Acta Scientiarum. Technology
ISSN: 1806-2563
eduem@uem.br
Universidade Estadual de Maringá
Brasil

Cassimiro Barbosa, Leonardo; Domingos De Angelis, Bruno Luiz
The greenway as a means to recover valley floor areas: A proposal for the Mandacarú stream, Maringá, Paraná State, Brazil
Acta Scientiarum. Technology, vol. 34, núm. 4, octubre-diciembre, 2012, pp. 365-372
Universidade Estadual de Maringá
Maringá, Brasil

Acta Scientiarum

http://www.uem.br/acta
ISSN printed: 1806-2563
ISSN on-line: 1807-8664
Doi: 10.4025/actascitechnol.v34i4.12529

The greenway as a means to recover valley floor areas: A proposal for the Mandacarú stream, Maringá, Paraná State, Brazil

Leonardo Cassimiro Barbosa[1*] and Bruno Luiz Domingos De Angelis

*[1]Departamento de Arquitetura e Urbanismo, Universidade Estadual de Maringá, Av. Colombo, 5790, 87020-900, Maringá, Paraná, Brazil. [2]Departamento de Engenharia Civil, Universidade Estadual de Maringá, Maringá, Paraná, Brazil. *Author for correspondence. E-mail: leonardo.cb@gmail.com*

ABSTRACT. This study proposes to recover the Mandacarú Stream, located in the city of Maringá, Paraná State, Brazil by developing a greenway. The stream in question has been extremely degraded, principally by human activity. The proposed methodology begins with preparing a scenario for the valley floor with a greenway in place. This is followed by an investigation of the corridor's ecological and cultural variables, taking a holistic view to synthesise and diagnose the information collected. Guidelines for recovering the valley floor and developing the greenway are then drawn up to direct the preparation of the final plan. As a result, the principal environmental impacts that undermine the quality of the study area were surveyed, such as erosion, loss of riparian vegetation, illegal sewage connections and lack of environmental education. A list of guidelines was developed for recovering and conserving the area, in combination with the development of a greenway along the valley floor. It is hoped that these guidelines can assist a future intervention at this location and that the proposed method can be used as the basis for the recovery of other urban valley floors.

Keywords: green urban areas, watercourses, landscape design.

O parque linear na recuperação de áreas de fundos de vale: propostas para o Córrego Mandacarú, Maringá, Estado do Paraná, Brasil

RESUMO. O presente estudo propõe a recuperação do fundo de vale do córrego Mandacarú, localizado na cidade de Maring, Estado do Paraná, por meio da implantação de um parque linear. O córrego em questão encontra-se bastante degradado, principalmente, pela ação antrópica. A metodologia proposta parte da elaboração de um cenário prévio para o fundo de vale com o parque linear implantado, em seguida será realizada uma investigação das variáveis ecológicas e culturais do corredor, além de uma síntese e diagnóstico destas informações coletadas por meio de uma visão holística, traçando-se diretrizes para recuperação do fundo de vale e implantação do parque que nortearão a elaboração do plano final. Como resultado, foram levantados os principais impactos ambientais que comprometem a qualidade da área de estudo como, processos erosivos, perda da vegetação ciliar, ligações clandestinas de esgoto e falta de educação ambiental. Elencou-se, ainda, uma série de diretrizes para recuperação e conservação do local, aliadas à implantação de um parque linear no fundo de vale. Espera-se que as diretrizes traçadas possam auxiliar uma futura intervenção no local e que o método proposto sirva de base para a recuperação de outras áreas de fundos de vale urbanos.

Palavras-chave: áreas verdes urbanas, cursos d'água, projeto da paisagem.

Introduction

Cities change all the elements of the landscape – soil, geomorphology, vegetation, fauna, hydrography, air and weather – and, without doubt, they are the constructions that have the greatest impact on the surface of the Earth. The growth of these spaces has intensified, principally since the Industrial Revolution, and today more than half of the world's population lives in cities. This has contributed to the worsening of some urban problems, such as the lack of infrastructure and environmental problems.

In general, the urban rivers and streams of Brazil are degraded and polluted, mainly as a result of the impact of urbanisation. For example, the impermeabilisation of the soil and urban drainage aggravate the phenomena of excessive runoff, causing urban area floods and leading to significant social and economic losses. This means that the urban population views rivers as the focus of the problem and demands public authorities take measures such as channelling and straightening river courses, widespread practices adopted in the first half of the XX century that, in the majority of the cases, only made the problem worse or transferred it to another location.

The preservation of valley floor areas has been regulated by the Forestry Code (BRASIL, 1965) since 1965. This law establishes that the ground cover along the banks of every watercourse are Areas of Permanent Preservation – APPs – and specifies a marginal strip that is to be preserved along the length of the course. At present, Resolution 302 from 2002 from the National Environmental Council (*Conselho Nacional do Meio Ambiente* - CONAMA) (BRASIL, 2002) in article 2 of the Federal Forestry Code with regard to APPs specifies the minimum marginal strip width to be preserved as a function of the width of the watercourse.

The number of plans and projects that have adopted the greenway as an effective measure with low environmental impact for the recovery of valley floor areas has been growing in Brazil and in the world. This increased recourse to APPs for developing public uses with low environmental impact has also led CONAMA to issue a resolution (Resolution No. 369 of 2006) (BRASIL, 2006) with the aim of regulating these uses, allowing interventions to be made in the vegetation in these areas, or for it to be suppressed, so that public domain green areas can be developed, as long as various legal considerations and restrictions are respected.

Greenways, more commonly referred to in Brazil as linear parks are being applied on valley floors. These have been inspired by the European and North American trend of returning valley floors to nature with greenways and parkways. Satisfactory results have been obtained in terms of maintaining biodiversity, recovering riparian vegetation, and water quality, promoting leisure activities, in addition to other benefits. The objective of the modern concept of greenways is to preserve these fundamental landscape structures, reconciling the social, cultural and ecological aspects in the same space, thus strengthening human integration with the natural world.

Fabos (2004) attributes the invention of the concept of greenways and parkways to the North American architect Frederick Law Olmsted, who first used it in a project for the University of Berkeley, USA in 1865. He planned to transform Strawberry Creek into a greenway to connect Berkeley to Oakland by a scenic route. The project, which was not implemented at the time, intended to apply the connection concept between parks and other free spaces.

The modern concept of the urban parks goes beyond the merely aesthetic character that it had in the past. Today, the aesthetic concept is only valid in the context of environmental planning, encompassing aspects of biophysical support and socio-cultural factors. In this form, the linear topology of these parks has increased in strength in recent years as it makes use of urban landscape structures such as the valley floors that are, as a rule, abandoned and degraded.

The development of a greenway requires reconciling a set of actions addressing illegal buildings, drainage, sewage, fauna and flora, the migration of residents from the periphery to the centre of the city, changes to the transport network, and negotiations with landowners, as well as reconciling the uses of preservation, leisure, tourism and others within the greenway area, at the level of the catchment area, and social relationships, adapting these relationships in accordance with the specifics of the location. The author also highlights that the possible benefits from developing this type of park include improvements to soil drainage, with an increase of the permeable area; protection and maintenance of the natural system; leisure options that can be combined with environmental education measures, stimulating social cohesion; structuring of the urban landscape, with consequent economic development of the region where it is developed; as well as combating illegal occupation.

The city of Maringá was founded by the Companhia Melhoramentos Norte do Paraná (CMNP) in 1947. It was planned by the Engineer Jorge de Macedo Vieira, who imprinted the concept of the garden city onto the design, taking the urban practices of Raymond Unwin and Barry Parker – creators of the first English garden city – as a reference. This resulted in an irregular design following the natural contours of the land and the presence of a dense forest as an element in the composition of the urban space, making the abundance of vegetation a strong part of the identity of the municipality (REGO, 2001).

In terms of valley floors, the municipality presently has 68 springs and 32 streams and brooks that cross the urban area, resulting in approximately 70 km of valley floor length. The city of Maringá is divided by the watershed – which runs in an East-West direction – with two principal catchment areas, the Pirapó river basin to the north and the rio Ivaí basin to the south. Meneguetti (2009) highlights the Maringá Road Guidelines Plan of 1979 (MARINGÁ, 1979) as responsible for retaining these areas in the urban area. The plan establishes a 60 m wide protection strip on either side of the water bodies in the city, bounded by roads designated as landscape, intended for the creation of greenways that will ensure that green areas are expanded and connect the areas not included in the original plan.

On this basis, the present study aims to set out guidelines for recovering the valley floor of the Mandacarú Stream in Maringá, through the development of a greenway. This stream lies in the Northern region of the municipality (Figure 1), with 85% of its course within the urban perimeter; its spring is in a densely urbanised area and its mouth, in the Maringá river, in the rural area of the municipality. There is significant loss of riparian vegetation and water quality on the valley floor; a large quantity of waste is inadequately discharged into the stream, resulting from the advance of urbanisation into the channel and the lack of environmental education.

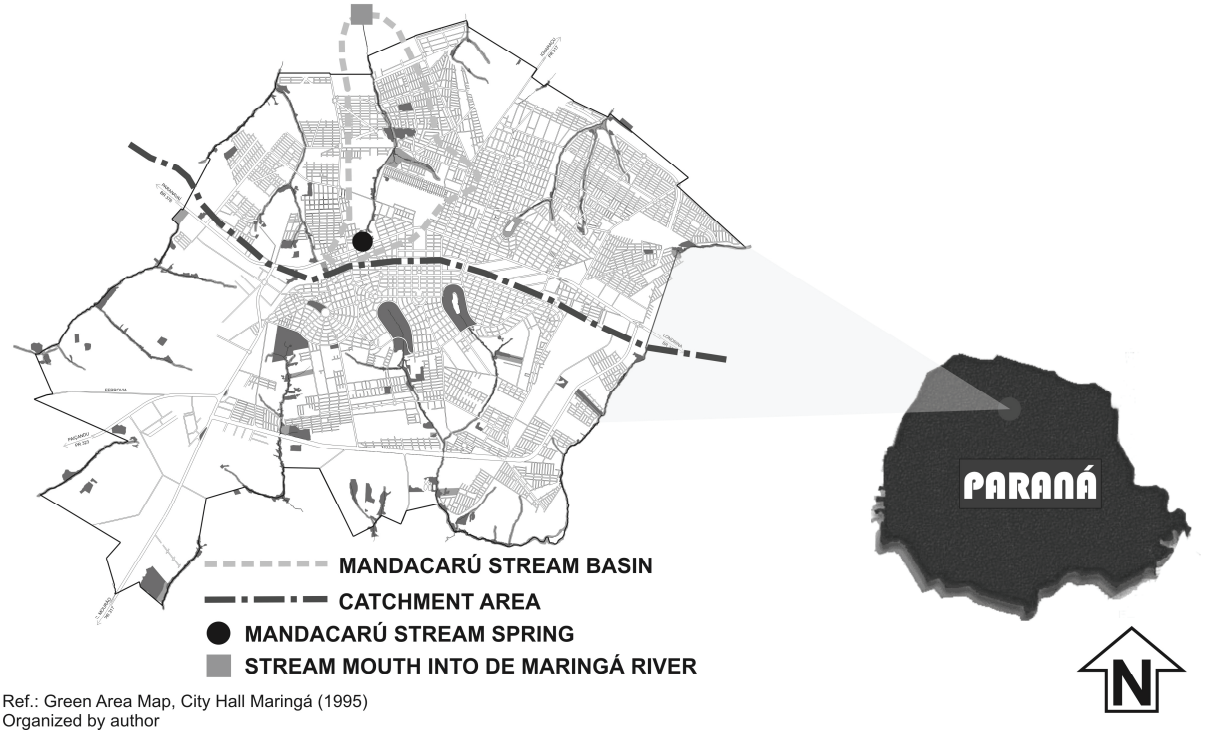
Material and methods

The research began with a literature review to guide the preparation of the most appropriate methodology for developing the greenway in Mandacarú stream, located in the city of Maringá, north of Paraná State, Brazil, with the aim of achieving its recovery. The spring of the valley is located at latitude 23°24'41,16"S and longitude 51°56'58,37"W.

The proposed method is based on two approaches of greenway implementation. The first has been used by authors such as Flink and Searns (1993), Pena et al. (2010) and Toccoline et al. (2006). The second was adopted by Franco (1997).

The method adopted by Flink and Searns (1993) begins with conducting an inventory involving analysis of the natural and cultural resources; it then determines the objectives, methods and actions for the area; and ends with the final plan, which must include all of the proposed changes for the area, together with cost estimation. Charles A. Flink is a very active professional in developing greenways in the USA. He is the founder and president of Greenways Incorporated, which has already implanted greenways in more than 100 locations, including 32 American states, and in countries like Argentina, Canada and Japan (FLINK, 2006).

In the study conducted by Pena et al. (2010), which had the objective of setting out a methodology for interventions in natural corridors, the proposed steps are: firstly an eco-cultural analysis, involving biophysical and geomorphological components, the vegetation and cultural analysis; then the intervention measures are prepared on the basis of the information gathered, and are divided into three essential areas, the recovery (class I), change in land use (class II) and conservation (class III). The authors stress that this type of intervention must adopt comfort, continuity and landscaping as principles of the ecological landscape. This methodology was applied in an area of the municipality of Azambuja, in the metropolitan area of Lisbon, Portugal.



Ref.: Green Area Map, City Hall Maringá (1995)
Organized by author

Figure 1. Location of the study area within the State of Paraná and the City of Maringá.

The methodology adopted by Toccoline et al. (2006) was applied by them in a park along the Lambro river created in 1983, which covers an area of 82 km² and runs through a series of municipalities to the north of Milan, Italy. The method used is structured in 4 phases: (1) analysis of the current landscape resources, such as existing historic green footpaths (to evaluate the possibility of connecting existing routes, and the characteristics appropriate to the corridor); (2) Evaluation of each element; (3) Composite evaluation; (4) Definition of the Greenway Plan. This study gave a special focus to the formation of the footpaths responsible for composing a connected network along the whole of the Lambro river. The final plan has served as a basis for the environmental plan for the area, which covers 35 municipalities, each one being responsible for the development of about 12 km of routes.

Despite some specifics as a function of the characteristics of each location, the methodology adopted by these three groups of authors have the following in common: an initial in-depth analysis of the corridor, covering a survey (biophysical and geomorphological) of the state of the natural areas and the cultural aspects of the corridor (for example, use and occupancy of the land, characterisation of the urban landscape). They then propose synthesising and diagnosing the information gathered, ending with the preparation of the final proposal.

The second approach, proposed by Franco (1997), differs from the above as it begins with preparing the desired scenario, before the analyses and surveys. According to the author, the advantage of this methodology is that it saves time as the future analyses and surveys derive from the desired scenario, and not the other way around, so that time is not lost in initial analyses that may be found to be of no use in preparing the final proposal. Franco applied this methodology, referred to as environmental design, on different scales, such as in the Baleia Condominium, located in the municipality of São Sebastião, São Paulo State (small scale), in the North Ecological Park in Brasília, Federal District (urban scale), and at the boundary of the Atibaia Environmental Preservation Area, in São Paulo State (regional scale).

The process used in the present study is a combination of the two approaches cited above, following the steps below:

1. The preparation of a desired scenario for the greenway to be developed, based upon the municipal laws for the use of valley floor areas (Complementary Law No. 334/99 and Law No. 198/2009) (MARINGÁ, 1999, 2009); the Municipal Macro-zoning Map from the Municipal Master Plan of 2006; analysis of satellite photos for the year 2010; and knowledge of the study area gained from *in loco* visits, including a photographic survey;

2. An eco-cultural survey of the catchment area, based on published studies, maps and charts from the Municipal Master Plan of 2006, analysis of satellite images for the year 2010, and *in loco* visits, including a photographic record, with the aim of confirming the information gathered, and general analysis of the state of degradation of the area, covering the following aspects: relief, climate, soil, vegetation, hydrology and water quality, land use and occupancy, land property rights, zoning and existing leisure equipment within the boundary of the catchment area;

3. The synthesis and diagnosis of the information gathered, through the classification of the analyses from the eco-cultural survey, using a holistic vision – treating all of the variables in an integrated way, as part of a single system – to enable guidelines for the final plan to be prepared, the guidelines being divided into: social guidelines (such as how the public will use the greenway, the required leisure equipment and expected social and cultural benefits); and Environmental guidelines (actions necessary for the recovery and conservation of the valley floor areas);

4. The final proposal, which is to be prepared on the basis of the guidelines from the above step, must achieve the objectives at the social, cultural and ecological levels.

The photographic record, made using a digital camera, allowed post-editing images. The maps prepared were based on the *.cdr (Corel Draw) format maps in the Municipal Master Plan from 2006, organised and edited with the help of Corel Draw X4 and AutoCAD 2010 software. The satellite photos analysed are available in the Google Earth Pro 2010 software. AutoCAD 2010 and Google Earth Pro software were used for measuring and quantifying the areas in the analyses.

Results and discussion

Synthesis and diagnosis

The eco-cultural survey of the Mandacarú Stream identified a series of environmental impacts suffered along the years that have undermined the environmental quality of the valley floor. The synthesis and diagnosis of this survey information have the objective of correlating the different factors that have the same impact, thus permitting an integrated vision of the processes and defining guidelines for the recovery of the area.

The impact of erosion is possibly one of the greatest concerns in the area in question, as it could lead to subsidence - the deepening of ravines until they reach the groundwater level - and also sedimentation - channel obstruction by sediment from a river or canal. In the case of the Mandacarú stream this impact is attributed to two principal causes:

- Natural Factors: the combination of the type of soil and the relief is a factor that has certainly contributed to the propensity of erosion of the valley floor, as the Red Nitosol present around the whole of the valley floor is susceptible to erosion when combined with the undulating relief, which occurs from the stream's spring until near its mouth. The erosion process is noticeably worse in the locations where this combination exists. The meandering nature of the channel is in itself an indication of the predisposition to erosion.

- Human Factors: anthropic activities related to urbanisation have contributed greatly to the worsening of these erosion processes. The surface runoff and high degree of impermeability of the surroundings are the principal factors responsible for the excessive increase in the maximum flow of the channel, in particular during periods of high precipitation. This fact is demonstrated by the analysis of the surroundings of the rainwater spillways and drain outlets, which show that erosion processes are much more advanced in these locations than at others, along with significant channel widening. In locations without any riparian vegetation, the erosion is also often more advanced.

The Mandacarú Stream has suffered over the years from the advancing urbanisation over its catchment area, which has resulted in considerable losses to the riparian vegetation, which, according to Queiroz et al. (2002) only represented 42% of the area intended for the APP. The analysis of satellite images revealed that the main deforested locations are in the area close to the confluence of the Diamante Stream and the Mandacarú Stream; shortly after the APP area corresponding to the Cinquentenário Park; in the neighbourhood of the municipality's Contorno Norte construction site, where is located the most densely urbanised area, and in the rural area of the municipality, close to the mouth of the channel.

The presence of invasive vegetation on the valley floor is the principal negative aspect with regard to the quality of the riparian forest. Large groupings of leucaena can be seen at various locations on the valley floor. The greatest problem of this type of invasive vegetation, common in riparian areas, is that it is difficult to eradicate as it buds vigorously after being cut. Other exotic species, such as eucalyptus and grevillea, are also found in large numbers in comparison to the native species.

The Mandacarú Stream has a high level of total coliforms, which significantly compromises its water quality and is a risk to the public should people come into contact with the water. This degradation to the watercourse is attributed to two causes. The first is the various types of runoff material carried from the impermeable surroundings into the stream through the rainwater drains, polluting the channel, which is unable to cleanse itself as its volume is low in the urban area. The second factor is the presence of clandestine sewage connections, without any control over the type of effluent that reaches the channel, which certainly contributes to its degradation. The water supply company for the municipality, *Companhia de Saneamento do Paraná*, (SANEPAR), itself surveyed the Mandacarú Stream with the purpose of locating clandestine sewage connections. Although the company has not released the survey results, the presence of clandestine sewage connections to the channel has been confirmed.

In addition, with regard to the pollution of the valley floor, it is notable that a large quantity of solid waste of all types is discharged at various places along the valley floor, both in the surroundings and into the watercourse. It is believed that the waste present on the bed of the channel arrives from the rainwater drains, as the amount of rubbish close to them is notable. This proposition is supported by the fact that the riparian vegetation makes it difficult for people to reach the bed of the channel and dump rubbish directly into the watercourse. Furthermore, the waste present around the valley floor results from direct dumping. In both cases, the lack of environmental education and public policies are factors responsible for the lack of awareness of the environmental harm caused by waste dumping to the environment.

With regard to flooding, channel flooding has not been confirmed in the catchment area. For Borsato and Martoni (2004), this is due to the morphology of the catchment areas found in the municipality – in contrast to that of the Borba Gato river basin – whose more rectangular shape, poor drainage and low gradient tend to provide a slower hydrological response, and consequently reduce the flooding peaks. These characteristics, in theory, reduce the risk for the population that may occupy the area adjacent to the stream, although this brings a range of other environmental factors, which leads to its occupancy being regulated by the legislation.

Currently, property rights and some occupancy of the land bordering the valley floor are the biggest obstacles to developing a greenway in the study area. Although the creation of greenways alongside watercourses has been governed by municipal laws since 1979 and the donation of the areas of the valley floors to the municipal authority has been provided for since 1984 (MARINGÁ, 1984), when land parcelling began, it is known that the public authority traded some parcels after this period. The map of Property Rights and Empty Parcels reveals that a considerable portion of the space required for developing a greenway is private property, which requires the public authority to appropriate these properties for development to proceed, an action that is not found to be straightforward in practice.

Comparing the information from the maps for Urban Occupancy Evolution and for Property Rights and Empty Land, it can be seen that, in fact, the greater part of the private property parcels are on the right bank of the upper third, which was occupied prior to the 1960s, and the left bank of the upper third, where the great majority is empty urban areas still not parcelled. Nevertheless, it is questionable that in some locations on the left bank of the middle third there are small private properties among the municipal property, since this area was parcelled in the 1990s. This situation becomes more serious at the end of the middle third, on the right bank of the stream, where the parcels date from the 1990s and 2000, and are all private properties. The positive factor is that the large majority of the private parcels have not been built upon, which facilitates the act of appropriation and negotiation with the landowners. The parcels approved after 2003 could not be analysed as the map of Property Rights and Vacant Land derives from the council's real estate data from 2003.

With regard to potentially illegal occupations, the most worrying finding is the apparent non-compliance with the municipal legislation. There is a total of 25 buildings along the valley floor in apparent disregard of the municipal regulation that reserves a strip without occupancy of 30-60 m for the APP and a further 30 m for the greenway on each bank. As there are few buildings on the banks of the stream, nearly all of these buildings do not comply with the municipal legislation, which reveals two possible scenarios: either these buildings have not been approved by the municipal council, or the council itself has not applied the law and has allowed more than the strip intended for the APP to be occupied, contrary to the federal legislation.

The buildings found closer than 30 m to the watercourse, five in all, are similar in that they are on parcels held as private property and are built from wood. The most likely hypothesis in this case is that these buildings derive from the time in which the surroundings of the stream were still not urbanised, and that they are remnants from previous small farm parcels. All of the buildings are very poor and apparently do not have the same infrastructure as the buildings cited above that occupy the 60-m non-building (*non aedificandi*) strip.

Finally, the analyses regarding the availability of sport, cultural and leisure equipment reveal a certain shortage in the area of public leisure, as the public access facilities, such as the Sports Centre, the Olympic Village and the State University of Maringá (UEM), impose some restrictions on the use of the facilities: prior reservation or payment of a maintenance fee, in the case of the Sports Centre; use of only part of the infrastructure and outside the athlete training hours, in the case of the Olympic Village; and the requirement for approval, awarded only to the university academics, in the case of UEM. These restrictions limit the use by that part of the population which, in the area of study, has only the Palmeiras Park facility and two town squares as free leisure options, one of the squares having just an elderly sports centre facility. The other town squares in the area of study do not have leisure facilities.

Guidelines for developing the greenway

Based on the information contained in the Synthesis and Diagnosis step, a list of guidelines was prepared with the intention of directing the preparation of a possible scenario for the catchment area and the development of a greenway. The proposed guidelines were divided into two categories: environmental guidelines and social guidelines.

Environmental guidelines: these are the actions required to guarantee the environmental recovery and conservation of the area. The following is proposed:

- construction of storage drains: located at various strategic points in the catchment area, such as along the greenway and in other free space areas, such as squares and parks. Their main function is to reduce the runoff velocity and volume and prevent the channel volume increase and the consequent erosion;

- an increase in the permeable area: another action that will contribute to the reduction in the velocity and volume of runoff. It is proposed to increase the minimum permeable area of the parcels,

which is currently 10%. The construction of ecological pavements - which have a permeable strip – is already provided for in the municipal legislation, but is seldom used in practice. Public areas, such as squares, should be noted for the presence of areas of vegetation and the use of semi-permeable pavements, which can also be used along the strategic routes of the urban area;

- energy dissipators the existing energy dissipators at the outlets of the rainwater drains and spillways must be reviewed; they are not currently performing their function effectively and erosion most often occurs at these places;

- utilisation of rainwater: the public authority could provide benefits for buildings that reuse rainwater, thus encouraging the rational use of this finite and essential resource for the maintenance of life;

- installation of green infrastructure: connections between the green areas and the free spaces are important so that the city's areas with vegetation are not isolated. This will allow species to migrate and facilitate the preservation of biodiversity. In the catchment area, thought must be given to connecting the valley floor with the other parks, which could be achieved by means of planted avenues. Thought must also be given to the urban-rural connections. At a later time, the possibility of connecting the various urban catchment areas must be considered;

- reforestation with native species: the deforested locations intended for the APP must be reforested with native species. This will contribute to the maintenance of biodiversity on the valley floor and also to containing the erosion processes, such as erosion of the banks;

- combat invasive vegetation: this type of vegetation must be combated as it undermines the maintenance of native species and, consequently, biodiversity;

- appropriation: continuity is an essential factor for the development of the greenway. Hence, the parcels and buildings bordering the valley floor up to the limit of the landscaped route must be appropriated for the development of the greenway to be viable;

- environmental education: the waste dumping resulting from lack of environmental education is the main cause of pollution on the valley floor. Raising public awareness will make the public a monitoring agent of the area, preventing and reporting waste dumping, which is currently undermining the quality of the valley floor;

- combat the clandestine sewage connections: these must be eliminated as they are undermining the quality of water in the channel and, consequently, the aquatic biodiversity.

Social guidelines: these determine the way in which the public interacts with the park and the equipment and the actions that are required to ensure that the equipment is actively used. The proposals in this area are:

- public participation in the process of developing the greenway: the local population must be present at all stages of developing the greenway. The objective of this action is to engender in citizens a sense of identification with the valley floor, so that they feel responsible for conserving it;

- nature study centre: the valley floors form a rich ecosystem that allows a range of environments to be studied. Consideration can be given to setting up a centre intended for study and research, together with the UEM, which borders the stream. This centre could also have the function of coordinating ecological visits to the valley floor for students and the general public, as an education measure and to raise environmental awareness;

- community garden: this type of facility already exists in various boroughs in Maringá and can be constructed at strategic places along the valley floor, principally in low-income districts. In addition to providing foodstuffs for participating families, it can provide income support, as excess production can be sold;

- active leisure: currently this kind of facility is lacking in the study area. It is suggested that in the study area footpaths, cycle ways, multi-sport grounds, elderly sports centres and playgrounds are adopted. The need to develop this type of facility should be discussed with the local population and potential users, so that their real needs are met and the risk of facility disuse is avoided;

- passive leisure: the green areas in general are attractive for possible passive or contemplative leisure. Accordingly, places of a scenic nature, shaded areas for relaxation, and places where the watercourse can be observed should be used as user attractions;

- cultural facilities: facilities dedicated to cultural events such as open-air theatre, local parties and other cultural events are another important feature to ensure that the park is actively used throughout the year;

- connectivity: attention must be given to the places where the valley floor is cut by high circulation routes so that the greenway is not fragmented;

- security: many spaces in the urban area fall into disuse because of the lack of security. It is important to ensure that the locations are well illuminated at night and that the public actively participates in the greenway security.

In general, the implantation of greenways must comprise: an integrated vision of the processes as a whole, taking the catchment area as a planning unit, focussed on environmental recovery and conservation; public participation in all of the greenway planning and development steps; measures to guarantee the frequency of use of the park, with regular events and fairs, as well as exploitation of possible economic benefits to ensure the sustainability of the proposal; multifunctionality of the greenway, encompassing leisure, commuting, research, education and culture; and the connection with the other free spaces, forming a green infrastructure that will leverage the benefits inherent to green areas and maintain biodiversity.

All of these guidelines were proposed with the objective of improving the quality of life and the landscape of the surroundings and the environmental recovery and conservation of the Mandacarú Stream, Maringá, Paraná State, based on the analyses and diagnosis conducted and taking social and cultural measures into consideration. These actions should guide the interventions in the valley floor catchment area and the development of the greenway.

Conclusion

The most recent planning strategies have adopted watercourses as a structural element, given the importance that water plays in maintaining life of earth. The methodology, based on eco-cultural survey and the synthesis and diagnosis of the survey, diagnosed the major environmental issues that have compromised the quality of water and the loss of vegetation and biodiversity in the channel, allowing guidelines to be prepared for the recovery of the area. It is hoped that the proposed method can serve as the basis for interventions in the study area as well for others valley floor areas.

References

BORSATO, H. F.; MARTONI, A. M. Estudo da fisiografia das bacias hidrográficas urbanas no Município de Maringá, Estado do Paraná. **Acta Scientiarum. Human and Social Sciences**, v. 26, n. 2, p. 273-285, 2004.

BRASIL. Código Florestal Brasileiro. **Lei Federal nº 4771**. Brasília: Congresso Federal, 1965.

BRASIL. Ministério do Meio Ambiente, Conselho Nacional do Meio Ambiente. **Dispõe sobre os parâmetros, definições e limites de Áreas de Preservação Permanente de reservatórios artificiais e o regime de uso do entorno**. Resolução n. 302, de 20 de março de 2002, publicado no Diário Oficial da União em 13 de maio de 2002.

BRASIL. Ministério do Meio Ambiente, Conselho Nacional do Meio Ambiente. **Dispõe sobre os casos excepcionais, de utilidade pública, interesse social ou baixo impacto ambiental, que possibilitam a intervenção ou supressão de vegetação em Área de Preservação Permanente (APP)**. Resolução nº 369, de 28 de março de 2006, publicado no Diário Oficial da União em 29 de março de 2006. Seção 1, p. 150-151.

FABOS, J. G. Greenway planning in the United States: its origins and recent case studies. **Landscape and Urban Planning**, v. 68, n. 2-3, p. 321-342, 2004.

FLINK, C. A.; SEARNS, R. M. **Greenways:** a guide to planning, design and development. Washington, D.C.: Island Press, 1993.

FLINK, C. A. A history of Greenways. **North Carolina Landscape Architect Journal**, 2006. Available from: <http://www.greenways.com/PDFs/HistoryofGreenways>. Access on: Sept. 5, 2010.

FRANCO, M. A. R. **Desenho ambiental**: uma introdução à arquitetura da paisagem com o paradigma ecológico. São Paulo: Annablume FAPESP, 1997.

MARINGÁ, P. M. **Plano de Diretrizes Viárias**. Maringá, 1979.

MARINGÁ, P. M. **Lei de Loteamentos** – Lei n°1735/84. Maringá, 1984.

MARINGÁ, P. M. **Lei Complementar 334/99**. Dispõe sobre o parcelamento do solo no município de Maringá. Maringá, 1999.

MARINGÁ, P. M. **Mensagem de Lei 198/2009**, de 22 de dezembro de 2009. Maringá, 2009.

MENEGUETTI, K. S. **Cidade jardim, cidade sustentável**. A estrutura ecológica urbana e a cidade de Maringá. Maringá: EDUEM, 2009.

PENA, S. B.; ABREU, M. M.; TELES, R.; ESPÍRITO-SANTO, M. D. A methodology for creating greenways through multidisciplinary sustainable landscape planning. **Journal of Environmental Management**, v. 91, p. 970-983, 2010.

QUEIROZ, D. R.; PINTO, R. B.; BATRES, V. B. K. A cartografia como subsídio à análise da ocupação do fundo de vale do córrego Mandacarú. **Acta Scientiarum**, v. 24, n. 6, p. 1777-1781, 2002.

REGO, R. L. O desenho urbano de Maringá e a idéia de cidade-jardim. **Acta Scientiarum**, v. 23, n. 6, p. 1569-1577, 2001.

TOCCOLINE, A.; FUMAGALLI, N.; SENES, G. Greenways planning in Italy: the Lambro river valley Greenways system. **Landscape and Urban Planning**, v. 76, n. 1-4, p. 98-111, 2006.

Received on February 17, 2011.
Accepted on September 29, 2011.