A BETTER CITY LIFE: MORE URBAN GREEN

Design principles to improve the living environment by urban green in Dutch pre-war middle or high dense neighbourhoods - the case of Utrecht Elinkwijk and Zuilen

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Human appreciation of contact with nature is a distant effect of the conditions under which early humans are evolved (van den Berg et al., 2007).
Here lies my thesis for my graduation project. The last year I have worked hard to turn my fascinations into a project, an urban design, a graduation thesis and above all: a step towards a better city life.

Starting my graduation I found out that city people are more stressed and less happy than people from rural areas. That concerned me and from that moment on I felt like I had to change that. Or lets say, at least try to change it. My personal aim as urban designer is to make people more satisfied and happy. Aiming high is hard and easy at the same time. I had to work hard for a valuable end result, but I knew I was doing it for a good reason. I did my best to have my influence on a better city life. And I hope this graduation thesis will function as an eye opener to the value of urban green.

I want to thank all my mentors for their interest and believe. This year has been very instructive for me, mainly because of them. Furthermore I want to thank my family, friends and above all Matthijs.
INTRODUCTION

This thesis is the result of one year graduating at the Technical University of Delft. It is made for the master Urbanism, part of the faculty of Architecture. In the studio “Urban Regeneration” graduate students do a research and make a design for an existing urban area within Europe.

This graduation thesis is about urban green in relation to the quality of the living environment. A research is done on the value of urban green. A design is made to implement this in two case studies: Utrecht Elinkwijk and Zuilen.

The first chapter describes the structure of the research. The methods, approach and planning are described. The second chapter is the theoretical framework, which is the underpinning of the project. The third chapter describes the location analysis. In the fourth chapter the conclusions from chapter two and three are translated to design targets. And it describes the design for Elinkwijk and Zuilen. The last chapter, chapter five gives urban design principles that can be used in other urban areas. The final conclusions are given in chapter six.
1

RESEARCH STRUCTURE

The place where you live is a part of your life. The perception of the living environment partly determines the perception of overall life. This graduation project tries to contribute to a better urban living environment and therefore to a better urban life. The key solution to this is urban green.

This first chapter discusses the motivation for the graduation project. It also gives the set up for the further research. The approach will be explained by means of methods.
1.1 Motivation

City man has stressed brain

For the first time researchers proved a fundamental difference in the brains of city man compared to the brains of people from the countryside. Just before the start of my graduation the newspapers where full of these results and I was interested in their content. A few examples:

>> Stadsmens heeft gestrest brein (Volkskrant 2011) <<
>> Stressed in the city: how urban life may change your brain (Time Healthland 2011) <<
>> Städter sind stressanfälliger (der Spiegel 2011) <<

The outcomes came from a research done in Germany and were presented in the journal Nature. Researchers scanned the brains of people from the city and the countryside while they were doing a difficult mathematical exercise. They measured the activity in the brain’s key region for stress. People from the city showed far more activity than people from the countryside (Lederbogen et al., 2011). The fact that people from the city are more stressed is the first explanation for some older findings. The city negatively affects the mental health of its dwellers. So do city people have more chance for mood and anxiety disorders and schizophrenia (Ibid).

Urban versus rural

The difference between urban and rural areas is constantly perceptible. People often say that you are a “city man” or not. From my own perspective, I have never felt that I belong to the city. That encouraged me to start reading about this difference between city and countryside.

Steenbekkers et al. (2006) describe the dissimilarities between Dutch living environments in rural and urban areas in their book “Thuis op het platteland”. Although the difference between city and countryside is becoming more unclear, there are still some clear distinctions. The dissimilarities that pop up in different literature are the higher social cohesion and the more open space and green areas in the rural areas. Alarming is the difference in perceived quality of life. People from rural areas are more happy and more satisfied with their living environment (Ibid).

The role as an urban designer

As a future urban designer I take both of these messages seriously. With the increasing urbanisation more and more people are living in the city. In the field of urbanism the city is the main project area. Therefore we should be conscious of what we are designing. I believe everybody can have its own influence. I hope I can make a contribution to a better city life with my graduation project.
1.2 Problem statement

Satisfaction with living environment

As mentioned by Steenbekkers et al. (2006) people from rural areas are more satisfied with their living environment than people from urban areas. 92 per cent of the inhabitants are satisfied with their living environment in the places that are not urbanized in the Netherlands. And less, 75 per cent in the places that are highly urbanized. People mention that space, greenness and safety determine this inequality (Ibid). People from the countryside are also more satisfied with other aspects of life. This satisfaction is also visible in the amount of people that say they are happy. 86 per cent of the people from the rural areas call themselves happy and 80 per cent in urban areas (Ibid).

Also other data confirm this difference in perceived quality of living environment and quality of life. A research on the living environment in the Netherlands confirms this difference. Especially people that live in cities in the Randstad are significant less satisfied with their living environment (RIVM, 2011). The difference in quality of life is not only a fact in the Netherlands. Over the whole world people from developed countries are more happy in rural areas (Berry and Okulicz-Kozaryn, 2009).

Quality of living environment

By quality of living environment is meant the degree in which the environment contributes to the well-being of its inhabitants and thus the degree in which it contributes to a long and happy life. (For a detailed definition see chapter 2: theoretical framework)

The quality of the living environment is influenced by both physical and social factors (Van Dorst, 2005). It is not easy to say in which degree environmental characteristics influence the quality of the living environment. Environmental characteristics that influence quality of living environment cannot be directly translated to a degree of influence (Ibid). Complicated situations cannot be easily translated to a set of characteristics, because a living environment acts as a whole. Social aspects are intertwined with spatial aspects, which causes even more complexity.

In figure 1 the domains of environmental quality are shown (Leidelmeijer and van Kamp, 2003).

Quality of living environment versus urban green

Urban green is land that consists predominantly of unsealed, permeable, soft surface (green areas) or elements of vegetation (green elements), whether or not they are publicly accessible or publicly managed. (For a detailed definition see chapter 2: theoretical framework)

Urban green has lots of environmental benefits. Urban green can be used for air, noise filtering, reduction of the urban heat island effect and for enlargement of biodiversity. It also has lots of social and psychological benefits. The most important ones are aesthetic improvement, stress reduction, child development and social interaction. Next to that, urban green can also improve physical health and increase property price. (For a full description of these benefits see chapter 2: theoretical framework)

With these benefits urban green can positively affect different domains of quality of living environment. These domains are highlighted in figure 1. The following domains can be covered almost entirely: Natural environment, natural resources and built environment. It can also improve parts of the domains services accessibility, economy, health, lifestyle and community.

It is not possible to say in which degree urban green can influence the quality of the living environment. But it is known that it influences a wide range of aspects related to it. As we argue ourselves, it is logical that people in an environment with better living circumstances are more satisfied. Urban green can be potential for less nuisance, less stress and a more healthy environment. This can only mean a positive influence for the quality of the living environment. Different data confirm that urban green is from significant importance for the quality of an urban living environment (Swanwick et al., 2003), but also for the quality of life (van Leeuwen et
Figure 1. Domains of livability and environmental quality, highlighted potential effects of urban green
(Source: Leidelmeijer and van Kamp, 2003, edited)
Especially in urban situations green spaces are a crucial part of quality of life (Van Herzele and Wiedemann, 2003). So highlights Chiesura (2004, p. 129): “Urban parks and open green spaces are of a strategic importance for the quality of life of our increasingly urbanized society”.

**Benefits of urban green not fully exploited**

Green areas and green elements have so many benefits that are especially interesting for urban areas. Policy makers and designers are not aware of all those benefits.

One of the most practical benefit of urban green that is not commonly known is the economic value. Urban green can raise nearby property prices (Morancho, 2003; Luttik, 2000). As a consequence of this unknown economic value, there is a risk that urban green will be taken from the political agenda. Urban green has already a widespread low priority (Swanwick et al., 2003). There are several policy documents in the Netherlands that indicate that urban green has priority in the political agenda. But it is the actual realisation that stays behind (Vreke et al., 2006).

Also other benefits are not commonly known. Scientific and political attention is more focused on large-scale ecosystems instead of the small-scale green areas in cities that have benefits to urban dwellers (Chiesura, 2004). Especially the social benefits are underestimated or not generally known.

Another problem is the fact that benefits of urban green stay theoretical interpretations. Often the preference of the user is forgotten. The theory and preferences should together conclude in design principles. However underpinned design principles for urban green do not yet exist. In that way urban green is not applicable for urban designers.

Urban green is from significant importance for the quality of the living environment in urban areas. Policy makers and designers are not aware of all the benefits of urban green and urban green is not applicable. Because of that, the benefits of urban green can not be fully exploited, while they are from significant importance for the quality of the living environment in the city.
1.3 Aims

The overall aim of the graduation project is to contribute to a better living environment in pre-war middle or high dense neighbourhoods in Dutch cities. One of the key solutions for a better quality of the living environment is urban green.

This graduation project aims to emphasise the importance of urban green and to make urban green more applicable. In that way the graduation should put urban green on a higher priority for politicians and urban designers. For urban designers it is important to dispose of design principles in order to be able to contribute to a better living environment.
1.4 Relevance

Social relevance

Better living environment in the city

The social relevance of this graduation project lays in the improvement of the living environment in the city. Data shows that people in the city are less satisfied with their living environment (Steenbekkers et al., 2006). With the increasing urbanisation, it is important that the city is a satisfying place to live in. Urban green can have lots of positive effects on its city dwellers. It is for everybody important to have a good physical and mental health. And it is for everybody important to be satisfied with their living environment. Urban green can contribute to the life of urban dwellers (Chiesura, 2004). This project contributes to the implication of urban green, so it can improve the living environment of the city.

Eye for preferences of the user

This graduation project pays attention to the preferences of the user. In that way urban green is not only seen from an academic point of view. Inhabitants will be satisfied when their preferences are included in the design.

Academic relevance

Overview urban green typologies

Urban green is a term that is used frequently. However the meaning of it is not always clear. Different studies try to give an overview of urban green typologies. Some are distinguished in use, scale, property (private or public) or appearance. Together the overviews form the whole range of typologies. However there is no one that shows the complete range of typologies by itself. Next to that, some typologies are too general, for example the term “garden”. This graduation project gives a detailed overview of all urban green typologies.

Overview benefits of urban green

Many studies have been made on the benefits of urban green. However almost all literature is written from one perspective, for example from a ecological perspective. Next to that, many publication on urban green are so ambitious that they tend to forget to give a realistic image. Some benefits of urban green need to be balanced. This graduation project gives a realistic overview of all the benefits of urban green from all perspectives.

Design principles

Several studies on urban green have been made, but almost all of them are from a theoretical perspective. The theoretical studies are most of the time one sided, mostly from an ecological point of view and some from a social point of view. Far less studies are done from a designers perspective. That is why there are also no design principles for urban green. This graduation project has academic relevance, because it gives an overview of design principles. Existing studies have been translated into design principles and new design principles are made especially for middle or high dense Dutch pre-war neighbourhoods.

A means of communication

The benefits of urban green and the design principles can be used as means of communication between municipality, property developer and inhabitants. The graduation project gives a clear overview on the benefits, but also on the compromises you have to make. In this way different parties can discuss what they want to achieve and for what price.
1.5 Scope - case Elinkwijk and Zuilen

Not all benefits of urban green may be crucial for the improvement of all living environments. Benefits of urban green differ from environmental aspects to social aspects. In some living environments the reduction of nuisance may be crucial, while in other environments the social improvement may be crucial.

The scope of the graduation project is set by the project location. (For a detailed explanation of the choice of this location see chapter 3: project location) The project location is Elinkwijk and Zuilen, two pre-war middle and high dense neighbourhoods in Utrecht Noordwest. The crucial benefits of urban green for these neighbourhoods is investigated. That may mean that not all benefits of urban green are covered by this graduation project.

In this way the project location is both a means to an end and a goal on itself. It is a way to investigate the applicability of urban green and a way to improve the living environment of Elinkwijk and Zuilen.
1.6 Research questions

Main research question

The graduation project aims to give answer to the following research question:

>> Which urban design principles - subtracted from the case Elinkwijk and Zuilen - can be used to improve the living environment by urban green in Dutch pre-war middle or high dense neighbourhoods? <<

Sub research questions

In order to be able to answer the main research question, the following sub research questions are used:

1A What are the general benefits of urban green that can improve the living environment of the city?
1B And which of these benefits can be used in the case Elinkwijk and Zuilen?

2A What are the user’s preferences for urban green?
2B And which of these preferences are not fulfilled in the case Elinkwijk and Zuilen?

3 What kind of urban green is already existing in the case Elinkwijk and Zuilen?

4 What are the problems of the living environment in the case Elinkwijk and Zuilen?

5 Which urban design can improve the living environment by urban green in the case Elinkwijk and Zuilen?
1.7 Research structure

The graduation project is built up by different parts. Part of the research is done by a literature review and part of the research is done by research by design. Together these two inputs has led to design principles to improve the living environment by urban green. The whole process is done from a designer's perspective. Design solutions popped up during the research. The research structure is visualised in figure 2 in chronological order.

Theory

The project started by doing a literature research on benefits of urban green and preferences for urban green. The benefits of urban green are described in the theoretical framework. The preferences for urban green have been published in a paper.

Location analysis

After this the location analysis is made. The existing green at the location has been analysed by making maps. While doing this, design solutions popped up. The location is also analysed on problems in the living environment. This has been done by a location visit and reading policy documents. This problems have been visualised in maps. An interactive design for the neighbourhoods gave opportunity for
inhabitants to give their own ideas. These ideas available from the municipality of Utrecht have been taken into account during the project.

Interim conclusions

The theory and inputs from the location together form interim conclusions. Preferred urban green for the location has been conducted from general preferences together with the ideas of inhabitants. Beneficial urban green for the location has been conducted from the problems in the neighbourhood that can be solved by urban green.

Design

During the literature research and the location analysis design ideas popped up. The method of research by design has been used during the entire process. The theory and location analysis has led to a set of solutions and problems. This has led to a set of design targets. From that point on the focus has laid on the design part.

After different ideas have been translated into different designs, the first evaluations have taken place. In figure 2 this is visualised as evaluation loops 1 and 2. The design ideas have been compared with the conclusions for preferred and beneficial urban green. In that way it is possible to evaluate whether the design interventions are necessary for the improvement of the living environment. The design also has been evaluated on other aspects. Is the design not compromising on other aspects? Like parking places, houses etcetera. Designs have been constantly evaluated and changed. This loop has been done several times: Designing is a circular process. After certain design variants a design has been made to improve the living environment of Elinkwijk and Zuilen.

Design principles

After the finish of the design for the neighbourhoods Elinkwijk and Zuilen, the second evaluation has taken place. This is visualised in figure 2 as evaluation loops 3 and 4. The design is divided in design principles. These principles have been compared with the general theory of urban green. Next to that, the evaluation has revealed in which situations this principles can be used. As a final conclusion the graduation thesis gives a set of design principles for urban green to improve the living environment in pre-war Dutch middle or high dense neighbourhoods.

End products

The most important end product is the graduation thesis itself. It is a document that describes the research and its outcomes. It includes all the other end products. The two main end products are the design and the design principles. Next to this, the literature research, location analysis and evaluations are important end products.

The design of the neighbourhoods Elinkwijk and Zuilen is on scale 1 to 2000 as floor plan. Street sections of 1 to 200 visualises the design of urban green elements. The ideas are strengthened with visualisations of the design. The design principles are shown in an overview.
1.8 Methods

During the research different methods are used. In table 1 these methods are shown. The different research questions are answered by means of these methods.

**Literature review**

For some topics there is already a lot of knowledge. Many literate is published about the benefits of urban green. By reviewing (reading and comparing) this literature, we can make new conclusions. This method has been used in chapter 2, the theoretical framework. In that way the benefits of urban green have been found, so as the preferences for urban green.

**Mapping**

Mapping is a way to analyse the spatial issues of the site. By subtracting one topic and abstracting this, a specific map for one topic can be drawn. By mapping, the morphology of the site becomes clear and spatial relations are shown. In chapter 3, project location, this method has been used. In that way existing urban green and problems in the living environment have been found.

**Demographic analysis**

Another way of analysing the site is a demographic analysis. This gives more sight in social issues of the site. By showing demographic data in a map, new conclusions can be drawn. This method has also been used in chapter 3.

**Location visit**

A location visit is another way of analysing the site. By observation and sensory perception the area can be analysed from your personal perspective. This method gives information about the 3D experience of the site, including all types of senses, such as sound. This method has also been used in chapter 3.

**Sectional analysis**

The last method that has been used for the analysis of the location is a sectional analysis. By drawing profiles, spatial proportions can be found. This method has also been used in chapter 3.

**Expert interview**

Some things could not be found in the location analysis. For these topics an expert interview has been done. In an expert interview conclusions can be drawn from the information given by the interviewee. This method has also been used in chapter 3.

**Research by design**

One of the most important methods of this graduation project is research by design. This is a creative process that starts with a vague idea and becomes more concrete in time. It is a method where problem finding and problem solving are taking place at the same time (Stolk, 2011). Different solutions are tested and changed in a circular process. Striking for urban design is the fact that you have to deal with many scales and relations. Designing can be done by sketching, computer drawings, mapping, modeling and more. This method has been used in chapter 4, design. In that way a design is made to improve the living environment in the case Elinkwijk and Zuilen.

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<th>Preferences urban green</th>
<th>Benefits urban green</th>
<th>Existing green</th>
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Table 1. Methods used during the graduation project
This chapter is the underpinning of the graduation project. It gives the theoretical background of urban green and quality of living environment. The main part of this chapter describes the benefits of urban green. Next to that, the preferences of the user are also included in this chapter.

This chapter answers the following sub research questions:
- 1A What are the general benefits of urban green that can improve the living environment of the city?
- 1B And which of these benefits can be used in the case Elinkwijk and Zuilen?
- 2A What are the user’s preferences for urban green?
2.1 Urban green

Definition

Urban green is a term that is used with different meanings. For a good research it is important to define this term. Urban green can be divided by urban green areas and urban green elements. Urban green space is used as a synonym for urban green areas.

Swanswick et al. (2003, p. 97) describe green space as: “Land that consists predominantly of unsealed, permeable, soft surfaces such as soil, grass, shrubs and trees”. Added to that, they give a definition for urban green space: “An umbrella term for all areas of land covered by this definition of green space, whether or not they are publicly accessible or publicly managed”. A separation is made in four main groups of urban green space. The first group is amenity green space such as parks, play areas, domestic gardens etcetera. Functional green space is the second group, which covers for example allotments and cemeteries. Water, woodland and grasslands are examples of urban green areas that belong to semi-natural habitats. The fourth group is linear green space such as rivers (Ibid).

Next to green areas, urban green can also indicate green elements. Urban green elements are elements of vegetation. Smardon (1987) divides vegetation in trees, shrubs and ground vegetation.

In this document the following definition for urban green is used: Land that consist predominantly of unsealed, permeable, soft surface (green areas) and elements of vegetation (green elements), whether or not they are publicly accessible or publicly managed.

Urban green typologies

The division of urban green in green areas and green elements still covers a wide range of typologies. To get more grip on the definition an overview is made on different types of urban green, see table 2. Urban green can be separated through use, scale, public/private or appearance.

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<td>Loose green elements</td>
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<td>Natural green space</td>
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Table 2. Urban green typologies

In this overview urban green is separated through scale. It shows different types of urban green on building, street, neighbourhood and city scale.

This separation is made by means of the different documents describing typologies of urban green (de Niet, 2005, Swanwick et al., 2003; Dunnett et al., 2002).
Building scale

Back garden

A back garden is a piece of land that is privately owned by the owner of the adjacent dwelling. It is placed inside an urban block and not publicly accessible. Most of the times it is not visible from the public street and if it is, it is clearly aimed towards the dwelling and not to the public. A back garden can differ a lot in appearance. The surface can be paved or permeable and mostly there is vegetation in form of trees, bushes or ground vegetation. The size of a back garden can differ from five square metres to a few hectares. Only back gardens that are visual from the public street are included in this research.

Front garden

A front garden is a piece of land that is privately owned by the owner of the adjacent dwelling. It is placed outside an urban block. Although it is not publicly accessible, it is visual from the public street and therefore it can have a visual quality. In opposite to a back garden it is aimed at the street. The appearance can differ like a back garden, but it has to be predominantly of soft surfaces or with green elements to be covered under the term urban green. The place should be at least one metre in depth to call it a front garden.

Over garden (Dutch term: Overtuin)

An over garden is a garden that is separated from the dwelling by a road or a waterway. There are different reasons for this separation, for functional use or for visual quality. It is an old type of urban green that is nowadays very rare. The places used to be owned by the owner of the adjacent dwellings, but nowadays some are owned by the municipality.
Elevation garden

An elevation garden is equal to a front garden, except for its size and use. The depth of the place is less than one metre. Most of the times it is privately owned by the owner of the adjacent building. Sometimes it is owned by the municipality and maintained by the owner of the adjacent dwelling.

Green elevation

A green elevation is a type of vegetation that grows on the vertical surface of a building. It is privately owned by the owner of the building. Usually it is a type of tree or shrub. It is covered by the term urban green element.

Green roof

A green roof is equal to a green elevation except for the fact that it grows on the horizontal part of a building. It exists of small vegetation like grass and moss.
Street scale

Green strip on side

A green strip is a piece of land that can be part of a street section. Mostly it is publicly owned by the owner of the street (municipality, province or state). Usually it consist predominantly of grass. Sometimes flowers or small elements of vegetation are integrated. If it is close to the sidewalk it can be used, but most of the time it is only for visual or safety purposes.

Green strip in middle

A green strip in the middle is most of the times planned because of safety reasons. In this way the lanes are separated from each other. Usually this piece of green is not accessible.

Flower box

Flower boxes are elements of vegetation that are put in a flower box. They are made for visual quality. They are publicly or privately owned.
Tree in paved surface

Trees in paved surfaces are planted by the municipality and often part of a street section.

Avenue (Dutch term: Laan)

An avenue is a street that is planted with trees on both sides. The trees are growing in the ground and most of the times in a green strip. The wide streets with rows of trees often have a monumental character. Sometimes the green areas can be used for walking, but most of the times it only has visual quality.

Avenue with water (Dutch term: Singel)

An avenue with water is a waterway integrated in a street section. Next to the water there are soft slopes that are often existing of grass. Most of the times an avenue with water has also tree lines. Like almost all avenues, it has a monumental character. Because the street sections are normally very wide, there is place enough to use the green areas.
Neighbourhood scale

Public garden

A public garden is an urban green area that is most of the time owned by the municipality or another public instance. It can be public or semi-public accessible. Most of the time the term refers to a place with a richness of green elements that are well maintained, like flower- or plant beds. However, the term can also be used for parks that are gated. Public gardens are specially designed for public access and enjoyment. Therefore they have most of the time also other facilities, like benches or play facilities. The size of a public garden can differ from one to two hectare if it refers to a garden that is publicly owned. If the term refers to parks, it can be tens of hectares.

Enclosed garden

An enclosed garden is a public garden that is enclosed by buildings. Although this term only refers to gardens and not to gated parks.

Sport field

A sport field is a green area that is designed for the use of different sport activities. It includes soccer fields, golf courses, etcetera. It is owned by the municipality or a private instance. Some sport fields are always open for public and some are only open for members on specific times. The area consist mostly of grass and some urban green elements.
Natural playarea (Dutch term: Natuurspeeltuin)

A playground is a place that is especially made for children’s play. It can have a stoney character, but is can also be enriched by green areas or elements. There are facilities like benches and play facilities. A special playground is a natural playarea. Which is an environment made of natural materials, natural shapes and plantation, made for a creative children’s play in a natural environment.

Children's farm

A children’s farm is an urban green area with animals. It is made for children to play and watch animals from a farm. Standard animals are chickens, goats and rabbits. Many time children’s farms occur within a park. It can be owned public or private and is publicly accessible.
City scale

Park

A park is an urban green area that is especially made for public access and public enjoyment. It is a combination of landscape elements with different plantation. Many parks have also water inside. There are also several facilities, like walking and cycling paths, soccer fields, benches and sometimes small pavilions. A park on city scale is in general between 10 and 50 hectares. It is almost always publicly owned.

Allotments

Allotment gardens are small plots that are owned or rented by people that have most of the time no private garden. There they have a place for gardening. Most of the time allotments are between 50 and 400 square metre. Tens or hundred small plots are generally gathered.

Zoo

A zoo is a private urban green area with animals. Animals from different species that are from wild origin are displayed for visitors. A zoo has a function for recreation, study and education. Most of the time a zoo has the appearance of a park, with plantation, water and natural shapes.
**Water stream**

A water stream is a piece of water that flows. Often water streams occur in green surroundings. The quays can be made of soft materials like grass. Many waters have trees along them. In this way a water stream can act as a recreation area or as a natural environment.

![Figure 11. River “De Vecht” Utrecht (Source: Google, 2012)](image)

**Green structure**

This type of urban green should not be seen as a separate category, because it can occur in different types of urban green. It is just the structure that is striking. Some streets, for example, can be shaped linear. In that way they can work as a link between several green areas. A green structure is an urban green area that is part of a more bigger green system.

![Figure 12. Green structure “Muiderslotplantsoen” Utrecht (Source: Google, 2012)](image)

**Cemetery**

A cemetery is an urban green area where dead people are buried. It is a privately owned and closed place. Many cemeteries consist of permeable surfaces and have a richness of green elements.

![Figure 13. Cemetery “Tolsteeg” Utrecht (Source: Google, 2012)](image)
2.2 Quality of living environment

There is no clear definition for the term living environment, neither for the term quality of living environment. There are a lot of terms that are similar and close to quality of living environment. Like quality of place, satisfaction of living environment, livability, quality of life and life satisfaction (PBL, 2010). For this research it is important to make a clear definition. Therefore it is first needed to make a clear definition for living environment.

**Definition living environment**

Van Dorst (2005, p. 28) gives a definition for a residential environment. He describes it as the environment of the dwelling that is used often. That can be a building, a street, a part of a neighbourhood or a part of a city. He highlights the fact that is has to do with both the physical and the social environment. It is perceived from an individual point of view (Ibid). The residential environment is a part of the total living environment, which also includes the places that are used often during the rest of the day. That can be for example the environment of the place you work.

The PBL (planning bureau for the living environment) (2010) focuses on the physical environment. They describe the physical living environment as the place where people are living. That includes the built environment, rural areas, water, infrastructure and nature. They also highlight that it is seen from the perspective of the user.

In this document the following definition is used for living environment: “The physical environment of the dwelling that is used often, seen from an individual perspective”. It is narrowed down to the physical environment and to the scale of the neighbourhood.

**Definition quality of living environment**

Van Dorst (2005) gives different explanations and terms for livability. Obvious livability (Dutch term: Kennelijke leefbaarheid) is the degree in which the environment meets the preferred condition of a specie. It is measurable in how long and satisfied people are living in a place. Perceived livability (Dutch term: Gepercipeerde leefbaarheid) is the appreciation of an individual for its living environment. It describes the subjective feeling of a person, so it is influenced by personal characteristics. Quality of living environment (Dutch term: Leefomgevingskwaliteit) is the degree in which the environment contributes to the well-being of its inhabitants. Expected livability (Dutch term: Veronderstelde leefbaarheid) is the degree in which the environment meets the expected conditions for obvious livability. This is not easy, because it is not always clear what the real causes and consequences of conditions are. In figure 14 the different terms are visualised. The relation between environment and individual is shown.

Leidelmeijer and van Kamp (2003) did a full research on the concept and definition of quality of living environment and livability. One of the definitions they give for quality of living environment is the following: “An environment of high quality conveys a sense of well-being and satisfaction to its population through characteristics that may be physical, social or symbolic” (Lansing and Marans, 1969 cited by Leidelmeijer and van Kamp, 2003). Next to that they highlight that quality of living environment is a crucial part of quality of life.

![Figure 14. Domains of sustainability (Source: Leidelmeijer and van Kamp, 2003)](image)
It is clear that different perspectives for livability and quality of living environment give different terms. It can be seen from the perspective of an individual and from the perspective of the environmental characteristics. The reviewed literature shows that quality of living environments focuses on the environmental characteristics and how they can contribute to a better well-being of its inhabitants.

This document is made from a spatial perspective and not from an individual perspective. Therefore the following definition for quality of living environment will be used: The degree in which the environment contributes to the well-being of its inhabitants and thus the degree in which it contributes to a long and happy life.

Figure 15. Terms for livability (Source: Van Dorst, 2005, edited)
2.3 Environmental and ecological benefits of urban green

When nature and other green areas are mentioned, in the first place you think either on its environmental benefits or on its ecological benefits. Nature preservation is mainly concerned about large ecosystems in relation to both of these benefits (Chiesura, 2004). Environmental benefits are not only important for a better climate on worldwide scale, but also on micro scale for a better microclimate for urban citizen. These several benefits contribute to a better living environment. Urban green areas or vegetation can have the following environmental and ecological benefits:

- Air purification
- Soil and water purification
- Noise filtering
- Wind filtering
- Urban heat island effect reduction
- Biodiversity enlargement
Air pollution

The main sources for air pollution in the Netherlands are traffic and industry. Traffic is the biggest cause and causes air pollution mainly by fine particles, nitrogen compounds and carbon monoxide (Milieu Centraal, 2012). Other air pollutants are carbon dioxide, ozone and sulphur compounds. Air pollution can be dangerous for people, because it can cause problems in the airways (Ibid).

Benefits of urban green

Green plants can improve air quality by absorbing carbon and other pollutants, regulating humidity and regulating temperature (Morancho, 2003). Purification of air is of high importance especially in the city, because it has a high air pollution caused by car emissions.

Scale of effect

Different vegetation species can purify air in different levels. So are trees more capable than bushes, because of their bigger size. Conifers can purify air better than deciduous trees (AgriHolland, 2012).

Green elements cannot be used to solve the problem of fine particles in the Netherlands. It can only improve hotspots: The areas that are close to the limited levels (AgriHolland, 2012). So is one square metre of moss capable of absorbing 20 grams of fine particles. An average city tree can absorb 100 grams, which is equal to the emitted fine particles driving a car for 3300 km (Ibid).

A research done in England shows that you need half a hectare of wood to compensate car emissions of one life time (NCRA, 2007). One hectare of Douglas fir forest can absorb 4 metric tonnes of carbon per year and one hectare of Beech 2,5 (Ibid).

Design principles

For purification of air it is important that there is enough ventilation. Therefore trees should not be placed next to the street, but close to the buildings (AgriHolland, 2012). It is also important that there is space in between trees. For a highway, trees should be placed at a distance of 100 to 200 metres (Ibid). Green elevations are also a good solution, because it can purify air and there is still enough space for ventilation.

Project

Air purification is not one of the main goals of this graduation project, it is only something that is taken into account. This is because the scale of effect of urban green is small. You need a number of green elements to compensate air pollution that is not realistic inside a city. Air pollution will be taken into account. While placing new trees, ventilation should not be blocked. Use of the car will not be simulated. Urban green elements can be used at hotspots to improve the air quality locally.
Benefits of urban green

In the same way (by absorbing pollutants) urban green can improve soil and water quality (Vreke and Salverda, 2009).

Project

Soil and water purification is not part of this graduation project. Because purification of soil and water is most of the time not dangerous for people, only if they come in physical contact with it. Besides that, there is not enough information and evidence in existing literature to support this benefit.
Noise pollution

Noise pollution is mainly caused by traffic, industry and neighbours. It can be a problem for people when it disturbs their night’s rest, which can cause stress (Milieu Centraal, 2012). Research also shows that noise pollution can influence the learning process of a child, because it can loose its concentration on school (Ibid).

Benefits of urban green

Urban green areas can act as an acoustic buffer, for example between traffic roads and residential neighbourhoods. In this way urban green areas can reduce noise pollution which is especially needed in urban areas (Morancho, 2003).

Scale of effect

The scale of effect of noise filtering is highly influenced by the depth of the vegetation line (Dienst Landelijk Gebied Arnhem, 2010). In general the effect on noise pollution is limited, because it only works in summer and because a considerable depth is necessary (Ibid). One continuous closed row of trees and bushes can reduce noise pollution of a traffic road by one decibel. A continuous line of vegetation with a depth of 200 metres can reduce ten decibel, which is also the maximum possible (Dienst Landelijk Gebied Arnhem, 2010). From a difference of three decibel people can experience noise reduction. This can be achieved by a vegetation line of 50 metres wide. From that point on noise reduction is significant. Note that only trees with leaves can reduce noise pollution, so the effect is only there in summer (Ibid).

Design principles

Plants with large leaves can improve acoustic quality the best. A research done in schools shows that plants should be placed in groups for an optimal result. Green walls are functioning well as acoustic buffer (van Zandwijk, 2011). For noise filtering it is important that the row of vegetation is continuous, closed and with enough depth (Dienst Landelijk Gebied Arnhem, 2010).

Project

Noise filtering is not one of the goals of the project, because it is not realistic to achieve. However it is important, because there is a lot of noise pollution at the site. We should only ask ourselves if this problem can be solved by urban green.
Benefits or urban green

Cheisura (2004) highlights that in the same way as noise filtering urban green areas have potential for wind filtering.

Project

Wind filtering is not part of this graduation project, because not enough literature is found to proof the benefit of urban green in relation to this.
Urban heat island effect

Urban areas can become far warmer than the surrounding countryside. This phenomenon is called the urban heat island effect (Kleerekoper, 2009).

Benefits of urban green

Vegetation can cool down the environment in an active and passive way. Active by improving air quality and passive by shading (Kleerekoper, 2009).

Scale of effect

A research done in London shows that the temperature in a park was in average 0.6 degrees Celsius lower than in a neighbourhood street. At the same time, a shopping street turned out to be three degrees Celsius warmer (NCRA, 2007). A park of one to two hectares can already be two degrees Celsius cooler (Ibid). Research in Merseyside shows that areas with 50 per cent vegetation cover are seven degrees Celsius cooler than areas with fifteen per cent cover (Ibid).

Design principles

Trees with a bigger tree cover have a bigger influence on temperature (NCRA, 2007). For a year round effect, different tree species should be mixed: Conifers and deciduous trees. A careful management is important, because dehydrated trees can cause an opposite effect, it can raise surrounding temperature (Ibid).

Project

Urban heat island effect reduction is not a goal on itself in this project, but can be easily achieved together with other goals. It should be taken into account that the more green areas and elements, the less warmer the area becomes.
Benefits of urban green

Green areas and plants are fundamental for preservation of flora and fauna (Morancho, 2003). Green areas can be a place for endangered animal or vegetal species. Not only outside the city, but also inside the city green areas can provide habitats for different species. Although it is necessary that these green areas are linked to a wider system (Rudd et al., 2002).

Scale of effect

Only urban green that is highly connected with a wider system can enlarge biodiversity (Rudd et al., 2002). A research example (done in Vancouver) shows the necessity of 325 links for a green area (Ibid). Smaller areas of urban green can act as an extension for the living area of animals, but their main habitat is most of the time in green areas over 100 hectares. Parks (under 100 hectares) are most of the times too isolated to enlarge biodiversity (Ibid).

Design principles

Private gardens are sources of different animal species and should be kept in the city for that reason (RLG, 2005). A research in Sweden shows the importance of different vegetation layers for the number of bird species (Sandstrom et al., 2006). The more trees, the more bird species. Also places with layers of shrubs had more bird species. The distance to the closest nature area is also important. Therefore green wedges should penetrate the urban tissue to allow connection between urban green and the surrounding nature (Ibid).

Project

It is not the goal of this graduation project to enlarge biodiversity, because urban green areas should have a number of links, that is not easy to achieve inside the city. While biodiversity enlargement is not a goal, it is important that the design should not achieve the opposite. Therefore fragmentation of urban green should be prevented and existing urban green (that is part of a habitat) should not be taken away.
2.4 Social and psychological benefits of urban green

Next to environmental and ecological benefits, there are other benefits where less attention is paid to. These are the benefits related to small scaled green areas in cities that can have a positive effect on citizen (Chiesura, 2004). Some of the following issues are particularly problems for urban areas. The importance of urban green areas is therefore even bigger. These several benefits contribute to a better living environment. Urban green areas and vegetation have the following social and psychological benefits:

- Aesthetic improvement
- Stress reduction and psychological restoration
- Child development
- Social interaction and social cohesion
Aesthetic improvement

Benefits of urban green

Over the whole world people prefer urban areas with urban green over urban areas without. People believe situations with urban green are more beautiful (van den Berg and de Vries, 2000). So do people prefer the view on forest instead of a commercial centre (Smardon, 1987). Urban settings with vegetation is judged higher than urban settings without vegetation (Ibid). In this way urban areas that have a “red” character and are disliked can be improved. Street sections with dominating cars can be improved with urban green.

Scale of effect

Also loose elements like plants can have aesthetic value (Morancho, 2003). Trees seem to have the most positive effect on the perception of a residential street (Smardan, 1987). The bigger the trees, the more the streets are preferred. Almost all urban green elements have aesthetic value. There is only one exception, empty grass-covered expanses are disliked (Ibid).

Design principles

Especially trees can improve the perception of a residential street. Other urban green elements can also be used. Empty grass areas should be changed into an urban area that does improve aesthetics.

Project

Aesthetic improvement is main goal in this graduation project. The more beautiful people think an environment is, the more stress reducing it seems to be (van den Berg et al., 2007), see next page. Therefore it is important that people perceive their environment as beautiful. It is also important, because people will live more satisfied in a liked environment. The project location has a really stony character and should be improved by urban green.
**Stress reduction and psychological restoration**

**Main goal**

**Stress**

City people are more stressed than people from rural areas (Lederbogen et al., 2011). Stressed people have more change on mental and physical diseases, therefore stress reduction is important.

**Benefits of urban green**

Green space can be a source for psychological restoration and reduction of stress (van den Berg et al., 2010). The restoration from stress is more efficient in a natural environment compared to an urban environment. In this perspective urban green is highly appreciated (van den Berg et al., 2007).

**Scale of effect**

The scale of effect of stress reduction by urban green cannot be measured in numbers. It can only be said that the effect is really easy to achieve. Stress reduction takes places from the first second people come in contact with green elements or green areas (de Vries et al., 2000). People do not even have to be in direct contact with green, only viewing a photo or video with urban green is already a source of stress reduction (Vreke and Salverda, 2009). The more beautiful people think an environment is, the more stress reducing the environment seems to be (van den Berg et al., 2007).

**Design principles**

Wild nature, gardens as well as other types of green give a restorative effect (van den Berg et al., 2010). Research until now did not show a relation between urban green on a wider scale (more than one kilometre away) and perceived health after stressful events (Ibid). Therefore only nearby green elements and areas should be used for stress reduction.

**Project**

Stress reduction is one of the main goals of this graduation project. Partly because it is the motivation for this graduation thesis. Next to that, stress reduction is needed in the city and quite easy to achieve.
**Natural playareas**

Playing can be done in many surroundings, but it gives extra benefits if it occurs in a green area, such as a natural playarea. Stehouwer et al. (2009, pp. 20-21) give a definition for a natural playarea: “An environment with natural materials and shapes, indigenous plantation and height differences, with the aim of a complex interplay between natural and landscape elements that challenges and fascinates children and learns about the wonders and subtleties of the natural worlds while they are playing”. Dutch terms that are used often are “speelnatuur” and “natuurspeeltuin”.

**Benefits of urban green**

Playing outside is from importance for the development of a child. Playing in a natural surrounding has a positive influence on the playing behaviour (van den Berg and de Hek, 2009). Children are physically more active, do more experiments, have more fantasy and have more place for wondering (Ibid). Langers et al. (2008) show that playing in a natural environment is good for children’s motorial development. Research also shows that playing in a green environment can prevent obese (Ibid). Playing outside is also good for the child’s sensory development and social development (Nische, 2011). Children that play outside during school time can concentrate better afterwords (Ibid).

**Scale of effect**

The exact scale of effect can not be measured. Preconditions are that there is enough space to be more physical active and that there is a difference compared to a normal playground. Than playing outside will have a positive influence on child’s development.

**Design principles**

Van Suchteren and van Dijk (2011) show the requirements of a successful natural playarea. The place should be recognisable and accessible. Children like the differences in space, for example low-high, dark-light, open-closed and dry-wet. There should be an active place (climbing, running) and a more passive place (hiding, relaxing) (Ibid).

**Project**

Child development is one of the main goals of this graduation project, because currently child development is on low priority at the project site. And if children are satisfied with their living environment, parents are too. The third reason is that contact with nature on low age is related to respect for nature on higher age (Stehouwer et al., 2009). Education in nature is important to gain respect for urban green on long term.
Social interaction and social cohesion

Social cohesion

Social cohesion is the degree in which the inhabitants feel part of the local society. That means that they have the same values, are in a social network and that they are interrelated (Vreke et al., 2010). Social cohesion is important for a neighbourhood, because it makes people feel involved and responsible.

Benefits of urban green

Most urban green areas are free accessible and therefore they can stimulate social interaction (Swanwick et al., 2003). Urban green areas can improve social cohesion on neighbourhood scale through different ways. It can be a place for meeting, it can be controlled by residents and it can strengthen the identity of the neighbourhood (Vreke et al., 2010).

Scale of effect

A quantitative analysis done by the University of Wageningen shows the correlation between urban green areas and the level of social cohesion in highly urbanised areas in the Netherlands. Allotment gardens and public gardens have the most positive influence on social cohesion. Ten per cent more allotment gardens raises social cohesion with 5,7 per cent. Ten per cent more public gardens raises 5,5 per cent. Only parks have a small negative influence, it lowers social cohesion with 0,9 per cent (Vreke et al., 2010).

Design principles

Social cohesion can be improved by short contacts. Therefore it is important that green areas are easy accessible. Urban green areas should be clean, safe and attractive. An activity, like a playground, can stimulate contacts (Vreke et al., 2010).

Project

Social interaction and cohesion is a main goal in this graduation project, because it has many influence on the quality of the living environment. Besides that, there is a meeting point missing on the project site.
2.5 Other benefits of urban green

Next to environmental and social benefits, urban green has some benefits that are not covered by these themes. The other benefits urban green can have are:

- Physical health improvement
- Increase property price
Physical health improvement

Main goal

Physical activity

One of the sources for a healthy life is physical activity. Medium physical activity can lower the change on different kind of diseases (RIVM, 2012). It lowers the change on arteriosclerosis, diabetes (type 2), a stroke, osteoporosis, intestinal and breast cancer and depression (Ibid). Indirectly it also lowers the change on some disease by improving weight, blood pressure etc. Intensive physical activity improves the condition of the heart and the lungs (Ibid).

Benefits of urban green

Urban green areas can encourage physical activity, which is a crucial part of physical health (Swanwick et al., 2003). Next to that, urban green can improve quality of air, soil and water which can be related to health. Research also showed that people in natural environments recover faster from diseases than people in other environments (Chiesura, 2004).

Scale of effect

Lee and Maheswaran (2010) did a literature research in order to know if the evidence on the relation between physical health and urban green areas is strong. The relation between physical activity and health benefits is strong, however the relation between physical activity and urban green is weaker (Ibid). Only if urban green areas are accessible people are likely to use them more often and become more physically active. Also the perceived safety influences the physical activity (Ibid).

A research done in the Netherlands shows that urban green can positively affect perceived physical health (van den Berg and de Vries, 2000). The amount of health complaines in the last 14 days lowers with 0,15 per person with an increase of 10 per cent more green (Ibid).

Design principles

There is no difference in types of green related to the improvement of perceived health. Urban green, countryside and nature all give about the same effect (van den Berg and de Vries, 2000). Also gardens and water improve perceived health (de Vries et al., 2000).

However for the factual improvement of physical health it is a precondition that an urban green area supports physical activity. This can be done by encouraging walking, cycling and other sports. Therefore only larger urban green areas can improve physical health. Urban green areas should be easy accessible and safe (Lee and Maheswaren, 2010).

Project

Improving physical health is one of the main goals of the graduation project. This is because people in the city are more limited to be physically active. People see physical activity also as relaxing. That is why this has to be improved.
Benefits of urban green

An important other benefit is the fact that urban green can increase nearby property prices (Luttik, 2000). Houses that have a view on urban green usually have a higher price. Rusche (2011) shows that also larger urban green can influence property price. Urban green infrastructure (a network of urban green spaces) can influence property price on a regional level (Ibid).

Scale of effect

Luttik (2000) did a research in three Dutch cities on the influence on housing price. She shows that a house viewing a park increases the property price with twelve per cent. A garden bordering on water increases the price with twenty-eight per cent. A research done in five middle-sized Dutch cities showed also a positive effect of urban green related to housing prices (Bervaes and Vreke, 2004). A house facing a park raises the price with six per cent. The housing price raises while facing a public garden with five per cent, an open space with ten per cent and water with eleven per cent (Ibid). This research could not find a link between the raise of the housing price related to the distance to a park. Only nearby urban green increases housing price.

Design principles

Morancho (2003) highlights that not the size of the urban green area influences the property price, but the distance from the house to the closest urban green area. This should be taken into account while making a design. Small urban green areas are facing more houses than one large urban green area. Water increases housing price the most.

Project

Increasing property price is not a goal on itself in this graduation project. But it does say something about the satisfaction of the inhabitants if they are willing to pay more. So the fact that people like to face urban green is something that will be taken into account in this graduation project. The raise of property price will also be achieved together with other goals.
2.6 Preferences for urban green

Next to the benefits of urban green it is also important to know more about the user’s preferences. It is crucial to know which preferred conditions for urban green can improve the quality of the living environment. Therefore differences between user groups should be taken into account. A literature review is done on user’s preferences. The results are published in a paper on February 2nd 2012 for the 9th Graduation Lab Urbanism Conference.

The paper describes preconditions, general preferences and specific preferences for urban green. It also describes the urban conditions to meet these preferences. Several of these design principles will be used in this graduation project. The urban conditions are listed below. For the full paper, see appendix A.

Urban conditions to meet preconditions

The appreciation of the living environment is influenced by ornamental urban green in the direct environment. This means that small green areas scattered around the city give more appreciation than one vast urban green area. Urban conditions that meet this preconditions are elevation gardens, front gardens, green strips and trees in the street (Crommentuijn et al., 2007). For public green the accessibility is most important for use. The distance to public green should maximum be 400 metres (Van Herzele and Wiedemann, 2003). To meet this condition, small green areas scattered around are effective. The amount of urban green is not important, only the proximity (Crommentuijn et al., 2007). Urban green should be well maintained in order to have a positive influence on the living environment (de Boer and de Groot, 2010).

Urban conditions to meet general preferences

In order to meet the general preferences for urban green the usage should be taken into account. The most important motive for use is relaxing (Chiesura, 2004). Urban conditions that can support this use are places to sit, to walk, to sport and to play. These facilities should be integrated in the urban green. The second most important motive is getting in contact with nature (Ibid). Spaciousness is seen as a quality. A large park with fully grown trees is a potential place for this (Van Herzele and Wiedemann, 2003). Naturalness is also seen as a quality. Different animal and plantation species can contribute to this idea (Ibid). An urban green area should therefore enhance biodiversity. For the appearance of urban green people prefer to see environments that are coherent and complex. This can be achieved by a richness of different elements that are orderly placed in an area (Kaplan et al., 1998).

Urban conditions to meet specific preferences

Families want to have a place where their children can play safely. Nearby small scaled public green is an urban condition that can meet this specific preference (Vreke and Salverda, 2009). For children under six, this urban green should be in proximity of 150 metres (Ibid). For young people there should be a place in urban green to meet each other, a park is fitting for this group. Immigrants want a place to meet and eat, a park is an urban condition that can meet their preferences. Elderly wants to have a safe place to sit, small scaled public or semi public is fitting for this group (Ibid).
2.7 Main conclusions from theory

As conclusion from the theory answers can be given to research question 1A, 1B and 2A.

>> 1A What are the general benefits of urban green that can improve the living environment of the city? <<

Urban green has potential for many environmental issues. Urban green can purify air (AgriHolland, 2012), filter noise (Morancho, 2003), reduce urban heat island effect (Kleerekoper, 2009) and enlarge biodiversity (Rudd et al., 2002). Next to that, urban green also has many social benefits. Urban green has potential for aesthetic improvement (Smardan, 1987), stress reduction (van den Berg et al., 2010), child development (Stehouwer et al., 2009) and social interaction (Vreke et al., 2010). Besides that urban green can also improve physical health (Swanwick et al., 2003) and increase property price (Luttik, 2000). Together these things will influence a wide range of aspects in the domains of quality of living environment.

>> 1B And which of these benefits can be used in the case Elinkwijk and Zuilen? <<

For this graduation project the social benefits are most important for improving the living environment in Elinkwijk and Zuilen. The benefits are taken to the design are: Aesthetic improvement, stress reduction, child development, social interaction and physical health improvement (see table 3).

>> 2A What are the user’s preferences for urban green? <<

The main reasons to use urban green are: watching, walking (the dog), playing, cycling, meeting and getting in contact with nature (Cheisura, 2004). Furthermore users prefer environments that are coherent and complex: a richness of different elements that are orderly placed (Kaplan et al., 1998).

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<tr>
<th>Environmental and ecological benefits</th>
<th>Main goal</th>
<th>Side issue</th>
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<td>Air purification</td>
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Table 3. Benefits of urban green
This chapter gives a conclusion of the analysis that is done for the project area. First it explains the reason to choose the location. It also gives a brief overview of the two locations. At the end, the project locations are evaluated and compared to each other.

This chapter answers the following sub research questions:
- 2B And which of these preferences are not fulfilled in the case Elinkwijk and Zuilen?
- 3 What kind of urban green is already existing in the case Elinkwijk and Zuilen?
- 4 What are the problems of the living environment in the case Elinkwijk and Zuilen?
3.1 Choice for project location

Reason to choose Utrecht

Utrecht is one of the biggest cities in the Netherlands and part of the Randstad. With 3099 addresses within one kilometre of an address, it is on the eight place of the most highly urbanised areas of the Netherlands (RIVM, 2011). Utrecht scores lower than the Dutch average on quality of living environment. So is only 76 per cent of the inhabitants satisfied with their living environment, while the Dutch average is 85 per cent. Only 75 per cent is satisfied with the existing green, while the average is 81 per cent (Ibid).

This makes Utrecht a good project location, because the living environment and the green can be improved. Other cities in the Randstad are also possible cities to improve. An obvious choice would be Rotterdam, where only 71 per cent of the inhabitants is satisfied with their living environment. However, I believe it is more valuable to choose a city where less research has been done, because it can add something to the existing studies.

Figure 16. Satisfaction with living environment in 2006 (Source: RIVM, 2011)
Reason to choose Noordwest

Within Utrecht there are several neighbourhoods where the satisfaction of the living environment is low. The neighbourhoods that score below average are Overvecht, Zuidwest and Noordwest. Overvecht and Zuidwest are neighbourhoods with a lot of sixties and seventies buildings. In these neighbourhoods there are many social problems that are not always related to the physical environment. Noordwest is the only exception, this is a pre-war neighbourhood. The problems in the living environment in Noordwest are more related to physical factors. That is why I choose Utrecht Noordwest as project location.

Figure 17. Grade for living environment (Source: ABF, 2010, edited)
Reason to choose Elinkwijk and Zuilen

Zooming in on Noordwest, the neighbourhood can be divided into demographic and spatial areas. Most of the area is built in the thirties. An exception are the neighbourhoods Lessesbuurt and Elinkwijk, which are garden villages from the 1915’s. The amount of urban green is the lowest in the demographic area Elinkwijk. This area contains spatial unities Elinkwijk and Zuilen. Elinkwijk is representative for a garden village and Zuilen is representative for the rest of the neighbourhood. This is why I choose these two neighbourhoods as project location.

Figure 18. Demographic and spatial division of Utrecht Noordwest - scale 1:20.000
3.2 Introduction project location

Location in Utrecht

Elinkwijk and Zuilen are two neighbourhoods laying in the Northwest of Utrecht. The area is near to two waterways: “Amsterdamrijnkanal” and “Vecht”. Elinkwijk and Zuilen are enclosed by the main road “Amsterdamsestraatweg”. On the south side of Elinkwijk lays the railway track from Utrecht to Amsterdam.
Origin of Utrecht Noordwest

The origin of Utrecht Noordwest started with the industries along the canal, which are nowadays changed into industrial estates. Together with the industry, the garden villages Elinkwijk and Lessepsbuurt arose in 1915. The surrounding was still unbuilt at that time, except for the Julianapark. Later in the thirties the areas in between the city centre and the garden villages where built. Nowadays the area exists mainly of dwellings and some light industry.
Introduction Elinkwijk

Dwellings

Elinkwijk is a garden village built in 1915. The neighbourhood consists of 318 dwellings and a day nursery. The dwellings are in general quite small with an average size of 57 square metre. There are row houses and semi-detached houses, with a maximum of three floors. All of the dwellings have a back garden and some of them also have of front garden. The density of the neighbourhood is 38 dwellings per hectare. This belongs to the category middle dense.

Surrounding

On the Northeast border of the area lays the Amsterdamsestraatweg. On the Southwest side the area is bordered by the railway track to Amsterdam. From the middle of Elinkwijk the Julianapark is 300 metres away.

Living environment

The streets in Elinkwijk are quite wide. Many streets have tree lines. Some streets have front gardens. There is no public green in Elinkwijk, except for two flower beds. The area along the railway track is made of grass and green elements, but is not accessible for public. Except for the streets and some small playgrounds, there is no public space in Elinkwijk.
Figure 22. Birds eye view Elinkwijk (Source: Microsoft Corporation, 2012)
Figure 23. Street views of Einkwijk (Source: Google, 2011)
Introduction Zuilen

Dwellings

Zuilen is an expansion area built in 1930. The neighbourhood consists of 860 dwellings, two schools, a day nursery, a church and some small facilities. All dwellings are row houses, with a maximum of three floors. Many dwellings are split into different smaller apartments. The average size of the houses is therefore now lower than in the beginning, namely 57 square metre. All dwellings on ground floor have a back garden and only some have a small front garden. The dwellings on higher floors have no access to private green areas. The density of the neighbourhood is 85 dwellings per hectare. This belongs to the category highly dense.

Surrounding

On the Northeast side of the area lays the Prins Bernardlaan, which is one of the main sources of urban green in the area. On the Southwest side the area is bordered by the Amsterdamsestraatweg.

Living environment

The streets in Zuilen are quite narrow. Because of the high density there are a lot of cars parked in the streets. There is almost no urban green in the area, only some trees. The Edisonstraat is an exception, it has many big trees. Some playgrounds and the streets are the only public space in Zuilen.
Figure 25. Birds eye view Zuilen (Source: Microsoft Corporation, 2012)
Figure 26. Street views of Zuilen (Source: Google, 2011)
3.3 Method of analysis

A location analysis is done to give answers to the following research questions:

- 2B And which of these preferences are not fulfilled in the case Elinkwijk and Zuilen?
- 3 What kind of urban green is already existing in the case Elinkwijk and Zuilen?
- 4 What are the problems of the living environment in the case Elinkwijk and Zuilen?

The analysis is done by a location visit, mapping and a sectional analysis. The analysis can be divided in three scales: Utrecht, Noordwest and Elinkwijk and Zuilen. Through this different scales the area is analysed on basic issues like functions, inhabitants and history. Besides that, extra attention is paid to two themes.

The first focus point is the appearance of the street. The quality of the street is close related to the quality of the living environment. The physical living environment can be divided by public and private domain. This graduation project focuses on the public domain. One of the most important parts of the public living environment is the street. The appearance of the street is analysed by mapping and sectional analysis. Street width, urban green and parking are things that determine the appearance of the street.

The second focus point is urban green. An analysis is done to see what type of urban green is already existing in the area. Urban green is divided in different typologies to make a distinction.
3.4 SWOT conclusions from analysis

This page gives an overview of the conclusions from the analysis. The conclusions are based on the maps, the demographic analysis, the sectional analysis, the location visit and the expert interview. For the full analysis, see appendix B.

**Elinkwijk**

**Strengths**

Based on analysis of existing urban green I can conclude that Elinkwijk has many visual urban green, which is a strength. The fact that it is a garden village, results in a wide set-up with a lot of back gardens and front gardens. The tree lines also function as visual green, which gives the streets a green and pleasant appearance.
Weaknesses

Based on the location visit I can conclude that there is a lot of noise pollution in Elinkwijk. This comes from the railway and from the Amsterdamsestraatweg. This is one of the weaknesses of Elinkwijk.

Another weakness, that can be conducted from the functional analysis, is the fact that there is almost no public space in Elinkwijk.

A weakness that can be drawn from the analysis of urban green is the fact that there is no public green. There is a lot of visual green like trees and front gardens, but there is no functional green. For example, there is no place to walk the dog or to play soccer.

The last weakness, that can be drawn from the historic analysis is the fact that this garden village lost some of its values. It used to be surrounded by grassland. Nowadays the area is surrounded by light industry and dwellings.

Summarised these weaknesses all say something about the quality of the living environment which has many elements for improvement.

Opportunities

Nearby Elinkwijk lays the waterway Amsterdamriijnkanaal. The waterside of this canal has opportunity. Nowadays the waterside is not maintained and close to industry. The view over the water gives a feeling of spaciousness. By changing the waterside, it can become more attractive and more people will use it.

Another opportunity of Elinkwijk that is found in the analysis is the green buffer along the railway. It is not publicly accessible at this moment. But it has potential as urban green area and for a walking or bicycle route to the train station.
Threats

One of the threats of Elinkwijk is the parking problem. The streets are already fully parked. In the neighbourhood are approximately 300 cars, including visitors (Municipality of Utrecht, 2008) and only 270 parking places. This means that only 90 per cent of the people can park their car. According to the parking norm for new developments (set by the Municipality of Utrecht) this area should contain even 390 parking places (Ibid). If there will not be a solution for the parking problem, the cars will dominate the appearance of the neighbourhood and will cause obstruction. Next to that, parked cars dominating the street also means that there is no place for other (important) functions, such as urban green or public space. This threat is really serious and from high importance in this graduation project.

Next to that, there is also another threat in Elinkwijk. The houses are not fitting with the demand side. They are quite old and small. We can assume that people are living in Elinkwijk for the identity of the neighbourhood and the living environment. If the quality of the living environment will decrease with the increasing parking problem, the neighbourhood will lose value. There is a serious threat that the neighbourhood will end in a downward spiral, see figure 31. In that way Elinkwijk may decline irreversible. As a result Elinkwijk may be demolished and Utrecht will lose an important conservation area.
Zuilen

Strengths

Based on the analysis of urban green in Zuilen we can highlight the Sint Bernardlaan as one of the strengths. It is an avenue which functions as public urban green area.

Another strength in Zuilen is the Edisonstraat. This is a wide street with trees from first order. The street has a pleasant appearance.

Weaknesses

The most important weakness of Zuilen is the fact that there is not enough urban green. There is only some visual urban green and no functional urban green at all.

One of the weaknesses of Zuilen is the stony character of the streets. Many of the streets are dominated by parked cars. Besides that, the streets are quite narrow, which makes the appearance even more unpleasant.

Another weakness of Zuilen is the fact that there is no public space, except from some playgrounds.
Opportunities

Zuilen used to have large dwellings that are now split into smaller apartments. The larger dwellings had their value, because they are rare in the surrounding. Therefore it can be seen as an opportunity to go back in their original state.

Figure 35. Opportunity Zuilen: Join split appartments

Threats

The threat in Zuilen is the same as in Elinkwijk, except for the fact that the problem is far larger. In Zuilen are 790 cars, including visitors (Municipality of Utrecht, 2008). There are only 540 parking places, not even 70 per cent of the people can park their car. For new developments even have to plan 1030 parking places (Ibid). The car problem in Zuilen is endless.

The downward spiral is already beginning, the dwellings are already downgraded to smaller apartments. Zuilen is already declining. If Zuilen will decline any further, there is a threat that it will be demolished. While at this moment the area still has opportunity to be saved.

Figure 36. Threat Zuilen: Parking problem
3.6 Elinkwijk versus Zuilen

In Elinkwijk and Zuilen the same problems play a role: The parking problem, the lack of functional urban green and the lack of public space. However there are two very important differences between these two neighbourhoods.

Size of problem

An important difference is the size of the problems. In Zuilen the problems are much larger than in Elinkwijk. In Elinkwijk 90 per cent of the people can park their car, in Zuilen only 70 per cent. In both neighbourhoods the streets are dominated by parked cars. Only in Zuilen the streets sections are very narrow and there is no visual urban green, so the streets have an unpleasant appearance. There is almost no functional urban green in both neighbourhoods. However in Elinkwijk all of the dwellings have back gardens and many have front gardens, which may function as alternative. In Zuilen only the dwellings on ground floor have a back garden and they are far smaller than in Elinkwijk.

Space for solutions

Another really important difference is the fact that Elinkwijk gives space for solutions, literally. With a density of 85 dwellings per hectare, compared to 38, Zuilen is far more densely built. Zuilen is so densely built that it does not have any freedom for solutions. The street sections in Zuilen are narrow and there is no place for other things except for cars. Next to that, Elinkwijk also has space for solutions in the surroundings, for example in the industrial estate. Zuilen on the other hand is surrounded by highly dense built residential areas, that does not give space for solutions.
Influence on design

The problems in Zuilen are much larger and the space for solutions is much smaller compared to Elinkwijk. This influences the design of both neighbourhoods. While in Elinkwijk some small interventions may be a solution for the problems in the living environment, in Zuilen the problems may be almost unsolvable.

Figure 39. Map density Elinkwijk

Figure 40. Map density Zuilen
3.5 Main conclusions from location

As conclusion from the location analysis answers can be given to research questions 2B, 3 and 4.

>> 2B And which of these preferences are not fulfilled in the case Elinkwijk and Zuilen? <<

There is a lack of functional urban green in both Elinkwijk and Zuilen. In this way not all preferences of users can be fulfilled. There is no place to walk the dog, play outside, cycle in an urban green area or to get in contact with nature.

>> 3 What kind of urban green is already existing in the case Elinkwijk and Zuilen? <<

Especially Elinkwijk already has a lot of visual urban green. Many streets have a green appearance, caused by the tree lines and the front gardens. Zuilen has far less urban green. In some streets there are trees or elevation gardens. Functional urban green is not existing in both neighbourhoods. Only some hundreds of metres outside the neighbourhoods are some functional urban green areas: Julianapark and Sint Bernardlaan. The waterway Amsterdamrijnkanaal and the green buffer along the railway have potential to be used as urban green.

>> 4 What are the problems of the living environment in the case Elinkwijk and Zuilen? <<

In both neighbourhoods there is a serious problem with the public domain of the living environment. Partly this is caused by the huge parking problem. The streets are stony and dominated by cars. In this way the streets are only functioning as infrastructure and not as public space. While there is also no other public space in the neighbourhoods.
This chapter describes the urban design made for the case Elinkwijk and Zuilen. It shows the design through several scales. The design on neighbourhood scale is showed in steps, together with the design interventions. This chapter answers the following sub research question:

- 5 Which urban design can improve the living environment by urban green in the case Elinkwijk and Zuilen?
4.1 Missing urban green

In the theoretical part I found beneficial urban green for the case Elinkwijk and Zuilen. In the analytical part I found preferred urban green. Comparing this with the existing urban green in Elinkwijk and Zuilen, I can conclude what type of urban green is missing.

Beneficial urban green

Urban green can be divided in urban green elements and urban green areas. The benefits of urban green used in this project are: Aesthetic improvement, stress reduction, child development, social interaction and physical health improvement. In table 4 is showed which types of urban green can achieve these benefits. Aesthetic improvement can be achieved by almost all types of urban green (van den Berg et al., 2007). In the same way, stress reduction can be achieved (Ibid). Playing outside for a better child development can be achieved especially with natural play grounds (Stehouwer et al., 2009). Social interaction can be achieved by urban green areas on neighbourhood scale, especially in public gardens (Vreke et al., 2010).

Preferred urban green

The main reasons to use urban green are: Watching, walking (the dog), playing, cycling, meeting and getting in contact with nature. In table 4 the preferences are also connected to types of urban green. For walking the dog is a chain of urban green areas needed or a larger urban green area. Playing outside is possible in middle scaled green areas. For cycling a larger scaled chain of urban green areas is needed. Meeting takes usually place on neighbourhood scale and can be achieved for example in a public garden (Vreke and Salverda, 2009). Getting in contact with nature is something that can be achieved by spacious areas or by seeing plantation or animal species (van Herzele and Wiedemann, 2003), for example at a waterside.

<table>
<thead>
<tr>
<th>Yes</th>
<th>Maybe</th>
<th>No</th>
</tr>
</thead>
<tbody>
<tr>
<td>Watching</td>
<td>Walking (the dog)</td>
<td>Playing</td>
</tr>
<tr>
<td>Back garden</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Front garden</td>
<td></td>
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<td>Over garden</td>
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<tr>
<td>Elevation garden</td>
<td></td>
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<tr>
<td>Green elevation</td>
<td></td>
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<tr>
<td>Green roof</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Green strip on side</td>
<td></td>
<td></td>
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<tr>
<td>Green strip in middle</td>
<td></td>
<td></td>
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<tr>
<td>Flower box</td>
<td></td>
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<tr>
<td>Tree in paved surface</td>
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<tr>
<td>Avenue</td>
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<tr>
<td>Avenue with water</td>
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<td>Public garden</td>
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<td>Enclosed garden</td>
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<td>Sportfield</td>
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<td>Playground</td>
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<td>Children’s farm</td>
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<td>Park</td>
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<td>Allotments</td>
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<td>Zoo</td>
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<tr>
<td>Green structure</td>
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<tr>
<td>Waterstream</td>
<td></td>
<td></td>
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<tr>
<td>Cemetery</td>
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</tr>
</tbody>
</table>

Table 4. Types of urban green that can fulfill preferred and beneficial urban green
4.2 Design targets

From the beneficial urban green, preferred urban green and the problems in the living environment in Elinkwijk and Zuilen the following design targets are set. Each design target is linked to a type of urban green (an element, area or link between areas), a distance from home, the benefits that should be achieved by it and the preferred use it should fulfil. The argumentation behind these design targets comes from the theory of chapter 2, where design principles are linked to beneficial and preferred urban green. Together these design targets should lead to a design which can improve the living environment of Elinkwijk and Zuilen.

### Stress reducing view

>> Everybody should have a stress reducing view within 0 metre from home <<

| Type of urban green:         | green element or green area |
| Distance from home:          | 0m                          |
| Main benefits:               | stress reduction, aesthetic improvement |
| Side benefits:               | increase property price, urban heat reduction |
| Preferred use:               | sitting, watching           |

### A place to meet

>> Everybody should have a place to meet others within 200 metres from home <<

| Type of urban green:         | green area                  |
| Distance from home:          | 200m                        |
| Main benefits:               | social interaction          |
| Side benefits:               | stress reduction, aesthetic improvement, increase property price |
| Preferred use:               | meeting, picnicking          |
Playing independent

>> Every child under six years old should be able to play outside independent within 150 metres from home and every child above six years within 400 metres from home <<

Type of urban green: green area
Distance from home: 150m/400m
Main benefits: child development
Side benefits: stress reduction, aesthetic improvement, social interaction, physical health improvement, increase property price
Preferred use: playing, doing sports

A place to get in contact with nature

>> Everybody should have a place to get in contact with nature within 800 metres from home <<

Type of urban green: green area
Distance from home: 800m
Main benefits: -
Side benefits: stress reduction, aesthetic improvement, increase property price, child development
Preferred use: getting in contact with nature

Bicycle and walking network

>> Everyone should have access to a walking and cycling network within 200 metres from home <<

Type of urban green: link between green areas
Distance from home: 200m
Main benefits: physical health improvement
Side benefits: stress reduction, aesthetic improvement, increase property price
Preferred use: walking (the dog), cycling, jogging
4.3 Design of network

Figure 41. Design for cycling network
Cycling network

A new cycling route is planned in the urban design in order to give inhabitants the possibility to be physical active. Physical activity is good for human health. The cycling paths are linked to green areas to make them better accessible. The cycling routes are also connected to the surrounding of Utrecht, where inhabitants may find a place to get in contact with nature. In this way the cycling network enables inhabitants to use other urban green areas inside and outside the city. With the cycling network inhabitants can practise their preferred use of cycling.
Walking network

Two new walking routes are planned in the urban design. In this way inhabitants from Elinkwijk and Zuilen can walk around the block with their dog. The walking network is connected to a wider system of urban green areas. In that way inhabitants have possibility to do also a longer walk. A walking network is good for physical health and it is a preferred use.

Figure 42. Design for walking network
4.4 Method of design

Size of intervention

Improving the living environment can be done in several ways. The buildings in Elinkwijk and Zuilen are still functioning well. The goal of this graduation project is therefore only to change the public space. Only if there is no other solution the building structure can be changed minimal.

Design in steps

The design interventions for Elinkwijk and Zuilen are split up in steps. This is done for several reasons.

Making place and being realistic

The aim of the design is to improve the living environment of Elinkwijk and Zuilen by urban green. Implementing urban green is not only adding trees and urban green areas. Simply because this is not possible in the existing situation. Before that, some other steps are needed. You need to make place for urban green. Many existing plans for urban green tend to forget this. An example of this is “Groendiep” made by the municipality of Utrecht. In figure 43 an example is shown on how to change a street section into a more green environment. The figure shows the end result. However, nothing is said about the place where the trees are standing. This used to be parking places. In the report of “Groendiep” no one takes notion of the amount of parking places that disappear. Plans for urban green are only going to be executed if they are realistic. This graduation project is split into several steps to emphasise that making place is a crucial step. Besides that, in that way a realistic image on the amount of parking places can be created.

Choosing the size of intervention

Another reason why the designs are split into steps is because not every municipality wants to invest equally in urban green and the living environment. Investments in the public domain of the living environment should be done by the municipality. This is something that will not be paid back directly. On a long term it will give the neighbourhood a better identity, it will be a more popular place to live and the housing prices may rise. Not every municipality has the opportunity for this kind of investments. Besides that, not all municipalities tend to believe in long term thinking. By splitting the design in steps, the threshold to invest in urban green will be lower and every municipality can choose its own strategy.

Subtracting design principles

The last reason why the design is split into steps is because of the research. The design interventions can be distinguished from each other more easily. In that way it is clear what design principles can be subtracted from the design.

Figure 43. Example idea from Groendiep (Municipality of Utrecht, 2008)
4.5 Design Elinkwijk

Step 1: Deal with parking

- No parking: Street sections ≤ 10m
- Maximum one sided parking: Street sections > 10m ≤ 12m
- Permanent parking garage
Parking problem

The first step towards a greener living environment is dealing with the parking problem. Parked cars should not dominate the appearance of the street. Therefore street sections under 10 metres are planned without parking in the urban design of Elinkwijk. Street sections between 10 and 12 metres are planned with parking only on one side. By this design intervention 25 parking places disappear in Elinkwijk. There is already a parking shortage in Elinkwijk, therefore a new parking garage is planned in an existing building. This will facilitate 90 new parking places. In total there are now 40 extra parking places in Elinkwijk.
Step 2: add urban green elements

- Wide sidewalk (with place for elevation garden)
- Tree lines
- Green strip

Figure 39. Step 2 design Elinkwijk - adding urban green elements
Wide sidewalk (with elevation gardens)

In the urban design of Elinkwijk are several streets planned with a wide sidewalk: A sidewalk of minimum 3,5 metres wide. A wide sidewalk give possibility to do more activities on the street. In this way the streets will be more lively and act as public space. A threshold between the dwelling and the street will encourage small children to play on the sidewalk (Municipality of Rotterdam, 2010). The extra space of the sidewalk can also be used for elevation gardens. In this way a wide sidewalk will encourage playing outside and having elevation gardens. That is good for child development, stress reduction and aesthetic improvement.

Tree lines

The place that becomes available by taking away some parking places can be used to implement urban green elements. In the design of Elinkwijk several tree lines are planned. The existing trees in Elinkwijk are categorised as third order trees. Third order trees have a maximum height of 6 metres when they are fully grown (Boom, 1975). The new planned trees in Elinkwijk are second order trees, they can become 12 metres high (Ibid) and will have a more prominent role in the street section. The tree lines are good for stress reduction and aesthetic improvement.

Green strip

Another green element that is planned in the urban design of Elinkwijk are green strips. This green strips are part of the walking network. Inhabitants can walk the dog along these green strips as preferred. Also other inhabitants can walk around the block. The green strips can exist of grass, ground vegetation and some small trees. Green strips are good for stress reduction, aesthetic improvement and physical health improvement.
Example wide sidewalk with tree line

Figure 40. Section AA: Fultonstraat - existing situation

Figure 41. Section AA: Fultonstraat - new situation
Figure 42. Fultonstraat - existing situation

Figure 43. Fultonstraat - new situation
Step 3: Add urban green areas

- Public garden
- Natural play area
- Urban green along railway
- Urban green along canal

Figure 44. Step 3 design Elinkwijk - adding urban green areas
Public garden

In the heart of Elinkwijk is a public garden planned. Public gardens have a positive effect on social cohesion. The public garden can be maintained by the inhabitants itself. It should be a place where people meet each other. It is also good for stress reduction and aesthetic improvement.

Natural playarea

Next to the public garden and the day nursery is a natural playarea planned. Instead of the existing stony playground the new design has a natural playarea. This will be a place where children can play freely and learn from nature. To make the place exciting there should be differences in space, like low-high, open-closed and dry-wet. Natural playareas are good for child development. At the same time it can be a place for social interaction, it makes the surrounding more beautiful and it is stress reducing.

Urban green along railway

Along the railway is a new urban green area planned in the design of Elinkwijk. The existing area will be changed and publicly accessible. This urban green area is part of the cycling and walking network. It is connected to the train station. This link between urban green areas will be good for physical health and will facilitate the preferred use of walking and cycling. Next to that, also this type of urban green is good for stress reduction and aesthetic improvement.

Urban green along canal

The area along the canal will be redesigned. It will be better accessible and more attractive. It will function as a place where people can get in contact with nature. The canal gives a feeling of spaciousness, which is seen as a component of nature. This urban green area also belongs to the cycling and walking network. It will be good for physical health, stress reduction and aesthetics.
References public garden

Figure 45 & 46. Grassentuin - Buro Sant en Co - Enschede (Source: Buro Sant en Co, 2012b)

Figure 47. Hermitage - Heeswijk Architecten - Amsterdam (Source: Heeswijk Architecten, 2012)

Figure 48. Masira - Buro Sant en Co - Amsterdam (Source: Buro Sant en Co, 2012a)
References natural playarea

Figure 49. Houttuin - Buro Sant en Co - Utrecht (Source: Buro Sant en Co, 2012c)
Figure 50. De Speeldernis - Rotterdam (Source: De Speeldernis, 2012)
Figure 51. Stellenbos - Rotterdam (Source: Buitenruimte voor contact, 2012)
Figure 52. De Klimop - Rotterdam (Source: Municipality of Rotterdam, 2012)
Urban green along railway

Figure 53. Section B’B: Slope railway - existing situation
Figure 54. Section B'B: Slope railway - new situation
Urban green along canal

Figure 55. Section C’C: Waterside Amsterdamrijnkanaal - existing situation
Figure 56. Section C'C: Waterside Amsterdamrijnkaal - new situation
End result Elinkwijk

Together these steps lead to the end result of the design of Elinkwijk. In three steps and only by changing the public domain, the living environment of Elinkwijk can be improved.

In the new situation of Elinkwijk inhabitants can practise their preferred use of urban green. The living environment is improved by making use of several benefits of urban green. The inhabitants of Elinkwijk will be less stressed and physically more healthy. Children will have a better development and there will be more social cohesion. The neighbourhood will be aesthetically improved by the new urban green elements and areas. As side effect the vegetation will reduce the urban heat island effect and the visual green will raise property price.

Hopefully the inhabitants of Elinkwijk will be more happy in this way.
4.6 Design Zuilen

Step 1: Deal with parking

- Maximum one sided parking: Street sections $> 10 \text{m} \leq 12 \text{m}$
- Maximum partly two sided parking: Street sections $> 12 \text{m} < 16 \text{m}$
- Permanent parking garage
- Temporary parking places

Figure 58. Step 1 design Zuilen - changing parking
Parking problem

Also in Zuilen the first step towards a greener living environment is dealing with the parking problem. However, this is far more difficult in Zuilen than in Elinkwijk. In the design the street section between 10 and 12 metres are planned with only on one side parking places. Street sections between 12 and 16 metres only have partly two sided parking. By this design intervention 110 parking places disappear in Zuilen. In the existing situation there is a shortage of 250 parking places. The new shortage will be 360 parking places, which is a huge amount. Therefore two new parking places are needed. The first planned parking garage in Zuilen is permanent and facilitates 240 places. The second car park is temporary and has 80 places. In the new situation there will still be a small parking shortage of 40 places. This cars need to be temporary parked outside the neighbourhood, for example in the parking garage of Elinkwijk.
Step 2: Add urban green elements

- Wide sidewalk (with place for elevation garden)
- Tree lines
- Trees at corners
- Green strip
Wide sidewalk (with elevation gardens)

Also in Zuilen there are several wide sidewalks planned. They will make place for playing outside and elevation gardens. That is good for child development, for stress reduction and aesthetic improvement.

Tree lines

The place that becomes available by taking away some parking places, is planned for urban green elements. The existing trees in Zuilen differ in specie and size. Most trees are from third order. The Edisonstreet is full with trees from the first order, they can become more than 12 metres high (Boom, 1975). Trees that are planned next to existing trees should be in the same order and specie. Trees that form a new tree line can be from second order, so they will have a more prominent role in the street appearance. The tree lines are good for stress reduction and aesthetic improvement.

Trees at corners

Some streets in Zuilen have only some small trees and do not have place for bigger trees. At this streets trees are planned at corners. In that way the appearance of the streets can be made green by some small interventions. These trees will aesthetically improve the streets and will be a source for stress reduction.

Green strip

In the design of Zuilen there is also a walking route planned. To facilitate this, green strips are planned in some streets. This green strips are good for stress reduction, aesthetic improvement and physical health improvement.
Example wide sidewalk with elevation gardens and tree lines

Figure 60. Section A1A: Balderikstraat - existing situation

Figure 61. Section A1A: Balderikstraat - new situation
Figure 62. Balderikstraat - existing situation

Figure 63. Balderikstraat - new situation
Example green strip

Figure 64. Section B'B: Swammerdamstraat - existing situation

Figure 65. Section B'B: Swammerdamstraat - new situation
Figure 66. Swammerdamstraat - existing situation

Figure 67. Swammerdamstraat - new situation
Step 3: Lower density

- Join apartments to one dwelling
Lower density

The density of Zuilen is far higher than in Elinkwijk. This causes the fact that there is less space for design solutions. The huge parking problem is partly solved in step 1 of the design of Zuilen. But still only a few people can park their car in front of their house. Walking from a parking garage is not the most ideal situation. Because the density is so high, there is also no place for urban green areas.

Join apartments

To lower the density and to enrich the area with other housing typologies, some apartments will be joined to one dwelling. Along the Edisonstraat apartments of approximate 60 square metre will be joined to a dwelling of 120 square metre. The same will be done with some apartments along the Linnaeusstraat. These blocks will be changed in more luxurious dwellings. The dwellings in the Edisonstraat are along a monumental green street and the dwellings in the Linnaeusstraat will have a small front garden. We can expect that this new urban green will raise property price. 210 apartments will be changed in 100 dwellings. In that way 100 parking places less are needed. The place of this parking places can now be used for urban green areas.
Step 4: Make place

- Demolish buildings

Figure 69. Step 4 design Zuilen - demolishing buildings
Demolish buildings

The amount of urban green in Zuilen is still quite low in step 3 of the design. There is almost no open space left where urban areas can be planned. Therefore in Zuilen there is no other option than to demolish some buildings. In the middle of Zuilen and at the Balderikstraat 25 houses will be demolished. This is the minimum possible. For a qualitative living environment, with functional urban green that can improve social cohesion and child development, this interference is necessary.

Parking problem

The density of the area is now fixed. Because of the change and demolishing of some dwellings, 120 parking places less are needed. In this new situation there are exactly the same amount of parking places as cars. While at that moment the parking problem is solved, it is still a point of attention.
Step 5: Add urban green areas

- Public gardens
- Natural playarea
- Green alleys

Figure 70. Step 5 design Zijl en - adding urban green areas
Public gardens

In step 5 of the design of Zuilen the temporary car park can be replaced. The parking places are no longer needed, because the density of the neighbourhood is now lower. In the design there is a public garden planned at that place. There is also a public garden planned close to the school and the church. These public gardens will stimulate social cohesion. It is also good for aesthetic improvement and stress reduction.

Natural playarea

With the demolishing of some dwellings there is now place for a natural playarea. The natural play area is planned in between the school and the day nursery. The natural playarea is good for child development and social interaction. Next to that, it also aesthetically improves the direct environment and is stress reducing.

Green alleys

The Balderikstraat is in the existing situation a long and stony street. To give also this area of the neighbourhood more urban green, two green alleys are planned. They are connected to the Sint Bernardlaan, so that inhabitants can make better use of that existing urban green. This green alleys will encourage physical activity, because more green routes are available. The green alleys are good for physical health. This urban green area is also good for aesthetics and stress reduction.
End result Zuilen

Together these steps lead to the end result of the design of Zuilen. Compared to Elinkwijk, more steps are needed to improve the living environment. Five steps are needed and it is not possible to change only the public domain. Also some building have to be changed in order to improve the living environment of Zuilen.

In the new situation of Zuilen inhabitants can practise their preferred use of urban green. The living environment is improved by making use of several benefits of urban green. The inhabitants of Zuilen will be less stressed and physically more healthy. Children will have a better development and there will be more social cohesion. New planned urban green will give the neighbourhood a better appearance. As side effect the vegetation will reduce the urban heat island effect and the visual green will raise property price.

Hopefully the inhabitants of Zuilen will be more happy in this way.
4.7 Main conclusions from design

As conclusion from the design an answer can be given to sub research question 5.

>> Which urban design can improve the living environment by urban green in the case Elinkwijk and Zuilen? <<

To improve the living environment of Elinkwijk and Zuilen the parking problem has to be solved first. In that way there will be more place for urban green. For Elinkwijk this means that three streets have to be changed, while in Zuilen eight streets have to be changed. After that, urban green elements (such as elevation gardens, trees and green strips) can be implemented in the streets. In Elinkwijk seven streets will be enriched with urban green elements. In Zuilen ten streets will be enriched with urban green elements. Furthermore, urban green areas (such as public gardens, natural playareas) can be implemented. However, before this step, some dwellings in Zuilen should be changed to make place. 210 dwellings in Zuilen should be joined and 25 dwellings should be demolished. After that, both neighbourhoods can be improved by adding urban green areas. Elinkwijk will get four new urban green areas and Zuilen five. As end result the living environment of the two neighbourhoods are improved by urban green. To achieve this endresult, far more steps were needed in Zuilen.
DESIGN PRINCIPLES

This chapter gives a list of design principles that can be used in other neighbourhoods. They are substracted from the design of Elinkwijk en Zuilen. It answers the main research question of this graduation thesis:

- Which urban design principles - substracted from the case Elinkwijk and Zuilen - can be used to improve the living environment by urban green in Dutch pre-war middle or high dense neighbourhoods?
5.1 Method of design principles

The theory gave answer to the question “What are the benefits of urban green?” and “What are the user’s preferences for urban green?”. For all these benefits and preferences general design principles are given in the theoretical framework.

Applied on the case Elinkwijk and Zuilen more specific design principles are developed through research by design. These design principles are different, because they take into account a certain location. In that way the design principles are put into perspective and have more value.

The following design principles are subtracted from the design of Elinkwijk and Zuilen. These principles can be used to improve the living environment of other Dutch pre-war middle and high dense neighbourhoods. It should be taken into account that these neighbourhoods were the scope of the research. In that way not all benefits and preferences of urban green are covered by the following design principles. The benefits that are important in the design are: Stress reduction, aesthetic improvement, child development, social interaction and physical health improvement. The user’s preferences that are important in the design are: Walking (the dog), cycling, playing, meeting and getting contact with nature.
5.2 Design principles street scale

Minimum neighbourhood street

The next design principles are interventions on street scale. These principles can be used in any street section. However all of these interventions need space. Therefore the minimum use for the street is set.

Roadway of 4,5 metres

To have a qualitative living environment, cars should not have a prominent role in the street section for several reasons. The first reason is for aesthetic purposes, people do not like the view on cars. Next to that, cars are a source of noise pollution and air pollution. Another reason to minimise cars is to create a safe living environment for children. There should be a roadway of 4,5 metres wide for two-way traffic. This is the minimum size for a road classified in the category for access roads of 30 kilometres per hour (Dutch category: Erftoegangs wegen) (Grontmij, 2009). By making a small two-way traffic roadway, people are forced to drive slowly and carefully. In this way the roads are also not attractive as traffic bypass. A minimum size for the roadway also gives more space for other elements in a street section.

Sidewalks of minimum 1,5 metres

To have a qualitative living environment, inhabitants should also have a chance to move by foot. For a comfortable way of walking the sidewalks should be at minimum 1,5 metres wide at both sides.

Minimum size neighbourhood street

The minimum size for a neighbourhood street is 7,5 metres (1,5+4,5+1,5). All the space that is left can be used for discussion. This is the space that can be used for parking, but also for urban green. The next design principles give an overview of the possibilities of urban green in a street section.

Plan wide sidewalks

>> Wide sidewalks stimulate children to play on the street and stimulate the creation of elevation gardens. <<

Small children like to place close to their parents. By creating a threshold between the dwelling and the street, the sidewalk will be a more safe place to play. A wide sidewalk gives children the freedom to create their own play. In this way a wide sidewalk will encourage children to play on the street (Municipality of Rotterdam, 2010). Playing outside is important for the development of a child (Ibid). A wide sidewalk also gives people the place to create an elevation garden. This elevation garden can act as a threshold between dwelling and street. Elevation gardens can aesthetically improve a street section, because people prefer streets with urban green above streets without (van den Berg and de Vries, 2000). People that have a view on the elevation garden from their house will experience stress reduction (van den Berg et al., 2010).

A sidewalk should have a minimum of three metres, the threshold should be maximum 1,20 metre (Municipality of Rotterdam, 2010). The best side to plan a wide sidewalk is the Southside. Elements that can act as a threshold are elevation gardens, benches, small walls or shelters. The streets should have a minimal car use and the preferred speed is thirty kilometre per hour (Municipality of Utrecht, 2009). Small walls can define the place for an elevation garden.

A wide sidewalk can be planned in all traditional streets. This is mostly in pre-war neighbourhoods. Research should reveal if planning a wide sidewalk is also effective in other neighbourhoods.

Plan tree lines

>> A tree line aesthetically improves the street and is a source for stress reduction. <<

Over the whole world people prefer urban areas with urban green over urban areas without urban green (van den
Berg and de Vries, 2000). A street that has a unpleasant appearance can be improved by implementing urban green. Planning tree lines is an easy way to do this, because trees do not have to take a lot of space. This depends on the order of the tree, the specie and the placement. In opposite to green strips, trees add something to the street section in three dimensions. In that way they can easily change the whole appearance of the street.

An average width for a line of trees is two meters. The trees should have enough space to grow in the ground. Therefore it depends on the underground infrastructure if it is possible to plan trees in a street section. The best side for tree lines is the Southside, because in this way they will reduce urban heat island effect by shading (Kleerekoper, 2009).

A tree line can be planned in all traditional streets as long as there is enough space. Designers should take in mind shading and should be aware of the growth process of a tree. Research should reveal in which way tree lines can add something to other types of neighbourhoods.

**Plan green strips**

>> *A green strip gives inhabitants the chance to walk (the dog).* <<

Another type of urban green that can be planned in a street section is a green strip. It is a strip of grass where people can walk their dog. In this way dog dirt will not be a problem in other green areas. Walking with or without the dog is the second most important motive for using urban green (Cheisura, 2004). The green strip can be enriched with flowers. In that way a green strip will also improve the aesthetics of the street.

An average width for a green strip is two metres. The green strip should be save to walk along. Therefore it is important that it is on a street with limited speed or that the green strip is separated from the traffic line. It is important that designers take in mind that this green strip is a part of a higher network. The green strips should be connected to other green areas, so people can walk around the block.

A green strip can be implemented in traditional streets, for example in pre-war neighbourhoods. More research is needed to say whether a green strips also fits in other types of neighbourhoods.

**Free space street**

A minimum street is 7,5 metres wide (sidewalk and roadway). For all the place that is left, we are free to plan other functions. Here is an overview of the functions that can be planned in the free space of a street section:

- Parking in line  2,0 metres
- Parking perpendicular  4,5 metres
- Elevation garden  0,5 metres
- Front garden  2,0 metres
- Tree line  2,0 metres
- Green strip  2,0 metres
5.3 Design principles neighbourhood scale

Minimum public space in neighbourhood

For a qualitative living environment a neighbourhood should have public space. Public space is a place to go outside and to meet other people. It is preferred by inhabitants and it stimulates social cohesion. It is important that the public space in the neighbourhood covers the preferences of all user groups.

Plan a public garden

>> A public garden stimulates the social cohesion of the neighbourhood. <<

Public gardens can raise social cohesion (Vreke et al., 2010). Social cohesion is important for the quality of the living environment, because it makes people feel involved and responsible. Therefore a public garden can be planned in a neighbourhood. Especially in pre-war neighbourhoods there is most of the time no public space. A public garden is a type of public space which has many benefits. A public garden can be a place for stress reduction. Research should reveal if there is a need for public gardens in other type of neighbourhoods, where there is more public space.

The best place to plan a public garden is in the centre of the neighbourhood. In this way the area is easy accessible for everyone. A public garden has more quality if there is a richness of animal and vegetation species. In that way it can be a place where people come in contact with nature, which is a preferred use of urban green (van Herzele and Wiedemann, 2003). People prefer environments that are coherent and complex (Kaplan et al., 1998). This is can be achieved in the design of the public garden by a richness of different elements that are orderly placed (Ibid).

Plan a natural play area

>> A natural play area stimulates the development of a child in a natural surrounding. <<

Playing in a natural surrounding has a positive effect on the development of a child (van den Berg and de Hek, 2009). Children are physically more active and have a more creative way of playing (Ibid). In a neighbourhood where there is no public space children are often limited to play outside. Many neighbourhoods are not safe enough for children. A natural play area give the children an opportunity to play outside. Playing in a natural environment will also raise attention for nature.

A place to plan a natural play area is next to a school. In this way the playground can be used and maintained by the school during school time. After school time it can be used by all the children of the neighbourhood. The natural play area should be safe, well maintained and free of dog dirt. Designers should take in mind that children like differences in space, such as open-closed and low-high (van Suchteren and van Dijk, 2011).

Natural play areas can be planned in all types of neighbourhoods. But further research should reveal if it is important for all types. For example a small village with a lot of forest around it may have enough play opportunities from itself. A natural play area is especially needed inside the city.
5.4 Design principles city scale

Urban designers can plan new urban areas inside a neighbourhood. But at the same time they can make existing urban areas better accessible. This can be done with networks.

Plan a cycling network

>> A cycling network stimulates physical activity and gives the inhabitants a chance to visit green areas outside the city. <<

A cycling network will stimulate physical activity. This is good for human health (Lee and Maheswari, 2010). Cycling is a preferred use, people see it as relaxing (Cheisura, 2004). While designing a cycling network designers should be aware of the existing green structures. Cycling paths should go along urban green areas, because in that way they can be stress reducing. It is important that the cycling network is safe. Therefore crossings with busy roads should be avoided. A cycling route is more interesting if it has a certain direction or endpoint. This can be an urban green area.

A cycling network can be implemented in all types of neighbourhoods, as long as designers take in mind safety and attractiveness.

Plan a walking network

>> A walking network stimulates physical activity and gives the inhabitants a chance to visit green areas inside the city. <<

A walking network can also stimulate physical activity and is also a preferred use. While designing a walking network designers should take in mind dogs. Some people would like to walk with their dog, but at the same time other people are afraid of dog dirt. A green strip can be a place to walk the dog. To stimulate physical activity a walking route should be safe and attractive. The green strips of the walking route should be well maintained, because people will be more satisfied with it (de Boer and de Groot, 2010).
5.5 Main conclusions from design principles

As conclusion from this chapter an answer can be give to the main research question.

>> Which urban design principles - subtracted from the case Elinkwijk and Zuilen - can be used to improve the living environment by urban green in Dutch pre-war middle or high dense neighbourhoods? <<

The design principles are:
- Plan wide sidewalks with elevation gardens
- Plan tree lines
- Plan green strips
- Plan a public garden
- Plan a natural playarea
- Plan a cycling network
- Plan a walking network

If designers take in mind these design principles they can achieve the benefits of urban green and can fulfil in user’s preferences. In that way urban designers can improve the living environment of Dutch pre-war middle or high dense neighbourhoods. Further research should reveal if these design principles can also be used in other types of neighbourhoods. See table 4 for the overview of all the design principles and the effects.

<table>
<thead>
<tr>
<th>User’s preferences</th>
<th>Benefits of urban green (main goals)</th>
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</thead>
<tbody>
<tr>
<td>Visual use</td>
<td>Functional use</td>
</tr>
<tr>
<td>Watching</td>
<td>Walking (the dog)</td>
</tr>
<tr>
<td></td>
<td>Playing</td>
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<tr>
<td></td>
<td>Cycling</td>
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<tr>
<td></td>
<td>Meeting</td>
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<td></td>
<td>Contact with nature</td>
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<td></td>
<td>Aesthetics</td>
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<tr>
<td></td>
<td>Stress reduction</td>
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<td></td>
<td>Child development</td>
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<td></td>
<td>Social interaction</td>
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<td></td>
<td>Physical health</td>
</tr>
</tbody>
</table>

Table 4. Design principles and its effects
6 CONCLUSIONS

This is the final chapter of this thesis. This chapter gives an evaluation of the design. Next to that, it gives recommendations for further research. At the end, it describes the final conclusions that can be drawn from the theory and from the design.
6.1 Evaluation

Benefits

In the theoretical framework ten benefits of urban green are described. From these benefits I choose five that were main goals for the case Elinkwijk and Zuilen. In the evaluation I will check if all benefits are achieved.

The main goals are all achieved. They were the focus of the whole design. The side issues on the other hand are not all achieved. They should have been side issues, but during the process they were forgotten. Some of the benefits turned out not to be as easy achievable as expected.

Air purification has not played a role during the process of designing. Measurement instruments should reveal if air purification is feasible and on which exact places. Noise filtering turned out to be not easy achievable. Many urban green elements are needed to achieve a significant difference. A much more simple solution is used for the noise pollution of the train: A noise barrier. Urban heat reduction is a benefit that is forgotten during the process. However it is partly achieved, new trees give shading on the Southside. More soft surfaces could have been used to drop temperature in the city. Biodiversity is a benefit that is also not easy to achieve. There should be a huge number of links with other green areas in order to enlarge biodiversity. It can be achieved if designers pay enough attention to links, for example by making an analysis with GIS. The project did not pay attention to the influence of urban green on housing price. This is something that can be exploited more.

For the main goals I want to highlight that not everything has to do with urban design. For example public gardens can raise social cohesion. However this is social process and many other things are intertwined with it. These social processes can be stimulated by organisation of for example events. It depends also on other things if this benefit will be achieved.

Preferences

In the design I took notice of the general preferences of the user. However it is as much important to take in notice the preferences of the inhabitants of the exact neighbourhood. Many elements of the design can only be successful if inhabitants agree with it. Next to that, some things should be designed together with the inhabitants. For example the natural playarea. This can only be successful if children also give their ideas during the design process.
6.2 Recommendations

Technical research

For further research I would recommend to study in more detail if all of the benefits of urban green are feasible and in which situations. Some of the benefits have a technical background, for example air pollution. These benefits should be more researched. And very important in here is that these investigations should be translated into design principles. Otherwise urban designers can never exploit the benefits of urban green.

Social research

For further research I believe it is also important that we take in mind the user’s experience. Many benefits of urban green are related to social processes. Urban green is stress reducing and people heal faster in a natural surrounding. This is the most simple way of health care we can think of. This should be researched more, so these benefits can be exploited more. Also other psychological processes can be researched in more detail, how people experience their environment with and without urban green.

Design

I would recommend a design in more detail for the natural playareas and the public gardens. At this moment, it are still vague ideas. The benefits of the urban green areas can be exploited more with a more detailed design.

Means of communication

This graduation project can be used as means of communication between municipality, inhabitants and project developers. In that way they can discuss whether they want to plan urban green in their neighbourhood. For this communication it is important that also inhabitants understand what we are talking about. For that reason, more visualisations of the design should be made. These visualisations should convince inhabitant of the benefits of urban green.
6.3 Final conclusions

Aim

The overall aim of this graduation project is to contribute to a better living environment in Dutch pre-war middle and high dense neighbourhoods by making use of urban green. Next to that, this graduation project aims to make urban green more applicable for urban designers.

Urban green is of high importance for the quality of the living environment.

Urban green is: “Land that consist predominantly of unsealed, permeable, soft surface (green areas) and elements of vegetation (green elements), whether or not they are publicly accessible or publicly managed”.

Quality of living environment is: “The degree in which the environment contributes to the well-being of its inhabitants and thus the degree in which it contributes to a long and happy life”.

Benefits

Urban green has lots of environmental benefits. Urban green can be used for air purification, noise filtering, reduction of the urban heat island effect and for enlargement of biodiversity. It also has lots of social and physiological benefits. The most important ones are: Aesthetic improvement, stress reduction, child development and social interaction. Next to that, urban green can also improve physical health and increase property price.

User’s preferences

People use urban green for several reasons. The most general preferences are: Walking (the dog), cycling, sitting and watching, playing, meeting and getting in contact with nature. Younger people have a specific preference for jogging and immigrants prefer picnicking.

Design

To improve the living environment of Elinkwijk and Zuilen the parking problem needs to be solved first. In this way there will be space for urban green. After that, urban green elements (such as elevation gardens) and urban green areas (such as public gardens) can be implemented. There is a major difference between the design of Elinkwijk and Zuilen. In Elinkwijk only some few steps are needed to improve the living environment. Zuilen is more densely built and therefore there is not much room for solutions, more steps are needed in that design.

Design principles

From the design of Elinkwijk and Zuilen the following general design principles can be drawn. These principles can be used to improve the living environment of other Dutch pre-war middle and high dense neighbourhoods.

- Plan wide sidewalks with elevation gardens
- Plan tree lines
- Plan green strips
- Plan a public garden
- Plan a natural playarea
- Plan a cycling network
- Plan a walking network

Aim reviewed

In this way the design should improve the living environment of Elinkwijk and Zuilen, so inhabitants can live a long and happy life. The design principles should make urban green more applicable, so other urban designers can also improve the living environments of other Dutch pre-war middle and high dense neighbourhoods.
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