HEALTHY URBAN NEIGHBOURHOODS WITHIN GREEN INFRASTRUCTURES

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ABSTRACT

Urban environments have a high risk of mental illness, such as depression and anxiety. As a testcase this research investigates strategies for decreasing depression/anxiety levels and -risks in the urban context of Boerhaavewijk, with the focus on urban green infrastructures and the facilitation of passive and active care. This research gives a method of improving mental health in urban environments, by providing a system of internal and external interventions with a scoring on effectiveness, cost, amount of functions, passive or active care and implementation time, together with the reflection of users, designers, and planners.

KEYWORDS: MENTAL HEALTH, URBAN ENVIRONMENT, PASSIVE AND ACTIVE CARE, URBAN GREEN INFRASTRUCTURES, DEPRESSION AND ANXIETY

I. INTRODUCTION

An important part of people and their wellbeing is their living environment. Because of the increase in population and buildings, urban areas suffer from densification and diminishing green environments. Green environments and qualitative features of building, such as being well insulated, have a positive impact on people and their physical and mental wellbeing (Galea et al., 2005). Because of lacking space caused by the substantial number of existing buildings, it is important to look at the possibilities to facilitate these healthy living environments within the existing urban fabric.

1.1. Unhealthy Urban Environment

In comparison to rural areas, there is a higher risk of mental illness in urban areas because of social and surrounding features (Buttazzoni et al., 2021), such as the lack of natural environments, public places (Callaghan et al., 2020), noise and air pollution (Baggaley, 2019) and social isolation (The Centre for Urban Design and Mental Health, n.d.). This is problematic because the world is increasingly urbanising. In 2014 more than half of the world's population was living in urban areas (55%), which is expected to be 70% by 2050 (Baggaley, 2019). Therefore, it is important to find ways to make these urban areas healthier. In the Netherlands, the national programme of liveability and safety is looking into problematic urban neighbourhoods with problems such as low income, bad living conditions and bad health. The research of Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (2022) shows that improving the physical living environment is one of the important factors to solve these problems.

1.2. Depression/anxiety and needed treatment

Not only in urban areas is mental health a recurring theme. On a global scale one in eight people suffer from a mental disorder, with depressive and anxiety disorders the most common (World Health Organisation, 2022). According to the World Health Organisation (2022) depression is one of the leading causes of disability worldwide. In 2019 on a global scale around 5 percent of people above 20 years old suffered from a depressive disorder, and 4.8 percent an anxiety disorder. In the Netherlands 5 percent suffered from a depressive disorder, and 7.8 percent from an anxiety disorder. Furthermore, almost one in five people in the Netherlands encounter a depressive or anxiety disorder at least once in their lives (de Graaf et al., 2010). Green environments and therapeutic treatment of people within can have a positive impact on mental health, especially for people suffering from depression and anxiety.

In the Netherlands already nine hundred care farms (Federatie Landbouw en Zorg, n.d.) offer farming practices as a nature based therapy (Social Farms & Gardens, n.d.). Implementing these farms in an urban setting has not received much attention yet (Hassink et al., 2020). For patients in urban areas this type of treatment could therefore be inaccessible. Or they must move to receive it, while it can be important to stay within one's own living environment because of the needs of the patient or the stimulation to deal with mental health problems within the triggering environment.

1.4. Location

According to the research of Vanham et al. (2016) Haarlem is an extremely urbanised city in the Netherlands. Boerhaavewijk, a neighbourhood in Haarlem, has a ratio of 4.500 inhabitants per square kilometre, which makes it one of the most densely populated neighbourhoods in the Netherlands (KadastraleKaart, n.d.). This neighbourhood is facing issues with wellbeing, social aspects, and characteristics of the neighbourhood (the broad living environment) (figure 1). For example, the greenery lacks quality according to the residents, the post-war flats need renovation, and more than half of the residents above 19 years old are at risk having depression or anxiety (Gemeente Haarlem, n.d.). Furthermore, looking at the neighbourhoods within the research of Ministerie van Binnenlandse Zaken en Koninkrijksrelaties (2022), Boerhaavewijk has similar problems such as low income and bad living conditions. Therefore, Boerhaavewijk is a valuable context to conduct research on in this graduation project.

Figure 1. Area analysis Boerhaavewijk, translated to English (Gemeente Haarlem, n.d.)

II. THEMATIC RESEARCH QUESTION AND METHOD

To find an answer to the problems stated above, the thematic research question of this paper is: *'What strategies are needed for decreasing depression/anxiety levels and -risks in the urban context of Boerhaavewijk, with focus on urban green infrastructures and facilitation of passive and active care?'*

To be able to answer this question, this paper is divided into two phases. The first phase will consist of the review of existing literature and an analysis of the chosen location Boerhaavewijk. This phase is related to the following sub questions: *'What are interventions within the building context that can decrease depression/anxiety levels and -risk?'* and *'What problems and opportunities exist within Boerhaavewijk in relation to health, with the focus on depression/anxiety levels and -risks?'* The interventions are focused on passive care, such as urban green infrastructures and active care such as therapy facilities. These interventions are found within buildings (internal interventions) and outside areas (external interventions). Potential interventions are systemized on aspects of effectiveness on mental health, cost, implementation time and passive or active care. This data is used within the second phase.

The second phase is related to the following sub question: *'Where and how can interventions be implemented within the existing urban context of Boerhaavewijk and how effectively can this improve mental wellbeing in Boerhaavewijk?'* Firstly, the existing neighbourhood of Boerhaavewijk is analysed and scored. Secondly, the found interventions are implemented and scored within a short term, a long term, and a maxed out urban plan for Boerhaavewijk. All plans are scored on effectiveness on mental health and amount of functions. The new plans are additionally scored on costs. Limits to the scoring system are that not all important aspects in relation to mental health can be considered within this research; part of the scoring system is based on subjectivity; and the data used to rank the different interventions are based on few references. Therefore, it is important to get a user reflection on the found strategies. This is done by asking the opinion of residents of Boerhaavewijk and people from a therapy facility in Rotterdam using a survey about the existing neighbourhood and the long term urban plan for Boerhaavewijk. This survey is done by firstly showing maps and impression images of these urban plans and secondly, a question list is provided related to mental health, with a scoring of 1 (very bad) to 5 (very good). This gives input on what scores good or bad according to the users and gives feedback on what can be changed in the urban planning. Limitations to this are that only nine people are surveyed; that residents could give answers that are based on personal interest; and that for the people from the treatment facility it is harder to have an accurate view of Boerhaavewijk.

III. PHASE ONE

3.1. External interventions

3.1.1. Green environments and mental health

The importance of green environments on people stems from an innate need of being connected to natural environments, which have restorative properties on health (Roe & McCay, 2021; Song et al., 2019). These restorative properties have positive effect on people and their wellbeing, such as reducing, recovering, and managing symptoms of mental health problems like depression and anxiety (Roe & McCay, 2021). Another restorative benefit of green environments is emotional restoration (Browning et al., 2014; Song et al., 2019; Schmutz et al., 2014), such as increasing happiness and reducing negative feelings (Browning et al., 2014; Douglas & Douglas, 2021). Besides having a direct impact on mental wellbeing, green environments also have an indirect impact by stimulating cognitive functioning, social wellbeing, and physical health. These direct and indirect impacts stimulate each other. Nature stimulates cognitive functioning by factors such as improved memory, increased attention, better concentration, and improved mood (Bratman et al., 2012). As an illustration, nature creates a sense of being away from everyday demands, which allows space for reflection without using cognitive resources like concentration (Roe and McCay ,2021). Another example is that an unblocked view on nature has cognitive benefits including decrease in boredom, irritation, and fatigue (Browning et al., 2014). Exposure to green environments positively benefits social wellbeing by the stimulation of social interactions (Song et al., 2019; Douglas & Douglas, 2021), for example by nature elements that can

activate human their emotions (Schmutz et al., 2014), the facilitation of social activities (Douglas & Douglas, 2021; Harada et al., 2021; Nieuwenhuijsen, 2021; Schmutz et al., 2014), the possibility of being amongst a crowd (Advanced Psychiatry Associates, 2020), and the creation of place identity (Ling and Chiang, 2018; Roe & McCay, 2021). Physical health is positively stimulated by green environments, e.g., by the stimulation of physical activity (Dewar, 2019; Douglas & Douglas, 2021; Roe & McCay, 2021; Song et al., 2019) and by noise, air and heat reducing effects of greenery (Roe & McCay, 2021; Song et al., 2019).

3.1.2. External interventions for urban planning

For this research specific urban greenery interventions, whose importance is described in various literature, are used for the urban planning of Boerhaavewijk. The benefits of these interventions are according to paragraph 3.1.1. In the following paragraphs these are explained in more detail.

3.1.2.1. Parks

The facilitation of parks gives access and direct exposure to public and collective green spaces that resemble natural environments (Roe & McCay, 2021). Every additional hour being in a park decreases the risk of having poor health (Nieuwenhuijsen, 2021) and parks promote being physically active (Vinuesa, 2022; Nieuwenhuijsen, 2021). As an illustration walking in a park improves mood, because of physical activity (Advanced Psychiatry Associates, 2020). Next to physical benefits, parks have social benefits such as the stimulation of strong social networks (Roe & McCay, 2021), decreasing feelings of loneliness by being amongst a crowd (Advanced Psychiatry Associates, 2020) and social activity by facilitating recreational functions (Nieuwenhuijsen, 2021).

3.1.2.2. Neighbourhood gardens, kitchen gardens and green roofs

Like parks, neighbourhood gardens give access and direct exposure to public and collective green spaces. These spaces have social benefits, such as improving social interactions and behaviour (Browning et al., 2014; Roe & McCay, 2021; Schmutz et al., 2014). Mental health benefits of gardens are increasing relaxation, reducing stress levels, and improving mood (Browning et al., 2014; Schmutz et al., 2014). When also giving the opportunity of gardening, gardens have additional health benefits, by physical activity (Harada et al., 2021; Schmutz et al., 2014) and by the stimulation of a healthy diet (Philips, 2013; Schmutz et al., 2014). Physical activity within gardens are better for mental health than other activities such as reading in a garden (Schmutz et al., 2014). Other mental health benefits of gardening are creating a sense of achievement (Advanced Psychiatry Associates, 2020; Schmutz et al., 2014), structure in daily life, and an improved life satisfaction (Schmutz et al., 2014). Lastly, the act of gardening together has important benefits on social cohesion (Harada et al., 2021; Schmutz et al., 2014). In an urban intervention, collective gardening by residents can occur in kitchen gardens, which are gardens where vegetables, fruits and herbs are grown (Cambridge University Press, 2023). Neighbourhood gardens and kitchen gardens can also be implemented in the form of green roofs.

3.1.2.3. Streetscape greenery and green walls

Improvements of streets and the facilitation of streetscape greenery is another important intervention. According to research from Roe and McCay (2021) improving the walkability of streets and adding streetscape greenery, improves the perceived social cohesion and networks in a neighbourhood. Elements of streetscape greenery, such as street trees, are important to connect different green spaces and thereby making them more accessible (Douglas and Douglas, 2021; Roe & McCay, 2021). Research of Nieuwenhuijsen (2021) states that adding trees has health benefits, by the reduction of crime and the stimulation of physical activity. Other health benefits of streetscape greenery stem from the improvement in air quality and the mitigation of the urban heat island effect (UHI) in urban cities by facilitating vertical greenery, like green walls. Next to health benefits, vertical greenery has social benefits such as the improvement of social interactions, safety, and place identity. On the building scale vertical greenery also has effects, namely cooling in the summer and an insulating in the winter, which has cost savings effects on energy (Ling and Chiang, 2018). This reduction could again have a positive effect on mental wellbeing, by reducing stress of high energy bills.

3.1.3. Implementation of external interventions

In table 1 and 2 an overview of functions within external interventions and ways of implementing these is shown. From the paragraphs 3.1. and 3.2. can be concluded that stimulation of physical and social activity within urban green infrastructures is of high importance for mental health benefits. In this paper the functions that stimulate these are described as physical active functions (PAF) and social active functions (SAF). Examples are sport facilities and places to sit. However, for people that suffer from mental illnesses, therapy facilities are additionally needed. An example is horticulture therapy through gardening. In this paper these facilities are describes as therapy functions (TF). Next to the facilitation of these functions, the way that urban green infrastructures are implemented is of importance to their impact on mental health. Examples are the amount of greenery per square meter, the accessibility of the green spaces and having views on greenery. The importance of these functions and ways of implementations are according to the analysis of the needs in Boerhaavewijk. Within the neighbourhood the amount of greenery is relatively high. However, this greenery could be more beneficial for mental health. Firstly, the greenery lacks quality (Gemeente Haarlem, 2019b) and biodiversity (AP+E & Studio dmau, 2022). Secondly, the greenery is not much used because recreational functions are lacking, such as playing, exercising, meeting, and sitting (Gemeente Haarlem, 2012; Gemeente Haarlem, 2019b). Thirdly, the greenery is not well connected (AP+E & Studio dmau, 2022; Gemeente Haarlem, 2012) and the accessibility is poor because of buildings, garage boxes and bad connections for biking and walking (Gemeente Haarlem, 2012). Lastly, hard surfaces should be reduced to reduce the effects of the UHI effect in the neighbourhood (Gemeente Haarlem, 2019b) and with that improve mental and physical health.

Table 1. Literature study functions within external interventions

	Sub-types	Examples
Functions	**Physical active functions (PAF)**	**Sport and play facilities** (Gemeente Haarlem, 2019b; Roe and McCay, 2021)
		Walking facilities (Acvanced Psychiatry Associates, 2020; Buettner, 2010; Gemeente Haarlem, 2012; Roe and McCay, 2021)
		Gardening and community food growing (Acvanced Psychiatry Associates, 2020; Buettner, 2010; Harada et al., 2021; Philips, 2013; Schmutz et al., 2014)
	Social active functions (SAF)	**Recreational facilities** (Gemeente Haarlem, 2019b; Roe and McCay, 2021)
		Sitting places (Rce and McCay, 2021)
		Places to read outside (Acvanced Psychiatry Associates, 2020)
	Therapy functions (TF)	**Nature based therapy** (Rce and McCay, 2021)
		Horticulture therapy (Browning et al., 2014; Hassink, 2009; Pedersen et al., 2016; Schmutz et al., 2014)

Table 2. Literature study implementation of external interventions

Ranked in research		Other
Way of implementation	**The amount of green** (Bos, n.d.; Harada et al., 2021; Nutsford et al., 2013; Roe & McCay, 2021; Song et al., 2019; Wouters, 2018)	**The perception of quality** (Douglas & Douglas, 2021; Gemeente Haarlem, 2019b; Roe & McCay, 2021)
	The accessibility to green (Browning et al., 2014; Dewar, 2019; Roe and McCay, 2021; Song et al., 2019; Vinuesa, 2022)	**The facilitation of connections** (AP+E & Studio dmau, n.d.; Douglas and Douglas, 2021; Gemeente Haarlem, 2012; Roe & McCay, 2021)
	The stimulation of physcial activity (Advanced Psychiatry Associates, 2020; Browning et al., 2014; Buettner, 2010; Dewar, 2019; Douglas and Douglas, 2021; Harada et al., 2021; Roe and McCay, 2021; Schmutz et al., 2014))	**The stimulation of a healthy diet** (Browning et al., 2014; Buettner, 2010; Hersenstichting, n.d.; Philips, 2013; Roe & McCay, 2021; Schmutz et al., 2014)
	The stimulation of social activity (Bos, n.d.; Douglas & Douglas, 2021; Harada et al., 2021; Hassink, 2009 Ling & Chiang, 2018; Pedersen et al., 2016; Philips, 2013; Roe & McCay, 2021; Schmutz et al., 2014; Vinuesa, 2022)	**Biodiversity** (AP+E & Studio dmau, n.d.; Browning et al., 2014; Ling & Chiang, 2018; McKinney & VerBerkmoes, 2020; Roe & McCay, 2021)
	The view on green (Browning et al., 2014; Dewar, 2019; Harada et al., 2021; Ling and Chiang, 2018; Roe and McCay, 2021; Schmutz et al., 2014; Song et al., 2019)	**The facilitations of safety measures** (Browning et al., 2014; Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022; Roe and McCay, 2021)
	Usability Activities within green is more important than only a view, however a view is more important than no view at all.	**The facilitation of weather measures** (Browning et al., 2014; Roe & McCay, 2021)

3.2. Internal interventions

3.2.1. Buildings and mental health

Not only external interventions are of importance to mental health, but also the internal interventions within buildings. Research from Galea et al. (2005) shows that neighbourhoods where the indoor and outdoor features of buildings are of inadequate quality, the risk of residents having a period or lifetime of depression is higher. The research of Roe and McCay (2021) acknowledges this, by stating that safe and healthy housing is needed to counter an increasing exposure to social stress and depression rates. In the Netherlands this is an ongoing task, where plans to change the quality of houses are made to go against negative social aspects and bad health of residents, especially in low-income neighbourhoods (Ministerie van Binnenlandse Zaken en Koninkrijksrelaties, 2022).

3.2.2. Implementation of internal interventions

In table 3 an overview of functions within internal interventions is shown. To be concluded from subparagraph 3.2.1. is that the quality and provision of buildings is important to mental health. In Boerhaavewijk problems with these is seen in factors such as small dwellings, poor energy labels, closed plinths (Gemeente Haarlem, 2012), and the need for other functions than living, such as meeting functions (AP+E & Studio dmau, 2022; Gemeente Haarlem, 2012). However, there is also a demand for more dwellings (Gemeente Haarlem, 2019b). Looking at the neighbourhood, it is seen that there are almost no functions available for therapy, even though the neighbourhood has a substantial risk on mental illness such as depression (Gemeente Haarlem, n.d.). According to Gemeente Haarlem (2019a) facilities for protected and guided living are needed. In Haarlem five new clusters of five to ten apartments for guided living and three locations for protected living is needed. In Boerhaavewijk a location for protected living is already found, however locations for guided living is still needed. Furthermore, according to Gemeente Haarlem therapy facilities are needed for the many people that are on a waiting list to receive treatment from a psychologist (W. Dieben, personal Gecommunication, 14 October 2022). A feasible way to address the problems described is by renovating the post-war flats and adding onto these flats, which will provide space for SAF and TF, together with improving and increasing the amount of living functions (LF).

Table 3. Literature study functions within internal interventions

Sub-types	Examples
Living functions (LF)	**Various dwellings** (Gemeente Haarlem, 2019b)
	Guided living (Gemeente Haarlem, 2019a)
Social active functions (SAF)	**A local supermarket** (AP+E & Studio dmau, 2022; AP+E & Studio dmau, 2023; Roe and McCay, 2021)
	Collective areas to do things together For example cooking (AP+E & Studio dmau, 2022; AP+E & Studio dmau, 2023)
	A café or restaurant (AP+E & Studio dmau, 2023; Roe and McCay, 2021)
Therapy functions (TF)	**Guided living** (Gemeente Haarlem, 2019a)
	Psychologist (Roe and McCay, 2021; W. Dieben, personal Gecommunication, 14 October 2022)
	Meeting places to talk to fellow sufferers (Talking Cafes, n.d.)

*(Left column spanning header: **Functions**)*

3.3. External and internal interventions and scoring

In figure 2 an overview of the found interventions is shown. These interventions are scored in the following paragraphs on effectiveness, cost, implementation time and active or passive care. The result of these are the systemised data for phase two (chapter 4), namely the urban planning of Boerhaavewijk.

Figure 2. External and internal interventions overview

3.3.1. Effectiveness

The effectiveness of the external interventions on reducing the risk factors of depression and anxiety are scored on the aspects of amount of greenery, usability, accessibility, stimulation of physical activity and social activity (figure 3), with a scoring of 1 (low) – 5 (high). The amount of greenery is of less importance than the usability and accessibility of the greenery, therefore the scoring of this category is halved. The stimulation of physical and social activity is described in literature as being of high importance to the benefits of greenery on mental health. Therefore, the scoring of these are doubled. A detailed overview of this scoring system can be consulted in the Appendix (A1).
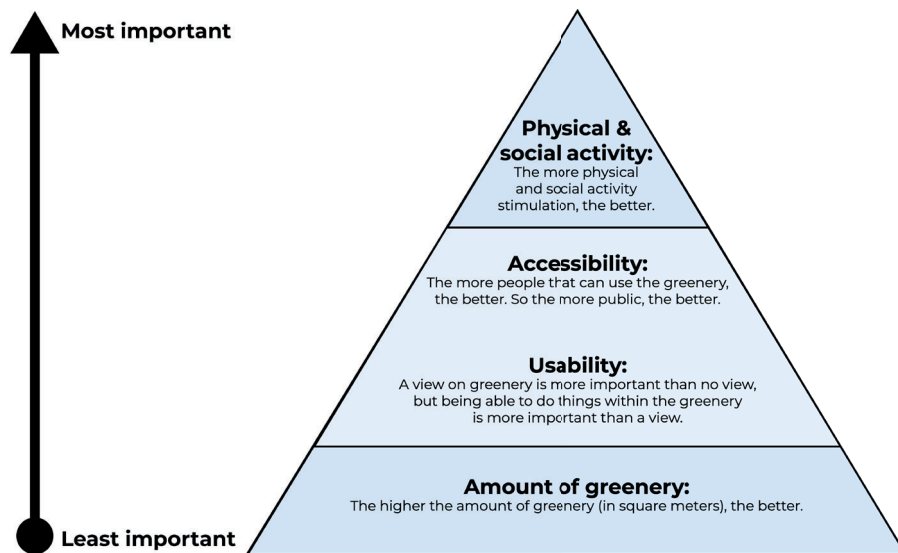
Figure 3. Explanation effectiveness categories

The higher the combined score of these categories, the more effective an average intervention is (Appendix A2). Seen in figure 4 is that different options for type of interventions has scored. As an illustration an extensive green roof scores the lowest, because the roof is only visual at times, is not accessible, and does not stimulate physical or social activity. A park with SAF scores high, because of the amount of greenery, accessibility, usability, and social activity stimulation. However, it only stimulates little physical activity, such as by walking through the park. A park with PAF does not score much lower on the stimulation of social activity, because PAF often stimulates social activity as well, such as by being able to exercise together. However, it scores higher on physical activity stimulation, and therefore higher on effectiveness than a park with SAF.
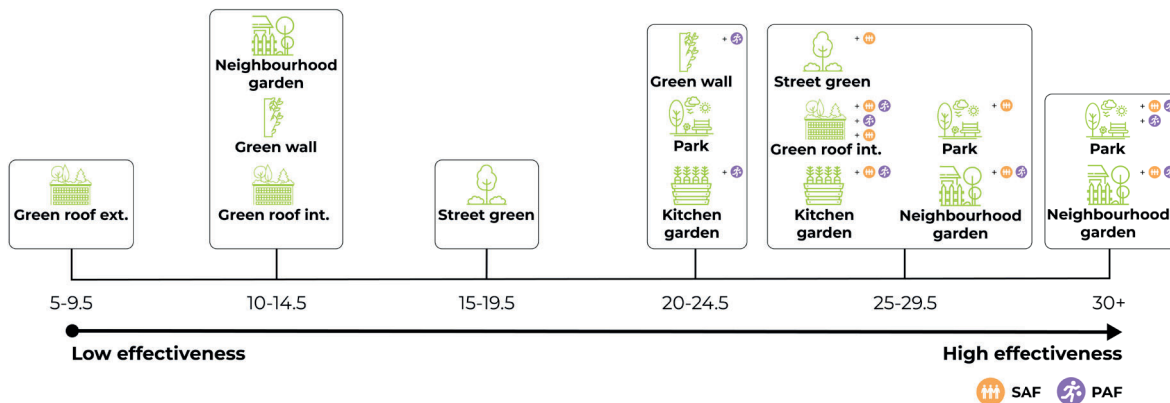
Figure 4. Effectiveness scoring external interventions

3.3.2. Cost

The cost of an average intervention is scored by looking at the average square meters and cost per square meters of the intervention (Appendix B1). The higher the score, the less affordable an average intervention is (figure 5).
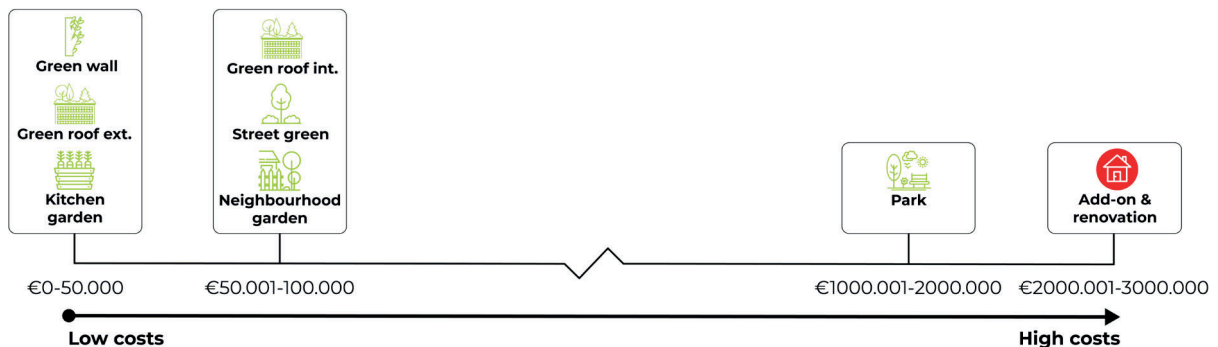
Figure 5. Costs external and internal interventions

3.3.3. Implementation time and type of care

The implementation time of an average intervention is scored on the possibility of adding it within one year, short term, or within five years, long term (figure 6, Appendix C1). Furthermore, the interventions are scored on the type of care they can provide (figure 6, Appendix C2). Interventions that can facilitate TF, provide active and or passive care. Interventions that cannot facilitate TF provide exclusively passive care.
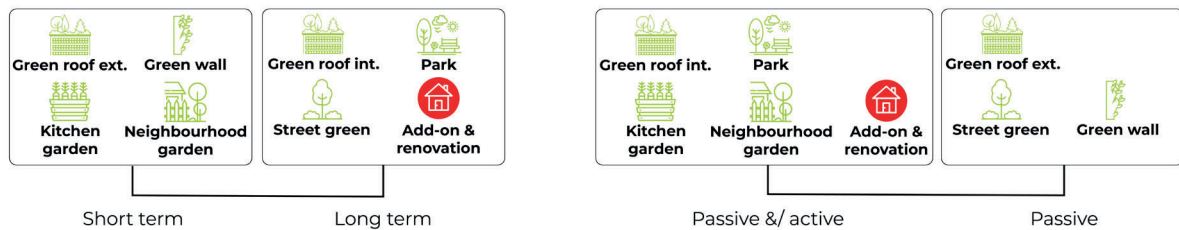
Figure 6. Implementation time and type of care of external and internal interventions

For people with depression and or anxiety the facilitation of active care is more important than passive care, to be able to treat their mental health problems (figure 7). For people without a mental illness but with the risk of depression and or anxiety preventative care is more important (figure 8), to reduce the risk of getting mental health illnesses and improve mental wellbeing.
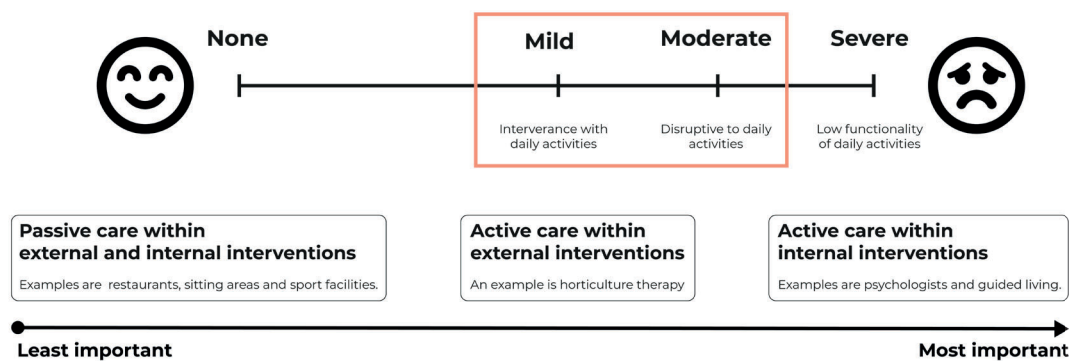
Figure 7. Hierarchy interventions for people with mild or moderate depression and or anxiety
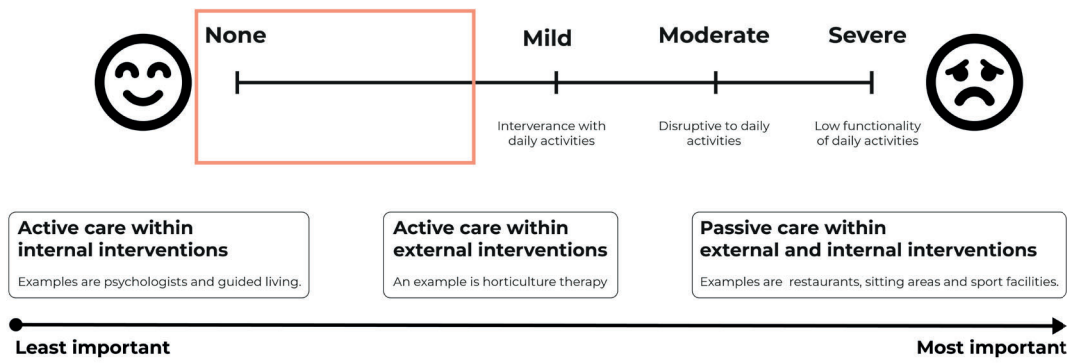
Figure 8. Hierarchy interventions for people with the risk of depression and or anxiety

VI. PHASE TWO

4.1. Urban planning

4.1.1. Existing neighbourhood Boerhaavewijk

Seen in figure 9 is the existing urban plan of Boerhaavewijk. The green spaces are mostly only visual, and the neighbourhood is lacking accessible and qualitative SAF and PAF. For example, the allotments are privately owned, meeting functions are limited to certain target groups and most playgrounds only have a low amount of equipment. On effectiveness the neighbourhood scored 50% (Appendix D1). The amount of PAF is 168 thousand m2, the amount of SAF is 24,7 thousand m2 and the amount of therapy functions is 1,5 thousand m2 (Appendix D2).

Figure 9. Existing urban plan of Boerhaavewijk.

4.1.2. Short term and long term urban plan

Seen in figures 10 and 11 are the short term and long term urban plan for Boerhaavewijk. For these urban plans a balance of different interventions has been chosen, with the goal to improve the neighbourhood on mental health by factors such as more qualitative greenery and buildings, improved accessibility and usability, and diverse facilitation of SAF, PAF and TF.

4.1.3. Short term urban plan

Within the short term urban plan (figure 10) the low cost external interventions green walls, extensive green roofs, kitchen gardens and neighbourhood gardens have been implemented. Green walls are added to large, closed surfaces directed to streets, to improve walkability and safety. Inaccessible extensive green roofs have been added on buildings that are not suitable for accessible green roofs, to improve factors such as the UHI effect. Even though these two interventions score low on effectiveness, they are important because of the reasons mentioned. Collective kitchen gardens with SAF, PAF and TF that score high on effectiveness have been added to closed parts of streets to improve social cohesion and safety by having more eyes on the street. The relatively big existing neighbourhood gardens are improved on effectiveness by making them facilitate a balance of SAF, PAF and TF. For all interventions is chosen to spread them throughout the neighbourhood to improve the connection of interventions and to provide the impact of accessibility, usability, amount of greenery and social and physical activity stimulation throughout the whole neighbourhood. With this the short term urban plan scored 56% on effectiveness (Appendix E1). The amount of PAF is 179,6 thousand m2, the amount of SAF is 26,3 thousand m2 and the amount of TF is 2,2 thousand m2 (Appendix E2). The costs of the short term plan are 10.535.124 euro (Appendix J and K).

Figure 10. Short term urban plan of Boerhaavewijk.

4.1.3. Long term urban plan

Within the long term urban plan (figure 11) the external interventions street green and intensive green roofs of low costs and parks of high costs have been implemented. Of the internal interventions the high-cost renovation and add-ons are used. The street green is used to connect the green spaces and improve the walkability of the neighbourhood. Within the street green, SAF such as benches, are added to score higher on effectiveness. Parks with SAF and PAF have been implemented to add quality to an existing park and to create a centre of the neighbourhood. Even though this intervention scores the highest on effectiveness, limited space has been dedicated to it throughout the neighbourhood, to balance calmer and busier areas. The renovation and add-ons are used to improve the quality of the post-war flats and to create more space for SAF, TF and LF. Accessible intensive green roofs have been added to these flats with SAF and PAF, which adds additional accessible greenery of high effectiveness within the neighbourhood. With this the long term urban plan scored 68% on effectiveness (Appendix F1). The amount of PAF is 197,4 thousand m2, the amount of SAF is 55,7 thousand m2 and the amount of TF is 5,2 thousand m2. (Appendix F2). The costs of the external interventions are 21.877.396 euro. For the internal area interventions, the costs are 55.914.984 euro for the renovation of 80,8 thousand m2 post-war flats, and 52.072.400 euro for the adding 35,9 thousand m2 on top of the post-war flats (Appendix J and K).
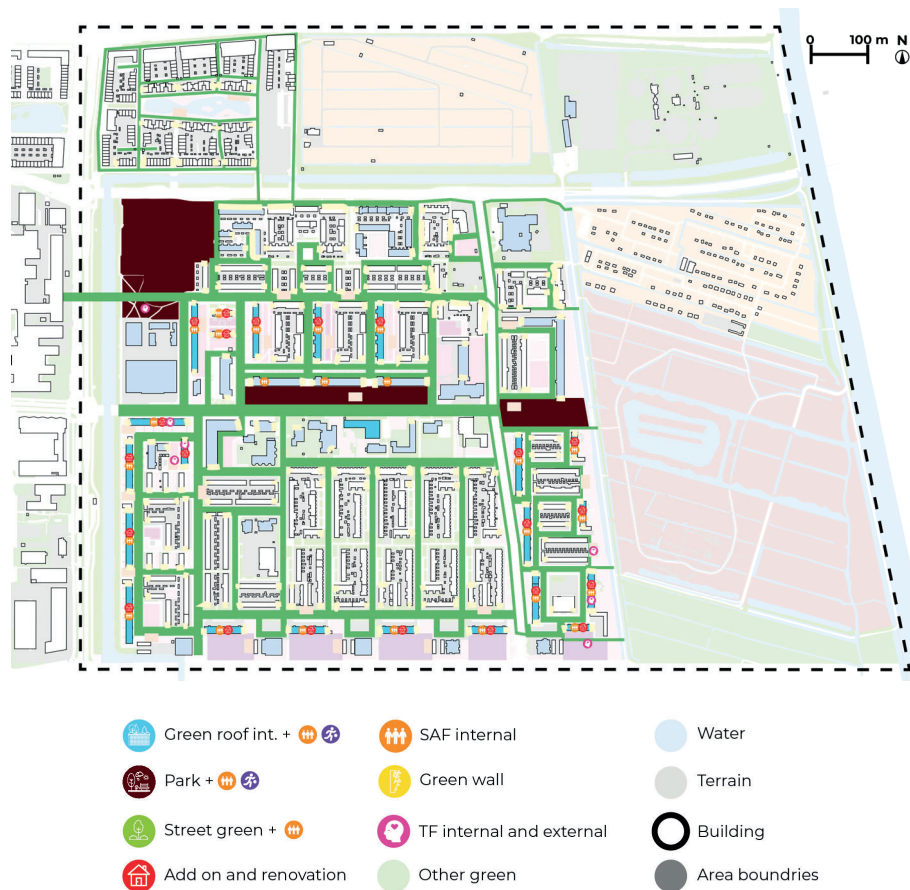
Figure 11. Long term urban plan of Boerhaavewijk

4.2.3. Maxed out urban plan

A maxed out urban plan can be seen in figure 12. Within this urban plan the highest scoring interventions on all possible locations have been added, to investigate what this would imply for its scoring. On effectiveness the maxed out urban plan scored 100% (Appendix G1). The amount of PAF is 204,9 thousand m2, the amount of SAF is 228,9 thousand m2 and the amount of TF is 18,6 thousand m2. (Appendix O3). The costs of the external interventions are 118.553.246 euro. For the internal

interventions the costs are 55.914.984 euro for the renovation of 80,8 thousand m2 post-war flats, and 52.072.400 euro for the adding 35,9 thousand m2 on top of the post-war flats (Appendix J and K).

Figure 12. Maxed out urban plan.

4.2.4. Comparison urban plans

In the urban plans the short term urban plan did not rank significantly better on effectiveness than the existing neighbourhood. The long term urban plan scored 18 percent higher, but also higher on costs. However, both urban plans score high on costs. Significant improvement in the amount of TF is seen for the short term urban plan, but not for SAF. For the long term urban plan this is significantly improved. Both the short term and long term urban plan do not show a significant improvement in the amount of PAF, which can be explained by the high amount of kitchen gardens within the existing neighbourhood. The long term urban plan shows most improvement compared to the existing neighbourhood, such as better connected greenery, more diverse functions that are available for a bigger variety of target groups. The maxed out urban plan shows an effectiveness of 100% and higher amounts of functions. However, this comes with extremely high costs and does not take into consideration factors such as the location and needs of its users.

4.3. Surveys

4.3.1. Outcomes survey

The survey and its scoring of the existing and long term urban plan by the residents and people from a therapy facility is shown in the Appendix (H). There is improvement seen between the scoring of the existing and long term urban plan for the residents, however this difference is more significant for the people receiving treatment (figure 13 & 14). In the next paragraphs these results are illustrated.
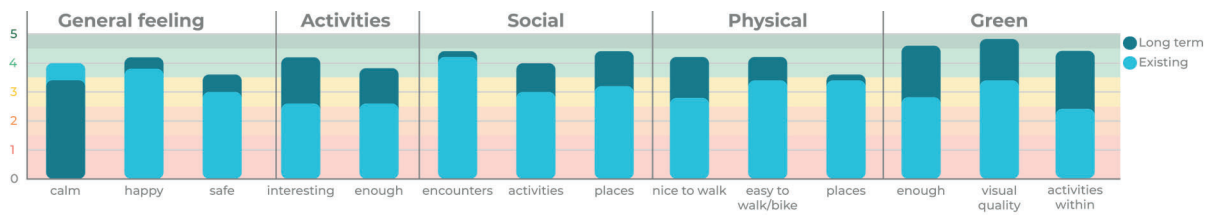
Figure 13. Results survey residents
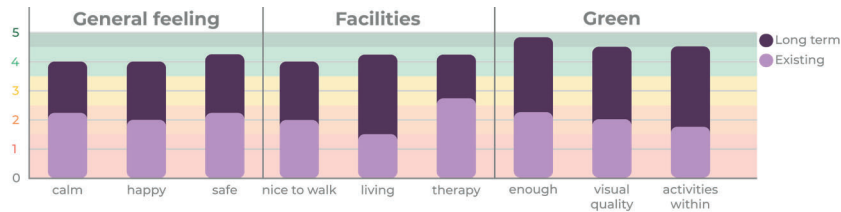
Figure 14. Results survey treatment facility

4.3.2. Residents

To be concluded from the surveys is that the residents their general feeling in the existing neighbourhood is good. Mentioned is that it is a quiet living area with good connections with the neighbours. However, because of criminality and lacking safety measures such as lighting, safety needs attention. When looking at the specifics, there are many things the residents are unhappy about, like bad connections for cyclists and pedestrians, bad state of dwellings, and lacking social cohesion. In the long term urban plan, the residents think that the neighbourhood would be safer, better looking, and they would feel happier there because of factors such as the facilitation of more functions. However, the balance between calm and busy parts is important. Even though there are some activities to do in the neighbourhood, such as groceries, walking in the forest and the community centre, in general residents feel there is not enough to do. There is need for more meeting places such as a café, little stores, seating, functions for different cultural target groups, more accessibility in the community centre for all ages and cultures, and more qualitative play facilities. This is seen in social aspects, where overall social cohesion is lacking within the neighbourhood. Within the long term urban plan, the residents feel that this has improved in factors such as more quality for walking, more play facilities, and better meeting facilities. However, the activities are not always according to individual needs. The residents feel there is less need for improving physical activities within the existing neighbourhood, compared to social activities. In the long term urban plan walkability is better according to the residents, but more focus on biking facilities could be needed. The residents are unhappy with the existing greenery, except for the park, tall trees, and some playing facilities for kids. The amount of greenery is decreasing because of new buildings, and the remaining greenery lacks quality, seating and functions for all ages. In the long term urban plan this is perceived better, because of the amount, diversity, quality, walking areas and functions of the greenery. However, some residents were questioning if green roofs would work.

4.3.3. Treatment facility

The general feeling of people from the treatment facility about the existing neighbourhood is not good because the environment feels boring, impersonal, not of quality, and unsafe. In the long term urban plan, the environment is perceived more esthetical pleasing and safer. Furthermore, the greenery makes them feel happier in the neighbourhood. For the existing greenery, people receiving treatment think it feels calm, but there should be more and better quality greenery, such as flowers and bushes and more functions within, such as sport and play. In the long term plan this is perceived better, especially the free sporting facilities in greenery is mentioned being of high importance. In the existing neighbourhood, because of the things mentioned, the people receiving treatment do not feel invited to walk, live or receive treatment. In the long term urban plan however, they would want to do all of these because of the improvements.

V. CONCLUSION

There are various strategies to decrease depression/anxiety levels and -risks in the urban context of Boerhaavewijk with the facilitation of urban green infrastructures and the facilitation of passive and active care. Firstly, internal and external interventions should be implemented within the neighbourhood that tackle existing problems and have a combined high scoring on effectiveness, and amount of physical active functions (PAF), social active functions (SAF), and therapy functions (TF). Secondly, a balance between passive and active interventions is needed, to make the urban plan efficient for both people with the risk of and people with depression and or anxiety. However, there are other important factors to consider, namely a reflection of the users on the found strategies, how to work with a budget and the importance of design. This has been considered in the discussion.

VI. DISCUSSION

5.1. Users

Because there are limits to the scoring system of this research and individual needs differ from literature conclusions, the reflection of users is important to make a good urban plan. In this research this has been done through a survey with residents and people from a therapy facility. The outcomes of the survey are in accordance with the findings of the research, however there are some points of attention, such as that the biking connections should be improved. It is important to take the user feedback into account and make changes to the urban plans accordingly where possible.

5.2. Budget

If given a budget, more attention must go to the costs of the urban plan, especially to make it achievable in a low income neighbourhood. To reduce the costs, the effectiveness and cost scoring of the interventions can be consulted to find interventions that score high on effectiveness while being of low costs and with this making a list of priorities. This should be done together with decreasing the number of interventions while still achieving a high effectiveness score and amount of functions, and using the feedback of the users to make decisions in what is most important.

5.3. Design

Even though some interventions score higher than others, a balance between the different interventions are needed for a good design. Only using the highest scoring interventions on effectiveness does not take into consideration factors such as the location, the needs of people and a balanced neighbourhood. There is most likely a tipping point of the scoring system where a higher effectiveness and amount of functions does not show improvement, which is seen in the maxed out urban plan. With the scoring system should be considered that design and preferences are of high importance and therefore be used as guidelines for a design, but not as the absolute truth. It is important that an architect and planner are consulted to make a logistic, balanced, and well-designed urban plan.

5.4. Future research

This research shows the start of a strategy to improve mental health within urban neighbourhoods. Even though the specific context of Boerhaavewijk is used, the interventions and scoring system are also applicable for other contexts. To extend on the strategies found in this research, future research is needed to extend on these, for example by collecting more data with the guidance of specialists and by making the scoring system parametric to make it easier to analyse different urban plans and getting more specific information on the importance of different aspects.

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APPENDIX A – SCORING EFFECTIVENESS

Table A1. External interventions effectiveness scoring system.

f	Aspects	1 * f	2 * f	3*f	4*f	5*f
0,5	Amount of greenery (m2)	0-500	501-1000	1001-1500	1501-2000	2001+
1	Usability	None	Little visual	Visual	Usable	Very usable
1	Accessibility	None	Private	Collective	Semi-public	Public
2	Physical activity stimulation	None	At times	Little	Average	A lot
2	Social activity stimulation	None	At times	Little	Average	A lot

Table A2. External interventions effectiveness score

Intervention	Amount of greenery	Usability	Accessibility	Physical activity stimulation	Social activity stimulation	**Effectiveness**
Park + SAF + PAF	2.5	5	5	10	10	32.5
Park + PAF	2.5	5	5	10	8	30.5
Neighbourhood garden + SAF + PAF	1.5	5	4	10	10	30.5
Intensive green roof + SAF + PAF	1	5	3	10	10	29
Neighbourhood garden + PAF	1.5	5	4	10	8	28.5
Park + SAF	2.5	5	5	6	10	28.5
Kitchen garden collective	0.5	5	3	10	10	28.5
Street green + SAF	2	5	5	6	10	28
Intensive green roof + PAF	1	5	3	10	8	27
Neighbourhood garden + SAF	1.5	5	4	6	10	26.5
Intensive green roof + SAF	1	5	3	6	10	25
Green wall + PAF	0.5	5	3	8	8	24.5
Kitchen garden private	0.5	5	2	10	4	21.5
Park basic	2.5	4	5	4	6	21.5
Street green basic	2	4	5	4	4	19
Green wall basic	0.5	3	5	2	4	14.5
Neighbourhood garden basic	1.5	3	4	2	4	14.5
Intensive green roof basic	1	3	3	2	4	13
Extensive green roof	1	2	1	2	2	8

APPENDIX B – SCORING COST

Table B1. External and internal interventions cost score. See Appendix I

Intervention	€/m2	Average m2	Cost (€)
Kitchen garden	35	200	7.000
Extensive green roof	30	762	22.860
Green wall	400	113	45.200
Neighbourhood garden	60	1523	91.380
Intensive green roof	120	762	91.440
Street green	38	2500	95.000
Park	132	10.000	1.320.000
Add on	1450	1.796	2.604.200
Renovation	692	4.040	2.795.680

APPENDIX C– SCORING IMPLEMENTATION TIME AND THERAPY CHARACTER

Table C1. External and internal interventions implementation time score. See appendix I

Intervention	Time
Kitchen garden	Short term
Extensive green roof	Short term
Green wall	Short term
Neighbourhood garden	Short term
Intensive green roof	Long term
Street green	Long term
Park	Long term
Renovation	Long term
Add on	Long term

Table C2. External and internal interventions therapy score

Intervention	Therapy
Kitchen garden	Yes
Neighbourhood garden	Yes
Intensive green roof	Yes
Park	Yes
Renovation	Yes
Add on	Yes
Extensive green roof	No
Street green	No
Green wall	No

APPENDIX D – EXISTING URBAN PLAN SCORING
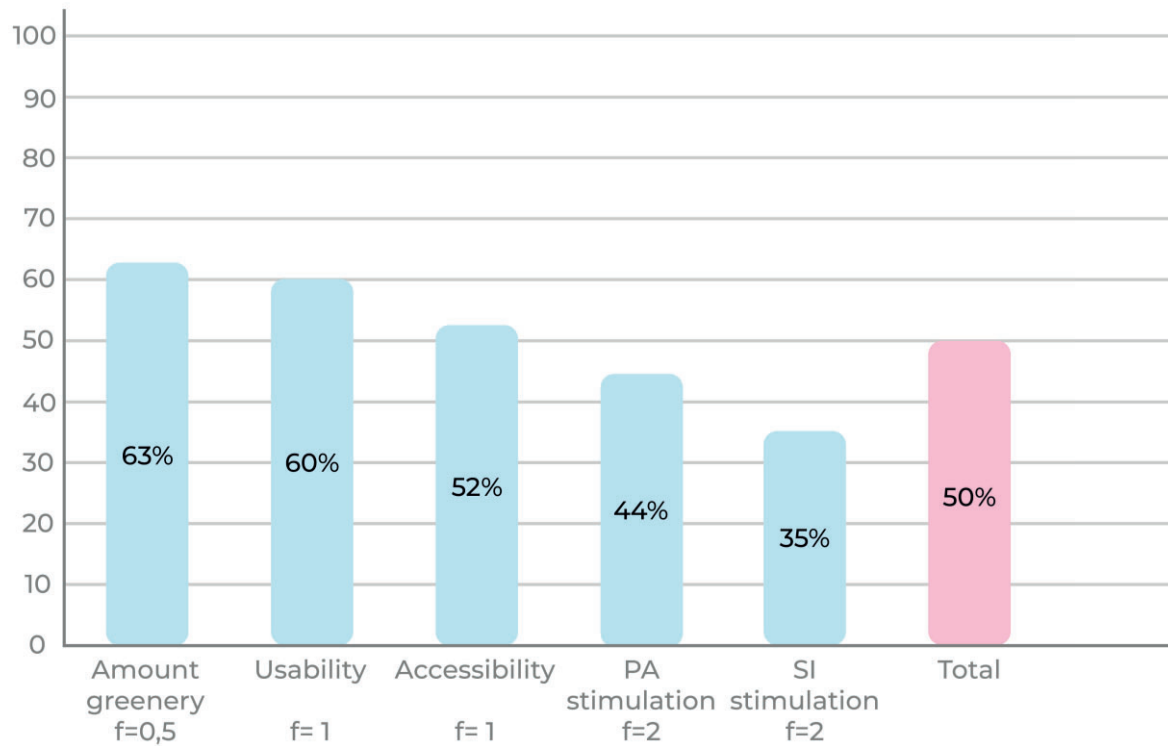
Figure D1. Effectiveness score existing urban plan of Boerhaavewijk. See appendix J and K
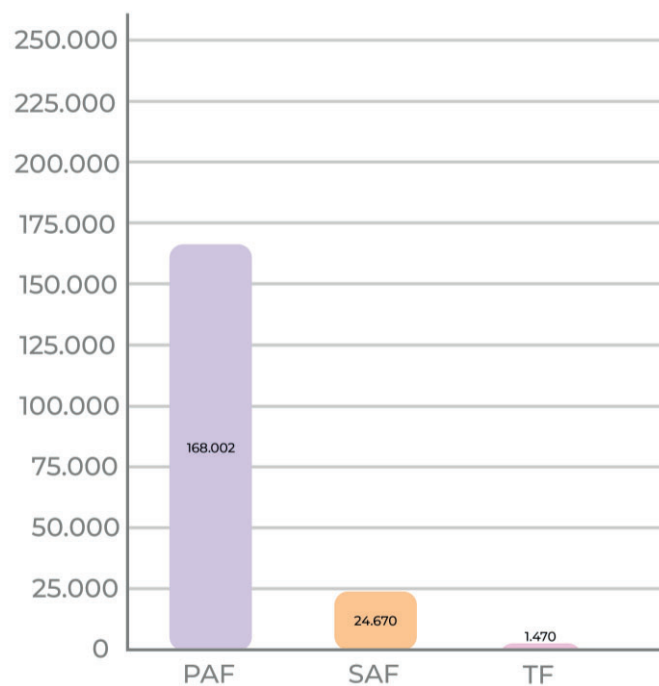
Figure D2. Functions amounts existing urban plan of Boerhaavewijk. See appendix J and K

APPENDIX E – SHORT TERM URBAN PLAN AND SCORING
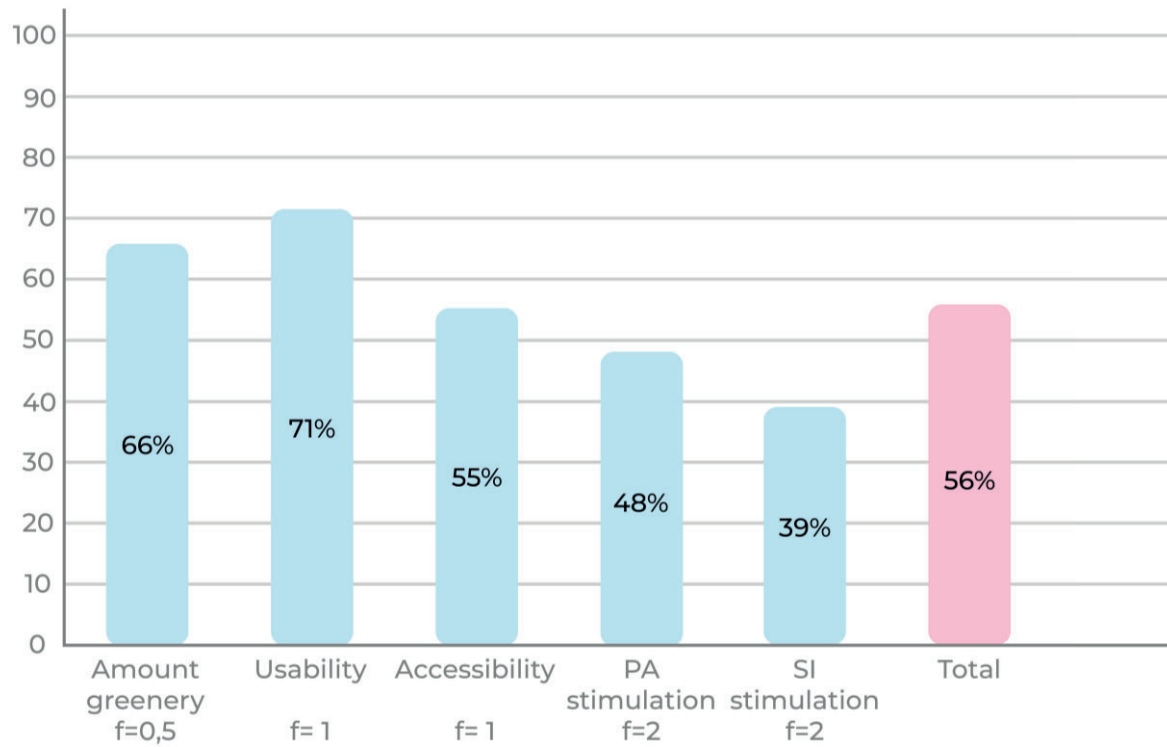
Figure E1. Effectiveness score short term urban plan of Boerhaavewijk. See appendix J and K
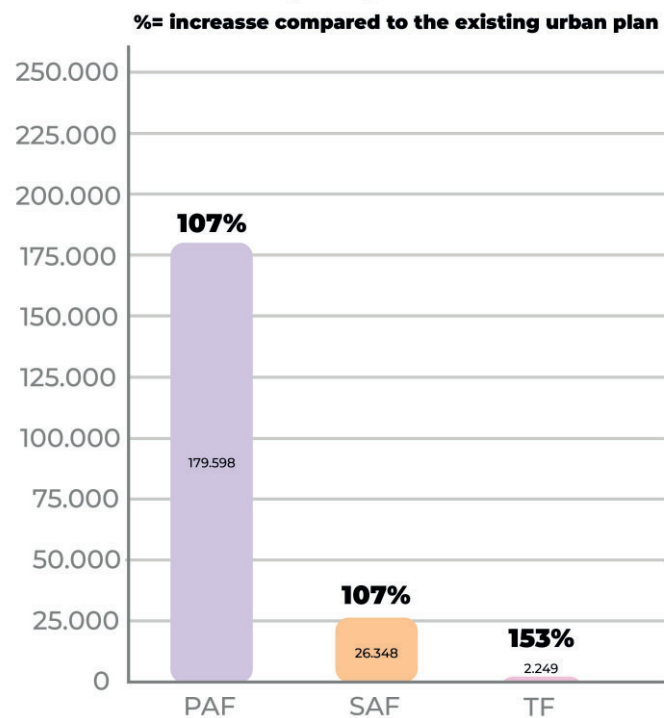
Figure E2. Function amounts score short term urban plan of Boerhaavewijk. See appendix J and K
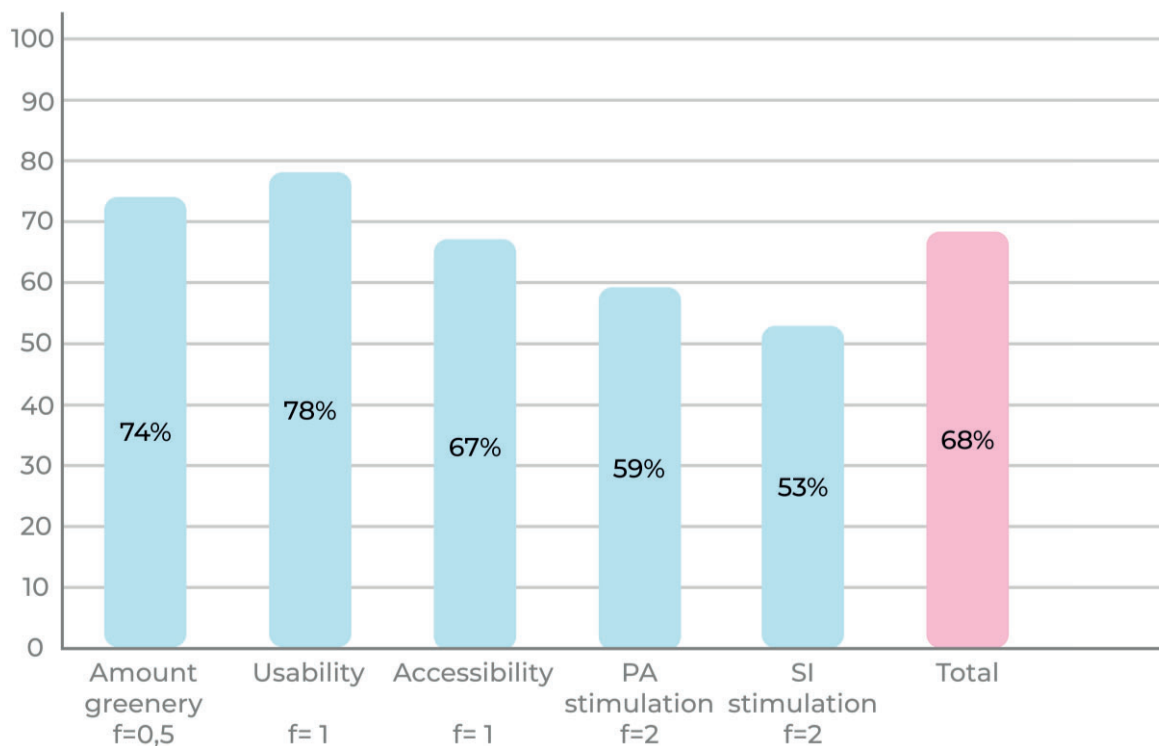
Figure F1. Effectiveness score long term urban plan of Boerhaavewijk. See appendix J and K
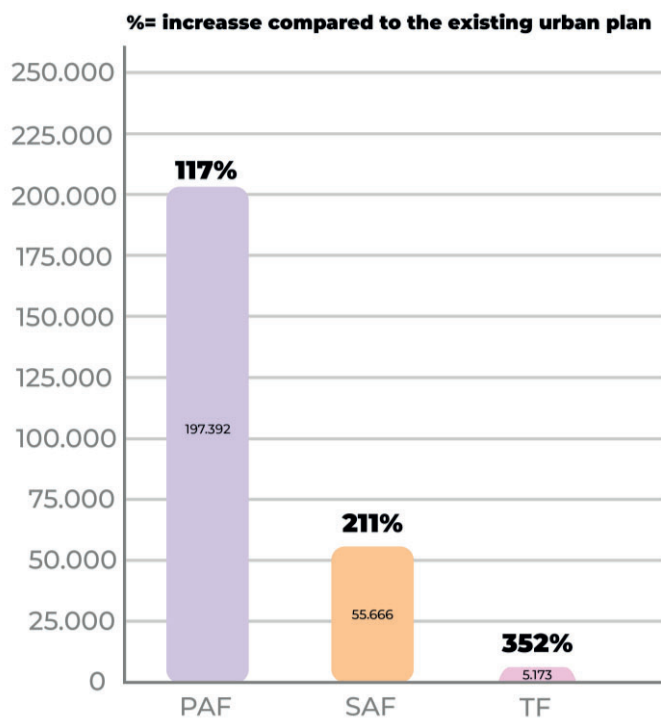
Figure F1. Function amounts score long term urban plan of Boerhaavewijk. See appendix J and K
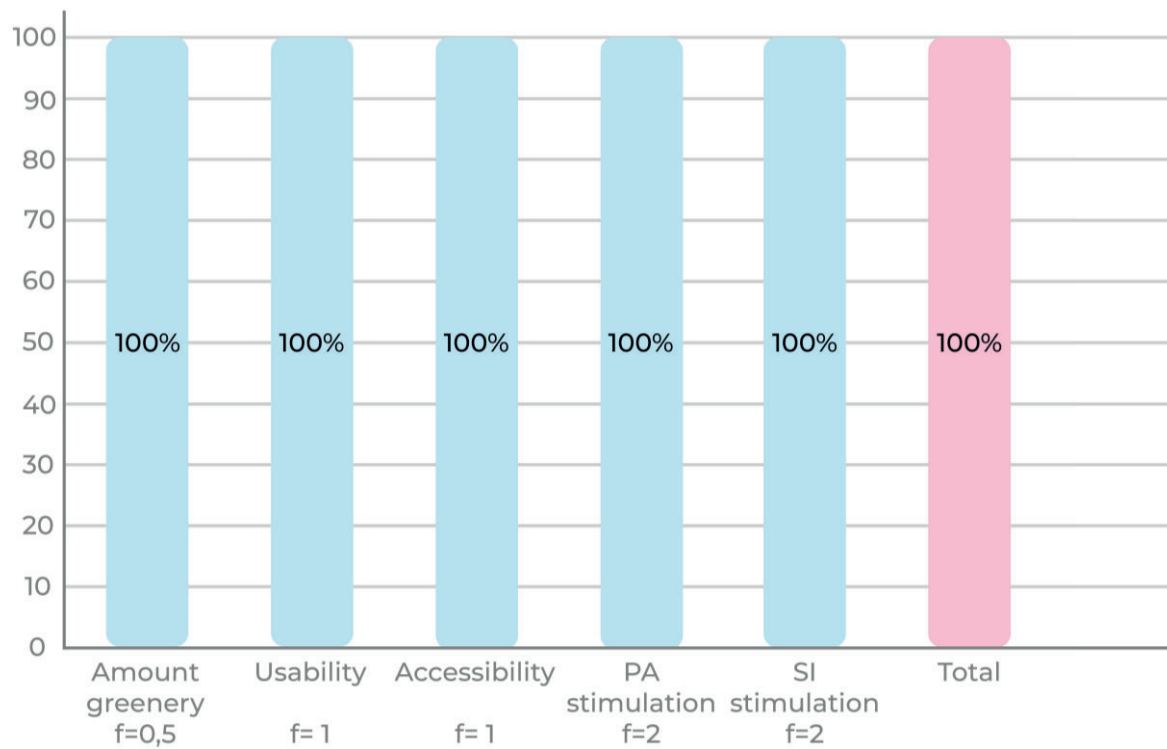
Figure G1. Effectivenss score maxed out urban plan of Boerhaavewijk. See appendix J and K
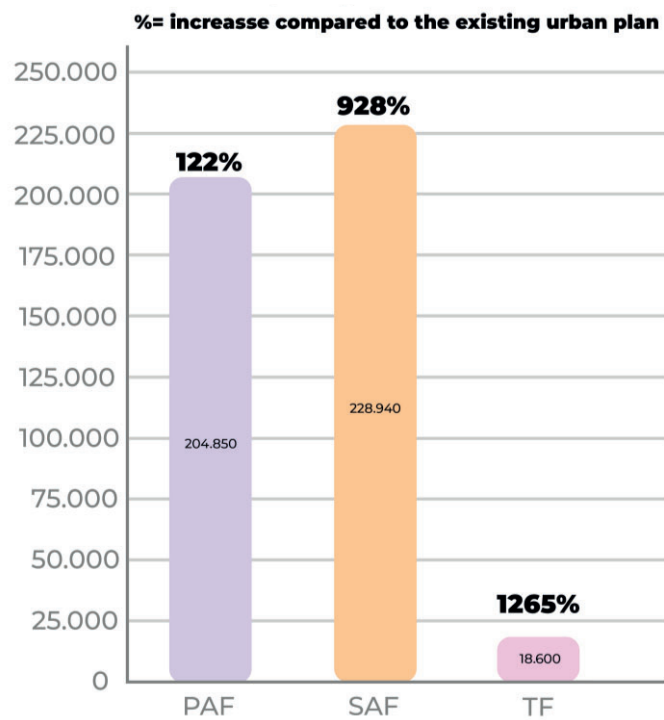
Figure G2. Functions amounts score maxed out urban plan of Boerhaavewijk. See appendix J and K

APPENDIX H – SURVEY OUTCOMES

Table H1. Survey Residents

Question	Never	Almost never	Some-times	A lot	Always
I can do things that I find interesting in my neighbourhood.	1	2	3	4	5
I feel at peace in my neighbourhood.	1	2	3	4	5
I feel happy in my neighbourhood.	1	2	3	4	5
I meet people in my neighbourhood.	1	2	3	4	5
I do enough things with others in my neighbourhood.	1	2	3	4	5
Question	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I like walking through my neighbourhood.	1	2	3	4	5
I can easily walk/bike through my neighbourhood.	1	2	3	4	5
There are enough places in my neighbourhood to exercise/be active.	1	2	3	4	5
There are enough places to be together with people in my neighbourhood.	1	2	3	4	5
There are enough things to do in my neighbourhood.	1	2	3	4	5
There is enough green in my neighbourhood.	1	2	3	4	5
It is nice to look at the green in my neighbourhood.	1	2	3	4	5
There is enough to do within the green in my neighbourhood.	1	2	3	4	5
I feel safe in my neighbourhood.	1	2	3	4	5

Table H2. Survey therapy facility

Questions	Never	Almost never	Some-times	A lot	Always
I feel at peace in this living environment.	1	2	3	4	5
I feel happy in this living environment.	1	2	3	4	5
Question	**Strongly disagree**	**Disagree**	**Neutral**	**Agree**	**Strongly agree**
I like walking through this neighbourhood.	1	2	3	4	5
There is enough green in this neighbourhood.	1	2	3	4	5
It is nice to look at the green in this neighbourhood.	1	2	3	4	5
There is enough to do within the green in this neighbourhood.	1	2	3	4	5
I feel safe in this neighbourhood.	1	2	3	4	5
I would like to live in this neighbourhood.	1	2	3	4	5
I would like to have therapy facilities in this neighbourhood.	1	2	3	4	5

Table H3. Results survey individual answers

Residents existing neighbourhood	1	2	3	4	5	total answers
I can do things that I find interesting in my neighbourhood.	1	1	2	1		5
I feel at peace in my neighbourhood.		1		2	2	5
I feel happy in my neighbourhood.			2	2	1	5
I meet people in my neighbourhood.				4	1	5
I do enough things with others in my neighbourhood.	1		2	2		5
I like walking through my neighbourhood.		2	2	1		5
I can easily walk/bike through my neighbourhood.		1	1	3		5
There are enough places in my neighbourhood to exercise/be active.		1	1	3		5
There are enough places to be together with people in my neighbourhood.		1	2	2		5
There are enough things to do in my neighbourhood.		2	3			5
There is enough green in my neighbourhood.		3	1		1	5
It is nice to look at the green in my neighbourhood.		2		2	1	5
There is enough to do within the green in my neighbourhood.		3	2			5
I feel safe in my neighbourhood.	1	1		3		5

Residents long term urban plan	1	2	3	4	5	total answers
I can do things that I find interesting in my neighbourhood.				4	1	5
I feel at peace in my neighbourhood.		2		2	1	5
I feel happy in my neighbourhood.			1	2	2	5
I meet people in my neighbourhood.				3	2	5
I do enough things with others in my neighbourhood.			1	3	1	5
I like walking through my neighbourhood.			2		3	5
I can easily walk/bike through my neighbourhood.				4	1	5
There are enough places in my neighbourhood to exercise/be active.			3	1	1	5
There are enough places to be together with people in my neighbourhood.				4	1	5
There are enough things to do in my neighbourhood.			2	2	1	5
There is enough green in my neighbourhood.				2	3	5
It is nice to look at the green in my neighbourhood.				1	4	5
There is enough to do within the green in my neighbourhood.			1	1	3	5
I feel safe in my neighbourhood.		1	1	2	1	5

Treatment facility existing neighbourhood	1	2	3	4	5	total answers
I feel at peace in this living environment.		3	1			4
I feel happy in this living environment.	1	2	1			4
I like walking through this neighbourhood.		4				4
There is enough green in this neighbourhood.		3	1			4
It is nice to look at the green in this neighbourhood.		4				4
There is enough to do within the green in this neighbourhood.	1	3				4
I feel safe in this neighbourhood.		3	1			4
I would like to live in this neighbourhood.	2	2				4
I would like to have therapy facilities in this neighbourhood.	1	1	1		1	4

Treatment facility long term urban plan	1	2	3	4	5	total answers
I feel at peace in this living environment.				4		4
I feel happy in this living environment.				4		4
I like walking through this neighbourhood.				4		4
There is enough green in this neighbourhood.				1	3	4
It is nice to look at the green in this neighbourhood.				2	2	4
There is enough to do within the green in this neighbourhood.				2	2	4
I feel safe in this neighbourhood.				3	1	4
I would like to live in this neighbourhood.				3	1	4
I would like to have therapy facilities in this neighbourhood.				3	1	4

APPENDIX I – SCORING INPUT

Table I1. Interventions information used in scoring

Intervention	Average m2	Average cost /m2	Implementation	Amount green
Park	**10.000** (Roo et al., 2011)	**132 euro** (Brolsma, 2020; Huysentruyt, 2021; Openbaargroen, 2019)	**Years** (Nillumbik, n.d.; Nillumbik Shire Council, n.d.)	70%
Neighbourhood garden	**1.523**	**60 euro** (Tuinaanleg Prijzen, n.d.)	**2-6 weeks** (De Groot Hoveniers, n.d.)	70% (Deloitte Netherlands, 2019; Milieu Centraal, n.d-b.)
Kitchen garden	**200** (Geers, 2022)	**35 euro** (veronica.regly, 2021; vtwonen, 2022)	**Days** (Kluiter, 2021)	100%
Street green	**2.500**	**38 euro** (Nest Natuurinclusief, n.d.)	**Years**	70%
Green roof int.	**762**	**120 euro** (Milieu Centraal, n.d.-a)	**Weeks** (De Groot Hoveniers, n.d ; Organic Roofs, n.d.)	70% (De Dakdokters, n.d.)
Green roof ext.	**762**	**30 euro** (Milieu Centraal, n.d.-a)	**Weeks** (Organic Roofs, n.d.)	100%
Green wall	**113**	**400 euro** (Gevelbekleding-info.nl, 2017)	**6-8 Weeks** (4Nature System, n.d.)	100%
Renovation	**4.040**	**692 euro** (Milieu Centraal, n.d.-a)	**Years**	-
Add-on	**1.796**	**1.450 euro** (Bergh Bouwsystemen, n.d.)	**Years**	-

Average m2 is taken from references and looking at the available m2 in the neighbourhood.
Average cost is taken from references.
Implementation time is taken from references or estimated.
Amount of green is the average choice for this project and/or taken from references. The percentage is the percentage of the intervention.

APPENDIX J – SCORING INTERVENTIONS OF URBAN PLANS

See next page.

Existing Neighbourhood

Area	Category	Intervention	Type	intervention m2	amount of greenery m2	amount of greenery %	Usability factor	Usability score	Accessibility factor	Accessibility score	PA factor	PA score	SI factor	SI score	Cost euro	Total cost euro	TF m2	TF % intervention	PAF m2	PAF % intervention	SAF m2	SAF % intervention	Diet m2 (part of PAF)	Diet % intervention
Outside area	Roads	Street green	Street green	11182,5	7827,8	70,0	4,0	44730,0	5,0	55912,5	2,0	22365,0	2,0	22365,0										
	Flat roofs	Green roof																						
	Facades	Green wall																						
	Ground green spaces	Park	Park	6016,0	5414,4	90,0	4,0	24064,0	5,0	30080,0	2,0	12032,0	3,0	18048,0										
			Park	247143,0	157549,0	63,7	4,0	988572,0	5,0	1235715,0	2,0	494286,0	3,0	741429,0										
		Kitchen garden	Kitchen garden private	81069,0	57540,0	71,0	5,0	405345,0	2,0	162138,0	5,0	405345,0	2,0	162138,0							57540,0		57540,0	
			Kitchen garden private	131569,0	93383,0	71,0	5,0	657845,0	2,0	263138,0	5,0	657845,0	2,0	263138,0							93383,0		93383,0	
		Neighbourhood garden	Neighbourhood garden + PAF	21110,0	20048,6	95,0	5,0	105550,0	4,0	84440,0	5,0	105550,0	4,0	84440,0							1061,4			
			Neighbourhood garden	85321,0	85321,0	100,0	3,0	255963,0	4,0	341284,0	1,0	85321,0	2,0	170642,0										
		Other	Other	161760,0	161760,0	100,0	2,0	323520,0	1,0	161760,0	1,0	161760,0	1,0	161760,0										
		Total sum			733988,0	581016,0			2760859,0		2278555,0		1922139,0		1601595,0										
		Total score (score / intervention m2)						3,8		3,1		2,6		2,2										
Outisde/inside area	Terrain			15902,0														1288,0		14614,0					
Inside area	Buildings			26256,0														182,0		1404,0		24670,0			
		Total sum		42158,0																					
		Total m2																1470,0		168002,4		24670,0		150923,0	

Urban Plan Long Term

Area	Category	Intervention	Type	intervention m2	amount of greenery m2	amount of greenery %	Usability factor	Usability score	Accessibility factor	Accessibility score	PA factor	PA score	SI factor	SI score	Cost euro	Total cost euro	TF m2	TF % intervention	PAF m2	PAF % intervention	SAF m2	SAF % intervention	Diet m2 (part of PAF)	Diet % intervention
Outside area	Roads	Street green	Street green + SAF	83868,8	58708,1	70,0	5,0	419343,8	5,0	419343,8	3,0	251606,3	5,0	419343,8	38,0	3187012,5					8386,9	10,0		
	Flat roofs	Green roof	Green roof ext.	38853,0	38853,0	100,0	2,0	77706,0	1,0	38853,0	1,0	38853,0	1,0	38853,0	30,0	1165590,0								
			Green roof int. + PAF + SAF	19137,0	13395,9	70,0	5,0	95685,0	3,0	57411,0	5,0	95685,0	5,0	95685,0	120,0	2296440,0	956,9	5,0	6698,0	35,0	4784,3	25,0	1913,7	10
		Total sum		57990,0	52248,9			173391,0		96264,0		134538,0		134538,0										
		Total score (score / intervention m2)						3,0		1,7		2,3		2,3										
	Facades	Green wall	Green wall	18591,9	18591,9	100,0	3,0	55775,8	5,0	92959,7	1,0	18591,9	2,0	37183,9	400,0	7436774,0								
	Ground green spaces	Park	Park + SAF + PAF	44385,0	31069,5	70,0	5,0	221925,0	5,0	221925,0	5,0	221925,0	5,0	221925,0	132,0	5858820,0	887,7	2,0	11096,3	25,0	11096,3	25,0		
			Park	247143,0	157549,0	63,7	4,0	988572,0	5,0	1235715,0	2,0	494286,0	3,0	741429,0										
		Kitchen garden	Kitchen garden collective	5600,0	5600,0	100,0	5,0	28000,0	3,0	16800,0	5,0	28000,0	5,0	28000,0	35,0	196000,0	200,0	3,6	5600,0	100,0			5600,0	100
			Kitchen garden private	81069,0	57540,0	71,0	5,0	405345,0	2,0	162138,0	5,0	405345,0	2,0	162138,0							57540,0		57540,0	
			Kitchen garden private	131569,0	93383,0	71,0	5,0	657845,0	2,0	263138,0	5,0	657845,0	2,0	263138,0							93383,0		93383,0	
		Neighbourhood garden	Neighbourhood garden + SAF	14493,0	10145,1	70,0	5,0	72465,0	4,0	57972,0	3,0	43479,0	5,0	72465,0	60,0	869580,0	289,9	2,0	4347,9	30,0				
			Neighbourhood garden + PAF	3468,0	2427,6	70,0	5,0	17340,0	4,0	13872,0	5,0	17340,0	4,0	13872,0	60,0	208080,0	69,4	2,0			1040,4	30,0		
			Neighbourhood garden + PAF + SAF	10985,0	7689,5	70,0	5,0	54925,0	4,0	43940,0	5,0	54925,0	5,0	54925,0	60,0	659100,0	219,7	2,0	1647,8	15,0	1647,8	15,0		
			Neighbourhood garden + PAF	21030,0	19968,6	95,0	5,0	105150,0	4,0	84120,0	5,0	105150,0	4,0	84120,0					1061,4					
			Neighbourhood garden	56455,0	56455,0	100,0	3,0	169365,0	4,0	225820,0	1,0	56455,0	2,0	112910,0										
		Other	Other	117791,0	117791,0	100,0	2,0	235582,0	1,0	117791,0	1,0	117791,0	1,0	117791,0										
		Total sum			733988,0	559618,3			2956514,0		2443231,0		2202541,0		1872713,0									
		Total score (score / intervention m2)						4,0		3,3		3,0		2,6									
		Total sum															21877396,5								
Outisde/inside area	Terrain	Existing		15902,0														1288,0		14614,0					
Inside area	Buildings	Existing		26256,0														182,0		1404,0		24670,0			
		Renovation	Existing flats	80802,0												692,0	55914984,0					4040,1	5,0		
		Add on	2 levels	35912,0												1450,0	52072400,0	1080,0	3,0						
		Total sum		158872,0													107987384,0								
		Total m2															129864780,5	5173,5		197392,3		55665,6		158436,7	

Urban plan Short Term

Area	Category	Intervention	Type	intervention m2	amount of greenery m2	amount of greenery %	Usability factor	Usability score	Accessibility factor	Accessibility score	PA factor	PA score	SI factor	SI score	Cost euro	Total cost euro	TF m2	TF % intervention	PAF m2	PAF % intervention	SAF m2	SAF % intervention	Diet m2 (part of PAF)	Diet % intervention
Outside area	Roads	Street green	Street green	11182,5	7827,8	70,0	4,0	44730,0	5,0	55912,5	2,0	22365,0	2,0	22365,0	-	-								
	Flat roofs	Green roofs	Green roof ext.	38853,0	38853,0	100,0	2,0	77706,0	1,0	38853,0	1,0	38853,0	1,0	38853,0	30,0	1165590,0								
	Facades	Green walls	Green wall	18591,9	18591,9	100,0	3,0	55775,8	5,0	92959,7	1,0	18591,9	2,0	37183,9	400,0	7436774,0								
	Ground green spaces	Park	Park basic	253159,0	157549,0		4,0	1012636,0	5,0	1265795,0	2,0	506318,0	3,0	759477,0										
		Kitchen garden	Kitchen garden collective	5600,0	5600,0	100,0	5,0	28000,0	3,0	16800,0	5,0	28000,0	5,0	28000,0	35,0	196000,0	200,0	3,6	5600,0	100,0			5600,0	100,0
			Kitchen garden private	81069,0	57540,0		5,0	405345,0	2,0	162138,0	5,0	405345,0	2,0	162138,0							57540,0		57540,0	
			Kitchen garden private	131569,0	93383,0		5,0	657845,0	2,0	263138,0	5,0	657845,0	2,0	263138,0							93383,0		93383,0	
		Neighbourhood garden	Neighbourhood garden + SAF	14493,0	10145,1	70,0	5,0	72465,0	4,0	57972,0	3,0	43479,0	5,0	72465,0	60,0	869580,0	289,9	2,0	4347,9	30,0				
			Neighbourhood garden + PAF	3468,0	2427,6	70,0	5,0	17340,0	4,0	13872,0	5,0	17340,0	4,0	13872,0	60,0	208080,0	69,4	2,0				30,0		
			Neighbourhood garden + PAF + SAF	10985,0	7689,5	70,0	5,0	54925,0	4,0	43940,0	5,0	54925,0	5,0	54925,0	60,0	659100,0	219,7	2,0	1647,8	15,0	1647,8	15,0		
			Neighbourhood garden + PAF	21030,0	19968,6		5,0	105150,0	4,0	84120,0	5,0	105150,0	4,0	84120,0					1061,4					
			Neighbourhood garden	56455,0	56455,0		3,0	169365,0	4,0	225820,0	1,0	56455,0	2,0	112910,0										
		Other	Other	167360,0	117791,0		2,0	334720,0	1,0	167360,0	1,0	167360,0	1,0	167360,0										
		Total sum			745188,0	528548,8			2857791,0		2300955,0		2042217,0		1718405,0									
		Total score (score / intervention m2)						3,8		3,1		2,7		2,3									
		Total sum															10535124,0								
Outisde/inside area	Terrain	Existing		15902,0														1288,0		14614,0					
Inside area	Buildings	Existing		26256,0														182,0		1404,0		24670,0			
		Total sum		42158,0																					
		Total m2															10535124,0	2248,9		179598,1		26347,8		156523,0	

Urban plan Maxed Out

Area	Category	Intervention	Type	intervention m2	amount of greenery m2	amount of greenery %	Usability factor	Usability score	Accessibility factor	Accessibility score	PA factor	PA score	SI factor	SI score	Cost euro	Total cost euro	TF m2	TF % intervention	PAF m2	PAF % intervention	SAF m2	SAF % intervention	Diet m2 (part of PAF)	Diet % intervention
Outside area	Roads	Street green	Street green + SAF	111825,0	111825,0	100,0	5,0	559125,0	5,0	559125,0	3,0	335475,0	5,0	559125,0	38,0	4249350,0					11182,5	10,0		
	Flat roofs	Green roof	Green roof int. + PAF + SAF	56809,0	56809,0	100,0	5,0	284045,0	3,0	170427,0	5,0	284045,0	5,0	284045,0	120,0	6817080,0	2840,5	5,0	19883,2	35,0	14202,3	25,0	5680,9	10,0
	Facades	Green wall	Green wall	26501,0	26501,0	100,0	5,0	132505,0	5,0	132505,0	4,0	106004,0	5,0	132505,0	400,0	10600400,0								
	Ground green spaces	Park	Park + PAF + SAF	733988,0	733988,0	100,0	5,0	3669940,0	5,0	3669940,0	5,0	3669940,0	5,0	3669940,0	132,0	96886416,0	14679,8	2,0	183497,0	25,0	183497,0	25,0		
		Total sum															118553246,0								
Outisde/inside area	Other	Terrain	Existing	15902,0														1288,0		14614,0					
Inside area	Buildings	Existing		26256,0														182,0		1404,0		24670,0			
		Renovation	Existing flats	80802,0												692,0	55914984,0					4040,1	5,0		
		Add on	2 levels	35912,0												1450,0	52072400,0	1080,0	3,0						
		Total sum		158872,0													107987384,0								
		Total m2															226540630,0	18600,2		204850,2		228939,9		30350,9	

APPENDIX K – SCORING OF URBAN PLANS

See next page.

Greenery amount

Greenery amount	Possible m2	Factor	Amount greenery possible	Used m2	Factor	Amount greenery existing	Used m2	Factor	Amount greenery Urban plan LT	Used m2	Factor	Amount greenery Urban plan ST
Roads	111825,0	1,0	111825,0	11182,5	0,7	7827,8	83868,8	0,7	58708,1	11182,5	0,7	7827,8
Flat roofs	56809,0	1,0	56809,0	0,0	0,0	0,0	57990,0		52248,9	38853,0	1,0	38853,0
Facades	26501,0	1,0	26501,0	0,0	0,0	0,0	18591,9	1,0	18591,9	18591,9	1,0	18591,9
Ground green spaces	733988,0	1,0	733988,0	733988,0	0,8	579850,5	733988,0	0,8	559618,3	733988,0		528548,8
Total m2	929123,0		929123,0	745170,5		587678,3	894438,7		689167,3	802615,4		593821,5
Total %			100,0			63,3			74,2			66,4

Usability

Usability	Possible m2	Usability max. score	Usability possible	Used m2	Usability score	Usability existing	Used m2	Usability score	Usability Urban plan 01	Used m2	Usability score	Usability Urban plan 01
Roads	111825,0	5,0	559125,0	11182,5	4,0	44730,0	83868,8	5,0	419343,8	11182,5	4,0	335475,0
Flat roofs	56809,0	5,0	284045,0	0,0	0,0	0,0	57990,0	3,0	173391,0	38853,0	2,0	77706,0
Facades	26501,0	5,0	132505,0	0,0	0,0	0,0	18591,9	3,0	55775,8	18591,9	3,0	55775,8
Ground green spaces	733988,0	5,0	3669940,0	733988,0	3,8	2760859,0	733988,0	4,0	2956514,0	733988,0	3,9	2835391,0
Total score	929123,0		4645615,0	745170,5		2805589,0	894438,7		3605024,6	802615,4		3304347,8
Total %			100,0			60,4			77,6			71,1

Accessibility

Accessibility	Possible m2	Accessibility max. score	Accessibility possible	Used m2	Accessibility score	Accessibility existing	Used m2	Accessibility score	Accessibility Urban plan 01	Used m2	Accessibility score	Accessibility Urban plan 01
Roads	111825,0	5,0	559125,0	11182,5	5,0	55912,5	83868,8	5,0	419343,8	11182,5	5,0	55912,5
Flat roofs	56809,0	3,0	170427,0	0,0	0,0	0,0	57990,0	1,7	96264,0	38853,0	1,0	38853,0
Facades	26501,0	5,0	132505,0	0,0	0,0	0,0	18591,9	5,0	92959,7	18591,9	5,0	92959,7
Ground green spaces	733988,0	5,0	3669940,0	733988,0	3,1	2278555,0	733988,0	3,3	2443231,0	733988,0	3,1	2289755,0
Total score	929123,0		4531997,0	745170,5		2334467,5	894438,7		3051798,4	802615,4		2477480,2
Total %			100,0			51,5			67,3			54,7

Physical Activity

Physical Activity	Possible m2	PA max. score	PA possible	Used m2	PA score	PA existing	Used m2	PA score	PA Urban plan 01	Used m2	PA score	PA Urban plan 01
Roads	111825,0	3,0	335475,0	11182,5	2,0	22365,0	83868,8	3,0	251606,3	11182,5	2,0	22365,0
Flat roofs	56809,0	5,0	284045,0	0,0	0,0	0,0	57990,0	2,3	134538,0	38853,0	1,0	38853,0
Facades	26501,0	4,0	106004,0	0,0	0,0	0,0	18591,9	1,0	18591,9	18591,9	1,0	18591,9
Ground green spaces	733988,0	5,0	3669940,0	733988,0	2,6	1922139,0	733988,0	3,0	2202541,0	733988,0	2,8	2031017,0
Total score	929123,0		4395464,0	745170,5		1944504,0	894438,7		2607277,2	802615,4		2110826,9
Total %			100,0			44,2			59,3			48,0

Social activity

Social activity	Possible m2	SI max. score	SI possible	Used m2	SI score	SI existing	Used m2	SI score	SI Urban plan 01	Used m2	SI score	SI Urban plan 01
Roads	111825,0	5,0	559125,0	11182,5	2,0	22365,0	83868,8	5,0	419343,8	11182,5	2,0	22365,0
Flat roofs	56809,0	5,0	284045,0	0,0	0,0	0,0	57990,0	2,3	134538,0	38853,0	1,0	38853,0
Facades	26501,0	4,0	106004,0	0,0	0,0	0,0	18591,9	2,0	37183,9	18591,9	2,0	37183,9
Ground green spaces	733988,0	5,0	3669940,0	733988,0	2,2	1601595,0	733988,0	2,6	1872713,0	733988,0	2,3	1707205,0
Total score	929123,0		4619114,0	745170,5		1623960,0	894438,7		2463778,6	802615,4		1805606,9
Total %			100,0			35,2			53,3			39,1

Passive score

Passive score	Maxed out plan	Existing	Urban plan LT	Urban plan ST
Greenery amount 0,5x	50,0	31,6	37,1	33,2
Usability	100,0	60,4	77,6	71,1
Accessibility	100,0	51,5	67,3	54,7
Physical activity 2x	200,0	88,5	118,6	96,0
Social activity 2x	200,0	70,3	106,7	78,2
Total score	100,0	50,4	67,9	55,5

Costs (in euro)

Costs (in euro)	Maxed out plan	Existing	Urban plan LT	Urban plan ST
Outside interventions	118553246,0		21877397,0	10535124,0
Inside interventions	107987384,0		107987384,0	
Total cost	226540630,0		129864781,0	10535124,0

Functions score

Functions score	Maxed out plan	Existing	Urban plan 01	Urban plan ST
PAF m2	204850,2	168002,0	197392,3	179598,1
SAF m2	228939,9	24670,0	55665,6	26347,8
Total m2	433790,1	192672,0	253057,9	205945,9

Therapy score

Therapy score	Maxed out plan	Existing	Urban plan 01	Urban plan ST
TF m2	18600,2	2248,9	5173,5	3328,9

APPENDIX L – IMAGES SHOWN IN SURVEY

See next pages.
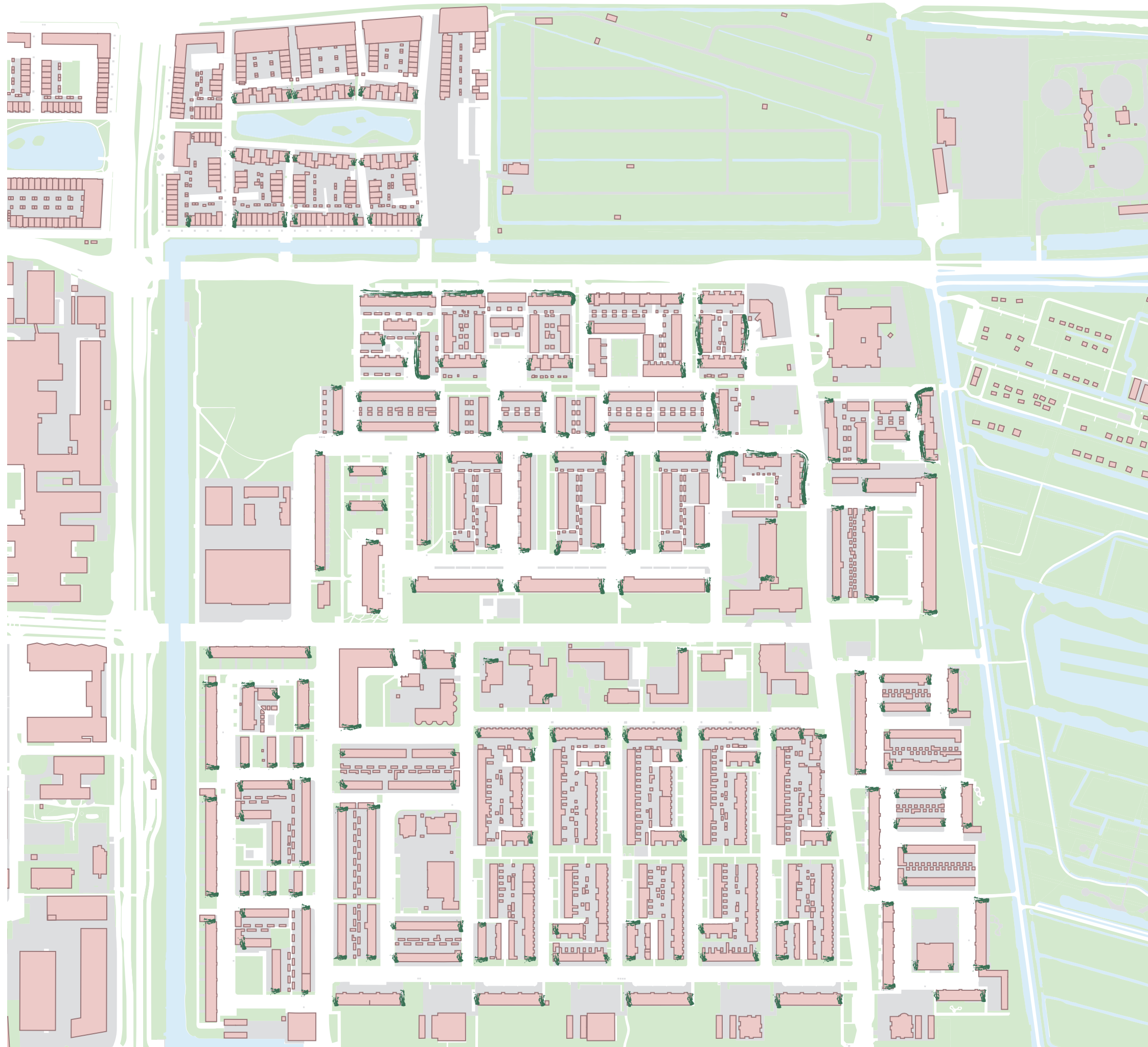
Boerhaavewijk nu

- Groen
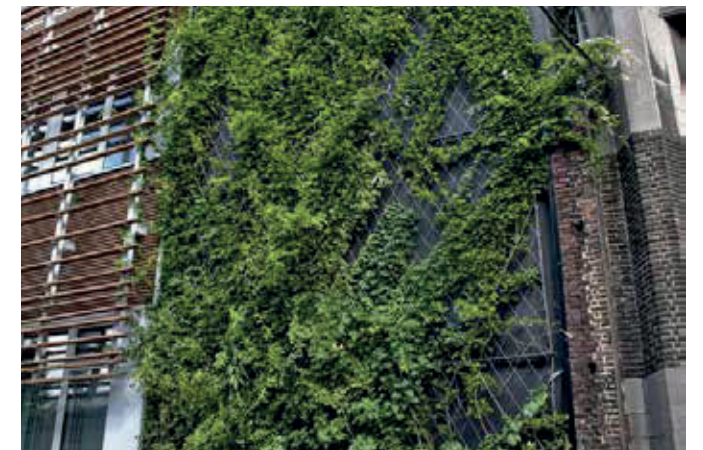- Water
- Gebouw
- Terrein
- Straat

Groene gevel
op gesloten delen

● Groene gevel

Referenties

Collectieve tuinen
op de plek van grasvelden

- 🟢 Groene gevel
- 🏃 Spel en sport
- 👪 Zitten en samenkomen

Referenties

Moestuinen
voor ogen op de straat

● Moestuinen

Referenties

Park
connectie wijk en groen

- 🟢 Park
- 🏃 Spel en sport
- 👪 Zitten en samenkomen
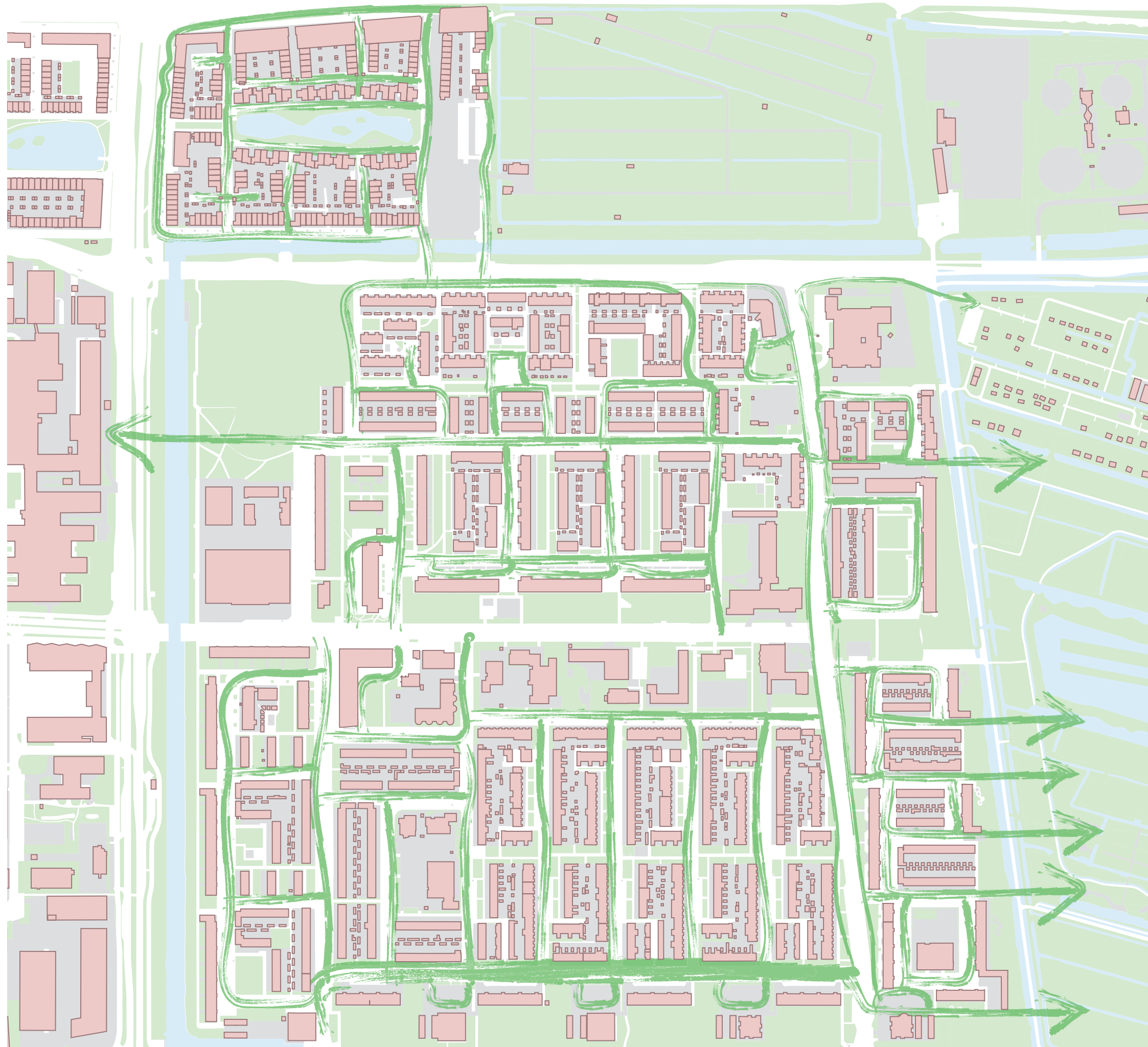
Referenties

Groene straten betere connecties
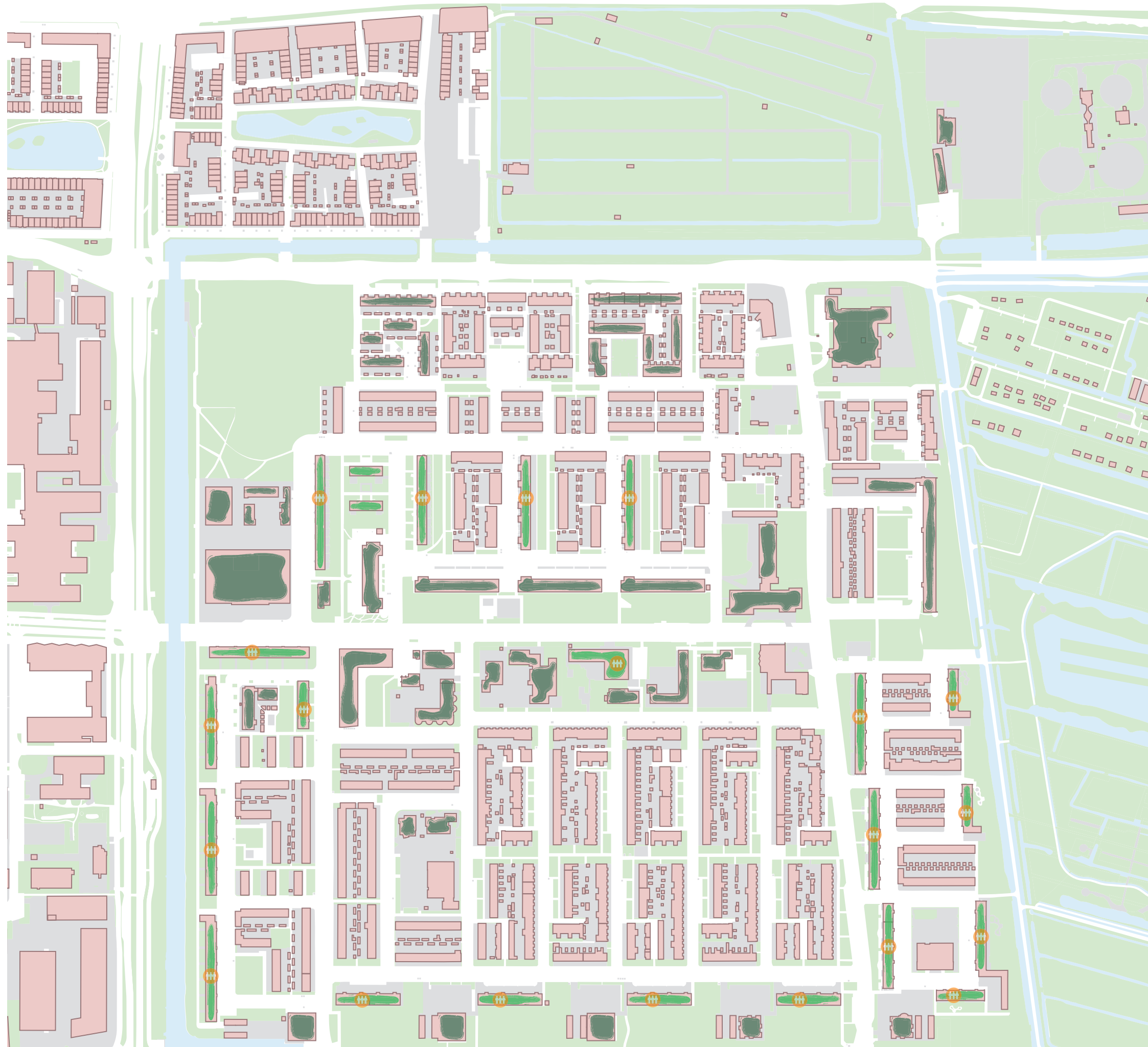
🟢 Vergroende straten

Referenties

Renovatie portiekflatten kwaliteit en functies

- Gebouwen
- Optoppen
- Renovatie en (deel)functies

Referenties

Groene daken
groen op hoger niveau

● Niet toegankelijk groen dak

● Toegankelijk groen dak

Boerhaavewijk visie