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# SOLUTIONS for present and future **emerging pollutants** in land and **water resources** management

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## Introduction

Monitoring programs under the Water Framework Directive -WFD- have accumulated vast amounts of data on contamination and on the ecological status of surface waters in the EU. At the same time, a wealth of chemical property and emission data from registration of chemicals (e.g. REACH) is becoming available. Although toxic effects on aquatic life are frequently observed, it remains a great challenge to link occurrence of chemicals with the ecological status of waters, to identify major chemical stressors, and to find solutions for the abatement of pollution-related risks.

Typically, complex mixtures of priority pollutants, emerging substances, by- and transformation products, and natural compounds occur in aquatic systems. The sheer number of potentially harmful chemicals challenges chemical monitoring, and consequently there is the danger that adverse impacts on aquatic communities and human health from unknown or unexpected chemicals and mixtures remain unrecognised.

Substances of emerging concern include a multitude of polar and even ionic compounds for which many of the classical analytical tools and predictive models do not apply. These substances and mixtures thereof may affect a multitude of toxicity pathways in organisms, populations, and communities.

An applicable conceptual framework and harmonized sensitive bioanalytical tools are lacking to cover these pathways in monitoring. Chemical analytical tools with analytical detection limits below the predicted no-effect-levels (PNEC) of target compounds are often lacking as well. While there is increasing knowledge on the production and use of chemicals, there is a lack of understanding regarding sources, transport pathways, transfer times, fate, and mixture effects, together with insufficiently developed modelling capacity to reliably predict risks to ecosystems and human health.

Monitoring, modelling and assessment of chemicals in European water resources are further challenged by the co-existence of the vast number of daily used pesticides and biocides, personal care products, pharmaceuticals, and additives to food, textiles and plastics with legacy chemicals whose production and use are forbidden since decades. Being often very persistent the latter are stored as parent compounds or metabolites in sediments and still contribute to risks. However, it is not only present and historical contamination. Production and use of chemicals are highly dynamic and prioritization and assessment tools developed today should also help to predict and address upcoming chemical risks.



## Chemical pollution

While concentrations of so-called Priority Pollutants and classical Persistent Organic Pollutants (POPs) are declining there are strong indications that the complex mixture of the numerous emerging pollutants including pesticides, biocides, personal care products, pharmaceuticals, additives to food and plastics and many more pose a risk to aquatic ecosystems and human health.

**SOLUTIONS** addresses major gaps in assessing emerging pollutants including:

- detection at very low concentration
- toxicant identification
- fate prediction
- European scale exposure prediction
- scenarios for pollution of the future
- abatement options



## Water quality

Despite significant management efforts addressing habitat quality the good ecological status of European surface waters as required by the Water Framework Directive is not achieved in most European water bodies. Sensitive species are declining and important ecosystems goods and services are endangered.

**SOLUTIONS** provides innovative approaches for assessing effects of emerging pollutants on the status of water resources including:

- effect-based monitoring
- ecological assessment
- toxicity prediction
- mixture effect prediction
- ecological and human risk modelling

## Objectives

The overall goal of the FP7 Integrated Project SOLUTIONS is to produce consistent solutions for the large number of legacy, present and future chemicals posing a risk to European water resources with respect to ecosystems and human health. To this end, SOLUTIONS

- develops a consistent conceptual framework for the assessment, prioritization and abatement of pollutants and mixtures thereof to protect European water resources and to minimize ecological and human health risks.
- delivers efficient tools for the identification of substances and mixtures posing risks by developing a new generation of monitoring approaches and tools for the early detection and identification of harmful substances. At the same time SOLUTIONS provides improved understanding and capacity for exposure, effect and risk modelling compiling a full chain of conceptually integrated models and databases accessible via a user-friendly computer tool to support decisions in environmental and water policies.
- demonstrates the added value of the new generation of tools in trans-European case studies in the Danube, Rhine, and rivers of the Iberian peninsula with links to existing monitoring programs such as the Joint Danube Survey.

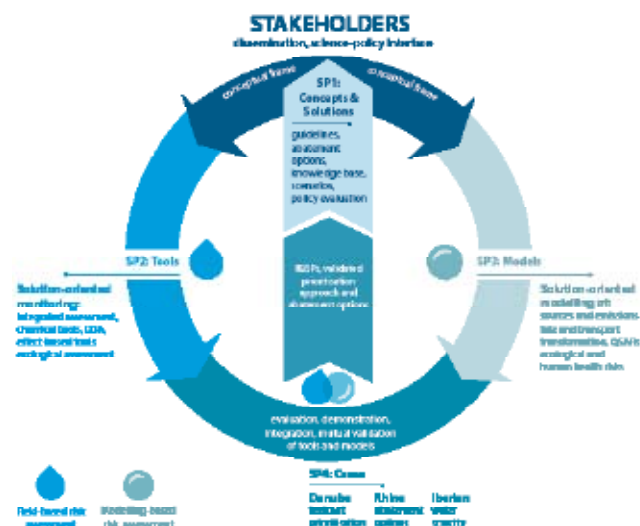
A specific focus of SOLUTIONS is on user-friendly products exploiting innovative science to provide solutions for water resources and chemicals management. To meet this objective we

- synthesize the new approaches, condense them into user-friendly guidelines, computer tools and recommendations for direct support of the implementation of WFD.
- evaluate potential opportunities and obstacles for cooperation between the WFD and other existing policies (e.g. REACH).
- assess abatement options and control measures for emerging pollutants in waste and drinking water treatment for effective risk reduction.
- deliver a common knowledge base on a wide range of toxicants, an evidence-based compilation of substances with emissions that might require regulation, and comprehensive lists of River Basin Specific Pollutants -RBSPs- for the case study in the Danube river basin as a result of the integrated application of the new generation of monitoring and modelling tools.
- identify upcoming risks by emerging pollutants of the future on the basis of scenarios on economic development, technology, demography, climate change and others.

## Approach

SOLUTIONS is structured into 4 highly integrated sub-projects resulting in the workflow illustrated below. Subproject SP1 on **Concepts & Solutions** provides the conceptual framework for the entire project, defines the anticipated products, and organizes the dialogue with stakeholders in order to make sure that we provide solutions for major problems on emerg-

ing chemicals and water resources management. SP1 guides and fully relies on the sub-projects **SP2 on Tools**, **SP3 on Models**, and **SP4 on Cases** which develop most of the underlying tools, models and data that are integrated and digested into solutions for major problems.



## Case Studies

Models and tools developed in SOLUTIONS will be applied, demonstrated and mutually validated in three river basin scale case studies with different focus. In the Case Study Danube a novel integrated approach for the identification of river basin specific pollutants is being developed combining effect-based and chemical monitoring tools with exposure and effect modeling. The initial quality evaluation will be based on the Joint Danube Survey 3 ([http://www.dan-](http://www.dan-ub survey.org)

[ub survey.org](http://www.dan-ub survey.org)), an extensive sampling campaign from the upper course in Germany to the Danube delta in Romania and Ukraine in August and September 2013. The case study Rhine focuses on the evaluation of the influence of upgrading of wastewater treatment plants and innovative drinking water treatment technology on ecosystems and human health. Compound prioritization under water scarcity conditions is addressed by Case Study Ebro and Llobregat.

### Case Study Rhine

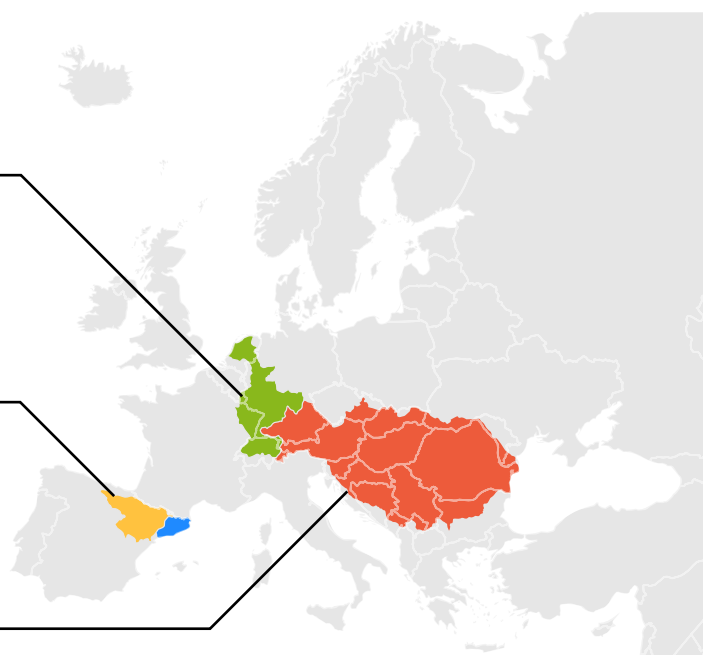
Focus: Abatement options in waste- and drinking water management

### Case Study Ebro and Llobregat

Focus: Risk assessment under water scarcity

### Case Study Danube

Focus: Identification of River Basin Specific Pollutants



## Project Facts

Project Type	Collaborative Project
Full title	Solutions for present and future emerging pollutants in land and water resources management
Acronym	SOLUTIONS
Programme	7th Framework Programme for Research and Technological Development of the European Commission
Grant agreement no.	603437
Start	October 1st, 2013
End	September 30th, 2018
Website	<a href="http://www.solutions-project.eu">www.solutions-project.eu</a>
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Consortium	39 Organisations (Research Institutes, Enterprises and Universities) from 17 countries