71. *Aqua-Riba* project: Sustainable Urban Water Cycle management systems in the integral regeneration plans for districts in Andalusia.

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Abstract After the deceleration of the processes of urban development that took place in the past decades, the main action taken by public policies within the field of architecture and urban planning in Andalusia has presently focused in the regeneration of the districts that were then raised without any sort of strategy with regards to Sustainability. Within this context, the RDI project *Sustainable Urban Water Cycle Management Systems in the Integral Regeneration Plans for Districts in Andalusia (Aqua-Riba)*, whose results are shown in the present article, has been developed.

The project arose as a tool to contextualize in the Andalusian territory the conceptual, methodological and instrumental approaches that would allow an effective incorporation of the eco-integrated and adaptive focus for the management of the Urban Water Cycle in architectural and urban-planning works developed in Andalusia. To this end, it reformulates the relationship between city, water and other resources (mainly land and energy), taking into account the ensemble of the socio-hydrological cycle and the integration of urban waters in the natural systems, including matters referred to efficiency and social cohesion such as citizen participation.

The most important result of the *Aqua-Riba* project is the *Guide for the Incorporation of Sustainable Urban Water Cycle Management Systems in the Integral Regeneration Plans for Districts in Andalusia* that is established as a key tool for such management. Its target groups are decision-makers and active agents within the processes of urban intervention as well as the social agents (associations and neighborhood communities and other social groups).

Keywords Urban water cycle, Eco-integrated management, Participation, District regeneration, Sustainable urban planning.

1 *Introduction*

During the past few decades, urban water supplies in Andalusia have made substantive progress. If we refer to sanitation and water treatment, the progress has been even more remarkable although the mismatches with regards to the established regulations are also more evident. Much has been done but much remains to be done because, with the accumulated technical, human, economic and social resources, the management of the Urban Water Cycle arises nowadays more ambitious goals in accordance with the challenges faced by the region: the growing pressure on resources, the greater quality demands, the growing need of supply assurance, greater efficiency and equity, the deterioration of obsolete infrastructures, the increase of the cost of service, the energy crisis and the climate change.

The point is that the Urban Water Cycle is, in several cases, still based on a conventional approach, with systems focused in huge investments, providing short-term benefits but devoid of sustainability and flexibility and that do require an intensive use of energy which affects its viability in the future. The impacts on water ecosystems to which depend upon –like the alteration of river systems, the overexploitation of aquifers or the deterioration of quality– are some of the effects caused by this model.

Facing this approach, the Directive 2000/60/EC, better known as the Water Framework Directive (WFD), has emerged as instigator of the change. The aim of the WFD is to safeguard surface, underground, coastal and transition water bodies, maintaining or restoring a good ecological status in all of them. Thus, with the entry into force of this directive, the management model, at least from a conceptual point of view, has been revised following sustainability criteria forcing the search of alternative measures to avoid the continuation of conventional approaches focused on the pressure on ecosystems.

To do this, the WFD adopts as its key idea the concept of *integration* that means the incorporation of different disciplines, approaches and experiences within the different decision levels and coordination between public administrations.

New water technologies also imply a fundamental support to move in that direction, prioritizing those investments aimed to reduce the demand and to integrate it with the supply. In combination with the protection of resources, natural water treatment techniques as well as the use of alternative resources, the new technological alternatives facilitate the protection and improvement of water resources, the reduction of service costs and of energy consumption, the flood control and the improvement of wastewater treatment.

From the *Aqua-Riba* project, this is what is meant when backing a rigorous use of the concept of *sustainability*, beyond the usual cosmetic instrumentalization of the term. It is possible and required to move forward *towards an eco-integrated and participative management model of the water that deals in a more effectively way to the challenges* of public health, security, economics, social cohesion and environment that the water management involves.

In view of the above considerations, it may be said that, currently and well into the 21st century, Andalusia has a powerful and advanced Urban Water Cycle management system[1] with technical, administrative and economic capacity to ensure the basic supply and sewerage needed for all the population in the region. All of this has been the result of a major joint effort, an important financial investment and the technical know-how collected over several generations. The point is that is necessary to continue the progress.

When talking about new alternatives and strategies, we are referring to facing up the new social demands and challenges of quality and efficiency, as well as to mitigate and correct the territorial and environmental costs, specially on aquatic systems and water landscapes, produced in former times.

To achieve all this, it is a priority to rely on methodological and instrumental tools that may be used by professionals in order to be able to intervene on the architectural and urban heritage and, thus, enhancing a gradual transformation towards an integrated and sustainable management of water and moving forward towards the formulation of similar regulations to those related to energy efficiency in buildings with the aim of, also, controlling their water efficiency (European Commission 2012).

The originality of this eco-integrated and participative approach that arises consists in inserting its proposals within the general evaluation of the Water Urban Cycle, including all the elements that take part of the water in the city: supply, sewerage, treatment, rainwater, hydrographic network on which the city is settled, drainage, runoffs, reclaimed water, gray water recirculation processes, underground waters, prices, fee structures or landscapes and open spaces linked to water. To this, the active incorporation of the social agents involved within a participative process of diagnosis, target identification, evaluation criteria and indicators as well as decision-making must be added.

Therefore, the proposal of the *Aqua-Riba* project emerges from the vocation of incorporating the Urban Water Cycle as an element of the urban project on the whole (dwelling, transportation, energy, public space, etc.) and has, among its goals, to provide the social agents with the required tools in order to their acknowledgement as trained agents in the environmental management of their habitat.

[1] Over more than a century, the Spanish society and the Andalusian as well have done a great effort to bring water to all the citizens. Initially, the priority was to supply households with enough quantity and quality of water; then, the sewerage and sanitation; later on, sewage treatment. This process was not linear, but was characterized by major territorial and social differences: certain cities, or some of their suburbs, already had a complete cycle in good condition while other territories or social sectors had not solved the issue of drinking water yet.

2 Objectives

The *primary goal* of the *Aqua-Riba* Project[2] consists in the creation of a tool in order to contextualize in the Andalusian region the conceptual, methodological and instrumental approaches that may allow an effective incorporation of the eco-integrated and adaptive focus of the Urban Water Cycle management in future architectural and urban renovation projects in Andalusia.

This goal is materialized in the development of the *Guide for the incorporation of the sustainable management of water in urban areas. Implementation for the renovation of neighborhoods in Andalusia*, whose main target is, in turn, to constitute itself in a tool for the integration of a set of practical and operational strategies within the processes of urban intervention, aimed to better the management of the Urban Water Cycle in the neighborhoods of this region. This Guide deals with the Urban Water Cycle as a whole, incorporating all those aspects referred to itself, without specializing specifically in any of them, while contributing the required information to deepen in each of them according to the different needs of its users.

It is not a compilation of simple solutions for specific management problems but its content intended to help the user to reformulate the relationship between city, water and other resources (mainly land and energy) and redefine the ways in which these relations can be approached to. This type of eco-integrated and participative management of the Urban Water Cycle that is proposed not only includes the supply of drinking water, its distribution to households and its proper discharge –something that is a lot– but also contemplates and integrates all the *water* phenomenon within the urban space, considering the whole of the socio-hydrological cycle and the integration of the urban waters in the natural systems, without forgetting issues referred to efficiency and social cohesion, as citizen participation.

The Guide also contains a methodological proposal for the architectural and urban planning and design that may facilitate the incorporation of the sustainable management of the water cycle in the inhabited spaces of Andalusia and is, therefore, conceived as a tool to be used by those decision-makers and active agents of urban intervention processes including policy-makers, technicians and management companies as well as social agents (associations and neighborhood communities and other social groups) to whose training as qualified agents on the sustainable management of their habitat it is meant to contribute.

The achievement of this general goal has allowed, furthermore, to develop a set of *operational goals*:

- To deepen in the specificity of the relationships between City-Water-Territory within the Mediterranean region and specifically in Andalusia, characterizing

[2] RDI Project *Sustainable Urban Water Cycle Management Systems in the Integral Regeneration Plans for Districts in Andalusia (Aqua-Riba)*, concerning the scope of the Consejería de Fomento y Vivienda de la Junta de Andalucía (Department of Development and Dwelling of the Regional Government of Andalusia), developed between 2013-2015 by a team led by the University of Seville.

our region on the basis of the climatic, hydrological, cultural, technological and socio-economic conditions which determine the strategies related to the integral management of the Urban Water Cycle (UWC).

- To identify and characterize any problems and notable issues in relation to the management of the Urban Water Cycle to which the Urban Restoration and Renovation Programs of the Department for Development and Dwelling are confronted to and, specifically, in the maintenance and management of the housing stock owned by the Agency for Dwellings and Renovation of Andalusia (AVRA).
- To select the most appropriate technologies for the materialization of adaptive and sustainable management strategies of the Urban Water Cycle in Andalusia, analyzing the viability of its incorporation within the restoration and renovation projects of neighborhoods and buildings.
- To identify and evaluate the different factors of socio-economic and institutional character that condition (hindering or facilitating) the formulation and application of these options, strategies and technologies.

3 Methods

As a starting point, in the *Aqua-Riba* project, a deep review of the last contributions was carried out in relation to three key aspects of the urban planning processes:

- The *urban sustainability*, a field in which, among the most interesting research works that analyze the methodology proposals, the European project *Eco-City* (Velázquez *et al* 2008) stands out dealing with the intervention in the city based on the incorporation of the aspects referred to the urban structure, the metabolic flows, the urban ecosystems and the socio-economic and cultural context.
- The *strategic planning for the integral management of the Urban Water Cycle*, a subject in which three European projects stand out, led by a powerful group of researchers and which have been consecutively developed: the *WaND/Water for New Developments* project (Butler *et al* 2010), the *SWITCH/Sustainable Water Management Improves Tomorrow's Cities' Health* project (2006-2011) and the *TRUST/Transitions to the Urban Water Services of Tomorrow* project (Phillip et al 2011).
- The *renovation of neighborhoods from the perspective of sustainability and participation*, with some interesting examples as the research project *rEactúa. Methodology for the energy refurbishment of residential blocks* (Lapanadería 2010) and the renovation projects of the Trinitat Nova neighborhood in Barcelona (Gea 21 2004), which assigns a prominent role to water with a general focus on urban sustainability and, at international level, the *Ekostanden Augustenborg* project (Sweden), an experience with an important social

component focused on the transformation of the traditional urban sewer system from an eco-integrated perspective.

One of the outcomes of the comprehensive analysis of the previous material that settled the status of the issue carried out by the *Aqua-Riba* project was the development of a set of 85 datasheets in which a series of basic tools was systematized for the implementation of proceedings (research programs and projects conclusions, decision support systems and new water management technologies).

Furthermore, the identification of this frame of reference provided the foundations on which to base the methodology proposal that has been tested with the case study of the urban space renovation in Las Huertas neighborhood in Seville (Spain).

To develop all this, the research has relied on a multi-disciplinary task team (architects, engineers, sociologists, ecologists and geographers).

4 Presentation of Results

The main outcome of the *Aqua-Riba* research project finally materialized in the *Guide for the incorporation of the sustainable water management in urban areas. Implementation to the renovation of neighborhoods in Andalusia* (see Fig.1) which contains, in turn, the different contributions that had been gradually obtained throughout its development.

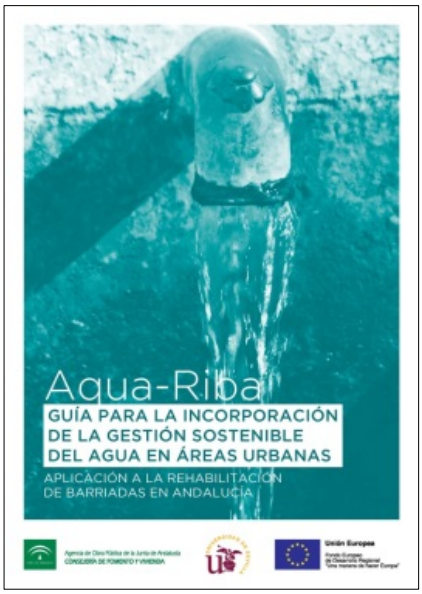

Fig.1 Cover of the Guide (Source: *Aqua-Riba* Project 2013-2015)

4.1 The Structure of the Aqua-Riba Guide

The *Aqua-Riba* Guide is structured in *a series of 6 chapters* as listed below:

- Chapter 1. Presentation of the Guide.
- Chapter 2. Sustainability and management of the Urban Water Cycle. The Andalusian case.
- Chapter 3. Methodology proposed.
- Chapter 4. Incorporation of the social agents.
- Chapter 5. Intervention strategies.
- Chapter 6. Decision support systems.

The first chapter contains the *Presentation* which describes the goals, the final beneficiaries and the structure of the Guide. The second one (*Sustainability and management of the urban water cycle. The Andalusian case*) is devoted to expose, with greater specificity, the situation of the Urban Water Cycle in Andalusia, its main components, strengths and weaknesses. In this same chapter, the principles in which the alternative model of the proposed management is based on, its characteristics and goals are exposed with greater detail. Thirdly, it is presented in a unitary manner the *Methodology proposed* for the implementation of the alternatives in which the eco-integrated strategy is materialized, closely related to the content of the following chapter (*Incorporation of the social agents*), that responds to the participative character of this strategy. Next, in chapters 5 and 6, the *Intervention strategies: Technologies* and *Decision Support Systems* are presented, in reference to supply, water-energy relationships, rainwater and water treatment.

The Guide is also complemented with a long series of Annexes in which the specific results of the different phases of the research developed in the *Aqua-Riba* project are synthesized:

- From the comprehensive analysis of the *status of the matter*, it resulted in a *set of 85 datasheets* (Annexes 4, 5 and 6 of the Guide) in which is synthesized an important volume of information, homogeneously structured and systematized about*:*
  - *Basic tools for the implementation of actions*: contents and sources arising from research programs and projects and decision support systems.
  - *New technologies for water management*, which include supply, the water-energy duality, rainwater and wastewater.
  - A set of illustrative actions of *examples of good practices* in the management of the Urban Water Cycle at the national and international level.
- *Socio-institutional framework of the Urban Water Cycle in Andalusia*, where the existing regulation is organized and commented according to competence and thematic areas and that defines the roles, rights, obligations and functions of the social agents that participate in these procedures.
- *Urban Water Cycle in Andalusia. Information Sources*. In the different sections of this document, those physical and socio-institutional factors that de-

fine the management of the Urban Water Cycle in Andalusia are summarized, facilitating, moreover, the access to the main information sources for that matter.

- *Implementation of the case study: Neighborhood of Las Huertas (Seville) 2014-2015*. This section includes the main documents where it is summarized the work developed in the case study of the *Aqua-Riba* project, whose main goal was the implementation and testing of the methodology proposed as well as the contextualization for the renovation processes of the proposed interventions to be developed within the Andalusian territory. Documents in reference to the characterization and diagnosis of the neighborhood, to the active participation processes developed with the social agents as well as to the planned intervention proposals and the future scenarios analyzed are included.

Although hereunder it is insisted on the aspects related to the innovative approach of the Guide and of its methodology proposal, it is outlined the great interest of other main aspects also developed in it, such as the incorporation of the social agents, the development of the intervention strategies or the development of the case study in the neighborhood of Las Huertas, some of which have been analyzed and detailed in other publications.

4.2 The eco-integrated and participative approach of the Aqua-Riba Guide

As mentioned, in spite of the positive evolution in quite a few aspects with regards to supply and sewerage in Andalusia, on the whole, the current model presents the characteristics of what in international bibliography is known as the *conventional approach* for management, characterized by fragmentation, lineal approaches, short-term solutions, lack of flexibility and an intensive use of energy.

Facing that model, the *new eco-integrated and participative model* for the management of the Urban Water Cycle (UWC) offers a new perspective and requires a reevaluation of current approaches and –when necessary– the implementation of fundamental changes. Instead of solving problems throughout costly investments, which are regarded as unquestionable, designed to the expansion of existing infrastructures and the end-of-process technologies, this approach is characterized by the strengthening of the following features:

- Contextualization of the urban cycle in a clearer and deeper way within the framework of the aquatic ecosystems on which it depends for the procurement of resources and for the discharge of effluents.
- Reinforcement of the principle, currently well-established, of joint management of the different phases of supply (catchment, water purification and distribution) and sanitation (sewage, treatment, discharge), adding also a closer

attention to the integration of rainwater, runoff processes, drainage network, public spaces, vegetation, infiltration and groundwater.

- Consideration of all the components of the Urban Water Cycle as parts of a system and emphasis on the fact that all administrations and institutions concerned should get involved in ensuring that that integration is achieved.
- Substitution, as a result of this reinforced integration, of the incoming and outgoing lineal designs of the system for circular running, where reutilization and recirculation that will reduce all incoming and outgoing to that same system are present (see Fig.2).
- Preference for innovative and flexible technologies, selected on the basis of an integral evaluation of the water cycle and of a long-term sustainability of the system as a whole.
- Strengthening of the integration of the water and energy cycles (capture of renewable energies, reduction of energy consumption, capture of CO_2).
- Integration of efficiency and cost responsibility criteria in the management of the cycle, combined with values of solidarity and equity.
- Implementation of new ways of public participation that may guarantee an effective and proactive transparency and citizen participation, as established in the European Directive 2003/35/, of May 26th, transposed to the Spanish legislation under the Ley 27/2006, of July 18th, regulatory of the "rights of access to information, to public participation and of access to justice in environmental matters".
- Adaptation of the set of the above strategies to the conditions of the physical and social context of the field of work.

Fig.2 Metabolic flows in the planning (Source: *Ecocity* Project 2002-2005)

4.3 Methodological proposal of the AquaRiba Guide

According to the principles stated here, the Guide defines a methodological framework for the incorporation of the eco-integrated and participated approach of the Urban Water Cycle (UWC) in architectural and urban renovation projects.

It is required to signify that, although the described process is specifically focused on matters referred to the UWC, it is understood this aspect as part of the integral intervention processes in urban areas in which water management is one more of the sectorial domains to be treated, necessarily, in relation to other meta-

bolic flows (energy, materials, waste, etc.) and to other aspects of the urban reality such as mobility, public space, equipment and socioeconomic and institutional aspects.

The methodological proposal responds to a 6-phase structured process as found in Figure 3. In this scheme, the expected results in each and every of the described work phases are defined, as well as a series of working sessions with the social agents, allowing their participation throughout the development of the intervention.

The methodology proposed for an urban intervention starts from two fundamental premises:

- The importance of incorporating, from the beginning, the greatest possible number of key actors within the process with the understanding, beyond the already conventional expression of this idea, that with its real implementation new energies will be generated –new social capitals– and the relationships between the social actors will be modified within the specific work scale.
- The understanding of the interventions within the urban space as continuous processes in which the iterative evaluation, collectively participated, of the implemented actions is used to correct the established strategies.

Fig.3 Phase scheme of the methodological proposal (Source: *Aqua-Riba* Project 2013-2015)

5 *Conclusions*

At large, the *Aqua-Riba* research project has given answer to the goals established in its initial approach. Following, a highlight of *its most innovative aspects*:

- The research proposal presented entails, as a whole, an innovative exercise since in Andalusia does not exist any methodological tools that facilitate the *incorporation of the Urban Water Cycle to the processes of urban intervention from an eco-integrated and participated perspective*.
- As it has been indicated above, the uniqueness of the eco-integrated approach consists in inserting its proposals in the general evaluation of the Urban Water Cycle, *including all the elements that form part of the water in the city*: supply, sewage, treatment, rainwater, hydrographic network on which the city is settled, drainage, runoffs, reclaimed water, gray water recirculation processes, groundwater, prices, fee structures or landscape and open spaces linked to water.
- The compatibility between the *ecological function of the water cycle* and the *satisfaction of social needs within the inhabited space* with regards to this resource thus becomes the cornerstone of this research. The incorporation of *innovative and flexible technologies* for the management of the Urban Water Cycle will allow the decentralization of an important part of these processes, will reduce its environmental burdens, will increase its resilience and will better its capacity of adaptive management face to hydrological risks.
- The project, thus, becomes pioneer in the *systematization of technological and construction solutions* that, with a comprehensive understanding of the hydrological cycles, will better the efficiency of its management in the design and configuration of the inhabited spaces. An example of these technologies are the Sustainable Urban Drainage Systems (SUDS), the rainwater collection systems or the soft technologies for treatment and reuse of gray water.
- Another innovative aspect to consider is that the research is focused on *renovation projects*, something that constitutes a new challenge needed in the current context of city production.
- Finally, it is also raised the *incorporation of the participation processes of social agents* both in preliminary phases of diagnosis as in the adoption of criteria for the valuation of existing technological alternatives. The successful completion of the case study in the neighborhood of Las Huertas has confirmed the suitability of the starting premises carried out in the methodological proposal allowing to better and concretize it.

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Agradecimientos

Acknowledgments The authors would like to thank the financial support by the European Union ERDF funds to the project *Sustainable Management Systems of the Urban Water Cycle in the Integral Renovation of Neighborhoods in Andalusia (Aqua-Riba)*.
Furthermore, they also thank the commitment and professionalism of the Personnel of the Public Works Agency and the Department of Development of the Andalusian Regional Executive, to the neighbors, retailers, professionals and the Neighbors Association Félix Rodríguez de la Fuente of the neighborhood of Las Huertas (Seville), to the managers and technicians of the Housing and Renovation Agency of Andalusia (AVRA, Provincial Office of Seville), to the Education Community and the Parents Association of the Baltasar de Alcázar School (Seville), to the administrator of Real State of the neighborhood of Las Huertas, Javier Carmona, to Santiago Barber, to the Department of Water Resources and Environmental Engineering, School of Civil Engineering, National Technical University of Athens: Christos Makropoulos and Evangelos Rozo, as well as to the researchers of the University of Seville: María C. Villarín Clavería, Mónica Alba, Violeta Cabello, Enrique Figueroa, Natalia Limones and Miguel Toro.