change in the neighborhood. This is interesting because it could mean different things. For example, people are content or do not have an idea, at the moment of asking, what to improve. Or people could be scared by the idea of change, which could only cause harm, because

'it is good the way it is'. With the nearby huge densification of the Merwedekanaalzone, which is known by most people, the association of change as a threat is understandable. The interviews also provided many interesting stories on who open space is perceived and used. Many residents liked to talk about their experiences of living in Rivierenwijk. Some of these stories are presented below, which were essential in understanding key open spaces and their living quality. The interviews proved that people living in the area are the best source in discovering what the opportunities and challenges for the local open spaces are. This information therefore forms the main input in the design interventions to improve open space quality.

Amount of cars



■ Little ■ Enough ■ Much

Amount of Green



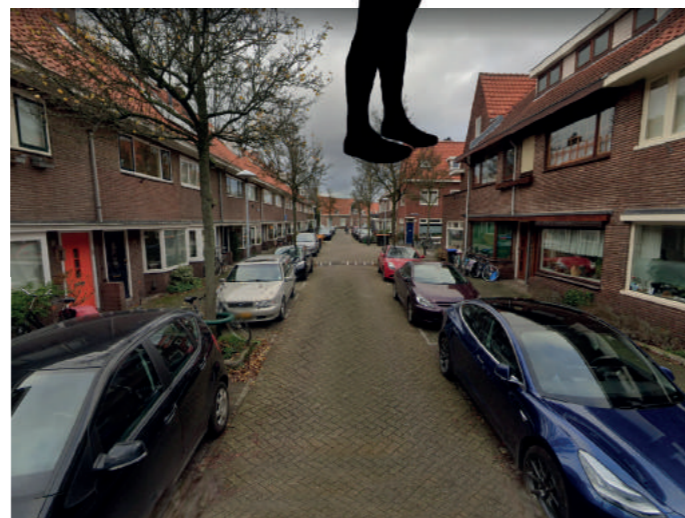
■ Little ■ Enough ■ Much

Fig 4.12 The perception of amount of cars and by the interviewed residents of Rivierenwijk - Source: by author

My mom always feeds the ducks at the Vaartsche Rijn, but its a steep and unsafe waterfront. I tell her not to because if she would fall, no one will see her. However, she does it anyway.



There is so much space for car parking, but no room to park your bike. Why can't we transform some parking lots for bike parking?



Around the corner is this huge paved square with no green. I get that it is a mosaic artwork, but you have to look at it from Google Maps to see it. In practice, it is boring and a waste of space. In summer it is unbearable because of the lack of shadow and green.



We have this small park in front of our house, but there is a fence around it for some reason. The municipality says it is publicly accessible but the fence is locked. What is the purpose of such open space?



# OPEN SPACE QUALITY

From the qualitative analysis it can be concluded that the available open space in Rivierenwijk is not all of equal quality and therefore not equally used. The different stories from residents represent the way how people experience the different open spaces, illustrating the variety in quality. To integrate this distinction is quality, an extra criteria has been added to the open space diagram, visualized below. Here, a distinction is made between high- and low quality of open space. Because the perception of quality is highly subjective, it is not possible to determine a specific quantity of 'high quality' and 'low quality' of open space, like is done in the previous analysis. However,

by acknowledging the difference in quality, and therefore the value for local residents, a more complete understanding of the available open space is presented. This gives a more realistic understanding compared to the quantitative analysis alone, where all open spaces contribute equally to urban liveability. As a result, it can be concluded that pressure by the residents on open space differs. High quality open spaces attract more people than spaces of low quality. A first step to reduce pressure on open space would therefore be to redesign the available open spaces of low quality, so the use of the total amount of open space is more equally distributed.

	Criteria	Description	Amount ha	Method
Surface Rivierenwijk 82,4 ha	'Total surface Rivierenwijk'	The total surface of the project area	82,4 ha	Quantitative analysis How much available space is there in Rivierenwijk?
Land 71,5 ha	'Open space is on land'	The total land surface of the project area	71,5 ha	
Ubuilt space 47,1 ha	'Open space is unbuilt'	The total unbuilt surface on land	47,1 ha	
Public space 32 ha	'Open space is public'	The total unbuilt surface on land which is publicly accessible	32 ha	
Walkable space 17,5 ha	'Open space is walkable'	The total unbuilt surface on land which is publicly accessible and not car dominated	17,5 ha	
Open space 17,5 ha <small>Paved open space 12,1 ha Green open space 5,4 ha</small>	Available open space	All unbuilt surfaces in the urban context which are publicly accessible and contribute to a better quality of urban life	17,5 ha	
	High quality open space Frequent used open space			
	Low quality open space Unused open space			

# OPEN SPACE QUALITY

## Climate resilience

Besides the quality experienced by its human users, the two environmental qualities of open space regarding climate resilience and biodiversity are highlighted. By determining how well the existing open spaces perform in these topics, more insight is provided in how urgent the trends of climate change and biodiversity loss will affect the neighborhood. Regarding climate resilience, a key element is the amount of unpaved, or green surfaces. Here extreme precipitation can more easily infiltrate, while natural elements have a cooling effect on their surroundings. Green areas and especially trees,

help to mitigate the extreme weather conditions and make the city more climate adaptive. On the contrary, paved or closed surfaces will aggravate the effects. The map below shows the amount of paved and unpaved surfaces in the established open spaces (figure 4.13). The second map shows the probable effect which the type of surface has on the urban climate. Here it is visible that the open spaces where the urban climate is worse consists of a closed paved surface with little green (figure 4.14). The photos show in more detail how these open spaces look like.

Type of open space surface



Fig 4.13 Type of open space surface - Source: by author



Tightly paved squares with no open soil



Are a line of trees enough to cool down the square?

The level of climate resilience



Fig 4.14 The effect on the urban climate - Source: by author

# OPEN SPACE QUALITY

## Biodiversity

Hereafter, it is necessary to know how the open spaces are performing in terms of biodiversity. For urban ecology the unbuilt spaces, safe from disturbing car traffic, are the most common settling places, because they often contain some sort of green. While we accept green and nature in these spaces, maintainers keep a tight eye on its development and intervene when nature develops in a 'messy' way. Biodiversity can be measured by the amount of plants species, and therefore the animal and insect species they attract, we allow in a certain

open space. The maps below shows how the open spaces are performing in how many plant species they contain (figure 4.15/4.16). It is again remarkable how little green space there is in the neighborhood, while the available green is at the same time consists of mostly monocultural lawns. However, there are some examples of recent redevelopment where unnecessary pavement has been replaced by a diverse perennial planting composition. This indicates the promising trend of more and diverse greenery in the city.



The traditional monotonous lawn



Pocket park with many different plant species

All the green within the open spaces



Fig 4.15 The amount of green within the open spaces - Source: by author

The quality of the green within the open spaces



Fig 4.16 The diversity in green within the open spaces - Source: by author



Contents:

- 5.1 Potential open space
- 5.2 Relation with built space
- 5.3 Typologies
- 5.4 Environmental qualities

# 5. IMPROVING OPEN SPACE

The previous chapter has provided insight into the situation regarding the existing, or so-called available open space in the neighborhood of Rivierenwijk. It is concluded that both the quantity as the quality of these spaces are insufficient and should be improved to sustain more sustainable densification. This chapter explores how the existing situation regarding open space can be improved from the perspective of urban design. First, it is examined how an improvement in quantity can be achieved and how such enlargement of available open space affects the densification potential. Secondly, a

spatial framework is presented with a typology of the different structural spaces in Rivierenwijk. Discussed is what the values, weaknesses and opportunities are of each typology, to provide sufficient input for the design proposals in the next chapter. Finally, it is discussed how the two environmental qualities of biodiversity and climate resilience can be integrated in an open space redesign. By providing an elaborate knowledge base about the concepts of the urban climate and nature inclusive design, a set of design principles are composed which can be integrated in the design process from the start.

**SRQ 2**

What are the opportunities to improve the quality and quantity of open space in Rivierenwijk?

<b>Topic</b>	<p style="text-align: center;"><b>Improving quantity</b></p> <ul style="list-style-type: none"> <li>- Defining the concept of potential open space</li> <li>- Establishing a specific definition with clear criteria</li> <li>- Defining design principles on how to redesign space</li> </ul>
<b>Strategy</b>	<p style="text-align: center;"><b>Spatial strategy</b></p> <ul style="list-style-type: none"> <li>- Defining different typology</li> <li>- Elaborating on each type of space</li> </ul>
<b>Quality</b>	<p style="text-align: center;"><b>Environmental qualities</b></p> <ul style="list-style-type: none"> <li>- Literature review on creating climate resilience</li> <li>- Literature review on creating biodiversity</li> <li>- Defining a set of design principles</li> </ul>

# IMPROVING QUANTITY

## 5.1 Potential open space

Space in the city is always considered as a scarcity and for a logical reason: the amount of space does not grow or reduce. The total surface of Rivierenwijk will also not increase or decrease. However, through redesign, space can get a different function, or even become multifunctional. In a denser growing city, multifunctional space is becoming more a priority for urban design. With more people living on the same square meter, more is happening in the same area. Open spaces leave much flexibility for multifunctional use. So can an open grasfield function as a place for picnics, sports or gatherings. While at the same time, with the right maintenance, it can offer space for ecology or store extreme precipitation. Redesigning space as 'available open space' is therefore a way to support more multifunctionality in the city.

Continuing the open space diagram it visualises a strategy on how to increase the amount of open space. By redesigning the space which is excluded from the previous analysis it could meet the criteria of available open space. Such excluded open space, can be referred to as 'potential open space', which is not available open space yet, but it can become through redesign. The diagram presents a framework in which redesigning the different space typologies can lead to such improvement in quantity, until a hypothetical situation where the total surface of Rivierenwijk could be defined as available open space.

### What is POTENTIAL open space?

**Definition:** 'Potential open space' is all space which is excluded from the available open space analysis, because it does not meet the set criteria. By redesigning the excluded space it could meet the criteria and become available open space.

Criteria	Description	Amount ha	Method
Surface Rivierenwijk 82,4 ha	'Total surface Rivierenwijk'	82,4 ha	Quantitative analysis How much available space is there in Rivierenwijk?
Land 71,5 ha	'Open space is on land'	71,5 ha	
Unbuilt space 47,1 ha	'Open space is unbuilt'	47,1 ha	
Public space 32 ha	'Open space is public'	32 ha	
Walkable space 17,5 ha	'Open space is walkable'	17,5 ha	
Open space 17,5 ha <small>Paved open space: 12,1 ha Green open space: 5,4 ha</small>	Available open space	17,5 ha	
High quality open space Low quality open space	Frequent used open space Unused open space		Qualitative analysis How effective is the available open space?
Traffic space 14,7 ha <small>Roads: 11 ha Parking: 3,6 ha</small>	'Redesigning car space'	14,7 ha	(Theoretical) Design challenge How can potential open space be included?
Private space 15,2 ha	'Redesigning private space'	15,2 ha	
Built space 24,4 ha	'Redesigning built space'	24,4 ha	
Water 10,9 ha	'Integrating water surface'	10,9 ha	
Open space			

# IMPROVING QUANTITY

## Traffic space

The category of traffic space consists of all the roads for fast mobility, like cyclists and cars, and all the parking lots in the neighborhood (figure 5.1). These spaces are providing generally not a comfortable walkable environment. While there are many examples where wide bicycle paths are also accessible for recreational walking, in the research with its limitations all bicycle roads are addressed as traffic space and therefore excluded as available open space. Redesign of these spaces can happen by degrading the road till a shared street where slow mobility offers a safer walking experience. Or by excluding the car completely and transforming the street until a 'living street', where walkability has the priority. Parking spaces offer, because of their individual character, the opportunity for flexible redesign for many different functions.

Photos

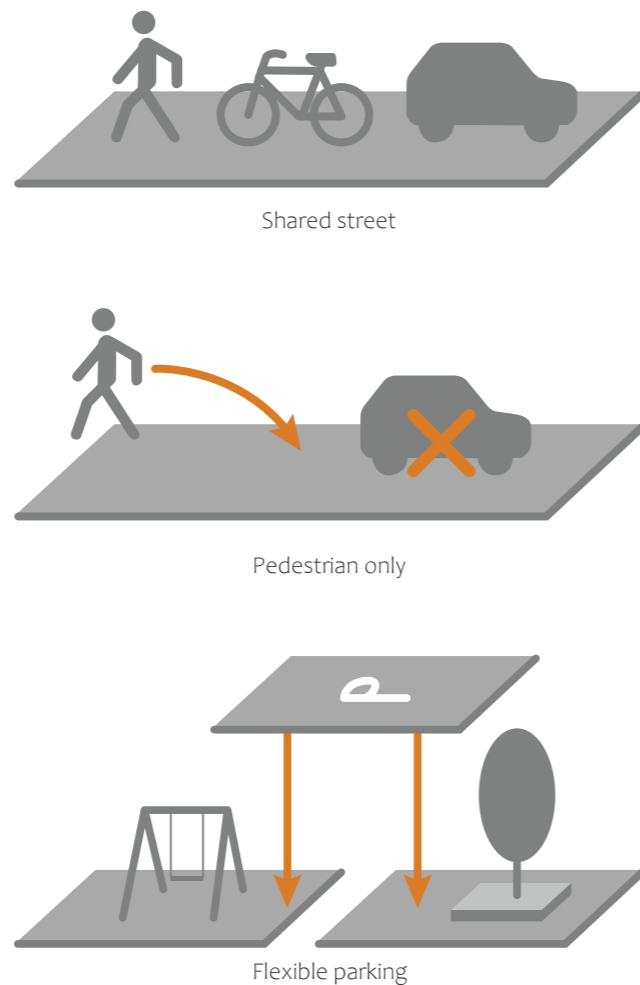


Fig 5.1 Different types of 'traffic space' - Source: by author

Traffic space



Design principles



## Private space

The most complex category is private space. These spaces, like gardens or front yards, are not publicly accessible and therefore not considered as available open space (figure 5.2). However, for the owner of the space it would fit the description and therefore contribute to an increased liveability. At the same time private gardens can contain many qualities for their surroundings if they are well designed. Green gardens can provide a better urban climate and offer a place for ecology. Confirming this complexity of private space is the fact that in the research of the municipality of Utrecht, private green space has been left out, because 'they have no influence on this space'. Due to the limitations of this study, private space is considered as space that can become available open space when it is made (semi) public. Therefore transforming front yards to informal meeting places without the traditional fences, or redesigning gardens as community gardens are design principles on how to include these spaces as available open space.

Photos

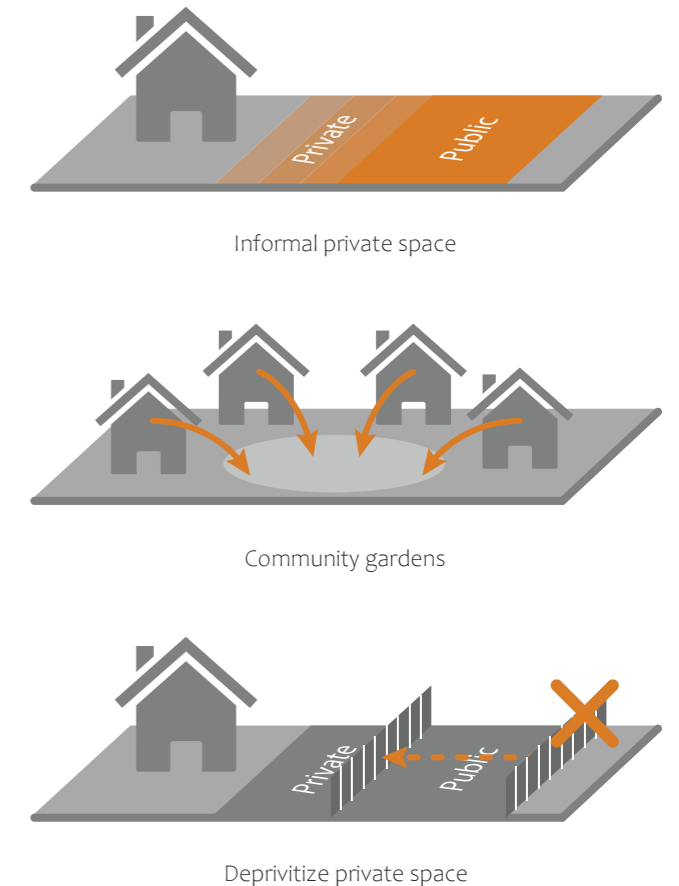


Fig 5.2 Different types of 'private space' - Source: by author

Private space



Design principles





# IMPROVING QUANTITY

## Built space

This category consists of all the built space in the neighborhood (figure 5.3). In general there are two strategies on how to include this space as available open space. The building could be demolished and the remaining space designed as public open space, or the rooftop could be redesigned as public accessible space. Transforming the roofs to green vegetation rooftops would be adding much quality to the roof, however it would still not count as available open space, because it would not be publicly accessible. Making public rooftops is a complex challenge, due to ownership, construction, sloping and the height difference. Redesigning green roofs, however not publicly accessible, should therefore still be included as a design principle, because it will improve the quality of the space greatly.

### Built space

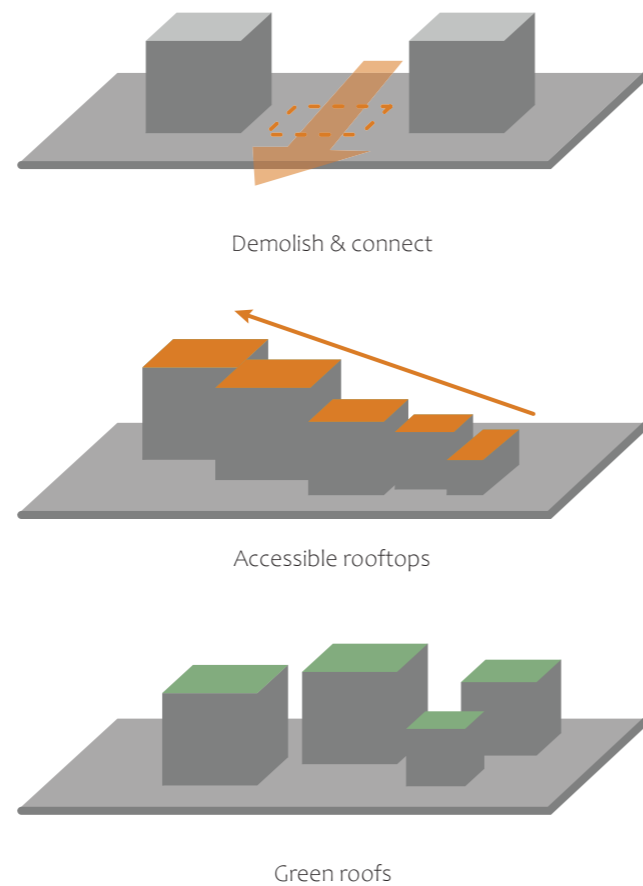


Photos



Fig 5.3 Different types of 'built space' - Source: by author

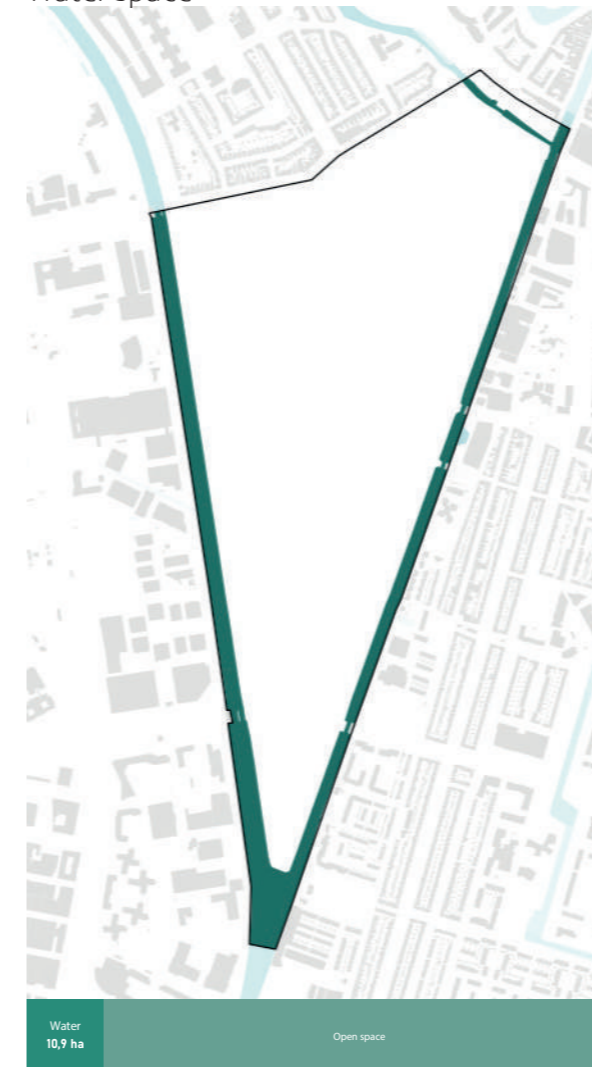
Design principles



## Water space

This category is made up of all the surface water of the two canals, the Merwedekanaal at the left and the Vaartsche Rijn at the right (figure 5.4). Surface water has many qualities, therefore the redesign of this category is focused on integrating the water in the adjacent open space, instead of making it completely fit the definition of available open space. By creating better views on the water, or places where you can access the water this space can be regarded as available open space.

### Water space

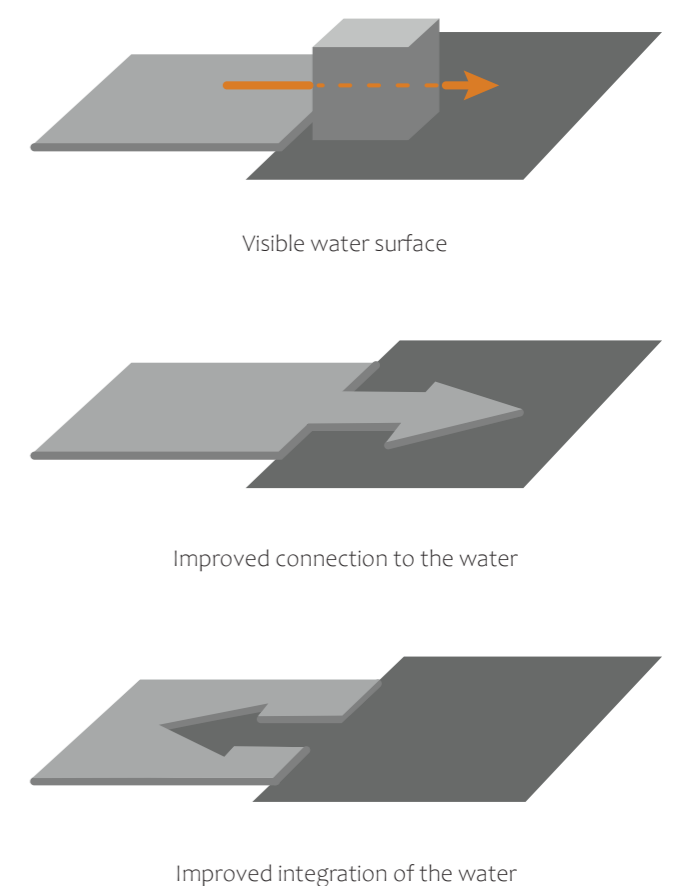


Photos



Fig 5.4 Different types of 'water space' - Source: by author

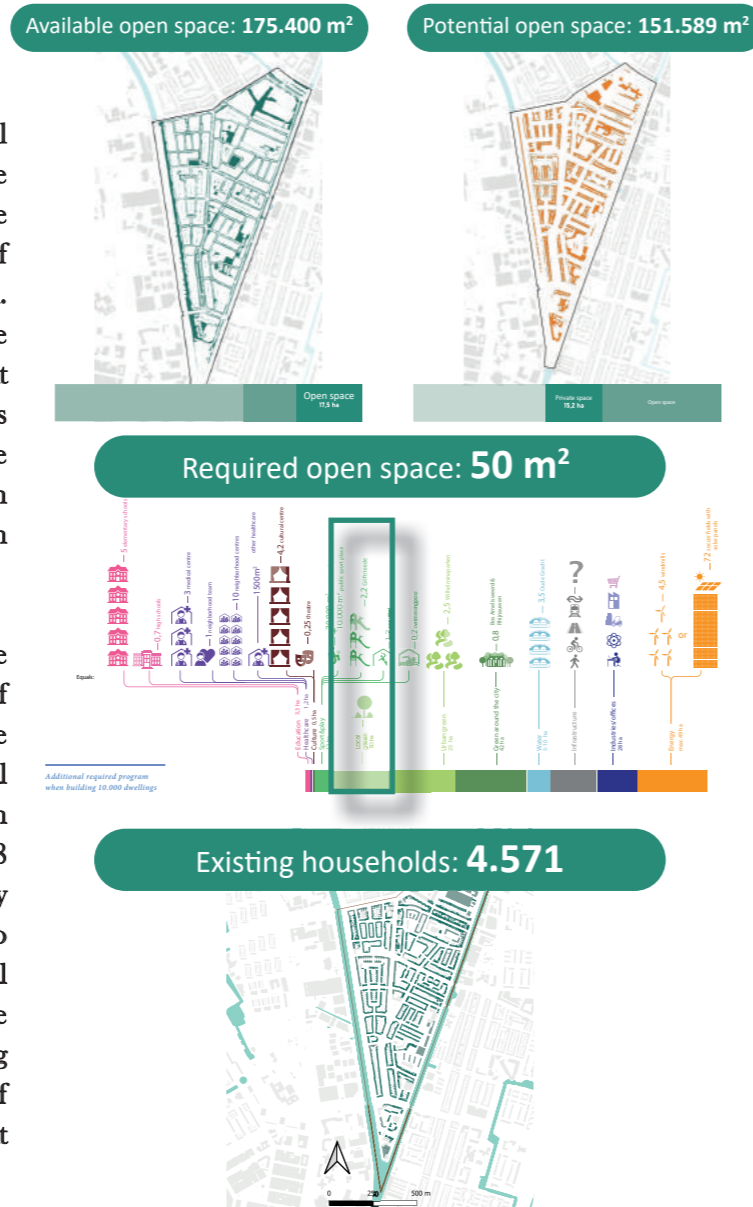
Design principles



## 5.2 Relation with built space

Redesigning potential open space till available open space will increase the total quantity of publicly, unbuilt and walkable open space. By using the same framework as before to define the relation between open space and built space, the effect of this increase regarding densification potential can be studied. Only now the redesigned potential open space is added to the total amount of available open space. The diagram at the right page shows that increasing the potential amount of households will also increase the potential additional households, or the densification potential. Therefore the link between open space redesign as a requirement for sustainable densification is established.

As a explorative exercise we could argue to redesign all the private space in Rivierenwijk to make it meet the criteria of available open space. This would increase the total available open space with 151.589 m<sup>2</sup>, resulting in a larger potential household of 6.540 dwellings. This mathematical approach would hereby justify a densification potential of 2.248 households in Rivierenwijk. However, following this strategy for sustainable densification, the addition of more dwellings to the neighborhood should happen without decreasing the total amount of open space. Here the approach becomes more complex, but it would be possible by for example roofstacking (Amer & Attia, 2017; Attia, 2015). At the same time this way of integrating density would offer opportunities to redesign built space to become available space.

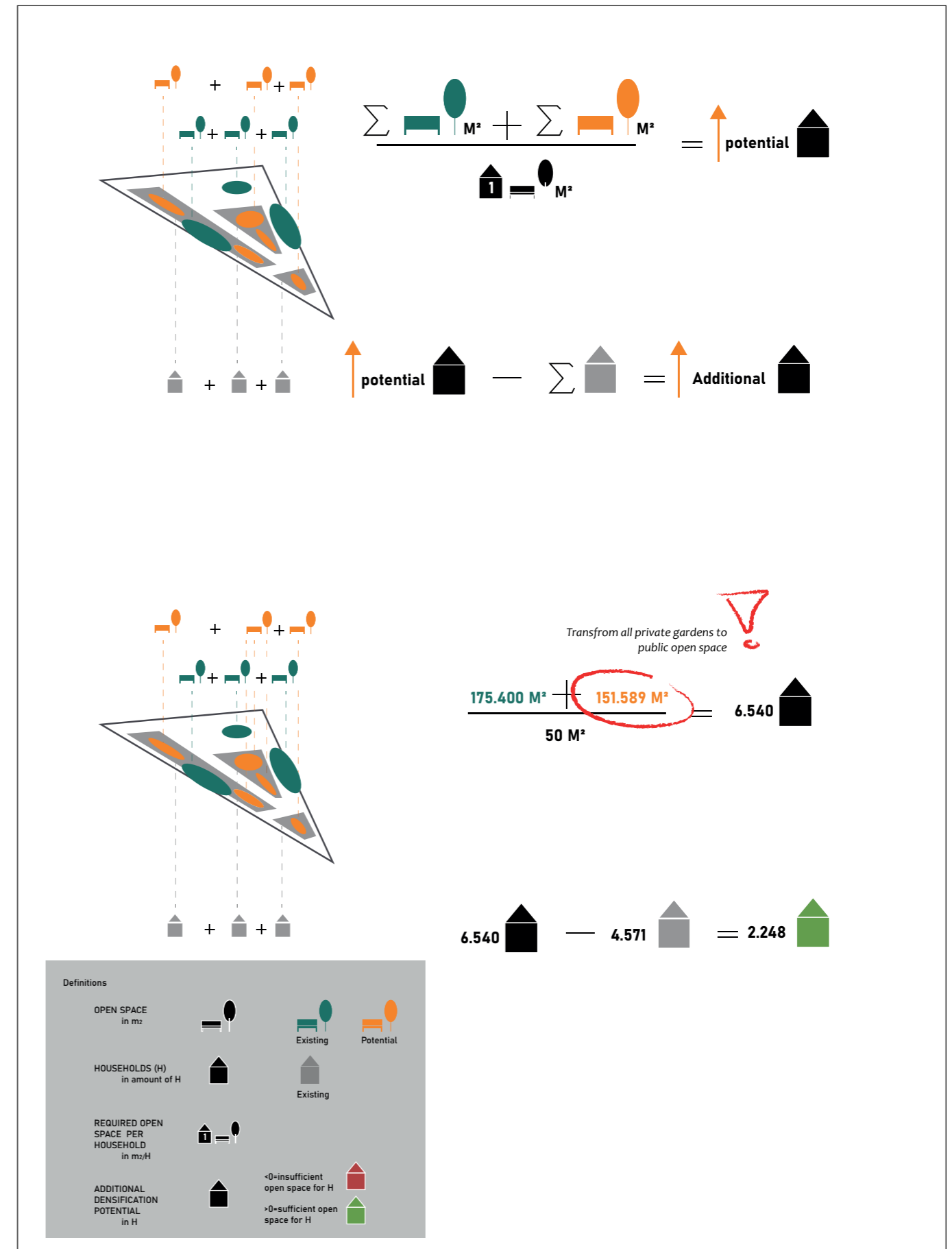


### Framework sustainable densification

$$\frac{\text{Available open space [m}^2\text{]}}{\text{Required open space per household [m}^2\text{]}} = \text{Potential households [H]}$$

$$\text{Potential households [H]} - \text{Existing households [H]} = \text{Potential additional households}$$

### CREATING ADDITIONAL DENSIFICATION POTENTIAL



# SPATIAL STRATEGY

## 5.3 Typologies

The previous spatial analysis regarding the different categories makes no distinction between spaces within the same category. A parking lot is for example approached the same way as a bicycle road, or a sidewalk along a car road is perceived similar as a walking path along the waterfront. Therefore, before testing the Open Space strategy by making design interventions in the neighborhood, a better understanding is needed about the different environmental types of Rivierenwijk (figure 5.5). The next part will discuss this typology in more depth and look at how each type relates to the previous open space analysis.

The established typology is based on the concept of the '15 minute city', also the starting point in the spatial vision of the municipality of Utrecht. In this city residents will find all the functions of the city, like work, sports and shopping in a close, walkable proximity of their home. With less long distant movement, and therefore less traffic, a liveable dense city is pursued. With a smaller movement radius, the space right outside your front door becomes more important and more valuable. These infrastructural spaces need variation to make living in such a smaller bubble still attractive. If all

the streets around your house are similar, it would not be very entertaining to walk around the neighborhood. Creating diverse and entertaining 'ommetjes', a fine walkable grid with different characteristic spaces, therefore is the purpose of this typology. Examples of such 'ommetjes' are shown in the scale comparison below, where a walk around the peninsula of Rivierenwijk is of similar length as a walk around the Singelpark in Utrecht. Creating multiple typologies along such walks is a

known strategy to diversify the urban fabric, like is done with Kanaleneiland by the design firm Flux, or in New York with the Big U project (figure 5.6 & 5.7). While these references are representing design interventions, the typology on Rivierenwijk presented on the following pages is one with an analytical character. The purpose is to analyse the existing characteristics, values and weaknesses of the typologies, to provide a base for the design proposals, presented later in the report.

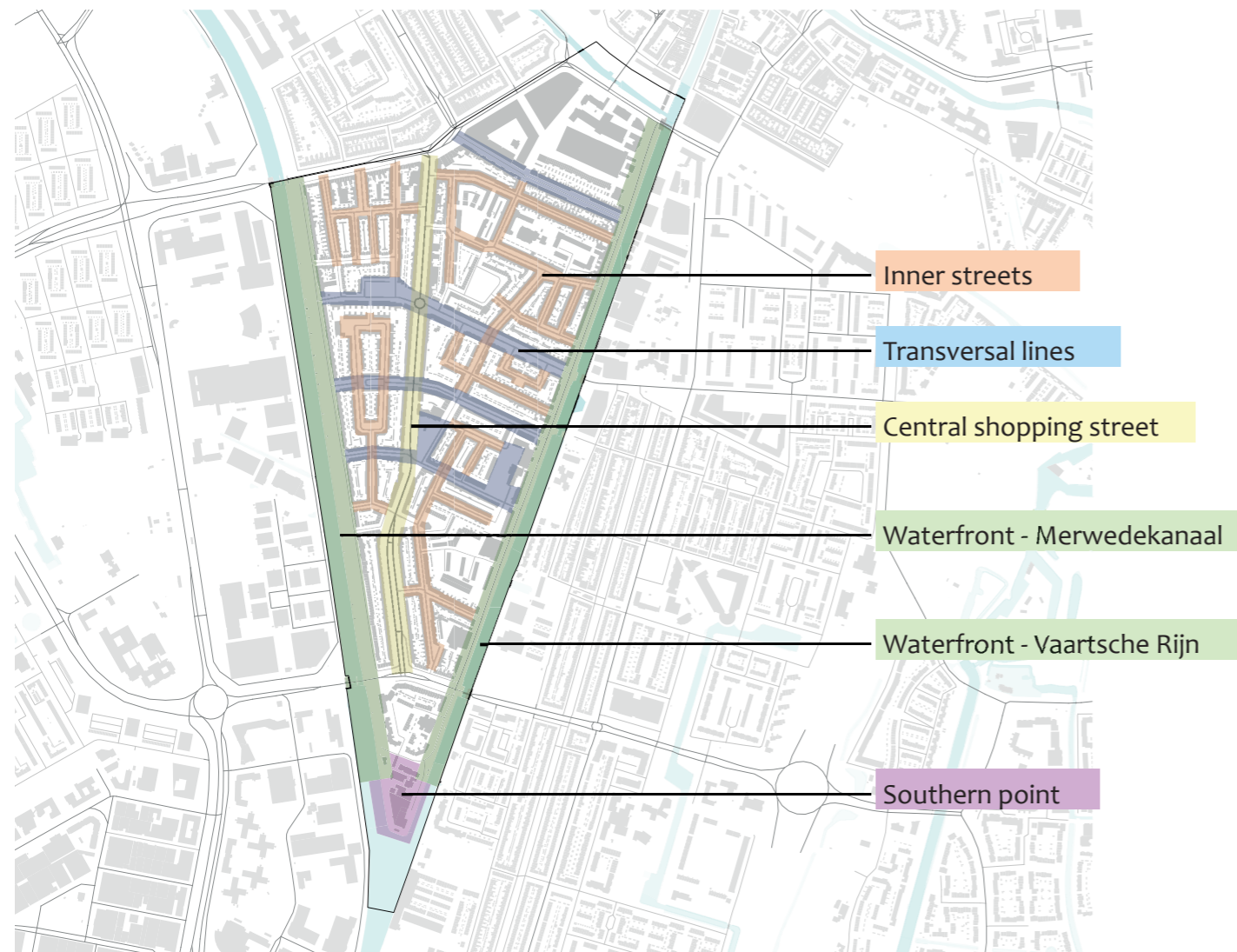


Fig 5.5 Different spatial typologies of space within Rivierenwijk - Source: by author

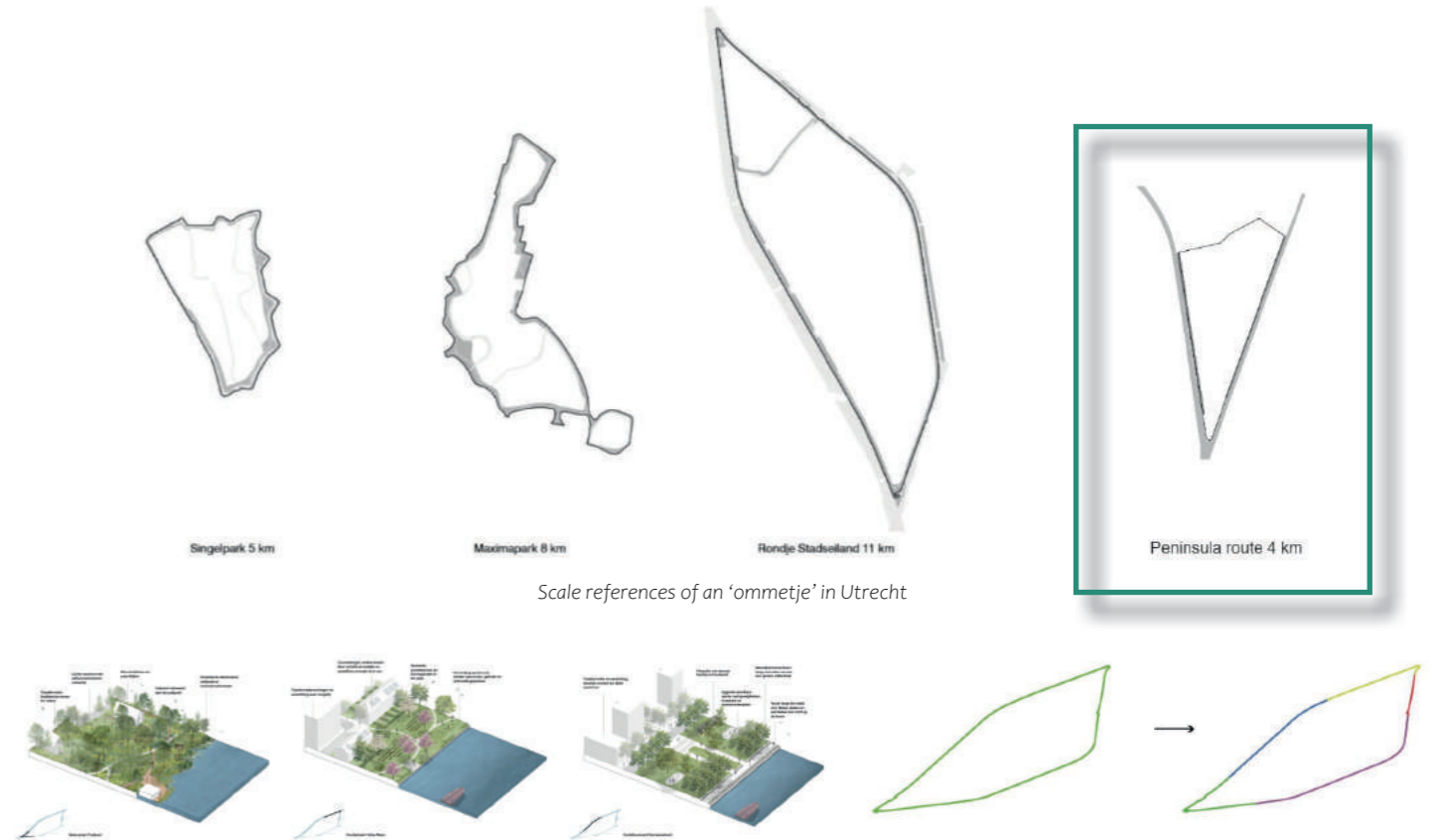


Fig 5.6 Design typology of a 'Rondje Kanaleneiland' - Source: Flux landscape architecture (2017)

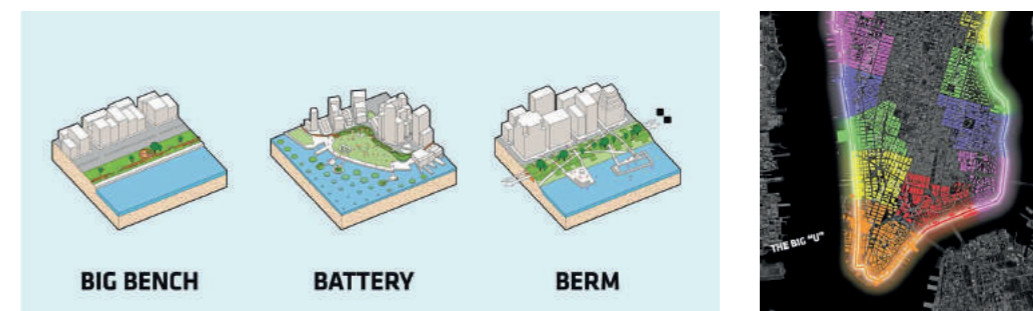


Fig 5.7 Design typology of the Big U in New York - Source: Bjarke Ingles Group (2013)

# SPATIAL STRATEGY

## Inner streets

The inner streets are the finest street network in the neighborhood. This is the space right outside each front door. These narrow streets are most of the time dominated by two rows of street parking. Together with the car road in the middle there is little space left for other functions. The remaining small sidewalks at both sides of the streets are therefore full with parked bicycles. Besides the small street trees, the only green is the informal facade gardens, an attempt by the residents to include more green in the street. It can be concluded that the current design of the streets provides little open space for the residents to socialize, play or meet.



Fig 5.8 The innerstreets in Riverenwijk

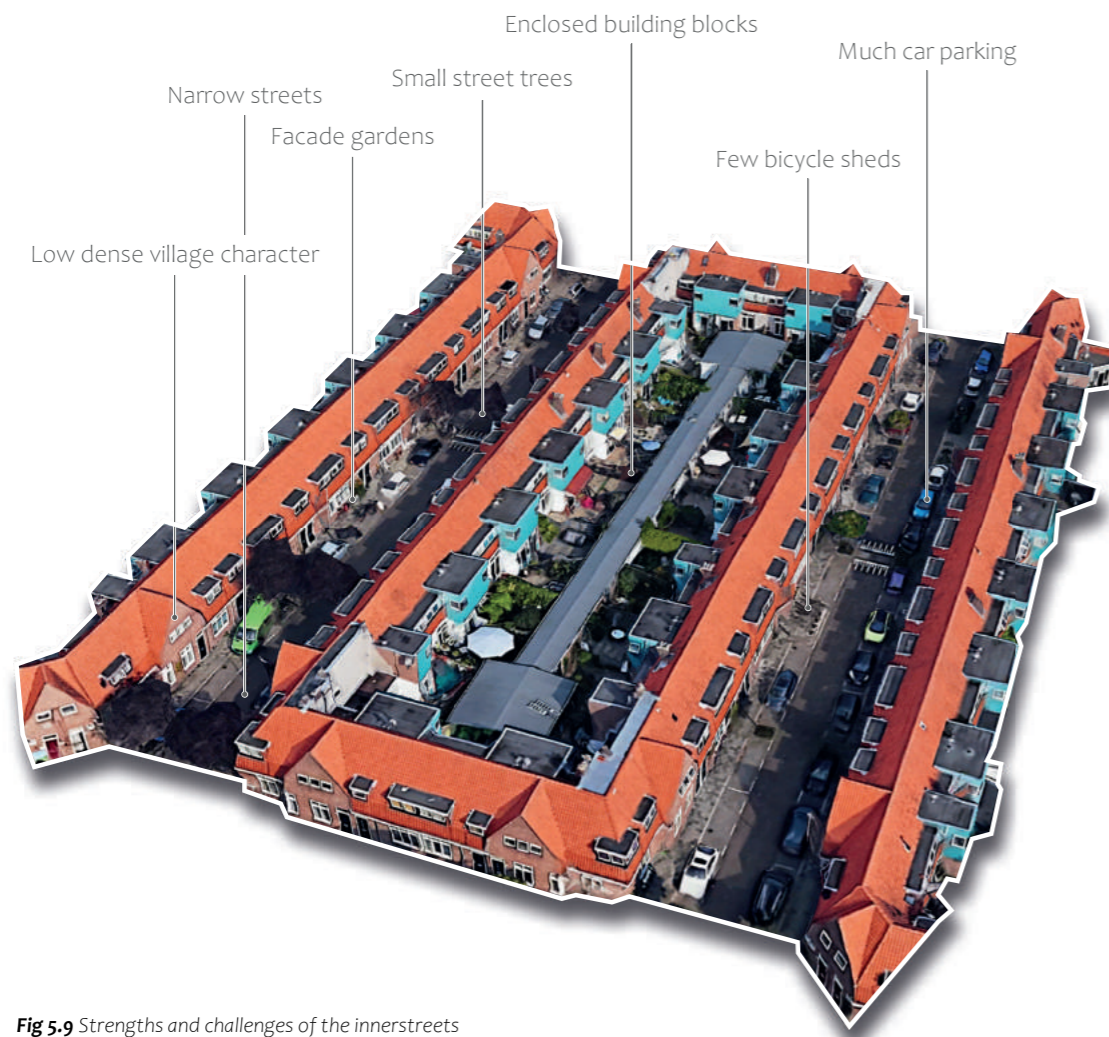
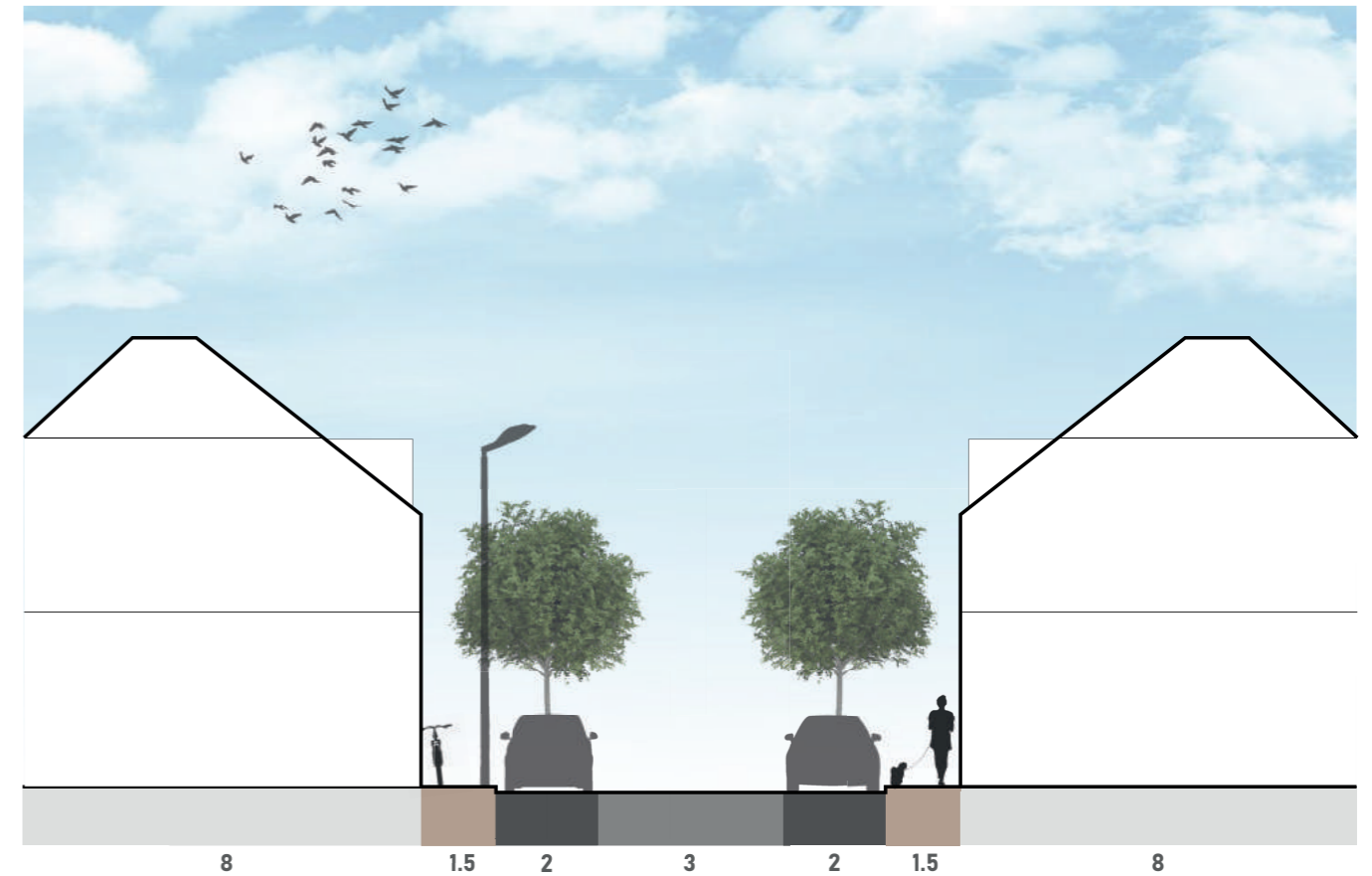


Fig 5.9 Strengths and challenges of the innerstreets



Fig 5.10 Open space analysis of the innerstreets



# SPATIAL STRATEGY

## Transversal lines

These important infrastructural lines are connecting the two waterfronts and the central shopping street by a transversal line. Wider than the inner streets, they also connect other open spaces, like parks, squares and playgrounds. Large tree lines, often of the same tree species, are guiding the transversal lines, proving a good orientation in the neighborhood. While the wideness of the street is necessary for the main infrastructural purpose, this also offers the opportunity for parking on the sidewalk. Hereby reducing the safe walkable experience of the streets.

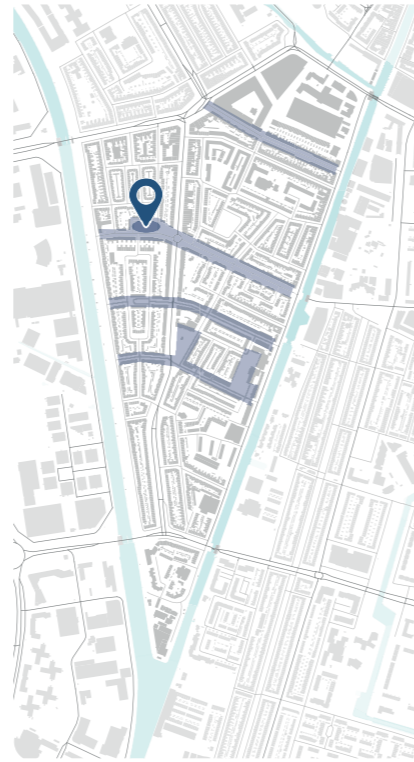


Fig 5.11 The transversal lines in Riverenwijk

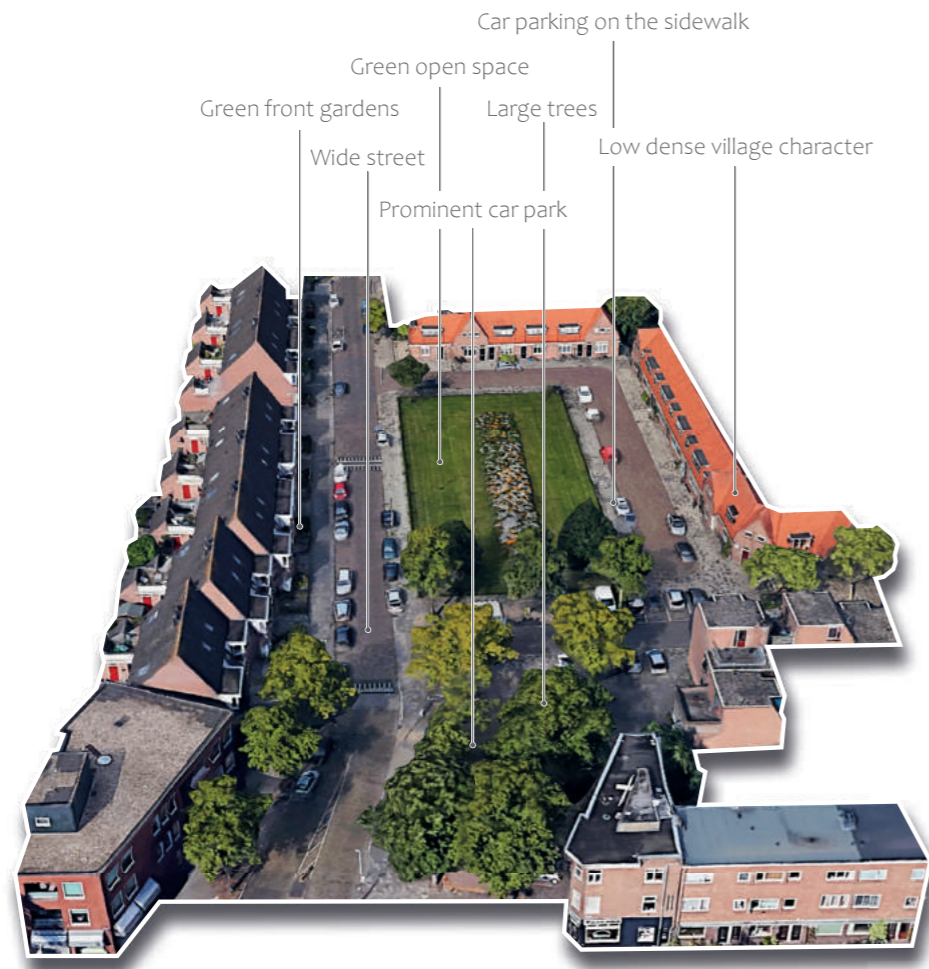
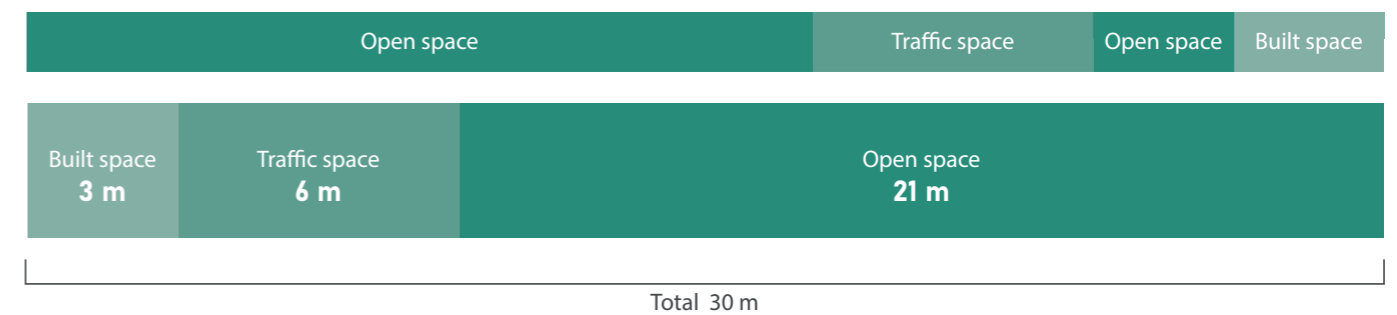


Fig 5.12 Strengths and challenges of the transversal lines



Fig 5.13 Open space analysis of the transversal lines



# SPATIAL STRATEGY

## Central shopping street

The main infrastructural line in Rivierenwijk is the Rijnlaan, in the middle of the neighborhood. All existing shops and cafes are in the northern part of this street, although there are no outdoor places to sit. A double line of Tilia trees is the only green in the street, which remain small because of their limited underground rooting space. Both sides have safe separate biking paths, providing good accessibility by bike. However, there are few crossings across the central car road, resulting in little interaction between the two street sides. This main street is also part of the public transport network, used by bus which has two stops in the street.



Fig 5.14 The central street in Rivierenwijk

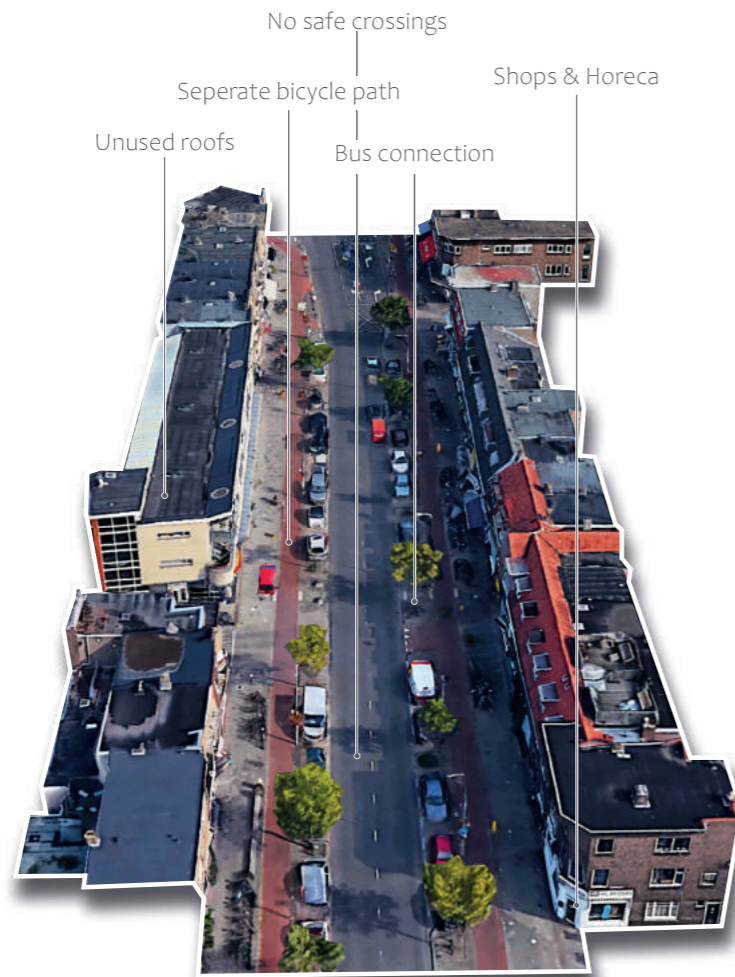
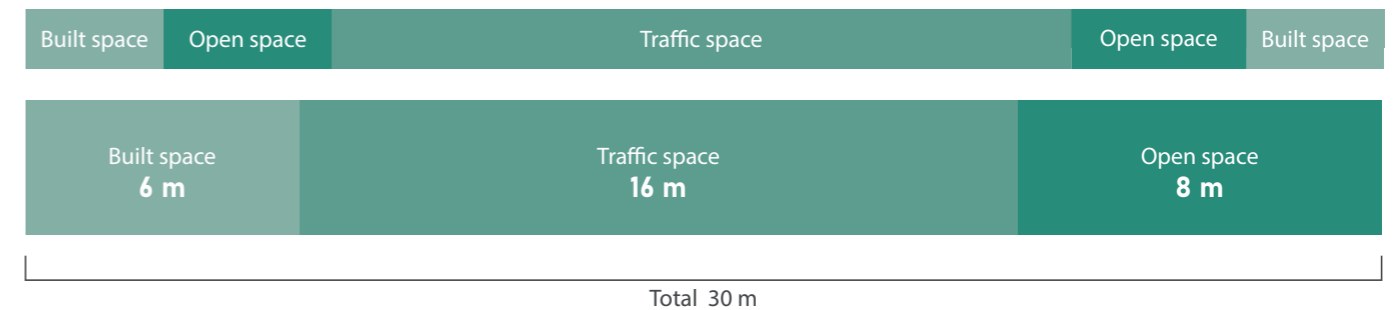
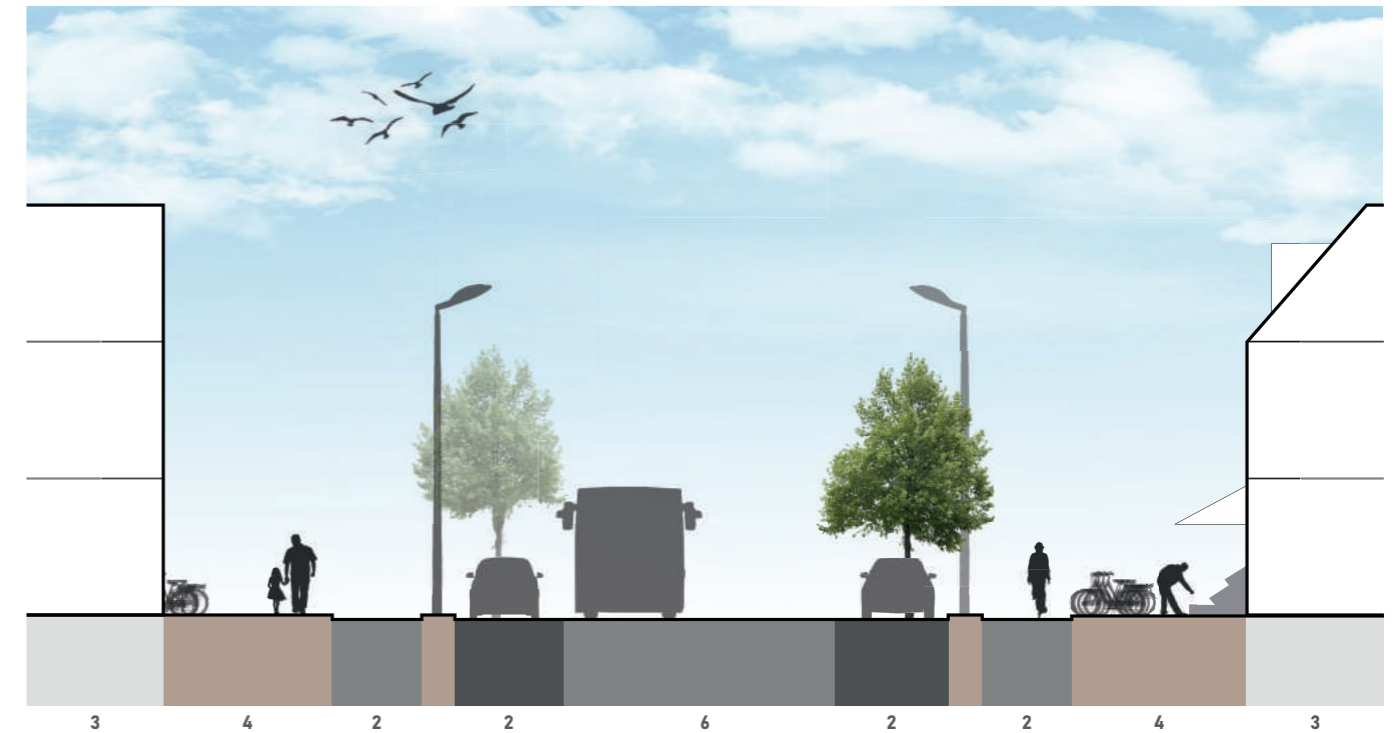


Fig 5.15 Strengths and challenges of the central shopping street

0 2.5 5

Fig 5.16 Open space analysis of the central shopping street



# SPATIAL STRATEGY

## Waterfront - Merwedekanaal

The waterfront of the Merwedekanaal is popular for recreation within the neighborhood. Even though there are only a few sights on the water, the green stroke with many mature trees of different species is a nice place to walk and play. The large front yards provide a blend between the public park and the houses, even though there is a road and car parking in between. The walking path in the park is however small, especially if the popularity among the residents is taken into account. While there is a variation between tree species, the short-cut lawn and the absence of a shrub layer offers potential for more quality for biodiversity.

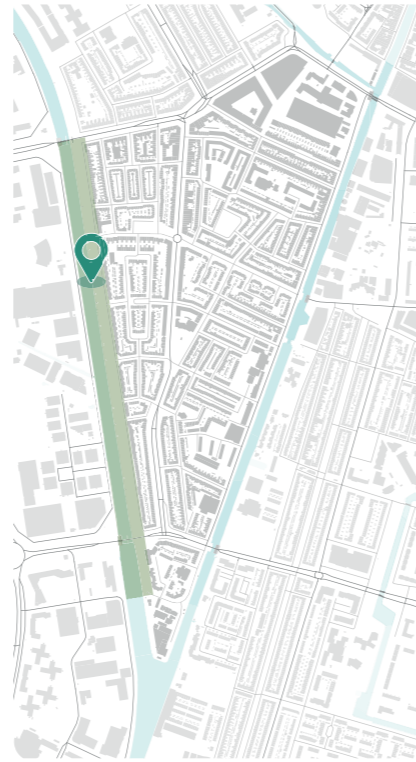


Fig 5.17 The Merwede waterfront

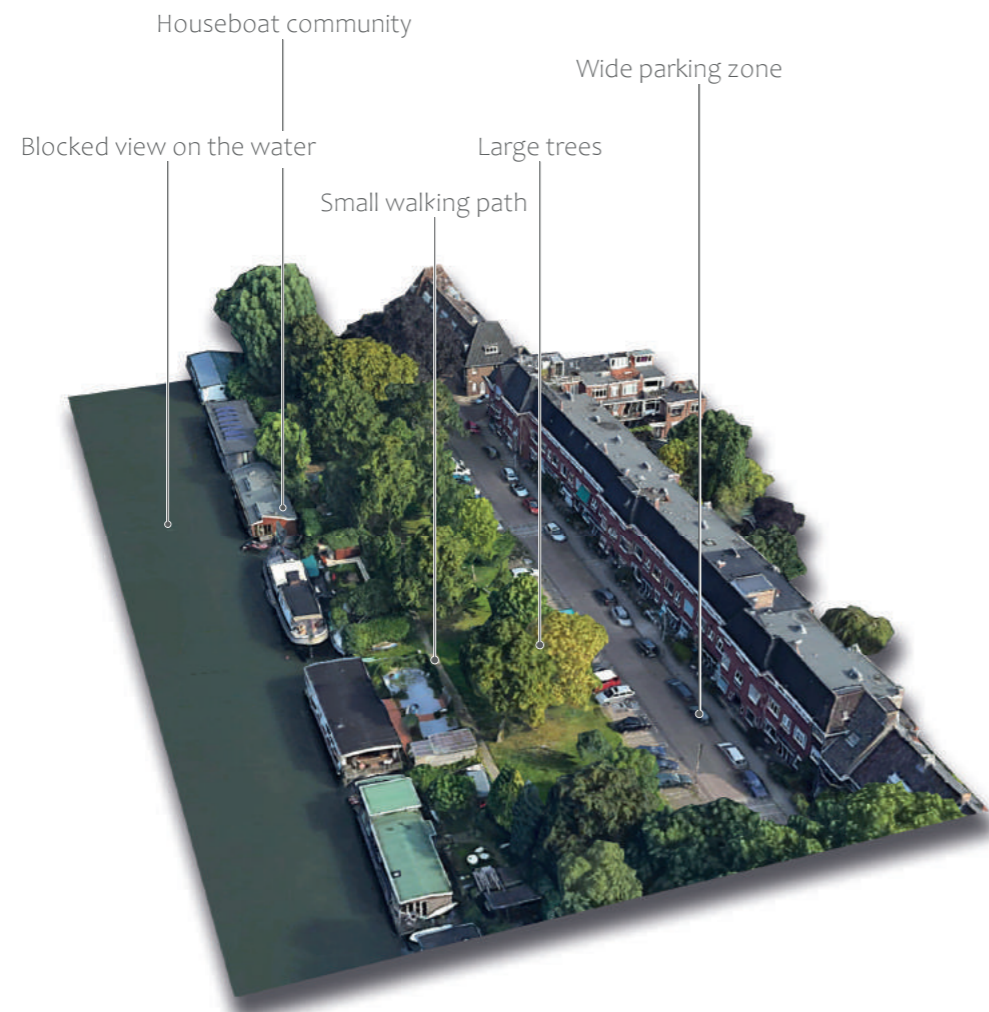
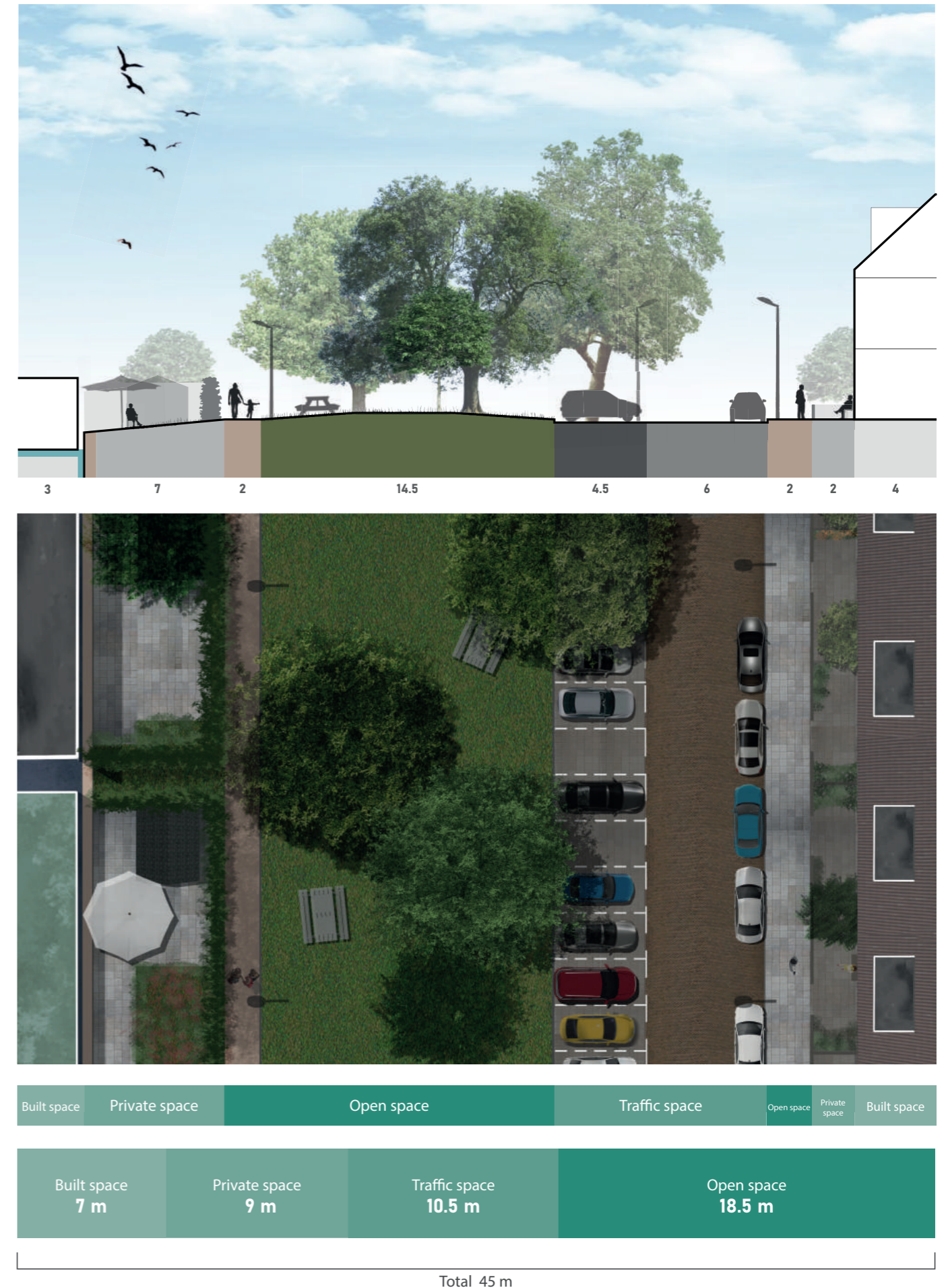


Fig 5.18 Strengths and challenges of the Merwede waterfront



Fig 5.19 Open space analysis of the Merwede waterfront



# SPATIAL STRATEGY

## Waterfront - Vaartsche Rijn

The east side of the neighborhood is bordered by the water of the Vaartsche Rijn. Guided by a robust line of Tilia trees this waterfront is cut off by a busy traffic road, consisting of a two-way car road with a bicycle road at both sides. The actual waterfront is therefore mostly inaccessible. Only after a row of parked cars there is a sidewalk for pedestrians, far removed from the waterfront. The large buildings along the street differ from iconic and historical interesting, to large apartment blocks with a boring and closed off plint. The route is part of the fast-cycling line from Nieuwegein to the city centre of Utrecht. More focus on slow mobility, like cycling and walking, could go together with improving the accessibility of the waterfront.

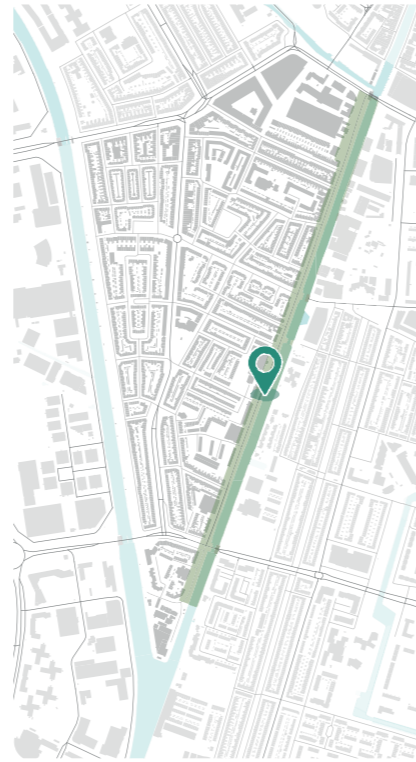


Fig 5.20 The Vaartsche Rijn waterfront

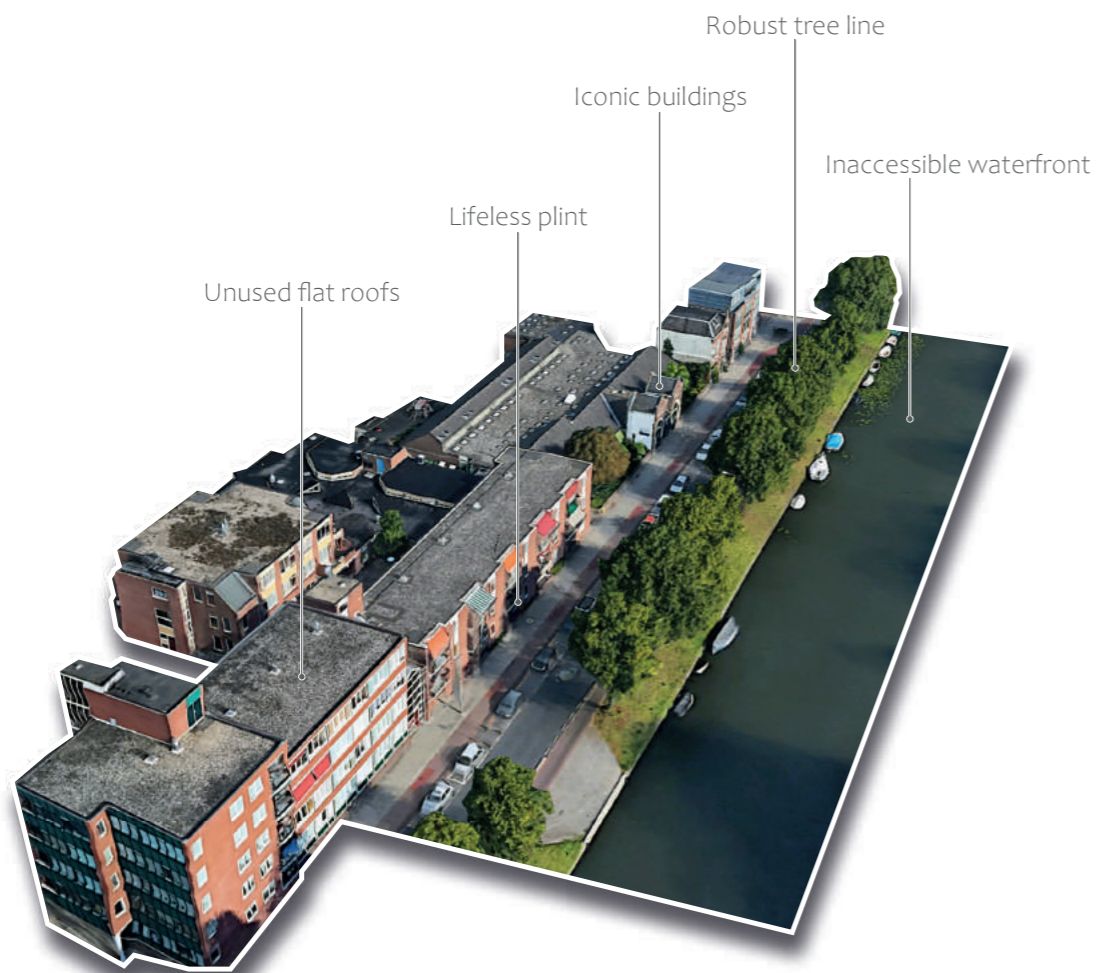
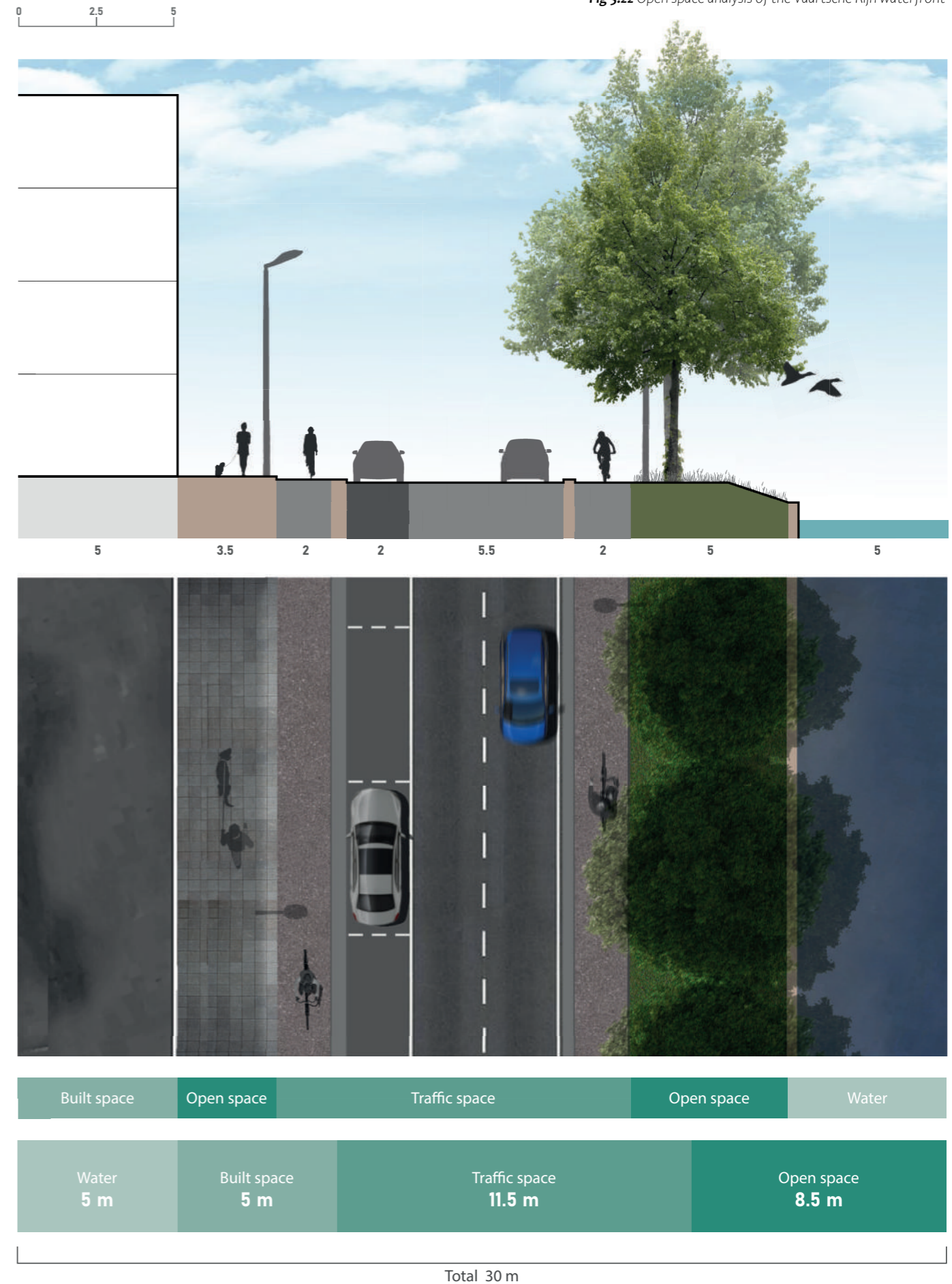


Fig 5.21 Strengths and challenges of the Vaartsche Rijn waterfront

Fig 5.22 Open space analysis of the Vaartsche Rijn waterfront





# SPATIAL STRATEGY

## Southern point

The southern point of Rivierenwijk is a small private industrial area, with a focus on shipping construction materials. Within Utrecht there are few places with a large wide view, like on this south tip, where there is a panoramic view over the water. Also the large poplar trees and the accessible waterfront offer much quality. The current industrial focus of the area offers a unique spatial character in Rivierenwijk. While this area is currently inaccessible and fenced off, it offers many opportunities to become a mixed-use area with recreation on the waterfront, housing and small industry. This combination can be a unique and valuable improvement to the neighborhood and its surroundings



Fig 5.23 The southern point of Rivierenwijk

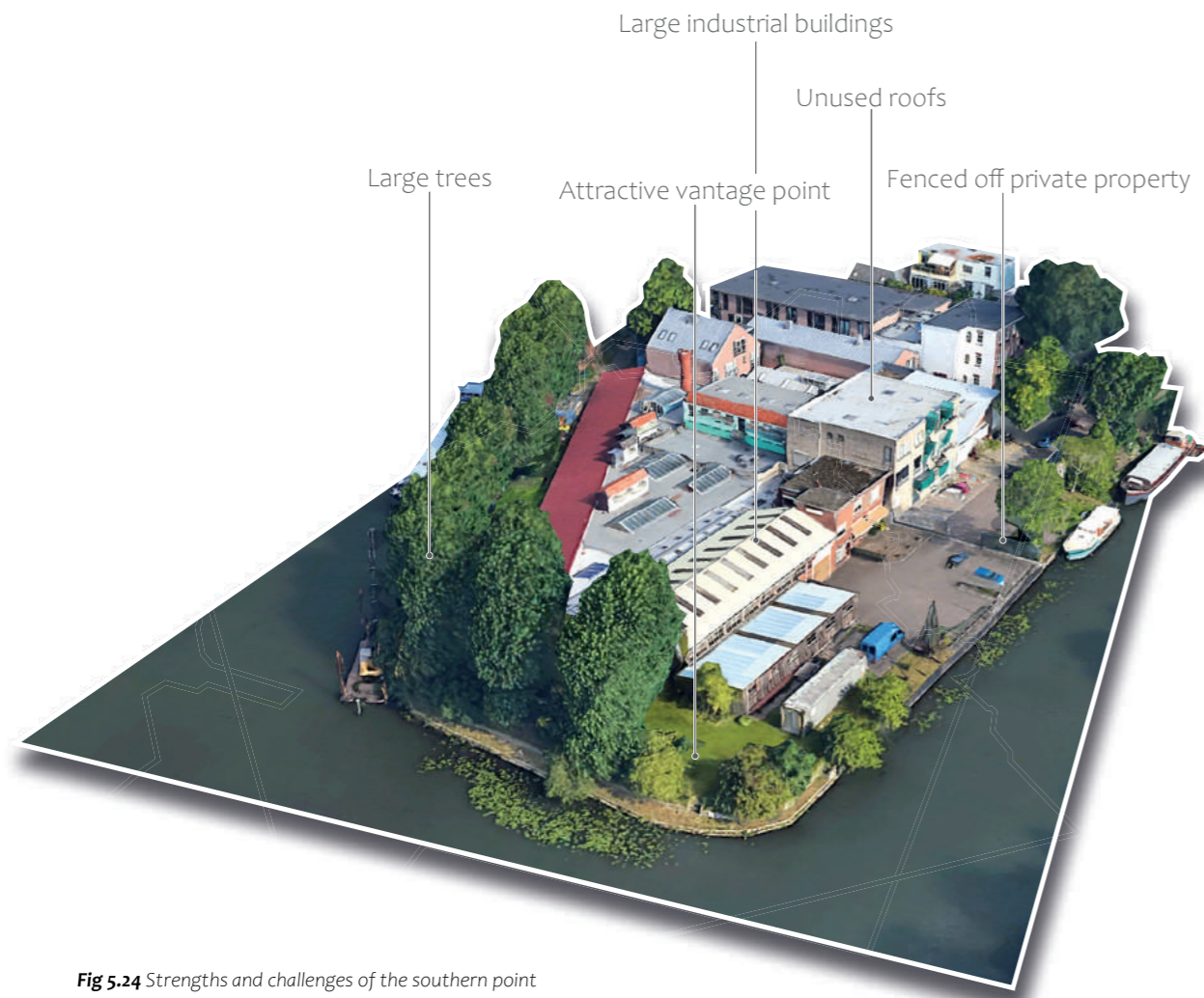
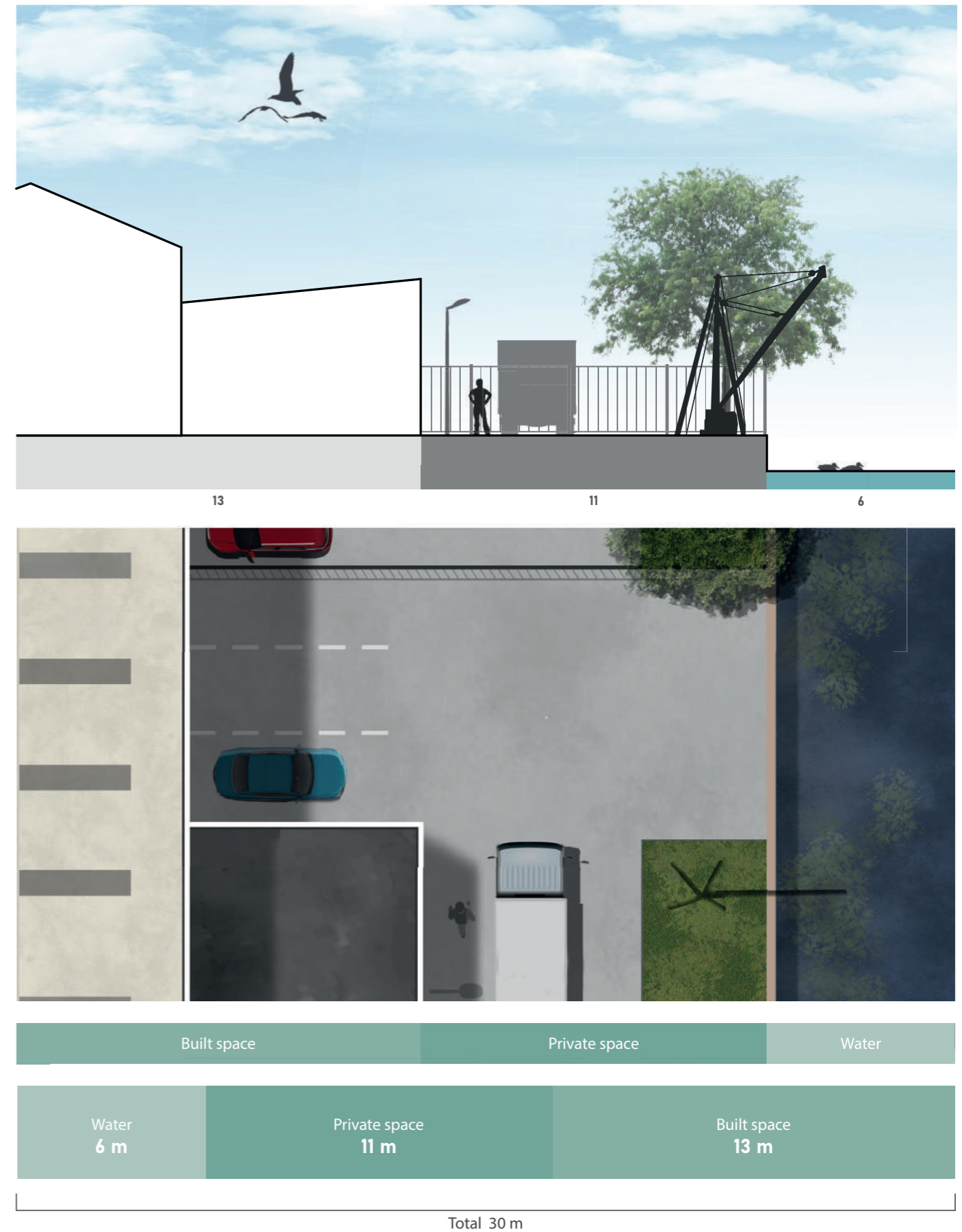


Fig 5.24 Strengths and challenges of the southern point



Fig 5.25 Open space analysis of the southern point



# ENVIRONMENTAL QUALITIES

## 5.4 Environmental qualities

### Climate resilience

The quality of life in the city is highly dependent on a comfortable urban climate. This living climate in the city is often different compared to the climate of the surrounding rural landscape. Mainly because of the physical conditions of the urban landscape. The high amount of paved surface absorbs for example more heat during the day, causing an urban climate with higher mean temperatures, also known as the urban heat island effect. Other characteristics of the urban climate are increased precipitation, altered winds and a noxious air quality (Masson et al, 2020). Compared to the climate of the rural landscape, the urban climate is less comfortable to live in, because it often aggravates the weather extremes, putting more

pressure on urban liveability (figure 5.26). For example, the large amount of paved surfaces prevents natural infiltration of precipitation, creating the risk of a flooded sewer system with consequences for human health. While on the other hand the many polluting cars and industries provide a more harmful air quality in the city.

In addition to this already more extreme urban climate, the trend of climate change is putting even more pressure on a comfortable living climate. Research shows that the effects of climate change are causing more extreme weather within the city, leading to more heat waves, periods of drought and

extreme precipitation, with many health hazards for the urban population (figure 5.27). This global trend is also affecting the city of Utrecht and to maintain a comfortable urban climate and mitigate the effects of climate change, a more climate adaptive design of the city is required (KNMI weer- dienstverlening, 2018). Climate adaptation can be defined as: 'actions taken at the local level to modify a system to better withstand impacts from a changing climate' (Masson et al, 2020). Because of the urgency for climate adaptation there are many sources available that provide design solutions, like the NAS-adaptation tool by Nationale Adaptatie Strategie, or the Climate app developed by Sweco, Bosch Slabbers, Deltares and the KNMI. In the

diagram below the most urgent effects of climate change on the urban climate are presented, together with exemplary design principles that would integrate climate adaptation in the urban fabric (figure 5.28).

### 400 extra doden tijdens hittegolf van juli

Gepubliceerd 9 augustus 2019

Tijdens de hittegolf eind juli, waarbij de hoogste temperaturen ooit werden gemeten in Nederland, zijn 2.964 personen overleden. Dat zijn er bijna 400 meer dan in een gemiddelde week in de zomerperiode, meldt het Centraal Bureau voor de Statistiek (CBS) op basis van voorlopige sterfcijfers.

Fig 5.27 News article about the additional deaths due to extrem heath Source: RTL nieuws

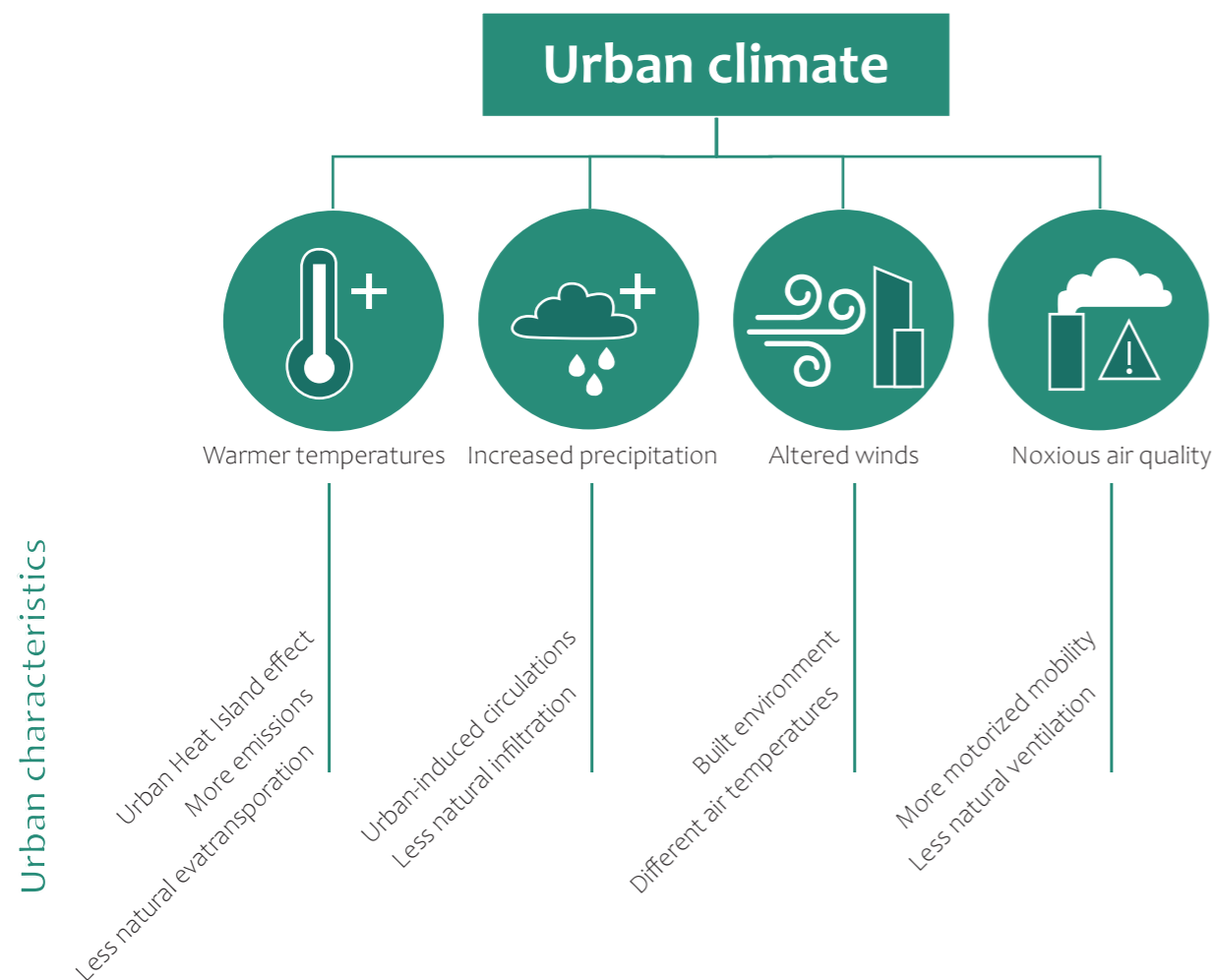


Fig 5.26 Characteristics of the urban climate - Source: adapted from Masson et al (2020)

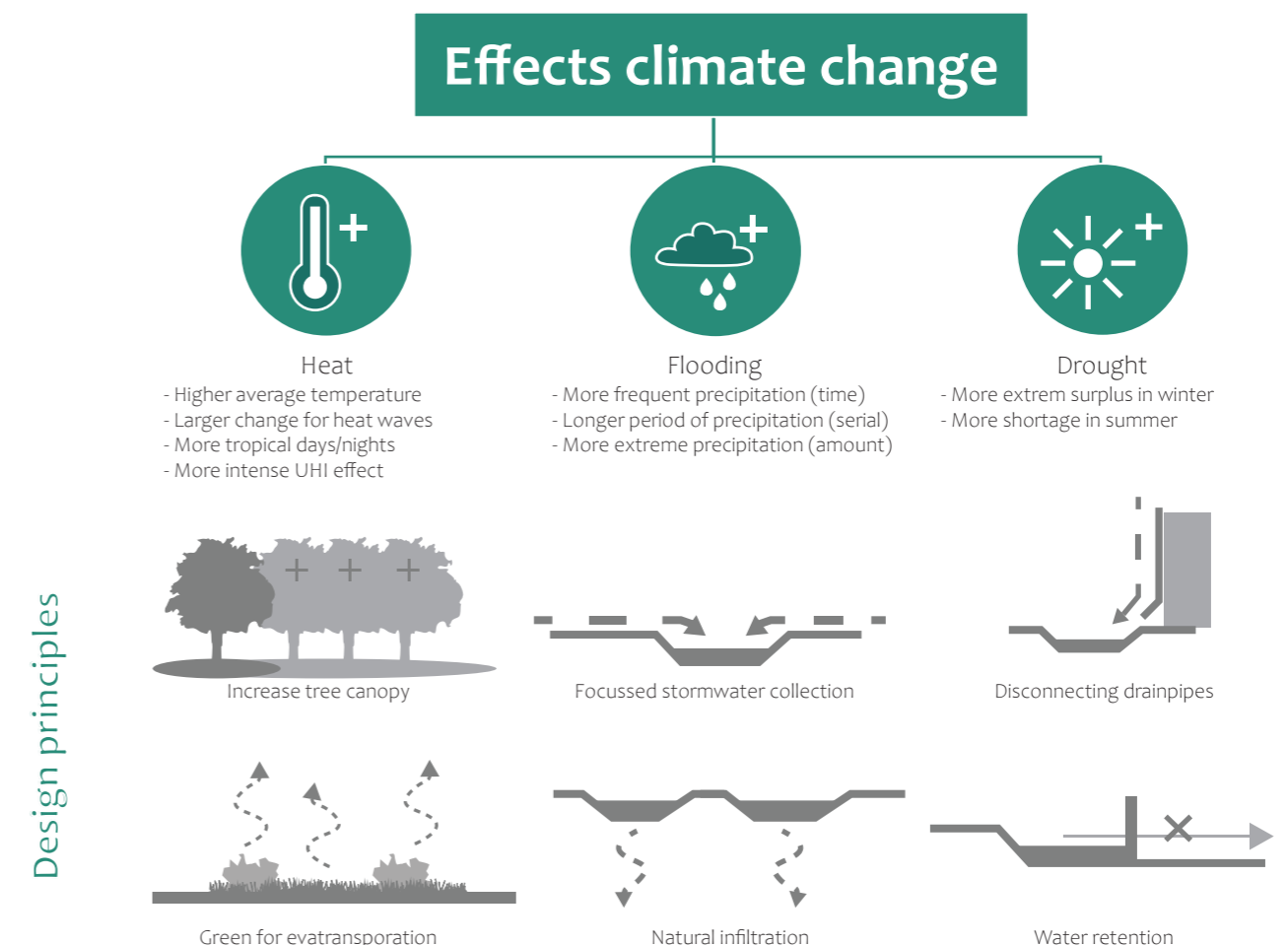


Fig 5.28 Designing for climate adaptation - Source: adapted from Climate Adaptation App

# ENVIRONMENTAL QUALITIES

## Biodiversity

Globally there is a trend of a strong decrease in biodiversity, or in other words in the variety among living natural organisms like plants, insects and animals. The Netherlands is no exception to this, with a biodiversity loss of 85% compared to the level of 1900, our national ecology is in great jeopardy (PBL, 2014). While our relation with nature has become more detached, biodiversity is of great importance by providing many ecosystem services (Millennium ecosystem assessment, 2005). Regulating clean air and water is essential for a healthy living environment, while at the same time we use many natural resources for our everyday life. A diminishing ecological system with a less diverse level of biodiversity is therefore a major threat to our existence as well. The reduction of the natural environment is one of the main causes for this descending trend. The historical

paradigm that the city is for humans and the surrounding wild, untamed landscape belongs to nature, is still present in our contemporary urban design (figure 5.29). However, with our continuously expanding urban- and agricultural landscape, less and less space remains where nature can thrive. The current strategy of preserving only a selection of natural areas, while neglecting their existence everywhere else, is no longer a sustainable model. A paradigm shift of our relation, where we move from parasitic to coexisting, is needed to prevent a major biodiversity collapse. This means that we should plan and design for nature and ecology in every environment, also in the urban context. Transforming the urban fabric towards more nature inclusive cities is therefore a great challenge for the coming decade (Vink & Vollaard, 2017).

The essence of nature inclusive design can be summarized in two aspects: aiming for sustainable maintenance and by a strong integration of ecology in the design (figure 5.30). From the book 'Darwin comes to town', by Menno Schilthuizen, it becomes clear that nature is very resilient, if it gets the time to develop and grow. The way of maintenance should therefore be cooperative with nature, instead of pursuing a static image, which is often very labour intensive. Our perception of green should shift towards an image where more 'messiness' is accepted. Mowing only parts of the grass for example, provides insects continuously with a habitat and nourishment. However, in the process, the traditional image of a neat, short cut lawn is

something that will be renounced. At the same time the aspect of ecology should be integrated in the urban design from the start. By approaching nature as an integral element of the design, which also requires space, energy and money, a nature inclusive city can be designed. The book 'Making Urban Nature' by Jacques Vink, Niels de Zwarte and Piet Vollaard provides many interesting principles on how to make ecology an equal element in the design. One of the most important lessons is to design a process. Nature will also grow and develop, and by taking this into account a design can become more valuable over time.

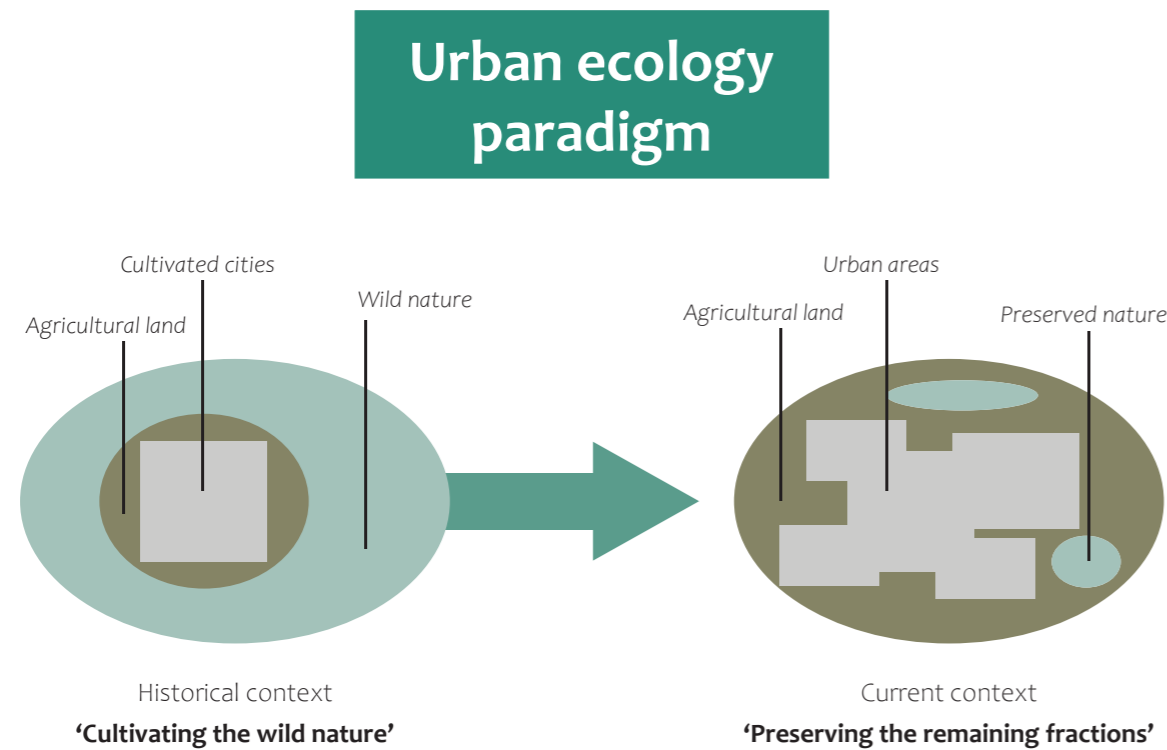


Fig 5.29 The unsustainable urban ecology paradigm - Source: adapted from 'Making Urban Nature' (2017)

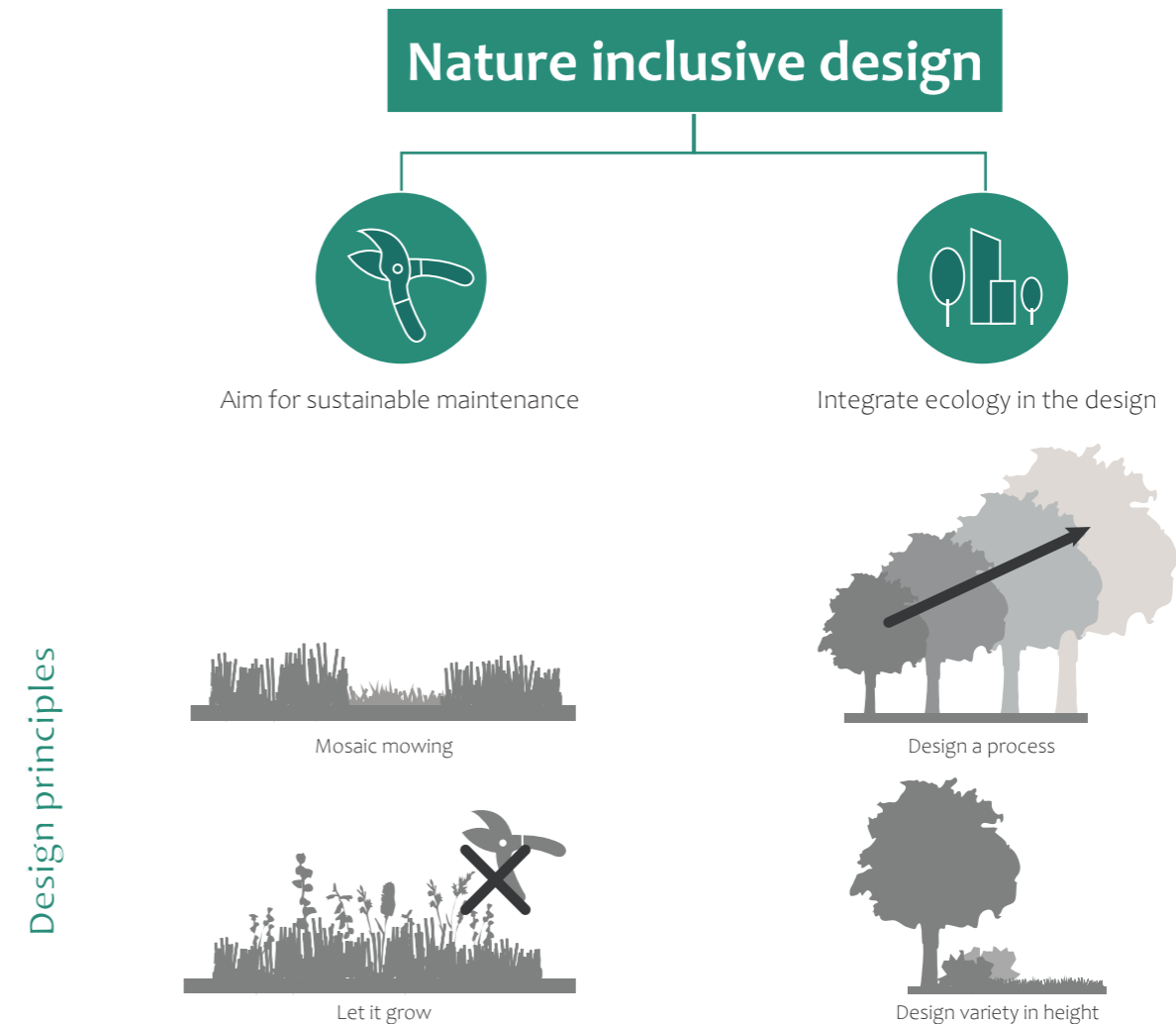


Fig 5.30 Designing for biodiversity - Source: adapted from 'Making Urban Nature' (2017) and 'Darwin Comes to Town' (2018)

# ENVIRONMENTAL QUALITIES

## Tree analysis

Designing a nature inclusive city means to create suitable conditions for a rich biodiversity. A key element in this design process is the use of trees. Both the variety in tree species in an area and the age of the specific trees are of great importance for local biodiversity. Different tree species mean a more diverse and longer flowering period, while providing more variety in nourishment with different fruits and seeds. As trees grow older they become more valuable for their environment, providing more shelter, flowers and fruits. The results of the tree analysis of Rivierenwijk is visualized in the maps below, which includes all the trees in the public space. The total of 1302 trees comprise 39 different tree species (figure 5.31). However, this is not equally divided. A detailed analysis shows that the 7 species of Acer, Prunus, Pyrus, Tilia, Platanus, Sorbus and Ulmus represent

979 trees, which is more than 75% of all the trees. A reason for this monotone use in tree species is the implementation of trees as a design element. Since the emergence of garden- and landscape architecture trees are main elements in designing the physical environment. Creating long avenues with similar trees is a great way to highlight a main infrastructural line. This is also visible in the age analysis of the trees (figure 5.32). It can be concluded that the oldest trees represent the most important green structure along the waterfronts and in the transversal line of the Waalstraat. The trees in the inner streets are much younger, because they are often replaced when they grow too large and cause nuisance in the small streets.

Using a similar tree species for each gradation of infrastructure is a commonly used design principle (figure 5.33). In the case of Rivierenwijk the central shopping street and two waterfronts form the main structural lines, accompanied by a single or double line of Tilia trees. The transversal lines are highlighted with elms. On the more local scale the inner streets are accentuated by a similar type of tree, providing a legible character of the street. While there is a larger selection of tree species between the streets, using only one tree species in the same line is not very valuable for urban ecology. It often makes nature in the city more vulnerable, like for example with the elm disease or the oak processionary moth. Highlighting the tree as both a design- as a natural element of equal importance should be the starting point in designing a nature inclusive city.



# ENVIRONMENTAL QUALITIES

Taking a closer look at the two waterfronts of Rivierenwijk the practical use of trees as natural- and design elements is clearly visible. The waterfront along the Merwedekanaal is designed as a stretched park, with mainly a recreational purpose. Scattered through the park, many different tree species can be found, providing a forestlike atmosphere. The diversity of trees makes the park not only attractive for humans, but offers a valuable place for urban ecology as well. The composition of many different tree species provides a variety in nourishment for insects, birds and small animals, in different seasons of the year. In April the Acer starts to bloom, attracting many insects. Around May the Crataegus follows with its many white flowers. Hereafter, around June, the Tilia develops its nectar-rich flowers, becoming a hotspot for especially bees. After the summer, around September, the Crataegus develops its bright

red berries which provide a necessary food source for birds in winter. Such analysis of flowering periods offers insight in why the use of different tree species is important when designing a nature inclusive city. On the contrary is the waterfront of the Vaartsche Rijn, accompanied by a single line of the same Tilia trees. The function of the trees as a design element is obvious by looking at the positioning of the tree line. The row disappears in the distance, highlighting the continuity of both the car road and the canal. However, the clear overview of the road invites speeding, which can lead to unsafe circumstances and create an even greater barrier towards the waterfront. Regarding biodiversity the Tilia trees certainly have value for many insects, but when the flowering time has ended the whole waterfront becomes much less beneficial for urban ecology because of the little diversity.

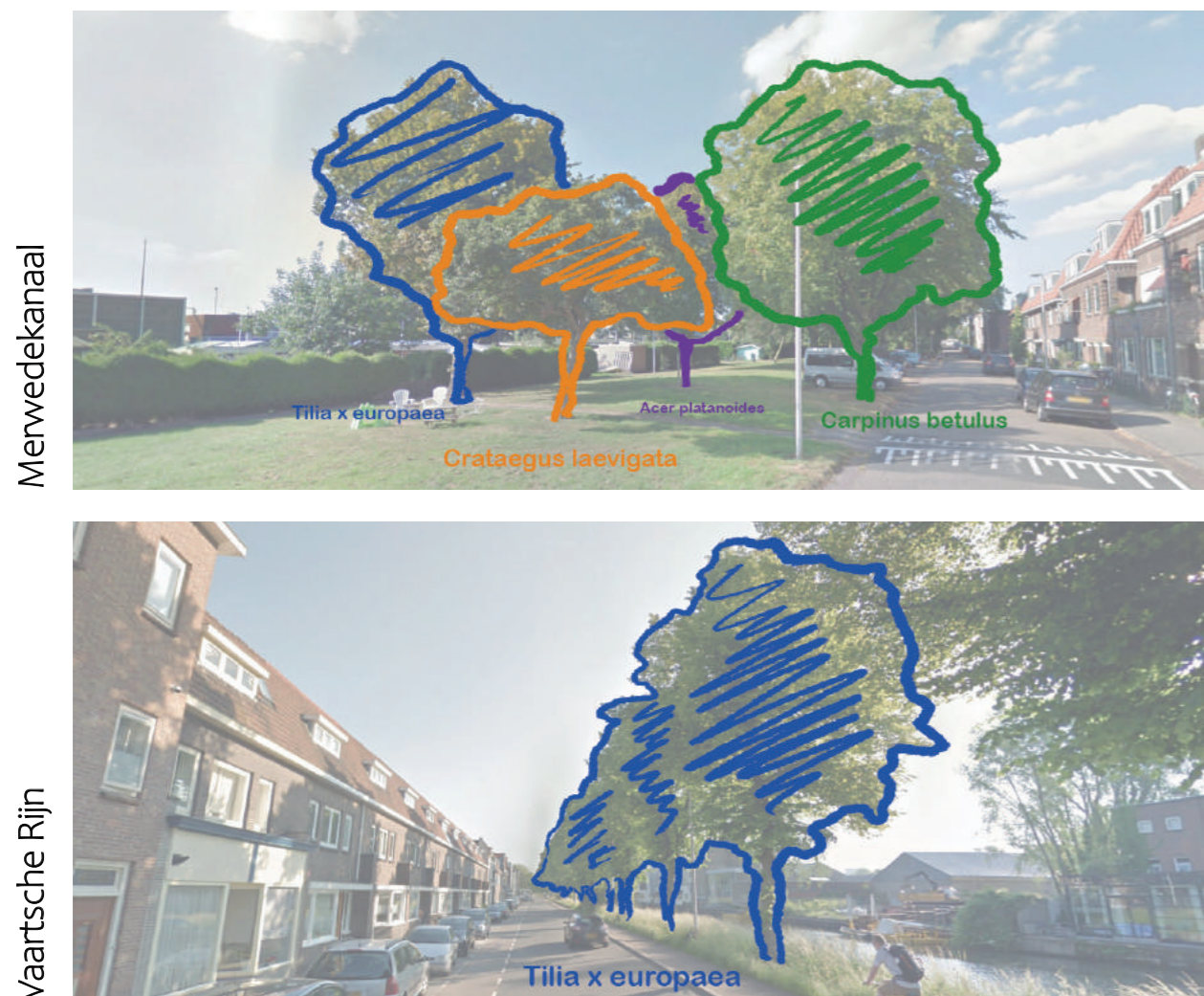


Fig 5.34 Tree variation on the waterfront - Source: Google Maps

## Tree analysis of the two waterfronts



Fig 5.35 Trees on the two waterfronts - Source: Gemeente Utrecht



Contents:

- 6.1 Design locations
- 6.2 Gated pocket park
- 6.3 Southern panoramic view
- 6.4 Vaartsche Rijn waterfront

## 6. DESIGN INTERVENTIONS

The previous two sub research questions provide a knowledge base on how a redesign of the different topological spaces in Rivierenwijk can contribute to a higher densification potential. To test this Open Space strategy, this chapter will present design proposals for three specific locations in the project area. By applying the strategy on real locations, a better understanding can be obtained on how the theoretical premise works in a real urban environment. After a brief introduction of the chosen locations, a in depth proposal is presented for each location.

Topic

Proposal

### SRQ 3

How can a redesign of available and potential open space improve the conditions for balanced densification?

#### Design locations

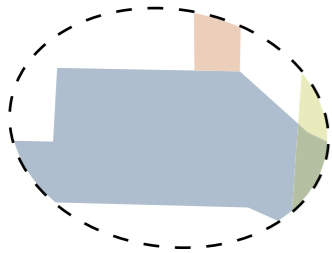
- Introduce the 3 chosen locations with a design proposal

#### Design proposal 1. & 2.

- Give a specific location analysis
- Propose a redesign strategy according to the open space diagram
- Give conclusions about what has been changed

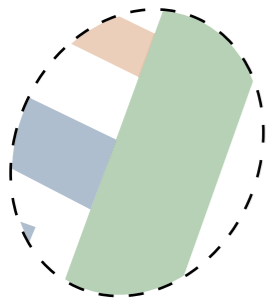
## 6.1 Design locations

From the analysis on the different typologies in the neighborhood it is concluded that there are six different types of spaces. To obtain representative conclusions through the research by design, it is important that all the typologies are represented. This has led to the result of the following two design locations (figure 6.1).



### Design location 1 - Gated pocket park

Central in this location is a large park surrounded with a locked gate. Along this busy transversal line, this location has much opportunity for a qualitative redesign. Where the park becomes a valuable open space connecting the shopping street and the Merwedekanaal waterfront. This currently car dominated street will connect in the near future the Merwedekanaalzone project with the historic city center. Hereby creating a great urgency for a redesign where slow mobility, like walking and cycling, has a main priority. Finally, this location connects the transversal line with the more fine grained inner street network.



### Design location 2 - Vaartsche Rijn waterfront

The fieldwork has shown how popular and valuable green open space along the waterfront can be. However, the waterfront along Vaartsche Rijn is not of a high quality. The inaccessible waterfront, with a busy infrastructural border provides much potential for a redesign. The road, which has been appointed as the fast-cycling road from Utrecht to Nieuwegein in the south, has to maintain its importance as a transport function. However, a stronger need for cycling instead of car mobility provides an argument for redesigning the location and while doing so it can restore its connection with the water.

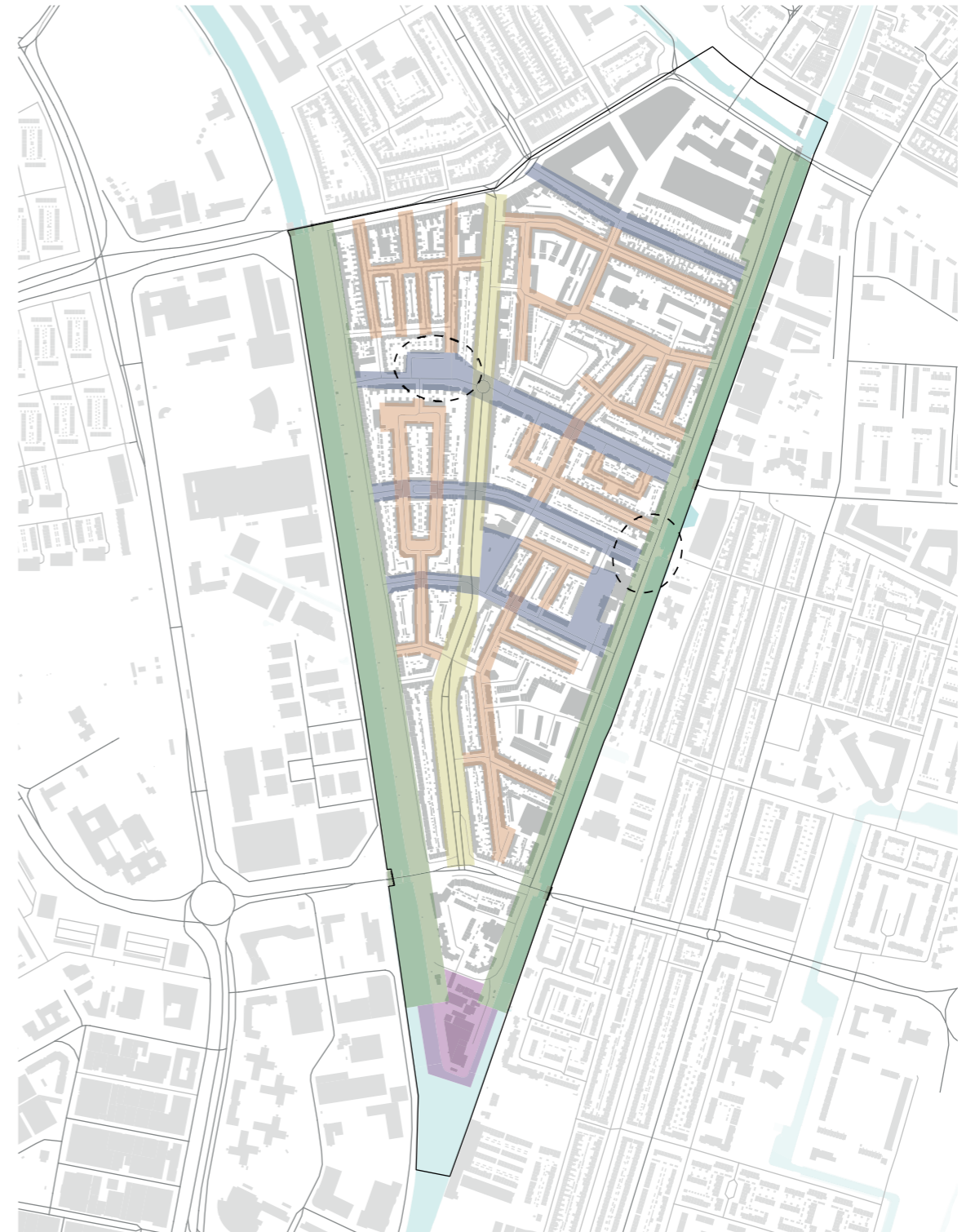








Fig 6.1 Locations of the design locations - Source: by author

# Design location 1

## 6.2 Gated pocket park

The location of the gated pocket park is visualised in the map below (figure 6.2). The park in the middle is bordered by both a sidewalk as a car road, preventing a strong integration with the neighborhood. Also the parking field under the trees disconnects the neighborhood from the shopping street and its facilities. While the park is intended to be public accessible, it is surrounded by a low fence.

### Legend

-  Tree
-  Sidewalks
-  Roads
-  Parking lots
-  Public green
-  Private space

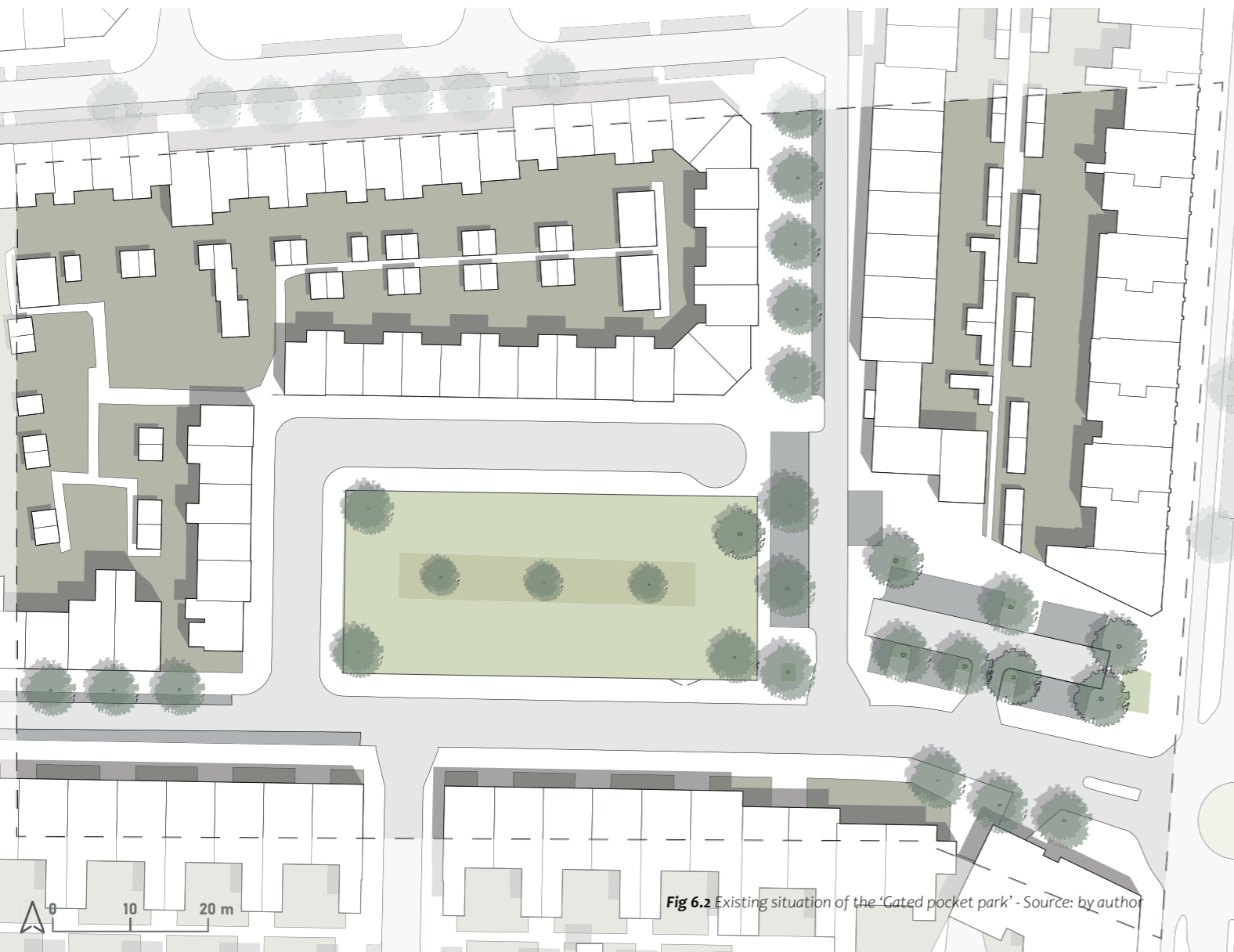
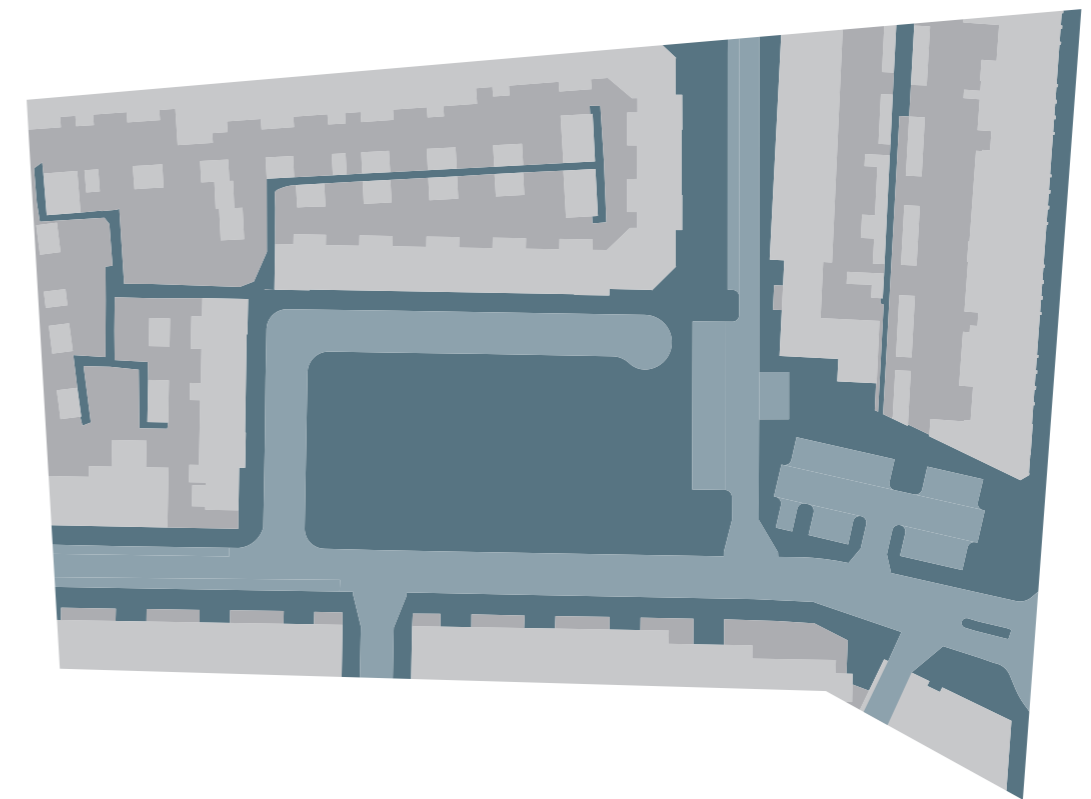


Fig 6.2 Existing situation of the 'Gated pocket park' - Source: by author

## Quantity

An analysis of the quantity of the design location is presented in the map below (figure 6.3). In terms of quantity there is a large portion of open space in this location. The low dense row houses with their own private garden comprising much of the other space. The traffic space, while the smallest category, is still a large portion of the space. Especially because of the prominent placement of the parking field.



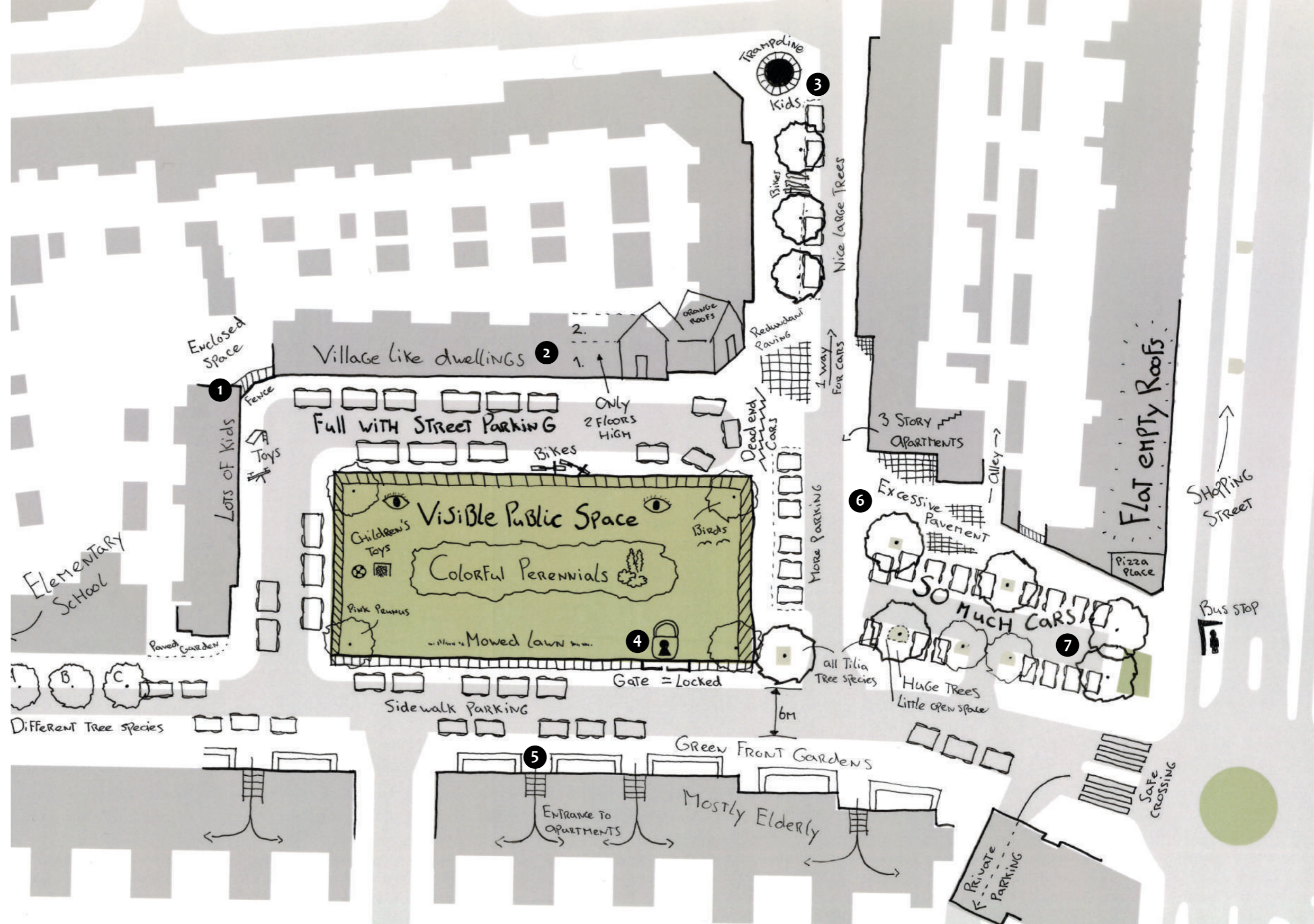
Built space 4400 m <sup>2</sup>	Private space 3200 m <sup>2</sup>	Traffic space 2600 m <sup>2</sup>	Open space 4400 m <sup>2</sup>
Total 14.600 m <sup>2</sup>			

Fig 6.3 Quantitative open space analysis of the design location - Source: by author



## Quality

To get a better grip on the actual living quality of the location, several site visits have resulted in this more personal analysis of the space. Where a more informal experience of the space has been visualized.



# Environmental qualities

## Biodiversity

An additional analysis regarding biodiversity and climate resilience is performed to get a better understanding on how well the design location performs regarding these environmental qualities (figure 6.4). While there are various (large) trees in the area, their diversity is not substantial. Almost all trees are, even though there are different subspecies, related to only three different species: Tilia, Prunus and Acer. Also the lower layers of green are lacking in quality. The traditional mown lawn consists of only grass, with only a small diverse strip of perennials and herbs in the middle. The interlayer of shrubs is missing completely in the location, leaving a gap in height alternation, between the trees and the graslayer.

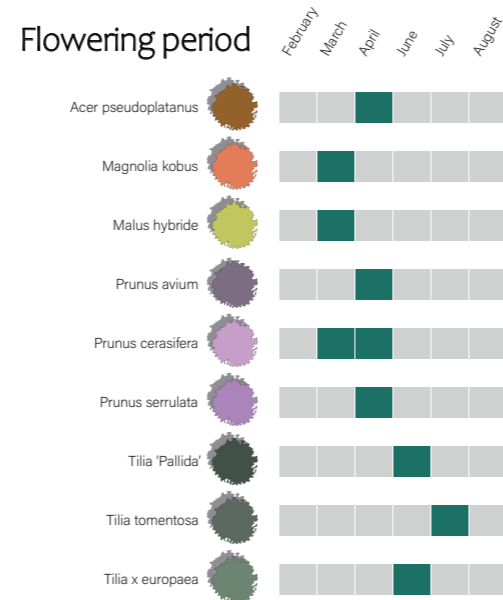


Fig 6.4 Value regarding biodiversity of the 'Gated pocket park' - Source: by author

## Climate resilience

Regarding climate resilience much of the location consists of open pavement. While this is not as bad as closed pavement, like asphalt, it still contributes in aggravating the extremes in the urban climate. A result is the urban heat island effect and the potential threat of flooding. The drainage system, the white lines on the second map, collect all the precipitation where there is little change for natural infiltration.



Fig 6.5 Different types of surface - Source: by author

## Scale comparison

To get a better sense of the scale of the area a scale comparison has been performed, presented on these pages. With measurements of 50 meter by 80 meter, the space between the buildings is quite large and can be of much more value for the neighborhood than it is right now (figure 6.6). Examples on what would fit in this space are visualized on the right.

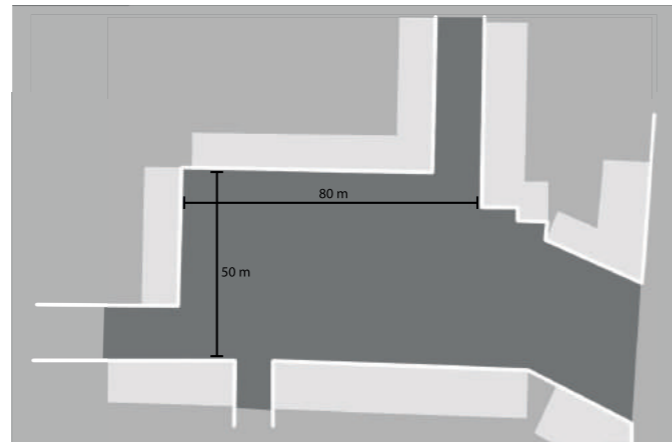
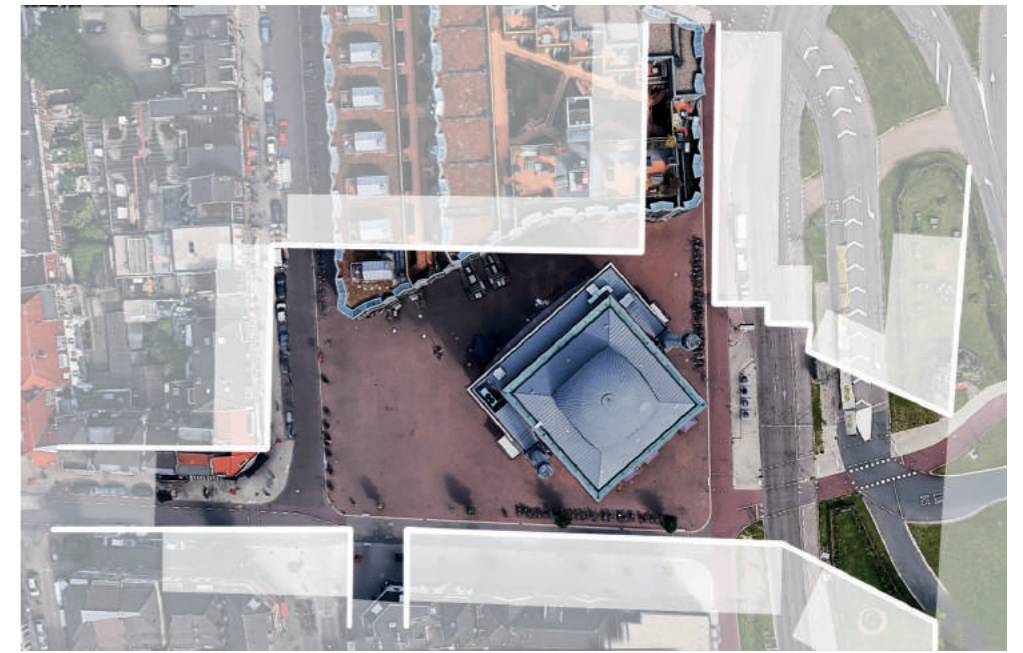


Fig 6.6 Dimensions of the pocket park - Source: by author



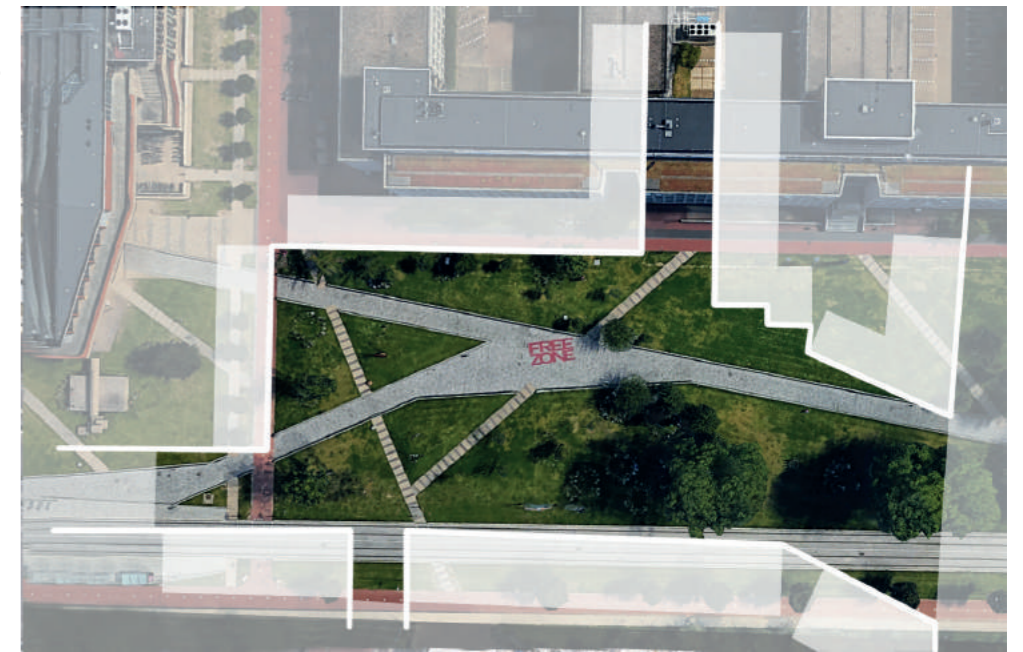
Fig 6.7 Existing situation of the design location - Source: by author

Ulu Mosque



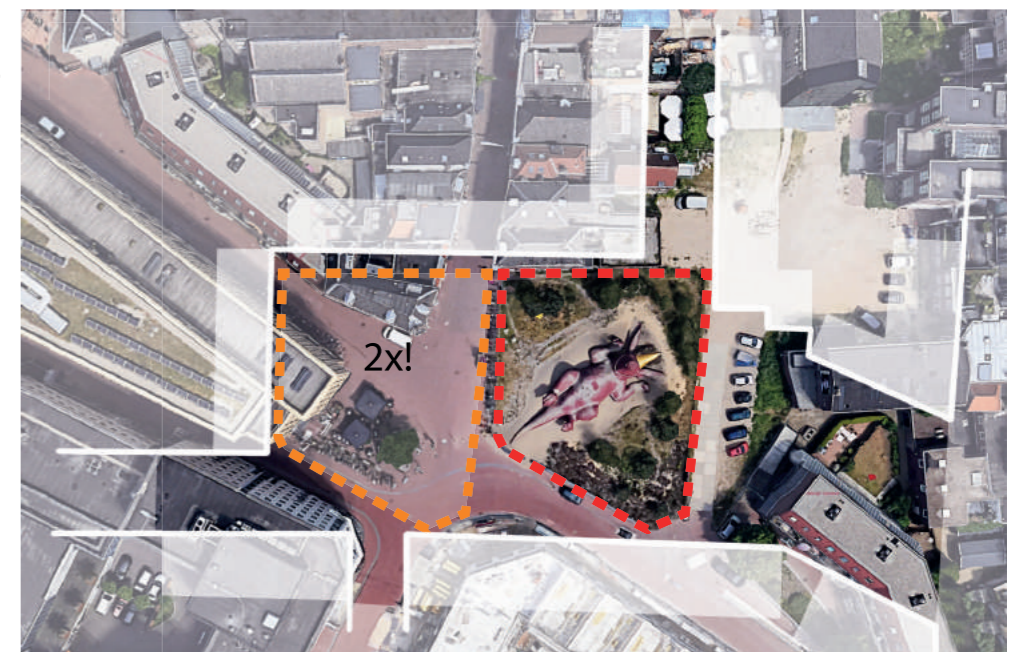
The gated pocket park could fit the remarkable Ulu Mosque of Lombok in Utrecht in. Being able to fit such a huge building shows the spaciousness of the location.

Mekelpark



A more familiar example is the Mekelpark at the TU Delft, which with a width of 51 meter could almost fit for a part on the design location.

Bartokpark

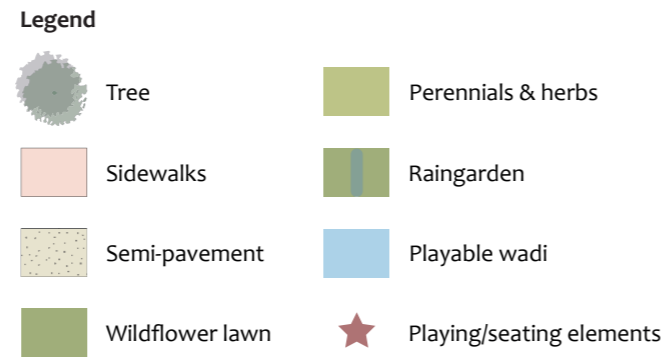


Famous among the pocket parks is the Bartokpark with the huge sculpture of an armadillo, by Buro Harro in Arnhem. This iconic park could actually fit twice in the space of the design location, showing that size is not really a problem.

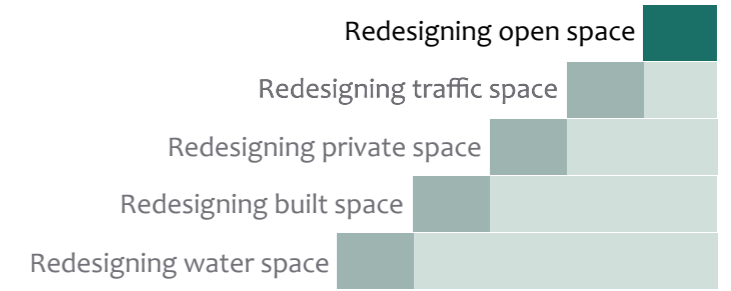
# Design location 1

## Step 1: Redesigning available open space

The first step according to the open space diagram is to redesign the existing available open space (figure 6.8). A key design intervention is to create a better integration of the park in its context. This is done by removing the fence, including the surrounding sidewalks and creating new walking paths that connect well to the other sidewalks. By adding more and diverse trees and lower vegetation more quality in green is established. With the addition of more playing and sitting elements the park can become more a place to stay instead of only move through.



## Design interventions



### Design actions

- Remove excessive sidewalk pavement
- Create green connection stroke
- More catchment of rain water
- Adding playing- and sitting elements
- Including sidewalk in pocket park
- Redesign of mowed lawn to natural playing area
- More divers planting
- More and divers trees

### References

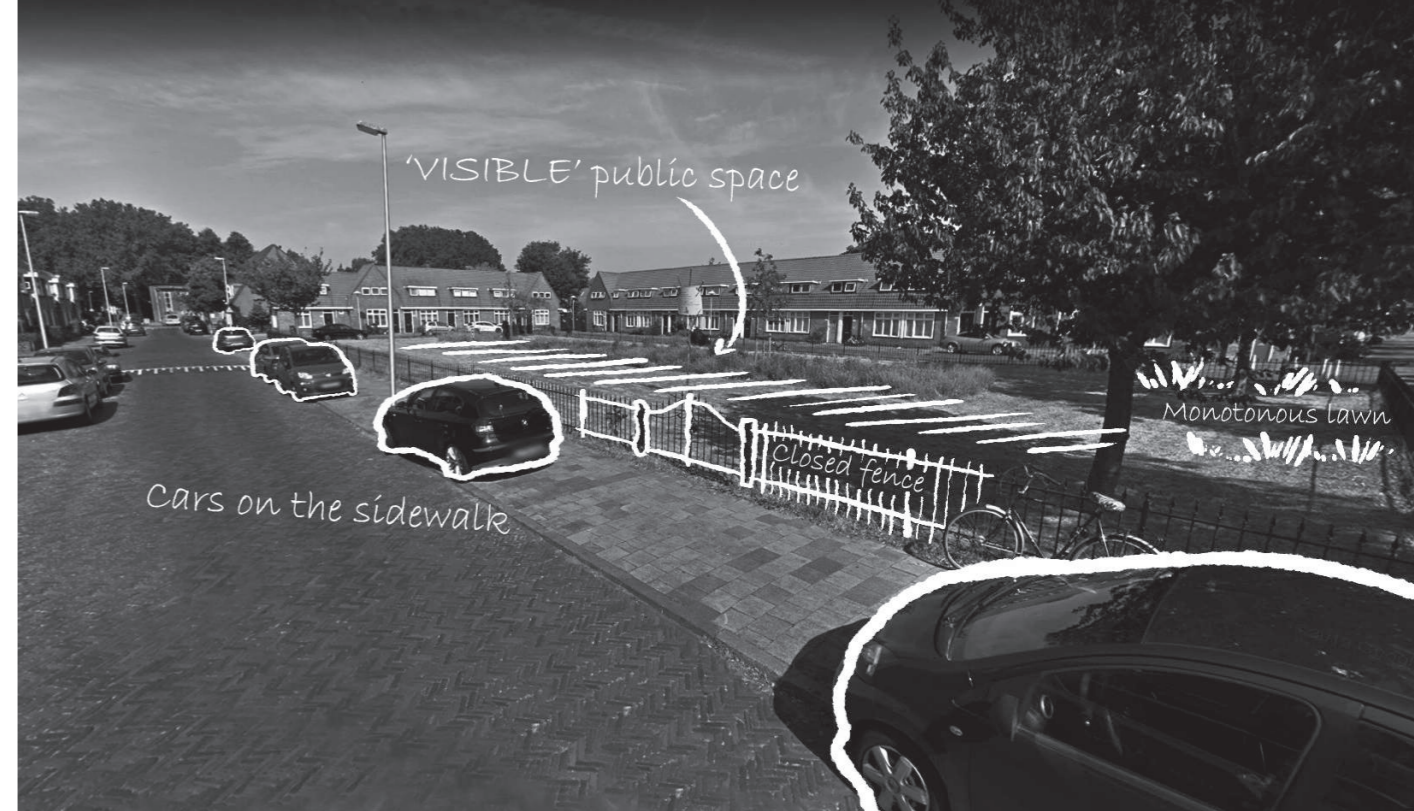


**Fig 6.9** Reference images - Sources in the Epiloque

Existing situation



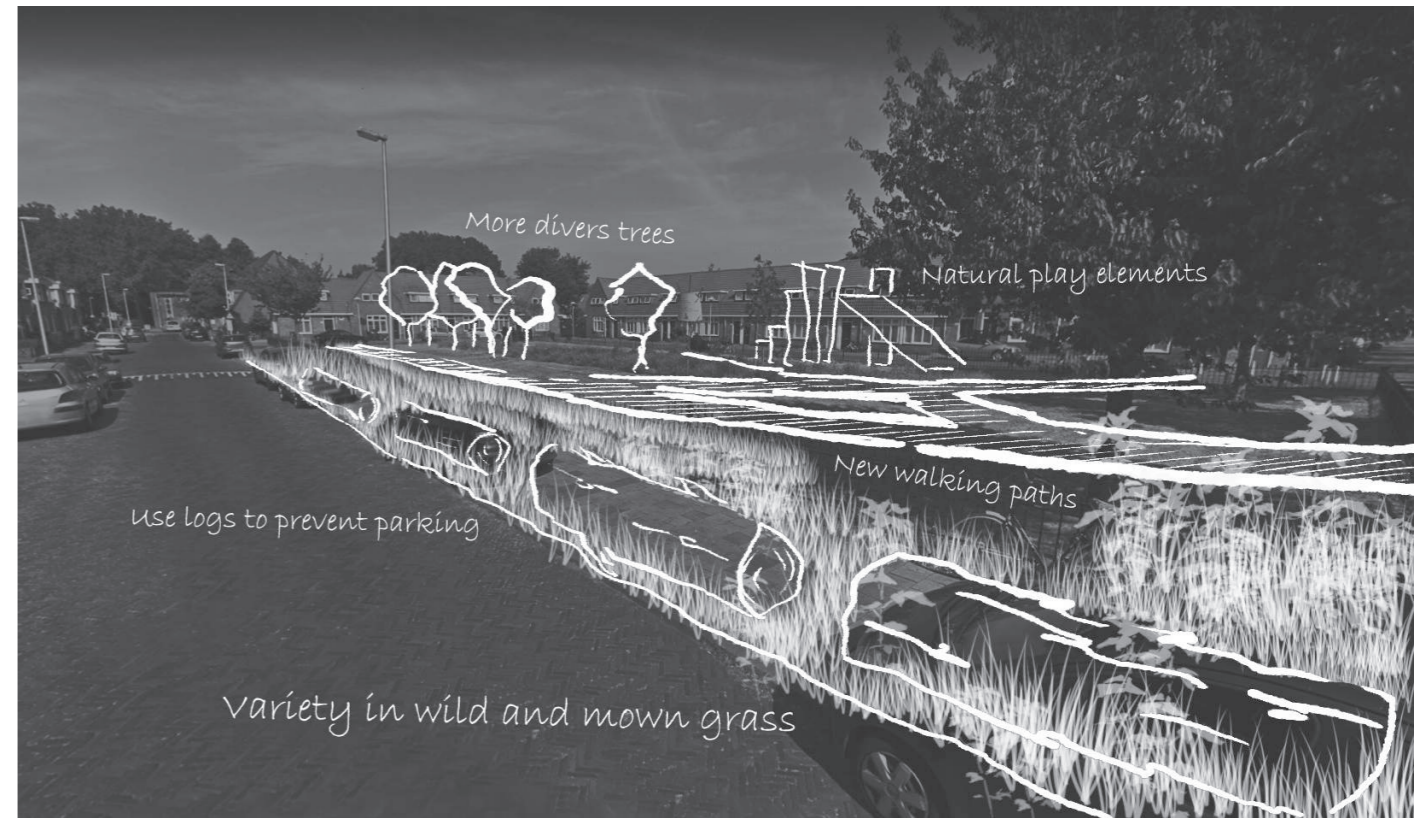
Existing situation



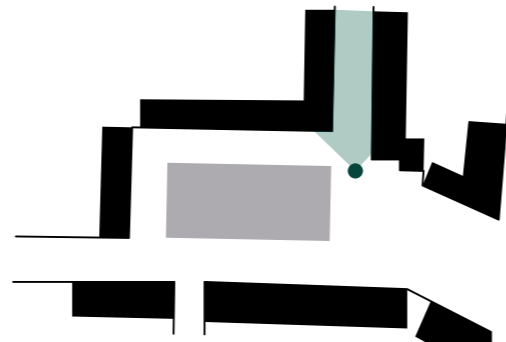
Redesign



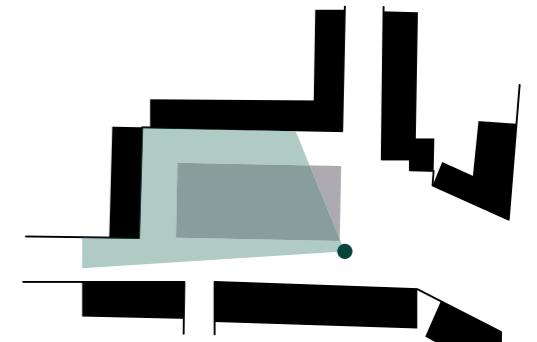
Redesign



Replacing the excessive pavement creates opportunities for more and diverse green. By sloping the remaining pavement to the new green more natural infiltration is stimulated. Creating a gradient in wet and dry conditions for urban ecology as well.



Including the sidewalk in the park design retakes the space back from the parking cars. Placing natural elements like logs on the edge prevents such parking situations in the future. At the same time will such a border prevent spontaneous crossing of the road, which can lead to unsafe conditions.



# Design location 1

## Step 2: Redesigning traffic space

A redesign of the traffic space will degrade the east-west transversal line to a road with a main priority for cycling (figure 6.10). The two streets going north are narrowed so that, while they are still accessible by car, will act more as a living street where slow mobility is the norm and cars are a guest. A wider sidewalk in the inner street makes it possible for residents to create an informal front yard where they can reside and socialize. The parking field is transformed into a terrace under the trees, offering more opportunity for cafes; fulfilling the wish expressed by many residents during the field work.

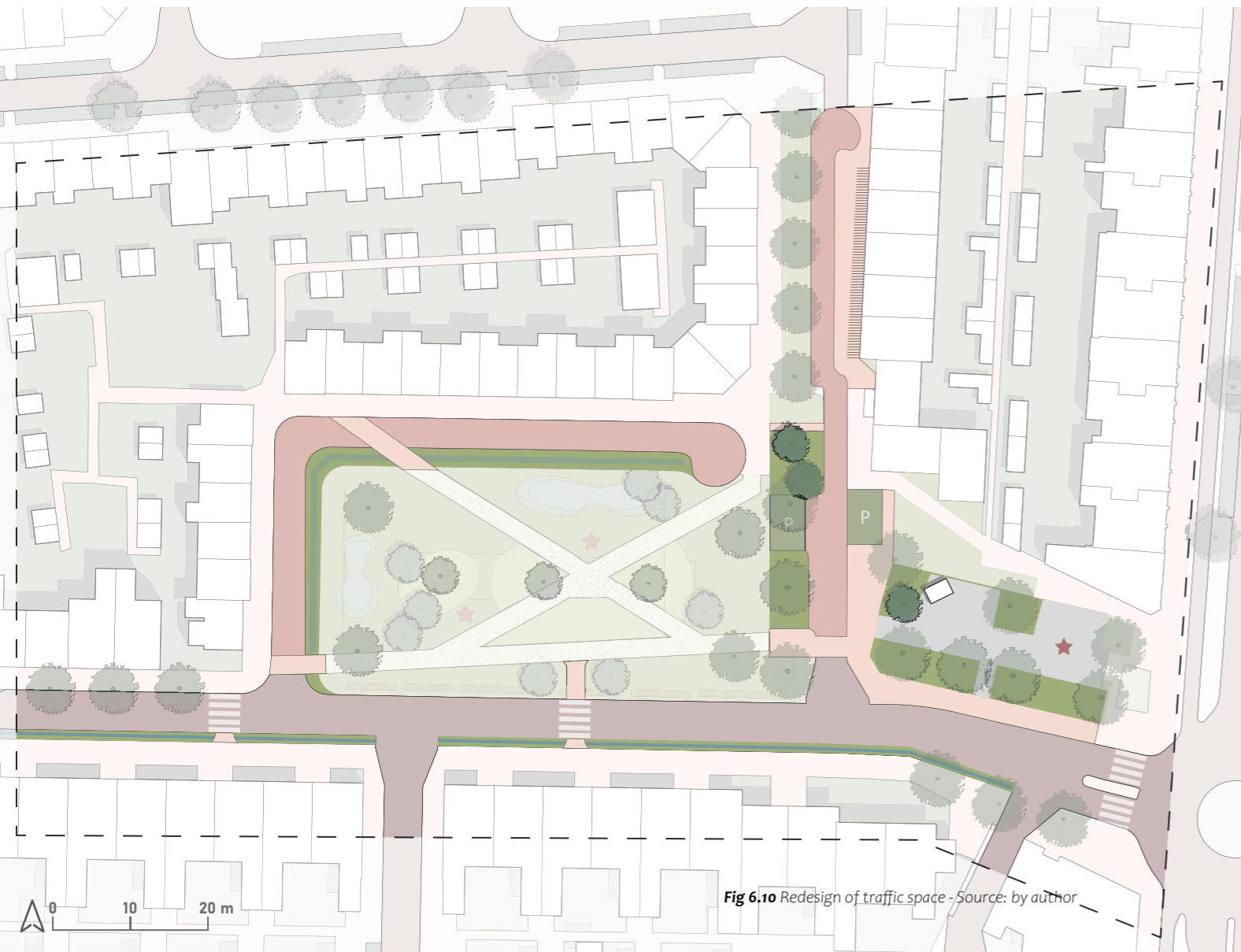
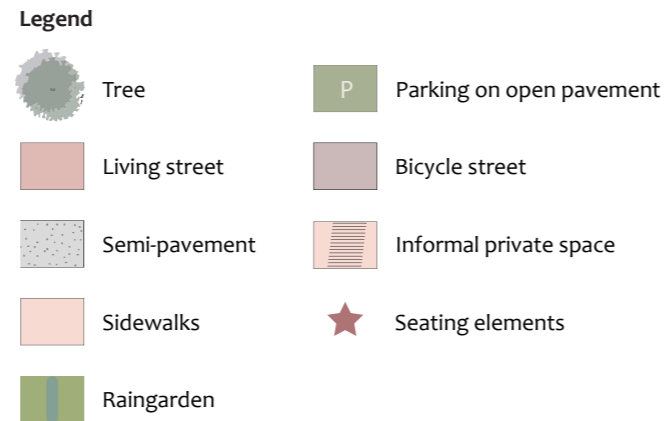
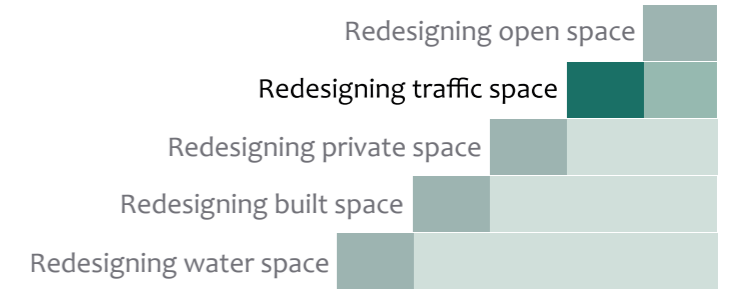


Fig 6.10 Redesign of traffic space - Source: by author

## Design interventions



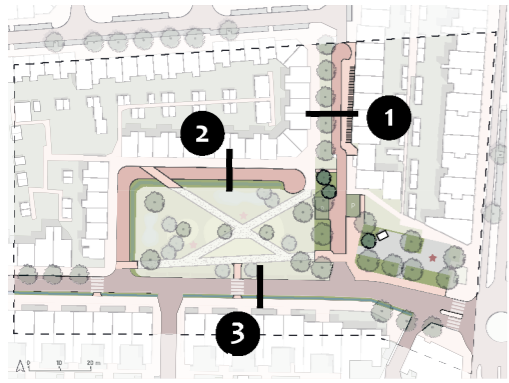
### Design actions

- Give cycling a priority in the transversal road
- Wider sidewalk for informal private space
- More green around the trees
- Creating a terrace under the trees
- Space for flexible cafes
- More narrow car roads
- A green rain garden around the park
- Parking on open pavement

### References

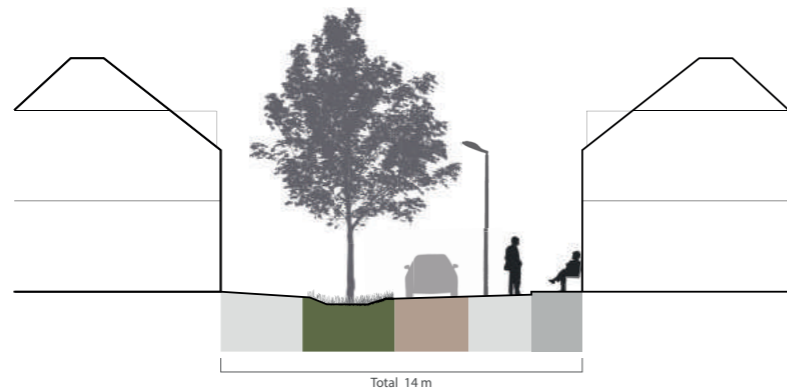


Fig 6.11 Reference images - Sources in the Epiloque



Disconnecting from the sewer system

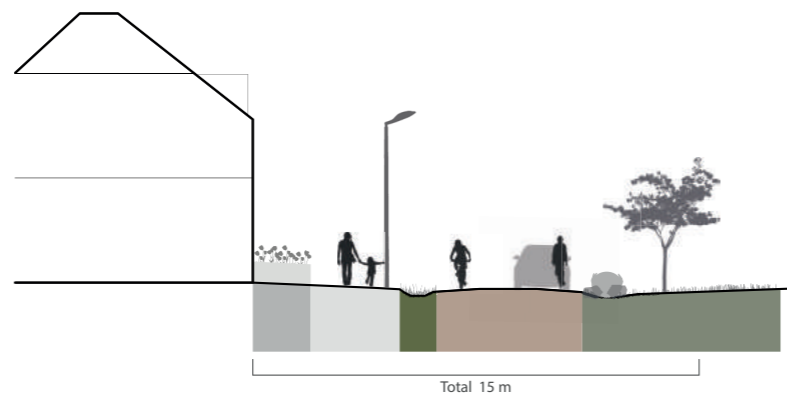
1 Stimulating natural infiltration of precipitation by a large green stroke where the remaining pavement slopes towards. The existing Acer trees can handle longer periods of humidity, creating more gradients for ecology.



2 The sidewalk and the living street slope towards a rain garden which can, by extreme precipitation overflow in a wadi in the park.



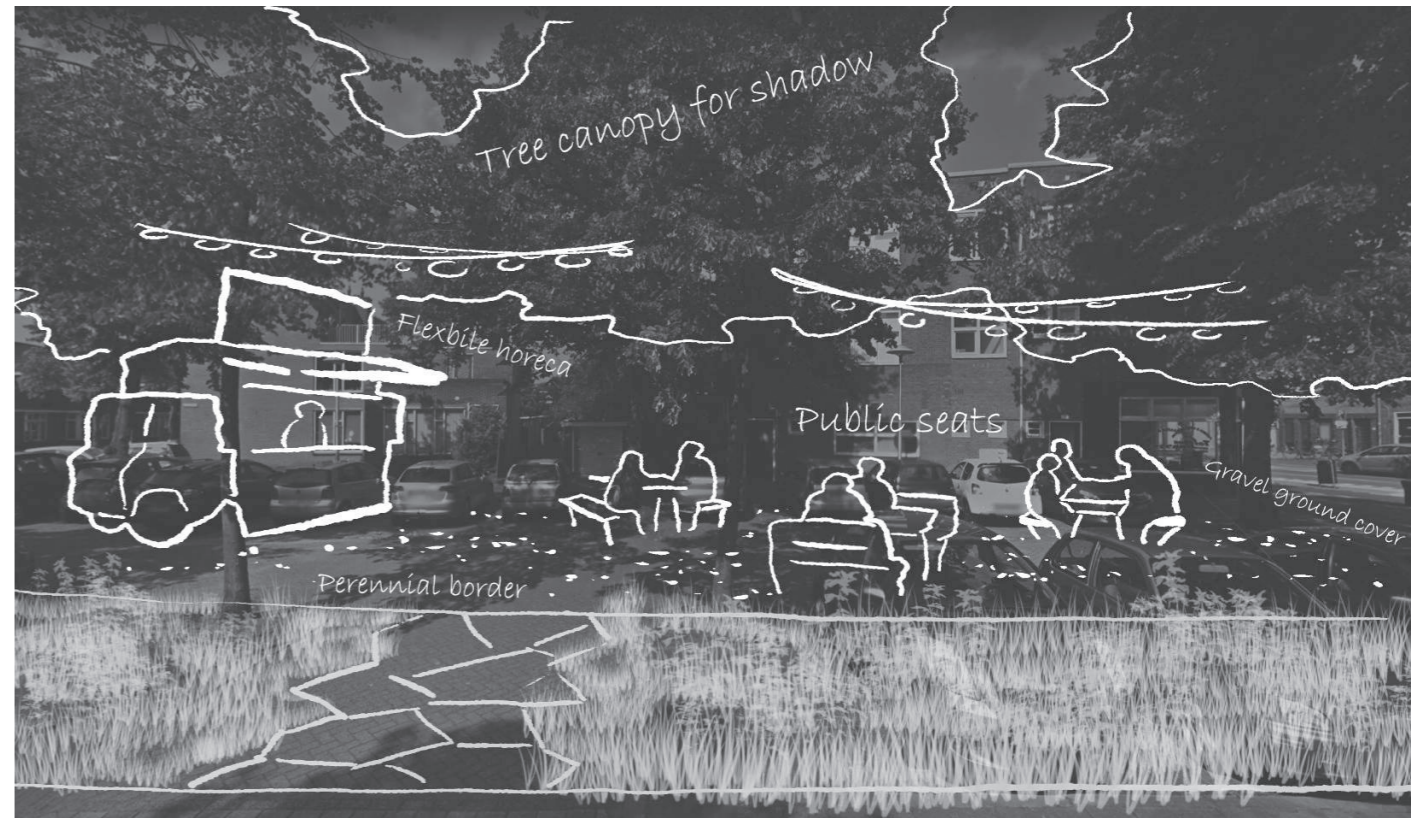
3 Narrowing the car road provides space for a small green strip along the sidewalk which stimulates natural infiltration of rainwater from the sidewalk and half of the bicycle road. The other half will drain towards the park.



Existing situation



Redesign



The large Tilia trees offer a nice opportunity for a terrace in the shade, with space for flexible horeca in addition to the existing pizza place.



# Design location 1

## Step 3: Redesigning private space

Due to the complexity of the private space only two locations have been chosen to transform into a community garden (figure 6.12). By merging some (parts) of the private gardens, an open space can be designed with still an enclosed character. Adding seating elements and collective activities, like urban agriculture and gardening, the community feeling is strengthened. The private front yards are kept intact, but more participatory initiatives, like providing subsidies or low maintenance planting schemes, are carried out in stimulating owners to create more green front yards.

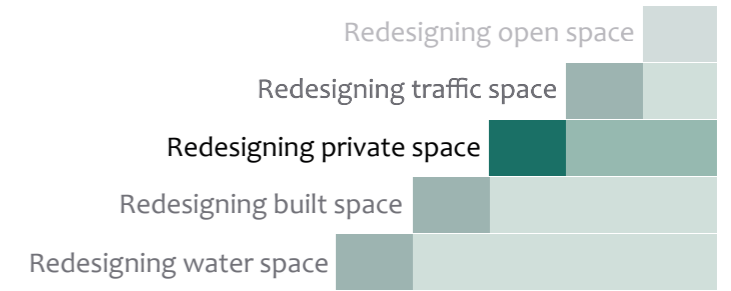
### Legend

- |   |                 |   |                     |
|---|-----------------|---|---------------------|
|  | Tree            |  | Urban agriculture   |
|  | Food forest     |  | Front yard greening |
|  | Semi-pavement   |  | Seating elements    |
|  | Wildflower lawn |   |                     |



Fig 6.12 Redesign of private space - Source: by author

## Design interventions



### Design actions

- Community gardens
- Adding semi-paved walking paths
- Fruit trees and agricultural plots
- Adding shared facilities like benches/picnic tables
- More divers planting
- Greening the private front yards

### References



Fig 6.13 Reference images - Sources in the Epilogue



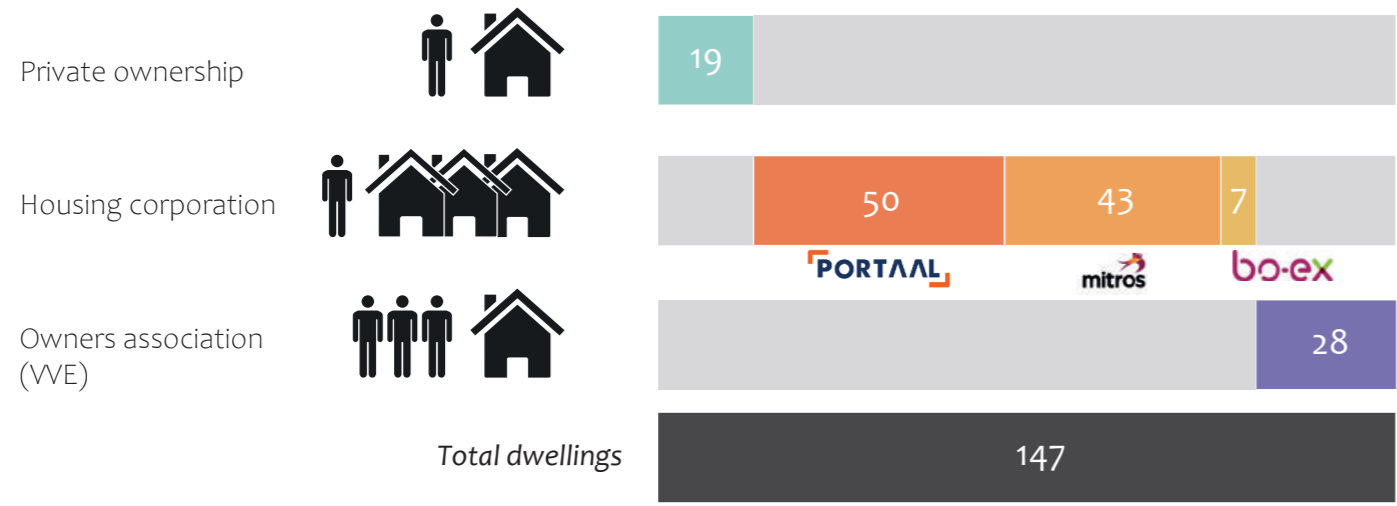
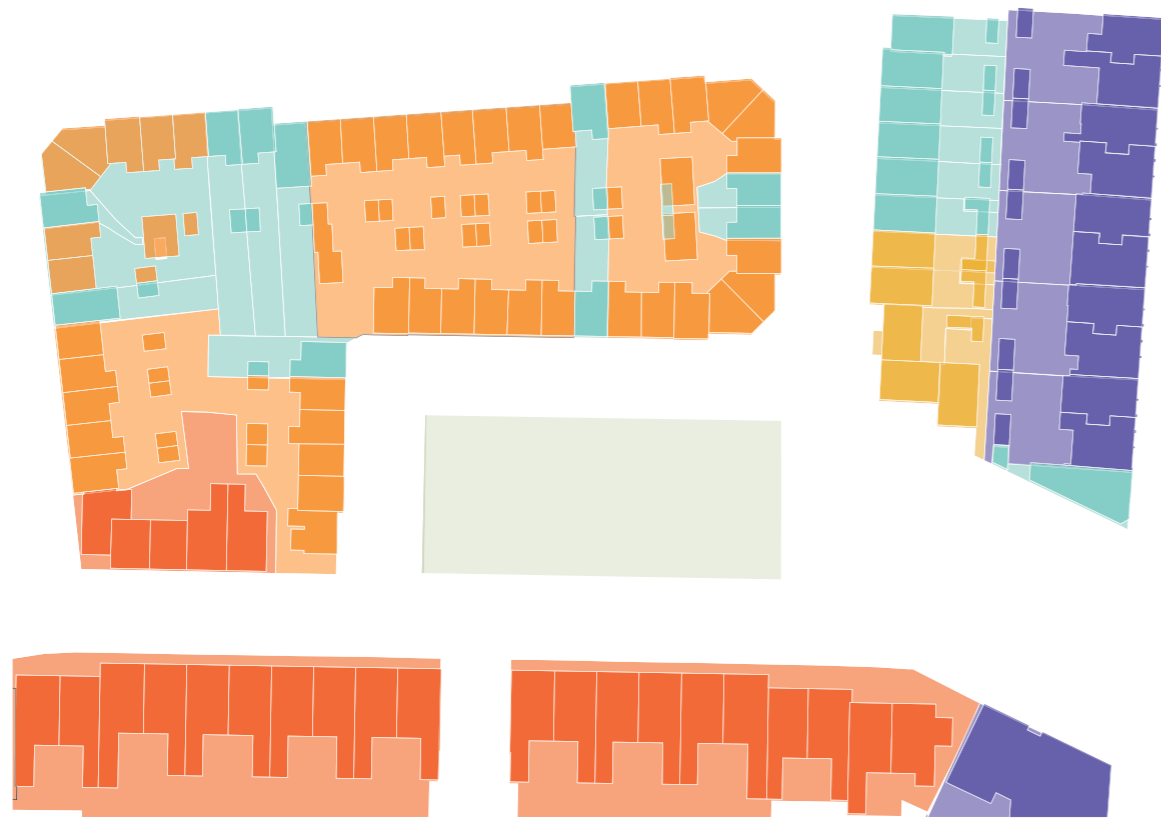
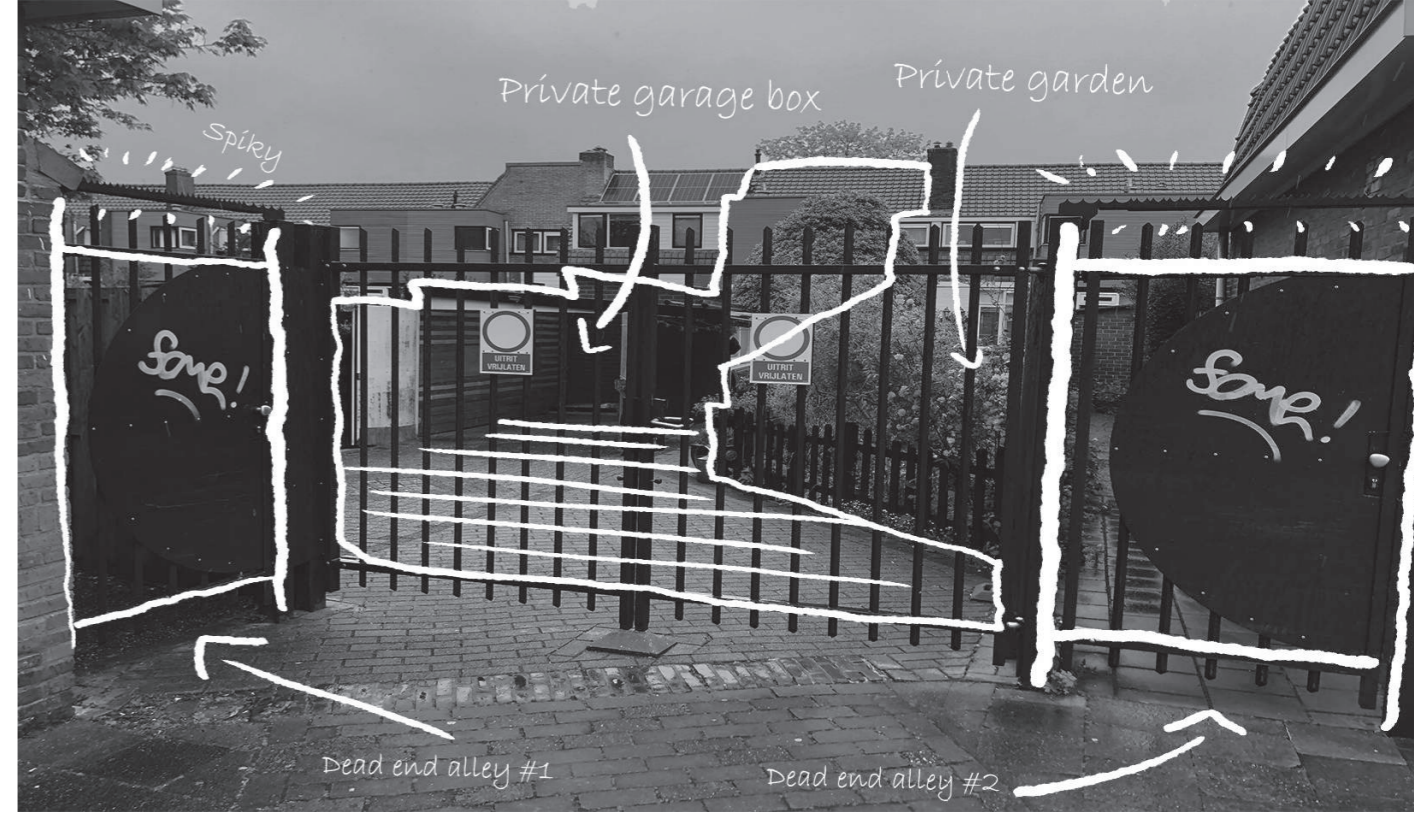


Fig 6.14 Ownership of the surrounding buildings - Adapted from Kadaster

In the process of deprivatizing some of the gardens it is important to know who the owners are. The map above shows that most of the dwellings and corresponding gardens in the location are owned by housing corporations, which can be beneficial in the negotiating process because there are less actors involved (figure 6.14). However, the space of the new community gardens also is on the property of three private owners. With the plan to transform only half of their gardens into a high quality shared garden, it could be a feasible compromise when they are compensated for their property loss.

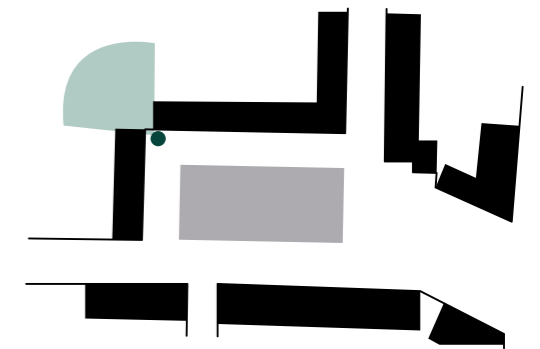
Existing situation



Redesign



By removing the fence, the merged private gardens are publicly accessible. Collective activities such as gardening or urban agriculture, stimulate a sense of community between the residents. The back alleys are still accessible, but the entrance has moved more to the back.



# Design location 1

## Step 4: Redesigning built space

The last step is looking at the built space (figure 6.15). Not all the rooftop of all buildings in the design location can be transformed to open space rooftops. The roofs of the small sheds are transformed into green roofs. As mentioned in the design principles, creating green roofs does not include the space as available open space, but will improve the quality greatly. The sloped roofs are designed as water roofs, where all rainwater is collected and superficially discharged to a natural infiltration stroke, like the rain gardens or the wadis. The large flat roofs of the building along the shopping street is transformed as a public rooftop. By reconstructing the corner building to a step-like construction, the rooftop will become much more inviting to access.

### Legend

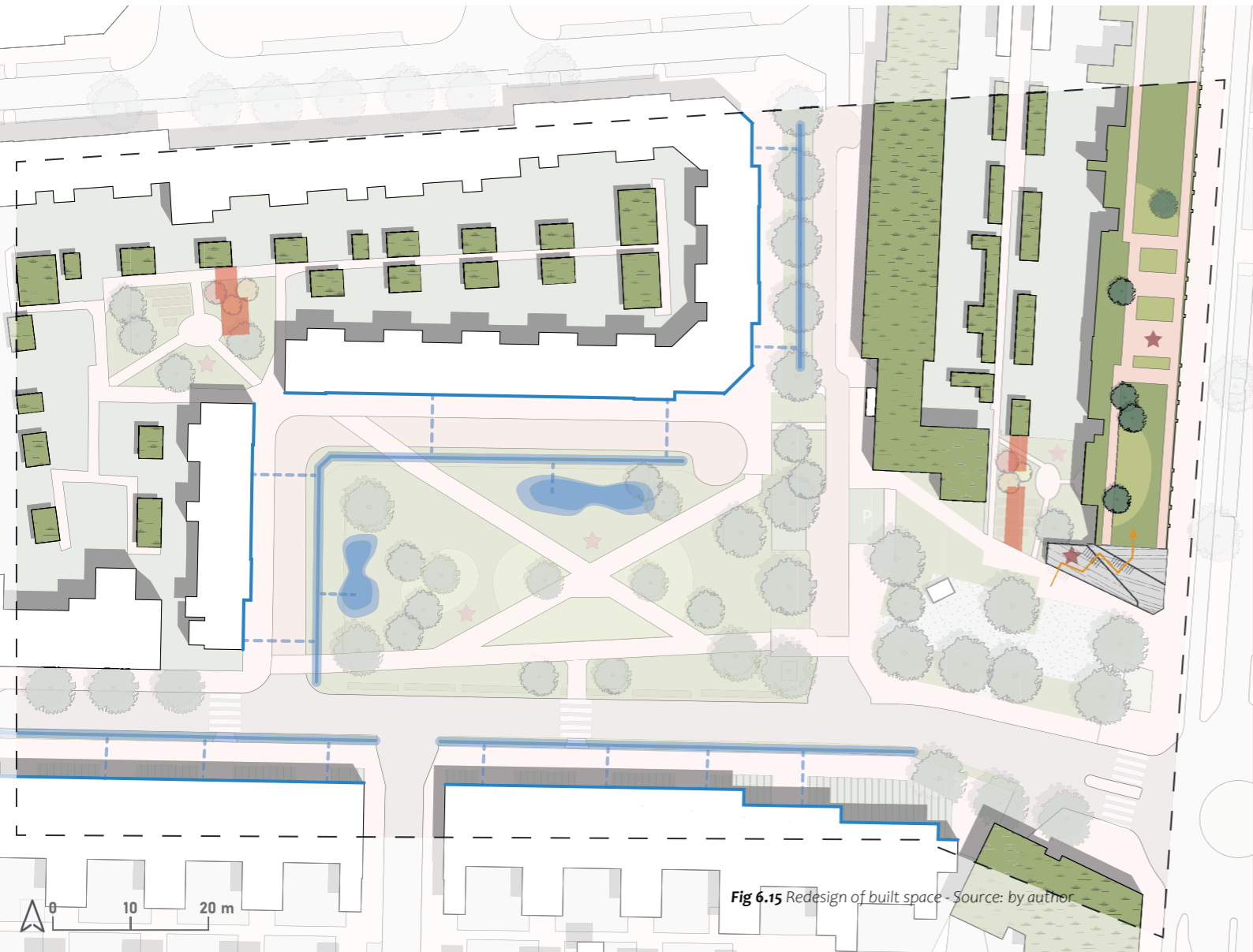
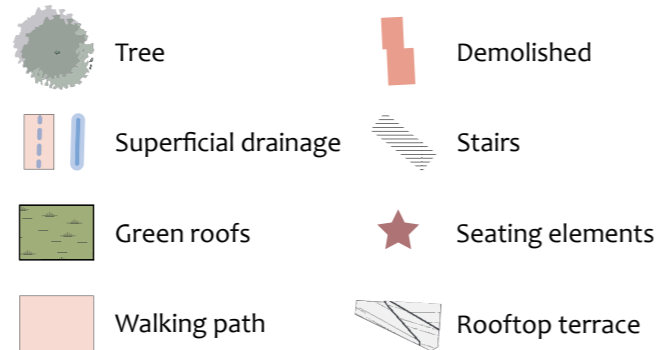
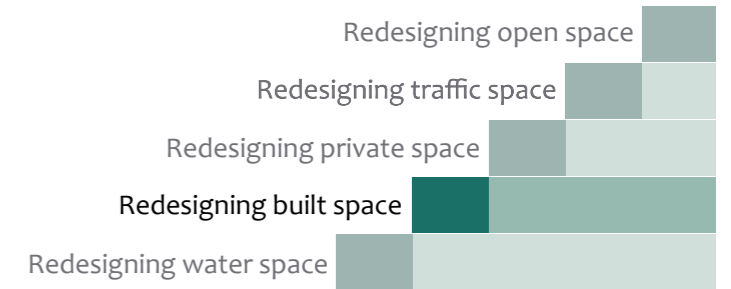


Fig 6.15 Redesign of built space - Source: by author

## Design interventions



### Design actions

- Creating more green roofs
- Demolishing some small sheds
- More catchment of rain water
- Guide rainwater from the roofs to natural infiltration places
- Large rooftop garden along the central street
- Reconstructing the corner building in a step-like construction

### References

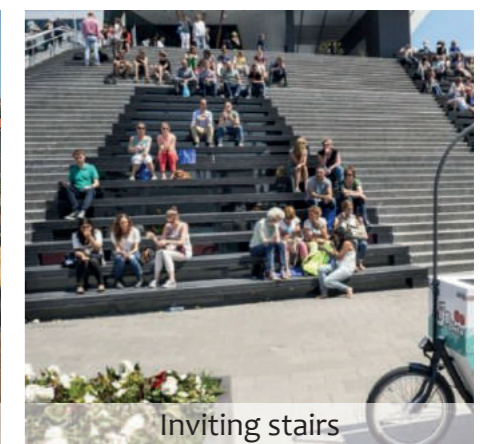
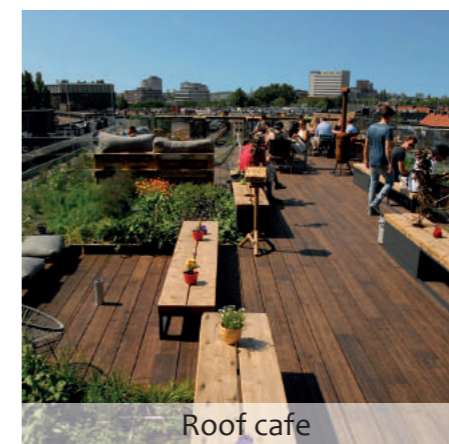
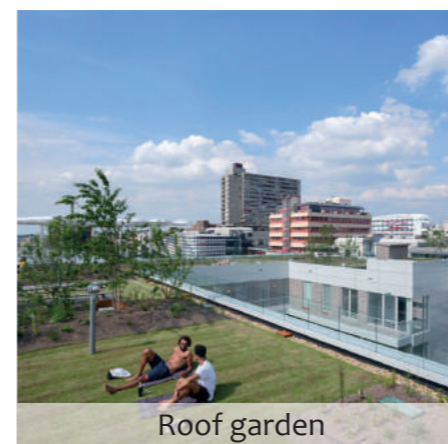
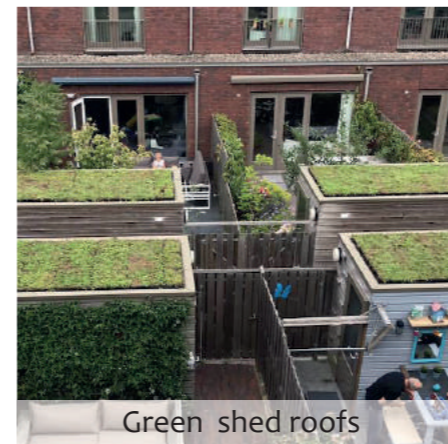


Fig 6.16 Reference images - Sources in the Epiloque

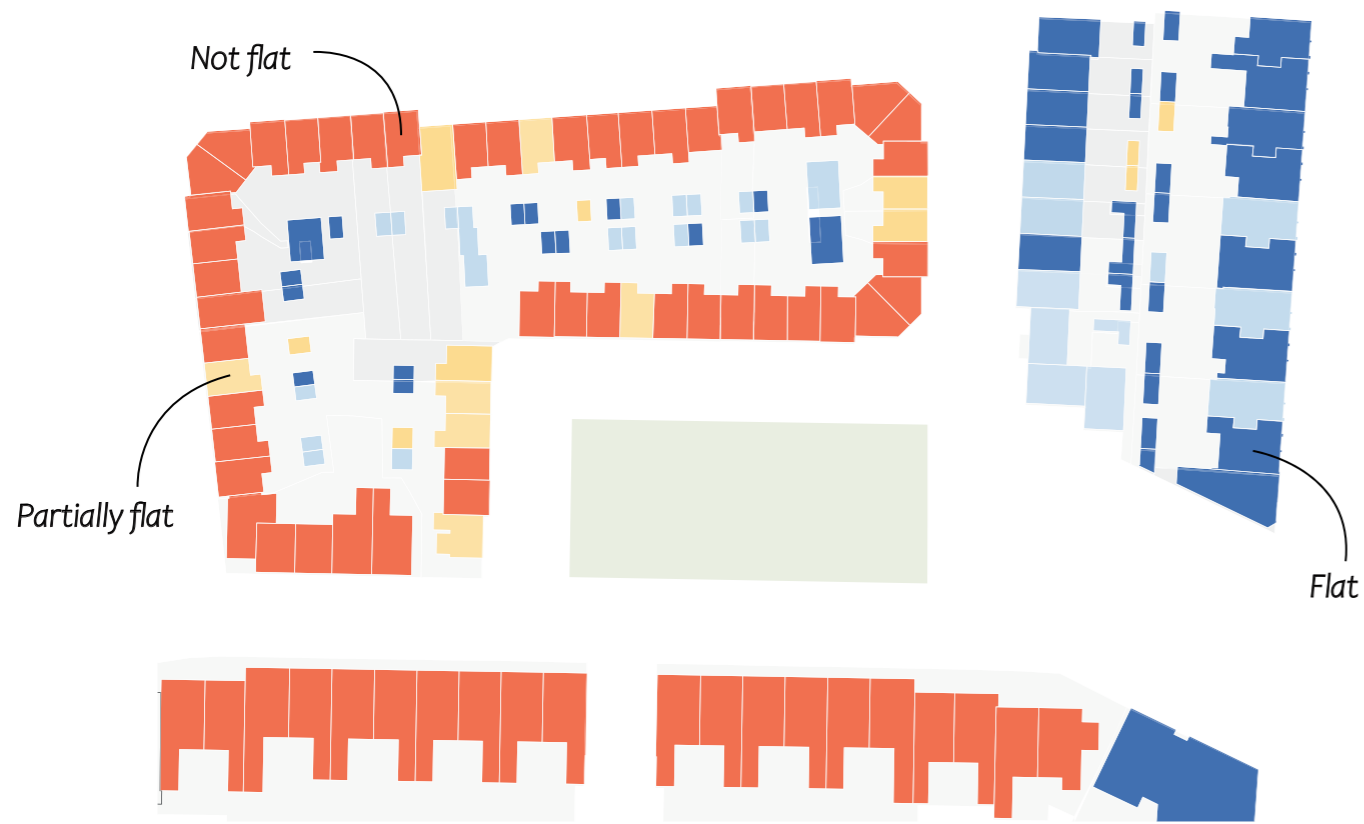
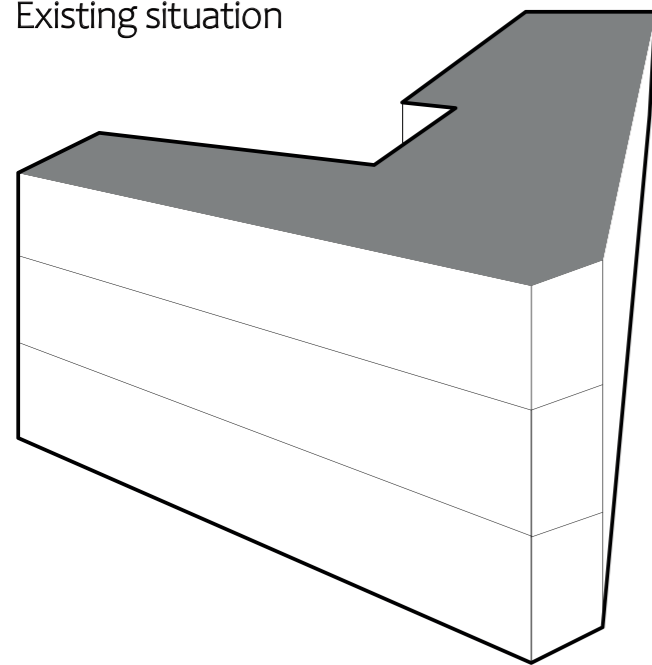
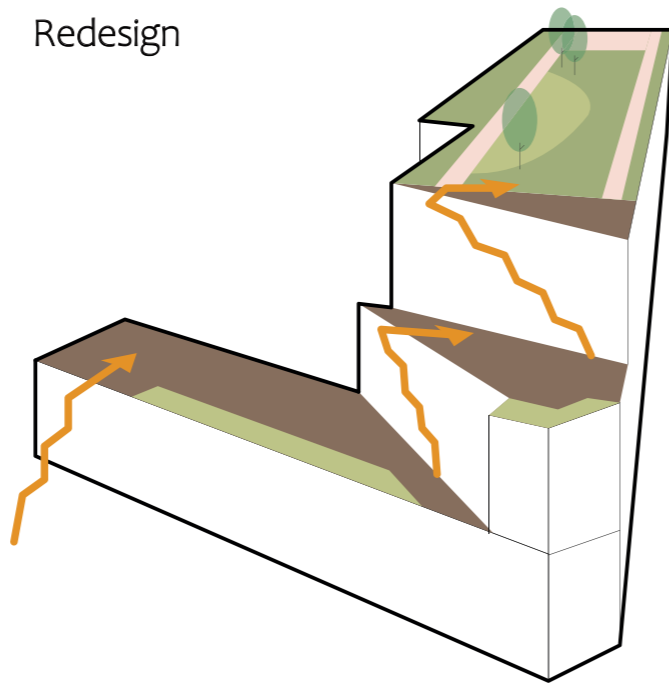


Fig 6.17 Flat roof analysis - Adapted from Atlas Leefomgeving

Existing situation



Redesign



The flat roof analysis is shown on the map at the top (figure 6.17). It is clear that the village-like dwellings with the sloped orange roofs are not suitable for accessible rooftop gardens. The buildings along the central street offers more potential, especially in combination with reconstruction of the corner building, so it will be more inviting to access the roofs. This aspect is often an issue when designing public rooftops.

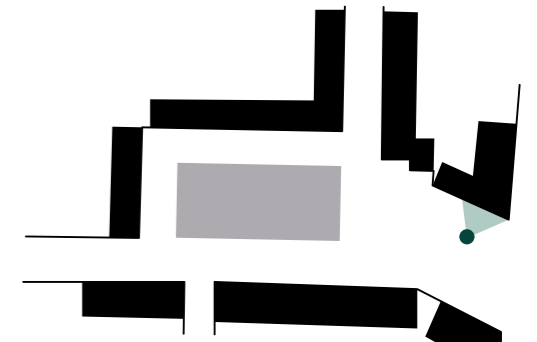
Existing situation



Redesign



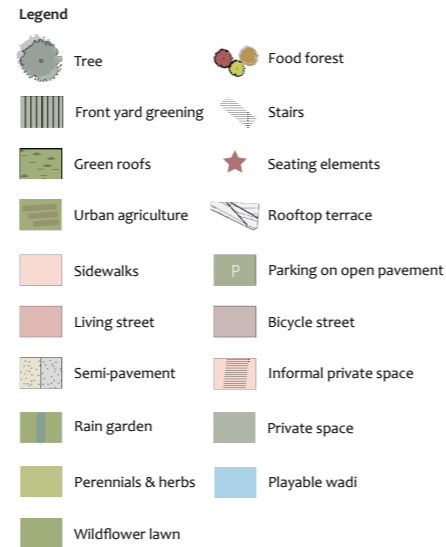
A representation of how the corner building could be transformed into a step-like building. With still many stairs to climb to reach the public rooftop, it has become more inviting to enter. Especially when the first floor functions as an extension of the terrace on the ground floor.



# Design location 1

## Design results

Combining the design interventions of all the discussed steps results in a design, represented in the map below (figure 6.18). The increase of more green, trees and space for pedestrians is well noticeable in the map. The overall design also gives a clear view on how the different spaces are connected with each other. The central shopping street is reconnected with a public space instead of the parking lot. From here is a clear way up to the roof gardens or to the community garden. Continuing the path leads to the well integrated pocket park which has connections to the inner street in the north and the second community garden. The transportation function of the transversal line is still present, but now with a more focus on cycling, with sufficient safe places for pedestrians to cross.



Reflecting on how a redesign improves regarding the topics of open space quality and the two environmental qualities is of great importance. Below is briefly discussed how the design intervention improves quality within each topic.

### Increased quality

- Better integration of the existing pocket park
- More public space for cafes (former parking place)
- More space for collective activities (community gardens/living streets)
- More public space to be, for playing, relaxing and socializing (rooftop garden, natural playing elements, benches & picnic tables)

### Biodiversity

- More trees, where a variety in species contributes to more biodiversity
- Creation of different habitats, from only dry low grass and high similar trees, to wet rain gardens and divers planting areas with shrubs and perennials

### Climate resilience

- More open pavement, and the introduction of semi-open pavement to stimulate natural infiltration of rainwater
- Disconnection of the drainage system of the closed paved areas and rooftops from the sewer system to natural infiltration areas.
- More space to store water to cool down the surroundings and prevent droughts
- Less stony paved areas and more open green to mitigate the effects of the urban heat island



Fig 6.18 Redesign of whole design location - Source: by author

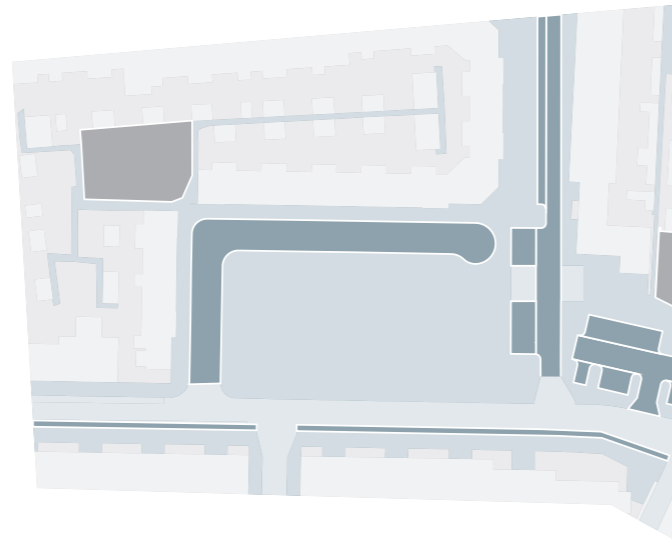
## Increased quantity

This last conclusive part reflects on the quantitative aspect of the redesign. The map below shows which spaces have been designed from potential open space to available open space. Responding to the trend of a less car dominated city, much of the traffic space has been redesigned as open space. The smaller areas of the built- and private space do add some open space, but compared to what is still unchanged, the contribution is relatively small.

The calculation on the next page shows if the improvement of open space quantity enables possible densification potential. Taking the same 50 m<sup>2</sup> of required open space per household from before, the current available open space would be insufficient for the amount of existing households. 59 from the existing 149 households in the project area would be without open space, resulting in high pressure on available open space. Redesigning potential open space and adding 3.020 m<sup>2</sup> of open space would increase to carrying capacity to 149 households. This would leave an additional densification of 2 dwellings in the project area.

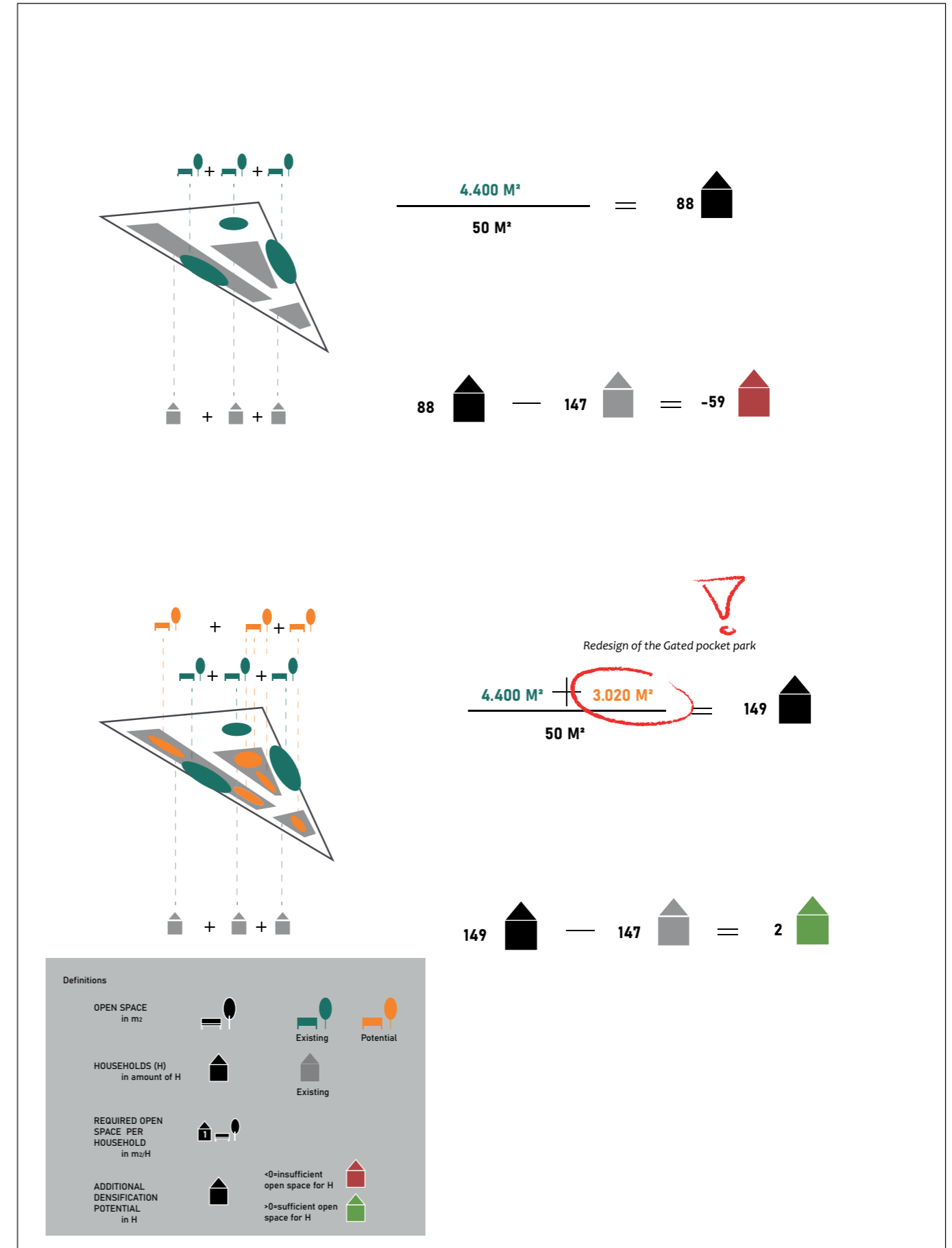
The fact that such a drastic redesign in the neighborhood regarding open space would not lead to a significant densification potential is quite frustrating. While reflecting more on this in the discussion part of this thesis, two points can be highlighted for now. It could mean that the current situation of Rivierenwijk regarding open space is very poor and that open space redesign is needed to improve the urban

liveability for the existing residents. However, neighborhoods like Rivierenwijk would in the end not be suitable for further densification. A second point of criticism is the amount of 50 m<sup>2</sup> open space per household, presented by the municipality of Utrecht. Is this amount even feasible when living in a compact city? The neighborhood of Rivierenwijk is, with its low row houses, not very dense. How does such a set number of open space work in the larger metropolises of the world like London or Paris. It makes you wonder if a set quantity of open space should be leading in providing urban liveability. Especially when realising that the existing pocket park is regarded as open space, but contributes due to its bad design little to liveability. Quality of open space should, even though it is much harder to specifically define, should therefore have a larger priority than quantity.



# SRQ3

## CREATING ADDITIONAL DENSIFICATION POTENTIAL



Existing situation	Built space 4400 m <sup>2</sup>	Private space 3200 m <sup>2</sup>	Traffic space 2600 m <sup>2</sup>	Open space 4400 m <sup>2</sup>
Design interventions	1050 m <sup>2</sup>	500 m <sup>2</sup>	1470 m <sup>2</sup>	
New situation	Built space 443350 m <sup>2</sup>	Private space 2700 m <sup>2</sup>	Traffic space 1130 m <sup>2</sup>	Open space 7420 m <sup>2</sup>
Total 14.600 m <sup>2</sup>				

# Design location 2

## 6.3 Vaartsche Rijn Waterfront

The second design location looks at the waterfront of the Vaartsche Rijn (figure 6.19). Remarkable is the clear distinction in the parallel spatial lines, with the same north-south orientation. From left to right the first space is categorized as private space, with the backyards of the apartment blocks, representing a second line of built space. Hereafter the sidewalk provides a narrow path of open space. The traffic space is a sequence of parking, a bicycle path, a two-way car road and another bicycle path. The stroke of green with the Tilia trees can be defined as an open space, however it is difficult to access. Finally there is the large water line of the Vaartsche Rijn canal.



Fig 6.19 Existing situation of the Vaartsche Rijn waterfront - Source: by author

## Quantity

For this location several design interventions are proposed, changing the street profile along the waterfront. While these interventions are concentrated in the small stroke it would seem that they have little effect on improving the quantity of open space. However, when the redesign is implemented on the total length of the waterfront it would have a significant effect (figure 6.20). The almost 1,5 kilometer long strip would, when redesigned with a focus on high quality, walkable public space, be a great contribution to the neighborhood of Rivierenwijk.

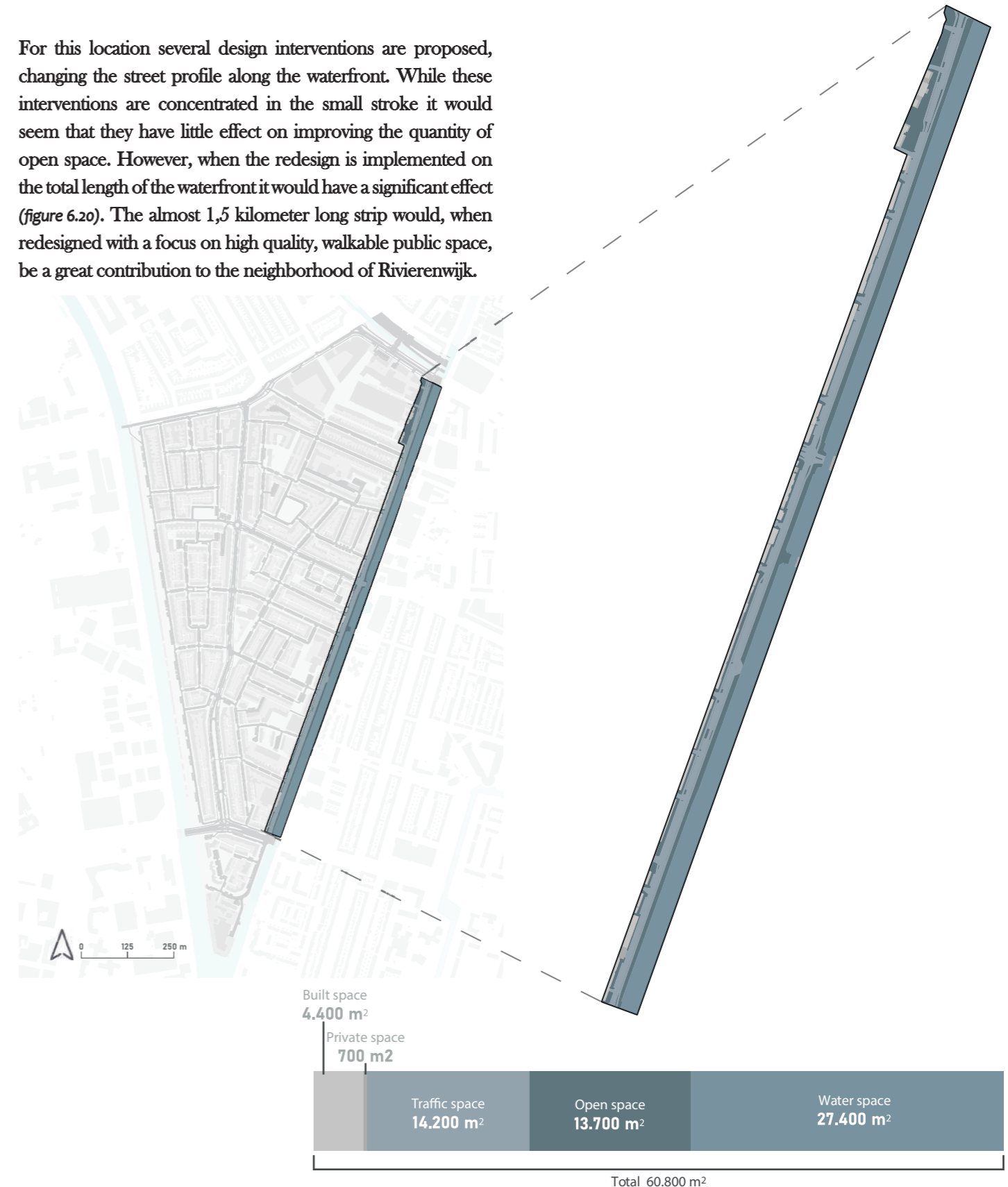


Fig 6.20 Quantitative open space analysis of the Vaartsche Rijn waterfront - Source: by author

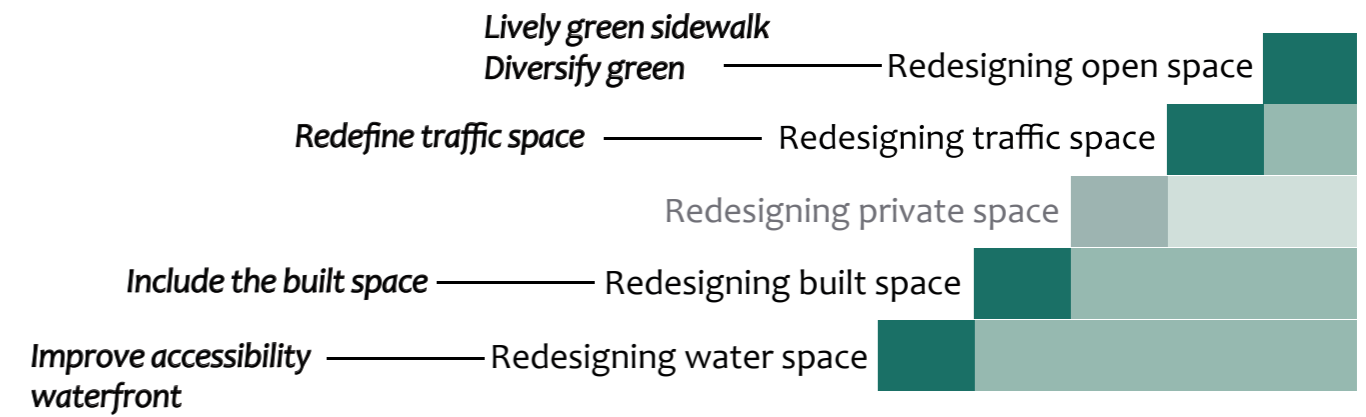
# Design location 2

## Design

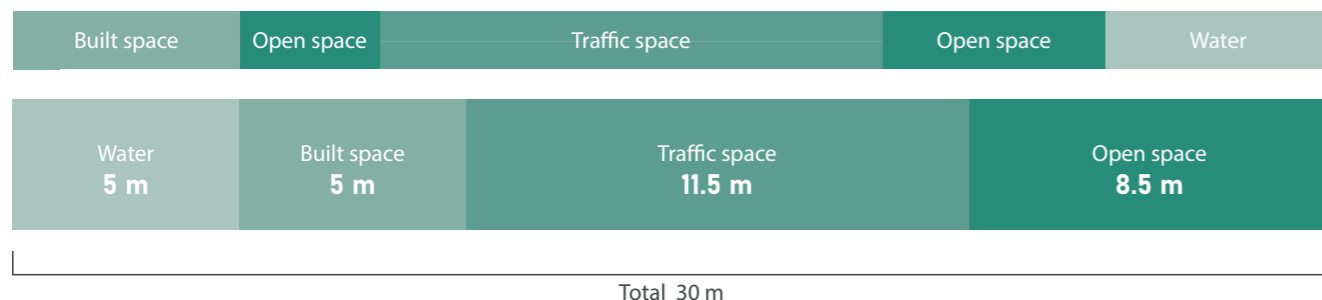
The redesign of the Vaartsche Rijn waterfront is built up with 5 design interventions, altering multiple space categories. First the traffic space is redefined. By degrading the road and putting more focus on slow mobility, with cyclists in particular, less space is required, while providing more opportunities for safe crossings towards the waterfront. A redesign of the sidewalk with more green will make the walking experience more interesting. Parallel a walking path along the water will make the waterfront more accessible. Redesigning the flat roofs of the built space as rooftop gardens with public spaces and green will create a better integration of the buildings as open space. Finally, more diverse green is added to the uniform tree line to improve the level of biodiversity. The next pages will discuss each design intervention in more detail.

### Design interventions

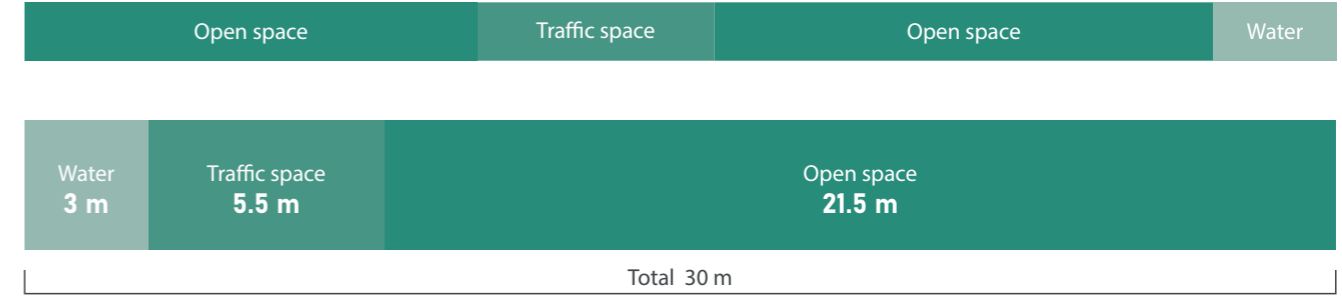
- Redefine traffic space
- Lively green sidewalk
- Improve accessibility waterfront
- Include the built space
- Diversify green



Existing situation



Redesign



# Design location 2

## Redefined traffic space

The first design intervention focuses on the redesign of the traffic space. Currently, the straight two-way car road offers no opportunity for safe crossings. By degrading the road to a bicycle highway where the car is subordinate to the cyclist, the infrastructural line will become less of a barrier. On the next page the effect of the redesign is discussed on multiple scales.



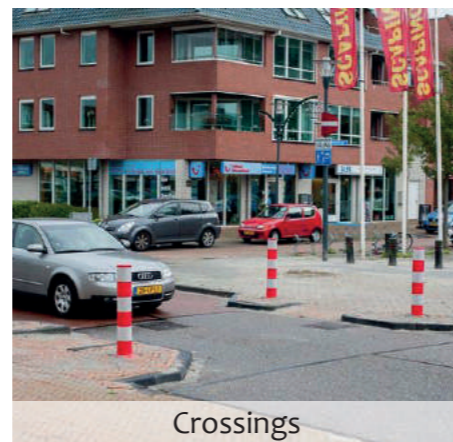
## References



Bicycle street



Bicycle highway



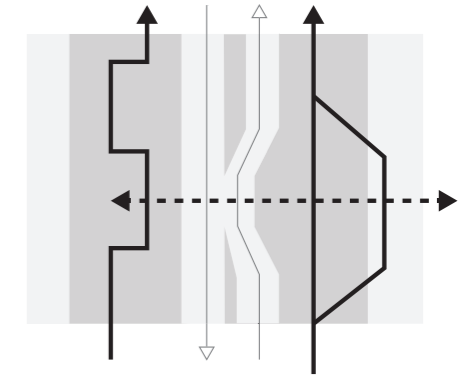
Crossings

Fig 6.21 Reference images - Sources in the Epiloque

On the smallest scale it is important that the current straight on character of the sidewalk and roads is diversified. Adding green on the enlarged sidewalk will provide a more interesting walking experience, while narrowing the bicycle road will provide safe and clear places to cross. A new walking path along the waterfront with places to access the water will add a new layer with much quality for pedestrians.

S

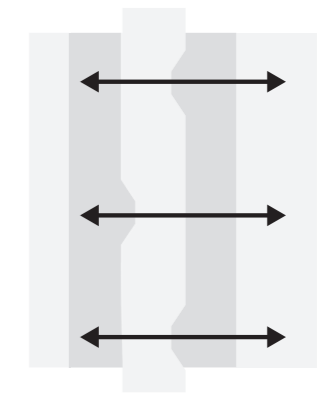
SLOW & FAST MOBILITY



Adding multiple narrowings across the bicycle highway will make it possible to access the waterfront in several places. The small notches will diversify the road, preventing the few cars from speeding.

M

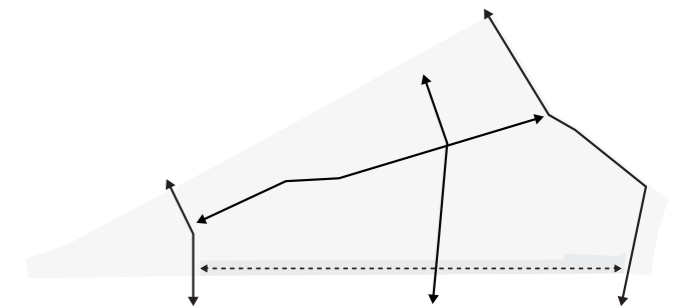
MULTIPLE CROSSINGS



On the scale of the neighborhood, car mobility will focus on the central road of the Rijnlaan and the two transversal lines. Removing the road along the water as a main connection will mirror the situation of the Merwedekanaal, where also no continuous car mobility is possible.

L

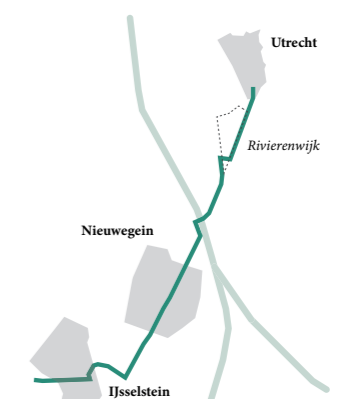
ROAD NETWORK



At the large scale it can be seen that the road along the waterfront is part of the fast cycling network from Utrecht to Nieuwegein. A redesign with more focus on the cyclist will promote the usage of bicycle traffic instead of car mobility.

XL

FAST CYCLING NETWORK



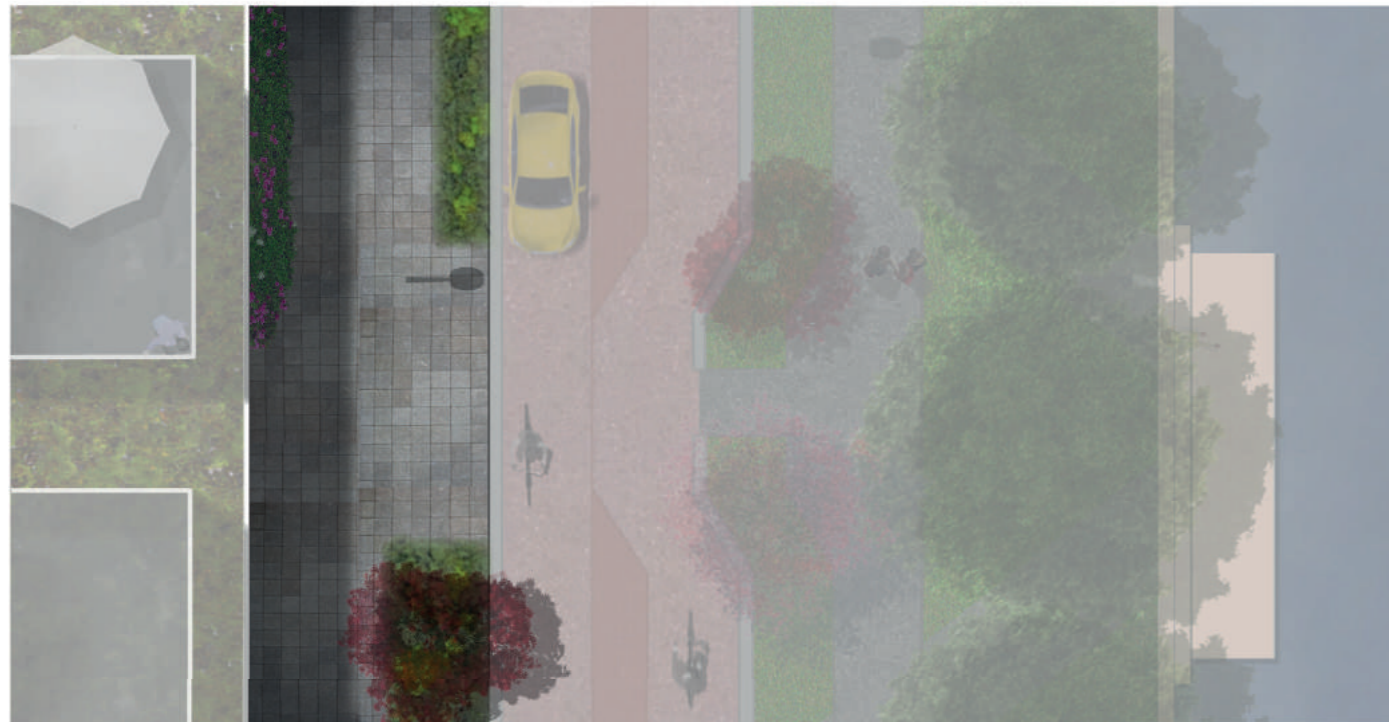


# Design location 2

## Lively sidewalk

The current sidewalk is lacking quality and diversity, resulting in a monotone and boring walking experience. The closed plint highlights the huge scale of the buildings, making walking along the path seem endless. By creating more entrances in the building more life on the street is stimulated. Facade green makes the sidewalk more attractive, while giving the residents of the apartments a small garden to care for. Seating elements will make the sidewalk not only a place to move, but also provide the opportunity to relax and meet other people.

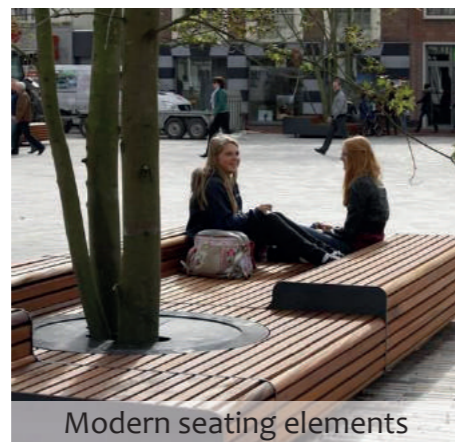
Because the sidewalk is enlarged there is space for more green. Less paved surface will improve the urban climate, while the colorful perennials will improve the quality of the sidewalk.



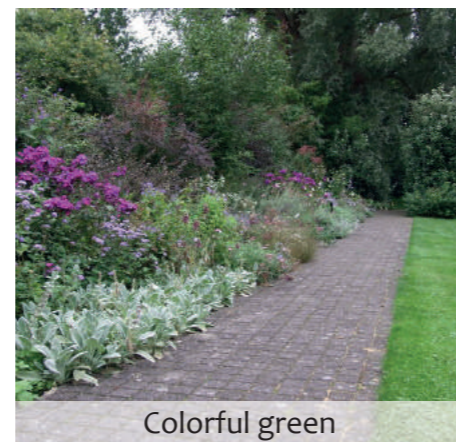
## References



Facade green



Modern seating elements



Colorful green

Fig 6.22 Reference images - Sources in the Epiloque

Existing situation



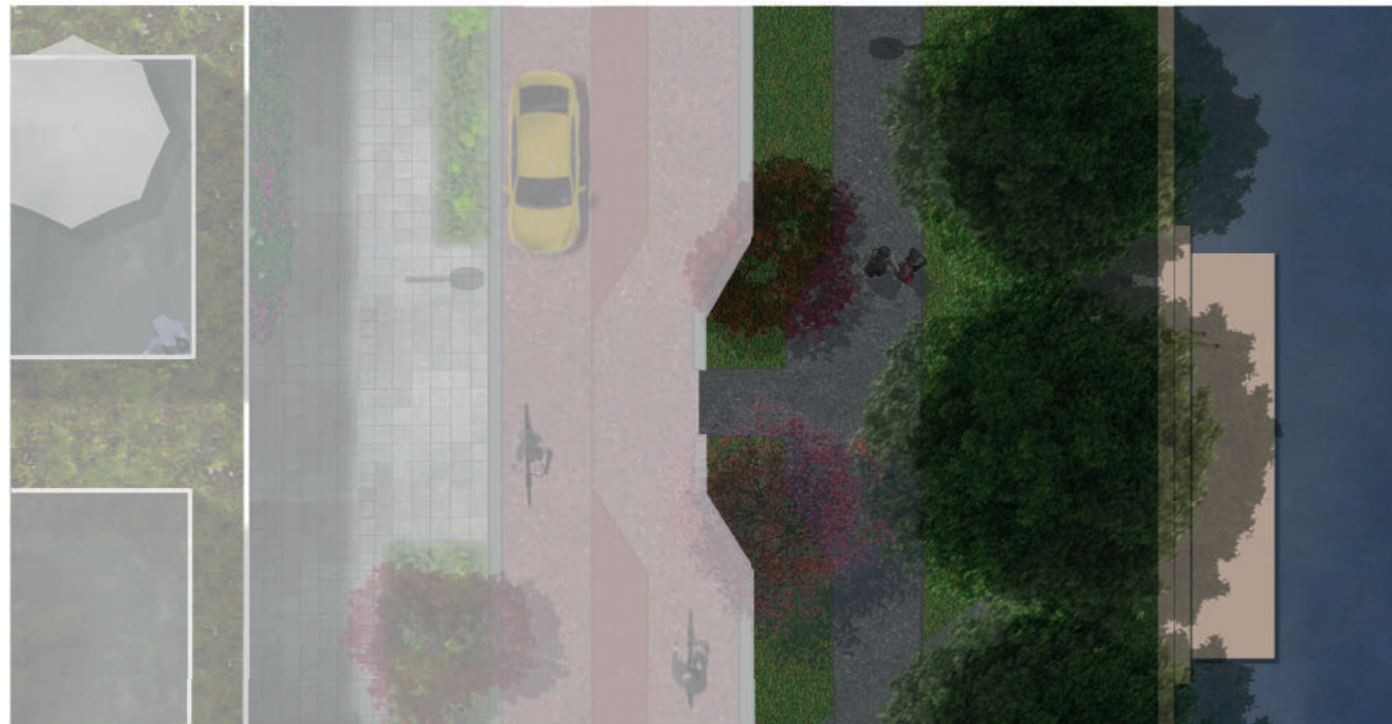
Redesign



# Design location 2

## Improve waterfront accessibility

The largest opportunity to improve the quality in this design location is to make the waterfront more accessible for recreational use. By adding a walking path along the water the walking experience is enhanced. Designing several places where you can get close to the water, with elements like platforms or stairs, will offer a place to relax. Especially on hot summer days, locations where you can reach the water are essential to find coolness in the warm city.



### References

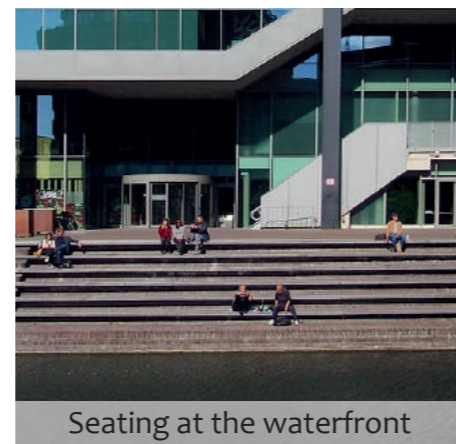
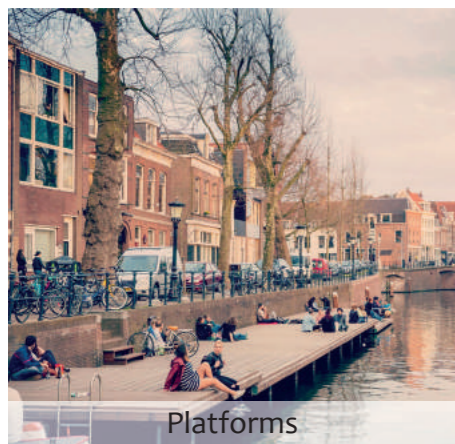


Fig 6.23 Reference images - Sources in the Epiloque

Existing situation



Redesign

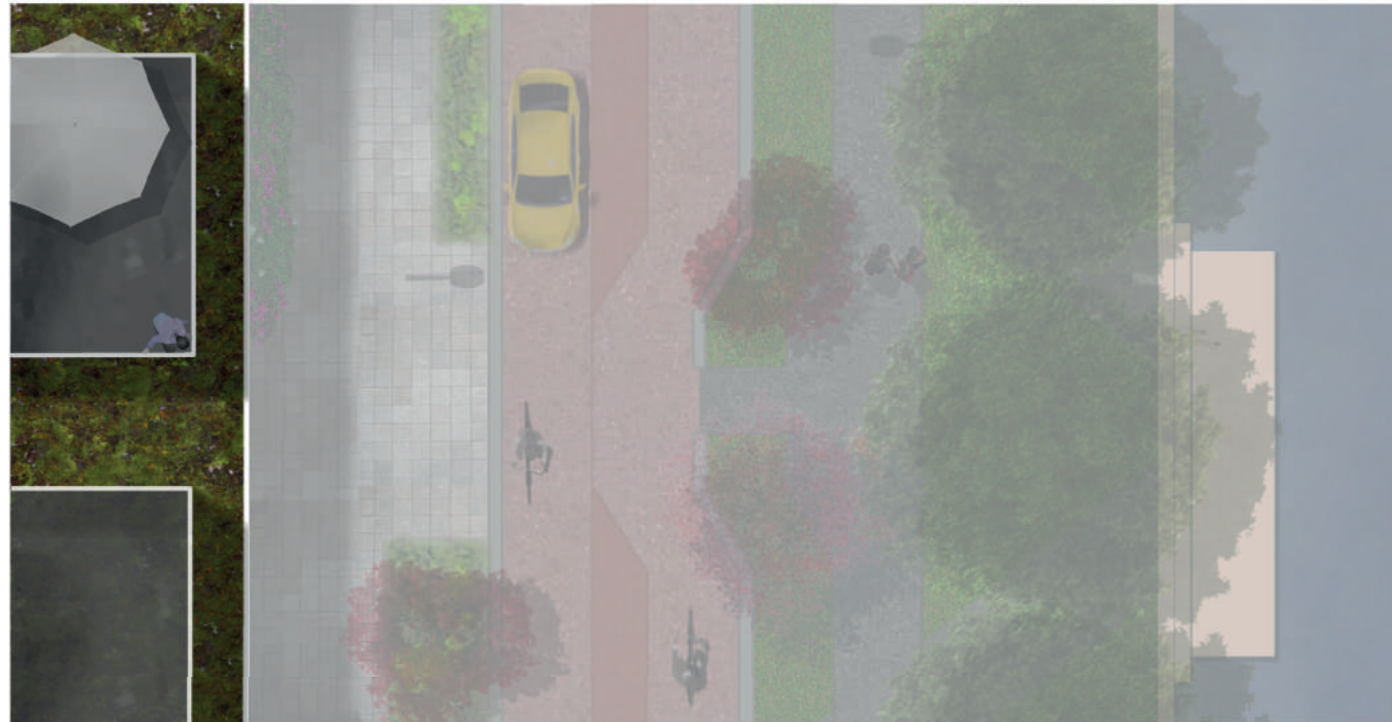


# Design location 2

## Include the built space

Many of the large apartment buildings along the Vaartsche Rijn have flat unused roofs. In the urban context where space is a scarcity, roofs should be an integrated part in the design. For the city of Rotterdam, the design firm 'the Urbanisten' has created many design proposals on how to use these roof spaces. Similar solutions could be part of the design intervention in Rivierenwijk. Creating green roofs with low, or when the construction is strong enough, high vegetation adds many qualities to the space. Making public roof gardens,

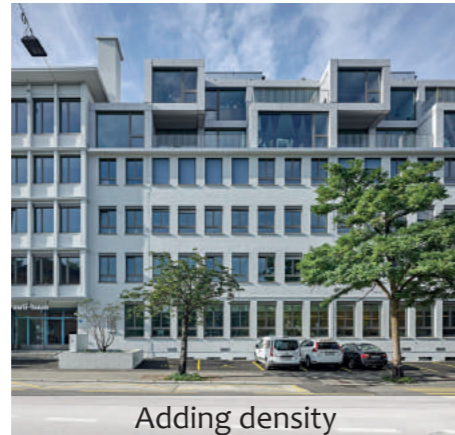
accessible through multiple entrances, adds a new layer of public space. A combination of vegetation and energy production can be implemented on the highest rooftops to improve the sustainability of the neighborhood. Redesigning the space along the waterfront will add many qualities and to maximize the use of the space, additional density can be added to the buildings through topping-up. To maintain the human scale of the buildings for the pedestrians on the street, setbacks should be a standard principle.



## References



Green roof



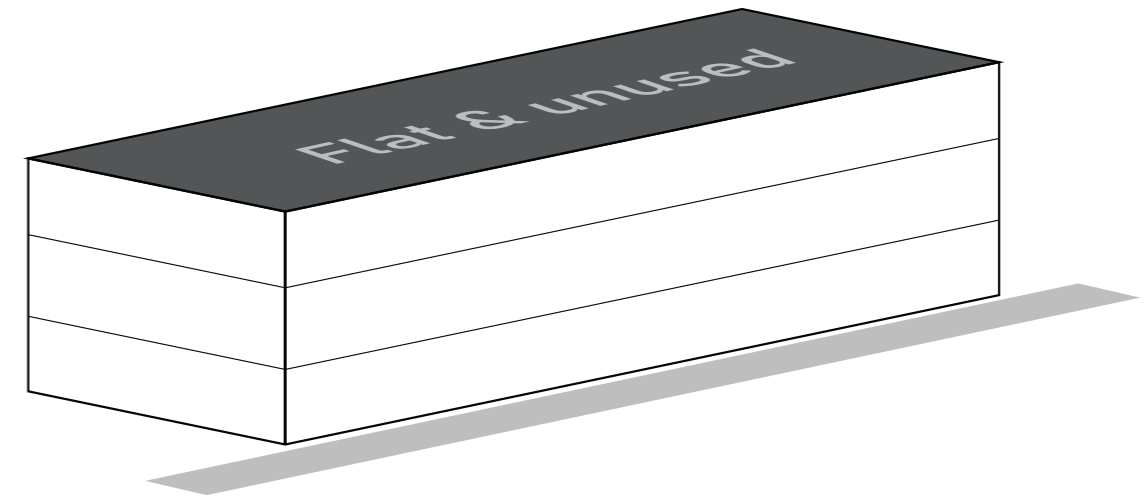
Adding density



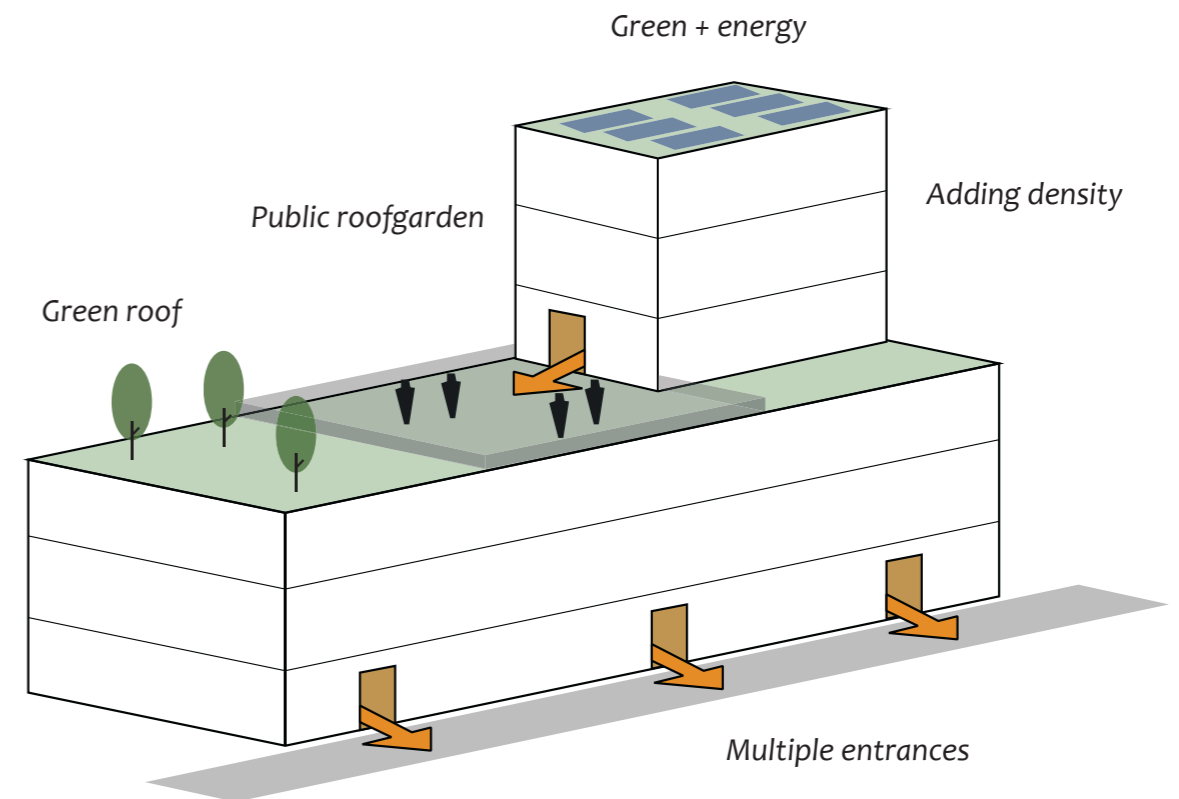
Public roofgarden

Fig 6.24 Reference images - Sources in the Epiloque

Existing built space



Redesign options

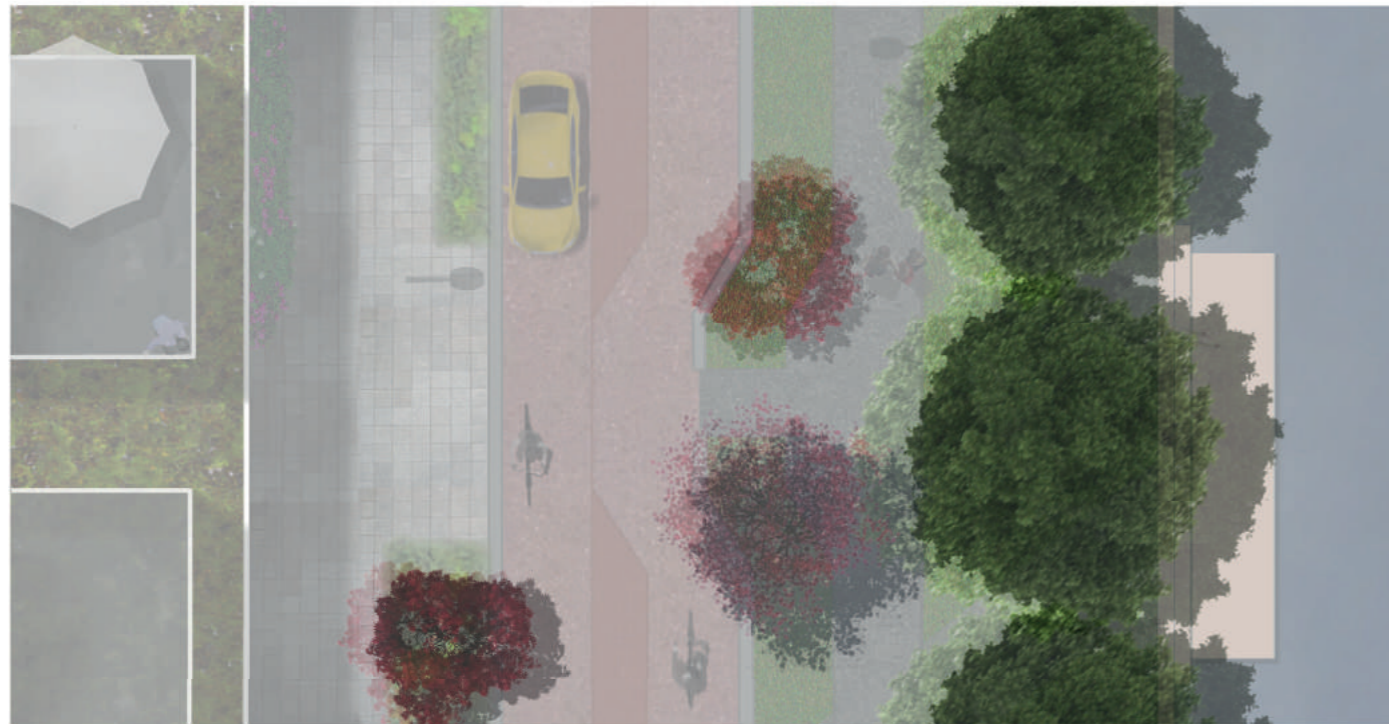


# Design location 2

## Diversify green

The existing green structure of the Vaartsche Rijn does not contain much variation. The long line of Tilia trees are robust but are, as explained in the tree analysis, used as a design element to accompany the infrastructural lines. The green stroke underneath consists of only grass and is mowed regularly. To improve the level of biodiversity more diverse green is required. This is done to bring variation in species, height and maintenance. Added to the line of Tilia trees are several groups of trees, consisting of a colorful composition that is complementary to the dark green of the existing tree line.

Reducing the traffic space leaves room for a perennial border with many different plant species, providing a shrub layer between the trees and the grass. To prevent the grass stroke from becoming too rough, mowing is still needed. However, by following a mosaic mowing scheme where not everything is cut in one go, insects will have a constant shelter to thrive. Finally a soft waterfront is created by adding more aquatic vegetation. Designing several places with a subtle transition from water to land will benefit especially waterbirds and amphibians.

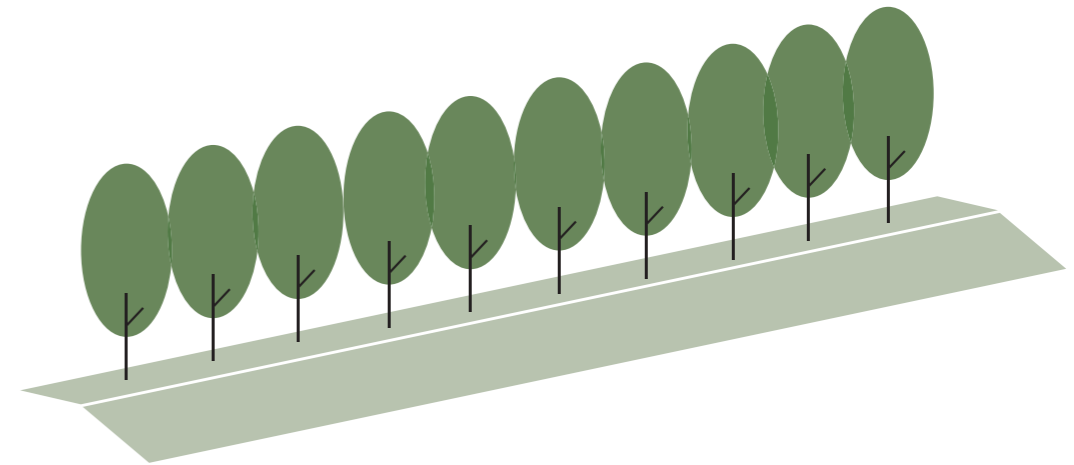


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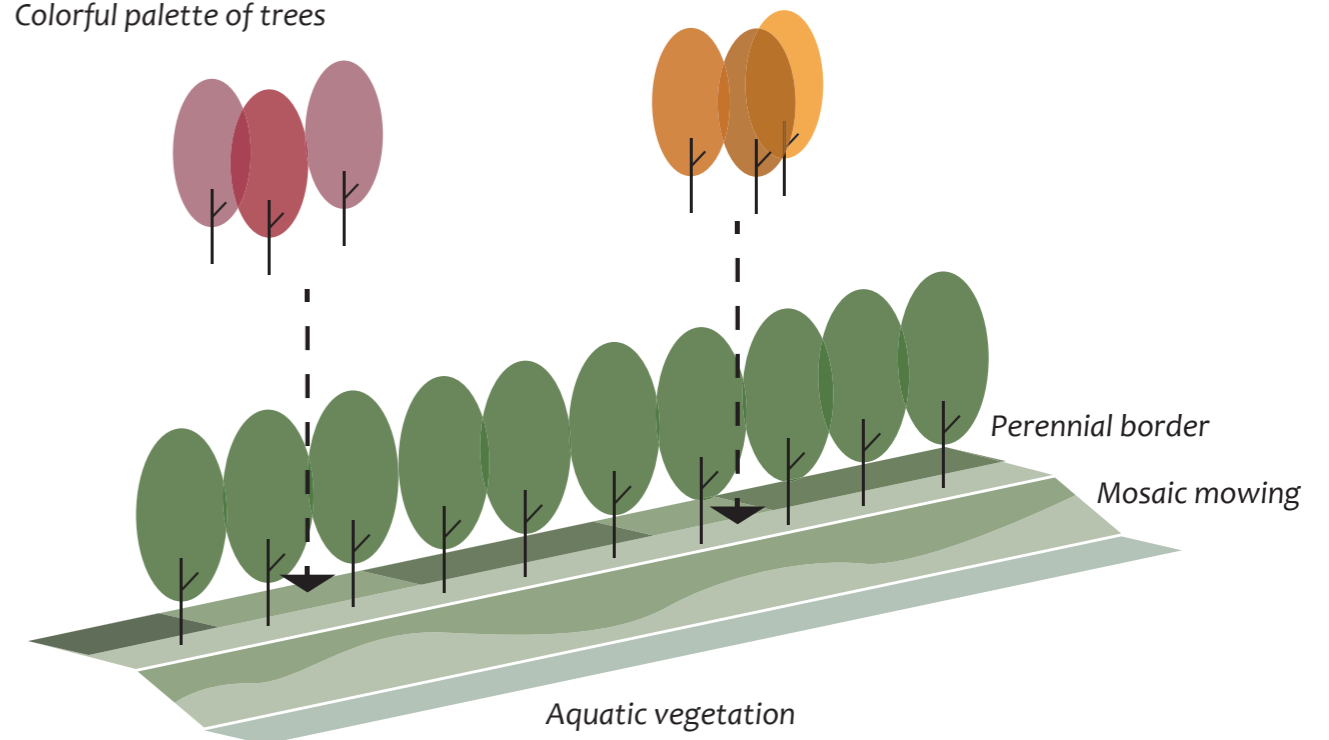


Fig 6.25 Reference images - Sources in the Epiloque

Existing green structure



Colorful palette of trees



Redesign in green structure

# Design location 2

## Increased quantity

Implementing the five design interventions on the total strip along the Vaartsche Rijn will have a significant effect on the quantity of available open space. The diagram below visualizes the quantity of the different space categories of the strip (figure 6.26). Using the same 50 m<sup>2</sup> of open space per household as before, will result in a carrying capacity of 275 households. The second diagram represents the design intervention and the quantitative effect for each space category (figure 6.27). Improving the accessibility of the waterfront will include more of the water space as open space. Because of the many large flat roofs, much of the built space can be transformed to usable

open space. The new bicycle highway would still require space for infrastructural use. However, this is much less than the existing situation where car mobility has the priority. With the increase in open space over 300 additional households could be added to the area. These densities can be implemented through up-topping and because of the already higher building height, compared to the low row-housing inside the neighborhood, this is a fitting location.

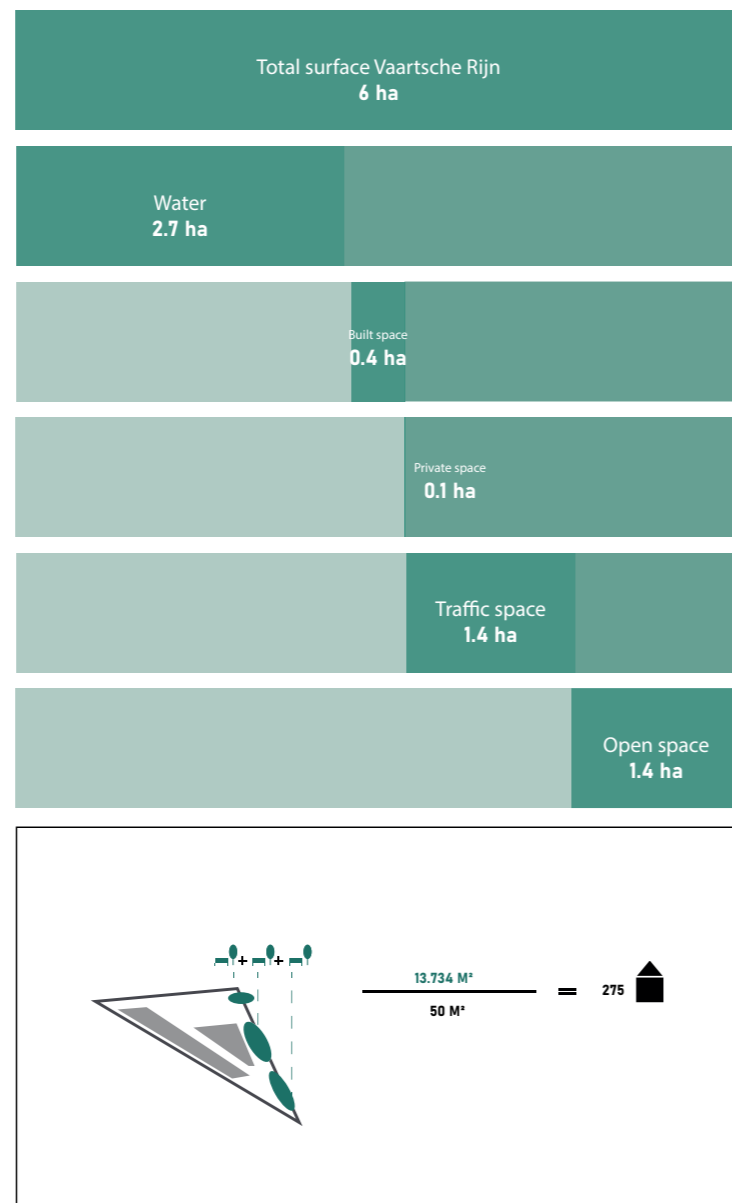
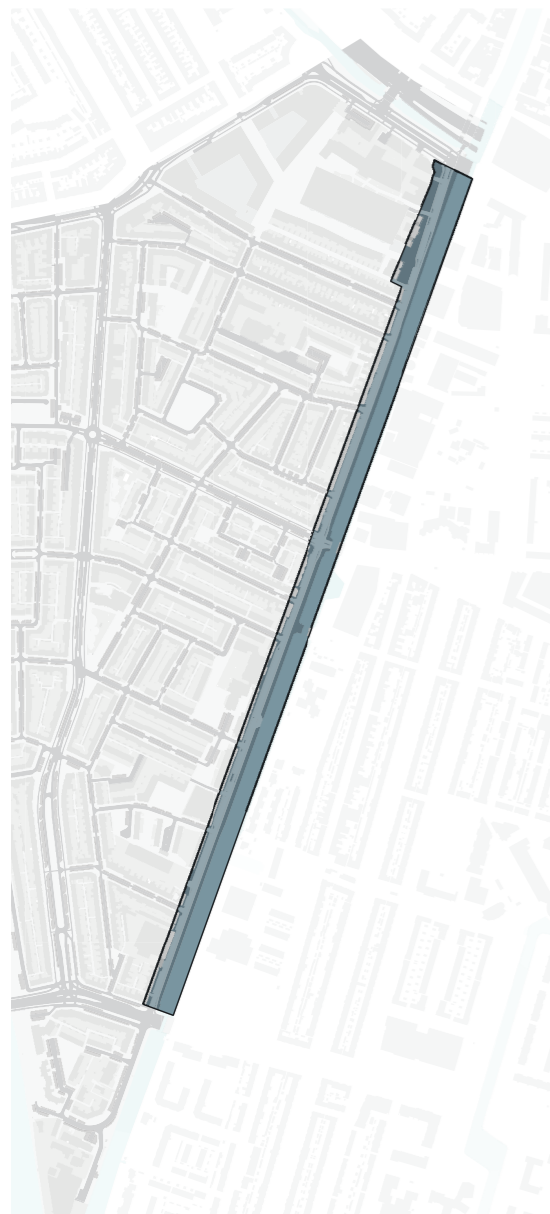


Fig 6.26 Existing quantity of the different space categories - Source: by author

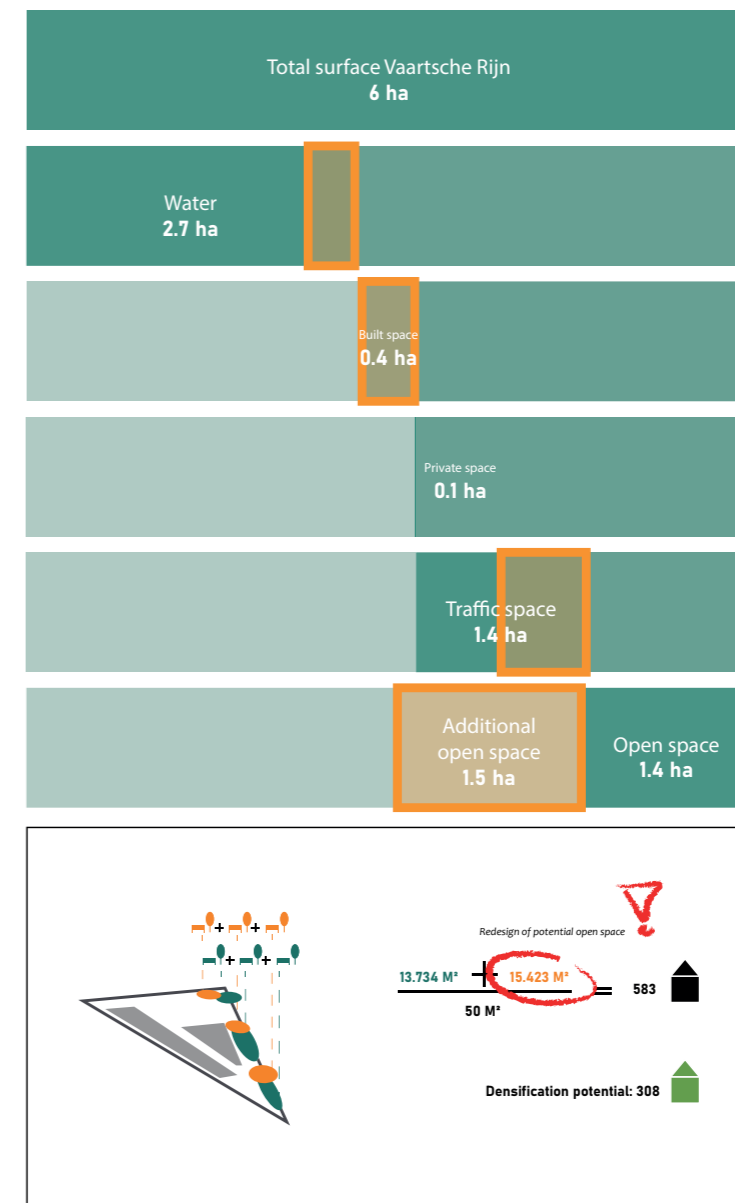


Fig 6.27 Quantitative result of the proposed redesign - Source: by author



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7.1 Morpho-typological analysis

7.2 Key design principles

7.3 Extrapolation on city scale

## 7. DESIGN EXTRAPOLATION

The final subquestion of this project explores the transferability of the proposed design interventions of the Open Space Strategy, where a redesign in quantity and quality of open space is the starting point for dealing with densification. The design interventions on quantity and quality of open space are generalized to create a more flexible set of principles. In addition, a morpho-typology study is done to find similar neighborhoods as Rivierenwijk. By combining the results of the two steps an estimation can be done on how well the principles can be used on a larger scale.

### SRQ 4

Which elements of open space redesign can be upscaled into generalized design principles for implementation in similar neighborhoods in Utrecht?

Topic

### Morpho-typological analysis

- Defining the spatial characteristics of Rivierenwijk
- Summarizing the environmental challenges of the typology

Results

### Design principles

- Generalizing of the used interventions to define a set of design principles

Testing

### Extrapolation on city scale

- Explore if the principles could work on neighborhoods in Utrecht with similar typology and challenges

## 7.1 Morpho-typological analysis

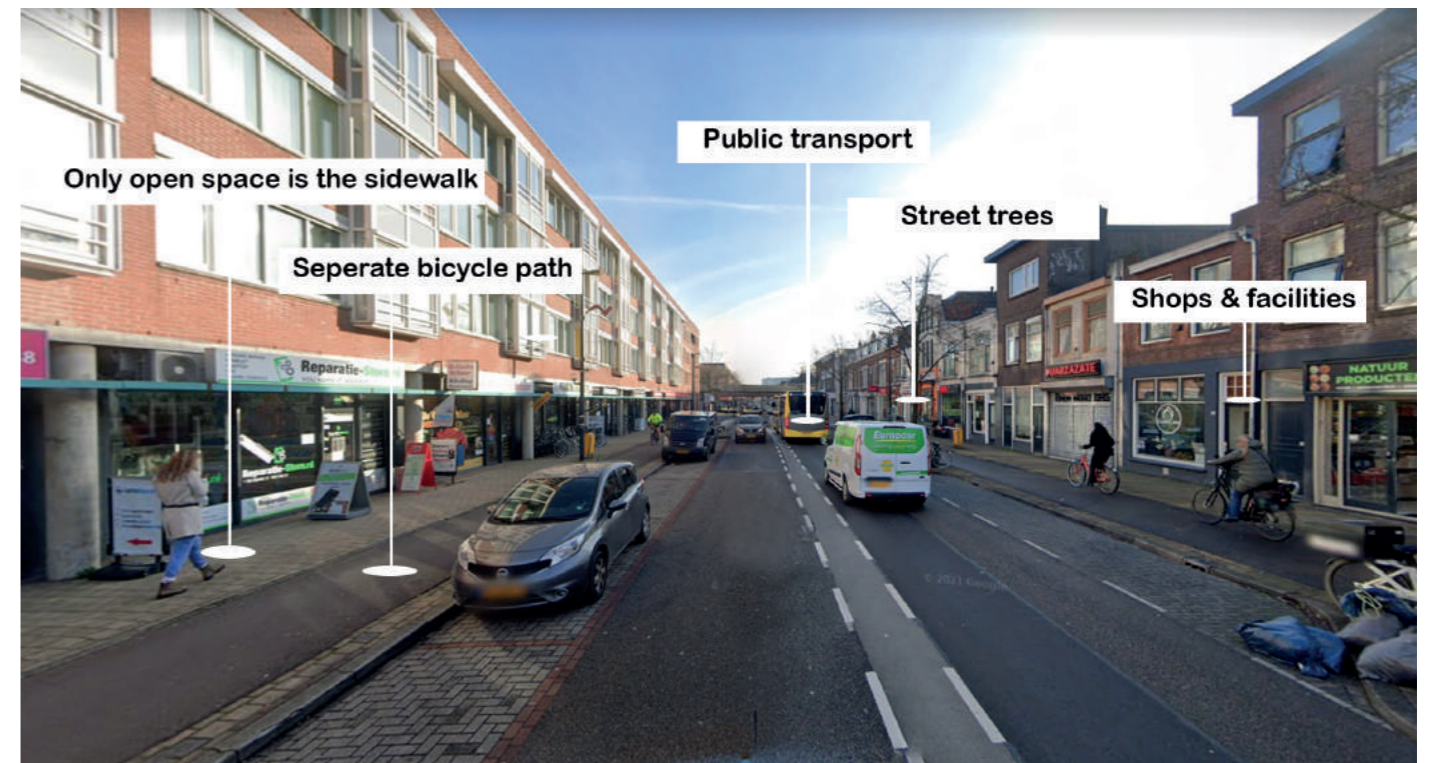
The city of Utrecht has a wide diversity of different neighborhoods. Each neighborhood typology has its own characteristics which results in a classification visualised in the map below (figure 7.1). The post-war neighborhood of Rivierenwijk can be classified as 'Tuindorp'. With mainly 2 till 3 level row housing, this typology has a low dense character. Each house often has a front and or backyard, making large public urban spaces less necessary. Car mobility has a dominant place in these areas, resulting in much space dedicated for roads and street parking. This leads to many paved surfaces, aggravating the extremes of the urban climate. Street trees form often the only green element in this typology. However, because of the narrow streets and small rooting space, most

trees are replaced when they grow too large. Resulting in a low level of biodiversity in this typology. Other neighborhoods that have a similar typology as Rivierenwijk are Lombok and the 2e Daalsebuurt (figure 7.2). Looking even closer at these locations similar spatial typologies can be recognized. The narrow innerstreets for example are well recognizable in streets like the Javastraat in Lombok. While the Amsterdamsestraatweg fits well the description of a central shopping street, similar to the Rijnlaan in Rivierenwijk. It can therefore be concluded that other neighborhoods with the typology Tuindorp have many similar characteristics. This improves the transferability of the design solutions used in Rivierenwijk for other Tuindorp neighborhoods.



Fig 7.1 Reference of a neighborhood typology based on building characteristics- Adapted from Esri Nederland Content

Amsterdamse straatweg - 2e Daalsebuurt



Javastraat - Lombok



Fig 7.2 Similar typologies within the different neighborhoods - Adapted from Google Maps

## 7.2 Key design principles

Reflecting on the design interventions results in a set of key design principles focussed on the context of Rivierenwijk. By generalizing these principles they become more transferable to other neighborhoods of the same neighborhood typology. Focussing rather at the design actions that deal with typical aspects of a Tuindorp neighborhood than site specific design actions, results in five guidelines which can be applied on other locations as well. Each key design principle is briefly explained below, offering a starting point when redesigning in other Tuindorp locations in Utrecht.

### 1 More and diverse green

Green in the city provides many benefits for both humans and nature. Also in mitigating the effects of climate change green is one of the most important design elements. In the transformation towards a more nature inclusive city it is not only the quantity, but also the quality of green which is important. Using different species, creating different habitats and pursuing a more diverse way of maintenance are essential principles in the transition towards a richer urban ecology.



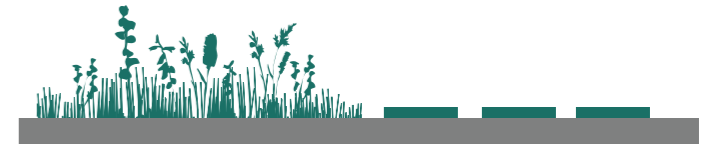
### 2 Less priority for car mobility

The existing traffic space, like roads and parking, requires much of the room in the city. By redefining the mobility modes in the city from a car oriented, to walking and cycling these spaces could become available again. Redesigning the current monofunctional spaces for more flexible use with multiple qualities is an important trend in urban design.



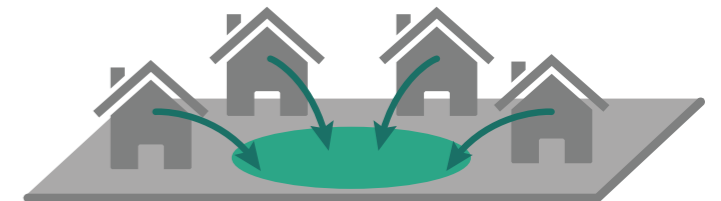
### 3 Soften the hard surface

Common in the city, but especially in this neighborhood typology, is the large amount of paved closed surfaces. The many pavement tiles and asphalt aggravates the extremes in the urban climate, while providing little space for nature. Shifting from the general perception that the city should be neatly paved is a major challenge in these neighborhoods.



### 4 Public community gardens

Typical for the dwellings in this typology are the front- and backyards that come with each individual home. However, densifying with such a large spatial footprint will not be feasible. Adding apartment blocks will have limited private outdoor space, like balconies. Such absence could be compensated by multiple public open spaces of decent size. Reducing the size of existing private gardens and redesign these as public community gardens is a key principle in maintaining sufficient outdoor space for all inhabitants.



### 5 Mixed use public spaces

Following the concept of the 15 minute city that Utrecht pursues, more functions and facilities will be needed across the neighborhoods. In this smaller radius sufficient public open spaces are needed where residents can play, meet, relax, eat and shop. While increasing the amount of green to provide a comfortable urban climate and a place for urban ecology.





## 7.3 Extrapolation on city scale

The coming decade the city of Utrecht will implement many densification projects within the city boundaries (figure 7.3). By creating multiple cores, besides the traditional historic city centre, the pressure can be divided more equally. This means however, that the whole city will be facing an increase in pressure on open space to some extent. Redesign in quality and quantity of open space over the whole city will therefore become an urgent challenge. This will mean that the similar

neighborhoods like Rivierenwijk will also need to improve their available open space. Adjacent to the tweede Daalsebuurt for example is the infill development of the Cartesiusdriehoek, which will also add pressure to the surrounding open spaces. Using the five key design principles as a starting point will help facing this similar challenge that Rivierenwijk has regarding the Merwedekanaalzone.

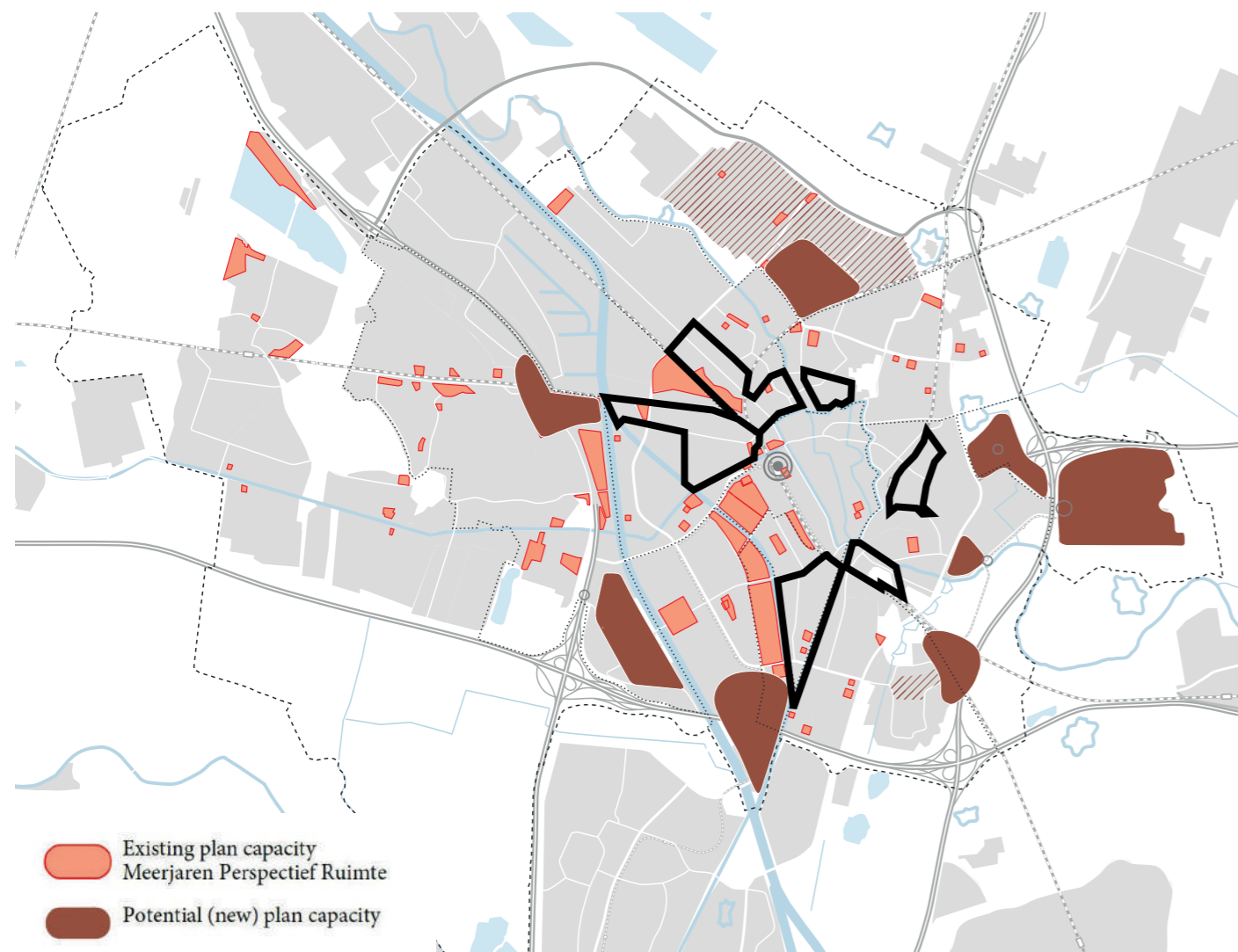


Fig 7.3 Possible densification potentials within the city boundaries - Adapted from: RSU 2040 (2021)

A brief analysis regarding the environmental qualities of the similar neighborhood typology is shown below (figure 7.4). It can be concluded that the amount of pavement and green surface in each neighborhood is similar to Rivierenwijk. Therefore creating the same urgency for a transition towards a more climate resilient and nature inclusive urban fabric. It also suggests similar conditions regarding aspects like dominant car mobility, lack of urban ecology and more extremes in the urban climate.

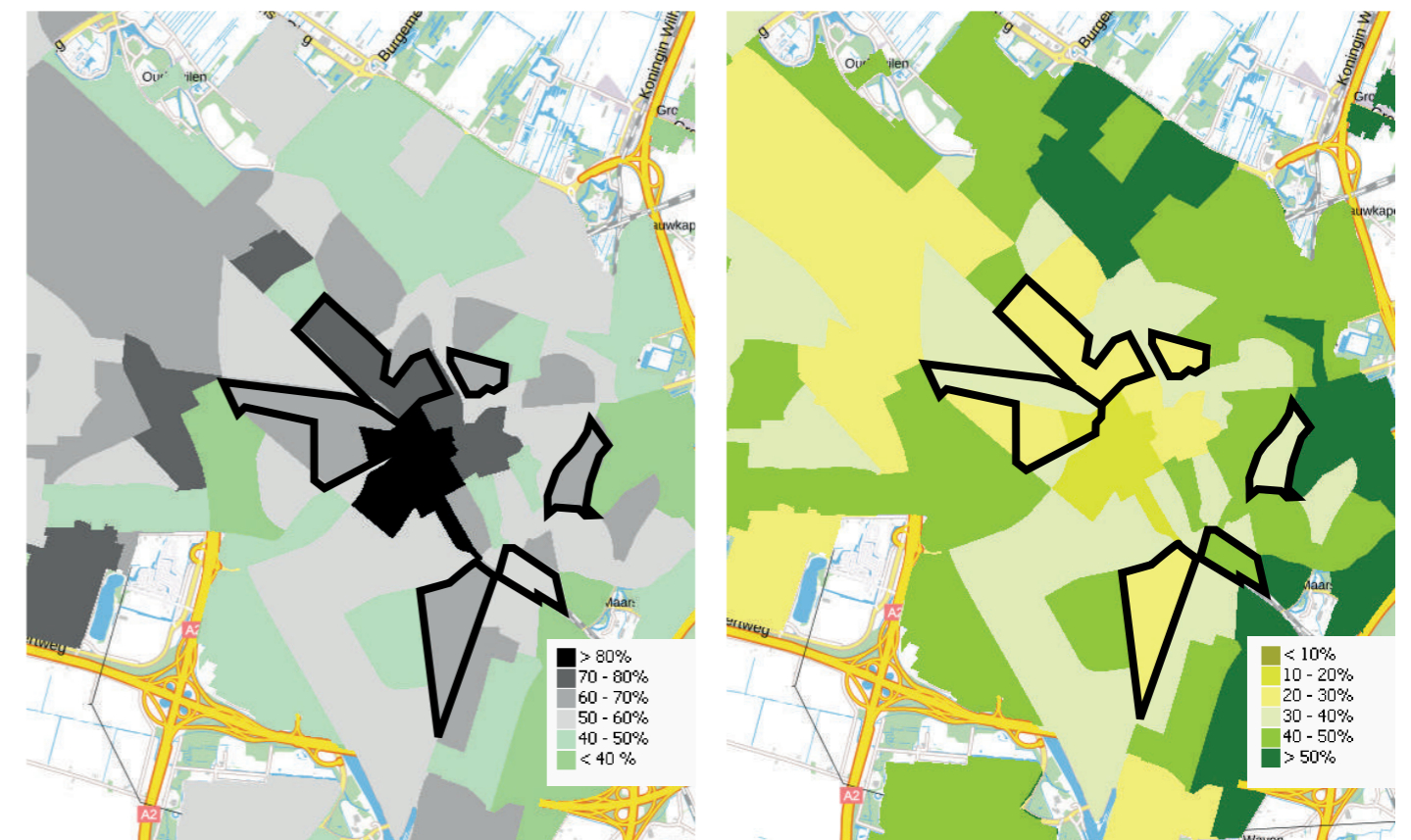


Fig 7.4 Current environmental performance of the similar neighborhood typologies - Source: klimateffectatlas.nl



This last chapter concludes the research, answering the main- and subquestions which were used throughout the process. It is followed by the general reflection of the process of the research, reflecting the relationship between research and design, the relevance of the project, Advantages and limitations chosen methodology and the value of the transferability of the results.

Contents:

8.1 Conclusions

8.2 Personal reflection

## 8. CONCLUSION & REFLECTION

## 8.1 Conclusion

### Main research question

How can by redesigning the quantity and quality of open space in post-war neighborhoods like Rivierenwijk in Utrecht, additional densification be enabled, while contributing to the transformation to make the city more climate resilient and nature inclusive?

### Research aim

The main aim of this research is to design the city from its open spaces, which are so essential for the quality of urban life. The challenges of densification, climate resilience and nature inclusivity should be examined from the redesign of quantity and quality of open space.

### Research goal

A redesign, in quantity and quality, of the existing and additional open spaces in Rivierenwijk, while improving the level of climate resilience and biodiversity.

In contrast to the current Built Space strategy, where the starting point is to add high volumes of built space to the city, the Open Space strategy is proposed. Here the starting point in sustainable densification is to provide sufficient quantity and quality of open space, thus to start from the perspective of open space. This paragraph provides the most key conclusions and reflections of this research. The established definition of open space used in this thesis is, however based on thorough literature review, not the only one possible. Other definitions with different criteria than unbuilt, walkable, public open space would possibly lead to other results than this research. As a result of the set criteria for open space the surface of Rivierenwijk is divided in different spatial categories. While theoretically defined, in practice these categories have much overlap. Bicycle roads are for example not perceived as open space, because of their mobility function. However, many of these wide roads are popular for walking, running or skating. Therefore providing the same qualities as open space. On the other hand are the sidewalks defined as open space, while many are claimed partially for car parking.

To provide sufficient open space per household a specific quantity is defined on what 'sufficient is. Based on research of the municipality of Utrecht an amount of 50m<sup>2</sup> of open space is upheld per household. It can be concluded that this number is quite ambitious and that even in a low dense neighborhood this requirement is not met. While a redesign of potential open space increases the amount of available open space it is questioned if a set quantity should be leading in adding density. More important is to look at open space quality and how space can have a multifunctional use. This research shows that improving both the quantity and quality of open space will increase the urban liveability for its residents.

The different spatial categories of water, built, private and traffic space make the analysis towards open space clear and systematic. However, it should be mentioned that this leads to some oversimplifications. Private gardens are a complex issue,

because while they do not fit the definition of public open space they do contribute to the urban liveability of their owners. As a result, it could be the case that in a neighborhood with lots of large private gardens and only little public open space, it is concluded that there is too much pressure on available open space and therefore a lower urban liveability. However, all the residents have a large private garden to their disposal, therefore experiencing little nuisance from the overcrowded public spaces. Regarding the built space the most efficient way is to redesign the flat roofs till public rooftop gardens. However, making rooftops publicly accessible is not the most logical thing to do. Creating private rooftop gardens or even inaccessible green roofs will provide many qualities for the owners or the environment, while this would not increase the amount of available open space. In redesigning the built space the aspect of public accessibility should therefore be less strict.

As said, working with the defined spatial categories offers a clear structured way of redesigning open space. However, it can be tempting to approach a location layer for layer and while offering more overview, at some point the design interventions have to come together at the same location. It is important to create in the end a holistic overview of the design interventions and study how they also influence each other. Also, there can be variation in the sequence of the different spatial categories, it is not a strict phasing where every step has to be dealt with equally.

Finally, this research about open space use and therefore pressure on open space is limited to the residents that live in Rivierenwijk. It should be acknowledged that, as stated in the problem analysis, neighborhoods are not islands within the city and that residents move through the city. While not included in this research, it should be mentioned that residents outside Rivierenwijk also use the open spaces and vice versa. This makes the real city much more complex, and the specific set amount of open space per household even more obsolete, because in the end quality attracts people, not quantity.

## Sub research questions

### SRQ1

What is the qualitative and quantitative condition of available open space in Rivierenwijk and how does it relate with densification?

Compared to the total surface of Rivierenwijk only a small portion, 17,5 hectare, can be perceived as walkable, unbuilt, public open space. Hereof, less than a third has a green natural character. The quality differs rather per location, resulting in attractive and frequently used high quality open space and unused low quality open space. While much of the residents seem content with their neighborhood there is a distinct lack of green experienced by the majority. Allocating the required 50m<sup>2</sup> of open space per household, would mean a shortage of open space for more than one thousand existing households. It can therefore be concluded that there is too much pressure on open space, which densification will only worsen. With detailed design interventions on two locations in Rivierenwijk

### SRQ2

What are the opportunities to improve the quality and quantity of both available and potential open space in Rivierenwijk to enable densification potential?

To improve the conditions regarding open space, and provide the opportunity for sustainable densification, the quality and quantity needs to be improved. By redesigning space that is not yet perceived as open space, here defined as potential open space, the portion of available open space can be enlarged. From the different space categories design principles are developed that provide strategies on how to carry out a redesign. By looking in more detail to the different spatial typologies of Rivierenwijk, a more realistic understanding is achieved on what the location specific strengths and challenges are. With additional field research among the residents sufficient knowledge is provided for developing integrated design interventions.

### SRQ3

How can a redesign of available and potential open space improve the conditions for balanced densification?

it is shown how both the quantity and quality of open space can be improved. Relating the design actions to the different types of space makes it clear what the quantitative effect is of the redesign. Reflecting on the qualities that are added on the locations provides a distinct overview on how the locations are improved. It is concluded that both interventions enlarge the carrying capacity of the amount of households that are supported regarding open space. However, with the existing pressure on open space it is not obvious that much density can be added to this particular neighborhood.

### SRQ4

Which elements of open space redesign can be upscaled into generalized design principles for implementation in similar neighborhoods in Utrecht?

Looking at the whole city of Utrecht similar neighborhoods as Rivierenwijk can be distinguished. Locations from this same typology have comparable challenges and characteristics, making the results of the research more transferable. Concluding with five key design principles, that deal with general aspects of the neighborhood typology, a starting point is provided for when redesigning on these similar locations.

## 8.2 Personal reflection

### Societal relevance

This thesis is about the relation between open space and built space. With the present urbanization trend in the Netherlands, many larger cities follow the concept of the compact city in reaction. With this strategy to densify within its urban boundaries, cities like Utrecht add high volumes of built space within its urban fabric. Open, unbuilt spaces in the city, like waterfronts, parks, squares and playgrounds are essential in providing a high urban liveability for its residents. With an increasing amount of built space replacing open spaces in the city and adding more pressure to existing open spaces, the balance between the two seems to be shifting. This raises the question how enough open space can be secured in the city, in the contrast to a more densified urban environment. Also, what is enough open space?

This thesis explores the hypothesis that to enable more densification, sufficient quantity and quality of open space in the city should be designed, to preserve the high level of urban liveability. So instead of looking for open spaces to add large amounts of built space, open spaces are the starting point for determining how much densification can be supported. By approaching the challenge of densification from the perspective of available open spaces, new insights can be found to stimulate the discussion on how to create sustainable densification.

In this research both the quantity as quality of open space are discussed. Building upon recently research done by the municipality of Utrecht estimations can be done on how much open space is needed per household. These quantitative results are further discussed from the perspective of quality. Is only enough square meters of open space per household sufficient to preserve high quality of urban life? Or is also reflection on the quality of such open spaces needed? This back and forth between quantity, which is more easily represented with numbers, and quality, which is more subjective to its use and function, makes the thesis a relevant contribution to the discussion about the relation between open space and built space in the urban context.

### Research advantages and limitations

The city of Utrecht, the project location of this thesis, has much open source and up-to-date data. Working with relevant GIS data and official documents benefits this research to make it relevant for practical use. Exemplary, is the document 'Ruimtelijke Strategie Utrecht 2040' by the municipality of Utrecht, which is published very recently. In here, nowadays and future challenges and opportunities about the city from the perspective of urbanism are discussed. Such recent and detailed sources are a great benefit in making the thesis a relevant project. Part of the research is field work and performing a survey among the inhabitants of the project area. Measurements are taken to create valid results, like varying in time and location of taking the survey. However, due to limitations in time it should be acknowledged that not a complete representation of residents of the project area can be obtained.

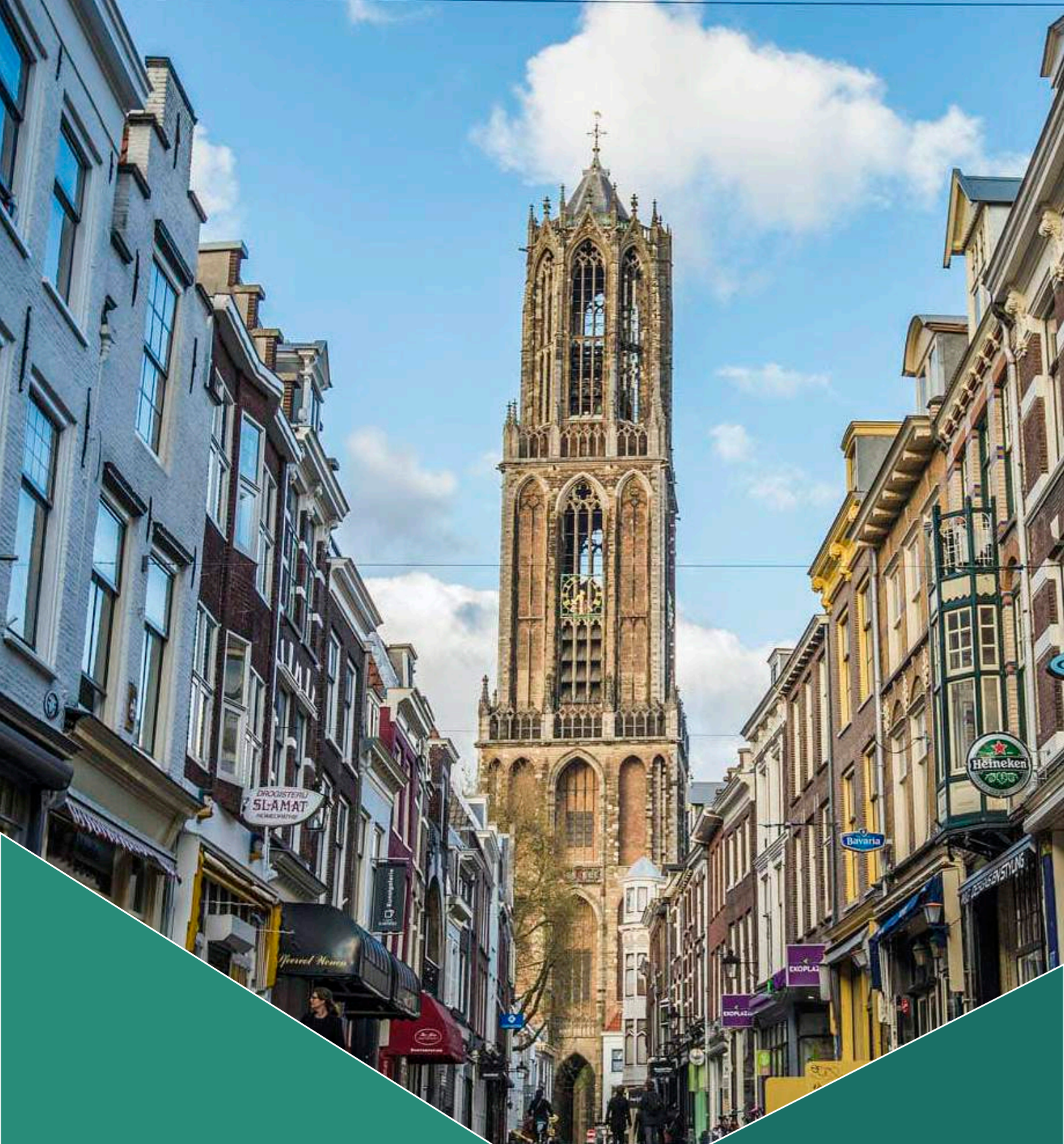
Further reflection on data collection with the survey, one result in quiet interesting. By asking people what they lack in the neighborhood and what they like to add many people answer 'nothing'. While it could mean that people are content with their living environment, this could be an simplified conclusion. It could also mean that respondents associated change with fear of losing what is already there. Next to the project location is a large redevelopment which causes much commotion. This strengthens the idea that change can do only harm. On the other hand, it could be that people lack the imagination to come up with valuable additions to their living environment. Referring to the famous quote of Henry Ford: "If I had asked people what they wanted, they would have said faster horses." Results of the survey should therefore carefully be interpreted, especially those where an 'open answer' is possible.

### Generalizing results

The project area of this thesis is a post-war neighborhood within the city of Utrecht and most research done is about the situation in this neighborhood. Results and conclusions of this thesis should therefore be seen in the context of this area and its location specific conditions. However, many challenges like densification, climate resilience and increasing the amount of green and biodiversity are well-present in both other parts of the city of Utrecht, as other large Dutch cities as well. It would therefore be possible to take certain design solutions from the thesis and test if they could work on similar locations too. Especially, if neighborhoods are taking with a similar character, like low-density, highly car orientated and a with mostly paved surface, success of the design intervention are more likely. Part of the thesis is to see what 'design ingredients' can be distinguished in redesigning various open spaces in the area. Improving the connection to a waterfront by creating a walking path along it, or designing places where you can access the water are an example of such a design ingredient which can be applied on different locations.

### Ethical issues

The central topic of open space reflects always back on how it contributes to a better living environment for its residents. To determine what 'sufficient' quality and quantity of open space means, it is essential to find out who is using the space and for what purposes. This information forms the main input in making effective design interventions to improve the urban liveability of the people using the space. The survey done during the field work and similar sources of citizen participation, are sources for such input. While valuable, these results should be interpreted carefully because it is always uncertain if it is representing all residents. From my own survey it becomes very clear that some people like to express their opinion and are more open to talk then others. This could lead to incomplete results and result in design interventions that only appeal to certain demographic groups. Being aware of this condition is very important to create a just urban design.



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