European Commission

NWRM

Natural Water Retention Measures

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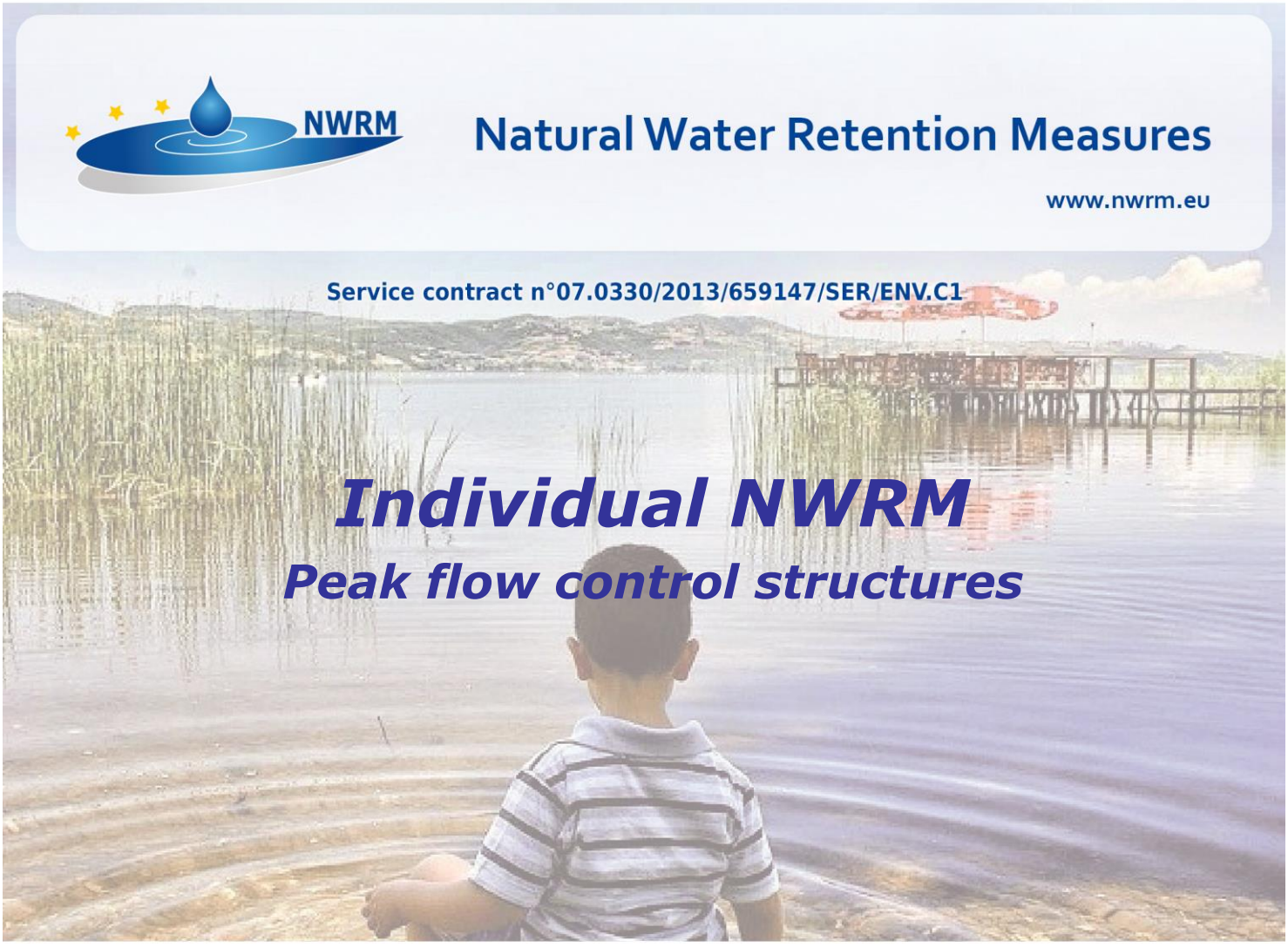

Individual NWRM

Peak flow control structures

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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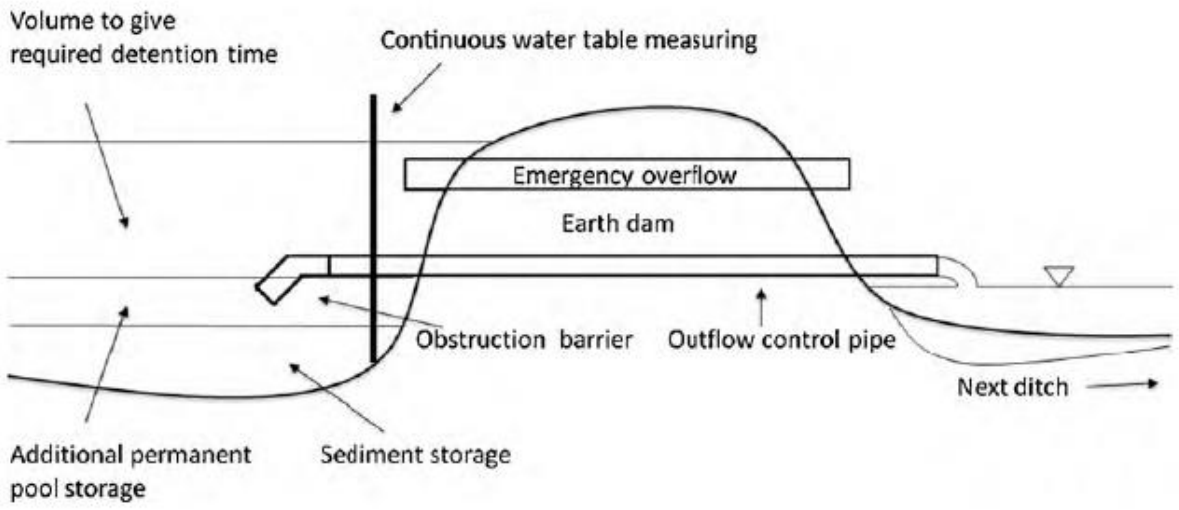
I. NWRM Description

Peak flow control structures are designed to reduce flow velocities in networks of forest ditches. Peak flow control structures are engineered ponds designed to limit the rate at which water flows out of a ditch network. Because the structures slow water flow, they will contribute to sediment control and can reduce the size of flood peaks. Peak flow control structures will have a limited lifespan as sediment will eventually fill in the upstream detention pond. However, ponds can be maintained by removal of accumulated sediment.

II. Illustration



Schematic of peak flow control structure from Martilla et al. (2010)

III. Geographic Applicability

Land Use	Applicability	Evidence
Artificial Surfaces	Possible	While this measure is primarily associated with forest management it shares some functional similarities with "U10 Detention Basins" and "U11 Retention Ponds".
Agricultural Areas	Possible	While this measure is primarily associated with forest management it may also be used in agricultural areas.
Forests and Semi-Natural Areas	Yes	Peak flow control structures are associated primarily with water management in the forest landscape. However, they may be relevant in other areas of extensive land management and have some functional overlap with "N1 Basins and Ponds". To date, these measures are mostly associated with peatland forestry in Finland.
Wetlands	No	It is unlikely that this measure would be relevant in either inland or coastal wetlands.

Region	Applicability	Evidence
Western Europe	Yes	The measure is most relevant in areas where precipitation exceeds potential evapotranspiration and will therefore be relevant in many areas of Western Europe.
Mediterranean	Possible	The measure is most relevant in areas where precipitation exceeds potential evapotranspiration and is therefore less likely to be relevant in the relatively warm and dry Mediterranean region.
Baltic Sea	Yes	The measure is most relevant in areas where precipitation exceeds potential evapotranspiration such as the Baltic Sea drainage basin.
Eastern Europe and Danube	Yes	The measure is most relevant in areas where precipitation exceeds potential evapotranspiration and will be widely but not universally relevant in Eastern Europe and the Danube.

IV. Scale

	0-0.1km2	0.1-1.0km2	1-10km2	10-100km2	100-1000km2	>1000km2
Upstream Drainage Area/Catchment Area	Yes	Possible	No	No	No	No
Evidence	Peak flow control structures are most effective in small headwater catchments but can also work in catchments of about 0.1 km2. Like many other forestry-related measures presented here, the benefits of the measures can be observed in much larger downstream catchments.					

V. Biophysical Impacts

Biophysical Impacts		Rating	Evidence
Slowing & Storing Runoff	Store Runoff	High	Peak flow control structures are primarily designed to slow and store runoff during high flow periods
	Slow Runoff	High	
	Store River Water	Low	Peak flow control structures are usually constructed within a ditch network therefore their impact on river water storage will be low.
	Slow River Water	Medium	Through slowing flows entering downstream water bodies, peak flow control structures have potential to slow also river water flows.

Reducing Runoff	Increase Evapotranspiration	None	
	Increase Infiltration and/or groundwater recharge	Low	Because peak flow control structures will store and slow water, they have some limited potential to increase infiltration and groundwater recharge. Increased infiltration because of slower water flows can also have some benefits for soil water retention.
	Increase soil water retention	None	
Reducing Pollution	Reduce pollutant sources	High	Through slowing water flows and enhanced settling of suspended solids and particle-bound nutrients peak flow control structures may effectively reduce pollution of downstream water bodies.
	Intercept pollution pathways	High	
Soil Conservation	Reduce erosion and/or sediment delivery	High	Reduction of sediment delivery is an important function of the peak flow control structures.
	Improve soils	None	
Creating Habitat	Create aquatic habitat	Low	Through increased amount of water residing temporarily within the pond, peak flow control structures may in some cases create specific aquatic habitat, as well as prevent deterioration of aquatic habitats in downstream water bodies.
	Create riparian habitat	None	
	Create terrestrial habitat	None	
Climate Alteration	Enhance precipitation	None	
	Reduce peak temperature	None	
	Absorb and/or retain CO2	Negative	Greenhouse gas emissions associated with breakdown of organic sediments may occur.

VI. Ecosystem Services Benefits

Ecosystem Services		Rating	Evidence
Provisioning	Water Storage	Low to Medium	Peak flow control structures will temporarily store water, however, due to their relatively small size, the impact will be Medium, at best.
	Fish stocks and recruiting	Medium	Prevention of sediment loss can contribute to preservation of fish stocks and maintain spawning sites.
	Natural biomass production	None	
Regulatory and Maintenance	Biodiversity preservation	Medium	Prevention of sediment loss can contribute to preservation of fish stocks and maintain spawning sites and habitat for species such as freshwater pearl mussel and other aquatic organisms.
	Climate change adaptation and mitigation	None	
	Groundwater / aquifer recharge	Low	Since peak flow control structures slow the transit of water through the forest landscape, they may have some ability to improve groundwater or aquifer recharge.
	Flood risk reduction	Medium to high	Peak flow control structures will contribute to flood risk reduction; effectiveness largely depends on catchment topography and dimension of the structure.
	Erosion / sediment control	High	Reduction of sediment delivery is an important function of the peak flow control structures.
	Filtration of pollutants	High	Peak flow control structures will be most effective at removing sediment bound pollutants
Cultural	Recreational opportunities	None	
	Aesthetic / cultural value	None	
Abiotic	Navigation	None	
	Geological resources	None	
	Energy production	None	

VII. Policy Objectives

Policy Objective		Rating	Evidence
Water Framework Directive			
Achieve Good Surface Water Status	Improving status of biology quality elements	Low	Peak flow control structures mainly will lead to local improvements of water quality status, but to some extent they may also contribute to water quality elements of WFD water bodies.
	Improving status of physico-chemical quality elements	Low	
	Improving status of hydromorphology quality elements	Low	
	Improving chemical status and priority substances	Low	
Achieve Good GW Status	Improved quantitative status	None	
	Improved chemical status	None	
Prevent Deterioration	Prevent surface water status deterioration	Medium	Through enhanced settling of suspended solids and particle-bound nutrients peak flow control structures will prevent surface water status deterioration.
	Prevent groundwater status deterioration	None	
Floods Directive			
Take adequate and co-ordinated measures to reduce flood risks		Medium to High	Peak flow control structures can be used as one of the measures to reduce flood risks; effectiveness largely depends on catchment topography and dimension of the structure.
Habitats and Birds Directives			
Protection of Important Habitats		Medium	Peak flow control structures can help to limit sediment inputs from managed forests which can later smother stream beds, destroying spawning habitat or extirpating benthic invertebrates such as freshwater pearl mussel.

2020 Biodiversity Strategy		
Better protection for ecosystems and more use of Green Infrastructure	Medium	Peak flow control structures offer increased protection for downstream aquatic ecosystems by limiting the potential for excessive sediment inputs from managed forests.
More sustainable agriculture and forestry	Medium	Peak flow control structures will help to make forestry and agriculture more sustainable as they can limit some negative impacts associated with sediment pollution.
Better management of fish stocks	Medium	By limiting the sediment pollution that will potentially smother streambed spawning habitat, peak flow control structures can contribute to better management of freshwater fish stocks.
Prevention of biodiversity loss	Medium	By limiting the sediment pollution that will potentially smother streambed habitat, peak flow control structures can contribute to prevention of aquatic biodiversity loss, especially for slow moving long-lived species such as freshwater pearl mussel.

VIII. Design Guidance

Design Parameters	Evidence
Dimensions	Dimensions of peak flow control structures depend on the amount of runoff and detention capacity of the drainage network behind the structure. For the dimensions of control pipe diameters depending on the catchment area, see Marttila et al., 2010
Space required	Space required for construction of peak flow control structures will not much exceed that required for construction of traditional sedimentation settling ponds.
Location	Location of the structure depends on the parameters of individual catchments. In some cases it would be best to integrate traditional settling pond and peak flow control structure.
Site and slope stability	Peak flow control structures will be more effective in flat terrain.
Soils and groundwater	
Pre-treatment requirements	
Synergies with Other Measures	Peak flow control structures may be integrated with sedimentation settling ponds (F9), and they may also directly influence effectiveness of downstream water protection structures, e.g., riparian buffers (F1) and overland flow areas (F14).

IX. Cost

Cost Category	Cost Range	Evidence
Land Acquisition	None	Typically there are no costs of land acquisition.
Investigations & Studies		
Capital Costs	Low	Establishment of structures and instalment of control pipes will require some initial costs.
Maintenance Costs	Low	Periodical removal of settled sediment may create maintenance costs.
Additional Costs		

X. Governance and Implementation

Requirement	Evidence

XI. Incentives supporting the financing of the NWRM

Type	Evidence

XII. References

Reference	Comments
Neary, Daniel G., George G. Ice, and C. Rhett Jackson. "Linkages between forest soils and water quality and quantity." Forest Ecology and Management258.10 (2009): 2269-2281.	Good general reference on forest water issues
Marttila, Hannu, and Bjørn Kløve. "Managing runoff, water quality and erosion in peatland forestry by peak runoff control." Ecological Engineering 36.7 (2010): 900-911.	Assessment of effectiveness of peak flow control structures for water quality improvement
Marttila, H. and Kløve, B. 2009. Retention of sediment and nutrient loads with peak runoff control. Journal of Irrigation and Drainage Engineering 135(2): 210-216	Evaluates effectiveness of peak runoff control in controlling sediment loads

F13: Peak flow control structures

Hannu Marttila, Bjørn Kløve. 2010. Dynamics of erosion and suspended sediment transport from drained peatland forestry. Journal of Hydrology 388 (2010) 414–425	Analyzes sediment dynamics and influencing factors during different events
Hannu Marttila, Kari-Matti Vuori, Hannu Hökkä, Juha Jämsen, Bjørn Kløve. "Framework for designing and applying peak runoff control structures for peatland forestry conditions." Forest ecology and management 260.8 (2010): 1262-1273.	Guidance for using peak flow control structures