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An Integrated Approach of Landscape Design in the Rehabilitation of an Urban River Corridor: River Tinto

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Abstract

Due to the increasing demand for its water resources, the changes in land use and the fast urban sprawl, the river Tinto became the mass of surface water of the river Douro´s watershed with lower physicochemical and biological quality. Taking into account its scale and urban context, the severity of the pollution level and the periodic flooding problem, became urgent to accomplish priority solutions for its riverside landscape, based on natural recovery principles and flood protection.

The purpose of this paper is to stress the contribution of the integrated approach of landscape design in the improvement of the life quality and safety assurance of the local population, taking into account information and proposals from previous projects, plans and programmes, bioengineering technical knowledge and the national legal mechanisms related to water resources management. It was intended to rehabilitate a stretch of the river Tinto with the creation of a riverside urban park – Meiral Park. This project's aim was to extend and qualify the public space, ensuring the river resilience and enhancing the hydraulic connectivity of its ecosystems and the multiple functionality of the place, through the integration of different uses – production, protection and recreation

With this project, it became obvious that landscape planners can take a more active and valid role in the management of water resources, through a multidisciplinary and intersectoral collaboration exercise. Indeed, it is believed that in the current political and economic context, incorporated into the guidelines of the Water Framework Directive, landscape design will gain a new dimension in the sustainable management of water resources.

Keyword: landscape design, water, river corridor, rehabilitation, law.

Introduction

The General Assembly of the United Nations has proclaimed the period 2005-2015 as the International Decade for Action "Water for Life", during which they must ensure the implementation of programmes and projects associated with this feature, by helping to achieve the internationally agreed goals. Concerning this matter, each Member State must set the internal organization and management models (Branco, 2007) that best fit their legal, institutional, economic and financial regime. However, it is clear that the development of water management, in general, remains dependent on the preparation of successive plans and designs, whose practical effectiveness is quite low (Matos, 2007). In part, this problem is due to the dislocation between planning and "the functioning of society as to how decisions are made, priorities are established, resources are affected and benefits are distributed" (Correia, 2007).

The proximity of the water lines to urban centres enhances recreational opportunities and production. However, the growing urban pressure has contributed to a continued artificiality, plumbing and linearization of river corridors. Thus far, considering this situation, it becomes

almost imperative to re-evaluate the practice of landscape planning in the rivers' rehabilitation, in order to improve the environmental, functional and visual quality of the riverside landscapes, not burdening the living cost of citizens.

According to Alves (2003), the rehabilitation process of a river must occur along with the definition of a riverside public space design. "In many highly developed areas, restoration may be driven largely by the recognition that stream corridors provide the most satisfactory opportunities to repair and preserve natural environments in the midst of increasingly dense human occupation" (USDA, 2001). However, "(...) the water resource management in contemporary society requires (...) also a better understanding of contextual processes involved in policy formulation and decision making" (Correia, 2007).

The purpose of this paper is to stress the contribution of the integrated approach of landscape design, in the improvement of the quality of life and safety assurance of the riverside population, taking into account information from previous projects and programmes, bioengineering technical knowledge and the national legal mechanisms related to water resources management. This was the starting point of a PhD thesis in Landscape Architecture and Urban Ecology.

It was intended to rehabilitate a stretch of the river Tinto with the creation of a riverside urban park – Meiral Park. The project's aim was to extend and qualify the public space, ensuring the river resilience and enhancing the hydraulic connectivity of its ecosystems and the multiple functionality of the place, through the integration of different uses – production, protection and recreation.

On the specific issue of the river Tinto, several studies and projects have already been developed by some administrative and scientific entities, where we could find data and relevant elements for the proposal (WS ATKINS, 2000; FCUP, 2004; ESB-UCP, 2006; COBA, 2007; FEUP, 2007; JMP, 2008; FCUP, 2009; JMP, 2010; Lemos, 2010; ARH-N, 2011; Teiga, 2011). Nevertheless, none of them uses or advocates in a clearly way the use of the legal mechanisms and the power of water as the primary driving forces of the landscape design development, at its recovery project.

Study Area and Methods

"A project goal of restoring multiple ecological functions might encompass the channel systems, the active floodplain, and possible adjacent hill slopes or other buffer areas that have the potential to, directly and indirectly, influence the stream or protect it from surrounding land uses" (Sedell et al., 1990; USDA, 2001). However, Saraiva (1999) goes further in the characterization of river systems, integrating the anthropic processes in the evolution of drainage networks, in order to "contribute to a better understanding of the role of rivers and river systems in landscape planning (...)" (Saraiva, 1999). In this sense, it is believed that their management should assume the integration of biophysical/chemicals processes and socio-economic and cultural factors that led to the formation, evolution and transformation of the riverside landscape. The river system is the set of these interdependent sub-systems, whose inter-spatial and temporal relationships form the riverside landscape.

Given the increasing demand for its water resources, the changes in land use and the fast urban sprawl, river Tinto became the mass of surface water of the river Douro's watershed with lower

physicochemical and biological quality. Taking into account its scale and urban context, the severity of the pollution level and the periodic flooding problem, as well as the expressed will of the public to restore the river and the existence of imminent projects that are already expected to take place in their valley, became urgent to accomplish priority solutions for its riverside landscape, based on natural recovery principles and flood protection.

Meiral Park is located in the river Tinto´s watershed and incorporates a stretch of the main water line that crosses the municipality of Gondomar, near the Wastewater Treatment Station (WTS) of Rio Tinto. The localization of the park allows it to serve as a landmark and a connecting link between the East Park of Oporto and Rio Tinto's historic centre, by anchoring it to the network routes of the municipality of Oporto and the urban centre of Rio Tinto (parish), which already has some public interest infrastructures.

"In many highly developed areas, restoration may be driven largely by several recognition that stream corridors provide the most satisfactory opportunities to repair and preserve natural environments in the midst of increasingly dense human occupation." (USDA, 2001) In fact, within river Tinto's watershed, the park's surrounding area is the most affected by the land speculation and the road network´s development. This situation contributed to the replacement of the "rural organic structure" of its landscape by a "winding urban web, without legibility and generally quite disqualified" (FCUP 2009). The limits of the urban system in the rural areas don't exist, as well as continuous/comfortable pedestrian systems and qualified public spaces, which could function as reference points in this riverside landscape.

The anthropic pressures also led river Tinto and its streams to a loss of connectivity and to the artificiality of its margins and bed. This situation contributes, not only to the difficulty in perceiving the landscape, but also to the degradation of water quality and natural ecosystems of the margins, and therefore the life quality of the riverside population. This situation is especially serious in the municipality of Gondomar, where the "point of ecological characterization (...) has the worst overall quality of habitat (...)" (FEUP, 2007). Currently, the river Tinto has hardly riparian gallery or ecological communities and most of the water body is intubated or walled with concrete walls or gabions.

The plumbing and linearization of the river watercourse, the deposition of waste and landfills, the construction and occupancy of margins and the destruction of riparian vegetation (JMP, 2008) have aggravated its flood regime. According to a study performed by FEUP (2007), in a point nearest Meiral Park, a flood with a return period of 5 years could reach at least 1.5 metres high and 12 metres wide. In turn, in a centennial flood, the water bed can reach 4 metres wide and 50 metres wide. These values are of concern because the WTS of Rio Tinto is located in the river Tinto's floodplain making this situation worse. Besides, in the area contiguous to that infrastructure, the concrete walls on both sides of the river banks are strongly constraining the water line, not allowing water infiltration in the surrounding land.

In order to guide the water policy in the countries of the European Union (EU) and upgrade/integrate/harmonize all the present legislation in this area, the European Parliament decided to approve the WFD, on 23 October 2000. Its implementation has a set of new challenges and responsibilities to the various Member States, in the protection and sustainable

use of water bodies in their territories. In Portugal, the Water Framework Directive (WFD) was transposed into the Water Act (Law n. º 58/2005 of 29 December) and establishes various environmental objectives to be achieved until 2015, based on the elaboration of Regional Hydrographical Management Plans (PGRH) and the identification of a series of actions that they should promote. Regarding the river Tinto, the North Region Portugal Hydrographical Management Plan of the river Douro´s watershed (ARH-N, 2011) foresees the redevelopment and enhancement of the river Tinto, during the years 2013 and 2014, based on the change of its hydro morphological conditions. The ultimate goal is to achieve its good ecological status in the year 2027, which naturally requires an integrated and interdisciplinary strategy.

In addition to the legislative instruments that transpose the EU directives, "the legislation on the water was (...) supplemented by important legislative instruments designed to update and harmonize the previous legislation (...) and operate the transposition of the WFD" (MAOTDR, 2008). In fact, "in regard to the relations between the rivers and the organization of the territory, they [the rivers] traditionally have been structural axes in spatial planning" (Saraiva, 1999), under the jurisdiction of several legal figures, such as the Law of Water Resources Ownership (Law n. º 54/2005 of 15 November) and the Public Water Domain (DPH), among others.

"The DPH represents a concept that is the basis of traditional water resources management (…)" (Saraiva, 1999). Nowadays, it consists of a "set of goods which, by their nature, the law submits to a regime of special character" (INAG, 2002). This regime establishes, on a legal support (MAOTDR, 2008), some notions and the correspondent rules that define their legal status. The main instruments in flood defence, in terms of non-structural measures, are the figures of Adjacent Zone (ZA) and the Zone Threatened by Floods (ZAC), whose legal regime establish "restrictions on incompatible or vulnerable land uses and (...) [ensure] the flow of flood runoffs and other hydrological and ecological functions, important to the water cycle and ecosystems that depend on it" (MAOTDR, 2008).

According to the types of rivers in Portugal, established by the National Water Institute, within the implementation of the Water Framework Directive (WFD), the river Tinto is characterized as a surface water body from type "Small Dimension North River" (N1 ≤ 100 km2). According to the Law of Water Resources Ownership (Law n. º 54/2005 of 15 November), the public watercourse comprises "streams not navigable or floatable, with the bed and margins, since located on public land, or that, by law, are recognized as usable for public purposes (...)" (Law n. º 54/2005, art. 5, paragraph c).

In this case, "the remaining water bed is limited by the line which corresponds to the extreme of the land covered by water in conditions of average flood (...)" (Law n º. 54/2005, art. 10, n. º 3). "Average flood" is characterized as a "flood with a return period of once in five years, accepting the matter in the juridical view of Professor Diogo Freitas do Amaral and Dr. Pedro José Fernandes (Commentary on the Law of the land of the Water Resources Dominion, 1978), where is referred, as a comment on Article 2, Decree-Law 468/71, paragraph 24, section B), note (40), that " average floods, according to the understanding of the General Directorate of Hydraulic Resources and Uses, are those whose occurrence can be expected once in every four or five years." In turn, "the margin of non-navigable or non-floatable waters, namely streams, ravines and streams with discontinuous flow, has a width of 10 metres" (FEUP, 2007).

"In relation to public non-navigable or non-floatable waters located in private buildings, their bed and margin are private, under Article 1387 of the Civil Code, submitted to administrative easements" (Law n. º 54/2005, art. 12, n. º 2). However, in case of water breakthrough, "when there are private parcels adjoining to public beds, the portions of land eroded by the waters slowly and successively consider themselves automatically integrated into the public domain [as ZAC], so that there is no place to compensation. If the private parcels adjacent to public domain waters are invaded by water but remain without corrosion of the land, its owners retain their property rights, but the state can expropriate these parcels" (Law n. º 54/2005, art. 14). The ZAC can be considered as the "contiguous areas to the watercourses' banks that extend to the largest flood limit reached with the probability of occurrence in the period of a century (centennial flood)." (INAG, 2002) For instance, if an area is flooded up to 50 metres wide, from the water line, under the law, it can be automatically considered a ZAC, giving rise to a potential expropriation of land.

Once a ZAC is classified as ZA, through a statutory act, the lands covered by it shall be submitted to several restrictions of public utility. (INAG, 2002) The ZA "is understood as the entire area adjacent to the edge that is classified as such for being threatened by sea or by floods. The adjacent zones extend from the edge of the rim to a conventional line set, classified for each case, which corresponds to the largest flood line achieved with a return period of 100 years or the greater flood known, when there is no data to identify the last one" (Law n. º 54/2005, art. 24, n. º 1 and n.º 2). Regarding the ZAC that are not yet classified as ZA, the approval of "land development plans or urbanization contracts, as well as the licensing of any urban operations or urban subdivision, or any works or buildings (…) require assent by the competent authority for the licensing of water use, when they are within the limit of the centennial flood or the range of 100 metres to either side of the bank of the watercourse, when that limit is unknown" (Law n. º 54/2005, art. 25, n. º 9).

The corridor's concept is one of the "core standards of the landscape's organization through which important flows of energy, materials and species are processed" and various resources to human activity are provided. It is therefore within the development/requalification of the river Tinto that the use of its corridor, as a natural linking path, may enhance the connectivity of its permeable areas for recreation, protection and production (e.g. rural areas), building a multifunctional landscape in one of the densest urban area of its watershed. Having the WFD by reference and based on the natural recovery principles, this proposal amend the land use and modelling of river Tinto's surroundings, towards the creation of an urban park, taking into account the data from FEUP (2007), the legal limits related to the Portuguese Law of Water Resources Ownership and bioengineering technical knowledge.

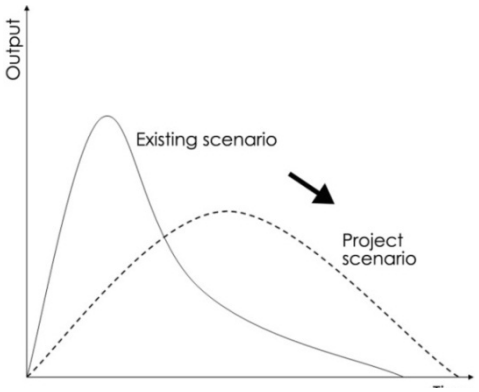

Figure 1 - Flood hydrograph

Results and Discussion

A river corridor includes the main channel, the margins and the floodplain. In Meiral Park, this structure is the element that generates the whole space and its design and delimitation took into account the legal concepts under current law and the values obtained in previous studies

(Figure 2). Thus, within the potential public domain area, it was possible to design a doubly functional area – recreation and protection – by creating paths along the margins and by implementing a meadow for informal use. This particular design element works as an infiltration band, by increasing the permeable area for absorption peak flood (Figure 1) and the hydraulic resilience of the river, while promoting biodiversity. This strategy was essential to avoid flooding the WTS.

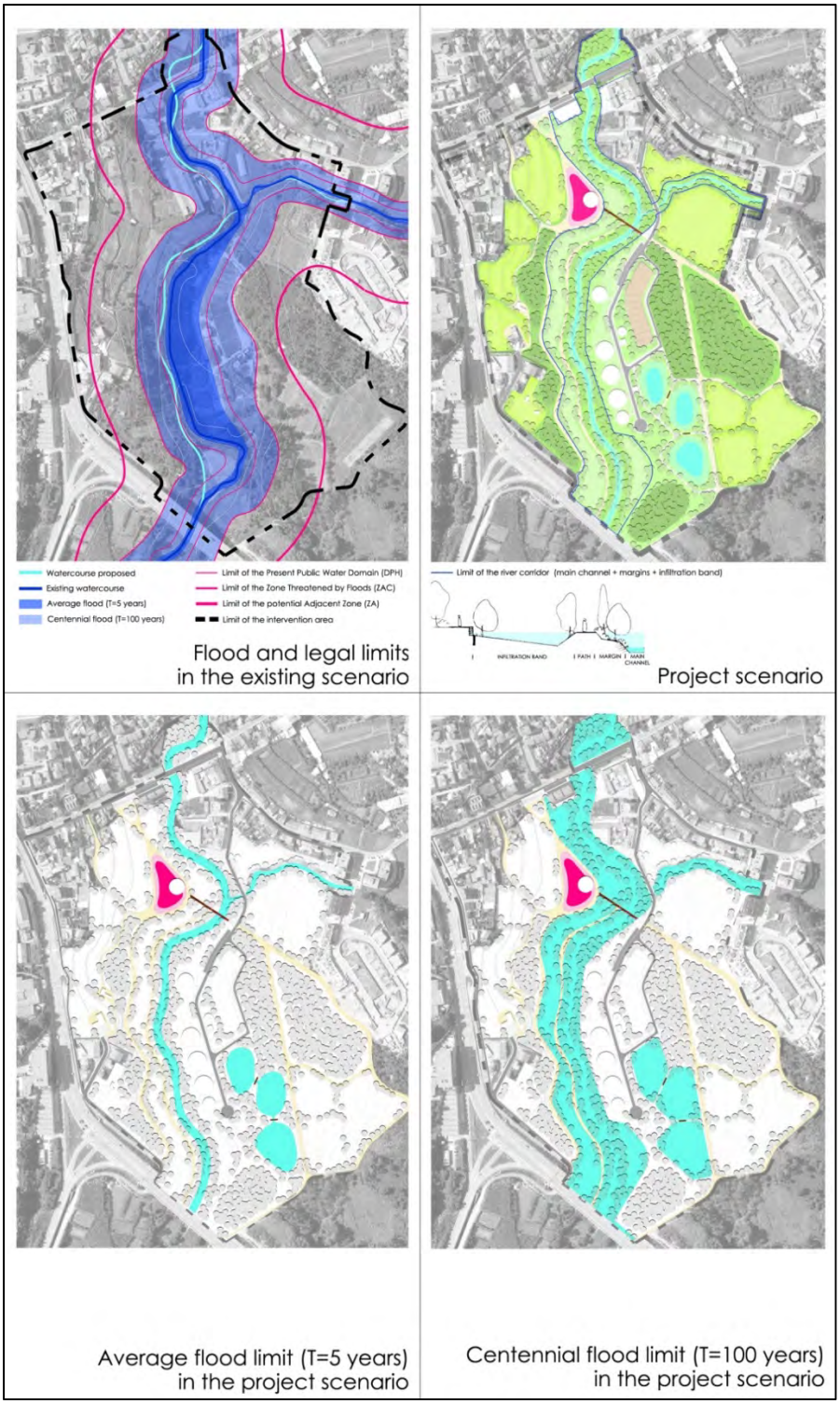

Figure 2 - Cartographic elements, developed for the Meiral Park project, which show the results of the river corridor strategy adopted.

Along with other measures, making it a meandering watercourse even made possible to overcome a number of problems: reduce the water velocity and, therefore, increase the infiltration; reduce sedimentation in the reference section (mouth) of the river; decrease in flow tip; increase reaction time; increase the available area for the installation of plant species; promote biodiversity; and increase capacity of the land to perform water purification.

Outside the limits of the new river corridor (in the range of 100 metres to either side of the bank of the watercourse), where the private lands can't easily be expropriated or mobilized, the redevelopment of the existing farming system becomes the key strategy to ensure the protection of water and soil resources. On account of

this, we proposed the promotion of environmental protection techniques within the little producers, the restructuring of farmland borders with native tree and shrub species and the installation of drainage ditches for agricultural effluents. The implementation proposal of a protection forest in the steeper area between the floodplain and the agricultural fields is also an important measure of protection and enhancement of the visual quality of the riverside landscape.

According to Abreu (2007), "the contribution of landscape to the land corresponds to a better understanding of the present complex issues and a demand for more valid proposals for the future." Indeed, with this multidisciplinary exercise, it became obvious that landscape planners can facilitate the administrative process since the project elaboration to its implementation, taking a more active role in the management of water resources. Through the proposal of design solutions adapted to the specificities of each site and local population needs, the compliance with the principles and concepts emanated from the Water Act and other regulatory instruments and the integration of the guidelines of previous projects, plans and programmes, landscape planners can contribute to an effective implementation of sustainable water management systems in the rehabilitation and recovery of small river corridors.

Conclusions

Assuming that "water is the driving dynamic landscape" (Quintino, 2011), to which a set of environmental services is associated (Tánago, 2011), it becomes evident the need to integrate ecological knowledge of the river systems, the aesthetic appreciation of the role of water in the landscape and the contextual processes involved in policy formulation and decision making in the application of planning and management of riverside landscapes. Based on the multidisciplinary and intersectoral collaboration (Saraiva, 1999), this exercise is, nowadays, a challenge for the professional practice of Landscape Planning and can undoubtedly contribute to the sustainable development of the territory. As a matter of fact, it will be within this political and economic context, properly incorporated into the guidelines of the WFD, that the integrated approach to planning landscape will earn a new dimension in the sustainable management of water resources.

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