FUTURE MOBILITY x LIVABILITY

NEW OPPORTUNITIES FOR ENHANCING LIVABILITY IN **AMSTERDAM**

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This has been a challenging year. But a lot of people have contributed to making this a report that I am proud of.

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Kendra Heide

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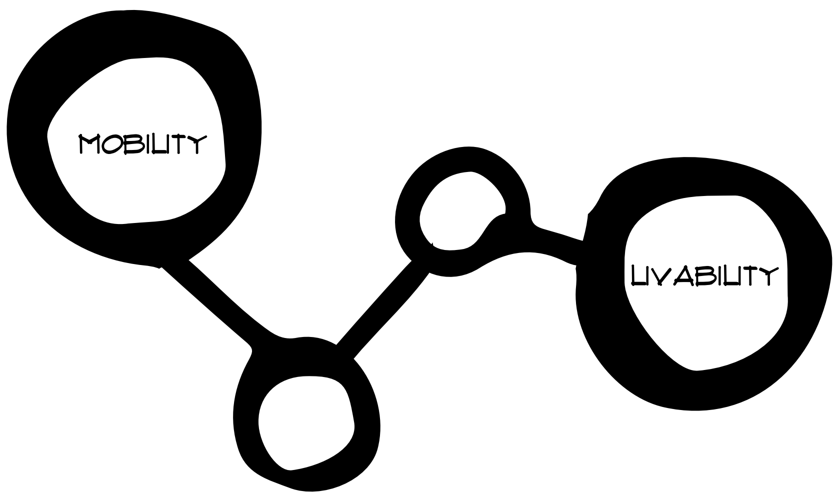


CHAPTER 1
INTRODUCTION

1.1 ABSTRACT

The city of Amsterdam is prospering, the amount of residents and visitors continues to grow every year. With this rapid population increase there are more people seeking to travel each day. This increases the pressure on all types of modalities in Amsterdam. As a result of this, the city becomes more busy, congestion increases, the air quality gets worse, noise caused by traffic increases and the public space diminishes. The current mobility systems have negative and positive effects on the livability in Amsterdam. The way people move through cities is changing rapidly. New technologies in mobility are making it possible for people to navigate through their city more safely and efficiently. Different modes of automated mobility will emerge in the next 30 years. (Papa & Ferreira, 2018) There are still many uncertainties related to their spatial impact on our cities. This graduation project attempts to identify how automated mobility can contribute to enhance livability in Amsterdam. It explores the spatial impact of automated mobility in Amsterdam. To understand this spatial impact the research projects first identifies the scenarios on how automated mobility will be implemented and subsequently researches how this new mobility system can contribute to enhance livability. The design project seeks to propose a model for the implementation of automated mobility in Amsterdam that contributes to enhancing livability.

Key words: Amsterdam, Automated mobility, Livability, Scenarios, Environmental health

1.2 MOTIVATION

Since moving to the Netherlands a couple of years ago I've been fascinated by the transportation network in the Netherlands. Growing up in Curaçao I have been accustomed to using the car to move around the island. In the Netherlands I have never used the car to travel because there are many other modes of transportation which are more sustainable and less expensive. Traveling back to Curacao for vacation has really opened up my eyes on how car dependent the island is and how the use of the car impacts the way we live. Because I don't drive in the Netherlands I am not in daily contact with the car culture however, this made me curious about the effects of the current mobility network in the Netherlands.

Looking into the future, new technologies in mobility such as Autonomous vehicles, electric power trains, vehicle sharing, bike sharing and other new advances are shaping urban mobility. This technology driven shift is going to change the way we live and move around in cities. These technologies are approaching our cities in the next few years. Therefore it is very interesting to research the spatial impacts of automated mobility in the Amsterdam Metropolitan Area.
This new trend in mobility will make a shift in the way we design streets. The design opportunity in the merging of the urban living environment, local mobility, and the Internet of Things (IoT) is very fascinating to me.

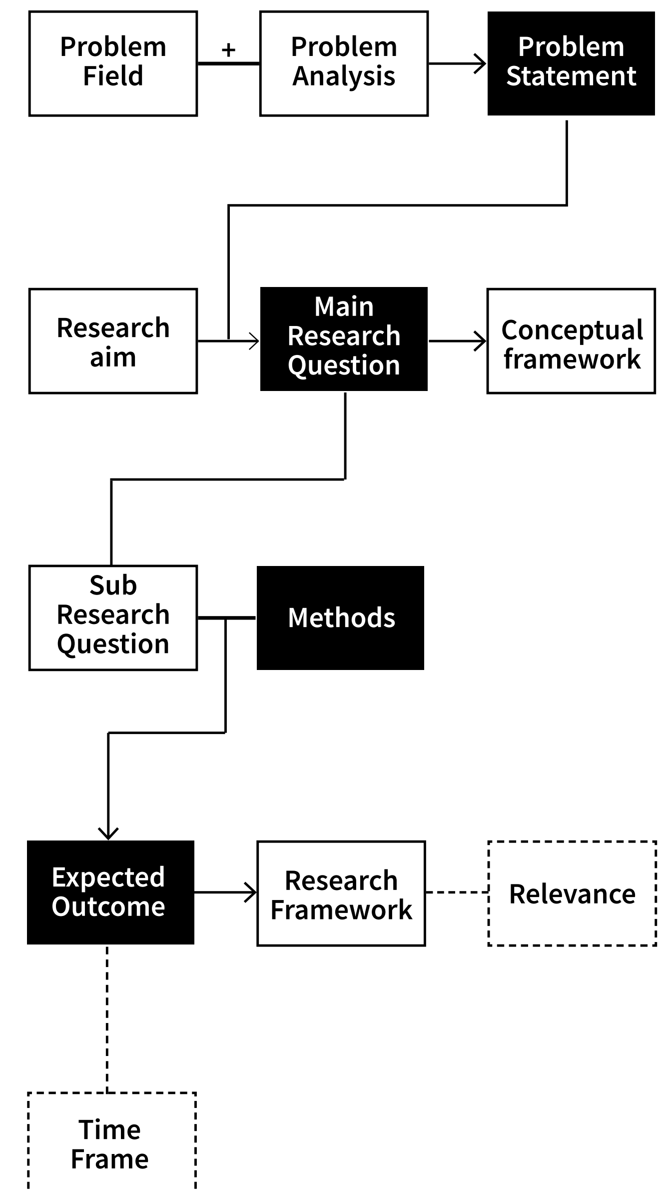
1.3 INTRODUCTION

INTRODUCING THE PROJECT

The Netherlands is one of the front runners of sustainable mobility in the world. With over 90,000 Electric vehicles charged every day, the Netherlands operates as one of the world's largest and most advanced charging infrastructures. (Automotive NL, 2018) New technologies in mobility are approaching in the next few years such as automated mobility. The metropolitan region of Amsterdam is prospering and is expected to grow rapidly in the next years. Rapid population means that there are also more and more people seeking to travel in the city. This new trend in mobility will change the way people move in Amsterdam. There are still many uncertainties related to the automated mobility, many studies have been done on the different specifications of this trend yet there are only a few studies who have tried to research the spatial impact of this shift in mobility. Thus, this graduation project will explore the spatial impact of automated mobility in the metropolitan region of Amsterdam. It will focus on the contribution of automated mobility to enhancing livability in Amsterdam.

The purpose of this chapter is to establish the methodological framework of this research project. The methodological framework explains the reason why the selected methods are used in the thesis project. It argues that the chosen methods will yield the best results. This chapter demonstrates that this framework is fit for the purpose of answering the proposed research problem.

The road map to this chapter is shown in diagram 1.3. The structure of this chapter is as follows, first the problem is explored, this chapter is an extension to the problem analysis chapter where the problems are explored in more detail. The problem statement is derived from the problem field and the problem analysis. The problem statement and the research aim lead to the knowledge gap which is used to develop the main research question. The conceptual framework shows how the main research question is approached. The next step is to explain why certain methods are used to answer each of the sub research questions. Lastly the expected outcome indicates the end product of this research project. The time frame explains how time is managed to reach the goals for each graduation examination period. The relevance chapter shows the scientific and social relevance of this research project.



1.3

Sources
1.3 Road map to the first chapter by Author (2018)

1.4 PROBLEM FIELD & ANALYSIS

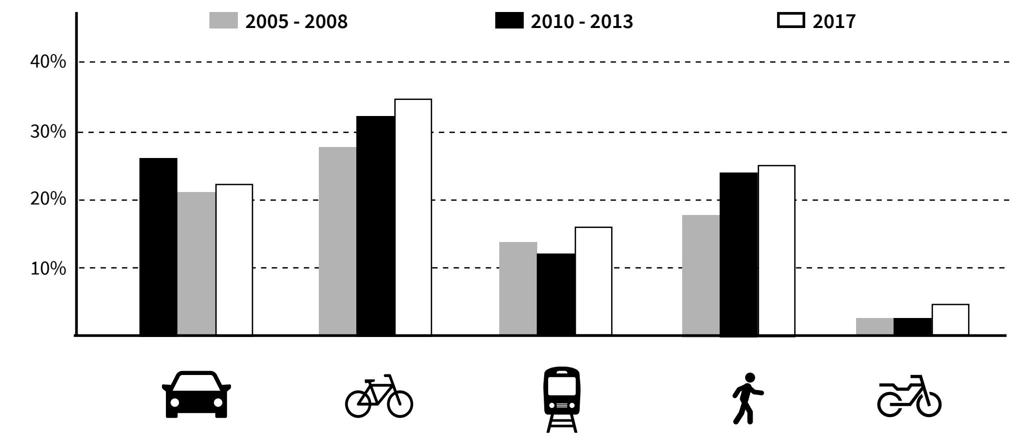
POPULATION GROWTH INCREASES PRESSURE ON MOBILITY

Cities around the world are facing an urgent set of challenges when it comes to getting around in the city. By the year 2030, 60 percent of the world's population will live in cities, more than 2 million people are likely to enter the middle class. (Bouton, Knupfer, Mihov & Swartz, 2018). The amount of vehicles is expected to increase to 120 million by 2025. Existing infrastructures cannot support this high demand for mobility, congestion is already intolerable and an increase in vehicle emissions presents serious health concerns. Rapid population growth in cities of today face a serious mobility challenge as more and people are seeking to travel. According to the municipality of Amsterdam, the population of is reported to grow to 1.042.200 residents in the year 2040. (Gemeente Amsterdam, 2015a) Because of the prospering economy, the increase in tourism and the expected population growth in Amsterdam there are more and more people cycling, walking and driving through the city. This increased rapid growth means that Amsterdam is becoming busier. (Daamen et al., 2016)
These new residents and visitors of Amsterdam all use different modalities to move around in the city. This population increase will add pressure to the existing mobility systems.

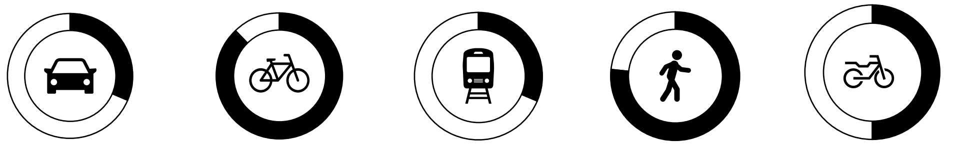
Private, public and active modes of transport will all be implicated.
The current mobility system is characterized by private vehicles, bikes, public transport (train, metro, bus, tram) and walking.

Diagram 1.4a shows how the modal split of Amsterdam has changed from 2005 to 2017. This diagram shows that on average in Amsterdam more people are moving by bike than by car, this graph excludes visitors. (OIS Amsterdam, 2017) Although there is a decline in car use in the past ten years, the car is still the most used mode of transport when looking at the inhabitants and visitors of Amsterdam.

Diagram 1.4b shows this. A large number of commuters and visitors use the car to go to town this could be an explanation for the decline. The number of vehicles registered in Amsterdam in 2017 was 346.530. This amount has increased with 1.3 percent from the previous year. (OIS Amsterdam, 2017) This results in more and more vehicles on the road which leads to more congestion. The use of bikes also continues to increase, in 2017 this was 36% this is 4% more than the previous year. There are more cyclist and more cars, which also means that there is a higher demand for parking spaces for both vehicles and bicycles. While this mode the use of the bicycle may have a positive impact on the quality of life, the amount of bicycle lanes and space for these lanes in the city stays consistent. This results in traffic congestion by bicycles ultimately putting pressure on accessibility. As shown in diagram 1.4a the growth in population also puts pressure on the public transportation system more people will use these modes of transport exceeding their capacity.



1.4a



1.4b

According to Stadsregio Amsterdam there are constant reports of trams, buses and trains being too crowded. As shown in image 1.4c the overcrowded trams can hardly move forward in busy city traffic. Population growth is associated with population demands that exceed infrastructure and service capacity. Map 1.4d shows the expected growth in a *low* scenario of both the largest station and some of the fastest growing stations in the AMA. It does so by layering growth (population change according to WLO 2040 Scenario Low) and capacity (the size of each station indicates the amount of passengers incoming/ outgoing).


Het Parool
Vrij, Onverveerd
HOME AMSTERDAM OPINIE STADSGIDS

Stampvolle trams komen amper vooruit in drukke stadsverkeer

Trams zitten vaak barstensvol, onder meer door een groeiend aantal toeristen, die met de Amsterdam Travel Card onbeperkt kunnen reizen in de stad. © Rink Hof

1.4c

Sources
1.4a. Diagram modal split 2005 - 2017 excluding visitors Retrieved by Author. Data source: CBS and Rijkswaterstaat (2018)

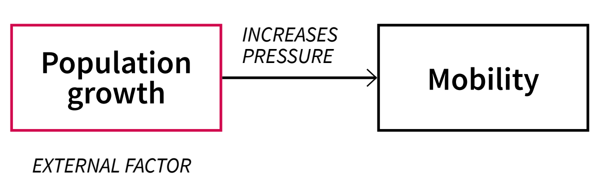
1.4b. Diagram modal split 2005 - 2017 Retrieved by Author. Data source: CBS and Rijkswaterstaat (2018)

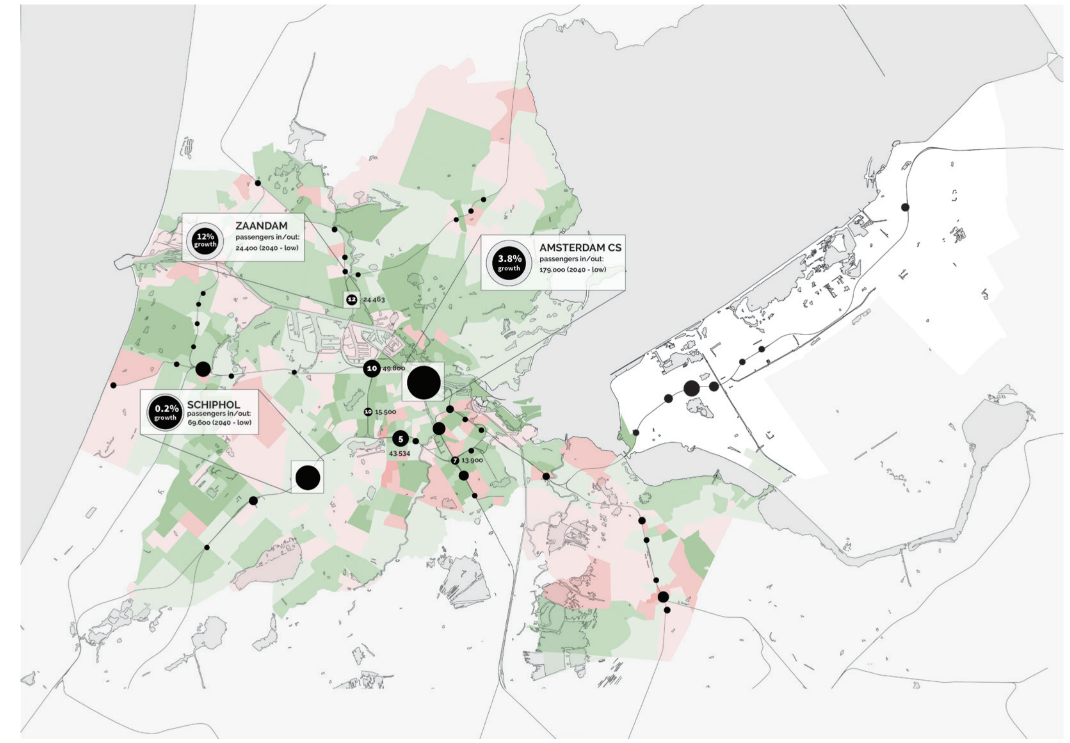
1.4c Screenshot Het parool news paper article highlighting the overcrowded trams in Amsterdam. (Het parool, 2018)

Map 1.4e shows the expected growth *high* scenario of both largest station and some of the fastest growing stations in the AMA. A percentage shows the growth in passengers in 2040. This is calculated according to a WLO 2040 scenario, and a low expected TOD strategy; in other words, in more extreme scenarios the percentages will be way higher.

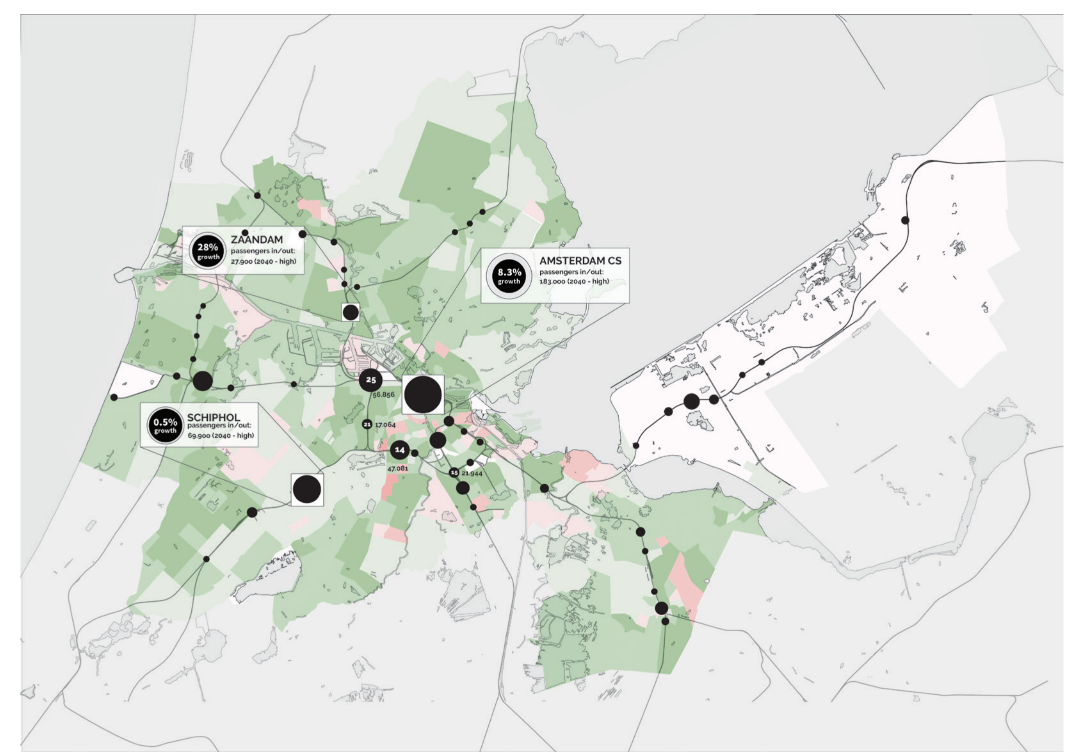
The WLO 2040 population growth scenario by the Planbureau leefomgeving expects the passenger flow of Amsterdam central station to increase with 3.8% in 20 years. and Amsterdam Sloterdijk station to increase with 10%. These multi modal Stations must accommodate this new passenger flow. As mentioned before current public transport modes can not meet this demand of population. From my own experience trains, buses, metros and trams in Amsterdam are overcrowded daily, they do not have the capacity to service the increased population. The consequence of this is an increase in private transport modes such as the vehicle. To try to meet this capacity, public transport modes will have to become larger and travel more frequently.

The diagram below highlights the summary of this section. As the population continues to grow, more people are seeking to travel this increases pressure on the mobility systems of Amsterdam. This results in overcrowding, a fight for space, congestion, and hinder in the streets of Amsterdam.





1.4d



1.4e

3.8% Growth

Amsterdam CS
Passengers in/out
179.000 (2040 - Low)

0.2% Growth

Schiphol
Passengers in/out
69.600 (2040 - Low)

12% Growth

Zaandam
Passengers in/out
24.400 (2040 - Low)

Legend

Shrinkage — Growth

● Train stations

Sources

1.4d growth/shrinkage of population for 2040, low scenario and a selection of important and/or fast growing large-mid size stations Retrieved by Author from Atlas
Data source: (WLO, 2018)

1.4e growth/shrinkage of population for 2040, high scenario and a selection of important and/or fast growing large-mid size stations Map by Author
Data source: (WLO, 2018)

MOBILITY IMPACTS LIVABILITY

Current transportation modes in Amsterdam include private vehicles, public transportation modes (trains, trams, metro's and buses), scooters, bicycles and walking. However the private vehicle still remains the dominant transportation mode in Amsterdam, this has many consequences for the livability of the city.

Congestion

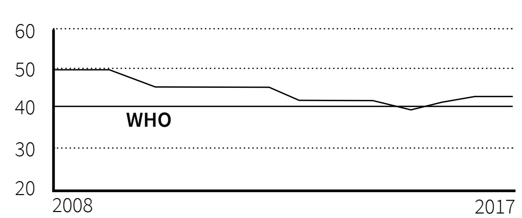
In 2017 a total of 427.000 passenger vehicles were sold, 9% more than the year before. This results in more vehicles on the roads causing more congestion. The entry points to the ring of Amsterdam the A10 highway are the main problematic areas. This is shown in the Amsterdam Metropolitan Region congestion map in Map 1.4i.

Congestion in the Netherlands keeps increasing in map 1.4i the amount of km per min is shown from 2013 to 2017. This number keeps increasing and is expected to increase with 35% by 2035 according to the ANWB. Congestion has an impact on the environmental health of the city, traffic congestion puts pressure on the road infrastructure, increases the pollution in the air and increases the travel time for commuters. Because of this congestion in Amsterdam, jobs in the city become inaccessible.

Pollution

The extensive use of the vehicle has consequences for the quality of life of the residents of the Amsterdam. Road vehicles are the single largest contributor to air pollution. (Gemeente Amsterdam, 2015) Vehicle exhausts emit a wide range of gases harming the environment and the human health. These gases remain suspended in our atmosphere ultimately having a negative effect on the livability of cities. According to the GGD the annual report on air quality concludes that the amount of NO2 in the city of Amsterdam was again above the of the standards of the world health organization (WHO). (GGD Amsterdam, 2018b) This is shown in diagram 1.4g.

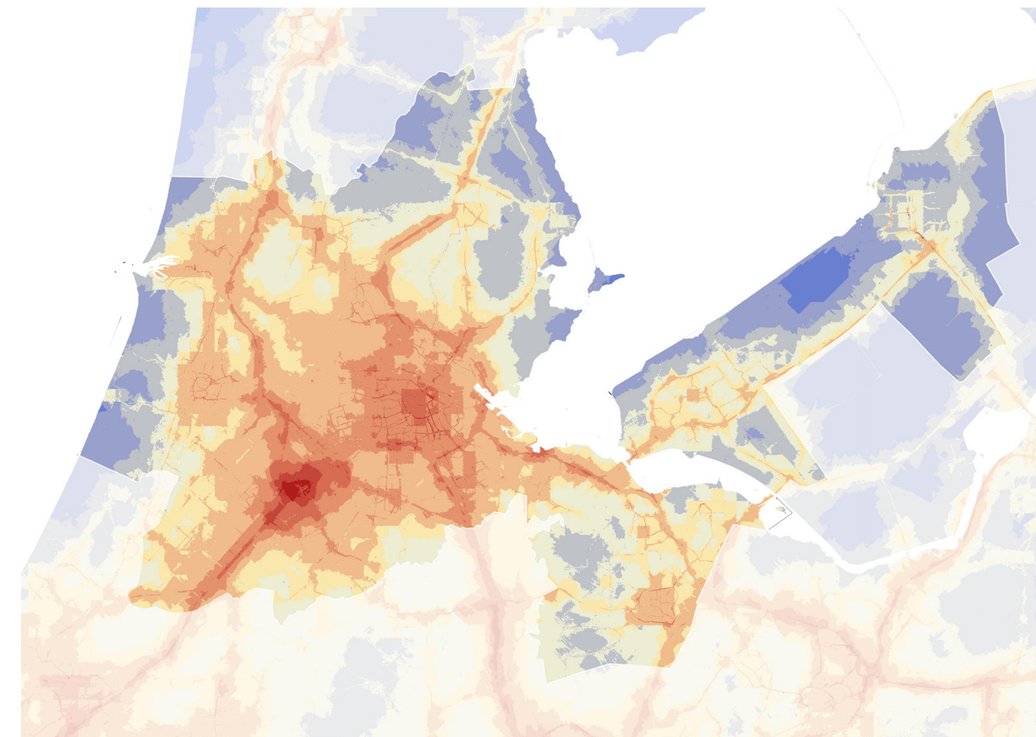
Map 1.4i shows the amount of NO^2 pollution in the Metropolitan region of Amsterdam. This map highlight the city centre of Amsterdam as one of the highest polluted areas in the AMA. Even Though we have made considerable progress in the fight against pollution, the amount of vehicles on the street has intensified and therefore it is still a big issue.



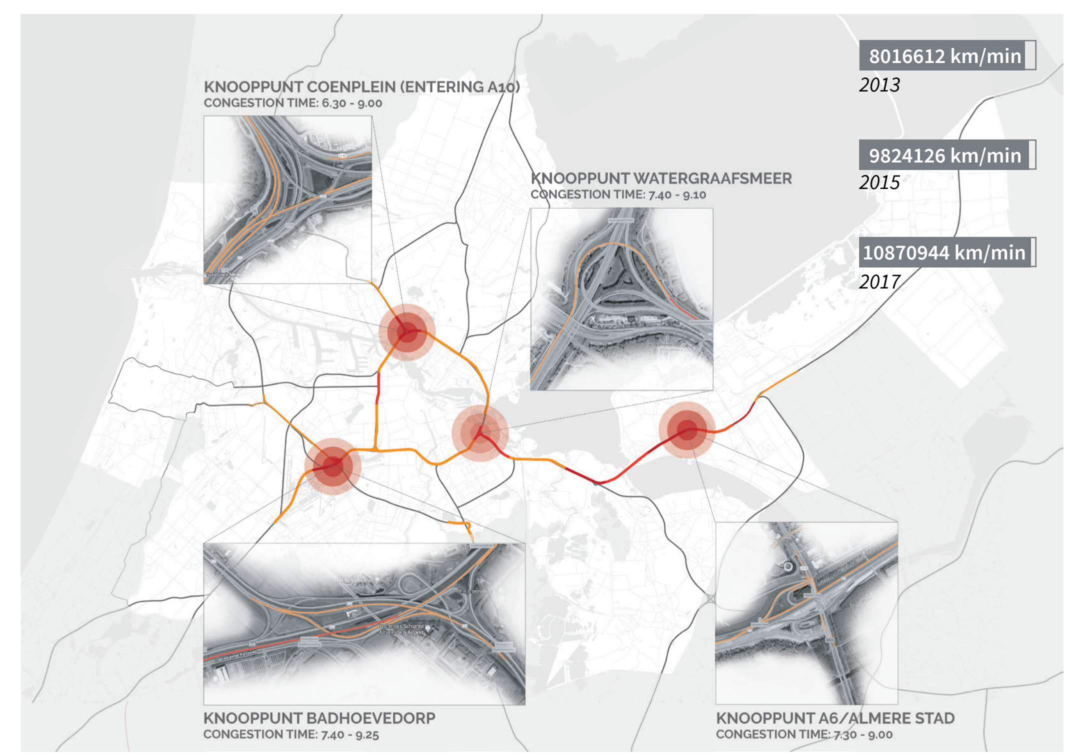
1.4g

Sources

1.4g Amount of NO2 in Amsterdam from 2008 to 2017. (GGD, 2018b)



1.4h



1.4i

Legend

Pollution

< NO_2 >NO_2

Road congestion

Main bottlenecks

Sources

1.4h Map: NO_2 pollution in the AMA. Retrieved by Author from Atlas. Data source: Nationaal Georegister qgis

1.4i Map: Bottlenecks & congestion areas AMA. Retrieved by Author from Atlas. Data source: Google maps

Noise

According to the municipality of Amsterdam the study regarding the livability of the city indicates that traffic noise has increased in the last years. The amount of residents which are confronted with serious noise nuisance from inner-city traffic has increased by almost 9 percent.

It is mainly traffic within the city that causes noise pollution. Road traffic cars, trucks, buses, mopeds and trams accounts for 96 percent of the serious noise pollution in Amsterdam. (RIVM, 2018)

Map 1.4j shows the distribution of noise pollution in the metropolitan region of Amsterdam.

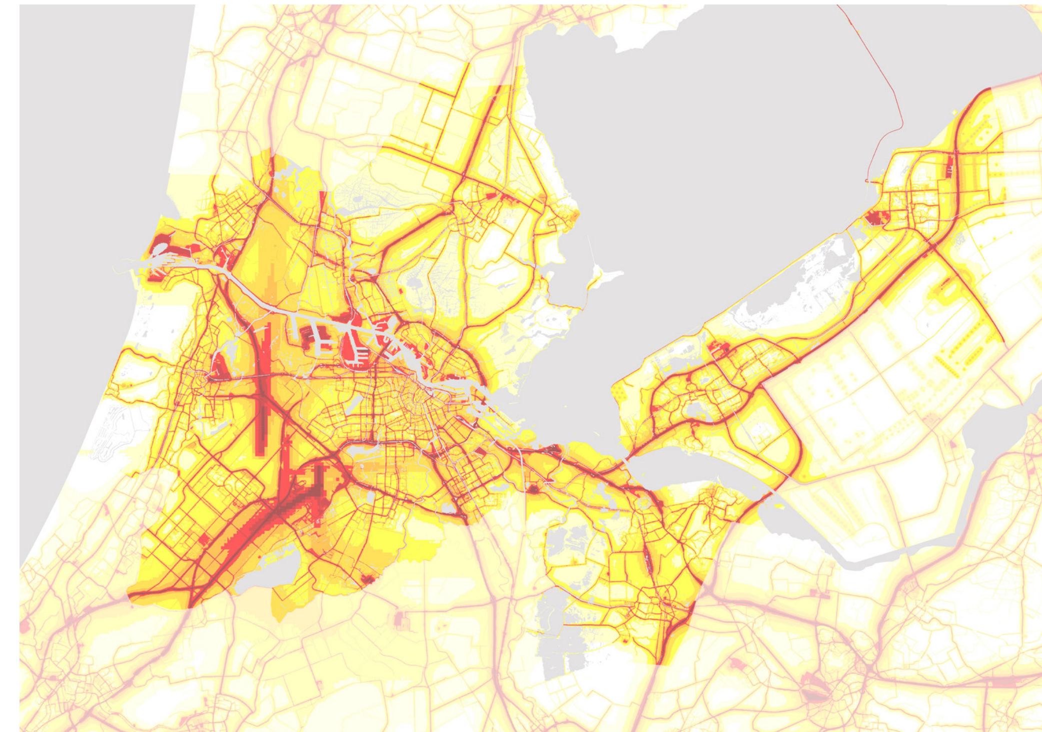
Noisy places is caused by more traffic. Measures are needed because stress due to stress and disturbed sleep can cause major health damage, such as high blood pressure and heart problems - especially after prolonged exposure. Traffic nuisance has a negative impact on the livability of the city. According to the RIVM a study on Noise and livability concludes that even with moderate exposure to traffic noise in the living environment, people's health deteriorates. Depending on the noise level, sleep disturbance and on the long therm cardiovascular diseases could occur. (RIVM, 2018)

Space

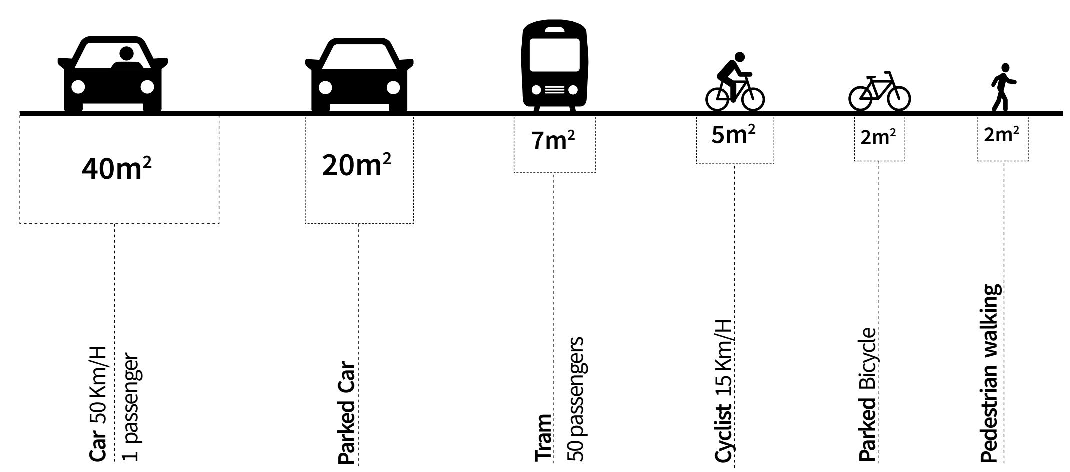
In the narrow streets of the city's historic areas, vehicles, bicycles, trams, buses and pedestrians all have to fight for space. Pedestrian pathways are often blocked by parked bicycles on the pavement making it more and more inconvenient to walk. We less frequently consider how much space vehicles take up in our cities. According to the municipality of Amsterdam the average vehicle stands still (parked) for 90 percent of the time.(Gemeente Amsterdam 2017a) Each vehicle needs more than one parking space, one at its current location, and one at home. Streets in the city centre of Amsterdam are dominated by parking spaces. Image 1.4k highlights the amount of space each modality takes in the road space.

A driving vehicle occupies about 40m^{2}]of the road space. The dominance of vehicles in the road space results in limited amount of space for cyclists and pedestrians.

Parking spaces, use up a large amount of space in cities that could be used for other purposes such as public spaces, trees and parks which are more beneficial to the quality of life. (Nieuwenhuijsen, 2014). Excessive parking spaces in the streets can negatively affect the livability of the city.



1.4j



1.4k

Legend

Intense noises

Less intense noises

Sources

1.4l: Cycle Congestion during peak times in Amsterdam.
Photo by Edwin van Eis in (Plan Amsterdam: City in Balance, 2018)

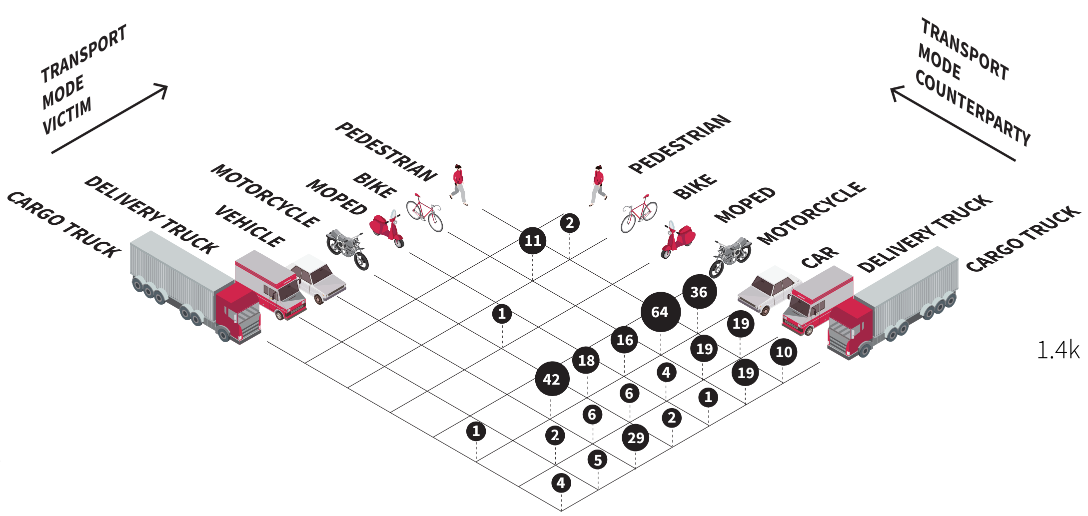
1.4k The Amount of space each transport mode occupies.
By Author (2018)
Data source: (Daamen et al. 2018)

Safety
The amount of traffic fatalities in the Netherlands has increased by almost 11 percent last year. In 2018, 678 people died in traffic, 65 more than in 2017. That year, the number of traffic fatalities was still lower than in 2016, according to the figures of the Central Bureau of Statistics (CBS). In 2017, for the first time, more cyclists died than motorists, in 2016 the number of people who died in the car was slightly higher than the number of cyclists: 233 motorists and 228 cyclists.
The diagram below shows the amount of traffic accidents by each mode of traffic in the Netherlands. Pedestrians form a vulnerable group in traffic. Children and people over 75 are particularly at risk. Accidents involving cargo trucks & delivery vans often have serious consequences, especially for the 'counter party'. so accidents with delivery vans are often more serious than between passenger cars.

This is because delivery vans are smaller than lorries, but they are still larger and heavier than passenger cars. They also have poor rear visibility.

The various modes of transportation simultaneously moving through the streets of Amsterdam causes situations where cyclists and pedestrians feel unsafe. The consequence of these different transportation modes moving through one space at the same time is an increase in traffic accidents which creates a negative impact on the livability of the city.

Despite the negative impacts of mobility on the livability of the city mentioned in the previous page, several current mobility systems also have a **positive impact** on the livability of Amsterdam.



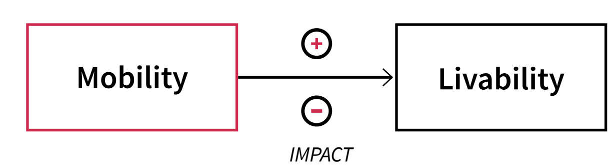
Sources
1.4l: Number of accidents caused by counter party. Data source: SWOV

Active transport
The number of people using bikes in Amsterdam has substantially grown reducing the use of the car in the city ring. Cycling is growing faster than any other mode of transport in Amsterdam. (Gemeente Amsterdam, 2015b) This high rate of bicycle journeys has positive impacts on the environmental health of the city. By cycling people contribute to a healthier city, a decrease in the amount of CO_2 emissions, reduced noise levels and benefits to their own personal health. (Gemeente Amsterdam, 2015b)

Accessibility
Amsterdam's mobility network system is varied. There are many different modes of transport traveling on the same routes or in close proximity to each other. This creates the opportunity to combine different modes of transport with each other to reach your destination. From the train to the metro to the bus/tram. The fact that there are multiple ways to reach your destination increases the accessibility which has a positive impact on the livability of the city.

Shared mobility
According to the planbureau voor de leefomgeving (PBL) there is over 30% less car ownership among car shares than before car sharing began. The shared car mostly replaces the second or third car within households. The study shows that car sharers emit 175 and 265 kilograms of CO_2 per person per year due to the reduced car ownership. (PBL, 2015). Shared cars reduce the car ownership levels and the amount of CO_2 distributed in the city which impacts the environmental health of the city. Shared bikes are also becoming very popular, these bikes are owned by one company and are shared amongst the people in Amsterdam.

The current mobility systems in Amsterdam all have positive and negative effects on influences of livability. The fact that mobility impacts the environmental health and well being of the people in the city is well known however, mobility also impacts the safety and accessibility of the city. These are all influences of livability. The diagram below shows the relationship between mobility and livability.



AUTOMATED MOBILITY X LIVABILITY

The way people get around in cities is changing drastically, technological advances in mobility are making it possible for people to reach their destinations more efficiently and safely. Since its invention about 130 years ago the automobile has gone a profound transformation. Automated mobility has the potential to reshape the transportation system and the built environment in ways not seen since the introduction of the automobile over a century ago. (Heinrichs, 2016) The advent of automated mobility represents opportunities and threats for essential change in urban mobility.

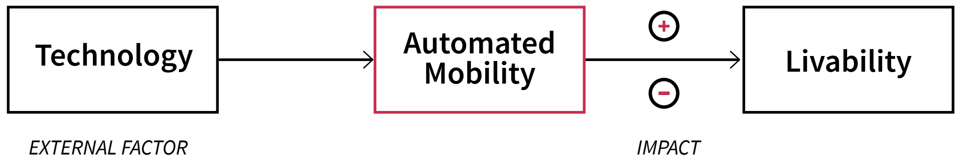
Threats

It has been mentioned by Littman and others that the advent of automated vehicles will **increase the amount of vehicles in the streets.** Because of the efficiency and convenience of this new technology in mobility vehicles will become more and more attractive to people. Ultimately increasing the amount of vehicles on the street. (Littman, 2018) Vehicle manufacturing companies such as BOSH and Tesla promise that the automated vehicle will become more compact in the future. This could mean that more vehicles could fit on our current streets, increasing the amount of vehicles on the road. Automated vehicles boast accessibility for all, this means that a wider group of people could be serviced by this mode of transport on demand. Think about vulnerable groups such as elderly, disabled people, children and even drunk drivers. This additional group of users could increase the vehicles on the road. Tens of thousands of vehicles could be added to our cities because of this technology driven shift in mobility. Consequences an **increase in vehicle miles traveled, congestion and crowdedness.** Automated vehicles could over power the use of other transportation modes. **Public transport and active transportation could become neglected** due to the attractiveness of the vehicle. New technology developments also feature micro mobility and logistics robots. These smaller modes of transport traveling through the streets also pose a threat to our society. Because of the efficiency and fast delivery of ground bound robots the amount of deliveries could be increased this means that there will be **more delivery robots traveling in the streets possible causing hinder to pedestrians.** Scooters, electric bikes, hover boards and other small personal modes of transport are considered micro mobility modes. These will increase which will also **increase the demand for micro- mobility parking.**

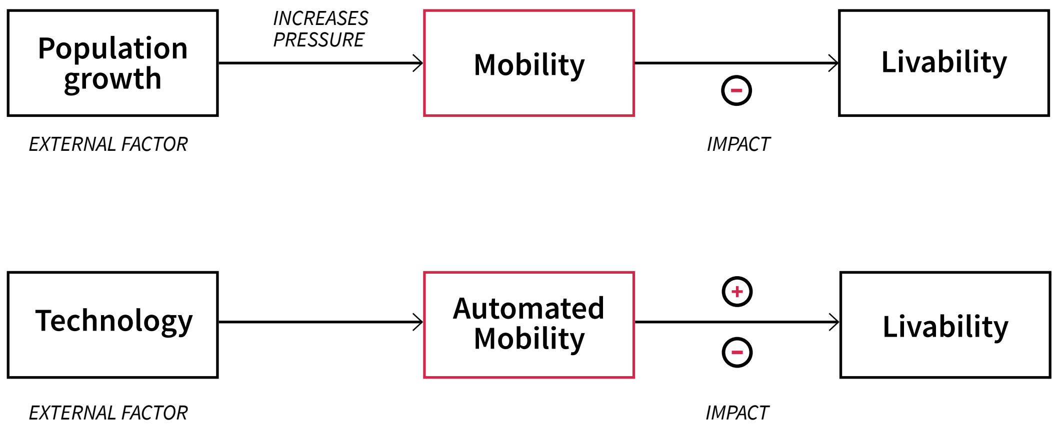
Opportunities

The advent of automated mobility can **free up space in the streets** by reducing the amount of necessary parking places in the streets . This creates the opportunity for expanding sidewalks and bicycle lanes, this will allow the pedestrians and the public to regain the right to the road. There is an opportunity to achieve a more balanced road use in the next years. This new technology introduces new **sustainable transportation modes** which has advantages for our environment by not using fuel to function, which minimizes the amount of pollution in our cities. This improves the air quality and ultimately the quality of life for the residents. Automation will not only be applied to vehicles but also to different modes of public transportation such as buses, trams, trains and metros. This could lead to an improvement in the public transportation system, these modes could travel more frequently, service more passengers and provide a more efficient service. (Buehler, 2018) **Automated mobility boasts accessibility for all**, vehicles provide mobility to the disabled, children and seniors. Potential impacts of the automated mobility are **lower emissions, improved road safety and reduced traffic noise.** Integration with other modes of transport and optimization of space which can contribute to enhance the livability of the city. (Chan, 2017) **The combination of efficient micromobility and shared mobility could reduce car ownership.** New development in technology also created new opportunities in the logistics department. **Smart logistics** are introduced to society making it easier to receive and deliver packages & goods. Ground bound robots & drones are quick and fast to deliver packages.

With this new shift in mobility and the region's rapid growth we must create a balance between mobility and livability. The advent of automated mobility represents opportunities and threats for essential change in urban mobility. New technologies in mobility have a potential impact on the quality of life in urban areas. This diagram below shows the relationship between technology, automated mobility and livability. It has the potential to change how mobility impacts the livability of the city.



PROBLEM SUMMARY



Consequences of rapid population growth are significant impacts on the demand for transport. Roads, public transport and active transport are all experiencing increasing levels of activity in Amsterdam.

As the previous section indicates, population growth means that there are more people seeking to travel which means that the pressure on current mobility systems will increase. Mobility has negative impacts on livability, the section above mentions that mobility threatens the environment, health, safety and accessibility of the city. These are all factors which influence the liability of the city. Rapid population increases pressure on the current mobility network which will only increase the negative impacts the current mobility network. The diagram above shows the relation between these factors.

Technology has led to the development of automated mobility. This new shift in mobility has negative and positive impacts on the livability. This new technology in mobility presents potential opportunities in improving the overall environmental quality with sustainable transportation, freeing up space in the city, reducing car ownership and providing accessibility for all. However this technology also threatens the livability of the city, there is a possible increase in the amount of cars on the road, an increase in congestion and crowdedness, more delivery robots on streets and a higher demand for micro mobility parking. New technologies in mobility can have a positive or negative effect on mobility. This diagram above shows the relation between these factors and summarizes the problem analysis.

1.5 PROBLEM STATEMENT

THE IMPACT OF THE CURRENT MOBILITY NETWORK

The current mobility network of Amsterdam has many negative impacts on the livability of the city. As the population of Amsterdam continues to grow, transportation providers are challenged with the growing need to adapt their infrastructure and public transportation modes. Current measures taken to meet this demand of mobility such as adding more road infrastructures and space for cars ultimately creating a negative impact on the livability of the city of Amsterdam.

As Amsterdam becomes more populated, congested and polluted, new technologies are emerging to solve mobility challenges.

New technologies in mobility such as automated vehicles (AV) have the potential to reshape the transportation system and the built environment in ways not seen since the introduction of the automobile over a century ago. There are still many uncertainties regarding the impact of automated mobility.

This new trend in mobility is also seen as a threat to the current mobility system in Amsterdam. Sustainable Mobility is required for developing sustainable livable cities.

Changes in mobility can have profound impact on the livability of cities. This shift in technology does not automatically lead to better livability for everyone. With the advent of automated mobility, how can we rethink mobility to create livable cities? where human activities are supported by a mobility system and not the other way around.

The problem statement can be defined as follows, the current mobility network has many negative effects on the livability and environmental health of Amsterdam. The current mobility network can not meet the demands of the growing population of Amsterdam without negatively impacting the livability. The advent of automated mobility automated mobility threatens livability whilst creating opportunities to enhance livability.

1.6 RESEARCH AIM

EXPLAINING THE PURPOSE OF THIS RESEARCH

The aim of this research is to create a healthy & livable urban environment for the growing population of Amsterdam with the implementation of automated mobility. This research explores how automated mobility can contribute to spatial interventions that enhance livability & the environmental health in the city of Amsterdam.

There are still many uncertainties related to the subject of automated mobility, the spatial implications and impact represent the knowledge gap in this research. There is a certain urgency in researching this subject due to the fact that this technology is approaching our cities in a few years. The implementation of this new technology will become a driver for more profound changes in the built environment. The Opportunities and threats of this new technology in the context of Amsterdam will be researched through design, aiming for a new future: a livable city where human activities are supported by the mobility system and not vice versa.

Urbanism as a profession must understand the threats and opportunities of automated mobility in our cities. It must take an active role in discussion with policy makers, urban designers and planners to capture the benefits of this shift in mobility.

1.7 RESEARCH QUESTIONS

Main Research Question:

With respect to Amsterdam's population growth, how can the implementation of automated mobility contribute to enhancing livability and the environmental health in the city?

Sub-research Questions:

1. What constitutes livability in the context of mixed use neighbourhoods & what are the indicators used in this project
2. How do local mobility systems impact the livability in Amsterdam?
3. In what reasonable scenario will Amsterdam grow?
4. How will automated mobility be implemented in the city of Amsterdam?
5. Which spatial interventions are essential to enhance livability and the environmental health in the project locations?
6. What are the main principles for enhancing livability and environmental health in the city of Amsterdam with the implementation of automated mobility?

1.8 METHODOLOGY

EXPLAINING THE METHODS & CONCEPTUAL FRAMEWORK

The main research question will be answered through 3 steps. Each step has a set of sub-research questions which are answered through a variety of methods which are explained in this section.

Step 1: **Analyzing the present situation** — Mobility → *Impact* → Livability

SRQ 1	What constitutes livability in the context of mixed used neighbourhood & what are the indicators used in this project	Literature review
SRQ 2	How do local mobility systems impact the livability in Amsterdam?	GIS Mapping Data analysis

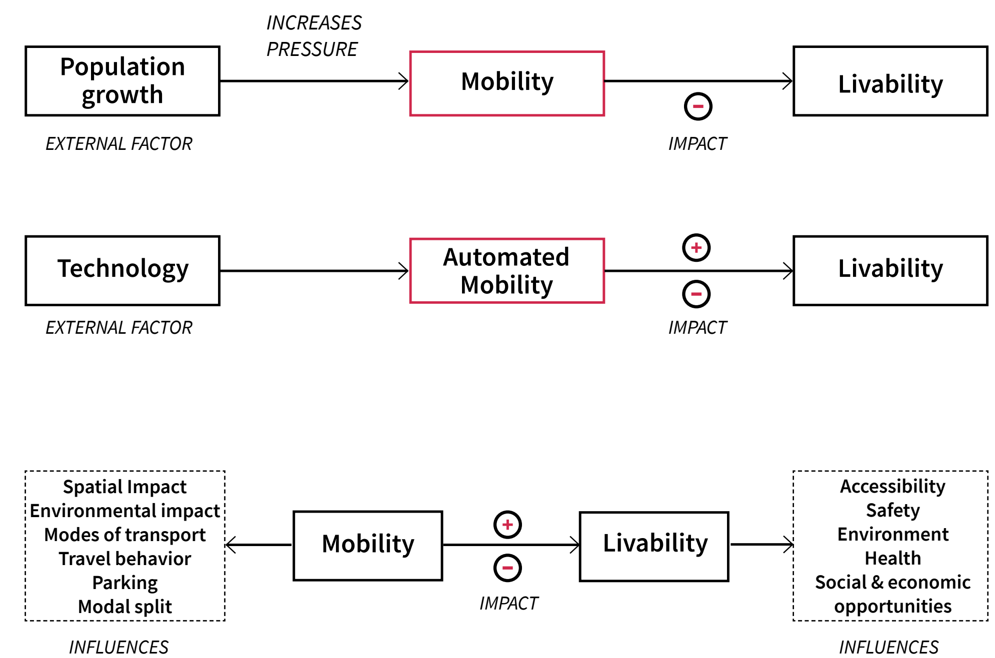
Step 2: **Future Scenario** — Scenario → Vision

SRQ 3	In what reasonable scenario will Amsterdam grow?	Policy Reports
SRQ 4	How will automated mobility be implemented in Amsterdam?	Scenario construction

Step 3: **Design proposal** — Vision → Design Strategy → Spatial interventions

SRQ 5	How can automated mobility engage spatial interventions needed to enhance livability in the project locations?	Design Strategy Spatial interventions
SRQ 6	What are the main indicators for enhancing livability in the city of Amsterdam with the implementation of automated mobility?	Evaluation Reflection

Conceptual framework



The conceptual framework explains how the main research question is approached. The main variables in this framework are Mobility and Livability. Population growth and automated mobility are the external factors which influence the impact of mobility on livability. The influences of mobility can either have a positive or a negative impact on the indicators of livability. The next section shows two examples of the narrative of the conceptual framework

Population growth leads to increased pressure of mobility which leads to more vehicles on the road, the environmental impact of these added vehicles could lead to health issues. More cars → increased traffic noise + more pollution = health issues → negative impact livability.

Automated vehicles could decrease the demand for parking spaces this could free up space in the streets. his space could be used for other purposes such as public spaces, trees, cycle lanes and wider sidewalks which are far more beneficial to the quality of life. Automated vehicles → reduced parking spaces = more space for green + public spaces. Increased environmental quality + safety on the streets → positive impact on livability.

Step 1: Present situation

1. What constitutes livability in the context of mixed used neighbourhood & what are the indicators used in this project?

Method: *Literature review*

To define livability and to determine which indicators will be used in this project a literature review is done. This will provide a body of knowledge and a better understanding of livability. This is done through critically reviewing the concept of livability in different aspects relevant to the project. In order to explore the significance of livability in the certain type of neighborhood, the theoretical section first studies the broad definition through a literature review, then explores livability in mixed use neighbourhood through theories. Based on the theme of this project the research also creates an understanding of the relation between mobility and livability.
On the first understanding of the site, this project tries to take a position in defining its own definition or own understanding of livability in the specific context. This gives an overview of indicators of livability used in this research project.

1. Definition of livability
2. Livability in mixed use neighbourhoods
3. Relation between livability & mobility
4. Indicators of livability in the project context

2. How do local mobility systems impact livability in Amsterdam?

Method: *GIS, Mapping, Data analysis*

To determine how local mobility systems impact the livability in Amsterdam a broad research analysis regarding the current mobility systems in Amsterdam is needed. This is done by using methods such as GIS, mapping and data analysis to translate the spatial context in to evidence.
The literature review has highlighted the relation between mobility and livability, it also highlights which aspects of livability are impacted by mobility. This creates the themes for the research analysis. For example an aspect of livability is environmental health, cars produce noise pollution and emit toxic gases in the air which are detrimental to the environment. Therefore the amount of pollution is researched through GIS, this will show that certain areas in Amsterdam are more polluted than others. This research question shows the impact of the existing mobility network's influence on the livability in Amsterdam. This results in a bottle neck map of the project locations

GIS | Mapping | Data Analysis

Step 2: Future situation

3. In what reasonable scenario will Amsterdam grow?

Method: *Policy reports*

To research in what reasonable scenario Amsterdam will grow, several policy papers are reviewed. These existing policy papers already have scenarios which indicate how Amsterdam will possibly grow. For example structuurvisie 2040 by the municipality of Amsterdam gives an indication of the growth of the city. The Planbureau voor de Leefomgeving (PBL) have also created a scenario regarding demographic developments by 2040. The answer to this question is a general scenario of the growth of Amsterdam on different subjects for example the locations for future development, demographics development, the behaviour etc. Elements of the scenario regarding growth will serve as a base for further constructing the conservative and progressive scenario for Amsterdam 2040 and 2060

Policy reports | Future development plans

4. How will automated mobility be implemented in Amsterdam?

Method: *Scenario construction*

The first step is to identify the internal en external factors of the scenario. The second step is to identify the future states for each factor and each scenario. These factors can be trends or events that would influence the new shift in mobility. These factors form the basis of the scenarios. The next step is to identify the key stakeholders. Stakeholders that are identified have an influence on the new shift in mobility or the identified factors. When constructing the scenarios a broad range of stakeholders can be identified because both directly and indirectly involved stakeholders can be relevant. The identified factors are combined in order to create the main story lines of the two scenarios. The scenario factors are established through reviewing many reports regarding future mobility scenarios, viewing videos regarding the future of mobility and having many conversations and brainstorm sessions with peers.

S1 | 2040 - 2060 | *CONSERVATIVE*

S2 | 2040 - 2060 | *PROGRESSIVE*

Step 3: Design

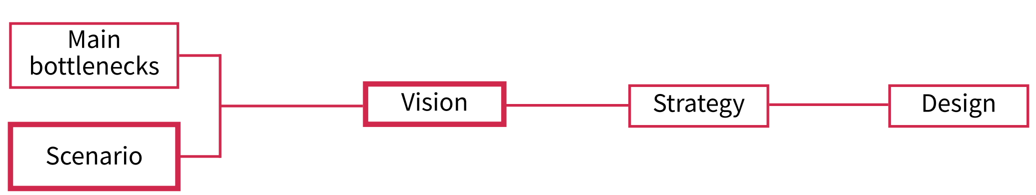
5. Which spatial interventions are essential to enhance livability and the environmental health in the project locations?

Method: *Design*

After the different scenarios have been constructed, the following step is to create the vision by combining the results of the analysis with the scenarios. The next step is to determine the strategy to achieve this vision. An overview will be made of the how automated mobility is implemented in the adjusted vision. Once the strategies have been developed they are assessed. They are assessed on the logic of the strategy and likelihood of it achieving the vision.

The final step is the design phase, the conclusion of the research analysis on the locations should highlight spatial interventions which are essential to contributing to enhancing livability & environmental health. The design will consist of an illustration of small scale interventions in the city centre and a neighbourhood development in Sloterdijk. It features the impact of large scale interventions on a smaller scale. The design also highlights the life of 4 different personae and how their life changes as a result of the spatial interventions.

The results of the design part is an overview of these spatial interventions and how they contribute to ehancing livability and environmetal health of these areas. This will be shown through a series of visual impressions such as, sections, plans, impressions and diagrams. These design methods are used as tools to translate the spatial context in to evidence.



6. What are the main principles for enhancing livability & environmental health in Amsterdam with the implementation of automated mobility?

Method: *Evaluation & Reflection*

Now that it is clear how automated mobility can engage spatial interventions in these locations the main principles can be determined.

First an evaluation must be done of each location in order to determine which spatial interventions are engaged by automated mobility and how they contribute to enhance livability.

Next the main principles for each location are formed. This is done by filling in a scheme shown in the diagram below. For each of the two project locations this scheme is used. The characteristics of the typology in each locations are described. What spatial interventions are needed in these locations and which indicator of livability the spatial intervention aims to enhance. This method is chosen to create an overview of the main principles of livability for each typology in these locations.

This scheme is created to become a guide and can be used in locations with similar characteristics where automated mobility is implemented.

1.9 EXPECTED OUTCOME

FINAL PROJECT OUTCOME

The aim of this research is to create a healthy & livable urban environment for the growing population of Amsterdam with the implementation of automated mobility. To create a livable & healthy city where human activities are supported by the mobility system and not vice versa. This goal is supported by multidimensional scenario at a city, district and neighbourhood level. The expected outcome is a set of visual representations of the design such as impressions, plans, diagrams, sections, street views etc.

The project outcomes are:

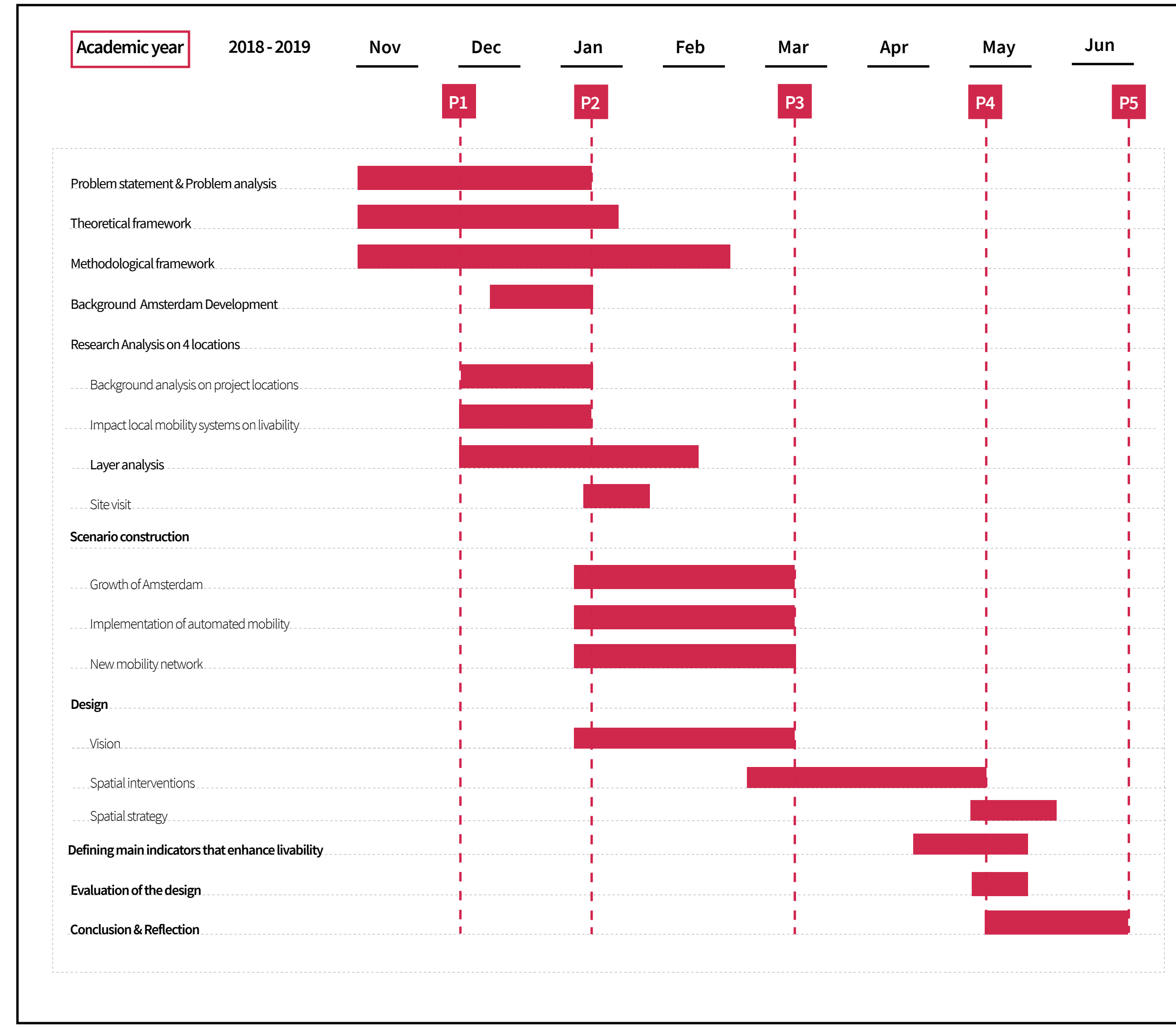
1. A new mobility network for Amsterdam. Introducing automated mobility to the current mobility systems in Amsterdam and integrating these systems with each other.

2. A neighbourhood design in Sloterdijk which features a new living environment. A selection of interventions in the neighbourhood are shown in detail.

3. Interventions alongside a recreational route from the city centre towards the recreational areas in Sloterdijk.

1.10 TIME FRAME

PLANNING FOR GRADUATION



P1 Goals

Define the problem, problem analysis, problem statement, main and sub research questions and the methodological framework. Determine the project locations.

P2 Goals

Refine methodological chapter and theoretical chapter to back up the project. Conclusion of research analysis, preliminary scenarios a vision and recommendations to proceed towards design

P3 Goals

Multidimensional scenarios for each one the project locations. Developing spatial interventions that best addresses the analysis of the research stage.

P4 Goals

Final design narrative with a report and presentation. This stage with preliminary products - new mobility network, spatial interventions that enhance livability and the evaluation scheme

P5 Goals

Elaboration of report and final presentation. Evaluation of the design, conclusion and reflection of the project.

1.11 RESEARCH FRAMEWORK

RESEARCH APPROACH SUMMARY

The current mobility network has many negative effects on the livability and environmental health of Amsterdam. The current mobility network can not meet the demands of the growing population of Amsterdam without negatively impacting the livability. The advent of automated mobility threatens livability whilst creating opportunities to enhance livability

PROBLEM STATEMENT

The aim of this research is to explore how automated mobility can contribute to spatial interventions that enhance livability and environmental health in the city of Amsterdam with respect to its rapid growth

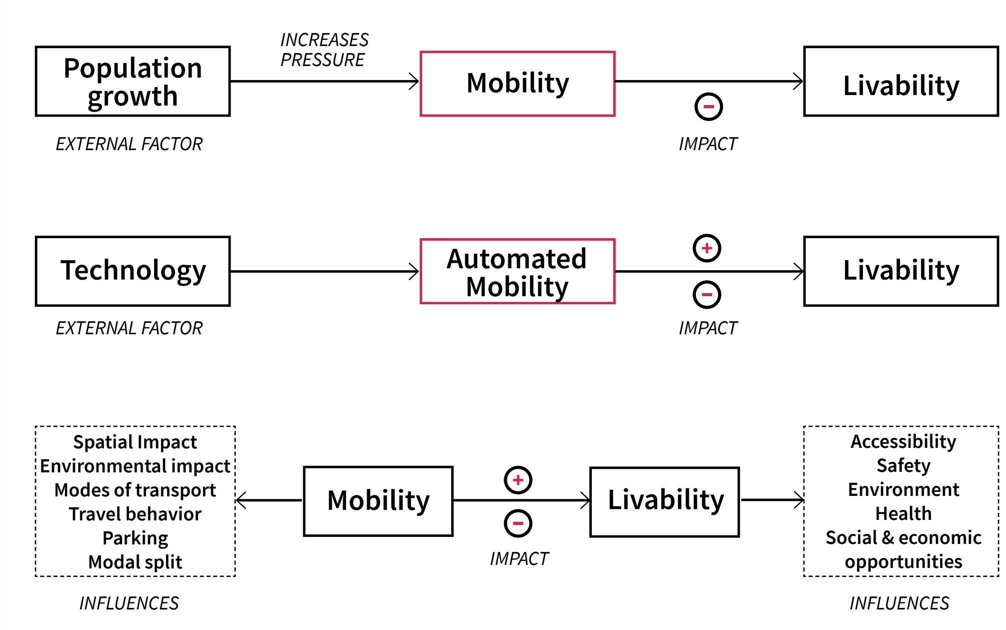
RESEARCH AIM

Knowledge Gap: Impact and spatial implication of automated mobility in the city of Amsterdam

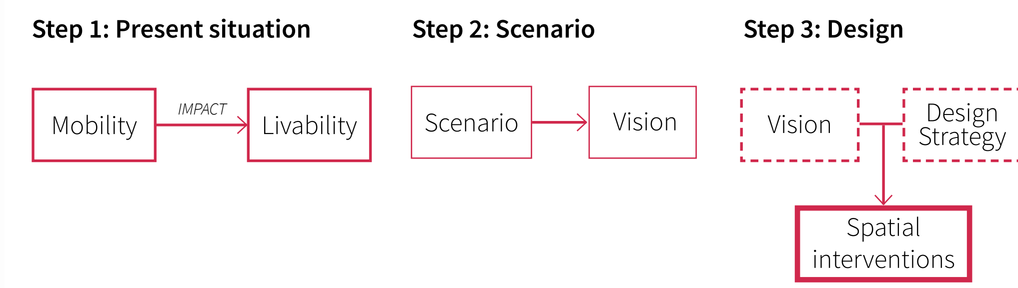
With respect to Amsterdam's population growth, how can the implementation of automated mobility contribute to enhancing livability and the environmental health in the city?

MAIN RESEARCH QUESTION

Step	SUB RESEARCH QUESTIONS	METHODS
Step 1: Context	(1) How is livability defined and which indicators are used in the context of this research project?	Literature review
	(2) How do local mobility systems impact the livability in Amsterdam?	GIS, mapping, data analysis
Step 2: Scenario	(3) In what reasonable scenario will Amsterdam grow?	Policy reports
	(4) How will automated mobility be implemented in the city of Amsterdam?	Scenario Construction
Step 3: Design	(5) How can automated mobility engage spatial interventions needed to enhance livability in the project locations?	Design
	(6) What are the main indicators for enhancing livability in the city of Amsterdam with the implementation of automated mobility?	Evaluation Reflection



CONCEPTUAL FRAMEWORK



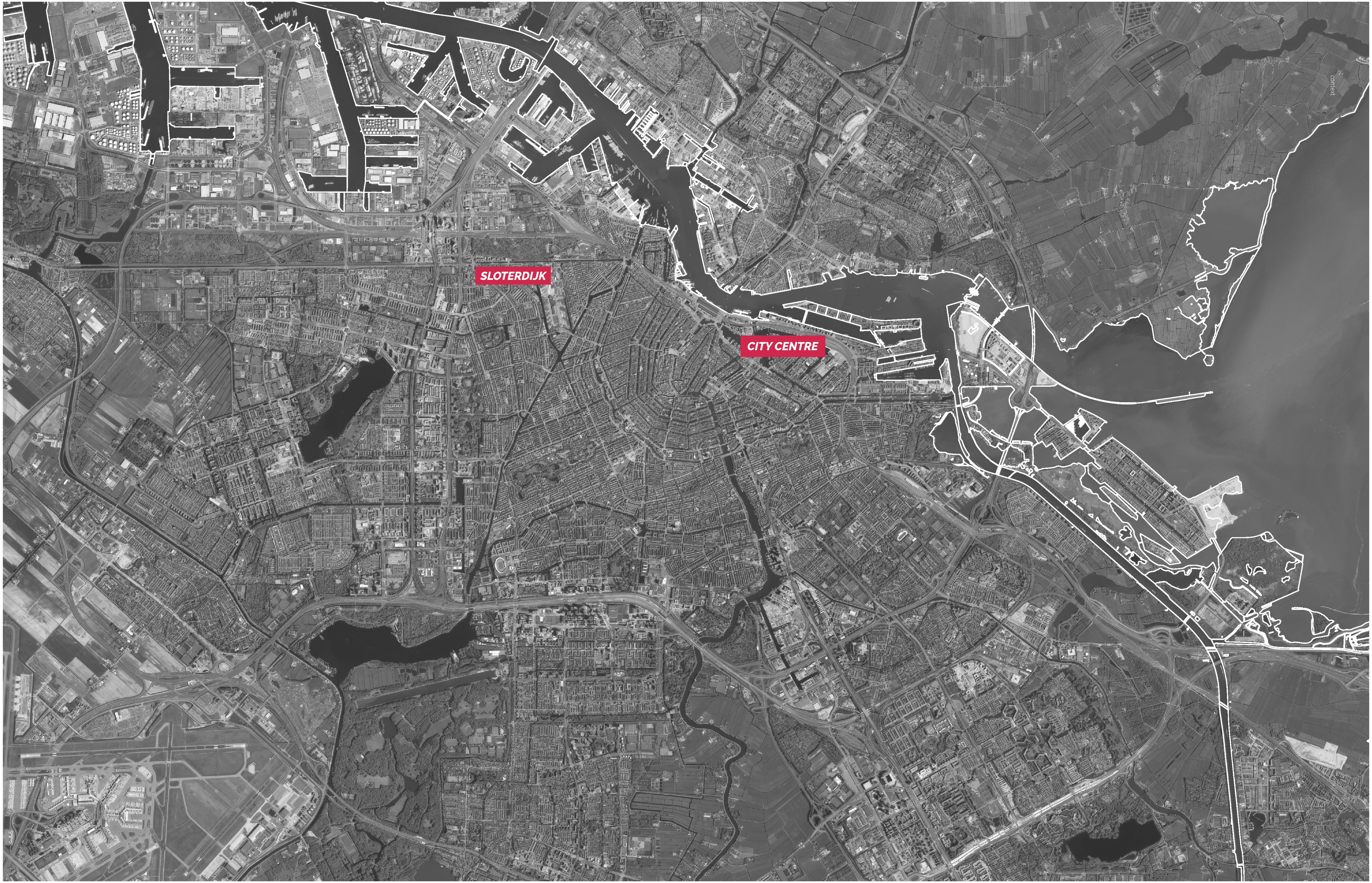
APPROACH

1. A new mobility network for Amsterdam. Introducing automated mobility to the current mobility systems in Amsterdam and integrating these systems with each other.
2. A neighbourhood design in Sloterdijk which features a new living environment. A selection of interventions in the neighbourhood are shown in detail.
3. Interventions allongside a recreational route from the city centre towards the recreational areas in Sloterdijk.

EXPECTED OUTCOME

CHAPTER 2

CONTEXT


SLOTERDIJK
CITY CENTRE

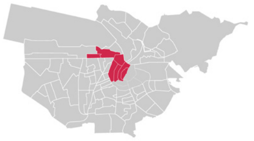
2.1 AMSTERDAM

CONTEXT

The Netherlands (Dutch: Nederland, is a country located in Northwestern Europe. The Netherlands consists of twelve separate provinces that border Germany to the east, Belgium to the south, and the North Sea to the northwest. The Amsterdam Metropolitan Area (AMA) is the region around the city of Amsterdam, with a total population of over 2.4 million inhabitants. The AMA is part of the larger polycentric randstad metropolitan area, it includes the 33 municipalities. Amsterdam is the biggest municipality in

Amsterdam is located in the province of North Holland in the west of the Netherlands. The Amsterdam city is the capital of the Netherlands. Amsterdam currently has a population of 863.202 inhabitants. It has a total of 8 districts; Amsterdam North, Centrum, West, Nieuw-West, Westpoort, Zuid, Oost and Zuidoost. . This research project is located in two sites in Amsterdam, the Centrum-West area in the centrum district and the Sloterdijk Area which is located in the West and Westpoort district. These locations are selected based on the variety of typologies and urban environments in these areas. These two locations currently have similar programs, a working & living environment.

The Sloterdijk area however, has less residences than the city centre, it also has a light industrial program. These two areas were built in different era's with different traffic characteristics. The context of these two locations are very different, there are different urban environments in these areas. The centrum-west location distinguishes three different urban environments in one district, the historical inner city, the working/ living environment (old) and the residential environment. The Sloterdijk are however distinguishes a newer version of the working/ living environment.



2.2 SLOTERDIJK

CONTEXT

The Sloterdijk area is located in the Amsterdam-West and Westpoort district of Amsterdam.
Amidst the highways, railways and business park, this historic location is still a small village spot. After the reclassification of the Amsterdam districts, the Sloterdijk area has been apart of the West district since May 2010. However, the business parks are part of the Westpoort district. In recent years, a number of large hotels have appeared in Sloterdijk. A few office buildings along the Haarlemmervaart are also being converted into homes. This area is considered as an urban working/living environment.

The Sloterdijk centrum and Sloterdijk I area are part of the havenstad development. This area is currently a business area with lots of offices, companies and hotels. It also has a light industrial program companies such as car repair shops, self storage facilities and party places and tool rental companies are all located in this area.

Alongside its working program it also features a leisure program including sport facilities, allotment gardens and a Childrens. In the next decades this area is going to be developed in to a complete working/living/leisure neighbourhood. The development features buildings with a mixed-use program of living, working and leisure. It also features a variety of recreational areas.

+ **Characteristics**

Program
Light industrial
Business area
Hotels
Residences
Recreational area

+ **Public transportation**
Train station (Amsterdam Sloterdijk)
Metro station (Isolatorweg)
Tram
Buses

+ **Recreational Areas**
2 Sport parks
Allotment gardens
Children's farm
Brettenschecg

+ **A10 Highway**

+ **Westpoort**

2.3 CENTRUM - WEST

CONTEXT

The Centrum West area covers the western part of Amsterdam Center, between the Marnixkade and the Nieuwmarkt / Munt / Leidsegracht. The west part of the city centre is known as the oldest part of Amsterdam. The inner city distinguishes three different urban environments.

The historical inner city
Also known as the tourist city, this area is part of the centrum west neighbourhood which was built in the middle ages. Currently this area serves as a tourist hot spot with lots of commercial shops, souvenir shops and restaurants.

The working/living environment (old)
This area is located in the jordaan, this is a mixed area where the program on the ground floor is dedicated to shops, offices, restaurants etc and the floors above are dedicated to living. This inner city of Amsterdam has many addresses on different levels.

The residential environment
The Frederik Hendrik neighborhood is a residential neighborhood in the West district of Amsterdam. The neighborhood was built in the last quarter of the 19th century. This is a residential neighbourhood which lies between the singel and the Kostverlorenvaart

Characteristics

+ **Program**
  Residences
  Cafés
  Shops
  Restaurants
  Tourist attractions
  Museums

+ **Public transportation**
  Train station (Amsterdam Centraal)
  Metro station (noord-zuid lijn)
  Tram
  Buses

+ **Unesco world heritage**

+ **Canalbelt**

"If you plan cities for cars and traffic, you get cars and traffic. If you plan cities for people and places, you get people and places" - *Fred Kent* "

CHAPTER 3
THEORY

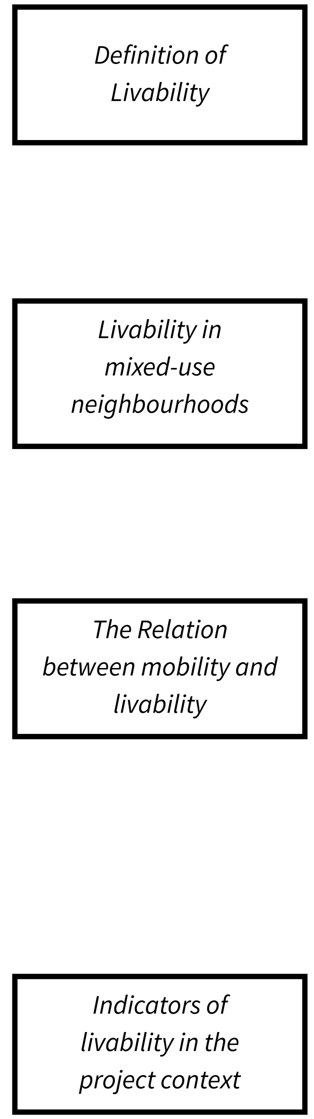
3.1 TEORETHICAL FRAMEWORK

The aim of this project is to enhance livability, as mentioned before, the first sub-research question is "What constitutes livability in the context of the working & living neighbourhood and what are the indicators used in this project?

In order to explore the significance of livability in the certain type of neighborhood, the theoretical section mainly focuses on livability concept, first study the broad definition through a literature review, then understands the relationship between working & living urban environment & livability through theories.

Third, based on the main theme whitin this project, the relation between mobility and livability is explored to gain a better understanding of the relation between the two main themes whitin this research project.

On the first understanding of the site, this project tries to take a position in defining its own definition or own understanding of livability in the specific context. This gives an overview of indicators of livability used in this research project.
The indicators in this part will be used in the design process when designing the spatial interventions and in the future to asses the scenarios.



3.2 LIVABILITY

DEFINING THE NOTION OF LIVABILITY

Livable [liv-uh-buh l]: Suitable for living in; habitable; comfortable. (Cambridge dictionary, 2019)

Livability [liv-abil-i-ty] :The degree to which a place is suitable or good for living in. (Cambridge dictionary, 2019)

Livability is recognized as a universal goal of the urban planning and design profession. However, there is no agreed definition of livability, each scholar describes a slightly different definition. The differences in definitions stem from the fact that these scholars approach the concept of livability differently depending on their research background.

One of the prevalent views regarding livability is related to the esthetics and physical characteristics of development blocks, streets and buildings (Jacobs, 1961). Jacobs claims that there are five elements that can be considered as urban design guidelines to generate urban diversity and maintain the quality of life. These five elements are: mixtures of use, short blocks, mingling buildings varying in age and dense concentration of people. (Jacobs, 1961).

A livabile place is a place that is well managed and somewhat devoid of nuisance, overcrowding, noise, danger, air pollution, dirt, trash and other undesirable interventions. (Appleyard, 1987)

Livability includes aspects such as, safety, health, affordability, environmental quality, and the presence of neighbourhood facilities such as parks, open space, sidewalks, provisions stores and restaurants. It refers to concerns related to the quality of life that are essential to the well-being of people and communities. (Wheeler, 2001).

According to van Dorst (2012) the notion of livability can be interpreted as quality of the match between people and their living environment.

Gehl highlights in “Cities for people” (2013) that people oriented planning particularly walkability, cycle ability and positive social life are key for achieving more livable, healthy and sustainable city.

Livability could be seen as a range of issues relating to the ‘quality of life and well-being’. It is a place based concept that refers to the elements of a home, neighbourhood, or city that contribute to quality of life and well-being. (Giap, Thy & Aw, 2014)

Based on the definitions stated above it is clear that livability is related to the quality of and access to facilities, leisure, transportation systems, safety and security, air quality, noise pollution, involvement of society and and economic opportunities.

3.3 LIVABILITY IN MIXED-USE NEIGHBOURHOODS

This research project is located in 2 sites, in Sloterdijk district and the Centrum-West district of Amsterdam. These two neighbourhoods are both considered as mixed-use neighbourhoods.
Mixed-use neighborhoods have three or more significant revenue-producing uses, such as retail, office, residential, hotel, entertainment, cultural and recreation. (Thrall, 2002) Mixed-use neighborhoods combine a variety of uses in one place such as residential, commercial, recreational and institutional uses. Livability in a mixed-use neighbourhood differs from the livability in a residential neighbourhood. As mentioned in the previous section the notion of livability is a place based concept. This section illustrates factors which are essential to livability in mixed-use neighbourhoods.

Amenities
According to Chiara et al. (1995) livability in a mixed-use area is enhanced by the amount of mixed-uses in an allocation and ratio, and also the facilities that cater to the neighbourhood. An example of these facilities are education, leisure, retail, medical and healthcare facilities. Allen et al. argues that an adequate amount of local amenities in neighbourhoods significantly contributes towards the experience of livability. (Allen et al., 2018)

Accessible services
Individual accessibility to the amenities and resources is an integral point to livability. The proximity of services in a mixed-use neighbourhood contributes the convenience to inhabitants, and the neighborhood offers a fixed consumer base in return. According to Vuchic (1999) the most important aspect of a neighbourhoods livability is its available transportation system. A mixed-use neighbourhood with a variety of transportation options that are accessible for people of all ages and incomes enhances livability (Vuchic, 1999). Hillman (1993) states that mixed-use neighbourhoods increase the provision of public transport choices. If there are no other transportation options available apart from private cars, it will lead streets to be overcrowded with streetcars, since the residents will rely on these as the only mode for them to travel.

Public spaces
There has to be a sufficient percentage of public open spaces, and other recreational amenities, within a mixed-use neighbourhood, public spaces provide major benefits to the society, environment and economy of a mixed-use neighbourhood (VCEC, 2008). Public spaces and public parks are essential to help reduce the feeling of overcrowding that mixed-use neighbourhoods tend to have. Hartig emphasizes that open public spaces and green spaces have positive effects on the health and general well-being of residents (Hartig, 2008) According to Jan Gehl(1988), The good quality of public space can support more activities occur, and then contribute to a better living quality. In the highly dense city center, the public space is limited and discontinuous, and normally being occupied by parking space and business activities.

Social Interaction
Providing an adequate amount of public spaces in mixed-use neighbourhoods means that people are more likely to meet each other, it increases the opportunity for social interaction in a neighbourhood.
Van Dorst argues that social interaction is a necessary element which contributes to livability. However, the amount of social interaction must be controlled, when people can choose the amount of social interaction they can live a comfortable life. (van Dorst, 2012)

Walkability
Walkability significantly contributes towards the experience of liveability in a mixed-use neighbourhood. Providing people with comfortable pedestrian access to stores, restaurants and other uses within a mixed-use neighbourhood encourages social interaction and the need to own cars. (Brookfield, 2016) Allen argues if amenities and services are located within walkable catchments between 400-800 meters it increases the livability in a neighbourhood. (Allen, 2018)

Safety
Providing people with more opportunities to walk in neighbourhoods will create the sense of surveillance effect on the streets, which results in an increased sense of safety (Jacobs, 1961). In contrary Newman (1972) argues that an increase in overcrowding of people working and living in the mixed-use neighbourhoods will give rise to a sense of anonymity which could lead to an increase in crime rates. In general safety in a neighbourhood is related to the neighbourhood management and maintenance (Dempsey et al,, 2012)

Economic opportunities
Mixed-use neighbourhoods that can accommodate a broad range of uses are likely to achieve more economic success. “Mixed-use development that contains low-risk, high-return anchor tenants, and offers the flexibility for the space or building to be converted for different uses in future, also influences economic success” (Barton et al., 2017) Mixed-use conditions are essential for neighbourhoods wishing to generate economic prosperity.

3.4 MOBILITY & LIVABILITY

To address livability in cities, mobility plays a crucial role due to its cross sectoral nature. Mobility affects many dimensions of livability such as the accessibility, walkability, public health and environmental air quality. Mobility and livability are inexorably intertwined. This next section highlights how mobility & transport impacts several factors of livability.

Pollution
The globally rising demand for mobility only increases the amount of emissions in the air. According to the PBL 17% of global CO2 emissions are attributed to the transport sector. (PBL, 2018) Air pollution is a detrimental environmental health problem affecting everyone around the world.

Congestion
Increased travel times and distances results in congestion, which could result in poor accessibility. Congestion is a this is a hinder to society, it negatively impacts the livability. Building new infrastructures such as roads and railways provide temporary relief. However, these new infrastructures also facilitate further growth which can lead to more congestion problems. Congestion has a lot negative effects associated with it, It increases travel time and cost since it requires more fuel, and it causes an increase in air pollution.

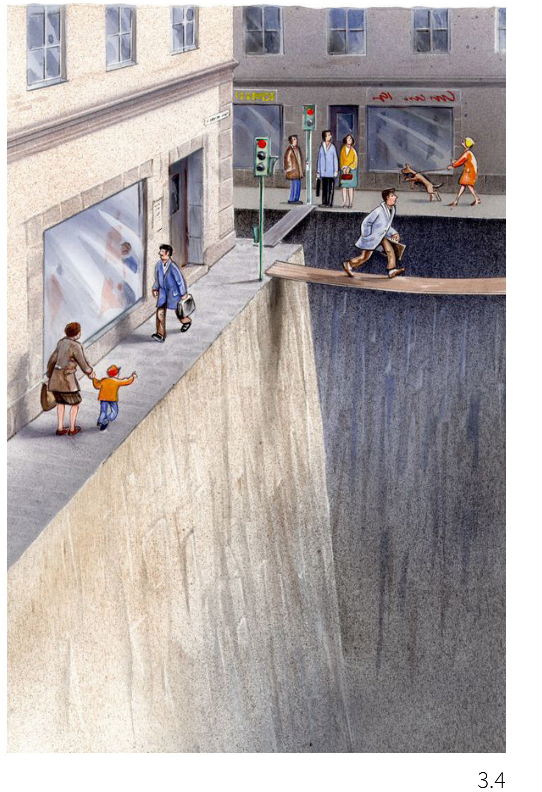
Parking
The amount of cars and cyclists on the road space continues to increase which also means that there is a higher demand for parking spaces for both vehicles and bicycles. Each vehicle needs more than one parking space, one at its current location, and one at home. Currently there are huge amounts of space for roads and parking which are consumed inefficiently. This means most parking spaces are empty for most part of the day. In compact cities this wasted space should be avoided at all costs.

Barrier effect
The barrier effect also known as severance implies the delays, discomfort and lack of access that vehicle traffic imposes on non-motorized modes. Poor accessibility of the pedestrian and cyclist network is caused by the barrier created by vehicle traffic. (Litmann, 2018)

Noise
Increased transportation of urban motorization increases physical health issues caused by noise pollution. Exposure to loud noises generally raises your stress levels, threatening noises such as an aircraft or high speed highways near your home. People who are exposed to these noises on a long term basis can experience severe public health issues. Tension and stress caused by exposure to loud noises can cause cardiovascular disease, anxiety, insomnia and depression. (Floud et al., (2010)

Safety
There is a continuous increase in the amount of road fatalities a year. Pedestrians, cyclists & motorcycle users suffer severe consequences in accident with other road users because they fail to protect themselves against the speed and mass of the other mode of transport. (Erso, 2019) These group of users are the most vulnerable road users. The various existing modalities often share road spaces, when these modalities clash in a neighbourhood/ area it can cause a negative impact on the livabilit. . According to Li, traffic affects neighbourhood liveability, as a result of changes in visual quality, walking environment and social cohesion. (Li, 2018)

Space
The amount of space requiered for various modalities continues to increase because of the growth of the modalities themselves. There is a huge amount of space in the roads which is dedicated to vehicles, an unused parking space could be used for other purposes which enhance livability. Image 3.4 illustrates the amount of space pedestrians have in the streets of today. These factors above make it clear that mobility and livability are inexorably intertwined. Influences and consequences of transportation modes have an impact on the livability of a city, district, neighbourhood and/ or place. According to Cervero et al., (2018) finding the right balance of mobility, livability and placemaking is an important component of attraction knowledge based industries and workers that will drive innovation and economic production in the next years.



3.4

Sources
3. Amount of space left for pedestrians in streets (Karl Jilg, 2014)

3.5 LIVABILITY IN THE PROJECT CONTEXT

This research project is located in 2 sites, in Sloterdijk and the Centrum-West district of Amsterdam. These two neighbourhoods are both considered as mixed-use neighbourhoods, there are residential, commercial and business activities occurring in these neighbourhoods. The notion of livability in a mixed-use neighbourhoods differs from for example a residential neighbourhood.
These neighbourhoods differ in characteristics, they were built in different era's and service different user groups.

Sloterdijk I
The Sloterdijk area is currently a business park, with several wholesale and transport companies, ICT business services, party centers and a mosque. It will gradually change in the next years in to a working, living and recreational urban environment. This area is planned to densify by building approximately 11.220 houses and offering 7.480 jobs.

Centrum-West
The Centrum-west location is a living & working environment consisted of small local businesses, cafe's, shops and services. These are located in the typical dutch row-houses in the city centre where the ground floor is mostly occupied by local businesses, shops and cafes and the floors above are occupied by residents.

There are several indicators related to livability and some of those indicators are issued by the local authorities of countries, such as the case of Singapore and the United States. Together with the theories of livability in mixed-use neighbourhoods and the relation between mobility and livability these indicators were adopted and adjusted to create a list of indicators which are relevant in this research project. The indicators are illustrated as follows.

Adopted indicators of livability

1. **Encourage social interaction**
Create more opportunities for social interaction through providing a variety of meeting places in the neighbourhood. People in the neighbourhood should be able to control the amount of social interaction they endure to live comfortably.

2. **Enhance green spaces**
Bring nature closer to the public realm through providing the city with space to relax from the regular rush of the urban living, which in turns will mitigate heat from the sun and enhance air quality.

3. **Developments of mixed-use neighbourhoods**
Offer a varied program in a neighbourhood to keep the neighbourhood active and alive at all times. Value the mix of functions in a neighbourhood, where a balance between working and living is required.

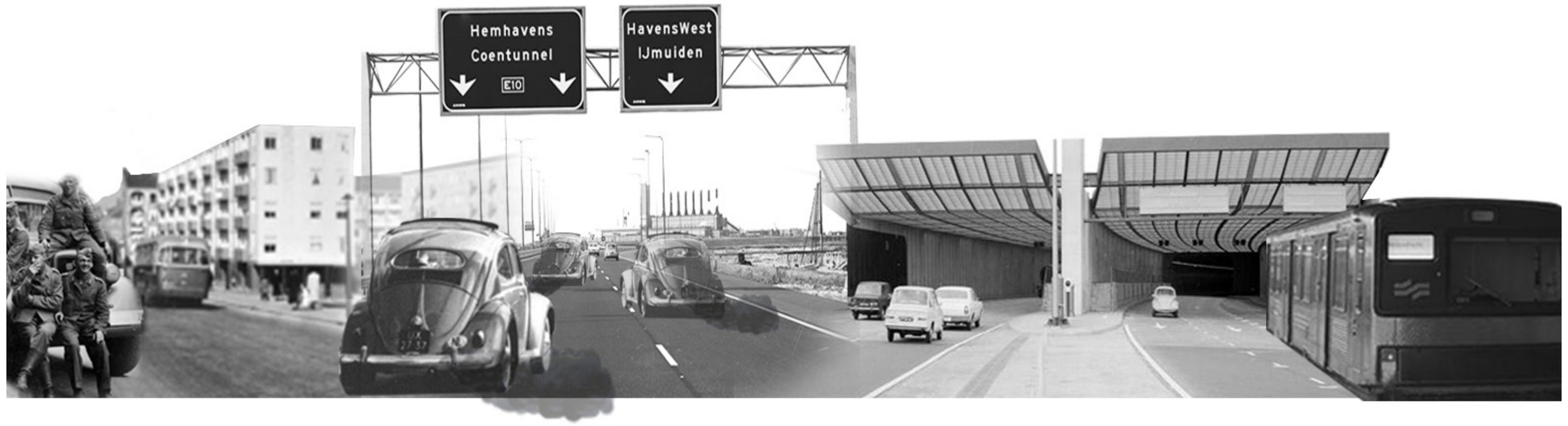
4. **Access to good quality public space**
All public spaces should include infrastructure to serve various functions to make the most of each land area. A qualitative amount of public spaces should be available. Good quality public space can support more social activities in a community.

5. **Varied sustainable transportation network**
Developing a public transport system that is sustainable, efficient and well connected. Provide safe, reliable, and sustainable transportation choices that will decrease household transportation costs, improve air quality, reduce greenhouse gas emissions, and promote public health.

6. **Encourage Walkability**
Enhance the unique characteristics of all communities by investing in healthy, comfortable, safe, and walkable urban neighborhoods.

7. **Create Economic Opportunities**
Enhance economic competitiveness through reliable and timely access to employment centers, educational opportunities, services and other basic needs by workers, as well as expanded business access to markets.

8. **Safety**
Safety is a basic need of every human being. In a neighbourhood safety is translated into road safety, sense of safety, the absence of noise, etc. A mixed use neighbourhood should have a friendly walking environment for pedestrians, where there are constant eyes on the street.



CHAPTER 4
BACKGROUND

2. The Bend in the Herengracht near the Nieuwe Spiegelstraat in Amsterdam 1672. Retrieved from RKDimages (2018)

4.1 AMSTERDAM DEVELOPMENT

HISTORY

This chapter shows the types of traffic and the infrastructure systems which has influenced the structure of the urban form of the city. The city is symbolized by transport infrastructure, in the form of its canals.

Before the 1800's

In the 1500's the city was originally viewed from across the river. As shown in image 4.1a. In the years between 1656 and 1662, the canals were extended, over the Amstel, giving the Amsterdam center its current shape. The Golden Bend of the Herengracht can therefore continue to this day as a symbol of the richness of the Golden Age.

The first canals have been dug for urban defense and water management. After urban expansions, the old defensive canals came were located within the city walls and lost their function. But they got a role in the place that would ultimately make the city wealthy: transport of merchandise. The transport of goods between the hinterland and the city was mainly transported through water, in the form of barges with cattle, vegetables, dairy, grain, peat and garbage. These products were transported to markets for trade. Markets were along the canals and were often equipped with cranes or wind shafts to speed up loading and unloading. Both the Singel and Prinsengracht were traffic canals with a lot of work functions. Warehouses, markets and business created a lot of pressure. The Herengracht and Keizersgracht were parallel to this one traffic routes and had no direct connection to the IJ. These canals were located in the bustle of busy city traffic.
In addition to traffic over water, there was also land traffic; people or goods were transported with wheelbarrows, sleds, hand carts and wagons, which were either pulled by horses or pulled by hand. The seventeenth century showed a strong increase in the number of wealthy Amsterdammers. Prosperity of Amsterdam has led to a strong growth in demand for comfortable passenger transport. This led to the use of carriages.

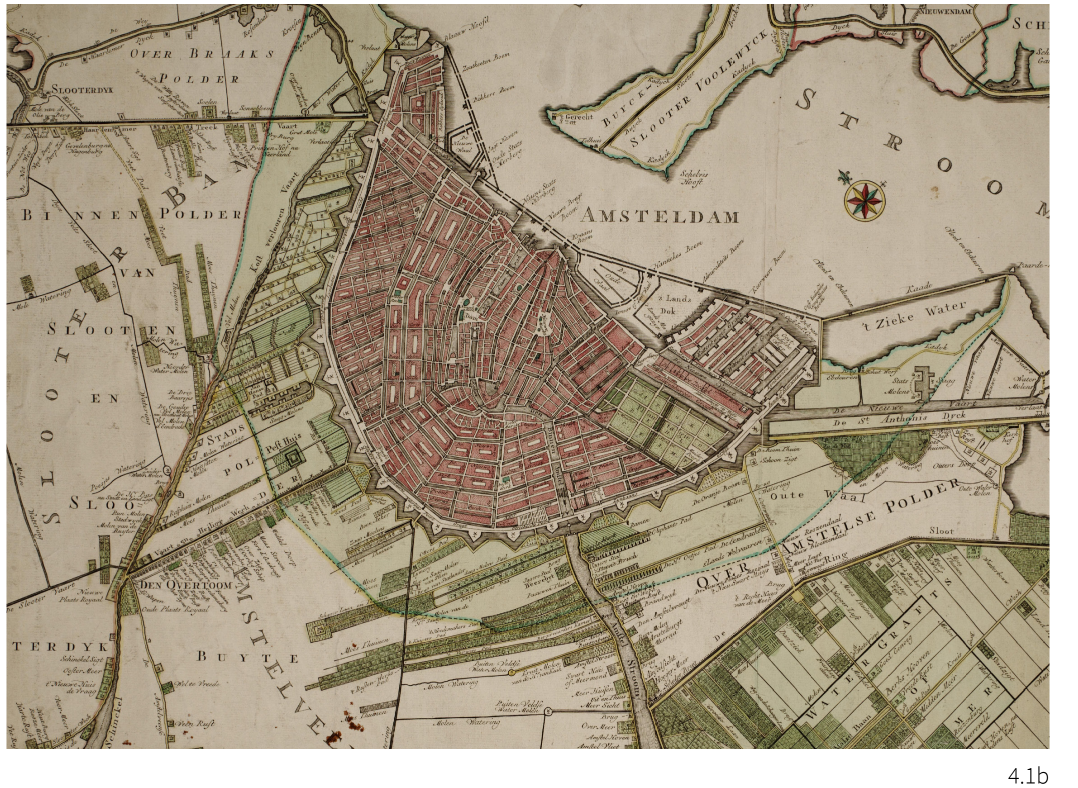
Streets were drawn straight and the width was based on traffic capacity.
The width of these streets was not chosen randomly, but functionally determined.
The width is based on research by the city architect Daniel Stalpaert: the streets had to be wide enough that three carriages could pass each other safely.

The width of the radians (36 feet, 10 meters) was based on the width of the carriages. Not only within the city centre but also outside the city.

1538

4.1a

1770



4.1b

Sources
4.1a Antoniszoon, (1538) Amsterdam in 1538

4.1b Mol ,(1770) Amsterdam arounf1770

Around the 1860's

From 1800 to 1866 there were a few developments, the vondelpark and two major developments in transport infrastructure.

The western and eastern docks were built shown in 1832 image 4.1d.
The westerdok was built when the part of the IJ was separated by the construction of the Westerdoksdam and Westerdokseiland, because of this separation the was no flow in the open connection with the IJ river. This resulted in an enclosed water surface.(image 4.1d) On the east side a similar construction was created. The eastern dock.

Shortly after this development in 1839 the first operating steam train on an iron railway from Haarlem to Amsterdam. The railway was constructed parallel to the canal. (Image 4.1c) The train service became a direct competitor of the existing barge transport of that canal known as the Haarlemtrekvaart.
In the years 1842-1847 the railway was extended to Leiden - The Hague - Rotterdam. This line is still referred to as the Old Line.

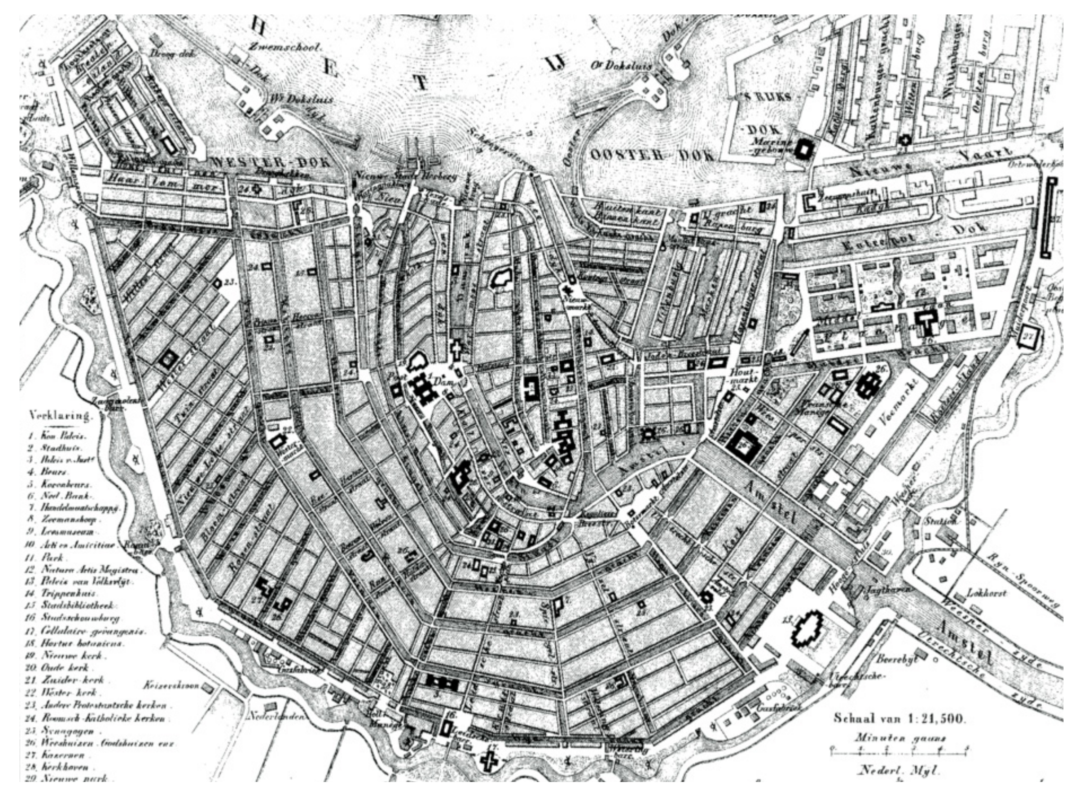
In 1843 the second railway was built, this line connects Amsterdam to Utrecht. The train stop was located outside the canal belt. In 1855 this connection was extended to Rotterdam.

New industry and activities have led to a population explosion, from 180,000 in 1810 to 520,000 in 1900. With the industrialization, from around 1860, a new period of expansion began. From then on the population growth can mainly be explained by the industrialization and the migration to the cities. What is noticeable in image 4.1c is the polder structure around the canal belt. This structure is noticeable in the development from 1900.

1850

4.1c

1860



4.1d

Sources
4.1c Amsterdam 1850 Retrieved by Author, (2018) Data source: Topo tijd reis

4.1d Amsterdam in 1866 Kuyper., J. (1866)

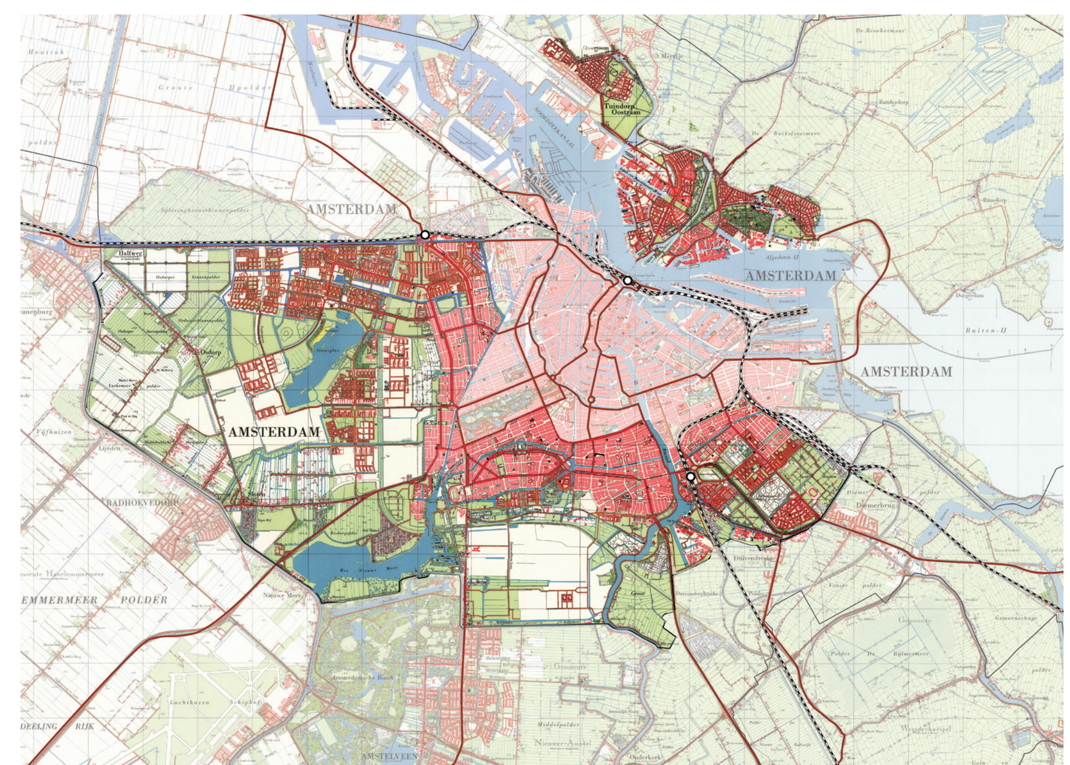
From 1900
After 1875 new residential areas were built outside the 17th century canal belt. Neighbourhoods such as the Pijp, the Dapperbuurt, the Kinkerbuurt and the Staatsliedenbuurt were built outside the Singelgracht. The first trams pulled by horses also emerged in 1875. In 1889 the Amsterdam Central Station was built separating the city orm the IJ river. New port islands were constructed in the eastern docklands. These port areas were to serve big steamships that transported goods. The northern bank of the IJ river was constructed to serve port functions. In 1896 the first vehicle drove on the streets of Amsterdam, the car was a new mode of transportation that was still very new to the people of Amsterdam. Alongside the emergence of the car, the first electric tram drove through Amsterdam. This new development on the northern bank of the IJ river has sparked the connection between the northside and the city centre of Amsterdam. Ferry boats started to serve the people traveling to the northern bank in 1900.
In 1930 Amsterdam had about 757,000 inhabitants. This growth was absorbed in the nineteenth-century belt and in the Transvaal neighborhood, the Indische Buurt and the Spaarndammerbuurt.

After the war, population growth increased rapidly.The General Expansion Plan (AUP) from 1935 was largely constructed, in the years 1950-60 the Westelijke Tuinsteden and in the south Buitenveldert were built. Amsterdam North also underwent a major expansion. This was possible due to the planned construction of the IJ tunnel and the connections on water via ferry boats. The Amsterdamse bos was also part of the general expansion it formed the largest of the green hedges of Amsterdam. The Amsterdamse bos was built in 1964, it also serves as a buffer between the Schiphol Airport and the new expansion of Amsterdam. Around 1960 the car started to dominate the streets of Amsterdam, local and long-distance car traffic made its way through the inner city. Since 1957 there has been a permanent connection between Amsterdam-Noord and Amsterdam through the Schellingwouderbrug and the Amsterdamse Brug. The Weesperstraat and the Wibautstraat were widened in the 1960s and designated as the main roads for traffic and as a supply route to the planned IJtunnel. The people working in Amsterdam began to live outside of the city. They traveled back and forth between Amsterdam and their hometown every day by car. The popularity of the car increased at the expense of the train and the bicycle.

1900

3.1e

1960



3.1f

Sources
4.1e Amsterdam 1900
Retrieved by Author, (2018) Data source: Topo tijd reis

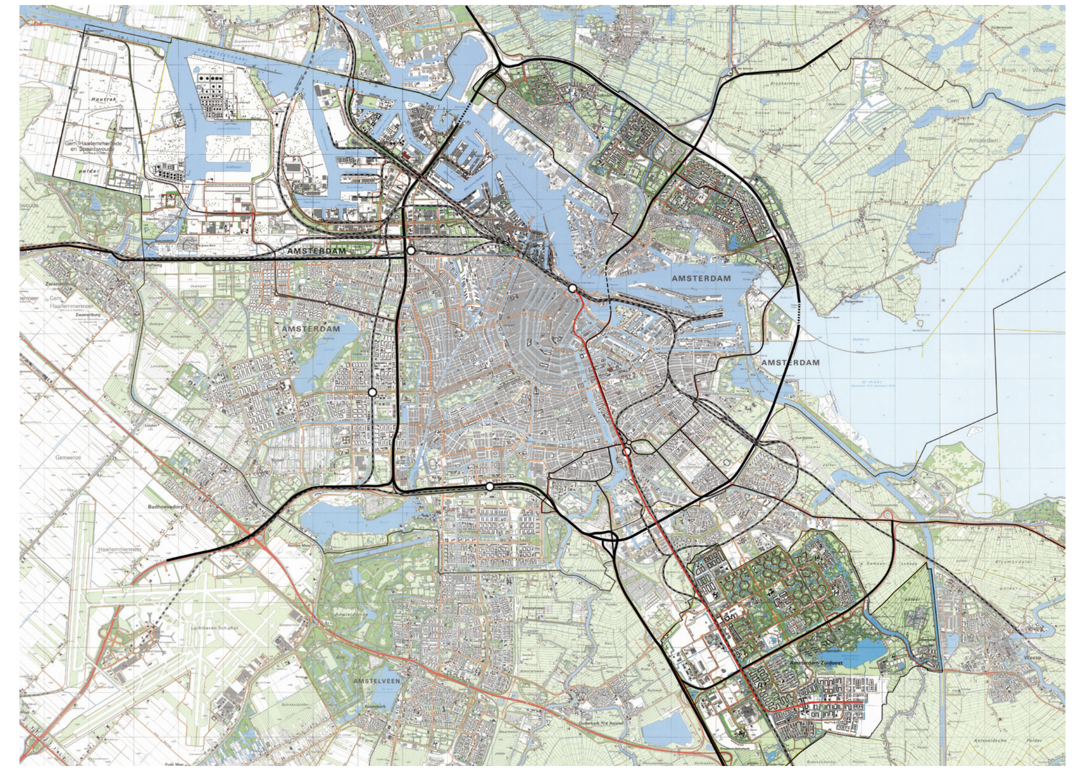
4.1f Amsterdam 1962
Retrieved by Author, (2018) Data source: Topo tijd reis

As the car became increasingly dominant in the roadspace, the amount of traffic in the inner city started to grow. In 1966 the A10 was built to manage the traffic flow going in and out of the city centre. The ferries also faced long waiting times therefore the coentunnel was opened in 1966 and the IJ tunnel in 1968. The strong growth in car traffic meant that Amsterdam has never been free from congestion and shortage of parking space since the 1960s. In 1970 the bijlmer neighbourhood was partially constructed with the projections of the success metro connection and the growth of the attractiveness of the car. In 1977 the first metro was operating in Amsterdam, from the central station to the waterlooplein and to the bijlmer neighbourhood. In 1983 the helm tunnel was created the connection from Amsterdam to Zaanstad by train.
Since the 1990s, new neighbourhoods have been built in Nieuw Sloten and De Aker.

Since the year 2000 in the IJmeer to the east of the city, the new IJburg district has been built on the islands. Satellite photo of Amsterdam in the year 2000. In 2003 the construction of the North / South line started, a metro connection between Amsterdam-North and Amsterdam-South. After a construction period of fifteen years, the new metro was opened in july of 2018.

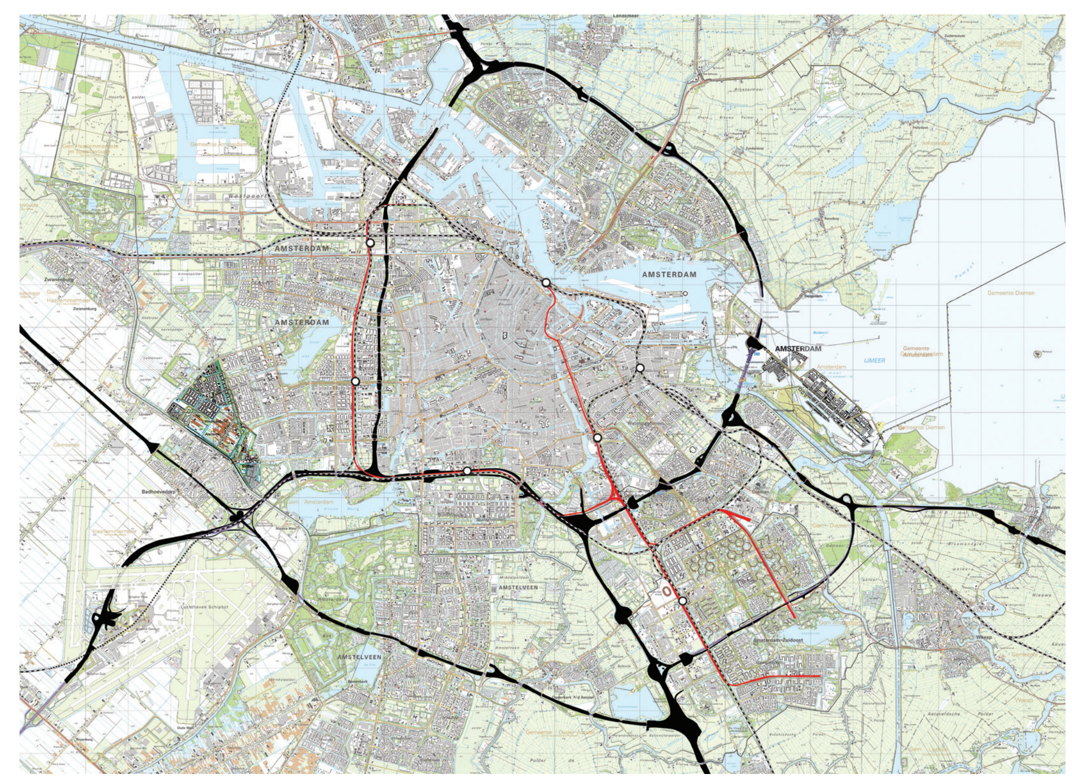
This chapter concludes with the notion that the development and shape of Amsterdam has been influenced by mobility and transport infrastructure. Before the 1800's water transport has shaped the structure of the canal. The transport of people on carriages have determined the with of the streets. When the car emerges streets were expanded to accommodate the car culture. Neighbourhoods were developed because of the reach of the car and the short travel time by car. In the 20th century metro connections were built to facilitate the bijlmer neighbourhood.

1990



4.1g

2006



4.1h

Sources
4.1g Amsterdam in 1990 Retrieved by Author, (2018) Data source: Topo tijd reis

4.1h Amsterdam 2006 Retrieved by Author, (2018) Data source: Topo tijd reis

4.2 TIME-LINE

HISTORY OF EMERGING MODALITIES IN AMSTERDAM

1800 – Transportation

Before the 1800's people and good were transported through the canals and transportation on land by horses wheelbarrows

1839 – First train

First operating iron railway from Amsterdam to Haarlem alongside the canal (halfweg)

1842
Second iron railway connection to Utrecht

1847:
Railway extension to Leiden, Den Haag and Rotterdam.

1875 – First Horse tram

Industrialization around 1860 leads to a rapid population growth in Amsterdam, from 180,000 in 1810 to 520,000 in 1900.

First operating tram on rails in Amsterdam pulled by horses

1889 – Amsterdam CS

First train station with two railways on an island separating the city from the IJ-river

Development harbour islands: New harbour area for big ships

1896 – First car

First functioning car drives in the streets of Amsterdam

From 1890 to 1905 there was a Sloterdijk stop on the old rail way line

1900 – First Electric tram

First operating electric tram in the rails of Amsterdam

First ferry boats connecting the north-side of Amsterdam

1922: First vehicle buses drive in Amsterdam

1922 – First operating bus route

Rapid increase in cars in Amsterdam. Cars have become the dominant transportation mode and parking places are scarce

Weesperstraat and Wibautstraat considered as main roads to planned IJ-Tunnel.

1930 – Population growth

Population growth has led to a total of 757.000 people in Amsterdam

Starting to develop the expansion plan of 1935 to absorb this added group of people.

1940 – World War II

World War II from 1940 - 1945

After war
1950 - 1960 partially developing the expansion plan of 1935

1960 – Car dominance

Rapid increase in cars in Amsterdam. Cars have become the dominant transportation mode and parking places are scarce

Weesperstraat and Wibautstraat considered as main roads to planned IJ-Tunnel.

1966 – Partial A10 Highway

The A10 highway to was built to distribute & controll cars going in and out of the city centre.

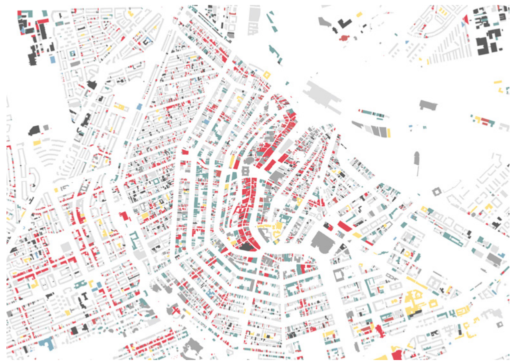
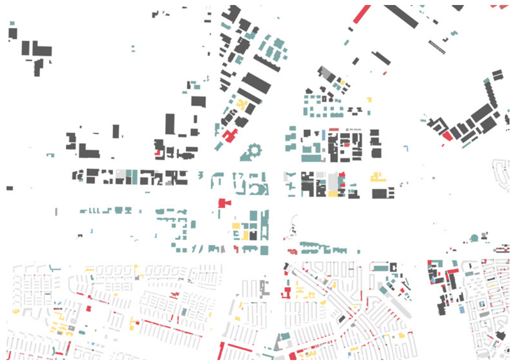
1968 – IJ-Tunnel

First car tunnel connecting Amsterdam North to the rest of Amsterdam.

1977 – First Metro

First metro from the central station to the waterlooplein and to the bijlmer neighbourhood

Development Bijlmer neighbourhood

CHAPTER 5

RESEARCH ANALYSIS

5.1 AIR QUALITY

SITE ANALYSIS

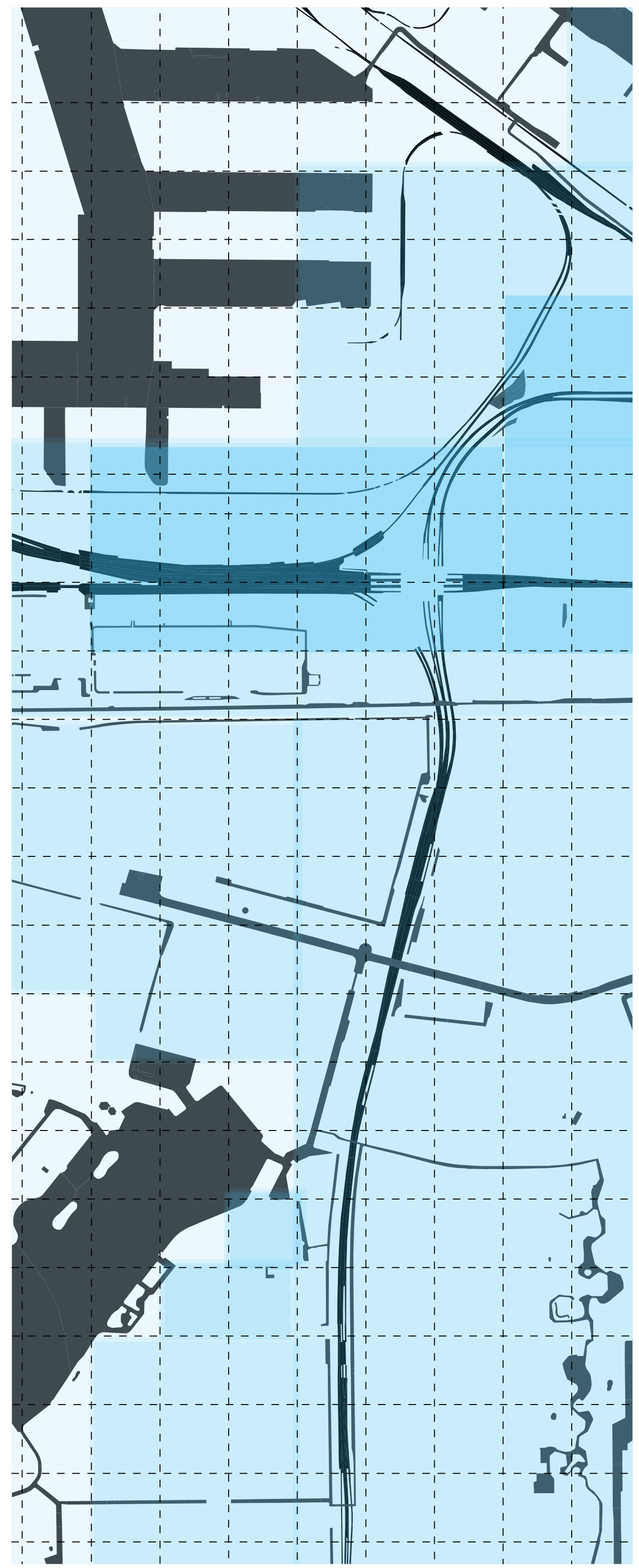
The air is unhealthy almost everywhere in Amsterdam.
The biggest cause is traffic. The following maps shows the NO_2 air pollution in Amsterdam. If you breathe in too much nitrogen you can become short of breath or suffer from asthma.
Air pollution is extra bad for children and elderly.

According to the GGD, traffic is the most important source of air pollution in the city. Dirty air mainly leads to increased health risks for children, the elderly and people who already have a respiratory disease or a cardiovascular disease, according to the GGD.

The measuring point along the Haarlemmerweg indicated a significant excess: 48.6 micro-grams NO_2 per m3, while the recommended exposure limit of the WHO is 40 micro-grams per m3. Too much NO_2 was also measured along the A10 West. The two site locations the Sloterdijk area and the city centre of Amsterdam have a high concentration of NO_2 and other dangerous emissions. These areas are also traffic intense areas which could be the cause of the high amount of pollution

Legend

High concentration of NO_2 — Low concentration NO_2



NOISE POLLUTION

SITE ANALYSIS

The amount of noise by a variety of modalities is shown in the next map. Modalities such as train, metro, tram, buses and vehicles. The Sloterdijk area is an intense noise cluster. This is caused by 3 major infrastructures in this location, the train, metro and highway which all go through this area. Alongside these 3 main infrastructures there are other key roads with high levels of noise pollution in the Sloterdijk area such as the transformatorweg which is one of the vehicle routes from the Sloterdijk area to the city centre.

Amsterdam central station is the big noise cluster in the city centre. The transportation hub where trams, metro's, buses, trains and vehicles meet. The city centre also has a few axis where the levels of noise pollution are high. Road traffic - cars, trucks, buses, mopeds and trams - accounts for 96 percent of the serious noise pollution in the city centre of in Amsterdam. (RIVM, 2018)

Measures are needed because loud noises after prolonged exposure can cause major health damage, such as high blood pressure and heart problems

Legend

High levels of noise

Low levels of noise

CYCLING NETWORK

SITE ANALYSIS

The cycling network in Amsterdam is very poor, limited amount of space for cyclists result in cycling congestion and hinder amongst cyclists. The narrow cycling lanes are featured in this map, as it shows there are a lot of narrow cycling lanes in the city centre. These images below portrait the real time cycling situation in the city centre of Amsterdam. Traffic on narrow cycling lanes at peak hours.

Legend

- Busy cycling routes
- Narrow cycling routes

PEDESTRIAN NETWORK

SITE ANALYSIS

The pedestrian network in Amsterdam is very poor, limited amount of space for pedestrians to walk and rest in the public space results into poor walkability. This map shows the current pedestrian network and public spaces in Amsterdam. Pedestrians are less dominant in a majority of streets in Amsterdam, space is given priority to cars, busses, trams, and cyclists. These images below portrait the real time walkability in Amsterdam's city centre.

Legend

Pedestrian Network

TRAFFIC INTENSITY

SITE ANALYSIS

The following maps shows the traffic intensities by cars, trams, and buses in the streets of Amsterdam. The thick line resembles the streets which experience intense traffic by all modalities. The thinner the line the less intense traffic. The data on this map is based on the Amsterdam Traffic Model.

The traffic intensities (motor vehicles) can be called up per road section. The data is subdivided into vehicle
categories and day periods that are required for air quality and noise
nuisance research. The stated
intensities apply for one hour and must be multiplied by the number of hours per time period. This concerns intensities for both directions together.

This map highlights the key busy routes in Amsterdam. Relieving the traffic of these streets would be key to managing the mobility pressure in Amsterdam.

Intense routes

Less intense routes

ECOLOGICAL STRUCTURE

SITE ANALYSIS

This map shows the ecological & main green structure of Amsterdam. The city of Amsterdam is a lobe city; it has a network of parks and green areas that extend deep into the city in the form of five green fingers.
The brettenzone just outside the Sloterdijk area extends all the way to the westerpark forming one of the green fingers . The Sloterdijk area is one of the key green connections in Amsterdam.

Legend

- Ecological network
- Main green structure

RAIN WATER BOTTLENECKS

SITE ANALYSIS

Water manager AGV has identified bottlenecks in water quality and poor quality of groundwater nuisance. Based on these outcomes and area knowledge, area experts have made a rainwater bottleneck analysis. A bottleneck is a (part of a) street or neighborhood with a (greatly) increased risk of nuisance and damage in extreme rain. The bottlenecks are prioritized as follows:

Dark blue (extremely urgent): Risk of serious damage to real estate (lots of water), vital infrastructure, hospitals and museums and disruption of accessibility

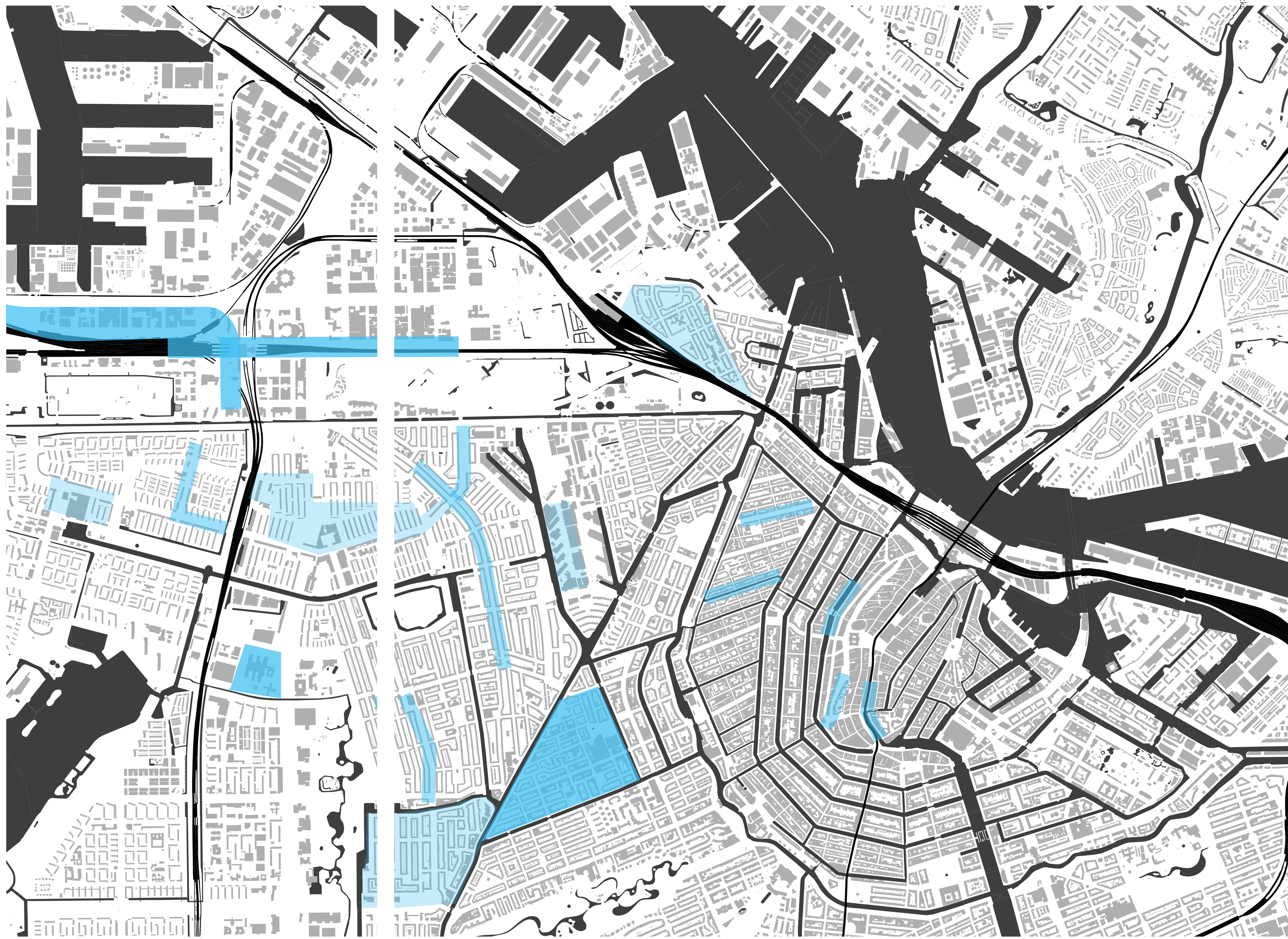
Blue (very urgent): Risk of damage to real estate and traffic problems

Light blue (urgent): Risk of property damage.

There have been reports of rainwater overflow in the Sloterdijk area around the station and the business park area on the west. The city centre also has some bottlenecks these are less urgent than the Sloterdijk bottlenecks .

Legend

Urgent — Less Urgent



PEDESTRIAN TOURIST DENSITIES

SITE ANALYSIS

This section describes the results of a method that calculated the most probable routes that tourists took between subsequent photo events. The calculated routes of all tourists were aggregated to create a road density map of Amsterdam's city centre. (van der Drift, 2015)

The following map shows the pedestrian tourist densities in the city centre of Amsterdam. A higher count naturally means that more tourists walked over this road. The width of roads represent the tourist density. The red circles highlight the detected clusters.

Hotspots

1. Amsterdam central station
2. Red light district
3. Dam
4. Westerkerk
5. Rijksmuseum
6. Nieuwemarkt
7. Begijnhof
8. Bloemen markt
9. Munttoren
10. Rembrandtplein
11. Leidseplein
12. van Gogh museum
13. Heineken
14. Vondelpark

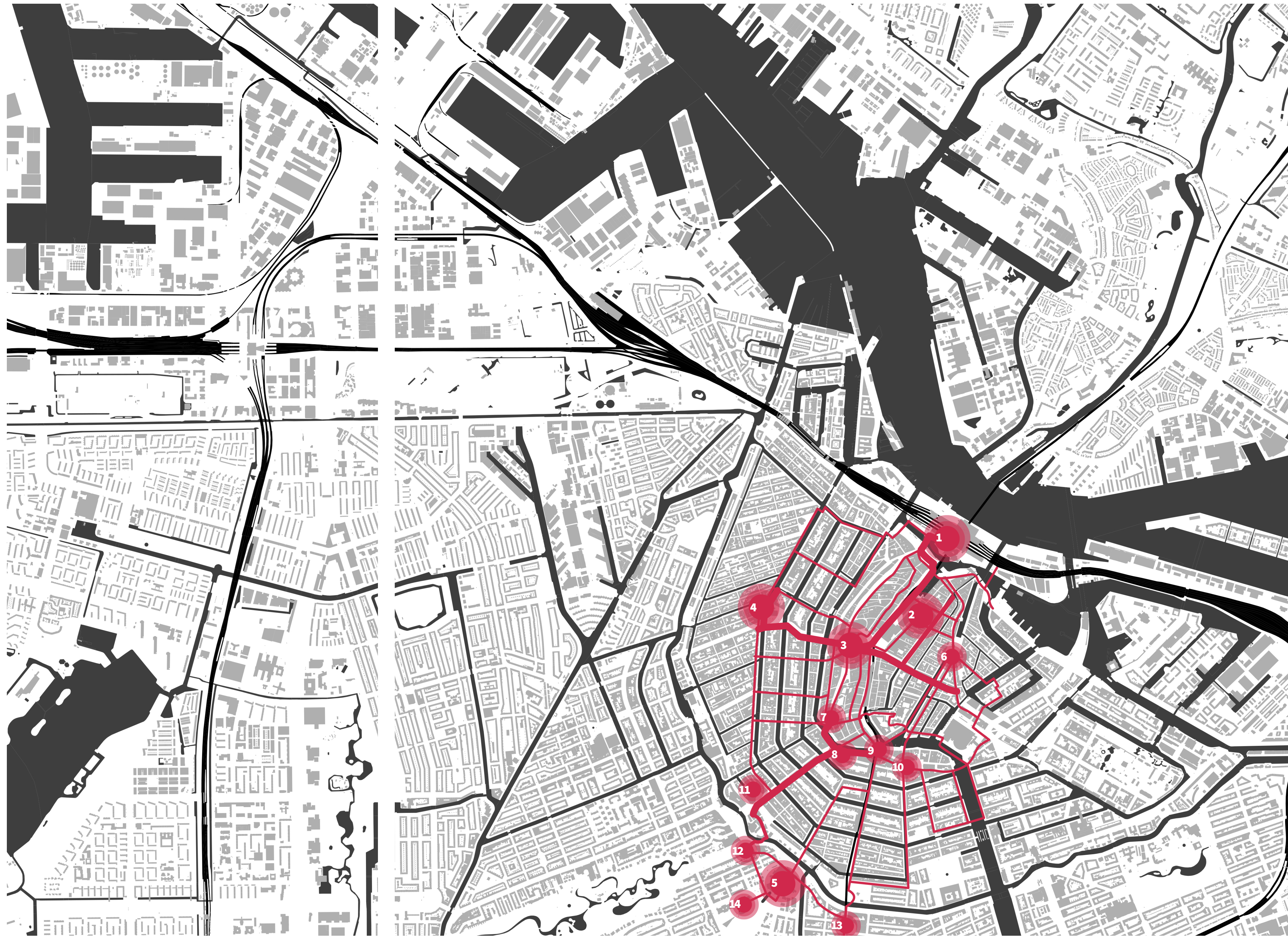
Source:
Pedestrian tourist densities map by author derived from van Drift, S (2015)

Legend

Hotspots

Crowded routes

less crowded routes



5.2 SLOTERDIJK

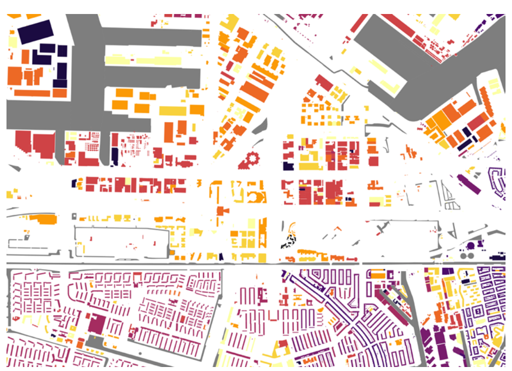
INVENTORY RESEARCH

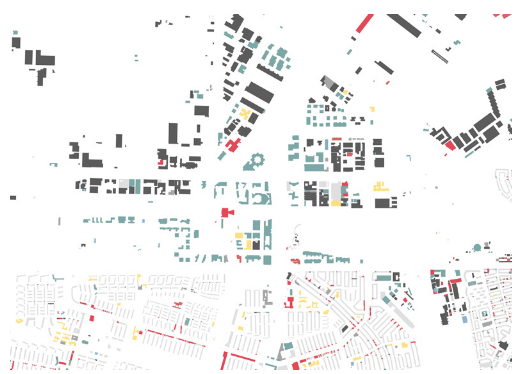

Blue network


Green network


Infrastructure


Buildings


Building age


Public buildings


Busiest cycling routes


Public Network

Legend

- Water
- Green areas
- Blocks
- Metro
- Tram
- Roads
- Railway

Building age

<1800 — >2005

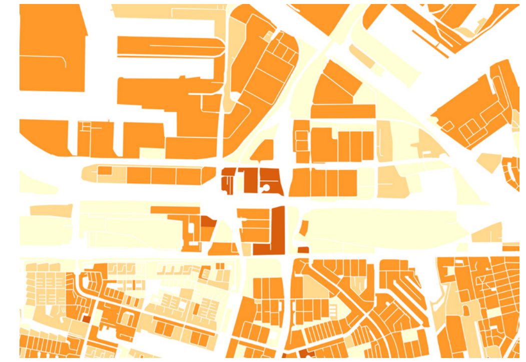
Public buildings

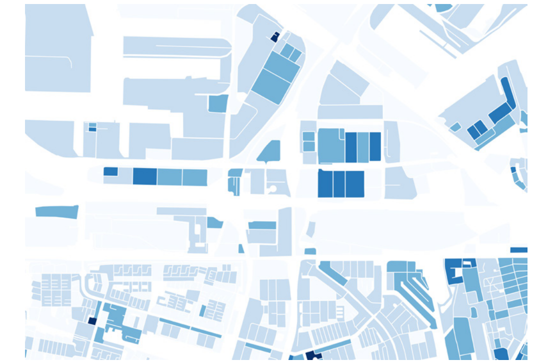
- Commercial
- Mixed Function
- Education
- Sports
- Healthcare
- Meeting space
- Other buildings

Busiest cycling routes

Public Network

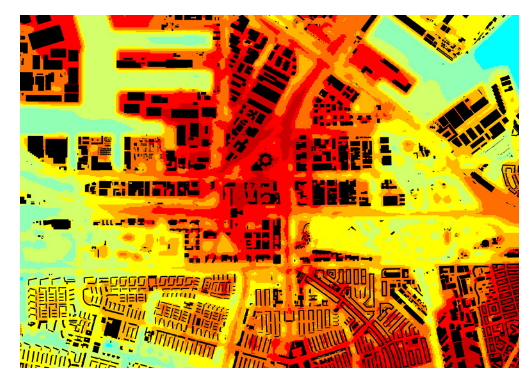
- Green urban space
- Open space with little or no vegetation
- Sports and leisure field
- Pedestrian Area

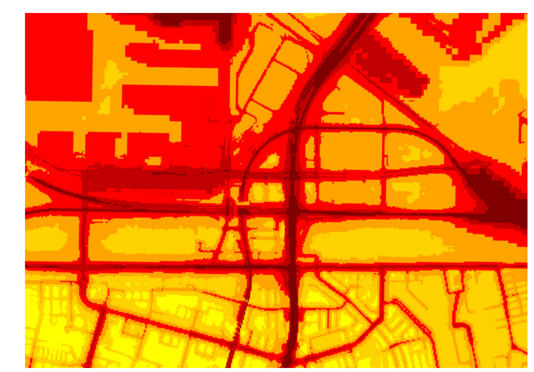

FSI


GSI

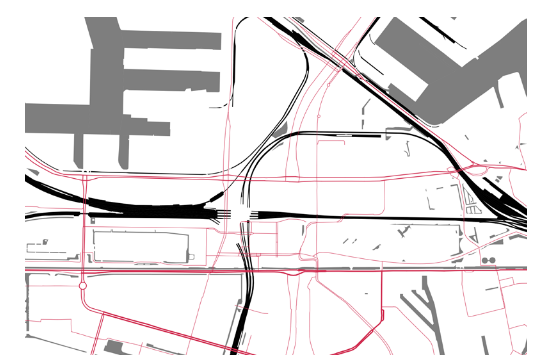

800 M walking density


No2 pollution


UHI


Noise


Trees


Streets (car activity)

Legend

FSI 0 - 149.9

GSI 0 - 1.0

800 m walking density

Close proximity

Pollution

< NO_2 — > NO_2

UHI

<0.2 — >2.0

Noise

Trees

Busiest streets

- High
- Low

SITE VISIT

FIRST IMPRESSIONS

MIX TRANSPORTATION HUB + LIGHT INDUSTRIAL BUSINESSES

NOT ACTIVE

MONOFUNCTIONAL

CAR DOMINANCE

WASTESCAPE

NEGLECTED HUMAN LAYER

I arrived by train to Amsterdam Sloterdijk station what I cal the centre of this area. What immediately caught my eye were the different layers of mobility pedestrian flows, cyclists, train metro, tram and bus. As I walked more towards the business park I felt the dominance of the car.

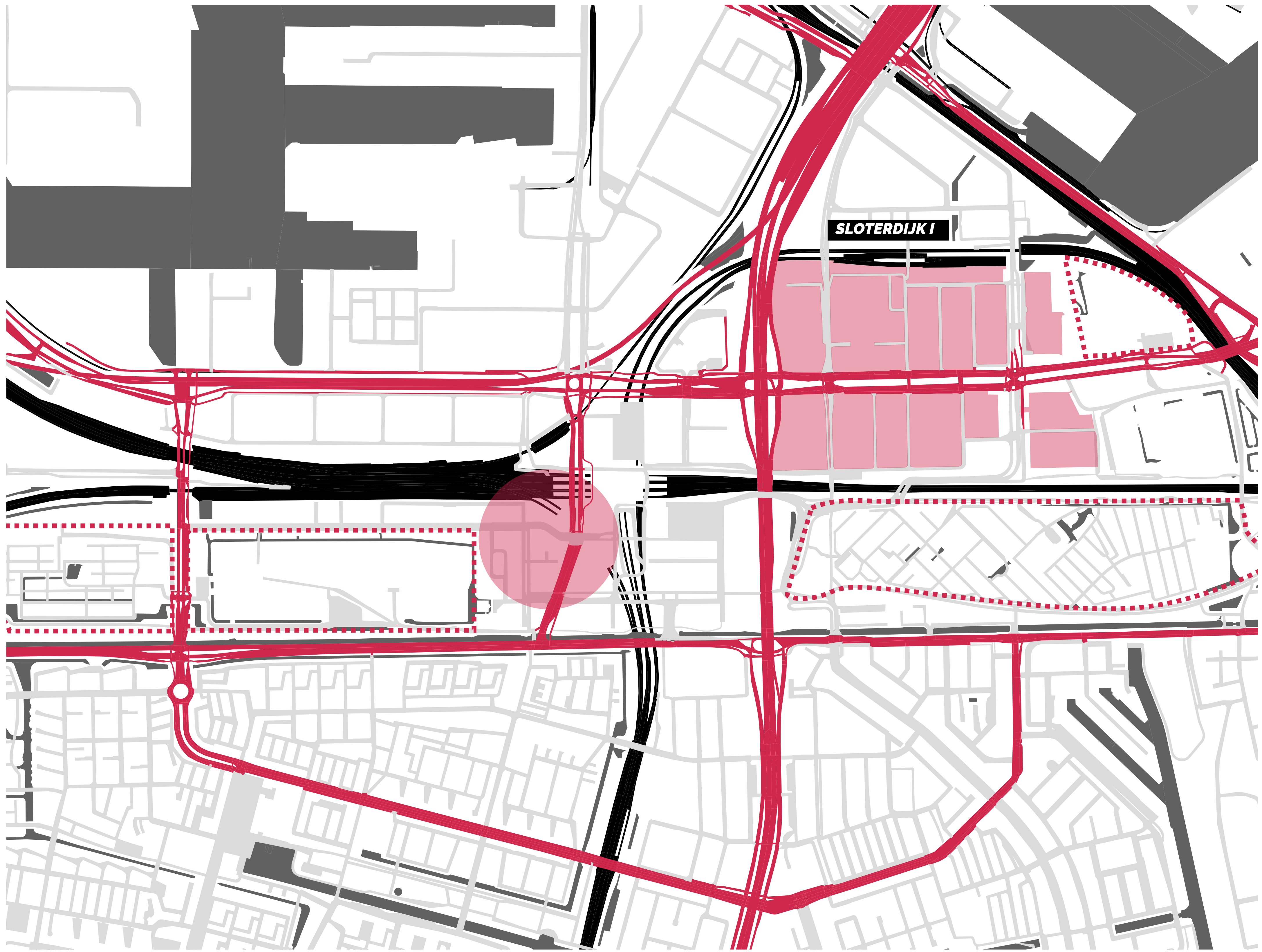
The first impressions of the area are a program with a transportation hub with light industrial buildings. A mono-functional inactive area where its human layer is completely neglected. It is clear that the car dominates the streets in this neighbourhood.

BOTTLENECK MAP

SLOTERDIJK

The bottleneck map concludes the research analysis with key crucial problems in the area.

- Traffic
  Highly congested area, at peak hours.
- Cars dominate street views
- Severe polluted area
  High levels of NO^2 and CO^2 pollution. Because of heavy traffic in this area.
- Noise
  Loud traffic noises from the highway and other public roads causes disturbance to the residents in this Sloterdijk area
- High amount of parking in streets and parking garages
- Poor quality of green areas in Sloterdijk 1 area
- Non-active area
  The location is not very lively. There are not a lot of activities happening in the streets/ public spaces
- Poor public network



Legend

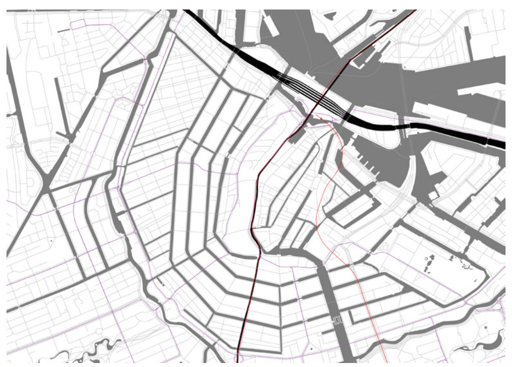
- Polluted roads
- Single function spaces
- rain water bottlenecks

5.3 CENTRUM-WEST

INVENTORY RESEARCH

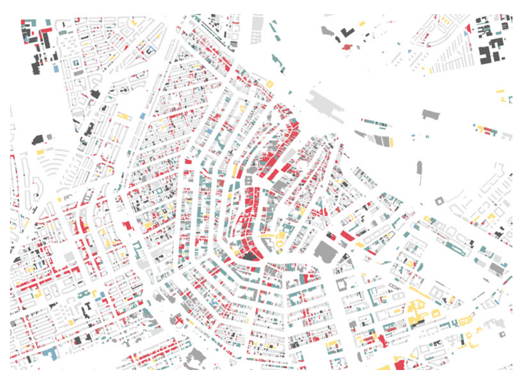

Blue network


Green network

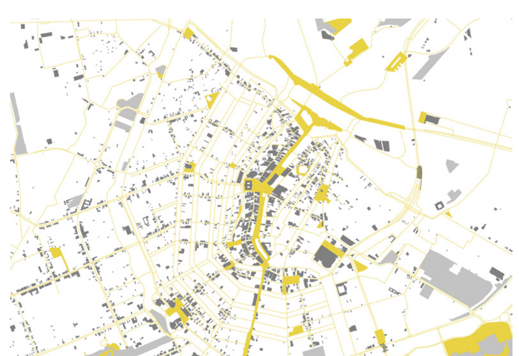

Infrastructure


Buildings


Building age


Public buildings


Busiest cycling routes


Public Network

Legend

- Water
- Green areas
- Blocks
- Metro
- Tram
- Roads
- Railway

Building age

<1800 >2005

Public buildings

- Commercial
- Mixed Function
- Education
- Sports
- Offices
- Meeting space
- Other buildings

Busiest cycling routes

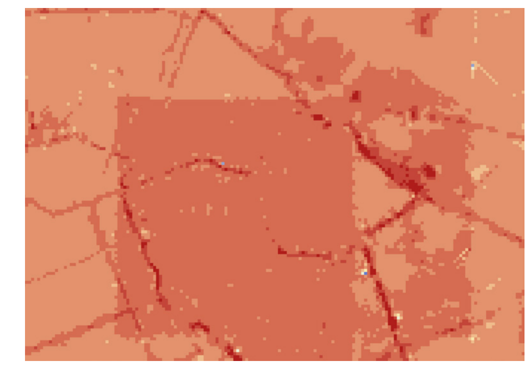
Public Network

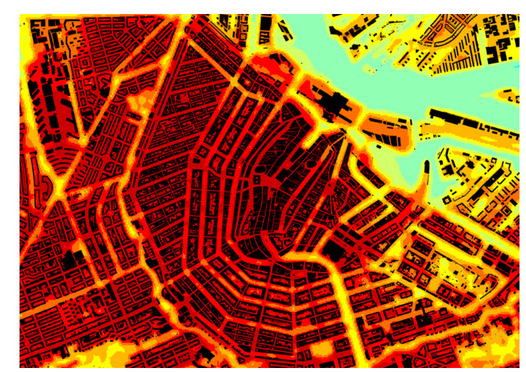
- Green urban space
- Open space with little or no vegetation
- Sports and leisure field
- Pedestrian Area

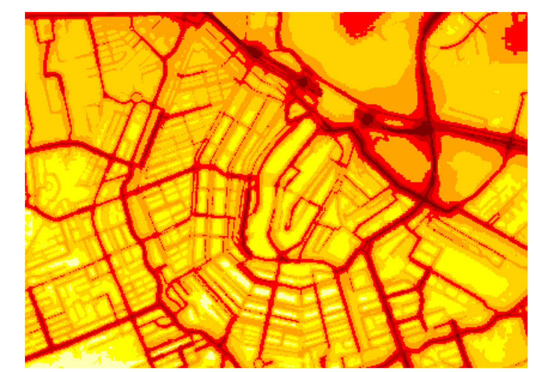

FSI

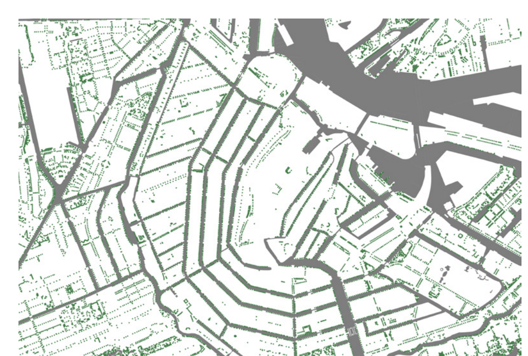

GSI


800 M walking density


No2 pollution


UHI


Noise


Trees


Streets (car activity)

Legend

FSI 0 - 149.9

GSI 0 - 1.0

800 m walking density

Close proximity

Pollution

< NO_2 > NO_2

UHI

<0.2 >2.0

Noise

Trees

Busiest streets

- Main roads
- Local roads

5.3 SITE VISIT

FIRST IMPRESSIONS

Source:
Egelantiersgracht.
Author: Roeland Koning

I arrived by train to Amsterdam Centraal Station, from there on I walked the location area. My first impressions of the centrum west area were a very busy and very active area. Cars dominated the beautiful canals beind the touristical hotspots.

The pressure of mobility was definity experienced when crossing occured between me the pedestrians, bikes, trams and cars. The pedestrian does not have much space to walk in the city centre. There are many narrow sidewalks where you have to jostle for space.

5.3 BOTTLENECK MAP

CITY CENTRE WEST

The bottleneck map concludes the research analysis with key crucial problems in the area.

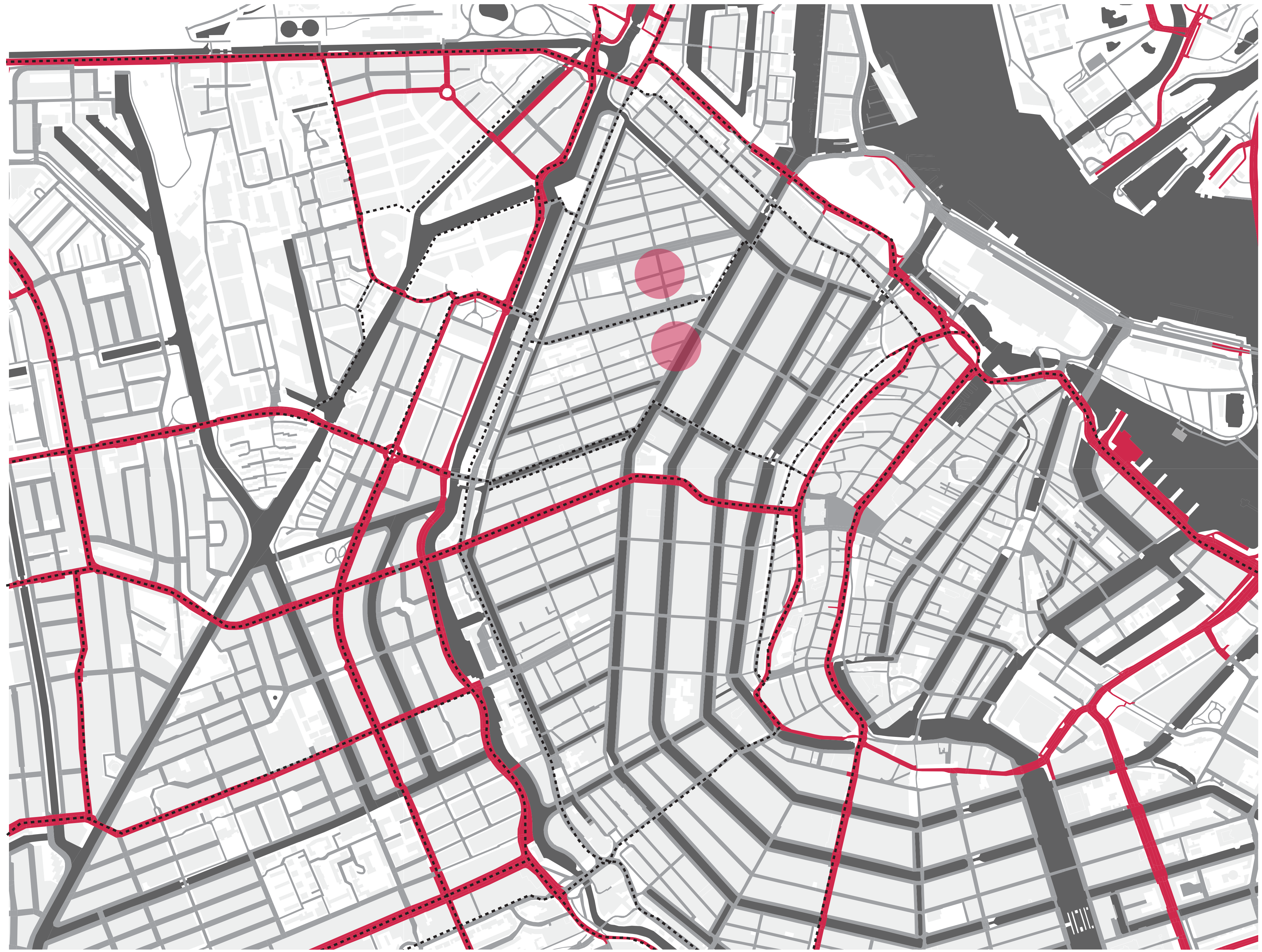
- **Intense Parking Pressure**
  Centrum west has the Highest parking pressure of Amsterdam.
- **Cars dominate street views**
- **Highly polluted area**
  High levels of NO^{2} and CO .
- **Busy cycling routes**
  Busy cycling routes in narrow lanes create hinder, congestion and safety issue for cyclists
- **Minimal amount of green**
  The Centrum-West district has the less amount of green areas.
- **Traffic**
  Congestion pressure in these streets is high. Residents experience this area as very busy at all times
- **Poor walkability**
  Narrow side walks decrease the desire to walk. It also decreases the opportunities for social interaction.
- **Intense Parking Pressure**
  Centrum west has the Highest parking pressure of Amsterdam.

Legend

Polluted roads

Busy cycling routes

rain water bottlenecks



5.4 AUTOMATED MOBILITY

RESEARCH ON NEW TECHNOLOGIES IN MOBILITY

The evolution of digital technologies, such as robotics, internet of things, artificial intelligence, (AI), high-performance computers, modalities in general, and cars in particular, are Hartog, 2019)

The integration of new technologies and communications systems opens up major potential for mobility in the 21st century, especially with regard to increasing road safety, optimising efficiency, reducing energy consumption and emissions and smart ways to improve logistics and transport infrastructure.

"Automated mobility" should be understood here in the context of full automation, where by computer systems are integrated into modalities in such a way that people are relieved from the task of controling/steering or managing the operating modality/system. Modalties such as a self-driving vehicle or bike are emerging examples of automated modalities. Automated mobility is more than just a self driving car. Automated mobility includes different modes of transport which include the automation function.

This project distinguishes 3 groups of different modalties where a form of digitization has been applied.

1. Micro-mobility
2. Smart logistics
3. Automated vehicles

MICRO-MOBILITY

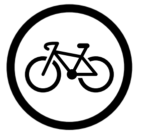
A new wave of micro-mobility is emerging. Micro-mobility are smaller size transportation modes.

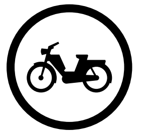
Mico-mobility includes:
Pedal Bicycles
Electric Bicyles
Dockless Bicycles
Mopeds
Electric Mopeds
Electric Scooters

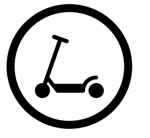
Sharing of these modes has become very popular in the last few years.
The fast growth of these modalities, along with the continued growth of car sharing services, indicates that we're approaching a great change of alternative transportation. (Lambe. 2018)

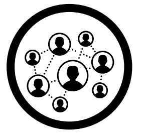
These bikes and scooters are competing to fill a transportation gap the first and last mile problem. This means traveling very short distances up to 3 miles to get to a destination or from the nearest public transportation hub. All these micro-mobility transportation modes mentioned above are very popular modes to tackle the first/last mile problem in the city.

Micro-mobility also includes the feature of mobility as a Service (MaaS).
Bikes, mopeds and scooters are shared among people in the city.
These modalities are owned by private companies such as mo-bike, swapfiets and felyx. These bikes, mopeds and scooters are stationed everywhere in the city and can be rented at any time of the day. Micro-mobility is growing fast, new modalities are on the rise.


Bicycles


Mopeds


Electric Scooters


Mobility as a Service

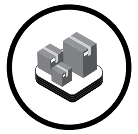
SMART LOGISTICS

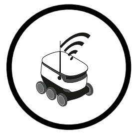
Smart logistics offers automated and more sustainable solutions for
transport and storage of products, during every step of the production process. Automated, because it can do more with less - and more sustainable because it takes the environment into account. Large trucks in urban centers are a growing source of congestion and nuisance. An emerging sollution to this issue are electric automated freight trucks for cargo transport, vehicles and ground bound robots to carry out smaller more efficient rounds of deliveries. Both at the level of business transport and at the level of transport to the consumer, such as parcel delivery companies such as UPS and DHL. The transportation process is optimized: fewer kilometers and reduced environmental impact in exchange for more deliveries.

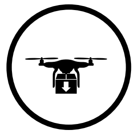
"Robots are quickly making their way into the logistics and transportation sector. They're providing safety, efficiency and accuracy in a wide variety of applications, mostly involving work in the distribution center." (Robotics Online Marketing Team, 2017) Smart robots can also immediately select the right product from the racks and transfer them at high speed to the means of transport with which it ultimately has to reach its destination.
Such transport means are controlled by a smart system. Once integrated with a smart navigation system, which helps to find the fastest route and avoid traffic jams, this can help to make transport smarter and deliveries more efficient.

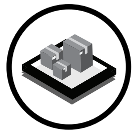
Delivery drones are expected to emerge in the next few years. Packages are being delivered trough small robotic drones in the air.
Parcel delivery robots on water (roboat) are emerging in the next few years. These roboats are currenty being tested on the canals in Amsterdam. Packages are delivered to water pods which could be opened by recipients with a QR code.


Automated freight trucks & Parcel trucks


Autonomous Mobile Robots


Ground-bound delivery robots


Drone delivery


Roboat (water based robot)

AUTOMATED VEHICLES

Automated vehicles/ selfr-driving cars are expected to emerge at level 5 (full automation) in the next decades. These automated vehicles are promised to be more compact and ultimately utilize less road space.
There are different types and sizes of the vehicle, these vehicles are flexible for transportation of goods and people.
The vehicle can for example transport packages from 6am to 9am and afterwards it will transport people. Companies such as Bosh, Google, Uber and Tesla are already experimenting with self-driving cars, starting with the innovative driver assistance systems for safety, security and comfort.

Ride-sharing/ehailing services such as uber and lyft are becomming more popular. These services operate on demand, once you remove the driver from the equasion the availability of the services will become more frequent.

These automated vehicles are likely to operate in fleets at first. According to Kok et al. (2019), by the year 2030 transport-providers who own and operate fleets of autonomous electric vehicles will prove passengers with faster services, increased safety and reduced travelling costs.


Automated vehicles


Automated vehicles on demand (AMOD)


Automated vehicle Fleets

CHAPTER 6

SCENARIOS

6.1 FUTURE TRENDS

Emerging technologies are not only shaping the mobility industry, digitalization of other industries are also developing fast. The following chapter describes a few trends occurring in the world in next decades.

Shopping industry

The shopping industry is becoming more and more digitalized. Advances in technology has made it possible for online shopping. These services are becoming more and more efficient. You can order something today and receive it tomorrow. Some businesses are only available online and do not have an actual physical shop. People are buying clothes online, getting them delivered to their homes, trying them on at home, and sending them back via post if they do not fit. These online services are expanding, now grocery stores such as Albertheijn and Picnik are providing deliveries of groceries.

Transport & Logistics industry

Digitalization transformation of the transport and logistics industry
enables the transport and supply chain optimization. Deliveries being tracked online by the customer online since they have ordered the product/service. Customers can follow the exact route from the warehouse to their homes, they can even contact the driver of the vehicle. Digitalization inside ware houses has made storing and loading more efficient by using logistics robots who move and select the packages from the warehouse.

Digital transformation also has impact on jobs in the logistics sector, automation of cargo trucks substitutes the driver from the delivery. Digital transformations have made the industry more efficient, resilient, decreased costs for the company , and the administrative burden. (Heistermann, Mallée & ten Hompel, 2016) Self delivery vans are the future of digitalization, autonomous delivery of goods. Additionally, companies such as amazon air are looking to carry packages trough drones.

Car-industry

The car industry is completely changing, digitalization has already made services possible such as GPS, self-parking, auto-pilot features, electric cars etc. The car industry will change even more in the next decades. Electric vehicles do not operate on fuels, if all cars will become electric we don't need gasstations anymore. People in this section will also lose their jobs, as their services are not necessary anymore. If automated cars have advanced sensors, traffic elements such as road markings, parking meters, traffic lights, traffic sensors, tolls etc are not necessary anymore. This has a huge impact on the streetview. Mobility as a service (Maaas) is reducing car-ownership, according to the PBL (2018) the car-ownership in the Netherlands has decreased because of more car sharing trips. People use these car sharing services because in the end the travel costs with are much cheaper than owning a personal vehicle.

Travel behavior

The behavior of people is also changing, people are going out less/ more. Technology has made it possible to work from home, study online, shop from home, do your groceries from home, there is no need to go outside for these purposes anymore. (Durand et al., 2017)Advances in technology are enabling the substitution of communication for travel. Services such as uber and lyft are changing traditional mobility patterns, they are much cheaper, most of the time they are available 24/7 and the service is very efficient. People will also move different, people are already sharing cars with other people(strangers), services such as Uber-pool pick up to 4 people along the way to drop off at their destinations. These services are much more cheaper than the single uber rides.

Transition Hubs

Moiblity transition places such as stations are becomming these HUBS with a varried program. Places where different programs meet each other to be efficient for the passengers. An example of these hubs are Train stations, supermarkets, pick up/ delivery points, gyms and other services are all together in one building or in the same area. People can immediately pick up their packages or pass by to do some groceries when they arrive at the station.

Circular economy

Circular economy aims at decoupling economic activity form the conspumtion of finity resources and taking waste out of the system.
it is based on 3 principles, eliminate waste and pollution, keep materials and producs in use and to regenerate natural systems. ("What is a Circular Economy? | Ellen MacArthur Foundation", 2019)

6.1 SCENARIO I

CONSERVATIVE SCENARIO

STORY

Digitalization has paved the way for automated mobility. Automated is introduced to Amsterdam. AV's are restricted to highways and main roads in the city centre Automated vehicles are mostly part of a platoon/fleet they In order to keep parked AV's out of the street view, av's are parked in public parking garages or private garages owned by fleets. These av's are parked outside of the city ring. They drive to several hop-on-hop-off stops in the city centre passengers can get on here and continue/end/start their journey. The cost efficiency of the shared automated vehicle service has reduced car ownership in Amsterdam.

The hop-on-hop-off zones are located near transit hubs which stimulates the use of the multi-modal transport network. These vehicles are promoting the use of public transportation systems by picking people at the hop-on-hop off locations at the multi modal hub. Passengers are combining their trips by taking the AV to the train station, arriving at their destination and taking a shared bike to work. Micro-modalities are very popular and efficient.

Cars driving in the city centre have to either be electric or automated, this contributes to Amsterdam's vision for improved air quality. Parking spaces have been reduced due to automated cars which are parked elsewhere and shared car services. Packages and goods are beginning delivered to your house by ground bound robots and delivery vans on selected delivery times. Because the emissions - free automated vehicle the environment in the centre is much healthier and livable. Parking spaces have reduced, this space can be used to expand sidewalks & cycling lanes or used for micro-modality parking

6.1 FACTORS

CONSERVATIVE SCENARIO

FACTOR	2040	2060
Automated vehicles	No automated vehicles driving in district Freight automated trucks travel on dedicated lane on the highway	Autonomous vehicles become a major portion of vehicle fleets. Dropping off people at the drop off zones and
Shared mobility	Increase in car sharing, bike sharing, ride sharing and e-hailing Policies encourage shared mobility services	Increase in automated car sharing, electric bike sharing, ride sharing and e-hailing AVs are only affordable and available by privileged (Affluent) users
Modal split	20% Private car 17% Public Transport 32% Cycling 29% Walking	17% Private car 20% Public Transport 33% Cycling 30% Walking
Public Transportation	Higher frequency of public transportation modes Improved efficiency of public transportation modes	Use of PT has increased because of reduced parking per household AV's are starting to be used in combination trips with public transportation and active transport modes
Cost of travel	Public transportation is protected by local and national policies so that the cost of travel could be lower than e-hailing, car sharing and ride sharing services	Public transport services will be protected by policies so that the high appeal of AVs does not exclude these public services from the transport system
Travel Behaviour	Changing user preferences: Preference for E-hailing and ride sharing services Increase in combination trips: Public transport + e-hailing + walking & cycling	Changing user preferences: Preference for E-hailing and ride sharing services Increase in combination trips: Public transport + e-hailing + walking & cycling

FACTOR	2040	2060
Parking	Parking spaces have become less because of car sharing yet it is still crowded with cars in the streets New development has to arrange parking on their own block Parking permits on the streets are not issued anymorev	Parking spaces have reduced due to automated cars which are parked elsewhere and reduced car ownership per household Automated vehicles park in selected parking spaces in the district in fleets
Car ownership	Car ownership has been reduced to a minimum due to reduced parking per household	Car ownership has been reduced due to shared cars, av's and reduced parking per household
Logistics	Packages are delivered by ground-bound robots on sidewalks and on the canals on scheduled times Freight automated trucks travel on dedicated lane on the highway	Packages are delivered by ground-bound robots on sidewalks and on the canals on scheduled times Freight automated trucks travel on dedicated lane on the high-way
Public safety	Automated trucks are only allowed on dedicated lanes on the highway and the robotic parcel deliveries have scheduled times for delivery	AV's on selected main routes which is known to cyclist and pedestrians Pedestrians and cyclists have right of way
Trends	Ageing population Change in housing units More working at home Increase in Online shopping More/less going out	Ageing population Change in housing units More working at home Increase in Online shopping More/less going out
Environmental Quality	Electric cars & car-sharing reduce the percentage of air pollution Noise pollution hasn't improved	Av's reduce the percentage of air pollution and noise pollution
Streets	New curb side uses: expanding sidewalks and cycling lanes	New curb side uses: expanding sidewalks and cycling lanes

6.2 SCENARIO II

PROGRESSIVE SCENARIO

STORY

Automated vehicles have become mainstream in the year 2060. Amsterdam has completely adopted this new mobility system. Av's and robots are roaming the streets. Av's operate on highways and on selected arteries in the city.

The cost efficiency of the shared automated vehicle service has reduced car ownership in Amsterdam. Av's are promoting the use of public transportation systems by picking people at the hop-on-hop off locations at the multi modal hub.

Technology has developed to an extent where pedestrians, micro-modalities and cars can share the road space safely in some areas. Parking spaces have been reduced due to automated cars which are parked in locations at nodes. The automated vehicle requires less space than the original vehicle. All this freed up space creates the opportunity to redesign the streets. The opportunity to introduce more green spaces/public spaces & to use this extra space for expanding sidewalks and cycling lanes.

Packages and goods are being delivered to your house by ground bound robots and delivery vans 24/7.
Cars driving in the city centre have to either be electric or automated, this contributes to Amsterdam's vision for improved air quality. Because the emissions - free automated vehicle the environment in the city is much healthier and livable.

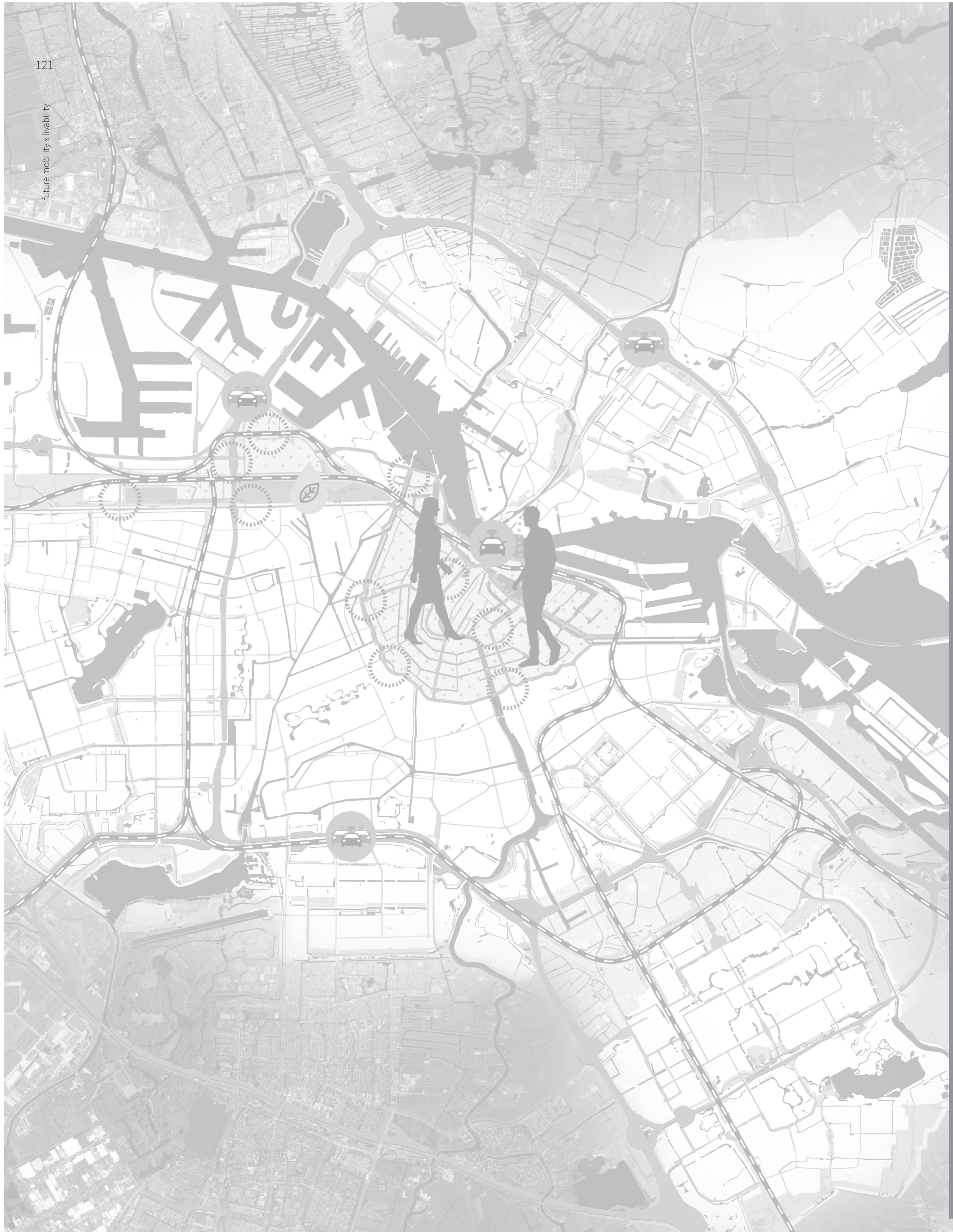
6.2 SCENARIO II

PROGRESSIVE SCENARIO

FACTOR	2040	2060
Automated vehicles	Automated vehicles are part of a platoon/fleet Automated vehicles travel to and from the business area and the sporting area	Autonomous vehicles become a major portion of vehicle travel. AV's & electric cars only allowed
Shared mobility	AVs are promoted in fleets Policies encourage the use of automated vehicles through fleets AVs are only affordable and available by privileged (affluent) users	Increase in private automated car sharing Policies encourage shared automated mobility services of fleets and private AV sharing
Modal split	19% Private car 18% Public Transport 33% Cycling 30% Walking	17% Private car 18% Public Transport 33% Cycling 32% Walking
Public Transportation	Higher frequency of public transportation modes Bus, metro, tram and train capacities are likely to be adjusted after automation AV's travel to transit hubs which increases the use of PT	Public transportation integration with Automated vehicle model AV's are used actively in combination trips with public transportation and active transport modes
Cost of travel	Public transport services will be protected by policies so that the high appeal of AVs does not exclude these public services from the transport system	Credit system: Using different combinations of transport systems to arrive to your destination will give you rewards which could reduce your trip fare
Travel Behaviour	Changing user preferences: Shared automated vehicles rather than personal vehicles. Increase in combination trips: Public transport + e-hailing + walking & cycling	Changing user preferences: Shared automated vehicles rath-er than personal vehicles. Increase in combination trips: Public transport + e-hailing + walking & cycling

FACTOR	2040	2060
Car ownership	Car ownership has been reduced to a minimum due to reduced parking per household	Car ownership has been reduced due to shared cars, av's and reduced parking per household
Parking	Parking spaces in the streets have reduced due to car sharing and automated cars which are parked elsewhere The old parking spaces in streets are used to expand cycling lanes ,sidewalks, public spaces and green spaces	Automated vehicles park outside the city in fleets and on selected arteries / main roads The old parking spaces in streets are used to expand cycling lanes and sidewalks these spaces are also used for public spaces and green spaces
Logistics	Packages are delivered by automated vehicles, robots on water and land. Freight automated trucks travel on dedicated lane on the highway	Packages are delivered by automated vehicles, robots on water and land. Freight automated trucks travel on dedicated lane on the highway
Public safety	AV's on selected main routes which is known to cyclist and pedestrians	AV's ensure the safety of pedestrians and cyclists in the streets
Trends	Aging population Change in housing units More working at home Increase in Online shopping More/less going out	Aging population Change in housing units More working at home Increase in Online shopping More/less going out
Environmental Quality	Av's reduce the percentage of air pollution and noise pollution	Av's reduce the percentage of air pollution and noise pollution
Streets	New curb side uses: loading zones for automated vehicles Public spaces Green spaces Reduced vehicle access Removed parking from main streets, opportunities for public space and green spaces	Shared streets Reduced vehicle access to create opportunities for community gathering, green space, and active transportation networks. New curb side uses: loading zones for automated vehicles Public spaces Green spaces

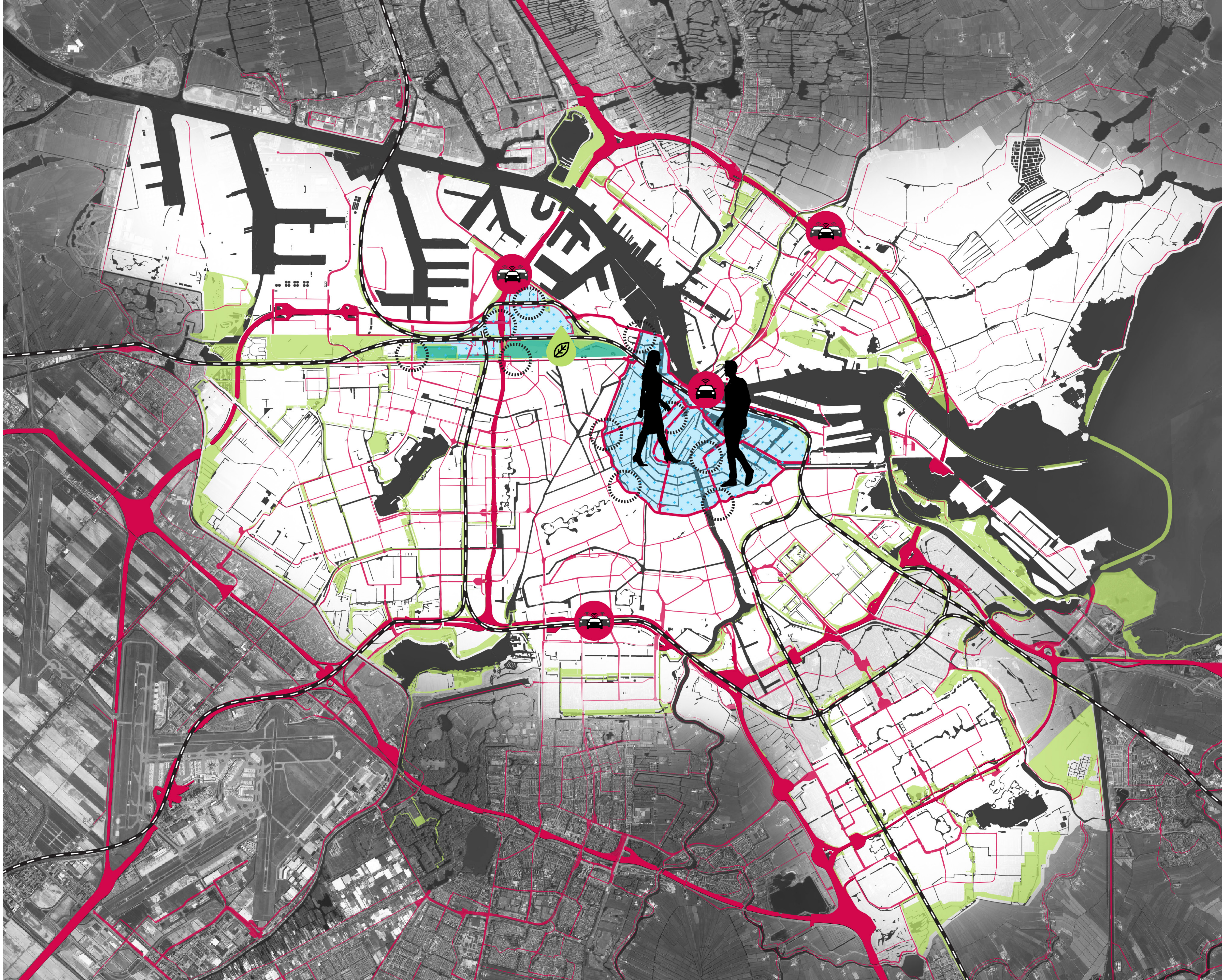

CRYSTAL TOWER
real estate
Amsterdam Sloterdijk
SLOTERDIJK STATION
HAVEN CITY
AMSTERDAM CENTRAAL STATION
BUSINESS PARK SLOTERDIJK
150
WELCOME ANA! YOU ARE SHARING A RIDE WITH 4 PEOPLE
CAR 2 GO



CHAPTER 7

SPATIAL VISION

7.1 THE VISON



+ AMSTERDAM

FAST AUTOMATED MOBILITY ROUTE

CITY CENTRE CONNECTION ROUTES AUTOMATED MOBILITY

MAIN ROADS AUTOMATED MOBILITY

EXISTING ECOLOGICAL STRUCTURE

NEW ECOLOGICAL CORRIDOR

PARKING HUBS/TRANSITION ZONES

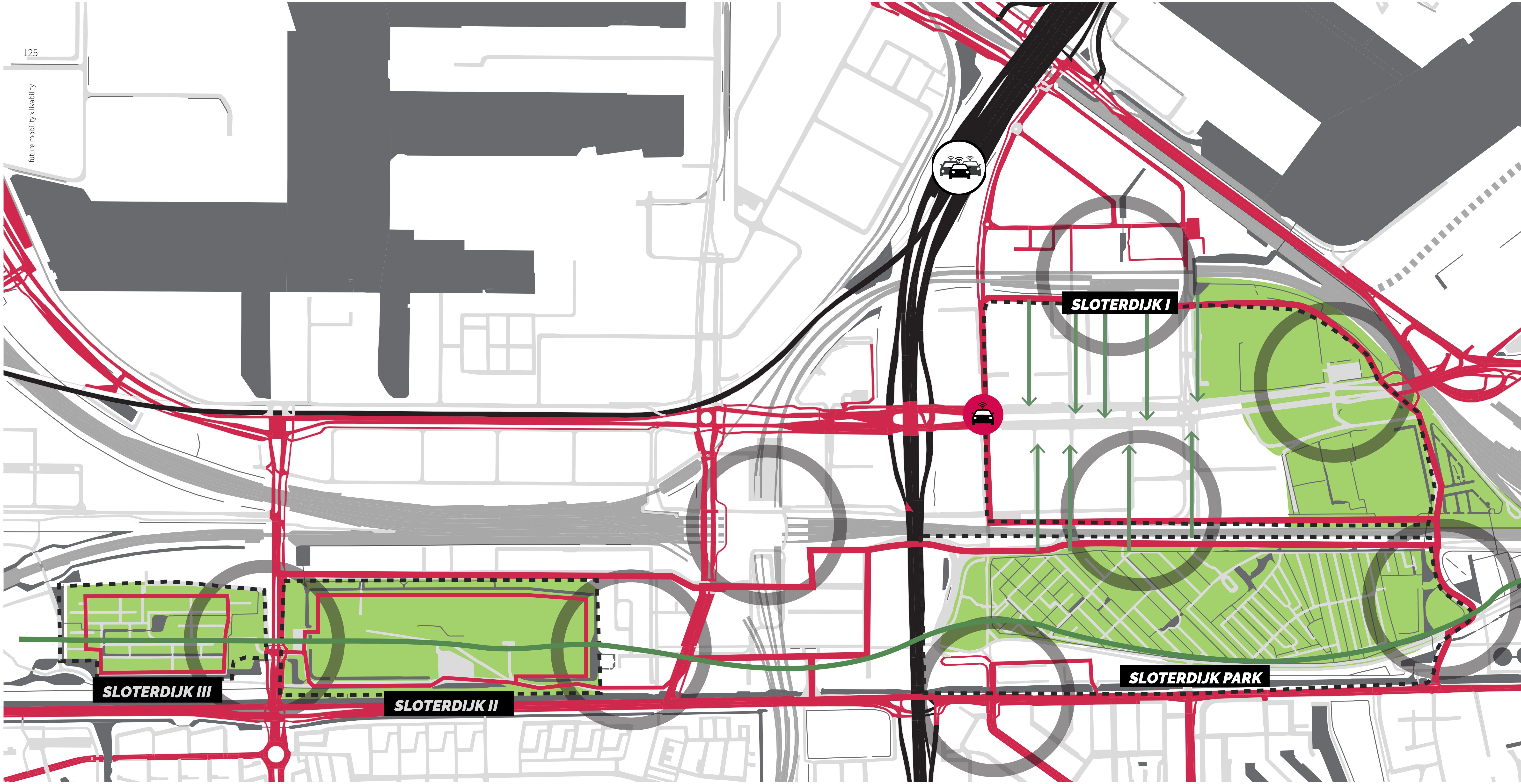
IMPROVE AIR QUALITY

AUTOMATED CARS ON HIGHWAY

AUTOMATED CARS ON MAIN ROADS

ENHANCE/PRESERVE ECOLOGICAL STRUCTURE

The main focus of the vision for Amsterdam 2060 is to increase walkability. By limiting the amount of cars to certain arteries, walkability and overall accessibility can be improved. Enhancing the green spaces in Sloterdijk will strengthen the ecological zone. The vision also focuses on improving the environmental health of the city.



7.2

SLOTERDIJK

SPATIAL VISION
1.15000

AUTOMATED CAR HIGH WAY

MAIN ROADS AV'S

PARKING HUBS

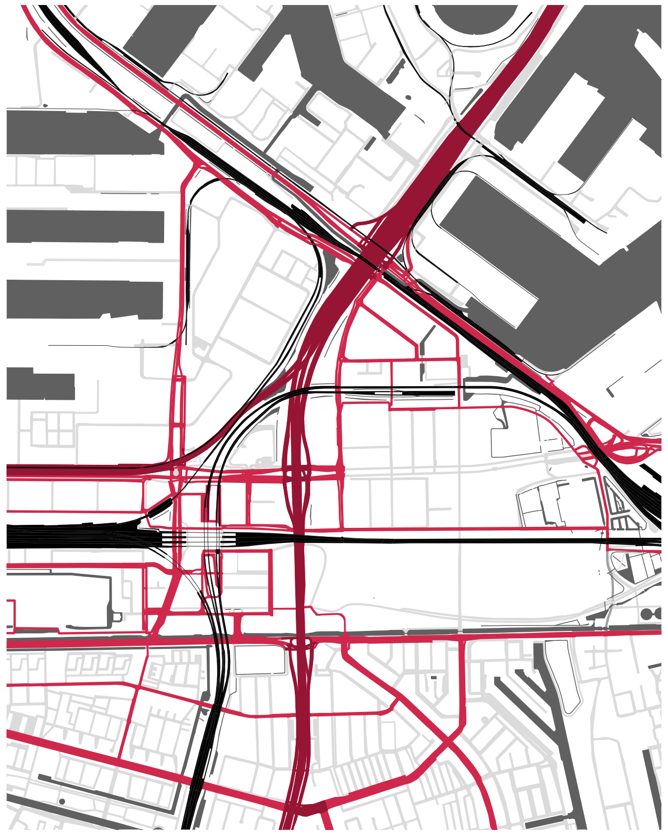
METRO CONNECTION

RECREATIONAL ROUTES

GREEN CONNECTIONS

The vision for Sloterdijk is to enhance and strengthen the ecological zone while densifying the location. AV's are restricted to roads around the neighbourhood.

AMBITIONS SLOTERDIJK



Av Network

- Automated vehicle high ways (fast)
- Automated vehicles main roads (slow)

Large scale

Regional connection automated vehicle highway

Introduce new highway exit/entrance which connects the main route to the city centre

System with dedicated fast automated vehicle routes and slow automated vehicle routes

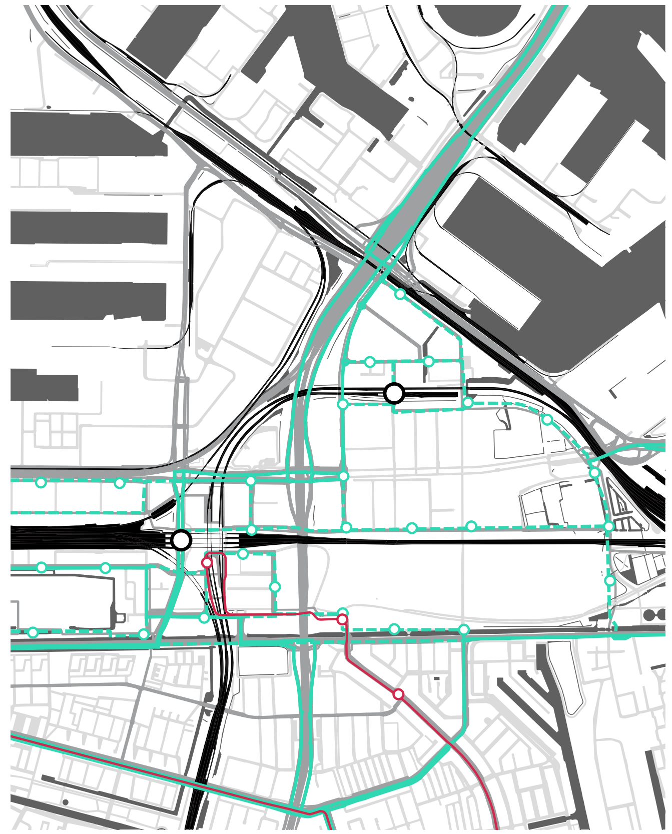
Small scale

Remove vehicular traffic on transformatorweg

Limit amount of vehicular traffic in the streets

Parking in garages/ at HUBS

Introduce a 50km/h speed limit on slow routes



Public transport network

- Tram
- Bus
- New bus connection
- New connection Metro
- Train

Large scale

Introduce new automated vehicle bus route

Highly accessible to metropolitan region

Introduce a sustainable transport system: No fumes, noise, green energy

Small scale

Introduce a shared mobility platform with all mobility as a service(MAAS) options. This platform gives you options to use other types of shared mobility systems.

Introduce campaigns to raise the quality image of Public transportation.

HUBS

- HUBS/ Transition zones

Large scale

Hubs/transition zones located near multiple transport interchanges

Hop/on / Hop-off zones located alongside main Automated vehicle routes.

Small scale

Introduce campaigns to promote shared mobility to decrease the amount of vehicles on the road.

Introduce a mobility platform which shows availability of the AV's & options for sharing rides with others at HUBS

Pedestrian & Cycling Network

- Pedestrian network
- Cycling network

Large scale

Introduce an enhanced pedestrian network which is connected public spaces & recreational areas in Sloterdijk

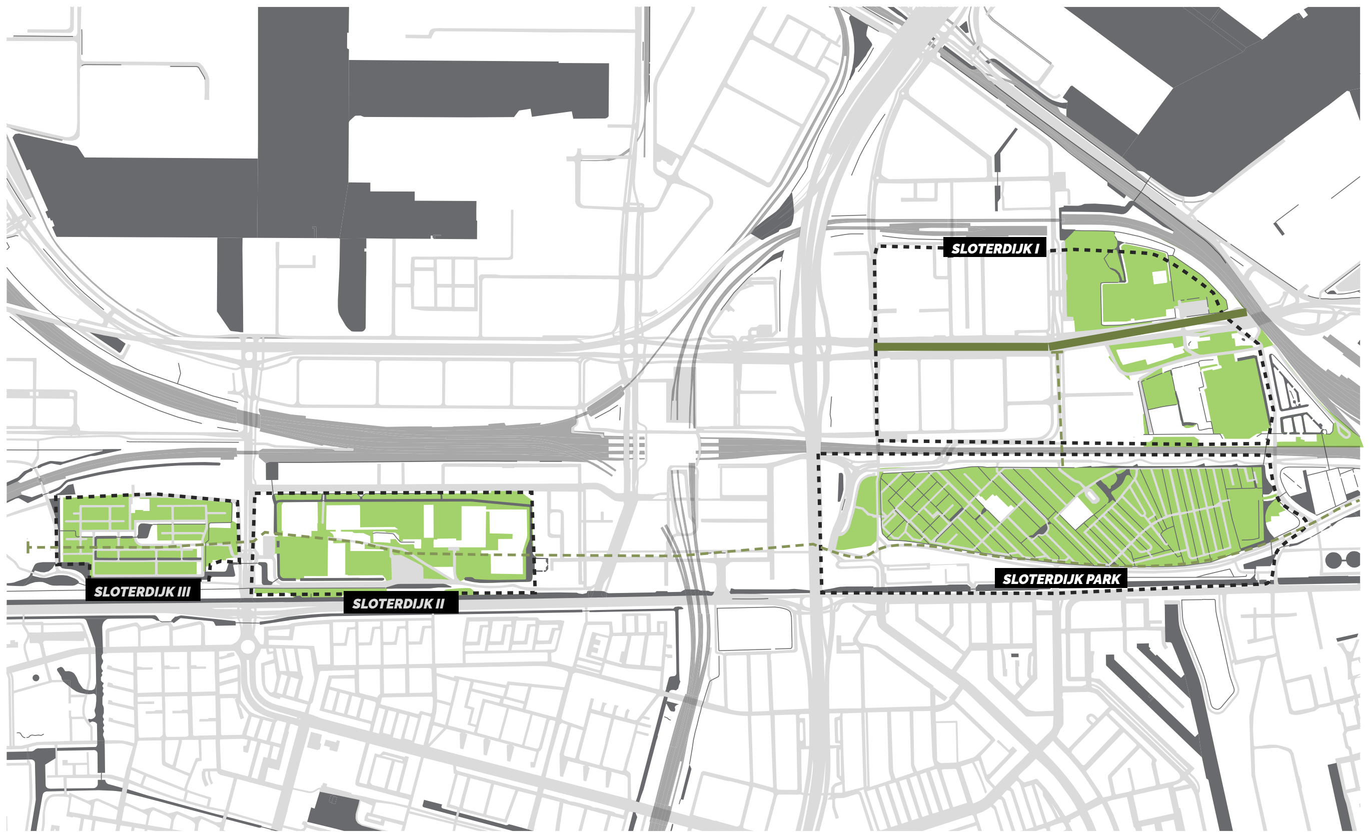
Introduce a safe, comfortable and efficient cycling network

Small scale

Expand cycling lanes and sidewalks

Introduce active public space by creating flexible public spaces

Introduce POPS (privately owned public spaces) owned by businesses for the public



Development **Green city**

- Linear park
- Recreational route

Large scale
Sloterdijk I: Mixed use development of existing businesses, new businesses, offices, leisure and residences

Sloterdijk Park: *Living in nature,* residences integrated in the park.

Sloterdijk II: Former sports fields are now a medium density mixed use development neigbourhood with businesses, offices, leisure and residences

Sloterdijk III: Former allotment gardens are transformed into a residential area where city farming is available for locals and residents of the neighbourhood.

Large scale
Connect, preserve & enhance ecological corridor

Enhance main green structure connecting scattered green spaces

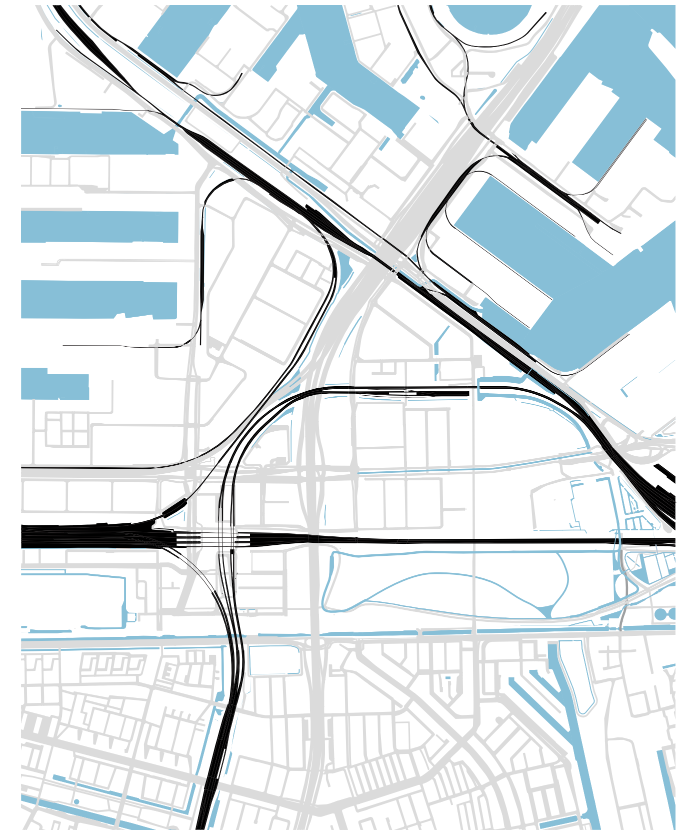
City park with various programs for the city

Linear park with water corridor

Small scale

Green roofs and facades, solar panels Give space to new forms of freedom within park

Introduce park "rooms" in urbanized areas sloterdijk I with different functions introduce urban farming.



Water storage

- Water bodies for water storage
  Rain proofing

Large scale
Water corridor in the transformatorweg is used as a storm water containing buffer

Enhance the ecological structure

Rainwater storage beneath sports fields

Urban water channels

Small scale
Rain water ponds for buffering and purifying of polluted water

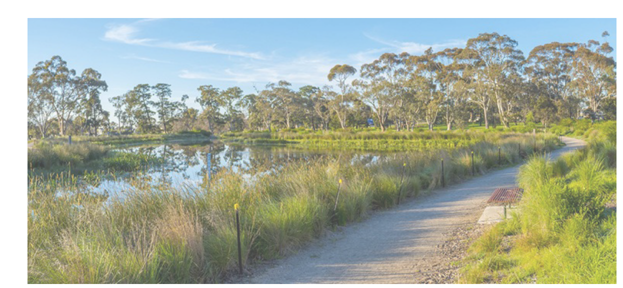
Bioswales are incorporated into the main green structure can help enhance biodiversity

References

Forest playground Maxima park, Utrecht

Urban farming, New York

Art exhibitions, New York



Sydney, Australia

7.3 CITY CENTRE

AUTOMATED VEHICLES MAIN ROADS

SHARED STREETS: PEDESTRIAN, PT & MICRO MOBILITY

SHARED STREETS: PEDESTRIAN, MICRO MOBILITY (EMERGENCY SERVICES)

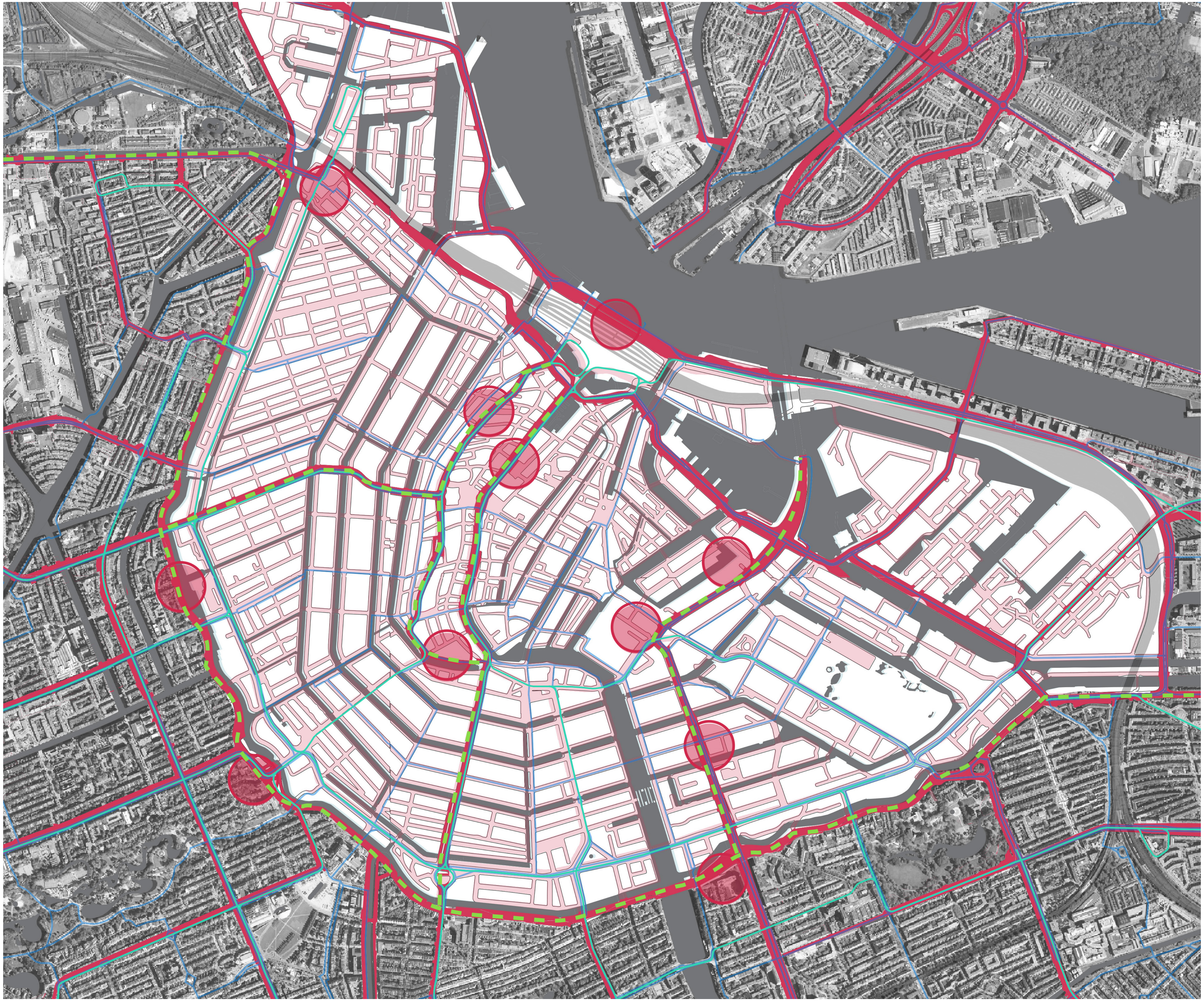
PARKING SPACES/ TRANSITION HUBS

ENHANCED CYCLING NETWORK

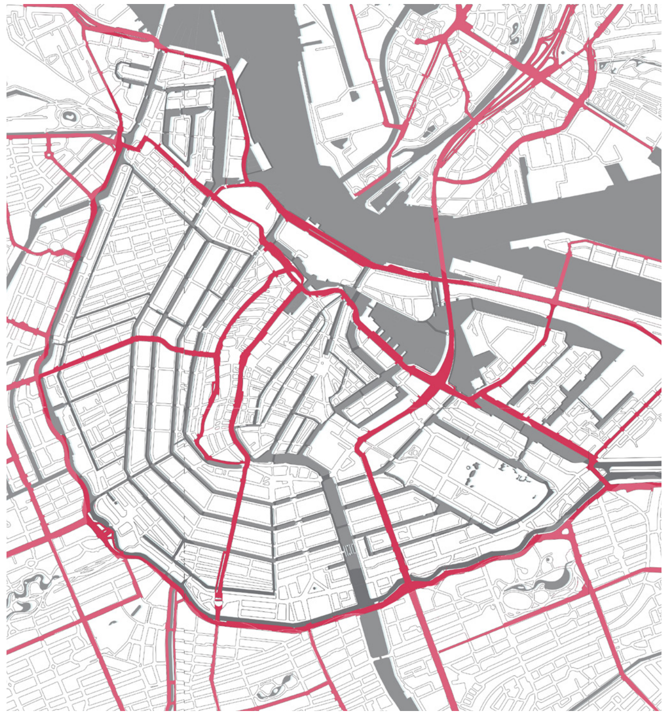
NEW BUS ROUTE

EXISTING TRAM ROUTE

Introducing a new fast mobility network where automated vehicles and electric vehicles are restricted to certain arteries will improve accessibility and encourage walkability. This will alleviate the traffic flow. Hubs located at key nodes in the city centre should absorb the parking pressure in the city centre combined with the notion that some automated cars are parked outside the city centre or continue to drive in a system. This creates the opportunity to introduce shared streets for pedestrians, micro-mobility and emergency services.



AMBITIONS CITY CENTRE



Automated vehicle network

Automated vehicles main roads

Large scale
Limited amount of cars in the city centre, no parking in streets

Automated buses in peak hours in the city centre, low speed limit.

Open access to all roads for emergency services.
Shared streets.

Small scale
Smaller more compact av lanes

Introduce campaigns to promote the use of other transportation modes to alleviate cars on the road.

Accessible Transition zones

Parking spaces/transition zones

Hop-on/Hop-off alongside road

Large scale
Well situated transition zones on a larger scale

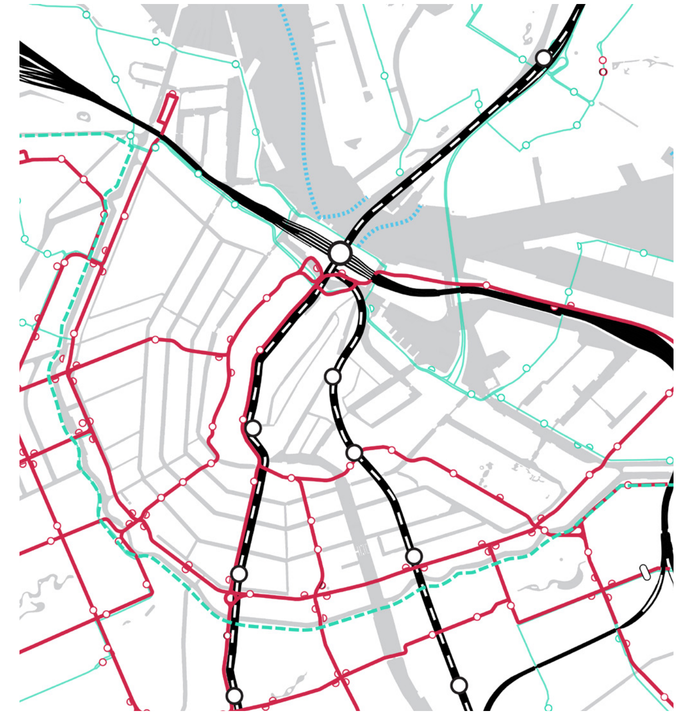
Transition zones located near PT stops

Hop/on / Hop-off zones located alongside main Automated vehicle road and parking spaces.

Small scale
Introduce campaigns to promote shared use

Mobility to decrease the amount of vehicles on the road.

Introduce a mobility platform which shows availability of the AV's & options for sharing rides with others



Connected public transportation network

Tram
Bus
New bus connection
Metro
Train

Large scale
A dedicated public transport street

Introduce a sustainable transport system: no fumes, no noise, green energy.

Hop-on / Hop-off zones located alongside new bus route outside inner-city ring.

Residences are reachable within 10 min walking distance from nearest transition zone.

Small scale
Introduce a shared mobility platform with all mobility as a service(MAAS) options. This platform gives you options to use other types of shared mobility systems.

Introduce campaigns to raise the quality image of Public transportation.

A walkable inner city

Pedestrian routes

Public spaces

Large scale
Create a strong & safe pedestrian network

Establish strong links between PT and the pedestrian network.

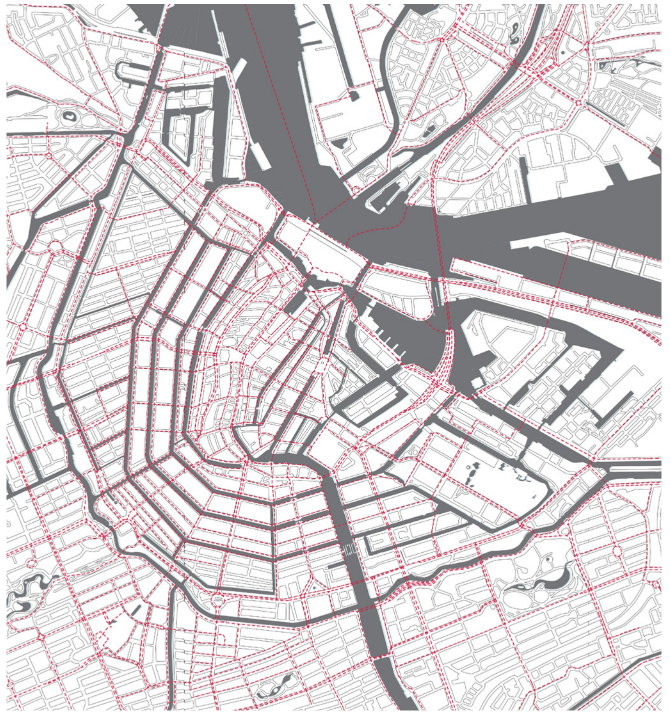
Accessibility to public spaces, squares and parks for all people.

Introduce a variety of street types that identify a hierarchy of the pedestrian network.

Small scale
Widen sidewalks

Introduce more public meeting places in streets

Introduce health and walk-to-work campaigns



Logistics

- Routes delivery systems on ground
- Routes delivery systems on water

Large scale
Platform for goods going in and out of the city centre

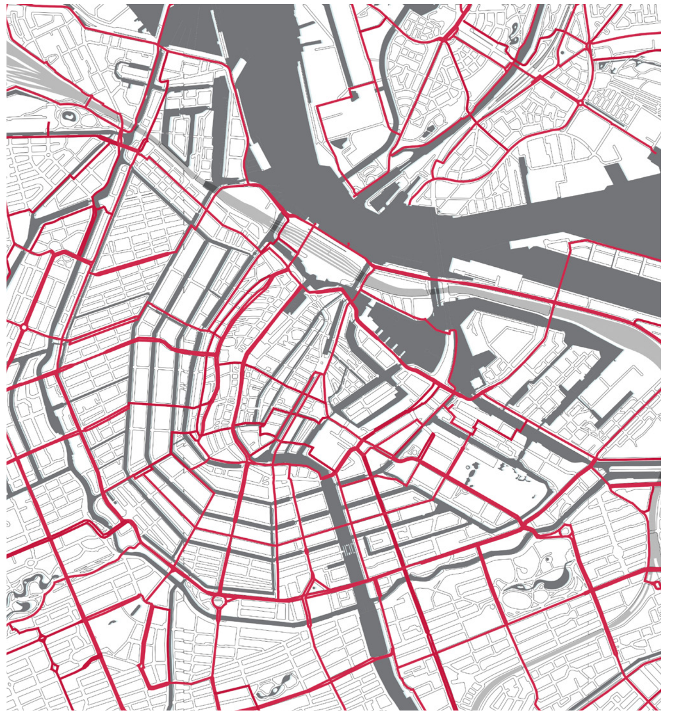
Central puck up points

Travel goods over water (high speed)

Selected times for delivery robots inside city centre
Waste pick-up services trough automated vehicles in city centre

Small scale
Introduce campaign to deliver goods at pick up point so that residents can pick them up there

Small delivery pods travel on pavement at low speed



Enhanced cycling network

- Improved cycling network

Large scale
Overall connected cycling network

Ensure strong connections with routes outside the city centre. Distinguish hierarchy of cycling routes.

Develop a system of safe, dedicated cycle lanes on main streets.

Small scale
Introduce cycling campaigns to raise awareness of cycling behavior and to promote the benefits of cycling.

Underground bicycle parking
Dock less micro mobility at pt stops

Shared streets

- Shared streets: Public transport, pedestrians, micro mobility & delivery pods
- Shared streets: pedestrian, micro mobility & delivery pods

Large scale
Distinguish hierarchy of streets

Shared main streets PT, pedestrians, micro mobility and delivery pods.

Shared streets slow traffic pedestrian,
micro mobility & delivery pods

Small scale
Re-design street profiles.

Flexible design of streets.

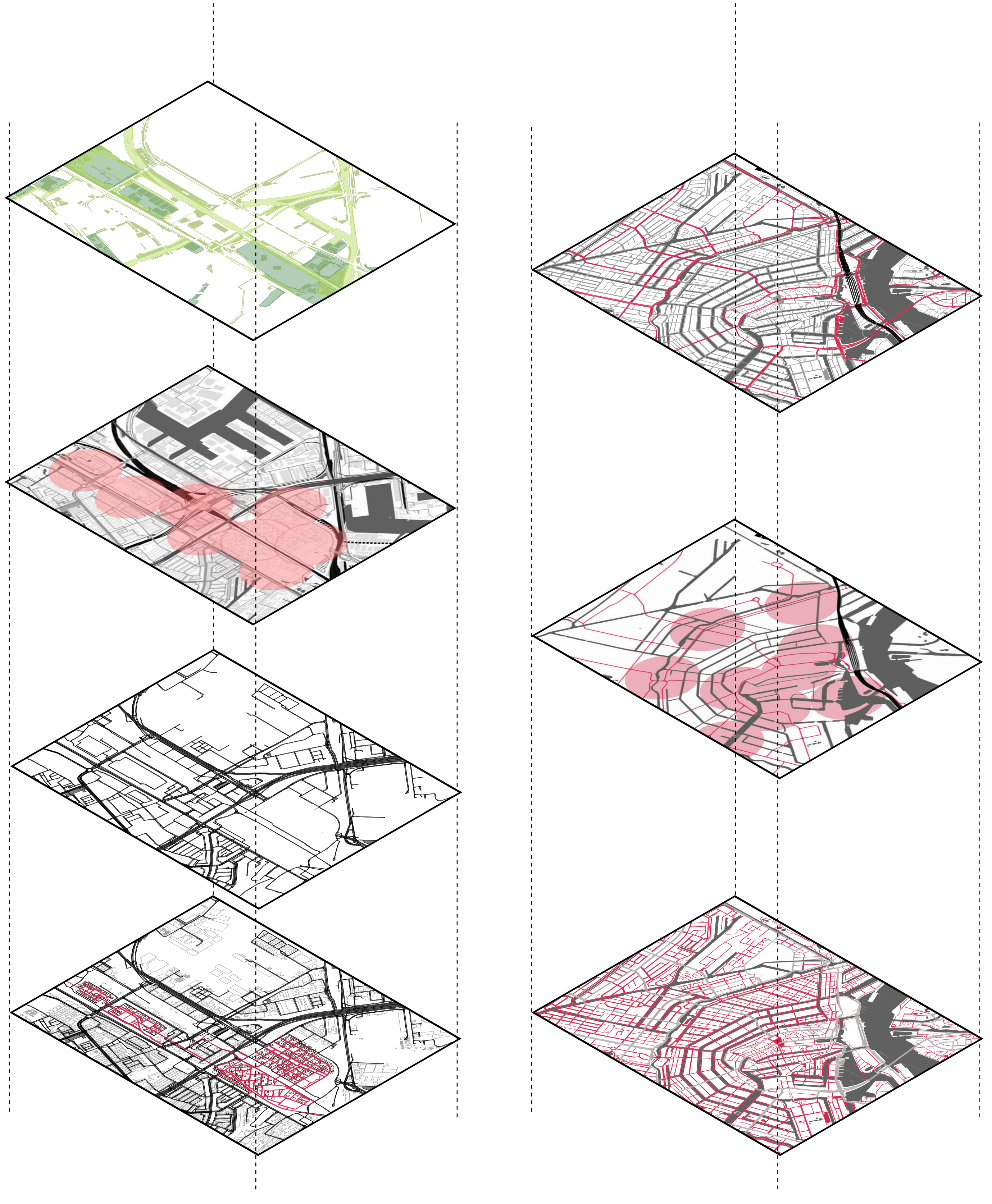
Introduce shared streets campaigns to raise awareness off rules in shared streets.

References shared streets

Copenhagen, Denmark

Madrid, Spain

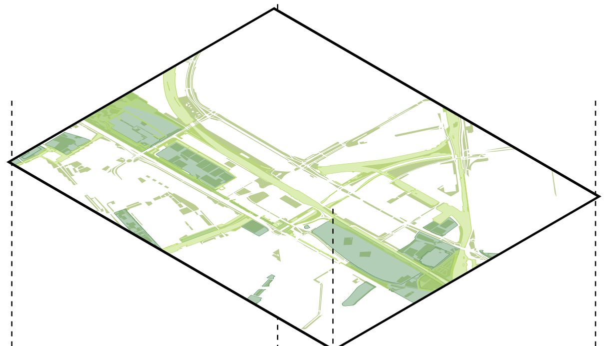
Bonn, Germany



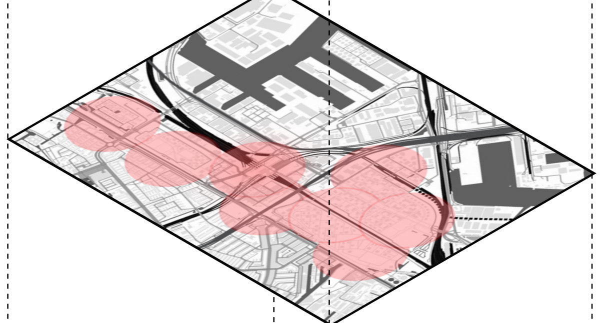
CHAPTER 8
DESIGN STRATEGY

8.1 DESIGN STRATEGY SLOTERDIJK

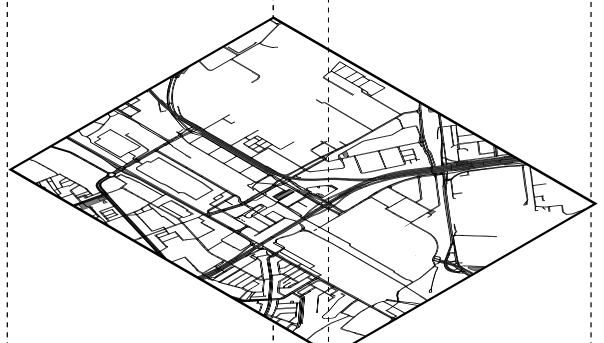
CITY SCALE



Enhance ecological structure

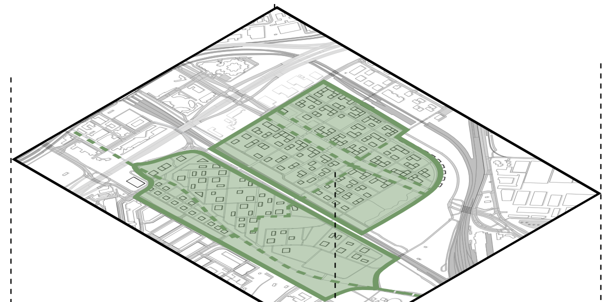


Parking HUBS & transition zones located near key nodes

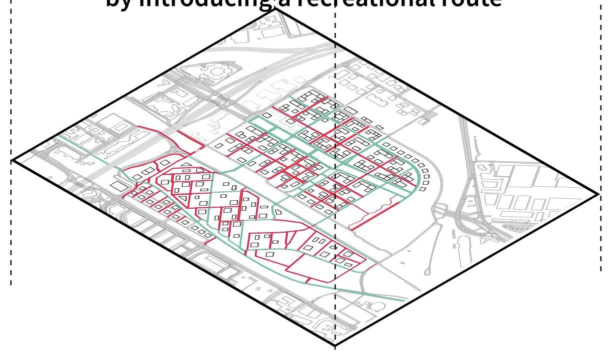


Steer motorized traffic to go around neighbourhoods

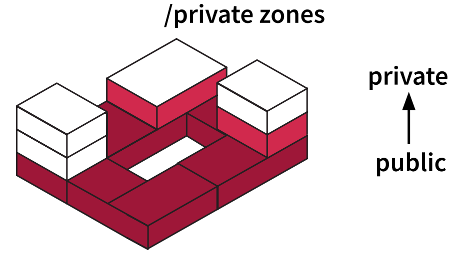
NEIGHBOURHOOD SCALE



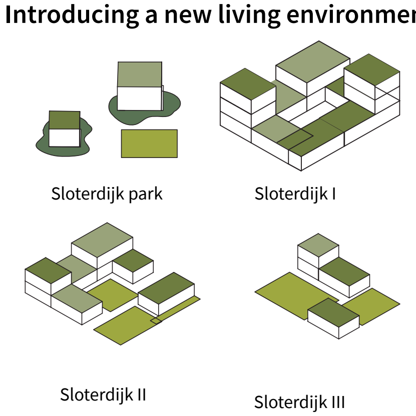
Connect neighbourhoods of Sloterdijk by introducing a recreational route



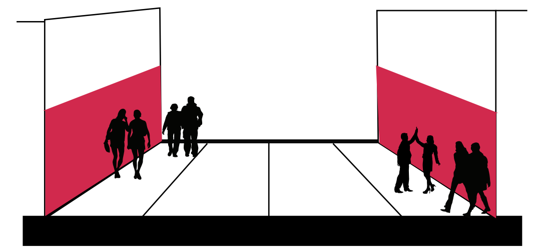
Hierarchy of streets to manage crowdedness in the streets and public /private zones



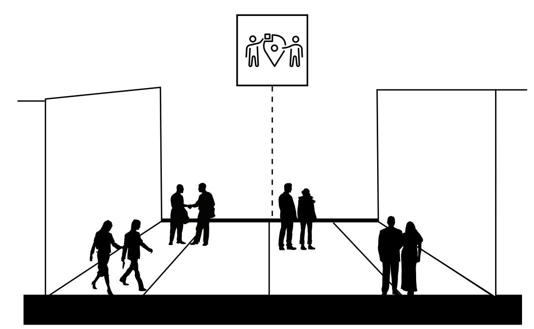
Introducing a new living environment



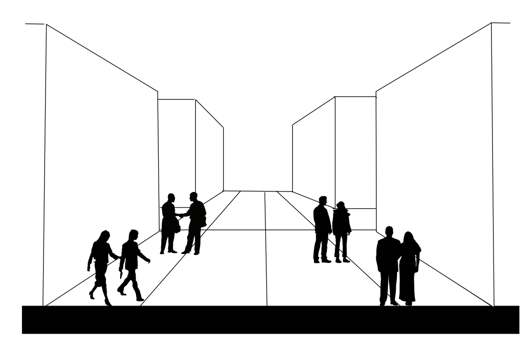
HUMAN SCALE



Active human layer by introducing a public program to the plinth.



Streets become places flexible streets, living streets places to meet



Short distances between blocks ensures improved walkability

The strategy for the design of the neighbourhoods in Sloterdijk is on 3 scales,the city scale, neighbourhood scale and the human scale. The city scale is focused on the connectivity and accessibility of the overall new mobility network in Amsterdam and the ecological value of this location in Amsterdam

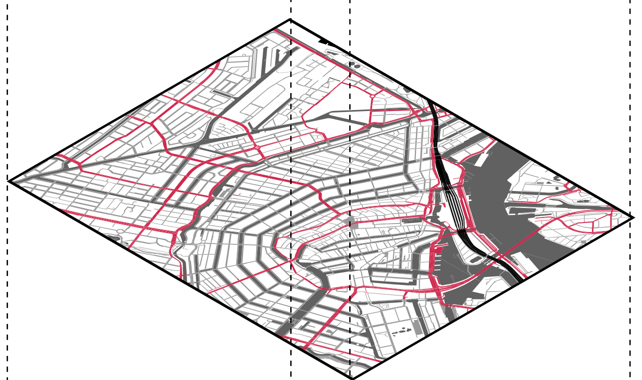
The neighbourhood scale on the other hand is focused on connecting these 4 neighbourhoods trough introducing recreational routes, managing crowdedness trough designing a hierarchy of streets in Sloterdijk. The spatial strategy for the Soterdijk area is to introduce a new living environment where several typologies are implemented this is shown in the diagrams on the left.

The design strategy on the human scale focuses on creating a walkable and active neighbourhood. This is created trough introducing 3 themes, first to add public programs to the plinth, such as shops, cafe's and pop-up stores. Second, the notion where streets, become places. Places to meet, places to eat, places to listen to music etc. Last, to create short distances between blocks. According to van Talen and Koschinsky short distances between amenities and ones home makes a neighbourhood walkable. These themes above contribute to the walkable and active neighbourhood according to Talen & Koschinsky (2013).

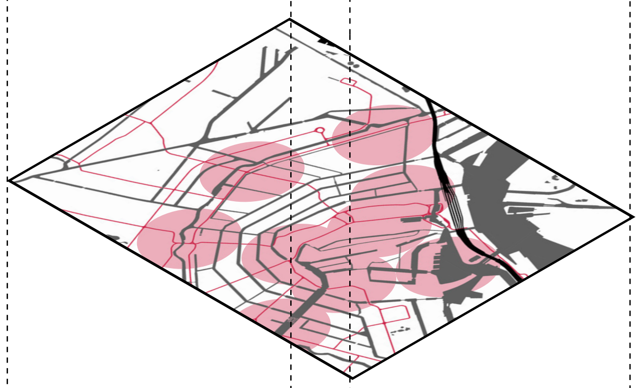
8.2 DESIGN STRATEGY CITY CENTRE-WEST

CITY SCALE

Limit the amount of vehicular activity in the city centre to maintain accessibility



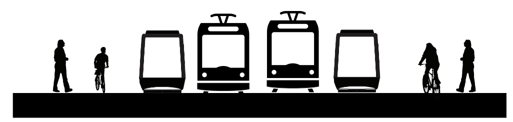
locate transition hubs & parking at key nodes (5m radius - 10min walking)



Create a network of secondary roads (not accessible by car)

NEIGHBOURHOOD SCALE

Separate streets by speed and status primary roads or secondary roads



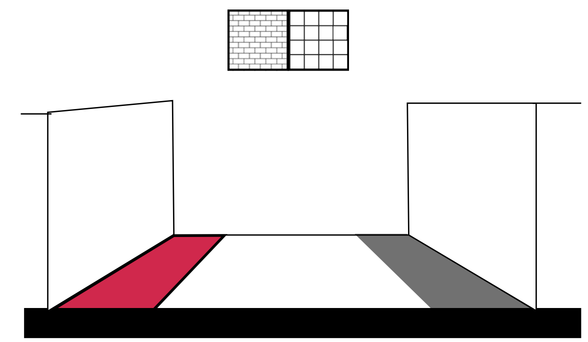
Primary Roads

Secondary roads

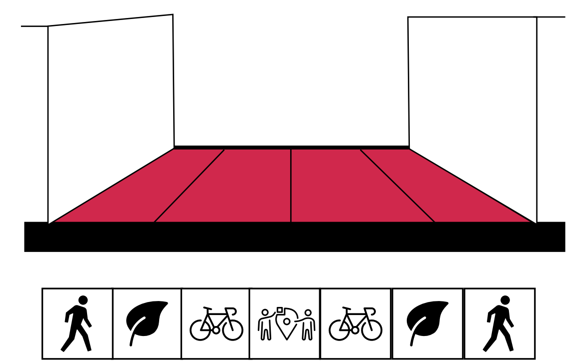
Status of the streets decides the internal organization of the street and the public spaces

HUMAN SCALE

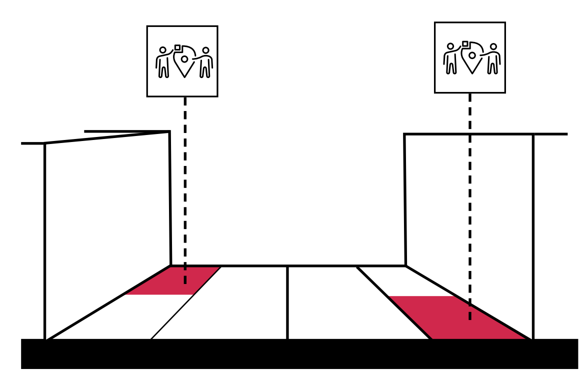
Preserve architectural quality carefully replacing materials when adjusting street profile



Recapture street space for the public realm



Introduce flexible spaces in street scape



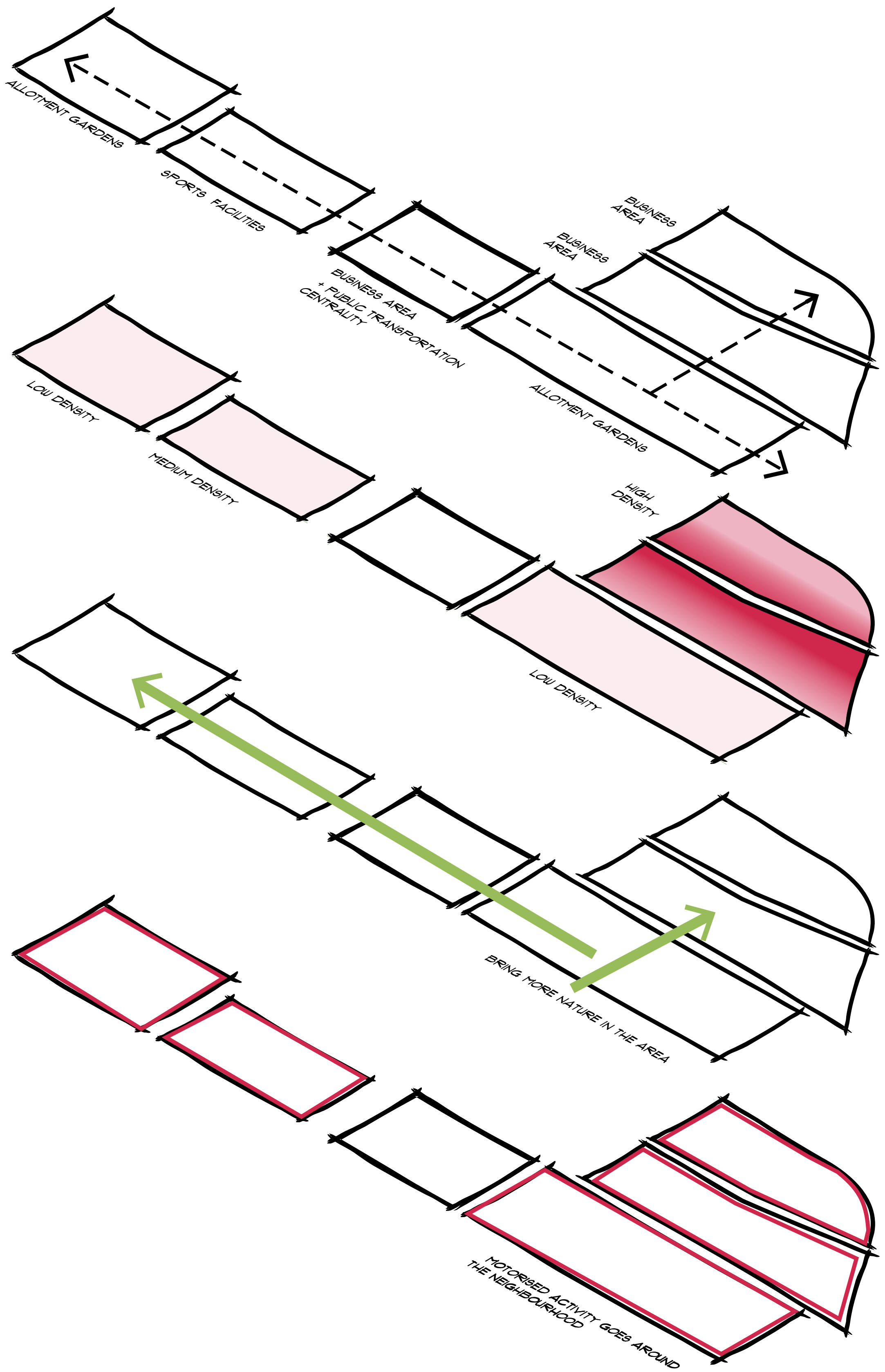
The strategy for the design of the city centre is on three scales, the city scale, neighbourhood scale and the human scale. There are 3 spatial strategies for each scale. The city scale is focused on the connectivity and accessibility of the overall new mobility network in Amsterdam. How it works on the bigger city scale effects all other scales .

The neighbourhood scale on the other hand is focused on the status of the street. This is key for redesigning the street profile. The status of the street decides the internal organization of the street and the public spaces. For example, primary roads have a priority to ensure a continues traffic flow without congestion and easy access. Pedestrians and cyclists are not the main priority here. However, in secondary roads pedestrians and cyclists have priority as there are no cars passing through the streets.

It is important to note that in the design strategy for the human scale the architectural quality of Amsterdam is preserved. The human scale is focused on the experience of the street and the environments.

CHAPTER 9
DESIGN

9.1 CONCEPT
Design Sloterdijk



MASTER PLAN CONCEPT

Amsterdam is making room for the expected population growth, existing mono-functional areas are being developed in to multi functional areas. To connect the area, qualities of the park have been blended into the new development. The natural landscape flows into the surroundings while the housing is merged with the landscape.
The buildings are organized with the taller buildings towards the street and the lower buildings located towards the park. The taller buildings towards the main streets have a maximum footprint while the buildings located towards the park leave a minimal foot print, allowing the park landscape to flow in between the structures.

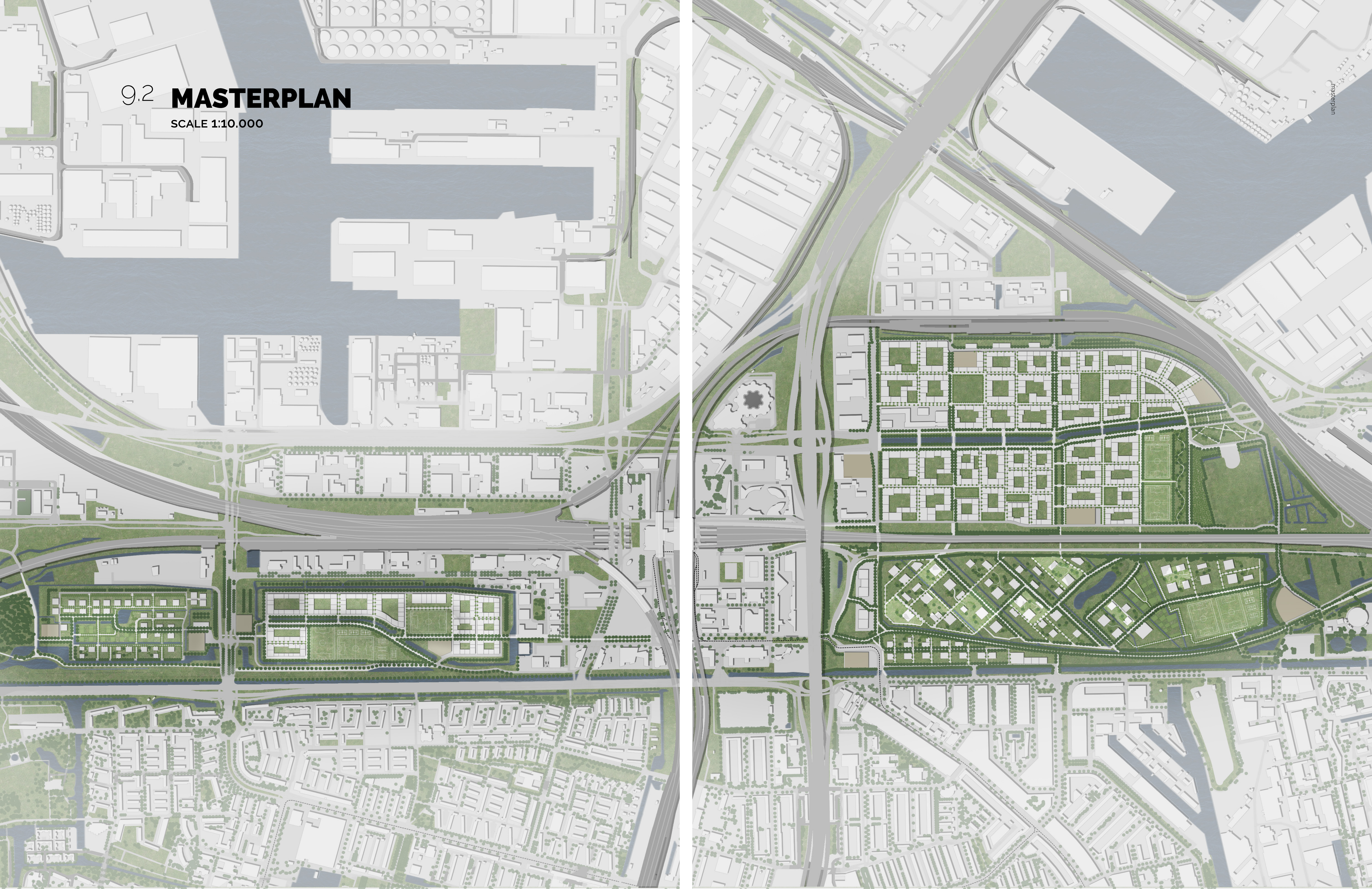
By eliminating car activity from streets there is more space available for non-car associated activities. Pedestrians and Cyclists dominate the streets. There is now space for flexible programs in the streets. Programs such as food-truck festivals, terraces, pop up markets and other cultural events or festivities.

AMBITIONS

- Increase walkability
- Limit car activity
- Connect recreational areas
- Increase built density
- Densification in nature
- Enrich biodiversity
- Introduce nature inclusive development
- Activate the human layer

9.2 MASTERPLAN

SCALE 1:10.000



DESIGN

SLOTERDIJK 1 &
SLOTERDIJK PARK

SCALE 1:5000

LEGEND

SPORTS FACILITIES

URBAN FARMING

SLOW MOBILITY ROUTES

COMMUNAL GARDENS

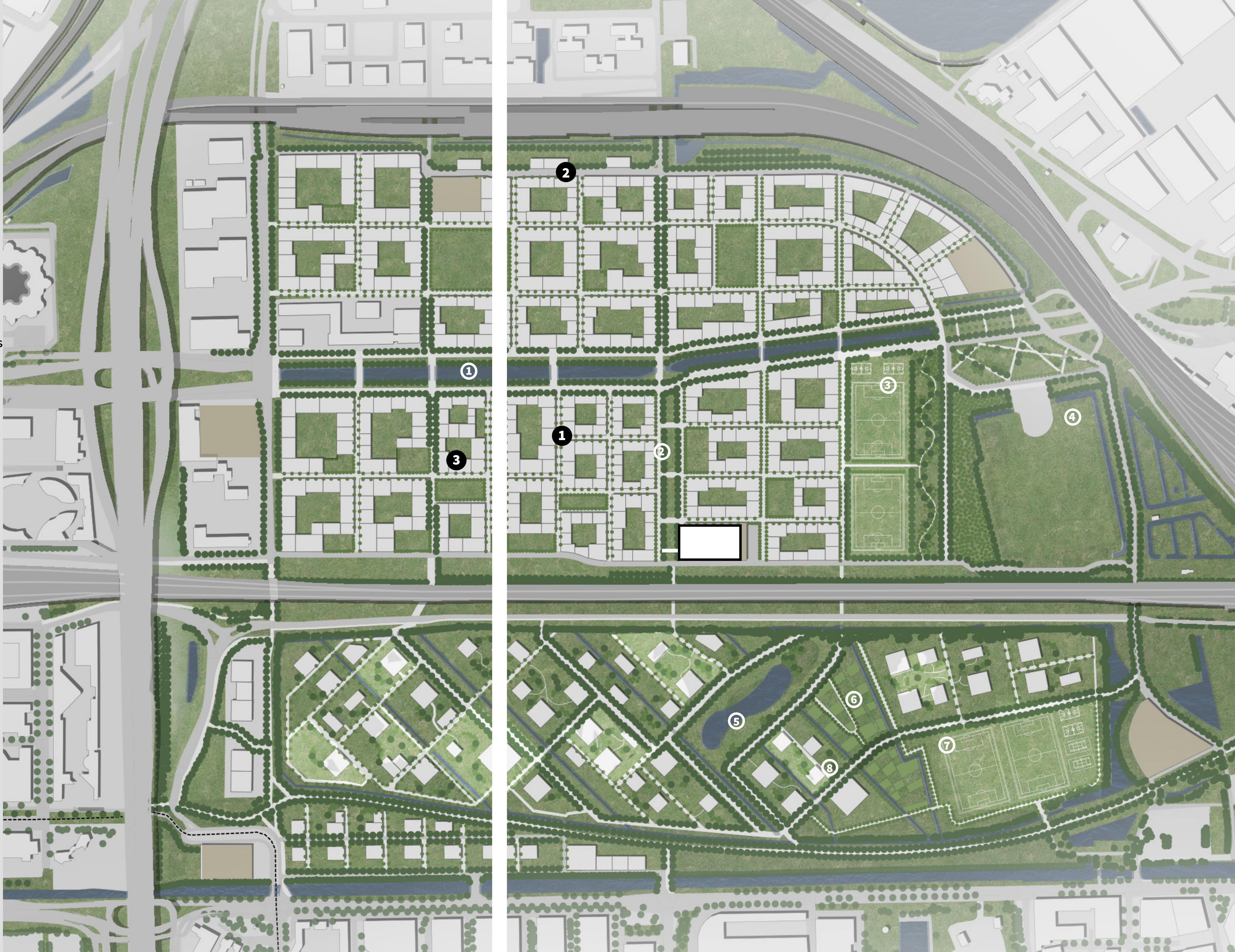
MOTORIZED ROADS

TRANSITION HUB

1 LINEAR PARK
2 PARK
3 SLOTERDIJK SPORTS
4 CEMENTARY
5 COMMUNITY PARK
6 CITY FARMING
7 SPORTS
8 COMPOST FACILITY

IMPRESSIONS

The design features a high density mixed use development and residential development in a Park. It features over 3.000 residences, 6 parking hubs, sport facilities, public parks and a recreational route to the brettenzone.



DESIGN

Sloterdijk 2 & 3

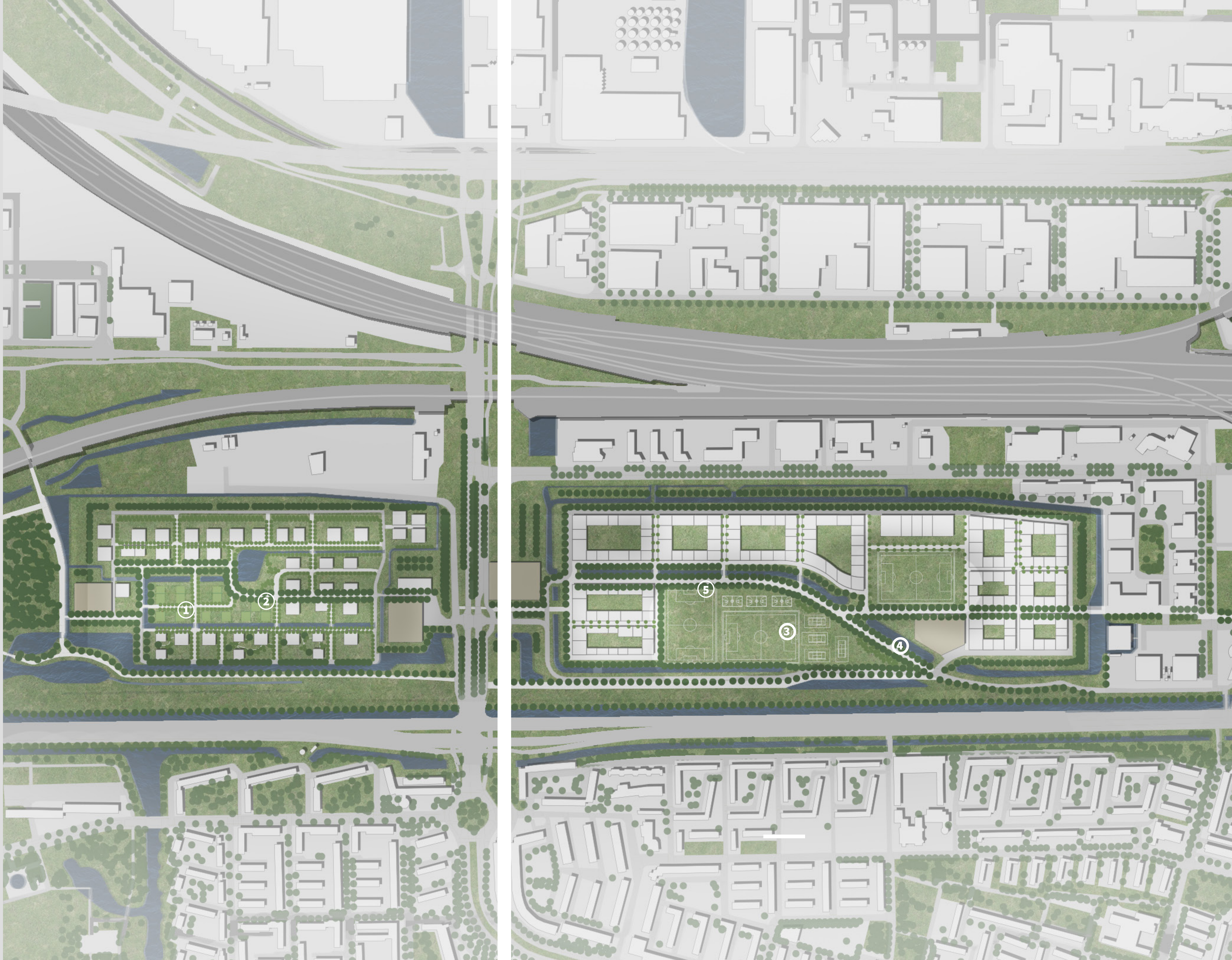
SCALE 1:5000

LEGEND

- SPORTS FACILITIES
- URBAN FARMING
- SLOW MOBILITY ROUTES
- MOTORIZED ROADS
- TRANSITION HUB

1 CITY FARMING
2 PARK
3 SPORTS
4 TRANSPORTATION HUB
5 RECREATIONAL ROUTE

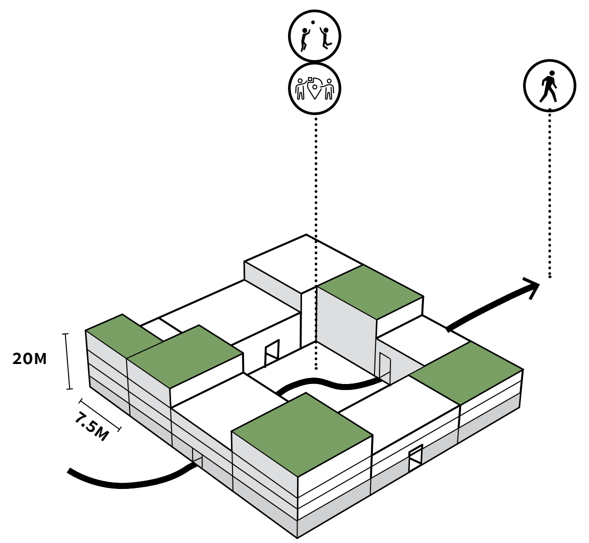
The former sport facilities and allotment garden locations are transformed into a residential development. Characteristics of the existing sport facilities and allotment gardens still remain. The new design features more than 1.000 residences 4 parking hubs, a recreational route to the brettenzone, sport facilites and urban farming.



SLOTERDIJK 1

CHARACTERISTICS

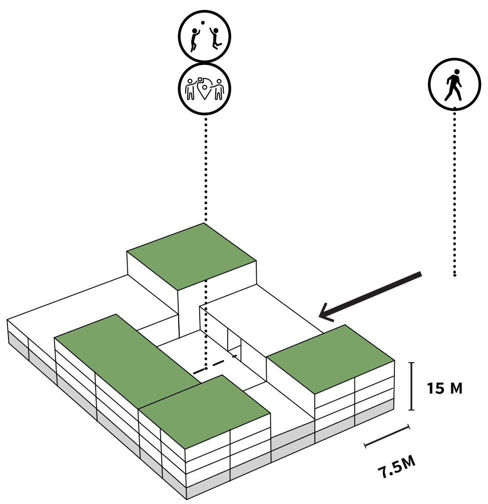
- MIXED USE DEVELOPMENT (LEISURE, RESIDENTIAL, WORKING)
- PLINTH = PUBLIC PROGRAM
- COURTYARDS
- POPS (PRIVATELY OWNED PUBLIC SPACES)
- GREEN ROOFS
- MAX HEIGHT = 25 M



SLOTERDIJK 2

CHARACTERISTICS

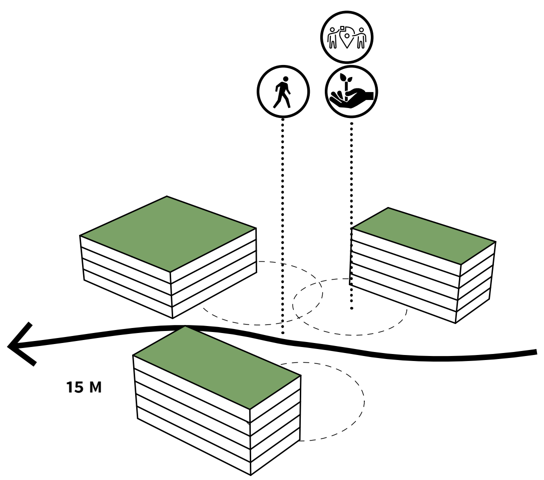
- MIXED USE DEVELOPMENT (LEISURE, RESIDENTIAL, WORKING)
- PLINTH = PUBLIC PROGRAM
- COURTYARDS
- GREEN ROOFS
- MAX HEIGHT = 15M



SLOTERDIJK PARK

CHARACTERISTICS

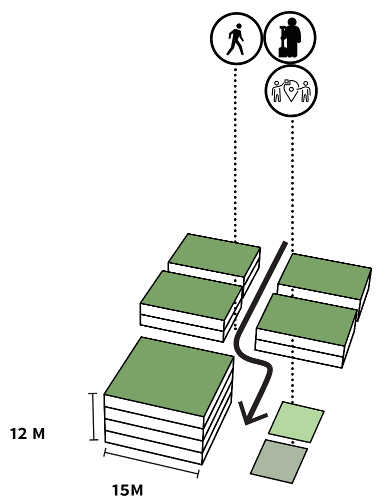
- RESIDENTIAL DEVELOPMENT
- COMMUNITY GARDENS
- URBAN FARMING
- GREEN ROOFS
- MAX HEIGHT = 18 M



SLOTERDIJK 3

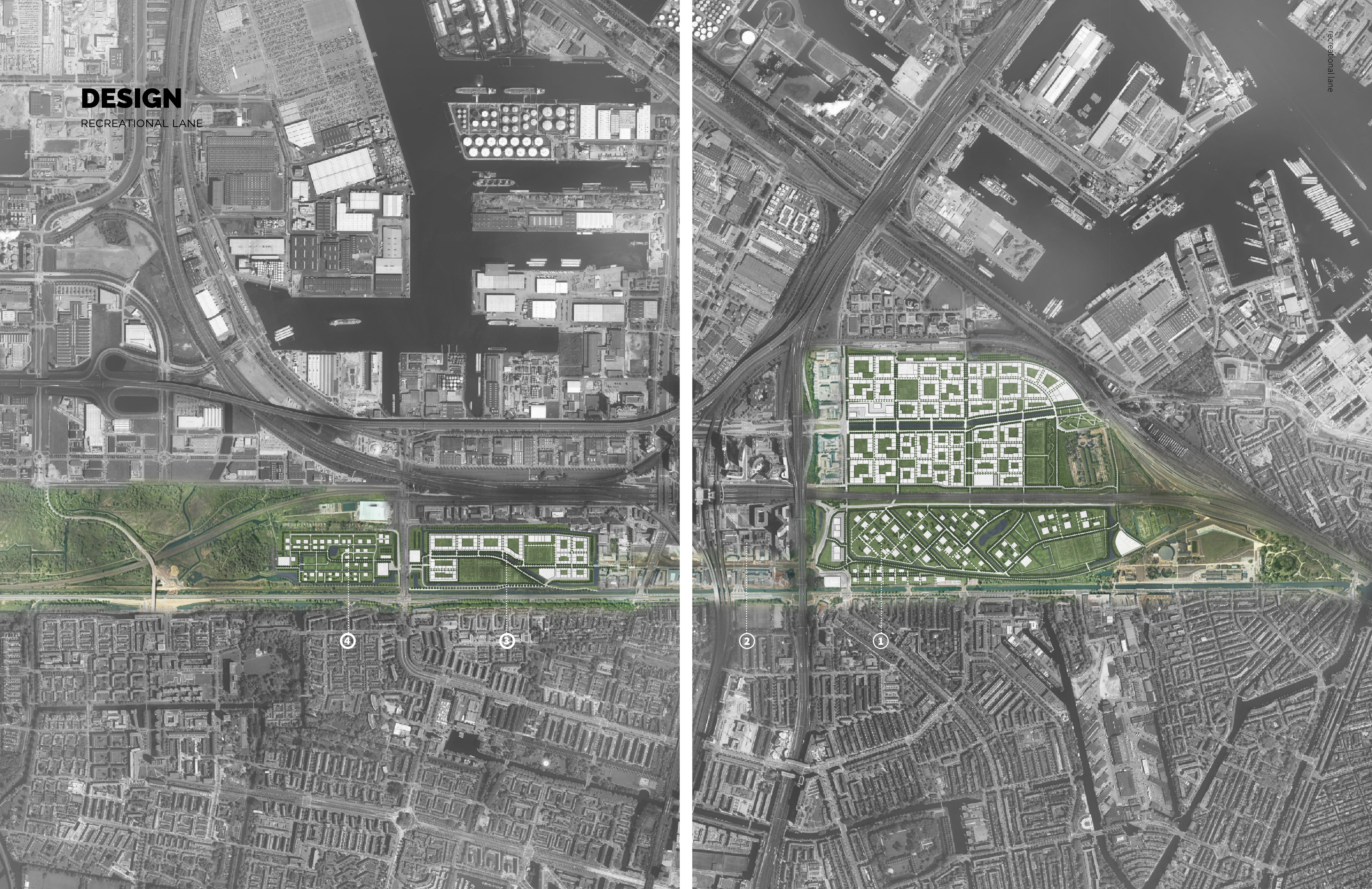
CHARACTERISTICS

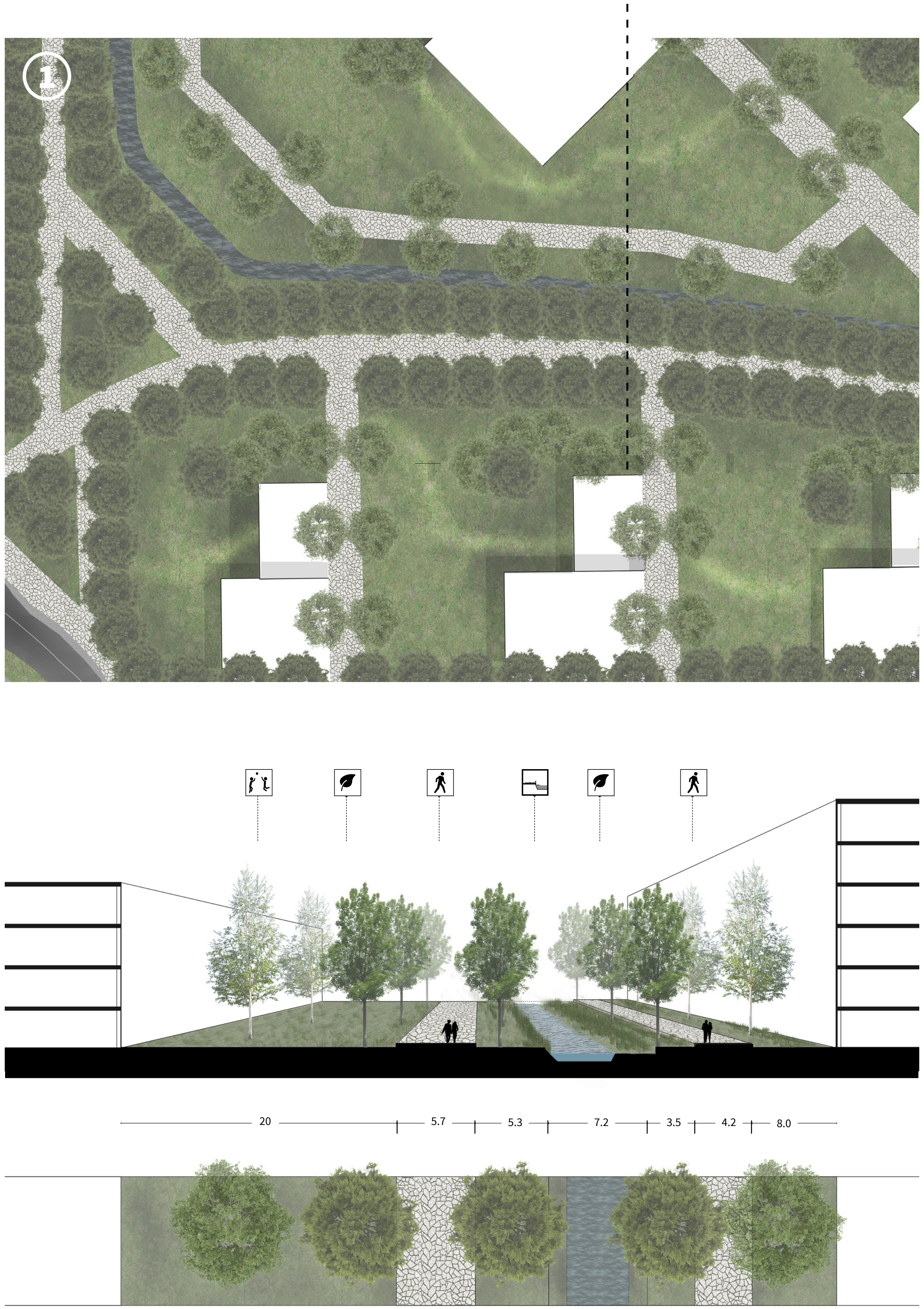
- RESIDENTIAL DEVELOPMENT
- COMMUNITY GARDENS
- URBAN FARMING
- GREEN ROOFS
- MAX HEIGHT = 12 M



DESIGN

RECREATIONAL LANE

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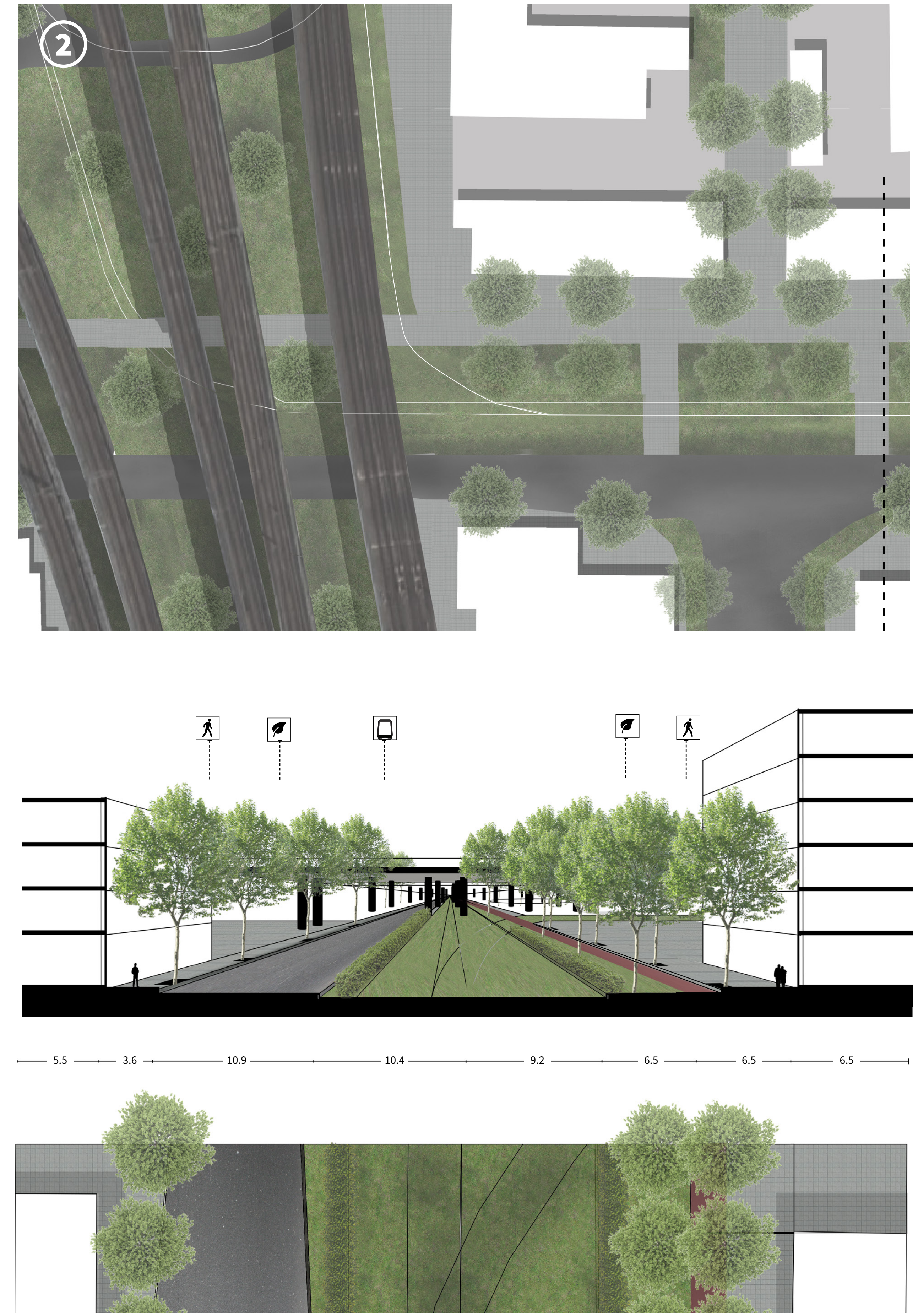
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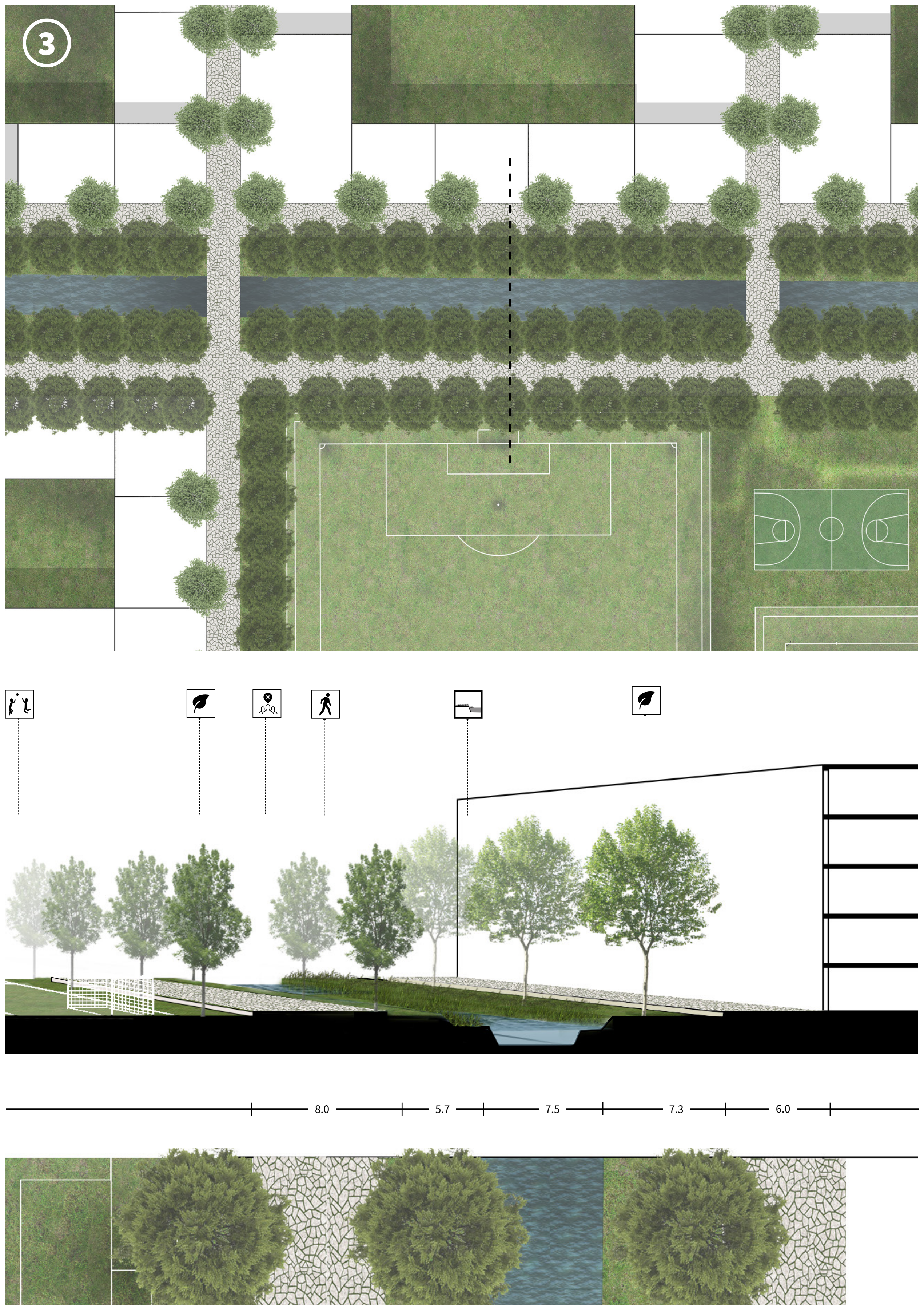
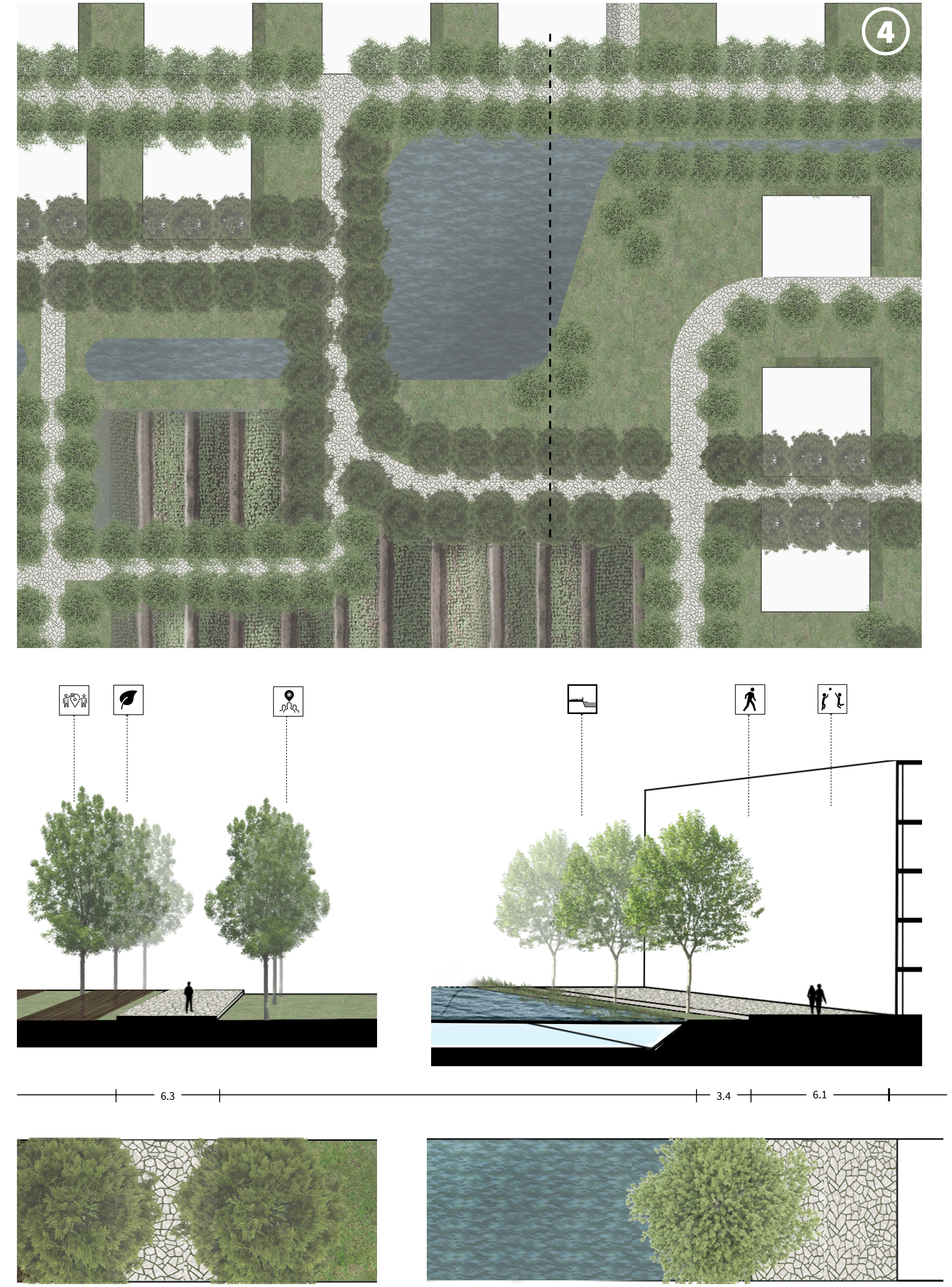


sloterdijk III section
scale 1:500



PERSPECTIVE SLOTERDIJK 1 MOTORISED ROAD

PERSPECTIVE
SLOTERDIJK 1 MAIN ROAD

PERSPECTIVE SLOTERDIJK 1 SECONDARY ROAD

PROJECT PHASING

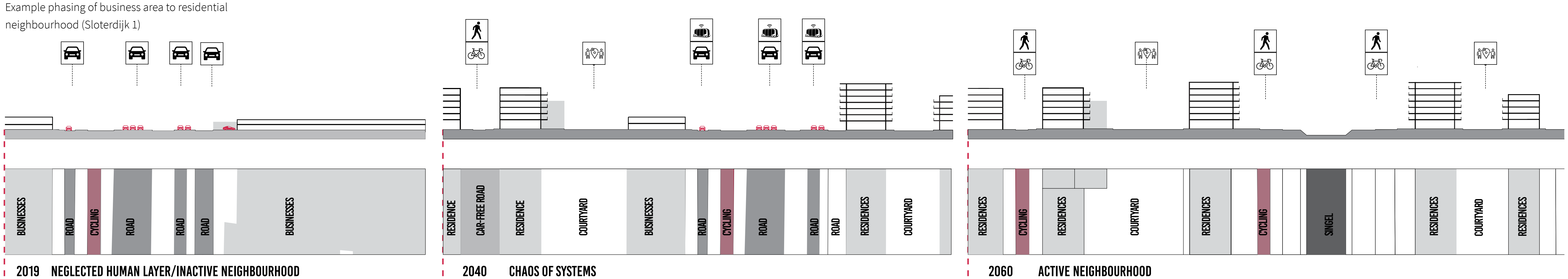
Sloterdijk development

Phasing of this project starts with initiatives from the government to reduce the amount of cars in the street by encouraging new developments to resolve parking on their own lot. The metro connection to central station is set to be finished around 2030-2035 along with the new entrance/exit. This could then already alleviate the vehicular activity in the Sloterdijk 1 area. Businesses and Industries will not move away at once this will happen gradually as rent contracts finish or other business opportunities develop elsewhere in Amsterdam. For a long period of time there will be a mix of new development and the existing buildings. The current sport facilities area may be one of th first neighbourhoods which is completed because of its empty fields. In the mean time other sport facilities in Amsterdam can be used. As automated mobility is introduced around 2040 car free neighbourhoods start to develop in the Sloterdijk 3 area. Sloterdijk 1 is completed around 2050.

INCREASING POPULATION GROWTH → *AUTOMATED MOBILITY IN BLOOM →* *AUTOMATED MOBILITY IN DEMAND*

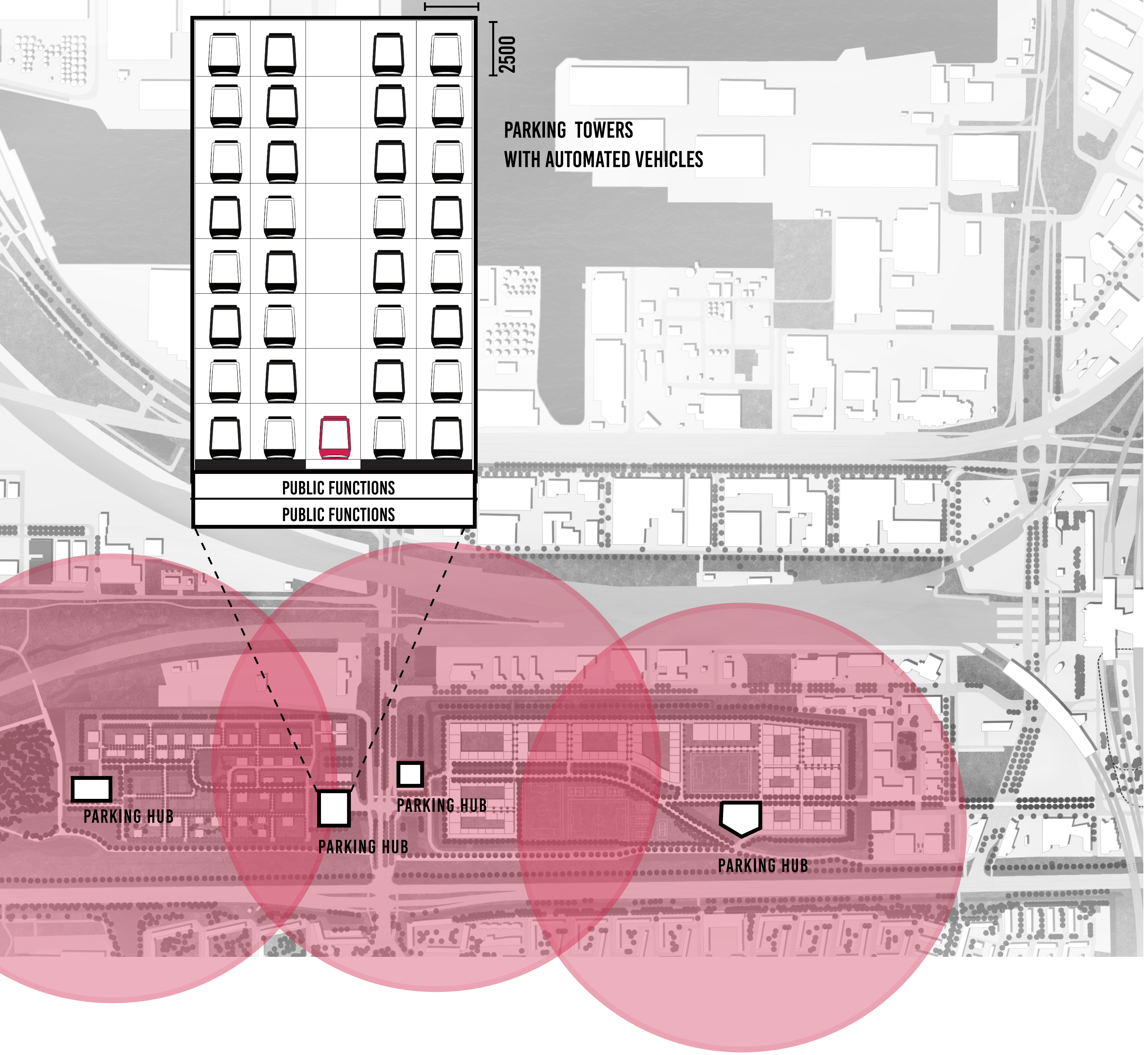
	2019	2030	2040	2050	2060
TRANSPORTATION	Increased frequency public transportation	**Metro connection to central station**	**Introduction automated vehicles** AV's and EV's and fuel operating cars all share the same road space	Transformator weg is car-free	**Automated mobility fully integrated in mobility network**
	Reduced parking per house hold	New high-way entrance/exit built		**New development:** Transportation HUBS	Increased walkability & cycle-ability
	No on-street parking	Introduce shared-ride services in neighbourhood ww	Automated vehicles operate in privately owned fleets only	**Automated vehicles restricted to roads outside the neighbourhoods**	Emissions free-cars only allowed in Sloterdijk
		Increased smart mobility options	Increased walkability & cycle-ability	AV & EV parking in transportation HUBS only	
DEVELOPMENT	Current residential & non-residential developments	Light industry companies and businesses start moving away	Rent agreements are ending, light industry & businesses are moving away	**All current businesses have left the business park area**	Sloterdijk 1, 2 and 3 and Sloterdijk park car-free neigbourhoods
		New businesses start to develop	**New development:** Sloterdijk 2 (former sport facilities)	**New development:** Transportation HUBS Recreational route	Local organizations are formed to maintain the urban farming in the park
			Car-free neighbourhoods start to develop in Sloterdijk park & Sloterdijk 3 (former allotment gardens)	**New development:** Singel & linear park Sport facilities on rooftops	High density development Sloterdijk 1 & 2
			New development: Sloterdijk 1 area courtyards & public spaces	New businesses arise in Sloterdijk 1 and 2	High density development Sloterdijk 1 & 2

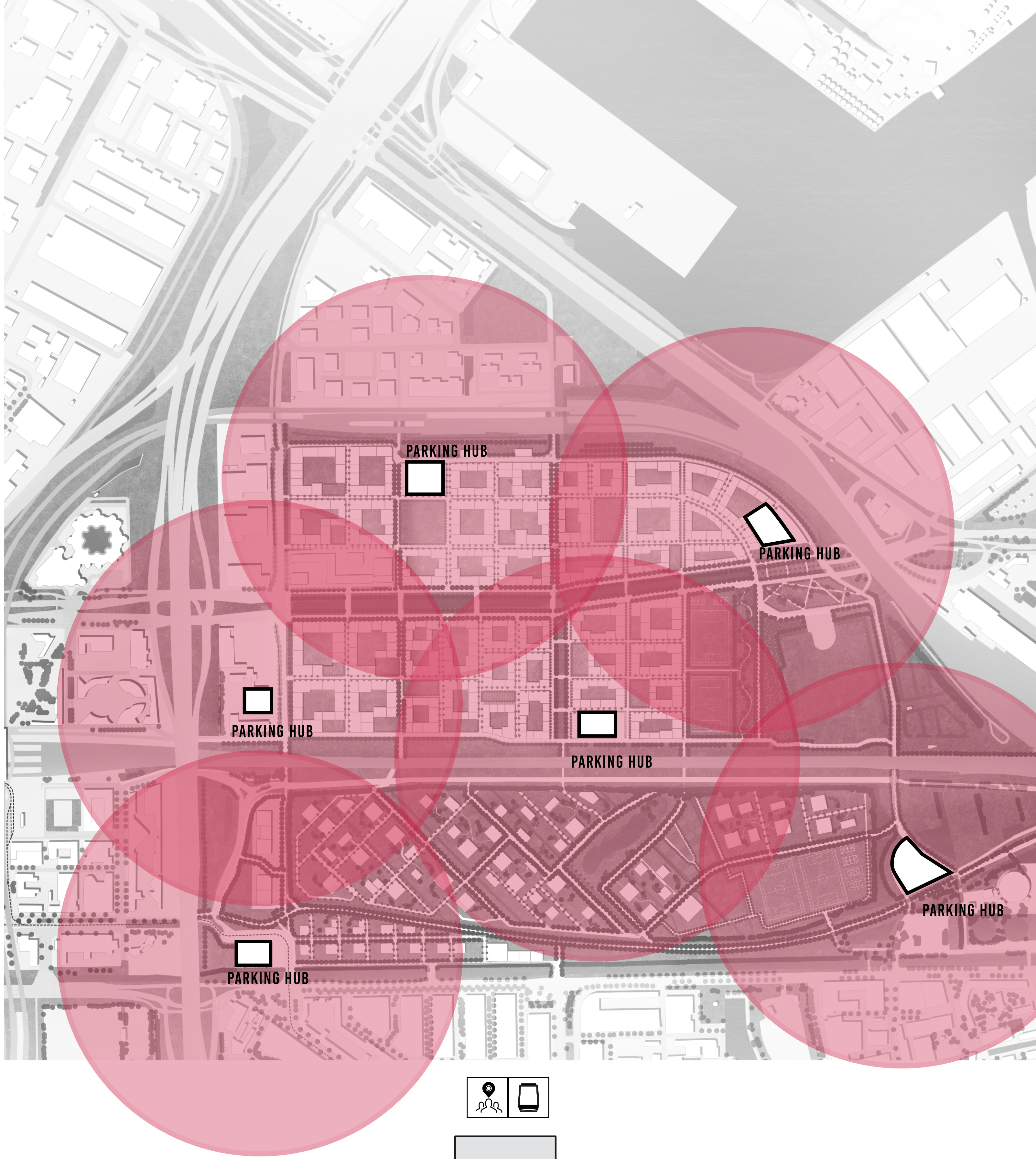
Example phasing of business area to residential neighbourhood (Sloterdijk 1)



PARKING

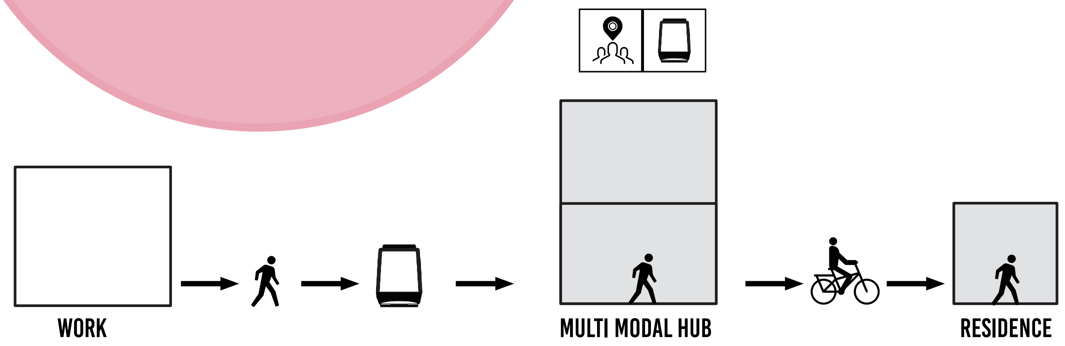
PARKING STRUCTURES





Parking structures are located at multi modal transportation hubs. Here transition to other modes of traffic is possible.
The circles represent a 500m radius of the parking structure .

The next diagram shows how the transition is made to ultimately reach your destination.

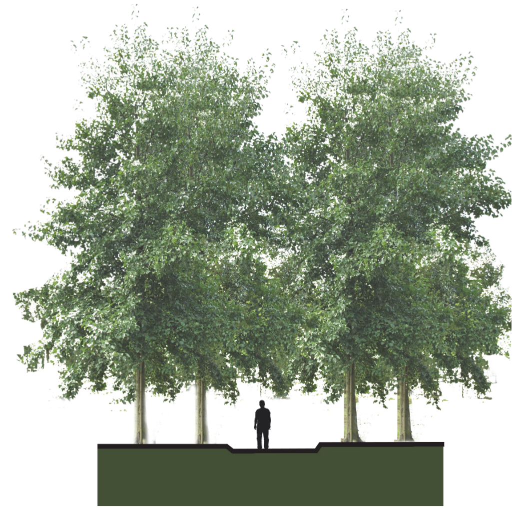


GREEN NETWORK

GREEN FLOWS

Dense forest

Trees are structures in a way to direct views and highlight main paths in the park with a lot of shadow and high contact with nature.



Alnus cordata

Tree lanes

Tree lanes with large trees around them, which enables people to have walk along side these trees on the pathway.

Fraxinus Excelsior, Tilia cordata

Community gardens

Gardens in the Sloterdijk Park neighbourhood. Fruit & Vegetable trees are planted near the residences

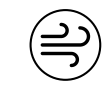
Tilia cordata, Acer campestre, Alnus glutinosa, Prunus avium

Bioswales

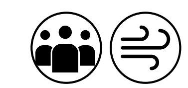
This type of vegetation is located next to the channels in the neighbourhoods. It's purpose is to enrich the environment and improve the water quality.

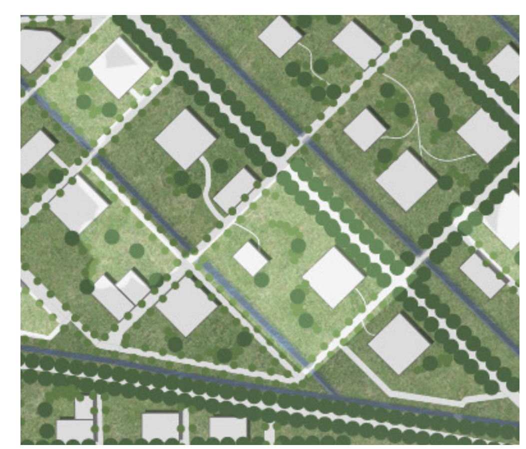
water quality improving vegetation

SLOTERDIJK 1 & SLOTERDIJK PARK

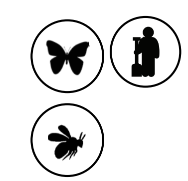


RECREATIONAL ROUTE

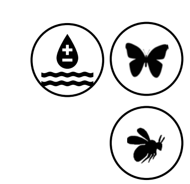




RESCIDENCES & GARDENS

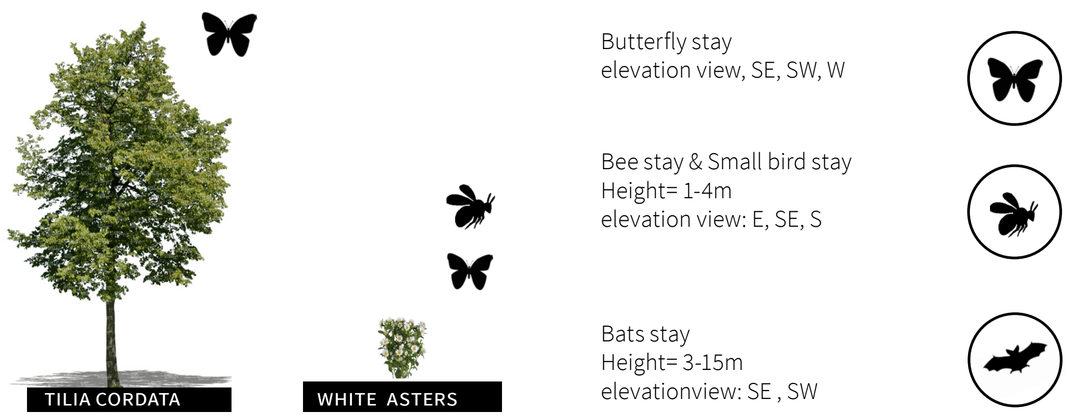


BIOSWALES



GREEN NETWORK

BIODIVERSITY

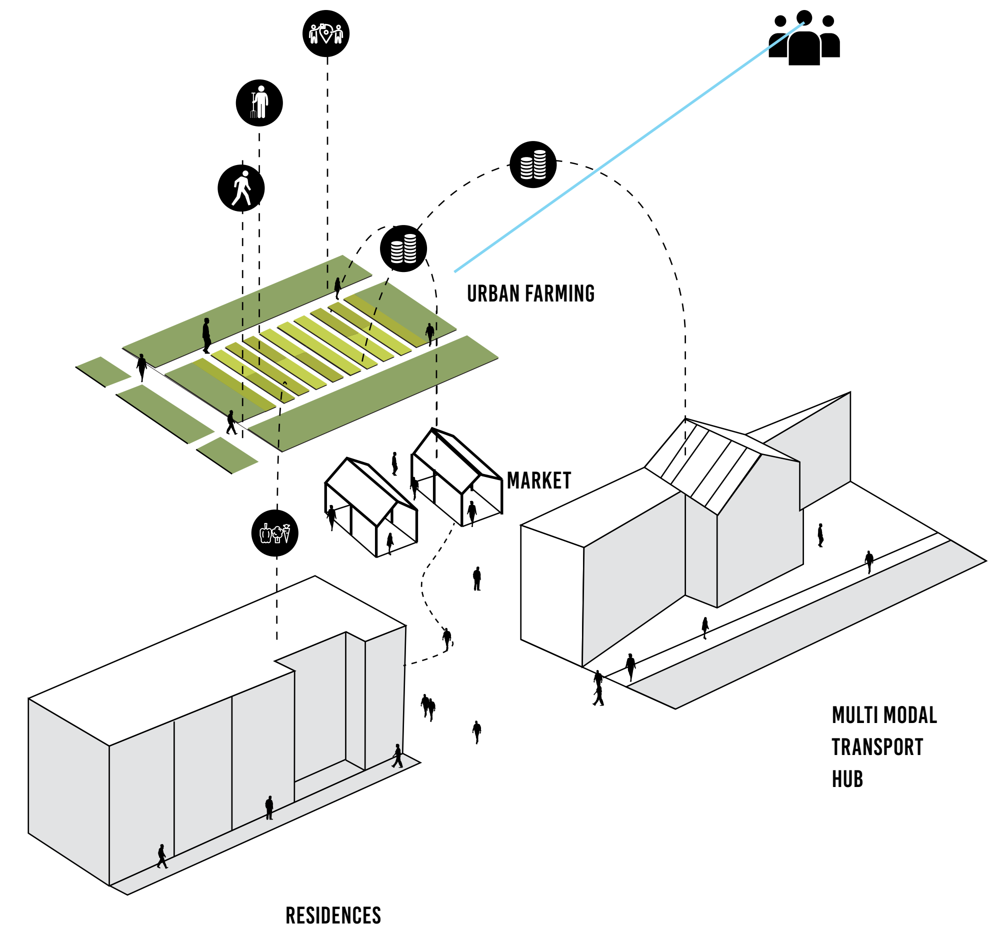


Introducing differnt tree groups to the neighbourhoods will enhance biodiversity, there are more options for exispecies to nest and stay. Nesting boxes are integrated in the prefab facade elements used for development. Pocket parks are created by surrounding tall buildings with a minimal footprint. Vegetation such as bushes are laid that insects and butterflies can stay. The balconies and loggias are also designed with ivy so there can be a living for other species. These interventions also add a lot of quality to the urban environment.

The wastewater from the houses in the park are transported to a septic tank which will then be transported to the hellofyte filter to purify and be used as irrigation water for plants in the gardens of the park, this way the loop is closed. The nutrients from the waste water can be composted in the compost facility near by and can be used to improve the soil.

GREEN NETWORK

URBAN FARMING



One of the characteristicts of this neighbourhood is its relation to urban farming and gardening. SLoterdijk park and Sloterdijk 3 used to be former allotment gardens. Reinventing the allotmentgarden typology by introducing community farming/city farming in Sloterdijk park will bring back the allotment garden characteristic.

The urban farm is maintained by an organization conststing of residents and other ambitious locals. Th organization is responsible for the maintenance of the farm.
The urban farm also generates economic opportunities by selling their product to the local neighbourhood market and the multimodal hub.

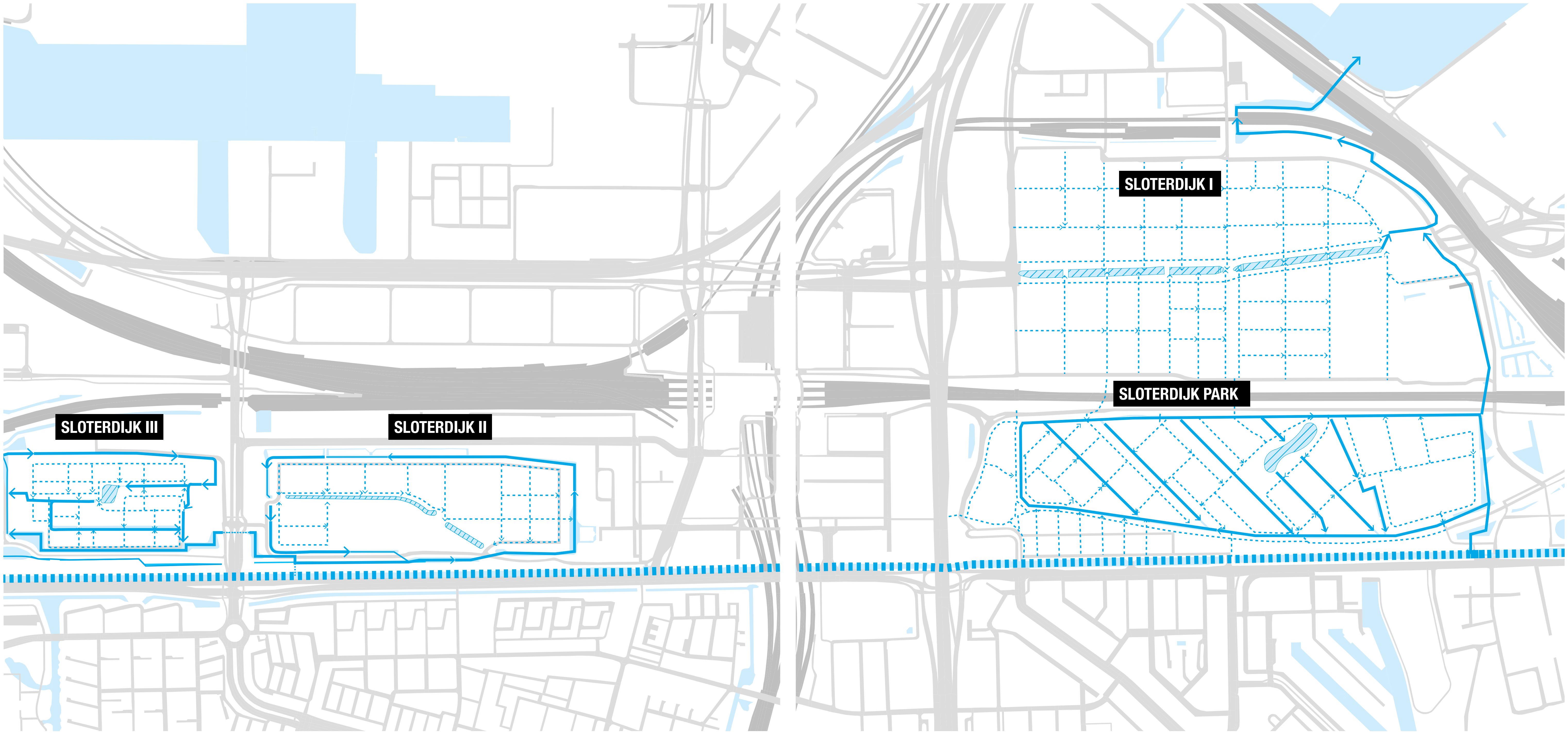
BLUE NETWORK

WATER FLOW SLOTERDIJK

The following map highlights the primary water structure in the area and it shows the direction of the water flow for each specific neighbourhood.

The street run off water goes to the singels, where water is stored, filtered and used to water plants in the neighbourhoods.

- Primary water structure
- Main water flow direction
- Street run off
- Rainwater storage



BLUE NETWORK

INTERVENTION BENEFITS

This matrix shows an overview of the interventions regarding the water network in the four neighbourhoods. This matrix has been adapted from (Collett, Friedmann and Miller,). The interventions primarily focus on runoff reduction though retention and infiltration. The interventions are aslo capable of improving the quality of the water through filtration and enabling biological treatment

As seen in the matrix, most of these interventions are multifunctional but tend to primarily address either water quantity or quality concerns. To address the storm water quantity and quality challenges that present themselves within these neighbourhoods it is important to utilize these interventions as combinations.

The storm water quantity and quality interventions also provide many additional social and environmental benefits. These interventions improve the air quality, enhance the aesthetic quality of the site and provides a wildlife habitat for many species.

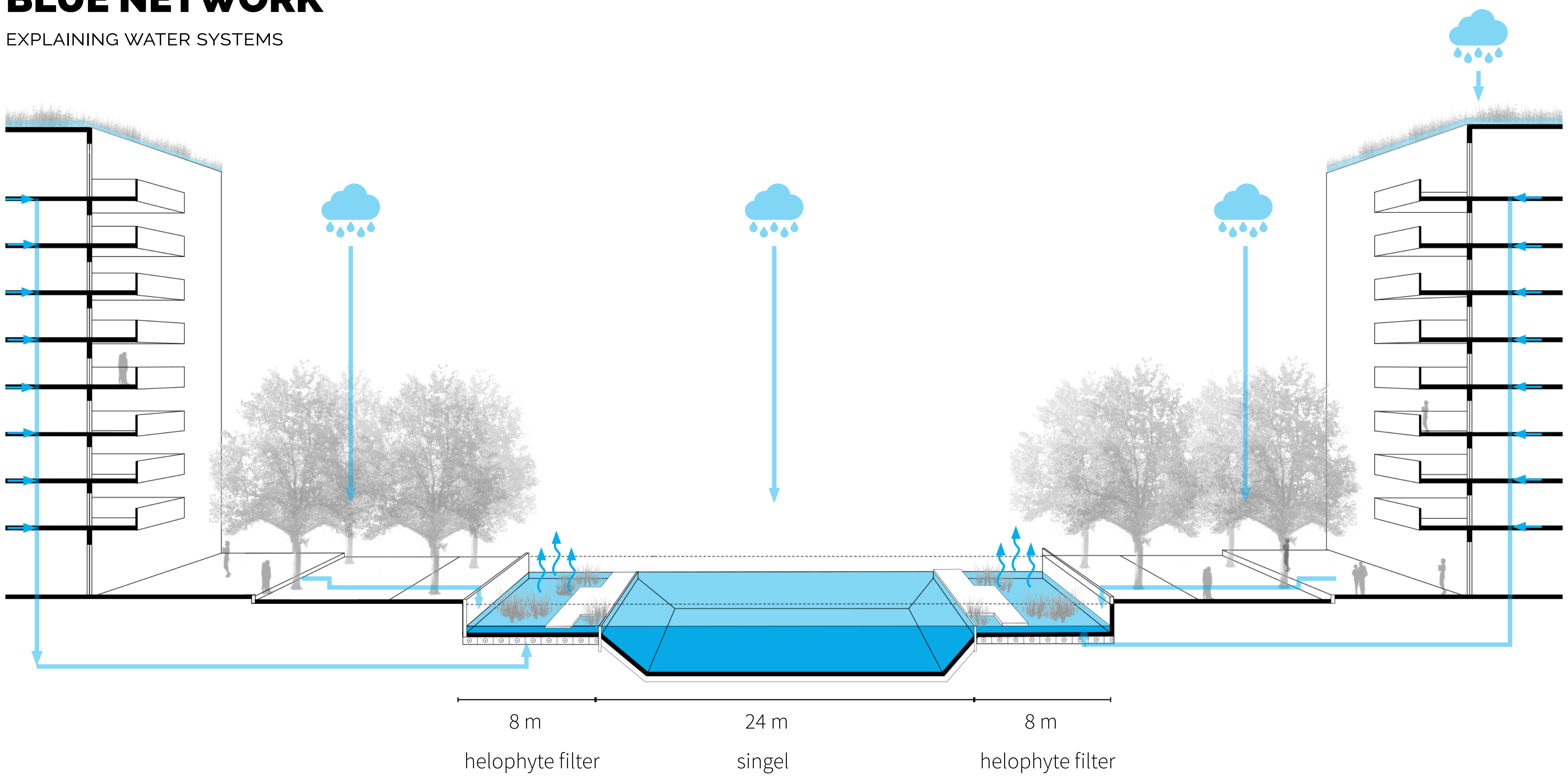
The following sections shows how these intervention are implemented in the neighbourhoods.

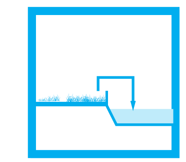
■ Primary function
□ Secondary function
⬚ Incidental
+ Additional

		Rain Garden	Residential Rainwater Harvesting	Permeable Paving	Vegetated Roof	Vegetated bioswale	Helophyte filter	Filtration pond
Stormwater quantity fuctions	Retention	■	■	■	■	⬚	□	■
	Infiltration	■	⬚	■		⬚	■	■
	Detention	□			□	□	■	□
	Evapotransporation	□	⬚		■	■	□	■
Stormwater quality functions	Sedimentation	■	⬚	□		■	■	
	Filtration	■	⬚	■	■	□	⬚	■
	Straining	□	⬚			■	⬚	
Additional Benefits	Provides Wildlife Habitat	+			+	+	+	+
	Aesthetic Quality	+	+	+	+	+	+	+
	Stores Runoff for Alternative use		+				+	+
	Provides additional pervious suraces			+	+			
	Improves Air Quality	+		+	+	+	+	
	Provides educational opportunities	+		+	+		+	

BLUE NETWORK

EXPLAINING WATER SYSTEMS

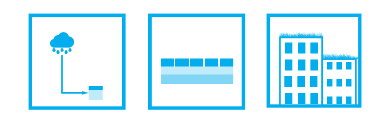


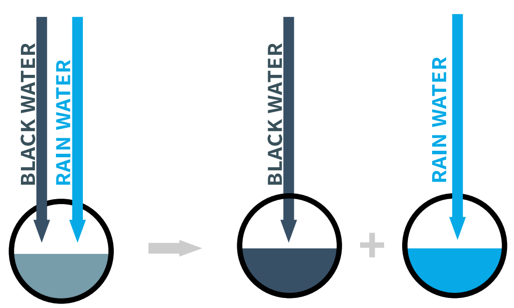


Helophyte filter

Stormwater management
Retention
Filtration
Evapotranspiration

Additional benefits
Wildlife habitat
Improves air quality
Aesthetic quality

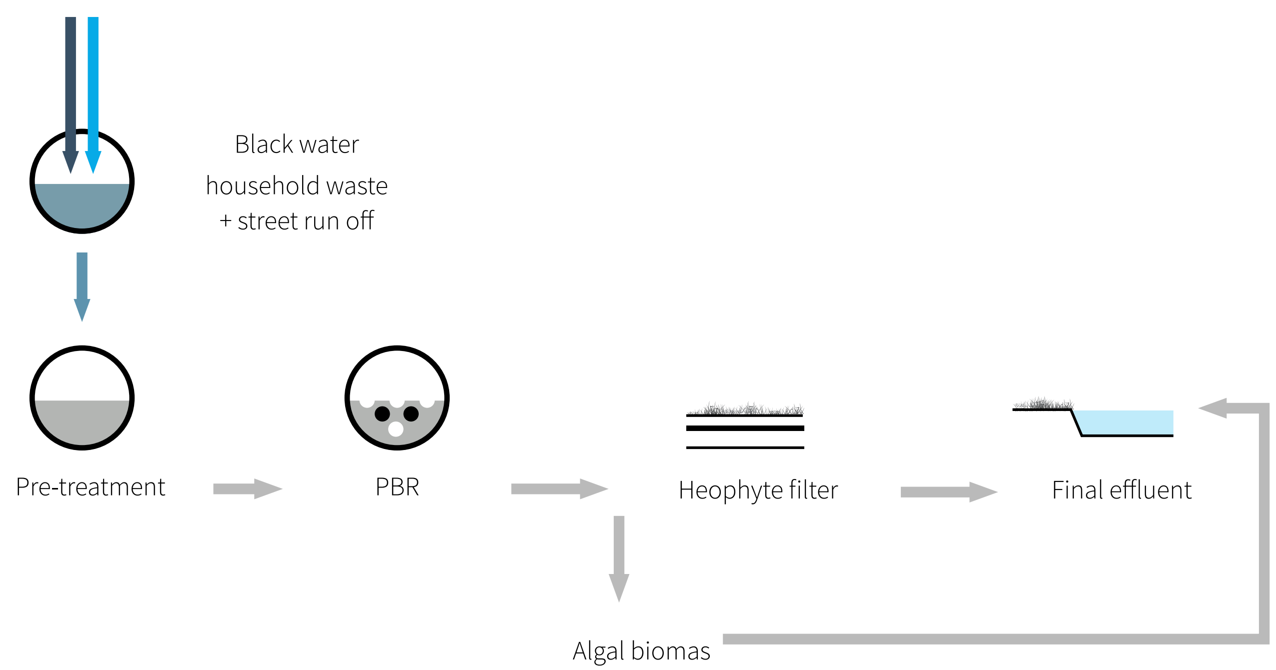




Concept: seperate systems to drain water and reuse filtered water

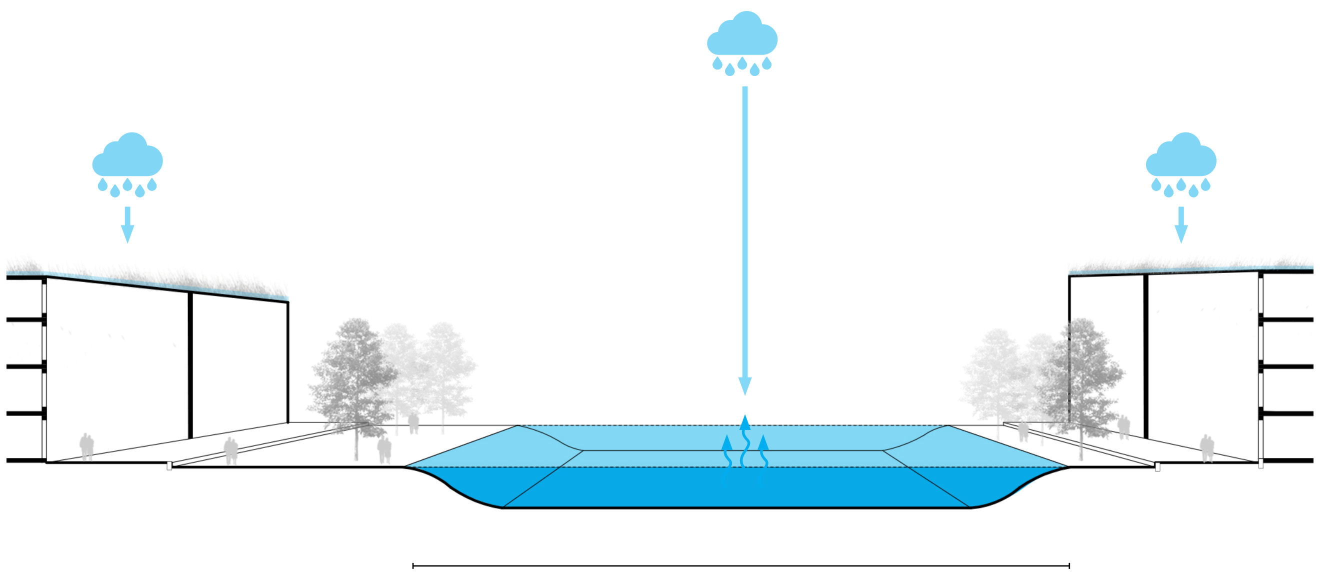
Cross section of the adjustments in the profile of former heavy traffic road, the Transformator weg. The added singel enables more water storage, the additional helophyte filter improves the quality of the water which can be reused.

According to Aquarama (2011) Helophyte filters spread the wastewater in a layer several centimetres below the surface of the filter. The water is transferred to a filter below the surface to prevent unpleasant odors. The wastewater seeps through the layer of sand and the roots where it undergoes biological treatment. A drain is placed at the bottom of the sand filter to capture the treated wastewater. Iron or copper particles are generally added to the sand layer to bind phosphates.

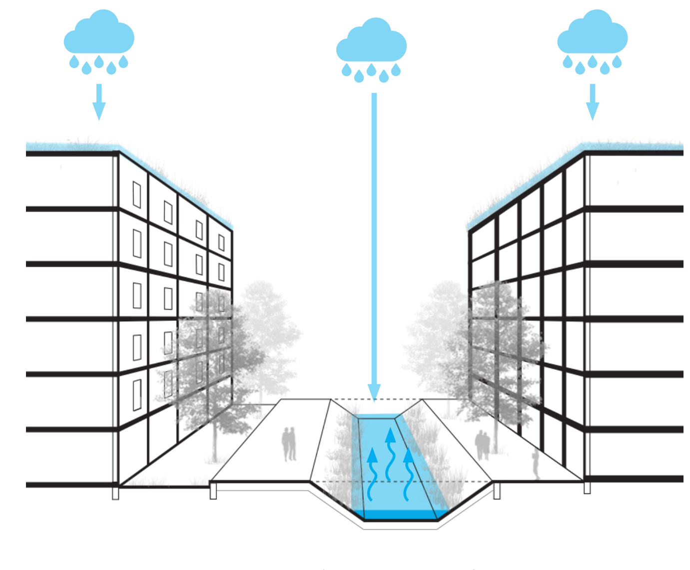


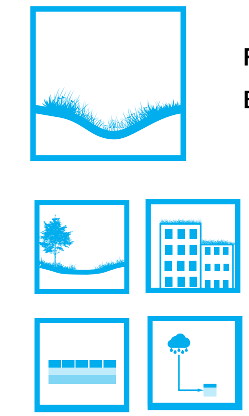
BLUE NETWORK

EXPLAINING WATER SYSTEMS

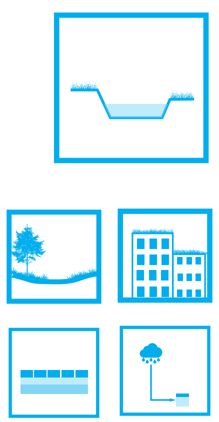


45 m
Filtering pond





8 m
Bioswale



Filtration Pond

The filtration pond stores storm water at peak moments. This pond aids in peak flow reduction and promotes sedimentation. Once the water reaches the maximum pool storage, the storm water is slowly released over 24-72 hours. This pond also provides an aesthetic appeal to the neighbourhood and wildlife habitat.

Storm water management
- Biological treatment
- Evapotranspiration
- Filtration
- Retention

+ Additional benefits
- Wildlife habitat
- Improves air quality
- Aesthetic quality

Bioswales are open, gently sloped vegetated water channels designed for treatment and conveyance of storm water runoff. These vegetated swales treat storm water by filtering out the contaminants which are conveyed in the water. The vegetation slows down the water flow, encourages sedimentation cleans the water and encourages the infiltration in to the subsurface which wil reduce flow

Storm water management
- Extended biological treatment
- Evapotranspiration
- Sedimentation
- Straining

+ Additional benefits
- Wildlife habitat
- Improves air quality
- Aesthetic quality

RANUNCULUS LINGUA

EQUISETUM FLUVIATILE

HIPPURIS VULGARIS

IRIS PSEUDACORUS

SCRIPUS LACUSTRIS

PHRAGMITES AUSTRALIS

Vegetation that filters the contaminated water and that can contribute to improving the water quality.

9.3 DESIGN CITY CENTRE

STREET PROFILE TRANSFORMATION

HOW WILL THE STREET PROFILE CHANGE IN THE FUTURE?

In the past the width of the streets in Amsterdam were designed to accommodate carriages and after a while also trams. When the car culture was introduced, it was first designed with the same size as the carriages. The car culture continued to develop, cars became faster, larger and less safe. Therefore, the street had to accommodate to the size, speed and security of the car. Many developments have been made in the design of the street profile since the car has been introduced. The streets have been separated in zones by street elements such as trees, curbs and road markings. These zones are created to ensure safety to the different user groups of the streets.
Technology has developed thus far that modalities have these safety sensors which can detect people and animals crossing the streets. Also, in-car displays have replaced road-side signs and traffic lights.

There is an opportunity to redesign the street once again. How will the street profile be adjusted with the implementation of automated mobility?

These next key themes will describe a future on how automated mobility might impact the street profile.

Street furniture

Because of the developing smart technology many furnitures of the street profile are going to be outdated. As technology keeps developing itself so does street lighting. New technologies have been added to the basic street light pole, the futuristic streetlight does not only illuminate but it integrates lighting with features such as Wi-Fi, a security camera for extra safety and an EV-charging fixture for electrical cars.

Think about road markings, traffic lights and parking meters. Will these still be necessary in the future? Car displays are introducing new technologies which shows a complete virtual map of the street with traffic lights, road marking lanes etc. It is not necessary to have any traffic lights or road markings physically in the street

Flexible spaces

Parking spaces are not necessary anymore as cars are constantly driving in a system or are parked in parking garage/tower. Parking spaces could be convert for public uses such as:
outdoor café seating,
street festivals & parades
events
street markets
musical performances
public art displays etc.

The flexible zone concept provides opportunities to favor more gathering areas. As a pedestrian zone, expands the pedestrian realm by an additional 67% and provides Gathering space opportunities.

Reduced space

The size of the modalities are also influenced by technology. The automated modalities are promised to be more compact. This could mean that there is more space for other zones in the street scape.

Curbs (separating zones)

Replacing concrete curbs with LED-embedded pavement can signal a change in the number of lanes, the width of a sidewalk or maybe even the direction of the street. With these dynamic curbs it would be easy to convert to a bigger public space. The transition to the different zones in the street is softer. Because of the safety provided by motorized traffic it is not necessary to have such hard transitions from the pedestrian/cyclists zone to the motorized zone in the street.

MASTERPLAN

CENTRUM - WEST

SCALE 1:10.000

LEGEND

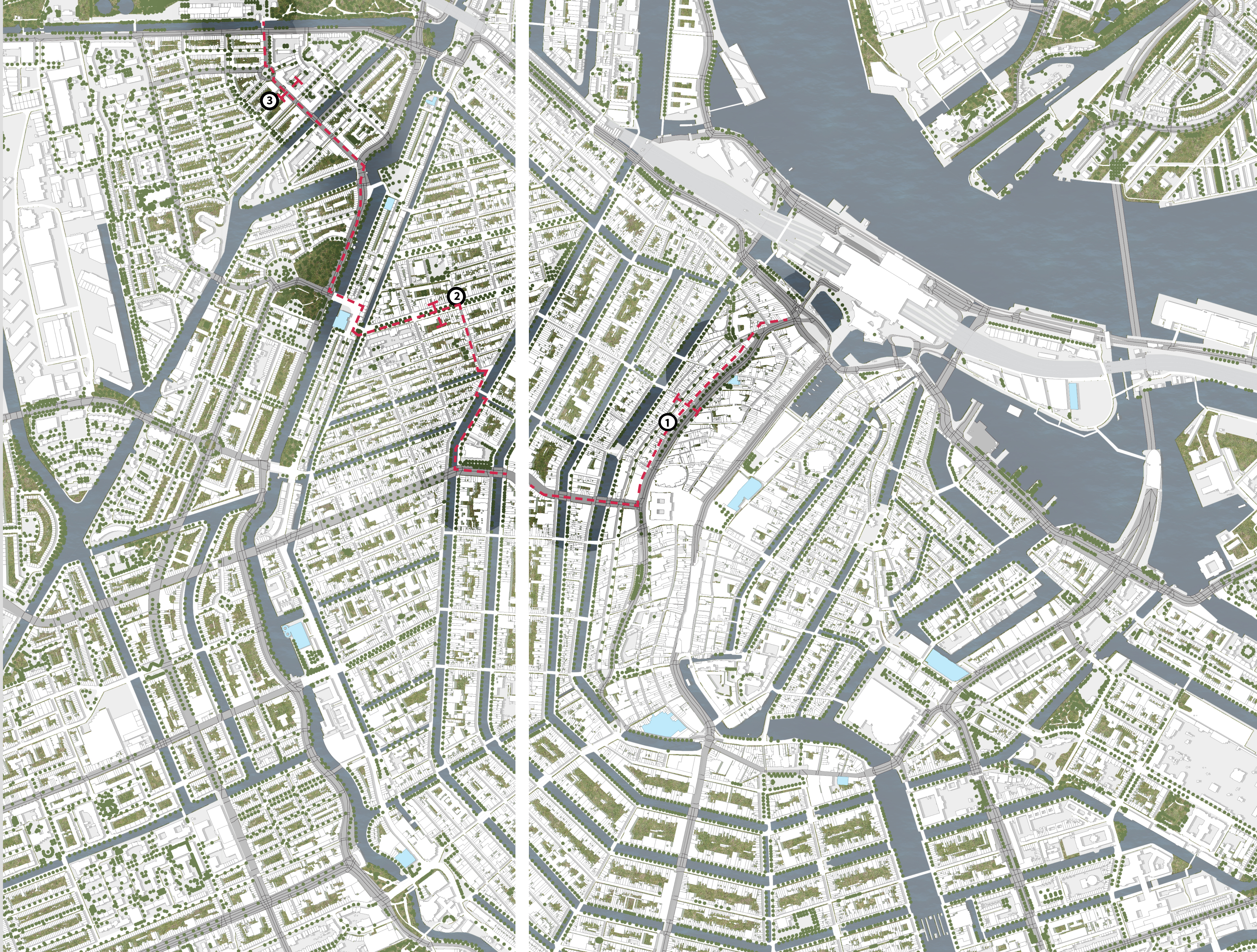
RECREATIONAL ROUTE

SLOW MOBILITY ROUTES

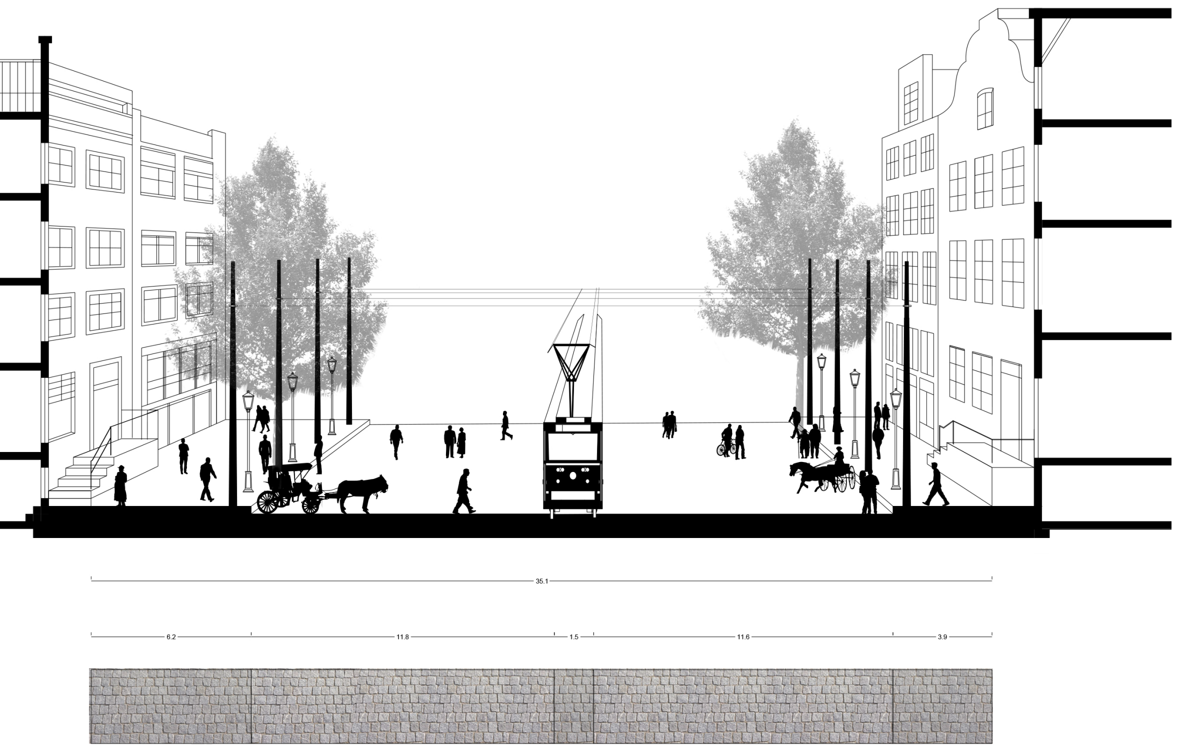
MOTORIZED ROADS

TRANSITION HUB

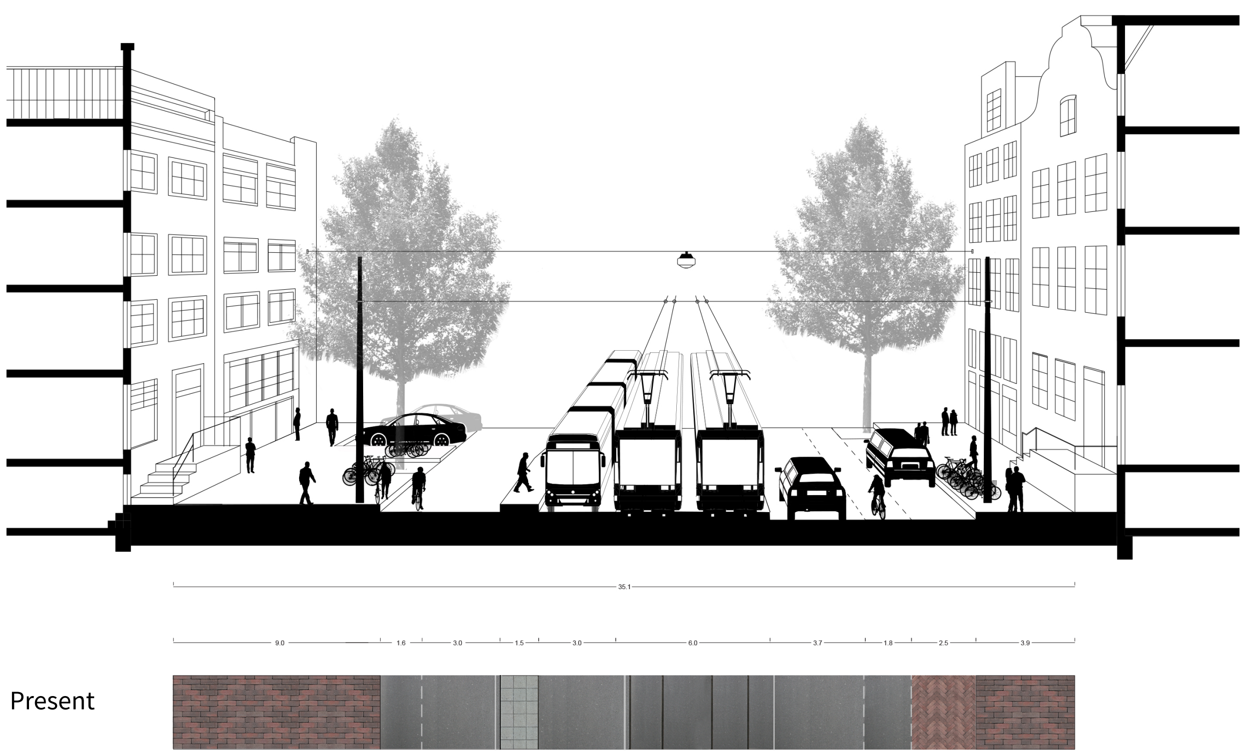
The design for the city centre is focused along a recreational route to the westerpark recreational area. The automated mobility routes are centred around the citycentre ring with a few arteries trough the city centre to maintain accessibility. The design zooms into 3 locations the nieuwezijds voorburgwal, the westerstraat and the vanlimburg stirumstraat.



SECTION 1 NIEUWE ZIJDS VOORBURGWAL SCALE 1:500



Past



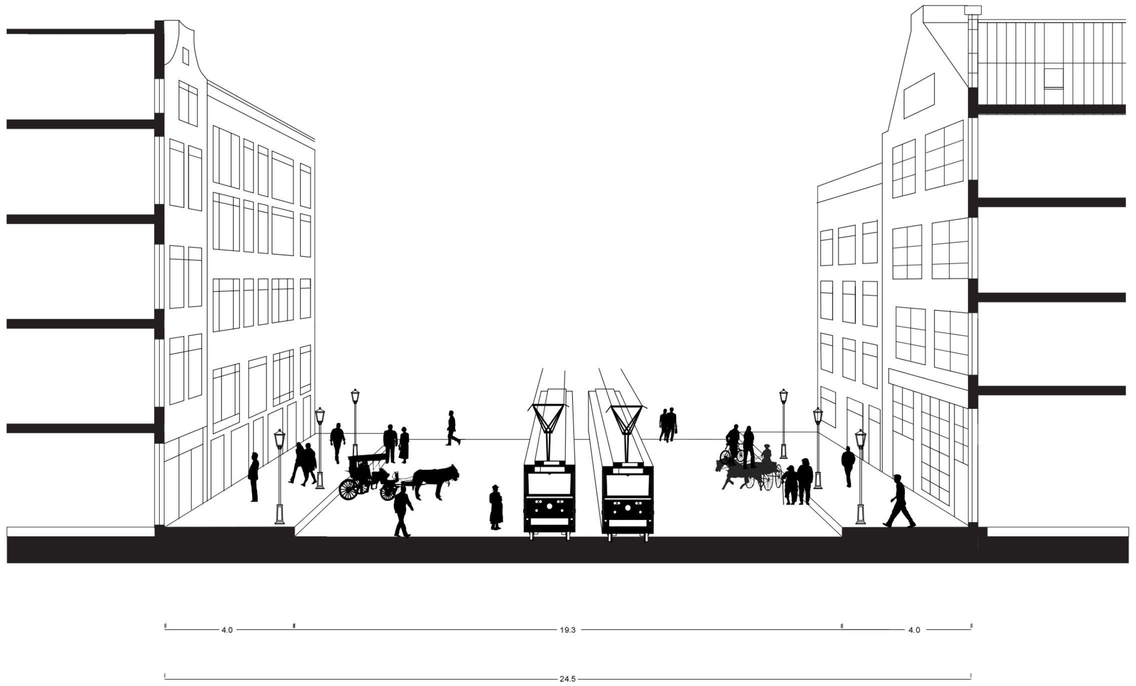
Present

Future

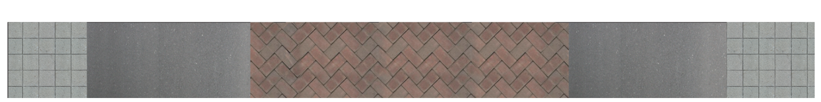
The street profile is constantly adapting itself to the size of the modalities and the security measures taken to ensure pedestrian safety in the streets. Security measures have changed through the years because of the increase in size and speed of the modalities. The biggest difference between the past and the present are several zones created to ensure the safety of the people on the street.

In the vision for Amsterdam 2050 the Nieuwezijds Voorburgwal is a primary road, it is one of the main arteries for automated vehicles in the city centre. This means there is limited amount of re-organization possible. Removing parking from the streets has freed up space which in this case for the Nieuwezijds Voorburgwal can be used to expand cycling lanes and sidewalks. Removing the parking spaces on main roads will alleviate the traffic flow. The redesign of the street features also features, minimal road markings, wider cycling lanes and sidewalks, modern technology streetlights and more space for public space.

SECTION 2 WESTERSTRAAT SCALE 1:500

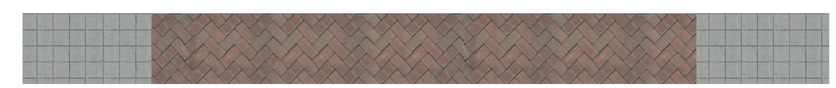


Past



Present

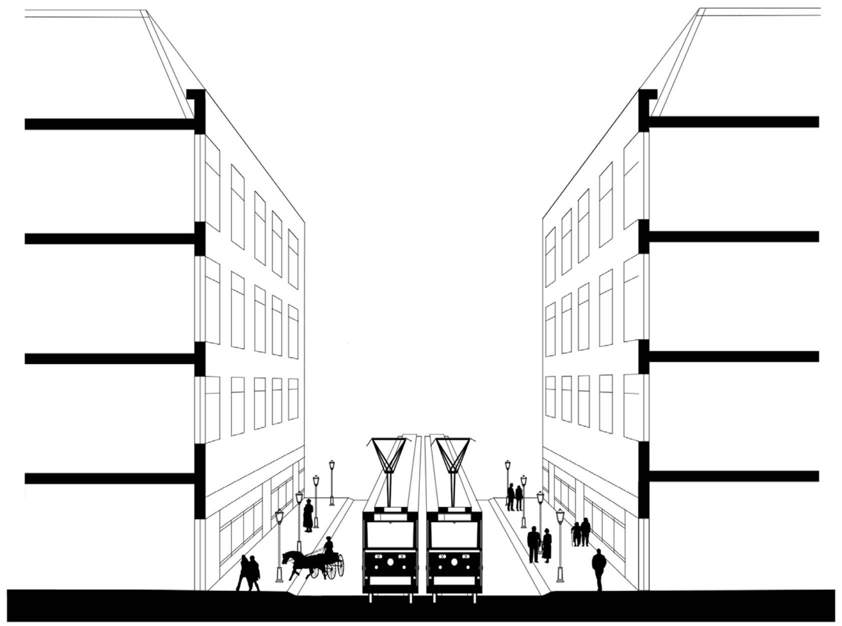
Future

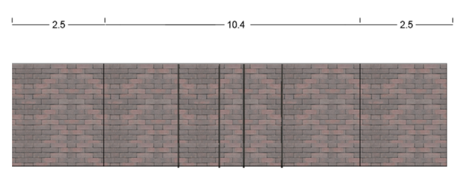


In the past there was a tram line passing through the westerstraat, as the street section shows there are two tram rail tracks in the middle of the westerstraat where parking is located at the present. This street is currently a shopping street with several cafes and restaurants. Currently this street consists of 75% parking, two parking lanes in the middle and two located on each side of the street. This street has always been a shopping street however, removing tram may have had an influence on the amount of people traveling to this shopping street. It is currently more of a neighbourhood shopping street for people living in the Jordaan neighbourhood.

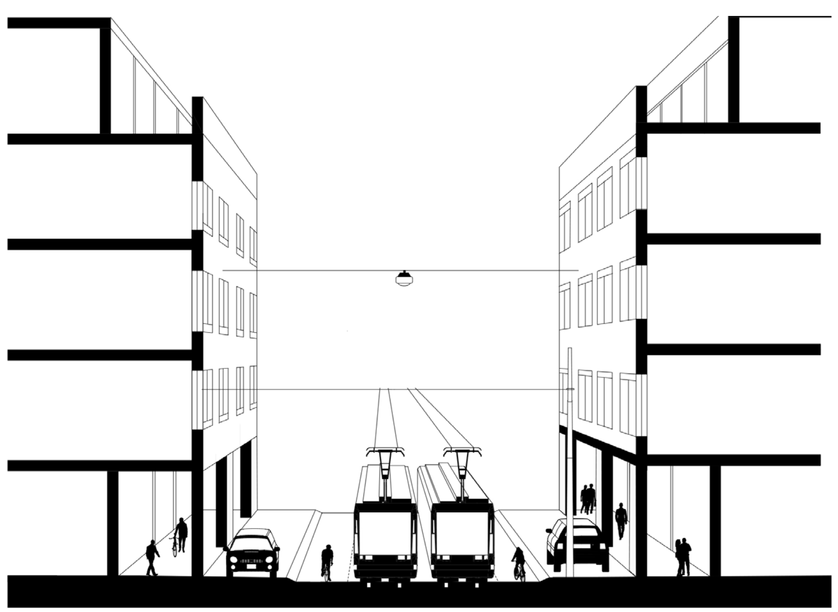
In the vision of 2050 the Westerstraat is a secondary road which means there is no car activity in this street. This street is not a primary street and could therefore be organized more flexible as to a primary street. Removing parking from the streets has freed up the middle space and the two parking lanes near each side of the road. This road could be reorganized to accommodate slow-traffic, materials currently used for the road could be replaced to symbolize the street as a slow traffic street. The space freed up space in the middle could be used to increase green spaces, add terraces to cafes and to add playgrounds. Flexible programs such as markets and pop-up events are possible, these programs should not occupy the slow-mobility zone as emergency services still need to pass through these streets and this should be possible at all times. New street elements such as modern street lighting and bicycle parking are added.

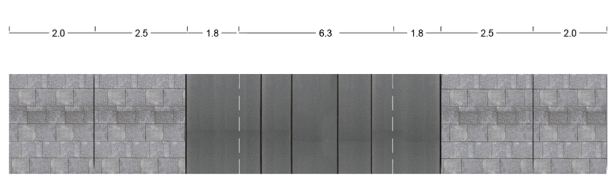
SECTION 3 VAN LIMBURG STIRUM STRAAT SCALE 1:500



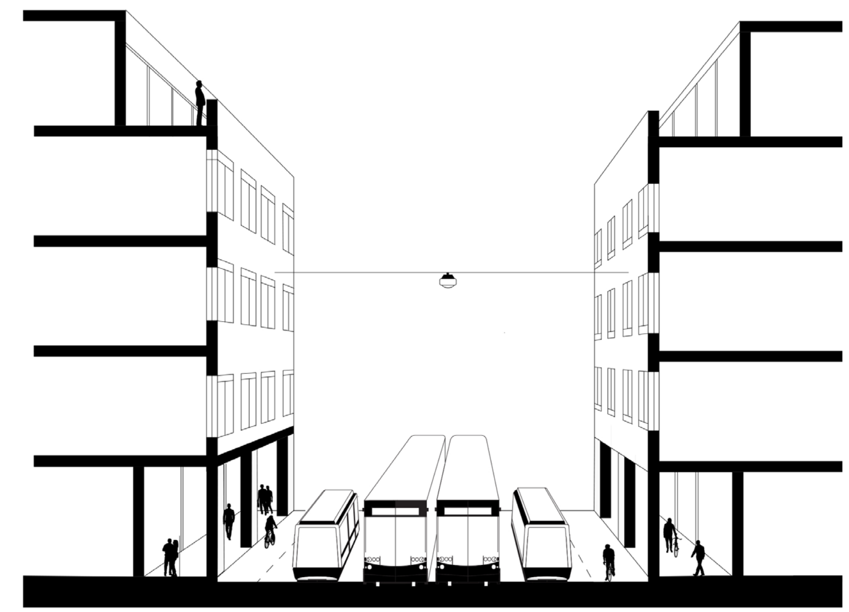


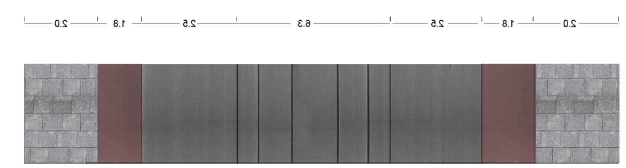
Past





Present





Future

The van limburg stirumstraat is not a wide street, in the past carriages would pass next to the trams or on the tram track, currently there is also a parking lane on both sides of the streets. Till this day cars and trams share the road space in this street. The renovation of the two buildings include a new sidewalk for pedestrians, the former sidewalk is transformed to parking spaces. Streetlights have been added to the buildings to create a bigger range of lighting in the street.

In the vision for Amsterdam in 2050 the van limburgstraat is a primary road, this means there is limited organisation possible.
The priory lies to increase the quality and efficiency of the current zones and spaces in the street. This street is one of the main arteries of the automated vehicle network in the city centre. Therefore, it is necessary to alleviate the traffic flow in this street especially during peak hours. Removing the parking spaces in this street and using the freed up space to increase the space for automated vehicles and cyclists will alleviate the traffic flow. New street elements such as projected road markings and modern streetlighting are also added to the redesign of the street. Futuristic trams can operate without any cables. there is no need for any lighting poles with tram cables.

9.4 LIVABILITY

CONTRIBUTION OF AUTOMATED MOBILITY

Research Question 6:

What are the main principles for enhancing livability and environmental health in the city of Amsterdam with the implementation of automated mobility?

Automated mobility is a catalyst for spatial interventions in these project locations. Automated mobility creates opportunities to enhance livability and the environmental health. The indicators of livability which have been determined in the theory chapter are:

- Encourage social interaction
- Access to good quality public space
- Mixed use development
- Enhance green spaces
- Sustainable transportation network
- Encourage walkability
- Create economic opportunities

The following matrix indicates which indicators of livability and environmental health are impacted by the spatial interventions in the project locations. According to the theory chapter, several of these interventions contribute to these indicators of livability, however they also offer additional benefits at the same time. The matrixshows these interventions on different levels in the city.

encourage social interaction

acces to good quality public space

mixed use development

enhance green spaces

sustainable transport network

encourage walkability

economic opportunities

Improve environmental health

■ Primary contribution

+ Additional benefits

Level	Interventions	encourage social interaction	access to good quality public space	mixed use development	enhance green spaces	sustainable transport network	encourage walkability	economic opportunities	Improve environmental health
City Level	Limited car acces			+		■	+		+
City Level	Recreational route	+	+		+		■	+	+
City Level	new residential development	+		■				+	
Neighbourhood Level	new public program	■	+				+	+	
Neighbourhood Level	car-free neighbourhood	+	+			■	+		+
Neighbourhood Level	Courtyards	+		+	■		+	+	+
Neighbourhood Level	New public spaces	+	■				+	+	
Neighbourhood Level	Transportation HUBS			+				■	
Neighbourhood Level	Sports activities	■	+	+	+				+
Neighbourhood Level	POPS (privately owned public spaces)	+			■		+		+
Neighbourhood Level	Adding trees & vegetation				+		+		■
Neighbourhood Level	Stormwater management				+				■
Neighbourhood Level	Transportation platform					■	+	+	+
Neighbourhood Level	Living streets				+		+	+	+
Community level	Community urban farming	■			+			+	
Community level	Introduce community programs	■						+	
Community level	Sharing car services with neighbours	+				■		+	
Community level	Pop-Up events	+					+	■	

Encourage social interaction

Social interaction is encouraged trough many ways, as the matrix shows many spatial interventions have the additional benefit of social interaction. According to the the theories of Guevara and López (2016) by adding a varied public program, introducing good quality public spaces and urban farming social interaction is encouraged amongst others.

Enhance green spaces

Bringing nature closer to the public realm through providing more public green spaces, courtyards, adding more green elements in the streets and creating public park provides the residents with space to relax from the regular rush of the urban living, which in return will also mitigate heat from the sun and enhance air quality. The addition of green spaces in the neighbourhoods improves the environmental health of the community.

Development of mixed use neighbourhood

The multi functional neighbourhoods are very diverse. These neighbourhoods are a mix of residential, office and leisure facilities. They offer many opportunities to the neighbourhoods and the city of Amsterdam.

Access to good quality public space

Encouraging the use of sustainable transportation such as emissions free automated vehicles, bikes and other modes of micro-mobility to travel to these public spaces. Adding a qualitative amount of public spaces could activate the neighbourhoods. Good quality public spaces can support more social activities in a community. (Guevara and López, 2016)

Varied sustainable transportation network

Introducing a public transportation system that is sustainable, efficient and well connected will improve accessibility. This will decrease household transportation costs, improve air quality, reduce greenhouse gas emissions, and promote public health. By introducing a new connected transportation platform, different modes of transportation are connected trough one system which could be very beneficial for commuters.

Encourage walkability

By limiting the amount of car access in the neighbourhood people are forced to walk or use other modes of micro mobility. Increasing the built density increases walkability, as different functions are closer to each other. By investing in the unique characteristics of the streets, such as the comfort, safety and health should generate walkable urban neighbourhoods. (Talen and Julia Koschinsky, 2013)

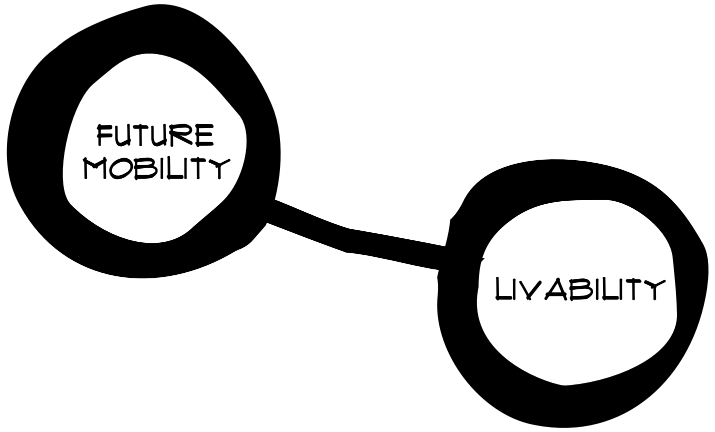
Create economic opportunities

Automated mobility creates the opportunity for several businesses to work together. By implementing automated mobility in the city several transportation networks can work together. Through a transportation platform other privatized mobility companies and public transport companies can work together to manage transitions to other travel modes and to prioritize certain streets during peak hours. Automated mobility encourages shared mobility platforms, where people share car services. "Subsidizing ride sharing services could expand access to people who are largely excluded and would provide a major improvement in their ability to access employment and other essential services." (De good & Schwartz, 2016)
The transition hubs are the key places where several economic opportunities can be created. Combining transportation with the basic needs of people could generate economic opportunities. For example, a transition HUB where automated cars are parked could also facilitate a supermarket. The daily flow of people going in and out of these transportation hubs make efficient use of their time by doing groceries, eating at a restaurant, shopping while waiting for the next mobility transition.

By increasing the built density, offices and companies are located closer to each other, this could spark economic opportunities in the neighbourhood. The increased built density in the Sloterdijk 1 area creates the possibility to develop different systems within a block. Introducing urban farming in the neighbourhoods food can be grown locally. Urban farming organizations & local residents could grow food locally and sell them in a market or at transition HUBS near by.

Safety

Safety is a basic need of every human being. In a neighbourhood safety is translated into road safety, sense of safety, the absence of noise, etc. By limiting the car access in the neighbourhood creates a safer environment for the residents. A mixed use neighbourhood should have a friendly walking environment for pedestrians, where there are constant eyes on the street.



FINAL CHAPTER **CONCLUSION**

10.1 CONCLUSION

PROJECT CONCLUSION

Addressing the research question:

With respect to Amsterdam's population growth, how can the implementation of automated mobility contribute to enhancing livability and the environmental health in the city?

Implementation of Automated mobility

This project set out to research how automated mobility could contribute to enhancing livability and the environmental health in the city. To understand this, we must first acknowledge how automated mobility is implemented in Amsterdam, the scenario plays a huge role in the contribution to enhancing livability and the environmental health in Amsterdam. Certain decisions regarding the implementation could be made in favor to enhance livability and environmental health.

The spatial vision limits the amount of vehicular activity in Amsterdam this improves the accessibility. Limiting the amount of vehicular activity to selected arteries will alleviate the traffic flow. Introducing a mobility platform where public transportation, private car/ride sharing companies and micro-mobility on demand services are connected encourages sustainable transportation and travel efficiency.

Av's are promoting the use of public transportation systems and cycling by picking people at the hop-on-hop off locations at the transportation hubs. These transportation hubs are the key places to transition to other modes of transport or to park your Automated vehicle. Promoting the use of cycling, e-hailing and ride sharing services will gradually change the travel behavior of the people of Amsterdam.

Automated mobility as a Catalyst

The implementation of automated mobility creates the opportunity to re-design the street profile. The automated vehicle is promised to be more compact which means it requires less space in the streets. Minimizing the space given to vehicles provides more space for walking infrastructure, such as sidewalks, and minimizes car speeds and volumes, leading to a safer, more convenient walking environment The street profile is adjusted to enrich the pedestrian zones to ultimately improve walkability and the public realm.

The implementation of automated mobility in Amsterdam limits the amount of vehicular activity to key arteries in the city. This creates the opportunity to develop car-free neighbourhoods in the city. Removing the car activity from the street creates the opportunity to create living streets where pedestrians and cyclists have priority. Small blocks reduce trip distances, making walking more convenient for trips. By increasing the built density in the current neighbourhoods in Sloterdijk walkability is improved. Adding green street elements contributes to enhancing livability and the environmental health in these neighbourhoods.

By creating multi-modal transition hubs where diverse businesses are located economic opportunities can be created.

To answer the research question, automated mobility contributes to enhancing livability and the environmental health by acting as a catalyst. It puts other spatial interventions in motion, it provides a platform to enrich spatial interventions that contribute to the livability and environmental health of Amsterdam.
The following diagram shows to which factors automated mobility contributes.

10.2 LIMITATIONS & FURTHER RESEARCH

There were a few limitations which I have encountered in the research and design process.

On the first hand, when analyzing the context there were certain environmental maps such as air quality and noise pollution which were outdated and not very clear. However, these maps where crucial to address a point in the design therefore an accurate map would have been more efficient.

Second, a major part of this project is based on the scenario of an unpredicted future which may lead to biased opinions towards the situation. However, I tried to construct the scenarios by viewing a variety of opinions and views of the future to understand the situation better. These were often difficult to construct because of the limited amount of information on the spatial implications of automated mobility.

Third, the theory paper is not linked to the theory chapter of the research analysis, this was not done on purpose. The theory paper was written before I had a clear understanding of what the subject of the theory chapter was and how it would contribute to the overall research project. The theory chapter was therefore written at the expense of my time.

Also, calculations regarding the vehicular activity of the main arteries in the city centre and in Sloterdijk would have been key to substantiate the decision for these main arteries. However, a lack of information about the activity of these roads have limited this aspect of the research

Furthermore, It is possible that there are some issues regarding the spatial impact of automated mobility which are not addressed in this research project. This remains as potential for future research.

Additionally calculations regarding the air quality and noise pollution with the implementation of automated mobility could be key to substantiate the benefits of introducing car-free neighbourhoods because of automated mobility. This remains as a next step in further research.
This research will contribute to future studies which aim to understand automated mobility in relation to livability and environmental health

10.3 RELEVANCE

Scientific Relevance

The emergence of automated mobility is expected to occur in the next 30 years. There are still so many uncertainties related to automated mobility and what their impact will be on our environment. Transport and city planners might be ill-prepared for what the future beholds. Therefore, gaining as much knowledge of automated mobility as possible, researching and using a scenario-based approach will contribute to the knowledge domain.

Current studies of Automated mobility focus more on the technology of the automated transport modes and not on rethinking how the urban space is used in the future when automated mobility is implemented. This research explores how automated mobility would impact the urban environment and how it could contribute to enhance it. This research could, therefore, pose as guidelines or principles for municipalities or designers to use as an example of how to implement this new technology or how not to implement it.

The Netherlands is one of the most advanced countries in sustainable mobility, and this would be the next step towards creating an environmentally friendly country. The spatial impact of this technology should, therefore, be researched, municipalities planners and designers should be prepared when this technology reaches the Netherlands to capture the benefits of this shift in technology.

Societal Relevance

This project easily fits into the future societal discourse, because of the major changes automated mobility brings to society.
The societal relevance of this research is to avoid foreseeable negative effects on the technology. It's no different with any technology shift. The world changed in many ways when the automobile was introduced. Other major technological inventions such as the television and the internet all introduced their own societal transformations and so will automated mobility. Measures taken because of this technology must be balanced and integrated with the needs of the people of the city. To ensure that safety and efficiency measures are balanced and integrated with society.

Human attitude toward car ownership will shift due to automated mobility. Car related businesses such as fuel companies will no longer serve a purpose to this group, most of the manufacturers will go out of business. Different jobs related to the car culture will not be needed anymore. We have to consider the possibility of a mass societal attitude shift towards car ownership. The masses will choose convenience and cost efficiency over ownership. Urbanism has the potential to steer this technology in mobility into a direction where human activities are supported by the future mobility system and not vice versa. It has the potential to seek the benefits of this new shift in mobility and use it as an advantage to enhance the urban environment.

10.3 REFLECTION

REFLECTION OF THE GRADUATION

Urban fabrics

This project carried out within the department of Urbanism as a part of the Design of the urban fabrics research group. This year, the studio focused on the topic of Automated mobility, exploring the possible impact of technological and societal innovations on the built environment within different scenarios. This theme is explored through three lenses, Living quality, Intensification (growth & densification) and Segregation and social sustainability. This thesis is related to the first two lenses the living quality and intensification as it addresses both the livability and expected population growth in Amsterdam.

Introducing Future mobility x livability

In the backdrop of this studio, this project investigates the relationship between the future of mobility and livability in Amsterdam. The current mobility network in Amsterdam has a negative impact on the livability in the city. Amsterdam continues to grow, an increased population means there are more people seeking to travel. This ultimately increases the pressure on the impact of the current mobility network. This project seeks to counter the negative impacts of its current mobility network by introducing automated mobility to preserve and enhance the livability in the city. This research project seeks people to think how automated mobility can be used to improve the living quality of urban areas by showing a possible future for the case of Amsterdam. Further, this project also explores the possibility of creating a healthy & sustainable living environment for the growing population of Amsterdam. The project can be understood by positioning it against the studio's objectives to grasp its academic relevance. Design of the urban fabrics research group aims to foster a sustainable livable urban environment, which is also an objective of this research project. Future mobility x livability looks at opportunities to enhance and preserve the livability of Amsterdam through introducing automated mobility.

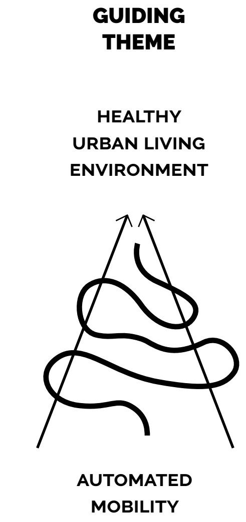
Role

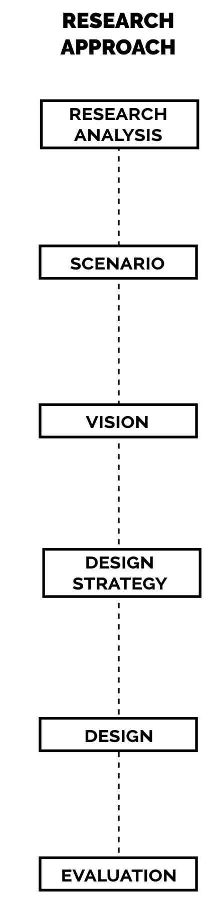
This graduation project takes on the role to explore and critically analyze the various possibilities automated mobility introduces to the urban environment. The role of the urban designer in this project is to understand the spatial implications which this new shift in mobility brings to society and how to use this as an advantage.

Relationship between research and design

Research and design both played a crucial role from the start of the project. In the first semester the relationship of research and design was mostly visible through the spatial translation of general knowledge and theories into a site analysis. According to Nijhuis (2017) this process is described as research for design, research is utilized to feed the design process. The research in this phase mainly consisted of mapping, literature and translating data into maps. Amsterdam has a broad range of data and maps available which made it easy to research certain topics. However, this also made it more difficult to narrow the research and choose a guiding theme of the research project.
"Designing is exploring and deciding within a potentially endless number of possibilities, to come up, in the end, with an internally coherent whole. To be able to create a coherent whole, a designer needs an inspiring direction or order. Using a guiding theme or qualities not only gives the design its character and identity in the complex and open design process, it also helps in making choices.
The guiding theme is the way in which the designer sees or frames the design situation at hand. "(Van Dooren et al., 2013, p.8)

When reflecting on my own process, I have to mention that this research project started with a focus on the spatial impacts of automated mobility in Amsterdam, but it evolved in an attempt to create e new urban living environment by introducing automated mobility. It unravels the importance of the relationship between the urban living environment and the future of mobility. The mapping process started with a number of maps regarding mobility in Amsterdam, but this was quickly transformed into a series of layers which shows the impact of the current mobility network of Amsterdam. The guiding theme has changed after literature, mapping and data has been collected which according to Van Dooren et al. (2013) is a common process while designing. The guiding theme has changed because o series of information and interests were made aware during the research. During the research process I could affirm that in the first semester the 'research through design' method was used more than the research through design . It was until after P2 that the switch was made from research to design, I found it difficult to bring an end to

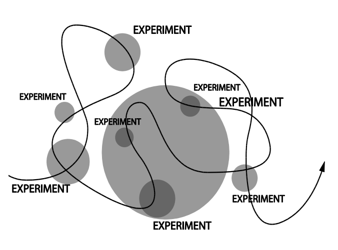




this analysis phase. This was mostly because of the construction of the scenarios, it was difficult to come to the point to make certain statements about the future because of the endless possibilities. Statements were made and the design phase was completely in motion. The research beforehand provided a clear path for the design, it highlighted the bottlenecks and attention areas which the design would address. After P3 there was a moment of realization, several questions were raised. Why am I making these design decisions? How does this specific design intervention contribute to the aim of the project? How does it contribute to the larger context? It was an attempt to start formulating a coherent story of the graduation project. This attempt however, was not clear to the audience as the questions above were raised after the P3 presentation. It forced me to sit down and create a coherent story line where all aspects are linked to each other. This provided some clarity. The phase between P3 and P4 is identified as the experimenting phase in the design process. According to van Dooren et al., (2013) a designer looks at the design problem and experiments in multiple ways with a variety of solutions. The designer collects a ton of information about the problem and the possibilities to come up with a specific design to address the problem. “It’s a process of thinking, experimenting, and learning from the results, a process of sketching, modeling, and critical rethinking the results, a process of continually changing and developing until a satisfying solution is found.” (van Dooren et al., 2013) This process is described as a research by design method. (Nijhuis, 2017). The figure below describes the experimenting phase where the results are critically reviewed and developed until a desired solution is found.

During this process, I've learned to critically view my design and if my drawings are communicative enough. After the P4 presentation the design had to be refined. Especially the design of the street profiles in the city centre. Because of the scale and complexity of the Sloterdijk location, I have neglected the design of the street profiles of the city centre. The contrast between the two locations was quite challenging throughout the project. Looking back at the process, I should have started on the city centre design earlier as the detailing and small scale of the city centre demanded a great amount of focus and understanding. However, given the little time I had left for the city centre design, I managed to zoom in quite a lot.

Finally, to conclude my reflection, this graduation project gave me a chance to enhance my capacities as an urban designer and has made an enormous impact on my intellectual development.



10.1

Sources
10.1 Designing is experimenting: a process of exploring and deciding, of trial-and-error. (van Dooren et al., 2013)

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