



## Hydromorphology of European rivers: consideration of processes, impacts of regulation, and benefits of restoration

REFORM – Restoring rivers for effective catchment management  
REFORM will provide tools and procedures to increase the success and cost-effectiveness of river restoration measures and to monitor the biological responses to hydromorphological changes with greater precision and sensitivity.

### Policy focus

The main aim of REFORM is to support river basin managers in preparing the next River Basin Management Plans (RBMPs) by providing timely, state-of-the-art knowledge on hydromorphology, the interaction with ecology, the ecosystem services of stream, river, and floodplain ecosystems, and wider environmental aspects.

### Key policy milestones requiring technical & scientific support

- The **Water Framework Directive** (WFD) requires the preparation of RBMPs every six years (2009, 2015, 2021 and 2027). During the drafting of the 1<sup>st</sup> RBMPs, an urgent need for a better understanding of the linkages between ecology and hydromorphology and the role of hydromorphology on the ecological status of rivers was identified. A better understanding of these ecological linkages and processes will help to provide more reliable predictions and improved assessment of potential effectiveness of measures in achieving the WFD ecological objectives. Also, the process of improving restoration measures based on monitoring results is challenging, particularly in the case of complex multi-stressor situations and for hydromorphological restoration and mitigation.
- The **Floods Directive** requires the preparation of flood risk management plans (2015 and 2021). In the planning of flood protection measures, restoration measures (e.g., water retention in tributaries, rehabilitation of river banks) may potentially play a significant role in lowering flood risks.
- The next reporting on conservation status and progress of implementation for the **Birds** and **Habitats Directives** will cover the period 2013-2018. Restoration measures can play a significant role in the achievement of biodiversity protection objectives for specific habitats and species.

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The following proposed actions of the **Blueprint** to safeguard Europe's water resources can benefit from the scientific results of REFORM: Guidance on Natural Water Retention Measures (Green Infrastructure); Guidance on ecological flow; Continuation of work on science-policy interface.

### Key REFORM outputs in support of policy milestones (Nov '11 – Feb '13)

This policy brief concentrates on the policy relevance of the first deliverables of REFORM produced in the period of November 2011 to February 2013.

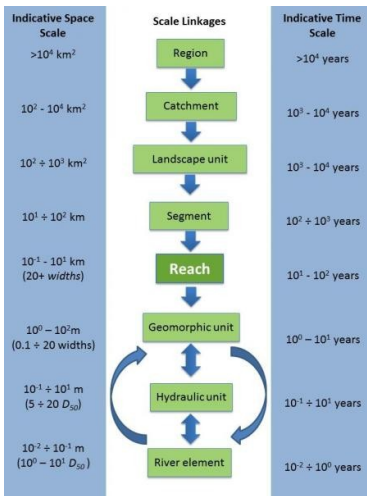
- *D1.1 "Review on eco-hydromorphological methods"* contributes to a better understanding of how to improve hydromorphological assessments of rivers and streams. D1.1 compares existing methods, including those used by EU Member States for the WFD implementation, identifies gaps in the applicability of methods, and recommends how to improve hydromorphological assessments.
- *D1.3 "Review on ecological responses to hydromorphological degradation and restoration"* focuses specifically on the linkages between hydromorphological variables that influence ecological status and functioning and on the tolerance thresholds of species. In addition, the effects of different pressures on hydromorphology have been analysed in the 1<sup>st</sup> RBMPs and Programmes of Measures (PoMs), identifying gaps in the knowledge and application of restoration measures and in their predicted ecological improvements.
- *D2.1 "Multi-scale framework and indicators of hydromorphological processes and forms"* develops a process-based European framework for investigating hydromorphology. It also develops and tests indicators/models of hydromorphological processes applicable to the assessment of reference hydromorphological river and floodplain conditions across Europe and identifies linkages between hydrology and biota and between biota and morphology. This work builds on existing WFD typologies and hydromorphological and ecological datasets and methods.
- *D7.2 "REFORM Geo-WIKI"* provides online access to the main tools and applications developed in the project, as well as an online portal for an interactive knowledge and information system on river restoration.

### Key conclusions and recommendations

- The review of **hydromorphological assessment methods** indicates that in most EU Member States, the consideration of physical processes remains the main gap in such assessments. The integrated use of different components of the assessment is limited but is recently increasing. There is a need for more comprehensive hydromorphological assessments and physical processes should be better considered in the relevant methods. The core of hydromorphological evaluation should be represented by the morphological and hydrological components. Physical, riparian, and longitudinal fish continuity assessments should provide a further characterisation of the overall stream condi-



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tions at selected sites.

- Despite the need for more comprehensive hydromorphological analyses, it is clear that the application of more methods and components of an overall hydromorphological assessment requires many resources. Thus, there is an increasing need for **initial screening tools**, which should be able to make a first characterisation and selection of potential critical reaches at catchment scale, based on remote sensing and available information on existing pressures.

- **A spatially hierarchical framework to assess hydromorphology** in rivers has been developed. It is important to adopt a spatially hierarchical method because the hydromorphological condition of a reach depends on dynamic interactions between water, sediment, and plants. Therefore, hydromorphological conditions need to be placed in a catchment context (to capture the impact of influences at their relevant spatial scales) and need to be evaluated over time (to capture sensitivity, dynamics and trajectories of change). The benefits of this spatially hierarchical hydromorphological assessment framework to WFD implementation include the provision of indicators of hydromorphological condition that can be derived from commonly measured or freely available datasets, as well as the improved understanding of linkages between hydrology, channel and floodplain morphodynamics, and ecology.

- There is an emerging need and challenge for developing new indicators for specific bottlenecks and limitations for species in river systems. The review of the available literature and project results revealed specific substrate requirements of indicative value for a rather limited number of species, which could be used as indicators or target species for environmental improvements. For a substantially higher number of species, the REFORM review allowed for the **establishment of thresholds for limiting factors** (e.g., current velocity, wave action, and shear stress) to guide river rehabilitation work. For measuring environmental improvements other than general biodiversity measures and species numbers, a river type- and region-specific index. The German fish-based assessment system (FRI) has been suggested for this purpose and will be evaluated on case-study target streams within the REFORM project.

- The 1<sup>st</sup> RBMPs and PoMs revealed that most EU Member States consider hydromorphological impacts within permanent river systems and are planning measures that typically address connectivity or impacts at the level of habitat complexity or substrate availability. In contrast, in many Mediterranean river catchments, which suffer from water scarcity and altered flow regime, measures ensuring environmental flows are much more relevant than in-stream habitat improvements.

In the 1<sup>st</sup> planning cycle, there has been high **uncertainty about suitable efficient measures**, which is particularly indicated by the dominance of conceptual measures (e.g., further investigations, information exchange, interventions, modified legislations, and cooperation) in the RBMPs, accounting to nearly 70% of all measures planned in the River Basin Districts (RBDs).





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### Further information on the REFORM project:

#### Starting/Ending date:

November 1, 2011 – October 31, 2015

#### Coordinator

Tom Buijse, Deltares

#### Type of R&D:

Collaborative project (large-scale integrating project)

#### Programme:

7th Framework Programme

Theme: Environment  
(including climate change)

Topic: ENV.2011.2.1.2-1 Hydromorphology and ecological objectives of WFD

Grant Agreement 282656

#### Web-Links:

[www.reformrivers.eu](http://www.reformrivers.eu)  
[wiki.reformrivers.eu](http://wiki.reformrivers.eu)

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## Consulting with stakeholders

REFORM operates in close cooperation with the ECOSTAT ad hoc working group on hydromorphology of the Common Implementation Strategy of the WFD, the LIFE+ RESTORE project, as well as the European Centre for River Restoration and has representatives of various stakeholder groups in its advisory board. At the interactive Stakeholder Workshop on River Restoration to Support Effective Catchment Management (26-27 February 2013, Brussels), ca. 110 participants from 23 European countries and various stakeholder groups were informed about the first results of REFORM and gave their feedback and recommendations on the outputs and plans for the next stages of the project. Key conclusions and recommendations of the workshop, as well as what REFORM can explicitly do about the issues raised, are provided in the Workshop Summary Report (<http://reformrivers.eu/events/stakeholder-workshop/documents>).

## Stay informed via the REFORM Geo-WIKI

REFORM has launched and will continue to populate a Geo-WIKI (<http://wiki.reformrivers.eu>) with generic river restoration knowledge and specific restoration case studies. This wiki uses the language of water management as the point of departure, and it will be filled further with contents from the REFORM work packages in the coming years.

## Where to find additional technical / scientific information?

All completed deliverables have been uploaded on the public website (<http://reformrivers.eu/results/deliverables>)

The content of the deliverables will be continuously uploaded in the REFORM Geo-WIKI in factsheets (<http://wiki.reformrivers.eu>) with linkages to background information and case studies throughout the course of REFORM

## Selected related projects / activities

WISER: Water bodies in Europe: Integrative Systems to assess Ecological status and Recovery (FP7 project), <http://www.wiser.eu>

RESTORE: Restoring Europe's Rivers (Life+ project), <http://www.restorerivers.eu>

European Centre for River Restoration, <http://www.ecrr.org>

## REFORM partners

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- ◆ University of Natural Resources and Life Sciences, Vienna (BOKU), AT
- ◆ French Research Institute for agricultural and environmental engineering (IRSTEA), FR
- ◆ Danube Delta National Institute for Research & Development, RO
- ◆ Swiss Federal Institute of Aquatic Science & Technology, CH
- ◆ Ecologic Institute, DE
- ◆ Leibniz-Institute of Freshwater Ecology & Inland Fisheries, DE
- ◆ European Commission Joint Research Centre, IT
- ◆ Masaryk University, CZ
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- ◆ Warsaw University of Life Sciences, PL
- ◆ Centro de Estudios y Experimentación de Obras Públicas (CEDEX), ES
- ◆ DLG, Government Service for Land and Water Management, NL
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