Workshop on hydro-morphological measures under the Floods and Water Framework Directives "Finding synergies and addressing challenges"

Background paper with conclusions from the workshop 4/5.12.2018 Budapest/Hungary

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1 Introduction

1.1 Background

Along with storms, floods are the most relevant natural disaster in Europe, in terms of economic costs due to direct damage to infrastructure, property and agricultural land, and indirect losses (e.g. production losses caused by damaged transport or energy infrastructure)[1]. Since centuries, urbanization has been accompanied by the construction of flood control infrastructures (levees, retention basins, channel straightening, transversal barriers etc.). In order to protect population and assets, such structures often interrupt river continuity, i.e. by disconnecting channels from floodplains, creating longitudinal barriers between upstream and downstream and straightening river stretches. Flood control can also be exerted by management of vegetation and/or sediments (e.g. selective cuts, dredging, etc.). Such actions may alter the ecological dynamics[2].

The 2018 EEA assessment of the State of Water[3] concluded that hydromorphological modifications causing altered habitats are, next to diffuse pollution from agriculture, the main reason for not reaching good ecological status (GES) / good ecological potential (GEP). The second River Basin Management Plans (RBMPs) show that the most commonly occurring pressures on surface water bodies are hydromorphological, affecting 40 % of all such bodies. In addition, 17 % of European water bodies have been designated as heavily modified (13 %) or artificial (4 %) water bodies. In fact, the second RBMPs (of 25 Member States) show that flood protection is the most common use for designating HMWBs (approximately 4500 HMWB across the EU). Also, the Commission assessment of the first and second RBMPs concluded that hydromorphological pressures are mainly attributable to hydropower, navigation, agriculture, flood protection and urban development.

At the same time, the Floods Directive aims to reduce and manage the risk of flood on human health, the environment, cultural heritage and economic activity through the implementation of combinations of different measures which may impact the hydromorphology of water bodies.

Hence, further discussions and exchange on hydromorphological measures in the context of the Floods and Water Framework Directive is facilitated for the coherent implementation of both Directives.

1.2 Relevant CIS process related to the topic of the workshop

As hydromorphological aspects between the Water Framework Directive (EU Directive 2000/60 - WFD) and the Floods Directive (EU Directive 2007/60 - FD) refer to the same fluvial processes, the issue of hydromorphology and flooding has been addressed several times within the CIS process. A first workshop "Linking the Floods Directive and the Water Framework Directive" on the issue was held on

[1] EEA, 2017. Climate change adaptation and disaster risk reduction in Europe, EEA Report No 15/2017 Copenhagen.

[2] https://ec.europa.eu/jrc/en/publication/wg-ecostat-report-common-understanding-using-mitigation-measures-reaching-good-ecological-potential

[3] See https://www.eea.europa.eu/publications/state-of-water

8-9 October 2014 in Rome, Italy[4]. The purpose of that first workshop was to highlight the links between the two Directives and allow discussion of the possible joint work of the relevant expert groups on these issues. In the discussion in Rome, the Programmes of Measures were considered as the most crucial common aspect. Also, the resource document "Links between the Floods Directive (FD 2007/60/EC) and Water Framework Directive (WFD 2000/60/EC)[5] touches on the issue of hydromorphological measures as a common element between both Directives. Since 2016, the various activities on hydromorphology within the CIS have been coordinated by an Ad-hoc Task Group (ATG) on Hydromorphology under the SCG (see 2016 Terms of Reference for ATG), in close cooperation with other CIS working groups, especially ECOSTAT. One of the tasks of the ATG is to deliver a report on hydromorphology in the Floods Directive (Report on knowledge exchange and key conclusions from workshop).

In addition, the EEA has been working on relevant issues, which should be considered in this context. In 2016, the EEA published a report on "Flood risks and environmental vulnerability - Exploring the synergies between floodplain restoration, water policies and thematic policies"[6]. The report focuses on the role of floodplains in flood protection, water management, nature protection or agriculture and the impact of hydromorphological alterations on the ecosystem services that floodplains provide. In 2017 the EEA also published a report on green infrastructure (GI) and flooding. The report looks at a number of case studies where the effectiveness of so-called 'GI solutions'[7] is demonstrated[8]. In 2018 the EEA also released a briefing on the importance of floodplains and why natural condition of flood plains are an important ecological part of a river system[9].

The Common Implementation Strategy (CIS) of the WFD has been dealing with hydromorphological issues since its first work programme. The table below provides an overview of relevant documents related to the issue of flooding and hydromorphology:

[4] http://www.isprambiente.gov.it/en/archive/ispra-events/2014/october/interconnessioni-en-en

[5] https://circabc.europa.eu/sd/a/124bcea7-2b7f-47a5-95c7-56e122652899/inks%20between%20the%20Floods%20Directive%20and%20Water%20Framework%20Directive%20-%20Resource%20Document

[6] https://www.eea.europa.eu/publications/flood-risks-and-environmental-vulnerability

[7] https://www.eea.europa.eu/publications/green-infrastructure-and-flood-management

[8] However it should be noted that GI solutions are not always effective, depending on physical factors and management strategies.

[9] EEA 2018: why should we care about floodplains?: Briefing No 14/2018

When	Output
2005	Guidance Document no. 4 on the identification and designation of HMWB and AWB[10]
2014	Technical Report: Links between the Floods Directive (FD 2007/60/EC) and Water Framework Directive (WFD 2000/60/EC)
2015	CIS summary conclusions on workshop on Hydromorphology and WFD classification[11] focusing on WFD assessment methods for BQEs and hydromorphological assessment methods (including a discussion on the use in MS of CEN standards).
2017	Workshop on river hydromorphological assessment and monitoring, November 2017, Madrid[12].
2017	Guidance document on Article 4(7) which addresses new modifications to the physical characteristics of surface water bodies[13]
2018	Report on common understanding of using mitigation measures for reaching Good Ecological Potential for heavily modified water bodies - Part 2: Impacted by flood protection structures[14]
2018	Workshop on significant adverse effects on use or the wider environment from measures, April 2018 - Brussels[15]

[10] https://circabc.europa.eu/sd/a/f9b057f4-4a91-46a3-b69a-e23b4cada8ef/Guidance%20No%204%20-%20heavily%20modified%20water%20bodies%20-%20HMWB%20(WG%202.2).pdf

[11] Summary conclusions workshop "Hydromorphology and WFD classification", 12-13 October 2015, Oslo, Norway, available: https://circabc.europa.eu/sd/a/34db37ad-21f4-4844-b716-4d7bc41d8039/2.1%20-%20Hymo_WS_summary_conclusions.pdf

[12] The final versions of the reports addressing river hydromorphological assessment and monitoring are on CIRCABC: Part 1: https://circabc.europa.eu/w/browse/cb7d6f1d-3fac-441d-bf24-1ecff5a90c3f, Part 2: https://circabc.europa.eu/w/browse/79ee7e82-e3ba-4bcc-bcb3-26c4116c982a

[13] https://circabc.europa.eu/sd/a/e0352ec3-9f3b-4d91-bdbb-939185be3e89/CIS_Guidance_Article_4_7_FINAL.PDF

[14] https://ec.europa.eu/jrc/en/publication/wg-ecostat-report-common-understanding-using-mitigation-measures-reaching-good-ecological-potential

[15] https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/e9fdb82f-3537-48d1-834f-ab6fa8ec22ca?p=1&n=10&sort=modified_DESC

When	Output
2018	ECOSTAT classification workshop, 29.05-.01.06.2018 Tallinn[16]; Background paper on hydromorphology[17]

1.3 Relevant links between the two Directives in the context of hydromorphology

The Floods Directive aims to reduce and manage the risk of flood on human health, the environment, cultural heritage and economic activity through the implementation of combinations of different measures envisaged by Flood Risk Management Plans (FRMP). According to Article 9 FD, "*Member States shall take appropriate steps to coordinate the application of FD and that of WFD focusing on opportunities for improving efficiency, information exchange and for achieving common synergies and benefits having regard to the environmental objectives laid down in Article 4 of Directive 2000/60/EC*". As illustrated further below, measures undertaken in the context of the Floods Directive can be structural and non-structural measures and may have negative or positive impacts on the hydromorphology and overall status of water bodies.

The WFD states under Article 1e: "The purpose of this Directive is to establish a framework for the protection of inland surface waters, transitional waters, coastal waters and groundwater which (…) contributes to mitigating the effects of floods and droughts". The aim of the WFD is for Member States to protect, enhance and restore all surface waterbodies with the aim of achieving good water status (natural) or good water potential (artificial, heavily modified). Moreover, Member States must implement necessary measures to prevent a deterioration of the status of water bodies.

The WFD further states that a water body may be designated as a Heavily Modified Water Body (HMWB) if the changes to the hydromorphological characteristics of that body necessary for achieving good ecological status would have significant adverse effects on flood protection (Art 4(3)a(iv), among other uses listed in Art 4(3)a). However, this designation is linked to a set of conditionalities. In the case of existing flood protection schemes, it has to be proven that restoration measures needed to achieve GES have a significant adverse effect on flood protection and that the beneficial objectives of the flood defence activity cannot be achieved by other means that are a significantly better environmental option, technically feasible and not disproportionately costly. In case of the designation of a HMWB due to flood protection, mitigation measures may be needed that consider the relevant site-specific circumstances to achieve the objective of good ecological potential.

In relation to new flood protection measures, Article 4(7) of the WFD may be of particular relevance as it allows deterioration or failure to achieve good status/potential in case specific conditions are met. This

[16] Presentations: https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/08ebf1c8-5d2a-49cf-bd03-30b0f33deb28?p=1&n=10&sort=modified_DESC

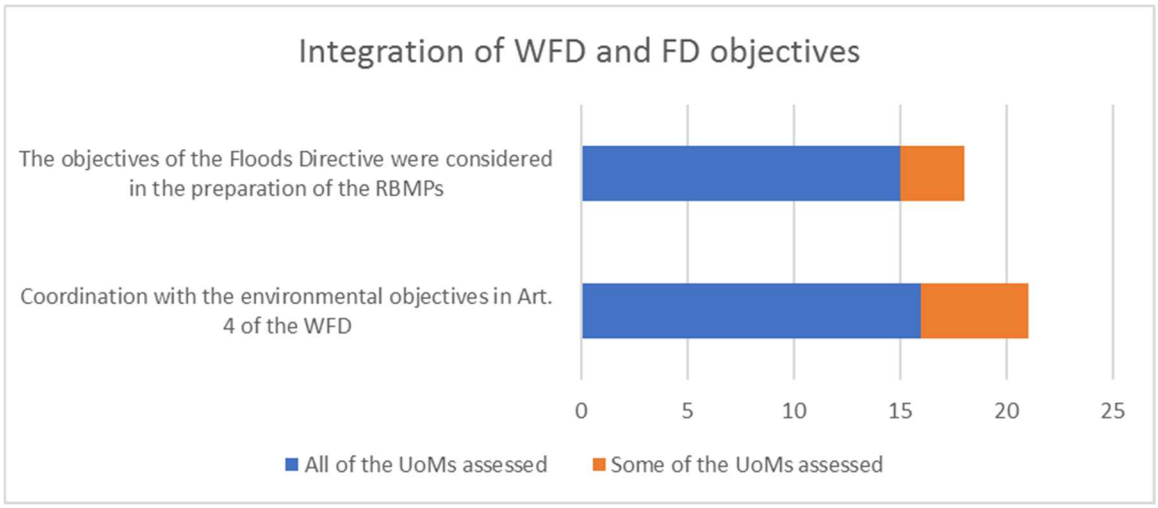
[17] https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/57aa5ad6-88af-4c73-97e3-ef5c73d20c5d/details

deterioration can be beside others the result of new modifications to the physical characteristics of a surface water body, caused by flood protection measures.

1.4 Lessons learned on coordination between the FD and WFD Directives

The assessment of the FRMPs[18] showed that 20 out of the 26 FRMPs refer to coordination with the environmental objectives set out in Article 4 of the WFD (see Figure 1 below). On the other hand, in just over half of MS the objectives of the FD were considered in the preparation of the RBMPs (based on reporting of RBMPs under the WFD). The majority of Member States have carried out joint consultations of the second cycle RBMPs with the Flood Risk Management Plans and a few have integrated the two plans into a joint plan.

Figure 1: Integration of objectives in RBMPs and FRMPs in the Units of Management (UoM)



Source: MS reporting under the FD and the WFD; FRMPs

Moreover, in at least nine MS, the FRMPs describe measures in terms of their WFD objectives: For many of these FRMPs, measures are assessed to determine whether they impact on WFD objectives.

In several areas, FRMP measures can support WFD objectives and vice versa. Moreover, synergies between FRMPs and RBMPs can include:

- Consistent and compliant application of WFD Article 4(7) and designation of heavily modified water bodies due to measures under the FD, e.g. flood defence infrastructure;
- The design of new and existing structural measures, such as flood defences, storage dams and tidal barriers, have been adapted to take into account achieving WFD Environmental Objectives;
- The use of sustainable drainage systems, such as the construction of wetland and porous pavements, have been considered to reduce urban flooding and also to contribute to the achievement of WFD Environmental Objectives;

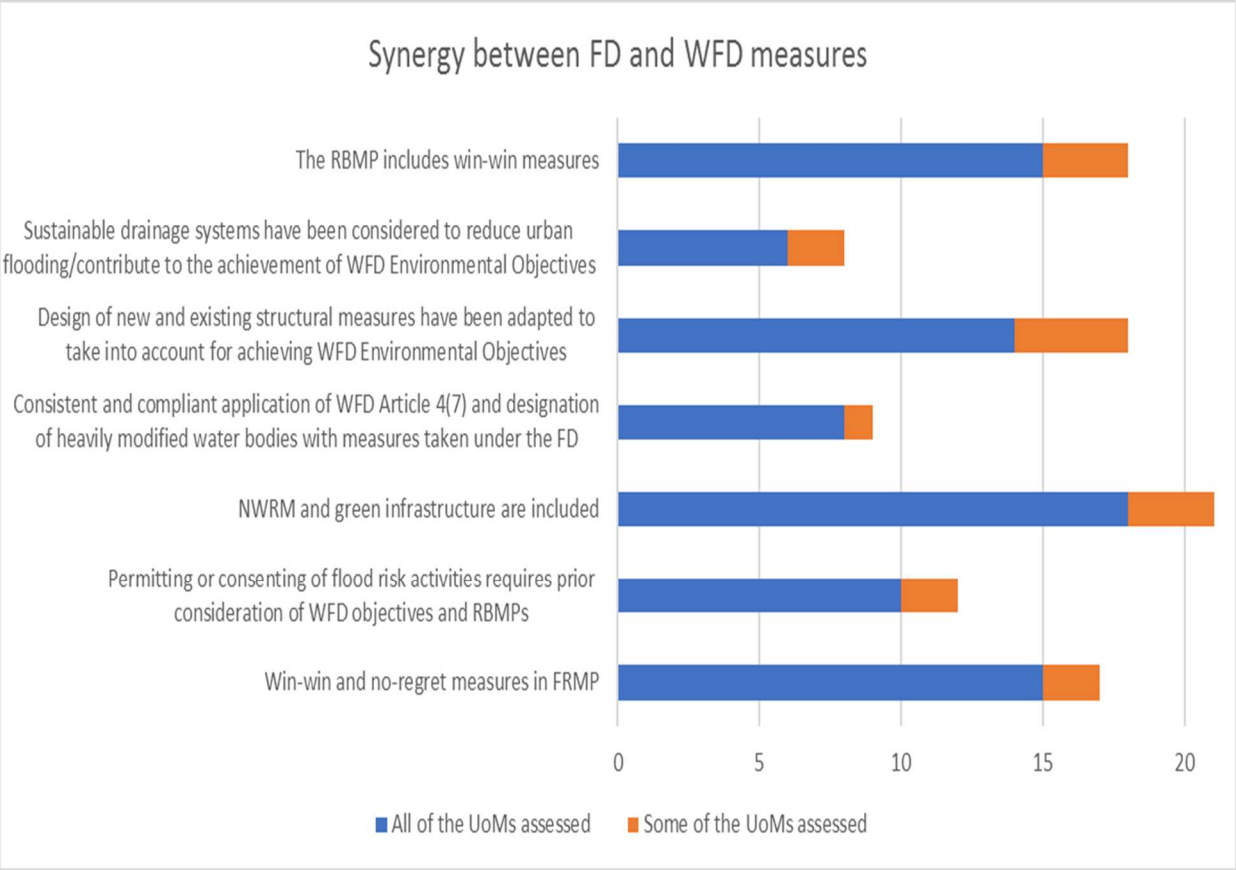
[18] Source: WISE electronic reports

- The RBMP PoM includes win-win measures in terms of achieving the objectives of the WFD and FD, drought management and NWRMs;

- Permitting or consenting of flood risk activities (e.g. dams, dredging, flood defence construction) requires prior consideration of WFD objectives and RBMPs.

The figure below shows how these actions were applied in the FRMPs assessed.

Figure 2: Synergies between FRMP and RBMP measures



Source: MS reporting under the FD and the WFD; FRMPs

In the context of the RBMPs under the WFD, a specific key type of measures refers to natural water retention measures. This key type of measure has been reported for addressing significant hydromorphological pressures in about one-third of the Member States.[19] Examples of such natural water retention measures include among others the restoration of floodplain meadows and floodplain forests.

At the same time, almost all Member States include measures for natural water retention (NWRMs) in some or all of their FRMPs.

[19] Source: WISE electronic reports.

1.5 Aim of the workshop

The specific aim of the workshop is to discuss:

- The implementation of restoration/mitigation measures to achieve WFD good status/potential at water bodies where hydromorphology is impacted by existing flood risk management measures,
- Impacts of new flood protection measures on hydromorphology and related assessments under the WFD.
- The role of sediment management strategies as a mean to achieve a dynamically stable equilibrium of rivers to achieve the objectives of both directives.

Therefore, also a set of case studies (Annex 1: Case Studies) has been collected and further will be presented at the workshop.

1.6 Audience for the document

The primary target audience for this background paper are the participants of the workshop and those involved in the implementation of the FD and/or the WFD, at either an international, national, regional or local scale. The paper is also intended to be of benefit to other parties interested in the implementation processes of the two Directives.

2 Effects of measures related to hydromorphology on status

Before putting measures related to hydromorphology in place – either to reach GES/GEP or to increase the level of flood protection – it is important to assess their effects on the status of water. For measures that improve the water status, this is important from a cost-effective point of view and for measures that increase flood protection, this is important to see if they are deteriorating the water status. In both cases appropriate assessment methods are needed.

According to Article 4 of the WFD, the assessment of good ecological status and potential needs to be based on biological quality elements (BQEs) and supporting physico-chemical and hydromorphological quality elements. The ecological status of a river can be assessed by evaluating indicators for the composition, abundance, species diversity or absence of various groups of organisms known as biological quality elements. BQEs that can be used for the classification of a water body's ecological status include phytoplankton, macrophytes and phytobenthos, benthic invertebrates fauna and fish fauna. Complementary hydromorphological quality elements are 1) morphological conditions 2) hydrological regime (rivers and lakes, 3) river continuity (rivers) and 4) tidal regime (coastal and transitional waters). Most water bodies have not been classified using all quality elements. The most frequently used BQEs for rivers are benthic invertebrates, phytobenthos/other aquatic flora/macrophytes

and fish; for lakes phytoplankton and for transitional and coastal water phytoplankton and benthic invertebrates[20].

Biological quality elements can be negatively impacted by hydromorphological pressures, such as physical alterations to water bodies (including continuity interruptions) that affect channels, shores, riparian zones and changes in water levels/flows due to dams, embankments, channelization and flow regulation.

[20] EEA (2018): European water – Assessment of status and pressures.

Table 1: Hydromorphological pressures and impacts on BQEs[21]

BQE	Pressure on BQEs with hydromorphological relevance
Phytoplankton	Not well researched. Mainly used for assessing nutrient levels.
Macrophytes	Channelisation causes physical alteration to sites and maintenance therefore in the form of vegetation management and dredging can negatively impact macrophyte traits
Benthic Invertebrates	Dredging can destroy habitat and increase erosion
Fish	Transversal structures can interrupt fish migration patterns and prevent access to spawning areas; dredging can negatively impact spawning areas; dams and weirs can increase sediment in water and negatively affect fish feeding and spawning areas; channelization can increase the velocity of streams, which can negatively impact fish that cannot tolerate fast-moving water.

While there is some understanding on how hydromorphological pressures can impact certain biological quality elements, at the moment further work is still needed to increase the common understanding on how WFD hydromorphological supporting elements are correlated to the BQEs. At the same time, supporting elements respond much more directly to restoration activities than BQEs, which are usually subject to hysteresis effects and may require many years to colonize restored water bodies. Supporting elements are therefore well suited to identify early successes of restoration. Among others, this is particularly applicable for hydromorphological parameters in surface waters.

Biological methods are typically focused on specific species/groups and the assessment metrics that are used do not necessarily respond to hydromorphological modifications in a comprehensive way. On the other hand, some MS methods assess hydromorphology per se, due to the complexity of responses, the lack of knowledge of certain key linkages between hydromorphology and biology, the complexity of responses, and, above all, to the fact that hydromorphology promotes functionality for river ecosystems (but the established BQE methods do not necessarily address this functionality).[22]

[21] See: wiki.reformrivers.eu; ETC (2015): Hydromorphological alterations and pressures in European rivers, lakes, transitional and coastal waters

[22] Source: Summary Report, Key conclusions and Recommendations of CIS Workshop on River Hydromorphological Assessment and Monitoring, 20-22 November 2017, Madrid. See: https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/29252c7e-4d00-4f33-a52c-e188e0ed9e5f?p=1&n=10&sort=modified_DESC

The restoration of habitats and lateral/longitudinal reconnection has a positive effect on the aquatic ecosystem, even if there are still remaining gaps to better and more precisely understanding how hydromorphological pressures affect biological communities[23].

3 Restoration/mitigation measures for the achievement of good ecological status/potential and potential effects on flood protection

3.1 Types of restoration and mitigation measures for achieving GES/GEP

In order to address the effects of hydromorphological alterations on the aquatic ecology and related processes stemming from existing modifications due to flood protection, measures need to be taken in order to achieve the WFD environmental objectives where they are not yet met. In general, two possibilities exist depending on whether the water body is designated as a natural water body or qualifies for the designation as HMWB/AWB:

- Restoration: By default, restoration measures should be explored, e.g. replacing hard infrastructure with a non-structural one (removal of structures without reducing safety levels), with the aim of restoring a water body close to its natural state. This would then require the water body to achieve GES.

- If restoration is not possible, then mitigation measures can be put in place. Such mitigation measures will then support reaching GEP.

The table below provides an overview of different types of measures to achieve good status/potential at water bodies impacted by flood protection.

[23] Source: Summary Report, Key conclusions and Recommendations of CIS Workshop on River Hydromorphological Assessment and Monitoring, 20-22 November 2017, Madrid. See: https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/29252c7e-4d00-4f33-a52c-e188e0ed9e5f?p=1&n=10&sort=modified_DESC

Table 2: Types of restoration and mitigation measures to reach GES/GEP at water bodies impacted by flood protection

Clusters of measures	Detailed measures
Measures to address interruption of longitudinal continuity (linked to dams for floods attenuation, Retention Check Dams, Grade control structures)	• Fish passages • Fish ramps • Downstream sediment by-pass actions • Openings (filtering action) for sediments • Additional flows
Measures to address interruption of lateral continuity (linked to bank reinforcements/protection, Embankments, Groynes, Concrete sea wall)	• Replacement of hard structures with soft engineering ones • Creation of natural-like irregularities • Set-back embankments • Increase of roughness trough wood/rocks • Beach creation or nourishment • Reconnection of side arms
Measures to address complex works (linked to flood detention basins, Flood Deviation channels, Flood Drainage systems, Channel straightening, Channel revetment)	• Creation of natural-like diversity within the flood detention basin • Storage tanks off-stream to delay and regulate drained water into the river • Irregular shaping of the banks to favour morphological diversity and habitat heterogeneity • Increase of roughness elements (cobbles or boulders)
Measures for sediment management and maintenance (linked to channel re-profiling (dredging included))	• Improve in-channel morphological diversity and riparian habitat • Create low-flow channel • Undertake habitat enhancement including provision of fish refuges

Source: Summary Report, Workshop on Significant adverse effects on use or the wider environment from measures 23- 24 April 2018 – Brussels. See: https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/e1943d75-583f-4059-8328-da918a0380b6/details

It should be noted that measures to achieve the WFD environmental objectives (see above) may positively or negatively influence the level of flood protection. This aspect needs to be considered in the planning process. Natural measures to manage flooding from rivers can play a valuable role in flood prevention, but there is little information on how specific mitigation measures related to the WFD impact flood protection

3.2 Positive impacts of restoration and mitigation measures on the level of flood protection

Where possible, win-win measures should be strived for to achieve GES while at the same time maintain or even improve the level of flood protection. For example, measures to restore natural floodplains by "making room for the river", for example by removing flood walls and other obstacles, have been shown to reduce flood water levels.

There are some interventions for which evidence of positive impacts on mitigating floods exist, but these tend to be most easily observed in the small-scale river catchments[24]. However, it is important to note

[24] For further details see http://ec.europa.eu/environment/water/adaptation/ecosystemstorage.htm

these measures might also have an impact on flood protection (e.g. reduce the flow or cause flooding to other landowners' property). The ultimate goal when implementing these measures is to achieve a balance between providing flood protection and protecting the conservation value of a watercourse.

3.3 Significant adverse effects of mitigation measures

In some cases measures to achieve GES may have a significant adverse effect on the level of flood protection which is relevant in the context of HMWB designation. The definition of the GEP allows taking into account such significant adverse effects. In the context of HMWB designation and GEP definition, the question of which measures for achieving GES or GEP constitute a 'Significant adverse effect on use or the wider environment' requires particular attention (see Article 4(3)(a) WFD)). At a CIS workshop on the WFD and HMWB (in 2009), it was concluded that the reasons and criteria for judgements on significance should be made clear.[25] Further discussions in a workshop on Significant adverse effects on use or the wider environment from measures on 23- 24 April 2018 – Brussels concluded[26]:

- **Definition of "use":** There is a need to distinguish flood protection for different purposes when assessing significance adverse effects of measures. Flood protection should not be considered a single use, as it depends on how the space is used, e.g. urban, agriculture or infrastructure. Typically, there is a hierarchy of uses: protecting lives is more important than protecting property which is more important than protecting grasslands. The arguments have to be convincing for the use of public money. Note that agriculture is not always protected from floods by everyone and everywhere; this depends on many factors including e.g. key benefits and geographical aspects; even removing flood defence in agricultural areas seems to be considered as a non-significant effect in some cases.

- **Key benefits and types of adverse effects:**
  - The key benefits of flood protection depend on the use of the areas which are protected from flood damage (e.g. safety of the population, economic benefits, or even cultural heritage, etc). There is also a need to consider where the benefit occurs, as it could be far away from the flood protection structure and protected area. These considerations are related to spatial planning within the catchment.

  - The increase of risk of flooding is the main adverse effect of measures for achieving GES or GEP on the use of flood protection.

- **Issues of scale:**
  - The importance of spatial planning, at multiple scales, especially for assessing the achievement of good status (GES) and the designation of HMWB was noted.

  - For flood protection use, there is always a need to look at both local and larger scales because of interdependencies within the catchment. This also applies to mitigation

[25] Conclusions of CIS Workshop Heavily Modified Water Bodies. Brussels, 12-13 March 2009.

[26] Summary Report, Workshop on Significant adverse effects on use or the wider environment from measures 23-24 April 2018 – Brussels. See: https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/e1943d75-583f-4059-8328-da918a0380b6/details

measures for GEP that cannot be seen in isolation from upstream and downstream areas.

- For benefits, larger scales may also be important (e.g. nuclear power plant flooding has far reaching effects).

- **Quantification of significant adverse effect on use:** The main criteria mentioned for the quantification of significant adverse effects is the level of protection in terms of flood hazard (e.g. protection against a 100-year flood) or flood risk. Participants also noted that the areas should be defined which are more or less strategically important for the benefits served by flood protection (protection of urban areas, agricultural areas and/or infrastructure). With respect to agriculture, it is important to take into account the season, importance of the agricultural areas (products thereof e.g. grassland vs. rare vegetables), also in the context of strategic planning. Flood risk management plans should be seen as reference documents for the derivation of elements for the quantification of significant adverse effect on use / risk assessment.

- **What is significant:** The assessment of significance is related to the acceptable risk to the protected benefits (i.e. hazard x damage). The acceptable risk depends on [the nature and] the value of the elements that are protected. It was also noted that the level of protection may sometimes be influenced by a political decision. Flood risk management plans could be seen as reference documents for determining levels of acceptable risk.

- The following table summarises the discussions on possible benefits of flood protection, types of adverse effects of mitigation or restoration measures on flood protection and criteria for assessing the significance of these adverse effects (discussions held at the workshop on Significant adverse effects on use or the wider environment from measures on 23- 24 April 2018 – Brussels):

Table 3: Benefits of flood protection and possible adverse effects on it from mitigation measures in order to achieve GES or GEP

Benefits of flood protection	Possible adverse effects of measures for achieving GES or GEP on flood protection	Criteria for assessing adverse effects of mitigation measures on flood protection	Threshold for significance
Protection of urban areas (households, businesses)	Increase of flood risk in close-by areas Reduction in value of real estate Relocation of households or businesses Increased soil erosion	Flood hazard / flood risk	Acceptable risk to protected benefits (hazard x adverse consequences, depending on the nature and value of the elements at risk)
Protection of infrastructure and traffic routes	Relocation of traffic routes	Flood hazard / flood risk	Acceptable risk to protected benefits (hazard x adverse consequences, depending on the nature and value of the elements at risk)
Protection of agricultural areas (note: agriculture is not protected by default, depends on local conditions)	Reduction of the agricultural production area Change of conditions for production through increasing soil wetness	Flood hazard / flood risk	Acceptable risk to protected benefits (hazard x adverse consequences, depending on the nature and value of the elements at risk)

Source: Summary Report, Workshop on Significant adverse effects on use or the wider environment from measures 23- 24 April 2018 – Brussels. See: https://circabc.europa.eu/ui/group/9ab5926d-bed4-4322-9aa7-9964bbe8312d/library/e1943d75-583f-4059-8328-da918a0380b6/details

3.4 Draft questions for discussion at the workshop

- For which types of ecological restoration and mitigation measures are positive or negative impacts observed on the level of flood protection? Are there relevant examples from your countries?

- In the second FRMPs, are you considering reviewing the flood protection strategy (e.g. removing inefficient structures and studying combinations of new and more efficient structures?)

- Do you have sediment management plans at the catchment scale, and how do they contribute to the objectives of the WFD and the FD?

- How are synergies between funding mechanisms (for WFD and for FD purposes) used in practice to support hydromorphological measures?

4 Effects of new hydromorphological modifications due to flood protection and WFD related assessments

4.1 Identified need for new flood protection measures

The Commission assessment of the first set of FRMPs clearly showed that in most Member States the number of flood protection measures has the highest share out of the four measure categories (Prevention, Protection, Preparedness, Recovery and review). Such protection measures can be classified as follows:

Table 4: Protection measures

Protection measures (numbering based on WISE reporting schema)	
M31	Protection Natural flood management / runoff and catchment management, Measures to reduce the flow into natural or artificial drainage systems, such as overland flow interceptors and / or storage, enhancement of infiltration, etc and including in-channel, floodplain works and the reforestation of banks, that restore natural systems to help slow flow and store water.
M32	Protection, Water flow regulation, Measures involving physical interventions to regulate flows, such as the construction, modification or removal of water retaining structures (e.g., dams or other on-line storage areas or development of existing flow regulation rules), and which have a significant impact on the hydrological regime.
M33	Protection, Channel, Coastal and Floodplain Works, Measures involving physical interventions in freshwater channels, mountain streams, estuaries, coastal waters and flood-prone areas of land, such as the construction, modification or removal of structures or the alteration of channels, sediment dynamics management, dykes, etc.
M34	Protection, Surface Water Management, Measures involving physical interventions to reduce surface water flooding, typically, but not exclusively, in an urban environment, such as enhancing artificial drainage capacities or though sustainable drainage systems (SuDS).
M35	Protection, Other Protection, Other measure to enhance protection against flooding, which may include flood defence asset maintenance programmes or policies

It is obvious that several of the measures listed above will have an impact on the hydromorphological regime and might therefore have an impact on the achievement of the objectives of the WFD. According to the WISE reporting of the second RBMPs, exemptions under Article 4(7) have been most commonly applied in RBDs due to impoundments for drinking water (13 RBDs) followed by flood protection schemes (12 RBDs)[27].

[27] Source: WISE electronic reports.

4.2 Approach to assess the potential impacts of new flood protection measures

For new measures priority should be given to the identification and implementation of those measures that can deliver on the objectives of both directives (win-win measures such as, for example, natural water retention measures or room for the river) or even more environmental policies (biodiversity, birds, habitat, etc.). However, in some cases, e.g. typically in highly urbanised areas, due to scarce or null availability of wide spaces for win-win measures, meeting flood protection objectives may sometimes require new infrastructure that can deteriorate the status or prevent the achievement of good status in one or more water bodies, because there is no other feasible alternative. Such projects may only be authorised if the conditions set out in Article 4(7) of the WFD are fulfilled.

Box 1: Circumstances under which Art 4(7) needs to be applied.

WFD Article 4(7):

Member States will not be in breach of this Directive when:

- *failure to achieve good groundwater status, good ecological status or, where relevant, good ecological potential or to prevent deterioration in the status of a body of surface water or groundwater is the result of new modifications to the physical characteristics of a surface water body or alterations to the level of bodies of groundwater, or*
- *failure to prevent deterioration from high status to good status of a body of surface water is the result of new sustainable human development activities*

and all the following conditions are met:

a) All practicable steps are taken to mitigate the adverse impact on the status of the body of water;

b) The reasons for those modifications or alterations are specifically set out and explained in the river basin management plan required under Article 13 and the objectives are reviewed every six years;

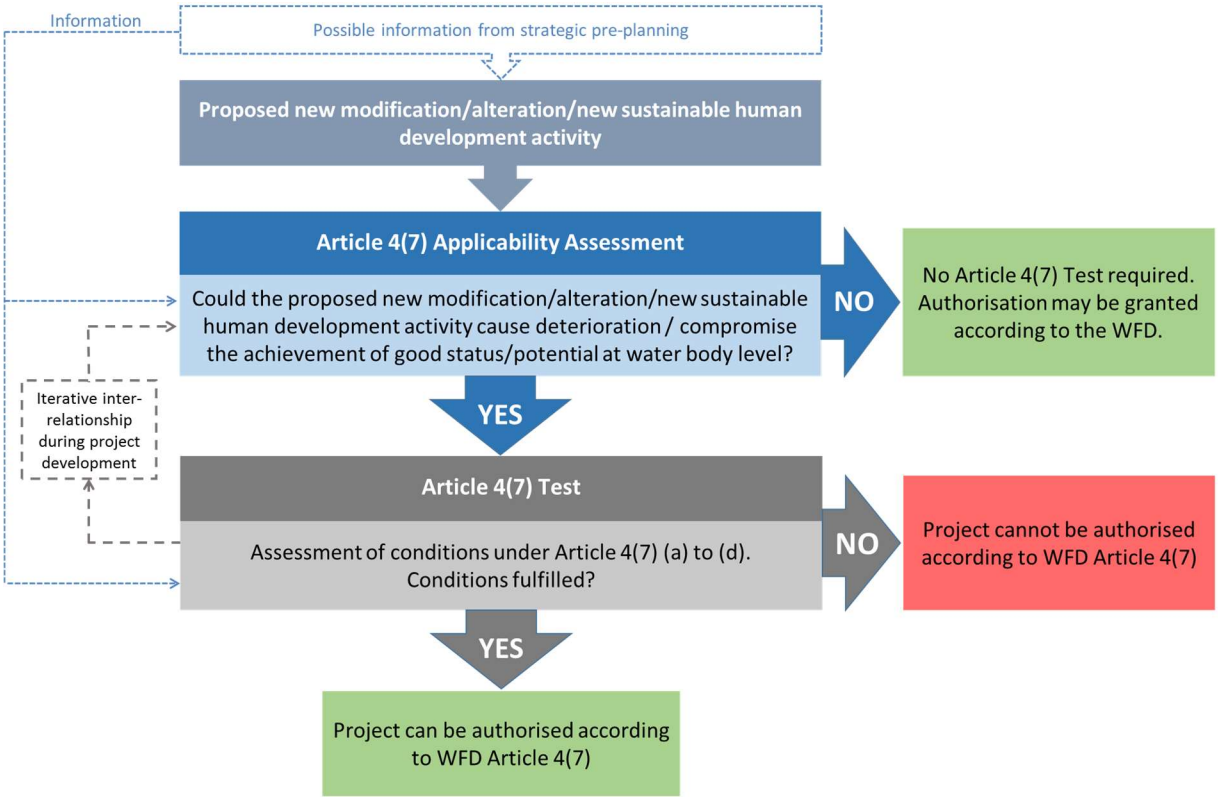
c) The reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives set out in paragraph 1 are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development, and

d) The beneficial objectives served by those modifications or alterations of the water body cannot for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option.

Whether a planned new flood protection project may cause deterioration of water body status/potential and, if so, whether the Article 4(7) conditions are fulfilled, needs to be assessed within an authorisation or licensing process. In 2017 a new CIS guidance on Article 4(7) was endorsed by the Water Directors[28]. Figure 3 outlines the basic logic of the necessary WFD-related assessments.

[28] https://circabc.europa.eu/sd/a/e0352ec3-9f3b-4d91-bdbb-939185be3e89/CIS_Guidance_Article_4_7_FINAL.PDF

Figure 3: Basic logic of the Art 4(7) assessment



Source: CIS Guidance number 36.

In the following, the necessary assessments are explained in more detail.

Phase 1: Applicability Assessment in relation to Article 4(7). This is to determine whether the proposed project may cause deterioration / non-achievement of good status / potential and therefore require an Article 4(7) Test during the permitting phase. The Applicability Assessment provides answers to the following questions:

- Is the project likely to have effects on water body status / potential?
- Is the project expected to cause a deterioration / non-achievement of good status / potential?
- Is an Article 4(7) Test required during the authorisation phase?

In order to do such an assessment, it is important that the links between hydromorphology and its planned modification due to a new flood protection project and the WFD Biological Quality Elements (BQEs) are well understood. This also requires the availability of the necessary expertise for performing such an assessment.

Phase 2: Article 4(7) Test: An Article 4(7) Test requires performing a number of assessments as set out in Article 4(7), which should be as simple and clear as possible but at the same time as detailed and comprehensive as necessary to reach reasonable results. Questions to be answered by the assessment are:

- Are all practicable steps taken to mitigate the adverse impact on the status of the body of water (Article 4(7)(a))? In other words, this condition requires taking all practicable actions leading to less deterioration of the conditions in the impacted water body or minimising the effects compromising the achievement of good status/potential.

- Can the beneficial objectives served by those modifications or alterations of the water body for reasons of technical feasibility or disproportionate cost be achieved by other means, which are a significantly better environmental option (Article 4(7)(d)). It is therefore necessary to assess "alternative means" for proposed new modifications or alterations

- A further condition which needs to be complied with is that "the reasons for those modifications or alterations are of overriding public interest and/or the benefits to the environment and to society of achieving the objectives set out in paragraph 1 are outweighed by the benefits of the new modifications or alterations to human health, to the maintenance of human safety or to sustainable development" (Article 4(7)(c)). Note that not all flood protection measures might automatically be of an overriding public interest.

- The reasons for those modifications or alterations are specifically set out and explained in the river basin management plan and the objectives are reviewed every six years (Article 4(7)(b)).

A planned new flood protection project that may cause deterioration or non-achievement of good status/potential at water body level can only be authorised in case these conditions are fulfilled. Note that the Article 4(7) Test is not required if there is sufficient evidence and justification that the planned flood protection measure will not cause deterioration or non-achievement of good status/potential. Further detailed information can be obtained from the respective CIS Guidance Document on Article 4(7).

4.3 Draft questions for discussion at the workshop

- How do you decide whether a planned flood protection measure has to undergo an assessment for potential deterioration? Which institutions are involved and which expertise is needed?

- Based on your experience, which types of flood protection measures are more likely to cause deterioration of water body status/potential, and which not.

- What is your practical experience with the evaluation in advance (ex-ante) of possible deterioration? How do you evaluate and quantify deterioration in terms of hydromorphological conditions and biological status?

- Have you experienced a case of cumulative effects in one water body or impacts in adjacent water bodies? How has this issue been addressed?

- What is your experience with the assessment of the individual Article 4(7) conditions in case a planned flood protection measure is expected to cause deterioration?

5 Conclusion from the workshop

During the workshop, the following conclusions have been identified based on the break-out group discussions:

Existing hydromorphological modifications due to flood protection and restoration/mitigation measures to achieve the WFD's objectives

1. A key aspect is integrating the whole planning process of the WFD and the FD from start to end, to ensure good coordination between the different Directives' objectives on the level of authorities but also on the level of consultants and planners who prepare relevant assessments. Overall, there is tendency towards more maturity in collaboration and a gradual change from a "grey" towards "green" attitude; however, communication between flood protection and restoration objectives still remains difficult (even within the same institution).
2. For various types of ecological restoration and mitigation measures, positive or negative impacts on the level of flood protection are observed. In practice, most countries look out for measures with positive impacts under both Directives (FD and WFD). If negative impacts on the level of flood protection (especially of urban areas) are recognised, the measures are modified in a way that flood protection is ensured as this is considered as the first priority.
3. In most countries, availability of space is a crucial issue as it is much easier to achieve multiple objectives when there is room to work with. Gaining land for restoration and mitigation measures is a difficult and time-consuming process. When claiming additional land, usually extra effort is needed on communication with the public at local level to raise awareness on ecologically oriented measures. However, there is normally broad acceptance of such measures after their implementation. Pilot projects increase the acceptance and the interest in some cases.
4. Further obstacles to the implementation of restoration and mitigation measures were discussed:
    - unclear legislation at MS level,
    - need of compensation for potential effects on agriculture,
    - lack of connection to spatial planning and land use management,
    - lack of funding,
    - lack of capacity to manage and carry out the projects,
    - lack of quantified evidence and facts showing that natural water retention measures (NWRM) can be as effective as structural flood protection measures,
    - difficulty to achieve changes to existing flood protection structures where the focus of managers and engineers is on maintenance and in particular when they are large scale,
    - also, the needed adjustments to legal requirements are difficult to achieve.
5. Some countries have already considered NWRM in their first FRMPs and the next step is to focus on the implementation of measures and better assessment of benefits from NWRM. Some

countries plan some updates of their flood protection strategies e.g. due to increased knowledge, more coordination with water authorities, update of methodologies for FRMPs, opening the process towards other sectors (spatial and emergency planning). Overall, it was also noted that further discussion is needed on what should be done to have a better uptake of nature-based solutions.

6. The management of sediments was acknowledged as a very important issue from a flood protection and from an ecological point of view. However, most countries do not have sediment management plans in place yet. During the workshop, a sediment management plan at RBD scale was mentioned only for the River Elbe. In addition, specific plans for smaller catchments at local level (e.g. in Norway)[29] or in relation to existing uses (shipping) exist. In the Danube area, there is a key Interreg project on the restoration of the sediment balance for the whole catchment ongoing (Danube Sediment Project), where currently quantitative assessments are undertaken. Qualitative assessments will be undertaken by the ICPDR in 2019 for the 4th time in the frame of the Joint Danube Survey (http://www.danubesurvey.org/jds4/). For coastlines, erosion and sediment transport causing flooding in coastal areas were identified as major issues that do not gain enough attention.
7. A various set of funding schemes for measures (separate for WFD and FD, combined, for FD only) exist. In general, flood protection measures are still considered of higher importance than implementing WFD measures, affecting therefore the availability of related funding. In this context, there is still room for improvement in terms of finding synergies between funding streams to support hydromorphological measures. Synergies can also be achieved via funding mechanisms for nature Directives and funds for climate change adaptation. Apart from finding synergies, ensuring the necessary funding for hydromorphological restoration and mitigation measures also needs to be ensured. In that context, the user pays principle needs to be pointed out.

Planned new hydromorphological modifications for flood protection in the context of the WFD

1. Potential flood protection structures that could deteriorate the status of a water body include in particular impoundments, dams/weirs, dredging (beyond maintenance) and embankments (depending on their size). Flood defences which are adequately set far away from the river banks are expected to have lower effects.
2. When planned flood protection measures undergo an assessment for potential deterioration, this is in most countries linked to EIA assessments. Assessments are based on expert judgement, existing information from monitoring or existing projects and are guided by

[29] Links to sediment management plan in Norway: Flood risk management for the River Laagen: https://www.oppland.no/Handlers/fh.ashx?MId1=12&FilId=6539, Report on sediment sources and sediment transport: http://publikasjoner.nve.no/rapport/2016/rapport2016_89.pdf, Horizon 2020 – Project on nature based solutions, with the same area as one of their demonstrators: https://phusicos.eu/

thresholds for significant pressures. In-house knowledge on ecological aspects within authorities is crucial to check and guide the assessments usually done by contractors.

3. However, there is still a remaining significant level of uncertainty in the assessments as data is often insufficient. With regard to cumulative impacts, hardly any experiences have been identified.
4. It was acknowledged that there is a need to increase the mutual understanding between WFD and FD expert communities, concerning WFD hydromorphology terms and engineering parameters for flood protection. This would help engineers have a better understanding of the context in which flood protection projects take place. This could be promoted by building a network of experts from both communities to share experience.
5. As regards the actual application and different steps of WFD Article 4(7), Member States do not have a wide range of experiences due to the limited application of Article 4(7) so far. For many projects, there is effort to avoid Article 4(7) by screening assessments in advance and avoidance of deterioration already in the planning process. The application of exemptions according to WFD Article 4(7) for flood protection measures is often done on the basis of overriding public interests (protection of lives). Cost benefit assessments are also used for decision support/making. In that context, the need for ensuring compliance of the different requirements of Article 4(7) was pointed out.
6. It was also acknowledged that, in certain cases, new flood protection measures are possible without deterioration. However, there is also need for more transparency on the basis of decisions for the application or non-application of WFD Article 4(7) (when no impact is expected from new structures). Such decisions and related justifications need to be documented in the decision making for new projects to increase transparency.
7. Looking for alternative options to specific flood protection projects (as part of the planning process) is important and resources are needed to develop such alternatives.
8. In addition, stakeholder involvement should start as soon as possible when projects are in the early planning phase to increase project acceptability and avoid problems afterwards.
9. In order to improve the assessments with regard to the Article 4(7) application, it was suggested following an EU coordinated and integrated approach to sharing knowledge on hydromorphology-biology responses, identifying the gaps and how they can be filled, and how knowledge improvement could be reached. Some group members suggested taking into account the CIS Guidance on Article. 4(7) as a good basis/framework for an integrated assessment of hydromorphological-biological responses.
10. Generic, simple good practice examples and case studies could be prepared and exchanged to help setting priorities, improving knowledge and understanding. Even failure case studies (e.g. to unsuccessful examples of WFD-FD coordination, or failed cases of hydromorphological improvement which could be hampering the achievement of the Directives´ goals) could help to better understand which are the interactions which are not properly understood yet.
11. As regards transboundary flood protection, a feasible way of working exists but it requires conventions/agreements to set the foundations of transboundary cooperation on flood management.

6 Annex 1: Case Studies

Case studies were collected leading up to the workshop focussing on:

- The implementation of restoration/mitigation measures to achieve WFD good status/potential at water bodies where hydromorphology is impacted by existing flood risk management measures,

- Impacts of new flood protection measures on hydromorphology modifications and related assessments under the WFD.

Four case studies from the Netherlands, Spain and Austria are presented below.

6.1 Combined solutions for reducing risk of flooding and improving water quality, biodiversity with added value for land use, recreation and urban planning in the Meuse and Rhine RBDs, Netherlands

The Netherlands has 4 catchment areas: the Schelde which enters NL near by the sea, the Eems (of which the Eems-Dollard Delta is shared with Germany) and the main rivers Rhine and Meuse.

In the Netherlands we have 30 years' experience in the planning and realisation of integration water- and land use management along our regional waters, main rivers and in the delta. The main drivers for early integration of the two were the SANDOZ pollution in the river Rijn (1986), plan Ooyevaar (1986) and the new strategy on nature conservation in combination with "room for the river" and the very high discharges and floods in the Rhine and Meuse (1993-1995), i.e. our Deltaprogramma.

The Netherlands takes a three-pronged approach to water management: contain, store and discharge by improving and restoring the "sponge" of the landscape, originally in rural areas but recently – due to intense precipitation - also in urbans areas.

In the execution of all our plans, also sometimes in a cross-border approach, we have created 1000s of hectares of new nature and recreational areas where water can be stored in periods of too much or too little water. Involved parties are the national and regional governments and national and regional private organisations and landowners, contractors, universities etc. This combined approach is one of the main factors of success.

Key activities within our programme is to dig out the floodplains, widen the river basin in combination with strengthening the flood defence system. Along our coast we restore and maintain the natural coastline and enlarge the natural flood defence in the sea. In general, the activities require of soil excavation, digging and transport of sand, clay and gravel. After finishing of the new infrastructure, nature restoration starts itself, the new areas are open for recreation and (extensive) agricultural use. Due to national law, new settlements, building or so called "non-river functions" are not allowed or - if possible - are removed.

Good examples within the programme include:

- de Doorbraak along the regional system in the eastern part of the NL (fluvial, pluvial)
- Room for the river Nijmegen-Lent along the river Rhine and de Grensmaas along the Meuse, cross border (fluvial)
- de Noordwaard in the delta of Rhine and Meuse (fluvial and sea: the delta)
- de Zandmotor along the coast (sea).

The impact of all measures taken in the past 30 years' of planning, decision making and execution is that we have maintained and improved our level of security against floods and we have improved water quality and biodiversity significantly. Our (Dutch) approach "polderen in the delta", works and is very successful; it started with ideas, strategies and came in to acceleration by natural events and let to an integral approach of public and private parties. Our national Deltaprogramma is enshrined in law and is funded by long term national and regional budgets. "Water" is not considered a political issue in the Netherlands. This enables a solid base for integrated water management, which is essential in the face of upcoming challenges of climate change.

The main conclusions from our experience can be summed as:

1. Looking for integral solutions is the best way of working and will lead to the best outcome for all stated goals.
2. The level of success depends on the amount of awareness and support to solve the problem; after "disasters" the awareness is high and all organisations are willing to solve problems. It's challenging to keep that momentum and is one of the main goals of our Delta programme.
3. Restoring natural situations and improving and enlarging the possibility for natural processes to play out will lead to better ecological quality and biodiversity. However, restoration of the original system is not possible due to societal situation in the Netherlands in that 17 million people live in a small country close to the sea.
4. Collaboration on a river basin scale is still difficult due to different policies, governmental situations and awareness; here lies room for improvement.

For additional information see:

- Deltaprogramma: www.deltacommissaris.nl/deltaprogramma
- General information on water management: www.helpdeskwater.nl

6.2 Case Noorwaard, implementation of restauration measures, Netherlands

Case Noorwaard is situated in RBD Meuse with large effects in RBD Rhine. It is part of water body Brabantse Biesbosch. The Noordwaard is ca. 2500 ha of agricultural land –former fresh water tidal area- reconstructed to wetland. The construction has primary focus to prevent floods above stream and

reduces water levels in case of flood event by 60cm close to the opening and 30cm ca. 5km upstream in the most important branch of river Rhine. The area used to have an amplitude of 1m tide or more. Due to the Haringvlietdam this is nowadays 20cm.

The construction enables flooding of the whole area, with influence and flooding from Rhine water to the Biesbosch. Under normal circumstances the area consists largely of wetlands, shallow water, and partly agricultural land (allowed to be flooded) and a few houses on terps. The plan consist of 70 km of new dikes, 29 terps, and 12 water regulation pumps, but as the area itself has changed from dry land towards wetland, the present hydromorphology inside the wetland functions relatively naturally.

The Noordwaard is a measure to reduce flood risk but has increased the area of wetlands connected to the main river. The biology is largely functioning as natural. Right from the beginning many Natura2000 habitats and species has colonised the Noordwaard. Also, the small level fluctuation (fresh water tidal area) has huge positive impact on especially bird species and emergent plants. In other 'room for the river' projects navigation is usually affected, especially because of changing water depths. This project is largely closed for navigation (and only recreational)

More information: https://www.youtube.com/watch?v=Wf8zVOY99IM&feature=youtu.be

6.3 Hijar river restoration project, Spain

The rehabilitation project is located in the water body ES091MSPF841 (Híjar River, from its source to its confluence with the Ebro River), whose catchment reaches 147,61 km2, as part of the Ebro river basin. The water body has a total length of ca. 28 km, while the project area covers the last 5 km before the confluence with the Ebro River (in the proximity of the town of Reinosa).

Reinosa has a population of more than 10.000 inhabitants, and historically has suffered recurrent flooding, being designated as an APSFR by the Ebro Flood Risk Management Plan. In order to protect the town and some agricultural land upstream, the river was constricted by embankments and bank reinforcements on both margins. These anthropic pressures have changed the originally braided river and its wide floodplain, into a straight pattern which lacks lateral connectivity and appropriate sediment transport, and just sustains reduced riparian zones.

Through this project, the hydromorphological and ecological condition of the river system will be improved, giving back space to the river for its dynamics, restoring the riparian vegetation, installing new flood protection structures in critical sections and creating a crosswalk along the river banks that will allow the population of Reinosa to enjoy, in a planned and organized way, all the social benefits provided by the river system.

The assessment method was the "Spanish Protocol for assessment of the hydromorphological status of rivers", published in 2017 (V.2), and already in use in river planning and management throughout the Spanish basins. The Protocol is based on a number of hydrological, geomorphological and connectivity indicators which help to understand the present hydromorphological dynamics of the river (structure and functioning) and the potential effect of implementation of different rehabilitation/restoration measures.

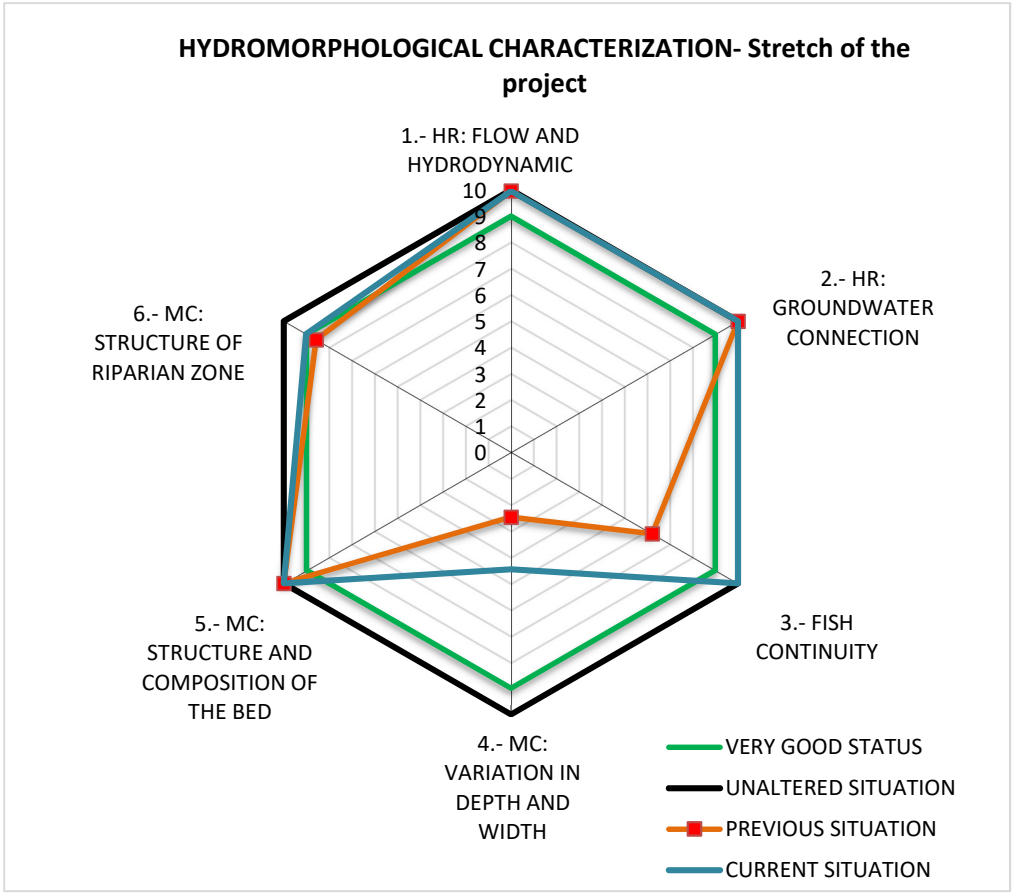
The measures that were applied in this project include:

- replacement of hard structures with soft engineering techniques
- set-back of embankments
- reconnection of side arms
- creation of natural-like diversity within the flood detention basin
- improvement of in-channel morphological diversity and riparian habitats

The selection of measures was based on their feasibility and potential efficiency in the study area. A wide range of alternatives was initially assessed considering costs and potential benefits, until the final set of measures was defined.

The ecological status of the water body was classified as “good” by the RBMP, however, that value did not clearly represent the hydromorphological alterations present in the river system. The impact of the project on the entire water body is limited, due to its length and the relative position of the project area. But still some hydromorphological indicators of the WB have been improved, generating a beneficial impact on the overall river dynamics.

Figure 4: Hydromorphological characterisation diagram



6.4 River Development and Risk Management Concept, Austria

The River Development and Risk Management Concept (GE-RM) in Austria has been implemented in 2016. It is a tool for an integrated planning process and serves for multiple purposes:

- Ensure close coordination of WFD and FD but also liaise with other relevant sectors such as spatial planning, emergency planning, nature conservation, building authorities, etc. under public participation.
- Serves as funding prerequisite referring to the Hydraulic Engineering Assistance Act - HEAA (regulates the funding of flood protection measures)
- Supports the priority setting by means of finding best solutions (max. synergies, min. conflicts); Priorities in the frame of the HEAA are defined as follows:
    - Passive (non-structural) flood protection has priority over active (structural) measures
    - Measures in the catchment area have priority over measures at / along the main channel
    - Retention measures have priority over linear structural measures
    - Natural and near-natural methods of building have priority over technical methods

The GE-RM will be tested and further developed in the frame of the LIFE Integrated Project “IRIS” (Integrated River Solutions in Austria) (runs until 2027). Within the project, seven pilot catchments (also “transboundary” catchments crossing Austrian province borders) will undergo a GE-RM-planning process and several integrated, synergistic measures (win-win solutions WFD-FD) will be implemented.

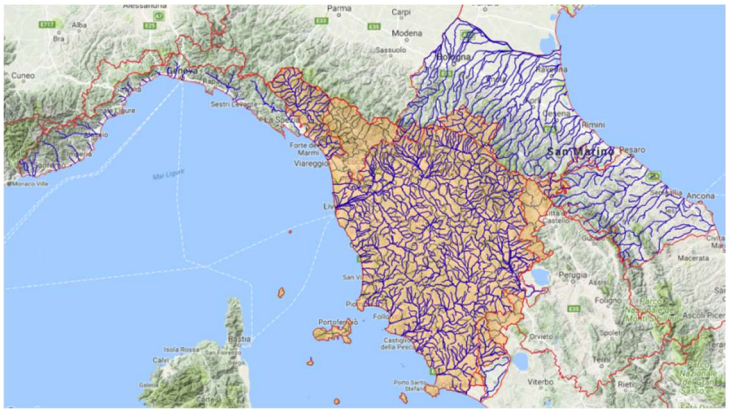
The main messages and first lessons learnt (not only from the GE-RM but also the AT approach addressing the WFD – FD coordination) are:

- Flood protection and flood risk management are feasible without deteriorating the ecological status – in contrast, comprehensively planned flood protection (multi-purpose) projects even have positive effects on the goal achievement of the WFD.
- Art. 4 (7) has to be applied in AT only in very special and rare cases as this approach seems to be a good solution addressing all relevant issues and sectors.
- Anticipatory, integrated and basin wide planning is the most important part of minimising conflicts and maximising (multiple) benefits
- Defining funding prerequisites (and respective budgets) certainly helps in the implementation and steering of the coordination process.

6.5 Flood Risk Management Plan (FRMP) measures' impact evaluation for the assessment of Art. 4(7), Italy

The case study area is located in the Northern Apennines District (ITC), specifically in the area of the Region of Tuscany (about 20.000 sq.km, 60% of District's surface). The aim is to estimate the impacts of a structural measure of the FRMP on water status/potential.

Map 1: Case study area

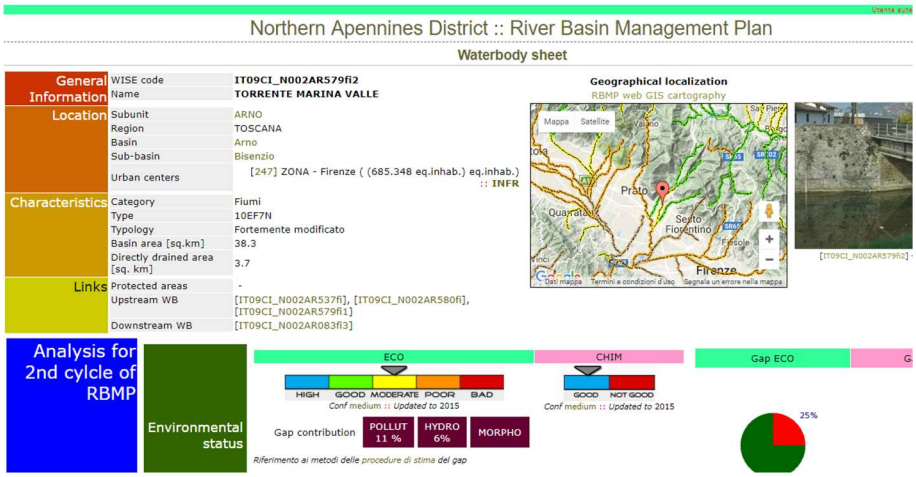


The procedure has been applied to all surface waterbodies in the area ranging from small rivers with about 10 sq.km to main river channels like the Arno river (downstream reach), about 8.000 sq.km basin area.

The structural measures of the FRMP might cause a physical alteration of water body as it might embrace longitudinal or transversal rivers' modification, including levees' restoration, dams' elevation, diversion spillways, expansion areas with related inlet / outlet culverts, river bank restoration.

In order to pre-asses the possibility of Art. 4(7) application, the 2nd cycle RBMP of Northern Apennines Basin District includes a detailed analysis of FRMP's structural measures. Each intervention based on a physical alteration of river or lakes was georeferenced and related to one or more water bodies. The list of flood defences' interventions is reported in a specific section of WB's reporting sheet in the Executive Information System of RBMP (see below).

Figure 5: Extract from EIS – Executive Information System for the ITC RBMP. Top portion of WB's sheet.



Since the linked interventions are mainly planned measures to be defined in terms of hydraulic solutions and structural details, the aim of the proposed list, related to each water body, is to focus the attention on the future potential application of Art. 4(7) for the interested water bodies. This includes the following analytical steps:

- Collection of detailed project's data related to structural characteristics:
    - geometrical dimensions of intervention: length - surface - volume
    - size of impacted WB's portion and comparison with WB's total length / surface
    - geomorphological indexes (i.e. IQM) - ex ante + ex post evaluation
- Comparison with threshold values (defined at district's scale)

The real impact in terms of physical alteration will be tested in the evolution of planned activities, applying common criteria for the evaluation morphological alteration and Art. 4(7) eligibility.

The described procedure has brought general benefits for an effective and coordinated analysis of RBMP and FRMP relationship. Reporting in an official information sheet all structural interventions potentially altering the physical characteristics of WBs allows public and private stakeholders to be aware of potential application of Art. 4(7). The discussion on the real impact of flood defence measures can be applied already in a preliminary project's phase, in order implement a more inclusive process regarding technical solutions' choices, and a specific awareness on the exemption to WFD's objectives.

As critical aspect, financial coverage issues can alter or invalidate technical analysis, bringing to incomplete or only partially useful project choices.

More information: http://www.appenninosettentrionale.it/eis/