

**REPROFILING  
THE SAVA RIVER  
IN ZAGREB**











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# REPROFILING THE SAVA RIVER IN ZAGREB

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Institute of Urbanism



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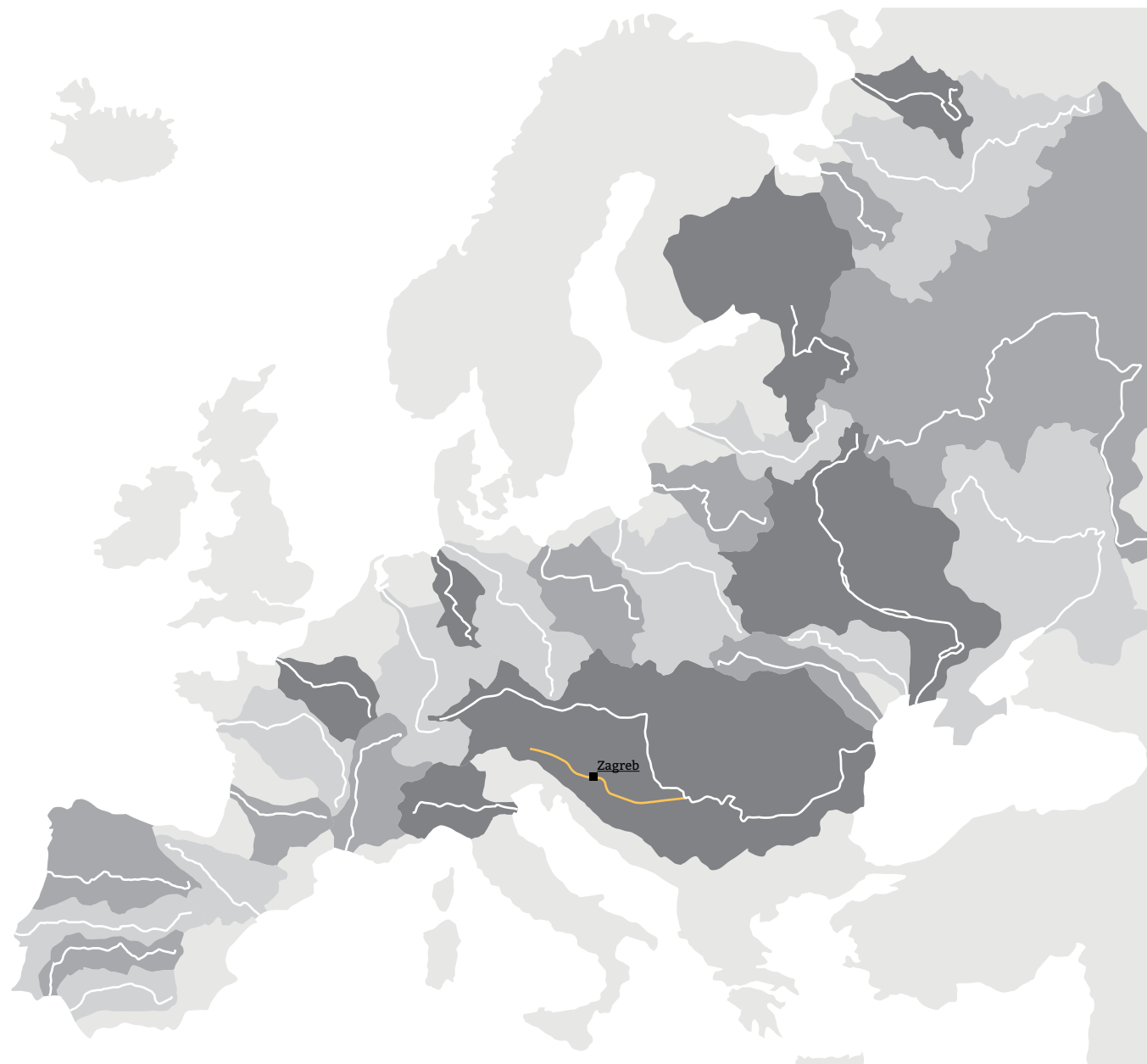
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# INTRODUCTION

01





Illustrated map of the  
basins of the biggest  
rivers in Europe.



Zagreb is the capital city of the Republic of Croatia and is located on the southern slope of the Medvednica mountain on the edge of the Pannonian Basin and has been the center of the European powers and multinational states in the past ( Roman, Byzantine, Habsburg, Ottoman, Soviet and Yugoslav Union ).

In the 18th and 19th centuries, Zagreb was an important part of the outer border of the Habsburg Empire (vojna krajina) to the Ottoman Empire. During this time the area was very unstable and there was a constant change in the borders. Zagreb was an important hub for cultural and ethnic overlaps.

The urban city of Zagreb is a city of modernism. The city grew from 3 sqkm in 1890 to 500 sqkm in 1990. The population grew in the same time period from 39,000 to 850,000 inhabitants.<sup>1</sup>

For a long time, the areas along the Sava River and the areas south of the river were not taken into account by urban designers, but anyway the Sava River had an impact on the urban fabric of Zagreb. Annually floods made and still make a flood protection necessary.

For that reason, the Sava River has been regulated through the whole length of the city. The regulation persists of embankments and 100-meter-wide riverbanks on both sides of the river. Over the years, a lot of floods occurred. One happened in the year 1964 and bursted dikes on several places and a huge area was covered with water and mud. A lot of buildings were destroyed. To prevent further floods, the city started to build higher embankments which made the Sava feel even more like a barrier in the city. This barrier prevents further urban developments on both sides of the river and splits the city. Over the years, a lot of discussions about future developments and sustainable flood protection took place.

Now there are plans for making a new channel that creates a sidearm of the Sava. Also a couple of power plants along the river are proposed, not only to generate energy, also to regulate the water level, the program is called „Zagreb na Savi“ and gives the city of Zagreb the opportunity to transform the existing riverbanks of the Sava River. This is also the chance for the city to create to a stronger relation between the city and the river.

<sup>1</sup> *ct. Blau & Rupnik, 2007, p. 8-24*

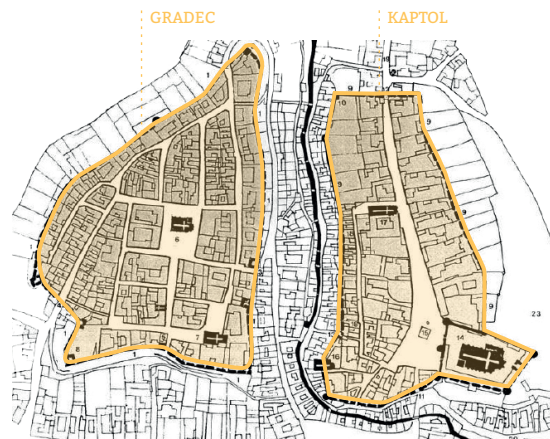




**ANALYSIS**

**02**

## TIMELINE



In 925, the kingdom of Croatia was founded. It already included almost all parts of today's Croatia. Central Croatia, Slavonia, parts of Dalmatian and Bosnia.<sup>2</sup>

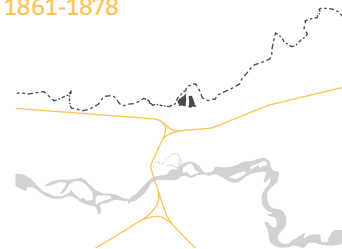
In 1527, Ferdinand I of Habsburg was elected as King of Croatia and Hungary, which was considered as a counter-measure for the defense against the Turks. This established the role of the Habsburgs in Hungary and also Croatia.<sup>3</sup>

1848



Originally, there were two independent cities, one consisted of the civil union Gradec and the others from the episcopal Kaptol and the periphery housed many different ethnic and national groups, which often led to violent conflicts.<sup>4</sup>

1861-1878



In 1861, the railway from Vienna and Budapest were started to get built without taking the city of Zagreb into account. One route connected Vienna to the Adriatic Sea and another one connected Budapest with the port of Rijeka and the industrial area of Karlovac. The exact guidance of the railway influenced the urban development of Zagreb.<sup>5</sup>

925

1527

1861

<sup>2</sup> ct. Gattermann, 2011, p. 30-31

<sup>3</sup> ct. Gattermann, 2011, p. 68

<sup>4</sup> ct. Blau & Rupnik, 2007, p. 8-24

<sup>5</sup> ct. Blau & Rupnik, 2007, p. 8-24



The first urban development plan was established in 1865, with the aim of replacing the older parts of the city with new buildings, which nevertheless should blend harmoniously into the old areas.<sup>6</sup>



□ Austrian Empire  
■ Kingdom of Croatia and Slavonia

1865

1867

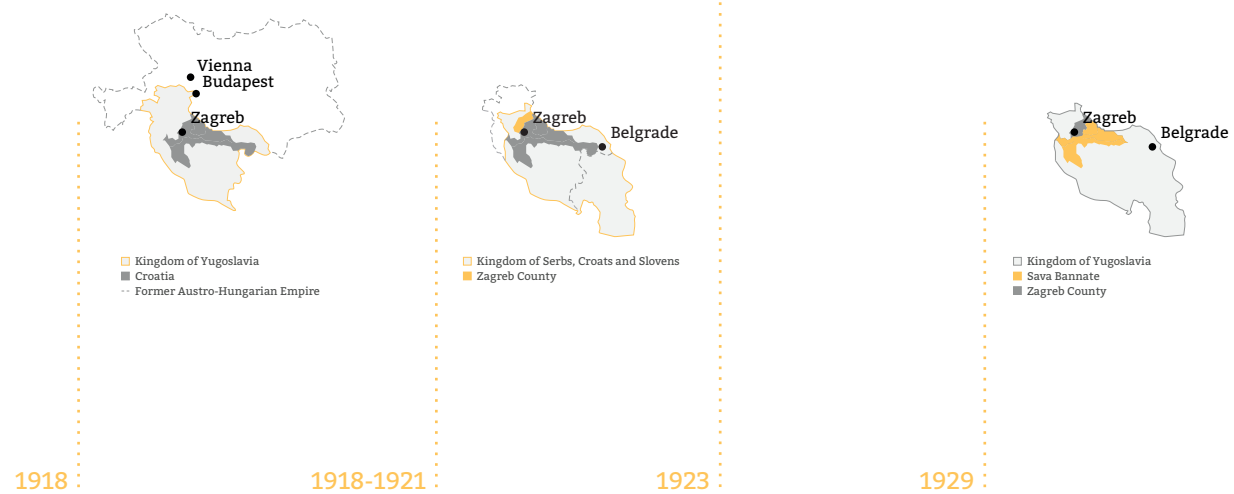
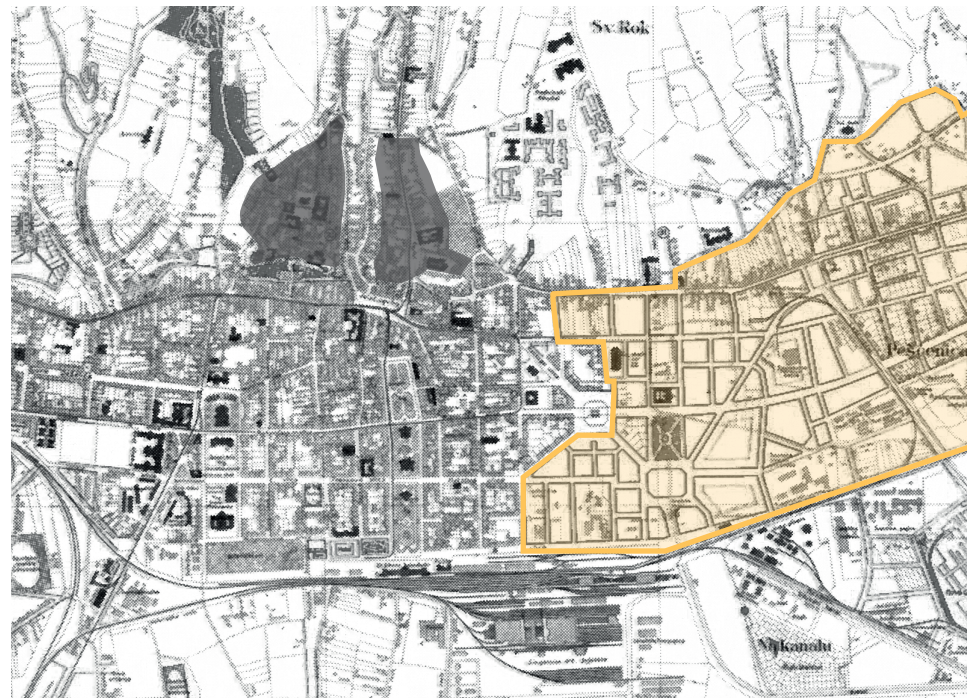
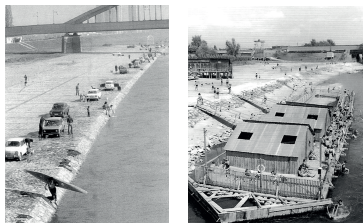
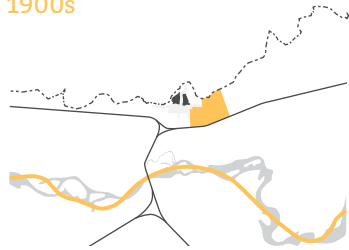


□ Austro-Hungarian Empire  
■ Kingdom of Croatia and Slavonia  
— Border of Austria and Hungary

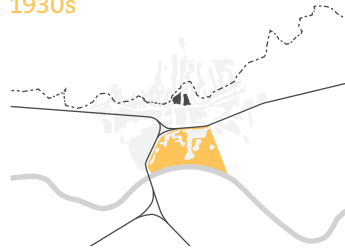
1878-1882

<sup>6</sup> ct. Blau & Rupnik, 2007, p. 8-24

1900s

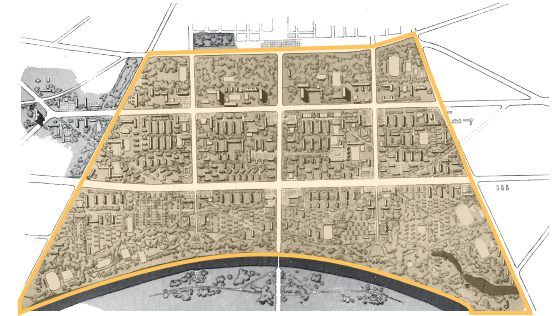


1930s

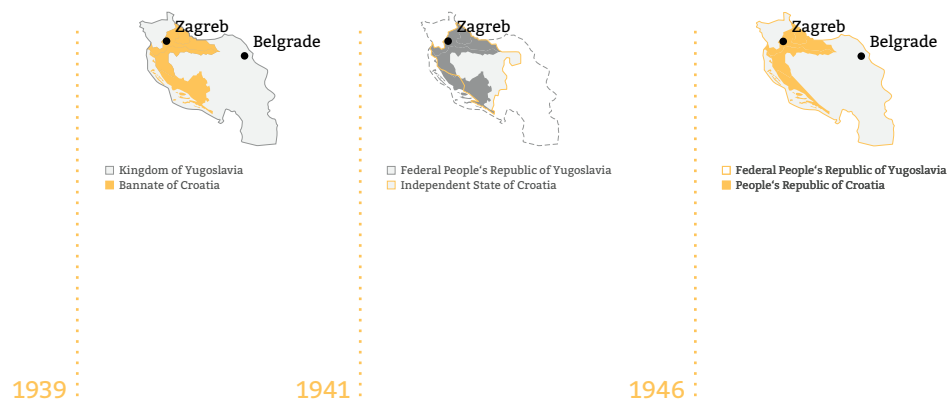


In 1930 an international competition for a new regulatory plan was launched. This plan should also take into account the areas between the railway line and the Sava (Trnje).

1947

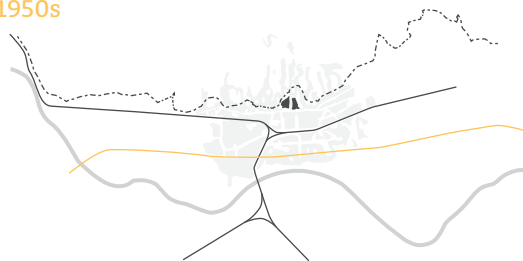


The first general plan was created in 1947 by Vladimir Antolić, the chief planner of the Socialist Republic of Croatia. The plan showed a socialist city with a new center between the railway line and the Sava, on an east-west axis and built on the regulation plan of 1936/1940. The general plan was never accepted formally, but in the fifties and sixties, it was expanded further piece by piece.



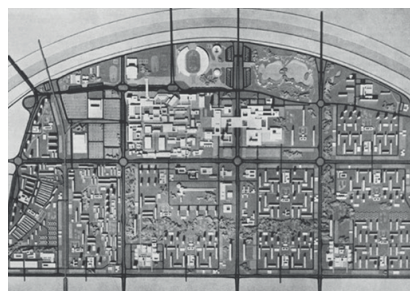
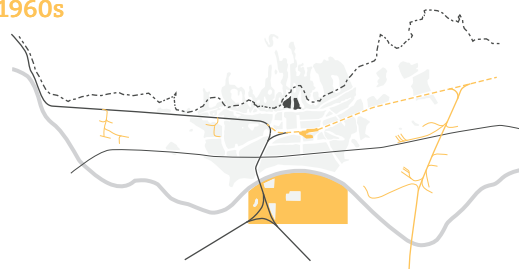


1950s



The brotherhood and unity highway connects the cities Ljubljana, Zagreb and Belgrade.

1960s



□ Federal People's Republic of Yugoslavia  
■ People's Republic of Croatia  
■ Annexion of Istria

1954



□ Socialist Federal Republic of Yugoslavia  
■ Socialist Republic of Croatia

1963

The Zagreb Fair was moved to an area south of the Sava with pavilions of the different nations. The density of the fair ground was supposed to be the new center of Novi Zagreb and the development of the Fair made it possible to build the infrastructure which laid the foundations for urban development in Novi Zagreb. In contrast to other trade fairs, the Zagreb Fair was not a unique event, such as the Olympic Games, but a permanent event. This gave Zagreb the opportunity to keep in touch with the rest of the world and allowed the city to open itself to new technological and cultural innovations.<sup>7</sup>

<sup>7</sup> *cf. Odak*, 2001, 42-45

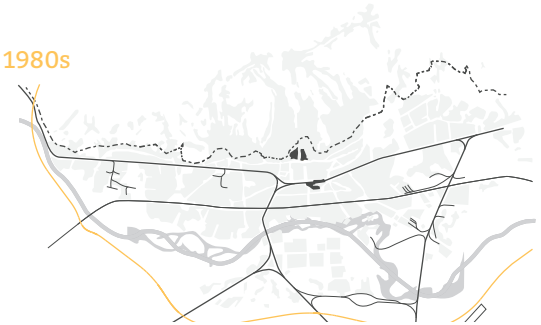


1970s

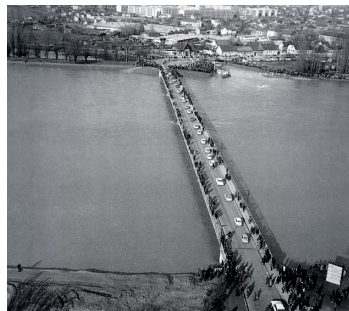


The airport and the rail junction were constructed.

1980s



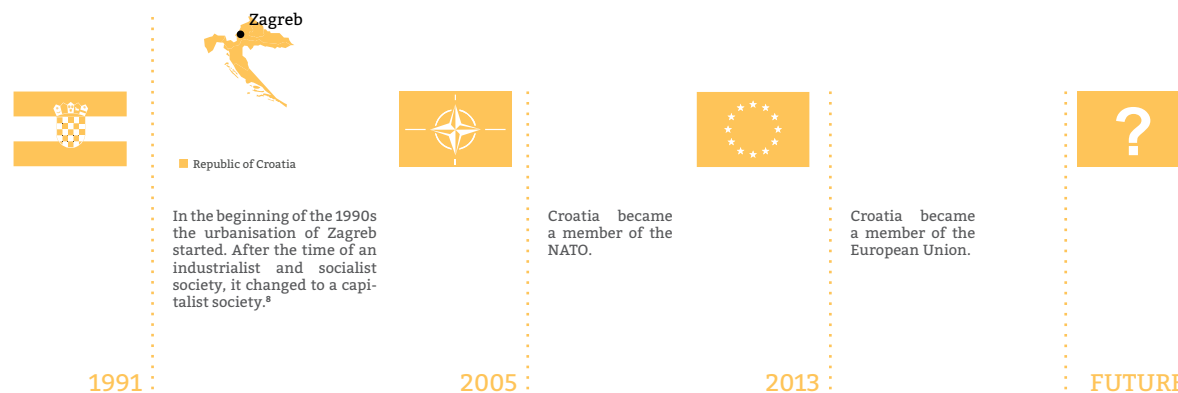
Highway A1 construction begins.



The great flood in the year 1964

1964





<sup>8</sup> *cf. Odak, 2001, 42-45*



## DEMOGRAPHIC DEVELOPMENTS AND ITS IMPACT ON CROATIA

Croatia is a thin populated country, its population is estimated at 4.25 million, its population density is 76 per sqkm. The largest city, which is also its capital is Zagreb with about 790.000 people. The second largest city is Split with a population of only 128.000 people. Over 90% of the population of Croatia are Croats and 86% are Roman Catholic.<sup>9</sup>

In the last 150 years, multiple elements, like immigration, two world wars and the war in Yugoslavia had a big impact on the population development. Over the last 150 years the growing population was less important than in other European countries, anyway it doubled its population in that period.

The first phase of demographic change was caused by natural changes by the end of the 19th century. In the beginning of the 20th century emigration increased, until the outbreak of the First World War and the Spanish Flu, which caused a shrinking population growth. After a slight recovery in the 1920s, war again followed and caused a second drop of the population. The rapid growth of the 60s and 80s was slowed down by the natural change, which can be linked directly to a de-

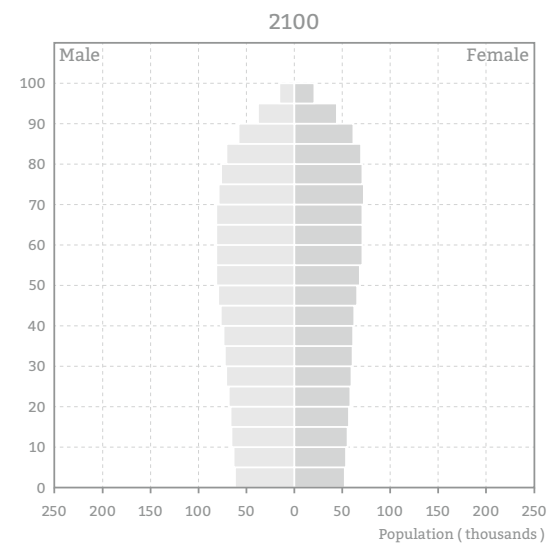
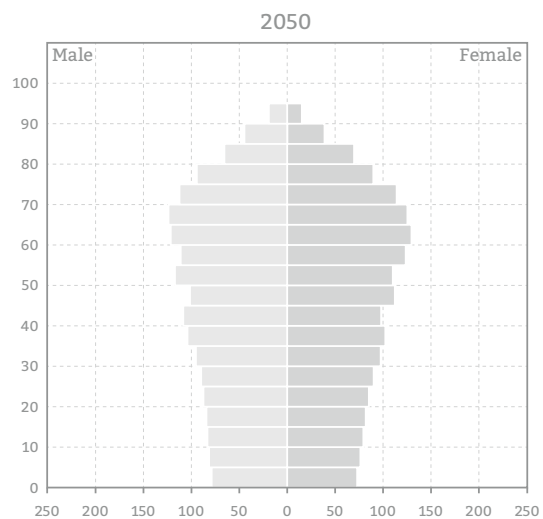
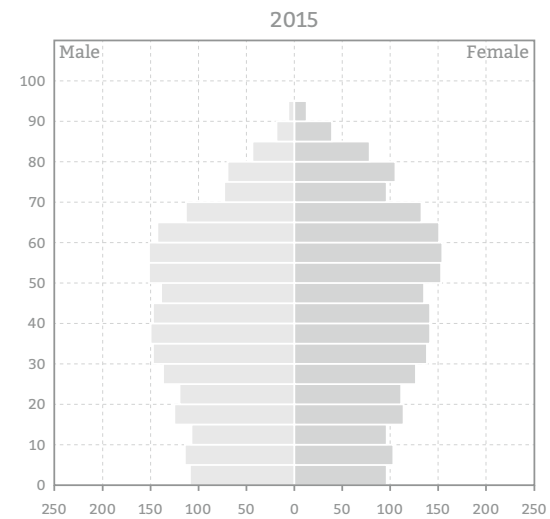
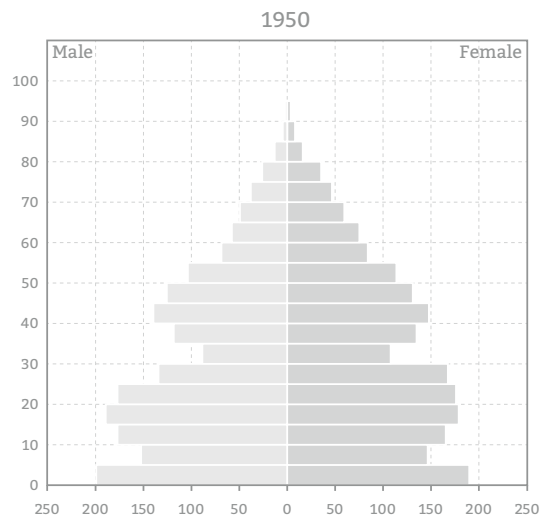
crease of birth rate and emigration of “temporary workers”. This resulted in an increasing demographic transition. The low rate of births stood in contrast to the economic development of this time. The war in the 1990s caused another shrinking of the already weak population rate. After the war the population declined by nearly two-third. This long term shrinking of the population, had many negative consequences, such as reduction of the core population, which caused a generation of less active working population and an increasing care need of older population, which meant economic and social loads for the state budget, such as pension insurance, social and health care of the elderly.

Beside of Croatia declining population also in other countries, which are part of the European Union, can be seen. There are three major processes: ageing, natural depopulation and spatial polarization of the population.

The rise of the life expectancy is one of the driving forces of ageing in the population, you see that process, by comparing the average age of today, which is 41.7 years and the average age of sixty years ago, which was 30.7 years.<sup>10</sup>

<sup>9</sup> ct. <http://worldpopulationreview.com/countries/croatia-population/>

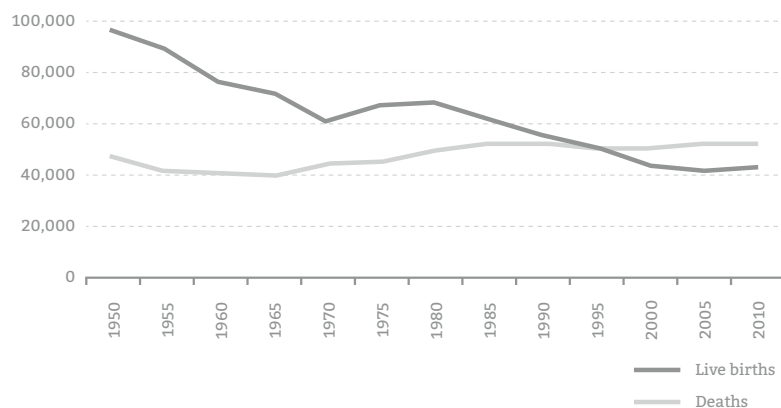
<sup>10</sup> ct. <http://www.croatia.eu/article.php?lang=2&id=14>



In Croatia, almost a quarter of the population is over 60 years old, which were 12% sixty years ago. Only 15% of the population today is at the elementary school age, which was 27% sixty years ago. There is a strong connection between birth rate and death rate. Quite all western countries are struggling with a higher death than birth rate, which causes an ageing of the population. Croatia is suffering a constantly falling rate of birth since the 1950s and a rising death rate.<sup>11</sup>

The fertility rate is just 1.5 children per woman, which is one of the lowest in the world. The death rate is exceeding since 1991. Croatia is one of the fastest shrinking countries in the world, its current rank is 14th.<sup>12</sup>

The ageing of the population is one of the most important trends in the last century and also it will be one of the biggest challenges in the future. If the rate of births is falling further and the death rate is not dropping, the ageing of the population will continue. The process of an ageing population is a global phenomenon, which has its fastest progress in developing countries, even those with a large youth population. There is a high potential of using the contribution of older people to society, such as caregiving, volunteering and passing cultural traditions to younger generations. An ageing population also has to face a lot of disadvantages, because elderly people may have a weak social support network or a lack of income. This can cause social discrimination



<sup>11</sup> ct. <http://www.croatia.eu/article.php?lang=2&id=14>

<sup>12</sup> ct. <http://worldpopulationreview.com/countries/croatia-population/>

and abuse. A fundamental goal is to keep the health, safety and independence of older people, but even if elderly people stay healthy, the ageing has a big impact on their needs. There will be new public policies and programs needed, which take care about the needs of older people, who cannot afford health care. That, for example, means affordable housing and accessible transportation. These factors can keep people actively be part of a social life. Also, the traditional family support network will require support in caregiving, because typically the family is taking care about their older relatives.<sup>13</sup>

Social pensions can protect from poverty and not only the older people themselves, it also would support the whole family household. This source of income can also help to balance the gender relation, because women tend to live longer than men.<sup>14</sup>

It will be very important to take care about demographic predictions for the City of Zagreb and it will be a big challenge to prevent people to emigrate. For those reasons, all needs of both young and old people have to be taken

into account. Especially to prevent emigration the young generations have to be supported in different ways. It will be essential to convince the government about the importance to focus on affordable housing and financial support. Especially, the young generations need financial support on their first steps in establishing their future.

The government is in charge to make the City of Zagreb more interesting for international companies and especially for firms in the European Union. This would give Zagreb the opportunity to become an important south-east business hub for the European Union. Improving educational and medical facilities the city can also be interesting for students and young people in the surrounding countries. This would not only prevent emigration, it will rather force immigration of well educated young people, raising the diversity not only in universities, but also on the job market. New companies create new jobs and prevent young people to go abroad to work in other countries and help the economy growing. An increasing population would lead to a change the aging of the population.

<sup>13</sup> *ct.* <http://www.unfpa.org/ageing>.

<sup>14</sup> *ct.* <http://www.unfpa.org/ageing>

## GEOGRAPHIC DESCRIPTION OF THE SAVA

The Sava is a tributary of the Danube and stretches over a length of 945.5 km, more than 562 km in Croatia. Beside the Tisa Basin, the Sava Basin ( illustration on the right page ) with a catchment area of about 100.000km<sup>2</sup> is the second largest basin of the tributaries of the Danube. Measured by the average flow velocity, which is about 1570m<sup>3</sup>/s it has almost the double flow velocity than the Tisa, which is only 810 m<sup>3</sup>/s. The origin of the Sava is in Slovenia in the Julian Alps. In addition to Slovenia and Croatia, the river also flows through Bosnia Herzegovina and Serbia, where it flows into the Danube in Belgrade. There are more than eight million people living in the Sava Basin.

Still a lot of parts of the Sava are still a free-flowing river with natural floodplains.<sup>15</sup>

The Sava Basin can be separated into three reaches, the upper, middle and lower reach.

The upper reach, which proceeds from the origin to the city of Zagreb, includes the two spring branches, the Sava Dolinka and the Sava Bohinjka. After the confluence of the branches, the character of the scenery chan-

ges from alpine to subalpine. The first natural floodplains are located shortly before the Sava reaches Zagreb. This is also where the strong river regulation and the middle reach starts. It stretches from Zagreb to Jasenovac, where the Una confluences into the Sava and the lower reach starts where the Sava shapes the border between Croatia and Serbia and ends where the Sava confluence the Danube in Belgrade.<sup>16</sup>

The lack of collaboration between the four countries among the Sava causes that each country is focusing on their own goals to achieve flood protection. There is no overall program for the whole Sava River and so over the last decades more and more river regulation took place and cut off natural floodplains from the river. The lack of floodplains causes a higher water level, which causes a higher risk of flood events today and influence the micro-climate of the Save. Only five areas along the Sava are designated as nature reserves.

Another challenge is buildings, which are built within the HQ100 area and are at risk of getting flooded during a 100 year flood event.

<sup>15</sup> *cf. Schwarz U, 2016, P.15-16*

<sup>16</sup> *cf. ISRBC, 2014, P.3*





## HYDROMORPHOLOGICAL CONDITIONS OF THE SAVA RIVER

Environmental experts claim that the reason for increasing and especially the irregular repeating of flood events in the last decades is not only caused by nature, it is rather caused by the influence of human interventions. For a classification of a river, the European Standard (WFD) recommends a table with five types to show hydro morphological conditions.<sup>17</sup> At the moment 582 damming and river regulation proposals are running in the Sava Basin and will decline the situation of the River.<sup>18</sup>

In the upstream of Zagreb 29 hydropower plants are already located. They cause a sedimental removal, which leads to a drop of the drinking water level. In the area between Zagreb and Sisak a new river bypass is projected and seven new hydropower dams are proposed. This will not only have a strong influence on the future development of the ecological system, but also have a deep impact on the characteristics of the Sava. The projected plans for a commercial waterway between Sisak and Belgrade will provide a strongly modification of the lower reach of the Sava, which is at the moment only slightly modified. The result of the hydromorphological assessment show a difference between the official evaluations of the Sava Commission's Management

Plan in 70% of the courses of the river. „It seems that the Management Plan tries to pave the way for positive decisions on planned navigation and hydropower development by including future negative effects in the current evaluations of the hydromorphology of the rivers. Sections of the middle and lower Sava were rated almost entirely as ‚potentially heavily modified‘ and were therefore not assessed in detail.”<sup>19</sup>

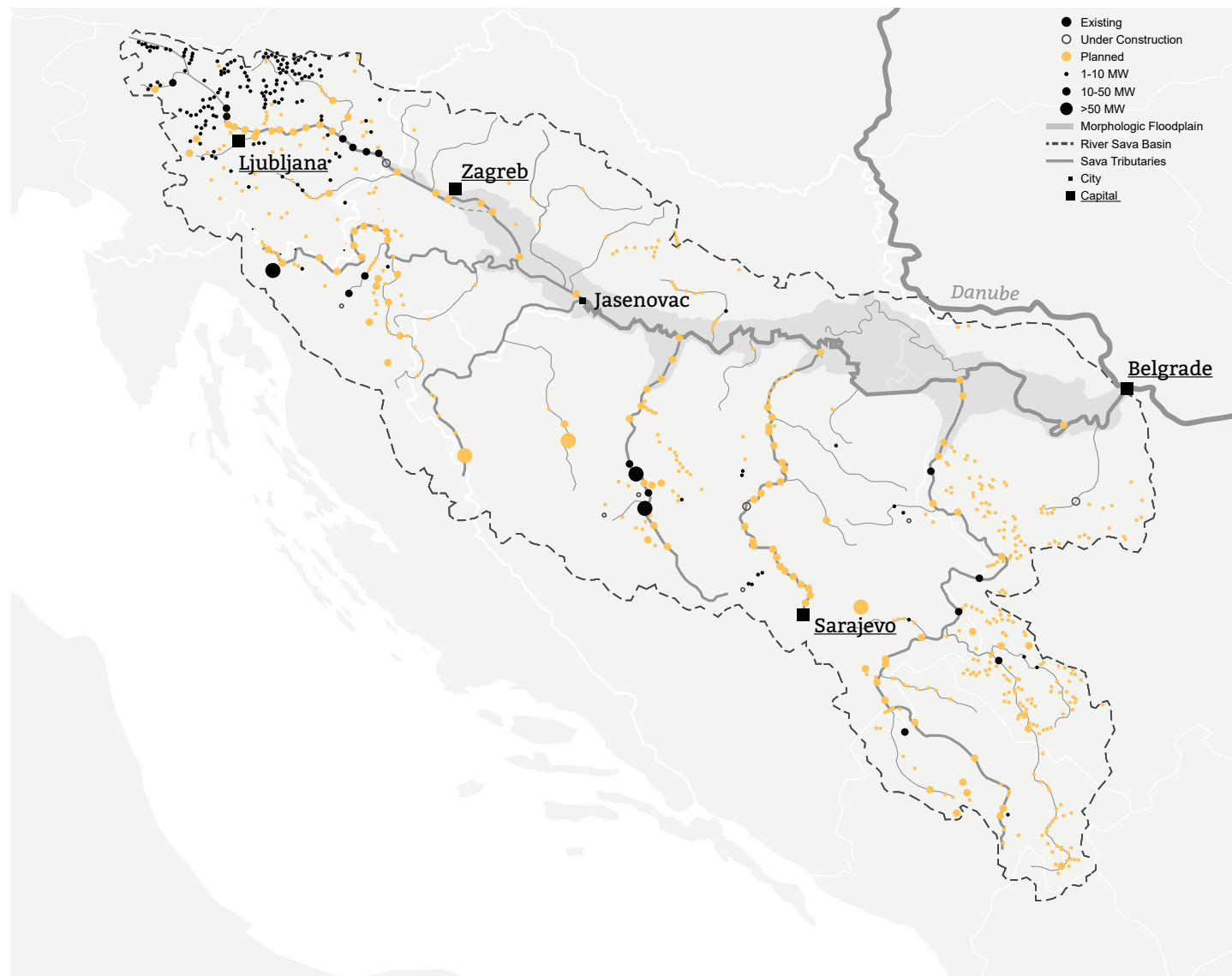
For this reason, nature should be taken more into account. Future developments offer a huge potential by implementing alternative solutions, such as reactivating former floodplains, creating of new wetlands and especially in giving back more room for the river what can be used as retentions during an inundation event and can highly decrease the impact of those events.

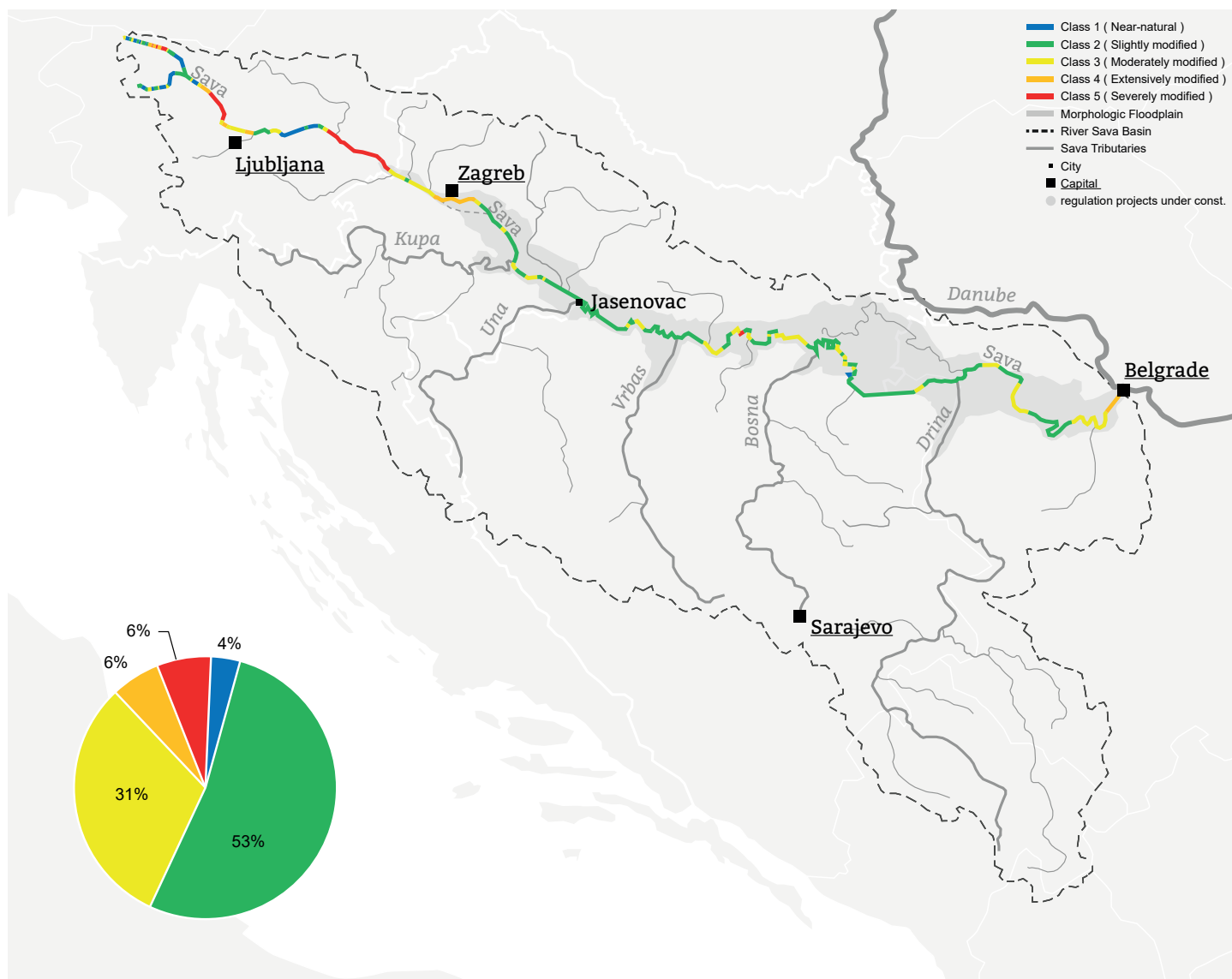


<sup>17</sup> *cf.* CEN/TC230 2011, P.20

<sup>18</sup> *cf.* Schwarz U, 2016, P.54

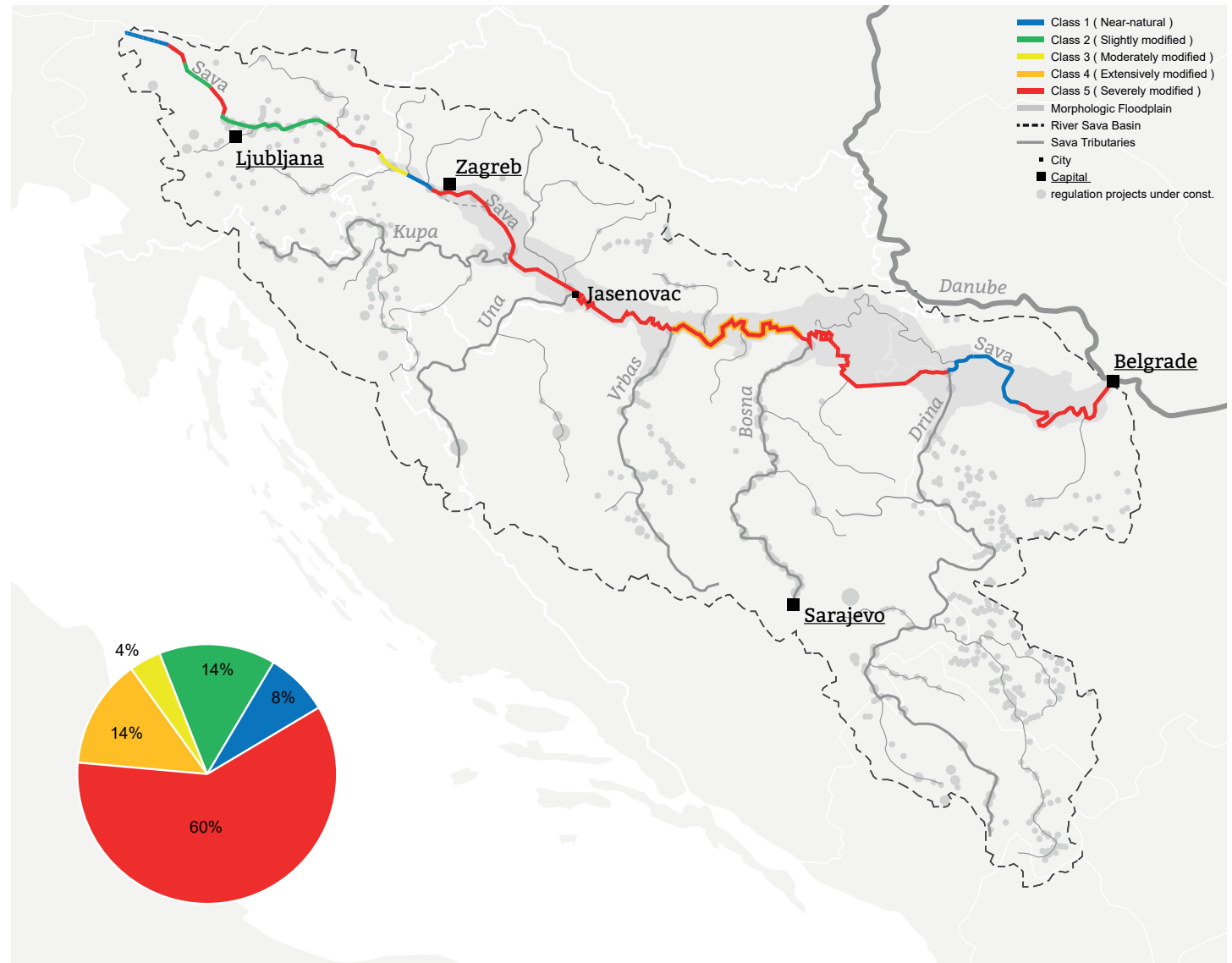
<sup>19</sup> Schwarz U, 2016, P.46





Hydromorphological  
Conditions of the Sava  
- Hydromorphological  
Assessment made by  
the Sava White Book

Hydromorphological  
Conditions of the Sava  
official Sava Commis-  
sion Management Plan

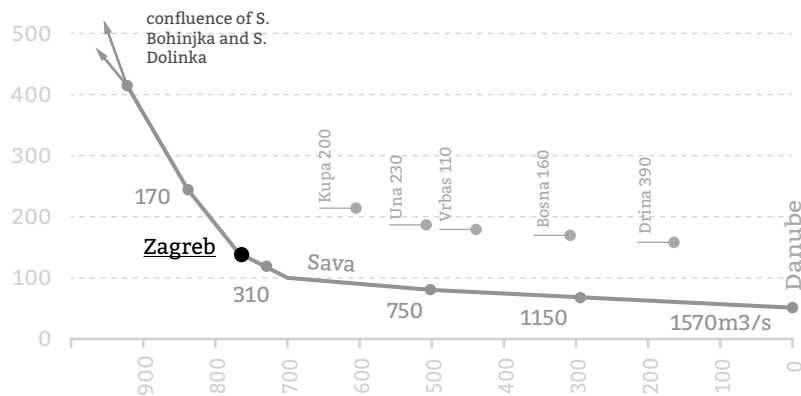


## BIODIVERSITY

The longitudinal profile of the Sava shows that the gradient downstream of Zagreb is very small. The difference in the altitude is only 35 meters by the distance of 660 km, until it flows in the mouth of the Danube.<sup>20</sup>

Along the Sava River the vegetation is mostly aquatic and wetland, especially the middle and lower reaches, where the floating speed is lower. The huge variety of plants in the wetlands not only work as a natural filter, to filter nutrients out of the water, they also decrease the sediment removal of riverbanks and reduce the impact of floods, by absorbing flood and rainwater. Beside the diversity of plants, the sensitive ecological systems of wetland are

also the habitat of a variety of animal species. This biodiversity is a very sensitive system and has to be protected, where already small interventions have an impact. The Sava basin houses an enormous number of bird species like the Eurasian spoonbill, grey heron, white stork, black stork and so on. Birds are used to live in natural habitats and are indicators for a well balanced ecological system. They are using the small islands of sand or gravel stones for breeding. The total breeding population along the Sava is about 3000 pairs, but upstream of the confluence of the Una is two thirds of the total population and this includes the areas around Zagreb. The bird habitats are overlapping with the floodplain areas.



<sup>20</sup> cf. Schwarz U, 2016, P.15-16

The riverbed has a rich fauna of aquatic species and a wide spectrum of microorganisms which are an important part of ecological processes and they are barely explored yet. The most common trees in the forests of Croatia are beech, common oak, durmast oak and common hornbeam.<sup>21</sup>

The Sava houses different kind of fish species, one of which is the huchen, which only occurs in freshwater rivers. The only area, where the huchen can naturally be found worldwide is

the Danube basin, but damming and regulation of the river cause a shrinking of the huchen population. Today almost two thirds of all huchen populations are living in the Sava and its tributaries. There are about 43 self-sustaining huchen populations and one populations can stretch over more than 100 km.<sup>22</sup>

The biodiversity is enormously important and is at risk of being destroyed by continuously river regulations.

Ordansko polje, a near natural floodplain, in the upstream short before the town of Sisak.



<sup>21</sup> *ct. State Institute for Nature Protection, Ministry of Culture - Republic of Croatia, 2006, P.32*

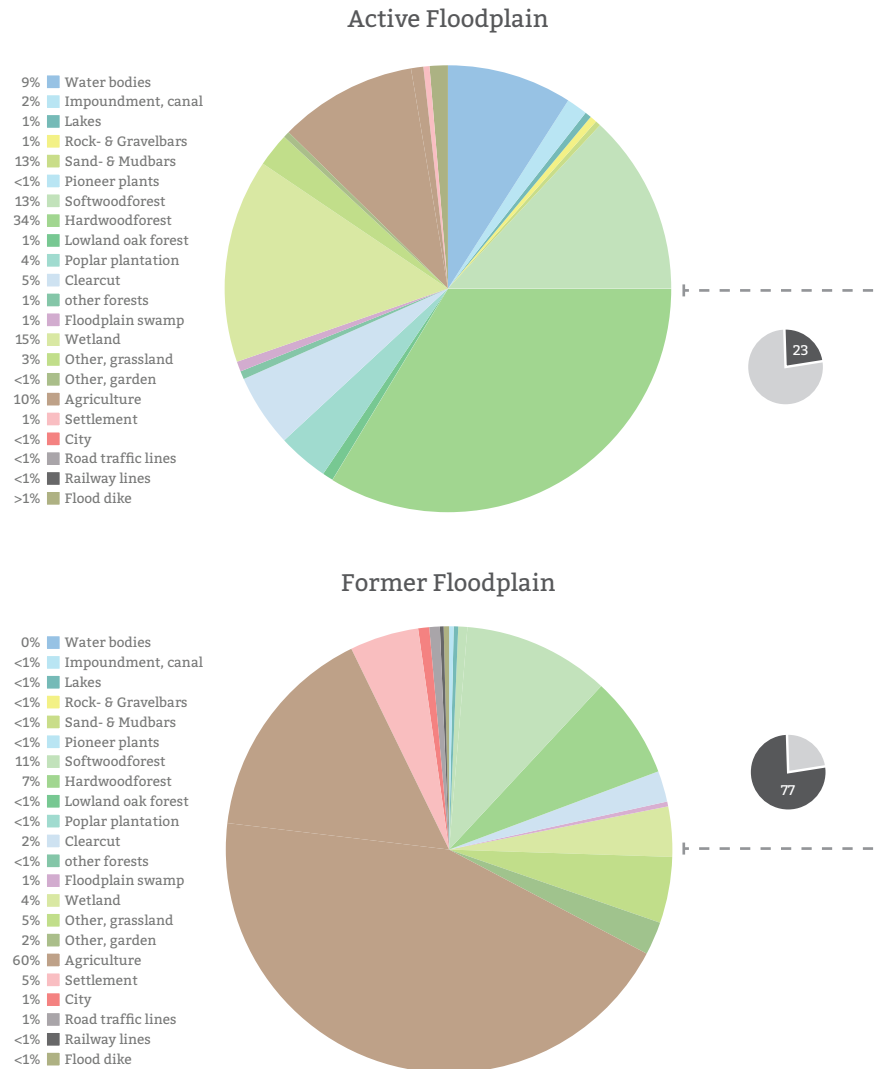
<sup>22</sup> *ct. Schwarz U, 2016, P.20-23*

## LAND USE

In the Sava White Book the first analysis in terms of land structure was made and shows the imbalance of active floodplain ( 23% or 206,725ha ) and former floodplain ( 77% or 687,625ha ). Active floodplains are regularly flooded during flood events. The Former floodplain have no connection to the river anymore, they are cut off by dike and river regulations. The changing of the land use and vegetation has an impact on the dynamics and the floodplain of the Sava River.<sup>23</sup>

The overall area, which also includes the lower courses of major tributaries represent 894,350ha. 50% is used for agriculture and 7% are settlements and infrastructure and 43% are typical large river land use types.

Especially in the two circle diagrams of active and former floodplain the influence of man-made interventions is visible. More than half of the former floodplains are used for agriculture.

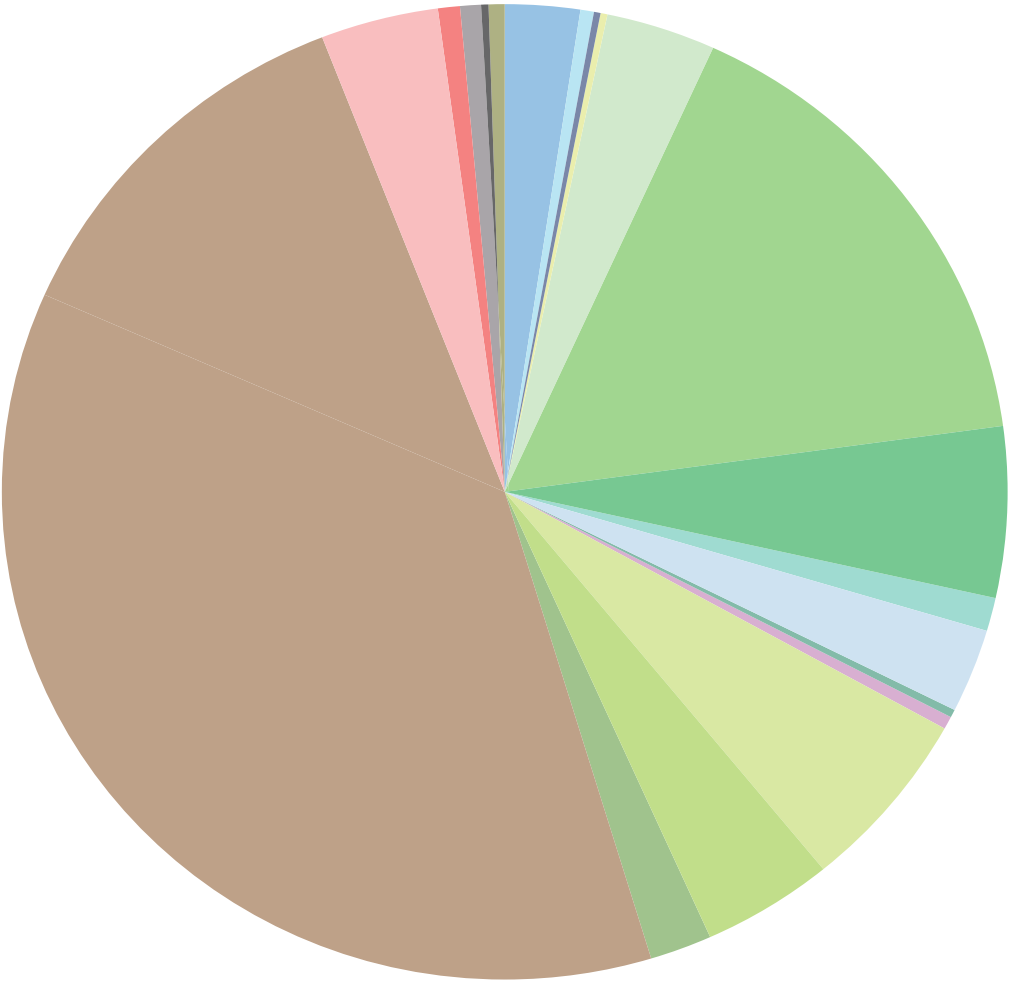


<sup>23</sup> ct. Schwarz U, 2016, P. 28



Active & Former Floodplains in total

- 2% Water bodies
- <1% Impoundment, canal
- <1% Lakes
- <1% Rock- & Gravelbars
- <1% Sand- & Mudbars
- <1% Pioneer plants
- 2% Softwoodforest
- 4% Hardwoodforest
- 6% Lowland oak forest
- 1% Poplar plantation
- 3% Clearcut
- <1% other forests
- <1% Floodplain swamp
- 6% Wetland
- 4% Other, grassland
- 2% Other, garden
- 60% Agriculture
- 4% Settlement
- 1% City
- 1% Road traffic lines
- <1% Railway lines
- <1% Flood dike







## FLOOD PROTECTION IN ZAGREB

03

## IMPACT OF INUNDATIONS IN THE PAST AND TODAY

The Sava reaches the Zagreb region in the north-west, before the river changes its flow direction from north-west to east, the Sava flows through an unpopulated area ( Sava-Zaprešić, Sava-Strmec ). This area is and has been used as a natural flood protection area, where the space beside the Sava is wider than through the city. In this area the embankments for the flood protection are beginning to shape the profile of the Sava. The embankment system leads through the whole city of Zagreb and has an average wideness of about 300m.

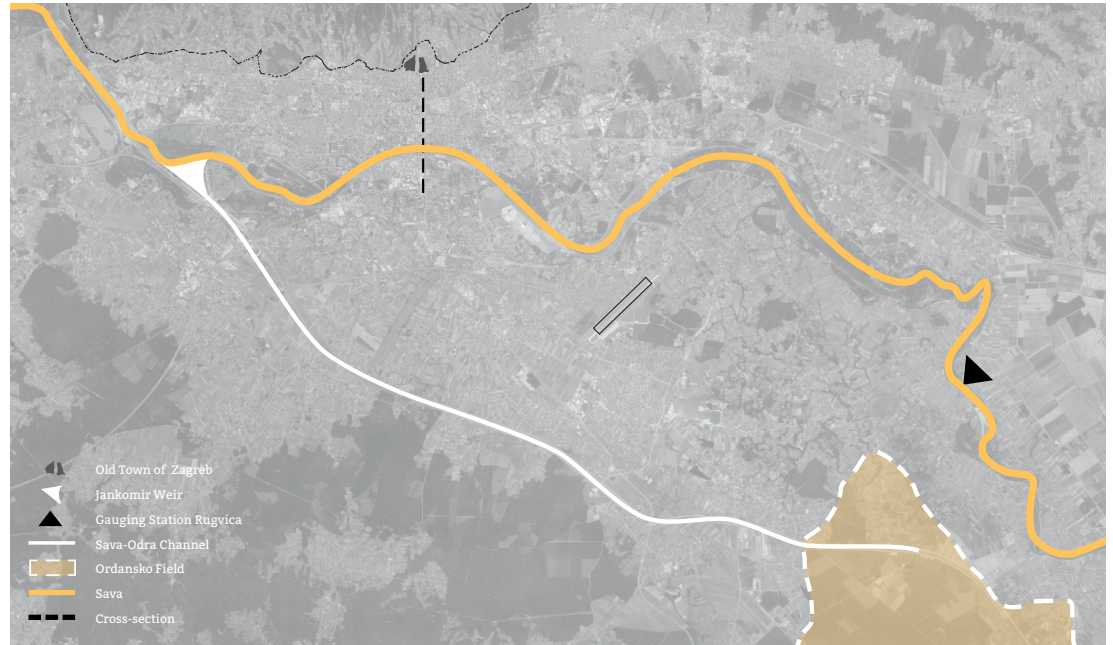
Zagreb is situated on the border of the upper and the middle reaches of the Sava River. The City of Zagreb was always affected by flood events of the Sava River, what makes a flood protection necessary. The continuous river regulation in Zagreb, cuts the river of its natural floodplains. The lack of floodplains causes a higher water level, what further on causes very expensive flood protection systems. An artificially protecting system tries to regulate river systems, which further on causes new technical interventions, which are leading to an extending of flood protection systems. In Zagreb the first flood was recorded in the year

1469 and the most famous flood happened in the year 1964. The river along the city was already strongly modified and the inundation protection at that time was weakly built and the areas along the river were densely populated. During the flood event in 1964 the dike broke on several places and caused a flooded area, about 6000 hectares in size. About 180,000 people lived in this area. 17 people died and 40,000 people had to leave their houses and 10,000 residential buildings had become uninhabitable after the flood. 3300 commercial properties were destroyed and a big part of the road system was underwater and covered with mud.<sup>24</sup>

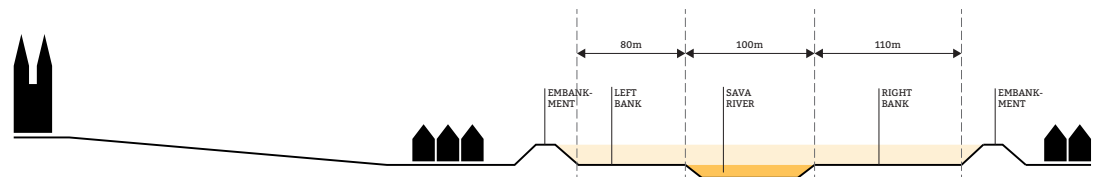


<sup>24</sup> *ct. Radionica Zagreb na Savi, 2013*

current situation of the Sava River and the Sava-Odra Relief Channel



illustrated section of the river and the embankment



After the catastrophe from 1964 Croatia started to work together with the United Nations to create a complete system for flood protection. The main parts of this system were to extend the Jankomir Weir, to develop the Sava-Odra Channel, which directs the floodwater to a non-populated area ( Odransko Field, a natural retention area ) and to build higher embankments, which also got extended 10 km in downstream direction. Also the canalization of the Sava from the Slovenian border to the Rugvica gauging station was part of the plan. The system was completed in 1978 and decreased the risk of flood plains, but was not a permanent solution.<sup>25</sup> These interventions caused a reduction of the river bottom ( from the border of Slovenia to the town of Sisak ) over the last 45 years. The average reduction is around 2m and can be explained by a various number of erosion protection works, the construction of dams and regulation of the river Sava and its tributaries. These changes are especially important for the area near Zagreb, where the river bottom dropped even more than 2m.<sup>26</sup>

The improving of the embankments cause an increasing of the water level, which is con-

nected to a drop in the drinking water level. Higher and stronger embankments can prevent local flood events but require a permanent control of the conditions of the dike to prevent collapsing.<sup>27</sup> The embankments go through the whole city and so the Save River is a kind of a natural barrier, which splits the city and prevents future urban developments. The total size of the area of the banks is about 350 hectares, which almost is bigger than the whole old town of Zagreb.<sup>28</sup>

The installation of the dike after the catastrophe prohibits a using of the spaces along the



Aerial view of the Save River during a flood

<sup>25</sup> *ct. Bonacci & Ljubenkovic, 2008, P. 1090*

<sup>26</sup> *ct. Bonacci & Ljubenkovic, 2008, P. 1091*

<sup>27</sup> *ct. Bonacci & Ljubenkovic, 2008, P. 1096*

<sup>28</sup> *ct. <http://www.zagrebnasavi.hr/prostorni/>*

Aerial view of the Sava River



river. There are areas, which get used for different purposes but the banks itself are mainly used as flood protection, that, in case of inundations, uses the 300m wide area to collect parts of the water. The other part of the water is collected in the Sava-Odra Channel and is directed to non-populated area the Odransko

Field.<sup>29</sup>

Not only in terms of future urban developments the City of Zagreb calls for connecting the North and South, but also because of continuous river regulations up- and downstream of Zagreb make new interventions for flood protection necessary.

<sup>29</sup> *et. Radionica Zagreb na Savi, 2013*



## THE ZAGREB NA SAVI PROGRAM

There are plans for a new extended protecting system of the Sava River, which include the river from the border of Slovenia to the town of Sisak. The concept foresees a reconstruction and modernization of the existing Sava-Odra Channel by a new Sava-Sava Channel, which will have the capacity to collect huge volume of water, to relieve the city of Zagreb, what would give the city the opportunity to redefine the riverbanks of the Sava.

The Croatian government commissioned the society Program Sava for developing a protecting, managing and usages plan for the Sava River from the Slovenian border to the city of Sisak. The goal of the project was to raise the environment protection, the uses of energy resources, the development of waterways and the flood protection for the city of Zagreb.

The full name of the project is, „Multi-purpose hydro-technical system of protection, management and use of the Sava River and hinterland from the Slovenian border to Sisak.”

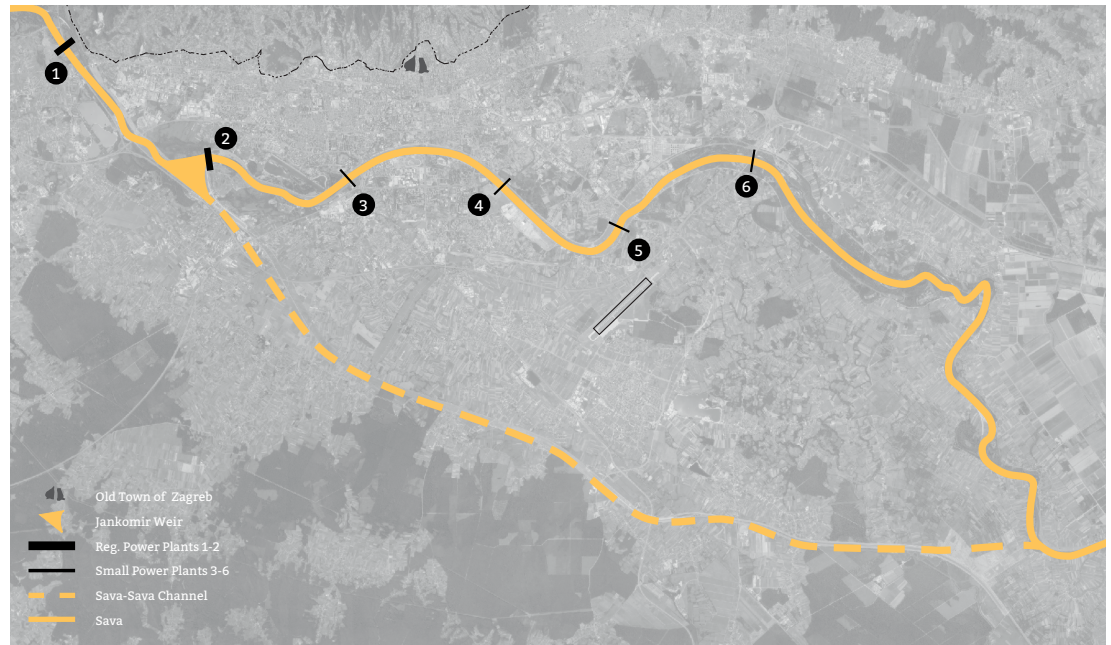
The part of the concept, which focused on the flood protection of Zagreb, was developed in the year 2013 and proposes the new channel,

which should lead the water as a tributary south of the city of Zagreb. There is already a channel existing, the Sava-Odra Channel, but for the new protection the channel has to be reconstructed and will confluence into the Sava. The new channel has to be wider and deeper. Also, it is proposed to make a new connection to the Sava River where the distance is the least. With the new planned channel, it would be possible to record a 4500m<sup>3</sup>/s flood wave.<sup>30</sup>

It will have a long-term effect for the city of Zagreb and its surrounding areas. The project focuses mainly on technical infrastructures, which lead to an even stronger regulation of the river and is proposed as sustainable development in water management, traffic and energy sustainable for the whole area. A series of hydroelectric power plants had been realized on the upstream of the Sava, they have an impact on the level of groundwater in Zagreb. The lower level of groundwater calls the city to find solutions for the supply of drinking water. There are two hydroelectric power stations planned on the east side of Zagreb one in Zaprešić (1) and another one in Prečko (2). Beside this two power plants there are also

<sup>30</sup> ct. <http://www.zagrebnasavi.hr/prostorni/>

proposed Zagreb na  
Savi program illustra-  
ted on orthogonal map



four smaller hydroelectric power stations planned (3-6), whose purpose is, in addition to energy production, to compensate the required altitude leaps in the course of the river. These differences in altitude are necessary

to stabilize the groundwater level and have a height of about 3m. The four smaller power plants are supposed to be totally under water, to look like waterfalls.<sup>31</sup>

<sup>31</sup> ct. *Radionica Zagreb na Savi*, 2013



## CRITICISM AT RIVER REGULATION PROJECTS

The ongoing progress of the river regulation projects in the Sava Basin will have a strong impact on the areas not only close by the HPPs, but also along River downstream. Each of those projects, which took place in the past, deals mainly with technical interventions and regulating the river. Nature is only taken partly into account.

River regulation projects are often sold as a solution for preventing flood events, generating “blue” energy and achieving new jobs, but the realizing process is often linked to a lot of criticism, which is only seldom considered. There is a need of taking a closer look on the consequences of intervening on the regulation of the microclimate and the natural flow of a river. To the public a picture is shown of a safer future. Embankments are drawing a visible image of security. They are proposed as the solution for everybody, but most of the project are connected to political power games and interests of private investments.

Indeed, the construction of hydro morphological power plants generate jobs, but for maintaining a power plant only a few workers are necessary.

The new technical improvements also need a constant service. Also, the areas in the downstream of the HPP get influenced, so will the current finished HPP in Brežice effect the flow speed, erosion of sediment materials and flood events in Zagreb. Same as the HPP in Mokrice, which is started to get build a bit downstream of the Town of Brežice on the border of Slovenia and Croatia. That will continue the modification of the Sava and will have an impact not only in Zagreb, but also in the downstream of Zagreb.

In the area between the border of Slovenia and Croatia and the City of Zagreb is a huge natural floodplain located. This space is a very important natural flood protection area and is mainly used for agriculture. There are only a few buildings. The impound of water will have an impact on that area, because the flow of the river is totally regulated and might bring the unique flora and fauna and its fascinating biodiversity at risk of getting destroyed. This floodplain is also the link between the finished river regulation projects in Slovenia and the proposed and commissioned “Zagreb na Savi program” in the Zagreb region. In both programs technical interventions are used

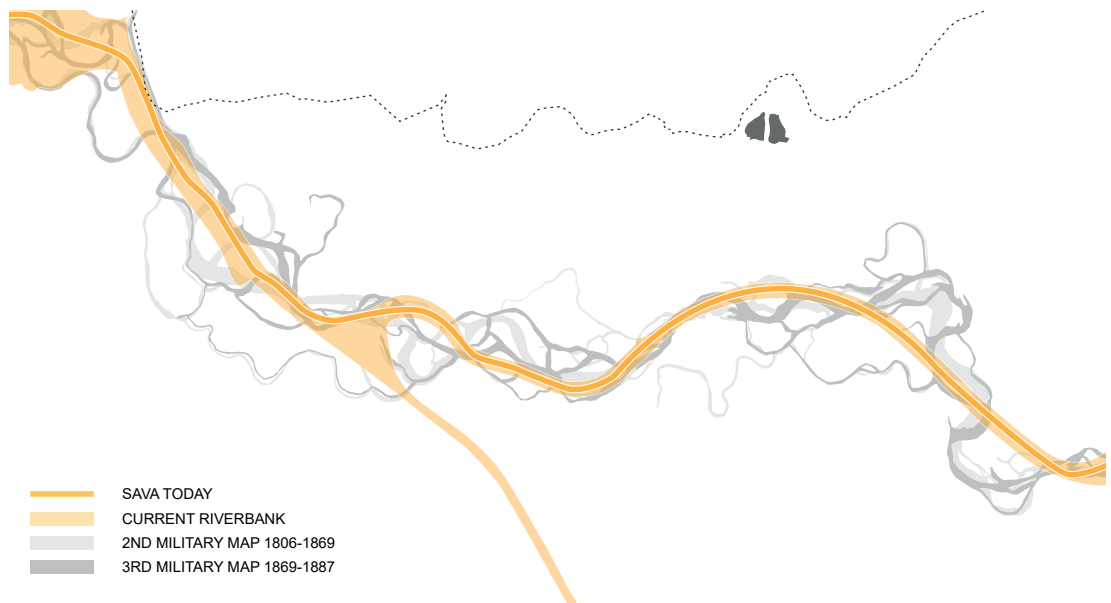
to regulate the river with HPPs. The goal is to achieve a protection for the towns and cities along the river and to generate energy. But these interventions also make the area depending on the technical infrastructures and will cause further services and modifications of the Sava.

Another driving force for the “Zagreb na Savi program” is the navigability between the Sava-Sava Channel and Velika Gorica. River navigation always has a strong impact on the

microclimate and the water quality of a river and also requires a strong modification of the river bottom.

Altogether there are benefits, but by weighing its advantages with the disadvantages, infrastructural and economic benefits are overweighting and nature gets adjusted and at the moment there are no alternative proposals for flood protection systems publicized for the Sava River, with focus on a natural way of dealing with inundations.

Natural and Artificial  
changing of the flow di-  
rection of the Sava



In terms of driving sustainability and the need of enhancing quality of life for the people of the City of Zagreb alternative solutions are desirable. A change in the aging of the population can be reached by increasing offer and quality of working and living. Not only new jobs raise the perspectives for young generations to stay in the country, it also promotes immigration. Affordable housing and a family friendly environment are also major factors to turnover emigration and thereby connected ageing of the population. Public funds should focus on these parameters and beside political promotions the facilities for education and medical infrastructures should get enhanced.

For this reason a new urban plan with special focus on the Sava and its riverbanks is developed. The project is named “Reprofiling the Sava River” and draws a new masterplan, which implements a renaturalization of the Sava into an urban context. The special combination of qualities of green space and new and reinforced urban infrastructures create a unique situation for the City of Zagreb.

Instead of a strongly modified river, Zagreb could be a pioneer city in realizing a project, which mainly deals with naturalization of the river, by reactivating natural floodplains and changing the land uses along the river. These facts are involved in the design process

and water will have an impact on the design. By merging water and green spaces with urban planning a lot of requirements have to be considered, but also offer a huge potential for creating urban spaces with unique qualities.

The time has come, where changes are not only necessary, but also essential. Changes, which are leading to a long-term solution, based on a sustainable and gentle way of handling nature.

It will be a challenge for generations to form a base for ongoing process. The fact that inundations are occurring more and more irregularly and in different places and not

only in Croatia, but also all around the world should make people more aware of the impacts of climate changes. The irregularly and on different location appearing inundations make forecasts almost impossible and often there is no time to react on short-term flood event. Prevention of inundations are aligned on today's specifications, those are associated with fatal events of the past and they are getting adjusted by another special event. It will be challenging not only to make the project economic profitable, but also to enforce natural character of the river. It will be a balancing act of economic urban developments and natural ways of transforming the nature.



## BEST PRACTICES

04





DALLAS, USA

STREEFKERK, NL

WAALWIJK, NL

NIJMEGEN, NL

MUNICH, GER

JINHUA CITY, CN





<i>projectname:</i>	TRINITY RIVER PARK
<i>located in</i>	DALLAS, TEXAS, USA
<i>type</i>	-
<i>status</i>	UNDER CONSTRUCTION
<i>year</i>	2016 AND ONGOING
<i>size</i>	1.150.000 SQM
<i>cost</i>	-
<i>client</i>	-
<i>architects</i>	MICHAEL VAN VALKENBURGH
<i>landscape arch.</i>	-

The Trinity River is shaping the City of Dallas, the most areas along the river are undeveloped spaces and are not connected to the public. The River stretches about 24 km (~15 miles) through the city. In the past the development plans for the river and the city have been separated that isolated the river from the urban life of the city.

The new park with a size of 1,15 skqm, will connect already existing green zones with each other. Altogether the nature district in Dallas will have a total size of about 10.000 acres (40,4 sqkm) that will make the area to the biggest in the United States, which is almost 10 times bigger than the central park in New York.

The design of the Trinity River Park deals with a naturalistic design and different public spaces, such as plazas and squares to create

stronger relation between the city districts. There are also five new bridges planned to make the crossing of the park easier. Also new forest trails are proposed, same as new sport fields and restoration of wetlands.

The project combine using spaces for natural floodplains and urban qualities for the people. The design also restores ecological qualities and protects the city from future flood events. The park will be open to the public.

There is also criticism about the project realization process, because the project will cost about 250 million dollars. 50 million dollars got donated by the philanthropist Annette Simmons. There is no exact plan of how the hole area will be build, it will be a realized in different phases that also include future changing in the design. The city announced to start to build the project in the year 2021.<sup>32</sup>

<sup>32</sup> ct. <http://www.mvva.com/project.php?id=114>





<i>projectname:</i>	YANWEIZHOU PARK
<i>located in</i>	JINHUA CITY, CHINA
<i>type</i>	CONTRACT WORK
<i>status</i>	REALIZED
<i>year</i>	2013-2014
<i>size</i>	260.000 SQM
<i>cost</i>	16.300.000 EUR
<i>client</i>	JINHUA MUNICIPIAL GOV.
<i>architects</i>	TURENSCAPE
<i>landscape arch.</i>	-

The City of Jinhua, with a population over one million people, had one last remaining riparian wetland with a size of about 260.000sqm. It is located on the confluence of the Wuyi River and the Yiwu River to the Jinhua River. This wetland remained undeveloped because it was flooded during the monsoon. One goal of the project was to preserve the existing riparian wetlands, but also to link the city districts with each other, to enhance the flood protection system and to integrate the organic shaped building to the new opera were focused in the designing process.

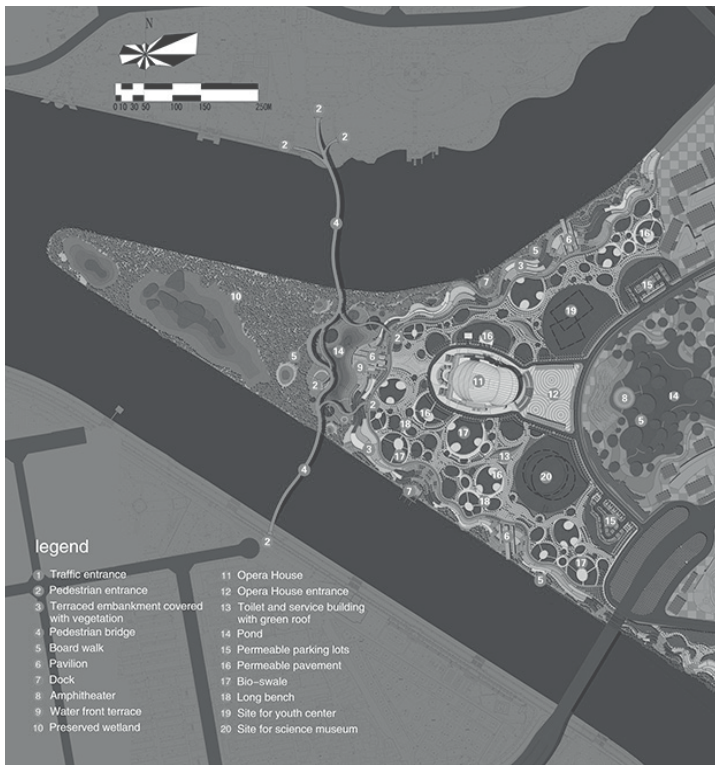
By a minimum of changes, the existing landscape of the riparian wetlands, should be preserved. With only small intervention the biodiversity of the space increased. The existing strategy for a long time for flood protection of the annual monsoon flood, was to build bigger concrete embankments to protect urban

development. The landscape architect could convince the city authority to build water-resilient terraces instead of concrete walls. A pedestrian bridges trails across the two rivers and links the north and south district with the new Yanweizhou Park. The design of the bridge is inspired by a Chinese dragon. The bridge is elevated for a 200-year flood event and keeps the connection straight also during the monsoon.

To integrate the oval opera house ( by Zhejiang Architecture Institute ) was a challenge for the designers, especially to integrate the building into a floodable and riparian surrounding area, which could get achieved by using curvilinear bridges, terraces and planting beds. The black and white concentric pavings and the meandering paths generate a multiplicity of spaces with different sizes and is not only used by visitors of the opera house.<sup>33</sup>

<sup>33</sup> ct. <https://www.turenscape.com/en/project/detail/4629.html>







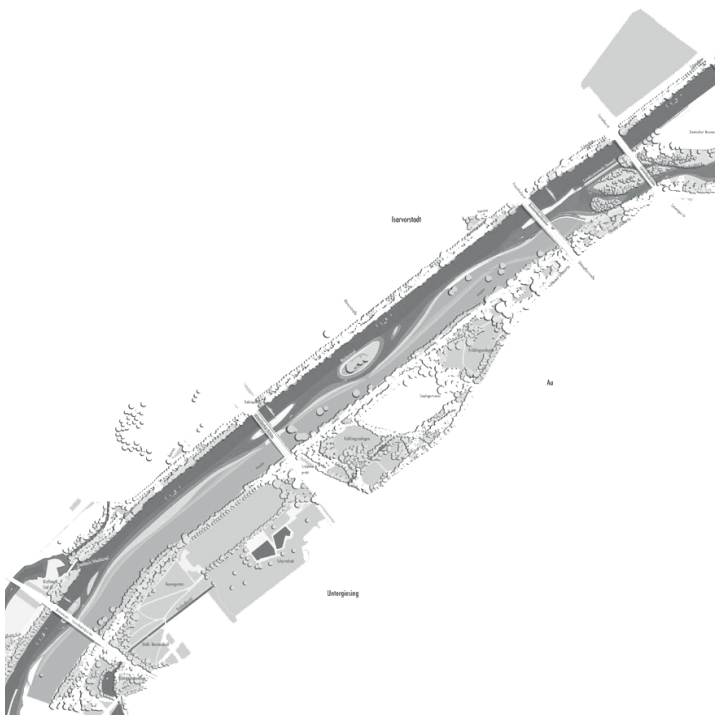
<i>projectname:</i>	DER ISAR PLAN
<i>located in</i>	MUNICH, GERMANY
<i>type</i>	CONTRACT WORK
<i>status</i>	REALIZED
<i>year</i>	2000-2011
<i>size</i>	
<i>cost</i>	35.000.000 EUR
<i>client</i>	FREISTAAT BAYERN
<i>architects</i>	-
<i>landscape arch.</i>	-

The idea behind the „Isar Plan“ is to improve flood prevention, to extend the leisure time activity program and to renature the riverbanks of the Isar. The Isar in Munich has a long history of flood prevention. The first actions were recorded in the medieval age, when riverbanks were constructed. The next bigger measurements took place in the 20th century, when HPP were built. In the early 80s, the call for more natural areas got louder. In some areas the flood protection guidelines

were maintained and the need for recreation areas increased. The first arrangements of the naturalization took place in the year 2000, when the riverbed got widened and the riverbanks were reinforced. In the year 2005 the Isar-Plan achieved its first challenge by handling a 100-year flood event. The upgrading of the sewage treatment plants offer a high water quality and enables bathing facilities. The new built flat sand and gravel banks give the Isar a natural appearance.<sup>34</sup>

<sup>34</sup> *ct. Der Isar-Plan, 2011*







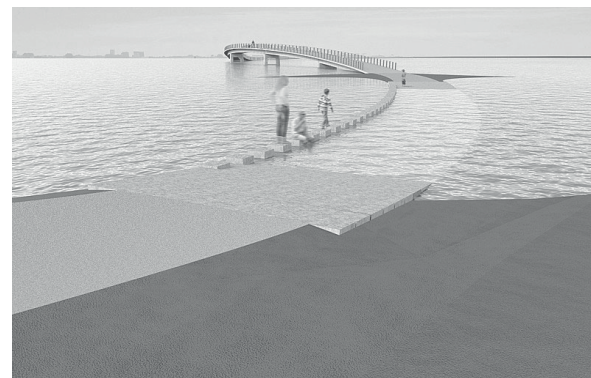
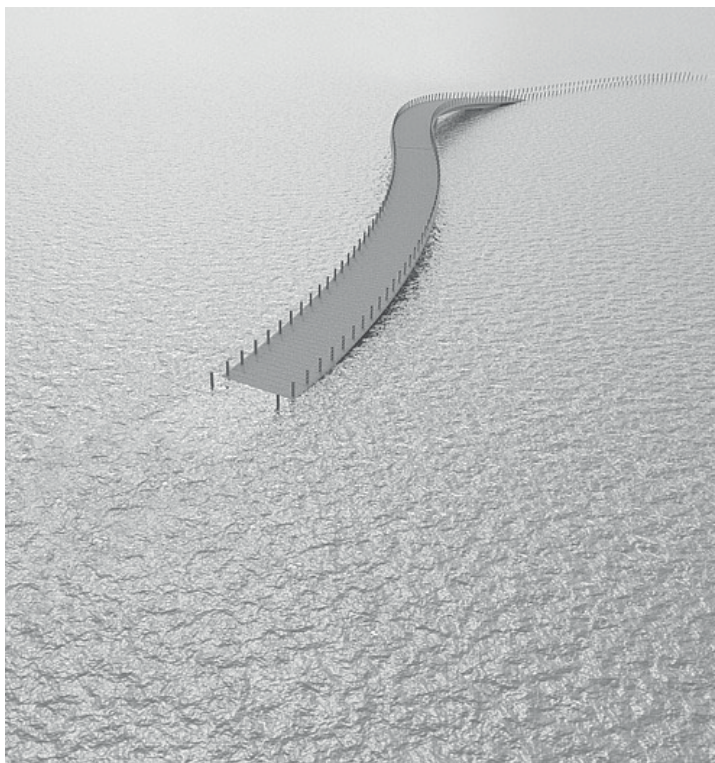
<i>projectname:</i>	ZALIGEBRUG
<i>located in</i>	NIJMEGEN, NL
<i>type</i>	CONTRACT WORK
<i>status</i>	REALIZED
<i>year</i>	2015
<i>size</i>	
<i>cost</i>	
<i>client</i>	MUNICIPALITY OF NIJMEGEN
<i>architects</i>	NEXT ARCHITECTURE
<i>landscape arch.</i>	-
	-

Same as the project on the previous pages, this project is dealing with higher flood events, caused by the climate change. The Zaligebrug is part of the „Room for the Rive“ project in Nijmegen in the Netherlands and focuses on flood protection by giving the river extending floodplains and relocating the existing dikes. In Nijmegen a new bypass was built and created a new island. The bridge connect the island and the northern bank and is located in the floodplain. What makes the Zaligebrug special

is, that during high water the bridge is partially flooded, same as parts of the island. The curved and asymmetrical form of the bridge continues the path. Other details are the steps-tones, which follow the path to the bridge. Depending on around five meter the fluctuation of the river, the path can be flooded. The step stones remain and will make it possible to access the bridge. This interacting with the water level was a main design element.<sup>35</sup>

<sup>35</sup> *ct. Next architects*









projectname:

OVERDIEPSE POLDER

located in

WAALWIJK, NL

type

CONTRACT WORK

status

REALIZED

year

2011-2015

size

cost

client

PROVINCE OF NORTH BRABANT

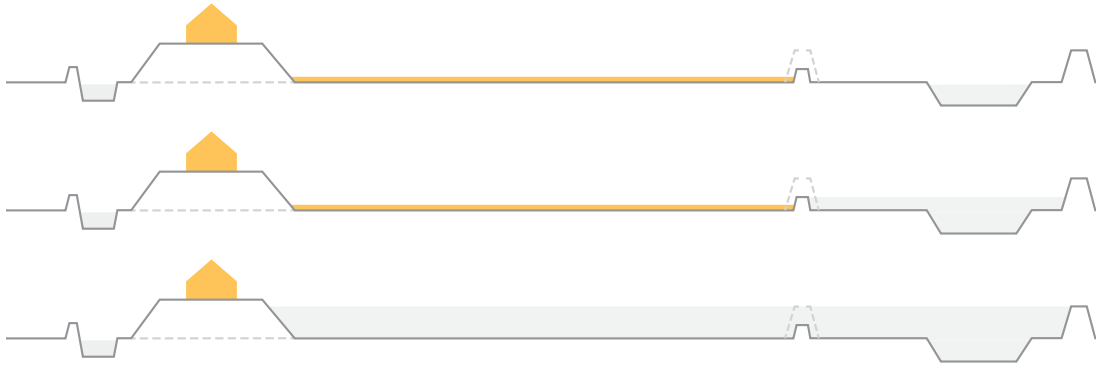
architects

ONIX ARCHITECTS

landscape arch.

BOSCH SLABBERS LANDSCAPE

AND URBAN DESIGN

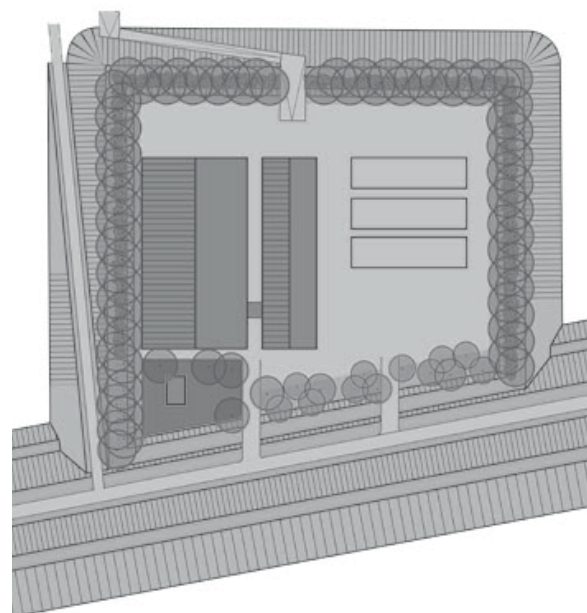
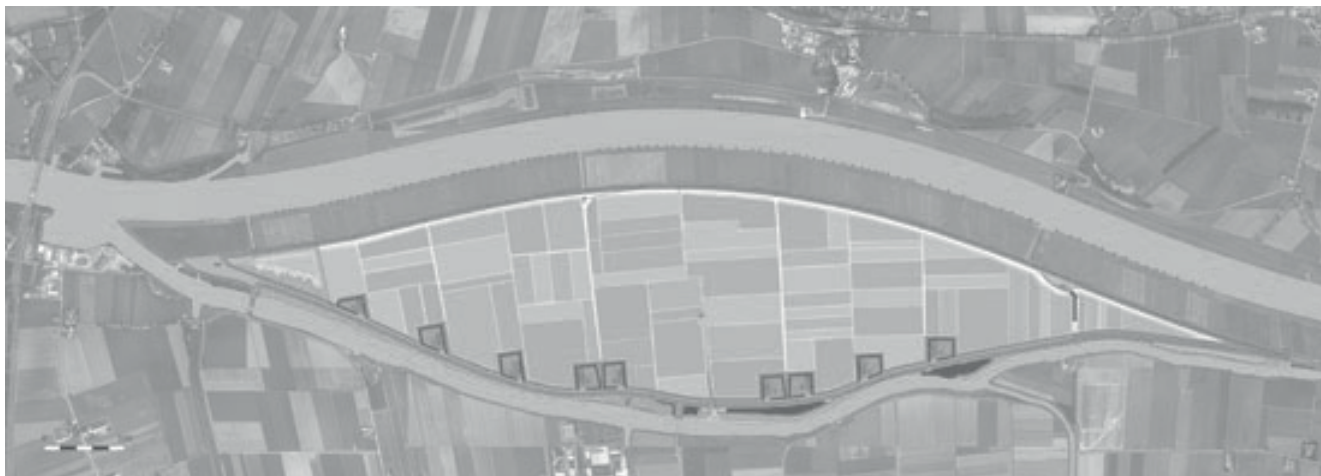


The Overdiepse Polder project is situated on the south bank of the Bergsche Maas and is part of the „Room for the River“ project to increase the drainage capacity of high water. In this case the goal is achieved by widening the river that lead to a drop of the water level by 27 cm. The inhabitants were involved in the project on a very early stage. The purpose of this project is to prevent the City of Den Bosch from flood events, for that reason the existing dike got lowered and a new dike was

built further inland. In cooperation with the farmers, the existing farms got demolished and new farms were built inside the dike on elevated areas.

For annually high water the lower dike is high enough to prevent the fields of getting flooded. During a 25 year flood event the fields will get flooded, but because of the wideness between the lower dike and the new dike, the elevated farms are safe.<sup>36</sup>

<sup>36</sup> cf. Bosch Slabber landscape architects and Onix architects



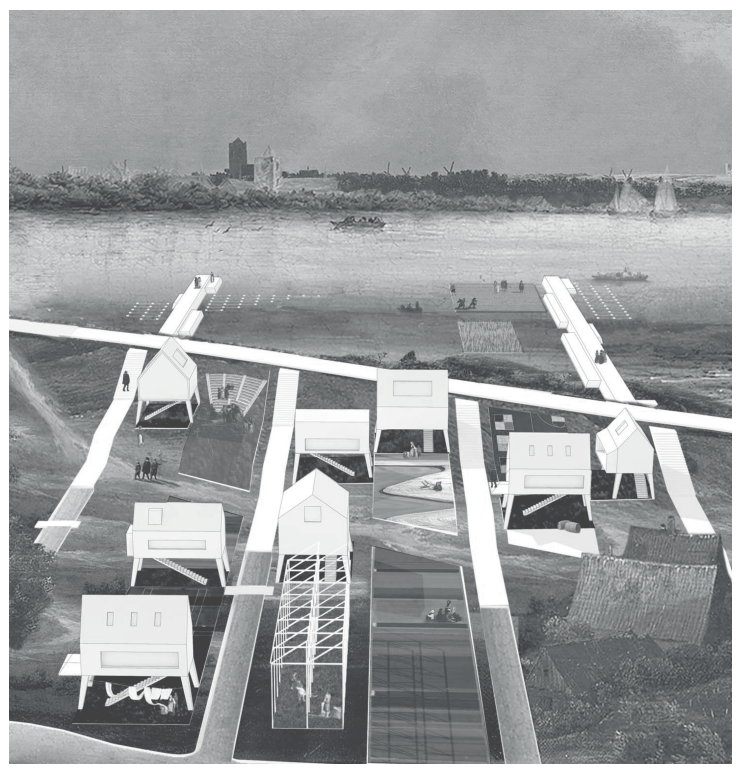
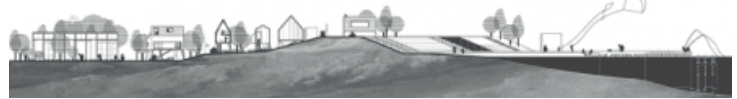
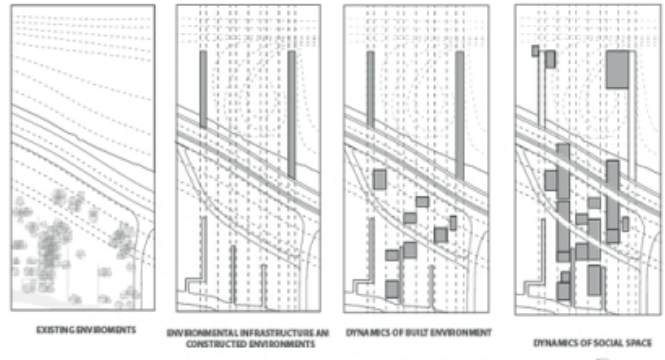


<i>projectname:</i>	PROTODIKE
<i>located in</i>	STREEFKERK, NL
<i>type</i>	COMPETITION
<i>status</i>	RUNNER-UP EUROPAN13
<i>year</i>	2015
<i>size</i>	16.780 SQM
<i>cost</i>	NOT REALIZED
<i>client</i>	WATERSCHAP RIVIERENLAND
<i>architects</i>	OPENACT
<i>landscape arch.</i>	-

Protodike focuses on an adaptable way of reinforcing the existing dike of the river Lek. The dike is a boundary between water and land, but the dike is not only a physical border. It is also separating the program of each side. The protodike wants to create a connection of both sides by mixing up the program with different interventions. It wants to transform something what is blocking to something what is connecting. It is an experiment, which proposes a new prototype-dike-infrastructure, which can be adapted and implemented on various other locations along the dike. Basically the protodike achieves an effect of generating new kind of urbanism and land use by only two single moves. New groynes make land use possible on water and also slow down the water flow and the sediment removal. The second move will succeed by creating a new „strip“ pattern of land use, which uses the dike as an infrastructural spine. The imple-

mentation of the protodike would be realized in five phases. Reinforcement, activation, connection, inhabitation and co-existence. In the first phase, infrastructural elements such as roads and groynes are added and make the people of Streefkerk aware of the new relationship between water and land. The participation of the inhabitants and the installing of water related programs is the goal of phase two. In phase three public spaces for sociocultural and leisure time activities will be added and temporary markets and workshops can be installed. The next phase is to add housing units void spaces. The lower part of the units is used as a semi-private buffer zone. Certain areas remain open to offer meeting points for the community and visitors. The pedestrian based environment is an adaptable and multi-layered framework, which is open for change and integrates the water as a new urban element.<sup>37</sup>

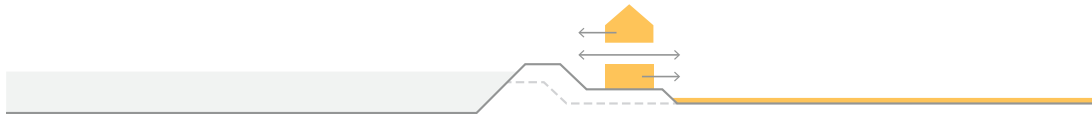
<sup>37</sup> cf. Zarco, Carlos & Palomar Sara, 2015







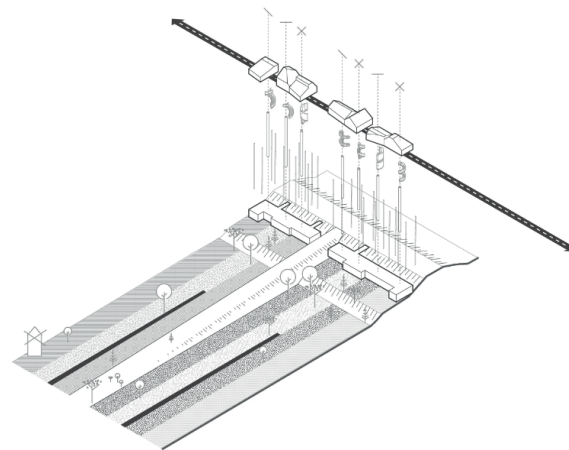
<i>projectname:</i>	IN-BETWEEN
<i>located in</i>	STREEFKERK, NL
<i>type</i>	COMPETITION
<i>status</i>	WINNER EUROPAN13
<i>year</i>	2015
<i>size</i>	16.780 SQM
<i>cost</i>	NOT REALIZED
<i>client</i>	WATERSCHAP RIVIERENLAND
<i>architects</i>	STUDIO SAVA
<i>landscape arch.</i>	-



This project called “In-Between” is the European13 competition winner of the competition in Streefkerk in the Netherlands. The design focuses one hand on generating and using of sustainable energy by recycling of existing ideas and on the other hand on redeveloping of the typology of the typical Dutch house. The volume of the Dutch house is split into two parts. The top part is to lift up and to create a new space “in between” top and bottom with new opportunities. The new created covered

space can be used in different ways and is a communication zone between private and public. The combination of individual houses to a network allows a sharing of the produced resources and strengthen the coherence. The foundation of the house is made by pillars, which are drilled in the ground and extended up to the street level and functions as the structure of the house. A core is placed in the center and includes the access way between the floors and the structural center.<sup>38</sup>

<sup>38</sup> ct. Saladin, Marie Saladin & Vassent-Garaud, Marion, 2015





## ANALYSING THE SAVA IN ZAGREB

05

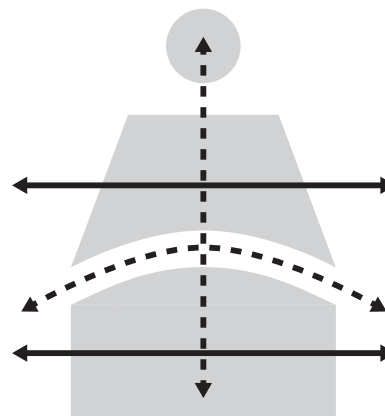


## URBAN STRUCTURE

The abstract map of the urban structure of Zagreb shows a dominant north-to-south axis and multi east-to-west axis, one of them is the Sava River. The areas straight next to Sava are not urbanized areas, because the spaces are included into the existing flood protection management scheme. For this reason, the Sava River and its riverbed are excluded for urban developments and this made the Sava to a visible border in the city. The areas next to the embankments house a diversity of program, which are common in suburban area, such as leisure activity related facilities, shopping malls, sport facilities, recreation areas, green spaces and single family housing. Same as the Sava in the South, the Medvenica Mountain limits developments in the north and caused a growing of the city mainly in east and west direction. ( shown in the timeline in the research part ), until the Zagreb Fairground moved to Novi Zagreb in the year 1963. The Zagreb Fair worked as an urban generator for the area and launched urban development processes. Although an urbanization took place south of the Sava, the main program for the city stayed on the Northside and can be observed on a closer look on the urban structure. Along the prominent north-south axis, which possess a

lot of significant urban key elements, such as the two antecedent cities Gradec and Kaptol, the Jelačić Square, which is the main square, the Mestrovic Pavilion, which is a perfect example for transformation, the Greenhorseshoe, which is one the fundamental public spaces and houses various cultural heritages of the city of Zagreb and the National Library are located on the left bank of the Sava. There are also institutions on the right bank of the Sava, such as the Museum Of Contemporary Art, which is right next to the former location of the Zagreb Fair with its national pavilions. Parts of the Fairground are still used as a congress center.

- ■ ■ MAIN AXIS
- IMPORTANT AXIS
- · · · · MEDVEDNICA MOUNTAIN
- URBAN KEY ELEMENTS





SHOPPING CENTER

SAVA

SVEUČILIŠNA BOLNICA

ZAGREB ARENA

ZAGREB FAIR

NATIONAL LIBRARY

GREEN HORSESHOE

JOSIP JELAČIĆ SQUARE

GRADEČ

KAPTOL

MESTROVIC-PAVILION

POWER PLANT

AIRPORT ZAGREB (ZAG)



## WATER RELATED TO THE SAVA

Beside the Sava there are several smaller and larger lakes. These lakes have been made artificially or are remaining parts of the pasture landscape. During a flood they can only take small parts of the water, because their spaces are limited. The banks of the Sava have originally been a natural flood protection and a home for many different animal and plant species. Due to the regulation of the river, large parts of the pasture landscape disappeared. Only a few are left in the area of Zagreb, one is located east of Zagreb, the Savica Lake, the lake houses a lot of bird species and therefor an ornithologist station is used for observation.

The artificial lakes are used for various purposes. They are used as a fish ponds ( Orešje & Rakitje ) or as swimming lakes ( Jarun & Budek ). The Jarun Lake itself is also divided into different areas. It has a flat beach access, which is designed as a bay and on the other side is a rowing course, a wakeboard course and other water sports facilities. In addition, there are a lot of bars and restaurants in the area around the lake and therefore the Jarun llake is also very busy in the evening.



OREŠJE LAKE & RAKITJE LAKE



JARUN LAKE

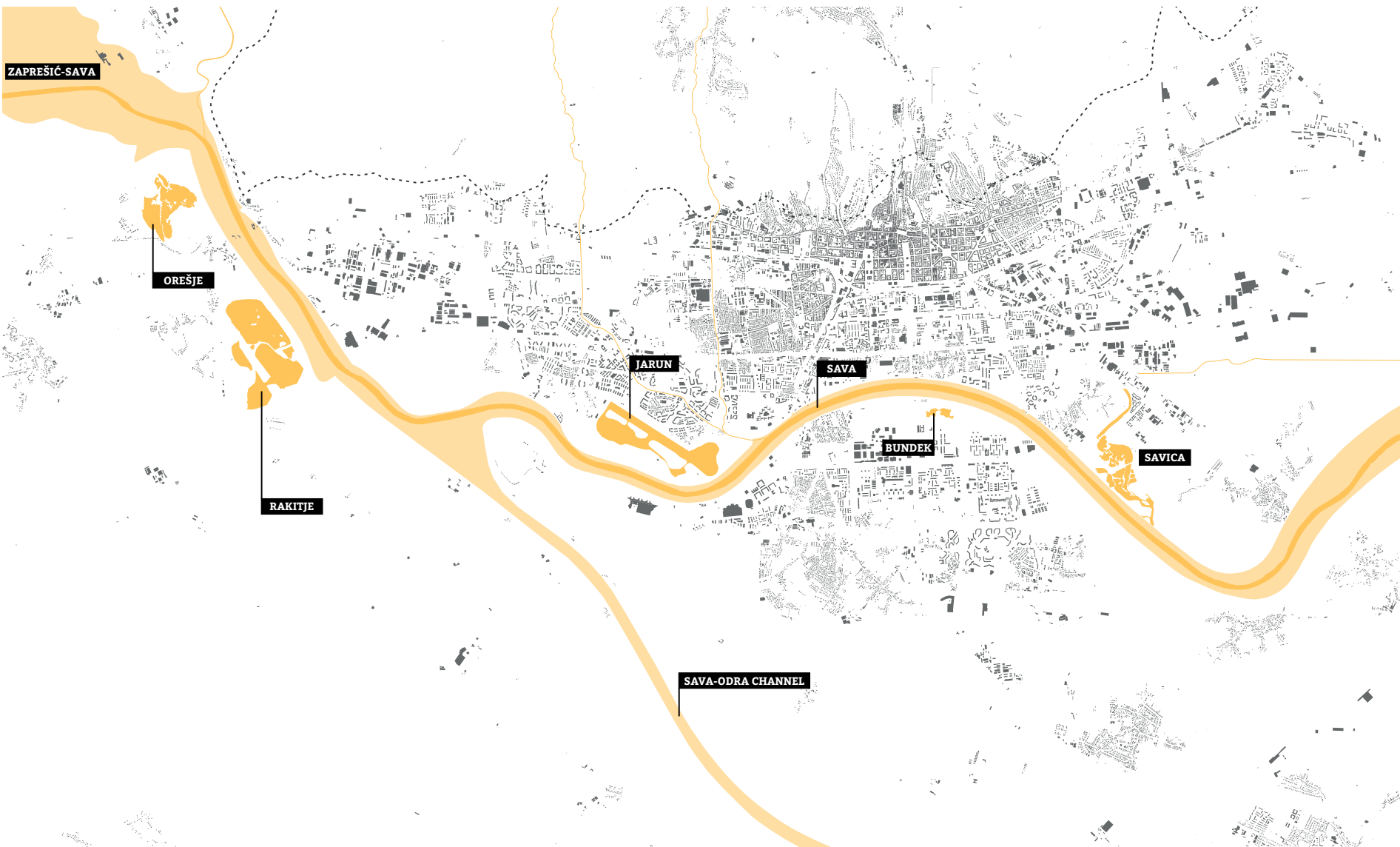


BUNDEK LAKE



SAVICA LAKE

- WATER
- RIVERBANK
- MEDVEDNICA MOUNTAIN




## GREEN SPACES ALONG THE SAVA

The major part of greenspaces next to the Sava disregarding agriculture are the areas which are linked to the lakes and leisure activities, same as the lakes, almost all of them are artificially made and offer a variety of leisure and sport activities.

For example the areas around the Orešje & Rakitje Lake, which are located in a distance to the urban areas, are a meeting point for fisherman, camper and hiker. Only a few areas are relicts of natural green spaces, like the Savica area, which is a former trailer of the unregulated Sava River.

As closer the urban center gets, the more intense and frequent is the usage of various activities. The Jarun and Bundek area, which are also artificially made lakes, are the most frequent areas, not only in terms of water sports, they also offer a wide range other leisure activities.

Despite the river is separating the city, it seems that all areas are linked through the Sava. Some spaces seem to be abandoned and hold a lot of potentials for further developing areas of the city.


 GREEN SPACE  
 PARTLY EXISTING FLOODPLAIN  
 MEDVEDNICA MOUNTAIN



ZAPREŠIČ-SAVA



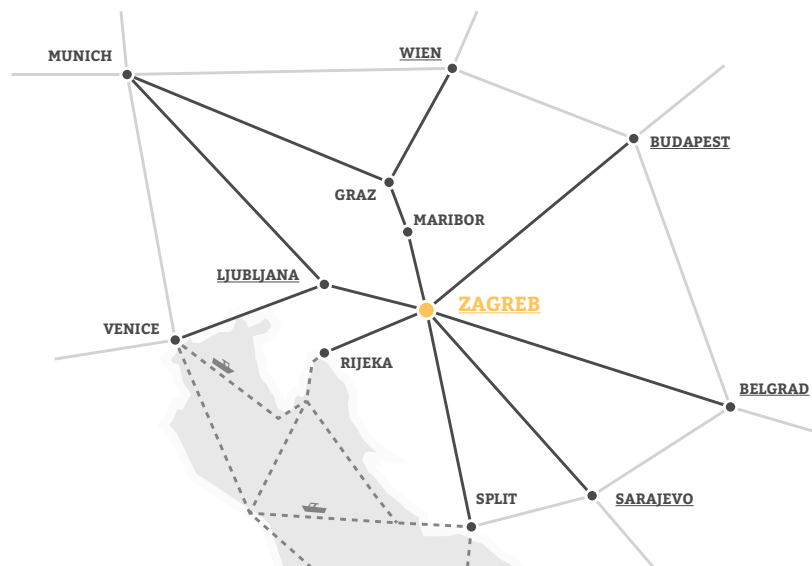
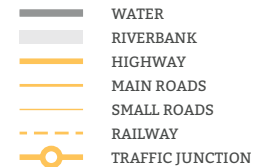
## TRAFFIC - ROAD & RAILWAY SYSTEM

The city of Zagreb has a well-connected traffic system and is an important traffic hub on the east border of the European Union and links it with the Balkan States. The highways, which are leading to Zagreb, are all in very good condition. Along these roads you also find the Zagreb airport.

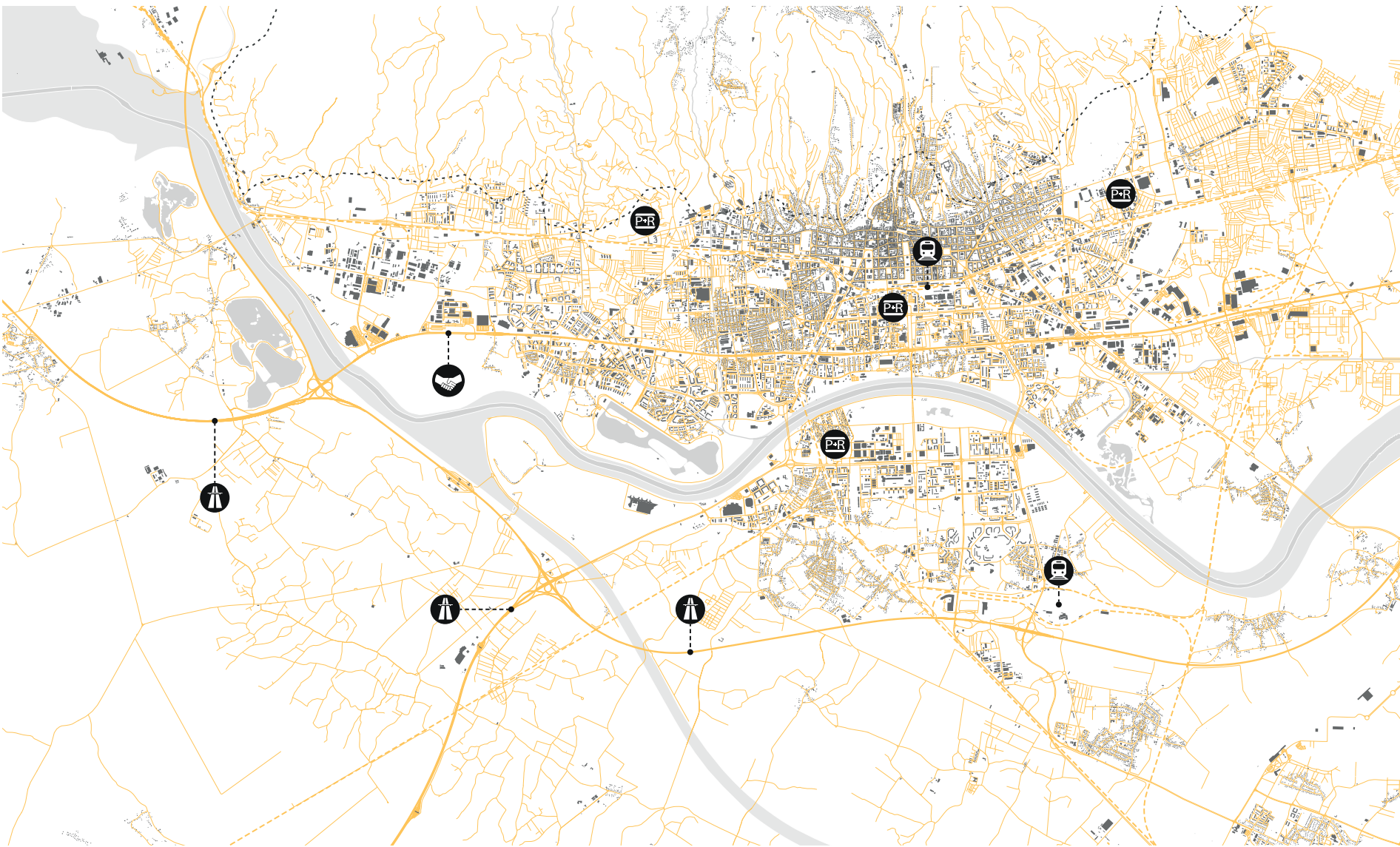
But also the road system of the city itself is well elaborated. Disregarding the Old town of Zagreb the road system is orthogonal with a strong east-west ( Brotherhood & Unity High-

way ) and north-south axis. The River Sava interrupts the dense grid of streets. In the Zagreb region, there are only nine bridges.

There are future projects in planning, which include new bridges. One is proposing a multiple use bridge next to Bundeck and another one is an extension of the Petrovaradinska Ulica and linking to the A3 highway in the Blato area, but this projects remained unrealized promises of the local government.

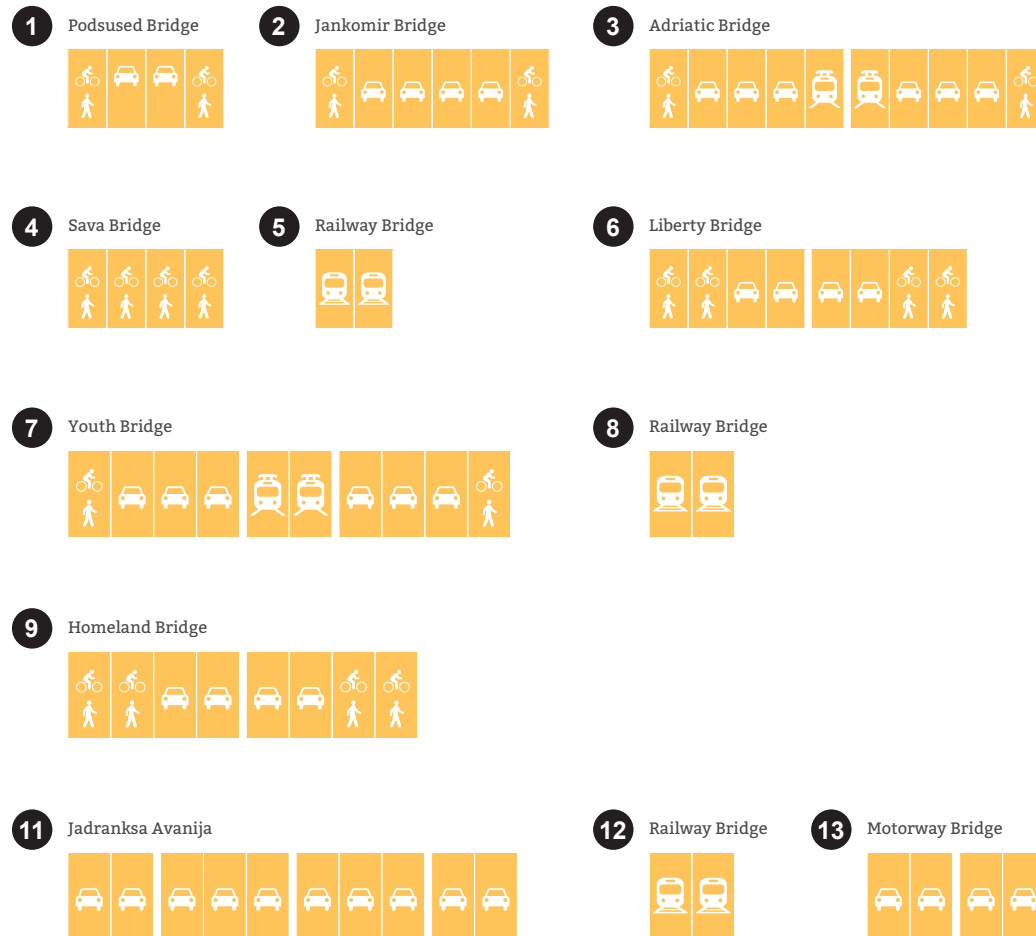








## TRAFFIC - BRIDGES



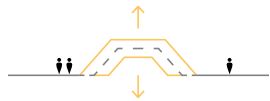




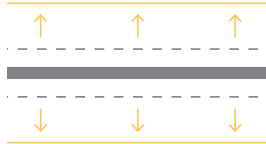
## PHASES OF TRANSFORMATION

## ECOLOGIC RECONNECTION OF THE SAVA

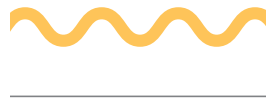
ADJUST EMBANKMENT



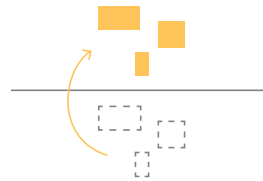
SHIFT EMBANKMENT



CHANGE THE COURSE



RELOCATE BUILD STRUCTURES



For the City of Zagreb the inundation protection is one of the major challenges. The development of the riverbanks of the Sava, which have been mostly disregarded in urban planning concepts in the past, grab an enormous potential for urban development and offer an unique opportunity for the City of Zagreb to take care of all the today's issues and to integrate them in developing processes.

The design of the Reprofilng the Sava project links urban qualities with qualities of the nature. This extraordinary situation gives the project the initial position to develop almost abandoned areas within an urban context. New connections and spaces with various

qualities are generated by providing a link between urban fabrics and natural landscape, which is further on drawn through the whole city. To achieve this result a sensitive way of executing the transformation is a very important goal during the design and construction process.

The Reprofilng The Sava Project is grouped in different phases, which are executed at different stages and time periods. Protecting the ecological system of the river, by meandering the course of the river and the renaturalization of the riverbanks are two key elements of the first phase. The changing of the course and the renaturation prevents sedimental erosi-

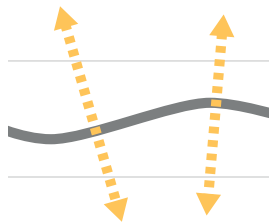
ons and carving the bottom of the river and provides a decreasing flow speed. The existing paved banks are transformed in flat banks, as it is partly in the upstream of Zagreb. Also part of the transformation of the river is the reactivation of former floodplains along the Sava by extending its riverbed. The expansion of the riverbed is achieved by several ways of shifting and transforming the existing embankments. The alternating requirements for the different section offer a variety of potential intervention. They are visualized in a collection of different elaborated typologies, which worked as a guideline for the design process. The changing of the course is continued through the whole city and same as the

shifting and transforming of the embankments a key element of the first sequence of the design.

Another fundamental key element is an improved regional planning. For that reason a part of the built structures, which are situated in the HQ100 area or which are located in potential flooded areas in the new design, are relocated to a raised territory. Besides the regional planning in the periphery, a sustainable urbanism in the inner city is part of the development area. The potential development areas through the city and the area in the upstream of the city have a strong impact on the progress in the downstream.

## ADAPTING THE NETWORK TO RECONNECT THE PEOPLE

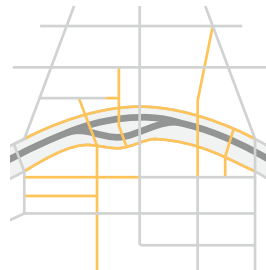
BUILD NEW CONNECTIONS



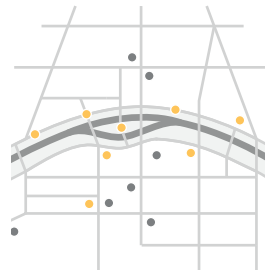
COMPLETE THE CYCLE PATH



DENSIFY THE NETWORK



ENHANCING THE PROGRAM



The appliances of the first and the second phase are overlapping in most parts during the process. The interventions of the first phase laid the foundation for new links between the city and the river and provides a stronger relation between the existing program and new developed urban elements.

The main parts of the second phase are to create a stronger network of connections, to shorten distances, to strengthen existing relations and to generate new relations. The other key element is the extending of the existing program, the implementing of new program and the enhancing of natural and urban qualities for the City of Zagreb.

A better connection between north and south or left and right bank of the Sava is achieved by several new bridges. The focus was to expand the amount of connections for pedestrian and bicycles to shorten distances. The bridges are not only for crossing the river, they are also used as a place to stay. Beside the pedestrian bridges, two new bridges for car traffic are build. Each of these two connections are a very important link for the periphery of Zagreb, what provides future urban development potentials and reliefs the other bridges and roads, that lead to the center. Even more important than the bridges for the cartraffic, are the new pedestrian and bicycle bridges, which are part of a new, complete

Sava-Cycle-Path-Network. This network is a significant part of the Reprofilng of the Sava project and connects existing isolated pedestrian roads and cycle paths, not only along, but also by crossing the river. The tight mesh of roads along and over the river works like arteries and are essential to keep the urban flow. There had been no overall cycle infrastructure for the city of Zagreb, the new cycle-path-network along the Sava work as a generator for the city to make people aware of the potentials of pedestrian and cycle friendly roads and should also connect the surrounding towns of Zagreb.

The expected change, that people are going by bike instead of using the car for short distances, will vast the volume of traffic of cars and implicates an improving of the quality of the air. Beside the reducing of carbon dioxi-

de, another positive effect is the increasing health of a cyclist, which is indisputable. The dropping of the emission of carbon dioxide is increased by improving the network of public transportation.

Besides the densification of the road network the program is enhanced too. Linked to the new bridges and new road connections, the new program is situated at new traffic hot-spots. Also the transformation of the profile of the embankments provide huge potentials for expanding the existing and adding of new program not only along but also integrate build structures in and on the dike.

An accurate declaration of the proposed developing steps is illustrated on the following pages by graduating the whole development area into segments.



## SYMBOL EXPLANATION



HIGHWAY



BROTHERHOOD AND  
UNITY HIGHWAY



RAILWAY



COURT OF JUSTICE



NATIONAL LIBRARY



MUSEUM OF  
CONTEMPORARY ART



ZAGREB ARNEA



HOSPITAL



SHOPPING MALL



INDUSTRY & CRAFT



FARMLAND



RESIDENTIAL AREA



SHELTER FOR  
ANIMALS



BIRD OBSERVATION



LOOK OUT



HIKING TRAIL



CAMPING SITE



FISH POND



PAINTBALL



GOLF COURSE



SURFING



SWIMMING



PADDLING



SAILING

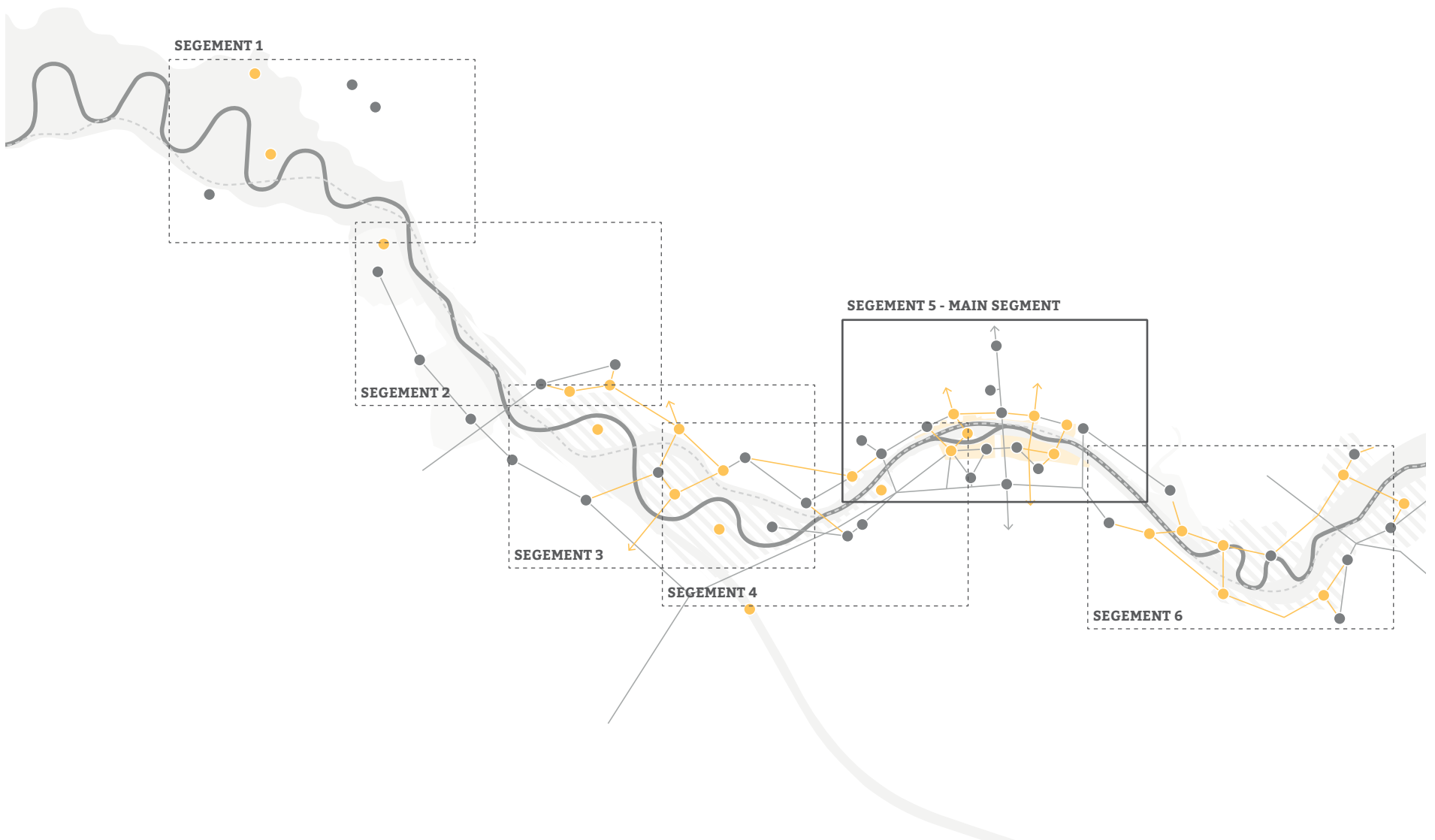


BUS HUB

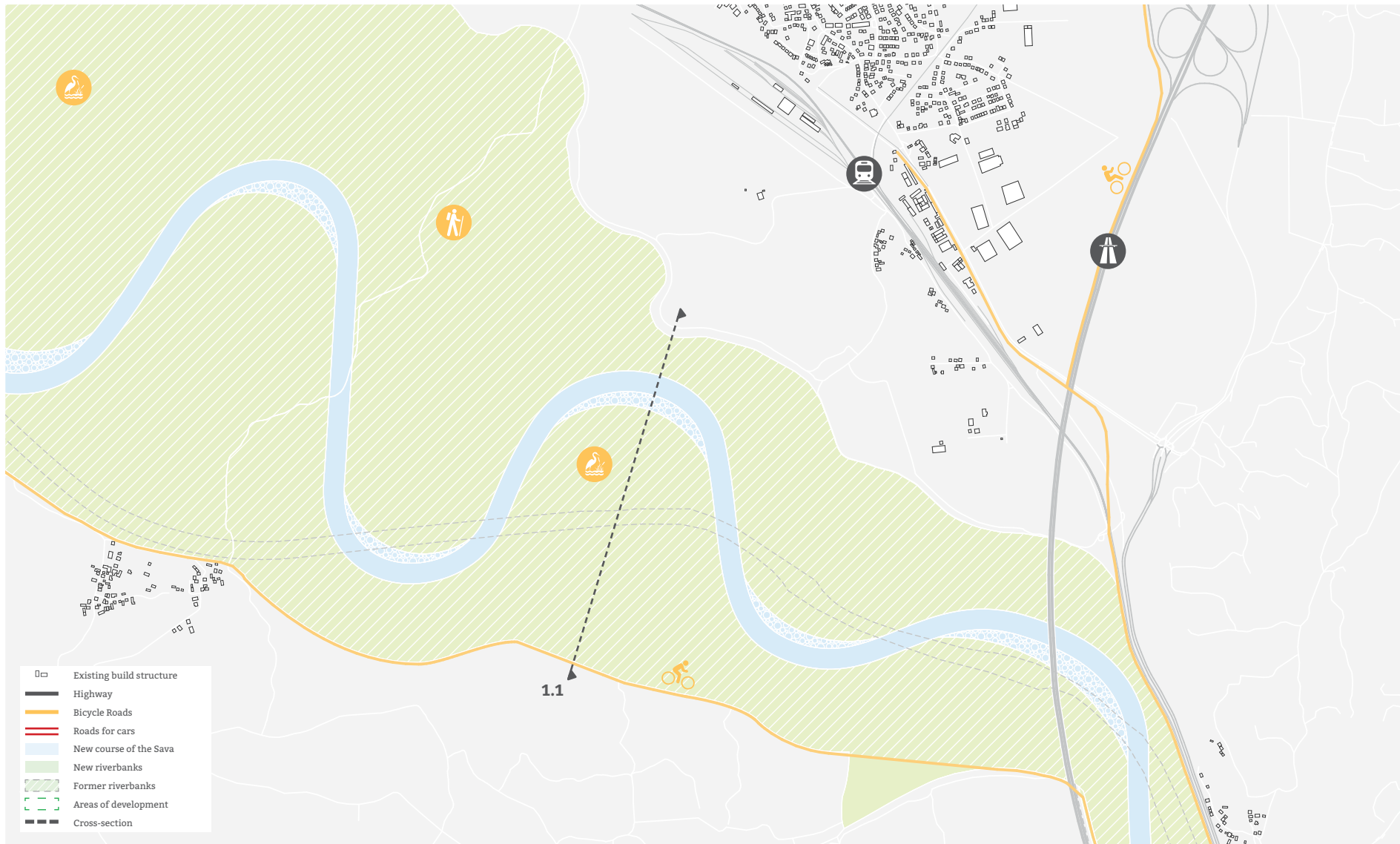


TV STATION

## OVERVIEW SEGMENTS



## SEGMENT 1 : ZAPREŠIĆ



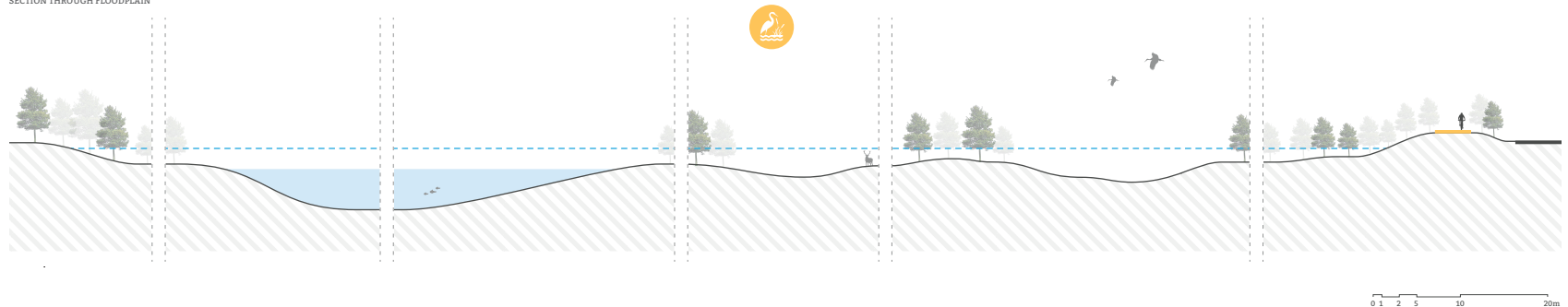
The Sava-Zaprešić area, which is located between the border of Slovenia and Croatia and the City of Zagreb is partly used as a floodplain. The possibility and usability of the natural floodplain got limited by river regulations and the increasing cultivation for agriculture in the past and today. On a closer look on the Zaprešić-Sava area, relicts of the floodplains can be observed, which also show former courses of the Sava on the left bank of the Sava. This are one of the last remaining floodplain relicts in the upstream of Zagreb and hold a huge potential to be used as retentions area, as it had been used in the past. Today the area is mainly used for agriculture. The right bank of the Sava is regulated with embankments and forms a strong barrier and only allows the water to spread on the left bank. At the border of Slovenia and Croatia a planned HPP in Mokrice will complete an almost total

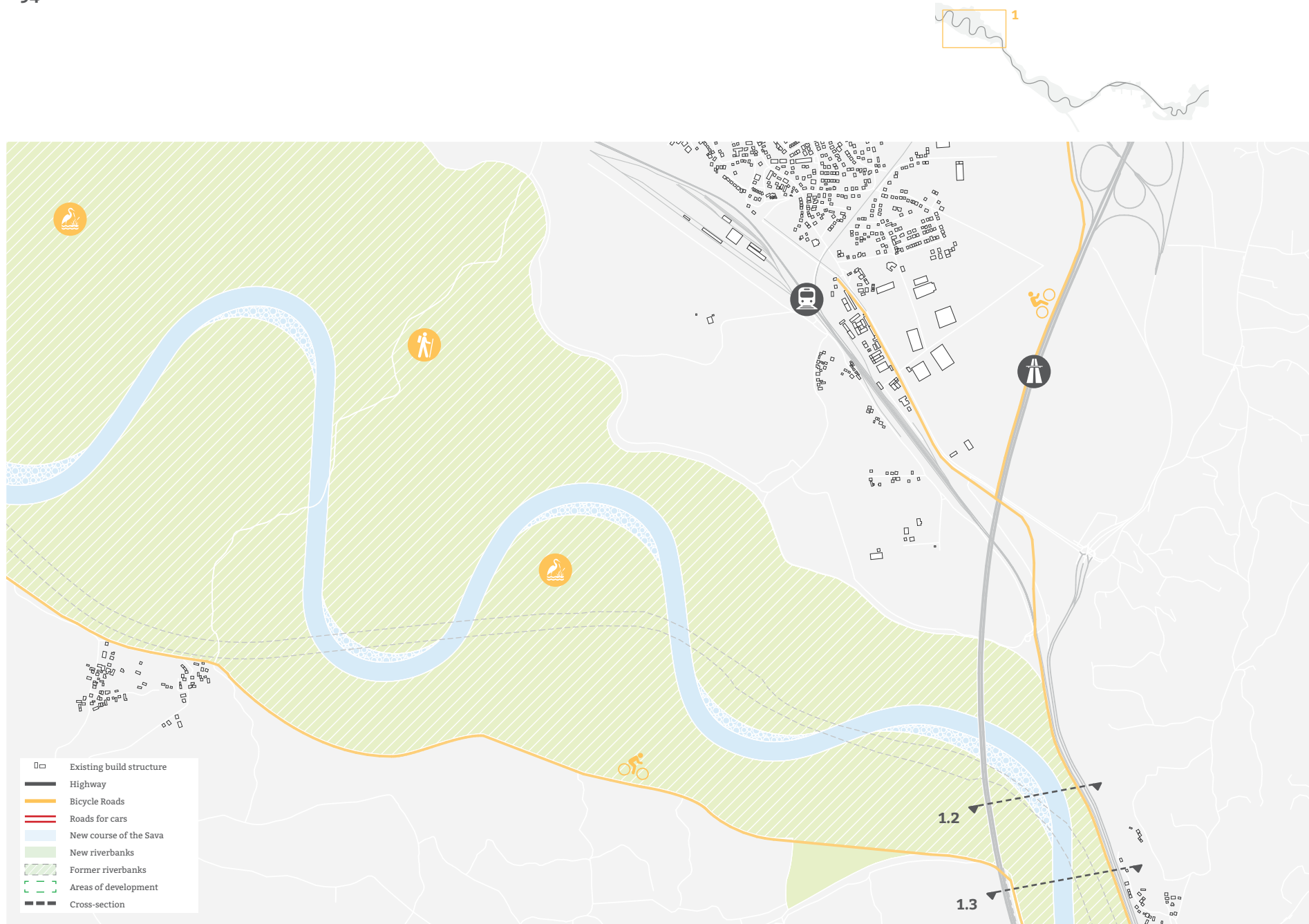
modified and regulated Sava in Slovenia. The heavy modifications will have strong influences and call for acting, but before the developing process is going to start, an evaluation of the accurate conditions of the Zaprešić-Sava area has to be carried out.

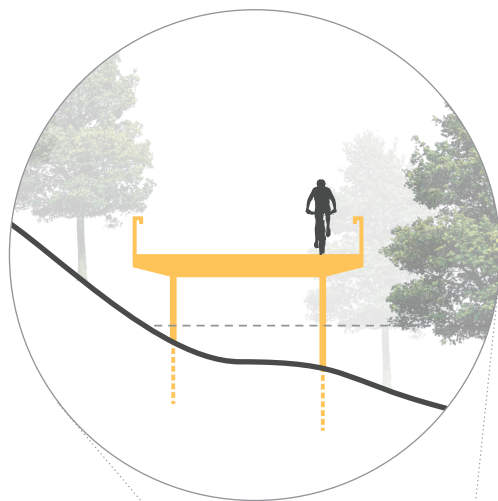
According to the results, the floodplains are naturally enhanced to make a stronger involvement in a new flood risk management possible and to enable a decreasing risk of high tides in the City of Zagreb.

The improved floodplains will have the capacity to absorb and record a major part of the water, what will lower the water level during a flood event. These procedures allow a transformation of the linear to a more meandered course of the Sava.

**1.1**  
SECTION THROUGH FLOODPLAIN







The meandering is continued after the Sava flows through the bridge of the Highway A1, the river makes a turn to the right. The development space in this section, is limited on both sides of the river by important traffic links. Because a shifting of the embankments was impossible, the banks were transformed.

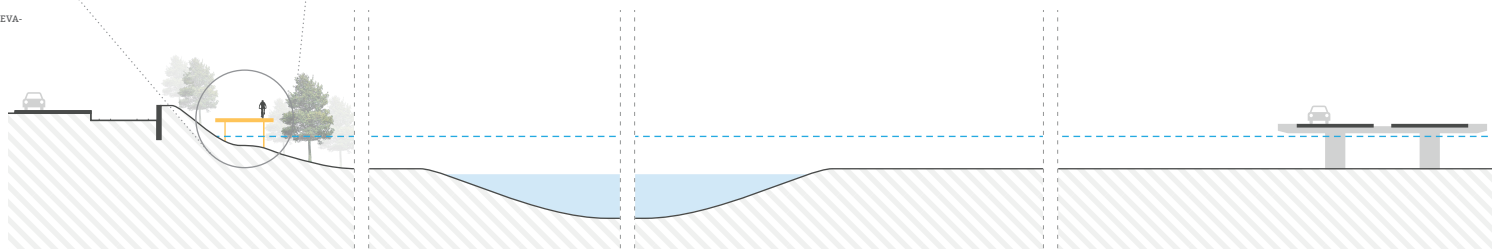
The transformation included a construction of cycle path on both banks of the river. On the left side, the embankment is elevated, depending on the slope of the new bank the path is

either paved or built on stills. The cycle path on the left bank connects the town of Zaprešić to the cycle-path-network. The path is elevated more than the HQ100 altitude. What not only allows the using of the path during a flood event, it also prevents the transport links in north direction of getting flooded.

On the other side the cyclepath is built on the top of the raised embankment next to the A1 highway, this profile is continued along the highway.

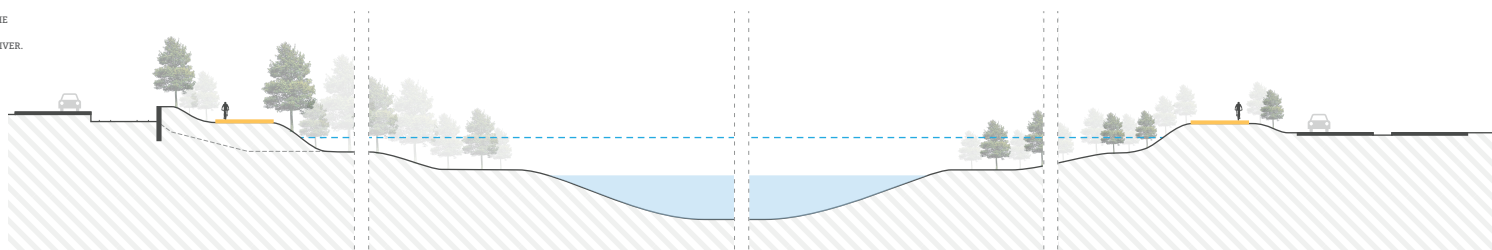
## 1.2

SECTION THROUGH THE SAVA WITH ELEVATED EMBANKMENTS ON COLUMNS.



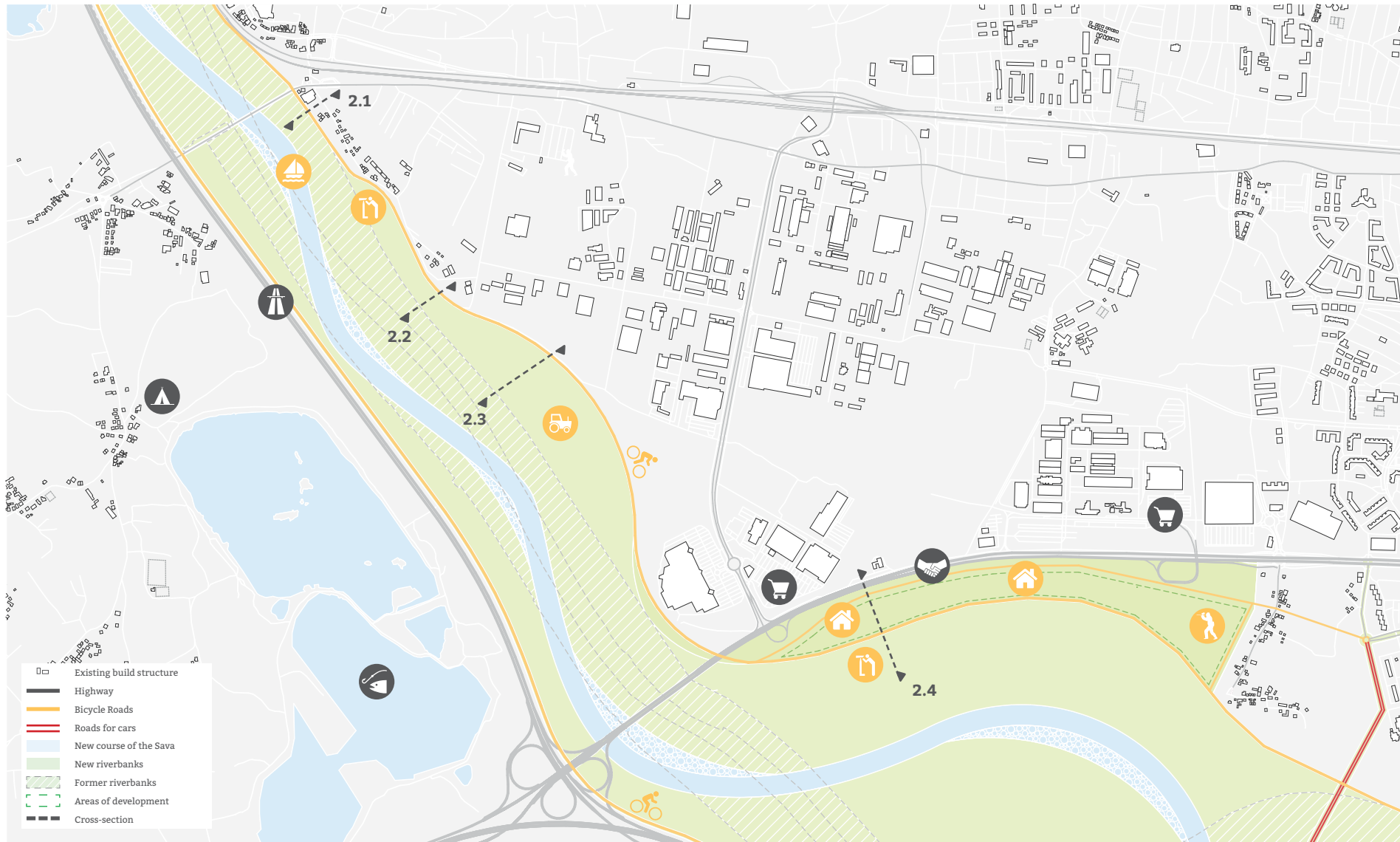
## 1.3

SECTION THROUGH THE SAVA WITH THE RAISED EMBANKMENTS WITH A CYCLE PATH ON TOP ON BOTH SIDES OF THE RIVER.



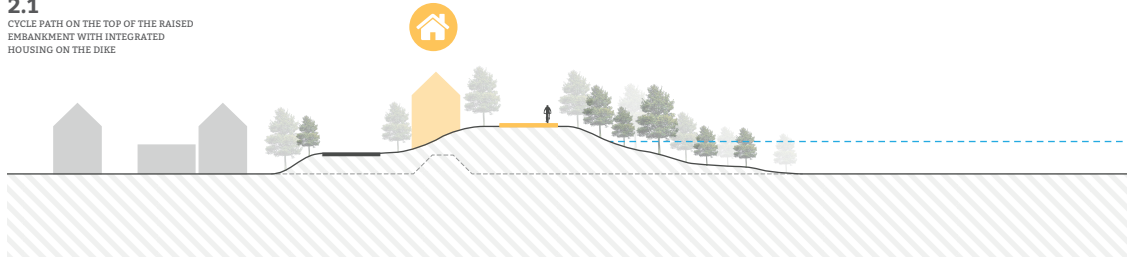
0 1 2 5 10 20m

## SEGMENT 2 : FROM PODSUSED BRIDGE TO JANKOMIR



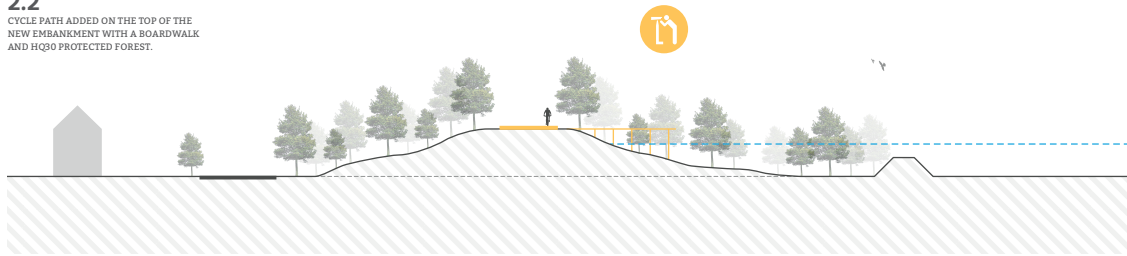
## 2.1

CYCLE PATH ON THE TOP OF THE RAISED EMBANKMENT WITH INTEGRATED HOUSING ON THE DIKE



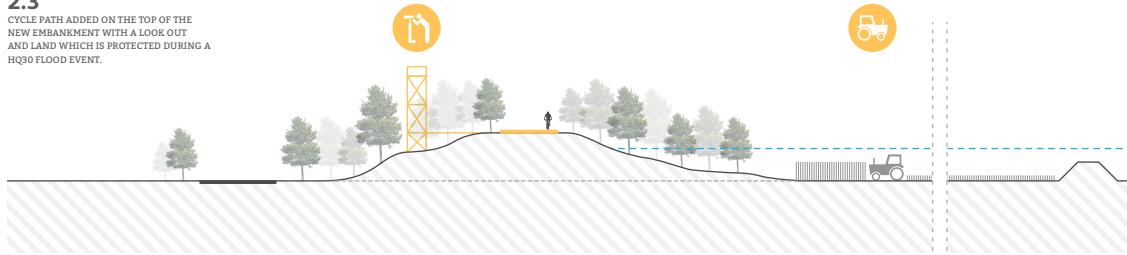
## 2.2

CYCLE PATH ADDED ON THE TOP OF THE NEW EMBANKMENT WITH A BOARDWALK AND HQ30 PROTECTED FOREST.



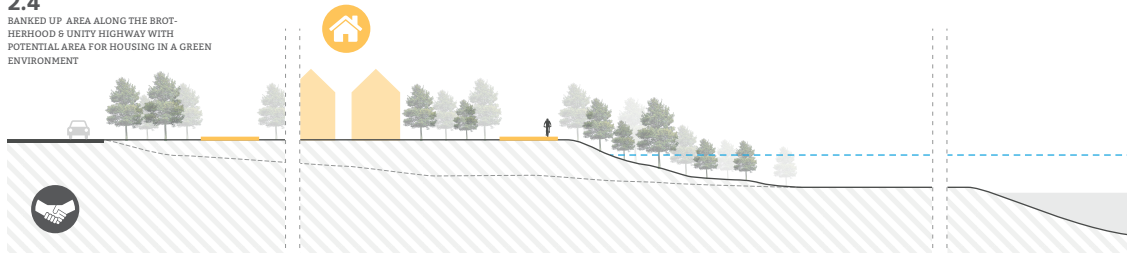
## 2.3

CYCLE PATH ADDED ON THE TOP OF THE NEW EMBANKMENT WITH A LOOK OUT AND LAND WHICH IS PROTECTED DURING A HQ30 FLOOD EVENT.



## 2.4

BANKED UP AREA ALONG THE BROTHERHOOD & UNITY HIGHWAY WITH POTENTIAL AREA FOR HOUSING IN A GREEN ENVIRONMENT



The second segments stretches from the Podsused Bridge to the Jankomir Bridge, along this segment the spaces of the riverbanks are limited on both sides by embankments. To improve the situation of this section, the riverbank is broadened by shifting the embankments. Besides the shifting, the riverbanks on the left side are also transformed, to prohibit a linear and artificial appearance. The profile of the dike is continuously changing its leaning and width. The natural character of the embankment is enhanced by covering the dikes with a diversity of plants. The Sava-Cycle-And-Walk-Path is part of new profile and is located on the top of the embankments. Along the path a couple of lock-outs and boardwalk are constructed. At the Jankomir Bridge the new embankments are moved closer to the Neighbour-&-Unity-Highway, same as on the right bank of the Sava, where the embankments are also shifted closer to the highway A1 almost on the total length till the Jadranksa Bridge.

The former embankments are not demolished and form a barrier by flood events which are not higher than HQ30. Existing build structures in the riverbanks are relocated to other locations.

0 1 2 5 10 20m



## SEGMENT 3 : JANKOMIR & BLATO

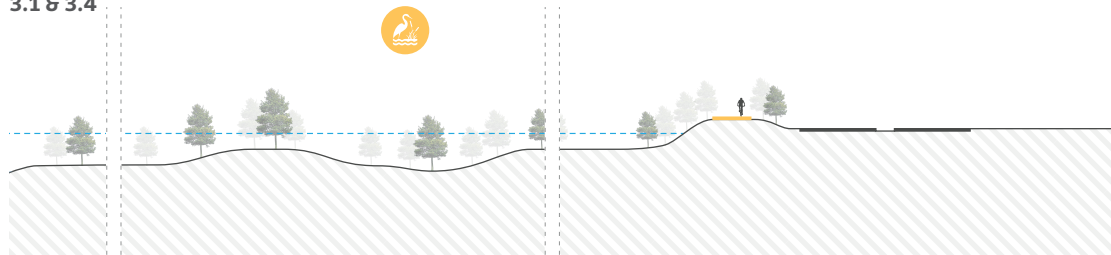


At the Jankomir Weir the Sava makes a turn to the left and the areas next to the riverbanks have been mainly used for agriculture ( Blato ) and leisure activities ( Jarun ). The plain constitution of the Blato and Jankomir area, which is only weakly covered with built structures, made it possible to transform the area into a huge wetland and recreation park. The

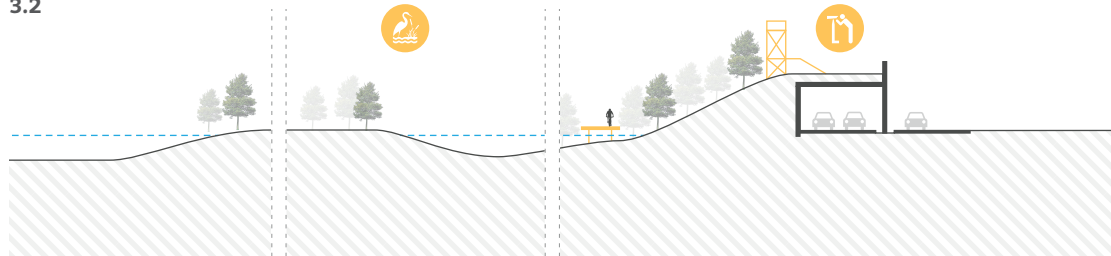
existing embankments are demolished, shifted or transformed. On the left bank they are moved closer to the brotherhood and unity highway and on the south east closer to the highway A1. This intervention generated an area with enormous dimensions. Beside the new wetland and recreation park, the Sava got a more meandered course. The natural and green character of the areas are enhanced. Small parts of the area are still used for agriculture, but are accepted to be flooded during a flood event. Artificial Islands are constructed for the animals to have a safe place during a flood event and give the landscape a natural up-and-down conducting topography. The existing golf course is relocated to another location. The Jankomir Weir is moved in the direction of the Jadranska Avenija and keeps his function as spillover to prevent an overrunning of the dikes. Same as the Weir, the Sava-Odra Channel keeps its function and is maintained and is used as a recreation area for the southern neighborhood.

A new bridge links the Lucko area with the Jankomir area and the Brotherhood & Unity Highway and prevents future urban developments in the southern periphery.

3.1 & 3.4



3.2

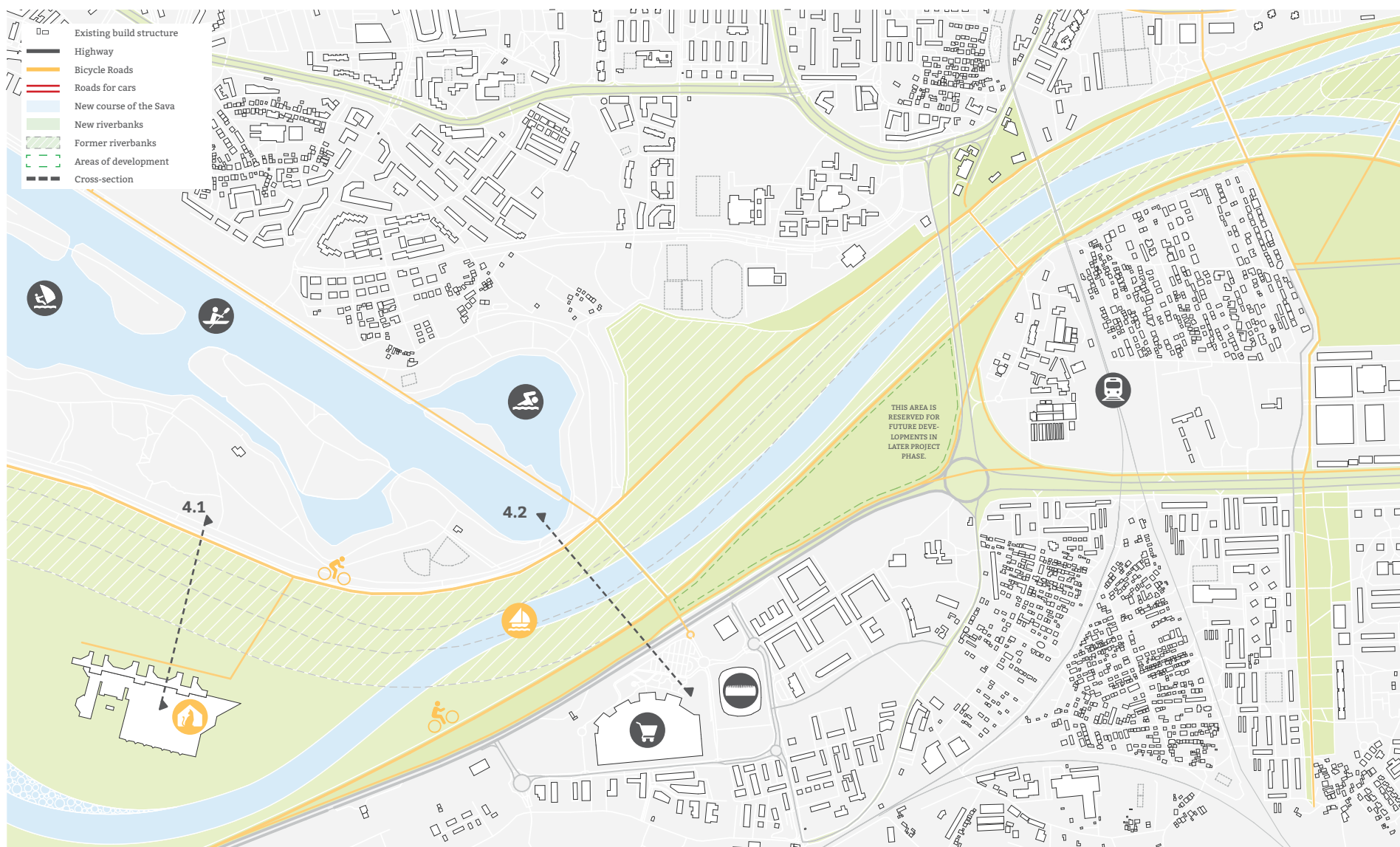


3.3



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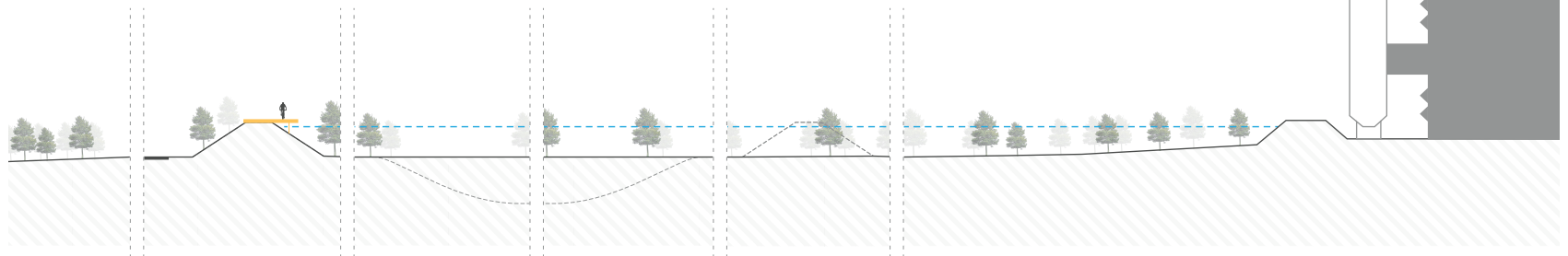
## SEGMENT 4 : JARUN & ARENA



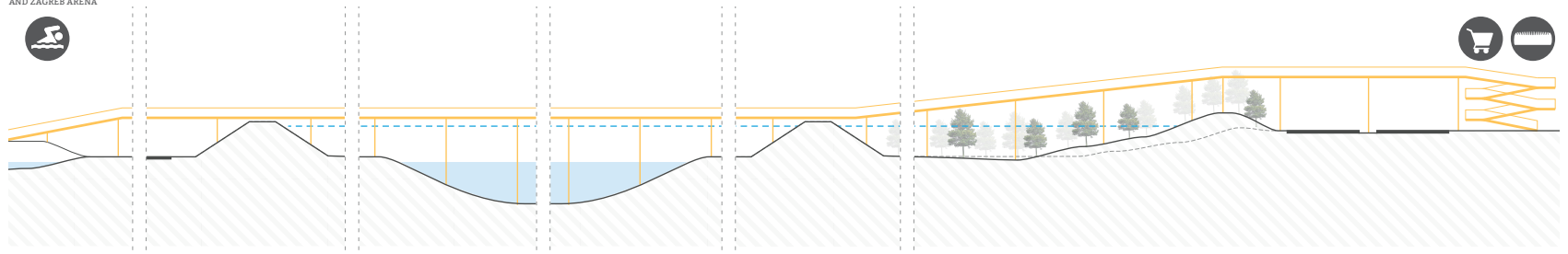
Short before the Sava leaves the recreation area of Jankomir-Blato, the abandoned area of the never finished Sveučilišna bolnica u Blatu is kept as a memorial. The hospital facility was built in the eighties, but never finished. The building expired more and more, since the building process was stopped during the Croatian War in the 1990s. The building should stay in the mind of the people for the next generations. Parts of the building are rebuilt as an observation and shelter for animals.

When the riverbanks get narrower the new course of the embankment merges with the existing embankments. In this area on both sides of the riverbanks are areas for leisure activities so it was obvious to connect them, so that both sides can benefit from the other side. This connection is achieved by a new pedestrian bridge with also stretches over the distributor road to link the Zagreb Arena and the Shopping Mall with the Jarun area.

**4.1**  
SECTION THROUGH SVEUCILISNA BOLNICA



**4.2**  
SECTION THROUGH THE LINK OF JARUN  
AND ZAGREB ARENA

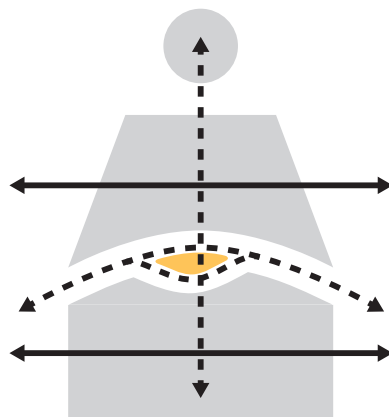
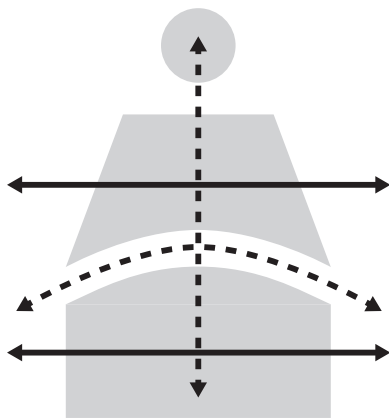


0 1 2 5 10 20m



## SEGMENT 5 : NEW SAVA ISLAND





A transportation hub at the Sava bridge is enhanced and by extending and increasing the frequency rate of the public transportation, the network it offers a perfect junction for the people to reach the old town of Zagrebs, just in a couple of minutes.

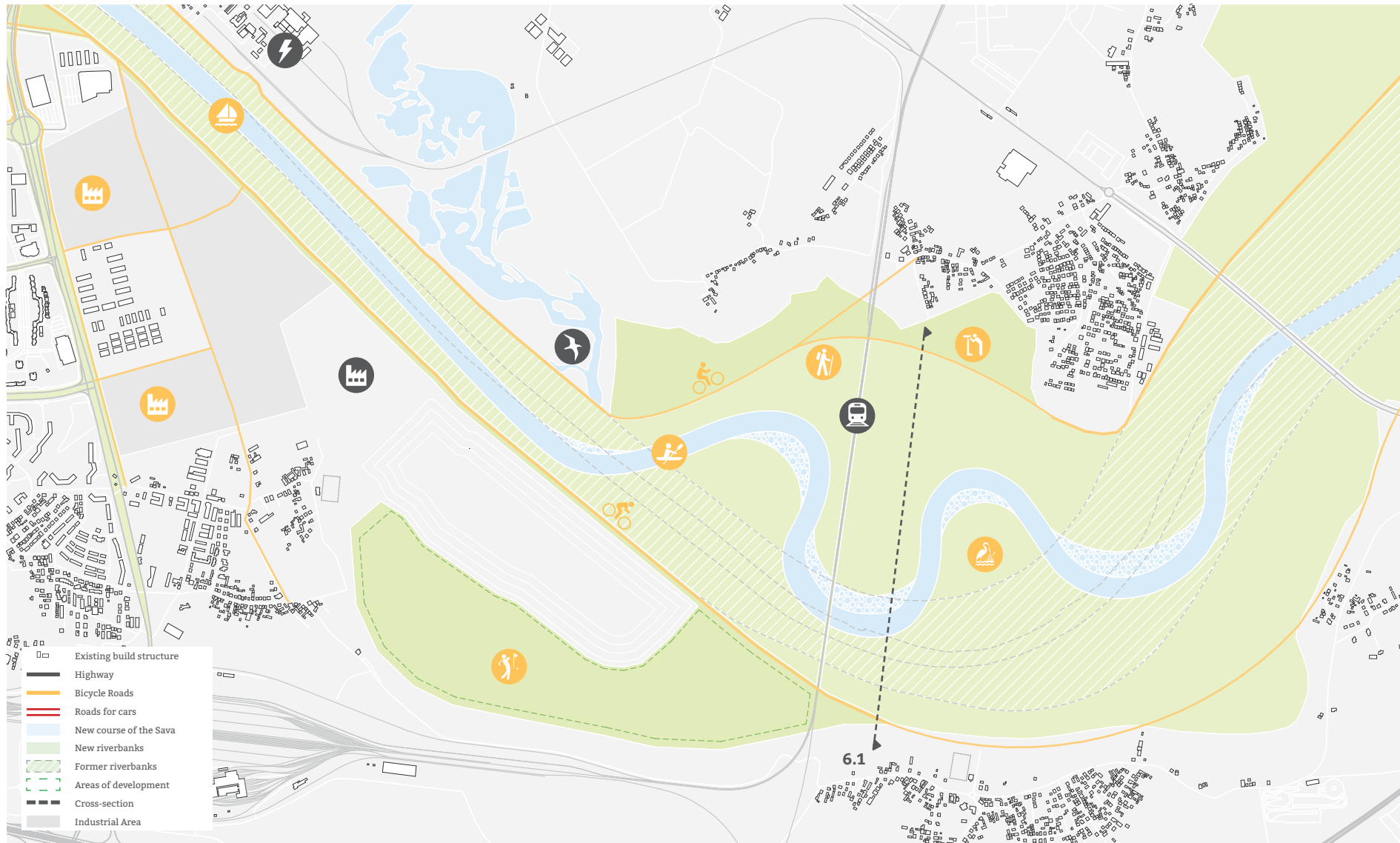
As closer as the Sava comes along to the urban areas, the expanding potentials get less and other tools for adapting the embankments are necessary. At the Sava Bridge, which has been the only pedestrian and bicycle bridge, before the Reprofilng The Sava River Project, the course of the Sava is not only alternated, it is also splitted in two streams, what creates a new island. While the embankments on the left are mostly kept or transformed, the embankment on the right stream are shifted and a new island is developed in the space between. The artificial island is a new city district and a new pioneer hotspot in the urban planning of Zagreb. The elevated island is a mainly car free area, which is, beside of public transportation, only accessible for pedestrian and bicycle by two bridges in the north and two in the south. The increasing amount of connections generate a strong network of

relations and make the island accessible in all directions. The area along the embankments on the right riverbank are only covered with a few buildings. The area is kept mainly as open green space for the public and is linked to the Bundeck area.

Between the Liberty Bridge and Youth Bridge a new connection for car traffic is constructed to complete an important north-south-axis which is an extension of the Ulica Savezne Republike Njemacke. It links the Brotherhood & Unity Highway and the Highway A1. The connection is located underground. The connection relieves the Avenija Veceslava Holjevca, which was highly frequented by cars, this road was originally designed for public transportation and pedestrians, but the increasing car traffic caused a redesign with a main focus on cars.

Next to the tunnel two new pedestrian bridges are build between the tunnel and the Youth Bridge. This bridges link the two neighborhoods of Savica and Zaprude. The Zaprude residential area is extend closer to the riverbanks, but with a strong relation to green spaces.

## SEGMENT 6 : SAVICA & DOWNSTREAM WETLAND



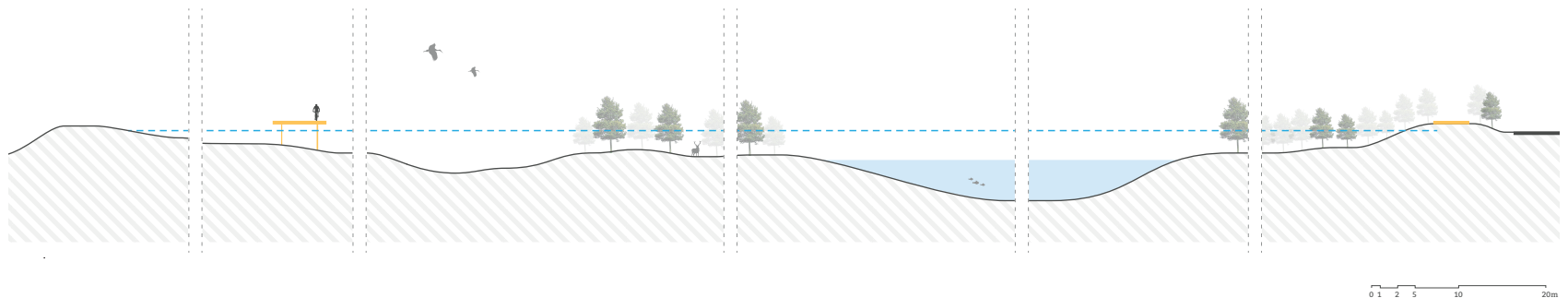
The last segment stretches from the Youth Bridge to the Homeland Bridge. The areas next to the riverbanks are mainly used for industry and agriculture. While major part of the industry is located on the right side of the river, except the powerplant, the left side is mainly used for agriculture. The build structures are family houses in a suburban environment.

In comparison to the industry area, the riverbank itself are used as retention area. The em-

bankments are shifted and the course of the Sava is meandered and same as segment one the area is used as a wetland park and is not only a refugium for animals it is also used for hiking and camping, the elevated cycle highway offer a short and safe link from the suburb to the city.

## 6.1

SECTION THROUGH FLOODPLAIN







## PHASES OF TRANSITION OF THE SAVA ISLAND

07



WATER FRONT PUBLIC GREEN SPACES  
NEW PERSPECTIVES SUSTAINABLE **YOUNG FAMILIES** DENSE NETWORK  
PUBLIC TRANSPORTATION WATER FRONT EUROPEAN HUB  
**ECOLOGIC** **BIODIVERSITY**  
PEDESTRIAN FRIENDLY  
ECONOMIC GROWTH **URBANISM** PARTICIPATION  
**CAR FREE** PIONEER PROJECT GREEN ISLAND  
MICROCLIMATE

## DEVELOPMENT OF SEGMENT NO.5 ( PHASE 1 )

PHASE 1.1:  
EXISTING STRUCTURES ARE DEMOLISHED OR/AND RELOCATED



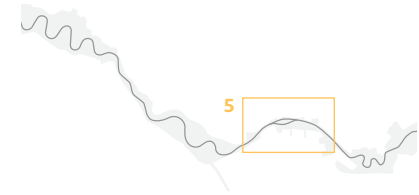
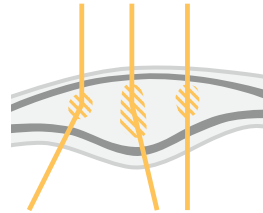
PHASE 1.2:  
THE EMBANKMENTS GET SHIFTED OR/AND TRANSFORMED



PHASE 1.3:  
NEW DIVIDED COURSE OF THE SAVA RIVER



PHASE 1.4 & 1.5:  
NORTH AND SOUTH IS LINKED & SMALL ISLANDS ARE RAISED



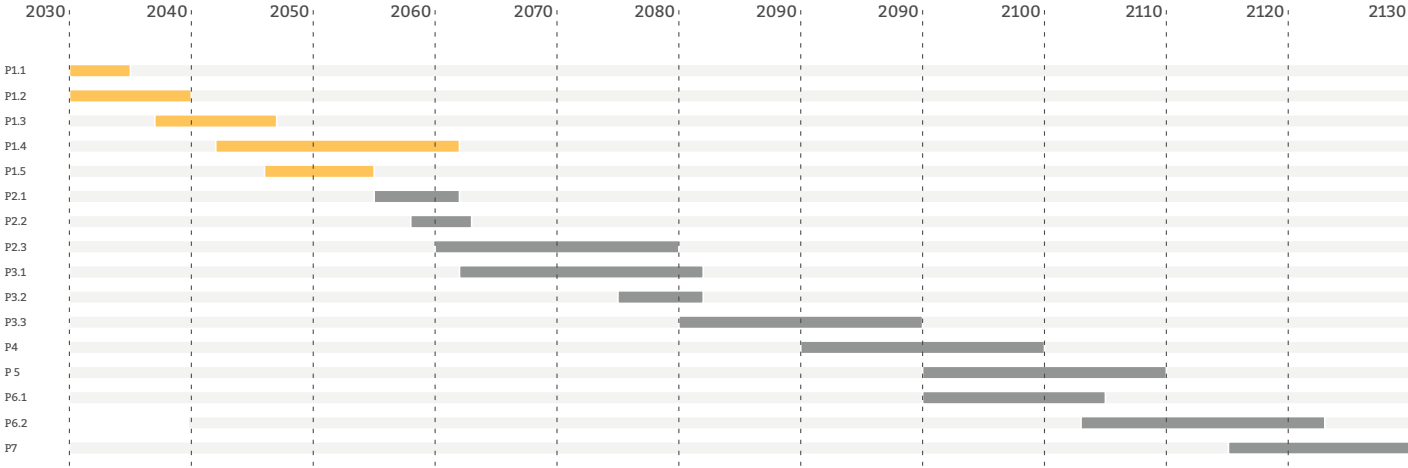
Segment number 5 is the segment with the shortest distance to the City of Zagreb. A central point of the segment is creating a new artificial constructed island, the Sava Island. It is a new city district to links the northern old town of Zagreb with the area of Novi Zagreb. It is located at the strong north south axis, which is one of the major axis of the city of Zagreb. A lot of important public facilities are aligned on this road, such as the national library, the court of justice and the contemporary art museum and the main train station of Zagreb. The first step was demolishing and relocating

of existing structures, which were located within the new planned riverbanks. At the same time the existing embankments got shifted or/and transformed to create the space for the new island. After the embankments were finished, the shifting of the course of the Sava began. The new river course is divided in two streams and provides the shape of the island.

When the construction of the embankments reached the secure point, to be save during an inundation event, three connections between north and south were built. While the

bridges got constructed, the first parts of the islands right, along these north-south connection were raised and created three small islands. After the small islands take shape and the bridges are constructed the people use the green spaces on the island. The green spaces

on the islands offer a variety of sport and leisure activities and the nearby river permits activities related to water. People started to spend their leisure time and their weekends on the island.











The creation of a strong relation of local people and the project, was an essential part of the design. An involvement of all involved parties to all parts of the design process enables a fast reacting on all occurring questions, problems and prevent of a lack of clarity. All people are invited to join open discussions as early and as many as possible. It was important to introduce the public at every single stage and to make them to an essential part of the project. This was offered in a constant amount of meetings, which were open to the public and include representatives of all involved parties.

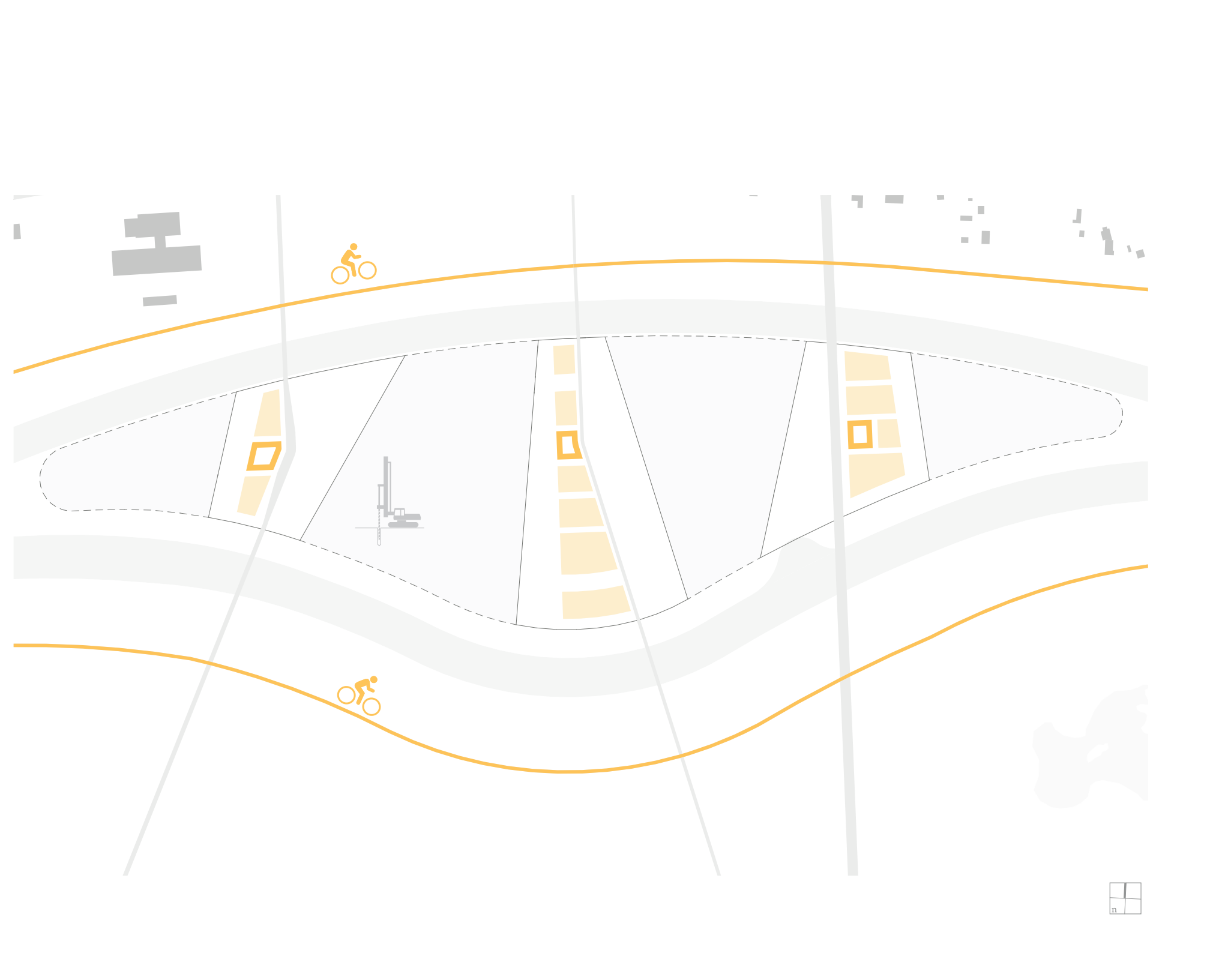


As a physical symbol for the narrow collaboration the first building on each island was a community center. Part of the program of each of the centers is an information desk. The information desks are not only used to show the ongoing progress, the already reached goals, the current status and the future planned developments of the island, but also of the whole re-profiling the Sava project.

Another important part of the community centers is an open and flexible floor plan, what allow a quick adapting and a multiple way of using the space. Same as urban planning the program is needed to be flexible and adaptable to temporary requirements. The space is not limited to the building structure, also the surrounding areas are used. The diversity of possible usage of the location not only invites new people to come to the island, but also make other cities aware of the concept of the project.

After the islands were linked to the urban fabrics and the community centers were built and people became familiar with the project, the linking of the separate island to one big island began.

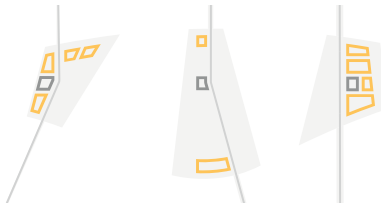
-  Main roads
-  Cycle highway
-  Sava
-  Existing buildings
-  Outline islands
-  Construction area
-  Festival and eventlocation
-  Community center





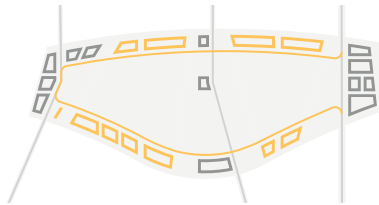
## DEVELOPING PHASES OF THE NEW ISLAND

### PHASE 2



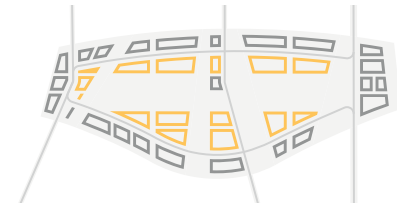
P2.1 public green spaces are constructed.  
P2.2 build structures are constructed.  
P2.3 linked to the public network.

### PHASE 3



P3.1 islands connected together.  
P3.2 tramline leads through the whole island.  
P3.3 build structures are constructed.

### PHASE 4



P4 build structures are densified.

### PHASE 5



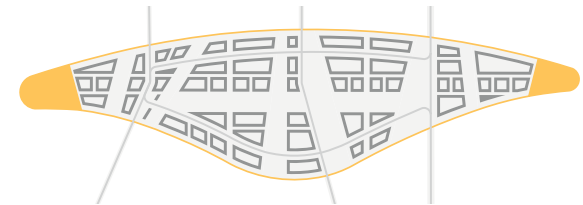
P5 build structures are constructed.

### PHASE 6

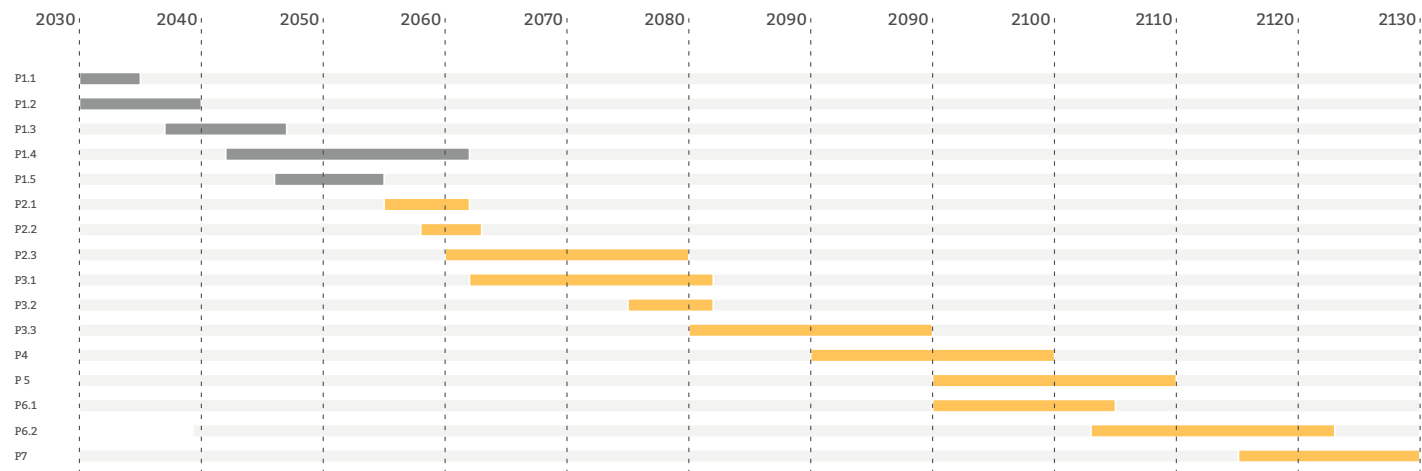
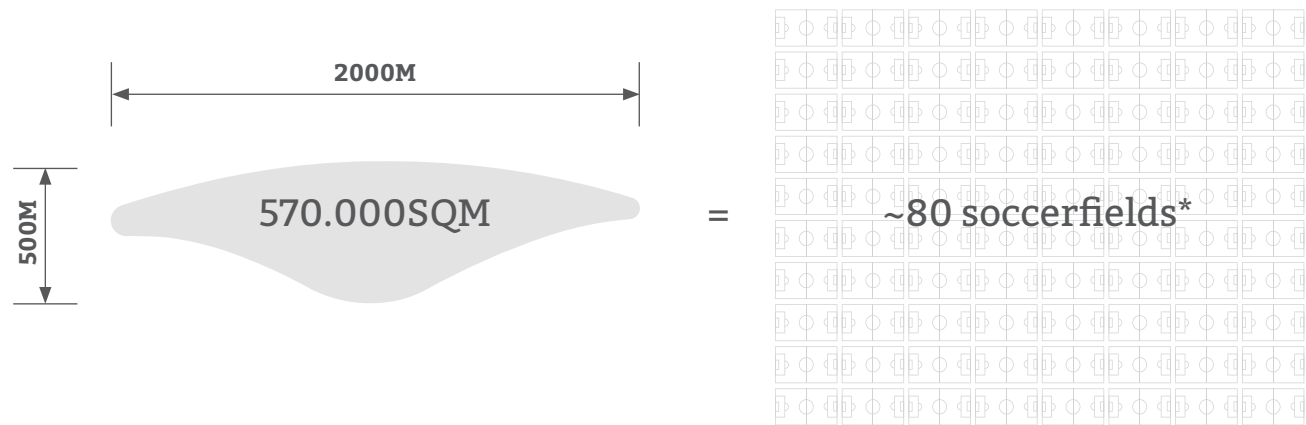


P6.1 the island is expanded east and west.  
P6.2 build structures are constructed on these expansions.

### PHASE 7

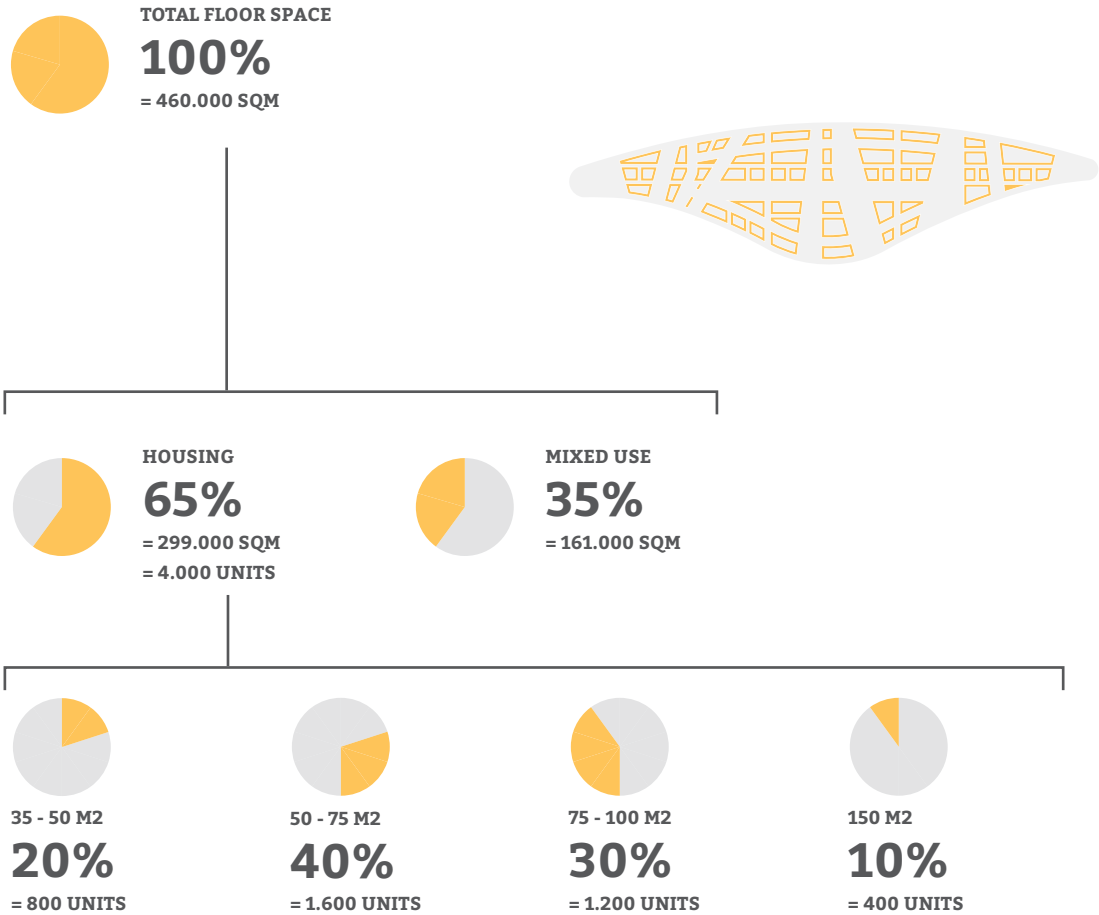


P7 at the east and west edges of the island public parks are build  
& public waterfront all around the island gets its final shape.



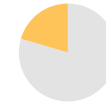
\*\* the assumed dimensions for a soccerfield is 68x105m.

GENERAL DATA OF THE NEW ISLAND





**100%**  
= 570.000 SQM  
TOTAL AREA



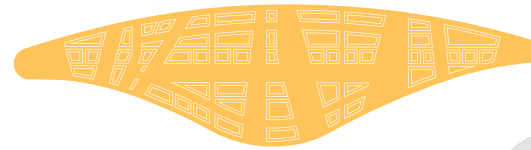
**~20%**  
= 115.000 SQM  
BUILD STRUCTURES



**~61%**  
= 345.000 SQM  
GREEN SPACES



**~19%**  
= 110.000 SQM  
ROAD NETWORK



**~34%**  
= 190.000 SQM  
PUBLIC GREEN

**~16%**  
= 90.000 SQM  
COLLECTIVE GREEN

**~11%**  
= 65.000 SQM  
PRIVATE GREEN

**~26%**  
= 164.000 SQM  
PUBLIC GREEN

**~8%**  
= 26.000 SQM  
POCKET FOREST

**~13%**  
= 71.500 SQM  
COLLECTIVE GREEN

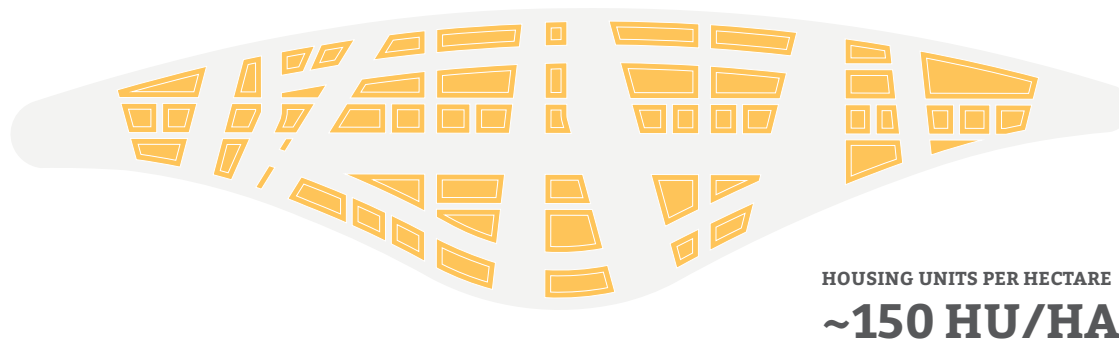
**~3%**  
= 18.500 SQM  
POCKET FORESTS



**~11%**  
= 44.500 SQM  
TOTAL AREA OF  
POCKET FOREST

## DENSITY ≠ DENSITY

CALCULATION CONSIDERING ONLY BUILD STRUCTURES  
AND COURTYARDS ( PRIVATE AND COLLECTIVE GREEN  
SPACES )



GROUND SPACE INDEX:  
 $115.000 \text{ SQM} / 270.000 \text{ SQM} = 0,4259$

**GSI = 0,43**



FLOOR SPACE INDEX:  
 $4 \times 115.000 \text{ SQM} / 270.000 \text{ SQM} = 1,7037$

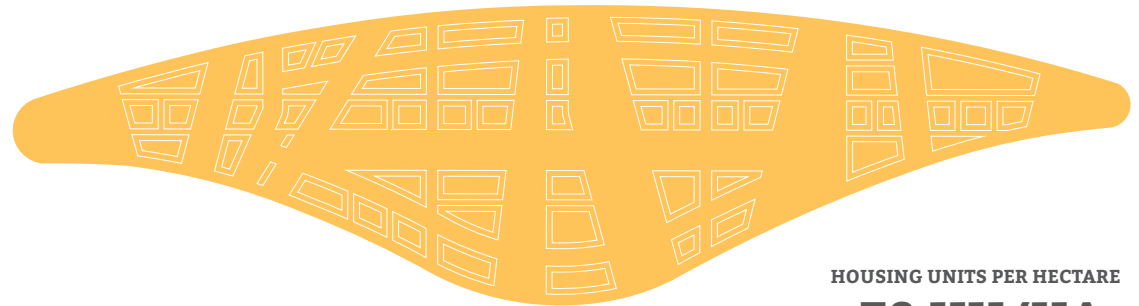
**FSI = 1,70**



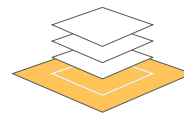
OPEN SPACE RATIO:  
 $155.000 \text{ SQM} / 460.000 \text{ SQM} = 0,3370$

**OSR = 0,34**

CALCULATION INCLUDE PUBLIC AND GREEN SPACES IN  
ADDITION TO BUILD STRUCTURES AND COURTYARDS

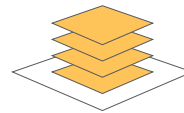


HOUSING UNITS PER HECTARE  
**~70 HU/HA**



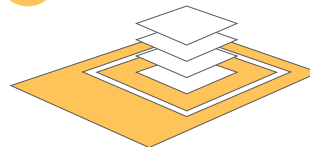
GROUND SPACE INDEX:  
 $115.000 \text{ SQM} / 570.000 \text{ SQM} = 0,2018$

**GSI = 0,21**



FLOOR SPACE INDEX:  
 $4 \times 115.000 \text{ SQM} / 570.000 \text{ SQM} = 0,8070$

**FSI = 0,81**



OPEN SPACE RATIO:  
 $345.000 \text{ SQM} / 460.000 \text{ SQM} = 0,7500$

**OSR = 0,75**

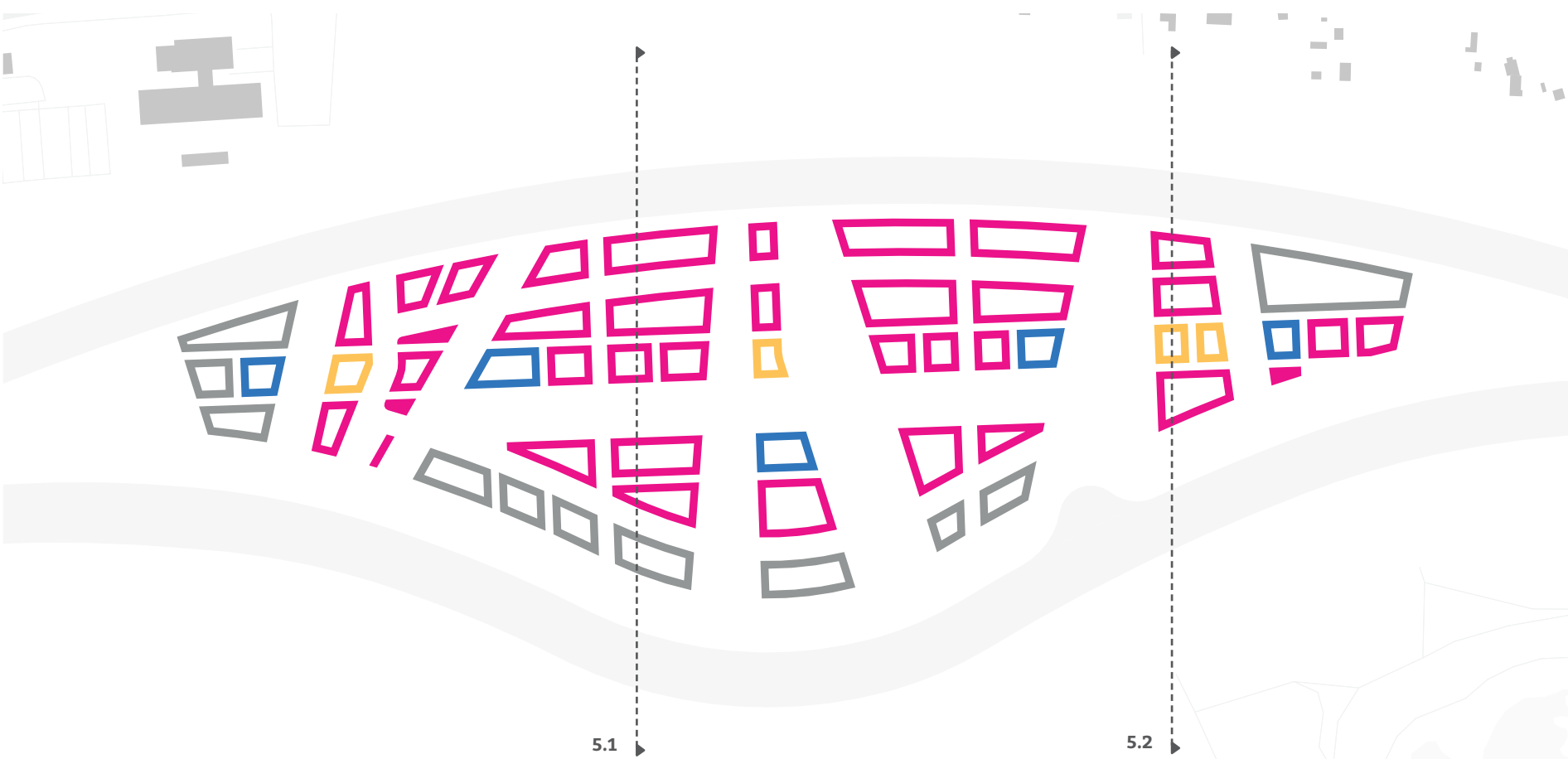
## BUILDING STRUCTURE

The total area, which is covered with buildings is 115.000 sqm. The average level count varies from 3 to 6 floors. A couple of buildings, gain a couple of more floors, to keep a certain density. The urban density on the island varies from 0,85 up to 2,56.

The program is mainly mixed use and the buildings are situated in an orthogonal grid. Not all of the plots are covered with build structures. All buildings have a strong relation to green spaces and the surrounding Sava River. For his reason parts of the islands were kept as continuous green spaces, which are also used as parks and leisure activities. As building typology the perimeter block development was chosen. The typology was also used in the old town of Zagreb. This kind of building typology generates two kind of spaces, one is extroverted and open to the public and the other is introverted and is only accessible for the inhabitants of the specific block, but not all perimeter blocks are completely closed. This happened not only to increase the public spaces, but also to improve the illumination of the buildings and opens the strong orthogonal road grid.



- Sava
- Existing buildings
- Community center
- Residential
- Mixed use
- Education



5.1



5.2



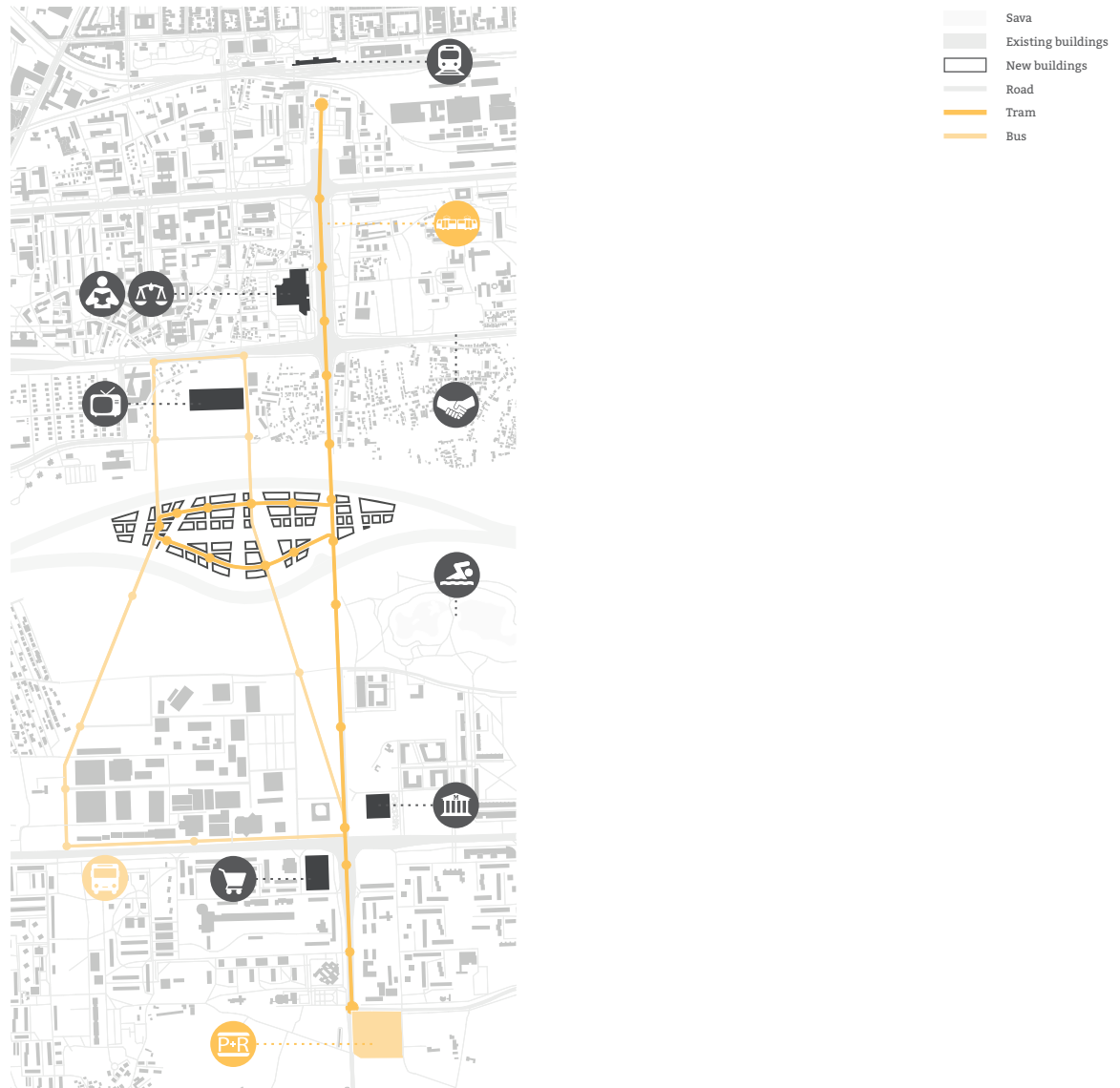


## PUBLIC TRANSPORTATION

The public network of Zagreb gained a new tram line and a new bus line. In addition to these new lines, also the already existing bus lines got adapted and dense the network of public transportation not only around the island, but also to the island.

The existing north-south connection for example, has already been operated by buses, but the increasing number and frequent rate would have caused long delays at important intersections, such as the crossing of the Brotherhood-And-Unity-Highway. To prevent this, the new tram got a separated lane. For a good public network a new bus loop line was implemented to expand the public network.

The new tram line ranges from the existing main train station to a new park and ride scheme in the South. The tram also passes the island via a new refurbished bridge ( former Most slobode ) During the developing process the frequency rate and the required park and ride are adapted.











## BICYCLE & PEDESTRIAN ORIENTED ROAD NETWORK

In addition to the improved public transportation network, the cycle network is increased by adding more bridges in the up- and downstream of the island (Segment No.5). All new proposed bridges include cycle and pedestrian lines in both directions. The raising of north-south connection were essential for a dense cycle network alongside the embankments, otherwise the river would still be a barrier as it has been before.

The pedestrian and cycle friendly environment without cars on the island was intended since the beginning and is adapted throughout the development process. The island, is same as the Reprofiting The Sava project, a

pioneer project to show the advantages of a pedestrian and cyclist friendly city.

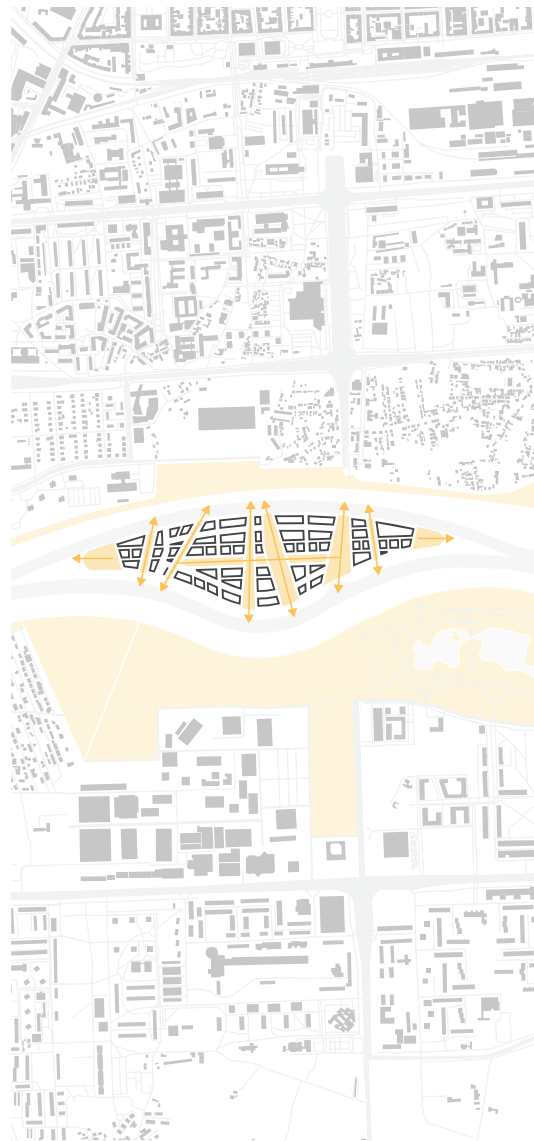
All infrastructures for the everyday life are located in a closer range as in other cities. All required facilities are in walkable distances. This makes cars unnecessary. There is a very limited access for cars kept, to ensure certain parts of public procedures, which can hardly be operated without car access. Therefore a couple of parking slots are located along side the shared street. On the shared street, tram, bus, cars and bicycles go on the same street. Because the car traffic almost zero, even younger children can use the pedestrian roads to walk to school or meet with their friends.

-  Sava
-  Existing buildings
-  New buildings
-  Program for everyday life
-  Diameter 200m
-  Streets



## GREEN SPACES

As mentioned before, the urban planning of the island is strongly related to green spaces and to the Sava. Almost 60% of the island are green spaces (not included are the cycle and pedestrian roads). The total area of is about 345.000 sqm. This is three times the space of the build structures. Not only all residential buildings have a strong relation to green, also all medical and education institutions are directly connected to a green space. Wide public green axis range across the whole island in north-south direction. They are not only connected to each other, but also to the Sava. One public green space in the center of the island connects the North-South axes in East-West direction. This space can be used in multiple ways. It is used for all kind of outdoor sport activities (soccer field, basketball field, racket, volleyball and so on ), but also for temporary events like music festivals or food markets. On the east and west end of the island, two parks are intended to be urban forests with a limited access. It will be only allowed to walk on marked paths, to protect the nature. The courtyards of the perimeter blocks are used as collective green spaces. Parts of the collective green spaces are also used as private green spaces.



- Sava
- Existing buildings
- New buildings
- Sava riverbanks
- Public green spaces
- Pocket forest
- Potential development areas
- Related to green space
- Related to Sava



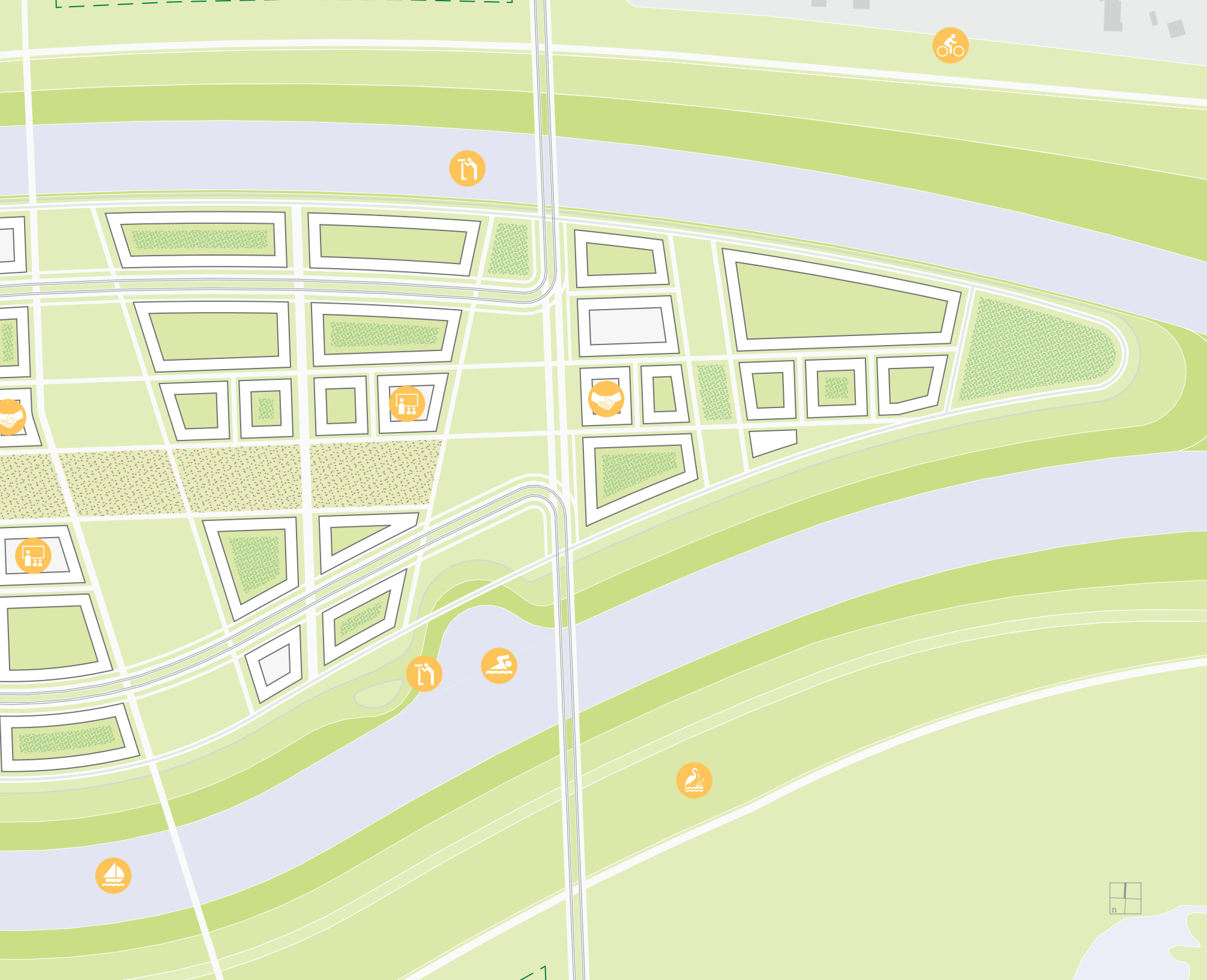


## DESIGN OF THE NEW ISLAND

08





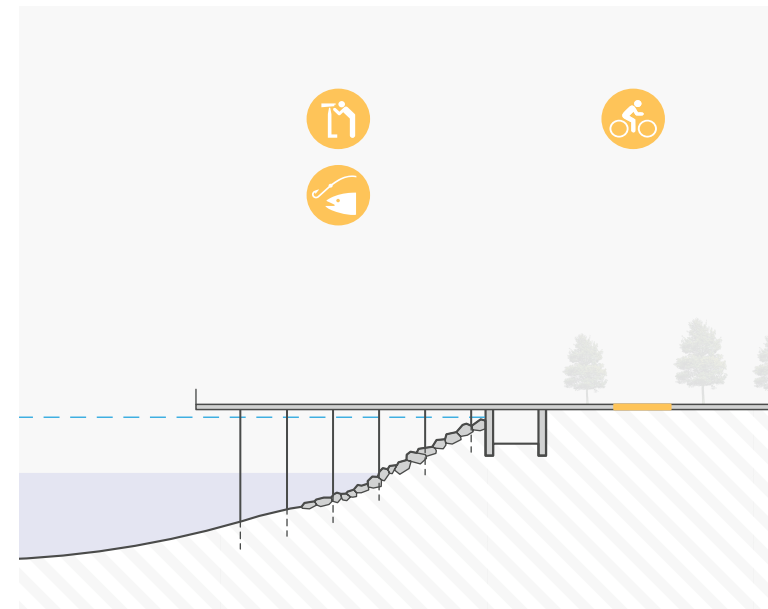
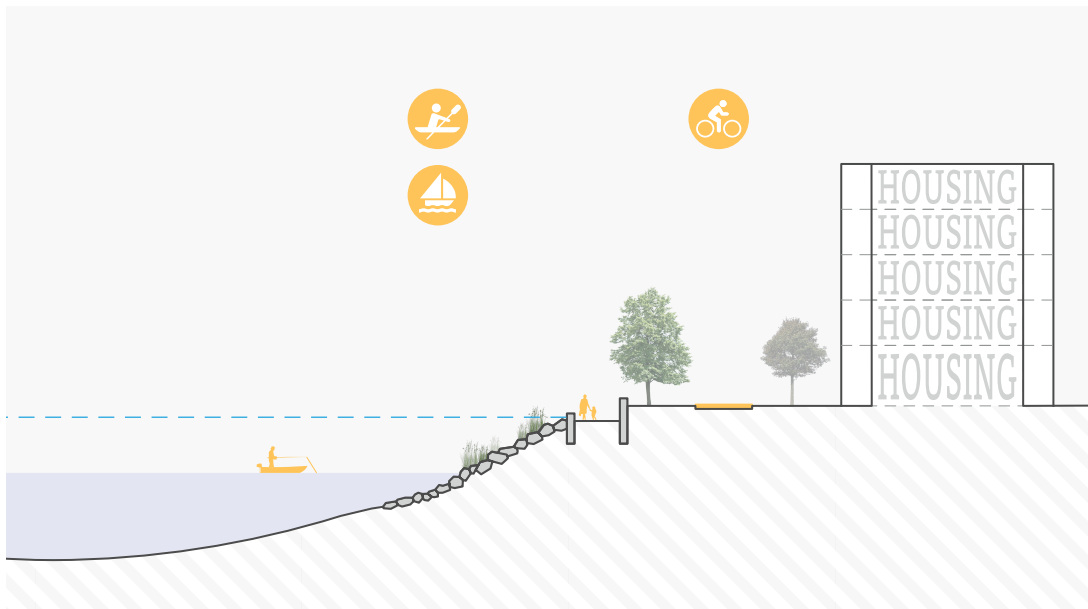
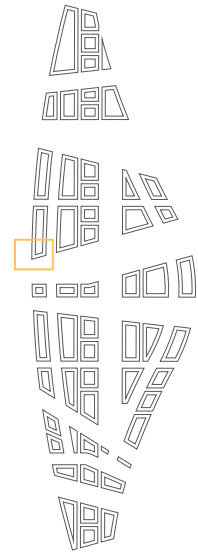


## WATER FRONT : THE PROMENADE

The riverbanks on the Northside of the Island are affixed with stones and include a pedestrian way. The boardwalk is changing its altitude difference to reach the bank of the Sava River. Parts of the walkway is going to be flooded during a HPP100 event. Another feature to get people closer to the river: the North-to-South axes are extended to range over the ri-

verbanks. The boardwalk goes through underneath the peer.

There is a cycle path all around the island. The cycle path can also be used for delivery and emergency purposes. The path is accompanied with trees on the side and is open to the public.





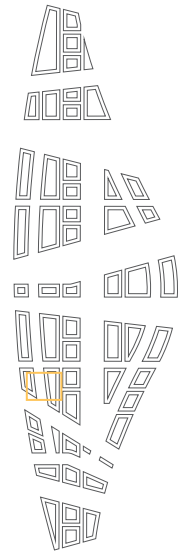
## THE SHARED STREET

The „Shared Street“ is used by the public transportation vehicles ( tram & bus ) and also for bicycles. The width of the street is about 6 meters in each direction and has a green strip between the roads. On both sides of the street there are green stripes too. Beside trees and bushes the green stripes offer spaces for cycle racks and benches.

On the street a limited access for cars is per-

mitted. Therefore a few car parking slots, are located in the green stripes too. Since there is not a lot car traffic, the slots are mainly used for delivery and maintaining service.

While the „Shared Street“ is mainly used by all kind of vehicles there is a separated walkway next to the building fronts, to enhance the space the groundfloor of the buildings is set back from the sidewalk.



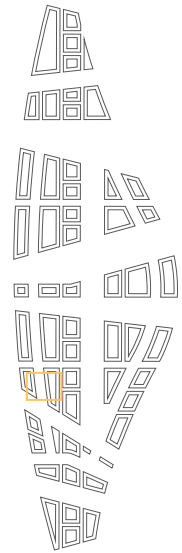


## THE POCKET FOREST

A pocket forest is a wild grown, dense green environment in an urban context. A couple of trees are planted in the construction phase of the building as a starting point for the self-growing habitat. The trees are common trees, which are also occurring in regular forests in Croatia. Trees like the beech, common oak, durmast oak and common hornbeam, but also other soft and hardwood trees. It is also the habitat of a variety of animal species. The small forests generate a unique microcli-

mate within the courtyards and cause a decreasing of the air temperature.

Beside ecologic advantages there are economic benefits too. A self-growing forest does not require a lot of maintaining services, using the forest as a natural air conditioning decreases the cost of air conditioning and provide a unique experience for the inhabitants. They live next to the nature and the change of the season is visible right out of their windows.









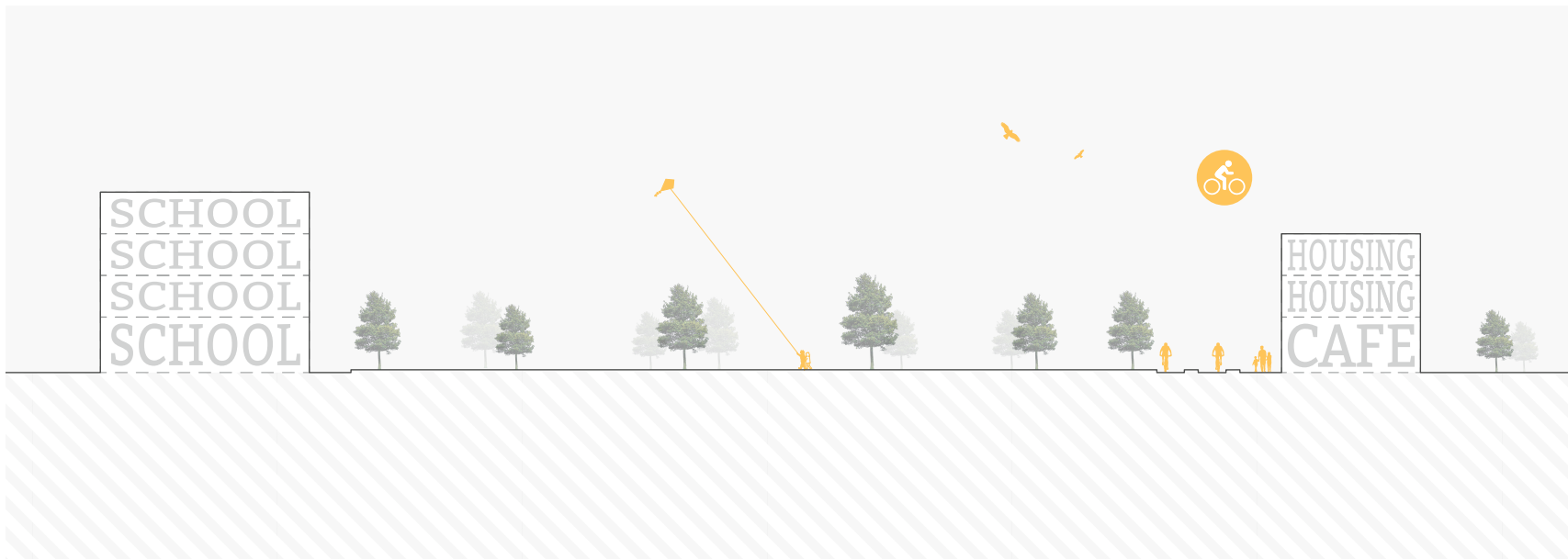
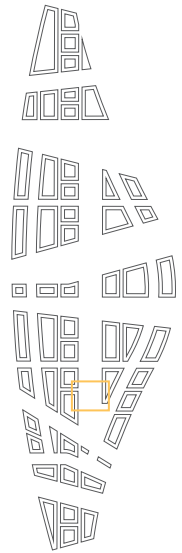
## THE CENTRAL PUBLIC GREEN

The center public space provide a huge variety of usage. It is used for all kind of temporary events, such as music festivals, food markets and design events. Certain spaces alongside the roads are paved. This enables a usage throughout the whole year.

Beside temporary events, there is also a fixed

program, like soccer fields, a baseball field, volley ballfields, a skate park, a dog park and multiple playgrounds for children.

Alongside the Southside of the Center Public Space a cycle highway ranges from east to west, is guided with a tree alley and connects the North South Axis.

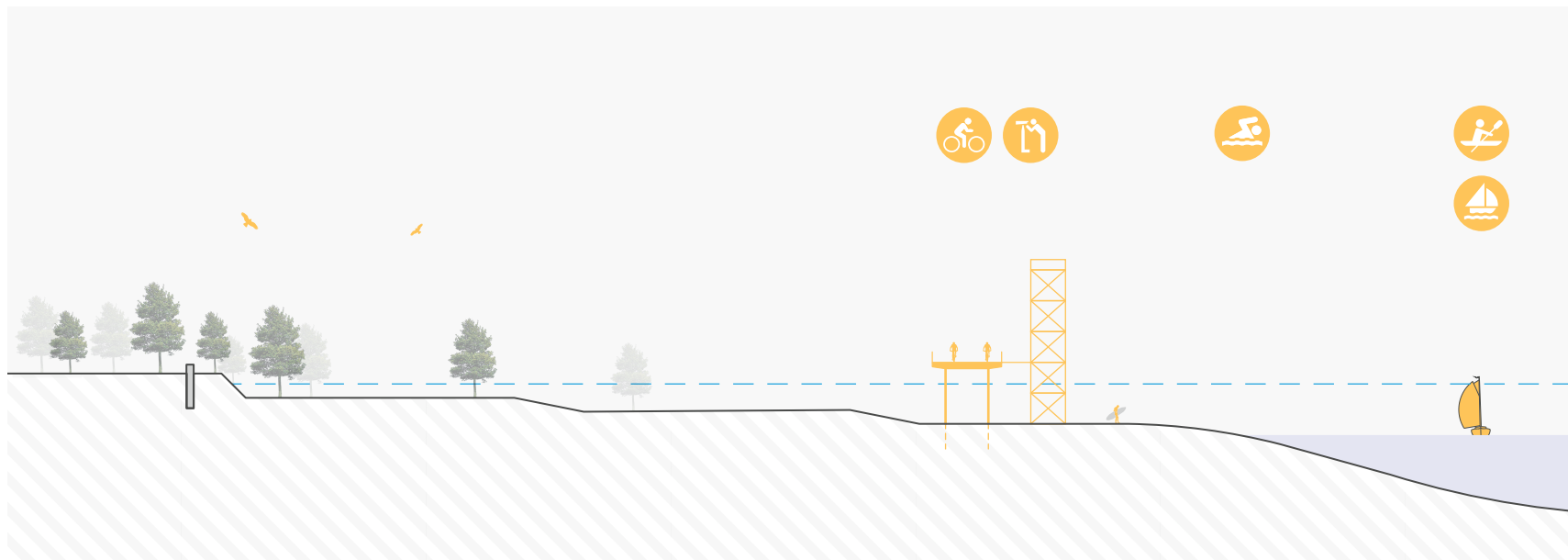


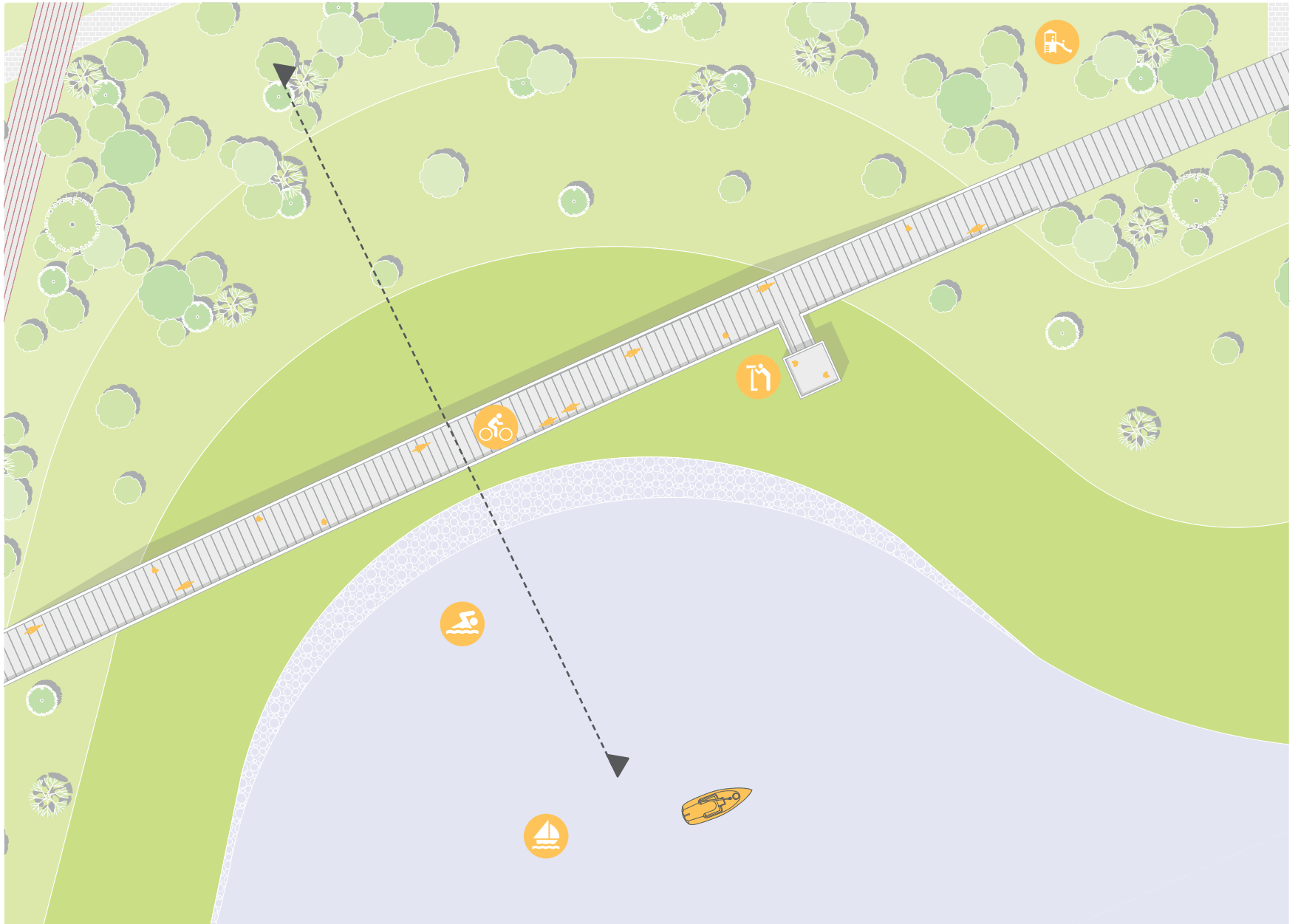


## WATERFRONT : THE BAY

To get people closer to the water and provide the possibility to swim in the Sava River the outline of the Island is shifted to the inside. This is made at one area at the riverbank in the South. Not only the outline of the island is shifted, also the slope of the riverbank is flatter than other areas of the riverbank.

The cycle path, which leads all around the island is not shifted and is constructed as a bridge in the area of the bay.



















visualisation of a courtyard with a pocket forest.













## CONCLUSION

09

The Reprofilng The Sava River Project is a pioneer project based in Zagreb, Croatia. The project demonstrates a symbiosis of ecologic, sociologic, economic and urban developments. The project is a counter proposal to common river regulation projects, which are already constructed or are going to be built in the up- and downstream of the Sava.

Ecological key elements of The Reprofilng The Sava Project are preservation and recreation of biodiversity. This is achieved by enhancing the riparian meadow land, re-naturalizing of the Sava River and re-constructing of the embankments and relieve areas within an urban context of getting flooded during an inundation event. Especially in terms of global warming and its unpredictable outcome, which are mainly expressed in regional natural disaster, sensitize the mind of the public and raise the awareness for the value of microclimate, floodplains and green environments. While other projects mainly focus on constructing HPPs to generate energy, this project not only focuses on economic factors, but also wants to improve demographic and sociologic developments.

The today's economic and sociologic developments are dividing our society more and more. This is not only occurring in Zagreb, this can be observed all over the world. It is one of the biggest issues of our today's society. For this reason, participation and public discussions are an essential part of the design.

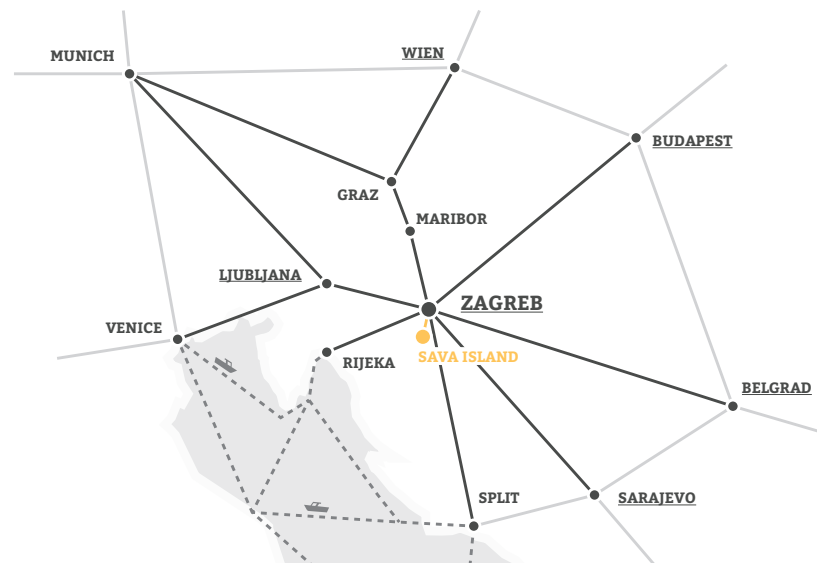
Demographic developments have a strong impact on the future development of the city of Zagreb. It is significant to reverse the current demographic trends. To prevent emigration, the new build island enable affordable housing for younger people, but also take care about the aging of the population. The layout of a major part of the residential buildings are designed for young families.

Creating affordable housing is focused same as enhancing assisted living and has an impact on the used building typologies. The numerous public and green spaces generate a variety of places where all people can spend their leisure activities in a very close distance to their work and home.

The island proposes a carless city. Cars only

have a limited access to the island. The road network is designed for bicycles and pedestrians and improve the health of the people. All areas of the island are well connected to the public transportation. Elderly people are able to take care about themselves longer and stay independent. Another positive fact of the carless island is the reduction of carbon dioxide output. The concept of a carless city could be extended to other parts of the city, to other cities or even to other countries. The decreasing of cars and promotion of large green spaces improve the quality of the air.

A dense public transportation network keep the people on the island in a close connection to the main train station and the center of Zagreb in the North and the highway and the airport in the South. Not only the connection within the city is well, also surrounding cities are well connected. Graz, Ljubljana, Sarajevo, Beograd are within short distance. Zagreb is an important south-east hub of the European Union and with the Reprofling The Sava In Zagreb Project, Zagreb has the potential to become a pioneer city of the future.







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10

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Source : [https://www.europan-europe.eu/media/cache/default\\_big/default/0001/12/12535\\_default\\_big.jpg](https://www.europan-europe.eu/media/cache/default_big/default/0001/12/12535_default_big.jpg) [ 17 07 2017 ]

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Highway / Source : [https://de.wikipedia.org/wiki/Autobahn#/media/File:Zeiche\\_n\\_330\\_-\\_Autobahn\\_StVO\\_1992.svg](https://de.wikipedia.org/wiki/Autobahn#/media/File:Zeiche_n_330_-_Autobahn_StVO_1992.svg)

Park-and-ride / Source : [https://de.wikipedia.org/wiki/Parken\\_und\\_Reisen#/media/File:Zeichen\\_316\\_-\\_Parken\\_und\\_Reisen\\_StVO\\_1992.svg](https://de.wikipedia.org/wiki/Parken_und_Reisen#/media/File:Zeichen_316_-_Parken_und_Reisen_StVO_1992.svg)

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ALL USED IMAGES, DIAGRAMS, MAPS AND PLANS  
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## ACRONYMS & ABBREVIATIONS

EU	EUROPEAN UNION	GSI	GROUND SPACE INDEX
NATO	NORTH ATLANTIC TREATY ORGANIZATION	FSI	FLOOR SPACE INDEX
CEN	EUROPEAN COMMITTEE FOR STANDARTISATION	OSR	OPEN SPACE RATIO
HPP	HYDROMORPHOLOGICAL POWER PLANT	SQM	SQUARE METER
HQ <sub>MAX</sub>	MAXIMUM DISCHARGE	SQKM	SQUARE KILOMETER
HQ100	100-YEAR DISCHARGE	HA	HECTAR
M <sup>3</sup> /S	M <sup>3</sup> PER SECOND (FOR DISCHARGE IN RIVERS)	HU	HOUSING UNITS
WFD	EU WATER FRAMEWORK DIRECTIVE		

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