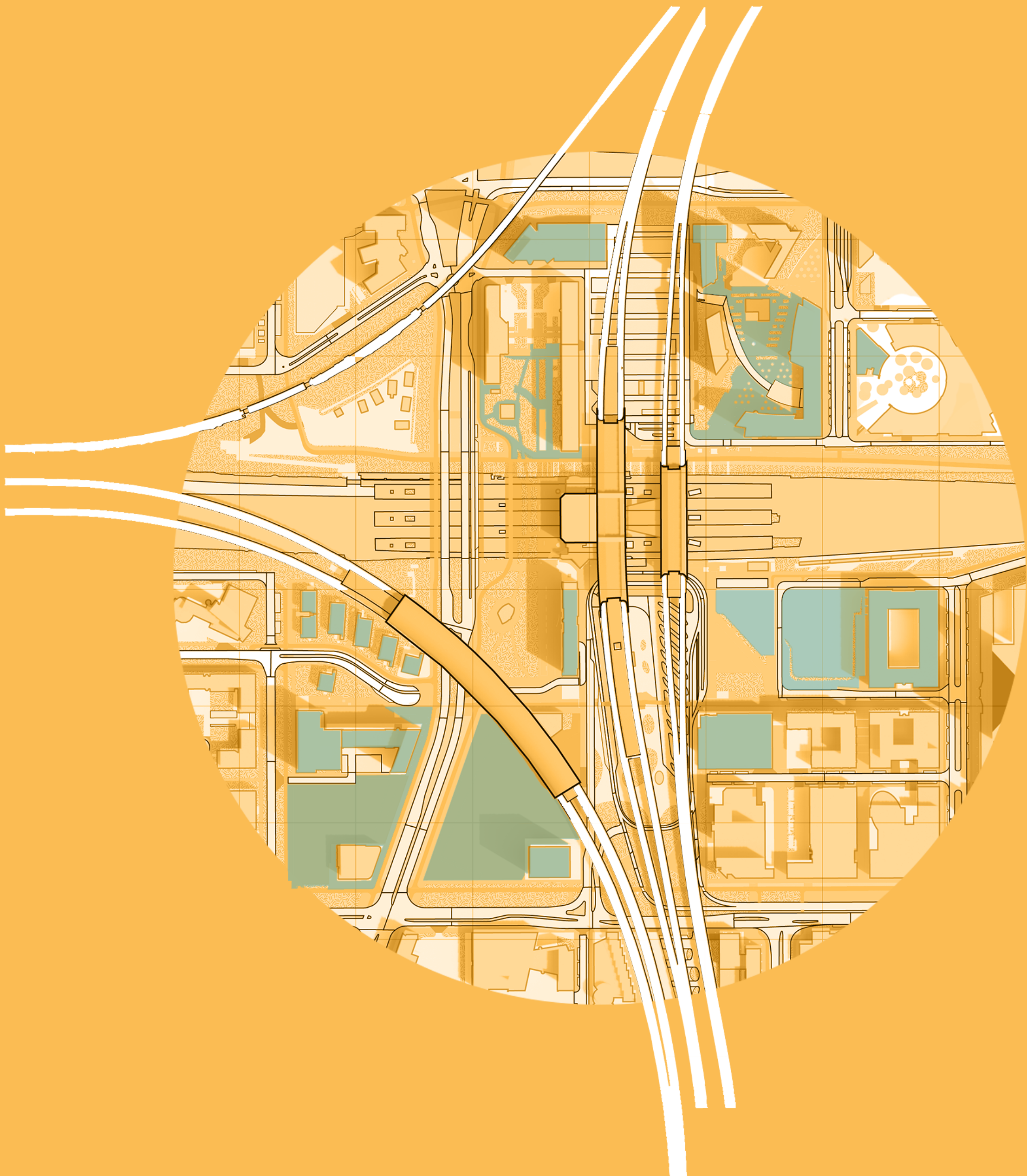

From node to place

A new livable and sustainable neighborhood in Amsterdam Sloterdijk

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Graduation Project
MSc. Urbanism

Colophon

From Node to Place:

A new livable and sustainable neighborhood in Amsterdam Sloterdijk

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All images created by the author, unless stated otherwise

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Abstract

This graduation project, having as a starting point the concept of Transit-Oriented Development (TOD), highlights the importance of high-density mixed-use developments around railway stations.

With this goal in mind, the station area of Amsterdam Sloterdijk was selected as a case study location. Sloterdijk is an important node within the overall transportation network and the plans of future development of the city of Amsterdam. However, the current spatial organization of the area, the high complexity, and several environmental problems are hindering its success as a place. Therefore, this graduation project, investigates through design, the potential of the area of Sloterdijk to become a sustainable and livable neighborhood, dealing with both the ongoing housing and the climate crisis in an integral way.

The primary method used in this graduation project was research by design, meaning that through several design iterations of different spatial elements, insights on the conflicts and potentials of these elements were revealed. Other methods used, included spatial mapping, literature review on the key concepts of livability, density, and TOD and fieldwork.

The results of this graduation project that can be extracted from the final proposal for the area of Sloterdijk, emphasize the challenges stemming from the high intensity of use and competition for space in places that function simultaneously as mobility hubs and as vibrant urban districts. Key elements of the design were the intense densification and introduction of housing and other functions to the area, the substantial reduction of space allocated to mobility, the careful consideration of public space that promotes social interaction, overcoming the various infrastructural barriers, and lastly the integration of green and blue networks with the aim of providing living spaces to various species, improve local microclimate and mitigate environmental risks

Key words:

Density, Transit-Oriented Development, Public space, Climate adaptation, Livability

Preface

Growing up in a dense and diverse city like Athens, I was fascinated by the intense experiences one can have in such lively urban environments. Due to the typically good weather conditions, people tend to spend a lot of their time outdoors, participating in outdoor activities or interacting with other people. Furthermore, several of its districts offer a plethora of options with shops, services, and activities, which enhance the attractiveness of these places.

The high density of people and activities, however, is coupled with several problems, such as high volumes of car traffic, substantial air pollution and a strong lack of quality green spaces, all of which are negatively affecting life in cities like Athens. This parallel the fascination regarding the liveliness of dense urban environments and the concern regarding several of their negative aspects were the starting point of this graduation project.

In the context of the Netherlands, the discussion regarding the concept of density is highly relevant partly also due to the pressing matter of the ongoing housing crisis. The intense urban development and lack of available space, call for a substantial increase in the densities of existing urban areas. At the same time, the advantages provided by the extensive national railway network, create promising conditions for the potential densification of cities in close relation to the public transportation network, which has positive effects on achieving sustainable development. Nevertheless, the realization of lively urban districts around railway stations is a challenging task but also a pressing matter for the future urban development of cities like Amsterdam.

During my first year of this master in Urbanism, I participated in the Delft Hyperloop team, a team that consists of students researching on the future implementation of the hyperloop technology. There, I had to conduct research on the potential of railway stations in the Netherlands where potentially a future hyperloop station could be located. Coming across the station of Amsterdam Sloterdijk, I was intrigued by the highly complex site and the problematic image of the surrounding urban environment. Further research revealed the importance of the area for the future urban development of the city of Amsterdam. However, its current state is hindering its potential as an important node of future development and as a place where people can work, live, and meet.

This graduation project, through the case study of Sloterdijk, will aim to find ways through design, in which future urban development can be realized in close relation to public transportation networks and more specifically around railway stations. Taking into consideration both the concepts of sustainability and livability, this project will illustrate a desirable future for the area of Sloterdijk, which is transformed into a dense, vibrant, and green urban district.

For this intense but also highly educating year, I would like to thank my mentors, Rients Dijkstra and Ulf Hackauf, for all the highly valuable and interesting discussions during our meetings this year, that helped me in developing my understanding of the dynamics of urban places and the interrelation of their spatial components. Lastly, I would like to thank my fellow peers for the interesting discussions and inspiration throughout the year.

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Context

1.1. Housing Crisis

The Netherlands is currently facing a major housing crisis, as various reasons are causing a **disproportionate growth of housing demand in relation to supply**. The housing problem escalated during the 2008 financial crisis which had long-lasting effects on the construction sector (NL Times, 2020).

Amongst various reasons, population growth (physical or due to migration), climate and taxing regulations and the transition to private ownership, have led to a problem with **significant negative impacts**. The process of finding a house has become extremely difficult and unaffordable for a large part of the population. Expected population growth of up to 18,8 million by 2030 along with current lifestyle changes such as increasing single-person households are going to put even stronger pressure on this matter. According to Kasja Ollongren of Home Affairs, **by 2030, around 845.000 new houses should have been built** to prevent a further deterioration of the problem (Dutch review, 2020).

A problem of national scale, housing crisis is mostly **affecting large cities** of the Randstad. The problem is particularly intense in the city of Amsterdam. The rapid population growth of about 11.000 new inhabitants per year is by no means met by the current rates of construction. Lack of space and problems related to nitrogen emissions slowed down the construction of houses from 2019 to 2021 leading in increased demand (NL Times, 2020).

Two interrelated crises

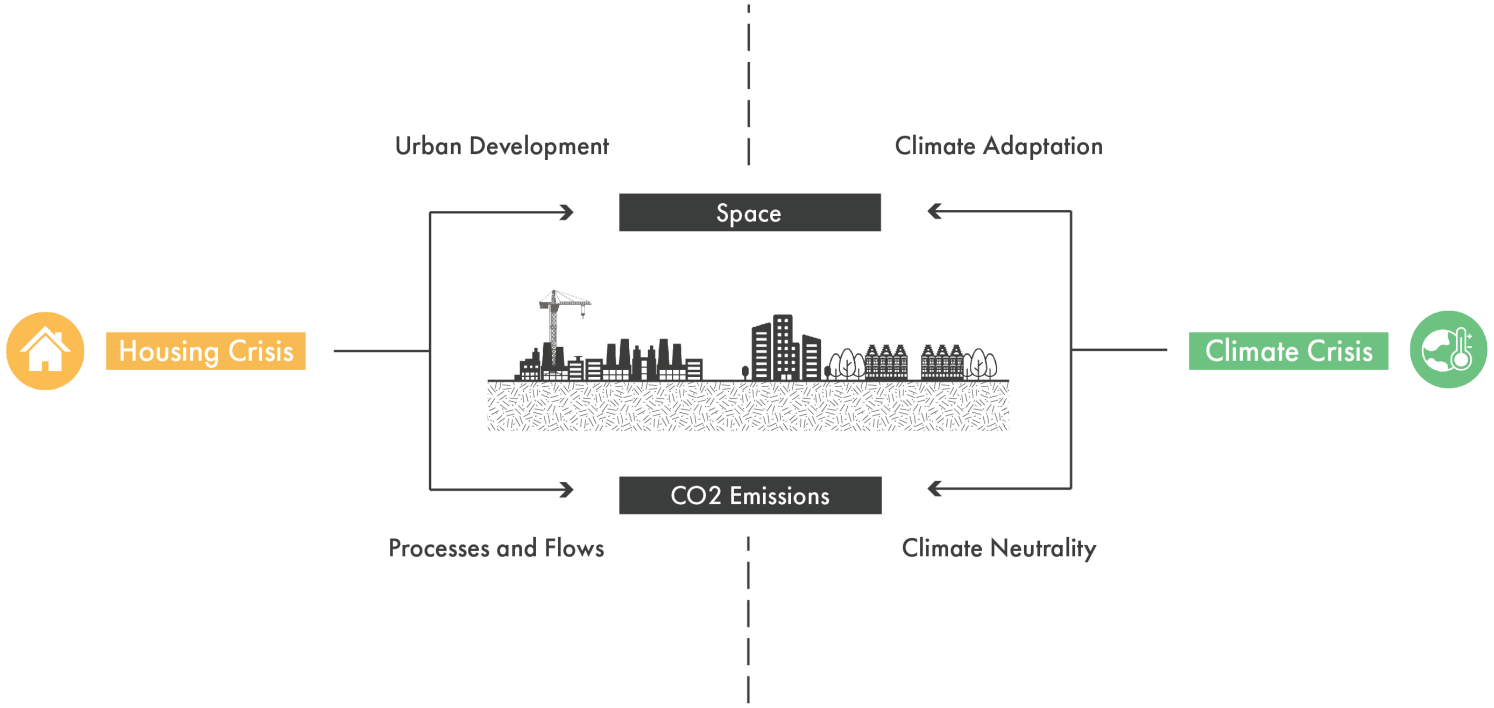
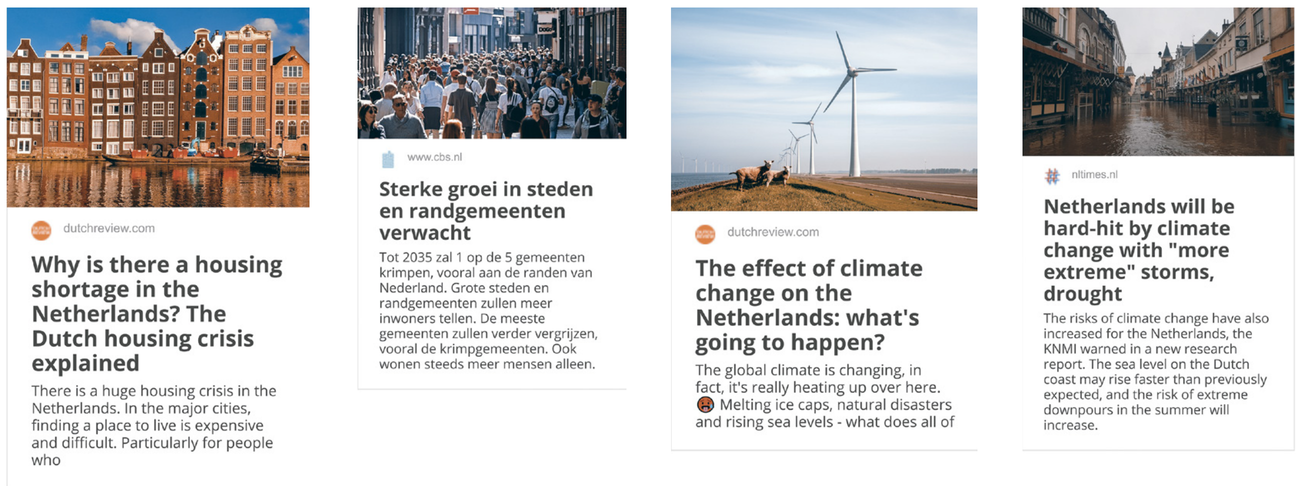


Figure 1. Conceptual diagram of the conflicting housing and climate crisis.



dutchreview.com

Why is there a housing shortage in the Netherlands? The Dutch housing crisis explained

There is a huge housing crisis in the Netherlands. In the major cities, finding a place to live is expensive and difficult. Particularly for people who

www.cbs.nl

Sterke groei in steden en randgemeenten verwacht

Tot 2035 zal 1 op de 5 gemeenten krimpen, vooral aan de randen van Nederland. Grote steden en randgemeenten zullen meer inwoners tellen. De meeste gemeenten zullen verder vergrijzen, vooral de krimpgemeenten. Ook wonen steeds meer mensen alleen.

dutchreview.com

The effect of climate change on the Netherlands: what's going to happen?

The global climate is changing, in fact, it's really heating up over here. 🥵 Melting ice caps, natural disasters and rising sea levels - what does all of

nltimes.nl

Netherlands will be hard-hit by climate change with "more extreme" storms, drought

The risks of climate change have also increased for the Netherlands, the KNMI warned in a new research report. The sea level on the Dutch coast may rise faster than previously expected, and the risk of extreme downpours in the summer will increase.

Figure 2. Website articles on the pressing challenges of housing provision and climate neutrality.

1.2. Climate Crisis

On the other side, **climate change constitutes the largest crisis of our time on a global scale.** Global warming caused by billions of tons of CO2 produced by human activity, is leading to an overall environmental degradation and poses great risks for the ecosystem. Rising sea levels, extreme weather events, drought and heat stress are going to affect without exceptions all parts of the world (UN, n.d.). Apparently, a country below sea level like the **Netherlands is particularly vulnerable**.

To face this challenge, the European Union presented in 2019 the **European Green Deal**, a set of policies that aim in transforming Europe into a climate neutral continent by 2050, while an international agreement on climate was signed in 2015 (COP21). Accordingly, the Netherlands, has set climate adaptation high in its agenda. Current national climate policies aim in **reducing CO2 emissions** by 49% by 2030 and by 95% by 2050 (Government of the Netherlands, n.d.).

However, coupled with the ongoing housing crisis, the Netherlands must face two interrelated major crises. The following construction of the 845.000 new houses by 2030, is putting immense pressure on the challenge of carbon emission reduction and at the same time limiting climate adaptation capacity. This large-scale addition of new houses is expected to **have a strong influence on the existing urban fabric.**

The way in which the housing crisis is resolved is going to play a major role in achieving a sustainable future for the Netherlands.

Context

1.3. Extensive consumption of space

Rapid Urbanization

But **what does a sustainable future mean**? In an era of rapid urbanization, it is expected that by 2050, about two thirds of the global population will be living in cities (UN, 2018). This is strongly related to **several advantages often related to cities** that are strengthening their attractiveness. Stemming from high concentrations of people and **extended economic and social networks**, knowledge and innovation are clustered, leading to economic growth. Combined with the increased **efficiency in the development and use of infrastructure**, these are some of the reasons for the increasing urbanization rates (Cervero, 2001). Apparently, this intense transformation to an almost completely urbanized world, will have a direct **influence on the ability of future generations of meeting their needs**.

Spatial manifestation

The **spatial manifestation of this transformation** is directly linked to several factors that influence the conceivable **levels of sustainability that can be achieved**. Urban form in either expression, sprawled or dense, through utilization of land, is directly linked to environmental issues regarding ecosystems, pollution and greenhouse gas emissions, fossil-fuel exploitation, and preservation of vital resources such as water. Our **behavior**, that is also expressed spatially through the urban form, will have a determinant influence on our future. The quest for a "**sustainable development**" has raised several debates regarding which type of urban development is more sustainable (Jabareen, 2006).

Expansion of cities

As stated by Berghauser Pont & Haupt (2009), cities grew substantially particularly during the past century, due to the **increased demand for space of humans**. By using the example of the city of Amsterdam, they indicate that for the period between 1880 and 2000, even though the population grew by a factor of 2.3, the area of the city grew by a factor of 20. This is evident in most of the contemporary affluent parts of the world, in which individual and collective behavior within complex economic and social networks, are **consuming increasingly larger pieces of space.**

Negative environmental and social aspects

This expansion of the urbanized areas is often coincided with the term "**Urban sprawl**" which typically refers to a form of urban development characterized by **low population densities and fragmentation of land** (OECD, 2018). Sprawling of living and working environments and the dispersion of functions, services, and infrastructure, besides their positive aspects, are linked to several **negative environmental externalities** of urbanization such as **car dependency, ecosystem fragmentation, higher demands in energy and increased greenhouse gas emissions** (Berghauser Pont & Haupt, 2009).

This physical dissociation of functions and services has also a negative impact on **societies**. By creating larger distances between living environments, workplaces and amenities, mobility demands increase, **negatively affecting the accessibility** of a large portion of the society to various services and amenities. Adding to this, separation of vital parts of everyday life, eventually leads to **social segregation** as different social groups do not coexist in the same place (Sim & Gehl, 2019).

It becomes apparent that a different form of development should be considered, where both of these environmental and social challenges could be possibly addressed.

Figure 3. The broadacre city concept by Frank Lloyd Wright. Source: https://www.motorsgrouping.com

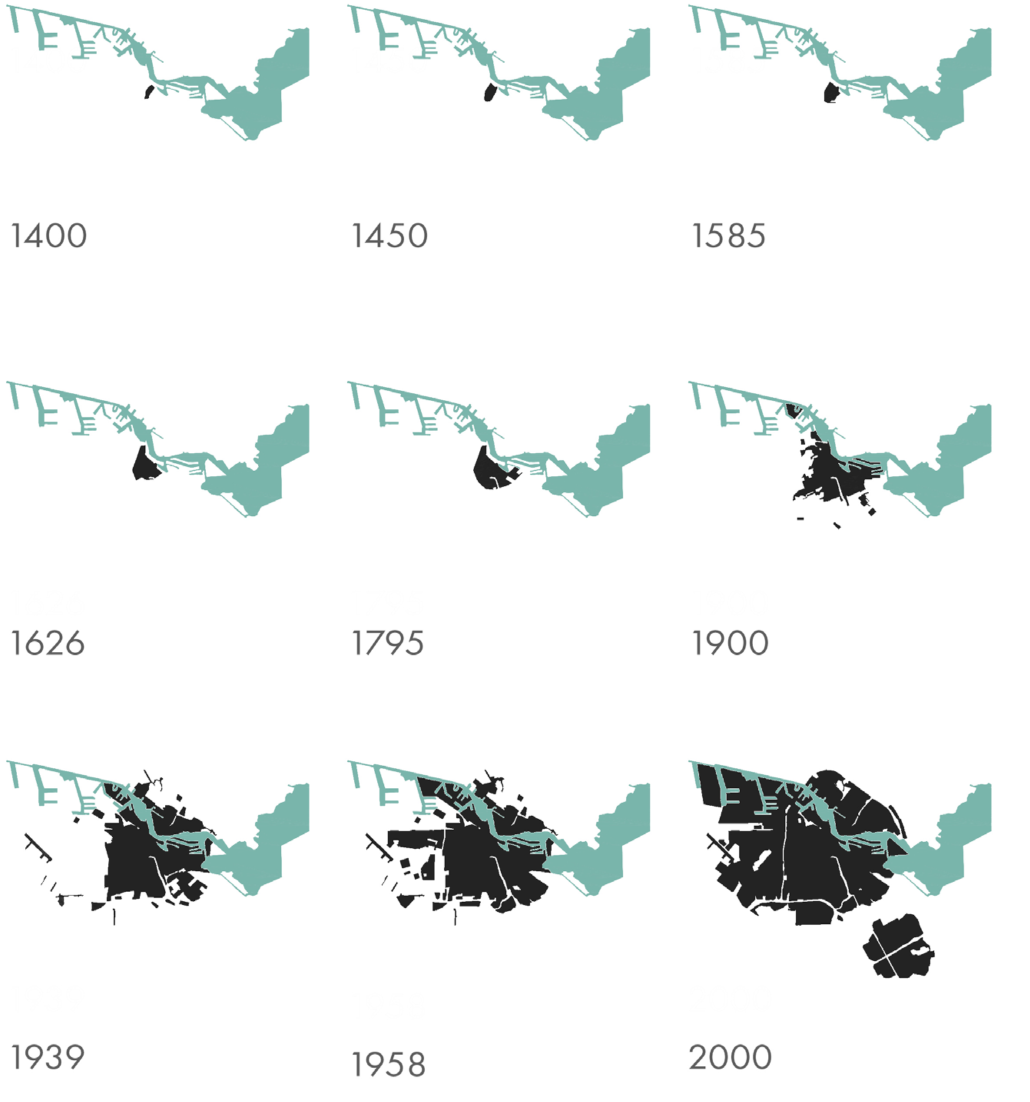


Figure 4. Territorial growth of Amsterdam 1400-2000. Source: (Berghauser Pont & Haupt, 2009). Adopted by author.

1.4. Embracing density

Perceptions of density

This different form of urban development could be expressed in more **compact** ways, as according to many researchers, the aspect of **density is a determining factor for sustainability** (Boyko & Cooper, 2011). Perceptions regarding density, which is usually defined as the **number of people**, **housing units or services** within a specific location, have been shifting during the past centuries. However, since the 1960s and the growing consensus regarding social and environmental problems originating from the rise of **private mobility and urban sprawl**, led to more positive perceptions of density (Berghauser Pont & Haupt, 2009).

Desnification as a national policy

In the **Netherlands**, almost the entire population is urbanized as around **90 percent of people live in cities**. Limited amount of space has led to the adoption of **national policies** that steer **urban development in a compact** way, in the form of **densification** of existing urban areas and with the aim of protecting agricultural land and areas with high environmental value (PBL, 2021). From the graph below, it becomes evident that the Netherlands is facing an extreme pressure on land due to high urbanization rates, therefore developing in a compact way is imperative.

Environmental benefits

As mentioned in the previous chapter, the way our cities are developed has a direct influence on energy consumption, infrastructure deployment, resource exploitation and CO2 emissions. In terms of **mobility**, high densities when coupled with a more balanced **mix of uses** and closer proximity of housing, working places and services, can have a great impact on **reducing car-dependency** and an increased use and **efficiency of public transport** (Newman & Kenworthy, 2015). This leads in a significant **reduction in carbon emissions** as public transportation is by large more energy-efficient per capita. At the same time, **walking and cycling** are also becoming more attractive, replacing thus even more travels done by private cars.

Another important benefit of higher densities in relation to sustainability, is the development of infrastructure. Clustering more people and functions together, leads in principle to more **efficient and less extensive infrastructure**, alleviating thus spatial pressure of vital **green and agricultural land** (Boyko & Cooper, 2011).

Social aspect of density

A term that has gained popularity that is often correlated to density, is the concept of urbanity. This term is commonly used to describe mostly positive aspects of urban life such as **diversity** and **complexity** and is based on the preconditions set by dense urban environments on boosting the **potential of human interactions** (Berghauser Pont & Haupt, 2009). According to Jacobs (1961), **higher concentrations of people** are automatically **creating diversity**, and this is simply related to sheer number of different backgrounds, requirements etc., while as she notes, other elements that influence diversity are trivial compared to the aspect of the number of people concentrated in a place.

Other social benefits, as they are described by Boyko & Cooper (2011), include a more diversified and affordable **housing provision** and improved **accessibility to services and facilities** (such as schools, everyday needs etc.). Another important benefit is the increased potential for **social interaction** in dense environments, that can also lead to higher levels of safety, due the more intense and extended activity on the streets (‘**eyes on the street**’). Finally, increased density of people can have a **positive effect on the aspect of social segregation and exclusion**, that is related to the physical isolation of certain parts of the society.

Figure 5. Top: Activities on street with space reclaimed from cars. Higher density of people can support a wide variety of activities and social iteraction of different social groups. Source: https://www.hechtgroup.com

Figure 6. Bottom: The Hague, aerial view. Cities are aiming in achieving higher densities through densification of existing urban fabrics. Source: https://www.expatica.com/nl

1.5. Transit-Oriented Development (TOD) as a starting point

An integrated approach

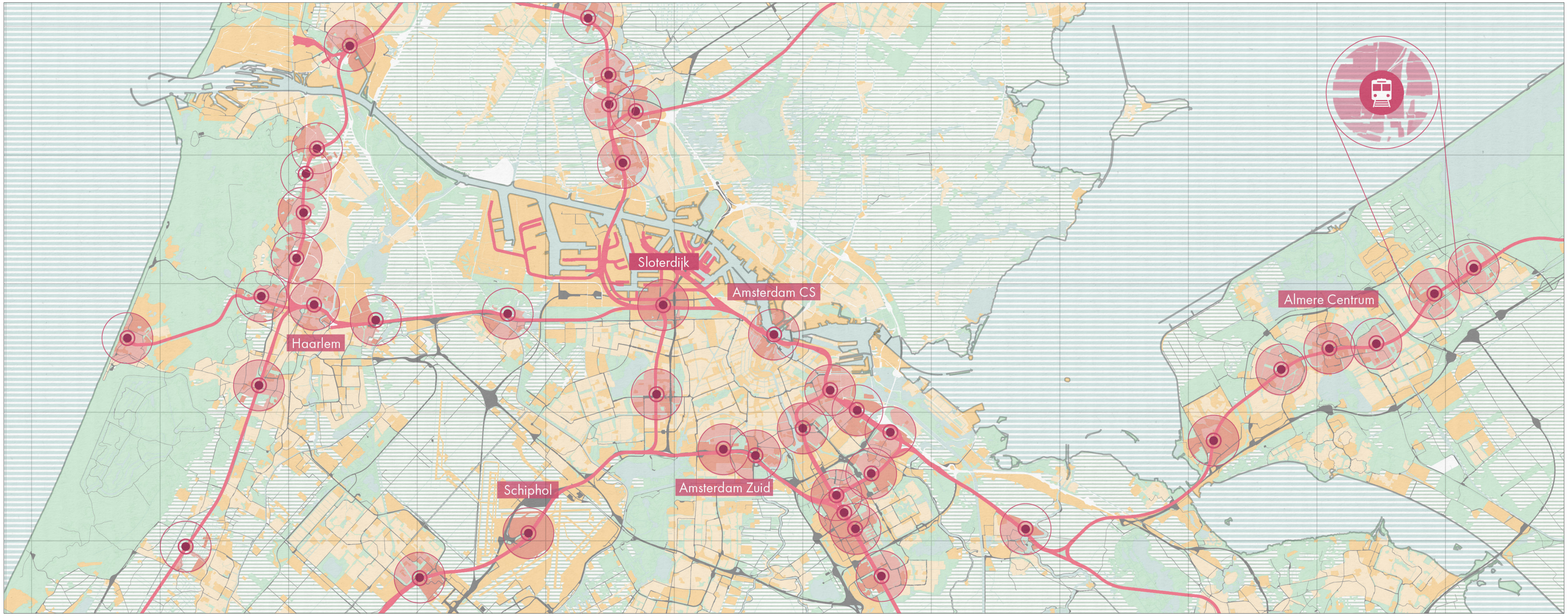
As analyzed above, the way in which the housing crisis is resolved is going to play a major role in achieving a sustainable future for the Netherlands. However, the aspect of housing is not an independent part of urban development. **Transportation**, as a **key component of urban development** and function, should be an integral part of the discussion for sustainable development. Currently, transportation is responsible for around one fourth of total emissions in the Netherlands (CBS, 2022) while **road traffic accounts for around 17% of the total emissions** (NL Times, 2019). Keeping in mind primarily the aspect of environmental sustainability, it becomes apparent that land use planning and mobility patters should be restructured.

TOD and sustainable development

Transit-Oriented Development (TOD) is a concept widely recognized as a means of achieving sustainable transportation through the **integrated planning of land-use and mobility systems** and therefore could be a supportive tool towards achieving sustainable development goals (Hrelja et al., 2020).

According to most definitions, TOD is the development of **high-density mixed-use areas around transit nodes,** usually of heavy or light railway. This high concentration of people, jobs, and facilities in combination with the good public transport and walkable environments, is a promising **tool to mitigate urban sprawl and car dependence** and therefore contributing to sustainable development (Cervero & Sullivan, 2011).

Figure 7. Map showing the railway lines and circles of 1km around railway stations in the region of Amsterdam.



Context

1.6. TOD as a national strategy

Urban development and infrastructure

Infrastructure is a **key element of urbanization processes**. Thinking of how cities develop, infrastructure is either following the development of urban settlements or can potentially act as a key driver for it (Belanger, 2012). When it comes to transportation, it is suggested that **urban development, mobility patterns and mobility infrastructure are strongly related to each other** as each one of these variants have a strong influence on the development of the others.

The importance of railways

One of the most influential **novel creations in transportation was the railway**. Since the 19th century, railway infrastructure determined on a great level the development of cities, albeit the rise of automobile in the 20th century. In Europe, in contrast to the United States, railway was still an important aspect of everyday mobility (Kasraian et al., 2015).

In the context of the Netherlands, railway infrastructure development played an important role in the **urbanization process of the last 150 years**. Before the development of railway, waterways were the main transportation infrastructure of the country. In the early years of the establishment of railway in the Netherlands (the first route that was connecting Amsterdam and Haarlem opened in 1939), railway and water transportation were competing each other while the railway exploited the advantages of the canal spatial structure. At the same time, transnational economic competition with Belgium and Germany pushed the need for a more extensive railway network that would connect the major cities of the area that later would form the Randstad, which was completed in 1855. However, competition with transportation on water and low economic benefits was still slowing down the development of the railway.

Since 1880 and the substantial growth of cities, **stations became increasingly important for the cities.** This signaled the beginning of a new area of greater development of the railway infrastructure (Cavallo, 2008). During that period, the network started to grow towards the north and south parts of the country. This development continued and **reached its peak by 1920** (Kasraian et al., 2015). After WWI and the rise of automobile, the railway network development declined because of this competition. Surprisingly though, in the 1960s the expansion of the network was stable and in the 1970s it started to slowly grow again.

As it is going to be further elaborated in the next chapters of this research, several planning policies such as the 'compact city' revival in the 1980s, where concentrated on the overlap of urban development and the railway network (Pojani & Stead, 2018). Concluding, in their research, Kasraian et al. (2015), suggest that there is a **strong correlation between urban development and railway infrastructure in the Netherlands**. While in the beginning, railway infrastructure was developed based on the existing urban structure, later urban development was concentrated around railway stations (Kasraian et al., 2015).

Benefits of accessibility

Despite the beforementioned difficulties in the development of the railway system in the Netherlands, the system managed to become the **busiest railway network in Europe** (ACM, 2019). According to data by CBS (2011), **two out of three people of the Netherlands live in a biking distance (less than 5 kilometers)** to a railway station. Following the trend of substantial growth in the last five years both on passenger and freight transport by railways, the network is expected to face capacity issues. Currently around 750.000 passengers use the train every day and this number is expected to rise (ACM, 2019).

With a length of around 3200 km and 401 stations around the country one of the main questions is whether it is possible to develop the railway network more or should we exploit its advantages through multimodal hubs.

Figure 8. Map showing the Dutch railway network in relation to built-up areas and open green spaces.

Legend

Open spaces | Agriculture
North Sea
Municipalities
Railway Stations
Railway Network
Built-up areas

1.7. Train station Areas as nodes of development

Train station areas: An Overview

As analyzed above, the railway has played an important role in the urban development of cities. Consequently, railway station areas (defined as the urban context surrounding railway station buildings and the complementary mobility infrastructure), have had a strong influence on their surroundings. (Martins da Conceição, 2014). But the relationship between station areas and cities has not always been the same. This can also be reflected in the station building itself, that from being just another piece of infrastructure, it gained a prominent role acting **as the entrance to cities** (Cavallo, 2008). Similarly, station areas evolved from being placed typically outside the city boundaries, to being integral parts of them **facilitating complex multimodal mobility systems and other important functions.**

The emergence of station area developments

Since the **1990s**, transformations of railway station areas have become amongst the most prominent projects for many European cities which is partly explained by the development of the **European High-Speed Rail**, including the Netherlands as part of the network (Bertolini et al., 2012). Many well-renowned projects have been realized since then, including Euralille (in Lille, France), a project that had the ambition of the overall regeneration of the city of Lille, through the development of the area of Euralille to facilitate the new HSR line that would run through the city (De Jong, 2009). This was part of a general trend of **capitalizing on higher levels of connectivity** and through high-profile station area redevelopments, aiming to a better positioning of cities on international competition (Bertolini et al., 2012). Similarly, in the **Netherlands**, most of the effort and capital was concentrated in **six railway station redevelopments** including the stations of Rotterdam,Breda, Utrecht, The Hague, Arnhem and Zuidas (Cavallo, 2008).

However, the r**e-emergence of train station area transformations in recent years**, is mostly related to the acknowledgement of socio-economic and environmental problems related to the constant expansion of cities and privatized mobility that steer urban development more closely to public transport infrastructure (Martins da Conceição, 2014). A new more **integrated approach of urban development and mobility** is becoming more prominent, putting the focus on concentrating development in compact forms in close relation to public transport networks.

Challenges

All these of course are followed by certain challenges, hindering the successful implementation of train station areas developments. The rapid technological and socio-economic transitions have posed significant challenges on the success of plenty of railway station areas. The **discrepancy of evolution between spatial and non-spatial elements**, and more particularly of the physical aspect of station areas and ongoing transitions in society, economy, governance etc., leads to the **incapacity of train station areas to meet contextual needs**. Moreover, the uncoordinated planning between urban development and transportation has as a result several discontinuities that in turn affect negatively the spatial and functional integration of station areas to the city needs (Martins da Conceição, 2014). From all the above, combined with the complexity stemming from the wide range of parties involved, it becomes clear that railway station areas demand **a careful and integral approach to planning and design**.

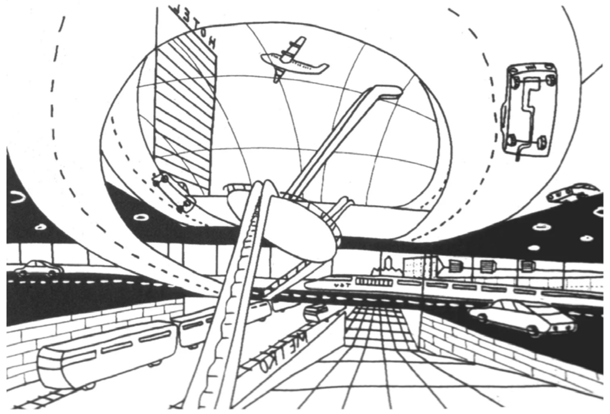


Figure 9. Conceptual illustration of the Euralille project from OMA. Source: www.oma.com

"All these elements define a new urban condition which is at the same time local and global, as important for the 'Japanese' as it is for the 'Lillois'."

OMA, n.d.

Figure 10. Utrech central station. One of the 6 key railway station projects in the Netherlands. Source: www.businessinsider.nl

Figure 11. The 'Europaallee' area is the surrounding the Zurich central station in Switzerlands. This development, taking place between 2004 and 2022, is one of the examples of station area development projects happening across Europe in the recent past, creating a mixed-use environment in the direct vicinity of a major railway station. Source: www.kcap.eu

1.8. Train Station Areas as places

Station areas: Places of possible interaction

One of the key characteristics and benefits that are embedded in the typology of railway stations (or transportation hubs in general) is the **concentration of a very extensive range of users**, stemming from the expansive and across different scales **accessibility** that a railway station provides. This specific part of a city attracts diverse societal groups and offers a place where due to the **intensity of use of space**, these **groups can potentially interact** (Bertolini, 1999).

Diversity also becomes an important aspect of train station areas from a **spatial perspective**. Given the distinct characteristics of each given train station area, different sets of arrangement of functions and users are required. This spatial diversity could potentially result in attracting even greater **range of different users and functions**, adding to the capacity of the transport hub to provide this desired interaction (Martins da Conceição, 2014).

According to Bertolini (1999) however, this desired interaction, requires something very important: that the **development of the transportation system** (the node) **is developed in close relation to the surrounding urban functions and activities** (the place). This was the base for his proposed Node-Place model which will be discussed further later.

Accessibility, Diversity and Inclusivity

As Bertolini suggests, **accessibility** is a key element of the potential success of a train station area as a place for interaction. However, the notion of accessibility needs to be explored **beyond the perspective of mobility**. This essentially means that in order to realize the role of train station areas as successful urban "places", the aspects of the **diversity of activities and inclusivity of various users** need to be considered equally (Bertolini,, 1999).

The notion of place

It becomes apparent that specific characteristics related to the notion of "place" can influence the success of a train station area. Of course, defining these characteristics that create this sense of place, can be a challenging task. According to Montgomery (1998), the success of a place is related to both **physical (spatial qualities)** and **non-physical elements**. The non-physical elements are primarily related to the **experience of a space** and to the **importance of activity**, as it is highlighted by thinkers like Jacobs.

Figure 12. Rotterdam Central Station and adjacent temporary staircase. Source: www.archdaily.com

Context

1.9. Considerations about density

Livability in dense urban environments

As analyzed before, **density** can potentially play an important role to the transition to a more s**ustainable urban development**. The aspect of sustainability within the framework of density, however, cannot be considered without relating it to the aspect of **livability**. Livability as a term and concept is usually contradicting with sustainability, as it is more subjective and can be realized at the expense of goals related to sustainable development. Therefore, **by realizing substantially higher densities** with the aim of providing adequate housing or limit the territorial growth of cities, **several factors of livability, such as health, can potentially be influenced negatively** (Lehmann, 2016). The aspect of livability for this graduation project, as it is going to be further elaborated, is based on the concept of sustainable livability by as it is articulated by van Dorst (2012). As it is defined, "**A sustainable living environment is healthy, safe and supports control over social interaction and contact with the natural environment**" (van Dorst, 2012, p.239). Therefore, the aspects of health, safety, social interaction and nature are defining the interrelation between sustainability and livability.

Figure 13. Finding quiet and green spaces in dense urban environments is usually challenging. Source: Personal archive.

Competition for space

One of the key challenges when applying higher densities in cities is that each of these components require certain amount of space in order to function. This causes the development of competition for space between these components and potentially to conflicts.

Starting with **mobility** as a key component of Train Station Areas, a large portion of open or closed spaces of these areas is dedicated to serve the local mobility system. The large **footprint** of train stations, space dedicated for parking private vehicles, bus lanes and tram stops, bike paths and parking, all of these jointly take up a large amount of space which is vital for the unobstructed **function of the system**.

At the same time, space dedicated to mobility and to other human activities, typically requires more **paved and non-permeable surfaces**, limiting thus the potential for open soil surfaces or trees in a high-density area. This poses threats to climate adaptation goals and strategies as paved surfaces have negative effects on heat mitigation and water management. Meanwhile, higher densities slow down **wind speed**, reducing in this way the natural ventilation and cooling of space, leading to **higher temperatures, increased need for energy and to higher levels of air pollution** (van Esch, 2015). All in all, health and wellbeing risks related to the **Urban Heat Island effect and risks related to flooding**, call for a more climate-sensitive design, however allocation of space for that matter is also required.

Furthermore, higher densities are posing threats to **ecology** in urban settlements as they may lead to loss of **urban green space**, discontinuities of green/blue networks and **biodiversity loss**. Despite the apparent benefits of green spaces and biodiversity in cities, implementation in densification processes is highly challenging (Haaland & van den Bosch, 2015).

Last but not least, **social space** in highly dense urban environments requires careful consideration. The aspect of **perceived density** is very important as it affects the perception of individuals in relation to the number of people in a specific area. This may potentially lead to the feeling of 'crowdedness' which has a negative connotation. (Berghauser Pont & Haupt, 2009). This highlights the importance of the "**control over social environment**", meaning that urban environments through design, need to provide people with the ability to **control their level of social interactions** (van Dorst, 2012). This in busy areas such as Train Station Areas is crucial.

1.10. Towards a model of sustainable and livable Train Station Areas

Chapter conlusions

The Netherlands is currently facing two major and interrelated crises, the **housing, and the climate crisis**. Current patterns of urbanization, resulting in the **constant growth of cities and extensive land conversion and infrastructure**, are recognized as the cause of environmental degradation, ecological fragmentation, and social segregation.

As an alternative, consensus on the **importance of density** in urban development, has been growing in the past few decades, namely that higher concentrations of people, functions and services could potentially lead to a more **sustainable development**. However, **competition for space** by various vital functions such as mobility, social space and ecology, results in the contestation of the potential success of high-density urban environments.

This graduation project, having as a starting point the concept of **Transit-Oriented Development**, an integrated approach to urban development and mobility, puts **Train Station Areas** at the forefront as the places for dealing with both crises in an integral way. It proposes an **updated model of living, working and recreation in high densities, in the direct vicinity of railway stations** of both local and urban influence. The high levels of **accessibility and intensity of use** of such places, create promising preconditions for urban districts of **great diversity and for potential social interaction**.

This multiplicity of potential users is enhanced by tailoring public space design and program for various age and social groups. **Inclusivity** however, as a core value of this graduation project, goes **beyond human populations**, taking into consideration the aspect of **ecology** in dense urban environments and the way to secure a livable environment for various species. By integrating nature in the design of train station areas, people living and working in the area, have **a direct contact with the natural environment**, alleviating thus negative connotations of high-dense environments. Nature finally, is being utilized as means of dealing with the changing climate, creating thus a safe and future-proof living environment.

All in all, this graduation project aims in the **redefinition of past paradigms of station area developments**, in which efficiency of the transportation systems and economic performance where the driving forces. Through the case study of Sloterdijk, **a new model of sustainable and livable train station areas** will be explored.

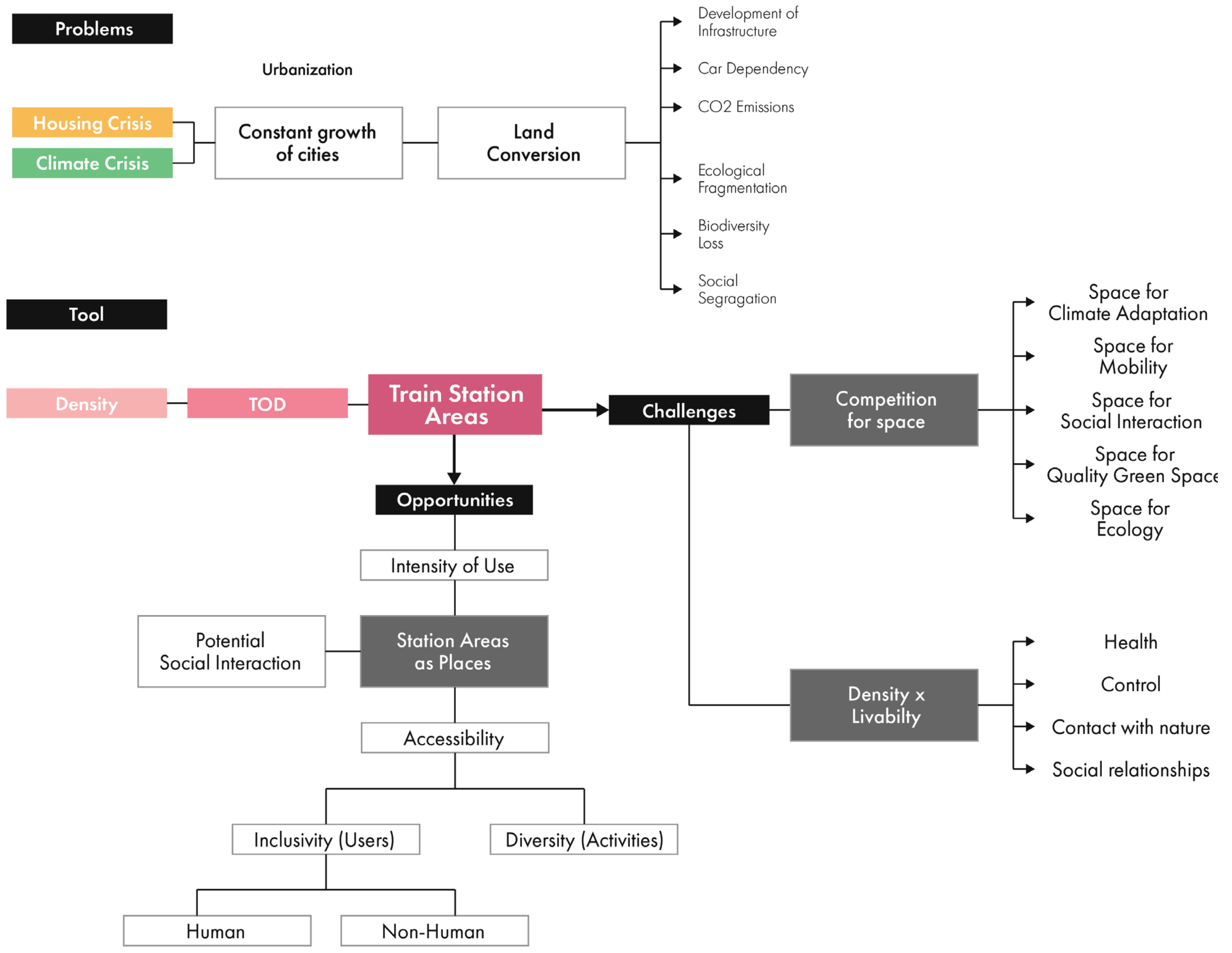


Figure 14. Mind map of the potential and challenges related to the implementation of TOD as a tool for sustainable development

Case study 2

Case study

2.1. The city of Amsterdam

Introduction

TThe selected location for this research is the area of **Sloterdijk** in Amsterdam. The city of Amsterdam is the capital and the largest city in the Netherlands with a population of 919,845 inhabitants (CBS, 2021) and a large **business and cultural hub**, being a **highly attractive** place for various groups of people.

Amsterdam along with the other large Dutch cities of Rotterdam, The Hague and Utrecht create the regional entity known as the **Randstad** which due to its polycentric structure is defined by Batten (1995) as a '**network city**'. This entails specific advantages such as high attractiveness for living and working on both local and international level. However, in practice these four major cities have their own ambitions and goals in terms of their development (Bontje, 2009).

At the same time, the city of Amsterdam is part of the greater **Amsterdam Metropolitan Area (AMA)** that consists of 30 municipalities and spans across two provinces, that of North Holland and Flevoland (Metropoolregioamsterdam, N.D.). According to Bontje (2009) the daily urban systems and formal or informal political cooperations that are formed within the AMA are critical for the development of the city.

In terms of the metropolitan structure, this region is currently dominated by a single core, the city of Amsterdam, while several small cities are surrounding it. Currently, the region is **transitioning from a monocentric urban model to a polycentric one** (Cheng et al., 2013). The municipality with its new Comprehensive Vision acknowledges this imbalance and aims to be transformed into a polycentric region. (Gemeente Amsterdam, 2022).

Constant population growth

Popularity of the Dutch cities and especially of the city centers, is **continuously growing** after a 30-year period of suburbanization that started in the 1960s (PBL, 2016). According to projections, medium and large-sized cities are going to grow even more as most of the expected population growth of the Netherlands is going to happen there. Lifestyle paradigms such as **single-person households** are favoring this trend of increasing popularity of the city centers while satellite municipalities around large cities are also going to develop because of this process (CBS, 2019). Currently, most of the population and employment of the Netherlands are within the urbanized areas while policies such as the Agenda Stad, aim to strengthen this urbanization process even more (PBL, 2016).

This trend is especially evident in the city of Amsterdam. Since 2010, Amsterdam grew rapidly both in terms of population and employment, as 11.000 new inhabitants moved to the city every year (Gemeente Amsterdam, 2021). Future projections are expecting that the city will have the largest growth on a national level with more than 150.000 new inhabitants by 2035, and a total population of over a million (CBS,2019). At the same time the municipality is creating plans to meet the needs of 250.000 new residents by 2050 (Gemeente Amsterdam, 2021).

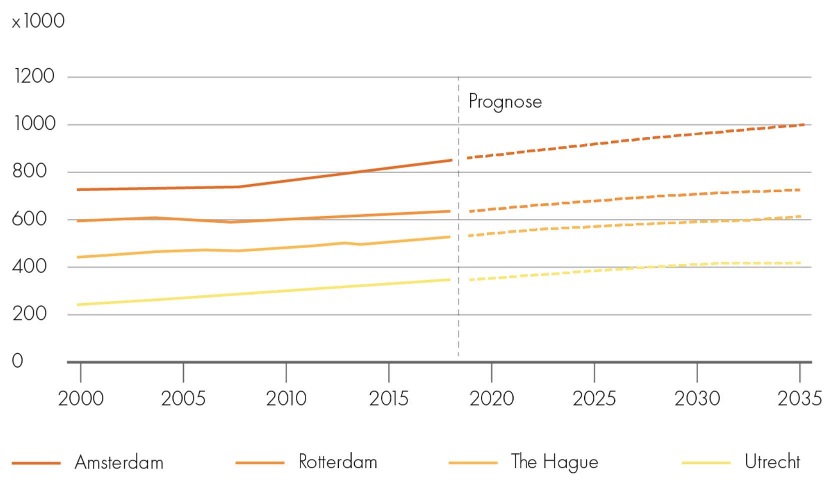


Figure 15. Current population figures and expected growth for the four major cities of the Randstad. Source: (CBS/PBL)

An attractive city

Popularity of cities is strongly linked to amount of **job opportunities** offered. This is also evident in the case of Amsterdam, where due to the recent transition to a **knowledge-based economy**, employment grew significantly, attracting thus more people in the city. Knowledge and innovation are regarded as key economic drivers that Amsterdam capitalized on and played an important role in the development of the city during the past 25 years. (Municipality of Amsterdam, 2017). This specialization of labor resulted in an increased attractiveness for the city and subsequently in flows of people from the region that **commute to Amsterdam for work**. This is highlighted by the fact that, for the period between 2008 until 2016, almost **90% percent of employment** growth of the Daily Urban System of Amsterdam, happened **within the core city of Amsterdam** (Goudappel Coffeng, 2018).

Currently within the city the are 633.800 jobs (CBS, 2018) and according to the Municipality of Amsterdam (2021), by 2050, space for **200.000 more jobs** should be created. This creates strong pressure for the development of more infrastructure and amenities for the incoming people. Multimodal nodes such as train station areas offer great opportunities for densifying work due to their great connectivity to the region (Municipality of Amsterdam, 2017). However, as it is going to be explored in the next chapters, the mix of functions and types of work concentrated in these nodes, is going to define their quality as places.

Figure 16. News related to the growing popularity of cities and particularly of that of Amsterdam. Sources: (www.nltimes.nl, www.dutchnews.nl)

Commuting

Commuting by public transport is important for the daily commuting to Amsterdam. About 60% of use of public transport in the Daily Urban System is related to the municipality of Amsterdam. The network is organized in a radial way since tangent movements are rare. Lastly, regarding the railway system, **commuting to Amsterdam by railway is mostly done from outside the Daily Urban System**. In 2016, around 58.000 people were commuting from the province of South Holland to the city of Amsterdam (Goudappel Coffeng, 2018). Sloterdijk in this system plays an important role acting as the entrance to the city from various directions, while being amongst the busiest stations of the region.

	Residential municipality		Work municipality	Employee jobs	Commuting distance
				x1000	km
1	Zaanstad	→	Amsterdam	24.0	15.0
2	Amsterdam	→	Haarlemmermeer	23.0	17.7
3	Almere	→	Amsterdam	20.5	29.4
4	Haarlem	→	Amsterdam	20.2	19.5
5	Utrecht	→	Amsterdam	19.7	36.2
6	Amstelveen	→	Amsterdam	18.5	8.8
7	Haarlemmermeer	→	Amsterdam	18.5	18.1
8	Nissewaard	→	Rotterdam	14.8	16.4
9	The Hague	→	Rotterdam	13.5	24.5
10	Rotterdam	→	The Hague	13.4	23.9

Figure 17. Employee jobs by municipality of residence and municipality of work. Source: longreads.cbs.nl

Daily Urban System of the AMA

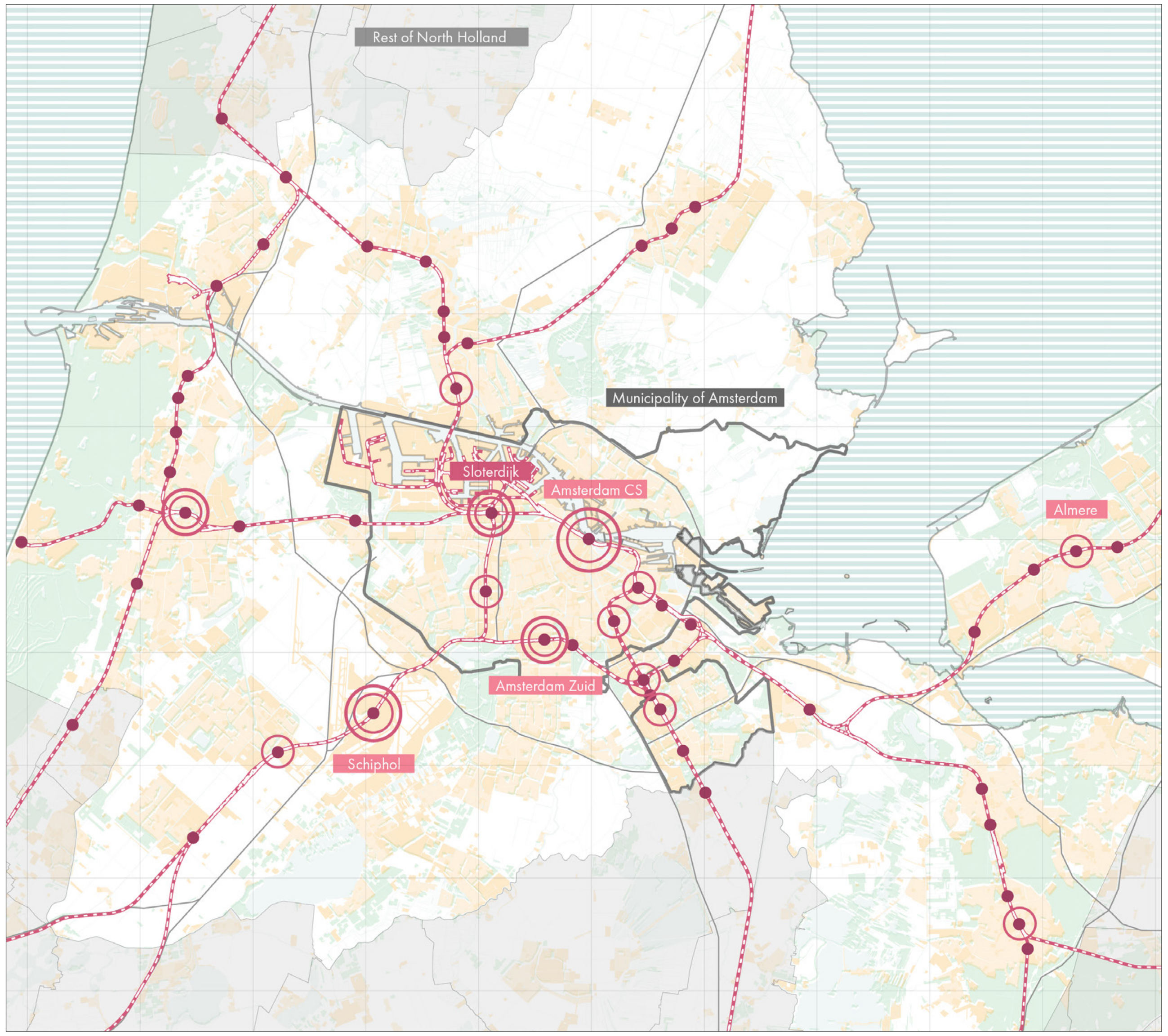


Figure 18. Daily Urban System of the Amsterdam Metropolitan Region (Goudappel Coffeng, 2018).

Legend

Municipality of Amsterdam
Railway Network
Stations (>40.000 daily ridership)
Stations (15-40.000 daily ridership)
Stations (<15.000 daily ridership)
Built-up areas

Grid Size: 5kmx5km
0 1 5 10 km

2.2. Practices of the past: monofunctional business districts

Urban development of Amsterdam

The strong **correlation of urban development and railway network** is also evident in the case of **Amsterdam**. Along with the railway, an extended network of metro, tram, bus, and bicycle are an integral part of the everyday mobility. Nevertheless, despite its apparent success, the development of this transportation network and the overall regional urban development, has created several **conflicts** between the city of Amsterdam and the surrounding medium or small sized cities. According to Pojani & Stead (2018), this was a result of several planning and political decisions starting after the second world war.

Starting after WWII, the city started to expand based on the General Expansion Plan by Cornelis van Eesteren, which was published in 1935. Following the "**concentric growth**" principle of the era, the city expanded along transportation corridors, while green spaces (**wedges**) were left in-between to maximize accessibility (Pojani & Stead, 2018). The plan was developed like fingers ("lobbenstad") starting from the historical core. Even though this was an attempt to decentralize Amsterdam, the lack of coordinated planning and underdeveloped public transport network of Amsterdam, led to the **strong dependence of the expansions to the city center of Amsterdam.**

After that period and starting from the 1980s, according to the "**concentrated concentration**" planning policies, development was spread throughout the region, creating a network of new centers such as Almere and IJburg.

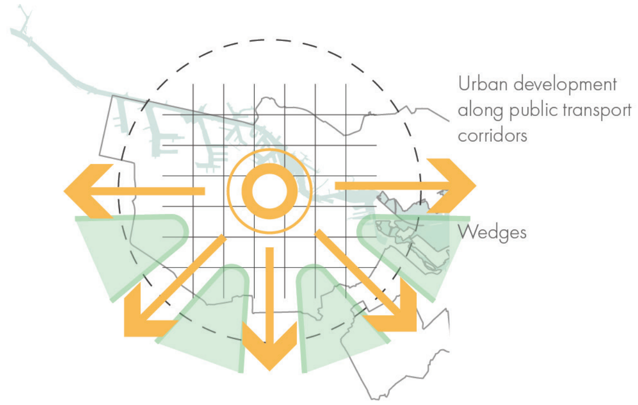
Specialized nodes

During the 1990s and 2000s, following a neo-liberal approach, a market-driven development process occurred. As a result of this approach, several new centers were developed. Important nodes for the economy of Amsterdam such as Schiphol Airport and Zuidas, led to the attemptt of replicating these models in other areas such as **Sloterdijk**, Amstel and Bijlmer. These areas even though they were promoted as TOD, in reality they were not (Pojani & Stead, 2018).

Figure 19. The Zuidas business district in Amsterdam. One of the monofunctional districts created in the urban region of Amsterdam. Source: www.cbre.nl

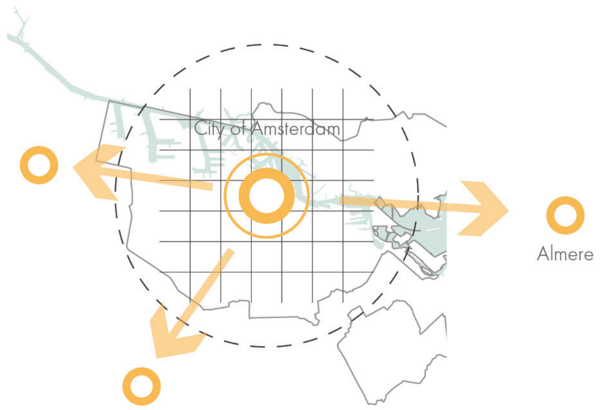
1945-80

Post-War Lobe City



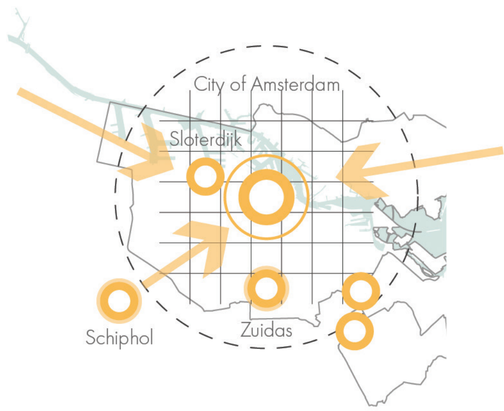
1980s

Concetrated deconcentration



1990s-

Compact City Approach



2.3. Facing the housing crisis

Transformation process

As mentioned before, the city of Amsterdam due to strong pressure, stemming from the ongoing national housing crisis in combination with immigration volumes, is undergoing a **significant transformation.** Up until 2008, Amsterdam developed primarily by realizing large-scale projects, in a cooperative manner between state and market. Policies specifically from the 1990s aimed mainly in the more balanced regional development, the international **economic competitiveness of Amsterdam** and the way to manage urban population growth. However, the uncertainty and negative outcomes of the 2008 financial crisis, put the existing policies in question and therefore in a substantial **altering of the process of urban development**, even though some of the main goals remain the same (Savini et al., 2016).

Existing and future plans

Structural Vision 2040 (Structuurvisie Amsterdam 2040)

This vision of Amsterdam published in 2011, aimed in creating guidelines for the urban development of Amsterdam until 2040. According to this vision, urban development should follow the "**Compact City" model** by densifying or transforming existing urban areas. The Structural Vision was replaced by the Environmental Vision Amsterdam 2050. However, two main guidelines are kept intact from the Structural Vision: The **main green structure and high-rise building zones**. These high-rise zones are concentrated around railway stations including Sloterdij and along the transportation corridor created by the A10 motorway and the adjacent railway lines.

Koers 2025

With the aim of **addressing the ongoing housing crisis,** the municipality of Amsterdam created a strategy plan that would guide the development of **50.000 new homes from 2016 to 2025.** Koers 2025 was a result of the Structural Vision 2040 guidelines for the urban development of Amsterdam, meaning that most of the development will be done through densification or transformation of empty and underused buildings.

Environmental Vision Amsterdam 2050 (Omgevingsvisie Amsterdam 2050)

The new vision replacing the Structural Vision creates clear directions for the urban development of Amsterdam. These, still within the Compact City framework, emphasize on the importance of **densification and the development of nodes around railway stations**. The vision can be summarized by five principles that include: a) **multicore development**, b) **growing within boundaries**, c) **sustainable and healthy exercise**, d) **rigorous greening** and e) **making city together**.

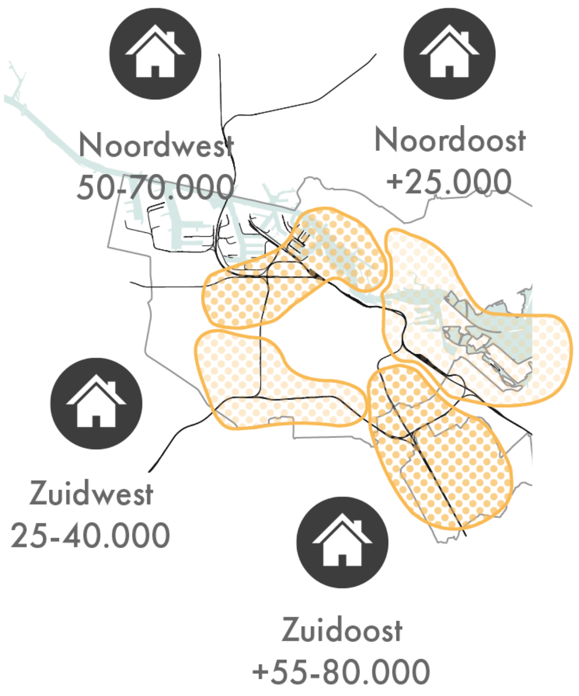


Figure 20. Diagram of population growth by 2050 in four different parts of Amsterdam.

Figure 21. The business district "Teleport" in Amsterdam Sloterdijk is dominated by large office buildings. High vacancy rates provide with a lot of opportunities for potential office space transformation into residential units. Source: https://www.mobiliteitsplatform.nl

Transforming office spaces into homes

As it is outlined in policy document Koers 2025, in order to realize this large transformation, the city of Amsterdam needs to maximize the potential of its existing building stock. This entails the conversion of obsolete office buildings or even complete office areas into residential ones. Only in 2016, 1370 new homes were realized from office space conversion (NL Times, 2017).

Sloterdijk as a business district offers many opportunities for either tranforming existing office buildings or completely replacing them.

Havenstad

Over the last few years, urban development of Amsterdam transitioned to a realization through small scale projects following values of **urban innovation**, that focus primarily on sustainable development and creative economies (Savini et al., 2016). Contrary to that spirit, in 2017 the municipality of Amsterdam presented the **Havenstad (Port-City)**, a large new development that covers over 650 hectares of land space. This development is located at the north-western part of Amsterdam, within the A10 ring and across the river IJ and as one of the epicenters of development, Sloterdijk is an integral part of the plan. According to the plans it is expected that by 2040, **70.000 new homes will be built**, with the aim of meeting the growing housing demand with a parallel creation of **58.000 new jobs**, in a new mixed-use environment (Gemeente Amsterdam, 2017).

Figure 22. Large-scale physical model showing the large transformation of the port of Amsterdam into a mixed-use area. Source: www.arcam.nl

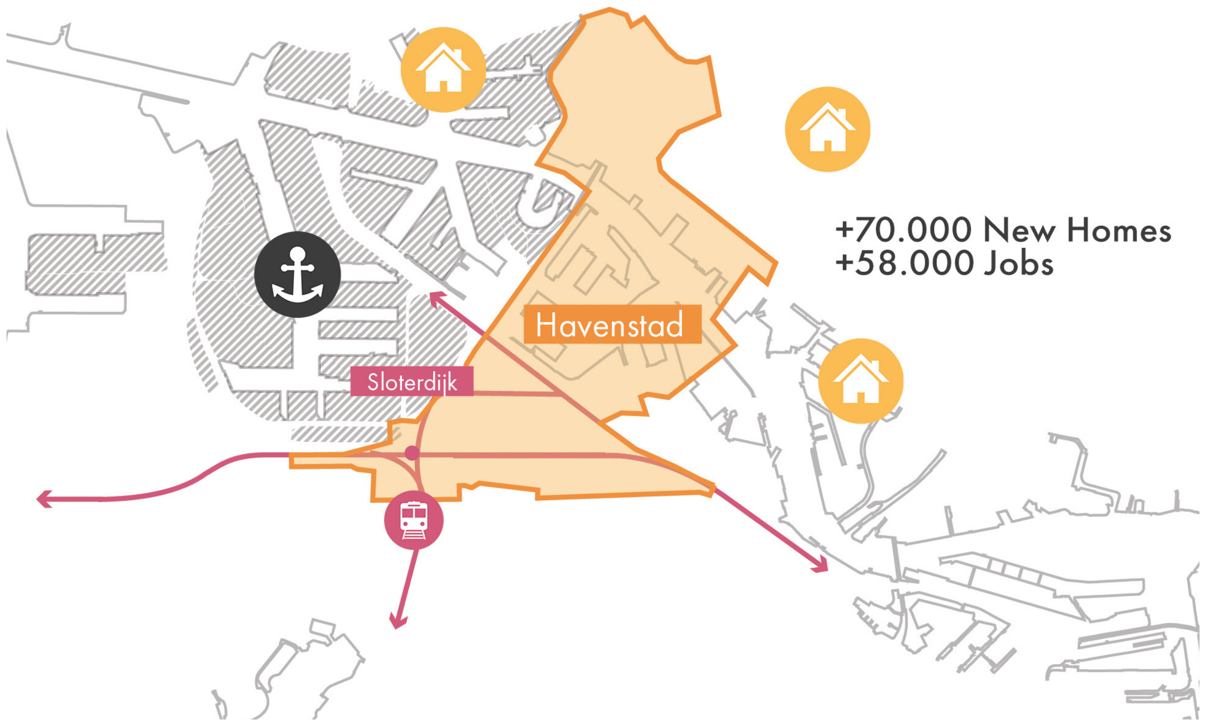


Figure 23. Diagram showing the new large development of Havenstad in relation to the mobility hub of Sloterdik.

Overview of housing development in Amsterdam

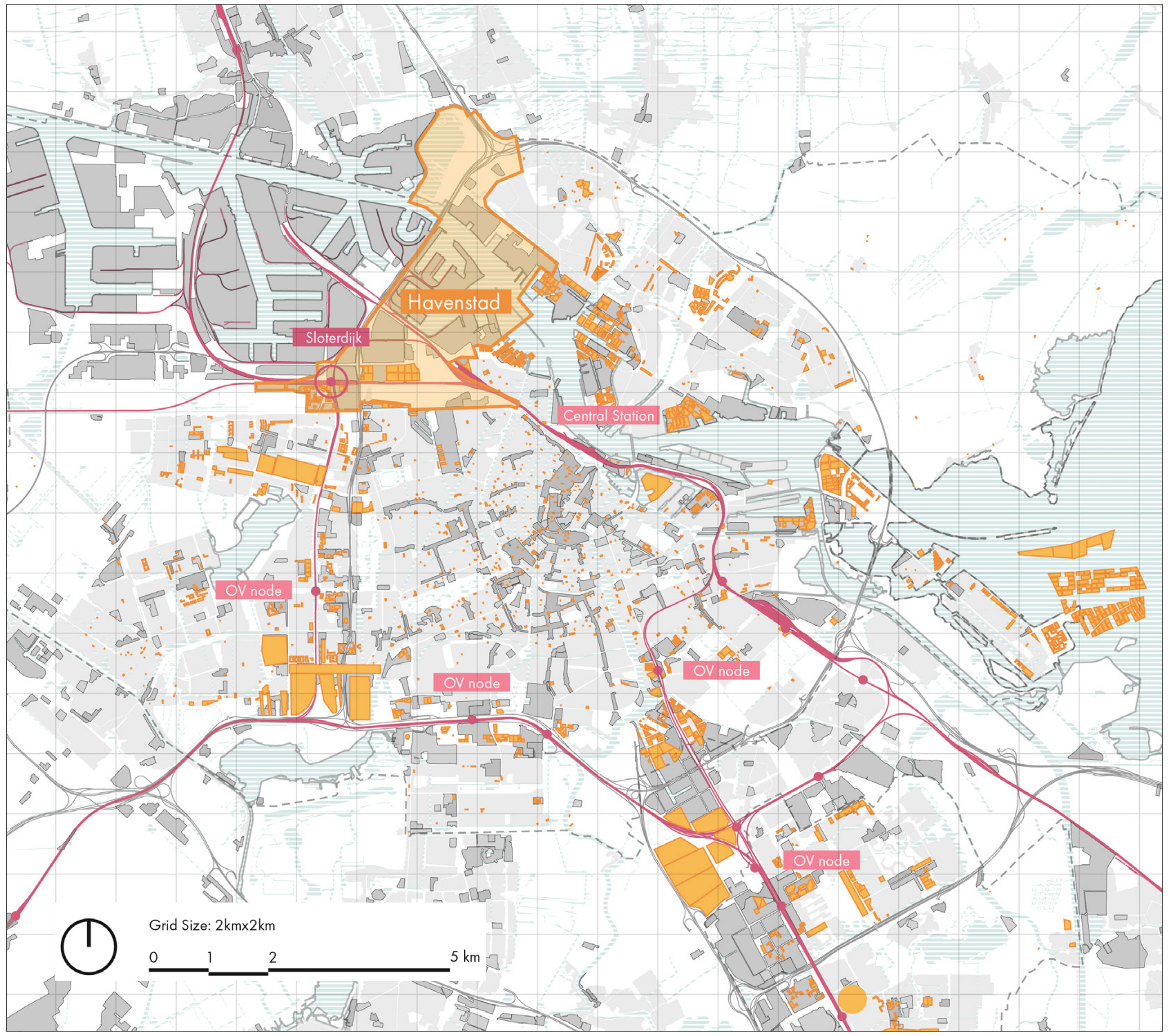


Figure 24. Most of the housing construction in the city of Amsterdam is happening within existing built-up areas. Office spaces and areas are transformed into residential. As it can be seen from this map, much of the large projects are happening along infrastructural corridors, while the large development of Havenstad is transforming part of the port into a mixed-use area.

Legend

- Municipality of Amsterdam
- Built-up area
- Company premises
- Socio-cultural activity
- Retail
- Railway Station
- Railway Network
- Road Network
- Havenstad
- Housing plans

2.4. Facing the climate crisis

Facing the Climate crisis

As introduced in the first chapter, the Netherlands and consequently the city of Amsterdam are facing the **urgencies and risks associated with the changing climate**. Climate change is not only about rising temperatures. It also includes **rising sea levels**, **extreme weather events** like precipitation and **prolonged drought**. All these have negative impacts to the economy, to health and to ecosystems.

Flooding

The Netherlands, since it is a **delta region** and lying primarily under water sea level, is particularly vulnerable to risks related to water such as **fluvial and pluvial flooding**. Flooding can be a very disastrous event, and even though the dike system is providing high levels of protection, chances of extreme events cannot be eliminated (PBL, n.d.). On top of that, flooding that occurs from **extreme precipitation** is an urgent problem in cities like Amsterdam. Since most of the land is currently paved, the capacity of the urban system to deal with large amounts of water is hindered, leading extensive damage to cities and pose **threats to human and non-human populations**. As it can be seen on the map (Figure 23), Amsterdam Rainproof has designated several areas that act as **bottlenecks** in the overall water management system, ranging from urgent to extremely urgent in terms of priority. Solving these issues requires a very well-coordinated and integrated approach (Rainproof, n.d.)

Heat

The Netherlands's climate is not characterized by high temperatures. However, that does not mean that the Netherlands is immune to the effects of rising temperatures on a global scale and to the **Urban Heat Island effect** (UHI) on a more local scale (van der Hoeven & Wandl, 2015). Heat waves are increasingly becoming a more common phenomena, and this has negative implications on multiple levels and subjects. High temperatures lead to an increased **energy consumption**, due to the need for **cooling, structural damage to vital infrastructure and ecosystem**. Finally, **health and well-being** are particularly affected for both human and non-human populations. As urbanization rates are growing, heat is going to be an increasingly urgent issue (AMS, 2020). In Amsterdam, UHI which is related to human activities and urban form, as it is depicted on the map (Figure 23) is mostly evident in the **historical core** of the city and in **large infrastructural nodes or industrial sites** such as Schiphol airport and Sloterdijk.

Policies

To mitigate the negative effects of climate change, the government of the Netherlands has developed two national strategies: the **Delta Programme** (mostly regarding fluvial flooding) and the **National Climate Adaptation Strategy** (NAS) (Klimaatadaptatiesnederland, n.d.). On a city scale, Amsterdam has developed its own policies the Amsterdam Green Infrastructure and New Amsterdam Climate, that address the pressing matters of climate adaptation and climate neutrality.

Conclusion

From the map (Figure 23), it becomes apparent that the area of Sloterdijk is a particular vulnerable area to both heat stress and flooding occurring from extreme precipitation.

Figure 25. People trying to stay cool during a heatwave. Source: www.washingtonpost.com

Case study

Overview of climate related urgencies in Amsterdam

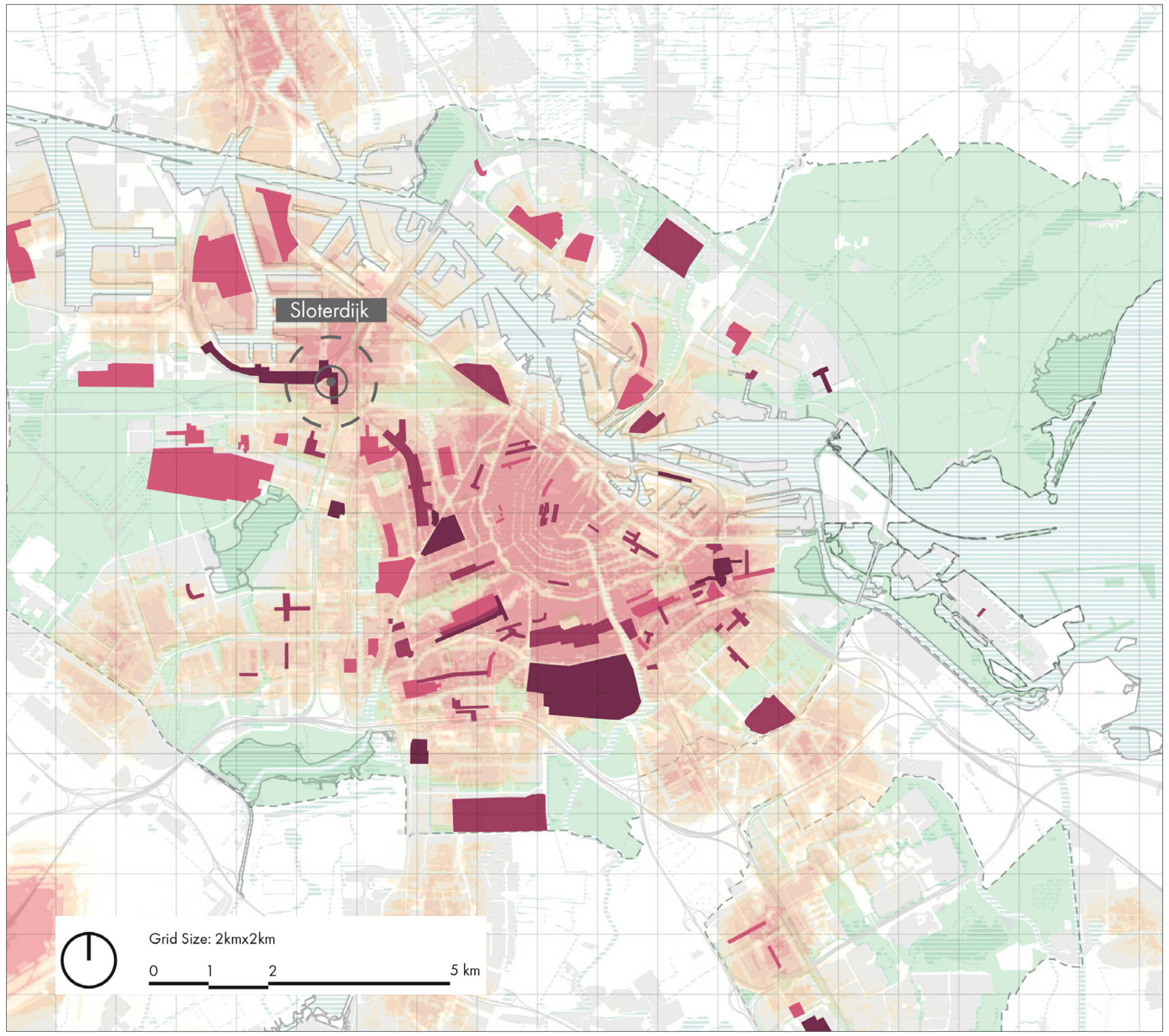


Figure 26. Map illustrating the current climatic urgencies the city of Amsterdam is facing. Source: Rainproof, atlasnatuurlijkkapitaal

Legend

Extremely Urgent Bottleneck
Very Urgent Bottleneck
Urgent Bottleneck
Main Green Network
Urban Heat Island effect

2.5. Amsterdam Sloterdijk: A crossroad of development

By overlapping the visions of the municipality for **high-rise development along infrastructural corridors and the ongoing housing developments**, as explained in the previous section, it becomes clear that the area around Amsterdam Sloterdijk railway station is at a **crossroad of development**. When combined with climate related urgencies such as heat and flooding, Sloterdijk appears to be both a **key location** for the future development of Amsterdam and a particularly **vulnerable** one.

In terms of the **mobility**, the railway station of Sloterdijk acts as the **entrance to the city** as it brings a large number of people into the city every day. From there and through this transportation hub, commuters transfer to other means of transport to reach the inner city of Amsterdam. In the meantime, the large development project of **Havenstad** is going to add more than 1**00.000 new inhabitants in the area**, putting immense pressure on the mobility system and consequently to the area of Sloterdijk which is still going to be the main node for interchange, retaining its function as a **major mobility hub**.

At this infrastructural and mobility junction, the future development of Havenstad is also connected with the **existing urban fabric of the city**. Therefore, functional, and spatial aspects of the area of Sloterdijk can have a huge impact on the future integration of Havenstad to the city.

Lastly, these developments are going to affect the **ecological structure** of the area. At this point, the **Brettenscheg**, one of the Amsterdam large regional ecological structures, is connecting the center of Amsterdam with natural areas outside the city, while it has effects on the urban climate. An apparent conflict appears at this point between urban development and the green structure.

All the above, call for an integrated approach in the design approach of the area of Sloterdijk, that has to deal with a significant increase in **population density** in its direct vicinity, strong **pressure on the overall mobility system** that will directly affect the station area and at the same time with all the beforementioned **climate risks**.

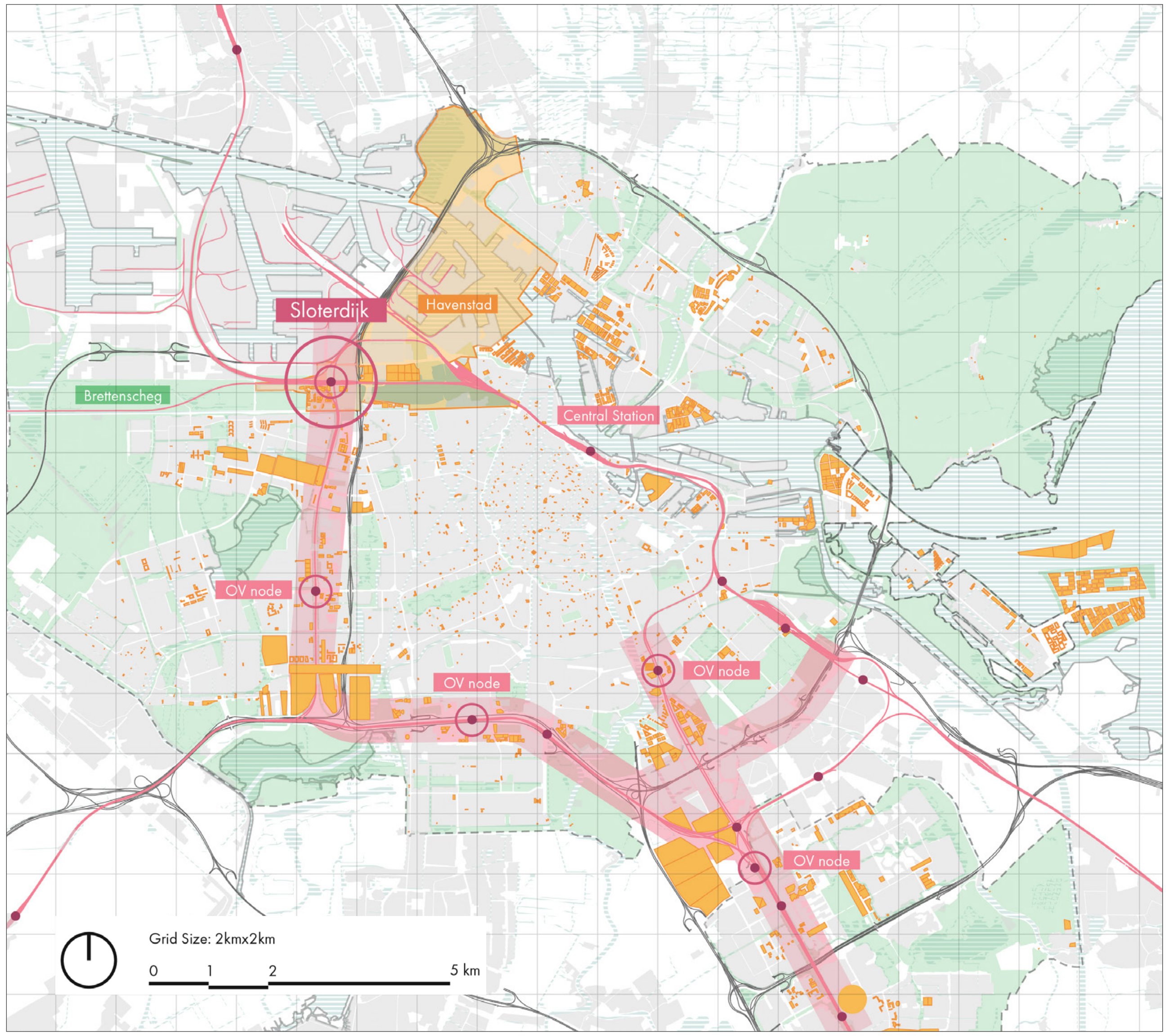


Figure 27. Map showing conflicts due to large scale developments and climate challenges.

Legend

- Municipality of Amsterdam
- Built-up area
- Main green structure
- Railway Stations
- Railway Network
- Road Network
- Sloterdijk
- OV Node
- High-rise zone
- Havenstad
- Housing plans

2.6. An unbalanced node development

As analyzed before, the region of Amsterdam is **transitioning from a monocentric to a polycentric region**. In literature, polycentric regions are often correlated with the notion of **network**. This implies that cities (or nodes) within a region, are part of a complex system that through co-operation and complementarity, function in a more horizontal way (Meijers, 2005). In the context of Amsterdam, this means the need for further development of several **sub-centers** in the region that will be able to complement the regional function of Amsterdam (Cheng et al., 2013).

Since the 1990s, the city of Amsterdam focused on large-scale developments either with a monocentric vision in the case of the redevelopment of the banks of IJ, or with a more polycentric one in the case of the **development of new nodes in the periphery of the city center** (Savini et al., 2016). This allowed for different **urban functions to be concentrated in different places.** Large office spaces, due to availability of space and benefits of good accessibility, were concentrated **around railway stations such as Sloterdijk.** At the same time, other city-level functions such as hospitals and large retail centers were developed around car infrastructure along the A10 ring while the old city center maintained a large amount of small scale and everyday functions (Cheng et al., 2013).

One of the main problems in the process of urban development of Amsterdam around nodes and more specifically railway stations, was the **lack of coordination between land use development and transportation planning**. Amongst other examples in the region, **Sloterdijk is a busy transportation node of regional importance**, however the **area around the station is still underdeveloped** (Bertolini, 1999). Sloterdijk is an evident result of the optimistic planning of Amsterdam (starting in the 1990s and lasting until the financial crisis of 2008), that based on a neoliberal approach, lead eventually to an **oversupply of office spaces and creation of non-diversified and vulnerable areas** (Savini et al., 2016).

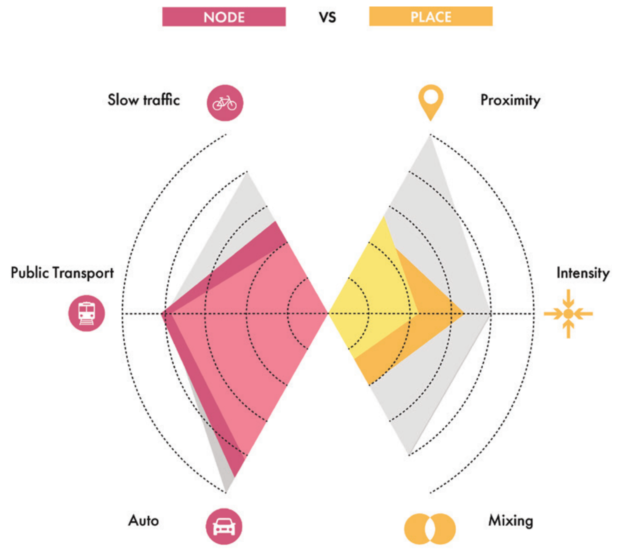


Figure 28. An unbalanced node vs place development of the Amsterdam Sloterdijk station area. Source: Noord-Holland & Deltametropool, 2013

"Without a transaction base cities and urban places become progressively more lifeless, dull and inert that is to say more suburban. Without activity, there can be no urbanity."

Montgomerry, 1998.

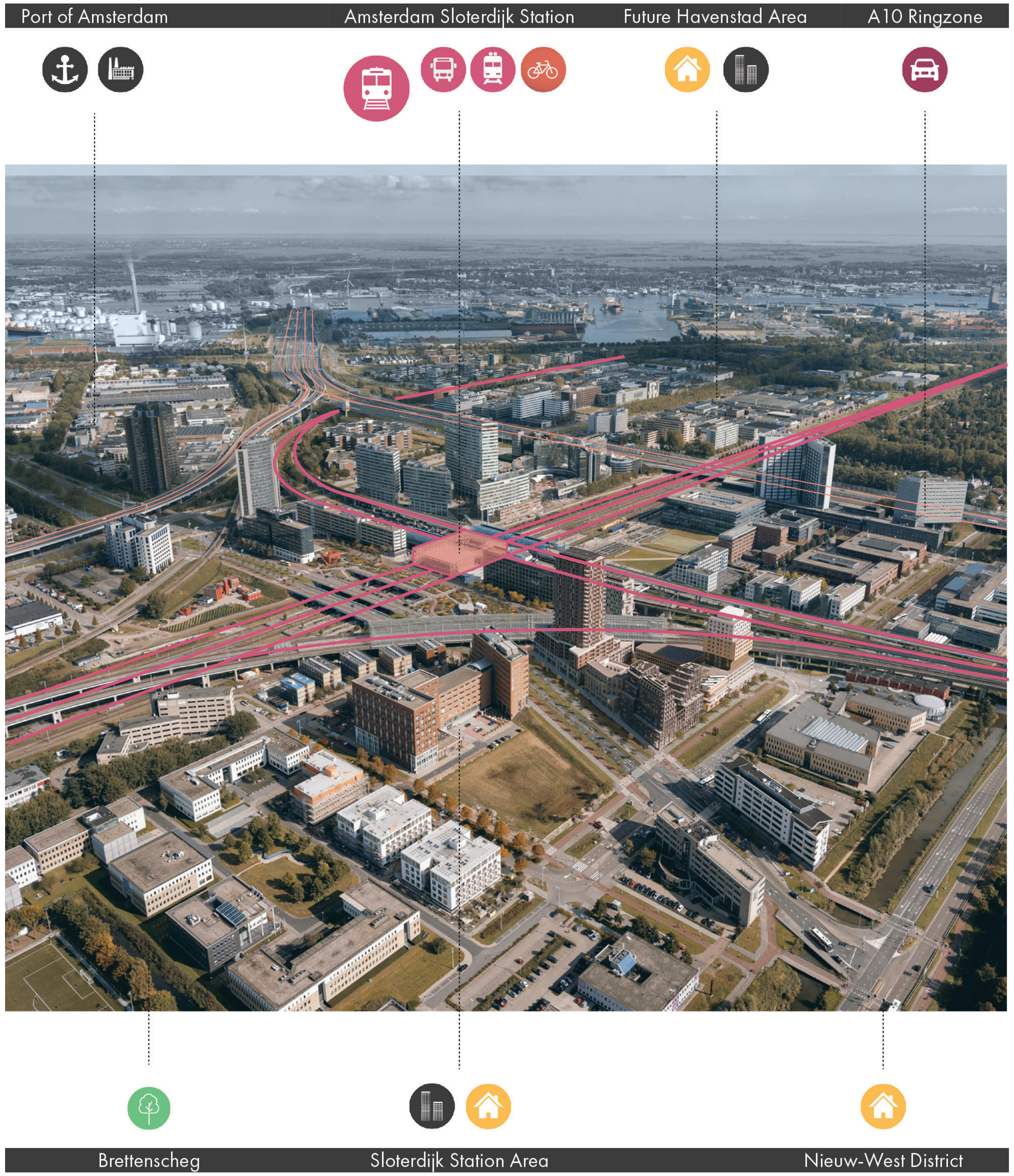


Figure 29. Aerial photograph of Sloterdijk. Infrastructure is a dominating feature of the area. An office district is developed around the station, known as 'Teleport'. In the diagram we can see the position of Sloterdijk between the port, the new Havenstad development and within the Nieuw-West district of Amsterdam. Source: www.nieuwbouw-motown.nl

2.7. Amsterdam Sloterdijk Station Area

Case study area

Sloterdijk, the site location chosen for this graduation project, is a neighborhood in the Nieuw-West district of Amsterdam. The area is characterised as the area around the major railway station of Amsterdam Sloterdijk.

Since the relocation of the station to its current position in 1986, an **office park was developed at the node**. The area remained, until recently, strongly monofunctional and functioned primarily as a **transfer hub**. This resulted in an area, that especially after working hours, is empty and regarded as **highly unattractive**. Additionally, due to its non-flexible office spaces and the economic crisis of 2008, the office park faced significantly **high vacancy rates**, enhancing thus the feeling of emptiness.

Dominated by infrastructure

Furthermore, Sloterdijk is currently **dominated by infrastructure**. Several railway lines are crossing the station area on different levels, while on the eastern border of the neighborhood, lies the A10 highway. On the north-western part, the area shares its borders with the port of Amsterdam, enhancing thus traffic volumes and noise levels.

Environmental degradation

This **immense infrastructure development** and amount of paved-areas dedicated for mobility, have resulted in **several environmental problems**. The area is facing strong **heat stress** and extensive warm days, while due to lack of porosity there it is vulnerable to **pluvial flooding**. The **lack of green** around the station is also enhancing the unattractiveness of the area. Large and inflexible structures and infrastructure are negatively affecting the **adaptation capacity of Sloterdijk** into the current urgencies and needs.

Amidst a time of extensive transformations such as the new large urban developments and the energy transition, the regional importance of the node of Sloterdijk makes it a great site location for researching on **how the future TOD can be spatially manifested.**

The Station

The most prominent component of the area is the Amsterdam Sloterdijk railway station, one of the largest stations of the Netherlands. Around **58.000 passengers** use the station everyday, making it the **9th busiest railway stations of the Netherlands**.

The station is complex system organised in multiple levels. The top level is dedicated to the line connecting Amstedam with Schiphol, while the lower level is for the lines Amsterdam-Haarlem and Amsterdam-Zaandam. In addition, a major mobility hub of several different modes of transport (including metro, tram, bus, and bicycle) is developed around the station, serving thousands of people every day.

In numbers

58.000	**Daily passengers**
9th	**Largest railway station in NL**
49 ha.	**Area of intervention**

Figure 30. The Amsterdam Sloterdijk station main entrance. Source: www.wikipedia.com

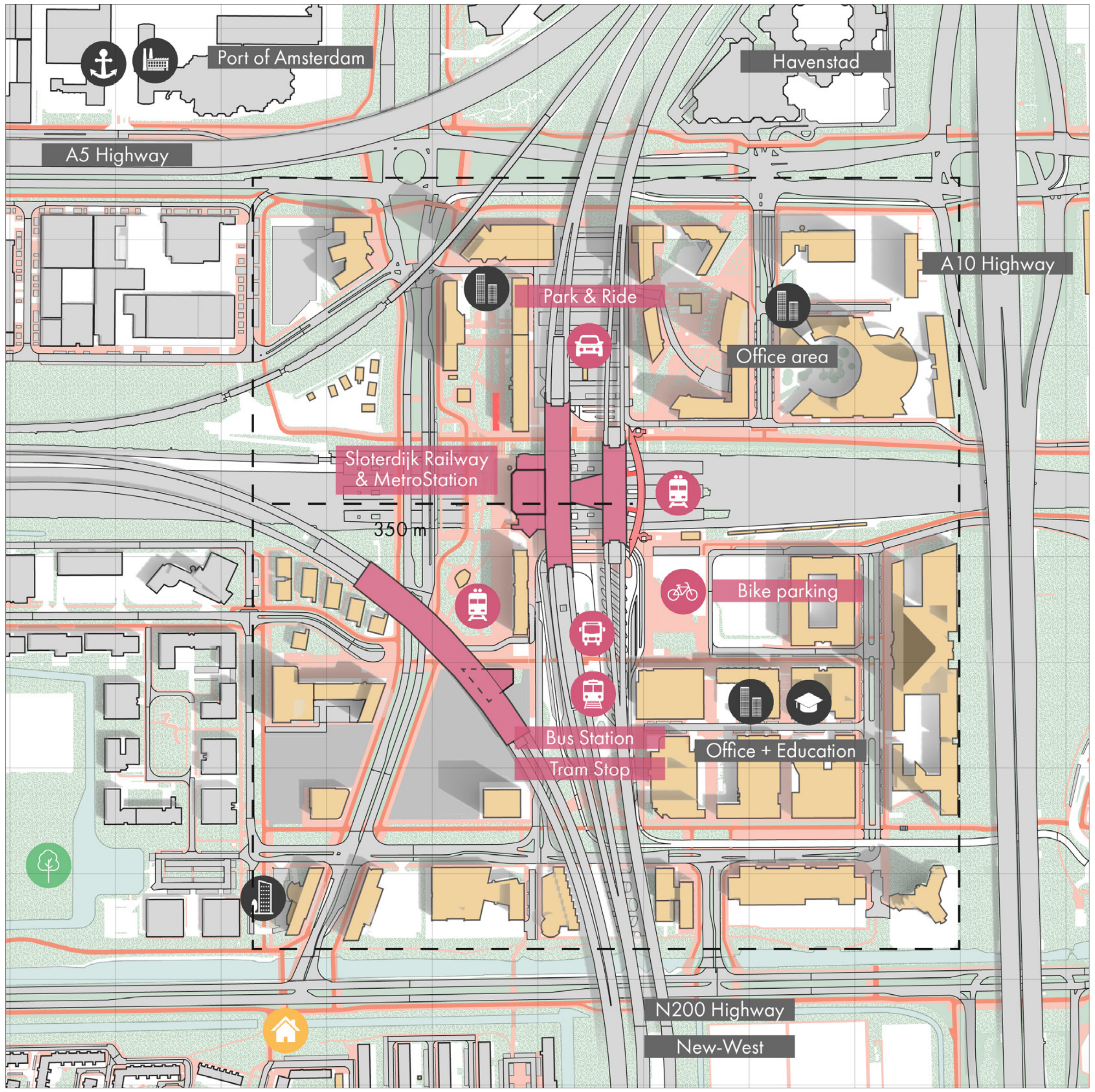


Figure 31. Plan of Sloterdijk station area.

Grid Size: 100mx100m
0 50 100 200m

Barriers

All these different modes of transport have different requirements in terms of **infrastructure**. Electrification of railway enabled the elevation of **railway lines**, thus the creation of complex crossing lines like those in Sloterdijk. Three important **highways** (A10 ringroad, A5 and N200) for the overall transport system also surround the area. These large infrastructural bodies create strong barriers and shape four separate "islands" or sub-areas around the station. Design interventions in the area need to take into consideration these elements, with an aim of integrating them in the overall design.

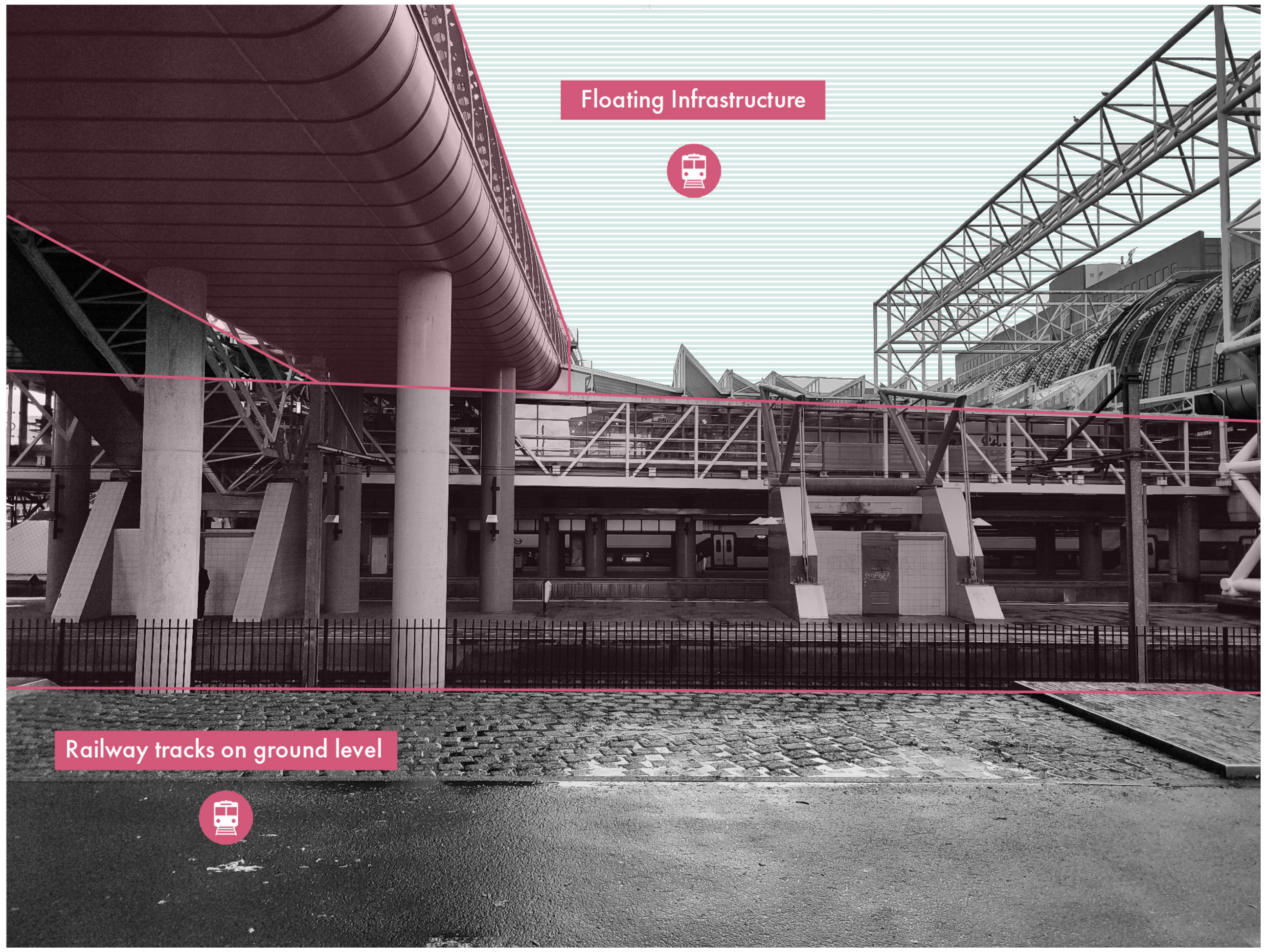


Figure 32. Image showing the domination of the area by infrastructure and the physical and visual barriers that the railway creates. The complexity of the station is negatively affecting wayfinding around the area.

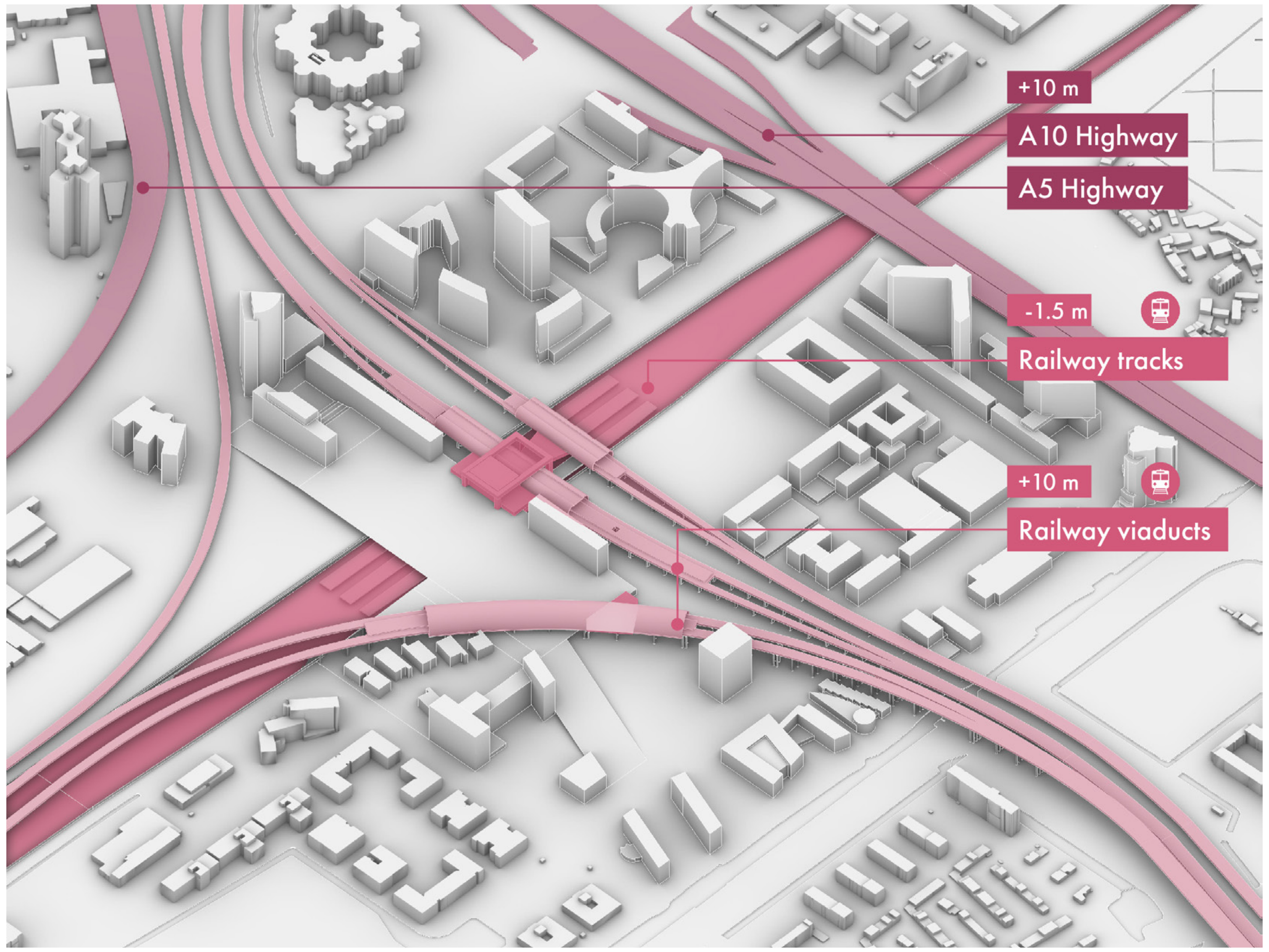
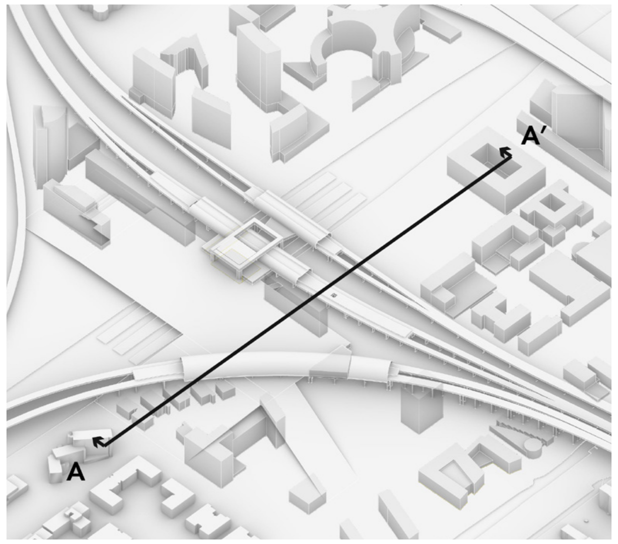
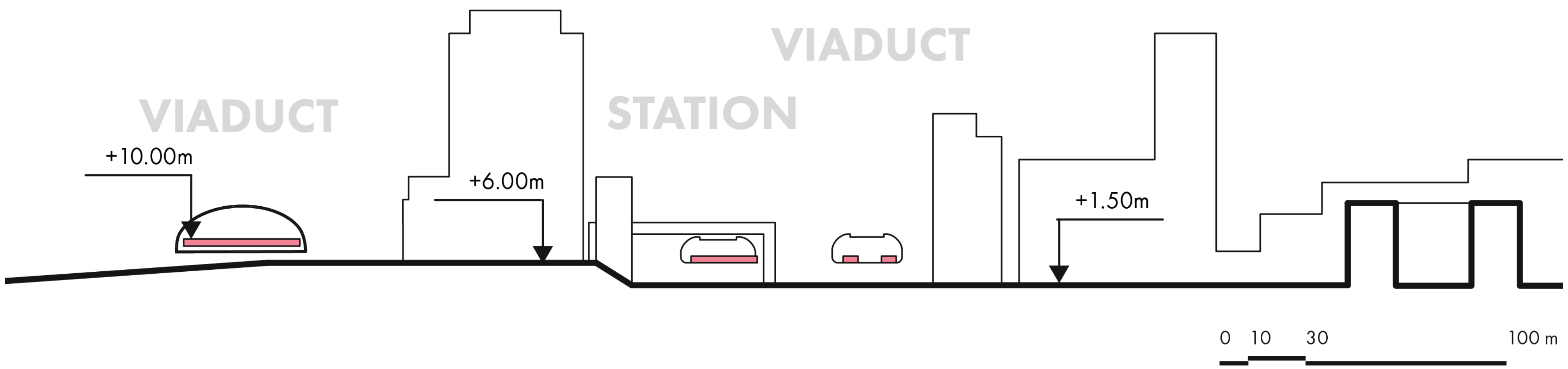


Figure 33. Diagram of the different infrastructural barriers of the area. These include the railway tracks, the viaducts for the direction of the railway and the highways that surround the station area.

Key



Section AA' Scale 1:2000



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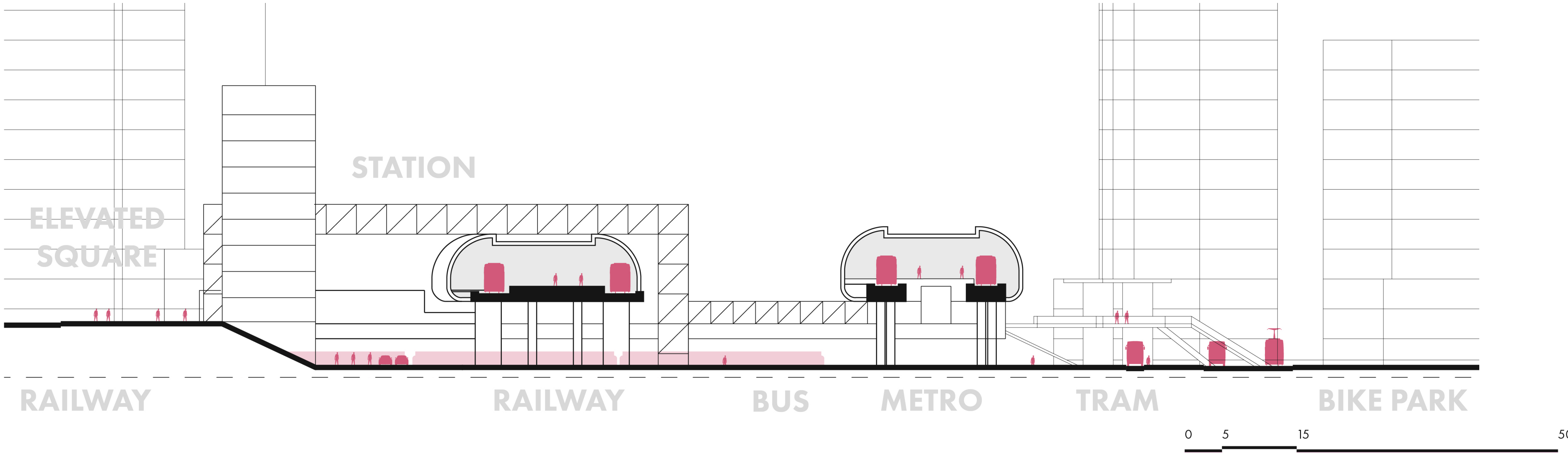

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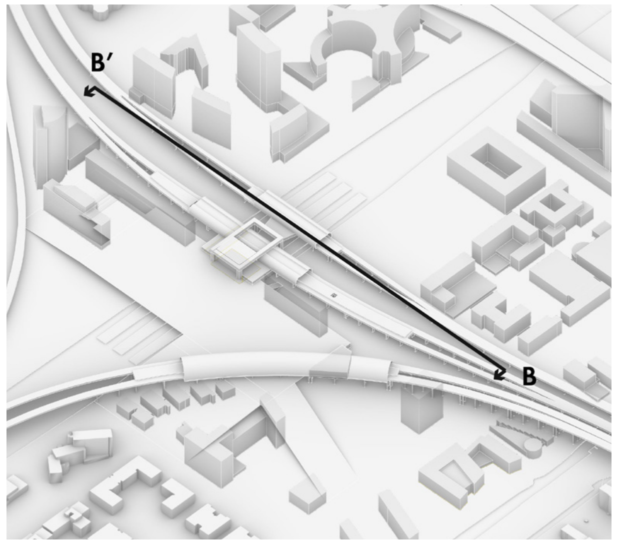

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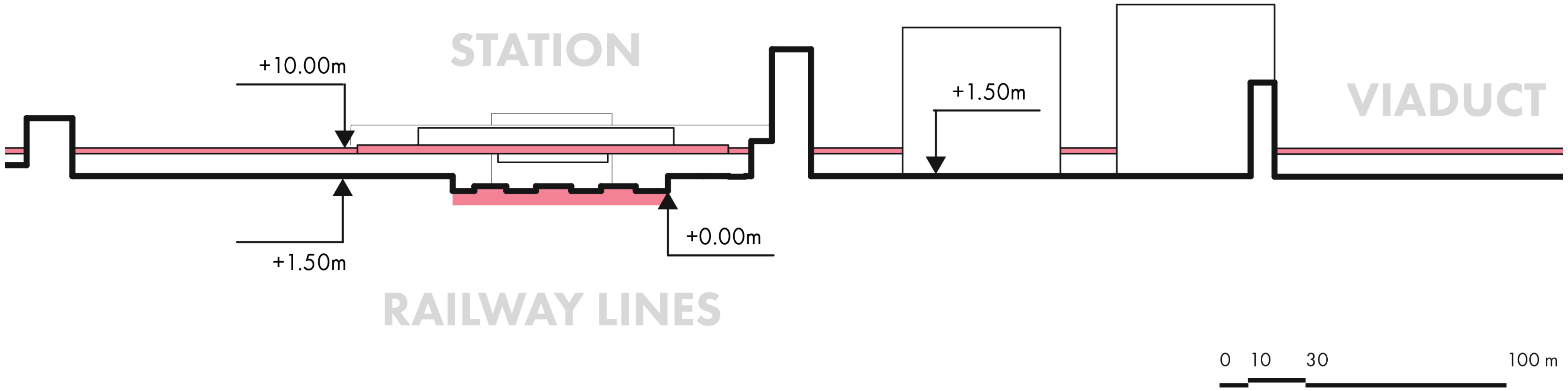

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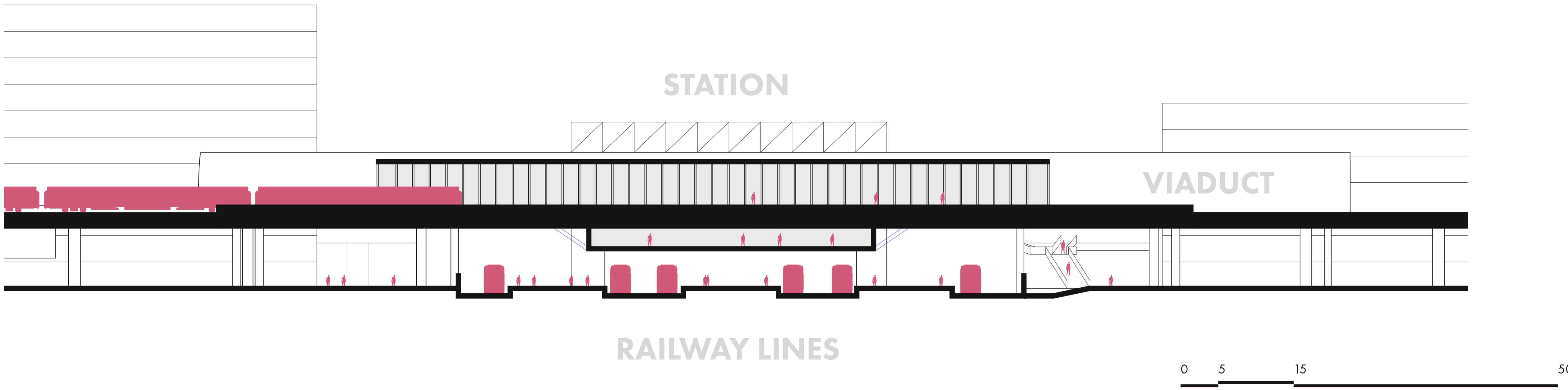

Space dominated by mobility

As it can be seen by the image below due to the primary use of the area as a **multimodal hub**, extensive space is used to facilitate mobility. Several modes of transport converge in the area including railway, metro, tram, buses, cars, and bicycles. In the current design of the station, these modalities are organized both in a **vertical and a horizontal way**. Particularly the North-South axis is primarily used for parking (cars on the north, bicycles on the south), while a lot of space is also taken by the movement of tram and buses.

Figure 34. Southern side of the station. The area on this side is used for tram and bus movement and for uncovered bicycle parking. The area does not provide any space for interaction or activity.

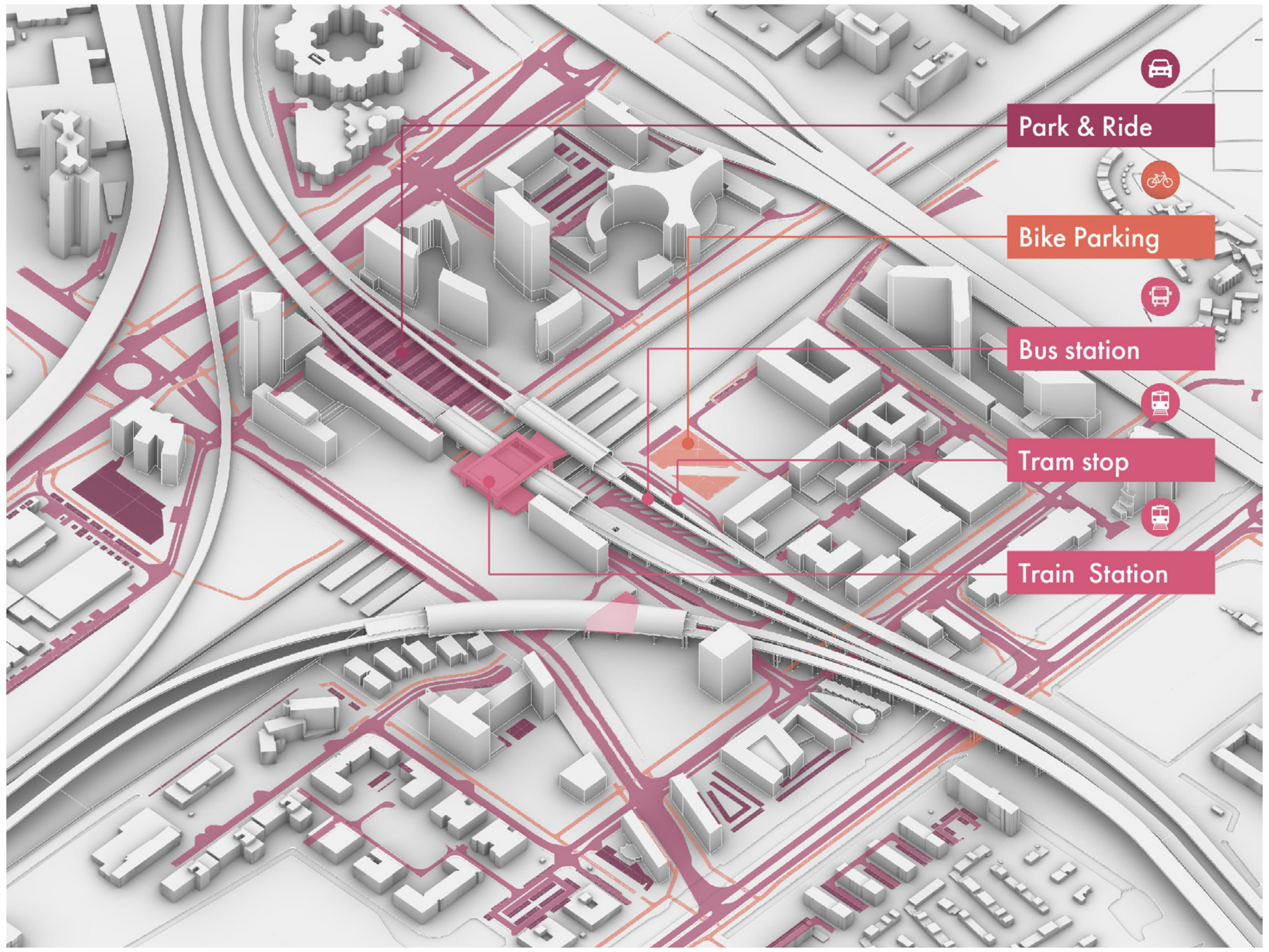

Figure 35. Diagram of space allocated to mobility.

Lack of diversity

The last of the main problems of the area is related to the realization of these specialized nodes in the city of Amsterdam. Several **large office buildings** were developed around the station. Due to high vacancy rates, there was an attempt for the transformation of several office buildings to hotels, but with little effects on the character of the area. Monofunctionality led to **little diversity** of users and thus a non-inclusive area, that is completely empty after working hours. **Large building blocks and non-active facades** are also intensifying this **lack of diversity**, negatively also affecting the **walkability** of the area.

Figure 36. Typical building block at the area of Sloterdijk.

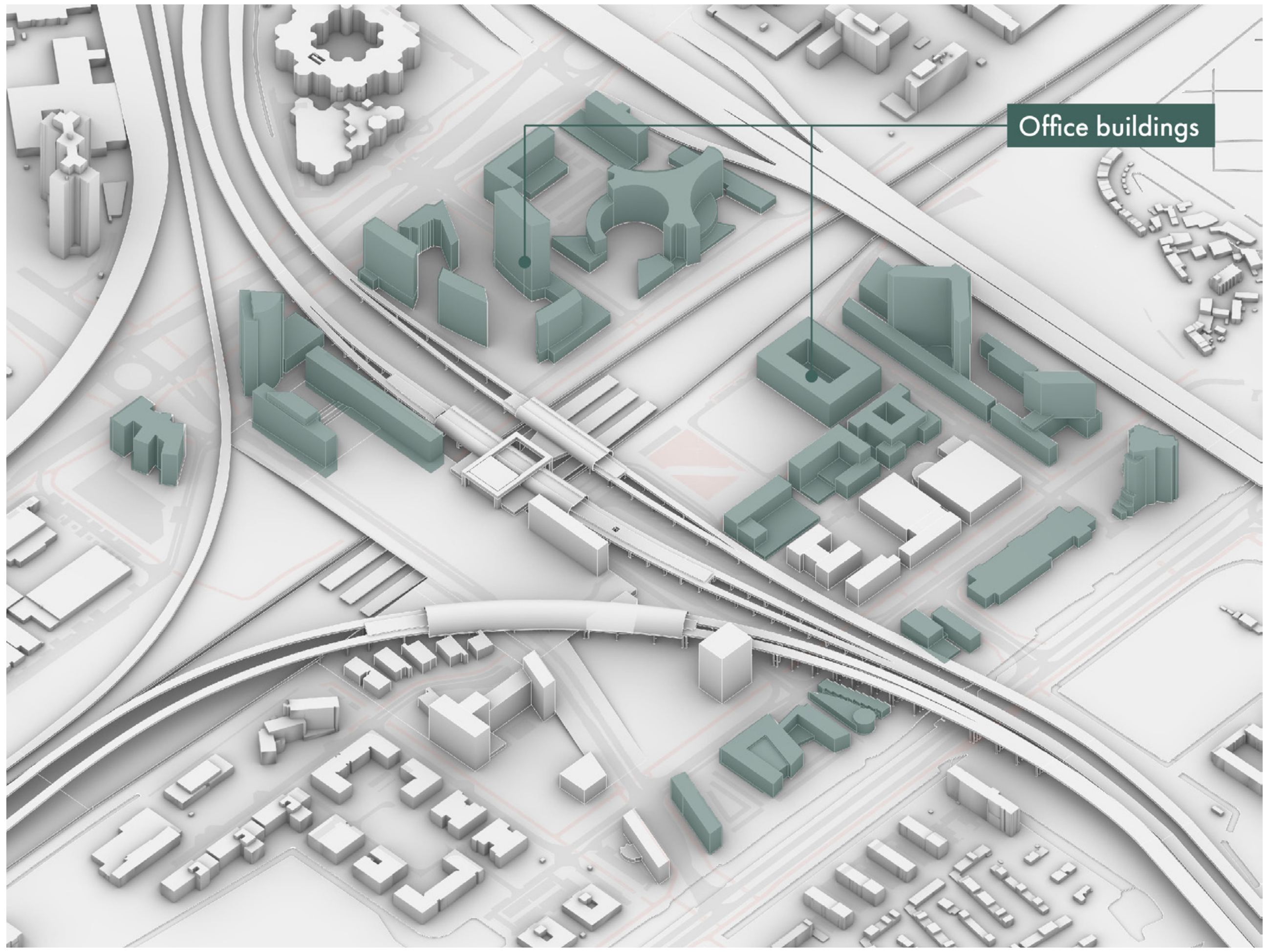

Figure 37. Diagram of office buildings around Amsterdam Sloterdijk. The area,as mentioned in previous chapters, was developed as a dedicated business district. As a result, plenty of office large buildings remain in the area.

Lack of social interaction

One of the primary problems of the area is related to its public spaces. Facilities and amenities around the station are focused primarily for commuters who stay for relatively short amount of time in the area and **lack diversity**. High vacancy rates of the surrounding office buildings are **reducing the number of possible users** of public spaces. Extensive use of **hard surfaces** and lack of green spaces are decreasing the overall quality of the space. Design of public space does not stimulate **human interaction** and does not provide places to stay, leading in a very **anonymous place**.

Figure 38. Image of the Carrascoplein square, one of the spaces on the side of the station of Sloterdijk, almost exlusively used for mobility.

Figure 39. Image taken from the station looking towards the Westerpark. Long and routes are connecting the station area with the surrounding office buildings.

Extensive paved areas

Last but not least, and in relation to the previous characteristics of the area, the amount of hard-paved surfaces have negative effects both on the local **microclimate** of Sloterdijk and on its **capacity to cope with flooding** due to extreme weather events. The area of Sloterdijk is heavily affected by the **Urban Heat Island effect**, due to the large amount of **infrastructure for mobility** (railways, highways, local roads) and that poses **threats to the physical well-being** of human and non-human populations. At the same time, the area of Sloterdijk is one of the most **urgent bottlenecks in terms of stormwater management** for the whole city of Amsterdam. Therefore, dealing with both issues is imperative.

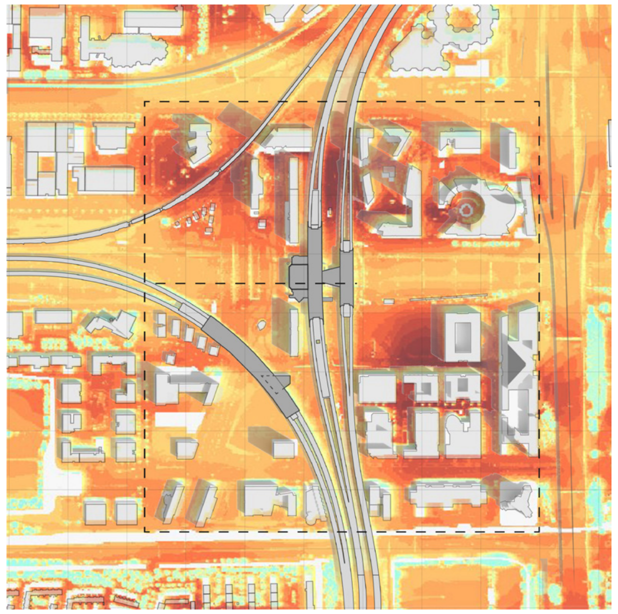

Figure 40. Perceived heat, scenario 2050. The area of Sloterdijk is among the most vulnerable areas to the Urban Heat Island effect. Source: Klimaateffectatlas.nl.

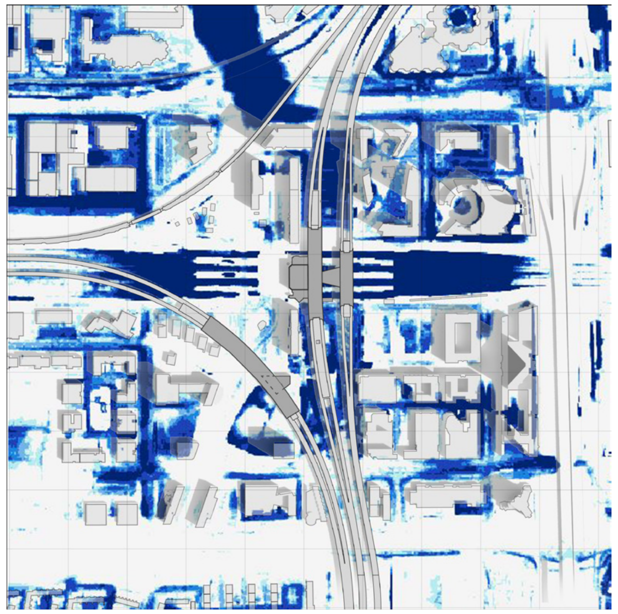

Figure 41. Flood depth (140mm/2 hours). Source: Klimaateffectatlas.nl

In numbers

190.229 m²	Car Roads
28.049 m²	Parking space
29.497 m²	Paved surface for bikes
67.106 m²	Covered by rails
1.051.759 m²	Total Area

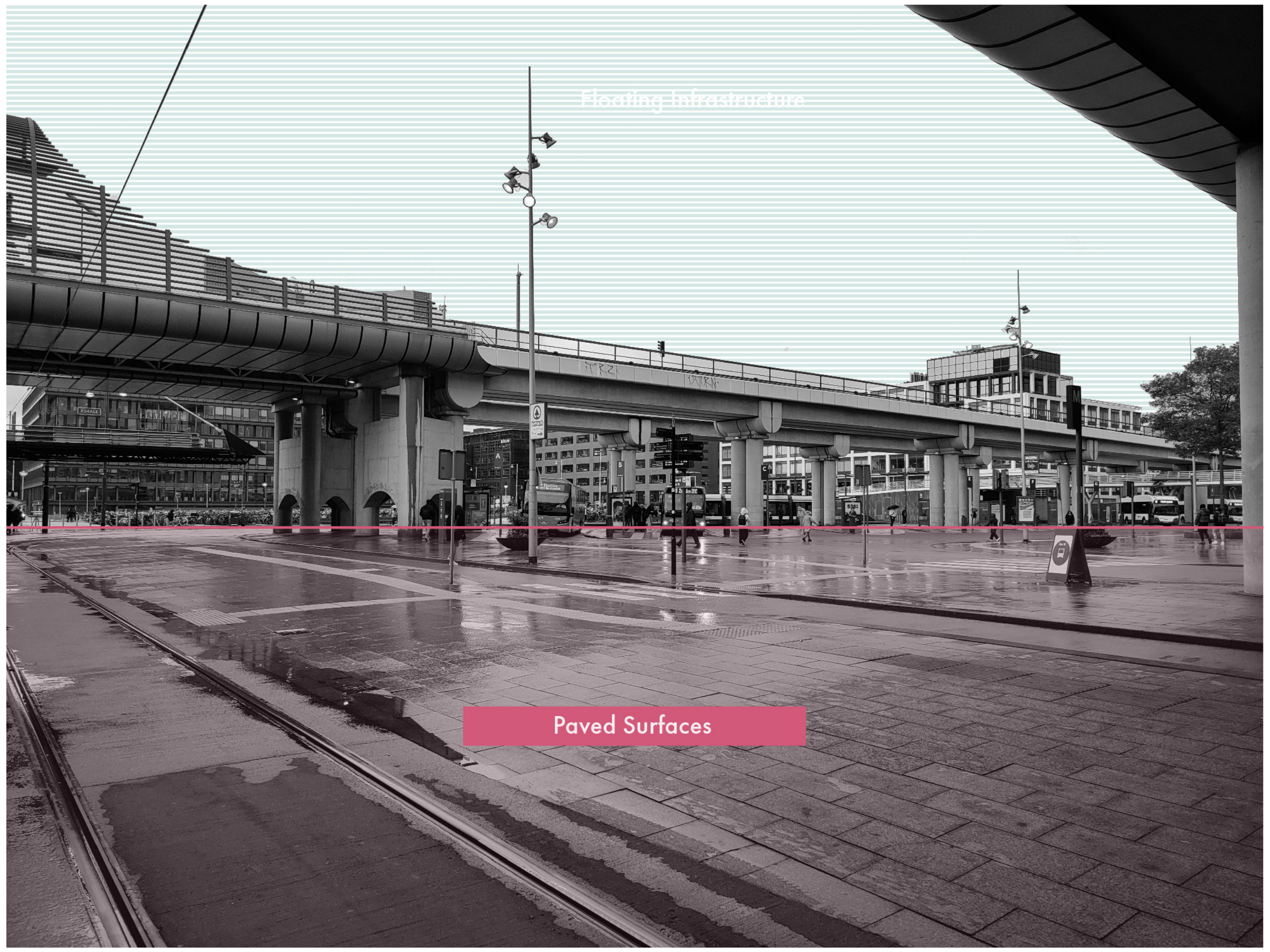

Figure 42. Image from the southern side of the station. Large amount of space is paved with non-permeable materials, having negative effects on the Urban Heat Island effect and on stormwater management.

2.9. Problem statement

Currently, the Netherlands is facing two major and interrelated crises: **housing and climate**. Housing demand due to the increasing population is leading to increasingly higher rates of growth and land conversion, negatively affecting several **sustainable development goals**.

Following a more **compact urban development** by increasing densities and the application of **Transit-Oriented Development** in the case of Amsterdam could potentially provide with a solid framework of dealing with the housing crisis. Careful consideration of the **design and planning part of applying higher densities,** dealing with the complexity due to the consequent **competition for space** between the various elements and with a careful consideration of **climate adaptation** and **ecology**, could potentially lead to more **sustainable and livable urban environments**.

An area such as **Amsterdam Sloterdijk**, due to its great connectivity and other location-specific benefits, could be a great place to begin with. The current image of Sloterdijk is however **very problematic**. The development of the area because of a market-driven approach in urban development since the 1980s, led to the creation of monofunctional and business-oriented nodes in Amsterdam. **Failing to adapt to societal and economic changes**, the area faced high vacancy rates and is overall regarded as **highly unattractive** (Thomas et al., 2018). **Social interaction in the area is scarce**, enhancing anonymity and the feeling of unsafety, particularly during the night while due to the low functional diversity and lack of activities, it functions almost exclusively as a **transfer node**. Large-scale infrastructural bodies create several **barriers** isolating the area from the rest of the city, while a large new development, the **Havenstad**, is going to increase spatial pressure on the station area even more. Dominated by mobility infrastructure and plenty of paved areas, the area is also facing **environmental degradation** and increased **vulnerability** to extreme weather events such as heat stress and flooding.

All in all, several key drivers of change are highlighting the **importance of Sloterdijk** as one of the key locations for the future urban development of the city of Amsterdam. However, the current design and spatial organization of the area are reducing its capacity to adapt to current and future needs.

"All in all, several key drivers of change are highlighting the importance of Sloterdijk as one of the key locations for the future urban development of the city of Amsterdam.

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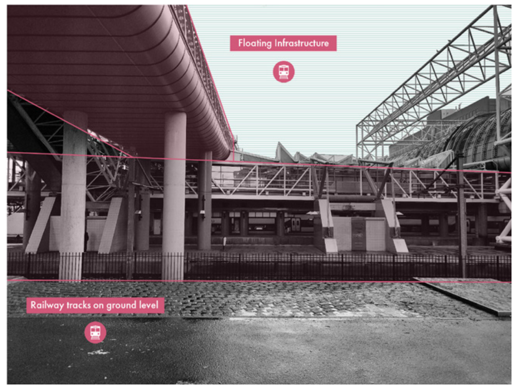
01 Barriers



02 Space dominated by mobility

03 Lack of diversity

04 Lack of social interaction

05 Extensive paved areas

Research structure 3

3.1. Research Aim

As explained in the problem statement, even though the densification through the application of **Transit-Oriented Development (TOD)** could provide with a solid framework for dealing with the **future urban development of the city of Amsterdam**, several issues are hindering its potential success. A study of **municipal policies** reveals how the future development of the city of Amsterdam will increase the pressure on the area of Sloterdijk, particularly from a mobility perspective, and how the future transformation of the area can contribute to a more balanced regional development.

However, the lack of a more integrated approach to planning, has led to several unbalanced developments of train station areas. Amsterdam Sloterdijk is facing several problems arising from this **disproportionate development of the mobility system**, that is related to the railway and metro station, in contrast to the urban functions and activities developed around the station area. The way to achieve this **balance between the node and place characteristics**, in an area that functions as a mobility hub of growing importance, is one of the main aims of this research.

Furthermore, key issues of the urban development through densification around mobility nodes, are primarily related to **high-density** and the consequent **competition for space between various vital elements** of cities. **Conflicts and trade-offs** arising from this competition, are typically **decreasing the livability** in high-density areas for both **human and non-human populations**. This **relation between sustainability and livability**, particularly in high-density train station areas, is a topic that needs to be further researched and is a crucial element for the redesign of the area of Sloterdijk.

Train station areas, as places of high intensity of use by a wide variety of users, have the **potential** of becoming **places of great diversity and interaction**. To foster this potential social interaction however, public spaces around the station area need careful consideration. The **functional mix** of the area and the various **activities** that it can provide or facilitate, are going to be one of the key elements of this research, keeping in mind the aspect of **inclusivity of different users**, as a core value to inform the design.

In order to achieve all the above, the aspects of d**ensity, public space, mix of uses, ecology and climate adaptation** are going to be explored in depth with the final aim of addressing the **spatial manifestation of a more balanced, and eventually livable and sustainable development of the train station area of Amsterdam Sloterdijk.**

3.2. Research Questions

Main RQ

"How can Sloterdijk be transformed from a mono-functional business district into a dense, livable and sustainable neighborhood, while maintaining its function as a major mobility hub?"

Sub-questions

SQ1 What where the negative aspects of past urban development processes that led to the creation of monofunctional business districts?

SQ2 What is the possible influence of the redevelopment of Amsterdam Sloterdijk to the transition of Amsterdam to a more balanced and polycentric region?

SQ3 How can the general concept of TOD be translated in the case study of Amsterdam Sloterdijk?

SQ4 How can both sustainability and livability be adressed in the case of Amsterdam Sloterdijk station area?

SQ5 How can the densification of Amsterdam Sloterdijk alleviate the ongoing housing crisis, by providing a diverse living environment to a wider range of people while other societal needs are addressed?

SQ6 How can the spatial re-organization of mobility and design of public spaces around the station, allow for the transformation of Sloterdijk into a lively and vibrant neighborhood that fosters social interaction?

SQ7 How can the multiple infrastructural barriers of Sloterdijk be overcome or integrated in the redesign of the area?

SQ8 How can the proposed spatial interventions increase the adaptability of the area to the changing climate, providing thus a safe and livable environment for both human and non-human populations?

3.3. Methodological Framework

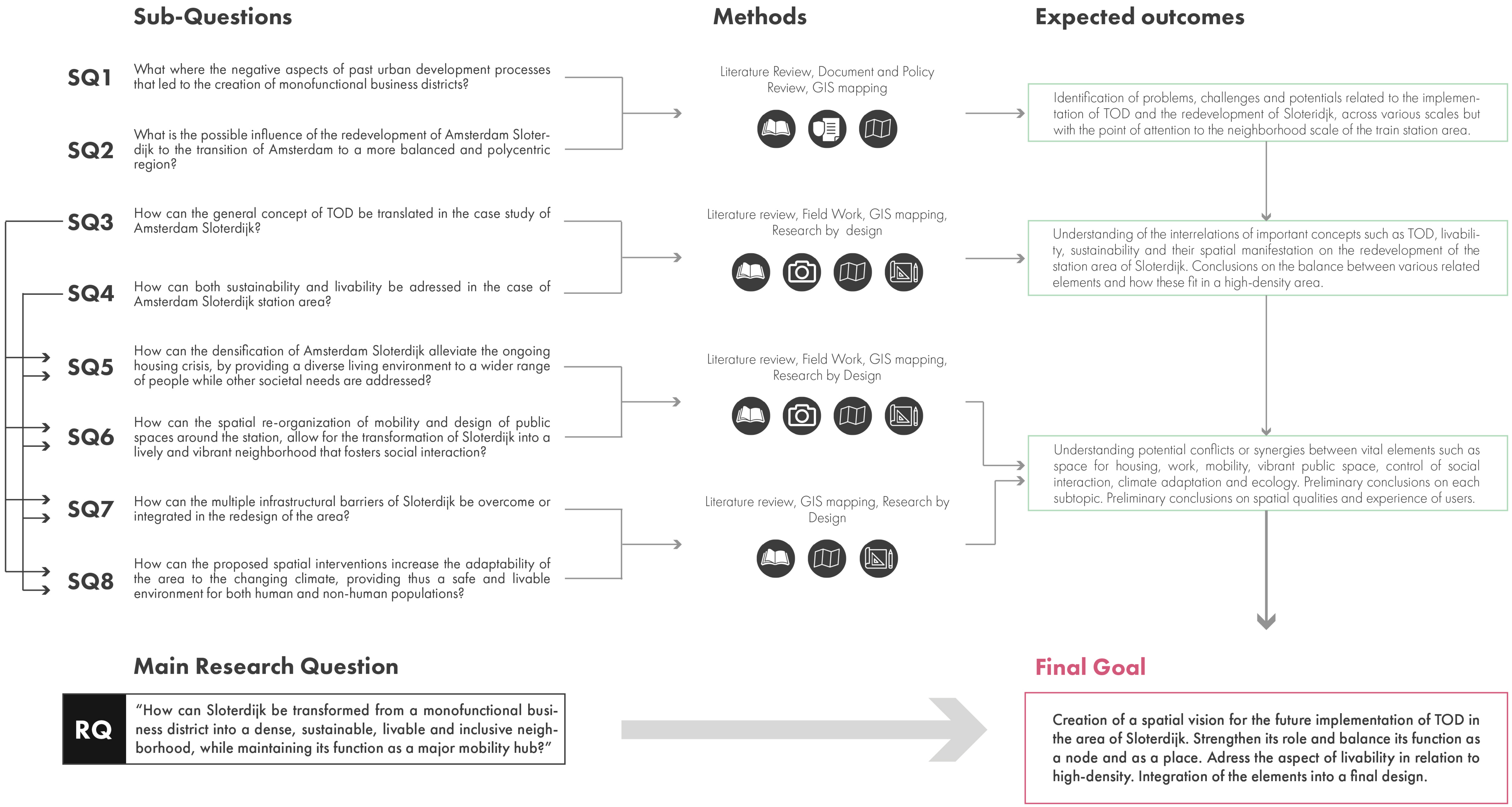


Figure 43. Methodological framework diagram.

3.4. Methods

As a starting point of this research, **literature review** on Transit-Oriented Development is conducted, to develop a deeper understanding of the concepts related to it, and the **challenges regarding its implementation**. Literature review is also used to study the urban development of Amsterdam of the recent past, and practices that led to the creation of several unbalanced nodes around the city such as Sloterdijk. Through **mapping, and municipal document and policy review**, the challenges on city scale are identified as well as the potential that Amsterdam Sloterdijk provides, as a **one of the most prominent locations in the metropolitan region of Amsterdam for TOD implementation**. Lastly, literature review is used to identify the **key concepts** of this graduation project such as livability, with the aim of creating the framework within which the design process will be developed.

Fieldwork was also an important method I used, that allowed me to better understand the area by experiencing space. Several problematic planning and design related issues of the station area of Sloterdijk such as the unattractive public spaces and the various infrastructural barriers that negatively affect the walkability, became more apparent during my visits to the area.

3.5. Research by design

Through the implementation of **research by design** as a **primary method of research**, the spatial aspects of the different elements, themes and concepts related to this graduation project are studied. The method of research by design, is used to describe the **inquiry process in which knowledge is generated through the act of designing** (Hauberg, 2011).

During my research I **developed several distinct design iterations** for each one of the main themes. This allowed me to extract conclusions for each theme and to identify **conflicts and potentials**. After this process, a preferred option was chosen to be further developed in the integrated design phase. The process of integrating all the elements in a combined design, revealed several weaknesses or strengths of the preferred options and led to their further refinement.

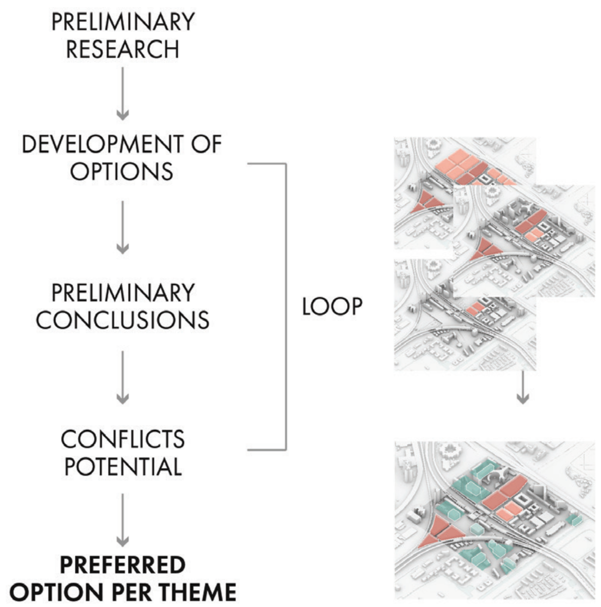


Figure 44. Process of research by design

Methodology

3.6. Overview of research

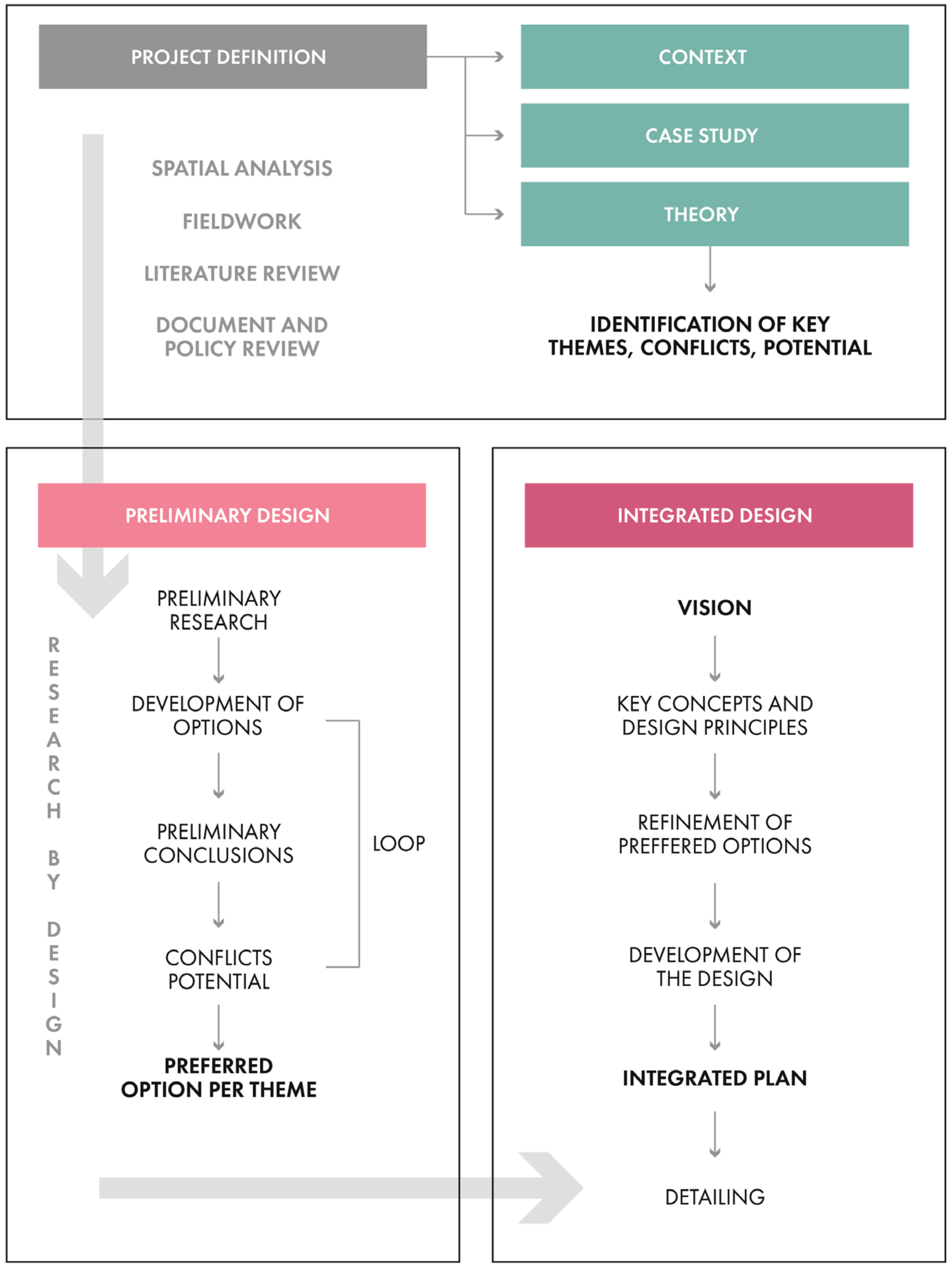


Figure 45. Diagram of research and report structure.

Theory 4

4.1. Transit-Oriented Development (TOD)

In the past 30 years, redevelopment projects of railway station and the surrounding areas have been increasingly popular. After years of several successful and failed implementations, European cities building on their gained knowledge, are embracing the concept of Transit-Oriented Development (TOD) as the way in which their **urban development** should happen (Bertolini et al., 2012).

TOD is typically defined as an approach of **integrated transportation and land-use planning** in which development is concentrated around **transportation nodes**, maximizing their efficiency, and leading to convenient and desirable walking and cycling environments. TOD implementation in Europe, in contrast to the American and Australian implementations, follows a more regional approach, where urban development is led by public transportation corridors (mainly railway lines) rather than focusing on a single location.

Developing cities on a regional scale in **compact, high density, mixed-use, walkable, and cyclable environments**, promoting the use of **public transportation** is considered sustainable in terms of **limiting urban sprawl, car dependency, and infrastructure development** (Thomas & Bertolini, 2015).Nevertheless, despite the existing knowledge, transferring of the model of TOD which was developed in the United States by **Peter Calthorpe**, is limited due the disparate context in terms of the urban environment, governance models and cultural preferences (Pojani & Stead, 2015). It is also important to note the difference between scholars that regard TOD as a universal model and those who suggest a more flexible approach to TOD (Hrelja et al., 2020).

In the case of the Netherlands, due to the dense railway system and extensive use of bicycles, it is considered that the Netherlands was developed based on TOD principles. However, several realized development projects around transportation nodes even though were marketed as TOD, they were not. Among others, the main **reasons for the failure** of multiple some TOD projects in the Netherlands were aspects of **governance, limited need for office spaces, lack of consensus and fragmentation of land**.

Several researchers describe TOD by using five Ds: Density, Diversity, Design, Distance to transit and Destination accessibility. These principles focus primarily on maximizing the potential of walking, cycling and use of public transportation by their efficient design and layout and by increasing the amount and mix of uses around the nodes (Hrelja et al., 2020). On another study by Pojani & Stead (2015), the framework proposed, included to main topics: place making and facilities logistics, while using eight widely regarded aspects of TOD: scale and density, public spaces for human use, safety, variety and complexity, connections, pedestrian/cyclist orientation, transit in the urban pattern and car movement and parking.

Conclusion

As a conclusion of my literature on the theory of TOD, this is limited to **rather general principles** that do not represent the **complexity of their application into space.** As it is going to be further explored in later stages of this graduation project, all the different elements that are part of a TOD, demand a certain amount of space and thus several **conflicts** arise. Therefore, the spatial translation of TOD needs to be further developed, taking under careful consideration the **specificities of each different location.**

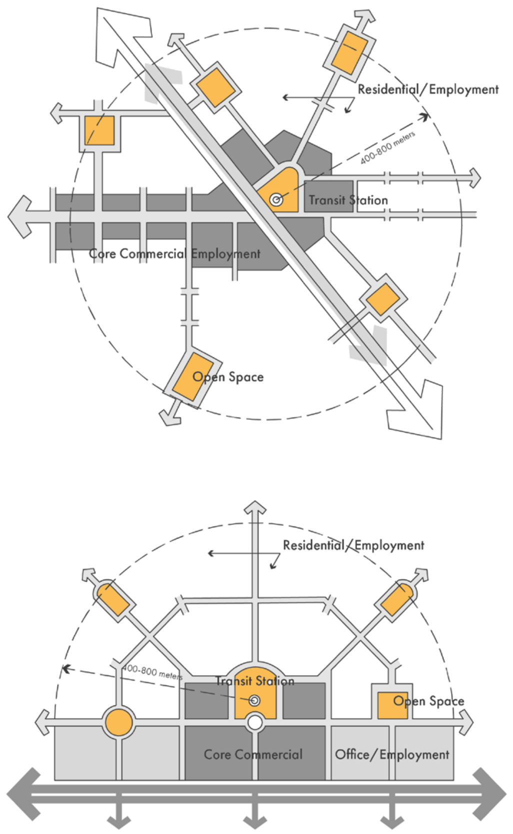


Figure 46. TOD model as defined by Peter Calthorpe, (Calthorpe, 1993)

4.2. Node-Place Theory

The Node-Place model theory describes the attribute of Train Station Areas of being both "**nodes**" within a network (e.g., mobility network) and "**places**" or in other words, areas where different users and activities come together (Bertolini, 2008). It is important to note here the relation between the node-place theory and **accessibility**, not only in relation to the "node" characteristics of a station area, but also in relation to its "place" characteristics. Accessibility in this sense relates to the **number and variety of activities**, taking place within a certain area, and last but not least to the aspect of **users** (Bertolini, 1999). The latter is a vital element for the potential **realization of TODs in a more inclusive way**, where various users are considered in the design process.

Train Station Areas, as they are i**nherently part of various networks**, are **competing or complementing** other station areas, formulating thus certain hierarchies between them. The node-place model was developed to understand the relationship between the different characteristics of train station areas. According to this model, **four different idealized types emerge**. On the one hand there are station areas where one of the two components are unequally developed/underdeveloped, leading to either **unsustained places or unsustained nodes.** Sloterdijk in this model is an unsustained node, as the mobility system and its value as node, are significantly more developed than the activities and functions around the station. On the other hand, there are station areas where node and place characteristics are equally developed, either leading to **dependent station areas** or to areas where the high intensity of the development is putting the **area under stress** (Bertolini, 1999).

Conclusion

This graduation project, using the case of **Sloterdijk**, aims in addressing the latter idealized type. Sloterdijk as an increasingly important location for the city of Amsterdam, is going to **face significant stress** as a growing mobility hub and as a new attractive place for living and working. Therefore, **integrated solutions to alleviate this stress should be explored.**

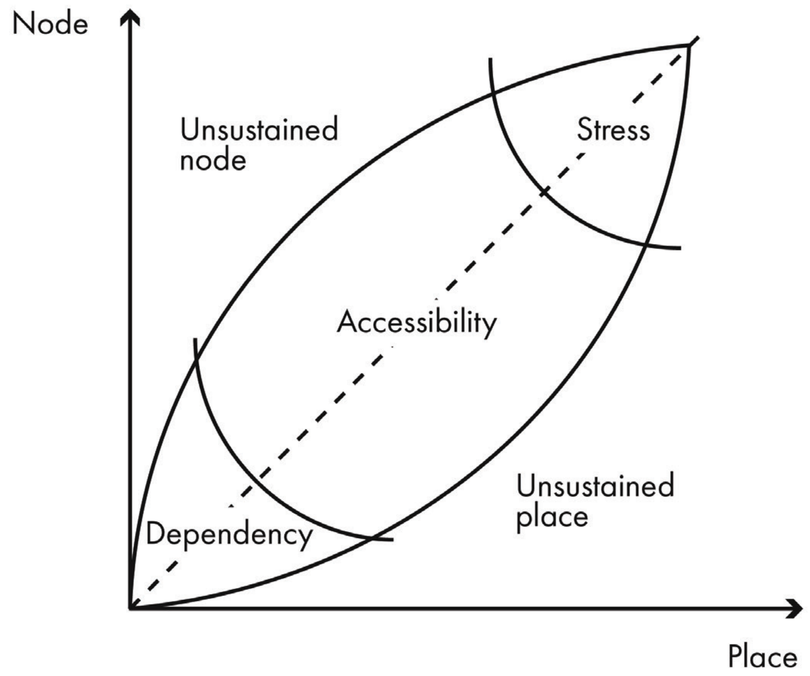


Figure 47. Node-Place model. Source: Bertolini, 1999

4.3. Theory of *Place*

The potential success of a train station area as a "place", within the node-place model, is also related to qualities that in theory are typically associated with the notion of Place in general. According to Montgomery (1998) **except from the physical attributes**, there are several qualities of space, other **psychological and mental** attributes are contributing to potentially successful urban places.

Additionally, **activity** is a vital element of a place, as places are also defined by all the different events and activities happening in an area. Activity is strongly related to the aspects of **vitality** and **diversity**, meaning that higher concentrations and presence of people are likely to support a wider range of different activities. Therefore, according to this theory, three main elements are distinguished: **form, image, activity.** The importance of **public space** needs to be also highlighted here, as the space within all these activities and potential human interaction can take place, taking into consideration of course the different **levels of activity** that each space should have, also leaving space for **privacy**.

Conclusion

The theory of Place is important in the transformation process of the area of Sloterdijk. As a busy train station area, Sloterdijk has the potential to become a place where u**se of space is intensified, and social interaction is facilitated**. Creation of vibrant public spaces, supported by a variety of activities that are **accessible to a wider range of people**, is of great importance.

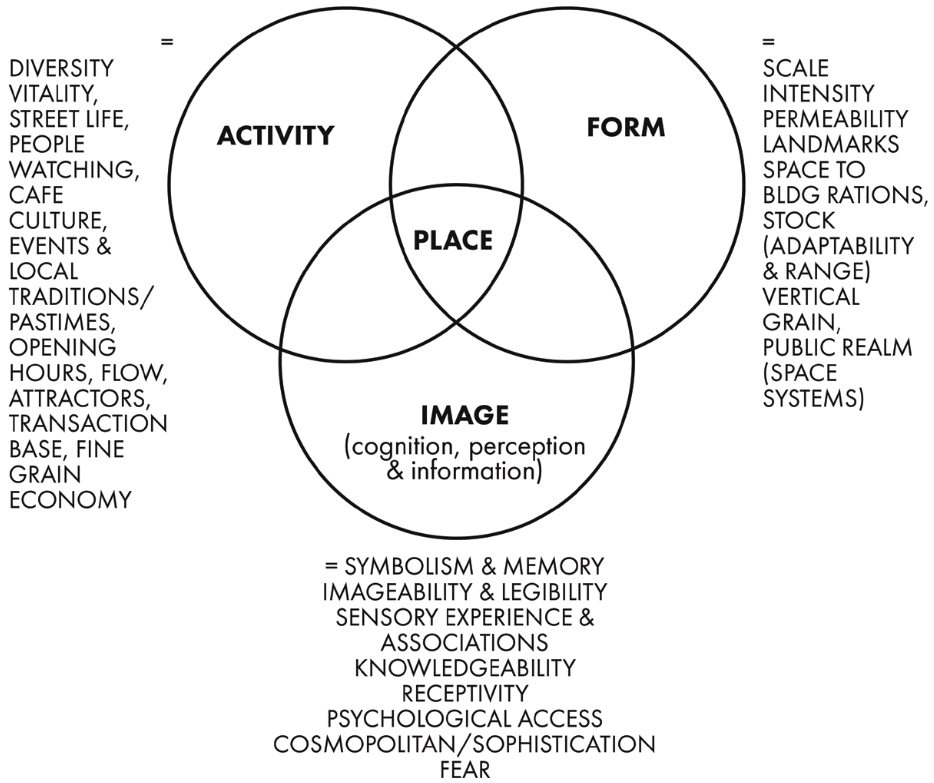


Figure 48. Urban sense of place. Source: Montgomery, 1998

4.4. Density

Density, as explained in the first chapter of this graduation project, is an **important concept** regarding urban development. Several **economic, social, and environmental benefits** have been identified in the past, leading to the rise of this concept as a key element of sustainable development. Nevertheless, due to the **lack of clarity** of its definition and its assessment, several concerns have been expressed.

Density is typically defined **as a number of units** (dwellings, people, functions etc.) within a given amount of space. Differences in the area definition for calculating density may significantly affect numbers and consequently the direct comparison between different cases (Boyko & Cooper, 2011). However, density is not only a matter of quantities but also of **spatial qualities**. For that, several other factors such as intensity of use, compactness, spaciousness, and building height amongst others, are equally important to understand the qualitative aspects of density (Berghauser Pont & Haupt, 2009).

Conclusion

For conducting my research, I used the below **four indicators of density (FSI, GSI, OSR, L)** that are widely used to measure several aspects of density. These indicators were used to **analyze examples** and as a base for my calculations in the **preliminary design phase**. As boundaries for calculating density, I used the **scale of the block**, due to the scale of my final design.

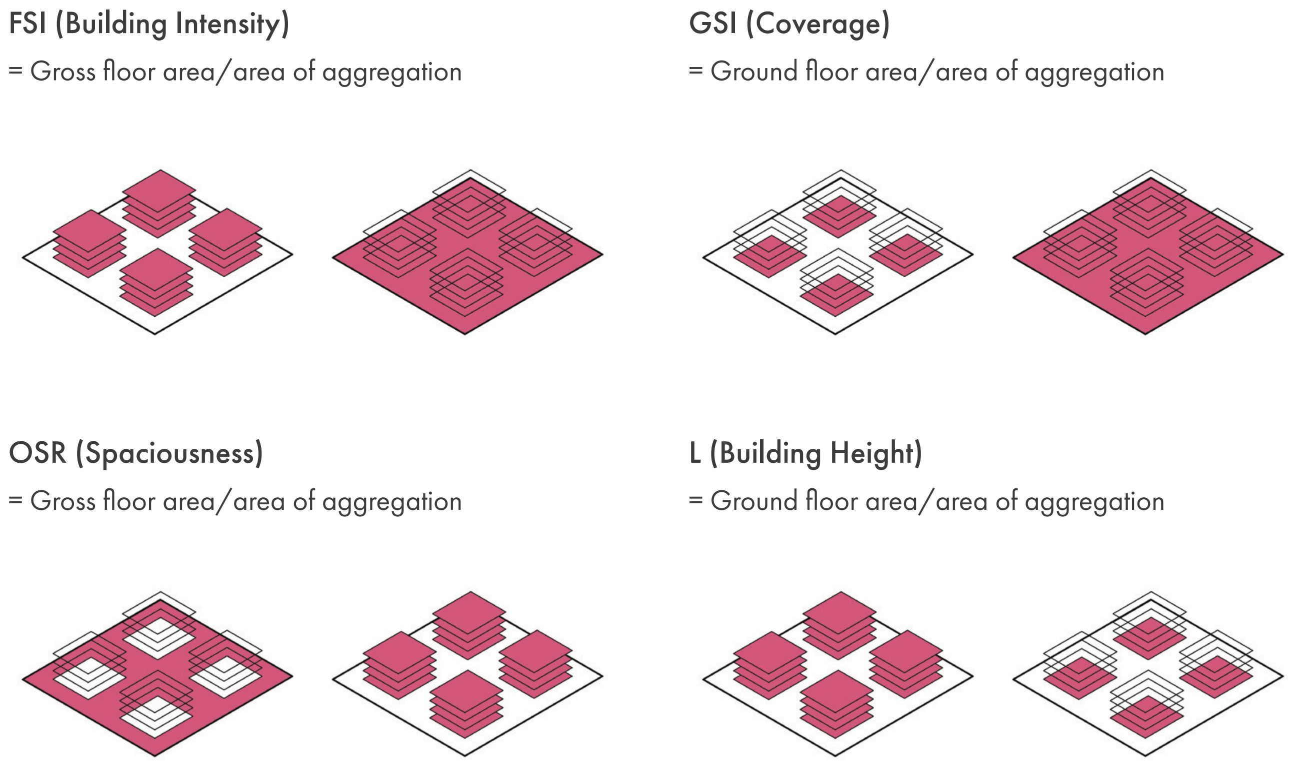


Figure 49. Different factors of measuring density. Source: Berghauser Pont & Haupt, 2009

4.5. Advantages and disadvantages associated to density

In this part, several advantages and disadvantages of density will be discussed in parallel. As perceptions differ, several advantages can be perceived by others as disadvantages.

Based on the work of Boyko and Cooper (2011), who conducted an extensive literature review on density, its advantages are related to the aspects of sustainable mobility, efficient land use development in relation to resources needed, economic growth, energy efficiency, and social sustainability.

a. Mobility

Starting with **mobility**, as one of the main themes of this graduation project, higher densities are usually linked to **reduced CO_2 emissions**. Clustering of people, services and infrastructure increases **efficiency** in terms of resources and development costs. At the same time, this proximity leads to fewer and shorter trips with private cars, as **walking, cycling and public transport** are more efficient in dense areas. At the same time, in high-density environments, there are still problems of traffic congestion and pressure for parking due to the cultural impact and cultural preferences to cars.

b. Land Use

In terms of land uses, in high-dense areas a more mix-use environment can be developed. **Accessibility** to more and diverse facilities and services, is higher. Accordingly, **infrastructure** that is developed to facilitate these uses, can be more compact and efficient. All these can have positive impacts on urban development in terms of land consumption and pressure on vital functions such as agriculture, by **limiting urban sprawl.** On the other hand, density can have negative impacts on recreation and **public space provision**, due to the **lack of available space**.

c. Impacts on society

In terms of the social benefits, it is considered that in dense environments, more parts of the society are mixed, leading to increased **diversity**. Increased **safety** can be also linked to higher concetration of people.

On the other hand, many scholars are linking density with **social** and **psychological** matters. Lack of privacy and other aspects of safety are considered as problems that come with high density. Moreover, according to others, concetration of people in cities leads to increased inequality and segragation, exacerbating thus pressing social issues.

d. Climate

Increased density is also beneficial for green space preservation outside of the cities. Nevertheless, lack of green spaces in high-density environments is negatively affecting the **coping capacity of cities** against air pollution and risks associated with extreme weather events. The **scale** is therefore important when considering benefits and disadvantages of density.

e. Energy

Regarding heat and electricity provision of cities, there is apparently a strong relation between **density and energy consumption**. In compact urban forms, infrastructure is developed more efficiently in terms of construction and operation costs, due to the higher ratio of people served and higher **research and development resources** allocated on these. **Sharing energy** within a system or loop is also one of the primary advantages of density. Still, these systems due to large demand are more **dependent and thus more vulnerable** . Therefore, **decentralized systems** operating in less dense areas entail specific **advantages** Boyko & Cooper, 2011).

Conclusion

As it is pointed out from all the topics analyzed in this chapter, there is not a direct answer to whether higher densities are more sustainable or more livable. The matter of qualities and the context in which each case is embedded, are necessary to determine the sustainability and livability aspect of density.

Theme	+ Advantages	- Disadvantages
Mobility	Reduced CO_2 emissions Efficiency Promotes walking, cycling and use of public transport	Traffic congestion Pressure for parking
Land Use	Accessibility to services Compact infrastructure Urban sprawl control	Lack of available space for publi use
Impacts on society	Diversity Safety (eyes on the street)	Lack of privacy Lack of control Safety Inequality Segregation
Climate	Preservation of green spaces outsides of cities	Reduced coping capacity Risks/Vulnerability Environmental degradation
Energy	Energy consumption Investments Sharing of energy in loops	Dependency Vulnerability

Figure 50. Overview table of advantages and disadvantages associated with density.

4.6. Sustainability x Livability

Sustainability and **livability** are two very popular concepts, used broadly in the discussion regarding urban development. **Ambiguity** of the terms has led to their open interpretation and use as a means of advocating decisions and practices (Ruth & Franklin, 2014). Within this graduation project these two terms are **juxtaposed**, with the aim of comprehending their meaning and extracting principles that will guide the analysis of the place and the potential spatial interventions.

Sustainability

Sustainable development as defined in the Report of the World Commission on Environment and Development (1987), is the "development that **meets the needs of the present without compromising the ability of future generations to meet their own needs**". Sustainability is a difficult concept to comprehend and opeationalize. From this definition however, it is clear that sustainability refers to **long-term goals** with the aim of future-proof practices with the global scale on mind (Ruth & Franklin, 2014).

Livability

The definition of livability is "**fit to live in**" and concerns the perception of humans for their environment (van Dorst, 2012).

Contrary to sustainability, livability refers to more present and location-based goals. Goals regarding livability seem easier to define and to achieve and as a result, are in higher priority for agencies and policy makers in comparison to sustainability goals. This leads to preconceptions of livability by these agencies and definition of characterisitcs that are universal. Livability however is **subjective** (Ruth & Franklin, 2014).

To illustrate this better, car infrastructure may improve the livability of a place, but with adverse impacts on its future. Therefore, the aim of **achieving livability can negatively affect the aim of achieving sustainability** (van Dorst, 2012).

Since livability is about the relation of species to their environment, the main study should be about their perceptions in this matter. This is according to van Dorst (2012) an **ecological approach.** For this graduation project, **spatial indicators** (density, spatial quality, green spaces, diversity etc.) linked to presumed livability will be used.

This ecological approach to livability emphasizes the distinction between the social and physical aspect of the human environments. This includes the notion of **territoriality**, areas in which people **personalize space** in a similar way to the way they personalize their home.

One of the key problems regarding territorial behaviour is the lack of personalization and **responsibility**, which leads to **anonymous** and anti-social spaces. This is particularly evident in the case of Sloterdijk, where social interaction is minimal and public space is used primarily for moving rather than staying.

Sustainable Livability

Due to the fact that livability is subjective, the concept of sustainable livability, as defined by van Dorst (2012) is utilized. With the term **sustainable livability** the primary focus is on adressing basic needs that are important for the well-being of people of present and future generations. These include:

1. Health and safety: an aspect that has a strong relation to the environmetal aspect of sustainability (climate).

2. Social relationships: an environment that can facilitate social interactions up to the desired level

3.Control: the ability to handle the amount of social interaction and the flexibility and adaptability of the built environment to people's needs.

4. Contact with the natural environment: the aspect of green in the built environment and the positive relation to health (physical and mental).

Conclusion

Due to the subjective nature of **livability** and the multiplicity different and **conflicting interests**, a different approach should be considered. Therefore, the concept of sustainable livability which is mostly related to the **social** aspect (but also to the environmental aspect) of **sustainability**, provides a useful and insightful way to deal with the aspect of livability. The four needs that are defined above, are going to inform several design principles for the redevelopment of Sloterdijk.

Theme	Sustainability	Livability
Health	Urban sprawl limitation Reduced car dependcy	Pollution Pressure on local ecosystem Microclimate deterioration
Safety	Vulnerability	Crime prevention Road Safety
Social relationships	Anonymity as a condition for social problems Shared territory for interaction	
Control	Flexibility Adaptability	Control of the individual of their social interaction Antisocial behaviour in anonymous environments Balance of public and private
Contact with natural environment	Environmenal quality and climate regulation Biodiversity	Stress reduction Recreation

Figure 51. Association of density with sustainability and livability.

4.7. Conceptual framework

As a final step of the analysis of relevant theories and concepts, a conceptual framework is constructed. Through this framework, the **interrelations** between the different concepts and theories can be identified, providing also with an overview of the key elements that are going to be addressed within the design phase of this graduation project.

This conceptual framework is developed across **two main axes**, which are equally important in the case of Sloterdijk as a train station area development. The first axis is related to the **node-place theory** related to station area developments and in close relation to the aspect of accessibility. **Accessibility** here refers to mobility (function of the area as a node within the overall network), to the importance of **inclusivity** (referring to a wide range of users and social groups) and to the amount and **diversity** of activities and services that Sloterdijk can potentially provide to its users.

The other axis is developed based on the apparent conflict between the concepts of **sustainability** and **livability**. This conflict is also interrelated to the concept of **density**, which is a central theme of this graduation project. Regarding livability, due to its subjective nature, the theory of **sustainable livability** was utilized (sustainable livability refers to the basic needs of species), in order to be able to operationalize the concept and to not confuse it with other non-spatial indicators typically used to measure livability.

Finally, all of these concepts and theories need to be comprehended in relation with the importance of their **spatial interpretation and application in the area of Sloterdijk**. Due to the wide variety of potential elements and intensity of use of space in this regionally important mobility hub, a **strong competition of space** occurs. Therefore, it becomes apparent that the spatial interpretation of these concepts in the design proposal for the area of Sloterdijk is imperative.

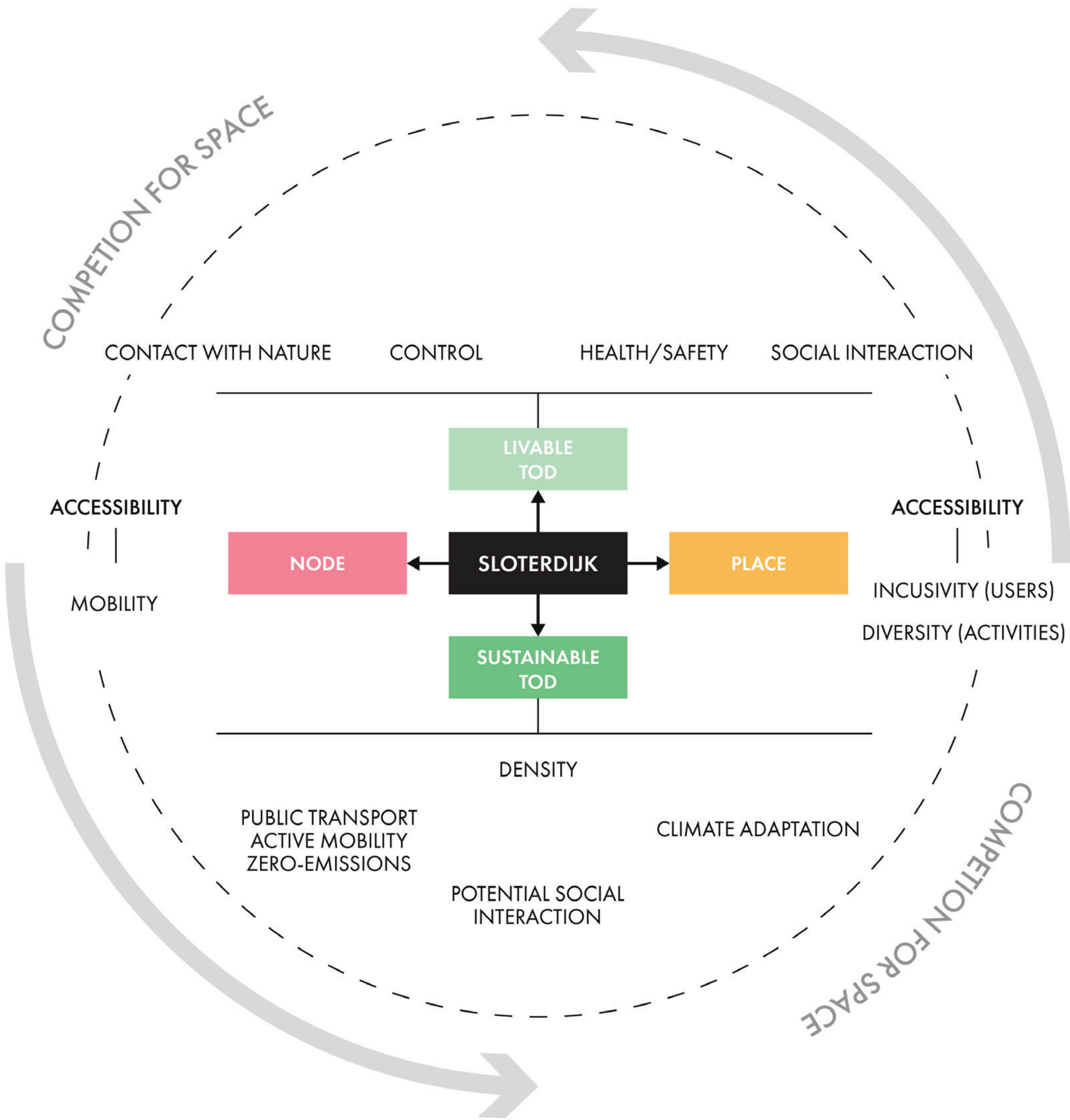


Figure 52. Conceptual framework diagram.

Preliminary design 5

5.1. Introducing housing

A primarily non-residential area

As analyzed in the second chapter of this report, the area around the station area of Sloterdijk was developed primarily as a business district since the 1980s. Since the 2008 economic crisis, the area had to deal with high vacancy rates. In an attempt to revive the area, some of the office buildings were transformed into hotels, but that had little effect on the liveliness of the area.

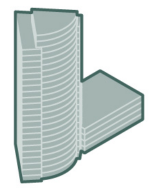
Due to limited number of houses, the area around the station is empty after working hours, as there is little development of activities and people visit the area almost exclusively to reach their working place.

The station area of Amsterdam Sloterdijk is characterized by large office buildings, particularly on the North-East area of the station. A much finer grain can be found on the South-Eastern part of the station of relatively more mixed functions, where three educational institutions are mixed with office buildings. Around the main station square, which is at the western side of the station, several large office buildings can be found, with minor retail functions on the ground floor that serve primarily commuters and professionals that work at Sloterdijk. Lastly, the area on the South-Western part of Sloterdijk station, is currently under development with some residential buildings being currently under construction.

Functions around Amsterdam Sloterdijk

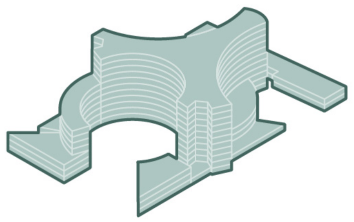
1. Office

328.351 m2



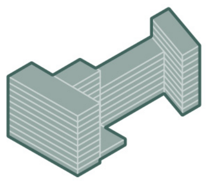
2. Mixed (Office/Hotel)

47.604 m2



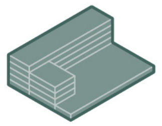
3. Hotel

34.428 m2



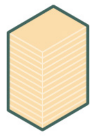
4. Education

22.903 m2



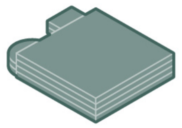
5. Residential

21.772 m2

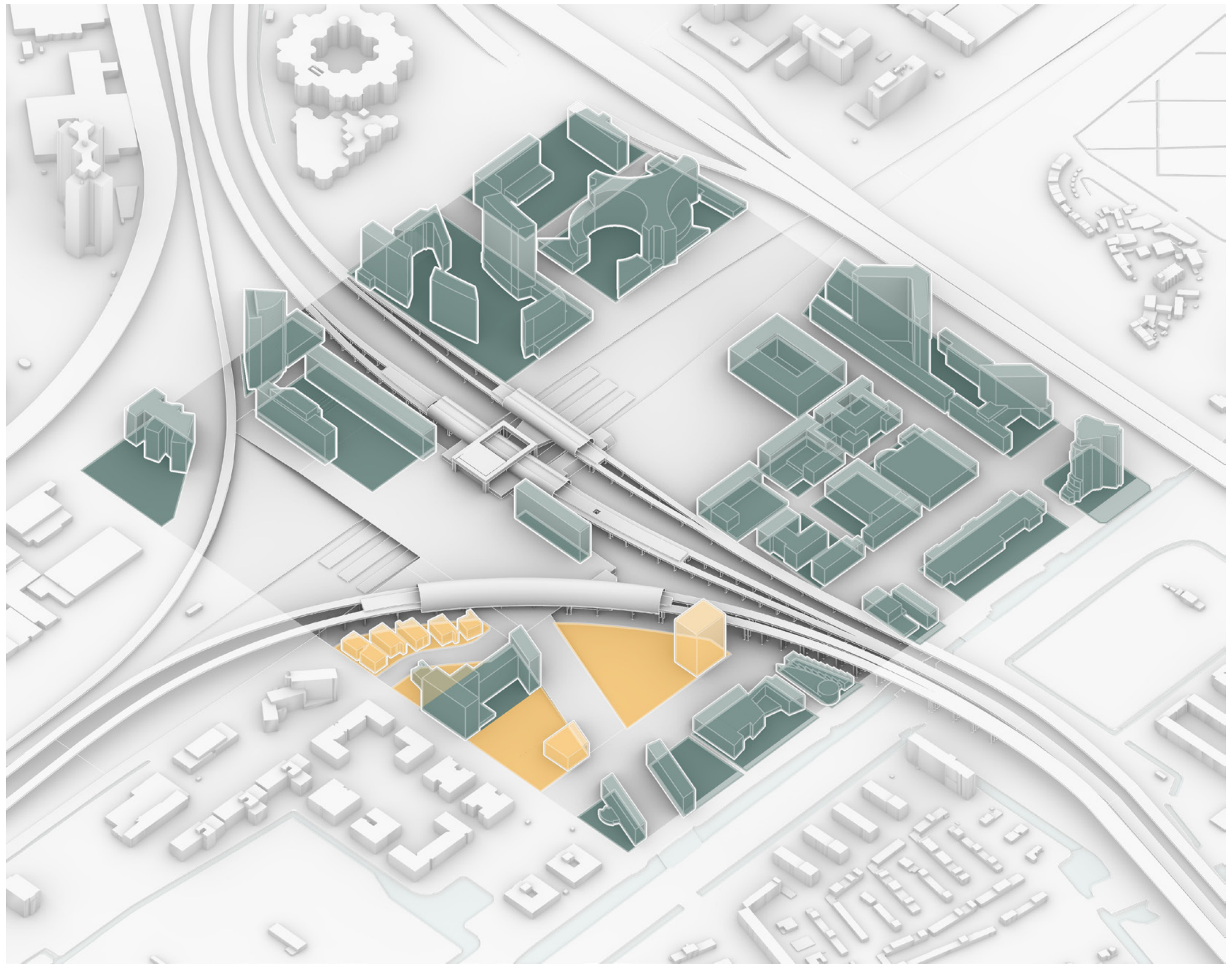


6. Mixed (Education/Office)

15.770 m2



Current distribution of functions



Current functional mix

Total programme: 471.428 m2

Total housing units: 237 

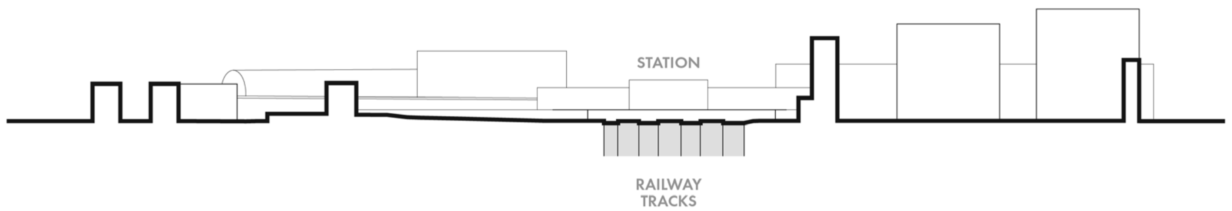
Total inhabitants: 356 

21.772 m2	449.656 m2
5	**95**
Residential	**Non-Residential**

Abundance of open spaces

The area is also characterized by a disproportionate amount of open spaces. This is strongly related to the space dedicated to mobility, as a large portion of it is taken by car roads, bus lanes and bike parking areas. Adding to that, most of the building blocks of the area are occupied by single standing buildings, leaving most of the block space free of use. This abundance of open space has negative effects to the quality of public spaces and to the overall vitality of the area.

From



To

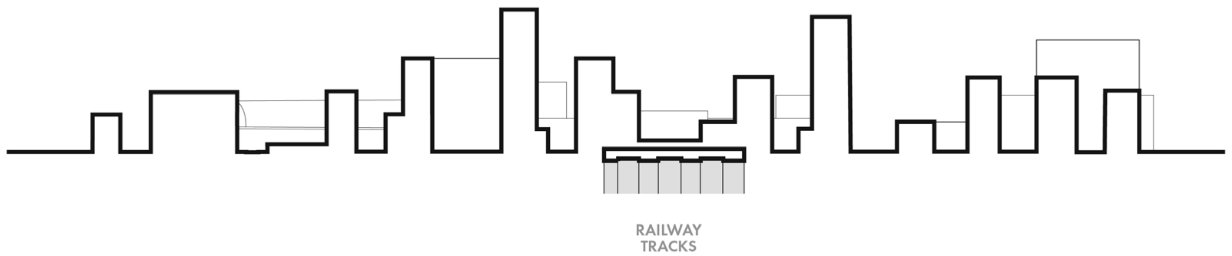


Figure 53. Cross-section showing the current and potential built form of Sloterdijk.

Figure 54. Space dedicated to mobility is negatively affecting the built density and the development of activitities in the direct vicinity of the station.

Figure 55. Space between buildings is also a defining factor for creating intimate public spaces as well as improving the walkability of the area.

Potential strategies for densification

After a preliminary analysis of the area is conducted, the potential strategies for densification are defined. These are closely related to the specific characteristics of the area and the opportunities its built form it provides.

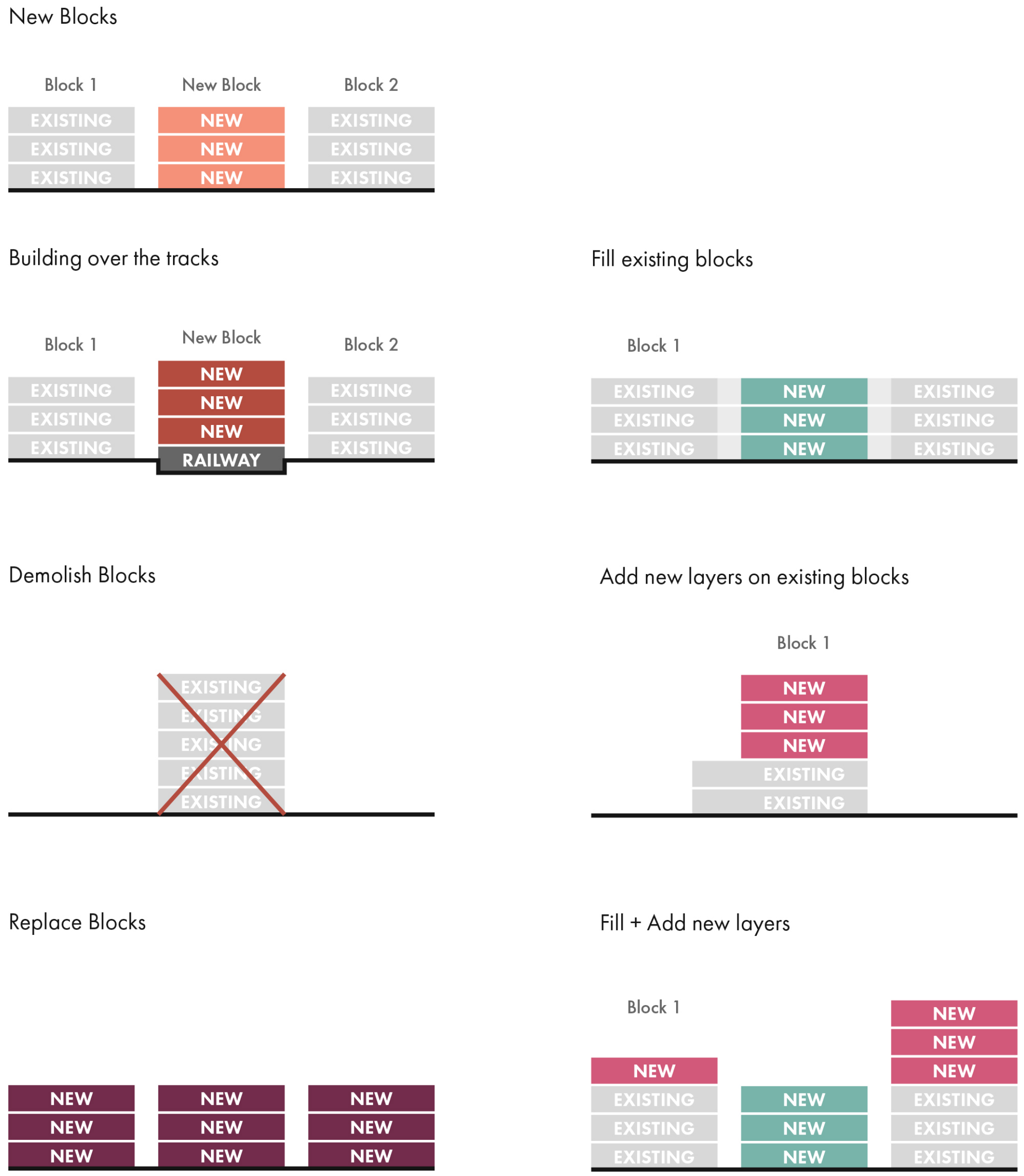


Figure 56. Overview of potential strategies for densification

Integration of new uses

As a main rule, most of the new addition of buildings should be primarily for housing or other functions such as retail, services, schools etc., to support life in Sloterdijk.

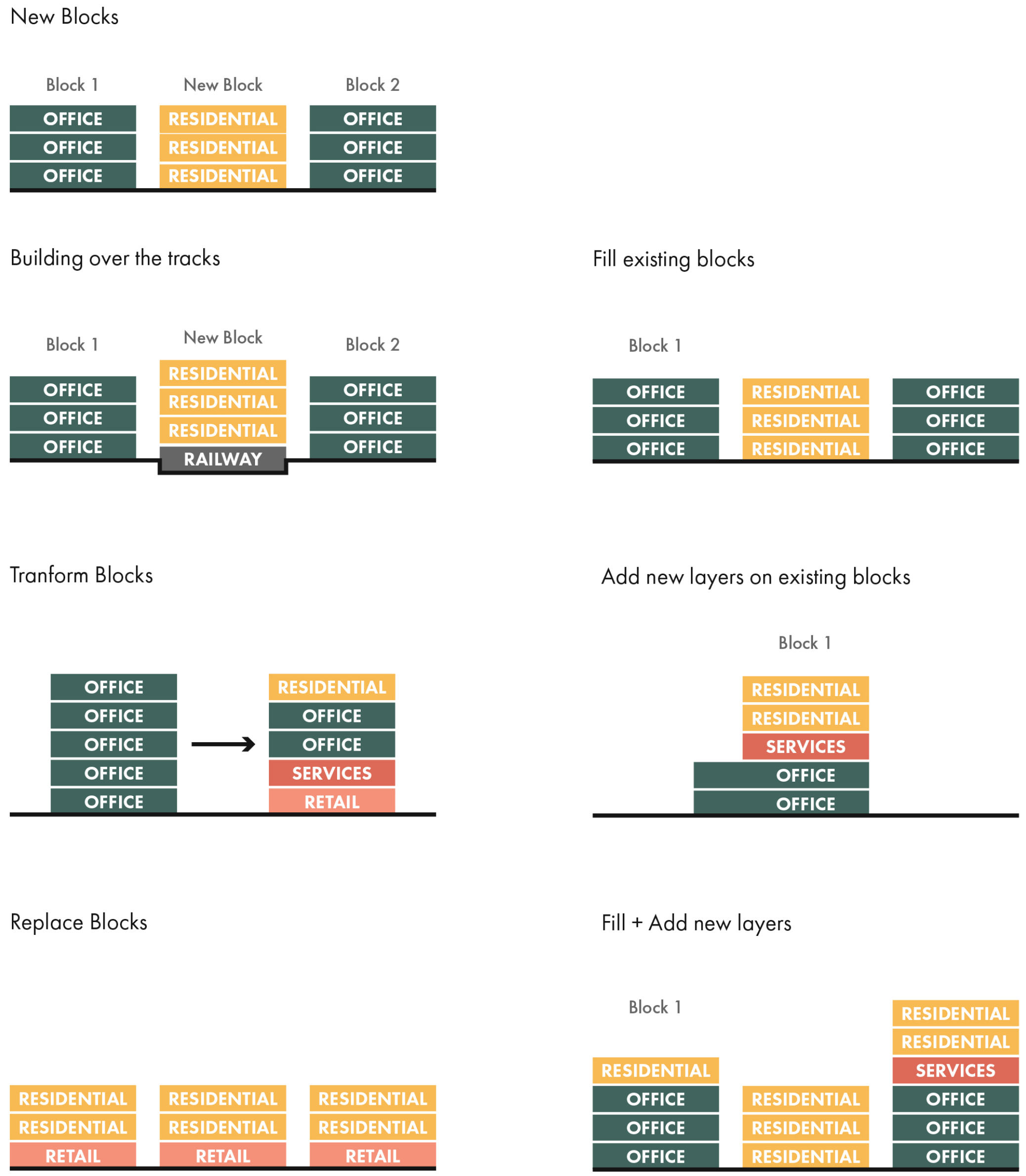
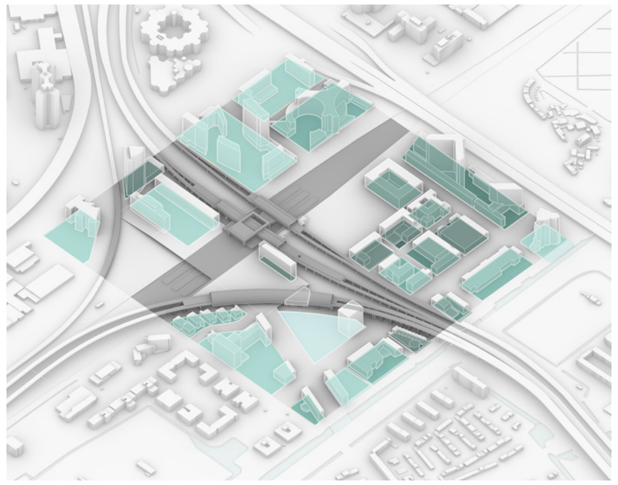
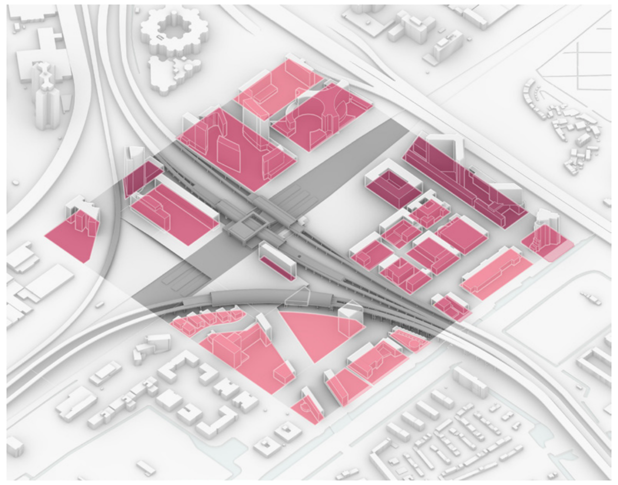


Figure 57. Overview of potential strategies for densification

Opportunities

Increase FSI/GSI





$$\text{GSI} = \frac{\text{Ground floor area}}{\text{Plan area}}$$

0-0,2 | 0,2-0,4 | 0,4-0,6 | 0,6-0,8 | 0,8-1

$$\text{FSI} = \frac{\text{Total floor area}}{\text{Plan area}}$$

0-2 | 2-4 | 4-6 | >6

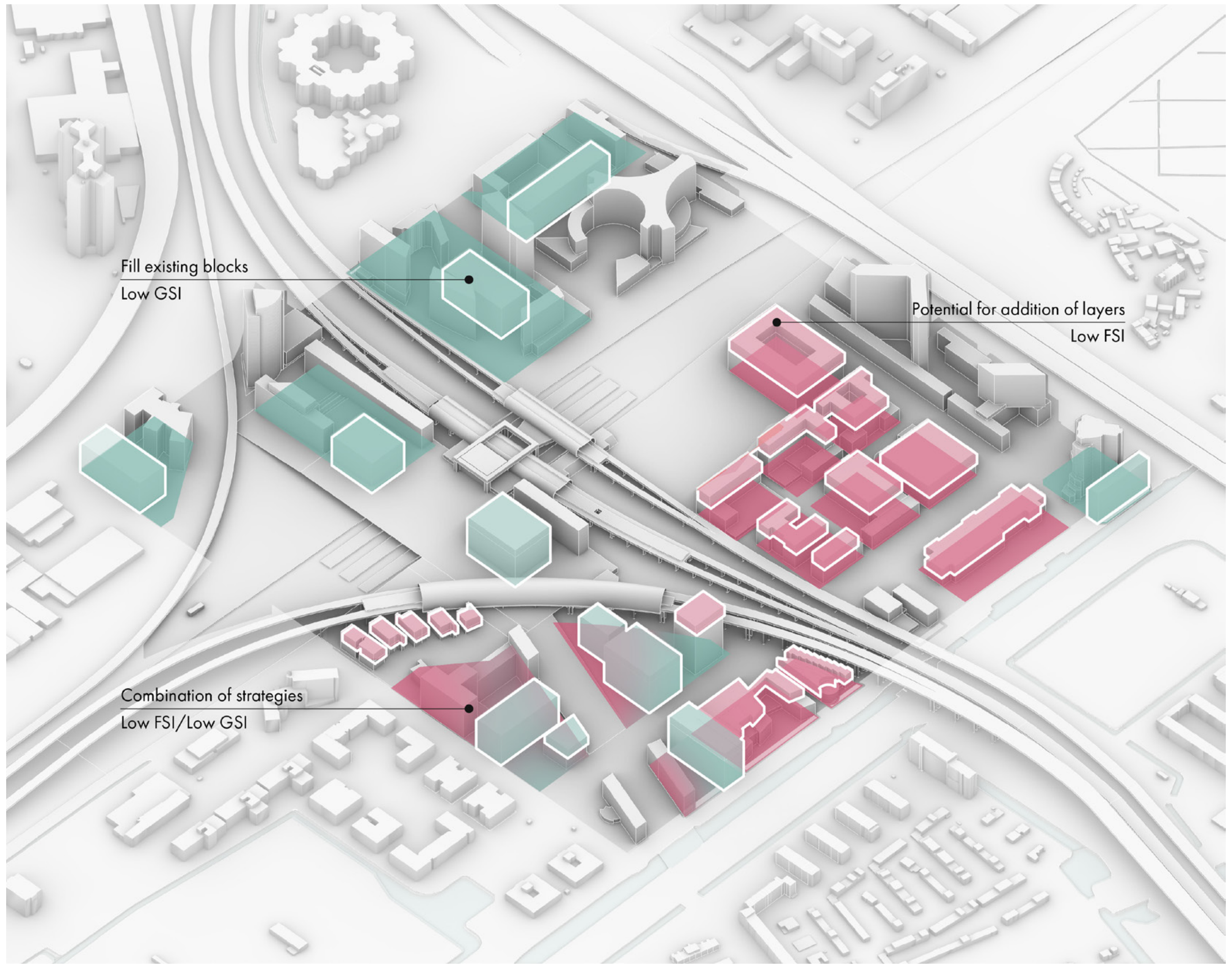
Reference project

Figure 58. De Karel Doorman building in Rotterdam by Ibelings van Tilburg architecten. Addition of new layers over existing building. Source: www.archdaily.com

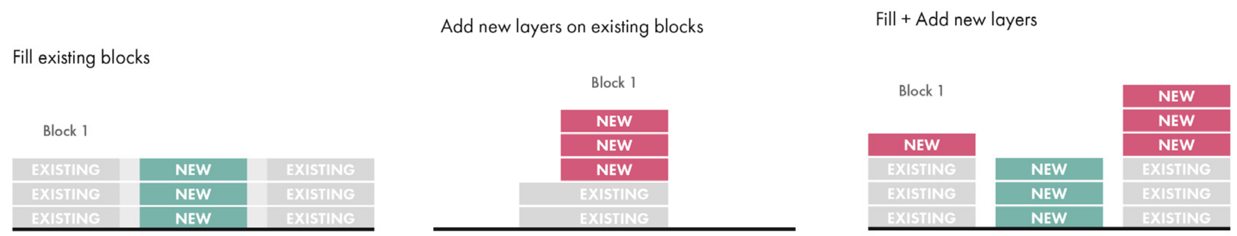
As a first analysis of the area, a study of the existing densities was conducted. This was related to the factors of GSI (Ground Space Index) and FSI (Floor Space Index) which can be seen on the diagram above. The area due to the typology of single standing towers that is dominating most of the area, presents low GSI numbers on its north and western side. That leaves large amount of spaces within the blocks that are currently underused neither contributing as quality green spaces or lively public spaces. These large blocks are also presenting low values of FSI, thus low intensity of use of space, regardless the height of the buildings. This typology has also negative effects on the vitality of public space as it will be further explained later.

The diagram on the right page shows the identification of potential intensification of use of space through strategies such as infill of existing blocks, addition of new layers of over existing buildings or a combination of both.

Potential



Strategies Applied



Opportunities

Remove/Transform existing large office buildings

Figure 59. Crystal Tower in Sloterdijk. One of the largest office buildings in Sloterdijk. Does this typology fit in the future Sloterdijk? Source: www.dekruijff.nl

Figure 60. Typical inactive facade of most of the office buildings found in the area, creating a very unattractive and unsafe place to be.

Make room for ecology

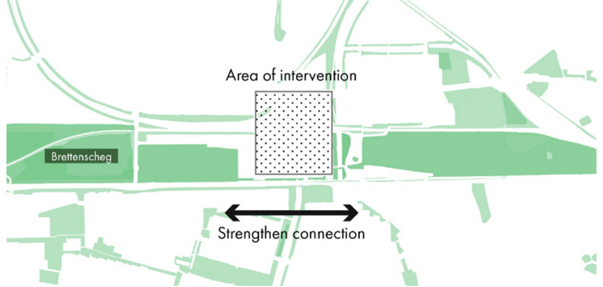
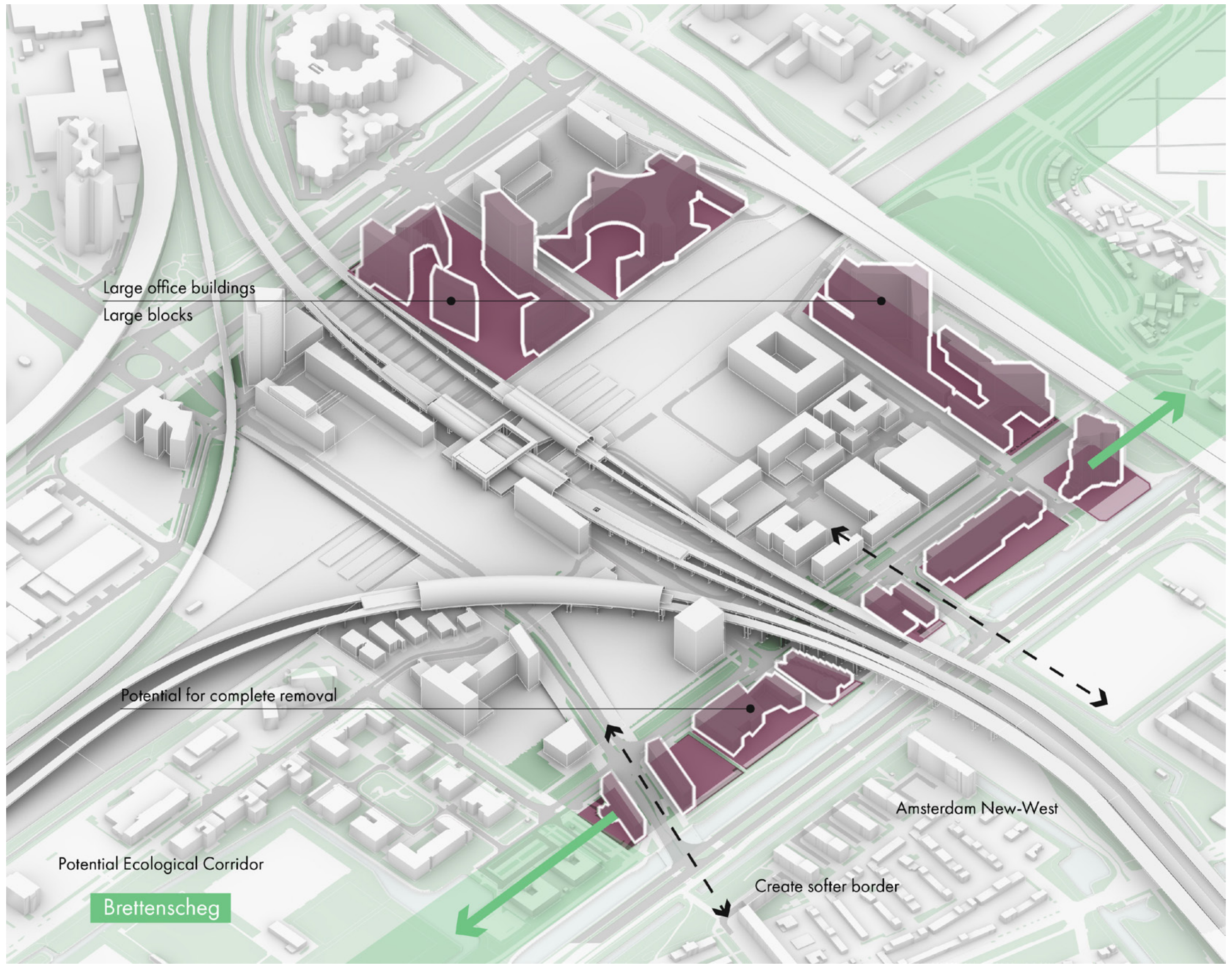


Figure 61. Diagram of the main green structure of the city of Amsterdam in the vicinity of the station area of Sloterdijk. A potential connection between the larger green patches could be beneficial for local biodiversity. This part will be further explored in later stages of the design

One of the elements currently dominating the area is the multiplicity of large office buildings. As the area was designed as a monofunctional business district, this typology is the most present in the location and has negative effects on several aspects such as diversity, safety due to lack of eyes on the street and walkability. Therefore, a potential transformation of the area could take into consideration either the transformation of the most suitable buildings to other uses such as housing (or hotels as it already happened extensively in the area) or their complete demolition. Of course, for that a thorough assessment on the long-term effects and sustainability of such action should be conducted.



Strategies Applied

Opportunities

Building over the railway tracks

Reference project-Rive Gauche, Paris, France

Figure 62. The Seine Rive Gauche redevelopment project. One of the largest realized development projects over railway tracks. Source: www.skyscrapercity.com

Figure 63. Eye level image of the railway barrier in Amsterdam Sloterdijk.

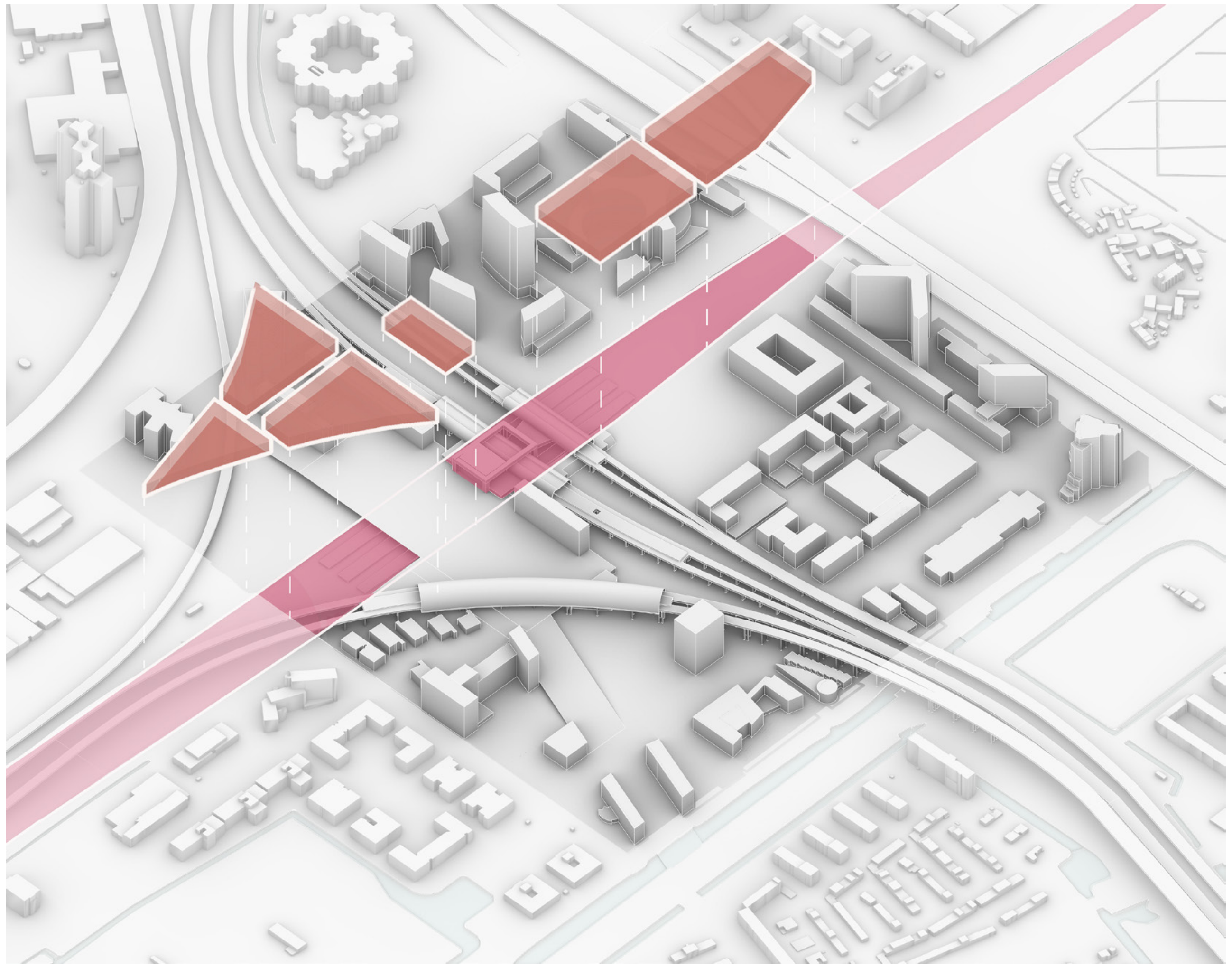
One of the key strategies for the realization of housing in the area of Sloterdijk is building residential units over the railway tracks.

This has multiple positive effects. Starting from the railway tracks which an other than its mobility function, is an inactive piece of land, with this strategy is activated and utilized.

At the same time, this part becomes an integral part of the proposed urban fabric having a strong connection through the street network that extends over the new structure. On the sides of the new construction, as part of the structural requirements, new active floor ground can be created, improving thus the quality of the streetscape.

The difference in levels creates also interesting qualities of space and sightlines particularly over the railway tracks.

Potential



Strategies Applied

Added programme	200.000 m2
Added housing units:	2000
Added inhabitants:	3000

Building over the tracks

Overcoming the railway barrier

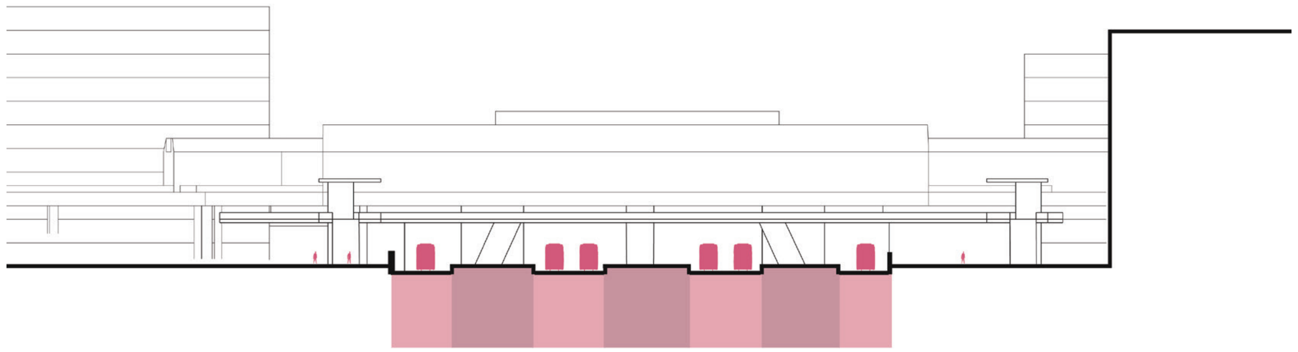


Figure 64. Cross section of current image of the barrier.

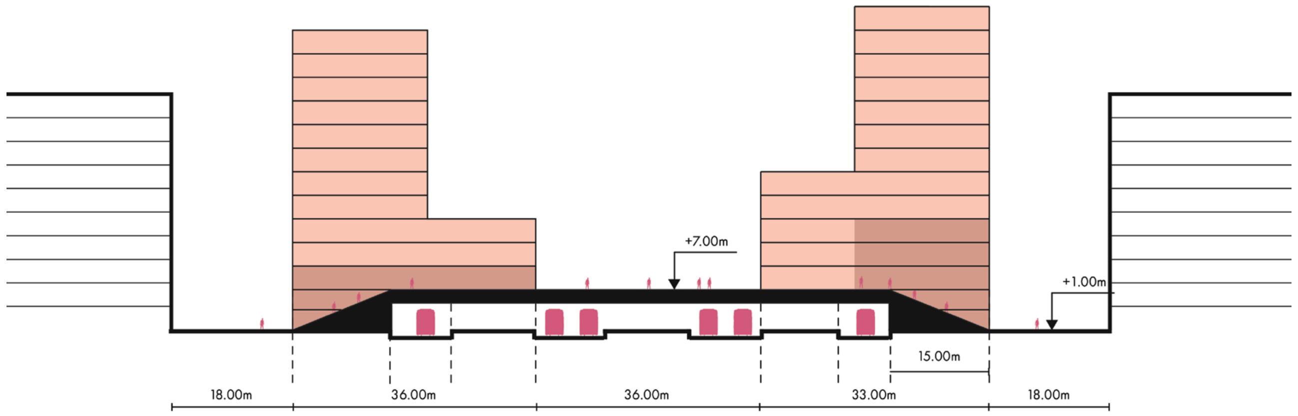


Figure 65. Cross section of potential future image of the barrier.

Perspective images

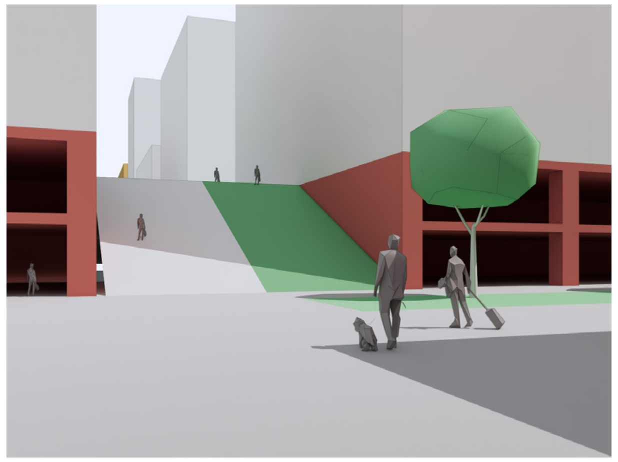


Figure 66. Perspective image of the connection between the lower and the upper level through staircases on the sides.

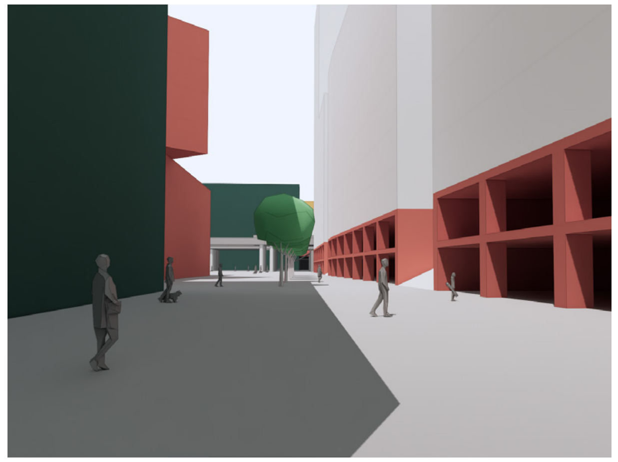
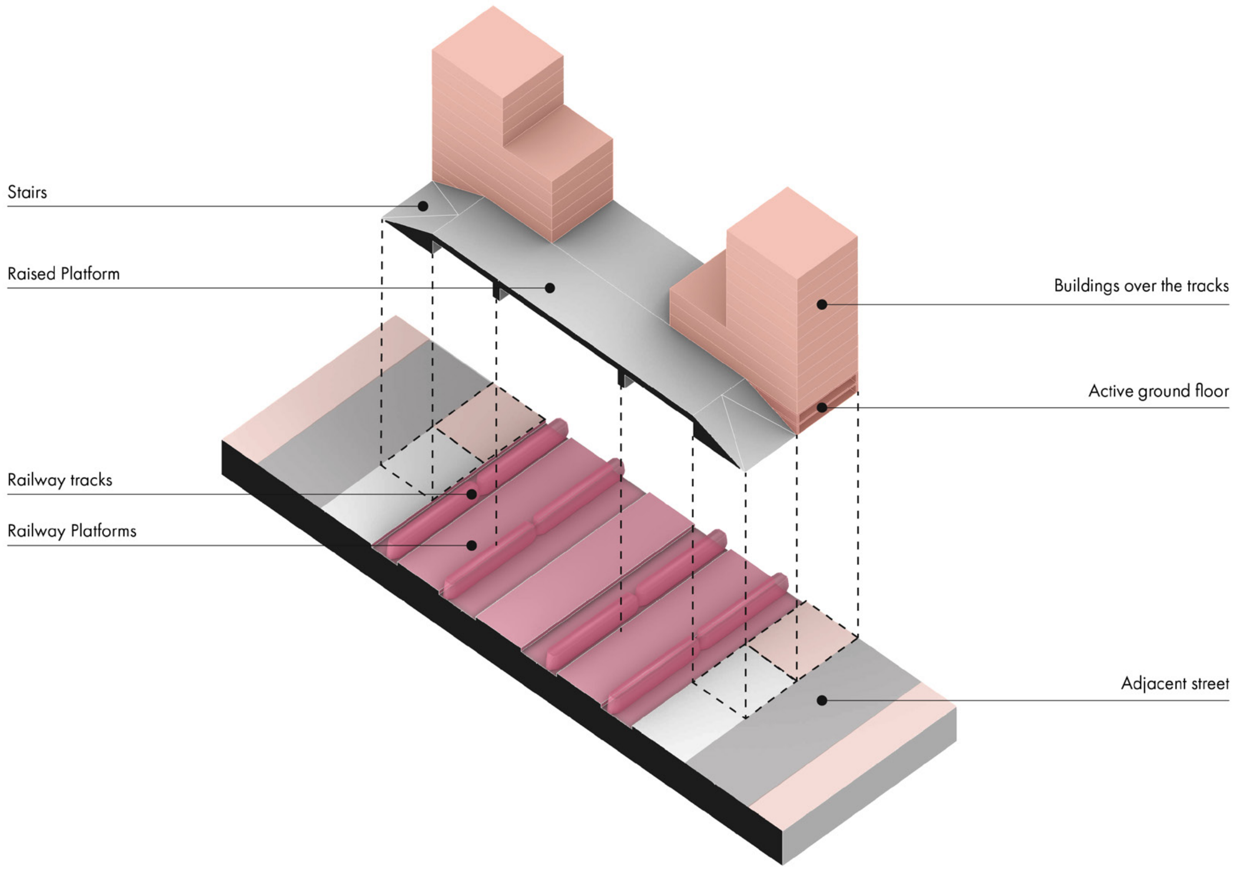


Figure 67. Perspective image of atmosphere of the street.



Development of options

1 New blocks

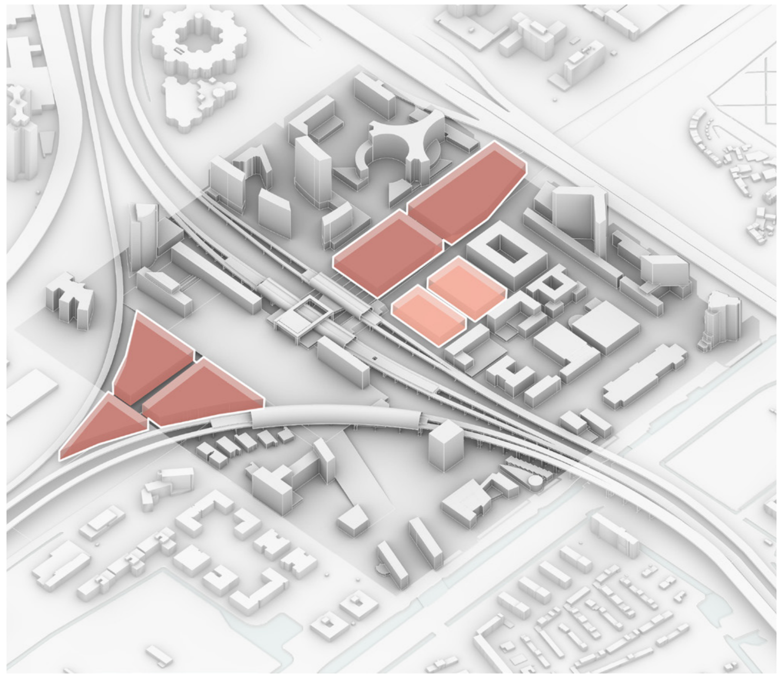
Added floor space:	88.845 m2
Total Residential:	110.617 m2
Total Programme:	560.273 m2

1106

1659

Conclusions:
+Feasibility
-Minor addition of houses/inhabitants
-Minor transformation

2 New Blocks + Build over the tracks



Added floor space:	289.235 m2
Total Residential:	311.007 m2
Total Programme:	760.663 m2

3110

4665

Conclusions:
+-Adequate addition of houses/inhabitants
+Residential core of the area
-+Feasibility of building over the tracks

3 Increase GSI + New Blocks

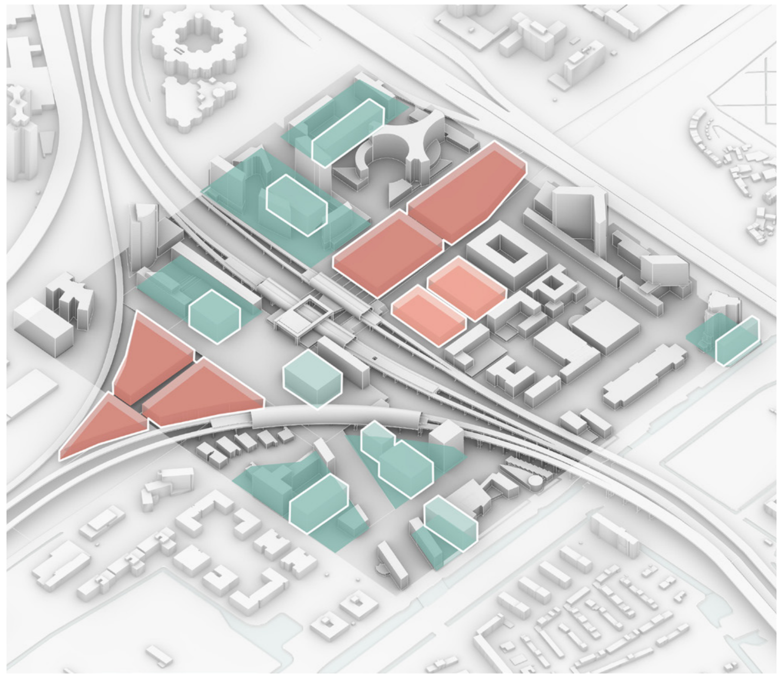
Added floor space:	316.972 m2
Total Residential:	338.744 m2
Total Programme:	788.400 m2

3407

5110

Conclusions:
+-Adequate addition of houses/inhabitants
+Feasibility of building in existing blocks
-No clear grid structure

4 Increase GSI + New Blocks + Build over the tracks



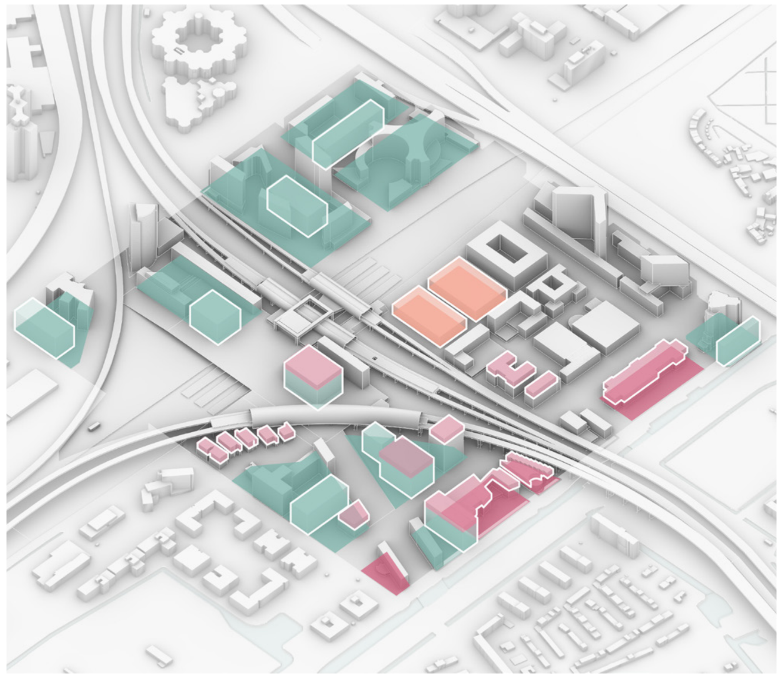
Added floor space:	517.362 m2
Total Residential:	539.134 m2
Total Programme:	988.790 m2

5391

8087

Conclusions:
+Significant addition of houses/inhabitants
-No clear grid structure
-+Feasibility of building over the tracks
-Feasibility of building within existing blocks

5 Increase GSI + FSI + New blocks



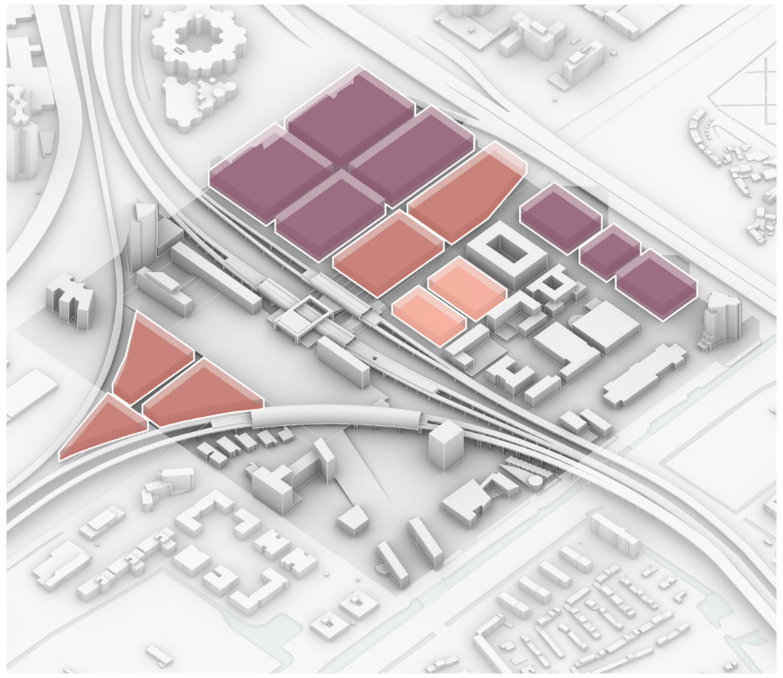
Added floor space: 347,758 m2
Total Residential: 369.530 m2
Total Programme: 819.186 m2

3734

5601

Conclusions:
+-Adequate addition of houses/inhabitants
-+Feasibility of building over existing buildings
-No clear grid structure
-Feasibility of building in existing blocks

6 Replace large office blocks + Build over the tracks



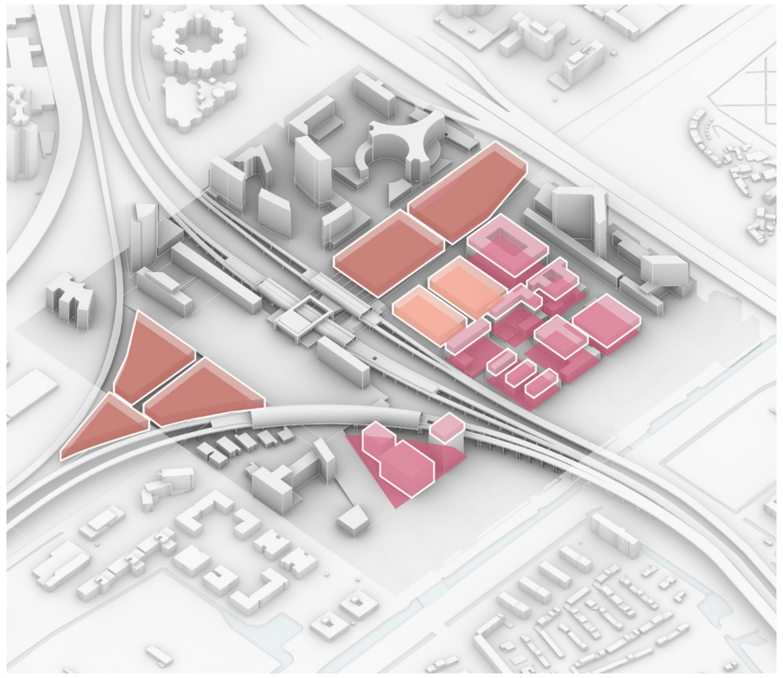
Added floor space: 416,876 m2
Total Residential: 628,582 m2
Total Programme: 888,304 m2

6305

9458

Conclusions:
+Significant addition of houses/inhabitants
+Improved grid structure
-+Feasibility of building over the tracks
-Large transformation

7 New Blocks + Build over the tracks + FSI



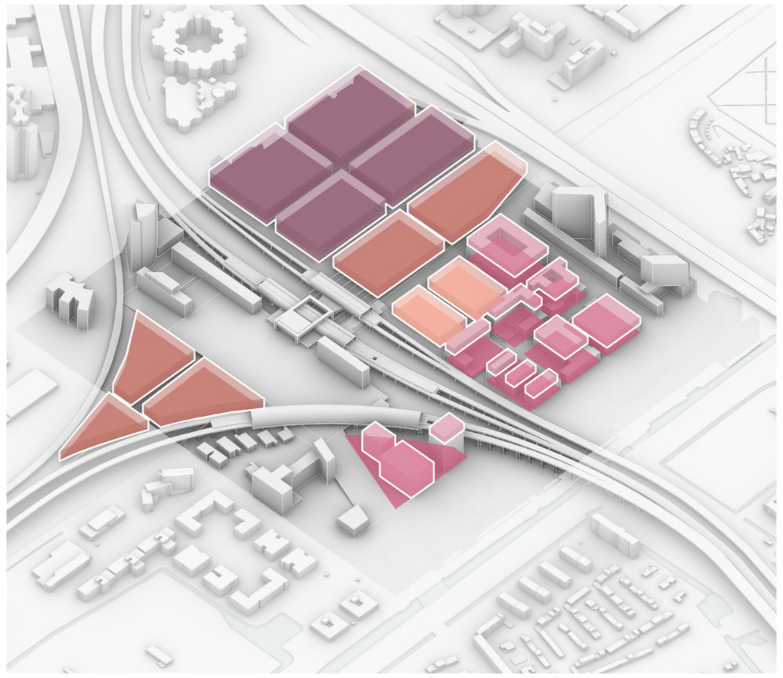
Added floor space: 308.166 m2
Total Residential: 364.753 m2
Total Programme: 756.342 m2

3648

5471

Conclusions:
+Adequate addition of houses/inhabitants
-+Feasibility of building over the tracks
-No clear grid structure

8 New Blocks + Replace large office blocks + Build over the tracks + FSI



Added floor space: 419.469 m2
Total Residential: 619.548 m2
Total Programme: 890.897 m2

6195

9293

Conclusions:
+Significant addition of houses/inhabitants
+Improved grid structure (network density)
-+Feasibility of building over the tracks

Discussion

As the preferred option for the addition of houses, option 8 was selected. This provides several benefits in relation to many themes. Starting from the importance of building over the railway tracks. As explained before, this densification strategy can potentially support a significant amount of new built area, and particularly for housing. At the same time, the street network on the east side of the station can be extended over the railway tracks, connecting thus the two sides with public spaces in between. The northern part of the railway tracks in this option is almost completely redeveloped, as the office buildings are removed at that part, providing lots of space for the development of other uses, including housing. Therefore, a better connection with the new blocks over the tracks is achieved. The office and education area on the southern side is preserved to the preferred block size they have (approximately 60x80m), and they densified with new layers on top. Therefore, a greater mix of uses is achieved in this part. Lastly, the office buildings at southern boundary of the area are removed giving space to ecology and leisure.

Numbers used for calculations

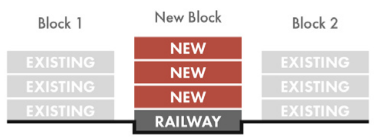
GSI	**0.5**
FSI	**5**
L	**5**
Average housing unit	**100 m2***
Average household	**1.5 people/household***

*Numbers of average house and household sizes for the city of Amsterdam. The average house is 74 m2, however the number of 100 m2 is used to include circulation space and other elements of buildings.

Strategies Applied

Demolish Blocks

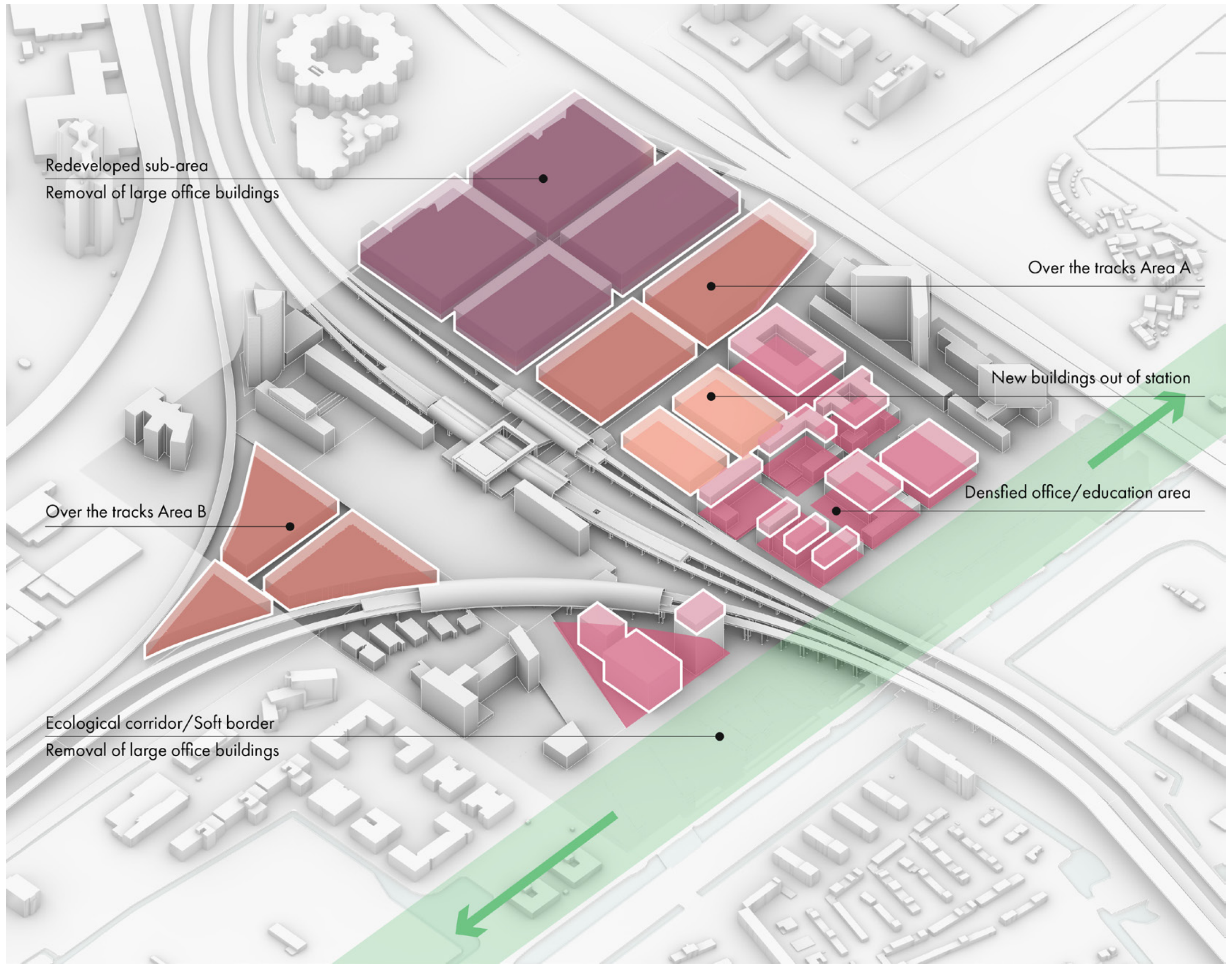
Building over the tracks



Replace Blocks

Add new layers on existing blocks

Preffered option + Refinement



8 New Blocks + Replace large office blocks + Build over the tracks + FSI

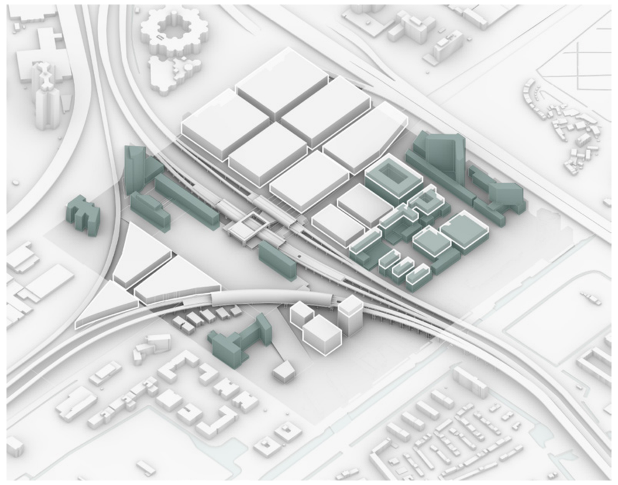
Added floor space:	416,876 m2
Total Residential:	628,582 m2
Total Programme:	888,304 m2

6305

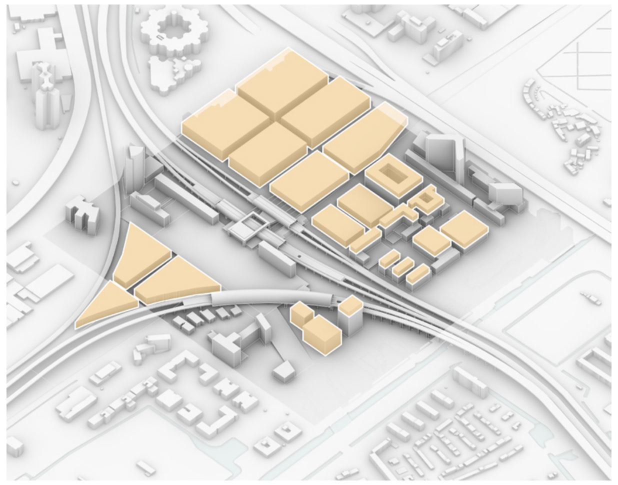
9458

Functional mix of the preffered optiont

After applying this option, a new functional structure of the area is created. As it is going to be further elaborated, several working places are preserved, as current patterns of work indicate that office spaces are going to be still relevant in the future, but with lower intensity. The new addition of houses creates three almost entirely residential neighborhoods, two over the tracks and one on the northern side of the station. This experiment also indicates the intensity of use of each area and its publicness.



-Creation of two work sub-areas, one outside the station square and one on the southern side of



-Significant addition of housing on the eastern side.
-New mixed area on the southern side

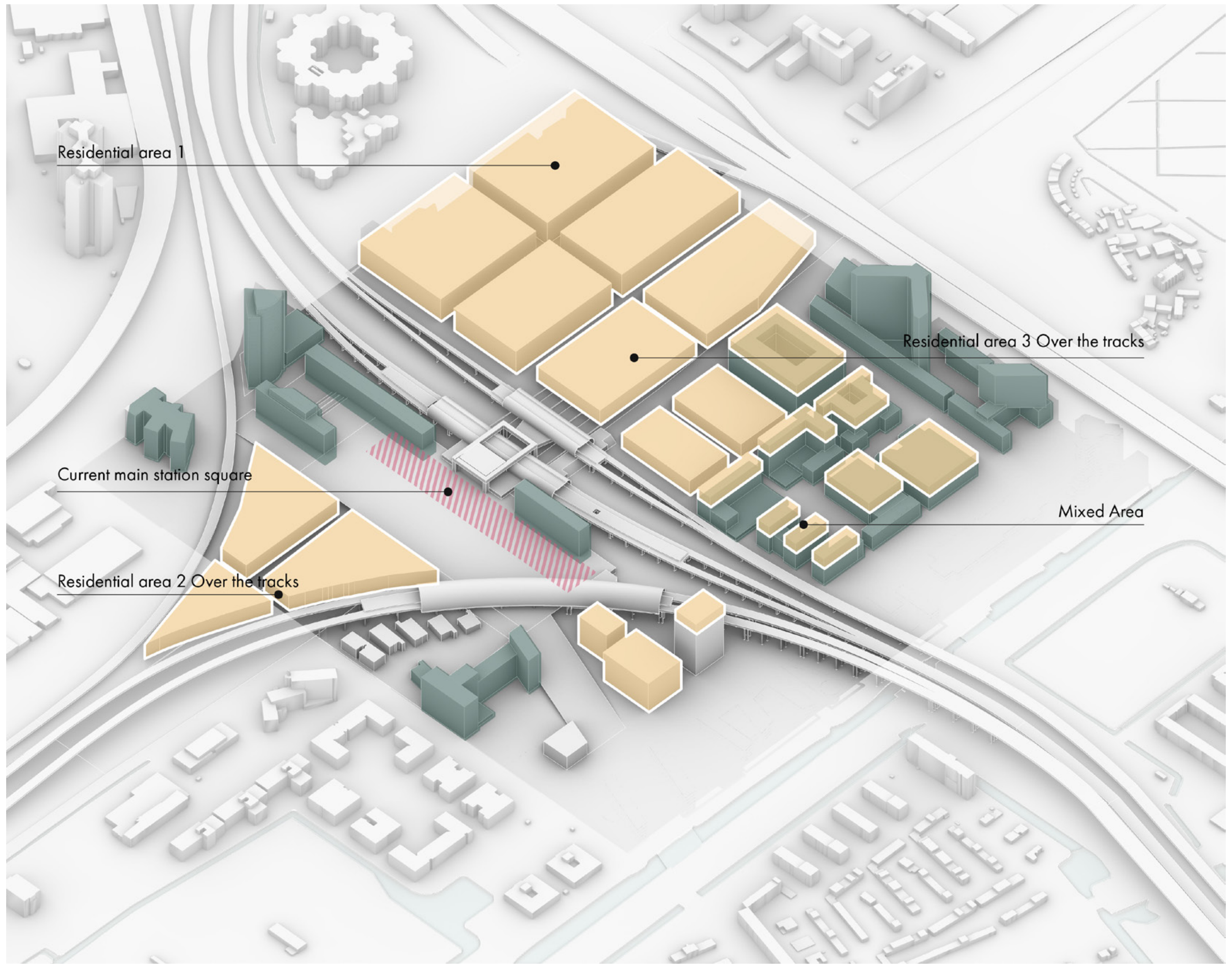
How functions are mixed

Building over the tracks

Replace Blocks

Add new layers on existing blocks

Integration of housing into the area



Total programme: 890,897 m2

Total housing units: 6195

Total inhabitants: 9293

619.548 m2	271.349 m2
70	30
Residential	**Non-Residential**

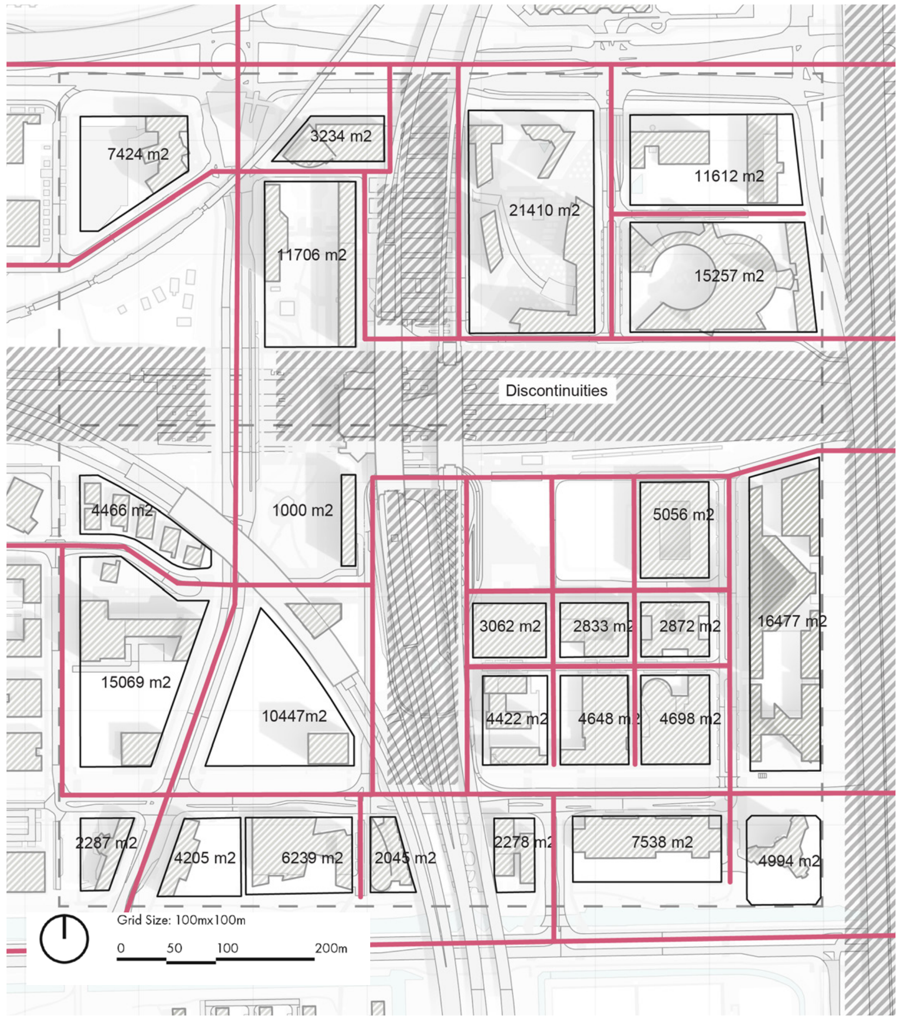
The numbers will be transformed with the addition of other functions in the area.

5.2. Grid Structure

Analysis of Current situation

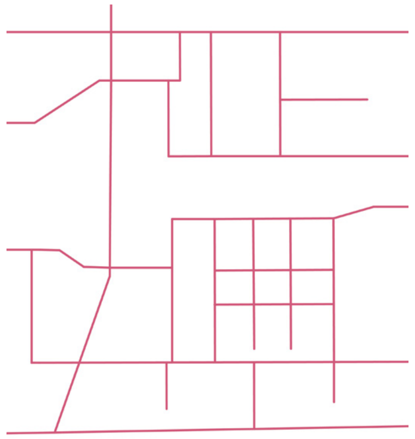
The urban form of Sloterdijk is characterized by **discontinuity**. Starting from the larger scale, the area appears to be disconnected from the overall structure of the city, due to distinct function of Sloterdijk as a **business district**. The urban fabric of Sloterdijk consists of **large office blocks** and **single-standing buildings** as opposed to the denser urban grid of the nearby district of New-West or the particular structure of the port area.

As can be seen from the image below, the grid network appears to be denser in the South-East part of the plan, while the rest of the network appears to have low density. That has negative effects on the **walkability** of the area as distances between blocks becomes significantly larger.



Key elements

- Low network density
- Large block sizes
- Barriers shaping the urban form



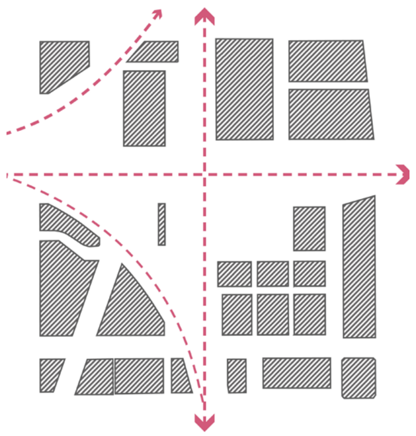


Figure 68. Top: Existing urban grid structure of the station area of Sloterdijk.

Figure 69. Bottom left: Diagram of the grid network.

Figure 70. Bottom right: Barriers shaping the block structure.

Barriers disconnecting the urban fabric

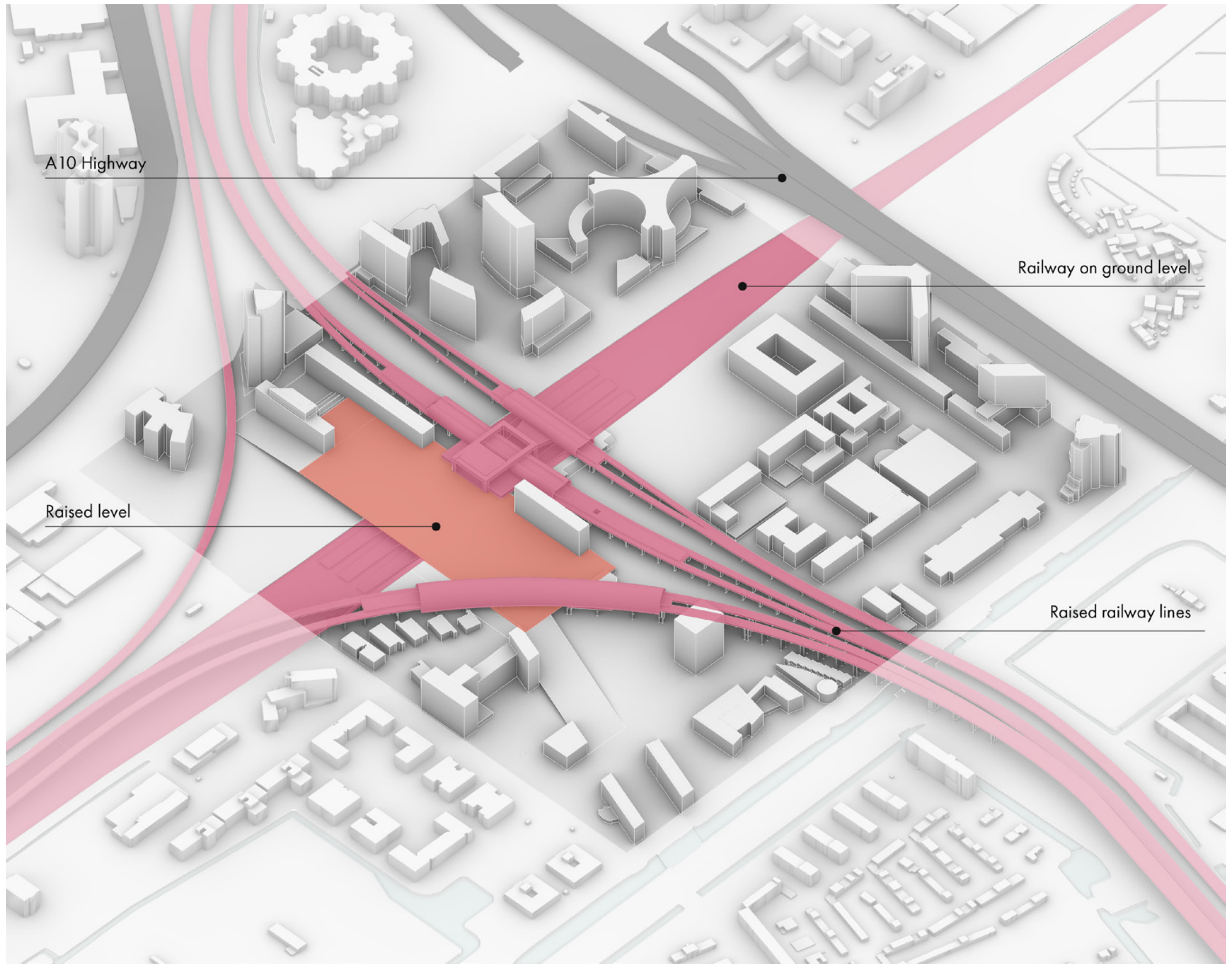


Figure 71. Various barriers that can be identified in the area around Sloterdijk shape the current urban fabric.

Legend

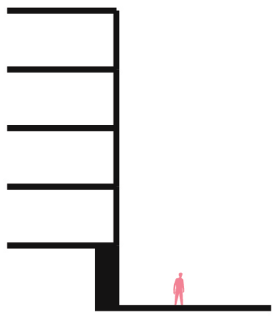
- Railways
- Highways
- Raised levels

This discontinuity is also strongly created by the **large infrastructure**, namely the **highways** and **railway lines**, that set several limits to the extent to which the area can be expanded and to the connectivity between the different sub areas. Most importantly, the railway lines on the East-West axis, create a strong border between the northern and southern sides of the area, while the **raised level** that connects them creates a border on the other direction.

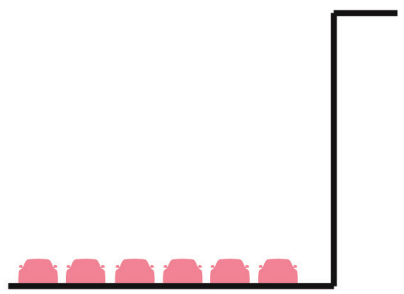
Blocks

Urban blocks of the station area of Sloterdijk were primarily developed to facilitate and maximize **office space**. Blocks are characterized by **large dimensions** and **low ground coverage**, particularly on the north side of the station, allowing thus a lot of open spaces to be used for **car parking**. On top of that, a significant percentage of ground floor space is also used for car parking, creating a lot of **inactive facades**, and eventually negatively affecting **public space quality** and leading to unsafety. Building typologies consist primarily of **single-standing buildings** of large dimensions, with low levels of interaction between the ground floors and the surrounding public space. Lastly, the **open spaces** of the block are typically **underused** and do lack transition zones between public and private spaces.

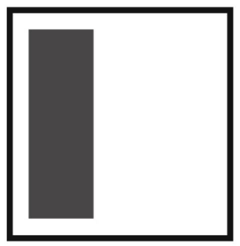
Characteristics



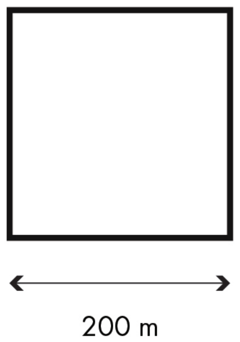
Inactive facades



Space for parking



Single-standing buildings

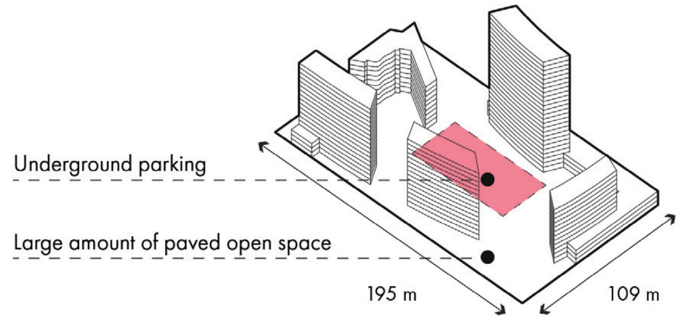


Large dimensions

Block typologies

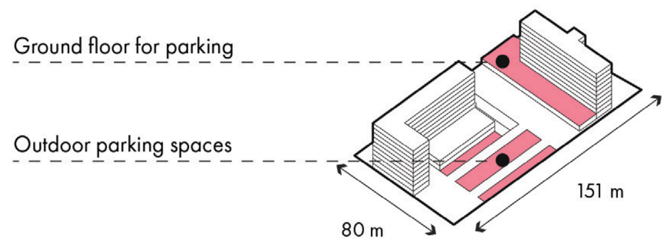
1 Large Block

Block size	**21.410 m²**
Total floor space	**54.593 m²**
GSI	**0.26**
FSI	**2.55**
L	**9.7**
OSR	**0.29**



2 Medium Block

Block size	**11.612 m²**
Total floor space	**21.797 m²**
GSI	**0.33**
FSI	**1.88**
L	**5.60**
OSR	**0.35**



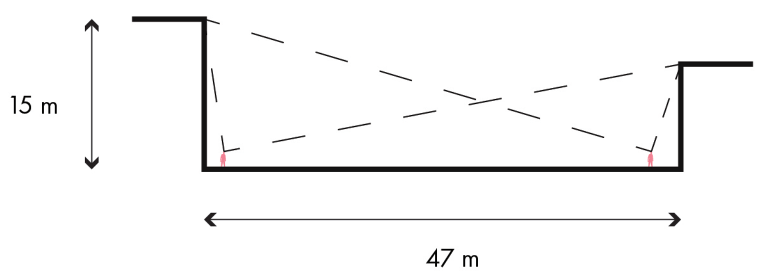
3 Small Block

Block size	**2.872 m²**
Total floor space	**12.288 m²**
GSI	**0.67**
FSI	**4.28**
L	**6.37**
OSR	**0.08**

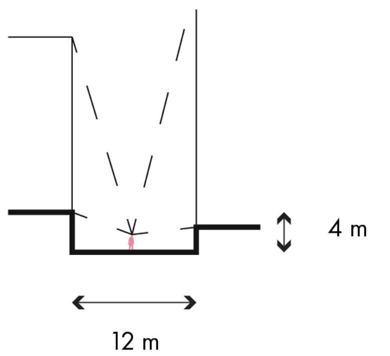
Steetscape

Streets in the station area of Sloterdijk are primarily used as **connectors** between the station and the various office buildings or other functions. As a result, **little activity** is concentrated along the streets. Most of the **space** on the streets is taken by the **various means of transport**, and especially **cars**. Typically, streets also contain **bike lanes** and some of them some **green verges** in the middle of the street. Little to almost **no street furniture** or other social spaces can be found on the streets, resulting in a total **lack of social interaction** between the various users of the area. The ratio between height and width of the street profile ranges from 1/3 to 1/1, lacking this way a **lack of enclosure and interaction** between the blocks.

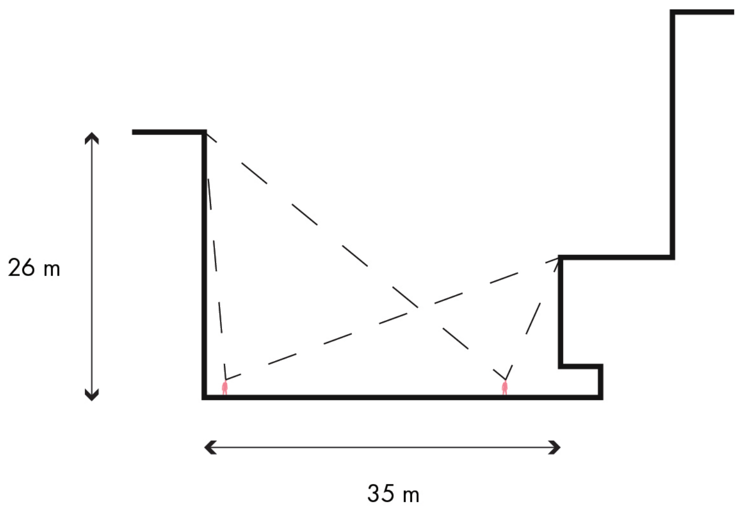
1 Ratio: 1/3



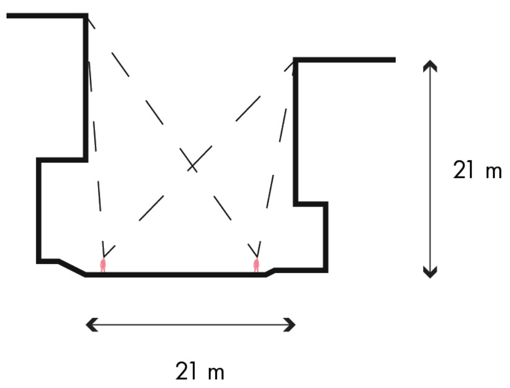
2 Ratio: 1/3



3 Ratio: 1/1.35



4 Ratio: 1/1



1 Mobility corridor

3 Business area

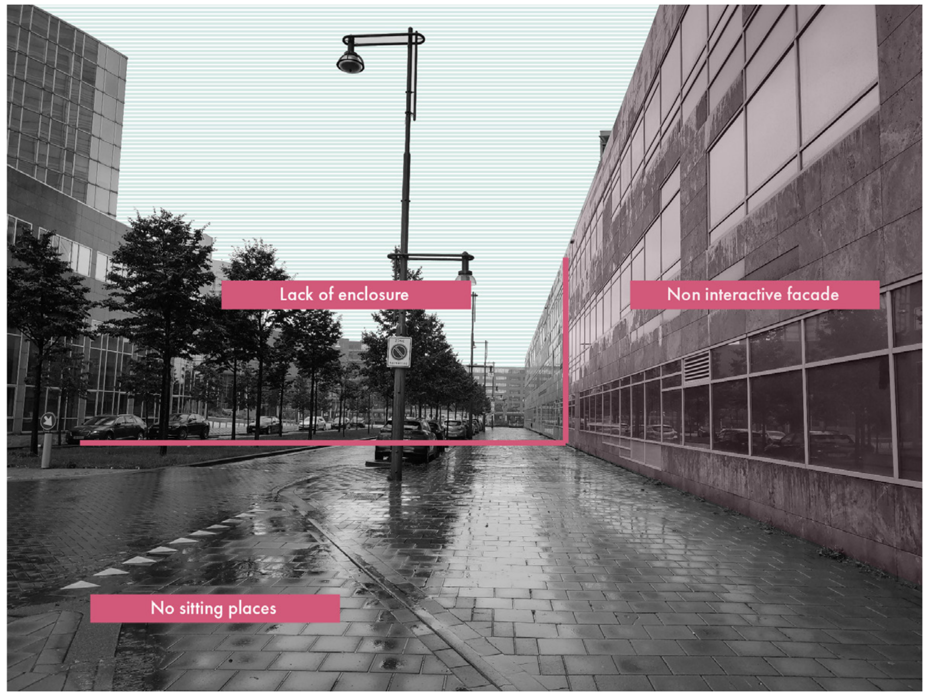


Figure 72. Analysis diagrams of the streetscape of Amsterdam Sloterdijk.

Analysis of examples

1 Boulogne Billancourt, Paris, France

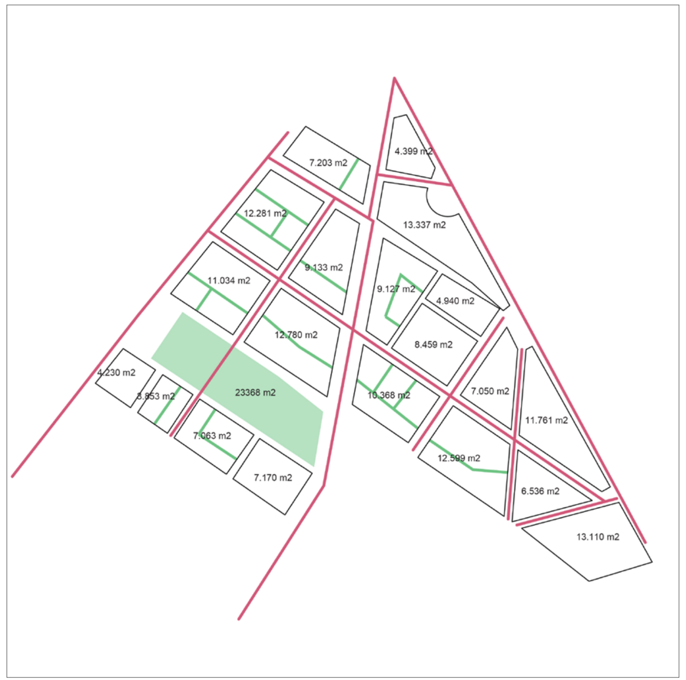


Figure 73. Boulogne Billancourt. Source: www.landezine.com

Average block size 0.7-1.3 He

Key elements

- Green/Blue network integration
- Secondary public space network through the blocks
- Block size of 1 hectare as a base

2 Europaallee, Zurich, Switzerland

Figure 74. Europaallee. Source: archdaily.com

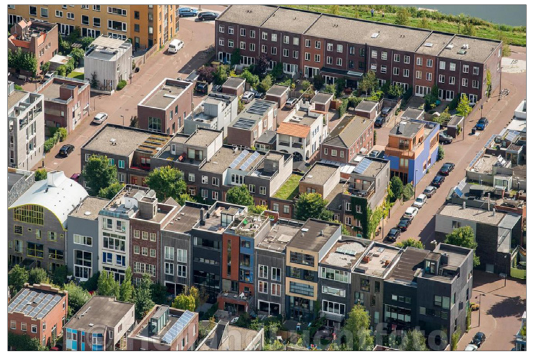
Average block size 0.3-1.4 He

Key elements

- Analysis of the relation to railway lines
- Block typology with setbacks as a base
- Public space network and sequence

3 Ijburg, Amsterdam, Netherlands

Figure 75. Ijburg. Source: www.holland-luchtfoto.nl



Average block size 0.3-1.6 He

Key elements

- Alteration between different block sizes
- Small building sizes (width)

4 Quartier Massena, Paris, France

Figure 76. Quartier Massena. Source: www.batiactu.com

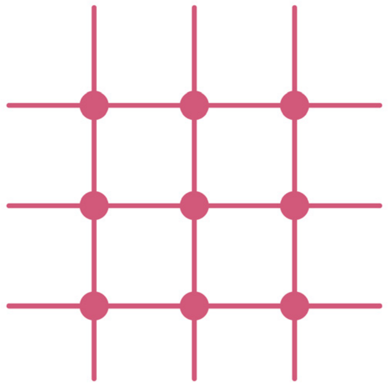
Average block size 0.4-1 He

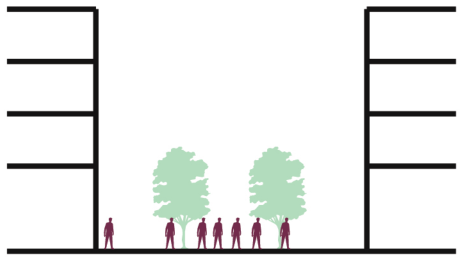
Key elements

- Small block sizes
- Green open spaces within a dense neighborhood
- Open block typology

Principles for design

1 Increase potential interaction

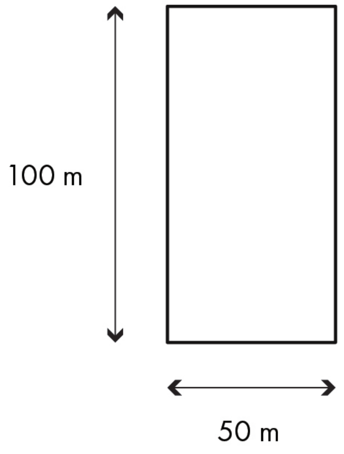


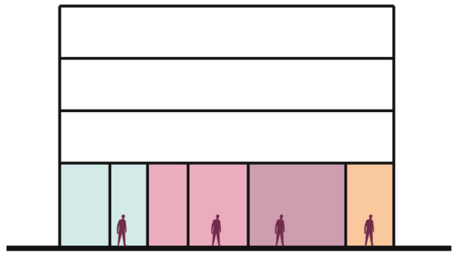


Enhance the potential of train station areas to become places of potential social interaction. Create spaces to facilitate this interaction.

Figure 77. Plaza Superilla de Sant Antoni, Barcelona, Spain. Source: www.archdaily.com

2 Increase diversity by decreasing sizes

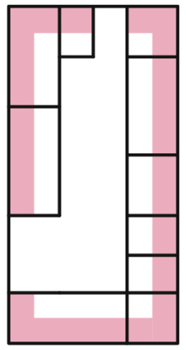


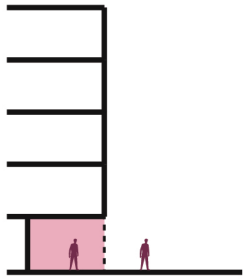


Decrease block size, facilitate future alterations according to needs. Finer grain of buildings can also increase diversity of uses and flexibility.

Figure 78. Street in Amsterdam with narrow buildings and high-density of active facades. Source: www.expedia.nl

3 Activate facades

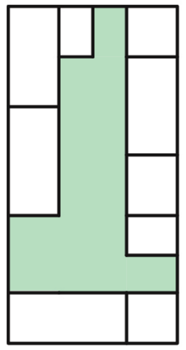


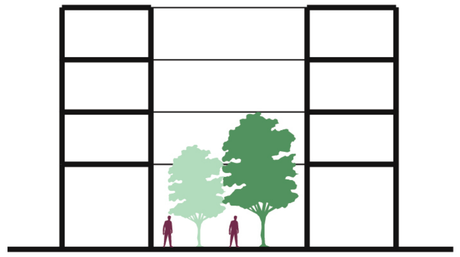


Open up ground floor facades to facilitate interaction between buildings and streets and intertwine interior and exterior spaces.

Figure 79. Various activities happening on a street in Amsterdam due to active frontage of buildings. Streets become more attractive and thus liveliness is enhanced. Source: whatsupwithamsterdam.com

4 Remove parking and introduce greenery within the block

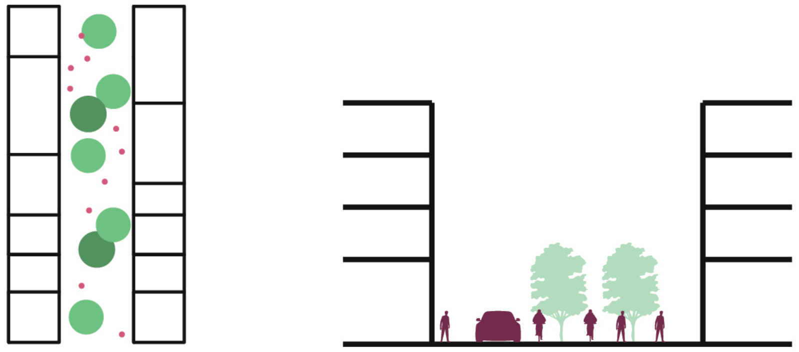




Create a secondary network of public space and facilitate interaction between neighbors. Provide with quiet spaces within the area.

Figure 80. Urban block at the Boulogne Billancourt district in Paris, France. A secondary network of public spaces is developed within the blocks, creating more quiet place in the district. Source: www.landezine.com

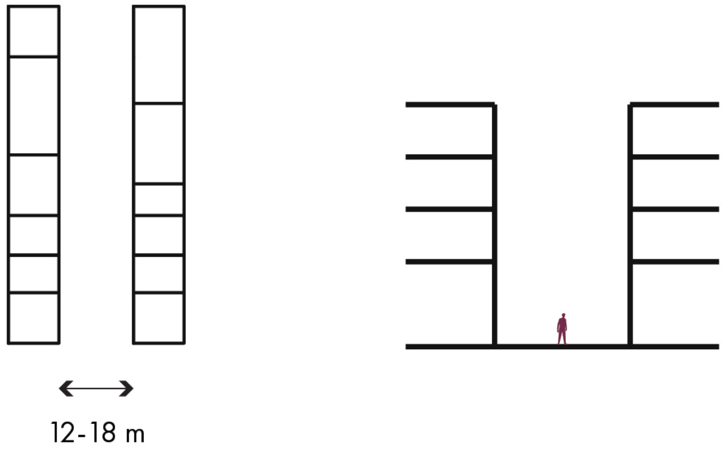
5 Minimize space allocated to mobility



Diverge public transportation and fast bike movement to a few axes. Minimize parking places for cars and slow down movement. Allow for other functions to develop.

Figure 81. New Road in Brighton by Gehl Architects. Transformation of a car-oriented street to a mixed street. Source: landezine.com

6 Reduce street width



Create a narrow street network for more residential-oriented sub-areas. Ensure adequate space for green/blue networks.

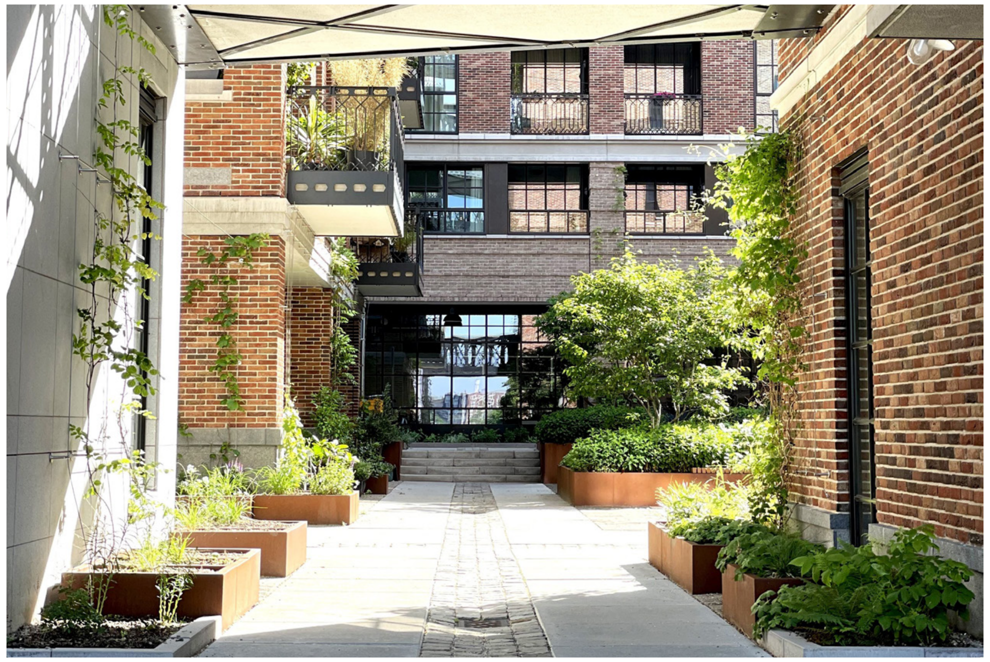
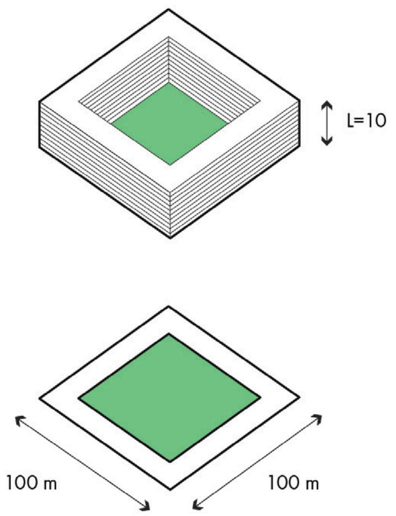


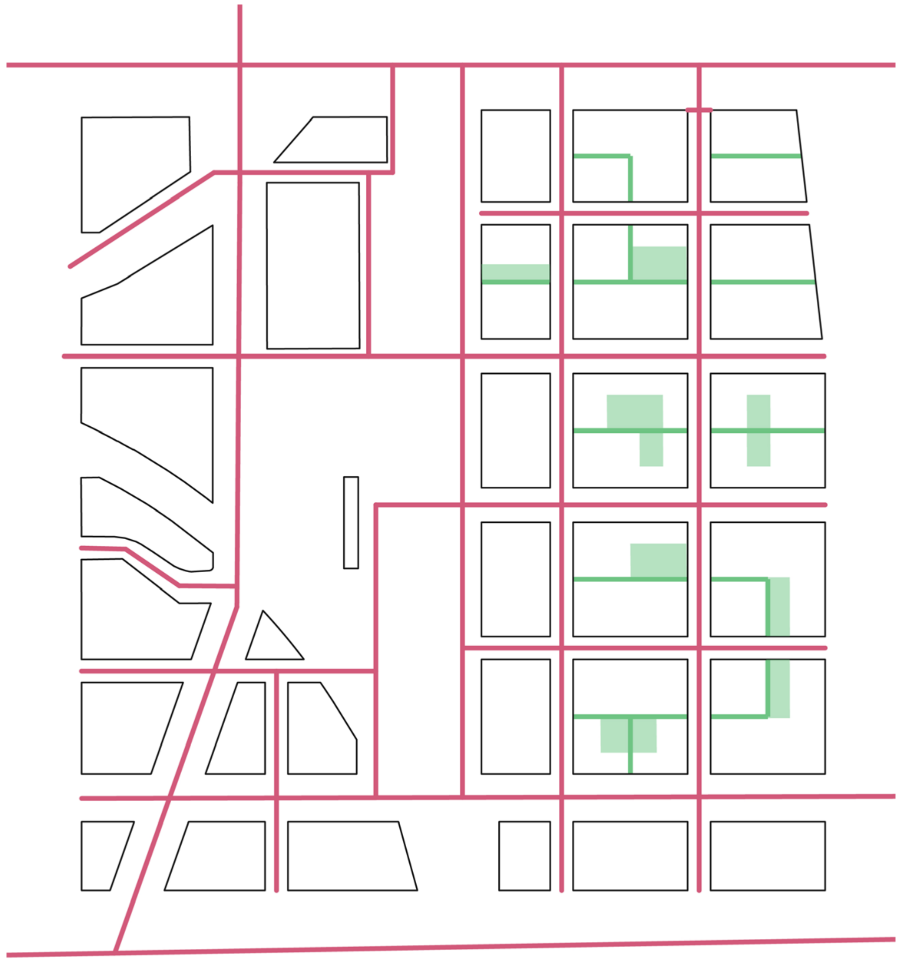
Figure 82. Narrow streets in the Little C development in Rotterdam. Source: www.thesandbox.nl

Exploration

1 Maximization Block Size 100m X 100m



Block size	**1 he**
Ground floor area	**5.100 m²**
Total floor space	**51.000 m²**
Housing units	**510**
GSI	**0.51**
FSI	**5.1**
OSR	**0.09**



For the first iteration, a block size of 100m x 100m was used based on the examples analyzed in the previous section. This block size allows a denser grid network compared to the existing in the area of Sloterdijk. By offsetting the outside line by 15m to create enough space for housing units and other functions such as retail, approximately half of the block is open space that can contribute to the overall green network and create space for interaction.

Note

For calculating the housing units, an average of 100 m² was used. In Amsterdam the average housing unit is 74 m² (CBS, 2016) and in that number, 25 m² were added for circulation.

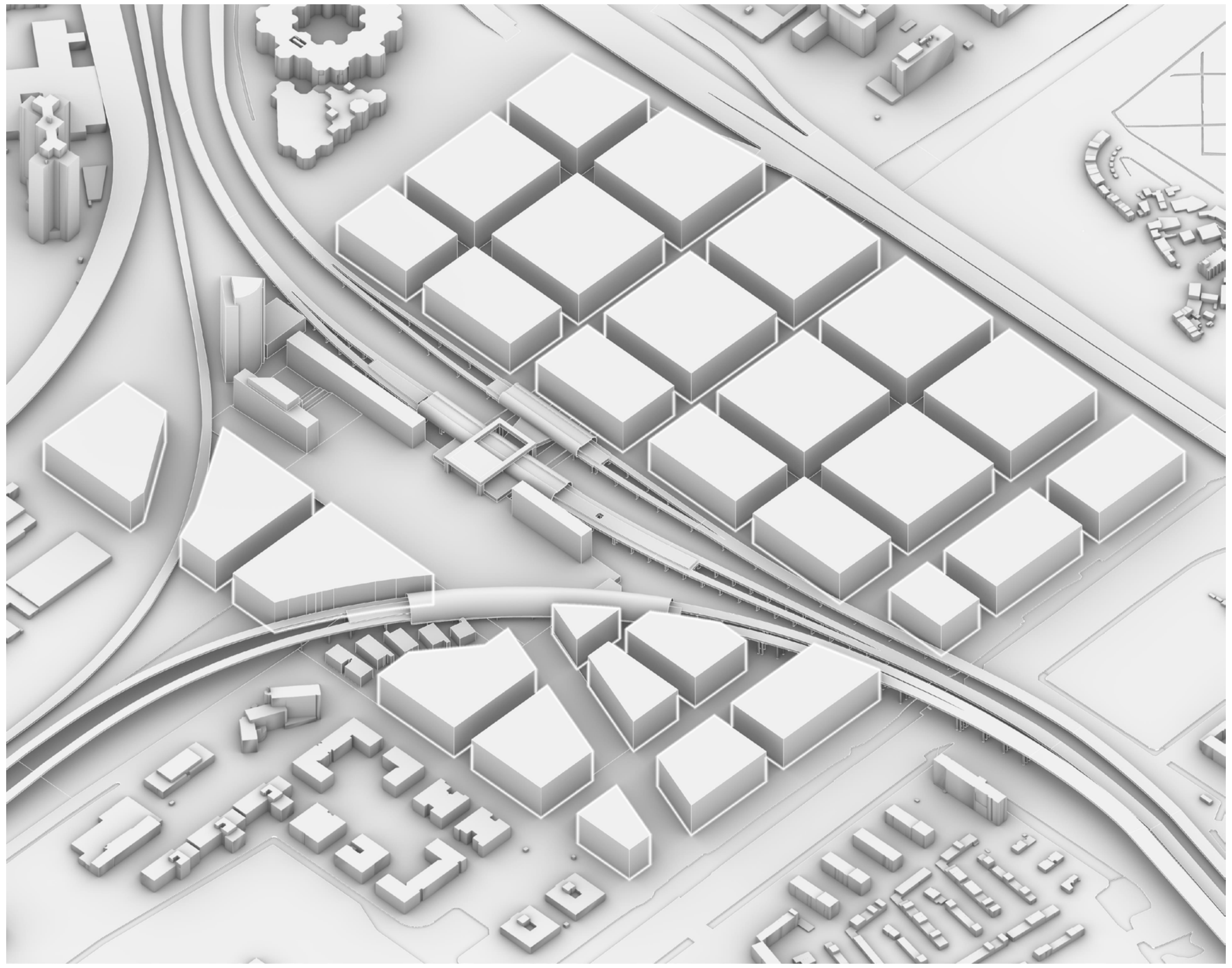
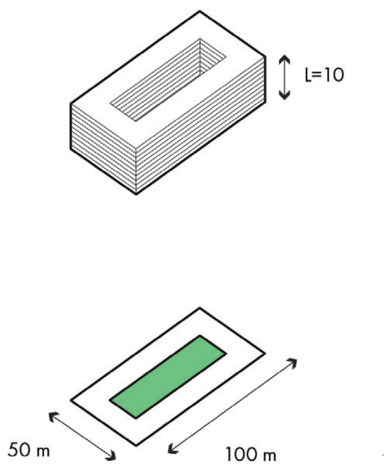
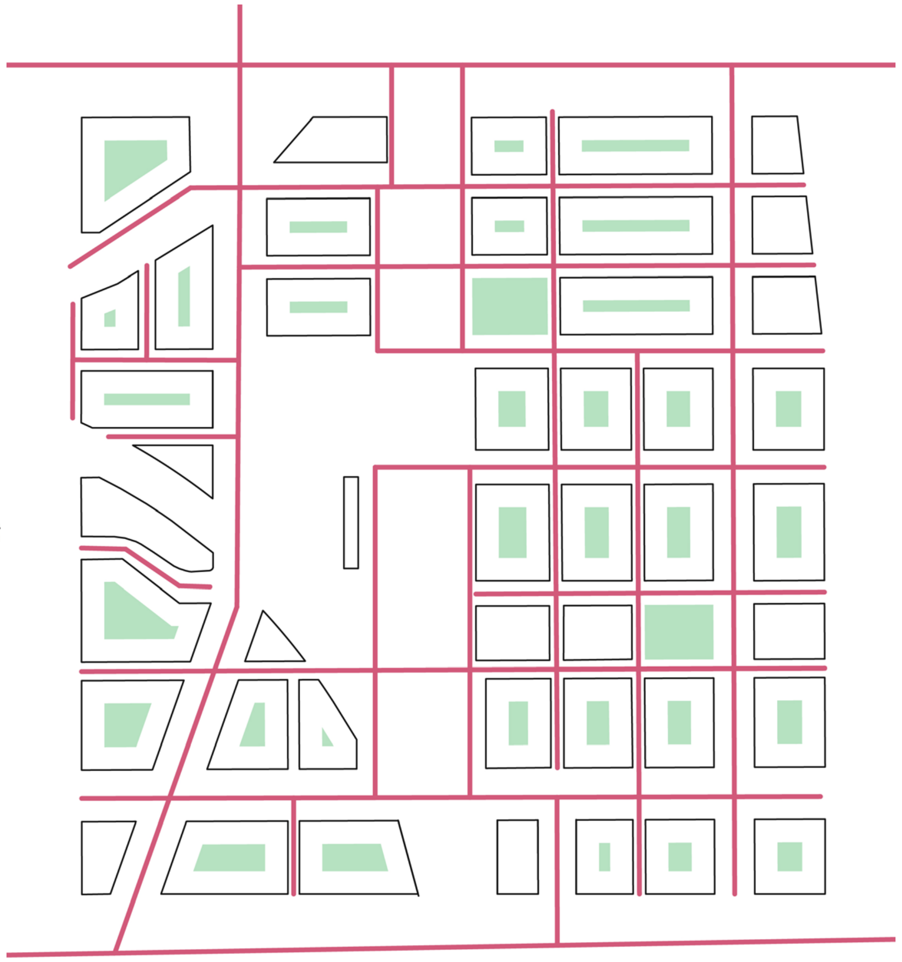


Figure 83. Simplified application of the 100x100m block size that allows for a volumetric visualization of this iteration.

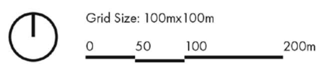
2 Maximization Block Size 50m X 100m





Block size	**0.5 he**
Ground floor area	**3.600 m^2**
Total floor space	**36.000 m^2**
Housing units	**360**
GSI	**0.72**
FSI	**7.2**
OSR	**0.03**

For the second iteration, a block size of 50m x 100m was used based mostly on the example of the Quartier Massena in Paris France. This grid size allows for an even denser grid network while the small block size can be more easily transformed or replaced in the future. As it can be seen from the calculations, FSI due to the number of floors can be very high, while OSR is very low, meaning that pressure on open space is increased. Therefore, a refinement of the number of floors and open space arrangement needs to be done in later stages.



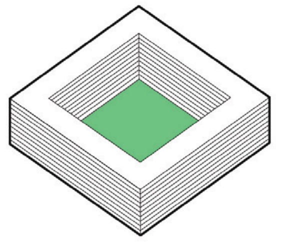
Note

For calculating the housing units, an average of 100 m^2 was used. In Amsterdam the average housing unit is 74 m^2 (CBS, 2016) and in that number, 25 m^2 were added for circulation.

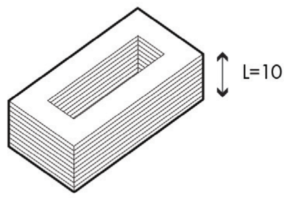
Figure 84. Simplified application of the 50x100m block size that allows for a volumetric visualization of this iteration.

3 Combined option + Block preservation

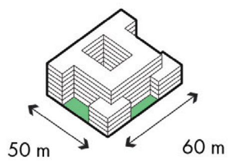
Block 100m x 100m

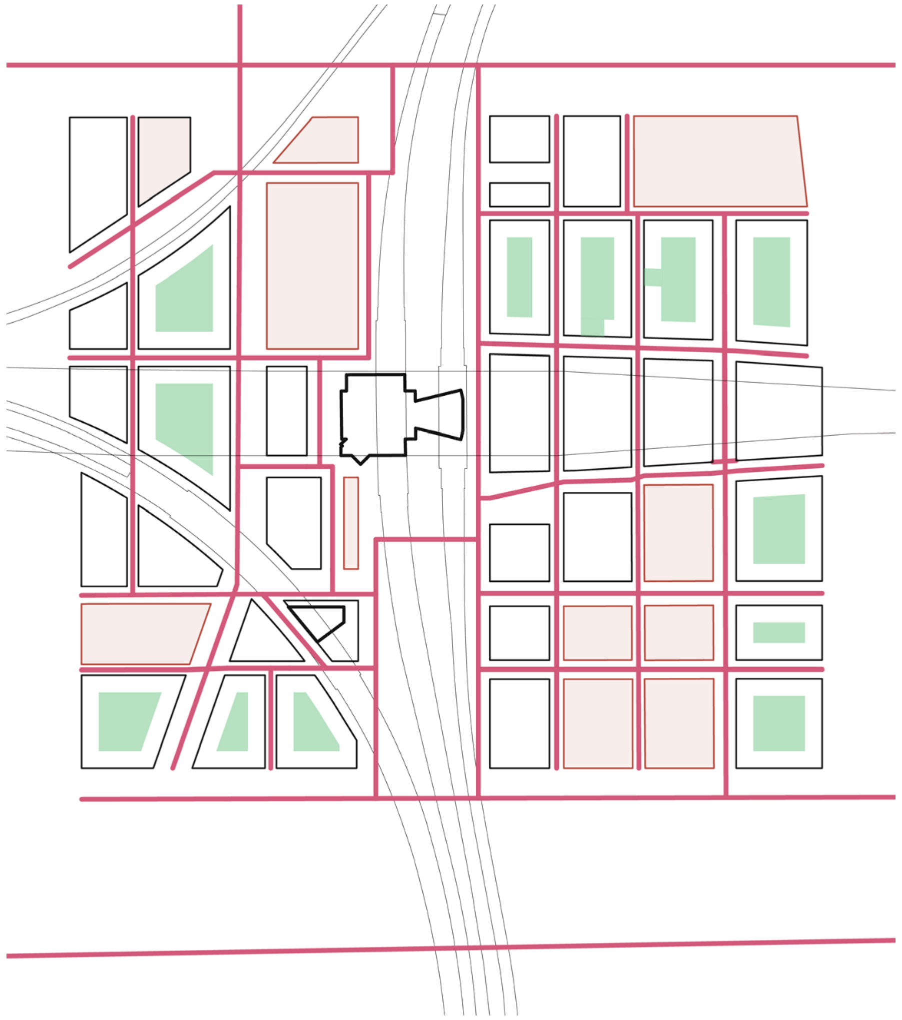


Block 50m x 100m

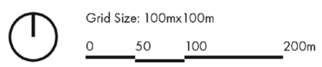


Existing fine grain block





The last option was to combine the previous two iterations. In the south-east side of the station, the smaller block of 50x100m was used, adjusting to the existing and preserved urban fabric at that side of the station area, which also consists of similar blocks. At the other parts of the area, the large block of 100x100m was utilized, providing thus more open spaces within the blocks while maintaining a dense grid network, following the principle of increasing possible interactions at the corners. This last iteration is used in the integrated design and further refined.



Preffered option + Refinement

Figure 85. Simplified application of the 50x100m and 100x100m block size combination and the existing fine grain block preservation option that allows for a volumetric visualization of this iteration.

5.3. Public space

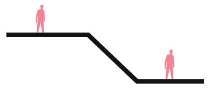
Overview of current situation

As it was analyzed before, public space at the Sloterdijk station area is highly **unattractive**. This is related to several factors, including the **prioritization of mobility** that occupies a large amount of space, the **lack of places** that attract people **to stay and interact**, the lack of quality green space, the **complexity** that negatively affects walkability, further accentuated by the substantial **height differences** that occur, and lastly the **lack of diversity in terms of activities** that can be found within the area of Sloterdijk.

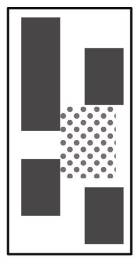
Quality of public space is a determining factor for both sustainability and livability. In this part of the design exploration, the aspect of **social sustainability** and some components of **livability** such as **control over social interactions** and **contact with nature**, will be addressed. Other elements of the public space will be explored in later chapters.

Key elements/Problems

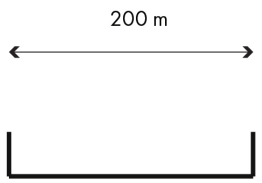
Dominated by mobility



Height differences



Undefined spaces



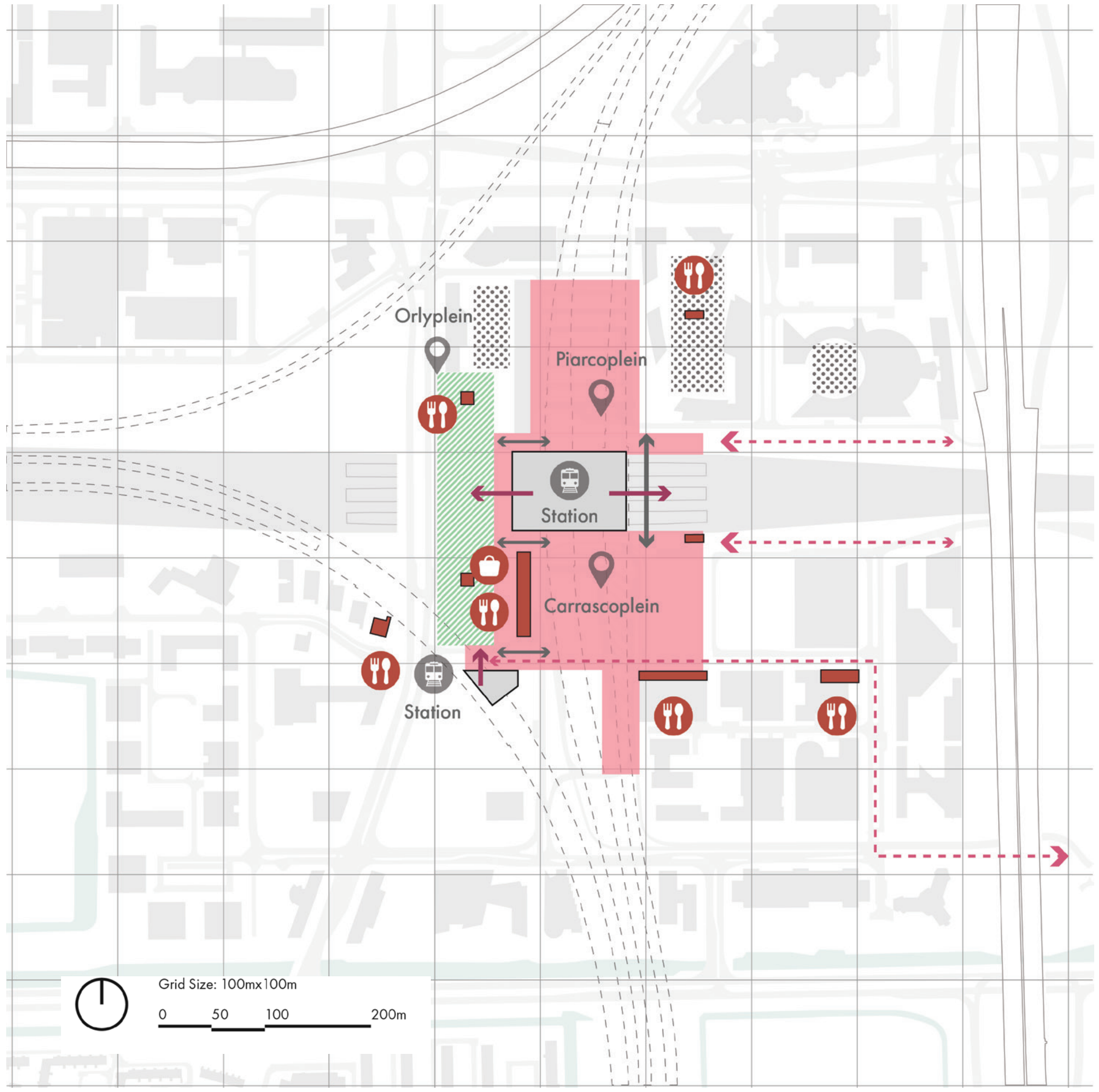
Large dimensions

Figure 86. Orlyplein, a green open space directly outside the main station entrance. Source: www.arcam.nl/

Figure 87. Large amount of space allocated to moblity.

Figure 88. Staircase connecting the North and South side of the station.

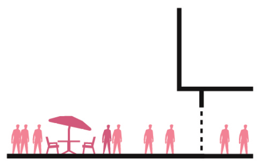
Existing public space diagram



Legend

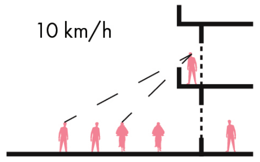
Green Spaces			
Space for commuting		Station	
Connections		Retail	
Level difference		Restaurants & Cafes	
Main Station Entrances		Space within office blocks	

Desired Qualities of public space



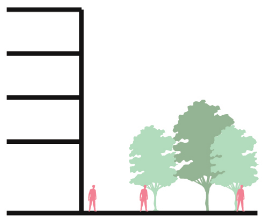
Space for social interaction

Facilitate social interaction at places with high potential. Careful design of public space, provision of sitting places, protection from weather



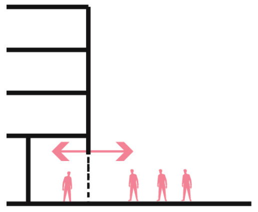
Safe streets

Increase eyes on the street by strengthening housing along the streets and main public spaces. Slow down traffic, increase activities on street such as children playing outside.



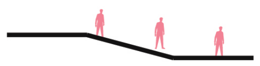
Quality green spaces

Create spaces that allow for control over social interaction. These places also provide cool spots around the neighborhood for periods of extensive heat stress. High importance of contact with nature.



Inside-Outside interaction

Increase inside-outside interaction by creating active facades. Ground floors are important to stengthen the liveliness of public space and improve walkability.



Soften barriers

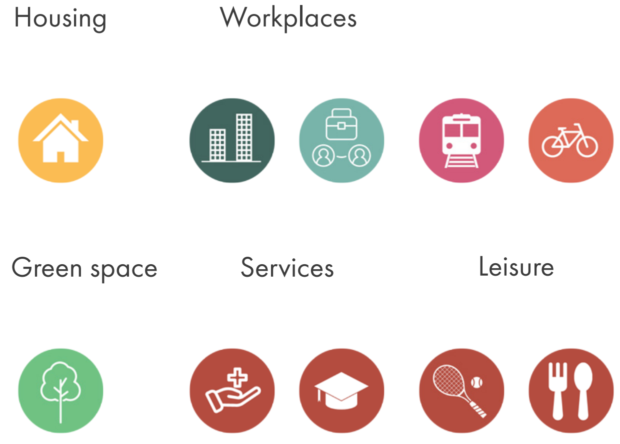
Soften the various barriers created primarily by the railway lines through design. Increase accessibility for people with mobility limitations.

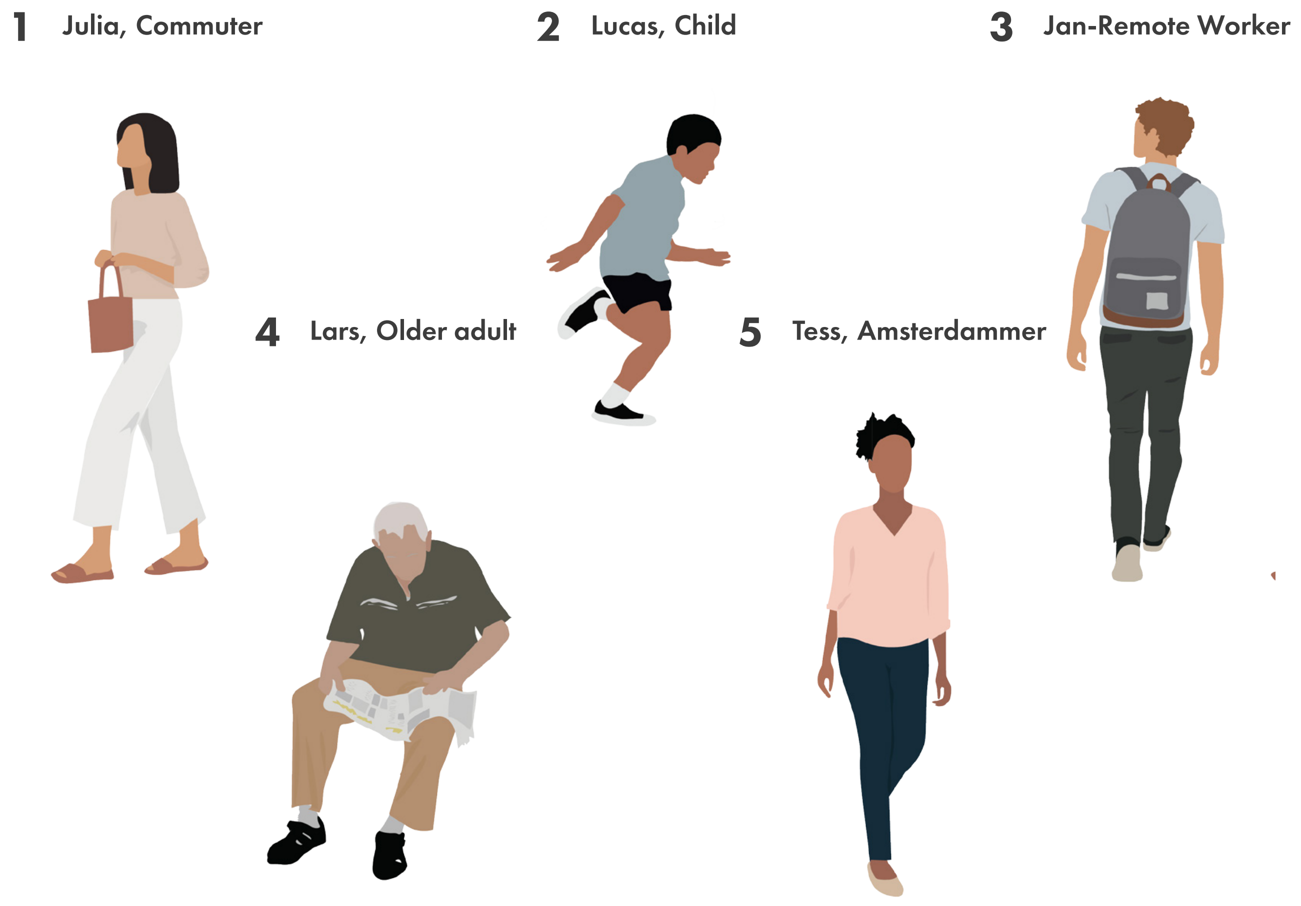
Development of personas

With the aim of acquiring a deeper understanding of the **desired qualities of public space and potential program**, several personas were developed. These personas can be categorized into **occasional users** (commuters and people from different parts of the city) or **inhabitants** (children, remote workers, older adults), as Sloterdijk due to its importance as a mobility hub and potential development does not only refer to local inhabitants.

An important element to the development of the personas was the aspect of **inclusivity**. This is an important element that is overlooked in such developments which often refer to professionals and high-income social groups. Therefore, in this chapter, public space qualities and program are developed based on different age and social groups.

What do they need?





1 Julia, Commuter

Julia commutes three times per week at Sloterdijk. She enjoys walking to her office and experience the liveliness of the city. She cherishes the morning talk with the people working at the local cafe. After work, she takes advantage of the great connection of Sloterdijk with other places in Amsterdam where she meets her friends.

Visitor

Possible Programme

Office space

Retail

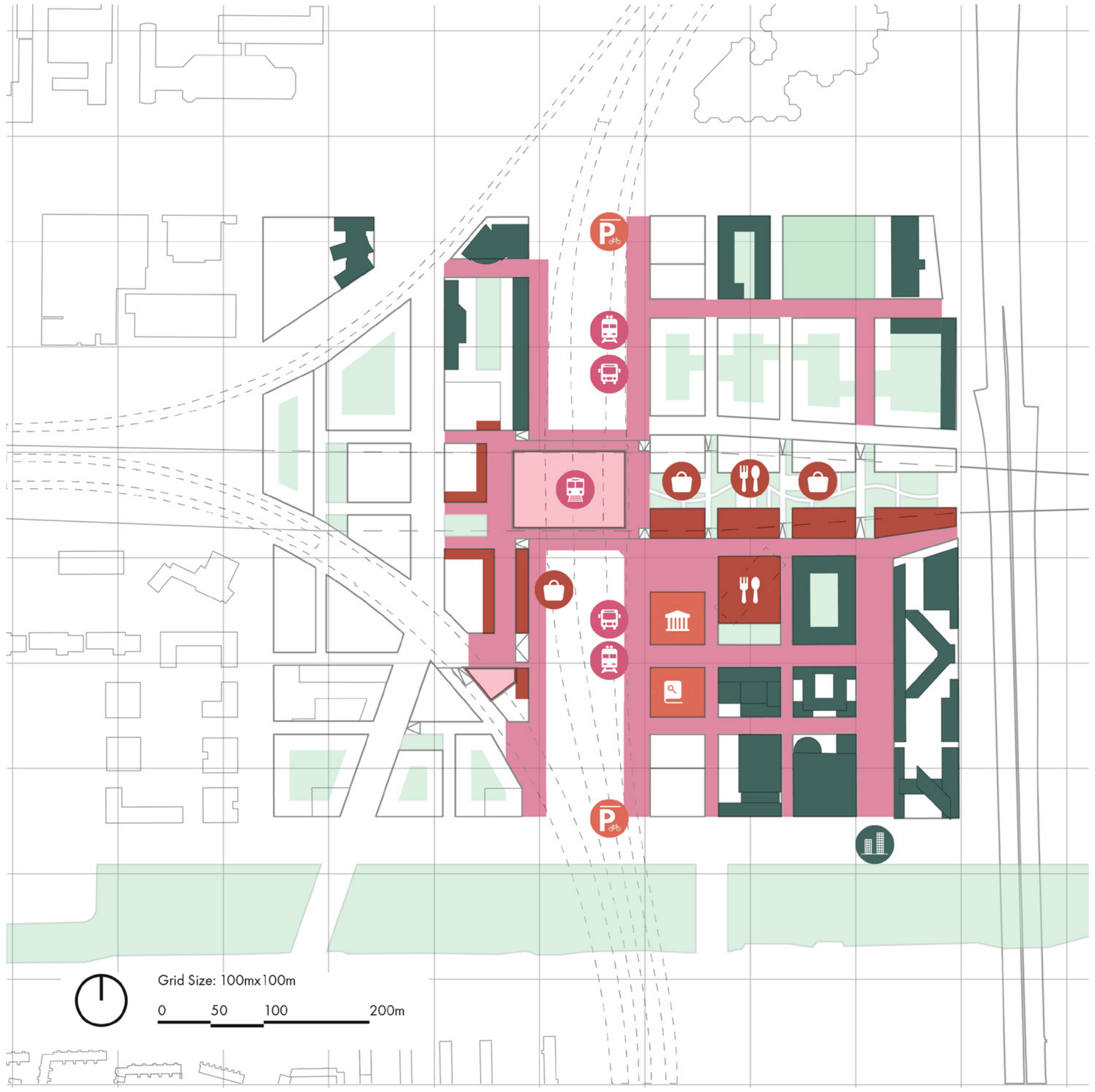
Leisure

Cultural activities

Public Transport

Bike facilities

Potential use of space and program



2 Lucas, Child

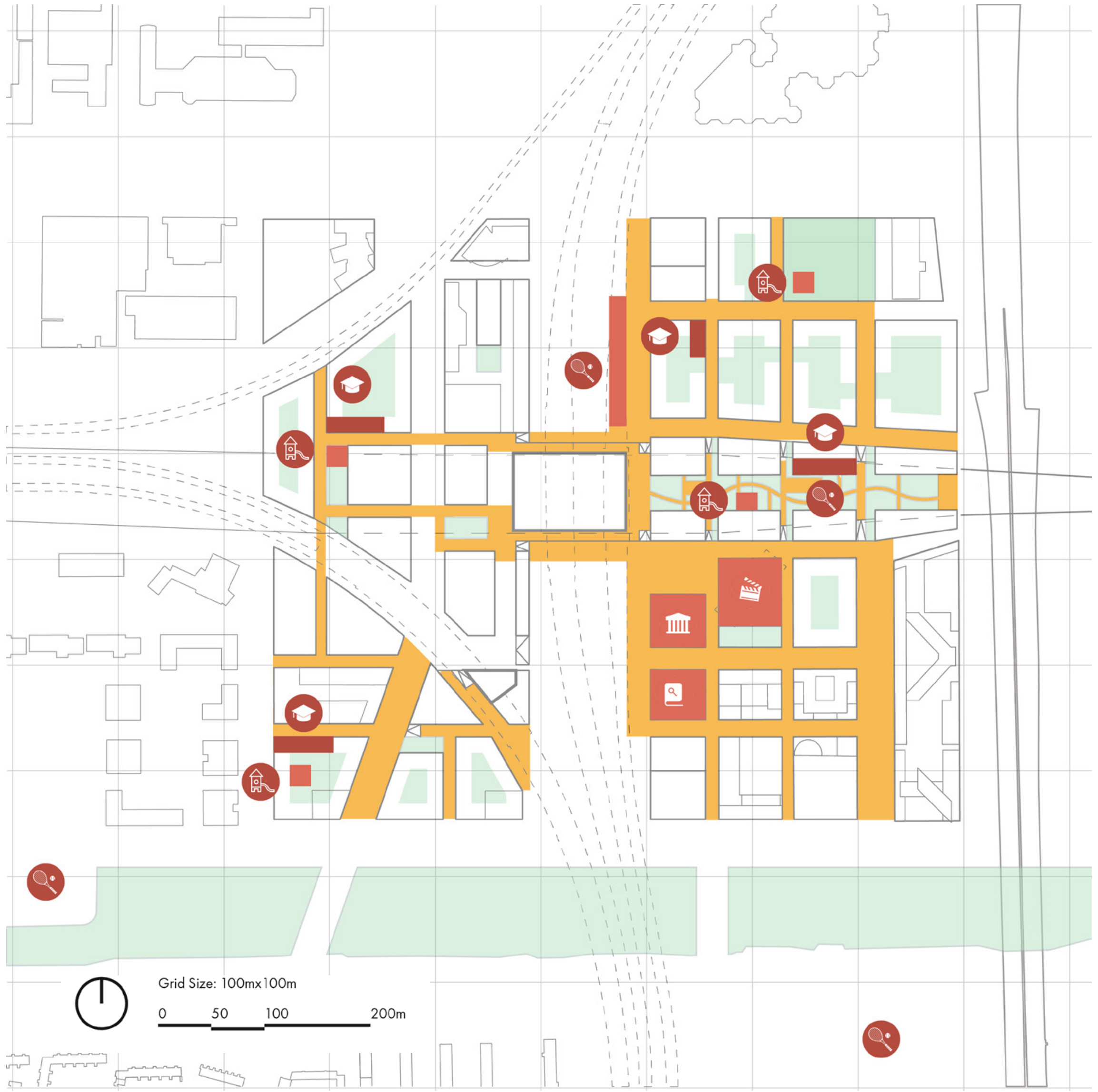
Lucas lives in Sloterdijk and attends the school that is located within walking distance from their home. The route he follows is safe due to the slow speed of the few cars that pass by. Afterschool activities are also located localy, while playgrounds are found in the same proximity within his residential block. Sports are located close by, just outside the Sloterdijk area, where his parents can bike with him there, without the need of car.

Local

Possible Programme

Education | Leisure | Cultural activities

Potential use of space and program



3 Jan, Remote Worker

Jan is remote worker and usually works from home. Sometimes his freelance work requires to meet with clients or other professionals, in meeting spaces that are provided close to the station square. To rest from work, Jan enjoys a walk around his block or a visit at the local park. After work he wants to meet with his friends and go visit a restaurant or the local cinema.

Local

Possible Programme

Co-working Space

Retail

Leisure

Cultural activities

Quality green space

Potential use of space and program

4 Lars, Older adult

Lars is retired and lives in Sloterdijk while his children live in the Hague. He wants to be independent, therefore he must have access to several services and facilities such as GPs, in close distance. In the morning, Lars does his groceries in the local shop around the corner and then walks to the small neighborhood park. In the afternoon he visits the local community center and meet his friends.

Local

Possible Programme

Services	Retail	Quality green space	Cultural activities

Potential use of space and program

5 Tess, Commuter

Tess visits Sloterdijk to experience the vibrant urban district. She travels by bike and parks at the underground parking facility. The number of people concetrated in Sloterdijk creates opportunities of different things to happen and makes an interesting experience. Small open air festivals, theaters, libraries are found here, as well as versatile public space to hang out or to skateboard.

Visitor

Possible Programme

Retail

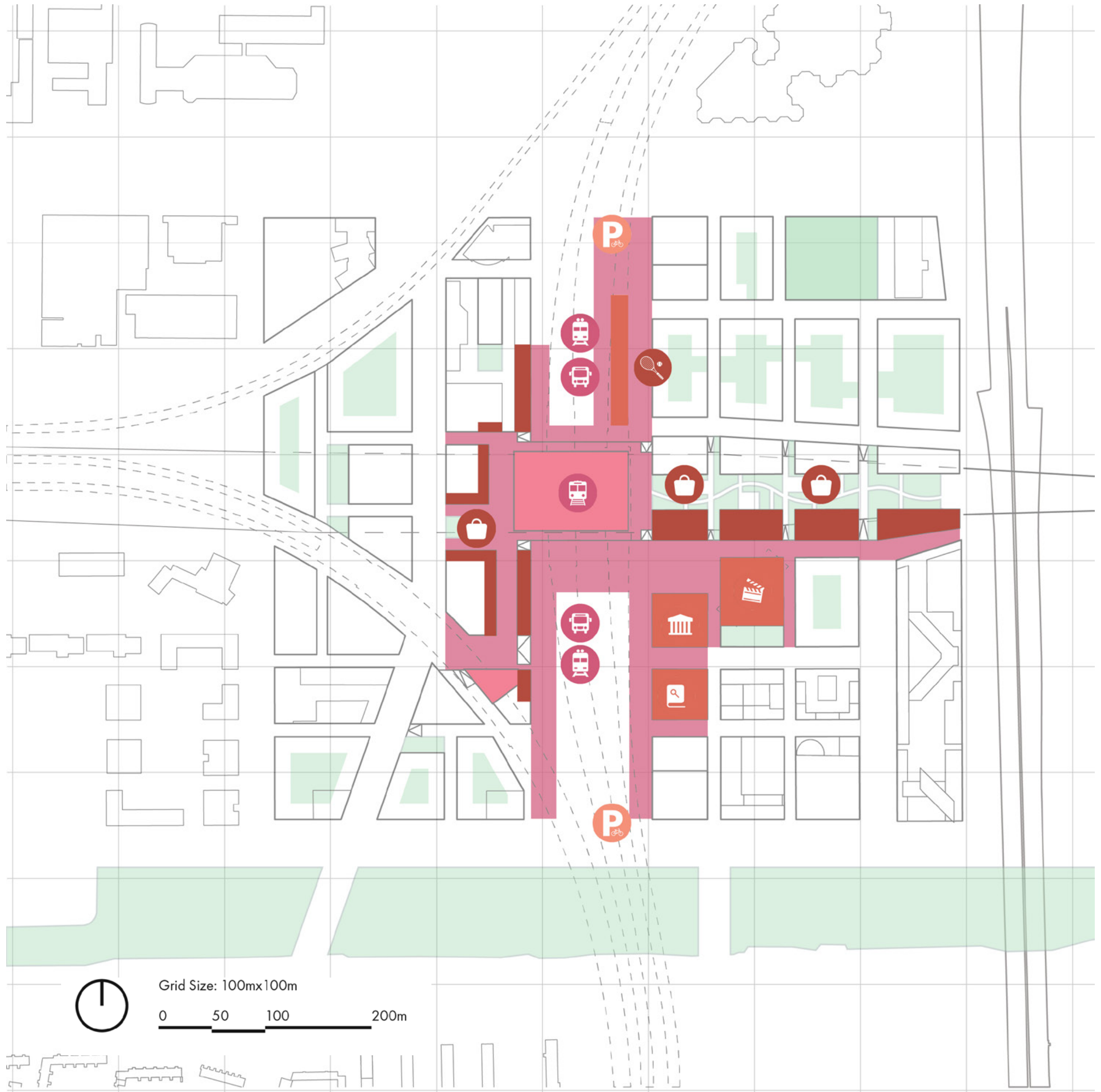
Leisure

Cultural activities

Public Transport

Bike facilities

Potential use of space and program



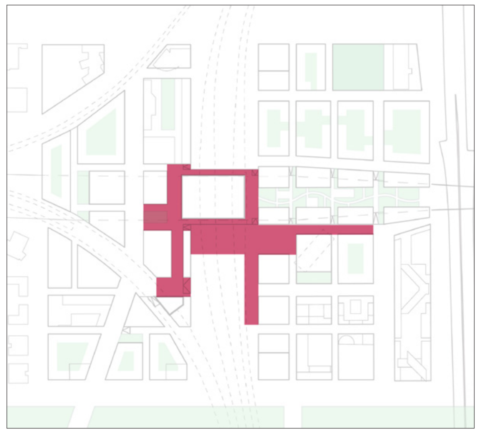
Intensity of use of public space

The design experiment of mapping the potential users and the space they need in the district, provided several interesting conclusions.

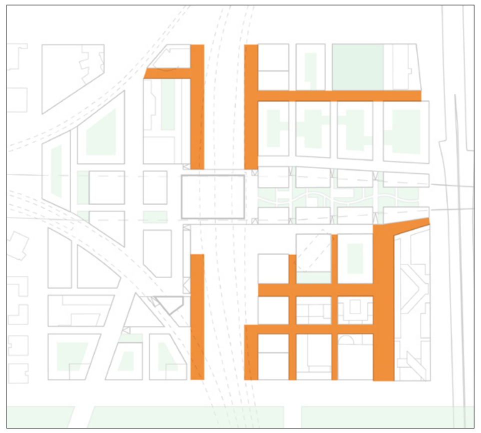
Firstly, four different levels of use of public spaces can be identified, based on the overlapping of the spatial exploration for each persona. The most intense use appears to happen around the center of gravity of the area which is the station and the surrounding public spaces. There the positioning of several public functions favours the movement of locals towards that area, while the movement that the mobility hub provides, increases the chance for potential interaction at the same space. This can be highly beneficial for the liveliness of the area. Quality of space there is crucial to facilitate this interaction.

On the other hand, space with a more calm and quiet character should be created in order to balance the high levels of urbanity of the very public areas. For that, several sub-areas of more residential units and green spaces should be developed.

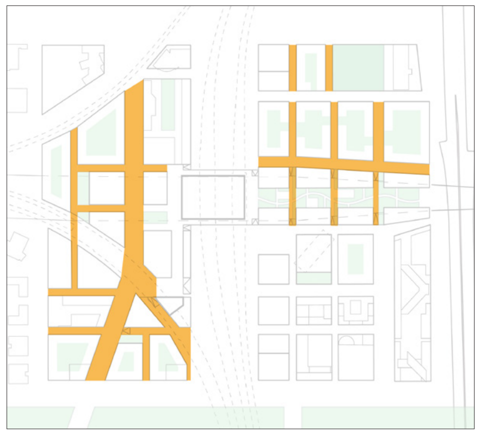
1 High-Primary public spaces



2 Medium-Working environment

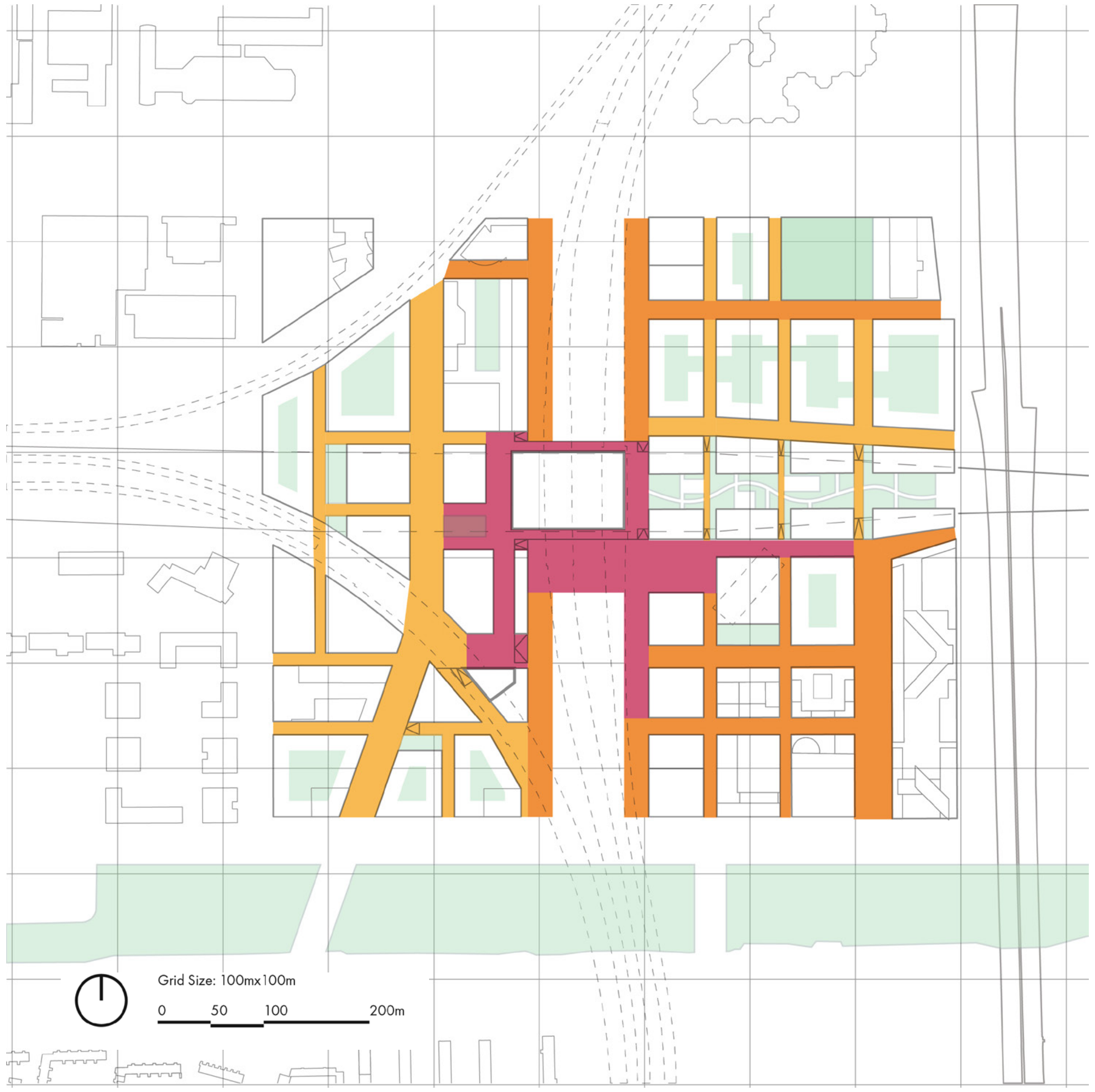


3 Medium-Everyday life



4 Low-Green spaces

Potential intensity of use based on personas



5.4. Mobility

Mobility networks within the city of Amsterdam

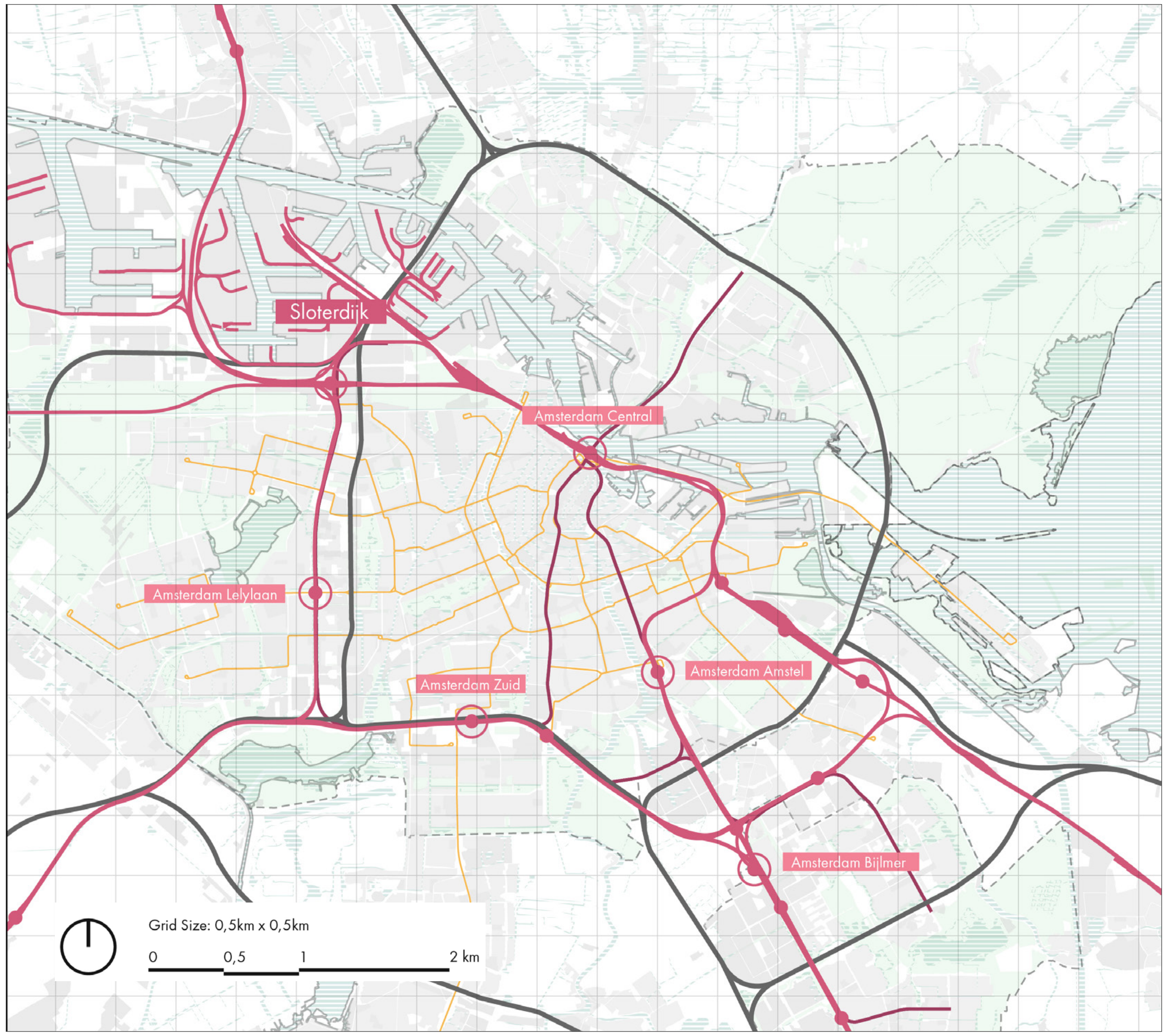


Figure 89. Public transport network of the city of Amsterdam. Sloterdijk is a very important node within the system as it acts as one of the entrances to the city.

Legend

Municipality of Amsterdam
Built-up area
Main green structure
Railway Stations
Railway Network
Road Network
Tram Network
Metro Network

Analysis of Current situation

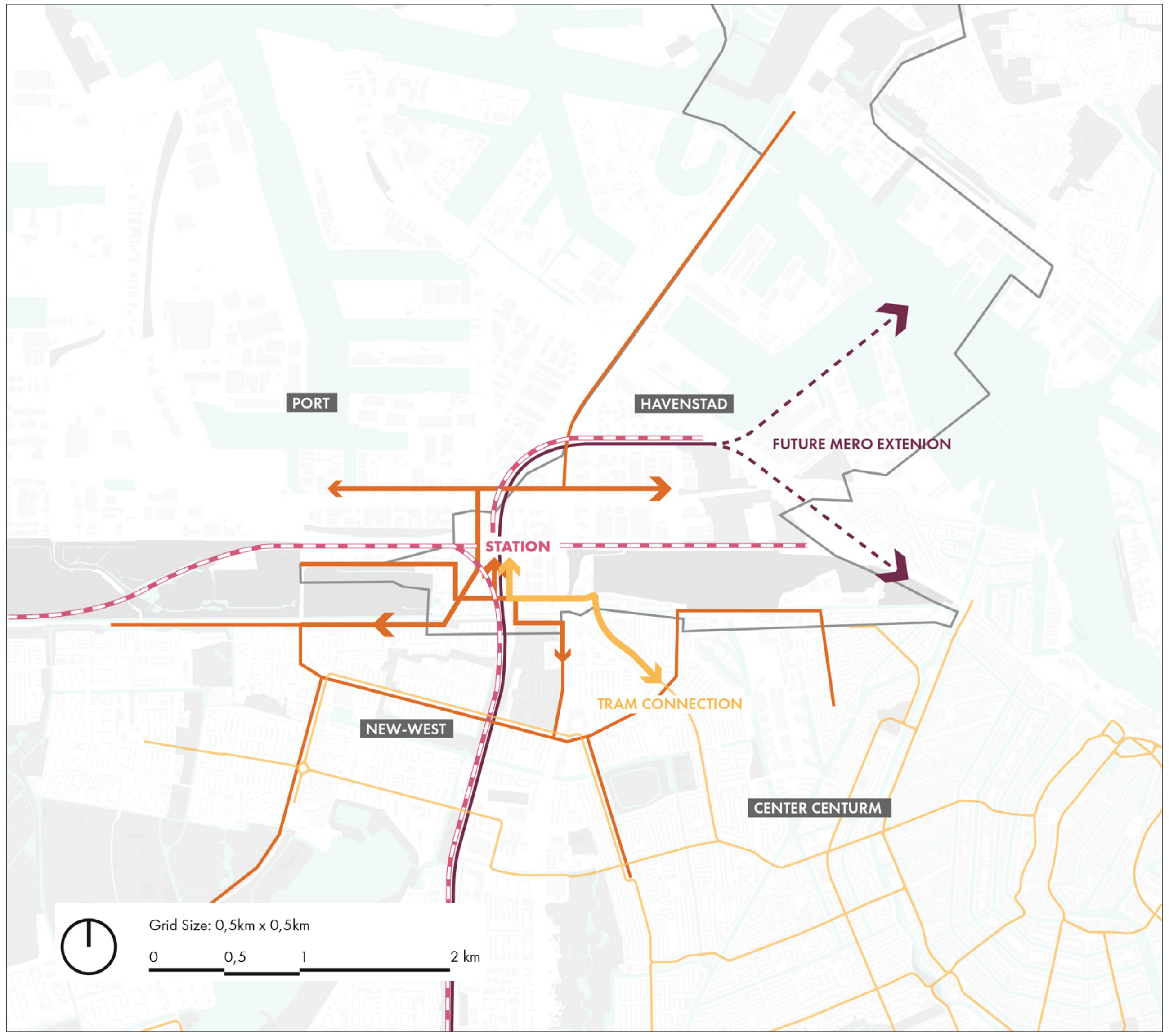


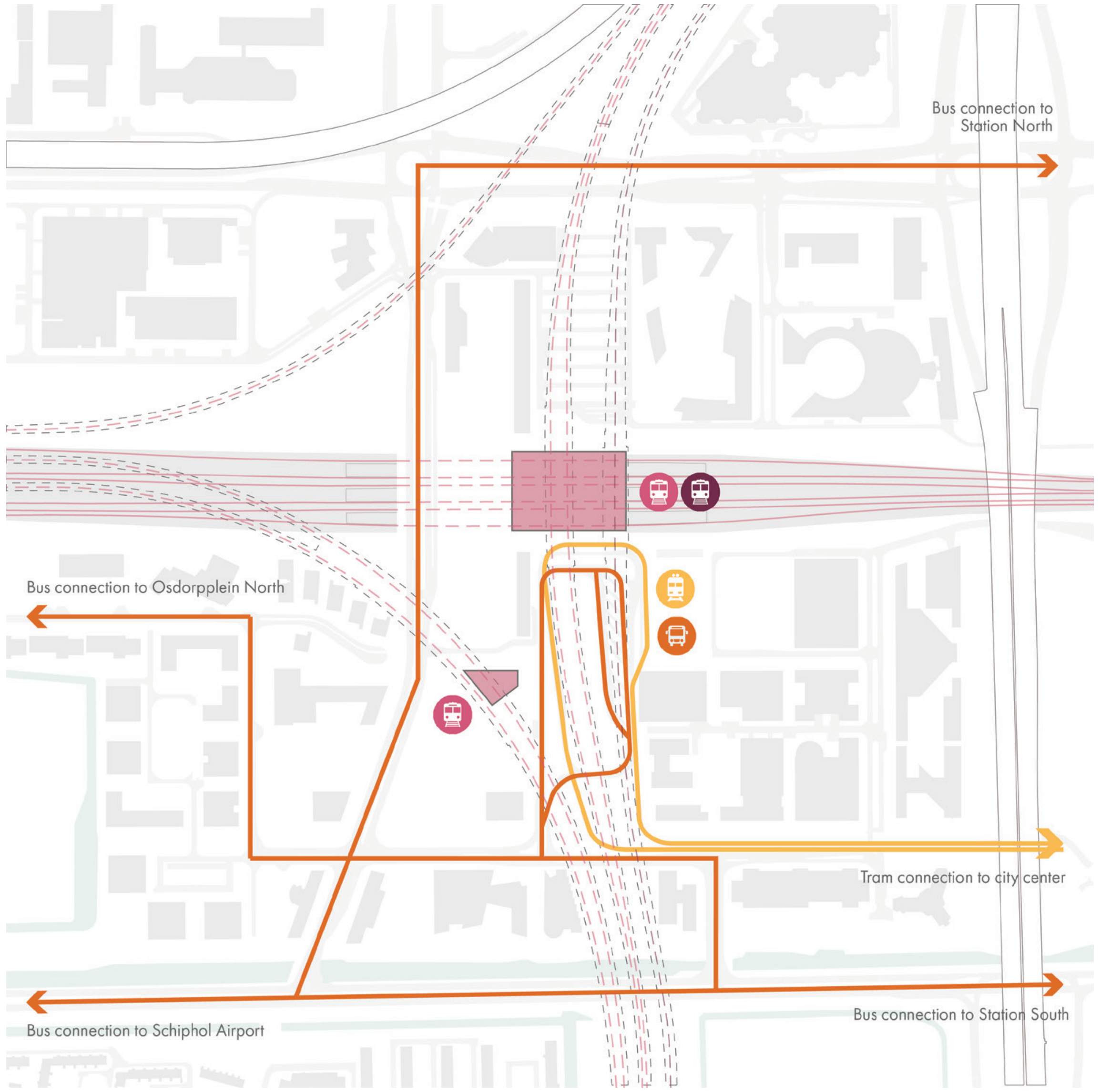
Figure 90. Public transport network of the city of Amsterdam. Sloterdijk is a very important node within the system as it acts as one of the entrances to the city.

Legend

Railway Lines
Railway Stations
Metro Lines
Metro Stations
Tram Lines
Tram Stops

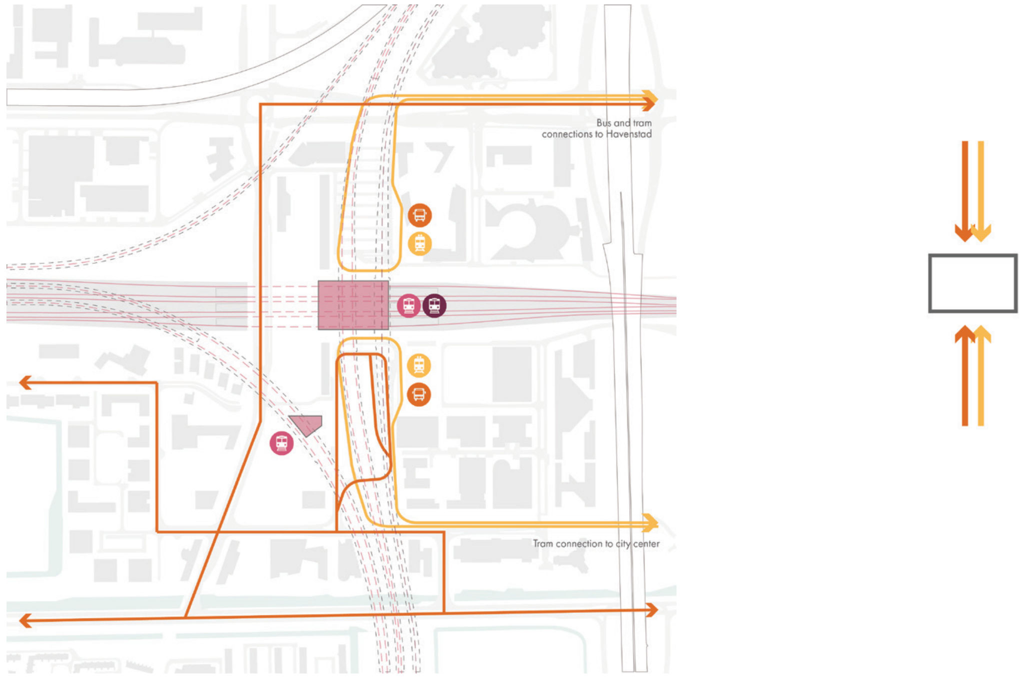
Figure 91. Image from the area around the station that now is used for trams and buses.

Structure of the mobility hub

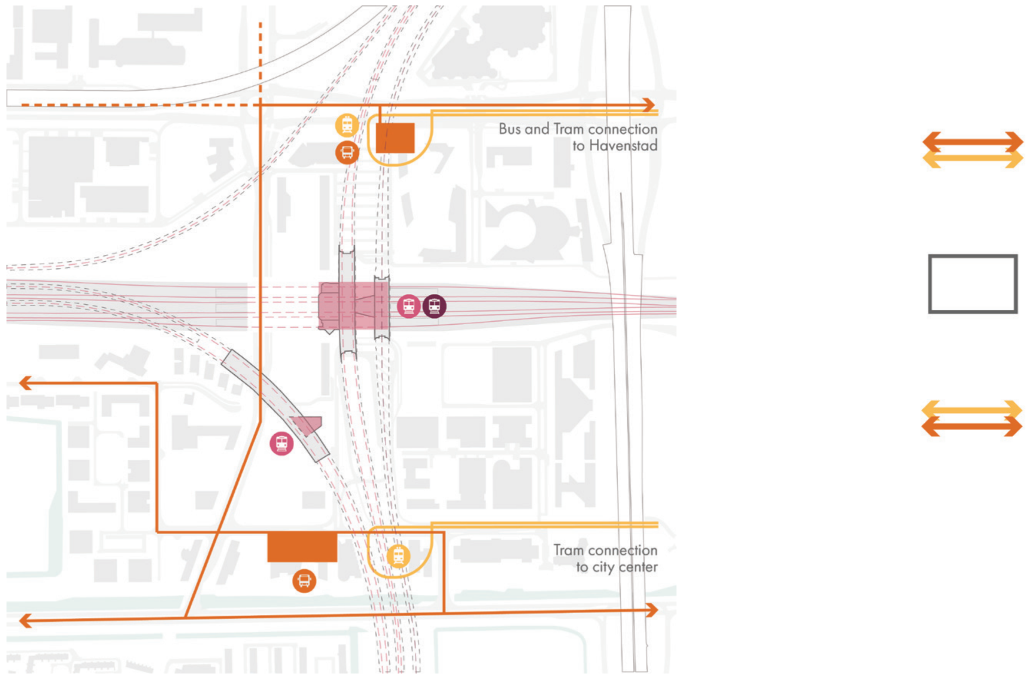


Development of options

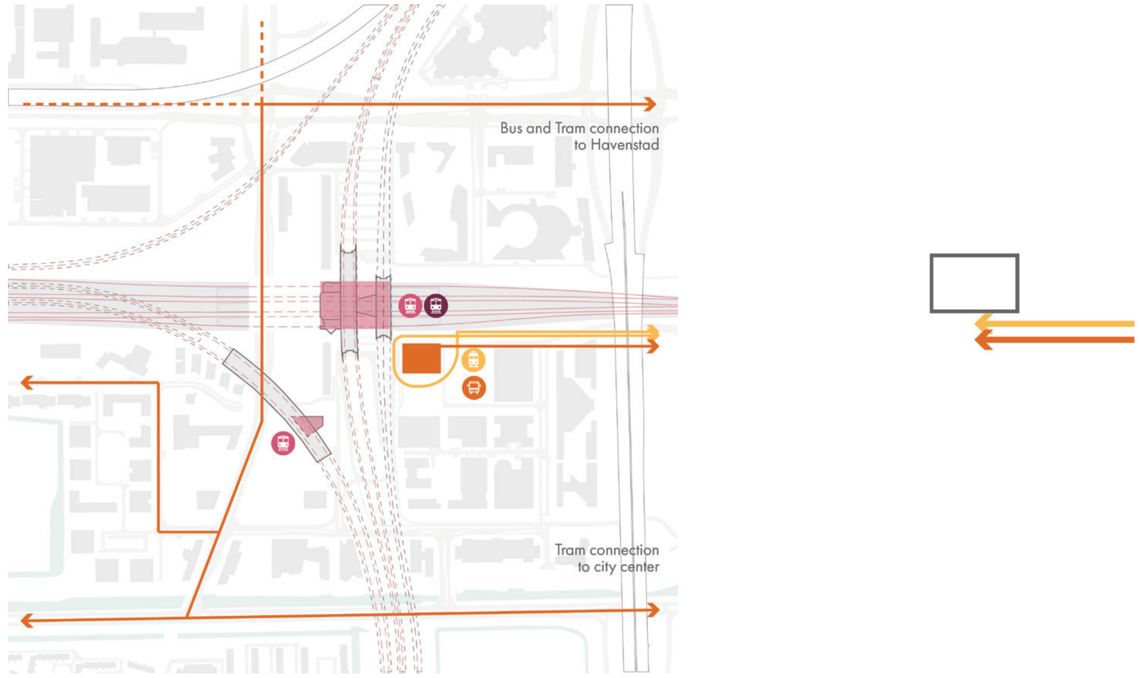
1 Proximity to station (2 Sides)



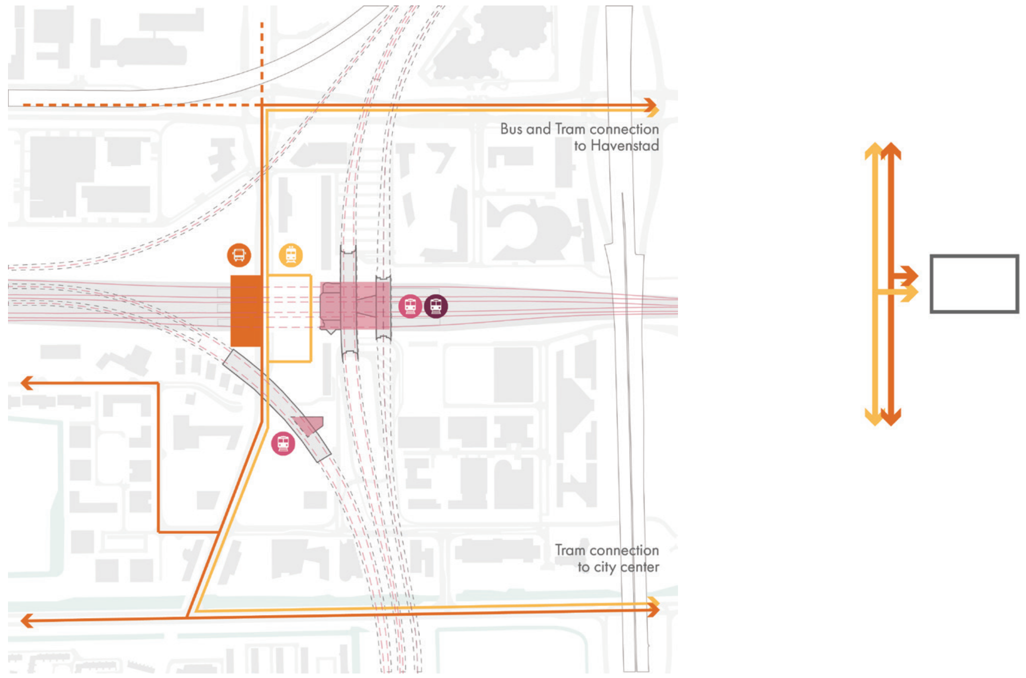
2 Straight connections (2 Sides)



3 To the side (1 Side)



4 South-North Connection (1 Side)



Bicycle network

Bicycle network

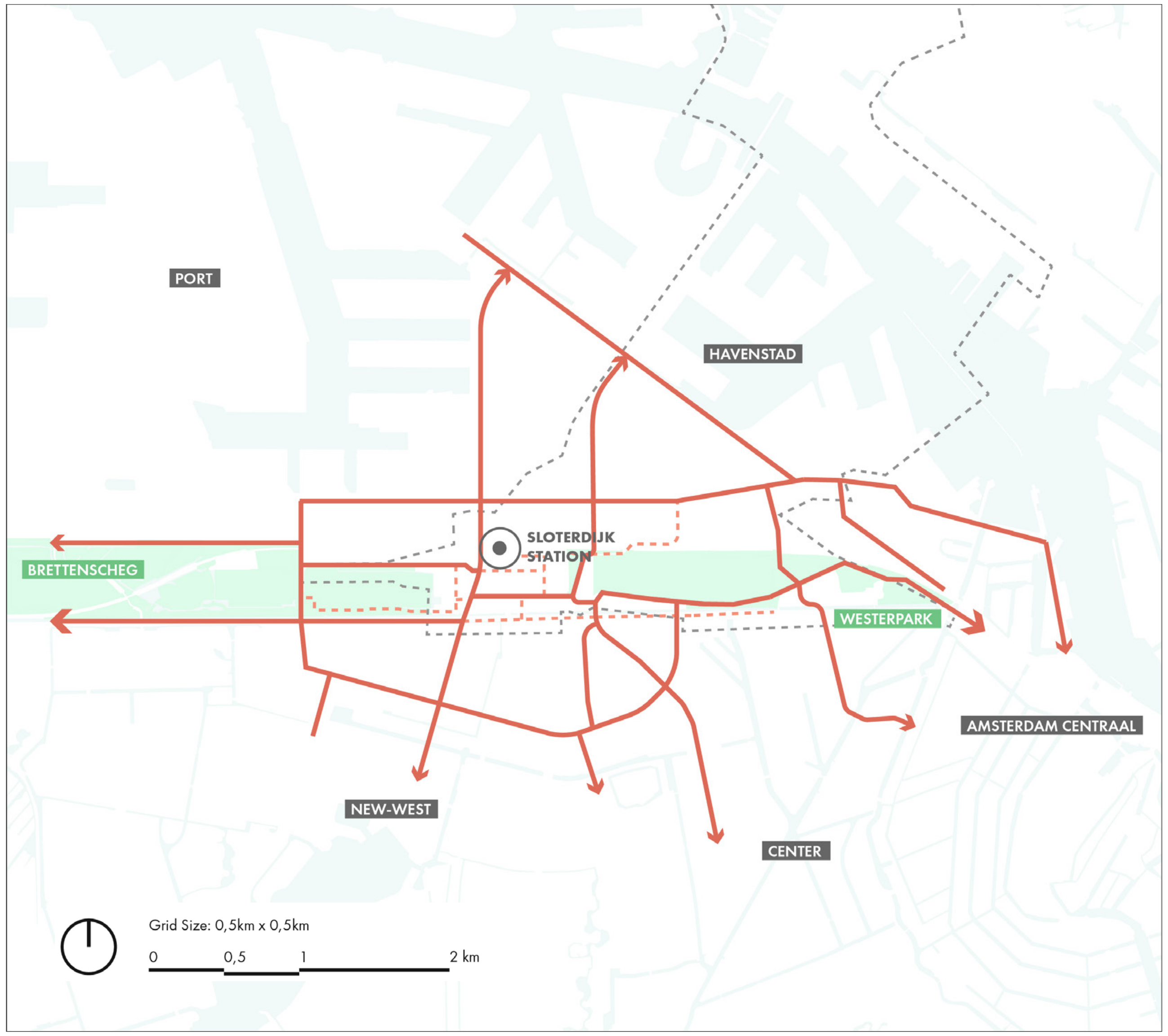


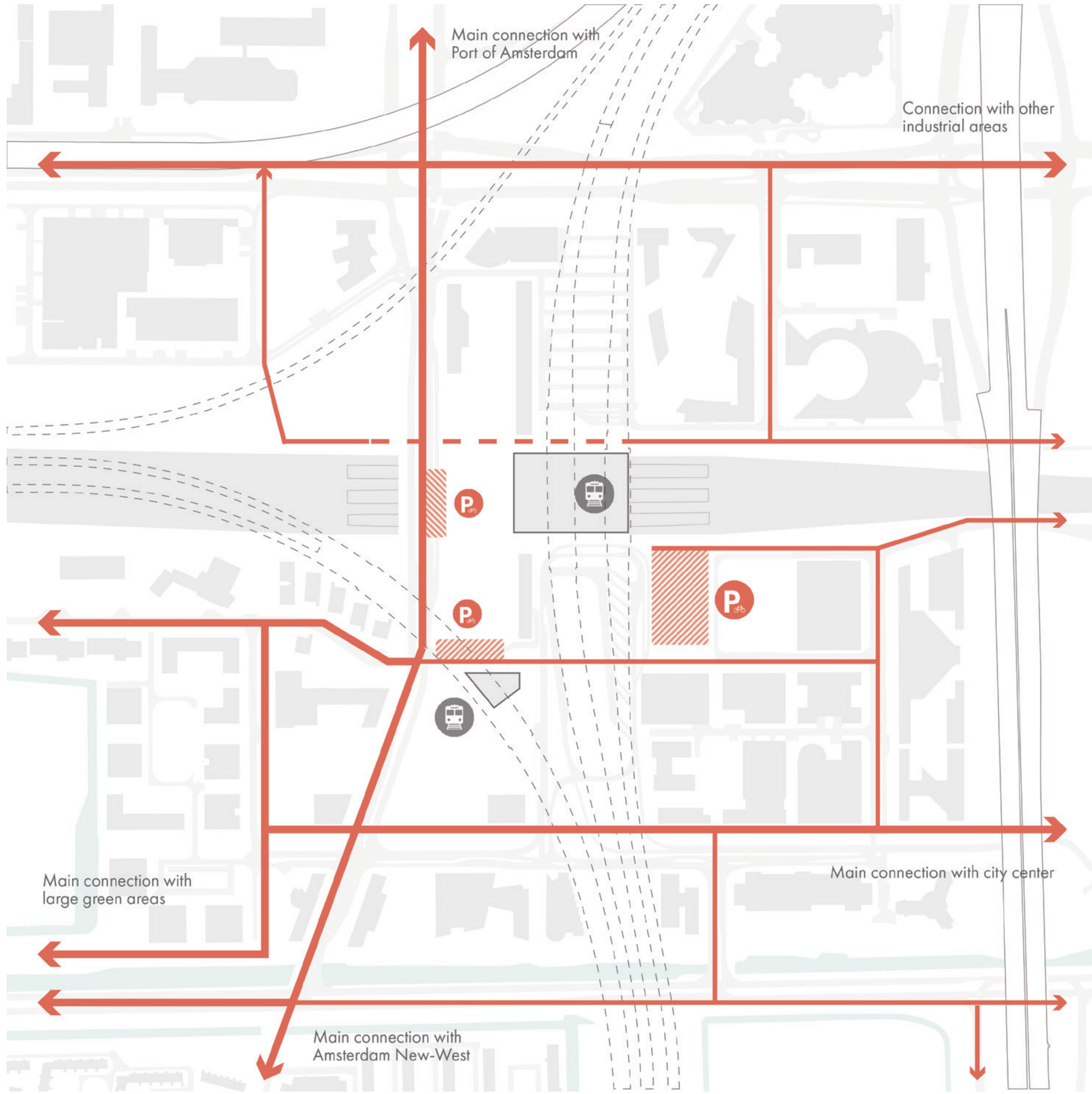
Figure 92. Public transport network of the city of Amsterdam. Sloterdijk is a very important node within the system as it acts as one of the entrances to the city.

Legend

Plus Network

Main Network

Current bicycle infrastructure



Outdoor bike parking

Challenges

Development of options for parking

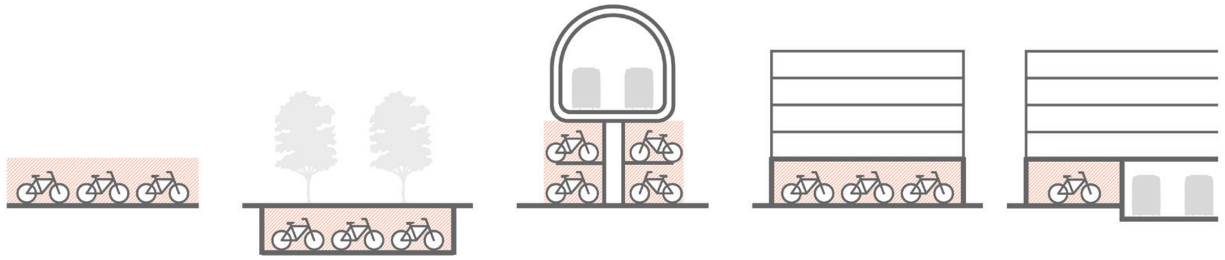


Figure 93. Bicycle parking facility outside the side of the station of Sloterdijk. Bikes are occupying a large amount of space.

Expected development of the Sloterdijk station

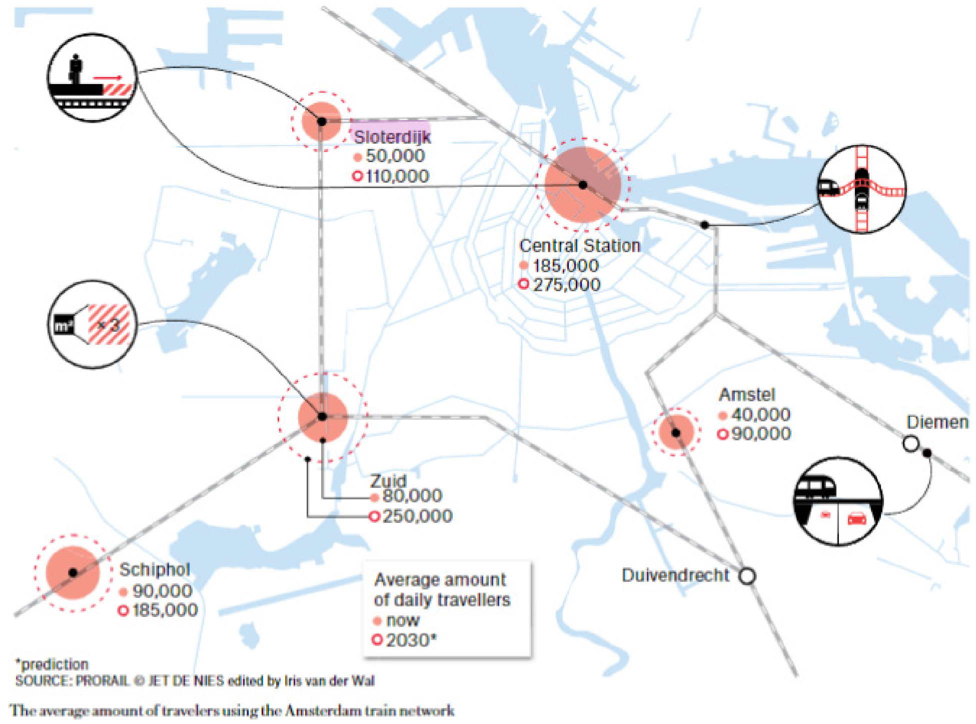
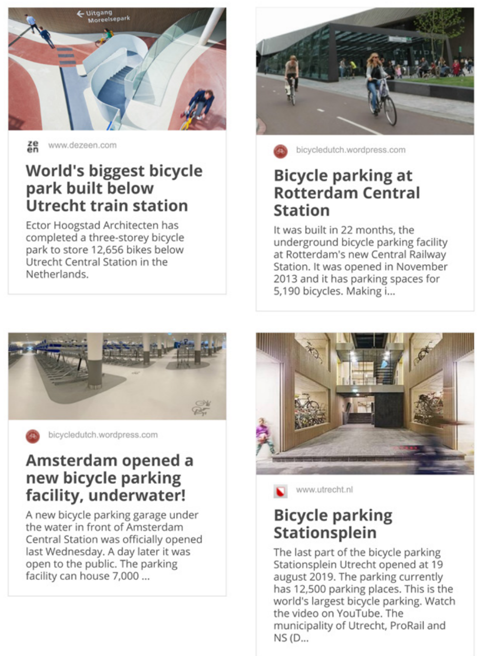


Figure 94. Future station developments. Source: Prorail

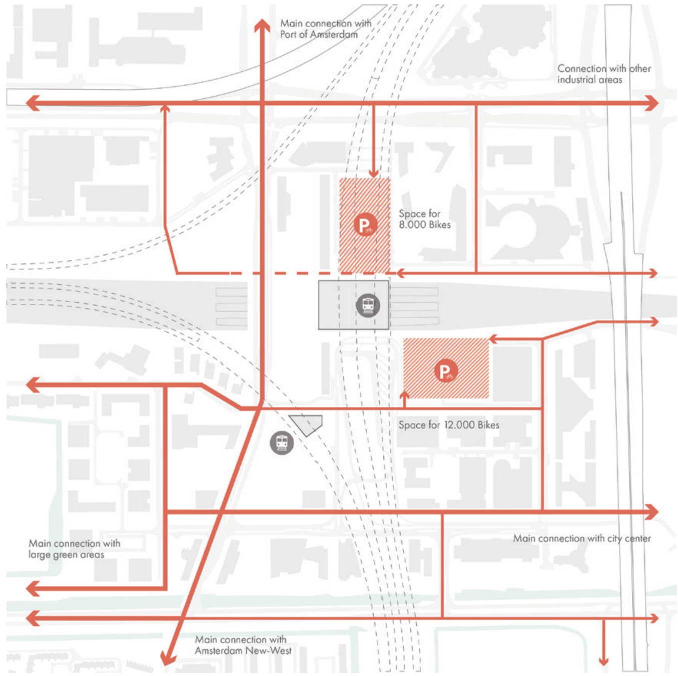


Examples for bicycle parking

With Havenstad the capacity of the station could be increased substantially, even up to 150.000-200.000. Therefore a similar capacity with Utrecht Central Station of 20.000 spots, could be a rational estimation for the parking capacity of the area of Sloterdijk.

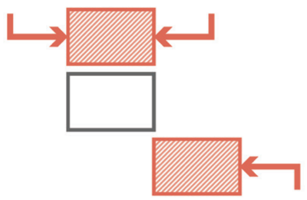
Development of options

1 Proximity to station (Outdoor parking)



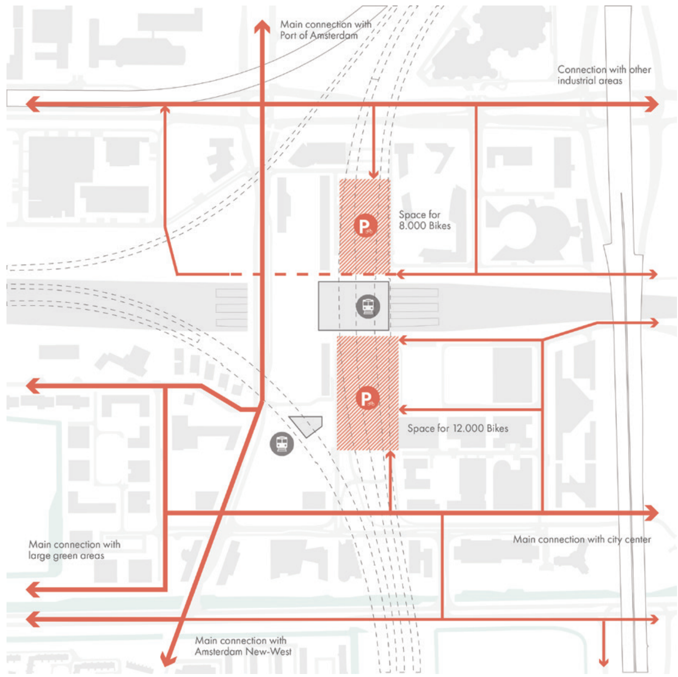
Number of places: 2
Number of bikes: 20.000

Type: Outdoor bike parking



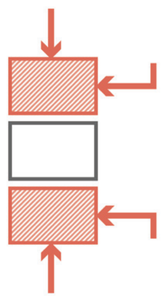
Conclusions:
+ Accessibility to station
+Space for public transportation on one side
-Square meters dedicated to bikes

2 Proximity to station (Outdoor parking)



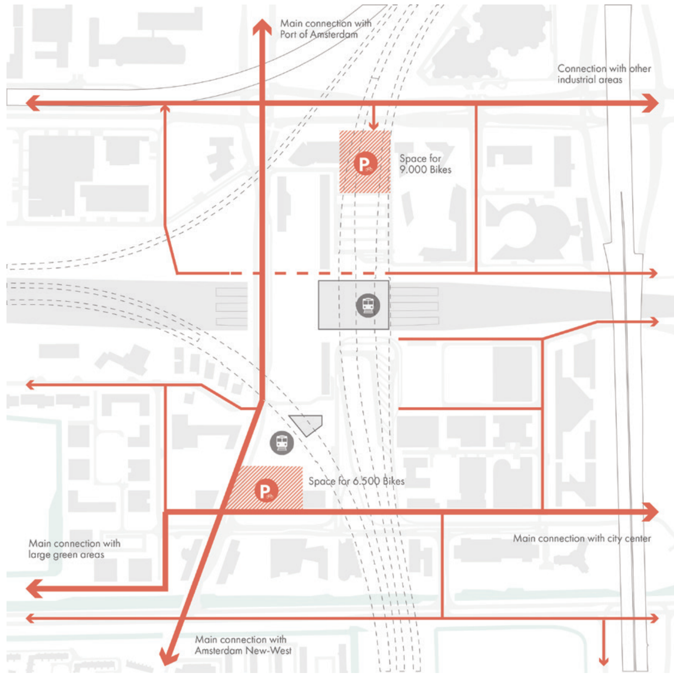
Number of places: 2
Number of bikes: 20.000

Type: Outdoor bike parking



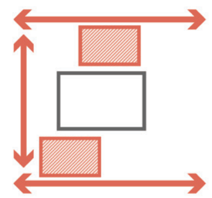
Conclusions:
+ Accessibility to station
-No space for public transportation
-Square meters dedicated to bikes

3 Straight Connections (Outdoor parking)



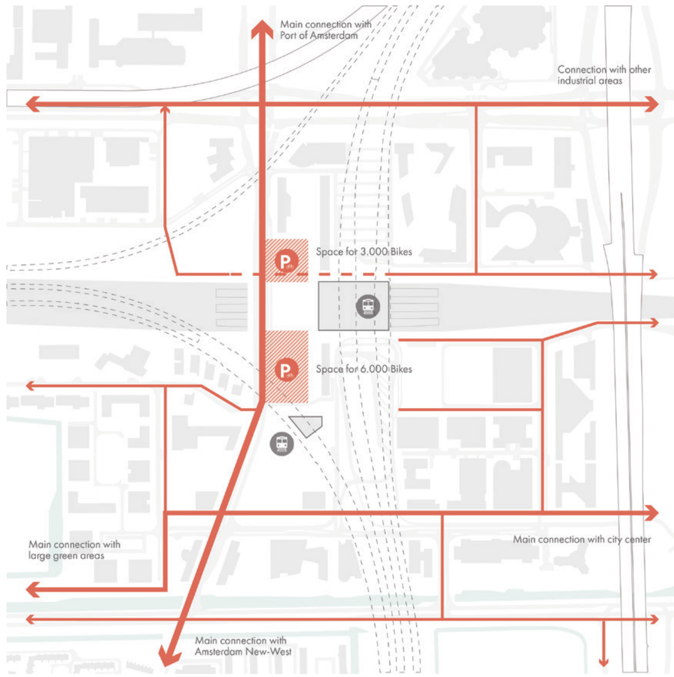
Number of places: 2
Number of bikes: 17.500

Type: Outdoor bike parking



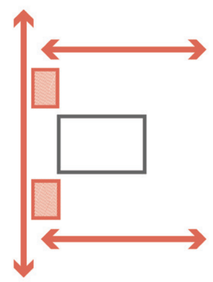
Conclusions:
+ Space for public transportation on one side
-Accessibility to station
-Square meters dedicated to bikes

4 Proximity to station (Outdoor parking)



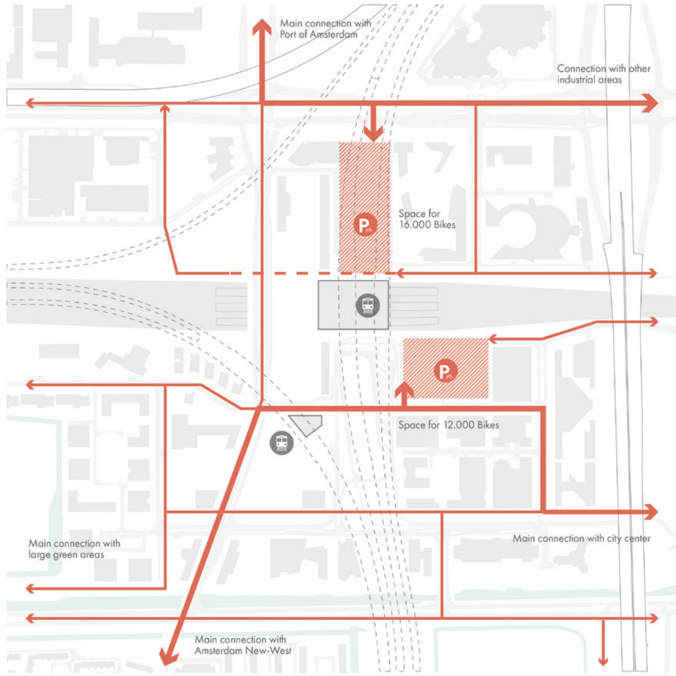
Number of places: 2
Number of bikes: 9.000

Type: Outdoor bike parking



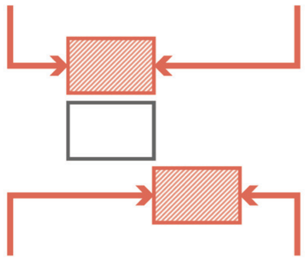
Conclusions:
+ Space for public transportation on both sides
+Accessibility to station
-Small amount of parking capacity

5 Proximity to station (Outdoor parking)



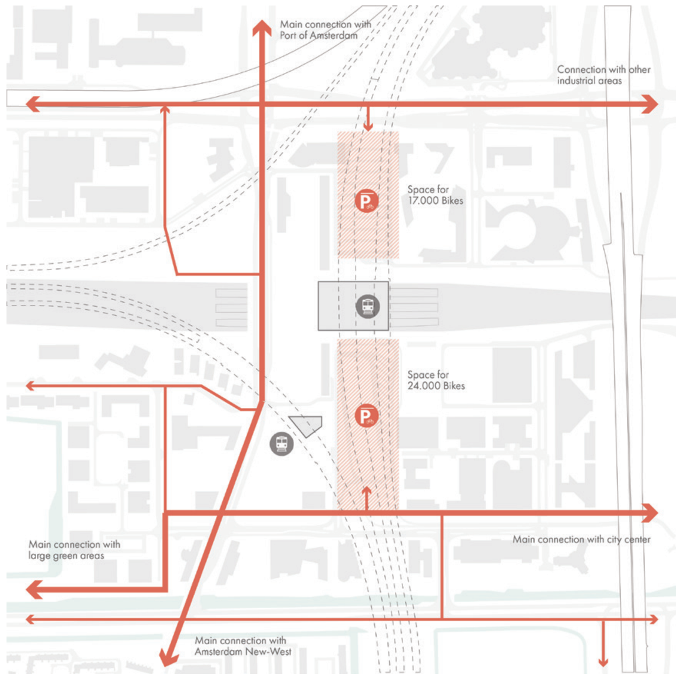
Number of places: 2
Number of bikes: 28.000

Type: Outdoor bike parking



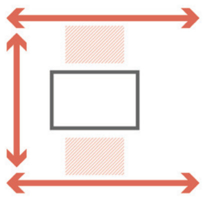
Conclusions:
+ Accessibility to station
+Space for public transportation on one side
-Square meters dedicated to bikes

6 Proximity to station (Underground parking)



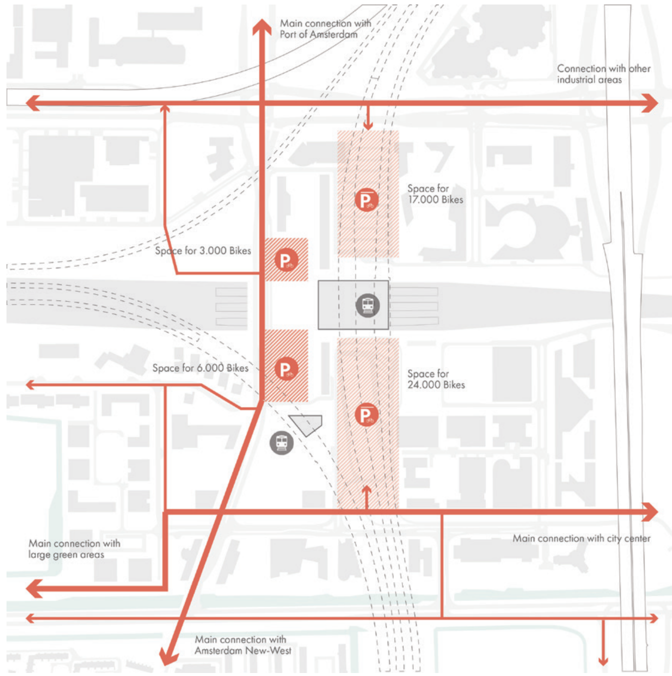
Number of places: 2
Number of bikes: 41.000

Type: Underground bike parking



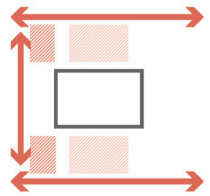
Conclusions:
+ Accessibility to station
+Large parking capacity

7 Straight Connections (Mixed parking)



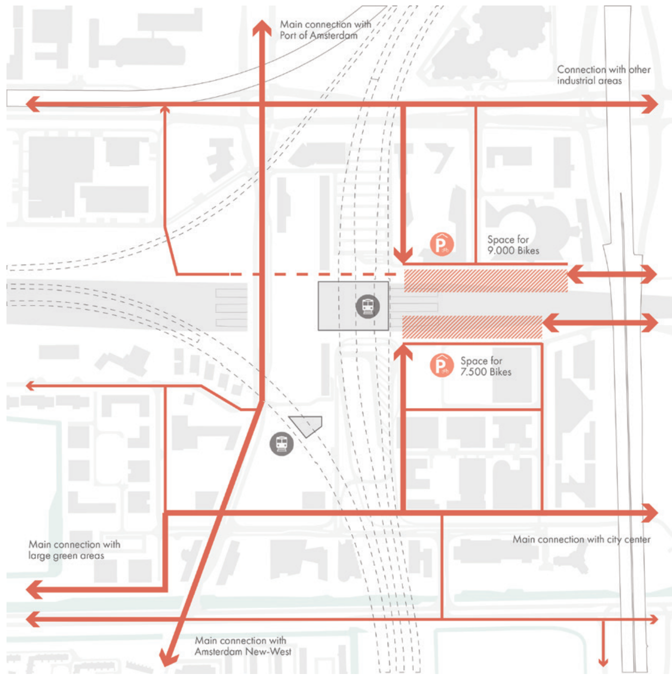
Number of places: 4
Number of bikes: 50.000

Type: Outdoor bike parking
Underground bike parking



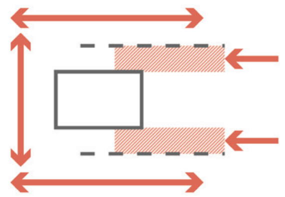
Conclusions:
+ Space for public transportation on one side
+Large parking capacity
-Square meters dedicated to bikes

8 Proximity to station (In-door parking)



Number of places: 2
Number of bikes: 16.500

Type: Covered bike parking



Conclusions:
+ Space for public transportation on both sides
+Accessibility to station
-Small amount of parking capacity

5.5. Ecological structure

Amsterdam Wedges

The rapid growth and construction rates of Amsterdam are posing serious threats to the existing ecological networks across all scales.

Green and blue elements create significant benefits for a city, both tangible such as recreation and intangible, such as environmental regulation. Green and blue infrastructure can have major impacts on the overall quality of life and health (mental and physical) of the urban population, while mitigating risks by contributing to processes of air pollution retention and heat stress relief (Paulin et al., 2019). Benefits stemming from green infrastructure are known as "ecosystem services" (MA, 2005). These benefits and their potential in the context of Amsterdam should be evaluated with the aim of identifying urgencies and potentials in the design process Sloterdijk.

As it is seen from this map, Sloterdijk is located within one of the eight wedges of Amsterdam, the Brettenscheg. The area of Sloterdijk is currently in between the two parts of the Brettenscheg. An analysis should be carried out to understand the potential implications of this structure and to identify possible solutions.

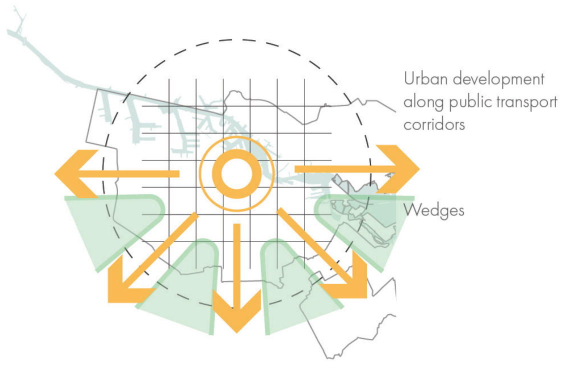


Figure 95. Ecosystem Services and assessment indicators. Source:

Ecosystem Service	Model	Indicator	Unit	Method
Air quality	1	PM_{10} retention	kg/yr	NK-Model
		PM_{10} retention	€/yr	NK-Model
Health	2	Reduction in probability of being overweight	%	See Appendix 2
	3	Reduced number of visits to general practitioner	visits/yr	NK-Model
		Reduced health costs due to urban green	€/yr	NK-Model
		Reduced health-related labour costs due to urban green	€/yr	NK-Model
Physical activity	4	Additional time spent on outdoor physical activity	min/yr	See Appendix 2
	5	Cycling	km/inhabitant/yr	See Appendix 2
	6	Time spent cycling to-from work	min/yr	See Appendix 2
		Avoided premature deaths from cycling to-from work	lives/yr	See Appendix 2
		Avoided premature deaths from cycling to-from work	€/yr	See Appendix 2
Property value	7	Contribution to property value	€	NK-Model
Recreation	8	Visits to recreation areas	visits/yr	See Appendix 2
		Visitation expenditures	€/yr	See Appendix 2
Urban cooling	9	Decrease in temperature	°C	NK-Model
Water storage	10	Reduced rainwater in sewers	m^3/yr	See Appendix 2
		Reduced water treatment costs	€/yr	See Appendix 2

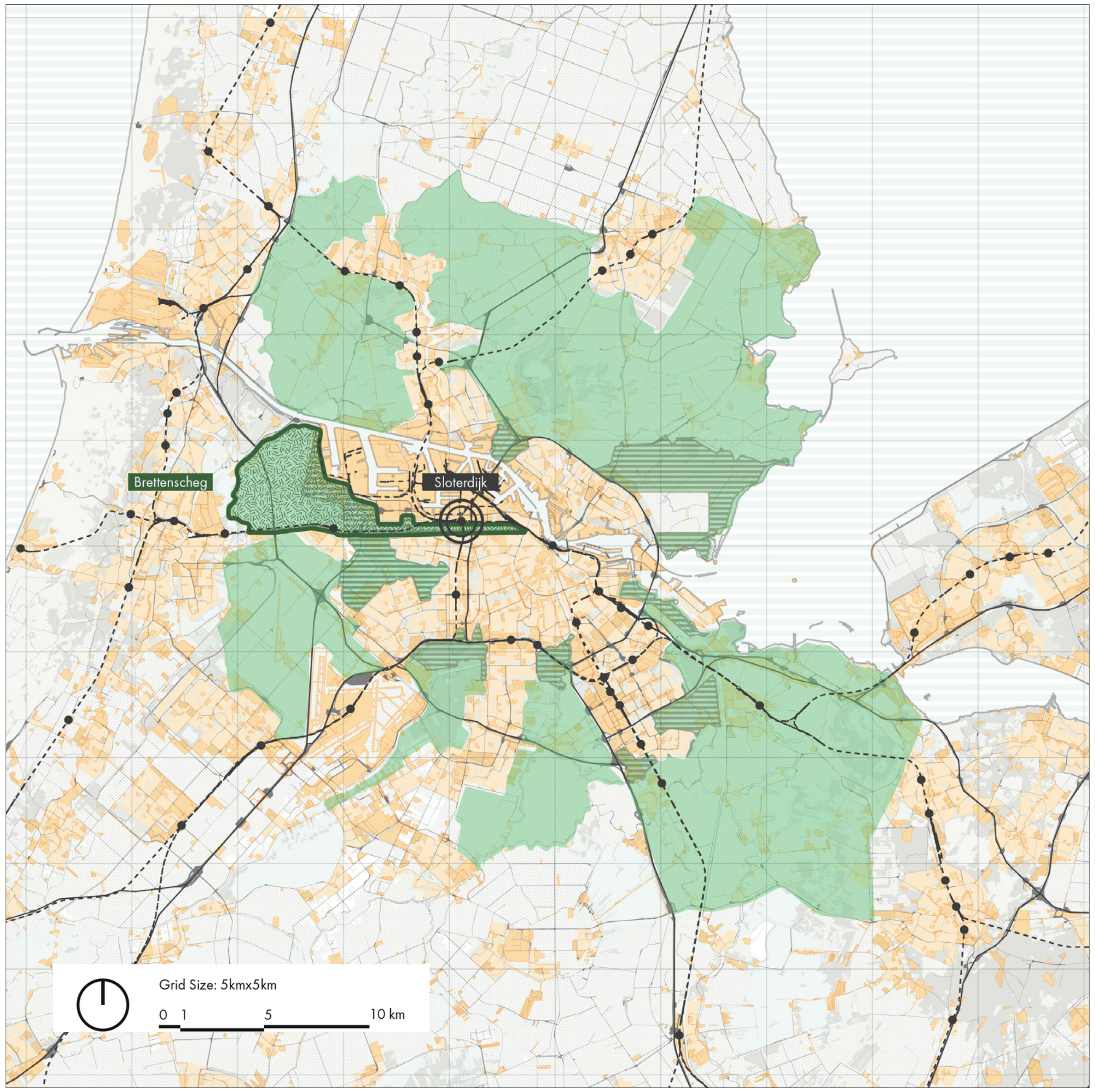


Figure 96. Regional map of the Amsterdam wedges and built-up areas.

Legend

Other functions
Residential areas
Amsterdam Wedges
Amsterdam Wedges Inside
Railway stations
Railway network
Road network

Ecological structure

The **ecological structure** is a network of green line and patches that function as habitats for different species. This network is essential for the **biodiversity** as it connects the inner-city areas with the large-scale green areas around the city.

Several **bottlenecks** were found in the area, created from the development of infrastructure. These were resolved through **underpasses** and other solutions on specific locations. Further analysis should be conducted to understand the value of these connections, to guide further design by research on potential adjustment of the green networks.

Eco-passages in the area of Sloterdijk

Figure 97. Types of ecological connections in relation to infrastructure. Source: Google Earth

What if?

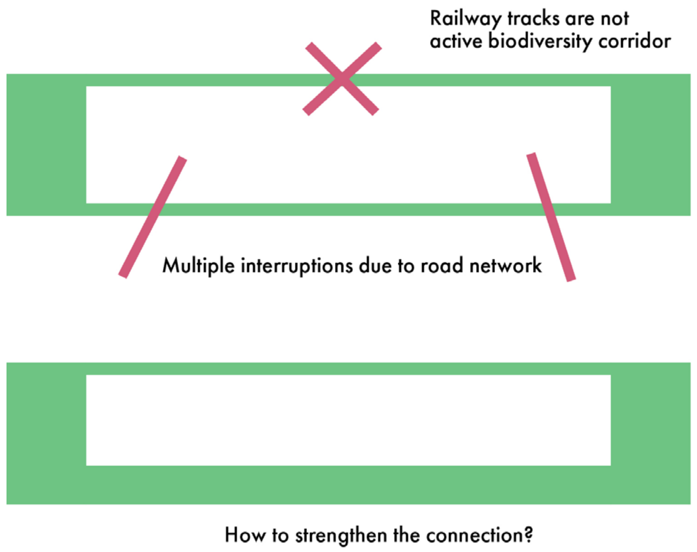


Figure 98. Diagram of potential enhancement of ecological corridors by extensive greening of the station area of Sloterdijk.

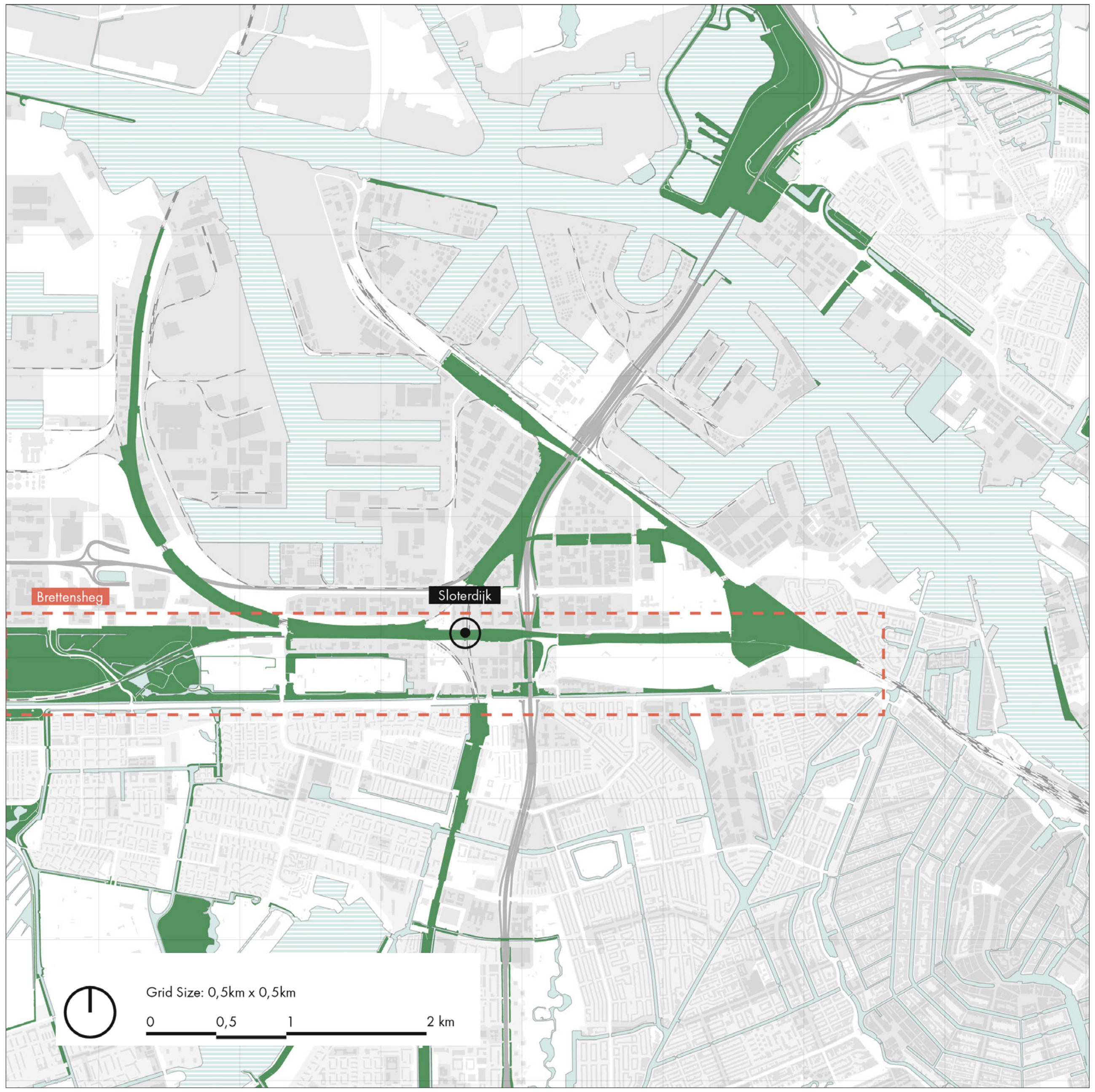


Figure 99. Regional map of the Amsterdam wedges and built-up areas.

Legend

Ecological Structure

Brettenscheg

5.6. Climate adaptation

Climate change is not only about rising temperatures. It also includes rising sea levels, extreme weather events like precipitation and prolonged drought. All these have negative impacts to the economy, to health and to ecosystems (NOAA, 2021).

To mitigate the negative effects of climate change, the government of the Netherlands has developed two national strategies: the Delta Programme (mostly regarding fluvial flooding) and the Climate Adaptation Strategy (NAS) (Klimaatadaptatiesnederland, n.d.)

As analyzed in the second chapter of this report, to deal with the two interrelated crises of housing and climate change, there is a demand for an integrated approach.

Therefore, for the creation of a sustainable and livable neighborhood in Sloterdijk, the aspect of climate adaptation is vital.

The following analysis was based on the Guideline 2.0. (bouwadaptief) guide, a set of goals and requirements set by the province of South-Holland, Amsterdam Metropolitan Area, the province of Utrecht and the province of Gelderland (Bouwadaptief, n.d.) For this graduation project, the goals of Amsterdam Metropolitan Area are considered.

Themes

1. Flooding (Pluvial)

Waterlogging during extreme levels of rainfall. Potentially harmful for vital functions and risk for species.

2. Drought

Drought is negatively affecting water demand in urban areas, and is threatening water quality, green areas and foundations.

3. Heat Stress

Particularly relevant in urban areas, prolonged heat stress poses severe health risks to species.

4. Subsidence

Subsidene is a continuous process at the sub-surface caused by both natural and human activities.

5. Biodiversity

This theme studies the negative affects of climate change and the declining diversity of species.

6. Flooding (Fluvial)

Fluvial flooding is flooding that occurs from surface water such as rivers and sea.

Requirements per theme (Amsterdam Metropolitan Region)

Flooding (Pluvial)

The requirements for flooding are related to an increased capacity of the urban environment to process rainwater during extreme precipitation. This means that most of the water (40-70mm) is either infiltrated or stored for later use by either natural or artificial drainage systems. At the same time severe damage to vital infrastructure or buildings is prevented along with risks for the species.

- No damage to buildings and infrastructure
- Process (inflitration/storage) of rainwater (40-70mm)

Drought

Requirements for drought related to groundwater and freshwater avalaibility in location site to secure that vital functions are not vulnerable to prolonged periods of drought. That guides also requirements related to soil subisence.

- functions and design based on groundwater levels
- inflitration positive design (50% minimum)
- design focus on saving water, store rainwater and improve water quality

Heat Stress

Protection from heat stress is secured through various measures that are mostly related to shadow provision in the urban environments and design of the area in a way that provides cool places in close proximity. Choice of materials in the urban environment are also important, as they can strongly influence surface temperatures. Lastly, it is important to conisder that cooling systems should not lead to more heat emissions.

- 40% of horizontal and vertical surfaces are resistant to heat
- At least 30% of shade at neighborhood level
- Cooling does not affect heating
- Cool places within 300 meters

Subsidence

Requirements for subsidence are related to measures that are socially cost effective within 60 years of lifespan.

- carrying capacit defines the program
- Damage by subsidence is within control

Biodiversity

A more ecological approach should be preffered when aiming to strength biodiversity. Provision of more greenery in the neighborhoods and appropriate habitats for various species are part of the requirements.

- Green over grey solutions
- At least 30% percent of greenery in the location

Flooding (Fluvial)

The requirements for fluvial flooding are mainly related to damage prevention and mitigation of risks for the population in the case of floods.

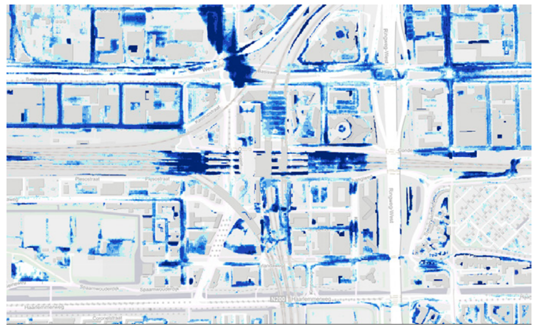
- Evacuation time
- Damage prevention

Figure 100. Overview of climate adaptation requirements for the metropolitan region of Amsterdam. Source: https://bouwadaptief.nl/

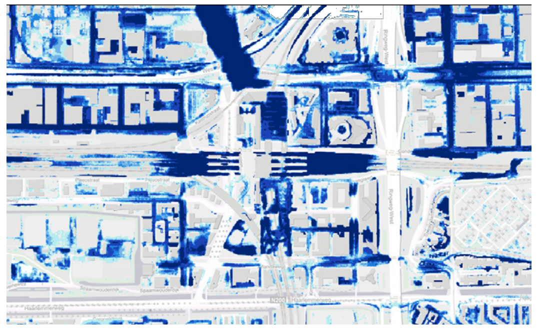
Overview table of climate urgencies

1. Flooding (Pluvial)

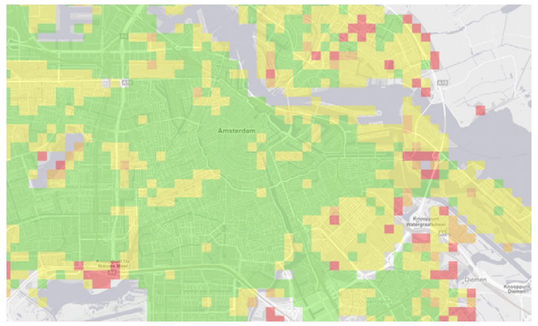
Flood depth (70mm/2hrs)



Flood depth (140mm/2hrs)

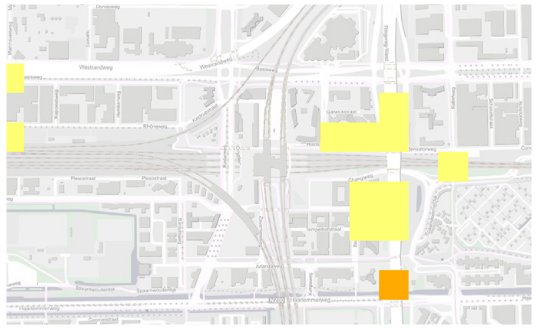


Urban inflitration opportunities

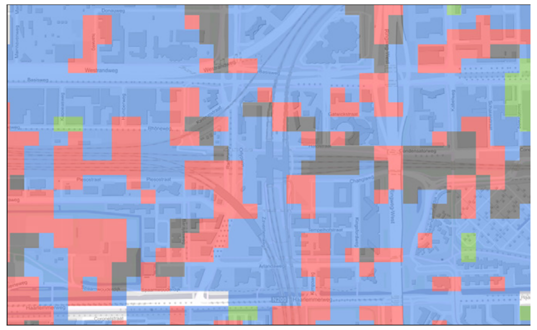


2. Drought

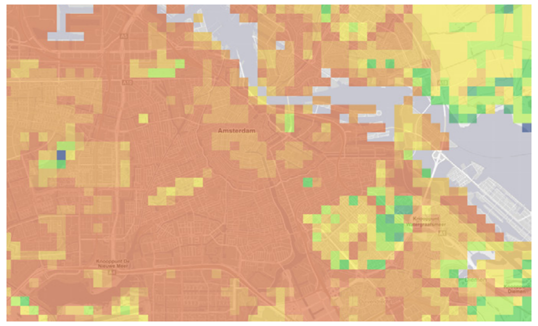
Soil subsidence (2020-2050)



Soil subsidence (2015-2018)

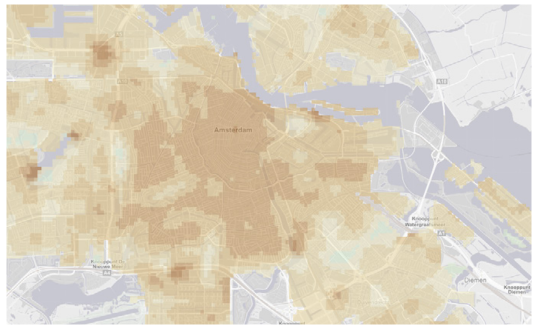


Mean lowest groundwater level

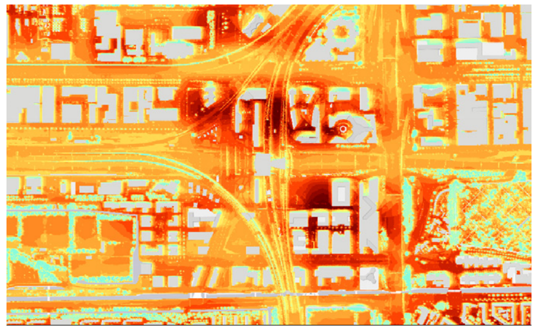


3. Heat Stress

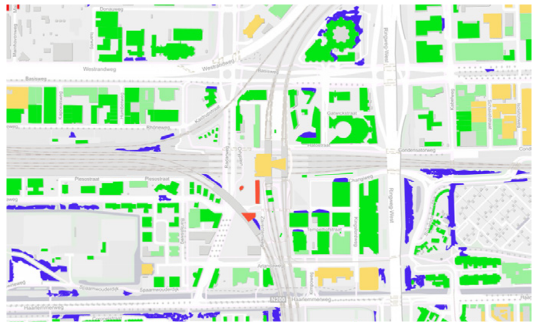
Number of warm nights



Perceived heat temperature map

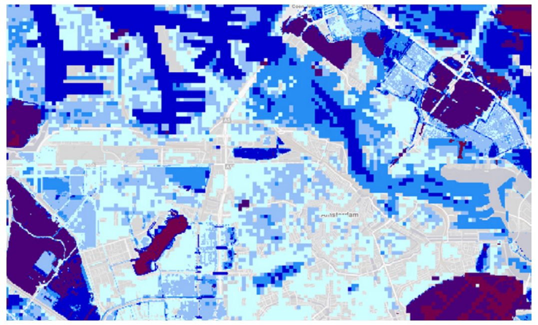


Distance to cool places

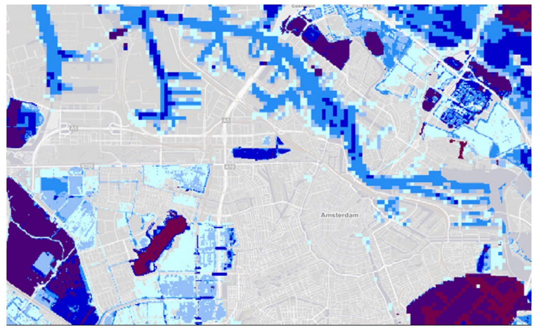


4. Flooding (Fluvial)

Flood Depth-Extremely low probability



Flood Depth-Low probability



Flood Depth-Medium probability

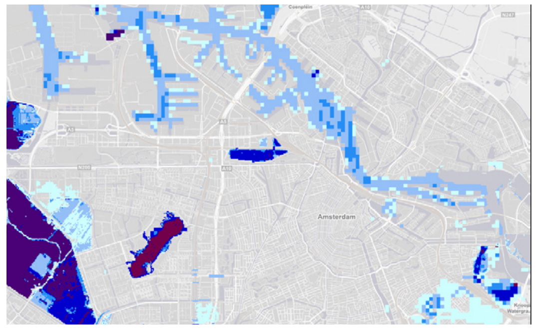


Figure 101. Enviromental risks maps. Source: klimaateffectatlas.nl

Conclusions

The area is suffering from excessive water retention above ground due to extensive paving for infrastructure and mobility. However, on the larger scale it presents with great inflitration opportunities. Therefore, with various measures there is high potential to solve this problem.

The area of Sloterdijk presents with extremely low groundwater levels which is negatively affecting the potential subsidence of soil, threatening key infrastructure and functions. Therefore measures should be taken to increase inflitration.

One of the primary problems of the area is heat stress. As we can see from the map on the city level, the area has one of the worst heat stress problems. On the neighborhood scale this is more intense in open areas that are extensively paved.

Requirements for fluvial flood risk are related primarily to whether the location is inside or outside the dike system. Sloterdijk since it is located within Amsterdam is very well protected. As we can also see from the flood depth map, the probability of flood is extremely low.

Main Conclusion

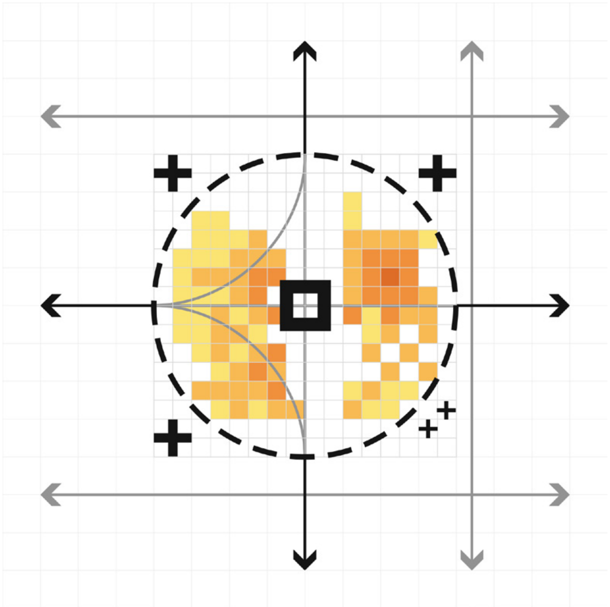
From this analysis the most pressing matters that are affecting Sloterdijk are extensive **heat stress** and **inflitration of water and groundwater level** that are affecting pluvial **flood risks and drought**. As a result, the measures taken will be related to these three themes. Fluvial flood risk is not a primary concern for the location.

Integrated design 6

6.1. Transformation of Sloterdijk into a new type of TOD

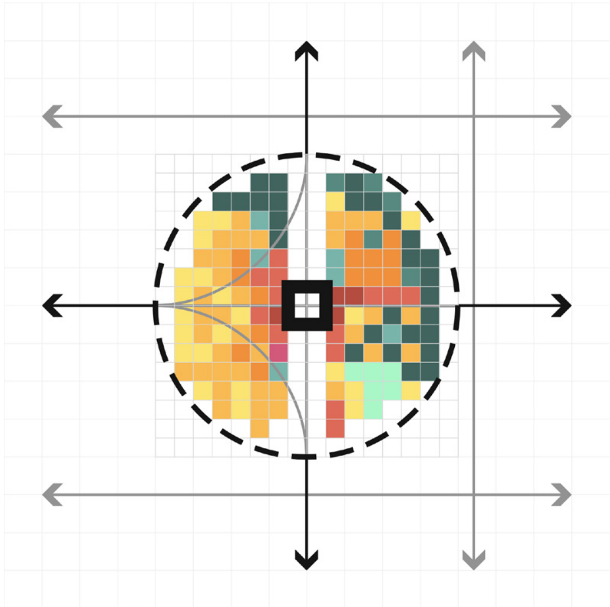
Design-Transformation Steps

The new type of TOD can be translated into four distinct design-transformation steps that combine elements from both the "conventional" TOD, as we are familiar so far, and the "new" that incorporates the aspect of healthy, safe, vibrant and inclusive environments.



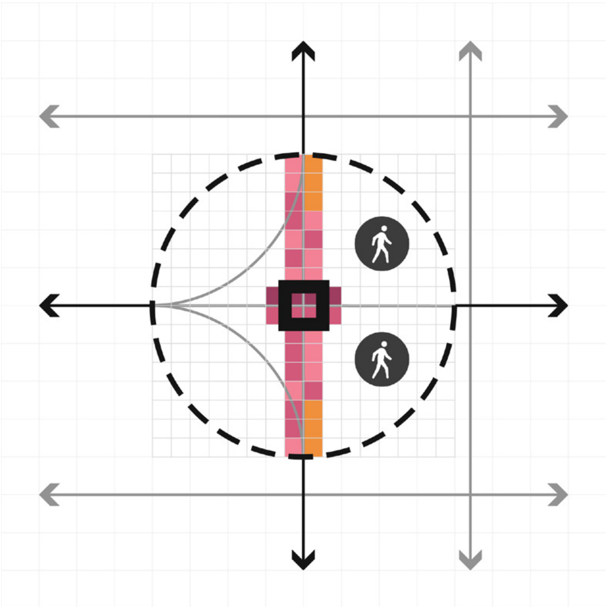
01 Densification-Space for living

Key element of this step is the transfrormation process from a business district to a mixed working and living area. Through several different densification strategies, a significant amount of houses is added, alleviating thus the ongoing housing crisis.



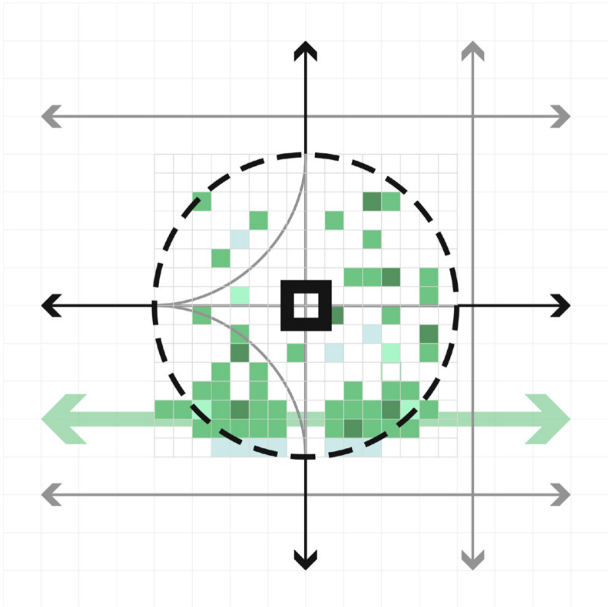
02 Mixed-Use urban districts

The transformation of the monofunctional business district into a lively and diverse neighborhood requires a thorough look at the program and quality of public spaces. In this step, through the lens of various different users, a framework for this transformation is created.



03 Sustainable mobility hubs

The current station area through the provision of plenty of space for cars through parking and car lanes, is facilitating the use of private mobility for everyday use. In the future of Sloterdijk car use is minimized, allowing space to be claimed by pedestrians and other modes of active, shared, or public transport. A complete plan for a sustainable mobility hub is created

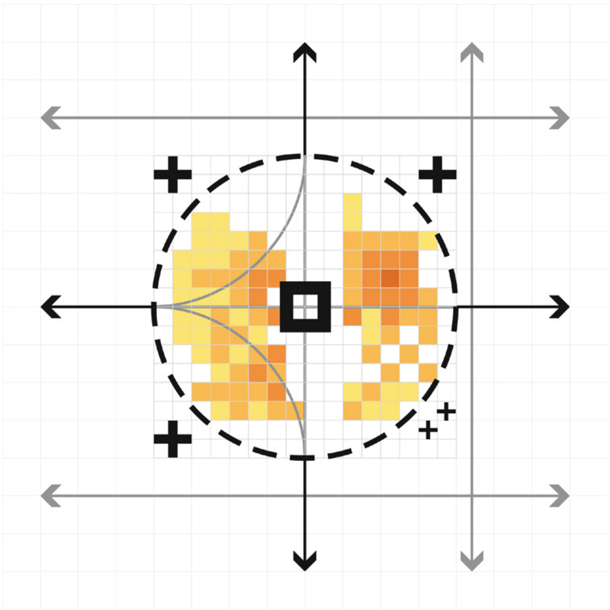


04 Healthy and safe environments

Current urgencies such as heat stess and flood risks need to be adressed through the prioritization of green and blue elements in public spaces and through their integration to a coherent and continuous network. A wide range of linear or surficial elements provide habitats for different species as well as contanct with the natural environment, elements extremely important in dense urban areas.

6.2. Place for living

Transformation process to facilitate housing



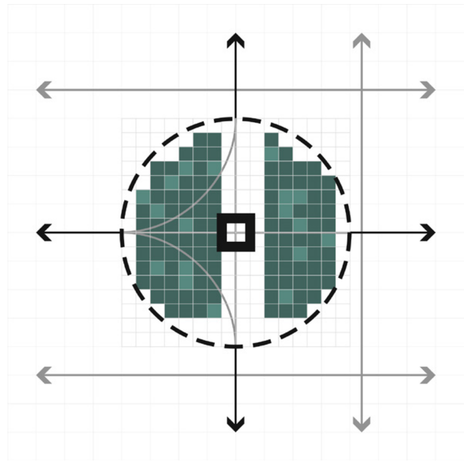
Goal

Total housing units: 7.000

Total inhabitants: 10.000

- Respond to the ongoing housing crisis
- Incorporate housing to the business district
- Create good conditions for living

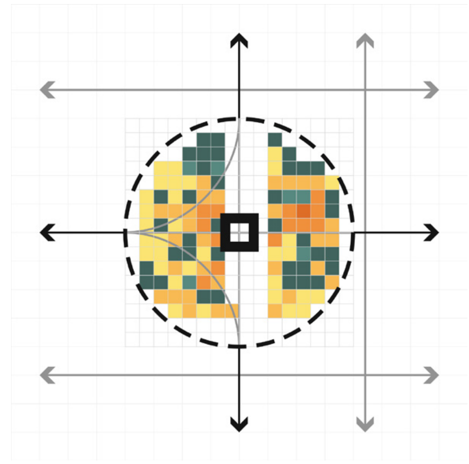
Integrating housing into the business district



From

5 Residential

95 Non-Residential



To

50 Residential

50 Non-Residential

Figure 102. Manifestation of Teleport business district in 1986. Source: https://www.weekvanhetlegegebouw.nl

Selected densification strategies

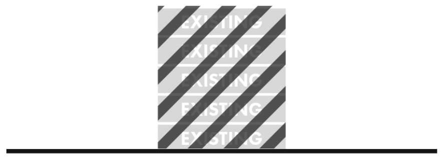
Add New Blocks

Add New Blocks Over the tracks

Adjust Existing-Build over existing buildings

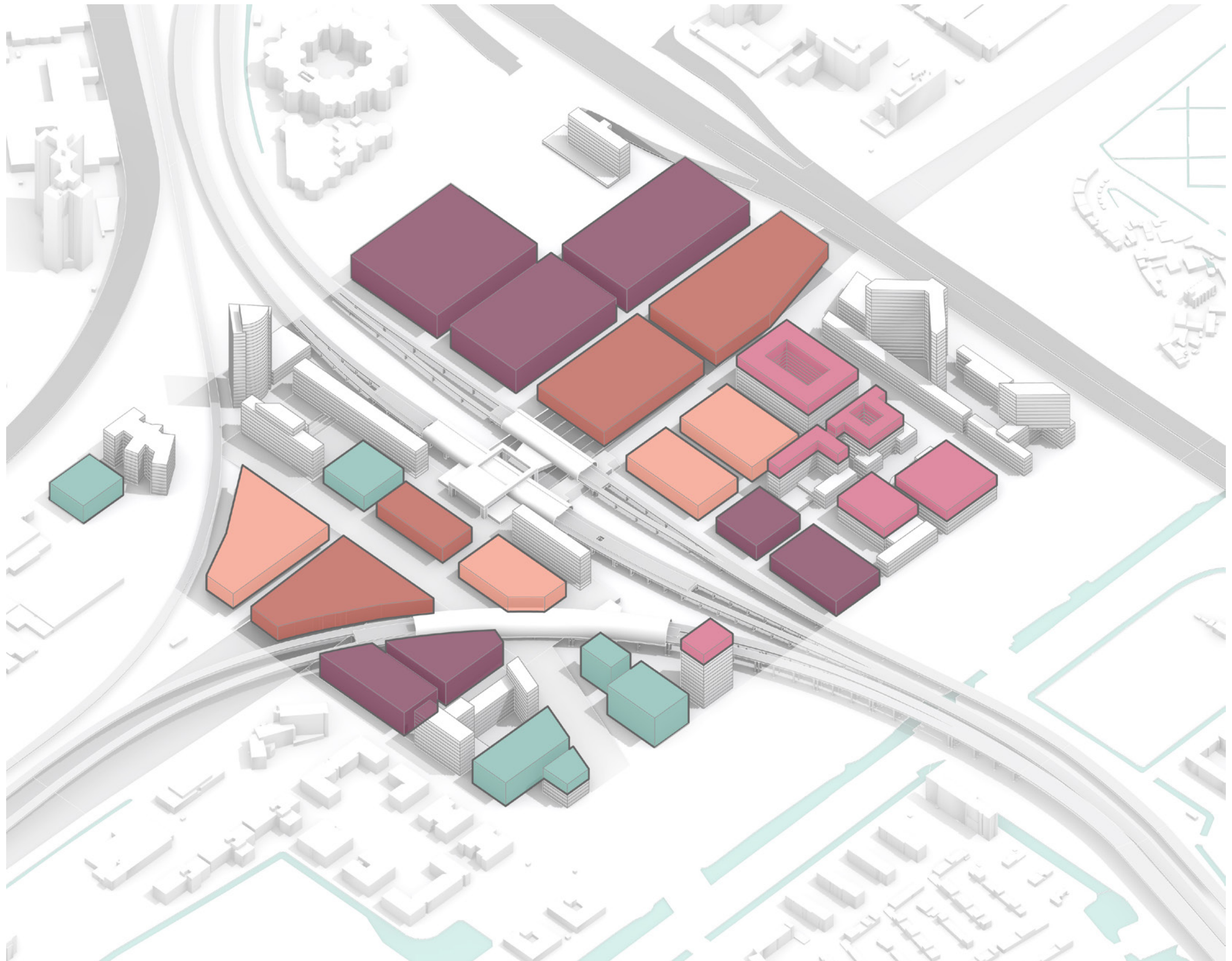
Adjust Existing-Fill blocks

Transform-Completely Remove Buildings

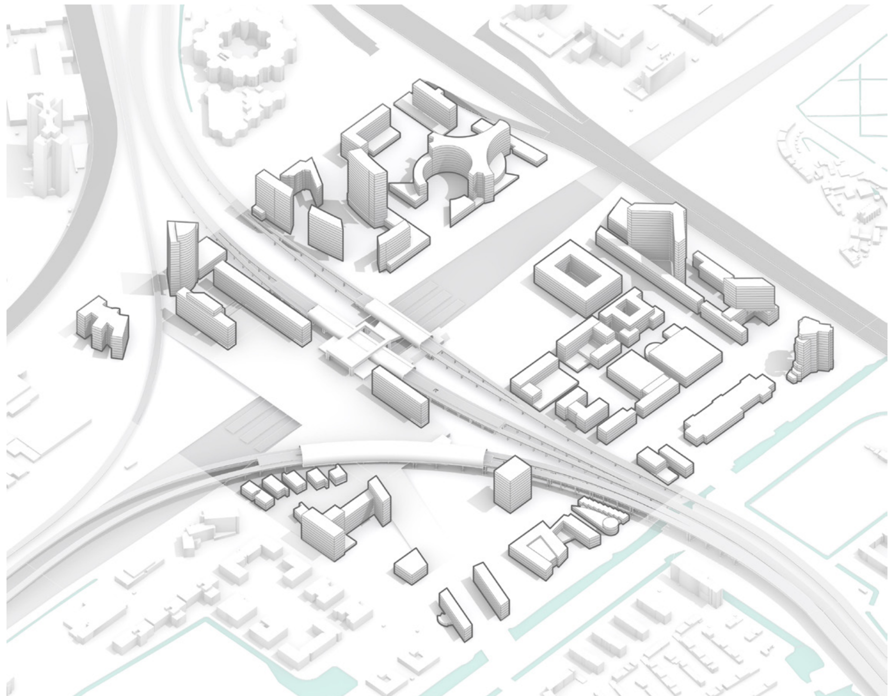


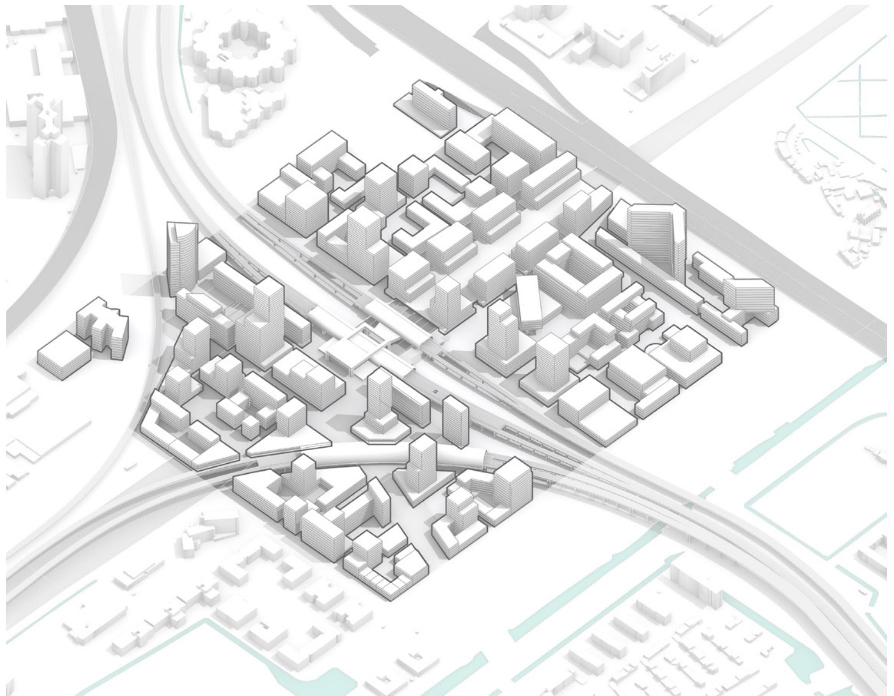
Transform-Replace existing

Diagram of densification strategies

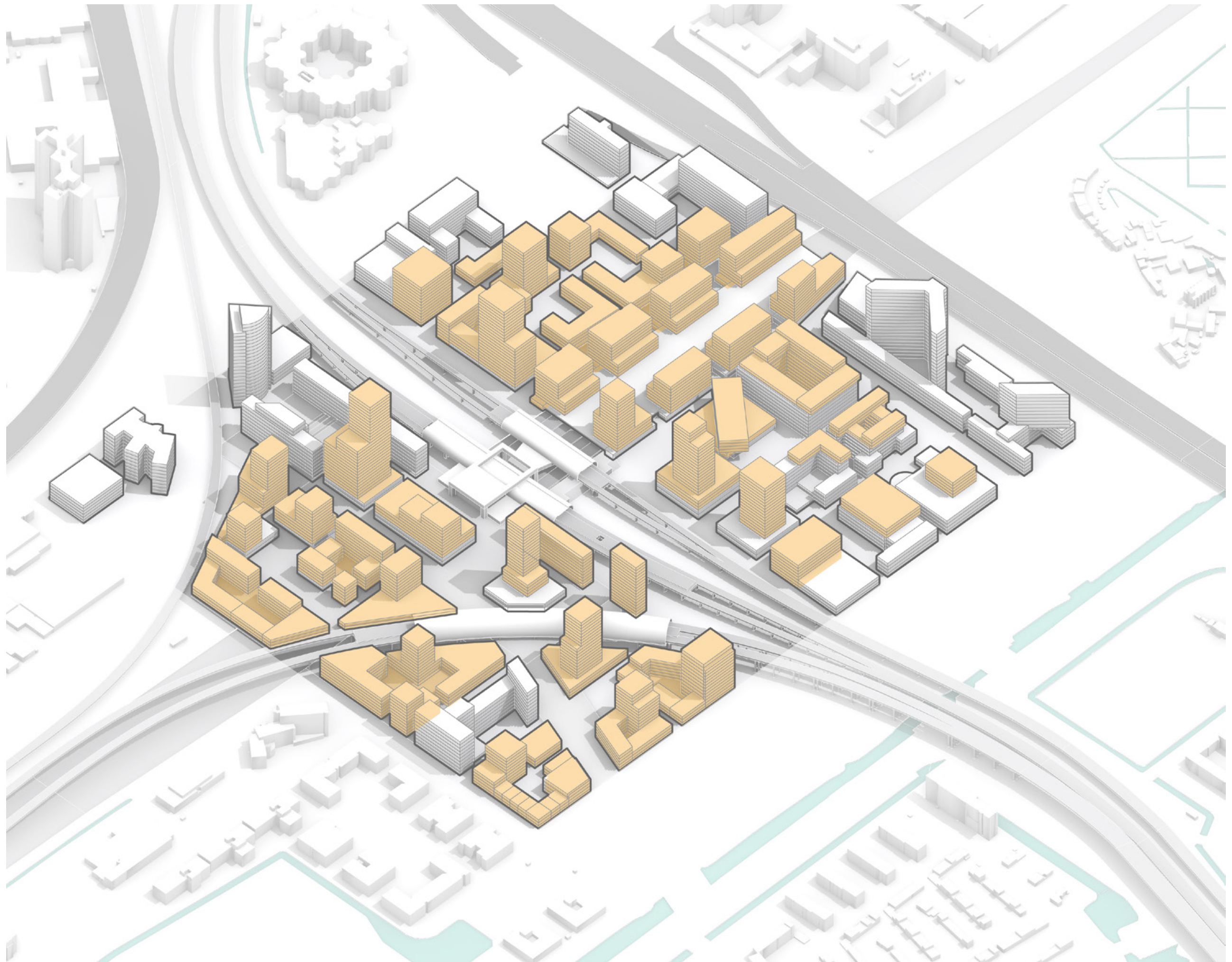


Before and after the transformation

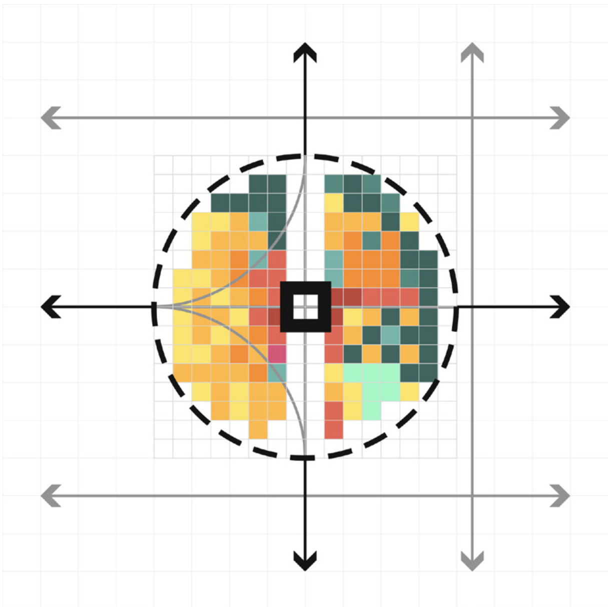




Refinement and integration of housing



6.3. A mixed-use urban district



"Knowledge-intensive" economy

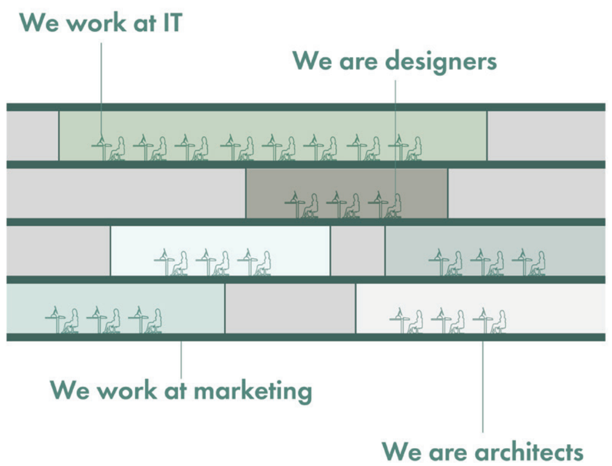
Cities are places where most of the jobs are concentrated, particularly those who belong to the "knowledge-intensive" work sector. These include a wide variety of jobs such as telecommunications, financial services, education, research, and design related jobs, typically attracting a highly skilled workforce (CBS, n.d.). As it was analyzed in the second chapter of this report, Amsterdam is the most attracting city for such jobs in the Netherlands and with an expected growth of 200.000 more jobs within the city proper by 2050, it becomes apparent that work is going to play an important role in the development of the city (Municipality of Amsterdam, 2017).

Office spaces are still relevant

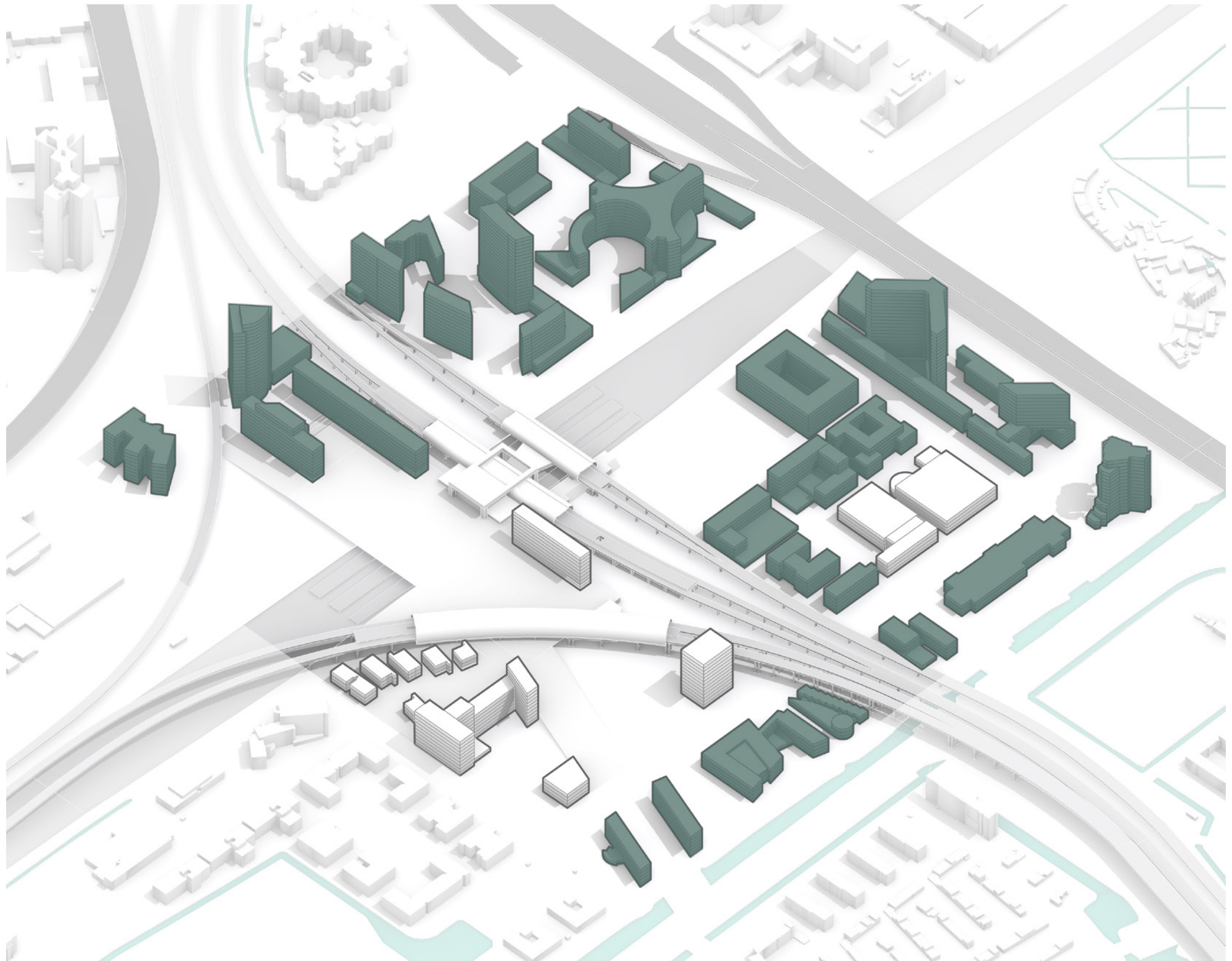
This, however, does not imply that we should replicate planning paradigms of the past, of highly specialized work-focused environments. As jobs in this sector can be typically done in a hybrid mode between on-site and remote work, less office space will be needed in the future. In the case of Sloterdijk itself, the business district has experienced a strong decrease in its popularity as a destination for work, due to the economic crisis but also because the area was considered very unattractive. This is very possible to change in the case of the transformation of Sloterdijk into a mixed-use environment, especially when combined with its connectivity to the overall transportation network. Currently more than 350.000 people work in Amsterdam but live elsewhere, therefore areas with great connectivity, such as Sloterdijk, will be favored.

"Thus, while car-oriented suburbanisation was central to 20th Century industrial economy, TOD is seen as an urban development concept more suited to postindustrial, service-based economies"

(Hrelja et al.,2020)



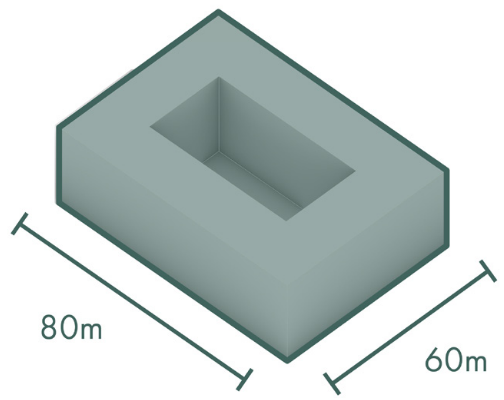
Preserved working space



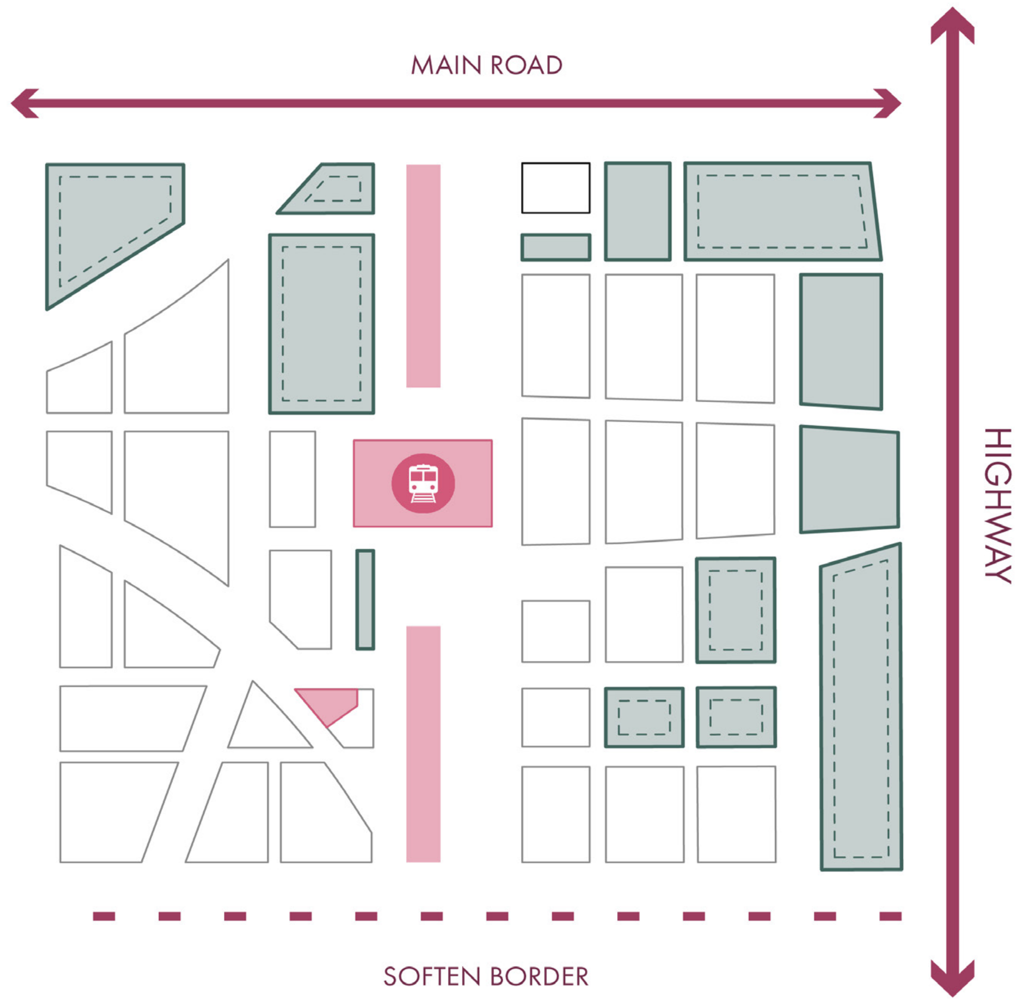
Conclusion

Maintain office buildings based on block size and location within the area. Smaller blocks are easier to transform/replace therefore they are preffered. This could also support as a possible transition to an almost entirely remote work future, where office space is substantially less relevant.

Preserving fine grain urban fabric



Proposed working space arrangement



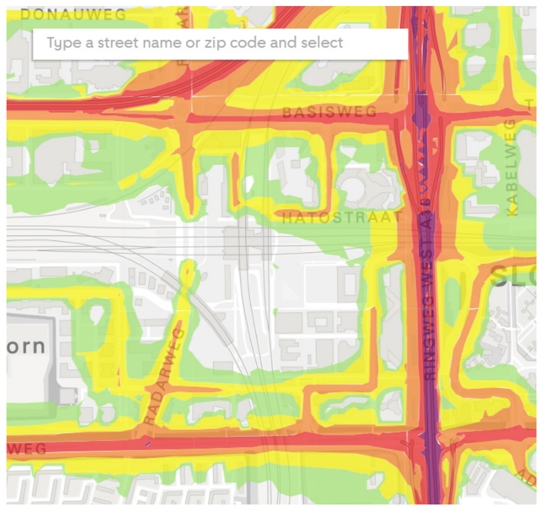
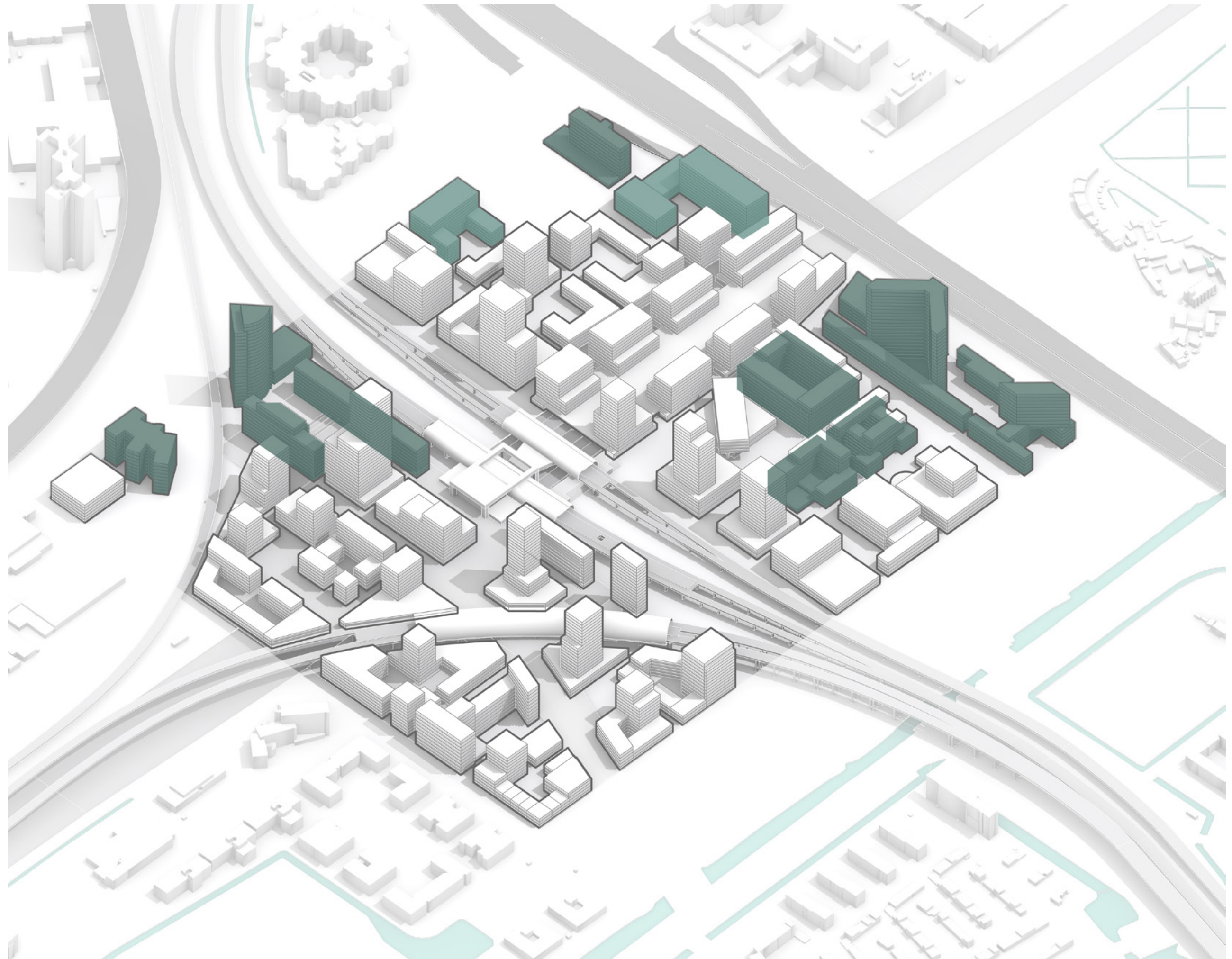


Figure 103. Noise pollution during night hours in the area of Sloterdjk. Main polluter is the A10 ringroad on the eastern part. Source: maps.amsterdam.nl



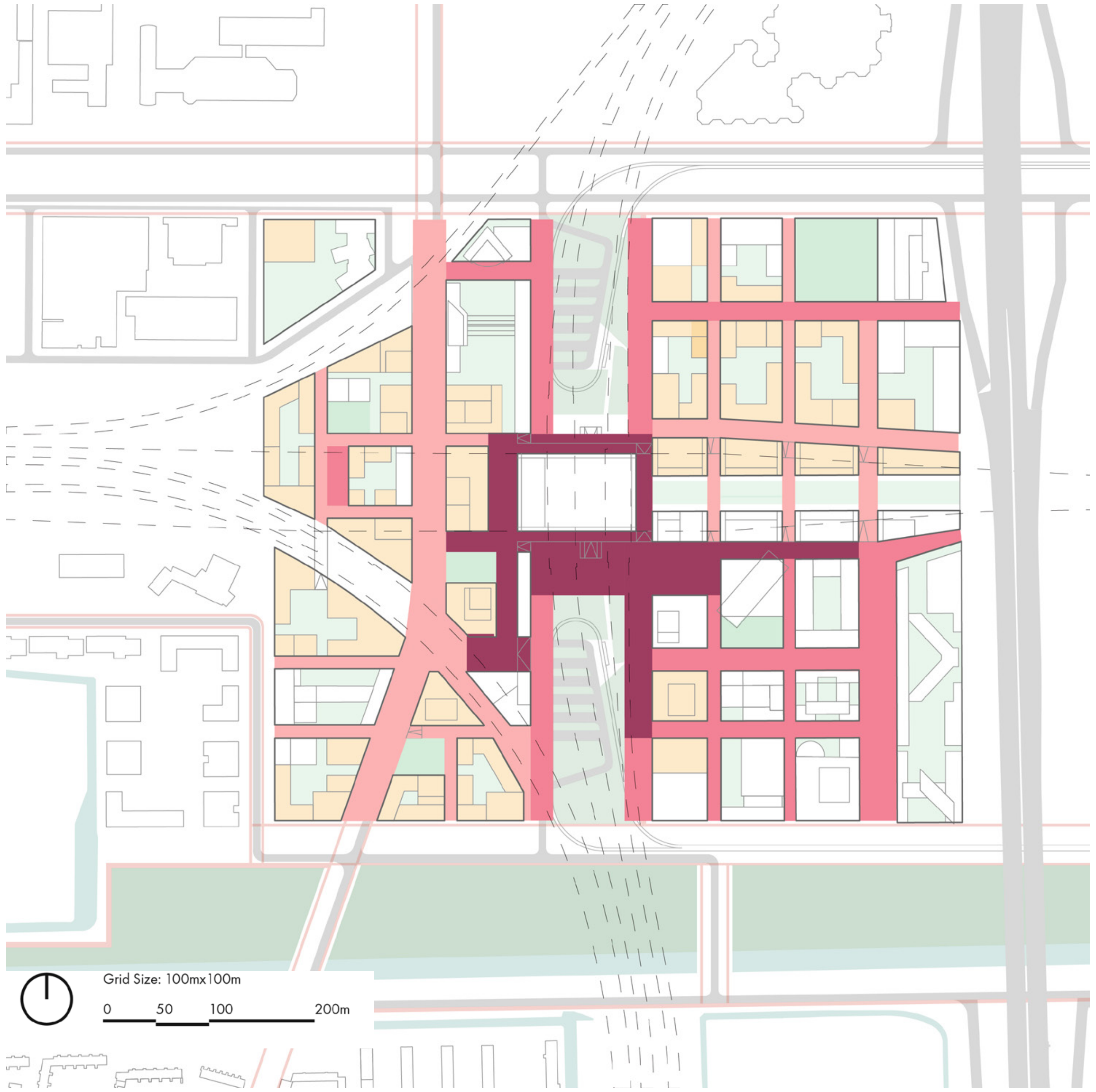
Conclusion

Adding to the preserved office space, a minor portion of new offices are developed close to the highway and the main road on the northen part of the area, to enclosue the area towards the inner side. Highways are are responsible for sound pollution, which especially at night can disturb sleep, thefore work spaces are preffered to be located in that areas. At the same time the southern area is free from office space, creating a softer border with the neighborhood of New-west.

Office space proposed

Total floor space:	219,866 m^2
Total employees: (mostly-office based)	10.000
Office space per person:	22 m^2

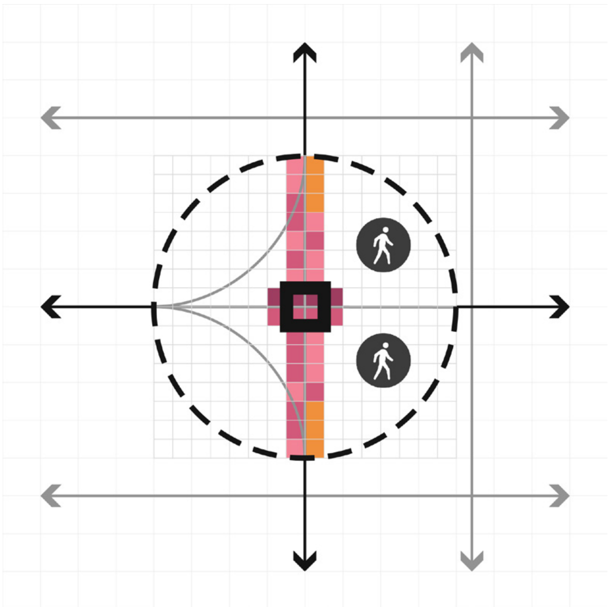
Intensity of use of space

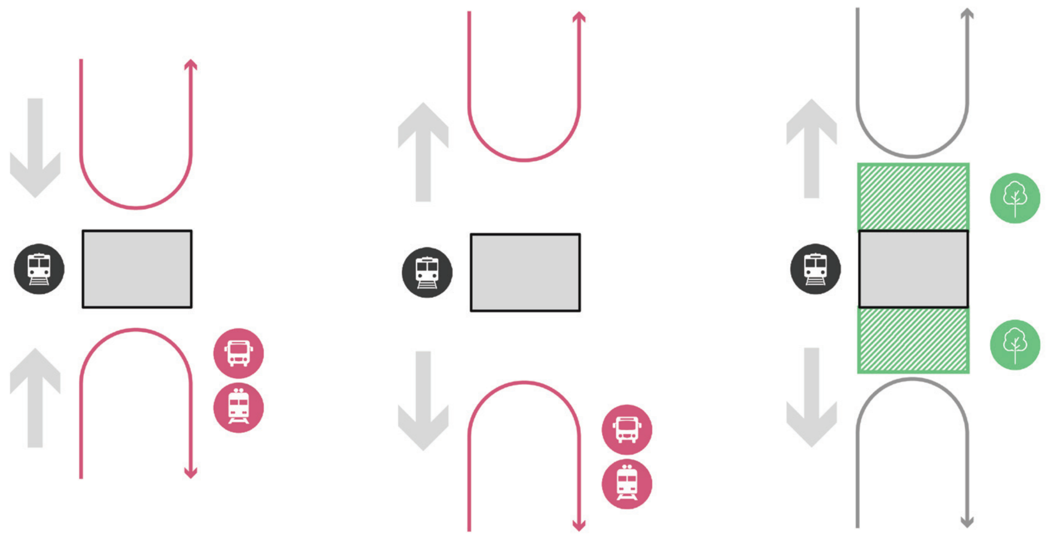


Program

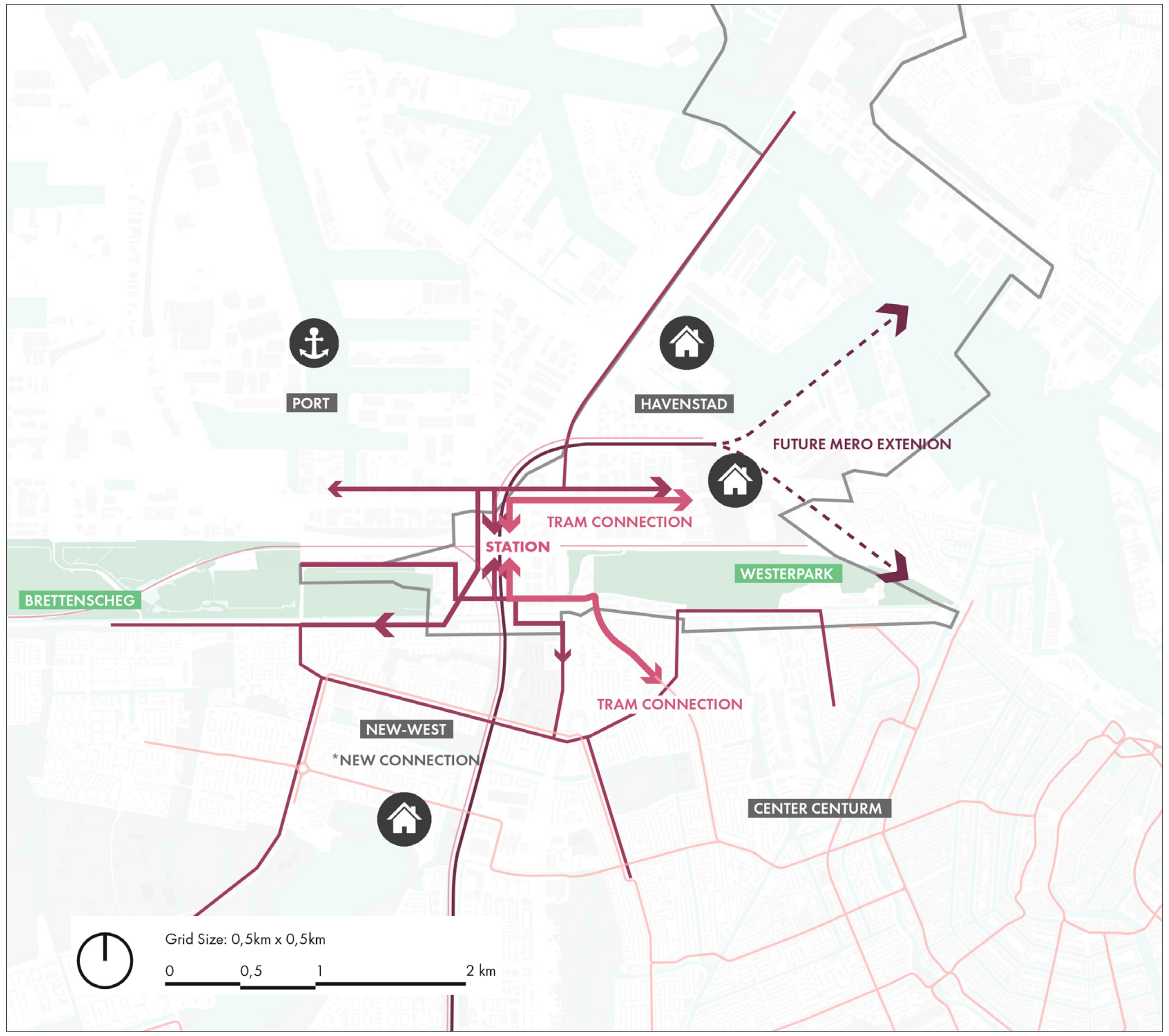
6.4. A Sustainable mobility hub

Principles





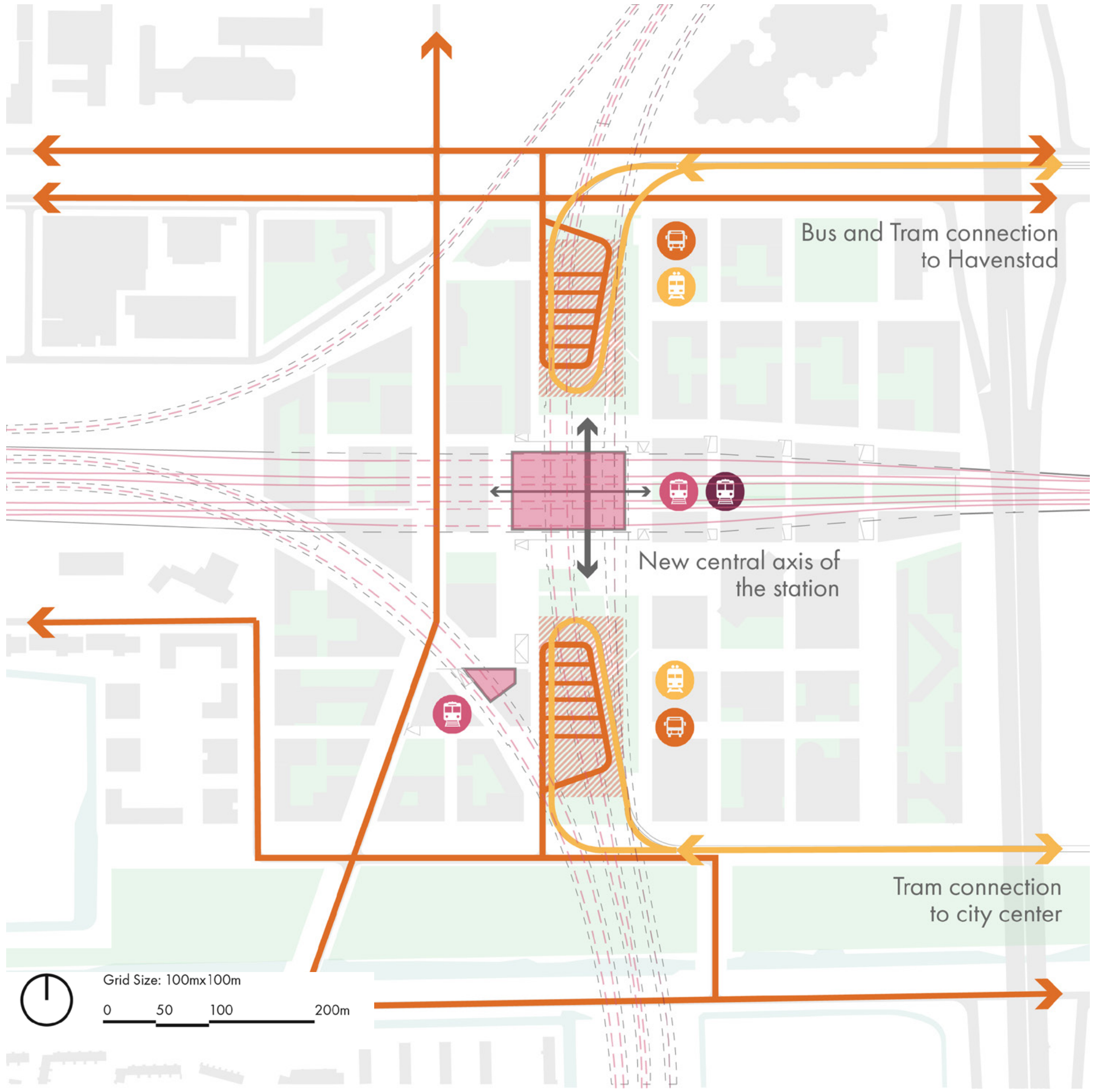
Vision for mobility



Legend

- Tram route
- Bus lane
- Railway line
- Metro line
- Green structure
- Havenstad
- Residential areas
- Port

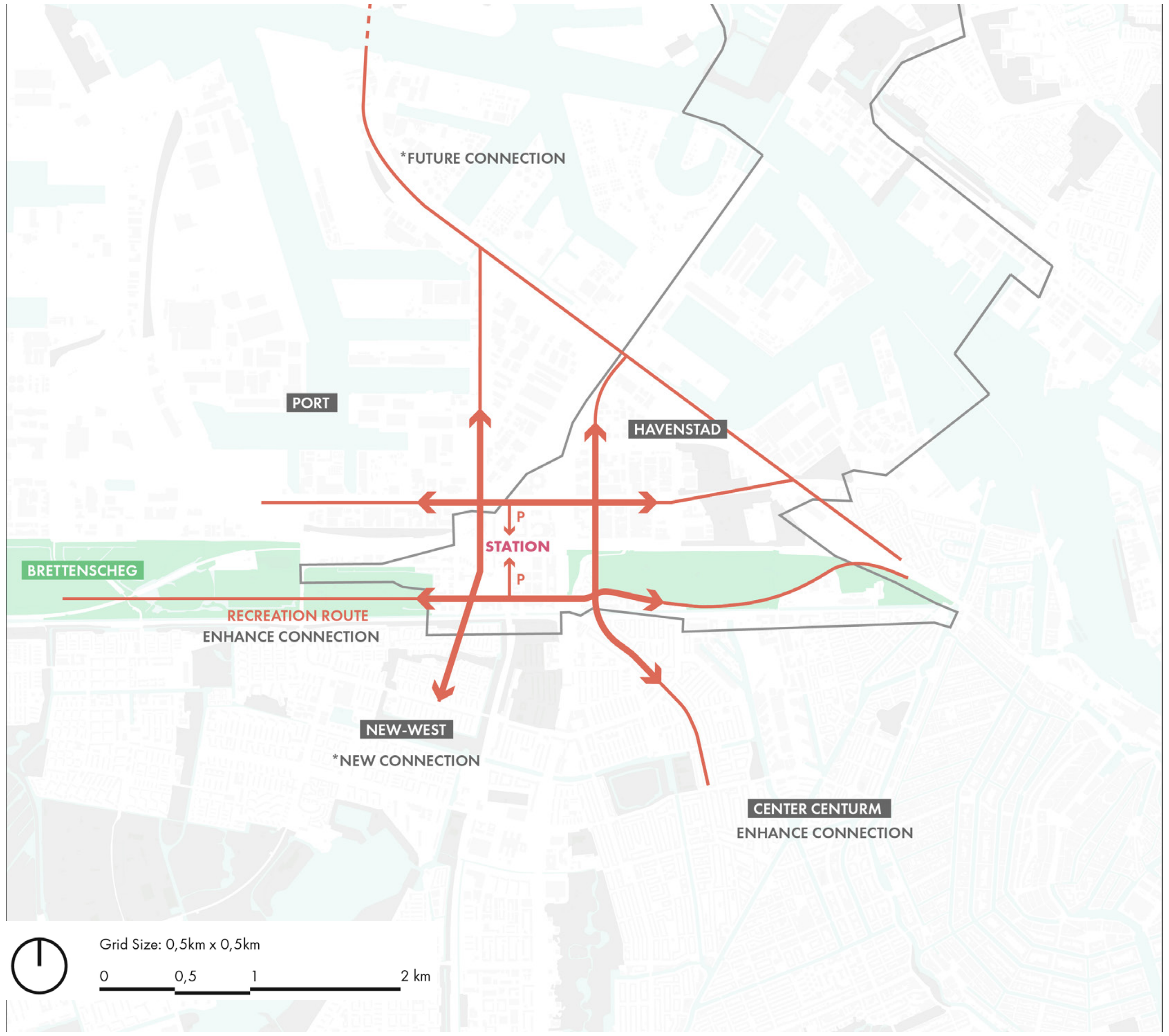
Public Transportation



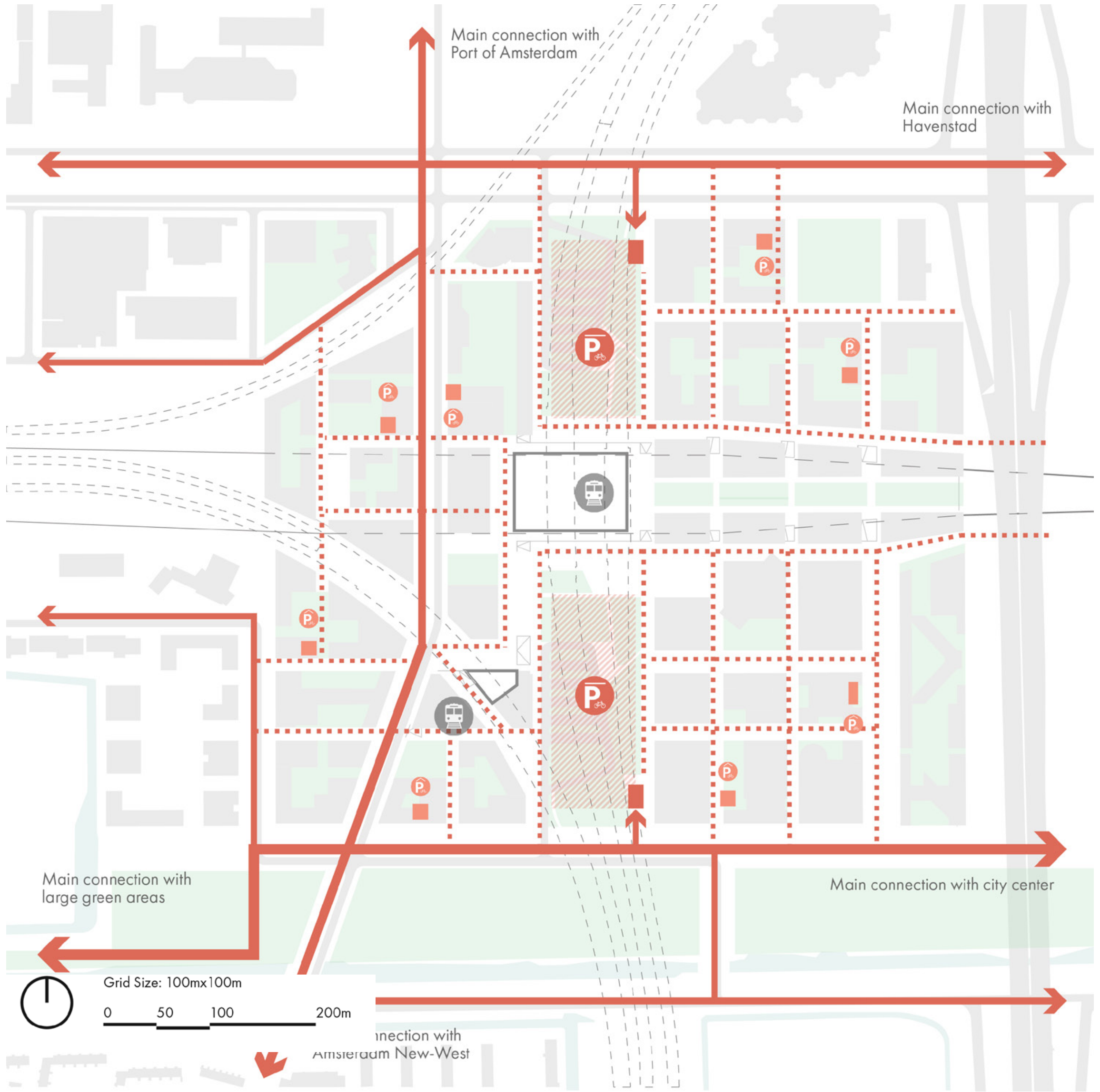
Legend

Tram route		Railway	
Bus lane		Metro	
Railway line			
Metro line			
Tram			
Bus			

Bicycle infrastructure



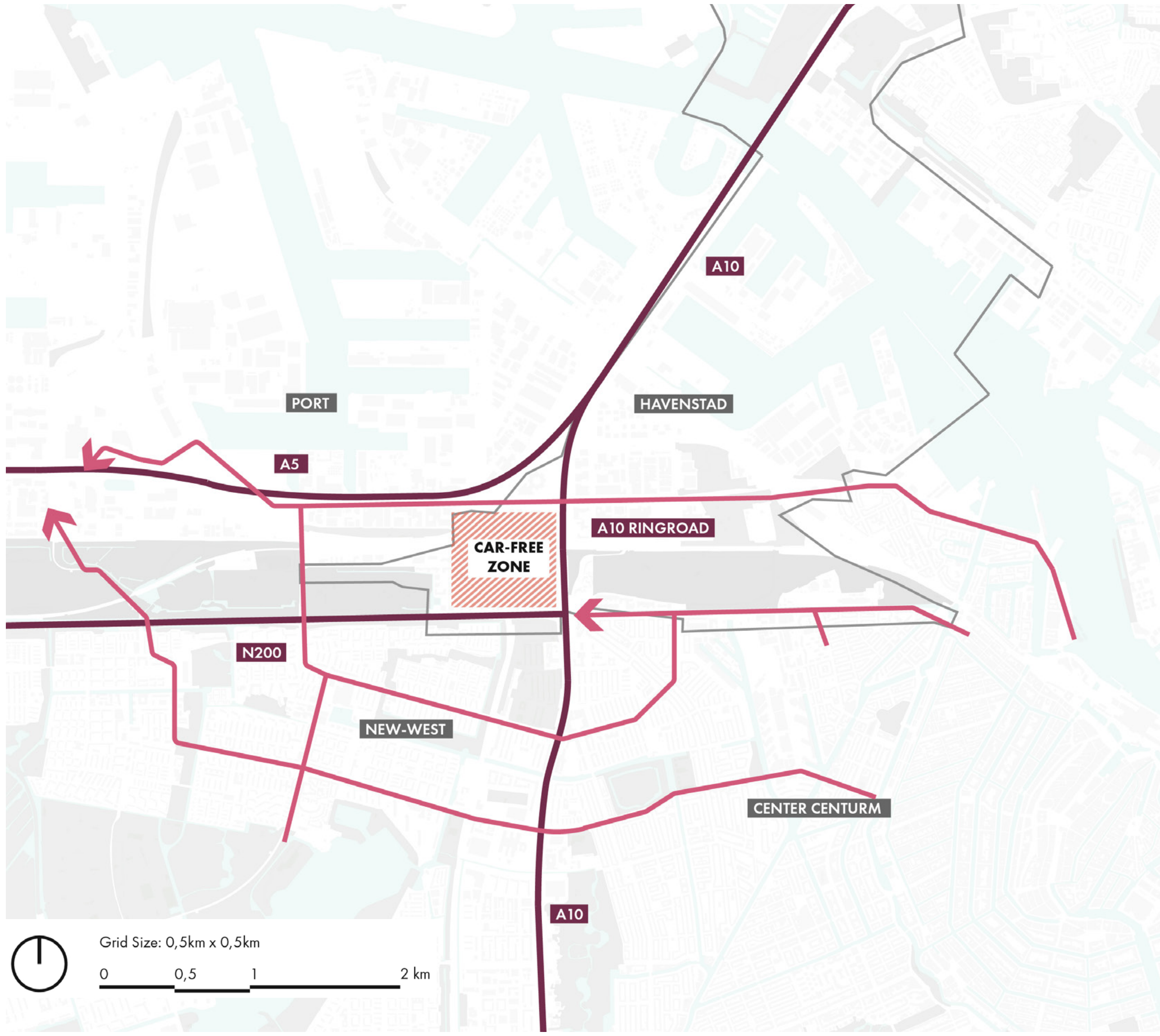
Proposed bicycle infrastructure



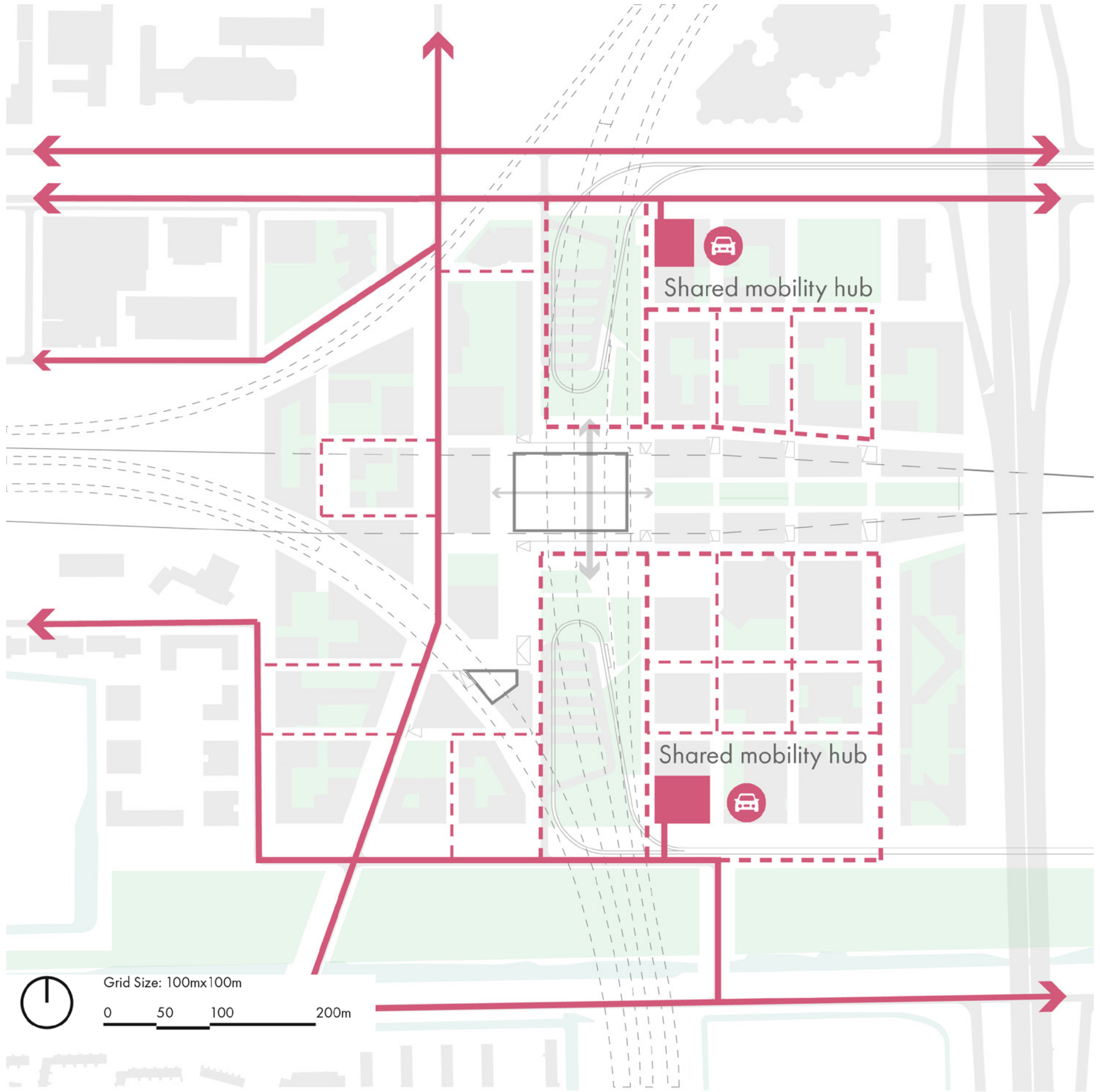
Legend

- Bike Route
- Shared Street
- District Parking area
- Underground parking
- Underground bike parking
- Neighborhood parking

Shared mobility



Proposed shared mobility plan



Legend

Car lanes

Shared Street

Shared mobility hub area

Shared mobility hub

6.5. A healthy and safe environment

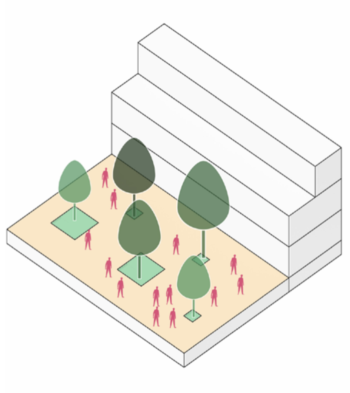
Creation of a green street network

Green and blue infrastructure are extremely important elements that through their integration within the overall green/blue network, they can have major impacts of improving both the sustainability and livability aspects of Sloterdijk.

Due to the intense densification of the are, the imporance of the street network in formulating an extensive and coherent green/blue network, is high. By limiting space taken by mobility and particularly private cars, a large amount of space can be transformed into soft and permeable surfaces, that can contribute substantially to both networks. According to the available amount of space that can be transformed into soft surface, four different street types are defined.

1. High-intensity street

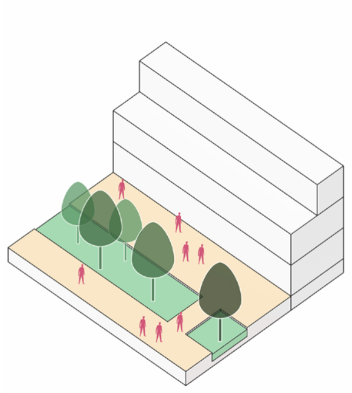
Porosity **10%**



-Integration of greenery into high-intensity use streets such as shopping streets.
-Tree lines and small green patches

2. Medium-intensity strreet

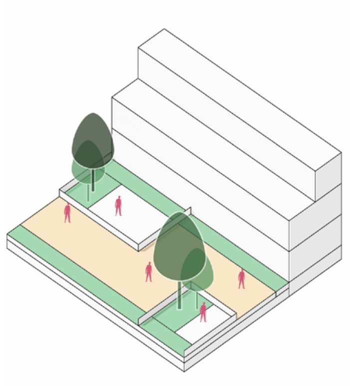
Porosity **30%**



-Allow space needed for ocassional car traffic
-Network of wide green patches

3. Residential Street

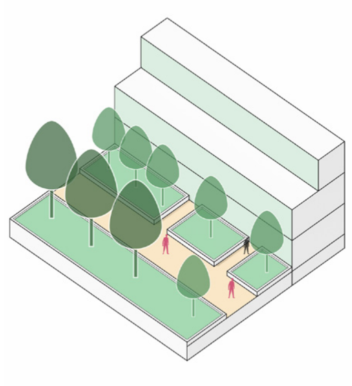
Porosity **40%**



-Semi-private green zones/gardens along facades
-Allow more space for on-street activities

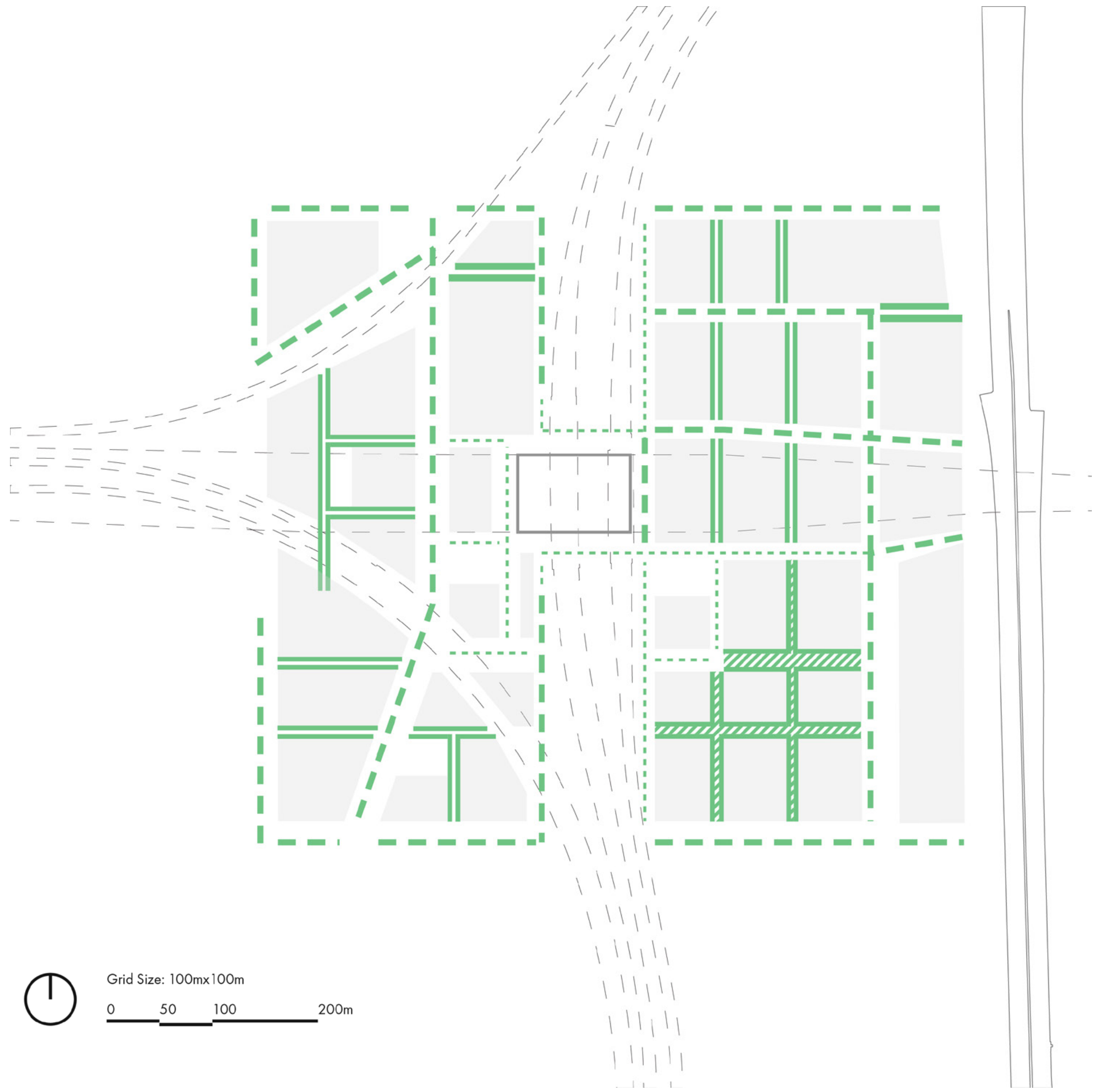
4. Business-area street

Porosity **60%**



-Maximize greenery on business streets as use of space is less
-Integration of greenery on facades

Street network-Definition of 4 street types



Street

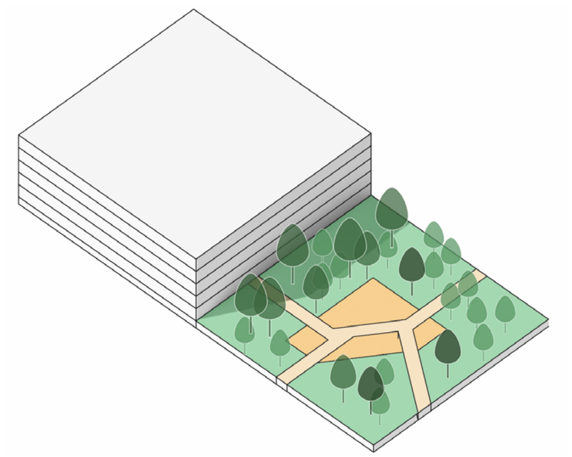
1. Tree-lined
2. Middle-verge
3. Residential Street
4. Business-area

Network of different green spaces

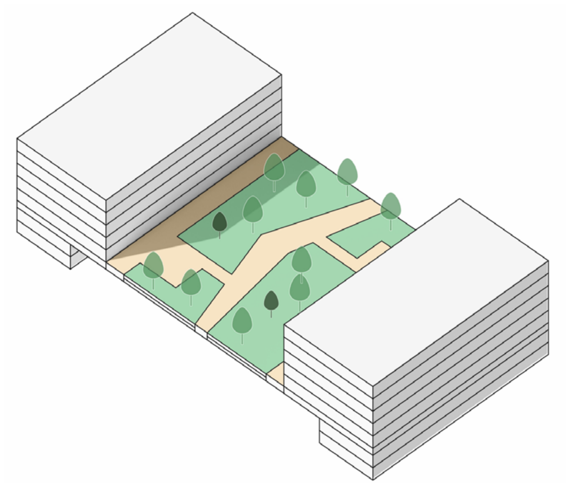
Additionally to the green street network, several different types of green spaces are added. Starting from urban parks, these create a network of cool spaces within the district of Sloterdijk. These cool places are extremely important for both human and non-human populations, providing healthy and safe environments in case of excessive heat, a problem that is particularly evident in the case of Sloterdijk.

Additionally, green space is also integrated within the blocks, creating a pleasant environment within the neighborhood. Due to the construction above the rail, some of these green spaces has no potential for inflitration, contributing positively however in the local microclimate through vegetation and less heat radiation. Lastly, new structures are designed with polder roofs which also are part of the green network.

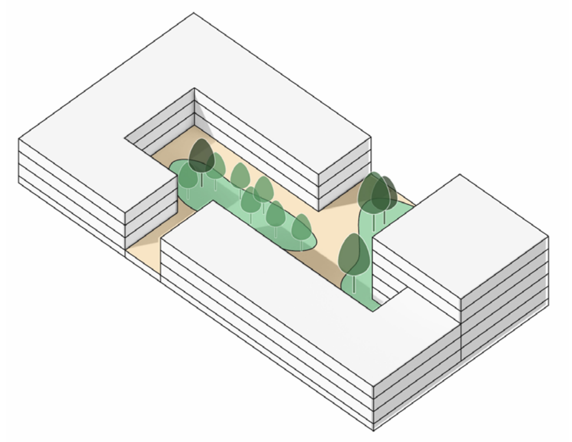
1. Urban park-Cool areas



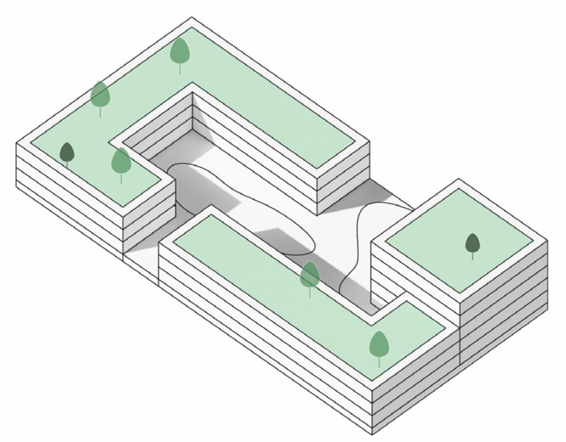
2. Raised park - No inflitration



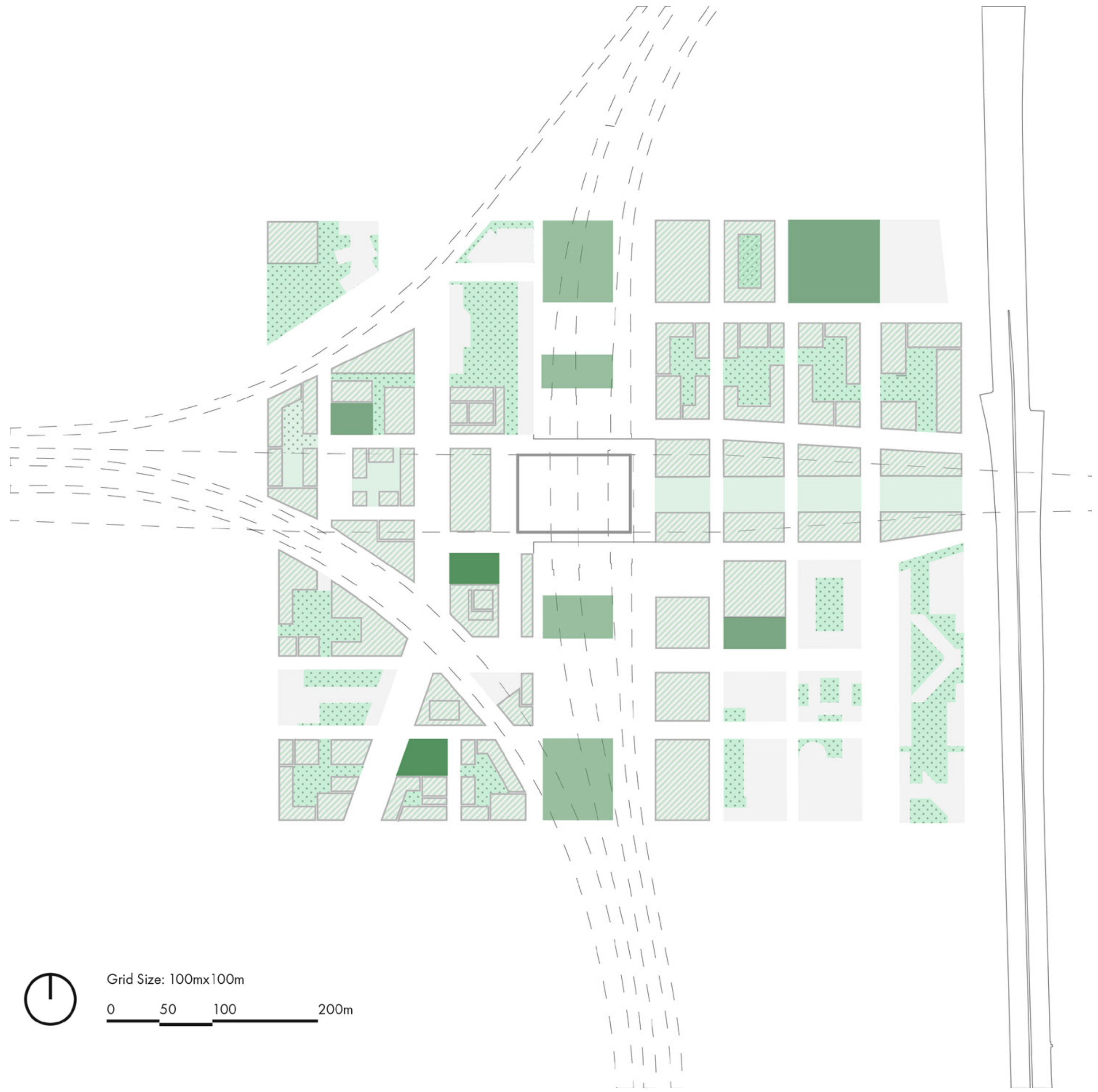
3. Inner-block greenery



4. Green/Blue Roofs



Green space network



Block

Inner block green space - inflitration

Inner block green space - no inflitration

Green/Polder roof

Neighborhood

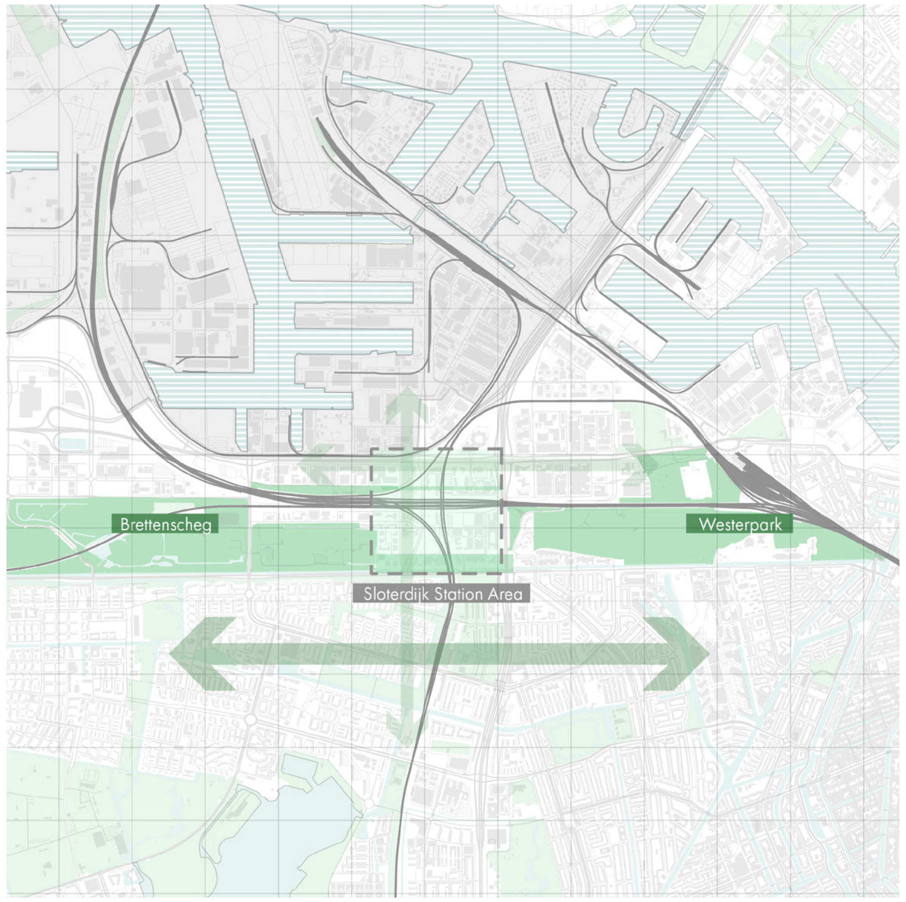
Park -Inflitration

Urban green - no inflitration

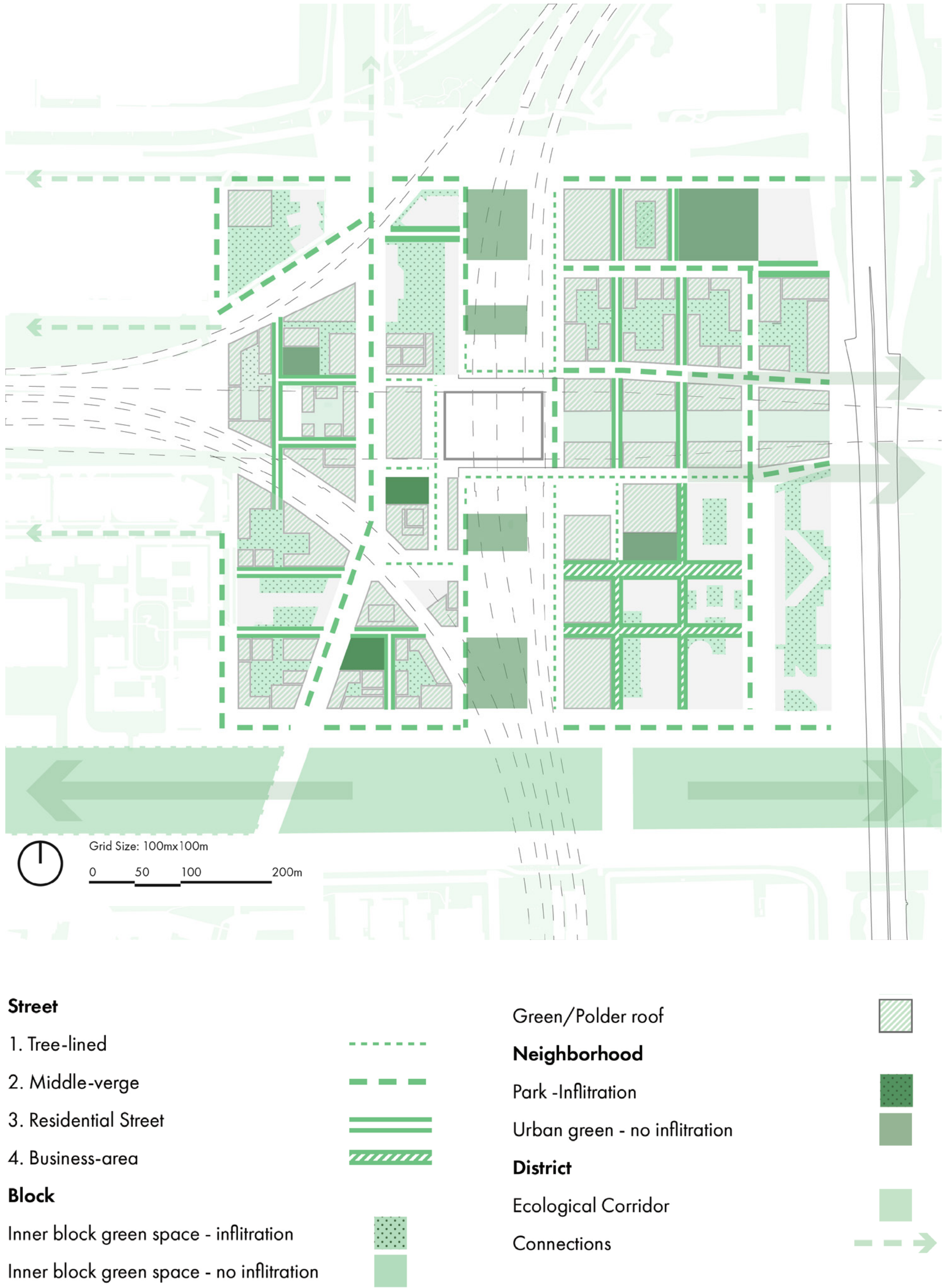
Complete Green network

To complete the green network, the city and district-level green structure is taken into account. As analyzed in the previous chapter, Sloterdijk is located within one of the large green structures of the city of Amsterdam, the Brettenscheg, creating a concrete barrier between the west and east part the green structure. By replacing the urban blocks on the southern part of Sloterdijk, a large space is now transformed into an ecological corridor, that will be primarily used by non-human populations. By integrating eco-passages (underpasses for fauna) in the two road connections interrupting the corridor, continuity is secured. On the other direction, connection between the district of New-West and Havenstad can be achieved through the main axis on the western part of the station and the continuous green patches that are created in the densified area above the railway tracks.

Integration with the overall green network



Complete green network diagram



Water management/Mitigating risks

At the same time with the green network, the blue network is developed. Key elements for the blue network are to retain and infiltrate as much water as possible during extreme precipitation, with the aim of mitigating pluvial flood risks. As this area is currently particularly vulnerable to flooding due to the extensive paved areas, the transformation of the strees and blocks to increase porosity, is imperative. Through polder roofs water is stored locally and then distributed to the overall network. Through underground water pipes, excessive water is directed bioswales through which water is purified naturally, and then water is directed to the larger water bodies of the area. Water squares in the main public spaces provide spaces where people can interact with water, while water can be retained in the part that due to the underground bike parking, water infiltration is not possible.

Measures

Polder roof

Figure 107. Example of polder roof in Zuidas, Amsterdam. Source: dakdokters.nl

Bioswale

Figure 105. Bioswale in Hannover. Source: www.urbangreenbluegrids.com

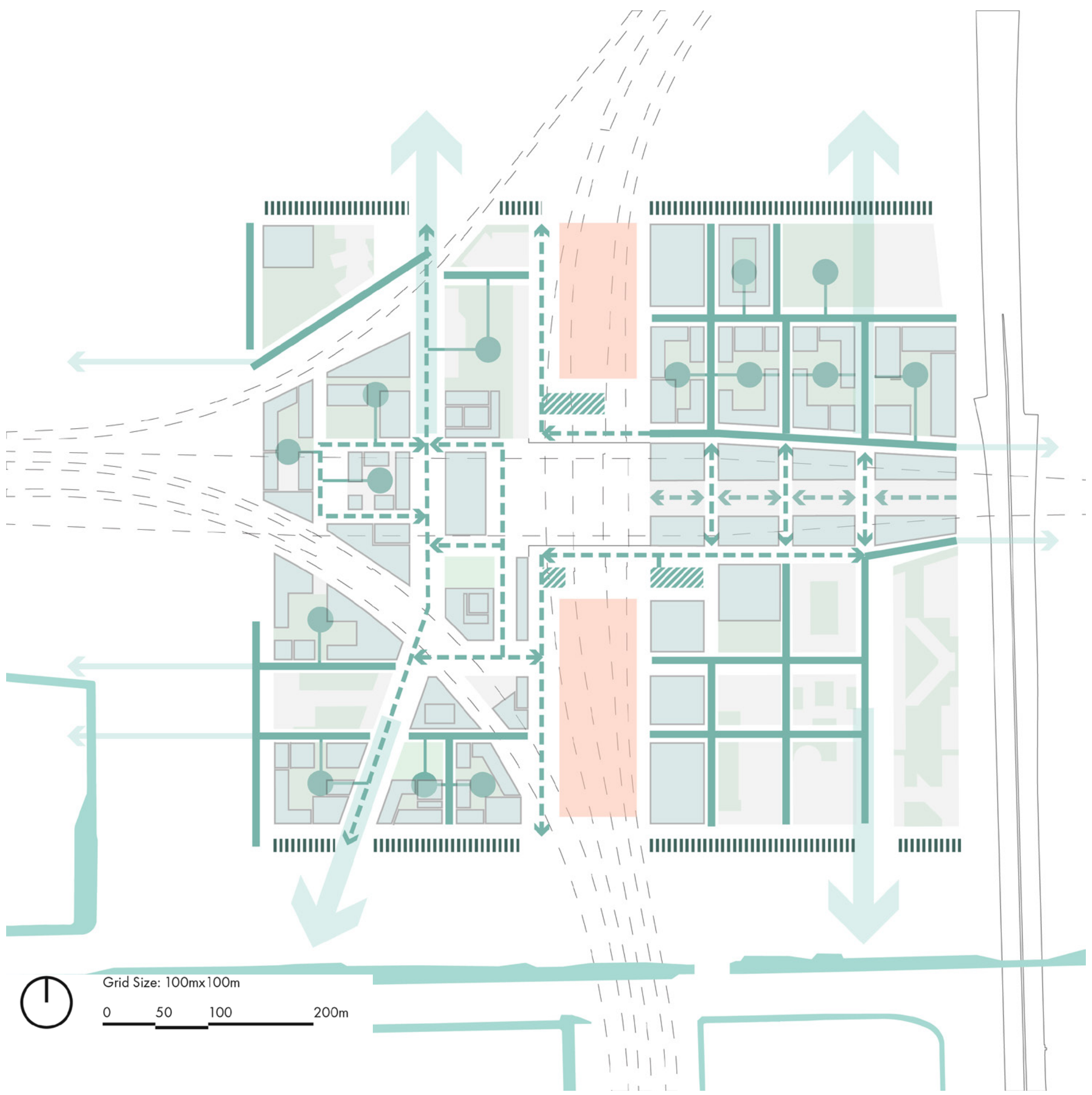
Raingarden

Figure 106. Raingarden in the Netherlands. Source: klimaatadaptatienederland.nl

Water retention square

Figure 104. Benthemplein watersquare in Rotterdam. Source: www.urbanisten.nl

Complete blue network diagram



Street
Raingarden
Underground pipe
Bioswale
Block
Block level temporary water storage
Polder roof
Inflitration area

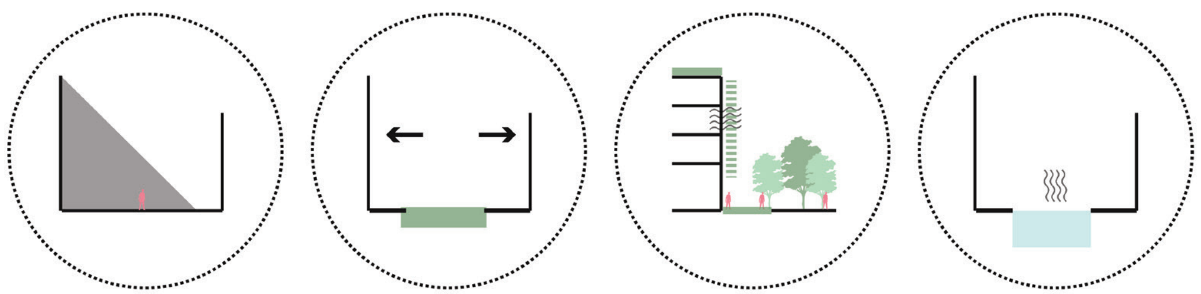
District
Temporary water storage-Watesquare
Canal-Haarlemmertrekvaart
Water direction
Underground bike parking

Heat stress mitigation

At the same time with the green network, the blue network is developed. Key elements for the blue network are to retain and infiltrate as much water as possible during extreme precipitation, with the aim of mitigating pluvial flood risks. As this area is currently particularly vulnerable to flooding due to the extensive paved areas, the transformation of the strees and blocks to increase porosity, is imperative. Through polder roofs water is stored locally and then distributed to the overall network. Through underground water pipes, excessive water is directed bioswales through which water is purified naturally, and then water is directed to the larger water bodies of the area. Water squares in the main public spaces provide spaces where people can interact with water, while water can be retained in the part that due to the underground bike parking, water infiltration is not possible.

Principles

Increase shadow | Increase permeable surfaces | Cool places | Water elements



Potential heat stress

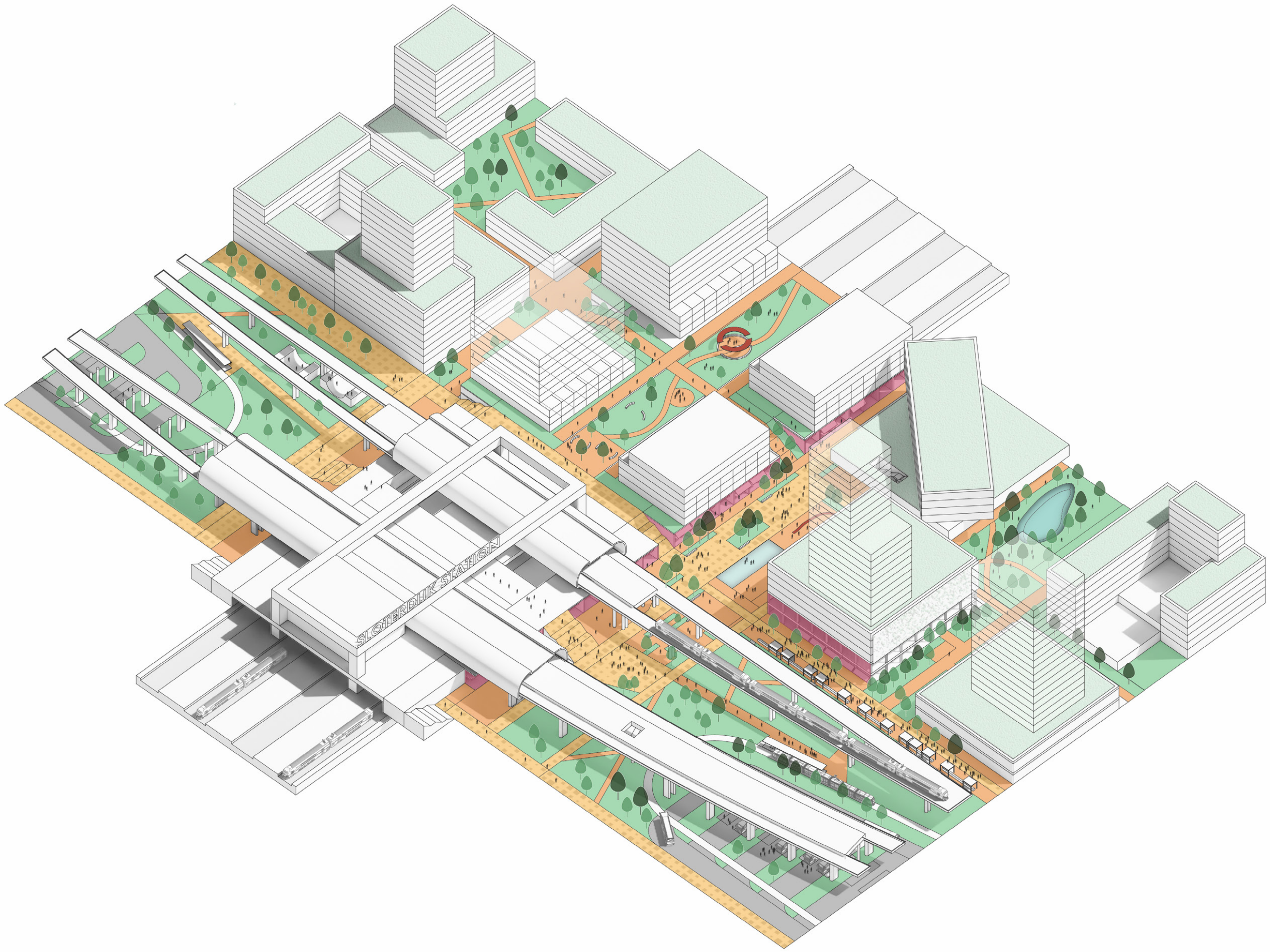
Paved areas

Expected heat stress

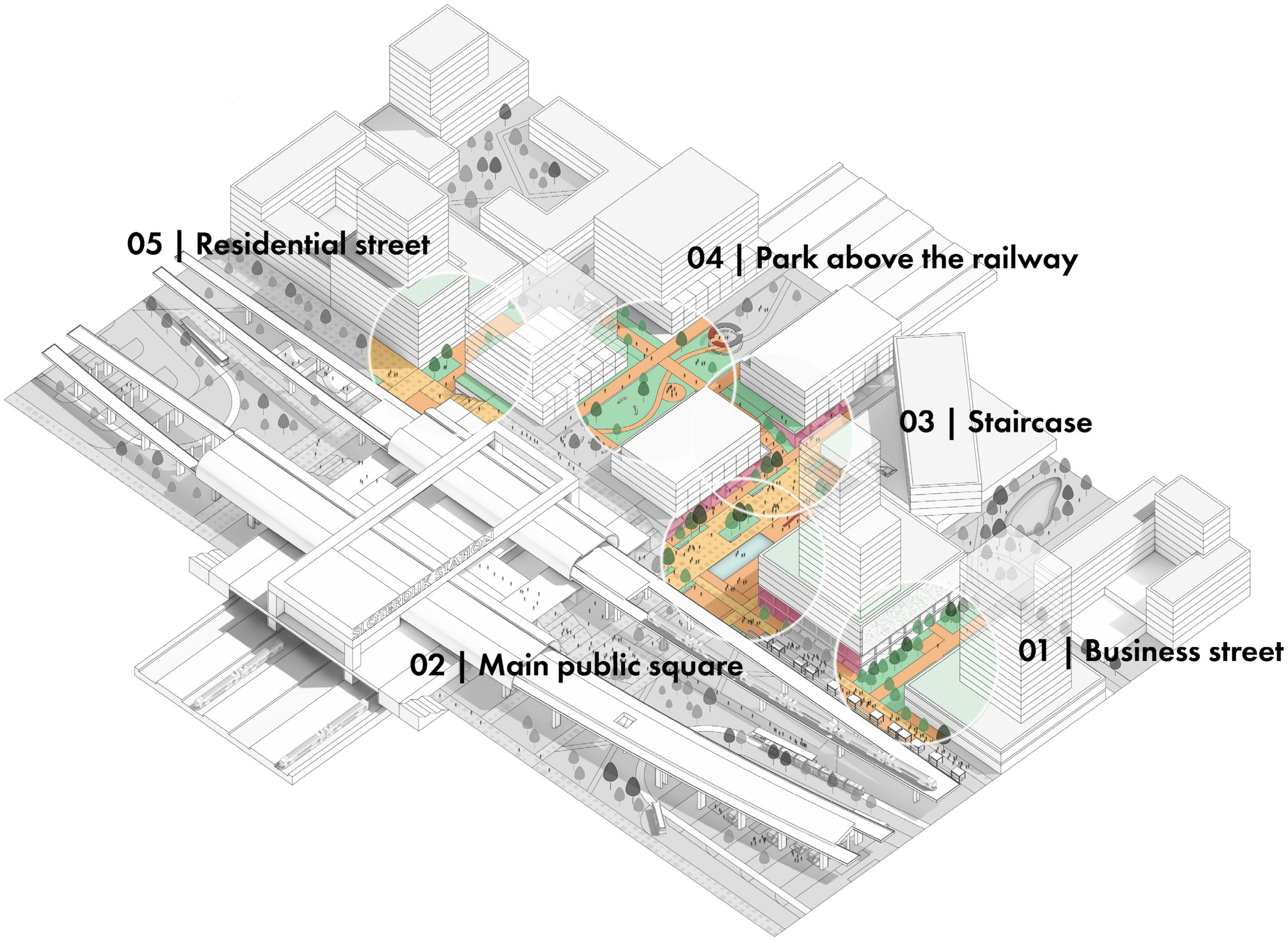
Cool places

6.6. Public Space

Isometric diagram



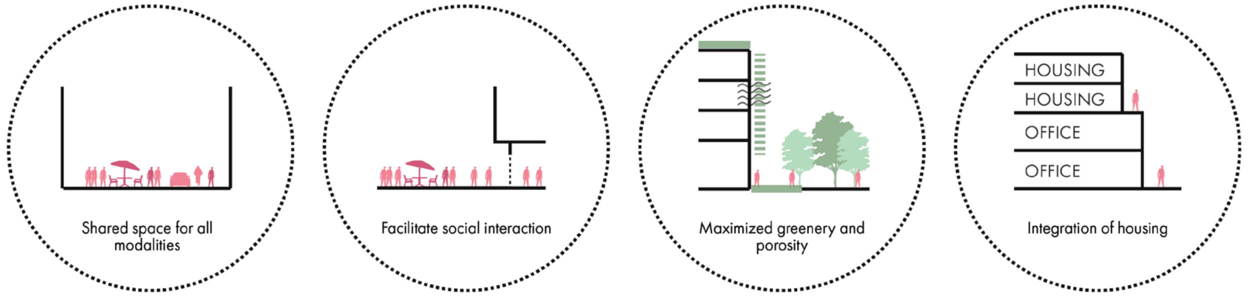
Distinction of 5 sub-areas



Differentiation between business and residential streets

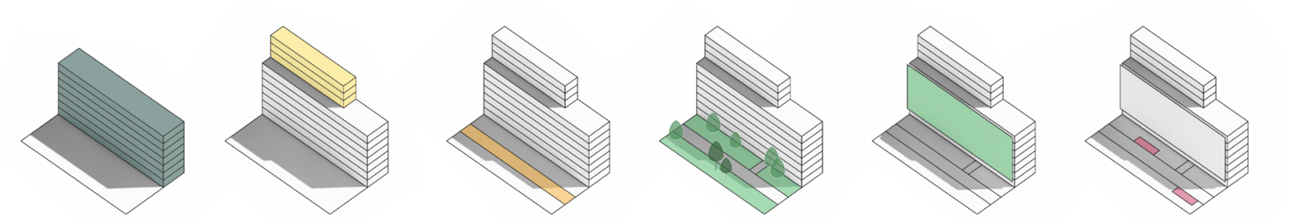
01 Business street

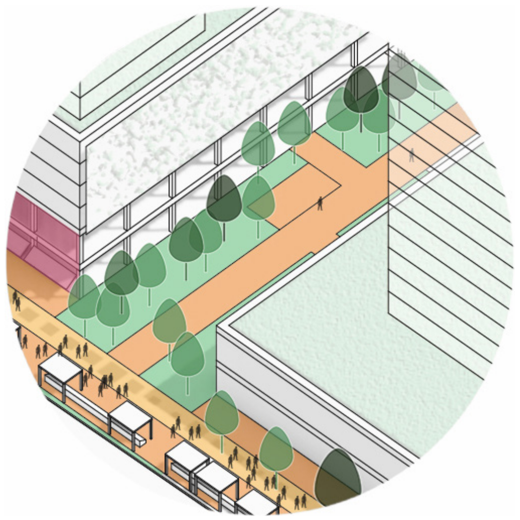
Principles



Design steps

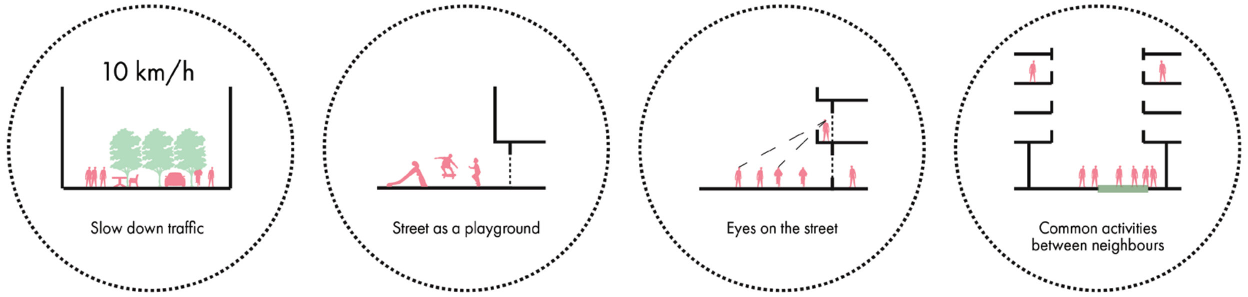
Road 20m | Addition of housing units | Middle shared street | Maximize green | Add green on buildings | Sitting places





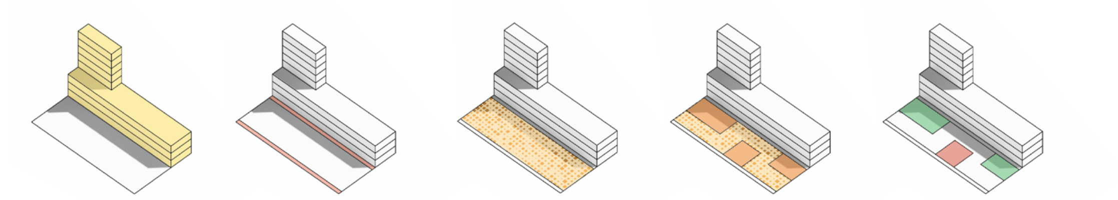
05 Residential street

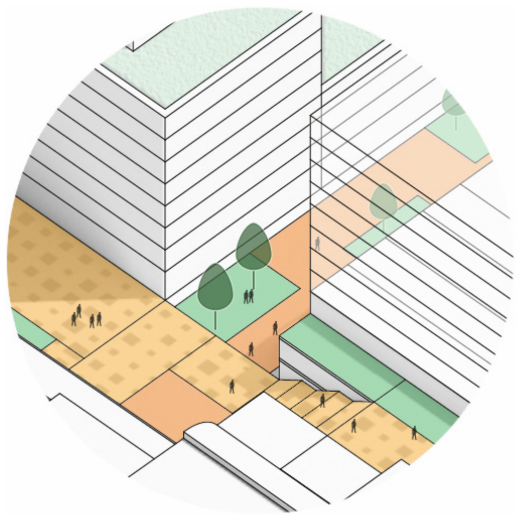
Principles



Design steps

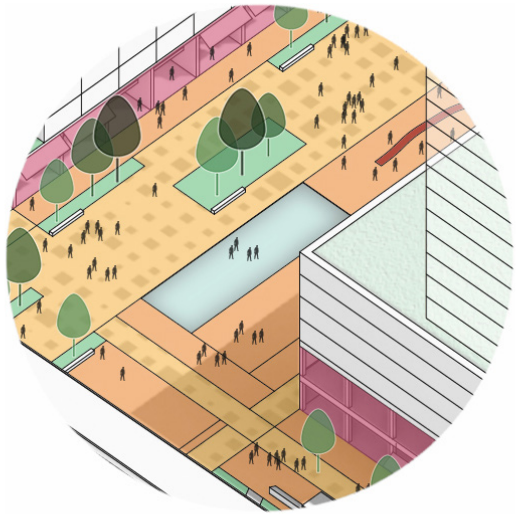
Road 12-18m | Semi private zone | Shared street | Slow down cars | Activities and green



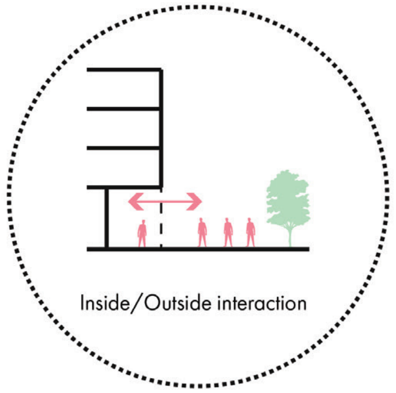


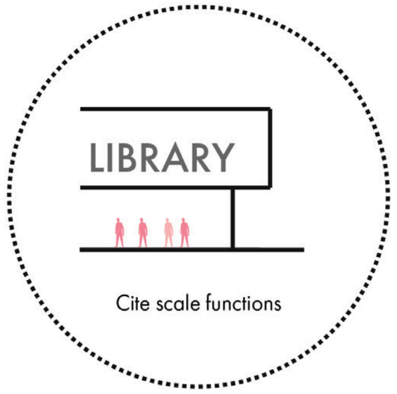
02 Main Public Square

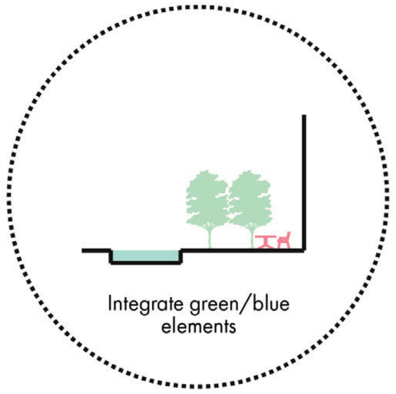
Fragment



Principles



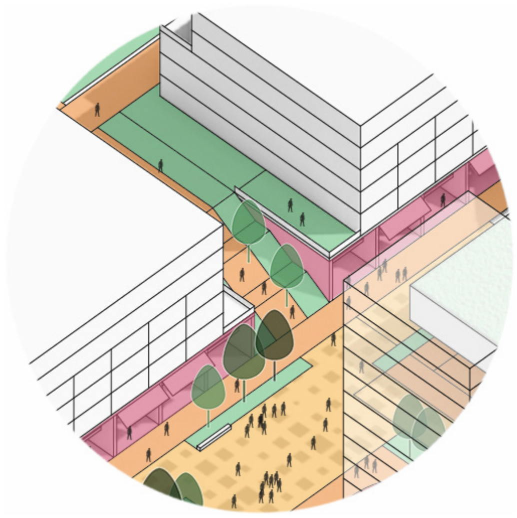




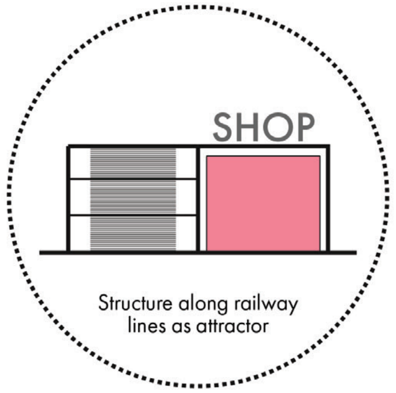
Eye level perspective

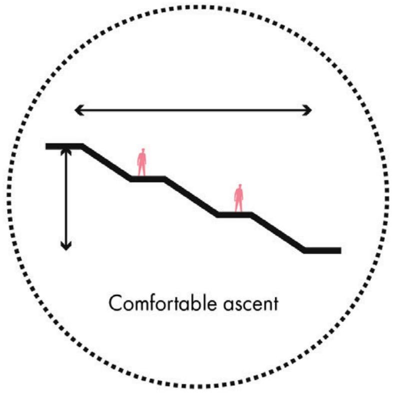
03 Staircase

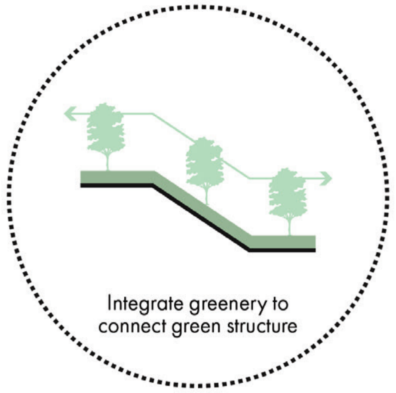
Fragment

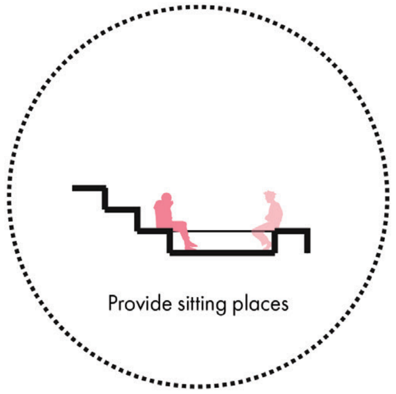


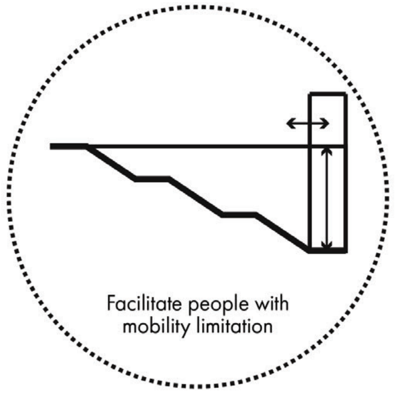
Principles





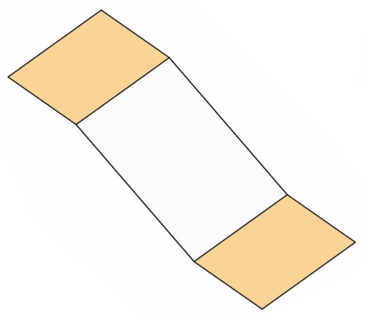




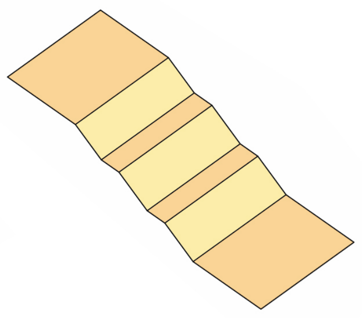


Design steps

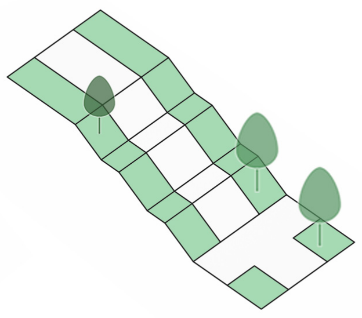
Connect levels



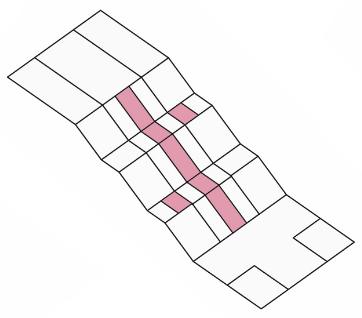
Split height



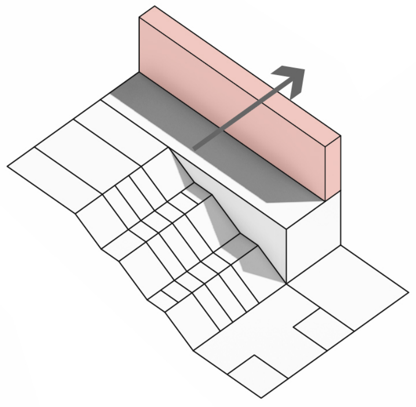
Green zones



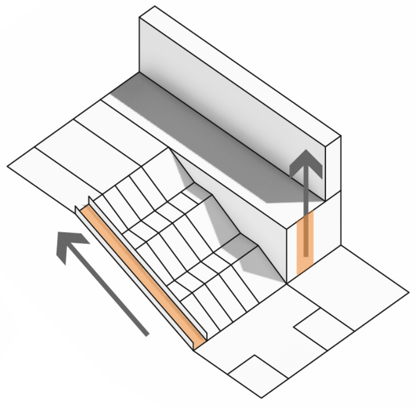
Sitting areas



Building Setback



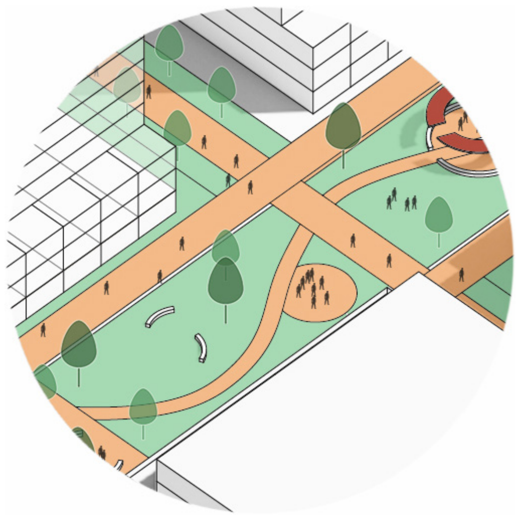
Elevators/Escalators



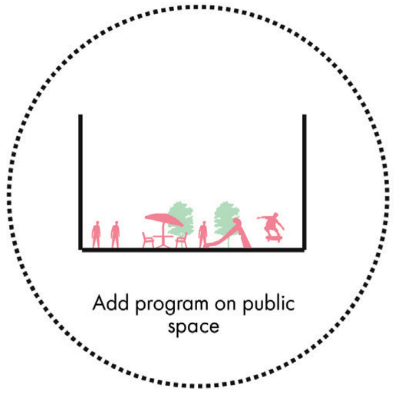
Eye level perspective

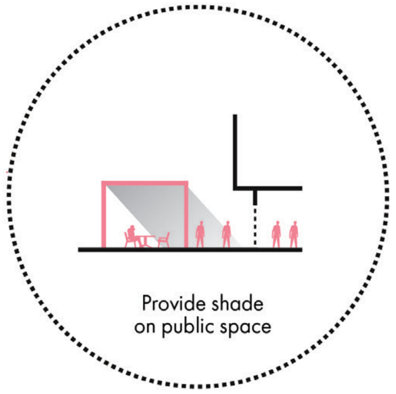
04 Public space above railway tracks

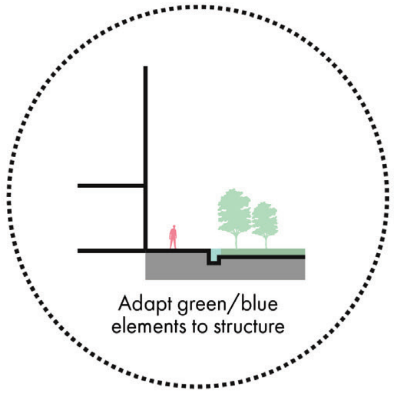
Fragment



Principles

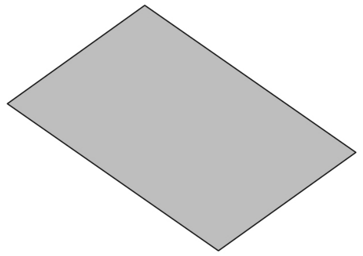




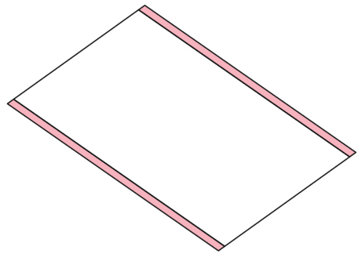


Design steps

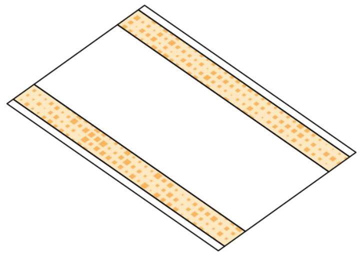
Create plaform



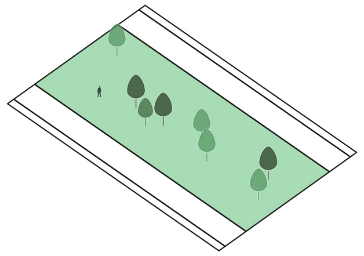
Semi-private zones



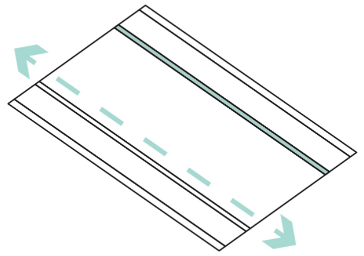
Wide sidewalks



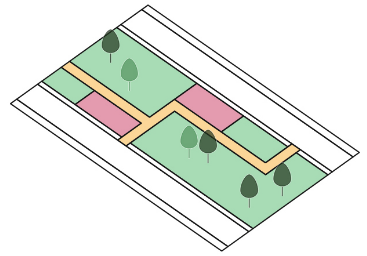
Green middle zone



Visible water gutter



Area for activities



Reflection 7

Reflection

Introduction

My graduation project "From Node to Place: A new sustainable and livable neighborhood in Amsterdam Sloterdijk" deals with the concept of Transit-Oriented Development and its spatial application in the case study of Amsterdam Sloterdijk, a major mobility hub and business district in Amsterdam West. With this project, and through the integration of a wide range of themes to the urban design aspect of TOD, I aimed in the creation of an overall spatial vision of the future TOD in the context of Amsterdam.

The project location, Amsterdam Sloterdijk, was selected for its importance as part of the mobility and employment network of Amsterdam and for its largely problematic function as a neglected part of the city. Amsterdam Sloterdijk proved to be a very promising location for this research as it is also part of a large transformation, the project of Havenstad, that is going to substantially increase spatial pressure on the area of Sloterdijk in the future.

The main points of focus for this graduation project were on density, program, public spaces, and sustainable mobility, bearing in mind the aspect of inclusivity of the different potential users, including both human and non-human populations. Analysis of the current urgencies the city of Amsterdam is facing, namely the housing and climate crisis, and the trend of substantial densification of the city, influenced the integration of climate adaptation and urban ecology as key elements of the design.

The project concludes with an overall vision for the area of Sloterdijk, which is transformed into an area where living and working and leisure coexist with the large mobility hub of the station. The urban fabric of which is transformed in such a way that is possible to adapt to current and future challenges and to eventually realize the potential of train station areas as places of great diversity, where social interaction is facilitated. At the same time qualities improving the livability and sustainability of the new neighborhood, are enhanced.

Relation to graduation studio

As mentioned before, this graduation project, draws the attention to the conflict between the two major crises that the Netherlands is currently facing, housing and climate. These two crises are interrelated, as the way in which the housing crisis is resolved, is going to play a major role in achieving a sustainable future for the Netherlands and vice versa. Therefore, this topic is directly linked to the urgencies that the field of Urbanism is dealing with.

In my approach to deal with these urgencies, the concepts of Transit-Oriented Development and density offer great potential. The complexity of the translation of these concepts into space requires a good understanding of space and context, therefore the integrated design and research approach of the studio Design of the Urban Fabric was a great match for my inquiry, as design is used as a method for research. Integrating design into the research process was highly beneficial in the way of simplifying the complexity of the area of Sloterdijk.

Furthermore, Design of the Urban Fabric studio puts the importance of place at the forefront of its approach, which allows for a deeper understanding of the urgencies and potentials of a given place. Starting directly with Sloterdijk as my project location allowed me to have a good understanding of the place from the early stages of my project.
t
Finally, within the current theme of the studio "Embracing Plurality-Growing porosity", my topic is strongly aligned with the studio's overall inquiry on the multiplicity of interactions within high-density urban areas in relation to both socio-economic and environmental issues.

Scientific and societal relevance

My graduation project started from a personal fascination regarding the concept of Transit-Oriented Development (TOD) and an overall academic interest on the matters of densification and sustainable mobility. This fascination led to the further refinement of my graduation project's topic, as a way to conceive the way TOD is a relevant concept that can be utilized to address and respond to ongoing urgencies. As a result, a more holistic approach was taken, also involving themes such as urban ecology and climate adaptation, both of which should be integral parts into the process of the spatial application of TOD. The complexity of the spatial translation of TOD in the case of Sloterdijk in relation to all the other themes addressed in this project, proves the necessity of a more holistic approach to the urban design of Train Station Areas. This is a valuable approach as literature on TOD is limited mostly to the mobility and functional perspectives of such developments.

In terms of the societal relevance, several concerns related to TOD and the process of densification, informed the project. Starting with developments around railway station areas, several realized projects resulted in the creation of exclusive urban districts. New developments around station areas are often market-oriented, primarily led by railway operators and developers, aiming in the maximization of profits, with little regard to social and ecological positive contributions. To alleviate this process, active involvement of municipalities is imperative to ensure these contributions. This graduation project dealt primarily with spatial and design related aspects that are related to the creation of more inclusive TODs. This was accomplished by highlighting the importance of public spaces and the provision of places with different qualities. A wide variety of public spaces with different characteristics ensures that people can have control over their desired social interaction, meaning that some public spaces can have higher intensity of human activities promoting social interaction while others provide quiet places which are highly valued in high-density areas.

Furthermore, considering the pressing issue of the current housing crisis, development of a high number of residential units in the area of Sloterdijk has a positive contribution to society. Diversification of the building stock and provision of a substantial share of social housing, can ensure the inclusion of larger parts of the society into the new area.

Risks associated with climate change, on local and global scale, are also strongly relevant in the case of Sloterdijk. Design decisions were made bearing in mind the possibility of mitigating risks related to heat stress and flood mitigation, with the aim of creating a healthy and safe environment for both human and non-human populations.

Considering the concept of accessibility which has a positive effect on society, is addressed and enhanced on three different levels. Firstly, due to fact that area is developed around a major mobility hub, accessibility to other places is high. The second level is related to the provision and therefore access of people who live in the area to a wide range of services and facilities such as schools, restaurants, libraries etc. Last but not least, the aspect of accessibility related to users, in my project is addressed through the consideration of their needs and how they can possibly use of space.

Ethical considerations regarding my graduation project are related to conflicts that could potentially arise with the current stakeholders through its implementation. Stakeholders include the railway operators and businesses established in the vicinity of the station area. For that purpose, the importance of public spaces, walkability and enhancement of public transportation should be highlighted along with a more sensitive approach to the changing climate and to the ecosystems. This will ensure even in a smaller scale, a more gradual implementation of the principles used in the integrated design.

Methods

Throughout the graduation project, several methods were used. First and foremost, the method of "research by design" was adopted. This means that by conducting design iterations, research knowledge is produced. For my project, several themes were distinguished in order to conduct more in-depth research to each of these important elements of the overall design. These iterations revealed several conflicts or potentials that arise with the spatial translation of each idea into the site. This process was helpful in the evaluation of each iteration and to the selection of the most promising ones for the integrated design. At the same time, the process of creating this integrated design revealed again several conflicts or potential synergies between the different elements. As result, this back-and-forth approach resulted in the refinement of the design.

The method of research by design was used particularly after my P2 presentation, as a method to dive deeper into the spatial aspects of the location. In retrospect, with the experience gained in the last part of my graduation project through this process, I believe that it would be even more beneficial to implement this method in an earlier stage of my project to allow more time for some parts it to be more refined. Nevertheless, the insights and knowledge gained through this method were crucial for the development of my project and as a method of working in my professional career.

After P2, Rients insisted on diving deeper into the spatial aspects and qualities of the design as the direction of the project was still abstract and the vision not clearly defined, while Ulf's feedback helped me in creating a more value-driven approach again keeping spatial qualities in mind. After my P3 presentation, and through this process of spatial exploration, the project was clearly defined.

Finally, in terms of the other methods used, mapping was also an important method of inquiry, particularly in the first stages of my project. Sloterdijk can be seen as a catalyst for the city of Amsterdam from various perspectives. Understanding of the context, its importance in the transportation network, the pressure from new developments, and the climate risks, revealed the urgencies but also the potentials that stem from all these.

Transferability

This project dealt with the transformation of a train station area into a dense, livable, and sustainable neighborhood. Amsterdam Sloterdijk is a very important node in the city of Amsterdam, a city which attracts large amounts of people for living and working and with ambitions of placing itself high in the competition among global cities. Therefore, several solutions utilized in this project such as the building over the railway tracks, would not be feasible in most of the other railway stations in the Netherlands, even in large cities such as the Hague.

Regarding the concept of Transit-Oriented Development, its transferability is also questionable as its spatial translation should be highly contextual and not just the application of the principles defined by literature. Cultural preference of biking in the Netherlands for example, is directly enlarging the catchment area of a potential TOD.

Nevertheless, the main principles and values of the proposed design can be used in relevant future projects. As work is becoming is location-independent, the creation of monofunctional business districts becomes obsolete. Accessibility provided by the transportation network will be enhanced by accessibility on the local scale of the train station areas and for multiple users in an inclusive manner. Careful consideration, diversification, and prioritization of public spaces over mobility systems, will ensure the vitality of the area and facilitate social interaction. A balance between busy and quiet places will enhance livability on such areas, while ecology will be integrated in the design process from early stages of the design. Lastly, climate adaptation as a crucial component of a dense urban environment will ensure a healthy and safe environment for human and non-human populations around transportation nodes. All these principles and values directly transferable to other station areas in the Netherlands.

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