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UNESCO world heritage city of Quedlinburg – blue-green sponge city
Master´s thesis

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Study program: Landscape architecture

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DECLARATION

I hereby declare that I have authored this master's thesis carrying the name „UNESCO world heritage city of Quedlinburg – blue-green sponge city" independently under the guidance of my supervisor. Furthermore, I confirm that I have used only professional literature and other information sources that have been indicated in the thesis and listed in the bibliography at the end of the thesis. As the author of the master's thesis, I futher state that I have not infringed the copyrights of third parties in connection with its creation.

In Prague on 09.04.2023

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UNESCO WORLD HERITAGE CITY OF QUEDLINBURG – BLUE-GREEN SPONGE CITY

SUMMARY

The master's thesis deals with finding solutions to improve the microclimate and stormwater management of the old town of Quedlinburg, a UNESCO World Heritage Site.

Literature research gave some examples of nature-based planning in urban development. Methods of stormwater mangement have been described below. This methods were applied in the design part of the thesis. The main historic dates of the development of Quedlinburg were also marked here. The necessary analyses of the focus area are also provided.

The design part shows interconnected solutions to improve the urban microclimate and stormwater management. The project was developed to the conceptual schematic design phase.

This work could form the basis for further development and adaptation of Quedlinburg's historic core to current public realm design requirements.

Keywords: climate change adaptation, historic monument protection, living city, public space, UNESCO world heritage, urban climate, water management

CONTENT

INTRODUCTION

Climate change is increasingly affecting our cities and towns. Higher air temperatures, less precipitation, heavy rains and flooding events happen more and more often.

Environmental planning is usually successful in natural settings, while in urban settings it is difficult to ensure the integrity of ecosystems. All because natural ecosystems have been irreversibly altered by human activities (Luoni 2010).

Urban projects are emerging in different parts of the world that not only provide functional public spaces, but also pay attention to the environment, improving biodiversity and managing water resources more carefully.

Making a city adapted to the current climate conditions is a challenge, but with the help of global experience, history and, most importantly, with the right interpretation of the requirements of a particular location, it can be achieved. Creating a more comfortable, natural, accessible city is a key to the present and to the future.

This master's thesis is the result of an international student competition for landscape architects initiated by the Federation of German Landscape Architects (BDLA) from 1.09.2021 to 01.03.2022 (Bund Deutscher Landschaftsarchitekt:innen, bdla).

AIMS OF THE THESIS

The main objectives are: to create a concept of improving the urban climate in the medieval urban structure; improving public spaces that will allow more time to spend in the town center; identifying areas that have the potential to improve blue-green infrastructure of the old town of Quedlinburg.

01

LITERATURE RESEARCH

01.1 HUMAN FACTORS IN CLIMATE CHANGE

A healthy environment is a part of the harmonious development of society. Our lives are constantly accompanied by the development of technical components that contribute to air, soil, and water pollution. Together with noise, haste and stress it affects the physical and psychological state of the human body (Attarian 2010; Hurych et al. 2011).

Vegetation use and stormwater management have a significant impact on the microclimate, health, culture, aesthetic, and economic (Hurych et al. 2011).

Climate is the quality of life in winter, spring, summer, and autumn. Without a quick and qualitative response to heat, drought and flooding, the loss of quality of life will accelerate considerably (Bernsee et al. 2021).

According to Bernsee et al. (2021) in the late twentieth and early twenty-first centuries, the „stone city" was the architectural and aesthetic ideal of urban development. This ideal needs to be revised and improved according to contemporary climatic conditions (Bernsee et al. 2021).

Nature-based design has many advantages. It can strenghten flora and fauna biodiversity. Designed ecosystem can lessen the negative impact of flooding, water pollution and other microclimate changes (Ivers 2021).

It is important to note that the infrastructure of anthropocentrism is now more tangible than ever. Nature is being shaped through our interventions. Much has already been done in terms of engineering. It is now necessary to realize that we are in a human-dominated era that brings both benefit and harm. Solutions must be sought to find an approach to positive change and support for the environment. The question is only whether this change will take a place by design or by disaster (Backhaus et al. 2015).

Climate change under the influence of various factors in the last ten years is more noticeable than ever. The warmest 20 years worldwide have been in the last 22 years. In Germany, in Saxony-Anhalt, an increase of 1.5 °C in the long-term average annual temperature was recorded. The purity of heavy precipitation can be expected to increase (Landesamt für Umweltschutz Sachsen-Anhalt (LAU) 2019).

The damage and economic consequences allow us to call an event extreme. In 2002, several days of heavy rains caused enormous damage to central Germany, Saxony and Bohemia. The Mulde and Elbe rivers burst their banks. The total damage to Germany is estimated at 11.6 billion euros and 1.2 billion euros in Saxony-Anhalt, 3 billion euros in Bohemia (Landesamt für Umweltschutz Sachsen-Anhalt (LAU) 2019).

In 2013 the Elbe River burst its banks again and there was a flood. But Germany was better prepared and the flooding did not cause such devastating damage. A system of dikes and flood control polders was developed (Landesamt für Umweltschutz Sachsen-Anhalt (LAU) 2019).

With clever nature-oriented design it is possible to adapt the environment to undesirable influences. This can also bring many recreational as well as economic benefits now and in the future.

„The landscape is a key element of individual and social well-being and its protection, management and planning entail rights and responsibilities for everyone."

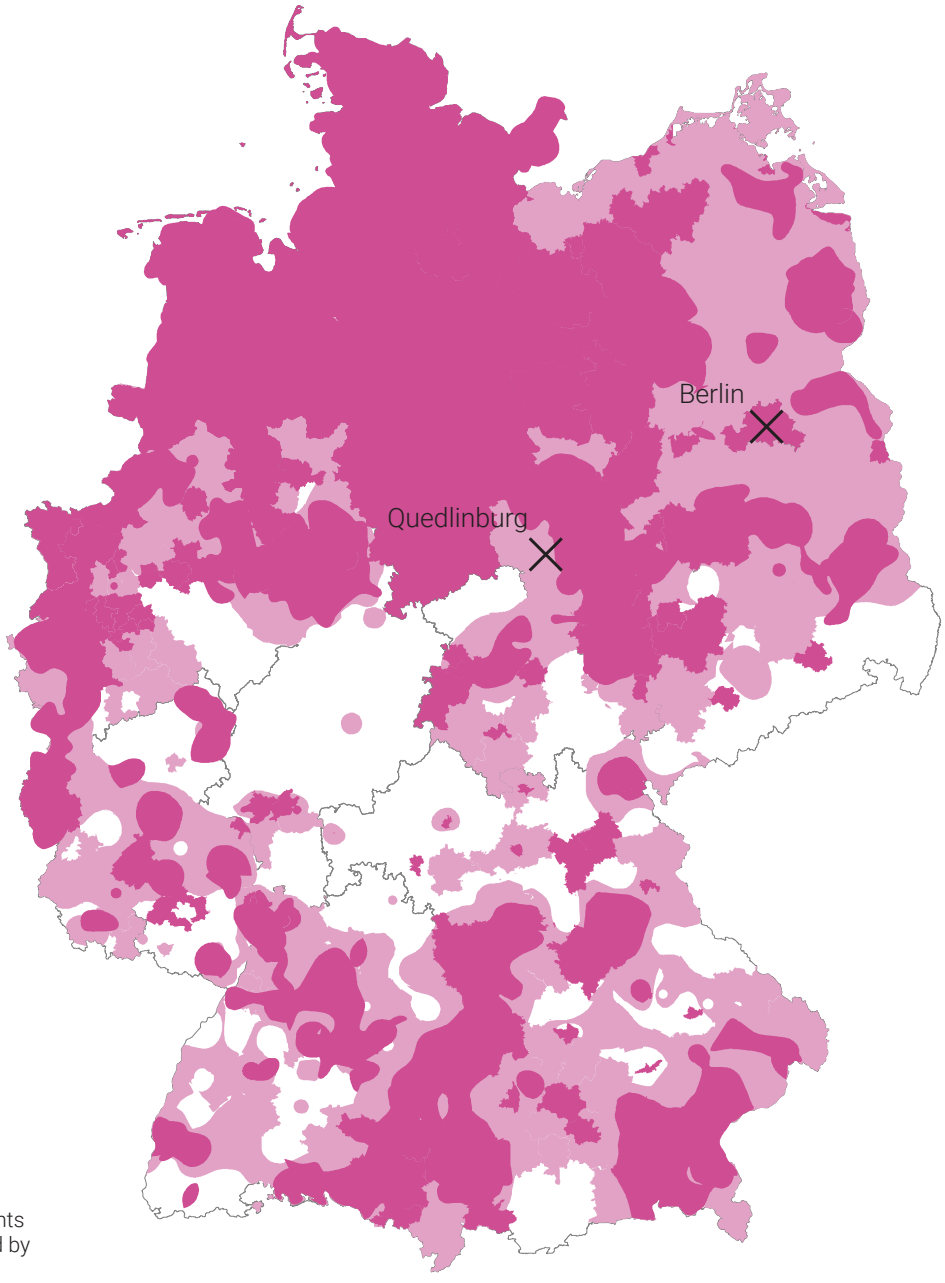
(European Landscape Convention 2000).

„Until 1700 landscape design, with notable exceptions, was predominantly metaphysical; after that date intellectual man finally displaced intuitive man, and landscape - again with notable exceptions - became realistic and wordly."

(Jellicoe & Jellicoe 2011)

Over the past 20 years, energy evolution has been one of the major influences on the landscape. Solar panels, wind farms, biogas and biomass plants are growing and taking over more and more territory (Backhaus et al. 2015). It is possible that since 1900 mankind has used more energy than in its entire history (McNeill 2003).

It is not known exactly how much human evolution negatively affects global climate change, but it certainly does. With intelligent planning and the application of various measures, it is possible to slow down the negative human impact on the environment.



Pic. 1 Changing the landscape in Germany since 1996 by creating plants for renewable energy production and by the land use changes.

01.2 EXAMPLES OF NATURE-FOCUSED PROPOSLAS

The development and prosperity of cities is inextricably linked to water. Trade, transport and industry were based on river transport routes and rivers were an important source of food for the people who lived on the banks (Prominski et al. 2017). Water acts as a regulator of temperature and humidity (Salzmann 2019).

More and more countries, cities and towns all over the world are realizing the importance of water and vegetation in cities and are working to renew and give back to these components.

Here are a few examples of nature-focused urban projects.

Name: Ulsteraue Geisa
Location: Geisa, Germany
Authors: Blaurock Landschaftsarchitektur, Storch Landschaftsarchitektur

The Ulster River floodplain east of the historic old town of Geisa has been revitalized. An unused area of the town has been transformed into an open and recreational space with high biodiversity. The result is a unique landscape with meandering parts of the river and gravel islands. There are beautiful playgrounds with lots of littoral vegetation, which serves as a refuge for local fauna (Bernsee et al. 2021).

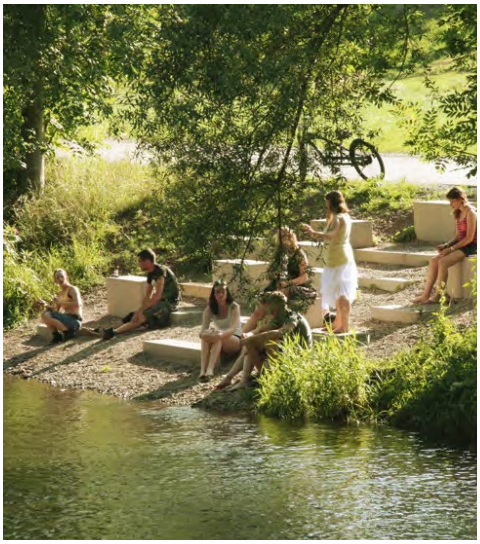
It is a project of natural charcter with small architectural forms made of natural materials which are linked to the surrounding area.

Name: Tanner Springs Park
Location: Portland, USA
Authors: Atelier Dreiseitl, Greenworks PC

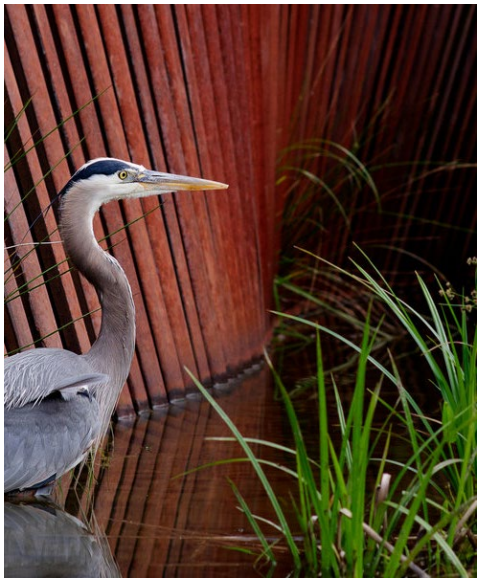
Atelier Dreiseitl designed a new green space in Portland's previously industrial area. The maximum amount of water drains into the park from buildings and adjacent surfaces. In the past there was a wetland and now it is a green space with its own special flora and fauna inside the urban development (Dreiseitl & Grau 2005).

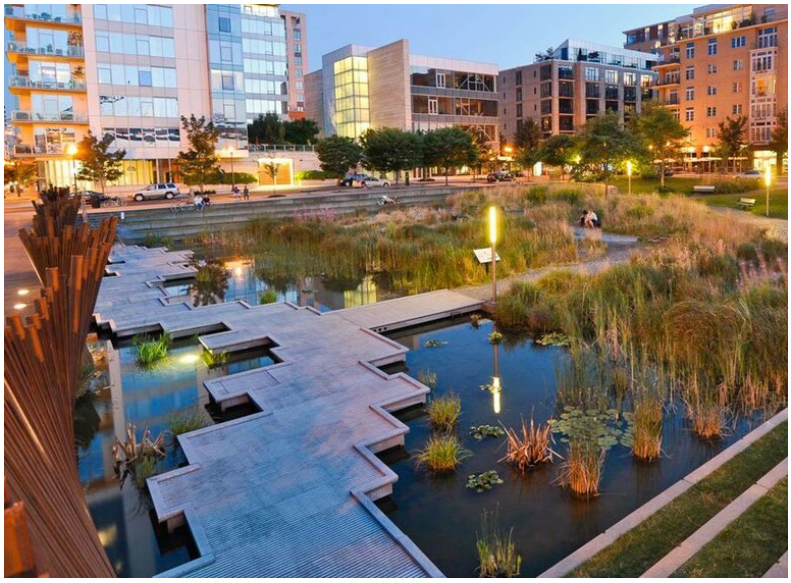
The park is a combination of more durable materials with a natural layer, because of the increased attendance at the park.

Pic. 2,3 Revitalisation of the Ulster river.



Pic. 4 Detail of the art wall.
Pic. 5 A general view of the Tanner Springs Park.





Name: Neptunigatan street
Location: Malmö, Sweden
Author: Edge

The formerly dead-end street has been transformed into a generous multifunctional urban space that efficiently manages stormwater. Flower beds slow, retain and clean stormwater that runs off the surrounding areas. A large number of plantings increase the biodiversity of the urban flora and create a pleasant microclimate (Edge 2019).

This is an example of a technical design solution that has a clear function of retention, soaking and reusing rainwater.

Name: Grey to Green
Location: Sheffield, UK
Authors: Nigel Dunnett, Zac Tudor, Sheffield City Council with Robert Bray Associates

The Grey to Green is the largest UK´s inner city green street. This is a long-term project that began in 2014. One of the main functions is to reduce and slow down surface water runoff. It is a multi-functional project, aiming to increase urban biodiversity and create a wildlife corridor, protect pedestrians from air pollution though multi-layered planting, achieve urban cooling through increased tree planting, treat contaminated water and promoting health and wellbeing. New offices and residential developments have taken place here. There is an improved likelihood for new sites coming forward for development too. The food and drink offer in the area has also increased (Grey to Green – Sheffield 2022; Nigel Dunnett 2020).

Pic. 6 The rain garden collects water from the surroundings. The excess is regulated and discharged into the storm drain.
Pic. 7 Vegetation fragment.

Pic. 8 Site before the grey to green transformation.
Pic. 9 Site after transofrmation. Water from adjacent surfaces is drained to the rain gardens and bioswales.

01.3 LOW-IMPACT DEVELOPMENT (LID)

Low-impact development (LID) is a complex of a soft engennering solutions based on a ecological principles of stormwater mangement. Classic water infrastructure redirects stormwater through pipes and canals to stormwater harvesting areas. With some LID solutions stormwater can be cleaned and retained right at the place where it accumulates. LID solutions are based on the infiltrate, filter, store, and evaporate stormwater that accumulates from adjacent areas (Luoni et al. 2010).

Stormwater management must be cost-effective, sustainable, and environmentally friendly. When stormwater management components uses, it can bring a number of benefits: reduction of pollutants, beneficial effects on microclimate, increased biodiversity and aesthetic function of the site (Obropta 2015).

Green infrastructure uses vegetation, permeable layers and surfaces to intercept stormwater before it enters the sewer system. Stormwater management reduces the load on the wastewater system by reducing the amount of polluted stormwater entering streams and reducing the number and volume of sewer overflows (Carlson et al. 2014).

The following are examples of stormwater management.

Retention ponds

This is an object that can retain large amounts of stormwater from adjacent surfaces. Water is gradually absorbed, so it is important that the retention pond has good water absorption characteristics. The depth is approximately 0,3 m to 2 m (Sýkorová et al. 2022).

Rain gardens and bioswales

Technically, a bioretention is a planted depression that retains water from adjacent surfaces (Dunnett & Clayde 2007). Concave area is about 20 to 30 cm deep and it is a retention area. To prevent flooding, stormwater can flow into the open subbase layer via a control pit (Fridell 2020). There are different approaches to implementing rain gardens. The technology is constantly evolving and the layers that make up the structure are improving.

Permeable surfaces

Gravel and vegetated systems are more permeable than other surfaces in the urban space, but the range of use of these surfaces is limited and maintenance is expensive. Permeable paving allows water to flow through it and removes sediment and other pollutants. It also reduces the flow and distributes rainwater (Luoni et al. 2010; Sýkorová et al. 2022).

Rainwater harvesting and reuse

Rainwater harvesting involves collection, storage, and reuse of runoff from roofs and from adjacent surfaces. With the help of accumulation tanks it is possible to reduce runoff volume and peak flows (Luoni et al. 2010).

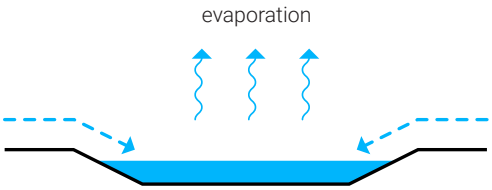
Green roofs

The forerunners of modern green roofs are Scandinavia´s earth and green roofs. Now green roofs are important part of sustainable buildings. A well-designed green roof improve roof protection and building insulation, the microclimate also improves. The choice of plants depends on the type of green roof. An extensive roofs have a substrate thickness of 5-15 cm for very robust and stress-resistant plants. Intensive roofs have a substrate thickness of 15-150 cm, on which even shrubs and trees can be planted (Zimmermann 2015).

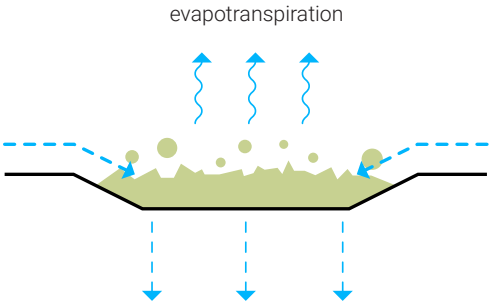
These are the main types of soft engeneering solutions for stormwater management. Numerous site data are required for the application of specific types. In conjunction with engineering and other soft engeneering approaches (founding of gravel paths, permeable paths, grass pavement, lawns, planting beds, artificial wetlands and planting shrubs and trees) the above discussed solutions will improve the overall microclimate of the site, increase biodiversity, and make stormwater collection into the sewer system much easier.

Pic. 10 Soft engeneering solutions for stormwater management.

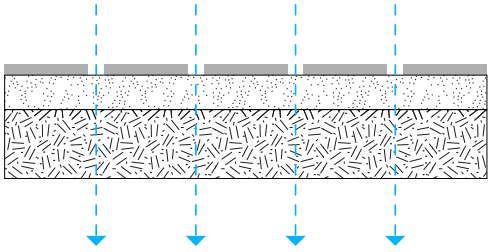
Retention ponds



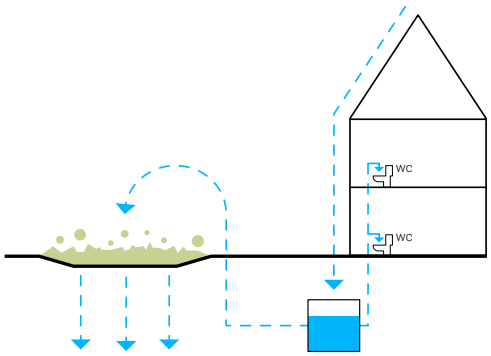
Rain gardens and bioswales



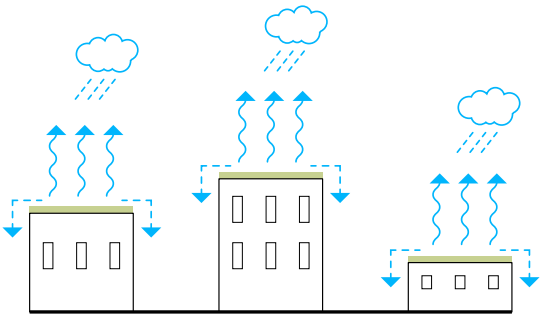
Permeable surfaces



Stormwater harvesting and reuse



Green roofs



01.4 HISTORY OF QUEDLINBURG

The first traces of settlements were noticed already in the Paleolithic era. The area was continuously inhabited and was interesting for settlers because of its fertile soil. This is evidenced by the 55 remains of settlements in and around the town (Rienäcker 1978).

Quedlinburg gained importance when it became the royal palace in the 10th century, where the Ottonian rulers celebrated Easter. It was first mentioned as a town in a document of King Henry the Fowler (Henry I.) dated April 22, 922 (Sickel 1879).

The Quedlinburg castle complex, founded by King Henry I and built up by Emperor Otto I in 936. In 994, Otto III granted the right of market, tax, and coining, and established the first market place to the north of the castle hill (Seggern 2018). In 1326, the town joined forces with Halberstadt and Aschersleben to form the Halberstadt Triple City Alliance, which lasted for 150 years. Quedlinburg prospered economically for the next four centuries. The tailoring and merchant trades were particularly intensive. The town became a member of the Hanseatic League in 1426. The abbey of Quedlinburg often challenged the independence of the town with the help of the bishopric of Halberstadt. In 1477 there was a rebellion in the town, but Abbess Hedwig, supported by her brothers Ernest and Albert, broke the resistance. Roland, who was a symbol of the town's independence and market freedom was overthrown and defeated (Feicke 2011). The citizens then submitted and withdrew from all alliances. In 1869, fragments of the statue of Roland were installed in front of Town hall (Richter 2019).

The greatest urban development of the town took place after the Thirty Years' War. Most of the preserved half-timbered houses were built during this period. Two town fires devastated large parts of the town in 1676 and 1797 (Wozniak 2011). In the 19th century, the city began to develop significantly as a result of the seeds and plants trade. This was reflected in town planning, with the appearance of several Art Nouveau villas.

The devastating Bode flood of 1926 destroyed all bridges and paralyzed the infrastructure. Subsequent floods repeatedly interfered with reconstruction works (Magistrat der Stadt Quedlinburg 1926).

Many historic old towns fell victim to redevelopment in the 1960s and 1970s. In Quedlinburg the historic heritage was largely preserved, but due to a lack of money and materials the threat of neglect and insufficient maintenance of the buildings was acutely felt. From the beginning of 1990, the town gradually began to be restored (Schlegel 2020).

The castle, church and old town, were added to the UNESCO World Heritage List in 1994 because of their exceptional preservation and outstanding Romanesque architecture (UNESCO 1994).

Without all the events that took place here, the old town might have looked different. Historical events have shaped the current appearance of the old town. The architecture of the Quedlinburg is masterfully restored and allows visitors to see how things looked centuries ago. It is one of the most distinguished examples of 1,000 years of settlement development in Europe.

Pic. 11 Quedlinburg 1647 by Matthäus Merian (1647).
pic. 12. Seal of Henry I.
pic. 13. Quedlinburg by Georg Braun and Frans Hogenberg (1581-88).
pic. 14. Castle and castle church (postcard).
pic. 15. Quedlinburg postcard.
pic. 16. Flower growing in Quedlinburg.
pic. 17. The flood disaster in Quedlinburg 30/31.12.1925.

922
First written mention of Quedlinburg as a town was in a document of King Henry the Fowler.

Pic. 12

1000
Emergence of the old town.


Pic. 13


Pic. 14


Pic. 15

17th century
Most of the preserved half-timbered houses were built during Thirty Years' War.

19th century
Plant breeding and seed propagation.


Pic. 16

1926
The devastating Bode flood destroyed all bridges and paralyzed the infrastructure.

Pic. 17

1994
The castle, church and old town, were added to the UNESCO World Heritage List.

The historical map of 1782 (Pic. 20) shows the various urban structures that have taken place in the past. For example, there was a green belt on the site of today's Wallstraße in the western part of the area concerned. This data was reflected in our design and helped us to create an overall landscape concept of the old town.

In 2011 a competition was held for the new look of Marktplatz in Quedlinburg. The competition was won by the WES LandschaftsArchitektur office (Pic. 18). Then the winning project was implemented.

Drainage canals now runs through the historic core (Pic.19), and they resemble the canals that ran through the square in a north-south direction before 1840 (Pic. 20) (WES LandschaftsArchitektur 2013).

It is also important to note that since the time of Charlemagne (768-814) the areas around Schlossberg have been used for horticulture. Quedlinburg was a world-famous flower city until World War II, when plant and seed production declined (Information board at the entrance to Wordgarten, December 2022).

Pic. 18 The winning Marktplatz design by WES LandschaftsArchitektur.
Pic. 19 Marktplatz, current state.

Pic. 20 Quedlinburg 1782 by C. C. Voigt.

02

ANALYTICAL PART

02.1 BASIC INFORMATION AND LOCATION OF QUEDLINBUG

UNESCO World Heritage Town of Quedlinburg is located about 10 km from the northern edge of the Harz Mountains in the valley of the Bode River at an average altitude of 123 m above sea level. The Harz ridge and the Brocken are about 30 and 60 km away respectively (Octagon Architekturkollektiv 2021).

Quedlinburg belongs geologically to the northern foothills of the Harz. The natural environment is characterized by mountain ranges that are covered by forests and wide plains between them with fertile, loess-covered soils (Littke et al. 2008; McCann 2008). The area around the town has a pronounced agricultural character. Administratively, the town is a part of the Harz region (Octagon Architekturkollektiv 2021).

The B6 federal highway runs along Quedlinburg, connecting Wernigerode (about 30 km), Goslar (about 55 km) and Brauschweig (about 85 km) to the west and Aschersleben (about 25 km) and the A14 to Halle (about 90 km) and Magdeburg (about 85 km) to the east (Octagon Architekturkollektiv 2021).

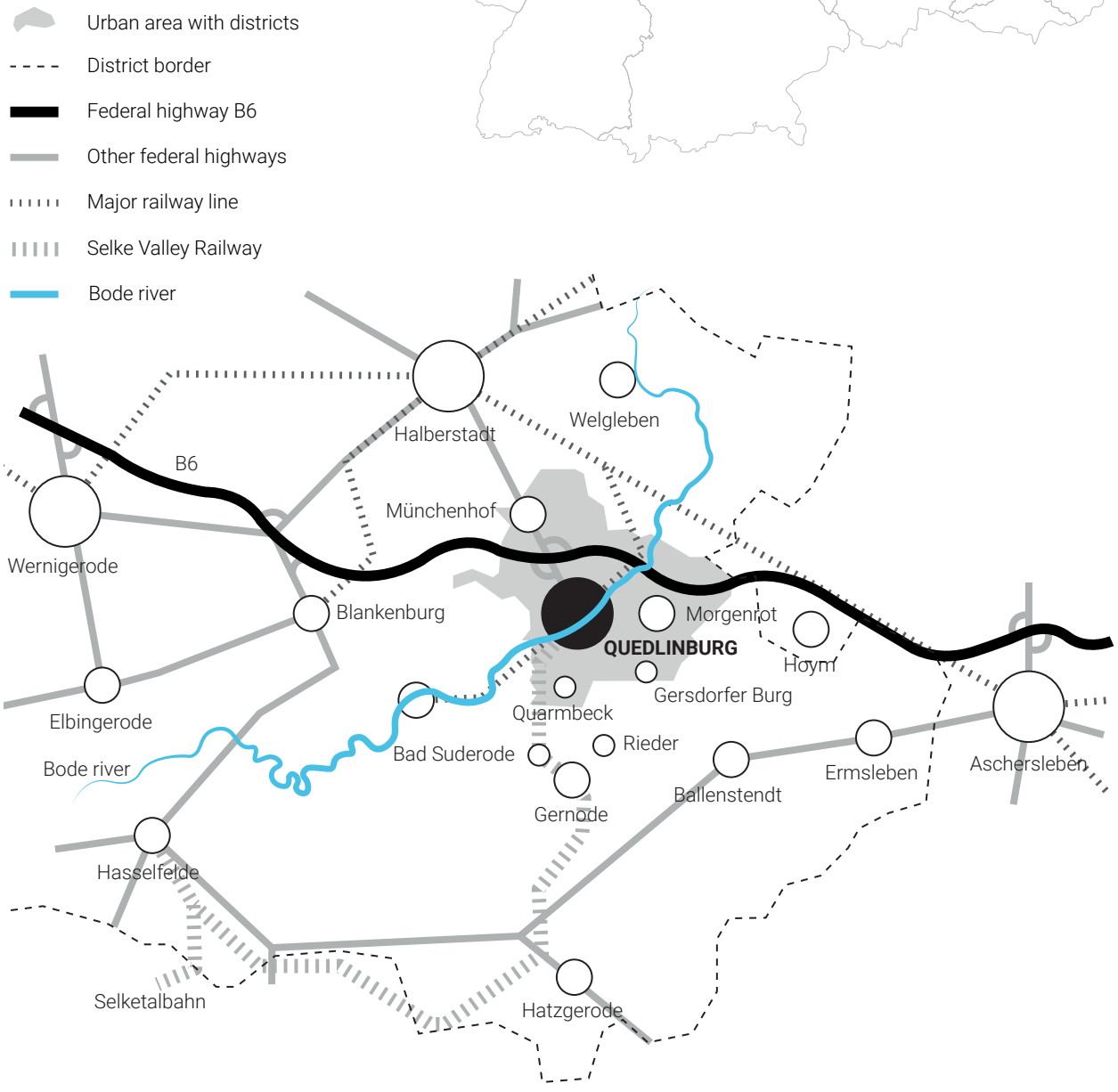
Harz-Berlin-Express, a direct connection to Berlin is offered occasionally at weekends. Quedlinburg is the connection point for the Harz narrow-gauge railway to the Brocken. The surrounding towns are also connected by a regional bus network that links Quedlinburg with Aschersleben, Wernigerode and Halberstadt as the next largest towns (Octagon Architekturkollektiv 2021).

Several bicycle and pedestrian paths run through Quedlinburg. „Aller-Harz-Radweg“ touches the southern core of the town, and the „Europaradweg 1“ runs from the center through the southern part of the town around the villages of Bad Suderode and Gernrode. The „St. Jakobus Pilgerweg“ runs through the old town as a supra-regional hiking trail. „The Romanesque road“ as part of the international „Transromanica“ leads as a tourist route along the four central stations (Rittmannsperger + Partner 2013; Octagon Architekturkollektiv 2021).

Country: Germany
State: Sachsen-Anhalt
Population: 25,463 inhabitants (31.12.2013)
Population density: 211 inhabitants/km²
Urban area: 120.41 km²
Unemployment rate: 9.0 % (June 2014)
(Stadt Quedlinburg 2013).

Pic. 21 Coat of arms and Roland in Quedlinburg.

Pic. 22 Quedlinburg location.
Pic. 23 Wider relations.



02.2 NATURE, ENVIRONMENT AND CLIMATE

Geology and climate

Quedlinburg belongs geologically to the northern Harz foreland. And it is characterised by the parallel, forested mountain ranges of Huy, Hakel and Fallstein and the wide plains in between, with fertile, loess-covered soils (Patzelt 2003; ARGE Westermann & Wallraf 2012).

The Harz is one of the most water-rich regions in Germany. However, Quedlinburg receives little rainfall because the town is located in the rain shadow of a low mountain range. At the same time, Quedlinburg lies in the „Foehn zone". Foehn wind is a dry, warm, downslope wind that occurs in the lee (downwind side) of a mountain range (Hess & Tasa 2016). There is also a large number of sunny hours and a small number of foggy days (ARGE Westermann & Wallraf 2012).

Despite Quedlinburg being in a rain shadow, there are heavy rainfall events that cause significant problems for the town's stormwater management.

The climatically favorable location and high quality soils have contributed to the historic prosperity of Quedlinburg.

Protected areas

Quedlinburg is located in the Harz National Park, where environmentally sound land use and strengthening the recreational function are priorities.

There are several nature reserves in the Quedlinburg area (Pic. 28):

1 - Heidberg
The nature reserve. It protects a predominantly warm, dry location on gently sloping slopes.

2 - Harslebener Berge und Steinholz
The nature reserve. It protects a dry forest area and dry, semi-dry and nutrient-poor grassland.

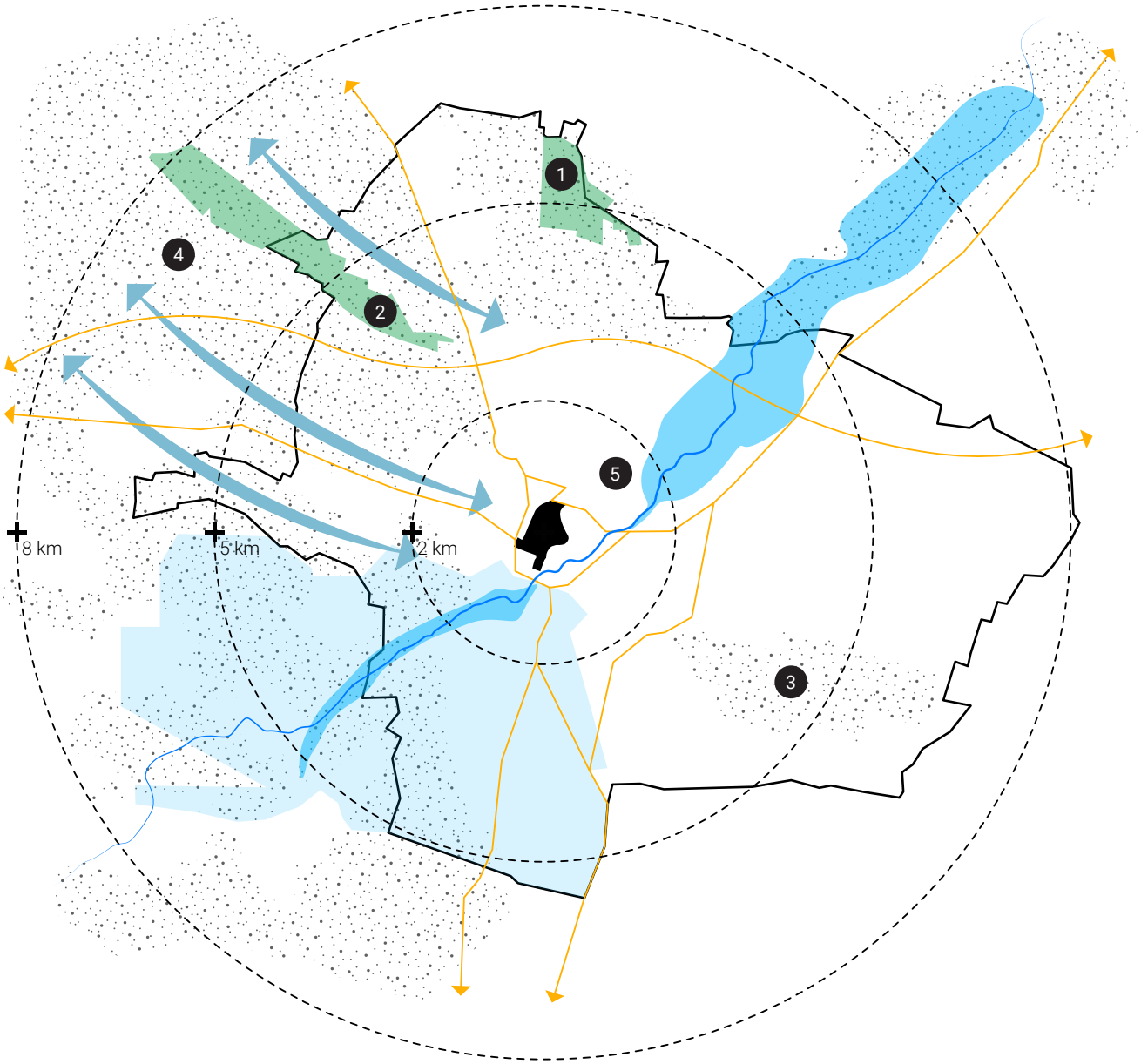
3 - Seweckenberge
It is a range of hills that reach a height of 180 metres.

4 - Harz and northern Harz foreland
River valleys, extensive farmland and mountain ranges characterize the gently undulating landscape in the northern Harz foothills.

5 - Bode and Selke in the Harz foreland
This area includes the course of the Selke from the edge of the Harz Mountains to its confluence with the Bode near Rodersdorf and the course of the Bode via Thale, Quedlinburg and Oschersleben to Stassfurt.

Other protected areas include:
- 17 existing and 18 planned sites with protected natural monuments;
- 15 area natural monuments as well as 4 temporarily secured ones;
- protected park (Brühl);
- all hedges, alleys and groves in the outer area are protected landscape features;
- the bat roost Stollen Altenburg;
- 77 biotopes.
(ARGE Westermann & Wallraf 2012).

pic. 24 Steinholz south side.
pic. 25 Teufelsmauer (Harz foreland).



Focus area (43,65 ha)

Municipality border

Main road

Landscape conservation areas

Nature reserves

Bode river

Flooded areas

Water conservation areas

Fresh air pathways

Pic. 26 Protected areas map.

02.3 URBAN STRUCTURE AND FOCUS AREA

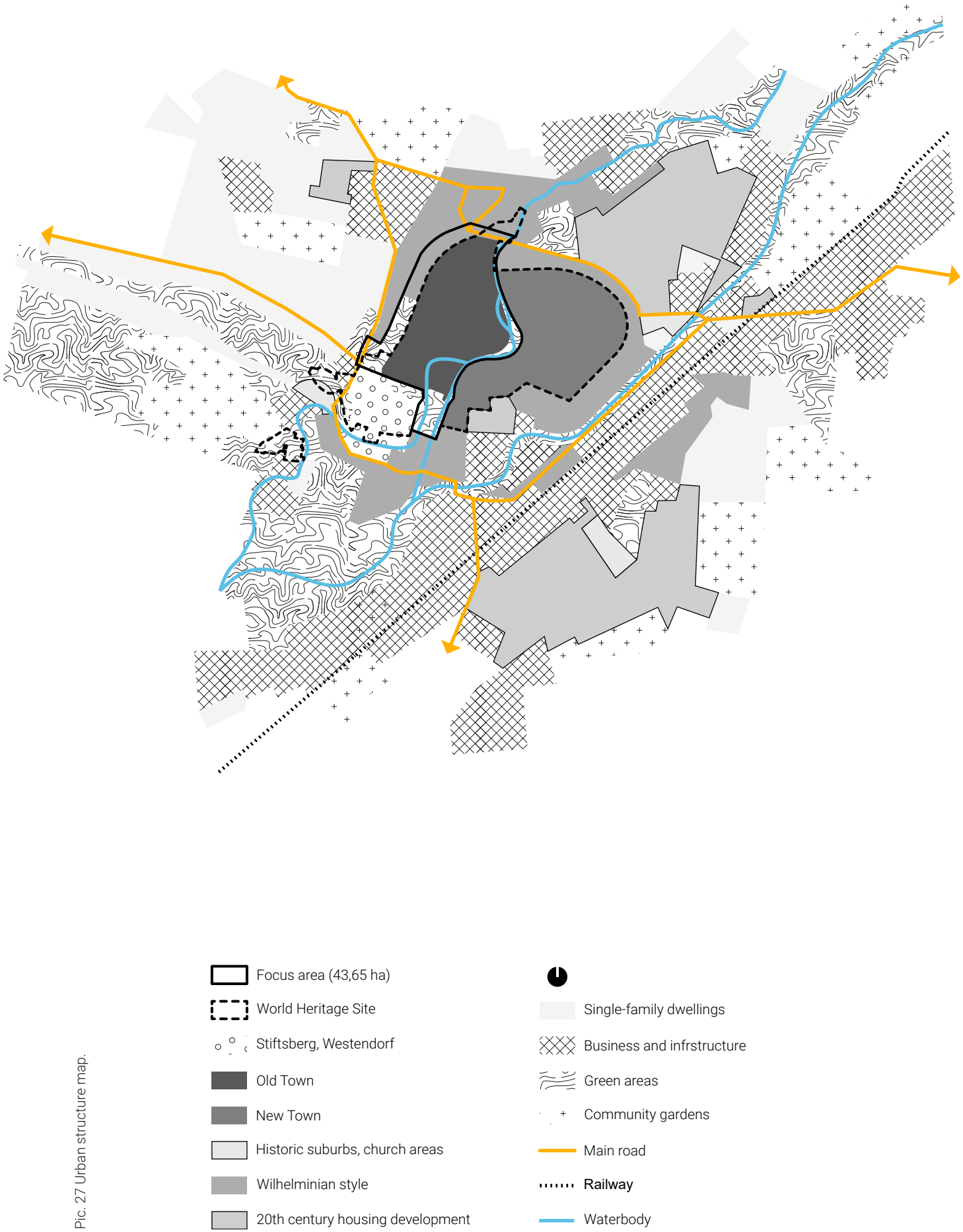
According to Jane Jacobs (1993) there are two kinds of ecosystems in a city: natural and man-made. These ecosystems need a lot of diversity to exist. Any small components can be of great importance to the whole. In natural ecosystems, gene pools have a fundamental value, and in urban ecosystems, types of labor have a fundamental value. Both types of ecosystems are fragile and vulnerable, easily damaged and destroyed (Jacobs 1993).

The old town of Quedlinburg has preserved one very important component. It is the human scale, which all over the world has been neglected and unappreciated by modernist architects. The presence of human scale is essential to a liveable, safe, sustainable, and healthy city (Gehl 2010).

The core of the Quedlinburg has a compact structure. The historic part of the inner town is divided into the old town and the new town. In the course of industrialization, a Wilhelminian-style belt was built around the medieval center of the city. There are also plots around the city that are used for gardening. Trade and services are concentrated in the historic part of the town and on the main access roads to it. Larger commercial and industrial areas are located along the railway (ARGE Westermann & Wallraf 2012).

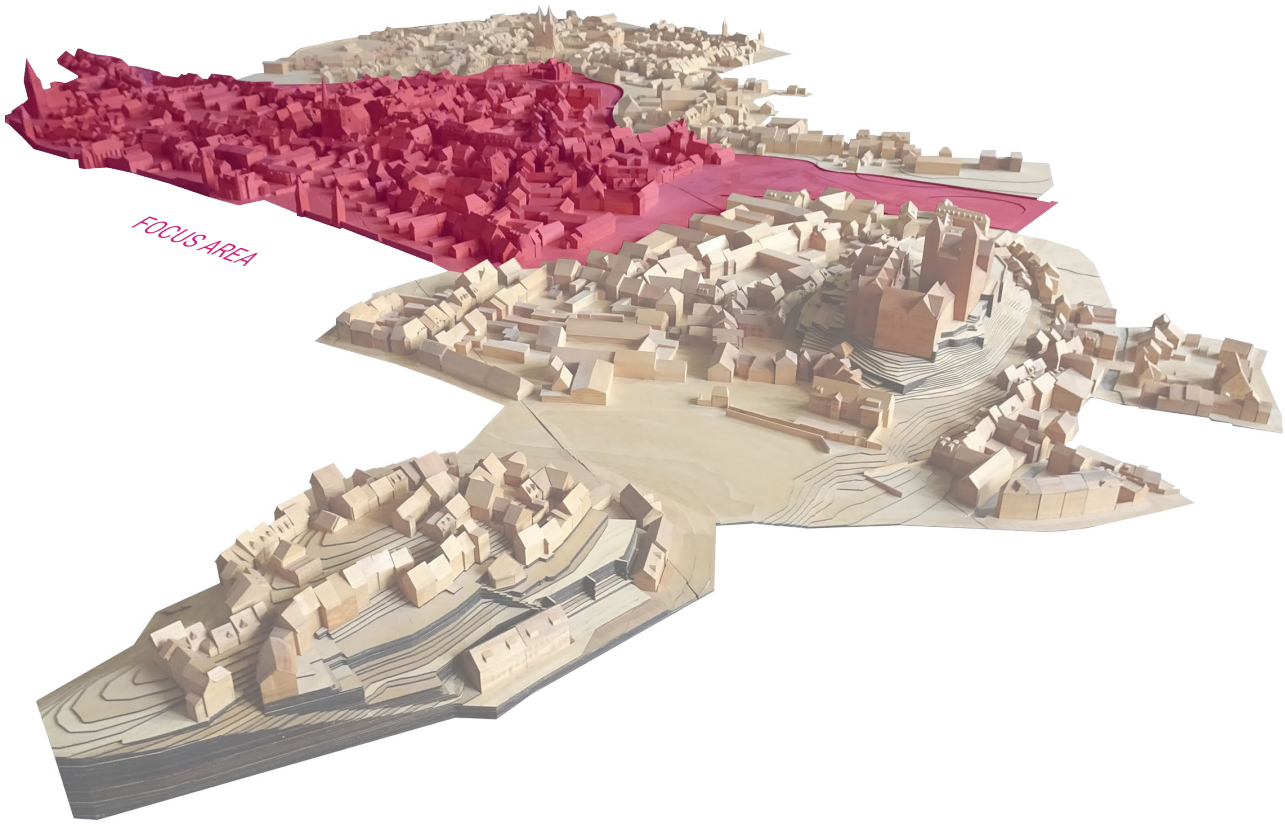
Since Quedlinburg is a half-timbered town, it is important to note that the building environment was centered on the cultivation, extraction and transportation of wood. In the Harz region, spruce dominated as wood (about 100% around 1200 year; about 75% around 1800 year) (Rittmannsperger + Partner 2013).

The focus area was selected on the basis that the historic core is Quedlinburg's most visited site. The number of visitors is growing and it is only necessary to adapt the old town to this. There is dense development and little green space in the area. This is currently causing some problems. During heavy rains the sewer system cannot handle all the stormwater. It is a challenge in such an important historic town to design some measures that will make the work of the sewage system easier and at the same time provide a pleasant place to live in.



Pic. 27 Urban structure map.

Pic. 28 Aerial map and focus area (43,65 ha).



Pic. 29 Focus area on the model of the old town of Quedlinburg.

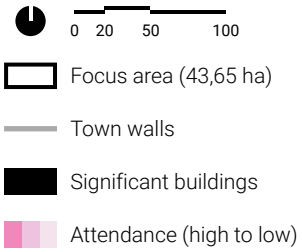
02.4 DOMINANT BUILDINGS AND LANDMARKS

Cities and towns are still the dominant landscapes in which people live. They are dynamic structures and can take many different forms (Dee 2001).

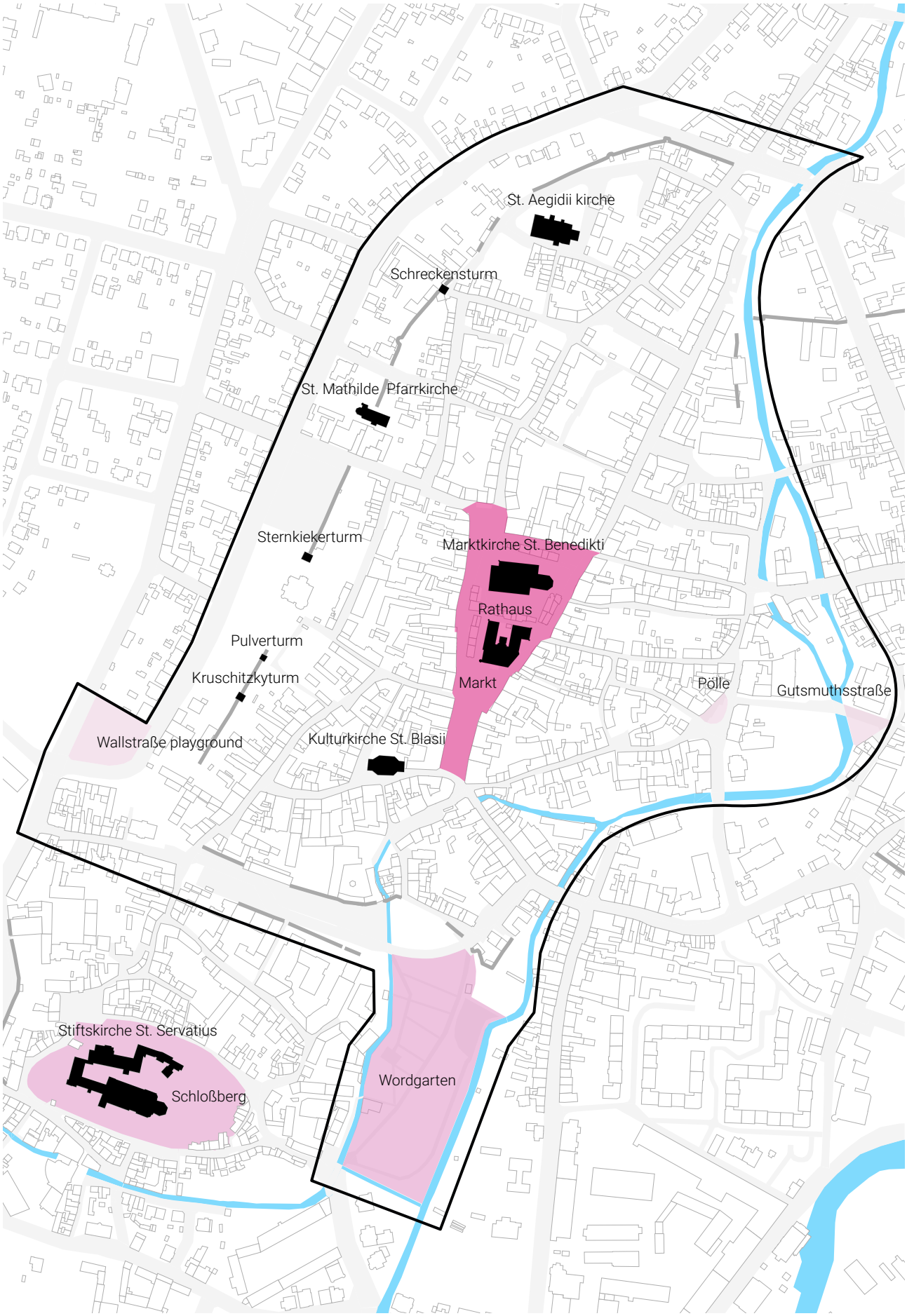
Man-made places are connected with nature in three ways. First, man wants to make nature's structure more precise. He wants to bring his understanding of nature to life. Secondly, man wants to supplement what is missing. Finally, he wants to symbolize his understanding of nature by transferring his experiential knowledge to another medium (Norberg-Schulz 1979).

The old town of Quedlinburg has a large number of dominants and landmarks that form the character of the landscape and become iconic for its image. For the picturescue character of the town are important Schloßberg with Stiftskirche St. Servatius, Nikolaikirche, Marktkirche St. Benedikti, Kulturkirche St. Blasii, St. Aegidii kirche, Schreckensturm, Sternkiekerturm, Pulverturm and Kruschitzkyturm.

The most visited places in the old town are Marktplatz, Stiftsberg and Wordgarten. The author came to these conclusions while walking through the old town.



Pic. 30 Panorama of the old town from Stiftsberg.



Pic. 31 Dominants and landmarks map.

02.5 THE OLD TOWN OF QUEDLINBURG

It is impossible to generalise about medieval cities form. Medieval towns have all shapes and sizes, settlements were large and small, bonded and free, chartered and unchartered, walled and unwalled, on hilltops and in valleys, some had space for gardens, others did not. Medieval city or town adapting themselves freely to every economic and geographical circumstance (Turner 2005).

Quedlinburg is a very good example of a central European town with an early medieval plan and many preserved individual buildings.The almost completely preserved townscape, the location in the landscape, the town silhouette, the large number of important timber-framing buildings on streets and squares underline the value of this exceptionally important cultural monument (Hanske et al. 2013).

In the old town there are protected romanesque, gothic, neo-gothic churches, medieval city fortifications, half-timbering buildings.

The streets of Quedlinburg are reminiscent of „The Shambles", one of the most famous medieval streets in York, UK, which is listed as an example of a medieval city in the book „Illustrated history of landscape design" (Boults & Sullivan 2010).

According to Bentley et al. (1985) the quality of towns permeability and the number of alternative ways through an environment is central for responsive places (Bentley et al. 1985). The old town of Quedlinburg absolutely meets these conditions.

Pic. 32 „The Shambles", York, UK.

Pic. 33 The streets of the old town.

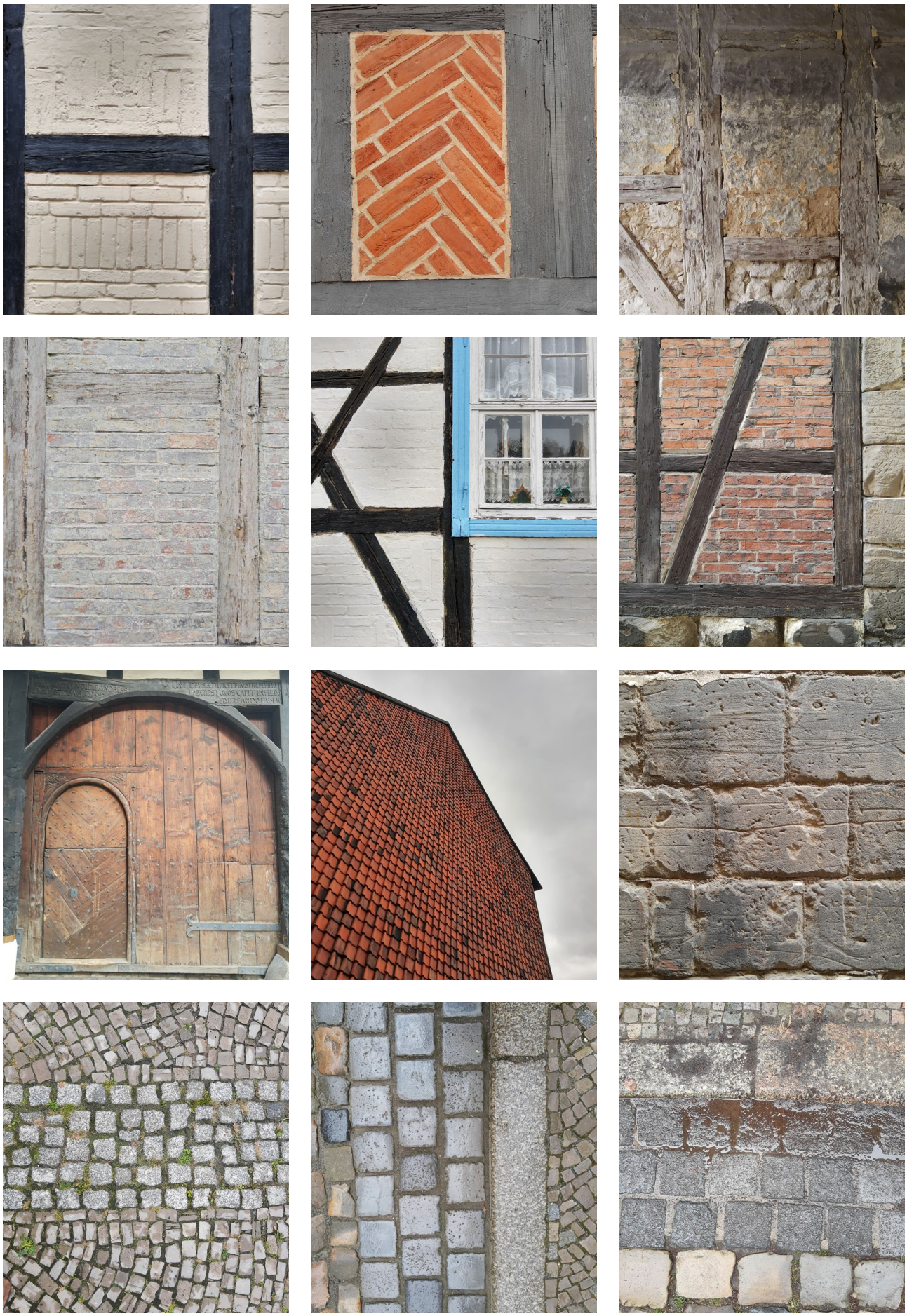
Materials can be seen, touched, smelled and even tasted. They are physical. They are available to our senses through perception (Yglesias 2014).

Peter Zumthor (2010) writes that materials can be poetic in the context of an architectural object, but only if they are used meaningfully, because the materials themselves are not poetic (Zumthor 2010).

In the old town of Quedlinburg everything is in its place no matter what time of year, time of day or weather. The architecture shows its beauty, detail and longevity. The old town is mostly pedestrian or mixed traffic and in some parts you can't hear the traffic at all. At this point the life of the historic core can be heard: the flow of streams, the creaking of shutters and doors, muffled voices. When it rains, the granite roads reflect the colourful half-timbered buildings.

"We perceive atmosphere through our emotional sensibility a form of perception that works incredibly quickly, and which we humans evidently need to help us survive."

(Zumthor 2006)



Pic. 34 Architectural details of the old town.

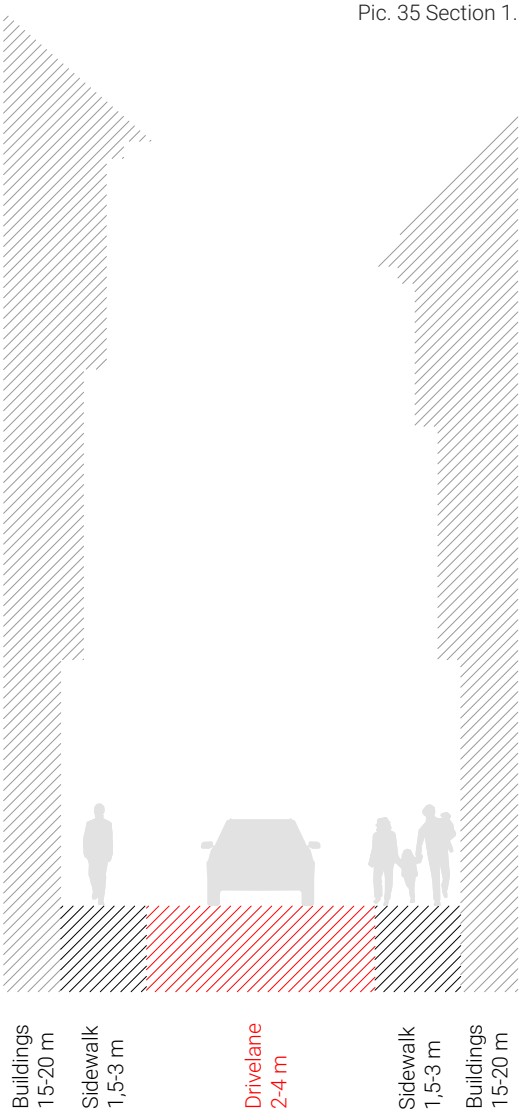
02.6 THE OLD TOWN STREETS

Quedlinburg has very dense development, so there is almost no vegetation in the open spaces of the historic core. Also on some streets there are large paved areas. From the sections we can see that the widest street in the target area is Wallstraße. Also the large paved parking area adjacent to the Wallstraße deserves further development. Some green spaces on the Carl-Ritter-Straße, Marschlinger Hof, Steinholzstraße, Grabengasse and GutsMuthsstraße could be expanded and more adaptable to stormwater management.

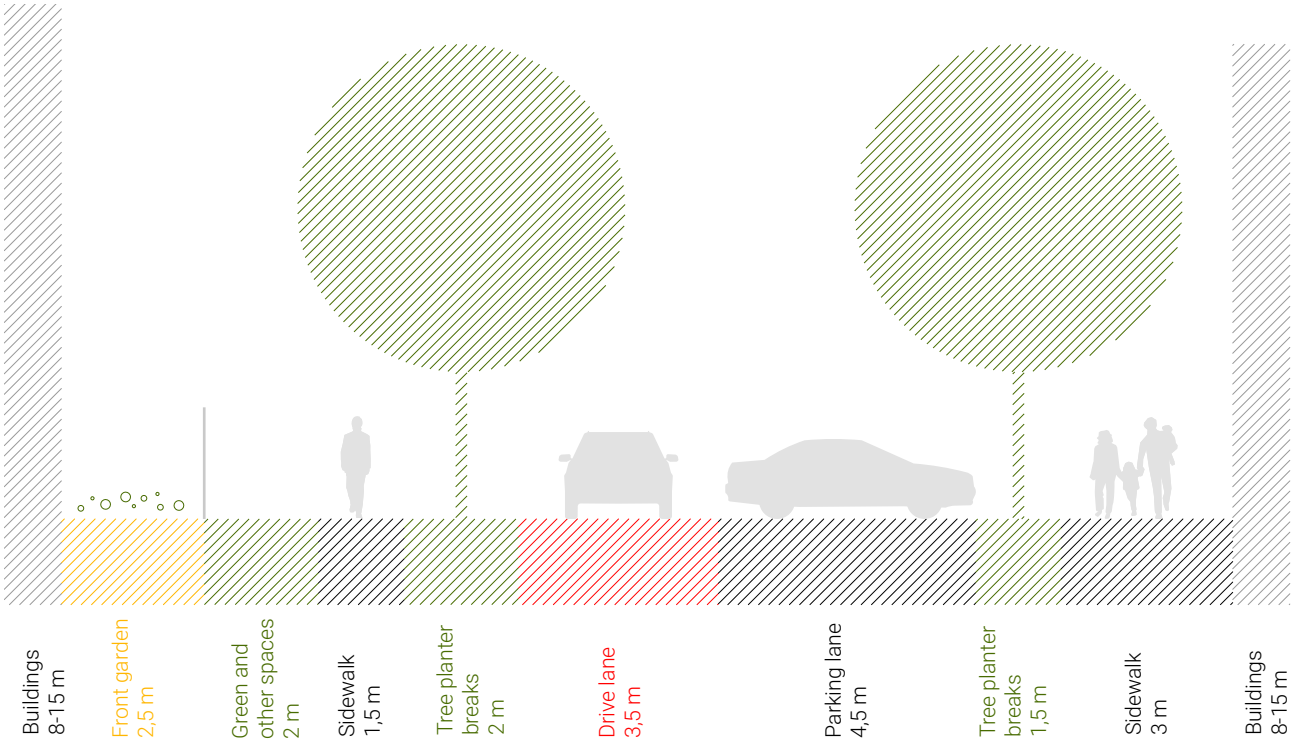
Only schematic sections with typical street dimensions inside the old town and on the outskirts are shown here.

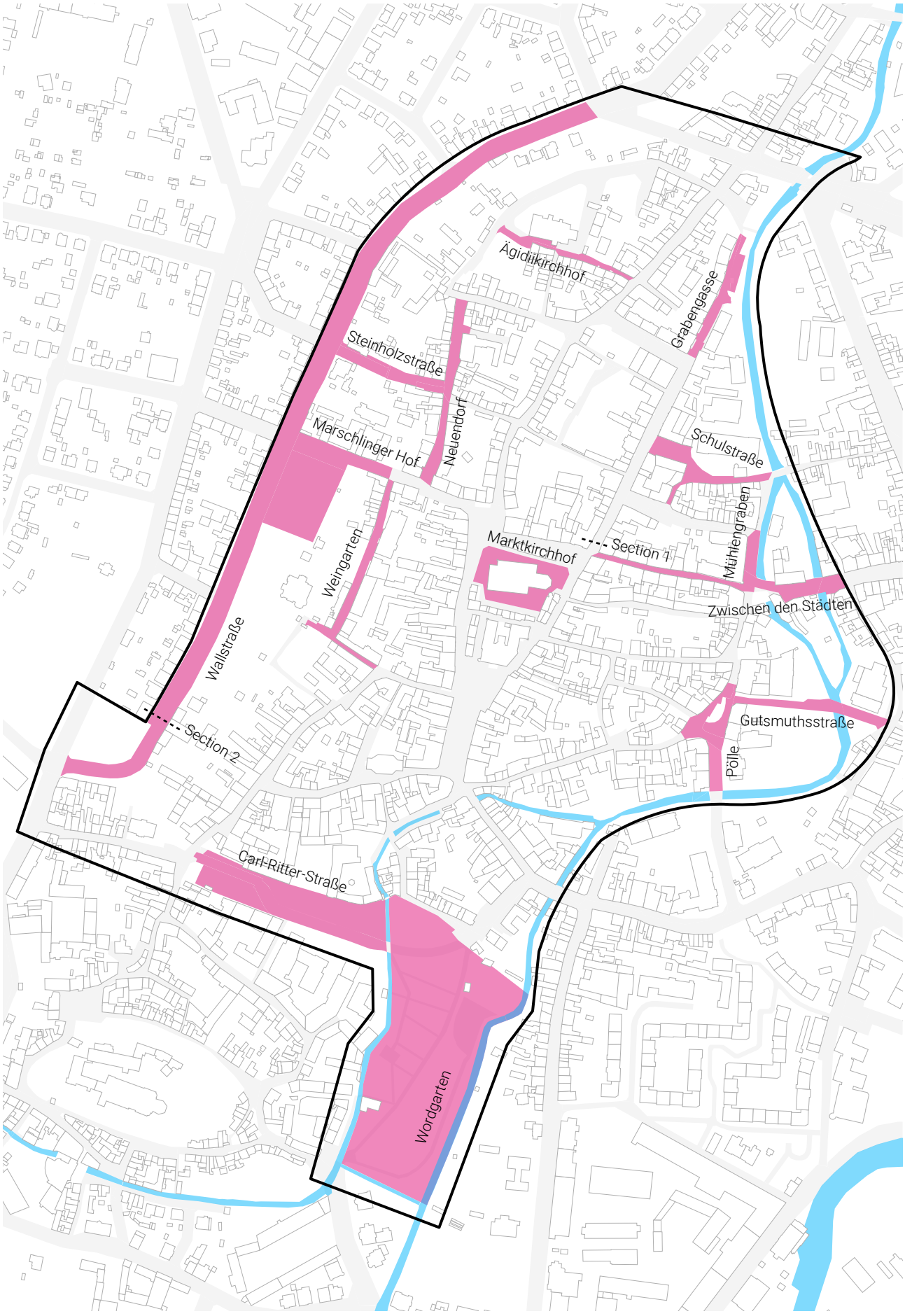
In summary, it can be said, that inside the old town drivelanes could be 2-4 meters wide, and the sidewalks 1,5-3 meters wide. Sometimes there are no sidewalks at all. On Wallstraße drivelane is approximately 8 meters with parking lots and sidewalks are 1,5 meters wide.

Pic. 35 Section 1.



Pic. 36 Section 2.





Pic. 37 Parts of streets with the potential to improve.

02.7 TRANSPORT AND ACCESSIBILITY

Creating space is natural for us, it's an important act of self-location (Loidl & Bernard 2014). A comfortable town with pleasant spaces and pedestrian streets is very desirable for visitors and also affects the economic component.

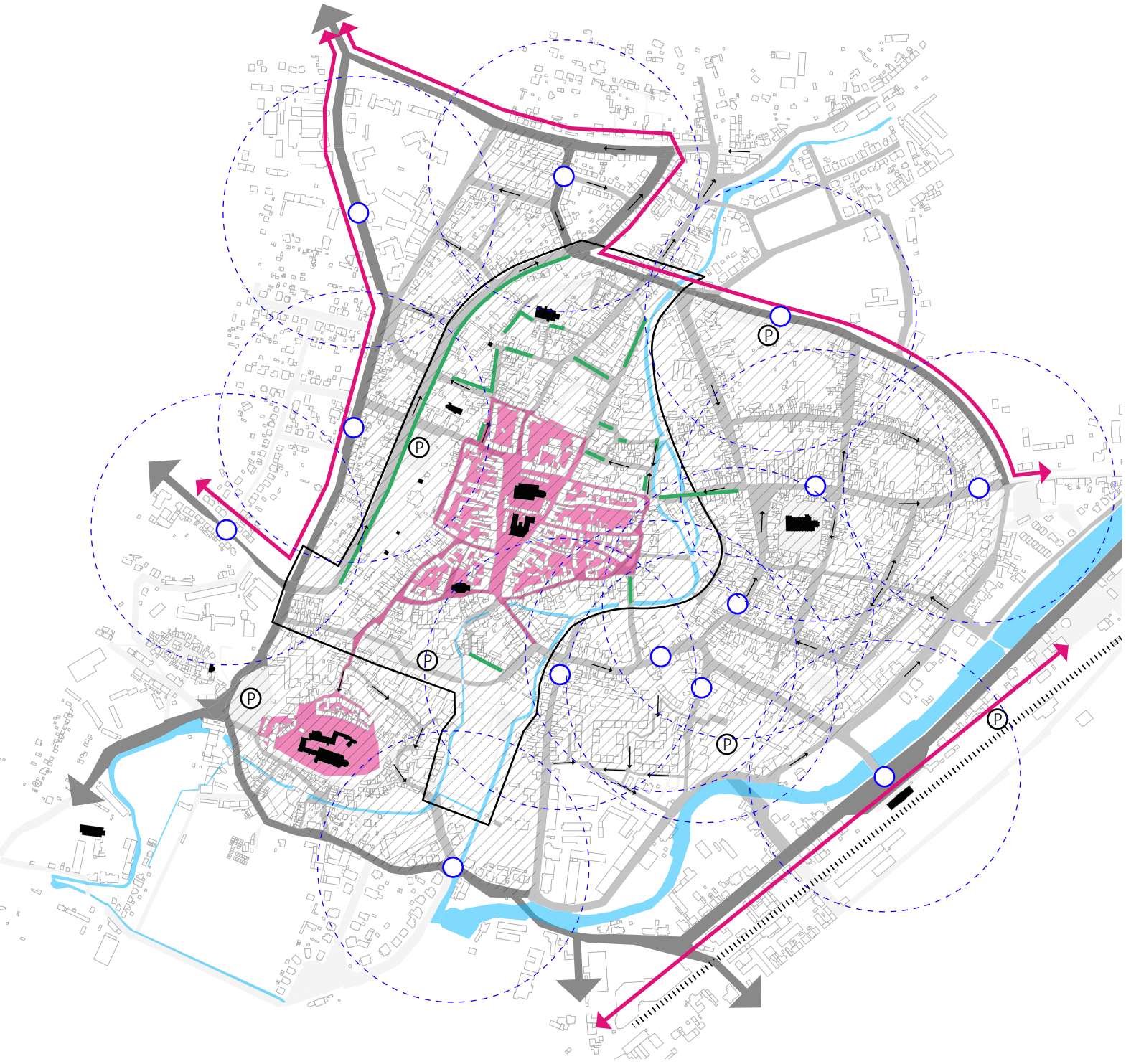
According to Speck (2013) the economic benefits that come with the well-being of walkable cities are determined by three factors. First, it makes city life more attractive to creative young people. Second, it increases the demand for goods and services. Third, residents savings can be spent locally (Speck 2013).

Currently in the old town of Quedlinburg there is a main ring for vehicular traffic with parking spaces for tourists, service personnel and local residents. A speed limit of 30 km/h applies here (Octagon Architekturkollektiv 2021).

It's worth noting that there are still plenty of parking areas in the old town. But there are also places, such as the public parking lots on Marschlinger Hof where it is possible to build a parking house.

In general, the historic core is well accessible to pedestrians. Marktkirchhof and Schloßberg are the main tourist spots are well connected and offer a pleasant walk through the narrow streets.

When the focus area was visited it was noticed that there were a lot of cars parked for long period along the roads. There are also parked cars in front of St. Benedict's Marktkirche. It is necessary to cultivate the trend of the city for people. Cars and people must not get in each other's way (Gehl 2010; Jacobs 1993). Walking around the city should be enjoyable for the visitor, and entry into historic spaces should be limited to the level of temporary parking. Of course, entry for service vehicles should be taken into account. Parking spaces can be created in a more natural way: permeable pavement, working with slopes for more sensitive water management, adding more trees and other vegetation structures etc.



Pic. 38 Transport and accessibility.

02.8 TOPOGRAPHY AND WATER

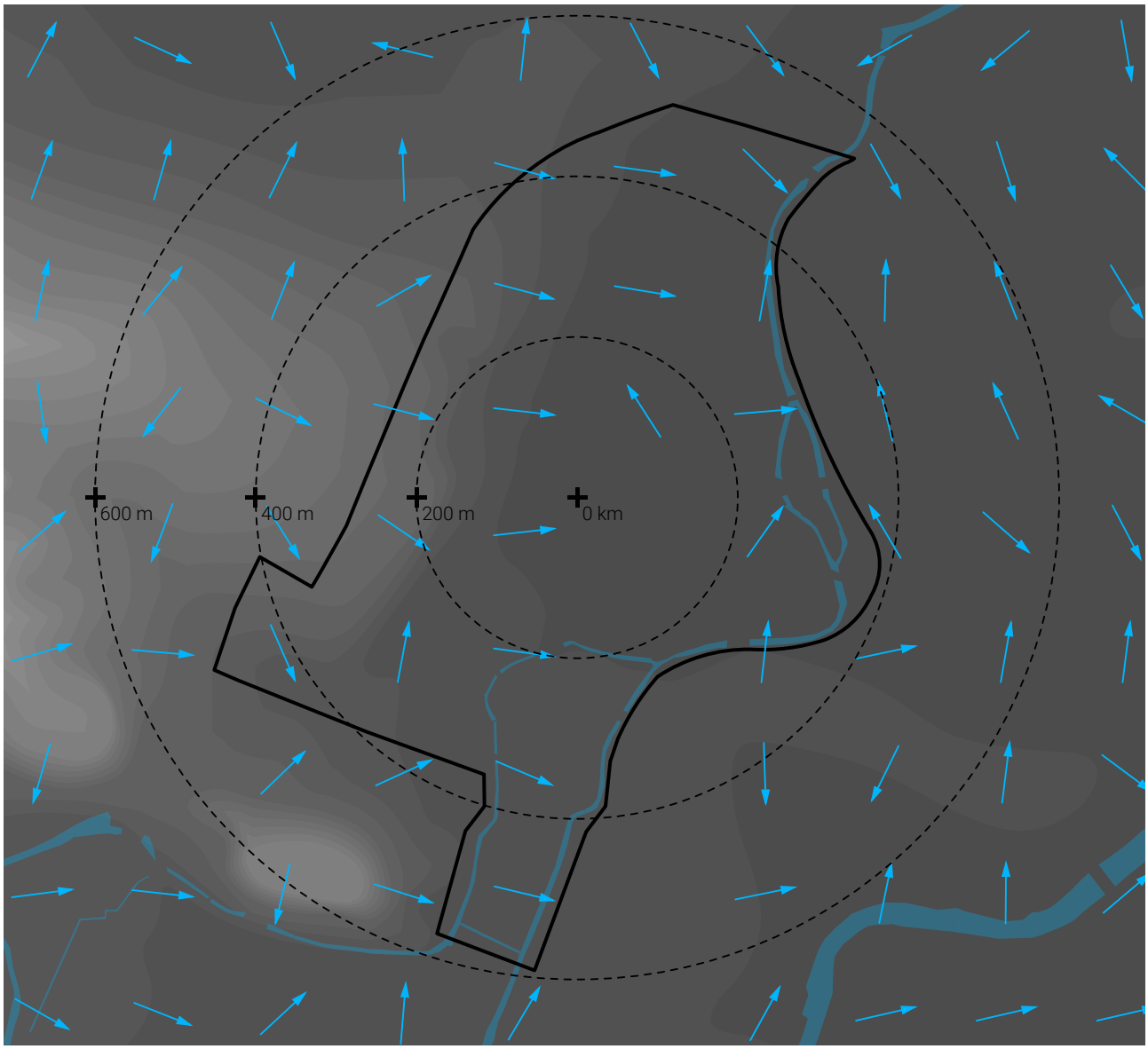
The importance of land can be gauged by the number of wars we do over it. From simple neighbor disputes to all-out war, control over land and redrawing borders have been the hallmark of the exercise of power throughout human history (Waterman 2015).

Each topographic form had its message. The mountains were forbidding, the rocky ravines dangerous, the broad valleys alluring (Simonds & Starke 2006).

Quedlinburg is located in the northeastern Harz foreland on the northern slope of the Harz. The ridges rising to the west of the Bode Valley have been favorable settlement sites since at least the Neolithic period.

Quedlinburg developed in the Middle Ages at an elevation of 125-130 m (old town) and 120-125 m above sea level (new town). According to regulation projects, the areas were gradually drained because of the frequently flooded floodplain of the Bode. The fertile black earth soils east of the town allow for highly productive farming (Rittmannsperger + Partner 2013).

The map shows that the terrain slope down to the east. After a rainfall, the water will flow through the old town center and drain into the Mühlgraben stream.



The map is based on current contour lines of the town. Water flow directions were generated in the Vectorworks software. It is only a simulation of the possible directions of water flowing through the terrain. Water running off the roofs is not reflected on this map.

Pic. 39 Topography and water flow directions map.

Focus area (43,65 ha)

Water flow directions

02.9 STORMWATER MANAGEMENT

Urban streams can receive water from the landscape in several ways. Untreated stormwater from sewers discharge by pipes and treated water from wastewater treatment plants. Water can also come from the groundwater after storms. Finally, water can either flow across the surface of soil. Overland flow is contaminated by industrial, agricultural or urban land use. Pollutants in the urban environment are hydrocarbons, heavy metals, phosphorus, nitrates (Austin 2014).

The engineering office for civil engineering Dipl.-Ing. Lars Deuter investigated the causes of the flooding in Quedlinburg and developed possible countermeasures.

The aim of the project was to create a hydraulic simulation model of the old town of Quedlinburg.

Flood model was based on rainfals which took place in Quedlinuurg. On 16.08.2015 there was 100-year rainfall event (51.4 mm in 45 min). Flooding of numerous streets and basements in the town center. On 02.06.2016 there was 2 times 5-year rainfall event (19.6/19.3 mm each 30 min consecutively). This caused some streets in the city center and the Mühlgraben stream to flood. On 22.06.2017 there was 10-year rainfall event (27.5 mm in 45 min). This caused some streets to flood without significant damage.

The model shows that the ditch system can discharge a 100-year flood event without overflow. However, due to inflows from green areas and access roads, the sewer system reaches its limits during 5-year flood and the sewage system overflows.

The most influential overflows can be seen in the following networks:

1. The sewer network „Donndorfstraße" has the largest considered catchment area. In this network, there is a strong overflow on Schillerstraße to Wallstraße. Rainwater flows to Donndorfstraße and collects on Staufenbergplatz and Schmale Straße.

2. Strong overflow on Schmale Straße.

3. There are overflows on Westerhäuser Straße and Lange Gasse. Water flows from Altetopfstraße through Hohe Straße and Blasiistraße to the Kornmarkt.

Research results:
1. Widening the ditch system is not possible due to surrounding development.

2. Some sections of the Mühlgraben stream are in urgent need of maintenance.

3. A larger dimensioning of the overflowing canal networks in the town center is impractical.

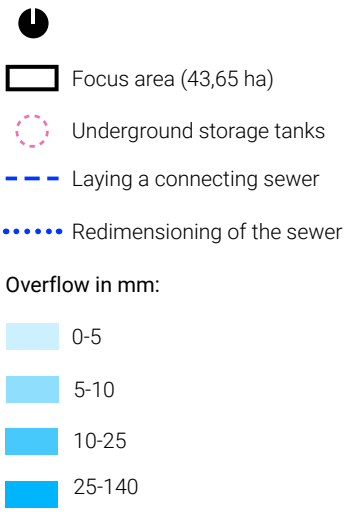
4. Controlling the dam that connects the Mühlgraben stream to the Stiefelgraben stream is also not relevant.

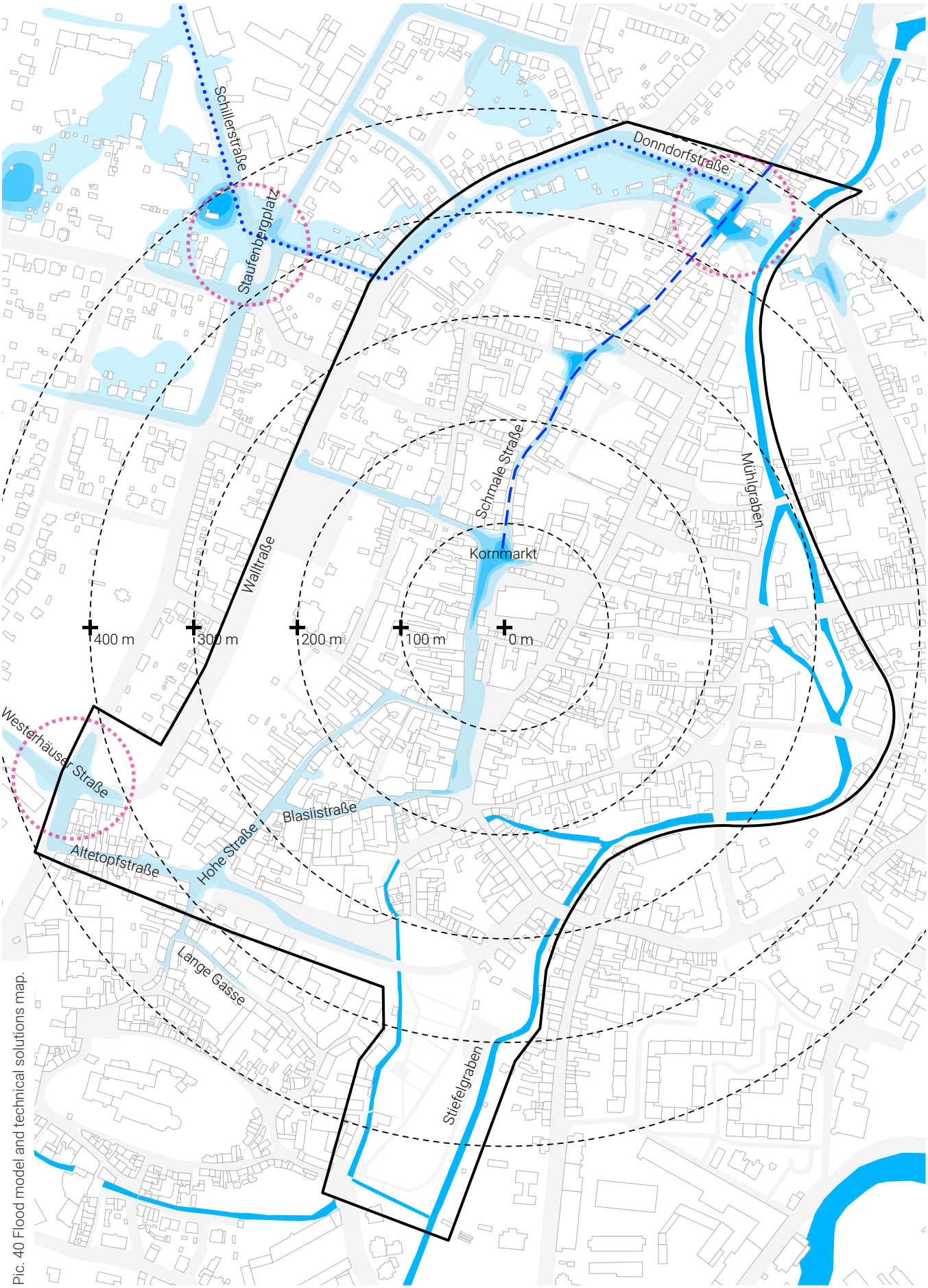
Technical solutions:
1. Underground storage tanks placement in Westerhäuser Straße, Schillerstraße, Donndorfstrasse.

2. Laying a connecting sewer from Kornmarkt through Schmale Straße to the recommended storage sewer in Donndorfstraße.

3. Redimensioning of the sewer Schillerstraße, Wallstraße, Donndorfstraße (Deuter 2018).

Since technical solutions for the target area have already been proposed (Pic. 40), it makes sense to focus on soft solutions that will help retain stormwater and improve the surrounding microclimate.





Pic. 40 Flood model and technical solutions map.

02.10 VEGETATION

The city is a part of nature, and nature is a continuum with wilderness at one end and the city at the other (Tichá 2017).

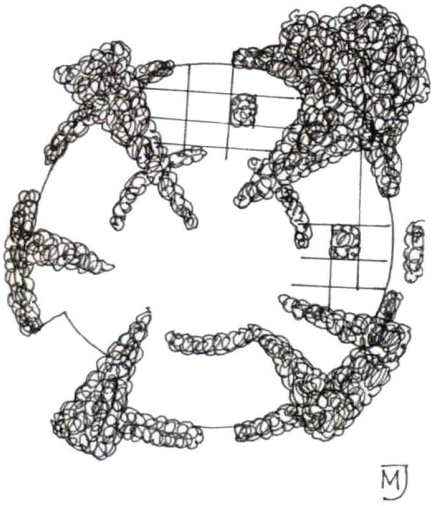
The area of the historic old town has narrow street spaces and there is almost no vegetation. Wordgarten, Wallstraße, and greens along the stream play an important role in terms of vegetation. Some courtyards also have mature plantings. These green spaces need to be developed and improved because they also have a positive effect on the microclimate.

The main trees and shrubs species were found on the streets of Quedlinburg: *Tilia cordata* (throughout focus area including Wallstraße alleys), *Acer platanoides* (throughout focus area), *Aesculus hippocastanum* (at several points), *Salix alba* (Wordgarten and along the stream), *Abies* sp. and *Juniperus* sp. (Wordgarten)., *Carpinus betulus* and *Ligustrum vulgare* (as hedges), *Parthenocissus quinquefolia* and *Parthenocissus tricuspidata* on the various buildings.

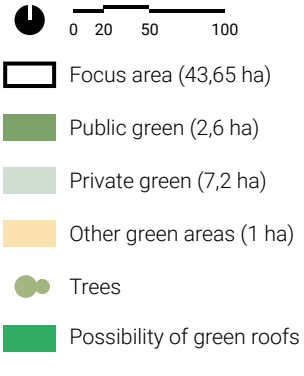
The combined system of vegetation prevails In Quedlinburg (Pic. 53). This system integrate checkerboard (regularly arranged vegetation areas), radial (green corridors connect the city centre and its outskirts) and circular (was established during the expansion of a smaller historic core) green systems (Vacek et al. 2014).

In the old town of Quedlinburg there are some buildings with flat roofs which should be provided with green roofs where it possible.

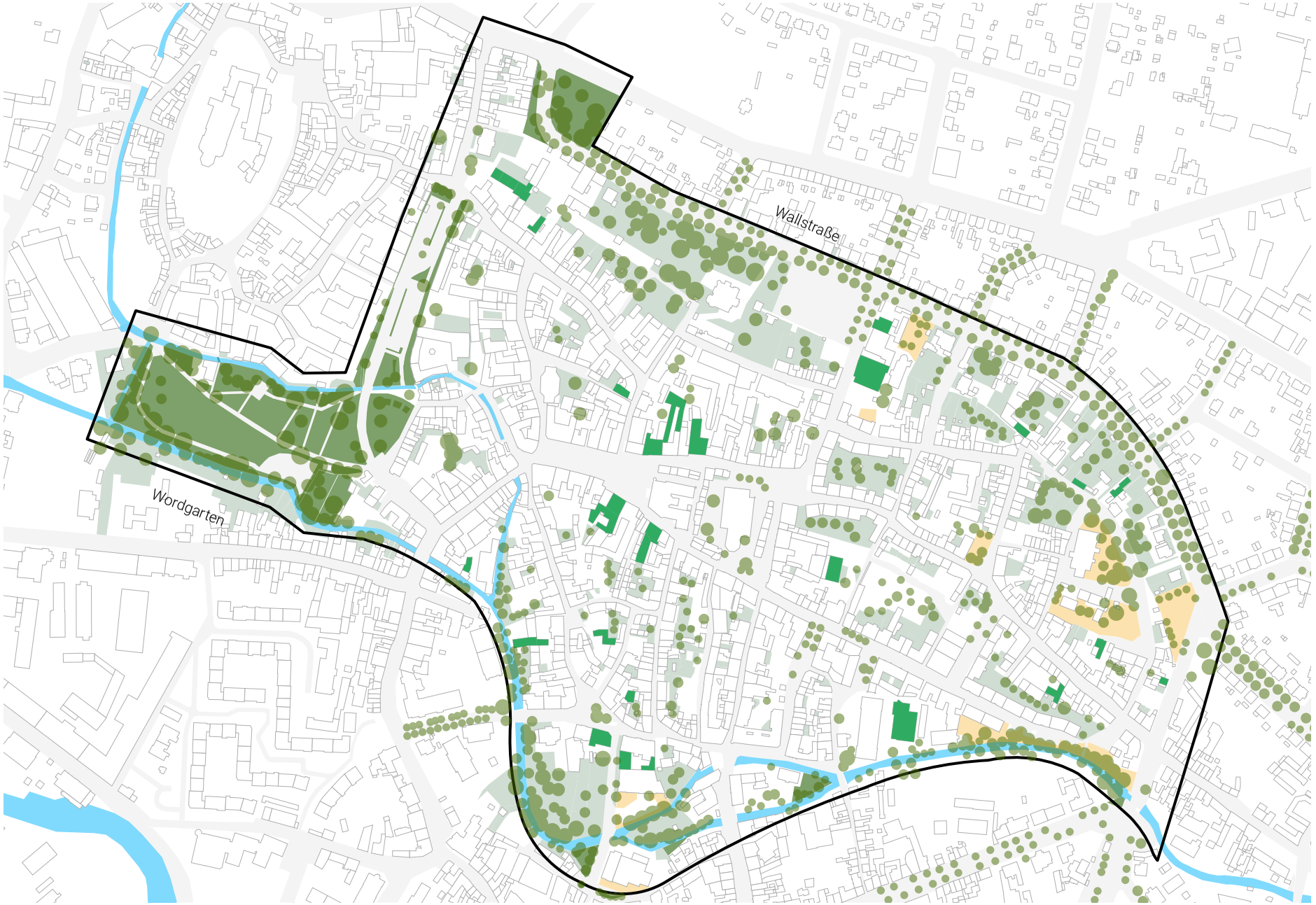
According to Christopher Alexander (1977), the flat roof shape is not natural from a structural, psychological or climatic point of view. A flat roof is appropriate where it can be green or used for visiting. All other parts of the roof that cannot be usable should be sloped or other shapes, but not flat (Alexander et al. 1977).



Pic. 41 Combined green system (by Matouš Jebavý).



Pic. 42 Vegetation in the focus area.



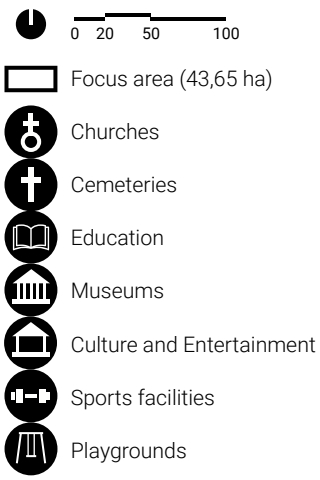
02.11 CULTURE AND LEISURE

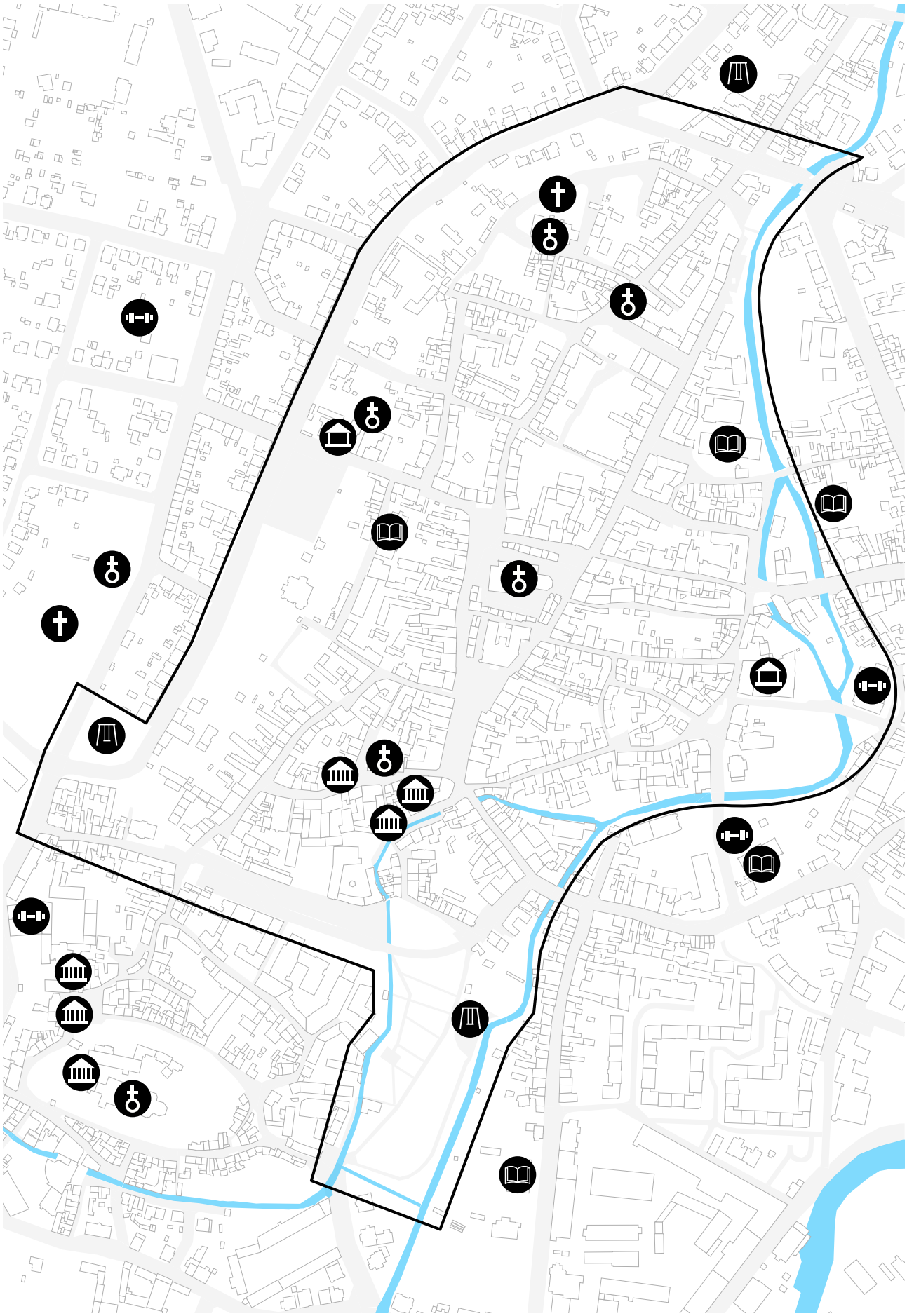
Strong public spaces usually have a central area where events happen and a surrounding field where people hang out and watch (Childs 2012). In the old town of Quedlinburg it is Markplatz, which has an open character and on the edges there are various cafes and stores. Buildings are the scenery for everyday life occurring within the spatial volumes they define (Moughtin 2003).

In addition to churches, half-timbered houses and the remains of the town's fortifications, Quedlinburg also has a large number of cultural and recreational facilities. There are museums, theaters, workshops, and sports facilities. Various cultural events are also held here. For example, there are classical music concerts, Christmas events, ecological events (ARGE Westermann & Wallraf 2012).

The Wordgarten park, the Markplatz and a smaller area in front of the Event Hause Kaiserhof are situated here. These places would be suitable for various events. For example, the Wordgarten would be suitable for music concerts and children's events. Also the park offers free areas for urban gardening and this could be combined with an event that focuses on this sphere. Locals could show off the biggest pumpkin to each other. There could be more intimate classical music concerts on the Markplatz. An outdoor movie screening could be organised around the event house Kaiserhof.

The infrastructure of the old town should be connected not only functionally but also aesthetically, sensually.





Pic. 43 Culture and leisure map.

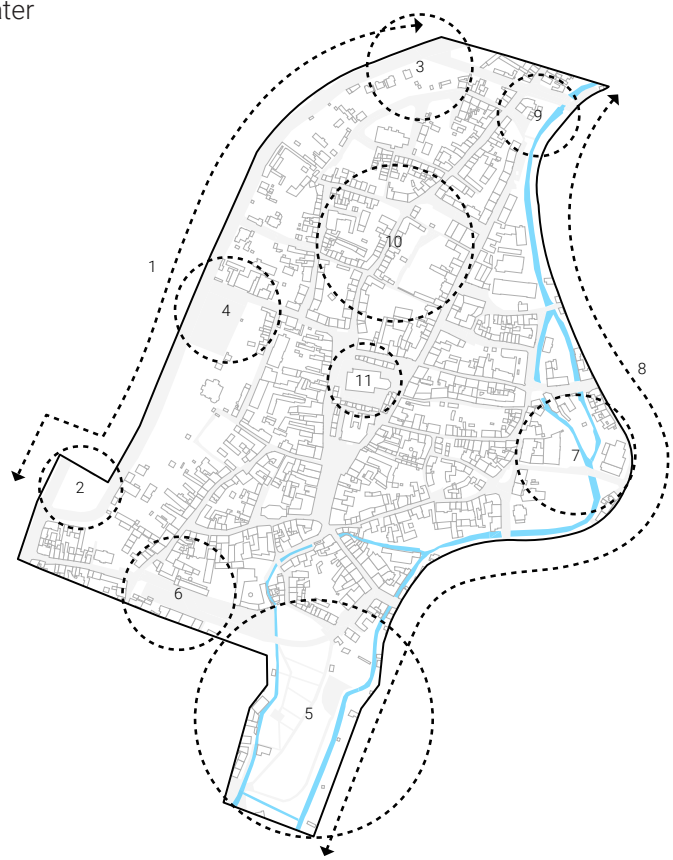
02.12 SOCIOLOGICAL SURVEYS

The publication by Octagon Architekturkollektiv „Quedlinburg 2036“ has a sociological survey. The participants were citizens of Quedlinburg, including merchants. Here is the basic information that was contained in these survey.

The questions were divided into four topics. In the „Ecology and nature“ topic the main proposals were care of existing and founding new vegetation, improvement of water areas, founding of urban gardening spaces. In the „Social town“ topic residents felt that the old town needed a swimming pool and more sports and recreational facilities for children and teenagers. In the „Cleanliness and safety“ topic according to the citizens the historic part of the town needs more waste bins, dog poop bags, public toilets, cameras and public lighting. „Mobility and infrastructure“ topic has some of important points: car-free downtown, public transport Improvement and reduction of traffic/ speed.

There are a lot of important things in the given survey that helped in the creation of the proposal. The author was guided mainly by those aspects that had a connection to the overall conceptual idea of the design. Sociologically the survey was very well thought out, and the author mainly took into account the following demands of the people: overall desire for greenery, strengthening of water management, urban gardening, playgrounds improvement, reduction of traffic/speed, improvement of parking situation.

The data from the sociological survey also helped the project to focus not only on an anonymous group of visitors but also on the citizens of the town who live here and use the public spaces on a daily basis.



Pic. 44 Problem areas with potential to improve.

1. Wallstraße
2. Westraße park
3. Northern part of Wallstraße
4. Marschlinger Hof parking lots
5. Wordgarten
6. Carl-Ritter-Straße
7. Area around Kaiserhof and swimming pool
8. Mühlegraben stream
9. Grabengasse
10. Courtyards
11. Marktkirchhof

What could contribute to a higher quality of life and living?

Priority of answers

Ecology and nature

Reservation and planting trees
Greening
City green maintenance
Green parks and meeting points
Water areas improvement
Regional food
Permaculture and urban gardening
Environmental education
Joint cleaning events

Social town

Outdoor/indoor pool
Places for teenagers
Playgrounds
Art and cutural events
Kid-friendly places
Disco
Evening events
Wider shopping opportunities
University foundation
Skatepark
Dogparks
Spa center
Political education
Climbing gym

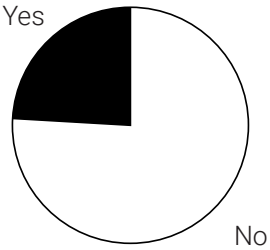
Cleanliness and safety

Waste bins and bags for dogs
Dogs excrements problem
Cleanliness in the downtown
Public toilets
Police presence
Traffic lights and crosswalks
Streets and paths lighting
Public cameras

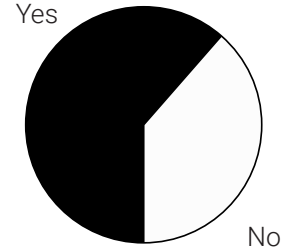
Mobility and infrastructure

Expansion of bike paths
Reduction of traffic/speed
Improvement of the parking situation
Car-free downtown
Roads and paths Improvement + lighting
Public transport Improvement
Internet improvement
E-charging stations
Electric scooters

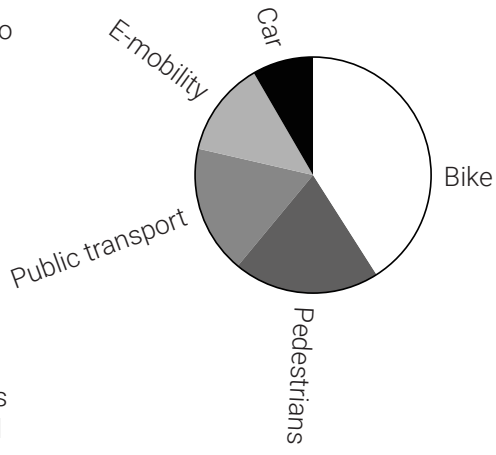
Are there enough meeting places in your neighbourhood?



Do you find the old town and the surrounding area well connetcted?

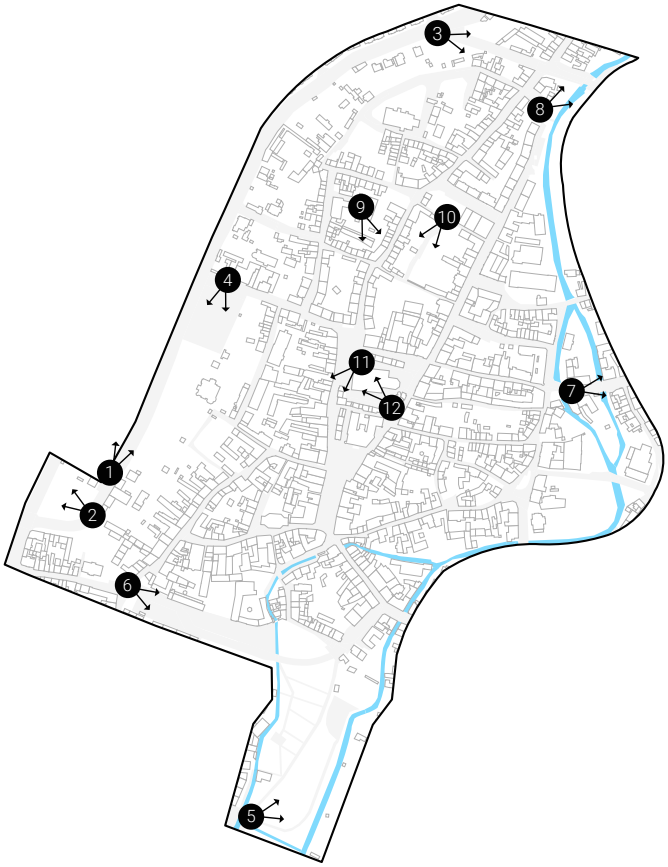


In which spheres does the town's traffic need improvement?



Pic. 45 Sociological survey charts

02.13 PHOTODOCUMENTATION OF AREAS TO BE IMPROVED



Pic. 46 Map and photodocumentation of areas to be improved.

1. Wallstraße
2. Westraße park
3. Northern part of Wallstraße
4. Marschlinger Hof parking lots
5. Wordgarten
6. Carl-Ritter-Straße
7. Area around Kaiserhof and swimming pool
8. Grabengasse
9.-10.Courtyards
11.-12. Marktkirchhof

1. Wallstraße.

2. Westraße park.

3. Northern part of Wallstraße.

4. Marschlinger Hof parking lots.

5. Wordgarten.

6. Carl-Ritter-Straße .

7. Area around Kaiserhof and swimming pool.

8. Grabengasse.

9. Courtyard 1.

10. Courtyard 2.

11. Marktkirchhof.

12. Marktkirchhof .

02.14 EVALUATION OF THE UNDERLYING DATA

The design was prepared in the form of conceptual schematic design and and all the data used by the author was sufficient. For a more detailed design, it is of course necessary to have more detailed documentation, especially with regard to the exact location of buildings and utility networks in the focus area.

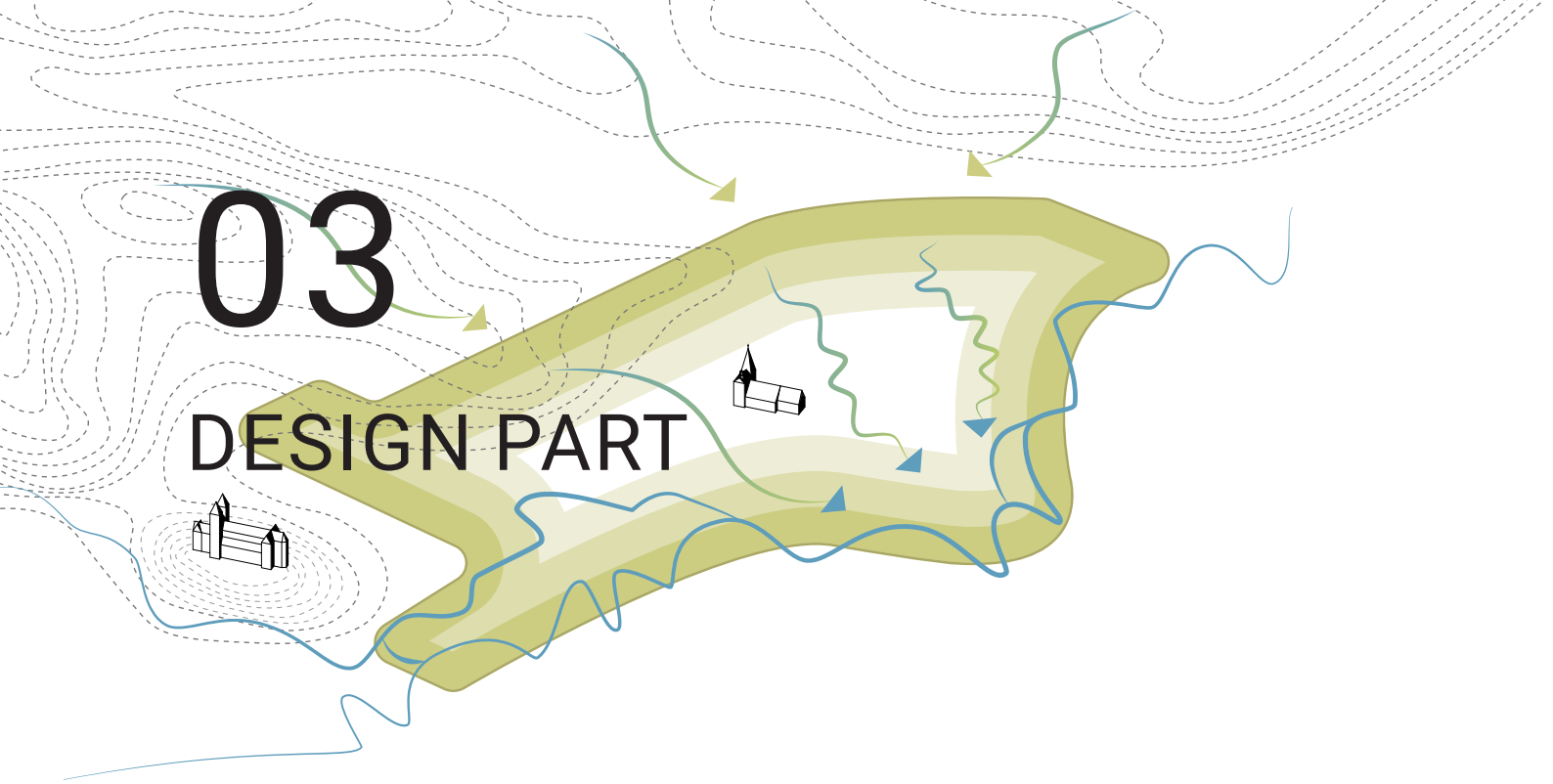
The most helpful publication was Quidlinburg 2036 by Octagon Architekturkollektiv, which helped to identify the main problems of the historic core and to look at the measures already proposed.

Also was very useful work of the engineering office for civil engineering Dipl.-Ing. Lars Deuter, who described the technical solutions for much easier processing of stormwater during heavy rainfall.

Together with several visits, consultations with experts, studying of historical maps and documents of the focus area, the author was able to generate a wealth of information that helped to create a proposal, which will be described in the next part of this work.

03

DESIGN PART



03.1 BLUE-GREEN WALLS OF QUEDLINBURG, MASTERPLAN

Everything is in interlinkage - every plant, animal, and microorganism has an integrated relationship within its ecosystem.

The „Blue-green walls of Quedlinburg“ is a complex of soft engineering solutions for managing stormwater by means of the vegetated treatment network. This network will strengthen the biodiversity and green infrastructure of Quedlinburg through creating new functional green areas, retention, filtration, infiltration, and treatment of stormwater. This complex of soft engineering solutions will have a great impact on the atmosphere, climate, and water circulation. Also, the structure of the construction containing stormwater harvesting underground tanks will make much easier the process of stormwater harvest by sewage.

Proposals

1 - Wallstraße
Bioswales and raingardens network.

2 - Weststraße park
More green connections to green spaces of Wallstraße. Playground with terrain modelations.

3 - Northern part of Wallstraße
Green area with more permeable surface. Biotope.

4 - Parking house
Approximately 300 parking lots for cars and bicycles. Open spaces in front of it whith lowered ground. Urban gardens, small park.

5 - Wordgarten
Revitalized and meandered Stiefelgraben. More natural part of the park with new biotope. Urban gardening, sport area and playgrund near water.

6 - Parking lots on Carl-Ritter-Straße
Green bioswales, new trees.

7 - Event House Kaiserhof and swimming pool
Connecting by wide bridge with the benches for rest, movie screenings, new trees, permeable surfaces.

8 - Mühlengraben
Constructions with benches, coastal benches and stairs to the water. Trees whith retention area on the parking lots.

9 - Grabengasse
Urban gadening.

10 - Courtyards
More trees, permeable surfaces and green roofs for residental parking lots. Meeting place for residents.

11 - Marktkirchhof
Rain gardens, benches, resting places.

Pic. 47 Masterplan.

03.2 OLD TOWN DESIGN STRATEGY

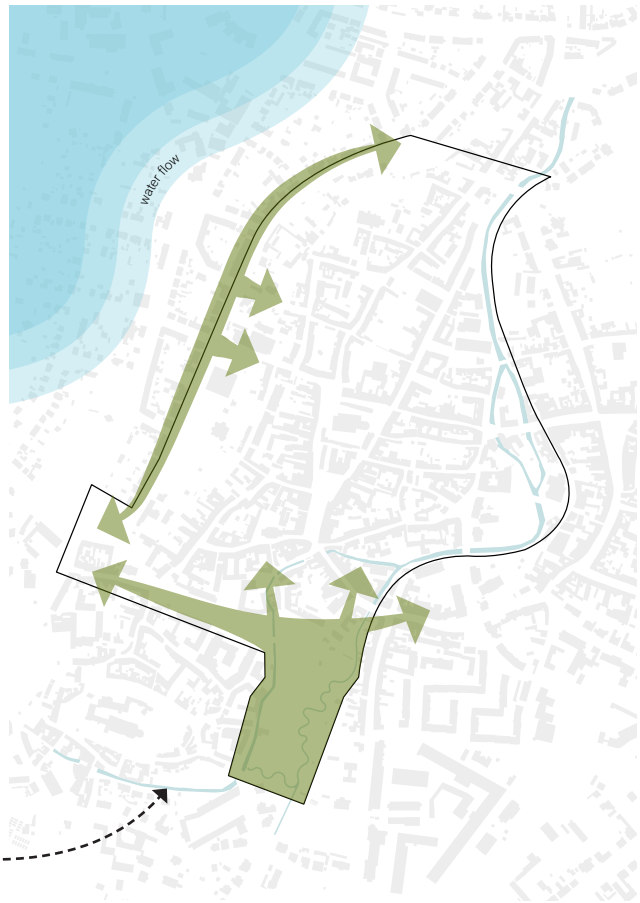
The main focus has been pointed on Wallstraße since this street is a potential barrier for harvesting of stormwater. When it rains heavily, stormwater flows from the upper streets through the Wallstraße to the historic core. Now Wallstraße has new designed green areas (bioswales, rain gardens) which will treat stormwater in a more natural way. This solution is also inspired by the history, because a historical map of C. C. Voigt from 1782 shows that there was a green belt on the site of today's Wallstraße (Pic. 47).

The pedestrian trend of the old town must be maintained. The parking house will provide more than 300 additional parking lots, which will make the streets more pleasant, there will be fewer cars on and near the sidewalks. It will be possible to ride a bicycle through the Wallstraße, because one of the walkways here will be for pedestrians as well as cyclists. Less cars in the focus area will allow to arange more permeable surfaces decreasing share of paved surfaces.

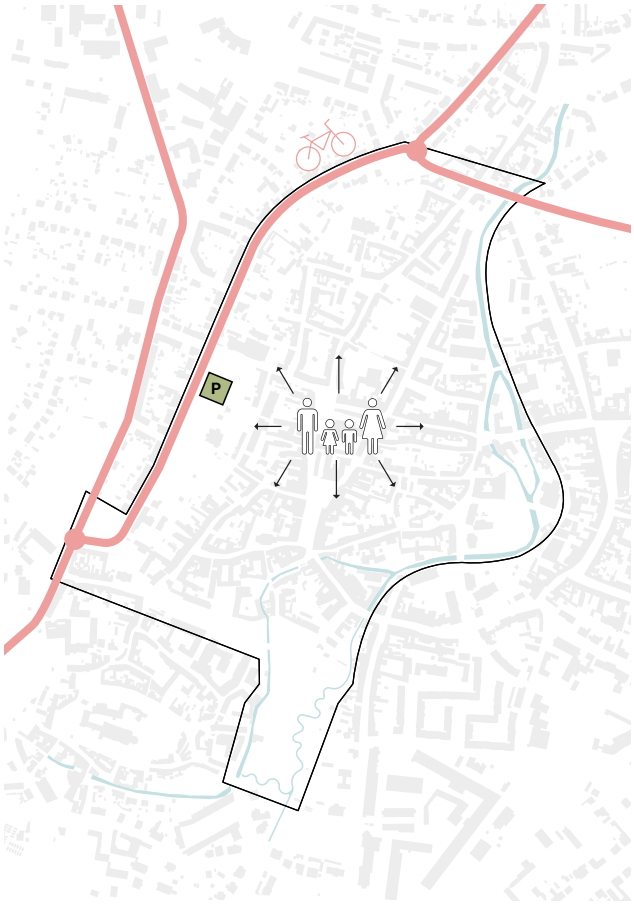
Stiefelgraben stream in the old town is mostly inaccessible and the walls are under historical protection. According to the proposal access to the stream will be provided at some points of the old town by means of structures with stairs and in the Wordgarten.

Pic. 48 Old town design strategy.

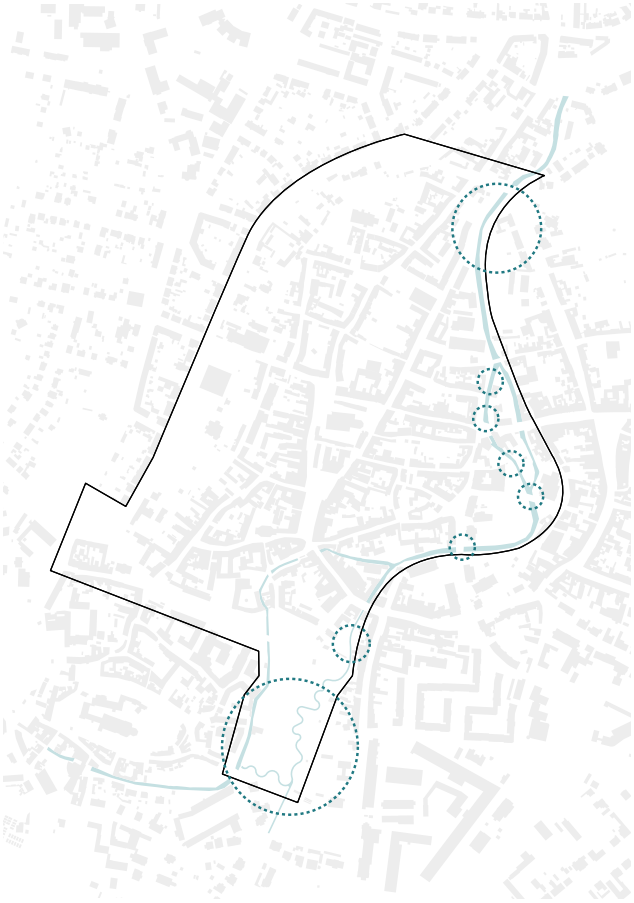
Inspiration by history of Quedlinburg.



Green Wallstraße and Wordgarten.



Human oriented traffic, bike path and parking house.



Water accesses.

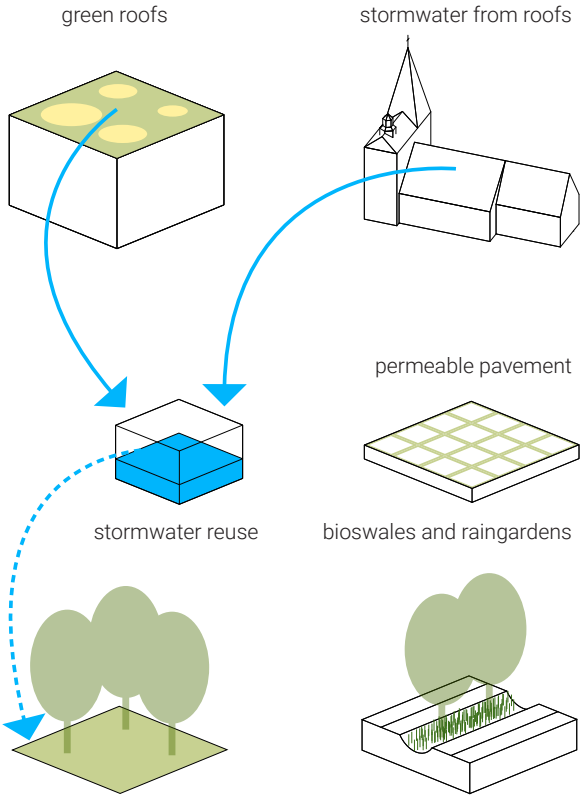
The design is a complex of soft engineering solutions for retention, filtration, infiltration, and treatment of stormwater which are located throughout the old town. The basic principles are: use of green roofs, permeable pavement, rainwater reuse, use of raingardens and bioswales. All this will also make it easier to work the sewer.

In the Walstraße and adjacent areas, most of the stormwater from the roofs and surfaces will be treated with bioswales and raingardens. The Wardgarten is a green park with a meandering stream and it will also retain as much stormwater as possible.

Proposals for improving the town's green infrastructure enhances urban ecology and offers new functions, activities, and meeting places for residents and tourists.

Pic. 49 Old town design strategy.

Soft water management.



Solutions for stormwater management.

Connection and development of urban ecology.

New functions, activities and meeting points.

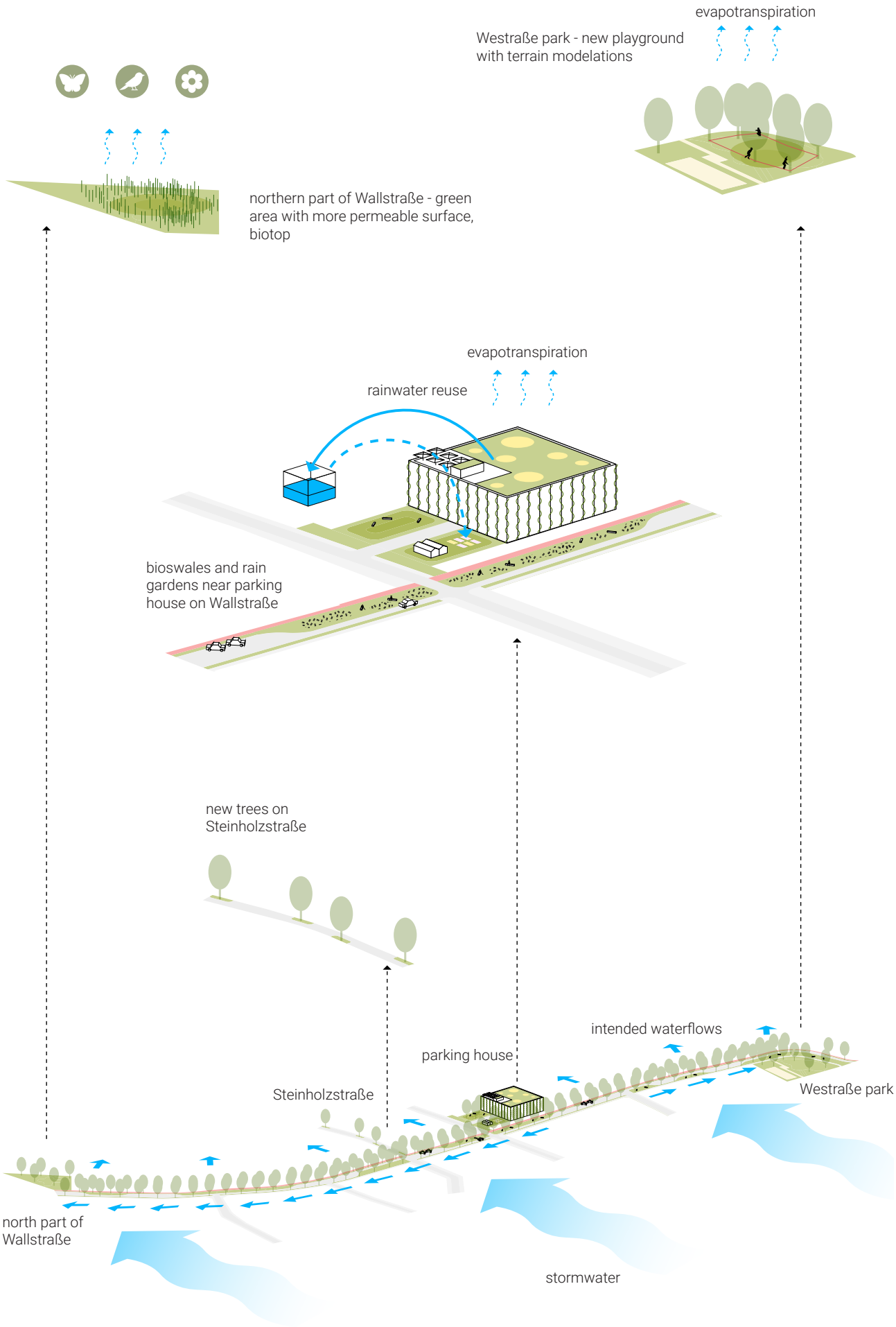
03.3 WALLLSTRASSE, WESTSTRASSE PARK, NORTHERN PART OF WALLSTRASSE, PARKING HAUSE

Wallstraße has new green areas (bioswales, rain gardens) which will treat stormwater in a more natural way. This street has new blue-green connections to Weststraße park and open space at the north of Wallstraße. Where necessary, new trees were added. The parking lots have been reduced that allow giving the street more for people, but not for cars. The parking lots have been left only for residents and emergency services. The rest of them will be moved to the parking house. Here will be a mixed use sidewalk for pedestrians and cyclists (bikepath). New trees with smaller retention spaces have been planted on Steinholzstraße.

A three-level parking house with around 300 parking lots for cars and bicycles, with open spaces in front of it has been placed on the intersection of Wallstraße and Marschlinger Hof. On the ground floor there is a small park. This building has a green roof with a cozy cafe and stormwater harvesting underground tanks which will collect stormwater for the vegetation above and below.

More about this area on pages 61-62

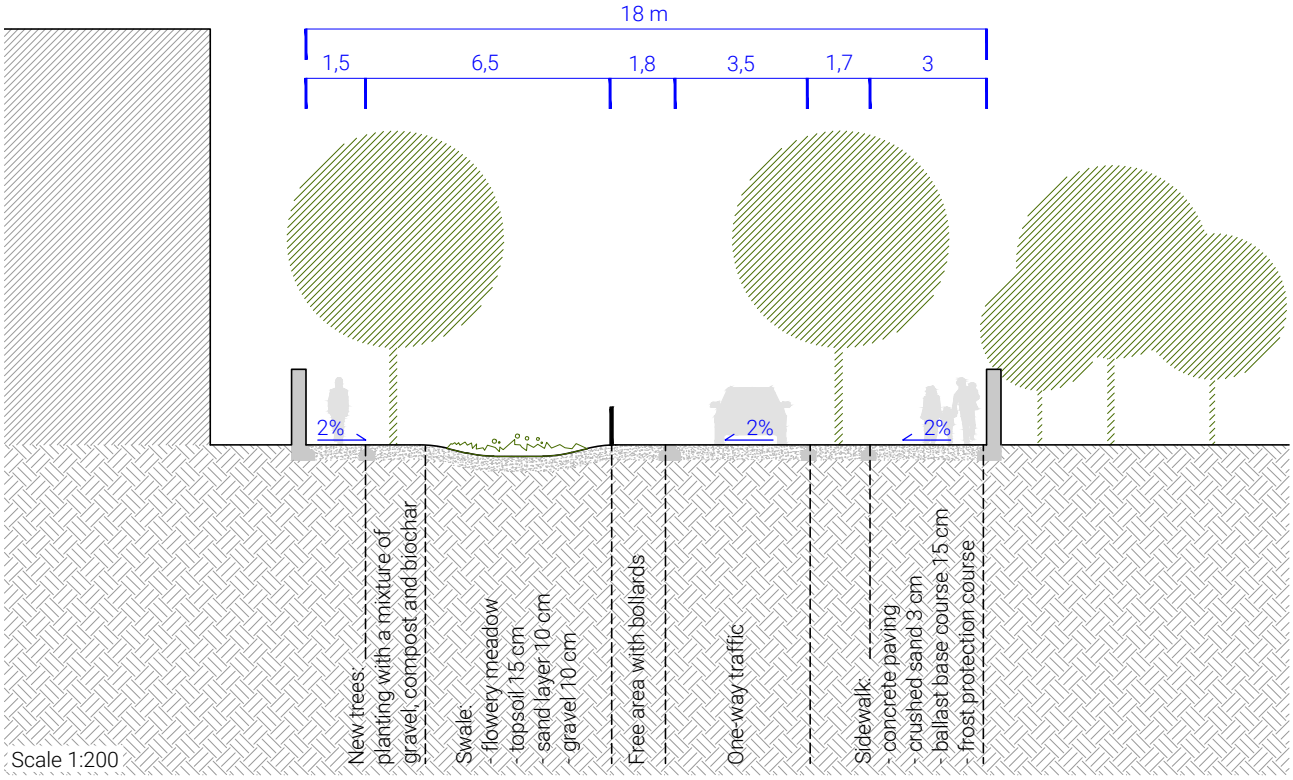
Pic. 50 Map and diagrams of focus area.


evapotranspiration
Westraße park - new playground
with terrain modelations
northern part of Wallstraße - green
area with more permeable surface,
biotop
evapotranspiration
rainwater reuse
bioswales and rain
gardens near parking
house on Wallstraße
new trees on
Steinholzstraße
intended waterflows
parking house
Steinholzstraße
Westraße park
north part of
Wallstraße
stormwater

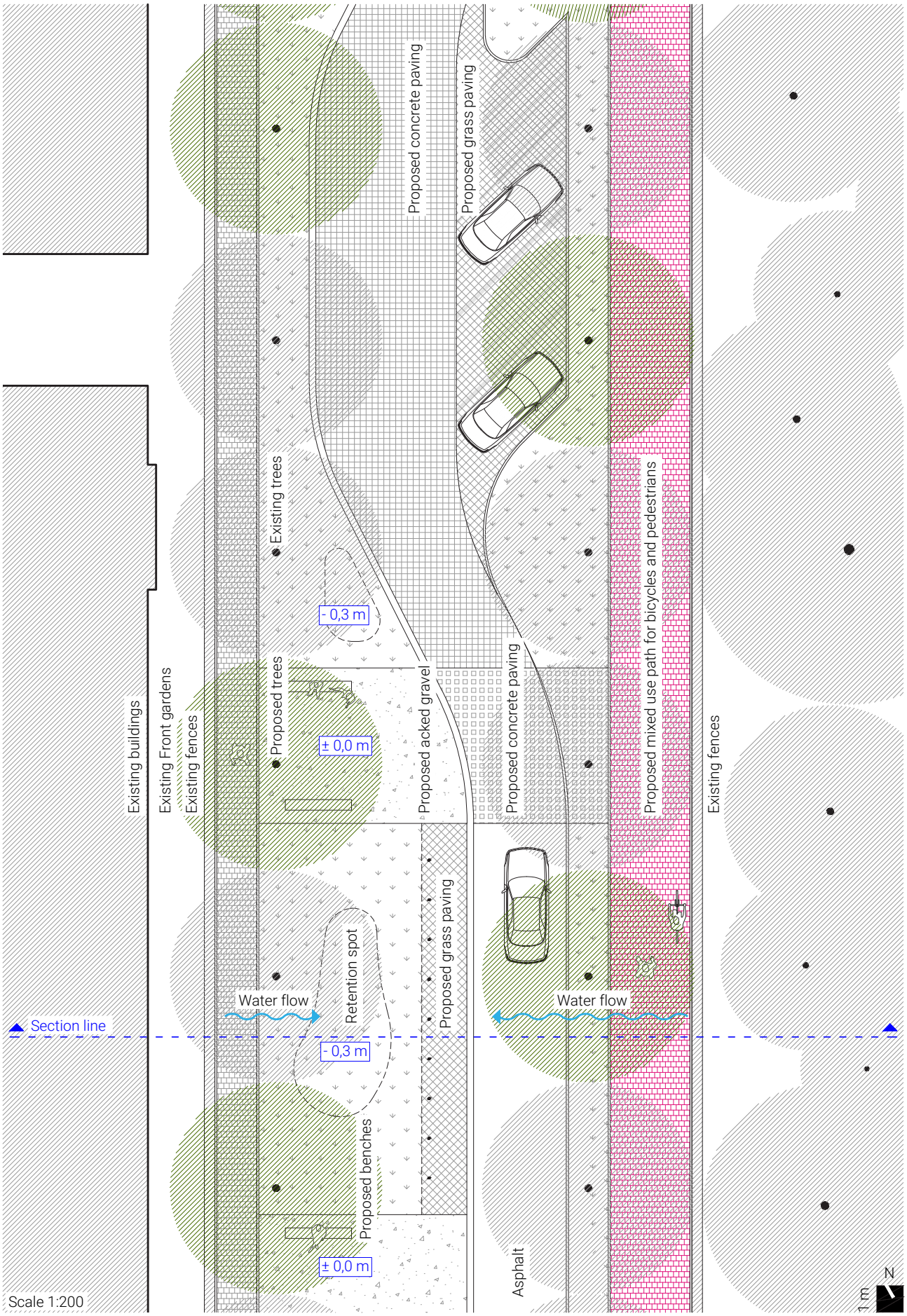
03.4 WALLSTRASSE DETAIL

The Wallstraße ride-on surfaces will be narrowed in some parts and widened in others. The street will remain one-way. One of the sidewalks will be both for pedestrians and cyclists. The alley of *Tilia cordata* species will be added in some places. Conditions for the trees will be improved. Stormwater from the road and pavements will be drained into 30 cm deep swales, which are located along the entire length of the Wallstraße. Swales will be planted with common meadow flowers mixture of this region. Benches will be also installed. In some places there will be crossings with a different permeable surfaces and with barriers for cars for more safe pedestrian movement. Curbs will be lowered as much as possible or used to control the direction of water flow.

Pic. 51 Schematic section of the Wallstraße (1:200).



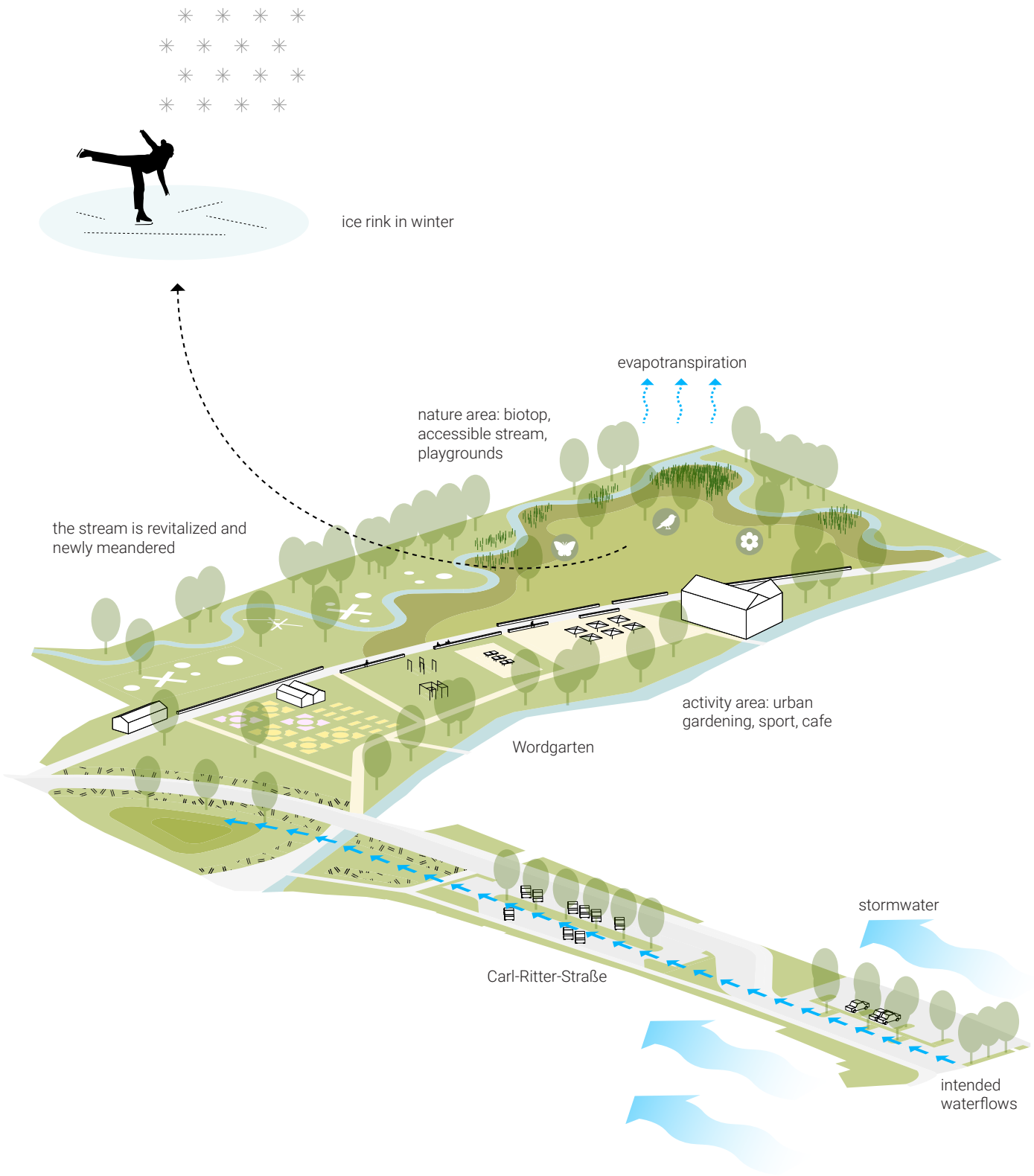
Pic. 52 Plan view of a part of the Wallstraße (1:200).



03.5 WORDGARTEN AND PARKING LOTS ON CARL-RITTER-STRASSE

Wallstraße will be connected to Wordgarten by green bioswales in the parking lots of Carl-Ritter-Straße. Path netwotk in the Wordgarten is the same as currently. There are benches along the main path. In the south Stiefelgraben stream is revitalized and newly meandered. Water retention capacity will be significantly increased. It will become a more natural part of the park with a new biotop. Here visitors will have the opportunity to enjoy flora and fauna and so many new activities will be available, - urban gardening, sports area, playgrounds near water. In winter the southern part of the park can be used as an ice rink. Wordgarten will confidently enhance the landscape biodiversity of the town.

Pic. 53 Map and diagram of focus area.

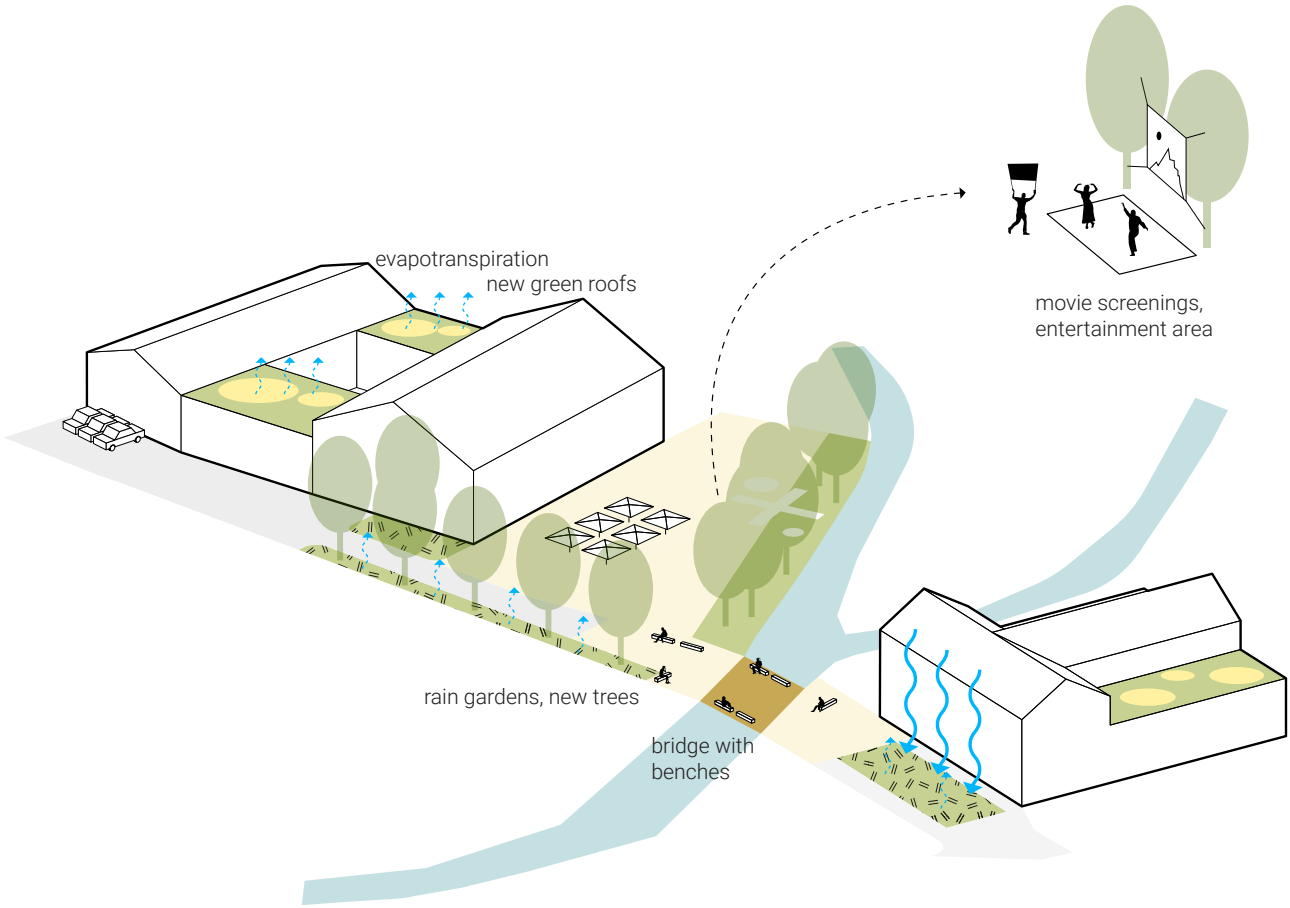

ice rink in winter
evapotranspiration
nature area: biotop,
accessible stream,
playgrounds
the stream is revitalized and
newly meandered
activity area: urban
gardening, sport, cafe
Wordgarten
stormwater
Carl-Ritter-Straße
intended
waterflows

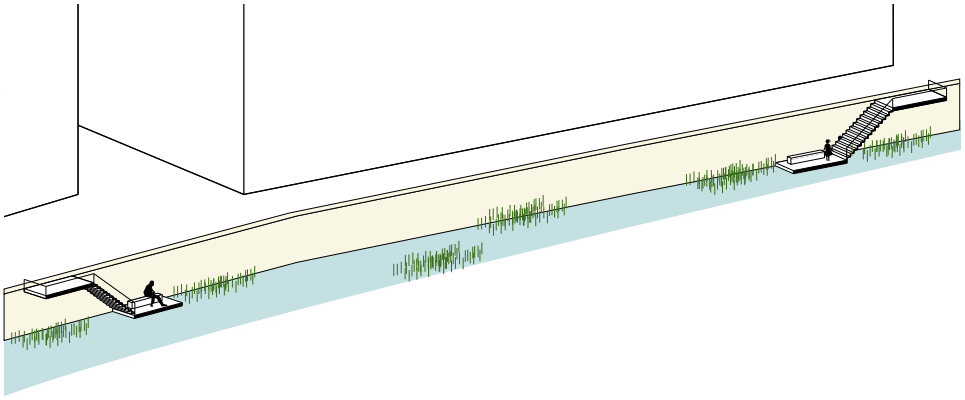
03.6 EVENT HOUSE KAISERHOF AND SWIMMING POOL, MÜHLENGRABEN, GRABENGASSE

Areas near Event House Kaiserhof and swimming pool are connected by a wide bridge with benches. Here are new trees and permeable surfaces Kaiserhof Event House offers outdoor movie screenings. Green roofs can also be created here. From the sloping roofs, water partially drains into the rain gardens.

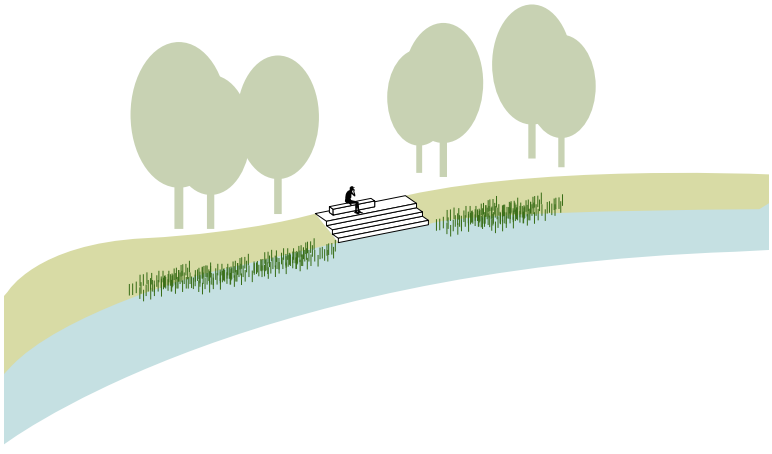
Access to the stream on Grabengasse and Mühlengraben streets has been provided by constructions with stairs (for saving the old walls of the stream), benches, and stairs to the water. A small area at the end of Grabengasse is for urban gardening. Also, there are some trees with retention areas.

Pic. 54 Map and diagrams of focus areas.





water accesses on
Mühlengraben and
Grabengasse



03.7 COURTYARDS

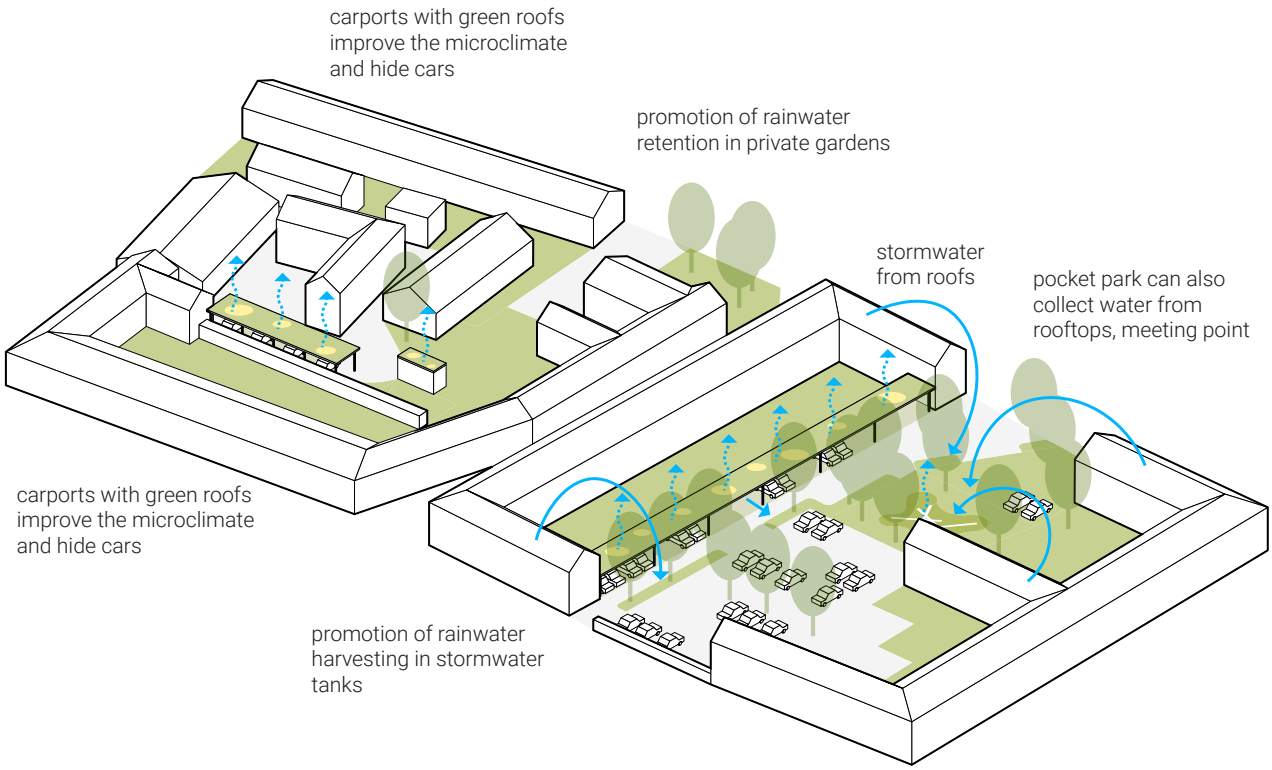
Courtyards have more trees, permeable surfaces, carpors with green roofs for residents. In one of them, there is a possibility to create a little bit more space for harvesting stormwater from the roofs and nearby surfaces. This area could also be used as a meeting place for the residents, grilling and any other activities.

It is necessary to promote the collection of rainwater into the underground tanks and the creation of retention areas both in the public space of the courtyards and in private gardens.

Here is an example of using different measures for two courtyards, but these solutions can also be used for other courtyards in the old town.

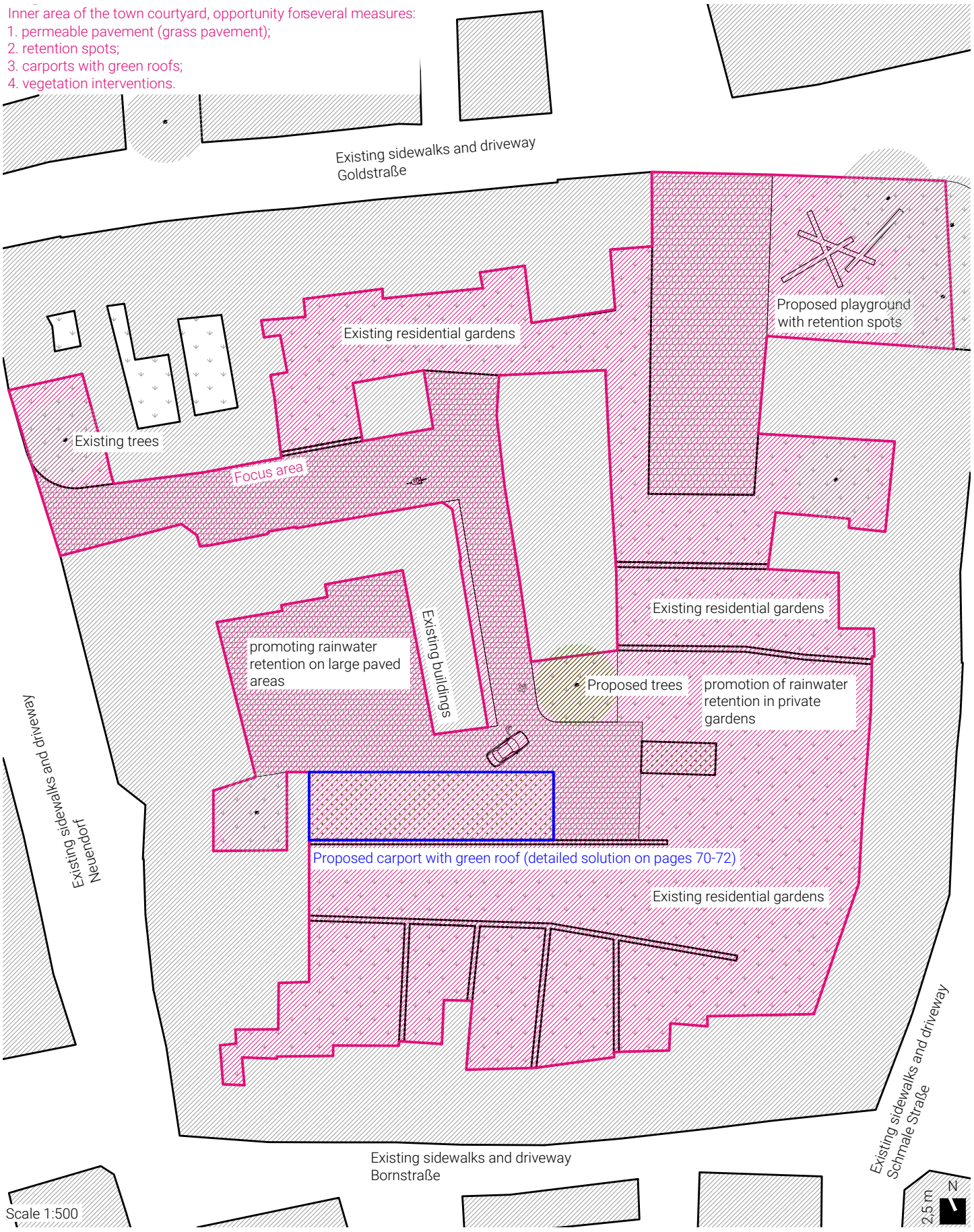
More about this area on pages 69-72

Pic. 55 Map and diagram of focus areas.


carports with green roofs
improve the microclimate
and hide cars
promotion of rainwater
retention in private gardens
stormwater
from roofs
pocket park can also
collect water from
rooftops, meeting point
carports with green roofs
improve the microclimate
and hide cars
promotion of rainwater
harvesting in stormwater
tanks

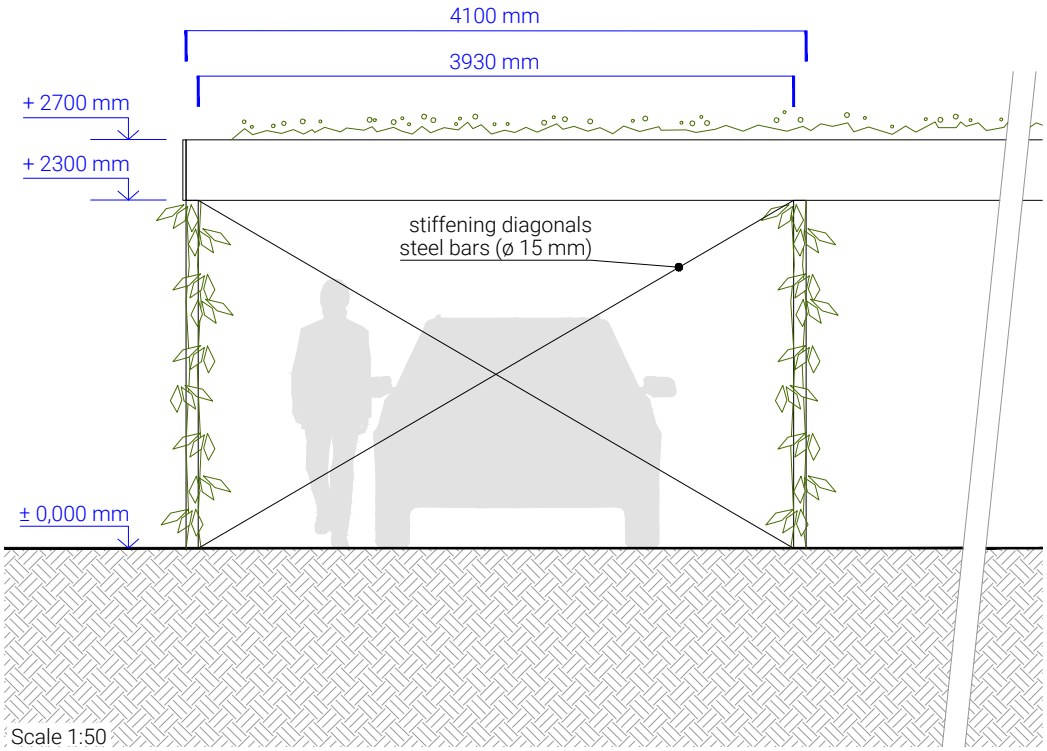
03.8 COURTYARDS DETAIL (CARPORT)

Pic. 56 Courtyard - plan view (1:500).



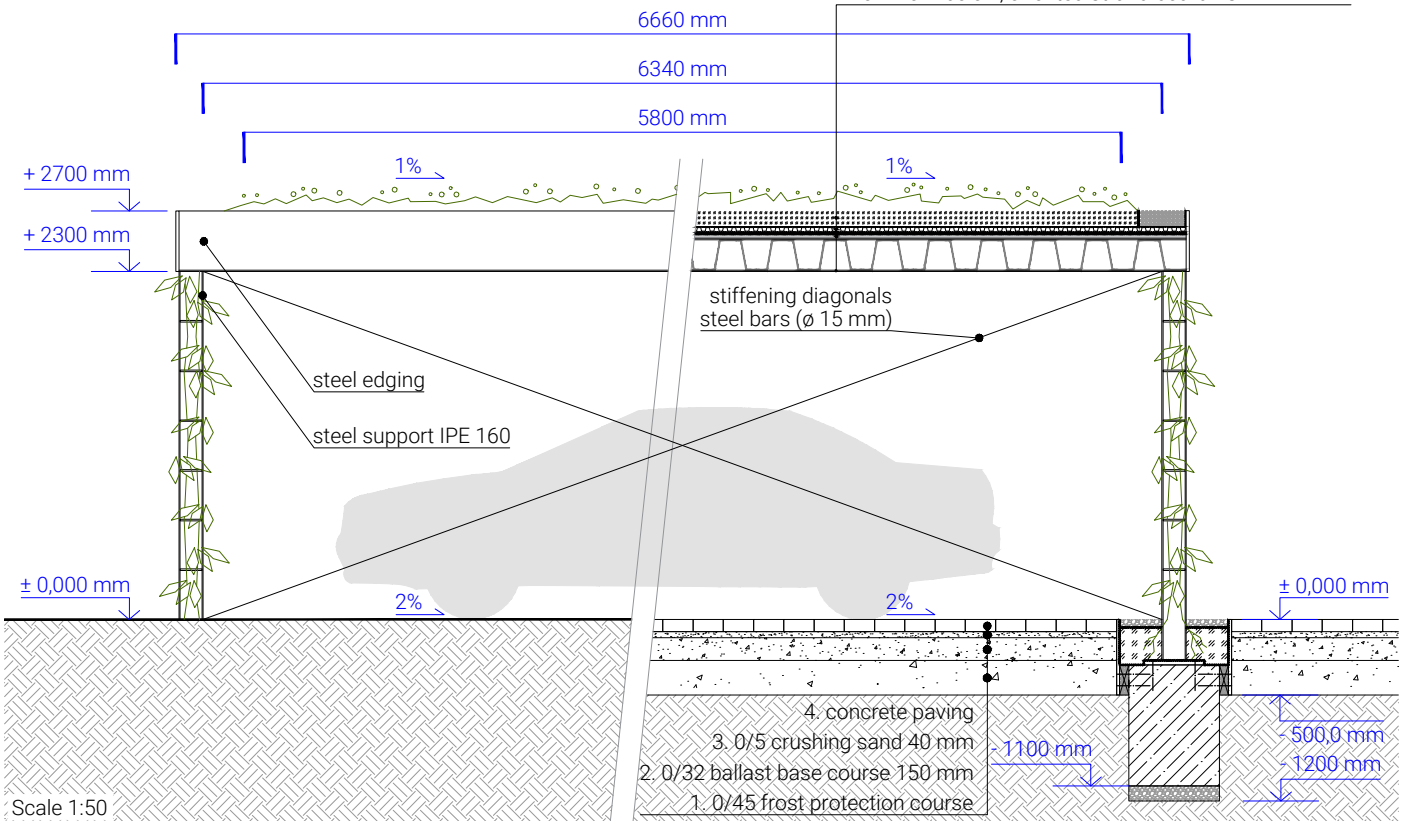
Pic. 57 Carport - front view (1:50).

There is new pavement throughout the courtyard and new trees have been planted. There will also be a carport with green roofs. The carport will provide shade and enhance the surrounding microclimate. The supporting structure will be made of steel profiles on which the *Parthenocissus* will climb. Green roof will be extensive.

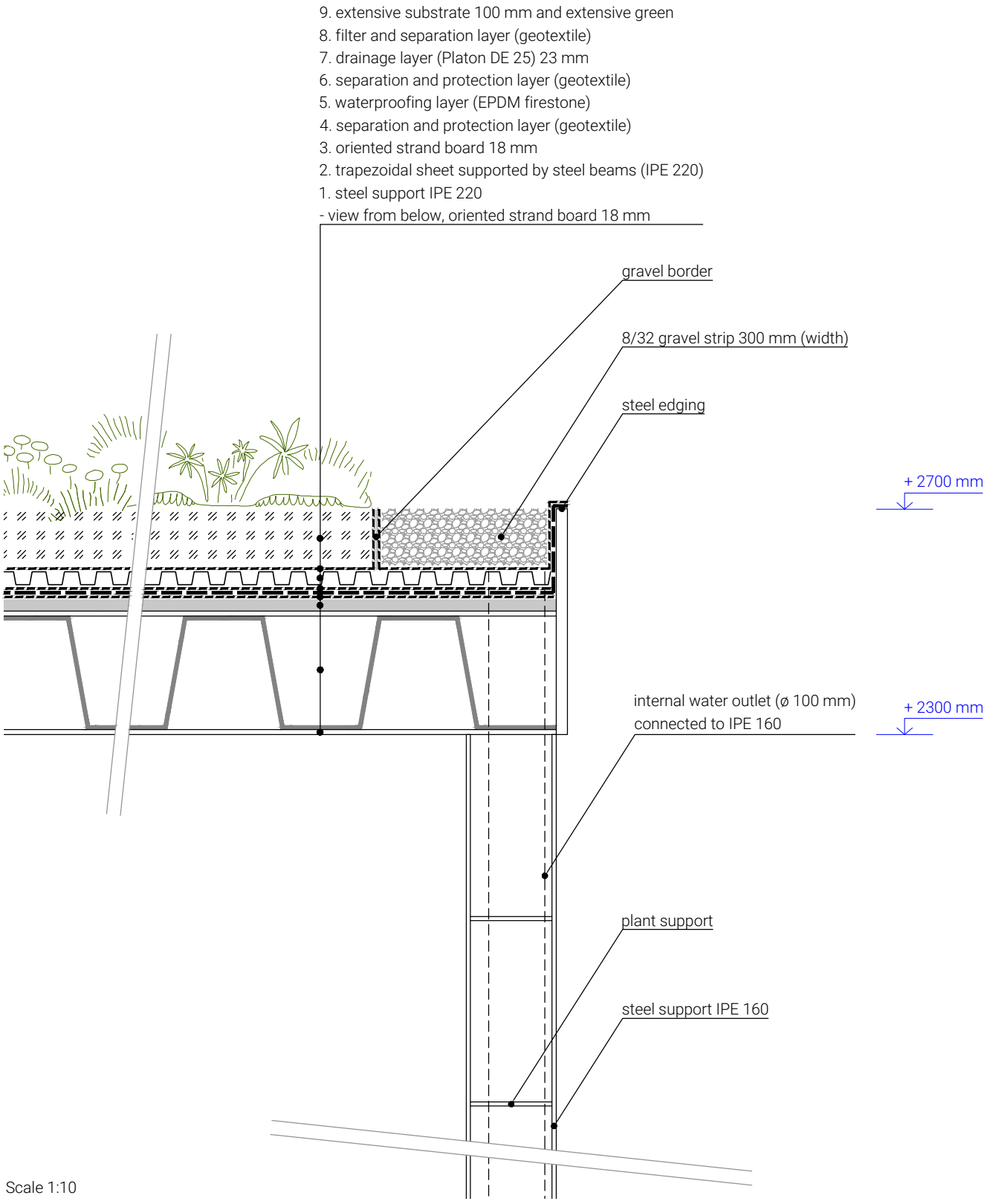


Pic. 58 Carport - side view (1:50).

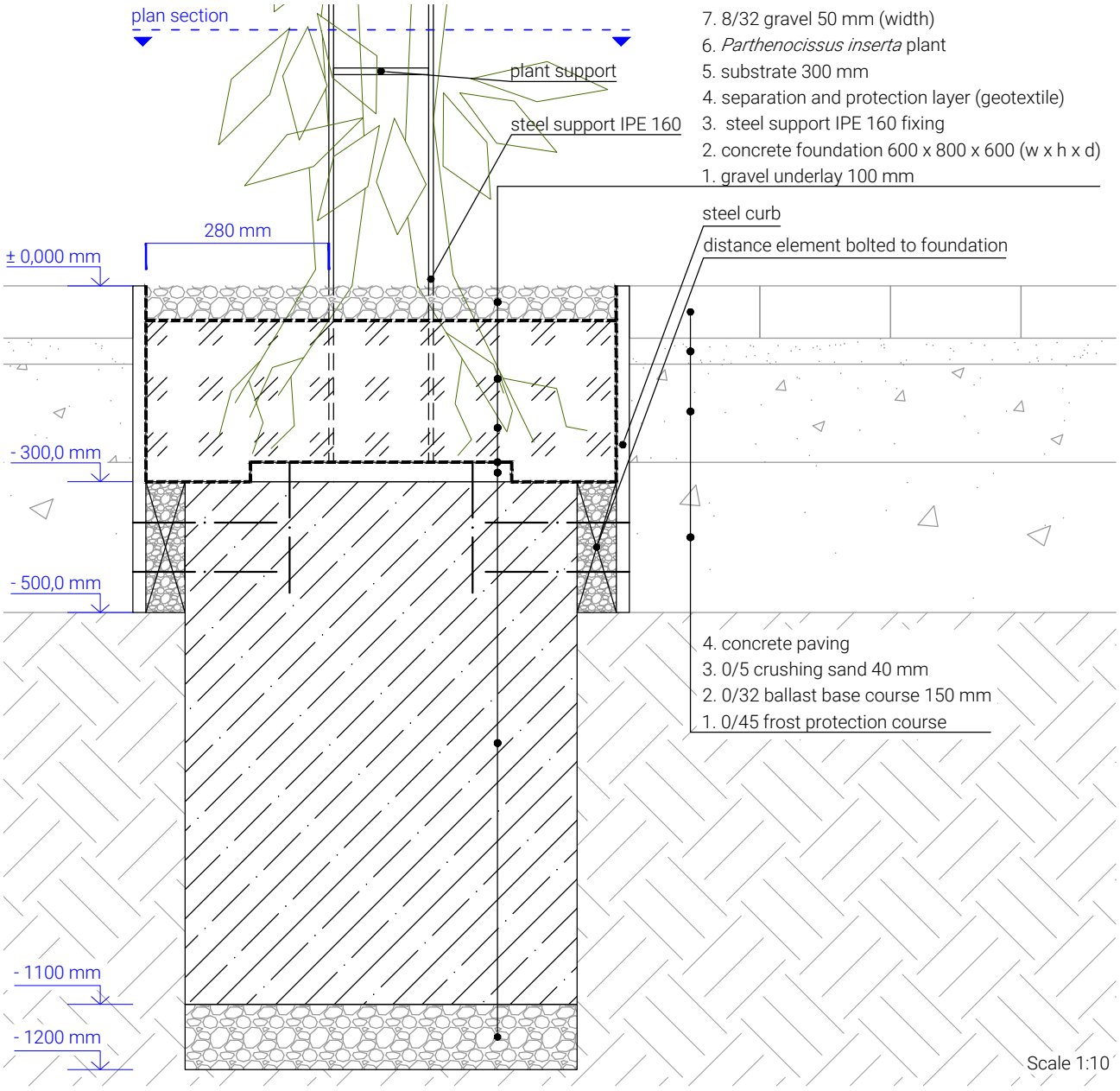
9. extensive substrate 100 mm and extensive green
8. filter and separation layer (geotextile)
7. drainage layer (Platon DE 25) 23 mm
6. separation and protection layer (geotextile)
5. waterproofing layer (EPDM firestone)
4. separation and protection layer (geotextile)
3. oriented strand board 18 mm
2. trapezoidal sheet supported by steel beams (IPE 220)
1. steel support IPE 220
- view from below, oriented strand board 18 mm



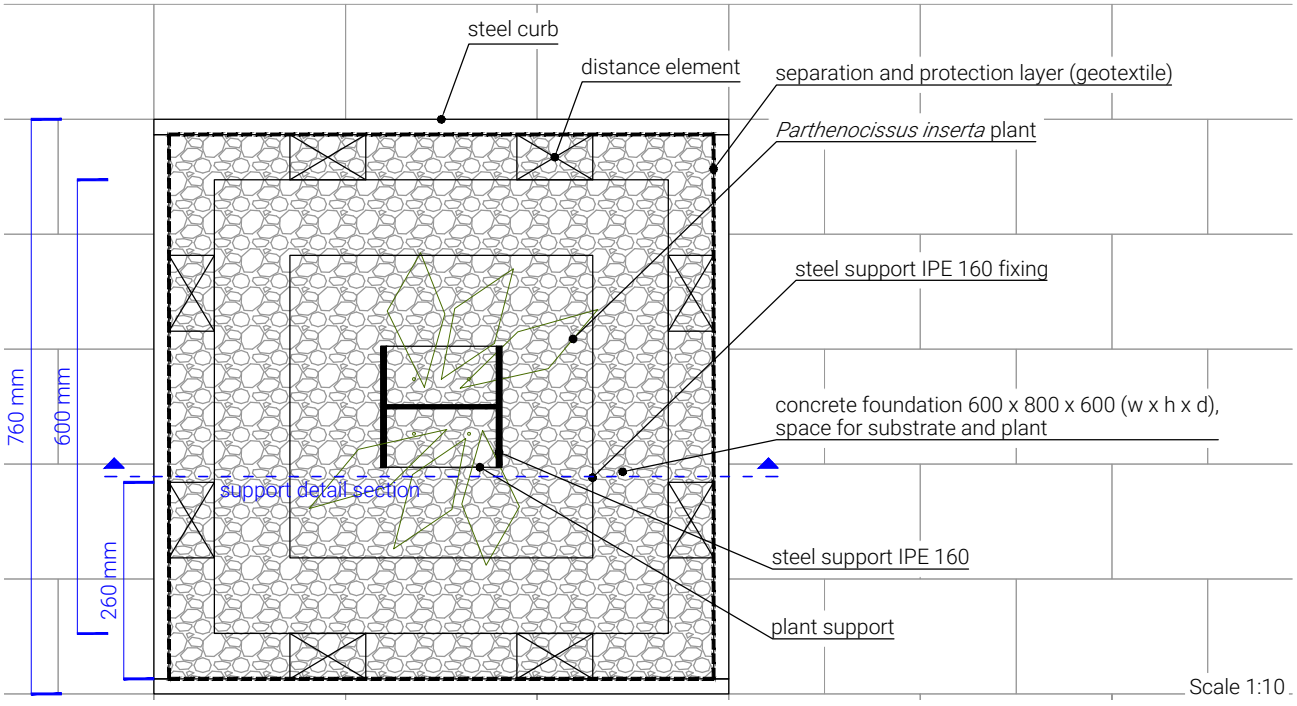
Pic. 59 Carport - cross section, green roof border detail (1:10).



Scale 1:10



Pic. 60 Carport - steel support vertical section (1:10).



Pic. 61 Carport - steel support horizontal section (1:10).

03.9 MARKTKIRCHHOF

Marktkirchhof is the area with two rain gardens near Marktkirche St. Benediktii. They will absorb stormwater from surfaces and rooftops and cool the air. The terrain gradually slopes into rain beds.

The range of plants has been selected for partial shade and should be able to cope with waterlogging. The range of plants can be tested and subsequently applied in other partial shade parts of the old town. There will be also one new tree (*Tilia cordata*).

All trees will have their habitat improved prior to paving and bedding. For trees to thrive in these challenging conditions, a dendrological survey is necessary.

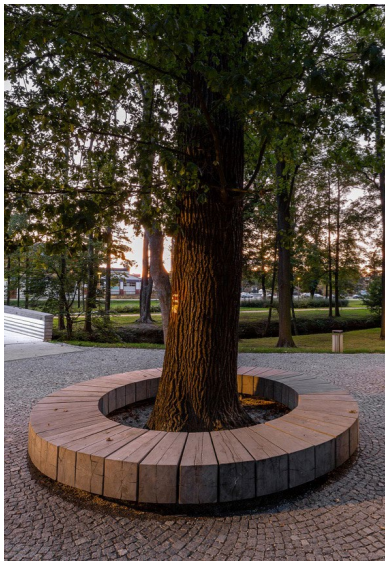
Around the Marktkirche St. Benediktii there are remnants of the grey granite paving, which is preserved in the design. On the empty areas, a lighter granite paving is proposed, which is used around the Marktkirchhof.

Pic. 62 Map and schematic plan view.

Three trees and two rain gardens are surrounded by two atypical benches. The benches are raised to allow water to flow freely into the rain gardens. The basic material is oak and the support structure is iron.

It is important to note that parking around Marktkirchhof is provided only for short periods for residents and emergency services.

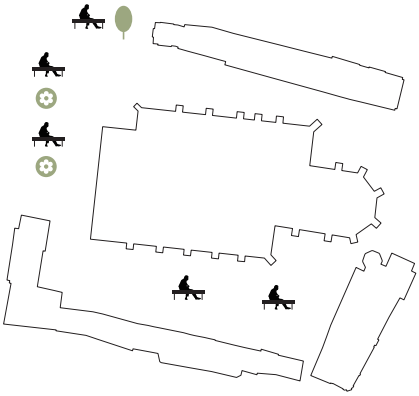
All objects behind the church will be removed: paved areas in the place of propoced rain gardens, construction for trash bins, bollards and traffic signs.



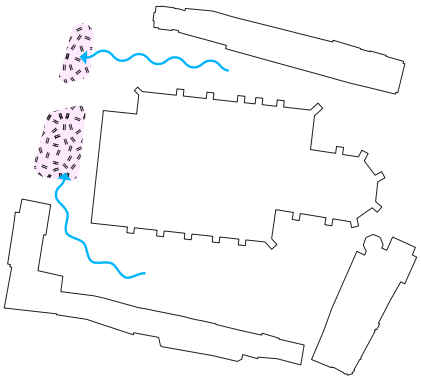
Pic. 63 Example of proposed benches (by Chvojka architect).

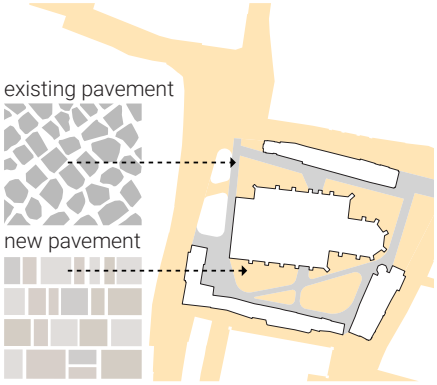
Pic. 64 Marktkirchhof diagrams.

two rain gardens surrounded by benches and three other benches in the area of Marktkirchhof

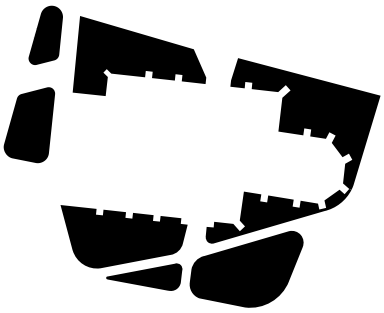


stormwater flows into rain gardens



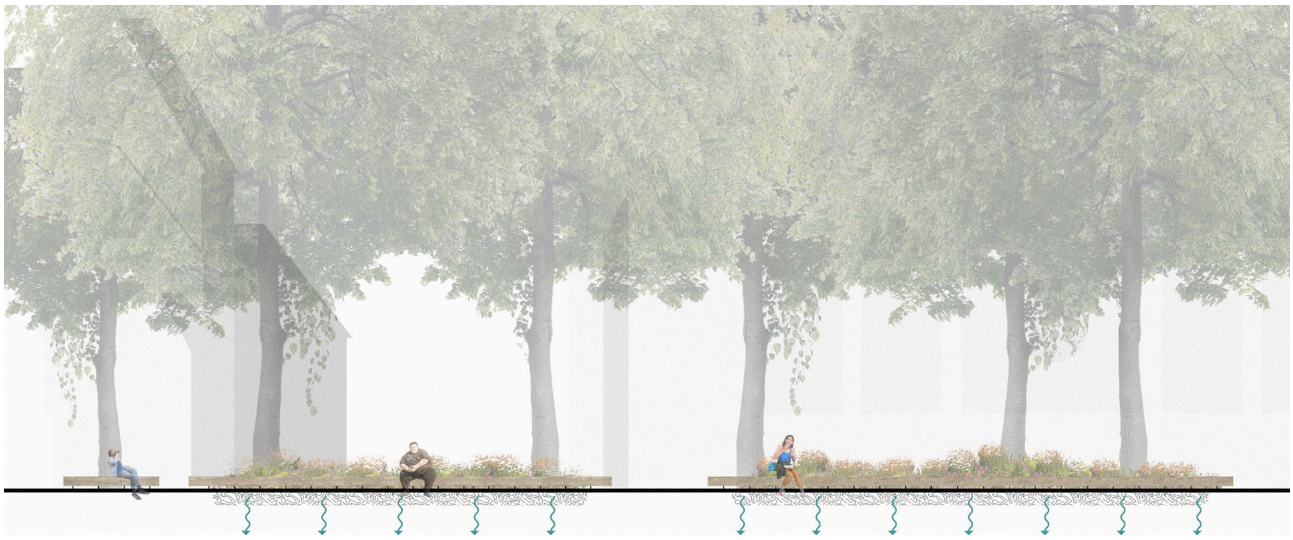


mixture of existing and new pavement



shapes

Pic. 65 Marktkirchhof visualisations.



03.10 RAIN GARDENS PLANTING PLAN

The rain gardens are situated next to the church and the surrounding terrain behind the western face slopes gently into it. The flower beds are made up of part-shade perennials, which can tolerate both shade and moderate sun. The habitat of the existing trees will be improved.

Pic. 66 *Agastache rugosa* 'Alabaster' (1).

Pic. 67 *Anemone hybrida* 'Andrea Atkinson' (2).

Pic. 68 *Aquilegia vulgaris* (3).

Pic. 69 *Aster ageratoides* 'Ezo Murasaki' (4).

Pic. 70 *Aster divaricatus* 'Beth Chatto' (5).

Pic. 71 *Brunnera macrophylla* (6).

Pic. 72 *Geranium* × *cantabrigiense* 'Cambridge' (7).

Pic. 73 *Geranium* × *cantabrigiense* 'Biokovo' (8).

Pic. 74 *Helleborus orientalis* 'Double Green' (9).

Pic. 75 *Hosta* 'Blue Cadet' (10).

Pic. 76 *Iris sibirica* 'Blue King' (11).

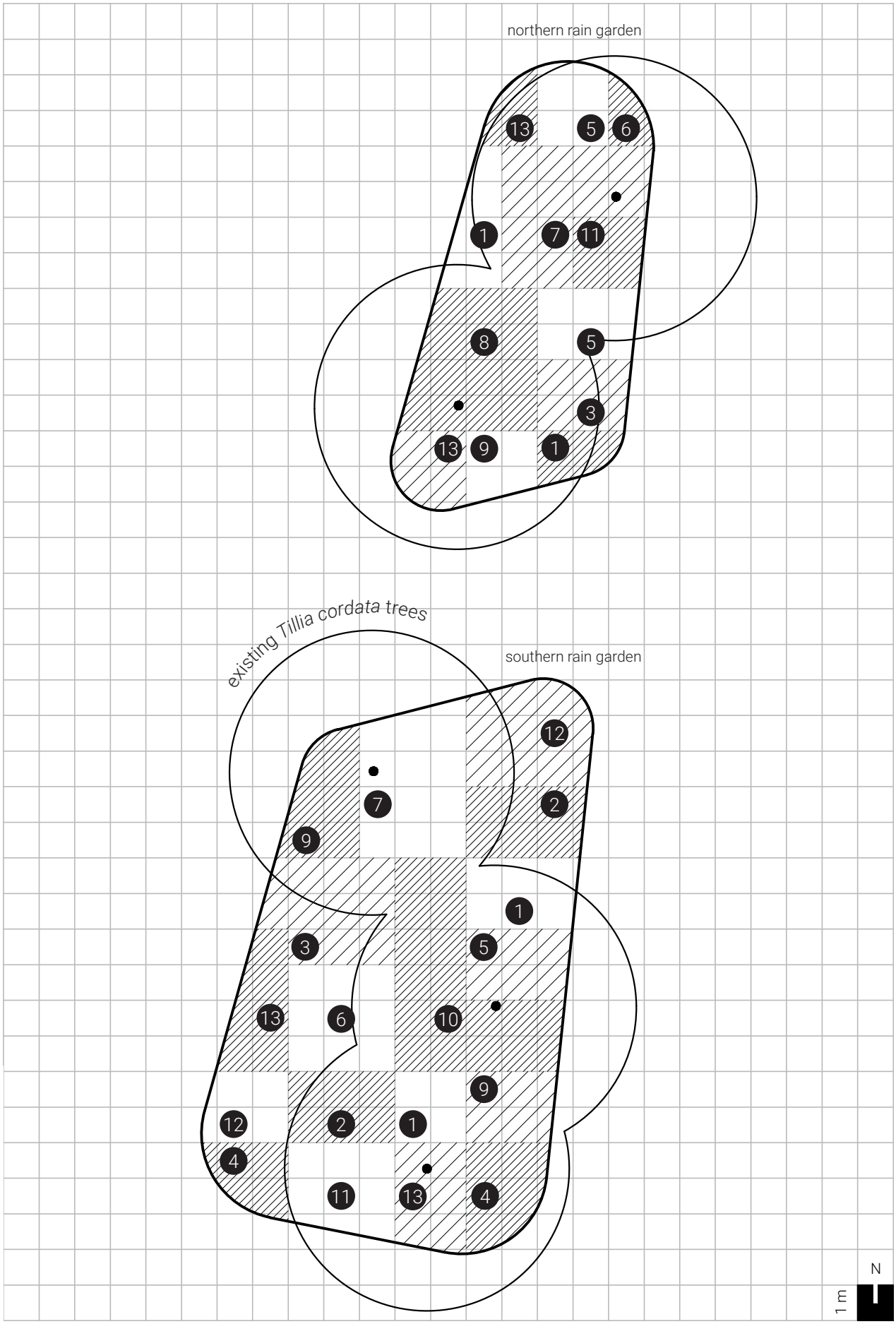
Pic. 77 *Sanguisorba officinalis* 'Rock and Roll' (12).

Pic. 78 *Sesleria autumnalis* (13).

Pic. 79 *Narcissus tazetta* 'Geranium'.

Pic. 80 *Narcissus cyclamineus* 'Tete a Tete'.

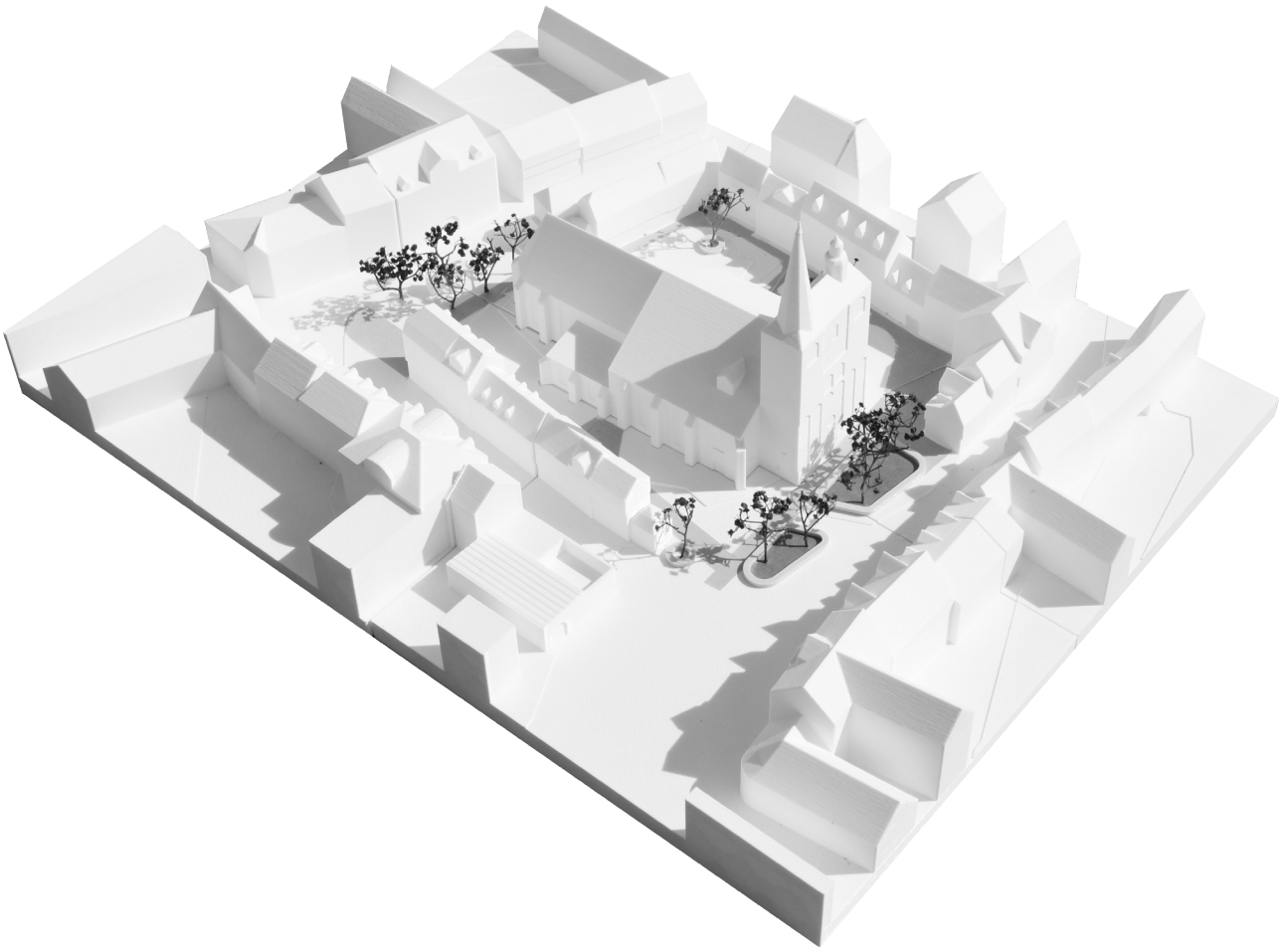
Pic. 81 *Galanthus nivalis.*

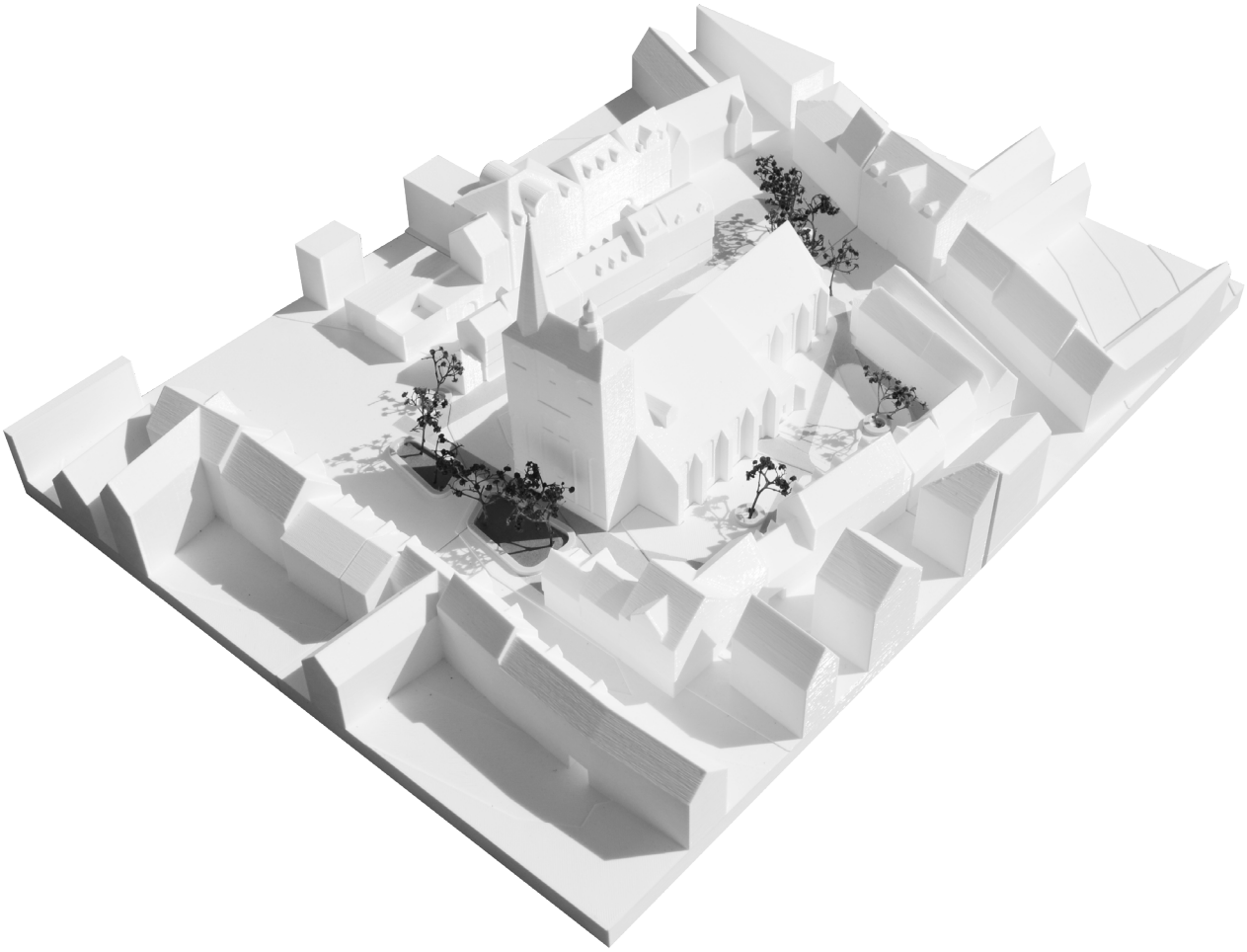


Pic. 82 Planting plan for rain gardens.

03.11 MODEL OF THE MARKTKIRCHHOF

Pic. 83 Marktkirchhof model photos.





03.12 ECONOMIC EVALUATION OF THE MARKTKIRCHOF PROPOSAL

Pic. 84 Marktkirchhof - construction cost.

Construction Cost Projection Based on Schematic Plan
Marktkirchhof

No.	*Item*	*Unit*	*Quantity*	*Unit cost*	*Cost (CZK)*	*Cost (EUR)*
	Preparatory works and demolition					
1	geodetic works	cit	1	4 000 Kč	4 000 Kč	172 €
2	marking out of utility networks and maintenance of their marking during construction	cit	1	2 500 Kč	2 500 Kč	108 €
3	removal of paved areas including foundations and possible curbs	m²	6	550 Kč	3 300 Kč	142 €
4	removal of bollards including foundations, dumping	pcs	10	468 Kč	4 680 Kč	201 €
5	removal of the construction for the trash bins	cit	1	12 500 Kč	12 500 Kč	538 €
6	removal of traffic signs including foundations, dumping	cit	1	3 500 Kč	3 500 Kč	151 €
	Sub-Total				**30 480,00 Kč**	**1 311 €**
	Preparatory vegetation works					
7	treatment of existing trees, including wood chipping and landfilling	cit	5	8 500 Kč	42 500 Kč	1 828 €
8	injection of the tree root system	pcs	5	12 500 Kč	62 500 Kč	2 688 €
9	macroinjection of the trees based on expert opinion	pcs	5	48 000 Kč	240 000 Kč	10 320 €
10	trees protection on site	pcs	5	3 500 Kč	17 500 Kč	753 €
11	care of trees during construction	pcs	5	1 500 Kč	7 500 Kč	323 €
12	airspade excavation to a depth of 60 cm in place of rain gardens	m²	198	7 240 Kč	1 433 520 Kč	61 641 €
13	airspade excavation under existing trees	m²	200	3 620 Kč	724 000 Kč	31 132 €
14	loading of blown soil, removal, dumping	m³	119,4	480 Kč	57 312 Kč	2 464 €
	Sub-Total				**2 584 832,00 Kč**	**111 148 €**
	Construction works					
15	stone paving	m²	1345	2 520 Kč	3 389 400 Kč	145 744 €
16	steel curbs	lm	79	1 100 Kč	86 900 Kč	3 737 €
17	atypical bench including realization	lm	117	10 000 Kč	1 170 000 Kč	50 310 €
	Sub-Total				**4 646 300,00 Kč**	**199 791 €**
	Vegetation works					
18	establishment of a rain gardens layers	m²	198	650	128 700,00 Kč	5 534 €
19	rain gardens - substrate, planting material, mulch	m²	198	1400	277 200,00 Kč	11 920 €
	Sub-Total				**405 900,00 Kč**	**17 454 €**
	Other works					
20	hydrogeological survey, seepage test	cit	1	15000	15 000,00 Kč	645 €
21	movement of materials on the construction site	cit	1	5 000 Kč	5 000,00 Kč	215 €
22	site cleaning during construction	cit	1	5 000 Kč	5 000,00 Kč	215 €
23	transport	cit	1	12 000 Kč	12 000,00 Kč	516 €
24	documentation of the actual execution	cit	1	2 500 Kč	2 500,00 Kč	108 €
	15% Construction contingency	*cit*	*1*	*1 156 052 Kč*	*1 156 052 Kč*	*49 710 €*
	Sub-Total				**1 195 551,80 Kč**	**51 409 €**
Grand Total (without VAT):					**8 863 064 Kč**	**381 112 €**

Prices are in Czech crowns according to Czech standards, conversion to euros is only approximate.
The price does not include the cost of design work, author's or technical supervision of the construction.

**cit - comulative item*
**lm - linear meter*
**pcs - pieces*

DISCUSSION

As mentioned at the beginning, this Master's thesis is a continuation of the work on the analysis and design of the old town of Quedlinburg. It was a documentation originally developed for a student competition organized by the Federation of German Landscape Architects. All supporting documents were provided by this organization. Due to the lack of experience working on projects of similar scale, it was quite difficult to identify some main points to focus on and to develop a workable strategy for the processing of the proposal. It was necessary to consult experts. The author and the thesis supervisor visited the focus area several times at different times of the year and under different weather conditions. These visits helped to explore the focus area in more detail. Before visiting the site, valuable advice was provided by architect B. arch. Peter Bednár (Jakub Cigler Architects) regarding design strategy and the overall thinking about the task. It was agreed that it was necessary to find a larger area that would be a concise point in the proposal and that would link the other smaller interventions. This was followed by a brief consultation about the task with the staff of GFSL landschaftsarchitekten in Leipzig, where the author was an intern. All the information we received helped us to think comprehensively about the work ahead. Subsequently, a site visit was carried out and initial analyses of the area were made.The site was visited together with Prof. Erich Buhmann. He provided some important advice and insights regarding the target area. This was followed by a summary of all the data and a discussion with Ing. arch. Martin Augustin, Ph.D. (supervisor) and Ing. Jindřich Vaňek (architect). It was decided that the proposal should be oriented towards soft water management and should build on existing technical water management measures (underground tanks). The overall design in a first step should have simple concise diagrams with no focus on detail. It is worth noting that in the task for the competition were marked spaces that need to pay special attention. To these spaces was added Wallstraße which, due to its size, became the biggest head gesture of the proposal. After the work was completed, the design was presented to the public and experts, first at the Kulturkirche St. Blasii, then at Quedlinburg City Hall.

It was also decided that the proposal for the student competition would be made into a master's thesis. The task and objectives of the thesis are based on the aim: „The task is to develop ideas on how principles of the sponge city can be implemented in a stone medieval urban structure such as Quedlinburg in order to improve the urban climate. How can stormwater retention, infiltration and evaporation be applied in a protected area?" The proposal is based on the need to bring a natural component to dense urban development, thereby creating an interconnected network of urban infrastructure to enhance the biodiversity of urban flora and fauna. The natural component refers to the use of vegetation, permeable surfaces, application of green roofs, meandering of watercourses, etc.

Due to the complexity of accessing utility networks data and ownership relationships, the proposal does not consider these data. From the beginning the author was focused on conceptual design and wanted to show the possibilities and potentials of the old town of Quedlinburg. The work should be understood as a conceptual vision that is not too detail-oriented. Communication with the various disciplines involved in transportation, utility networks and stormwater management is necessary to create a more detailed solutions.

It must be said that the sociological surveys that were presented in the publication Quedlinburg 2036 (Octagon Architekturkollektiv 2021) were taken into account in the proposal. The design has sought to take into account the requirements of the citizens and visitors to create a connected convenient infrastructure for the urban flora and fauna. In the author's opinion, the infrastructure should not only be functional and easy to use but also sustainable. Overall, the initial intentions have been met and a connected design of soft solutions has been created.

The biggest intervention was made on Wallstraße. It is the street with the widest street profile and a wide one-way flow. Here is an avenue of mature Tilia trees, which is replenished and treated. Stormwater from the surrounding areas flows into the swale and excess water into the sewer. This street should be solved with the traffic engineer. Traffic will be calm here with obstacles with swales and the maximum speed of 30 km/hr. In the author's opinion, Wallstraße, Westraße park, the Northern part of Wallßstrase and the parking house should be solved together in an architectural and landscape competition. The dimensions, floor space, parking capacity and multifunctionality of the parking house is questionable. Parking house not only for parking but also for people to stay (green roof with cafe). It is a difficult task to design a building of such dimensions in an old city of such importance, but with the help of a good architectural competition a functional design can be achieved.

CONCLUSION

In Wordgarten park, the main intervention is the revitalisation of the Stiefelgraben stream. During visits to the town, the small amount of water in the stream was noticeable. Still, the creation of a natural shape to the stream should enhance biodiversity and make it more pleasant for visitors. It is necessary to have a water management expert's comments on this part of the area in order to develop a strategy. The walls along the stream are foundation protected, therefore the design of the stream access should be handled very sensitively.

Around the Marktkirche St. Benedikti on Marktkirchhof two rain gardens were designed into which the surrounding rainwater is drained. The terrain from the church slopes down to the beds. For this solution it is necessary to check whether the increase in moisture that will accumulate in the rain gardens will not damage the foundations and walls of the church.

Other designs focused on applying much more vegetation, permeable surfaces and water access. Green roofs are also applied where necessary. These solutions are necessary because the old town has dense urban development, little vegetation, and as mentioned, the stream is walled off in most places. A more detailed analysis of these sites is needed as well as promotion of the application of green solutions to private gardens.

The proposal was developed as a conceptual schematic design and may be useful for future architecture and landscape architecture competitions that will focus both on the old town of Quedlinburg or the entire town. The work would also be beneficial in refining objectives in the future development of the old town.

From the author's point of view, this work is beneficial as a conceptual design for improving the urban microclimate and green infrastructure of Quedlinburg's historic core. It would be possible to further elaborate on these proposals in more detail and to determine the limits of application of each intervention. Also, this work could be used in the design of a spatial plan for the entire town and the creation of a connected urban infrastructure of Quedlinburg.

This master's thesis was focused on the old town of Quedlinburg. The aim was to find solutions that could improve the green infrastructure and water management of the old town. This is based on the fact that there are little green spaces and permeable surfaces in the historic core.

The design was preceded by an analytical part where the old town was described from an urban, historical, natural and social points of view. Solutions for soft stormwater management were also described, on the basis of which the author created a conceptual design with individual measures for different locations of the focus area. Completed and upcoming projects related to the aesthetic and technical aspects of Quedlinburg's public spaces were shown. Together with field surveys and expert feedback from professional architects and landscape architects a landscape concept for the focus area of the old town of Quedlinburg was developed.

In the proposal the author focused on different areas in the focus area and created a vision for each of this spaces. The author tried to support the positive aspects of the current state and eliminate the negative ones. Th effort was to connect the urban structure with nature and also to satisfy all visitors of the old town of Quedlinburg.

The overall work has the character of a conceptual schematic design, the aims of the work have been achieved.

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