

Aveiro (PT)

Setting/problem

The European Union has adopted the Directive 2007/60/EC on the assessment and management of flood risk (EC, 2007). The purpose of the directive is “to establish a framework for the assessment and management of flood risks, aiming at the reduction of the adverse consequences for human health, the environment, cultural heritage and economic activity associated with floods in the Community” and shall be carried out in coordination with the Water Framework Directives (2000/60/EC; 2006/118/EC). The Ria de Aveiro is a shallow coastal lagoon on the central coastal zone of Portugal, where three major rivers converge (river Vouga, Antuã and Boco) and that is connected to the Atlantic Ocean through a single inlet. The region is considered a flood-prone urban region, with much of the flooding events occurring when heavy rainfall (causing high river flows) coincides with low pressure systems N/NW of Portugal or high pressure systems S/SW of Portugal (causing S/SW wind related storm surges). Climate change is likely to amplify the effects of these forcings, due to an increase in rainfall depth and intensity, a rise in sea levels, and an increase in the intensity of extra-tropical cyclones in the North Atlantic (IPCC, 2007; Santos & Miranda, 2007).

Due to its favourable morphological and geological features, the Aveiro region underwent severe urbanization and industrialization over the last decades – in particular along the margins of the lagoon (Fidélis, 2007). This led to an increase in floods and flooding risk, affecting economic activities, biodiversity, people and infrastructures in one of the most important and fastest growing regions in Central Portugal (Pinto et al., 2009). Based on historical population growth data for the region, it can be expected that population growth and associated urbanization in the Aveiro region will continue over the next decades (Pinto et al., 2009) – although the current financial-economic crisis is likely to dampen population growth rates in the medium term.

Case study

Consequently, over the next decades continued urbanization in the Aveiro region will increasingly enter into conflict with green/blue space preservation/rehabilitation requirements for flood and storm-water control. While it is widely acknowledged that urban green/blue space provides multiple functions and benefits, the multifunctional character of green/blue spaces is poorly integrated into urban design and planning practice. The question arises how urbanization needs and housing preferences can best be integrated with green/blue space preservation/rehabilitation requirements for flood and storm-water control in the Aveiro region.

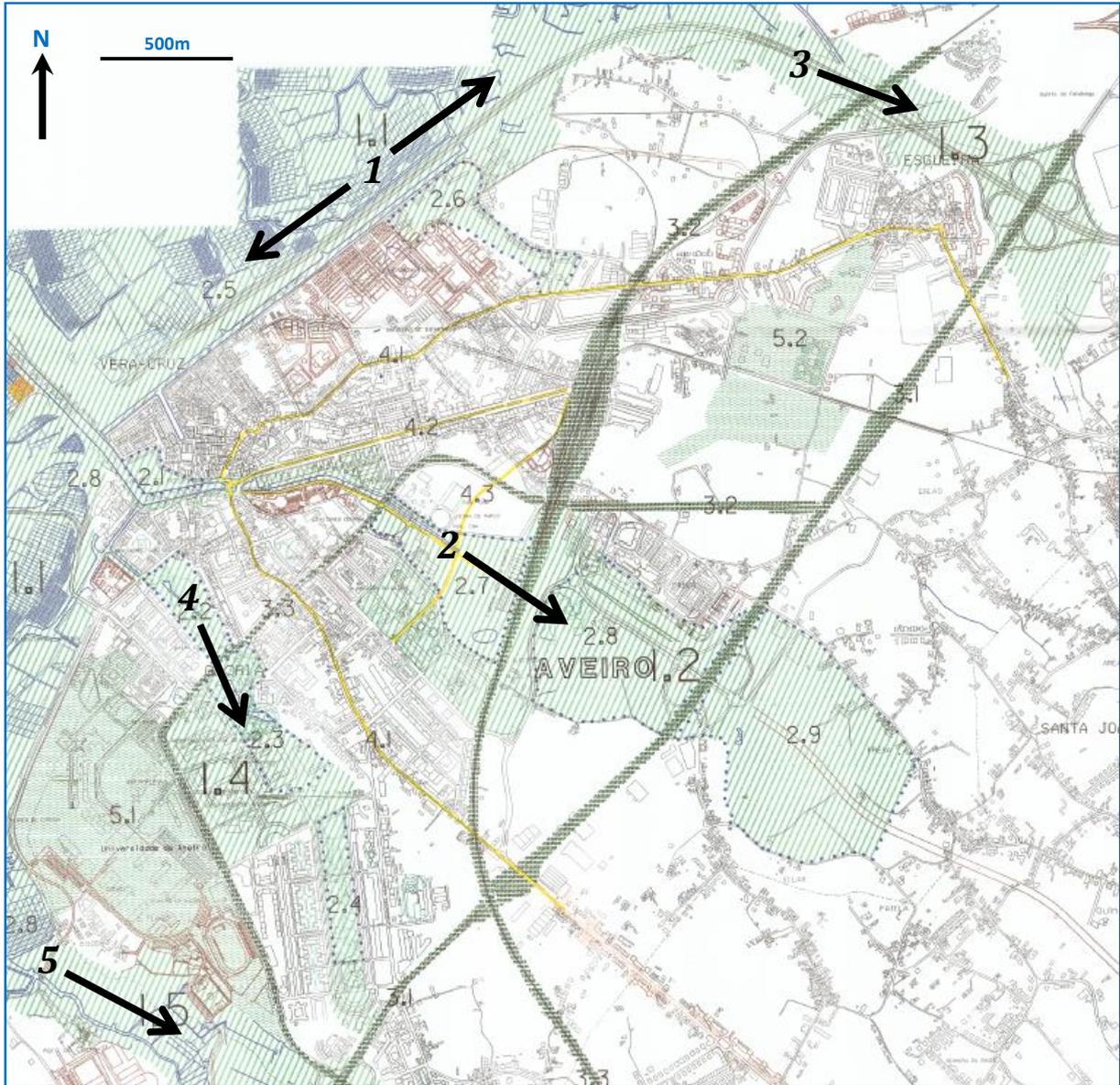
Figure 2 Portugal case study area: the city of Aveiro (Google maps, 2012).



The study area comprises the urban/urbanizing area of the city of Aveiro, with a surface area of about 15 km² and a population of 26,078 inhabitants in 2009 (INE, 2012; see Figure 2). Aveiro has had numerous floods over the last 100 years, caused by high water levels in the Ria de Aveiro and/or large river flows. Floods in Aveiro occur mostly during storms with heavy rainfall events affecting, in particular, the old city center which is of high historical, cultural and touristic value (MiSRaR, 2010).

In 1985 a hydraulic security system was implemented to protect Aveiro from inundations, including seven floodgates and one canal lock (MiSRaR, 2012). In response to a rise in water levels in the Ria de Aveiro, the gates were raised with 0.40 meters in 2001. In addition, a command and monitoring center was implemented in 2009, as to coordinate the operation of gates in correspondence with tidal, wind and meteorological conditions. Hence, when heavy rains are forecasted the low tides are used to empty the channel system to a minimum water level of 0.66 meter and, in turn, the channel system is used as a retention basin. Finally, the highway to the north of Aveiro (built in 1995) acts as a semi-closed barrier between Aveiro city and the Ria de Aveiro in case of high water levels.

Figure 3 The Aveiro 5-Finger Plan (Municipality of Aveiro, 1997).



In anticipation of the European Floods Directive (2007/60/EC), the municipality of Aveiro developed a '5-Finger Plan' with the aim to increase the green/blue spaces in the city. The plan envisaged the preservation/rehabilitation of five green/blue strips ('Fingers') and was included in the 1997 urban development plan (Figure 3). Due to the lack of financial resources as well as urbanization pressure, only one green/blue strip got fully implemented (Finger-4) while for the other four green/blue strips only 'islands' were created.

In the 2009 urban plan for Aveiro, the 'Finger Plan' was re-introduced – now containing the remaining four fingers (Fingers 1, 2, 3 and 5). Finger-2 is considered of key importance for flood control, recreation, tourism and cultural activities (Polis, 2004), as the area forms part of a 8 km² catchment area (generating peak flows during storm events), is at the centre of major residential areas (e.g. Beira Mar, Barrocas, Forca, Bairro do Liceu and Forum) and is close to the historic city center (750m). The development of an urban green/blue park as part of Finger-2 is, therefore, expected to reduce flood risks in Aveiro as well as to provide additional social, environmental and economic benefits (Polis, 2004).

Objective

As identified in the Polis Urbanization Plan (Polis, 2004), the Finger-2 plan comprises various green/blue space components – including: the Còjo canal, the Fonte Nova canal, the Fonte Nova lake, the Jerónimo Campos park and the Forca Vouga park. The objective of this Finger-2 case study is to assess what combination of green/blue space preservation/rehabilitation components best conciliates urbanization needs/preferences and flood/storm-water control.

Outputs

It is expected the DST will provide spatially explicit information on:

- The (added) value of green/blue space preservation/rehabilitation scenarios, in terms of household welfare, property values (halo-effect) and flood control (expert-based).
- The preferred locations and types of urban development needed to house the existing/growing population, for each of the green/blue space preservation/rehabilitation scenarios.
- Cost-benefit indicators for each of the green/blue space preservation/rehabilitation scenarios (e.g. based on investment and maintenance costs, property values, recreation values and flood mitigation benefits).
- The (added) value of green/blue space as compared to urban space (these values will highly depend on available green/blue and urban space – provides information to the definition of best practices).

The above mentioned information for each of the scenarios should, preferably, be provided in the form of tables, graphs and/or maps, as to inform resource managers, urban/rural planners and other relevant stakeholders in the planning, design and management of urban green/blue space.