

# Designing Healthy Density

## From Paradox to Nexus

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### Abstract

In an increasingly urbanised world, inner-city densification is a key strategy for achieving sustainable urban development. However, this process often conflicts with urban health goals, giving rise to the Health-Density paradox: the tension between Sustainable Development Goal (SDG) 11 for sustainable cities and communities, and SDG 3 for good health and wellbeing. This thesis explores how these contradictory objectives can be reconciled through design. Rather than seeking a universal solution, it argues for a context-sensitive approach by reconceptualising both urban density and urban health. Using the neighbourhood of Overvecht Zuid in Utrecht as a case study, the research investigates how urban densification strategies can be tailored to specific contexts in a way that promotes, rather than compromises, urban health.

This study applies a conceptual framework in which urban density is prescriptively defined through Floor Space Index (FSI) and Ground Space Index (GSI), while urban health is unpacked into eight determinants. The eight determinants are People, Lifestyle, Community, Local Economy, Activities, Built Environment, Natural Environment, and Global Ecosystem. The maximisation method structures the design process, enabling transparent urban design decisions throughout the process. The results suggest that targeted increase and decrease in GSI across the site can strengthen different health determinants. Although empirical data on the precise relationship between density measures and health determinants remains very limited.

All in all, this thesis demonstrates that the maximisation method can effectively serve as a design framework to operationalise the Health-Density nexus, offering a path towards urban densification strategies that supports urban health.

### Keywords

Urban health, urban density, Sustainable Development Goal 3: Good health and wellbeing, Sustainable Development Goal 11: Sustainable cities and communities, paradox, nexus, Overvecht Zuid, Utrecht



# Preface

They say writing a thesis is a solitary endeavor, but anyone who has attempted it knows better. Behind every analysis, vision map, and design intervention lies a small city of support and encouragement.

First and foremost, I must thank my mentors, for their guidance [REDACTED]

[REDACTED] Thank you  
Marjolein [REDACTED]

[REDACTED] Your ability to balance critical feedback with genuine encouragement made all the difference. Thank you Deepti [REDACTED]

[REDACTED] Without your insightful feedback, this thesis might still be a chaotic collection of design concepts and ambitions.

To my community of fellow graduation students and friends [REDACTED]

[REDACTED] Thank you for being the co-designers of this academic ride. Our many study sessions in the library made the process significantly more fun. It has been a joy to complete this chapter of my life together with you. I can't wait to see how you'll shape our cities, one thoughtful intervention at a time. May your path be as walkable, vibrant, and well-connected as your designs.

To my roommates: Lisa, Elsa, and Pablo. Thank you for reminding me there's a world beyond academic deadlines. You made more of a difference than you probably realize. To my family and friends, I am grateful for all the support I received along the way. Your faith in me meant everything.

Finally, I want to give my gratitude to [REDACTED] for bringing coolness in moments of heat and stress. Your unwavering support, well timed distractions, and ability to make me laugh like no other have been an invaluable blast. You've been my structural support, my open plaza when I needed air, and my guiding skyline [REDACTED]

May this thesis serve as a modest contribution to my field, but be slightly less sprawling than suburbia. Onwards to the next master (Architecture) and yet another thesis to come.

Tejon Tomas Kraan  
Delft, June 2025

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# PART I



Introduction

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Problem field  
the Health-Density paradox

2

Concept & Theory  
defining urban density & urban health

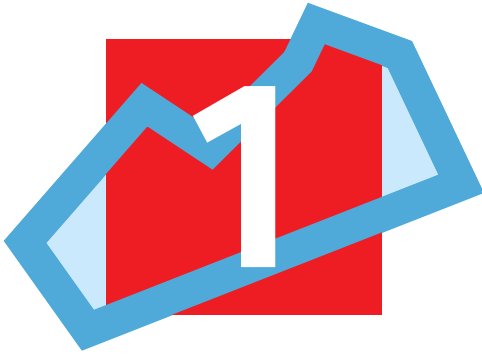
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# Introduction

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In this chapter, the thesis is introduced by first outlining its key topic and main research question. This is followed by a discussion of the relevant background, which provides context for the topic. Subsequently, the chapter positions this thesis within the broader context. This chapter concludes with a reading guide.

*What is the main topic of this thesis?*

## 1.1 Topic

This thesis bears the title *Designing Healthy Density*. The title veritably reveals the main topics: urban density and urban health in the field of urban design. Also, It unveils the design objective this thesis aspires to meet: Designing urban density as a means to improve urban health.

Integrating both urban density and urban health proves to be more complex than it might appear at first glance (Schonebeek, 2024). Even more so, within the coming chapters, it will become clear that urban densification and urban health can be at odds with each other (Figure 1). In an increasingly urbanised world (Deelen et al., 2020; Galea et al., 2019; Groot et al., 2018; PBL en CPB, 2015), inner-city densification is inevitable in the face of creating sustainable cities and communities. However, this process should not come at the expense of the health of urban residents (United Nations, 2015). Exploring this health-density paradox by examining the interplay between the key topics is crucial to develop urban densification strategies that are both sustainable and health-conscious. Therefore, the main research question this thesis seeks to answer is:

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*How could the **Health-Density paradox** be converted into a **Health-Density nexus** in the urban densification strategy for Overvecht Zuid, Utrecht?*

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The neighborhood of Overvecht Zuid will serve as the case study for this thesis. Chapter 4 will elaborate on the selection of this site. Overvecht is a post-war neighborhood located in the northern part of Utrecht, developed during the 1960s. Utrecht, situated in the centre of the Netherlands, is home to a population exceeding 370,000 residents (Utrecht in cijfers, 2024), making it the fourth largest city in the country. The municipality of Utrecht has outlined plans to add between 2,500 and 7,300 new dwellings to the existing housing stock within the boundaries of Overvecht Zuid (U Ned, 2020). The urban densification planned for this area presents an opportunity to research the potential for a health-density nexus.

## 1.2 Background

Researching the relationship between urban density and urban health is no novelty. Records indicate urban designers and planners have recognised the relationship between urban density and health since the second half of the nineteenth century. Prior, urban density was primarily a consequence of processes involved in city development. Factors such as building techniques, legal regulations, cultural traditions, and economic profitability requirements influenced urban densities (Berghauser Pont & Haupt, 2021, p.9).

Historical evidence supports the negative impact of high population densities on public health. In fact, it is argued that the concept of density emerged largely as a result of public health concerns. During the Industrial Revolution, high-density urban environments were reasoned to be significant contributors to disease outbreaks (Berghauser Pont & Haupt, 2021, p.9). Poor living conditions in rapidly industrializing cities were frequently linked to limited access to daylight, fresh air, clean water, and effective sanitation systems; issues that were particularly prevalent in high-density urban settings (Berghauser Pont & Haupt, 2021, p.27-28). During the bubonic plague outbreak of 1664, for example, the high-density neighborhoods of Amsterdam suffered more losses than others. Similarly, at the time of the fourth cholera pandemic of 1886, which claimed 21,000 lives, the majority of victims were concentrated in these high-density neighborhoods (Berghauser Pont & Haupt, 2021, p.26-27).

In response to these challenges, a noteworthy movement emerged at the end of the nineteenth century, which promoted decentralized, lower-density urban designs to reduce overcrowding and pollution, while enhancing sanitation and green spaces: the Garden City Movement. Influential figures such as Dr. Benjamin Ward Richardson envisioned the idealised city "*Hygiea*," where each family would inhabit a house of minimum size accompanied by a garden, thereby limiting density (Buder, 1990, p.69-71). Advocates of this approach sought to mitigate the health risks associated with high density by promoting lower-density living environments. As these ideas gained traction, density norms began to be incorporated into urban planning and regulations across Europe, with local governments adopting prescriptive measures to reduce the adverse health effects of overcrowding (Berghauser Pont & Haupt, 2021, p.8-9). Since then, the quest to identify universal optimal urban density measures for health improvement has remained a recurring topic among scholars and urban planners.

During the modernistic period, a new philosophy of healthy urban density caught on. Modernist planners and architects sought to use rational, scientific principles to design cities, often involving the application of density norms to ensure functionality and livability (Berghauser Pont & Haupt, 2021, p.29). Advances in building techniques, such as reinforced concrete and steel, facilitated the construction of taller buildings, allowing for increased vertical density while preserving open public spaces to enhance living conditions. Guided by the motto "*Light, air, and space*," modernist architecture and urban design rejected traditional building practices in favor of functional and minimalist forms. The ideal was to create comfortable, modern homes within healthy, green, and open urban environments that would be accessible to all (Le Corbusier, 1929).

The journalist, theorist, and activist Jane Jacobs, shed a light on another aspect of health, in her well known book *“The Death and Life of Great American Cities”* (Jacobs, 1961). She refuted this modernist approach to urban planning emphasizing to foster key elements of a thriving city such as social interaction, community vitality, and urban diversity to create safer, more vibrant, and livable cities; An approach which has direct implications for public health. She believed a higher density, consisting of at least 100 dwellings per acre, would suffice to create a successful urban environment.

The recent COVID-19 pandemic has reignited attention to healthy urban density. Once again, government officials have claimed that population density exacerbated the spread of the virus, resulting in recommendations for reducing density to save lives. However, Adlakha et al. (2024) shed a new light on the topic, stating these recommendations were premature, potentially harmful, and counter effective. Their paper states that approximately 95% of COVID-19 hospitalisations and deaths were linked to non-communicable diseases. This prompted the authors to argue that the pandemic is better understood as a *“syndemic.”* A syndemic is the convergence of different aspects such as the interaction of multiple health conditions, compounded by social, economic, and environmental factors. COVID-19 exemplifies this dynamic, involving not only health conditions directly related to the virus, but also non-communicable diseases and health inequities rooted in socio-economic, racial, and ethnic disparities. In contrast with the government recommendations, this highlights the need to prioritize activity-supportive built environments, characterized by high density, mixed land use, connected street networks, and recreational access, while ensuring equitable access to these features as part of syndemic mitigation efforts. Furthermore, the authors argue that density norms should not be shaped predominantly by their performance during rare, *“once-in-a-century”* events like pandemics, but rather by their enduring influence on urban health in everyday contexts.

Drawing to a close, as history reveals, experts and decisionmakers have taken divergent stances on the optimal urban density for protecting urban dwellers against disease, as well as increasing health and wellbeing among them. No ideal universal urban density recommendation has been established for enhancing urban health and perhaps none ever will. Therefore, it would be inane to try to achieve this in this thesis. Rather, this thesis aims to contribute to the ongoing discourse on healthy urban densification strategies based on a context-specific case. Offering insights to append to the current understanding of this critical topic.

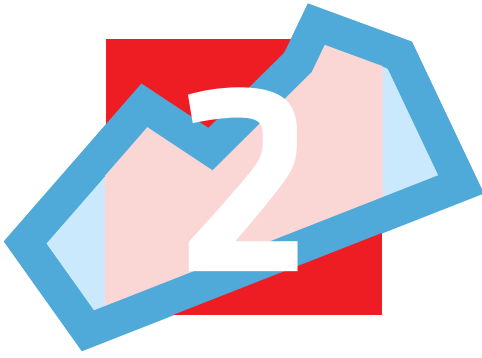
### 1.3 Reading guide

To answer the main research question, this thesis spans ten chapters. To enhance readability of each chapter, all chapters commence with a brief description and a dedicated chapter-specific table of content following the format presented at the beginning of this chapter. As outlined in the *Table of contents*, the work is structured into two parts, each comprising five chapters. *Part I* provides context to this thesis. It positions this thesis into a broader scientific frame of reference. *Part II* culminates in a design and strategy for Overvecht Zuid. This part concludes by answering the main research question.

Succeeding this *Introduction* chapter, *part I* first goes into the *problem field* chapter. This chapter begins by undertaking the formation of the problem statement. This foundation is further reinforced in chapter 3 *Concept & Theory*, which presents a literature study on the key concepts and theories to the central themes of this thesis. By the end of chapter 3, the positioning of this thesis within the context of these concepts and theories becomes evident in the conceptual framework. Subsequently, the *Site selection* chapter provides the justification for selecting Overvecht Zuid, supported by an analysis of Utrecht in terms of urban health determinants and urban density. *Part I* is finalised by the *Methodology* chapter, elaborating on the subquestions and methods employed to answer them. This chapter results in the methodological framework.

The chapters in *Part II* adhere to the structure of the maximisation method. Starting with the *Spatial analysis* chapter. This chapter analyses the current state of Overvecht Zuid, specifically examining the relationship between urban density and urban health in Overvecht Zuid. Subsequently, multiple scenarios for the healthy urban densification of Overvecht Zuid are developed in the *Maximisation* chapter, by addressing each urban health determinant separately. In the *Optimisation* chapter, these scenarios are synthesised into a vision map, which aligns with the primary objective of this thesis: a health-density nexus in the urban densification strategy for Overvecht Zuid. This process involves evaluating how the scenarios complement or compete with one another. Penultimately, in the *Integration* chapter, the vision map for Overvecht Zuid is translated into a design and development strategy for Overvecht Zuid. *Part II*, and thereby this thesis, ends with the *Conclusion* chapter, which answers the main research question, accompanied by a discussion and reflection.





# Problem field

*the Health-Density paradox*

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As the main topic and research question are introduced, this chapter will draw upon a comprehensive review of relevant literature to paint a picture of the problematisation of this study: the Health-Density paradox. First the paradox will be explained, after which both perspectives of the paradox are elaborated on. Penultimately, possible solutions will be put forward. Eventually, this chapter will culminate in a problem statement.

*What is the Health-Density paradox?*

## 2.1 The paradox explained

To explain the Health-Density paradox right away: within urban development the goal for good health and for sustainable urban developments lead to contradicting recommendations concerning suitable density measures. In this thesis the paradox is named the Health-Density paradox, because it can be explained using the concepts urban health and urban density. Figure 1 summarises the conflict between these goals, concepts, and trends within the Health-Density paradox. One perspective of the paradox recommends lower population densities through peripheral urban expansion strategies to reach the goal of improved health and wellbeing. The other perspective, however, shows that, in an urbanising world, higher population densities are necessary in the face of creating sustainable cities and communities.

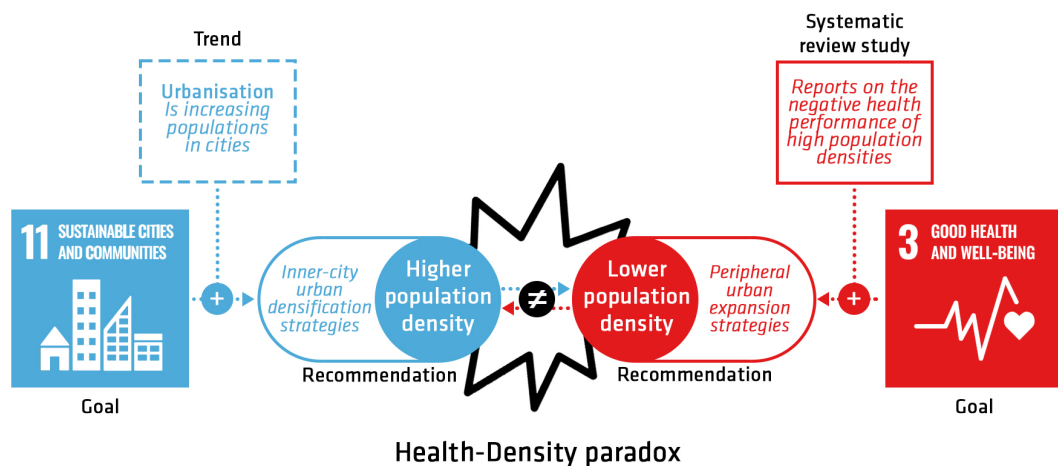


FIGURE 1 A conceptual framework for the Health-Density paradox, by Tejon Tomas Kraan, visualisation of the SDGs are by United Nations, 2015.

The Health-Density paradox is rooted in the two of the seventeen Sustainable Development Goals (SDGs), the United Nations adopted in August 2015. The SDGs, shown in Figure 2, were introduced to replace its predecessor, the Millennium Development Goals (MDGs) from 2000, in order to fully meet the urgent environmental, economic, and political challenges the world faces since the start of the 21<sup>st</sup> century (United Nations Development Programme, n.d.).

*SDG 11: sustainable cities and communities* is important because it addresses the critical need for sustainable urban development in a rapidly urbanizing world. By focusing on inclusivity, safety, resilience, and sustainability, this goal helps to ensure a better future for billions of people while protecting the environment and fostering economic growth (United Nations, 2015).

Simultaneously, *SDG 3: good health and wellbeing* is crucial to ensure healthy lives and promote wellbeing for everyone at all ages. By addressing health inequities, strengthening health systems, and fostering innovation, SDG 3 does not merely improve individual wellbeing, but also drives economic and social progress globally (United Nations, 2015).

## SUSTAINABLE DEVELOPMENT GOALS



**FIGURE 2** The 17 Sustainable Development Goals adopted by the United Nations in August 2015. From “the 17 goals,” by the United Nations, 2015 (<https://sdgs.un.org/goals>).

To comply with all the SDGs, it is crucial to balance SDGs 3 and 11 to ensure the health of city residents while creating sustainable dense cities. But, how come there are no clear solutions yet for urban designers? In an interview with *Gebiedontwikkeling.nu*, Hanneke Kruize, Lector Healthy Urban Development at the *Hogeschool Utrecht* and the *RIVM*, says:

*“The knowledge of health professionals about the living environment and health is not optimally used. The experts are not around the table, or are only involved late in the process. Secondly, the knowledge that is already available about health and the healthy living environment in the city is difficult to find for many professionals in the spatial domain - such as urban designers, architects, and urban planners.”* (Monster, 2023)

This highlights the necessity to investigate the knowledge gap between research and urban design related to urban density and urban health. This is important in order to provide urban designers and planners with the tools and know-how to convert the Health-Density paradox into a Health-Density nexus.

## 2.2 Health risks perspective

As mentioned, urban densification strategies and urban health are at odds with each other. A study comparing more than 900 European cities states that the number of natural deaths in highly-populated cities is 12% higher compared to less densely populated, greener cities (Lungman et al., 2024). Berghauser Pont and Haupt (2021) also confirm this correlation in a systematic review paper on the performance of urban density, reviewing 330 empirical studies. On the basis of the results of this paper, they conclude that many studies report on the negative effects of high population density on multiple health aspects (Figure 3, aspect 6). Thereby showing, that the current scientific discourse supports the plausibility of the Health-Density paradox.

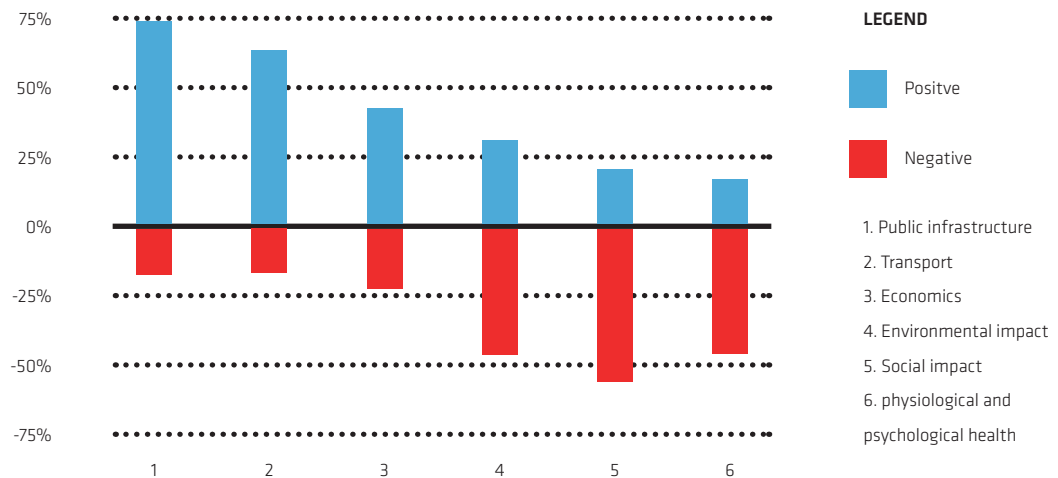


FIGURE 3 A diagram showing the performance of high urban density. from Spacematrix. Space, Density and Urban Form (1<sup>st</sup> ed., p. 152), by Berghauser Pont & Haupt, 2021, nai010 publishers.

It is crucial not to oversimplify the concept of health. Since the 1960s, the pleas of Jane Jacobs (1961) for the involvement of the social components to urban planning, briefly mentioned in the introduction, have been broadly recognised. Reciprocally, inadequate attention to health may worsen social segregation caused by health disparities (van Velze et al., 2020). Studies like these, demonstrate that social aspects, such as social interaction, community vitality, and urban diversity that create safer, more vibrant, and livable cities should be an integrated into the concept of health.

Additionally, as Philippe Rahm illustrates in Figure 4 there is a strong relationship between the microclimate and the physical environment on human health. To fully encompass the problem at hand, this thesis recognizes environmental health as an integral part of health within cities under the term *urban health*. The concept of urban health was introduced by Sandro Galea, Catherine K. Ettman, and David Vlahov in their eponymously named book explaining: “A consideration of cities and health does not mean thinking of cities as adverse to human health, nor as cities as generators of human health. Rather, an urban health approach considers cities as the modal form of human living and recognizes that such a commonly felt exposure must, by definition, influence much of what we do and how we do it” (Galea et al., 2019, p.12).

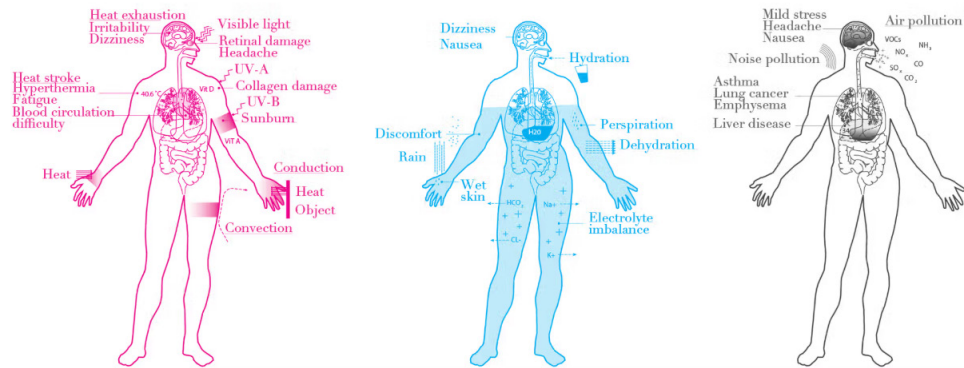


FIGURE 4 A drawing showing the relationship between health and environmental aspects. From “Climatic Architecture,” by Philippe Rahm, 2023. nai010 publishers.

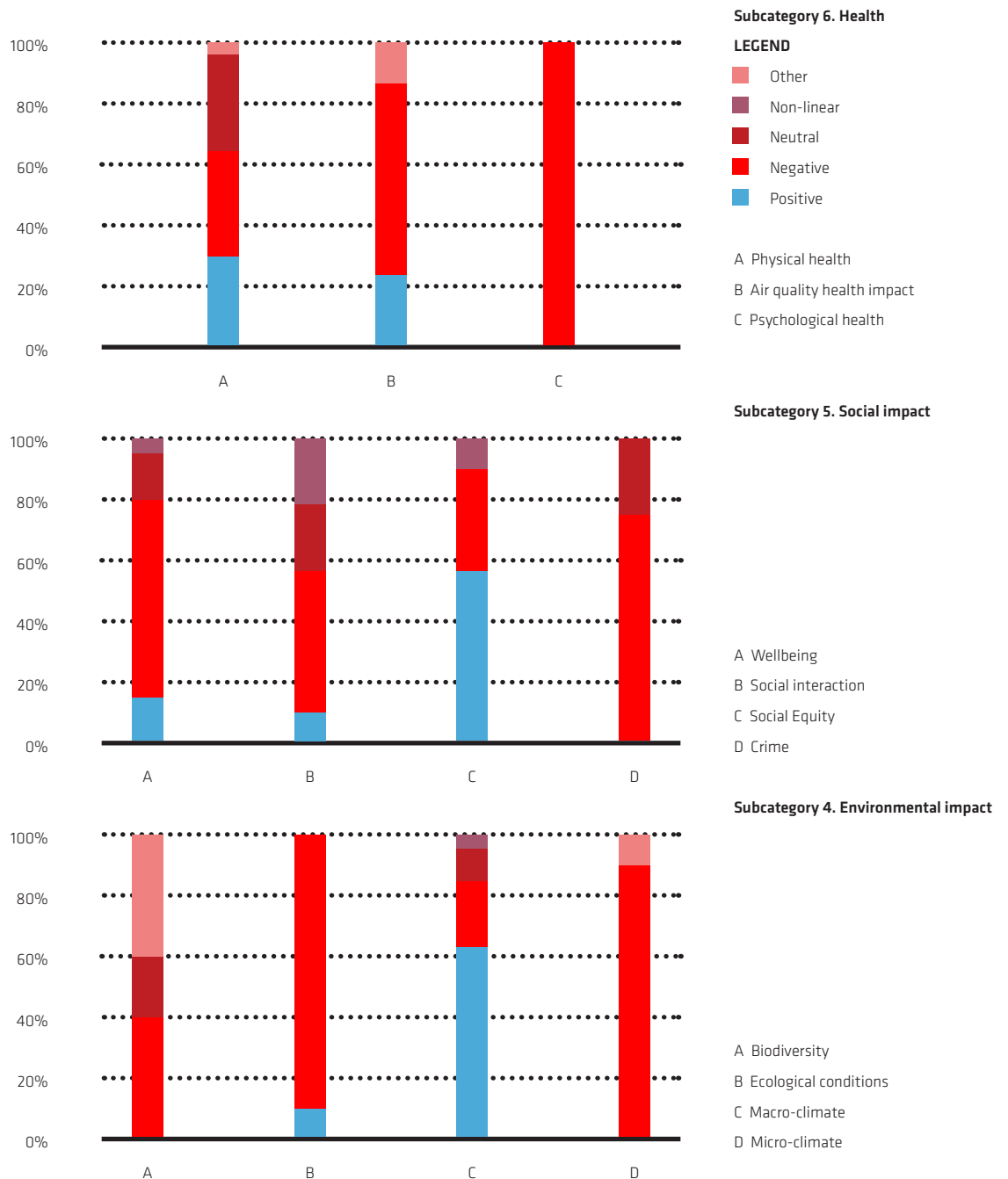
The extension of the concept of health to an integral urban health approach, reinforces the problem at hand. As the fourth aspect depicted in Figure 3 shows, Berghauer Pont and Haupt (2021) prove that the impact on the environment increases with high urban densities. The social impact of higher urban densities paint an even more bleak picture of the problem (Figure 3, aspect 5).

There are numerous studies, investigating these urban health risks caused by higher urban densities (Figure 5). Residents of densely populated cities experience physiological health risks, due to poorer air quality and increased heat stress can be found throughout the body. They include cardiovascular and respiratory disease, renal failure, liver damage, neurological dysfunction, and even birth defects (Nidhy et al., 2020; Ramly et al., 2024).

Additionally, Ramly et al. (2024) emphasize the increased psychological health risks like depression, insomnia and anxiety that are caused by high urban density-induced heat stress. Nidhy et al. (2020) add cognitive dysfunction to this list. Another impact on psychological health caused by high population densities is chronic stress (Beenackers et al., 2024). Partly because an increase in population density also reduces the opportunity to recover from stress.

Berghauer Pont and Haupt (2021) elaborate on the social impact of urban density. Wellbeing, often based on quality-of-life indicators, generally decreases with increased population densities. Higher population densities and crime rates, as part of social health, also seem related, although more research is needed to state this confidently. Concerning social interactions, their research shows that medium densely populated cities are optimal and higher densities are detrimental. Beenackers et al. (2024), confirms this notion stating that high population densities can actually decrease social interaction due to increased anonymity. They also link a reduced sense of safety, a lower sense of place and neighborhood reputation, weak social cohesion, a lack of social support, and little community engagement to higher population densities.

As Figure 5 shows, Berghauer Pont and Haupt (2021) have found negative correlations between higher urban densities and biodiversity, ecological conditions, and the microclimate. Negative effects stated are the loss of genetic diversity and population size over time, and the worsening of heat stress and the urban heat island. However, one positive aspect of higher density is its potential to reduce greenhouse gas emissions



**FIGURE 5** Diagrams showing the reported relation between higher urban densities and sub-category “4. Environmental impact”, “5. social impact”, and “6. Health” (see Figure 3). From Spacematrix. Space, Density and Urban Form (1<sup>st</sup> ed., p. 153), by Berghauser Pont & Haupt, 2021, nai010 publishers.

Researches into the performance of urban density on urban health, such as the studies outlined above, are significant because they back up the argument for the recommendation of urban development with lower population density. A strategy which promotes urban expansion into the peripheral areas of cities.

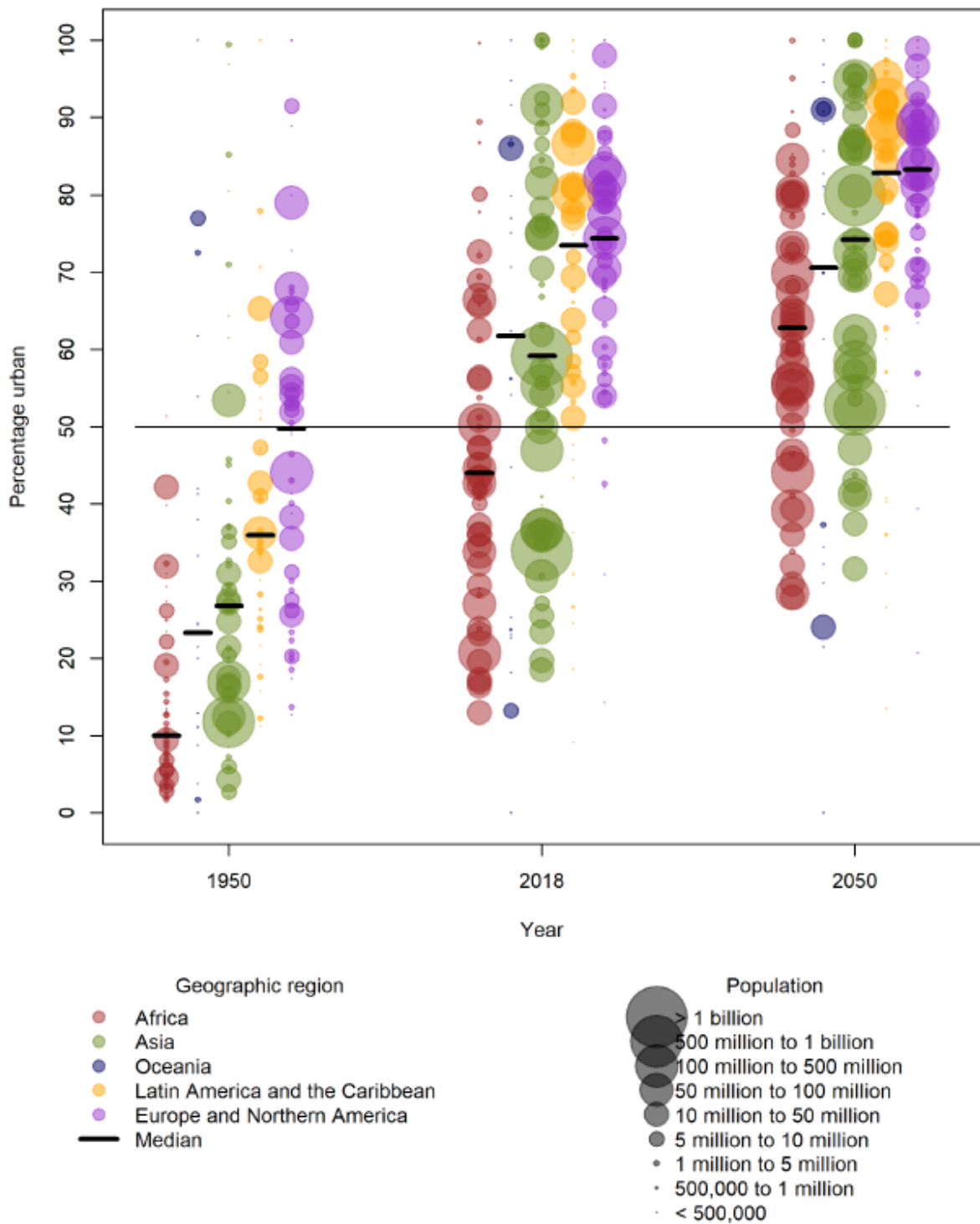
## 2.3 Sustainability & Urbanisation perspective

*“Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs”* (World Commission on Environment and Development, 1987). Setting the SDG 11 has been particularly urgent to obtain sustainable development while facing the urbanisation trends that are observed globally (Galea, 2019). Urbanisation is defined as the increase in the proportion of people living in towns and cities (European Environment Agency, n.d.). In the World Urbanisation Prospect report, the department of economics and social affairs at the United Nations (2018) foresees that cities across continents are becoming the modal form of living (Figure 6). In the past century, the amount of urban dwellers has increased and this trend is projected to continue to increase in the coming 50 years. Moreover, Galea (2019) states that, by 2050, an estimated 68% of the global population will reside in cities. And so, urbanisation is a defining trend of urban developments worldwide. Therefore, it requires careful consideration in urban designs and planning to accommodate sustainable growth and ensure equitable opportunities for all.

Similar to other countries, the Netherlands experiences urbanization. This has led to pressure on the housing market, which is more harsh in urban areas than elsewhere (Deelen et al., 2020; Groot et al., 2018; PBL en CPB, 2015). The housing shortage has resulted in a national housing crisis, which particularly affects vulnerable groups, increasing inequality. To mitigate this crisis, the Dutch government has set a target of building 1 million homes by 2030. In the past two years, almost 180.000 new homes have been built. However, the task remains large: from 2024 onwards, more than 800.000 homes must be added, of which two thirds have to be affordable housing (Rijksoverheid, 2024). Meeting the needs of the present and the future, necessitates making efficient use of every available square meter, including those inner existing urban areas.

To house the increasing urban populations while complying with the SDG 11, government institutions at all levels are committed to develop and promote dense, mixed-use, walkable urban environments (Garnett, 2017). According to Kersten Nabiliek (2012) from the Planbureau van de Leefomgeving (=Dutch Environmental Assessment Agency), Dutch spatial policies have endorsed inner-city densification strategies for half a century. Inner-city densification strategies refer to urban planning aimed at increasing population and dwelling density within existing city areas by optimizing land use, adding housing, and improving infrastructure. Antecedently, this urban planning strategy has been deployed as a key strategy to limit suburban sprawl in order to protect peripheral, natural and agricultural landscapes. Other benefits of inner-city densification strategies, Nabiliek (2012) states, are the decrease in energy consumption and the feasibility of public infrastructure investments. Moreover, they argue, that inner-city densification fosters social diversity as well as cultural and economic development.

It is worth mentioning that within inner-city densification strategies the dwelling- and population density will inherently increase. Thus, endorsing inner-city densification strategies, means recommending higher population densities (Figure 1).



**FIGURE 6** A graph showing the percentage of population residing in urban areas for all countries of the world, by geographic region and population size, 1950, 2018 and 2050, from "World Urbanization Prospects: the 2018 revision," by the United Nations Department of Economics and Social Affairs, 2018.

The Dutch Ministry of Housing and Spatial Planning, has drawn up the NOVEX-programme (2022) with the objective of building 1 million homes by 2030. Within this programme, the ministry has appointed 16 areas of interest to accommodate the vast majority of new housing (Figure 7). To tackle the national housing crisis in a sustainable manner, the emphasis of the NOVEX programme has been put on inner-city urban densification strategies throughout the country.



**FIGURE 7** A map showing the NOVEX-areas, adapted from “Programme NOVEX”, by Ministry of Housing and Spatial Planning, 2022.

## 2.4 Achilles heel

Once again, history appears to repeat itself: the Health-Density paradox shows that a universal recommendation for urban density does not exist. The paradox shows that two contradicting urban density recommendations are promoted in the pursuit of creating sustainable development. On the one side, it is proven that high population densities can cause harm to the health of urban dwellers. Yet, on the other side, Inner-city densification strategies are inevitable in the face of creating sustainable cities and communities in an increasingly urbanising world (Figure 1).

In previous paragraphs, it is established that urbanisation will have a persistent influence on city planning and design. In order to handle this sustainably, the need for inner-city densification strategies is crucial, reinforcing its position into the Health-Density paradox. Nevertheless, there remains room for leeway. Two vulnerabilities can be identified within the argumentation of the Health-Density paradox:

### 1 **The definition of urban density via population density will generally lead to a dead end.**

The empirical studies, which Berghauser Pont and Haupt (2021) make use of in their systematic review paper (see Figure 3), for the greatest part express urban density via population density. Likewise, local governments oftentimes merely name the amounts of dwellings that are to be added to the existing housing stock in appointed areas or neighbourhoods, indirectly describing it in terms of dwelling density (Planbureau van de Leefomgeving, 2022). Inner-city densification intrinsically implies an increase in population and dwelling density. Consequently, inner-city densification can be interpreted as a threat to urban health. So, defining urban density this way does not present an opportunity for improvement. Thus, with the aim of coming to an Health-Density nexus for Inner-city densification strategies, a more suiting definition of urban density is needed.

### 2 **Using health as a general indicator is too generic and ineffective in determining the performance of urban density explicitly.**

When applying the urban health concept, introduced in this chapter, the concept of health comes to be rather multifaceted. Subsequently, there is more than one aspect that can determine the urban health on site. Through the concept of urban health, it can even be theorised that both the SDG 3 and 11 are inseparably interconnected. Obtaining good health and wellbeing means to reduce the environmental issues and social challenges, which is inherently part of creating sustainable cities and communities and vice versa. So, attempting to diagnose a city's health based solely on a generic interpretation of the concept of health, is an oversimplification that disregards the complexity of urban health.

Due to these two vulnerabilities, it begs the question if the reinterpretation of the concepts of urban density and health could be central to converting the Health-Density paradox into a Health-Density nexus.

Perhaps the achilles heel of the Health-Density paradox resides in the definitions of its core concepts: urban density and urban health. To be more specific, maybe the concept of urban density can be redefined beyond commonly used metrics such as population or dwelling density. While the notion of urban health can help with a reinterpretation of the concept of health toward a more nuanced perspective. Thus, in this thesis it is hypothesised that this reinterpretation will enable urban designers and planners to address the pathways linking urban density and urban health, without the paradoxical implications currently observed. By doing so, a Healthy-Density nexus can be achieved.

As was stated in the introduction, it would be inane to try too establish an ideal universal urban density recommendation for the betterment of health. However, the reinterpretation of concepts might ignite a shift in which the relationship between urban density and urban health will vary greatly across locations. This calls for a context-sensitive approach, in which each site requires tailored density recommendations that may, at times, contradict between different contexts. This approach will not lead to universal optimal density recommendations, but rather a framework to successfully convert the Health-Density paradox into an Health-Density nexus.

## 2.5 Problem statement

Combining all aforementioned information, the problem statement is as follows\*:

---

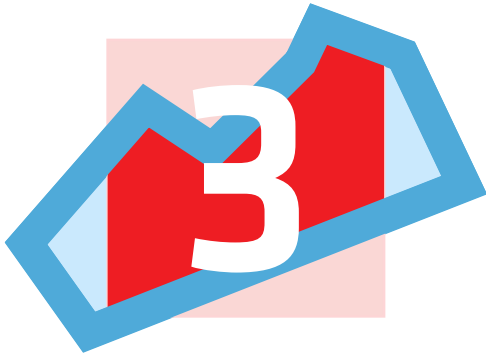
Despite efforts to meet the sustainable development goals (SDGs <sup>[1]</sup>) with inner-city urban densification strategies, a paradox appears <sup>[2]</sup>. The ambitions for SDG 11: sustainable cities and communities on the one hand and SDG 3: good health and wellbeing on the other, result in contradictory urban density recommendations. In an increasingly urbanising world <sup>[3, 4, 5, 6]</sup>, inner-city urban densification is a crucial strategy <sup>[7, 8]</sup> in the face of creating sustainable cities and communities. However, these strategies should not come at the expense of the health of urban residents. Yet, extensive research shows that higher population densities do lead to certain health issues <sup>[9, 10, 11, 12, 13]</sup>. This paradox is specified as the Health-Density paradox. Perhaps a design exploration, investigating the Health-Density paradox by examining the definition and interplay between its key topics, can remedy the situation and convert the Health-Density paradox into a Health-Density nexus in the case of context-specific inner-city urban densification strategies.

---

- [1] *United Nations, 2015*
- [2] *Schonebeek, 2024*
- [3] *Deelen et al., 2020*
- [4] *Galea et al., 2019*
- [5] *Groot et al., 2018*
- [6] *PBL en CPB, 2015*
- [7] *Garnett, 2017*
- [8] *Nabiliek, 2012*
- [9] *Beenackers et al., 2024*
- [10] *Berghauser Pont & Haupt, 2021*
- [11] *Lungman et al., 2024*
- [12] *Nidhy et al., 2020*
- [13] *Ramly et al., 2024*

\*Exclusively for the problem statement, the referencing style has deviated from the standard APA7 style for readability purposes.

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# Concepts & Theory

*defining urban density & urban health*

## Contents

3.1 Defining urban density	27
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The previous chapter has stated the problem and achilles heel thereof. It is hypothesised that shedding a new light on the concept of urban density and urban health could contribute to convert the Health-Density paradox into a Health-Density nexus. This chapter will show that these concepts can be conceptualised in more ways than one, opening up new possibilities for evaluation of the paradox. First, this chapter will delve into the reconceptualisation of the concept of urban density. Subsequently, the redefinition of urban health will follow. The relationship between these reconceptualisations will be presented in the conceptual framework.

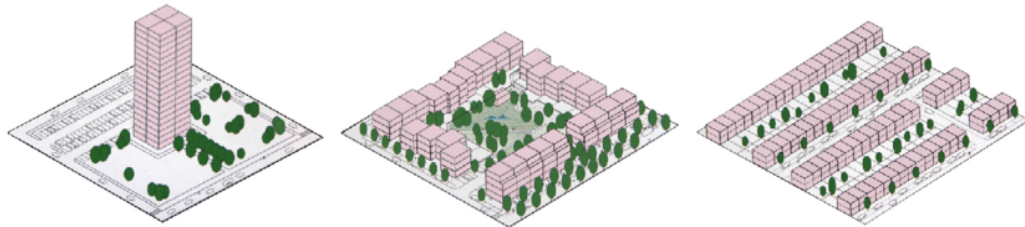
*How can the reconceptualisation of urban density and urban health contribute to convert the Health-Density paradox into a Health-Density nexus?*

### 3.1 Defining urban density

Since the late nineteenth century, urban designers and planners have recommended urban density norms, defined through dwelling density, on a regular basis (Berghauer Pont & Haupt, 2021). Yet, as mentioned earlier, it is necessary to redefine the concept of urban design beyond conventionally used metrics such as dwelling density. Fortunately, Berghauer Pont and Haupt (2021) state, urban density can be conceptualised in more ways than one. They distinguish two definitions of urban density, based on their use:

- 1 “*prescriptive*” use, in which urban density is used as a norm in urban design and planning.
- 2 “*descriptive*” use, in which urban density is used to describe the urban form of a built environment.

Applying the prescriptive definition of the concept of urban density results in the conventionally used metrics like dwelling density. Yet, as is shown in Figure 8, Fernandez Per and Mozes (2004) prove completely different urban conditions can be accomplished within an identical dwelling density. Thus, this definition of urban density poorly reflects urban density in spatial morphological terms that are relevant to urban design and planning.



**FIGURE 8** A drawing illustrating the lack of relation between density and urban form when using conventional density measures. Three areas with 75 dwellings per hectare, by Fernandez Per & Mozas, 2004.

Such drastically different urban conditions, will plausibly lead to drastically different outcomes when studying their performance of urban density on urban health. Applying the descriptive definition of the concept of urban density will, however, leave room for leeway for urban designers and planners to do spatial interventions for the benefit of enhancing urban health. These spatial interventions can be used as leverage points to convert the Health-Density paradox into a Health-Density nexus. Thus, a conceptual shift towards descriptively using urban density will be remarkably advantageous.

In their book *Spacematrix, Space, Density and Urban Form*, Berghauser Pont and Haupt (2021) introduce a multivariable approach, which can be utilised in determining urban density descriptively. This approach makes use of the basic indicators FSI (= floor space index) and GSI (= ground space index).

The floor space index is a value to describe the building intensity (Berghauser Pont & Haupt, 2021). As Figure 9 illustrates, the FSI is determined by dividing the gross floor area with the area of the associated site (Planbureau voor de Leefomgeving, 2024). The value of the FSI is at least zero and can, in theory, be infinitely large. However, in practice, a building will be confined in terms of limited construction techniques.

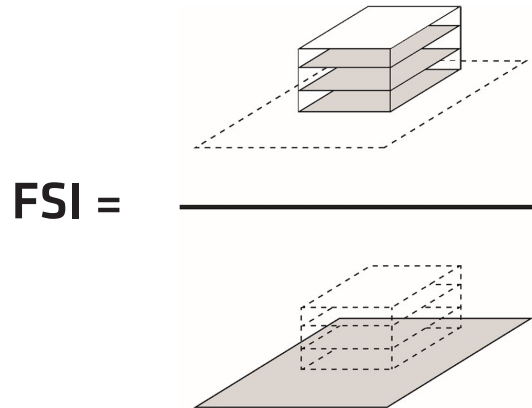


FIGURE 9 A drawing illustrating the Floor space index is the floor area of 1 or more buildings divided by the associated site area, by Planbureau voor de Leefomgeving, 2024.

The ground space index is a value to describe the coverage of a site (Berghauser Pont & Haupt, 2021). Figure 10 illustrates that the GSI is determined by dividing the building footprint with the area of the associated site (Planbureau voor de Leefomgeving, 2024). The value of the GSI can range between zero and one. Zero meaning, no building are built in the area, and one being the area is completely taken over by a building.

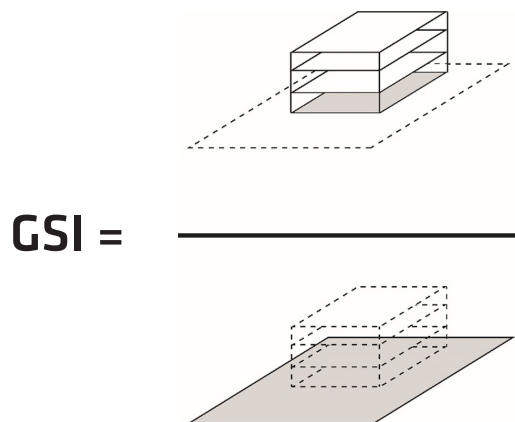
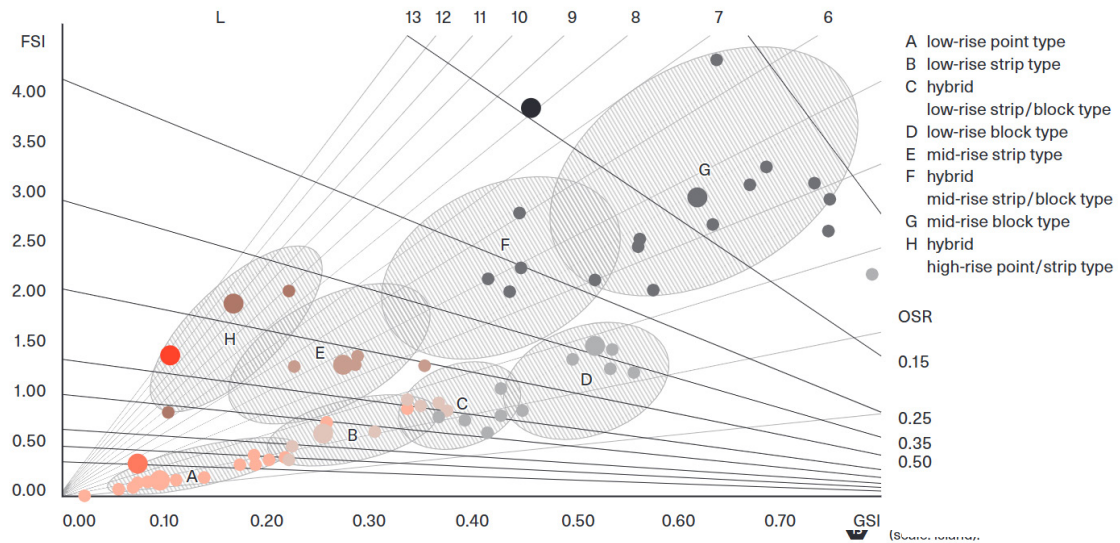


FIGURE 10 A drawing illustrating the Ground space index is the footprint of one or more buildings divided by the associated site area, by Planbureau voor de Leefomgeving, 2024.

Combining the FSI and GSI in a multivariable approach, like Berghauser Pont and Haupt (2021) proposed, proves to be an effective way to define urban density for morphologically describing urban form. As Figure 11, shows the combination of the FSI and GSI has successfully described various urban forms.



**FIGURE 11** A graph showing clusters of building types, proving the multivariable approach, using Floor space index and ground space index helps to define descriptive urban density effectively. Berghauser Pont and Haupt, 2021.

The Dutch Planbureau voor de Leefomgeving (2024) has made an effort to automatise the calculations of the FSI and GSI in the *Ruimtelijke Dichtheden en Functiemenging in Nederland* (Rudifun) geodata base. This geodata base will equip this thesis with evidence-based indicators.

The third basic indicator, network density (N), is not an available indicator in the Rudifun geodatabase. Other descriptive urban density indicators such as building height (L) are merely derivatives of the FSI and GSI (see Figure 11). Although the Rudifun database does provide geodata for these, this thesis will mainly focus on the basic indicators FSI and GSI. For the analysis of Utrecht the FSI and GSI on the neighborhood level are used.

In later analyses of the selected site, the building blocks are used. When a site is selected indicator for spaciousness (OSR) will be introduced to get a sense the amount of the size of public space.

### 3.2 Defining urban health

According to the constitution of the World Health Organisation (2020) every individual has a fundamental right to the highest attainable standard of health. In the same constitution, the organisation defines health as: “(...) a state of complete physical, mental and social wellbeing and not merely the absence of disease or infirmity” (World Health Organisation, 2020). This is in line with the calls for a less generic way of interpreting the concept of health to effectively determine the performance of urban density on health, mentioned in the previous chapter.

The concept of health was already put into a broader perspective with the notion of urban health that included social and environmental factors. However, in order to respond to context-specific health problems with spatial interventions, it is necessary to differentiate concrete and actionable urban health determinants that take the nuanced, multifaceted character of the concept into account.

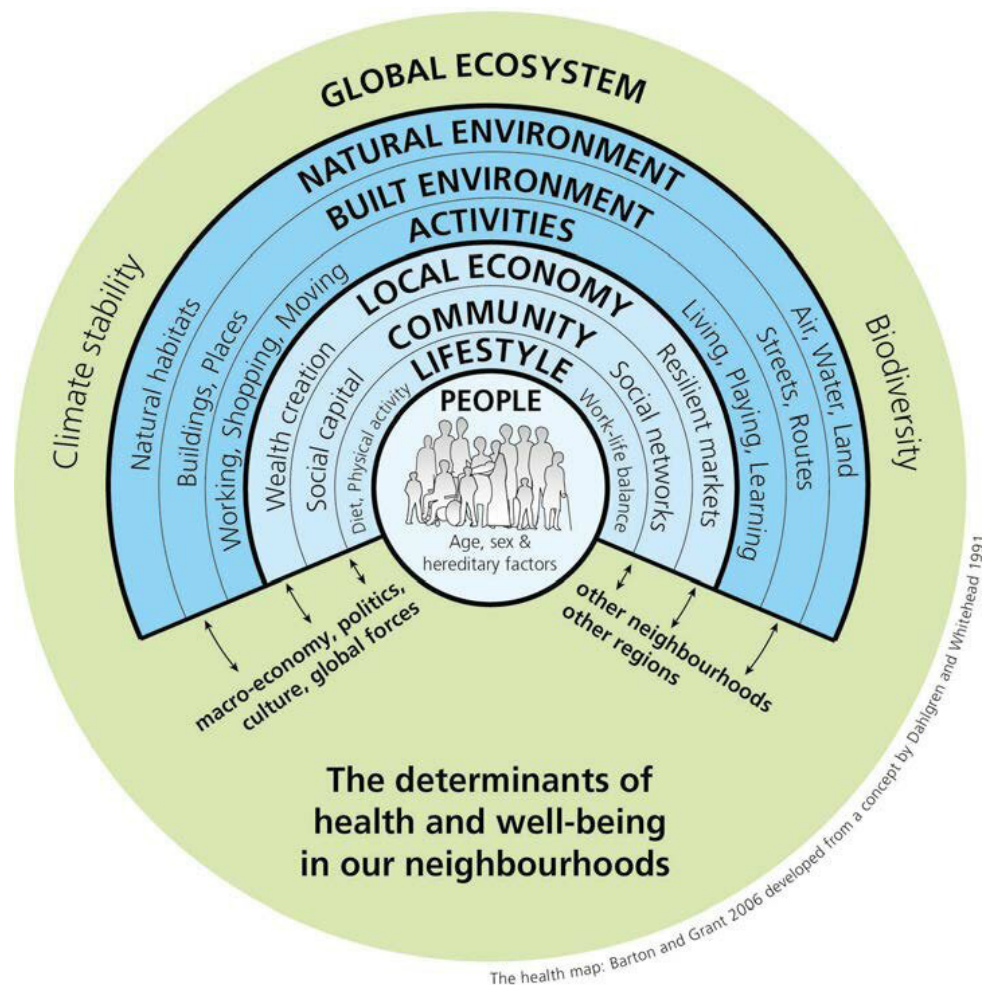


FIGURE 12 A framework called the health map showing the eight determinants of health and well-being in our neighborhoods, by Barton and Grant, 2006.

Barton and Grant (2006) have developed a model to reinterpret the concept of urban health to indicate its nuanced and multifaceted character. Barton and Grant came up with the “*health map*” (Figure 12). A visual instrument for communicating and analysing the determinants of health and wellbeing in our neighborhoods. As shown in Figure 12, Barton and Grant (2006) place people at the heart of the map, reflecting the focus on the health and wellbeing of people now and in the future. The different facets of urban health are reflected in the series of spheres which move through social, economic and environmental determinants. The outer sphere, representing the global ecosystem, places all urban health determinants within their biosphere. This reinforces the direct relationship between creating sustainable cities and urban health. Additionally, the community sphere aligns with the goal of creating sustainable communities. As is being strived for in this thesis, the health map-model allows for SDG 11 to inform the definition of urban health. The interplay between the eight urban health determinants are often indirect and complex. The model is designed to reflect these sequential health impacts (Barton & Grant, 2006).

Applying the health map-model, allows urban designers and planners to analyse the concept of urban health with fresh eyes. Moreover, it will help them to come up with context-specific spatial intervention to resolve urban health concerns. Thus, in this thesis, the concept of urban health will be defined by the eight determinants of health and wellbeing in our neighborhoods presented in the health map-model.

Each urban health determinant is aimed at accomplishing the objective of...

- 1 **People** - ... representing the physiological and psychological health concerns, which urban dwellers currently experience (Barton, Grant & Guise, 2010).
- 2 **Lifestyle** - ... promoting healthy lifestyles (Barton, Grant & Guise, 2010).
- 3 **Community** - ... enhancing a sense of local community (Barton, Grant & Guise, 2010).
- 4 **Local economy** - ... promoting enterprise and employment (Barton, Grant & Guise, 2010).
- 5 **Activities** - ... increasing equity and enhancing freedom of choice (Barton, Grant & Guise, 2010).
- 6 **Built environment** - ... enhancing environmental qualities (Barton, Grant & Guise, 2010).
- 7 **Natural environment** - ... safeguarding natural habitats and promoting wildlife (Barton, Grant & Guise, 2010).
- 8 **Global ecosystem** - ... mitigating and adapting to climate change.

### 3.3 Conceptual framework

To answer the question *How can the reconceptualisation of urban density and urban health contribute to convert the Health-Density paradox into a Health-Density nexus?*: By defining urban density prescriptively through the floor space index and ground space index, combined with the multifaceted definition of urban health into the eight determinants People, Lifestyle, Community, Local economy, Activities, Built environment, Natural environment and Global ecosystem, this conceptual shift leads to recommendations for context-specific inner-city urban densification strategies. Thereby, the Health-Density paradox can, in theory, be converted into a Health-Density nexus.

In Figure 13, the conceptual framework represents the Health-Density nexus and shows the relationship between the redefined concepts. The conceptual shift to convert the Health-Density paradox into a Health-Density nexus, can be seen by comparing Figure 13 to Figure 1.

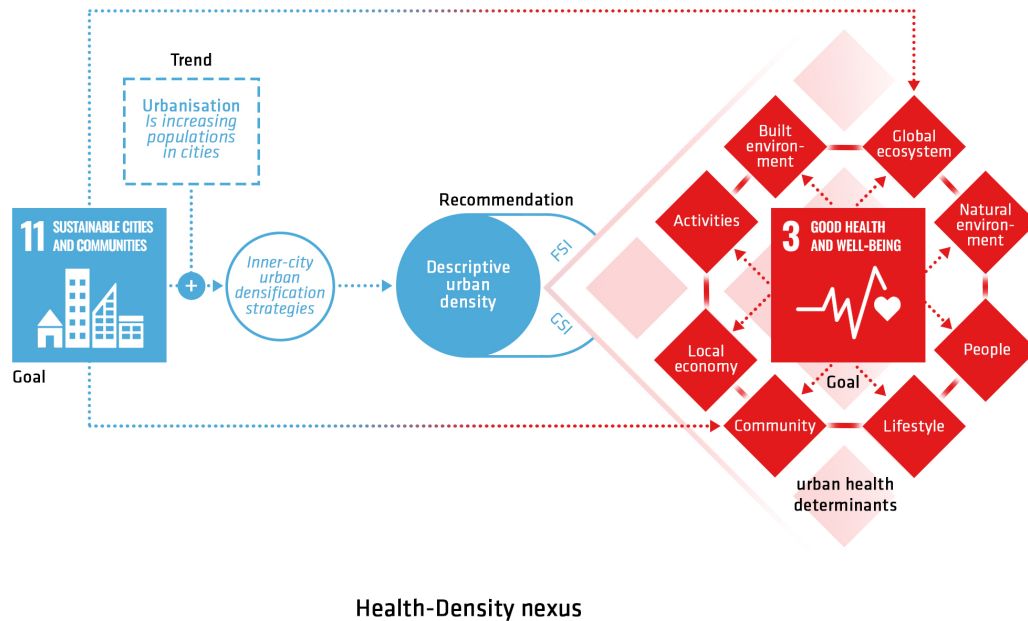


FIGURE 13 The conceptual framework for the Health-Density nexus, by Tejon Tomas Kraan, visualisation of the SDGs are by United Nations, 2015.

Further research through a context-specific design exploration is needed to determine whether this conceptual framework is applicable in practice. This will be done in *Part II* of this thesis.





# Site selection

## *analysing Utrecht*

### Contents

4.1 The big U	36
4.2 Analysing urban density in Utrecht	38
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4.4 Synthesis map of Utrecht	49

In this chapter, Utrecht will be analysed in order to select a neighborhood of Utrecht as the case study for this thesis' design exploration. The city of Utrecht is one of the area of interest in the NOVEX programme. The choice for Utrecht is motivated by the remarkable prioritisation of inner-city urban densification strategies outlined in the development vision, which responds to the ongoing urbanisation of the Utrecht metropolitan region. The chapter will first introduce this vision. After which the analysis of urban density and urban health will follow. This chapter will culminate in a site selection with the use of a synthesis map of Utrecht.

*What site in Utrecht would be suitable for the design exploration towards a Health-Density nexus?*

► **FIGURE 14** A map representing the basal spatial structure of the city of Utrecht, by Tejon Tomas Kraan.

Utrecht

# Base map

scale 1 : 75.000



0 0,5 1 2 3 6 12km

## Legend

 Highways

 Railways

 Train stations

 Urban green-blue structure

 Residential / Commercial zones

 Industrial zones

## 4.1 the Big U

The spatial policy document “*Utrecht Nabij*” states that, by 2040, between 104.000 and 125.000 homes and workspace for more than 80.000 jobs will have to be built in the Utrecht metropolitan region (U Ned, 2020). To do so, the vision integrates seven interrelated principles (Figure 15):

- 1 Concentrate new homes and jobs in urban core areas and around regional public transport hubs
- 2 Invest in urban green and make landscapes more accessible
- 3 Intensify residential and work locations in inner-city urban areas
- 4 Develop complementary “*Metropolitan Ports*”
- 5 Focus on strengthening economic clusters
- 6 Organize smart, healthy and safe mobility
- 7 Arrange the mobility system coherently and multimodal

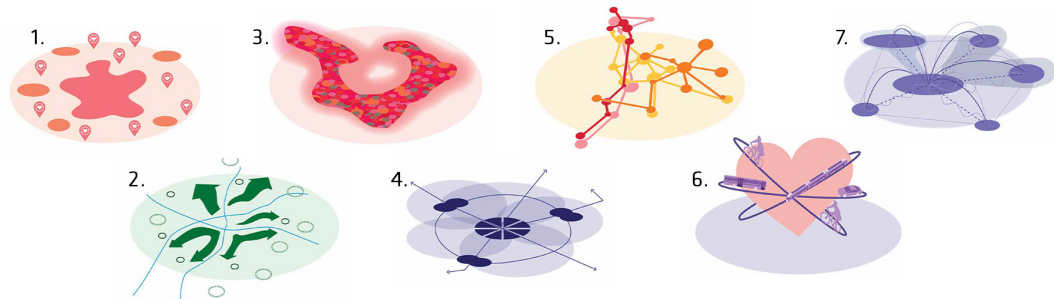


FIGURE 15 Illustrations that represent the seven interrelated principles for the vision of “*Utrecht Nabij*”, by U Ned, 2020.

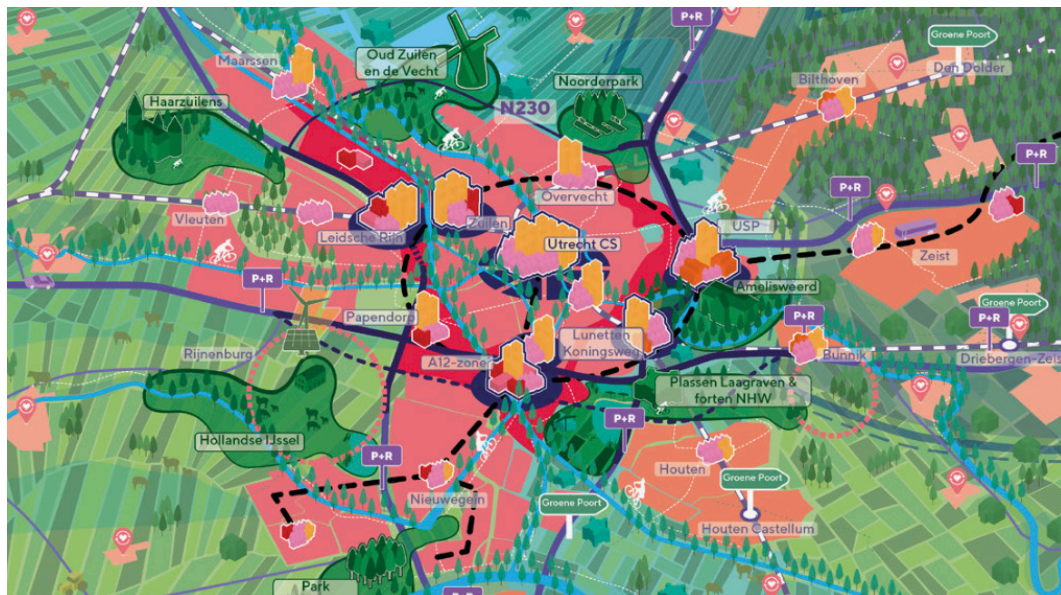
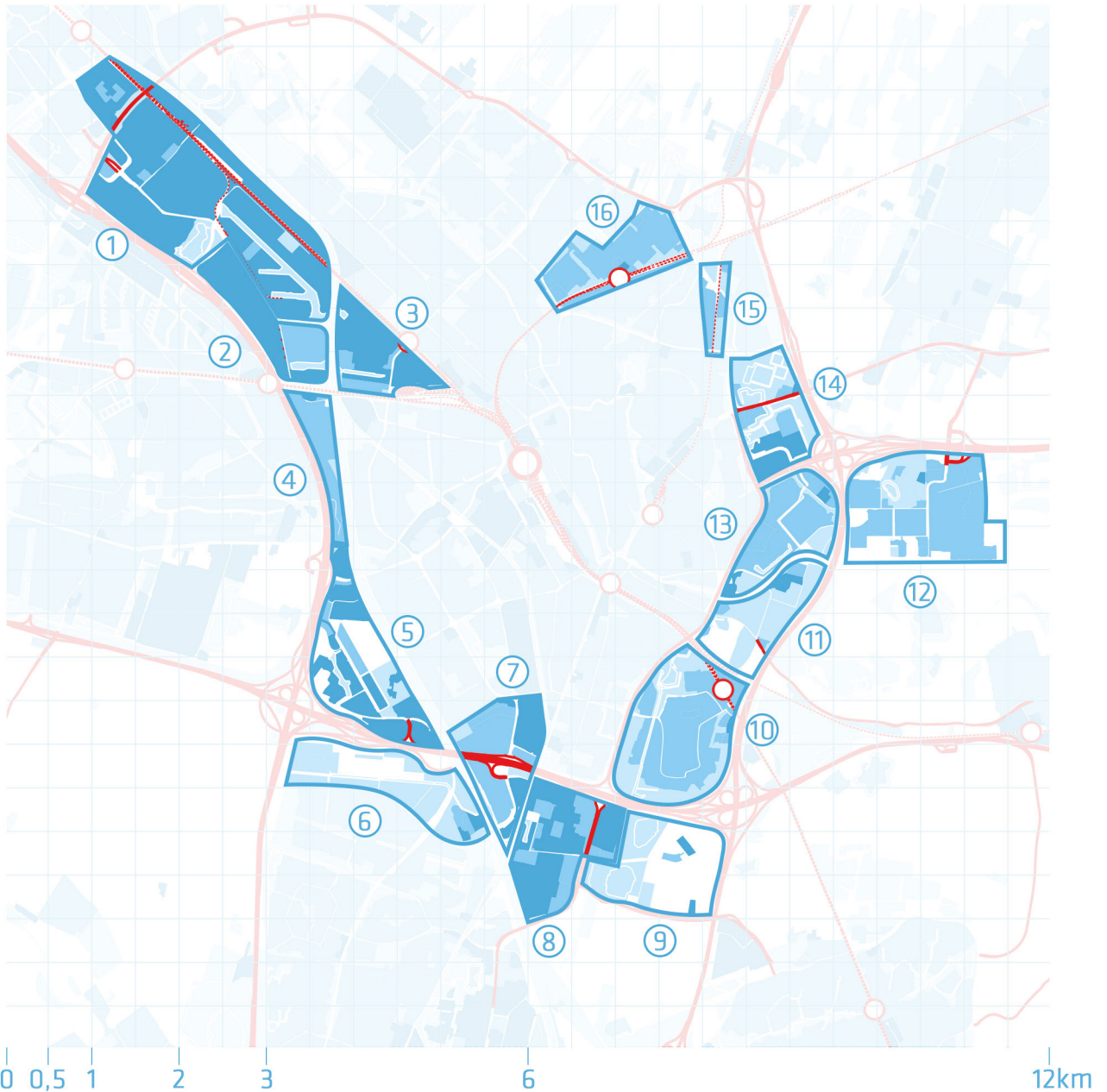


FIGURE 16 A cutout of the vision map “*Utrecht Nabij*”, by U Ned, 2020.

Utrecht

# the Big U

scale 1 : 75.000



## Legend

- |                         |                         |                         |                        |
|-------------------------|-------------------------|-------------------------|------------------------|
| ① Lage weide            | ⑤ Papendorp             | ⑨ Laagggravense plassen | ⑬ Rijnsweerd Zuid      |
| ② 4e Kwadrant           | ⑥ Galecopper zoom       | ⑩ Lunetten              | ⑭ Rijnsweerd Noord     |
| ③ Werkspoot kwartier    | ⑦ Westraven             | ⑪ Maarschalkenweerd     | ⑮ Zone museumspoorlijn |
| ④ Leidsche Rijn centrum | ⑧ Liesbosch / Laagraven | ⑫ Utrecht Science Park  | ⑯ Overvecht Zuid       |

◀ **FIGURE 17** A map representing the neighborhoods in the Big U that will undergo future inner-city urban densification, by Tejon Tomas Kraan.

As is shown in Figure 16, these principles are reflected in the vision map (U Ned, 2020). And so, the urbanisation of the region will largely be accommodated within the current city borders in order to preserve the peripheral landscapes. In the vision of U Ned (2020), the neighborhoods that will undergo inner-city urban densification in the coming 20 years, are mainly concentrated around public transport hubs in a U-shaped area, “the Big U”, from Zuilen and Leidsche Rijn Centrum via Westraven, Lunetten-Koningsweg and USP to Overvecht (Figure 17). In the following sub-chapters the region will be analysed in order to select one of these neighborhoods as the case study for the design exploration towards a Health-Density nexus.

## 4.2 Analysing urban density in Utrecht

Firstly, the urban density in Utrecht is analysed. This is done in two ways:

- 1 The ambitions of the municipality in terms of urban densification are expressed prescriptively with the use of dwelling density (Figure 18).
- 2 The current urban density of the region is represented descriptively with the use of FSI and GSI (Figure 19).

In the prescriptive map of urban density, which is shown in Figure 18, the thickness of the outline of each neighborhood represents the dwelling density (= number of dwellings per km<sup>2</sup>). Based on data from the Gemeente Utrecht (2024), the current dwelling density is given in blue. The urban densification ambitions of the municipality of Utrecht are retrieved from the policy document by U Ned (2020) that was introduced earlier in this chapter. In this document a range of new dwellings per neighborhood is stated. In this map, the range is converted into minimum planned dwelling density by 2040 and the maximum planned dwelling density by 2040. In four of sixteen neighborhoods no data was found. These four are currently brown- or green fields. This means that the current dwelling density is near zero and no ambitions for urban densification is quantified in these areas.

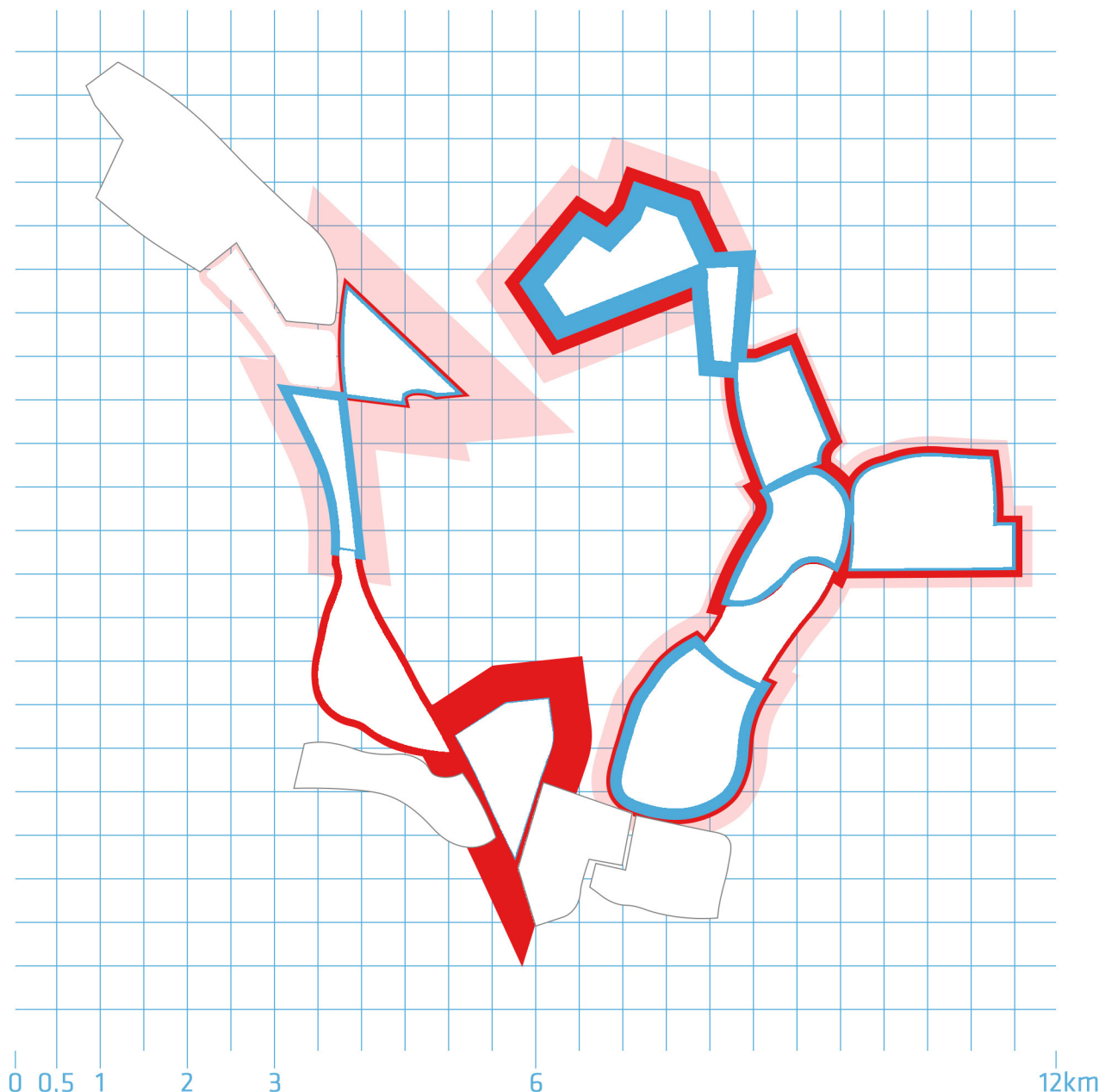
This map is used to get a sense of the pressure each neighborhood will experience from the urban densification ambitions of the municipality. It becomes clear that the pressure is highest in the Werkspoorkwartier, Westraven, and Overvecht Zuid. Overvecht Zuid is unique within this top 3 because it already is a residential area with a high dwelling density. This means the urban densification of this neighborhood will directly impact the health of current inhabitants. Thus the urban densification must be approached with due consideration. The Werkspoorkwartier and Westraven neighborhood, on the other hand, are currently an industrial and commercial area with barely any current inhabitants.

▶ **FIGURE 18** A map representing the urban density of Utrecht prescriptively by using dwelling density, by Tejon Tomas Kraan based on data from Gemeente Utrecht (2024) and U Ned (2020).

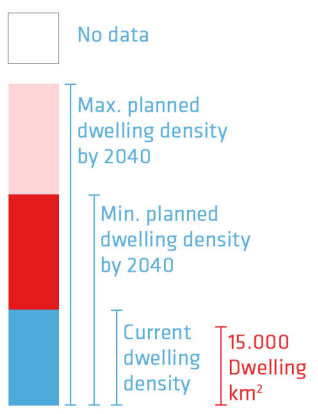
# Urban Density Dwelling Density

Utrecht

scale 1 : 75.000



## Legend



In the descriptive map of urban density, which is shown in Figure 19, the FSI and GSI are represented by a pattern with sequences of semi circles. Left-facing semi circles represent the FSI, whereas the semi circles on the right represent the GSI. This is done with the use of the Rudifun dataset by the Planbureau van de Leefomgeving (2024). To increase the readability of the map, the data is divided into a grid of 500 by 500 meters.

This map is used to get a sense of the spatial morphological aspect of urban density in Utrecht. Firstly, it becomes evident why the Big U is selected by the municipality for urban densification. Compared to the central areas in the city, the neighborhoods in the Big U offer much more space for urban densification. However, differences can be pointed out between the neighborhoods in the Big U. Overvecht Zuid, for example, is less compact but has a moderate FSI. This means there will be lot more space on the ground level. This neighborhood will offer different possibilities to approach the urban densification strategy than a neighborhood with a higher GSI, but lower built intensity like is seen in the 4<sup>e</sup> kwadrant neighborhood.

To complete the urban density of Utrecht, a synthesis map is made (Figure 20). This is done by combining the maps of the prescriptive urban density (Figure 18) and the descriptive urban density (Figure 19). This map will later be used to select a site.

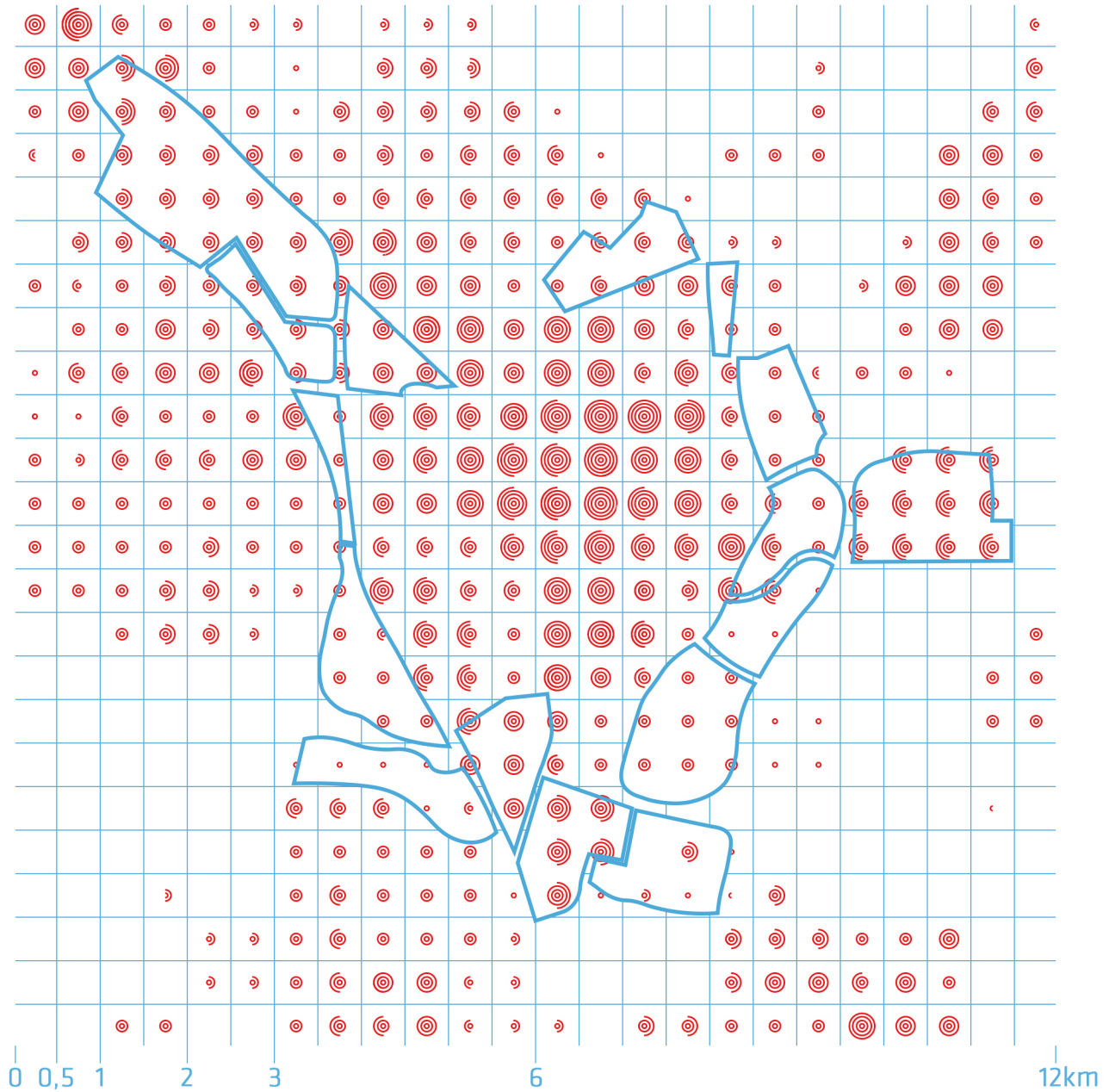
► **FIGURE 19** A map representing the urban density of Utrecht descriptively by using dwelling density, by Tejon Tomas Kraan based on data from Planbureau van de Leefomgeving (2024).

►► **FIGURE 20** The synthesis map representing the urban density of Utrecht, by Tejon Tomas Kraan based on data from Planbureau van de Leefomgeving (2024), Gemeente Utrecht (2024), and U ned (2020).

# Urban Density FSI / GSI

Utrecht

scale 1 : 75.000



## Legend



**Built Intensity**  
Floor Space Index  
(FSI)

□	0	None	0	□
◁	0 - 0,25	Very low	0 - 0,1	◁
◄	0,25 - 0,46	Low	0,1 - 0,2	◄
◅	0,46 - 0,72	Moderate	0,2 - 0,3	◅
⊖	0,72 - 1,17	High	0,3 - 0,4	⊖
⊕	1,17 - 1,61	Very high	0,4 - 0,5	⊕

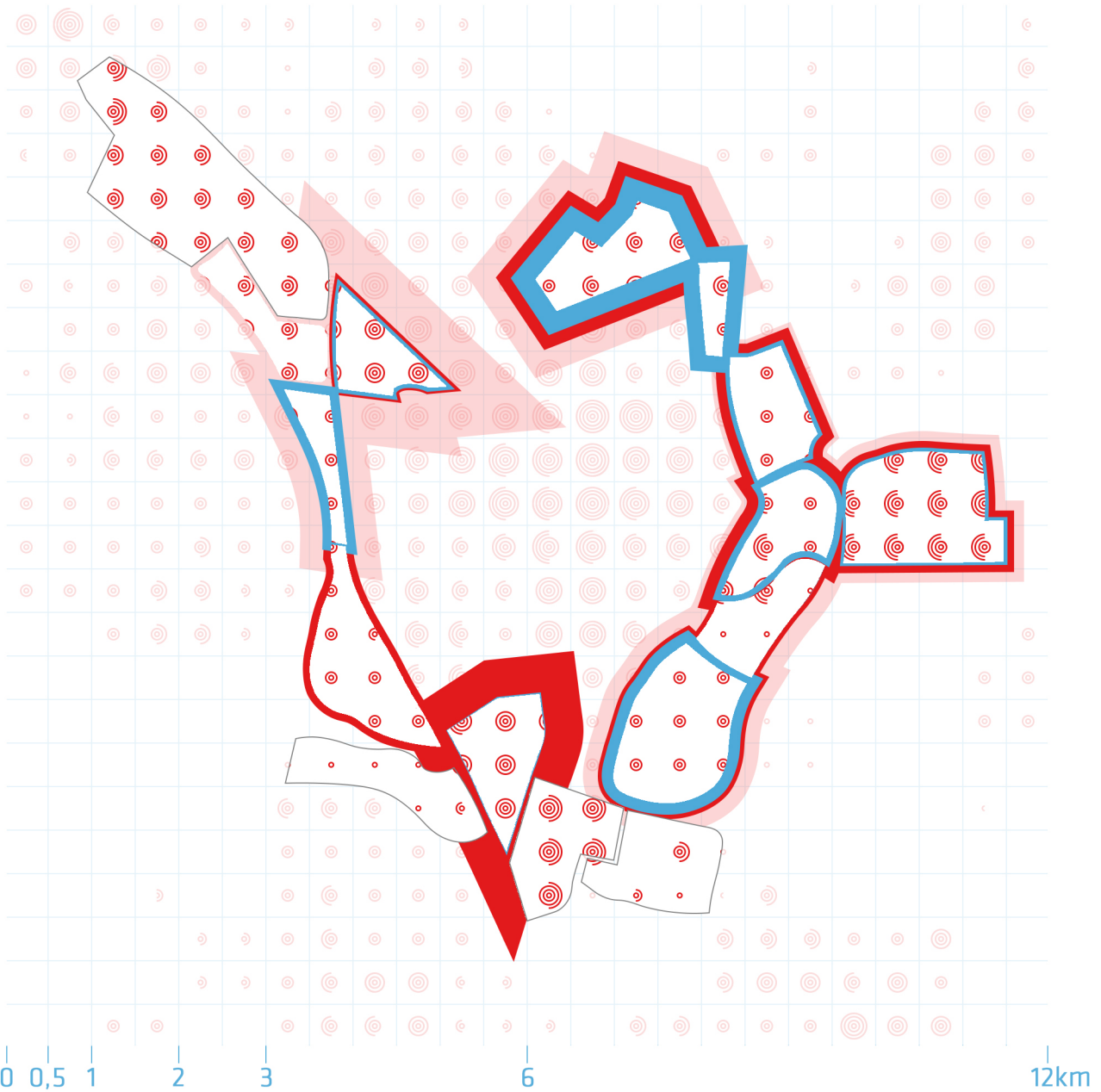


**Compactness**  
Ground Space  
Index (GSI)

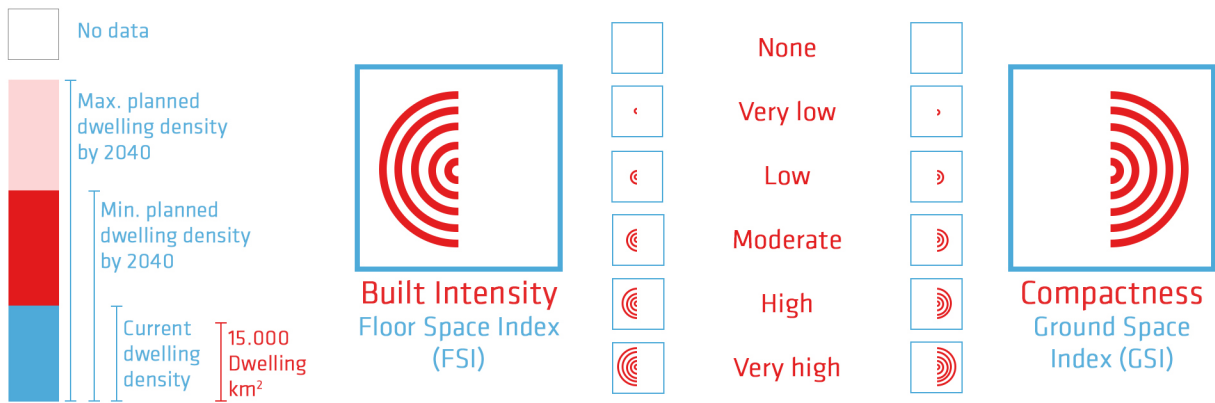
# Urban Density Synthesis map

Utrecht

scale 1 : 75.000



## Legend



### 4.3 Analysing urban health in Utrecht

Each urban health determinant, mentioned in the previous chapter, is analysed separately with the use of indicators.

- 1 **People** - Vulnerable places will be determined with the indicators:
  - anxiety and depression rates (Geodata: RIVM, 2022)
  - rates of frail health of people aged 65 plus (Geodata: RIVM, 2022)
  - rates of long-term health conditions (Geodata: RIVM, 2022)
  - rates of poor perceived health (Geodata: RIVM, 2022)
  
- 2 **Lifestyle** - Vulnerable places will be determined with the indicators:
  - movement friendliness (Geodata: Ministerie IenW\*, 2024)
  - exercise guideline rates (Geodata: RIVM, 2022)
  - amount of shaded paths (Geodata: Ministerie IenW\*, 2024)
  - presence of cool places (Geodata: Climate Adaption Services, 2024)
  
- 3 **Community** - Vulnerable places will be determined with the indicators:
  - social support rates (Geodata: RIVM, 2022)
  - social frailty rates (Geodata: RIVM, 2022)
  - loneliness rates (Geodata: RIVM, 2022)
  
- 4 **Local economy** - Vulnerable places will be determined with the indicators:
  - rates of people having difficulties making ends meet (Geodata: RIVM, 2022)
  - WOZ-values (Geodata: Ministerie IenW\*, 2024)
  - percentages of social housing (Geodata: CBS, 2023)
  
- 5 **Activities** - Vulnerable places will be determined with the indicators:
  - rates of people with small action radius due to a restriction in movement (Geodata: RIVM, 2022)
  
- 6 **Built environment** - Vulnerable places will be determined with the indicators:
  - noise contours (Geodata: Ministerie IenW\*, 2024)
  - light emission contours (Geodata: Ministerie IenW\*, 2024)
  
- 7 **Natural environment** - Vulnerable places will be determined with the indicators:
  - species diversity (Geodata: Ministerie IenW\*, 2024)
  - amount of green in neighborhoods (Geodata: Climate Adaption Services, 2024)
  - air quality (Geodata: Ministerie IenW\*, 2024)
  
- 8 **Global ecosystem** - Vulnerable places will be determined with the indicators:
  - perceived heat during a hot summer day (Geodata: Ministerie IenW\*, 2024)
  - presence of flood risks (Geodata: Ministerie IenW\*, 2024)
  - urban heat island effect (Geodata: Ministerie IenW\*, 2024)
  - water nuisance on streets (Geodata: Ministerie IenW\*, 2024)

*\*Ministerie van Infrastructuur en Waterstaat*



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

People



Anxiety and depression

Frail health aged 65+

Long-term conditions

Poor perceived health



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

People



Anxiety and depression

Frail health aged 65+

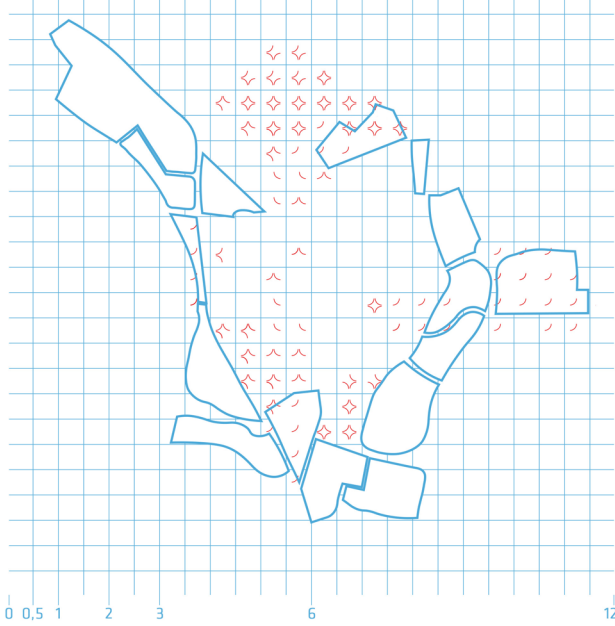
Long-term conditions

Poor perceived health

### Urban Health Risks People

Utrecht

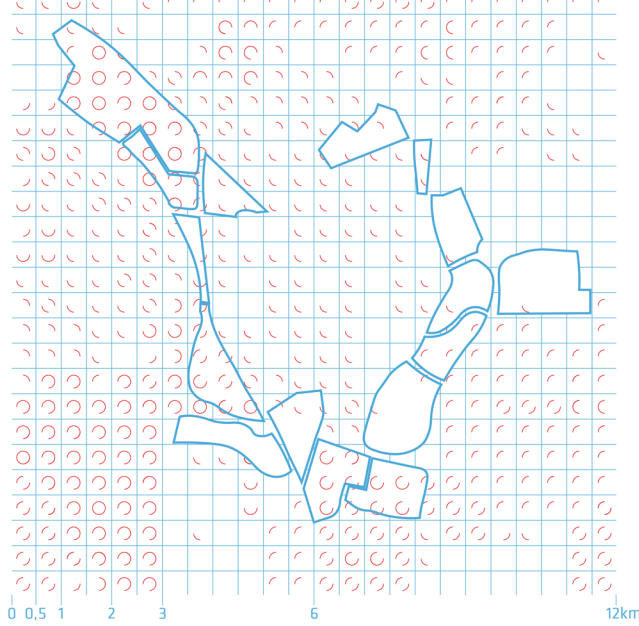
scale 1: 75.000



### Urban Health Risks Lifestyle

Utrecht

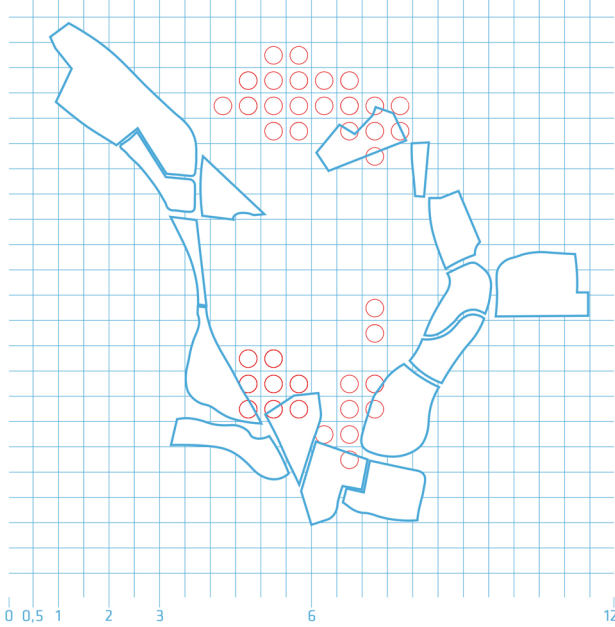
scale 1: 75.000



### Urban Health Risks Activities

Utrecht

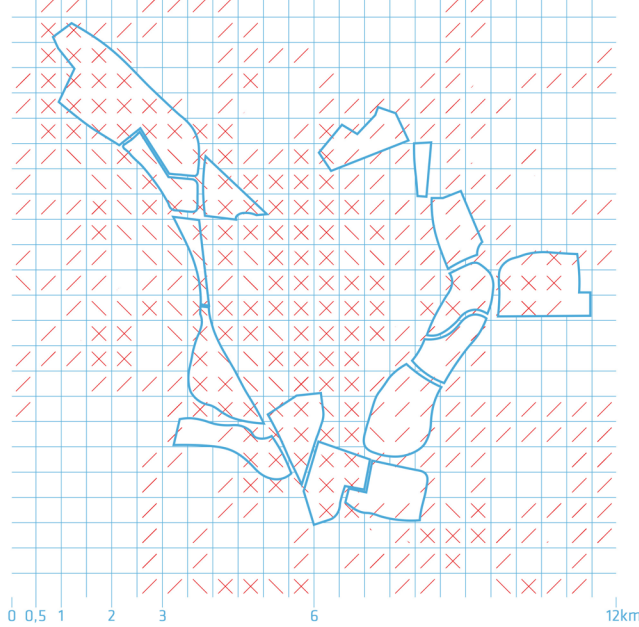
scale 1: 75.000



### Urban Health Risks Built environment

Utrecht

scale 1: 75.000



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

Activities



Restriction in movement (small action radius)



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

Built environment



Noise nuisance

Light emission nuisance



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

Community



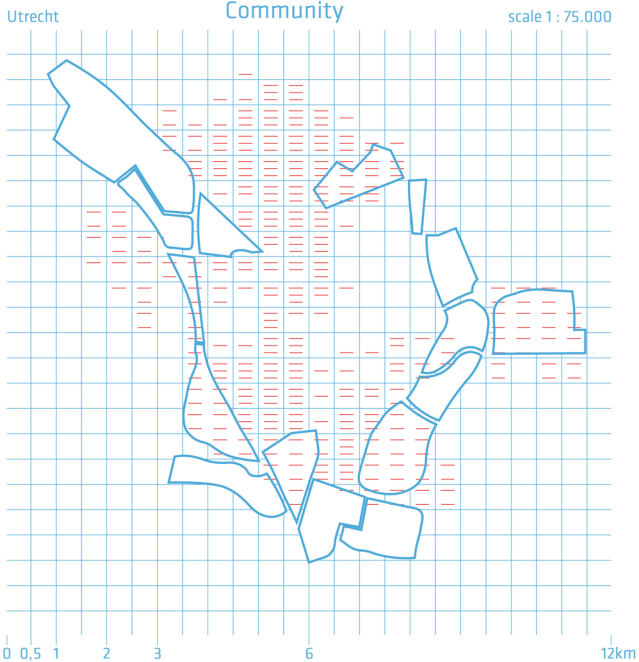
Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

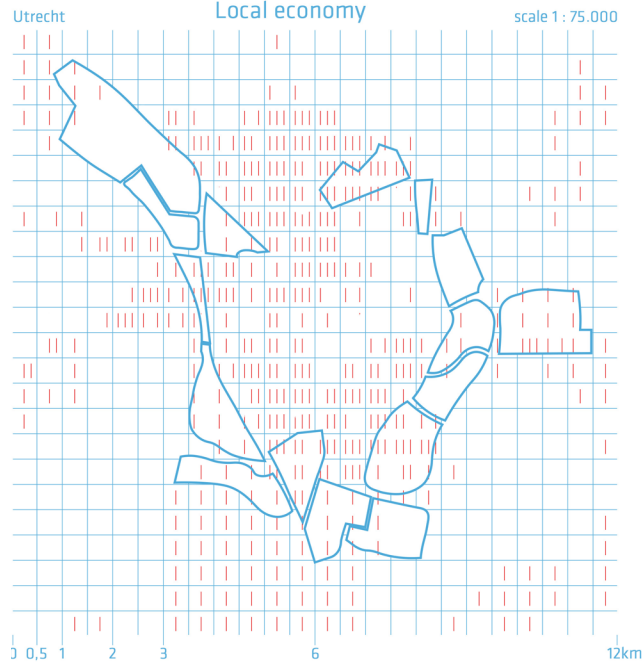
Local economy



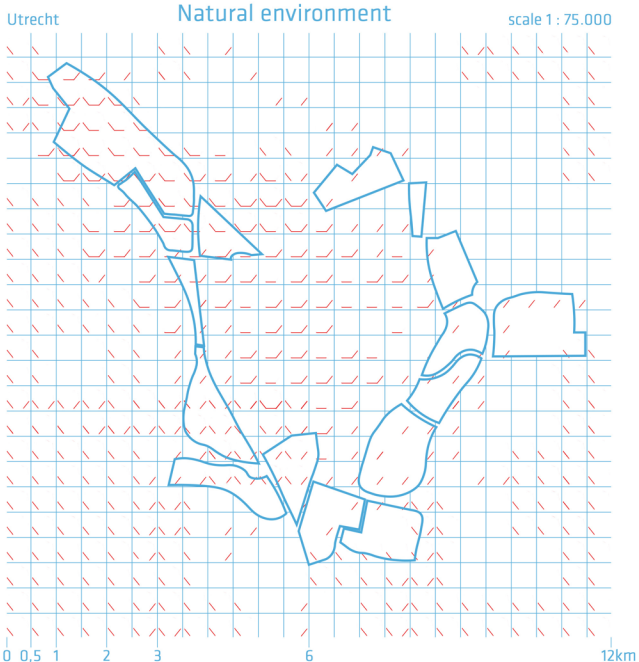
### Urban Health Risks Community



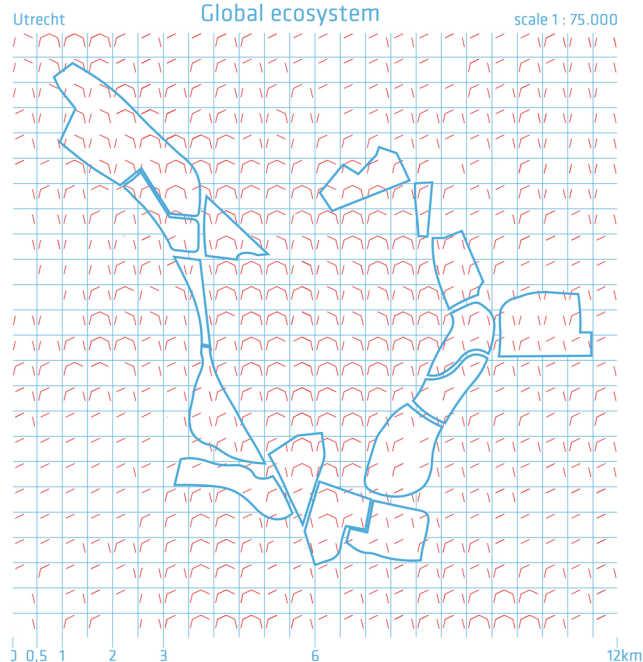
### Urban Health Risks Local economy



### Urban Health Risks Natural environment



### Urban Health Risks Global ecosystem



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

Natural environment



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

Global ecosystem



◀ **FIGURE 21** A collage of the maps representing the separate urban health determinants in Utrecht, by Tejon Tomas Kraan based on data from RIVM (2022), Ministerie van Infrastructuur en Waterstaat (2024), Climate Adaption Services (2024), and CBS (2023)(see page 41 for specifics).

The analysis of each separate urban health determinant is shown in Figure 21. Full size versions of these maps can be found in Appendix 1 to 8 of this thesis.

In order to unify the geodata of each indicator, a technique called “*pictogram mapping*” is used. Within this mapping technique the data is simplified to the same 500 by 500 meter grid that has also been used in the analyses of the urban density. Moreover, special attention has been given to the design of the legend. The complete pictogram legend incorporates all the individual urban health indicators combined. Per grid cell, the presence of each respective urban health risk indicator is marked with a specific icon. It is designed so that every icon is still visible when layered on top of each other, as is shown in Figure 22.

With layering the urban health determinant maps the synthesis map emerges representing the urban health of Utrecht (Figure 23). This map exists of 576 pictograms: one in each grid cell. In each grid cell a pictogram emerges which represents the unique combination of urban health challenges that the specific area is experiencing. Therefore this map can be read as a spatial expression of a multi-criteria analysis.

From the synthesis map in Figure 23, it becomes evident that there are two main focus areas in Utrecht which endure the most urban health risks. The first is found in the south of Utrecht which is enveloped in the lower arch of the Big U. The Westraven and Papendorp neighborhoods are located within this spot. The other focus area is found in North of Utrecht in Overvecht. As part of the larger Overvecht neighborhood, Overvecht Zuid is experiencing the most urban health problems of all the neighborhoods in the Big U.

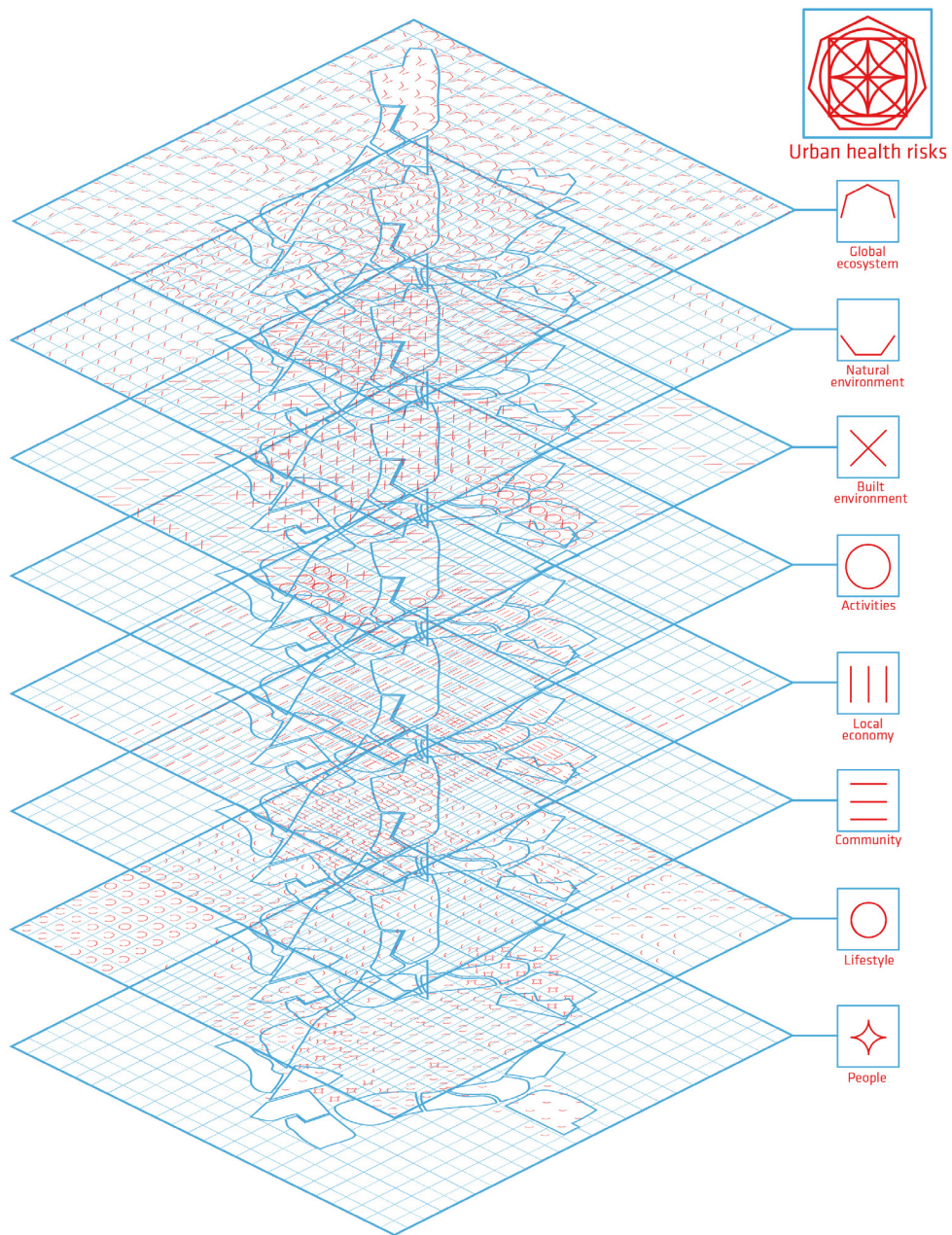


FIGURE 22 An illustration showing the layering of urban health determinant maps, by Tejon Tomas Kraan.

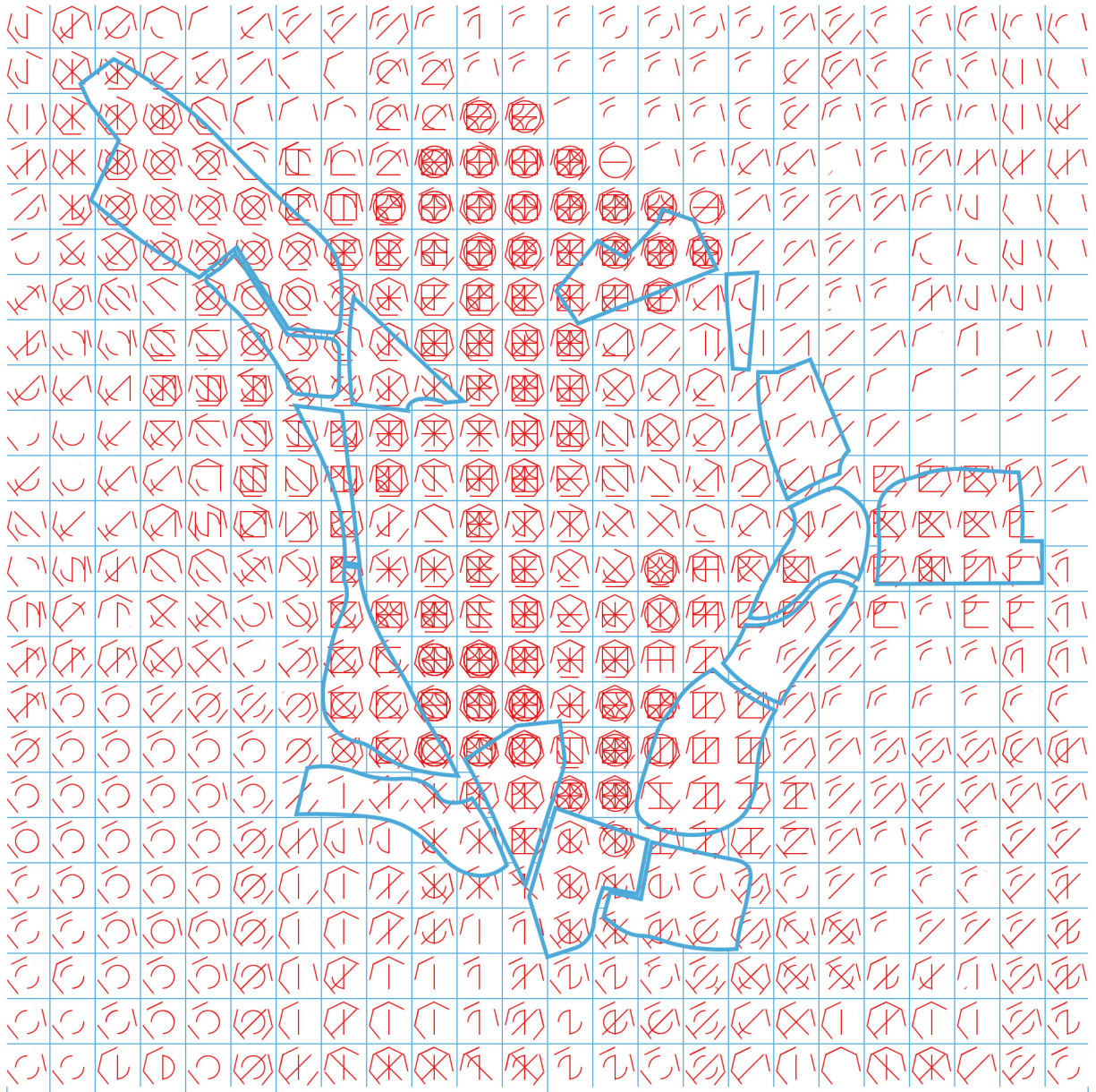
► FIGURE 23 The synthesis map representing the urban health of Utrecht, by Tejon Tomas Kraan based on data from RIVM (2022), Ministerie van Infrastructuur en Waterstaat (2024), Climate Adaption Services (2024), and CBS (2023)(see page 41 for further specifics).

# Urban Health Risks

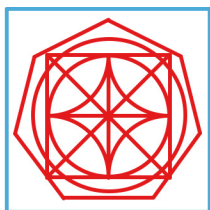
## Synthesis map

Utrecht

scale 1 : 75.000



0 0,5 1 2 3 6 12km



Iconography Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

Global ecosystem	Natural environment	Built environment	Activities	Local economy	Community	Lifestyle	People

#### 4.4 Synthesis map of Utrecht

Figure 23, shows the isonometric synthesis map combining the urban density and urban health synthesis maps of Utrecht. Based on the urban health synthesis map, each neighborhood in the Big U has been given a urban health neighborhood profile which originated from the pictograms related to that specific site. These profiles provide an instant overview of the health challenges that exist in the neighborhood. The urban health neighborhood profiles surround the isometric map. The larger the square of the profile, the more urban health risks that neighborhood experiences. Next to the profiles, the urban health determinants are arranged from highest to lowest priority to get an overview of the most prevalent issues at hand.

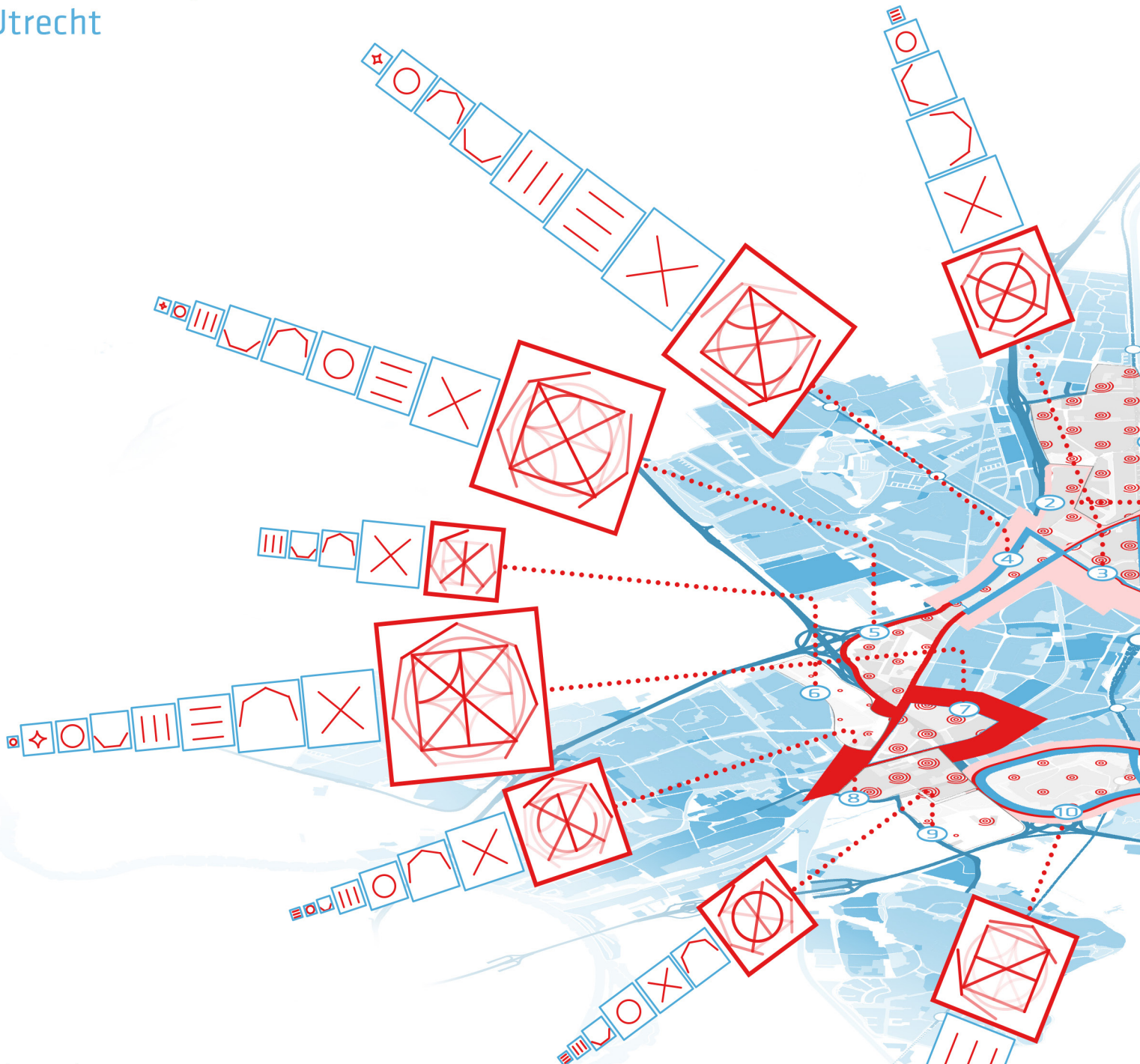
Overvecht Zuid has the worst urban health score of all the neighborhoods in the Big U, followed by Westraven en Papendorp. In Overvecht Zuid, the Community determinant is the highest urban health risk, followed respectively by the determinants of Local economy, Global ecosystem, Activities, Built environment, and People. In Westraven, the Built environment determinant is most prevalent, followed respectively by Global ecosystem and the community determinant. For the Papendorp neighborhood, the focus lies on the Built environment, Community, and Lifestyle determinants.

Overvecht Zuid is one of the few areas in the Big U that currently already has a relatively high dwelling density. Moreover, the added dwelling density that will occur due to the densification of the neighborhood will put a lot of pressure on this site. The FSI and GSI, however are low to moderate, which could explain the high potential of inner-city urban densification interventions in this area.

To answer this chapter's question: *What site in Utrecht would be suitable for the design exploration towards a Health-Density nexus?* For the reason stated above, Overvecht Zuid is selected as the site.

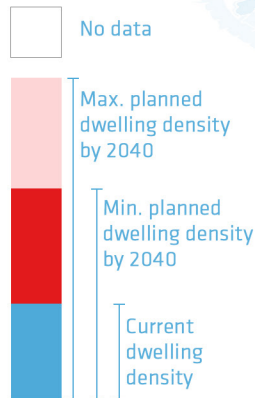
► **FIGURE 24** The isonometric synthesis map combining the urban density synthesis map (Figure 20) and the urban health synthesis map (Figure 23) of Utrecht, by Tejon Tomas Kraan based on data from Planbureau van de Leefomgeving (2024), Gemeente Utrecht (2024), U ned (2020), RIVM (2022), Ministerie van Infrastructuur en Waterstaat (2024), Climate Adaption Services (2024), and CBS (2023)(see pages 36, 38, and 41 for further specifics).

# Urban Density-Health Utrecht

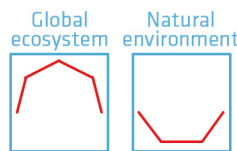


## Legend

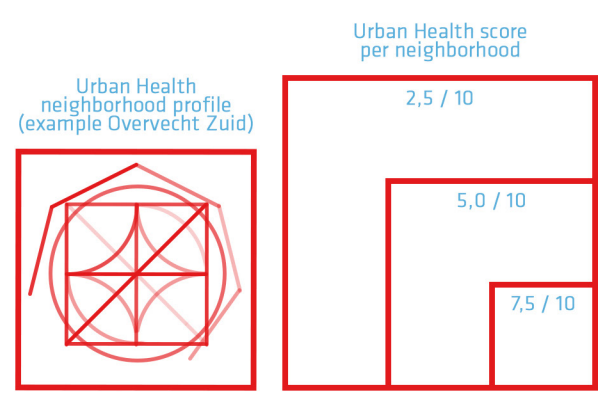
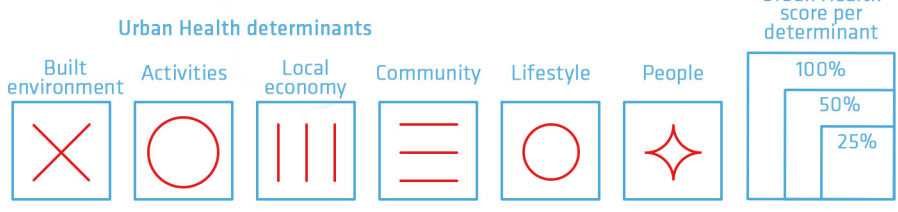
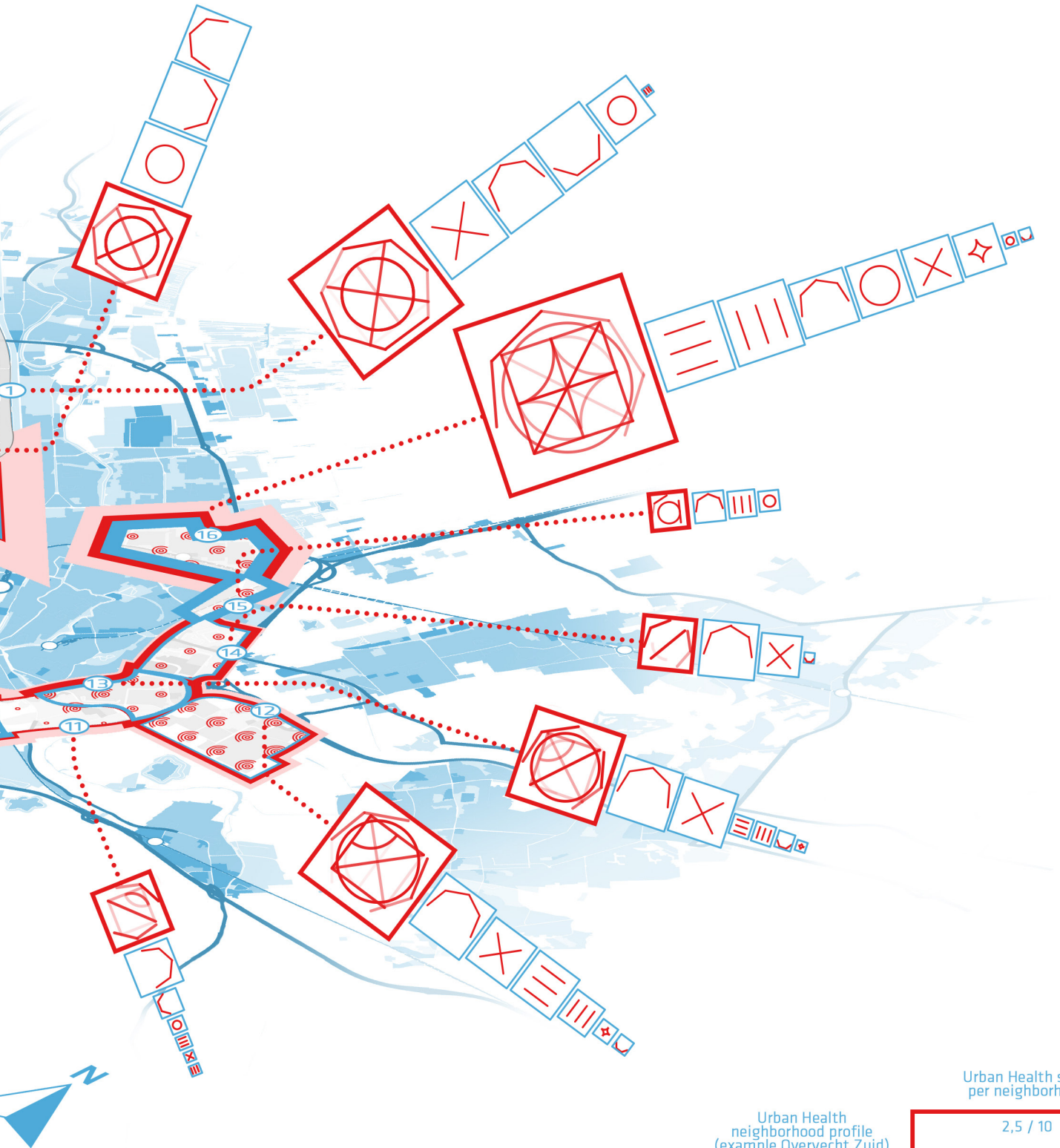
- |                         |                        |
|-------------------------|------------------------|
| ① Lage weide            | ⑨ Laaggravense plassen |
| ② 4e Kwadrant           | ⑩ Lunetten             |
| ③ Werkspoor kwartier    | ⑪ Maarschalkenwaard    |
| ④ Leidsche Rijn centrum | ⑫ Utrecht Science Park |
| ⑤ Papendorp             | ⑬ Rijsweerd Zuid       |
| ⑥ Galecopper zoom       | ⑭ Rijsweerd Noord      |
| ⑦ Westraven             | ⑮ Zone Museumspoorlijn |
| ⑧ Liesbosch / Laagraven | ⑯ Overvecht Zuid       |



- |  |               |
|--|---------------|
|  | Very high GSI |
|  | High GSI      |
|  | Moderate GSI  |
|  | Low GSI       |
|  | Very low GSI  |
|  | Very low FSI  |
|  | Low FSI       |
|  | Moderate FSI  |
|  | High FSI      |
|  | Very high FSI |



# Synthesis Map Isometric





# Methodology

*towards a health-density  
nexus*

## Contents

5.1 Main research question	53
5.2 Maximisation method	54
5.3 Methodological framework	56

In this chapter, the methods to convert the Health-Density paradox into a Health-Density nexus will be presented. This chapter will start with a summary of everything discussed in part I of this thesis in order to state the main research question. Subsequent, the maximisation method will be explained step by step with the associated subquestions. This chapter concludes with the methodological framework and a planning towards a Health-Density nexus.

*What methods are used in the design exploration towards a Health-Density nexus?*

## 5.1 Main research question

To summarise all aforementioned:

- Chapter 1* This thesis explores the complex relationship between urban density and urban health, addressing the longstanding debate among experts and decision-makers regarding the optimal density for enhancing urban health. While a universal recommendation for healthy urban density remains impossible to identify, this study aims to contribute to context-specific insights to the discourse on this critical topic
- Chapter 2* Despite efforts to meet the sustainable development goals (SDGs) with inner-city urban densification strategies, a paradox appears. The ambitions for SDG 11: sustainable cities and communities on the one hand, and SDG 3: good health and wellbeing on the other, result in contradictory urban density recommendations. In an increasingly urbanising world, inner-city urban densification is a crucial strategy in the face of creating sustainable cities and communities. However, these strategies should not come at the expense of the health of urban residents. Yet, extensive research shows that higher population densities do lead to certain health issues. This paradox is specified as the Health-Density paradox. Perhaps a design exploration, investigating the Health-Density paradox by examining the definition and interplay between its key topics, can remedy the situation and convert the Health-Density paradox into a Health-Density nexus in the case of context-specific inner-city urban densification strategies.
- Chapter 3* The conceptual shift, in which urban density is redefined prescriptively through the floor space index (FSI) and ground space index (GSI), combined with the multifaceted definition of urban health into the eight determinants People, Lifestyle, Community, Local economy, Activities, Built environment, Natural environment and Global ecosystem, shows it can achieve context-specific recommendations for inner-city urban densification strategies. Thereby, the Health-Density paradox can, in theory, be converted into a Health-Density nexus. Further research through a context-specific design exploration is needed to determine whether this conceptual framework is applicable in practice.
- Chapter 4* For this design exploration, Overvecht Zuid, a neighborhood in Utrecht with significant urban health challenges, serves as the thesis's case study. Although its FSI and GSI values indicate the high potential for inner-city urban densification interventions, the neighborhood will be extensively densified. Moreover, the area experiences striking health risks, particularly in the domains of Community and Local economy among others.

Thus the main research question, this thesis seeks to answer is:

---

*How could the Health-Density paradox be converted into a Health-Density nexus in the urban densification strategy for Overvecht Zuid, Utrecht?*

---

## 5.2 Maximisation method

To answer the main research question, this thesis will make use of the maximisation method. The maximisation method, is a method to structure the design exploration process towards an integrated sustainable urban design. By structuring the design process in this way, helps to transparently demonstrate the decisions made behind an urban design.

The maximisation method structure, that was presented during a workshop is shown in Figure 25 (K. Aalbers, personal communication, November 14, 2024)

The structure consists of four sequential steps:

- 1 **Analysis**, in which the subject site is analysed on relevant topics.
- 2 **Maximisation**, in which scenarios are made addressing each relevant topic separately.
- 3 **Optimisation**, in which all maximisation scenarios are combined into a vision, while evaluating how they complete or compete with each other.
- 4 **Integration**, in which the vision is translated into an integrated urban design.

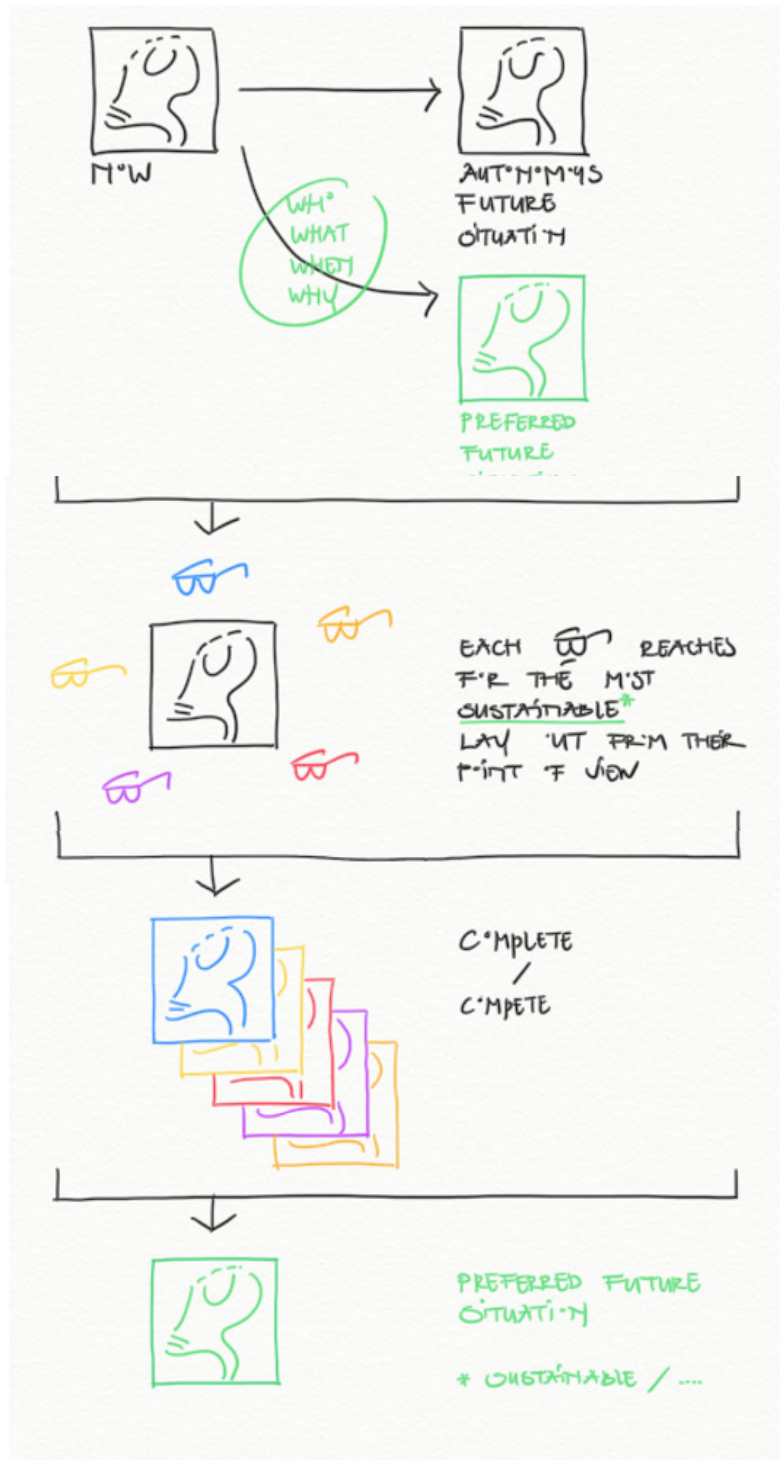


FIGURE 25 A drawing presenting the four steps of the maximisation method, by Kristel Aalbers, 2024.

### 5.3 Methodological framework

As shown in the methodological framework (Figure 26), part II of this thesis will be structured according to the maximisation method, with a chapter dedicated to each step. The subquestions that will be answered in order to answer the main research question, are:

*How are urban density and urban health currently embedded in Overvecht Zuid?*

*How should Overvecht Zuid be densified if each urban health determinant were to be addressed separately?*

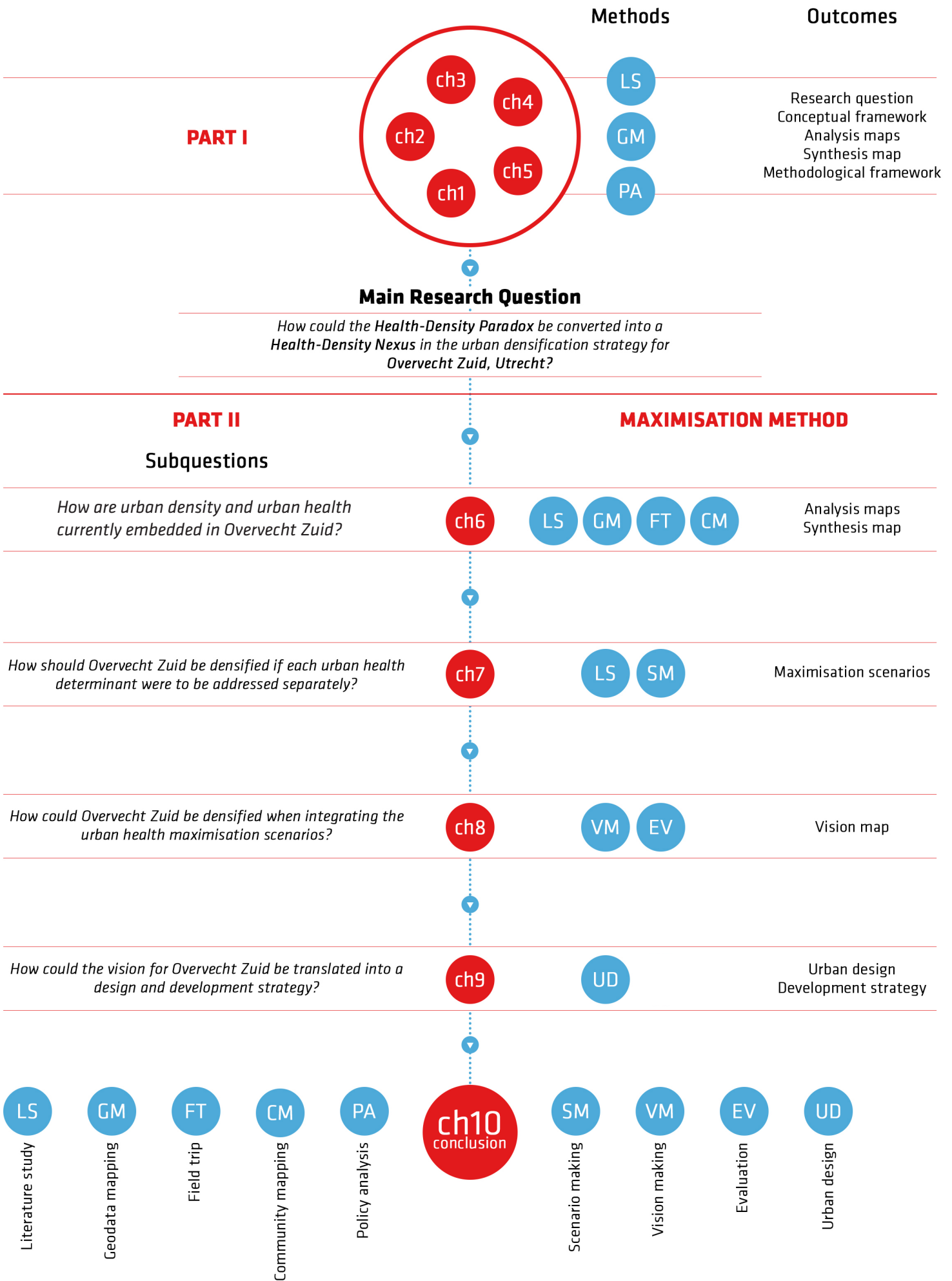
*How could Overvecht Zuid be densified when integrating the urban health maximisation scenarios?*

*How could the vision for Overvecht Zuid be translated into a design and development strategy?*

To answer these sub questions, the methodological framework shows which methods will be used and what the outcomes can be expected.

- **Literature study** is a way to gain knowledge on a topics, by means of reading relevant literature.
- **Geodata mapping** is a way of acquiring spatial information on the selected site, based on geodata. In this thesis QGIS has been used.
- **Field trip** is a method in which the area is visited. It is used to gain real-life observations on eye level.
- **Soft mapping** uses supra-factual cartography to illustrate everyday experiences through text and drawings.
- **Policy analysis** is a literature study of related policy documents. It is used to get an understanding of the ambition of local governments.
- **Scenario making** is a design exploration used to illustrate multiple possible directions in which an urban design could go in the future.
- **Vision making** is a way of establishing local ambitions for an urban design in a vision map.
- **Evaluation** is a method used to judge whether the intended outcome is achieved. It is used to adjust the urban design accordingly.
- **Urban design** consists of plans, sections and impressions, which represent a possible future for an area. This is used to visualise the projects, communicate ideas, and inspire others.

► **FIGURE 26** The methodological framework showing the structure of the thesis with sub questions, methods, and outcomes, by Tejon Tomas Kraan.



The image features a solid blue background. In the upper right, there is a light pink square partially enclosed by a thick red outline that forms a jagged, irregular shape. The rest of the page is decorated with various red line-art elements, including a large, complex shape on the left side and several smaller, abstract shapes at the bottom and right edges.

# PART II

Spatial analysis  
understanding Overvecht Zuid

6

Maximisation  
scenarios of healthy urban densification

7

Optimisation  
complete / complete

8

Integration  
urban design

9

Conclusion

10





# Spatial Analysis

*understanding Overvecht Zuid*

## Contents

6.1 Historical analysis	62
6.2 Urban density analysis	65
6.3 Urban health analysis	68

In this chapter Overvecht Zuid is being analysed. First, a historical analysis will go into the origins and conceptualisation of the design of Overvecht Zuid. Afterwards, the current urban densities of the area will be analysed. The last analysis will focus on the relevant urban health determinants in the area. Together, these analyses will help to answer the subquestion:

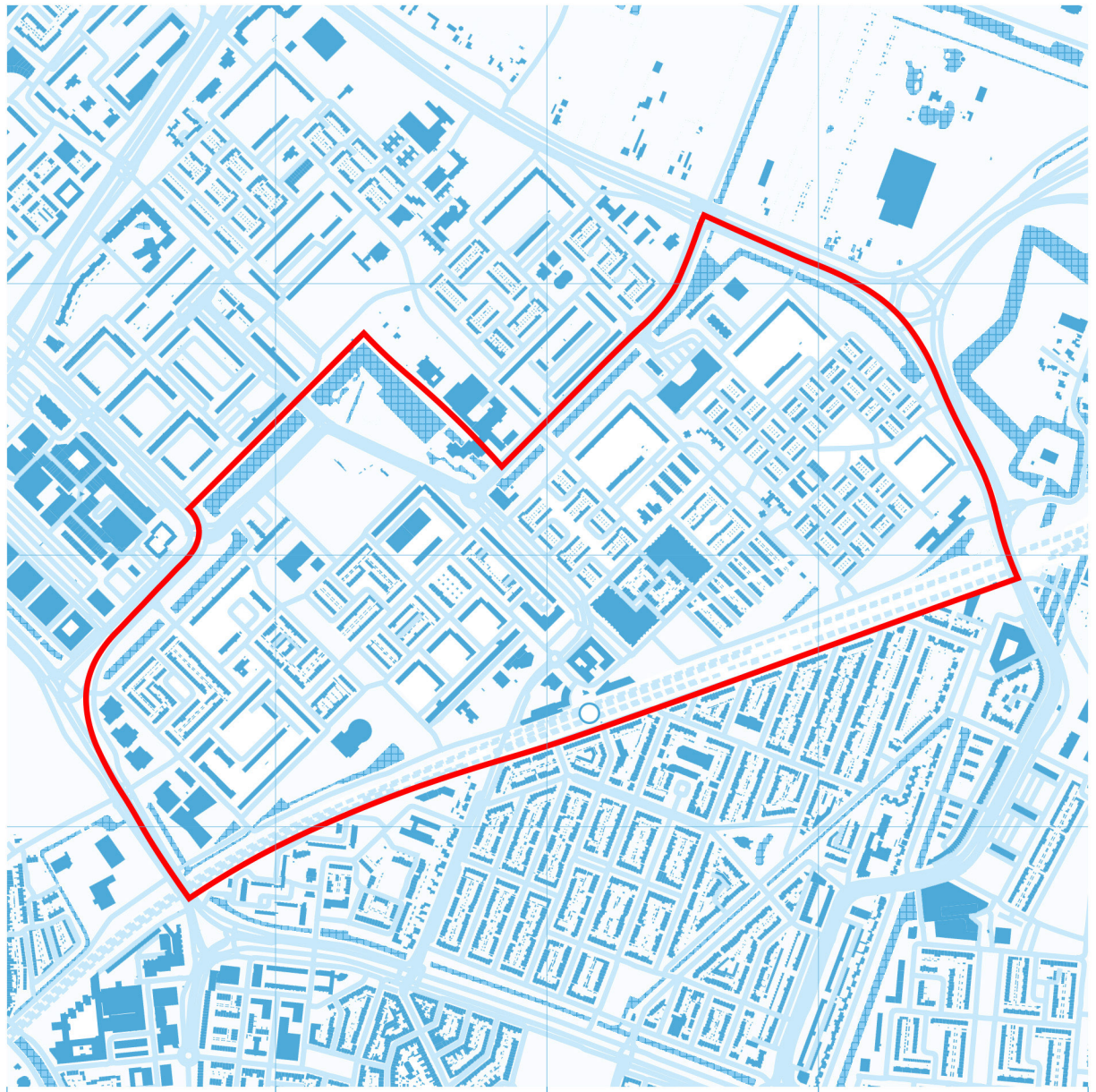
*How are urban density and urban health currently embedded in Overvecht Zuid?*

► **FIGURE 27** A map representing the basal structure of Overvecht Zuid, by Tejon Tomas Kraan.

# Base map

Overvecht Zuid

scale 1 : 12.500



0 0,5 1 1,5 2km

## Legend

 Roads

 Railways

 Train station

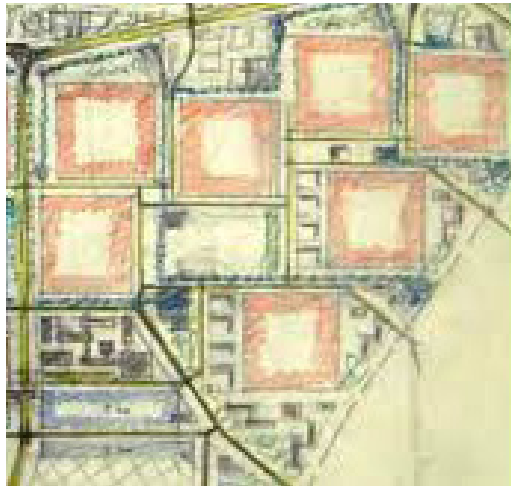
 Buildings

 Water

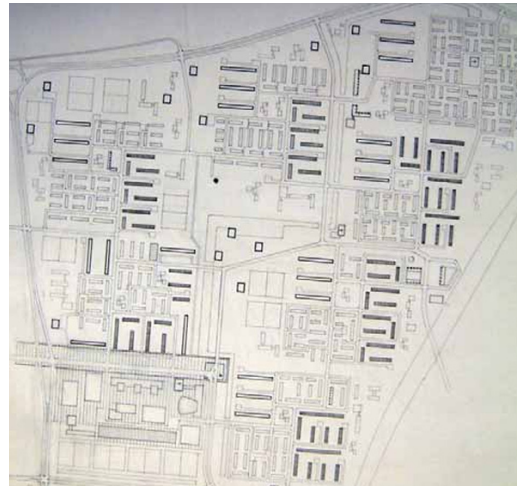
## 6.1 Historical analysis

In 1960, the housing shortage led to the rapid urban expansion of Utrecht. As part of this urban expansion, the design for Overvecht accommodated 45,000 people. The designers envisioned the neighborhood as the modern counterpart to Utrecht's old city centre. It would be a healthy city with more light, air, and space (Meurs, 2011). To achieve this, the "neighborhood unit" concept was introduced in which, inspired by the garden city movement, the continuous urban fabric was segmented into smaller units (or "stamps") of modestly sized residential clusters strategically positioned within green zones (Figueiredo et al., 2021). Central to this planning approach was the separation of living, work and recreation to establish an orderly structured urban ensemble (Pieterse, 2011).

Constant Hanekroot designed the northern part of Overvecht, whereas Wim Wissing was responsible for the design of Overvecht Zuid. As is shown in Figure 28 and 29, Wissing divided the area into seven such neighborhood units consisting of about 800 dwellings each. Originally, these units included a mix of row houses and medium-rise apartment buildings limited to six stories. However, in response to the persistent housing shortage, modifications were made to the initial design, incorporating multiple ten-story apartment complexes (Meurs, 2011).



**FIGURE 28** Wissing's sketch plan for Overvecht Zuid 24 april 1958 showing the neighborhood units, by Wissing archive (NAi).



**FIGURE 29** Wissing's sketch plan for Overvecht Zuid 28 october 1958 showing the internal composition of each neighborhood unit, by Wissing archive (NAi).

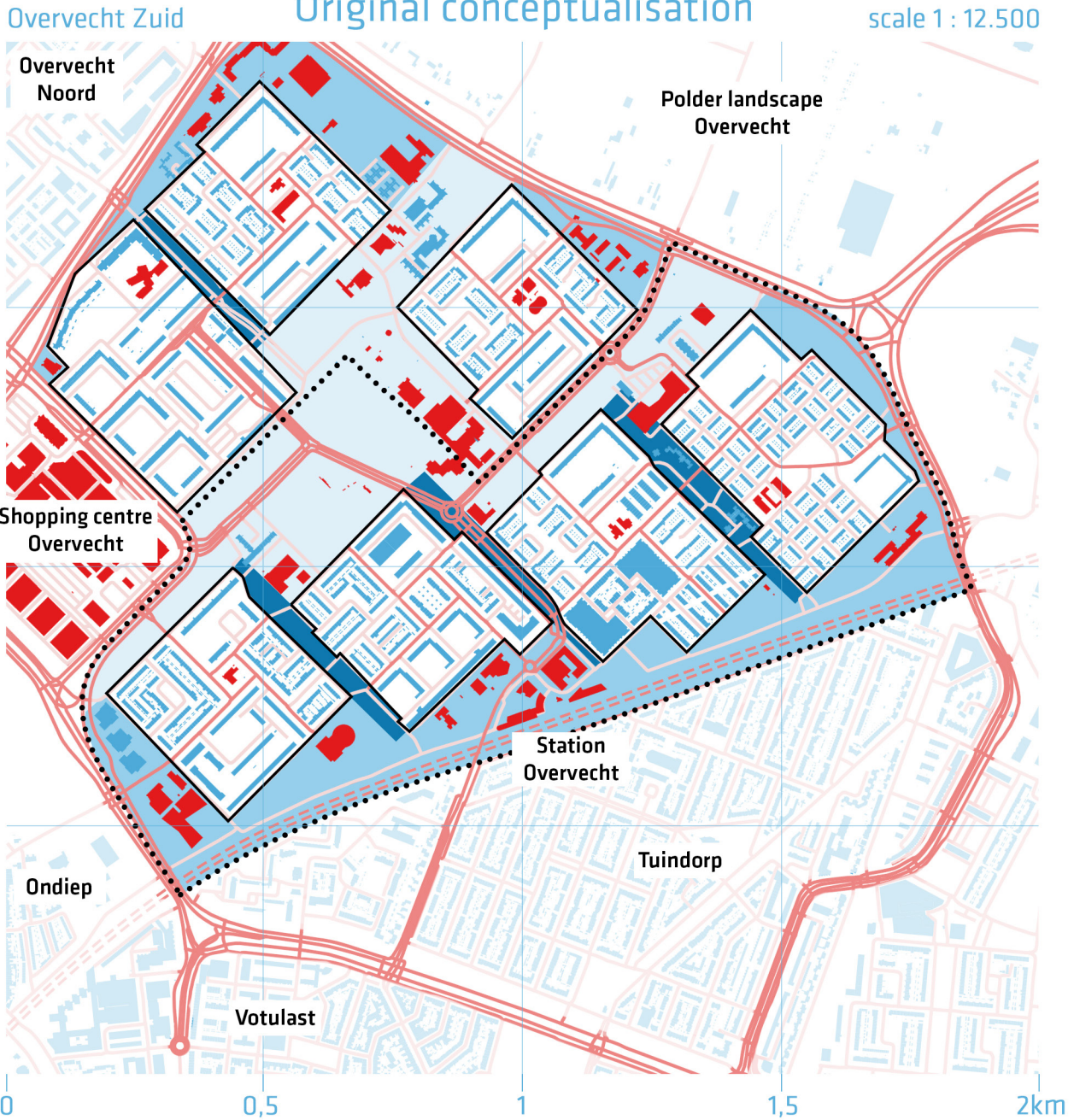
Between the neighborhood units of Overvecht Zuid recreational green strips were designed (Figure 30). On the edge of the area Wissing established green zones to act as a buffer between the area and the surrounding environment. Additionally, at the heart of all the neighborhood units the Watertoren park was laid out (Meurs, 2011). Before the construction of the buildings, the ground was covered in two meters of sand. And so, this tabula rasa construction method left little trace of the original peat and polder landscape in the green zones of the area today.

► **FIGURE 30** A map of the historical analysis of Overvecht Zuid showing Wim Wissing's design for seven neighbourhood units, by Tejon Tomas Kraan.

# Analysis map

## Original conceptualisation

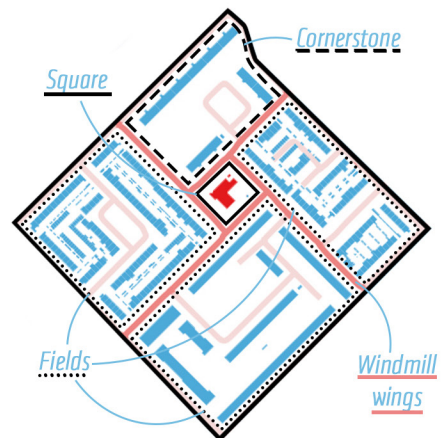
scale 1 : 12.500



### Legend

- Dwelling
- Public building
- Neighbourhood unit
- Project area in Overvecht Zuid
- Watertoren park
- Green buffer zone
- Green recreational strip
- Car road network

### Highlight Neighborhood unit



Although the use of innovative construction techniques was very progressive, the ideas about living and working were still firmly rooted in the tradition of the nuclear family (Pieterse, 2011). The car-centric design of Overvecht Zuid facilitated the daily commute of a male breadwinner to and from his work. With all the necessary amenities within walking distance, the neighborhood unit became a spatially well-defined, small-scale and functionally autonomous area. Based on the assumption that physical proximity equalled social bonding, the neighborhood units was supposed to function as a family-friendly place for women and children to grow up and grow old without ever having the need to leave their familiar environment (Figueiredo et al., 2021).

All neighborhood units in Overvecht zuid have a similar layout. While the overall design remains consistent, the internal composition of each stamp varies. Each stamp consists of a “*Cornerstone*”, the “*Fields*”, a “*Square*”, and the “*Windmill wings*” (Figure 30). The Cornerstone, consisting of ten-storey apartment buildings arranged around a green courtyard, is repeatedly located in the northern corner and is the tallest section of the stamp. It serves as a prominent landmark visible from a distance. The Fields are smaller, structurally cohesive sub-neighborhoods composed of either medium-rise apartment buildings or low-rise housing. Together with the Cornerstone, the Fields enclose the centrally positioned Square, which is typically designated for special, public functions such as community centres. Finally, the Windmill Wing consists of the streets that weave through the various sub-areas. The layout of these streets resembles the wings of a windmill and serves as the primary access routes to the neighborhood (Gemeente Utrecht, n.d.).

In spite of the ideology behind Overvecht Zuid, today, it has turned out to be the backdrop of the multicultural society rather than the intended manifestation of the welfare state. The uniformity of the prefabricated, large-scale residential blocks, initially intended to foster social equality and shared prosperity, was soon perceived as monotonous, impersonal, and socially ineffective (Meurs, 2011).

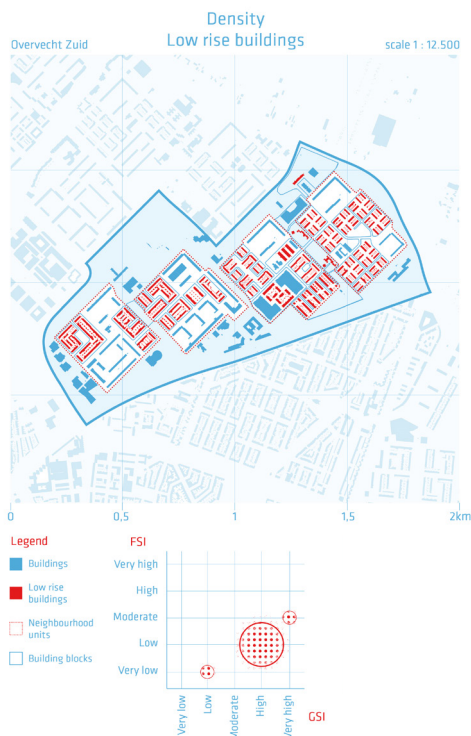
Moreover, the original design of Overvecht Zuid was meant to create an extensive public realm at ground level to serve as a communal space for residents. Over time, however, this public realm became unsafe. The indistinct delineation between private and public spaces, as well as the challenges in maintaining the vast public spaces contributed to these issues (Meurs, 2011).

Although the green spaces make an important contribution to Overvecht’s green character, they failed to enhance urban vitality within the neighborhood units. The car-oriented infrastructure, which prioritized car-friendly roads over people-friendly streets, has been detrimental to social cohesion. Additionally, the strict functional division between living, working, and recreation caused a lack of urban vibrancy, hindering the development of a thriving local economy (Meurs, 2011).

## 6.2 Urban density analysis

The Rudifun geodata base (Planbureau van de Leefomgeving, 2024) provides the information of the GSI and FSI on the building block level to analyse the urban density of Overvecht Zuid descriptively. The neighborhood is dissected into four different types of spatial morphological urban densities based on these indexes. To give an example, the analysis in Figure 31 shows the low rise buildings type which generally has a high GSI and a low FSI. Later, this information can be used to explore the possible urban densification strategies that can be implemented per type. The full page analyses of the FSI and GSI can be found in Appendix 9 to 12.

Besides the analyses of building typologies, similar analyses are done which focus on the spaces in between buildings. This is done with the OSR (= Open Space Ratio) indicator, which is also provided in the Rudifun geodata base (Figure 32). This indicator expresses the spaciousness of the unbuilt area (Planbureau van de Leefomgeving 2024). It is a derivative of the FSI and GSI and is determined with a simple calculation:  $OSR = (1 - GSI) / FSI$ . Later, this can be used to make a prioritisation of spaces in the urban densification strategy of Overvecht Zuid. The full page analyses of the FSI and GSI can be found in Appendix 13 to 17. Figure 33 shows all the analyses combined. This will later be the basis of the design of each maximisation scenario.



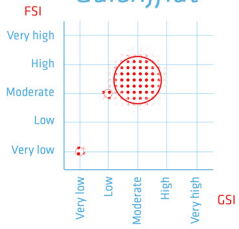
**FIGURE 31** The analysis on the spatial morphological urban density showing the low rise buildings with a high GSI and low FSI, by Tejon Tomas Kraan based on data from Planbureau van de Leefomgeving (2024).



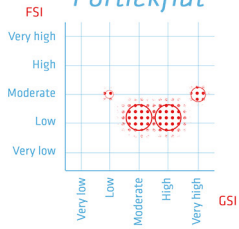
**FIGURE 32** The analysis on the Open Space Ratio types in Overvecht Zuid showing the public places with a very low spaciousness, by Tejon Tomas Kraan based on data from Planbureau van de Leefomgeving (2024).

- **FIGURE 33** A two-page illustration showing all the urban density analyses done in Overvecht Zuid both on the spatial morphological urban density types (left) and the Spaciousness (right), which are the base for the densification strategies per building types and public spaces, by Tejon Tomas Kraan based on data from Planbureau van de Leefomgeving (2024).

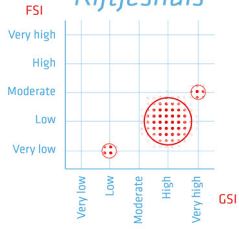
**Urban density type 4:**  
high rise buildings  
"Galerijflat"



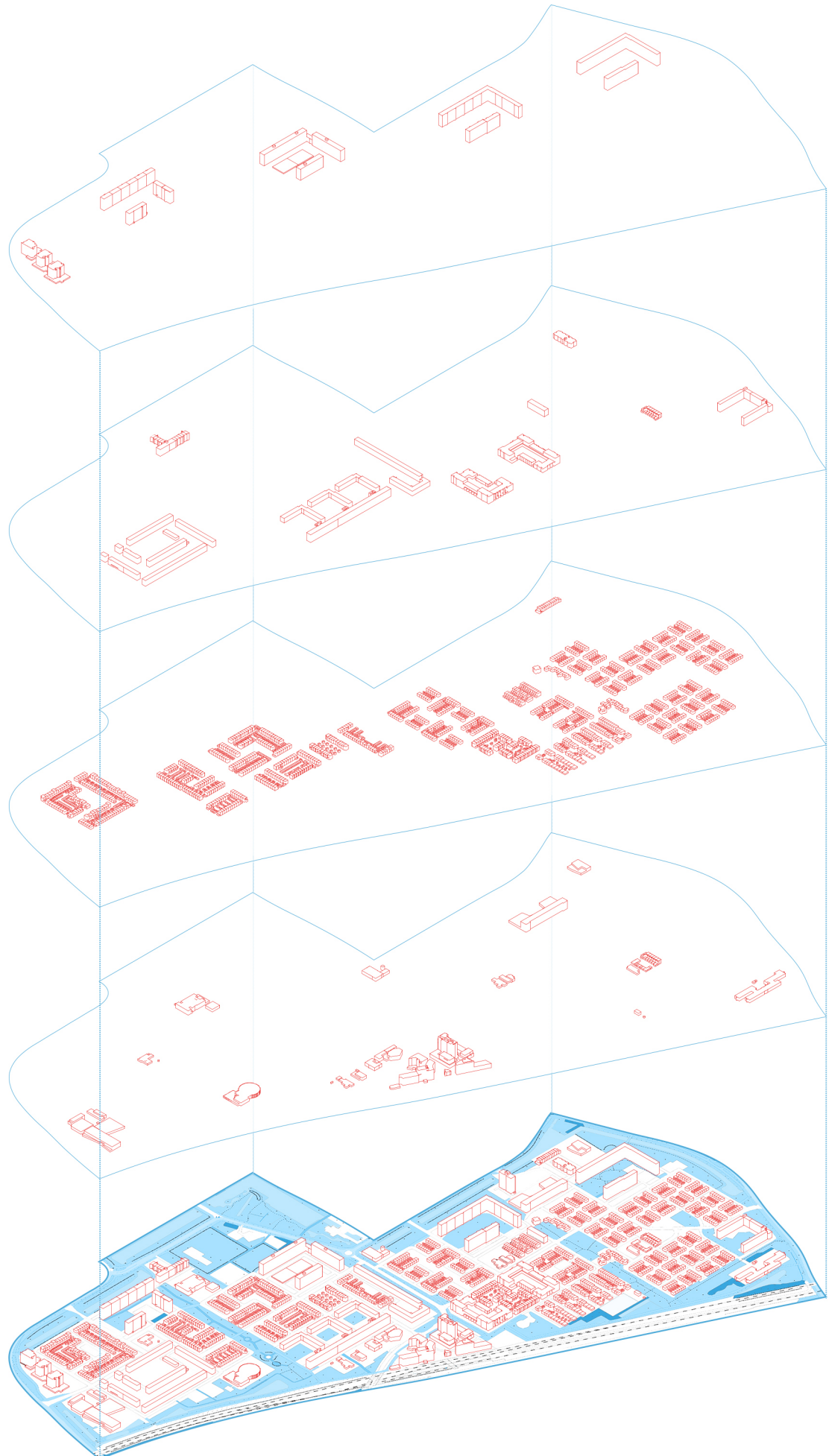
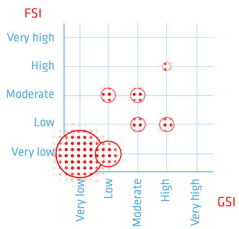
**Urban density type 3:**  
medium rise buildings  
"Portiekflat"



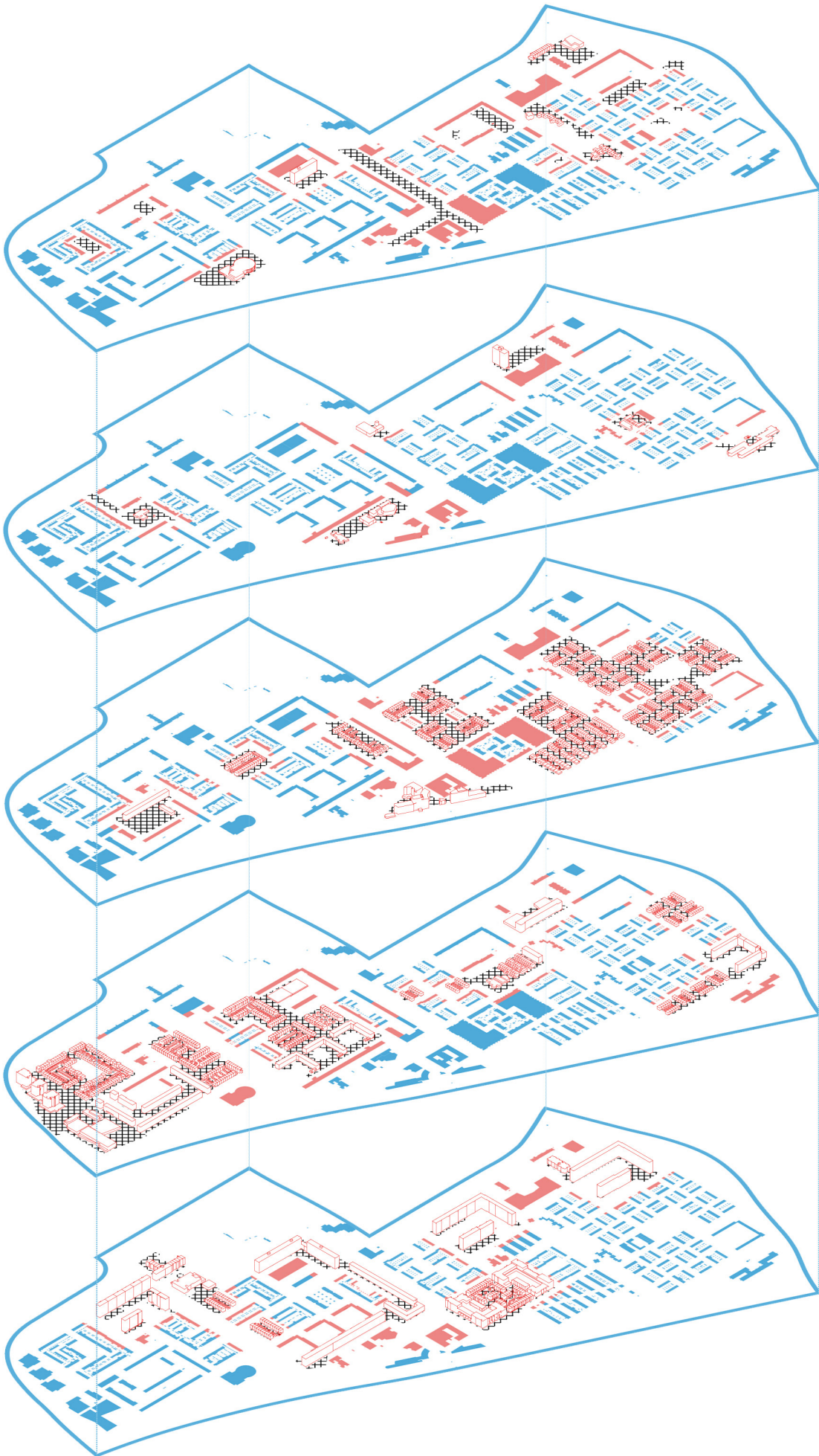
**Urban density type 2:**  
low rise buildings  
"Rijtjeshuis"



**Urban density type 1:**  
public buildings  
"Object in space"



**Overvecht Zuid**



**OSR type 5:**  
 very high OSR  
 = more than 5

**OSR type 4:**  
 high OSR  
 = 2 tot 5

**OSR type 3:**  
 moderate OSR  
 = 1 tot 2

**OSR type 2:**  
 low OSR  
 = 0,6 tot 1

**OSR type 1:**  
 very low OSR  
 = 0 tot 0,6

### 6.3 Urban health analysis

The analysis of the site selection in Chapter 4 has given an prioritisation of urban health risks in each neighborhood. The greatest health challenges Overvecht Zuid is facing are related to the Community determinant, followed respectively by the determinants of Local economy, Global ecosystem, Activities, Built environment, and People. Nevertheless, to keep the scope of this thesis within feasible limits, the analysis and subsequent design of Overvecht Zuid will merely focus on the three urban health determinants with the highest priority for this neighborhood: first Community, then Local economy, and lastly Global ecosystem. Although the analysis and design of the remaining determinants could have changed the final outcome, this thesis aims to showcase the methodology that is used in order for it to be repeated in the future with the other urban health determinants.

The analysis of the site selection in Chapter 4 has also given a good idea about the problems this neighborhood is facing on the city scale. However, this analysis, which only made use of geodata, often fails to show how these problems are rooted in the human scale. To get to the core of these challenges the urban health analysis will be an exploration of the human scale. To do so, this thesis makes use of multiple site visits in which eye-level observations are done. This is done in one of the neighborhood units in Overvecht Zuid, called the “*Taagdreefbuurt*”. This neighborhood unit is chosen because it most clearly embodies Wim Wissing’s original concept for the neighborhood units. The result for this unit can be an example to the redevelopment of the other units in the neighborhood.

The observations of the Taagdreefbuurt consist of photos, sketches, and notes made in various locations throughout the neighborhood unit. To bring these diverse sources of observations together in a unified way, the “soft mapping” method has been used which is inspired by Jan Rothuizen’s soft atlases (n.d.). Rather than representing the precise physical reality of a place, a soft map uses supra-factual cartography to illustrate everyday experiences through text and drawings. By bringing together all observations into the soft maps, a deeper understanding of the human scale was gained. Rather than a final product, the soft maps should be seen as the process or exercise in which the neighborhood unit is explored through drawing. The main take aways from each soft map are summarised in bullet points:

#### **Community soft map (Figure 34)**

- The transitions between private and public has a great influence on the sense of ownership in public space.
- Foundation Impulzz and Overhoop are at the core functions to the community in the neighborhood unit.
- The neighborhood is a residential area with little other functions which ensures that the public space is rarely activated during the day.

► **FIGURE 34** A soft map showing the analysis of the Community urban health determinant of the Taagdreef neighborhood unit, by Tejon Tomas Kraan.



- The green areas in and around the neighborhood unit are mostly badly maintained and do not invite residents to meet each other.
- There are plenty eyes on the street, but the low quality street design, makes for an unsafe atmosphere.
- The neighborhood is filled with roads that are designed for cars rather than streets for walking and cycling which could promote lively everyday street life.
- The broad road corners and lack of car bumps make people drive fast.

**Local economy soft map (Figure 35)**

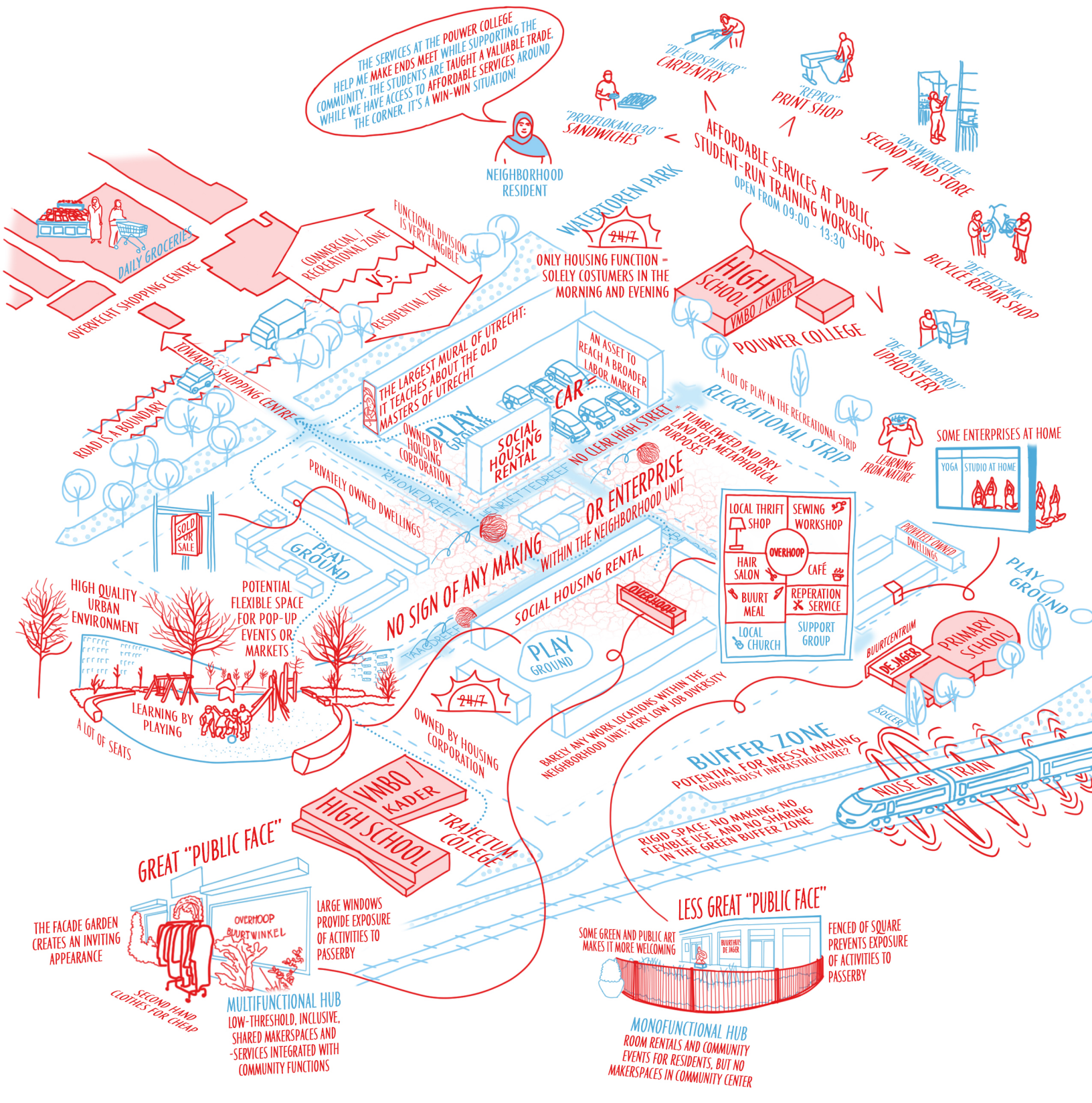
- There is no sign of any making or enterprise within the neighborhood unit.
- There is a major functional division between the commercial and recreational zone (Overvecht shopping centre) and the residential zone (Taagdreefbuurt), even though most of these function could easily be mixed with little to no nuisance.
- The high schools offer great services to the residents, but they are located outside the neighborhood unit.
- The existing buildings in the neighborhood unit have poor public faces.
- The neighborhood unit is designed for cars. At the same time, the car is an essential asset to reach a broader labor market and have greater economic opportunities.
- Many green spaces experience uncomfortable nuisance from adjacent infrastructure, which renders these places useless. Rather, these places can be used to concentrate “messy making”, which are maker spaces that produces noise, dust, and/or problematic odours.
- The low quality atmosphere of public space isn't very inviting to possible costumers.

► **FIGURE 35** A soft map showing the analysis of the Local economy urban health determinant of the Taagdreef neighborhood unit, by Tejon Tomas Kraan.

# Analysis map Local economy

Taagdreef buurt

Soft map



**Global ecosystem soft map (Figure 36)**

- The car dependency incorporated in the neighborhood design, makes for higher CO2 emissions.
- Unlike the renovated social housing blocks and schools, the privately owned houses generally have bad energy labels.
- Even though the anthropogenic sand top layer is great for infiltration, most streets are designed badly and are impermeable for rain water which gives water nuisances.
- The green design of the neighborhood helps to reduce heat stress, yet it also creates more car dependency
- The asphalt roads within the neighborhood cause local heat stress.
- The playgrounds with little greenery create local heat stress.
- The cool refuges in the green areas around the neighborhood units are not attractive to stay in.
- There is a high potential for a mobility transition with the Overvecht train station around the corner.

► **FIGURE 36** A soft map showing the analysis of the Global ecosystem urban health determinant of the Taagdreef neighborhood unit, by Tejon Tomas Kraan based on data from Ministerie van Infrastructuur en Waterstaat (2024).





# Maximisation

*scenarios of healthy urban densification*

## Contents

7.1 Towards a maximisation scenario	75
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7.4 Global ecosystem maximisation	81

In this chapter maximisation scenarios will be designed for the three main urban health determinants. Within a maximisation scenario the urban design of the neighborhood is exclusively fixated on one single urban health aspect. This chapter starts with the maximisation scenario for the urban health determinant Community. Subsequently, the scenario for Local economy will follow. Lastly the the Global ecosystem urban health determinant will be maximised.

*How should Overvecht Zuid be densified if each urban health determinant were to be addressed seperately?*

## 7.1 Towards a maximisation scenario

To create a design for each maximisation scenario, the relationships between FSI/GSI and each urban health determinant are going to be examined as was shown in Figure 13. Scientific evidence on these exact relationships is relatively sparse. There are few empirical studies on the performance of urban density that discuss density using a combination of FSI and GSI measures (Berghauser Pont and Haupt, 2021). Nonetheless, a few do. Ye et al. (2018), for example, show that built coverage (GSI) tends to exert greater influence on urban vitality than built intensity (FSI). They show a building block with a higher GSI increases urban vitality.

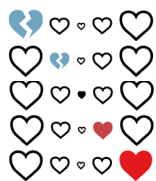
Urban vitality, or “*the presence of an active street life, and generally the extent to which a place feels alive or lively*” (Montgomery, 1998) plays a key role in strengthening local communities, because lively streets encourages community engagement and make communities more civic-minded, inclusive, and livable (Mehta & Bosson, 2021).

According to Liu et al. (2022), urban vitality also supports the local economy. It attracts investment and skilled labor, fosters creativity and competitiveness, and contributes positively to economic resilience, thereby driving broader economic development. Furthermore, Chen et al. (2022) demonstrate a positive correlation between urban vitality and innovation.

Empirical studies on the performance of urban density on the Global ecosystem urban health determinant are more direct. In the case of water management, the amount of pervious surfaces, is directly relates to the GSI, while not being influenced by the FSI (Kim et al., 2016; Li et al., 2016; Trudeau & Richardson, 2016). Besides, according to Kim & Ryu (2015) both high-rise developments and densely built low-rise areas have been associated with heat stress.

The studies stated above form the basis of each maximisation scenario. On top of that, the designs of the scenario are further enhanced using a toolbox composed of design interventions. These design interventions are compiled from a number of publications by urban designers and planners, shown in Figure 37.

The cards with design interventions are all structured in the same way Figure 38. They are numbered and given a title. An image is added to further illustrate what the intervention encompasses. Moreover, the source of the publication of origin is stated along with a summary of the intervention. Lastly, to embrace the complex multifaceted nature of the concept of urban health, the intervention is scored on all the urban health determinants:



A big, blue, broken heart means it directly impacts the determinant negatively.

A medium, blue, broken heart means it can impact the determinant slightly negatively.

A small, black heart means the determinant is barely impacted in any ways.

A medium, red heart means it can impact the determinant slightly positively.

A big, red heart means it directly impacts the determinant positively.

Note: in the cases sufficient literature is lacking, the relationships is estimated.

Appendix 18 shows all the design interventions in full size.



FIGURE 37 A collage of the reports and books used to compile the toolbox. From left to right and top to bottom: Groenblauwe netwerken, by Pötz (2016), Patterns for urban manufacturing, by Cities of Making (2025), Making space for Collective Living, by Posad Maxwan Strategy & Design (2022), Restorative cities, by Roe & McCay (2021), and Bouwen aan leefomgevingskwaliteit, by Vereniging Deltametropool (2022).

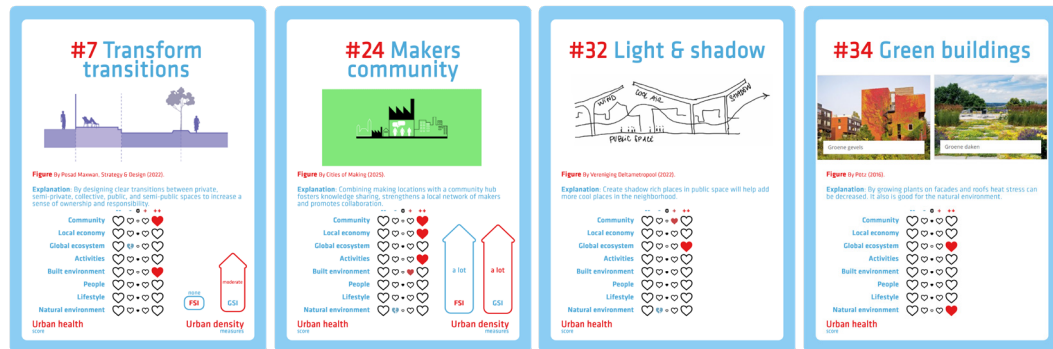


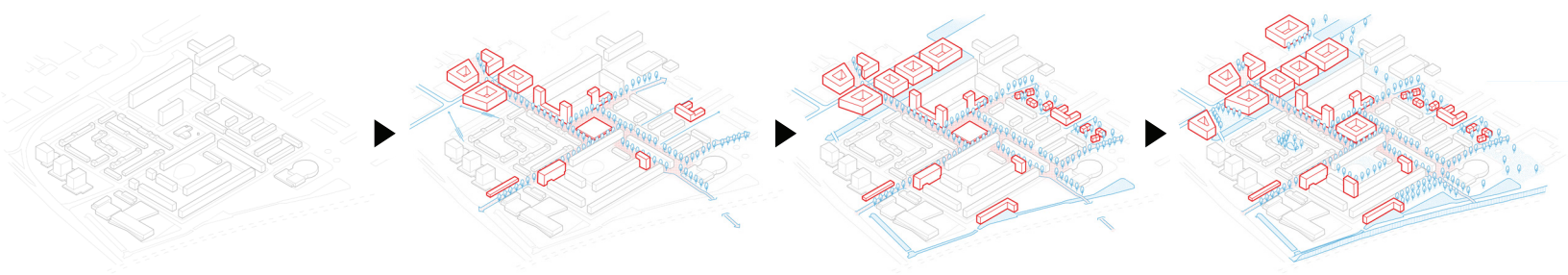
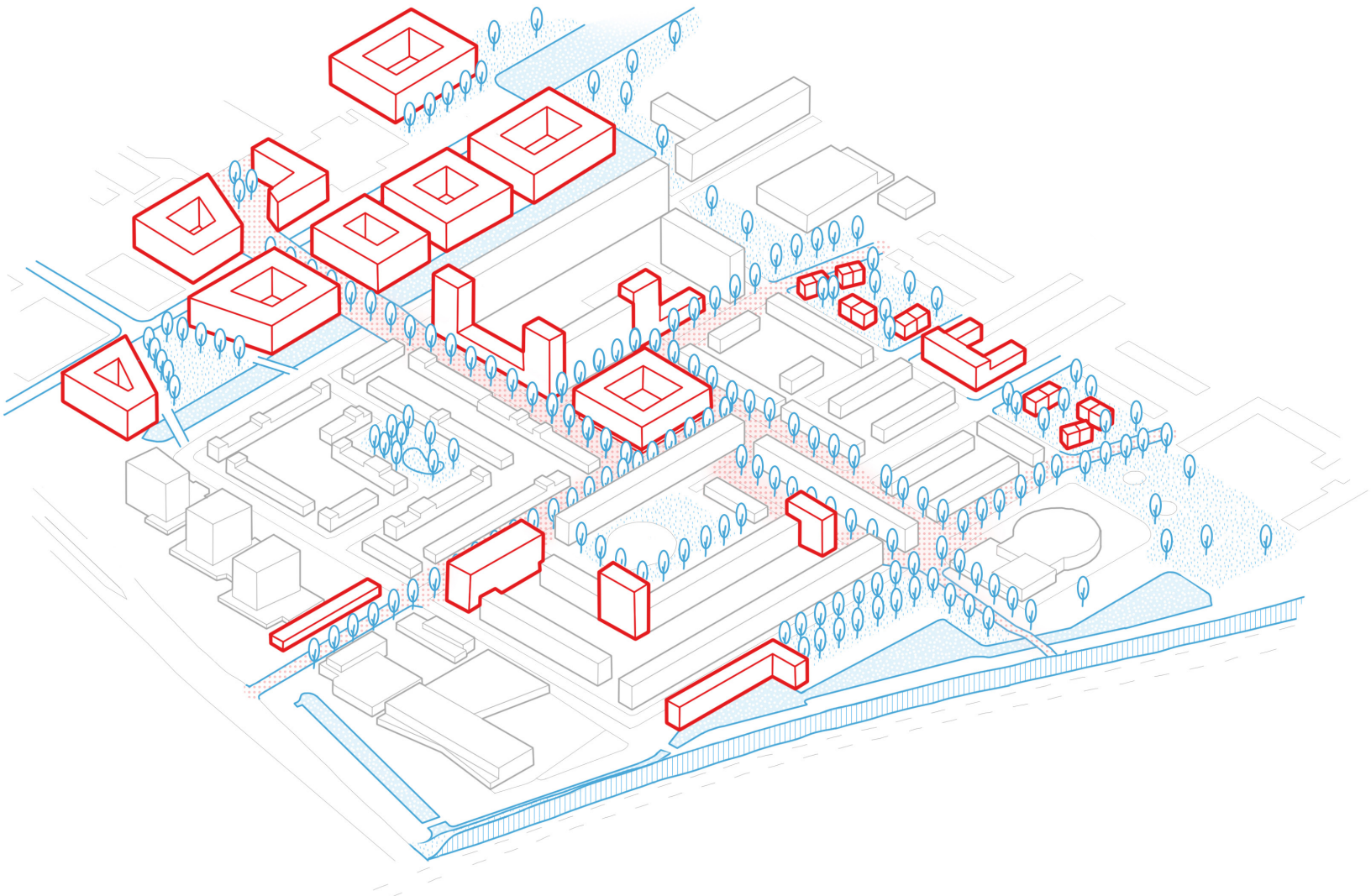
FIGURE 38 A collage of some of the design interventions from the toolbox, by Tejon Tomas Kraan.

## 7.2 Community maximisation

Figure 39 illustrates the sequence of interventions undertaken to achieve the maximisation scenario for the Community determinant. Guided by the awareness that a higher GSI will lead to an increased urban vitality which is beneficial to the sense community, the following steps were taken towards the community maximisation scenario:

- 1 In order to prevent displacement of the current inhabitants, in the name of demolition-and-rebuilt strategies, all existing dwellings should be preserved.
- 2 Connect the neighborhood to the city with safe, active-mobility oriented street designs.
- 3 Introduce a wide range of public facilities, an a wide range of housing typologies, to diversify the community.
- 4 Create opportunities for people to meet each other in public space, but also by carefully designing the transitional zones between public and private.

**FIGURE 39** A isometric drawing showing the Community maximisation scenario including the steps taken to come to the final outcome, by Tejon Tomas Kraan.



1.

2.

3.

4.

# Community

enhancing a sense of local community

1. Sustain current community > preserve existing dwellings
2. Add safe streets connected to the surroundings

**#1 Use the unused**

**Figure 10: Emerging Development (EDS)**

Explanation: Make existing streets, streets, parks, and overhead building available to the public.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#4 No roads, but streets**

**Figure 10: Emerging Development (EDS)**

Explanation: Create streets that are used instead of highways, marking and used (streets) that are built and used.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#5 Eyes on streets**

**Figure 10: Emerging Development (EDS)**

Explanation: Create streets and buildings that are used to create safety in public space and a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#7 Transform transitions**

**Figure 10: Emerging Development (EDS)**

Explanation: The transition between different urban forms, creating a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#12 Active plinths**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#13 Fill-in spaces**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

## 3. Diversify community

**#3 Diversify**

**Figure 10: Emerging Development (EDS)**

Explanation: Create a mix of building types to offer a diversity of uses and activities. This creates a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#9 Community hub**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

## 4. Create opportunities for encounters

**#2 Sharing is caring**

**Figure 10: Emerging Development (EDS)**

Explanation: Create shared facilities where people can meet each other. This creates a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#6 Less door = more**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#8 Unplanned encounters**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#25 A home for every need**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#10 Take a seat**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#11 Garden together**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#14 Gather around**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#24 Makers community**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

**#28 Learn by playing**

**Figure 10: Emerging Development (EDS)**

Explanation: The ground floor of buildings can be used with active and safe streets. This creates a sense of safety and security in public space to increase a sense of security.

Community	+	+	+
Local economy	+	+	+
Global ecosystem	+	+	+
Activities	+	+	+
Built environment	+	+	+
People	+	+	+
Lifestyle	+	+	+
Natural environment	+	+	+

Urban health Urban density

### 7.3 Local economy maximisation

Figure 40 illustrates the sequence of interventions undertaken to achieve the maximisation scenario for the Local economy determinant. Guided by the awareness that a higher GSI will lead to an increased urban vitality which promotes urban manufacturing and enterprise, the following steps were taken towards the local economy maximisation scenario:

- 1 The local economy determinant emphasises the economic capital of the local community. Instead of replacing the current population with a wealthier population, the challenge of the Local economy determinant during a redevelopment is to strengthen the economic capital of the current inhabitants. In order to prevent direct and indirect displacement of the current inhabitants caused by gentrification, all existing dwellings should be preserved. Including rent controlled social housing.
- 2 Insert opportunities for urban manufacturing, by introducing makerspaces of various sizes.
- 3 Redevelop it into a mix-use neighborhood by introducing complementary functions.
- 4 Create a well-designed public realm, to attract new clientele.

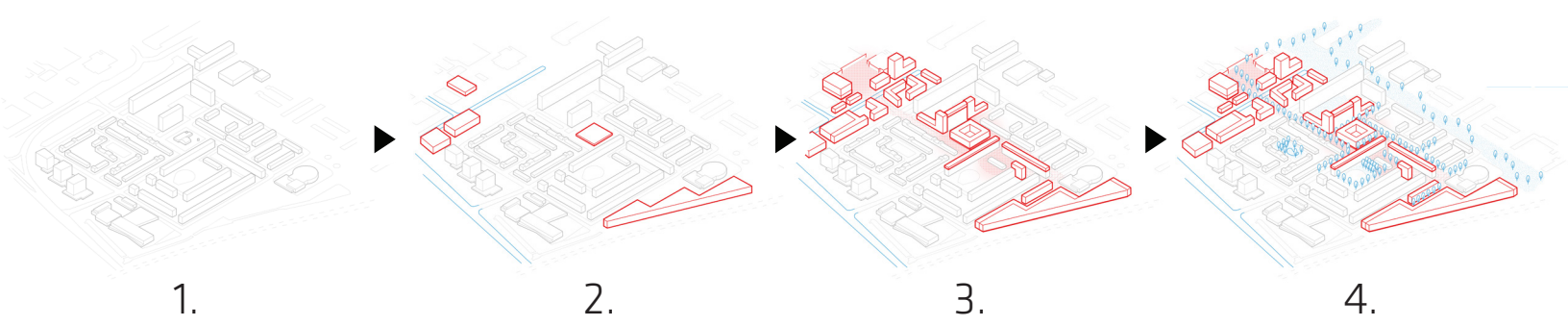
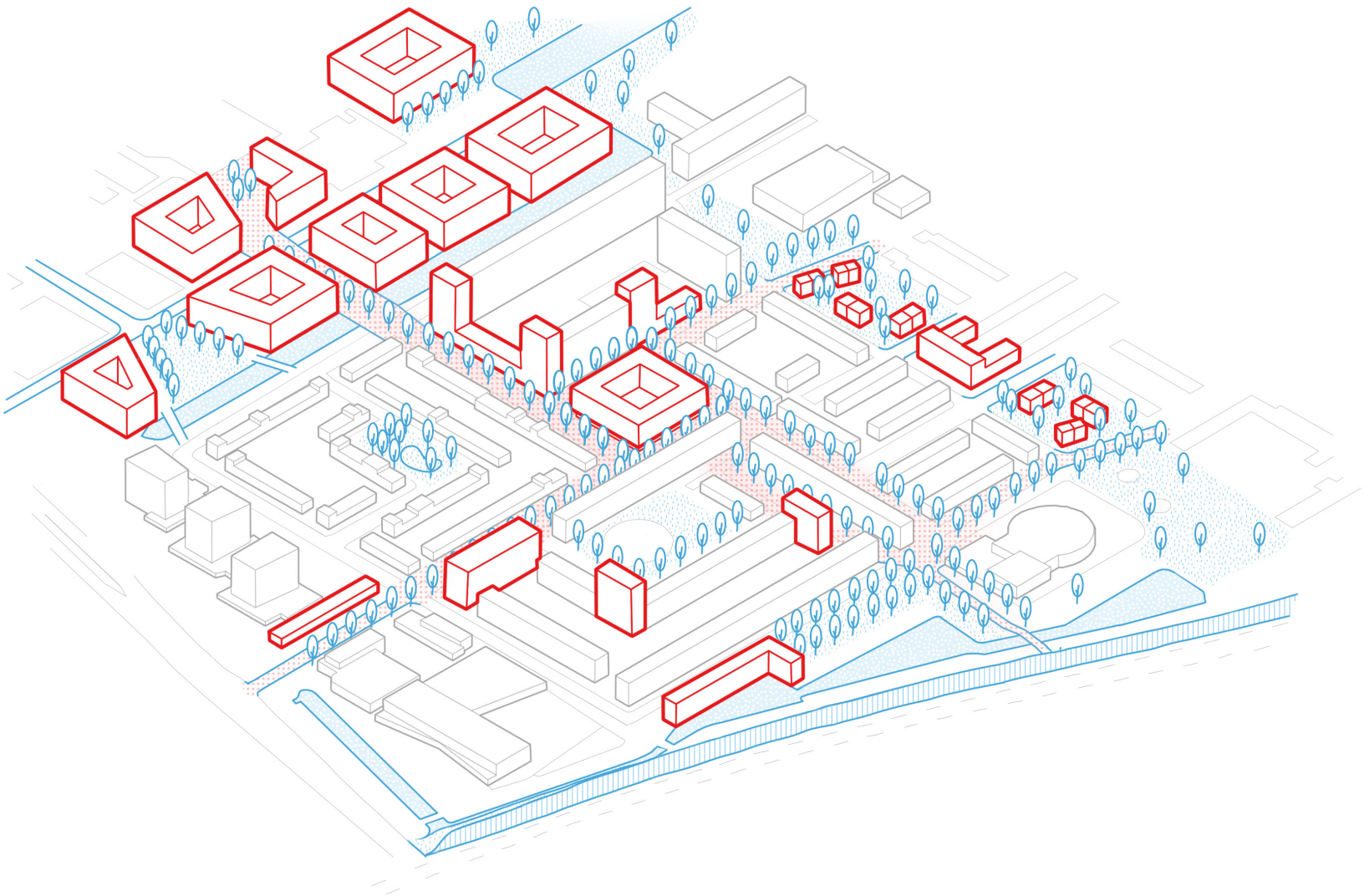
► **FIGURE 40** A isometric drawing showing the Local economy maximisation scenario including the steps taken to come to the final outcome, by Tejon Tomas Kraan.

## 7.4 Global ecosystem maximisation

Figure 41 illustrates the sequence of interventions undertaken to achieve the maximisation scenario for the Global ecosystem determinant. Guided by the awareness that a lower GSI is beneficial to water management and midrise developments lead to less heat stress, the following steps were taken towards the Global ecosystem maximisation scenario:

- 1 In order to safeguard the embedded energy within the existing buildings, demolition is not an option. And so all existing buildings are preserved.
- 2 Reduce green house gass emissions with design interventions like solar panels and an active-mobility strategy.
- 3 Mitigate heat stress with green design interventions and creating grey shadows where needed.
- 4 Create a strong water management strategy while taking advantage of housing opportunities along waterbodies.

▶▶ **FIGURE 41** A isonometric drawing showing the Global ecosystem maximisation scenario including the steps taken to come to the final outcome, by Tejon Tomas Kraan.



# Local Economy

*promoting enterprise and employment*

1. Prevent displacement by gentrification > keep existing dwellings

2. Insert making into the neighborhood

**#16 Microzoning**

**Figure 16: Microzoning (2005)**  
**Explanation:** Inserting or increasing small parcels of building within the urban fabric can provide additional floor area and/or allow greater flexibility for experimentation in the uses, sizes and building types.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#17 Size wise**

**Figure 17: Size wise (2005)**  
**Explanation:** Different lot sizes suggest a diverse range of businesses and other opportunities to be created or renewed without disrupting the neighborhood.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#18 Messy making**

**Figure 18: Messy making (2005)**  
**Explanation:** Inserting manufacturing activities that generate noise, dust, and strong odors along with other uses helps reduce disruption.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#22 Vertical making**

**Figure 22: Vertical making (2005)**  
**Explanation:** Encouraging multi-story buildings that generate noise, dust, and strong odors along with other uses helps reduce disruption.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#23 Flexible spaces**

**Figure 23: Flexible spaces (2005)**  
**Explanation:** Flexible spaces can allow makers to share facilities, equipment, and space with other makers and entrepreneurs in the neighborhood and reduce costs.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#24 Makers community**

**Figure 24: Makers community (2005)**  
**Explanation:** Combining making facilities with a community hub and services can help makers and entrepreneurs in the neighborhood.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

3. Develop into a mix-use neighborhood

**#3 Diversify**

**Figure 3: Diversifying land use (2005)**  
**Explanation:** Introducing a wide range of facilities to attract a diversity of people and uses. This contributes to urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#13 Fill-in spaces**

**Figure 13: Fill-in spaces (2005)**  
**Explanation:** Flexible and usable outdoor spaces for neighborhood recreation can be developed between existing structures to help reduce parking and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#15 Job diversity**

**Figure 15: Job diversity (2005)**  
**Explanation:** A wide range of job opportunities, evenly distributed across the neighborhood, can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#20 High street**

**Figure 20: High street (2005)**  
**Explanation:** Encouraging mixed-use activities along high streets, including ground-floor retail, can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#25 A home for every need**

**Figure 25: A home for every need (2005)**  
**Explanation:** Introducing a wide range of housing types within the neighborhood can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#26 Around the corner**

**Figure 26: Around the corner (2005)**  
**Explanation:** Introducing public services and public facilities in easily accessible and centrally located areas can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#27 Twentyfour-seven**

**Figure 27: Twentyfour-seven (2005)**  
**Explanation:** Creating round-the-clock services, such as public services, can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

4. Attract clientele

**#2 Sharing is caring**

**Figure 2: Sharing is caring (2005)**  
**Explanation:** Introducing shared facilities where people can meet each other can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#4 No roads, but streets**

**Figure 4: No roads, but streets (2005)**  
**Explanation:** Designing streets for active travel instead of cars can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#12 Active plinths**

**Figure 12: Active plinths (2005)**  
**Explanation:** Designing buildings for active travel can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#19 Spaces that work**

**Figure 19: Spaces that work (2005)**  
**Explanation:** Designing public spaces for both recreation and active travel can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#21 Public face**

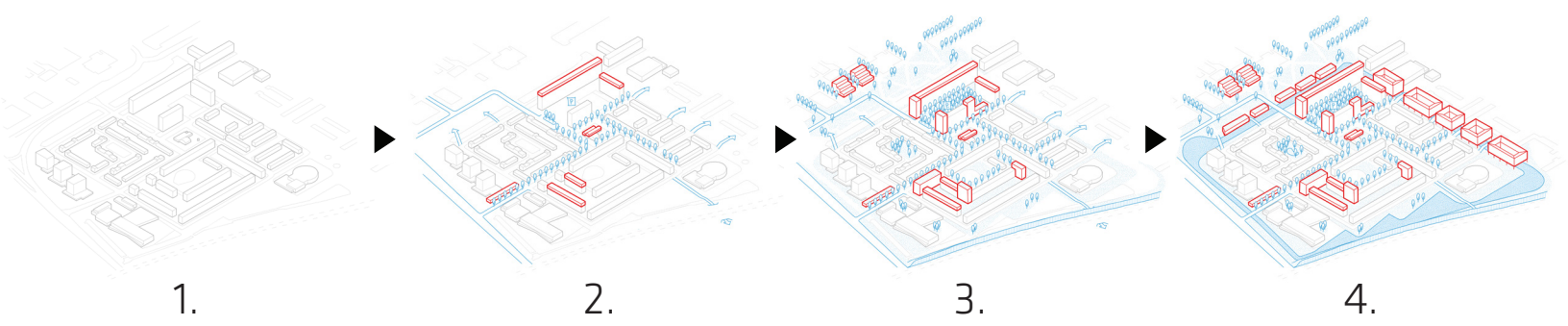
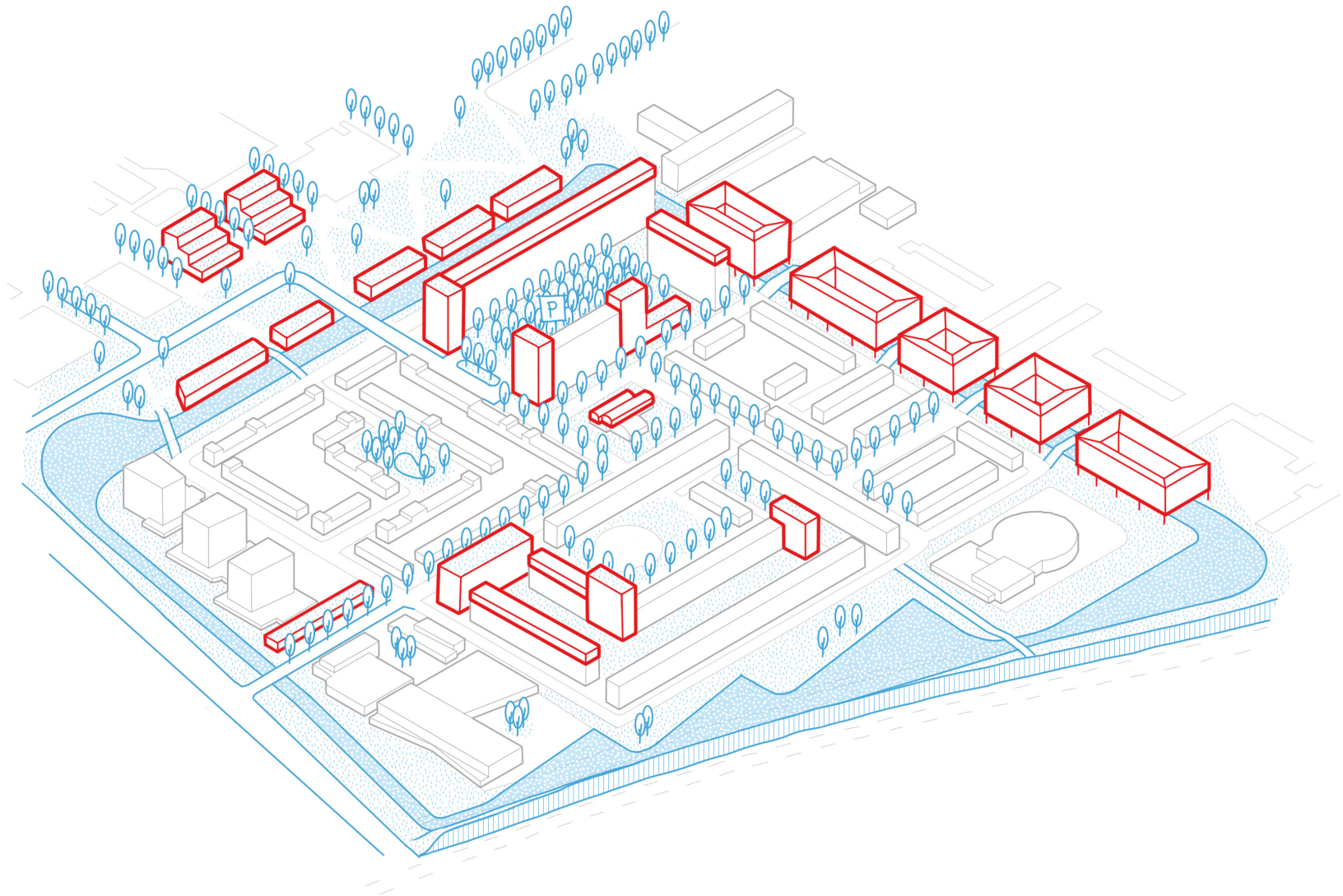
**Figure 21: Public face (2005)**  
**Explanation:** Designing buildings with an interesting and attractive public face can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2

**#28 Learn by playing**

**Figure 28: Learn by playing (2005)**  
**Explanation:** Providing a range of play opportunities can help reduce unemployment and improve urban equity.

- Community: 1/2
- Local economy: 1/2
- Global economy: 1/2
- Activities: 1/2
- Built environment: 1/2
- People: 1/2
- Lifestyle: 1/2
- Natural environment: 1/2
- Urban health: 1/2



# Global Ecosystem

## climate change adaption and mitigation

1. Embedded energy > preserve existing buildings
2. Green house gas emission reduction

### #1 Use the unused

**Figure 6: Healthy Development (2016)**  
 Explanation: Make existing spaces, houses, walls, and (over)built buildings available to the public.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

Urban density: +

### #4 No roads, but streets

**Figure 6: Healthy Development (2016)**  
 Explanation: Create streets that are not just roads but spaces for people to walk, play, exercise, shop, and socialize.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #33 Electrifying

**Figure 6: Healthy Development (2016)**  
 Explanation: Making our green buildings improve the energy label of buildings with clean, sustainable energy.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

## 3. Heat stress mitigation

### #31 Trees everywhere

**Figure 6: Healthy Development (2016)**  
 Explanation: Trees help to cool the air locally by creating shade and cooling evaporation. Trees also improve air from the atmosphere.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #32 Light & shadow

**Figure 6: Healthy Development (2016)**  
 Explanation: Create shadow rich areas in public spaces which help add more cool spaces in the neighborhood.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #34 Green buildings

**Figure 6: Healthy Development (2016)**  
 Explanation: By getting plants on facades and roofs heat stress can be decreased in cities & green for the natural environment.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #38 No low albedo

**Figure 6: Healthy Development (2016)**  
 Explanation: Roof colors can be decreased with a high albedo, reducing heat absorption. A high albedo can be achieved with light colors and white.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

## 4. Water management

### #29 Roofs & rain

**Figure 6: Healthy Development (2016)**  
 Explanation: Focus on the design that can water on roofs. It manages water and helps to reduce water in the water cycle.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #30 Let it in

**Figure 6: Healthy Development (2016)**  
 Explanation: Create public spaces with permeable pavements, grass and trees spaces which help reduce water evaporation.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #35 Rainwater pond

**Figure 6: Healthy Development (2016)**  
 Explanation: Drastically good at ground surface water for collection, storage and infiltration with permeable pavements.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #36 Water movement

**Figure 6: Healthy Development (2016)**  
 Explanation: Water that moves is a higher quality and reduces mosquitoes which help reduce the surrounding area.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #37 Green car space

**Figure 6: Healthy Development (2016)**  
 Explanation: Promote green spaces over car parking spaces. Make sure that green spaces are designed to be better and more green.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +

### #39 Rain garden

**Figure 6: Healthy Development (2016)**  
 Explanation: Rain gardens, especially along streets and roads, help to manage rain water evaporation.

Community	+	+	+	+
Local economy	+	+	+	+
Global ecosystem	+	+	+	+
Activities	+	+	+	+
Built environment	+	+	+	+
People	+	+	+	+
Planet	+	+	+	+
Lifestyle	+	+	+	+
Natural environment	+	+	+	+

Urban health: +



# Optimisation

*compete / complete*

## Contents

8.1 Towards the optimisation	87
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8.2 Vision	89

In this chapter, the next step of the maximisation method is elaborated on: the optimisation phase. This phase will work towards an integrated vision for the densification strategy. This is created by combining each individual maximisation scenario with each other. This chapter starts with an explanation of the optimisation process. Afterwards, the actual optimisation is showcased.

*How should Overvecht Zuid be densified when integrating the maximisation scenarios?*

## 8.1 Towards the optimisation

The optimisation process involves combining the individual maximisation scenarios and evaluating them concurrently as the process unfolds. This is an iterative process, moving back and forth between design and evaluation. For an outsider, this process can seem elusive at times. To clarify and communicate this process as effectively as possible, it has been structured into two main parts.

The first part focusses on combining the Community and Local economy maximisation scenarios; the urban health determinants with the highest priority in Overvecht Zuid. It begins by comparing the two scenarios to identify areas where they complete each other, and seeking synergies between their respective goals. Then, areas of competition are analysed and redesigned to achieve a symbiotic compromise.

The second part build upon the results of the first, integrating them with the Global ecosystem maximisation scenario. Again, first looking into where they complete each other, followed by iteratively designing where they compete with each other.

Each step of this process is illustrated through drawings (Figure 42 to 46). On the right you can find the maximisation scenarios that are being combined. The isometric drawing on the left shows the considerations of the urban health goals that are combined in the spot that are highlighted. All texts in blue refer to the Community determinant, all texts in red are linked to the Local economy determinant, and all texts in black are for the Global ecosystem determinant.

## 8.2 Community + Local economy

### Complete

Figure 42 shows where and how the Community and Local economy maximisation scenarios complete each other and how these are combined in a synergetic way. The Community and Local economy have a lot in common. Perhaps this can, in part, be explained because both determinants benefit from high urban vitality which is created with an increased GSI. Besides, the goals of both determinants are often very similar, which gives a lot of opportunities for synergies. For example, the goal to diversify community aligns in many ways with the goal for a mix-use neighborhood. A diversity of functions can attract many different people from all backgrounds and walks of life. At the same time diversifying the community, can lead to a wider diversity of people who activate the public spaces at different moments during the day. Also, designing safe streets with many opportunities for encounters in a high quality public space with a lot of eyes on the street can easily be united with the local economy goals to create attractive public spaces. Lastly, a renewed community centre in the heart of the neighborhood can double as a community hub as well as a makers hub.

### Compete

Figure 43 shows where and how the Community and Local economy maximisation scenarios compete with each other and how this is resolved with a symbiotic comprise. The highlighted areas are the spots where the individual maximisation scenarios differ from each other and how this has been resolved. Generally, the conflicts between both scenarios were relatively easy to bridge. One major general consideration was to allow cars within the neighborhood to safeguard and enhance the economic opportunities for residents. This is done while creating safe, low speed streets in the neighborhood. The largest focus areas are found at opposite ends of the neighborhood. On one end, next to the shopping mall, the decision was made to prioritise the local economy goals by implementing an attractive mix-use area with a central public square for pop up events and local markets with many opportunities for encounters. On the other end, next to the train tracks, the community goals were prioritised by integrating small scale makerspaces into a noise barrier to create an attractive, green public space which can be used for smaller community events.

## 8.3 Community + Local economy + Global ecosystem

### Complete

Figure 44 shows how the third maximisation scenario is added to the optimisation and where and how the scenarios complete each other and how these are combined in a synergetic way. Even though the Global ecosystem maximisation scenario differs from the other two in many ways, there are some similarities to be found. For example, a carefull placement of mid- and high rise buildings can cast shadows to reduce heat stress while diversifying the range of housing typologies. Also, creating safe, pedestrian and cyclist friendly streets supports an acitve-mobility strategy, which promotes a reduction in greenhouse gass emissions. Lastly, attractive, green public spaces do not only provide the oppportunity for encounters and social events, but can also be utilised within a water management strategy.

### Compete

Figure 45 shows where and how the three maximisation scenarios compete with each other and how this is resolved with a symbiotic comprise. The highlighted areas show the spots where the individual maximisation scenarios differ from each other and how this has been resolved. The largest difference between the scenarios is the waterbuffering element that surrounds the neighborhood in the Global ecosystem scenario in order to create a sufficient water management strategy. This does, however, provide the opportunity to add a range of housing typologies surrounded by attractive, green-blue public spaces. Another large difference, was to apply adaptive reuse to the community centre at the heart of the neighborhood unit. Both because this protects the embedded energy in the existing building as well as it being a recognisable structure to the current community. However, the building will be expanded with new funtions to create a mix-use hub.

## 8.4 Vision

The fully optimised vision for the densification strategy, shown in Figure 46, illustrates how each individual maximisation is brought together. This will form the basis of the integration which is elaborated on in the following chapter.

▶ **FIGURE 42** A isometric drawing showing where and how the Community and Local economy maximisation scenarios complete each other and how these are combined in a synergetic way, by Tejon Tomas Kraan.

▶▶ **FIGURE 43** A isometric drawing showing where and how the Community and Local economy maximisation scenarios compete with each other and how this is resolved with a symbiotic comprise, by Tejon Tomas Kraan.

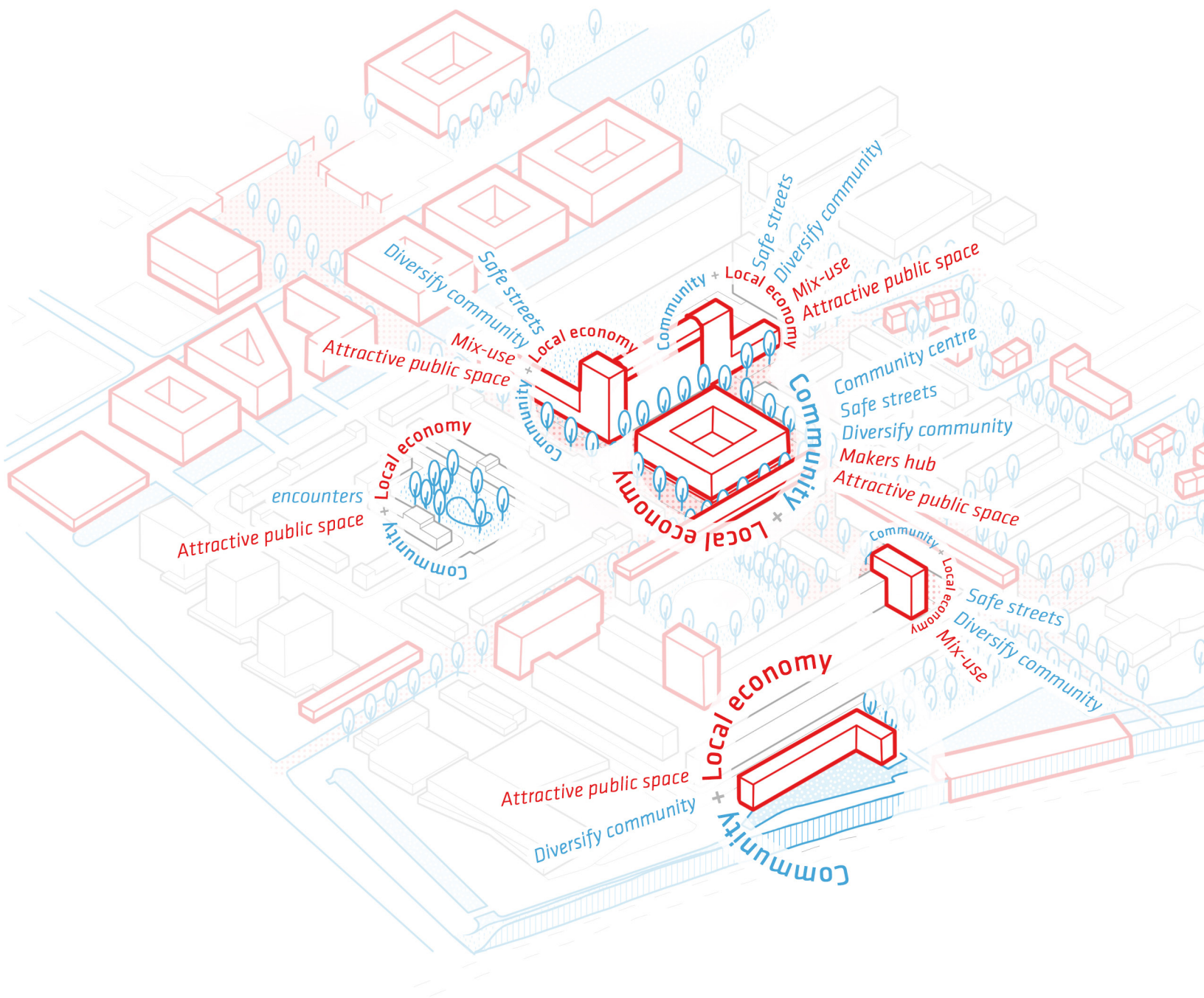
▶▶▶ **FIGURE 44** A isometric drawing showing where and how the three maximisation scenarios complete each other and how these are combined in a synergetic way, by Tejon Tomas Kraan.

▶▶▶▶ **FIGURE 45** A isometric drawing showing where and how the three maximisation scenarios compete with each other and how this is resolved with a symbiotic comprise, by Tejon Tomas Kraan.

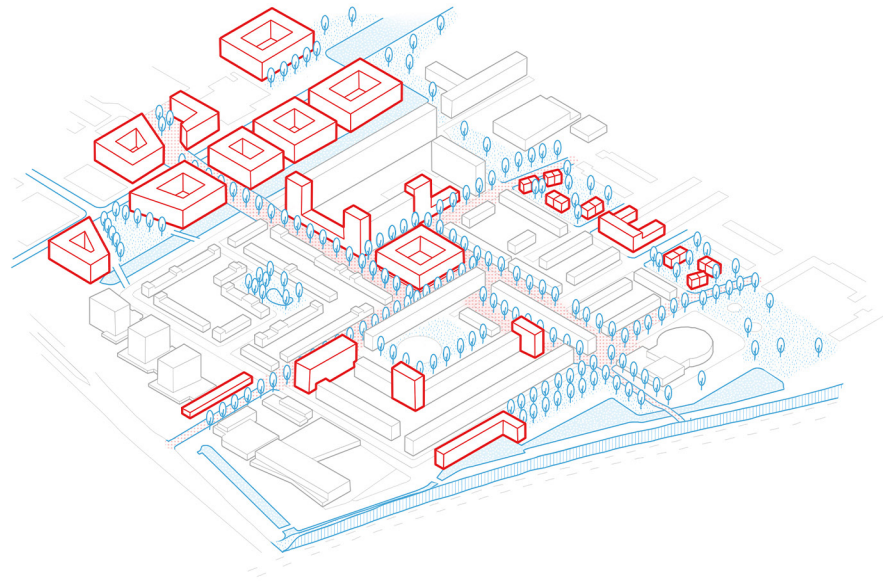
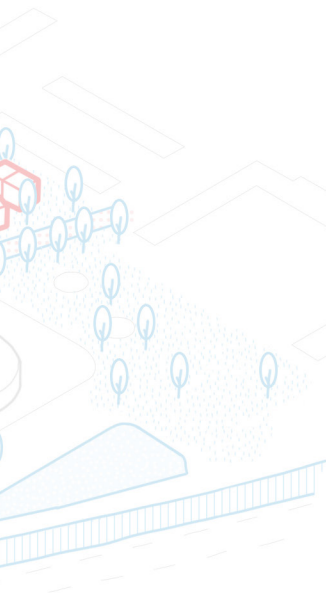
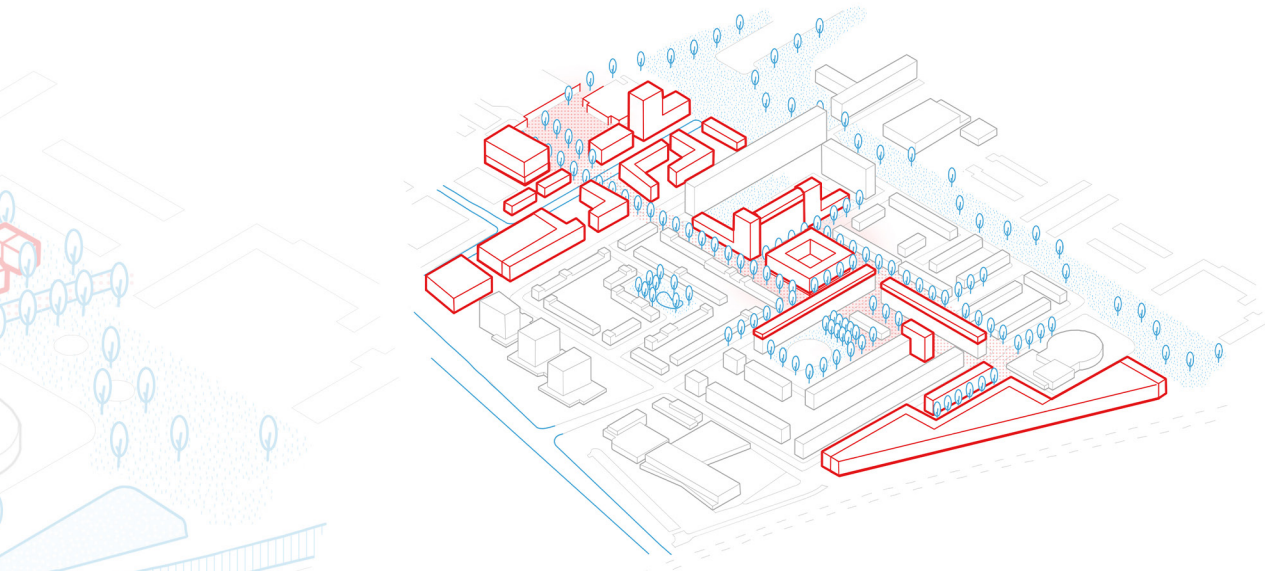
▶▶▶▶▶ **FIGURE 46** A isometric drawing showing the vision for the densification strategy combining all maximisation scenarios, by Tejon Tomas Kraan.

# Optimisation

*complete / compete*



**Community + Local economy**



**Local economy**  
maximisation

+

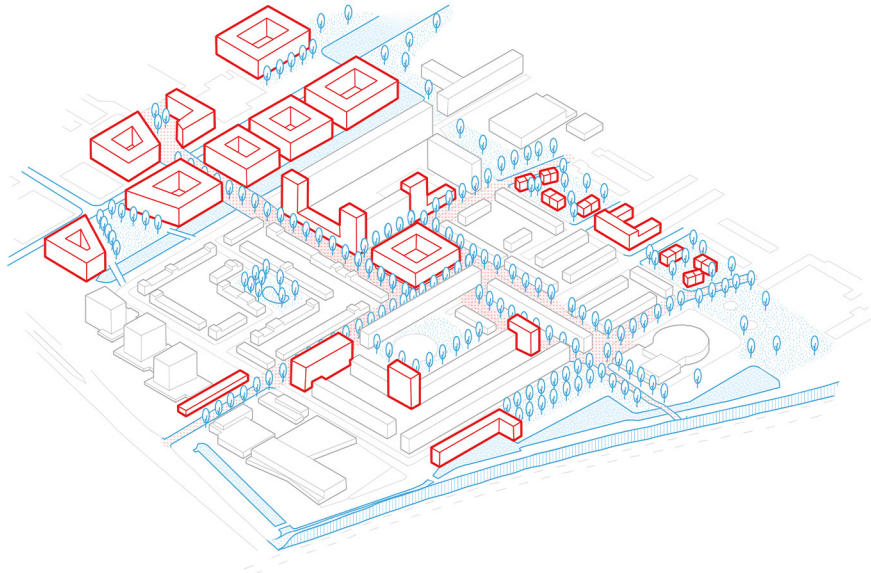
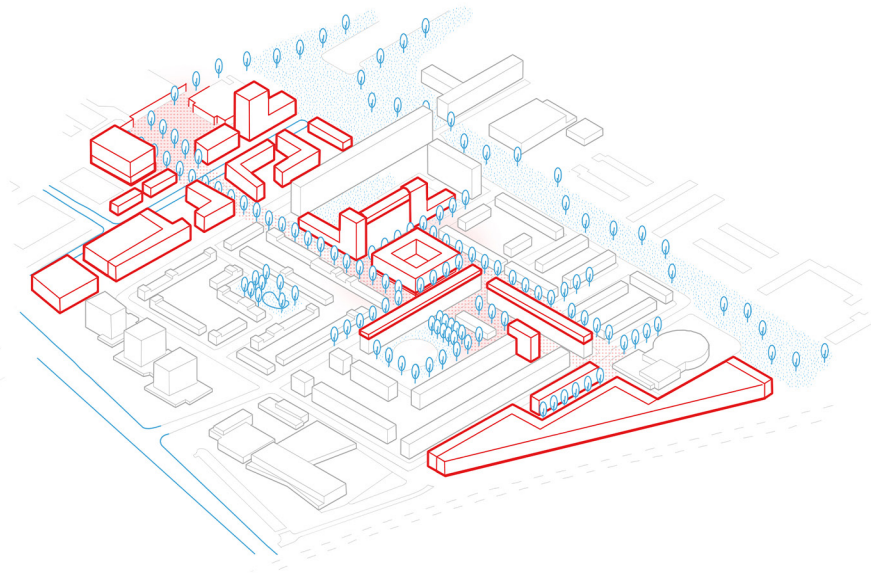
**Community**  
maximisation



enters in  
e public space  
diversifying community



reate encounters in  
ractive public space  
aces integrated  
rier



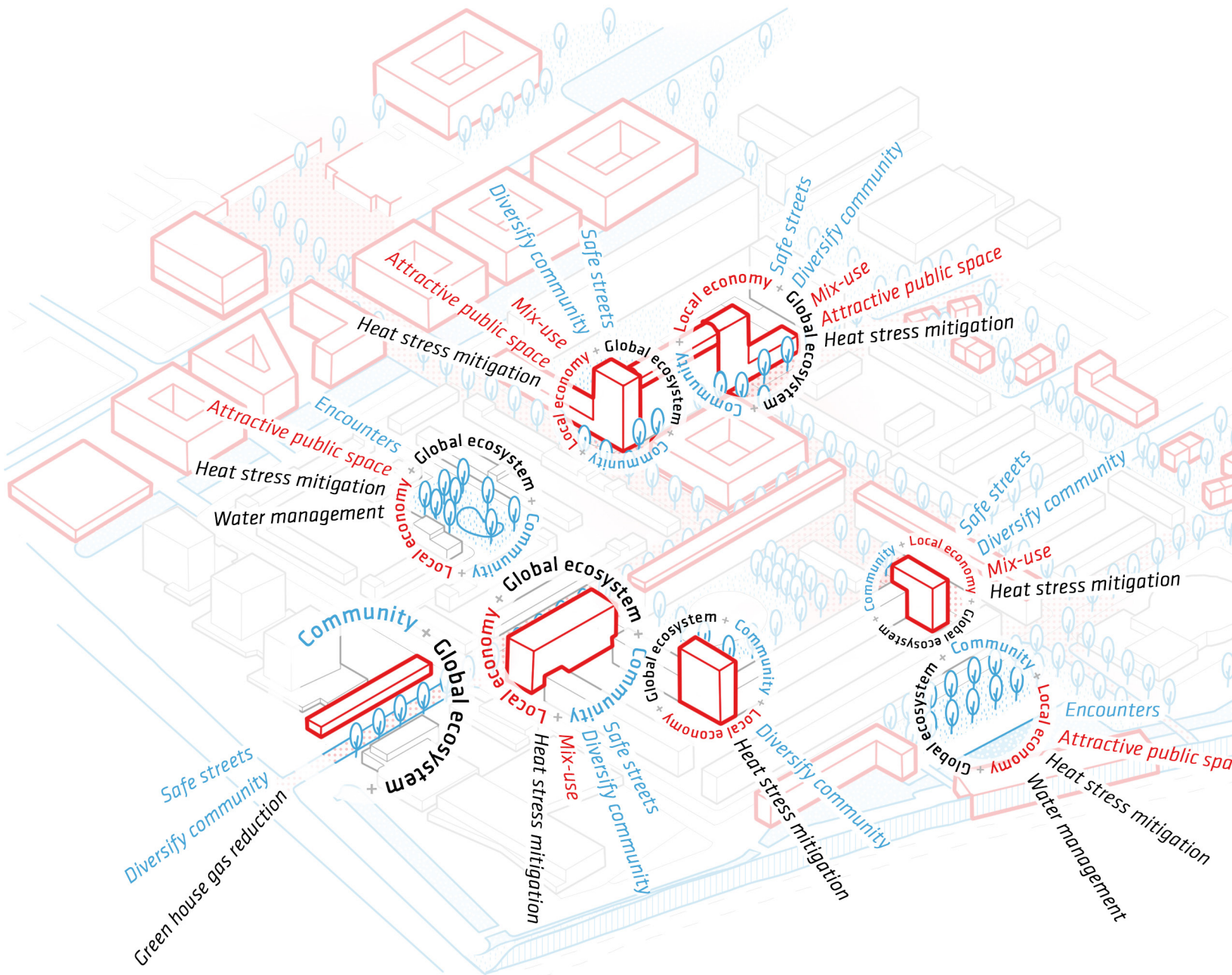
Local economy  
maximisation

+

Community  
maximisation

# Optimisation

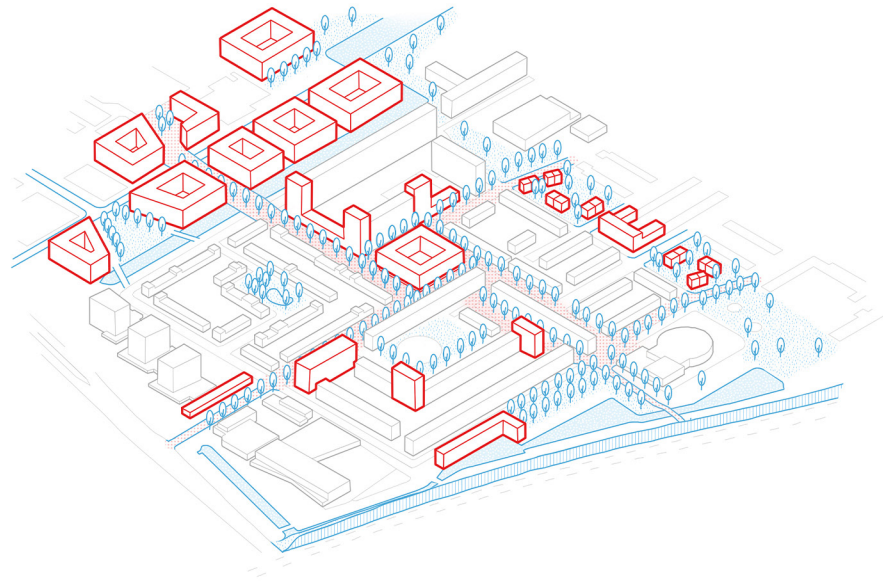
*complete / compete*



**Community + Local economy + Global ecosystem**

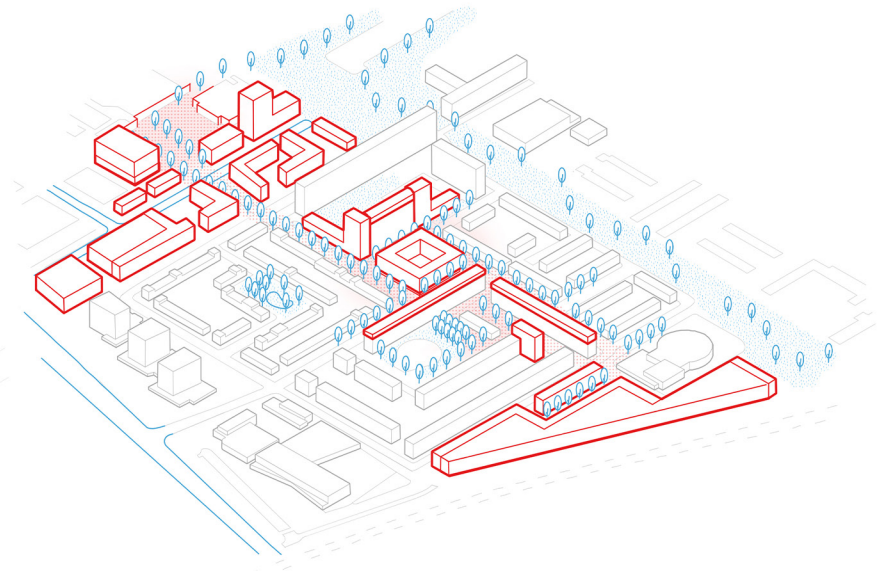
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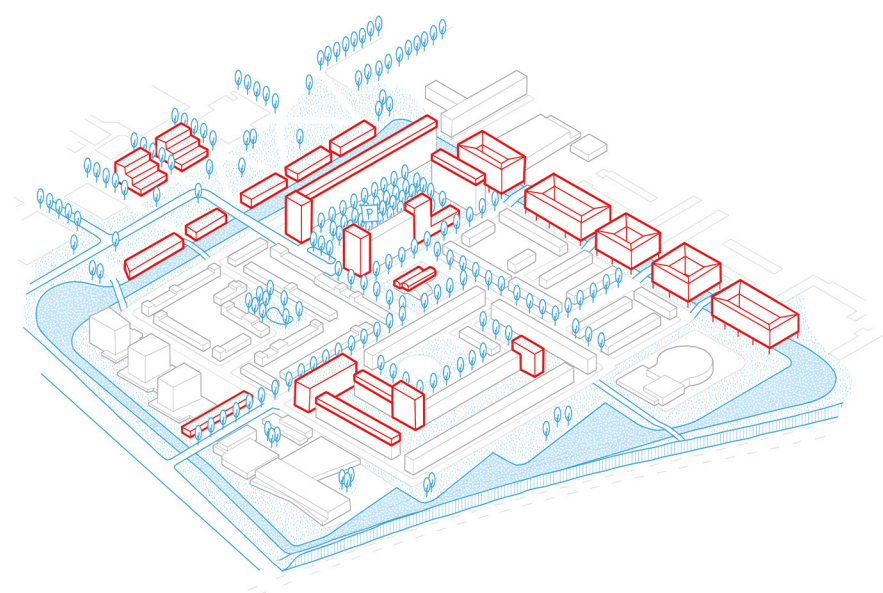
**Community**  
maximisation

+



**Local economy**  
maximisation

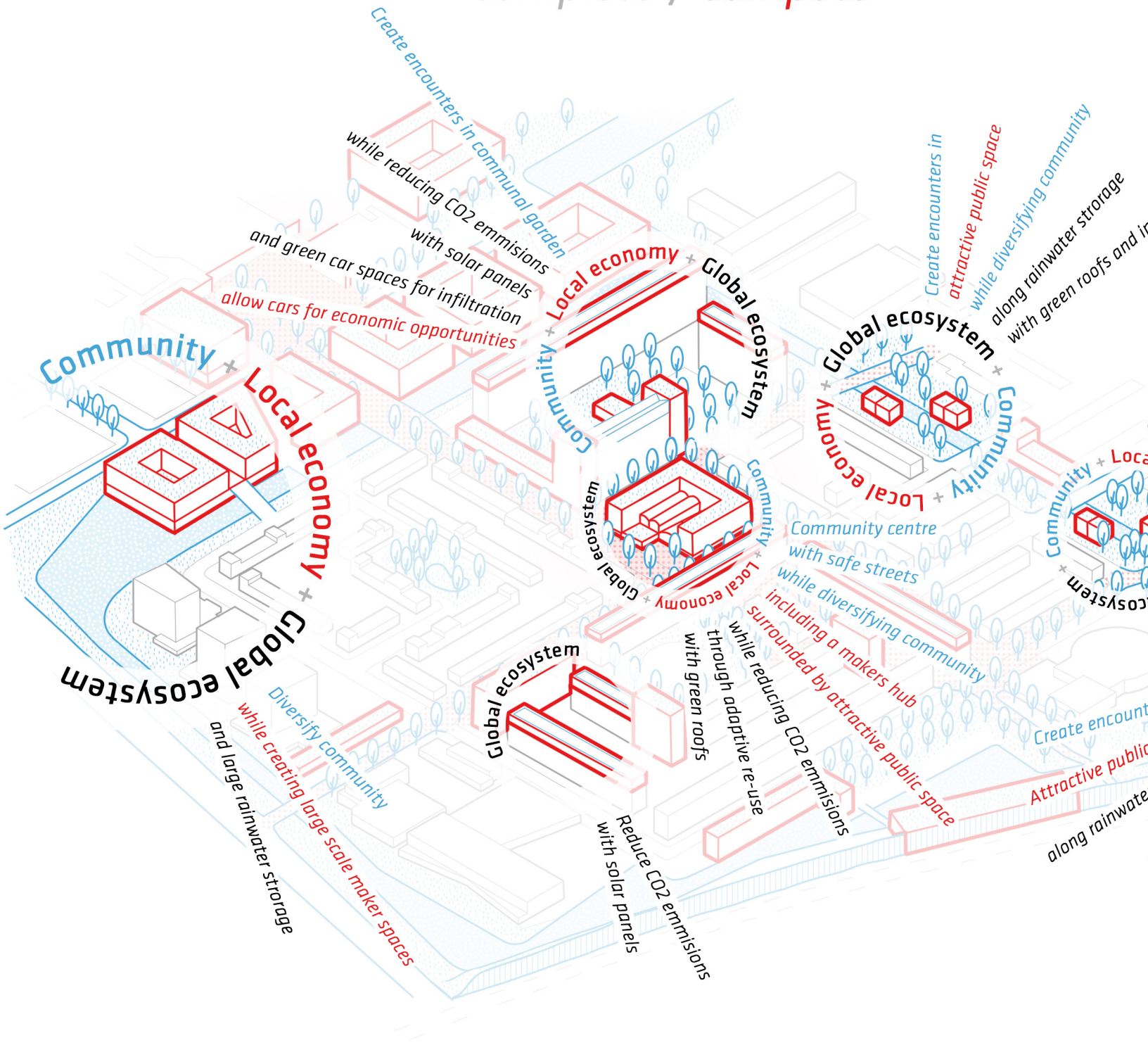
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**Global ecosystem**  
maximisation

# Optimisation

*complete / compete*



**Community + Local economy + Global ecosystem**

tem

filtration

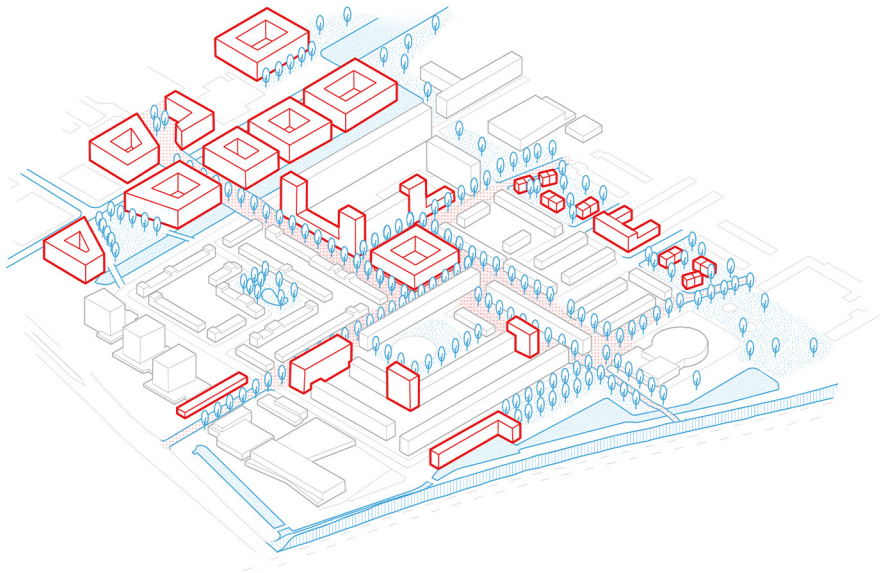
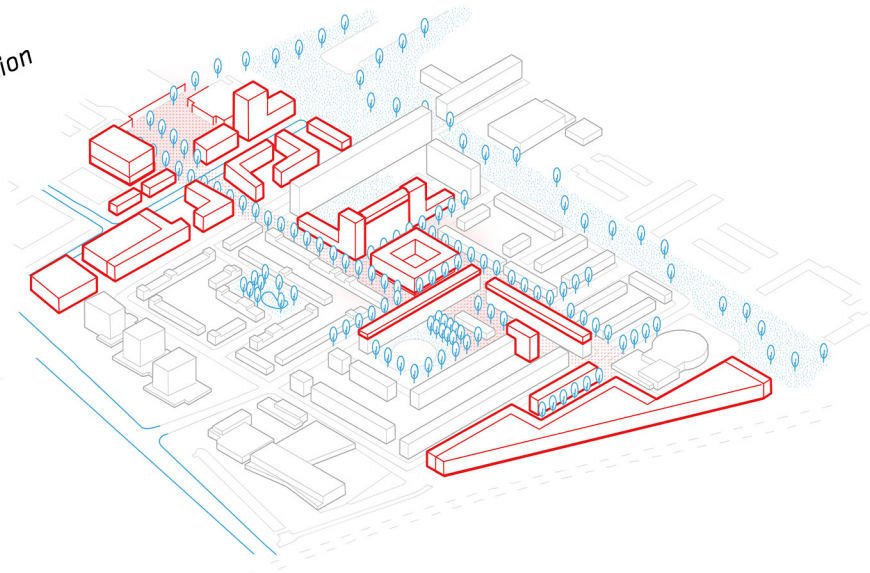
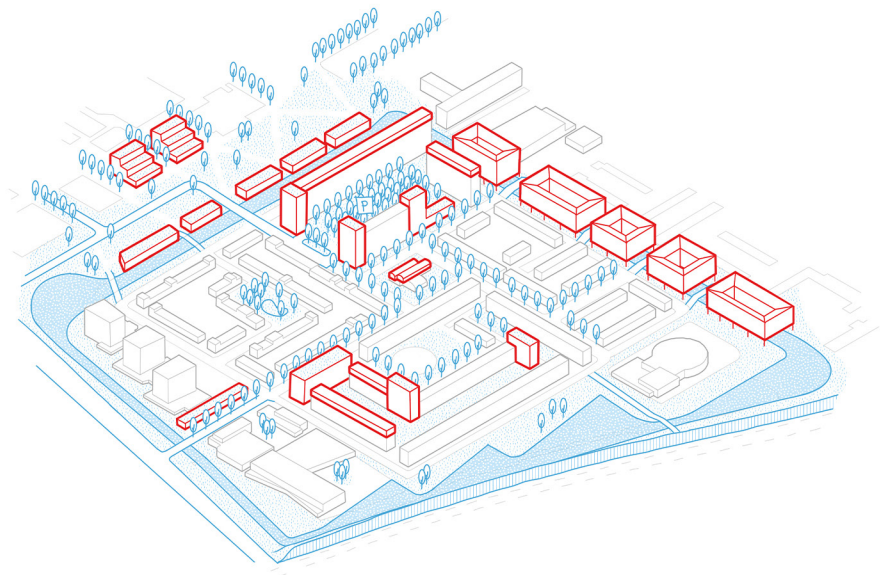
Create encounters in attractive public space while diversifying community

along rainwater storage with green roofs and infiltration

Global economy

Community + Local economy + Global ecosystem

ers in space  
r storage  
and infiltration



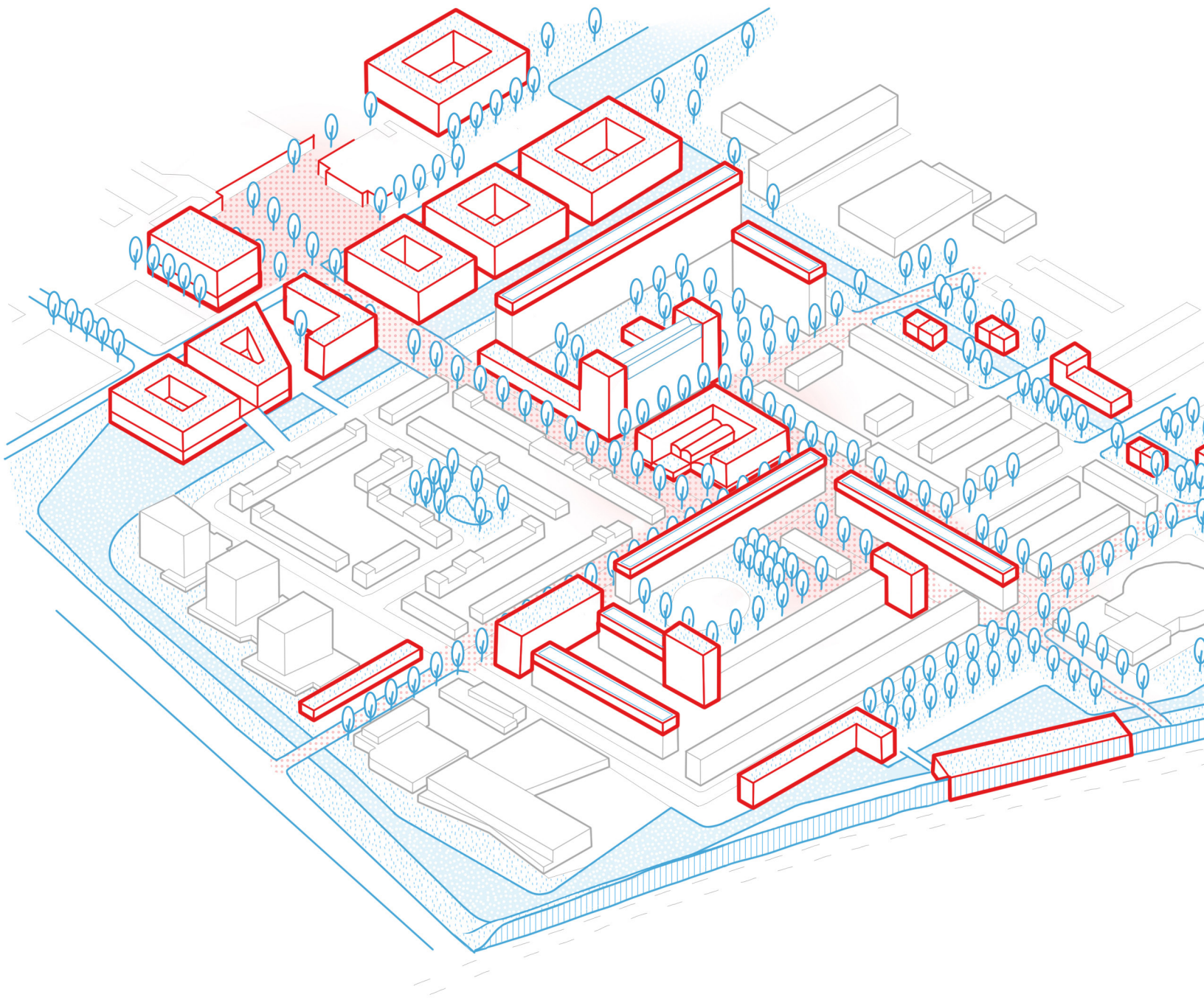
Global ecosystem  
+ maximisation

Local economy  
+ maximisation

Community  
+ maximisation

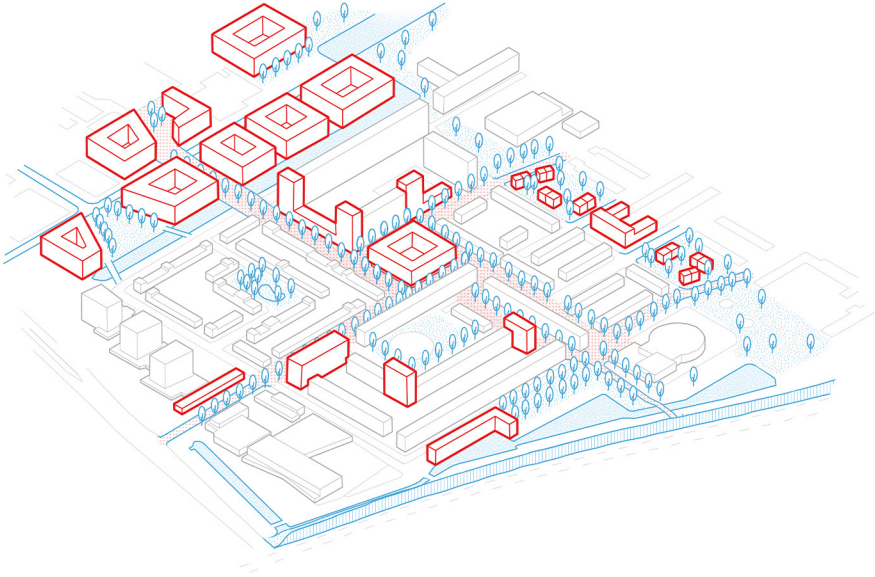
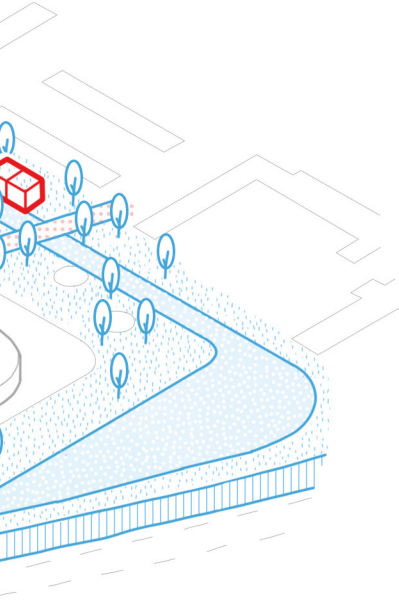
# Optimisation

*complete / compete*



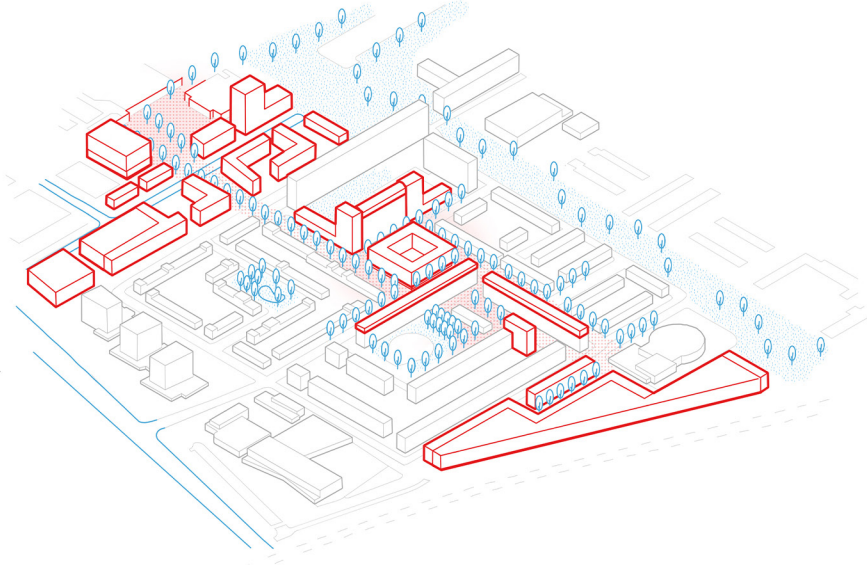
**Community** + **Local economy** + **Global ecosystem**

tem



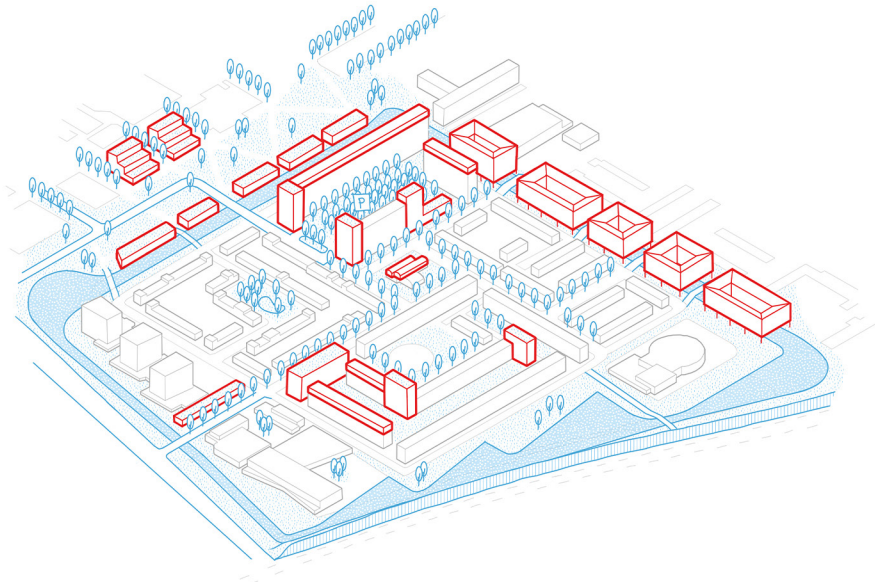
**Community**  
maximisation

+



**Local economy**  
maximisation

+



**Global ecosystem**  
maximisation



# Integration

## *urban design*

### Contents

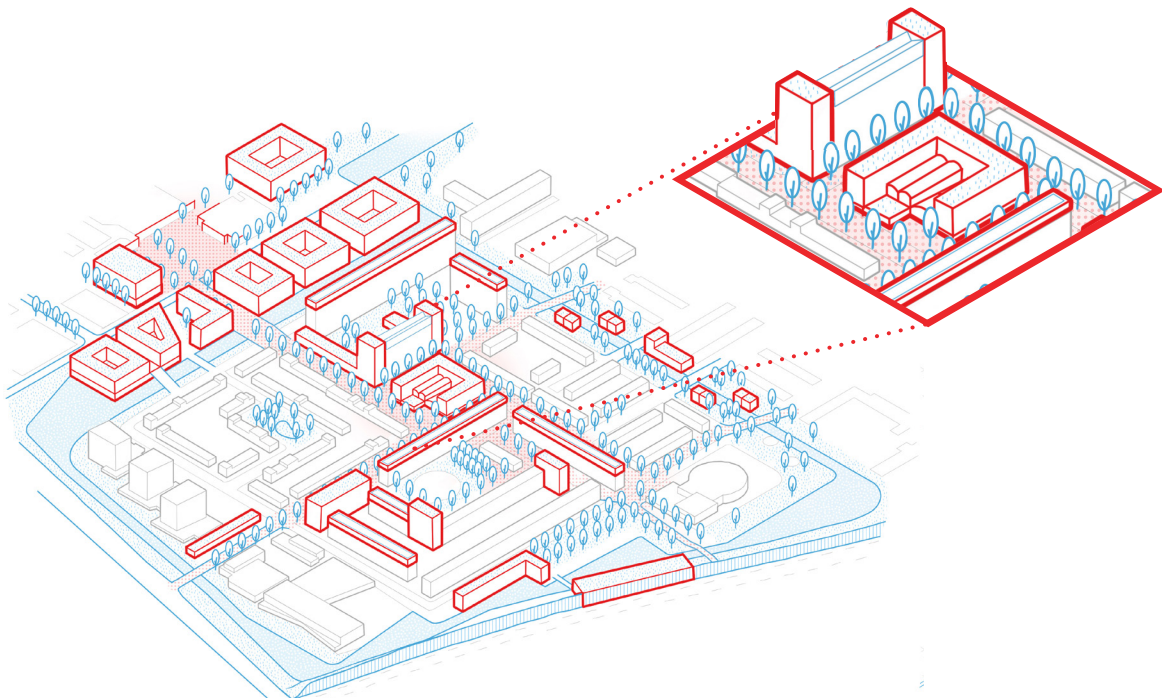
9.1 Towards the urban design	101
9.2 Urban design	101

This chapter shows how the vision is translated into a fully developed urban design. The urban design will focus on the redevelopment of the community centre at the heart of the neighborhood and the public spaces surrounding this building. This location is chosen because of its central location within the masterplan, showing both a lot of conflicts as well as synergies among the urban health determinants. The urban design will be presented in a plan and a section.

*How could the vision for Overvecht Zuid be translated into an urban design?*

## 9.1 Towards the urban design

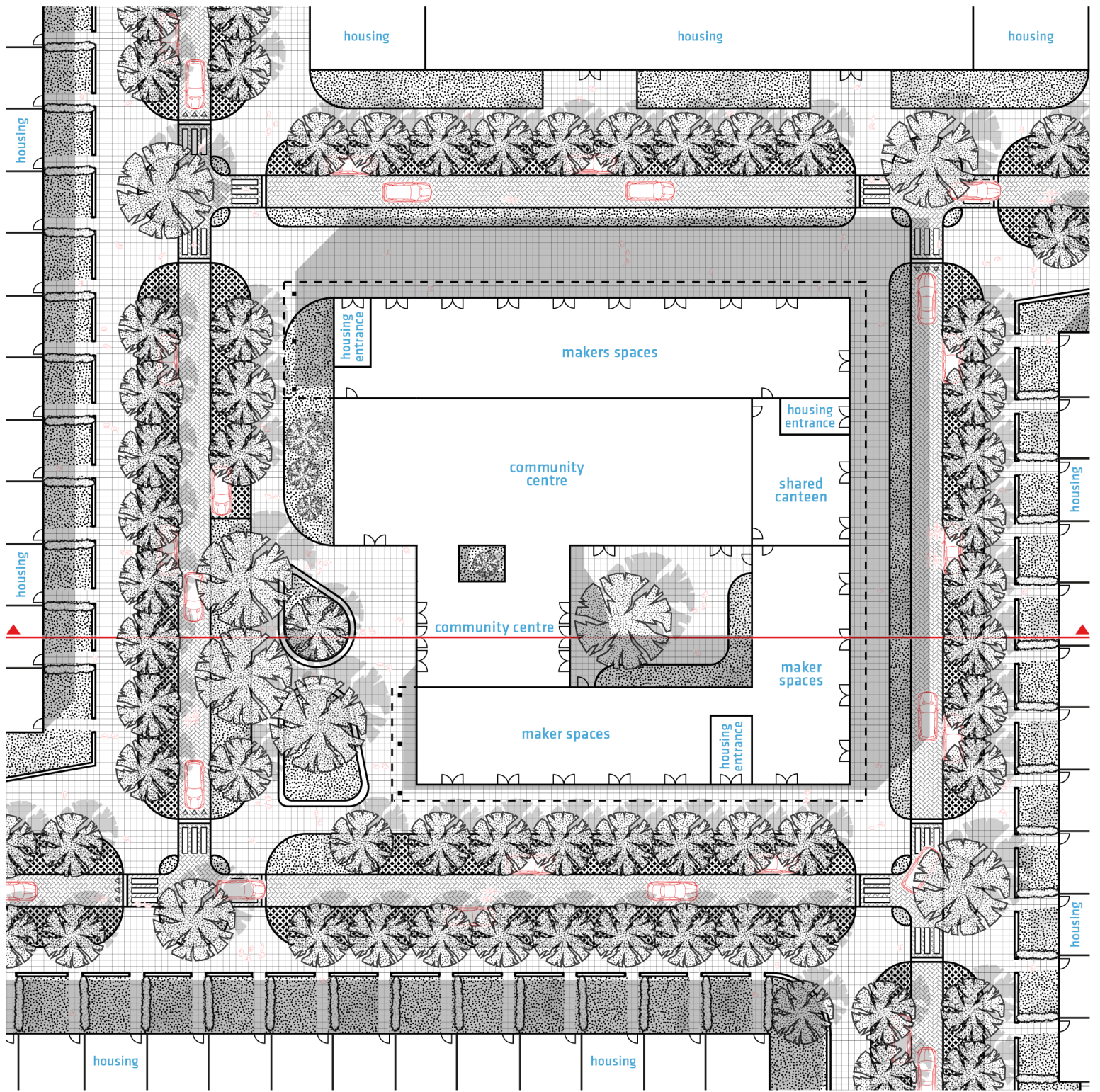
The focus area of the urban design is highlighted in Figure 47. The urban design is based on the location specific goals presented in the optimised vision. The optimised vision in the previous chapter shows that the redeveloped **mix-use** area will have a **community centre** and **makers hub** in the centre, surrounded by **safe streets** and **attractive public spaces**. Moreover, the **densification along the high street** will aid to **diversify the community**. Furthermore, this redevelopment will provide ecosystem services aimed at **heat mitigation**, **water management**, and **CO<sub>2</sub> reduction**. This chapter will show how these 10 goals (highlighted in bolt above) for this area of the neighborhood, based on the main three urban health determinants, are manifested in the plan and section. Together they represent the urban design for this area.



**FIGURE 47** A highlight of the optimisation scenario showing the focus area of the neighborhood for the urban design, by Tejon Tomas Kraan

## 9.2 Urban design

The urban design for the focus area of the neighborhood is represented in the plan (Figure 48) and section (Figure 49). Again, the urban design is enhanced using the toolbox composed of design interventions, shown in Figure 37. The urban design shows how the 10 goals from the optimised vision are manifested through the redevelopment of the area:









# Plan



scale 1:500



-  sidewalk tiles
-  building
-  "klinker" paving
-  green space
-  permeable paving
-  tree

## 1 Community centre

The existing community centre building will be preserved and renovated. Rather than being fenced off, the urban design shows it becomes an integrated part of the neighborhood. To do so, extra attention is given to the transitions between the building and public/collective spaces. A green public square will be added in front of the community centre to create an attractive and welcoming public space. The courtyard in the middle of the building block is a collective space shared with the maker spaces.

## 2 Safe streets

Currently the streets in the neighborhood are car-oriented, with wide asphalt roads, large bends, and no speed bumps. The new urban design adopts an active-mobility strategy: Troads become one-way and are paved with klinkers, a typical Dutch pavement that signals low-speed driving. Sharp corners, speed bumps, and pedestrian crossings replace the wide bends to slow traffic and improve safety for cyclists and pedestrians. While cars remain welcome to support local economic activity, the design prioritizes pedestrian and cyclist safety. Greenery along the streets help slow traffic, separate cars from pedestrians. Lastly, a mix of functions will activate the public spaces throughout the day and create “eyes on the street”, which improves overall safety in the streets.

## 3 Diversify community

The optimised vision and urban design show that new housing will be added to this area. In order to diversify the community of current residents, this plan will focus on different target groups and housing typologies. The area is currently flanked by private ground-level homes and social housing apartments. To expand the variety of housing typologies in the neighborhood, the redevelopment of the new building block will focus mainly on adding a mix of studios and apartments for the middle class, students and starters. Aside from diversifying the community, it also supports enhancing housing mobility within the neighborhood.

## 4 Mix-use

As the analyses (Chapter 6) showed, the neighborhood is currently a monofunctional residential area. In this plan a greater mix of uses is implemented. A new building block is added at the centre of the area. This block will be placed around the existing community centre. It has a mix of maker spaces and a community centre in the urban plinth, and is topped with new housing. This will aid to activate the public spaces throughout the day.

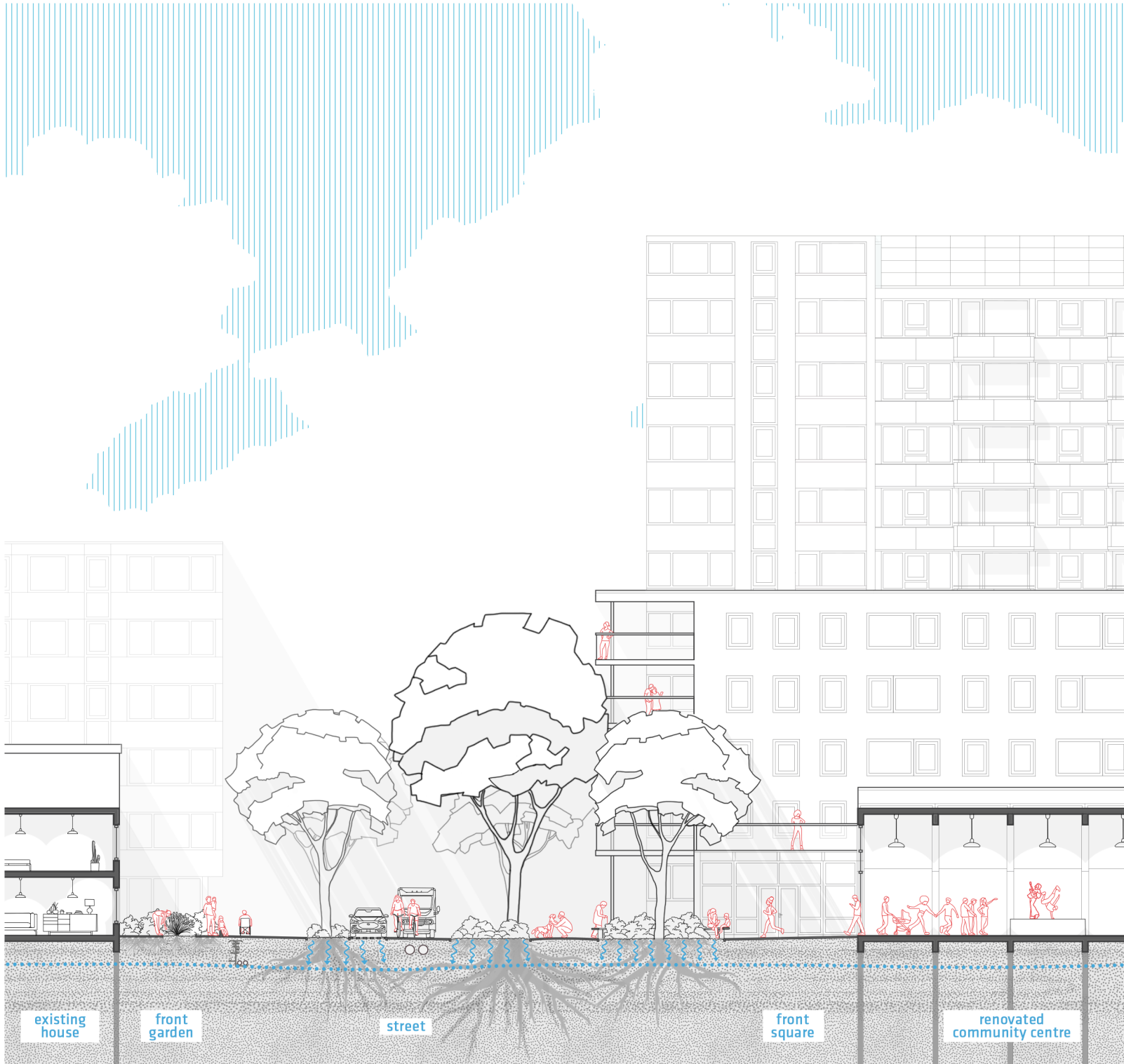
## 5 Makers hub

Maker spaces will be added in the new building block. These are placed around the community centre, facing the street to provide a great public face and attract costumers to these public services. The student-run workshops at the Pouwer college will be placed in some of these maker spaces to create an interaction between the labour market and students which encourages (serendiptious) networking. Locating these services at the core of the neighborhood ensures better visibility and accessibility. The community centre also acts as a makers hub, encouraging knowledge exchange, collaboration, and a strong local network of creators and businesses.

◀ **FIGURE 48** The plan showing the urban design of the community centre and surrounding public spaces in a scale 1:500, by Tejon Tomas Kraan.

▶ **FIGURE 49** The section showing the urban design the urban design of the community centre and surrounding public spaces in a scale 1:250, by Tejon Tomas Kraan.

# Section



scale 1:250



collective courtyard

new apartments  
new maker space

street

front garden

existing house

## 6 Attractive public space

The soft maps analyses (Chapter 6) showed that the quality of the public realm in this area is currently relatively low. The community centre appears inaccessible, and unsafe because it is completely fenced off and surrounded by wide asphalt roads. To counter this, the public space is redesigned to support active mobility and calm traffic. A total of 33 trees is added to provide more greenery into the area. A small, green public square with seating is created at the front of the community centre. Moreover, transitions between public and private spaces are softened to foster a sense of ownership. New public functions will activate the area throughout the day, making the public spaces more lively and attractive.

## 7 Densify along the high street

The windmill wings structure, introduced in chapter 6, will remain as the main structural element within the neighborhood unit. Densification will, for a large part, happen along these high streets. The new building block, located at the crosspoint of these high streets, forms an important node at the centre of this structure. Being an important node, a substantial densification is implemented in the plan, with new public functions with new housing above.

## 8 Heat mitigation

As was stated earlier, a total of 33 new trees is added to the area in this plan, bringing the total amount to 74 trees. Trees play a vital role in reducing heat stress in urban areas. By providing shade, trees significantly lower surface temperatures on buildings, streets, and sidewalks. Moreover, through evapotranspiration, trees release water vapor, which cools the surrounding air. Vertical piping systems will organise the cables and pipes in the subsurface in order to create space for tree roots in the subsurface to ensure proper growth of the street trees. New buildings also cool down public space by casting grey shadows on the streets. Lastly, new buildings will have high albedo facades and green roofs.

## 9 Water management

To manage water nuisances that currently occur on the streets, the plan shows that car parking spaces are paved with permeable paving. Also, hard surfaces are replaced with green spaces where possible. The public space is designed with sloped streets to direct rainwater to these designated places for infiltration. Excess rainwater from buildings will be directed towards a separated sewerage system.

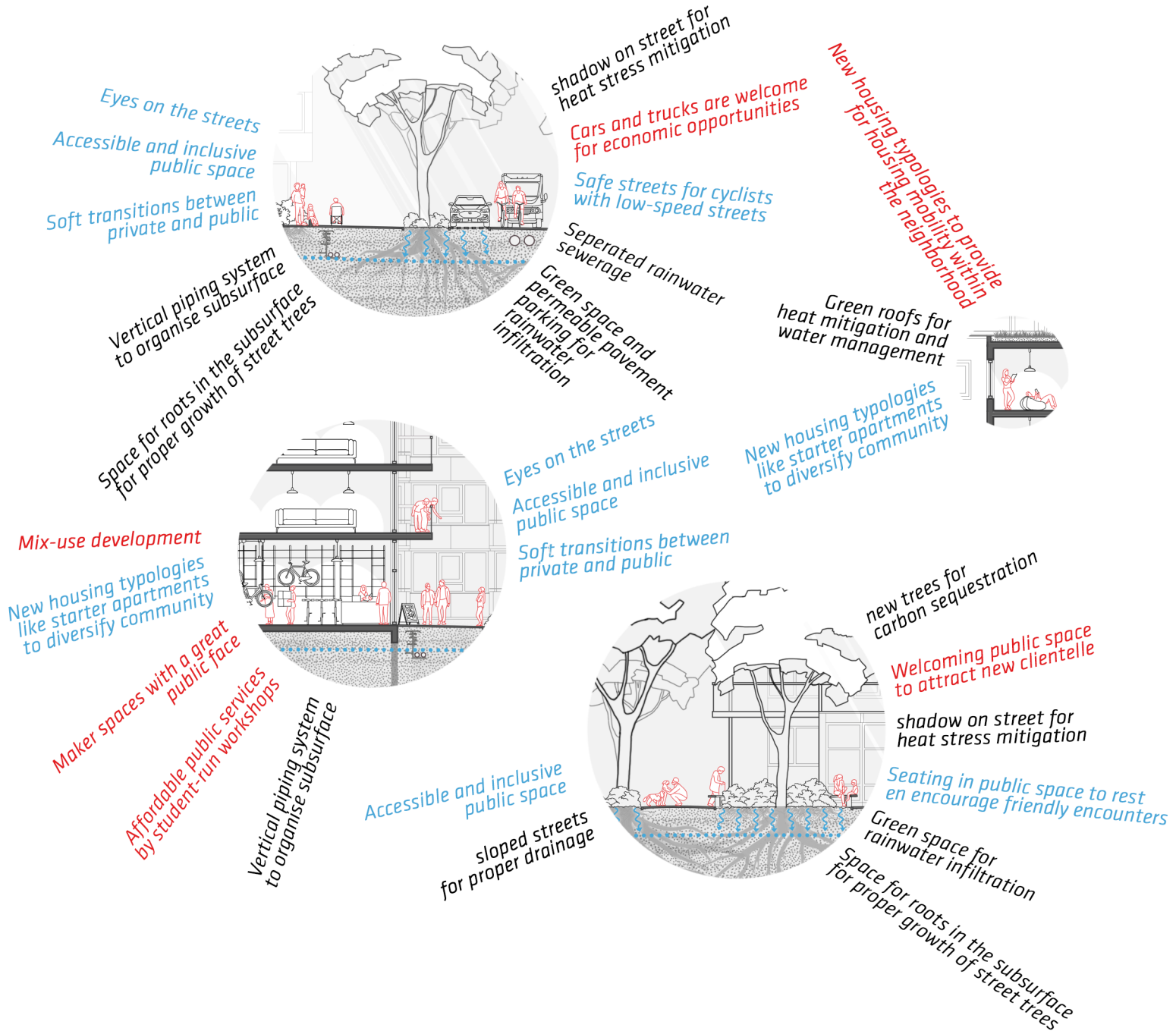
## 10 CO<sub>2</sub> reduction

The aforementioned active-mobility strategy helps to reduce car dependency and will thus lower greenhouse gas emissions. Also, the added greenery will aid to sequester carbon from the atmosphere. The renovation of the community centre and new buildings will have to comply to high energy performance norms to improve energy labels.

Figure 50 shows highlights from the section and further explains how the three urban health determinants have shaped the section of the urban design.

► **FIGURE 50** Highlights from the section explaining how the three urban health determinants Community (blue), Local economy (red), and Global ecosystem (black) have shaped the urban design, by Tejon Tomas Kraan.

# Community + Local economy + Global ecosystem





# Conclusion

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This chapter will result in an answer to the main research question. In the conclusion each subquestion will be answered to come to this answer. Afterwards the results of this thesis will be discussed by critically looking into the methodologies and framing of the project. Finally, the reflection will provide insight into the ethical aspects of the design process, the project's relevance, and personal development guided by several reflection questions.

*How could the Health-Density paradox be converted into a Health-Density nexus in the urban densification strategy for Overvecht Zuid, Utrecht?*

## 10.1 Conclusion

### *Chapter 1* *What is the main topic of this thesis?*

This thesis explores the complex relationship between urban density and urban health, addressing the longstanding debate among experts and decision-makers regarding the optimal density for enhancing urban health. While a universal recommendation for healthy urban density remains impossible to identify, this study aims to contribute to context-specific insights to the discourse on this critical topic

### *Chapter 2* *What is the Health-Density paradox?*

Despite efforts to meet the sustainable development goals (SDGs) with inner-city urban densification strategies, a paradox appears. The ambitions for SDG 11: sustainable cities and communities on the one hand, and SDG 3: good health and wellbeing on the other, result in contradictory urban density recommendations. In an increasingly urbanising world, inner-city urban densification is a crucial strategy in the face of creating sustainable cities and communities. However, these strategies should not come at the expense of the health of urban residents. Yet, extensive research shows that higher population densities do lead to certain health issues. This paradox is specified as the Health-Density paradox. A design exploration, investigating the Health-Density paradox by examining the definition and interplay between its key topics, can remedy the situation and convert the Health-Density paradox into a Health-Density nexus in the case of context-specific inner-city urban densification strategies.

### *Chapter 3* *How can the reconceptualisation of urban density and urban health contribute to convert the Health-Density paradox into a Health-Density nexus?*

The conceptual shift, in which urban density is redefined prescriptively through the floor space index (FSI) and ground space index (GSI), combined with the multifaceted definition of urban health into the eight determinants People, Lifestyle, Community, Local economy, Activities, Built environment, Natural environment and Global ecosystem, shows it can achieve context-specific recommendations for inner-city urban densification strategies. Thereby, the Health-Density paradox can, in theory, be converted into a Health-Density nexus. Further research through a context-specific design exploration is needed to determine whether this conceptual framework is applicable in practice.

### *Chapter 4* *What site in Utrecht would be suitable for the design exploration towards a Health-Density nexus?*

For this design exploration, Overvecht Zuid, a neighborhood in Utrecht with significant urban health challenges, serves as the thesis's case study. Although its FSI and GSI values indicate the high potential for inner-city urban densification interventions, the neighborhood will be extensively densified. Moreover, the area experiences striking health risks, particularly in the domains of Community and Local economy among others.

Thus the main research question, this thesis seeks to answer is:

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*How could the Health-Density paradox be converted into a Health-Density nexus in the urban densification strategy for Overvecht Zuid, Utrecht?*

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*Chapter 5      What methods are used in the design exploration towards a Health-Density nexus?*

The design exploration towards a Health-Density nexus is done using the maximisation method, which structures the process into four steps: Analysis > Maximisation > Optimisation > Integration. This approach is supported by various methods, including literature study, geodata mapping, field trips, soft mapping, policy analysis, scenario making, vision making, evaluation, and urban designing. Together, these methods enable a transparent and comprehensive approach to integrating urban health considerations into densification strategies. Starting with the analysis:

*Chapter 6      How are urban density and urban health currently embedded in Overvecht Zuid?*

In its 1960s design, the concept of the “neighborhood unit” was implemented to create a healthy, modern neighborhood with ample green space and clear functional divisions. However, the car-centric layout, separation of functions, and monotonous architecture have undermined social cohesion, urban vitality, and local economic development. The area was built with a mix of low, medium- and high-rise residential blocks arranged in a standard “stamp” design (Figure 30). Spatial analyses of GSI, FSI, OSR have shown the current spatial morphological state of the buildings and public spaces in the neighborhood (Figure 33). Today, health challenges in Overvecht Zuid are most strongly linked to urban health determinant Community, Local economy, and Global ecosystem. Soft mapping reveals a need for improvement on aspects such as public space activation, mix-use development, and active-mobility strategies to address these challenges (Figure 34, 35 and 36). To further explore these design solutions a maximisation scenario is made for each urban health determinant focussing on a single neighborhood unit:

*Chapter 7      How should Overvecht Zuid be densified if each urban health determinant were to be addressed separately?*

For the Community determinant, increasing built coverage (GSI) boosts urban vitality and social cohesion. Design interventions include preserving all existing dwellings to prevent displacement, designing safe streets, diversifying the community with new housing typologies, and creating opportunities for encounters in public- and semi public spaces (Figure 39). For the Local Economy determinant, similar strategies to increase GSI support urban manufacturing and entrepreneurship through mixed-use development, introducing maker spaces, and improving public space design (Figure 40). Preserving affordable housing is also ensured to prevent displacement as a result of gentrification. In contrast to the other scenarios, the Global Ecosystem scenario requires lowering GSI to improve water management and reduce heat stress, prioritizing topping of buildings, and preserving existing buildings for their embodied energy, integrating green infrastructure, and enabling active-mobility (Figure 41). Next, the optimisation:

Through an iterative design process that balances and combines the goals of Community, Local Economy, and Global Ecosystem health determinants, the optimisation is build up. First, synergies between the Community and Local Economy scenarios are leveraged. They both benefit from high urban vitality with an increased GSI. Shared goals are to diversify functions, enhance the quality of public spaces, and support social and economic activity. Where goals compete, compromises are made, such as allowing low speed car access to enhance economic opportunities, while maintaining safe, livable streets. Then, the Global Ecosystem goals are layered in, bringing in the goals of heat mitigation, active mobility, and green-blue infrastructure for water management. Goals that compete for space, like space for water buffering, are resolved by integrating housing and public functions within those systems. The resulting vision combines all three urban health determinants into a cohesive, integrated densification strategy for the neighborhood unit. Lastly, the goals are integrated into an urban design, which shows the design intervention on a more detailed scale:

The vision for Overvecht Zuid is translated into an urban design (Figure 48, 49, and 50) by spatially manifesting the 10 location-specific goals that were identified in the optimised vision. This design transforms the area into a mix-use, inclusive, and resilient urban environment. It achieves this by integrating a revitalised community centre and makers hub, enhancing safety through traffic calming, diversifying housing types to attract a broader demographic, and activating public spaces with mix-use functions. Ecosystem services are added by implementing extensive greening, permeable surfaces, and sustainable building practices to support heat mitigation, water management, and CO<sub>2</sub> reduction. Together, these interventions form a comprehensive and coherent urban design that brings the vision for Overvecht Zuid to life. Seamlessly combining the urban health determinants of Community, Local economy, and Global ecosystem. With the integration phase now complete, the full maximisation method has been carried out, allowing the main research question to be addressed:

**Main research question**

*How could the Health-Density paradox be converted into a Health-Density nexus in the urban densification strategy for Overvecht Zuid, Utrecht?*

This thesis shows that the urban densification strategy for Overvecht Zuid, Utrecht, the Health-Density paradox can be converted to a Health-Density nexus via the structured four-step maximisation method. This conversion is grounded in a theoretical reconceptualisation of urban density and urban health, linking descriptive density measures to the urban health determinants. Research has shown that the descriptive density measure Ground Space Index (GSI) has a superior influence on the urban health determinants. An increased GSI can be implemented in targeted areas to boost urban vitality, supporting the Community and Local economy urban health determinants. Conversely, a lower GSI is applied in other parts of the neighbourhood to enhance the Global Ecosystem determinant. This thesis demonstrates how the maximisation method can be employed to operationalise the Health-Density nexus framework in the context-specific case of Overvecht Zuid, resulting in a well rounded, integrated urban design and densification strategy that promotes urban health.

Nevertheless, empirical evidence on the exact relationships between the descriptive urban density measures and urban health determinants is relatively sparse. And so, in practice, the theoretical underpinning that a reconceptualisation of urban density and urban health can yield clear densification recommendations for every urban health determinant turns out to be less self-evident. Through the use of a toolbox of design interventions, the design exploration in this thesis offers preliminary insights where empirical data is currently limited.

## 10.2 Discussion

Having drawn the conclusions, this discussion reflects critically on how the methodology and scope influenced the outcomes, and the extent to which the urban health indicators assessed during the site selection are improved by the proposed urban densification strategy. Each discussion point will be accompanied by recommendations and implications for future research or urban design and planning practices.

### Methodology

The methodological approach in this thesis is centred on applying the four-step maximisation method as a design framework to navigate the complex interplay between urban density and urban health, as outlined in the Health-Density nexus framework. Rather than prescribing fixed solutions, the method supported an iterative and context-sensitive design process, allowing for the balancing of competing health determinants across the varying spatial conditions within Overvecht Zuid.

While the framework enabled iteration and exploration, it does not result in actionable densification recommendations. A literature review was conducted to examine existing, empirical studies on the relationships within the Health-Density Nexus framework. However, the available empirical evidence remains meager and is insufficient to form universally applicable design guidelines.

This reinforces the need for complementary empirical research to substantiate the direct relationships between these urban density indicators and health outcomes, and to further validate the Health-Density nexus framework proposed in this thesis.

### Scope

The conceptual framework of this thesis was based on the multifaceted nature of urban health, which comprises eight distinct determinants and the complex interactions between them. Due to time constraints and feasibility considerations, the decision was made to focus on the three most critical determinants in the context of Overvecht Zuid: Community, Local Economy, and Global Ecosystem. These were identified as top priorities through the initial assessment conducted during the site selection and subsequently formed the foundation for the design process.

However, the exclusion of the other five determinants, particularly Activities and Built Environment, which scored only marginally lower than Global Ecosystem, may have

influenced the final outcomes. Had they been included, these two determinants could have meaningfully shaped both the optimised vision and the urban design. Additionally, determinants that initially received relatively strong scores, such as People, Lifestyle, and Natural Environment, are likely to be affected by the proposed densification strategy. Ignoring this could lead to unintended negative consequences, potentially diminishing Overvecht Zuid's overall urban health score.

Such omissions pose a challenge to the goal of achieving a true Health-Density Nexus, and underscore a key limitation. Without a more holistic consideration of all eight determinants, there is a risk that improvements in some areas may be offset by declines in others. While the precise impact of including the remaining determinants remains speculative, it is plausible that their inclusion would have influenced both the optimisation process and the final urban design. In light of this, further design explorations are recommended to build upon the current work by incorporating the full range of urban health determinants. Doing so would not only enhance the robustness of the framework, but also ensure its applicability to broader urban densification contexts in a more comprehensive and balanced manner.

### Urban health indicators

The site selection process was conducted with a set of urban health indicators aligned with each determinant of the Health-Density Nexus framework. These indicators served to identify key spatial health challenges in Overvecht Zuid. In retrospect, the impact of the proposed urban design on these indicators is now assessed.

The effect of the urban design on the Global Ecosystem determinant can most effectively be assessed. Indicators related to heat stress and water nuisances were used for the site selection. The corresponding interventions, ranging from improved water retention and infiltration to the improvement of green spaces directly target these challenges. Moreover, design interventions are implemented to reduce greenhouse gas emissions. In doing so, the design not only meets but also exceeds the requirements identified during the site selection.

In contrast, the impact on the Community and Local Economy determinants is more difficult to measure. The selected indicators such as social frailty, loneliness, lack of social support, and difficulties to make ends meet, are inherently more qualitative in nature. While the design fosters social interaction, mix-use, community spaces, and improved walkability, their success depends heavily on behavioural factors, longterm community engagement, and evolving socio-economic dynamics. In these areas, the design relies more on soft data and design intent than on hard, measurable outcomes.

Additionally, the Local economy indicators WOZ-value and the percentage of social housing, can encourage gentrification which is counterproductive. While they suggest economic growth, they risk displacing existing residents, thus weakening the local economy.

This highlights a broader limitation: not all health outcomes can or should be assessed quantitatively. Many depend on lived experience of the community. Therefore, future processes should integrate participatory tools, such as surveys, post-occupancy evaluations, and stakeholder workshops, to better capture these qualitative dimensions.

### 10.3 Reflection

In the previous eight months, I have guided the thesis process towards the outcomes presented previously in this chapter. This reflection evaluates the outcomes of my graduation project, focusing on the product, process, and planning. It critically examines the chosen research methods and assesses their effectiveness. It also reflects on what I personally learned throughout the process. It starts out with a short anecdote of an experience during my site visit that has led to two reflection questions. To answer those questions a short theoretical background is given. This theory will be used to reflect on my own process and outcomes. This reflection concludes with the answers to the mandatory reflection questions stated in the graduation manual.

Although, I am personally familiar with the city of Utrecht, the site selection in chapter 4 has led me to a place that I knew little about, let alone had visited more than once in my life. Later, as I was on the site visit making sketches and writing notes on the everyday experiences of local residents for the soft maps of this thesis, I realised: even though I know a lot about this place by now, I am still an outsider here. Although this didn't stop me from continuing the process, I am, in retrospect, curious about the role of an urban designer as an outsider. Therefore the two reflection questions that I developed are:

- 1 In what ways could my design process have been adjusted to provide insiders of the community more influence on the final result?
- 2 How did being an outsider in this project redefine my attitude for future project towards the role of urban designer?

To answer those questions I will first dive into some theory on citizen participation. Citizen participation refers to the active involvement of individuals and communities in decision-making processes that affect their own (built) environments (Arnstein, 1969). It is an approach which ensures transparency and inclusivity in urban planning and design. Citizen participation is not a singular method. Rather, various methods allow for different levels of citizen participation. Arnstein, describes these different levels of citizen participation in her "*Ladder of citizen participation*" model, shown in Figure 49. The ladder of Arnstein has eight levels of citizen participation. These are grouped into three general categories:

- **Nonparticipation** means no citizen power: *Manipulation* and *Therapy* are forms of pseudo-participation used to control or pacify citizens without granting real influence.
- **Degrees of Tokenism** is limited or symbolic power: *Informing*, *Consultation*, and *Placation* involve citizens being heard or involved, but with little assurance that their input will impact decisions.
- **Degrees of Citizen Power** which is actual influence: *Partnership*, *Delegated Power*, and *Citizen Control* reflect increasing levels of shared authority, from joint decision-making to full community control over programs and policies.

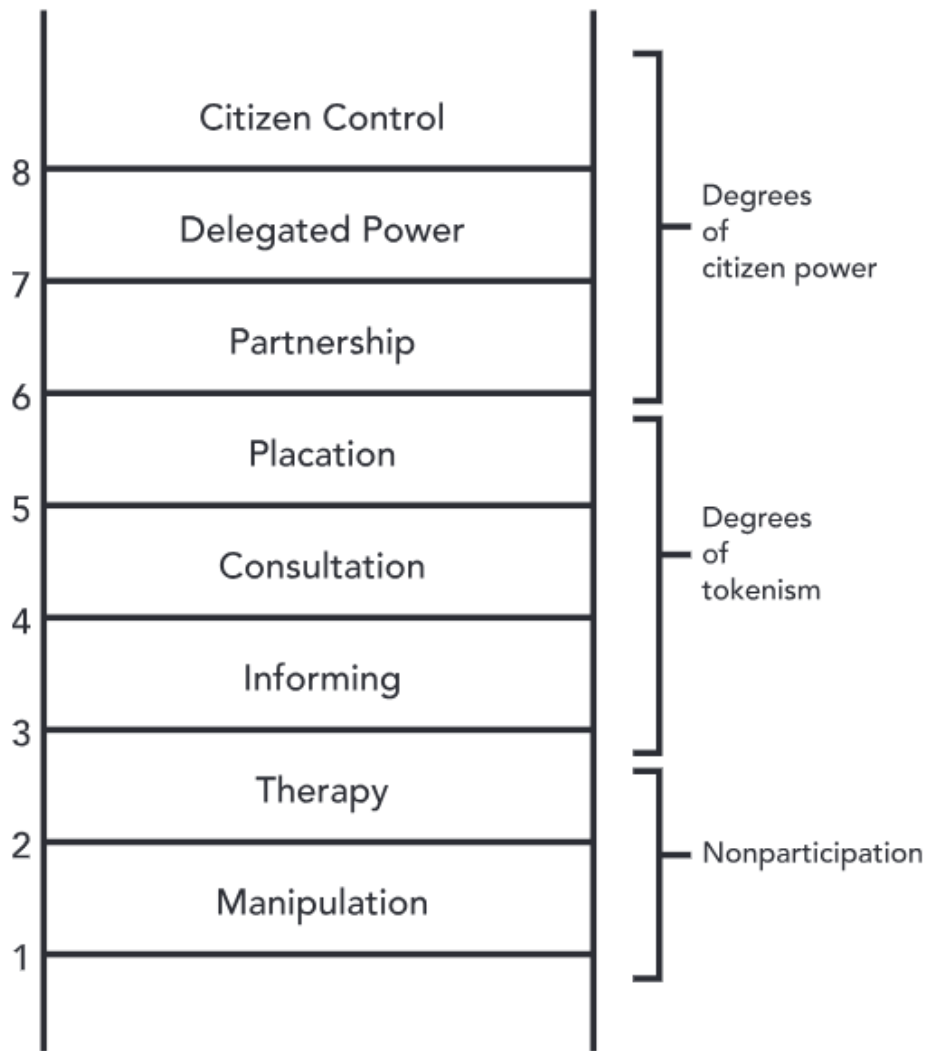


FIGURE 51 The ladder of citizen participation, by Arnstein (1969).

The answer to the first reflection question: *In what ways could my design process have been adjusted to provide insiders of the community more influence on the final result?* This question will be answered by using use of the ladder of citizen participation as a reflection framework.

During the analysis phase of the maximisation method, the analysis of the urban health determinants could be adjusted by adding more participatory elements. Especially the soft maps are based on my own observations. Citizen science tools like mobile sensors, participatory mapping, and digital platforms allow real-time data generation and community-driven monitoring. Including these citizen science methods could further amplify the analysis of each urban health determinant. The highest possible level of citizen participation in the ladder during this phase, however, would be Consultation in which citizens are invited to express opinions and experiences, through surveys or meetings.

During the maximisation phase of the process, one of three Degrees of citizen power can be applied. Decisions made during this phase could be made in partnership with the designers or citizens can be in full control of the outcome of each scenario. A pattern language is a method that could be used during this step to help citizens make evidence-based decisions on each maximisation scenario and to transmit design knowledge in an accessible manner.

The level of citizen participation in optimisation phase would currently be at the nonparticipation level. Through public debates opportunities will come out to rise higher on the ladder. The final vision for the densification strategy of the neighborhood is going to impact the community a lot. Therefore, citizen participation in this phase might be the most important of all phases.

During the integration phase the urban design process can be adjusted in order to design public spaces in partnership with citizens. The urban designer is still necessary in this phase to ensure lawful, safe, sustainable, and sound urban designs of high quality. Yet, co-design workshops can ensure a good partnership with citizens to ensure the public spaces meet the wishes of the residents.

All in all, the final result of the project could become much richer by including citizen participatory practices during all stages of the process. This relates directly to the second reflection question: *How did being an outsider in this project redefine my attitude for future projects towards the role of urban designer?*

Cities are complex socio-ecological systems. Yet, conventional top-down approaches, such as geodata analyses, often overlook informal, hyperlocal, and marginalized experiences. Participatory design, however, navigates this complexity by enabling underrepresented groups to express their needs, assert agency to make claims on public space, and shape the policies that affect their daily lives. Citizen participation methods offer a way to integrate these lived experiences and crowd sourced data into design and decision making processes.

Moreover, citizen participation is not only a way to gather better data or achieve more efficient outcomes. On an ethical level, it is a matter of spatial justice, social values, and empowerment. Thus, my experience as an outsider during this project has deepened the understanding of the urban designer's role as an enabler of citizen empowerment. Moving forward, I see it as my responsibility to actively facilitate participatory practices in future projects.

Lastly, the five mandatory reflection questions are answered below.

**1 What is the relation between your graduation project topic, your master track (A, U, BT, LA, MBE), and your master programme (MSc AUBS)?**

The concept of urban density and urban densification strategies are quintessentially urban phenomena. By applying the "urban health" concept, as was elaborated on in chapter 2 and 3, a broader understanding of health is adopted which includes the social and environmental dimensions inherent to the multifaceted nature of health in the built environment. These topics are also central topics in the Urbanism

master track. Therefore, urban health is strongly connected to the subjects of the Urbanism master track.

Within the AUBS master program, this thesis addresses contemporary issues connected to the built environment. The reconceptualisation of the health-density paradox presents a new perspective of resolving paradoxes alike that might occur in the built environment. Moreover, it is a step toward reaching the Sustainable Development Goals, which is strongly related to the faculty's philosophy and approach of designing the built environment.

**2 How did your research influence your design/recommendations and how did the design/recommendations influence your research?**

The research has provided the theoretical basis for the conversion of the health-density paradox into a health-density nexus. This novel conceptual framework was operationalised through the design of Overvecht Zuid to demonstrate its practical applicability. In turn, the design process contributed to the research by addressing a gap in empirical evidence regarding the FSI/GSI recommendations in relation to each urban health determinant. The idea that a reconceptualisation of urban density and urban health would directly lead to clear densification recommendations for every urban health determinant proved to be more complex and nuanced than initially anticipated. The design exploration, supported by a toolbox of spatial interventions, helped bridge gaps in existing data. Nevertheless, further empirical studies is recommended in order to strengthen and generalise the direct relationships between these urban density indicators and health outcomes, and to validate the framework across different urban contexts.

**3 How do you assess the value of your way of working (your approach, your used methods, used methodology)?**

This thesis has shown how the maximisation method can be utilised to come to a well rounded, integrated urban design and densification strategy to promote urban health. However, as has been extensively discussed before, the final result of the project could become much richer by including citizen participatory methods during all stages of the process.

**4 How do you assess the academic and societal value, scope and implication of your graduation project, including ethical aspects?**

To promote health through urban design is of value to all. This thesis is socially relevant because it gives insight into a paradox within the Sustainable Development Goals. By examining the interplay between SDG 3 and SDG 11, my work aims to enhance urban health through inner-city urban densification strategies. To do so, my thesis covers social issues such as the Dutch housing crisis, social segregation caused by health disparities, and urbanization to contribute to more inclusive, equitable and just cities.

Academically, this thesis provides urban planners, designers, and other professionals who work within the domain of the built environment, a framework and methodologies to navigate the conflict between inner-city urban densification strategies and urban health. Thus, it will offer evidence-based recommendations for integrating health into these strategies with a context-sensitive approach. Moreover, it provides a foundation for future research and design to optimise the Health-Density nexus in other urban contexts. Although five of the eight urban health determinants fell outside the scope of

this thesis, similar methods can be applied to the other determinants in order to get an even more nuanced result.

5 **How do you assess the value of the transferability of your project results?**

In chapter 1 of this thesis, I established that no ideal universal urban density recommendation has been established for enhancing urban health and perhaps none ever will. Therefore this thesis aims to contribute to the ongoing discourse on healthy urban densification strategies based on a context-specific case. While the results of this thesis are not directly transferable to other sites due to its context-specificity, the maximisation method, combined with the urban health framework, applied in this thesis offers a replicable framework. This method can guide similar projects in other urban settings, helping to identify locally appropriate strategies that align health outcomes with density considerations.

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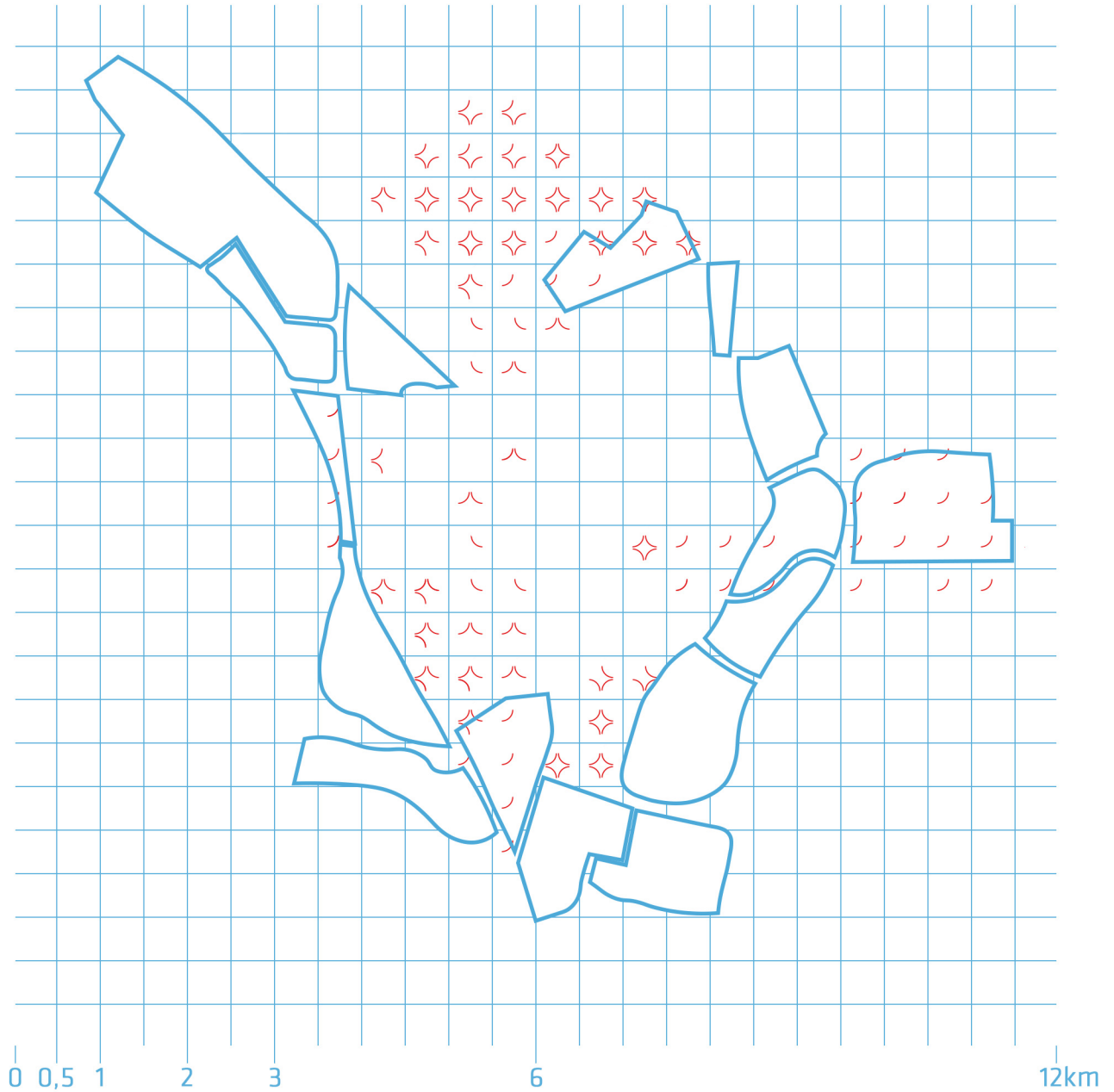
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## Appendices

# Urban Health Risks People

Utrecht

scale 1 : 75.000



Iconography  
Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

People



Anxiety and depression



Frail health aged 65+



Long-term conditions

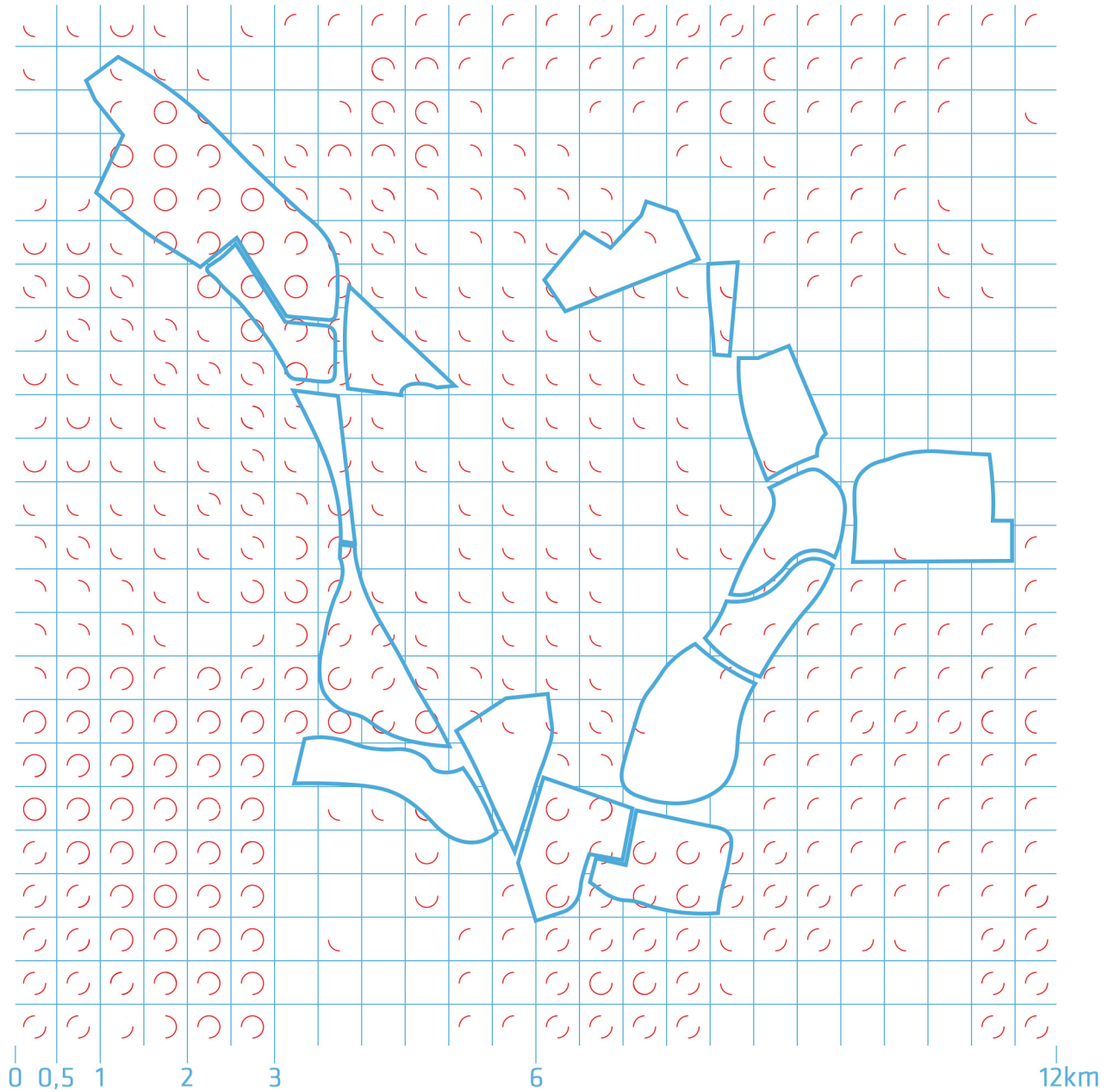


Poor perceived health

# Urban Health Risks Lifestyle

Utrecht

scale 1 : 75.000



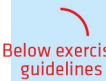
Iconography  
Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

## Lifestyle



movement unfriendly neighborhoods



Below exercise guidelines



Unshaded paths

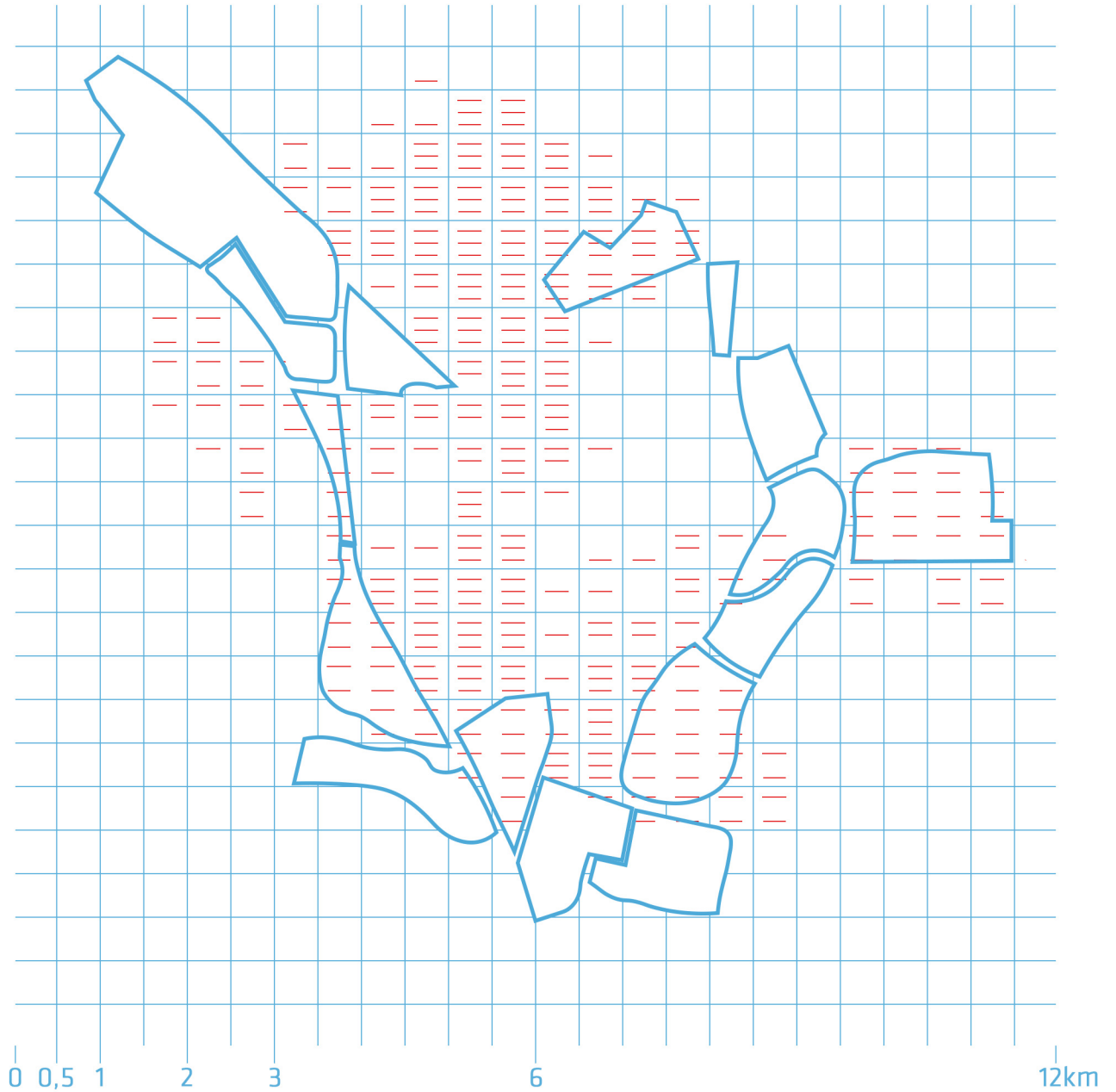


Lack of cool places

# Urban Health Risks Community

Utrecht

scale 1 : 75.000



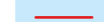
Iconography  
Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

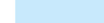
Community



Lack of social support



Social frailty



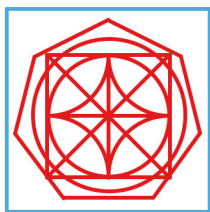
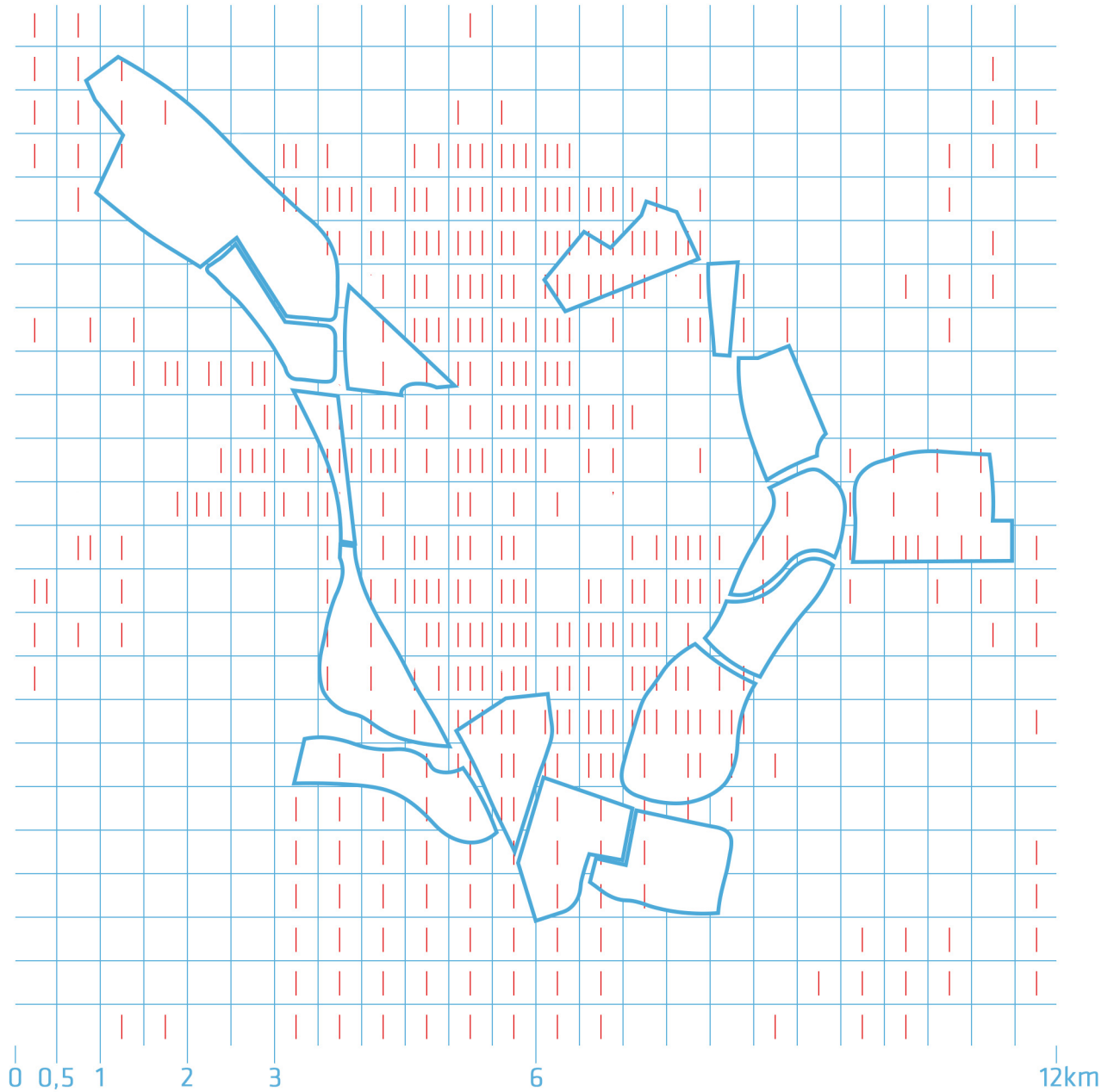
Loneliness

# Urban Health Risks

## Local economy

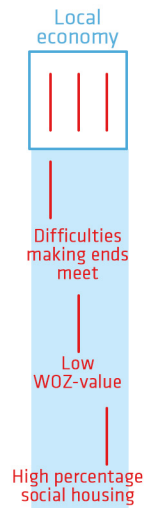
Utrecht

scale 1 : 75.000



Iconography  
Legend

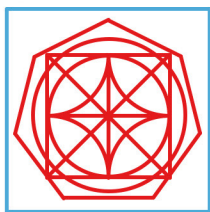
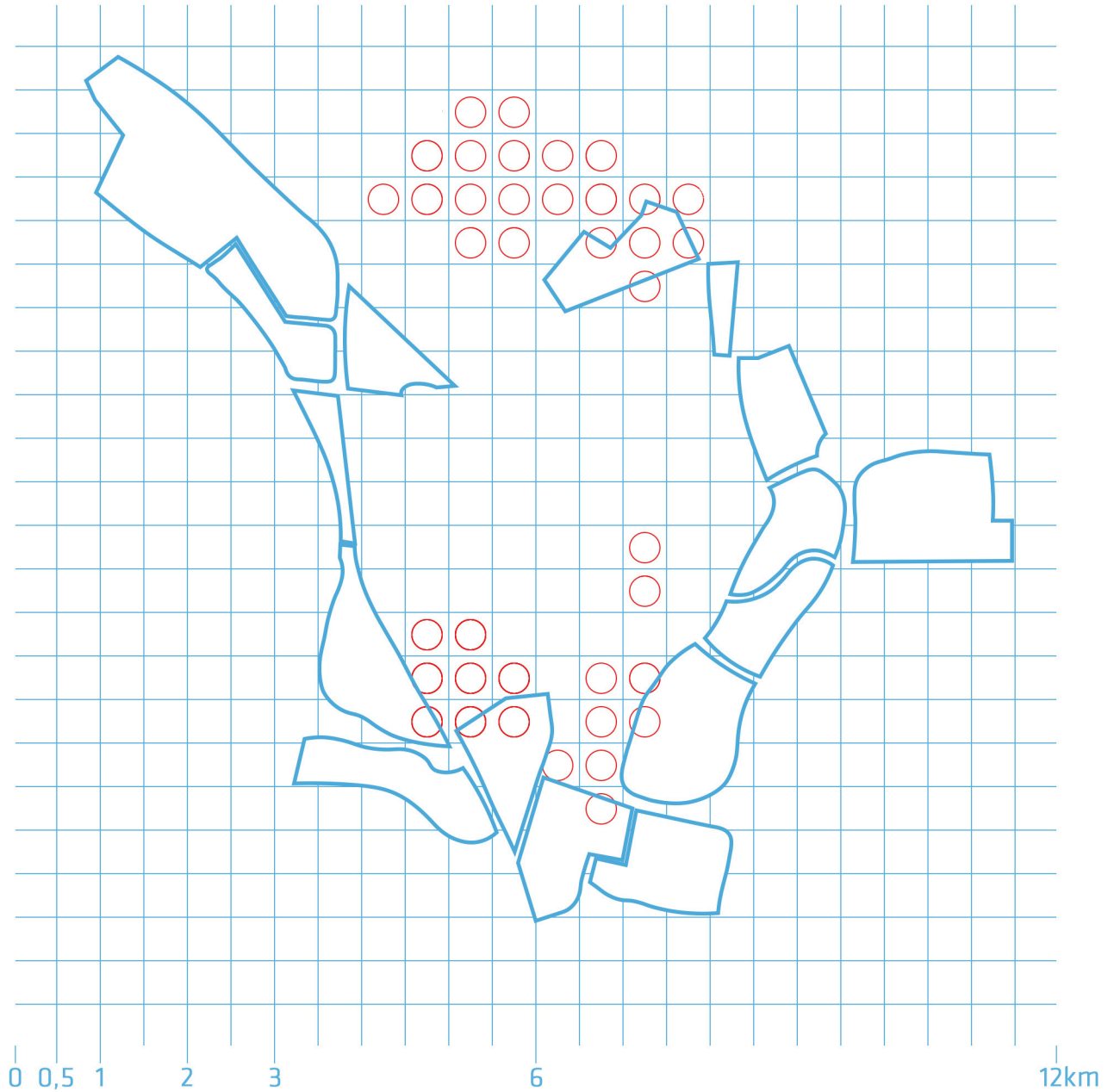
Urban health indicators based on the Health map (Barton and Grant, 2006).



# Urban Health Risks Activities

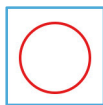
Utrecht

scale 1 : 75.000



Iconography  
Legend

Activities



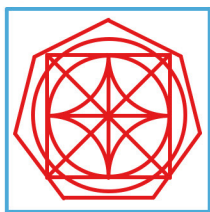
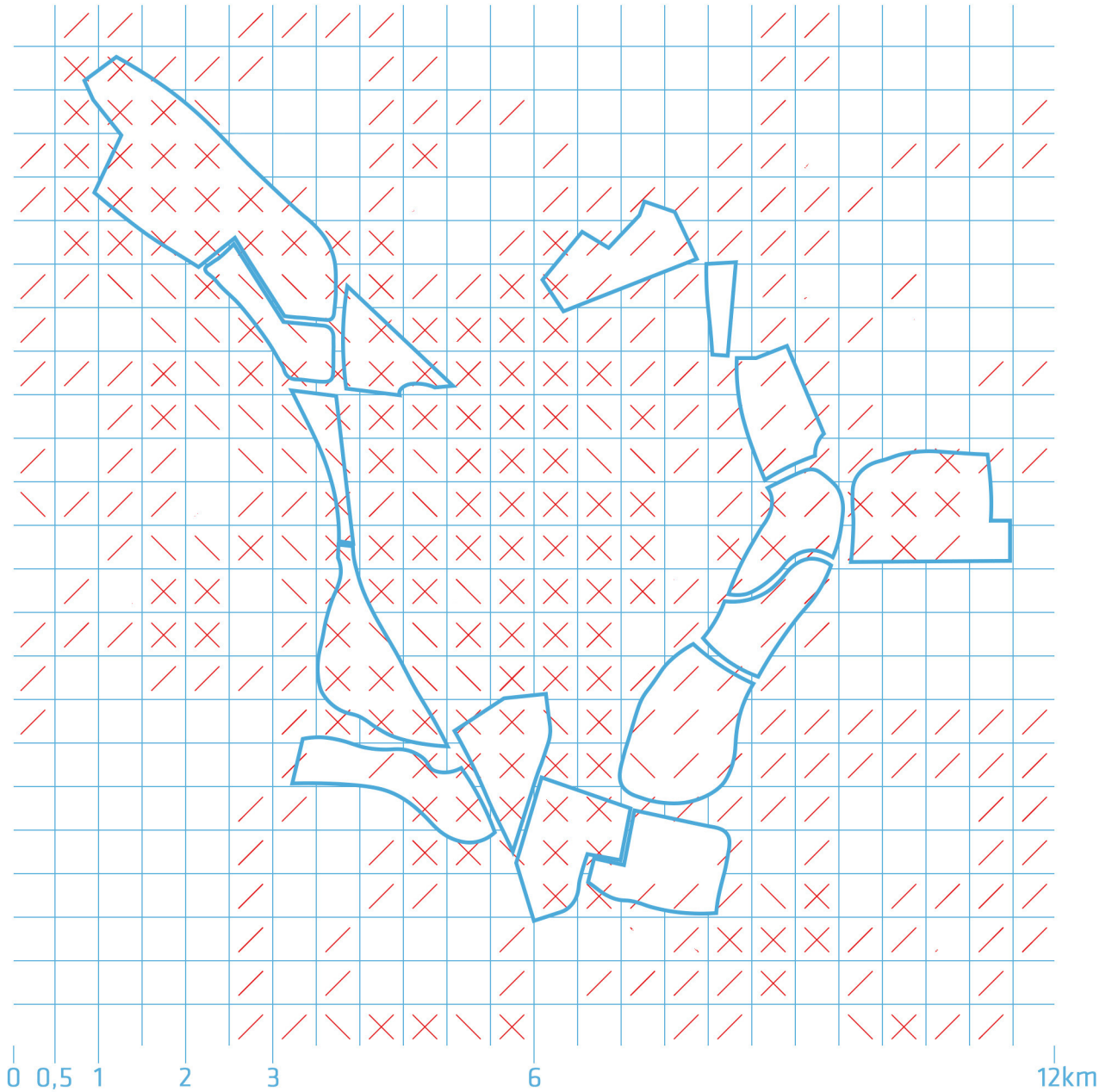
Restriction in  
movement  
(small action  
radius)

Urban health  
indicators based  
on the Health map  
(Barton and Grant,  
2006).

# Urban Health Risks Built environment

Utrecht

scale 1 : 75.000



Iconography  
Legend

Built  
environment



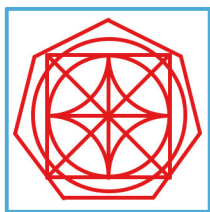
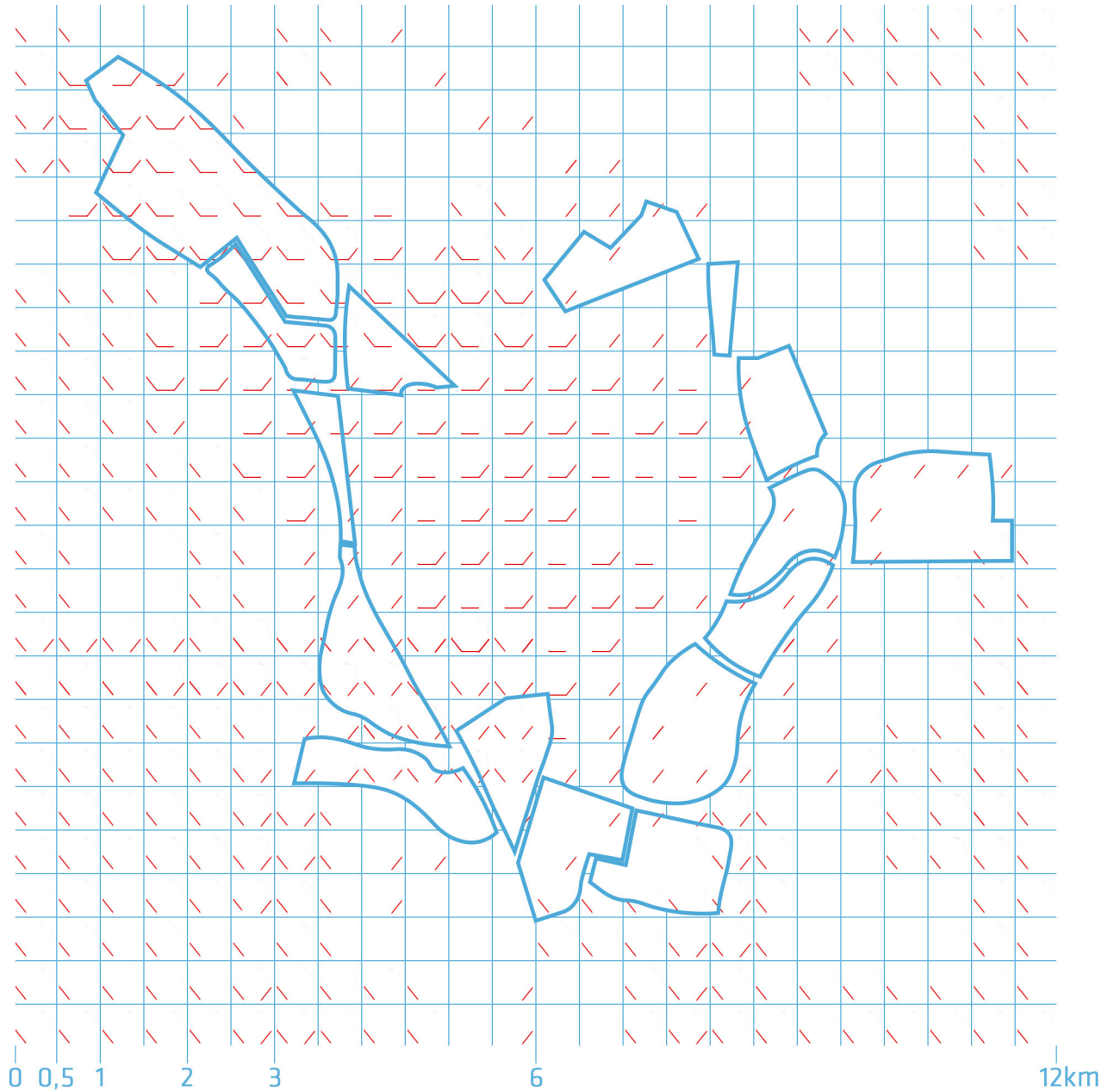
Light  
emmission  
nuisance

Urban health  
indicators based  
on the Health map  
(Barton and Grant,  
2006).

# Urban Health Risks Natural environment

Utrecht

scale 1 : 75.000



Iconography  
Legend

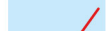
## Natural environment



Low species diversity



Little green in neighborhoods



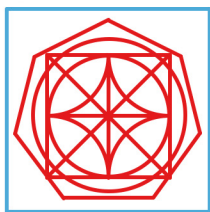
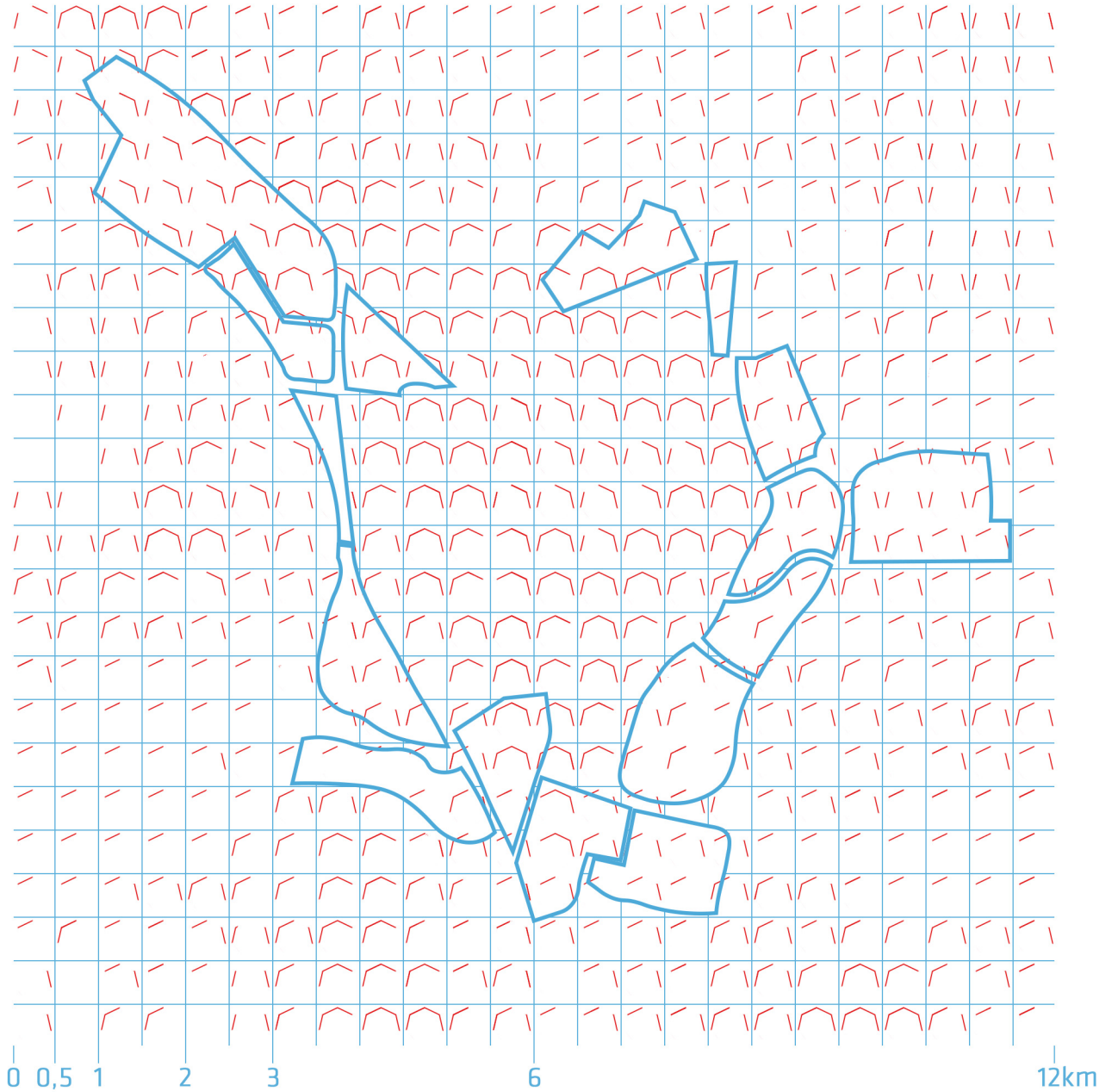
Poor air quality

Urban health indicators based on the Health map (Barton and Grant, 2006).

# Urban Health Risks Global ecosystem

Utrecht

scale 1 : 75.000



Iconography  
Legend

Urban health indicators based on the Health map (Barton and Grant, 2006).

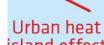
Global ecosystem



High perceived heat (summer day)

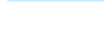


Flood risks



Urban heat island effect

Water nuisance on streets



# Density Public buildings

Overvecht Zuid

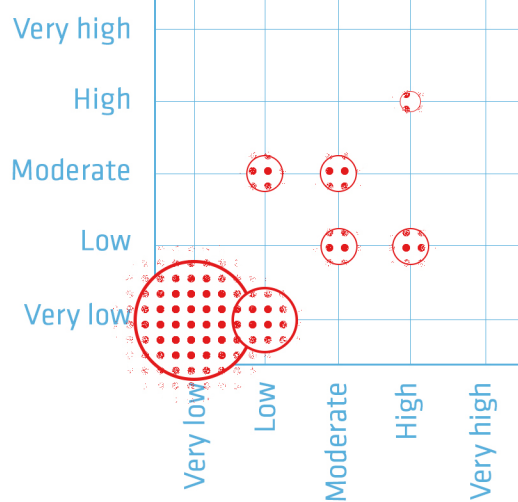
scale 1 : 12.500



## Legend

- Buildings
- Public buildings
- Neighbourhood units
- Building blocks

## FSI



photos will be taken during the upcoming fieldtrip

Portrait

GSI

# Density Low rise buildings

Overvecht Zuid

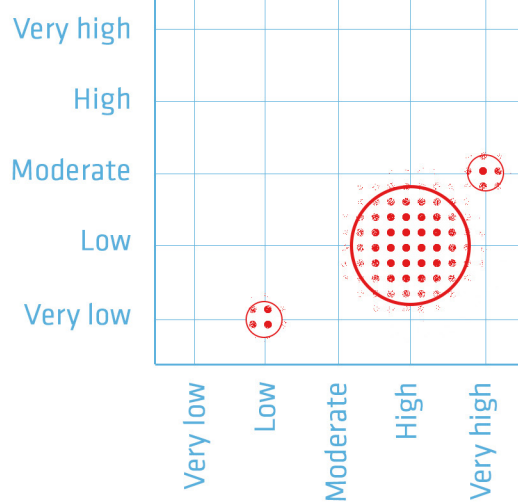
scale 1 : 12.500



## Legend

- Buildings
- Low rise buildings
- Neighbourhood units
- Building blocks

## FSI



photos will be taken during the upcoming fieldtrip

Portrait

GSI

# Density Medium-high rise buildings

Overvecht Zuid

scale 1 : 12.500

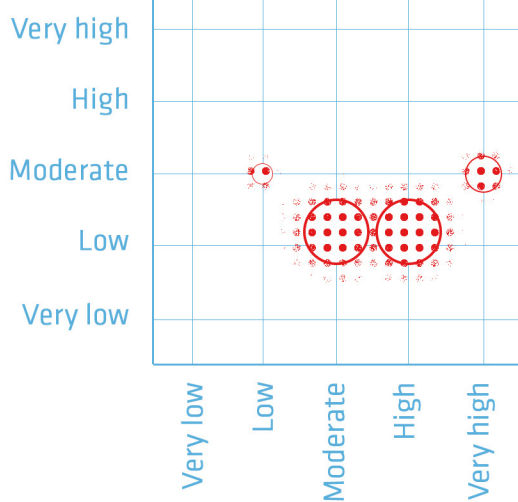


0 0,5 1 1,5 2km

## Legend

- Buildings
- Medium-high rise buildings
- Neighbourhood units
- Building blocks

## FSI



photos will be taken during the upcoming fieldtrip

Portrait

GSI

# Density High rise buildings

Overvecht Zuid

scale 1 : 12.500

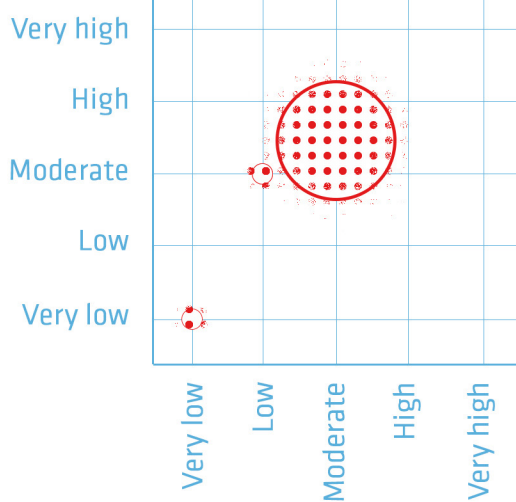


0 0,5 1 1,5 2km

## Legend

-  Buildings
-  High rise buildings
-  Neighbourhood units
-  Building blocks

## FSI



photos will be taken during the upcoming fieldtrip

Portrait

## GSI

# Analysis map Open Space Ratio (OSR)

Overvecht Zuid

scale 1 : 12.500



## Legend

 Zone 1: High OSR

 Buildings

 Buildings in zone

 Buildings enclosing the zone

# Analysis map Open Space Ratio (OSR)

Overvecht Zuid

scale 1 : 12.500



## Legend

 Zone 2: High OSR

 Buildings

 Buildings in zone

 Buildings enclosing the zone

# Analysis map Open Space Ratio (OSR)

Overvecht Zuid

scale 1 : 12.500



## Legend

-  Zone 3: moderate OSR
-  Buildings
-  Buildings in zone
-  Buildings enclosing the zone

# Analysis map Open Space Ratio (OSR)

Overvecht Zuid

scale 1 : 12.500



## Legend

 Zone 4: Low OSR

 Buildings

 Buildings in zone

 Buildings enclosing the zone



# Analysis map Open Space Ratio (OSR)

Overvecht Zuid

scale 1 : 12.500



## Legend

-  Zone 5: Very low OSR
-  Buildings
-  Buildings in zone
-  Buildings enclosing the zone

# #1 Use the unused

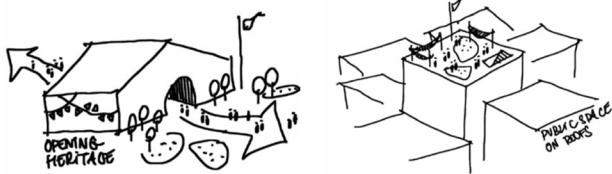
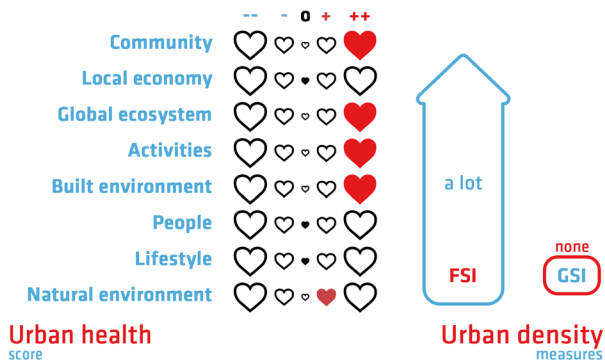


Figure By Vereniging Deltametropool (2022).

Explanation: Make existing streets, squares, roofs, and (heritage) buildings accessible to the public.

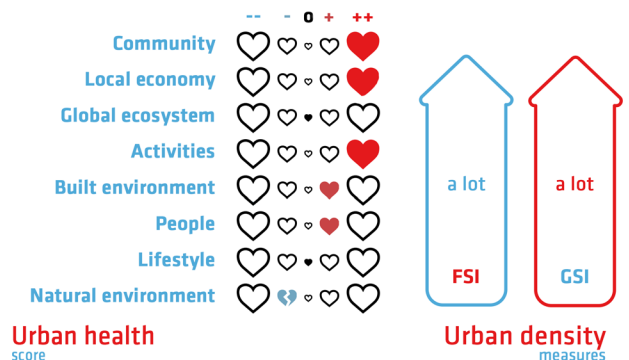


# #2 Sharing is caring



Figure By Vereniging Deltametropool (2022).

Explanation: Introduce shared facilities where people can meet each other. This contributes to urban vitality.

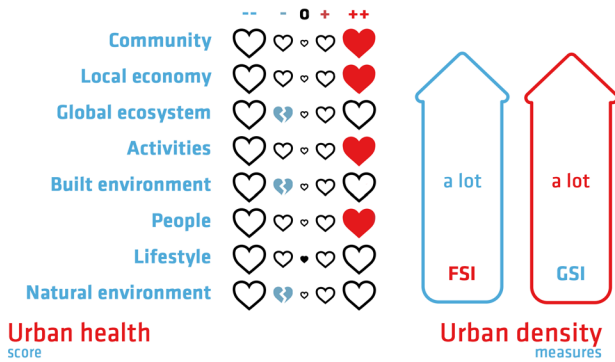


# #3 Diversify



Figure By Vereniging Deltametropool (2022).

**Explanation:** Introduce a wide range of facilities to attract a diversity of people all day long. This contributes to urban vitality.



# #4 No roads, but streets

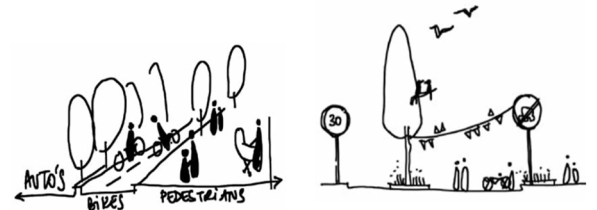


Figure By Vereniging Deltametropool (2022).

**Explanation:** Design streets for active travel instead of carfriendly roads by implementing wide sidewalks, few obstacles, clear markings and speed limitations. Streets will become lively and safer.

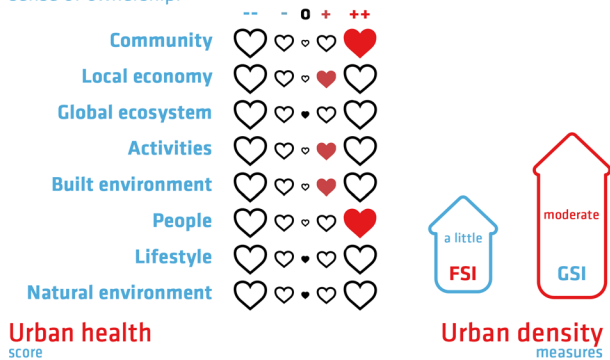


# #5 Eyes on streets



Figure By Vereniging Deltametropool (2022).

**Explanation:** With a clear layout and balconies or windows to provide views on the street to create safety in public space and a sense of ownership.



# #6 Less door = more

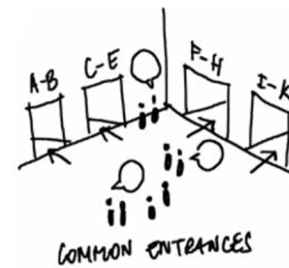
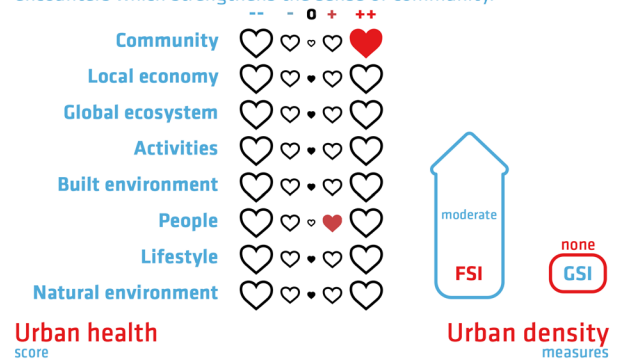


Figure By Vereniging Deltametropool (2022).

**Explanation:** Urban densification gives the opportunity for more common entrances. These contribute to more coincidental encounters which strengthens the sense of community.

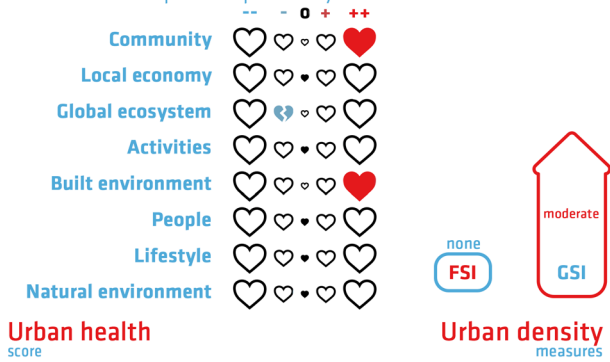


# #7 Transform transitions



Figure By Posad Maxwan, Strategy & Design (2022).

**Explanation:** By designing clear transitions between private, semi-private, collective, public, and semi-public spaces to increase a sense of ownership and responsibility.



# #8 Unplanned encounters

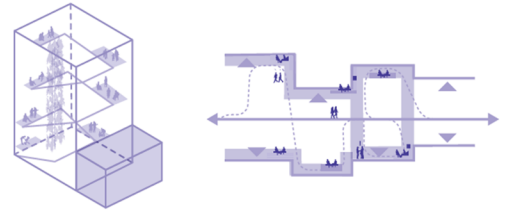
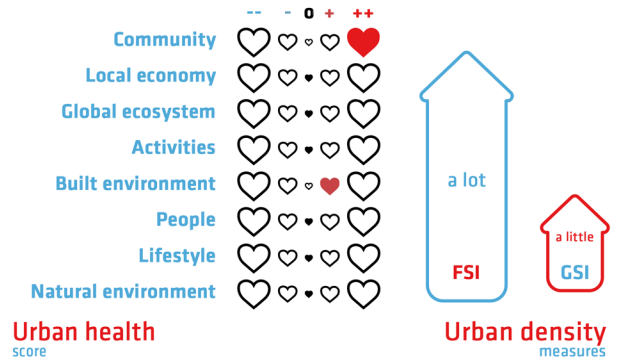


Figure By Posad Maxwan, Strategy & Design (2022).

**Explanation:** By designing spaces to meet in the semi-public and semi-private spaces coincidental encounters will happen more often.



# #9 Community hub

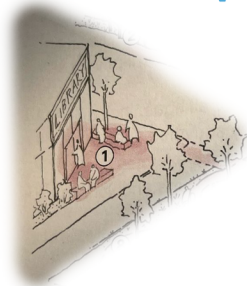
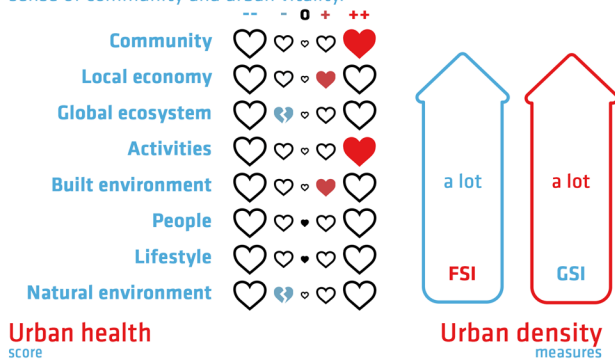


Figure By Roe & McCay (2021).

**Explanation:** By planning a community hub the inhabitants will have a building to meet for community events. This contributes to a sense of community and urban vitality.

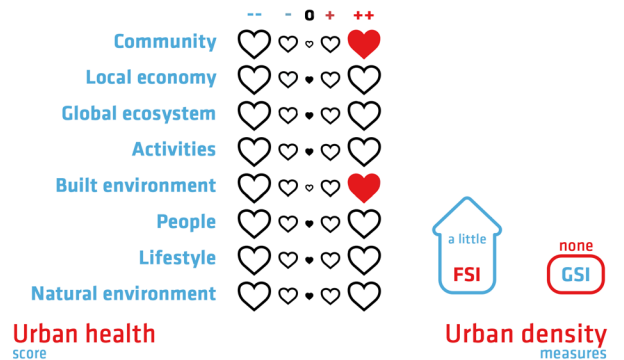


# #10 Take a seat



Figure By Roe & McCay (2021).

**Explanation:** By placing enough seats people can sit down and enjoy public spaces for longer which can lead to coincidental encounters.

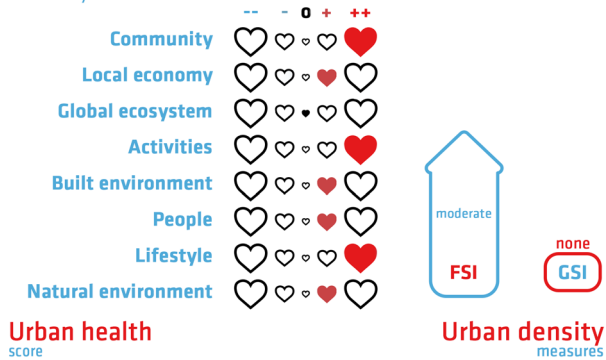


# #11 Garden together



Figure By Roe & McCay (2021).

**Explanation:** Community gardens can strengthen a sense of community. Growing your own food can reduce grocery costs, provide a healthy diet and be educational for kids and others.

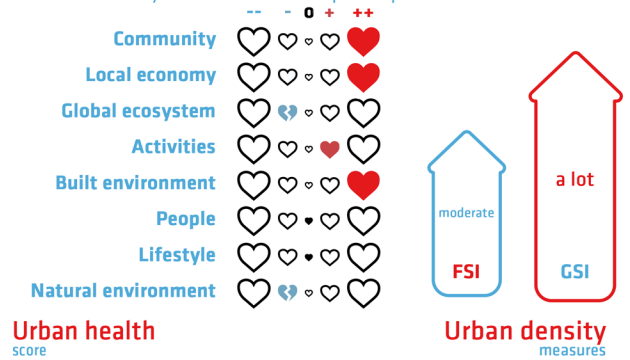


# #12 Active plinths



Figure By Roe & McCay (2021).

**Explanation:** Plinths of buildings can be activated with cafes and other public businesses. This contributes to a lively streetscape and a sense of safety. It also softens the public-private transition.

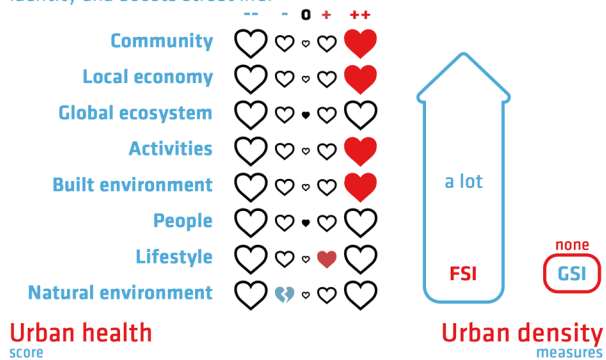


# #13 Fill-in spaces



Figure By Vereniging Deltametropool (2022).

**Explanation:** Flexible and usable outdoor spaces for neighborhood festival days or pop-up events/markets helps create a sense of identity and boosts street life.



# #14 Gather around

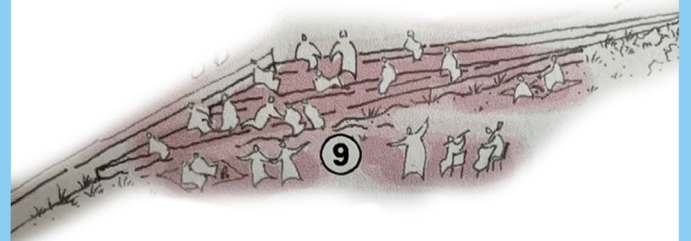
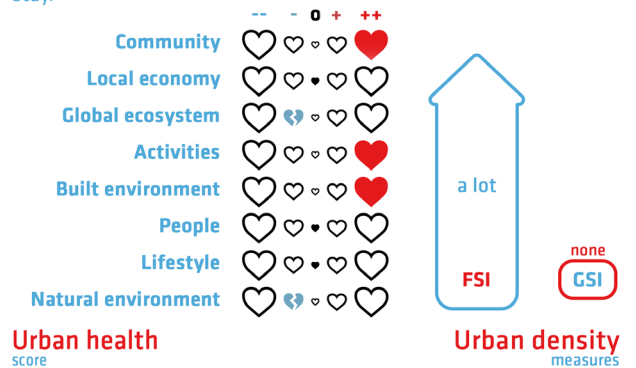


Figure By Roe & McCay (2021).

**Explanation:** Dedicating parts of public space to gathering with larger groups can support outdoor community events and places to stay.

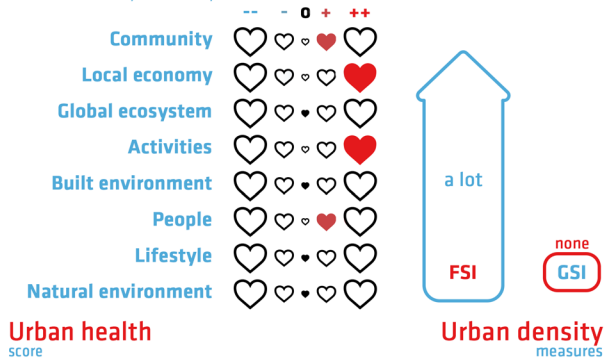


# #15 Job diversity



Figure By Cities of Making (2025).

**Explanation:** A wide range of job opportunities, evenly distributed throughout the neighborhood, ensures more workplaces that align with the skills, abilities, and interests of the local workforce.

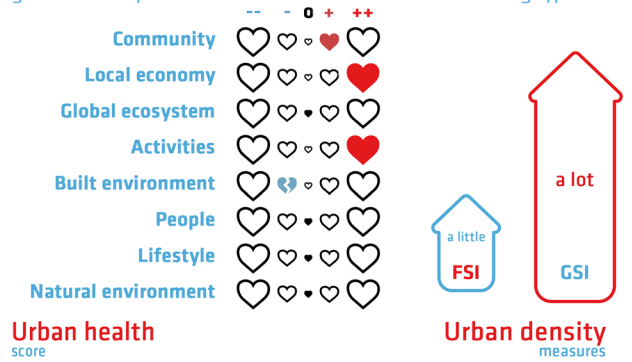


# #16 Microzoning



Figure By Cities of Making (2025).

**Explanation:** Inserting or preserving micro zones of making within the urban fabric can protect vulnerable local businesses or provide grounds for experimentation in mix used areas and building types.

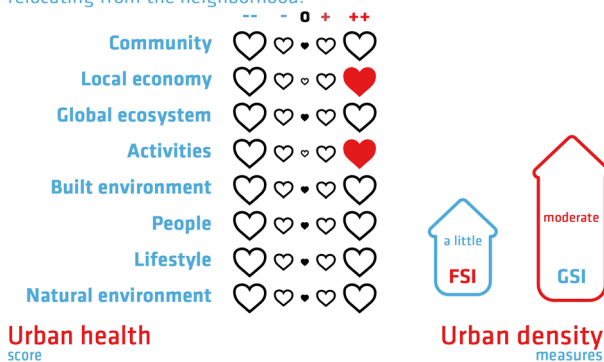


# #17 Size wise



Figure By Cities of Making (2025).

**Explanation:** Different unit sizes support a diverse range of businesses and allow manufacturers to expand or downsize without relocating from the neighborhood.



# #18 Messy making

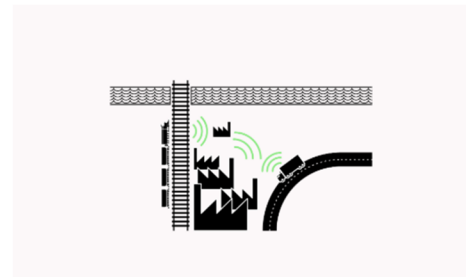
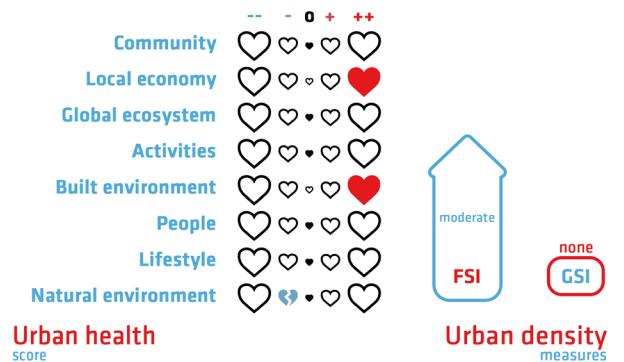


Figure By Cities of Making (2025).

**Explanation:** Grouping manufacturing activities that generate noise, dust, and strong odors along infrastructure helps reduce disruptions.

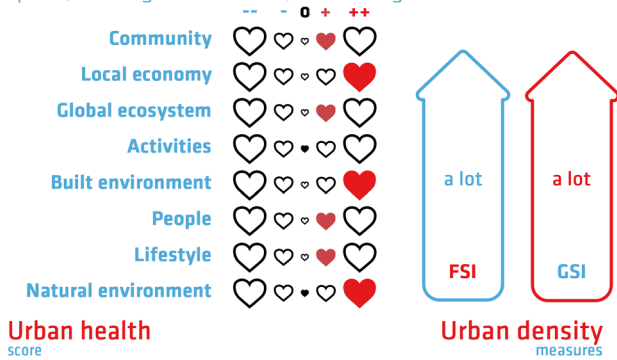


# #19 Spaces that work



Figure By Cities of Making (2025).

**Explanation:** A well-designed public realm appeals to both employees and clients, enhancing safety, supporting mixed-use spaces, boosting staff retention, and drawing visitors in.

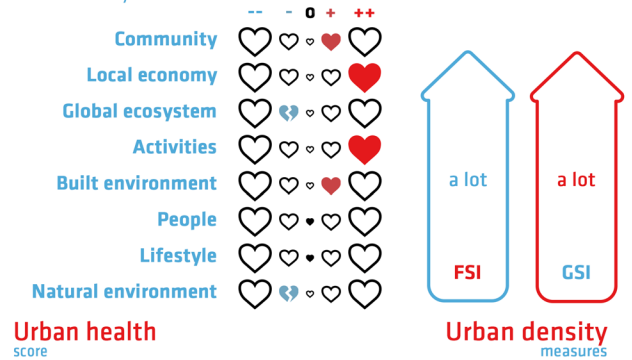


# #20 High street



Figure By Cities of Making (2025).

**Explanation:** Clustering mixed-use activities along high streets maximizes regional accessibility and high pedestrian traffic, and thus visibility.

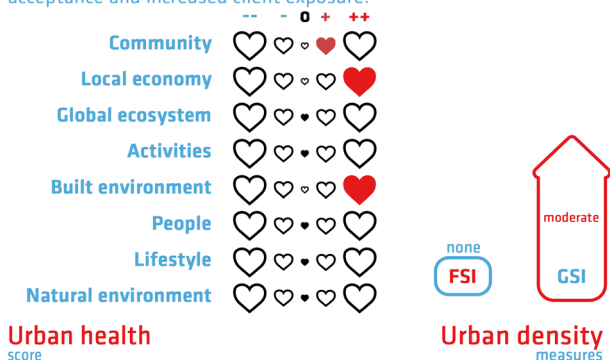


# #21 Public face



Figure By Cities of Making (2025).

**Explanation:** Businesses with a welcoming and attractive public face integrate more seamlessly into the neighborhood, gaining greater acceptance and increased client exposure.



# #22 Vertical making

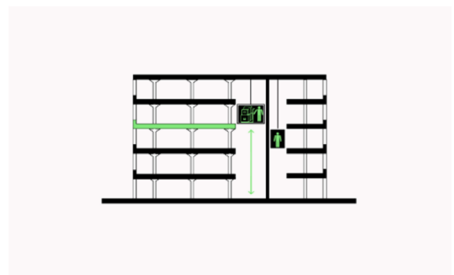
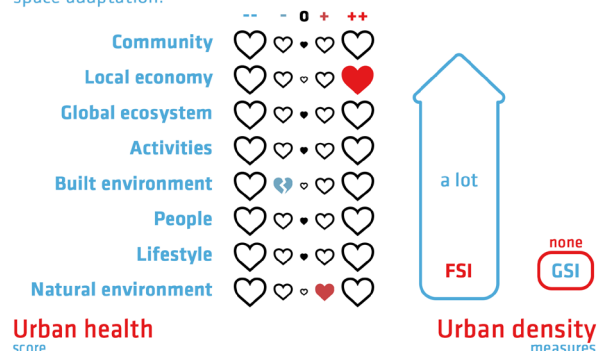


Figure By Cities of Making (2025).

**Explanation:** Freight elevators and strong load-bearing floors in multistory buildings support industrial growth and enable flexible space adaptation.



# #23 Flexible spaces

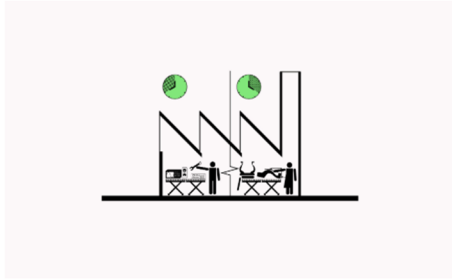
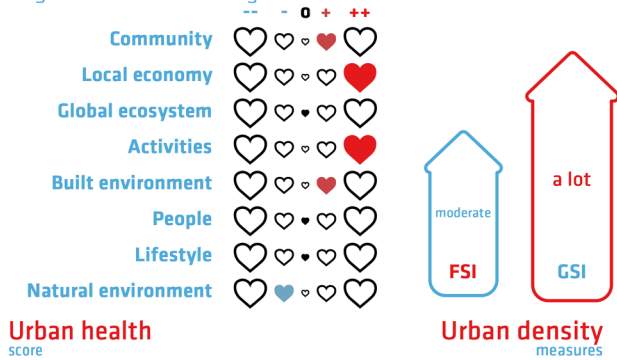


Figure By Cities of Making (2025).

**Explanation:** Flexible spaces can allow makers to share facilities. This allows start-ups to test new initiatives and enterprises in the neighborhood while reducing economic risks.



# #24 Makers community

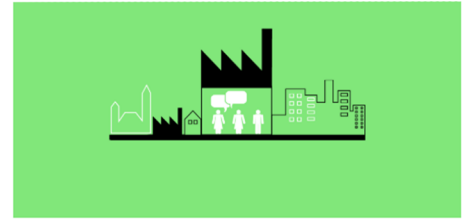
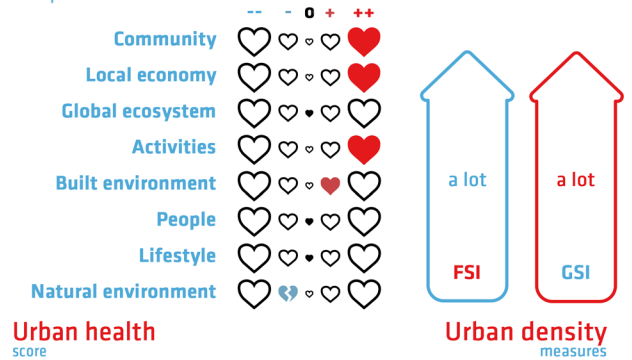


Figure By Cities of Making (2025).

**Explanation:** Combining making locations with a community hub fosters knowledge sharing, strengthens a local network of makers and promotes collaboration.

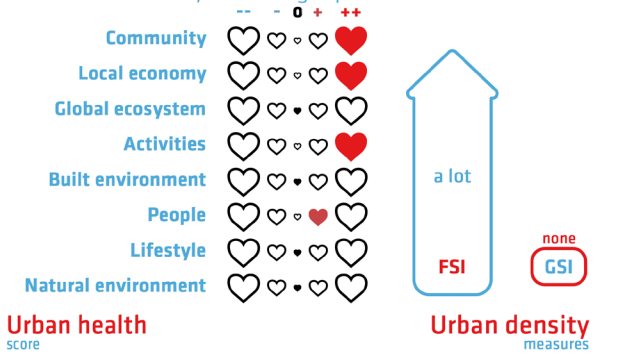


# #25 A home for every need



Figure By Vereniging Deltametropool (2022).

**Explanation:** Implementing a varied range of (rental) properties will make the neighborhood affordable for everyone and therefore welcome a wide variety of income groups.

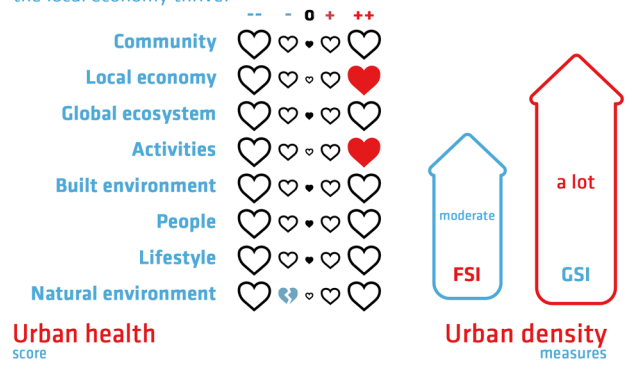


# #26 Around the corner



Figure By Vereniging Deltametropool (2022).

**Explanation:** Having public amenities and work locations in easily accessible and visible places instead of in peripheral zones can help the local economy thrive.



# #27 Twentyfour-seven

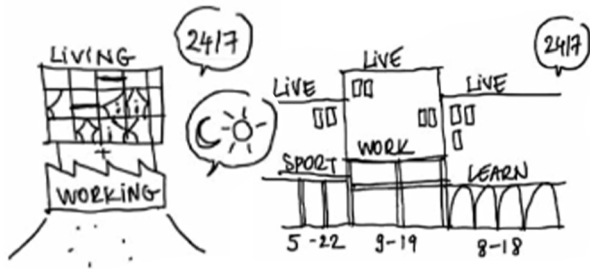
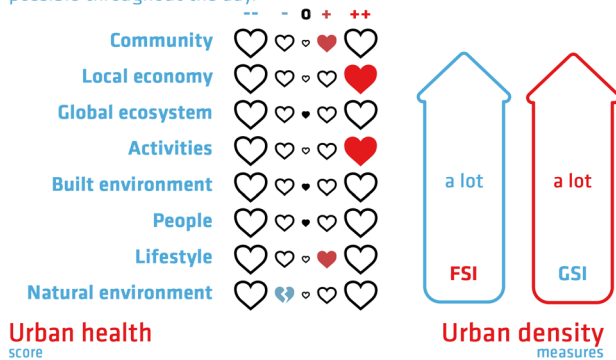


Figure By Vereniging Deltametropool (2022).

**Explanation:** Create room for public amenities, work and making spaces with a functional mixing and programming as much as possible throughout the day.



# #28 Learn by playing

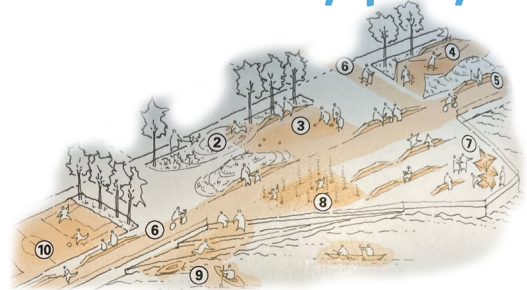
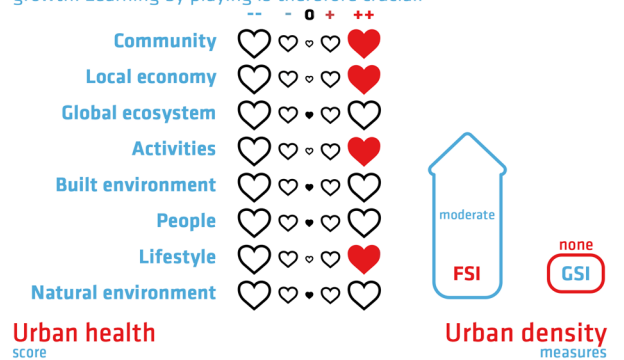


Figure By Roe & McCay (2021).

**Explanation:** Playing is crucial to their development because it supports a wide range of physical, cognitive, emotional, and social growth. Learning by playing is therefore crucial.



# #29 Roofs & rain

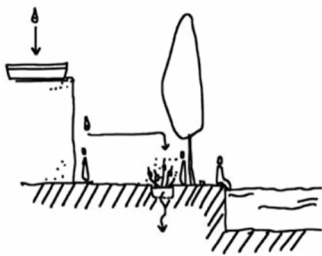
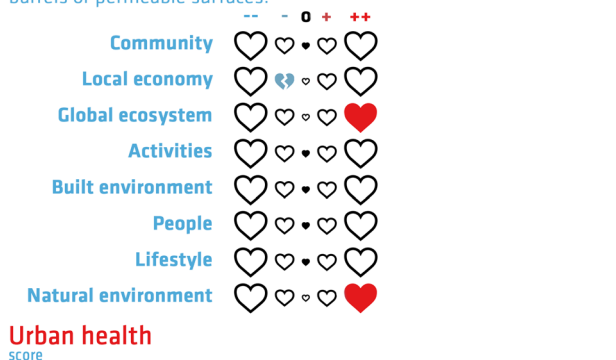


Figure By Vereniging Deltametropool (2022).

**Explanation:** Ensure in the design that rain water on roofs is managed well by redirecting the rain water to surface water, rain barrels or permeable surfaces.



# #30 Let it in

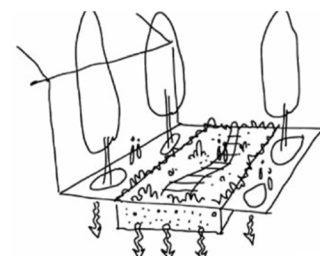
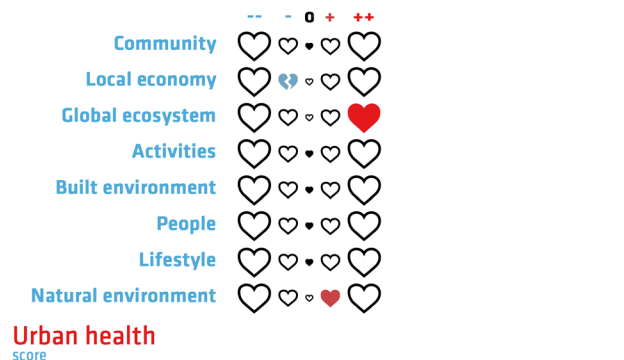


Figure By Vereniging Deltametropool (2022).

**Explanation:** Design public space with permeable pavements, green and blue spaces, or wadi's in order to reduce water nuisance.



# #31 Trees everywhere

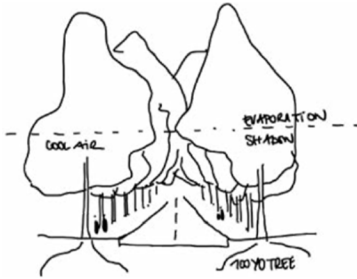


Figure By Vereniging Deltametropool (2022).

**Explanation:** Trees help to cool the air locally by creating shadow and through evaporation. Trees also sequester CO2 from the atmosphere.



Urban health score

# #32 Light & shadow

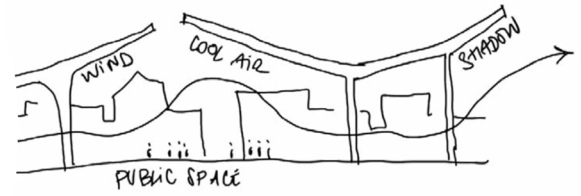
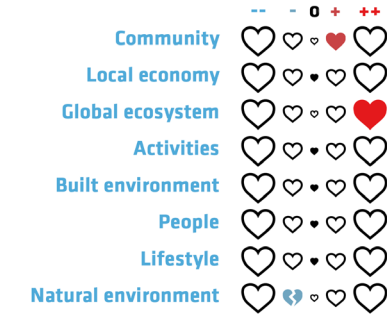


Figure By Vereniging Deltametropool (2022).

**Explanation:** Create shadow rich places in public space will help add more cool places in the neighborhood.



Urban health score

# #33 Electrifying

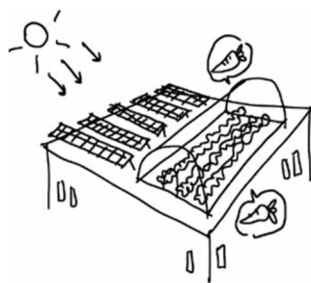
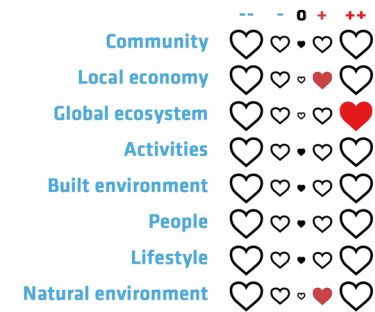


Figure By Vereniging Deltametropool (2022).

**Explanation:** Adding solar panels to buildings improve the energy labels of buildings with clean sustainable energy.



Urban health score

# #34 Green buildings

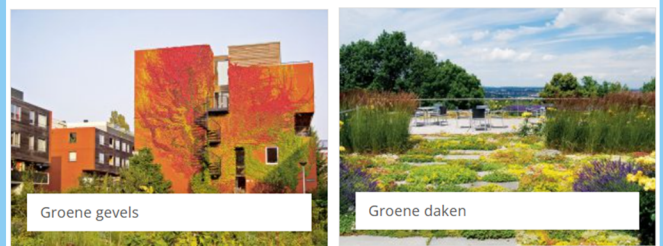
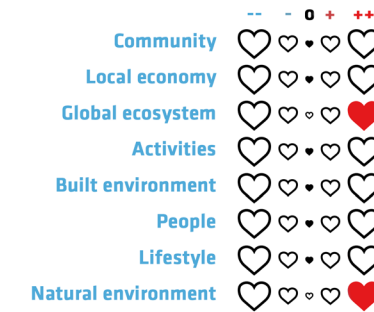


Figure By Pötz (2016).

**Explanation:** By growing plants on facades and roofs heat stress can be decreased. It also is good for the natural environment.



Urban health score

# #35 Rainwater pond



Figure By Pötz (2016).

**Explanation:** Designing a pond or open surface water for rainwater storage, purification and infiltration will help manage water nuisances.



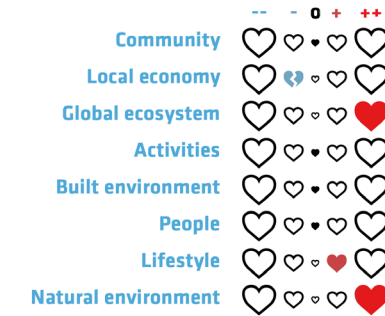
Urban health score

# #36 Water movement



Figure By Pötz (2016).

**Explanation:** Water that moves has a higher quality and increases evaporation which helps cooling the surrounding area.



Urban health score

# #37 Green car space



Figure By Pötz (2016).

**Explanation:** Prioritise green spaces over car related spaces. Make sure that green also occupies car related spaces for better infiltration and to reduce heat stress.



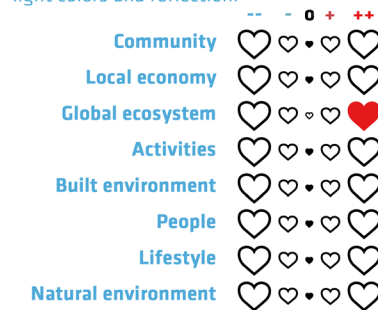
Urban health score

# #38 No low albedo



Figure By Pötz (2016).

**Explanation:** Heat stress can be decreased with a high albedo materialisation of buildings. A high albedo can be achieved with light colors and reflection.



Urban health score

# #39 Rain garden



**Figure** By Pötz (2016).

**Explanation:** Rain gardens, especially along streets and roads, help to manage rain water nuisance.

