European Commission

NWRM

Natural Water Retention Measures

www.nwrm.eu

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Individual NWRM

Removal of dams and other longitudinal barriers

Environment

This report was prepared by the NWRM project, led by Office International de l'Eau (OIEau), in consortium with Actéon Environment (France), AMEC Foster Wheeler (United Kingdom), BEF (Baltic States), ENVECO (Sweden), IACO (Cyprus/Greece), IMDEA Water (Spain), REC (Hungary/Central & Eastern Europe), REKK inc. (Hungary), SLU (Sweden) and SRUC (UK) under contract 07.0330/2013/659147/SER/ENV.C1 for the Directorate-General for Environment of the European Commission. The information and views set out in this report represent NWRM project's views on the subject matter and do not necessarily reflect the official opinion of the Commission. The Commission does not guarantee the accuracy of the data included in this report. Neither the Commission nor any person acting on the Commission's behalf may be held responsible for the use which may be made of the information contained therein.

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I. NWRM Description

Dams and other transversal barriers are obstacles crossing the river section and causing discontinuities for sediment and fauna. Removing them consists in destroying all the obstacles, restoring the slope and the longitudinal profile of the river, therefore allowing re-establishment of fluvial dynamics, as well as sedimentary and ecological continuity.

II. Illustration

Brives dam being erased, Loire River, France

http://www.rivernet.org/general/dams/decommissioning_fr_hors_poutes/briveschareNSAC_f.htm

III. Geographic Applicability

Land Use	Applicability	Evidence
Artificial Surfaces	Yes	This measure could be undertaken in any kind of water course where dams, weirs and other longitudinal barriers have been constructed.
Agricultural Areas	Yes	
Forests and Semi-Natural Areas	Yes	
Wetlands	Yes	

Region	Applicability	Evidence
Western Europe	Yes	The measure is applicable regardless of the region because artificial longitudinal barriers exist in all four regions. The
Mediterranean	Yes	

Baltic Sea	Yes	most examples of already undertaken removal works are found in Western Europe.
Eastern Europe and Danube	Yes	

IV. Scale

	0-0.1km2	0.1-1.0km2	1-10km2	10-100km2	100-1000km2	>1000km2
Upstream Drainage Area/Catchment Area		✓	✓	✓		
Evidence	The review of the case studies shows that this measure is applied predominantly for small and medium sized rivers. In the case of bigger sized rivers, appropriate management of the dam can re-establish part of the functions targeted by this measure without removing the dam. The renewable energy production, as well as the multi functionality of big dams is also an argument that can prevent the measure to be taken.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	None	
	Slow Runoff	None	
	Store River Water	None	
	Slow River Water	None	
Reducing Runoff	Increase Evapotranspiration	None	
	Increase Infiltration and/or groundwater recharge	None	
	Increase soil water retention	None	

Reducing Pollution	Reduce pollutant sources	Low	In some cases removal of a dam and restoration of the natural flow might improve the oxygen concentrations and thus the self-purification capacity of the river.
	Intercept pollution pathways	None	
Soil Conservation	Reduce erosion and/or sediment delivery	Medium	The measure results in restoration of the natural pattern of erosion, sediment transport and deposition. It may result in increased erosion and sediment delivery downstream. Whether these impacts are positive or negative is a subject of site specific assessment and may vary depending on the scale (distance upstream and downstream) that are considered.
	Improve soils	None	
Creating Habitat	Create aquatic habitat	High	Removal of longitudinal barriers restore the river continuity, de-fragment stream habitats and improve their quality.
	Create riparian habitat	None	
	Create terrestrial habitat	None	
Climate Alteration	Enhance precipitation	None	
	Reduce peak temperature	None	
	Absorb and/or retain CO2	None	

VI. Ecosystem Services Benefits

Ecosystem Services		Rating	Evidence
Provisioning	Water Storage	None	
	Fish stocks and recruiting	High	By enhancing fish migration through restoration of the river continuity and decrease of stream habitat fragmentation, this measure allows enhancing fish stocks and recruiting
	Natural biomass production	None	

N9: Removal of dams and other longitudinal barriers

Regulatory and Maintenance	Biodiversity preservation	High	Restored aquatic habitats and river continuity result in increased diversity of fish and other aquatic communities.
	Climate change adaptation and mitigation	None	
	Groundwater / aquifer recharge	None	
	Flood risk reduction	Low	Impacts are controversial. On the one hand the dams and weirs are often considered as flood protection measures and their removal may increase flood risk. However in some cases these barriers are not secured or compromised and their removal prevents the risks of accidents in flood cases. Scale is a very important consideration for these measures: it may be the influence on flood risk further upstream or downstream, not only at the site itself, that is of interest.
	Erosion / sediment control	Medium	Restoration of the natural erosion and sediment delivery affects the downstream section and should be assessed case by case depending on the environmental and development objectives for the river.
	Filtration of pollutants	None	
Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	None	
Abiotic	Navigation	Medium	The restoration of river continuity may improve navigation conditions.
	Geological resources	None	
	Energy production	Medium	Specific case to be considered here is modification of the longitudinal barrier instead of its complete removal. Many dams and weirs are suitable for reconstruction with addition small hydropower facilities and fish passages.

VII. Policy Objectives

Policy Objective		Rating	Evidence
Water Framework Directive			
Achieve Good Surface Water Status	Improving status of biological quality elements	High	Restored and defragmented habitats result in improved ecological status. This is particularly valid for the following BQEs: fish, benthic invertebrates and macrophytes.
	Improving status of physico-chemical quality elements	Low	Mainly relating to potential improvements to temperature regime and improved dissolved oxygen concentrations.
	Improving status of hydromorphological quality elements	High	Restored longitudinal continuity
	Improving chemical status and priority substances	None	
Achieve Good GW	Improved quantitative status	None	
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	Low	Prevents deterioration of surface water status caused by hydro-morphological alterations.
	Prevent groundwater status deterioration	None	
Floods Directive			
Take adequate and co-ordinated measures to reduce flood risks		Low	Impacts are controversial (see above)
Habitats and Birds Directives			
Protection of Important Habitats		High	Restored aquatic habitats.
2020 Biodiversity Strategy			
Better protection for ecosystems and more use of Green Infrastructure		High	Restored aquatic habitats.
More sustainable agriculture and forestry		None	

Better management of fish stocks	High	Improved conditions for seasonal fish migration and reproduction.
Prevention of biodiversity loss	High	Prevention of decline/loss of fish species, which are sensitive to habitat fragmentation (migratory fish).

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	Dimensions of the direct removal works vary depending on the site specifics, number and dimensions of existing dams and weirs. Length of the stretch to be improved by means of this measure will vary on a case-by-case basis but depends on the length of the river and the distance between barriers. A typical length may vary between 1 - 50 km.
Space required	No specific space requirements.
Location	At the location of the existing longitudinal barrier.
Site and slope stability	Some dams and weirs are constructed in order to break the energy of flows on the site or downstream. It is important to assess the possible negative impacts of its removal and whether there are feasible options to mitigate these impacts.
Soils and groundwater	No specific requirements
Pre-treatment requirements	If there is evidence for significant accumulation of polluted sediment behind the dam, it is recommended to remove and safely dispose of these before removal of the barrier. This is a rare case but should be taken into account.
Synergies with Other Measures	The measure could be combined with reconnection of floodplains, oxbow lakes and other retention volumes in order to mitigate flood risk and to further restore the natural erosion and sediment transport rates.

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition	None	
Investigations & Studies	About 10% of the capital costs	Difficult to calculate precisely the costs for studies and investigations for the particular measure as in reviewed cases it was designed and implemented together with other measures.

Capital Costs	EUR 50'000 – 1'000'000	Removal of single dam or weir is not very expensive but it is often combined with other restoration works to take effect. The costs could be significantly higher if the facility is modified or reconstructed in order to mitigate the environmental impacts but to preserve its functions.
Maintenance Costs	1 – 5% of capital costs	Assumption based on figures from the case studies
Additional Costs	None	

X. Governance and Implementation

Requirement	Evidence
Measures in RBMPs to improve the ecological status of river sections affected by hydro-morphological alterations;	River continuity is one of the hydro-morphological quality elements according to WFD.

XI. Incentives supporting the financing of the NWRM

Type	Evidence
EU and national funds allocated for implementation of programmes of measures according to WFD 2000/60/EC and Habitat Directive 92/43/EC	Projects funded by LIFE+ Programme and national budgets.

XII. References

Reference	Comment
http://nwrm.eu/content/%C3%B3rbigo-river-ecological-status-improvement-stretch-iduero-river-basin	Órbigo River ecological status improvement (Stretch I)_Duero River Basin
http://nwrm.eu/content/seymaz-river-renaturation	Seymaz river renaturation
http://nwrm.eu/content/river-basin-management-ill	River basin management of the Ill
http://nwrm.eu/content/restoration-comana-wetlands	Restoration on Comana wetlands

N9: Removal of dams and other longitudinal barriers

http://nwrm.eu/content/restoration%C3%A5%C2%A0umava	Restoration_Å umava
http://nwrm.eu/content/ljubljanica-connects	Ljubljanica Connects