

## 1. INTRODUCTION

One of the most important aspects in the development of the modern world is the rapid movement of people from rural places to urban centres. In Europe much of the population live in cities and towns and these areas have a strong influence on the national achievement of the objectives of sustainability. The environment of urban areas extends far beyond their boundaries; in the context of rivers, these are modified to meet the needs of the urban population and often act as conduits for waste waters.

Rivers in rural, urban and sub-urban settings are complex, multi-functional ecosystems that have developed their own self-sustaining balance. Modification of a particular function over another may cause an imbalance that if it persists, eventually leads to degradation of the aquatic environment and ecology. Historically, development of watercourses has been undertaken for a variety of reasons such as water supply, navigation or flood control. Across Europe there are wide variations in the way in which rivers have been modified depending upon the needs of their adjacent communities. In Southern Europe where water resources issues dominate, rivers have had their flow regimes altered to provide sufficient water supply, for example by the construction of dams. In Eastern Europe, where rapid unchecked development, industrialisation and infrastructure building has taken precedence over protection of natural systems, watercourses suffer from severe chemical contamination, and poor water quality. In Western Europe, many watercourses have been heavily engineered to defend against flooding and provide transport infrastructure.

In the past urban watercourses have been confined to narrow river corridors with the channels canalised and concrete and other man-made materials forming the bed and banks of the river. Many urban streams have been converted into closed conduit sewers, and now receive both storm drainage and raw or dilute sewage from the surrounding area. The pollutant loading also frequently leads to poor water quality, indeed this adverse impact of urbanisation often extends to the watercourse downstream of the urban area. The result is that many urban watercourses have virtually no aesthetic or amenity value, support a limited range of ecosystems, and do not meet the water quality objectives prescribed by the EC Water Framework Directive (WFD).

Modification of watercourses is recognised in European legislation through the Water Framework Directive, which defines a "*heavily modified water body*" as a "*body of surface water, which as a result of physical alterations by human activity is substantially changed in character*". The WFD provides the basis for long-term, sustainable development, enhancement and planning of European rivers with an emphasis on natural ecosystems, and intrinsic wildlife value. Within the WFD there is a requirement that all EC members' states should "*protect, enhance and restore all bodies of surface water with the aim of achieving good surface water status*". Thus within the constraints of the urban environment heavily

modified water bodies should be subject to environmental enhancements such as rehabilitation or enhancement of river corridors. This rehabilitation can then contribute to meeting the expectations of the urban citizens to improve the quality of urban life, and comply with the WFD legislation.

In seeking to rehabilitate urban rivers and watercourses it is important to draw the distinction between rehabilitation and restoration. Rehabilitation seeks to improve the state of the river in terms of physical characteristics, chemical quality, ecological diversity and aesthetic appearance, whereas restoration is directed at recreating the pristine physical, chemical and ecological state. Rehabilitation is a realistic objective in many urban areas, leading to broader social and economic benefits to the community, but in most cases true restoration is not a practical option. Thus there is a need to consider methods and criteria to enhance the overall quality of urban rivers within a multi-functional perspective.

The URBEM project will provide new tools, techniques and procedures to enhance watercourses located in urban areas. These tools should provide enough scope to cover the differing, multi-functional uses of urban watercourses and their adjacent communities across Europe. One of the specific technical and scientific objectives of the URBEM research project is "*to develop innovative urban watercourse rehabilitation techniques for use in future schemes*". This objective is covered by **Work package 8 - New techniques for urban river rehabilitation**.

The URBEM project will also provide a global rehabilitation framework strategy because urban streams rehabilitation not only depends on local intervention but considering the upstream flows. A main reason is that a lot of historical cities in Europe have expanded around large rivers and their surrounding river hydrographic network. The actual suburban area contributes in some cases for a great part to the impairment of strictly urban rivers. However there are some more free space to rehabilitate suburban rivers and streams using "green buffers" and sustainable urban drainage systems.

URBEM will investigate new techniques and materials for incorporation into urban river systems in order to enhance the visual and ecological value. Due to differences between rural and urban areas presently developed rehabilitation techniques for rural areas may not be suitable, and thus new urban-specific techniques will be developed. In many restoration schemes to date attention has been confined only to the river channel itself. The approach of URBEM is based on the belief that the whole river corridor and its interactions with the urban environment are an integral part of the system (Gardiner, 1992).

Innovative techniques will be developed, which include, amongst others:

- Methods to naturalise the flow regime of a river;
- New materials and techniques;

- Method of incorporation of wetland, floodplains and sustainable urban drainage methods;
- Method to incorporate safety features into rehabilitation techniques.

The first work document to be prepared in WP8 deals with the **recommendations on how to naturalise flow regimes**.

In many urban rivers the flow regime has been altered by urbanisation. This means that the time and spatial flow patterns in the channel are different in character to how they were before urbanisation. Within the urban constraints it is important to investigate methods to return the flow regime towards its original or improved state within the particular physical constraints of the urban environment. This may involve encouraging the use of infiltration and retention or other forms of sustainable urban drainage. The URBEM project would investigate the best ways to incorporate such techniques into an urban environment in order to naturalise the flow regime of the river whilst improving runoff quality. The rehabilitation, or in a few cases the restoration, of the natural flow regime through the urban area may also lead to benefits in the river downstream.

Information from Work package 2, Existing case studies, will be used to investigate any current methods for re-naturalising watercourse flow.

The present Recommendations are divided into 5 Chapters, namely, Characterisation of flow regimes, Modifications of flow regimes in urban areas, Water Framework Directive and flow regimes, Procedures for re-naturalising flow regimes and **Recommendations on how to re-naturalise flow regimes**.