

Urban River Basin Enhancement Methods

Classification of the Aesthetic Value of Urban Rivers

– application of the methodology –

Work Package 4

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Summary

The present report tests the methodology previously developed to evaluate and classify the aesthetic values of urban watercourses (Deliverable 4.2) through a case study application of a representative European urban stream (Jardas stream, Portugal). The application of the methodology to the Jardas stream is presented in detail, with an indication of the adjustments made to the initial methodology proposed. Further applications of the methodology to three small urban streams in Ljubljana (Slovenia) are also presented.

The Jardas stream was chosen for the initial case study application of the methodology developed as being representative of a river in the Iberic-Macaronesian region subject to typical urban pressures. Jardas is a small urban watercourse that crosses a high-density urban area – Agualva-Cacém – located in the periphery of Lisbon, Portugal.

The evaluation was performed using the framework of viewpoints already identified by the methodology and the corresponding criteria. As part of the methodological development some indicators listed in the earlier deliverables have undergone some adaptations and improvements during the application to this specific case.

A Geographical Information System (GIS) was used in this application to perform spatial analysis, to integrate different information and carry out measurements. This application revealed that GIS can be a useful platform to integrate all the data and tasks needed in this approach.

In order to achieve a greater consolidation of the methodology and ensure its generalized utilization in the EU, there is the need to continue testing the methodology in a wide range of conditions that might occur throughout Europe. Therefore, in addition to the application to Jardas stream (Portugal), the methodology was further tested in three case studies – Ljubljana river, Mali Graben river and Glinscica stream (Slovenia). These case studies show that, in general, the methodology performed well and was found to be useful to evaluate the aesthetical values of these urban watercourses as well.



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Part I -

Application of the Methodology to the Jardas Stream



1. Introduction

The development of a methodology of aesthetical classification of urban rivers, as any other methodological development, calls for a stepwise approach towards the final consolidation of the methodology.

This report presents the application of the proposed methodology to evaluate and classify the aesthetic values of urban watercourses (Deliverable 4.2) to the Jardas stream. This validation process requires further applications as planned in the URBEM project to achieve an increasing level of consolidation of the methodology under construction, having in mind its subsequent generalization.

This methodology aims to be used on a European wide level, therefore its applications must be carefully chosen in order to cover the range of situations that might occur and need to be evaluated.

Thus, the Jardas stream was chosen as being representative of a river in the Iberic-Macaronesian region subject to typical urban pressures. Jardas is a small urban watercourse that crosses a high-density urban area – Agualva-Cacém – located in the periphery of Lisbon.

The evaluation was performed using the framework of viewpoints already identified by the methodology and the corresponding criteria. As part of the methodological development some indicators listed in the earlier deliverables have undergone some adaptations and improvements during the application to this specific case, which will be reflected in the body of this report. In Annex 1 a full list of viewpoints is presented as a reference framework to other case study applications.

As already mentioned in Deliverable 4.2, a Geographical Information System (GIS) was used in this application to perform spatial analysis, the integration of different information, and carry out measurements. This application revealed that GIS can be a useful platform to integrate all the data and tasks needed in this approach.



2. The Study Area

The study area is located near Lisbon, in the parish of Cacém, municipality of Sintra (Figure 1) located in Metropolitan Area of Lisbon.

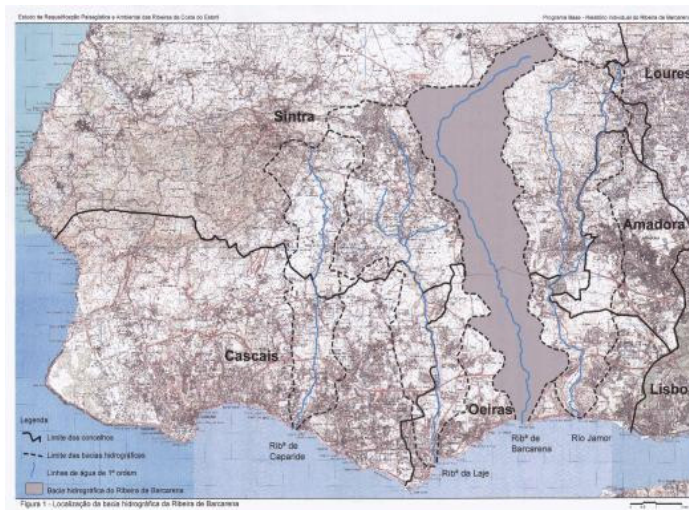


Figure 1 – Geographic localization of Jardas basin (Saraiva *et. al.*, 2001)

Jardas is a tributary stream of the Tagus River. It has a North-South orientation and crosses several densely populated urban areas until it reaches its mouth near the city of Oeiras.

2.1 The urban area

The urban area of Cacém is highly populated (figure 2 and 3). The National Population Census (2001) shows a population of 81843 inhabitants, which represents a population density of 78,60 residents/hectare. It is one of the fast growing suburbs of Lisbon showing a very young demographic structure – only 105 aged people (over 65) per 100 young people (under 14).



Population	Area	Density	Population aged >65	Width
81843	10.4 km ²	7860 (inhabit./ km ²)	~10%	~9,4 m

Figure 2 – Localisation of study area within the Jardas basin (Saraiva *et al.*, 2001)

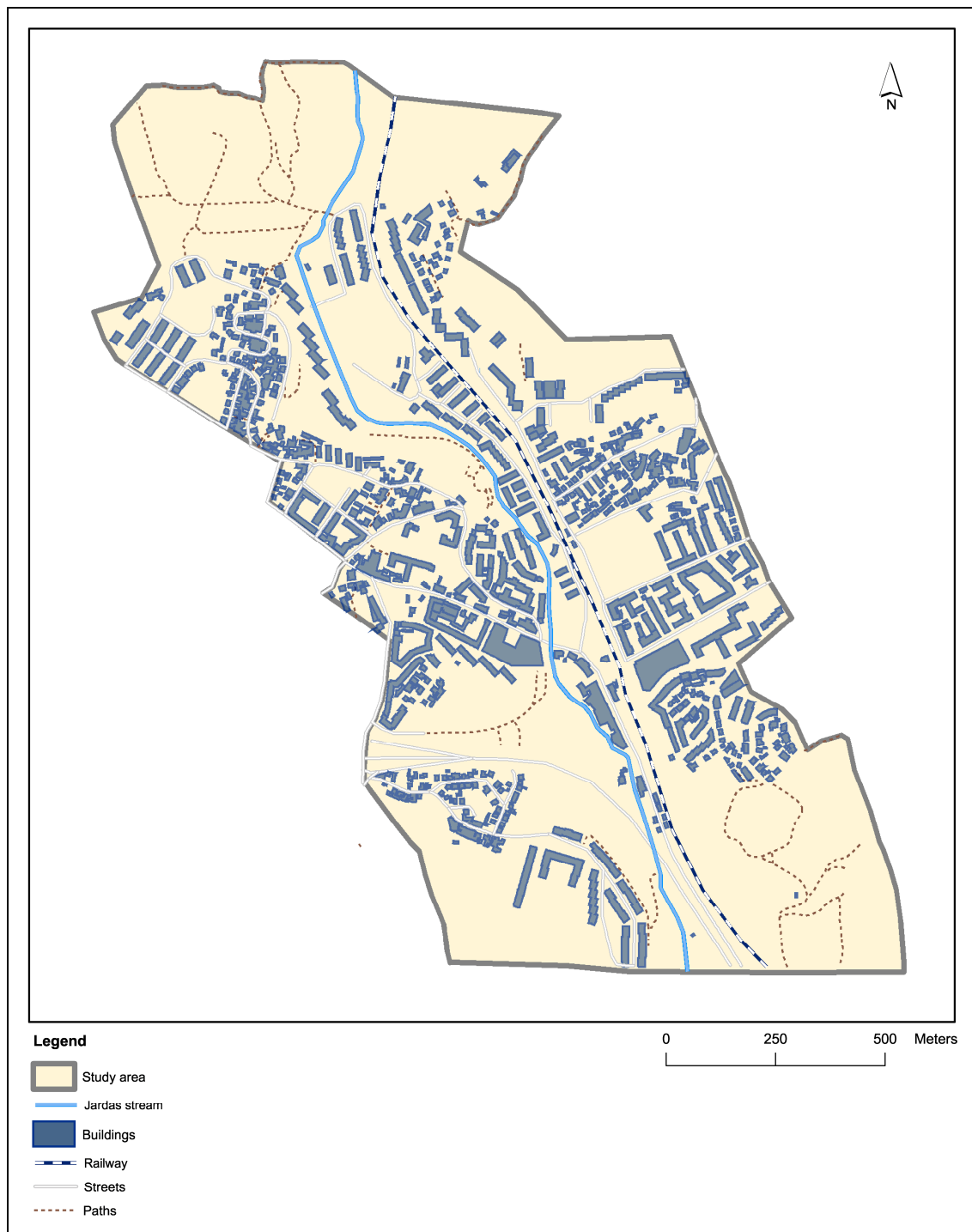


Figure 3 – Study area



2.2 The Jardas river corridor and riverfront

The study area is defined by the urban reach of the stream (figure 4). This reach is 2,5 km long and shows an average width of 9,4m and has a permanent flow regime.



Figure 4 – Urban landscape of Jardas stream in Cacém

Two spatial units have been considered in this approach:

- a) river corridor
- b) riverfront

The **river corridor** was defined as the area that contains both sides of the stream with a width of approximately 500m on each side, corresponding to about a 10-minute access by foot to the water. This distance seemed to be satisfactory and reasonable given three fundamental aspects:



- 1) It is an area where close relationships can be established between the river and the people and where aesthetical values are more easily revealed;
- 2) It is an area where rehabilitation processes can be accommodated;
- 3) Its size makes the application of the methodology operational.

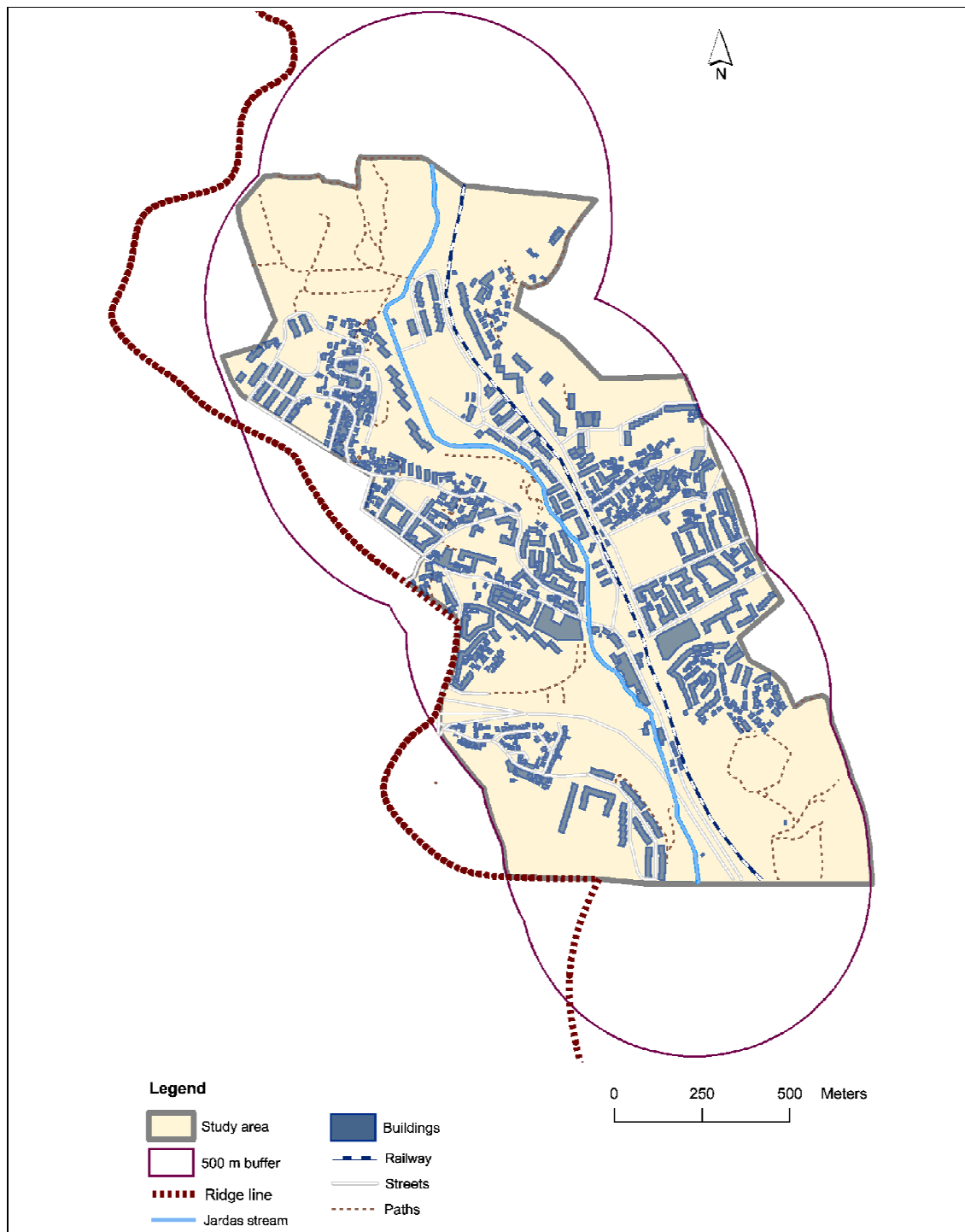
Direct observations in the study area have shown that it was advisable to make local corrections to its theoretical limits. Two types of constraints were considered:

- 1) The existence of a ridgeline, with strong effects in the definition of visual perspectives to the river, can reduce the river corridor defining the adjusted boundary.
- 2) Adjust the 500 m buffer line taking into account existent physical obstacles such as road networks, buildings and walls. The different built structures intersected by the corridor boundary were included within the corridor.

The river corridor (RC) of Jardas Stream was then rectified according to these constraints. This geographical limit (study area) shows to be highly adequate to perform aesthetical analysis and evaluation. The area within the RC limits is 198,4 hectares, with a population density of 25340 inhabitants per hectare, which represents 1.6 times more than the density of Agualva-Cacém parish.

Another important area considered was the **riverfront**, *i.e.* the direct contact area between the river and the first line of buildings, including these buildings. The identification of the riverfront area is important according to some criteria that were identified relating to the direct relationships between city and the watercourse (figure 5).

The area of Jardas Riverfront has the total amount of 22,8 hectares.



Study area	Study area perimeter	Jardas stream length
198,4 ha	7,47 km	2,49 km

Figure 5 – Delimitation of the study area

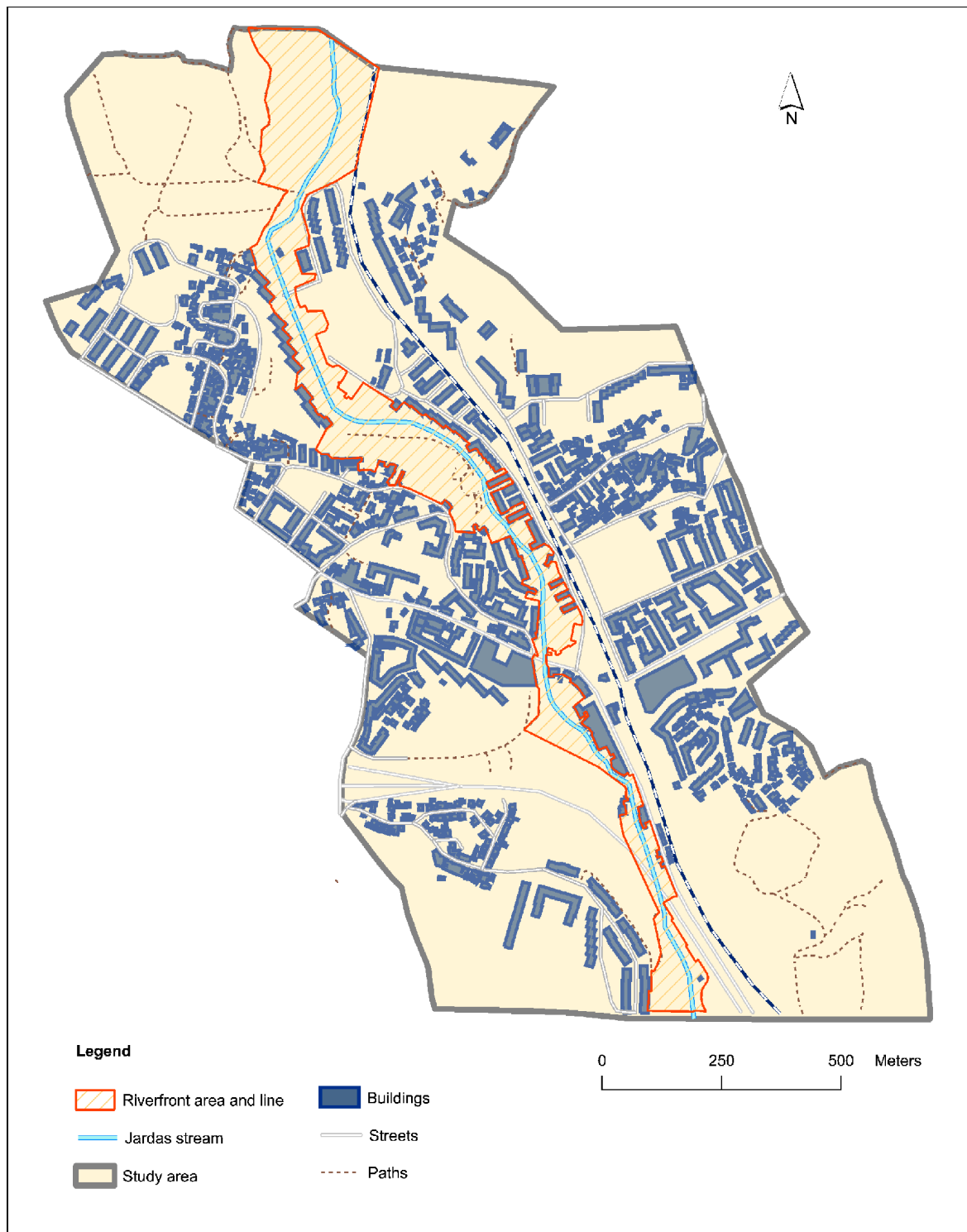


Figure 6 – Riverfront area in Cacém



3. Aesthetical performances of the Jardas Stream

3.1 The viewpoints framework

The fundamental viewpoints for aesthetical evaluation were extendedly presented in Deliverable 4.2 (figure 7). This framework was used as a reference guide to find elementary viewpoints that could enable an in-depth analysis. The viewpoints identify fundamental aspects that contribute to the evaluation of the aesthetical values of urban rivers.

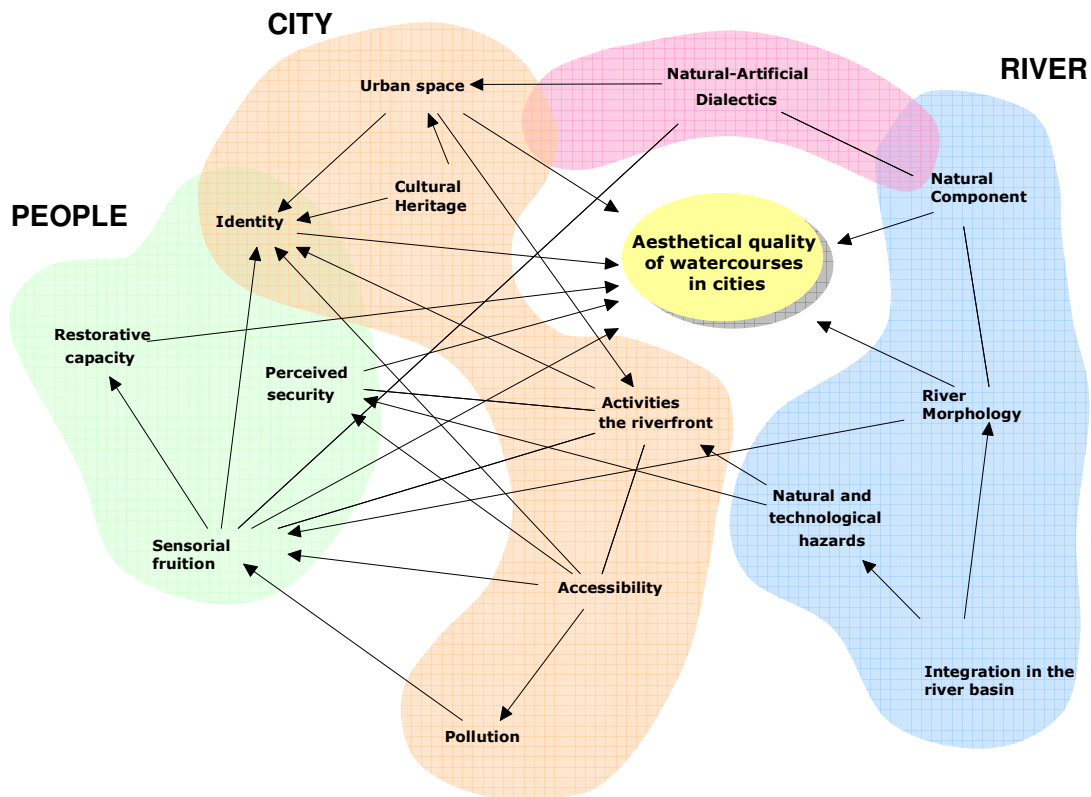


Figure 7 – Fundamental viewpoints

3.2 The system River-City-People

As presented in Deliverable 4.2, the methodology used in our research framework is based in multicriteria approach which establishes that the **aesthetic quality of an urban watercourse** depends on several attributes that can be related to each one of



the three dimensions of triangle vertex – River, City and People, and also its relationships (figure 8).

Within the River-City-People approach a set of characteristics and evaluation parameters was used for each one of these dimensions. This approach has been applied to Jardas case study.

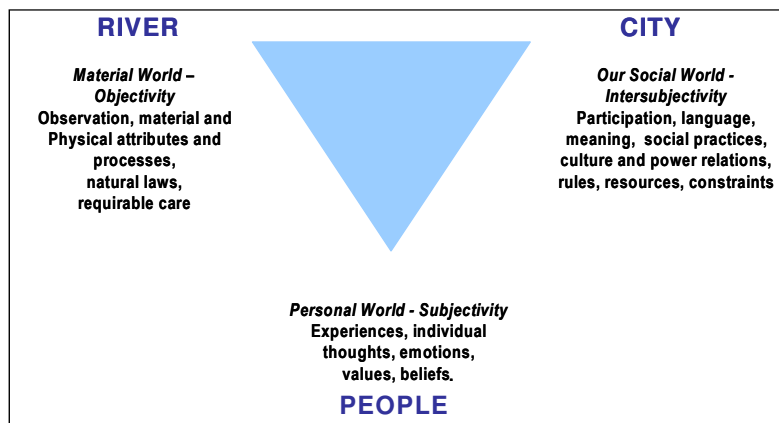
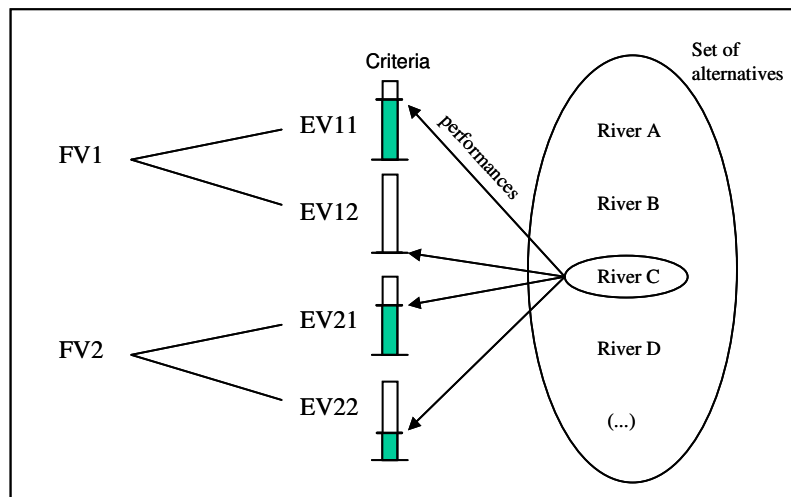


Figure 8 –River-City-People framework

3.3 Measuring performances

Following this viewpoint framework structured in two disaggregation levels - Fundamental and Elementary Viewpoints - a set of measurement indicators and descriptors were defined.



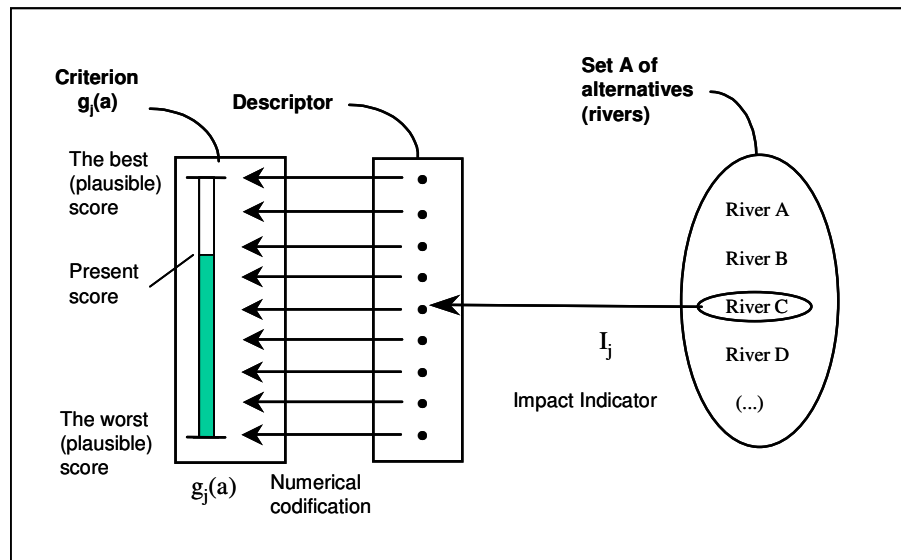


Figure 9 –Criteria, Descriptors and Impact indicators

As mentioned in deliverable 4.2 the meaning of these terms, in the context of Decision Theory, is the following :

- **Indicator** (Bana e Costa, 1992) is an impact measurement - a procedure, rule, technique or process - that associates to each potential action a subset of impact levels. Each of these levels represents the impact as real as possible in terms of aesthetic performance. Usually it is a quantifiable measure expressed in a cardinal scale.
- **Descriptor** (Bana e Costa, 1992) is a scale that describes unambiguously an ordered set of impact levels according to a given viewpoint. Descriptors are sometimes called attributes (Keeney and Raiffa, 1976). They can be quantitative or qualitative, discrete or continuous, direct (natural), indirect (proxy) or built.

Often, the impact indicator can perform also the role of a descriptor if its set of impact levels coincides with the counter-domain of that indicator. The "Index of Sinuosity" is an example of this situation. The classification used, "straight, sinuous, meandering", is only useful to understand the meaning of the impact levels. Other times, an ordered set of classes was used, like in "Quality of the built space in RC". In this type of descriptors each class is described unambiguously, as much as possible, and can



associate quantitative performances, given by impact indicators and qualitative meaning.

Sometimes, even a picture or a drawing can be used if it represents better the viewpoint than the use of simple words. This is often used in landscape evaluation.

In the following chapters, the set of descriptors (or indicators) used for each elementary viewpoint will be always presented in the beginning. When descriptors are used, classes are always ordered. These sets of classes (descriptors) or the counter-domain of indicators (expressed in a cardinal scale) are always bounded by a lower-limit and an upper-limit – the plausible minimum score and the plausible maximum score¹. The higher numerical code represents a preferable performance in terms of aesthetics and the lower the least preferred situation, unless otherwise stated in the text.

These extreme points of the scale should be set in such a way that partial performance of all watercourses should fall within the scale (multicriteria literature calls it a “global scale”). These plausible extreme scores were established for each attribute based on the analysis of the Jardas Stream and on experiential knowledge of the authors. However, these scores need further validation based in more practical applications of this methodology to other urban watercourses. It is possible that in some instances other indicators or descriptors could be more adequate.

The importance in bounding the scales is directly related to the evaluation process in order to perceive, in first place, the actual performance, and in second place, where we can go, i.e. the real/practical increase that can be made for each viewpoint when a river rehabilitation process takes place. In some cases, in order to obtain plausible maximum scores, more specific and in depth studies need to be undertaken. For instance, in the case of “Density of Landmarks”, to fix the plausible maximum score more analysis may be needed relating urban morphology, available land for new landmarks, urban policies, existent cultural heritage that can be rehabilitated and enhanced, visual permeability of the built space, etc. In case of doubt, there is no problem if this plausible maximum estimated score is fixed above the real plausible

¹ These scores are usually indicated in the text, except when they are obvious such as in the case of descriptors with a small number of classes.



maximum score, which only will affect the accuracy of the relative performances of rivers.

It seems clear, at this point, that the results from the evaluation process will become more accurate as more knowledge can inform the process, which depends namely on the amount of case studies and on the quality of data/information available.

4. The River: evaluation of viewpoints

As presented in Deliverable 4.2 a set of characteristics were identified as contributing to the aesthetical value of a river (Table 1).

Table 1– Fundamental and elementary viewpoints for the river component

Fundamental viewpoint	Elementary viewpoint	Indicator Code
River Typology	Basin size	R1
	Stream order	R2
	River width	R3
	Valley morphology	R4
River Morphology	Degree of disturbance of the natural dynamics	R5
	Sinuosity	R6
	Bank Shape	R7
	Presence of elements in the channel	R8
Biological Components	Biological diversity	R9
	Presence of riparian vegetation in river banks	R10
	Width of riparian vegetation	R11
	Presence of different type of vegetation species	R12
Natural and Technological Hazards	Flood vulnerability	R13
	Bank erosion or landslide risk	R14

4.1 River Typology

Some characteristics may be changed in order to enhance the aesthetical value, whereas other characteristics are intrinsic to the river itself and might not be changed by man, at least not under ordinary circumstances (e.g. basin size, river width, stream order or valley morphology).



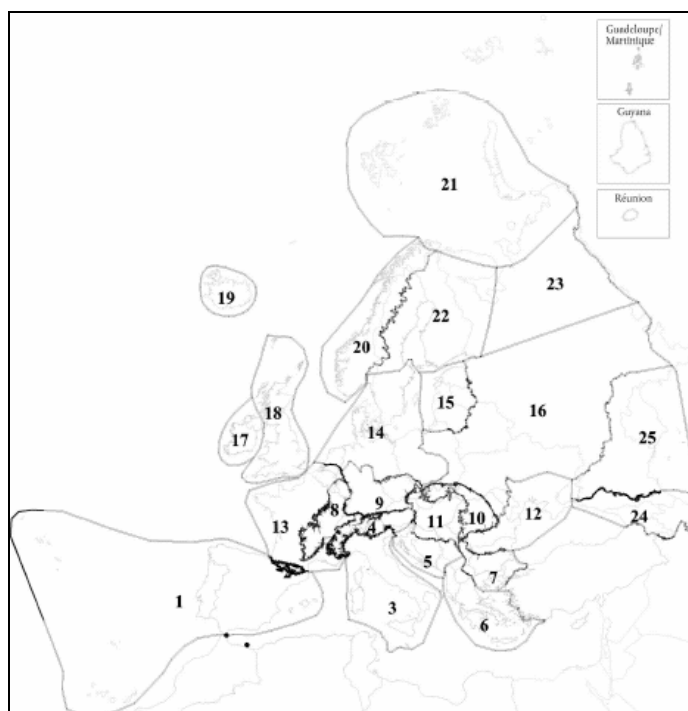
It is important to analyse these characteristics in order to set the frame for further evaluation procedures. They are dependent on the natural conditions and vary along biogeographic or ecological regions although they are only comparable within the same reference system. This means that a Mediterranean river cannot be directly comparable to a Scandinavian river, concerning, for instance, flow regime or ecological value. These aspects show the need for the definition of a river typology – a reference system – in which rivers might be comparable.

In methodological terms, the first step is to find out the corresponding ecologic regions of a river. Then, a classification of the river is undertaken concerning the following attributes: basin size, stream order, and river width and valley morphology. The resulting typology will enable the evaluation and comparison of the state of a river in relation to its reference system (figure 10).



Figure 10 – River typology model

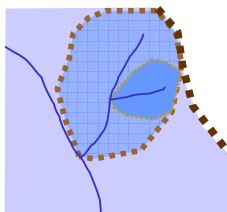
In the context of this project the ecological classification proposed by the Water Framework Directive (2000) based on Ecoregions for rivers and lakes - System A - (figure 11) was considered relevant to be used as first input of the river typology model.



1. Iberic-Macaronesian region; 2. Pyrenees; 3. Italy, Corsica and Malta; 4. Alps; 5. Dinaric western Balkan; 6. Hellenic western Balkan; 7. Eastern Balkan; 8. Western highlands; 9. Central highlands; 10. The Carpathians; 11. Hungarian lowlands; 12. Pontic province; 13. Western plains; 14. Central plains; 15. Baltic province; 16. Eastern plains; 17. Ireland and Northern Ireland; 18. Great Britain; 19. Iceland; 20. Borealic uplands; 21. Tundra; 22. Fenno-Scandian shield; 23. Taiga; 24. The Caucasus; 25. Caspic depression

Figure 11 – Eco-regions for rivers and lakes (System A – WFD, 2000)

4.1.1 Basin size



The river basin size is an important parameter that gives the notion of the relative size of a river, in a spatial context. The basin size influences processes such as the sediment yield, the hydrograph response and the amount of discharge. The shape of a basin exerts also influence on the river behaviour (Mount, 1995).

For the aesthetic evaluation purpose, a five scale for basin size was established, trying to relate the watercourse with the relative dimension of its drainage area, in order to assess its scale according to the urban environment and to the surrounding landscape and to give a sense of hierarchy. This 5-point scale was selected based on the



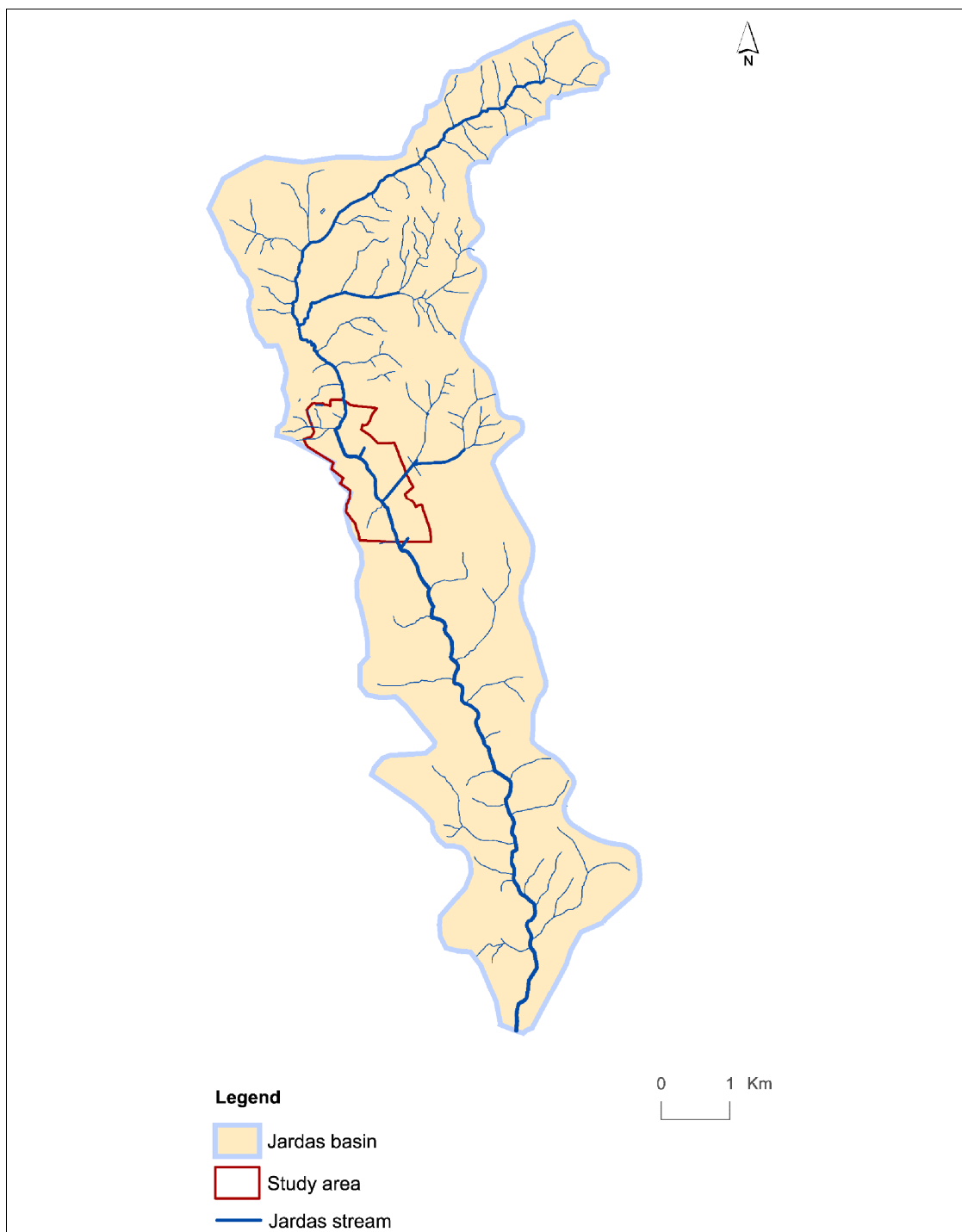
proposed thresholds by the WFD (2000) by including the class 'very small' to accommodate very small coastal and other watercourses basins (table 2).²

Table 2– Scale adopted for basin size

Class	Scale
1	Very small (< 50 km ²)
2	Small (50 to 100 km ²)
3	Medium (100 to 1.000 km ²)
4	Large (1.000 to 10.000 km ²)
5	Very large (>10.000 km ²)

Using this basin parameter and scale we can have a notion of the relative size of a river, in a spatial context. Using GIS tools it was possible to calculate the area of the Jardas catchment and classify it as a very small basin.

² In light of WP 2 results many urban river rehabilitation projects have been done on streamlets up to small rivers (5-25m) with mostly smaller basins than 50 Km². Therefore, a further differentiation in this class 1 may be needed (to be revealed by further case studies)

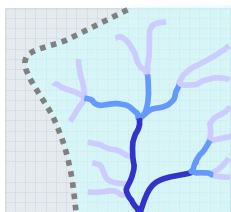


Basin area	Basin perimeter	Classification
35,22 km2	41,90 km	Small basin

Figure 12 – Jardas basin area



4.1.2 Stream order



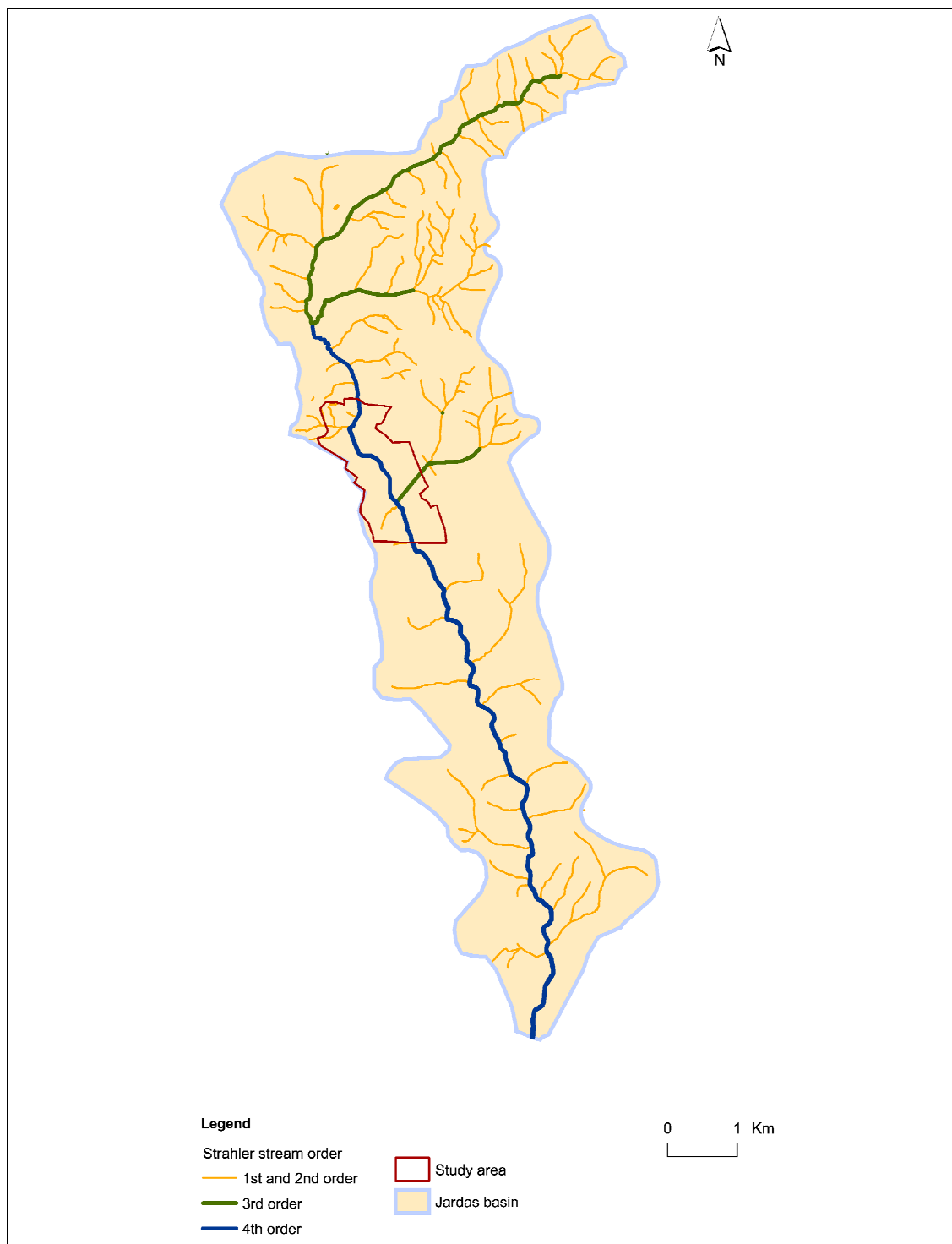
Strahler's classification is the most used nowadays. Within a given catchment or basin, stream order is correlated with other parameters, such as drainage area or channel length. Consequently, the knowledge of what order is a watercourse can provide information concerning other characteristics such its location in the basin, its hierarchy and relative channel size (FISRWG, 1998).

The Strahler stream ordering system was adopted to define the stream order, being adopted a 3 point scale based on 1:25 000 scale topographic map (table 3).

Table 3– Scale adopted for stream order

Class	Scale
1	1st and 2nd order
2	3rd and 4th order
3	>5th order

Using the stream network coverage in Arc GIS context it was possible to classify each stream arc. Stream order within the Jardas basin is class 2 (figure 13).

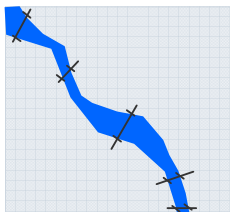


Strahler classification 4th order

Figure 13 – Strahler stream order of Jardas



4.1.3 River width



The width of a watercourse is determined by several aspects, such as its location in the catchment, the stream order, the bankfull flow discharge and its fluctuations, the valley profile, among others. The influence of this parameter in the aesthetic evaluation process leads to the consideration of five-point scale classification, according to the literature review (Leopold & Marchand, 1968; Dunne & Leopold, 1978).

The 5-point scale used to classify the river width ranges from 'non-existent' (i.e. non-visible or culverted) to 'very large' (over 200 meters wide).

Table 4– Scale adopted for river width

Class	Scale
1	Non existent (culverted)
2	Narrow (0 – 5m)
3	Medium (5-20m)
4	Large (20 – 200m)
5	Very large (more than 200 m)

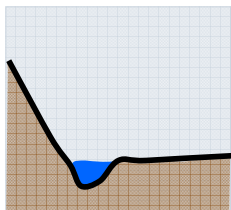
The Jardas stream has an approximately 10 m streambed width, which according to Leopold & Marchand (1968) can be classified as a medium river.



Figure 14 – Jardas river width



4.1.4 Valley morphology



Valley morphology depends on several factors and processes, such as lithologic substract drainage pattern, geomorphology, rainfall pattern and frequency distribution and other aspects related with this dynamic system. The classes to group the morphology of valleys correspond to four different typologies ranging from deep v-shaped valleys to broad wide floodplains (Table 5).

Table 5– Scale adopted for valley morphology

Class	Scale	Valley Profile Type
1	Large, broad floodplain	
2	Asymmetric	
3	U-shaped	
4	V-shaped	

The dominant valley morphology of Jardas is V-shaped, *i.e.* class 4, although other types of valley occur along the stream (figure 15).

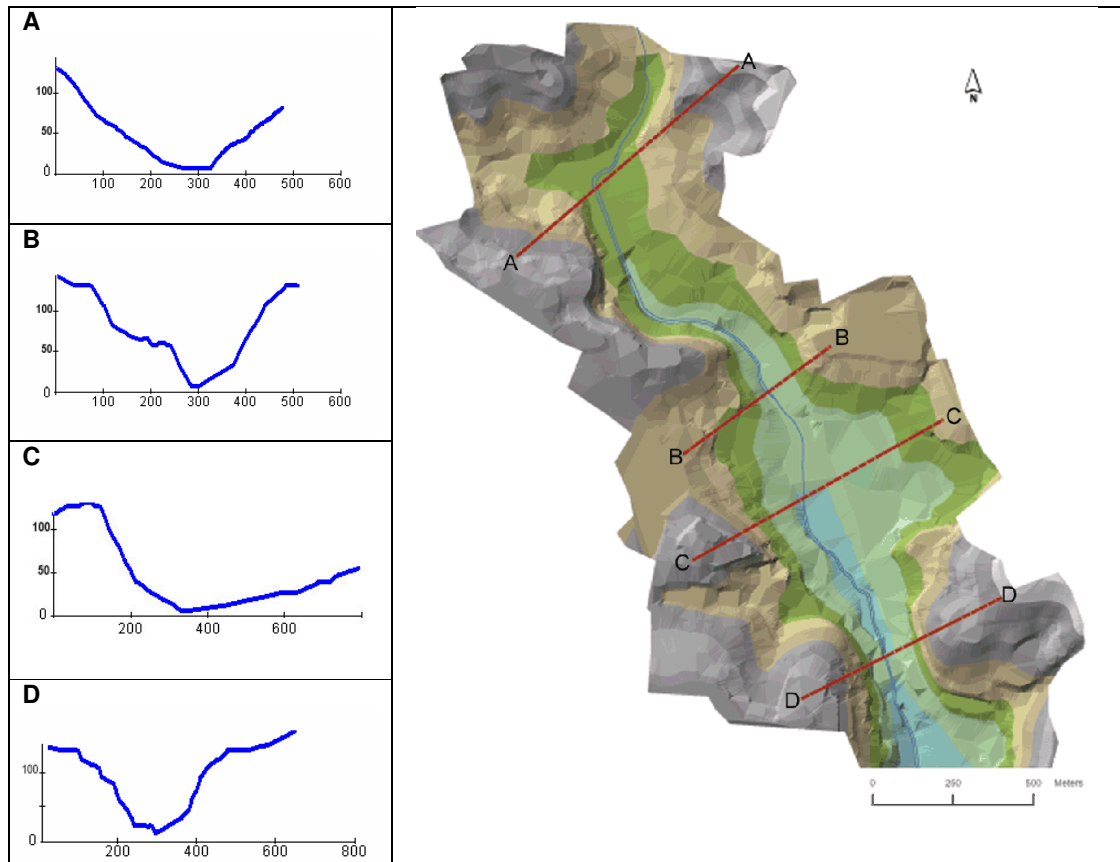


Figure 15 – Jardas valley morphology

4.1.5 Jardas river typology

In summary, the **river typology** of the Jardas stream can be characterized as following:

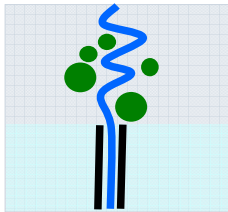
- It is included in the Iberic-Macaronesian region;
- It is a very small river basin (35,2 km²) – (R1-Class 1);
- It is of 4th stream order (R2-Class 2);
- Showing a medium size width with an average of 9,4 meters (R3-Class 3);
- The dominant valley morphology is v-shaped (R4-Class 4).



4.2 River Morphology

This fundamental viewpoint is evaluated by using four elementary viewpoints: respect of natural dynamics, sinuosity, bank shape and presence of elements in the channel.

4.2.1 Respect of natural dynamics



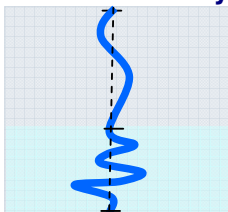
The respect of natural dynamics is measured by using the indicator 'degree of disturbance' through the use of the 3-point scale presented in the following table.

Table 6– Scale adopted for degree of disturbance classification

Class	Scale	Characteristics
1	Highly disturbed	▪ Very artificial ▪ Channelized ▪ Concrete bed and banks
2	Moderately disturbed	▪ Artificial ▪ Channelized or concrete bed or banks
3	Undisturbed	▪ Close to natural conditions

Jardas stream can be classified as “Moderately Disturbed” due to the presence of some artificial elements (as presented in figure 14).

4.2.2 Sinuosity



Sinuosity of a river describes the existence or absence of a meandering pattern in the landscape. Sinuosity can have influence in the aesthetic appearance of a river, creating a sense of mystery, discovery, rather than a straight reach. Studies developed on river aesthetic attributes showed preferences for meandering and sinuous rivers, comparing with straight patterns (Herzog, 1985; Lee, 1979; Saraiva, 1999; Monteiro, 1998).



By applying the index proposed by Christofolletti (1991) and presented in figure 16, it was possible to define a 3-point scale that distinguishes straight from meandering rivers.

Table 7– Scale adopted for sinuosity

Class	Scale
1	Straight ($IS < 1.05$)
2	Sinuuous (IS between 1.05 – 1.5)
3	Meandering ($IS > 1.5$)

Index of sinuosity

$$Is = 100(Cc - Cv / Cc) + 100(Cv - Z / Cc)$$

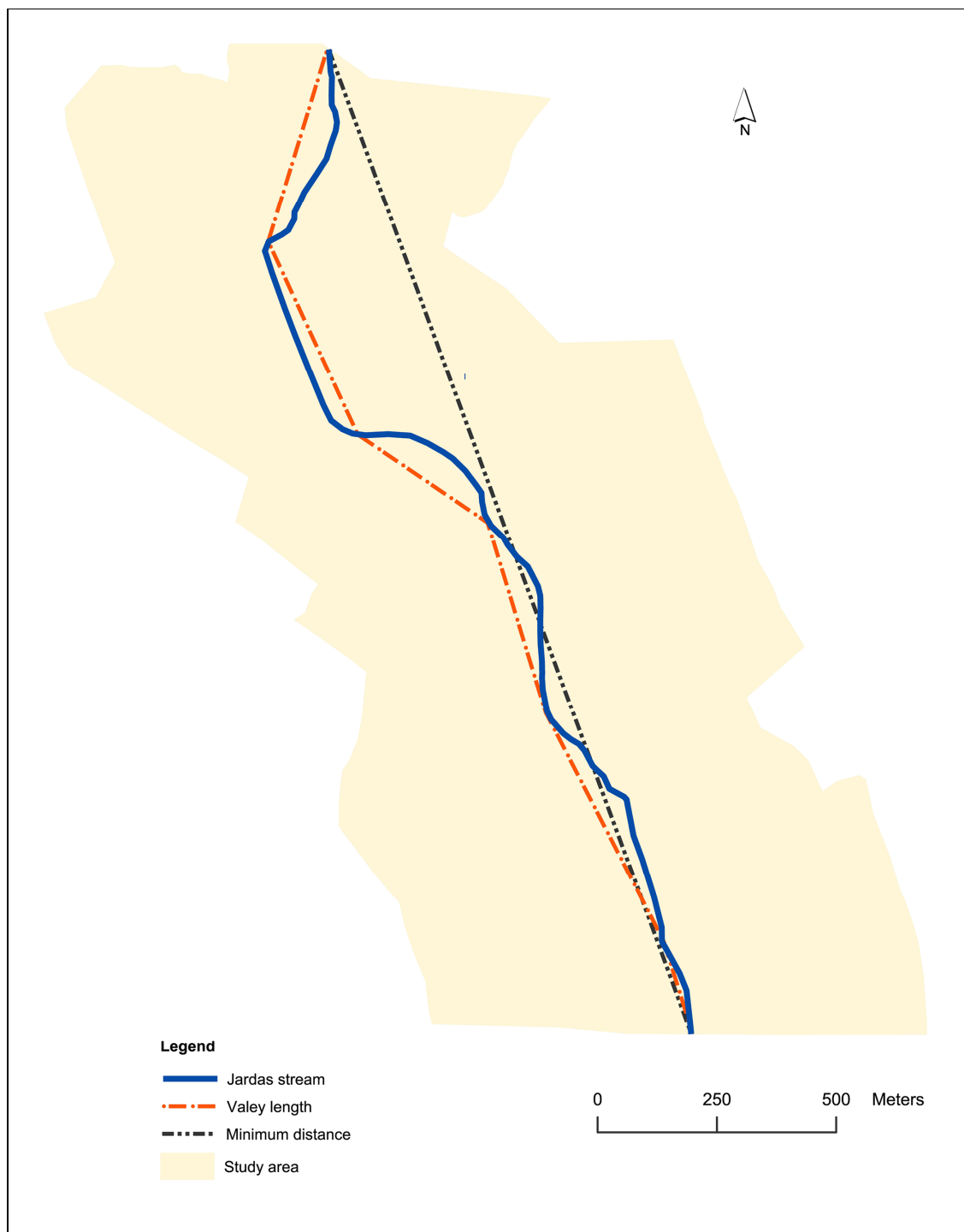
Cc: length of riverbed

Cv: length of valley

Z: distance between the limits of the reach

(Mansikkaniemi, in Christofolletti, 1991)

The application to the Jardas stream shows a value higher than 1.5 using the proposed methodology (Figure 17), which corresponds to 'meandering'.

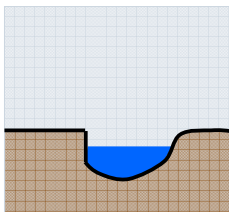


Cc	Cv	Z	Index of sinuosity	Classification
2,49 km	2,34 km	2,20 km	$IS = 100 (Cc-Cv/Cc)+100(Cv-Z/Cc) = 12$	Meandering

Figure 16 –Jardas stream sinuosity



4.2.3 Bank shape



Water banks and water shores are very important elements in river management and rehabilitation, acting as boundaries between water and land. Bank shape is influenced by several factors – edge definition, space, edge features, riparian environment and evidence of human impact (Litton *et al.*, 1974).

The visual edge of any water body has two important dimensions: the horizontal one, running parallel with the water shore; and the vertical one, creating the demarcation between land and water.

This elementary viewpoint is assessed by using a 4-point scale ranging from the most artificial situations - culverted watercourses with no visible banks - to natural banks, based on dominant riverbanks typology defined by Saraiva *et al.* (2001) (table 8).

Table 8– Scale adopted for Bank shape typology

Class	Scale	Characteristics
1	Culvert watercourses	
2	Vertical banks (walls) and trapezoidal watercourses	
3	Asymmetric banks (wall and levee)	
4	Natural banks	

At Jardas stream a wide range of situations can be observed. Nevertheless the predominant bank shape can be classified as “Asymmetric” as exemplified in figure 18.

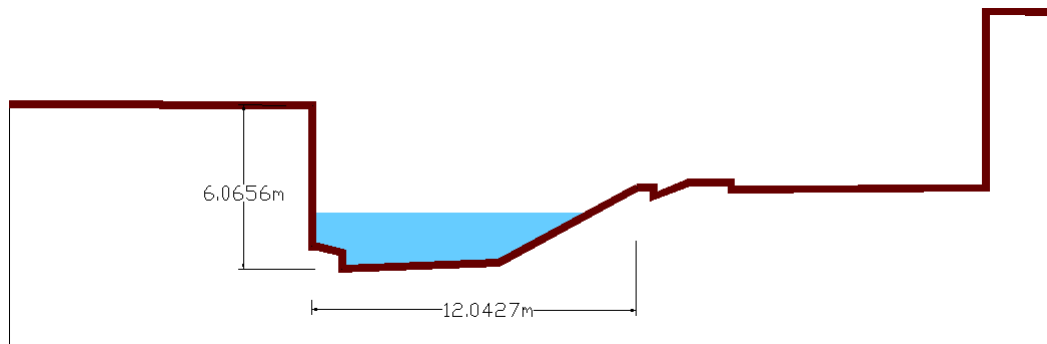
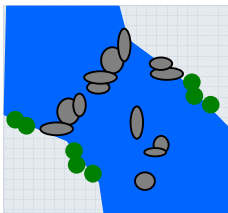


Figure 17 –Jardas stream bank shape typology

4.2.4 Presence of elements in the channel



This elementary viewpoint is assessed by the presence of elements in the channel as riffles, weirs, and rocks amongst others. The construction of a 3-point scale is defined by the average of these elements present in a 500 meters reach (table 9).

Table 9– Scale adopted for Bank shape typology

Class	Scale
1	Non existent in a 500 meters reach
2	1 or 2 sets of elements present in a 500 meters reach
3	More than 3 sets of elements present in a 500 meters reach or presence of very relevant elements

Five sets of elements were found in Jardas stream along a 2.5 Km reach. The elements present are riffles and single rocks as it can be seen in figure 19. Due to the reduced depth of the stream, small elements become more visible.

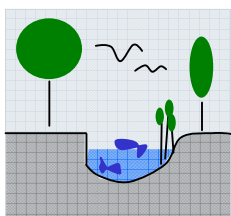


Figure 18 – Elements present on Jardas stream

4.3 Biological Components

The fundamental viewpoint – biological component – is evaluated based on four elementary viewpoints: biological diversity, presence of riparian vegetation in riverbanks, width of riparian vegetation and temporal diversity

4.3.1 Biological diversity



The biological diversity is the variety of organisms in the river ecosystem. Therefore the presence of fauna and flora is one of the main parameters to evaluate the ecological status of the river, which can be assessed through a set of indexes or indicators adapted to the ecological conditions of the region.

This elementary viewpoint is evaluated by using the indicator proposed by Cortes et al. (2002) - 'Ecological status of river corridor', which is defined through a set of parameters adapted to the ecological region of the Jardas stream: Biological Quality



(BMPW' index), Exotic Fish Species, Autochthonous Fish Species, Riparian Vegetation and Exotic and Invasive Flora.

The 3-point scale ranges from highly artificial to natural situations.

Table 10– Scale adopted for biological diversity

Class	Scale
1	River corridor highly disturbed or artificial
2	Moderately disturbed
3	Undisturbed and with highly biological interest

The evaluation of Jardas stream ecological status was available from the study by Saraiva *et al* (2001) and shows that it is included in Class 1 and Class 2, ranging from moderately disturbed to highly disturbed (figure 20). However, the value calculated by this study does not include the fish indexes and the BMPW' index since no data was available for Jardas stream. Therefore, a more accurate definition of the Jardas classification depends on further expert's studies on fauna.

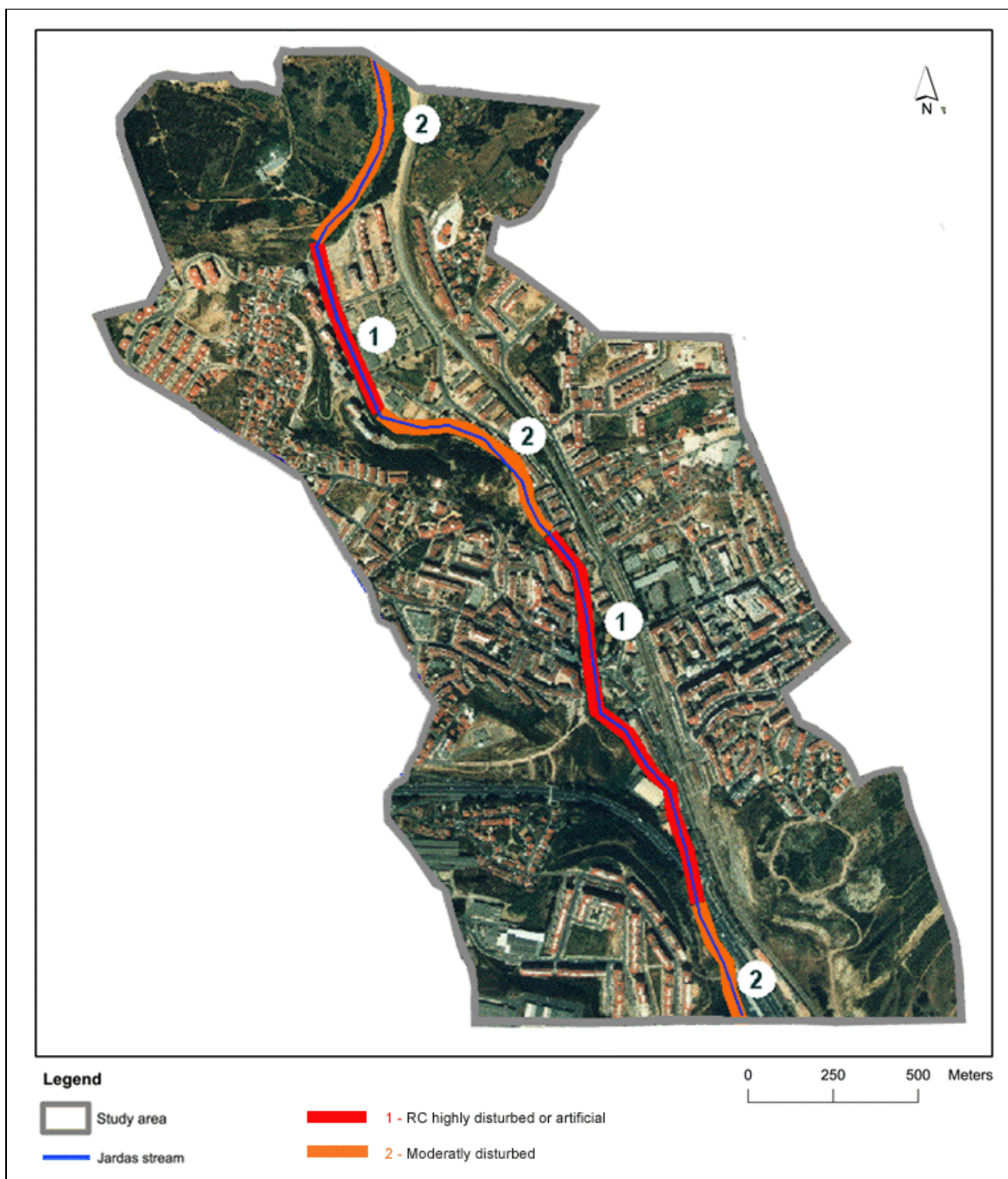
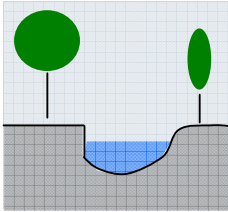


Figure 19 – Ecological status of the Jardas river corridor (Saraiva *et al.*, 2001)



4.3.2 Presence of riparian vegetation in river banks



The presence of riparian vegetation in the riverbanks especially of different types and stages of development increases the aesthetic quality of the river corridor by adding diversity, contrast and mystery to the landscape. The riparian vegetation reveals the presence of the river on the landscape through a linear pattern of green. The vertical distribution of the vegetation is, therefore, an important element in aesthetic evaluation assessment.

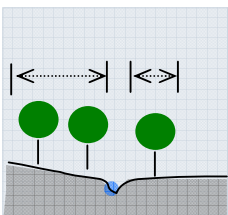
The vertical distribution is measured by the presence of riparian vegetation in riverbanks on the following 4-point scale (table 11).

Table 11– Scale adopted for presence of riparian vegetation in riverbanks

Class	Scale
1	Absence of vegetation
2	Presence of herbaceous vegetation
3	Presence of sparse trees in one or in both margins
4	Presence of well developed and continuous riparian vegetation in one or in both margins

For the application of this index to the Jardas stream it was also used the study developed by Saraiva *et al.* (2001) which shows that it is included in class 2 (figure 20).

4.3.3 Width of riparian vegetation



The width and spatial distribution of riparian vegetation translates both the ecological and aesthetical quality of the landscape. Although influenced by several factors, it is commonly accepted by landscape ecologists that a 12 meters width is the minimum for a linear riparian corridor (Forman, 1995). A 4-point scale was used

ranging from complete absence of vegetation to riparian forests larger than 20 meters (table 12).

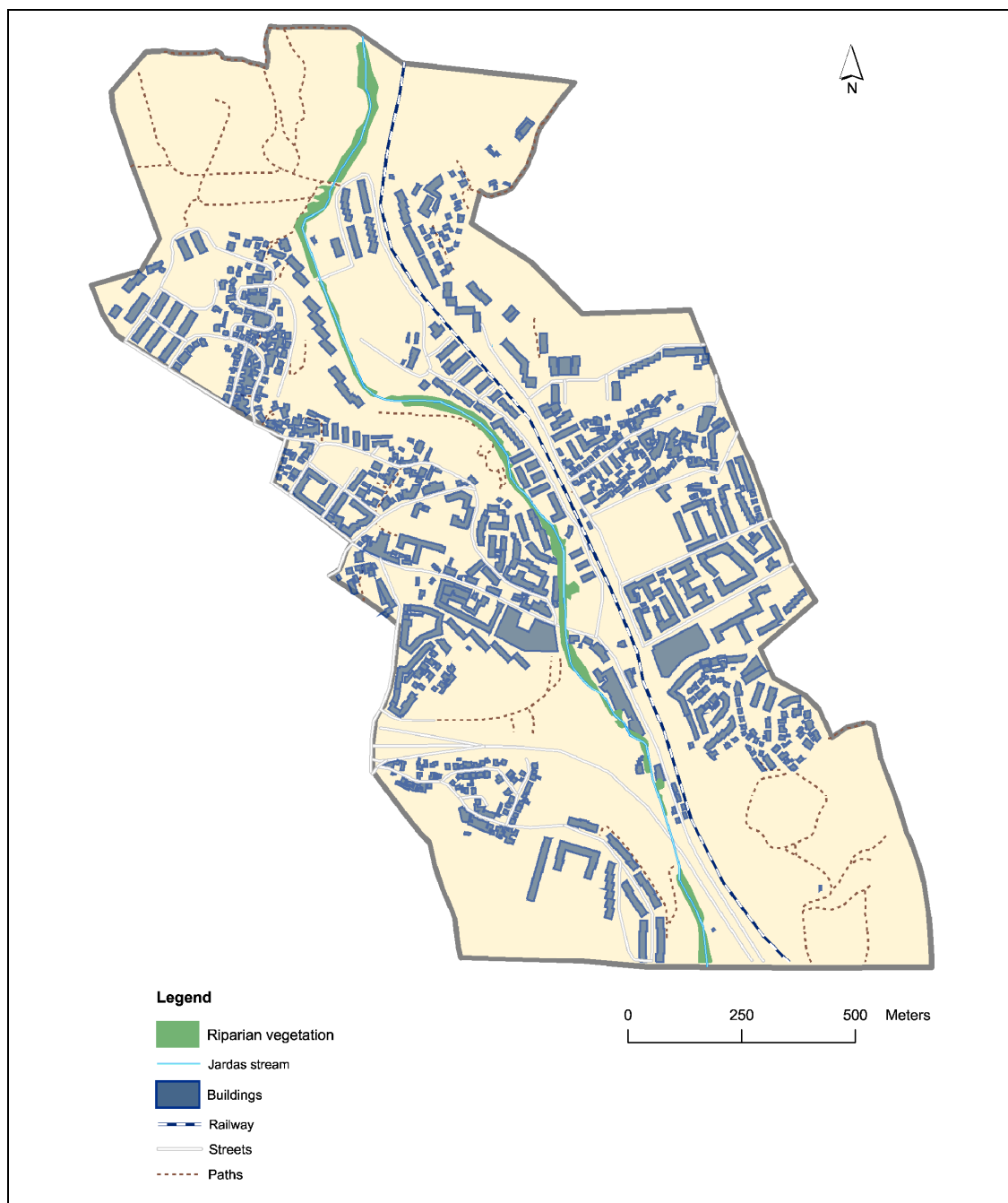
Table 12– Scale adopted for width of riparian vegetation

Class	Scale
1	Absence of vegetation
2	Narrow (0-12 meters)



3	Medium (12 – 20 meters)
4	Large (>20 meters)

The application to the Jardas stream is presented in figure 21 and it shows that the average vegetation width is around 2.5 meters including it in the class 'narrow'.

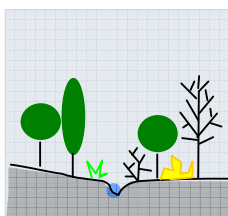




Average	Classification
5,5 m	Narrow

Figure 20 – Jardas stream average riparian vegetation width

4.3.4 Presence of different types of vegetation species



The seasonal dynamics of vegetation introduces variety and contrast of colours and textures in the urban landscape. Therefore the presence of riparian vegetation with a mixture of species with different characteristics - such as type of tree and shrub species (evergreen, deciduous, coniferous), stand age, colour of foliage, presence of flowers, fragrances and flowering season - are usually more attractive for people than areas that have no species variation.

The temporal diversity can be assessed by the observation of different type of vegetation species that show different seasonal behaviours, as defined on the following 3-point scale.

Table 13– Scale adopted for presence of different type of vegetation species

Class	Scale
1	Low variety of species
2	Presence of 1 to 5 species types
3	Presence of a high variety of species types, i.e. more than 5 species with different colours, stand age, flowering season, foliage type

Concerning this elementary viewpoint the Jardas stream ranges from “Presence of 1 to 5 species types” to “Low variety of species”, showing a dominant low diversity (figure 22).

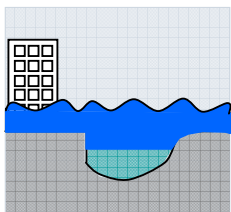


Figure 21 – Example of Jardas temporal diversity

4.4 Natural and technological hazards

This fundamental viewpoint includes two elementary viewpoints: flood vulnerability and bank erosion or landslide risk. The measurement proposed requires the availability of adequate risk cartography.

4.4.1 Flood vulnerability



Floods are natural events, which mainly depend on the hydrological regimen and the soil cover within a specific catchment. The flood risk increases with land use changes at the catchment level, notably those leading to increased imperviousness, which may favour surface runoff, and also with the presence of housing in the natural floodplain, which may contribute, to a higher risk.

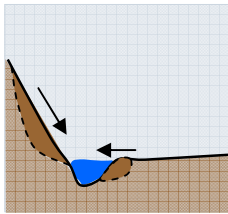
Flood vulnerability is measured by the percentage of the river corridor located within the area of a 100-year flood event. This can only be assessed with the use of existing expert mapping.

Indicator		Description
R13	% of the river corridor affected by flood event	Surface of river corridor located within the areas of the 100 year flood event / Surface of RC * 100 [%]



In Mediterranean-type Rivers even small catchments as the Jardas are prone to flood events. However no available cartography of flood risk was found for Jardas Stream. Even considering how important 'Flood Vulnerability' can be, it was not possible at all to evaluate this viewpoint in Jardas stream.

4.4.2 Bank erosion or landslide risk



The risk associated with these erosion processes depends on the geological characteristics of the site itself, as well as the changing land uses. Landslides are highly favoured by the presence of stratified clay deposits in the subsoil, or by soil types with a high capacity of absorption of water, which in slopes tends to lead to the sliding of soil masses in presence of extreme precipitation events.

The risk may increase due to human action by destabilizing the slope, as for instance constructions on the slope or changes in soil cover that may alter the relation between infiltration and surface runoff along the slope.

Bank erosion is generally associated with unstable soil conditions along the banks due to either the soil type itself or due to missing stabilization by riparian vegetation. The risk might be increased through the alteration of the bank shape and removal of vegetation.

Indicator	Description
R14 % of banks with potential erosion or landslides	Length of banks in both margins with potential erosion or landslides / Length of banks * 100

The bank erosion or landslide risk is measured, on existing expert studies and maps, by the percentage of the length of banks with potential for erosion or landslides. In Municipality of Cacém and in other institutions from Central Administration there is no existing risk mapping. As in the previous chapter it was not possible at all to evaluate this viewpoint. However, possible risks of this type are apparently not relevant in Jardas stream.



5. The City: evaluation of viewpoints

As presented in Deliverable 4.2, a set of characteristics was identified as contributing to the aesthetical value of a river concerning the city's fundamental and elementary viewpoints (Table 14).

Table 14– Fundamental and elementary viewpoints for the river component

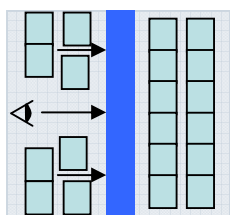
Fundamental viewpoint	Elementary viewpoint		Indicator Code
Urban space quality	Visual permeability	Visual contact	C1
		Depth of views	C2
		Width of views	C3
	Density of landmarks		C4
	Built space quality		C5
	Public utility of riverfront		C6
	Intensity of construction		C7
Cultural heritage	Cultural heritage		C8
Activities	Diversity of uses		C9
	Attractiveness of riverfront		C10
Accessibility	River crossing	Existence of bridges	C11
		Use of bridges	C12
	Surface of parking		C13
	Public transport		C14
	Walkways and bikeways		C15
	Level of disruption		C16
	Anchorage places		C17
	Use of river by boats		C18
Pollution	Pollution		C19

5.1 Urban space quality

The urban space quality can be evaluated through a set of five elementary viewpoints: visual permeability, landmarks / reference points in the landscape, quality of built space in the river-corridor, public utility of river waterfront and intensity of construction in the riverfront.



5.1.1 Visual permeability



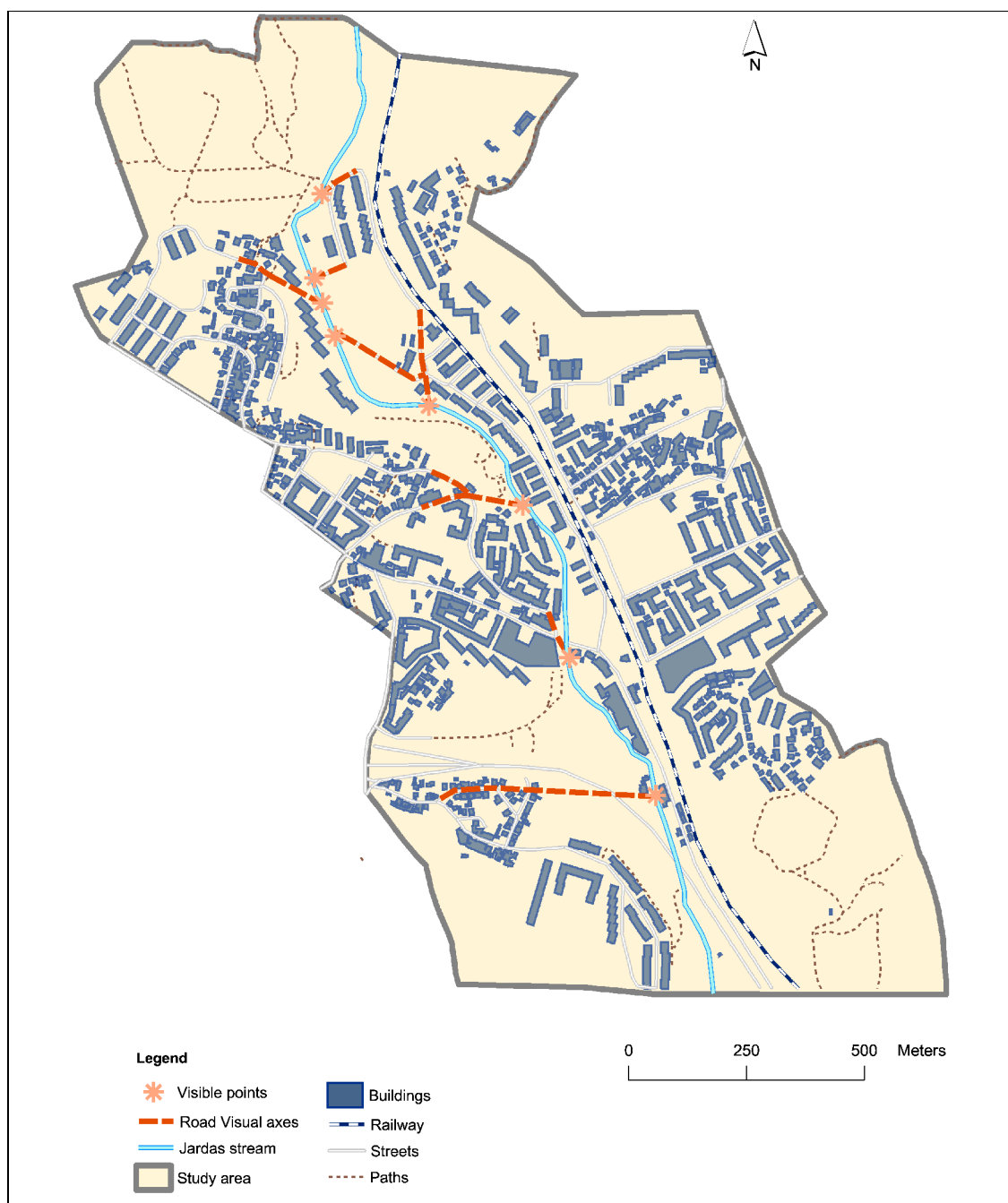
Visual permeability is dependent from river perspectives and from the wideness of views. These perspectives are influenced by urban morphology, which determines the variety of visual access from buildings and the contact with water. This elementary viewpoint can be measured by a set of three indicators presented in Table 15.

Table 15– Visual permeability indicators

Indicator	Description
C1 Linear density of visual intersections	Number of visual intersections/river length (Km)
C2 Average length of visual axes with the river	Total length of visual axes/number of visual axes intersecting the river
C3 Number of belvederes	Number of belvederes/Area of River corridor (km ²)

The performance of each indicator in the Jardas stream was determined with the support of GIS technology as represented in figure 24 and confirmed later *in situ* to validate the measurements.

The plausible maximum values for indicators C1 and C2 were calculated by analysing possible visual intersections in GIS and later confirmed through fieldwork. For indicator C3 all potential sites for belvederes were determined through fieldwork.

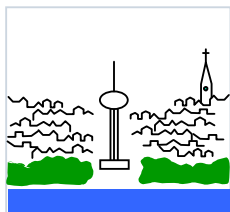


Indicator	Minimum Plausible	Actual Score	Maximum Plausible
C1 - Linear density of visual intersections	$C1_{pm}=0$	$C1=8/2,49=3,21$	$C1_{pm}=20/2,49=8,23$
C2 - Average length of visual axes with river	$C2_{pm}=0$	$C2=1670/8=208,8$	$C2_{pm}=3763/8=470,38$
C3 - Number of belvederes	$C3_{pm}=0$	$C3=0/2km^2=0$	$C3_{pm}=3/2km^2=1,5$

Figure 22 –Visual intersections with Jardas stream



5.1.2 Density of landmarks



The density of landmarks is explained by the presence of remarkable points in the landscape of the river corridor. The well-known method of Kevin Lynch (1960) can be adopted to identify existent landmarks that were physically perceptible in the landscape.

In the Jardas stream corridor no landmarks were identified, which can be partially explained by its suburban character of a quick and dense urbanization process. This does not mean that nothing can be done to improve physical references on the landscape. A rehabilitation process can promote new built or natural landmarks, which should be carefully analysed in order to estimate a plausible maximum score.

Specific analyses should be made to find ideal values on the river corridor of each case study. Those will represent the best values that can be achieved, which helps to explain the meaning/value of the actual score. This ideal score can be also a good reference to fix the maximum plausible score (the upper limit of the scale).

In the case of Jardas stream, a landscape analysis revealed five places that were foreseen as potential good locations for new landmarks.

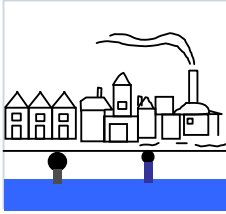
Table 16–Density of landmarks

Indicator	Description	Minimum Plausible	Actual Score	Maximum Plausible
C4 – Density of landmarks	Number of landmarks/Area of River Corridor (Km ²)	$C4_{pm}=0$	$C4=0$	$C4_{pm}=5/2km^2=2,5$

The attribute density is a single quantitative measurement of landmarks concentration on landscape and do not explain how this quantity is distributed in river corridor. It may be the case that all the landmarks are grouped in one single location. In that instance, one can considered them as only one landmark – groups of historical buildings, towers and pointed domes, etc. – instead of counting all remarkable elements.



5.1.3 Built space quality in river-corridor



The built space quality regards the quality of construction and the state of conservation of buildings, salubrity conditions and the existence of basic infrastructures. These elementary viewpoints can be assessed by a descriptor that evaluates the dominance of urban built space quality in the river corridor.

This descriptor is defined by a three-class scale:

- **Good quality** –good or very good physical and functional conditions. They fulfil entirely the requirements needed to accomplish their purpose (residential, industrial or commercial areas), with no misuses or malfunctioning detected. These areas have all basic infrastructures and good sanitary conditions.
- **Medium quality** – these areas do not have the problems associated with the low quality areas but cannot be considered as having high quality standards (e.g. some suburban areas located in the periphery of great cities, generally occupied by medium or low standard buildings but having all basic infrastructures that reasonably satisfy people needs). These areas can be incomplete (not entirely consolidated) or under development but their general use or purpose/function is considered adequate.
- **Bad quality** - Built urban spaces that clearly need rehabilitation, conservation or renewal. This can occur for several reasons: absence of sanitary conditions; lack of basic infrastructures; moderate or unsatisfactory conditions in terms of the state of conservation or quality of construction. Housing does not have adequate conditions for households; developed or urbanised land is no longer in use for housing, industries or services; the land is derelict or contaminated (brownfields), etc.

Using data and information collected from extensive surveys that were conducted in the Jardas study area, it was possible to classify the built space in the riverfront since urban areas were identified according to classification described above.

Considering that we can identify and measure Good, Medium and Bad quality of urban areas, a 5-class qualitative descriptor can be formed using the diagram presented on



figure 26. Each side represents, in percentage, the amount of urban area of each class that is present in the river corridor.

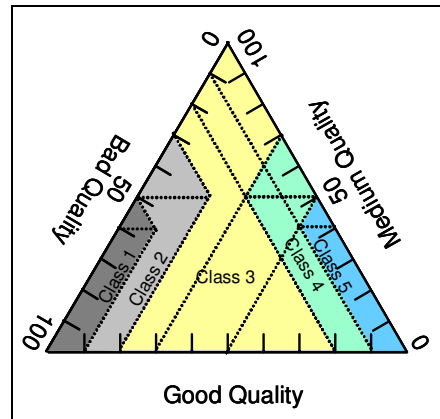


Figure 23 – Diagram to classify the urban space quality

The classes of built space quality were chosen according to the following intervals of variations as represented in table 17.

Table 17– Scale adopted for built space quality

Class	Scale
1	$GQ < 10\% \wedge BQ > 50\%$
2	$GQ < 20\% \wedge BQ > 30\%$
3	Remaining region
4	$GQ > 30\% \wedge BQ < 20\%$
5	$GQ > 50\% \wedge BQ < 10\%$

These classes seemed adequate considering the Jardas case study. However it is possible to choose other regions corresponding to each situation. According to this descriptor, the plausible maximum level will be class 5 and the plausible minimum will be class 1.

An extensive site survey in the Jardas river corridor allowed us to classify built space based on the attributes detected. Using the triangular diagram shown in figure 26, the Jardas can be classified as class 4, which correspond to the point represented with the coordinates (85,4,11). This point means that 85% of the urban area is of good quality, 4% as medium quality and 11% as bad quality.

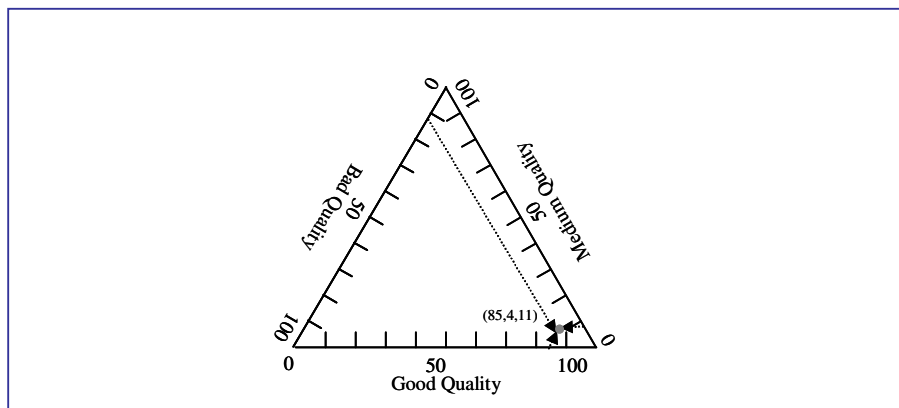
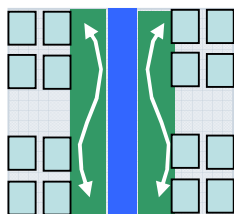


Figure 24 – Built space quality of Jardas river corridor

5.1.4 Public utility of river watersides



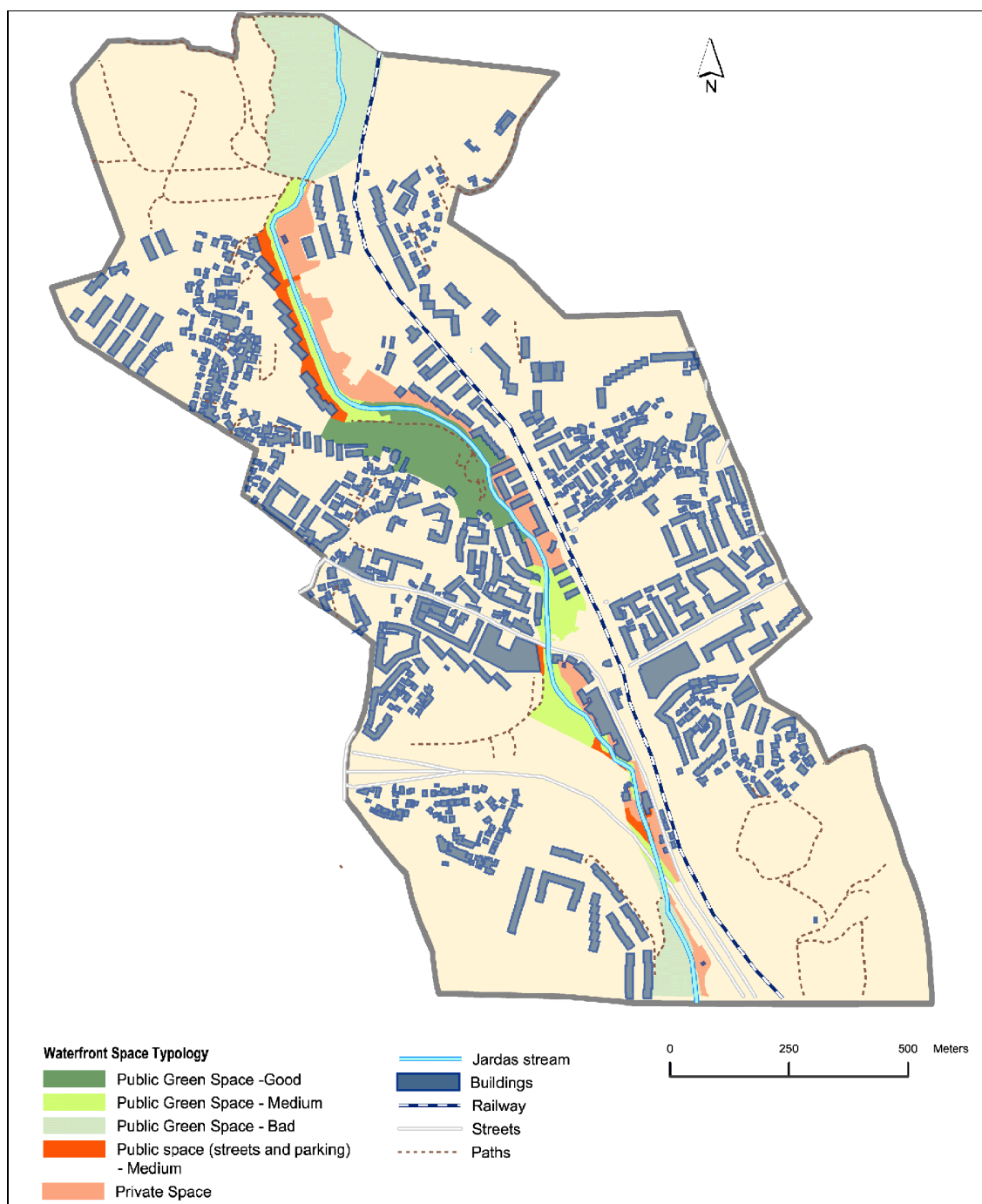
The public utility given to both river watersides concerns the equity of river aesthetical values. The more people have non-restricted access to river watersides, the more equal will be the distribution of existent aesthetical values by people. If the ownership of river waterfront land is private it will be likely that access will not be entirely free to people. The balance between public open areas in good condition and private open areas can reveal the importance given by society and its political representatives to this issue.

This elementary viewpoint can be measured by an indicator, which sets the rate between public open areas (in good conditions) of river watersides and private open areas in the riverfront. In the Jardas stream case, the analysis of those issues is shown and the results presented on table 18 and figure 27.

Table 18– Public utility of Jardas watersides

Types of public utility	Hectares
Private space	4,6
Public space (streets and parking)	1,2
Good public green space	4,5
Bad public green space	8,2
Medium public green space	4,3

These values gave an actual score of 1,25 (surface of streets, parking and public open areas in good conditions / surface of private areas).



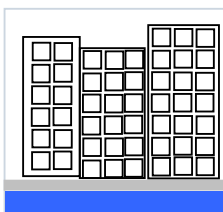
Public open areas				Private open areas
Green space			Streets and parking	-
Good	Medium	Bad	Medium	-
4,51 ha	4,31 ha	8,2 ha	1,2 ha	4,56 ha

Figure 25 – Jardas public utility of margins within the riverfront

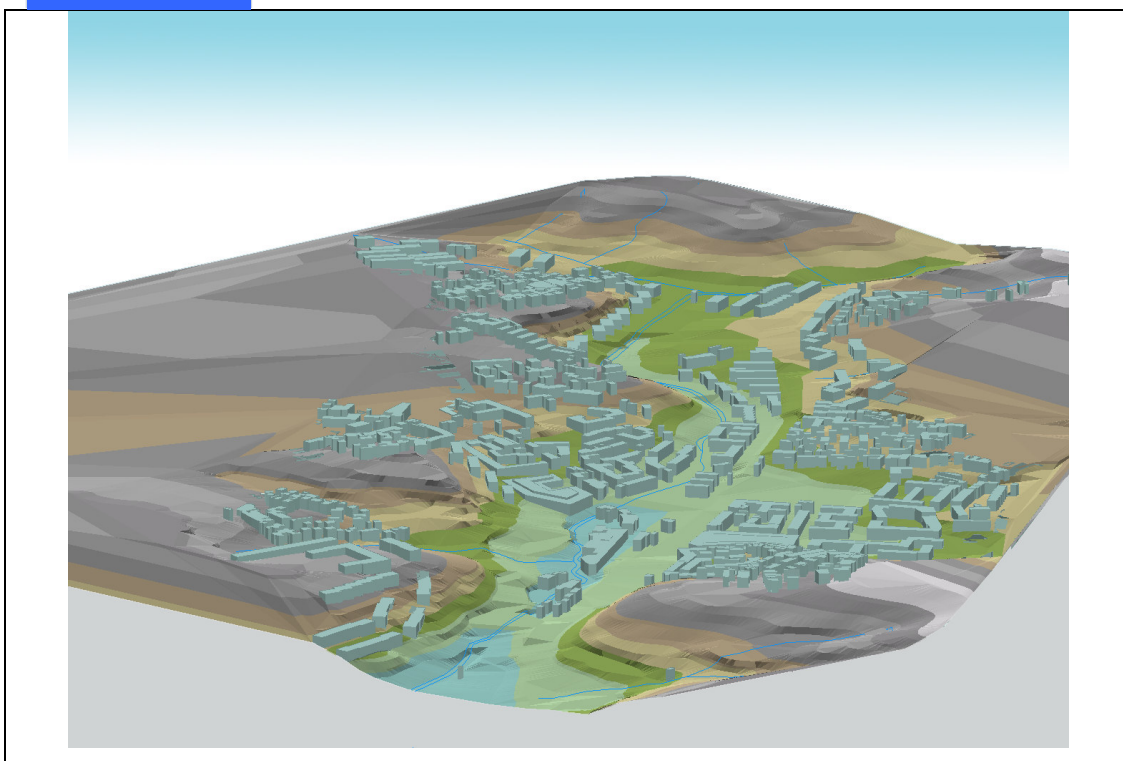


In order to set a maximum value to this criteria, the analysis of the rehabilitation potential of the stream revealed that it could aspire to have a score of 3,96 if all public spaces allocated to streets, parking, parks and green areas would improve their state of conservation and utilization. Hypothetically, (although not in the case of the Jardas stream), changes in land tenure could also be considered, such as free or forced transference of land from private owners to the public administration, if considered appropriate.

5.1.5 Intensity of construction in the riverfront



The intensity of construction on the river margins can be evaluated by an indicator often used in urban planning that shows the relation between gross floor area of construction and net surface of the riverfront in urbanized riverfront areas (Figure 26).



Indicator	Description	Minimum Plausible	Actual Score	Maximum Plausible
C7 – Intensity of construction in the riverfront	Gross floor area of construction / net surface of RF	$C6_{pm}=0$	$C6=247,795/170,170=1,46$	$C6_{pm}=6$

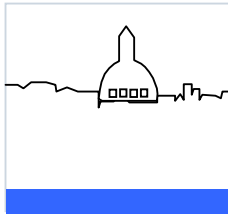
Figure 26 – Jardas intensity of construction in the river corridor



The gross floor area of construction (247.795 m²) was divided by the net riverfront area - riverfront area without social equipments and main streets (170.170 m²) -, which gave the value of 1.46 m²/m². The maximum score was considered to be 6 m²/m², a value found in the surroundings of Cacém and which means the worst situation, being the minimum score of zero the best plausible situation.

It should be noticed that the higher the numerical value the worst the performance is. This means that it was considered that a low level of intensity of construction would have better consequences in the aesthetical performance of the river³.

5.2 Cultural heritage



The cultural heritage within the river corridor can be divided into two elementary viewpoints: public interests of present CH values and attractiveness of existent CH values

5.2.1 Public Interest of present Cultural Heritage values

This elementary viewpoint regards the collective memories and its social representativeness. The monumental buildings (physically perceptible), the natural landscapes and historical sites (not physically perceptible) are also important elements for the definition of the public interest of present cultural heritage values that can be:

- Historical;
- Cultural;
- Natural;
- Ecological;
- Industrial;
- Archaeological;
- Architectural;
- Social.

³ This assumption reflects clearly a value judgment expressed by the authors, which should be confirmed or researched in each real case study.



The amount of classified CH units in the river corridor with officially recognized public interest is the indicator chosen to evaluate this viewpoint.

In the Jardas stream no cultural heritage values have been identified, which is coherent with the weak representation of the river in the local collective memory and local culture perceived by the authors after direct contact with people. This issue is also correlated with the weak level of connection between the people and the river as shown in chapter 6 (see indicator P11).

As mentioned in chapter 5.1.4, it is possible to improve this level of public interest. An integrated rehabilitation process should preserve and improve local existing values (mainly when they are absent or not preserved) or even creating new cultural heritage values. This can be particularly significant for future generations as they can render more sustainable the link river-people.

5.2.2 Attractiveness of existent CH Values

The attractiveness of the existent cultural heritage values can be assessed by the annual amount of visitors of the CH units present in the river corridor. Although, the amount of visitors does not always correlate with cultural heritage values, it was considered that in most situations this indicator reflects the attractiveness of the place. The state of conservation was considered as a factor that can influence indirectly the attractiveness.

A descriptor with a seven-point scale was defined, regarding these two elementary viewpoints, combining the amount of CH places and the amount of visitors (Table 19).

Table 19– Scale adopted for cultural heritage

Class	Scale
1	Very low or no contribution
2	Low
3	Medium/Low
4	Medium
5	Medium /High
6	High
7	Very High contribution (high amount of classified places and high attractiveness)

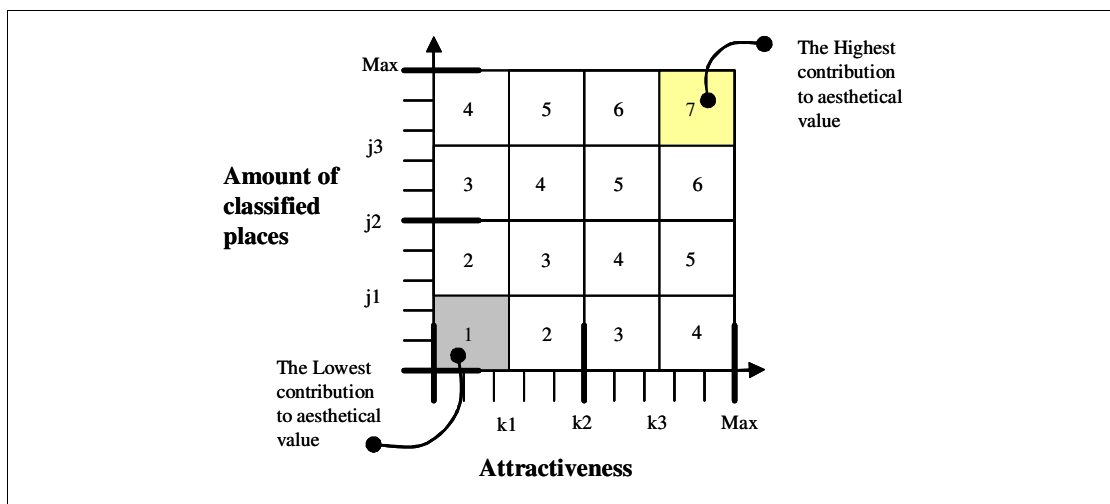


Figure 27 – Cultural heritage descriptor

According to the specific characteristics of each case study, the domain of variation of each indicator (between zero and the maximum value) can be divided into three or more classes. In figure 29 each dimension was divided in 4 classes.

The resulting combination is shown in figure 29 after a judging process made by the authors that shows a linear compensation between the two indicators. However, non-linear iso-values can also be considered.

Direct observations in the study area have shown that there were no classified places and no visitors to take in consideration in the Jardas river corridor (Table 20). The Jardas stream should therefore be classified as class 1.

Table 20– Cultural heritage scores

Indicator	Description	Minimum Plausible	Actual Score	Maximum Plausible
- Amount of classified places - Annual amount of visitors	CH scale combining previous indicators (7 classes)	1	1	7



5.3 Activities on the riverfront



This viewpoint has two fundamental dimensions: diversity of uses versus dominant activities in RF and attractiveness of RF activities.

5.3.1 Diversity of Land Uses / Dominant Activities In Riverfront

The diversity of land uses in the riverfront can be assessed using two indicators. The first one measures the percentage of urbanized area in Riverfront, and the other the percentage of occupation by different types of activities such as dwellings, services, commerce, and industries among others.

For this elementary viewpoint a five-point scale was established (Table 21).

Table 21– Scale adopted for diversity of uses

Class	Scale
1	Predominantly urban with dominance of one type of activities/ uses
2	Predominantly urban with diversity of urban activities
3	Partially urbanized with preponderance of one single class of activities
4	Partially urbanized with diversity of urban activities
5	Non urbanized or predominantly non urban

Class 5 was considered as the class that better contributes to the aesthetical value and Class 1 represents the class with least contribution. Some attention must be given to the Plausible Maximum (class 5) that can be achieved in each situation. In cities with a very urbanized and consolidated riverfront (some areas may be even historical) it is not conceivable to transform those areas in order to achieve the top of the class (non urbanized or predominantly non urban). In those situations the maximum level of achievement should be set in a lower class, if it is plausible.

It can also be even considered that the only plausible transformation process will be in terms of urban density and not in terms of reversing a predominantly urban area to a partially urbanized area. In that case only two classes are possible (class 1 and 2) and



it is advisable to undertake further research in order to better differentiate these classes.

The application of this descriptor to the Jardas stream is represented in figure 30 and it is classified as predominantly urban with dominance of one type of activities/ uses (Class 1) – residential activity.

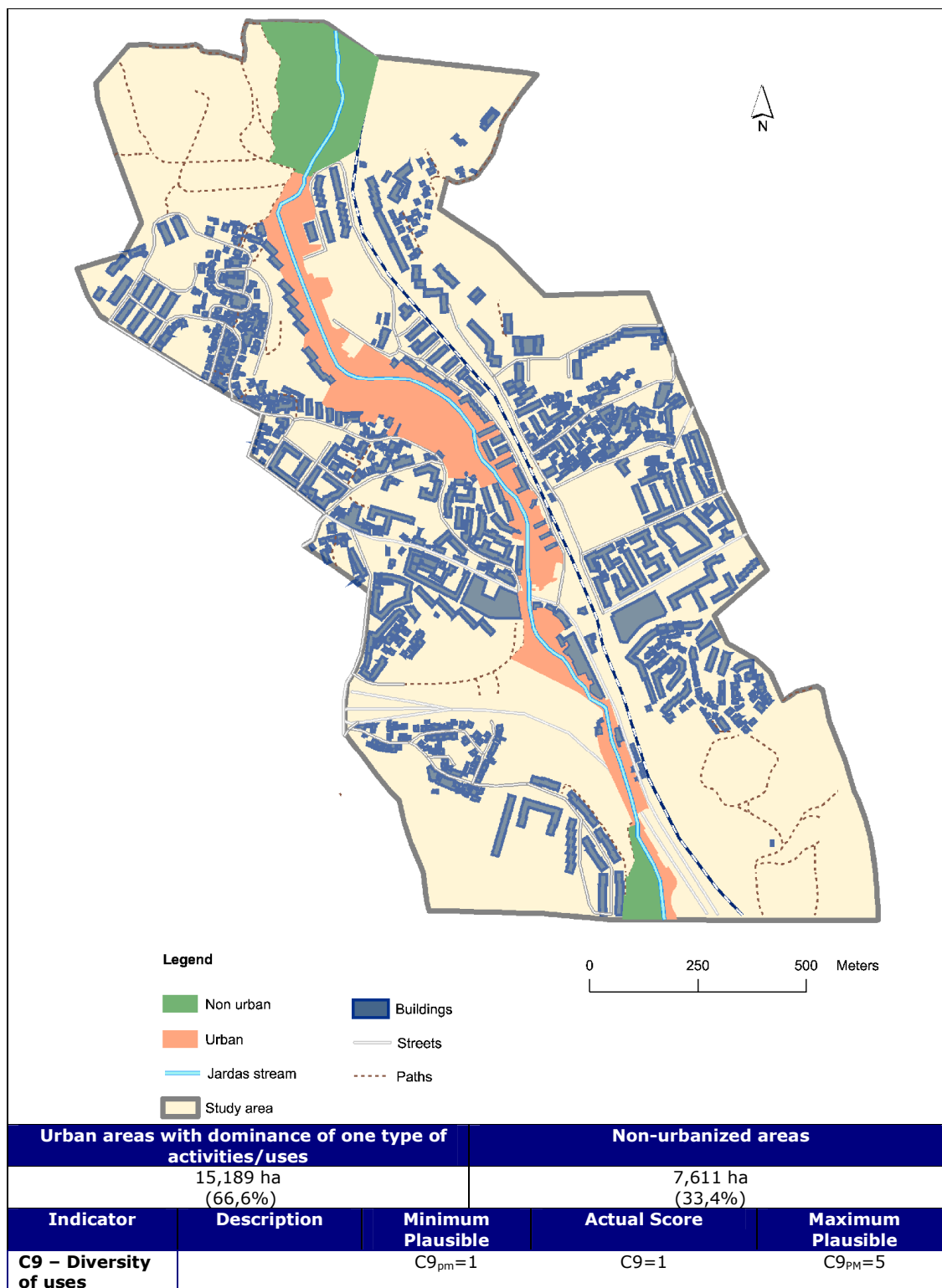


Figure 28 – Jardas diversity of uses in the riverfront



5.3.2 Attractiveness of existent activities

The attractiveness of the existent activities in the riverfront is influenced by their distinctiveness, which makes them different from other common places in the city playing a different or specific role in the daily life of the city. Other elements can also influence this attractiveness like the presence of leisure, touristic activities (coffee-shops, boutiques, etc.), occasional or regular public events (social, sports, cultural...), presence of supra-local urban functions (social-infrastructures, etc.) and relevant economic activities or special commercial units (rare or non-daily use). A proxy indicator to measure this elementary viewpoint can be the real estate value – the average price of m² in riverfront (a more sustainable human capital measurement can also be considered as an alternative proxy).

The descriptor of attractiveness corresponds to a five-point scale (Table 22).

Table 22– Scale adopted for attractiveness of riverfront

Class	Scale
1	Very Low attractiveness
2	Low attractiveness
3	Medium attractiveness
4	High attractiveness
5	Very High attractiveness

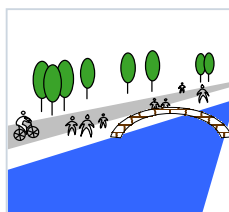
The riverfront of the Jardas stream is clearly class 1 (“Very Low attractiveness”) according to qualitative information given by local real state agencies in general (Table 23)

Table 23– Attractiveness of riverfront score

Indicator	Description	Minimum Plausible	Actual Score	Maximum Plausible
C10 – Attractiveness of riverfront		C10 _{pm} =1	C10=1	C10 _{pm} =5



5.4 Accessibility



Accessibility can be measured by how easy the city or the river makes it for people to get near to or cross the watercourse. The set of indicators suggested to measure/value accessibility are listed in Table 24.

Table 24– Accessibility indicators

Indicator	Description
C11 Linear density of walking/biking bridges	Amount of bridges/river length [b/Km]
C12 % of people that daily cross river	Amount of people (or bikes) that cross bridges/population in river corridor [p/pop]
C13 Density of surface parking	Amount of visible public and private car parking places/river corridor area in hectares [p/ha]
C14 Public transport services	Area of river corridor/length of public transport lines [ha/Km]
C15 Soft modes infrastructures	Length of pedestrian paths [Km/Km]
C16 Non-sustainable disruptive ways	Length of non-sustainable disruptive major roads, highways or railways/river length [Km/Km]
C17 Linear density of anchorage points	Amount of anchorage points/length of river corridor [Km/Km]
C18 Density of boats in the river	Daily average number of boats navigating present in the river/water surface [n/Km ²]

The measurements are indicated in figures 29 to 32 and the scores of each indicator are presented in Table 25.

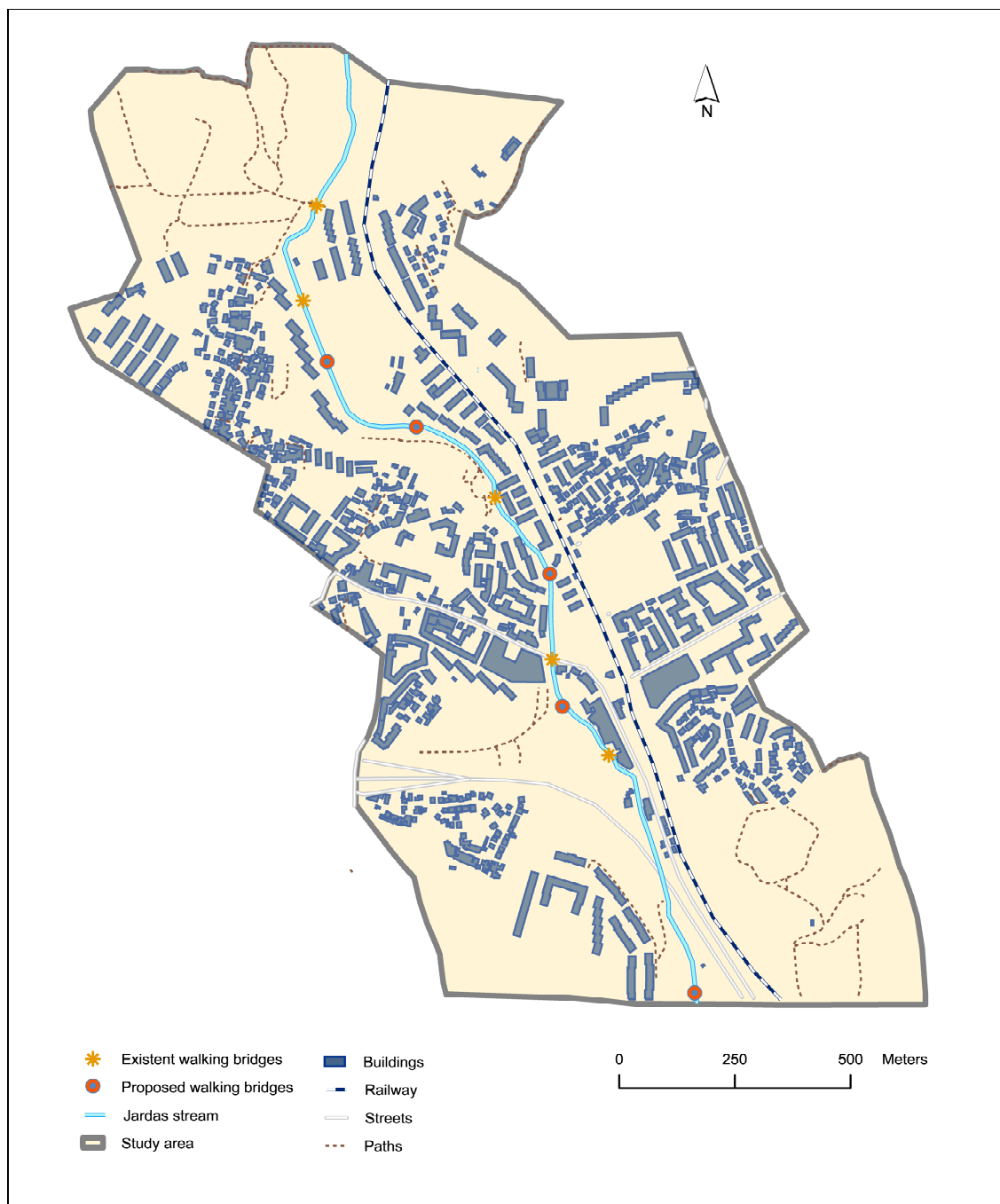


Figure 29 – Crossing the river in Jardas

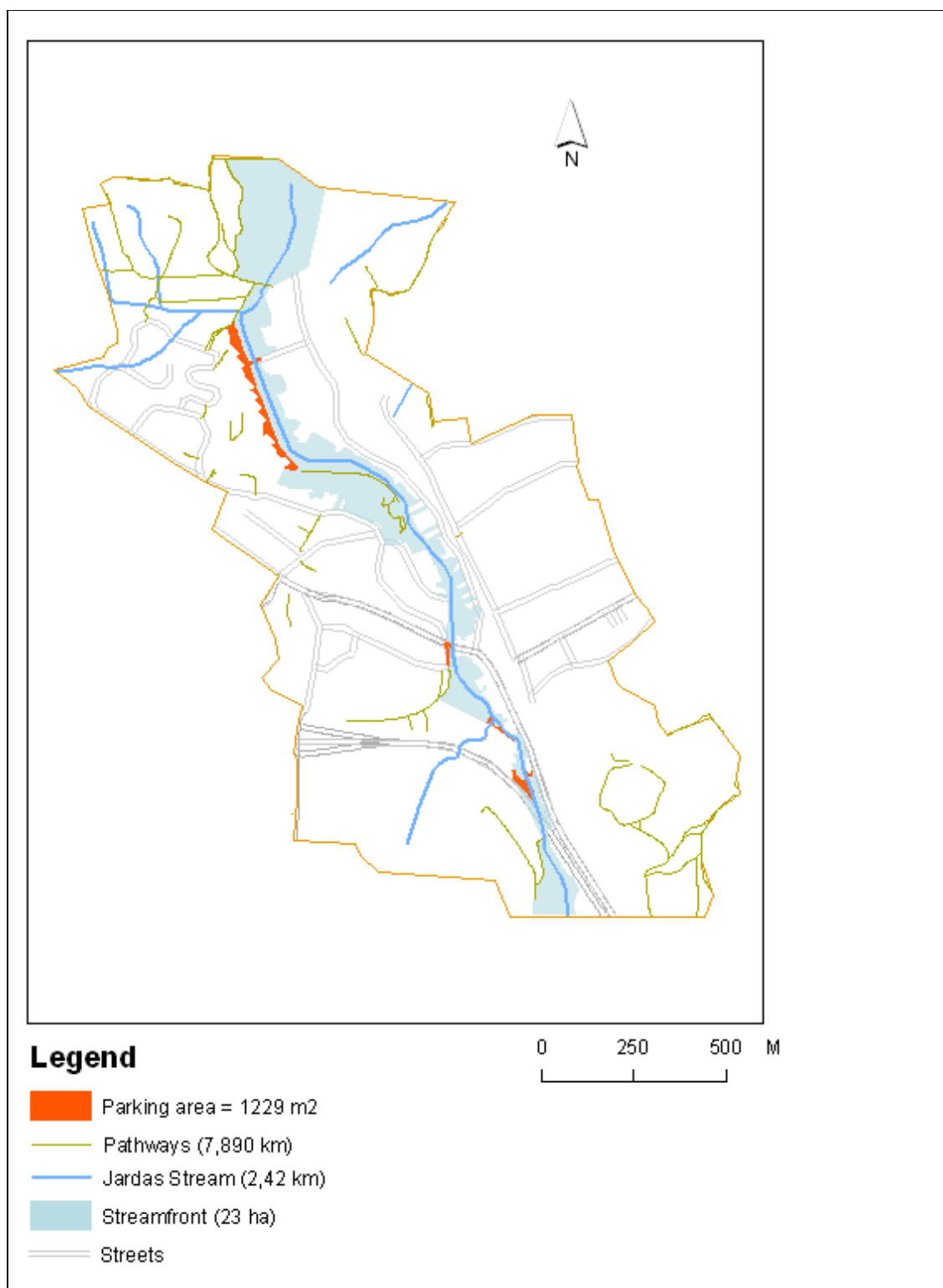


Figure 30 – Parking area and pathways in Jardas

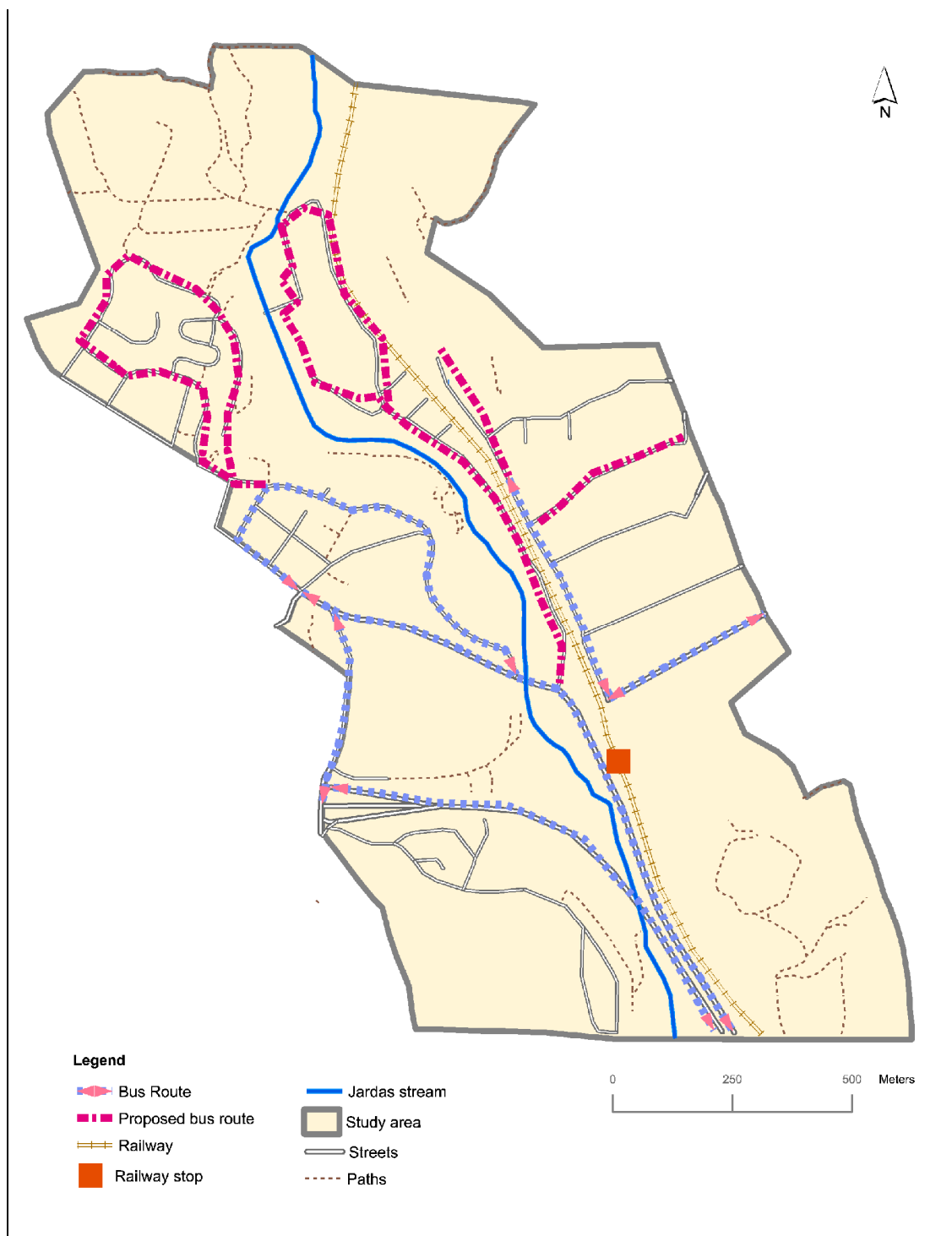


Figure 31 – Public transportations

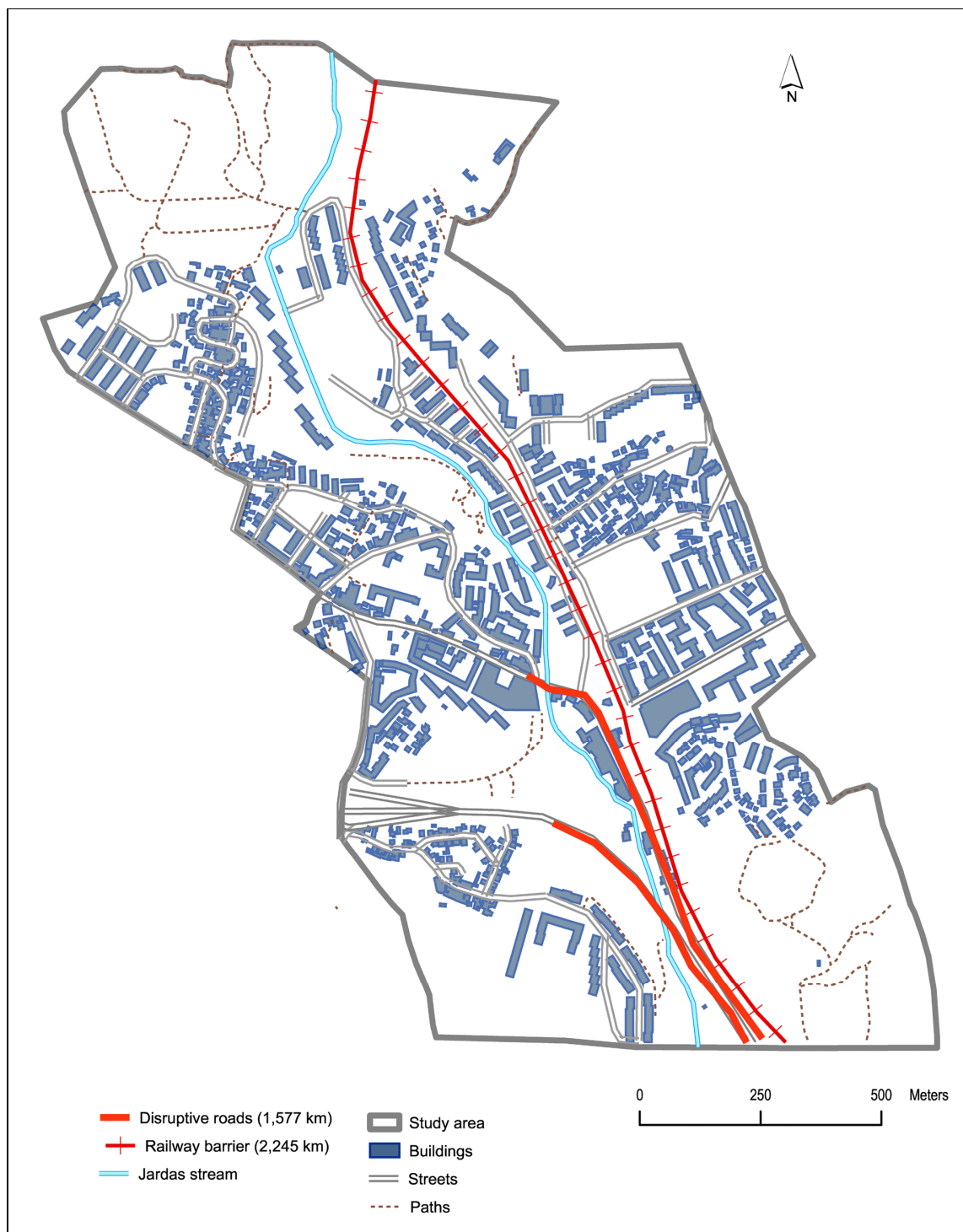


Figure 32 – Disruptive major roads

Table 25– Accessibility indicators scores

Indicator	Description	Minimum Plausible	Actual Score	Maximum Plausible
C11 – Linear density of walking/ biking bridges	Amount of bridges/ river length (b/km)	$C11_{pm}=0$	$C11=5/2,49=2,01$	$C11_{pm}=10/2,49=4,02$
C12 – % of people that daily cross river	Amount of people (or bikes) that cross bridges/ population in river corridor (p/pop)	$C12_{pm}=0$	$C12=1400/81,843=17,11$	$C12_{pm}=818431/81,843=1000$
C13 – Density of surface parking	Amount of visible public and private car parking places/ river corridor area in hectares (p/ha)	$C13_{pm}=0$	$C13=(1229/20)/200,3=0,30$	$C13_{pm}=200/198.4=1,0$
C14 – Public transport services	Area of river corridor/length of public transports lines (ha/km)	$C14_{pm}=200,3/9,46=20,97$	$C14=200,3/4,76=42,08$	$C14_{pm}=200,3$
C15 – Soft modes infrastructures	Length of pedestrian paths or bikeways in RC/Length of the river	$C15_{pm}=0$	$C15=6,167/2,49=2,48$	$C15_{pm}=5$
C16 – Non sustainable disruptive ways	Length of non-sustainable disruptive major roads/River length	$C16_{pm}=0$	$C16=1,58+2,25/2,49=1,54$	$C16_{pm}=2$
C17 – Linear density of anchorage places (along the river in both margins)	Amount of anchorage points/ length of river corridor (km/km)	$C17_{pm}=0$	$C17=0$	$C17_{pm}=4$
C18- Density of boats in the river	Daily average number of boats present in the river/ water surface (n/ km ²)	$C18_{pm}=0$	$C18=0$	$C18_{pm}=3/(2,4*9,4)=0,13$

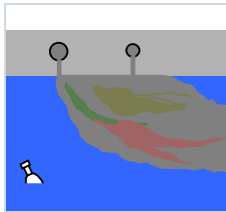
Some remarks should be made regarding the plausible maximum and minimum values established for these indicators. These limits of the scale of each indicator should be carefully determined in order to include any performance level that can be achieved through future actions on a river rehabilitation process.

It is advisable, in some situations, to make additional studies with expert teams in order to achieve real and plausible values that can be attained. Whatever will be the rehabilitation process, the desired (or planned to be achieved) performance should be measured and set by the scale chosen.

The difference between the actual score and the planned/ideal/desired score will represent the improvement that can be expected following each dimension of evaluation.



5.5 Pollution



Pollution of urban watercourses is today one of the main aspects that affects the general ecological and biological performances of rivers, as well as the quality of life of people that live in urban areas located near those rivers. Pollution that is sensorial percept by people affects the aesthetical performance of rivers and should be considered in its physical manifestations like odour, colour of water, littering, etc.



Figure 33 – Examples of river pollution

The bibliographic research indicated that the method developed by Environment Agency for England and Wales (www.environment-agency.gov.uk) named “General Quality Assessment of rivers: aesthetics” could be adopted in spite of the misuse of the word aesthetics.

The method deals with a systematic classification of litter: gross litter, general and sewage litter and dog faeces, oil, surface scum, foam, sewage fungus, ochre, colour and odour. Each parameter is assigned a class and the overall grade for a site is derived from the ‘score’ allocated to each parameter. The final score is simply the sum



of the number of points for all parameters, which can be classified in a global 4-point scale (Table 26).

Table 26– Scale adopted for pollution

Class	Scale
1	Good
2	Fair
3	Poor
4	Bad

The assessment of the viewpoint 'pollution' was performed by using the methodology proposed by Environment Agency (2000) concerning the aesthetical quality of rivers based on litter, oil, scum, foam, fungus, colour and odour. The scoring of the Jardas is presented in Table 27, where partial measures of variables and resulting performances of indicators are presented. The application of the classification scheme for each parameter results in the upper limit of grade 1 – good aesthetic quality – for the reach considered.

Table 27– Assessment of pollution in Jardas stream

(using methodology from Environment Agency, 2000)

Litter (Number of items)	Type	Class 1	Class 2	Class 3	Class 4
	Gross	0	1-2	3-9	10+
	General	0-5	6-49	50-99	100+
	Sewage	0	1-5	6-24	25+
	Faeces	0	1-5	6-24	25+
Other Aesthetic Parameters (Percentage cover of oil, scum, foam, sewage fungus, ochre)		Class 1	Class 2	Class 3	Class 4
		0	>0-5%	>5-25%	>25%
Colour		Blue/Green	Red/Orange	Brown/Yellow/Straw	
	Colourless	Class 1	Class 1	Class 1	
	Very pale	Class 1	Class 2	Class 1	
	Pale	Class 3	Class 3	Class 2	
	Dark	Class 4	Class 4	Class 3	
Odour		Group 1	Group 2	Group 3	
	No smell	Class 1	Class 1	Class 1	
	Faint smell	Class 1	Class 2	Class 3	
	Obvious smell	Class 2	Class 3	Class 4	
	Strong smell	Class 3	Class 4	Class 4	
Group 1: Tolerated and less indicative of poor water quality (musty, earthy, woody). Group 2: Rated as indicators of poor water quality (farmy, disinfectant, gas, chlorine). Group 3: Rated as indicators of very poor water quality (sewage, polish/cleaning fluid, ammonia, oily smell, bad egg (sulphide)).					



6. The People: evaluation of viewpoints

As presented in Deliverable 4.2, a set of dimensions was identified as contributing to the aesthetic evaluation of the river by the public. All the dimensions (see table 3) were the result of the interaction between the human component and the environmental component that includes the river and the city.

First, in order to have information about people's perception of the river in the city context, it is necessary to ask them. Therefore, for each viewpoint of the people component a questionnaire was developed. For each indicator there is one or a group of questions as it will later be explained. Second, a delimitation of the definition of the public is required. As it is underlined by several authors, it is possible to distinguish between several publics: the population or residents of the river corridor; the rest of the population of the city; the people that use the river corridor, that can include population from the city and from outside the city; technicians involved in the planning, restoration and conservation of the river; as well as decision makers, and researchers.

In this methodology the population considered is only the one living in the river corridor. However, especially in projects of river restoration, it is very important to include the technicians and decision makers because they bring their own cultural background to their projects. These different groups of publics differ in the dimensions that they emphasize in aesthetic perception (e.g. risk perception, environmental values, or recreational values).

Table 28– Fundamental and elementary viewpoints for the people component

Fundamental viewpoint	Elementary viewpoint		Indicator Code
Public perception	In relation to the River	Aesthetic	P1
		Water	P2
		Biodiversity	P3
		Risk related with the perception of flood risk	P4
		Pollution	P5
	In relation to the City	Urban quality	P6
		Accessibilities	P7
		Security Infrastructures	P8
	The dimensions identified	Relax	P9
			P10



	with the people relationship with the river	Attachment	P11
Place Identity	Continuity Self-esteem Self-efficacy Distinctiveness		P12 P13 P14 P15
Restorative Capacity	Being away Fascination Extent Compatibility		P16 P17 P18 P19

6.1 River Landscape Public Perception

A river in the urban context can be analysed as a public space, defined as an open space accessible to the public, and where people can develop individual or group activities.

To understand the public river landscape perception as a public space it is necessary to identify the cognitions, feelings and behaviour of its users.

Through the analysis of the literature about public perception of river areas in urban contexts, several dimensions that can be identified:

- dimensions related with the river;
- dimensions related with the city ;
- dimensions that reveal the people's relationship with the space.

In relation to the river the following dimensions were identified:

- **Aesthetic** – includes the simple aesthetic evaluation of the river, with questions like "Is this river beautiful?";
- **Water** – relates to the quantity of water in the river;
- **Biodiversity** - relates to the perception of adequate presence of fauna and flora in the river corridor;
- **Risk** relates to the perception of flood risk;
- **Pollution** includes pollution of the water and the banks.

In relation to the city the following dimensions were identified:

- **Urban quality** – relates with the quality of the build up area, its degradation as well as the presence of noise;



- **Accessibilities** – includes questions about public transport, parking areas, and access;
- **Infrastructures** – includes infrastructures like commerce, sports infrastructures and green open areas;
- **Security** relates to the perception of perception of the level of delinquency or crime.

The dimensions identified with the relationship between people and the river were:

- **Relaxation** – relates to the perception of the area that allows people to reduce stress and promote positive moods and feelings. The questions regarding this aspect of perception are about the pleasantness, peacefulness and relaxation qualities of the area;
- **Attachment** – it is the psychological bonding to the environment.

To evaluate the river landscape perception of residents it is necessary to use questionnaires with questions that include all the dimensions identified before. In the annex 2, part C, entitled River Perception lists the questions developed to evaluate the river landscape public perception. The following table presents the distribution of the questions for the dimensions of this viewpoint.

Table 29– Distribution of questions for river landscape public perception

Dimensions	Questions of the questionnaire
Aesthetic	1
Water	10
Biodiversity	14,15
Risk	6
Pollution	2,7, 8, 11, 12, 13, 29
Urban quality	3, 4, 9, 28
Accessibilities	17, 18, 19
Infrastructures	20, 21, 22, 24, 25, 26, 27
Security	23
Relax	5, 15, 30
Attachment	31, 32, 33, 34, 35

6.2 Place Identity

The research concerning the relationship between the human behaviour and the environment gives relevance to the link between the person and the environment. The term *place identity*, which is commonly used, refers to “*those dimensions of the self*



that define the individual's personal identity in relation to the physical environment by means of a complex pattern of conscious and unconscious ideas, beliefs, preferences, feelings, values, goals, and behavioural tendencies and skills relevant to this environment" (Proshansky, 1978, p. 155).

Some studies show that place identity can play an important role in the perception of environmental changes (e.g.: Twigger-Ross and Uzzell, 1996, Speller, *et al.*, 1996), in the perception of environmental problems (e.g.: Bonaiuto, *et al.* 1996), and in the perception of public areas as natural parks (e.g.: Loureiro, 1999). These studies show that a positive and strong place identity reduces the negative perception of some environmental problems or increase the positive perception of some environmental aspects.

Several recent studies use the Breakwell's model to understand the role of place in the identity processes (e.g. Twigger-Ross and Uzzell, 1996; Speller, *et al.*, 1996; Bernardo *et al.*, 1996; Speller *et al.*, 2002). The Breakwell's model proposes four principles of identity: continuity, self-esteem, self-efficacy and distinctiveness.

Continuity – refers to the desire to preserve continuity of the situation over time. It is possible to maintain continuity by establishing a link to a place that is a reference for past actions and experiences, or to a place that is congruent with personal values, i.e., maintaining continuity via characteristics of places which are generic and transferable from one place to another.

Self-esteem - refers to the positive evaluation of our physical environments or the physical environments of the group one identifies with.

Self-efficacy - is defined as an individual's belief in their capabilities to meet with the environmental demands.

Distinctiveness - is the desire to maintain personal distinctiveness or uniqueness. In terms of place identity, the distinctiveness can be understood as the attribution of positive features to the place in comparison to different places.

Using this framework it is possible to understand how a relevant element in the landscape, like an important watercourse that crosses a city, can contribute to the



identity of its residents. So, the enhancement of that river can contribute to the reinforcement of the identity to the city.

In the context of the URBEM Project, a questionnaire was developed (annex 2, part E) that includes questions about all the principles described before in order to contribute to the identification of the importance of the river and the city to the identity of its residents. The following table presents the distribution of the questions for the dimensions of this viewpoint.

Table 30– Distribution of questions for Place Identity

Dimensions	Questions of the questionnaire
Distinctiveness	1, 2, 3, 4
Continuity	5, 6, 7, 8
Self-esteem	9, 10, 11, 12
Self-efficacy	13, 14, 15, 16,

6.3 Restorative Capacity

There is empirical evidence that shows that the viewing of natural scenes (like visiting natural places or even viewing photographs of natural scenes) may have a restorative effect, contributing, for instance, to reduce stress and promote positive moods and feelings (e.g.: Ulrich, 1981, 1984; Ulrich et al., 1991). Thus, natural spaces in urban areas can promote a positive view of the place, in particular with the presence of water (Kaplan and Kaplan, 1989).

The Attention Restorative Theory (ART) was developed by the Kaplan couple (Kaplan and Kaplan, 1989; Kaplan, 1995). The tasks that require mental effort draw upon direct attention. The individual must expend effort to achieve focus and inhibit intrusive distractions. As outlines S. Kaplan, this type of attention is particularly fragile and can result in directed attention fatigue. According to ART, it is necessary to rest directed attention by using an involuntary attention that requires little effort.

The resultant directed attention fatigue may become manifest not only in decreased performance, such as decreased helping behaviour and increments in accidents, but also in negative emotions, irritability and decreased sensitivity to interpersonal



cues. Restoration of the directed attention capability requires entering a situation in which functioning does not involve demands on directed attention but can instead rely on fascination.

Natural environments can be restorative because they stimulate the involuntary attention. These processes require little effort because they allow cognitive freedom (they allow the subject to concentrate only on the environmental aspects that they choose) and escape from the daily activities - in the natural environments there is freedom of rules and obligations.

The Kaplan's consider four interrelated characteristics of restorative experiences: being away, fascination, extent, and compatibility.

Being away - the first condition for restoration involves getting distance from further demands on directed attention and the ordinary present or routine aspects of one's life. There are three ways in which a sense of being away can come about: escaping from unwanted distractions in the surroundings, distancing oneself from one's usual work and reminders of it, and suspending the pursuit of particular purposes (Kaplan and Kaplan, 1989).

Fascination - the natural environments are important sources of fascinating elements. These are restorative because they demand effortless attention and use the involuntary attention.

Extent - the natural environment has also the function of extent that is treated by the Kaplans (1989) as a function of connectedness and scope. People in contact with the natural environment feel beyond their own limits, almost as being part of nature.

Compatibility - the match between the person's goals and inclinations, environmental demands, and the information available in the environment for the support of intended and required activities (Kaplan, 1983). In short, compatibility exists in situations in which what the person wants to do matches what the environment demands and supports.

The understanding of restorative person-environment transactions can be useful in environmental design, planning, and policy (Kaplan & Kaplan, 1989; Kaplan, 1983;



Ulrich, 1992). The measurement of restorative qualities of person-environment transactions can also help in applying such understandings (Hartig et al, 1996). These qualities are accessible by asking people about their perceptions of environments.

In the context of the URBEM project a questionnaire was developed to test the restorative capabilities of a river in the urban context, which is consistent with the Attention Restoration Theory (ART). The following table presents the distribution of the questions for the dimensions of the Restorative Capacity.

Table 31– Distribution of questions for Restorative Capacity

Dimensions	Questions of the questionnaire
Being away	1, 4, 8, 12, 16, 19
Fascination	2, 5, 9, 13, 17
Extent	3, 6, 10, 14
Compatibility	7, 11, 15, 18

6.4 Application to the Jardas stream

6.4.1 Design and construction of the Questionnaire - methodology

A questionnaire was developed to evaluate the following viewpoints: public perception of river landscape, place identity, and restorative capacity. The questionnaire includes also one group of questions about the activities in the river corridor, and one group of questions about public preferences concerning the future potential projects for the river, riverfront and urban area.

The questionnaire is structured as follows:

- A. General questions - questions about how long the subjects live in the urban area; the main reasons why they choose to live there; where they work/study or stay during the day; and what they do during the free time and where.
- B. Activities in the river area – a long list of possible activities linked to the river and the area near the river, like fishing, walking, jogging, and shopping. The subjects should answer by indicating, in a five-point Likert Scale, the number that best reflects their answer.



- C. River perception - a list with possible characteristics of the river and the area near the river, organized in the dimensions referred in the viewpoint river landscape public perception.
- D. Preferences for the future – a list of questions about potential projects in the river, riverfront and city.
- E. Place Identity Scale – a list of questions in order to assess the importance of the river and the urban area regarding the identity of the subjects.
- F. Restorative Capacity Scale - includes a list of questions in order to evaluate the restorative capacity of the river, using the ART of Kaplan & Kaplan (1989) as a guiding framework. The questions are organized in terms of the four interrelated characteristics of restorative experience: being away, fascination, extent, and compatibility.

A general version of the questionnaire was developed to be applied to any type of river context (annex 1). To be useful to a specific case study, this general version should be adapted to the characteristics of the river, to the specific urban context, and to the social background. It is also important to incorporate information related with existing projects that might change the area.

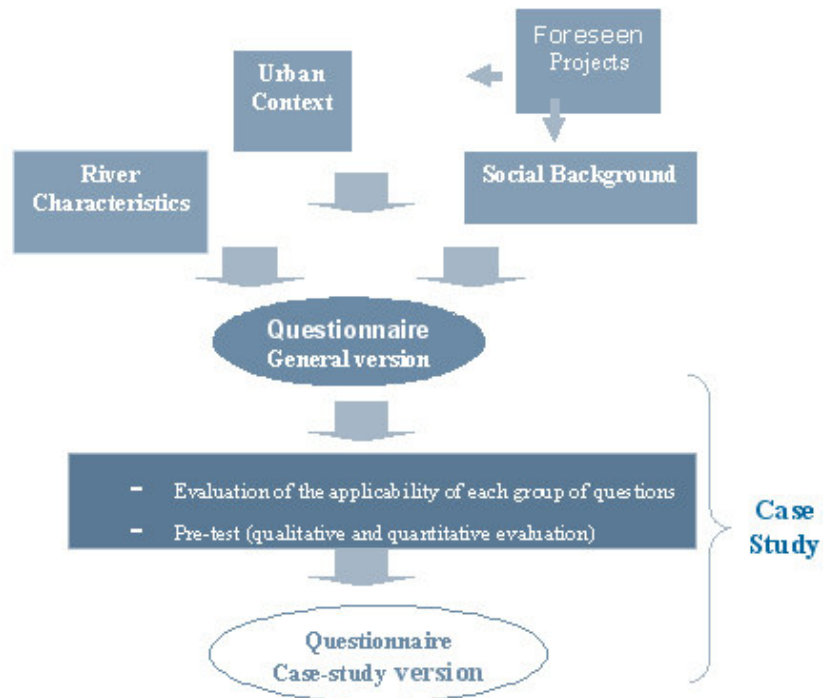


Figure 34 – Adaptation of the questionnaire

The adaptation to a specific case study of this general version of the questionnaire includes several steps (see Figure 34):

- Characterization of the case study (river, city and people);
- Evaluation of the applicability of each question to the study context;
- Pre-test the questionnaire in order to identify the possible problems of the questionnaire, like questions that the subjects cannot understand or that are badly formulated. The qualitative and quantitative analysis of the pre-test allows the reformulation of the questionnaire.

After this procedure, a well-adapted questionnaire to the specific characteristics of the case study is obtained.

The general version of the questionnaire was also adapted to the Jardas study site after a significant reduction in the amount of questions. In order to carry out the pre-test, twenty questionnaires were distributed to Cacém residents and collected after



they were filled out. This pre-test makes possible a last adjustment to the questionnaire.

In the case of Jardas stream it was found that the Restorative Capacity Scale and the Identity Scale are not applicable to this situations due the dimensions of the Jardas river.

While running this pilot, it was found that:

- People do not recognize the Jardas stream as a relevant element in the city or as a privileged place to rest during the leisure time.

Therefore,

- Some questions included in both questionnaires did not make sense in the Jardas stream context, and frequently are misunderstood or not understood at all;
- These questions were not included in the Jardas final version of the questionnaire.

6.4.2 Population and Sample

The definition of the population for each study depends on the aims of the study. Sometimes it can include all the population of the urban area, or only the population that is potentially affected by an intervention in the river corridor.

The sample should be representative of the population, *i.e.* the sample must have the same characteristics of the population in order that the results of the sample can be generalized to the population. Several methods can be used, such as random selection of the sample or the identification of the population distribution in terms of the main socio-demographic characteristics in order to have the same distribution in the sample.

In the Jardas case study, due to the river characteristics, the population was defined as the residents who lived in the river corridor. The sample was chosen considering three main criteria:

- Gender;
- Age - three groups of age was considered;
- Residential distance to the river – two groups was considered: (1) residents that live in the first and second block near the river, and (2) the rest of the residents.

One hundred and twenty nine (129) residents were interviewed during the month of September 2003.

Table 32– Sample Distribution

Age		Residential area		Total
		1	2	
<25	Female	10	10	20
	Male	10	17	27
25-65	Female	10	10	20
	Male	11	10	21
>65	Female	10	10	20
	Male	10	11	21

6.4.3 Results

River Public Perception Profile - results

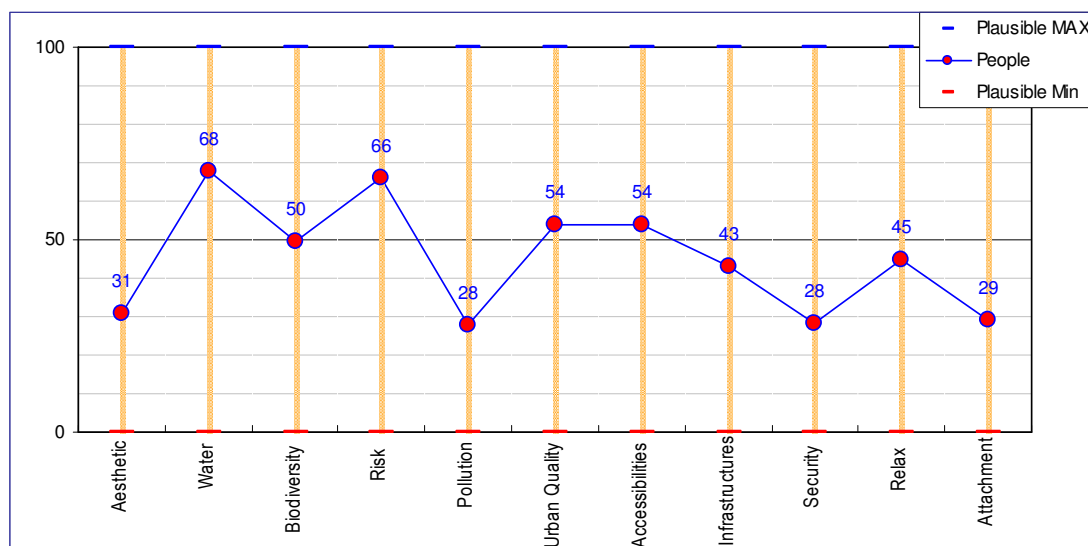




Figure 35 – River Public Perception profile

The results of public perception show that the residents have a negative view of the river regarding *aesthetic* and *pollution* dimensions. Regarding city dimensions, public perception is located in the centre of the scale with better impressions attributed in average to *urban quality* and *accessibility*. People have a bad image of *infrastructures*. The *security* of the area is the worst aspect (28%) quoted by people. Concerning the people dimension the residents reveal a very low attachment with the watercourse and a perception of the area as a bad place to relax.

Activities in the River Area

The Cacém residents reveal only a few behaviours related to the river. The most referred behaviour was walking along the river, which was mentioned by about fifty percent of the residents. Less than fifteen percent of the residents refer to have activities and behaviours like meeting people, contacting nature and thinking.

The analyses of the results allow us to verify that the proximity of the residents to the river is an important factor in the use of the river corridor. The residents that live in the first and second block near the river mention a greater number of behaviours, such as walking, reading, contacting nature and thinking in the river area, than the other residents.

Preferences for the Future

In relation to the preferences for the future, the question has three main aspects: preferences about the river, about the riverfront and about the city.

In relation to the river, the aspects that are referred as those that should be improved are related to two aspects: the cleanness ("cleaning the river", "water cleanness (garbage)", the "banks cleanness (garbage)"); and solving flood hazards problem.

Regarding the riverfront, the answers reveal that the most preferred aspect is related with the increase of recreational areas: "new green areas near the river", "new pedestrian paths", "new bike paths", and "new sport infrastructures (e.g.: courts,...)". In relation to the city, "better transports" and "more green areas" are the most important aspects to improve.



7. Geographic information technologies

This chapter focuses on the use of Geographic Information Technologies within Work Package 4 of the URBEM project supporting the classification of the aesthetic value of the selected urban river – the Jardas Stream. The importance of GIS tools is to analyse and relate a large amount of different information in a spatial context and to reach new conclusions about these relationships. A GIS, therefore, can reveal important new information that leads to better decision-making (Burrough, 1986). Different kinds of data in map or in alphanumeric form can be entered into a GIS. A GIS can also convert existing tabular information into map forms and vice versa. For example, census or hydrologic tabular data can be converted to a map form and serve as layers of thematic information in a GIS. A GIS makes it possible “to identify drainage features such as ridges, valley bottoms, channel networks, and surface drainage patterns, and to quantify sub-catchment and channel properties such as size, length, and slope” (Maidment and Djokic, 2000). The accuracy of this derived information is a function both of the quality, scale and resolution of data, and of the GIS processing algorithms used to extract this information.



Table 33– GIS Functional capabilities

Examples of functional capabilities of GIS	Examples of basic questions that can be investigated using a GIS	Examples of applications
Geographic and alphanumeric data entry, storage and manipulation (depends of the purpose of the study)	What is important to the study...?	Topography, hydrology, soils, roads, property boundaries, current land use, flooding frequencies, aerial photographs, survey values, etc.
Map production and characterization	Where is it...? What type of area is...? (City, agriculture land, forest, etc)?	Map localization Extracting project information from: i) maps – region map, district map, ii) aerial photographs
GIS functions	Area? Perimeter? Buffers? Intersection? Slope analysis 3D Models Visibility Viewsheds, etc. } analyses	Measuring parameters Spatial analysis between geographic entities Streams and watershed automatic delineation
Decision and planning support A critical component of a GIS it's the ability to resume multidisciplinary data and produce information that can be used to make decisions about resources.		

7.1 GIS applications in URBEM

Figure 36 provides an overview of the methodology implemented. The following main processing blocks can be identified: database creation (input), GIS analyses and applications, and GIS derived and new information (output).

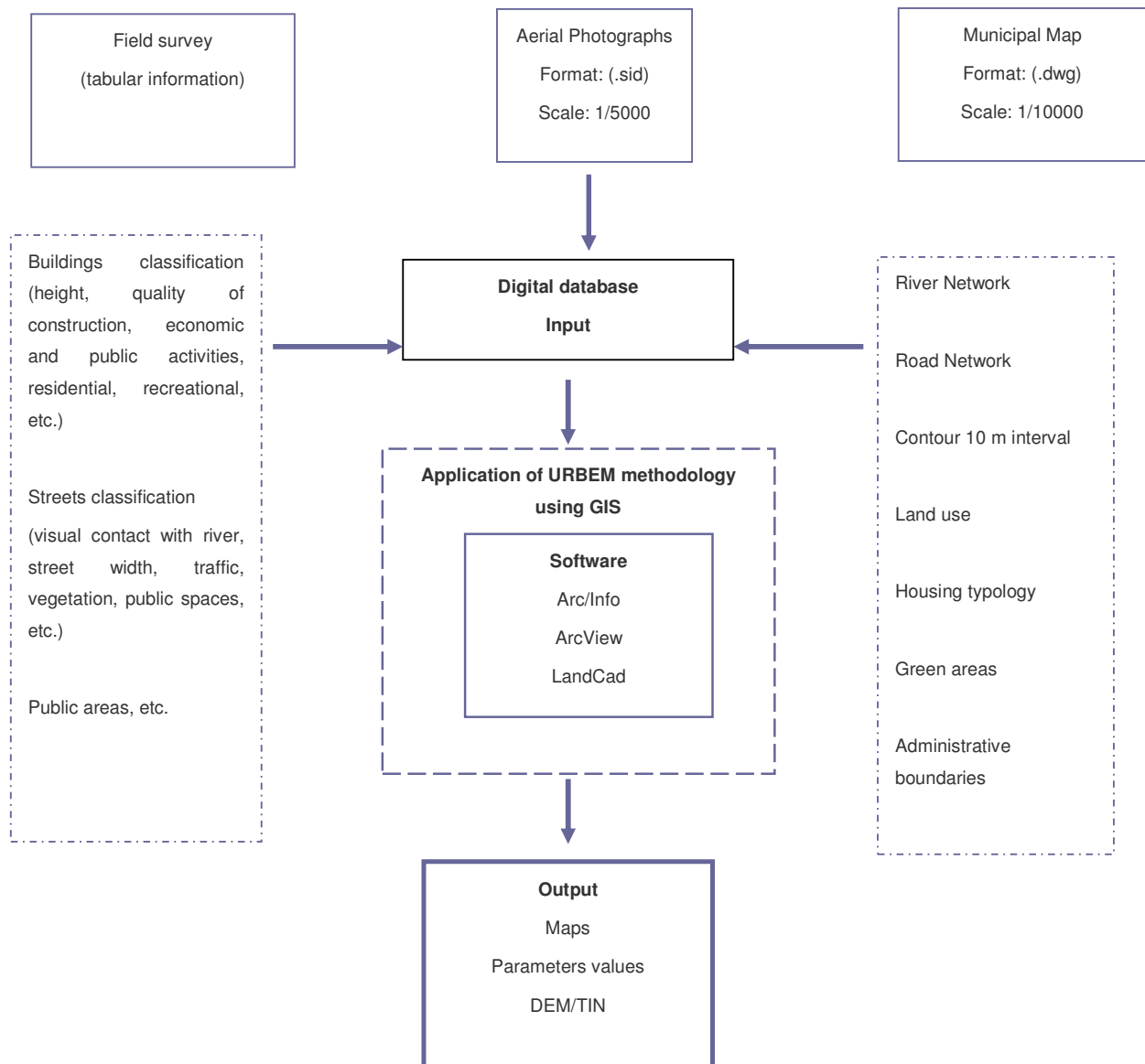


Figure 36 – Overview of the methodology

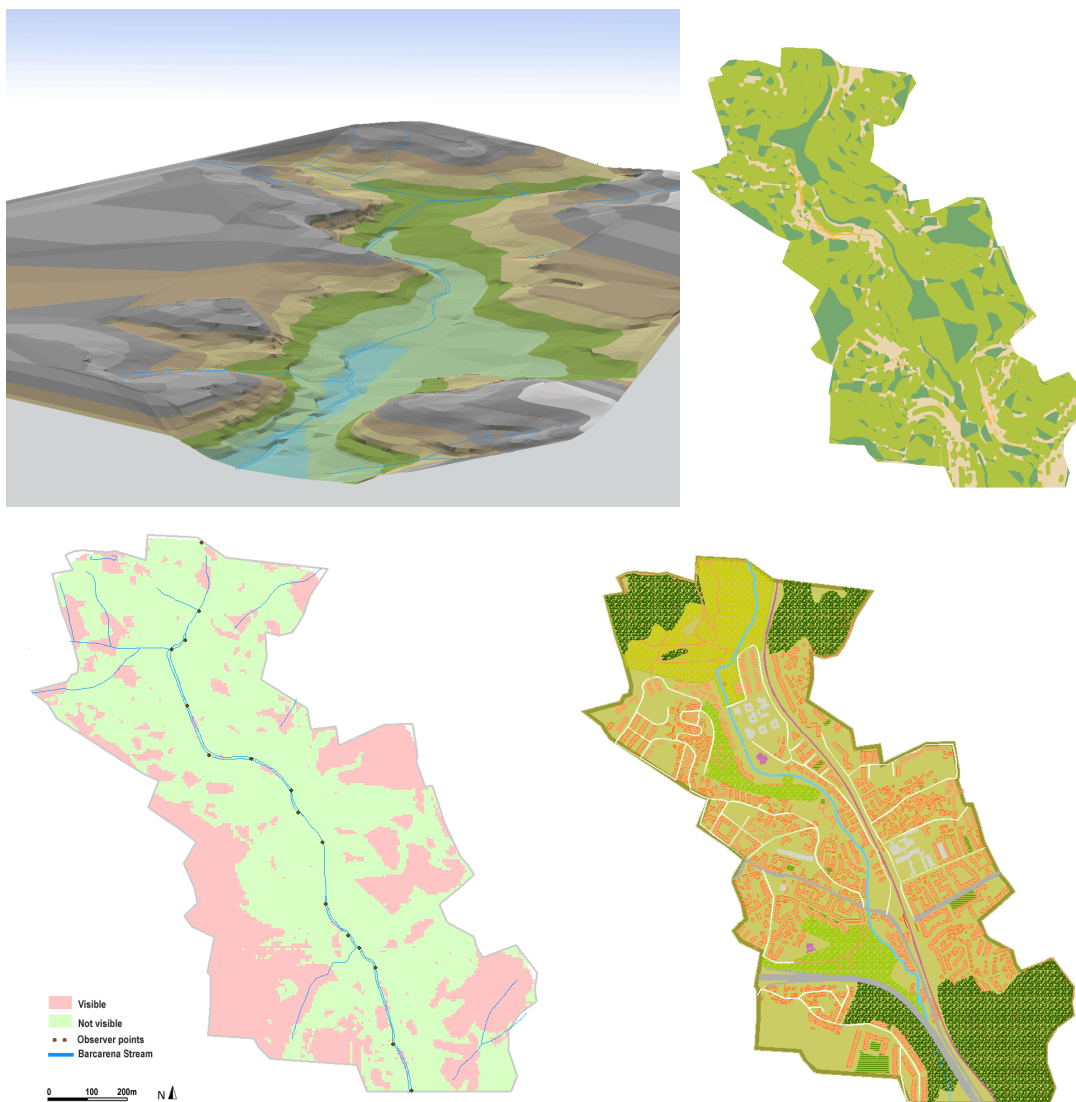


Figure 37 – GIS products: DTM, Slope analysis, viewshed and land use map.

8. Aesthetical evaluation process

8.1 Aesthetical profile of Jardas stream

All Jardas partial performances, with respect to each elementary viewpoint and measured through the chosen indicators / descriptors, were standardized to a cardinal common scale of performance, usually called criterion (see Chapter 3.3).



Simple linear functions were used to convert the real scales to a common scale varying from 0 (the worst plausible level) to 100 (the best plausible level). Some attention must be given to this conversion in order to obtain a correct orientation of the scale. Sometimes, the higher the score of the indicator, the lower is its performance, meaning that there is an inverse relationship between the counter domain of the indicator and the aesthetic value scale.

Partial value functions give meaning to the scores obtained through some measurement process, which implies that some value judgement should be made by a decision-maker considering its own preference system. There is no impediment in the adoption of a non-linear monotonic value function once the right procedures are used, but these issues will be presented in a more detailed manner in the following chapters.

All sets of criteria performances for Jardas stream can now be globally represented by figures 40 and 41 (see also annex 3).

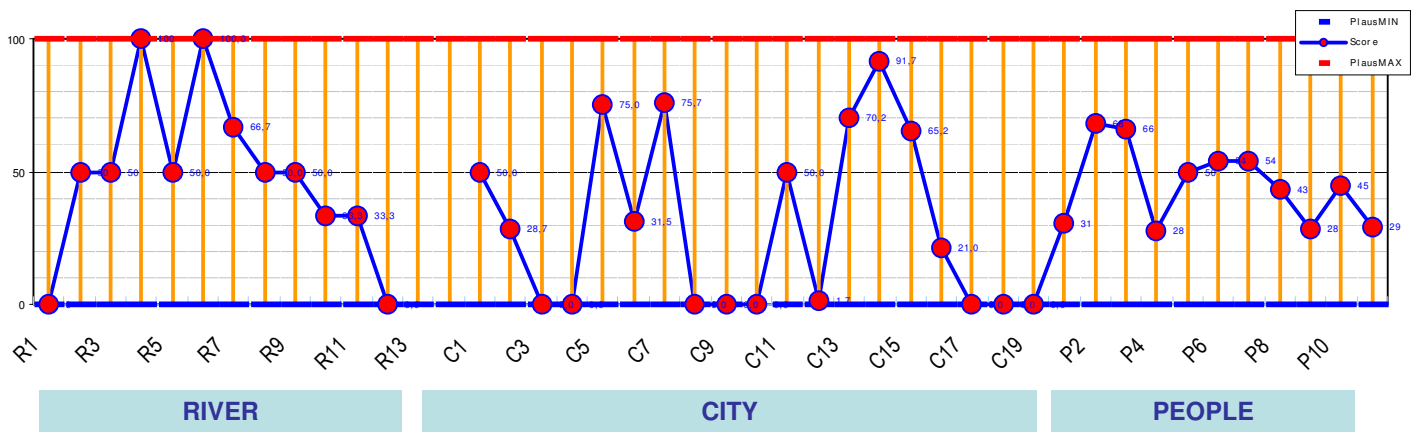


Figure 38 – Profile of aesthetical performance for Jardas Stream

This profile is the most neutral way (without considering value judgements) of showing the aesthetical performance of a watercourse, in the sense that:

- all the real scales have been standardized to a common scale (0-100), allowing comparability between performances;



- b) the profile does not express the preference system of decision-makers in the sense that criteria are not weighted yet and only linear functions have been used as simple scale transformations or normalization procedures.

This “clean look” of the aesthetical profile (not subject to any preference system) doesn’t block or stop the analysis of the results obtained. In fact, the upper and lower limits are useful bounds in order to perceive the meaning of those partial performances, how distant the river performances are away from these levels and to know the criteria improvements that can be made in rehabilitation process of the watercourse - “action space”.

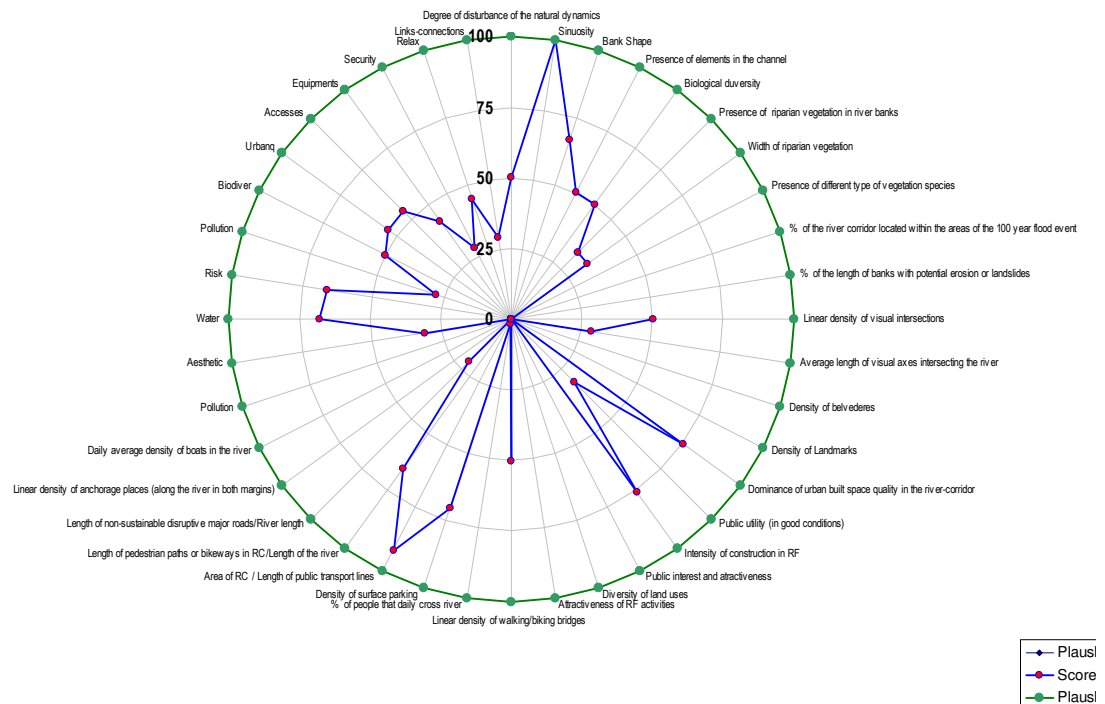


Figure 39 – Radar diagram of Jardas performances and the “action space”

In this “action space” (Figure 39) the criteria regarding ‘River Typology’ - R1,R2,R3,R4 – are not represented. These characteristics - basin size, river width, stream order or valley morphology - are intrinsic to the river itself and might not be changed by man, at least not under ordinary circumstances.



8.2 Multicriteria evaluation and classification of urban watercourses

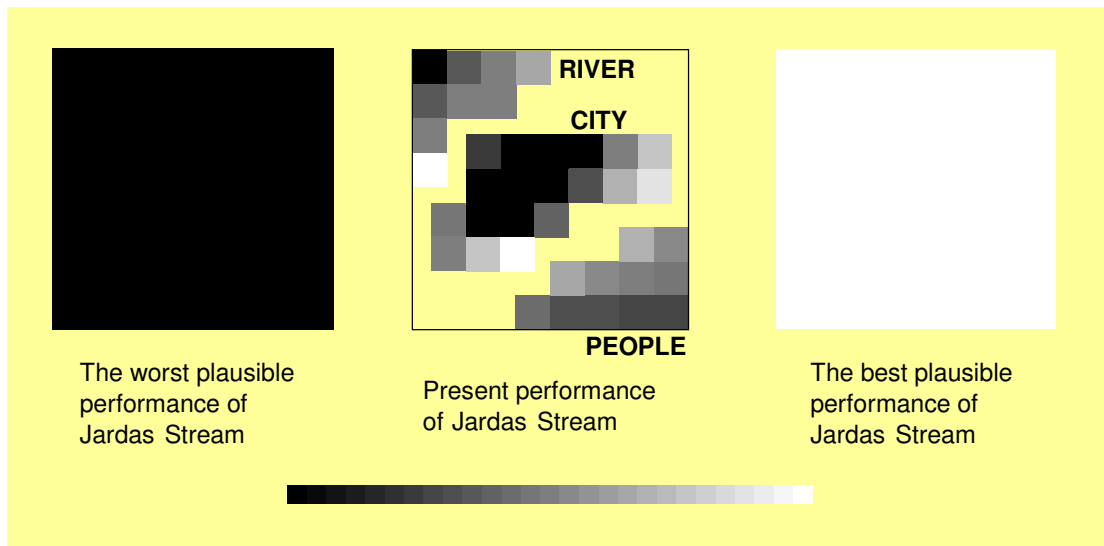


Figure 40 – Visual representation of Jardas stream performance

Figure 40 is another way of representing visually the aesthetical performance of Jardas stream using the methodology proposed. In this case a grey scale was used after the numerical conversion of the common criteria scale (0-100) to 27 levels of grey colour. Like in Figure 39 'River Typology' criteria were not represented.

This figure should be carefully read using the following protocol:

- If we accept that the white square can represent how beautiful one river will be (the plausible best aesthetical value that Jardas stream can aspire to have)...
- If we accept, also, that the same river can be so ugly and unpleasant as represented by the black square (the plausible worst aesthetical value that Jardas stream can have)...
- If we consider that some river components (elementary viewpoints) are significant and equally important in terms of their contribution to the aesthetic value of the river (the small squares in the centre of the figure, which have the same size)...



- d) ... than, we can say at present moment, that this river (Jardas stream) can be represented by the figure 41 (the small squares were grouped according to the criteria inscribed in each main topic – river, city, people).

The final result shown by this figure demonstrates that, using the set of criteria proposed, Jardas performance appears to be more close to the worst situation than the best situation which confirm the general impression of the authors of this report.

The figure is also illustrative of the rehabilitation potential existent in Jardas corridor. The average distance (average difference of shade intensity) between present performance (central square) and the best plausible situation (white square) reveals that human interventions can significantly improve the Jardas performance in several criteria.

8.2.1 Preference System

Until this stage, we avoided the use of the word “value” just because it was considered interesting to have a clear picture of the aesthetical performance of a river that can be interpreted and analysed, as neutral as possible, i.e., not influenced by the preference systems of the actors that are judging the performance of rivers. In fact, we cannot say that this is entirely true because some preferences were already revealed in the structuring stage when the experts team elected some viewpoints instead of others – or in the normalization of scales. We have written in previous chapters that the conversion process between scales used linear value functions for reasons of mathematical simplicity. But, in fact, this normalization process should express the preference system of actors or decision-makers (DM) with whom the facilitator / analyst should promote a consensual agreement as much as possible. Such preference model can contain two main components referred to in the MCDA literature:

- *Partial preferences* in terms of each individual criterion, expressing the relative importance of achieving different levels of performance for each criterion;
- *Global preferences* in terms of the aggregation model allowing inter-criteria comparisons or the combination of preferences across criteria.

Following the Multi-attribute Value Theory for multicriteria decision support, based on Value Measurement Theory (Keeney and Raiffa, 1976; Roberts, 1979; Von Winterfeldt



and Edwards, 1986), the first component – also called intra criteria information – can use Partial Value Functions. The second – also called inter-criteria information – can use weights and aggregation models to get an overall evaluation of alternatives. In our case, evaluation alternatives are all urban watercourses that may be chosen to be evaluated and/or to be rehabilitated.

The application of a valid multicriteria evaluation approach to these alternatives (watercourses), in order to get an overall valued picture of their aesthetical values, must consider those components of the preference system. This means that to convert the “Profile of aesthetical performance” of a river into a “Profile of aesthetical values”, or even an aggregated score of aesthetical value, we must include in the methodology specific procedures. These procedures will allow eliciting scores in order to express value functions; to elicit weights or scaling factors between criteria; to express an aggregation model, i.e. an overall evaluation score allowing comparing watercourses in terms of their aesthetical value. These procedures intended to consider the preference system of actors involved in the rehabilitation process of urban watercourses.

In spite of the specific characteristics of aesthetical evaluation, it seems possible to apply these multicriteria procedures, which will be tested in further steps of this work.

8.3 Classifying urban watercourses based on an aesthetic value profile approach

The methodology presented in previous chapters was fully applied to only one case study – the Jardas stream. Let us consider that the methodology will be applied to other urban watercourses in near future. It is expected that the results obtained – several aesthetic value profiles – will give different behaviours in terms of partial performances for each alternative (urban watercourses) and also different value judgements – weights and value functions. In that stage we can foresee different types of comparative analysis:

1. Determine sets of watercourses that have similar aesthetical partial profiles according to each “world” (river, city, people), or viewpoint;
2. Correlate partial and global performances with “River Morphology” characteristics, by which rivers may be influenced significantly;



3. Ordering and classifying rivers by their level of aesthetical rehabilitation potential;
4. Ordering and classifying rivers by their global level of present performance or by the performance achieved in each “world”;
5. Correlating the potential of rehabilitation with other external factors that can help to understand their present state;

Regarding the classification of aesthetical rehabilitation potential, there is the conviction that we can expect to obtain at least three different classes of rivers:

- Rivers with less artificialization levels, predominantly non urbanized in their river corridor, where natural components have been preserved by the urban development of its surrounding city;
- Rivers more strengthened by urbanization process, more artificialized, where natural components, biodiversity and diversity have been affected or even suppressed;
- Rivers in transition from one stage to the other stage that combine performances from both stages, but still having significant opportunities for rehabilitation interventions.

The methodology presented in this report tries to apply a rational approach to the aesthetic field of urban river landscapes, which is traditionally perceived as an intrinsically subjective matter. Like all methodologies, only forthcoming applications can prove its practical validity and usefulness.



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Annex 1- List of viewpoints by domain

	Fundamental viewpoint	Elementary viewpoint	Indicator Code
RIVER	River Typology	Basin size	R1
		Stream order	R2
		River width	R3
		Valley morphology	R4
	River Morphology	Degree of disturbance of the natural dynamics	R5
		Sinuosity	R6
		Bank Shape	R7
		Presence of elements in the channel	R8
	Biological Components	Biological diversity	R9
		Presence of riparian vegetation in river banks	R10
		Width of riparian vegetation	R11
		Presence of different type of vegetation species	R12
	Natural and Technological Hazards	Flood vulnerability	R13
		Bank erosion or landslide risk	R14
CITY	Urban space quality	Visual permeability	Visual contact C1
			Depth of views C2
			Width of views C3
		Density of landmarks	C4
		Built space quality	C5
		Public utility of riverfront	C6
		Intensity of construction	C7
	Cultural heritage	Cultural heritage	C8
	Activities	Diversity of uses	C9
		Attractiveness of riverfront	C10
	Accessibility	River crossing	Existence of bridges C11
			Use of bridges C12
		Surface of parking	C13
		Public transport	C14
		Walkways and bikeways	C15
		Level of disruption	C16
		Anchorage places	C17
		Use of river by boats	C18
	Pollution	Pollution	C19



	Fundamental viewpoint	Elementary viewpoint	Indicator Code
PEOPLE	River Landscape River perception	Aesthetic	P1
		Water	P2
		Biodiversity	P3
		Risk related with the perception of flood risk	P4
		Pollution	P5
			P6
		In relation to the City	P7
		Urban quality	P8
		Accessibilities	P9
		Security Infrastructures	P10
			P11
		The dimensions identified with the people relationship with the river	
		Relax	P12
		Attachment	P13
	Place Identity	Continuity	P14
		Self-esteem	P15
		Self-efficacy	P16
		Distinctiveness	P17
	Restorative Capacity	Being away	P18
		Fascination	P19
		Extent	P20
		Compatibility	P21



Annex 2 - Questionnaires



The Technical Institute of Lisbon and the University of Évora are undertaking a study concerning the importance of rivers and streams in urban areas. This study is part of a European Project, called URBEM (Urban River Basin Enhancement Methods). The main objective of this project is to develop techniques and methodologies to improve rivers in urban areas.

The city of Cacém was chosen to test the methodology proposed in this project. Therefore the collaboration of the Lisbon' residents is needed in answering this questionnaire. The answers are, obviously, confidential.

Thank you.

A. GENERAL QUESTIONS

1. How long have you been living in Cacém? _____ years

2. What was the main reason for choosing to live in Cacém?

- ☐ Family/friends live here ☐ Convenience (near the work, school, ...)
☐ Housing prices ☐ Natural environment ☐ Others _____

3. Where do you work/study or where you stay during the day?

- ☐ Cacém ☐ Lisboa ☐ Other place _____

4. Where do you usually spend your free time (weekends)?

- ☐ Cacém ☐ Lisboa ☐ Other place _____

5. What do you usually do on your free time (weekends)?

- ☐ Walking ☐ Doing sports ☐ Shopping (shopping centre)

Other _____

6. Indicate two or three words that, in your opinion, characterize the river that crosses your city?

1. _____

2. _____

3. _____



B. ACTIVITIES IN THE RIVER AREA

Please tell us what activities you perform that are linked to the river. Answer by indicating the number that best reflects your answer.

	1 Never	2 Rarely	3 Sometimes	4 Often	5 Very Often
	1	2	3	4	5
1. Shopping near the river	☐	☐	☐	☐	☐
2. Using public services (banks, post office, ...) near the river	☐	☐	☐	☐	☐
3. Going to a café or restaurant	☐	☐	☐	☐	☐
4. Going to a bar or a disco	☐	☐	☐	☐	☐
5. Participating in cultural events	☐	☐	☐	☐	☐
6. Going to museums, exhibitions in the river area	☐	☐	☐	☐	☐
7. Doing sports (like jogging, biking, playing soccer)	☐	☐	☐	☐	☐
8. Watching sport events	☐	☐	☐	☐	☐
9. Walking	☐	☐	☐	☐	☐
10. Bird watching	☐	☐	☐	☐	☐
11. Watching others	☐	☐	☐	☐	☐
12. Picnicking	☐	☐	☐	☐	☐
13. Reading	☐	☐	☐	☐	☐
14. Thinking	☐	☐	☐	☐	☐
15. Going for a boat trip	☐	☐	☐	☐	☐
16. Fishing	☐	☐	☐	☐	☐
17. Meeting people	☐	☐	☐	☐	☐
18. Contacting nature	☐	☐	☐	☐	☐



C. RIVER PERCEPTION

To your knowledge, does this river have any of the following characteristics? Indicate using the same the five-point scale.

	Nothing			Very	
1. Beautiful	☐	☐	☐	☐	☐
2. Clean water	☐	☐	☐	☐	☐
3. Interesting	☐	☐	☐	☐	☐
4. Pleasant	☐	☐	☐	☐	☐
5. Peaceful	☐	☐	☐	☐	☐
6. Flood Hazards	☐	☐	☐	☐	☐
7. Water pollution	☐	☐	☐	☐	☐
8. Smelly	☐	☐	☐	☐	☐
9. Noisy	☐	☐	☐	☐	☐
10. Pests/ Mosquitos	☐	☐	☐	☐	☐
11. Dumping/garbage in the water	☐	☐	☐	☐	☐
12. Dumping/garbage on the river banks	☐	☐	☐	☐	☐
13. Vegetation on the banks	☐	☐	☐	☐	☐
14. Animals (fish and birds)	☐	☐	☐	☐	☐
15. Welcoming area	☐	☐	☐	☐	☐
16. Lack of accessibility	☐	☐	☐	☐	☐
17. Bad accessibility	☐	☐	☐	☐	☐
18. Lack of public transports	☐	☐	☐	☐	☐
19. Lack of parking	☐	☐	☐	☐	☐
20. Lack of benches	☐	☐	☐	☐	☐
21. Not enough shade	☐	☐	☐	☐	☐
22. Safe area (without delinquency)	☐	☐	☐	☐	☐
23. Lack of cafés and restaurants	☐	☐	☐	☐	☐
24. Lack of commerce	☐	☐	☐	☐	☐
25. Lack of green areas	☐	☐	☐	☐	☐
26. Lack of sport infrastructures	☐	☐	☐	☐	☐
27. Degraded area	☐	☐	☐	☐	☐
28. Dirty area	☐	☐	☐	☐	☐
29. Allows to relax	☐	☐	☐	☐	☐
30. Allows to be more linked to the nature	☐	☐	☐	☐	☐



- | | | | | | |
|---|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| 31. Allows spending more time in this city | ☐ | ☐ | ☐ | ☐ | ☐ |
| 32. Allows to be more connected to my city | ☐ | ☐ | ☐ | ☐ | ☐ |
| 33. Allows to be more connected to the inhabitants of my city | ☐ | ☐ | ☐ | ☐ | ☐ |
| 34. Allows knowing better the culture of this city | ☐ | ☐ | ☐ | ☐ | ☐ |



D. PREFERENCES FOR THE FUTURE

Below, a range of potential modifications in the river, riverfront and city are listed. Please, tell us, in your opinion, what is more important to be changed.

Choose the four most important aspects that can be changed

1. River

Rank by level of importance

- | | |
|--|--------------------------|
| a. Cleaning the river | ☐ |
| b. Flood hazards resolution | ☐ |
| c. Water Cleanliness (garbage) | ☐ |
| d. Bank's Cleanliness (garbage) | ☐ |
| e. Taking care of the river banks | ☐ |
| f. Improvement of the river fauna | ☐ |
| g. Taking care of the riverbank vegetation | ☐ |
| h. Construction of bridges | ☐ |
| i. Placing of anchorage | ☐ |
| j. Construction of yacht clubs | ☐ |
| k. Rent boat | ☐ |
| l. Others _____ | |

2. Riverfront

Rank by level of importance

- | | |
|--|--------------------------|
| a. New green areas near the river | ☐ |
| b. New pedestrian paths | ☐ |
| c. New bike paths | ☐ |
| d. New sport infrastructures (e.g. courts,...) | ☐ |
| e. New cultural spaces (e.g. museums, galleries, theatres,...) | ☐ |
| f. New cafés and restaurants | ☐ |
| g. New bars and discos | ☐ |
| h. New shops | ☐ |
| i. Increase the places to be seated | ☐ |
| j. Increase shaded areas | ☐ |
| k. Increase surveillance | ☐ |
| l. Cleanliness | ☐ |
| m. Others _____ | |

3. City

Rank by level of importance

- | | |
|-------------------------------------|--------------------------|
| a. Better transports | ☐ |
| b. More shopping centres | ☐ |
| c. More green areas | ☐ |
| d. More cultural infrastructures | ☐ |
| e. More areas for sports activities | ☐ |
| f. Others _____ | |



E. Below you will find a range of statements with which you may agree or disagree. Please indicate the degree to which you agree with the following statements (choose the number that best reflects your answer).

1	2	3	4	5
Not agree				Agree completely

	1	2	3	4	5
For me, this city is more beautiful than the others	☐	☐	☐	☐	☐
I like better to live in this city than in the others	☐	☐	☐	☐	☐
This river is more beautiful than the others	☐	☐	☐	☐	☐
This river gives the city a sense of uniqueness	☐	☐	☐	☐	☐
I feel like a citizen of Lisbon	☐	☐	☐	☐	☐
My main memories are connected with this city	☐	☐	☐	☐	☐
Contemplating the river is part of my life	☐	☐	☐	☐	☐
I have many memories related with this river	☐	☐	☐	☐	☐
I am proud to live in this city	☐	☐	☐	☐	☐
I like to think that I am a citizen of Lisbon	☐	☐	☐	☐	☐
I am proud in living near this river	☐	☐	☐	☐	☐
I like to think that I live near the Tagus River	☐	☐	☐	☐	☐
I have advantages in living in this city	☐	☐	☐	☐	☐
Living in Lisbon offers me a more relaxing life style	☐	☐	☐	☐	☐
I have advantages in living near this river	☐	☐	☐	☐	☐
Living next to the river provides me a feeling of tranquillity	☐	☐	☐	☐	☐



F. Below you will find a range of statements about the river that crosses your city with which you may agree or disagree. Please indicate the degree to which you agree with the following statements choosing the number that best reflects your answer.

	1 Not agree	2	3	4	5 Agree completely
	1	2	3	4	5
1. Being here helps me to relax	☐	☐	☐	☐	☐
2. This place is charming	☐	☐	☐	☐	☐
3. It is a confusing place	☐	☐	☐	☐	☐
4. Spending time here gives me a break in my everyday routine	☐	☐	☐	☐	☐
5. This place is boring	☐	☐	☐	☐	☐
6. This place is chaotic	☐	☐	☐	☐	☐
7. I identify myself with this place	☐	☐	☐	☐	☐
8. This place (helps me) allows me to relax	☐	☐	☐	☐	☐
9. I would like to spend more time here	☐	☐	☐	☐	☐
10. Everything here is coherent	☐	☐	☐	☐	☐
11. I like to be in places like this one	☐	☐	☐	☐	☐
12. When I am here I do not need to think of my responsibilities	☐	☐	☐	☐	☐
13. I would like to come here often	☐	☐	☐	☐	☐
14. Everything here is in harmony	☐	☐	☐	☐	☐
15. I feel well here	☐	☐	☐	☐	☐
16. Coming here helps me to forget my obligations	☐	☐	☐	☐	☐
17. There is nothing special to see here	☐	☐	☐	☐	☐
18. This place is very much like me	☐	☐	☐	☐	☐
19. This place helps me to rest	☐	☐	☐	☐	☐

G. DEMOGRAPHY		Date - / /03	Nº

Age - _____			
Sex -	☐ Female	☐ Male	
Educational Level -	☐ Primary school	☐ High school- first level	
	☐ High school- second level	☐ Graduate	
Residential area:	☐ Area 1 (first and second block close the river)	☐ Area 2	



Annex 3 - Indicators performance

Code Indicator		Real Values			Standardized values		
		Plausible minimum	Present score	Plausible Maximum	Units	PlausMIN	PlausMAX
R5	Degree of disturbance of the natural dynamics	1	2	3	Qualit	0	100
R6	Sinuosity	1	3	3	Qualit	0	100
R7	Bank Shape	1	3	4	Qualit	0	100
R8	Presence of elements in the channel	1	2	3	Qualit	0	100
R9	Biological duversity	1	2	3	Qualit	0	100
R10	Presence of riparian vegetation in river banks	1	2	4	Qualit	0	100
R11	Width of riparian vegetation	1	2	4	Qualit	0	100
R12	Presence of different type of vegetation species	1	1	3	Qualit	0	100
R13	% of the river corridor located within the areas of the 100 year flood event	0		100	%	0	100
R14	% of the length of banks with potential erosion or landslides	0		100	%	0	100
C1	Linear density of visual intersections	0	4,12	8,23	km/km	0	100
C2	Average length of visual axes intersecting the river	0	107,95	376,36	m	0	100
C3	Density of belvederes	0	0	0,02	n/Ha	0	100
C4	Density of Landmarks	1	4	5	n/Ha	0	100
C5	Dominance of urban built space quality in the river-corridor	0	50	100	%	0	100
C6	Public open areas (in good conditions)/ private	0	1,26	4	%	0	100
C7	Gross floor area of construction / net surface of RF	0	1,46	6	m2/m2	0	100
C8	Public interest and attractiveness	1	1	7	Q	0	100
C9	Diversity of uses	1	1	5	Q	0	100
C10	Attractiveness of RF activities	1	1	5	Q	0	100
C11	Linear density of walking/biking bridges	0	2,06	4,12	n/km	0	100
C12	% of people that daily cross river	0	17,11	1000,00	p/res.	0	100
C13	Density of surface parking	0	0,3	1	n/Ha	0	100
C14	Area of RC / Length of public transport lines	20,97	35,68	198,40	Ha/km	0	100

Code	Indicator	Real Values			Standardized values			
		Plausible minimum	Present score	Plausible Maximum	Units	PlausMIN	Score	PlausMAX
C15	Length of pedestrian paths or bikeways in RC/Length of the river	0	3,26	5	km/km	0	65,2	100
C16	Length of non-sustainable disruptive major roads/River length	0	1,58	2	km/km	0	21,0	100
C17	Linear density of anchorage places (along the river in both margins)	0	0	4	n/km	0	0,0	100
C18	Daily average density of boats in the river	0	0	0,13	n/Ha	0	0,0	100
C19	Pollution	4	1	1		0	0	100
P1	Aesthetics	1	2,23	5		0	31	100
P2	Water	1	3,72	5		0	68	100
P3	Risk	1	3,64	5		0	66	100
P4	Pollution	1	2,11	5		0	28	100
P5	Biodiversity	1	2,99	5		0	50	100
P6	Urban	1	3,15	5		0	54	100
P7	Accesses	1	3,15	5		0	54	100
P8	Equipments	1	2,72	5		0	43	100
P9	Security	1	2,13	5		0	28	100
P10	Relax	1	2,79	5		0	45	100
P11	Links-connections	1	2,17	5		0	29	100

Annex 4 – Scales of Descriptors and Indicators



1. RIVER

Fundamental viewpoint	Elementary viewpoint	Indicator Code
River Typology	Basin size	R1
	Stream order	R2
	River width	R3
	Valley morphology	R4
River Morphology	Degree of disturbance of the natural dynamics	R5
	Sinuosity	R6
	Bank Shape	R7
	Presence of elements in the channel	R8
Biological Components	Biological diversity	R9
	Presence of riparian vegetation in river banks	R10
	Width of riparian vegetation	R11
	Presence of different type of vegetation species	R12
Natural and Technological Hazards	Flood vulnerability	R13
	Bank erosion or landslide risk	R14

RIVER TYPOLOGY

Eco-regions (Water Framework Directive, 2000)

1. Iberic-Macaronesian region; 2. Pyrenees; 3. Italy, Corsica and Malta; 4. Alps; 5. Dinaric western Balkan; 6. Hellenic western Balkan; 7. Eastern Balkan; 8. Western highlands; 9. Central highlands; 10. The Carpathians; 11. Hungarian lowlands; 12. Pontic province; 13. Western plains; 14. Central plains; 15. Baltic province; 16. Eastern plains; 17. Ireland and Northern Ireland; 18. Great Britain; 19. Iceland; 20. Borealic uplands; 21. Tundra; 22. Fenno-Scandian shield; 23. Taiga; 24. The Caucasus; 25. Caspic depression

based on:

R1 - basin size

Class	Scale
1	Very small (< 50 km ²)
2	Small (50 to 100 km ²)
3	Medium (100 to 1.000 km ²)
4	Large (1.000 to 10.000 km ²)
5	Very large (>10.000 km ²)



R2 - stream order

Class	Scale
1	1st and 2nd order
2	3rd and 4th order
3	>5th order

R3 - river width

Class	Scale
1	Non existent (culverted)
2	Narrow (0 – 5m)
3	Medium (5-20m)
4	Large (20 – 200m)
5	Very large (more than 200 m)

R4 - valley morphology

Class	Scale	Valley Profile Type
1	Large, broad floodplain	
2	Asymmetric	
3	U-shaped	
4	V-shaped	

This subset of River Typology characteristics is intrinsic to a river itself (the river that is being evaluated) and might not be changed by man, at least not under ordinary circumstances.

RIVER MORPHOLOGY



R5 - Degree of disturbance of the natural dynamics

Class	Scale	Characteristics
1	Highly disturbed	- Very artificial - Channelized - Concrete bed and banks
2	Moderately disturbed	- Artificial - Channelized or concrete bed or banks
3	Undisturbed	Close to natural conditions

R6 - Sinuosity

Class	Scale
1	Straight ($IS < 1.05$)
2	Sinuuous (IS between $1.05 - 1.5$)
3	Meandering ($IS > 1.5$)

Index of sinuosity

$$Is = 100(Cc - Cv / Cc) + 100(Cv - Z / Cc)$$

Cc: length of riverbed

Cv: length of valley

Z: distance between the limits of the reach

(Mansikkaniemi, in Christofolletti, 1991)

R7 - Bank Shape

Class	Scale	Characteristics
1	Culvert watercourses	
2	Vertical banks (walls) and trapezoidal watercourses	    
3	Asymmetric banks (wall and levee)	
4	Natural banks	

R8 - Presence of elements in the channel



Class	Scale
1	Non existent in a 500 meters reach
2	1 or 2 sets of elements present in a 500 meters reach
3	More than 3 sets of elements present in a 500 meters reach or presence of very relevant elements

BIOLOGICAL COMPONENTS

R9 – Biological diversity

Class	Scale
1	River corridor highly disturbed or artificial
2	Moderately disturbed
3	Undisturbed and with highly biological interest

R10 - Presence of riparian vegetation in river banks

Class	Scale
1	Absence of vegetation
2	Presence of herbaceous vegetation
3	Presence of sparse trees in one or in both margins
4	Presence of well developed and continuous riparian vegetation in one or in both margins

R11 - Width of riparian vegetation

Class	Scale
1	Absence of vegetation
2	Narrow (0-12 meters)
3	Medium (12 – 20 meters)
4	Large (>20 meters)

R12 - Presence of different type of vegetation species

Class	Scale
1	Low variety of species
2	Presence of 1 to 5 species types
3	Presence of high variety of species types, i.e. more than 5 species with different colours, stand age, flowering season, foliage type

NATURAL AND TECHNOLOGICAL HAZARDS



R13 - Flood vulnerability

Indicator	Description
R13 % of the river corridor affected by flood event	Surface of river corridor located within the areas of the 100 year flood event / Surface of RC * 100 [%]

R14 - Bank erosion or landslide risk

Indicator	Description
R13 % of banks with potential erosion or landslides	Length of banks in both margins with potential erosion or landslides / Length of banks * 100



2. CITY

Fundamental viewpoint	Elementary viewpoint	Indicator Code
Urban space quality	Visual permeability	C1
	Visual contact	C2
	Depth of views	C3
	Width of views	C4
	Density of landmarks	C5
	Built space quality	C6
	Public utility of riverfront	C7
Cultural heritage	Intensity of construction	C8
Cultural heritage	Cultural heritage	C9
Activities	Diversity of uses	C10
	Attractiveness of riverfront	C11
Accessibility	River crossing	C12
	Existence of bridges	C13
	Use of bridges	C14
	Surface of parking	C15
	Public transport	C16
	Walkways and bikeways	C17
	Level of disruption	C18
	Anchorage places	C19
Pollution	Use of river by boats	C20
Pollution	Pollution	C21

URBAN SPACE QUALITY

Visual permeability

C1 – Visual contact

C2 - Depth of views

C3 - Width of views

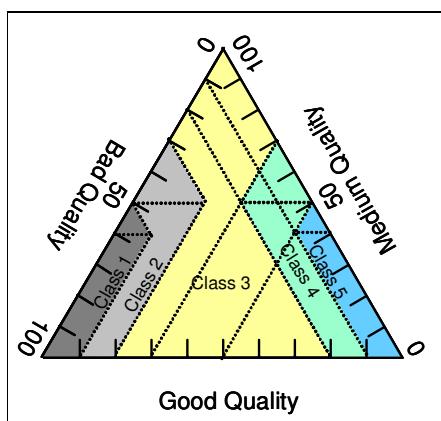
Indicator	Description
C1 Linear density of visual intersections	Number of visual intersections/river length (Km)
C2 Average length of visual axes with the river	Total length of visual axes/number of visual axes intersecting the river
C3 Number of belvederes	Number of belvederes/Area of River corridor (km ²)



C4 - Density of landmarks

Indicator	Description
C4 Density of landmarks	Number of landmarks/Area of River Corridor (Km2)

C5 - Built space quality



Class	Scale
1	$GQ < 10\% \wedge BQ > 50\%$
2	$GQ < 20\% \wedge BQ > 30\%$
3	Remaining region
4	$GQ > 30\% \wedge BQ < 20\%$
5	$GQ > 50\% \wedge BQ < 10\%$

C6 - Public utility of riverfront

Indicator	Description
C6 Rate of public open areas / private areas	Surface of public open areas in good condition / surface of private areas

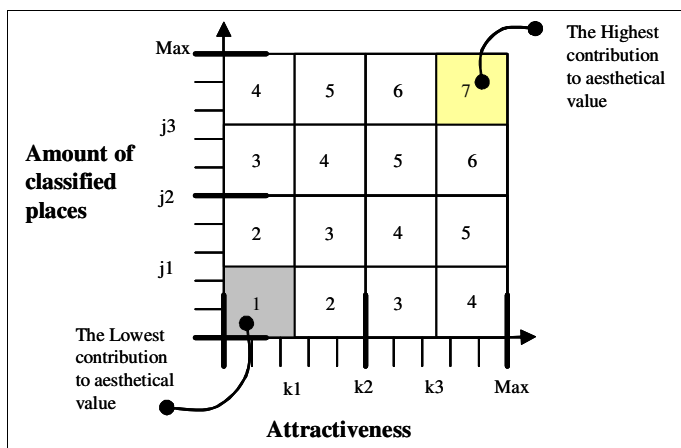
C7 - Intensity of construction

Indicator	Description
C7 Intensity of construction in the riverfront	Gross floor area of construction / net surface of riverfront area [m2/m2]

CULTURAL HERITAGE

C8 - Cultural heritage

- Public interest
- Attractiveness



Class	Scale
1	Very low or no contribution
2	Low
3	Medium/Low
4	Medium
5	Medium /High
6	High
7	Very High contribution (high amount of classified places and high attractiveness)

ACTIVITIES

C9 - Diversity of uses

Class	Scale
1	Predominantly urban with dominance of one type of activities/ uses
2	Predominantly urban with diversity of urban activities
3	Partially urbanized with preponderance of one single class of activities
4	Partially urbanized with diversity of urban activities
5	Non urbanized or predominantly non urban

C10 - Attractiveness of riverfront

Class	Scale
1	Very Low attractiveness
2	Low attractiveness
3	Medium attractiveness



4	High attractiveness
5	Very High attractiveness

Proxy indicator : real estate value – the average price of m² in riverfront .

(a more sustainable human capital measurement can also be considered as an alternative proxy)

ACCESSIBILITY

River crossing

C11 - Existence of bridges

C12 - Use of bridges

Indicator	Description
C11 Linear density of walking / biking bridges	Amount of bridges/river length [b/Km]
C12 % of people that daily cross the river	Amount of people (or bikes) that daily cross bridges / population in river corridor [p/pop]

C13 - Surface of parking

Indicator	Description
C13 Density of parking surface	Amount of visible public and private car parking places/river corridor area in hectares [p/ha]

C14 - Public transport

Indicator	Description
C14 Public transport services	Area of river corridor/length of public transport lines [ha/Km]

C15 - Walkways and bikeways

Indicator	Description
C15 Soft modes infrastructures	Length of pedestrian paths [Km/Km]

C16 - Level of disruption

Indicator	Description
C16 Non-sustainable disruptive ways	Length of non-sustainable disruptive major roads, highways or railways/river length [Km/Km]



C17 - Anchorage places

Indicator	Description
C17 Linear density of anchorage points	Amount of anchorage points/length of river corridor [ap/Km]

C18 - Use of river by boats (navigability)

Indicator	Description
C18 Density of boats in the river	Daily average number of boats navigating in the river/water surface [n/Km ²]

POLLUTION

C20 – Pollution

Class	Scale
1	Good
2	Fair
3	Poor
4	Bad

Methodology proposed by Environment Agency (“General Quality Assessment of rivers-aesthetics”, 2000).



3. PEOPLE

Fundamental viewpoint	Elementary viewpoint		Indicator Code
Public perception	In relation to the River	Aesthetic	P1
		Water	P2
		Biodiversity	P3
		Risk related with the perception of flood risk	P4
		Pollution	P5
	In relation to the City	Urban quality	P6
		Accessibilities	P7
		Security Infrastructures	P8
	The dimensions identified with the people relationship with the river	Relax	P9
		Attachment	P10
Place Identity	Continuity		P11
	Self-esteem		P12
	Self-efficacy		P13
	Distinctiveness		P14
Restorative Capacity	Being away		P15
	Fascination		P16
	Extent		P17
	Compatibility		P18

PUBLIC PERCEPTION

Dimensions	Questions of the questionnaire
Aesthetic	1
Water	10
Biodiversity	14,15
Risk	6
Pollution	2,7, 8, 11, 12, 13, 29
Urban quality	3, 4, 9, 28
Accessibilities	17, 18, 19
Infrastructures	20, 21, 22, 24, 25, 26, 27
Security	23
Relax	5, 15, 30
Attachment	31, 32, 33, 34, 35

(see Annex 2 – Part C of the questionnaire)



Characteristics of Public Perception are classified in a five-point scale

- 1 – Nothing
- 2 –
- 3 –
- 4 –
- 5 – Very

PLACE IDENTITY

Dimensions	Questions of the questionnaire
Distinctiveness	1, 2, 3, 4
Continuity	5, 6, 7, 8
Self-esteem	9, 10, 11, 12
Self-efficacy	13, 14, 15, 16,

(see Annex 2 – Part E of the questionnaire)

A set of statements classified by a numerical code that best reflects the opinion of people:

- 1 – Not agree
- 2 –
- 3 –
- 4 –
- 5 –Agree completely

RESTORATIVE CAPACITY

Dimensions	Questions of the questionnaire
Being away	1, 4, 8, 12, 16, 19
Fascination	2, 5, 9, 13, 17
Extent	3, 6, 10, 14
Compatibility	7, 11, 15, 18

(see Annex 2 – Part F of the questionnaire)

A set of statements classified by a numerical code that best reflects the opinion of people:

- 1 – Not agree
- 2 –
- 3 –
- 4 –
- 5 –Agree completely

Part II – Application of the Methodology: three case studies in Slovenia

9. INTRODUCTION

Environmental goals of the European Water Framework Directive foresee the restoration or rehabilitation of all surface water bodies by the year 2015. For management and control of enhancement of the state of European rivers, the methods for chemical, biological, hydromorphological valuation of the river environment will be needed. Some of them are well-known and are being used already. In the context of the modern care of the river environment, rivers in urban environment areas can be considered as a special category. Urban rivers are particular from at least two points of view: narrowness of river corridor inside the urban tissue and also a variety of uses inside the urban river corridor for everyday and leisure activities of city population. That is the reason why the determination of urban river corridors, which should be prioritised for the implementation of revitalisation or rehabilitation measures, also requires the analysis of the aesthetic value and aesthetic potential of urban rivers besides the already mentioned methods for chemical, biological and hydromorphological state of the river environment. Undoubtedly, the aesthetic value is an important element in the process of renewal and rehabilitation of rivers, certainly, it is the element that is usually noticed first.

Partner from Portugal has in co-operation with other partners drawn up a draft method for a combined expert and survey assessment of the aesthetic value of urban rivers. The draft method is based on three groups of viewpoints: »river«, »city«, and »people«, which combined provide a basis for the assessment of the aesthetic value of urban rivers. The aim of the methodology for the classification of the aesthetic value was to establish the value and potential of aesthetics of urban rivers in order to identify the priorities for renewal and rehabilitation. The terms renewal and rehabilitation are commonly connected with interventions into the aquatic environment, which would help mitigate water ecosystem degradation and improve its ecological (hydromorphological) state.



10. CASE STUDIES

In Slovenia, the method was tested on three urban rivers in Ljubljana: i.e. on the Ljubljanica, Mali Graben, and Glinscica. In the course of testing, several strengths and weaknesses of the proposed method were identified.

By selecting three test rivers, we set out to test the possibilities of application of the method for quality assessment of the aesthetic value of urban rivers of different stream orders regarding river typology. The length of the study reaches was 2,600 m on the Ljubljanica, 2,150 m on the Glinscica, and 3,750 m on the Mali Graben river. The test reach on the Ljubljanica river includes the city centre, from Spica in the Trnovo area to Ambrož Square. The test reach of the Mali Graben stretches from the Dolgi most bridge to Barjanska Road, along the southern edge of the city. The test reach of the smallest stream, the Glinsica, reaches from Brdnikova Street to Cesta na Brdo Road in the area between Rozna dolina, Roznik and Vic area. Owing to intensive urbanisation, the stream corridor areas of the test reaches were characteristically heavily modified.

11. RESULTS

11.1 THE LJUBLJANICA RIVER

Study area description

The urban development of the city of Ljubljana is historically linked with the Ljubljanica river. In the design of the city, the Ljubljanica river creates a linear landscape element, furthermore, the river corridor provides an important ecological element. Numerous spatial activities and uses connected with the Ljubljanica river have been developed in the areas around the river. With the development of the medieval city of Ljubljana in the area between the Ljubljanica river and the Castle hill, the Ljubljanica river has become a significant design element of future urban planning. The augmentation of needs of the city population has provoked the regulations of the river banks and diversions of the river flow. Nevertheless, the Ljubljanica river has kept its role as a central space of the urban tissue. Through history, the Ljubljanica river has had numerous roles. The river has been



used as an important transport line, port, entertainment area, market place, and also as a conduit for sewer and refuse. In the 19th century, the Ljubljanica river and surrounding areas provided a continuously attractive social space. Between the 1st and 2nd World Wars, the open city bathing area was arranged in the area, which is nowadays called Livada. The bathing site remained open until the late fifties of the 20th century. The river banks were grassy with gentle slope and thus easily accessible. Due to the very dense mediaeval city structure, the Ljubljanica river corridor was the most important open space of the mediaeval urban area.

At the entrance to the city, the Ljubljanica river had low and unfortified banks, and the area was subjected to floods. To reduce the flood risk, a diversion channel was excavated in the period from 1772 to 1780 between the Castle hill and the hill of Golovec according to the plan of a Jesuit, Gabriel Gruber. Later, the regulation and deepening of the Ljubljanica river channel was carried out in the reach of the river through the Ljubljana city centre. The image of the river changed drastically between 1913 and 1918, when banks on the river section through the city were heavily reinforced with high concrete walls. The plan for regulation was developed by engineer Alfred Keller. The natural Ljubljanica river channel was transformed into a ditch, which alienated the river body from the city life. The monotony of the river channel regulation was changed by architect Jože Plečnik. He gave a new identity to the river and to the city as a whole.

River typology

Regarding the size, the basin of the Ljubljanica area is in the middle class (100 to 1.000 km²). The Ljubljanica river catchment area comprises 785.9 km². According to the Strahler stream ordering system, the Ljubljanica river is a 3rd order stream. The average width of the active cross section and the average bankful width range is between 20–200 m. The Ljubljanica river channel passes at the foot of the Castle hill; the valley morphology type is asymmetric. The study areas includes a large part of the old city centre with a high density of buildings (

Figure 41). The length of the study reach is 2600 m.

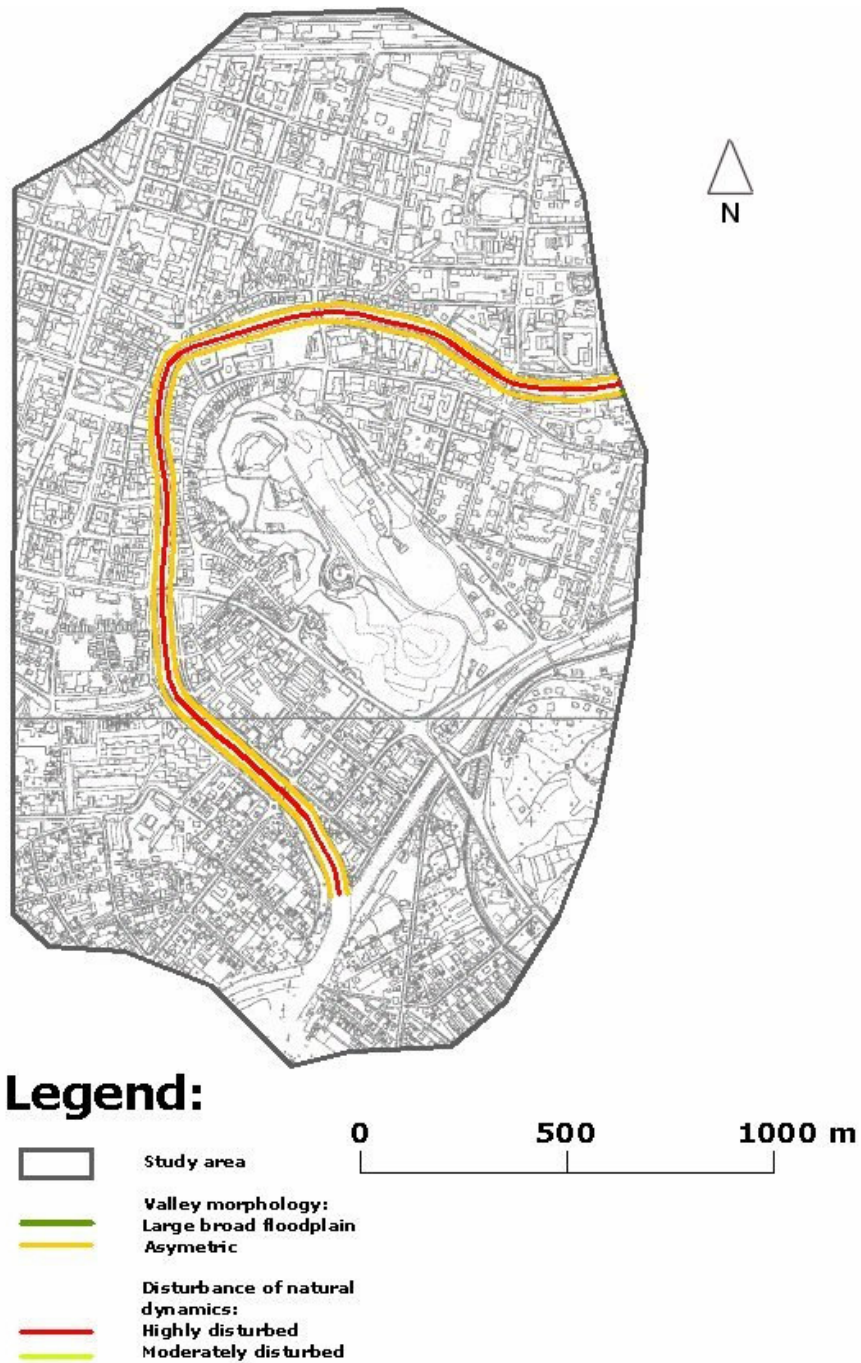


Figure 41 - Ljubljana



River morphology

The degree of the disturbance of natural dynamic processes in the Ljubljana river corridor is high due to the high building density in the city centre. The river channel was deepened several times, banks are reinforced with almost vertical concrete walls. On short subsections, the banks are grassed above the concrete walls (**Error! Reference source not found.**).

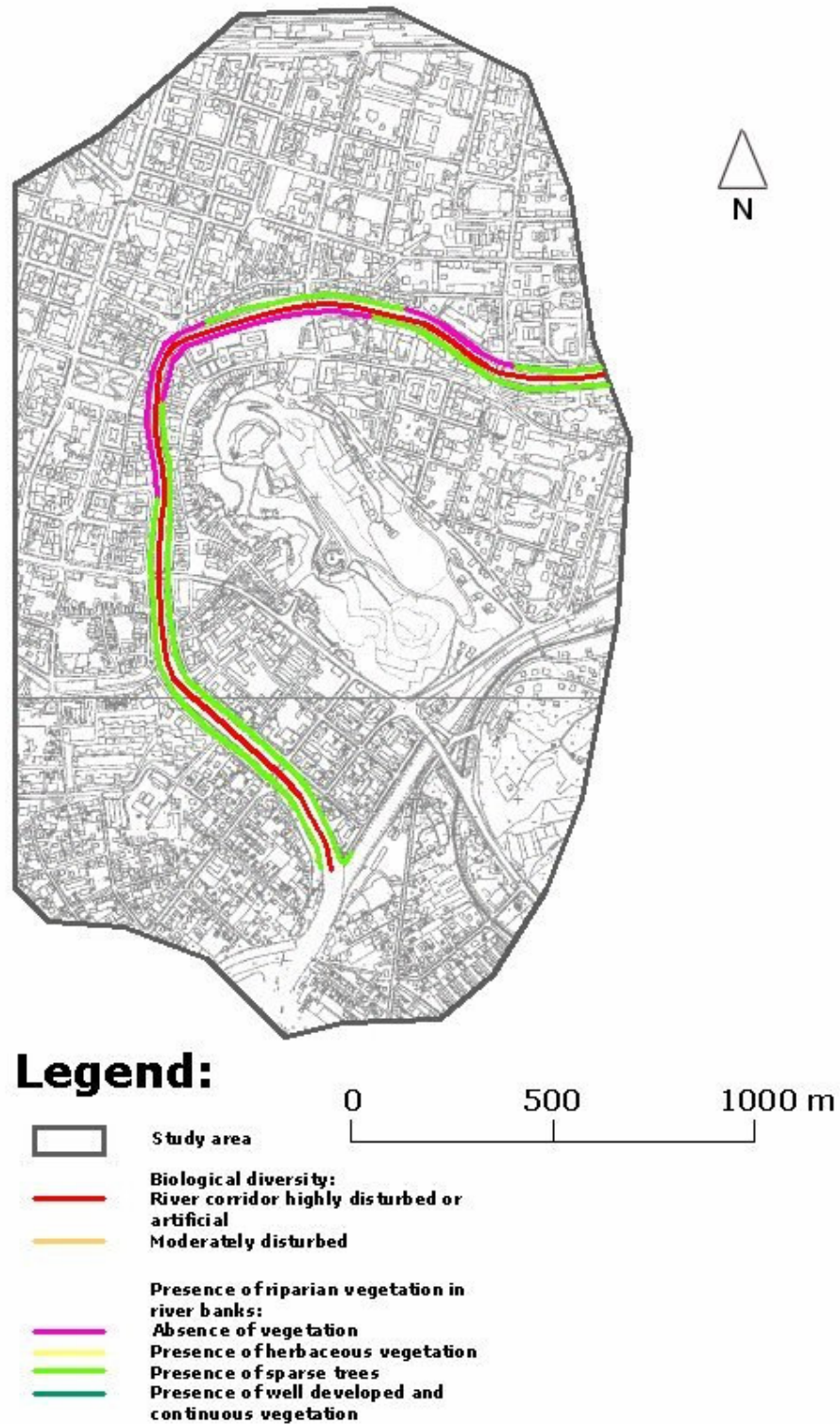


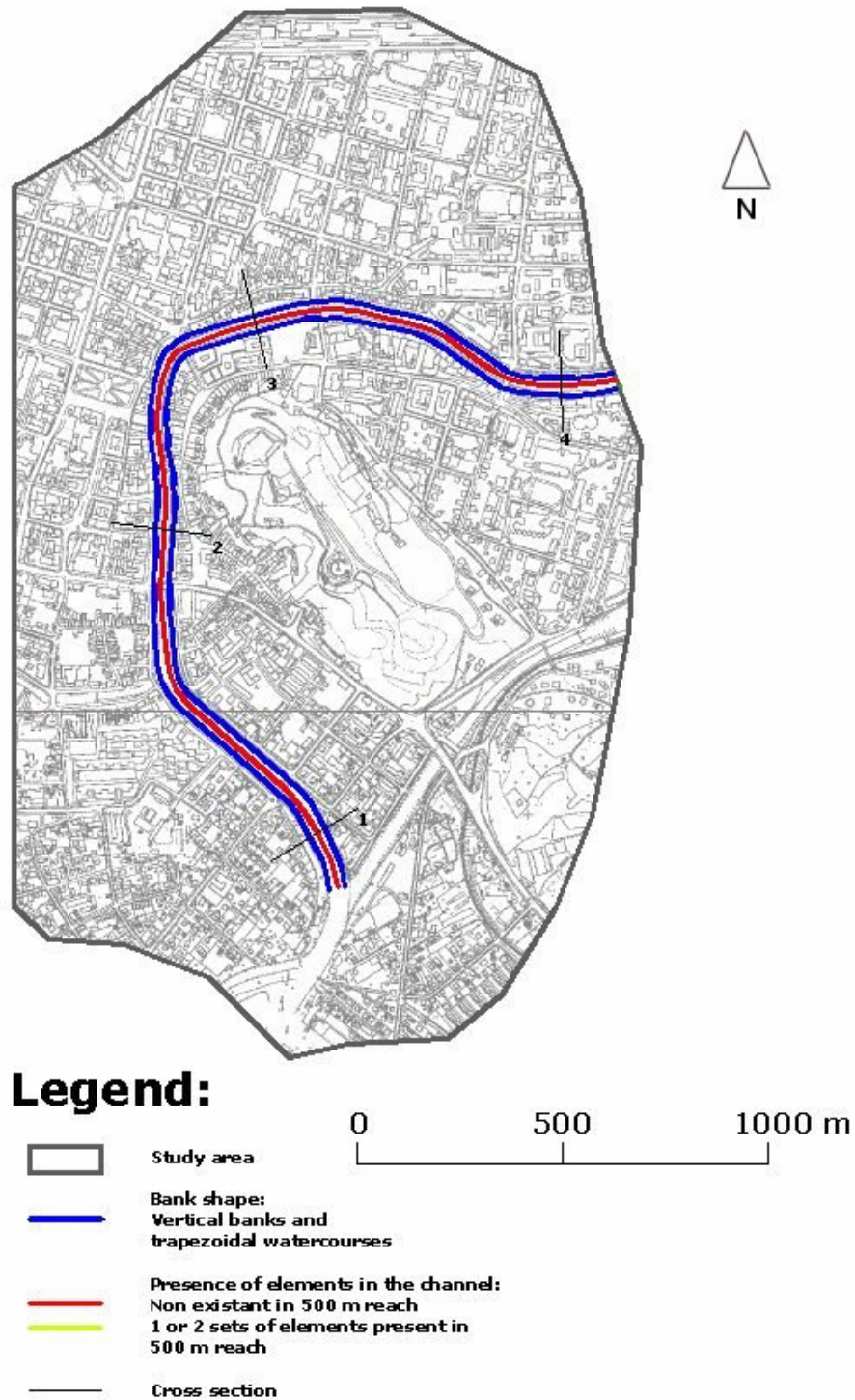
Figure 42



In the study reach, some individual trees and lines of trees are present on the top of the banks. Inside the narrow city centre, the riparian vegetation is completely absent. Local sinuosity of the river was diminished with the regulation works (Figure 44).



Figure 43

**Figure 44**



Along the entire study reach, the cross section is of trapezoidal shape with unchanged slope and bank arrangements. The hydro-morphological elements of the natural river channels (runs, pools, riffles, weirs, asymmetric cross sections) were removed from the stream channel during the regulation works in the 19th century.

Biological components

The Ljubljana river corridor has undergone intensive regulation works combined with the development of the urban tissue in the entire study reach. In some subsections, buildings were situated right next to the river channel. As mentioned, the riparian vegetation mainly includes sparse trees; only short subsections of the river channel are partly shaded. The width of the riparian vegetation is in a range of 0–12 m. The variety of species of the riparian and aquatic vegetation is very low (Figure 42).



Figure 45

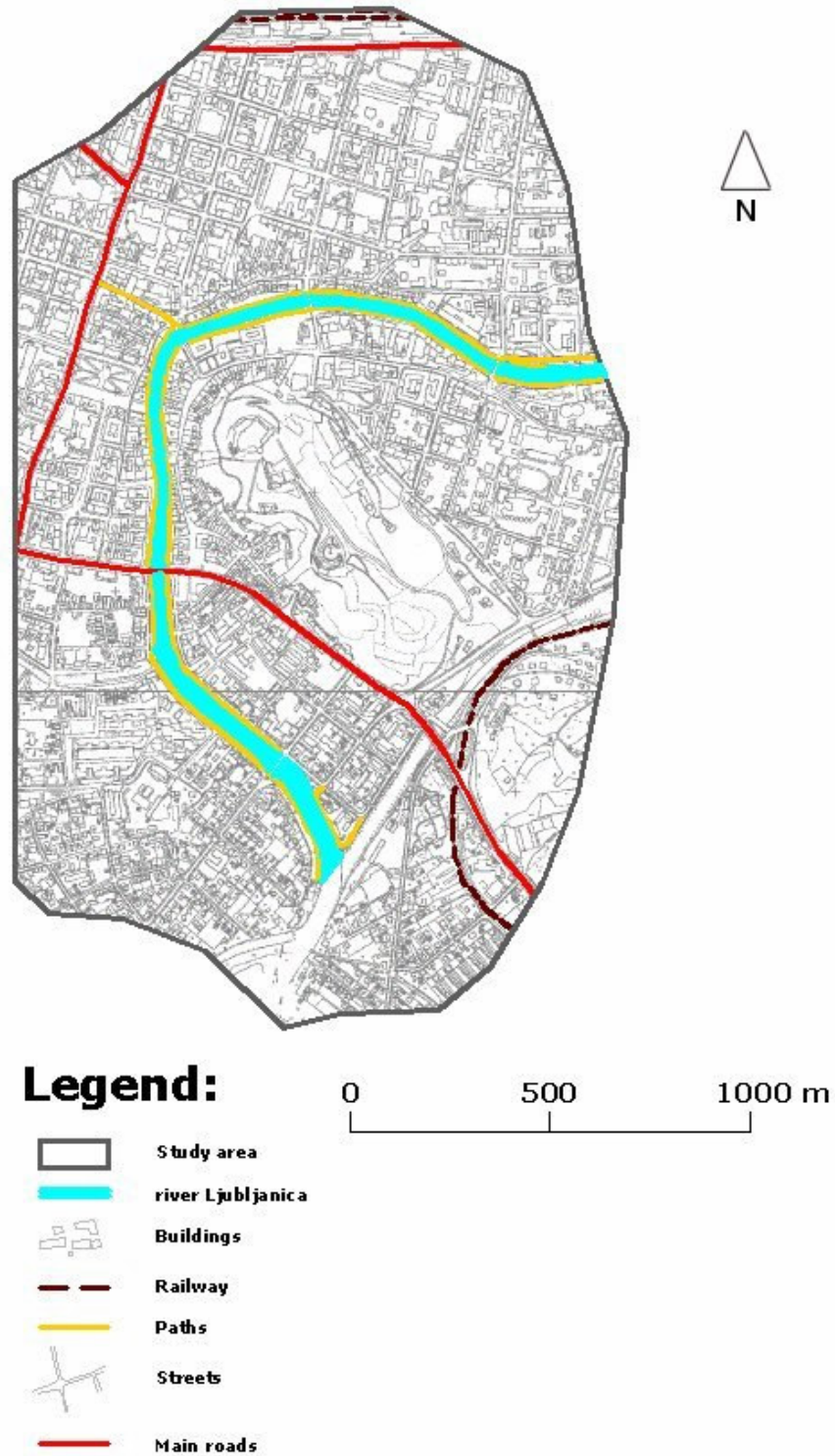
Natural and technological hazards

Flood vulnerability of the surrounding urban areas in the study area was high in the past. Intensive regulations of the Ljubljana river channel (widening of the cross section, deepening, introduction of the water barrier) and the excavation of the Gruber channel (diversion of the water away from the city centre) have diminished the flood vulnerability. We estimate that the area of a 100-year flood event spreads over 25 % of the urbanised part of the river corridor. Bank erosion processes and landslide risks are not present in the study reach.

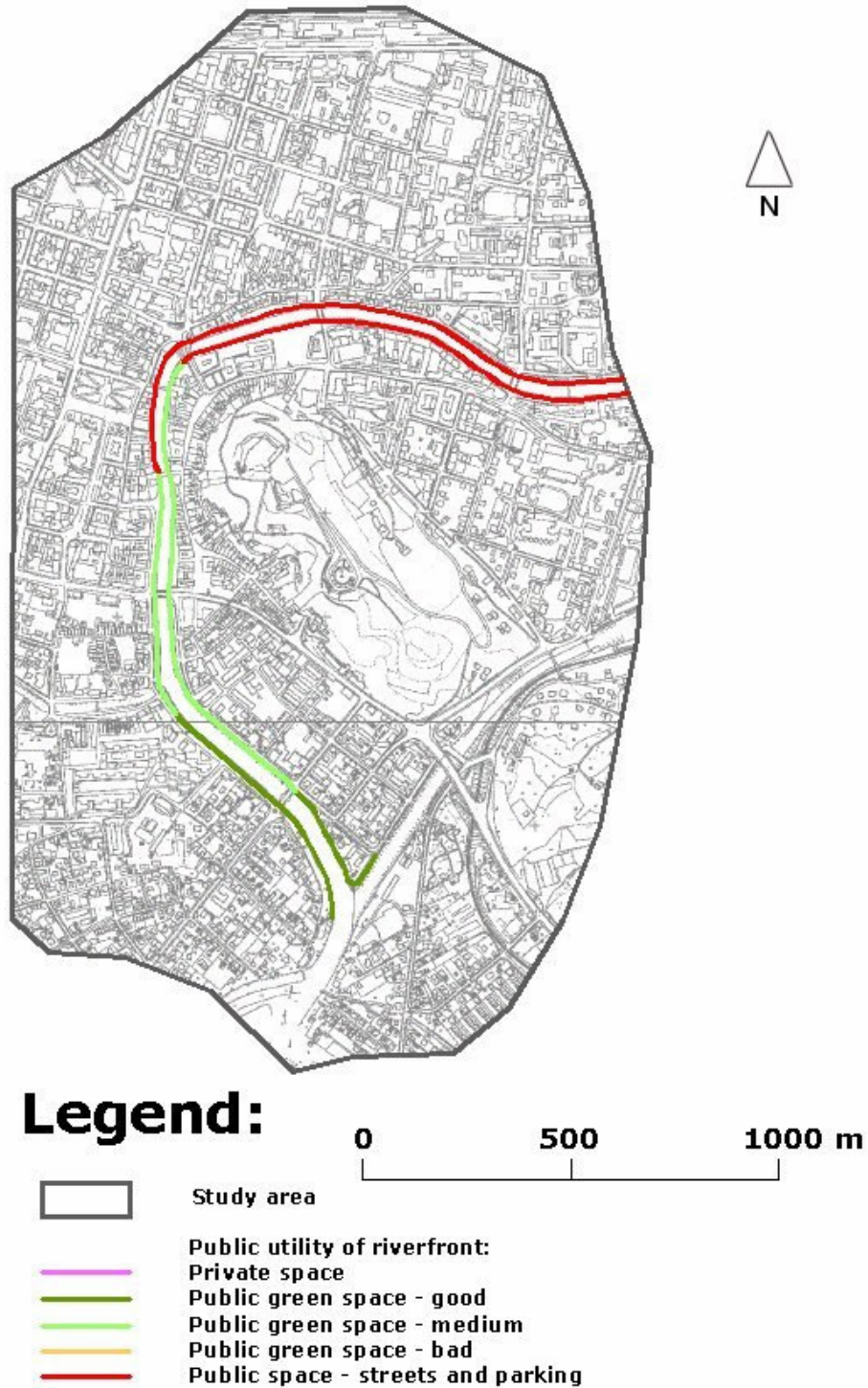


Urban space quality

The visual permeability of the urban space is characterised by longitudinally and transversally oriented visual axes, which were designed in detail. The linear density of the visual intersections is 11 visual intersections / km of river length. The average length of a visual axis is 100 m. An important landmark in the study area is the tower of the Ljubljana castle on top of Castle hill (Figure 46). High quality constructions (residential, business and commercial) with developed sewage and rainwater drainage system are characteristic. The rainfall runoff from the urban area drains directly into the Ljubljanica river. Poor quality constructions are to be found in some areas of the old city centre where several old buildings require reconstruction (Figure 47). Footpaths are arranged along the entire study reach on both sides of the river channel. (Figure 46). The green system of the city of Ljubljana is especially well developed in the upper part of the study reach (area called Trnovski pristan), before the river enters the narrow city centre in the middle part of the study reach. In the downstream part of the study area, traffic and parking surfaces prevail along the channel (Figure 48).

**Figure 46**

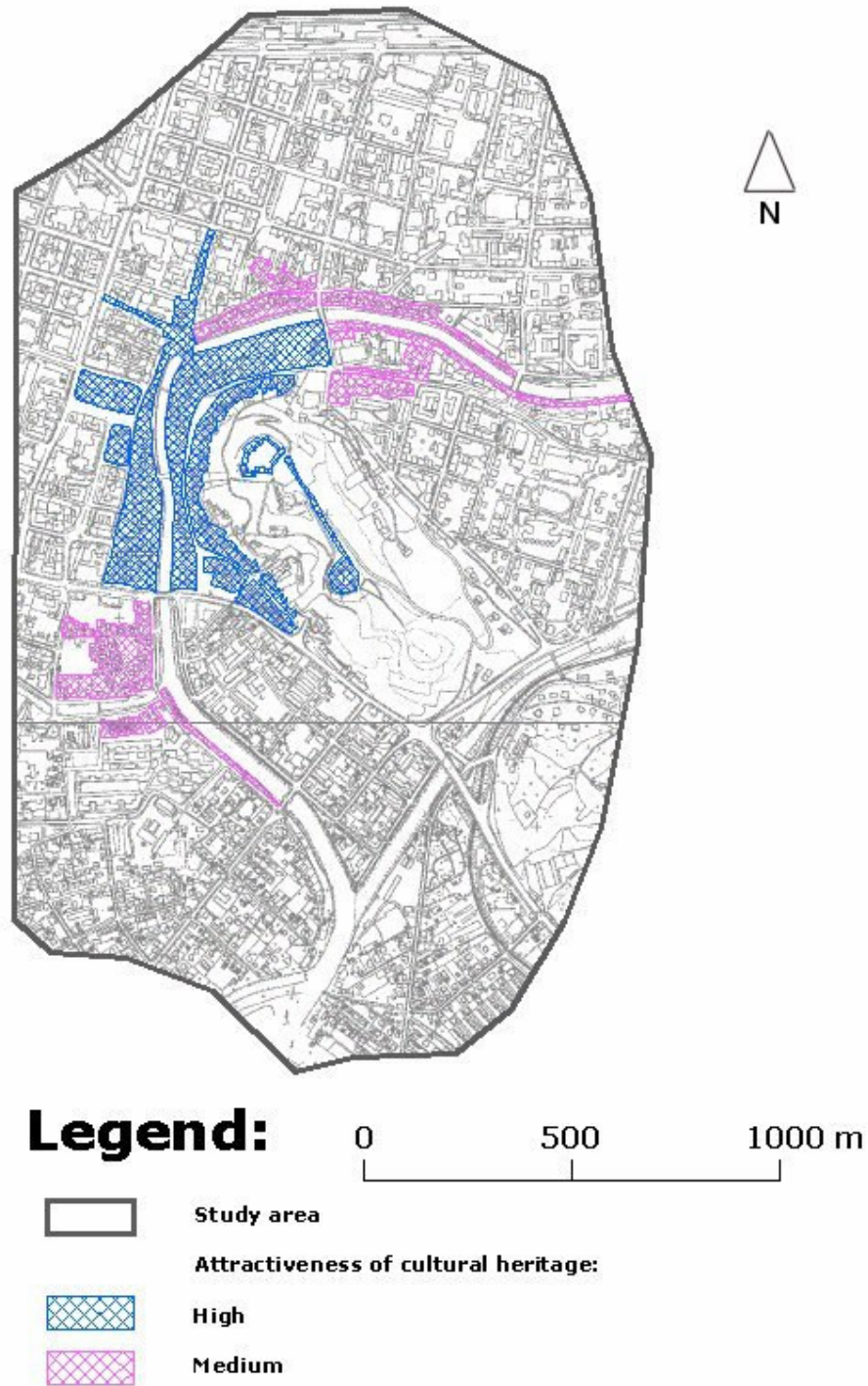
**Figure 47**

**Figure 48**



Cultural heritage

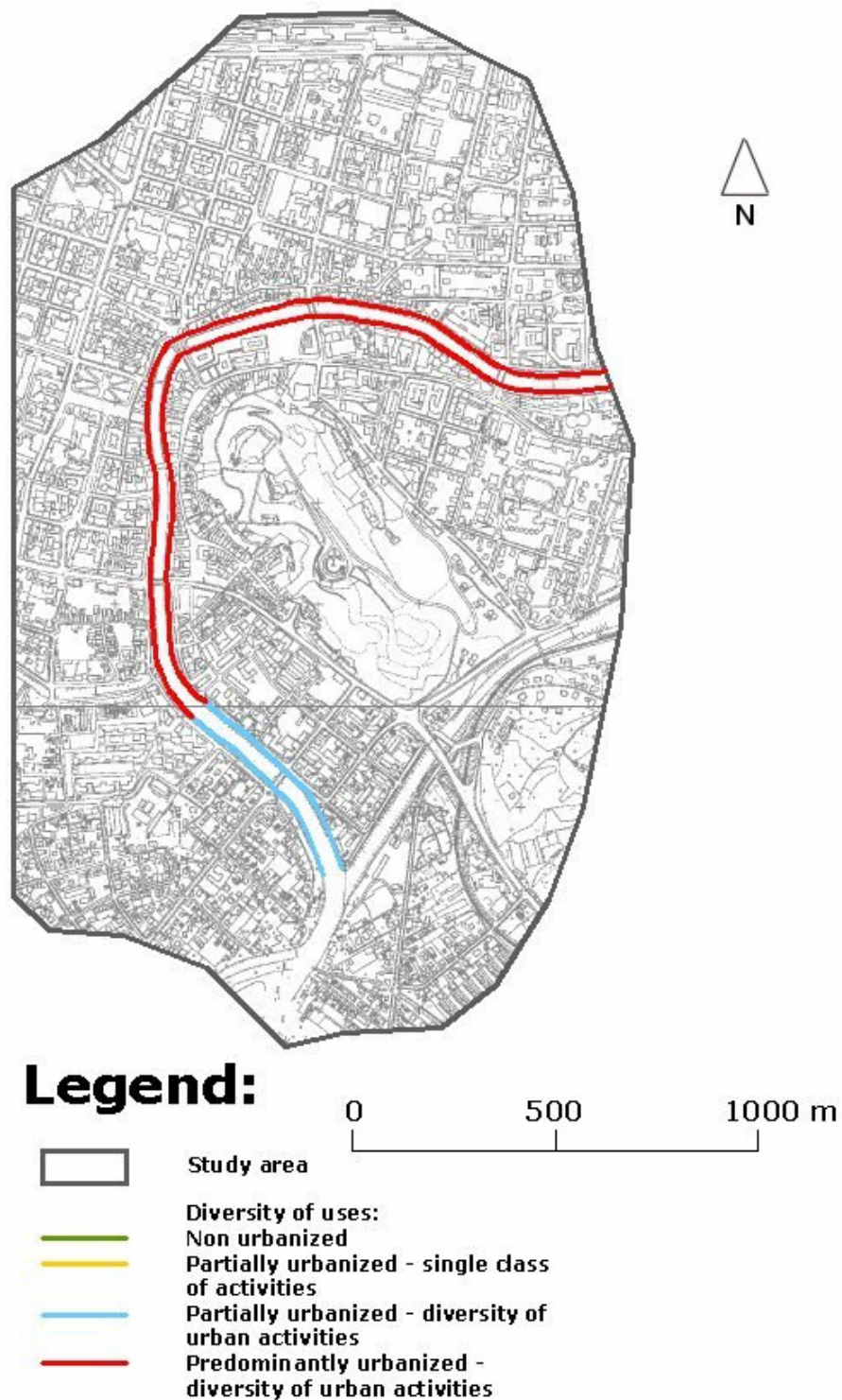
In the part of the old city centre, which is directly connected with the river, the cultural heritage is extremely abundant and attractive. It draws numerous inhabitants of Ljubljana, daily commuters and tourists every day all year long, especially in the summer time. Cultural heritage undoubtedly contributes to extremely high aesthetic value of the study area (Figure 49).

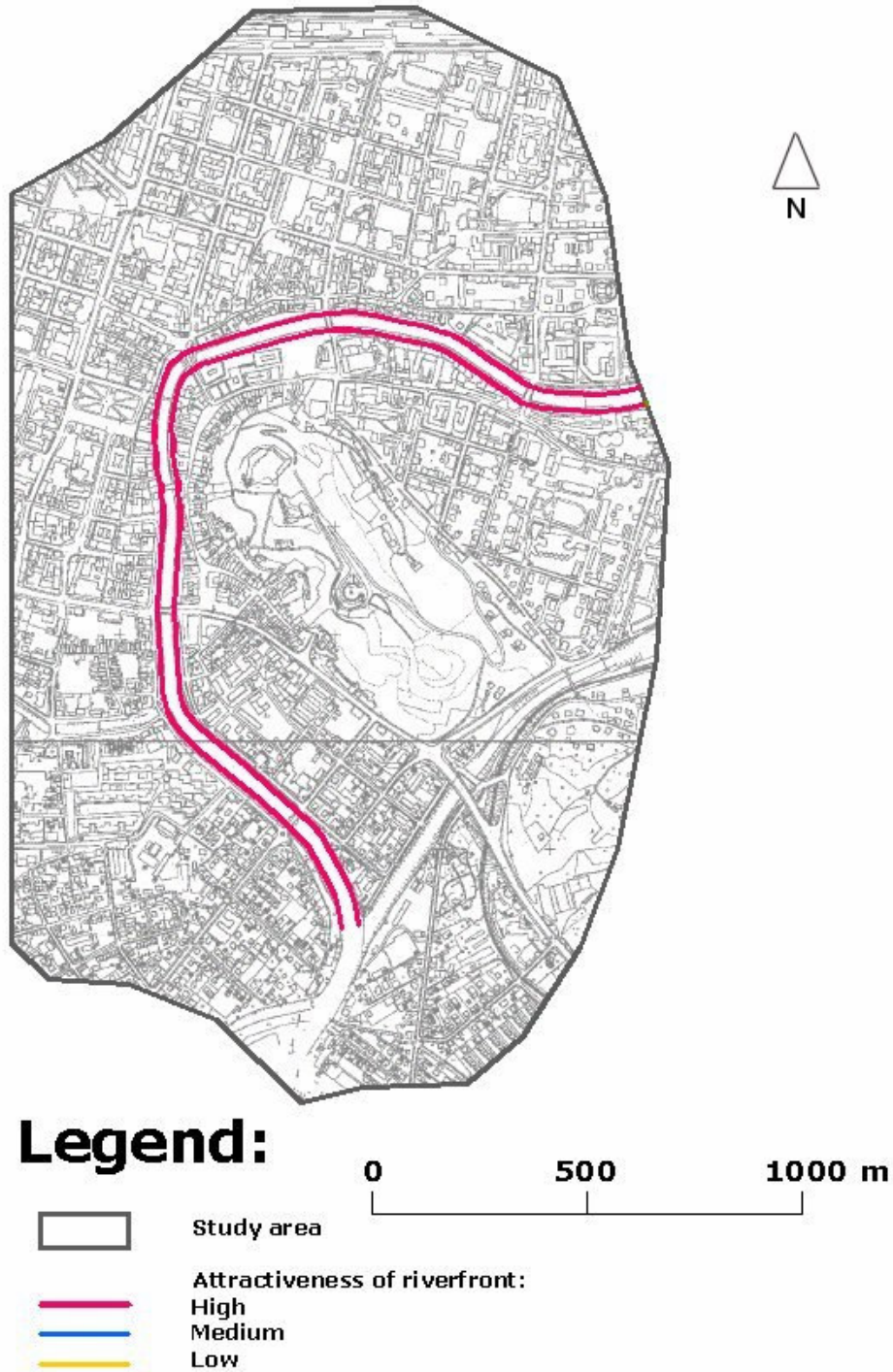
**Figure 49**



Activities on the riverfront

In the upstream part of the studied area, a partially urbanized use of the riverfront area prevails. The green system of the city of Ljubljana is well arranged and enables access to the Ljubljanica river water body. In the area of the city centre, there is a diversity of urban activities with predominantly urbanized use of riverfront (Figure 50). The attractiveness of the entire study area is high due to numerous possibilities of spatial uses and activities (footpaths, bikeways, cultural and social events, tourist activities), (Figure 51).

**Figure 50**

**Figure 51**



Accessibility

There are 9 river crossings in the study area (six for automobile traffic and three for pedestrians and cyclists). The network of public transport lines is well developed (Figure 52). Tourist navigation with boats of all sizes is organised on the river (Figure 53).

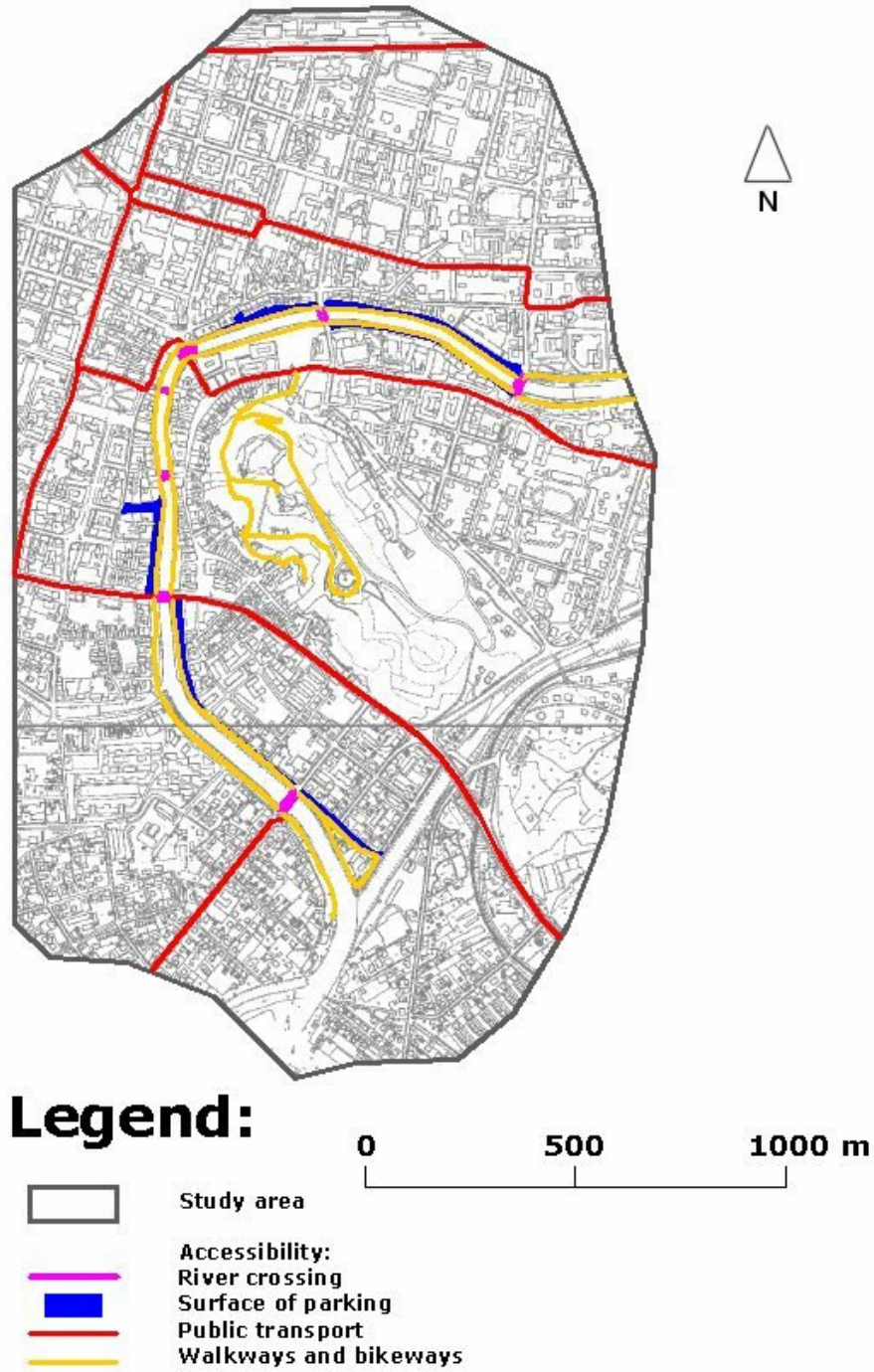


Figure 52

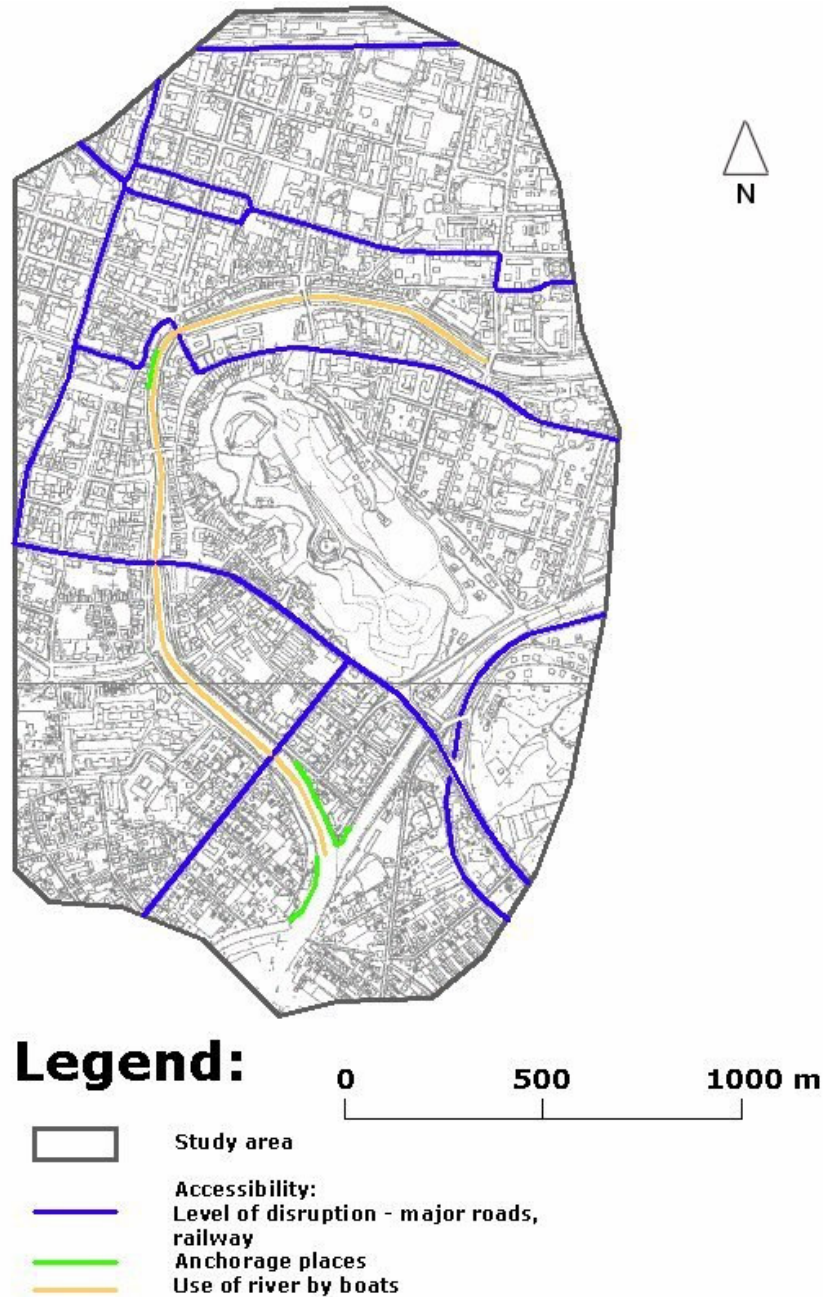


Figure 53

Pollution

The Ljubljana river is moderately polluted with litter and other pollutants, which are deposited in the channel because of the weak river flow. Water has a dark blue to green colour, it is not transparent and it has no odour.



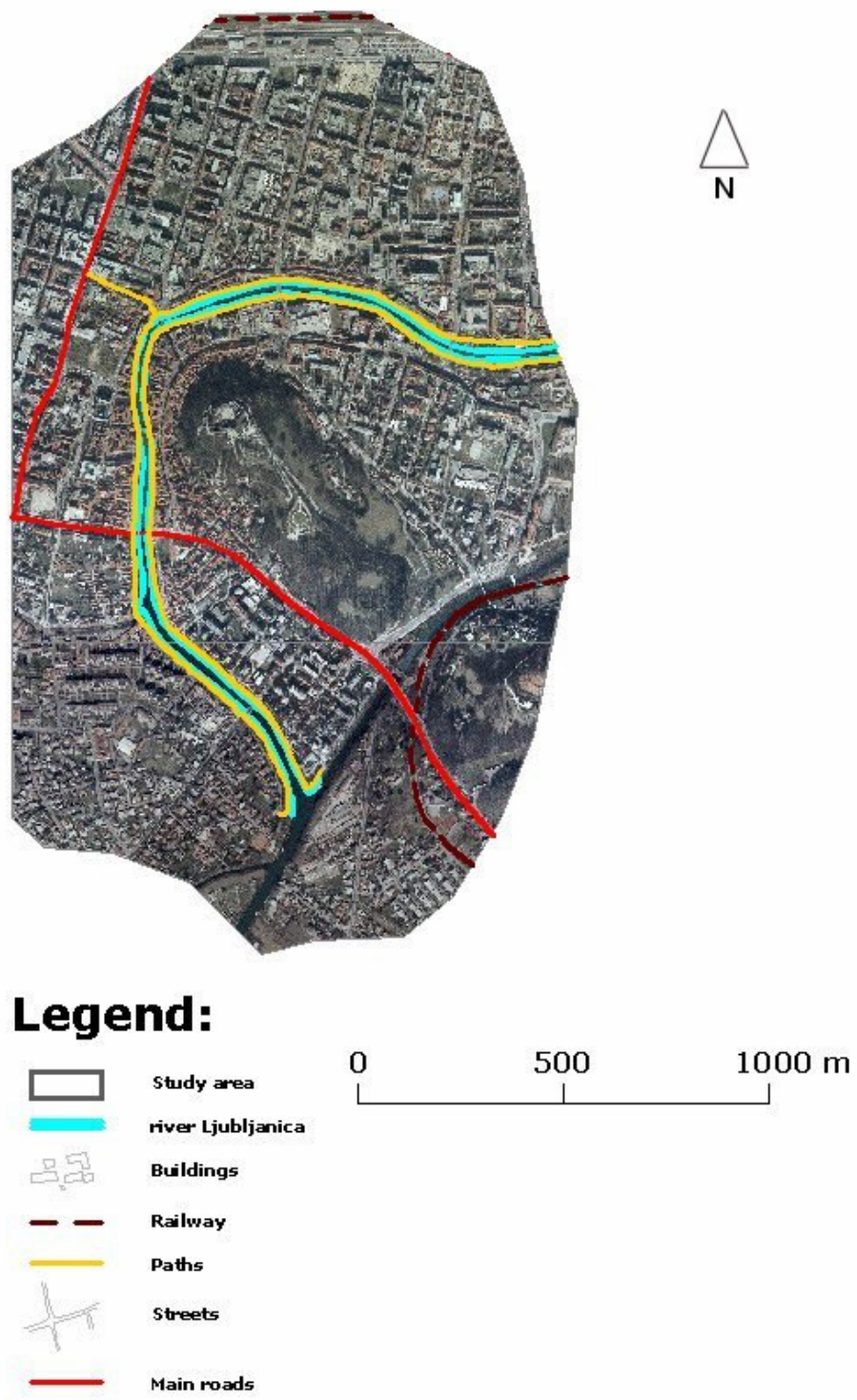


Figure 55 - Ljubljana Aerophoto of the Study Area

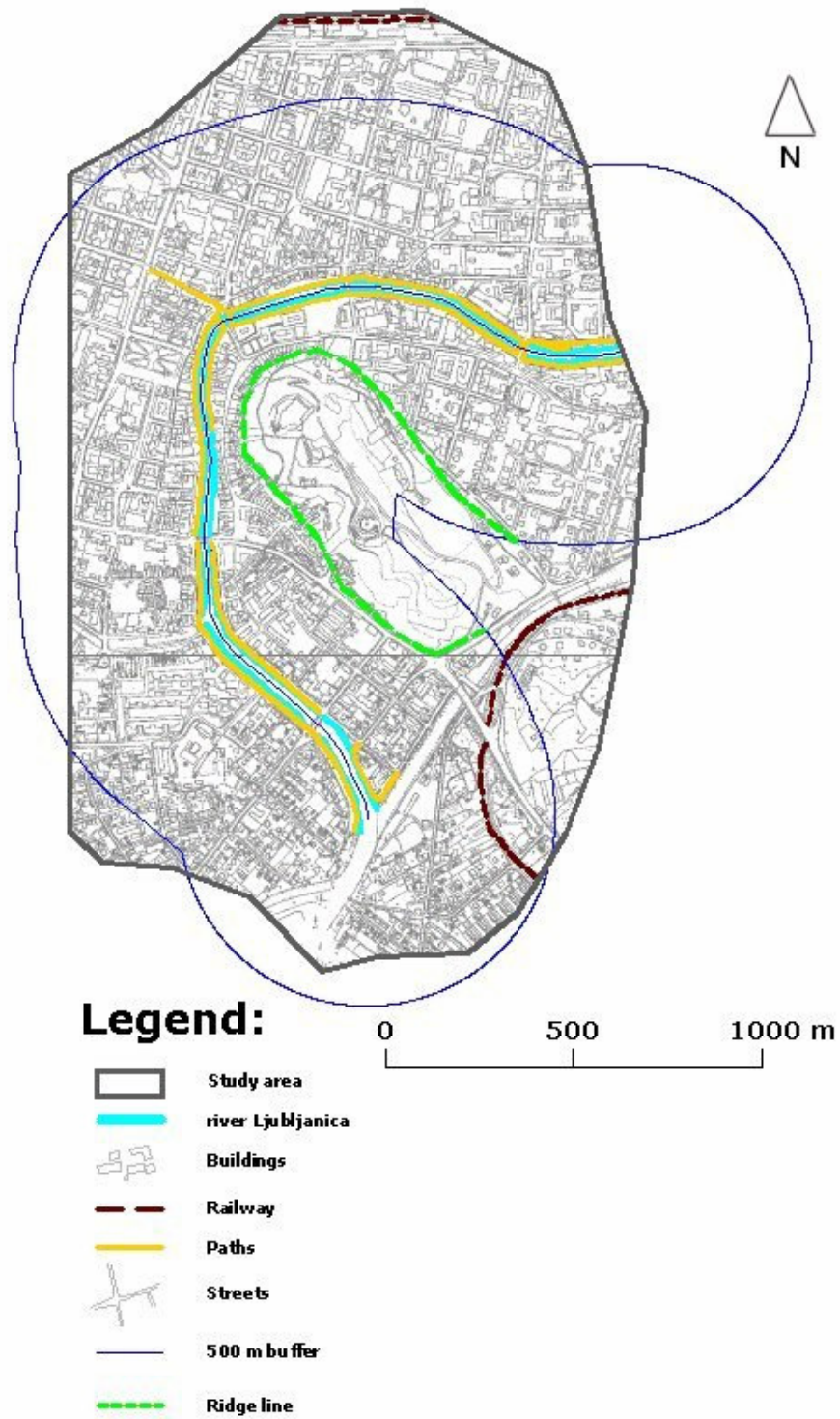


Figure 56 - Delimitation of the study area

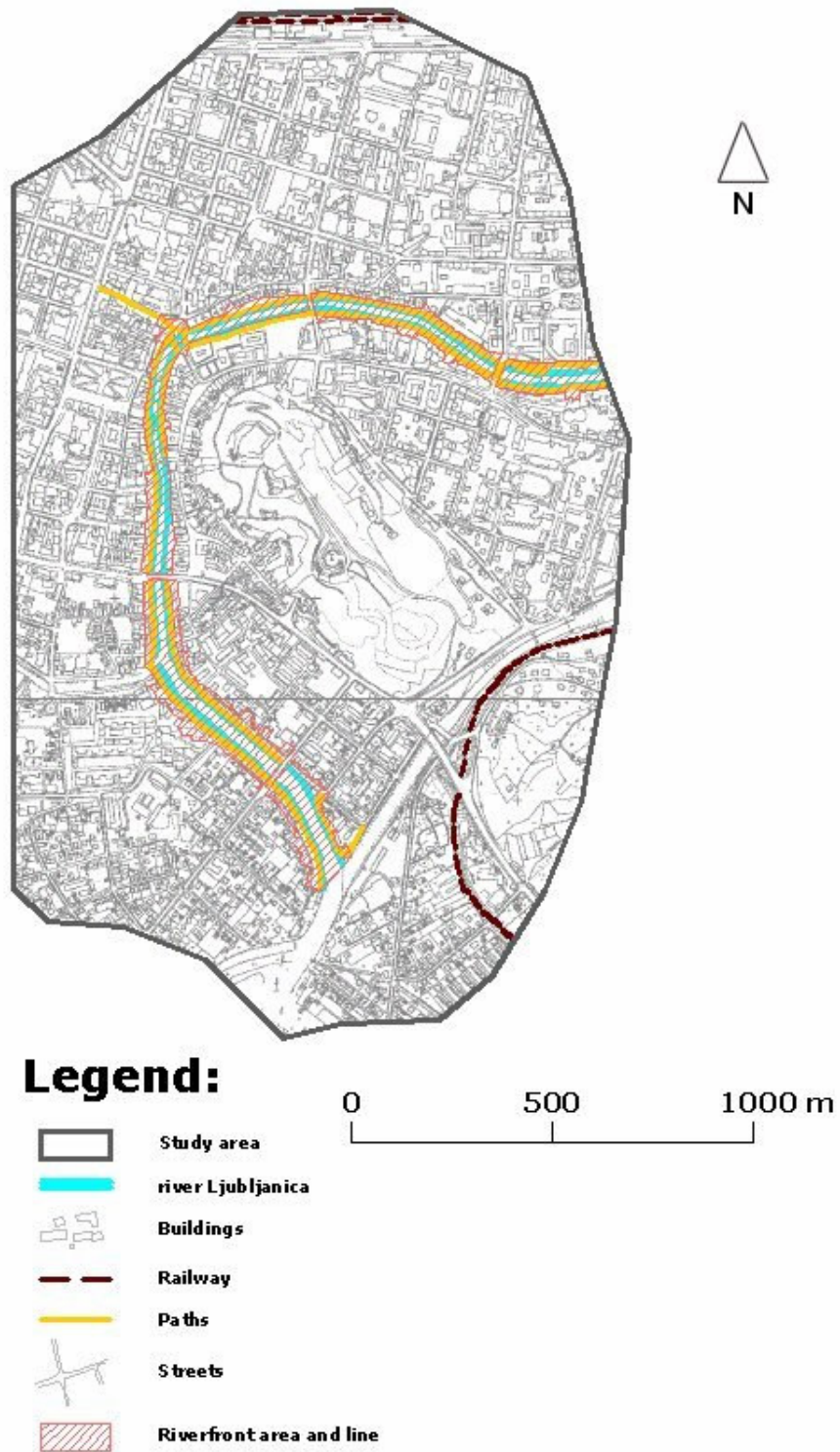


Figure 57 - Riverfront area



50 m

CROSS SECTION 1



CROSS SECTION 2



CROSS SECTION 3



CROSS SECTION 4



Figure 58 - Cross sections

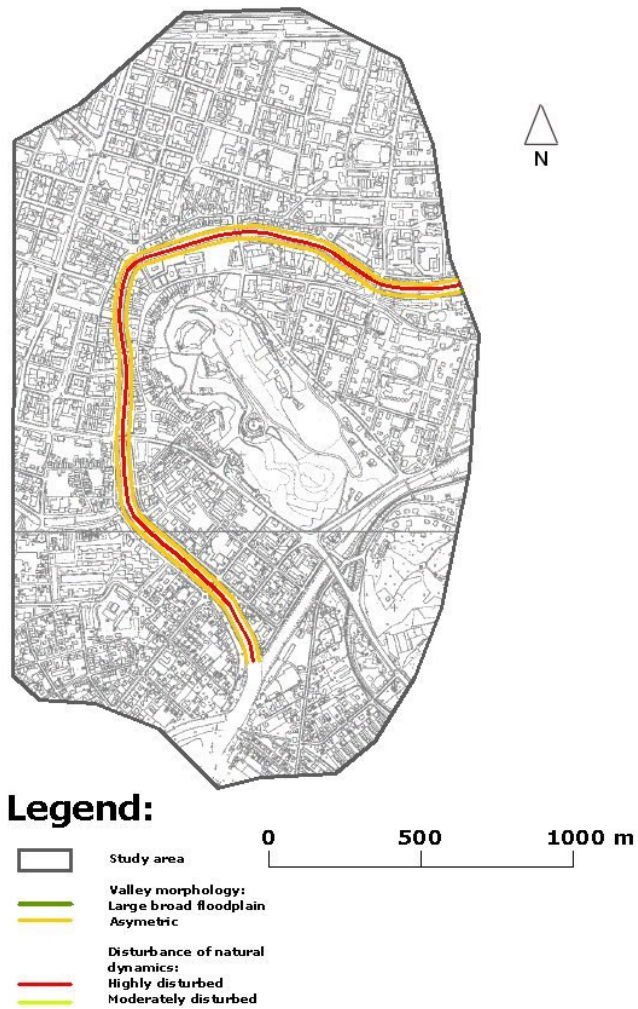


Figure 59 - The Ljubljana river study area

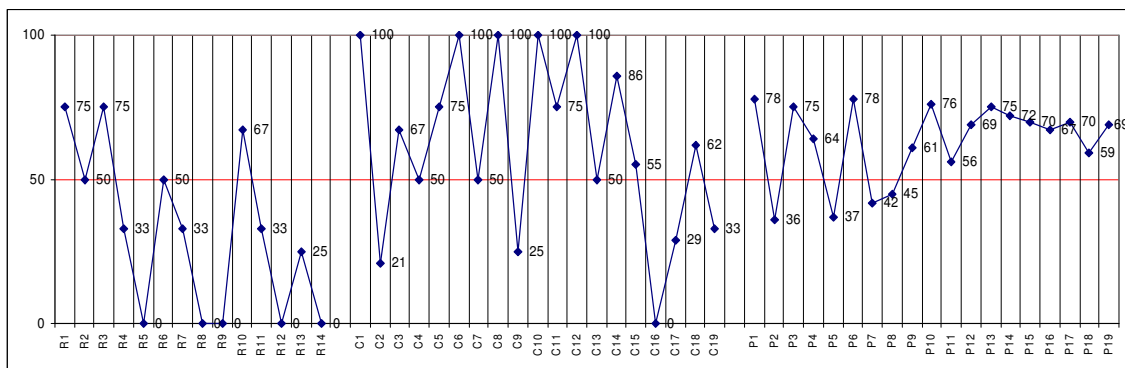


Figure 60 - Profile of aesthetical performance for the Ljubljana river

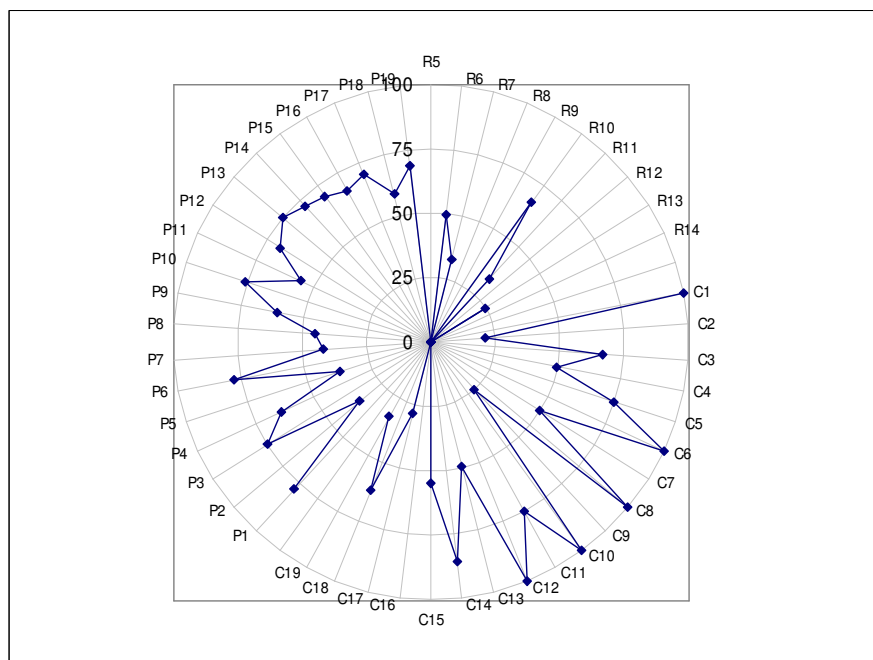


Figure 61 - Radar diagram of the Ljubljana river performance



Figure 62 - The Ljubljanica river through the city centre.

11.2 THE MALI GRABEN RIVER

Study area description

The Mali Graben river is a continuation of the Gradaščica river in its downstream section. Its boundary is the central ridge of the Polhov Gradec Mountains to the north, running from Ljubljana (Šentvid) via the Toško čelo (590 m. a. s. l.), Sveta Katarina, Grmada (898 m a. s. l.) and Tošč (1,021 m a. s. l.) up to the Pasja ravan (1,029 m a. s. l.). Here the boundary turns south and across the ridges of Sivka (934 m a. s. l.), Gabrovec (841 m a. s. l.), Špik (851 m.a. s. l.) and Kovček (789 m a. s. l.) and drops to the south to the back slope of the Polhov Gradec Mountains, spreading between the Horjulščica valley and the Ljubljana Marshes. The Gradaščica gets its name at the confluence of the two main headwater branches, the Božna and the Mala voda near Polhov Gradec. At the Bokalce dam the Gradaščica splits into two watercourses, i.e. into the urban Mestna Gradaščica and the Mali Graben, running past Kozarje, Dolgi most and Vič at the edges of bogs up to the Ljubljanica, into which it flows right above the Špica. The urban Gradaščica is – as an artificial channel – directed through Vrhovci, western part of Vič and Trnovo. At the crossroads of Koprška Road with Jamova Road the Glinscica flows into the urban



Gradaščica and then they together flow into the Ljubljanica. Section of the Mali Graben from Bokalce dam to the outflow to the Ljubljanica river is about 6 km long, average slope of the reach is 0.17 %. Although the Mali Graben was intensively regulated, mainly to assure the conveyance of a discharge of up to 170 m³/s, the hydraulic conductivity is not sufficient. Therefore, the surrounding areas are often flooded.

In the past, the course of the Mali Graben was situated apart from the urban area of the city of Ljubljana. Due to the fast development of the city that eventually grew into an important cultural, political and economic regional centre, the Mali Graben became the boundary between the managed urban space and the green urban space on the periphery. During the last two decades, the urbanization spread to the right bank of the Mali Graben. Next to the city's southern by-pass at Cesta dveh cesarjev Road there emerged an industrial zone. To a large extent, the population distribution increased with the rise of several new residential areas (Sibirija, Rakova Jelša); in the vicinity of these settlements, new residential areas on both river banks have been built. As anticipated, these areas of Ljubljana will face further building expansion.

River typology

The catchment area of the Mali Graben river comprises 154.3 km². According to the Strahler stream ordering system, the section of the Mali Graben is a stream of 1st order. The average width of the active cross section and the average bankful width are in the range of 5–20 m. In terms of morphology type, the stream is a broad floodplain along most of the course. The densely built-up areas are located mostly to the north of the river, directed towards the city centre; the built-up areas also spread towards the area south of the river corridor (Figure 63). The length of the study reach is 3,750 m.

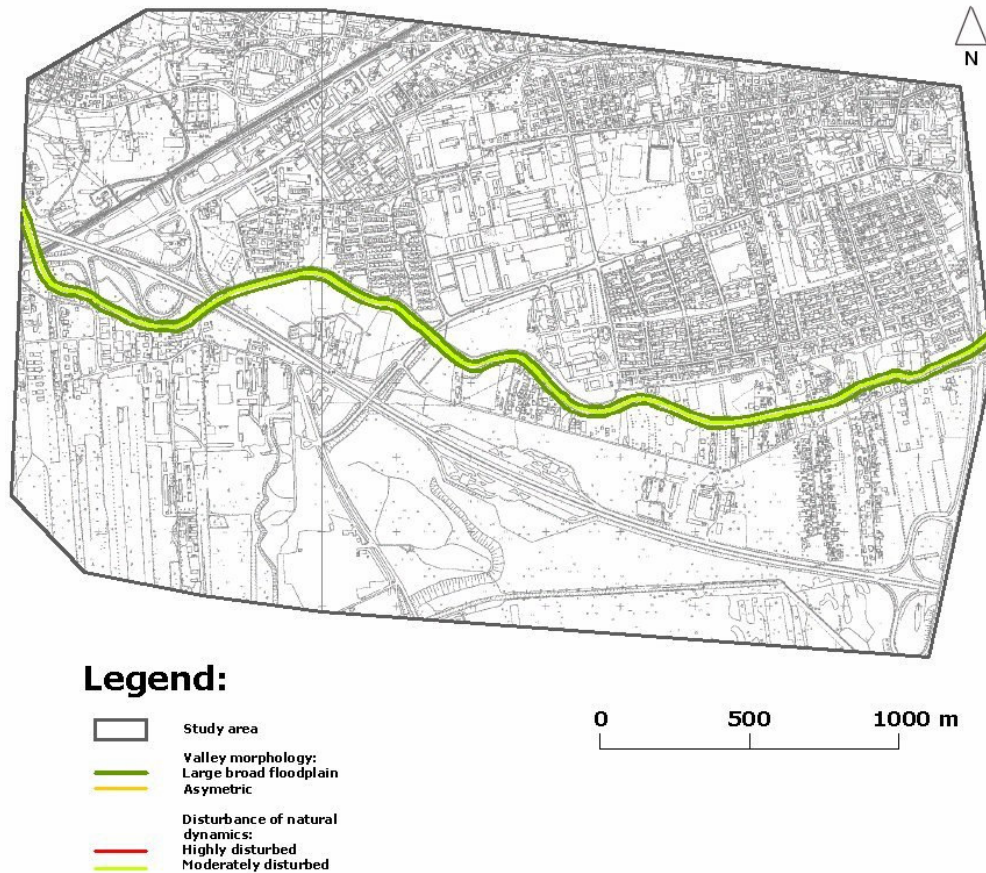
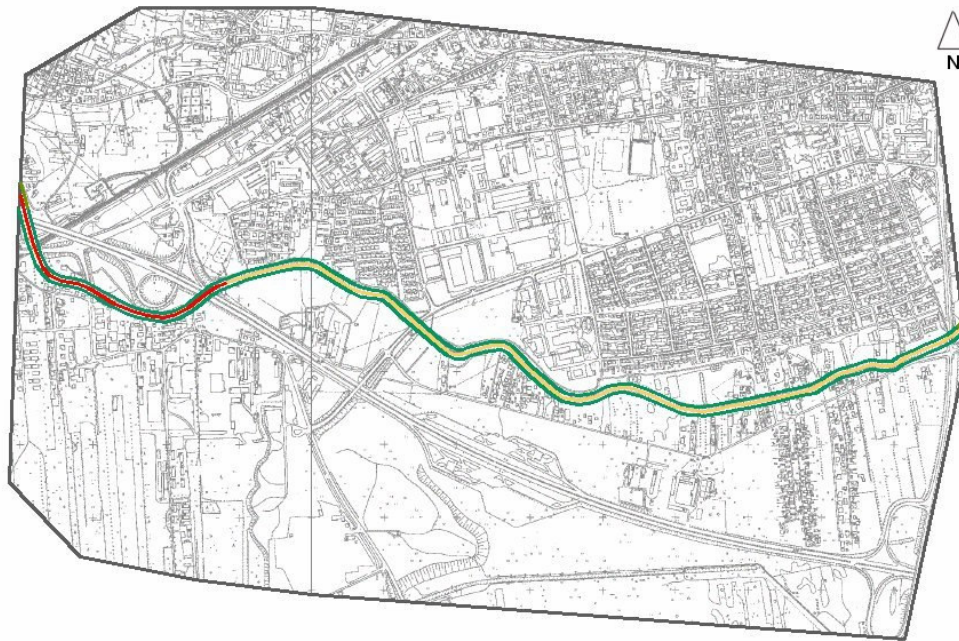


Figure 63

River morphology

The degree of disturbance of natural dynamic processes on the Mali Graben is high in the upper reach of the study area, where the river corridor is disconnected because of traffic infrastructure. In the lower, maintained and managed study area, the degree of disturbance is moderate. The bottom of the river is natural, the banks are technically arranged, however, they are densely grassed and covered in riparian vegetation (Figure 64). Index of sinuosity of the stream is 1.15, calculated according to the method proposed; the local sinuosity is further diminished due to past regulations (Figure 65). Characteristic of the entire study reach is the trapezoidal cross section with steady slope and bank formation. The hydro-morphological elements (runs, pools, riffles, rocks, weirs) were partly removed from the channel (Figure 66). During the restoration works in the 1980's several weirs were built into the channel, which changed the morphological structure of the channel bottom (emergence of pools) and the river course structure.



Legend:

- Study area
- Biological diversity:
River corridor highly disturbed or artificial
- Moderately disturbed
- Presence of riparian vegetation in river banks:
Absence of vegetation
- Presence of herbaceous vegetation
- Presence of sparse trees
- Presence of well developed and continuous vegetation

0 500 1000 m

Figure 64

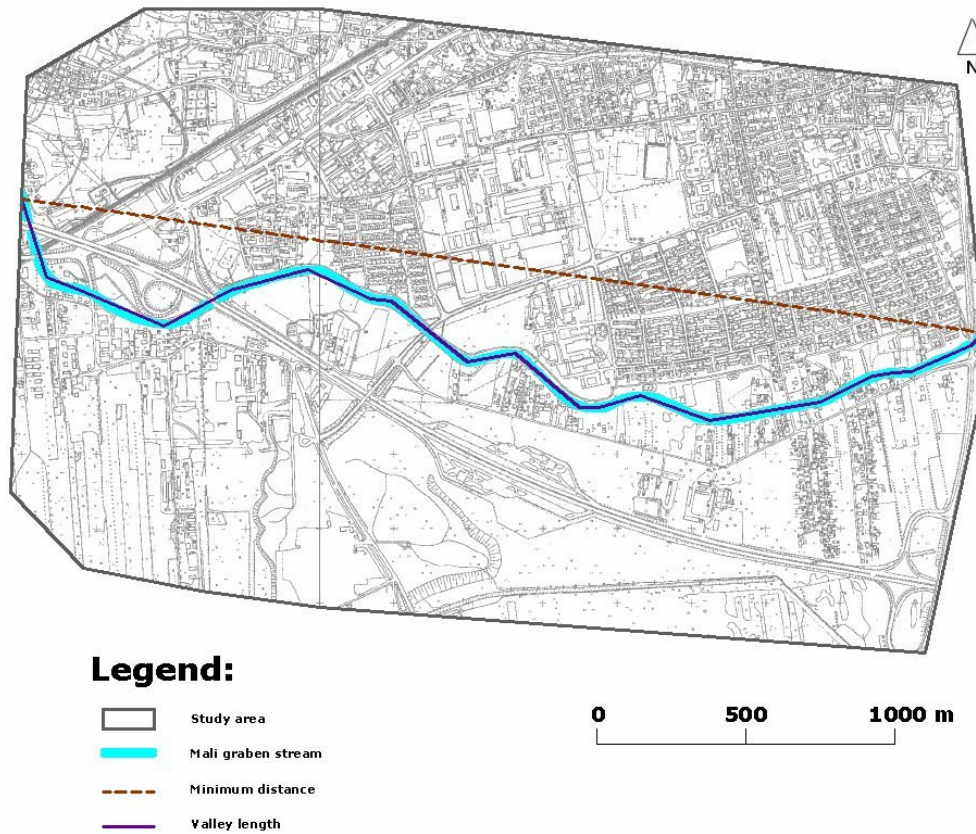
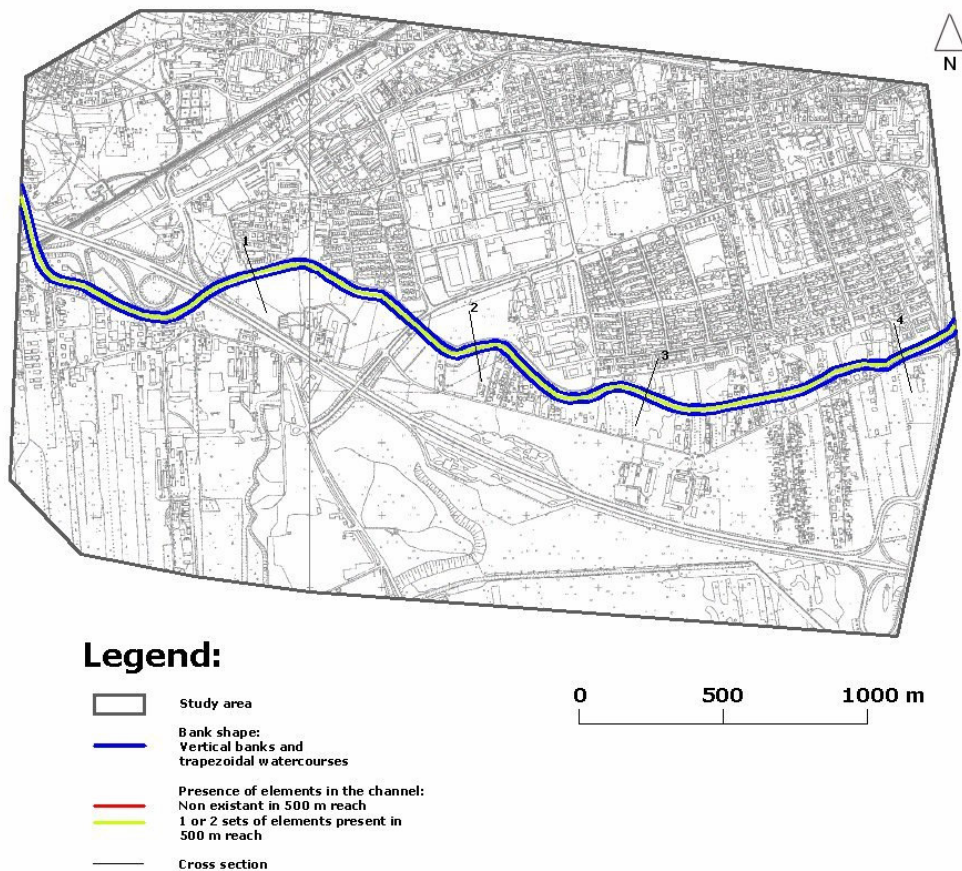
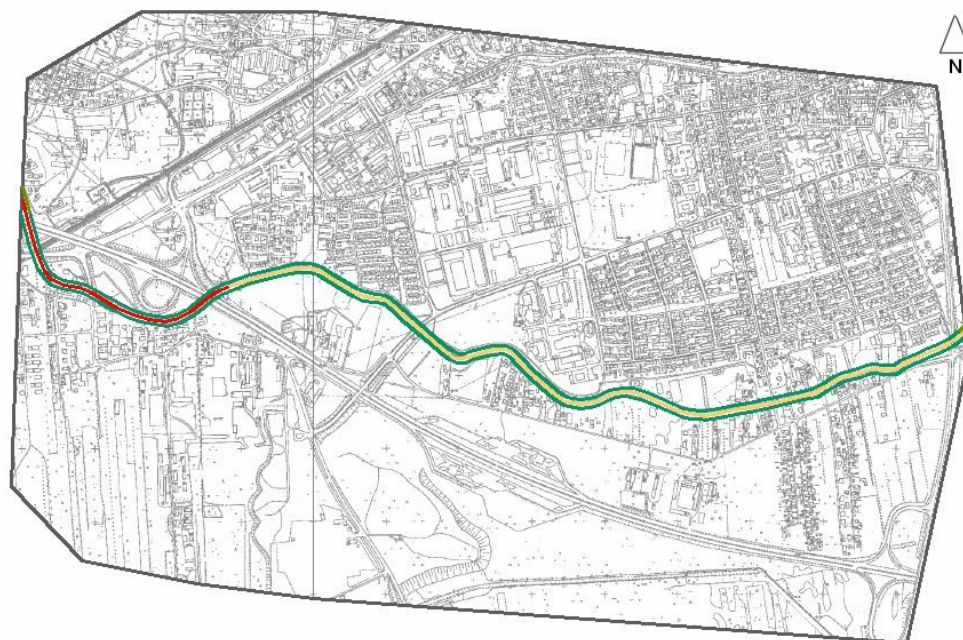


Figure 65

**Figure 66**

Biological components

Even though the river corridor of the Mali Graben river has undergone intensive regulations, the riparian vegetation on the study reach remained well developed, ranging in a width of 12–20 m. During the vegetation period the channel is strongly overgrown and shaded. The variety of species (aquatic, amphibian and terrestrial vegetation) is high (Figure 67).

**Legend:**

- Study area
- Biological diversity:**
 - River corridor highly disturbed or artificial
 - Moderately disturbed
- Presence of riparian vegetation in river banks:**
 - Absence of vegetation
 - Presence of herbaceous vegetation
 - Presence of sparse trees
 - Presence of well developed and continuous vegetation

0 500 1000 m

Figure 67

Natural and technological hazards

Flood vulnerability of the urban areas in the Mali Graben river corridor is high. It has been estimated that more than 75 % of river corridor areas are of 100-year flood event. No bank erosion processes and landslide risks have been identified.

Urban space quality

The built-up area on the left bank (along the residential area of Murgle) is characterised by urban visual axes. The linear density of the visual intersections is 4 visual intersections per km¹ of river length. The average length of the visual axis is 200 m. There are no typical belvederes in the study area, nor any landscape points (Figure 68). Characteristic of the study area on the left bank of the Mali Graben and to the north, is



quality housing in private ownership and commercial areas in the central part of the study reach with proper public utility infrastructure. The rainfall runoff is diverted into the river. Individual buildings with poor quality public utility infrastructure spread mostly on the right bank of the Mali Graben and in the area south of the river (Figure 69). Poor quality urban environment is also in the upper part of the study area with a dense traffic network. The Path around Ljubljana as an important element of the urban design runs parallel to the left bank of the Mali Graben (Figure 70) and adds to the amenity value of the area. In general, the state of the green system within the study area is good (Figure 71).

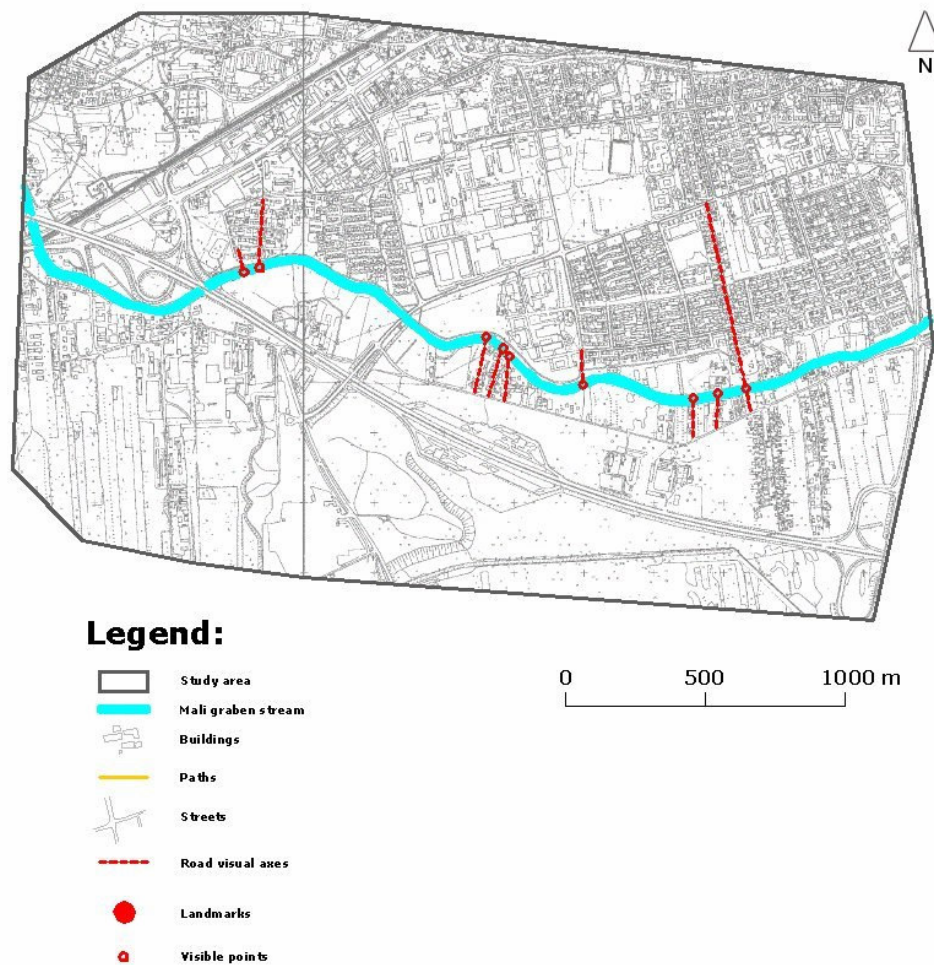


Figure 68

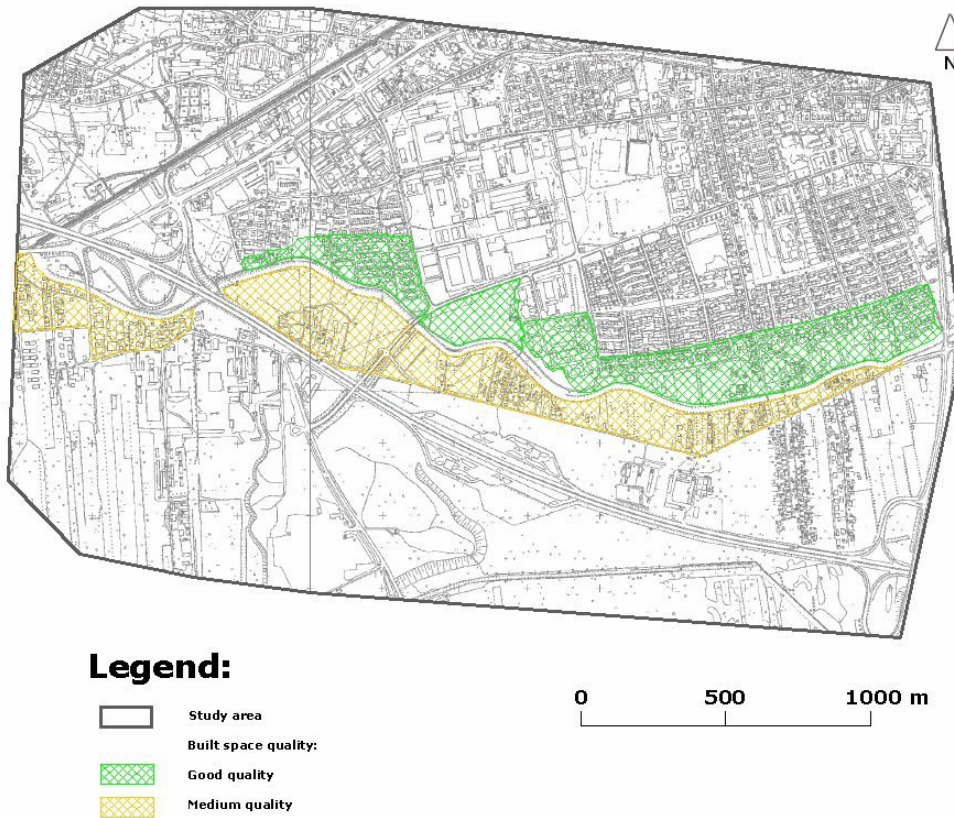


Figure 69

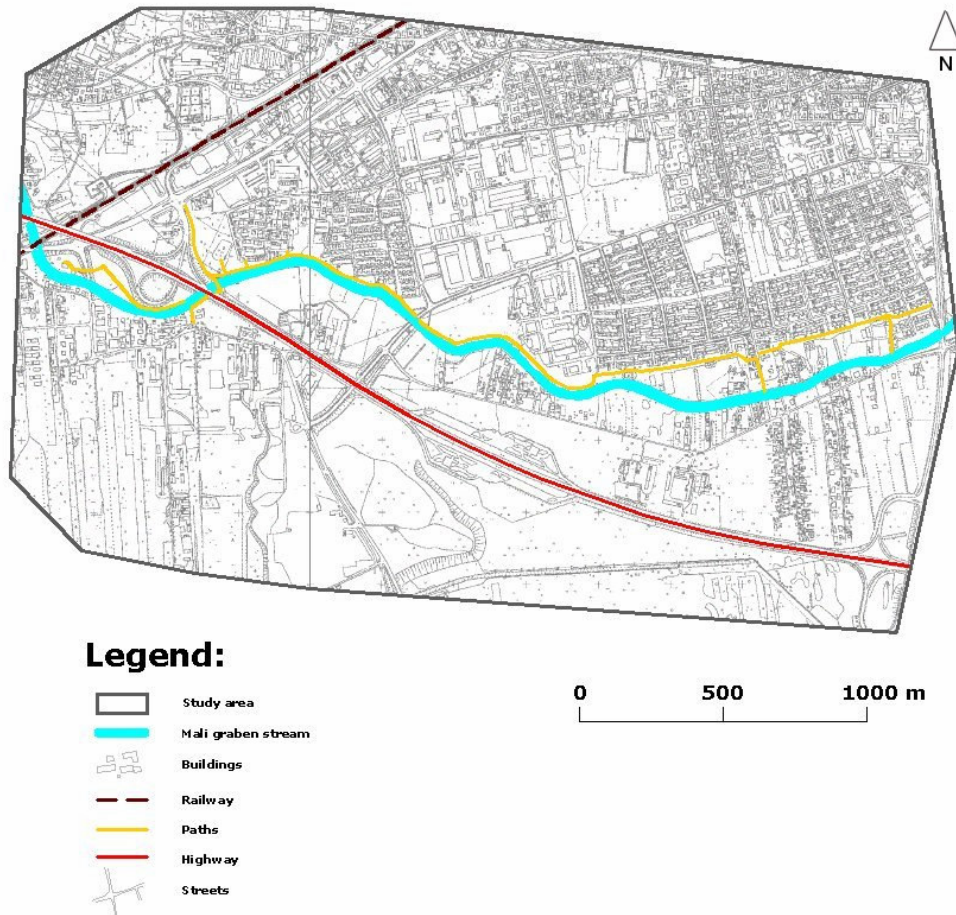


Figure 70

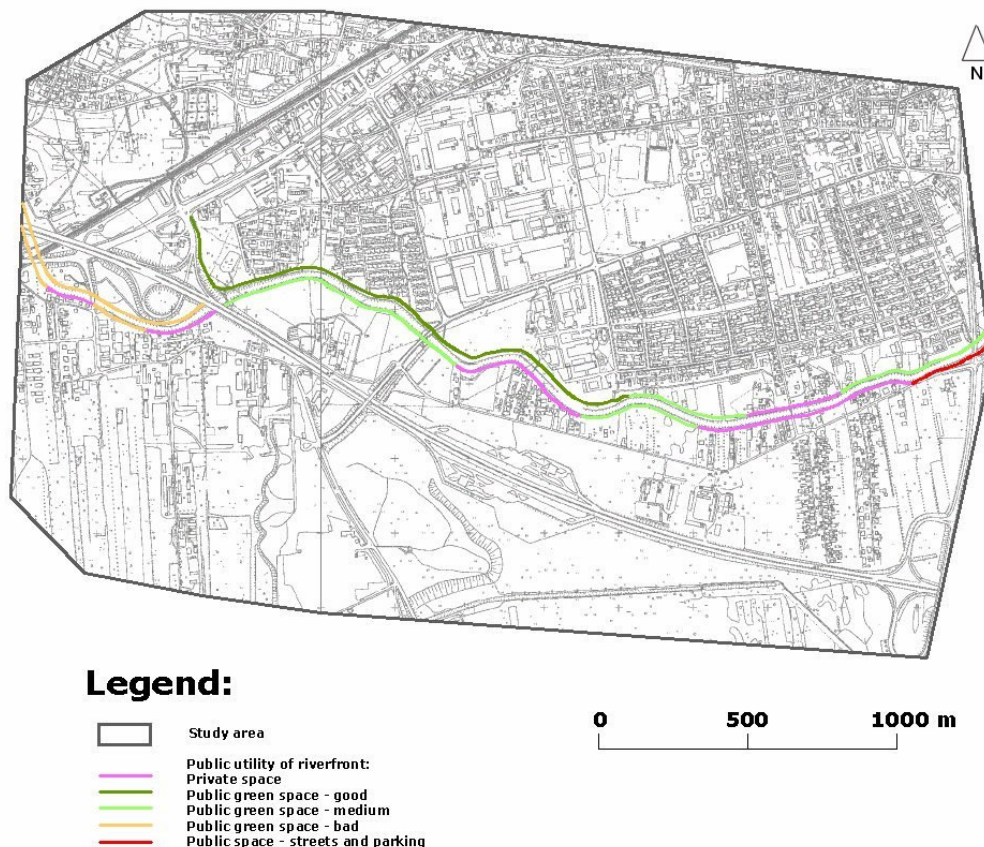


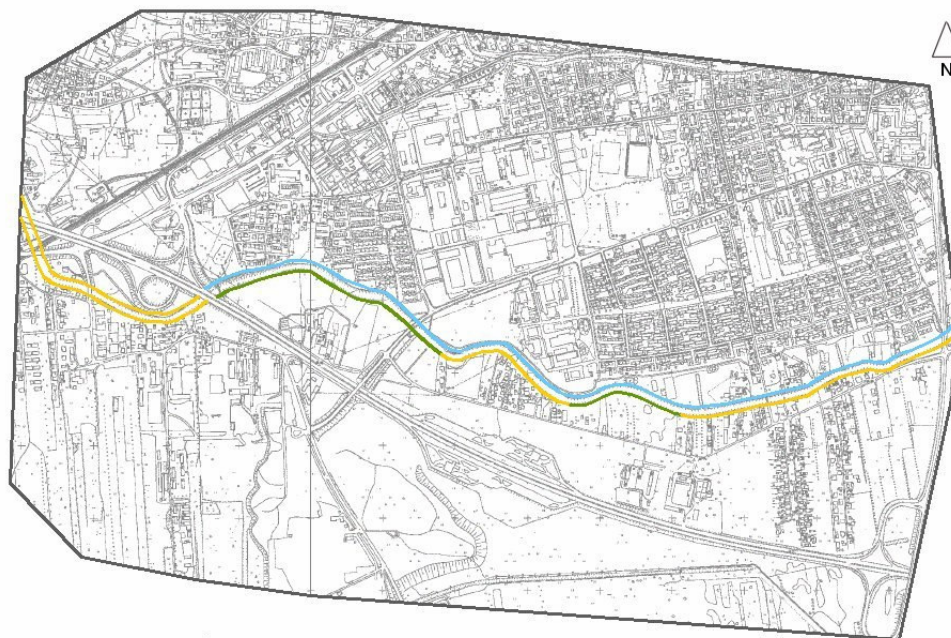
Figure 71

Cultural heritage

There is no cultural heritage present within the river corridor.

Activities on the riverfront

Urban activities prevail in the upper study area. The lower study area is an open suburban space with abundance of green areas (Figure 72). The amenity value of the riparian areas is highest on the left bank and to the north of the river due to the characteristically high residential quality and recreational possibilities (footpaths, bikeways) and the Path around the city of Ljubljana (Figure 73). The quality of riparian areas is poor in the upper part of the study area due to the traffic network, and on the right bank in the area to the south.

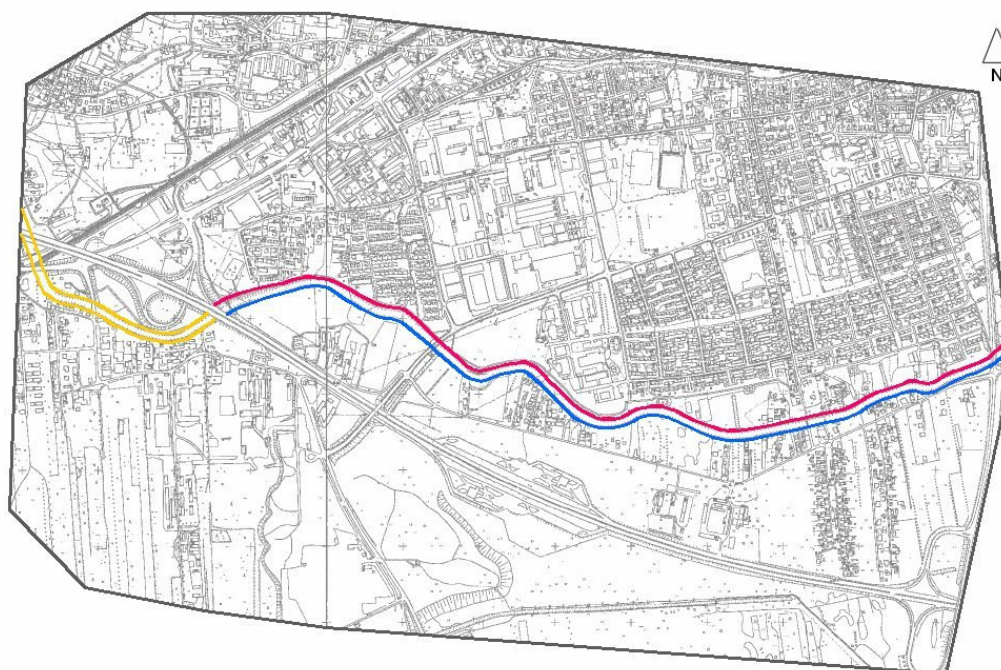


Legend:

-  Study area
-  Diversity of uses:
Non urbanized
-  Partially urbanized - single class
of activities
-  Partially urbanized - diversity of
urban activities
-  Predominantly urbanized -
diversity of urban activities

0 500 1000 m

Figure 72



Legend:



0 500 1000 m

Figure 73

Accessibility

Out of 10 river crossings, 7 are intended for automobile traffic, 1 for rail traffic, 2 for pedestrians and cyclists. Well-maintained footpaths and bikeways are characteristic for the area north to the river. The bridges of the south by-pass, rail, Tržaška Road, Cesta v Mestni log Road and Barjanska Road are the most disruptive elements in the river corridor (Figure 74). With regard to the size of the Mali Graben, the navigation on the river is not possible, also there are no anchorage points.

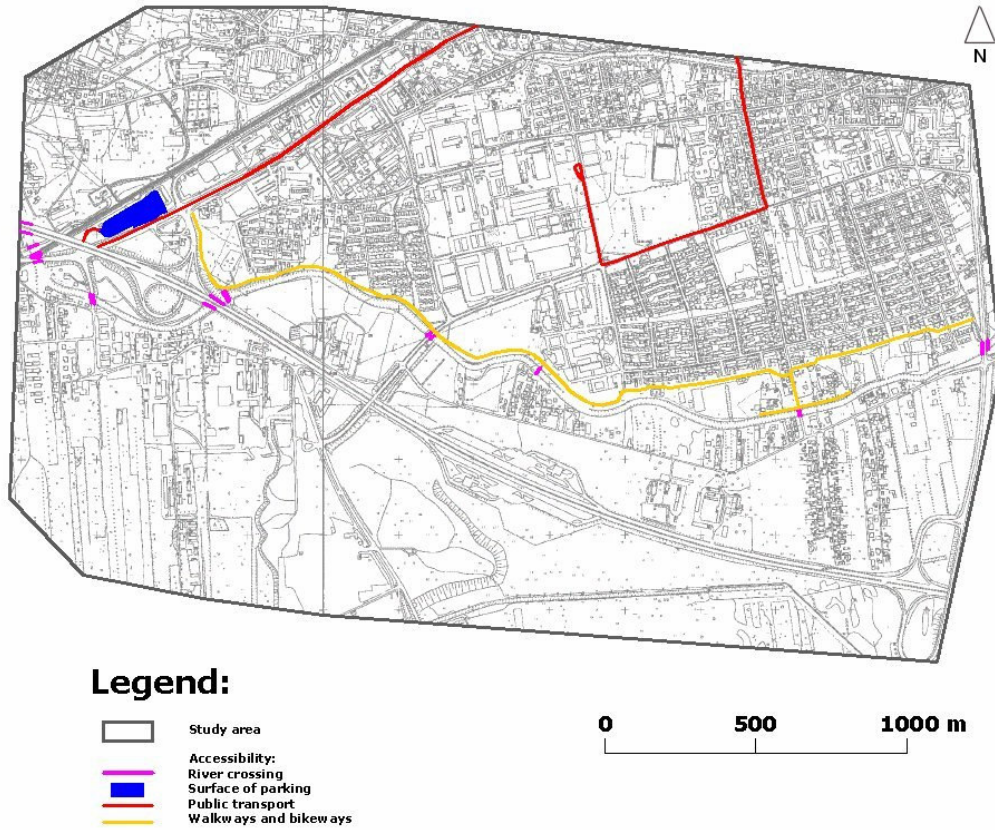


Figure 74

Pollution

Within the study reach, the Mali Graben is partly polluted with litter and other pollutants (occlusion of alluvial waste material because of the intensive riparian vegetation); the water is transparent and has no colour or unpleasant odour.



Legend:

 20 Photo ID

0 500 1000 m

Figure 75 – Position of the Mali Graben photos

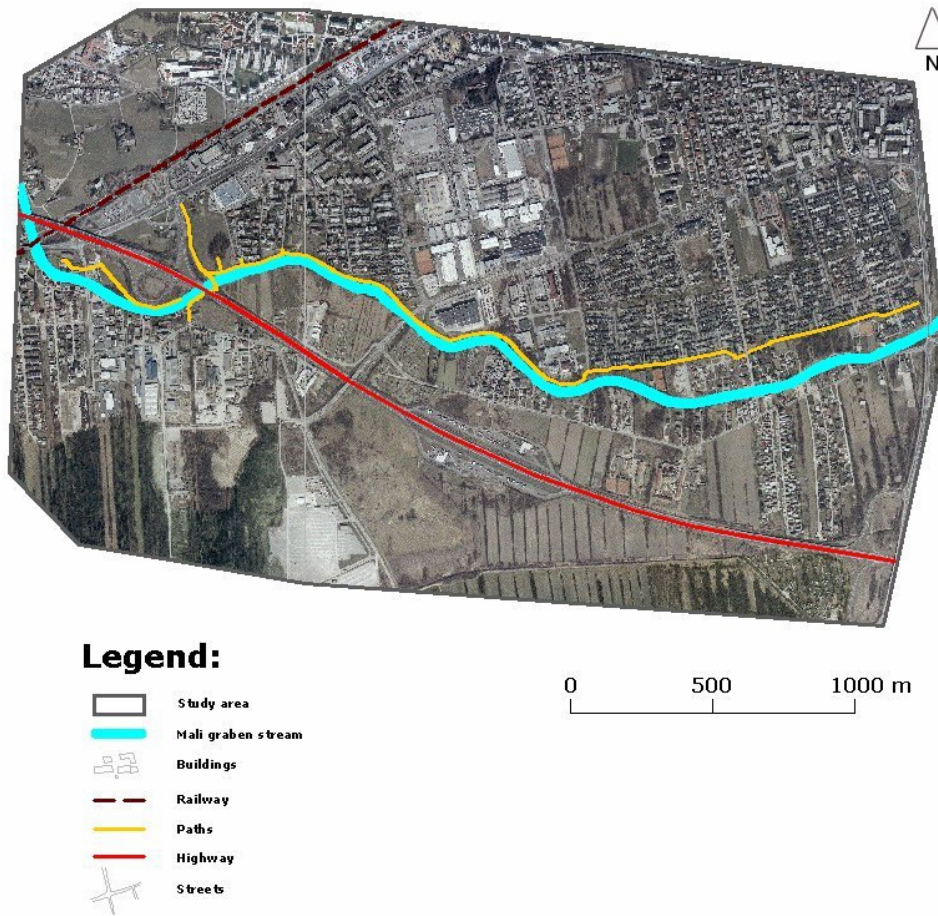


Figure 76 - Aerophoto of the Mali Graben study area

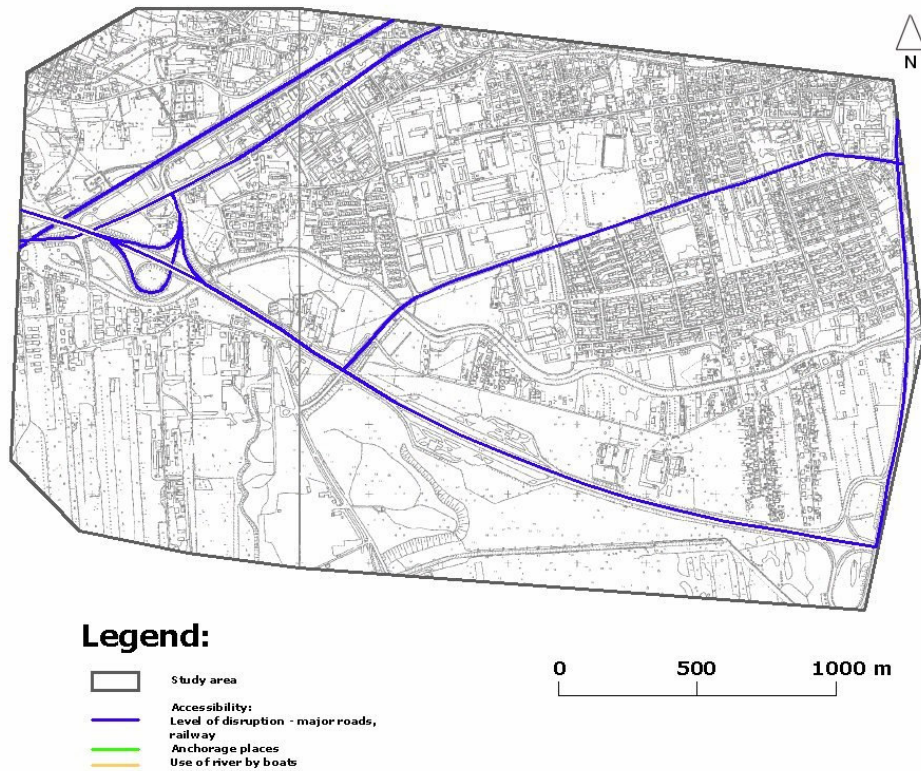


Figure 77 – Accessibility in Mali Graben Study Area

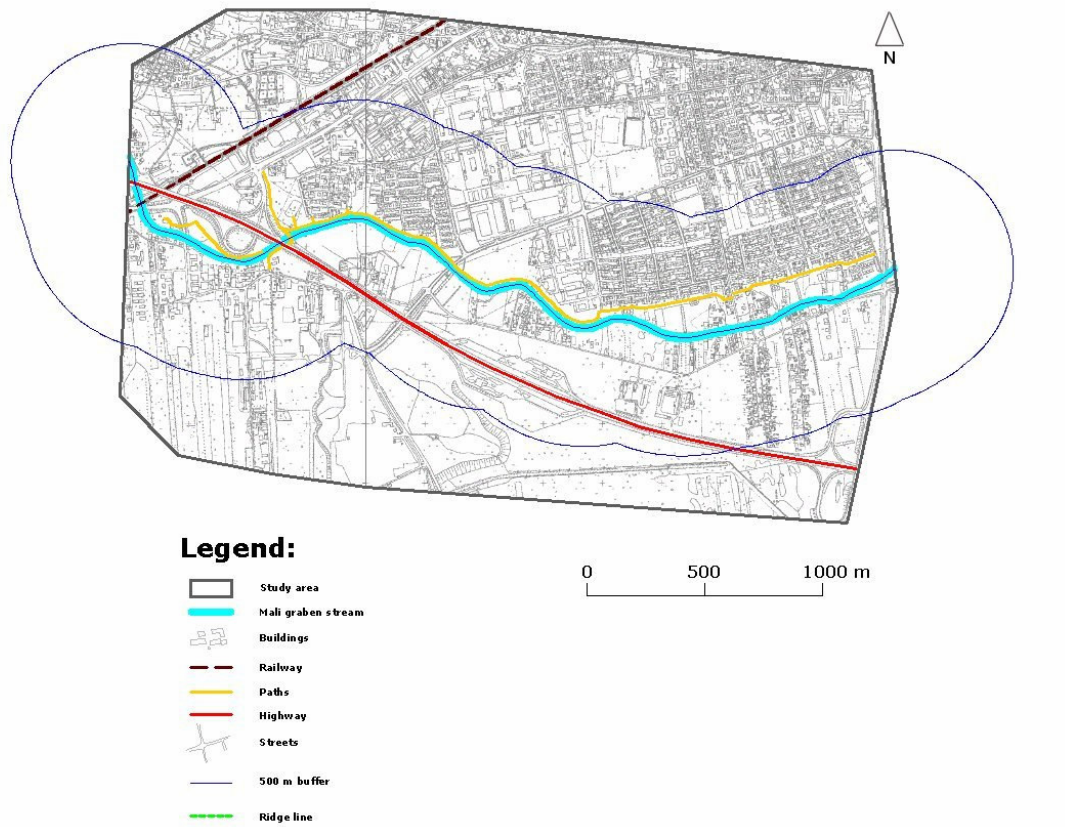
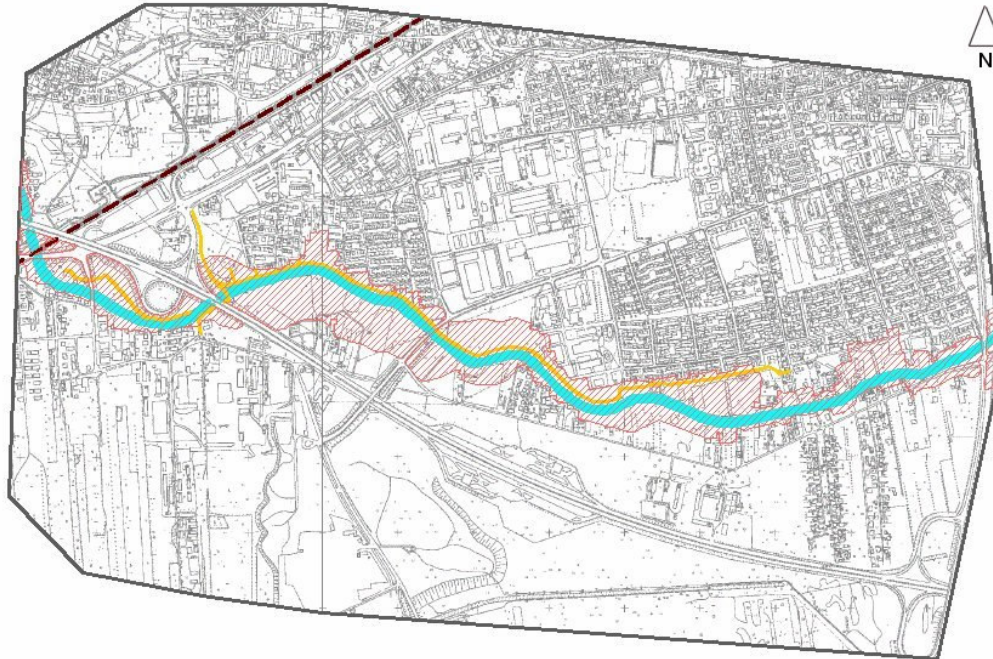


Figure 78 - Delimitation of the Mali Graben study area



Legend:

-  Study area
-  Mali Graben stream
-  Buildings
-  Railway
-  Paths
-  Streets
-  River front area and line

0 500 1000 m

Figure 79 - Riverfront of Mali Graben area

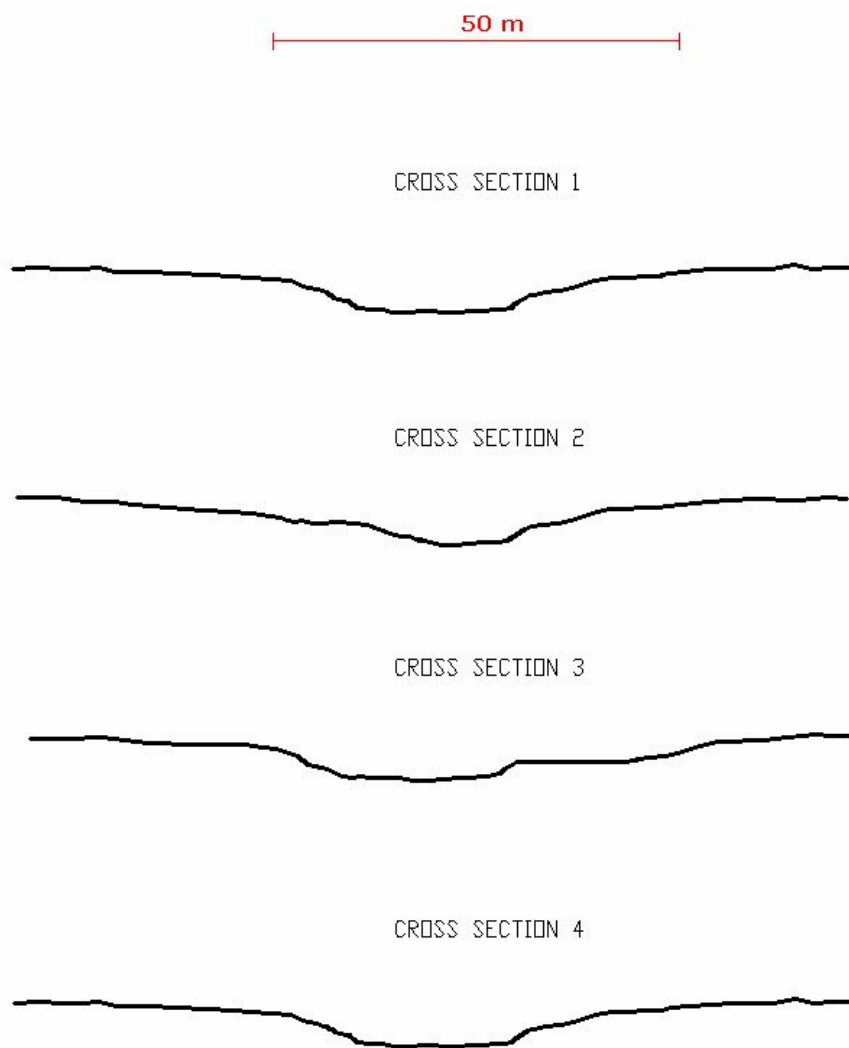
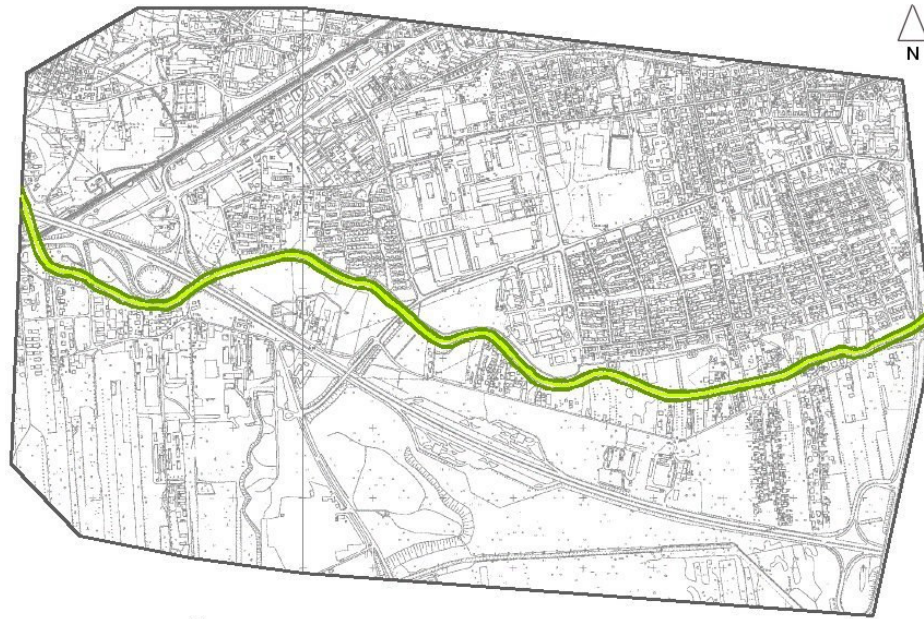


Figure 80 - Cross sections



Legend:

- Study area
- Valley morphology:
Large broad floodplain
 Asymmetric
- Disturbance of natural dynamics:
Highly disturbed
 Moderately disturbed

0 500 1000 m

Figure 81 - The Mali Graben river study area

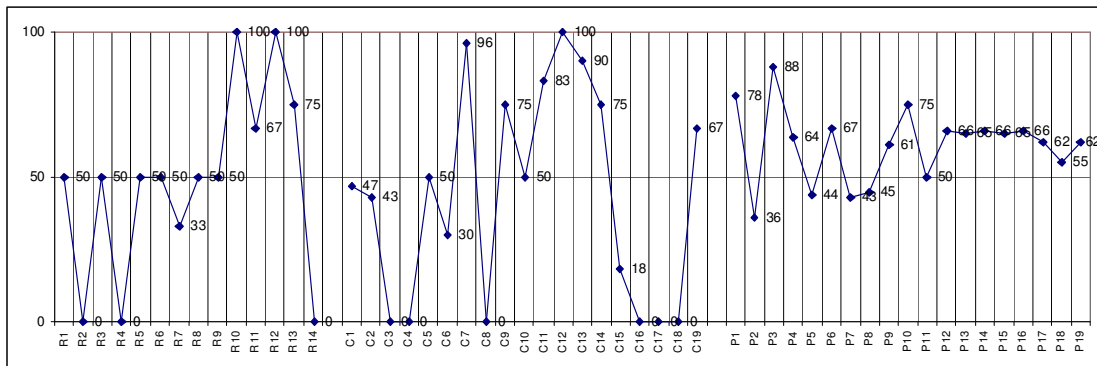


Figure 82 - Profile of aesthetical performance for the Mali Graben river

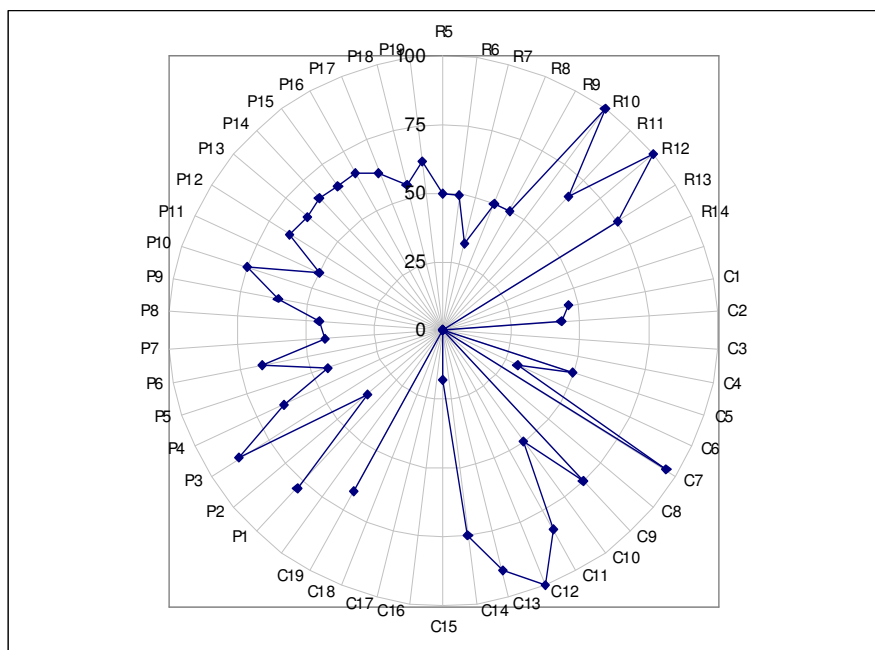


Figure 83 - Radar diagram of the Mali Graben river performance



Figure 84 - The Mali Graben river



11.3 THE GLINSCICA STREAM

Study area description

The Glinscica stream has its source under the northeastern slopes of Toško čelo and at Podutik passes into the plain area of the Ljubljana Plain. The topography of the basin is comprised of a hilly area to the east and west and a plain area that spreads out in the southern part. The relief of the Glinscica drainage basin is versatile, comprising hilly headwater areas as well as plains. The characteristics of surface runoff vary in relation to relief characteristics, vegetation cover, earth composition, the proportion of permeable and non-permeable surfaces. The plain area of the drainage area is of poor permeability. The Glinscica headwater reaches northwards to the slopes of Toško čelo and Črni vrh, the divide towards east reaches into the urban areas of the Municipality of Ljubljana (Dravljje, Šiška), across Šišenski hrib, Rožnik and flows into the Gradaščica, presenting the southernmost point of the basin. Westwards, there is a divide through an urban area across Brdo and as far as Tičnica, where it changes its course towards north across Stražni vrh hill, Preval to Toško čelo. A major tributary of the Glinscica is the Pržanec, whose headwaters reach into the Velika trata and Mala trata slopes; it diverts water from the mostly plain area east of the Glinscica. The precipitation watershed area of the Glinscica comprises 17.4 km². The position of the runoff within the urban area is determined by the removal of rainfall water by way of a sewage system, thus the orographic barrier fails to coincide with the Glinscica drainage. The total drainage area of the Glinscica up to its outlet into the Gradaščica is somewhat bigger and comprises 19.3 km² of the catchment area. This is because the precipitation runoff from the areas between Gunclje, railway, orographic barrier between the Glinscica stream and Sava river catchments, and urban areas at the run-off part of the Glinscica via the stormwater sewer was diverted to the Gliščica stream catchment area. There are an estimated 38 % of urban areas, that is 6.6 km². Due to the extension of the paved, impermeable urban surfaces, especially on the plain part of the Glinscica watershed, the hydrological conditions have changed drastically in the last 20 years. Widely extended urban areas have spread in the areas of Podutik, Dravljje, Koseze and Brdo.



River typology

The catchment area of the Glinscica stream comprises 19.3 km², according to the Strahler stream ordering system, the Glinscica is a 1st order stream. The average width of the active cross section and the average bankful are classified as (0–5 m). In terms of morphology, the valley profile type is mainly a large broad floodplain, except at the joint of the Glinscica corridor with the slopes of the Rožnik hill. In the downstream part of the study area, the river corridor is more densely urbanised (Figure 85). The length of the study reach is 2150 m.

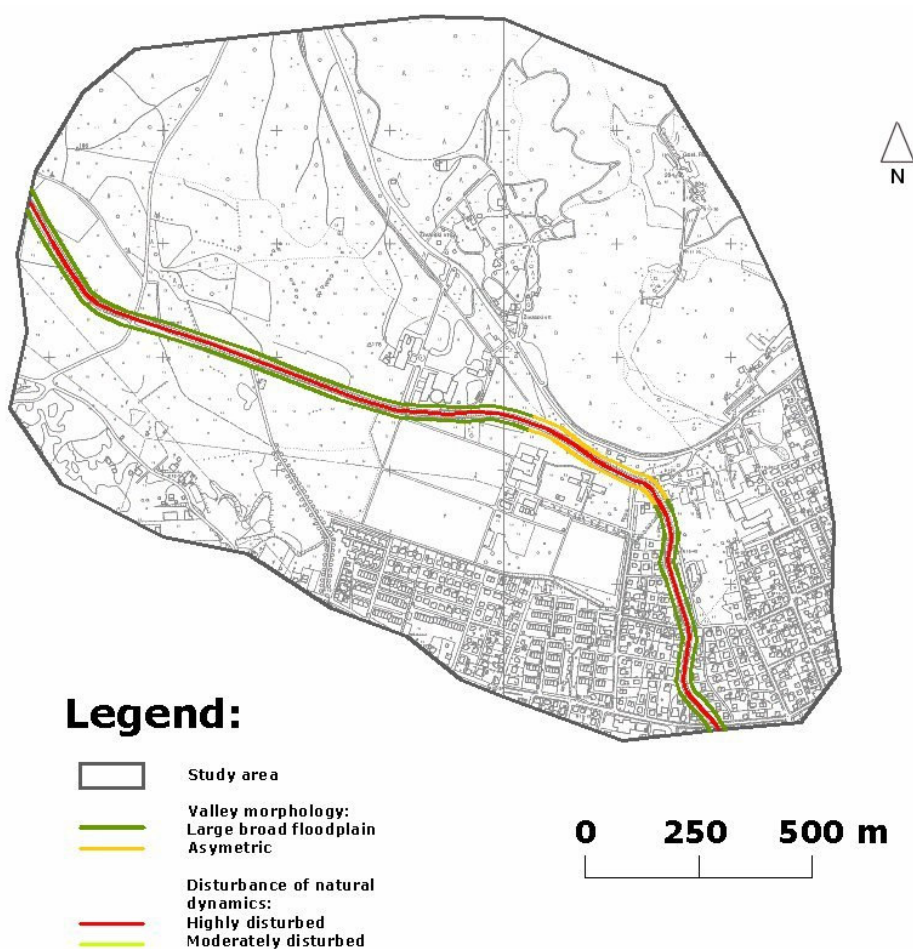
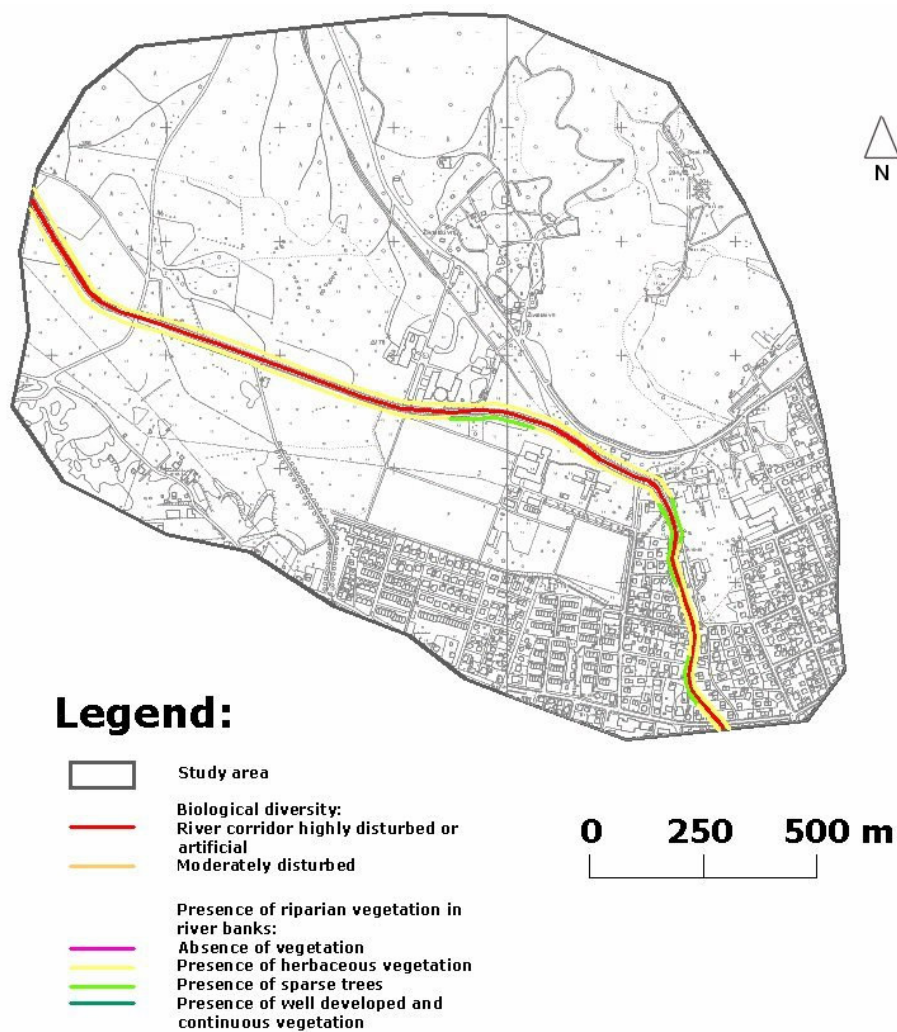


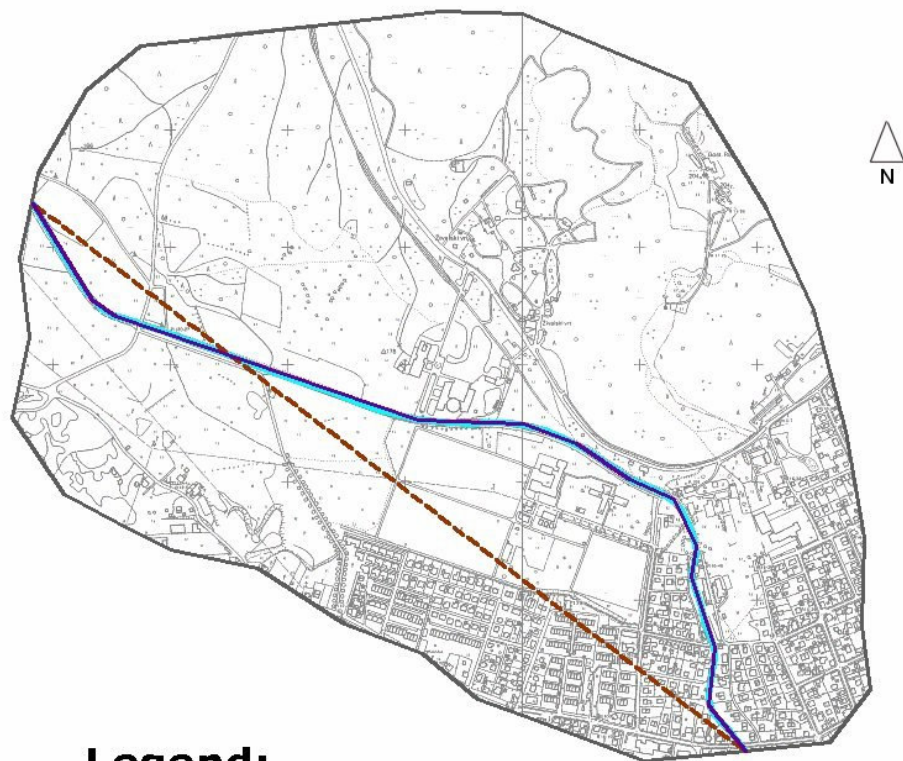
Figure 85



River morphology

The degree of the disturbance of natural dynamic processes in the river Glinscica corridor is high and remains mainly unchanged along the entire study reach. The bottom of the river Glinscica channel is paved with concrete plates, the river banks are technically arranged and grassed (Figure 86). Index of sinuosity of the stream, calculated according to proposed method, is 1.13. The local sinuosity of the Glinscica channel is further diminished due to past regulations (Figure 87). Along the entire study reach, the cross section is of trapezoidal shape with unchanged slope and bank arrangements. The hydro-morphological elements of the natural river channels (runs, pools, riffles, weirs, asymmetric cross sections) were removed from the stream channel during the regulation works (Figure 88).



**Figure 86****Legend:**

-  Study area
-  Glinscica stream
-  Minimum distance
-  Valley length

0 250 500 m

Figure 87

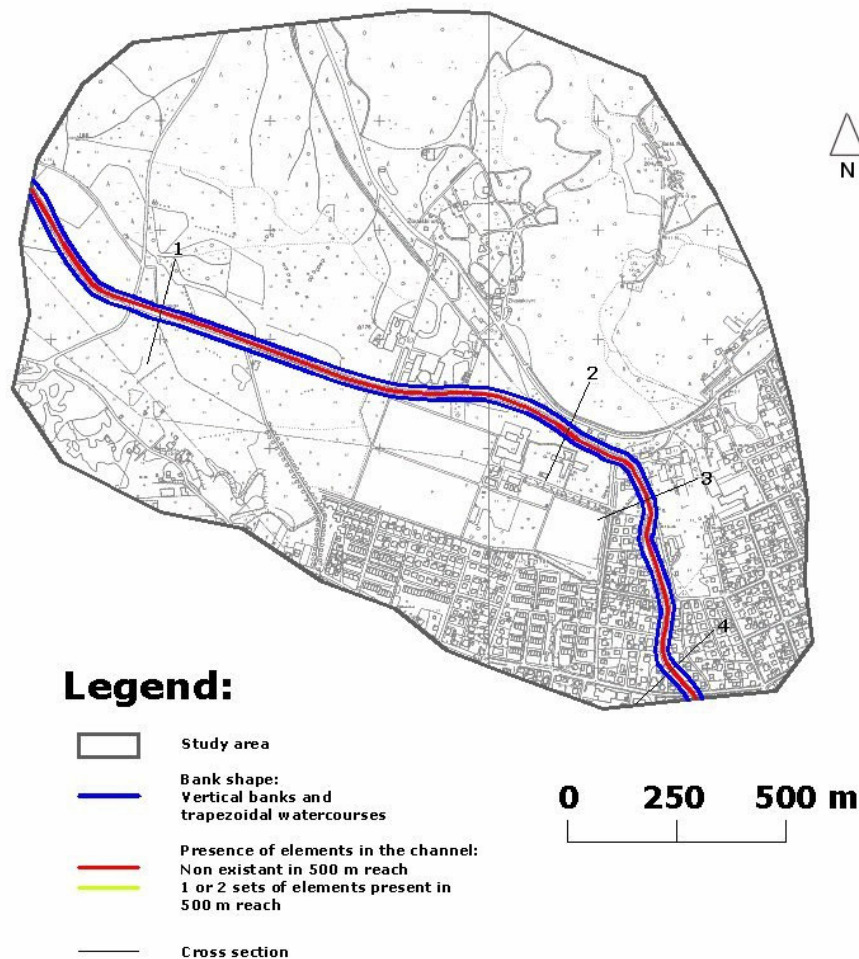


Figure 88

Biological components

The biological diversity of the river corridor was highly disturbed during the regulations. The riparian vegetation was almost entirely removed. In the downstream section of the study reach, the Glinscica stream banks have slowly become overgrown with vegetation, which is advancing from the private gardens along the Glinscica channel. The variety of species of riparian and aquatic vegetation is low (Figure 86).

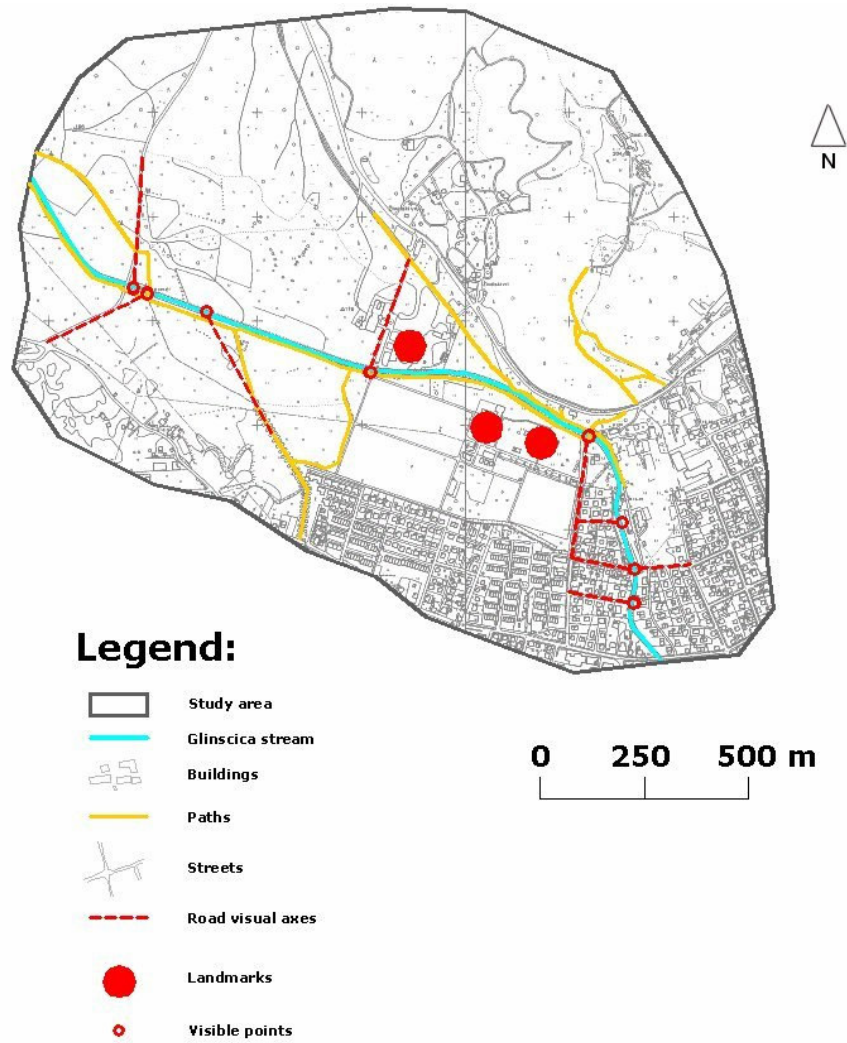


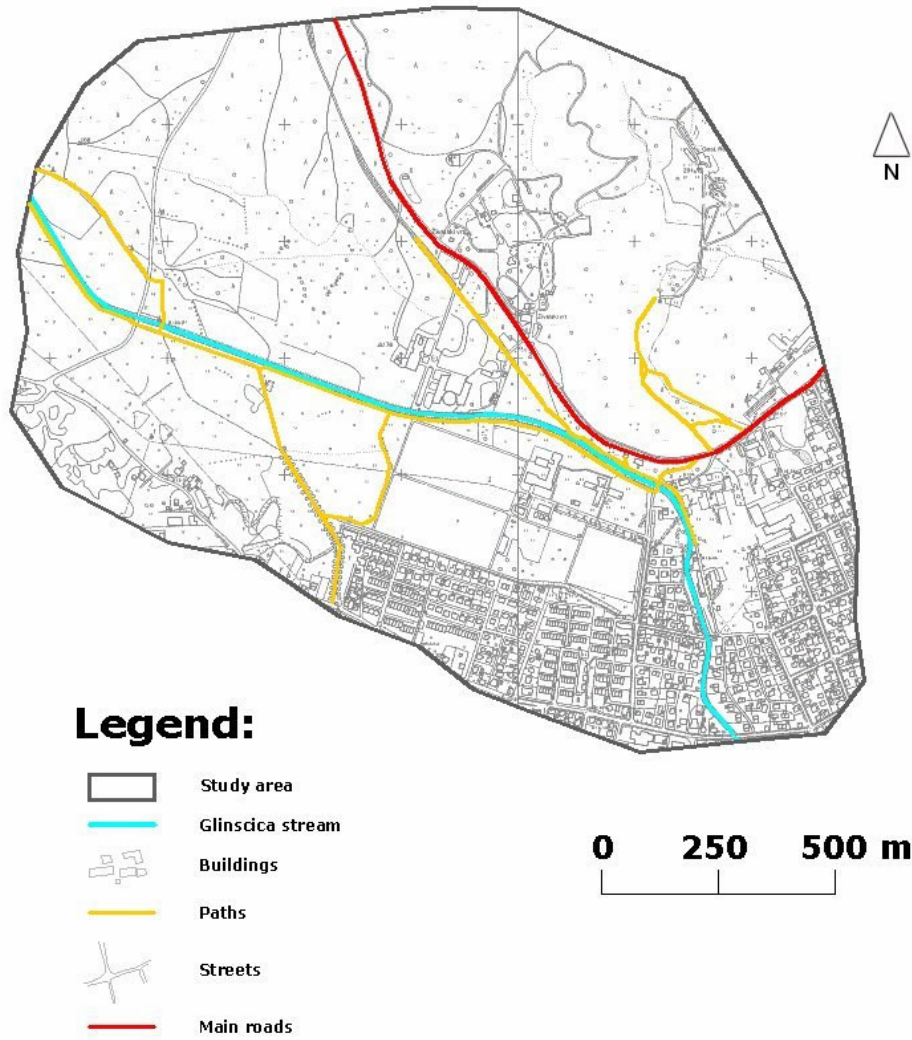
Natural and technological hazards

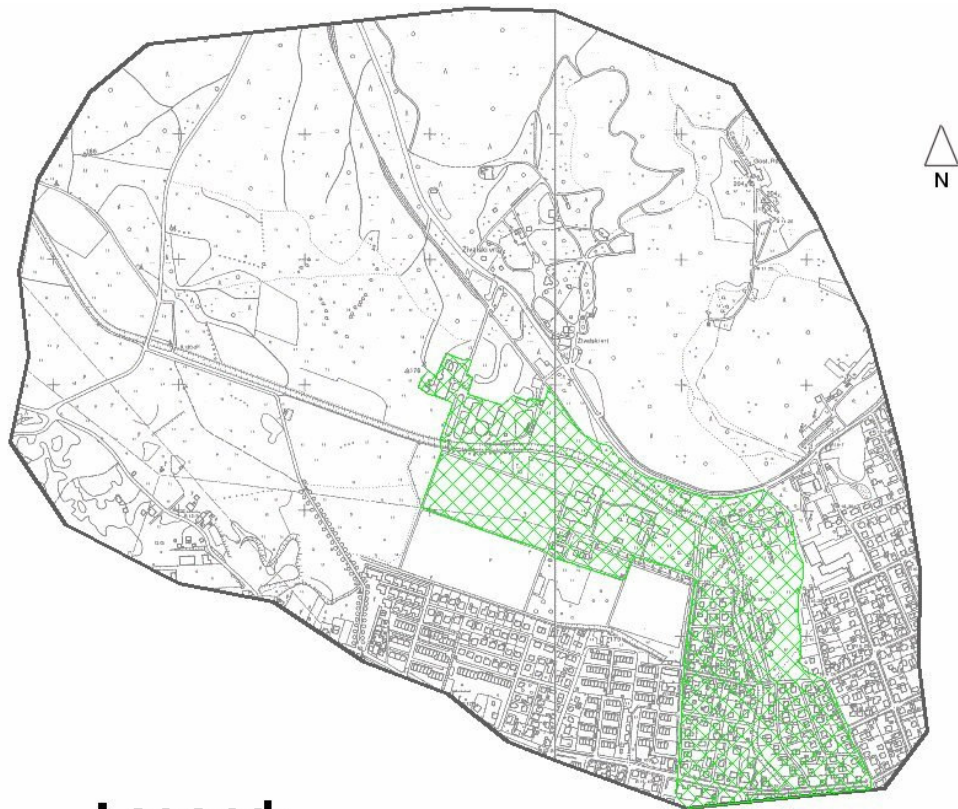
Flood vulnerability of the urban areas in the Glinscica stream corridor is high. We estimate that the area of a 100-year flood event spreads over 75 % of the urbanised part of the river corridor. There are no bank erosion processes and landslide risks present in the study reach.

Urban space quality

The urban and suburban space is characterised by long and wide visual axes of open, mainly unurbanised areas in the upper part of the study reach. In a more densely urbanised lower part of the study reach, the urban visual axes are more narrow and short. The linear density of the visual intersections is 4 visual intersections / km of river length. The average length of the visual axes is 250 m. There are no typical belvederes in the study area, the buildings of the Biotechnical Faculty and the Department of Biology feature as landscape points (landmarks), (Figure 89). For the downstream section of the study reach, quality residential housing in private ownership with good sanitary conditions is characteristic. The sewage system is well developed. The rainfall runoff is diverted into the Glinscica channel through the surface water drainage system. The upper part of the study area is rural, the meadows along the stream are in private property. The path around the city of Ljubljana ("Pot" in Slovene) as an important part of the urban design is in public property (Figure 91, Figure 90). In the study area, the state of the green system is good (Figure 92).

**Figure 89**

**Figure 90**



Legend:

-  Study area
-  Built space quality:
Good quality
-  Medium quality

0 250 500 m

Figure 91

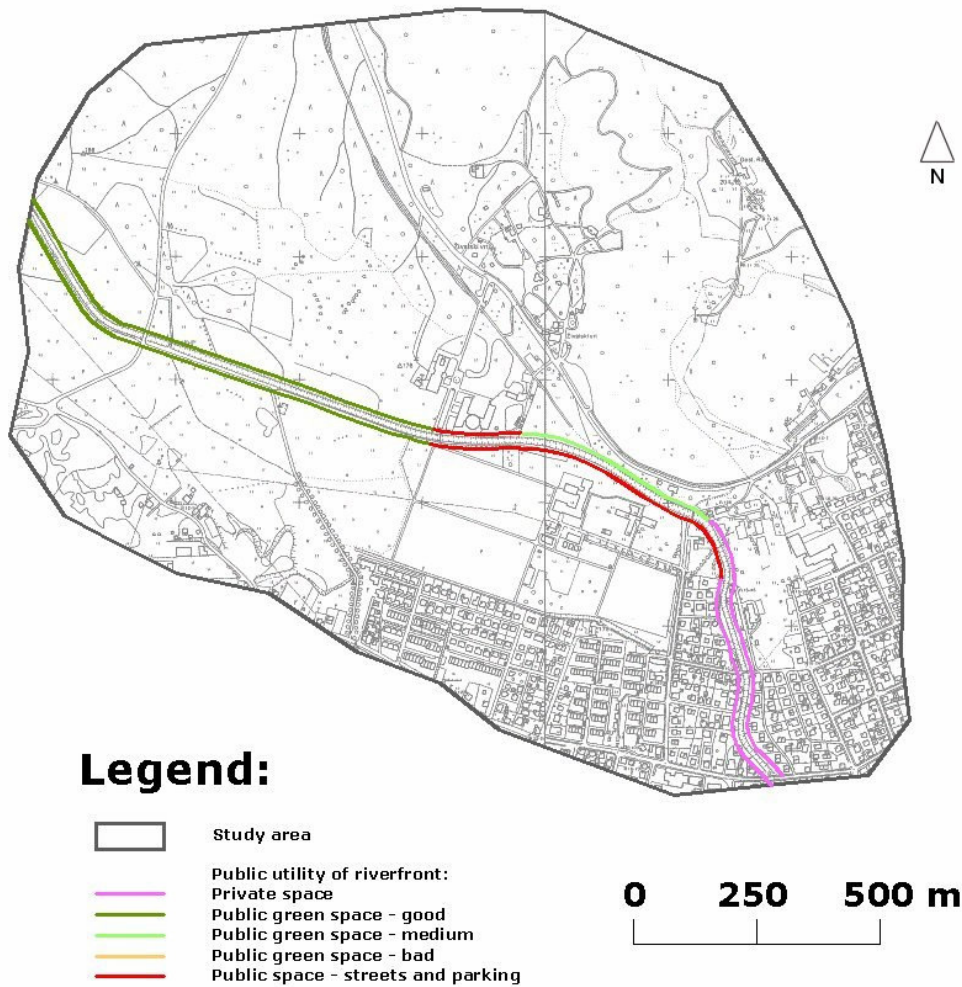


Figure 92

Cultural heritage

There are no elements of cultural heritage within the river corridor.

Activities on the riverfront

In the lower part of the study area, urban activities prevail. The upper part of the study area is open suburban space with the dominance of green areas (Figure 93). The attractiveness of the riverfront area is high in the lower, more densely urbanised area, and also in the upper, open suburban area due to the quality of the residential area and



recreational possibilities (footpaths, bikeways, ZOO, botanical gardens, river crossings, path around the city of Ljubljana) (Figure 94).

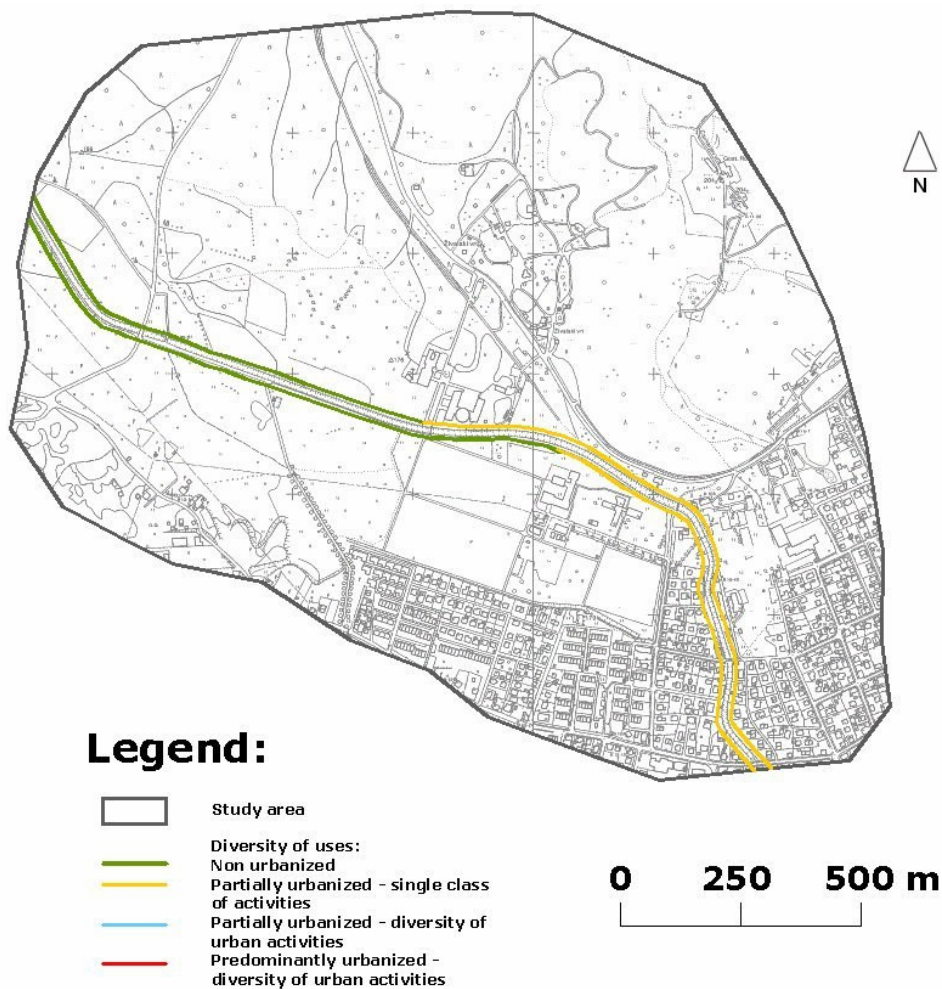
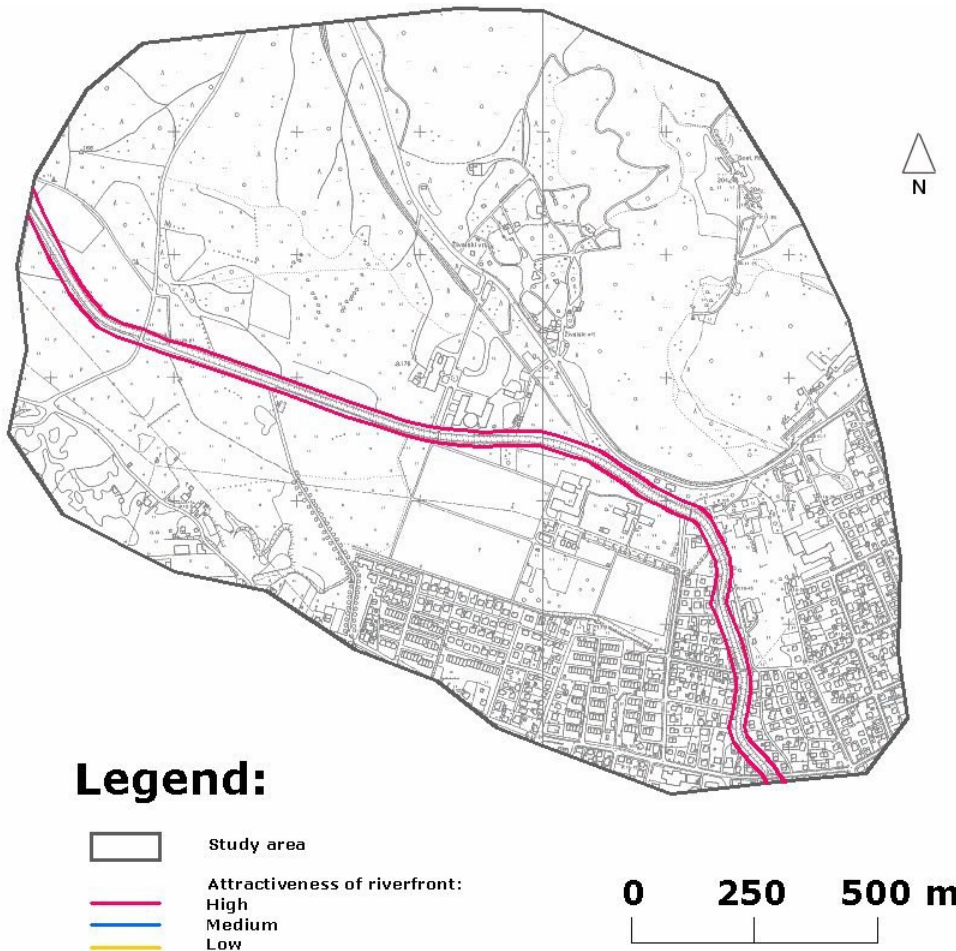


Figure 93

**Figure 94**

Accessibility

In the study area, there are 6 river crossings (two bridges for automobile traffic and 4 for pedestrians and cyclists). Near the Biotechnical Faculty, parking lots are arranged next to the Glinscica channel. The public traffic route passes along Cesta na Brdo Street and crosses the Glinscica channel in the lower part of the study reach. In the upper part of the study reach, there is a well-planned arrangement of footpaths and bikeways along the Glinscica channel. The most disruptive elements in the river corridor are bridges on Cesta na Brdo Street and Brdnikova Street in the uppermost and lowermost sections of the study reach (Figure 95). Because of the size of the Glinscica stream channel, navigation on the river is not possible and there are no anchorage points.

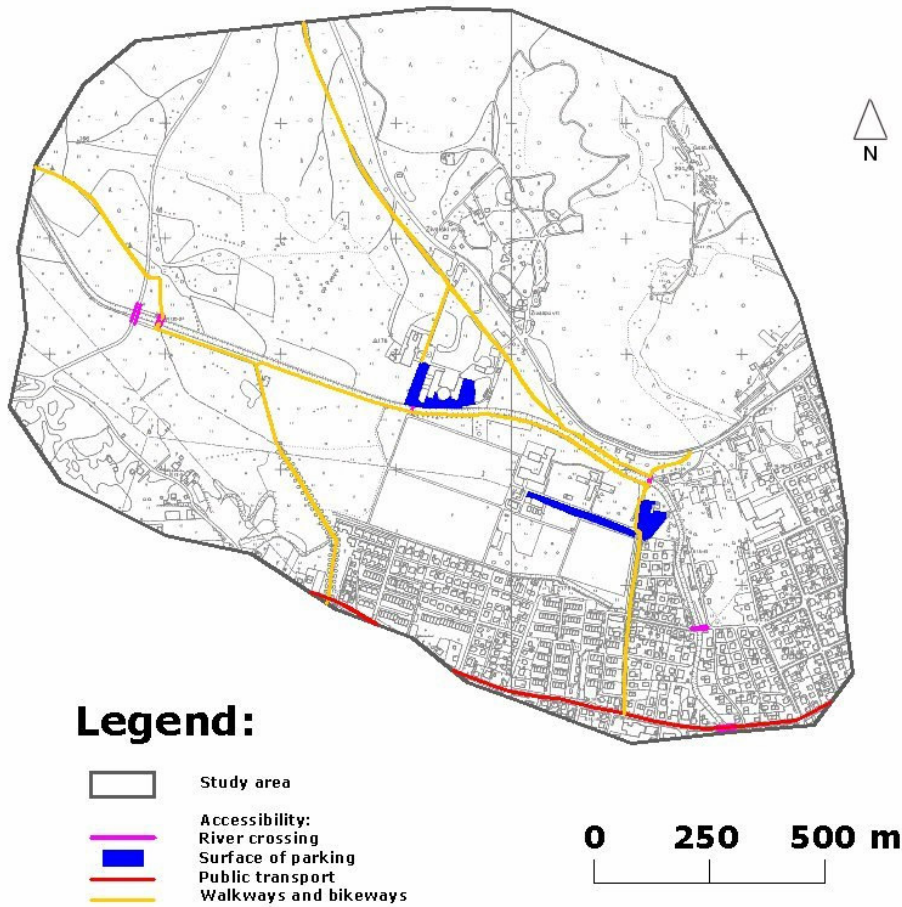


Figure 95

Pollution

In the study reach, the Glinscica stream is not polluted with litter and other pollutants, water has no specific colour and odour.

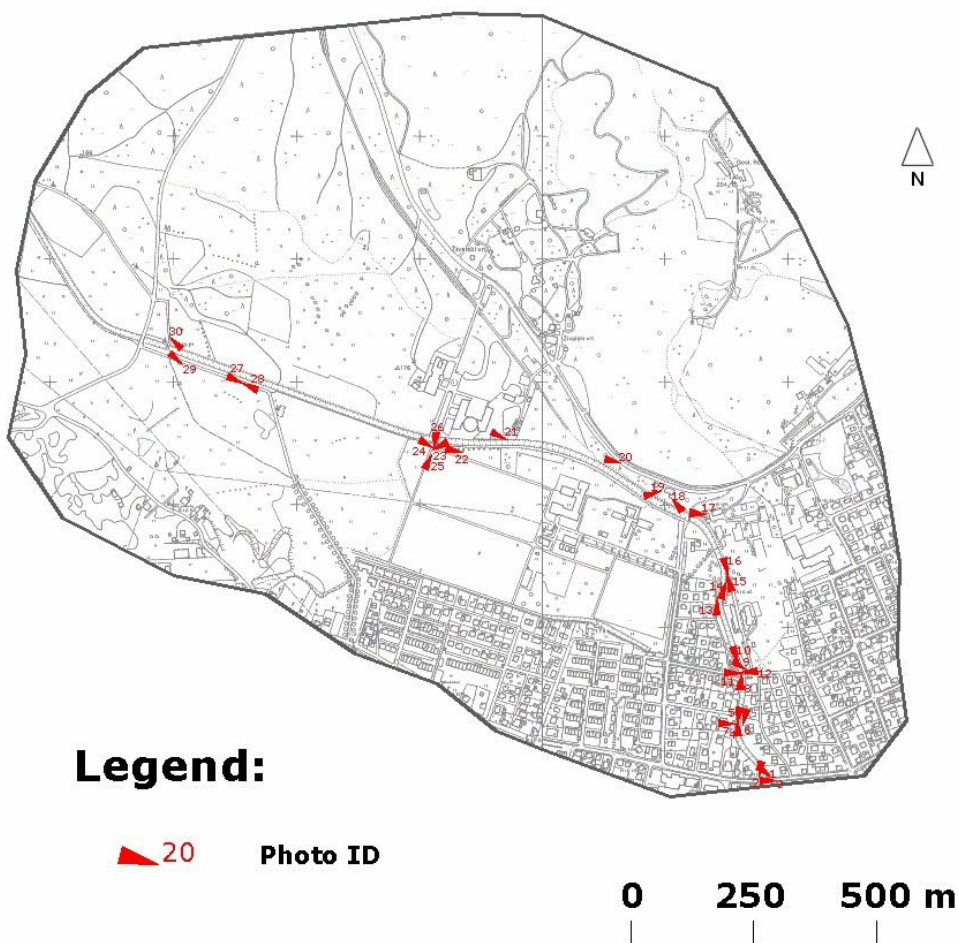


Figure 96 - Position of the Glinscica photos

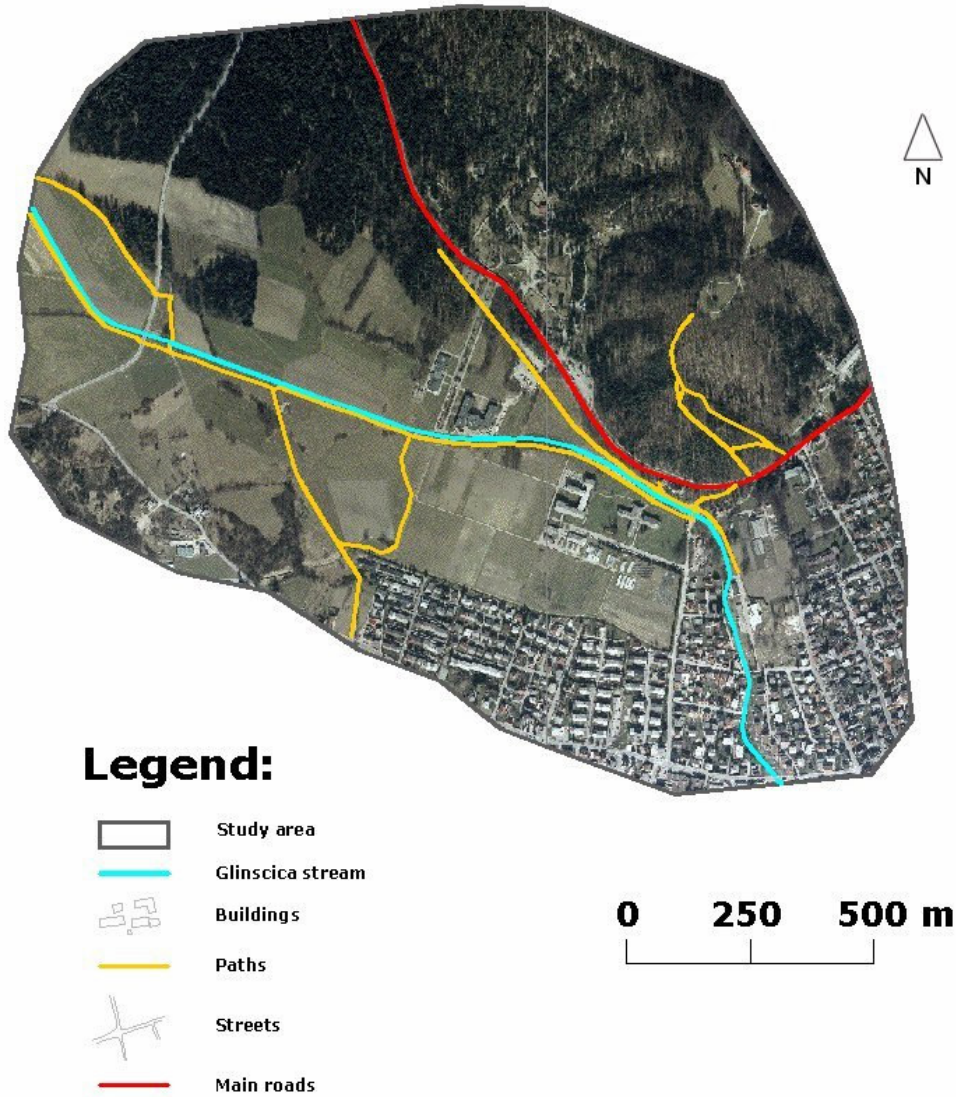


Figure 97 - Aerophoto of the Glinscica study area

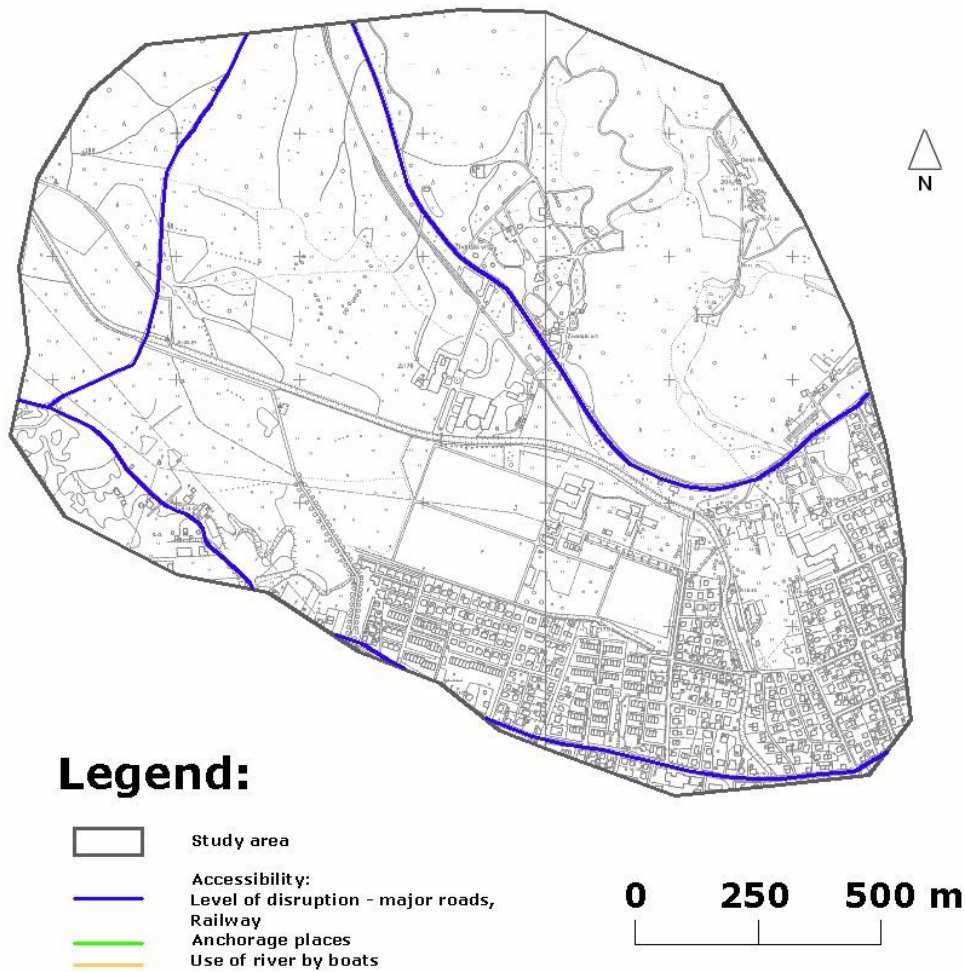


Figure 98 – Accessibility in Glinscica

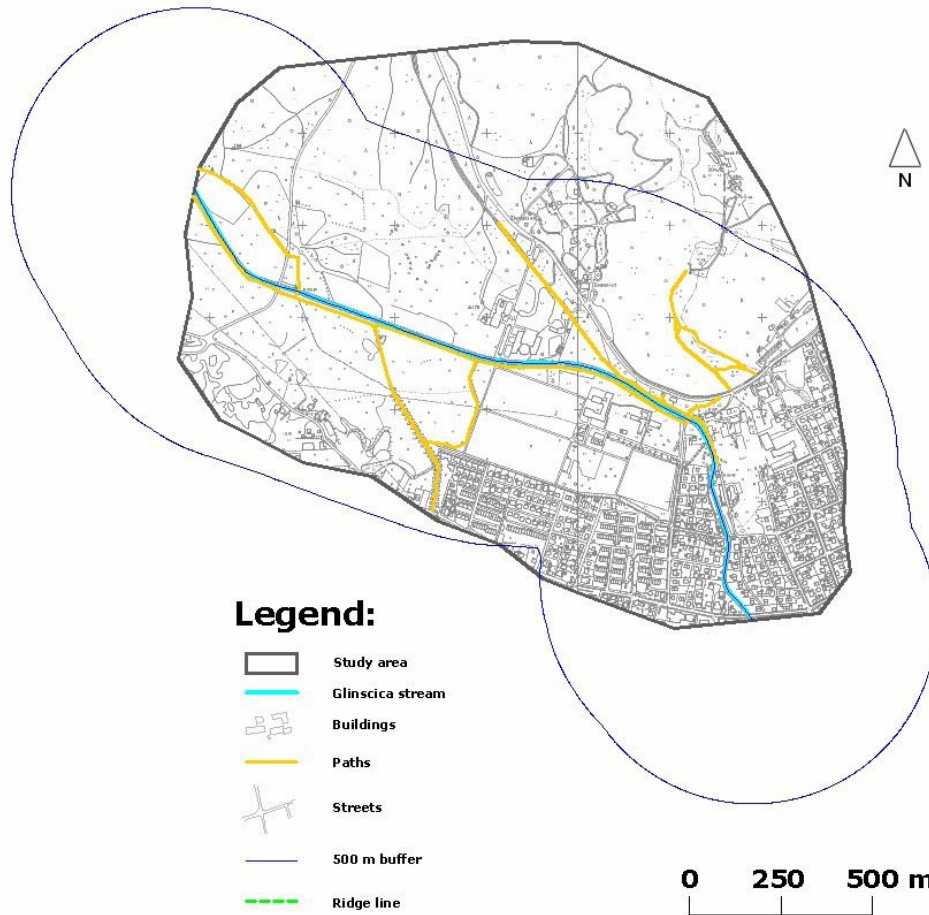


Figure 99 - Delimitation of the study area

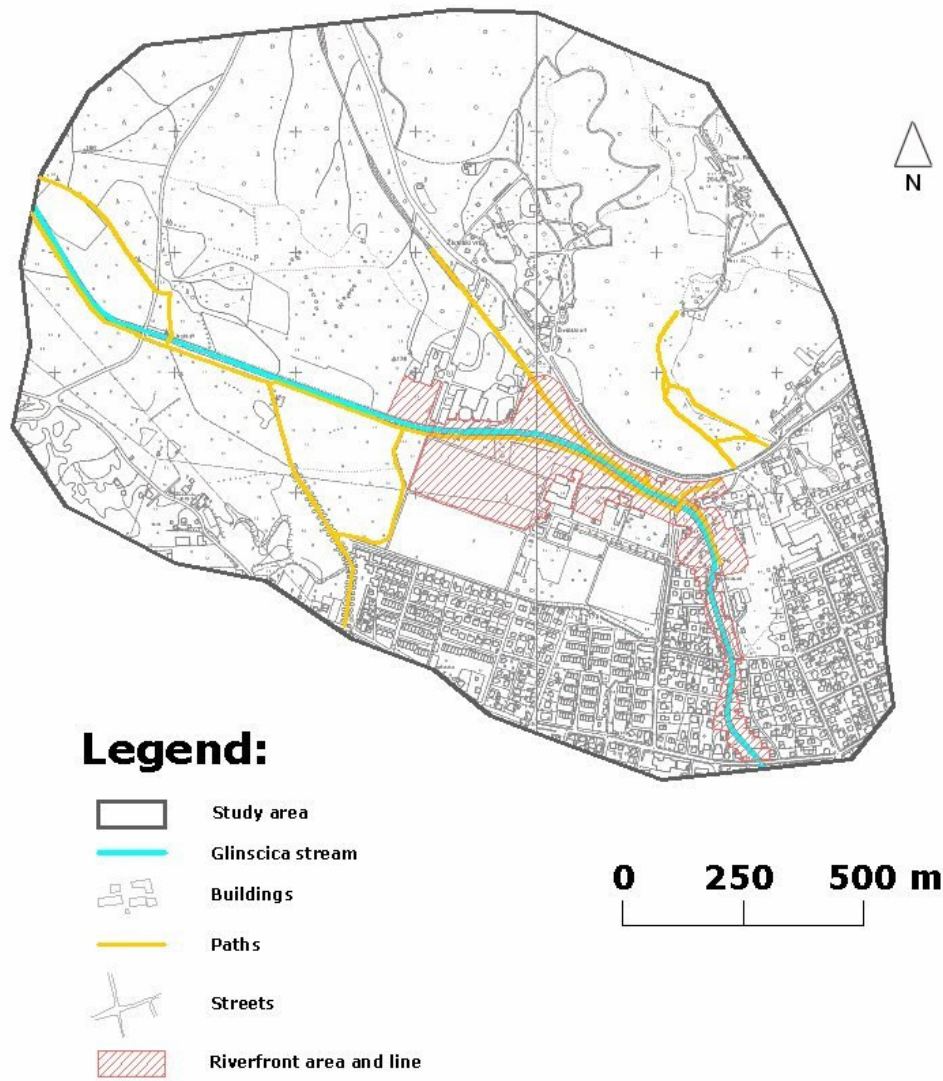


Figure 100 - Riverfront area

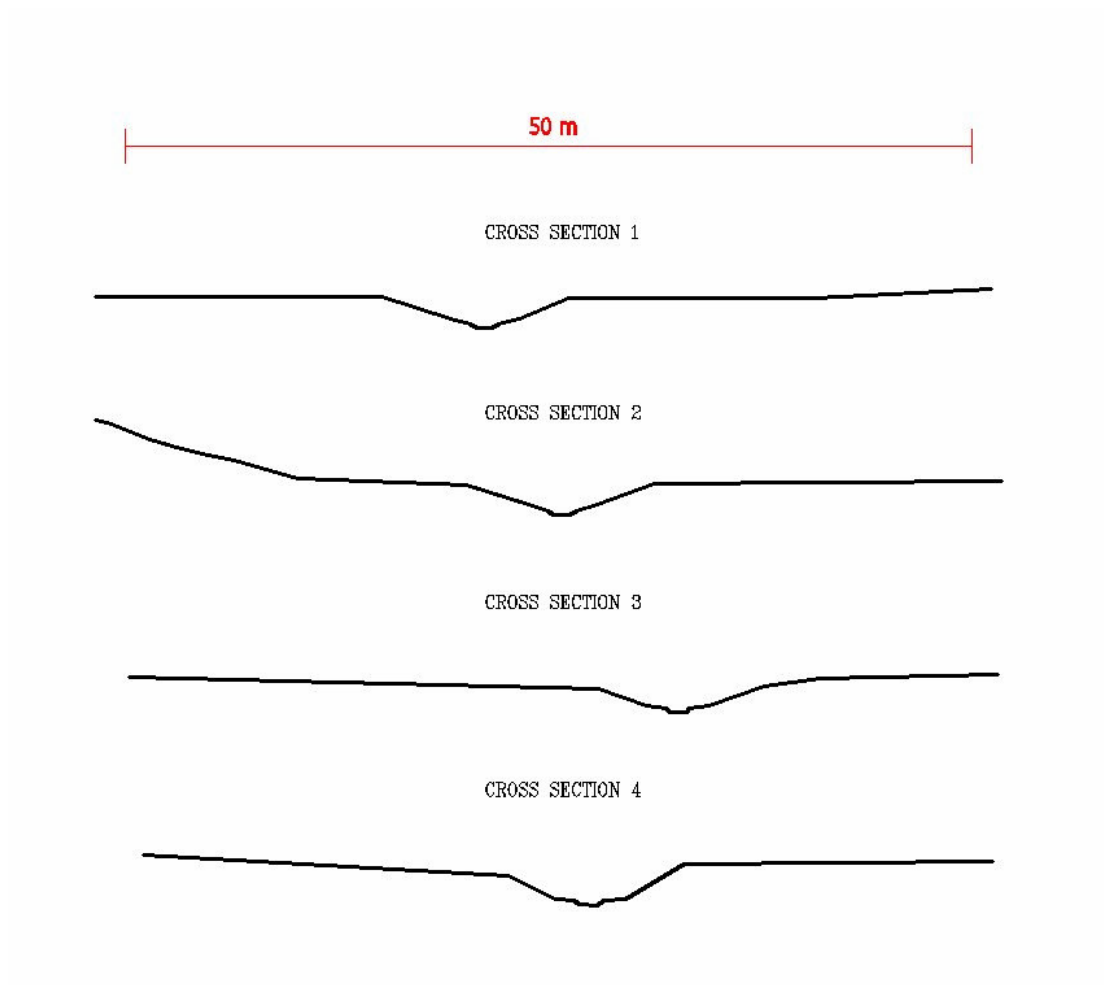


Figure 101 - Cross sections of Glinscica

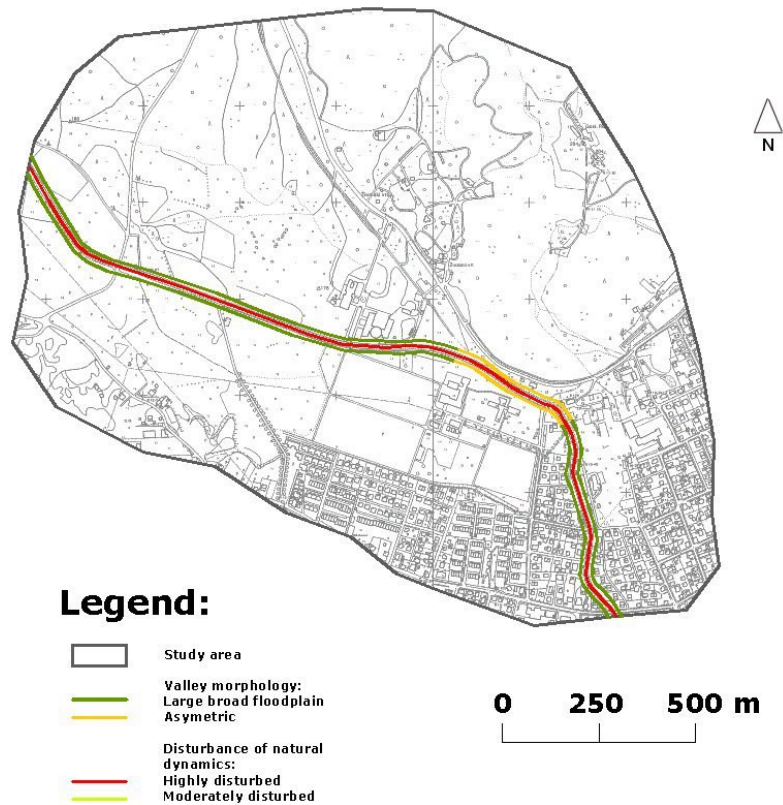


Figure 102 - The Glinscica stream study area

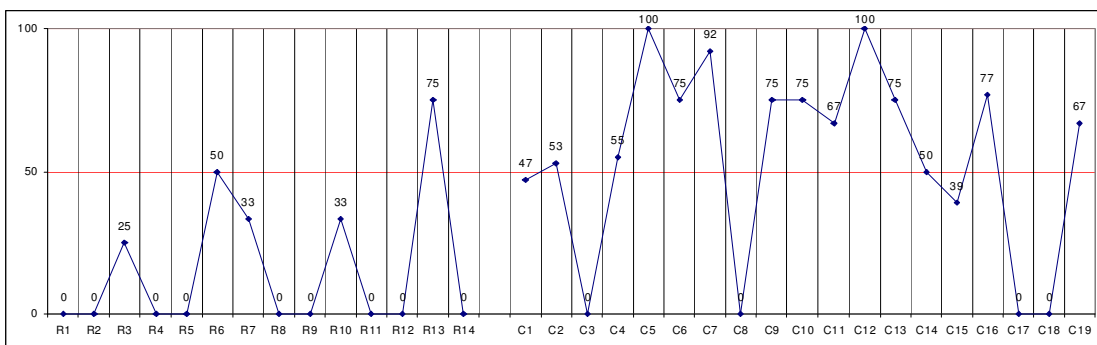


Figure 103 - Profile of aesthetical performance for the Glinscica stream

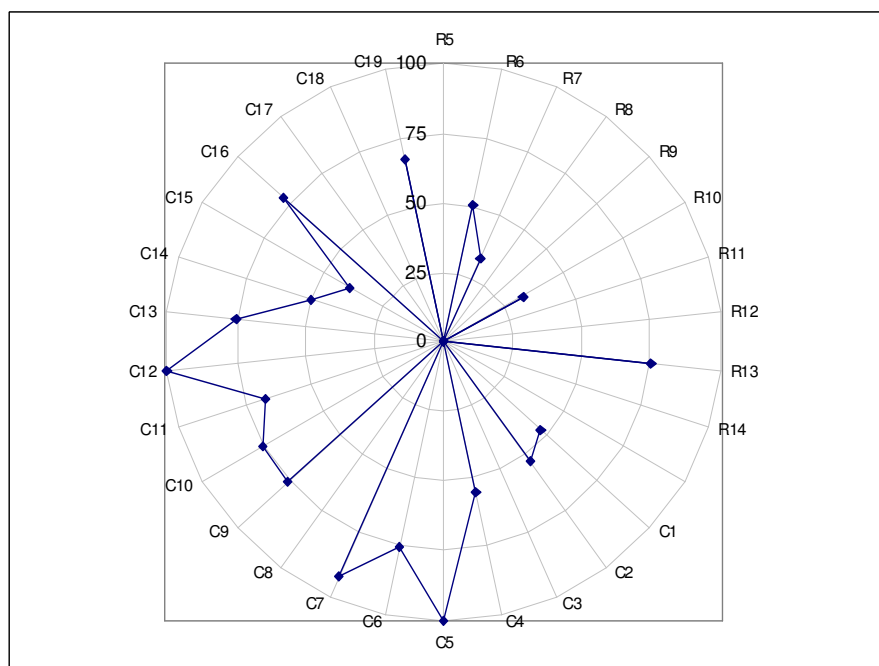


Figure 104 - Radar diagram of the Glinscica stream performance



Figure 105 -The Glinscica stream

12. COMMENTS AND RECOMMENDATIONS

DIMENSIONS “RIVER” AND “CITY”

The results of the method have shown that the aesthetic value of an urban river cannot be equivalent to its hydromorphological state. Accordingly, a hydromorphologically heavily modified test reach of the Ljubljana with concrete embankments through the city centre can have high aesthetic value.

When applying the method, the influence of subjectivity of corresponding viewpoints should be considered (dimension: »city«), where the degree of aesthetic value of a specific viewpoint in a certain area is established on the basis of expert assessment (e.g. most fitting number of potential river crossings in the area, appropriate density of landmarks etc.). Having this in mind, the accuracy and repeatability (robustness of the method) should be checked.



The method cannot be applied in a simple manner. Several data are required, which are often not available for the area (e.g. intensity of construction, number of people that use the bridges daily etc.).

DIMENSION “PEOPLE”

When considering the dimension “people”, the respondents felt the questionnaire was not well prepared and that the questions were too similar and made too little sense. There are some shortcomings in the questionnaire, e.g. the respondents found that none of the answers offered was appropriate. As a consequence, problems emerge in evaluating and comparing the results.

Respondents had many problems with sets of questions A and D. In set A the number of possible answers is not given. People typically spend their weekends elsewhere than their leisure time during the week. In questions 4 and 5 all answers were taken into account, thus the number of answers exceeded the number of respondents.

In set D respondents had many problems when choosing 4 most important aspects of urban river management. For example, some wanted to choose less than 4 aspects and some dismissed all the choices given (in particular with reference to point 3). Furthermore, they had problems with ranking (e.g. they considered all measures/arrangements equally important). This again brought about difficulties in terms of evaluation.

When considering the problems that have emerged in the execution of the survey, it has been established that the survey needs to be improved. We suggest that the number of questions should be reduced; some questions might need rephrasing.



The existing survey can be applied to large-sized or more prominent water bodies in the urban environment (e.g. the Ljubljanica river). Application to small-sized or less important/recognizable rivers is more restricted (e.g. the Glinscica stream). In that respect, the making of a separate questionnaire should be considered.

Presumably, there must have been a mistake in instructions for evaluation of set C “River Perception”, because the proposed evaluation does not make sense. Thus, we adapted the evaluation as follows:

	Distribution of questions according to the instructions	New proposed distribution of questions
Aesthetic	1	1
Water	10	10
Biodiversity	14, 15	13, 14
Risk	6	6
Pollution	2, 7, 8, 11, 12, 13, 29	2, 7, 8, 11, 12
Urban quality	3, 4, 9, 28	3, 4, 9, 27, 28
Accessibilities	17,18,19	16, 17, 18, 19
Infrastructures	20, 21, 22, 24, 25, 26, 27	20, 21, 23, 24, 25, 26
Security	23	22
Relax	5, 15, 30	5, 15, 29, 30
Attachment	31, 32, 33, 34, 35	31, 32, 33, 34

Table 34 - Proposal for new distribution of questions

The evaluation is performed on the basis of a 1–5 grading scale, where positive as well as negative statements are graded on the basis of a common scale. In the next step the statements are joined into sets. The evaluation of a single set cannot be the average value of a single statement, therefore a common procedure of evaluation should be proposed.

Lengthiness can be identified as the primary weakness of the developed methodology. In future, the method should be rationalized by selecting some of the key viewpoints from



each set/dimension and accordingly, by improving (reducing) the scope of the questionnaire.

13. CONCLUSIONS

The application of the method for classification of the aesthetic value of three test rivers in Slovenia has raised some theoretical dilemmas and has also shown certain problems in terms of practical application of the method. In our opinion, the method offers a good basis for further research in the field of assessment of aesthetic value of urban rivers and streams. From the view of further optimisation of work procedures and methodological processes, some recommendations and comments should be considered. This could be done through involvement of the existing methods for the analysis of the quality of the visual environment and established procedures for restoration or rehabilitation of urban rivers and streams in combination with the experiences gained through practical realisation of such projects.

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