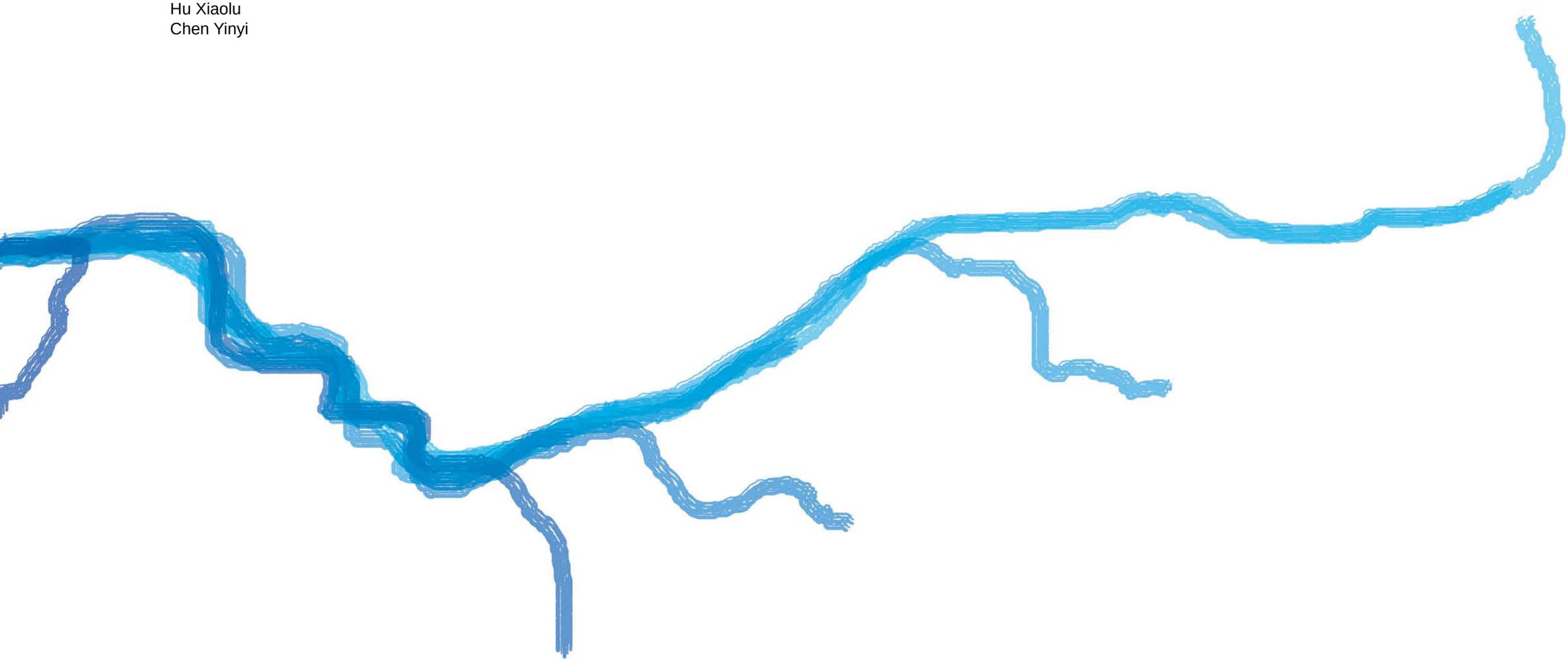
Bring NATURE back to CITY

Introduce the Twekkelerbeek in Enschede, the Netherlands

Master Thesis Landscape Architecture
Wageningen University

Hu Xiaolu
Chen Yinyi



Hu Xiaolu
Chen Yinyi

Chair Group Landscape Architecture
phone: +31 317 484 056
fax: +31 317 482 166
e-mail: office.lar@wur.nl
www.lar.wur.nl

Hu Xiaolu: avacoco@163.com
Chen Yinyi: dream86315@sina.com

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Introduce the Twekkelerbeek in Enschede, the Netherlands

Thesis Report
Master of Landscape Architecture

Dr.Ir. I. Duchhart (Supervisor)

Dr. H.J. (Henk) de Haan (Co-supervisor)

Ir. R. van Etteger MA (Examiner)

WAGENINGEN UR
For quality of life

PREFACE

This thesis report is the result of eight months of research and design on introducing Twekkelerbeek in Enschede to solve the flood problem and improve the places. In the process, we use three aspects of landscape approaches to achieve the goals in threes scales. Experience approaches are implemented in guiding the water experience in the urban scale; engineering approaches are utilised to fulfil the drainage assignment in the city scale; social approaches are functioning in making places for local communities. Therefore, in the waterway designs, people can feel not only the visual direction with strong water identities but also the vivid centres with varied activities and comfortable places with natural images. The water stories connect people with the landscape. In the mean time, people recreate the water stories in their daily lives.

We would like thank in particular our supervisors Ingrid Duchhart and Henk de Haan from the Wageningen University. From the beginning until the end they have invested time and energy in guiding the process of our final thesis. Their enthusiasm, criticism, and professional knowledge have inspired and motivated us. Especially, the combined academic thinking in landscape and social professions open our views on a boarder scope in research and designs.

Furthermore, we would like to thank Peter Dijkstra from the municipality of Enschede for guiding us an informative trip in local neighbourhoods and providing us the related data about our design site. Last but not least, we would like to thank our colleague students, friends, and family for their positive support, interesting discussions, and critical listening.

SUMMARY

In the context of global urbanization, there are several problems existing and impacting on people's life. Natural water infiltration is blocked by impermeable paving and ineffective underground drainage pipes, so the increasing floods occur and cause both environmental and financial damages. Meanwhile, urban places are suffering from their homogenizing fate. Universal designs deny the sense of places but leave these empty spaces without identity, so people don't come and talk. The existing social problems can't be solved.

Chapter 1 Problem Statement

Enschede is a typical post-industrial city in the Netherlands with both troubles in floods and lack of places. On one hand, many natural brooks have been disappearing with the steps of city expansion, so drainage problems show up with the frequent floods. On the other hand, places can be barely found in this city, so the urban squares can't help to encourage the integration among people with varied ethnicity.

Chapter 2 Research Design

In the present researches, flooding problems always catch more attentions but places miss their positions. For example, the master degree thesis 'Water-Ways to Climate Adaptation' from Dijk & Veul designs a waterway in Enschede to adapt climate changes but without considerations on places for people. Therefore, we decide to introduce another waterway Twekkelerbeek with broader objective to solve the flood problem as well as improve the places.

We believe that introducing the natural waterway back to city can solve these problems. Firstly, nature water system can cure the urban drainage problems. Besides, the waterway as a urban infrastructure has the potential to become places for people. Additionally, combined landscape approaches can link nature with people by creating nice water experience.

Chapter 3 Approaches

In order to achieve our objective to solve the flood problem and improve the places, three goals are set in different scales and six landscape approaches from experience, engineering, and social theories are selected to reach these goals. According to the studies on these theories, design principles and criteria are generated.

Chapter 4 Experience Guiding

In the urban scale (in the urban area of Enschede), Landscape Narratives and Experiential Landscape guide us to create the nice experience along the waterway by telling the water stories. We start with the narratives approach to organize the water story along the brook. Afterwards, we analyse the existing experiential landscape to find out the present situations in Enschede. Based on that, we generate further concepts to dissolve our water story into the realistic experience.

Chapter 5 Drainage Assignment Fulfilling

In the city scale (within the boundary of Enschede), Vulnerability Framework and Sustainable Urban Drainage System help us to test if the plan for experience can fulfil the drainage assignment. The drainage route in rural area is specified and the assignment is set based on the calculations. Afterwards, the hydrologic plans in normal and high water level situations are made to prevent the floods and guide our detailed designs.

Chapter 6 Place Making

In the site scale (in the neighbourhood of Acacia), in order to make place for people, PlaceMaker Method and Place Diagram are used to collect layman knowledge. We firstly select a typical neighbourhood to do social field work for the knowledge of local habits, wishes and preferences in the guides of PlaceMaker Methods and evaluate the place by Place Diagram. Further, based on the result we make two concept designs and go back to the site for further feedbacks, which gives us a broader view on what people concern. At last, we generate two designs for the water square as well as generalized concepts for the waterway.

The waterway design outcomes combine the professional knowledge with the layman knowledge in master plan and detailed designs. When walking along the natural brook, people can feel not only the visual direction with continuous water identities but also the vivid centres with varied activities and comfortable places to sit and chat. The water stories connect people with the landscape. In the mean time, people recreate the water stories in their daily lives.

Chapter 7 Waterway Design

In the end, we evaluate our design outcomes by a modified user focused system: Quality Function Deployment. The result proofs our designs have mostly fulfil the local demands by good control on floods, creating water experience, and making places for chatting and other activities. Therefore, we can say that applying combined landscape approaches to introduce nature back to city offers the practical solutions to the problems of floods and lack of places. We hope this thesis can inspire professionals from different fields with the comprehensive thinking in urban projects.

Chapter 8 Reflection and Conclusion

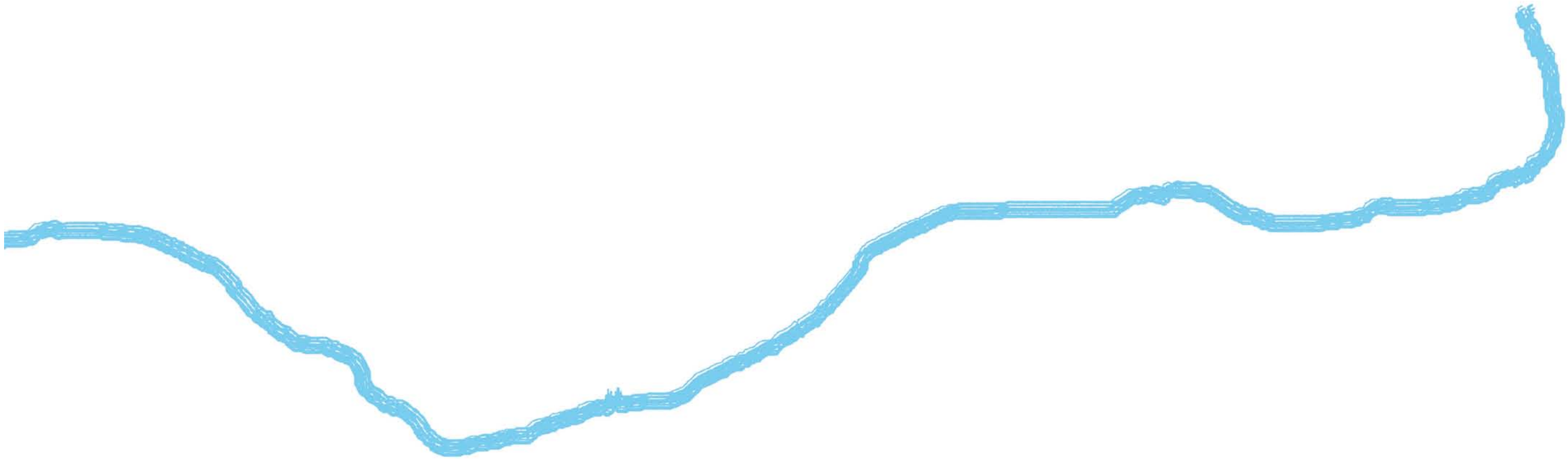
CONTENTS

CHAPTER 1 PROBLEM STATEMENT

Long time ago, our earth looked like a jade with the colours of green and blue. Everything on the earth was obeying the law of nature. But now, the global urbanization makes natural areas look like the scarce jades in the concrete forests. In cities, natural water flows are blocked by impermeable pavings and natural places are transferred into empty squares. Consequently, we are suffering from floods and lack of places. Therefore, in this thesis, floods and lack of places are the main problems in our discussion.

Enschede is a typical post-industrial city in the Netherlands with both of the problems. But the recent researches and the plans from local municipalities focus only on solving the floods without thinking of the places. Based on these plans we derive our idea of introducing Twekkelerbeek to prevent floods as well as make places.

In this chapter, we state the importance in solving these two problems and analyse each of them from the global context to the city of Enschede.



1.1 FLOODS

1.1.1 FLOODS IN GLOBAL CONTEXT

As we know that floods in cities cause a large amount of physical destruction with financial damages but also impacts on people's daily lives. Therefore, it is necessary to solve the flood problem for better urban environment. However, the reasons for floods occurring in urban areas have close relations with the urbanization.

Figure 1.1.1-1.1.2 illustrate the sharp differences between the natural drainage system with the urban one.

In natural areas, most rain water infiltrates through vegetation covers. Only 5% of water from the precipitation flows to rivers, which releases no pressure on floods (figure 1.1.1).

Impermeable surface

Ineffective underground drainage system

However, in urban areas, the impermeable surfaces are massively used. They largely reduce the rainwater infiltration amount by 90%. When storm comes, runoff on the ground is swiftly formed. Most of them is transported to rivers by underground pipes (figure 1.1.2). Unfortunately, the present underground drainage system is not effective in coping with the precipitation amount. On one hand, the system is not flexible to fulfil the long period drainage assignment. Take the dutch drainage system for example, it is only designed based on a rainstorm with an occurrence frequency of 1/2 years (Buishand & Wijngaard, 2007), which means when unexpected heavy rainstorm occurs, the pipes can not transport so much water out of the city and finally result in floods. On the other hand, even if the pipes are enlarged to fulfil the instant drainage assignment, the 95% of water drained to the river is definitely putting more flooding pressures in down stream, which causes floods as well.

Therefore, floods in cities are intimately related to the impermeable surfaces and the ineffective underground drainage system.

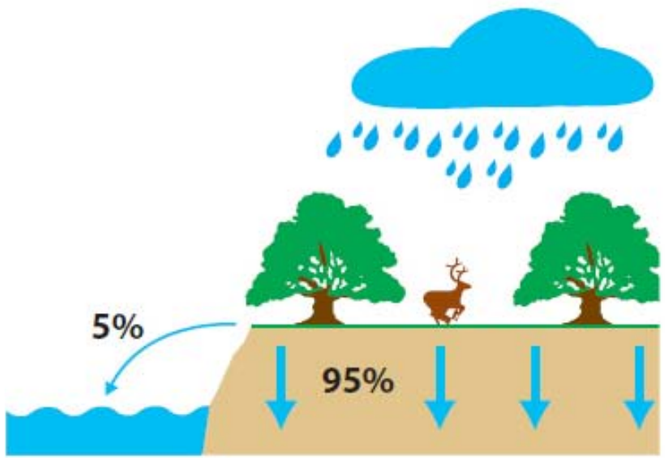


Figure 1.1.1 Water Drainage in Nature Area (Interpave, 2010)

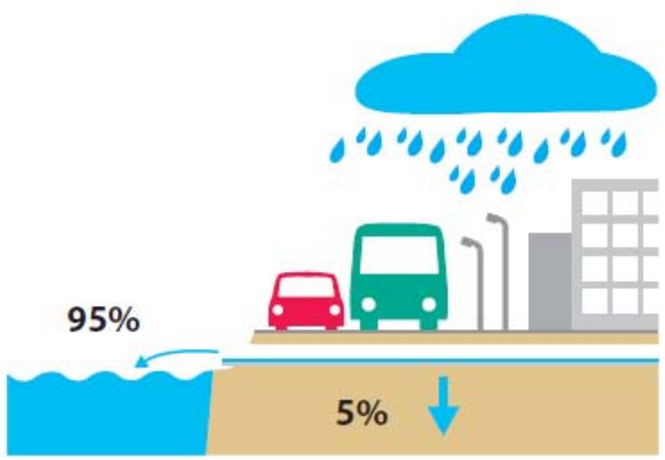


Figure 1.1.2 Water Drainage in Urban Area (Interpave, 2010)

1.1.2 FLOODS IN ENSCHEDE

In the Netherlands, floods annoy many cities, including Enschede. Although Enschede is located on the east boundary of the country (figure 1.1.3), where is relatively high in altitude, it still surfers much from the urban floods (figure 1.1.4).

In the following part, we firstly explain the specific flooding reasons from the view of geo-hydrological situation and urbanization impact. Secondly, the flood probability is analysed by layer approach. Finally, two existing plans to solve the flood problem from local municipalities are introduced.

Figure 1.1.3 Location of Enschede (based on Yücesoy, 2006)

Figure 1.1.4 Floods in Enschede (Dijk & Veul, 2010, Gemeente Enschede, 2002)

GEO-HYDROLOGICAL SITUATION

One of the reasons for floods in Enschede is its geo-hygrological situation.

Push-moraines with boulder clay

Stream deposit at eroded valleys

Enschede belongs to Twente area, where there are comparatively large differences in height, soil types and water systems in a short distance (Dijk & Veul, 2010). These characteristics were formed during the Pleistocene period. As shown in figure 1.1.5, the Saalien glacier (the penultimate major ice-advances in Europe) moved from north to south-westwards, extended to a line running from Zandvoort to Nijmegen and pushed up high ridges on its flanks. Subsequently, the moving glacial surge deposited the boulder clay on the ridge summits. In the Eemian inter-glacial, the melted ice eroded the moraines and the fluvial deposits spread over the permanently frozen subsoil. During the Weichselien period, the country became an arctic desert. The melting down phase and the deposition of sands continued in the area of Twente (Lambert, 1985, p12-13). In the Holocene period, the warmer and wetter weather caused more stream to deposit at the low area and valleys, e.g. loam and peat (Louw, 2006, p9). In all, the push-moraines, eroded valleys and the deposited materials formed the striking elements of the present Twente landscape and its special geo-hydrological system.

Steep slope

Impermeable layer under the thin aquifer

The geo-hydrological structure with the location of the city makes Enschede comparatively vulnerable to floods. On one hand, the city lies on the west slope of moraine and the altitude is going down from east to west across the whole city. When rain comes, the fast runoff caused by the steep slope in the upstream, however, gets slower because of the gentle slope in the downstream. So the flat areas in the west get flooding problems. On the other hand, the impermeable layers are widely spread underneath the thin aquifers with less than 25-metre deep (Louw, 2006, p9). So the runoff cannot infiltrate underground. Therefore, Enschede endures the floods during the precipitation periods.

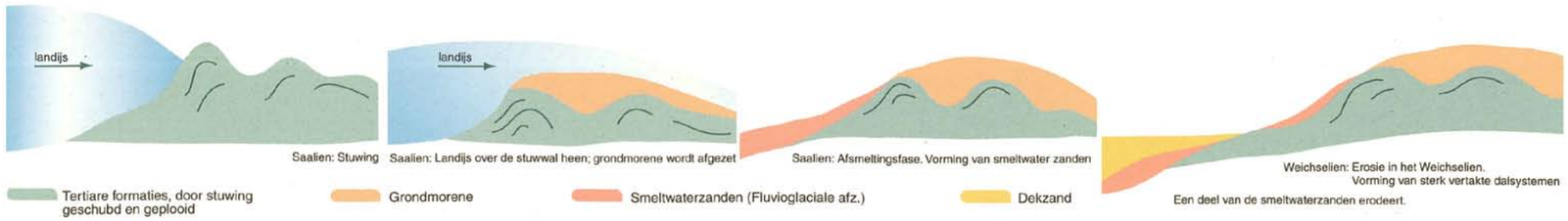


Figure 1.1.5 Moraine Forming Process (Louw, 2006, p9)

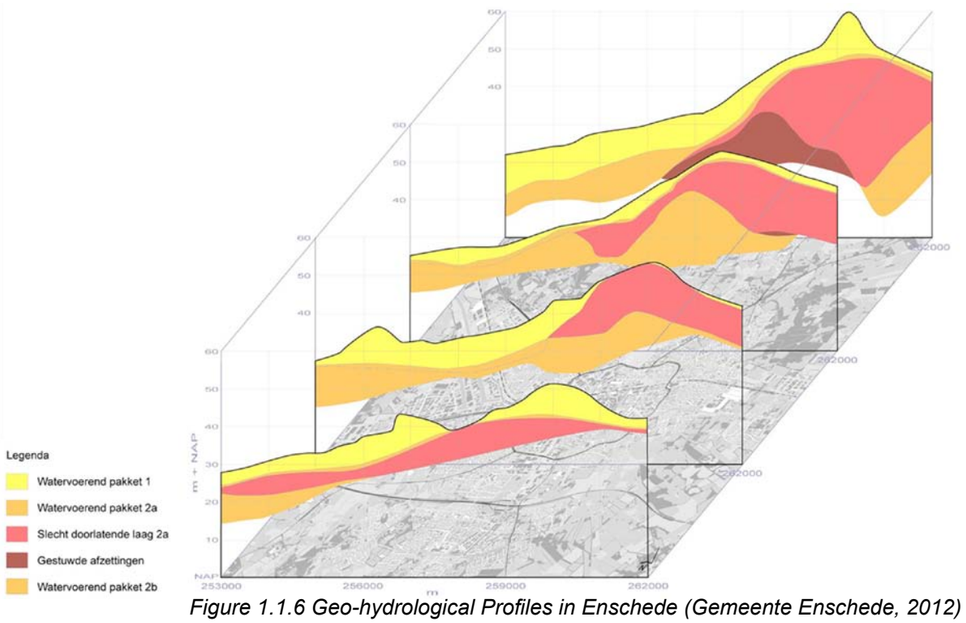


Figure 1.1.6 Geo-hydrological Profiles in Enschede (Gemeente Enschede, 2012)

URBANIZATION IMPACT

Another reason for floods in Enschede is the urbanization impact.

In the history, a large number of brooks existed along the eroded valleys. They reduced the flood probability by storing water on site. Till 1880, Enschede was the town with the largest number of waterways in the east of the Netherlands (Gemeente Enschede, 2002).

However, with the thriving textile industry and city expansion, natural brooks were gradually disappearing. In the rural area, in order to provide energy for increasing industrial demands, the marshes were drained and the peat were mined out of the waterway. Several brooks are made into fast drainage canals (Louw, 2006, p17). In the urban area, the natural brooks were gradually changed into open sewers and at last were filled up to release spaces for streets and houses (Dijk & Veul, 2010).

Take one of the waterways Twekkelerbeek as an example, it flowed from the city centre all the way to the west with more than 4 km length before 20th century. But nowadays, this brook remains only 1.5 km in the west. From figure 1.1.7-1.1.9, it is clear that urbanized areas haven been occupying and excluding the nature step by step.

Brooks turned into canals
Waterways removed for streets and houses

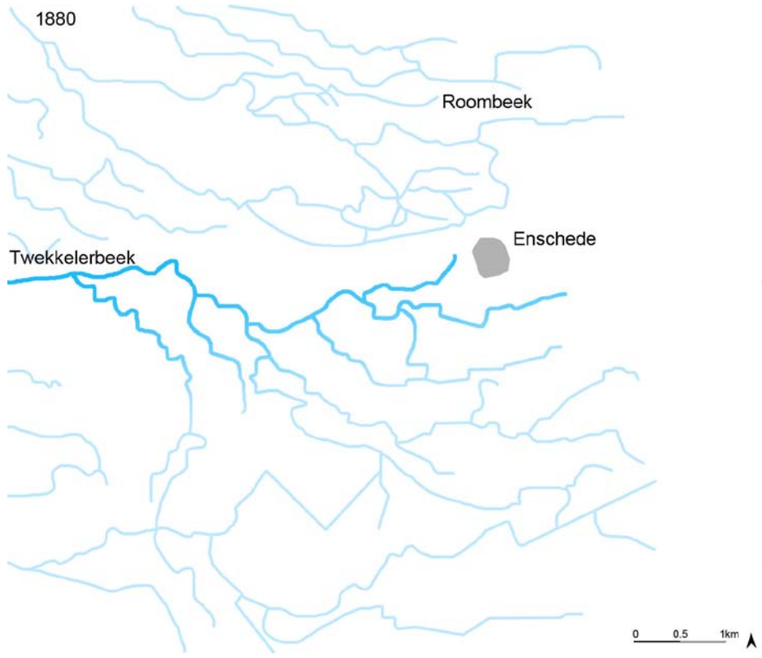


Figure 1.1.7 Waterways in Enschede in 1880
(based on data from Gemeente Enschede, 2002)

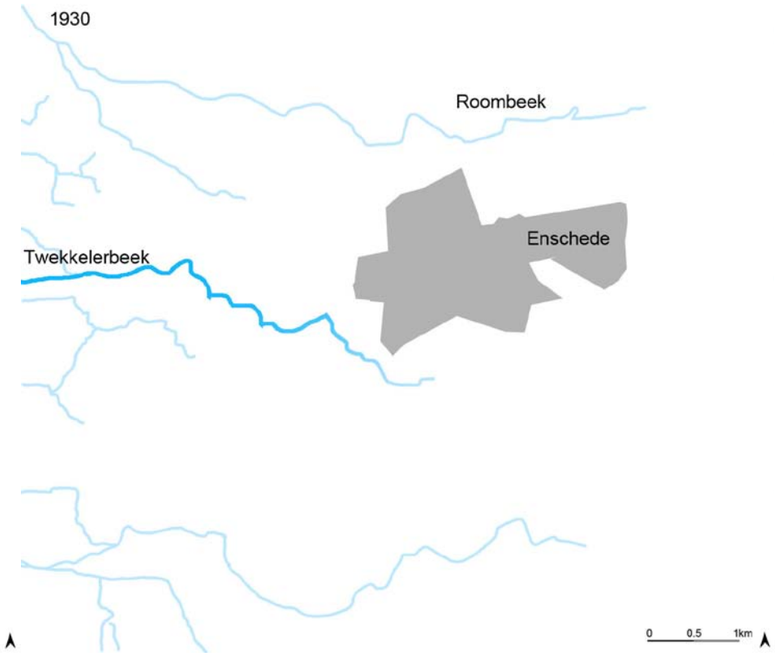


Figure 1.1.8 Waterways in Enschede in 1930
(based on data from Overijsselinkkaart, 2011)

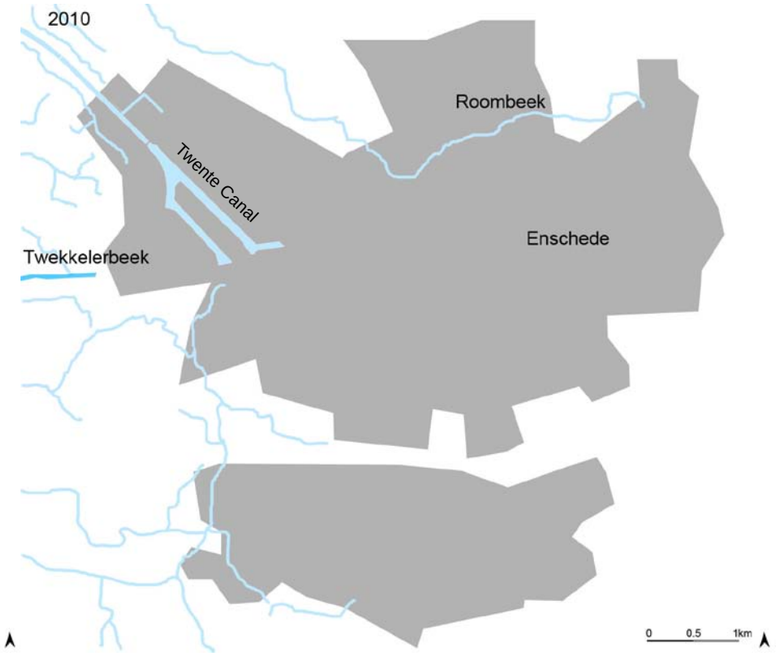


Figure 1.1.9 Waterways in Enschede in 2010
(based on data from GIS)

INCREASING FLOOD PROBABILITY

The flood problem has bothered people in Enschede frequently in the latest twenty years (Louw, 2006, p17). Further, the flood probability is still increasing.

Seepage

On one hand there is water coming from underground. In the industrial period, groundwater level was very low because the textile factories pumped up a lot of water(Dijk & Veul, 2010). As the demands for water decreased, the groundwater was rising (Louw, 2006, p17). Up to now, the groundwater almost reaches the top soil in the low area and seeps out at some certain points (figure 1.1.10-1.1.11).

Excess water amount

On the other hand, there is rain water coming down. According to our study on the recent ten year precipitation and evapotranspiration data in Enschede (figure 1.1.12), certain amount of excess water is remained in two third of the time in each year. But because of the impermeable surfaces, the water can't infiltrate underground, so large amount of runoff is formed and flow from east to west (figure 1.1.13) and puts high pressures on the drainage systems.

Twekkelerbeek as deign object

By piling up the maps on altitude, groundwater, seepage and surface soil, we constitute the flood probability map (figure 1.1.15). As it shows, the flood probability in the areas along the historical route of Twekkelerbeek is relatively high. Therefore, we pay more attentions on this brook and decide to take it as our design object.

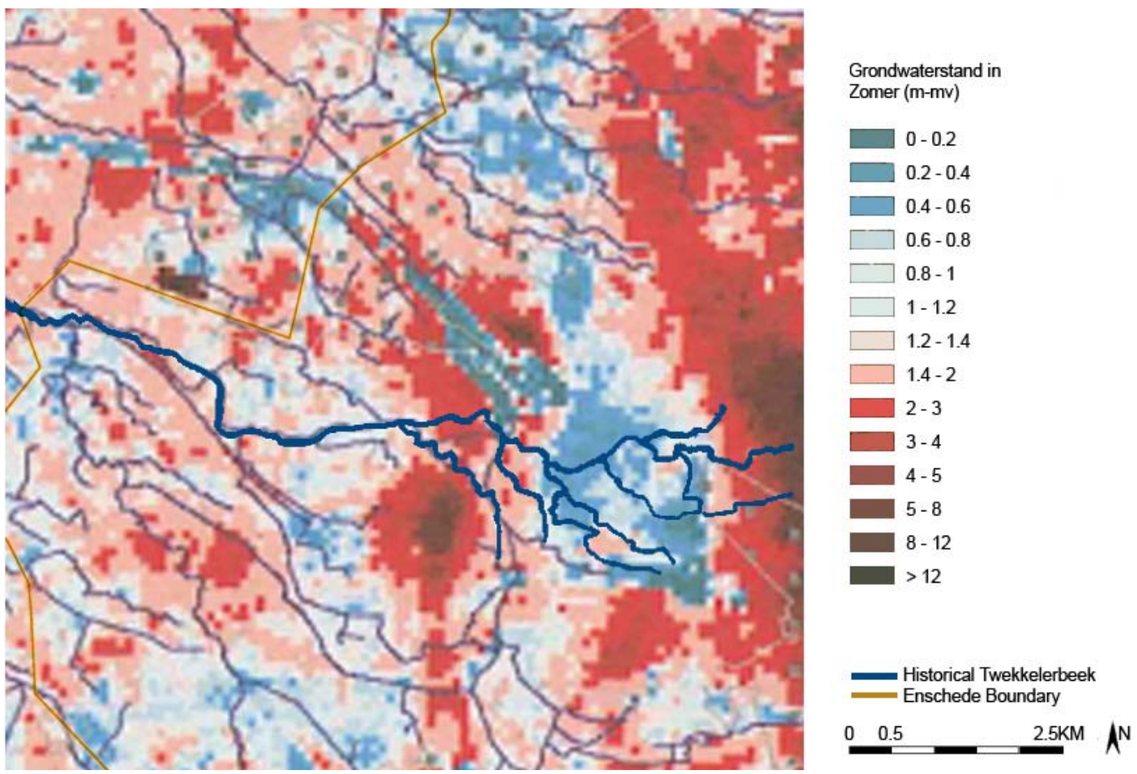


Figure 1.1.10 Groundwater Level Map(based on map from Louw, 2006)

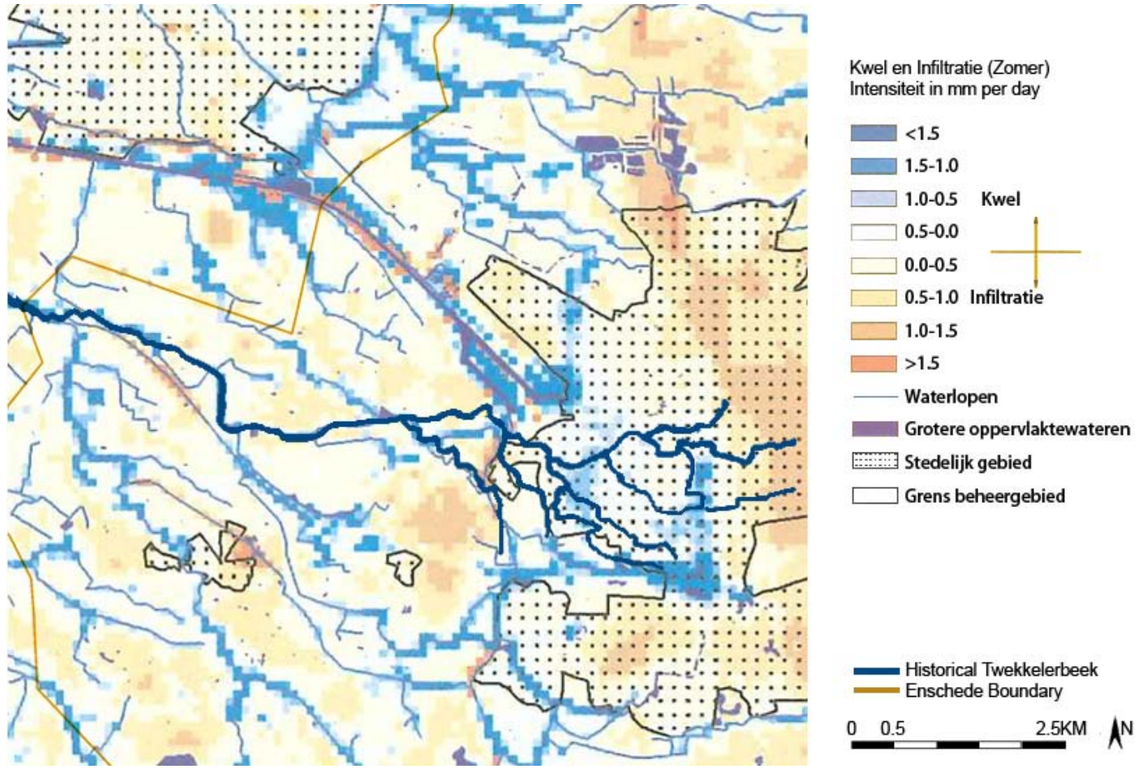


Figure 1.1.11 Seepage Map (based on map from Louw, 2006)

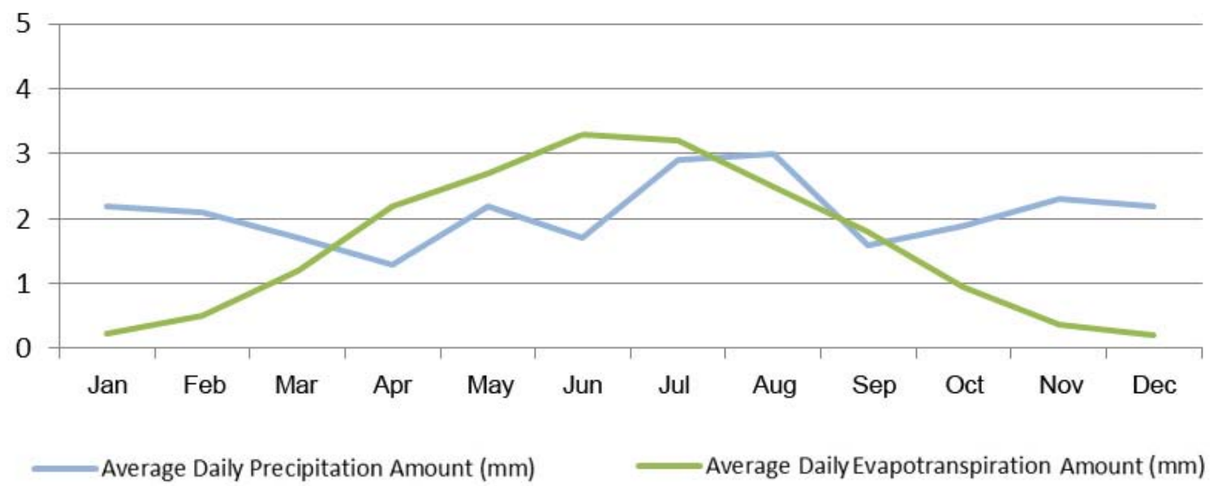


Figure 1.1.12 Precipitation and Evapotranspiration Amount in 2000-2010 (based on data from KNMI, 2012)

Excess water in eight months per year

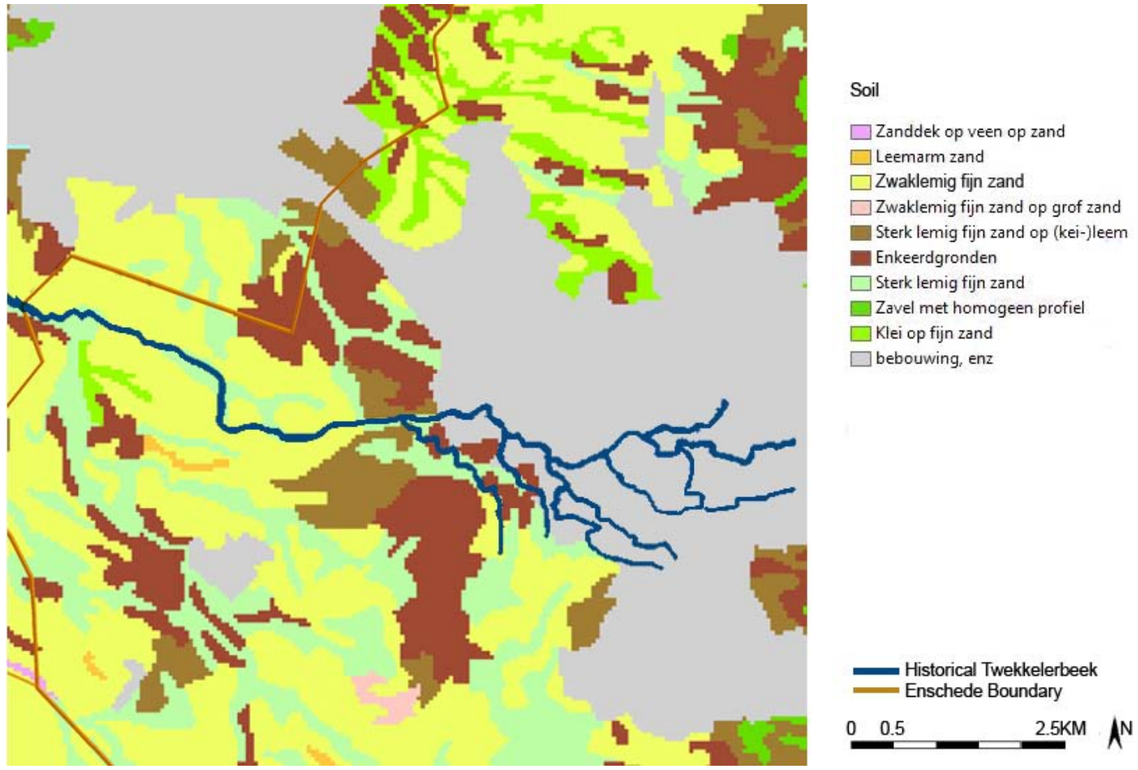


Figure 1.1.13 Topsoil Map (based on map from GIS)

Large impermeable surface in the urban area

Runoff direction from east to west

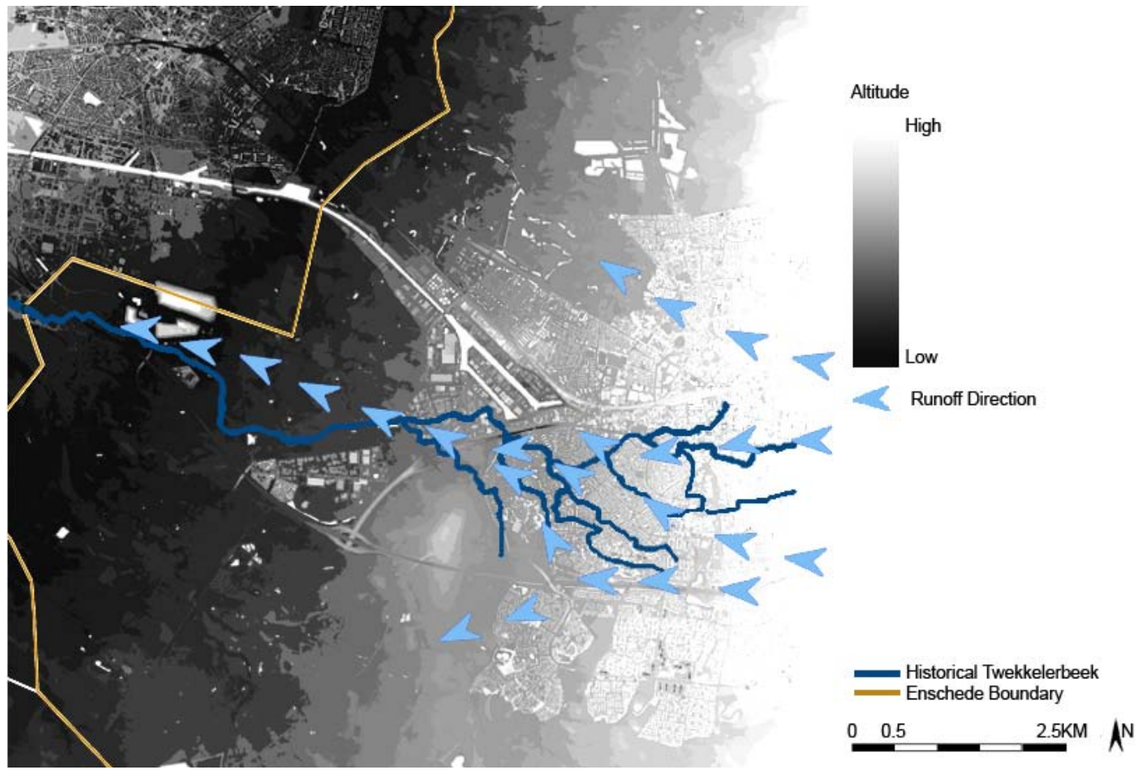


Figure 1.1.14 Altitude and Runoff Direction (based on map from GIS)

High flood probability along Twekkelerbeek

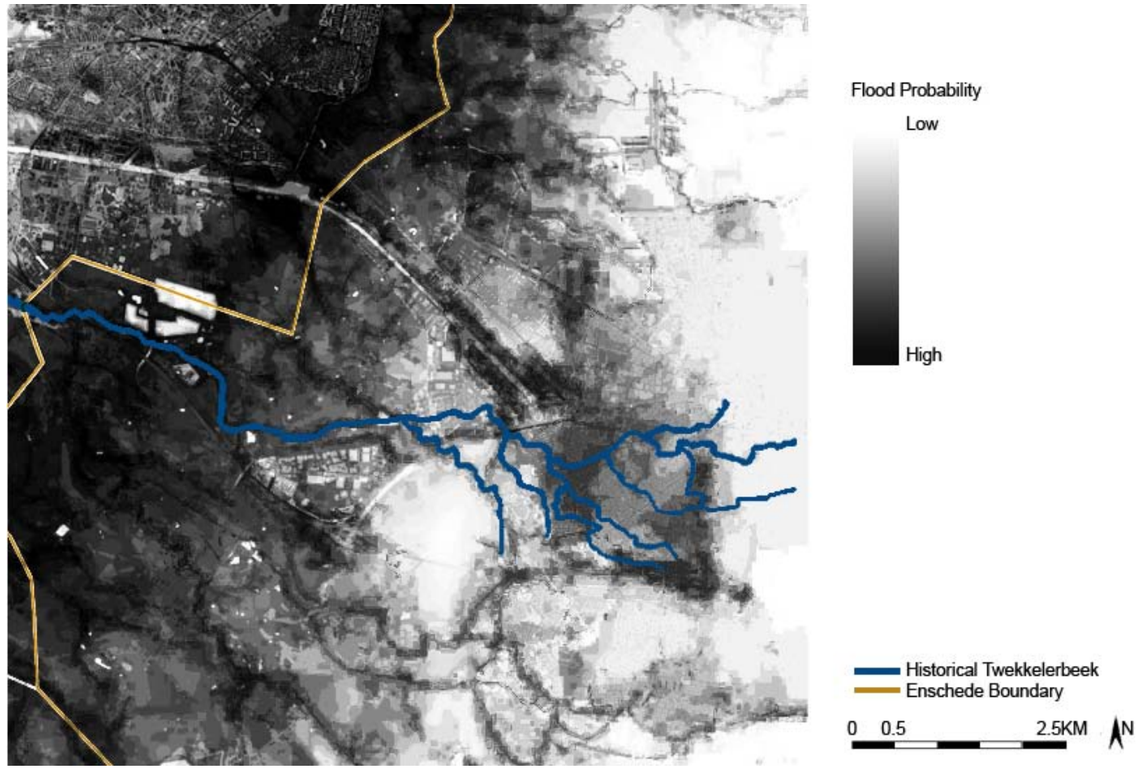


Figure 1.1.15 Flood Probability Map

RECENT PLANS

The local municipalities have already made two plans to deal with the problem of flood.

One is the plan of Blue Veins. In 2002, the municipality of Enschede and water board Regge en Dinkel generated the Water Vision, which brings the old waterways back into the urban area in order to solve the flood problem shown in figure 1.1.16 (Boutkan 2002, our translation).

Plan of Blue Veins in the urban area

The brook 2 is called Roombeek, which is the first and only one presently implemented waterway. By the reference study on this brook (Appendix 1), we find out that there is no flood after its construction. In the drainage aspect, it is successful. But from the landscape aspect, there is still improvement potential. People living close to the brook appreciate the improved environment but still would like to have more natural places along the brook. This result guide us to form our design objective and encourage us to look for more approaches in the waterway design (Chapter 2). Besides, this plan has already suggest a guiding route for Twekkelerbeek in urban area, which is generally follows the historical Twekkelerbeek. We use it as a reference plan and search for a concrete route for the waterway shown in Chapter 3.

Roombeek

Wish for natural places

Another existing plan is called Boeldershoek made by the municipalities of Enschede and Hengelo, and water board Regge en Dinkel (figure 1.1.17). It involves the remaining part of Twekkelerbeek in the rural area. This plan is located close to the boundaries between Enschede and Hengelo, where there is a landfill site. It aims at retaining the excess water in this area to prevent floods as well as separating the clean and dirty water by two waterways. One of them follows the historical route of Twekkelerbeek. But the other one is a new stream Strootbeek. (Gemeente Hengelo, 2011). We consider this plan in the drainage routing for the waterway shown in Chapter 5.

Boeldershoek plan in the rural area

Landfill site

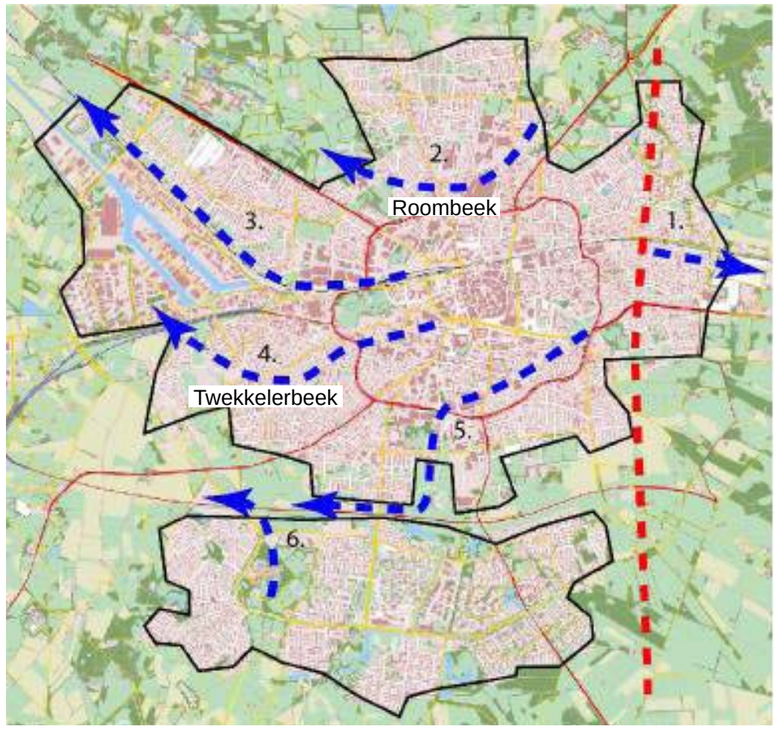


Figure 1.1.16 Blue Veins (Gemeente Enschede,2002)

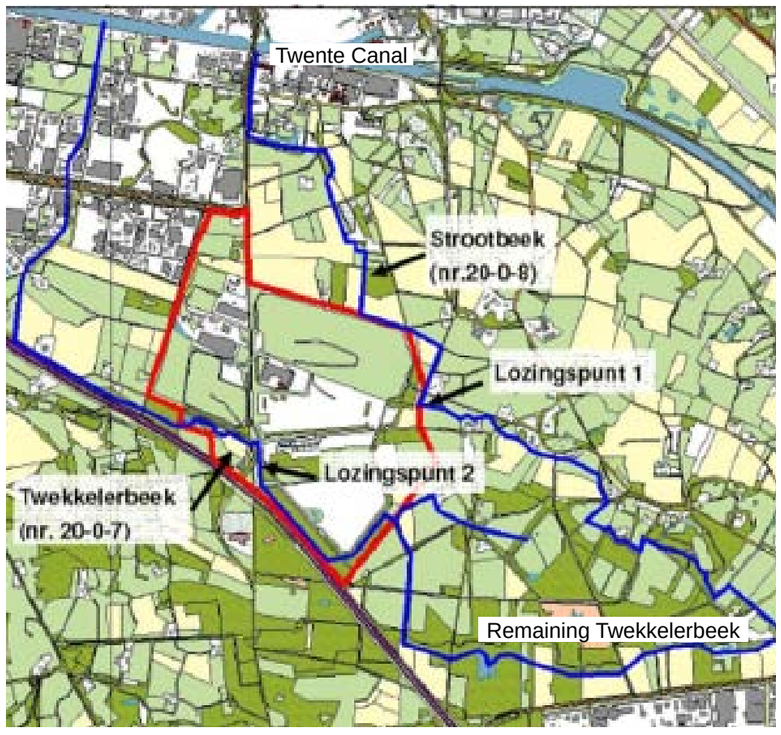


Figure 1.1.17 Boeldershoek Plan (Gemeente Hengelo, 2011)

1.2 LACK OF PLACES

Lack of places with few attention

Except for floods, lack of places is another problem caused by urbanization. In the rapid urban development and global designs, cities become spaces rather than places with identity and sociability. The city landscape is no longer a part of people's daily life. So people don't care about it and lose their connection to their living environment. Therefore, landscape designs lost the life and meanings. However, this problem doesn't get as much attention from society and government as the flood problem such as the Roombeek project. But in our views, places in landscape designs are significantly important because we believe that good designs should be rooted from the land as well as people's heart, so we would like to improve the places and let them to attach people's daily lives.

In this part, the lack of places is explained in aspects of identity and sociability. Afterwards, the social problems in Enschede are stated in order to indicate its demands for places.

1.2.1 LACK OF IDENTITY AND SOCIABILITY

IDENTITY

Places are as diffuse and differentiated as the range of identities in a world. They are far more than points or locations because they have distinctive meanings and values with cultural identities for persons. Place is fundamental to the establishment of personal and group identities and the formation of biographies. Locales are places created and known through common experiences, symbols and meanings. People both live out their lives in place and have a sense of being part of it (Tilley, 1994, p15-18). The attachment to a place makes people to love it and take care of it. As a result, the landscape in the place will be alive.

Universal phenomenon of losing place identity

Nowadays, it is abundantly clear that loss of place identity has become a universal phenomenon (Hough, 1990; Carmona, et al., 2003, Roca & Claval, 2011). In fact, urban places all over the world seem to be suffering the same kind of homogenizing fate as we find in several facets of contemporary life: universal food, homogenized sound, consumer entertainment. Much of the urban landscape – the parks and gardens and formal open spaces of the city – has been subjected to a universal design standard that denies a sense of place; life becomes a series of isolated events, nodes of activity between home, made accessible by a no-man's-land environment of highways, immigrants' effect and transient society (Hough,1990, p87-92).

Lack of place identity in Enschede

Enschede, as a typical post-industrial city, also lost its identity. Universal designs can be easily found in several residential areas (figure 1.2.1).

Figure 1.2.1 Designs Lack of Identity(Roombeek, 2011)

SOCIABILITY

Places with a lot of people interacting with each other are attractive and vivid, which looks more inviting to others (Whyte,1980). People can know each other by talking and playing in places. People from different countries with different cultural backgrounds have more chance to talk and know each other and become friends. Afterwards the society of integration can be gradually built among local communities.

More chance for people to talk

However, these sociable places become scares and scares with the modern motto of ‘Less is more’, which left the space with emptiness by hard pavement, few tree and chairs with low utilization. The chance for people to pause and talk is very few. So the sociability in the place is consequently low. These public spaces barely used can be physically neat but boring.

Less is more

Less is bore

For Enschede, its public spaces also lack of sociability. During our excursion in the urban area, we do not find people talking, sitting or taking other activities in the public spaces (figure 1.2.2). These spaces are not attractive to communities. As a result, they do not take the role in stimulating the community integration and sociability.

Empty spaces in Enschede

Figure 1.2.2 Empty Public Spaces in Enschede

1.2.2 SOCIAL PROBLEMS IN ENSCHEDE

On one hand, Enschede lacks places. On the other hand, the social problems in the city need places.

Textile industry with immigrants

There are several social problems with long history in Enschede. They can be traced back till the industrial period. Since the 1950s, Enschede input many immigrants from other countries to feed the labour demands of the thriving textile industry. From late 1970s to 1990s, due to the competitive textile industry abroad, Enschede lost its status as a major industrial centres in the Netherlands. Afterwards, unemployment rates began to rise, and social problems were revealed.

Employment, education and integration problems

Nowadays, there are a lot of immigrants living in the city. As figure 1.2.3 shows, 29% of the residents in Enschede are not local Dutch, in which more than 10% of them come from Mediterranean followed by 5.9% of Turkish people. Those immigrants with low skills for former textile factories are suffering from the high unemployment rate, low education level and integration problems (Yücesoy, 2006, p81).

As we have discussed, places can engage people to talk and communicate with each other, which finally will mitigate these existing social problems. Therefore, places are important in Enschede.

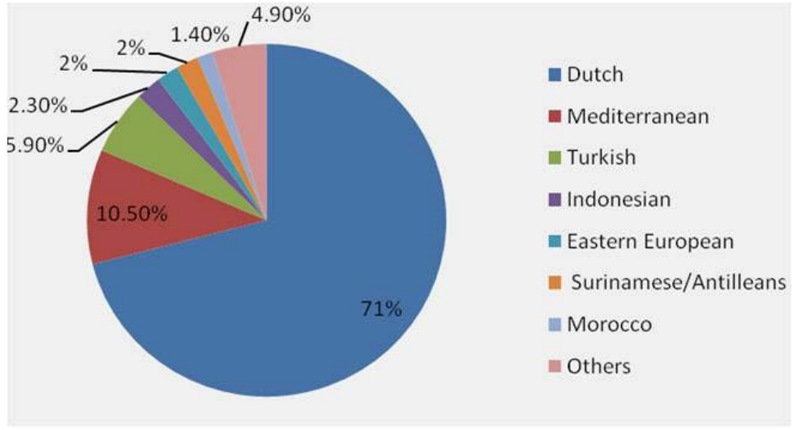


Figure 1.2.3 Ethnicity Data of Enschede (CBS, 2010)

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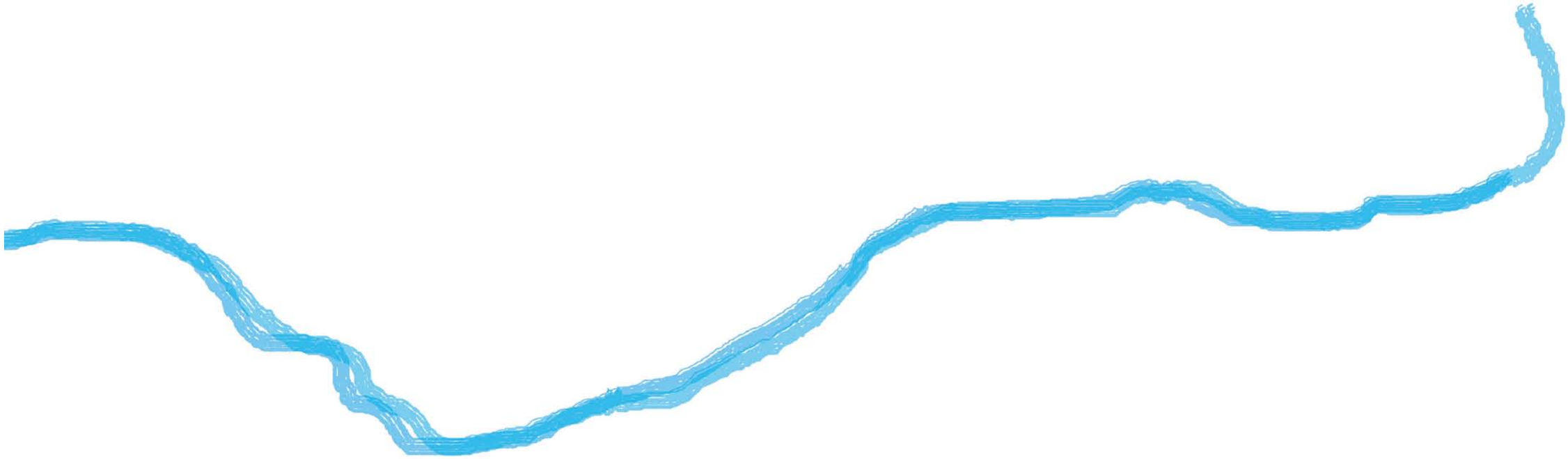
CHAPTER 2 RESEARCH DESIGN

After the problem statement, we ask ourselves that how can we solve the flood problem and improve the places in Enschede? Based on the research context studies, we realize the knowledge gap in existing approaches. We believe that introducing the natural waterway back into city can help to solve the problems. Thereafter, our goals with specified design principles and criteria in three scales are set. At last, the methods with concrete research and design procedure guide us to achieve the goals.



2.1 THEORETICAL LENS AND KNOWLEDGE GAP

Based on the problem statements, we set our research question: How can we solve the flood problem and improve the places in Enschede?

Nowadays, there have been some approaches to prevent floods and improve places respectively, but they don't work together. So the existing approaches can not fulfil the two tasks in the same time.

Drainage methods without places

On one hand, to solve the flood problem, there are two major solutions. One is the structural measures, relying on artificial structures to prevent the floods, such as the underground piping system. These measures have been applied widely in the Netherlands for centuries. But the recent studies show that these methods are not effective nor sustainable. Besides, the piping system is hidden underground and far from people's daily life. They are not legible nor attaching. So when floods come, people complain a lot without understanding the natural process.

Another way to solve floods is the sustainable drainage system. It mimics the nature with more adaptability and legibility than the former method. So it is presently encouraged and accepted by more and more people. But it still can not directly improve the places especially in urban environment because it lacks the considerations on local communities preference.

Place making without connections to nature

On the other hand, to improve the places, related studies always emphasize on human social relations, with little attention to the natural systems nor urban infrastructures, both of which support people's life (Barlett, 2005). Places are made but people's connection to nature and their living environment is still lost.

Based on the research context studies, it is clear that there is gap between drainage system designs and place making. However, landscape approaches have the ability to fill the gap by building the relations between people's daily life with urban infrastructures.

Figure 2.2.1 Inclusive Image of Nature: Vondelpark in Amsterdam (Google Street View, 2012)

2.2 HYPOTHESIS AND SIGNIFICANCE

2.2.1 HYPOTHESIS

As landscape architects, we believe that we can solve the flood problem as well as improve the places by introducing the natural waterway back to city.

First of all, urban drainage system has the potential to create both function values and social values. Natural waterway can both fulfil the drainage assignment as a engineering system and benefit people's daily life as natural places.

Secondly, landscape architects have the ability in building the connection between nature and human by landscape approaches. However, mono approach is not enough to solve floods as well as make place, so the combination of engineering, social and experience aspects of approaches in designing is necessary

Combined approaches

Additionally, nature can solve the problems of floods and lack of places. Here what we mean by 'nature' is the inclusive images of nature(figure 2.2.1), one of the five types of nature images hold by general public in the Netherlands. It includes all living beings, culture, and environment in the definition of nature (Buijs, 2009). On one hand, city is an integral part of nature, and nature should be intimately interwoven into the social life of cities (Benton-Short & Short, 2008, p5). On the other hand, to become natural is the best way to solve the floods in cities, as we have discussed.

Inclusive images of nature

Therefore, using landscape approaches in bringing nature back to city is possible.

2.2.2 SIGNIFICANCE

This thesis combines the knowledge of landscape, engineering and social aspects to introduce the natural waterway in urban environment. Therefore, the thesis has its significance in several fields shown as follows:

For the landscape architects, this thesis expands the professional performance to the field of urban infrastructure planning and design. Practically, we enhance the sustainable development in cities with living environment design by our comprehensive landscape approaches. Hence, we act as an example in taking the leading role in interdisciplinary infrastructure project as landscape architects. Besides, the considerations on the local people's daily lives and the method in combining our professional knowledge with the layman knowledge would be inspiring for landscape architecture practices.

For landscape architects

For other professions, this thesis is also helpful. Firstly, it opens the engineers' views in landscape architectural thinking, especially, the views on urban drainage system can become the lifeline of cities beyond the functional level. Secondly, for socialist, this thesis uses urban infrastructure to improve the social values of encouraging social integration. So this thesis has cross-border values.

For engineers
For socialist

For the project itself, the design outcomes in this thesis have the realistic significance for the municipality in Enschede. It works as a recommendation design for the city to solve the existing problems.

Municipality in Enschede

2.3 GOALS AND CRITERIA

Based on the hypothesis, we set the objective as introducing the natural waterway in Enschede. Thereafter, we divide the objective into three goals applied in the city, urban and site scales (figure 2.3.1). To treat with floods, we set the first goal as improving the urban drainage system during the long period in the city scale. At the same time, the second goal is coming as improving the places to attach people's daily life in the site scale. But between these two scales, we need to find out the proper route for the waterway with nice experience, so the third goal is filling the scale gap by experiencing the waterway in the urban scale. Moreover, a list of design principles are made based on our researches in related theories. At last, the criteria derived from the principles work as a checklist in each research and design phase. The relationships between scales, problems, goals, principles and criteria are illustrated in table 2.3.1.

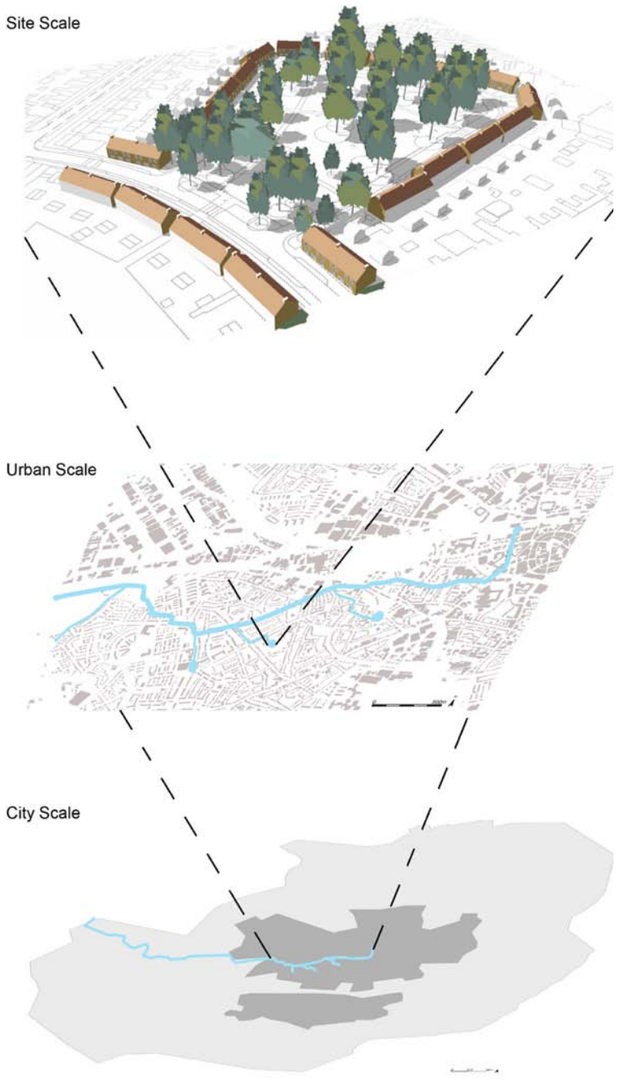


Figure 2.3.1 Three Scales

Scale	Problems	Goals	Principles	Criteria
Site Scale (in neighbourhood)	Lack of places	Improving the places to attach people's daily life	People can enjoy the place; The sociability of the place should be upraised.	Varied activities Space for activity Good comforts Sitting options Natural images Place for talking Place for meeting
Urban Scale (in urban area)	Waterway route	Experiencing the water-way	People can experience the waterway with its own identity; People can experience the nature changes along the waterway.	Continuous direction Vivid centres Water level changes Varied water vegetations Precipitation changes
City Scale (in city boundaries)	Floods	Improving the urban drainage system during the long period	The ponds should store enough runoff; The waterway should cope with extreme weath-er in the future.	Coping with the 1/100 year 2-hour and 48-hour rainstorms Flexibility

Table 2.3.1 Scales, Problems, Goals and Criteria

2.4 METHODS

In order to achieve these goals, we study varied theories in the experience, engineering and social fields. The relevant approaches we have found are used to collect the professional and layman knowledge. Based on these knowledge, design concepts are created and used to guide the design outcome. Table 2.4.1 shows the steps we approach from theory to design. It also indicates the relationship between research and designs (details are shown in Appendix 2). Between each two steps we check the criteria in order to control the quality of research and designs.

In the process, step one to three focus on the experience improvement in the urban scale. We firstly use the landscape narratives theory to generate the original ideas for waterway routing in the urban scale, which works as the base for finding potential places and further analysis. Subsequently, we use the four concepts from the experiential landscape approaches to analysis the existing experiential landscape along the route in Enschede. So we can find out the realistic problems and use the waterway with its stories to improve the places.

Experience improvement in the urban scale

The step four to six turns to drainage system improvement in the city scale. We choose the proper route in the rural area and set the drainage assignment with the vulnerability framework and fulfil it with the sustainable urban drainage system approaches.

Drainage system improvement in the city scale

Since in the former steps, we only collect the professional knowledge, from the seventh steps, we collect layman knowledge and focus on making places to attach people's life in the site scale. Guided by the PlaceMaker Methods, we do the social field work in a typical neighbourhood with site observation, questionnaires, concept designs and interviews. Thereafter, we evaluate the place with the measurements from Place Diagram to find out the strength and weakness. Afterwards, we return to the site with our concept designs and collect more feedbacks from local people. Finally, based on the community's habits, preference, wishes and concerns, we generate two designs for the water square.

Places improvement in the site scale

In the last step, based on all research result and design concepts we yield the design for waterway in order to fulfil our objective.

Goals	Approaches	Knowledge Collection	Concept Generation	Design Outcomes
Improving the places to attach people's daily life in the site scale	PlaceMaker Methods (Realm setting, desk study, expectations, map study, site observation, questionnaires, data accumulation)	Step 7. Social field work	Step 9. Water square concepts	Step 11. Water square designs
		Step 10. Feedback collection		
	Place Diagram (Uses & activities, comfort & Image, access & linkage, sociability)	Step 8. Place evaluation		
Experiencing the waterway in the urban scale	Landscape Narratives (Naming, opening, sequencing, revealing & concealing, gathering)		Step 1. Original ideas for waterway routing	Step 12. Brook design, Pond design, Master plan, Detailed design
	Experiential Landscape (Centre, direction, transition, area)	Step 2. Experiential landscape analysis	Step 3. Concepts for direction & centres	
Improving the urban drainage system during the long period in the city scale	Vulnerability Framework (Threshold domain, coping & recovery domain, adaptive domain)	Step 5. Drainage assignment calculation	Step 4. Waterway routing in rural area	
	Sustainable Urban Drainage System (Decentralized ponds, site control)		Step 6. Drainage assignment fulfilment	

Table 2.4.1 Methods

REFERENCE

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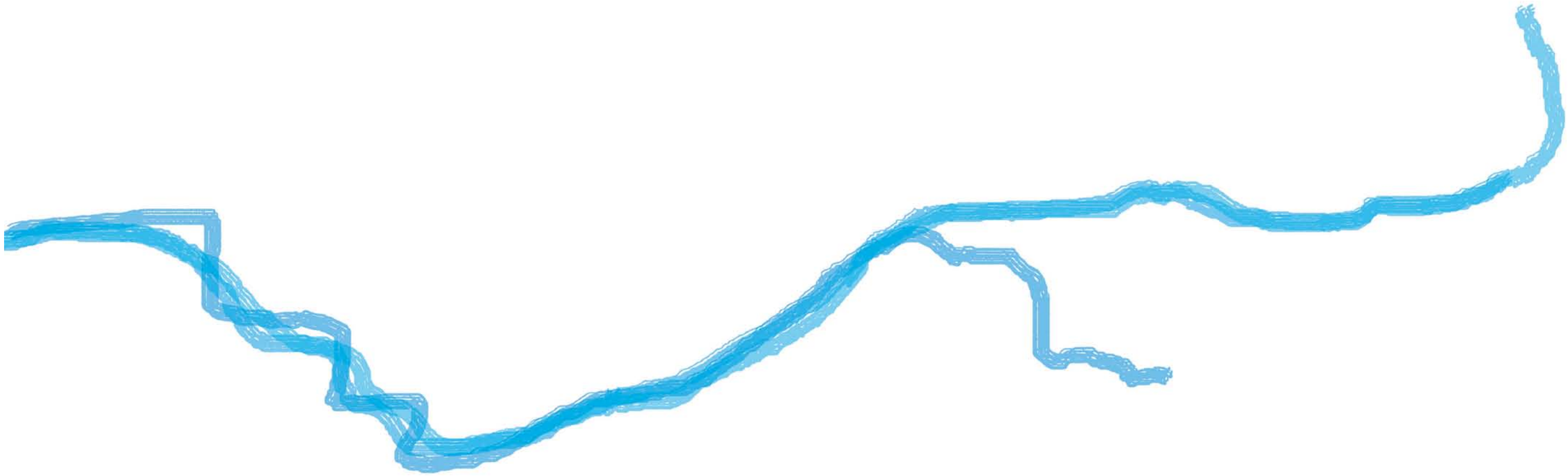
CHAPTER 3 APPROACHES

In this chapter, we introduce the details of the experience, engineering and place making approaches, which are the tools for knowledge collection and concepts generation. Besides, the evaluation approach for our design outcomes are shown at last.



3.1 EXPERIENCE APPROACHES

A landscape is a series of named locales, a set of relational places linked by paths, movements and narratives. It's a cultural code for living, a writing pad for inscription, a scape of and for human praxis, a mode of dwelling and a mode of experiencing (Tilley, 1994, p34).

3.1.1 LANDSCAPE NARRATIVES

On one hand, places configure narratives. On the other hand, we come to know a place because we know its story. It is through narrative that we interpret the process and events of place (Potteiger & Purinton,1998, p4-p6). They are far more than points or locations because they have distinctive meanings and values with cultural identity for persons (Tilley,1994, p15).

Bonds between people and landscape
Stimulation of imagination
Engagement of participation

Narratives establishes bonds between people and features of the landscape. Both land and language are equally symbolic resources drawn on to foster correct social behaviours and values (Tilley,1994, p33). Meanwhile, narratives is used to stimulate the imagination and engage participations (Potteiger & Purinton,1998, p14). So landscape narratives help designers to create places with closer distance between people and the landscape in both physical and mental sense.

The methods of narratives are shown below (Potteiger & Purinton,1998, p73-p187):

Naming gives abbreviated stories of discovery, biography, and identity. Names create a continuity with the past, the family line, or cultural memory while projecting future hopes and aspirations. Naming both situates things within narratives and marks the starting point of narratives.

Sequencing is the ordering of names, trees, paths and other elements, events, and characters, structures meaning, for every part understood in terms of what comes before and what follows. A story begins with an event. Any two events can make up a narrative sequence, one to establish an recent situation and the other to alter it. In fact, landscape readers tend to make sense and connect the given events of a narrative. The order of experience rather than the physical composition affords the meaning to the sequence.

Opening up the history
Drama and surprise

Revealing and concealing information, whether in a decipherable sequence or all at once, creates drama, suspense, or surprise that engages the reader with a story. There are three fundamental ideas connected to landscape narratives: secrets, transparency, and masking or unmasking information. Each of them creates specific relations between the author and the reader. Secrets activate the desire to pursue the mystery; transparency invites the reader to figure out the processes and structures by opening up the information like history; masking and unmasking goes back and forth to open up the paradoxical space between what is hidden and what is not. They work together to stimulate the drama and surprise in experiencing the landscape.

Compressing large ideas into small spaces

Gathering together broader experience into a tangible and cohesive place in landscape reflects the interconnection of natural and cultural processes. There are three manifestations of gathering: the miniature compressing larger ideas and places into smaller contained and identifiable spaces; the souvenir working as a reminder or representation of a larger event or place; and the collection assembling in an ordered way to reveal narratives of the collected and collector.

Opening involves ways of creating places responsive to cultural and natural processes. Public streets are places where a diverse group of people participate in the ongoing narratives. Stories are made every day by those who freely come and go. When the place has open views and allows varied activities or even with unfinished designs, people will be encouraged to engage with their diverse ways and explorations.

In our designs, we focus on using the methods of sequencing, revealing and concealing, gathering and opening to tell the story of water along the waterway.

Places afford local experience and evoke feelings. Human acts and feels in the environmental context and communicate with the context by gesture and speeches so that sense of place can be produced and maintained (Thwaites & Simkins,2007,p32-33).

3.1.2 EXPERIENTIAL LANDSCAPE

Experiential landscape is an approach to constitute the outdoor places that people use during daily life. The core of this theory is a commitment to the idea that human experience has spatial dimensions. Experiences can be conceptualized in spatial terms as centre, direction, transition and area, each of which has its effects on the experiential dimension (Thwaites & Simkins, 2007,p xi-p xiii). The relation between spatial and experiential dimension and the sub types in each of the concept are shown in table 3.1.1 - 3.1.2.

Spatial dimensions of human experience

In practises, experiential landscape is useful in the site analysis to summarise the main experiential qualities evident and identify potential strengths and weaknesses that will help inform change or bring focus to deficient spots (Thwaites & Simkins, 2007,p 137). So we use this theory as the approach to analyse the existing urban environment to guide our designs.

Site analysis

	Centre	Direction	Transition	Area
Spatial Dimension	**Subjectively significant location engendering a sense of here-ness and proximity.** Being mainly convex in shape and contained; Being made up of smaller centres; Having views beyond; Having transitional features; Being on a route that encourages passers.	**Subjectively significant continuity engendering a sense of there-ness and future possibility.** Stimulated by the perception of: Linear containment (awareness of the possibility of continuity and how to realise it); Route (the actual act of going from here to there); Anticipation (the incentive or motivation for going).	**Subjectively significant point or area of change, engendering a sense of transformation in mood, atmosphere, or function.** Spatially concentrated or spatially extended; Change in material, colour, form and direction etc, framing and gateway features; Choice of onward movement.	**Subjectively significant realm engendering a sense of coherence and containment.** Thematic continuity: rhythm, pattern, co-ordination in texture, space and form, detail and symbol, building type, use, activity, degree of maintenance, topography; Degree of privacy: private, semi-private, semi-public, public; Made up of integrations of centre, direction and transition in continuity, other areas.
Experiential Dimension	**Attachment of significance**	**Orientation**	**Change**	**Neighbourhood awareness**
	Social imageability: functional use, goals and motivations, physical features, social meanings; Restorative benefit: being away, extent, fascination, and compatibility; Social interaction and territoriality: communication, primary, secondary and public territory.	Movement: choice, imagination, and attention; View: landmarks, views and vistas, sequence.	Direction and level; Entrances, exits and gateways; Atmosphere and function.	Public and private awareness: private, semi-private, semi-public, public; Thematic continuity: rhythm, pattern, co-ordination in texture, space and form, detail and symbol, building type, use, activity, degree of maintenance, topography.

Table 3.1.1 The Concepts of Experiential Landscape (Thwaites & Simkins,2007,p49)

Concepts	Definition	Types	Features
Centre	Subjectively significant location engendering a sense of here-ness and proximity.	Social Imageability	Presence of facilities Pronounced physical features Visual variety and complexity Social meaning
		Social Interaction	Significant convergence of routes Presence of features for waiting Seating in social groupings Presence of features encouraging comment Revealingness Places of arrival/departure
		Restorative Benefit	Separation from distraction Comfort and shelter Provision for rest Presence of nature Stimulating features
Direction	Subjectively significant continuity engendering a sense of there-ness and future possibility.	Kinetic	Enclosure Rhythm Non-engaging facades Ease of movement Clear primary route
		Sensory	Exploration and mystery View, smell, sound Deflective facades Linearity of floor scape
Transition	Subjectively significant point, or area, of change engendering a sense of transformation in mood, atmosphere, or function.	Threshold	Change in material, colour, form and shape, level, direction etc. Frames and gateways
		Corridor	Human scale Short distance Clear entrance and exit Little internally distinguishable character Linear continuity of materials Framed views
		Segment	Overlapping of adjacent spaces Internally distinguishable character Central local point Choice of direction Physical or psychological engagement
		Ephemeral	Sun to shade Wet to dry Light to dark Seasonal effects
Area	Subjectively significant realm engendering a sense of coherence and containment		

Table 3.1.2 Types of Concepts in Experiential Landscape (Thwaites & Simkins, 2007,p59)

3.2 ENGINEERING APPROACHES

3.2.1 CONCEPTS EVOLUTION OF WATER MANAGEMENT

Three approaches of flood management

Urban drainage system is influenced by the evolving concepts and approaches in water management and governance. In the history of the Netherlands, there are three successive approaches of flood management (Green et al., 2000, cited in Szollosi-Nagy & Zevenbergen, 2005, p3- p4):

Indigenous flood adaption: the local adaption, e.g. building houses on dunes and river levees. This approach was popular in the Netherlands between 500 BC and 700 AD (Lambert, 1985), but is gradually abandoned after urbanization and economic growth, because of its failure in structural measures to protect the whole communities.

Flood control and defence: the structural measures, e.g. dikes and dams. They have been developed well in the Netherlands since 9th century(Ruimte voor de Rivier afdeling Communicatie, 2011). The continuous defence system with seaward dikes, inland dikes, sleeper dikes, summer dikes, winter dikes and dams have protected Dutch people for centuries. The construction methods have transformed from earth dikes with seaweed cover during middle ages to current sand dikes with clay, rock and tarmac cover. The latest large projects, Zuiderzee Works and Delta Works, were built from 1920s to 1990s. They improved the safety and reclaim large areas of land (Lambert, 1985). However, the criticism to such methods has increased since the late 20th century, for the fact that they were ineffective when coping with increased sea and river levels, led to cyclical patterns of investment, needed high cost of maintenance, and impacted sustainability, e.g. changes in river morphology and sedimentation.

Living with floods: with this approach, the flood-prone areas are kept free from urbanisation. The green belts along the river serve as water pass, temporary storage area, as well as recreational area. The Room for the River Programme is a successful illustration to this approach. The program gives spaces to floods in more than 30 locations. Moreover, the measures are combined with local projects to improve the landscape (Ruimte voor de Rivier afdeling Communicatie, 2011).

Complex urban situations
Various holistic approaches

Since urban floods impact on not only natural, but also economic, social and cultural systems, the flood management in urban area is supposed to measure more complex situations than in rural area. There is no single strategy identified to be effective in all situations. We need various holistic approaches to support sustainable development and maximize the economic efficiency of land use. The measures should reduce flood probability and impact with flood protection, preparedness and resilience in different scales (Szollosi-Nagy & Zevenbergen, 2005, p5). During our research and design, we focus on improving flood resilience with urban drainage system on the city scale.

Water governance

Recently, a new concept of water governance emerged from the consideration on the intricate situation of socio-technical coevolution. There are various definitions and discussions on water governance, because of different interests and biases in varied international institutions. But most of them are involved in the common features: accountability, transparency, participatory and sustainability.

Sustainability

In these features, the sustainability is the most important one. It should not only mean maintaining a sustainable use and cycles of material, but also refer to the sustainable technologies themselves that can continue to work over time (Robbins, 2007, p106) in the social, economic and politic context. This is one of the biggest challenges for the current ecologists and engineers.

Criteria for good water governance

Tropp (2005, p10 -p13) defined four dimensions for good water governance (figure 3.2.1):

Sustainable use in the environmental dimension;
Efficient use in the economic dimension;
Equitable use in the social dimension;
Democratic use in the political dimension.

These criteria are all what we consider in the research and design. But since our goal is to introduce the natural waterway to improve the drainage system, sense of places, and landscape experience, we pay more attention on the environmental and social dimensions.

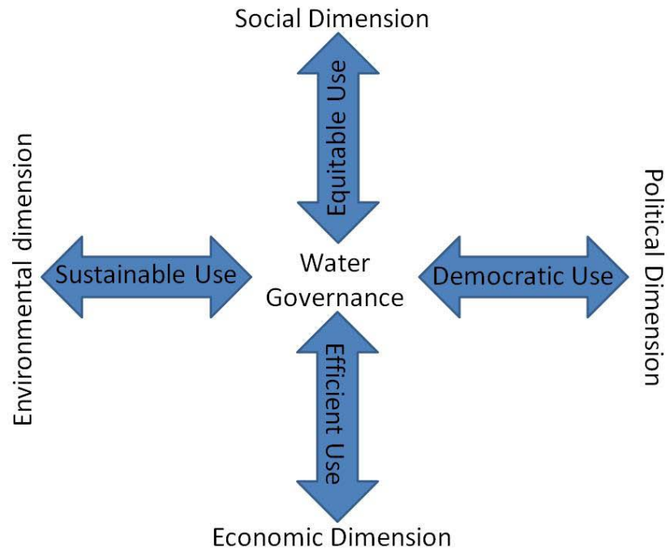


Figure 3.2.1 Four Dimensions of Good Water Governance (Tropp, 2005, p10 -p13)

3.2.2 VULNERABILITY OF THE URBAN DRAINAGE SYSTEM

Vulnerability

Vulnerability is the sensitivity of a system exposed to shocks, stresses and disturbances (White, 1974; IPCC,2001; Turner et al., 2003; Leurs, 2005, cited in Graaf & Matsushita, 2008, p144). It shows the capacities to cope with high peak runoff, which combines the threshold capacity, coping capacity, recovery capacity and adapting capacity (Graaf et al., 2007, cited in Graaf & Matsushita, 2008, p144). Table 3.2.1 indicates the identities of the four components' responsibility and the hazard they deal with.

Four capacities

The four capacities cover all degrees of damage in long period with close connections among them (figure 3.2.2). We should improve all of them to strengthen the urban drainage system (Graaf & Matsushita, 2008, p147). Firstly, we should ensure the threshold capacity to cope with the usual amount of precipitation. The height of threshold is determined by the historical disaster record. But if the precipitation exceeds this threshold, the coping and recovery capacity is required to reduce the damage. Additionally, nowadays, the extreme weathers occur more and more frequently. To cope with the high uncertainty for a long period, we need the adaptive capacity. Obviously, the underground piping infrastructure cannot fulfil the needs of high coping, recovery and adaptive capacities. These engineering measures are not sustainable in the long term (Graaf & Matsushita, 2008, p144). Therefore, we should consider different thresholds with diverse capacities.

Name	Type	Frequency of hazard	Time orientation	Uncertainty of hazard
Threshold Capacity	Damage prevention	High	Past	Low
Coping Capacity	Damage reduction	Medium	Instantaneous	Low
Recovery Capacity	Damage reaction	Medium	Instantaneous / Future	Low
Adaptive Capacity	Damage anticipation	Low	Future	High

Table 3.2.1 Four Components of Vulnerability (Graaf & Matsushita, 2008, p144)

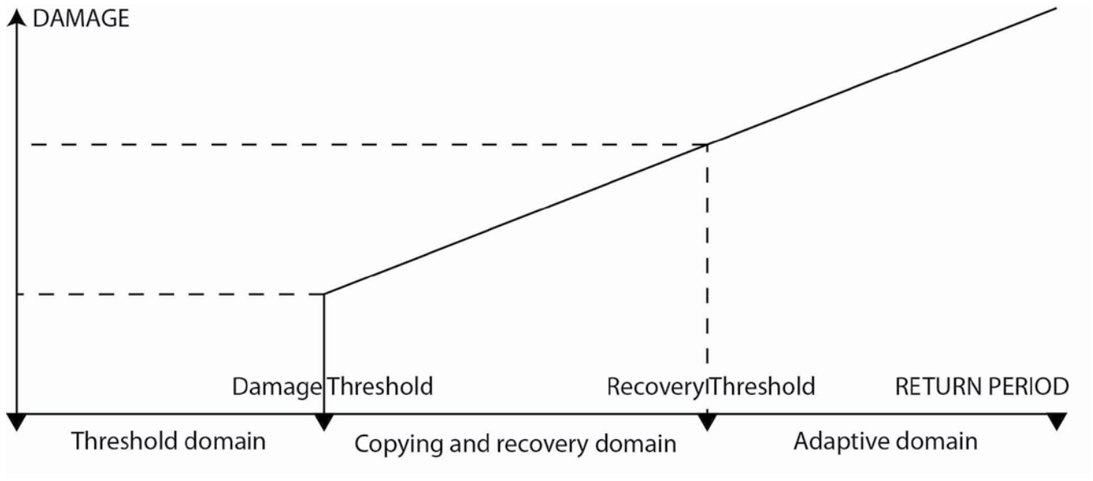


Figure 3.2.2 Four Components and Three Dimensions of Vulnerability Framework (Graaf & Matsushita, 2008, p147)

3.2.3 SUSTAINABLE URBAN DRAINAGE SYSTEMS

The latest Sustainable Urban Drainage Systems (SUDS) are the integrated approaches with considerations on water quantity, quality and environmental benefits issues (Maksimovic et al., 2001, p8). The philosophy of SUDS is to replicate as closely as possible the natural drainage from an undeveloped situation where rainfall soaks into the ground and saturates soil and vegetation before significant runoff occurs (CIRIA, 2007).

There are some characteristics to ensure the sustainability of SUDS (CIRIA ,2000; Maksimovic, 2001, cited in Szollosi-Nagy & Zevenbergen, 2005, p8):

Management of runoff flow rates;
Reduction of the impact of urbanisation on flooding;
Protection or enhancement of water quality;
Provision of a habitat for wildlife in urban watercourses;
Encouragement of natural groundwater recharge.

Management train

Site control

The water drainage process in SUDS mimics nature. A management train includes prevention, conveyance, pre-treatment, source control, site control and regional control (figure 3.2.3). Storm water should be managed in small sub-catchments rather than being conveyed to and managed in large bottom of catchments (CIRIA , 2007, p1-12). We focus on the site control in the design.

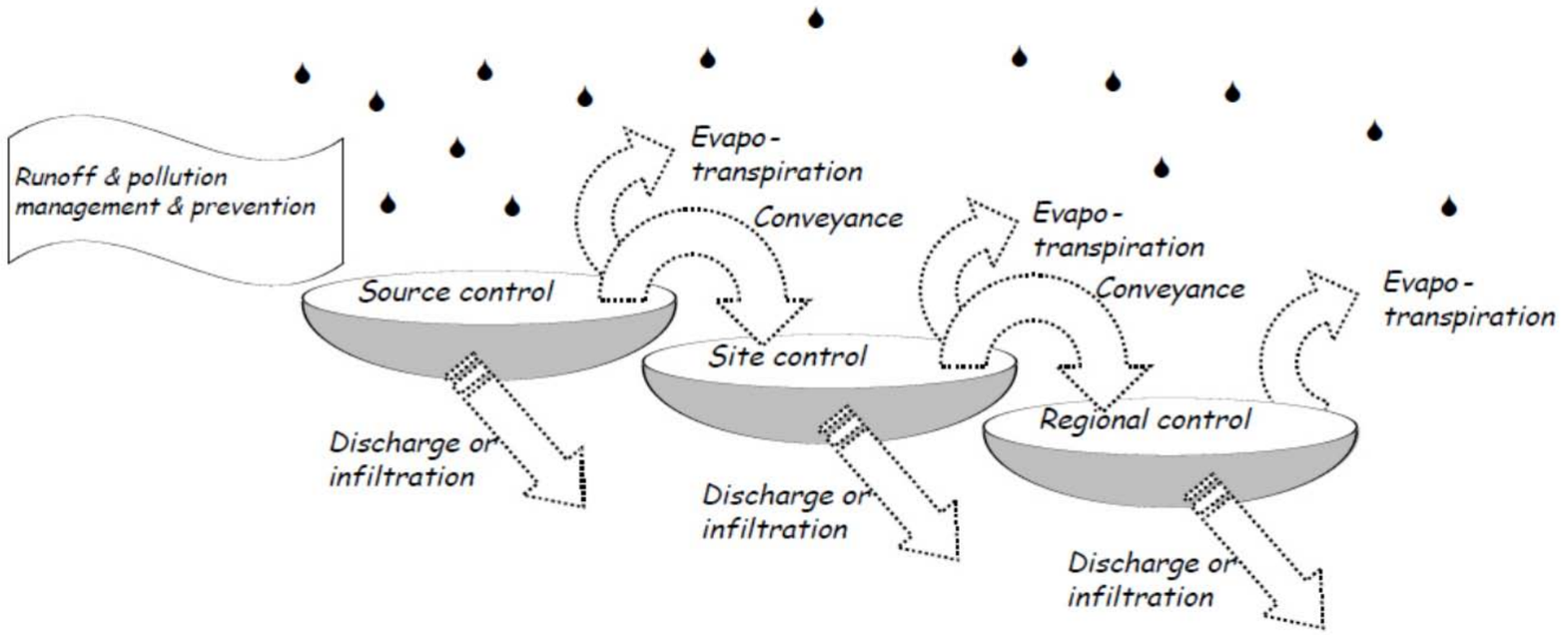


Figure 3.2.3 SUDS Management Train (CIRIA,2001)

SUDS approaches are various and general (CIRIA, 2007, p9). They have different characteristics and performances. The selected approaches should suit the topography, soils, groundwater, catchment scale and availability of space. So lots of multidisciplinary issues should be considered in SUDS design (figure 3.2.4).

Consideration on multidisciplinary issues

Figure 3.2.4 SUDS Design and Planning Issues for Consideration (CIRIA, 2007, p2)

Approaches selection

Since the infiltration rate in the urban area of Enschede is low, we mainly use the visible storage-oriented approach: retention ponds and detention basins (figure 3.2.5-3.2.6).

Retention ponds are the permanent ponds or wetland, which can store extra amount of water after rain. Detention basins are normally dry and are filled with water only after rain. In the areas with restricted spaces for water above ground, the subsurface storage techniques are considered, e.g. geocellular / modular systems under the parking lots. Besides, the pervious pavement are also wildly used to increase the infiltration ability , e.g. grass grids.

Further design criteria, images and structures of these approaches are shown in Appendix 3.

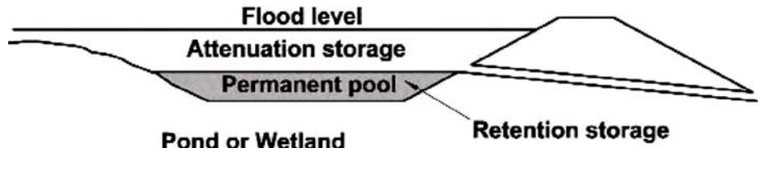


Figure 3.2.5 Retention Pond (CIRIA , 2007, p4)

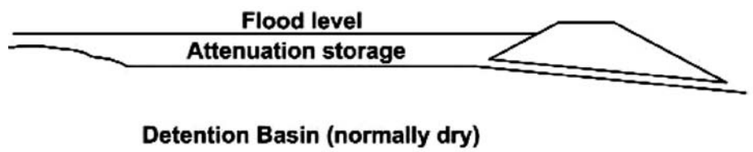


Figure 3.2.6 Detention Basin (CIRIA , 2007, p4)

3.3 PLACE MAKING APPROACHES

3.3.1 PLACE AND PLACEMAKING

Before the research on placemaking, we firstly look into the evolution of definitions for place (table 3.3.1).

PLACE EVOLUTION

Source	Definition of place	Emphasis
1968, Barker	Behaviour setting in by ecological-psychology	Environment determines individuals
1974, Tuan	Dialectical process in experience	Human functioning interacts with nature order
1976, Relph	Meanings out of experience	Physical setting and activities determine meanings
1977, Canter	Settings in environmental psychology	Activity, physical attributes and conceptions
1980, Norberg-Schulz	Reminiscent of spirit	Spirit rooted in the environment, pre-existing naturalness to be discovered
1988, Walter	Location of experience	Human participation, expressive action
1994, Jackson	Brand	How it looks, how it feels, and the story, history behind
1998, Montgoerg	Activity, form, image	Transaction base of economic activity in different layers,
1998, Crang	Places provide an anchor of shared experiences between people and continuity over time	Shared experiences
1999, PPS	Enjoyable space for its social and physical attributes.	Access & linkage, Comfort & image, Uses & activity, Sociability
2001, Sircus	A place engages us in an emotional experience organised to communicate purpose and story	Emotional experience
2001, Motloch	The mental construct of the temporal-spatial experience as the individual ascribes meaning to settings.	Spatial experience, perception, associational meanings
2003, Carmona	Places are that real to people	Invite and reward intellectual or emotional involvement, provides a sense of psychological connectedness.

Table 3.3.1 Evolution of Place Definitions

Place has its origins in the ecological-psychology theory of Barker(1968) and derives from the behaviour setting, which is a collective conception defined in terms of fitting behaviour, physical attributions and time. It is based on the assumption that individuals within the setting are interchangeable, and their behaviour can be determined through control of the socio-physical context(Thwaites & Simkins, 2007,p31).

In the theory of Canter(1977), the term place appears increasingly in environmental psychology. It is used as a similar word as settings. The concept of place is closely linked with geographical research and architectural design. For landscape architects, the holistic entity should be incorporated into consideration. Canter pointed out the need to orientate research in environmental psychology in the direction of wholes rather than simple assemblages of elements, since place is the interaction of actions, conceptions and physical attributes. In order to identify a place, we need to know what behaviour is associated with it, what the physical parameters are, and what conceptions people have of that behaviour in that particular physical environment (Canter 1977, cited in Thwaites & Simkins, 2007,p31).

Edward Relph's Place and Placelessness (1976) was one of the earliest works focusing on the psychological and experiential aspects in place. He regarded place as essentially centres of meaning constructed out of lived-experience. In order to make a place, we need to imbue them with meaning, individuals, groups or societies (Carmona, 2003).

Sense of place

In the 1980s, the concept of ‘sense of place’ (in Latin: genius-loci) came up in the theoretical framework of place. Norber-Schulze (1980) attempted to unify physical and spiritual elements in place. Each place possesses its own spirit rooted in the environment. Genius-loci defines a place in a way which transcends physical attributes by assigning spiritual significance with which human intervention must harmonise. Human activities is defined as a response to place rather than a component to identify a place (Thwaites & Simkins, 2007,p32).

Human expressive acts in the cultural context

When we look into an entirely experiential term, place is defined as a dialectical process between human and nature. Place are not just products of physical environment but the products of intentional human acts. Tuan (1977) regards place as a pause for people , in which place is defined in the terms of human expressive acts in the cultural context. The sense of place is a social phenomenon that exists independent of any individual’s perceptions, yet is dependent on human engagement for its existence (Tuan, 1980)

Spatial focused theory

In the last ten years, there are two branches in the development of the theory of place. One is the spatial focused theory represented by the Place Diagram, there are four aspects of qualities place should have(PPS, 1999, cited in Carmona, 2003):

Good places are accessible;
People are engaged in activities there;
The space is comfortable and has a good image;
It is a sociable place: one where people meet each other and take people when they come to visit.

(Details are shown in Chapter 3.3.2)

Mental focused theory

Another one is mental focused theory represented by Motloch. He defined place as a human mental construct. So in his opinion the place can only be managed but not designed (Motloch, 2001, p247).

Human and environmental mutual influence

From the history of the place theories development, place is coming from an environment determining concept to a human and environment mutual influencing one with emphasis on local stories and experience. Besides, the theory from PPS has covered most aspects of the previous theories with its ultimate goal of sociability in place. So the place we are going to design is defined following PPS.

PLACEMAKING

After understanding what is place, we still need to find out what is placemaking itself.

From the PPS (2011), placemaking is described as a process of making a successful place, which has these characteristics below:

Placemaking is community-driven, visionary, function before form, adaptable, inclusive, focused on creating destinations, flexible, culturally aware, ever changing, multidisciplinary, transformative, context-sensitive, inspiring, collaborative, and sociable. Placemaking strikes a balance between the physical, the social and even the spiritual qualities of a place.

From this definition, placemaking is a bottom up concept. For our situation, the relative top down project, we still can use this placemaking concept to make the place for people. Besides, it is clear that we need a lot of social works and our designs should be adaptable and inclusive to the layman knowledge rather than only relying on the professional knowledge. So what shall we ask local community and how can we collect the layman knowledge for our designs? The following approaches are giving the answers.

3.3.2 PLACE DIAGRAM

Place Diagram is the most important placemaking theory from PPS. It indicates the specific criteria for place evaluations. They are used in making the questionnaire and interviews for our social field work.

SOCIABILITY

This is the aim but most difficult part in place making. When people see friends, greet their neighbours, and feel comfortable interacting with strangers, they tend to feel a stronger sense of place.

Figure 3.3.1 Place Diagram (PPS, 2011)

USES & ACTIVITIES

Activities are the basis of a place. Having something to do gives people a reason to go to a place. When there is nothing to do, a space will be empty and that means that something is wrong.

ACCESS & LINKAGES

The accessibility of a place is judged by its connections to its surroundings, both visual and physical, which means that a successful public space is easy to get to and get through; it is visible both from a distance and up close.

COMFORT & IMAGE

Whether a space has a good image is key to its success. Comfort includes safety, cleanliness, and the availability of places to sit with several choices.

3.3.3 PLACEMAKER METHOD

The PlaceMaker method comprises six phases in place making (table 3.3.2). It emphasises on the combination of professional perception on the place identity with the layman's perceptions. Therefore, this scheme gives us a guideline for our place evaluation and layman knowledge collection processes.

Realm setting Desk study

In phase 0, various types of database realm is decided and the general desk information should be collected.

Expectations

The first phase is devoted to an anticipatory analysis. The aim is to analyse expectations.

Site observation

The second phase has four surveys: denominative, perceptual, graphical and photo surveys are coming from desk studies.

Map study

The third phase consists of an traditional cartography analysis, in order to identify the relationships between the site and the whole city, and between the elements in the area.

Questionnaires

The fourth phase is the questionnaire administered to users of the area in order to obtain an idea of the place as perceived.

Data accumulation

The fifth phase involves checking the various types of data collected and the maps produced, and selection of the elements useful for building up the final evaluation.

Phase	Objectives	Actions	Products
0	Construction of the analysis grid	Choice of categories Choice of parameters Choice of significant days Choice of time slices	Grid of the database
1	Anticipatory analysis	Preliminary observations carried out prior to first inspection	Map of preliminary ideas of the place
2	Perceptive and denominative description of the elements	Denominative survey Perceptive survey Graphical survey Photographic survey Video survey	Map representing results obtained from surveys
3	Identification with traditional cartography of the elements required for area description	Analysis of traditional planimetry – on urban scale – on territorial scale	Map showing site components deduced from traditional cartography
4	Identification of elements of the place perceived by people not involved in the study	Questionnaire for visitors	Map representing results of questionnaire
5	Processing the collected information	Overlay of the maps with the different elements observed from the anticipatory and effective analysis Check of the different elements observed from different analysis tools	Construction of graphic system Construction of complex map

Table 3.3.2 PlaceMaker Scheme (Sepe, 2010)

3.4 DESIGN EVALUATION APPROACH

Since our design is to make places for people, when evaluating our design outcomes, we need to know if they meet with the needs and wishes from local communities. Therefore, we selected a customer-oriented approach in final design evaluations and reflections.

Quality Function Deployment is an approach with the focuses on customers for product and service professions. It guides managers through the concept generation, creation, and realisation of new products and services. The QFD process can help to gain an in-depth understanding of the requirements of customers needs and wants thus prioritising the features of the product/service to these requirements. In the process, it starts by listing customer demands, in the customer language, it systematically translates these requirements into appropriate 'design' measures(Innovation Process Management, 2003). Besides, this model use the graphic analysis called house of quality(figure 3.4.1).

In order to use this approach to evaluate our landscape architectural design outcomes. We modify the model and come up with the evaluation steps listed below:

Original Quality Function Deployment

Step 1: List the customer requirements

Step 2: Rank each attribute
(Customers rank the importance of their demands)

Step 3: Benchmark the performance of the current products
(Customers give marks to the new product and others)

Step 4: Identify and rank improvement objectives

Step 5: Generate the list of design parameters
(Translate the customer requirements into technical specifications)

Step 6: The QFD interaction matrix
(Use scores to identify the interaction between demands and parameters)

Step 7: Benchmark the technical performance of products
(Make the design parameter into measurable data)

Step 8: Determine the technical target for the new product
(Figure out the weak points to improve)

Step 9: Identify supporting and conflicting design parameters
(Consider the requirement priority ranking)

Step 10: Beyond the house of quality
(Use this model in downstream development process)

Modified Quality Function Deployment

Step 1: List the wishes and benefits of local community

Step 2: Benchmark the performance of our designs
(Give the marks for the all design outcomes)

Step 3: Generate the list of design parameters
(Translate the requirements into design specifications)

Step 4: The QFD interaction matrix
(Use symbols to identify the interaction between demands and parameters)

Step 5: Determine the design improvement for future
(Figure out the weak points in designs)

Step 6: Identify conflicting design parameters

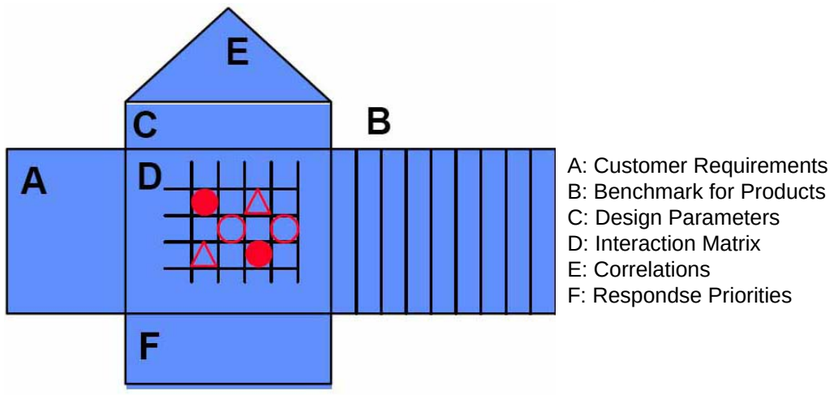


Figure 3.4.1 House of Quality (based on Innovation Process Management, 2003)

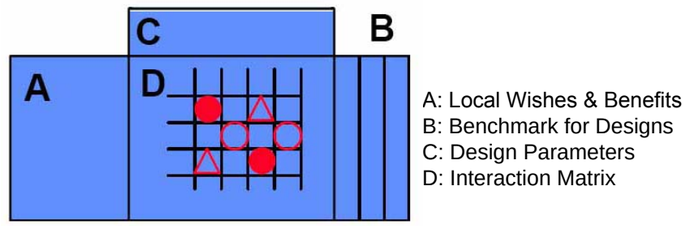


Figure 3.4.2 Modified House of Quality

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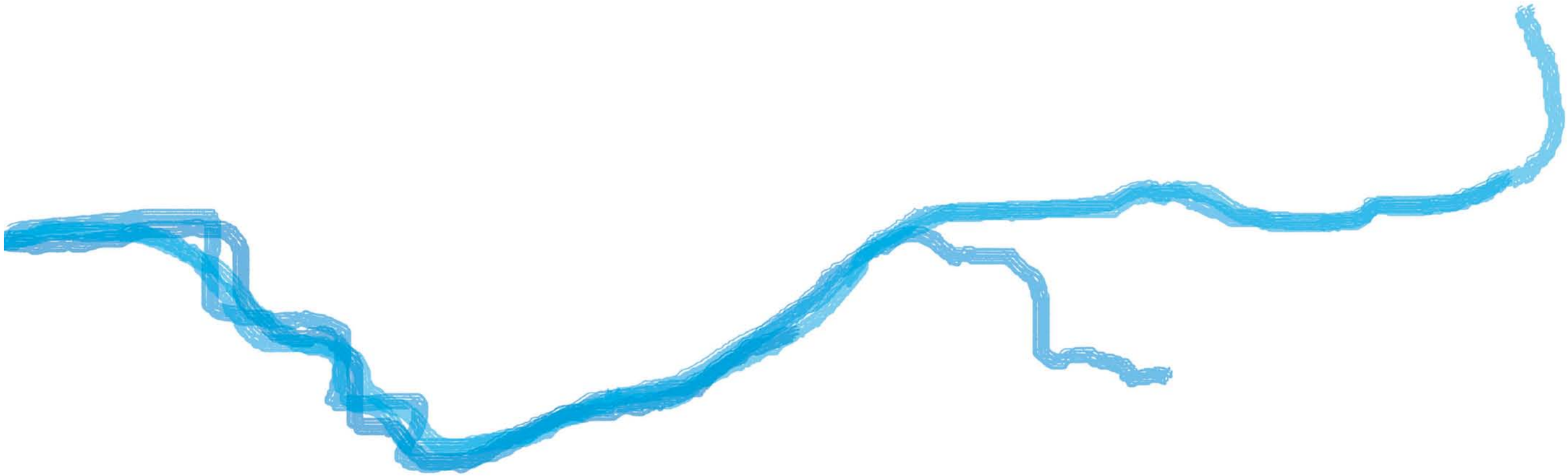
CHAPTER 4 EXPERIENCE GUIDING

This chapter focuses on creating nice experience for the Twekkelerbeek in the urban scale. We start with the landscape narratives approach to tell the water story along the brook. Afterwards, we analyse the experiential landscape to find out the present situations in Enschede. Based on that, we generate further concepts to dissolve our water story into the water experience.



4.1 TELL THE WATER STORY

4.1.1 FOLLOW THE HISTORICAL ROUTE

Revealing the history

Waterway adapting to urban fabric

From Chapter 1, we know the historical story of the Twekkelerbeek. Besides, in the theory of landscape narratives, we understand the method of revealing the history can encourage the common memory for bonding people with landscape. Therefore, we want to tell the story of the Twekkelerbeek by following the historical water route. But there are several conflicts between the waterway and existing buildings (figure 4.1.1). So the route of the new waterway mostly follow the historical route but with some adaptive modifications to meet with the present urban fabric.

Figure 4.1.1 Historical Route of Twekkelerbeek (based on maps of Enschede in 1880 and 2010)

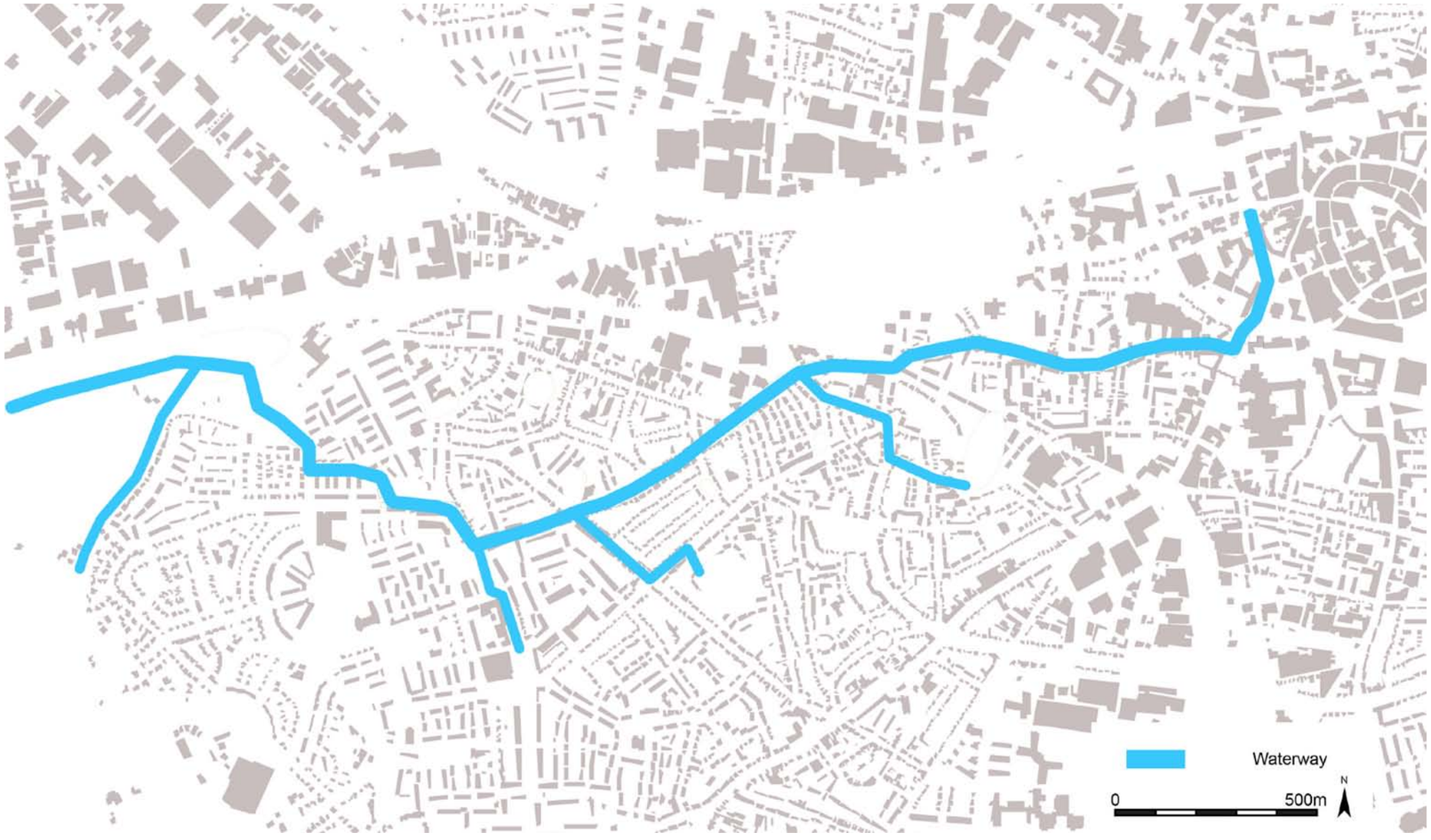


Figure 4.1.2 Waterway Routing

4.1.2 MIMIC THE NATURE

In the history, the Twekkelerbeek was naturally formed, so when we want to tell the story of this brook we should also open to the natural process of water system.

Open to natural process

In natural system, water ponds are mostly formed in the spring spot and connection spots of brooks. When water flows from the spring to the down streams, these ponds aside and the brook itself are getting bigger and broader. Based on this natural rule, we mimic the system by placing gradually enlarged water ponds along the direction of water flows. Besides, the waterway is also designed to be narrow in the upstream and become wider in the down stream (figure 4.1.3).

Gradually enlarged ponds
Widened brooks

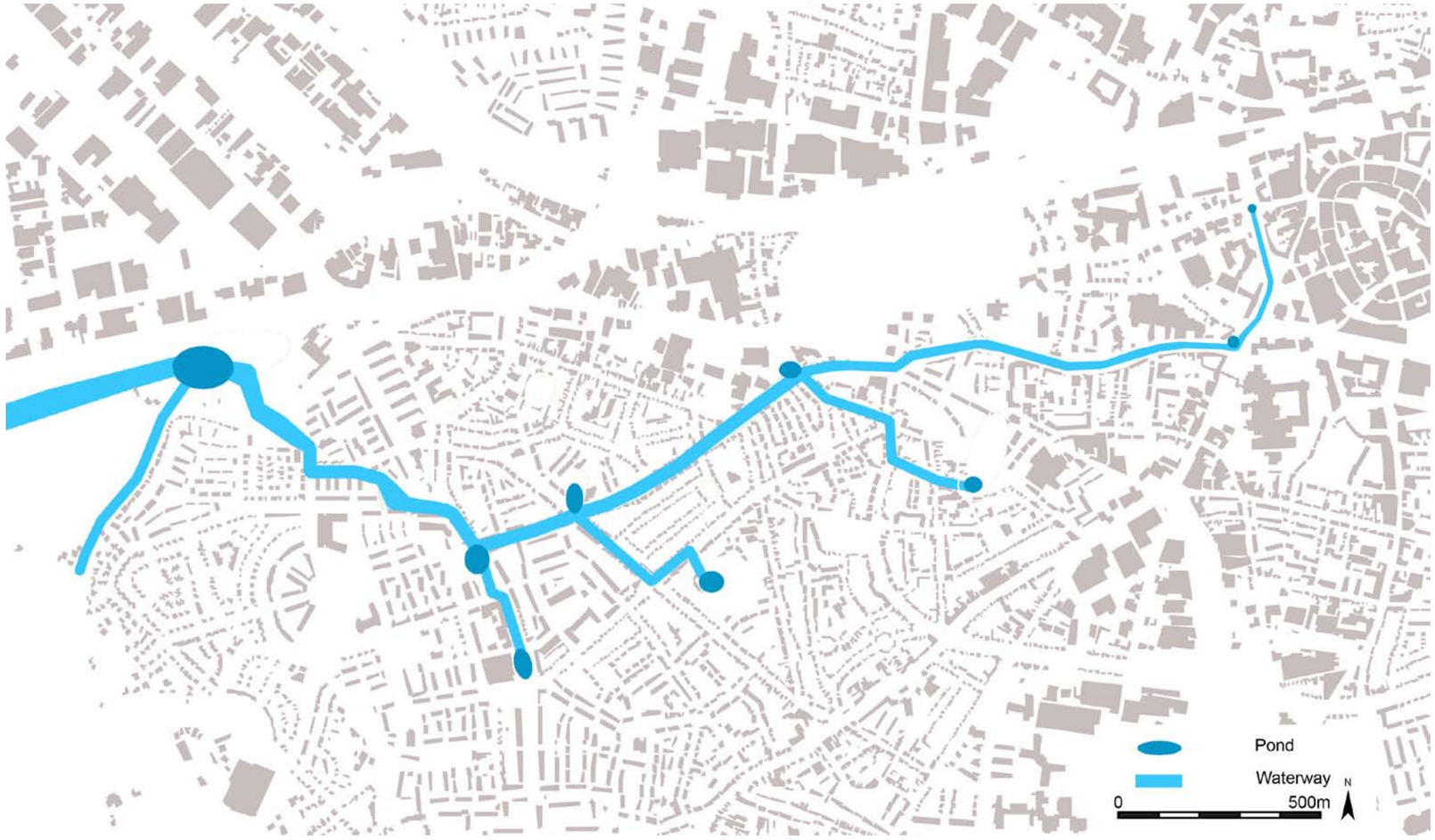


Figure 4.1.3 Natural Waterway

Plants adapting to water situations
Plant community

Few water tolerant trees in middle part
Dense brook trees for the rest

In nature areas, plants are growing adapting to the water situations. So along the Twekkelerbeek, plants have a lot of potential to tell the story of water. Firstly, we design the cross section structure of the plant community along the waterway with shrubs, trees and wetlands to tell the story vertically (figure 4.1.4). Secondly, in order to tell the story horizontally, we study the groundwater table along the brook (figure 4.1.6). It is obvious that the middle part has very shallow water table, which only can afford restricted numbers of water tolerant trees to live. So we decide to plant trees with good water tolerance in low density for this specific part. While for the rest, we plant more dense trees to bring nature back into city. Especially, in order to create the image of natural water landscape with local identities, all the vegetations we select for our waterway are the wild plant species in Twente area, which can be commonly seen along natural streams, brooks or wetlands.

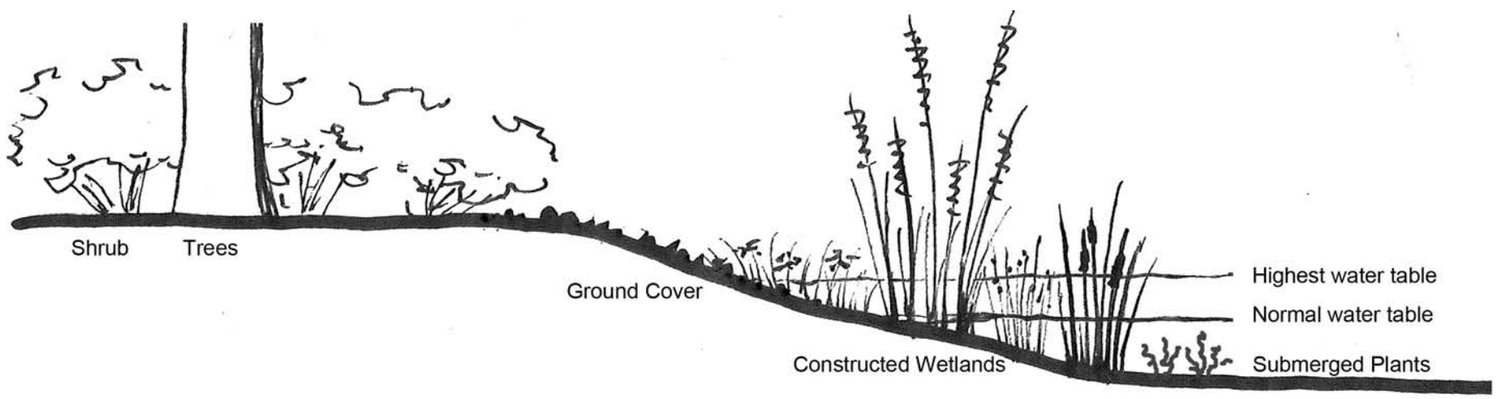


Figure 4.1.4 Plant Community

Little Green Sedge (Dwergzegge)
Carex oederi subsp. oederi
5 to 30 cm

White Willow (Schietwilg)
Salix alba
20 to 50 cm

Lesser Tussock-sedge (Ronde zegge)
Carex diandra
20 to 70 cm

Glaucous Sedge (Zeegroene zegge)
Carex flacca
20 to 90 cm

Common Club-rush (Mattenbies)
Schoenoplectus lacustris
75 cm to 2 m

Common Reed (Riet)
Phragmites australis
1 to 3 m

Figure 4.1.5 Wetland Plants List (based on data from Wilde Planten, 2012)

		Mean highest water table	Mean lowest water table
*	Shallow:	0.1-0.3 m	0.5-1.4 m
**	Moderate:	0.3-1.0 m	1.4-2.0 m
***	Deep:	>1.0 m	>2.0 m

Figure 4.1.6 Groundwater Table Situation(based on map from Louw, 2006)

Bay Willow
(Laurierwilg)
Salix pentandra
6 to 8 m

Midland Hawthorn
(Tweestijlige meidoorn)
Crataegus laevigata
6 to 8 m

Common Alder
(Zwarte els)
Alnus glutinosa
6 to 12 m

White Willow
(Schietwilg)
Salix alba
6 to 20 m

Black Poplar
(Zwarte populier)
Populus nigra
15 to 25 m

Figure 4.1.7 Natural Brook Trees with Good Water Tolerance(based on data from Wilde Planten, 2012)

Downy Birch
(Zachte berk)
Betula pubescens
6 to 8 m

Wild Cherry
(Zoete kers)
Prunus avium
6 to 8 m

Field maple
(Spaanse aak)
Acer campestre
6 to 12 m

Hornbeam
(Haagbeuk)
Carpinus betulus
6 to 25 m

Small-leaved Lime
(Winterlinde)
Tilia cordata
12 to 35 meter

Figure 4.1.8 Natural Brook Trees with Poor Water Tolerance (based on data from Wilde Planten, 2012)

4.2 EXPERIENTIAL LANDSCAPE ANALYSIS

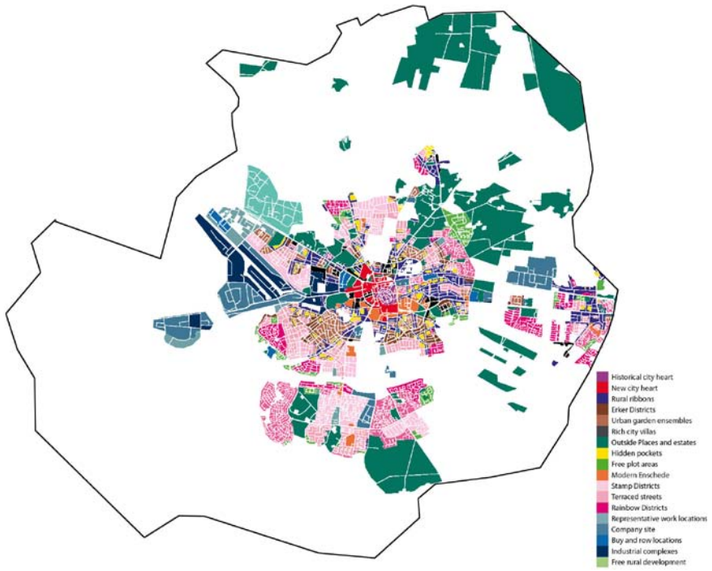


Figure 4.2.1 Neighbourhood Identity Map (based on Gemeente Enschede, 2004)

In order to make nice experience along the waterway, we need to do the experiential landscape analysis in the present Enschede. Firstly, the Neighbourhood Identity Map from local municipality (figure 4.2.1) gave us the general views on the several area identities. Secondly, the map of four concepts from the theory of experiential landscape is made according to our site experience. As figure 4.2.2 shows, Enschede is a city with lots of identities in different areas, transitions, centres and directions. The following paragraphs illustrate each of the concept respectively.

Complex and diverse city experience

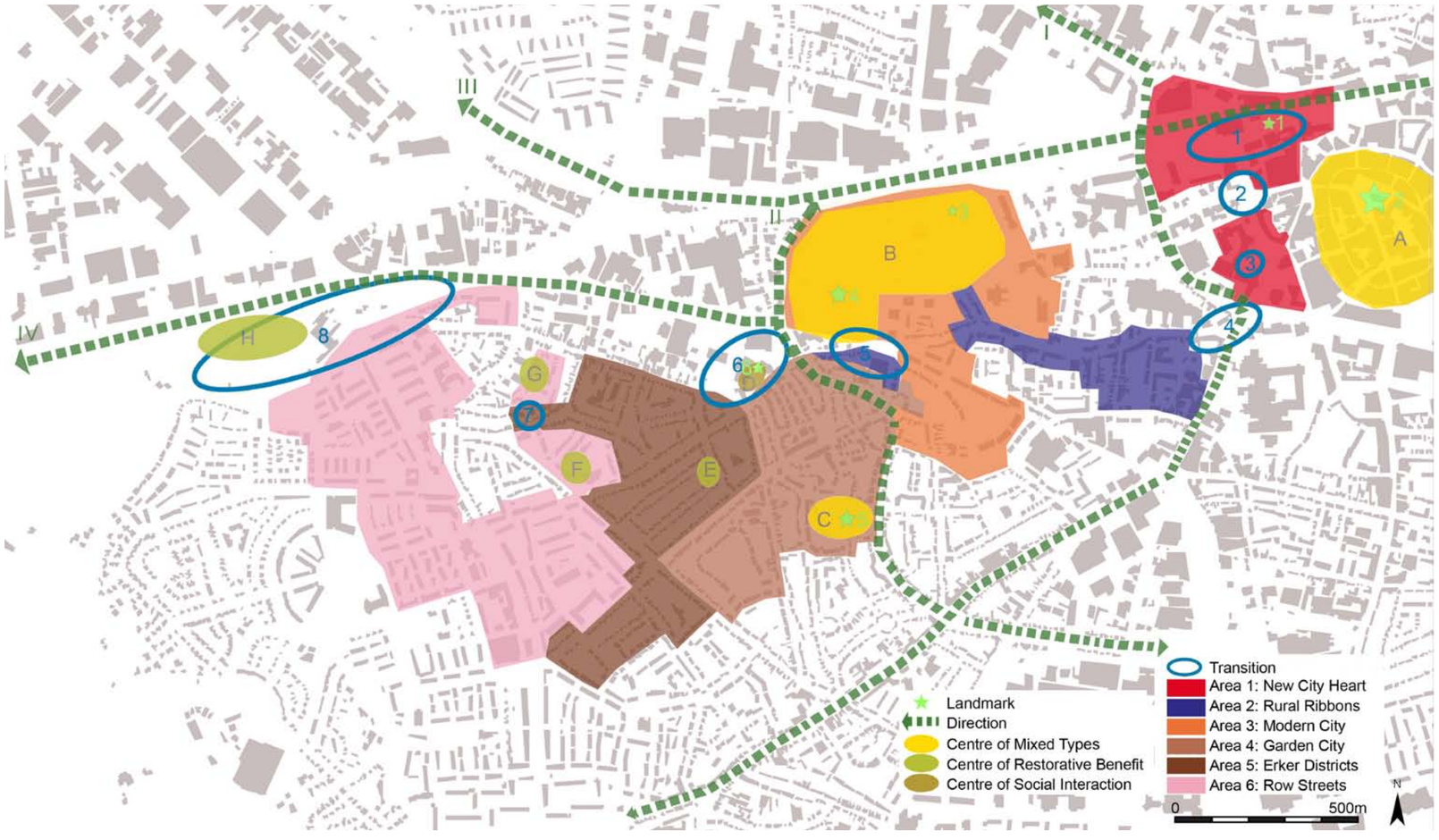


Figure 4.2.2 Experiential Landscape Analysis

4.2.1 AREA

There are six areas with different identities. Figure 4.2.3 shows the area typical street views, profiles, buildings, and materials. The following maps indicates detailed analysis and evaluations.

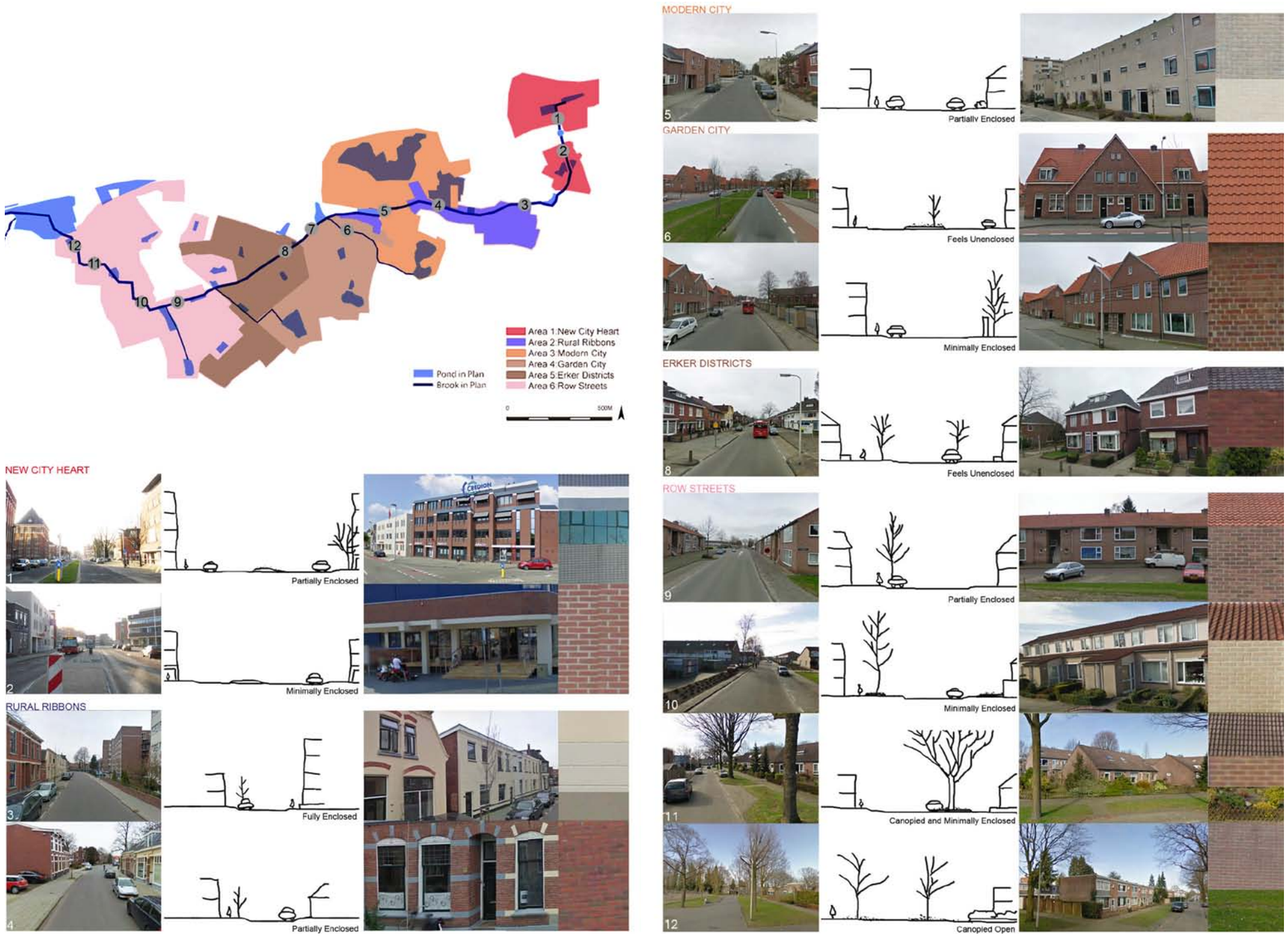


Figure 4.2.3 Areas Analysis

Limited space in the middle

AREA SPACIAL ANALYSIS

The spaces in the six areas are divided into six categories according to space division system by Motloch (2001).

From the analysis map (figure 4.2.5), the space along the water direction is coming from minimally enclosed to fully enclosed and gradually turning into open. So the minimally enclosed space in the beginning has space for natural brooks. While the space in the middle part is quite limited, so it is necessary to change the existing functions to make room for water. Besides, the gradually enlarged spaces from the middle to the west part ensure the possibility to fulfil the ideas of widening the brook along the water flows.

In Chapter 7, there are three brook designs shown. Each of them has its typical spacial characteristic.

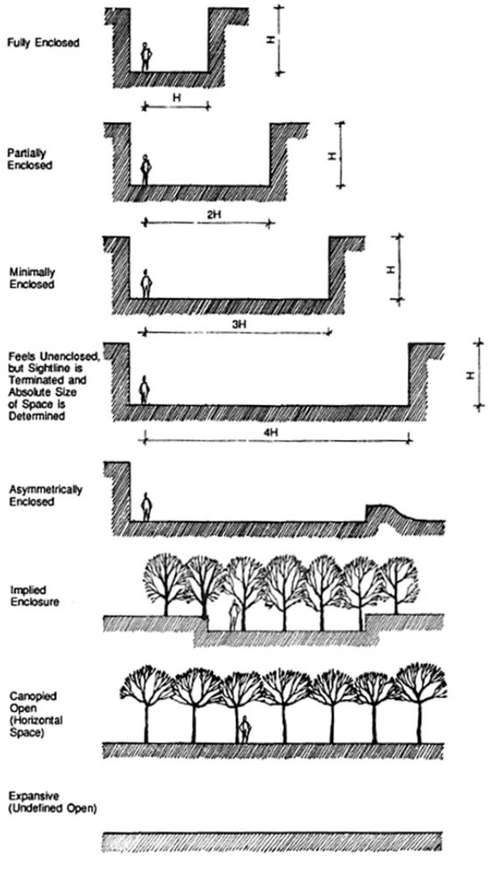


Figure 4.2.4 Degree and Nature of Enclosure (Motloch, 2001, p191)

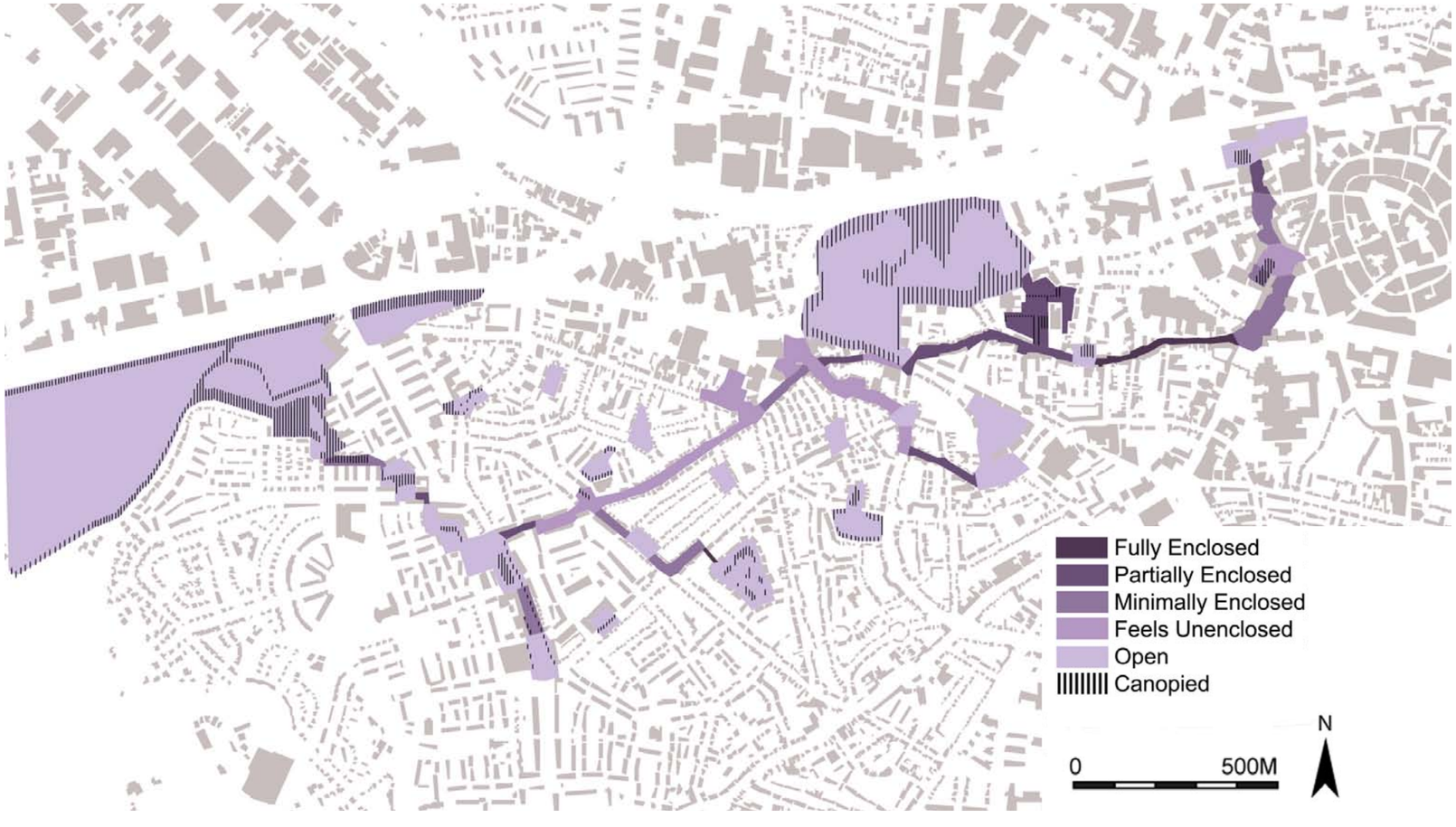


Figure 4.2.5 Area Spatial Analysis

AREA IDENTITY AND EVALUATION

Table 4.2.1 shows the detailed identities of these six areas, and the following table indicates our evaluations on the sense of areas along the waterway.

Area	Building type	Use and activity	Main spatial type	Degree of privacy
1. New city heart	Modern building with open ground floor	Services like library, police station, shops etc.	Changeable spaces but mostly are minimally enclosed	Public
2. Rural ribbons	History from the middle age; Materials are different but the height and width are the same; Height is more than width; Village character	Living, traffic	Fully Enclosed	Private housing, public street
3. Modern city	Built after 1960's; Contemporary material.	Living, traffic, recreation	Fully enclosed spaces along the road, open ones in the rest	Private housing, public street
4. Garden city	Enclosed park or public garden with common building inside; Red ceramic tiles; City heritage	Living, traffic, recreation	Open spaces around ponds in plan, fully enclosed spaces along secondary brook in plan, unenclosed spaces in the rest	Private housing, semi-public parks, public street
5. Erker districts	Built between two world wars; Close link to industrial history of the city; House facade and roof volume, separated by a crossing Cornice; Little gardens face to the street.	Living, traffic	Open spaces around ponds in plan, fully enclosed spaces along secondary brook in plan, unenclosed spaces in the rest	Private housing, public street
6. Row streets	Built in 1950-1970's; Straight row houses in two floors; Front gardens.	Living, traffic	Partially enclosed spaces along roads, canopied open spaces in the rest	Private housing, public street

Table 4.2.1 Area Identity Description

After war buildings for living

Area	Sense of Area	Reason	Strength	Weakness
1.New city heart	Weak	Various building materials, height and width; several transitions in the area breaking the rhythm of the area	Strong sense of area in Garden city, and Erker districts, because of the high thematic continuity with cohesive rhythm and pattern, building type , texture, space and forms	Weak sense of area in New city heart because of too many transitions in between;
2.Rural ribbons	Middle	Different colors, but controlled building height and width in most parts. But the part close to modern city lack of characteristic of the major part.		
3.Modern city	Middle on the road, Strong for the rest	In the north and south parts the sense of the modern city is strong with the modern materials and light colors, while the sense on the road side is low because of the building height difference and darker colors		Area of Rural ribbons and the area of Modern city are mingled with each other and weaken the sense of areas in each other.
4.Garden city	Strong	Identical building details and patterns		
5.Erker districts	Strong	Identical building details and patterns		
6.Row streets	Middle	Same building scales and styles but different building age and colors		

Table 4.2.2 Sense of Area Evaluation

Strong sense of area in mono identity

Weak sense of area in mixed identities

4.2.2 TRANSITION

Weakened continuity

There are eight transitions along the route. Those located on the boundary of each two areas act as the identity changing spots, but the ones in side of the area weaken the continuity in our experience. Figure 4.2.6 shows the images of these transitions and table 4.2.3 indicates their characteristics and the evaluations on their sense of transition. The location of these transitions are numbered in figure 4.2.2.

Figure 4.2.6 Transitions(Google Stree View, 2012)

Transition	Description	Sense of Transition	Reason	Strength	Weakness
1	It is the square in front of the rail way station, which transits the transportation	Strong	The square is big, the legibility is strong, and the change is obvious	The transition 4 & 8 on the boundary of the two areas have strong sense in changes.	The transitions 2,3,7 in the area weaken the sense of their area and also weaken their own sense of transition;
2	It is a normal crossroad. The building type changes into single houses in this spot	Middle	The material and colors on these houses are in harmony with the background. Only the building styles change.		
3	It is a urban square with matrix of trees	Middle	The trees have the seasonal changes by themselves. In this spot the space is extended so the experience is changed		
4	It is located on the boundary of city center and residential area	Strong	Varied kinds of architectures in different scale of spaces and the functional turning point from public service area into the living area		
5	It is the entrance of the Volkspark	Middle	Green elements make the change. But the sense of the park entrance is weak.		Transition 5 & 6 have low coherence with the location.
6	It is located in the outside of ring road and also the south boundary of industrial area	Strong	The industrial area in the north with large factories are strongly against the garden city type of residential area in the south		
7	It is a spot with building type changes	Weak	Row houses and erker houses both use the red bricks as the main material		
8	It is large green area between the north high way and south residential areas	Strong	Large size and differences with strong green elements		

Table 4.2.3 Sense of Transition Evaluation

4.2.3 CENTRE

There are eight centres of three types in the areas. The mixed centres are collected close to the city heart with strong identities. The two parks both have the strong sense of centre for their high values of recreation and sociability. However, most of the other centres are the restorative centres with playing and sport facilities, but with low rate of use, result in low sense of centre. Table 4.2.4 shows the details of evaluations. The location of these centres are shown in figure 4.2.2.

Centre	Description	Sense of Centre	Reason	Strength	Weakness
A	It is the old city centre. Now it is a cluster of shopping streets and recreational centre	Strong	The long history of being a centre, the landmark for the whole city, and the attractiveness	Mixed functions can be found in mixed centres A B C.	Mono function in other centres restricts the sense of centre for them. Lack of mixed centres in the west residential areas.
B	It is Volkspark, a famous city park in Enschede	Strong	It attracts lot of people to come and use it as a recreational and social place		
C	It is Ainsworthpark, a small park surrounded by residential areas	Strong	This park is the result of public participation. Locals use it frequently		
D	It is a mosque for religious people	Strong	The architecture has strong identities with the religious influences		
E, F, G	They are playground with playing facilities for kids	Middle	The facilities only attract children. They are not special or with any identity		
H	It is a standard football field	Weak	It work as a sport centre in restorative functions		

Table 4.2.4 Sense of Centre Evaluation

Weak restorative centres

4.2.4 DIRECTION

The directions are all for traffic, so they have strong sense of movement directions (table 4.2.5). While the existing landmarks have no coherence to each other creating no visual directions (figure 4.2.7).The location of these directions are shown in figure 4.2.2.

Direction	Description	Sense of Direction	Reason	Strength	Weakness
I	Main road linking the Enschede North and South	Strong	The linear shapes help the experience on the road as a sense of direction; The flow of cars, cyclists and pedestrians make them all with strong sense of movement directions	Strong sense of direction on main roads.	There is no main direction leading people walking from city centre to west residential areas;
II	City ring road				
III	Rail way				
IV	High way linking Enschede with Hengelo				No landmarks on the directions cause low imageability for

Table 4.2.5 Sense of Direction Evaluation

No visual direction

Figure 4.2.7 Landmarks

Landmarks incoherent to directions

4.3 CONCEPTS

4.3.1 WATERWAY WITH DIRECTION

After analysing the existing experiential landscape in Enschede, we realize the diverse identities in the urban context. In order to guide a enjoyable water experience along the waterway, the waterway should has its own identity with continuous sense of direction to link the existing different areas.

In order to enhance this direction, several landmarks should be placed in key spots to guide the visual and movement directions (figure 4.3.1). Besides, the urban furniture, pavings, and landmarks should be identical along the whole waterway.

Direction starting from the train station

The major direction following the main brook

Other directions flowing with the minor brooks

A set of landmarks along the direction

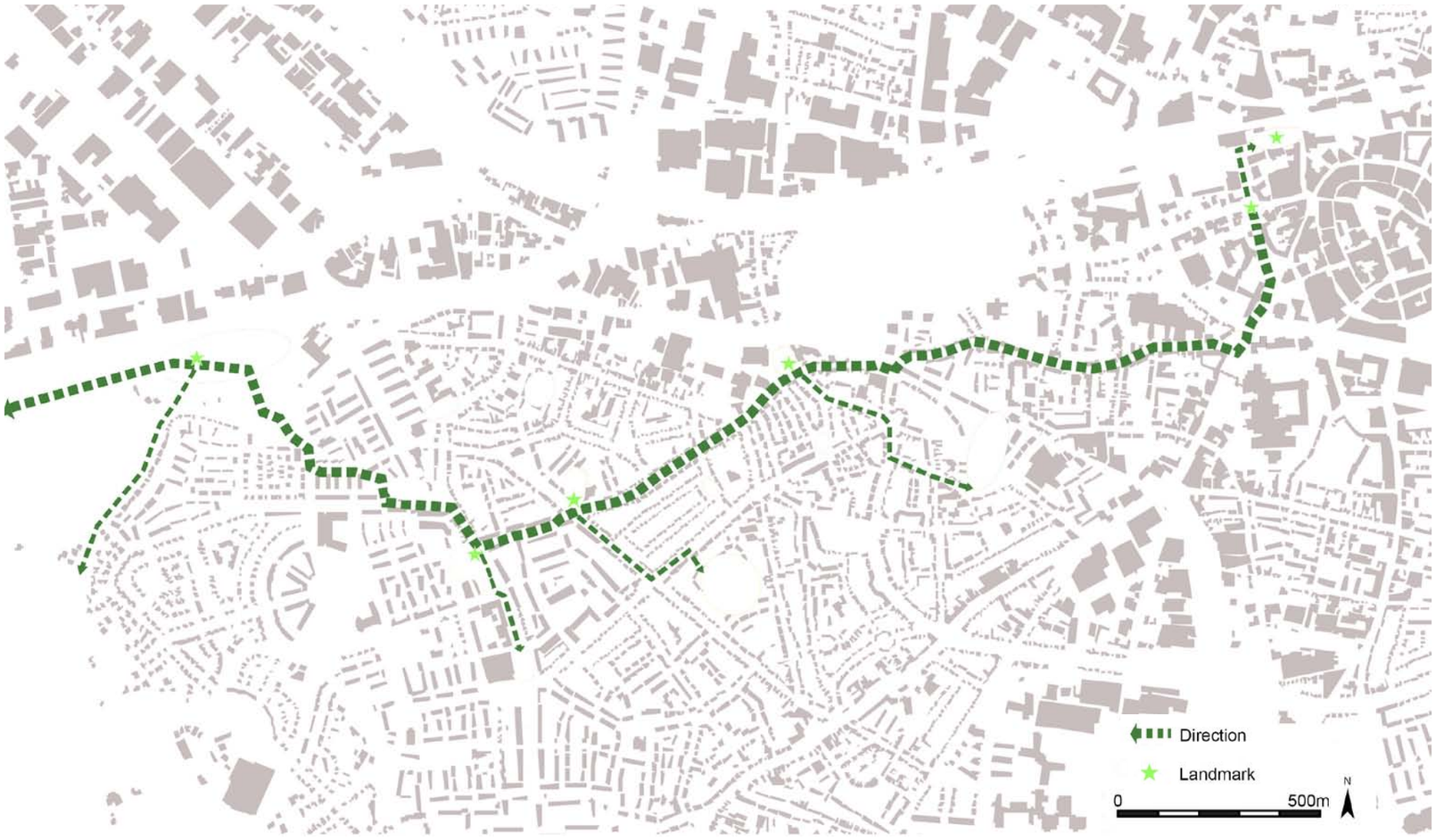


Figure 4.3.1 Waterway Direction with Landmarks

So what kind of urban furniture, pavement, and landmark would be suitable for Twekkelerbeek? We find the answers by landscape narratives.

URBAN FURNITURE

Urban furniture along the brook should give people with the sense of history and images of nature. So firstly we look into the furniture style in the old times. From the painting of Enschede (figure 4.3.2), we notice that black metal was commonly used. Besides, wood material let people feel nature. Therefore, we implement metal and wood in the furniture designs.

Take bench design for example, it is made with metal structure and wood bars. As we all know that bench is set for people to stay and get relaxed. So people has more time to read the landscape. Therefore, we use the gathering method of landscape narratives in shaping the backrest into the route of Twekkelerbeek with a sign of the bench location on it in order to make people realize the whole waterway as well as afford the furniture with their own identities.

Gathering the whole waterway on bench

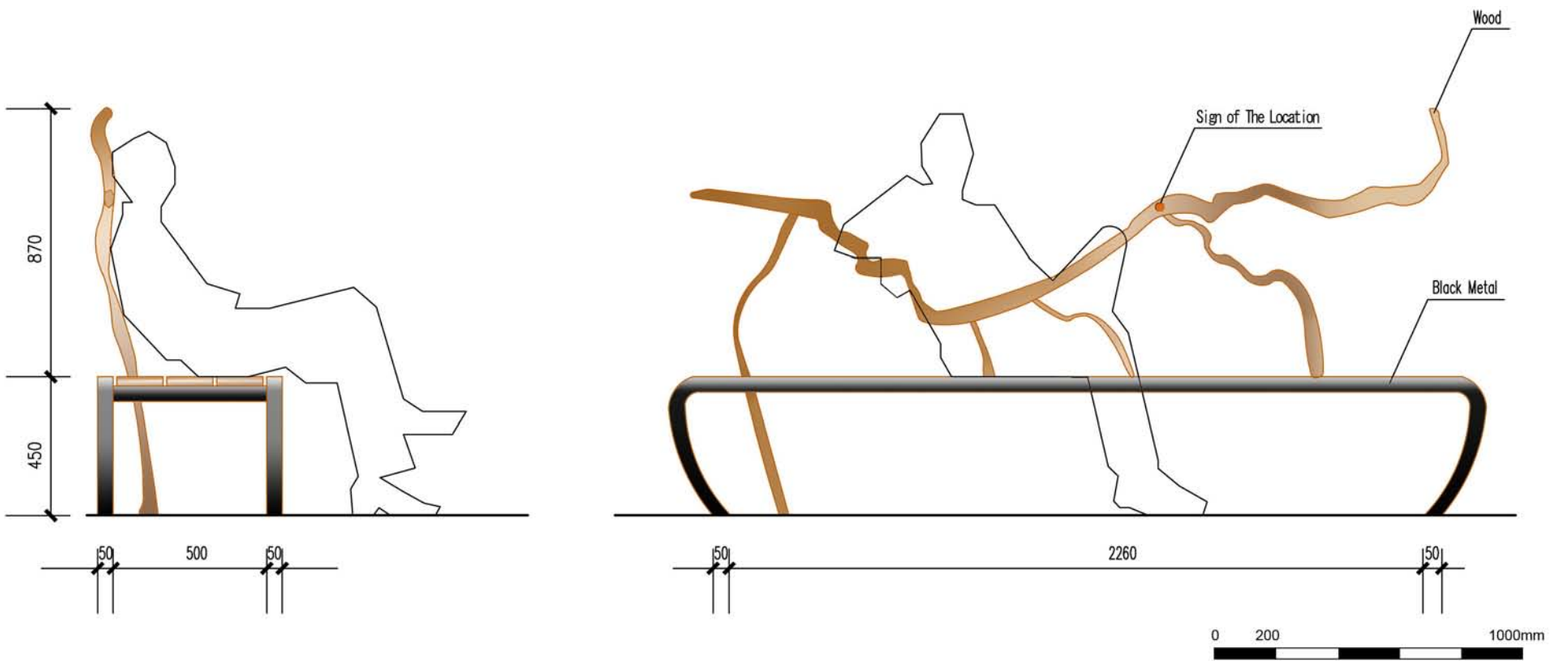


Figure 4.3.3 Bench Design

Figure 4.3.2 Old Painting in 19th Century: City Fire in Enschede (Visitenschede, 2012)

PAVEMENT

We choose the bound recycled glass porous pavement (filter pave) as our material for the paving along the waterway. This type of pavement consists of bonding processed post-consumer glass with a mixture of resins, pigments, and binding agents. It not only provides a permeable paving material for water infiltration but also reuses disposed glass to be sustainable. Besides, it is very safe and comfortable for people to walk on, because it has stronger compressive strength than porous asphalt, better flexibility than pervious concrete (Stormwater management academy, 2011). Further, since the recycled glass is mixed with resins and binding agents, people can feel good in walking and kids can play safe on the pavement (figure 4.3.4).

Nowadays, there are five different colour choices for this material (Presto Geosystems, 2012), in which we select the sapphire blue (figure 4.3.5) for our paving, because it is close to the color of Dutch boulders (figure 4.3.6). So the paving can imitate the nature and metaphor the geological formation process of Enschede mentioned in Chapter 1.

Figure 4.3.4 Close View on Filter Pave (Presto Geosystems, 2012)

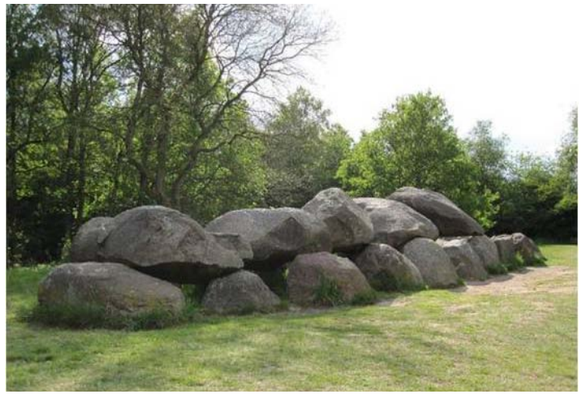


Figure 4.3.5 Dutch Boulders

Figure 4.3.6 Sapphire Blue Pavement

LANDMARKS

Revealing the precipitation

The water in our waterway is mainly coming from rains. So our story includes the rain water. Hence, we come up with the idea to create a series of surprise and drama for people by revealing the present precipitation.

Rain sensor is an instrument affording passers to feel the precipitations. It consists of a metal hanger and a wooden pole with an end shaped like a spoon to keep rain water. The wooden pole can turn around with different speed according to the weather When it is clear, the pole is kept horizontal; as it is drizzling, the pole is turning slowly around the middle part by the end with contained water; when it comes the rain storm, it turns faster and finally drop off the water, which surprises the passers.

The rain sensors act as a set of landmarks to enhance the continuity of the waterway experience. Besides, the surprise of the dropping water engages people to read the stories and reminds them with the changing climate and water issues.

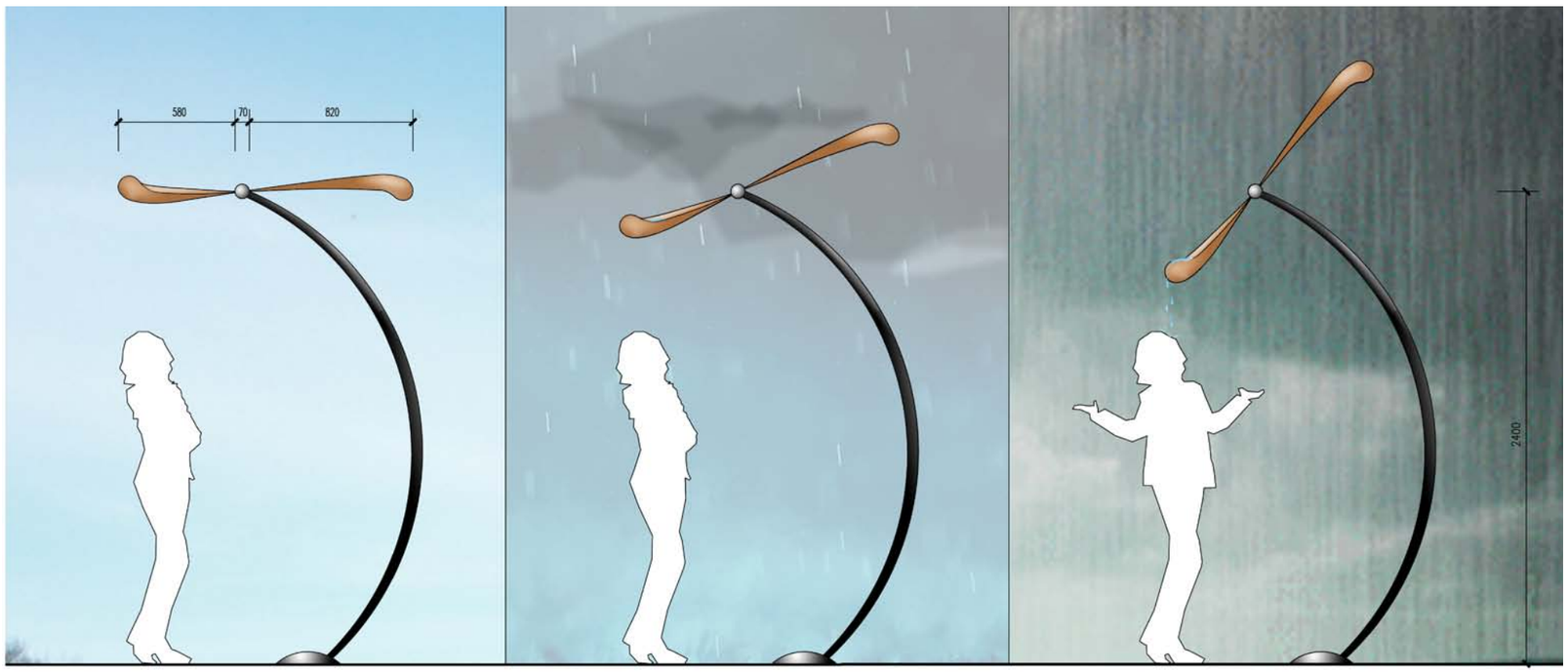


Figure 4.3.7 - Figure 4.3.9 Rain Sensor in Different Weathers

4.3.2 WATERWAY WITH CENTRES

Direction guides people to walk along the waterway. While centres invite people to stay, to talk, and to feel the here-ness. They are the potential places. So we set the centres in the locations of water ponds as well as the site with landmarks to engage people to feel the water landscape, and meanwhile, uprise the sociability (figure 4.3.10).

Centres with ponds
Centres with landmarks

Figure 4.3.10 Waterway with Centres

REFERENCE

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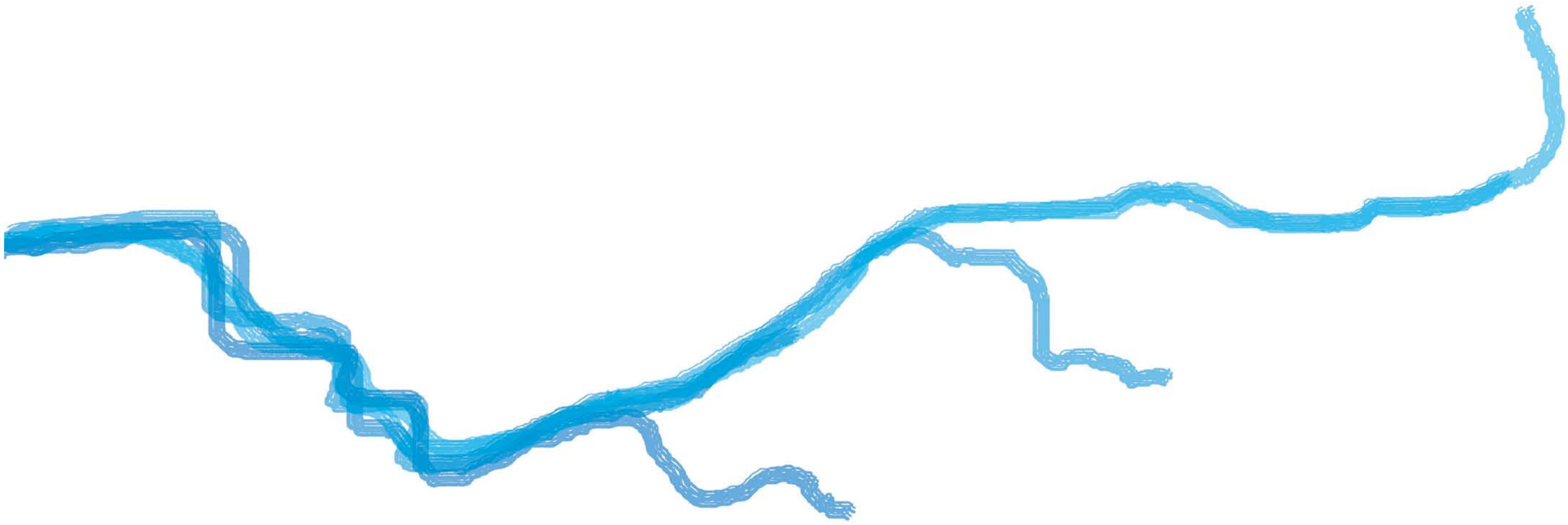
CHAPTER 5 DRAINAGE ASSIGNMENT FULFILLING

After guiding the experience along the waterway, we need to figure out if this waterway in our ideas can also fulfil the drainage tasks. In this chapter the drainage route is specified in the city scale and the assignment is set based on the calculations. Afterwards, the hydrologic plans in normal and high water level situations are shown.



5.1 DRAINAGE ROUTING

Whether the drainage task can be fulfilled or not is not only decided by the urban part of the waterway but also the rural part. So before we calculate the total drainage assignment, we need to know where the water collected in the urban area should flow.

In Chapter 1 we notice that there have already been two plans for the part in rural area. The Boeldershoek plan drains the water to the agriculture area, which shares the major part with the historical Twekkelerbeek, but the plan of Blue Veins guides the water to the Twente canal in the industrial area (figure 5.1.1). So which way is leading to a effective drainage system?

We choose to mainly follow the historical route with some modifications in the rural area (figure 5.2.1), since the following reasons:

Flood pressure in Twente canal

It is not feasible to discharge extra runoff from the upper stream via Twente canal, because the canal now has been under high pressure of water, which is poured by the wastewater plant. In fact, a spot with flood problems in 1/100 year frequencies is found on the boundary of the city;

Adaptive waterway in agricultural area

Besides, the historical route in the agricultural area has higher adaptive capacity than the canal in the industrial area. In the future, it can be easily widen and store a large amount of water to cope with the increasing precipitation amount;

Modification to fit the present land use

Further, we modify the historical route to fit the existing land use. One short part of the historical route bypasses the industrial area, where available space is limited, so we modify it to highway side; the historical route also crosses a landfill site, so we modify it to the route in the plan of Boeldershoek to prevent water pollution.

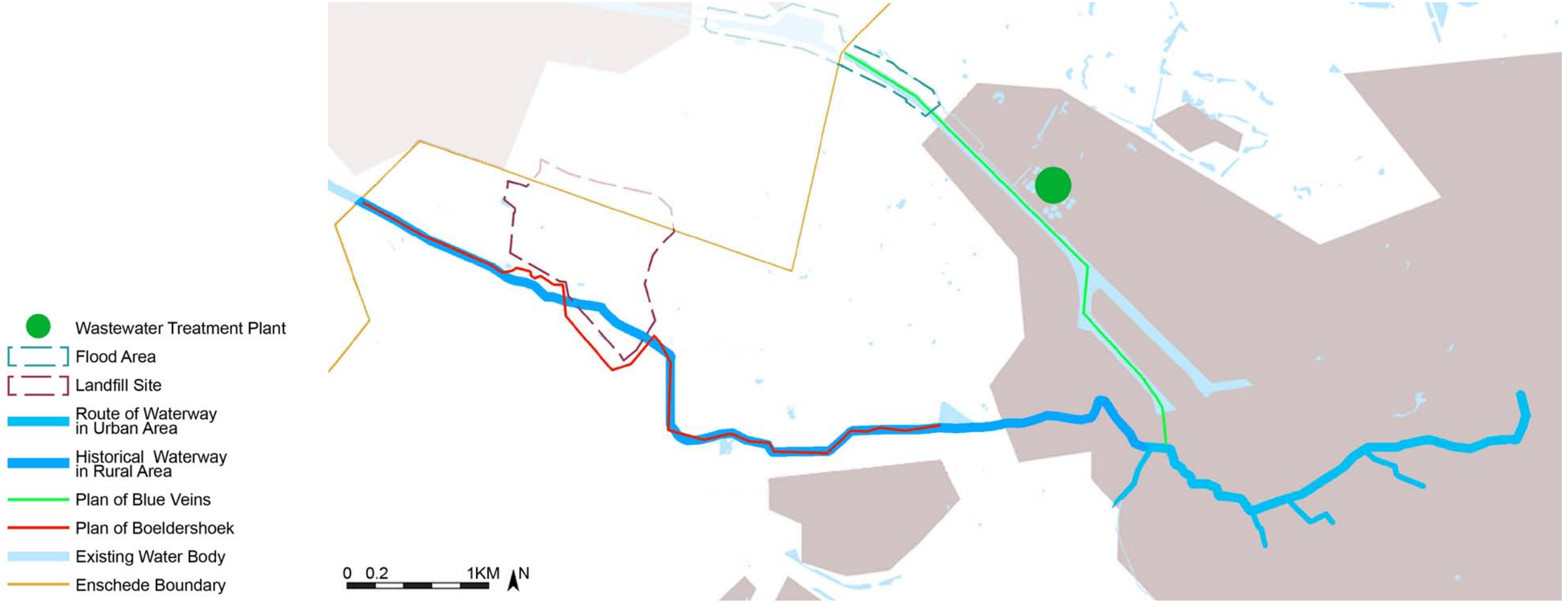


Figure 5.1.1 Drainage Plans Overview (based on Altas van Overijssel, 2011 & Gemeente Hengelo, 2011)

5.2 DRAINAGE ASSIGNMENT CALCULATION

Now we can start to calculate the assignment for water drainage. Firstly we define the catchment area as the site surrounding the planned waterway within 1 km. Then we sum up the peak runoff amount according to the land use map with in the catchment area (the detail calculation is shown in Appendix 2).

By means of the vulnerability model, we separate the drainage assignments for the whole Twekkelerbeek in Enschede city into three dimensions (figure 5.2.2):

The threshold capacity in coping with the 2 hours peak precipitation is fulfilled by the detention and retention ability of 160696 m^3;

In order to deal with the increasing runoff from 48 hours precipitation, advanced coping and recovery capacity is needed. The retention amount should increase by 15377 m^3;

At last, the sustainable drainage system should also have enough adaptive capacity to retain extra runoff, with considerations on the fact that extreme weather will occur in the future, e.g. higher peak precipitation in winter and longer drought in summer.

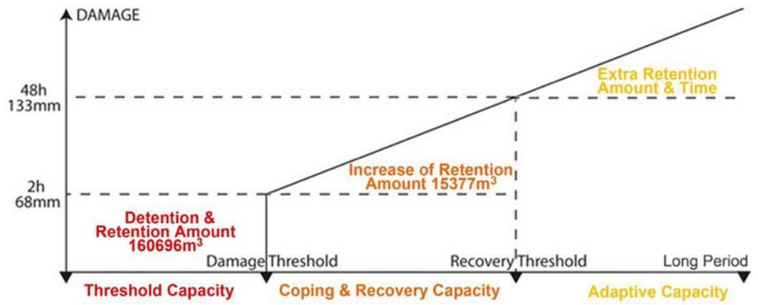


Figure 5.2.2 Sum of Drainage Assignment

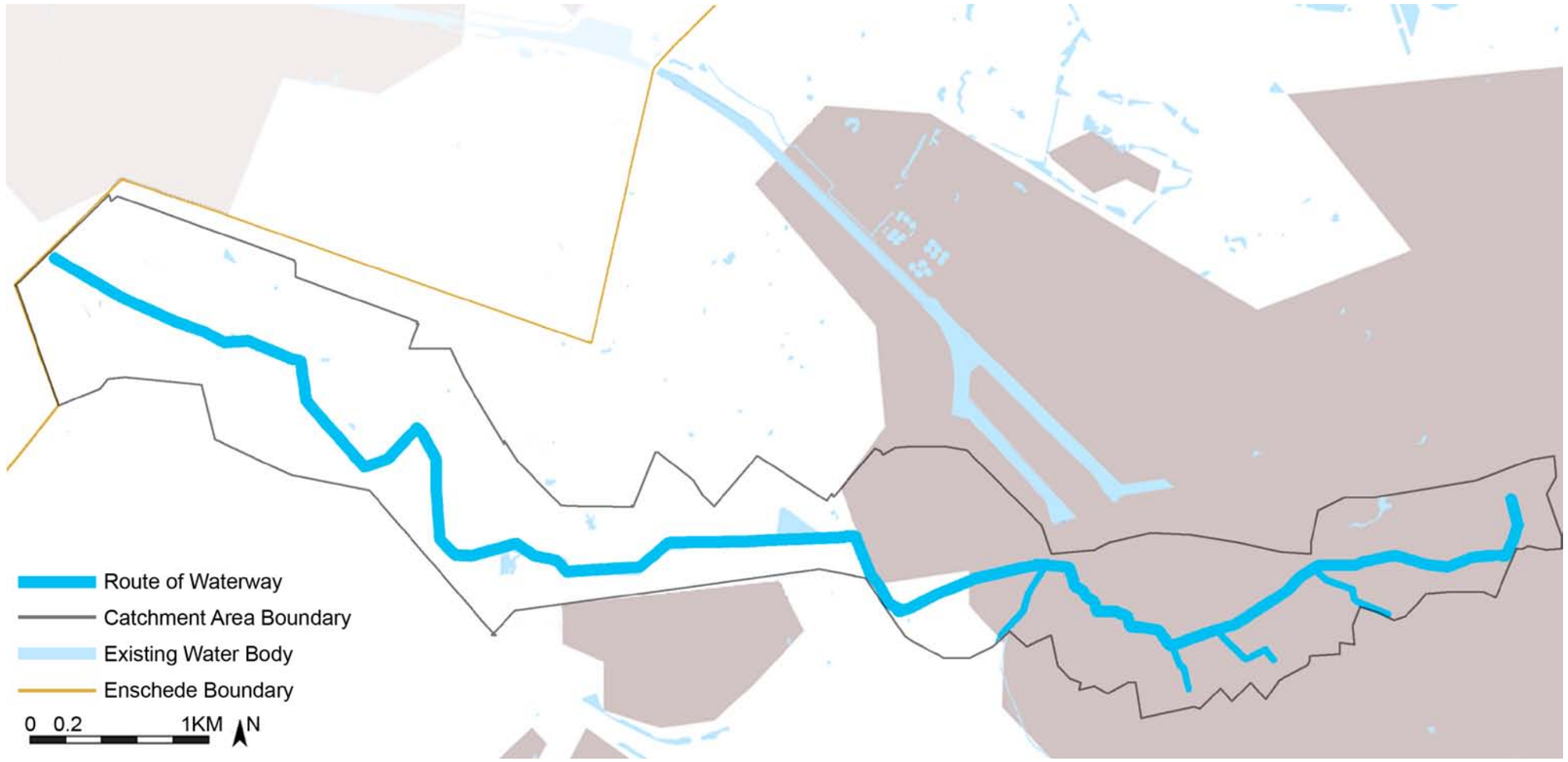


Figure 5.2.1 Drainage Route for Waterway in City Scale

5.3 DRAINAGE ASSIGNMENT FULFILMENT

Waterway with decentralized ponds

In order to fulfil these drainage assignment in three dimensions, we use the brooks with ponds in our plan for the water retention, which have the water flows in normal situation(figure 5.3.1). However, only with this way is not enough. So it is necessary to modify the available open spaces into decentralized detention ponds to store extra runoff after heavy rains temporarily, which are filled with water when storms come(figure 5.3.2).In the areas with restricted spaces for water above ground, the subsurface storage techniques are applied, e.g. geocellular /modular systems under the parking lots. Moreover, the pervious pavement are also wildly used to increase the infiltration ability , e.g. grass grids (details in appendix 3). In fact, these modifications do not influence the local people's daily life use very much, because in normal water level situation without rain storms, these open spaces still can fulfil the present functions as playground, square and parking lots etc.

The following tables show the specific drainage assignment for each pond to cope with1/100 year 2-hour and 48-hour rainstorms. They guide our detailed designs.

Retention ponds	L	K	J	I	H	G	F	E	D	C	B	A
Surface area during normal period(m^2)	22310	16013	1267	1504	823	539	607	1630	396	252	7580	21
Normal depth of retention ponds(m)	2.00	2.00	1.00	1.00	0.80	0.80	0.80	1.20	0.80	0.80	1.20	0.80
Normal retention amount(m^3)	**44620**	**32026**	**1267**	**1504**	**658**	**431**	**486**	**1956**	**317**	**202**	**9096**	**17**
Sum normal retention amount(m^2)	**92579**											

Table 5.3.1 Retention Amount in Normal Water Level Situation

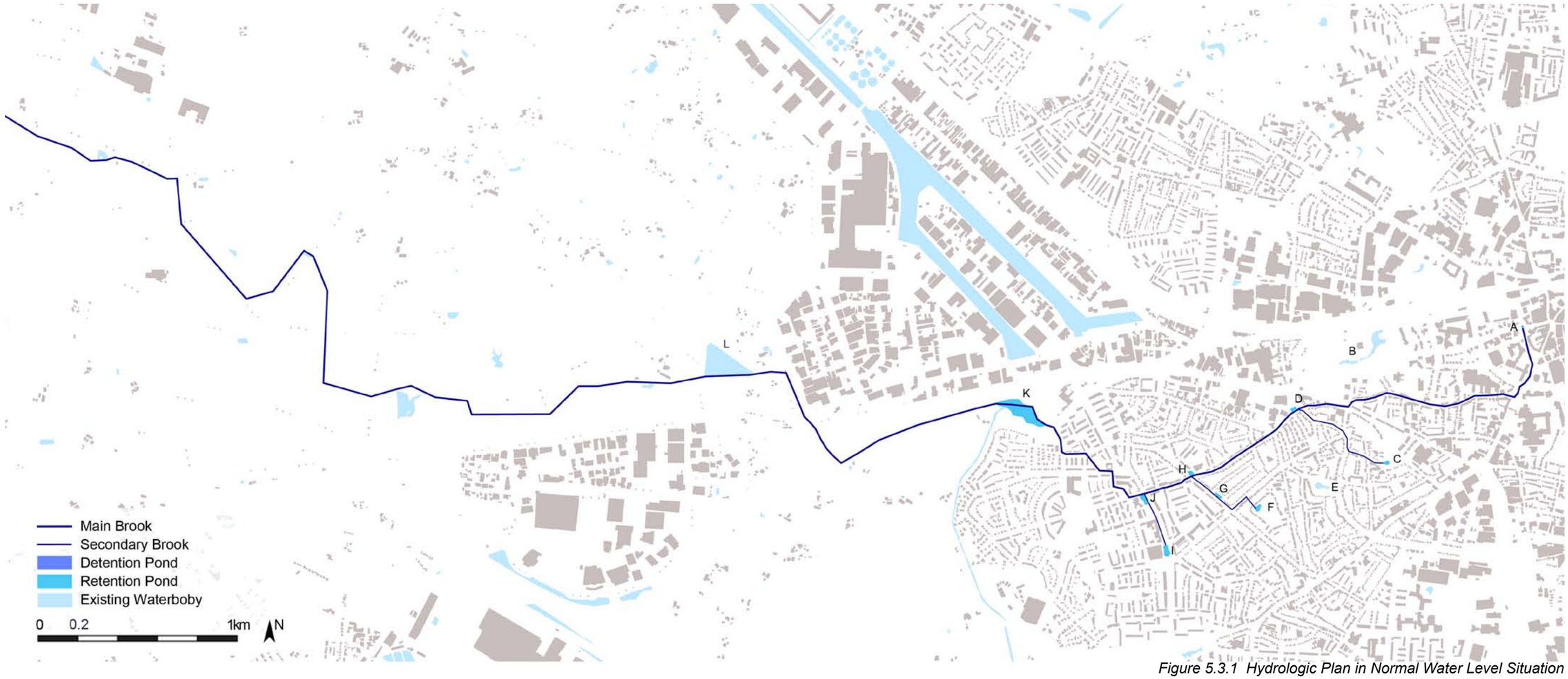


Figure 5.3.1 Hydrologic Plan in Normal Water Level Situation

Retention ponds	L	K	J	I	H	G	F	E	D	C	B	A
Surface area after 2h percification (m^2)	145000	45000	4599	3126	1492	825	8975	4513	1954	11147	20000	23
2h increase of water level (m)	0.50	0.40	0.30	0.30	0.30	0.30	0.30	0.30	0.30	0.20	0.10	0.20
2h retention amount(m^3)	**72500**	**18000**	**1380**	**938**	**448**	**248**	**2693**	**1354**	**586**	**2229**	**2000**	**5**
Sum 2h retention amount(m^3)	**102379**											
Surface area after 48h percification (m^2)	147100	45588									47509	
48h-2h increase of water level (m)	0.04	0.18									0.06	
48h-2h retention amount(m^3)	**5884**	**8206**									**2851**	
Sum 48h-2h retention amount(m^3)	**16940**											

Table 5.3.2 Retention Amount in High Water Level Situation

Detention ponds	23	22	21	20	19	18	17	16	15	14	13	12	11	10	9	8	7	6	5	4	3	2	1
Surface area of detention ponds (m^2)	63418	12663	1966	2086	1609	1232	1690	848	1926	990	1019	1877	319	1649	740	2873	16307	1001	1602	1887	825	2651	2336
Average depth of detention ponds (m)	0.50	0.50	0.40	0.30	0.30	0.60	0.60	0.30	0.30	0.60	0.30	1.00	0.30	0.50	0.60	0.60	0.40	0.60	0.40	0.40	0.60	0.60	0.60
2h detention amount (m^3)	**31709**	**6332**	**786**	**626**	**483**	**739**	**1014**	**254**	**578**	**594**	**306**	**1877**	**96**	**825**	**444**	**1724**	**6523**	**601**	**641**	**755**	**495**	**1591**	**1402**
Sum 2h detention amount (m^3)	**60392**																						

Table 5.3.3 Detention Amount in High Water Level Situation

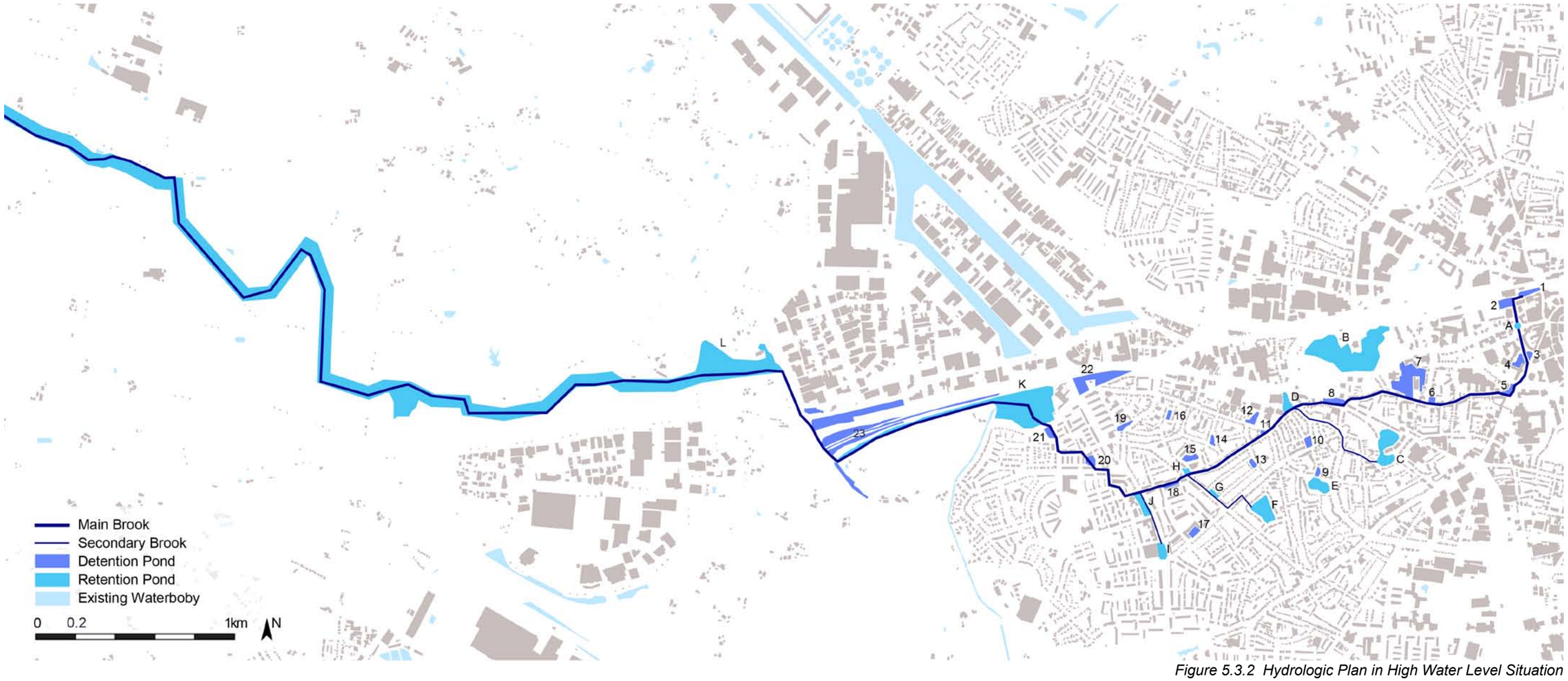
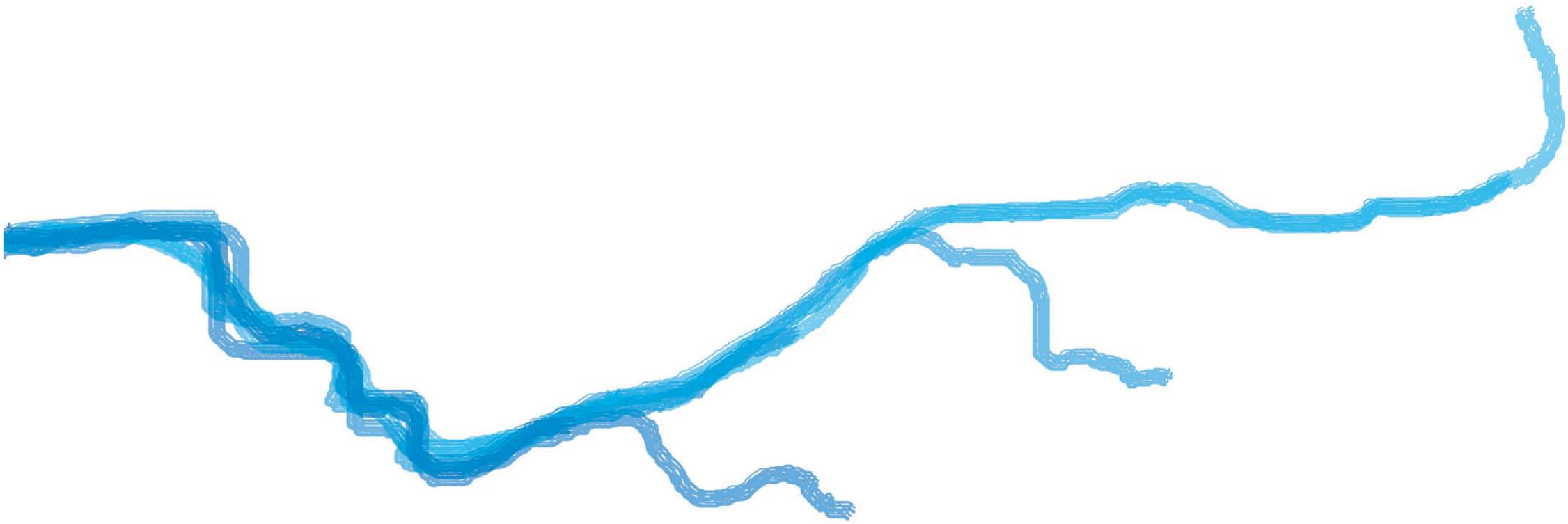


Figure 5.3.2 Hydrologic Plan in High Water Level Situation

CHAPTER 6 PLACE MAKING

The design of spaces should always be informed and underpinned by an understanding of different people's needs and activities(Dee, C. 2001, p36).

After creating a nice waterway experience and fulfilling the drainage functions we still have no idea on how to make the place to attach local people's life because we don't know the local people. Therefore, we select a typical neighbourhood to do social field work for knowledge of local habits, wishes and preferences following the process of PlaceMaker Methods and thereafter evaluate the place by Place Diagram. Further, based on the result we make two concepts designs for local community to choice, which gives us more broader views on what people concern. Afterwards, we derive our design concepts for the water square as well as the whole waterway.



6.1 SOCIAL FIELD WORK

Figure 6.1.1 Acacia on Waterway(based on Google Map, 2012)

What is the best site for our social field work and place improvement? This place should has the following characteristics:

Located on our planned waterway;
With similar ethnicity distribution as the city of Enschede, which ensures that the result can be applied in the whole waterway;
With relatively high population density, which means more needs for place improvement;
With relatively poor images, which means more potential for place improvement.

Among the districts along the route, Stevenfenne ranks highest according to our selection criteria. Thereafter we contact with the district manager, Peter Dijkstra, for more information. With his recommendation and our field trip on sites, we notice that the neighbourhood Acacia is the most problematic one. This neighbourhood is not only with poor physical environment which is complained by local community but also with lots of unemployment, youth and integration problems (Dijkstra, personal communication, January 18, 2012). So we take Acacia as our field work and design site.

Figure 6.1.2 Acacia in Stevenfenne (based on Google Map, 2012)

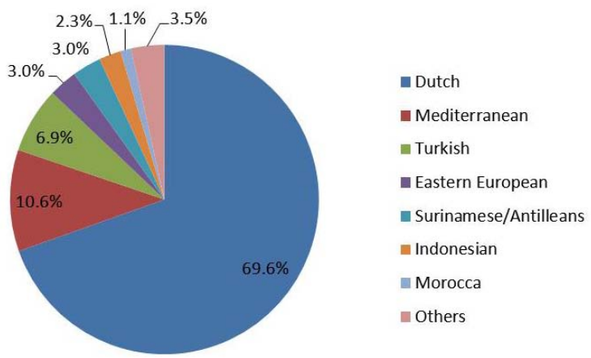


Figure 6.1.3 Ethnicity Distribution of Stevenfenne (CBS,2010)

6.1.1 CONTEXT STUDY

LOCATION

Acacia is situated in the east par of the district Stevenfenne (figure 6.1.2). So we start with the history and population study of the district.

HISTORY

When the textile industry thrived in the late nineteenth century, many manual workers were pulled to Enschede. They were housed in specially-erected neighbourhoods, often right next to the factory. These neighbourhoods in Stevenfenne were built in the principles of the garden city. The external spaces in this development are often in the form of an enclosed park or public garden with common buildings. The private gardens behind the houses are the collective green atmosphere in this area. The houses are simple, but the roofs with their rhythmic forms and ceramic tiles in varying colours play a dominant role in the landscape. Each ensemble of houses is different in colour, shape and structure with their own identities. They are representatives of the scarce available historical heritage in the city. However, not all heritages are equally well preserved (Gemeente Enschede, 2004, our translation). In Acacia the old houses were demolished in the second world war. The present roll houses were built in 1950s, which are by now rented by varied people from different places (Dijkstra, personal communication, January 18, 2012).

GENERAL SOCIAL PROBLEMS

Stevenfenne is a district in the west part of Enschede with 4853 residents. There are lot of social problems in this district especially in the Acacia. The most serious problems are the unemployment, youth and integration. Firstly, the employment rate in this district is very low with only 7.6%. As a result, the domestic violence and wrongly guided education for children are commonly happening. Hence, this problem indirectly links to the youth issues. Besides, in respect of ethnicity, Dutch people only occupy 69.6% of total residents. While Mediterranean and Turkish people together cover 17.5% of the locals, which is followed by people from Suriname and Eastern Europe. It is clear that the people in Stevenfenne has a large variation in ethnicity as the city of Enschede does (figure 6.1.3), which causes more integration problems (Dijkstra, personal communication, January 18, 2012).

6.1.2 PLACE EVALUATION

Based on the professional and behaviour observations on site, and questionnaires (appendix 5) for local community we evaluate the present place quality of Acacia according to PlaceMaker Method steps, and four aspects in Place Diagram.

PLACE IDENTITY

We analysis the physical and perceived identities in Acacia, which mainly include the buildings, materials, urban furniture, degree of privacy, space type, names and signs.

Pic 6.1.4 Physical Identity in Acacia

Post war houses with several negative identities complained by local people

Measurements	Present conditions	Locals' opinions
Buildings	The roll houses with front yards were built in 1947. Each building has two floors in the terrain of 24 m*7 m with the typical style of after war houses.	The existing furniture are blamed for their bad sanitation and the problems below:
Materials	Concrete is paved on the footpath crossing the green spaces; Bricks are used on walls while the red tiles are applied on the roofs.	The benches are comfortable but too few and in bad colours;
Urban furniture	The fitness facility, football facilities and children's playing facilities are in the mode of modern type. However, the wooden benches are in the style of nature. Because of lacking management, most of them are in poor conditions.	The footpaths are in good width with proper locations but too rough to walk on;
Green elements	The flat grassland and averagely 15 m high deciduous trees make up the structure of the green spaces.	The football facility is too small, in bad location and with bad colour and form;
Degree of privacy	Public green open spaces and roads, semi-public front pedestrian paths, private front and back yards.	The kids playground is too small, too boring and in bad colours;
Main spatial type	Open spaces with structure of grass and trees. Spatial sense between trees is not strong.	The blue fitness facility is broken. It is noisy and unsafe.
Names	The street names are labelled on walls e.g. Acadiaplantsoen and Berkstraat. But there is no neighbourhood names we can find.	But the trees are regarded as good element on the site with good colour, amount and form.
Signs	There is no sign or symbol for this neighbourhood.	
Strength	**Good images of trees.**	
Weakness	**The existing elements are incoherent to each other;** **The facilities has no relation to the trees and the conditions of them are poor.**	

Table 6.1.1 Identity Evaluation

Facilities irrelevant to each other

Figure 6.1.5 Physical Element Map (base on CAD from Municipality and Site Observation)

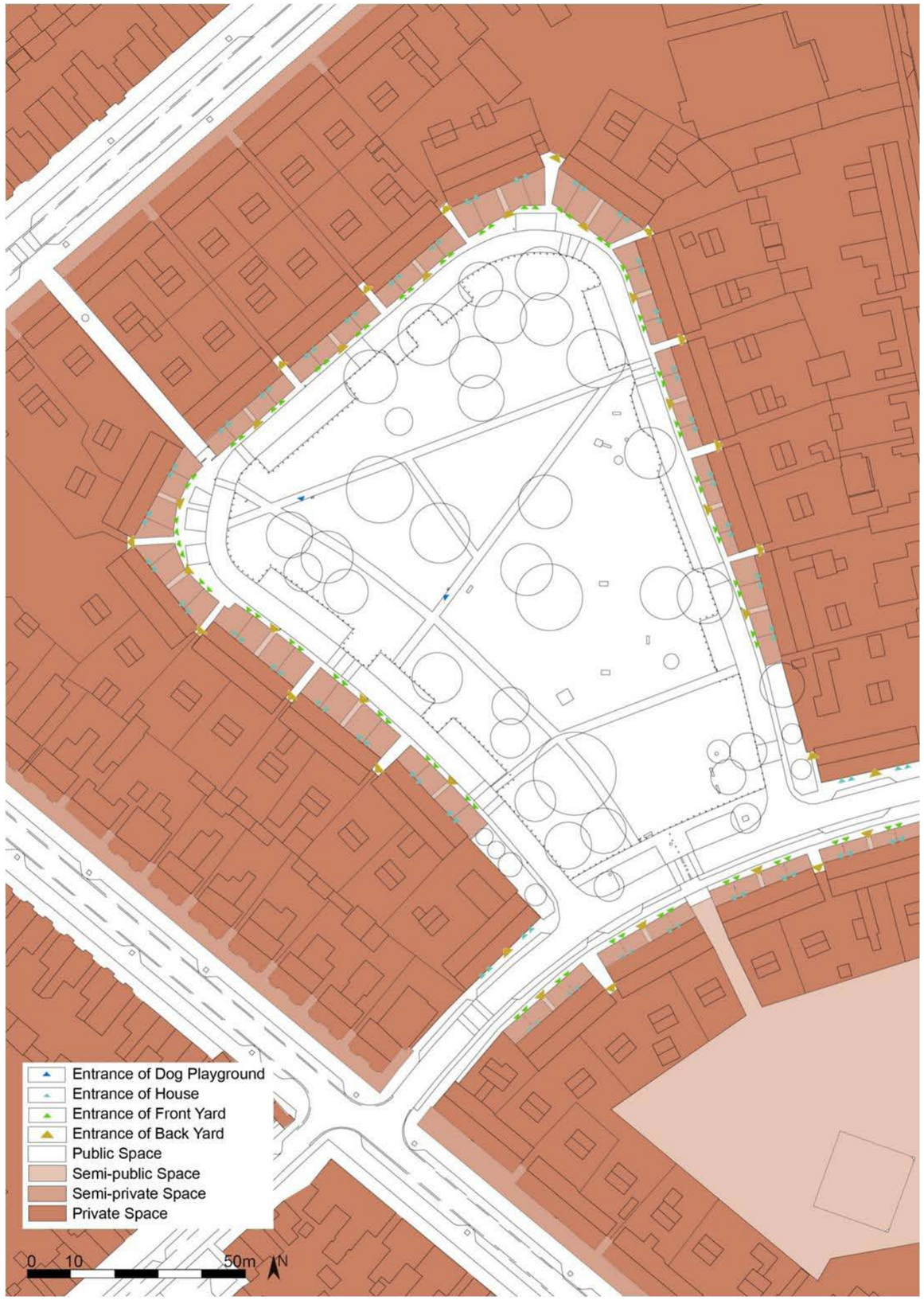


Figure 6.1.6 Degree of Privacy Map

Figure 6.1.7 Space Analysis Map

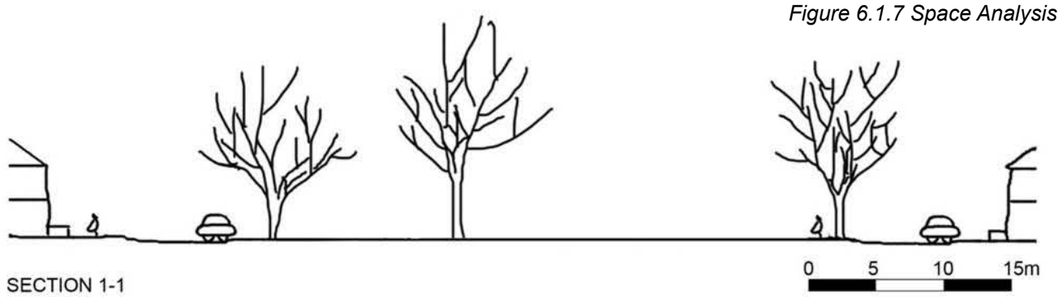


Figure 6.1.8 Typical Section

ACCESS AND LINKAGE

This part of evaluation includes physical connection, visual connection, variety transportation options, and parking patterns.

Poor connection outward

Good connection inward

Figure 6.1.9 Access and Linkage Analysis

Measurements	Present conditions and locals' behavior	Locals' opinions
Physical connection	Inside of the site, it connects with the surrounding houses well. But the site has poor connection with city centre without bus stop nearby.	The access and linkage of this site is good.
Visual connection	The site can be seen inside of the neighborhood. But from the north entrance we can only see a small part of the site.	The parking conditions are generally satisfied for the convenient location and proper amount. But some parallel parking space is not big enough for some cars, so they park the car on the roads.
Variety transportation options	People can drive and cycle to this site but can't take a bus or tram to this site.	
Parking pattern	There are 61 parking places around the site. In weekdays, before 6 pm, around 20 cars are parked here. After 6 p.m. there are more than 30 cars. In weekends, around 40 cars are parked here. Sometimes people park their cars on the roads rather than in the parking lot.	
Strength	**Good visual and physical connections in the neighbourhood**	
Weakness	**Poor visual connections to main roads and poor physical connection to city centre;**	
	Unattractive entrances on the site.	

Table 6.1.2 Access and Linkage Evaluation

COMFORT AND IMAGE

This part of evaluation includes cleanliness and maintenance (figure 6.1.10), sitting place with its views (figure 6.1.11-6.1.12), safety on the site. Besides the shading patterns are shown in figure 6.1.13-6.1.14.


Dirty Pathway


Poor Grass


Facility without Management


Details

Figure 6.1.10 Cleanliness and Maintenance

Measurements	Present conditions and locals' behavior	Locals' opinions
Cleanliness	The sanitation condition on the site is very poor with domestic trash and dogs' shit on the ground.	All the objects on the site are complained for their sanitation and management problems;
Maintenance	No people in charge maintain this site.	Women in the interviews show more demands for the cleanness for kids in
Sitting place	There are 5 benches on the site with low use rate. Only the benches near the dog playground and kid playground have few utilization rate. People prefer to sit in the front yards. Some kids play and site in the blue fitness facility.	Exiting sitting places are not clean nor enough;
Safety	No accident is observed. But some parents are watching their kids to avoid them to cycle on the roads.	The footpath and roads are not safe enough for kids and old people.
Strength	**No strength being found in this aspect**	
Weakness	**The sitting places are not properly designed and not attractive to locals;**	
	The improperly designed dog playground and few litter bins cause the poor sanitation;	
	The improperly designed kids playground and few playing facilities cause safety problems.	

Table 6.1.3 Comfort and Image Analysis

Poor sanitation

Safe problems for kids


People Sittting round the Dog Playground


Bench in the Front Yard

Figure 6.1.11 Sitting Place and Utilization Rate

Low sitting rate

Benches with poor views

Figure 6.1.12 Views from Benches

Figure 6.1.13 Summer Shading Pattern (from 9:00-18:00)

Figure 6.1.14 Winter Shading Pattern (from 10:00-16:00)

USE AND ACTIVITIES

This part includes the analysis of present activity patterns (figure 6.1.15-6.1.17), activity conflicts (figure 6.1.18), and using rhythms (figure 6.1.19).

High passing rate

Figure 6.1.15 Passing Route and Parking Lot Analysis Map with Photos

Measurements	Present conditions and locals' behavior	Users' opinions
Users	Most people passing by live in Acacia or come to visit relatives and friends.	They like the trees and grass, but they do not like the path pavement. But they are not satisfied by the sanitation, safety and walkability of path.
Activity Area and Rhythm	They mainly go through the roads and the north-south footpath; On weekdays between 12:00-13:00 and 15:00-17:00, passing rate is high; On weekends, the passing rate is low. Most people pass by more than 7 times per week.	
Strength	**The general landscape for passers is good.**	
Weakness	**The passing rate at the footpath is too high;** **The north-south footpath is parallel to roads and they are too close to each other.**	

Table 6.1.4 Passing Analysis

Activity: Dog walking

Dog walking in every where

Figure 6.1.16 Dog Walking Analysis Map with Photos

Measurements	Present conditions and locals' behavior	Locals' opinions
Users	Most of dog walkers live in Acacia.	Local people worry much about the sanitation because dog shit is everywhere;
Activity Area and Rhythm	People walk dog everywhere, but mainly around the dog playground and along the main foot path;	They do not like the form or colors of dog playground.
	There is no surge in dog walking in a whole day. People averagely walk their dogs 10 times per week.	
Strength	**Dog walking is a stimulus for people to chat, which improves the sociability.**	
Weakness	**The dog playground is not attractive to local people;**	
	Dogs are not limited in a certain area.	

Table 6.1.5 Dog Walking Analysis

Playing on the streets

Figure 6.1.17 Playing Analysis Map with Photos

Measurements	Present conditions and locals' behavior	Locals' opinions
Users	Most of players are 5-10 years old and live in Acacia. They mainly play football and ride bikes.	Parents worry about the safety and sanitation. They are also not satisfied by the quantity and quality of the playing facilities.
Activity Area and Rhythm	Kids mainly cycle along the foot path, but also on the roads; they play football on grass as well as in front of houses; they play in the front yards and climb the broken fitness facility;	
	In weekdays after 15:00 the place is occupied by kids; In weekend kids play all the day time.	
	Averagely, kids play 8 times per week.	
Strength	**Parents can watch their kids in distance;**	
	Kids play in groups of people in mixed ethnicity and ages;	
	Kids are the stimulus in social interaction.	
Weakness	**There is no safe, clean or attractive site for cycling, playing football and other sports.**	

Table 6.1.6 Playing Analysis

Activity conflicts and rhythm

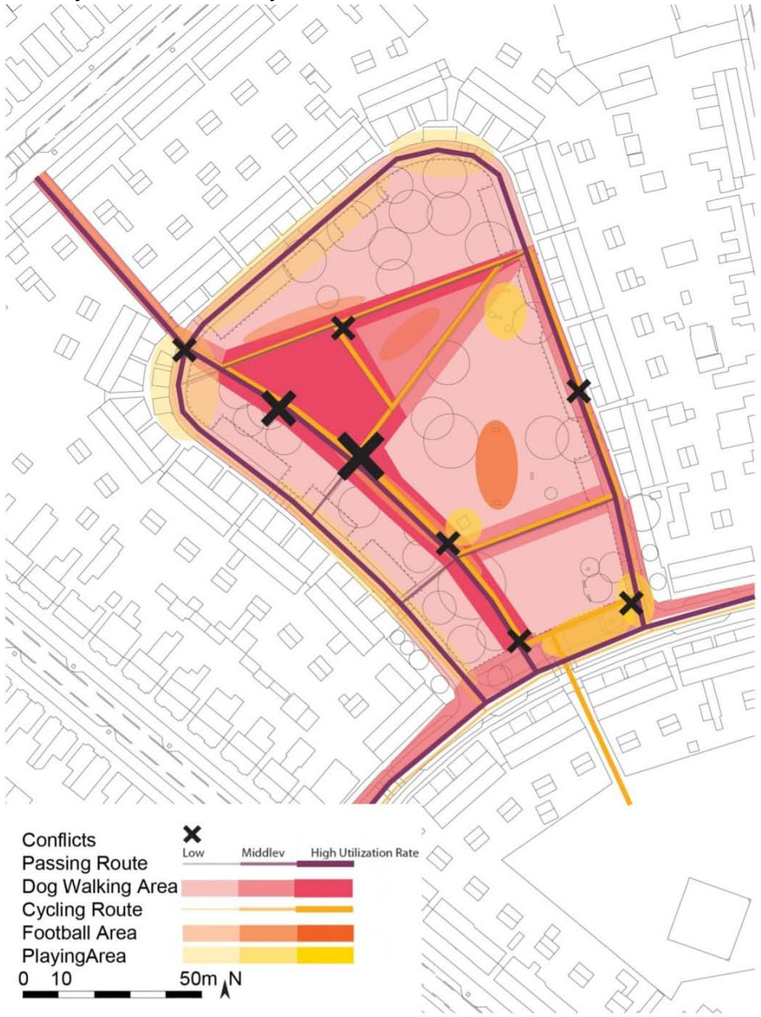


Figure 6.1.18 Activity Conflicts Analysis Map

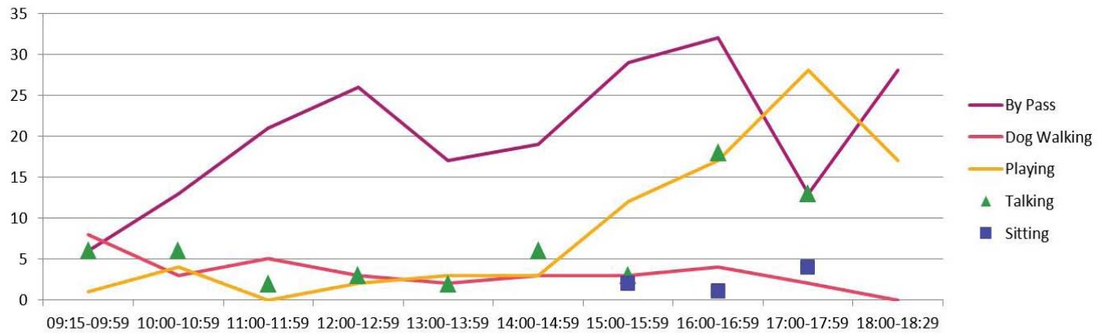


Figure 6.1.19 Activity Rhythm

Conflicts between passing and other activities

More various activities in afternoons

Measurements	Present conditions and locals' behavior	Locals' opinions
Activities	Most people pass by the site. The most of the rest walk with dogs and playing.	They are not satisfied by the quantity and quality of the facilities. The bad sanitation and safety conditions also influence the quality of activities.
Users	Young people use the area more frequent than people in other ages; 36.7% people are alone on the site. The others are with family or friends.	
Activity Area and Rhythm	There are many conflicts spots especially along the foot path, which causes the sanitation and safety problems; People like to stay in their own yards rather than in the open area; More people use the site in afternoons.	
Strength	**Activities are the stimulus in social interaction;** **People living here are not annoyed by the noise from kids or dogs.**	
Weakness	**Activity variety is low;** **The activity areas and footpath are not properly placed.**	

Table 6.1.7 Use and Activities Analysis

SOCIABILITY

This part includes the analysis of social activity: meeting with friends, smiles, eye contact, chatting; and also the social activity mode: age and ethnic situation.

Chatting in corners

Figure 6.1.20 Sociability Analysis Map with Photos

Measurements	Present conditions and locals' behavior	Locals' opinions
Meeting with friends	People chat with friends in parking lot, front yard and dog playground. People also chat when they are walking dogs, passing and playing.	People prefer to meet their friends in their own yards;
Smiles, eye contact, chatting	People chat with smile and eye contacts.	Most people talk to the neighbors and regard it as a sociable neighborhood, while the rest especially the non-Dutch people meet with integration problems.
Mix of age, ethnic groups	Adults chat only with their own ethnic group in the similar ages. Kids play with mixed group.	
Volunteerism	No one volunteers.	
Strength	**Neighbours interaction in mixed age with smiles and eye contacts;** **Kids playing groups in mixed ethnicity and ages;**	
Weakness	**Integration problem between Dutch and non-Dutch adults;** **There is no comfortable and attractive places for chatting.**	

Table 6.1.8 Sociability Analysis

SUMMARY OF PLACE EVALUATION

The strength and weakness on the site are given according to the place evaluations.

Figure 6.1.21 concludes the result of the evaluations in four aspects. It is clear that the sociability and accessibility are not as problematic as the others. While the uses and activities are weak because of several conflicts and low using rate. Comfort and image are even weaker since the sanitation, safety and facilities are not satisfying.

Figure 6.1.21 Summary of Place Evaluation

Strength:

Good images of trees;
Kids play in groups of people in mixed ethnicity and ages;
People living here are not annoyed by the noise from kids or dogs;
Neighbours interaction in mixed age with smiles and eye contacts;
Decentralized parking lots.

Weakness:

Poor visual connections to main roads and poor physical connection to city centre.
Unattractive entrances on the site.
The existing elements are incoherent to each other;
Ugly colour and forms of the existing facilities;
The improperly designed dog playground and few litter bins cause the poor sanitation;
The improperly designed kids' playground and few playing facilities cause safety problems;
Dogs are not limited in a certain area;
The sitting places are not properly designed and not attractive;
Low activity variety;
People walking dogs conflict with people passing by;
Kids playing space conflicts with traffics.

6.1.3 LIVING HABITS, WISHES AND PREFERRED DESIGN STYLES

In the behaviour observations and questionnaires, we also know the living habits, wishes and preferred design styles. They are all taken into our considerations in designing.

LIVING HABITS

People sit in their front yard and watch outside;
Dog owners walk with their dogs all over the site;
People skate and play football, volleyball, and basketball;
Kids, dogs and sports stimulate their talking;
People talk beside the dog playground, front yard, parking lot and street corners.

WISHES

Playing facilities for kids;
Water landscape and flowers;
Safe, clean and attractive site for sports, such as football, volleyball, tennis etc;
Comfortable places for sitting and chatting.

PREFERRED STYLES

Style of nature/colourful

When asked about what kind of design style they like, most people choose the style of nature and the style of colourful (table 6.1.10).

Objects	Person	Details
Kids playing ground	29	Sports space for
Flowers	27	football,
Sport space	26	volleyball,
Sitting place	25	tennis,
Streams	22	judo,
Bushes	18	basketball,
Ponds	16	
Fountains	15	
Dog playing ground	7	
Hard paving	7	
Small spaces	5	

Table 6.1.9 Wishes for Design Objects

Styles	**Total Votes**
Natural	33
Colourful	25
Exciting	13
Artistic	9

Table 6.1.10 Preference in Design Styles

6.1.4 CONCEPT DESIGNS AND FEEDBACKS

In order to know exactly what kind of design for Acacia the local community would prefer and their detailed concerns, we make two concept designs. Afterwards, we explain the projects for the local community and let them to choose the designs.

CONCEPT DESIGN ONE: COLOURFUL ACACIA (Designed by Hu Xiaolu)

This design uses colours of blue, pink, green, and orange to represent four expected functions. And the space is divided into four zones, which are entrance, kids playground, dog playground, and football field to avoid activity conflicts.

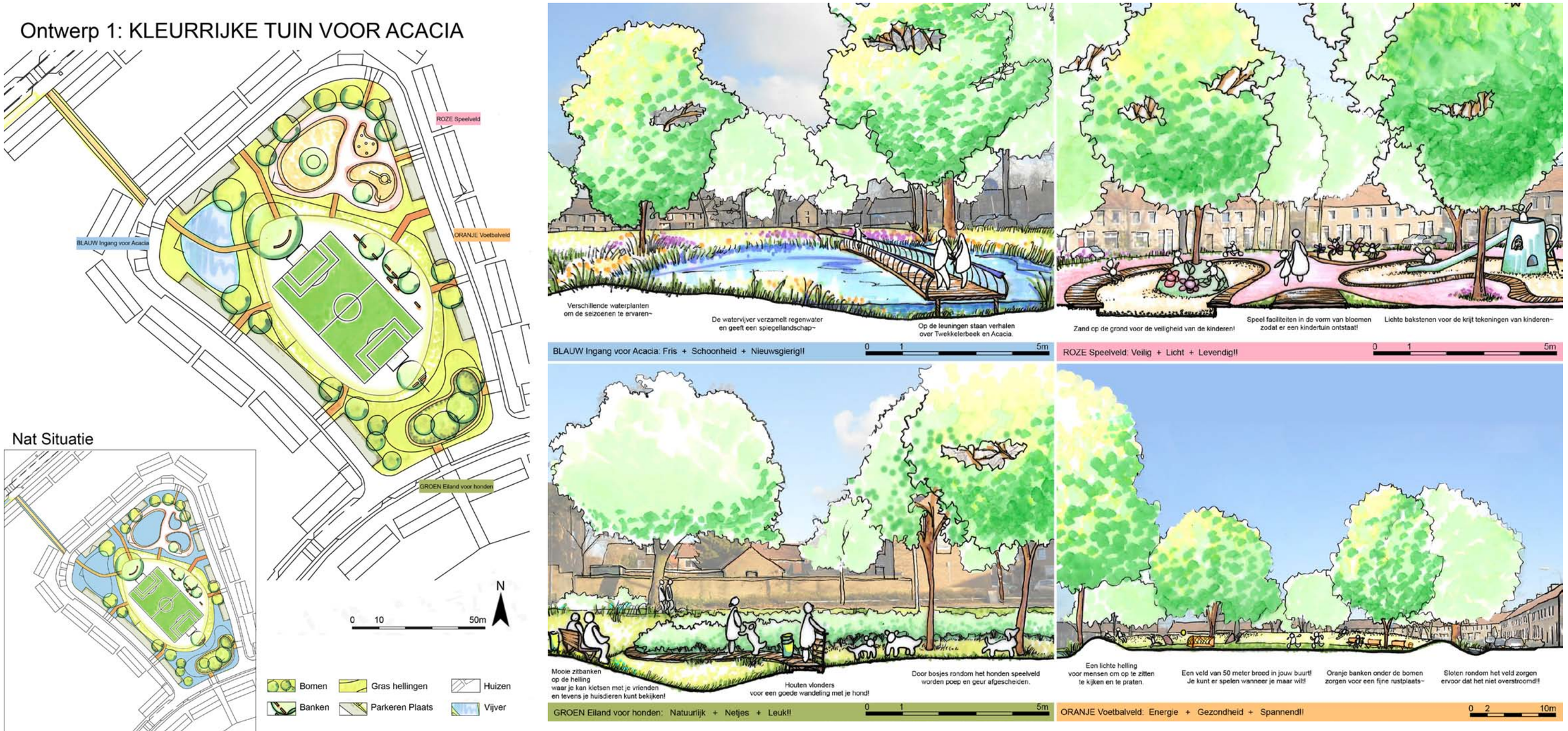


Figure 6.1.22 Concept Design One: Colourful Acacia

CONCEPT DESIGN TWO: NATURAL ACACIA (Designed by Chen Yinyi)

This design keeps the original trees and grass. The open land can be versatile for various activities. Besides, this fascinating site with comfortable sitting places attracts people to stay.

Figure 6.1.23 Concept Design Two: Natural Acacia

FEEDBACKS

When we ask the local community's favour on our designs, we not only let them select out their preferred concept design as a whole, but also let them choose the design objects. The reasons for their choices are been asked about. Therefore, we can know more details for further design improvements.

The feedbacks from the local community are shown below.

From figure 6.1.24, more than two thirds of respondents prefer Colourful Acacia;

For the design objects, the pink kid playground gains the highest votes since, in their views, the light couloirs are very good for kids' environment. While the Natural ponds and streams, Orange football field, and Natural dog playground take many votes as well, because of the vivid water elements, their favourite sports, and the nice space for dogs.

Colours for kids

However, respondents also give us more concerns. In respect for the water ponds, some people emphasis that the safety for kids should be concerned, because they frequently play by themselves without parents; For the parking lots, people prefer the design with decentralized parking lots and the ones closer to their house because of the convenience.

Safety for kids
Decentralized parking lots

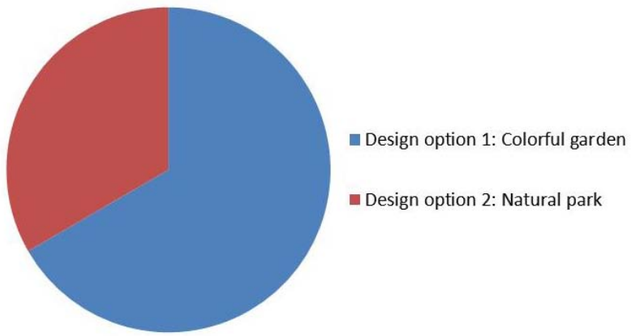


Figure 6.1.24 Votes for Concept Designs

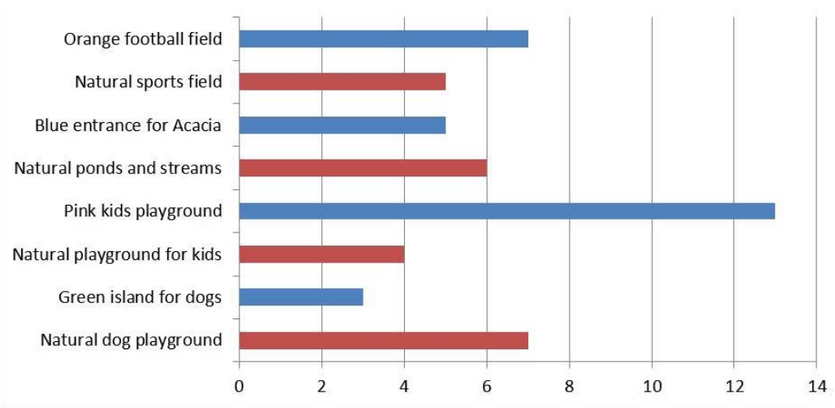


Figure 6.1.25 Local Votes for Object in Designs

6.2 WATER SQUARE CONCEPTS AND DESIGNS

6.2.1 COMMON CONCEPTS

Based on the result of the place evaluation, local people's habits, wishes and preferences, we generate the design concepts for both of our water square designs.

OPEN VIEWS TO WATER

From the wish list we know that people like water landscape, so in our designs, we both make room for water first. Besides, we tell the stories of water by the revealing the changeable water levels, in order to let water attach people.

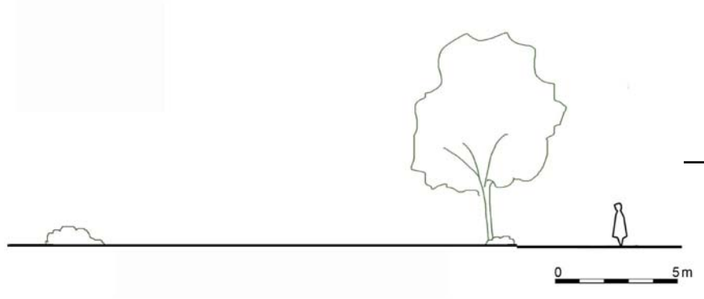


Figure 6.2.1 Present Acacia

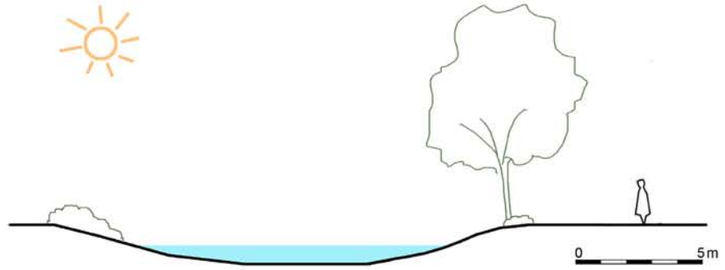


Figure 6.2.2 Water in Low Level

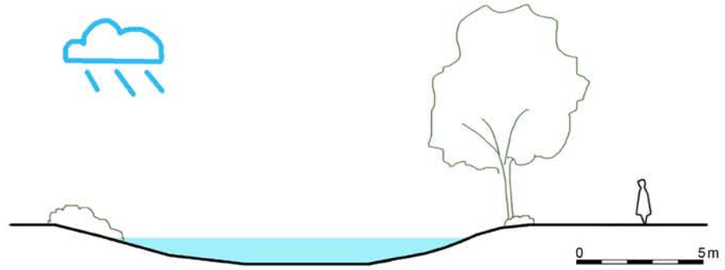


Figure 6.2.3 Water in High Level

GENTLE SLOPES

People in Acacia concern about the safety for kids very much. So the water pond is designed with gentle slopes of 1:4 to 1:5.

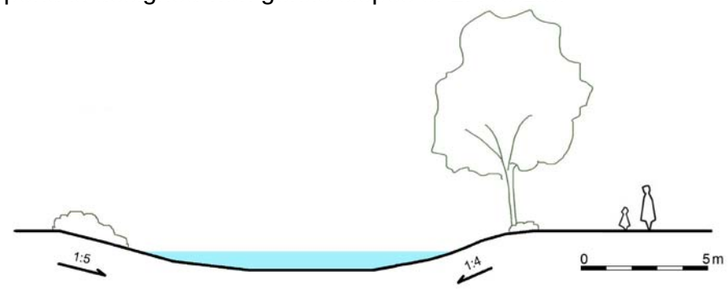


Figure 6.2.4 Gentle Slopes

COLOURFUL NATURE

From the feedback for our concept designs we know that nature with only green trees are not enough, colourful flowers are gaining more favours from local people. Besides, in order to find out what is the best colour schemes for telling the water stories, by using the landscape narratives, we decide to plant the blue, purple and white wetland species beside the pond. Further, in order to enhance the local identities, the species are all selected from local wild wetland plants(figure 6.2.6).

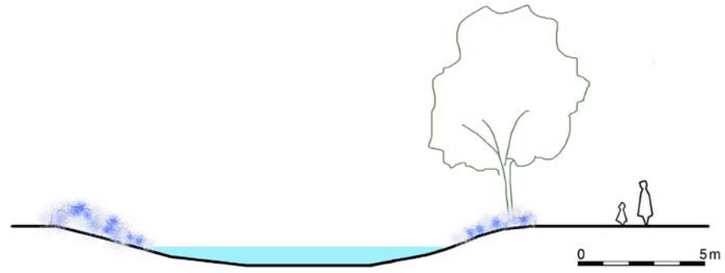
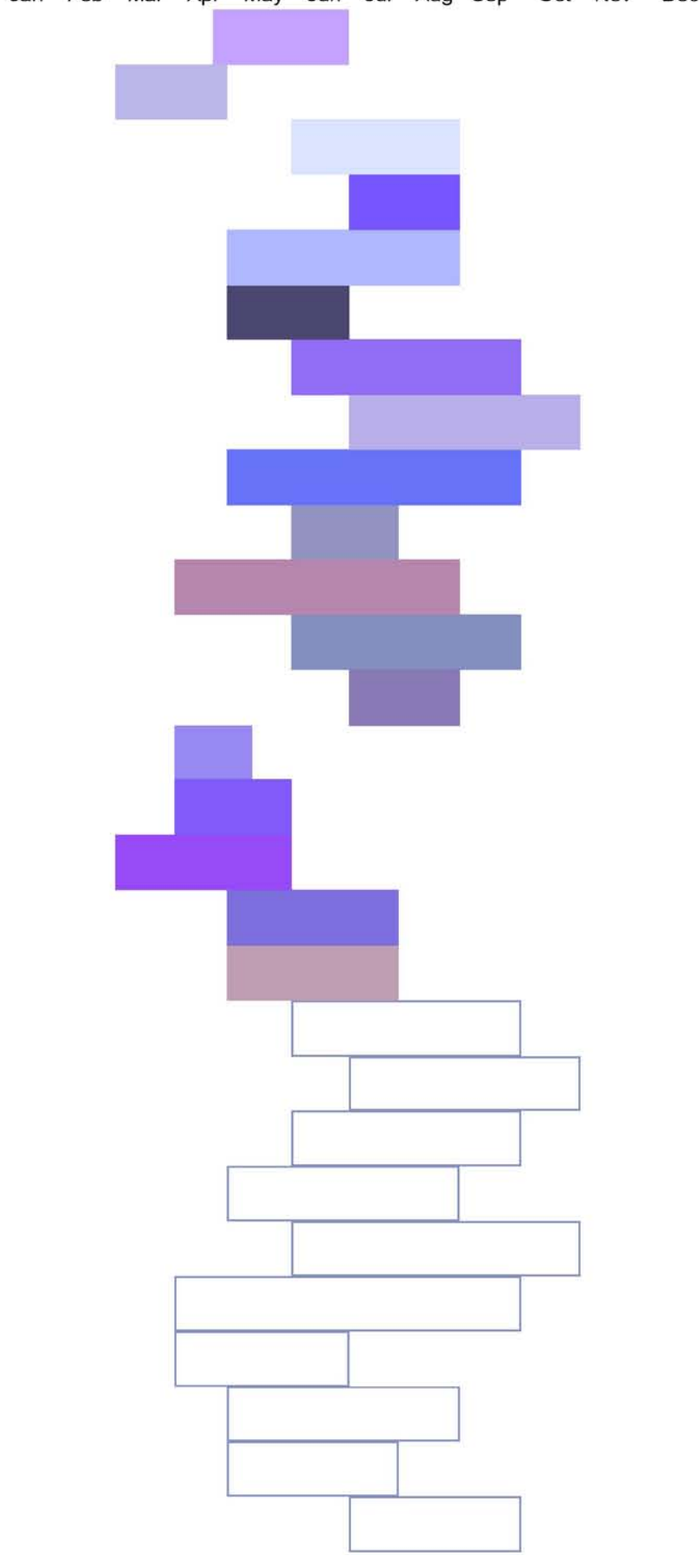


Figure 6.2.5 Colourful Natural

Num	Names	Height
1	**Bugleweed (Kruipend zenegroen)** *Ajuga reptans*	7 to 30 cm
2	**Windflower (Blauwe anemoon)** *Anemone apennina*	10 to 20 cm
3	**Alpine Enchanter's-nightshade (Alpenheksenkruid)** *Circaea alpina*	5 to 30 cm
4	**Marsh Gentian (Klokjesgentiaan)** *Gentiana pneumonanthe*	15 to 60 cm
5	**Water Forget-me-not (Moerasvergeet-mij-nietje)** *Myosotis scorpioides*	15 to 100 cm
6	**Black Rampion (Zwartblauwe rapunzel)** *Phyteuma nigrum*	20 to 80 cm
7	**Common Skullcap (Blauw glidkruid)** *Scutellaria galericulata*	5 to 60 cm
8	**Devil's-bit Scabious (Blauwe knoop)** *Succisa pratensis*	30 to 90 cm
9	**Brooklime (Beekpunge)** *Veronica beccabunga*	15 to 60 cm
10	**Peach-leaved Bellflower (Perzikbladig klokje)** *Campanula persicifolia*	30 to 90 cm
11	**Bitter Vetchling (Knollathyrus)** *Lathyrus montanus*	15 to 40 cm
12	**Ivy-leaved Bellflower (Klimopklokje)** *Wahlenbergia hederacea*	5 to 30 cm
13	**Long-Leaf Speedwell (Lange ereprijs)** *Veronica longifolia*	60 to 120 cm
14	**Early dog-violet (Blauwsporig Bosviooltje)** *Viola reishenbachiana*	5 to 25 cm
15	**Dwarf Periwinkle (Kleine maagdenpalm)** *Vinca minor*	15 to 50 cm
16	**Sweet Violet (Maarts viooltje)** *Viola odorata*	5 to 15 cm
17	**Common milkwort (Gewone vleugeltjesbloem)** *Polygala vulgaris*	5 to 30 cm
18	**Wood Speedwell (Bosereprijs)** *Veronica montana*	10 to 45 cm
19	**Common water-plantain (Grote waterweegbree)** *Alisma plantago-aquatica*	30 to 120 cm
20	**Hedge bedstraw (Glad walstro)** *Galium mollugo*	30 to 120 cm
21	**Fen Bedstraw (Ruw walstro)** *Galium uliginosum*	15 to 60 cm
22	**Floating water plantain (Drijvende waterweegbree)** *Luronium natans*	10 to 80 cm
23	**Grass of Parnassus (Parnassia)** *Parnassia palustris*	15 to 30 cm
24	**Ivy-leaved Crowfoot (Klimopwaterranonkel)** *Ranunculus hederaceus*	5 to 25 cm
25	**Greater Stitchwort (Grote muur)** *Stellaria holostea*	15 to 50 cm
26	**Bog Stitchwort (Moerasmuur)** *Stellaria uliginosa*	5 to 45 cm
27	**Wild baby's breath (Lievevrouwebedstro)** *Galium odoratum*	30 to 50 cm
28	**Wild angelica (Gewone engelwortel)** *Angelica sylvestris*	90 to 180 cm

Blooming Period



Images

Figure 6.2.6 Colourful Natural Flowers (based on data from Wilde Planten, 2012)

SHARED SPACE

Because there are several conflicts between traffic and activities on the site with many people's worries about the safety for kids, we use the concept of shared space on the streets surrounding Acacia.

Shared space is an emerging approach to urban design, traffic engineering and road safety in Europe to reduce the adverse impacts of traffic in towns (Hamilton-Baillie, 2001). The core of this concept is integration. It integrates street functions for walking, passing by cars, cycling etc without traffic signs. In the shared space, traffic speed is slow for these function integrations.

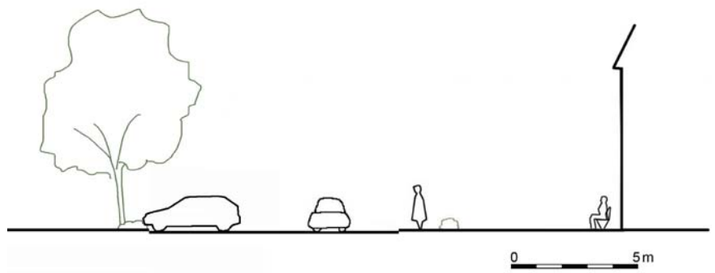


Figure 6.2.7 Present Acacia

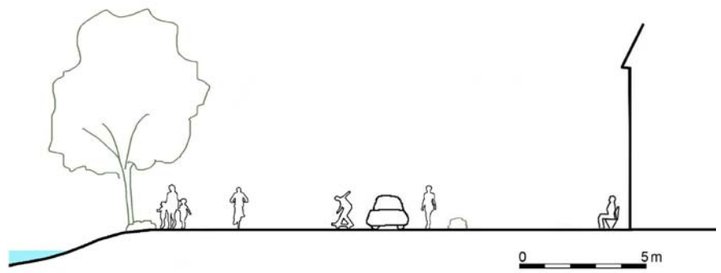


Figure 6.2.8 Shared Space

GREEN PARKING LOT

Parking lot is one of the concerns from the local feedback. People are satisfied with the amount but complaining on their locations. Sometimes they even park their cars on streets rather in the lots. Therefore, in our designs, we place the parking lot much closer to their houses. Besides, the paving of the parking lot is changed into grass grid in order to improve the infiltration rate and promote the natural feeling.

Figure 6.2.9 Present Parking Location

Figure 6.2.10 Green Parking Lot Location

Figure 6.2.11 Present Parking Lot

Figure 6.2.10 Green Parking Lot

6.2.2 DESIGN OPTIONS

The two design options are improved from the concept designs according to the feedback. In order to use water to create the place identity, makes spaces for varied activities, and uprise the sociability, they are both implementing the common design concepts but differed by each designer's inspirations.

COLOURFUL ACACIA (Designed by Hu Xiaolu)

This design is inspired from the colourful lights reflected by the rain drops. Each drop is telling the water story by its colour and functions. They are the pink drop for kids, green drop for pets, and blue drop for sports. The topography on the site is specifically designed for water experience. When rain comes, the water is rising up from north to south. People can feel the gradual changes in natural process. While in the dry season people can still feel the water story by the blue drop in the centre, the paving is changing from dark to light blue following the height of the site.

Figure 6.2.11 Colourful Acacia in Normal water level Situation

Figure 6.2.12 Colourful Acacia in High Water Level Situation

Figure 6.2.13 Water Pond in Blue Entrance in Normal Water Level Situation: Colourful wetlands plants, wooden bridge in natural shapes to welcome every visitor .

Figure 6.2.14 Water Pond in Blue Entrance in High Water Level Situation

Figure 6.2.15 Pink Drop for Kids Playground: Kids friendly spaces, water related facilities, comfortable sitting places for parents;

Figure 6.2.16 Green Drop for Pets Playground: Grass island for pets, benches under the reserved big tree for pet lovers and neighbours to talk.

NATURAL ACACIA (Designed by Chen Yinyi)

The features of this design include firstly it mimics the natural water system with a stream originating from the forest which gathers into a pond later at the north entrance. Secondly, the vegetation system is supplemented with more blooming shrub and wetlands. Thirdly, the continuously changing views along the footpath and multiple sitting places attract people to stay and communicate. During rain, water is gradually collected in several basins, which can also be used as playgrounds for kids playing, sports and party in dry times. After rain, water is drained in 2 hours and don't influence the normal activities much.

Figure 6.2.17 Natural Acacia in Normal Water Level Situation

Figure 6.2.18 Natural Acacia in High Water Level Situation

Figure 6.2.19 North Entrance in Normal Water Level Situation: Interesting cycling rout for kids and attractive sitting places along the natural pond.

Figure 6.2.20 North Entrance in High Water Level Situation

Figure 6.2.21 Playground: Attractive wooden playing facilities and cycling route, natural ponds for fishing and comfortable sitting places at the boundary.

Figure 6.2.22 South Entrance: Large places for sitting and skating, dog playground surrounded by blooming shrub

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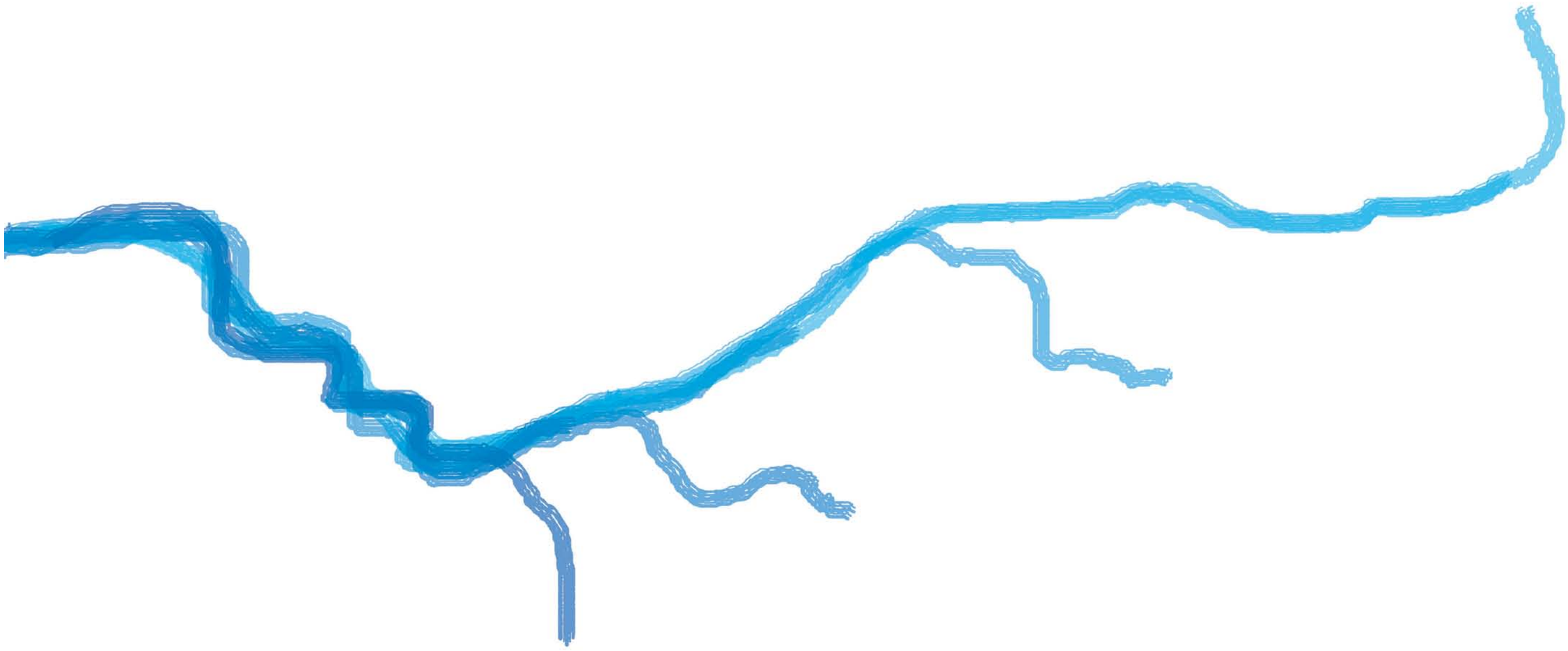
CHAPTER 7 WATERWAY DESIGN

The waterway design combines the professional knowledge from chapter 4 & 5 with the layman knowledge from chapter 6 in brook and ponds designs, master plan and detailed designs.

When walking along the natural brook, people can feel not only the visual direction with strong water identities but also the vivid centres on street corners with varied activities and comfortable places to sit and chat, The water stories connect people with the landscape. In the mean time, people recreate the water stories in their daily lives.



7.1 BROOK AND POND DESIGNS

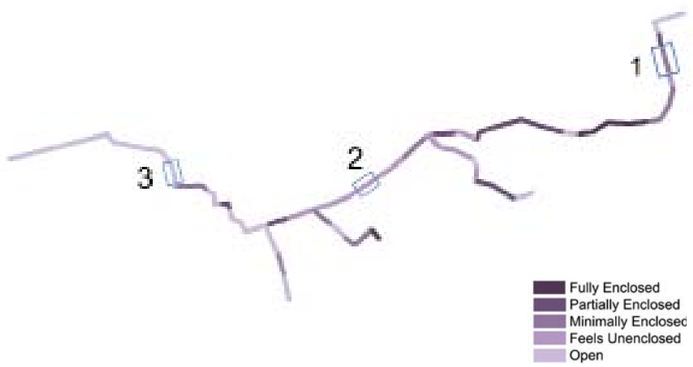


Figure 7.1.1 Location of Brook Designs

BROOK DESIGNS

The brook is designed with continuous visual direction. This is realized by firstly, the wetlands and trees of the same pattern along the brook feature the consistency of its plant community. Besides, the uniform sapphire blue filter pave integrates different areas.

Secondly, the brook is designed with natural experience. The increasingly wider waterway mimics the nature process of water flow. Starting from 2-3 m wide at the beginning, gaining to 3-4 m later, the waterway eventually achieves 5-6 m wide. In addition. as the water level rises increasingly dramatic as the precipitation increasing, people can also experience the process of raining. During rain, the water table is raised by 0.15-0.35 m and submerge the wetlands. Besides, the rain sensors rotate faster during the heavy rainstorm. Additionally, the local wild species are selected to connect people with the indigenous ecosystem. Last but not least, to improve the experience quality at the narrow street, we share the space among roads, sideways and parking lots. Then the brook gets more space and people are close to the water in a comfortable and safe environment.

Furthermore, the water flow rate can't exceed the maximum natural flow rate of 2m/s considering the flood problem (Dijk & Veul, 2010). Since the flow rate is related to the area of discharge profile, the brook is designed with enough space to retain water during the rainstorm. The extra area of discharge profile during the rain is 0.4 m^2 to 1.2 m^2.

However, for adapting to the varied urban environment, the waterway changes from the centre to the suburban area. We select three typical parts of brook to illustrate this change (figure 7.1.1). Each of the designs is applied in the similar spatial situation.

The brook design 1 is located on a 24 m wide road where a separation zone lays in the middle of the road. So we modify the spare space into a 10 m wide green belt.

The brook design 2 is located on a 16 m wide road in the dense residential area. Because the road is in east-west direction, the south side of the road is in shade, where blooming wetlands cannot grow well and water cannot reflect the blue sky. Besides, in the Netherlands, sunny day is precious. People prefer to stay in the sunshine. So we modify the parking lots on the north side of the road into the 5 m wide brook and improve the south parking lots with the grass grids and trees. But since this part of brook is not wide enough, the side slope of it is only 1:2.5.

The brook design 3 is in the suburban area, where space is large. The waterway is more than 20 m wide with the broade green belt.

POND DESIGNS

The ponds are the main components of the centres. Surrounding these ponds, comfortable talking and meeting places are designed in multiple sites, where offer enough space for various activities. The water square concepts and designs in Chapter 6.2 illustrate how the ponds can be designed into attractive places.

While, the centres are also designed to fit the urban environment. Figure 7.1.2 shows the locations of the two selected ponds.

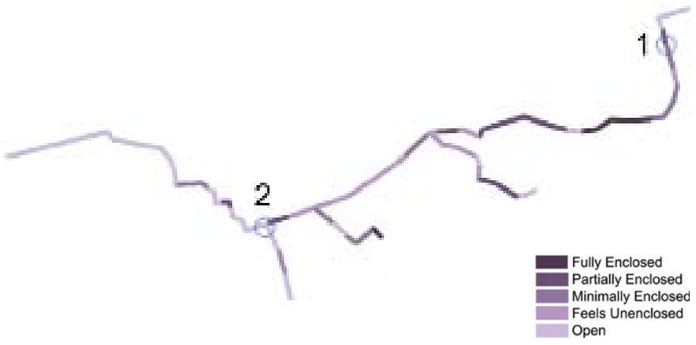


Figure 7.1.2 Location of Pond Designs

The first pond is located at the cross road in the urban heart area, which is also the location of the fountainhead of the historical Twekkelerbeek. We design it with the rain sensors to highlight the beginning point of the waterway. The benches are placed at the corner and facing the pond. The fascinating square attracts people to stay.

The second pond is located in the residential area. Now it is a tedious square with cement pavement. We improve it by a 1267 m^2 large pond surrounded with wetlands and trees. Benches are placed at the corner of roads. It's an attractive place for meeting friends, playing on the sand pond and walking dog on the grass.

The following figures illustrate the designs on brook (figure 7.1.3-7.1.26) and ponds (figure 7.1.27-7.1.32).

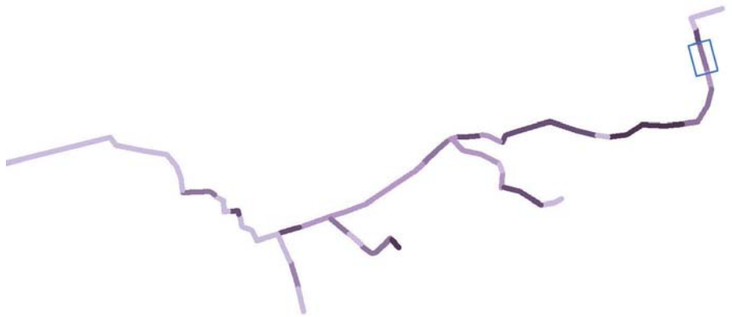


Figure 7.1.3 Location of Brook Design 1

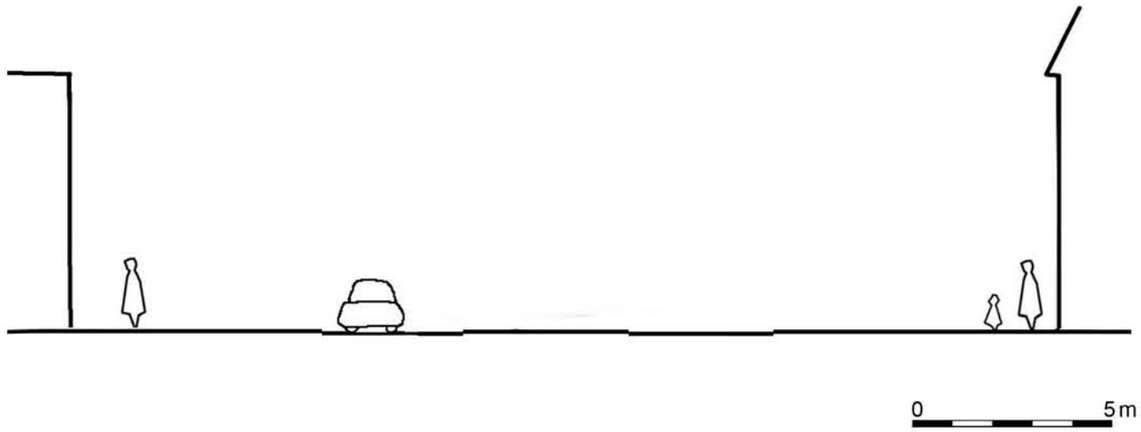


Figure 7.1.4 Present Section 1-1

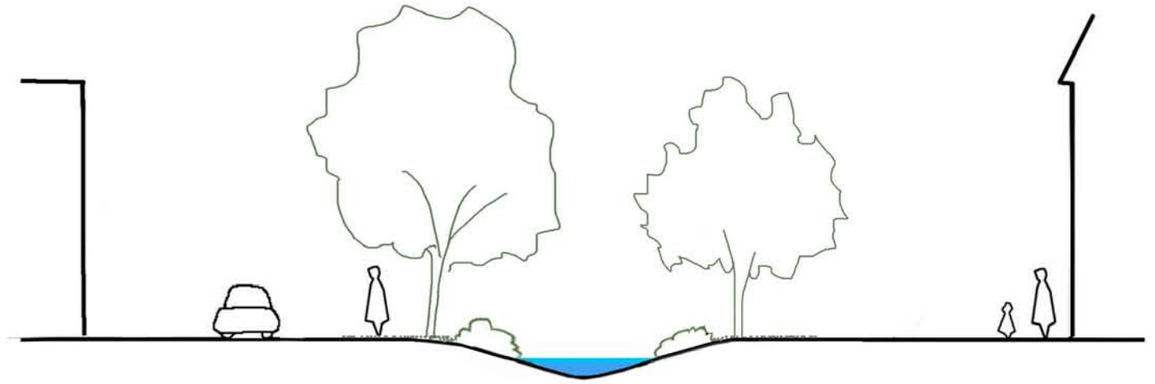


Figure 7.1.5 Section 1'-1' of Brook Design 1

Figure 7.1.6 Present Layout 1

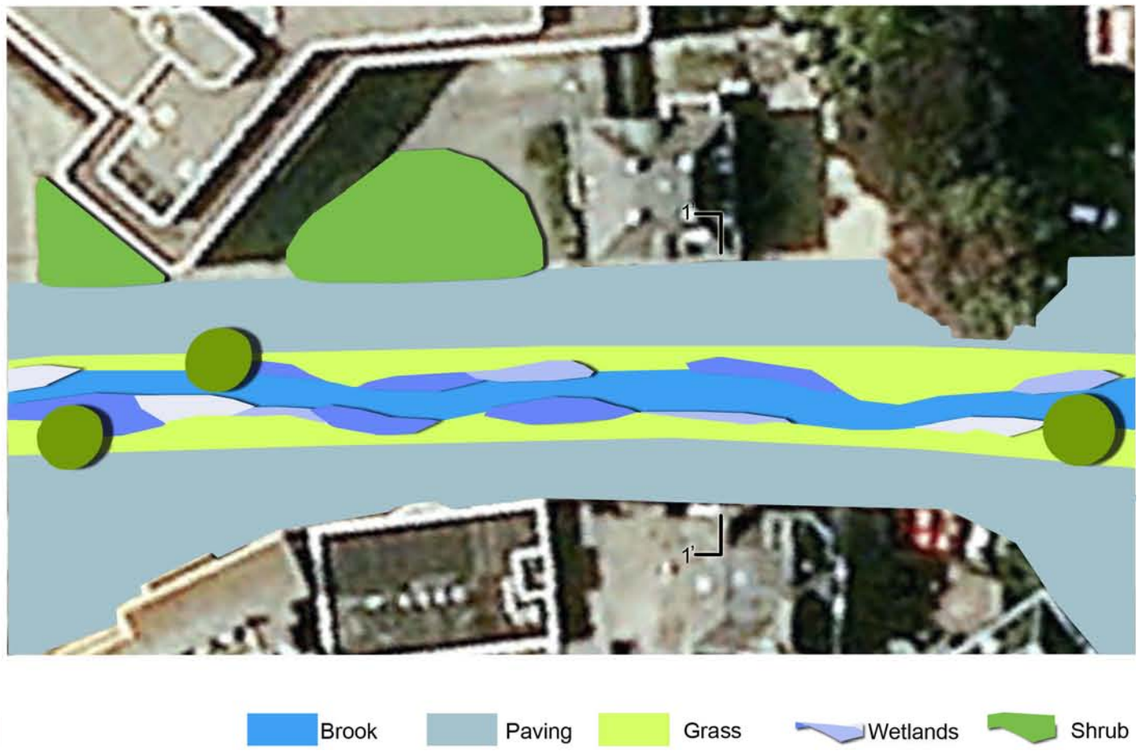


Figure 7.1.7 Master Plan for Brook Design 1

Figure 7.1.8 Present Situation 1 (Google Street View, 2012)

Figure 7.1.9 Brook Design 1 in Normal Water Level Situation

Figure 7.1.10 Brook Design 1 in High Water Level Situation

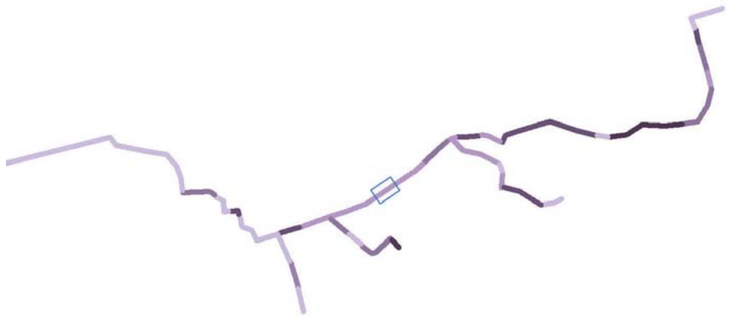


Figure 7.1.11 Location of Brook Design 2

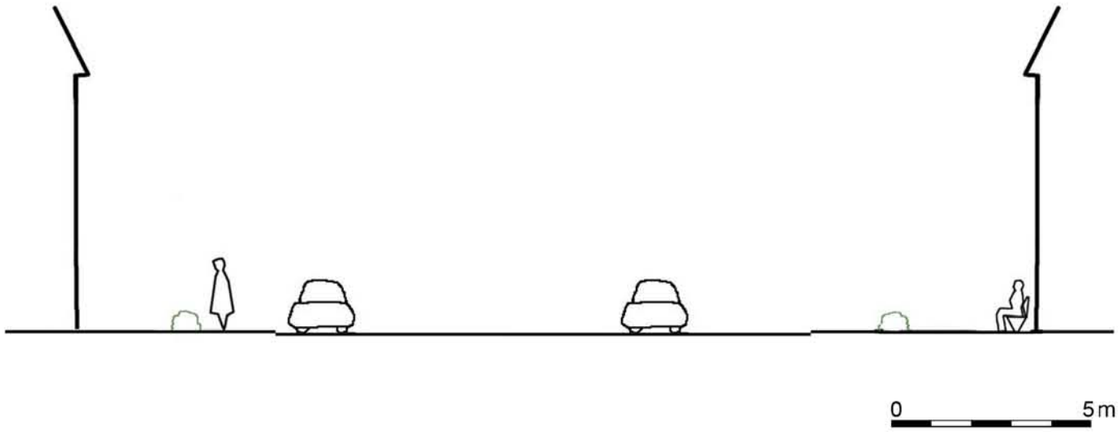


Figure 7.1.12 Present Section 2-2

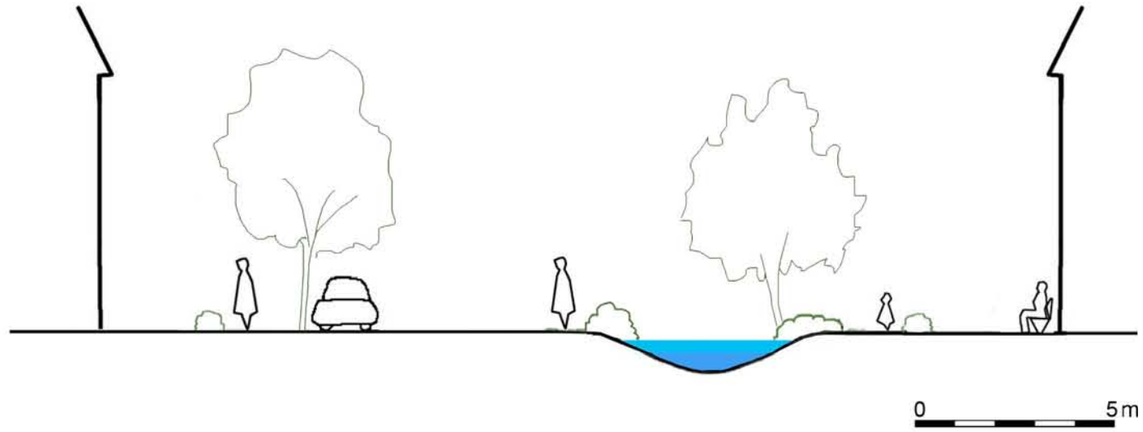


Figure 7.1.13 Section 2'-2' of Brook Design 2

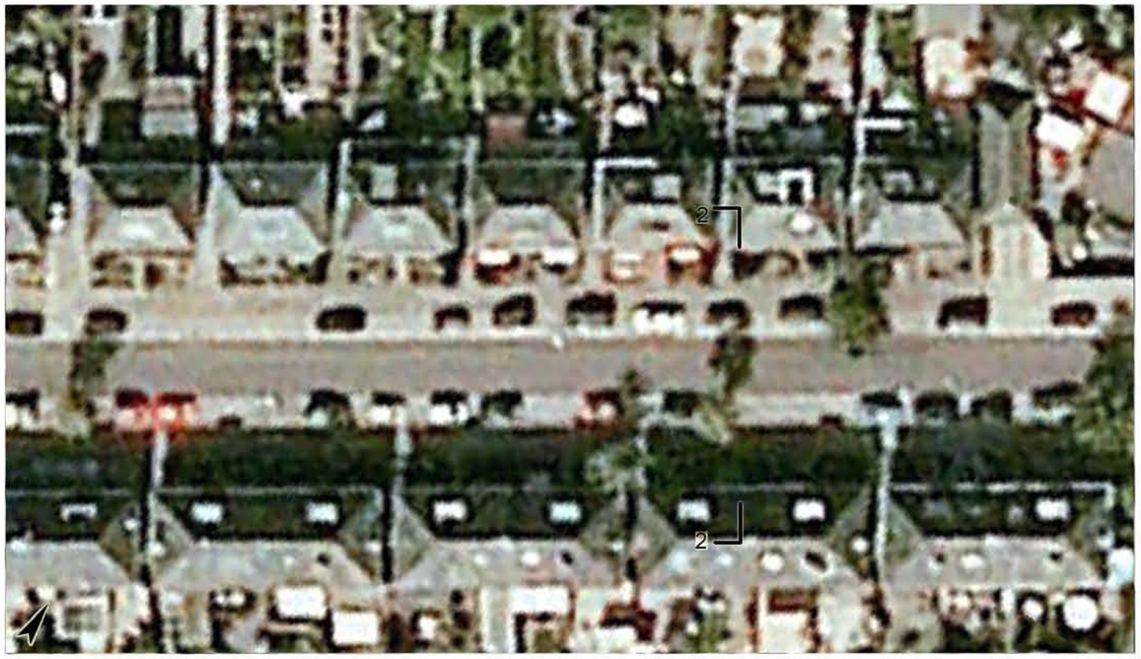


Figure 7.1.14 Present Layout 2

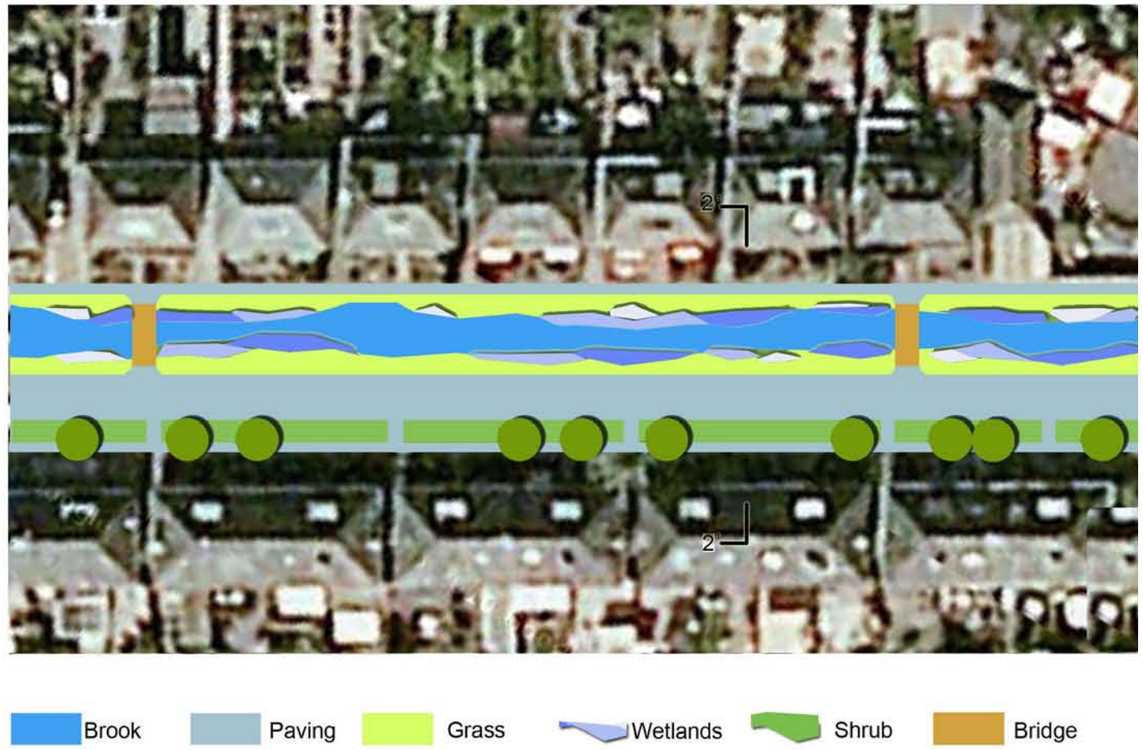


Figure 7.1.15 Master Plan for Brook Design 2

Figure 7.1.16 Present Situation 2 (Google Street View, 2012)

Figure 7.1.17 Brook Design 2 in Normal Water Level Situation

Figure 7.1.18 Brook Design 2 in High Water Level Situation

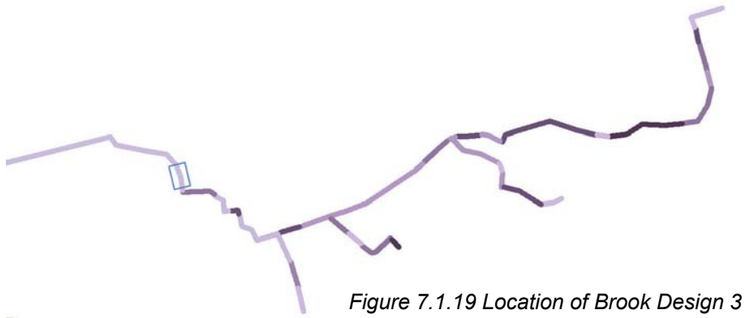


Figure 7.1.19 Location of Brook Design 3

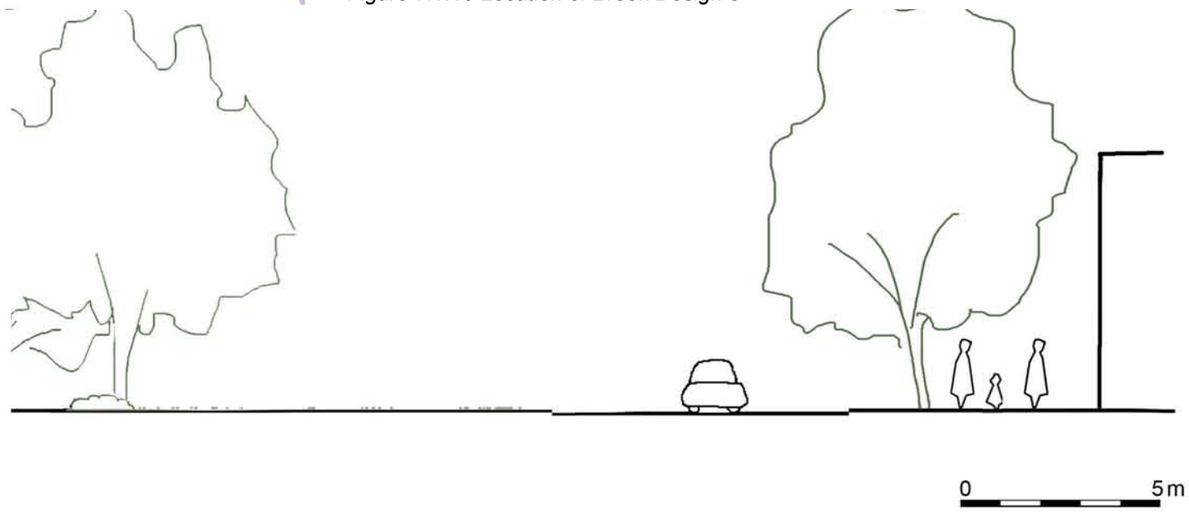


Figure 7.1.20 Present Section 3-3

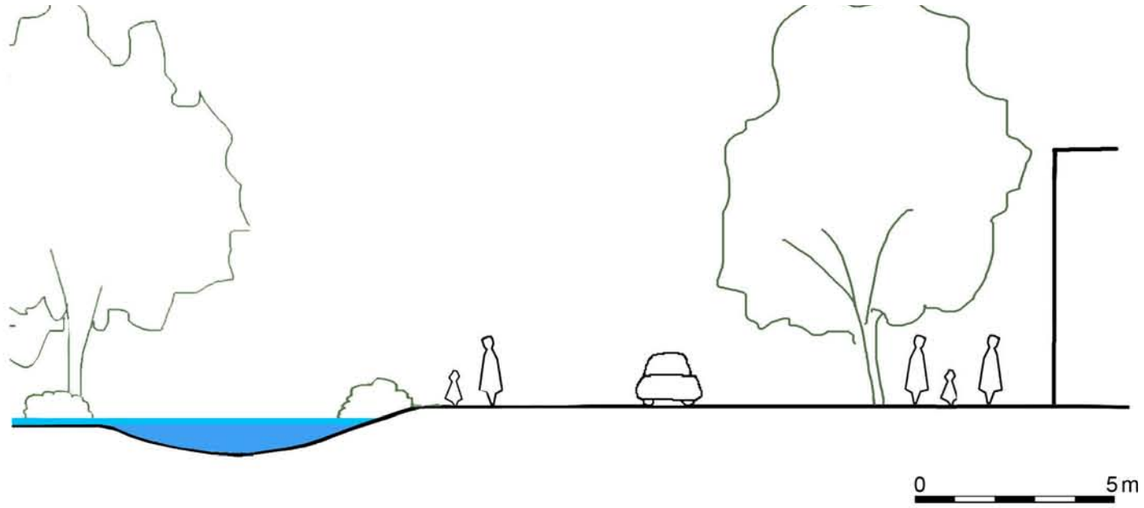


Figure 7.1.21 Section 3'-3' of Brook Design 3

Figure 7.1.22 Present Layout 3

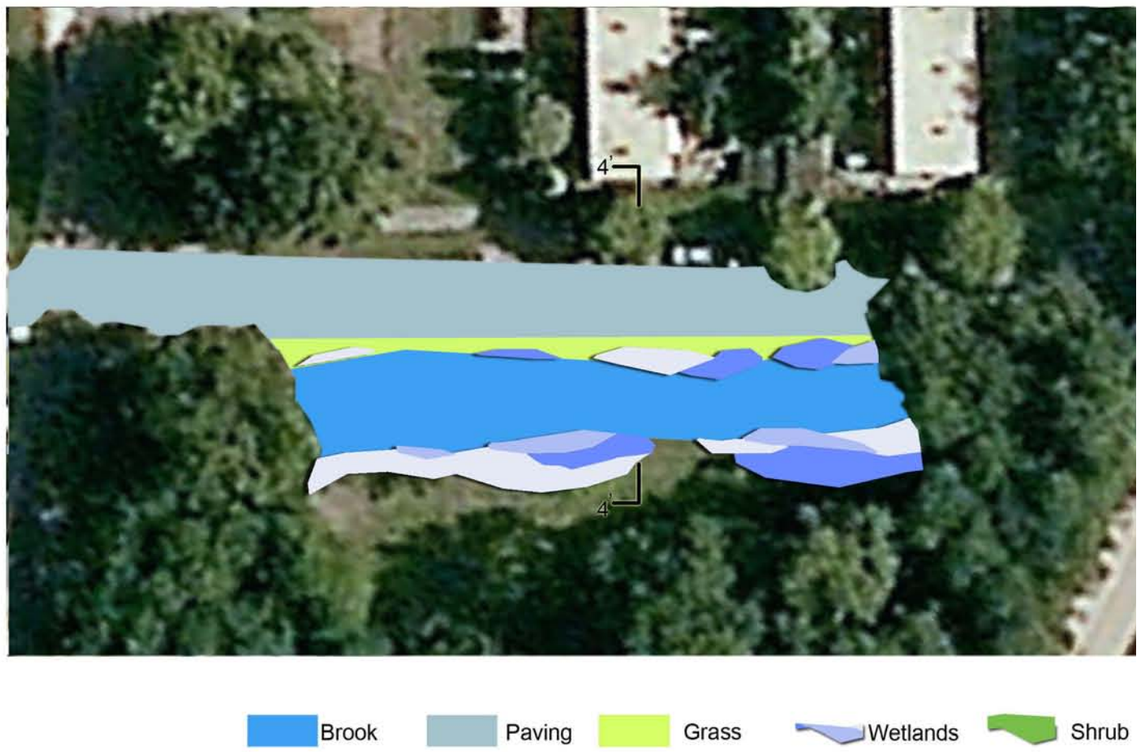


Figure 7.1.23 Master Plan for Brook Design 3

Figure 7.1.24 Present Situation 3 (Google Street View, 2012)

Figure 7.1.25 Brook Design 3 in Normal Water Level Situation

Figure 7.1.26 Brook Design 3 in High Water Level Situation

Figure 7.1.27 Location of Pond Design 1

Figure 7.1.28 Present Situation 4 (Google Street View,2012)

Figure 7.1.29 Pond Design 1 in Normal Water Level Situation

Figure 7.1.30 Location of Pond Design 2

Figure 7.1.31 Present Situation 5 (Google Street View,2012)

Figure 7.1.32 Pond Design 2 in Normal Water Level Situation

7.3 MASTER PLAN

This part is showing the master plans of Twekkelerbeek in both normal and high water level situations. Figure 7.3.1-7.3.2 are the overviews for the plan.
In order to show our designs better, we divide each of the master plan into five parts, which are illustrated in figure 7.3.3-7.3.12.

Figure 7.3.1 Master Plan Overview in Normal Situation

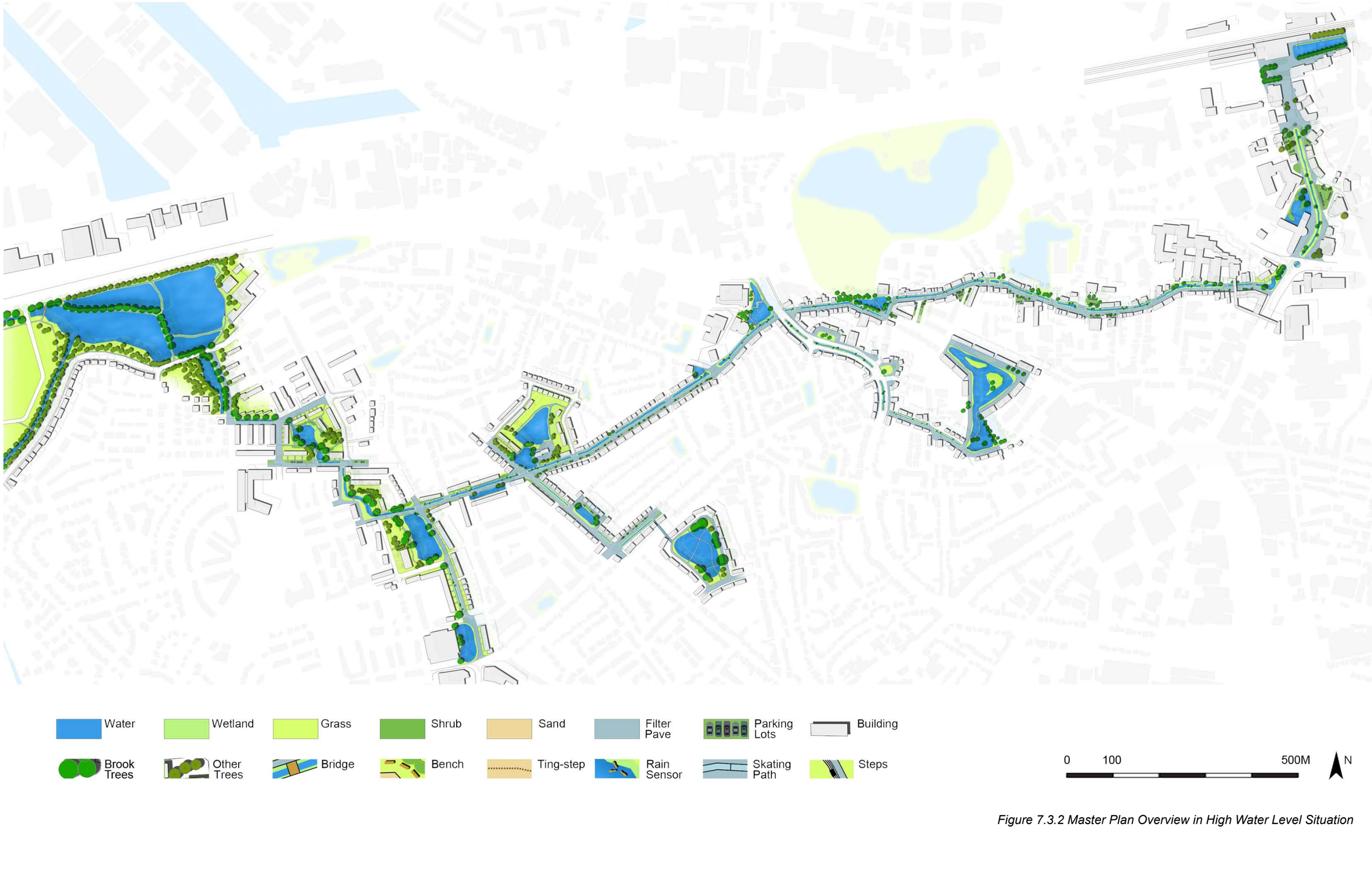


Figure 7.3.2 Master Plan Overview in High Water Level Situation

Figure 7.3.3 Master Plan Part 1 in Normal Situation

Figure 7.3.4 Master Plan Part 1 in High Water Level Situation

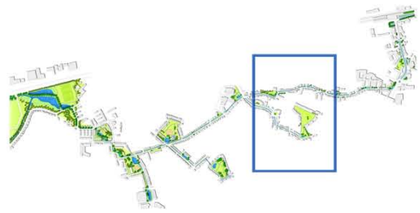


Figure 7.3.5 Master Plan Part 2 in Normal Situation

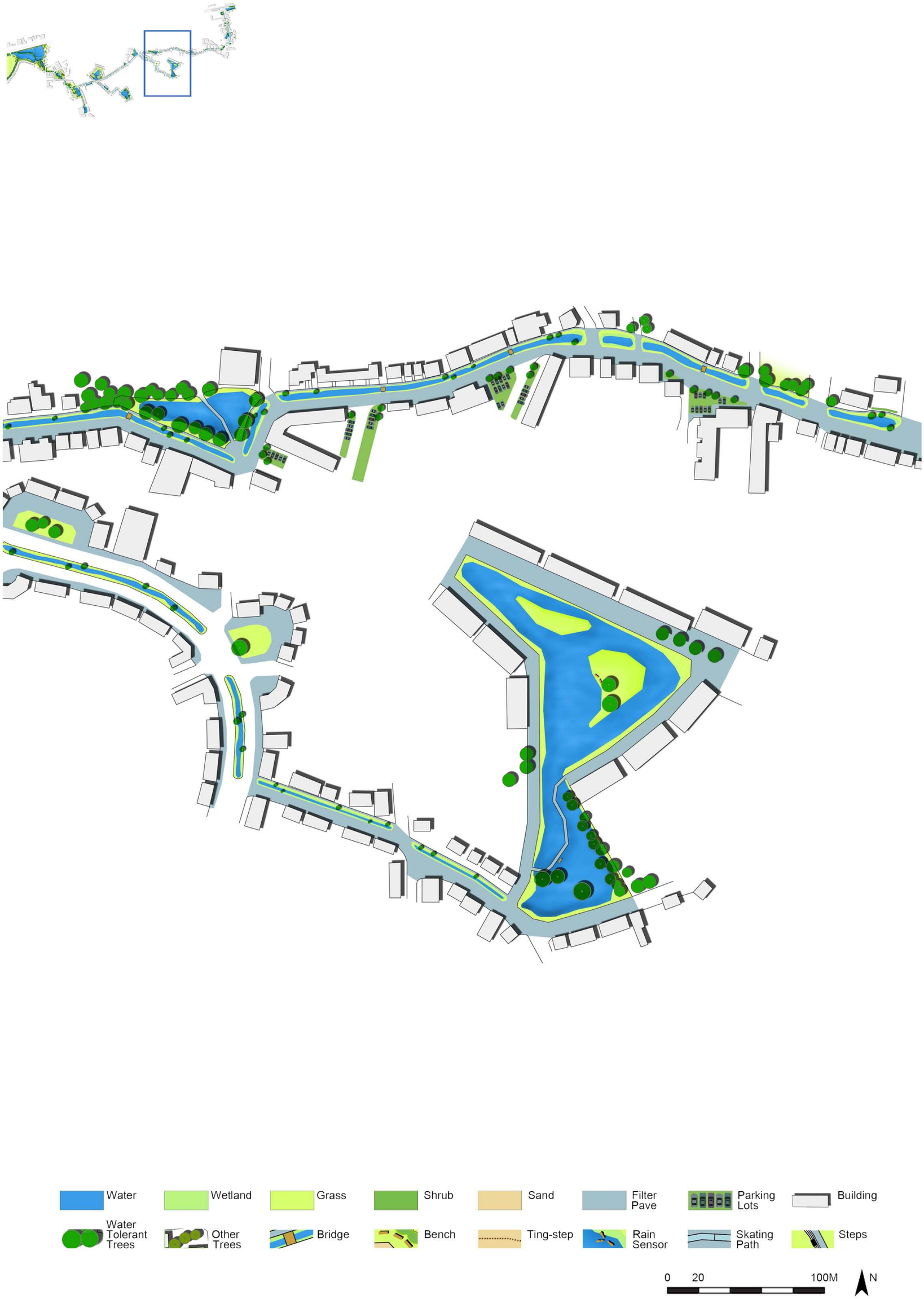


Figure 7.3.6 Master Plan Part 2 in High Water Level Situation

Figure 7.3.7 Master Plan Part 3 in Normal Situation

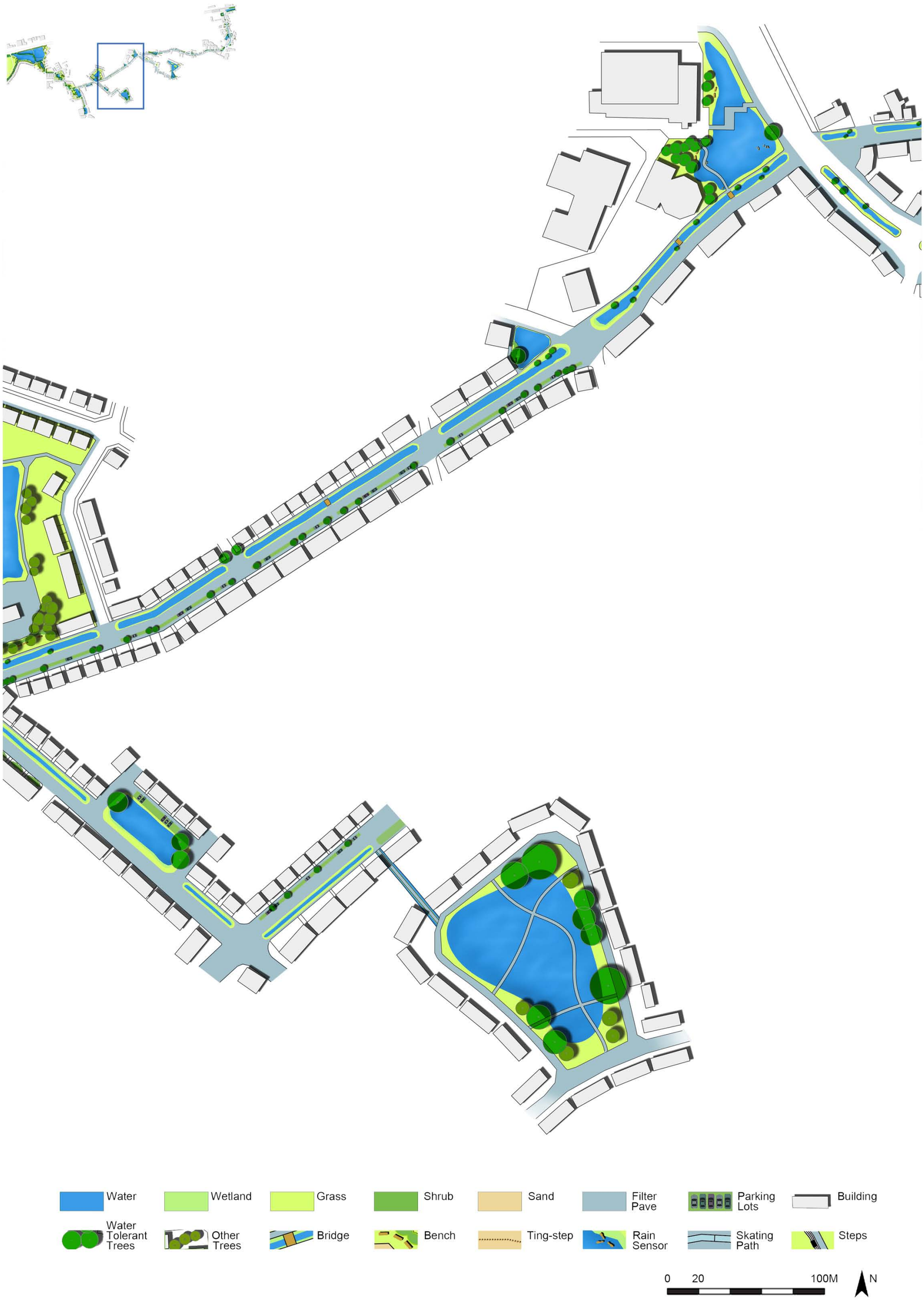


Figure 7.3.8 Master Plan Part 3 in High Water Level Situation

Figure 7.3.9 Master Plan Part 4 in Normal Situation

Figure 7.3.10 Master Plan Part 4 in High Water Level Situation

Figure 7.3.11 Master Plan Part 5 in Normal Situation

Figure 7.3.12 Master Plan Part 5 in High Water Level Situation

7.4 DETAILED DESIGN

This part includes the detailed designs on waterway, bridge, constructed wetlands and night lighting.

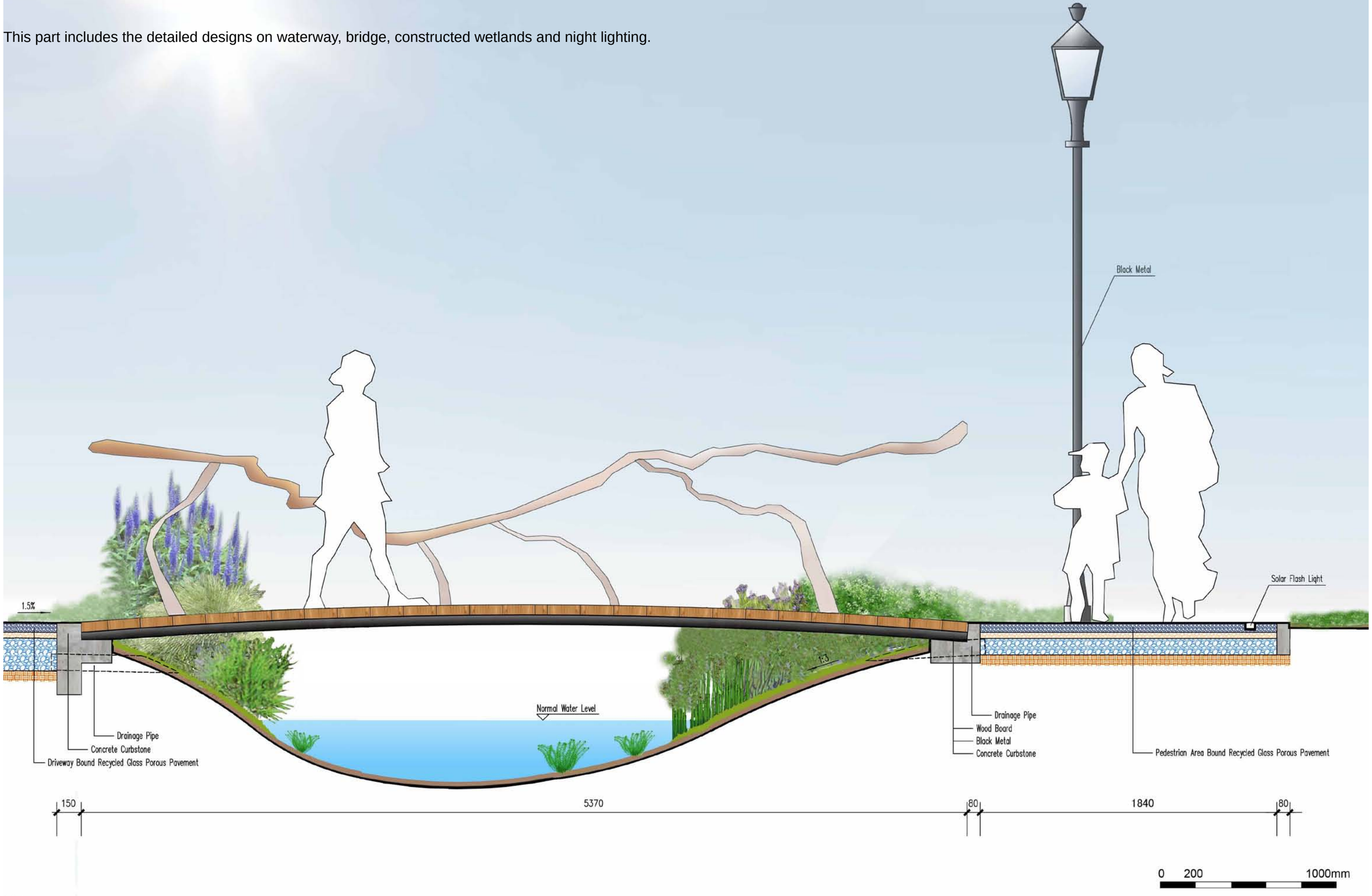


Figure 7.4.1 Detailed Section (A-A) in Normal Water Level Situation: Pipes are installed under ground to drainage water from street to brook (details of the pavement is shown in Appendix 3).

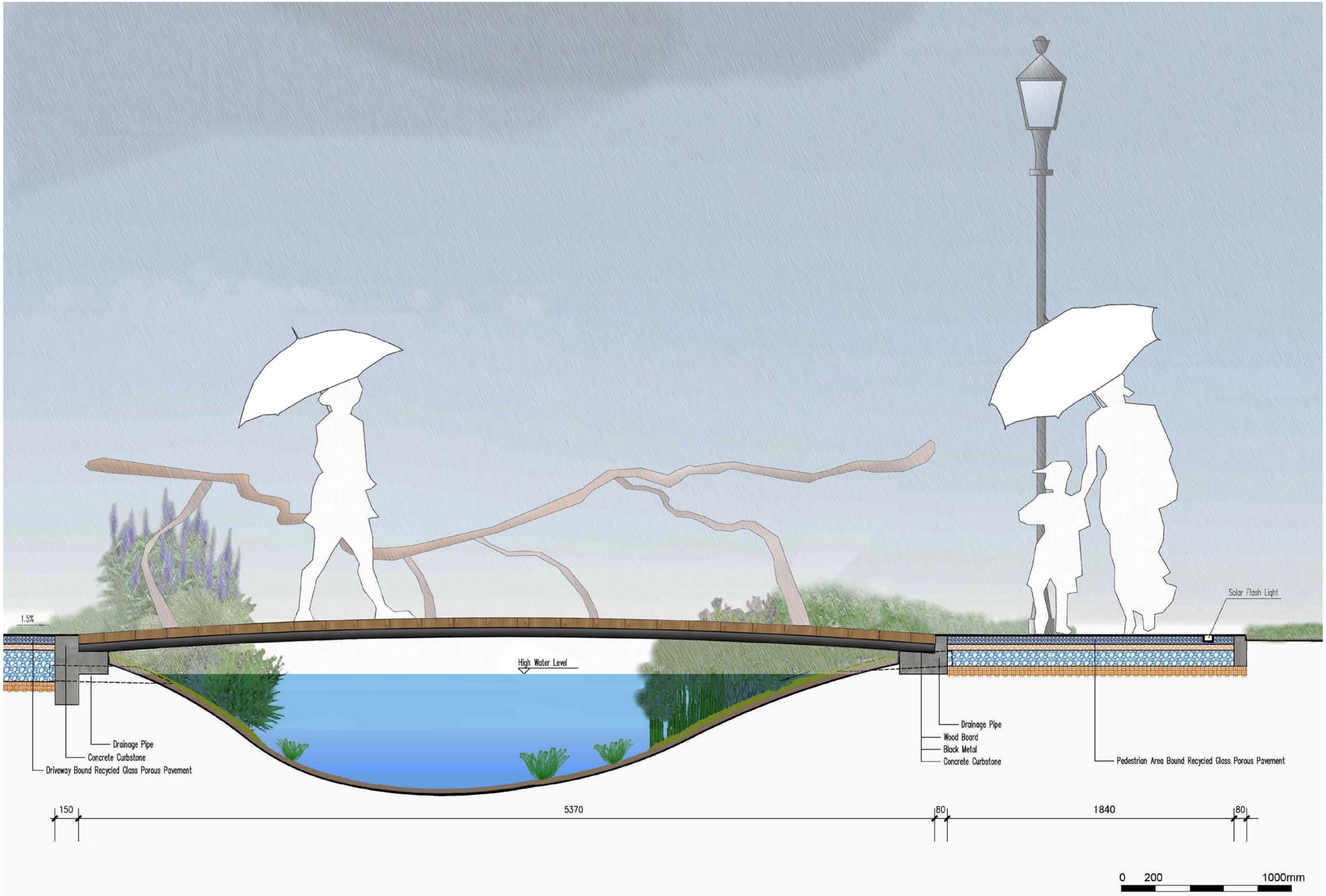


Figure 7.4.2 Detailed Section (A-A) in High Water Level Situation: Water level is controlled at least 15 cm below the ground to prevent floods.

Figure 7.4.3 Detailed Design: the natural brook is framed to make the acceptable landscape for people to experience.

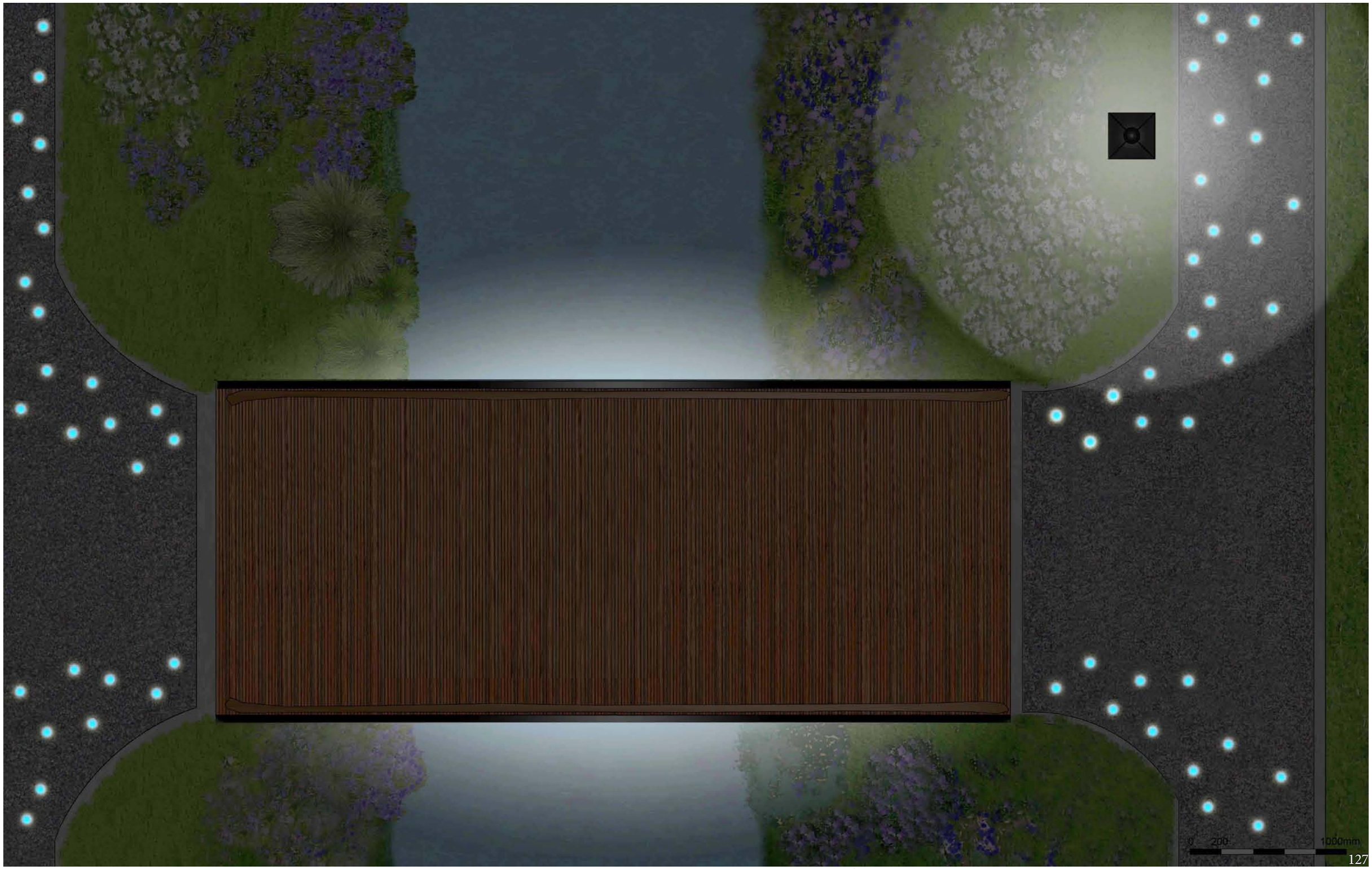


Figure 7.4.4 Detailed Design in Night Lighting: LED ground lights are flashing with blue light in the night to guide people to have nice brook experience with continuity.

Figure 7.4.5 Lighting Design Collage

REFERENCE

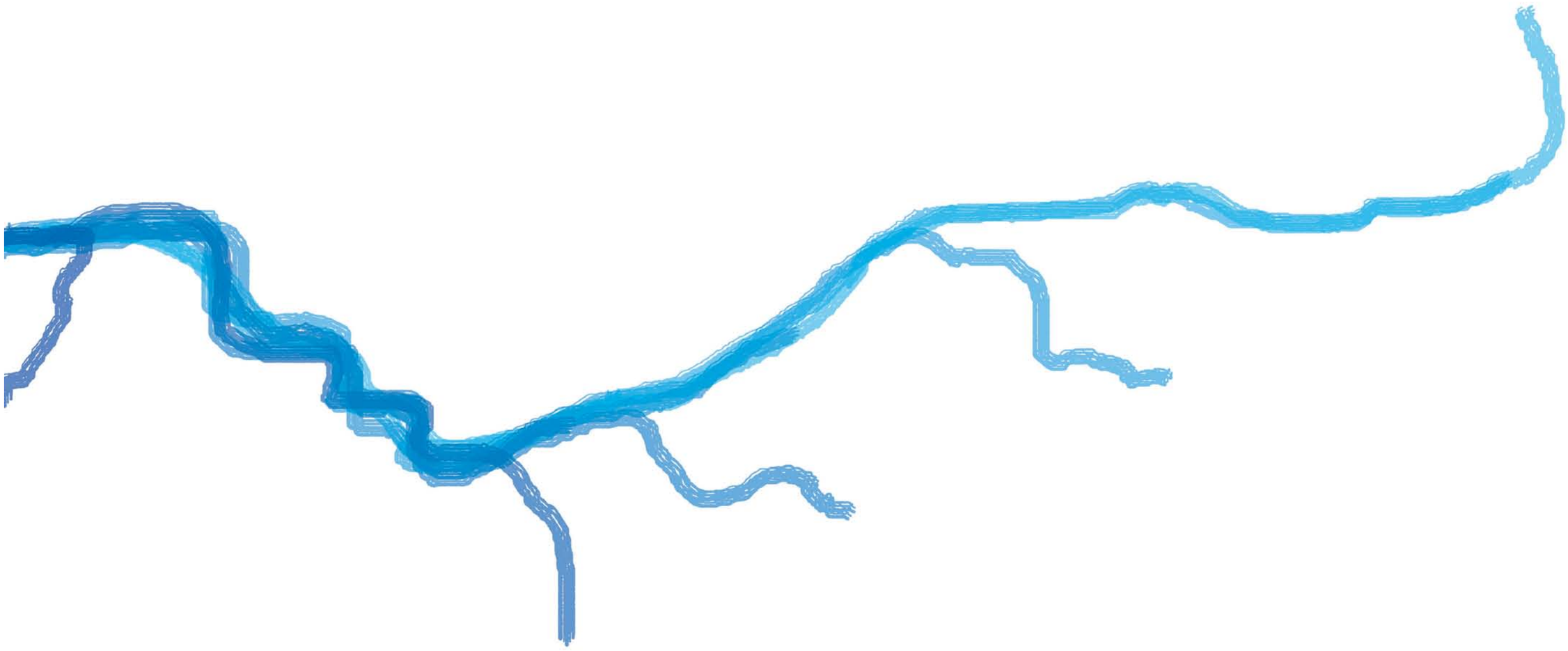
Google Street View (2012) Available at: http://maps.google.com (Accessed: 28 October 2011)

Dijk, P. & Veul, J. (2010) *Water-ways to Climate Adaptation: a landscape-based design approach for sustainable urban water systems*, Unpublished Master thesis, Wageningen University, Wageningen.

CHAPTER 8 REFLECTION AND CONCLUSION

After the whole procedure, our main question 'How can we solve the flood problem and improve the places in Enschede?' is answered by our design outcomes, which actually have solved both of the problems. Therefore, the hypothesis of 'Introducing the natural waterway back into city can help to solve flood problem and improve places.' is proofed.

But we still need to check if our design is fulfilling the local communities demands. In this chapter, the design outcomes are evaluated by Quality Function Deployment. Subsequently, the reflections on what we have learned from the research and design process are indicated. At last, the practical value and recommendations for the future are discussed.



8.1 DESIGN OUTCOME EVALUATION

Do our designs meet with local community's requirements?

In the designs, the layman knowledge from the local community is used to generate our design concepts. But do our final designs meet with their demands and benefit their lives? In order to answer this question, the customer focused system: Quality Function Deployment is modified to be used for our design outcome evaluation. Table 8.1.1 shows the evaluation results.

At first, the local wishes and their benefits are listed in column A. Secondly, the marks for each item in the waterway design and the two water square designs are given in column B. The reasons for the benchmark are listed in table 8.1.2. Subsequently, we translate the items from column A into design parameters (column C). Afterwards, the relationships between the local demand and design parameters are clarified by the symbols in the matrix. At last, we conclude the weaknesses in the designs and identify the conflicting parameters for design decision making.

Fulfilment on local demands

From the evaluation, it is obvious that our designs have mostly fulfil the local demands by good control on floods, creating water experience, and making places for chatting and other activities. However, there are still some weaknesses in the designs. In respect of safety, the marks for all the designs are relatively low because in some parts the water depth and gradient of slopes can not be safe enough for little children. While, in the waterway design, some present parking lots are relocated to make room for water, as a consequence, it is less convenient to park.

Safe water body VS water storage demands

Parking convenience VS space for activities

In order to find out the source of these weak points in our designs, we identify several conflicting design parameters. The first one is the safe water body with proper depth and slopes against water storage demands for drainage. Another one is the convenient parking against space for water experience with proper size of water surface. So it is clear that in order to fulfil the water drainage assignment and create a nice water experience for local people, the designs should have some necessary compromises in safety and parking.

So how to make up for these weaknesses? In our opinions, further social works should be undertaken. The detailed design should be shown to local communities in order to let them know more about the future changes in the landscape. When people know the story of the project, they can discuss and come to the better solutions with the help of experts.

A Local Wishes & Benefits	C Design Parameters: Variety of activities	Space for activities	Parking lot amount	Distance to houses	Gradient & depth slope	Speed of traffic	Amount of benches	Various sitting options	Area of water surface	Blooming period	Variety of species	Storage amount	Flow speed	B Benchmark for Designs: Design for Waterway	Colorful Acacia	Natural Acacia
Flood control												○	●	5	5	5
Water landscape and flowers					△				●	○	●	○	○	5	5	5
Comfortable places for chatting	○	○				○	●	○		○	○		△	5	5	5
Safe environment					●	○						△		4	4	4
Convenient parking			●	○										3	5	5
Varied activities	●	○												5	5	5

● = Strong Relationship — Very satisfied = 5, Satisfied = 4,
○ = Medium Relationship — Just Ok = 3, Need improvement = 2,
△ = Weak Relationship — Dissatisfied = 1.

Table 8.1.1 Design Quality Evaluation

8.2 REFLECTIONS ON THE LEARNING PROCESS

What can we learn from the research and design process?

Before this thesis we both believe that a project should start with thinking on a larger scale dominated by scientific engineering approaches. While when the scale is smaller, the artistic inspirations with landscape approaches might control the process. But after this thesis, we realize that this is not necessarily true.

In the very beginning, we start with the engineering approaches focusing only on the water drainage efficiency in the city scale. After that , we think about the social efficiency by the means of enhancing the existing local identities in order to gain the social support. However, the result of the first plan is not satisfying, because the water brook is emerged from urban fabric. As a consequence, the following questions come: Is this the most beautiful Twekkelerbeek? Regarding the existing context and the waterway, which one is more important?

Landscape taking the leading role

We finally find the answers from landscape approaches. Hence, we realize that the landscape should take the leading role in the project. Because it can combine the history, the common memories, and the hydrological system together to create a nice living environment. After this detour, we felt that the project is more easily dealt with. The historical route of the waterway become our first choice for routing. The water experience and water stories are transferred into original concepts. Engineering approaches act as the tools to fulfil the drainage assignment. The social approaches guide us to get to know the local people's habits, wishes and preference for further design improvement. Thereafter, based on both professional knowledge and layman knowledge, we come up with the final designs. In this process, the landscape approaches not only fill the gaps between the city scale and site scale but also help us in creating a nice water experience to attach people's lives. Therefore, the designs become vivid and meaningful.

Local Wishes & Benefits	**Benchmark for Designs**		
	Designs for Waterway	**Colourful Acacia**	**Natural Acacia**
Flood control	Max storage amount is 176073 m^3, fulfilling the hydrologic plan	Max storage amount is 2706 m^3, fulfilling the hydrologic plan	Max storage amount is 2693 m^3, fulfilling the hydrologic plan
Water landscape and flowers	Continuous water brooks with natural wetland plants in blue, purple and white	1228 m^2 water surface in normal situation, colourful wetland flowers	804 m^2 water surface in normal situation,different species, long blooming period, mimic the natural waterway
Places for chatting	Benches set in street corners and aside ponds	Wooden steps circling the kids playground, 10 benches, grass slopes for casual sitting	Long steps along the footpath, 8 benches ,9 stools in different sites
Safe environment	Shared space to slow down the traffic, average slopes of 1:3.5, depth of water in west part is more than 0.6 m *	Shared space to slow down the traffic, average slopes of 1:4, depth of water is more than 0.6 m *	Shared space to slow down the traffic, gradient of slopes <1:3, depth of water is more than 0.6 m *
Convenient parking	Some parking lots are centralized in minor streets	Present parking lots amount is kept, but their position are changed closer to the houses	61 parking lots in front of the houses
Varied activities	Shared space for skating, cycling, wide grass land for walking, open green space for recreation	Sport facility installation spots for football, volleyball etc, varied playing facilities for kids, dog island for pets	Space for sports, kids playing, dog walking and BBQ, flexible usage of grass, attractive facilities and cycling rout for kids
* 0.6 m is proper water depth for children safety.			

Table 8.1.2 Reasons for Benchmarks

8.3 PRACTICAL VALUE AND RECOMMENDATION

Can this methodology be applied in realistic practices?

For the realistic practices, the most important aspect is the timing of the design. Especially in China, most landscape architects are struggling with the limited time for project designs. So is our design method applicable for the real practices?

The answer is yes. On one hand, our method has a clear and reasonable structure, which puts each specific approach into the right position as discussed above. On the other hand, it is time effective compared to other methods with a mono approach.

Firstly, we start from the city scale, landscape approaches guide us to follow the historical waterway, likewise saving time in the routing process, as there are several choices from the technical sense but only one historical route;

Secondly, we zoom out to the urban scale in order to test if the original concepts can technically fulfil the drainage assignment;

Thirdly, we zoom into a typical neighbourhood for local layman knowledge in order to generate more concrete design concepts. Thereafter, we apply them on the whole waterway designs, which saves the time of consulting other communities.

Therefore, our methodology has its unique practical values for future designs.

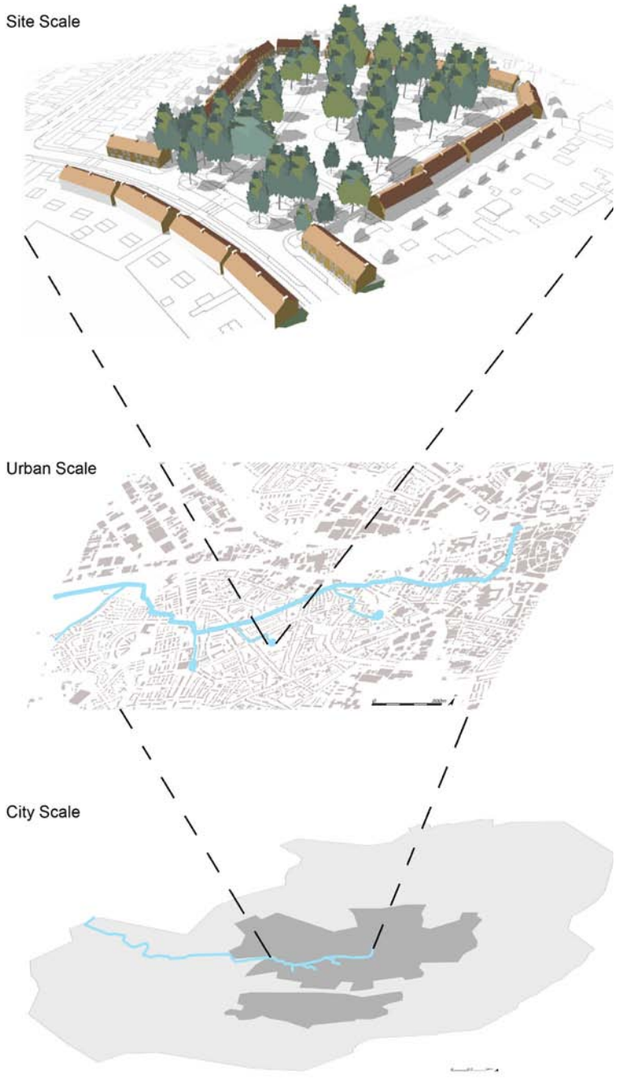


Figure 8.3.1 Review on Three Scales

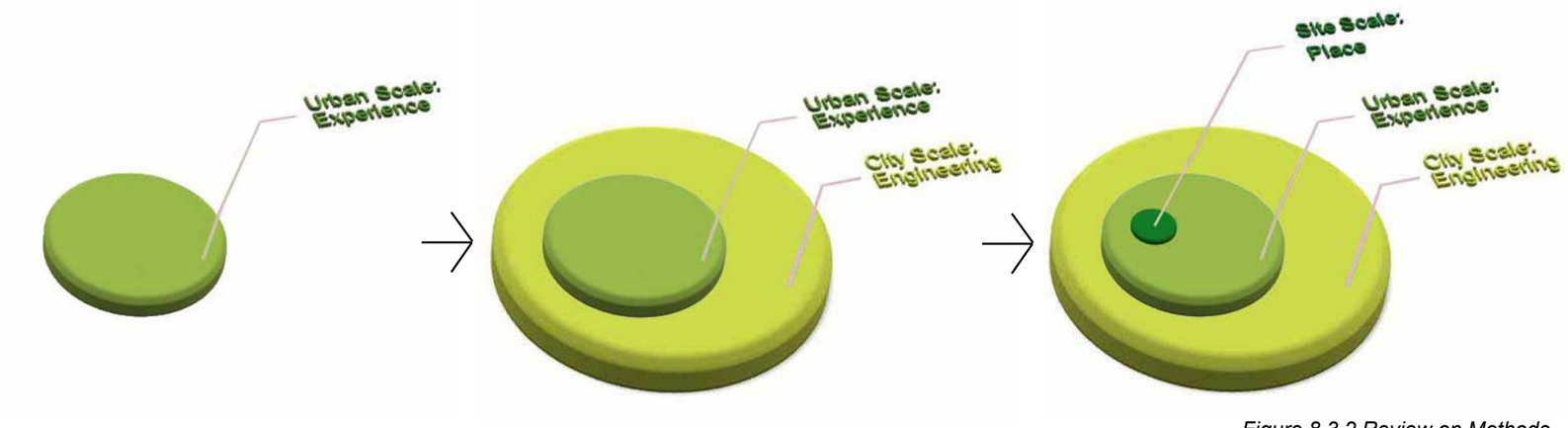


Figure 8.3.2 Review on Methods

What should be improved in the future?

There are two kinds of improvements for future.

The first one is about the generalization of the result from a neighbourhood to the whole waterway. When we select Acacia as our social field work site the criteria we consider are probably not enough. For example, the difference of incomes, age, gender could also make the neighbourhood too unique to be generalized. Therefore, future researches can be made to discuss this problem in typical site selection and generalization.

Another one is the interdisciplinary cooperation. As two designers from China conducting the Dutch project, we are not familiar with the local ecology, environment, and cultural situations, which also could be nice inputs for our designs. So in the future, the international and inter-disciplinary cooperation should be encouraged. Actually, landscape architectural projects always involve many professions. For excellent and efficient practices, more experts from different domains should work together and help each other to achieve the goals.

APPENDIX

APPENDIX 1 REFERENCE STUDY ON IMPLEMENTED WATERWAY

CONTEXT

Roombeek is around 9 km long from Kotkampvijver to Hengelo. It crosses the Roombeek area, which is famous for the textile industry. In the year of 2000, this area suffered from a disaster of fireworks explosion because of careless management. After that, a supervised reconstruction of the area was carried out, called Project “Reconstruction Roombeek” (Roombeek GIS, 2011). Now, it is a working-class suburb and takes the essential roles in inspiring the lively neighbourhood not only on flood prevention but also on landscape improvement. The baseline information of the project is shown in table A.1.1.

Our study focuses on the Stroinksbleekpark (P1 in figure A.1.1) and the brook in Roomweg (P2 in figure A.1.1), which are relatively with more fame than the rest part. Stroinksbleekpark is located in the cultural cluster, which is bounded by buildings and Lonnekersporlaan. Its design idea is to create a retention space for water and a public space for recreation with wetland, bridge and steps. The brook in Roomweg is located in the commercial district with a large stream of people. It is functioning in reducing the runoff flowing speed and referring to the randomness of natural processes and the fireworks explosion with impermeable concrete and sharp edged stepping stones.

Since this is the recently realized project in Enschede, we want to learn from it by making critical reflections on its effectiveness and legibility. We collected the data with field observation, interviews of designers and locals, and questionnaires of locals. Then we analysed the data of the designers’ initiatives, design concepts, project practice and the users’ perceptions.

Project Name	The pond in Stroinksbleekpark	The brook in Roomweg
Location	Part 1	Part 2
Design Date	2006	2006
Designers and Firms	Marina Eenschoten	Edwin Santhagens
Design Firms/ Institution	Municipality of Enschede	Buro Sant en Co
Construction Date	2007-2008	2007-2008
Construction Cost	€ 1.700.000	€2.000.000
Construction Firms	Netters Infra	Netters Infra
Client/Developer	Municipality Enschede, Water Board Regge and Dinkel	
Managed By	Municipality of Enschede	

Table A.1.1 Roombeek Baseline Information (Municipality Enschede, 2011)

Figure A.1.1 Roombeek Waterway (Waterschap Regge en Dinkel, 2006)

EFFECTIVENESS AND SUSTAINABILITY

Whether the effectiveness and sustainability of the drainage system are really reached is determined not only by its ability in preventing flood during the emergent periods but also by the on-going quality of the project in the realistic practice, e.g. the actual functions during the long return period, the economy of maintenance as well as the reflection from users.

The result of our questionnaires shows that no flood is occurred in the Roombeek area after the construction of the waterway. The drainage system plays its effective role in flood protection. But most interviewees complained on the bad maintenance. Since the limited precipitation in summer, the brook in Roomweg is almost dried up. Then a lot of algae grows in the waterway during the hot days. The algae with its stink smelling reduces its utilization and landscape quality of this area. Unfortunately in the maintenance, the waterway is not cleaned frequently, because it takes nearly 10000 euro in cleaning each time (Dijkstra, personal communication, January 18, 2012). In the contrast, the water quality at Stroinksbleekpark is much better, since the water retained in the pond is always flowing. Besides, the surrounding aquatic plants act as water filters and create a valuable habitat to the fishes and birds, which keeps the ecological balance of the pond.

From the comparison of the two projects, we believe that flowing water, natural permeable material and varied ecosystem is better than still water, artificial impermeable material and monotonous planting. And, mimic of the natural cycle is essential for the drainage system. The brook in Roomweg fails in the long term maintenance, because it only visualizes the form of waterway. While water doesn't infiltrate into underground or purified by the wetland. The natural water cycle is still blocked.

During the study, we also realize that a sustainable drainage system needs a comprehensive consideration on the meso scale, e.g. initiative concepts, and integrating spatial plan in the micro scale, e.g. the material selection and the detailed designs.

Figure A.1.2 Stroinksbleekpark (taken by author, 2011)

LEGIBILITY AND ATTACHMENT

Roombeek is a popular place for people in Enschede. Many people move to the areas along the waterway to live, just because the attractive environment along the brook (Dijkstra, personal communication, January 18, 2012). But does it really form a natural place to activate the community, enhance the sense of place, and uprise the local people's environmental awareness?

According to our observation and questionnaires, people like to take various activities near the pond in Stroinksbleekpark, most of interviewees consider the site as a good neighbourhood area and come to take a rest frequently. People prefer to meet with friends and sunbath near the pond. Many interviewees also regard this site as their backyard and an important part of their living place. Besides, the fishes and ducks in the pond attract people, especially children. However the situation is a little different for the brook along Roomweg. People regard it as a commercial area. The waterway is more like a background for shopping, walking dog and passing. People don't feel much connection with the nature here.

Additionally, from the feedbacks, the awareness to the flood problem is very low. People don't know the essential function of the re-visualized waterway. So they also don't realize that the climate change has caused increasing precipitation and high pressure to the existing underground piping infrastructure in Enschede. Also the low awareness on flood issue causes the harder application of the visualized waterway in the future projects.

From the study, we understand that a legible and attached waterway should not only flow along historical route generally, but also engage the human to interact with nature by offering the natural sites for various activities. Besides, it should call the common memory and show the functions with several legible detailed designs.

Figure A.1.3 The Brook in Roomweg (taken by author, 2011)

APPENDIX 2 RELATION BETWEEN RESEARCH AND DESIGN

This part shows the tables indicating how do we research by the approaches and how do we derive the design concepts from researches.

		Professional Knowledge										
		Starting Points						Inspiration			Professional Analysis	
		Landscape Narratives	Experiential Landscape	Vulnerability Framework	Sustainable Urban Drainage System	Place Diagram	PlaceMaker Method	Other thesis and theories	Government Documents	Artistic Interpretation	Drainage Assignment	Experiential Landscape Analysis
Professional Analysis	Drainage assignment setting			Thresholds				Recent thesis				
	Existing Experiential Landscape Analysis		Concepts						iArea identity			
	Spatial Analysis		Area Identity									
Social Field Work	Researcher Observation						Site observation					
	Behaviour Observation						Site observation					
	Questionnaires & Interviews						Questionnaires					
	Existing Experiential Landscape Analysis		Concepts									
	Strength & Weakness Analysis					Place evaluation	Data analysis					
	Concept Designs & Feedback							Research by design				
Design Concepts for the Waterway	Following the historical route	Revealing history				Historic						
	Waterway to link the existing areas		There-ness									Varied identities
	Adaptive waterway to urban fabric											Urban fabric
	Shared space					Walkable						Narrow street
	Same paving		Continuity		Porous pavement	Walkable						Varied facades
	Local wild species	Revealing natural	Continuity									
	Brook trees	Sequencing & revealing										
	Landmarks (Rain Sensor)	Sequencing & revealing	There-ness							Bamboo water clock		
	Enlarged ponds and widened brook	Revealing & opening										
	Centres in spots		Here-ness			Sociability						
	Benches with brook shaped back	Gathering										
	Decentralized ponds				Decentralized ponds						Drainage Assignment	

Table A.2.1 Research and Design Part One

			Professional Knowledge				Layman Knowledge		
			Starting Points				Layman Knowledge from the Social Field Work		
			Landscape Narratives	Experiential Landscape	Place Diagram	Artistic Interpretation	Habits	Concerns	Preference & Wishes
Common concepts for water square	Open views to waterway				Attractive		Sitting in the front yard		
	Shared space				Safe			Safety & Convenient parking lots	
	Gentle slope				Safe			Safety	
	Blooming wetland in blue, purple & white		Revealing nature						More colourful flowers
	Benches set in corners						Talking at the fork roads		
Design Concepts for Natural Acacia	Water System	Gradually storing water					Dog walking & Playing		
	Vegetation System	Preserving big trees			Green				Liking the present trees
	Traffic System	Straight roads			Walkable		Conflicts between passers & others		
		Roads with changing views			Attractive	English garden	Low rate of activities		
		Decentralized parking lots			Convenient		Sitting in the front yard	Convenient parking lots	
	Places for activities	In sun			Attractive				
		Flat grass land		Here-ness	Active & Green				Wishes for sport places
		Sands, hill, cycling rout and wooden facilities		Here-ness	Active & Safe	English garden	Kids cycling on the roads	Safety for kids	Wishes for playing facilities
		Dog playground surrounded by shrub		Here-ness	Clean		Talk stimulated by dogs	Sanitation	
		Large space at the fork roads with benches		Here-ness	Interactive & neighbourly		Talking at the fork roads		Wishes for talking places
		Steps along the road for sitting			Interactive		Talking along the roads		Wishes for talking places
Design concepts for Colourful Acacia	Structure	Rain drop shaped zones	Revealing the water story		Attractive				
		Functional zones in colours			Attractive	Colour schemes			Wishes for future functions
	Blue drop	Dark blue square	Metaphor	Here-ness					
		Sapphire skating place	Metaphor		Vivid		Skating		
		Light blue sport centre	Metaphor		Vivid		Football, volleyball etc		
		Height increases from North to South	Revealing nature						
		Ground light t shaping the brook and indicating the location	Gathering & revealing	Here-ness	Evening use				
	Green drop	Grass island for pets			Free of dog shit			Sanitation	Size & brushes
		Benches under the big tree		Here-ness			Talk stimulated by dogs		Wishes for talking places
	Pink drop	Kids friendly spaces			Play with water	Water related facility			Wishes for playing facilities
		Comfortable sitting places for parents		Here-ness					Wishes for talking places

Table A.2.2 Research and Design Part Two

APPENDIX 3 TOOLBOX OF SUSTAINABLE URBAN DRAINAGE SYSTEM

Wet Swales (CIRIA , 2007, p10):

Limit velocities during extreme events to 1-2 m/s, depending on soil type, to prevent erosion;
Maintain flow height of water during frequent events below the top of the vegetation (typically 10 mm);
Maximum side slopes of 1:3 (where soil conditions allow);
Minimum base width normally 0.5 m.

Figure A.3.1 Wet Swale

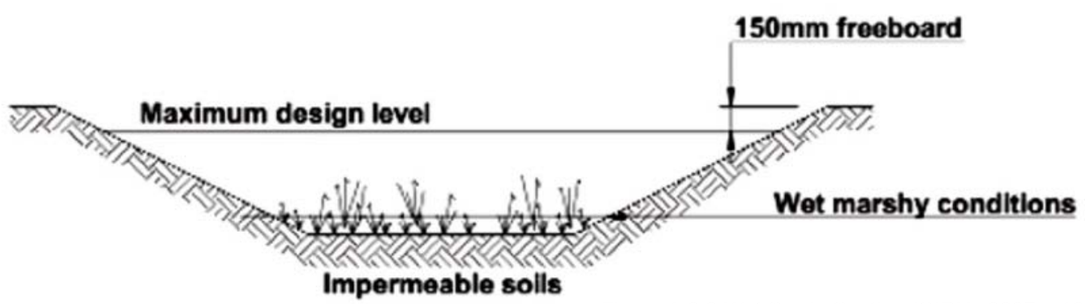


Figure A.3.2 Wet Swale Section (CIRIA, 2007, p10)

Retention basin (CIRIA , 2007, p17):

Permanent pool volume for water quality treatment;
Temporary storage volume for flow attenuation;
Sediment forebay or upstream pre-treatment;
Minimum depth for open water areas of 1.2 m;
Maximum depth of permanent pool of 2 m;
Maximum side slopes of 1:3.

Figure A.3.5 Retention Pond

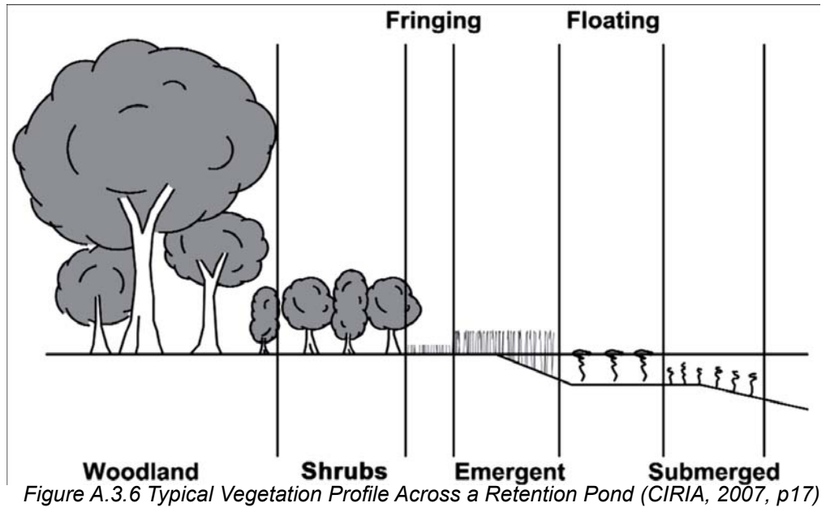


Figure A.3.6 Typical Vegetation Profile Across a Retention Pond (CIRIA, 2007, p17)

0etention basin (CIRIA , 2007, p16):

Detention volume for relatively short period to manage design storms via constrained outflow;
Maximum side slopes of 1:4 for maintenance and safety reasons, unless the situation allows steeper slopes to be used;
Bioretention and wetland/ micropools at outlets is desirable for enhanced pollution control.

Figure A.3.7 Detention Pond

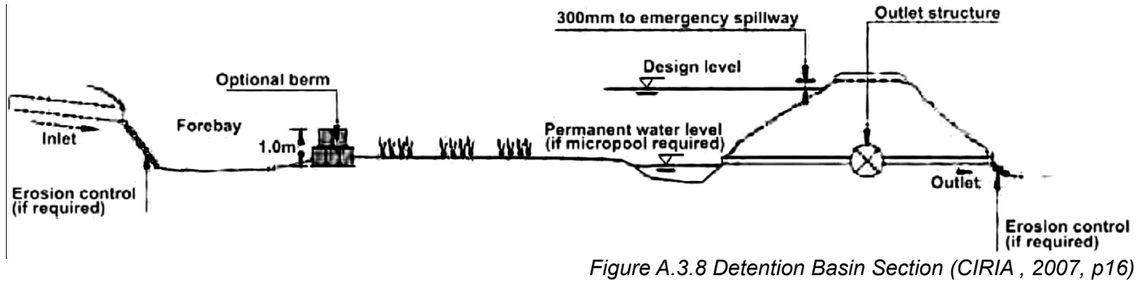


Figure A.3.8 Detention Basin Section (CIRIA , 2007, p16)

Geocellular / modular systems (CIRIA, 2007, p13):

Standard storage design using limiting discharges to determine storage volumes;
Structural design to relevant standards for appropriate surface loadings;
Appropriate geotextile/geomembrane for wrapping.

Figure A.3.9 Geocellular System Image (CIRIA, 2007, p38)

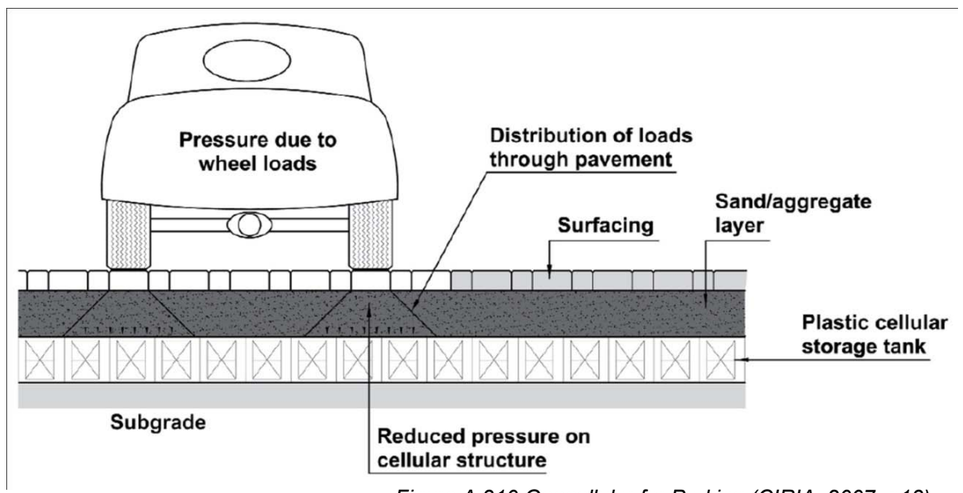


Figure A.310 Geocellular for Parking (CIRIA, 2007, p13)

Pervious pavements (CIRIA, 2007, p12):

Pervious surface and sub-base to be structurally designed for site purpose and design vehicular loading;
Surface infiltration rate should normally be an order of magnitude greater than the design rainfall intensity;
Temporary subsurface storage volume to meet requirements for infiltration and/ or controlled discharge;
Geotextile may be specified as a filtration treatment component near the top of the structure;
Soil and other material must be prevented from contaminating the pavement surface and sub-structure.

Figure A.3.11 Parking Lots with Grass Grid

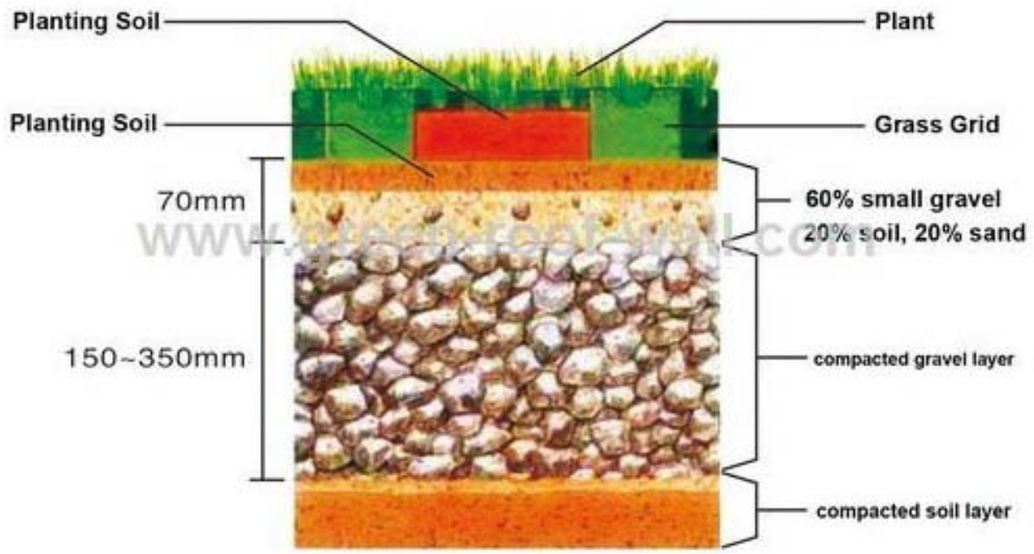


Figure A.3.12 Grass Grid Section

FilterPave (Presto Geosystems, 2012)

This material is bound recycled glass porous pavement. This type of pavement consists of bonding processed post-consumer glass with a mixture of resins, pigments, and binding agents. It not only provides a permeable paving material for water infiltration but also reuses disposed glass to be sustainable. It has different construction methods for different situations.

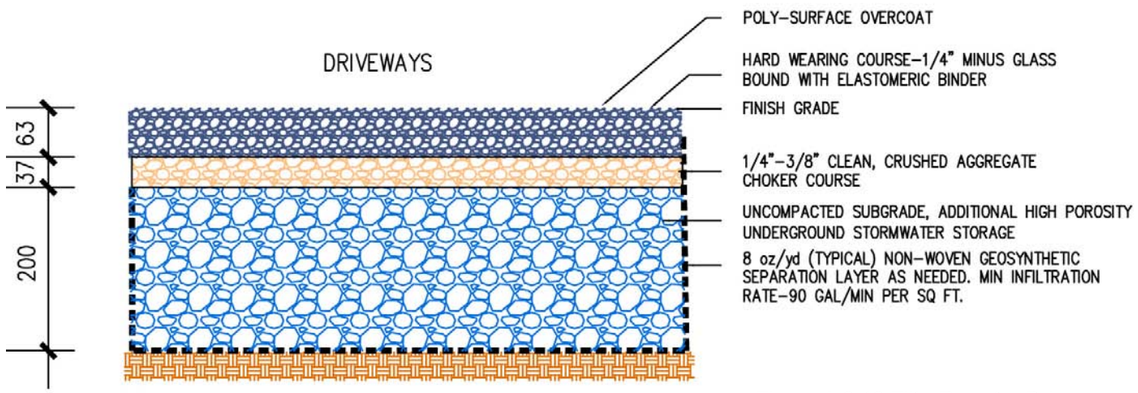


Figure A.3.13 FilterPave for Driveways

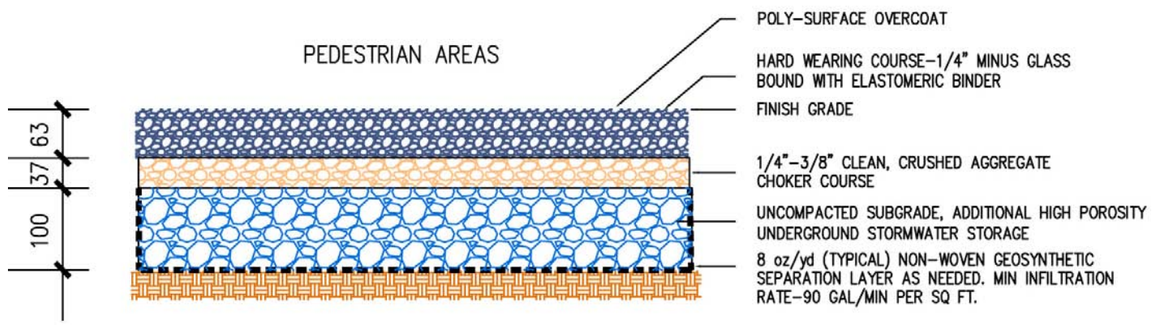


Figure A.3.14 FilterPave for Walking Path

APPENDIX 4 DRAINAGE ASSIGNMENT CALCULATION

The drainage assignment via the Sustainable Drainage System (S) is calculated in each part of the catchment area by the order from the upstream to the downstream (figure A.3.1). It follows the basic formula:

$$S=Q-W$$

Q: the peak runoff;

W: the drainage water via the sewage system.

While calculating the peak runoff (Q), we take the Rational Equation (McCuen, 2004):

$$Q=\sum C\times i\times A$$

C: the runoff coefficient. It is varied with watershed slope, land-use, and hydrologic soil type. Based on Land Use Map from GIS and Welstandsnota maps, we classify the catchment area into several types to find out their runoff coefficient from the rational method.

i: the rainfall intensity. Since the waterway should improve the threshold capacity of the drainage system to deal with 2-hour cloudbursts as well as the coping and recover capacity to deal with the more serious 48-hour long term rainstorms, we consider the normative precipitation value of 68mm for a 2h rain shower in 2100 (i2h) and of 133mm rain over a 48h period (i48h) both in our assignment calculations (KNMI, cited in Dijk & Veul, 2010).

A: the drainage area for each kind of runoff coefficient.

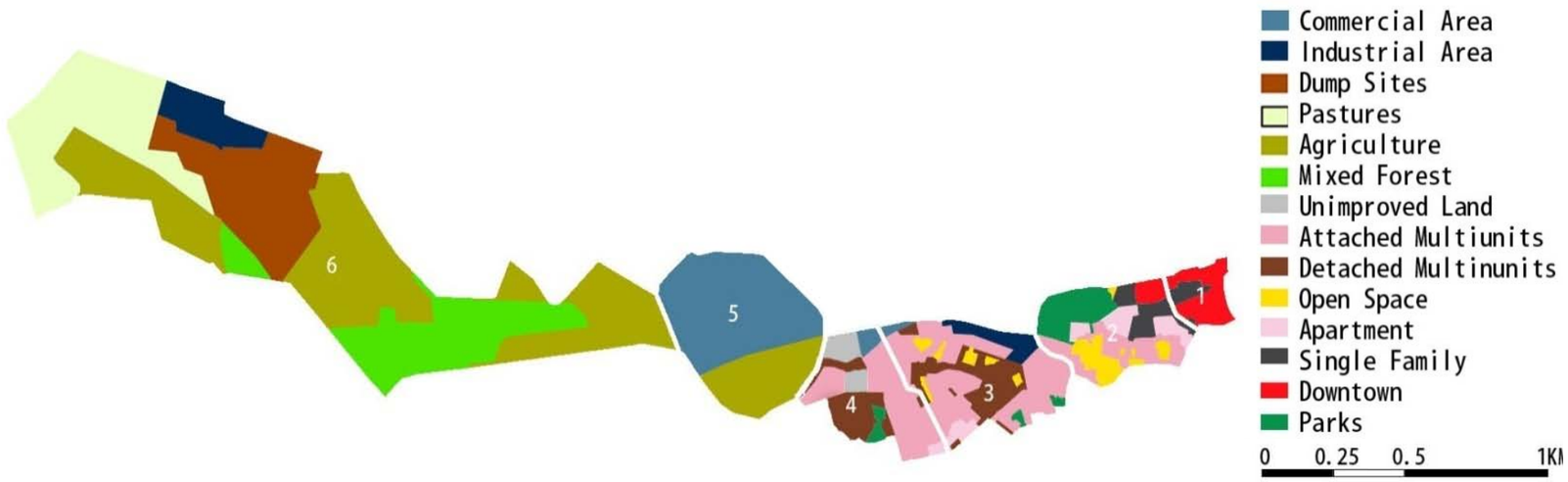


Figure A.4.1 Land Classification Map (Based on the land use map in GIS)

When calculating the discharge via the sewage system (W), we implement the formulas from Dijk & Veu (2010):

$$W=a\times[7mm+(0.7mm\times t)]$$

a: the area of each part of the catchment except for the large scale water body, the Twentkanaal.

t: the drainage period, and the unit used in calculation is hour.

Therefore, for 2 hours rain shower $W_{2h}=a\times[7mm+(0.7mm\times 2h)]$;
for 48 hours rain shower $W_{48h}=a\times[7mm+(0.7mm\times 48h)]$.

Catchment	1	2	3	4	5	6
Commercial (km^2) (C=0.72)			0.02	0.03	0.70	
Industry (km^2) (C=0.7)			0.07			0.19
Dump site (km^2) (C=1)						0.66
Pasture (km^2) (C=0.37)						0.76
Agriculture (km^2) (C=0.21)					0.29	1.51
Forest (km^2) (C=0.14)						0.68
Unimproved land (km^2) (C=0.2)				0.08		
Attached multiunits (km^2) (C=0.7)		0.15	0.42	0.25		
Detached multiunits (km^2) (C=0.5)			0.19	0.15		
Open space (km^2) (C=0.19)		0.09	0.04			
Apartment (km^2) (C=0.6)		0.08	0.03	0.01		
Single family (km^2) (C=0.4)	0.03	0.08				
Downtown (km^2) (C=0.85)	0.13	0.04				
Parks (km^2) (C=0.2)		0.13	0.02	0.02		
Total area (km^2) (A)	**0.16**	**0.58**	**0.77**	**0.53**	**0.99**	**3.80**
2h runoff amount (m^3) (Q_{2h})	8219	18077	32133	20093	38222	101379
2h drainage amount via pipes (m^3) (W_{2h})	1346	4901	6499	4470	8277	31934
2h storage assignment (m^3) (S_{2h})	**6873**	**13176**	**25634**	**15623**	**29945**	**69445**
Sum 2h storage assignment (m^3)	**160696**					
48h runoff amount (m^3) (Q_{48h})	16075	35356	62848	39300	74758	198284
48h drainage amount via pipes (m^3) (W_{48h})	6506	23687	31413	21606	40005	154345
48h storage assignment (m^3) (S_{48h})	9569	11669	31436	17694	34753	43939
48h-2h storage assignment (m^3) (S_{48h}-S_{2h})	**2696**	**0**	**5802**	**2071**	**4808**	**0**
Sum 48h-2h storage assignment (m^3)	**15377**					

Table A.4.1 Drainage Assignment

To evaluate the capacity of the drainage system, we need to calculate the drainage capacity of the system for 2h and 48h precipitation respectively .

The drainage capacity is reflected by three aspects: discharge ability of brooks, storage ability of detention and retention ponds for 2h precipitation, and additional storage ability of retention ponds for 48h precipitation. Since the discharge amount via brooks of the upper stream will also be the additional drainage assignment to the downer stream, for each part of the catchment area, the sum of the discharge amount via brook (B), the detention amount (D) and retention amount (R) should reach the sum of the drainage assignment via the Sustainable Drainage System (S) and the discharge amount via the brooks of the upper stream (b).

Therefore, when D + R≥(S+b)-B, we consider the assignment is achieved. For 48h rainstorm, the sum of increase retention amount should be more than the sum of 48h drainage assignment minuses the sum 2h drainage assignment.

Discharge ability is determined by the rate of flow in brooks, which should not exceed the maximum rate of 2m/s (Dijk & Veul, 2010). The flow rate (V) equals the discharge amount via brook (B) divided by the area of discharge profile (P) and drainage period. For 2 hours V2h=B÷P÷7200s. For 48 hours precipitation, the rate of flow doesn't exceed 2m/s since the long discharge period. When the flow rate is much smaller than the 2m/s maximum rate, the discharge profile (P) can be controlled to a smaller amount with valve to extend the drainage time via brook and reduce pressure at the downer stream.

Moreover, the detention amount (D) equals the surface area of detention ponds multiplies the average depth of detention water. The retention amount (R) equals the surface area of retention ponds multiplies the average increase of water level. So we get the data from following tables.

Catchment	1	2	3	4	5	6
2h storage assignment (m^3) (S)	6873	13176	25634	15623	29945	69445
Additional 2h storage assignment from upper stream (m^3) (b)	0	2626	2085	15182	2744	980
Sum 2h storage assignment (m^3) (S+b)	**6873**	**15802**	**27719**	**30805**	**32689**	**70425**
2h detention amount (m^3) (D)	4242	9488	7209	7744	31709	0
2h retention amount (m^3) (R)	5	4229	5328	20318	0	72500
Sum 2h storage amount (m^3) (D + R)	**4247**	**13717**	**12537**	**28061**	**31709**	**72500**
Discharge amount to downer stream (m^3) (B)	2626	2085	15182	2744	980	0
Average area of discharge profile (m^2) (P)	0.4	0.5	1.1	1.2	1.2	
Discharge flow rate (m/s) (V)	**0.91**	**0.58**	**1.92**	**0.32**	**0.11**	
Feasibility for 2h precipitation	**Feasible**	**Feasible**	**Feasible**	**Feasible**	**Feasible**	**Feasible**

Table A.4.2 Drainage Fulfilment for 2h 68mm Precipitation (Threshold Capacity)

Catchment	1	2	3	4	5	6
48h-2h storage assignment (m^3) (S)	2696	0	5802	2071	4808	0
Additional 48h-2h storage assignment from upper stream (m^3) (b)	0	2696	0	5802	0	4808
Sum 48h-2h storage assignment (m^3) (S+b)	**2696**	**2696**	**5802**	**7873**	**4808**	**4808**
48h-2h retention amount (m^3) (R)	0	2851	0	8206	0	5884
Feasibility for 2h precipitation		**Feasible**		**Feasible**		**Feasible**

Table A4.3 Drainage Fulfilment for 48h 133mm Precipitation (Coping and Recovery Capacity)

APPENDIX 5 BEHAVIOUR OBSERVATION AND QUESTIONNAIRES

During the 11 hours site observation, we map the route and scope for each activity and record the age, gender, ethnicity and characteristic of each people. By piling up the behaviour observation maps for each hour, we get the following data.

Figure A.5.1 Behaviour Observation Map

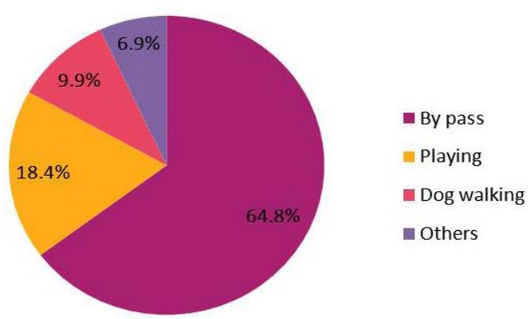


Figure A.5.2 Activities in Observation

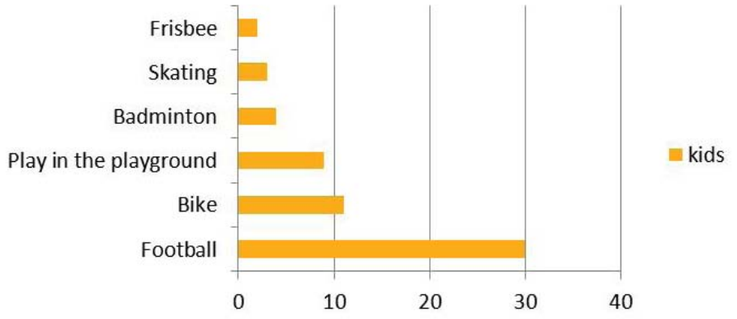


Figure A.5.3 Playing Modes

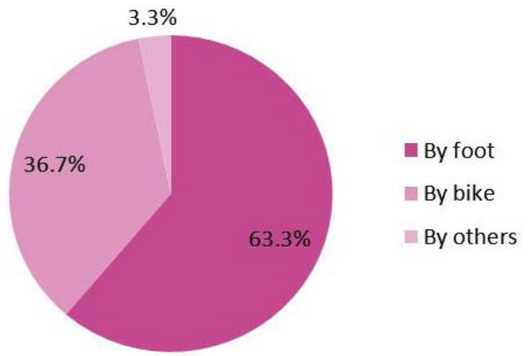


Figure A.5.4 Bypass Modes

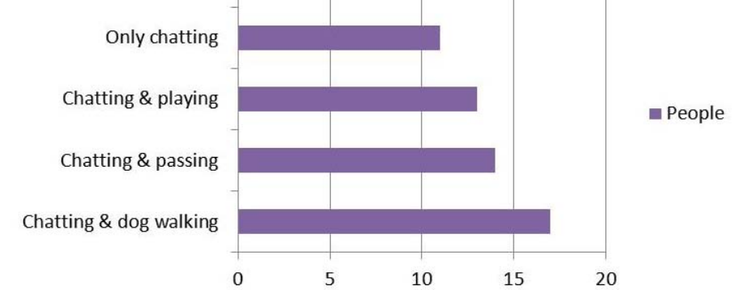


Figure A.5.5 Chatting Modes

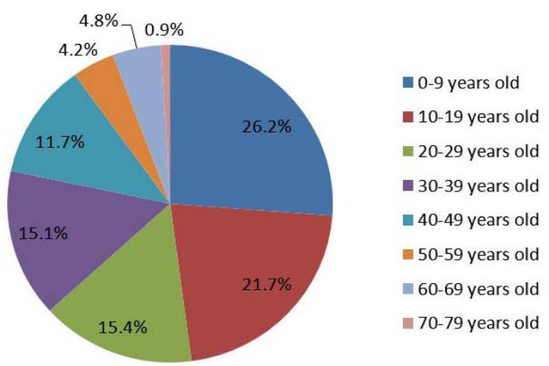


Figure A.5.6 Age Distribution in Observation

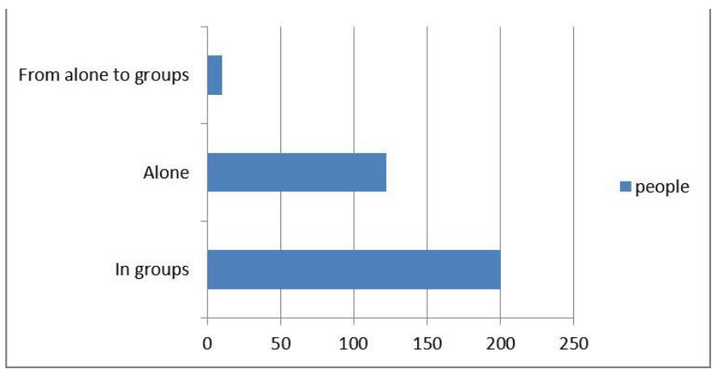
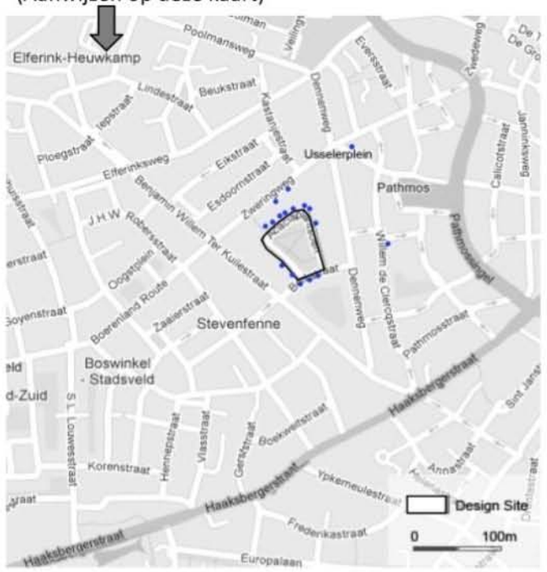


Figure A.5.7 Users Situation in Observation

Hallo! Wij zijn master landschape architectuur studenten van Wageningen Universiteit. Wij doen onderzoek over deze buurt. Ons doel is om een plan te maken ter verbetering van deze ruimte. Hiervoor willen we graag advies van u. Deze vragenlijst is anoniem en duurt slechts 5 minuten.

1. Waar woont u?
(Aanwijzen op deze kaart)



2. Langs welke weg passeert u doorgaans deze buurt
(Teken de route op deze kaart)

3. Hoe vaak passeert u hier?
A. Minder dan 1 keer/week; 2
B. 1 keer/week; 2
C. 2-7 keer/week; 3
D. Meer dan 2-7 keer/week. 19

4. Waarom passeert u hier doorgaans?
A. Op weg naar het Werk; 9
B. Boodschappen doen; 12
C. Op weg naar school; 8
D. Andere: 7 visit friends & family.

5. Hoe passeert u hier doorgaans?
A. Met de fiets; 21
B. Lopend; 9
C. Andere: 10 car.

6. Ergert u zich aan het lawaai van kinderen?
A. Ja; 1 B. Nee. 24

7. Ergert u zich aan het lawaai van honden?
A. Ja; 2 B. Nee. 23

8. Bevallen de aanwezige objecten? (Kruis uw redenen hieronder aan.)

Objecten	Tevreden/ Ontevreden	Redenen						Andere meningen
Bomen	U bent tevreden: 19	Hoeveelheid 10	Kleur 7	Vorm 7				
	U bent niet tevreden: 7	Te veel /Te weinig 8	Te lelijk	Te groot				
Gras	U bent tevreden: 14	Hoeveelheid 6	Goed Beloopbaar 8	Hygiëne 2				
	U bent niet tevreden: 9	Te veel 2	Te ruw 2	Te vies 9				
Pad	U bent tevreden: 9	Breedte 6	Goed Beloopbaar 3	Gemak 5	Hygiëne 2	Bestrating 2	Veiligheid 2	
	U bent niet tevreden: 11	Te breed/Te nauw 1	Te ruw 7	Ongemak 2	Te vies 9	Te lelijk 7	Onveilig 4	

9. Hoe kan deze buurt aantrekkelijker worden voor u? (Meerdere keuzes mogelijk)
8 A. Meer sport ruimte. Welke sporten? football, volleyball, tennis, judo B. Meer ruimte voor kinderen; 7 C. Meer zit ruimte; 10 D. Meer ruimte voor honden; 1
4 E. Voeg vijvers toe; F. Voeg waterstroom; 9 G. Voeg fonteinen toe; 5 H. Voeg bloemen toe; 11 I. Voeg struiken toe; 8
1 J. Voeg kleine ruimtes toe. K. Voeg plein met hard bestrating. 2 M. Andere: management.

10. Welke stijl wilt u in het ontwerp van deze buurt terug zien?
A. Kleurijk; 7 B. Natuurlijk; 20 C. Spannend; 4 D. Stil; E. Artistiek; 6
F. Andere stijl: _____.

Age: ; Female/Male; Dutch/Non-Dutch.

Figure A.5.9 Result of the Questionnaire for People Passing

Objects	Person	Details
Flowers	11	Sports space for
Sitting place	10	football,
Streams	9	volleyball,
Sport space	8	tennis,
Bushes	8	judo
Kids playing ground	7	
Fountains	5	
Ponds	4	
Hard paving	2	
Dog playing ground	1	
Small spaces	1	

Table A.5.1 Wishes for Future Design from People Passing

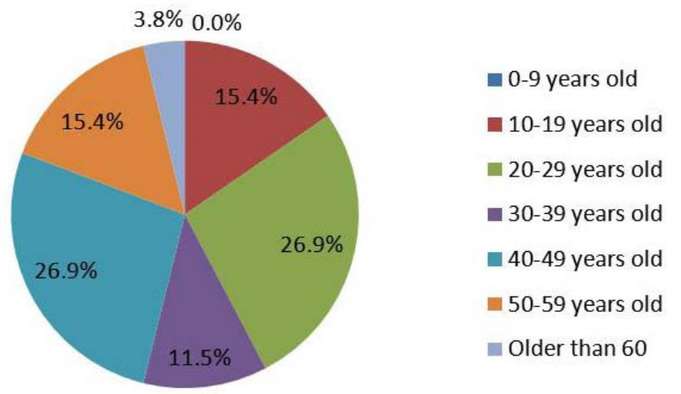


Figure A.5.8 Interviewee Age Distribution of People Passing

Hallo! Wij zijn master landschape architectuur studenten van Wageningen Universiteit. Wij doen onderzoek over deze buurt. Ons doel is om een plan te maken ter verbetering van deze ruimte. Hiervoor willen we graag advies van u. Deze vragenlijst is anoniem en duurt slechts 8 minuten.

1. Waar woont u? (Aanwijzen op deze kaart)

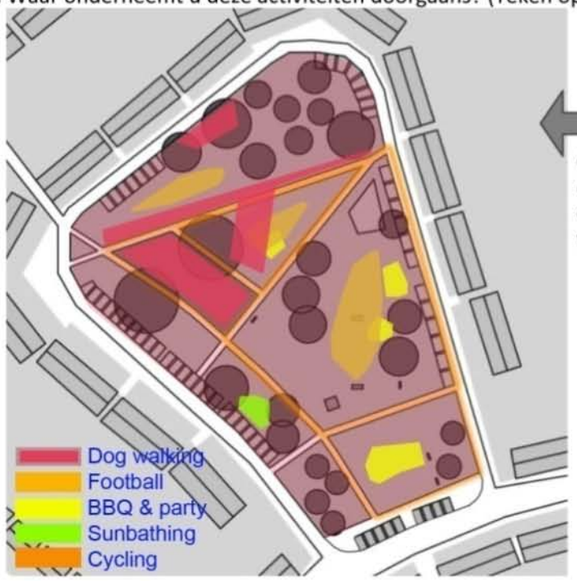
2. Welke activiteiten onderneemt u in deze buurt? (Meerdere keuzes)

A. Hond wandelen;22 B. Zonnebaden;9 C. Vrienden ontmoeten; 13 D. BBQ en feest; 10
E. Voetballen; 15 F. Fietsen; 14 G. Rolschaatsen;6 H. Jogging; 2
I. Badminton; 3 J. Spelen; 11 K. Andere: Volleyball.

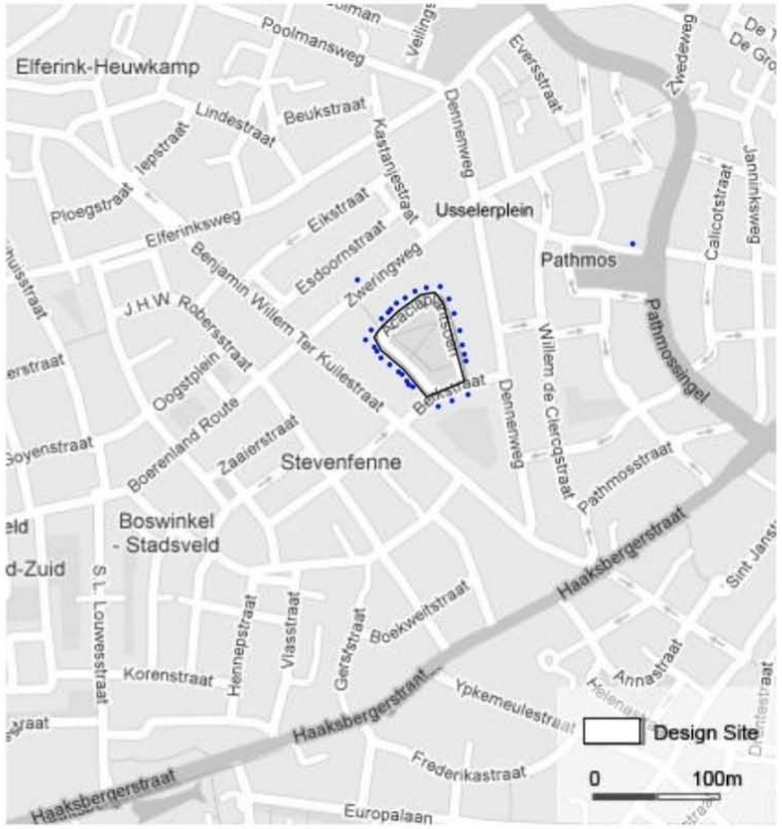
3. Wanneer en hoe vaak onderneemt u deze activiteiten?
(Vul het onderstaande formulier in.)

Activiteiten	Waneer?(kruis hieronder aan)	Hoe vaak?
1._____	Ochtend/Middag/Nacht,	_____keer /week
	Weekdag/Weekend	
2._____	Ochtend/Middag/Nacht,	_____keer/week
	Weekdag/Weekend	
3._____	Ochtend/Middag/Nacht,	_____keer /week
	Weekdag/Weekend	

4. Waar onderneemt u deze activiteiten doorgaans? (Teken op de kaart.)



Geef de plekken aan waar u deze activiteiten onderneemt en vermeld daarbij de naam van de activiteit.



5. Praat u hier vaak met uw buren? A. Ja; 28 B.Nee. 2

6. Denkt u dat deze buurt een gezellig plaats is? A. Ja; 26 B.Nee. 4

Zie de volgende pagina~

Figure A.5.10 Result of the Questionnaire for People Staying

Objects	Person	Details
Kids playing ground	22	
Sport space	18	
Flowers	16	
Sitting place	15	
Streams	13	
Ponds	12	Basketball, foot
Bushes	10	
Fountains	10	
Dog playing ground	6	
Hard paving	5	
Small spaces	4	

Table A.5.2 Wishes for Future Design from People Staying

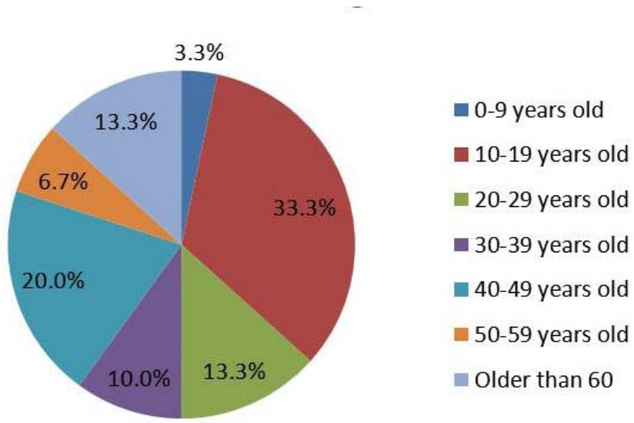


Figure A.5.11 Interviewee Age Distribution of People Staying

7. Bevallen de aanwezige objecten? (Kruis uw redenen hieronder aan.)

Objecten	Tevreden/ Ontevreden	Redenen						Andere meningen
Bomen	U bent tevreden: 23	Hoeveelheid 13	Kleur 11	Vorm 6				
	U bent niet tevreden: 2	Te veel2/Te weinig7	Te lelijk 3	Te groot 1				
Gras	U bent tevreden: 11	Hoeveelheid 2	Goed Beloopbaar6	Hygiëne 3				
	U bent niet tevreden:12	Te veel7	Te ruw 6	Te vies 16				Too much holes
Pad	U bent tevreden: 13	Breedte 6	Gemak9	Hygiëne1	Veiligheid 3	Bestrating3	Goed Beloopbaar 4	Dark
	U bent niet tevreden:13	1Te breed/Te nauw6	Ongemak 1	Te vies13	Onveilig 8	Te lelijk 7	Te ruw 6	
Pakeerplaasten	U bent tevreden: 17	Hoeveelheid 5	Gemak 6	Hygiëne3	Bestrating 4			
	U bent niet tevreden: 7	2Te veel /Te weinig5	Ongemak3	Te vies6	Te lelijk 4			Too wide
Hond speeltuin	U bent tevreden: 8	Grootte 6	Gemak3	Hygiëne2	Geur 2	Kleur 2	Vorm 2	
	U bent niet tevreden:15	2Te groot/ Te klein 6	Ongemak3	Te vies16	Te stinkend14	Te lelijk 4	Te lelijk	
Speel faciliteiten Kinderen	U bent tevreden: 6	Hoeveelheid 1	Gemak 1	Hygiëne	Veiligheid 2	Kleur 1	Vorm2	Variëteit
	U bent niet tevreden:17	Te veel /Te weinig22	Ongemak7	Te vies 14	Onveilig 13	Te lelijk 13	Te lelijk9	Te saai 16
Voetbal faciliteiten	U bent tevreden: 6	Grootte 2	Gemak 2	Hygiëne1	Veiligheid 3	Kleur 2	Vorm3	
	U bent niet tevreden:13	2Te groot/ Te klein13	Ongemak6	Te vies 10	Onveilig 4	Te lelijk 6	Te lelijk6	
Blauw fitnessapparatuur	U bent tevreden: 5	Veilig 1	Gemak1	Hygiëne	Kleur 2	Vorm 2		Broken, noisy
	U bent niet tevreden:17	Onveilig11	Ongemak 5	Te vies16	Te lelijk 13	Te lelijk 10		
Banken	U bent tevreden: 15	Hoeveelheid 6	Gemak6	Hygiëne2	Kleur4	Vorm 3	Comfort 6	
	U bent niet tevreden: 7	Te veel /Te weinig13	Ongemak 2	Te vies 9	Te lelijk6	Te lelijk 3	Oncomfortabel 4	

8. Ergert u zich aan het lawaai van kinderen? A. Ja; 4 B. Nee. 26

9. Ergert u zich aan het lawaai van honden? A. Ja; 4 B. Nee.26

10. Hoe kan deze buurt aantrekkelijker worden voor u? (Meerdere keuzes mogelijk)
18 A. Meer sport ruimte. Welke sporten? Basketball 5; Football 4 Skatebaan 2; Fitness 2; B. Voeg vijvers toe; 12 C. Voeg waterstroom; 13 D. Voeg fonteinen toe; 10
16 E. Voeg bloemen toe; F. Voeg struiken toe; 10 G. Voeg kleine ruimtes toe; 4 H. Voeg plein met hard bestrating. 5

11. Welke stijl wilt u in het ontwerp van deze buurt terug zien?
A. Kleurijk; 18 B. Natuurlijk; 13 C. Spannend; 9
D. Stil; E. Artistiek; 3 F. Andere stijl : Clean; Safe; Kids friendly.

Age: ; Female/Male; Dutch/Non-Dutch

Figure A.5.12 Result of the Questionnaire for People Staying

Activity	When (person)				Average frequency (times/week)
	Morning	Afternoon	Night	Weekday/Weekend	
Dog walking	5	7	3	Weekday	10
	6	8	4	Weekend	
Football	2	9	3	Weekday	9
	2	9	3	Weekend	
Meeting wit	4	5	2	Weekday	8
	4	5	2	Weekend	
Playing	2	3	1	Weekday	8
	2	3	1	Weekend	
Cycling	5	4	3	Weekday	7
	5	4	3	Weekend	
Volleyball	2	2	2	Weekday	5
			2	Weekend	
Sun bathing	3			Weekday	4
	4	1	1	Weekend	
BBQ & party	1	1		Weekday	3
	1	4	2	Weekend	

Table A.5.3 Activity Rhythm on Site

Objects	Satisfaction	Amount	Size	Width	Colour	Form	Pavement	Sanitation	Smelling	Convenient	Safety	Walkability	Variation	Comfort	Details
Trees	21	4			8	5									
Parking lots	10	0					0	-3		3					Too wide
Benches	8	-7			-2	0		-7		4				2	Too few
Path	0			0			-4	-12		8	-5	-2			Too dark, uneven
Grass	-1	-5						-13				0			Too much
Dog playgrou	-7		0		-2	2		-14	-12	0					Too smelling
Football facil	-7		-13		-4	-3		-9		-4	-1				Too small
Kids playgrou	-11	-21			-12	-7		-14		-6	-11		-16		Too few, too boring, not in the centre
Blue fitness fa	-12				-11	-8		-16		-4	-10				Too noisy
Trees	33	6			15	12									
Parking lots	10	0					0	-3		3					Too narrow
Benches	8	-7			-2	0		-7		4				2	Too few
Grass	4	-1						-20				0			Too much
Path	-2			5			-9	-12		11	-7	-6			Too dark, uneven
Dog playgrou	-7		0		-2	2		-14	-12	0					Too smelling
Football facil	-7		-13		-4	-3		-9		-4	-1				Too small
Kids playgrou	-11	-21			-12	-7		-14		-6	-11		-16		Too few, too boring, not in the centre
Blue fitness fa	-12				-11	-8		-16		-4	-10				Too noisy

(Numbers:People like-People dislike)

Table A.5.4 Evaluation for Existing Objects from People Staying

APPENDIX 6 ALGAE CONTROL

In the Netherlands, algae is booming in warm days, which reduce the water experience quality. As Appendix 1 shows, the algae problems in Roombeek are annoying the local community. Therefore, we study the methods to control the algae in our brook, which are listed below.

FLOATING PLANTS

Sunlight is essential to algae's growth. Since our brook is mostly in the sun to attract people to experience as well as affording flowers to bloom, we need to think how to create the shade by the floating plants. So the local floating vegetations are selected (figure A.6.1).

WATER FLEAS

Figure A.6.2 Water Fleas (UFZ, 2012)

Water fleas are some of the most important subjects for freshwater toxicology. They can clear algal blooms in water landscapes. Moreover, water fleas are a critical part of freshwater ecosystems as most freshwater fish species and many bird species depend on water fleas as a significant source of food(Waterflea, 2012). So we can introduce water fleas into the brooks and ponds to control the algae.

FISHES

There are a few algae eating fishes. Such as Black Molly, Otocinclus Cats, Siamese Algae Eaters, Plecos, Butterfly Goodeid, The Florida Flag Fish, Rosie Barbs, they can act as algae "clean up crews", working excellently in combating algae (Aquaticcommunity, 2012). Therefore, the fishes can be raised in the water landscape.

Floating-leaved pondweed
(Drijvend fonteinkruid)
Potamogeton natans

Floating water plantain
(Drijvende waterweegbree)
Luronium natans

Pond Water-crowfoot
(Grote waterranonkel)
Ranunculus peltatus

White Water Lily
(Witte waterlelie)
Nymphaea alba

White-flowered Buttercup
(Witte waterranonkel)
Ranunculus ololeucos

Figure A.6.1 Floating Plants (Wilde Planten, 2012)

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