Sustainable Design of Public Open Spaces in the Great Porto Metropolitan Area

ISABEL MARTINHO DA SILVA
Departamento de Geociências, Ambiente e Ordenamento do Território – Grupo de Arquitetura Paisagista /CIBIO (Research Center in Biodiversity and Genetic Resources) Universidade do Porto Rua do Campo Alegre 687, 4169-Porto PORTUGAL isabelsilva@fc.up.pt

Abstract: This paper results from a research line developed within the research project “The Greater Porto Metropolitan Park Network” (GAMP/CIBIO). The objective of this research line was the development of Manuals of Good Practices for the design, construction, and management/maintenance of metropolitan parks. These manuals were built upon a series of guidelines for the sustainable management of natural resources and hard landscape materials, applicable international and national legislation, and certification requirements of the Green Flag Award.

The incorporation of widely accepted sustainability principles in the construction of these guidelines makes them potentially applicable to a wider range of situations, which have contributed to the development of manuals of good practices for sustainable public open space design, construction, and management/maintenance.

This paper presents the sustainable management guidelines developed for the natural resources (soil, water, vegetation, biodiversity) and hard landscape materials that support a Manual of Good Practices for Public Open Space Design. It also presents a summary of the main sustainable design guidelines composing this manual.

Keywords: sustainability, sustainable design, public open spaces, manual of good practices

1 Introduction
This paper results from a research project for the creation of a Metropolitan Park Network (MPN) in the Great Metropolitan Area of Porto (GMAP). This project was composed by three research lines: i) the identification and characterization of sites with potential to integrate a MPN; ii) the definition of park limits, hierarchy and typology; and iii) the definition of guidelines for the design, construction, and management/maintenance of parks. Guidelines were subdivided in two categories: general guidelines and specific guidelines. General guidelines apply to every park in the MPN, and can be used as a Manual of Good Practices (MPG) for park design, construction, and management/maintenance (Figure 1). Specific guidelines apply to different park typologies or to individual parks according to their specific needs.

In this paper, we are going to present a summary of the MPG developed for the sustainable design of metropolitan parks. Given their extensive and comprehensive conception, this MPG can be applied for the sustainable design of public open spaces, in general, located in the GPMA.

The main objective behind the elaboration of the MPG was the creation of sustainable public open spaces. Sustainability is achieved through an appropriate use and management of natural resources (soils, water, vegetation, and biodiversity) and hard landscape materials. It has also been included in the MPG all the international and national legislation applicable, as well as the certification requirements of the Green Flag Award having in mind the future certification of the new and renewed public open spaces in the GPMA. (Figure 1).

In the paper we present, first, the sustainable management guidelines of natural resources (soil, water, vegetation, biodiversity) and hard landscape materials that support a Manual of Good Practices for Public Open Space Design. It also presents a summary of the main sustainable design guidelines composing the MPG. For better reading, the sustainable design guidelines are organized according to the sequential phases of a public open space project.
Fig.1: Methodology used in the construction of Manuals of Good Practice for the design, construction and maintenance/management of public open spaces.

2 Sustainable management guidelines
The MGP has been built upon sustainable management guidelines of natural resources (soil, water, vegetation, biodiversity) and hard landscape materials (Figure 1). These guidelines, a group of general recommendations, were the basis for the redaction of the sustainable design guidelines composing the MGP.

2.1 Guidelines for Soil Sustainable Management
i) Soil carrying capacity and natural fertility must be respected.
ii) High fertility soils must be preserved and protected.
iii) Soils prone to erosion must be protected.
iv) Soil permeability must be protected and promoted.
v) Damaged or contaminated soils must be restored.

2.2 Guidelines for Water Sustainable Management
i) Natural water systems and wetlands must be preserved and/or restored.
ii) The soil natural drainage system must be preserved and/or restored.
iii) Public open space design should promote a sustainable water use, namely through the use of local water resources; water harvest, recycling and storage for local use; minimization of irrigated areas; and optimization of irrigation.

2.3 Guidelines for Vegetation Sustainable Management
i) Native vegetation must be preserved and promoted.
ii) Non invasive ornamental vegetation must be preserved and promoted, namely tree specimens.
iii) Invasive exotic vegetation must be eliminated.
iv) Vegetation should be adapted to the proposed land use, namely to carrying capacity.
v) Plants should be grouped according to their management and maintenance needs.
vi) Integrated pest management and biological pest control must be implemented.
vii) Organic fertilizers and compost obtained locally should be used.

2.4 Guidelines for Sustainable Biodiversity Management and Biodiversity Promotion
i) Ecosystems, habitats and local species must be protected and/or restored. Special attention should be given to deciduous woodlands, wetlands, watercourses and associated riparian areas.
ii) The disruption of local ecosystems should be prevented by avoiding an excessive use of non-native species.
iii) The heterogeneity of landscape must be promoted.
iv) Ecological corridors must be preserved and promoted.
v) Organic farming, integrated pest management and biological pest control must be promoted.

2.5 Guidelines for Sustainable Hard Landscape Materials Management
i) “Reduce, Reuse, and Recycle” is the main guideline for the sustainable management of hard landscape materials in what concerns their origins.
ii) Use less materials, reuse materials, and use recycled materials, in the expressed order, is the sustainable path.
iii) Use reusable and recyclable materials (destiny of materials).
iv) Use materials with a low impact in the environment in what concerns its extraction, production, transportation, and application: local materials; ecomaterials; certified materials; materials with high carbon sequestration.
v) Avoid or minimize the use of toxic materials.
3 Sustainable design guidelines

3.1 Site assessment
The sustainable design of a public open space requires a detailed site assessment, in order to evaluate the existing situation. All the ecological, historical and cultural features of the site must be assessed, namely: i) natural drainage lines; watercourses, water surfaces and wetlands; ii) soils and corresponding type, fertility, and vulnerability; iii) remarkable geologic formations; iv) vegetation, with special attention for trees and other remarkable specimens, including the evaluation of their health situation; v) fauna with identification of breeding areas and ecological corridors; vi) hard landscape structures such as pathways, walls, water elements (irrigation systems, wells, tanks, etc.); vii) heritage (built heritage, historic gardens, archeological values); viii) views.

This site assessment is fundamental for the sustainable management of the natural and cultural site resources, as well as for the eventual maintenance and improvement of the site character.

3.2 Conceptual Plan
The sustainability of an open space is determined in the elaboration of the Conceptual Plan. The Conceptual Plan must comply with the management guidelines for the natural resources and hard landscape materials enunciated on part II, by adjusting the proposed land uses to the site’s suitability, namely through the integration of the following guidelines:

i) Proposed land uses must adjust to soil carrying capacity and fertility, with pavements and other built elements being located whenever possible in low fertility soils.

ii) Proposed vegetation must adjust to the site location and to the function and aesthetic desired for the open space. Public open spaces in rural areas or where the main goal is the promotion of the ecological function (ecological parks) should make a wide use of native vegetation. Native vegetation can also be used in other typologies of public open spaces, namely more urban typologies, as it requires a lower maintenance and promotes a greater biodiversity.

iii) Proposed vegetation should minimize water consumption. Proposed land uses should maximize, whenever possible, non-irrigated areas or low-irrigation areas. High-irrigation areas should match active recreation areas or other areas requiring a high carrying capacity.

iv) Proposed vegetation should maximize biodiversity, namely through the supply of habitat and food for fauna. Other measures promoting biodiversity are: the creation of landscape heterogeneity through the design of a diversity of parcels; the design of ecological corridors; the fixing of nests in trees; the design of non-mowed stripes in lawns and meadows; the design of a suitable illumination.

v) Proposed construction materials should be local materials in order to better integrate the built structures in the landscape and reduce energy transportation costs. However, in small public open spaces in highly impermeable urban areas one must propose the use of permeable or semi-permeable pavements.

vi) Whenever the construction of public open spaces requires the demolishing of pavements or other built structures one should reuse the demolished materials in the construction of the new pavements or built structures.

vii) As maintenance is one of the most important factors in the sustainability of a public open space, maintenance should be clearly defined in the design of the Conceptual Plan. The Conceptual Plan should propose low maintenance areas, namely through the proper choice of low maintenance vegetation, hard landscape materials, urban furniture, and equipment.

In what concerns vegetation, plants should be grouped according to their maintenance needs, designing clear transitions between low and high maintenance areas.

3.3 Intervention Measures on the Site’s Existing Elements
The site assessment results in a number of intervention measures on the site’s existing hard and soft landscape elements. In general terms, these measures define what should be protected and what should be removed/demolished on the site. A sustainable design should promote the following intervention measures:

i) Removal and storage for future use of the topsoil located within the “building envelope”.

ii) Preservation and/or restoration of the site’s natural water system and natural drainage system, and of any existing wetland.

iii) Definition of “vegetation to preserve”, “vegetation to transplant”, and “vegetation to remove”. A sustainable design should maintain the native vegetation, and the non-invasive ornamental vegetation, especially the tree and shrub specimens. In what concerns trees, only the sick, highly damage, very old, and invasive species specimens should be eliminated.
iv) Protection of the site ecosystems, natural habitats, and viable populations according to the Convention on Biological Diversity, with special attention to deciduous woodlands, wetlands, watercourses and associated riparian areas.

v) Preservation and promotion of ecological corridors, namely through the preservation of hedgerows and traditional walls.

vi) Definition of built structures “to maintain” and “to demolish”. A sustainable design should maintain the reasonably preserved built structures, namely those of heritage interest. In case of demolition, the reuse of the demolished materials in the construction of new structures on the site should always be considered.

3.4 Protection Measures
Protection measures are necessary to protect the ecological and cultural features “to maintain” during the construction phase. These protection measures should be integrated in any sustainable design process.

The delimitation of a “building envelope” is the main impact minimization measure of public open space construction on the local ecosystem. The literature defines “building envelop” as the area where all the construction activities occur, considering that everything outside this envelope should be classified as “protection area” during the construction phase. The “protection area” should not be accessible to machines or workers.

The “building envelope” should be located, whenever possible, in disrupted areas or areas with a low ecological value. Construction should be avoided in high fertility soils, with pavements and other built elements being located, whenever possible, in low fertility soils. Similarly, construction should be avoided in high biodiversity areas.

The “building envelope” must be signed in all the drawings of all the project phases.

Vegetation to preserve should, whenever possible, be included in the “protection area”. When there are specimens located inside the “building envelope”, it is necessary the delimitation of a protection area that includes the root system of each specimen to be protected.

3.5 Site Grading
Site grading is determinant in the design of sustainable public open spaces. To have a positive contribution to sustainability, site grading should not change severely the local topography, namely its natural water system and its natural drainage system.

Other important guidelines for a sustainability oriented site grading are: i) a balance between cut and fill, in order to minimize soil transportation costs; ii) to minimize the use of retaining structures; iii) to avoid the design of steep embankments as they are difficult to stabilize and to maintain; iv) to design sustainable urban drainage systems (SUDS) that promote water harvest and storage for local use; v) to design retention ponds for flood control and biodiversity promotion; vi) to keep unchanged the existing grade in the protection area of trees; and vii) to comply with the accessibility legislation.

3.6 Irrigation
Being water a scarce resource, a sustainable irrigation design should be based on the use of local water resources: local water system and/or water harvest, recycling and storage for local use. Water resources unsuitable for direct use should be treated. Public open space design should favor natural treatment systems, namely constructed wetlands. Drinkable water should not be used for irrigation, except when local water resources are not available or are unsuitable for direct used, namely through contamination.

Irrigation should be optimized. Irrigation should meet vegetation needs, avoiding an under or over irrigation, namely through the adoption of differential irrigation.

3.7 Planting
The design of sustainable planting procedures is determinant in the sustainability of public open spaces.

Sustainable final grading and ploughing procedures should not negatively impact the soil, water and plant resources of the site. Ploughing should minimize erosion risks and promote water infiltration, and be avoided or minimized in sensitive areas, such as margins of watercourses and areas under the canopy of trees.

Sustainable fertilization should not be homogeneous, but adjusted to existing soil fertility and proposed land uses (differential fertilization). The use of compost produced on site should be promoted, through the design of composting units. Plant material to use on planting and sowing should be ecologically, functionally, and aesthetically adapted to the site and surrounding landscape. As already mentioned, a sustainable design should promote the use of native vegetation, better adapted to the ecological conditions and requiring a lower
maintenance effort. Proposed vegetation should also minimize water consumption, both through the use of non-irrigated vegetation and through an optimized use of irrigated vegetation. Irrigated vegetation should be grouped according to its water needs in order to optimize irrigation.

Plants with higher maintenance requirements should be used in areas that maximize their benefit, namely areas requiring a high carrying capacity. Clear transitions should be designed between areas with different maintenance needs in order to optimize maintenance.

3.8 Built Structures
A sustainable public open space should minimize built structures, adjusting them to the users' needs. Paved areas must support the expected flows and uses, complying, among other requests, with the accessibilities legislation.

A sustainable choice of materials for pavements and other built structures should prefer the following materials: i) used or recycled materials (origin of materials), namely from on site demolitions; ii) reusable and recyclable materials (destiny of materials); iii) local or traditional materials in order to decrease transportation costs and achieve a better integration in the surrounding landscape; iv) permeable or semi-permeable materials to facilitate drainage and water infiltration.

3.9 Site Furniture and Recreation Equipment
Site furniture and recreation equipment should be functional, resistant and easy to maintain. Sustainable design of site furniture and recreation equipment for public open space should meet the following guidelines:

i) Site furniture should be uniform within each public open space for maintenance simplification.

ii) Site furniture and recreation equipment should meet the site needs, in order to avoid unnecessary acquisition and maintenance costs.

iii) Whenever possible, the use of used and/or reusable site furniture and recreation equipment should be proposed.

iv) Site furniture must be preferably installed in paved areas. Installation in green areas reduces its durability, and causes difficulties in the maintenance/management of green areas.

v) The number of waste containers should be minimized, namely through the adoption of larger containers. Waste containers should be concentrated on site entrances instead of being uniformly distributed all over the site. Recycling waste containers are the most sustainable choice.

4 Conclusion
The sustainability of an open space is defined in its design, namely the sustainability of its management/maintenance.

The manual of good practices for the design of public open spaces is an extensive and comprehensive compilation of guidelines/rules to assist landscape architects and other professionals involved in the design of public open spaces in the design of sustainable spaces. This paper presents a summary of these guidelines/rules organized according to the sequential phases of a public open space project.

The manual of good practices for sustainable design was based upon a series of guidelines for the sustainable management of the most important natural resources involved in public open space design (soil, water, vegetation and biodiversity) and a series of guidelines for a sustainable use and management of the hard landscape materials.

While, initially conceived for the design of metropolitan parks in the GPMA, the incorporation of quite universal sustainability principles in the construction of this manual makes it potentially applicable to a wide range of situations, namely to different typologies of open spaces and to geographic locations outside the GPMA.

References