The interaction between the Floods Directive and the Nature Directives

Scoping document

April 2020

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This document is intended to facilitate discussions, however, it is itself not legally binding. Any authoritative reading of the law should only be derived from the Directives themselves and other applicable legal texts or principles. Only the Court of Justice of the European Union is competent to authoritatively interpret Union legislation.

Contents

List of abbreviations

APSR	Areas of Potential Significant Risk
BD	Birds Directive
CAP	Common Agricultural Policy
CHAMP	Coastal Habitat Management Plan
EC	European Commission
EEA	European Environmental Agency
EU	European Union
FCS	Favourable Conservation Status
FD	Floods Directive
FHRM	Flood Hazard and Risk Map
FRMP	Flood Risk Management Plan
HD	Habitats Directive
MS	EU Member States
MSFD	Marine Strategy Framework Directive
PFRA	Preliminary Flood Risk Assessment
RBMP	River Basin Management Plan
SAC	Special Area of Conservation
SCI	Sites of Community Importance
SEA	Strategic Environmental Assessment
SPA	Special Protection Area
WFD	Water Framework Directive (2000/60/EC)

1 Introduction

As the implementation of the Floods Directive[1] (FD) proceeds, Member States (MS) are encountering issues and questions on how specific practical decisions for flood management interact with other European Union (EU) legislation. Such interactions may identify opportunities for synergies, for example helping to deliver objectives of both the FD and other EU Directives, or may create challenges where a decision made in implementing one particular Directive appears to create difficulties in applying another.

This scoping document provides an overview of how the FD relates to, and interacts with, the Birds Directive[2] (BD) and the Habitats Directive[3] (HD), hereafter referred to as the Nature Directives. It sets out the key requirements of these Directives and their potential implications (Section 2) and outlines the interactions between the FD and the Nature Directives, and how climate change influences these interactions (Section 3). The document describes some of the key challenges and opportunities related to the interaction (Section 4), and provides a series of case studies across MS, organised by type of flood risk measure, to illustrate how challenges can be addressed and synergies between the Directives can be exploited (Section 5). Section 6 draws conclusions.

Other Directives, such as the Water Framework Directive (WFD) and the Marine Strategy Framework Directive (MSFD), also strongly relate to, and can interact with, the FD and the Nature Directives.. It is recognised that this interaction with other Directives can also create challenges and opportunities, and reference is made to EEA (2016), which summarises links between the FD, WFD and Nature Directives; see also Box 1.1. This report builds on the overview of policy and process links in EEA (2016), summarised in Section 3.1, but focuses only on the interaction between the FD and the Nature Directives.

The envisaged audience for this report consists of the flood risk authorities and statutory nature conservation bodies across the MS. The aim of this document is to help them in developing flood risk management measures and nature conservation initiatives, in particular at the early stages of planning, when potential synergies and challenges can be identified and factored into the design of the measures. The primary focus is on physical measures, while recognising that there are also links between the Directives for non-structural measures, and even for governance of and engagement around the two Directives.

Box 1.1. The role of floodplains and hydromorphology

In floodplains, found at the interface between rivers and their catchment, the policy areas of floods, nature and WFD come together. The ecosystem services provided by preserved or restored floodplains support achieving key objectives of the WFD, the Nature Directives and the FD. Presently, only 40 % of waterbodies achieve good ecological status and 17% of floodplain habitats achieve good conservation status (EEA, 2019). Studies have shown that 70-90 % of floodplains have been environmentally degraded as a result of structural flood protection, river straightening, disconnection of floodplain wetlands, agricultural land use and urbanisation over the past two centuries. The largest pressures on floodplains are linked to hydromorphological pressures, land use, and pollution (EEA, 2019). Floodplains cover 7 % of the continent's area and 25 % of its

[1] Directive 2007/60/EC on the assessment and management of flood risks.
[2] Directive 2009/147/EC on the conservation of wild birds; codified version of Directive 79/409/EEC.
[3] Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora.

terrestrial Natura 2000 site area. Statistics on the spatial extent and land use distribution of floodplains in Europe are available from the floodplain statistics viewer (https://www.eea.europa.eu/data-and-maps/data/data-viewers/floodplain-areas).

The structure of rivers is inherently linked to (and influences) freshwater-dependant habitat quality and extent. It follows that structural changes caused by flood risk management interventions have the potential to influence river hydromorphology and, by extension, related habitats and species.

2 Background to the Directives

This section provides basic background to the respective Directives, to support readers in using this document.

2.1 Background to the Floods Directive

2.1.1 Reporting cycle

The FD was adopted on 23 October 2007. Its aim is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The approach is based on a six-year cycle of planning.

The FD is implemented by MS in three phases over six-year cycles. During the first phase, , the MS carry out Preliminary Flood Risk Assessments (PFRA) for river basins and for coastal zones, in order to identify areas of existing or foreseeable future potentially significant flood risk. These areas are referred to as ‘Areas of Potentially Significant Flood Risk’ (APSFR).

During the second phase, MS prepare flood hazard maps and flood risk maps (FHRM). These flood maps identify areas prone to flooding during events with a high (where appropriate), medium and low probability of occurrence, including those where occurrences of floods would be considered an extreme event. The maps also include details of expected water depths or water level, flood extent, the flow velocity or water flow, economic activities that could be affected, the number of inhabitants at risk and the potential environmental damage.

The third phase of the FD requires MS to produce catchment-based Flood Risk Management Plans (FRMP). Its 6-yearly schedule is harmonised with the WFD River Basin Management Plan (RBMP) cycle. The FRMPs are strategic-level and / or operational documents that consider the full portfolio of flood risk management measures (prevention, protection and preparedness). They include objectives for managing the flood risk within the APSFRs and set out a prioritised set of measures for achieving those objectives.

The FD states that MS should coordinate their flood risk management practice in shared river basins, including with third countries, and shall not undertake measures that would increase the flood risk in neighbouring countries. MS should also take into consideration long-term developments, including climate change, as well as sustainable land use practices. All assessments, maps and plans prepared should be available to the public, and MS are required to encourage the active involvement of interested parties in the preparation of the FRMPs.

The FD planning cycle is shown in Figure 2.1. It is aligned with the WFD’s planning cycle, in line with the requirement for co-ordination between the two Directives.

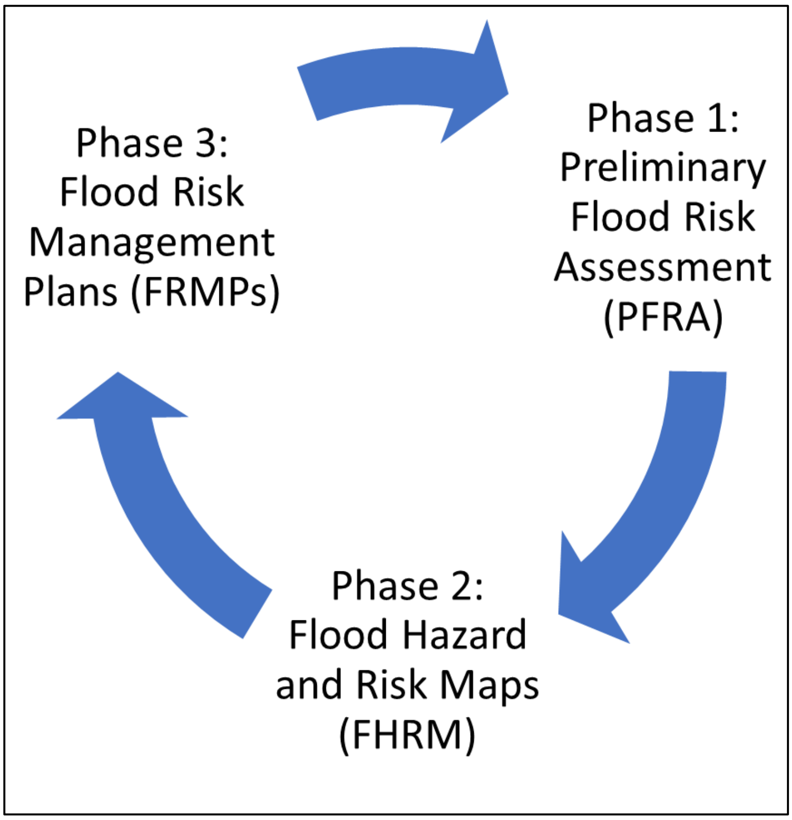

Figure 2.1 The 6-yearly FD planning cycle

To facilitate implementation of the Floods Directive, the Commission (and other organisations) produced various supporting documents. A selection of such documents is provided in Box 2.1.

Box 2.1. Relevant guidance documents for the Floods Directive

- Links between the Floods Directive (FD 2007/60/EC) and Water Framework Directive (WFD 2000/60/EC): Resource Document (European Commission, 2014).
- Guidance for Reporting under the Floods Directive (2007/60/EC): Guidance Document No. 29: A compilation of reporting sheets adopted by Water Directors Common Implementation Strategy for the Water Framework Directive (2000/60/EC) (European Commission, 2013a).
  This document has been updated for the second cycle of implementation of the FD.
- Guide for preparation of flood risk management schemes funded by the European Investment Bank (European Investment Bank, 2007).
- European Overview - Flood Risk Management Plans (European Commission, 2019)

The FD does not make explicit reference to the Nature Directives, but there are important indirect links that ensure that flood management takes account of sites and species protected under the Nature Directives. This is described in more detail in Section 3.1.

2.2 Background to the Nature Directives

2.2.1 Objectives

The EU has developed a comprehensive biodiversity policy framework, at the heart of which are the Nature Directives.

The BD aims to maintain wild bird populations at levels that correspond to ecological, scientific and cultural requirements in the EU territory of the MS. This concept is further developed and defined in the overall objective of the HD, which is to maintain or restore habitats and species of Community interest (as listed in Annexes I, II, IV and V of the HD) to Favourable Conservation Status (FCS). Some species and habitats of Community interest are referred to as 'priority habitats and species' since they are in danger of disappearance and the EU has particular responsibility for their conservation in view of the proportion of their natural range which falls within the EU territory.

In simple terms, FCS can be described as "a situation where a habitat type or species is prospering (in both quality and extent/population) and with good prospects to do so in the future as well" (see Box 2.2). Importantly, FCS is assessed across the whole national territory or across biogeographical or marine regions within the national territory if there is more than one such region within the MS. There is no specific deadline established by the Nature Directives to achieve FCS.

Box 2.2 The definition of Favourable Conservation Status (FCS)

According to the Habitats Directive, the status of a habitat qualifies as "favourable" when its range is "stable or increasing", the "structure and functions which are necessary for its long-term maintenance exist and are likely to continue to exist for the foreseeable future" and "the conservation status of its typical species is favourable".

The conservation status of a species is deemed favourable when, inter alia, the species "is maintaining itself on a long-term basis as a viable component of its natural habitats", "there is, and will probably continue to be, a sufficiently large habitat to maintain its populations on a long-term basis" and "the natural range of the species is neither being reduced nor is likely to be reduced for the foreseeable future".

The BD and HD are similarly designed and structured, with a similar set of specific objectives and measures requiring not only the conservation of species, but also their habitats, as well as defined habitat types, through a combination of site and species protection and management measures, supported by monitoring and research.

2.2.2 Natura 2000 network of protected areas

One of the key ways to achieve the objectives of the Nature Directives is the establishment and management of Natura 2000, which aims to be a coherent network of protected areas that comprises Special Protection Areas (SPA) classified under the BD and Special Areas of Conservation (SAC) designated under the HD.

MS must classify as SPAs the most suitable sites for bird species listed in Annex I of the BD, and take similar measures for regularly occurring migratory species, especially those associated with wetlands and particularly wetlands of international importance.

MS identify Sites of Community Importance (SCI) for habitat types and species of Community interest listed respectively in Annexes I and II of the HD, which are then reviewed by the European Commission and included in the EU list of SCIs. MS then have six years to designate each SCI as an SAC and establish the necessary conservation measures to maintain or restore the natural habitats and the populations of species of wild fauna and flora at FCS. Similar management measures are required for SPAs. While the establishment of the necessary conservation measures is required for all Natura 2000 sites, it is for each MS to determine how the measures are to be established and implemented, as the Nature Directives do not prescribe how this should be done. The conservation measures have to be based on conservation objectives that are site-specific and relate to each of the habitats and species for which the site was designated.

Although Natura 2000 management plans are not obligatory under the HD, the European Commission strongly encourages the competent authorities to produce such management plans, in close cooperation with local stakeholders.

A Natura 2000 management plan represents a solid and efficient framework for setting a site's nature conservation objectives, which should relate to each of the habitats and species for which the site was designated and provide a structure for identifying and planning the necessary conservation measures to achieve them. Furthermore, such plans provide opportunities for the integration of nature conservation requirements with other interacting objectives, such as flood management and management of groundwater and surface water resources. FRMPs produced by MS for the FD should at the very least take into account Natura 2000 site management plans (or, if these do not exist, other documents setting out their conservation objectives and measures), and Protected Areas from other Directives, including the Nature Directives, are included in the Flood Hazard and Risk Maps. However, there are much greater potential mutual advantages from ensuring the plans are more closely integrated, ideally along with RBMPs under the WFD as well.

The Natura 2000 network includes both terrestrial and marine sites, and recent data (March 2019) shows that it currently covers a land area of nearly 800,000 km^2 (approximately 18% of land of EU MS) and over 550,000km^2 of the marine area (approximately 9.2% of EU waters)[4]. In the EU, 25% of the floodplain area has been designated as Natura 2000 sites, but the share varies among countries. In Poland, Croatia and Bulgaria the share exceeds 40% (EEA, 2019). Information on each site, including their location and boundaries, and the species and habitats for which they are designated, is publicly available on the interactive Natura2000 Viewer[5].

Natura 2000 is not intended as a system of strict nature reserves from which all human activities would be excluded. While it includes strictly protected nature reserves, most of the land remains accessible for sustainable activities. The approach to conservation and sustainable use of the Natura 2000 areas is much wider, largely centred on people working with nature rather than against it. However, MS must ensure that the sites are managed in a manner that safeguards their conservation objectives.

[4] Natura 2000 Barometer http://ec.europa.eu/environment/nature/natura2000/barometer/index_en.htm
[5] http://ec.europa.eu/environment/nature/natura2000/data/index_en.htm

MS are required to take appropriate steps to avoid the deterioration of natural habitats and species in SACs, SCIs and SPAs, as well as disturbance of the species for which the areas have been designated, in so far as such disturbance could be significant in relation to the objectives of the Nature Directives.

In particular, in the case of potentially damaging plans or projects, which include FRMPs (see further discussion in Section 3), the provisions of Article 6(3) of the HD apply. According to this, plans or projects which, individually or in combination with other plans and projects, are likely to have a significant effect on a site, but are not directly connected to their management, are to be subject to an 'appropriate assessment' of their implications on the site(s) in view of the site's conservation objectives.

In accordance with the precautionary principle enshrined in Article 6(3), competent national authorities can authorise a plan or project only if they have established, taking into account any suitable mitigation measures, that it will not have an adverse effect on the integrity of the site. If it cannot be excluded, on the basis of objective information, that a plan or project will not have an adverse effect on the integrity of the site, it cannot be authorised, unless it satisfies the exceptional conditions of Article 6(4) of the HD.

Under Article 6(4) of the HD, following a negative assessment, a plan or project may still be permitted if there are no alternative solutions and there are 'imperative reasons of overriding public interest', including those of a 'social or economic nature'. Where an affected site hosts a priority habitat type or species, the only considerations which may be raised are those relating to human health and public safety, to beneficial consequences of primary importance for the environment or, further to an opinion from the European Commission, to other imperative reasons of overriding public interest.

Where such plans and projects are approved, the MS must take all compensatory measures necessary to protect the overall coherence of Natura 2000, and inform the Commission of the measures adopted.

An example that illustrates the concept of public safety, flood defences and the HD is provided in Box 2.3.

Box 2.3 Concept of public safety, flood defences and the Habitats Directive

With regards to public safety, flood defences and the Habitats Directive a judgement of the European Court of Justice on 28 February 1991 in a case involving the European Commission v Federal Republic of Germany ('Leybucht Dykes') is useful. The judgement preceded the adoption of the Habitats Directive and hence Article 6. However, the decision retains its relevance, because the Court's approach influenced the drafting of Article 6.

The case related to the construction of works to reinforce flood dykes on the North Sea at Leybucht in Germany. The works involved a reduction in the area of an SPA. The Commission's view was that the work would result in the deterioration in 'living conditions' of protected birds and the loss of land areas of considerable importance, leading to lower population densities for some species listed in Annex I to the HD (in particular, avocet).

As a matter of general principle, the Court stated that the grounds justifying such a reduction must correspond to a general interest which is superior to the general interest represented by the ecological objective of the Habitats Directive.

In this specific case, the Court confirmed that the risk posed by flooding and the protection of the coast constituted sufficiently serious reasons to justify the works on the dikes and the strengthening of coastal structures as long as the measures were confined to a strict minimum and involve only the smallest possible reduction of the SPA. The German Government emphasised that during the planning stage of the project, the competent authorities took account of all bird conservation requirements and balanced them against the requirements of coastal protection. Further, the German Government stated that the new line of the dyke and the temporary disturbance caused by the works constitute the smallest possible interference on bird life in the Leybucht.

(Source: Judgment of the Court, 28 February 1991 (Case C-57/89)

To facilitate implementation, the Commission has produced several guidance documents on these general provisions, as well as some sector guidance of relevance to the FD and flood management measures, taking into account relevant jurisprudence of the Court of Justice of the EU. A selection of these guidance documents is provided in Box 2.4.

Box 2.4. Relevant European Commission guidance documents on Nature Directives
Up to date guidance can be found in:
https://ec.europa.eu/environment/nature/natura2000/management/guidance_en.htm
At the time of writing this report, the most relevant documents were as follows:

- Managing Natura 2000 sites: the provisions of Article 6 of the 'Habitats Directive' 92/43/EEC (updated in 2018) (European Commission, 2018).
- Assessment of plans and projects significantly affecting Natura 2000 sites. Methodological guidance on the provisions of Article 6(3) and (4) of the Habitats Directive 92/43/EEC (European Commission, 2002). This document is currently being updated.
- Links between the Water Framework Directive and Nature Directives - Frequently Asked Questions (European Commission, 2011).
- A Starter’s Guide Overview on the main provisions of the Water Framework Directive, the Marine Strategy Framework Directive, the Birds and Habitats Directives, and the Floods Directive: similarities and differences (European Commission, 2016a).
- Guidelines on Climate Change and Natura 2000 (European Commission, 2013b).
- Fitness check of the EU Nature Legislation (Birds and Habitats Directives) (European Commission, 2016b).

2.2.3 Landscape conservation measures in the wider environment

In addition to the designation of Natura 2000 sites, Article 10 of the HD encourages MS to manage features of the landscape when formulating land-use planning and development policies with a view to improving the ecological coherence of the Natura 2000 network. Article 10 specifically refers to those landscape features ‘that are essential for the migration, dispersal and genetic exchange of wild species’ and, as an example, refers to a river with its banks as a linear and continuous structure.

In this context, it is clear that there is a potential for interaction between Nature Directives and the Floods Directive. Measures set out in FRMPs (and subsequent appropriately planned and designed flood management measures) have the potential to support the implementation of Article 10 and, therefore, the objectives of the Nature Directives. On the other hand, poorly planned and designed flood risk measures can have a negative impact on landscape features that are essential for wild species, thus going against the objectives of the Nature Directives.

2.2.4 Species protection measures

In addition to site protection measures, both Nature Directives lay down provisions for the protection of species.

The BD has a requirement for the protection of all bird species. The HD has requirements for the strict protection of specific species of Community interest listed in Annexes IV of the Directive. In addition to the protection of animal species from killing and capture, this includes protection from deliberate disturbance, destruction or taking of eggs and deterioration or destruction of breeding sites or resting places.

These requirements of the Nature Directives are largely focussed on deliberate damage or disturbance to species and their habitats. This can cause conflicts with flood management measures, and therefore has to be accounted for in strategic planning of flood risk management measures. Furthermore, it should be noted that the activities described in the previous paragraph are also unlawful under other nature conservation legislation at a national level. Consequently, mitigation measures would need to be implemented to prevent such unlawful activities when delivering flood management measures.

3 Interactions between habitats and flood management

3.1 Links between the Directives

The Nature Directives do not refer explicitly to flood risk management. However, the FD and Nature Directives are linked through the role of water in defining the nature conservation interests of European sites, setting conservation objectives and defining Favourable Conservation Status.

Similarly, the FD does not make explicit reference to the Nature Directives, but there are important indirect links that ensure that flood management takes account of sites and species protected under the Nature Directives. The EEA report 'Flood Risks and Environmental Vulnerability' (2016) summarises these links as follows:

"The Floods Directive is related to EU nature legislation by the requirement to include protected areas in the flood risk maps (EU, 2007, Art. 6 §5(c)) and by a specific mention of the need to take into account nature conservation in the FRMPs (EU, 2007, Art. 7 §3). The Floods Directive also recognises the opportunities created by giving rivers more space through the maintenance or restoration of floodplains in flood risk management.

Through the links to the WFD, all activities under the Floods Directive must be in line with the requirements of the Birds and Habitats Directives as well, for example, when flood-protection measures potentially affect one or more Natura 2000 site (EU, 1992, Art. 6). The Floods Directive, from 2007, came after the WFD and the Birds and Habitats Directives and obviously refers to these other policies. However, to come to a mutual understanding and synergies between water and nature policies, the objectives and working methods of the Floods Directive should be taken into account when developing actions under the WFD or the Birds and Habitats Directives".

In addition: as planning documents, FRMPs are generally subject to the requirements of the Strategic Environmental Assessment (SEA) Directive[6] The SEA involves a strategic assessment of the potential impact of the FRMPs on the environment, including on sites and species protected under the Nature Directives. Furthermore, Article 6(3) of the Habitats Directive stipulates that any plan or project not directly connected with the management of a site, but likely to have a significant effect on the site, must be subject to appropriate assessment of its implications in view of the site's conservation objectives (see Section 2.2). In addition to site protection, the species protection provisions are also relevant and should be taken into account while developing FRMPs.

3.2 Practical interactions

Figure 3.1 shows how different types of physical flood management measures could affect nature, in particular floodplain connectivity.

[6] Directive 2001/42/EC on the assessment of the effects of certain plans and programmes on the environment.

<table>
<tr><td colspan="3">Hard engineering</td><td colspan="3">Mitigated hard engineering</td><td colspan="3">Green infrastructure</td><td colspan="3">Nature-based solutions</td></tr>
<tr><td colspan="3">Heavily modified river or coastline</td><td colspan="6">- Natural processes +</td><td colspan="3">Natural river or coastline</td></tr>
<tr><td colspan="12">Example interventions</td></tr>
<tr><td colspan="3">Coastal and fluvial flood walls and defences, river diversions, pumping</td><td colspan="3">Hybrid hard and nature based solutions, permeable pavements</td><td colspan="3">Managed re - alignment of coastal defences, river restoration</td><td colspan="3">Natural floodplains and coastal zones with minimal interventions</td></tr>
<tr><td colspan="12">Example outcomes</td></tr>
<tr><td colspan="4">Floodplain disconnected from its channel or the sea</td><td colspan="4">Floodplain connected with its channel or the sea but with a high degree of control</td><td colspan="4">Floodplain connected with its channel or the sea but with a high degree of freedom</td></tr>
</table>

(Source: Adapted from RSPB, 2010)

Figure 3.1 Flood management measures and their outcomes for natural processes and floodplain connectivity

In general, physical flood management measures can impact habitats in two ways:

- direct impact through their footprint (loss through construction or gain through removal of existing measures);
- indirect impact through influence on the hydraulic regime (surface water or groundwater) or change in quality (including fresh to salt water). This particularly relates to the dynamic nature of water systems, and how habitats find their niche by adapting to a water system's properties.

On the other hand, habitats can contribute to flood management typically by functioning as a 'sponge', working as a Natural Water Retention measure that helps to attenuate peaks at various spatial and temporal scales. Case by case assessment is always needed to determine how much this could reduce flood risk, in particular during more extreme events. This type of green infrastructure usually delivers multiple benefits in addition to flood protection including climate mitigation and adaptation and human health.

The interactions between physical flood risk measures and habitats are presented below in more detail from two perspectives:

- Habitat perspective: how different habitat types are influenced by flood risk management, and how they can contribute to flood risk management – see Section 3.2.1;
- Flood management perspective: how different flood management measures influence biodiversity, either positively or negatively – see Section 3.2.2.

Following these two perspectives, the important impact of climate change on these interactions is discussed in Section 3.3.

3.2.1 Habitat perspective

A wide range of habitats may be potentially affected by physical flood risk management measures, and, in many cases, can also contribute to flood mitigation.

Table 3.1 identifies these relationships for generic habitat categories; these are not intended to relate to habitat types specifically listed in Annex I to the HD. To help illustrate the content of the table, reference is made to the case studies in Section 5.

Table 3.1 Habitat types and their relation to flood management

Habitat types	Potential negative impacts of flood management measures	Potential contribution to flood management	Case studies (Section 5)
Bog and mire habitats	May be drained and destroyed if surface or groundwater regime is affected by a flood management measure.	Can function as sponges, which slow down runoff and can reduce peak flow downstream. Conversely, if saturated, it can cause rapid run-off that can increase peak flow.	5.2.2
River bank and bed vegetation	Can be destroyed or highly degraded by river dredging and/or bank clearance and re-profiling.	Can slow the flow, which can reduce flood risk downstream (attenuating high flows) or increase risk upstream (by increased roughness / blockage).	5.3.1
Floodplain grasslands and wetlands	Can be destroyed or degraded if cut off from natural river flooding by flood banks, and/or if pumped dry to retain flood storage capacity. Can also be degraded by a change in flooding regime (e.g. more frequent flooding of storage areas for downstream risk reduction, which could adversely affect breeding birds).	Act as flood storage areas (washlands), depending on storage volume and distribution throughout a catchment.	5.1
Floodplain, riverine woodland	Can be destroyed by embankments, or cut-off from floodplain, resulting in change to terrestrial woodland. As a result, this habitat type is now rare over much of Europe.	Can slow the flow, which can reduce flood risk downstream (attenuating high flows) or increase risk upstream (by increased roughness). Flood management benefits are greatest in the middle and lower river reaches of medium to large catchments.	5.1
Coastal dune grassland	May be destroyed by footprint of coastal defences or degraded by over-stabilised dune systems because there is a close link between geomorphological dynamics and ecological diversity.	Help to stabilise dunes. Some potential for direct wave attenuation reducing overtopping.	5.4.1 5.4.3
Coastal dune woodland			5.4.1
Coastal salt marshes and meadows	May be destroyed by footprint of coastal defences and lost through coastal squeeze (i.e. erosion where backed by a hard defence). May also be degraded by drainage behind seawalls.	Reduce wave height and energy and thereby the risk of coastal erosion and flooding.	5.4.1 5.4.2
Shingle and stony beaches	May be destroyed by footprint of coastal defences and lost through coastal squeeze.	Reduce wave height and energy and thereby the risk of coastal erosion and flooding.	

3.2.2 Flood management perspective

Different flood management measures can have different impacts on habitats and species. These impacts can be positive and negative, and sometimes both. Table 3.2 summarises these typical effects on biodiversity. To help illustrate the content of the table, reference is made to the case studies in Section 5.

The focus in this section is again on physical measures. Non-structural measures can also have positive and negative impacts, and it is equally important to consider the interactions in planning and implementation.

All flood measures can benefit any habitats and species in flood prone areas that require low flood probability, i.e. nature areas that would suffer from a significant flood. This is not mentioned explicitly in the table.

Table 3.2 Flood management measures and their relation to biodiversity

Flood Management Measures	Hydraulic impacts	Potential negative biodiversity impacts	Potential positive biodiversity impacts	Case studies (Section 5)
River measures				
Creation / raising of river embankments / levees / flood defences	Reduces chance of flooding locally. Can increase peak water levels locally and elsewhere.	Loss of riparian habitat and/or loss/degradation of floodplain habitat and associated species (e.g. from reduced flooding frequency); damage and disturbance from engineering works.	Potential for incorporation of local linear habitats (e.g. corridors), depending on management and maintenance practice (e.g. mowing).	
Floodplain/wetland restoration (reconnecting rivers with floodplain)	Provides additional storage in the floodplain which attenuates the flood wave, reducing peak water levels.	Can be damaging for non-wetland habitats, or if flooding regime is not appropriate for wetland habitats that are present. Floodwater can also be polluted (e.g. with nutrients from agriculture and sewage works storm-overflows). Pushing this polluted 'brown water' onto the floodplain has the potential to be damaging (e.g. for some vegetation types sensitive to nutrient enrichment).	Can help restore or create wetland habitats, e.g. floodplain grasslands or riverine woodland. By supporting the nutrient input, this can be beneficial to original habitats (e.g. lowland softwood alluvial forests) that are characterized by the occurrence of nitrophilic species (e.g. *Urtica dioica, Rubus caesius, Galium aparine, Rubus fruticosus, Plagiothecium undulatum, Alnus glutinosa*) requiring nutrients from flood water.	5.1

Flood Management Measures	Hydraulic impacts	Potential negative biodiversity impacts	Potential positive biodiversity impacts	Case studies (Section 5)
Hard in-river flow management structures (dams, barrages, weirs, sluices)	Helps control flow and water levels, reducing variability	Major impacts are from changes in water depth and flow, e.g. creating large deep slow-flowing pools in place of more diverse sequences of shallow and fast and slow and deep stretches and loss of habitats and species due to submersion. Slowing the flow of water encourages silt deposition (with the potential for increased ongoing maintenance, such as dredging, with further potentially negative impacts) and reduced oxygen levels. The creation of a more homogenous habitat would lead to an overall reduction in species richness and diversity. A knock-on effect of such altered conditions can be encouragement of the establishment of invasive non-native species. Barriers to fish migration can be created, although this can be partly mitigated (e.g. fish passes). The introduction of in-river structures is likely to fragment riverine habitat.	Can create more favourable conditions for some species (but usually to the detriment of others; see potential negative impacts). On balance, such measures are unlikely to result in positive impacts, unless the structure is essential to protect certain habitats from flooding.	5.3.2
River engineering (straightening, widening, deepening)	Can increase the conveyance capacity, reducing flood water levels upstream but potentially increasing them downstream.	Profound impacts on river channel structure, causes loss of habitat features (e.g. meanders, shoals) and changes in flow and depth.	Very unlikely to have positive impacts.	

Flood Management Measures	Hydraulic impacts	Potential negative biodiversity impacts	Potential positive biodiversity impacts	Case studies (Section 5)
River restoration (recreating original meanders, bed raising)	Can slow the flow, increasing flood levels upstream but potentially reducing them downstream.	Depending on the nature of the measures, a reduction in peak flood water levels could potentially have negative biodiversity impacts in downstream areas. For example, the favourable condition of habitats and species may rely on a particular flooding regime and an alteration of the regime could have negative effects.	At the location of the flood management measure, this can recreate a more natural structure, flow regime and ecological processes (e.g. with more diverse river habitat features and associated vegetation and fauna).	5.1
River channel dredging and clearance	Can increase the conveyance capacity, reducing flood water levels upstream but potentially increasing them downstream.	Can potentially affect not only the area being dredged (e.g. mortality, including eggs and larvae of aquatic and semiaquatic organisms), but also surrounding areas though an increasing turbidity, sedimentation, resuspension and release of contaminants.	May be necessary to maintain flow rates, open water and substrate conditions required by some habitats and species.	5.3.1
Catchment measures				
Installation of leaky barriers	Can increase local bankside flooding. Can slow the flow, increasing flood levels upstream but potentially reducing them downstream	As noted above, pushing polluted water onto adjacent habitats can harm sensitive vegetation.	Can create new habitat features (e.g. pools) in structurally degraded rivers.	
Creation of offline storage areas	Creates flooded areas locally. Provides temporary storage for high flows, which can assist with reducing flood peaks downstream.	May create flood regimes that are not beneficial for biodiversity to certain habitats and species, e.g. by creating ecological traps, e.g. providing breeding habitat for ground-nesting birds which are then flooded, isolating and trapping fish as flood waters subside, negatively affecting habitats and associated species (e.g. invertebrates, amphibians).	May create new wet grassland or other wetland habitats that can be beneficial for some species, but this depends on location, soils, flooding regime and context. If temporary storage areas are only infrequently inundated, there is unlikely be significant potential for biodiversity gain.	

Flood Management Measures	Hydraulic impacts	Potential negative biodiversity impacts	Potential positive biodiversity impacts	Case studies (Section 5)
Buffer strips	Can stabilise river banks / reduce erosion, reducing risk of blockage which in turn reduces conveyance. Can slow down surface flow and increase infiltration, reducing flood risk.	This measure is unlikely to have significant negative effects on biodiversity.	Buffer strips can mitigate the movement of sediment, nutrients and pesticides from agricultural fields, thus improving the water quality of the receiving watercourse. They can also act as a source of food, nesting cover and shelter for many species.	
Forest measures (e.g. catchment woodland, cross-slope woodland, floodplain woodland and riparian woodland)	Can interrupt surface flow pathways and encourage the infiltration of water into soil, which slows runoff, reducing downstream flood peaks.	Potential negative impacts on existing habitats and species are possible, depending on the baseline situation.	Potential positive impacts are possible; e.g. selectively logged forests, if they are managed appropriately, can provide habitat for otherwise threatened species.	
Conversion of riparian forest into grassland, or thinning of forest and clearing undergrowth	Increases surface flow and can thus decrease flood levels locally, but increases flood peaks downstream	Loss or degradation of valuable riparian forest; clearing of undergrowth opens the way to invasive species which can be counterproductive also for flood prevention (even thicker and less manageable undergrowth)	Represents a significant change in habitat, and has potential for positive impacts, depending on the nature of habitat created. Can create more favourable conditions for some species.	
Conversion of riparian forest into arable land	Increases surface flow and can thus decrease flood levels locally, but increases flood peaks downstream	Loss or degradation of valuable riparian forest and undergrowth, opens the way to invasive species	Very unlikely to have positive impacts.	
Conversion of riparian forest into woody plantation in reticulation structure	Increases surface flow more easily than riparian forest and can thus decrease flood levels locally, but increases flood peaks downstream	Loss or degradation of valuable riparian forest and undergrowth, no natural undergrowth, the holes of plantation open the way to invasive species	Represents a significant change in habitat, and has potential for positive impacts, depending on the nature of habitat created. Can create more favourable conditions for some species.	
Soil and land management (changes in land use that influence hydrological function).	Change run-off, typically increase permeability to slow down run-off, reducing flood peaks downstream	None likely for habitats and species.	Potential positive impacts are possible, depending on the land management practices (e.g. reduced pesticides application).	5.2

Flood Management Measures	Hydraulic impacts	Potential negative biodiversity impacts	Potential positive biodiversity impacts	Case studies (Section 5)
Headwater drainage management	Increased drainage reduces flood levels locally but may increase flood peaks downstream.	Changes to drainage systems can potentially adversely affect the water table and habitats and species that are particularly groundwater-dependant. This is particularly relevant for bogs and peatlands.	Interventions in field drains can be used to create wetlands. May be necessary for maintaining flow rates, open water and substrate conditions required by some habitats and species.	
Run-off pathway management (overland flow barriers, non-floodplain wetlands, offline storage)	Can interrupt surface flow pathways and encourage the infiltration of water into soil, which slows runoff, reducing downstream flood peaks.	None likely for habitats and species.	These measures can assist in improving the soil structure, thus creating potential positive impacts on habitats and species.	5.2
Coastal measures				
Hard coastal defences (seawalls, groynes, revetments, breakwaters)	Reduces chance of flooding and erosion locally. Can cause erosion downdrift, leading to increase in flood risk.	Hard coastal defences and structures can influence sediment transport, thus reducing the ability of the shoreline to respond to natural forcing factors and fragment coastal habitats.	There is limited potential for positive impacts on flora and fauna. However, microhabitats for algae, invertebrates and fish can be created within the structure of hard defences; such measures are often proposed as mitigation for the direct loss of habitat due to the construction of the hard defence.	
Intertidal area (saltmarsh and mudflat) management and creation	Can reduce the height and energy of waves in storm surge conditions.	Where intertidal area is created through realignment, existing habitats can be affected. Note that these may not be sustainable in the long term (in light of coastal squeeze and sea level rise).	Such schemes can be used to create new saltmarsh, mudflat and creek habitat for waterbirds, invertebrates and fish.	5.4.1 5.4.2
Sand dune management	Beaches/dunes function as a direct flood defence and help to reduce the impact of waves.	Dune management can limit the dynamic evolving processes that are essential for their biodiversity.	Where done sensitively, support of natural dune habitats.	5.4.1

Flood Management Measures	Hydraulic impacts	Potential negative biodiversity impacts	Potential positive biodiversity impacts	Case studies (Section 5)
Beach nourishment (sand or shingle)	Counteracts beach erosion; reduces the height and energy of waves in storm surge conditions	During the nourishment process, beach and near-shore habitats can be smothered, resulting in a decrease in species richness and diversity, at least in the short-term following the nourishment activity. Use of unsuitable sediment can have longer term negative impacts on local habitats. Habitats in the source area can also be affected.	Where beach erosion has been caused by human interference (structures, mining), and if carried out in a sensitive manner and in an appropriate location, beach nourishment can provide ecological benefits via enhancing and protecting certain habitats. Benefits increase if natural processes are allowed to redistribute the nourished sediment.	5.4.3

3.3 Climate change

Climate change has already started to influence both flood risk and habitats, and it will continue to do so throughout this century, regardless of the greenhouse gas emission scenarios. It therefore plays a growing role in the management processes for both the FD and Nature Directives and it implies a growing need for pro-active adaptation, both in terms of flood risk and habitats. The EU Strategy on adaptation to climate change (EU, 2013) called for coherent, flexible and participatory approaches to enable planned adaptation, and this was reinforced through the evaluation of the Strategy in 2018. This document focuses in particular on the impact of climate change on the interaction between flood management and biodiversity.

Of the many and various climate change effects on habitats and species, 'coastal squeeze' is particularly relevant for its interaction with flood risk. Coastal squeeze is the process by which the presence of hard coastlines like seawalls, prevents the gradual inland migration of intertidal habitats as sea levels rise. This can directly counter the flood risk-reducing role of intertidal habitats, and it can also lead to a conflict between flood management and nature. Moving the flood defences inland could help sustain intertidal habitats, but may imply the loss of currently protected features like property and infrastructure, but also brackish or freshwater habitats. On the other hand, holding the defended coastline in its current location despite higher sea levels will become even more challenging after coastal squeeze will have removed the protection of the intertidal area. As the speed and degree of sea level rise and other long-term climate change impacts is uncertain, managing and adapting to coastal squeeze typically must be done in stages.

The challenges facing river catchments are partly similar to those of coastal environments, yet they will also experience other climate change effects such as reduced flows and droughts. Whilst the use of nature-based approaches to climate change adaptation may be more widely considered compared to coastal areas, it is also acknowledged that they do not always fully solve the flooding problem on their own, and more research into their effectiveness is needed. However, if designed well and provided that the right solutions are chosen from the planning stages, nature-based solutions can be win-win and 'no regret' measures to address both flood management and nature protection challenges.

4 Challenges and opportunities

4.1 Current status

EEA (2016) concludes that currently the synergies between water and nature policies are underexploited, as well as the potential to use other policies such as the Common Agricultural Policy (CAP) to meet both flood and nature objectives. It identifies the need for early cooperation, negotiation and flexibility to avoid conflicts.

The EU's Strategy on Green Infrastructure (European Commission, 2013c) – and subsequent methodological guidance (Estreguil et al*.,* 2019) - supports the strategic deployment of green infrastructure and ecosystem restoration in Europe, with a wide range of benefits for habitats and flood risk management. The Natura 2000 network is seen as the EU green infrastructure's backbone.

The principal information on flood risk management at EU level is based on the reporting under the FD, which contains information on past and potential future floods, the FHRMs and FRMPs.

No systematic European-scale assessment of floodplain status has been carried out. Floodplain loss and assessment of its quality is not registered or reported consistently within the EU (EEA, 2016). With new spatial data reported under the FD combined with Corine Land Cover data, and information reported under the HD, there is potential for new overviews of the status of floodplains and their use (EEA, 2016).

4.2 Implementing the Directives to meet flood and habitat objectives

This section summarises how the direct process of Member State reporting can help address the challenges and maximise the opportunities.

The many connections identified in Section 3 highlight the importance of the strategic planning at the FRMP stage, and the need to include strategic assessments of potential effects on Natura 2000 sites and on protected species at a catchment scale. This strategic and catchment-wide approach will enable identification of synergies between the FD and Nature Directives in both directions; both in terms of preventing negative impacts and of creating multiple benefits.

The strategic focus of the FD and Nature Directives provides an opportunity to promote the ecological restoration of Natura 2000 sites. The condition of an ecosystem can be categorised from undisturbed, through extensively or intensively used, to highly degraded (Lammerant et al. (2013) (cited in Eftec et al*.,* 2017). In this context, 'restoration' refers to the improvement of ecosystem condition from a lower to a higher level of naturalness (Eftec et al*.,* 2017), as opposed to taking measures to restore or compensate for the effects of a specific project.

A key objective of the Nature Directives is to maintain or restore habitats and species to FCS (see Section 2.2.1) (Eftec et al*.,* 2017). The policy framework related to the management of Natura 2000 sites also supports restoration of these sites. Consideration of the potential for ecological restoration at the FRMP stage provides a clear mechanism by which the FD and Nature Directives can be implemented in a synergistic way to achieve multiple and mutual benefits.

In addition to integration of the content, the governance structures for FD and Nature Directives at MS level could also benefit from better integration and synchronisation, and this should extent to the Directives' participatory processes.

4.3 Catchment and project level considerations

This section summarises how project and catchment level actions can help overcome the challenges and maximise the opportunities. The case studies in Section 5 aim to illustrate these project and catchment level challenges and opportunities in practice.

The integration of flood management and nature management objectives has to be part of an even wider perspective: many conflicts can only be solved, and many opportunities can only be taken through fully integrated planning (also including transport, energy, water supply, land use, forestry and agriculture), and at the scale of the catchment / coastal cell. As indicated in EEA (2019), this is a complex undertaking, and achieving positive results requires a combination of political prioritisation, planning of relevant measures, cooperation among multiple governing institutions, as well as an active stakeholder process, often spanning across years. Although such processes are often challenging and difficult, there are many examples of very positive outcomes, some of which are included in Section 5.

This integration may be reflected upon in the strategic environmental assessment processes for the adoption of relevant plans, thus allowing for cumulative impacts to be taken into account as well. For example, forest clear cutting on large areas of the water catchment may lead to increased flood risk, if the forest management plans do not take into account the role of forest management practices in water and sediment run-off.

Existing and planned land uses are crucial boundary conditions with respect to the availability of land for the implementation of all measures. This can constrain what is possible in terms of combined benefits, but other sectors can also bring opportunities for additional benefits, including potential funding. A good example would be recreation / tourism. Tourism can benefit from nature-friendly flood risk management measures, and therefore could generate co-funding from local businesses, or from local authorities keen to support tourism.

At a project level, the best solution provides the optimum balance between different benefits while mitigating negative impacts, and meeting legal requirements while being economically viable and affordable. With the concept of ecosystem services, (positive) impacts of measures can be systematically recorded. This would also make it possible to objectively compare different planning options against each other and choose the most favourable one. In general, the evidence shows that it is usually possible to design projects with a net positive effect on flood risk and biodiversity. For example, an important Natura 2000 wetland for birds could, in principle, be used for mitigating the impacts of floods (i.e. by providing a flood storage area). However, water levels may need to be kept lower than desirable for wetland habitats in order to maximise the area's flood mitigation potential.

The resulting scheme may be sub-optimal from one or both perspectives, but still creates benefits for both.

Conflicts can also occur e.g. when the conservation objectives of certain Natura 2000 areas are not compatible with certain flood management measures. Works that may have detrimental impacts on a Natura 2000 site are subject to an appropriate assessment (see Section 2.2); this means mitigation measures have to be taken to avoid detrimental impacts, and, if detrimental impacts are not avoidable, Article 6(4) might be applied if the conditions are met.

5 Case studies

This section presents a series of case studies across various Member States that illustrate examples of the interaction and integration between the FD and Nature Directives. The case studies are not promoted as good practice examples, but serve to illustrate the challenges and opportunities. They were provided by Member State representatives to the Common Implementation Strategy's Working Group on Floods.

The case studies have been grouped according to the type of measures proposed in order to support the overview of flood management impacts and potential negative and positive biodiversity impacts presented in Tables 3.2.

Other relevant case study examples are available online, for example on the European Natural Water Retention Measures Platform (www.nwrm.eu), which provides examples structured by sector (agriculture, forest, hydro-morphology and urban) and by benefit provided.

5.1 River restoration and floodplain reconnection

5.1.1 The Stork Plan, the Netherlands

The following case study, from the Netherlands, illustrates a change in policy leading to the re-naturalisation of the floodplain from agricultural use to a successful combination of nature, flood protection and other functions.

Traditionally in the Netherlands, agriculture was the main land use in the floodplain and within other areas adjacent to rivers. In the 1980s, increased nature conservation concerns led to a discussion about the use of floodplains and the value of natural rivers. It became clear that the protection of small, isolated natural areas had limited added value for nature and the concept emerged of a network to link protected areas.

The river system played an important role in this concept. In 1986, a river trust organised a competition on how to develop the river landscape. The winner was the 'Stork Plan' (the name symbolises the return of the black stork to the river landscape). This plan separated areas of agricultural use (behind the winter dikes) from nature conservation areas (in the floodplain). The Stork Plan was endorsed by the World Wildlife Fund and continued to develop into the Nature Policy Plan, which was officially adopted by the government in 1989.

Through acquisition, landscaping and management, a coherent network of 750,000 ha of nature conservation area was envisaged. This was termed the Ecological Main Structure. As part of this plan, 50,000 ha of connecting zones (i.e. new conservation areas that served to connect isolated areas) was created.

The floods of 1993 and 1995 gave a new impulse to the role of the rivers in the Ecological Main Structure, and budget for the realisation of new nature conservation areas in combination with flood safety was made available within the framework of the Policy Plan for the Great Rivers. This resulted in three main programmes: Further Elaboration for the River Area, the Meuse Projects and Room for the River. Sand, clay and gravel extraction for dikes and Room for the River along the Meuse, helped to create new nature conservation areas that connected isolated nature areas. An integrated approach to water resulted in the re-meandering of regional water courses which were historically straightened to allow a better drainage and a more efficient agriculture.

5.1.2 Merlue catchment, France

The River Merlue is a 7.9km long tributary of the River Valouse which drains a catchment of around 15 km^2. Approximately half of the catchment is covered by managed forests and the other half by grassland.

In its middle reaches, the Merlue used to cross a marsh; however, more than a century ago, the riverbed was moved to the edge of the marsh in order to drain the land and enable the planting of softwood.

The River Merlue is part of the 'Petite montagne du Jura' Natura 2000 site. Around 300 m of the River Merlue was restored to its original course that crossed the marsh. These works not only helped to increase habitat diversity within a Natura 2000 site, but by restoring the river to its former course through the marsh, this increased the flood storage area available, which reduces the downstream flood risk.

5.1.3 River Dijle Belgium

The restoration of the River Dijle in Belgium achieved two main results. Firstly, the project contributed towards the work undertaken by the competent authorities to reinstate a more natural flooding regime in the Dijle valley, to increase water retention upstream and so prevent flooding in Leuven. The project also secured and restored large coherent blocks of land to Annex I habitat status, by removing poplar plantations, weekend cottages, overgrowth, re-modelling former fishponds and installing appropriate recurring management, partly in collaboration with local farmers via a direct marketing scheme for environmentally sound produce (www.restorerivers.eu).

5.1.4 Sigma Plan II, Scheldt estuary, Belgium

The Sigma Plan II in the Scheldt estuary protects Flanders against flooding by:

- Raising and reinforcing the river defences;
- Reducing the water during floods by reconnecting the river to its floodplain known as 'depoldering'.

The process of depoldering involves constructing a new flood defence further inland. Breaches in the old flood defence are created allowing the tides to flow in and out of the area. Mudflats and marshes develop in the depoldered area. At the same time, water pressure on the flood defence is relieved, reducing the likelihood of floods inland. This concept is shown in Figure 5.1.

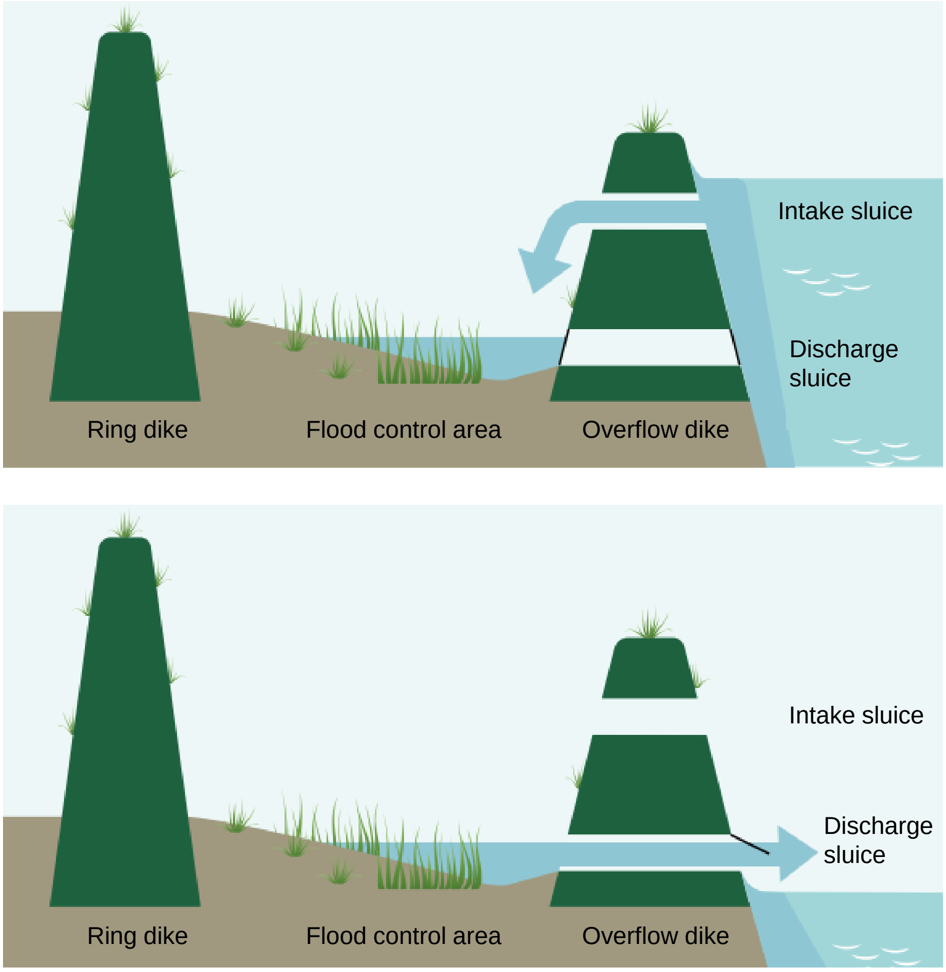

Figure 5.1 Process of 'depoldering' in the Scheldt Estuary (source: Sigma Plan, 2017)

The Sigma Plan has combined the implementation of flood protection measures and Natura 2000 restoration work that has included the creation of 500ha of mudflats, 1,500ha of tidal marshes, 1,500ha of grasslands, 2,000ha of reed and riparian zones and 400ha of marsh woodland.

The Sigma Plan II illustrates the importance of seizing opportunities to integrate ecological restoration objectives when restoring a modified river system under pressure from many human activities and highlights that the use of green infrastructure through combining flood protection with nature restoration is a cost-efficient means to improve protection of Natura 2000 areas (SigmaPlan, 2017).

5.1.5 The Noordwaard, the Netherlands

Website: https://www.ruimtevoorderivier.nl/depoldering-noordwaard/

The Noordwaard is an area of 4,450 hectares that borders on the Biesbosch National Park in Brabant and the Nieuwe Merwede river (a branch of the Rhine delta). As part of the Room for the River programme, the polder was reconnected to the adjacent river, allowing water to flow in and out of the Noordwaard during periods of high water reducing the flood risk of the downstream area. The Noordwaard drains river water through the new flood channel when the Nieuwe Merwede river rises to more than 2m above normal river levels.

One of the objectives of the project was to restore the landmarks that have long been associated with the Biesbosch. The flow of the river, combined with tidal action, has improved the nature conservation value of the area and provides important habitat for overwintering and migratory water-birds.

5.1.6 River Waal, Nijmegen, the Netherlands

Website: https://www.ruimtevoorderivier.nl/room-for-the-waal/

In this case, a dike was moved 350 metres inland at the location of the village of Lent, and an ancillary channel was dredged in the floodplain to help drain the river during extremely high water.

The associated measures and wider benefits in this case concern urban and industrial areas, with minor benefits for the local 'green' space. However, the flood risk measure itself is a nature-based solution because it allows the river system to function more naturally and reduce the need to raise dikes or to take 'grey measures' upstream or downstream.

5.1.7 River Elbe, Germany

Website: http://www.ddni.ro/manager/editor/UserFiles/File/Scientific%20annals/volume/19/11.pdf

Two of the biggest projects related to the relocation of dikes on the River Elbe took place within Natura 2000 sites. In the 'Lenzener Elbtalaue' scheme, realignment of the flood defence dikes created 420ha of additional floodplain storage (Figure 5.2). In terms of habitats, the aim of the project was to re-create floodplain forest, pasture and floodplain meadows.

This project demonstrates that the need to restore floodplains is targeted, and perfectly matches, the requirements of the WFD and the Nature Directives (Damm, 2013).

Figure 5.2 **420ha of rich-structured floodplain habitat developing on former pasture land (photograph: K. Nabel, in Damm, 2013)**

A further example of the creation of additional flood storage on the River Elbe, which achieved conservation and flood protection objectives simultaneously, is provided by the 'Mittlere Elbe' project (http://www.deich-loedderitz.info/).

5.1.8 Lower Danube, Hungary, Romania and Bulgaria

In Romania, the National Strategy for Flood Protection prioritised non-structural measures and green infrastructure over structural measures for flood mitigation. In Hungary, Romania and Bulgaria, the restoration of 2,236 km^2 of floodplains along the Lower Danube has been estimated to cost €50 million. The benefits in terms of flood protection, improvements in water quality and tourism have been estimated to be €112 million.

5.1.9 River Traisen, Austria

The River Traisen is one of the largest tributaries of the Danube in lower Austria. The river is a heavily modified water body following the construction of the hydropower plant, Altenwörth, in 1976 and the main river has been disconnected from its floodplain via a number of flood risk management measures.

The floodplains of the River Traisen are located in a Natura 2000 site. However, the disconnection meant that the river was missing aquatic and terrestrial habitats that are usually found on floodplains. This led to an unfavourable conservation status for the whole Natura 2000 site.

A restoration project was implemented to restore a 12.5 km stretch of the River Traisen, reconnecting it to its natural riparian forest areas. Around 40 fish species benefited from this measure, of which 25 species are listed in Annex II of the Habitats Directive.

The reconnection of the River Traisen to its floodplain provided an increase in flood storage thus reducing downstream flood levels.

5.1.10 HoWaBO, The Netherlands

Website: https://www.aaenmaas.nl/in-jouw-buurt/projectenkaart/howabo/

The city of Hertogenbosch lies at the confluence of the small rivers Aa and Dommel with the River Meuse. When the River Meuse is in flood, the Aa and Dommel cannot discharge their flow and this has caused significant flooding in the past, for example in 1995. The chosen solution was the creation of a 750 hectare storage area. This was combined from the outset with the ‘Blues in the Marshes’ project which aimed to restore protected fen meadow habitat, for protected species such as the Scarce Large Blue (*Phengaris teleius*) butterfly. Approximately half of the storage area overlaps with the Natura 2000 areas, and the measures taken support both aims. For example, the ‘Blues in the Marshes’ project included removal of topsoil to create the desired wet and nutrient-deficient fen meadow habitat. This in itself increased the potential storage volume, and much of the topsoil could be used to create the embankments required for the storage areas. The implementation was supported by LIFE+ funding:
http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=4316.

Figure 5.3 **Scarce Large Blue (photograph: Waterschap Aa en Maas)**

5.1.11 Arga River Restoration, Spain

Websites:

- http://nwrm.eu/case-study/fluvial-and-ecosystem-restoration-arga-aragon-rivers-spain
- https://www.miteco.gob.es/es/agua/temas/delimitacion-y-restauracion-del-dominio-publico-hidraulico/estrategia-nacional-restauracion-rios/Plan-PIMA-ADAPTA-Rio-Arga-Fase-2.aspx
- https://www.youtube.com/watch?v=JmPUzqbjdbY (Video about the project, describing the initial situation and the main issues and the solution adopted)

The lower reaches of the Aragon and Arga rivers form part of the Natura 2000 network because of the presence of Mediterranean river forest habitats (Mediterranean poplar and willow forests) and species such as the European mink (*Mustela lutreola*), the otter (*Lutra lutra*), the European pond turtle (*Emys orbicularis*) and night heron (*Nycticorax nycticorax*). Since the 1970s the lower Arga River has suffered degradation due to human interference, such as straightening of meanders and construction of flood defences. In addition to degrading the river forest habitats, these interventions have also caused flooding both upstream and downstream.

The Arga River Restoration project aims to recover the natural river dynamics, achieving objectives related to the Floods Directive, the Water Framework Directive and the Habitats Directive. A particular aim is to restore the habitats for the European mink, which was recently declared to be critically endangered. The first phase of the project was completed recently; it reconnected and restored the Soto Sardilla meander near Funes (Navarra). The second phase began in November 2017 and will focus more on the main channel of Arga River. Works include reopening of channel connections, removal of accumulated sludge, removal and setback of defence structures, creation of wetlands and fluvial islands, and work to enable public engagement (routes, information signs).

Figure 5.4 Panoramic view of the area and detail of the new wetlands created

5.1.12 Remodelling of the Híjar and Ebro River Park, Spain

Website: https://www.miteco.gob.es/es/agua/temas/delimitacion-y-restauracion-del-dominio-publico-hidraulico/estrategia-nacional-restauracion-rios/Plan-PIMA-ADAPTA-Rio-Hijar-Ebro-Cantabria-Fase1.aspx

The project area concerns the lower reaches of the Híjar River and its confluence with the Ebro River, part of the Natura 2000 network because of the presence of low altitude meadow habitat and a wide range of vulnerable insects, plants, birds, fish, reptiles, amphibians and mammals, including the otter. The area suffers from flooding and the habitat is under threat due to disruption of river longitudinal continuity, and loss of river space due to embankments and reinforcements.

The Híjar River Restoration project aims to recover and improve the natural fluvial system, in particular by slowing the flow and creating more space. This will help work toward natural preservation of the Híjar River's processes and ecosystems, while also improving landscape quality and facilitating public use of the area. The project started in 2015. Works were carried out over a river length of around five kilometres, on both banks. These included recovery of meanders, revegetation, removal of waste, setback and removal of 1200 metres of levees, bio-engineering to stabilise margins, construction of fish passes and public access and information facilities.

Figure 5.5 Panoramic view of the Híjar and Ebro River Park

5.1.13 Restoration of floodplains, Senné depression, Slovakia

The objective of this demonstration pilot project was to restore the original floodplains affected by capital-intensive drainage systems while establishing measures focusing on retention of water during flood events.

In the past, several measures have been taken to protect the Senné depression from incoming waters and to drain inland waters, in particular construction of the Záchytny bypass channel (which collects water from the Vihorlat Mountains and directs it in to the Uh) and construction of the Stretávka pumping station designed to draw off water from 25,100 ha of agricultural land during a 21 day period. Other measures included river straightening and flood protection dams, construction of the Vihorlat flood protection reservoir to reduce the floods in the Laborec river and construction of channels between the Vihorlat reservoir and the Laborec and Čierna Voda rivers.

The above water management practices have critically impaired floodplain ecosystem functions (e.g. flood attenuation, nutrient reduction, pollution control, groundwater recharge, fish spawning areas) that in turn have reduced the variability and dynamic processes inherent in natural floodplain habitats.

The Senné depression is the most important area for nesting and migrating birds in Slovakia; the area contains a State Nature Reserve, SPA (covering 1,490 ha) and two candidate SACs.

The intervention consisted of the reconstruction of the existing floodgate at the confluence of the drying bypass channel with the Žiarovnický stream. The intervention ensured the supply of water to wetlands during flood events or the dry period and thus will improve the condition of ponds in the nature reserve. The intervention reduces flood risk by decreasing water discharge into Stretavka pumping station while simultaneously allowing retention of water in the nature reserve.

5.1.14 Restoration of Danube inland delta, Slovakia

Websites:

- https://www.BROZ.sk/beesandfish/en
- https://broz.sk/projekty/ochrana-a-obnova-uzemi-natura-2000-v-cezhranicnom-regione-bratislavy-life-10-natsk080/
- https://stary.broz.sk/danubebirds/en

The Danube floodplain area in Slovakia consists of various Natura 2000 sites. Between Bratislava and Klížská Nemá, the Danube river created a unique inland delta. A complete change in water regime due to the separation of river branch systems from the main channel in 19th and 20th centuries caused the loss of the natural dynamics and the original diversity of habitats and species.

In the framework of the LIFE projects (LIFE07 NAT/SK/000707, LIFE 10 NAT/SK/080, LIFE12 NAT/SK/001137), several parts of Slovak inland delta were restored. Actions were focused on the restoration of the water regime in five river branch systems, restoration of vast areas of natural floodplain forest, restoration of wetlands and restoration of the traditional management of the meadows and forest steppe habitats. Since 2012, 17.5km of river branch system were restored through reconnection to the Danube, removing of barriers and dredging of the necessary sections. These measures increased the overall biodiversity of the area and simultaneously affected the flood risk by increasing the flood storage potential of the area.

5.2 Catchment measures and land use change

5.2.1 Kempen-Broek, Belgium/Netherlands

Website: http://www.rlkm.be/en/kempen-broek/nature-and-landscape/climate-buffer/

The 'BorderPark Kempen-Broek' captures rainfall in the headwater of rivers to minimise the risk of downstream flooding. Measures that have been taken include restoration of a wetland specifically to avoid flooding of the town of Weert. Bogs that were drained for agriculture have been restored and forest floodplains have been recreated.

The measures are referred as a 'climate buffer' and are located in the area between Weert, Bocholt and Kinrooi.

5.2.2 Peatland restoration, Germany

Website:
https://www.nabu.de/imperia/md/content/nabude/europa/evidence_gatheringquestionnaire_ngos_germany.pdf

The preservation of peatland via the implementation of Natura 2000 sites can help to mitigate the effects of floods. In Germany 10% of peatlands can be found in Bavaria and many of the well conserved peatlands are protected within Natura 2000 sites. In 2008 the Bavarian Government launched its Climate Programme, which includes €8.8 million between 2008-2011 and €2.5 million between 2011 to 2014 to protect peatlands.

5.2.3 Alto Garda Bresciano, Italy

The site Alto Garda Bresciano located in Lombardy, Italy, is protected by the Habitats Directive and the Birds Directive. The site covers an area of around 21,500 ha and includes six municipalities with approximately 15,000 inhabitants. In 2014, a study showed that in terms of flood mitigation (i.e. reduction in peak flood water levels) over 800 of the 15,000 inhabitants benefited from the positive impacts on flood flows arising as a result of the presence of the Natura 2000 site.

5.3 River channel works

5.3.1 River bank vegetation, the Netherlands

Vegetation is often cleared to improve water conveyance in the event of high/peak flows. As a result, river banks and floodplains (the area between the so-called winter-dikes) appear clear of trees, shrubs and hedges, making the river landscape uniform and of little ecological value.

It is possible to improve floodplain conveyance and retain valuable vegetation, as was done in the Netherlands in the programme ‘Streamline’. The general policy regarding maintenance of the floodplain between the dikes is that the vegetation should be kept short to help convey the water in case of floods; ‘roughness’ resulting from vegetation is an obstacle to water flow.

In large parts of the Dutch rivers, however, there was a backlog of vegetation maintenance. Towards the end of the Room for the River programme, this maintenance backlog had to be solved but, over time, vegetation had become an appreciated part of the landscape and endangered species had settled.

To meet both flood management and ecological requirements, the Streamline programme was developed. Using hydraulic models, the pathways where water would flow fastest (the hydraulic streamlines) were identified. Computational modelling was undertaken to assess what percentage of these pathways had to be smooth to enable the channels to convey the required peak flows.

Vegetation was removed only in the areas of these flow paths, with the exception of Natura 2000 areas, zones with endangered species or trees and hedges with a cultural heritage value (identified on maps before 1900). This concept was summarized in the phrase ‘rough where possible, smooth where necessary’.

5.3.2 Weir removal, Saxony, Germany

This example relates to the demolition of an existing weir and the subsequent naturalisation of the site (see Figure 5.6 (before) and Figure 5.7 (after)). The project has positive effects for the fish migration (relevant to the HD), the achievement of a good ecological surface water status (relevant to the WFD) and the enhancement of water discharge in order to improve flood prevention (relevant to the FD).

Figure 5.6 River prior to weir removal

Figure 5.7 River following weir removal, showing naturalisation of the channel

One of the important points to note for this example of integration of the FD and Nature Directives is that it has the potential to be replicated at many sites (including those where rivers form part of protected areas under the BD or HD) and, therefore, could make a significant contribution to alignment of the objectives of several Directives.

5.4 Coastal management

5.4.1 Living with the sea, LIFE Nature project, UK

The protection of large sections of the south-east coast of the UK through hard defences is becoming unsustainable due to coastal erosion that is being exacerbated by climate change. As a result, flood risk and erosion is now being increasingly managed by coastal realignment (retreat), but this can lead to detrimental impacts on some Natura 2000 sites owing to habitat loss and changes (e.g. freshwater wetlands becoming brackish), such as at the North Norfolk SPA detailed in Box 5.1, which is subject to a LIFE project.

Box 5.1: North Norfolk SPA
Website:
http://ec.europa.eu/environment/life/project/Projects/index.cfm?fuseaction=search.dspPage&n_proj_id=346
The North Norfolk Coast SPA encompasses much of the northern coastline of Norfolk in eastern England. It is a low-lying barrier coast that extends for 40 km and includes a great variety of coastal habitats. The main habitats include extensive intertidal sand and mudflats, saltmarshes, shingle and sand dunes, together with areas of freshwater grazing marsh and reedbed, which has developed in front of rising land. The site contains some of the best examples of saltmarsh in Europe.

To address these increasing nature conservation and flood management / land protection conflicts, a LIFE Nature project was launched: Living with the sea: managing Natura 2000 sites on dynamic coastlines (LIFE99 NAT/UK/006081). This was carried out by English Nature and the Environment Agency, with an advisory group including the National Farmers Union, the Country Landowners Association and several conservation organisations. The project developed a strategic approach to integrating the management of flood risk with the ecological needs of Natura 2000, in order to maintain the overall ecological requirements of the Natura 2000 sites over the long term.

The specific objectives of the project were to:

- Develop a strategy for the management of coastal habitats on dynamic coastlines supporting habitats and species covered by the Nature Directives, through the development of a model for Coastal Habitat Management Plans (CHaMPs) and their production for seven pilot areas (covering altogether 32 pSCIs and SPAs). Each plan was intended to provide a 50-year strategy for maintaining the ecological integrity of the area and to identify specific on-site measures for putting this strategy into practice;
- Develop best practice guidance on the recreation and restoration of coastal habitats;
- Implement demonstration projects under the North Norfolk Coast Management Plan Overview to examine actual on-the-ground coastal habitat recreation and restoration and to understand what their role may be in maintaining the ecological integrity of the features of European importance; and
- Develop a framework for maintaining features of European importance in dynamic coastal situations.

The seven CHaMPs produced by the project were published on the English nature website, together with good practice guidance (as a CD-ROM), but these no longer appear to be available. However, the final project report is still available (see http://publications.naturalengland.org.uk/publication/60046). This provides a summary of its results and some case studies and an outline plan for England. It promotes a more strategic approach to site management and the response to dynamic change that will help to implement the Habitats and Birds Directives. In particular its key recommendations were:

- Manage sites as part of a coherent network to ensure that it can respond to environmental change.
- Through this, promote closer integration of the aims of the Habitats Directive and the Birds Directive.
- Take a strategic approach to the management of the network, with greater emphasis on the role of the wider environment and linking measures within and beyond sites to achieve favourable conservation status.
- Integrate data and spatial information to improve the adequacy of use for monitoring and management, and apply scientific understanding of predicted coastal evolution to management decisions.
- Carry out periodical reviews of site management, conservation objectives, and incorporate better understanding of predicted change across the network.
- In the long-term, move towards a presumption to restore functional coastlines, linked to a major programme of habitat restoration in more sustainable locations.
- Actively promote sustainability through engagement with all stakeholders and the development of joint projects. Regularly review stakeholder views and understanding of the implications of climate change.
- Focus on systems, not features, to develop a more innovative approach to habitat compensation arising from flood defence schemes.
- Develop a national strategic plan for habitat restoration required to deliver sustainable flood defence.
- Address form and function of features within and beyond sites and inform management decisions through monitoring and surveillance.
- Co-ordinate action across Europe in response to environmental change.
- Base policy development on real examples, to improve management practice and achieve the aims of the Habitats and Birds Directives.

5.4.2 Wallasea Island, UK

Website:https://www.rspb.org.uk/our-work/our-positions-and-casework/casework/cases/wallasea-island/

This case study is similar to that described in Section 5.4.1, in that it was proposed in response to the increasing risk of coastal erosion due to the effects of climate change.

The project comprised the realignment of seawalls to recreate intertidal areas that existed prior to being enclosed. Low-lying land levels were raised using 3 million tonnes of clean spoil from tunnelling for Crossrail, a project to build major new railway connections under central London.

Wallasea Island is entirely surrounded by sites designated under the Nature Directives and, therefore, the realignment of seawalls enables the creation of estuarine habitats that make a significant contribution to the functionality of the designated sites. The measures also offset the issue of potential future erosion of designated habitats due to the effects of climate change.

5.4.3 The Sand Motor, the Netherlands

Website: http://www.dezandmotor.nl/en/

The Netherlands has been using sand nourishment to compensate for coastal erosion since 1990, in order to protect Holland (the western part of the Netherlands) against flooding from the North Sea.

The Sand Motor is a pilot project that aims to assess whether, by depositing a large amount of sand in a single operation, sand nourishment can be carried out in a more effective and natural way. Natural processes will transport the sand rather than man depositing sand on beaches at the target locations and redistributing it with bulldozers, thereby greatly reducing disruption of the beach ecosystem. The project's third objective (alongside coastal protection and knowledge development) is to create space for amenity and for habitats in an extremely densely populated area.

The Sand Motor was created in 2011 by depositing 21.5 million cubic metres of sand at a single location on the coast of Hook of Holland (near the Hague) as a hook-shaped peninsula. It extended 1km into the sea and was 2km wide where it joins the shore. The land created was 128 ha. The expectation is that most of this area will eventually be submerged, but 35 ha will remain, forming new beaches and dunes along a stretch of approximately 5km along the coast (see Figure 5.8). During the design stage, it was predicted that sand nourishments in the area will be unnecessary for the next 20 years. Since its implementation, this has increased to over 30 years, because research has shown that the beach develops more slowly than expected.

Research on the Sand Motor is being undertaken in six areas: weather, waves and currents; sand distribution; water table and water quality; flora and fauna; recreation; and management.

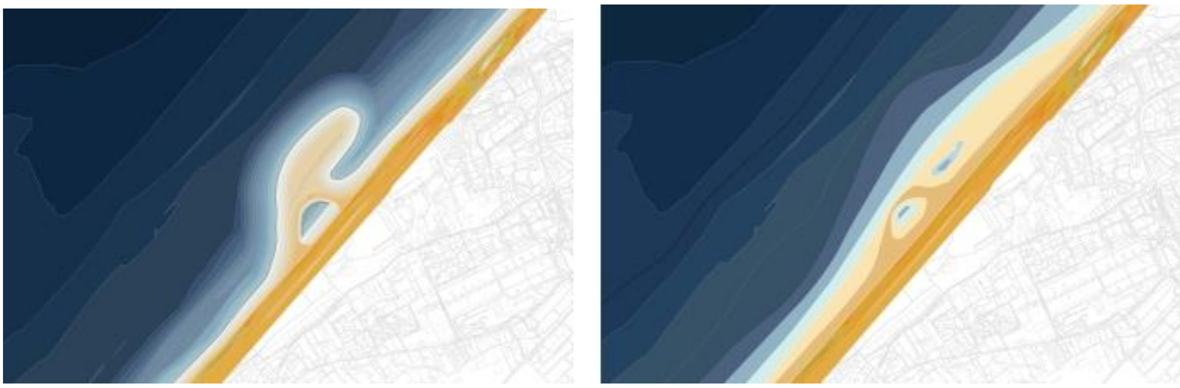

Figure 5.8 The Sand Motor in 2011 (left) and as projected in 20 years (right)

6 Conclusions

The findings of this scoping study have demonstrated that there is a need to promote the synergies between restoring and improving protected habitat and species, including within Natura 2000 sites, and flood risk management. This has to start at the planning stage, by making connections between the planning processes and by engaging across the organisations responsible for flood management and nature. As the document shows, there are many examples in the EU that show that flood prevention can go hand in hand with positive biodiversity management. Although there have been numerous projects within the EU that achieve this, there appear to be few readily available, well documented, examples.

In addition to these opportunities, there are signals that practitioners struggle with the challenges of combining the objectives of the Floods Directive and the Nature Directives. There is a need on the strategic level to identify and solve the existing conflicts between flood protection measures (even those with synergies for the implementation of the WFD), and the application of the BD an HD in the common practice. By finding solutions for these very vital constraints the implementation of natural river restorations and other flood protection measures in the sense of the WFD would be much easier.

There could be value in providing a structured overview of the costs and quantified flood risk management benefits (e.g. in terms of economic damage, reduced risk to people) of the different options, ranging from hard engineering to natural flood risk management, including consideration of climate change scenarios. The concept of ecosystem services and economic valuation could be used for this purpose.

Feedback from flood risk managers and case studies indicate the limiting factors for the implementation of flood protection measures with synergies to WFD, HD or BD measures. This suggests that it would be easier to achieve synergies if areas are selected where more land is available, the conditions for agricultural subsidies were more supportive, and more public funding was available for WFD measures.

Green infrastructure and nature-based solutions delivering multiple benefits are preferable for achieving the objectives of both the Flood and the Nature Directives, but in cases where built 'grey' measures are selected for flood protection, these can be planned and designed in such a way that they preserve or develop valuable habitats with corresponding flora and fauna.

The integration of flood management and nature management objectives has to be part of an even wider perspective: many conflicts can only be solved, and many opportunities can only be taken through fully integrated planning (including also transport, energy, water supply, land use, agriculture), and at the scale of the catchment / coastal cell.

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