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EU policy document on

Natural Water Retention Measures

By the drafting team of the WFD CIS Working Group Programme of Measures (WG PoM)

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Context of this document:

Under the 2013-2015 Work Programme of the Common Implementation Strategy (CIS) for the Water Framework Directive (WFD), and in response to the 2012 *Blueprint to Safeguard Europe's Water Resources* proposals, the Working Group Programme of Measures (WG PoM) is asked to develop a CIS guidance or other tool for supporting the implementation of NWRM in Europe. This document has been prepared by a dedicated NWRM drafting team of the WG PoM, with input received from the NWRM Pilot Project, and discussions in WG PoM and WG Floods.

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Executive summary

Natural Water Retention Measures (NWRM) are multi-functional measures that aim to protect and manage water resources using natural means and processes, therefore building up Green Infrastructure, for example, by restoring ecosystems and changing land use. NWRM have the potential to provide multiple benefits, including flood risk reduction, water quality improvement, groundwater recharge and habitat improvement. As such, they can help achieve the goals of key EU policies such as the Water Framework Directive (WFD), the Floods Directive (FD) and Habitats and Birds Directive.

Despite the growing knowledge base on the positive role that NWRM can play in integrated water management, the need for a better knowledge base and exchange of good practices is recognised. More robust information, in particular on the effectiveness of NWRM under different conditions and on their (potential) additional benefits as compared to other measures, will facilitate the identification of contexts and conditions where NRWM may provide multiple benefits and be cost-effective, and hence may promote more widespread implementation of NWRM. The evidence currently collated in the context of the European Commission NWRM pilot project (www.nwrm.eu) is expected to be valuable in supporting the uptake of NWRM in River Basin Management Plans (RBMPs) and Flood Risk Management Plans (FRMPs). In addition, efforts are required to raise awareness of decision-makers on the potential of NWRM to provide multiple benefits.

Today, the performance of NWRM is often assessed from a single sector/single objective view point, thus not fully accounting for the multiple benefits they potentially provide. In addition, research and demonstration in pilot activities is to be promoted to gather further evidence on the effects of NWRM on flood mitigation at the catchment scale. Enhanced coordination between planning processes across different policy areas (e.g. River Basin and Flood Risk Management, but also nature protection, rural development and land use/spatial planning) is seen as a pre-requisite for enhancing the chances of the multiple benefits of NWRM to be considered appropriately in management decisions.

Limited financial resources are often mentioned as a barrier to the implementation of NWRM. While a range of funding sources is available at European and other levels, utilisation of these funding sources for financing NWRM remains limited. In parallel to enhanced coordination between sector-based planning processes, blending and integrating financial resources available from different sources can also contribute to facilitating more widespread implementation of NWRM.

1. Aim and target group of this policy document

This policy document aims to explain the policy relevance of Natural Water Retention Measures (NWRM) and to stimulate the uptake of NWRM as effective tools for achieving water and related policy objectives. This policy document is primarily targeted at water managers and decision–makers at national, regional and local levels. It aims to encourage water managers to support the uptake of NWRM in River Basin Management Plans (RBMPs) and to facilitate their implementation via enhanced coordination with other sectors. For more technical and scientific information on NWRM, the reader is referred to the European Commission Pilot Project on NWRM (www.nwrm.eu).

2. What can you achieve with NWRM?

Natural Water Retention Measures (NWRM) are multi-functional measures that aim to protect and manage water resources and address water-related challenges by restoring or maintaining ecosystems as well as natural features and characteristics of water bodies using natural means and processes. Their main focus is to enhance, as well as preserve, the water retention capacity of aquifers, soil, and ecosystems with a view to improving their status. NWRM have the potential to provide multiple benefits, including the reduction of risk of floods and droughts, water quality improvement, groundwater recharge and habitat improvement. The application of NWRM supports green infrastructure, improves or preserves the quantitative status of surface water and groundwater bodies and can positively affect the chemical and ecological status of water bodies by restoring or enhancing natural functioning of ecosystems and the services they provide. The preserved or restored ecosystems can contribute both to climate change adaptation and mitigation.

However, considering the range of NWRM and associated effects, a case-by case-review will be needed to identify the case-specific benefits of NWRM.

Table 1. Illustrating the diversity of measures classified as NWRM[1]

Type	Class	Non-exhaustive list of examples
Direct modification in ecosystems	**Hydro-morphology (Rivers, Lakes, Aquifers, connected wetlands)**	Restoration and maintenance of rivers, lakes, aquifers and connected wetlands; Reconnection and restoration of floodplains and disconnected meanders, elimination of riverbank protection…
Change & adaptation in land-use & water management practice	**Agriculture**	Restoration and maintenance of meadows, pastures, buffer strips and shelter belts; soil conservation practices (crop rotation, intercropping, conservation tillage...), green cover, mulching…
	Forestry and Pastures	Afforestation of upstream catchments; targeted planting for "catching" precipitation; Continuous cover forestry; maintenance of riparian buffers; urban forests; Land-use conversion for water quality improvements…
	Urban development	Green roofs, rainwater harvesting, permeable paving, swales, soakaways, infiltration trenches, rain gardens, detention basins, retention ponds, urban channel restoration…

While the knowledge base on the effectiveness, applicability, costs and benefits of NWRM is growing, further research and results are needed to fully demonstrate their potential. The on-going EU pilot

[1] More information can be found in the catalogue of measures of the NWRM pilot project (www.nwrm.eu).

project on NWRM is collating evidence in a catalogue of measures accompanied with a practical guide. NWRM include a wide range of measures that range from small-scale ponds, soil conservation practices, green roofs in urban areas, to large scale floodplain and wetland restoration and aquifer recharge. They can be divided in two broad types (see Table 1): 1) Measures that modify and restore ecosystems and 2) Measures that adapt and change land-use and water management practices.

NWRM is used as a new overarching term to group measures that retain water using natural means and processes, while at the same time having the potential to provide multiple benefits to other sectors (see section 4). Yet, NWRM are not something new: they encompass approaches that are partly overlapping or follow similar concepts and objectives such as *Room for the River*, *Ecosystem-based Adaptation*, *Natural Flood Risk Management or Green Infrastructure*. NWRM are considered to be complementary to grey infrastructure such as dikes, concrete reservoirs or waste water treatment plants. In addition, grey infrastructure may support the implementation of NWRM, if the natural water retention process cannot be guaranteed by natural processes alone. Even though it is expected that NWRM can mitigate the extent and intensity of the negative impacts of grey infrastructure on ecosystems, NWRM cannot always be considered as cure-all measures.

NWRM can address major causes of not achieving good water status and major threats to biodiversity, mainly by natural flow regulation and natural water treatment. Natural flow regulation can lead to a reduction in the risk of floods in wet conditions and also better water replenishment of groundwater and surface water bodies in dry conditions. Through dilution and the natural water filtering function, some NWRM also provide natural water treatment. NWRM can either restore the natural functions or actively preserve functional habitats such as intact floodplain wetlands. They can thus be applied to enlarge the area and functioning of aquatic, terrestrial, urban and coastal ecosystems. In agricultural and grassland ecosystems, NWRM can contribute to reversing biodiversity loss by creating small landscape elements such as buffer strips, small pools or wetlands. In the urban environment, NWRM can mitigate the impact of intense rainfall and heat waves and improve the quality of stormwater discharging into the receiving water bodies. Forest NWRM have the potential to ensure soil protection, water quality and improve water retention. Urban NWRM (e.g. Sustainable Urban Drainage Systems, SUDS) have the potential to improve water quantity and water quality in urban environment. In view of the increasing impact of climate change, NWRM are nature-based solutions that can address climate change adaptation, future natural hazards, and mitigation by facilitating natural carbon sequestration and storage.

Furthermore, NWRM can also be used - when integrated in land use planning and as part of green infrastructure - to address habitat fragmentation and lack of connectivity that are major drivers for the loss of biodiversity. Besides the enhancement of biodiversity and the provisioning of ecosystem services, NWRM can also provide benefits to society, namely jobs, green growth, improvement of health and quality of life, cooperation and innovation and promotion of diversification of the economy, as highlighted, for example, in the *Europe 2020 Strategy for Smart Sustainable and inclusive growth*[2] and the EC Communication *Green Infrastructure— Enhancing Europe's Natural Capital*[3].

[2] http://ec.europa.eu/europe2020/pdf/europe2020stocktaking_en.pdf.

[3] http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructures/1_EN_ACT_part1_v5.pdf.

NWRM offer a variety of measures, the benefits they provide hence depends firstly on the type of NWRM and secondly on the location, implementation design and combinations with other measures. Examples of potential benefits are shown in Table 2.

Table 2. Potential benefits expected from selected examples of NWRM

NWRM	Description	Potential primary benefits
Reconnection of oxbow lakes 	The historic straightening or canalisation of rivers resulted in the disconnection of meanders and formation of oxbow lakes. The re-connection of oxbow lakes to the main channel will restore the natural river flow conditions.	Enhanced water storage, attenuation of peak runoff, restoration of river continuity, diversifying flows and habitats, groundwater recharge
Conservation tillage 	By leaving crop residue on the soil surface, conservation tillage improves water infiltration into the soil and reduces soil erosion.	Water quality improvement, decreased runoff, soil conservation, increased infiltration potential
Installation of green roofs 	Coverage of a top of a building or structure with vegetation planted over a waterproof membrane.	Retain precipitation, provide insulation to buildings, new habitats for wildlife in urban environments, reduce peak flows, water quality improvement, soften extreme temperatures in cities, amenity space

A growing evidence base, including from the NWRM pilot project, is providing better insights on the performance of NWRM. Many knowledge gaps however remain, in particular on the conditions under which NWRM perform best and how they are best combined with other measures, as well as where they might be cost-effective. One important knowledge gap relates to the effectiveness of NWRM when it comes to the scale and location of deployment. Implementation of NWRM is known to be effective and to deliver more easily measurable benefits at the local scale, whereas less evidence is available on the multiple benefits and win-win situations of NWRM at a larger, river basin scale and across sectors, despite the fact that benefits are expected to be more significant. This can depend on the location of the NWRM within the river basin (e.g. upstream or downstream), the area taken by NWRM, the combination with other measures and the type of extreme weather events (e.g. return period, intensity, extent). NWRM can for example be effective for frequent, lower peak floods, but may be less effective for more severe floods. Another knowledge gap are the potential trade-offs that NWRM might have on local flood risk, economic activity or environment. Hence, expert advice is needed to ensure that NWRM are implemented in appropriate locations and for contexts in which they can be effective.

3. What is the policy relevance of NWRM?

NWRM are, owing to their multifunctional character, measures that have the potential to help to achieve the goals of a range of EU policies, including policies on surface water, groundwater and coastal management, nature conservation, agriculture, forestry, energy, disaster risk management, green growth and climate change mitigation and adaptation. The uptake of NWRM in sectoral plans, however, is often limited as its choice is often based on the costs and benefits for one particular

sector. When the performance of NWRM is considered in a holistic framework, the full range of benefits will become apparent. In this perspective, NWRM can contribute to the integration of the Water Framework Directive and Floods Directive and more broadly strengthen EU policy coherence.

3.1. Strengthening the coordination of the Water Framework Directive and the Floods Directive

NWRM can contribute to both WFD and Floods Directive (FD) goals and can enhance synergies between the implementation of both directives and support the coordination between the River Basin Management Plans (RBMPs) and Flood Risk Management Plans (FRMPs). The uptake of NWRM in RBMPs is triggered through the potential to improve or preserve hydromorphological conditions, as well as the water quantity and quality. The FD refers to the need to take NWRM into account in the FRMPs: these can include floodplains, sustainable land use practices, dike relocation and natural measures that have the potential to retain flood water e.g. by giving more space to rivers (see box 1). In both directives, the uptake of measures is to be motivated by means of a cost benefit analysis including long-term environmental benefits.

Box 1: Example from the Netherlands – Room for the river

The Room for the River Programme has changed the way of thinking on flood risk reduction in the Netherlands. The continued strengthening of the dikes (the classical approach) had proven its effectiveness on flood risk reduction, but was perceived not sustainable in the long term. The Room for the River programme aims to give the rivers more room to be able to carry more water, while also improving the natural flow dynamics and improving biodiversity. Hence, more space is given for water that would have to be contained in the river. The Room for the River programme is expected to be completed in 2015. A good example is the 'Room for the River' measure at Deventer (see photo). Here, by excavating side channels in the flood plain over a length of 10 km with an average width of 100 m, the River IJssel will have more room to convey water. With these side channels, the river will also regain its natural dynamics creating new river habitats and improving biodiversity. The floodplain can be used for agricultural purposes and will be maintained by an organic dairy farm.
Source: http://www.ruimtevoorderivier.nl/english

The latest (2012) EU level review of the RBMPs and associated Programmes of Measures (PoM)[4] stressed that hydromorphological alterations (including the alteration of habitats) and diffuse pollution are key factors for not achieving good water status. In addition, many Programmes of Measures (PoMs) of the first cycle insufficiently address water scarcity and drought, even though these are reported to be of major concern across the Mediterranean area, and for some parts of Central, Eastern and Northern Europe. NWRM can provide/maintain green infrastructure that represents a better environmental option[5] to address the above concerns, in combination with other measures. NWRM can:

- Improve water status by reducing the impact of diffuse pollution (filtering, bio-oxidation, and dilution function);
- Reduce the risk of more frequent lower intensity floods;

[4] *Commission Staff Working Document – European Overview– Accompanying the document Report from the Commission to the European Parliament and the Council on the Implementation of the Water Framework Directive (2000/60/EC) - River Basin Management Plans (COM(2012) 670 final)*, volumes 1 and 2, European Commission, Brussels.
[5] As covered by the information package ''Towards Better Environmental Options in Flood Risk Management'' (communicated by the Commission in 2011 to Water Directors).

- Improve water availability, under conditions of water scarcity and drought, by attenuating runoff naturally regulating the flow regime and recharging soils and aquifers though increasing infiltration by natural means (i.e. afforestation, land-use changes, green covers, wetland restoration, etc.);
- Restore the hydromorphological conditions of river banks and the floodplains.

Considering the range of benefits NWRM can have, a greater uptake of NWRM in the 2nd and 3rd cycle RBMPs and in 1st and 2nd cycle FRMPs would, where applicable, be beneficial to achieving the objectives of the WFD and the FD respectively. When selecting NWRM, it will be important to understand local conditions and assess where and how these measures would need to be implemented in order to fully benefit from NWRM and minimise potential trade-offs NWRM may have. Further evidence on potential benefits, including for flood risk management, can also support their uptake.

3.2. Strengthening coherence between EU policies on water, biodiversity, agriculture and climate change adaptation and mitigation

The implementation of NWRM supports the aims of the EU's Seventh Environmental Action Programme (7EAP), in particular in terms of countering on-going loss of natural capital; and the Roadmap to a Resource Efficient Europe, which fosters investments in Green Infrastructure and the restoration economy. NWRM can help to comply with legal obligations of the Birds and Habitats Directives and could as such be taken up in the Natura2000 management plans and other conservation actions. NWRM are measures, applied throughout the river basin, that improve the environment and can improve the status of species and habitats towards a favourable conservation status, also improving the coherence requirements of the Natura2000 network. They can also contribute to the different targets of the EU 2020 Biodiversity Strategy, especially Target 2 (which states that by "2020, ecosystems and their services are maintained and enhanced by establishing green infrastructure and restoring at least 15% of degraded ecosystems"), as well as related global Aichi targets. NWRM could also be selected when compensation is needed for displaced habitats, as required under the Birds and Habitats Directive. With respect to the Common Agricultural Policy, some NWRM can be used as agri-environment-climate measures which qualify under the Rural Development Policy (Pillar II) and could be encouraged to be taken up in the Rural Development Programmes (RDP). NWRM can also be effective measures for climate change adaptation and mitigation.

In conclusion, NWRM have the potential to provide multiple benefits for various sectors and policies. In order to enjoy the range of benefits, the selection for NWRM is best coordinated across sectors and scales and hence included in the respective action plans, e.g. River Basin Management Plans, Flood Risk Management Plans, Rural Development Programmes, Adaptation Strategies, local development plans (including those in urban environment). An example from Austria (Box 2) shows how floodplain restoration can be designed to achieve multiple objectives.

Box 2: Floodplain restoration (Austria) achieves multiple objectives

In Austria, as an Alpine country with limited area available for permanent settlement the protection and restoration of retention areas and floodplains is generally a complex task. Nevertheless, numerous projects and activities have been implemented along various rivers in Austria, especially during the past two decades. Even along the largest river in Austria, the Danube, which is bound by various interventions several floodplains have been protected and restored. Besides multiple projects with the main purpose of flood risk reduction (e.g. by resettlement and restoration of retention areas) several meanders that historically have been cut off from the main channel have been re-connected. The re-connected meanders are important for flood risk reduction, biodiversity, water status (hydromorphological conditions), drinking

water and recreation. The process of floodplain protection and restoration is steered by the Austrian principle that "nature oriented" measures have to be implemented and funded with priority if the direct benefits are comparable to those of structural measures.

One example is the Lobau wetland near Vienna. In the Lobau, a trade-off analysis is performed to select the management options that best address various management objectives, including the need to safeguard or improve the ecosystem condition of aquatic and terrestrial habitats, drinking water production, recreational use, flood risk reduction, navigation, agriculture and fisheries. Six options to reconnect the meanders are assessed representing a gradient from complete isolation to full reconnection with the Danube River channel. The best-compromise solution found by the analysis was a partial reconnection of the wetland with the Danube.
Sources: http://wisa.bmlfuw.gv.at/ ; www.bmlfuw.gv.at ; http://www.wetwin.eu/downloads/Wetwin_09.pdf ;

3.3. Justifying the selection of NWRM: The multi-benefit perspective

In the current period of financial and economic crisis with strong competition over public budget (including within the environmental sector), allocating public funds for supporting the implementation of measures that contribute simultaneously to the achievement of many policy goals (including FD, WFD, Habitats Directive, climate change policies) is likely to be very appealing to policy makers. Therefore, the multiple benefits NWRM can deliver are the primary justification for choosing and implementing NWRM as compared to grey infrastructure measures. NWRM can be considered as complementary measures to grey infrastructure measures. While NWRM cannot fully replace grey infrastructure, NWRM can reduce the need for grey infrastructure and in addition reduce, to some extent, the negative impact of grey infrastructure.

NWRM can address several policy objectives at the same time (e.g. water management and biodiversity related ones). Typically, in the planning process, NWRM are evaluated for their cost-effectiveness to achieve a single policy goal (e.g. flood risk reduction). If the measures are found to be cost-effective, they can be included in the Programme of Measures, as illustrated in Box 3. However, the potentially high costs of land consolidation and difficulties in quantifying the benefits can bring NWRM down in the cost-effectiveness priority list. The latter often results in the non-selection of NWRM, despite other benefits they are expected to provide. The latter argument is valid in particular in densely populated and highly productive agricultural areas, where land is scarce.

The following approach could be followed in order to select green infrastructure, such as NWRM and ecosystem restoration, using best available techniques and mitigation measures, in combination with grey infrastructure: from the pool of possible green and grey measures to reach the intended purpose, use green infrastructure whenever possible; where green infrastructure alone is not adequate to guarantee the desired level of protection, blend it with grey infrastructure to reach the required level; if relying mainly on grey infrastructure, mitigate, and where not possible compensate, the negative effects of grey infrastructure with NWRM e.g. by restoring areas to still reach positive economic, social and environmental effects of the measures. In particular, consider green infrastructure in the assessment of the 'significantly better environmental option' required by WFD Article 4.7.

The lack of an integrated framework to assess the costs-benefit ratio and cost-effectiveness of NWRM to achieve multiple-policy goals remains. This is, together with an insufficient understanding of the benefits at various scales, a major impediment to the widespread implementation of NWRM. With an integrated assessment framework, it can be demonstrated that the cost-effectiveness and cost-benefit ratio of NWRM will improve when considering the cumulative costs, benefits and

effectiveness in achieving multiple policy objectives in comparison to the achievement of individual policy goals. Under some conditions, NWRM may outrank other measures to achieve multiple policy objectives (see Box 3 for illustrative examples).

Box 3: Visiting evidence on cost-effectiveness

Illustration 1 – Financial appraisals and any single purpose could be enough to justify the adoption of many NWRM. The village of Belford, downstream, had a history of flooding, but the cost of conventional flood defence improvements had been judged to be cost-ineffective, at around €3m. In contrast, upstream NWRMs, based on run-off attenuation measures, were estimated to deliver the same level of flood protection at a cost below €0.25m. This made this the best alternative without the need to mention that besides providing the same size of flood protection by the attenuation of the flow, NWRMs do not have negative impacts over the village, reduce sediment loads and substantially improve water quality.

Illustration 2 – The impact of soil conservation practices on river loads can be equal to 20 tonnes or an 8% annual decrease of Total Phosphorus (TP) against baseline. Filter strips in corn fields reduced annual sediments by 66 Kilotonnes or 5%, NO3–N (nitrates–nitrogen) by 71 tonnes or 9.5% and TP by 27 tonnes or 10%, with an additional cost of 3.1 €/ton, 3.3 €/kg and 8.1 €/kg of each pollutant respectively. Considerable reductions of several pollutant types can be achieved in parallel, even at low total cost, by combining targeted implementation strategies only in small parts of the catchment, enabling policy makers to factor in local socio-economic variables (Panagiopoulos et al., 2011).

Illustration 3 – Making fair comparisons requires adapting the methodologies to the differences between NWRM and conventional alternatives. To account for environmental benefits of green roofs, Niu et al. (2010) propose obtaining a net present value (NPV) based on a 40-yr lifetime of green roofs, or one replacement of conventional roofs. The objective was to quantitatively assess whether and when the premium cost of a green roof system breaks even with that of a conventional roof system. For a building with a 1,795 m2 roof area, the installation cost of a green roof is 27% higher than that of a conventional roof ($550,598 vs. $434,731). As a result of estimating the benefits over the lifetime of the green roof, its NPV is about 25% lower than that of a conventional roof.

Source: NWRM Pilot project: www.nwrm.eu

4. Recommendations to stimulate implementation of NWRM

To stimulate NWRM implementation, four sets of recommendations are proposed. Each set of recommendations is further described below. The four major recommendations are:

- Make policy coordination truly operational;
- Give more attention to land use planning in water management;
- Mobilise and combine financial resources;
- Raise awareness and strengthen the knowledge base and exchange of best practices on NWRM.

4.1. Make policy coordination truly operational

The coordination of planning across sectors and scales is a key success factor for many policies at EU, national, regional and local level. Even though this process is seemingly simple, and mainly requires enhanced communication and cooperation, in practice concrete examples of effective mechanisms for coordination are not widespread. Barriers that hinder the selection of NWRM are related to knowledge gaps on the performance (cost and benefits) of NWRM, limited awareness of the mutual benefits of coordination and the perception that grey infrastructure is better than green infrastructure. NWRM can be used as a lever to enhance policy coordination. The following recommendations are given to make policy coordination truly operational:

- Provide support for the uptake of pilot projects that strengthen evidence to demonstrate the multiple benefits that NWRM potentially have across policy sectors at local scale and river basin scale;
- Contribute to developing a better knowledge base that better demonstrates how costs, benefits and effectiveness values can be used for the analysis and selection of the different management options;

- Create a common understanding among sectoral decision-makers of the mutual benefits of NWRM, identify barriers for implementation including legal and institutional ones, potential conflicts and synergies. This might require joint assessment methods and mechanisms;
- Agree on rights and responsibilities for coordinated action by all levels. A high-level mandate for coordination is hereby essential; which includes agreements on implementation and maintenance of NWRM;
- Agree under which conditions and which locations NWRM can be taken up in planning;
- Discuss – at an early stage of the planning process - benefits, conflicts and synergies of specific NWRM in relation to a potential uptake in RBMPs, FRMPs, Rural Development Programmes, Natura2000 management plans and national adaptation strategies;
- Provide better access to European and national funds for integrated measures such as NWRM (see section 4.3);
- Strengthen the coordination of WFD and FD implementation to identify mutually supportive NWRMs.

4.2. Give more attention to land use planning in water management

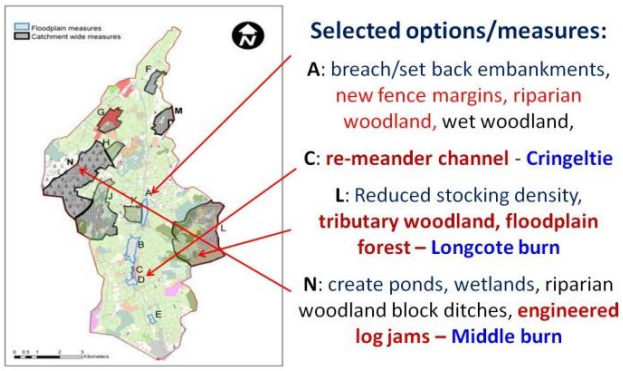
The implementation of NWRM often requires large areas of land. These might not be available or difficult to access due to private ownership of land and water or regulations on spatial planning. Land may be challenging to acquire when financial compensation and land consolidation is required. Stronger coordination can be valuable, as both water management and spatial planning use a multi-functional approach and aim to integrate all sectors, including agriculture, recreation, industry, and households. Water management authorities typically work at river basin and catchment scales, while land use planners typically work at the scale of administrative areas such as municipalities. As a result, their planning units often do not match up, creating barriers in terms of integration. Box 4 below presents two cases stressing the spatial dimension of NWRM implementation within a catchment/river basin scale.

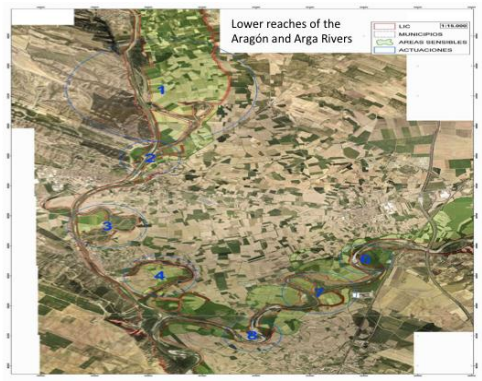
In addition to the recommendations under section 4.1, the following steps should be considered to improve coordination of water management and spatial planning. These are:

- Early involvement of land-use planners in river basin and floods risk management planning. This is done, for example, in the Eddleston river basin (Scotland, see box 4)
- Expanding from the traditional “water stakeholders” to land use and spatial planning stakeholders such as private owners of land.
- Coordinate the development of RBMPs and FRMPs with spatial or land-use planning.
- Where relevant, upscale the effectiveness of many local-scale NWRM measures to the river basin scale. This may require the up scaling of the spatial planning process to a more large-scale strategic planning to encompass the requirements at river basin scale, e.g. large-scale floodplain restoration projects.
- Systematically consider the role of green infrastructure in the planning and authorisation of new urban developments.

Box 4. Putting NWRM into practice at the sub-basin spatial scale

Decades of human interventions for protecting agricultural land and villages had transformed the **Eddleston Water** (**UK**, part of the larger Solway Tweed River Basin District **between England and Scotland**) into an ecologically-poor river: straightened, embanked and cut off from its floodplain. To address the objectives of both flood and habitat policies, new measures including NWRM (such as the establishment of riparian woodlands, the restoration of floodplain and the creation of wetlands) were proposed for different parts of the sub-basin and implemented within a truly participatory process at the sub-basin scale. These measures also helped to improve the water status, thus contributing to the achievement of the WFD good status.





The **Arga and the Aragón rivers** are two of the main tributaries of the Ebro River (**Spain**) with very intense river dynamics and swift adjustments to natural and artificial flow changes. These dynamics had been significantly altered by river (defense) works that eliminated most of the flooding points while bringing the river ecosystem to a poor ecological status. NWRM measures - such as the removal of earth embankments, the reconnection and ecological improvement of oxbow lakes and the restoration of wetlands and floodplains - have been proposed in different parts of the catchment to achieve the overall improvement of the fluvial ecosystem, leading to the recovery and increase in valuable water-dependent ecosystems hosting in particular the European mink (*Mustela lutreola*) and priority habitats, and providing solutions to the endemic flood challenges of the river system.

Source: NWRM Pilot Project (www.nwrm.eu)

4.3. Mobilise and combine financial resources

Limited financial resources are often mentioned as a barrier to the implementation of NWRMs. Many projects that aim at constructing and maintaining NWRM benefit from European, national, regional or local public funds. But experience shows that the financing potentials of public funds often remain largely untapped. Factors that explain this situation include: co-financing rules that make them less attractive in some regions; the absence of binding targets within certain policies and funding instruments; related administrative burden making access difficult for individual professionals and small municipalities; the short duration of these funds (a few years only); possible conflicts with state aid rules. Funding is also particularly challenging when: (1) the purchase of land or compensation for changes in practices of land-owners or land managers (e.g. farmers) is needed, often requiring complex negotiations; (2) long-term financial support for NWRM maintenance costs is at stake; and (3) when there is no single major and well-identified benefit that can make the measure sufficiently "attractive" for one policy planning process (e.g. WFD, FD, Habitats Directive...) that will channel financial resources.

Today, funding opportunities for NWRM exist in most of the EU funding mechanisms, in particular: the European Agricultural Fund for Rural Development (EAFRD) (which is Pillar 2 of the Common

Agriculture Policy), the European Regional Development Fund (ERDF), the European Social Fund (ESF) and the Cohesion Fund (CF). In particular, the Rural Development Programs (RDP) represent a key source of financing for supporting NWRM that can be included in agri-environment climate measures, non-productive investment measures, Natura 2000 and WFD-related payments or forest/afforestation measures. Competitive funding to support NWRM is also available through the Natural Capital Financing Facility (NCFF), the financial instrument of the LIFE 2014-2020 programme: it gives priority to integrated water catchment projects that represent a clear opportunity for NWRM funding accounting for their multiple benefits. The EU research programme Horizon 2020 also offers funding opportunities for enhancing the existing knowledge base on NWRM under the Challenge Climate Action, Environment, Resource Efficiency and Raw Materials.

Accessing private financing sources, in combination with public sources, also represents an option for supporting NWRM implementation in particular when public funds are scarce. Private investment can be attracted, for example, through Payments for Ecosystem Services (PES), product labelling and certification, bio-carbon markets or biodiversity compensation funds. These financing mechanisms have great potential when compensation to land users come into play, as they can substitute public compensation payments while providing land users with an alternative/complementary source of income. Box 5 below illustrates different funding mechanisms that can support NWRM.

Box 5: Financing NWRM: Examples from Germany and France

In **Germany**, two financial instruments have been created by which the funding of implementing NWRM is an option.

- The **German Forest Climate Fund** (or Waldklimafonds in German) is a national programme that supports projects that aim at adapting forests to climate change by enhancing, in particular, the retention of water in forest areas.
- The **MoorFutures** is a voluntary carbon market instrument implemented by the governments of two Federal States in Germany - Mecklenburg Western Pomerania and Brandenburg. MoorFutures certificates can be purchased to offset CO_2 emissions of companies, organisations and individuals. For 50-70 €, one ton of CO_2 emissions can be offset. The finances are then invested in protecting and restoring peatland (or moor) that are sinks for carbon while also performing water and nutrient retention functions. Since 2012, nearly 10.000 certificates have been sold funding the restoration of two peatlands.

In **France**, Water Agencies give subsidies to support the implementation of WFD measures. The Seine-Normandie Agency, for example, offers higher subsidy rates to implement NWRM: 60-70% compared to 20-40% for grey infrastructure. Covered measures include the reduction of runoff in urban areas, retention ponds and vegetated structures (e.g. grazed trenches, permeable pavements). The Agency also subsidises 60% of the land acquisition costs for these measures.

Sources: NWRM Pilot Project; www.waldklimafonds.de ; http://www.moorfutures.de/en/projects/projectregister; http://www.eau-seine-normandie.fr/index.php?id=7687

To enhance the implementation of NWRM, the following steps should be pursued:

- To promote the development of truly integrated projects (as promoted by LIFE) for supporting the implementation of NWRMs at the sub-basin scale for achieving multiple objective goals, as this will facilitate the mobilisation of combined sources of funding (including EU funding).
- To actively promote synergies between, and a combination of, different EU funding instruments to optimise the investment opportunities and leverage additional funding for NWRM.
- To support the development of innovative financing instruments and payment schemes, such as shared investments between beneficiaries (public and private), reduced taxes, subsidies for the implementation of NWRM, payments for recovering NWRM costs from sectors benefiting from NWRM.

4.4. Raise awareness, strengthening the knowledge base and exchange of best practices on NWRM.

The implementation of NWRM is often challenging from a technical point of view. Considering that NWRM can be used to pilot integration and coordination across sectors and policies, the implementation of NWRM may also be challenging from an institutional point of view especially in the start-up phase. For this purpose, the following recommendations are given:

- Exchange best practices, tools and methodologies. These can act as a catalyst to boost the further uptake of NWRM. Currently under development by the European Commission-funded NWRM Pilot Project are a catalogue of measures and a community of practice.
- Raise awareness at local level of the possibilities and the multi-benefits aspect of these measures, alongside the training of experts to help decision makers to implement them, or propose better options.
- Involve local communities and organisations early in the process, especially with a view to identifying the triggers that communities need to engage lasting changes.
- Put more emphasis on NWRM research in order to reduce uncertainties in the effectiveness of NWRM related to their location, scale, operation and maintenance; and to mitigate possible negative effects that they may have; and to unlock existing financial, legal etc. barriers.

In order to reach the full potential of NWRM, tools could be helpful and used such that the multiple benefits for various policy goals can explicitly be accounted for, both in the planning and implementation stage, but also as part of Member State reporting.

5. Conclusions

Natural Water Retention Measures (NWRM) are multi-functional measures that aim to protect water resources using natural means and processes. NWRM can contribute to reducing the risk of floods and water scarcity and drought while also improving the status of surface and ground water bodies. NWRM can support the achievement of the goals of a range of EU policies, including those for surface water, groundwater and coastal management, nature conservation, agriculture, forestry, urban, disaster risk management, green growth and climate change mitigation and adaptation.

Despite growing evidence, the lack of knowledge and awareness of the potential costs and benefits NWRM, can have remains one of the strongest impediments to their widespread implementation, together with the complex process for implementation. Furthermore, the ex-ante assessments performed under different (sectoral) planning processes rarely provide the opportunity of simultaneously considering the multiple benefits of NWRM and their overall cost-effectiveness in contributing to the achievement of multiple policy goals. In addition, more research and demonstration in pilot activities regarding the effects of NWRM on flood mitigation at the catchment scale needs to be promoted to foster the uptake of NWRM by decision makers in flood risk management.

The integration and coordination of planning across sectors and scales is vital for many EU policies, and for NWRM in particular. NWRM can contribute to achieving the objectives of the Water Framework Directive and the Floods Directive. Win-win situations have to be identified at the catchment scale, such as not to compromise the objectives of either Directive. Their uptake should therefore be promoted in the next and subsequent planning cycles of the WFD and FD. In addition,

NWRM can contribute to achieving objectives of the Birds and Habitats Directives, for example as measures for achieving favourable conservation status, the connectivity requirements of Natura2000 and the restoration target of the EU 2020 Biodiversity Strategy (Target 2). In order to fully enjoy the multiple benefits, the selection for NWRM is best coordinated across River Basin Management Plans, Flood Risk Management Plans, *Natura* 2000 Management Plans, the Rural Development Programmes and urban stormwater management. Considering that the implementation of large-scale NWRM can be very challenging, especially regarding compensation and land consolidation, there is in particular a need to coordinate river basin planning with land use and spatial planning.

Limited financial resources are often mentioned as a barrier to the implementation of NWRMs. While a range of funding sources is available at European and other levels, utilisation remains limited. It is recommended to explore ways of combining and tailoring them and to develop innovative financial incentives and payment schemes giving incentives to deliver the multiple benefits NWRM can provide.

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