Urban River Basin Enhancement Methods

Classification of the aesthetic value of the selected urban rivers – Methodology –

Project Deliverable 4-2

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Summary

This document aims at reporting on the approach pursued to establish a methodology to evaluate and classify the aesthetic values of urban watercourses. In the framework of the URBEM the overall aim is the integration of these aesthetic values, that can have both tangible and intangible dimensions, into decision making process for river rehabilitation. Together with these issues, it was intended to analyse the debate on river landscapes quality perception and evaluation, based mainly on expert assessment, but integrating also results deriving from public surveys.

CESUR-IST/UTL methodology for the assessment of river corridors is focused in the aesthetical value in order to guide rehabilitation interventions at city scale to make the most of their potential aesthetical value (Part I). Closely linked to this methodology TU DRESDEN developed a “Site method for aesthetic evaluation” that aims at being specially designed for assessment of project sites before and after improvement (Part II) focused on the project scale.

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Part I -

Classification of the aesthetic value of the selected urban rivers: Methodology

1 Introduction

This report intends to state the steps followed on our search to establish a methodology for evaluating river aesthetics.

Aesthetic values of river corridors can be considered as a specific contribution for a global assessment of those systems, in the framework of the URBEM project. The overall aim should be the integration of these aesthetic values, that can have both tangible and intangible dimensions, in the decision making process for river rehabilitation. Together with these issues, it was intended to analyse the debate on river landscapes quality perception and evaluation, based mainly on expert assessment, but integrating also results deriving from public surveys.

Some questions have been raised in the beginning of the study aiming to establish levels of answers that could organize our research.

These questions and their level of possible answers can be illustrated in figure 1.

Why	Aesthetic values should contribute to urban watercourse rehabilitation? To assess the aesthetic appeal of a river corridor? Aesthetic evaluation should be done?	**PARADIGMS**
What	To do in terms of aesthetical evaluation? Approach (es) can be used?	**METHODOLOGIES**
How	To do it? To assess / evaluate aesthetics?	**TECHNIQUES**
Where	urban watercourses to study	**CASE STUDIES**

Fig. 1 – Main Questions

So, in our point of view, aesthetic quality in the urban environment can be considered as a complementary dimension of sustainability, which should be achieved together with other components of sustainable development, such as economic, ecologic and social aims. This assumption means that aesthetic quality, in our concept, goes

beyond an external/visual appearance and should be observed through a more comprehensive approach related with other dimensions of the urban landscape.

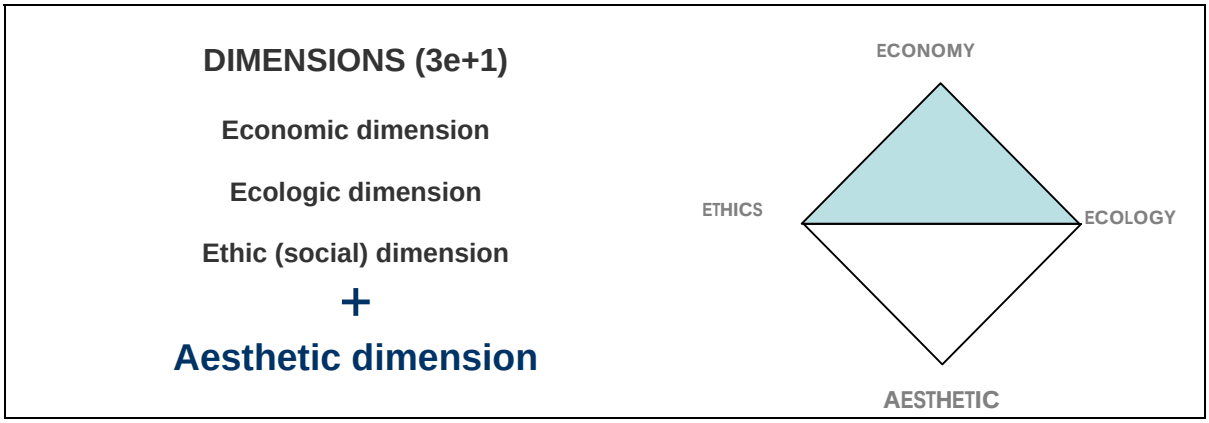


Fig. 2 – Sustainability Paradigm

Aesthetic appreciation and evaluation is actually an important concern in the field of environmental awareness and planning. The balance between natural and human environments has always been a field of interest in human societies, in a search for beauty, delight and balance of human works and their environmental relationship.

Thus, environmental aesthetics is becoming an interdisciplinary field of research, crossing disciplines so diverse such as geography, planning, landscape architecture, psychology, and philosophy, among others. This recognition shows that aesthetic values in the environment are a raising issue, as an important complement area of research such as sustainable development, planning and resource management (Berleant, 1997).

Rivers and cities are systems that have their own patterns, originated by physical and functional characteristics and conditions. Rivers are mostly natural systems, influenced by geomorphology and climate, showing specific hydrologic, hydraulic and ecological processes and patterns. Human use and appreciation of rivers relies on their physical characteristics but also on formal and phenomenological aspects, such as unity, contrast, identity, reflection and several other visual and aesthetical attributes, recognized worldwide.

Cities are built by people for people to live. Their historical, social, cultural and economic context makes them social systems with a high degree of complexity. Quality of life and of the urban environment is actually a high valued attribute in terms of achieving aims of urban sustainability. The balance between natural features within

the urban environment is actually a relevant issue in the search for a sustainable urban planning and management.

On the other hand, people are the constructers and therefore users of cities. Urban quality of life is a very important aim to be achieved by local decision makers and citizens. Quality of the urban landscape is one of the contributing attributes for a pleasant urban life, where aesthetic awareness and aesthetic values play an important role in the overall appreciation of the urbanity. Physical settings influence human inhabitants and contribute to their well being and satisfaction. On the other hand, human beliefs, values and attitudes shape their environment and their degree of satisfaction about it. Public perception of the urban landscape and its involvement in their management are critical issues when considering sustainability as a target for urban rehabilitation.

Environmental aesthetic evaluation can be envisaged within the theoretical field of landscape perception and evaluation. This area has a wide scientific contribution deriving from landscape architecture and planning, environmental psychology, environmental aesthetics and natural resources management. Several approaches and methodologies have been developed, since the sixties, to assess and evaluate landscape and scenic values, aiming to integrate these values into the planning and design process.

Aesthetic values can be assessed through different approaches and motivations. The literature reviewed establishes several approaches, from the expert or professional point of view, concerning technical aims and the integration in the planning process. Other approaches come from the social sciences framework, namely from the environmental psychology, integrating behavioural studies related with public perception and public preferences for scenic and aesthetic values. Other approaches are more concerned with the intangible, sensorial and emotional aspects of landscape appreciation, named as humanistic or phenomenological approaches.

Table 1 summarizes a synthesis of different approaches proposed by several authors in this field, aiming to synthesize the motivations and methods underpinning the complex framework of landscape and scenic evaluation.

Table 1 - Synthesis of methodologies for landscape aesthetic evaluation

Zube *et al.*, 1982	Zube, 1984	Daniel & Vining, 1982	Porteous, 1982
Expert Paradigm	Professional Paradigm	Formal or Ecologic Aesthetics	Planners
Psychophysical/ Cognitive Paradigms	Behavioural Paradigm	Psychophysical/ Psychologic	Experimentalists
Experiential Paradigm	Humanistic Paradigm	Phenomenological	Humanists
__		__	Activists

Recent developments in this field show the need to integrate and cross those approaches in order to attempt, as much as possible, the complexity and subjectivity of aesthetic values. The use of mixed methodologies is been recommended, crossing expert approaches with other that involve public surveys, either measurable criteria and parameters together with subjective and intangible assessment (Bell *et al.*, 2001; Porteous, 1996; Saraiva, 1999).

This was one path followed by our team, looking for attributes to classify the aesthetic quality of an urban watercourse using not only expert methodologies but also behavioural and phenomenological approaches. The integration of the results obtained trough this approaches will be preformed trough multicriteria techniques.

2 The methodology

2.1 Multicriteria approach

The field of multiple criteria decision analysis (MCDA), sometimes named as multiple criteria decision aid or multiple criteria decision making (MCDM) has been fully developed in the last 30 years, by increasing its methodological foundations and widening its scope of applications. In this process several disciplines have been included in these multicriteria techniques, in the procedures and in the methodologies, thereby enriching the practice of multicriteria evaluation.

MCDM issues are generally related to different choices or courses of action. We need to select when some standard of judging conflicts with to a substantial extent. As in everyday decisions we often need - explicitly not consciously - the consideration of multiple factors ("criteria", in general sense). Multiple criteria decision aid has emerged when decision makers, faced with complex decision problems, recognized the need to have some methods for organizing and synthesizing information in such a way that they feel comfortable and confident to make a decision. Multiple criteria decision analysis is "umbrella terms to describe a collection of formal approach which seek to take explicit account of multiple criteria in helping individuals or groups explore decisions that matter" (Belton, 2002:2).

In evaluation processes, where a great diversity of units of measurement and valuation procedures should be taken into account, MCDA becomes a "natural" – if not inevitable – approach for organising information and structuring the problem following a more rational way of evaluating. A multicriteria methodology can be also applied to plans monitoring by an *in continuum* evaluation (Silva, 1999).

Aesthetics is a subject where all the people as something to say – to like, to dislike or even to express their indifference to the subject. Aesthetics, also supports evaluation discourses by experts fully based in holistic approaches, giving rise to the consideration of a wide set of subjective values. These values are not always very well apprehended or perceived by people/users or even by experts that usually don't work in this domain. Aesthetic values are also influenced by socio-economic and cultural aspects of society, which make even more difficult any evaluation procedure that seeks to evaluate urban rivers in different political, societal and cultural contexts.

In this problematic area - the problem of general aesthetical classification - we should not to expect to find the "right answer", the "right model" or the "right prescription" to apply or adopt. The optimisation paradigm, in our perspective, should not be adopted here.

In the literature, there are several methods and techniques developed in different domains, as mentioned before, which are related with some specific subjects of aesthetical evaluation. Considering this diversity, a multi-methodology can be a well-supported approach to deal with several perspectives by combining different methods and techniques.

Multimethodology just means, to employ more than one method or methodology to tackle real-world problem in the complexity of this project. We will adopt here the three main arguments referred by Mingers (2001:289):

a) Multimethodology is necessary to deal effectively with the full richness of the real world, especially with aesthetical aspects which are inevitably multidimensional;

b) Combining different methods and approaches may well yield a better result;

c) This combination can generate new insights and provide more confidence in the results by validating each other.

Habermas (quoted by Mingers, 2001: 290) developed a framework that considers the advantages of viewing the world not only through a particular instrument but by accepting different representations or general ways of looking at the world, also known as paradigms. In this framework, he suggests the usefulness of distinguish our relations to and interactions with three worlds: (i) the material world; (ii) the personal world and; (iii) the social world. The first is the physical world and is more or less independent of human beings, the second is the world of individual thoughts, emotions, experiences, values and beliefs and the third is the world that we share and participate in, a complex set of language, meaning, social practices, rules and resources that enables and constrains our actions.

The *Three Worlds* of Habermas inspired our urban watercourses aesthetical multicriteria evaluation approach. In fact we can find in a River some aesthetical attributes that are intrinsically connected to its natural and physical components where our relationship to this world is mainly the observation. The river "existed before us and would exist whether or not we did. We can shape it through our actions, but ultimately we are always subject to its laws" (ibidem). Some aesthetical attributes are more related with individual emotions and the way we experience and value the presence of the watercourse. Others are more related with the social world that, in this context, we represent by the City as a social construction.

Some of these cities have been developed beside rivers in a deterministic way to benefit from its presence (transport, water resources, and alluvium soils). Throughout time, rivers have been modified according to development society need. Within the actual framework of a more balanced development that takes into account

environmental, social, institutional and economical perspectives, the rehabilitation process of urban rivers demand for a more sustainable action.

Therefore, we established in our research framework a three dimensional approach based on triangle vertex – River, City and People. Aesthetic quality of an urban watercourse depends on several attributes that can be related with each one of these dimensions and also in their relationships.

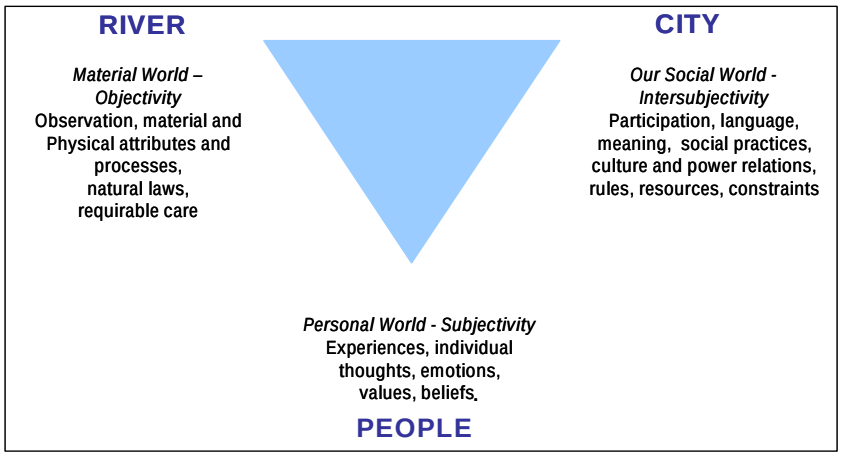


Fig. 3 – River-City-People framework

2.2 The process

There are on MCDA literature several perspectives and approaches in terms of process, i.e., how to deal with a given problem in a pragmatic way (see Bana e Costa, 1992; Belton, 2002). For the purpose of this work we have chosen the process proposed by Valerie Belton and Theodor Stewart (2002), which can be grouped in three key phases:

a) Problem identification and structuring – to opening up the issue, capture and manage the complexity and begin to understand when the decision makers feel comfortable and agree with some representation of the complexity and how they might move forward;

b) Model building and use – seeks to extract the essence of the issue in a more convergent mode of thinking in such a way that can be possible to elaborate more detailed evaluation of potential ways to progress;

c) Action plan – the final phase is related with outcomes and recommendations, aiding satisfying decisions that have to be taken and informing the development of an action plan.

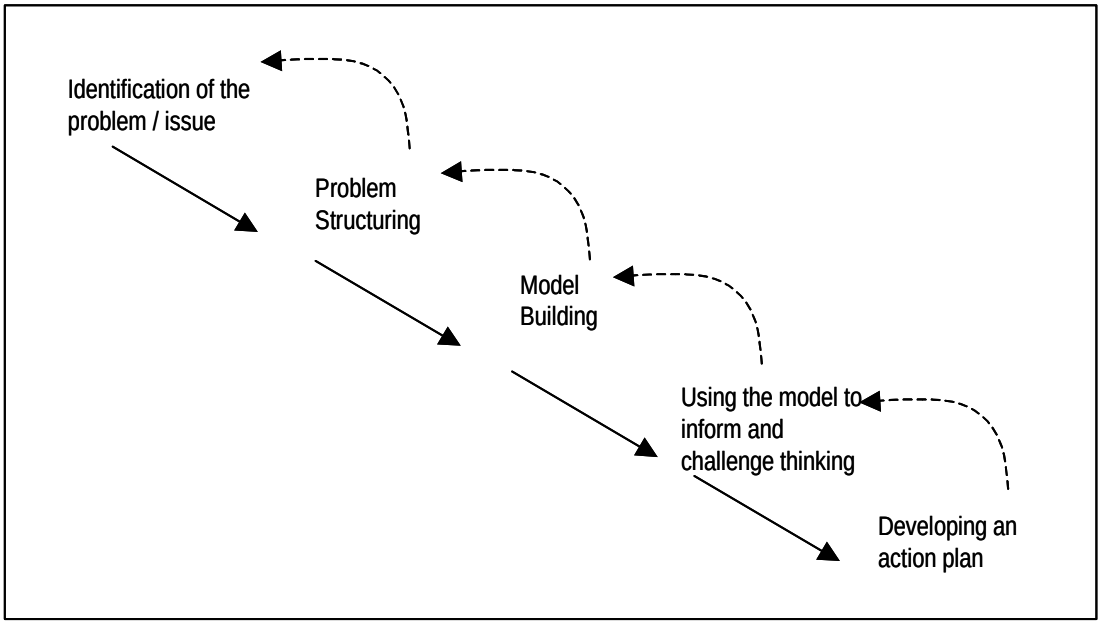


Fig. 4– The Process of MCDA (Belton, 2002)

As indicated in Fig. 4 one can expect some interaction within and between the key phases of this process that can likely to be exposed to several internal and external influences and pressures.

2.3 Identifying the problem

As mentioned in the URBEM project one of the main objectives is related to the development of a procedure or methodology to evaluate urban rivers / watercourses focused in their aesthetical value in order to guide rehabilitation interventions to make the most of their potential aesthetical value.

In this context the object to be evaluated will be urban watercourses – previously identified in a set of existing case studies – where this methodology can be applied.

To evaluate urban watercourses should also means to be able to compare their performance according to their present and potential aesthetical values and to be able to recognize some sort of general classification of those rivers. Usually, classification means to put in classes or categories, following one or several criteria (sorting problematique). But we should also admit that it could be interesting to place watercourses in some form of preference ordering (ranking problematique) (Roy, 1996) to distinguish the best from the worst examples in terms of some aesthetical characteristics.

The third aspect represents the true challenge of this work. It means that we have to find the main characteristics, to describe then to organize ideas and to make clearer the meaning(s) of aesthetic value of urban watercourses. What will be the factors that can explain the aesthetics of the river that can benefit or damage its value(s). How to make operational, as much as possible, some sort of procedure or methodology that may help decision makers or technicians to assess present situations, to decide on future rehabilitation action tacking in account this aesthetical dimension as well as reference standards specific to each case studies. The following chapters will try to clarify these issues.

2.4 Structuring the process

In the area of Problem Structuring Methods there are a broad range of general managerial tools for clarify, organize, simplify, even solve, ill-structured problems or complex organizational decision processes like:

Strategic Choice – (Friend and Jessop, 1971; Friend and Hickling, 1987);

Strategic Options Development Analysis – SODA (Eden and Simpson, 1989);

Soft Systems Methodology – SSM (Checkland, 1981);

(See also Rosenhead, 2001)

Expert Panel / Users Panel

To make more explicit the meaning of the aesthetics of a watercourse we felt the need of using a tool that could help the team to generate ideas and facilitate the emergence / capture the multiplicity of aspects considered relevant to our problem.

We considered well fitted to this purpose that this discussion can start within a panel of technicians working or interested by the subject of watercourse rehabilitation and coming from the following scientific and professional areas:

- Hydraulic Engineering
- Environmental Engineering
- Geomorphology
- Architecture

- Landscape Architecture
- Environmental Psychology
- Biology
- Urban Planning
- Economy

In other contexts one can admit that this same discussion can be prepared and organized with the population, users or even local authorities, affected by or that can be involved in an urban watercourse rehabilitation process.

The “Post-It” technique was chosen to be applied to this “Experts Panel” formed by experts from all the scientific areas referred above. In the session the participants must be confronted with a key-issue that should be well thought and phrased. In our case we chose “What can Influence the aesthetical quality of a watercourse in a city?” (Fig. 5). “Post-it” technique, Oval Map Technique and Cognitive Maps are very similar methods in their purposes. We adopted the procedure referred by Eden e Ackerman (2001), adapted to this specific situation.

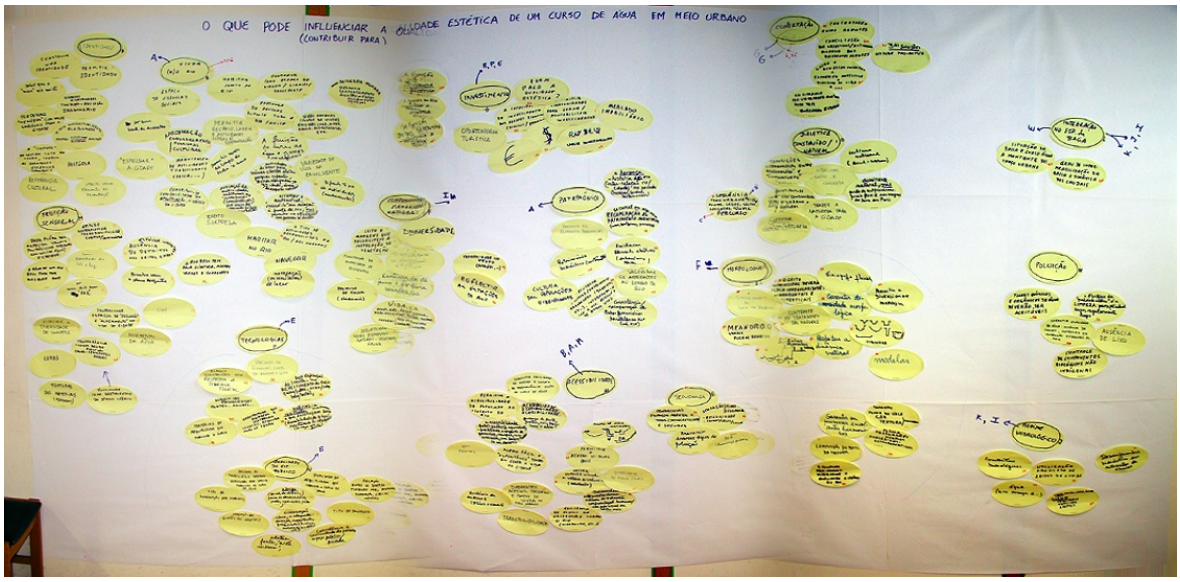


Fig. 5– Final result of Post-It session with “Experts Panel”

The facilitator(s) has a neutral role. He tries to moderate the discussion and stimulate the emergence of ideas. In a second stage, normally after a break, the participants try tries to organize the small post-it sheets clustering them by their affinity, drawing the more important influence relationships between concepts and labelling the cluster with

a statement that should express their content. This statement generally becomes a fundamental viewpoint of evaluation.

After this “Post-It” session it starts the work of analysing and reflecting deeply about the ideas that were expressed. In complex structuring processes the number of ideas that can be expressed by participants can increase to 300-400 concepts. The use of software like Decision Explorer[1] can help the team to manage this reach mess of ideas and to represent the network of mutual influence relationships (see figure 4 based on concepts that emerged from the session of “Experts Panel”).

[1] Decision Explorer is produced by Banxia Software Ldª - (www.banxia.com)

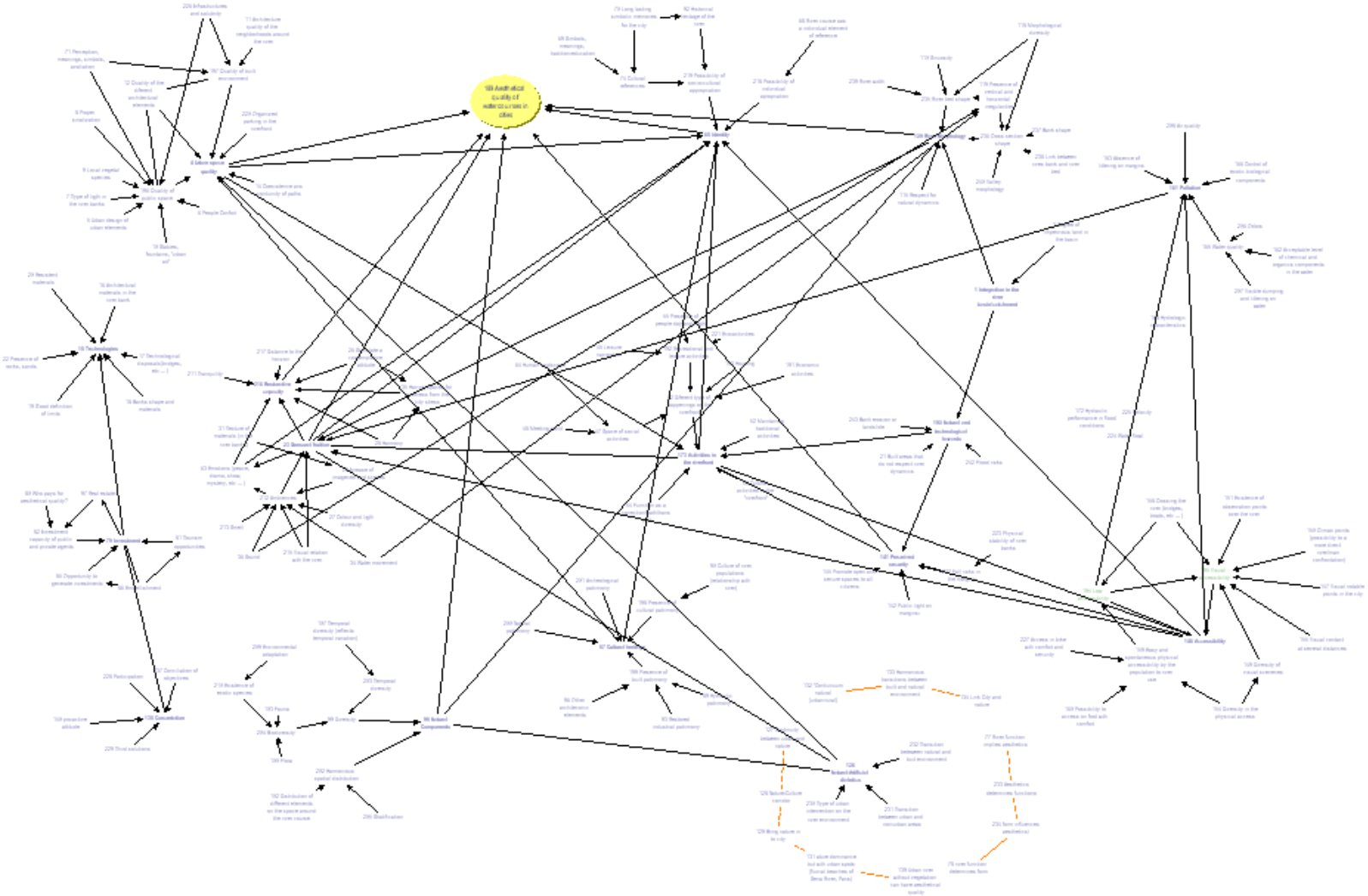


Fig. 6– The total cognitive map after modelled by software

Two aspects should be remarked. The first relates to the existence of direct and indirect relationships, which are very likely to be mentioned by participants due to this very subjective and sometimes unclear field of aesthetics. It is not always easy to differentiate what influences directly the aesthetical value (like “sensorial fruition”) and what ideas only have an indirect and marginal influence.

Other set of concepts that emerge from this process is related with means, like material or financial resources, and the mention to detailed solutions that can promote the aesthetical value of rivers. The further analysis should purge this complex network without losing the richness that it contains.

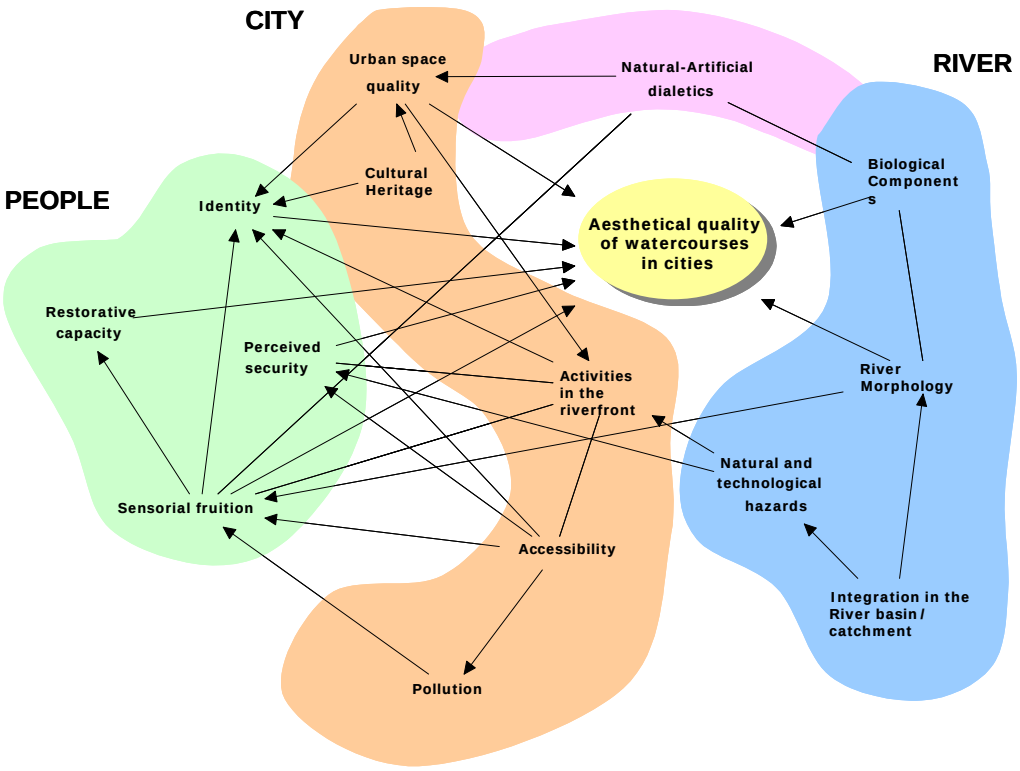


Fig. 7– Minimal network expressing the relationships between fundamental viewpoints

The minimal network (Fig. 7) synthesizes the fundamental viewpoints considered more relevant to aesthetical classification of urban watercourses. This network confirms the classical dialectics Natural-Artificial which is particularly relevant in urban contexts. This dialectics, in terms of evaluation, means that there is a pre-positioning of people facing natural and artificial world that determine and influence their value system of preferences.

The obtained result, represented in Fig. 7, also confirms the World – People – River framework already explained in previous chapters and represented by three clusters of fundamental viewpoints.

3 Viewpoints for aesthetic assessment

The general areas of concerns or viewpoints presented above should have some proprieties already identified by literature (Bana e Costa, 1992):

- Consensualness
- Intelligibility
- Isolability

They emerged from the "post-it" group discussion and can be used as a reference guide to other teams that would like to apply this methodology. Anyway, those viewpoints will be the result of a structuring process that should be well discussed and agreed by the people involved in a similar process, to guarantee a satisfying representation of the aesthetical factors that influence the river being analysed.

But the complete version of cognitive map obtained usually shows other more elementary viewpoints that help us to better explain and understand the meaning of the corresponding fundamental viewpoint. Conceiving the network as a value tree, these more elementary viewpoints are located between the top level (fundamental viewpoint) and the bottom level (alternatives of action) aiding to refine the meaning of the top level and to find measures of the aesthetical value.

This effort can be much better achieved in real practical situations, i.e., leading with a real case study. According to this, a small urban watercourse has been chosen - Jardas Stream – having an average width of 10m and a permanent flow regime. This narrow river crosses a high-density urban area – Barcarena-Cacém – where rehabilitation projects have been recently prepared. The following chapters will include several examples that refer to this small river where some were applied with the help of GIS.

The following discussion is mostly related with the city-river relationship in two types of areas which were often used to set geographical context of some indicators:

a) **The River Corridor (RC)** - the river or watercourse and the adjacent areas in both sides are directly influenced by it.

b) **The Riverfront (RF)** - is the direct contact area between the river and the first line of buildings.

Fig. 8 - River corridor based on a buffer of 500 m

Fig. 9 - Riverfront

3.1 RIVER

3.1.1 Natural components

In the context of urban environment the degree of naturalism of rivers is considered one of the major contributions for its aesthetic quality. The presence and diversity of natural components along river corridor, such as vegetation and fauna, are representative criterions of quality of the river ecosystems as well as major factors for its aesthetic quality. Diversity is generally accepted to be with more valued than uniformity in river corridors and its aesthetic quality augments in function of variety of species, vegetation stages and contrast with land uses.

The aesthetic value of vegetation is related with physiognomic aspects such as colour, form, density, vertical and horizontal structure, composition and variety, and also with biological and ecological aspects (Monteiro, 1998). Besides its major importance as a resource for wildlife and fishes, riparian vegetation as a representative role in the

protection of river banks from erosion and in the process of filtering contaminants (MOPT, 1992).

P1. Spatial Distribution

The existence of various types of vegetation in different stages of development increases the aesthetic quality of river corridor by adding diversity, contrast and mystery. The riparian vegetation enhances the presence of the river on the landscape by revealing its presence through a linear pattern of green. Therefore it can be recognised at long distances even when its presence is not evident and the contact with nature is commonly from a distance (Kaplan *et.al*, 1998). The spatial distribution of the vegetation is, therefore, an important element in aesthetic evaluation assessment and both horizontal (a) and vertical (b) distribution is a relevant factor. These geometric parameters have strong influences in the human perception of the river and of its presence in the urban landscape.

(a) The **horizontal distribution** can be evaluated by the width of riparian gallery and by the pattern of distribution of such vegetation. The width of riparian vegetation is influenced by several aspects but it is commonly accepted by landscape ecology standards that a 12 meters length is the minimum area to have a linear riparian corridor (Forman, 1995). In consequence, a 4 scale classification that can be considered for the evaluation of the horizontal distribution of river vegetation (Fig. 10).

Width of riparian vegetation edge

(i) Non existent (no vegetation);

(ii) Narrow (presence of edge species: 0-12 m);

(iii) Medium (linear corridor: 12-20 m)

(iv) Large (linear pattern: >20m)

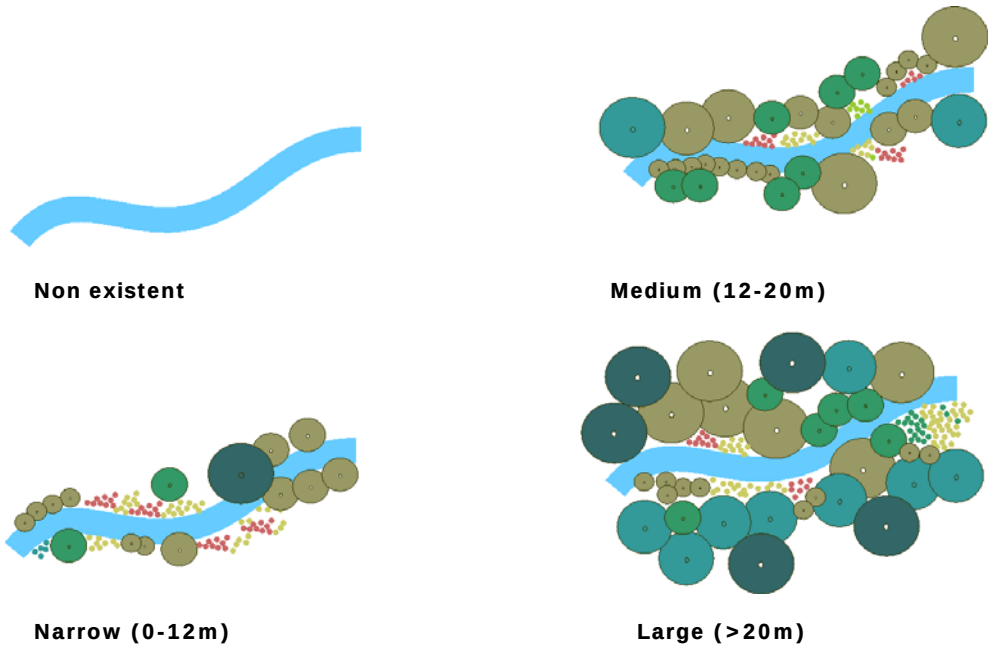


Fig. 10– Width of river corridor

The vegetation pattern on the river corridor is focused on the distribution and density of species. Generally, sinuous distributions, similar to natural forms, are considered more attractive than linear ones because it augments the mystery and sets a variety of scenarios along river corridor paths, which encourages exploration. It also helps to define vistas and views, which are important for adding quality to the landscape (Kaplan et. al, 1998). The distance to the margins is also an important factor in the horizontal distribution of vegetation in river corridor since it allows the visual or physical access to the river and both situations are interesting from the aesthetic value point of view (Fig. 11). A way to evaluate these parameters can be by analysing the horizontal density of vegetation (shrubs and trees) along a river corridor and the permeability of open views. Moderate permeability and density of vegetation along the river and irregular distribution of open views are the most adequate situation.

Shrubs density

- Absent
- Sparse - >8 meters
- Medium – 2-8 meters
- Dense – 1-2 meters

Trees density

- Absent
- Sparse – sparse riparian gallery
- Medium – continuum presence of riparian gallery
- Dense – dense riparian gallery

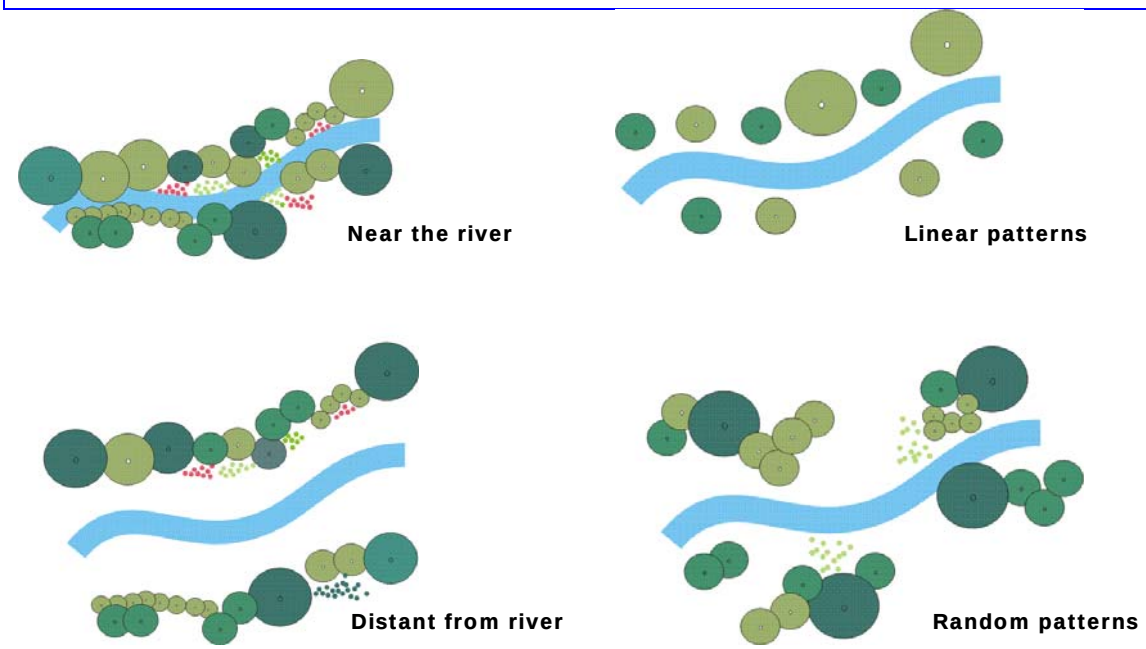


Fig. 11– Distance of vegetation to river margins

(b) The **vertical distribution** can be evaluated by the species distribution in the rivers section and also by the vegetation stage of development. The height and density of riparian galleries is important for evaluating degree of naturalness of waterscapes edges, especially if it as the presence of trees in high stage of development (Monteiro, 1998). Situations with vegetation under the eye-level are usually more attractive because allows better visual contact with the water and also increases the perception of safety (Kaplan *et al.*, 1998). This could be measured by defining an area of visual obstruction counting from ground level (Fig. 12).

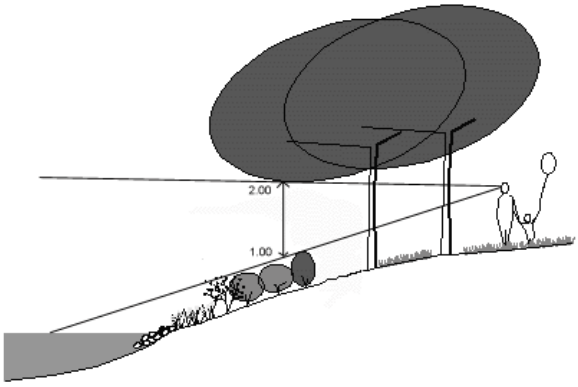


Fig. 12– Level of visibility in river corridor

Descriptor of visual obstruction to watercourse

(i) from 0-1.00m and >tree canopy baseline – obstructed visibility

(ii) 1.00m to tree canopy baseline– good visibility

The height of trees influences the presence of riparian gallery in the urban landscape but also influences the visualization from city to river by obstructing visual contact with water, especially in small rivers. Depending on the location of the analysis it can be defined classes of tree height in order to define the aesthetical quality of the river.

The diversity of vertical distributions of vegetation (the presence of various types of vegetation cross section) is also an important element for the attractiveness of waterscapes (Fig. 13).

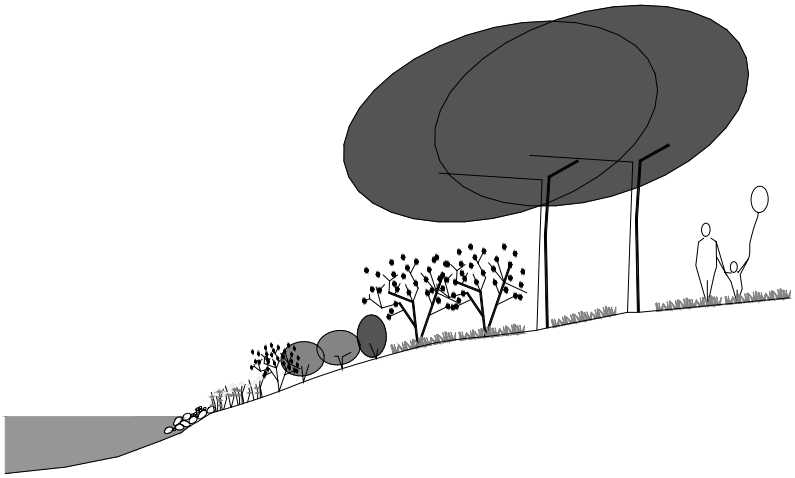


Fig. 13– Vertical structure of vegetation in river corridor

The presence of riparian vegetation in both river margins also enhances the sense of naturalness. This could be evaluated by classifying the presence of riparian vegetation on margins in classes (Saraiva *et al.*, 2001).

Index of riparian vegetation presence in margins

1 – Absence of vegetation

2 - Presence of herbaceous and shrubs

3 – Presence of sparse trees, in one or in both margins

4 – Presence of well-developed riparian gallery with tree and that is mainly continuous in one or in both margins.

P2. Biodiversity

In this context, biological diversity is the variety of organisms in the river corridor ecosystem. Therefore the presence of fauna and flora it is one of the main parameters evaluate the ecological status of the river corridor, which evaluated through a set of indexes or indicators adapted to the ecological conditions of the city-region that can be generally defined as:

(i) Index of conservation of riparian vegetation

(ii) Index of birds species

(iii) Index of fishes

The presence of autochthones species in the river corridor is relevant for the biodiversity of riparian areas. Therefore, it is relevant the identification of the riverside vegetation of invasive species and the evaluation of presence and dynamics in the river corridor as well as of planted/ornamental species. Both can be classified in 5 classes by the observation of the number of species.

Classes of ornamental species and invasive species

- 0-10% - very low presence
- 10-25% - low presence
- 25-50% - moderate presence
- 50-75% - high presence
- >75% - very high presence

P3. Temporal diversity

The seasonal dynamics of vegetation introduces variety and contrast of colours and textures in the urban landscape. Therefore the presence of riparian galleries with a mixture 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 variation of species.

Therefore temporal diversity can be classified in 3 classes dependent of the diversity of species and raging from (i) low or null diversity of species; (ii) medium diversity (e.g. presence of deciduous and evergreen trees and shrubs); (iii) high diversity of species (e.g. presence of trees and shrubs species with different colours of foliage, flowering season and stand age).

Fig. 14– Colour of tree foliage in autumn

3.1.2 River morphology

River systems are natural dynamic elements, which have specific behaviours and patterns, influenced by geology, geomorphology and climate. Its morphology and behaviour reflects a balance of forces and processes that operate through it and upon it (Mount, 1995). In natural systems, the movement of energy and matter shows the tendency to attempt a dynamic equilibrium with the discharge and sediment load provided by its basin or watershed (Schumm, 1977). This dynamics of the river system is the result of complex interactions between the geometric properties of a river, the landscape where it flows and the energy and forces that act on it (Mount, 1995).

There are specific spatial and temporal patterns associated with each river and its physical and biological processes. Adjustments in the river behaviour can occur due to natural or man-made conditions, considered for various time scales, from a relative short term into a long-term scale.

Physical characteristics of each river are related with this trend to attempt this state of equilibrium, affecting variables of its channel morphology, such as profile, gradient, channel cross section, and channel pattern. Fig. 15 illustrates the generalized model illustrating hierarchical process and geomorphic variables (Mount, 1995). Discharge and sediment load can show a high level of fluctuation, associated with patterns of hydrological regime.

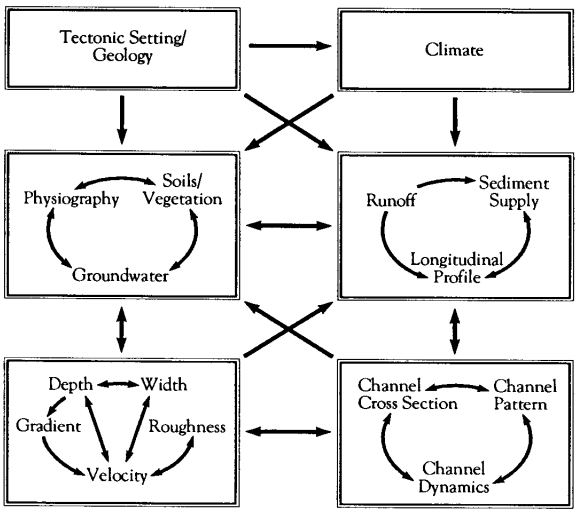


Fig. 15- Generalized model illustrating hierarchical process and geomorphic variables (after Mount, 1995)

Urban reaches show considerable changes towards an undisturbed pattern. The urbanization process induces changes in the hydrologic regime, usually accompanied by structural works affecting water flow, runoff processes, sediment load and transport. These changes can affect only the urban reach or the upstream catchment, depending on the size and impact of that process. Generally, infiltration is reduced and runoff increased and “flashier”, increasing flood hazard (Kondolf & Keller, 1991).

Changes in sediment load induce also modifications on the dimensions and geometry of river channels (Kondolf & Keller, 1991). The urbanization process typically induces channel widening, down cutting, straitening and bank modification, with the use of impervious and rigid materials in bank and edge management. Several reaches of urban watercourses have been transformed in concrete-lined channels, with less

environmental values, affecting the existence and diversity of riparian vegetation and wildlife.

Visual appearance of urban watercourse reaches offer characteristics and attributes according to this 'artificialization', with features designed to reduce flood risks, prevent erosion or control the river 'irregularity'. Urban uses in the riverfront and river corridor usually are adapted to the physical manipulation of the urban river landscape, with great or less presence of the 'natural' elements, such as vegetation. River edges show generally a geometric pattern, due to the replacement of naturally or irregular alignments, as a logical response to pressures on management or land availability (Manning, 1997).

The emerging trends of river rehabilitation look for a more sustainable management of urban watercourses. Introducing variety in channel and bank diversity, in order to enhance habitats and opportunity for amenities and recreation, towards a more pleasant urban environment.

P1. Riverbed Width

River width is a geometric parameter that has a strong influence on the inter-relationships between the river and the city. It influences the scale of the river corridor and the waterfront and its uses, the accessibility network, the transponibility, traffic and many other factors in the urban/watercourse environment. Public perception of an urban watercourse is also highly dependent of its size, where width shows a relevant role, affecting notions such as scale, distance, visual contact, depth, reflection, attractivity, enclosure, among others (Cano, 1985; Moughtin, 1999).

The scale and size of an urban watercourse within the urban morphology is a very important relationship (Fig. 16).

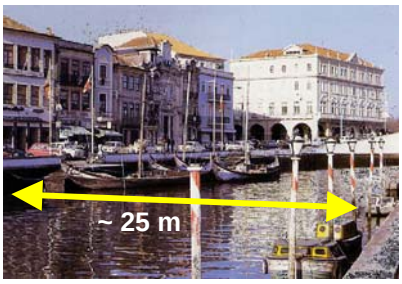
Fig. 16– City/River relationships

This parameter has been chosen in our methodology as one of the starting items for selecting the case study, due to its relevance in the urban context.

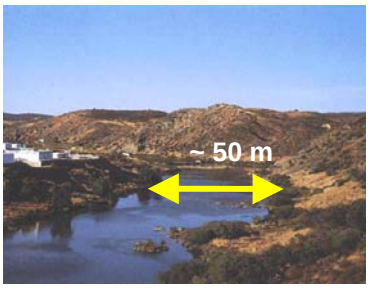
Small river
(Barcarena)

Medium size river
(Toledo)

Large river
(Lisboa)



Aveiro
Vouga river



Mértola
Guadiana river

France
Sena river

Fig. 17– River width

The width of a watercourse is determined by several aspects, such as its location in the catchments, 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, described above, lead to the consideration of five-scale classification, according to the literature review (Leopold & Marchand, 1968; Dunne & Leopold, 1978):

1. Non existent (culverted);
2. Narrow (0-5m)
3. Medium (5-20m)
4. Large (20-200m)
5. Very large (> 200m)

P2. Sinuosity

Sinuosity of a river is a variable that 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).

Sinuosity of a river is "a reflection of the channel length required to cover a given point-to-point or straight-line distance" (Mount, 1995). It can be assessed for a river reach through a sinuosity index (SI)

SI = thalweg length/valley length, or
SI = length of channel axis/length of meander belt axis.

Index of sinuosity (IS) (Mansikkaniemi *in* Christofoletti, 1991):

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

Cc: length of the riverbed;
Cv: length of the valley;
Z: distance between thee limits of the reach.

Three general classes can be considered (Mount, 1995):

1. Straight (SI< 1.05)
2. Sinuous (SI between 1.05 – 1.5)
3. Meandering (SI> 1.5).

Fig. 18– River sinuosity

P3. Morphological diversity

The river system is, by definition, an element with high degree of morphological diversity. Form and process in river dynamics evolve together, in the search of an adapting equilibrium and response to climatic and physical conditions. Boon (1992) describes these systems under a four-dimensional conceptual framework that explain the domain of interaction of structure, form and function (Fig. 19):

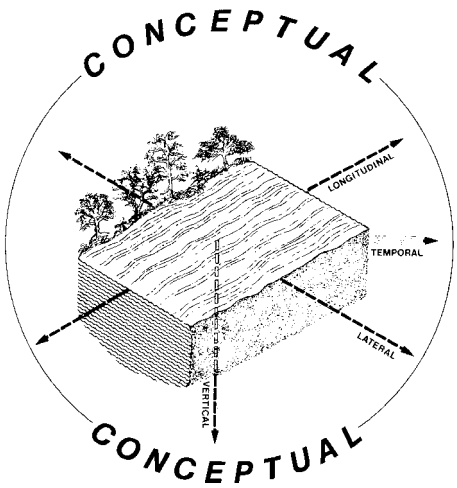


Fig. 19– A multi-dimensional framework for river management (from Boon, 1992)

- the *longitudinal* dimension, from source to mouth;
- the *lateral* dimension, explaining the connections between the river, the floodplain and the valley;
- the *vertical* dimension, relating superficial flow with groundwater and substratum;
- the *temporal* dimension, related with change and its time span within the catchment.

Morphological diversity is then an intrinsic attribute of rivers and watercourses. Human interventions can act with the aim of prevent irregularity and hazards, generally reducing diversity, either in ecological or morphological terms. This is case in urban environments, designed for a more controllable river management.

From the visual and aesthetic point of view, diversity is one of the most appreciated attributes, and mostly associated with the presence of water and water features in the landscape. Attributes such as diversity, complexity, contrast, and variety are identified in the literature, either as formal or cognitive factors that contribute to an aesthetic experience (Litton *et al*., 1974; Lee, 1979; House & Fordham, 1992; Manning, 1997; Saraiva, 1999; Swanwick, 1996; Ulrich, 1983). It is assumed that a high degree of diversity contributes to increase the aesthetic value of an urban watercourse.

Morphological diversity can then be assessed through an expert evaluation, considering a scale established according to the characteristics of the considered environment, and for a selected urban reach. An example of a three-scale evaluation could be:

1. Low degree of morphological diversity;
2. medium degree of morphological diversity;
3. High degree of morphological diversity;

A river with its surrounding landscape, where land form and vegetation are the major ‘natural’ features, create a specific ‘land-water pattern’, that contribute to the feeling of three major basic aesthetic criteria, according to Litton et al., 1974 – unity, variety and vividness.

Unity is a formal attribute that gives consistency and harmony of different parts juxtaposed, linking the elements to its whole. This quality of wholeness is more then the sum of parts and is recognized as having an identity of its own. This attribute is characteristic of water in the landscape, through notions such as continuity, reflection, and also from an ecologic point of view.

Variety can be described as richness or diversity. It can be expressed through movement, colour, and edge differences. As much variety or richness may be seen, the greater the aesthetic quality, as the presence of variety insures a maximum opportunity for visual stimulus.

Vividness is a visual quality which gives distinction and contrast and produces a strong visual impression Vividness is often enhanced through the presence of feature combinations.

After Litton *et al.*, 1974

These aesthetic criteria, such as unity, variety, vividness, diversity and complexity, perceived by citizens and river users can also be assessed by interviews and enquiries, to understand how these attributes contributes to aesthetic appreciation and setting preferences. Psychological approaches, such as developed by Kaplan & Kaplan (1979) identified complexity as an important attribute for cognitive processing of environmental information and for landscape preferences.

P4. Valley morphology

Valley morphology depends on several factors and processes, such as lithologic subtract drainage pattern, geomorphology, rainfall pattern and frequency distribution and other aspects related with this dynamic system.

Some morphologic types of valleys can be identified, depending if there is a symmetric or asymmetric shape:

- Steeply sloping V-shaped valley,

- Gently-sloping V-shaped valley;
- Vertically walled canyon;
- U-shaped valley (glaciated);
- Steep sloped wall with a floodplain (asymmetric);
- Vertical wall with a floodplain (asymmetric);
- Large, broad floodplain;
- Terraced floodplain;
- Broad, braided, episodic semi-arid river channel.

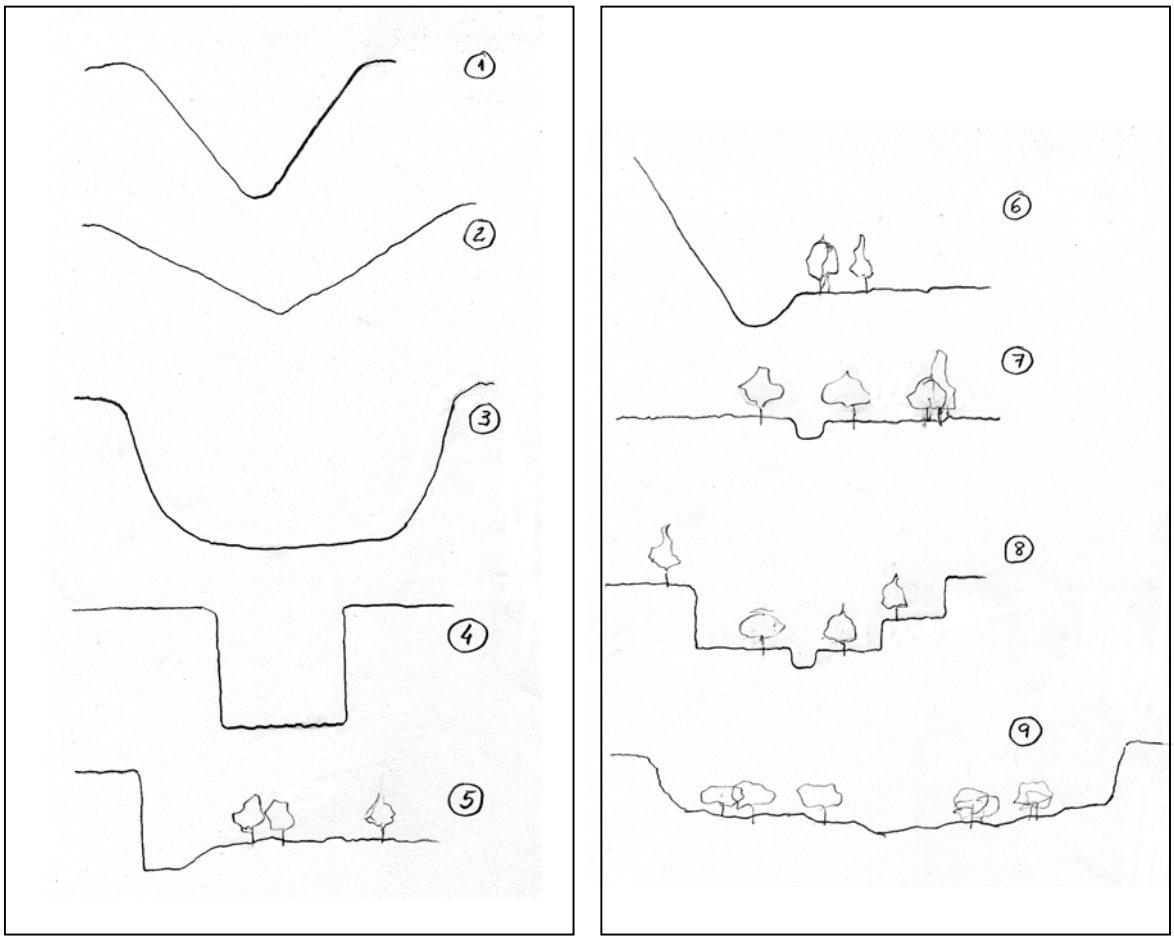


Fig. 20– Types of valley morphology

Urban development is also related with this attribute, influenced by slope, drainage conditions and others, but it is generally more developed when there is few slope constrains, such as the case of large and flat floodplains.

A very important relationship attribute of a valley is the width/height ratio, which is related with landform, slope, boundaries definition, and sense of enclosure, view depth. Valley morphology patterns induce variations in shape, texture and colour perceptions, creating a sense of a 'land-water pattern'. "This sense of pattern will be largely revealed along skylines but also as ridgelines, separated in space and seen against more distant similar images" (Litton *et al.*, 1974).

Visual attractiveness of a river is generally highly related with the existence of steep slopes, creating several features such as cascades, rapids, and waterfalls. Visual diversity is incremented with slope, creating more fields of observation and several aspects of aesthetic appreciation. In this sense, valley diversity contributes to the aesthetic criteria referred above.

P5. Bank shape / Presence of vertical and horizontal irregularities

Water banks and water shores are very important elements in river management and rehabilitation. They act as boundaries between water and land, contributing to a shoreline 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.

Several types of shore edges can be identified, showing different combinations between those horizontal and vertical dimensions. They also can show a gradual or abrupt change, either on one dimension or both.

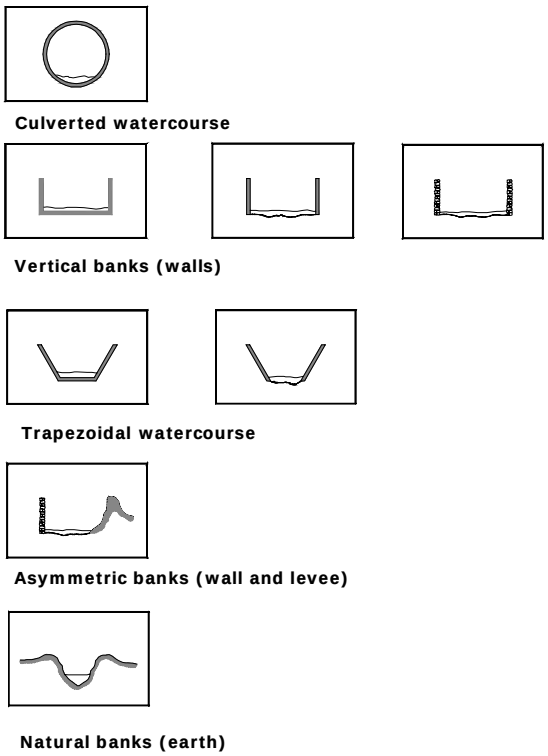


Fig. 21– River banks typology (Saraiva *et al.*, 2001)

Vertical characteristics of edges and riverbanks can be described through cross-sections. Fig. 19 shows several types of vertical edges and riverbeds, but much more

combinations can be found in urban environments. These are shown just as an example, and more detailed options will be developed in latter stages of the project

P6. Respect of natural dynamics / change of natural dynamics

As we saw above, urbanization changes the process of natural river dynamics, with reflects on morphological conditions and patterns. A gradient of extensive-intensive can be found in the contact of rivers with cities, from a diluted human pressure, with a more 'natural' environment, into an intensive pressure, with human concentration and maximum control and artifice (Manning, 1997). This balance between natural and man-made environments is hard to achieve and to assess, is differently perceived and appreciated by people. Some very intensive urban river environments can be very attractive; others can look highly artificial, unnatural or degraded.

In general terms, human appreciation of river landscapes shows a trend of preferences for naturality, legibility, integrity, and correlations between these variables and public preferences have been found in the literature (Bernáldez *et al.*, 1989; Herzog, 1985; Saraiva, 1999, Ulrich, 1983). Although, human-made and controlled environments are also valued and appreciated. An adequate balance between natural and cultural values should be the target to attempt in rehabilitation projects, according to each case and context.

This assessment can be conducted by expert evaluation or public surveys.

1. Classification for this parameter could be established on the degree of disturbance
2. Undisturbed
3. Slightly disturbed
4. Moderately disturbed
5. Highly disturbed

3.1.3 Integration in the catchment/watershed/river basin

Each river is strongly related with the territory that generates runoff and sediment transport, which is conducted by the water movement that reaches the fluvial system.

So, the spatial concern of the catchment, river basin or watershed shows a strong relevance when dealing with rivers and watercourses, even in the urban context.

A watershed is defined as an area of land that drains water, sediment and dissolved materials to a common outlet at some points along a stream channel (Dunne & Leopold, 1978 *in* FISRWG, 1998). This area can occur at multiple scales, ranging from largest river basins, such as the Nile or the Ganges, to catchments of very small size, only with few hectares. It is a spatial unit where hydrologic, hydraulic and ecological processes are interrelated through the water motion flow.

Several functions and parameters can describe the relationships between a river and its river basin. So, in urban watercourses, it is important to assess its location within the basin, because that influences several morphological and functional characteristics. In this chapter, only those that can influence the aesthetic appearance of an urban watercourse are mentioned – size, stream order and degree of impervious land in the catchment -, selected through the results obtained by the expert panel.

P1. Size of the basin

The river basin size is an important parameter that gives the notion of a 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).

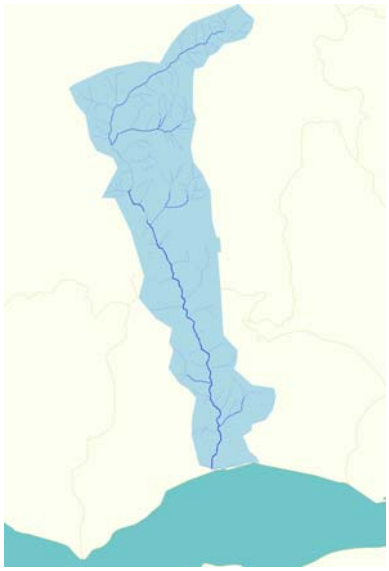


Fig. 22– Size of Barcarena river basin

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.

1. very small (< 50 km2)
2. small (50 to 200 km2)

3. medium (200 to 1.000 km2)
4. large (1.000 to 10.000 km2)
5. very large (>10.000 km2)

Size of the basin (measured in Km^2)

P2. Stream order

Stream order is a method for classifying or ordering the hierarchy of river network within a river basin (FISRWG, 1998). Several classifications have been established, such as the one developed by Horton (1945) and Strahler (1957). 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).

A general way of describing the size of a stream or river is the Strahler stream ordering system (Strahler 1964). Using this method the smallest permanent streams are called "first order" and two first order streams join to form a larger, second order stream; two second order streams join to form a third order, and so on. Smaller streams entering a higher-ordered stream do not change its order number.

Fig. 23 - Strahler's stream order method (Tibbalds, 1992)

P3. Degree of impervious land in the basin

The degree of imperviousness in the basin affects the hydrologic regime and the runoff/infiltration rate. This imperviousness is due mainly to urban and industrial development and other land use changes within the basin/catchment. The relevance of these changes depends upon the size of the basin, and is more significant in small catchments, where hydrograph response to rainfall is more evident.

This parameter has influence at mainly two levels:

1) at the basin/catchment level, increasing flood risk and vulnerability, either inside a city, or upstream or downstream;

2) at a local level, namely within the urban areas, with reflects on homogeneity, loss of diversity, less presence of natural elements and of permeable surfaces.

It can be assessed by measuring the impervious area present in a setting, and calculate the rate towards the catchment area (1), or towards the viewshed (2).

3.1.4 Natural and Technological hazards

Natural hazards on the river corridor are mostly associated with floods and massif soil erosion processes, both in form of bank erosion or landslides. The risk associated to these hazards highly depends on the natural characteristics, as geological structure and hydrological regimen. Nevertheless the risk might be increased, or even induced, by human behaviours, as improper land uses, for instance, turning it into a technological hazard. Therefore increasingly it is spread the idea of using the concept of semi-natural hazards in order to reflect this independence.

P1. Bank erosion or landslide

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 through the presence of stratified clay deposits in the subsoil, or by soil types with a high capacity of absorption of water, which in conditions of slopes tend to lead to the sliding of soil masses in presence of extreme precipitation events. The risk may increase by human action with destabilize the slope, as for instance

constructions on the slope or changes in soil cover which 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 improved though the alteration of the bank shape and removal of vegetation.

Length of banks with potential erosion or landslide

P2. Flood vulnerability

Floods are natural events, which depend of mainly 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 witch may favour surface runoff, but also with the presence of housing in the natural floodplain which may contribute to a higher risk

Flood vulnerability
Percentage of the river corridor located within the area of 100-year flood event and the number of people living in the flood plain.

3.2 CITY

3.2.1 Cultural heritage

With a human lifetime measured in a relatively short time span and the remains of our cultural heritage measured in hundreds if not thousands of years, it is important that we value, select and manage those aspects of our heritage that should be passed on to future generations.

Who decides what, how and when this is done is one of the key concerns of cultural heritage planning. There is an increasing concern and movement to wisely manage all aspects of our cultural heritage. This does not mean “preserving” things in a way that no change can ever occur but to encourage use and adaptive re-use of valued heritage places, as well as their celebration and commemoration as part of our continuing legacy to future generations. This custodial and stewardship role presents many

challenges in the face of rapid and ongoing change. How the community encourages or promotes these activities is the challenge for the future.

Built heritage features of architectural and/or historical interest comprise a wide variety of features including dwellings, churches, town halls, mills, lighthouses, railway stations and bridges. This built heritage ranges from public buildings in the high styles of architecture to modest vernacular dwellings, farmsteads and industrial buildings. Such features usually display an array of historical associations with people, places, events or activities.

Built heritage resources are found throughout the new City in urban, suburban and rural areas. These features are considered to be of cultural heritage value to the community in which they are located, and frequently, in a wider context, to the region, province or nation.

Unlike built heritage features that occupy individual sites or locations, cultural heritage landscapes comprise collections or groups of many features, objects or spaces that have been made or modified by past human activity.

Cultural heritage landscapes reflect human activity and include areas like traditional "Main Streets", historic downtown cores, crossroad villages and rural hamlets, farming areas, mill valleys and watercourses.

Concerning aesthetic value of cultural heritage in urban areas the main priority will be the identification of the areas or punctual elements which value had been classified or recognized within the river corridor:

- Value as public interest (local, regional, national)
- State of physical conservation
- Attractiveness (number of visitors)

Considering these attributes and their relative importance in each urban, social and cultural context a global descriptor may be considered.

Cultural Heritage Descriptor

- very high value;
- high value:
- moderate value;
- low value;

- very low value.

3.2.2 Urban space quality

a) Visual permeability of the city morphology in the river-corridor (RC) allowing visual contact with the river / watercourse

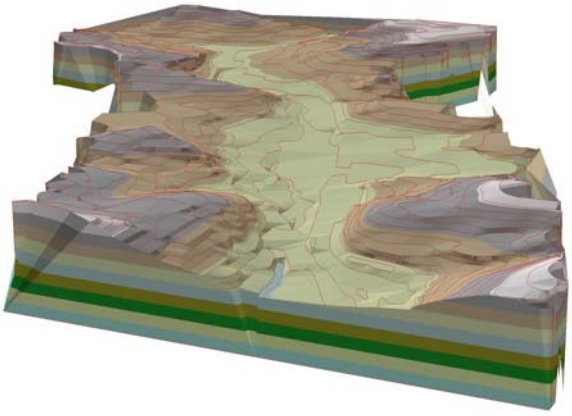
The aesthetic value of an urban space may be determined by the quality/quantity of existing visual resources and by the manner in which they are perceived in the built environment.

The visual permeability of an urban space generally depends upon two interrelated issues:

a. **Site and situation** related with the morphological qualities of the terrain surface;
b. **Urban settlement patterns** related with the morphology of built space

Site and situation

The visual contact with the river/watercourse (vegetation, wildlife and scenic systems) greatly increases the scenic value of a place and is dramatically affected by the terrain morphology. When considering the terrain form, shape or structure of a valley it is important to include elevation data.



Viewshed Analysis inventories the extent of the view from and to the stream corridor within the study area. The viewshed provides a generalized indication of the surface area that likely is visible from a specific point or from a set of points distributed along an area or pedestrian, railroad, road and stream networks.

The Fig. 24 provides the surface visible from a set of points distributed along the stream and pedestrian paths which is obtained from the application of a GIS software (ArcGis) to Jardas (Barcarena) Stream.

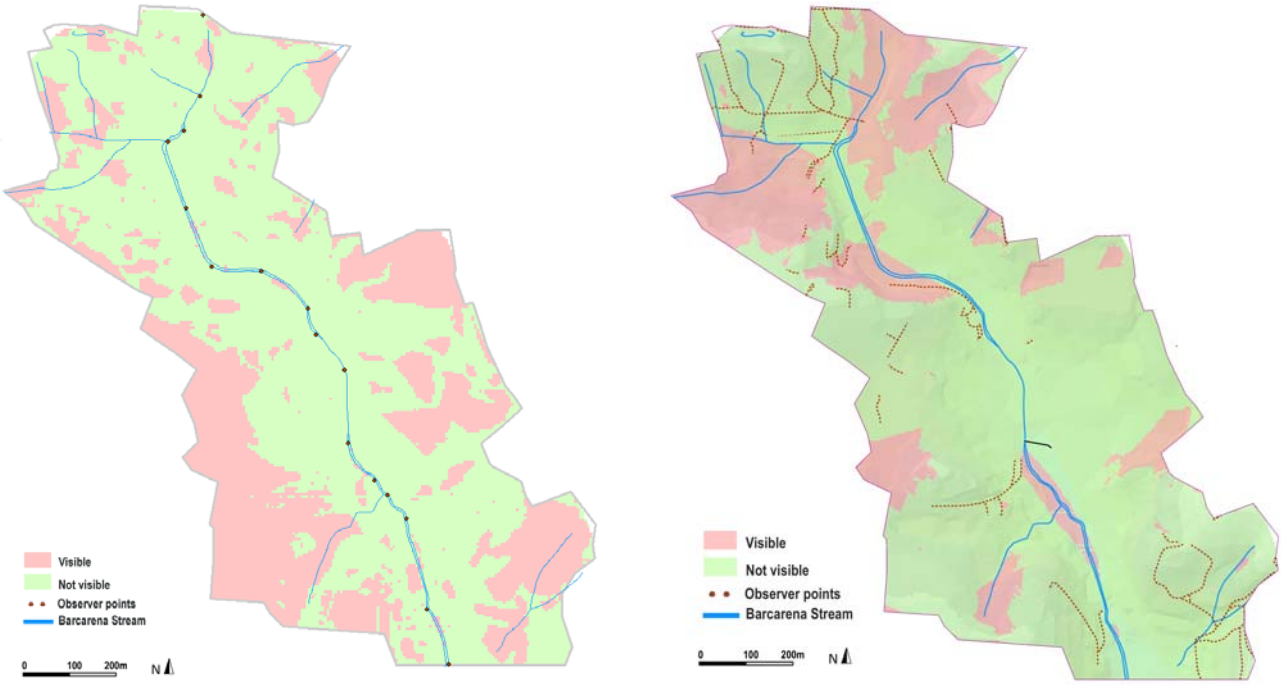


Fig. 24 - Viewsheds of Jardas (Barcarena) stream with intervisibility areas.

Urban Settlement Patterns

Urban settlement patterns focused on spatial distribution of buildings, alignments of streets and open spaces (gardens, parks, river/watercourse, etc.).

The urban pattern is a combination of different factors: historical formation date, terrain morphology, etc. The city visual permeability and accessibility to the riparian area is largely influenced by this urban structure. Studies in urban patterns have usually adopted buildings as the basic morphological component (Fig. 25).

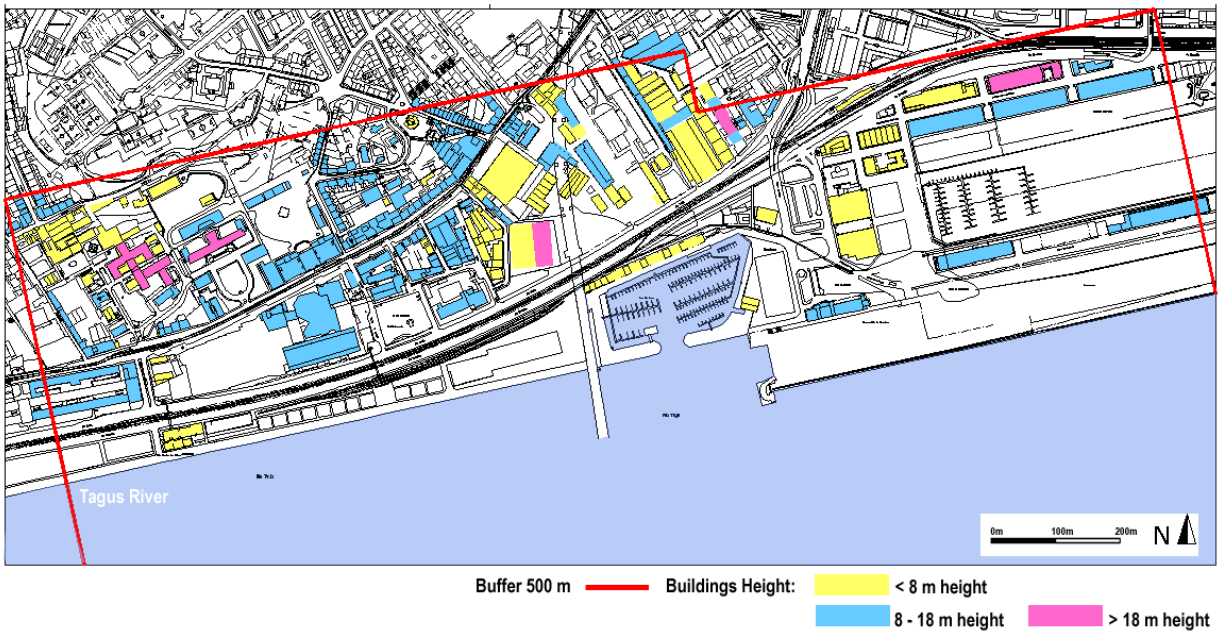


Fig. 25– Buildings heights

Visual access should be maintained to the waterfront by preserving and providing additional view corridors. This will also allow visual permeability from the waterfront into the inner areas and enhance the microclimate of inner by facilitating air movement through breezeways.

River views are often strongly valuated by people, which affect the housing prices and the real state market. The main question here is what morphologies and building typologies should de adopted that assures some equity in terms of the distribution of this (sometimes) highly appreciated value (Fig.25). This is highly dependent of urban design and urban planning options.

Buildings are always obstacles to public views, meaning to views taken at ground level from the public space. In presence of very sloppy river corridors it may be possible to have views over to roofs at the rivers from specific points. Thus the public views depend mostly of spatial arrangement of the buildings as presented before.

We must also consider, in urban areas, the free space that is stretched in to corridors with circulation purposes. These way roads and pedestrian paths provide access to the landscape and are important view corridors to the river/stream scenario.

Considering graphs theory we can represent these linear features as a set of arc and nodes. “To achieve a linear network that can be traced by the computer from line to line it is necessary to add topological pointers to the data structure. The pointer structure is often built up with the help of nodes” (Burrough, 1998).

In this context it was important to consider the network visual axis that has a physical connection with the river stream. The number of intersection between the two types of entities (circulation network and stream) may be used, per se, as an indicator of the city-river visual connectivity and visual contact.

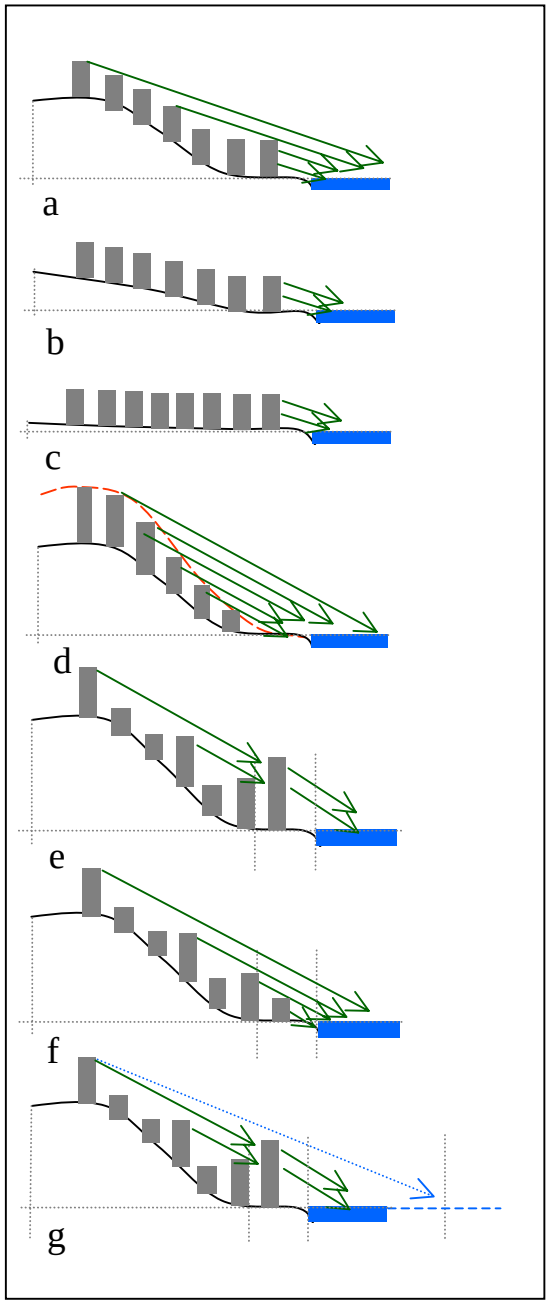


Fig. 25 – The influence of urban morphology in views.

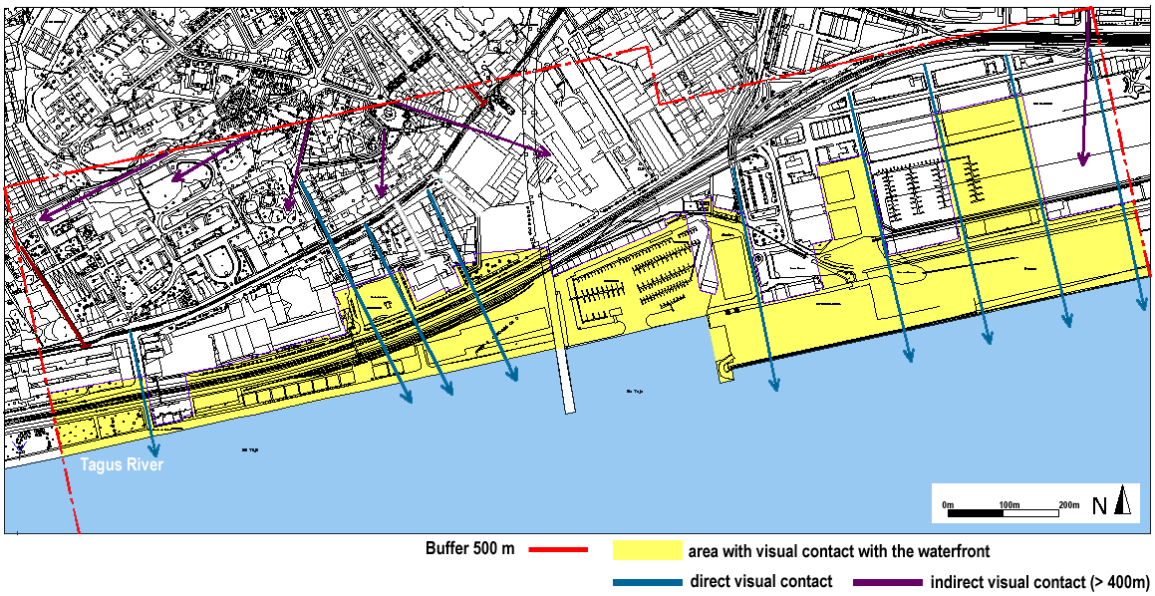


Fig. 26– Typology of visual contact with water

The length of these visual axes is also important. It measures the level of penetration in the city revealing how much permeable in depth the urban tissue is. Higher average length of these visual penetrations revels (or not) higher presence of the water surface (and the river) inside the city structure.

The Space Syntax methodology, which is also derived from graph theory, has had strong improvements in the domain of Architecture under the impulse of Bill Hillier, (Hillier, 1997; Heitor, 2000). Space syntax methodology describes and analyses the relationships between spaces of urban areas and buildings. The spaces are understood as voids (streets, squares, fields…) between walls, fences, and other impediments or obstructions that restrain (pedestrian) traffic and/or the visual field. In this context a river or stream can be also considered an axial space (as a street). It can be integrated and modeled under the network analysis where connectivity, *integration*, *control value* and *global choice* are considered important syntactic measures that can be calculated.

GIS can help this analysis complemented with local surveys to assess the local conditions that can affect the river visibility from inside the urban tissue. The line of sight traced along the road shows the parts of the surface that are visible or hidden from an observer point (Fig. 27 and Fig. 28). The terrain profile shows that the

riparian area would not be visible from viewpoints along the road due to the surface morphology.

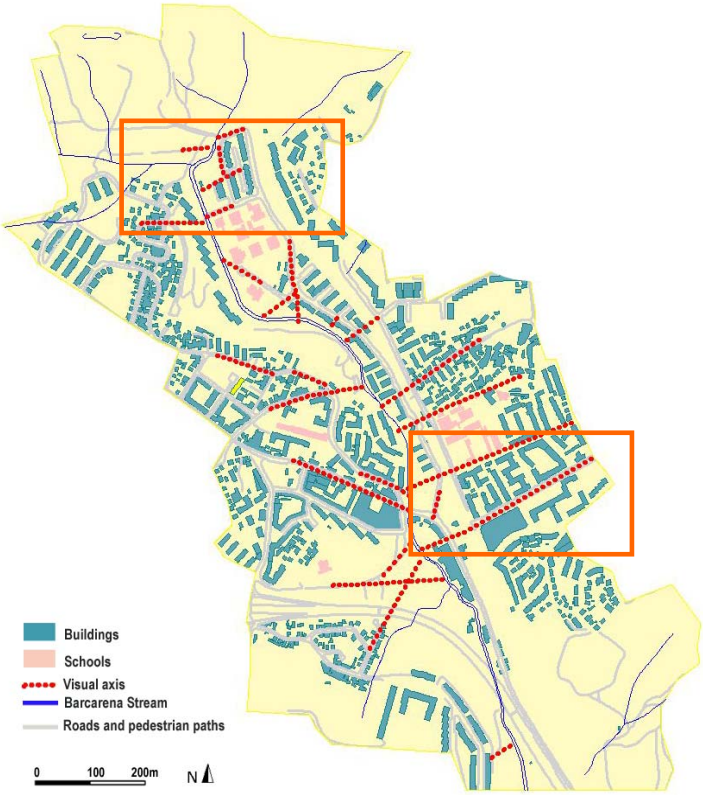
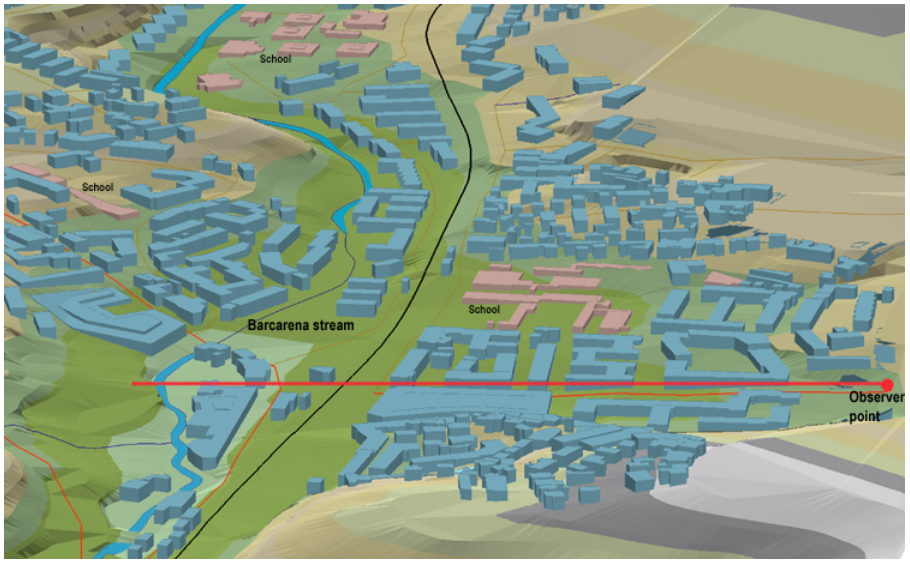
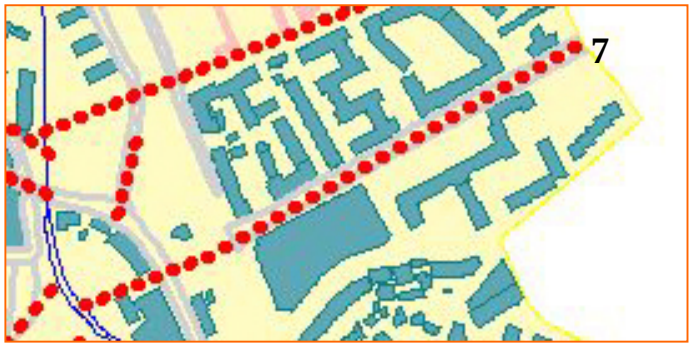


Fig. 27– Typology of visual contact axes with watercourse in Jardas (Barcarena) stream.





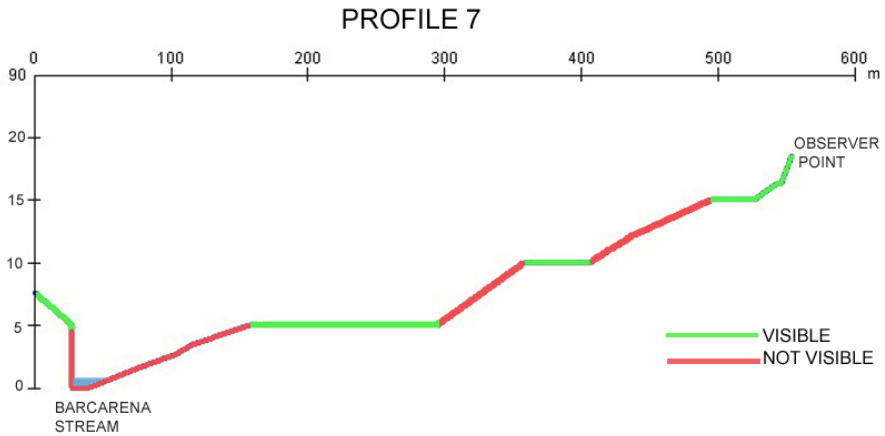


Fig. 28– Profiles contact with water from the city to the river and from the river to the city

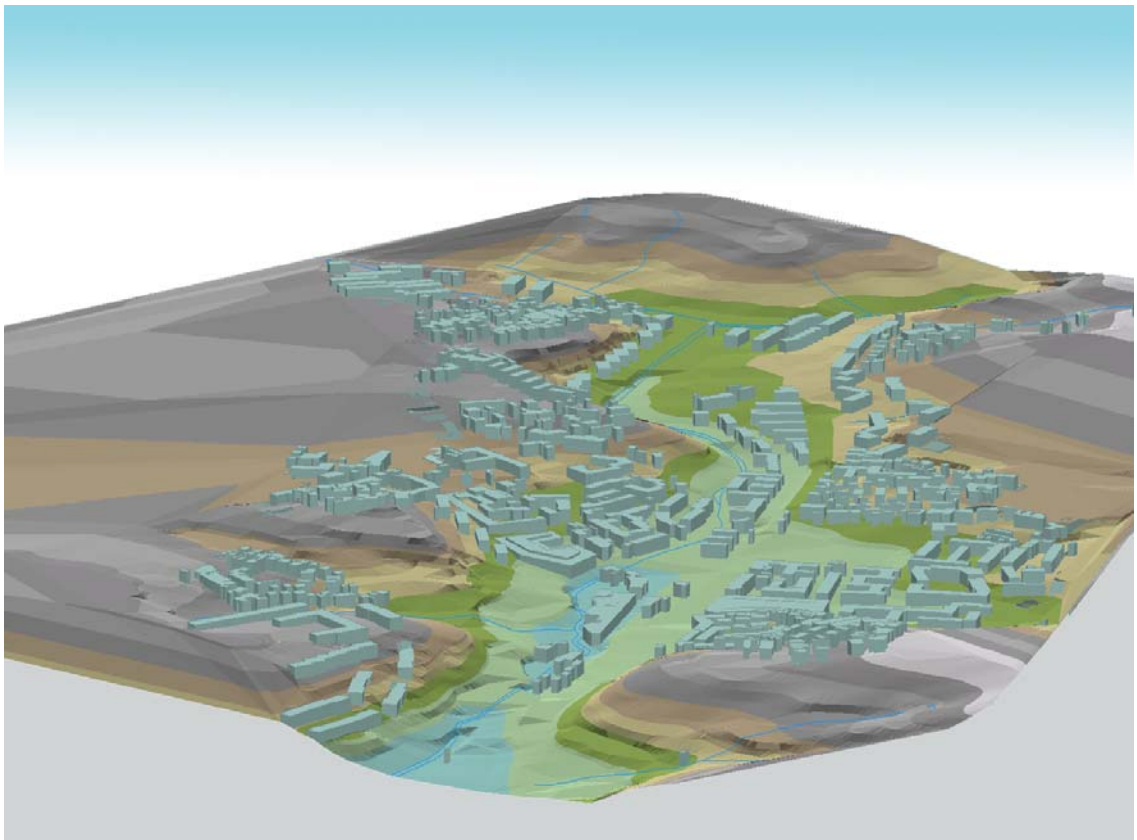


Fig. 29– Townscape of Barcarena/Cacém, modelled with a GIS, wrapping the Jardas stream

The townscape of urban area Barcarena/Cacém illustrates the urban nature of the landscape (Fig. 29). The interrelationships between buildings, valley morphology and stream elements combine to create the urban landscape. In some places the urban development completely ignored the visual contact with the river watercourse: streets aren't connected with the watercourse; the railroad cuts the urban tissue and acts as a barrier; the buildings are distributed along the stream blocking the significant views to the valley of Jardas stream.

Indicators of Visual Permeability:

- Number of visual intersections with the river axe;
- Average length of visual axes with the river;
- Number of belvederes / terraces (public spaces with large views over the landscape and river;

Descriptor of Visual Permeability

Very High permeability – indicators previously mentioned with high scores; a good spatial distribution of points and visual axis along River Corridor allowing high impact panoramas.

Moderate permeability – moderate number of intersections and moderate number of visual points (like belvederes); an average length of linear visual axes between 50 and 250 meters, that allows extent perspectives over the river with an interesting aesthetic value; irregular distribution of visualization points and axes to the river but covering all the extension of RC.

Low permeability – few visual intersections with river and few observation points that allows wide perspectives to the river; the average extension of linear visual axes in RC is less than 50 meters; the aesthetical quality of perspectives over the river from public belvederes and linear views from streets and public spaces is narrow and with weak value.

b) Near contact zones (proximity of visual and physical contact) with watercourse

Visual permeability analysis refers to city scale and specifically to the river corridor. However, it is important to consider some aspects that relate morphology of physical contact with the river. In this context, physical contact is considered as an intense sensorial contact that allows getting close in touch with the watercourse and all that is connected with this experience. The fig.31 represents a typology of possible forms of physical contacts between people and the watercourse.

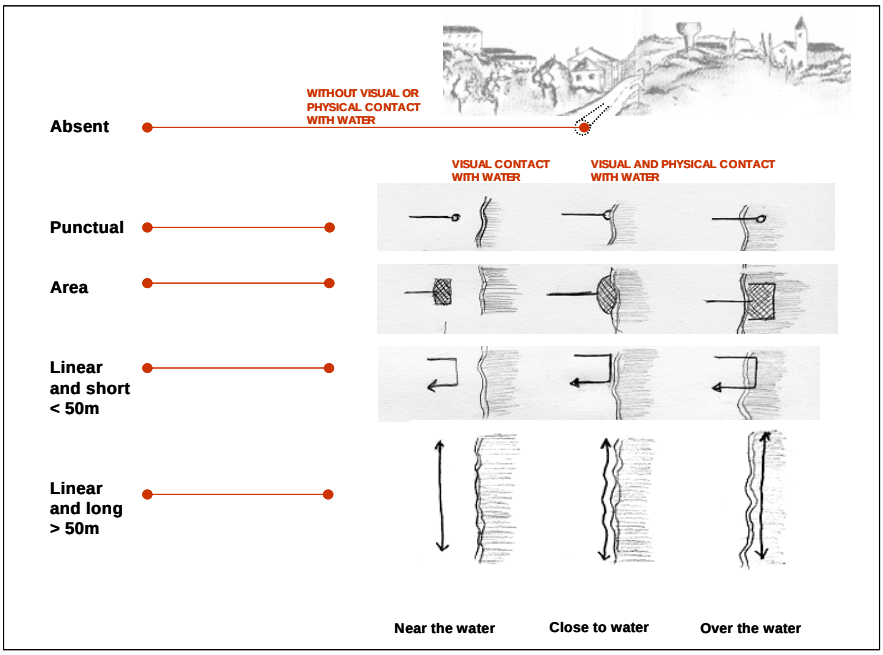


Fig. 30– Typology of contact with water

In the first case the watercourse is visually absent because it is culvert that is a solution adopted in many cities since a long time to hide the bad conditions of rivers or to gain extra space to the city.

Physical contact refers to small dimension spaces where the access with the watercourse is done only by one path. The contact zone can have several types, such as:

a) Near the water – there is no physical contact with water but there is a very strong sensorial relationship with the watercourse;

b) Close to water – there is a physical and complete relationship with the watercourse in the river bank;

c) Over the water – this is a quite intense form of contact with the watercourse because the observer is over or inside water. In some occasions this type of contact can allow the city observation.

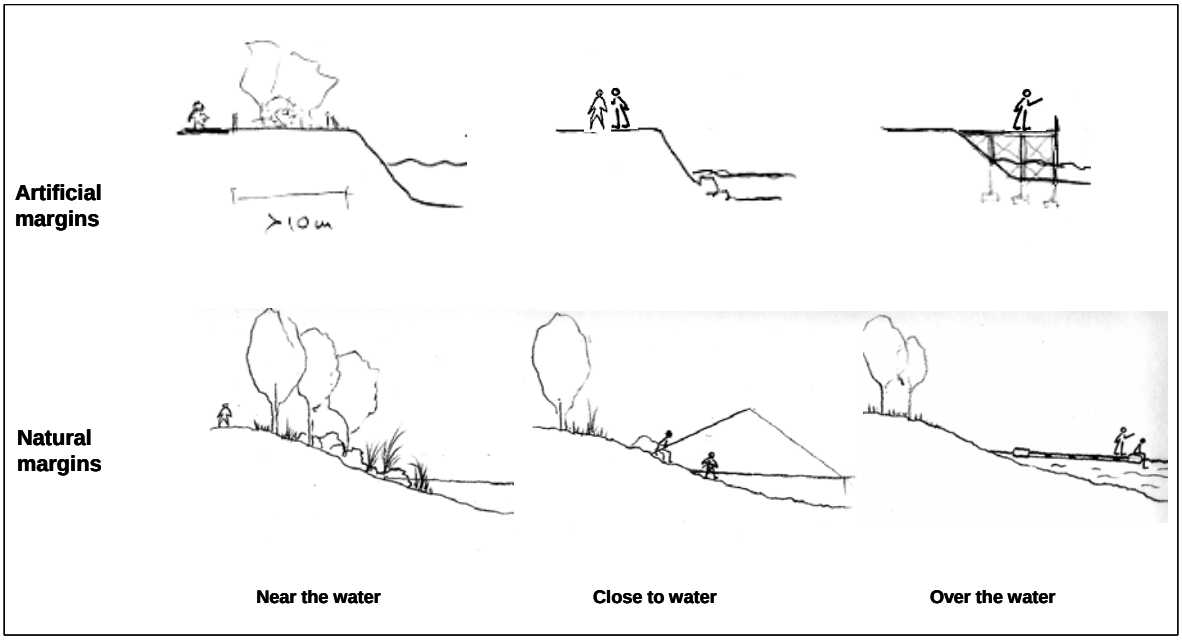


Fig. 31– Physical contact with water: natural and artificial banks

Considering that the majority of contact zones have public access one relevant aspect is that of safety. The principle that should guide the evaluation of present situations or future rehabilitation actions is referred by Manning (1997:80) "…obvious hazards

should be avoided or warned against and techniques exist for making the actual contact point as safe as it need be. But action should never extend to destroying some essential feature of the river in the interests of safety, or to prohibiting all access to it. (…) precautions must be related to context".

c) Public Utility given to River Watersides

The relative position between the river and the city is very important. In peripheral urban areas that are still undeveloped land and the amount of open spaces is usually high. In these more external rings, agriculture, forest and natural spaces are predominant. In central areas the urban space are usually denser. Private space is occupied with buildings and social infrastructures. Green public areas, parks, etc usually use public open space. In these areas the access by people is usually free.

It seems important to calculate the balance between public open areas (with free access) and private (non-public) areas in the river corridor and its riversides, which indicates the value given by planning authorities to the presence of river in terms of public utility of the watercourse to increase the global aesthetical value of the city increasing the global benefits of its inhabitants and users. A high ratio (higher relative quantities of public open areas close to the river) means that the city allows a non-restricted access to the watercourse valuating this situation in benefit of people. A low ratio (higher quantities of private areas) expresses low preoccupation of local administration with the distribution of this value by all the people, which can also mean a low public recognition, or valuation of the presence of watercourse in the city.

Sometimes public open areas (that are usually public proprieties) are not in good conditions to a pleasant and safe use by people. Some of them may not have a stable and planned use and some parcels may still waiting for detailed plans. In our perspective can be important to assess the state of conservation and global quality of these areas to guarantee an adequate public use by the population.

Indicators of Public Utility of River Watersides:

Ratio (quantitative balance) between public open areas (in good conditions) and private (non-public) areas in both watersides of the river.

d) Quality of the built space in river-corridor

Urban areas are very complex spaces and sometimes highly heterogeneous. We are here centred on the quality of the built space, i.e., the conditions that an urban built space requires to a normal accomplishment of their physical and functional purpose.

There are several factors that affect their normal appearance:

1. The quality of construction – which is related with a good structural design and long lasting materials;

2. The state of conservation (maintenance) of buildings – that can be identified by cleaned façades, windows, doors and roofs in good conditions, walls painted, etc., which can be influenced by to their age or dereliction;

3. The existence of basic infrastructures like potable water supply, sewerage, electricity, drainage, etc.;

4. The existence of sanitary conditions in public spaces – which are conditions that can jeopardise public health like visible sewage, rats, litter, etc.;

According to this we think it will be possible to classify built urban areas in three simple classes:

High Quality – Built spaces classified like this are in good or very good state in terms of physical and functional conditions. They fulfil entirely the requirements needed to accomplish their finality. They can be residential areas, industrial or more commercial ones but there are no misuses or malfunctioning detected in accordance with what was planned for that area. These areas: have all basic infrastructures; are in good sanitary conditions; the state of conservation and the quality of construction can be good or reasonable.

Medium Quality – Urban areas not having the problems of the low quality areas but which cannot be considered as having high quality standards (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 finality is considered adequate.

Low Quality – Built urban spaces that clearer need intervention of urban rehabilitation, conservation or renewing which can occur for several reasons: absence of sanitary conditions; lack of basic infrastructures; moderate or unsatisfactory conditions in terms of state of conservation or quality of construction. The housing do not have adequate conditions for households. Developed or urbanised land is no longer in use for housing, industries or services, derelict or contaminated land (brownfields), etc.

Indicator:

I1: Percentage of River Corridor occupied by High Quality urban built areas;

I2: Percentage of River Corridor occupied by Low Quality urban built areas;

3.2.3 Pollution

Urban areas are major sources of water pollution, mainly trough the discharge of untreated or only partially treated sewage into the waterways.

Along with domestic wastes, sewage carries industrial contaminants and nutrients (phosphorus compounds, contributed principally by detergents, as well as nitrogen compounds), which cause eutrophication of water bodies.

Rain drainage is another major polluting agent because it carries such substances as highway debris (including oil and chemicals from automobile exhausts), sediments (soil), and acids and radioactive wastes from mining operations.

Agricultural areas also contribute to river pollution by rain runoff and by irrigation return-flow of fertilisers and pesticides, as well as discharges of animal wastes from farms. Industries besides contributing with chemical components are often source of physical pollution when using water is cooling systems, which by returning to the waterbody causes an increase in water temperature disturbing ecosystem functions.

In context of assessment of aesthetic quality physical, chemical or biological pollution are only considered if they have a visual impact. Therefore 4 indicators are used to

assess both the pollution in the water body – dissolved or suspend matter (I2, I3 and I4) as well as on margins (I1). These indicators are of high seasonal variability since the visibility of pollution is highly depending on the hydrological flow regimen of the watercourse: high discharges may dilute pollution and low flows concentrate water pollution, as well as, it uncovers dump and litter on margins.

P1. Visible dumping and littering on margins

The visible pollution on margins may be caused by (a) being used directly as a dumping site, or (b) through the accumulation of litter that has been thrown in upstream, is transported by water and deposits on margins (Fig. 32). It might also consist on (c) natural objects as tree trunks, branches or dead animal transported by water flow. 3 classes of pollution are considered ranging from high density of objects visible on margin to low density.

Fig. 32– Litter on river margins

P2. Floating dumping and littering on water

Dump and litter may also consist on lighter objects (in comparison to I1) that are able to flow on water. Also here, 3 classes of pollution are considered ranging from high density of objects visible floating on water to low density of objects.

P3. Water Turbidity

Visible pollution in the watercourse can both be assessed by the turbidity of water as well as by the watercolour (Fig.34).

Turbidity can be measured by the degree of transparency of water, meaning that the public generally associates low transparency as being highly polluted, whereas highly transparent water is interpreted as “pure”. This is in fact not true, since very transparent water might be ecology dead due to; for instance, acid rain, and low

transparency might be caused by high sediment loading due to soil erosion upstream or due to specific geo chemical characteristics of the bedrock.

Therefore 3 classes of transparency are used depending on the depth of view. On highly transparent water the ground might be visible, on medium transparent water the ground might only be visible at a reduced depth near the margins, and at low transparency there is nothing visible below water surface.

Fig. 32- Floating dumping and littering on water

I4. Watercolour

Watercolour is highly associated with I3 – Water turbidity. Higher turbidity or higher concentration of pollutants or sediment gives the water a more intense colour (fig. 33).

Also, water colour changes with distance of view: higher distances tend to homogenize water into a “bluish clean” colour, whereas at closer distance it becomes visible a wider range of colours. In this case a classification is more difficult to establish since it depends on the colour of soils and bedrock what is the natural colour of water in this specific water shed. In general it can be stated that the most appreciated colour is ‘no colour’ at all, followed by natural colours, as sediment loading may produce it.

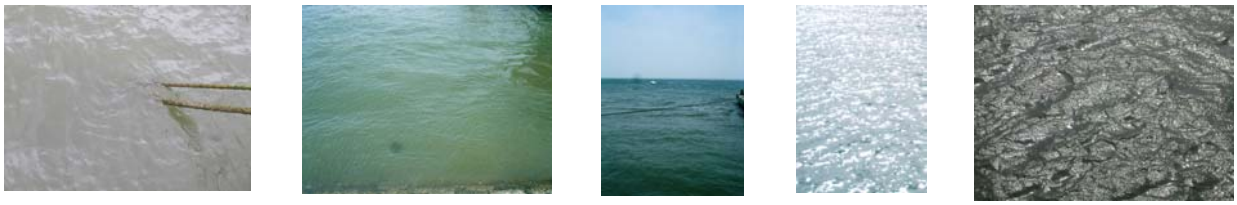


Fig. 33- Watercolor

Descriptor:
A – No colour
B – Natural colour
C – Artificial colour

3.2.4 Activities in the river front

In the context of the aesthetic assessment of rivers in urban environment it is important to consider the domain of the human activities in the space contacting directly the river (river front).

With the increased presence of people at the riverfront the number observers augments, meaning that there is a higher potential interaction between the people and the river. In this context the following descriptors aim to inform on intensity of actual or potential presence of people at the riverfront that may enrol in various activities. These activities may be of different nature: economic, traditional, and residential, as well as, recreational.

P1. Economic activities

Economic activities may be subdivided into sectors, as services and industry. These activities provide employment, which contributes by itself to the presence of the employees in the area. On the other hand there are activities that may attract human presence by providing personal services as, for instance, retail trade or schools. Besides these more permanent infrastructures, there are also occasional events that have to be taken into account (i.e. the monthly flee market, fairs).

I1. Units of services, industries or public infra-structures (i.e. education)

I2. Employment within the RF (total)

I3. Presence of commercial units

I4. Frequency of occasional commercial events (e.g. fairs)

P.2 Traditional activities

Traditional or cultural activities are in this context defined as those activities that are which are performed for a long time performed by the river (i.e. fishing, Easter picnic) and that attract people to the riverfront on these specific events.

I1. Existence of facilities

I2. Frequency of occasional events

I3. Occasional events

1.3 Housing

I1. Inhabitants in the river corridor

I2. Built areas within the corridor occupied by residential buildings

I3. Households in the RF

I4. Inhabitants within the RF

1.4 Recreational use

Outdoor recreation is a major component of leisure where participants choose and control their activities also according to the recreation values and aesthetic appearance of the site. Rivers and nature in general as they have a high restorative value are often chosen for leisure activities, both in terms of every day activity or for vacation where a window facing the park, the sea, the river is highly valued.

I1. Presence of recreational facilities

I2. Tourism (hotels)

The ranking in classes on the contribution of each indicator the aesthetic quality of the river has to be decided upon each urban context.

3.2.5 Accessibility

Crossing the river …

Many towns and cities owe their existence to water, developing around a port or being located at a major crossing point. There are several built structures that allow people to cross a river, a watercourse or a stream: a tunnel under the water (motorways, railways); stepping stones to be used by people; fords that can be used by vehicles; bridges that can be low and close, in touch with the water; high bridges, uplifted, detached. Tunnels are not relevant in this context. They don't allow people to see and

to have sensorial contact with the river. Fords and stepping-stones allow people to walk on the water involving us directly with the river. However they are affected by floods, hazardous and adventurous and belong on minor watercourses, like streams or creeks.

In most urban watercourses, bridges are in fact the common way to cross the water having two fundamental functions (Manning, 1997):

a) Linking function - links two margins allowing uninterrupted circulation along the river;
b) Contact zones – where people wait over the water, watch, enjoy the view and spread out to explore from this convenient access point that happen in different ways (see chapter 2.7.2).

Fig. 34– Crossings at Douro river (Oporto), and Thames (Walligford, London)

In cities, most of the bridges were built to allow the passage of road and rail traffic. The majority of the existent bridges allow all kinds of traffic to cross but others are exclusively to pedestrians or bikes. In fact the so-called *light modes* of transportation – walk or bike - are the ones that promote a more close contact with the water, the sight, the landscape.

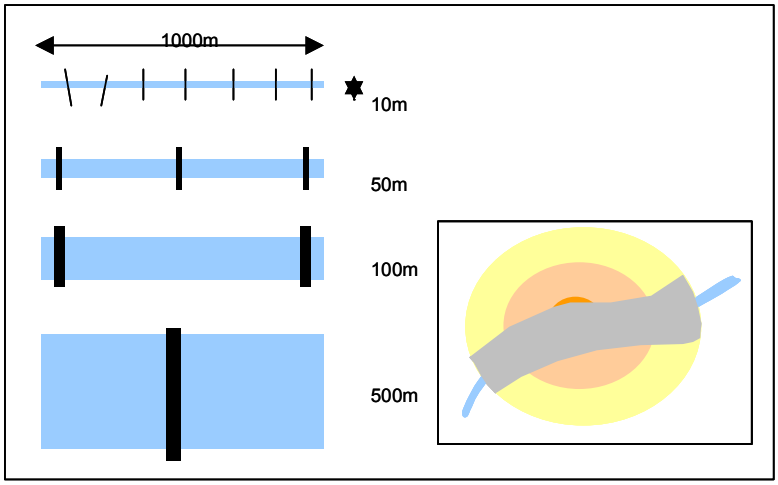


Fig. 35– Influence of the width in the amount of crossings

The possibility to enjoy the crossing, as an aesthetical event, is related to the amount and availability of walking bridges. However, is also evident that a very large river cannot have the same amount of bridges as a small and narrow river. Its width influences dramatically the cost of a bridge.

Linear density of bridges along the river seems to be a good indicator that will measure reasonably the contribution of river crossings to the usufruct of the river by people, as a very special place of contact. We admit that the correlation between the length of crossings and the potential of fruition cannot be linear, meaning that, for instance, very long bridges (normally high) are not suitable for pedestrian crossing.

In Jardas stream there are a few water crossings because streets aren't connected with the watercourse partially due to the railroad that blocks the access (Fig. 36). These spatial obstacles reduce the access to waterfront and justify the weak use and perception of Barcarena waterfront.

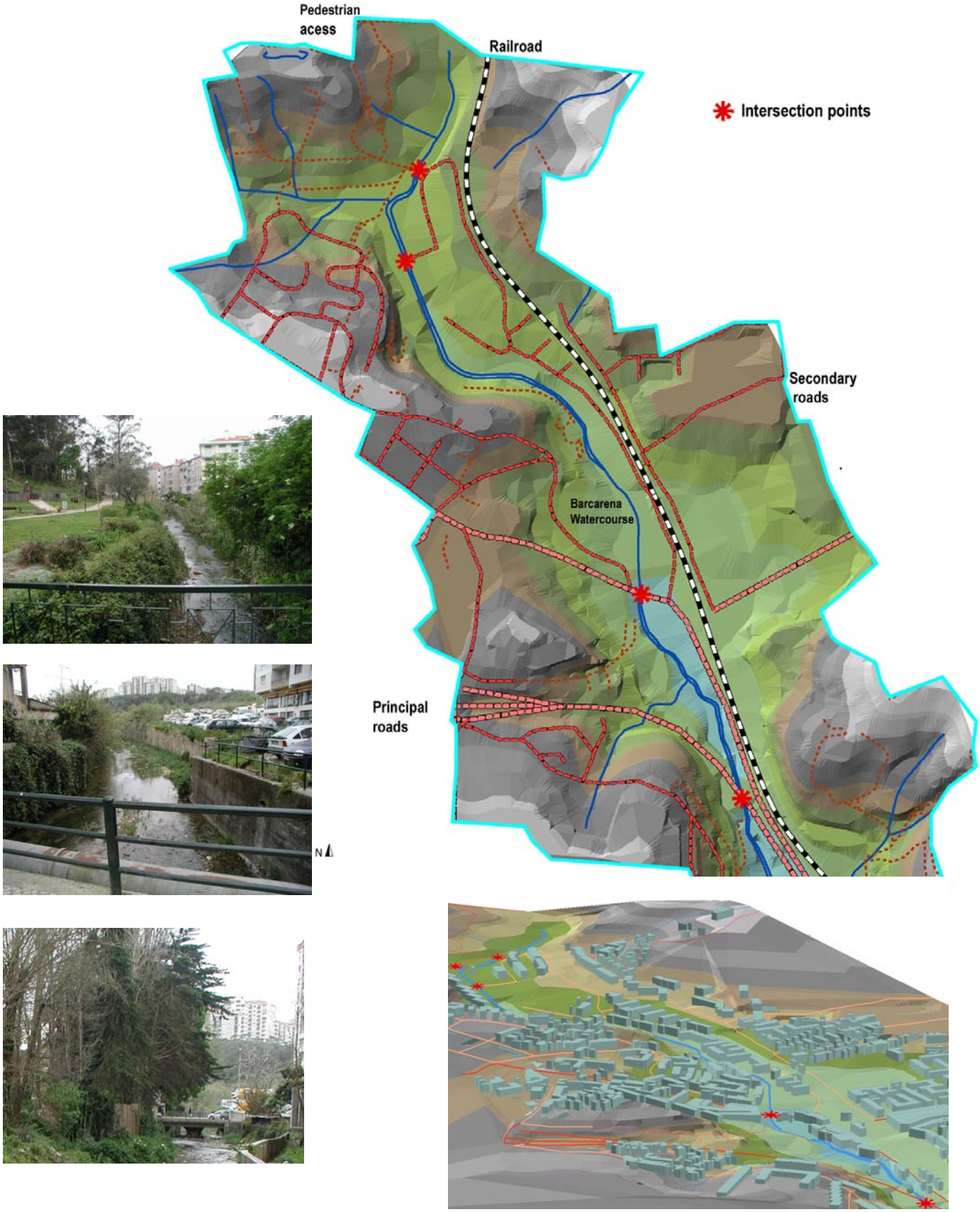


Fig. 36– Crossings in Jardas Stream (Barcarena/Cacém)

In cities we can also cross the rivers by boat or ferries. In cities with estuaries and very large rivers like Tagus River in Lisbon and therefore with low densities of bridges, there are a great amount of daily traffic of passenger that cross the river by boat or even by ferryboats. The majority of these daily trips are done by commuters and students but others are pure recreational. This is relevant in what concerns the relationship of the people with the river and what concerns the development of a collective aesthetical notion related with a daily contact with water.

Indicators:

Linear Density of walking bridges (even not exclusive for walking) allowing visual relationship with water:

→ Number of walking bridges / length (in Km) of the river section in the city

Percentage of people that daily cross the river

→ Daily passenger traffic by boats or ferries that cross the river / Total population of the city

From the river to the city…

The traditional function for the waterfront is associated with the transportation of people and goods. The movement of goods by water transport has decreased significantly. Nevertheless it remains an important function to some port cities.

We have considered that the water transport adds colour, movement and life to the urban watercourses that should be seized and balanced by retaining and developing public and private water transport. Also, the leisure activities, associated with the regeneration of disused water frontages, are becoming popular and appealing for users and tourists.

The distribution of anchorage places, docks, floating pier, etc, along the river can be a good indicator of the existent possibilities related to water transports and its future development in terms of the potential of rehabilitation.

Fig. 37- Anchorage places being used by traditional boats (Aveiro, Portugal)

Indicators:

Linear density of anchorage points (anchorage places, docks, floating pier, etc.):

→ Number of contact points for water transport purposes / length (in Km) of the river section in the city

Daily average density of boats in the river :

→ Daily average number of boats navigating/present in the river in a normal day / length (in Km) of the river section in the city limit

From the city to the river ...

The access to riversides from the city it's a prerequisite to promote the use by people, which should be well balanced in terms of nature and landscape preservation and in terms of the transportation modes used. It is well known the problems derived from the use and abuse of private car that has several recognized environmental impacts that have to be mitigated and minimized.

Fig. 38– River and pathway side by side (Seville).

For these purposes more adequate sustainable transport solutions exists:

a) Car parking surfaces located closer to riversides that don't have any fundamental function in terms of the urban transport system are considered inappropriate. Car parking surfaces will be, in fact, a car trip generator for visitors and should be always controlled and inhibited. Thus parking in the riverfront is not advisable if a public transport system can be implemented.

b) The promotion of public transports systems or soft modes is considered a long time ago a valid alternative to access riverfront in central urban areas, in spite of using the private car, which is generally accepted as a sustainable solution.

c) Being the river an important focus and generator of events we must mention the problem of valleys that have become a corridor for major urban roads or railways. Manning (1997:79) mentions this disruption that may be devastating. "(…) major route following the river's edge tend to separate it from its hinterland, the land which topographically and scenically belongs to the river. The most severe disruption arises where vehicles are involved. (…) Even in cities, total disruption is neither necessary nor acceptable."

Indicators:
Parking offered
- Density of parking public places offered in Riverfront
Access in public transport: connectivity from the river-corridor to the city
- Length of public road and underground transport networks in river corridor / Total area of RC
Access in soft modes – foot and bike: length of the ways offered inside river-corridor
- Length of pedestrian paths or bikeways in River Corridor with a visual relationship over the river / Total length of the river within city
Disruption due to the existence of major roads (or rail) network
- Length of non-sustainable major roads, motorways, railroads acting as a barrier between river and the city / Total length of the river within city.

3.3 PEOPLE

3.3.1 Sensorial fruition

P1.Odour

The measurement of the odour is subjective and moderate by cultural, social and psychological factors. It is possible to distinguish between different types of odours:

Natural odours (e.g.: flowers, water)

Urban odours (e.g.: urban pollution, odours associated with some activities as a bakery)

Industrial odours (e.g.: industrial pollution)

The odour can be evaluated in terms of the attractiveness or degree of annoyance.

P2.Sound and Noise

The measurement of sound is based primarily on its physical components. The decibel scale measures the physical components of sound or noise amplitude. However this scale does not accurately reflect the perception of loudness.

Noise it is a sound that is undesirable or unwanted, i.e., a subjective and emotional interpretation of a phenomena. The aversiveness of noise depends on volume, predictability, and perceived control. In combination with other factors, noise can have adverse effects on physical and mental health.

In the context of aesthetic evaluation with can distinguish different types of sound and noise:

Natural noise (e.g.: birds, wind)

Human noise (ex: children),

Urban noise (e.g.: traffic)

Industrial noise

These types of noise may be objectively evaluated in terms of its amplitude, frequency, purity and regularity). And subjectively in terms of its attractiveness or degree of annoyance.

3.3.2 RIVER LANDSCAPE PERCEPTION

Several approaches tried to evaluate the environmental preferences (e.g.: Berlyne, 1974; Kaplan, 1987; Bernaldez, 1981; Saraiva, 1999; Zube, 1984). Some propose expertise evaluations and some underline the importance of user or public evaluation.

In this proposal it is considered two types of evaluation: (i) an expertise evaluation of aesthetic preferences and; (ii) public perception of river landscape

P1.Expertise evaluation of aesthetic preferences

It is possible to identify different approaches and methodologies to evaluate the aesthetic characteristics of a landscape. Kaplan and Kaplan (1989) developed a model of environmental preferences, that combine nativistic and constructivist elements. In one hand they consider that the human being prefer environments that landscapes in which the traits of our species are most useful. So, for instance, they like green areas, and the presence of water. One other the couple Kaplan concludes that humans have a fondness for environments that provide rapid and comprehensive information.

The Kaplan's model includes four main components: coherence, legibility, complexity and mystery.

Coherence – degree of organization of a scene, or to which a scene "hangs together". The coherence is positively correlated with the preference.

Legibility – or degree of distinctiveness that allows the viewer to understand the content of a scene. The greater the legibility, the greater the preference.

Complexity – or number and variety of elements in a scene.

Mystery – degree to which a scene contains hidden elements that stimulate the search of this information.

The human being like complex scenes and scenes with some degree of mystery. However if the scenes are very complex and/or with great mystery it can be source of fear.

The experts may use this approach to classify the river landscape in relation to theses four components.

P2.Public perception of river landscape

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 public 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. Carr *et al.,* (1992) define three dimensions in the public space, which are the result of the interaction between the physical characteristics of the space and the characteristics of its user: necessities, rights and meanings and attachments.

(1) Necessities – public spaces have a role of satisfaction of the human necessities. This necessities include, comfort (physic, psychological and social) relax and active involvement and passive involvement;

(2) Rights – are related with the freedom of the use of the space and also the feeling of control of this space. Concepts as appropriation and action must be included in this dimension.

(3) Meanings and attachments – it is the capability of the human being develop symbolic meanings and links with the spaces.

To evaluate the river landscape perception of the inhabitants it is necessary use questionnaires with questions that include all this principle describes before. The questionnaire in preparation in the context of the Urbem project includes a part to test the river landscape perception of their inhabitants.

3.3.3 Identity

The research about the relation between the human behaviour and the environment give an important relevance to the link between the person and the environment. They use the terms, place identity and place attachment. It is possible to identify two types of approaches: the first group tried to understand the importance of the place to the identity of the subject (e.g.: Proshansky et al., 1983, Feldman (1990), Lalli, 1986). The second one tried to study the different forms of place attachment (e.g.: Giuliani and Feldman, 1993, Altman and Low, 1992).

One possible definition of place identity is “By place identity we mean 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 verified that the place identity play an important role in the perception of environment changes (e.g.: Twigger-Ross and Uzzell, 1996, Speller, et al., 1996), perception of environmental problems (e.g.: Bonaiuto, et al. 1996), and perception of public areas as natural parks (e.g.: Loureiro, 1999) and so on. These studies verify that a positive and strong place identity reduce the negative perception of some environmental problem or increase the positive perception of some environmental aspect.

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 - The desire to preserve continuity over time and situation. It is possible to maintain continuity thought the link to a place that was the reference for the past action and experiences. Or maintain continuity by the link to places that are congruent with the personal values, i.e., maintain 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, which one identifies.

Self-efficacy - is defines 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 understand as the attribution of positive features to the place in comparison to different places.

Using this framework allows understand how a relevant element in the landscape, as an important river that cross a city, can contribute to the identity of the inhabitants.

So, the valorisation of this river can contribute to the reinforcement of the identity to the city.

To evaluate the identity of the inhabitants to the river and to the city it is necessary use questionnaires with questions that include all these principles describe before. The questionnaire in preparation in the context of the Urbem project includes a part to test the importance of the city and the river to the place identity of their inhabitants.

3.3.4 Restorative capacity

There are several empirical evidences that viewing natural scenes (as visiting natural places, or even viewing photographs of natural scenes) may have a restorative effect, for instance contributes to reducing stress, and promote positive moods and feelings (e.g.: Ulrich, 1981, 1984, Ulrich et al. 1991). So, natural spaces, in special with water (Kaplan and Kaplan, 1989), in urban areas can contribute to a positive view of the area.

Despite, authorities and researchers agree that natural scenes have this positive potential, there is some controversy regarding the explanation of this mechanism (Ulrich *et al.,* 1991, Kaplan, 1995). Two important explanations were developed in the last decade: stress reduction and attention restoration theory (ART). Both theories grew from research programs that were initially developed as explanations of landscape preferences (Bell, *et al.,* 2001).

The stress reduction is supported by several studies (e.g.: Ulrich, 1979, 1984, 1986, 1991, Parsons *et al.,* 1998) showing that contact with certain types of nature creates what are called *restorative responses*. The restorative responses include reduced physiological stress, reduced aggression, and restoration of energy and health. Settings that foster these responses are called *restorative environments*. The main principle in this theory is that human life includes high levels of stress. According to the functional-evolutionary perspective, humans have a biological affiliation to certain restorative natural settings. However they do not have such prepared response to urban environments, because the human being has only a few generations of experience with these environments. So, certain types of natural environments can be very important because creates some restorative responses (from stress).

The attention restorative theory (ART) was developed by the couple Kaplan (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 outline 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 performance decrements 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, that requires little efforts because allows cognitive freedom (allow the subject only concentrate in the environmental aspects that they want) and escape from the daily activities (in the natural environments there are freedom of rules and obligations).

Kaplan considered four interrelated characteristics of restorative experiences: being away fascination, extent, and compatibility.

Being away - a necessary first condition for restoration involves getting distance from further demands on directed attention and the ordinarily present or routine aspects of one's life. Three ways in which a sense of *being away* can come about include 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 & Kaplan, 1989)

Fascination - the natural environments are important sources of fascination elements, and there are restoratives because they demand effortless attention and use the involuntary attention.

Extent - the natural environment has also de function of extent, which is treated by the Kaplan's (1989) as a function of connectedness and scope. The men in contact with the natural environment feels beyond they own limits and as a part of the nature.

Compatibility - refers to 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 with what the environment demands and supports.

Understandings of restorative person-environment transactions can be useful in environmental design, planning, and policy (Kaplan & Kaplan, 1989; Kaplan, 1983; Ulrich, 1992) and measurement of restorative qualities of person-environment transactions can help in applying such understandings (Hartig, Korpela, Evans and Gärling, 1996). These qualities are accessible by asking people about their perceptions of environments.

The design and management of restorative environments can be aided with an instrument for measuring qualities of restorative person-environment transactions. The Perceived Restorativeness Scale (PRS) (Hartig *et al.,* 1997) and Scale of Restorative components of Environment (Laumann, Garling and Stormark, 2001) both included four factors that are consistent with attention restoration theory. In the context of the Urbem project we are developing a questionnaire to test the restorative capabilities of a river in the urban context.

3.3.5 Perceived Security

The analysis of the security in relation to the river in urban context must be analysed in terms of the technical evaluation and the public risk perception. Technical evaluation of risk is very different from law views of risk. However, when we intend to modify the preventive behaviour of the population, these perceptions must be taken in account to define the risk communication strategies adequate to the target population.

Two types of risks must be considered:

- the risk caused by the river characteristics and urban physical pattern (ex: floods)
- the risk associated to the use of the river area (ex: attack, drown)

P1.Public Risk Perception

The analysis of the research about risk perception allows identifying some important questions:

The public risk perception is well structured, and multifactor, including factors as "dread risk" (including perceived lack of control, dread, catastrophic potential, fatal consequences); "Unknown risk" and "number of people exposed to the risk" (Slovic, 1987). Research has shown that lay people' risk perception and attitudes are closely related to the position of a hazard within this type of factor space.

The previous experiences of hazard, as well as the characteristics of the society are important factors in the development of behavioural adjustments to minimize its threat and mitigate its effects (Burton, Kates e White 1978).

Continuous exposures to uncontrollable threat modify risk estimations, and consequently risk adjustments, in order to cope with stress (Taylor and Brown, 1988; Taylor, 1992). So, it is expected that residents living under high objective risk, will minimize their probability of damage.

The social role of the different public involved in the risk management produce different estimation of risk (Douglas Wildavsky, 1982).

P2.Public Risk Perception of Crime

Fear of crime and associated stress are major problems in urban areas (Bell *et al.,* 2001). Frequently the fear of crime is not related with the true likelihood of being victimized. Sometimes the fear of crime increases faster that the real crime (Taylor and Hale, 1986) or the fear of crime differs in different groups of the same neighbourhood.

Different aspects of the urban environment can have an impact on fear of crime: environmental configuration (e.g.: Lavraska, 1982); perceived loss of territorial control (e.g.: Taylor and Hale, 1986); decay of the environment and signs of urban "incivilities" (e.g.: White *et al.,* 1987); environmental configuration that facilitated the concealed of attackers (e.g. Nasar and Jones, 1997).

The characteristics of the population are also important in the fear of crime. The research reveals that those who are more concerned are those with lower incomes, minorities, the aged, and females (Bell et al. 2001). The fear of crime can have important impacts in the human life. People with fear of crime feel they must restrict their activities greatly to avoid being victimized (Keanes, 1998).

Some environmental and social characteristics of the area can be important to promote the feeling of security. The environmental urban design that helps promote cohesion residents may moderate fear (e.g.: Fried, 1963); the presence of signs of defence and signs of appropriation was associated with less crime (Newman, 1972); having supportive neighbours may act to quell fear of being victimized (e.g. Gubrium, 1974).

To evaluate the risk perception in relation to floods or fear of crime, that are subjective but determine the human behaviour, it is necessary to ask the population about it. If the perception of risk have a big discrepancy in relation to the technical evaluation of risk, it is necessary to develop a process of risk communication based in the characteristics of the population and in their risk perception.

4 Evaluating and Classifying

Multicriteria analysis allows complex problems to be broken down into workable units and to be structured in such a way that enables the complexities of the problem to become clearer. It has the advantages of unravelling issues and adding new knowledge about the problem.

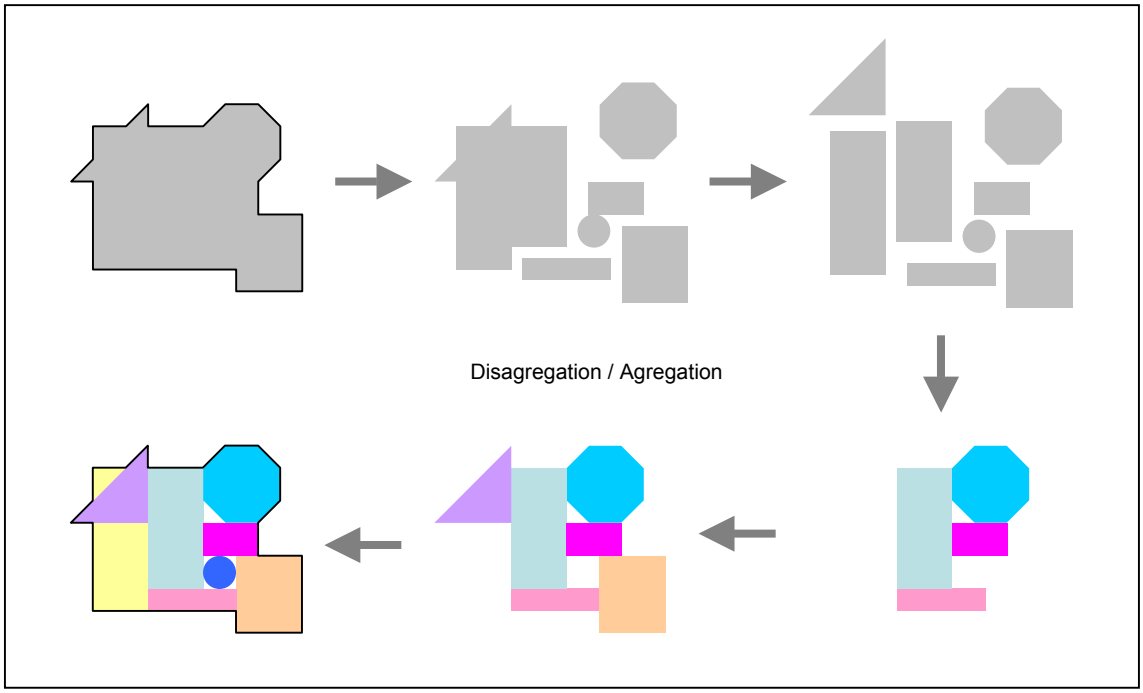


Fig. 39– Unravelling the complexity

In the evaluation phase usually we seek to identify a set of criteria by which existent or future alternatives can be ranked, the decision maker preferences or weights which must be assigned to the various criteria and an aggregation procedure that transforms the set of criteria in a single synthesis criterion expressing a single “compromise” rank order. The final step involves sensitivity and robustness analysis.

The previous chapters presented the structuring process that lead to the identification of a set of primary elements of evaluation. We used descriptors and impact indicators.

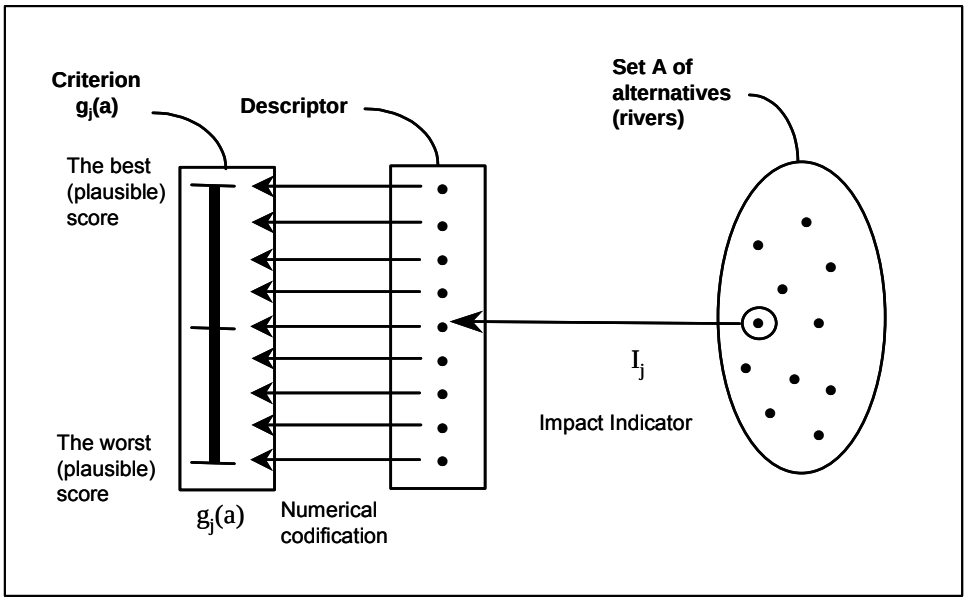


Fig. 40– Criteria, Descriptors and Impact indicators

A *Descriptor* is a scale that describes unambiguously an ordered set of impact levels according to a given viewpoint.

An *Impact Indicator* is 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.

From the viewpoint side, the *descriptor* describes it through a set of impact levels. From the side of actions (rivers) the *impact indicator* indicates the probable impact of each river - potential (future) action. 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 scale "straight, sinuous, meandering" is only useful to understand the meaning of the impact levels. In the case of the "Quality of the built space in RC" a descriptor – "High quality, Moderate quality, and Low quality" - was chosen to classify each urban area according to that viewpoint. It's a qualitative scale that can be explained by mixed information. In that case we had to quantify the amount of areas that exists in River Corridor belonging to each class in percentage of total RC area.

After this process we must built the set of criteria. *Criterion* means a function *g* defined in *A* (set of alternatives - rivers) having values in a completely ordered set (Vincke, 1989), i.e., a cardinal set with an absolute discriminative power allowing to

compare each pair of alternatives (rivers) based on the corresponding impact indicators.

To achieve this we must built a numeric rule of codification that reproduces the order of attractiveness between levels (see Fig. 40). Usually 0 is chosen to the minimum (plausible) score and 1 to the maximum (plausible) score.

After this, when a complete set of evaluation criteria is defined and agreed, an aggregation function, ***V,*** is usually applied. Usually this function is additive like the following,

$$g(a) = V\left(g_j(a)\right) = \sum_{j=1}^{n} w_j g_j(a)$$

$\boldsymbol{w_j}$ - Weight of the criterion g_j

$$\sum_{j=1}^{n} \boldsymbol{w_j} = 1$$

.

The weights represent the relative importance of criteria, i.e., a scaling factor that relates scores on that criterion to scores on all other criteria.

In this stage and considering the aesthetical dimension of our problem, two issues arise:

1. In a rigorous perspective we have to be sure that this additive formulation is the right one to our problem. In fact, when we use an additive function that joins all criteria in a single criterion we are accepting that an increase in the criterion g1 is compensated by a decrease in criterion g2. This is not always accepted in real situations – a decision maker may not accept to increase the amount of pathways or to spend money in the ecological rehabilitation of the river while Low Quality Urban Areas without basic infrastructures still persist.
2. Even accepting that a compensatory model is appropriate, the criteria weights have to be elicited. There are several methods in the literature that can be applied (e.g.," swing weight method"). However, it has been argued that this process can lead to different interpretations. People do not respond to them in any consistent manner and responses do not relate to the way in which weights are used in the synthesis of information.

However it will be highly probable that people feel some sort of inability to elicit their preferences in terms of the relative importance of aesthetical viewpoints that have been identified. Also, an aggregation function is very beautiful from a mathematical perspective but it hides the richness of the problem expressed in terms of the performance of the urban watercourses according to the several criteria that have been chosen.

For the general purpose of aesthetical classification of urban watercourses, considering the evaluation problems identified in previous chapters and the subjective dimension of aesthetics it was considered appropriate not to use any global aggregation function, i.e., not to calculate some sort of an aggregated index that allows to classify rivers by a single score.

Alternatively it was preferred to analyse the **aesthetical profile of urban watercourses** supported by a battery of partial performances following each viewpoint like presented in Fig. 41.

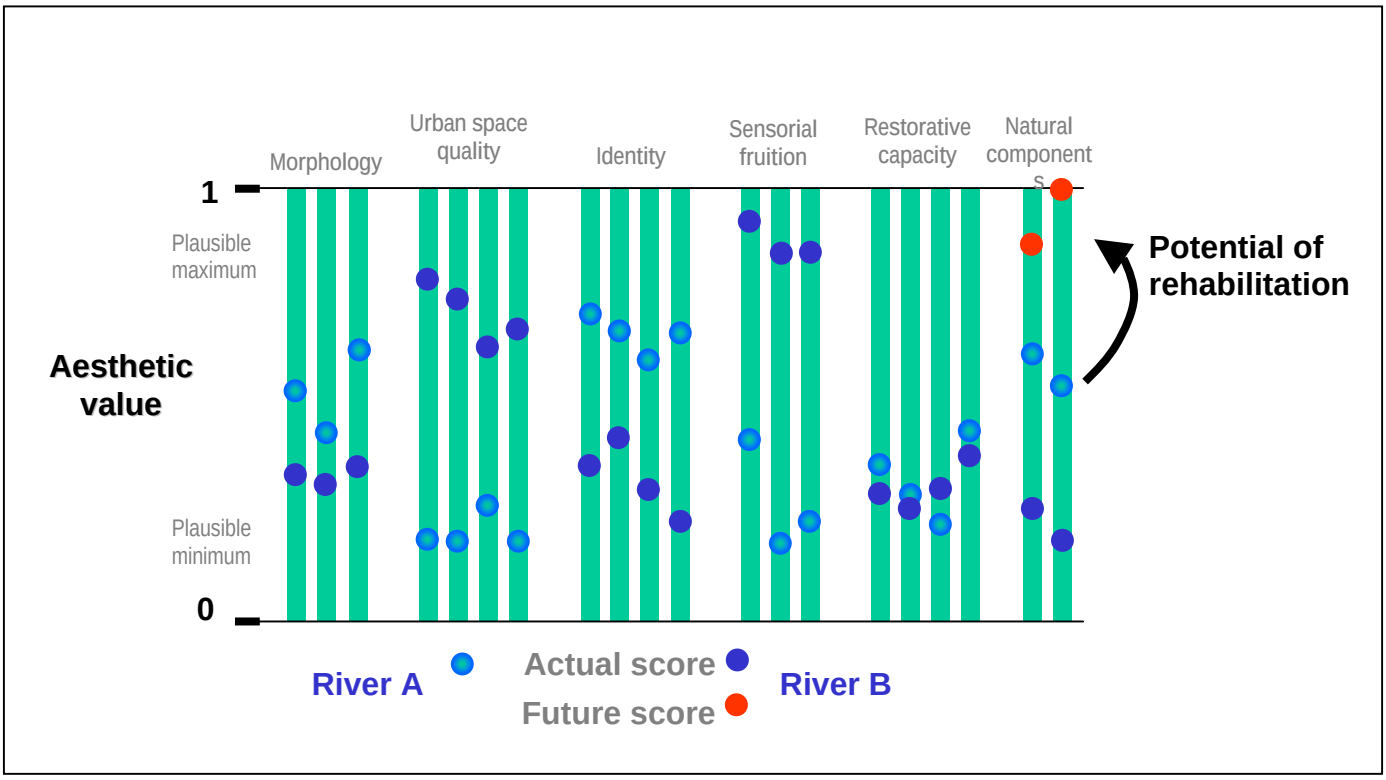


Fig. 41– Aesthetical profiles of urban rivers

This approach has, at least, the following advantages:

- Reveals the diversity of characteristics of each urban watercourse. Some could be more related with social and cultural environment, others with a more naturalized landscape or a more urbanized landscape or even with a specific geographic context;
- Allows to perceive and better understood the different dimensions that can be improved in a river rehabilitation process;
- To compare the performances between rivers in different dimensions and analyse their scores with reference values;
- To make a comparative analysis and get some conclusions about the profiles of aesthetical characteristics.

All this can be done in the follow-up of this work according to the implementation of the methodology to different rivers.

4.1 Data acquisition and analysis

This chapter focuses on the data needs and techniques that can be applied in the context of the development of a river aesthetic classification in urban environment.

In this context landscape is formed by a combination of different components to create a place, locality or region with a specific aesthetic value. “These include the underlying geology and soils, the topography, archaeology, landscape history, land use, land management, ecology, architecture and cultural associations, all of which can influence the ways in which landscape is experienced and valued”(Chapman *et al.*, 1995). All these landscape components are possible to represent and analyse in a geographic context and as geographic features.

For the purpose of aesthetical classification of urban watercourses the following cartographic data was considered as necessary:

Hydrology (scale: 1/25000);

Topography (scale: 1/10000); using this topographic data it was possible to derive a digital elevation model (DTM).

Aerial Photographs (resolution: 10m); information used to identify the most recent changes in urban space.

Land-use (scale: 1/10000); these information includes different layers: road network, urban areas, elevation, hydrography, green areas, forest areas, agriculture areas, etc., split by thematic layers.

Geographic Information Systems (GIS)

GIS technologies has become an almost indispensable tool for capture, display, structure, store, interpret, analyse, manipulate, update, simulate, model and post process environmental entities and phenomena with geographic information (Aronoff, 1989). Nowadays GIS have relevant role to support management tasks due to it specific abilities. For the purpose of aesthetical classification GIS can be very useful to:

a) Data integration

b) Data analysis

c) Presentation of the results from the analysis.

Table 1 – Data integration in a GIS environment

GEOREFERENCED DATA		
ALPHANUMERIC DATA	**MAPS**	
	VECTORIAL	RASTER
Inquiries and surveys	Topographic	Aerial photography
Census	Thematic maps	Raster images

The need to integrate and analyse this wide range of spatial information is seen as a key to the importance of GIS in landscape studies.

GIS can integrate both the geometry data (coordinates and topological data) and the alphanumeric data (information describing the properties of spatial data). These alphanumeric attributes are presented as tables linked to the graphic information.

Commonly GIS are equipped with a few tools that are important for the spatial analysis and the terrain models generation. Computer based tools (internal manipulation algorithms) can process a wide range of complex information in order to

extract the parameters necessary to classify the aesthetic value of the urban landscape.

Spatial information is stored as points, lines and areas, defined by co-ordinate geometry; while, non-spatial information, known as attributes data, is stored in tables.

Vectorial data is composed of graphic elements that consist of points, lines and area features. Area features are depicted as polygonal features and corresponding area centroids. The graphics elements are linked to relational database information that further describes and defines each individual feature.

The spatial analysis is the ability to combine the basic data elements in form of a question about the spatial relationships that exist between graphic features. Within a software environment and using the GIS multi-layered information we can create buffers (zones around features), remove or merge common boundaries between adjacent areas and reclassification based on queries.), calculate areas, make queries, generate Digital Elevation Models, etc.

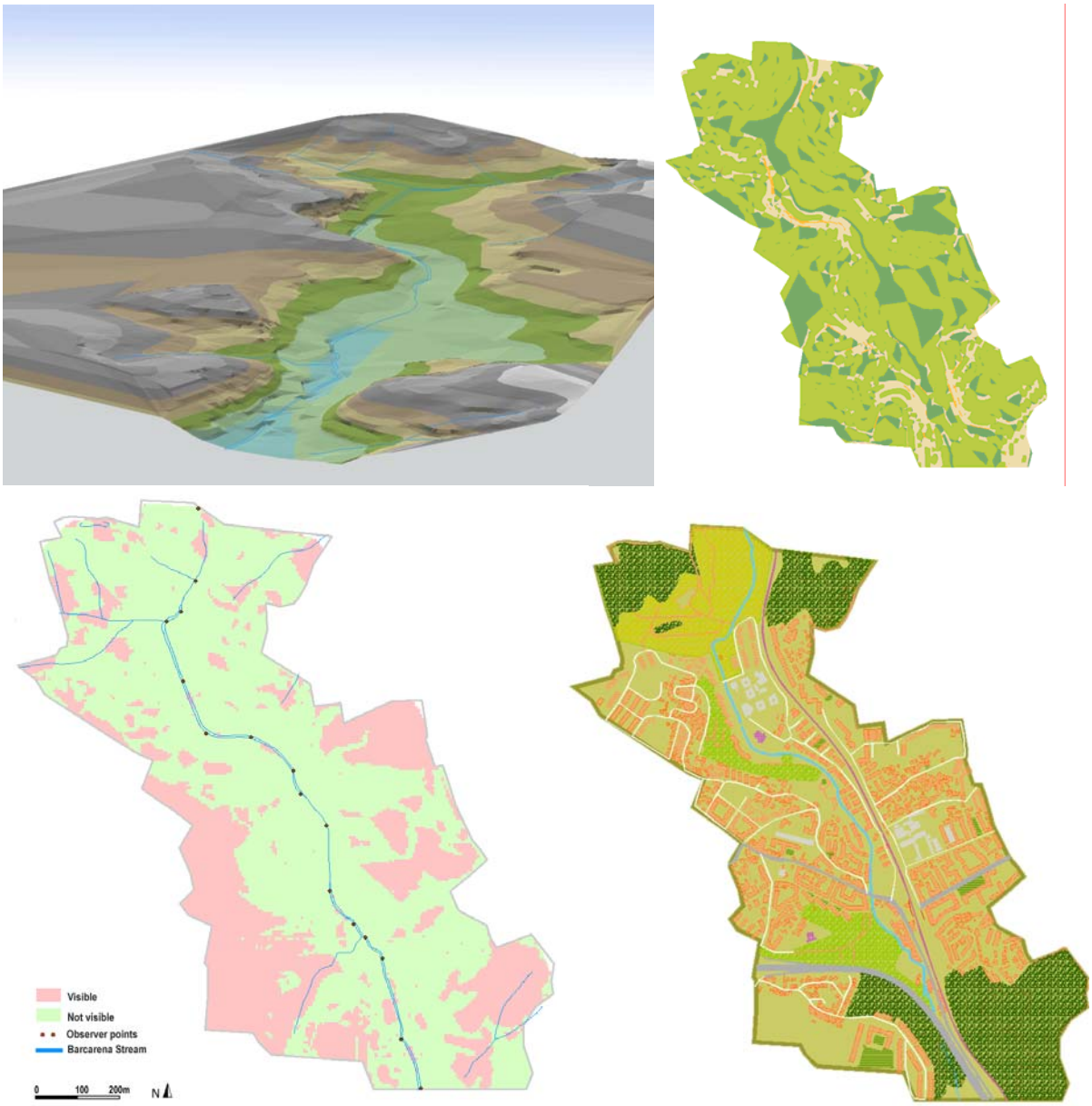


Fig. 42– GIS products: DTM, Slope analysis and viewsheds.

4.2 Public inquiry

Objectives

The identification and description of parameters of the aesthetic evaluation allows identifying a group of parameters that cannot be evaluate objectively. In relation to the inhabitants' perception of river, the river restorative capability and identity as well

as attachment of the inhabitants to the river, it is necessary to answers the population. With this purpose in mind a questionnaire was design that will be used to test in a specific situation, and can be adapted to different case studies.

The main objective of this survey is to understand the importance of the river for the people in terms of their perception, activities and identity.

Inquiry structure

The questionnaires were structured according to the following topics:

1. General questions about the subjects relation to the city, like how long they live in the city, the reasons why they choose this city, place of the job, where they spend the free time;

2. Behaviours /activities related to the river and the river corridor. This part includes a long list of possible activities developed in the river corridor or at the riverfront.

3. River landscape perception It was used the model of Carr *et al.,* (1992) which define three dimensions in the public space: (1) necessities (that include, comfort (physic, psychological and social) relax and active involvement and passive involvement); (2) rights (appropriation and action) and (3) meanings and attachments. Several questions are developed in order to include the dimensions describe before.

4. Preferences for the future – there is a group of questions concerning the inhabitants' preferences in relation to possible improvements of the river, riverfront and the city.

5. Identity – it was used the Breakwell' model, described before, to developed an identity scale in relation to the river and to the city. The main objective is to understand the importance of the river and the city to inhabitants' identity.

6. Evaluation of the restorative components of environment - it was used the Kaplan's' framework to developed a scale of restorative capability of the river.

7. Socio demographic characteristics: age, gender, educational level, and occupational status.

Inquiry Adaptation to a new case study

The inquiry was constructed in order to be flexible enough to be adapted to different case studies. It is possible to identify the main steps towards the adaptation to a specific case study:

1. Characterization of the river
2. Identification and characterization of the public
3. Characterization of the city
4. Identification of the foreseen and/or wanted projects
5. Evaluation of the applicability of the different aspects of base inquiry to the case study. Inquire adaptation to the new case study
6. Pre-test the inquire adapt version (qualitative and quantitative evaluation)
7. Elaboration of the final version of inquires to use in this specific case study.

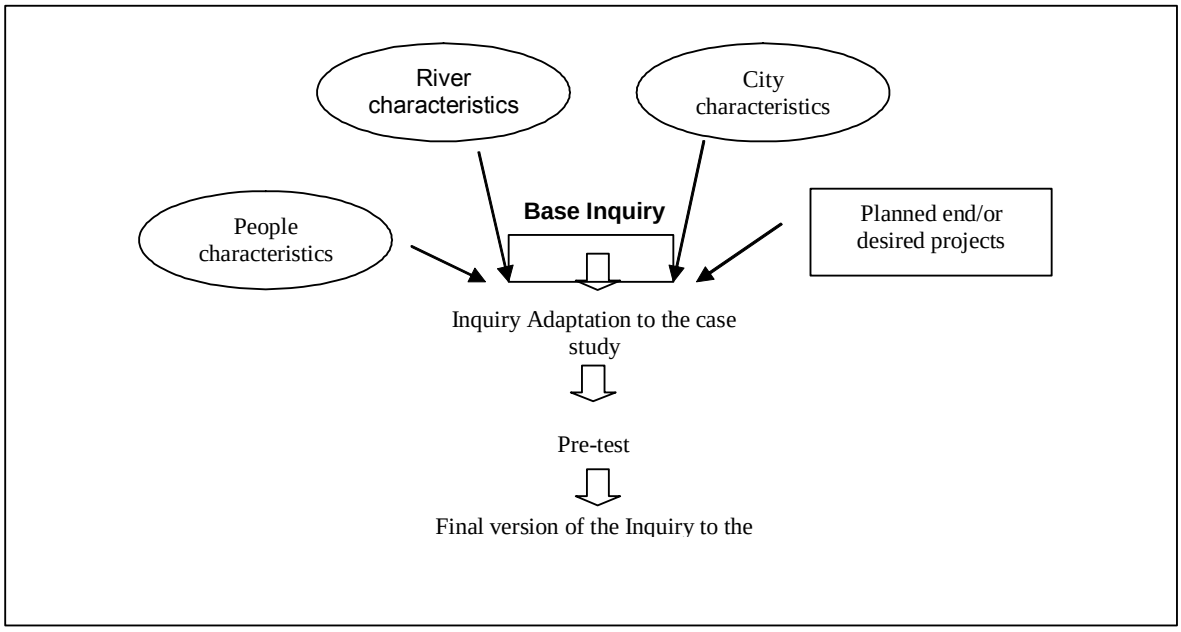


Fig. 43– Inquiry methodology

5 The Limits of Objectivity and Evaluation

As quoted above, the intersection of a river and a city is a compromise between "natural" and "cultural" systems. Therefore, the resulting landscapes show a wide spectrum of man-made features, which transformed more or less deeply the previous context.

This coexistence raises the question of the appreciation of more natural environments, or those built and adapted by humans. The aesthetic experience has several roots, either in the appreciation of nature towards a more cultural approach. Human personalities, values and beliefs influence the experience and knowledge of the environment, with a permanent search for what is called beauty, harmony or coherence. Also social values and constructs influence our appreciation of settings and behaviours, where the personal views are infused with cultural ones.

Aesthetic values are partly influenced by "mystique" affection for landscape and its beauty, and also by cultural features that show human presence, influence and intervention over its surrounding environment.

Aesthetic appraisal can show a polar trend, between satisfaction and disgust, where critical judgement is joined with appreciation (Berleant, 1997). Natural environments can be perceived as insecure, unpredictable, and hostile.

Urban aesthetics focus on the built environment, shaped for human purposes. A common tendency could try to oppose in aesthetic terms the city with the countryside, which is not the main question. The historical and social dimensions cannot be dissociated from the concept of urban beauty and meaning.

In other hand, urban aesthetics can also show negative values, associated with pollution, crowding, litter, oppressive buildings, and other effects of urban sprawling and discomfort. Different views about aesthetic attributes and their expression in the urban environment can often lead to conflicts, either ideological or reflecting economic concerns, such as individual property interests. The high degree of subjectivity is a crossing subject in this field, where no uniformity in responses and attitudes can be found.

In the particular case of our research, it is important not to intend to classify “nice” or “ugly” urban watercourse reaches, but to investigate which are, in each situation, the characteristics and attributes that can be enhanced, both in “naturalistic” or “constructed” environments.

In any case, there is always an opportunity to create or recreate new urban landscapes, based on criteria recognised as relevant for a wide aesthetic appreciation. The search for attempting unity, diversity, novelty, creativity and other important ingredients to aesthetic experience should be included in all rehabilitation and renewal urban schemes. Environmental creativity can be looked as a new tool for sustainable planning and management of urban landscapes, joining artistic, cultural and natural processes towards a more pleasant aesthetic environment.

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Part II

A "Site Method" for Aesthetic Evaluation

1. The Site Method in the Context of URBEM

The CESUR-IST/UTL team is leader of the URBEM Work Package # 4 "Classification of the Aesthetic Values of Selected Urban Rivers – Methodology". This method is designed to assess the aesthetic appeal of river corridors. According to the work package description, the assessment method is to be used to prepare a visual analysis for before-and- after restoration conditions. It is recommended to use the CESUR-IST/UTL methodology for the assessment of river corridors and to use the "Site method for aesthetic evaluation" for project sites before and after improvement.

According to the Water Framework Directives (WFD) cities should meet a "good ecological potential" in "heavily modified water bodies" (Article 2/23). A URBEM study evaluated case studies of 23 urban river enhancement installations that represent state of the art and "best practicable technology" for cities to follow. The study found that the average size of projects was relatively small (over 50% are between 500 and 2000 m), costing 100.000 to 2 Mio € (52%). Reasons for the small size included space constraints, use conflicts in cities, and budgetary limitations. It is probable that, in the future, most urban river enhancement projects will be of limited size rather than for extensive sections of the river corridor. For this reason the "Site method for aesthetic evaluation" has been proposed.

River restoration and waterfront development are high visibility projects that have become a priority all over the world. Some projects have been instrumental in the economic revival of cities, including Pittsburgh (Salvesen, 2001), Saint Paul (Hammel, 2001) and Wilmington (URBEM, WP 2). City planners recognize that urban rivers are usually among the most vivid and memorable features of a city and play a prominent role in shaping the structure, character and identity of urban areas. Innumerable historic paintings of urban waterfronts often symbolize the image of the whole city. But in the nineteenth and throughout much of the twentieth century, the water quality in most urban rivers was so bad that most cities turned their backs on their

waterfronts. The widespread interest in urban river enhancement did no emerge until advances in wastewater treatment technology had created a water quality that was sufficiently high to convince cities that their waterfronts had enormous potential for development.

It is proposed to integrate the "site method" into the URBEM "Decision Support Methodology for Urban Planners and Public Environmental Authorities" (Work Package # 5). The method is designed to ensure that decision makers understand how measures that address river ecology would fit into the urban fabric. Work package 5 will include a visual analysis of before-and –after restoration conditions to show the potential for urban river rehabilitation. Indicators for judging the success of river enhancement projects will be proposed in Work package 10. . The TU Dresden gained experiences with aesthetic considerations for river enhancement in case studies conducted on the Cuyahoga River in Cleveland, Ohio and the Alster River in Hamburg. Another case study to apply a prototype "site method" is expected to be conducted in the spring of 2004, involving students and practitioners.

The restoration of the environmental and ecological integrity of urban rivers may also enhance aesthetic experiences, in-so-doing enriching the quality of social life and increasing economic values in riverine districts of cities. The field of urban aesthetic evaluation has been much influenced by Kevin Lynch (1918-1984) through numerous works including "Image of the City" (Lynch, 1984), "Site Planning" (Lynch, 1971), "City Sense and City Design", (Lynch, 1990) and other numerous writings. (SOMETHING HERE Positive aesthetic experiences are in part dependent on the subject having a clear and vivid image of the urban fabric.) His recommendation to open up public access to the waterfront, to create public spaces and to preserve historic structures, led to civic improvements to Boston's Government Center and its waterfront, resulting in one of the most memorable and delightful districts in contemporary urban America.

2. The Method Described

The "Site method for aesthetic evaluation" is designed for relatively small project sites and is expected to achieve a multiple set of objectives related to the work packages contained in the URBEM project:

- Provide an aesthetic analysis of pre-improvement conditions (WP4)
- Assess the potential of alternative rehabilitation sites (WP5)
- Provide a procedure to identify potential sites for watercourse rehabilitation (WP6)
- Act as a social appraisal tool (WP7)
- Provide a procedure to select appropriate (new) techniques for urban river rehabilitation (WP8)
- Function as a component of a decision support methodology (WP9)
- Be used in a post-improvement comparison as an indicator of success (WP10)
- Be part of a training and dissemination workshop and exhibit (WP11)

The method emphasizes pre-and-post enhancement assessment, and relates to other work elements of the URBEM project. For example, stream restoration techniques selected in Work package 8 will have aesthetic implications. Similarly, the social appraisal (WP7) will be influenced by the appearance of a site. The method focuses on enhancement of sites on urban rivers. The enhancement program for riverfront sites must be designed in the context of the district of the city in which the site is located. Kevin Lynch defines districts as sections of the city that have some common recognizable character (47). Each may be special in its own way, its history, its architecture, its open spaces, or its waterfront. The function of rivers will often be responsible for giving the adjacent districts the common identifying characteristics that make them distinctive, docklands for instance. The topography of the river will be critical in determining function of riparian uses and therefore the characteristics of adjacent districts. The bluff bank of the river for instance was usually the location of the main defensive stronghold of the city and of the most affluent residential areas

commanding fine views. Historically, low lying banks of the river hosted less desirable uses such as trash disposal, gravel extraction, sewage facilities, and docking. People will sensitive to these characteristics and distinctions through aesthetic stimuli that evoke memories which give the site meaning. Therefore the method categorizes resources or elements to be identified and mapped in an aesthetic site inventory. Under three headings, (1) the river and (2) the city and (3) the people, we discuss how these resources are perceived, experienced and appreciated by people and how this appreciation affects social activity.

1. The River

- Ecologic river zone
- State and quality of water body
- Channel type
- Streambank
- Floodplain
- Fauna
- Flora

2. The City

- Spaces
- Access
- Boundaries or transitions forms
- Focal points (and landmarks)
- Activity nodes

3. The People

- Sensory perceptions.
- Experiencing the site
- Experiencing the elements of the city
- Experiencing motion through the city

The list of resources is extensive, but every element will rarely occur on a particular site. Resources are to be individually located and recorded on “field survey forms”. Each should be documented with a photograph. Resources with potential for enhancement, such as an obstructed view, are also to be identified and described on the survey form. Special recordings, such as “stop-frame motion pictures” (recording one frame per second) may be utilized to provide supportive documentation of resources that are experienced in motion.

Elements should also be rated by degree of importance. From this process distribution patterns of resources will emerge. The analysis of these patterns would lead to the development of criteria for visual enhancement. These could be used for example, to reinforce border elements that shape spaces or identify neighborhoods, to avoid obstruction of important views of the river or to landmarks beyond, or to enhance the individual identity and character of landmarks along the river(bridges for instance) by lighting, color coordination etc. The site method for aesthetic evaluation presented here is one component in a comprehensive urban river basin enhancement program that considers both the requirements of the Water Framework Directives and the need for cities to enhance the economic and social viability of its waterfronts by careful attention to the important role that the river plays in shaping the image of a city. An aesthetic evaluation will inform the design of the enhancement program.

2.1 The River

It is appropriate to start an urban river aesthetic assessment investigation with the river itself. Case studies of the URBEM projects showed that a majority of stream enhancement projects occurred on stream of less than 25 m width. Thirty percent of the projects were carried out on streams only1-5 m wide. A great advantage of

working with smaller rivers is that they are more manageable than larger ones. Enhancement projects have been carried out on larger rivers with distinctive waterfronts including the Hamburg Harbor and the tidal Anacostia in Washington DC that were URBEM case study examples, but projects at that scale are in a minority.

Measures to enhance aesthetic experiences were included in 61% of the completed projects that were investigated. Case studies identified ecologic enhancement (96%), urban upgrading (43%), flood control (39%), and amenity/recreation (43%) as benefits. It is common to consider amenity and recreation together. There also is a generally accepted concept in the literature that ecologically healthy natural environments are aesthetically pleasing (Leopold, USDA). This may also be applied to river systems, but it would be a mistake to conclude that urban rivers are always producing less positive aesthetic responses than rivers in natural settings.

An aesthetic analysis of a river should not be an isolated task. It is integral to a comprehensive planning effort that will be proposed as the final output of URBEM. Aesthetic stimuli are an essential consideration in how people experience a site and are therefore important elements of a social appraisal (WP7). Stakeholders will readily identify these experiences which are therefore an important part of stakeholder involvement (WP9). It is essential that aesthetic analysis is understandable to the public and is an integral part of all tasks in enhancement projects including those based on scientific method. The scientific basis for hydro-morphological river enhancement are well understood but the aesthetic implications of such improvements need careful consideration. In URBEM case study sites, participants were asked to summarize river morphology using the “Rosgen Classification” (see summary in the appendix). The classification is based on the physical characteristics of the river including slope, curvature (sinuosity), width-to-depth ratio, particle size in streambed, stream entrenchment and land forms. Another classification method is the “Gewässerstrukturgüte Kartierung”(LAWA 1998) which is used in central Europe. In many countries projects that require public funding are required to conduct an assessment of existing state in order to assess need. This existing method is well suited to the task and lends itself to pre-and-post improvement assessment, problem definition, and an expression of the preferred state. The two existing classifications systems mentioned above were adapted for aesthetic analysis, for reasons of efficiency and functionality. All the components of those classifications relate to the

senses, however they need to be transferred into terms understood by urban decision makers. Categories to be used for a river analysis are:

- Ecologic river zone
- State and quality of water body
- Channel type
- Streambank
- Floodplain
- Fauna
- Flora

Ecologic Stream Zone

River zones or stream types are a geomorphic characterization of streams. They express channel slope and channel shape (narrow-deep, wide-shallow) and give an indication of the type of fish that are native to each zone. In the URBEM case study analysis participating cities were asked to define river zones using a method devised by Huet. To encourage stakeholder participation, the different zones, typical aquatic habitat, flora and fauna should be illustrated. This is particularly important in cities with tidal rivers, such as the Thames in London or the Elbe in Hamburg, where at low tide the river is reduced to a slimy trickle, meandering through banks of deep brown mud. People find it hard to believe that these mud flats are an important feeding habitat for wading birds and that migratory fish, such as sea trout use the channel on their way upstream. Comparing current conditions to a reference stream in a similar river zone will show the potential for ecologic enhancement and will help to set potential goals.

State and Quality of Water Body

People view healthy rivers as more pleasing than rivers they know to be polluted. A healthy aquatic environment will usually be visually apparent, but lower reaches of

rivers that tend to have higher natural turbidity, may be seen as polluted and trigger a negative aesthetic response. Good water quality also allows recreational uses of the river which will dramatically improve its public's image. EU states have started to monitor water quality for each section of a river according to the WFD. The URBEM case study survey made inquiries concerning the ecological and chemical state of water bodies including physio-chemical pollutants, chemical pollutants and state of bathing water quality. In some rivers, such as the Elbe which used to be one of the most polluted rivers in Europe, water quality has improved dramatically. Last year an Elbe swimming day was held and observed in cities between Dresden and Hamburg. Urban river enhancement sites depend on water quality control on upstream sections of the river. Sufficient water quality greatly increases the potential of a site for enhancement (WP6). Important variables are

- Water quality rating of stream section
- Frequency of combined sewer overflows
- Perceived quality of water by stakeholders

Channel type

The channels of rivers vary according to stream order. First order (younger) streams are more directional with little flood plain, while mature rivers meander widely in broad flood plains But river channels have been modified for various purposes, often to make them navigable. These modifications can produce dramatically different appearance. The dammed and locked channel of the River Moldau in Prague gives the impression of a series of lakes. Further downstream, it has not been dammed but the channel is narrowly confined and much faster flowing. In urban areas river channels have almost always been confined for various reasons. In contrast, a natural stream or river channel has much more visual and habitat diversity with cut banks, sand bars, gravel beds, pools and riffles. The Rosgen classification was used in case study investigations. It provides a broad, hierarchical structure for the diagnosis of a river channel and its floodplain. The following categories of the Rosgen method are to be adapted for an aesthetic analysis of streams.

- Slope classes (8 categories)

- Categories of sinuosity (9)
- A classification of stream types according to channel form and dominant bed material
- Longitudinal, cross-sectional and plan view categorization of stream types (9 categories)
- Width-to-depth ration stream classes (9 categories)
- Particle size of sediments in bed and banks
- Stream entrenchment ratio and stream type (6 categories)
- Land form Feature/stability stream class

Streambank and streambed

The "Gewässerstrukturgüte" (LAWA, 1998) offers a comprehensive system to analyse streams. Almost all of the categories listed have aesthetic implications. To define the physical conditions of streambank and streambed is a part of standard planning procedure and a pre-requisite for post-improvement evaluations. Each of the following inventory categories should be judged against the value of healthy hydro-morphological and geo-morphological conditions in the stream. Some states provide assistance for the evaluation of streams through an Internet site (GESIS, 2003). There always are stream sections in urban areas that are in a semi-natural state. Others have been heavily modified and confined to hard, constructed edges. These sometimes edge the channel, sometimes the flood plain. These well-defined edges emphasise the visual contrast of the city and the river. The following Standard Categories of "Gewässerstrukturgüte" are also to be used here:

- Forms of streambed stabilization
- Forms of streambank stabilization
- Transverse structures in the streambed
- Streambank erosion

- Sediment deposits
- Bridge crossings
- Culverted Streams
- Profile of channel cross section

Floodplain

In many countries, areas adjacent to rivers subject to frequent flooding are legally part of the river. During the historic development of cities, the flood plains of many urban rivers have been filled and developed, confining the river to a narrower channel. Floodplains have influenced city form. Some cities have managed to retain the flood plains. Dresden for instance the flood plain is managed as broad grass meadows on both sides of the river channel, forming a central open space that structures the downtown. The openness of this feature gives the city and its waterfront a unique spaciousness and increases the sense of continuity along the river. It is a vivid aesthetic experience. Others cities are enacting restrictions to prevent development of remaining floodplains. The 100 year frequency flood is generally used to define floodplains, which can further be divided into open floodway districts where high velocity flows are likely to cause damage and flood fringe areas where flood damage is primarily caused by ponding. The standard “Gewässerstrukturgüte” analysis considers the following:

- The extent of the 1,2,5, and 10year floods
- Ground cover of floodplain
- Flood control structures

Fauna

A healthy and diverse aquatic fauna is an indication of water quality and will further add to positive aesthetic experiences and increase recreation opportunities. The WFD not only considers chemical water quality but also fish fauna (Toby fauna covers fish and invertebrates) and invertebrates as an indication of good hydro-morphological

conditions in a stream. Participants of the URBEM case studies answered questions concerning these parameters. The “River Invertebrate Prediction and Classification System (RIPPACS)” is used in Britain to classify streams. Species abundance and diversity of aquatic life are used as indicators of water quality and river purity. A healthy stream with abundant aquatic life is usually viewed as aesthetically pleasing, and to experience wildlife along the water is an enriching experience:

- Macrophytes, benthic invertebrates
- Fish fauna by composition, abundance and age structure
- Riparian fauna

Flora

The bright green foliage of willow, the flowers of red maple, or the white bark of sycamore will often indicate the presence of a stream. Typical riparian trees can be used by designers to signal water and to enhance the identity of place. In addition the shallow littoral zone along the river bank with its emergent aquatic vegetation plays an important role in water quality protection and as a wildlife habitat. Aquatic and riparian vegetation are important elements in maintaining stream functions, water quality and the beauty of the steam environment. The German nature protection law discourages engineered structure to channel streams, but promotes the use of biological measures paying special attention to vegetation along the riverbanks (BnatSchG). German law recommends a 10 m vegetated strip along the banks of streams. In the North America forested buffer strips are recommended along streams to meet ecologic and aesthetic objectives. Existing issues for conserving and enhancing vegetation along the water have both ecological and aesthetic concerns. The following forms of vegetation are of interest:

- Submerged aquatic vegetation
- Wetlands and emergent vegetation of the reed bank zone
- Vegetation of the streambank
- Vegetation of a streambank buffer strip

2.2 The City

The five categories of elements of city form and image are similar to those used by Kevin Lynch.

- Spaces
- Access
- Focal points (and landmarks)
- Boundaries or transitions forms
- Activity nodes

Spaces

Urban spaces include squares, parks, rivers and streams. Rivers are often among the largest open spaces in the city. Streets, intersections and alleyways are also open spaces, and they often create important vistas. (Streets are the principal means by which we mentally organize the city, but we deal with these elements under the category "access"). Urban squares are normally bounded by buildings, while urban parks and rivers are more natural features. Clearly these urban open spaces will vary greatly in form and size and have very different visual qualities. But they all tend to be elements that are highly distinctive and memorable, lend character and identity to their surroundings and give structure to the city.

- Rivers and streams.
- Parks and other "natural" public spaces
- Squares and plazas
- Recreation areas

Rivers and streams: The configuration of rivers usually results in their being equivalent to linear parks. But the appreciation and use of rivers will vary depending on accessibility to the banks. Rivers provide open vistas to the city beyond. They are also in sharp visual contrast with the city which is extremely complex, often visually chaotic. The river on the other hand is very simple in form, and the smooth horizontality of the water contrasts with the vertical forms of the city. River views are often responsible for creating famous images of a city. Examples are the "Canaletto view" of Dresden with its distinctive city outline viewed across the Elbe River, or the view of Big Ben and the Houses of Parliament across the River Thames in London. Lateral views along rivers are often the longest in the city.

Parks and other "natural" public spaces: Many urban parks are based on stream valley systems, sometimes because this was the left-over land after development. Fairmount Park in Philadelphia and Rock Creek Park in Washington DC are examples. Riverfront parks as linear open spaces have often been designed to permit observation of the water and the opposite shoreline, adding to the visual experience. Parks have been created on floodplain building setbacks from the water, or publicly owned setbacks for sewer lines or other underground utilities. Parks contrast strongly with the urban fabric because they are usually relatively natural. So too are rivers. They contrast also in form. The river has extraordinary simplicity of form that makes it an excellent foil for the complexity of the surrounding urban fabric. Parks too are relatively simple in form but do not have the extreme simplicity of the river.

Squares and plazas: Public squares and plazas are often important landmarks and social activity nodes in a city. They are often associated with historic buildings and events and are frequently historic meeting places. They are usually exciting places where there is a great number of aesthetic stimuli competing for attention. They are symbolic of the city for many citizens.

Recreation areas: Passive recreation areas are places where people come to escape from the noise and tension of daily life. Most people prefer more natural areas for this purpose. Active recreation areas include sports facilities for organized recreation. Both types of recreation are temporal uses particularly suitable for areas of periodic floodwater inundation. Although major rivers are often among the largest open spaces in a city, they are not as accessible as parks. Rivers have multiple functions some of

which are incompatible with recreational use. The river is an exciting place for children to go and play but it is also a dangerous environment. Danger may be caused by the nature of the river, by its unpredictable behavior (flooding), or by other incompatible uses. These uses may pose a threat by polluting the water making it unfit for recreational uses, or traffic on the river can make swimming or boating hazardous. “Going to the park” is a routine for many urban kids. Younger children will usually be accompanied by a parent, and often meet their friends there. Because of their attraction, rivers are often a destination for mothers with children. For adults and children alike, the river is a vivid image. Recreation at the river most often involves walking along it, occasionally going down to the waters edge; and watching activity on it both commercial and recreational activities such as rowing and sailing. It is in effect a linear park. Sometimes there are green spaces along the banks and in the core of the city there is often a large riverfront plaza.

In urban areas public access to the riverbanks varies. In many cases it has been preempted in the past by other uses, particularly those involving docking and warehousing. Today, although new uses sometimes obstruct access (affluent hotels are probably the worst offenders), public access to the banks of urban rivers has greatly increased. But even a small break in the continuity can disrupt not only the use of the river as a linear park but also its perception as such. Rivers used for transportation usually had a towpath on one bank that in many cases has become a right-of-way for pedestrians.

ACCESS

Lynch found that the pathways of a city, the expressways, streets, alleys, railroads, bike ways and pedestrian routes are the most important elements that shape our mental map of the city. We experience these pathways while in motion, and the spaces and points of visual interest are experienced in sequence. Boundaries and transition areas structure the experience. We may travel on foot, bicycle, bus, tram, train, or auto. Trains have their own exclusive rights of way, buses and trams have fixed routes. Some people have an intricate knowledge of bus routes and transfer points and their mental map of the city is largely based on this. On foot, bicycle or auto we decide what route we will take, and we make a mental map of how we will get to our destination. Planning our various activities involves making a mental map of

how to get there and back, and places to visit en-route. It is not surprising therefore, that paths are the most important element by which we mentally organize the city. Paths that change direction, or change their name tend to disorientate the traveler. It helps at the larger scale to know the point of origin and the ultimate destination of a path. Paths are usually at grade, but they may be elevated (providing the visitor much better orientation), or they may be underground which may confuse orientation. Included are:

- Rivers
- Arterial roads and secondary roads
- Railroads
- Bikeways
- Alleys and Pedestrian ways
- Public transport facilities
- Intersections

Rivers: As was noted earlier, urban rivers were once important paths to get around the city. Of course, they may still be used for transportation, in which case the direction of flow or the state of the tide on tidal reaches will affect timing, speed etc. Ships will come in on the flood tide and depart on the ebb. Noises associated with barge traffic on working rivers are often indicative the present state of the tide. The use of urban rivers for transportation has in the past resulted in drastic modifications to the river channel, and derelict industry, docking facilities and warehousing along the riverfront. However many rivers are seeing a huge increase in recreational traffic on the river. Water taxis, barge tours, riverboat excursions and boat rentals offer increasing opportunities to experience the city waterfront from the river. Many cities including Hamburg, Ljubljana and Dresden are planning for increasing tourist and leisure-time uses of the river, but many city residents are more likely to perceive a river as a boundary or obstruction than as a path.

Arterial roads and secondary roads: Urban areas are to a great extent, experienced from automobiles traveling on a hierarchy of roads from limited-access expressways to arterial and secondary streets. Expressways are often elevated and offer panoramic views of the city and can be important elements in our mental organization of the city. However the limited access of these highways makes them impenetrable to cross movement and they can often form a barrier between city neighborhoods. Because many such highways have been routed along rivers, taking advantage of derelict industrial sites along the riverfront, they often separate the urban fabric from the river. There are countless examples of this in the United States. Many arterial streets also follow the river banks as they are funneled to bridges where they merge and cross the river. They too may obstruct access to the riverfront. Because of the funneling effect of bridges they are frequently serious bottlenecks for traffic and as such, are places on travel routes that are well remembered, sometimes for negative reasons.

Railroads: Railroads often run parallel to the river. Therefore they may obstruct access to the water but also can give the passenger wonderful views of the river. When railroads cross the river on bridges, passengers get panoramic vistas in both directions along the river that are often among the most memorable events on a journey. When railroads (and roads) cross rivers, engineering considerations usually dictate that crossings be at 90 degrees to the river. If the river at that point is not flowing in the general direction that it flows through the city, the observer may be badly disoriented.

Underground railways of course are quite different, and people who use the subway or metro frequently will have a mental map of a city that is based on the subway map. For clarity, a subway map is likely to be stylized and bear only a superficial resemblance to the real city above. Emerging from underground, one may be surprised to find that places shown as quite distant on the map are in reality very close or vice-versa.

Bikeways: Bikeways may be exclusively for bicycles or they may be shared with vehicular traffic or pedestrians. The riverfront is a favorite route for cyclists if there is continuity of access. When bikeways are shared with vehicular traffic, the cyclist must

be so wary of inattentive or aggressive drivers that their visual experience of the city is very limited.

Alleys and Pedestrian ways: As vehicular traffic on streets has become heavier and sidewalks in busy cities become narrower, alleys and back ways are increasingly used by pedestrians. They often are attractive, quiet and intimate connections between open-spaces, including the river and the larger urban fabric. It is important to identify both those pathways that run alongside the river and those that link the urban district with the river.

Public transport facilities: Facilities that serve the enhancement site or nearby urban communities should be identified and mapped. Proximity and connections to important destination points should be noted and assessed for possible enhancement.

Intersections: The points at which streets merge or cross are important nodes in the structure of a city. Unfortunately, because they are also often bottlenecks for traffic, they are usually well remembered. Where more than two roads intersect, or if they intersect at angles other than ninety degrees, the traveler is often confused.

FOCAL POINTS AND LANDMARKS

Prominent landmarks and focal points help to make cities memorable. Lynch characterizes these points as having clarity of form, figure-background contrast and the prominence of spatial location. A hill, such as Arthur's Seat in Edinburgh is visible from many points in the city, and also its rugged topography contrasts strongly with its urban surroundings. This gives it considerable spatial prominence. Buildings are the most common urban focal points and landmarks, but in cities located on major rivers, bridges are among the most prominent landmarks. Visual attention is drawn to a focal point by directing the view of it by means of a vista or panorama. The viewer's attention may be focused along a narrow street or an avenue, or it may be a panoramic view across a river or open space. Such features do not always need to be dramatic. Often small features and details make places memorable. Lynch points out that historical associations powerfully reinforce landmarks (81). Ancient cities such as Istanbul, Rome or Prague have tremendous richness of form, texture and detail, with strong historical significance that all add to the visual experience.

Rivers occupy the lowest elevation in a city and are therefore not prominent topographically. The wide spatial, horizontal quality of a river and reflections of the city in the water may serve to enhance the prominence of adjacent landmarks. The view of Manhattan Island from the Upper Bay of New York Harbor is an example of a prominent landmark made more so by its location on the water's edge. In spite of lack of topographical prominence, the river itself is often an important landmark.

Important focal points and landmarks may be outside the city (such as the view of the Rocky Mountains from Denver) or they may be landmarks within the city (as were the Trade Center Towers in Manhattan). As with the same examples, landmarks may be natural or man-made. They may be only significant locally as a landmark (the local pub for instance), or they may be recognized internationally (Big Ben in London for instance). An essential characteristic of landmarks is their singularity. Included are:

- Prominent Landforms
- Single Buildings
- Grouping of buildings
- Engineered structures
- Monuments, statues etc.
- Visually important natural features, tree masses, avenues etc.
- Vistas and Panoramas

Prominent Landforms: In some riverine cities the bluff overlooking the river is the most prominent feature. As a general rule, this is the case only for cities on upstream stretches of rivers where there are sharp cut banks. The bluffs often have strong historical associations with the military defense of the city, and can provide impressive vistas along the river.

Single Buildings: Building may be landmarks of focal points for several reasons. They may have architectural or historical significance. Buildings may also have characteristic or prominent forms or other features that make them memorable.

- Architectural significance — Work of famous architect
  Good example of particular style
- Historical significance — Association with a historic event
  Association with a historic person

Grouping of buildings: Groups of relatively insignificant buildings may become focal points or landmarks because of grouping or location.

Engineered structures: Bridges can be the focus of a view or afford views from them. When moving from the confinement of a city across a bridge, broad prospects of the shoreline and views up or down the river are revealed. The location of some bridges can make them especially prominent, the Golden Gate Bridge in San Francisco for instance. But many bridges also have design or historical significance, the Brooklyn Bridge in New York or Ironbridge in Coalebrookdale in England for instance. Other engineered structures may have significance including docks, canals, and locks.

Monuments, statues etc: Some monuments and statues in riverine districts may be historically related to the river. Others may be situated in prominent locations on the banks, but others may have little or no connection to the river.

Visually important natural features, tree masses, avenues etc: Characteristic flood plain species of trees along rivers can provide strong visual reinforcement of riparian zones. Trees may also have been deliberately planted to delineate the course of the river or even to connect the river to the urban fabric

Vistas and Panoramas: Views of the river. These will include glimpses of the river through gaps in buildings, framed views of the river down streets or avenues, longitudinal views from bridges and panoramic views from riverside plazas. The characteristics of important views should be specified. Viewpoints should also be recorded.

Views across the river: The river provides an unobstructed foreground which allows features on the opposite bank to be viewed, often enhanced by reflection in the water.

Views from the river: People traveling the river on boats will get excellent views of the city which will constantly be changing as the viewer moves up or downstream.

EDGES, BOUNDARIES, AND TRANSITIONS.

Visually perceived spaces are shaped by their outer limits, boundaries or transitions. The earliest places shaped by humans were clearings surrounded by woodlands. Boundaries to riverine districts in which the site is located will already have been identified. The river is not an enclosing element like a woodland edge but it is nevertheless the strongest physical and visual boundary that separates riverine districts. Like an expressway or a railroad, a river can be both a path (if you are in a boat) and an edge (If you are in your car).

- Edges that are reinforced by topography
- Edges that are formed by vegetation or natural areas
- Edges formed by streets
- City edges to the river that are important visually
- Setbacks from the river channel that create a boundary or edge
- Edges to the river that obstruct physical or visual access
- Edges to the river that enhance physical and/or visual access
- Gateways and portals

Edges that are reinforced by topography: The bluff slope along a river will often be a prominent topographical edge that defines areas in riverine districts. Steep land along tributary streams will sometimes cause a distinct physical break between two riverfront districts.

Edges that are formed by vegetation or natural areas: Parkland may be located along a topographical feature such as a tributary stream or have no relationship to the

topography. In either case, natural areas or areas of parkland often form clear boundaries to city districts.

Edges formed by streets: A path can also be a boundary that can provide access but can also be an obstruction. An extreme case is a limited access expressway crossing the city. When you are on it, it is a path but, try to cross it, and you find it is an obstruction to movement and clearly an edge. A city street may also form the boundary between two distinct areas of the city

City edges to the river that are important visually: (These may be inventoried under “landmarks”)

Setbacks from the river channel that create a boundary or edge: Structures of a city that have a distinct setback from the banks of the river on each side often define spaces. Locations along these edges are often the most prestigious addresses in town. Examples are the Jungfernstieg along the Alster in Hamburg.

Edges to the river that obstruct physical or visual access: Flood protection walls or levees will often block views of the river from the city. They may also separate the city spatially from the river. They rarely form an edge between districts of the city.

Edges to the river that enhance physical and/or visual access: In cases where levees or floodwalls form a strong boundary or obstruction between city and river, ramps or steps to enable people to cross them will reduce their impact.

Gateways and portals: Edges are rarely impenetrable and if the points of penetration are well defined they form important gateways. Bridges are points at which the river can be crossed and are clearly important landmarks in the city structure. Gateways in a city wall are similar. Gateways help to create a “sense of arrival”. If areas on each side are very different the experience of passing through a gateway is especially vivid.

SOCIAL ACTIVITY NODES

Places that are nodes of social activity are landmarks in a city. Their use by the public attests to their importance:

- Sites of arrival or departure
- Important traditional meeting places
- Sites of recurring events or activities
- Historic sites

Sites of arrival or departure: These are important points on pathways and may be covered under "access". They include riverboat and ferry landings, railroad and bus stations, transfer points for public transport

Important traditional meeting places: These are often located at a place where a well known landmark is located or at sites of arrival or departure. Other places that are well-known, easily described and memorable will be traditional for people to arrange to meet. They will almost always have very strong visual identity and distinctiveness.

Sites of recurring events or activities: Events or activities may have a strong association with a place and the aesthetic qualities of that place. Events may be regularly occurring or sporadic and the frequency of occurrence will vary. Weekly markets are a defining event in many small towns.

Historic sites: Historic sites are usually important activity nodes. Because they are prominent and easily described, they are often also traditional meeting places. Events to commemorate the historic significance of a place may also be important social events. Historic sites will attract tourists and some of their attraction for social activity will derive from the cosmopolitan atmosphere.

2.3 The People

- sensory perceptions.
- experiencing the site
- experiencing the elements of the city

- experiencing motion through the city

Sensory Perceptions

Aesthetics includes all the human senses. The most sensitive for humans is sight, but sounds, smells and touch all add to the way we experience our environment. Some of the sounds and smells of the river and the city can be even more strongly evocative than sights and it is the ability to bring back old memories that are the most powerful stimuli. The cry of seagulls and the smell of fresh mud when the tide goes out along the Thames in London; the rhythmic beat of the paddlewheels and the sound of music as a paddle steamer passes on the Elbe.

The brain is “constantly trying to fit the present situation into an old context” (Hudacsko). When the brain makes a match, we experience a positive affect which then helps access related memories. We are all aware of the memories so easily triggered by such simple stimuli as a couple of musical notes or the smell of new-mown grass.

Experiencing the site

Aesthetics are sensed and expressed emotionally”. “Discerning the predictable properties of emotion has been a major scientific challenge”. “The seemingly limitless range of human emotions is accounted for by a handful of biological reactions” which will vary only with the rate and intensity of stimuli”. These experiences can also be classified as positive or negative.

“Six types of aesthetic emotional experiences can be identified:”

- Attraction
- Distraction
- Stress
- Relief
- Disillusionment

- Aversion

Attraction: is experienced when the brain makes a match with the present aesthetic stimuli and conjours up related positive memories. When aesthetic attraction occurs, Hudacsko suggests, our minds are processing new information in an “optimal fashion”. A scene is made memorable by vivid, intense stimuli that focus our attention on that scene and it will not be memorable if there are too many competing stimuli.

Distraction: will occur if stimuli appear suddenly with great intensity, and focus our attention elsewhere. Hudacsko calls this “over-optimal processing”. This is one of the negative aesthetic experiences.

Stress: will occur when the brain cannot process the information quickly and retrieve related memories”. This is “sub-optimal” processing. Getting lost in a city is a stressful situation because the brain cannot make a match with a memory that will show us the way The surroundings may be beautiful but the brain is not trying to match memories of beautiful scenery. Fear is another form of stress, when the rate of distressing experiences increases rapidly.

Relief: occurs when the sub-optimal processing that leads to stress ceases. Laughter is triggered by sudden relief from stressful situations and joy is really relief from low level stress. Relief will occur if you are lost in a city and suddenly realize where you are. Memories come flooding back.

Disillusionment: has to do with anticipation. It may occur if one is anticipating relief from stress and it does not happen, or anticipating an attraction that is not realized.

Aversion: is, unlike the preceding experiences, is quite subjective. It occurs when an object appears that we have tagged unacceptable. This is a learned behavior and therefore personal and subjective.

Experiencing elements of the city

Kevin Lynch wrote that, if the city is visibly organized and sharply identified, then the citizen can inform it with his own meanings and connections. Clear organization and identification will make it possible for the brain to match stimuli to past situations and

to bring up related memories resulting in a pleasurable experience. Most people would probably say that natural landscape is more aesthetically pleasing than urban landscape. This is because people have more negative experiences that result from distraction, stress and disillusionment in the city than in the countryside. But Lynch has suggested that the urban landscape "can and should be just as meaningful and delightful as the natural landscape and should be designed to be so" (Lynch, 1990)

Spaces: include city squares and parks. The openness and comparative simplicity of parks and city squares contrasts strongly with the density and complexity of the rest of the urban fabric. The aesthetic stimulus will probably be matched quickly by the brain and the memories evoke are likely to be pleasant. Entering an open space in a city may give a great sense of relief as the stress of excessive stimuli is lessened. The simplicity and spatial quality of urban rivers and the views of landmarks afforded by them make for an attractive experience, and one that is much less stressful than the more chaotic urban scenery

Access: When we travel through the city, we experience a sequence of spaces and forms. The river itself, once an important pathway in most cities for both people and goods, is more often an obstruction to access and may cause serious bottlenecks where roads converge at bridges. The inevitable delays may make crossing the bridges stressful for the traveler. On the other hand, the glimpses we get of the river are among the more memorable experiences on the journey.

Focal points: Focal points demand visual attention. Views of these focal points, which usually are also important landmarks, are memorable experiences. They also may be visible from several viewpoints, and this familiarity makes it easier for the brain to match the experience, which thereby becomes more attractive. Urban waterfronts typically offer a high concentration of focal points and because of the openness of the river, fine, unobstructed views. Variations of views of the same focal points may be obtained from different viewpoint, giving the viewer much better orientation and therefore increasing the attractiveness of the experience.

Boundaries or transitions: form the outer limits or edges of perceived spaces or districts. The clearest boundaries are visually prominent, continuous in form, and impenetrable to cross movement. Generally effective boundaries are as harmonious as possible and focus attention on the characteristics of the enclosed area. The sensory

stimuli of the effective boundary are muted and not distracting. In urban settings, buildings shape spaces just as masses of trees tend to shape spaces in parks. Rivers clearly are important and among the most prominent boundaries in the city.

Gateways and portals are extremely important elements along edges. The characteristics of areas on each side may be quite different. Passing from one pace to another one is likely to experience relief or disillusionment.

Social activity nodes: are urban spaces of intense activity and a high intensity of aesthetic stimuli. Therefore they can cause considerable stress. The designer can reduce the stressful stimuli by creating a consistent language for signs and other features so that they may be easily read and intelligible. Activities at nodes that relate to current events or events of the past are likely to be attended by people in a relaxed frame of mind when the brain can process diverse stimuli. But nodes are also everyday places that are strategic points in a city or important transfer points on routes through the city. They tend to occur at places where paths cross or converge and include places such as transportation hubs. As such, serious distraction can occur at the points, focusing attention away from important messages.

Experiences in motion

When travelling through the city, visual images are constantly changing. The sequence of these experiences can be important in forming a mental picture of the city. But the sensory stimuli may be so diverse and come in such rapid succession that the experience becomes stressful, and distracting if the stimuli are too demanding.

Continually repeated, evenly spaced features such as street trees can lessen the stress and give the traveler a sense of harmony and progression. Different speeds will change the traveler's experience of the city. Pedestrians experience the city much more slowly than a cyclist or motorist and the detailing of the pathways, visibility from the path, and the character and rhythm of the spatial visual experience can be purposefully arranged.

Demands on the attention of the traveler by competitors for road space will seriously increase stress and distractions.

3. The Method Applied

- Application in light of the URBEM method
- Aesthetic inventory of pre-improvement conditions
- Rating of resources by degree of importance
- Mapping of distribution patterns
- Aesthetic opportunity and constraint analysis
- Scientific analysis input through hydrologist and city planners
- Architectural programming to define goals and objectives through a “functional site
- programming method”
- Design criteria and policy determination

The “Site Method” will be used to prepare an aesthetic analysis as an integrated part of the process of urban river enhancement. The costs of preparing an aesthetic inventory and analysis before an improvement project has commenced will need to be justified to city fathers. So will the expenditure to compare this analysis with post improvement conditions some years later when planted trees, and other improvements have matured. The URBEM existing case studies analysis found that, of 23 case studies investigated, only 22% included any sort of visual analysis. A high 61% of case study participants named visual and spatial concerns and the enhancement of aesthetic experiences as components of their projects. A post development evaluation to apply indicators of success to all aspects of an improvement project is a stated objective of URBEM and helps to justify public expenditures. To justify the cost and to assure funding, a visual analysis should provide multiple benefits to improve its cost-effectiveness. Following is a list of the potential benefits of a visual analysis:

- Provide an aesthetic analysis of pre-improvement conditions (WP4)
- Help to assess the potential of alternative sites (WP5)

- Implement and test a river rehabilitation assessment tool (WP6)
- Be part of an social appraisal tool (WP7)
- Provide input into the selection of appropriate (new) techniques for urban river rehabilitation (WP8)
- Function as a component of a decision support methodology (WP9)
- Be used in a post-improvement comparison as an indicator of success (WP10)
- Be part of a training and dissemination workshop and exhibit (WP11)

When a proposal for a visual analysis is made, its contents, implications and usefulness need to be made clear. As a planning endeavor, an aesthetic analysis involves first a survey and inventory of existing conditions, then value and policy determination, and finally an implementation, or use phase. The analysis can help to overcome reservations held by some concerning any form of re-naturalization in the city. Ecological upgrading of a stream by requiring hydrologic forest buffers to provide shade, leaf litter input, runoff pollution filtration and bank stabilization may excite a water resources planner. But it will do little for architects and city planners if the buffer blocks views of important landmarks or when it obstructs a popular open space. Many methods have been developed to defining river corridors in rural landscapes based on aesthetic criteria. In a city however, urban rivers need to be evaluated on different criteria. The architect Kevin Lynch applied a lifetime of research to this problem.

3.1 Application in light of the URBEM method

The following is an explanation of how to carry out the various tasks of a site based aesthetic analysis as part of an urban river basin enhancement method:

Aesthetic analysis of pre-improvement conditions

When the Site Method is being used to conduct an aesthetic analysis (WP4) of pre-improvement conditions, cooperation between water resources planners and city

planners is essential. Changes to any site will require a review and approval process that will involve many city agencies. Advocates for improvements along urban rivers will need to find allies. Those could be the department of the environment, the recreation department, historic preservation officers, or the city planning office. All of these will find a sensitive inventory of existing conditions as a useful basis for future urban planning. When conducting an aesthetic analysis of a stream section or alternate stream sections that are being considered for improvement, one would initially start with the stream or river itself.

The river

- Ecologic river zone
- State and quality of water body and
- Channel type
- Streambank
- Floodplain
- Fauna
- Flora

The city

- Spaces
- Transitions and boundaries
- Focal points
- Activity nodes
- Movement

The people

- Sensual experiences

Assessing the Potential of alternative rehabilitation sites.

A site may be chosen because of its natural beauty, or it may be derelict, disturbed or devastated and in need of enhancement. It is a standard planning procedure to develop outline schemes for alternative sites for public improvements and to develop a final plan for a chosen site. An analysis of alternative rehabilitation sites (WP5) is best conducted by establishing a set of aesthetic review criteria based on the desired image of the city and its waterfront. In order to compare sites, clear goals and objectives are needed. It is important to include elements in the inventory that produce negative aesthetic responses as these are also important in the comparative review process.

- Stream section inventory of aesthetic resources of alternative sites
- Goals and objectives of enhancement program
- Comparison of alternatives

Implement and test aesthetic assessment as a river rehabilitation appraisal tool

Aesthetic criteria for the assessment of alternative sites should be tested as part of a river rehabilitation assessment tool. For such a test (WP6) criteria need to be reasonable and practical. Our judiciary system, rooted in the tradition of logical reasoning frowns upon decision making that is arbitrary (determined by chance, whim, or impulse), capricious (sudden and unpredictable), and unreasonable (not governed by reason or rational thinking). When it comes to aesthetics, particular care needs to be taken to be reasonable. Aesthetic assessment can be conducted by experts, or in a more costly fashion through surveys of the general public. Criteria for an assessment need to be understandable and acceptable by the general public and decision-makers. The aesthetic assessment should develop criteria that stakeholders can modify as part of a social assessment. A assessment tool will need to be found reasonable by the following groups:

- City planning departments, and their architects and planners

- Recreation departments, and their landscape architects and planners
- Environmental departments and their scientists
- Civil engineering departments
- Multi-disciplinary consulting agencies
- The general public and it's political representatives

Using aesthetic assessment as part of a social appraisal tool

Aesthetics will be a part of a social appraisal tool (WP7) involving stakeholder identification, and stakeholder perception of the urban environment. The WFD mandates stakeholder involvement in planning and decision making. This will enable citizens to participate in consultations about rehabilitation projects and should help to develop indicators for evaluating enhancement projects. How a river enhancement site appeals to the senses, and how it relates to social activities, the behavior of people and their human comfort all are a part of social appraisal. It has long been proven that meaningful public participation in decision making requires an educated constituency. Public involvement in the formulation of a plan can achieve this.

- Stakeholder identification
- Initial survey of stakeholder awareness and perception of the urban environment
- Aesthetic indicators against which enhancement projects can be measured
- Enable stakeholders to react to alternative rehabilitation schemes
- Develop a aesthetic appraisal tool for social use
- Demonstrate and test aesthetic appraisal tool

Aesthetic assessment as an input into the selection of appropriate (new) techniques for urban river rehabilitation.

Aesthetics will provide input into the selection of appropriate (new) techniques for urban river rehabilitation (WP 8). The channel of a small stream that is straight will look quite different from a meandering channel with gravel point bars, or a channel with braided bars. A visual interpretation of reeds along a shoreline can be that they accumulate litter. The public may interpret the emerging tips of aquatic vegetation as a sign of polluted water. Each enhancement technique will have a characteristic appearance that will have implications on the distinctiveness and image of a neighborhood.

- Visualize the appearance of enhancement techniques
- Interpretation of aesthetic implications of techniques (eg. noise of running water, shade, visual screen)
- Screening techniques to meet aesthetic goals

Aesthetic assessment as a component of a decision support methodology

A “decision support methodology” (WP9) for city authorities must give careful consideration to aesthetic aspects. The WFD offers new opportunities through stormwater runoff management and the enhancement of urban streams in the city. Both have potential for aesthetic enhancement and are a new aspect of urban design.

A decision support methodology to be developed by URBEM will reflect the natural and social sciences, and the design arts, and will consider aesthetic criteria. The “architectural programming” method, as developed by William Peña has been amended to include aesthetic design considerations into urban decision making. In future all proposals to re-naturalize urban waterfronts will need to consider aesthetics and require stakeholder participation in decision making. Ideally tasks will be part of a planning process that is comprehensible and easy to use.

- Panel of experts
- Stakeholder involvement in planning process

- Testing of method through workshops

Aesthetic Assessment for a post-improvement comparison as an indicator of success

The final purpose of an aesthetic is to be used in a post-improvement comparison as an indicator of success (WP10). This work element will have implications on the content of the initial inventory. Targets for indicators of success need to lend themselves to monitoring. Design decisions should aim to meet targets set.

- Re-improvement inventory
- Post-improvement inventory
- Comparison of pre-and-post improvement conditions
- Targeting indicators of success

Training and dissemination workshop

The aesthetic assessment method is to be part of a training and dissemination workshop and exhibit (WP11) to be carried out at the end of the project. It is also to be tested at the end of the first project year. The target audience and future users are city agencies and their consultants, including civil engineers, water resource experts, landscape architects, and multidisciplinary consulting firms.

- Manual to use aesthetic component
- Testing

3.2 Aesthetic inventory of pre-improvement conditions

An aesthetic inventory should be conducted for the riverine district in which the site is located to ensure that the site design fits the context of the district. The inventory is best conducted on foot. Consideration should be given to the impact of the river looking towards it, from the river itself and from the opposite shoreline. The inventory can be more detailed close to the project site on a neighborhood scale. A custom “field

survey" form should be designed for specific sites. Forms should be used to record each resource identified. Location may be recorded by street address or by grid coordinates. A photograph should be taken of each resource recorded.

3.3 Rating aesthetic resources

Each items identified in the inventory should be rated for a number of attributes. First, the significance of the item in supporting the distinctive character of the riverine district that is being surveyed should be assessed, and secondly the significance of a resource in forming a vivid and coherent image of the district. The significance of the resource in terms of present use and popularity must also be rated. Resources that do not meet their full potential should be identified. For buildings the physical condition of the structure, and for natural features the quality of management should be recorded. This rating should be conducted in the field and recorded on field survey forms. The rating applies to all resource categories and resource groups (Fig. 1).

	Resource identification and spatial quantification	Qualitative resource identification through rating
1. TheRiver		
2. The City		

Fig. 1 - Aesthetic inventory and rating

3.4 Mapping of distribution patterns

Field survey forms and photographs should be processed for computer storage. Printouts showing the geographic distribution of resources by type can now be prepared. Photographs can be keyed to their location on printout maps to be used at public meetings. The process may highlight distribution patterns of resources that will suggest strategies for enhancing both the project site and the district in which it is located.

3.5 Aesthetic Opportunity and Constraint Analysis

By mapping the elements of river and city that evoke popular aesthetic appreciation, distribution patterns will be revealed. This mapping will likely be carried out by a lead

contractor or consulting firm, bringing together inventory and analysis that may have been done by specialist sub-contractors. Distribution patterns and spatial combinations of resources should be analyzed to identify opportunities and constraints for enhancement.

The Aesthetic Opportunity and Constraint Analysis should have two components: (1) the River, and (2) the City. Elements of each that will evoke an aesthetic experience will have been inventoried. Opportunity and constraint analysis is a process that brings separate elements together to identify where they can supplement and strengthen each other.

The River

Seven elements of the river are considered in the Aesthetic Opportunity and Constraint Analysis where they will be grouped according to their functional relationships. An appraisal considers whether elements affect the aesthetic experience of the stream or river positively or negatively. Positive or negative responses will be influenced by the perception of stakeholders of the importance of the elements for the ecological health of the river system. Elements mapped were:

- Ecologic river zone and quality of water body
- channel type, streambank and floodplain
- fauna and flora.

Ecologic River Zone and Quality of Water Body: In the URBEM Hamburg-Wansbek case study, a stream that had been classified as a flatland sand-stream was found to be a salmonid stream that could support trout. After habitat improvements were made trout were successfully reintroduced. Residents now have a totally different perception of their neighborhood “clean water trout stream”.

Channel Type, Streambank and Floodplain: Together the channel, streambank and floodplain legally constitute a stream. Whether a stream is straight and channelized, meandering, or braided, deeply entrenched or shallow makes a great difference when it comes to its aesthetic appeal. Channel and stream banks are a part

of the floodplain. Here aesthetic opportunities and constraints relate to positive and or negative appeal.

Fauna and Flora: Fish fauna, small life forms in the stream, aquatic vegetation, wetland, and vegetation along the streambank will all influence the aesthetic appeal of a river. The appeal will depend in part on abundance and distribution of aquatic life and water related vegetation.

The City

Five elements of the city image will be considered in conjunction. Elements mapped were:

- spaces, boundaries or transition forms
- focal points, activity nodes
- access

Spaces and Boundary or Transition Forms: Spaces, boundaries and transition forms should be considered together. They are functionally related, because boundaries form spaces. Across a boundary there is transition from one space to the other. Resource elements should be mapped together, showing their relationship. This relationship should then be analyzed in regard to positive and negative aesthetic response (attraction, distraction, stress, relief, disillusionment and aversion). Some resource distributions will indicate clear opportunities for protection and enhancement. Relationships that invoke a negative response may be an opportunity for improvement. An abandoned industrial structure that forms a boundary between two open spaces along a river may be deemed enough of an aesthetic aversion to be demolished, creating an opportunity for a larger riverine open space. Or, if it is architecturally or historically significant or an important landmark, it might be restored for adaptive reuse and enhance the spaces on both sides

Focal points and Activity nodes: Focal points are centers of visual attraction that are often located within urban spaces (Identified above). It is important that views of prominent landforms, buildings or landmarks are not obstructed. Stream improvement plantings can sometimes block important views. A view might be a broad prospect, or

a confined vista. Characteristic views have historically been sought out by photographers and are being offered as postcards that create a memorable image of a city. Here also we have positive and negative experiences. Examples in new member states of the EU are historic or religious visual focal points that have intentionally or through ignorance been blocked from view during communist times. Nodes of social activity are resources, which are accessible and invoke a mostly positive aesthetic response. But this is not to say that negative aesthetic stimuli do not exist. Designers should never assume that there are no opportunities to enhance activity nodes. An example is a drug sale and consumption scene along the banks of the Limat River in Zurich that was successfully ended when the site was transformed into a riverfront park.

Access: Architects and landscape architects have long understood that sequential views when moving through spaces create a powerful visual image. Sequences of views offered should be carefully designed. A professor of architecture at Kent State University (Harker, 2003) teaches a CAT – MOUSE system that uses a Circulation Analysis Technique and Movement Sequence Evaluation. In the analysis focal points at the terminus of views, nodes, and vistas are assessed according to their importance to establish and clarify relationships of elements within a hierarchy. The movement sequence evaluation considers perceptual and behavioral responses of people to their environment as they move through spaces. It can be shown that on a curving path the eye will focus on an “active zone” on the outside curve and pay less attention to a “passive zone” on the inside curve. A clear sense of confinement or contraction is experienced when moving though a narrow portal followed by a sense of relief or expansion when moving out into a broad space.

3.6 Scientific analysis input through hydrologists and city planners

In river enhancement projects cooperation between civil engineers, hydrologists, urban designers and landscape architects is essential but unfortunately is often lacking. For this reason it is recommended that such cooperation be made mandatory by cities that engage in such projects. This can best be achieved by establishing a “Design Commission” for each project site.

River improvement projects are multidisciplinary enterprises that should involve the input of hydrologists, limnologists, transportation experts, civil engineers, city planners and design disciplines. For such an enterprise a special board is usually established by the lead city agency, which may be the planning commission, or the natural resources or parks department.

Aesthetic considerations are a vitally important part of any environmental improvement program. It is recommended that an aesthetic assessment be prepared for all projects to be integrated into the decision making process.

3.7 Defining Goals and Objectives under Stakeholder Participation

The European Environment agency defines stakeholders as "an institution, organization, or group that has some interest in a particular sector or system". The second meeting of UNECE Task force on Access to Justice in 2003 further confirmed the Aarhus convention on Access to Information and Public Participation in Decision-making and Access in Environmental Matters.

The Water Framework Directives insist on public information and consultation and stakeholder involvement. Fig. 2 below shows division of Level A and Level B stakeholders. Level A stakeholders represent groups of individuals, organizations and institutions, while level B stakeholders represent public agencies.

Level A Stakeholders	Level B Stakeholder
Residents Landowners Allotment garden tenants Voluntary nature associations City and neighborhood associations Educational institutions and students Sport clubs Business and industrial corporations Political parties	City executives Department of natural resources City engineering department Water and Sewer Agency City planning commission Parks and recreation department Rivers and harbors agency

Fig. 2 - Stakeholder Groups

Public participation programs for stream valley planning in the past have found that there can be no meaningful public participation in decision making without an educated constituency (Tourbier, 1985). Reflecting similar needs, many European

countries have supplemented nature education laws with nature education programs. How citizens perceive their urban environment and their aesthetic response to it are social concerns. In order to enable stakeholders to participate in the design of rehabilitation projects, they need to be informed about the resources (river and city) at hand, and they need to know the options and alternatives for their future. The components of URBEM WP7 Social Appraisal Tool should be closely related to the aesthetic evaluation (WP2) of a city.

Stakeholder participation with the involvement of scientific experts and the consultants who performed the aesthetic analysis is best achieved in a series of meetings at which the "Architectural Programming Method"(first introduced by William Peña), is used.

The City	a) Resource identification and spatial quantification	b) Qualitative resource identification through rating	c) Goals and objectives	d) Design criteria	e)Planning concepts
1. Spaces					
2. Boundaries or transition forms					
3. Focal points (and landmarks)					
4. Activity nodes					
5. Access					

Fig. - 3 Application of aesthetic assessment to define planning concepts

Fig. 3 shows a rational programming matrix that applies the components of the aesthetic analysis of the city. The horizontal axis of the matrix shows the sequence of (a) resource identification and spatial quantification, and (b) resource rating, leading to (c) goals and objectives, and (d) design criteria, and concluding with (e) planning concepts. The vertical axis of the matrix contains (1) spaces, (2) boundary and transition forms, (3) focal points, (4) activity nodes, and (5) access. Aspects of the river are explored similarly. Sensory perception considerations are applied to both.

The matrix will be used as a basis for discussion groups with workshop participants and invited experts. During these discussion groups, comments will be formulated on index cards to be displayed on a wallboard for every field of the matrix and from these comments design concepts will be proposed and summarized in proceedings of the meeting.

3.8 Design criteria, policy determination and planning concepts

The most important portion of any project is to set goals and objectives (Aufgabenstellung) to solve problems. The task described here is to attach to these goals and objectives design criteria and planning concepts that are developed by a "Design Commission". A consulting firm would carry out the actual plans for an enhancement project.

4. Conclusion

The aim of URBEM is to define enhancement methods for urban rivers. Enhancement has an aesthetic component that relates to city planning and design of communities adjacent to rivers. The cultural heritage of a city is reflected in its structures, spaces and waterfronts, making them legible and memorable and coherent for the observer. A methodology to assess the aesthetic qualities of urban rivers needs to reflect the image and heritage of a place. The aesthetic evaluation methodology needs to be integrated into an overall planning method, a final product of URBEM, forming a decision support methodology for urban planners and public environmental authorities. It is proposed that the CESUR-IST/UTL team method be used for an overall river corridor assessment, and that the "Site Method" be used at the project scale.

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6. Appendix : Products and Uses of the Aesthetic Assessment

Products and use of the aesthetic assessment – The River

Knowledge of the functional aspects of a river system will give context and meaning to visual features along the river and add to the aesthetic appreciation of the riverine environment.

Comparison of the project river with a reference stream (a stream in a largely undeveloped state) permits stakeholders to understand the impact of the historical development of the project stream. An illustrated comparison of the richness of the flora of the reference stream and relatively impoverished fauna of the project stream would be a valuable tool in discussions with stakeholders.

Stakeholders should be encouraged to make comparative aesthetic evaluations of rivers with different water qualities in order to illustrate the importance of water quality in the aesthetic appreciation of the river. Problem sections of the project site and sources of water pollution can then be identified on maps for the stake holders.

Drawings of different stream channel types and form are part of the Rosgen method of stream classification. An understanding of the different characteristics of different orders of streams will help stakeholders understand the distinctive visual characteristics of each type of stream. This will enable them to make suggestions that increase the visual distinctiveness of the project stream.

Elements of streambank and floodplain are part of the “Gewässerstrukturgüte” (LAWA 1998) standard inventory form. Typical drawings of each element in different situations will help stakeholders understand the visual character of their particular project site and to make appropriate suggestions for enhancement

The flora and fauna in the reference stream will help stakeholders set goals for the improvement of the health of the riverine environment which in turn will lead to an increased aesthetic appreciation. If the improvements are not realized, disillusionment may result in a negative aesthetic experience, but if the project is successful anticipation can add to the positive affect.

Enhancement projects will increase the potential nature observation and recreation along a stream. These uses clearly will increase the positive aesthetic appreciation of the river

An inventory of flora is part of the standard “Gewässerstrukturgüte” analysis. Because of the importance of riparian vegetation to the aesthetic appreciation of the river, other categories have been added to be able to express the visual character of vegetation as an important element of the natural riverine landscape

Products and use of the aesthetic assessment – The City

Recognition by stakeholders of the elements (including the river) that structure the urban fabric is an important aspect of urban river enhancement projects.

Spaces

The diverse spaces of a city, the sequence in which they are experienced, and how they are shaped and enclosed by buildings or trees, create a vivid image of the city.

The river is one such space and its spatial relationship with other urban spaces must be recognized

The specific uses of squares, parks, and recreation areas and other urban spaces should be clearly related to river improvement plans.

The relationship between spaces in the city that are more natural and the river can be important aspect of conserving remnant patches of habitat in the overall urban nature conservation

Access

The pattern created by the streets and the river in a city will probably form the basis of the mental map of the city for most people. The streets are the principal access routes and the river the principal obstacle. The mental map is an essential tool in the legibility and comprehension of the city, and critical in the aesthetic experience of the city.

Public transportation routes also form the basis of mental maps of the city. For passengers on public transport, the negative aesthetic experience of distraction is less likely to occur as it is not essential for the traveller to focus attention driving or cycling.

Most pedestrian paths are sidewalks on city streets where negative sensual stimuli (noise, diesel fumes, danger) will strongly affect the experience. But where footpaths can be completely separated from traffic, more positive stimuli will be experienced, and can be enhanced by the designer.

In riverine districts of the city, the river will be the destination for many pedestrians and the linkages between the urban fabric and the river by designated footpaths is important for the aesthetic experience of the residents.

Focal points and landmarks

Prominent landmarks and focal points have been inventoried together with the viewpoints and the vistas that allow them to be seen. Designers can minimize distracting stimuli that draw the viewer's attention away from the focal point. They can remove obstructions to the view of the focal point and they can also make the viewpoints more accessible.

Where ecological enhancement of the river involves reestablishing riparian trees and other measures care should be taken not to obstruct important views.

The positive aesthetic experiences provided by bridges should receive attention in river enhancement projects. The negative experiences associated with delays and frustration can be minimized by good traffic engineering

Edges, boundaries and transitions

Measures to increase the effectiveness of boundaries to enclose space or to emphasise the distinctiveness of adjacent areas can be proposed by the designer.

Measures to reduce the distracting aesthetic stimuli along a boundary goes hand in hand with focusing attention on focal points within the area

Boundaries in urban areas are frequently formed by parks, belts of trees or other remnant natural areas. Ecologic enhancement measures for these areas should be compatible with the overall urban nature conservation plans for the city

When passing across a boundary from one area or space to another through a gateway, or across a bridge, designers should consider contrasts in the aesthetic stimuli on each side of the boundary. Viewers will be particularly sensitive to contrasting stimuli, which will also emphasise the distinctiveness of each area.

In any enhancement project, the river will be one of the most prominent boundaries. It is harmonious, and legible. Yet there will be a concentration of positive aesthetic stimuli along the boundary. It does not however like most boundary elements enclose a space or obstruct the view. Designers should be aware of these factors.

Features that are likely to cause averse aesthetic experiences may be deliberately blocked by planting screens that should be part of the ecological enhancement plan for the river.

Activity Nodes

The designer should reduce the frequency and intensity of stressful visual stimuli by creating a consistent language for signs and other features so that they may be intelligible and easily read.

Designers should reduce intensity of aesthetic stimuli that distract drivers at dangerous nodes.

Regulations to ban some aesthetic stimuli such as car horns can be enacted.

Designers must recognize that nodes are, by definition, exciting and busy places, where usually there are pedestrians, vehicles, cyclists intermingling. Clear and intelligible direction and signage that focus attention, and the reduction of distracting stimuli can make these safer places

Products and use of the aesthetic assessment – The People

Sensory perception

All the human senses, sight, smell, noise and touch, affect aesthetic experiences, which can be positive or negative. The designers role is to enhance the positive and minimize the negative.

The aesthetic stimuli and the related memories invoked by rivers are intense and evocative and the designer must take care to preserve these stimuli in enhancement plans

Experiencing the site.

Designers should be aware of the six aesthetic emotional experiences, and attempt to enhance the positive and minimize the negative in their plans.

The importance of a clear and legible urban structure to the enhancement area cannot be overestimated. Elements that fit into a comprehensible structure will produce aesthetic experiences that can easily be understood and therefore have a positive affect.

Conversely, the same elements that are part of a chaotic urban structure may produce negative experiences because the are not readily identifiable or understood

Experiencing the elements of the city

The various elements that make up the structure of the city were considered individually under The City. I t is important that the designers consider how each of these elements will be perceived by people.

It should be remembered that aesthetic stimuli for residents and tourists will invoke different memories that will be much more specific for residents

The designer should also be aware of how the elements of the city and the aesthetic experiences produced by them relate to one another.

Experiences in motion.

Designers should be sensitive to matching the visual stimuli to the design speed.

Designers should consider ways of making the experience more harmonious by spacing regular features along the route

Designers must reduce distracting stimuli at points of conflict between travelers

Powerful positive aesthetic experiences occur when traveling the river on a boat. These experiences should be made widely available by promoting riverboats and good landing facilities.