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First Flood Risk Mangement Plans - Member State: Hungary

Accompanying the document

REPORT FROM THE COMMISSION TO THE EUROPEAN PARLIAMENT AND THE COUNCIL

on the implementation of the Water Framewrok Directive (2000/60/EC) and the Floods Directive (2007/60/EC)
Second River Basin Management Plans
First Flood Risk Management Plans

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Acronyms

APSFR	Areas of Potential Significant Flood Risk
CBA	Cost-Benefit Analysis
EEA	European Environment Agency
FD	Floods Directive
FHRM	Flood Hazard and Risk Map
FRMP	Flood Risk Management Plan
NGO	Non-Governmental Organisation
NWRM	Natural Water Retention Measures
PFRA	Preliminary Flood Risk Assessments
PoM	Programme of Measures
RBD	River Basin District
RBMP	River Basin Management Plan
SEA	Strategic Environmental Assessment
UoM	Unit of Management
WFD	Water Framework Directive
WISE	Water Information System for Europe

Introduction

The Floods Directive (FD) (2007/60/EC) requires each Member State (MS) to assess its territory for significant risk from flooding, to map the flood extent, identify the potential adverse consequences of future floods for human health, the environment, cultural heritage and economic activity in these areas, and to take adequate and coordinated measures to reduce this flood risk. By the end of 2011, Member States were to prepare Preliminary Flood Risk Assessments (PFRAs) to identify the river basins and coastal areas at risk of flooding (Areas of Potential Significant Flood Risk – APSFRs). By the end of 2013, Flood Hazard & Risk Maps (FHRMs) were to be drawn up for such areas. On this basis, Member States were to prepare Flood Risk Management Plans (FRMPs) by the end of 2015.

This report assesses the FRMP for Hungary[1]. Its structure follows a common assessment template used for all Member States. The report draws on two main sources:

- Member State reporting to the European Commission on the FRMP[2]: as per Articles 7 and 15 of the FD this reporting provides an overview of the plans and details on their measures
- One FRMP (Hungary reported one plan, for its single Unit of Management (UoM), HU1000).

[1] The present Member State assessment reports reflect the situation as reported by each Member State to the Commission in 2016 or 2017 and with reference to FRMPs prepared earlier. The situation in the MSs may have altered since then.

[2] Referred to as "Reporting Sheets" throughout this report. Data must be reported in a clear and consistent way by all Member States. The format for reporting was jointly elaborated by the Member States and the Commission as part of a collaborative process called the "Common Implementation Strategy": http://ec.europa.eu/environment/water/water-framework/objectives/implementation_en.htm
Whereas a key role of the Commission is to check compliance with EU legislation, the Commission also seeks information to allow it to determine whether existing policies are adequate. It also requires certain information to create a European-wide picture to inform the public.

Overview

Figure 1 Map of Units of Management/River Basin Districts

International River Basin Districts (within European Union)
International River Basin Districts (outside European Union)
National River Basin Districts (within European Union)
Countries (outside European Union)
Coastal Waters

Source: WISE, Eurostat (country borders)

Hungary produced one FRMP – *Magyarország árvízi országos kockázatkezelési terve* (January 2016) – which covers the entire country. Hungary has designated a single unit of management (UoM) for the entire country, HU1000: its area is identical with that of the HU1000 River Basin District (RBD) under the Water Framework Directive (WFD), for which Hungary has reported one River Basin Management Plan (RBMP).

The Hungarian FRMP was adopted on 25 March 2016 via Governmental Decree 1146/2016 (III. 25.) on the National Floods Risk Management Plan of Hungary.

The table below gives an overview of the information reported by Hungary, including the UoM code, the name, and the number of APSFRs reported. It shows that Hungary reported all documents required to the European Environment Agency's (EEA) WISE [3]: the FRMP as a PDF and the reporting sheet as an XML. The table does not show if hyperlinks to national websites were reported, even if these national websites contain the FRMP.

Table 1 Overview of UoM in Hungary

UoM	Name	Number of APSFRs	XML Reported	PDF Reported
HU1000	Danube	2	Yes	Yes
TOTAL		**2**		

The FRMP can be downloaded from the following web site:

- http://www.vizugy.hu/index.php?module=vizstrat&programelemid=145

Overview of the assessment

The table below gives an overview of the evidence found in the assessment of Hungary's FRMP. The following categorisation was used for the column concerning evidence:

- **Evidence to the contrary**: An explicit statement was found stating that the criterion was not met;
- **No evidence**: No information found to indicate that the criterion was met;
- **Some evidence**: Reference to the criterion is brief and vague, without a clear indication of the approach used for the criterion. Depending on the comment in the adjacent column, "some evidence" could also be construed as "weak evidence";
- **Strong evidence**: Clear information provided, describing an approach followed in the FRMP to address the criterion.

Table 2 Overview of the evidence found during the assessment of the FRMP

Criterion	Evidence	Comments
FRM objectives have been established	Strong evidence	Objectives have been established at national level.
FRM objectives relate to...		
...the reduction of potential adverse consequences	Strong evidence	The objectives were established at national level and related measures identified. The main focus and priority

[3] http://rod.eionet.europa.eu/obligations/603/deliveries?id=603&tab=deliveries&d-4014547-p=1&d-4014547-o=2&d-4014547-s=3

Criterion	Evidence	Comments
		in setting objectives and planning measures is the protection of human life and health. Additional areas of focus are the minimisation of negative environmental consequences and harmonisation of flood risk management measures with WFD requirements.
...to the reduction of the likelihood of flooding	Strong evidence	A further key objective of the FRMP is to reduce flood risks.
...to non-structural initiatives	Some evidence	FRMP objectives consider non-structural initiatives, calling for strengthening the self-protection capability of the society.
FRM objectives consider relevant potential adverse consequences to...		
...human health	Strong evidence	The main focus and priority in setting objectives and planning measures is the protection of human life and health.
...economic activity	Some evidence	While not directly stated as an objective, the reporting sheet indicates that risk levels were identified for industrial properties.
...environment	Some evidence	The minimisation of negative environmental consequences is an additional focus for the objectives.
...cultural heritage	Some evidence	While not directly stated as an objective, the reporting sheet indicates that risk levels were identified for cultural heritage.
Measures have been...		
...identified	Strong evidence	The FRMP sets out 46 aggregated measures.
...prioritised	Strong evidence	A cost-benefit analysis (CBA) method was elaborated and applied to the identified measures.
Relevant aspects of Article 7 have been taken into account such as...		

Criterion	Evidence	Comments
...costs & benefits	Strong evidence	Hungary carried out cost/benefit analysis for structural measures.
...flood extent	Strong evidence	Measures are focused on the main flood areas.
...flood conveyance	Strong evidence	Actions to increase river channel capacity to convey water for flood alleviation are included in the measures.
...water retention	Strong evidence	The FRMP includes six measures with NWRM elements, though specific details on the measures are not provided.
...environmental objectives of the WFD	Strong evidence	Coordination with the RBMP included the WFD's environmental objectives
...spatial planning/land use	Strong evidence	The FRMP includes measures that address spatial planning
...nature conservation	Some evidence	Potential impacts on Natura 2000 have been assessed, but nature conservation actions are not incorporated in the measures
...navigation/port infrastructure	Strong evidence	One measure addresses navigation issues
...likely impact of climate change	Some evidence	Hungary's reporting provides a brief review of climate change impacts – however, these are not directly addressed in the measures[4]

[4] Hungary subsequently informed that the potential consequences of climate change effects have been considered in the extreme flooding scenarios (Fluvial-1000 and Pluvial-100). The measures in the FRMP thus consider the impacts of the climate change. According to Hungary, structural measures are intended to handle the increased flood risk mostly via the reduction of the inundation hazard. The non-structural measures target climate change impacts.
Key measures include LOKTERV, a planning activity to prepare for the risk of dyke breaches. Protected floodplain areas are investigated with detailed 2D modelling, calculated by the Hungarian ÁKIR software and ÁKK methodology where the effects of climate change are incorporated. The MASZ measure in 2014 was dedicated to address the effects of climate change. It recalculated 2300 km of river sections to define Q100 water levels as the new characteristic design parameters. In the statistical analysis, climate change effects were incorporated. The overall result of the recalculation was that almost in all rivers the design flood levels (MÁSZ) increased by 1 to 1.5 meters in the last two decades, which is partly a result of climate change impacts.
The NMKT planning activity considered the new MÁSZ surfaces and for embanked floodplains, 2D modelling was carried out to define conveyance zones. In regional plans, measures were defined to decrease or avoid further emerging the MÁSZ levels, thus having the explicit purpose to mitigate the climate change impacts.

Criterion	Evidence	Comments
Coordination with other countries ensured in the RBD/UoM	Some evidence	According to information in the reporting sheets, coordination took place within the ICPDR Flood Protection Expert Group, but no details are provided on the elements of coordination.
Coordination ensured with WFD	Strong evidence	The following level of coordination is mentioned in the FRMP: i) Coordination of FRMP and RBMP at national level, ii) Joint consultation of draft FRMP and RBMP, iii) Coordination between authorities responsible for developing FRMP and RBMP, iv) Coordination of objectives, v) Planning of win-win and no-regret measures in FRMP and RBMP, vi) Permits or permissions for flood risk activities (e.g. dredging, flood defence maintenance or construction) that requires prior consideration of WFD objectives.
Active involvement of interested parties	Strong evidence	Opportunities for active involvement were provided in particular via national information forums, held in 12 locations in July-August 2015. Additionally, two other events were held primarily for informing the broad public.

Good Practices

The assessment identified the following good practices in the Hungarian FRMP assessed.

Table 3 Good practices in the Hungarian FRMP

Topic area	Good practices identified
Integration of previously	Efforts were undertaken for the development of a new method for

The TELVIZKAR planning activity considered the new MÁSZ surfaces and the changed regime of the rivers in places where no primary dikes exist. For more than 160 settlements, preparatory plans have been made for operative measures to address high flood scenarios and their consequences (potential inundations). The changes in river regime were partly due to land use change and also meteorological and hydrological changes in the catchments, and they are related to the effects of climate change.

Topic area	Good practices identified
reported information in the FRMPs.	risk and hazard mapping, by means of 2D modelling. The application of this method resulted in a new, more precise delineation of the areas of flood risk.
Consideration of climate change in the FRMPs assessed.	In 2014, HU revised the 1 % probability design flood levels for all relevant river sections, based partially on the climate change scenarios described in the Second National Climate Change Strategy 2014-2025 with lookout to 2050. These new figures were considered in the 2D modelling, which assisted the determination of flood risk levels. Hungary's FRMP includes non-structural measures for planning that address climate change impacts.
Use of CBA in the FRMPs assessed.	Hungary carried out CBA for structural measures. Within the framework of a multiphase evaluation of design alternatives for structural measures, a benefit-cost analysis was carried out in order to reliably estimate the economic aspects of the measures, either alone or in the form of a package of measures. In determining the benefit-cost ratio, the assessed risk level reduction over the planned 30-year timeframe was considered as a benefit. Costs included investment and operating costs, calculated for the planning time horizon.
Public participation.	Twelve information forums were held across the country, with sessions enabling participants to express their opinions. In addition, two other events were organised to inform the broad public. Annex 1 of the FRMP provides an extensive list with the written comments and recommendations received from stakeholders, as well as the comments made in discussion forums, and moreover indicates how they were taken into account in the finalization of the FRMP.
Flood risk governance.	Coordination between the RBMP planning and FRMP planning was ensured. The same organisation was responsible for both planning activities at national level.

Areas for further development

The assessment identified the following areas for further development in the Hungarian FRMP assessed.

Table 4 Areas for further development in the Hungarian FRMP

Topic area	Areas identified for further development
Integration of previously reported information in the FRMPs.	The interpretation of the APSFRs (Areas of Potentially Significant Flood Risk) in Hungary's FRMP is not clear, and it is not clear how many APSFRs have been identified and used for the plan. Earlier reporting stated that HU has two APSFRs, while the FRMP for HU states "*that in the preparation of the FRMP, 8 planning units were created and the results aggregated and presented at this level, though the investigations and calculations were carried out at flood basin level (APSFR)*". It is unclear from the FRMP how the eight planning units relate to the two APSFRs and the number of flood basins modelled (120 in total).[5]
Setting of objectives for the management of flood risk.	The FRMP discusses risk management objectives in Chapter 5[6]. The objectives do not have defined targets and it is not clear how and when they will be achieved.
Planning/implementation of measures and their prioritization for the achievement of objectives.	Other than the use of CBA, it is unclear how the measures have been prioritized. Hungary does not appear to have prioritised its measures since all measures are reported as having "moderate" priority[7]. Costs are identified for 26 out of 46 measures. It is unclear in the FRMP why costs for the remaining measures have not been

[5] Hungary subsequently clarified that the aim of the PFRA was the delineation of the areas designated for detailed examination. Along the river sections that are protected by dams, the endangered areas were defined in 1977 using then available methodologies. The areas were allocated for the 1 % and the 0.1 % exceedance probability.
The online maps show the APSFRs. They are not hazard maps, as they only show the areas exposed to flooding, do not give information about probability or water depth. Maps known as "blue maps" represent the extent of flood basins that can be flooded by floods of 1 % and 0.1 % probability.
Further, in Hungary the basic units of the FRMPs are embanked floodplains, which are disconnected from flood dynamics by dykes and delineate an area that has a certain statistical probability of flooding. Floodplains are separated from each other by natural terrain or artificial infrastructures, so that a flood cannot pass from one basin to another.
There are 120 modelled flood basins. They overlap with municipality and county borders, institutional operational borders, and in some cases the national border, but each is managed by only one regional Water Directorate. The Water Directorates are responsible for preparing plans and coordinating local and regional discussions with contributing parties and the wider audience. For each of the 120 modelled flood basins, flood extent, water depths or water level is modelled for each scenario.
The locations of the proposed interventions were linked to the sub-units defined by Hungary's RBMP. The FHRMs and FRMP have been prepared on the basis of eight planning units.

[6] This chapter is full of technical details related to limit or threshold values of different categories, but vague in providing a clear picture on measurable and specific objectives across the categories that are defined in the Floods Directive (FD).

[7] Hungary subsequently noted that it was planned to carry out the 46 measures listed in the FRMP by 2021 with no specific prioritisation among them: therefore, they were all considered as having moderate priority.

Topic area	Areas identified for further development
	provided. Hungary's reporting sheets refer to a preliminary identification of 400 measures, and it is not clearly indicated how these are related to the 46 measures reported for the FRMP[8].
Consideration of climate change in the FRMPs assessed.	The climate change aspect of flood risk is mentioned in the FRMP, but the text is vague on how actually climate change was considered. There is no reference in the FRMP to the national climate change adaptation strategy.
International issues in flood risk management.	Whereas international coordination took place within the ICPDR Flood Protection Expert Group, no details are provided in the FRMP or in Hungary's reporting sheet on the elements of coordination (ICPDR's international FRMP for the Danube River[9] contains information on Hungary's international coordination)[10].

Recommendations

Based on the reported information and the FRMP, the following recommendations are made to enhance flood risk management (not listed in any particular order):

- The interpretation of the Areas of Potentially Significant Flood Risk (APSFRs) in the FRMP is not clear. It is assumed – based on Hungary's reporting – that there are two APSFRs, however there are references to planning units and flood basins. The number of APSFRs should be clarified, along with their relationship to the planning units and flood basins.
- To be able to assess progress in achieving the objectives, the FRMP should develop objectives that are more specific in terms of quantitative targets, locations and the timeframes for achievement.
- Provide more clarity on the number of measures, the relationship between the FRMP's measures and measures described as preliminary.

[8] Hungary subsequently informed that the 400 measures are for 2030. Out of the 46 measures (in the FRMP), 42 measures were listed in Government Decision no. 1084/2016. (II. 29), and 4 are non-structural measures (MASZ, Recalculation of the design/regulatory flood levels; NMKT, Flood plain Management Plans; LOKTERV, Rescue and Evacuation Plans; and TELVIZKAR, Municipality defence plans for water-related damages). These measures should be implemented by 2021.

[9] Available at: https://www.icpdr.org/main/activities-projects/flood-risk-management

[10] Hungary subsequently noted that, in addition to chairing of the ICPDR's Food Protection Expert Group, there are border commissions with all five neighbouring EU Member States and two non-EU countries: for all, water management issues are high on the agenda. Information exchange and coordination with neighbouring Member States and countries took place at all stage of the development of PFRA, FHRMs and FRMP. For instance, with Austria, methodologies were analysed mutually in depth and conclusions for the next cycles were developed and presented at EU level (in the Working Group on Floods). In the context of the EU Strategy for the Danube Region and the Danube Flood Risk Management Plan, Danube countries worked together and shared information.

- The next version of the FRMP should include an estimation of the cost of all measures.
- The prioritisation approach for measures should be explained better in the 2nd cycle FRMP.
- The FRMP should more clearly explain how climate change is addressed in flood risk management and coordination between the FRMP and the national climate change adaptation strategy reinforced.
- The FRMP should better reflect international coordination issues.

1. Scope of the assessment and sources of information for the assessment

1.1 Reporting of the FRMPs

Hungary produced one FRMP, which covers the entire country, thus the UoM is identical with the HU1000 area of the WFD RBMP as well[11].

1.2 Assessment of the FRMPs

Hungary reported one FRMP (UoM Code: HU1000, UoM Name: Danube), which is assessed.

Table 5 UoM assessed in Hungary

UoM code	UoM Name
HU1000	Danube

[11] While Hungary produced and reported one national FRMP, Hungary also prepared flood plans for eight sub-national water management planning units. These sub-national plans have not been assessed here.

2. Integration of previously reported information

2.1 Conclusions drawn from the preliminary flood risk assessment

The conclusions of the PFRA are presented in the FRMP. According to the FRMP, the flood risk modelling that was used for the PFRA has been updated, mainly as a consequence of floodplain developments: new infrastructures that influence water flow were included in the model (examples include roads, railways and hydro-engineering structures). The update of the model led to an update of the calculation of the potential extent of flooding.

A link is given in the FRMP to the maps[12]. The FRMP's Chapter 3.2 on Preliminary assessment of risks provides short, textual information on the PFRA work. The FRMP states that it uses the same APSFRs which were identified in the PFRA (according to Chapter 1.6).

One issue is that it is unclear how many APSFRs have been identified and used for flood risk management in Hungary. Earlier reporting stated that HU has two APSFRs, while the FRMP states that "in the preparation of the FRMP eight planning units were created and the results aggregated and presented at this level, though the investigations and calculations were carried out at flood basin level (APSFR)". It is unclear how the eight planning units relate to the two APSFRs; moreover, Hungary's FRMP refers to so-called "flood basins", which are areas of flood risk: 120 flood basins were modelled[13].

2.1.1 Coordination with neighbouring Member States on shared RBDs/UoMs

According to Hungary's reporting sheets[14], coordination with neighbouring Member States was limited to information on the development status of the FRMP; however, the national plan

[12] http://www.vizugy.hu/index.php?module=vizstrat&programelemid=145

[13] Hungary subsequently clarified that the aim of the PFRA was the delineation of the areas designated for detailed examination. Along the river sections that are protected by dams, the endangered areas were defined in 1977 using then available methodologies. The areas were allocated for the 1 % and the 0.1 % exceedance probability.
The online maps show the APSFRs. They are not hazard maps, as they only show the areas exposed to flooding, do not give information about probability or water depth. Maps known as "blue maps" represent the extent of flood basins that can be flooded by floods of 1 % and 0.1 % probability.
Further, in Hungary the basic units of the FRMPs are embanked floodplains, which are disconnected from flood dynamics by dykes and delineate an area that has a certain statistical probability of flooding. Floodplains are separated from each other by natural terrain or artificial infrastructures, so that a flood cannot pass from one basin to another.
There are 120 modelled flood basins. They overlap with municipality and county borders, institutional operational borders, and in some cases the national border, but each is managed by only one regional Water Directorate. The Water Directorates are responsible for preparing plans and coordinating local and regional discussions with contributing parties and the wider audience. For each of the 120 modelled flood basins, flood extent, water depths or water level is modelled for each scenario.
The locations of the proposed interventions were linked to the sub-units defined by Hungary's RBMP. The FHRMs and FRMP have been prepared on the basis of eight planning units.

[14] FRMP for HU (EU UoMCode: HU1000) – WISE Electronic Report – 22. 03. 2016 in Summary of Coordination paragraph

was not coordinated with neighbouring Member States. There was no coordination in cases where RBDs/UoMs are shared – rather, it is stated that at a later stage, Hungary will coordinate flood risk areas with neighbouring Member States.

The international Danube FRMP, which is coordinated by the International Commission for the Protection of the Danube River (ICPDR), provides a "roof level" plan dealing with issues relevant to the entire basin. It was endorsed by all ICPDR member countries, consequently providing a level of coordination. The Danube "roof" FRMP differs from national plans, which were elaborated for more detailed issues, and some of which may have transboundary implications. The international Danube FRMP provides further information on Hungary's international coordination[15].

2.1.2 Information how the PFRA was used in the development of the FHR maps

As noted above, the flood risk modelling that was used for the PFRA has been updated, mainly as a consequence of floodplain developments. A 2D numerical modelling technique[16] was introduced and applied to calculate the potential flooding, and this work required updating of the information based on the flood basins, which resulted in the above-mentioned modifications.

For the flood hazard and flood risk maps, Hungary revised the design flood protection levels on all rivers that were the subject of mapping: the new levels draw upon the modification of the findings of the PFRA. Design flood level is the water level for the base flood used in planning – for Hungary's FRMP, this refers to the water level for a 1 % probability flood (based on river flow rate at a given section for the 1 % probability flood)[17].

[15] Hungary subsequently noted that, in addition to chairing the ICPDR's Flood Protection Expert Group, there are border commissions with all five neighbouring EU Member States and two non-EU countries: for all, water management issues are high on agenda. Information exchange and coordination with neighbouring Member States and countries took place at all stage of the development of PFRA, FHRMs and FRMP. For instance, with Austria, methodologies were analysed mutually in depth and conclusions for the next cycles were developed and presented at EU level (in the Working Group on Floods). In the context of the EU Strategy for the Danube Region and the Danube Flood Risk Management Plan, Danube countries worked together and shared information.

[16] A 2D numerical model was applied as, according to the FRMP, this is the only technique with which interim changes could be tracked effectively and the calculations could be run taking into account the new circumstances.

[17] This information was found in Chapters 3.2, 3.3 and 3.4 of the FRMP.

2.2 Presentation of Flood Hazard and Risk Maps (FHRMs) in the FRMPs

The FRMP provides a link to www.vizugy.hu[18]: this is the home page of the Hungarian Water Management Directorate, while the specific page where the maps can be found is: http://www.vizugy.hu/index.php?module=vizstrat&programelemid=145.

Floods from pluvial, fluvial, groundwater and artificial water bearing infrastructure sources have been identified in the FRMP. Floods from other identified sources and from combined sources have not been taken into account in the FRMP[19].

2.2.1 Maps for shared flood risk areas

Flood hazard and flood risk maps have not been prepared for flood risk areas shared with other Member States. Hungary has seven neighbouring countries of which five are EU Member States (Austria, Croatia, Romania, Slovakia and Slovenia) and two, Ukraine and Serbia, are neighbourhood and candidate countries respectively. About 95 % of the discharge in Hungarian rivers originate from upstream countries (six out seven neighbouring countries, except Serbia) and, consequently, share flood basins with all of them.

By the time of the finalisation of the FRMPs, 120 flood basins (i.e. areas of flood risk) were identified within HU, including some which have a transboundary character, but according to the FRMP, only information about the development status of the FRMPs was exchanged with other Member States. No information on transboundary measures were reported by Hungary.

2.2.2 Conclusions drawn from the flood hazard and flood risk maps

In the Hungarian FRMP, FHRMs have been used to develop the FRMP. Based on the reporting sheets and the FRMP:

- FHRMs were used to set priorities for flood risk management (e.g. locations, economic activities, assets);
- FHRMs were used as a tool in the public participation process;
- Specific objectives on flood risk reduction were defined based on the FHRM;
- Measures were defined based on the FHRM.

Due to developments in the floodplain, since the FHRMs were first published, the 2D model has been updated. This resulted in a change of the calculated flood risk and flood extent. The

[18] Chapter 1.6 of the FRMP.
[19] Nor have seawater floods, which are not relevant for Hungary.

modelling results, and the FHRM itself, were used to define specific objectives on flood risk reduction and also as a tool in public participation process[20].

2.3 Changes to the APSFRs or other Flood Risk Areas

Any changes in the identification of APSFRs or other Flood Risk Areas since December 2011 should be reflected in the FRMP. As noted above, Hungary carried out a significant update of the model used for the calculation and mapping of the flood risk: there were significant modifications both in the number of flood basins investigated and the extent of them. This resulted in a change of the potential flood risk, the potential flood risk extent and the desired flood protection levels[21] [22].

2.4 Areas for further development in the earlier assessment of the flood hazard and risk maps

The following areas for further development were identified in the assessment of Hungary's FHRMs[23]:

- No modelling technique was used to identify the extent of potential flooding and old design flood levels were applied;
- With regard to adverse consequences, Hungary did not report the number of inhabitants affected for the medium probability scenario (as required in the Floods Directive (FD) Art.6(5)(a));
- No information about fluvial floods was reported;
- It was also not clear how pluvial floods risk were considered in the elaboration of FHRMs;
- Links to national FHRMs were not available for all UoMs;
- Hungary reported that new maps, based on new numerical modelling and further improvements, will be published, but the publication date was not indicated;
- Hungary seems to have defined flash floods in small rivers as pluvial floods for the PFRA. Pluvial (flash flood) hazard maps were not prepared by 2014 because the required detailed survey of the significant creeks had not been finalised. It was unclear when the maps would be finalised.

[20] FRMP Chapter 5.
[21] Chapters 1 and 3 of the FRMP Hungary's reporting sheet.
[22] Hungary subsequently informed that new FHRMs were reported in 2016 (these, or any updates, will be assessed by the European Commission at a later stage).
[23] European Commission, Assessment of Flood Hazard and Flood Risk Maps – Member State Report: HU – Hungary, December 2014. Available at: http://ec.europa.eu/environment/water/flood_risk/pdf/fhrm_reports/HU%20FHRM%20Report.pdf

Areas for further development identified earlier in FHRM reporting have been addressed. As mentioned above, Hungary carried out significant modifications both in the number of flood basins investigated and their extents when 2D numerical modelling technique was applied to calculate potential flooding. In connection to the preparation of flood hazard and flood risk mapping, Hungary revised the design flood stage levels of all rivers that were subject of mapping[24]. As a result:

- Modelling techniques were applied;
- The FRMP includes the number of inhabitants exposed to flood risks, including inhabitants in small river catchments;
- The FRMP addresses both fluvial and pluvial flood risks (along with those related to artificial water bearing infrastructure);
- Links to national FHRMs are now available[25].

2.5 Good practices and areas for further development in the FRMPs regarding integration of previously reported information

The following **good practice** was identified:

- Efforts were undertaken for the development of a new method for risk and hazard mapping, by means of 2D modelling. The application of this method resulted in a new, more precise delineation of the areas of flood risk.

The following **area for further development** was identified:

- The interpretation of the APSFRs (Areas of Potentially Significant Flood Risk) in Hungary's FRMP is not clear, and it is not clear how many APSFRs have been identified and used for the FRMP.

[24] Chapters 1 and 3 of the FRMP and the reporting sheet.
[25] The link, provided earlier in this section, is: http://www.vizugy.hu/index.php?module=vizstrat&programelemid=145

3. Setting of Objectives

3.1 Focus of objectives

The FRMP discusses the objectives of flood risk management and states that the first priority is given to human health and its protection, with the minimisation of the environmental damages caused by flooding as second priority. The reduction of flood risks is a further objective; harmonisation of flood risk management measures with WFD requirements is also indicated as an objective. The FRMP moreover calls for strengthening the self-protection capability of society (Chapter 5.1).

While not directly referring to objectives, the FRMP discusses the technical characteristics of the protection measures and alternatives, and in the reporting sheets, numerical values are given on how the different risk levels were determined for properties, protection of human health, cultural heritage, industrial properties, natural protection areas, and groundwater resources. However, these values are not associated with the objectives, rather with indicators of risks[26].

Based on the information found in the FRMP[27]:

- The objectives aim to reduce the adverse consequences of floods;
- The objectives aim to reduce the likelihood of flooding[28];
- The objectives refer to measures that will be implemented;
- The objectives refer to non-structural measures[29];
- The objectives aim to coordinate flood risk with neighbouring countries (e.g. to ensure that measures taken do not increase flood risk in neighbouring countries).

3.2 Specific and measurable objectives

No specific information can be found in Chapter 5, where the objectives of the plan are discussed, to indicate that objectives are specific or measurable: The objectives are not

[26] Examples of the indicators include:
- Properties – the values (in HUF) of the properties which are exposed to floods;
- Human health – the indicators are grouped in five classes: Class 1 (low risk) when the inundation is 0 – 0.8 m; Class 2 (low medium) with inundation 0.8 – 1.5 m; Class 3 (medium) 1.5 - 2.0 m; Class 4 (medium high) 2.0 – 3.0 m; Class 5 (high) above 3.0 m inundation.
- Cultural heritage: the indicator of risk is proportional of the surface area of the basin where cultural heritage can be found.

[27] These categories are included in Art. 7 of the Floods Directive.

[28] The assessment adopts the generally accepted definition of risk as a product of consequence times likelihood, thereby also in alignment with Art. 7(2) of the FD.

[29] Non-structural measures include measures such as flood forecasting and raising awareness of flooding as well as land use planning, economic instruments and insurance

quantitative and are not time-bound; though it is mentioned in which APSFR the objectives will be achieved, Hungary only has identified two APSFRs, and more detailed location information (such as which planning unit or "flood basin" is concerned) is not provided. More specific and measurable targets are instead provided on the measures.[30]

3.3 Objectives to reduce adverse consequences from floods

In the FRMP assessed, objectives address adverse consequences to human health first of all and to environment and economic activity secondly.

3.4 Objectives to address the reduction of the likelihood of flooding

The objectives aim to reduce the vulnerability and risk due to flooding; however, without further specification.

3.5 Process for setting the objectives

The following elements were considered in setting the objectives:

- Objectives have been coordinated between regions (i.e. twelve regional water management directorates) sharing flood risk areas within the national UoM.
- The objectives have been coordinated between countries sharing flood risk areas in transboundary RBDs/UoMs in the context of the ICPDR's preparation of a roof report for the river Danube.
- The objectives were discussed with stakeholder/s before their establishment (see section 7 below).

3.6 Good practices and areas for further development regarding setting objectives

The following **area for further development** was identified:

- The objectives do not have targets defined and it is not clear how and when the objectives will be achieved.

[30] Hungary subsequently noted that a key target is to implement the 46 measures by the end of the first FRMP cycle (2021).

4. Planned measures for the achievement of objectives

Hungary reported no individual measures and 46 aggregated[31] measures[32]. Out of the 46 aggregated measures, two measures (4 %) deal with prevention and three measures (7 %) with preparedness, while the great majority of the measures (41 measures or 89 %) are for protection[33].

The responsibility for all 46 measures is at national level. Implementation of three measures has been completed (at the time of reporting); three are in on-going construction phase, while 87 % (40) of the measures reported have not been started yet.

In Hungary's reporting sheet, however, the Summary of the Objectives states: "As an outcome, the ÁKK[34] project formulated more than 400 measures over the country." (The ÁKK was the project that elaborated the HU1000 FRMP). It is not clear if all these measures were incorporated into the 46 aggregated measures reported for Hungary[35], nor how measures were aggregated: a definition of aggregated measures was not found[36].

Please see Annex A for Supplementary tables and charts on measures for this and subsequent questions in this section.

4.1 Cost of measures

Table 6 Estimated overall budget for the measures in the assessed FRMP

	Estimated budget of 26 planned measures (2015-2021) in HUF
HU1000 (for 26 of 46 measures)	183 billion

Note: Budget information was reported for 26 out of the 46 measures.

[31] The Reporting Guidance mentions "Measures can be reported as individual measures (recommended for major projects) or aggregated measures,…" and also notes that measures may be comprised of "many individual projects". European Commission, Guidance for Reporting under the FD (2007/60/EC), 2013, pp. 54-58.

[32] The information reported to WISE was the starting point for the assessment in this section. The majority of the statistics presented are based on processing of information reported to WISE. Assuming that the Member States accurately transferred the information contained in their FRMPs to the reporting sheets (the sheets are the same for all Member States and are not customisable) and barring any undetected errors in the transfer of this information to WISE arising from the use of interfacing electronic tools, these statistics should reflect the content of the FRMPs.

[33] For details about all measure aspects and all measure types, see Annex 3.

[34] Árvízkockázat kezelés, or flood risk management.

[35] Hungary subsequently informed that the 400 measures are for 2030. Out of the 46 measures (in the FRMP), 42 measures were listed in Government Decision no. 1084/2016. (II. 29), and four are non-structural measures (MASZ, Recalculation of the design/regulatory flood levels; NMKT, Flood plain Management Plans; LOKTERV, Rescue and Evacuation Plans; and TELVIZKAR, Municipality defence plans for water-related damages). These measures should be implemented by 2021.

[36] Hungary subsequently clarified that these projects can best be viewed as aggregated measures since they include all the processes including design, construction and maintenance.

Hungary's FRMP, in Table 27 of Chapter 5.2.3, gives individual preliminary cost estimates for 26 measures out of the total 46 measures for the period 2014-2020: HUF 183 bn (approximately €580 m)[37]. It is stated that actual project costs will be elaborated during the project preparation part of the implementation phase.

4.2 Funding of measures

According to the Hungarian FRMP, the measures will be funded using a combination of the public budget at the national level and EU co-funded projects (Operational Programme under Cohesion Policy)[38].

Hungary's reporting sheet mentions that the General Directorate of Water Management of the Ministry of Interior is the organisation that will coordinate nationwide the implementation of the measures. It is also stated that projects will be carried out via public procurement using national and international funding sources.

4.3 Measurable and specific (including location) measures

The measures in the FRMP are specific and measurable. Among other information, the measures reported by Hungary are specified by measure type as well as measure location (see the table below).

Table 7 Location of measures

	HU1000
International	
National	✓
RBD/UoM	✓
Sub-basin	✓
APSFR or other specific risk area	
Water body level	
More detailed than water body	

Source: FRMP

[37] Hungary noted subsequently that three groups of floods were created for the examination of flood hazards:
- Floods of river sections protected by dykes (fluvial floods);
- Floods of river and stream sections not protected by dykes (flash floods or pluvial floods);
- Inland inundations (excess water).

These measures do not include the excess water related projects. The reason for this is that in the first cycle of the FD, Hungary worked out the Complex Excess Water Hazard Probability to evaluate the risk of excess water inundation, but hazard and risk reduction measures have not been made for the endangered areas. So, the 26 measures are floodplain (fluvial) and pluvial flood risk reduction projects, whereas the 46 measures reported also include projects related to excess water.

[38] Hungary subsequently indicated that all the measures will be co-funded projects under the relevant Operational Programme.

4.4 Measures and objectives

As explained in section 3, Hungary's objectives are not specific or measurable. Consequently, it is not clear how measures will contribute to the achievement of objectives, nor clear by how much they will contribute[39]. It is also not clear whether the objectives will be achieved when all measures are completed.

The information on measures provided in the FRMP as well as in Hungary's reporting to WISE Electronic Report is minimal.

4.5 Geographic coverage/scale of measures

Hungary has reported two prevention measures and three preparedness measures: all of these measures are at national scale. Out of 41 protection measures, 22 are at local, 16 at sub-basin and three at national scale.

No information is given about the geographic coverage of the expected effects for any of the 46 listed measures in the FRMP for Hungary.

4.6 Prioritisation of measures

According to the FRMP, CBA was carried out to prioritize structural measures (section 6 below describes Hungary's approach to cost/benefit analysis). It is also mentioned in the FRMP that actual costs will be determined once each project is designed.

In Hungary's reporting of measures, however, all measures are listed to be of "moderate" priority (see Table A3 in Annex A) [40].

4.7 Authorities responsible for implementation of measures

Hungary's national Ministry of Interior is the responsible authority for the implementation of all measures, according to the reporting sheets. Consequently, all measures reported are implemented by a national authority.

4.8 Progress of implementation of measures

According to the information reported by Hungary, implementation of three of the measures has already been completed (7 % of all measures), three are in the on-going construction phase,

[39] Hungary subsequently informed that a key target is to implement the 46 measures by the end of the first FRMP cycle (2021).

[40] Hungary subsequently informed that it was planned to carry out the 46 measures listed in the FRMP by 2021 with no specific prioritisation among them: therefore, they were all considered as having moderate priority.

while the remaining 40 measures listed (87 %) have not been started yet (see Table A5 and Figure A5 in Annex A).

The FRMP indicates that all 46 measures are to be implemented by the end of the cycle (2021).

4.9 Measures taken under other Community Acts

Member States have been asked to report on other Community Acts under which each measure has been implemented. For Hungary's FRMP, the following links are indicated:

- WFD: In the reporting sheet, the section on "Summary of Development" states that during the preparation of flood risk management plans, the harmonization with the WFD has been monitored. This was ensured by the continuous coordination of the design work of the RBMP and the FRMP, as the planning of flood risk management and river basin management planning was done in the same institutional system: the regional water directorates managed the documents under the overall control of the nationally responsible organisation, the General Directorate of Water Management (OVF).
- EIA Directive: No reference found in the FRMP or WISE reporting[41].
- SEA Directive: The FRMP underwent an SEA procedure. The SEA report was published on the official website of the FRMP (www.vizugy.hu) on 3 December 2015.
- Seveso Directive: no reference was found in the Hungarian FRMP or WISE reporting[42].
- Civil protection Mechanism: no reference was found in the Hungarian FRMP or WISE reporting[43].
- Other Community Acts: while the FRMP lists relevant EU Acts (and national obligations), it does not specify how they are addressed in flood risk planning.

4.10 Specific groups of measures

With regard to **spatial planning/land use measures**, the following types of measures are included in the Hungarian FRMP[44]:

[41] Hungary subsequently indicated that the planned measures in the FRMP are strategic measures. The implementation of these measures may be carried out after detailed planning, environmental checking, and after an authorisation procedure.

[42] Hungary subsequently noted that the fluvial or pluvial flood risks of affected Seveso sites appear in the FHRMs.

[43] Hungary subsequently informed that since 2016 the General Directorate of Water Management (OVF) has participated in the common implementation of a Disaster Risk Assessment System. The aim of the project is to build a GIS based system for disaster risk assessment. The project primarily involves the identification, analysis, evaluation and mapping of hazards which are reinforced and enhanced by the effects of climate change. The OVF supports the project by providing the results of FHRM and FRMP. Further, Hungarian officials have participated in expert courses on the EU Civil Protection Mechanism.

[44] According to information provided in Hungary's WISE reporting.

- Six M31[45] type measures;
- one measure establishing or enhancing flood forecasting or early warning system (measure type M41[46]); and
- two measures establishing or enhancing flood event institutional emergency response planning (measure type M42[47]) which also contain elements of spatial planning / land use (see below).

It is stated in Chapter 5.2.1.4 of the FRMP that the effects of land use regulations were investigated in a 30-year time horizon, which should imply the consideration of climate change.

Chapter 5.4 on *Measures to manage flood beds* briefly mentions that in 2014, flood bed[48] management plans were finalised, in which the possibility of FRMP-defined relevant measures were taken into account. It is also mentioned in this chapter that, based on the findings and recommendations of these plans, a ministerial decree would be issued that will determine the concrete measures.

Natural water retention measures (NWRMs) have been planned. Hungary plans six M31 type measures[49], some of which contain natural water retention elements.

Measures that specifically consider nature conservation. While the FRMP does not specify measures that incorporate nature conservation, it does address the potential risks of measures to natural areas. In the risk assessment part of the FRMP, Natura 2000 areas were considered. There are 43 flood basins where partial or full inundation of a Natura 2000 area can be expected. Ecological damages can be expected on 11 315 ha (see also below).

One M32 type measure[50] deals with **navigation issues**, namely reconstruction of a lock on the Tisza River.

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[45] 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.

[46] Preparedness, Flood Forecasting and Warning, Measure to establish or enhance a flood forecasting or warning system.

[47] Preparedness, Emergency Event Response Planning / Contingency planning, Measure to establish or enhance flood event institutional emergency response planning.

[48] The flood bed refers to the area between two flood protection levees on either side of a river.

[49] 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.

[50] 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

Dredging to increase the river channel capacity and its ability to convey water for flood alleviation purposes is planned within the Hungarian FRMP. The FRMP lists - in Table 30 on page 53 - projects that have already been approved by the Government for small river flood risk reduction. Some of these projects contain elements of dredging work. There is, however, no clear information about the exact number of measures related to dredging. It is stated in Table 31 that 26 WFD-related water bodies will be the subject to river bed regulation, which involves dredging.

One of the measures, named "KEOP 1.5.0 programme", will support, among other actions, river bed rehabilitation.

4.11 Recovery from and resilience to flooding

The role of insurance policies is not discussed in the Hungarian FRMP, nor in Hungary's reporting[51].

Ecosystem services were considered in risk calculations in relation to Natura 2000 areas as well as in defining non-structural measures. It was considered that in these areas, inundation with less than 50 cm would not represent risks as the potential benefit for the ecosystem is higher than the potential damage.

4.12 Monitoring progress in implementing the FRMP

No information is provided either in the FRMP or in the reporting sheets to identify[52]: a) What is monitored; b) How the monitoring will be carried out; c) if any organisation, apart from the Competent Authority, is foreseen to be involved in monitoring the progress of the implementation of measures. No information is provided to indicate that a monitoring baseline has been established.

4.13 Coordination with the Water Framework Directive

The table below shows how the development of the FRMP has been coordinated with the development of the second River Basin Management Plan of the WFD.

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development of existing flow regulation rules), and which have a significant impact on the hydrological regime.

[51] Hungary subsequently noted that insurance policies were discussed in the Flood Risk Management Concept Paper (which identified possible measures to 2030) and related annex as possible measures for risk management.

[52] Hungary subsequently remarked that the General Directorate of Water Management (OVF) is constantly monitoring the implementation of the projects.

Table 8 Coordination of the development of the FRMP with the development of the second River Basin Management Plans of the WFD

	HU1000
Integration of FRMP and RBMP into a single plan	
Joint consultation of draft FRMP and RBMP	✓
Coordination between authorities responsible for developing FRMP and RBMP	✓
Coordination with the environmental objectives in Art. 4 of the WFD	✓
The objectives of the Floods Directive were considered in the preparation of the RBMP [a]	✓
Planning of win-win and no-regret measures in the FRMP	✓
The RBMP PoM includes win-win measures in terms of achieving the objectives of the WFD and Floods Directive, drought management and NWRMs [a]	✓
Permitting or consenting of flood risk activities (e.g. dredging, flood defence maintenance or construction) requires prior consideration of WFD objectives and RBMPs	✓
Natural water retention and green infrastructure measures have been included	
Consistent and compliant application of WFD Art. 4(7) and designation of heavily modified water bodies with measures taken 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 WFD Environmental Objectives [a]	
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	

Notes: [a] based on reporting under the WFD

Not enough information was available from the reporting to assess all terms in the table above. The reporting sheet does not contain information in the field "WFD Measures". However, the following levels of coordination have been mentioned in the FRMP:

- Coordination of FRMP and RBMP at national level,
- Joint consultation of draft FRMP and RBMP,
- Coordination between authorities responsible for developing FRMP and RBMP,
- Coordination of objectives,
- Planning of win-win and no-regret measures in FRMP and RBMP,
- Permits or permissions for flood risk activities (e.g. dredging, flood defence maintenance or construction) requiring prior consideration of WFD objectives and RBMPs. (From Chapter 6 of the FRMP)

In addition, reporting under the WFD indicates that FD objectives were considered in the preparation of Hungary's RBMP, and its programme of measures includes win-win measures for the Floods Directive.

4.14 Good practices and areas for further development with regard to measures

The following **good practice** was identified:

- Coordination between the RBMP planning and FRMP planning was ensured. The same organisation was responsible for both planning activities at national level.

The following **areas for further development** were identified:

- While Hungary's FRMP refers to the use of CBA, Hungary did not indicate priorities among its measures. Indeed, according to Hungary's reporting, all measures are identified as having "moderate" priority[53].
- Costs are identified for 26 out of 46 measures. It is unclear in the FRMP why costs for the remaining measures have not been provided.

[53] Hungary subsequently noted that it was planned to carry out the 46 measures listed in the FRMP by 2021 with no specific prioritisation among them: therefore, they were all considered as having moderate priority.

5. Consideration of climate change

The Hungarian FRMP does not refer to the expected effects of climate change. On the other hand, Hungary's reporting sheet, uploaded to WISE, references the Second National Climate Change Strategy 2014-2025 with outlook to 2050 (*Második Nemzeti Éghajlatváltozási Stratégia 2014-2025, kitekintéssel 2050-re*). It indicates that the Strategy describes tendencies and expected changes that would influence the frequency of high floods. It is stated, however, that the Strategy does not provide numerical values about these events.

The FRMP does not set definitive timeframe for climate change scenarios as it does not refer directly to such scenarios. There are indications in the FRMP and in the reporting sheet that climate change will lead to a shift in the occurrence of extreme events and changes in numerical recurrence times. It is mentioned that a national database was developed with all hydrological information, and this was used for the recalculation of design flood levels and discharges and the extrapolation to calculate extreme events probability.

The reporting sheet gives a very brief summary of climate change aspects of the FRMP. No information is provided whether the main sources of flooding will change under long-term climate change scenarios.

5.1 Specific types of measures planned to address climate change

Hungary's FRMP includes non-structural measures that address climate change impacts, such as the LOKTERV project, a planning activity to prepare for the risk of dyke breaches. These measures deal with a) the preparation of a Flood Management Plan for the entire country and b) recalculation of the design flood levels (1 % probability). Both measures consider climate change aspects[54].

[54] Hungary subsequently informed that the potential consequences of climate change effects have been considered in the extreme flooding scenarios (Fluvial-1000 and Pluvial-100). The measures in the FRMP thus consider the impacts of climate change. According to Hungary, structural measures are intended to handle the increased flood risk mostly via the reduction of the inundation hazard. The non-structural measures target climate change impacts.
Key measures include LOKTERV, a planning activity to prepare for the risk of dyke breaches. Protected floodplain areas are investigated with detailed 2D modelling, calculated by the Hungarian ÁKIR software and ÁKK methodology where the effects of climate change are incorporated. The MASZ measure in 2014 was dedicated to address the effects of climate change. It recalculated 2300 km of river sections to define Q100 water levels as the new characteristic design parameters. In the statistical analysis, climate change effects were incorporated. The overall result of the recalculation was that almost in all rivers the design flood levels (MÁSZ) increased by 1 to 1.5 meters in the last two decades, which is partly a result of climate change impacts.
The NMKT planning activity considered the new MÁSZ surfaces and for embanked floodplains, 2D modelling was carried out to define conveyance zones. In regional plans, measures were defined to decrease or avoid further emerging the MÁSZ levels, thus having the explicit purpose to mitigate the climate change impacts.

5.2 Good practices and areas for further development concerning climate change

The following **good practices** were identified:

- In 2014, HU revised the 1 % probability design flood levels for all relevant river sections, based partially on the climate change scenarios described in the Second National Climate Change Strategy 2014-2025 with lookout to 2050. These new figures were considered in the 2D modelling, which assisted the determination of flood risk levels.
- Hungary's FRMP includes non-structural measures that address climate change impacts.

The following **area for further development** was identified:

- Although Hungary's reporting sheet refers to the Second National Climate Change Strategy 2014-2025 with outlook to 2050 document, it is not clear how climate change is taken into consideration in the FRMP.

The TELVIZKAR planning activity considered the new MÁSZ surfaces and the changed regime of the rivers in places where no primary dikes exist. For more than 160 settlements, preparatory plans have been made for operative measures to address high flood scenarios and their consequences (potential inundations). The changes in river regime were partly due to land use change and also meteorological and hydrological changes in the catchments, and they are related to the effects of climate change.

6. Cost-benefit analysis

Within the framework of a multi-phase evaluation of design alternatives, a CBA was carried out to estimate the economic aspects of structural measures. The results of the analysis were provided in terms of the benefit-cost ratios for the measures[55]. In determining this ratio, the extent of reductions in risks to assets over the planning timeframe (30 years) was considered as a benefit.

The cost was considered as the sum of investment and operating costs calculated for the planning timeframe. The present value (at 2015 price levels) for both the reduction of the risk and the costs was determined. The total cost was made up of three elements:

1. Capital costs: One-time cost, which was considered to be paid out in 2027. The cost value was discounted to the level of 2015.
2. Depreciation costs: This is 2 % of the investment costs to be paid in 2027 and this amount should be paid annually from 2028 till 2057. For comparison, the total depreciation costs to be paid during the 30-year period were discounted to the level of 2015.
3. Maintenance costs: The amount for the period of 30 years, discounted.

Only the national benefits of measures have been included in the CBA. No indication was found in the FRMP or Hungary's reporting sheets if transboundary, downstream benefits were considered[56]. Furthermore, Hungary did not report any transboundary measures. According to Hungary's reporting sheet (the Summary of Cost/Benefit), the FRMP considered multi-benefits, though details were not found in the plan itself.

The CBA was used as a criterion for the establishment of priorities for the selection of measures. Nonetheless, it was used only for structural measures.

6.1 Good practices and areas for further development

The following **good practice** was identified:

- Hungary carried out cost/benefit analysis for structural measures.

[55] Information for this section is taken from the FRMP and from Hungary's reporting sheets (specifically, the Summary of Cost/Benefit)

[56] Hungary subsequently noted that its CBA methodology was among the most advanced among those in use in the Danube international basin and also noted that a common methodology has not been developed for the Danube basin.

7. Governance including administrative arrangements, public information and consultation

7.1 Competent authorities

In the FRMP and its Reporting Sheets, Hungary did not indicate any updates to the Competent Authorities and/or the Units of Management previously identified for the Floods Directive. However, there is one document reported to the European Commission on the matter, dated 2016.

7.2 Public information and consultation

The table below shows how the public and interested parties were **informed** of the FRMP, concerning the draft FRMPs. Information on how the consultation was actually carried out and which stakeholders participated is presented in the rest of the section[57]:

Table 9 Methods used to inform the public and interested parties of the FRMP

	HU1000
Media (papers, TV, radio)	✓
Internet	✓
Digital social networking	✓
Printed material	✓
Direct mailing	
Invitations to stakeholders	✓
Local Authorities	✓
Meetings	✓

Source: FRMP

According to the regulations, the public consultation process started already in the working phase between the preparation of the hazard and risk maps and risk management plans.

Information to the public on internet (www.vizugy.hu) was made available in July 2015. On this site, before the national information forums started, the hazard and risk maps and recommendations on risk management measures, grouped by type of measures, were released.

National information forums (for all types of stakeholders) were held in 12 locations in July-August 2015 with information sessions, enabling the participants to express their opinions and

[57] Information in this section taken from Hungary's FRMP as well as the reporting sheets, specifically the sheet on Summary of the Consultation

draft proposals. Additionally, two other events were held primarily for informing the civil population.

The table below shows how the actual **consultation** was carried out:

Table 10 Methods used for the actual consultation

	HU1000
Via Internet	✓
Digital social networking	
Direct invitation	✓
Exhibitions	
Workshops, seminars or conferences	✓
Telephone surveys	
Direct involvement in drafting FRMP	

Source: FRMP

The draft version of the FRMP was made available via internet in a downloadable form for written comments. In addition, the consultation forums mentioned above provided a mechanism for input.

The table below shows how the **documents** for the consultation were provided:

Table 11 Methods used to provide the documents for the consultation

	HU1000
Downloadable	✓
Direct mailing (e-mail)	
Direct mailing (post)	
Paper copies distributed at exhibitions	
Paper copies available in municipal buildings (town hall, library etc.)	

Source: FRMP

7.3 Active involvement of Stakeholders

The table below shows the groups of **stakeholders** that have been actively involved in the development of the FRMPs assessed[58]:

[58] Information from the FRMP and the reporting sheets, in particular the Summary of the Consultation.

Table 12 Groups of stakeholders

	HU1000
Civil Protection Authorities such as Government Departments responsible for	✓
Flood Warning / Defence Authorities	✓
Drainage Authorities	✓
Emergency services	✓
Water supply and sanitation	✓
Agriculture / farmers	✓
Energy / hydropower	✓
Navigation / ports	✓
Fisheries / aquaculture	✓
Private business (Industry, Commerce, Services)	✓
NGO's including nature protection, social issues (e.g. children, housing)	✓
Consumer Groups	
Local / Regional authorities	✓
Academia / Research Institutions	✓
General public (via online questionnaires)	

Source: FRMP

As noted above, Hungary organised 12 consultation forums in July and August 2015 with on average 40 stakeholder representatives at each meeting. The public and stakeholders could also comment on the FRMP in a written form, and these comments were taken into account for the finalisation of measures.

The table below shows the **mechanisms** used to ensure the active involvement of stakeholders:

Table 13 Mechanisms used to ensure the active involvement of stakeholders

	HU1000
Regular exhibitions	
Establishment of advisory groups	
Involvement in drafting	
Workshops and technical meetings	✓
Formation of alliances	
Information days	

Source: FRMP

The consultation forums, described above, provided the main mechanism for active involvement of stakeholders.

7.4 Effects of consultation

Annex I of the FRMP gives details of written comments by stakeholders to the plan and indicates how they were taken into account in the final plan. This Annex also specifies the effects of comments made at the stakeholder meetings on the plans.

7.5 Strategic Environmental Assessment

The FRMP underwent an SEA procedure. The SEA was published on the official website of the FRMP (www.vizugy.hu) on 3 December 2015[59].

7.6 Good practices and areas for further development regarding Governance

The following **good practices** were identified:

- Twelve information forums were held across the country, with sessions enabling participants to express their opinions. In addition, two other events were organised to inform the broad public.
- Annex 1 of the FRMP provides information about the written comments and recommendations of relevant stakeholders, as well as the comments made in discussion forums, and indicates how they were taken into account in the finalisation of the FRMP.

[59] FRMP chapter 1.1 Background and WISE electronic Report Summary of Consultation.

Annex A: Supplementary tables and charts on measures

This Annex gives an overview of the data on measures provided by Hungary in the reporting sheets. These tables and charts were used for the preparation of section 4 on measures.

Background & method

This document was produced as part of the assessment of the Flood Risk Management Plans (FRMPs). The tables and charts below are a summary of the data reported on measures by the Member States, and were used by the Member State assessors to complete the questions on the Flood measures. The data are extracted from the XMLs (reporting sheets) reported by Member State for each FRMP, and are split into the following sections:

- **Measures overview** – Tabulates the number of measures for each UoM
- **Measure details: cost** – Cost & Cost explanation
- **Measures details: name & location** – Location & geographic coverage
- **Measure details: authorities** – Name of responsible authority & level of responsibility
- **Measure details: objectives** – Objectives, Category of priority & Timetable
- **Measure details: progress** – Progress of implementation & Progress description
- **Measure details: other** – Other Community Acts

On the basis of the reporting guidance (which in turn is based on the Floods Directive)[60], not all fields are mandatory, and, as such, not all Member States reported information for all fields.

Some of the fields in the XMLs could be filled in using standardised answers – for example, progress is measured via the categories set out in the Reporting Guidance. This means that producing comprehensive tables and charts required little effort. For many fields, however, a free data format was used. For some Member States, this resulted in thousands of different answers, or answers given in the national language.

In such situations, tables and charts were developed using the following steps:

- A first filter is done to identify how many different answers were given. If a high number of different answers are given, Member State assessors were asked to refer to the raw data when conducting the assessment, and this Annex does not reflect these observations;
- If a manageable number of answers are given, obvious categories are identified, and raw data sorted;
- Measures missing information may be assigned categories based on other fields (for example, if the level of Responsibility Authority is missing, the information may be obvious from the field "name of Responsible Authority");

[60] http://icm.eionet.europa.eu/schemas/dir200760ec/resources

- Measures where obvious categories cannot be defined based on other available information (as the example above on the name of the Responsible Authority), are categorised as "no information".

Types of measures used in reporting

The following is table[61] used in the reporting on the types of measures. Each type of measures is coded as an M-number. Measures are grouped in an 'aspect'.

NO ACTION M11: No Action	**PREPAREDNESS** M41: Flood Forecasting & Warning M42: Emergency response planning M43: Public Awareness M44: Other preparedness
PREVENTION M21: Avoidance M22: Removal or relocation M23: Reduction M24: Other prevention	**RECOVERY & REVIEW** M51: Clean-up, restoration & personal recovery M52: Environmental recovery M53: Other recovery
PROTECTION M31: Natural flood management M32: Flow regulation M33: Coastal and floodplain works M34: Surface Water Management M35: other protection	**OTHER MEASURES** M61: Other measures

[61] Guidance for Reporting under the Floods Directive (2007/60/EC): https://circabc.europa.eu/w/browse/a3c92123-1013-47ff-b832-16e1caaafc9a

List of Annex A tables & figures

Measures overview

Table A1: Total number of measures

Number of individual measures	0
Number of individual measures including measures which have been allocated to more than one measure type	0
Number of aggregated measures	46
Number of aggregated measures including measures which have been allocated to more than one measure type	46
Total number of measures	46
Total number of measures including measures which have been allocated to more than one measure type	46
Range of number of measures between UoMs (Min-Max)	n/a
Average number of measures by UoM (including measures allocated to more than one measure type)	46

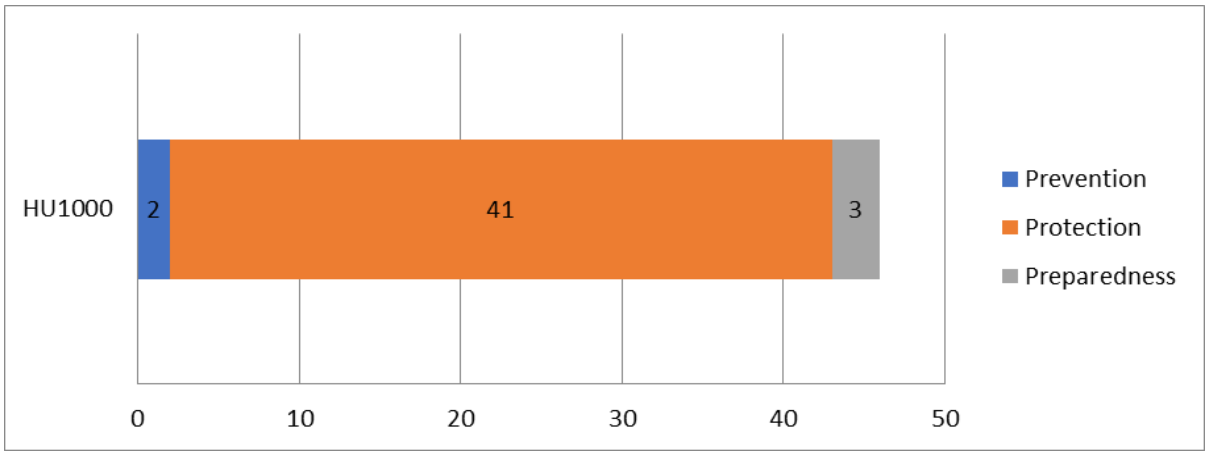
Table A2: Total number of measures (aggregated and individual), per measure type and UoM

	Prevention	Total	Protection		Total	Preparedness		Total	Recovery & review	Other	Total	Grand Total
	M24		M31	M32		M41	M42					
HU1000	2	2	6	35	41	1	2	3				46
Grand Total	**2**	**2**	**6**	**35**	**41**	**1**	**2**	**3**	**0**	**0**	**0**	**46**

Notes: The codes used are explained in the previous section.
All measures are aggregated as Hungary did not report any individual measures.

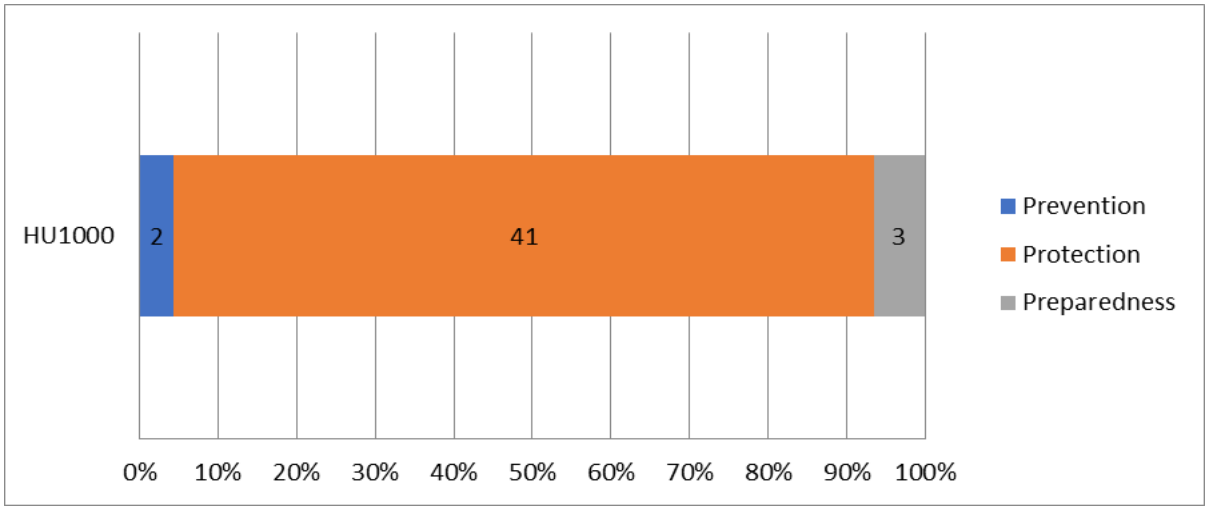
The information in Table A2 is visualised in Figures A1 and A2 below:

Figure A1: Number of total measures by measure aspect



Note: All measures are aggregated as Hungary did not report any individual measures.

Figure A2: Share of total measures by measure aspect



Note: All measures are aggregated as Hungary did not report any individual measures.

Measure details: cost

Member States were requested to report information on:

- Cost (optional field);
- Cost explanation (optional field).

Hungary did not provide information about the cost of the measures in the reporting sheets.

Measure details: name & location

This section includes information on:

- Location of implementation of measures (mandatory field);
- Geographic coverage of the impact of measures (optional field).

Location of measures

In the reporting sheets, Hungary provided information about the location of most planned measures, however, this was an open question, and as such, the level of detail varies and a large number of different responses were given. It was thus not practical to aggregate the information.

Geographic coverage

Hungary did not report the geographic coverage of the measures in the reporting sheets.

Measure details: objectives

Member States were requested to report information on:

- Objectives linked to measures (optional field, complementary to the summary provided in the textual part of the XML);
- Category of priority (Conditional, reporting on either 'category of priority' or 'timetable' is required);
- Timetable (Conditional, reporting on either 'category of priority' or 'timetable' is required).

Objectives

Hungary did not provide information about the objectives of the measures in the reporting sheets.

Category of priority

Information about the category of priority can be provided under the following categories:

- Critical;
- Very high;
- High;
- Moderate;
- Low.

Hungary reported the priority for all measures as 'moderate'.

Table A3: Category of priority by measure aspect

	Moderate	Grand Total
Preparedness	3	3
Prevention	2	2
Protection	41	41
Grand Total	**46**	**46**

Figure A3: Visualisation of Table A3: Category of priority by measure aspect

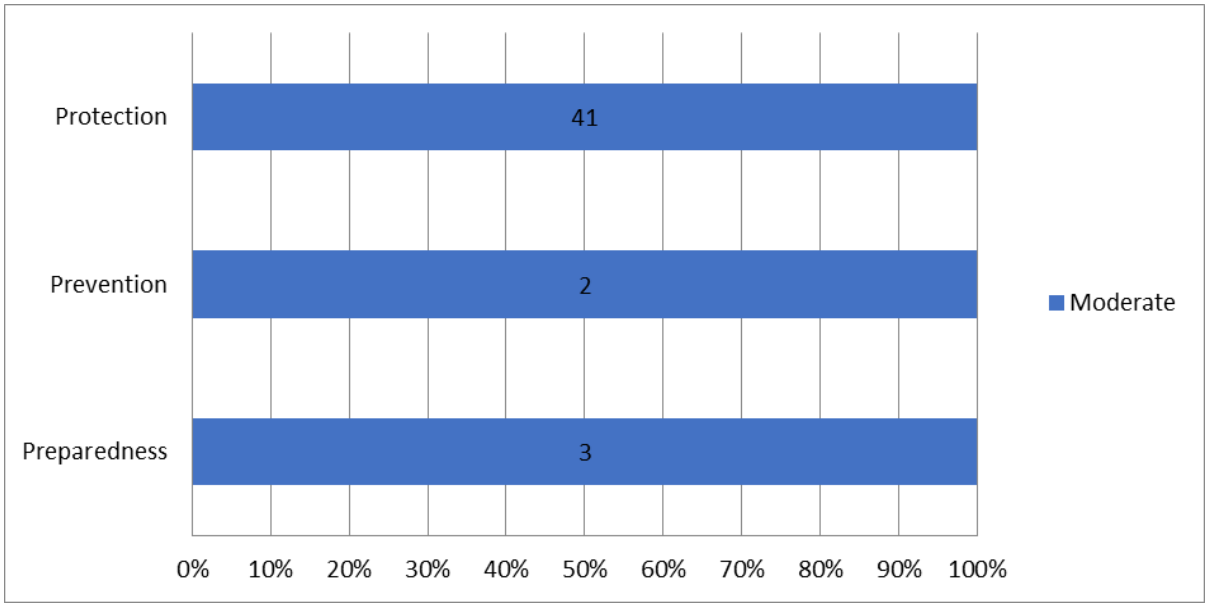
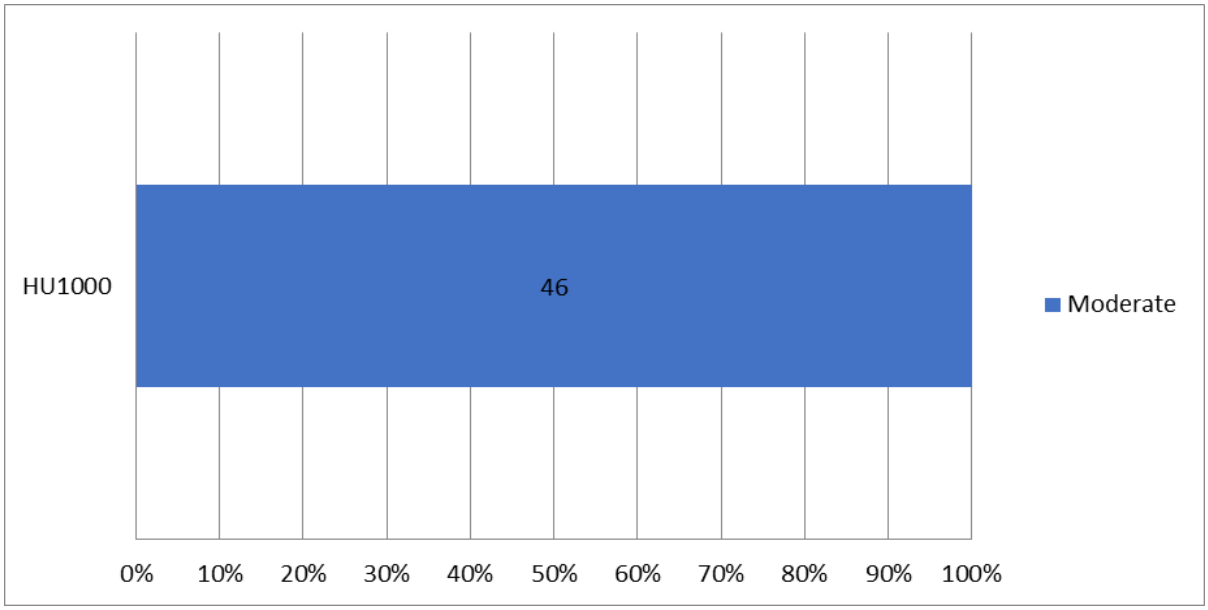


Table A4: Category of priority by UoM

	Moderate	Grand Total
HU1000	46	46
Grand Total	**46**	**46**

Figure A4: Visualisation of Table A4: Category of priority by UoM



Timetable

Hungary did not report the timetable of the measures in the reporting sheets.

Measure details: authorities

Member States were requested to report information on:

- Name of the responsible authority (option if 'level of responsibility' is reported);
- Level of responsibility (option if 'name of the responsible authority' is reported).

Hungary reported the same responsible authority for all measures i.e. the Ministry of Interior. Hungary did not report the level of responsible authority within Hungary's governance system in the reporting sheets.

Measure details: progress

Member States were requested to report information on:

- Progress of implementation of measures (mandatory field) - this is a closed question whose responses are analysed below;
- Progress description of the implementation of measures (optional field) - this is an open text question for which not all Member States reported and whose answers are not analysed here.

The progress of implementation was reported as[62]:

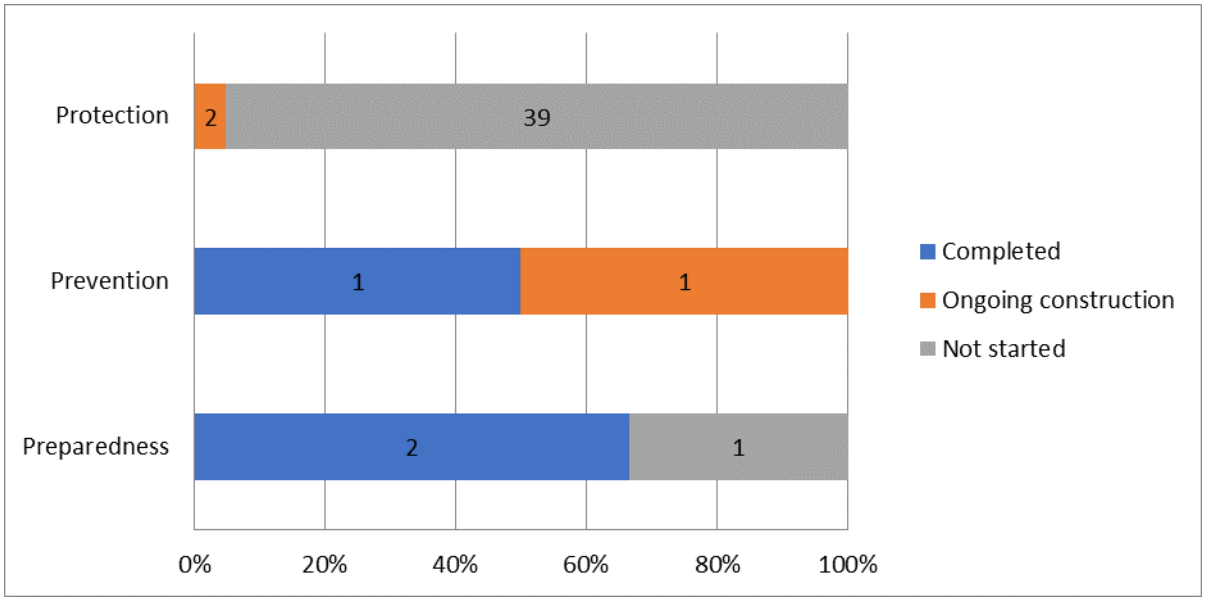
- COM (completed);
- OGC (ongoing construction);
- POG (progress ongoing);
- NS (not started).

A full definition of these terms can be found at the end of this section.

Table A5: Progress of implementation by measure aspect

	Completed	Ongoing construction	Not started	Grand Total
Preparedness	2		1	3
Prevention	1	1		2
Protection		2	39	41
Grand Total	**3**	**3**	**40**	**46**

Figure A5: Visualisation of Table A5: Progress of implementation by measure aspect

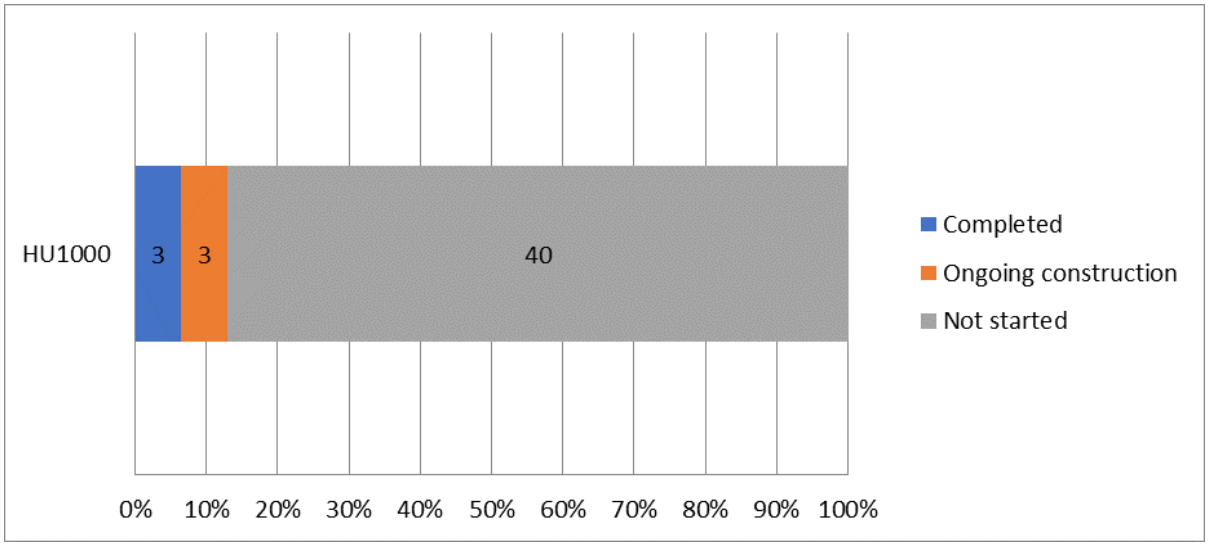


[62] Guidance for Reporting under the Floods Directive (2007/60/EC): https://circabc.europa.eu/w/browse/a3c92123-1013-47ff-b832-16e1caaafc9a

Table A6: Progress of implementation by UoM

	Completed	Ongoing construction	Not started	Grand Total
HU1000	3	3	40	46
Grand Total	**3**	**3**	**40**	**46**

Figure A6: Visualisation of Table A6: Progress of implementation by UoM



The categories describing the progress of measures are defined in the EU Reporting Guidance Document on the Floods Directive:

For **measures involving construction or building works** (e.g. a waste water treatment plant, a fish pass, a river restoration project, etc.):

- Not started (NS) means the technical and/or administrative procedures necessary for starting the construction or building works have not started.
- Progress on-going (POG) means that administrative procedures necessary for starting the construction or building works have started but are not finalised. The simple inclusion in the RBMPs is not considered planning in this context.
- On-going construction (OGC) means the construction or building works have started but are not finalized.
- Completed (COM) means the works have been finalised and the facilities are operational (maybe only in testing period in case e.g. a waste water treatment plant).

For **measures involving advisory services** (e.g. training for farmers):

- Not started (NS) means the advisory services are not yet operational and have not provided any advisory session yet.
- Progress on-going (POG) means the advisory services are operational and are being used. This is expected to be the situation for all multi- annual long/mid-term advisory services that are expected to be operational during the whole or most of RBMP cycle.

- On-going construction (OGC): Not applicable
- Completed (COM) means an advisory service that has been implemented and has been finalised, i.e. is no longer operational. This is expected only for advisory services that are relatively short term or one-off, and which duration is time limited in relation to the whole RBMP cycle.

For **measures involving research, investigation or studies**:

- Not started (NS) means the research, investigation or study has not started, i.e. contract has not been signed or there has not been any progress.
- Progress on-going (POG) means the research, investigation or study has been contracted or started and is being developed at the moment.
- On-going construction (OGC): Not applicable
- Completed (COM) means the research, investigation or study has been finalised and has been delivered, i.e. the results or deliverables are available (report, model, etc.).

For measures involving administrative acts (e.g. licenses, permits, regulations, instructions, etc.):

- Not started (NS) means the administrative file has not been opened and there has not been any administrative action as regards the measure.
- Progress on-going (POG) means an administrative file has been opened and at least a first administrative action has been taken (e.g. requirement to an operator to provide information to renew the licensing, request of a permit by an operator, internal consultation of draft regulations, etc.). If the measure involves more than one file, the opening of one would mean already "ongoing".
- On-going construction (OGC): Not applicable
- Completed (COM) means the administrative act has been concluded (e.g. the license or permit has been issued; the regulation has been adopted, etc.). If the measure involves more than one administrative act, "completed" is achieved only when all of them have been concluded.

Measure details: other

Member States were requested to provide information on:

- Other Community Acts associated to the measures reported (optional field);
- Any other information reported (optional field).

Hungary did not provide any information for these tabs in the reporting sheets. However, as noted in section 4 the FRMP has provided some information on this topic.

Annex B: Definitions of measure types

***Table B1 Types of flood risk management measures*[63]**

	No Action
M11	No Action, No measure is proposed to reduce the flood risk in the APSFR or other defined area,
	Prevention
M21	Prevention, Avoidance, Measure to prevent the location of new or additional receptors in flood prone areas, such as land use planning policies or regulation
M22	Prevention, Removal or relocation, Measure to remove receptors from flood prone areas, or to relocate receptors to areas of lower probability of flooding and/or of lower hazard
M23	Prevention, Reduction, Measure to adapt receptors to reduce the adverse consequences in the event of a flood actions on buildings, public networks, etc...
M24	Prevention, Other prevention, Other measure to enhance flood risk prevention (may include, flood risk modelling and assessment, flood vulnerability assessment, maintenance programmes or policies etc...)
	Protection
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
	Preparedness
M41	Preparedness, Flood Forecasting and Warning, Measure to establish or enhance a flood forecasting or warning system
M42	Preparedness, Emergency Event Response Planning / Contingency planning, Measure to establish or enhance flood event institutional emergency response planning
M43	Preparedness, Public Awareness and Preparedness, Measure to establish or enhance the public awareness or preparedness for flood events
M44	Preparedness, Other preparedness, Other measure to establish or enhance preparedness for flood events to reduce adverse consequences

[63] Guidance for Reporting under the Floods Directive (2007/60/EC): https://circabc.europa.eu/w/browse/a3c92123-1013-47ff-b832-16e1caaafc9a

	Recovery & Review
M51	Recovery and Review (Planning for the recovery and review phase is in principle part of preparedness), Individual and societal recovery, Clean-up and restoration activities (buildings, infrastructure, etc), Health and mental health supporting actions, incl. managing stress Disaster financial assistance (grants, tax), incl. disaster legal assistance, disaster unemployment assistance, Temporary or permanent relocation , Other
M52	Recovery and Review, Environmental recovery, Clean-up and restoration activities (with several sub-topics as mould protection, well-water safety and securing hazardous materials containers)
M53	Recovery and Review, Other, Other recovery and review Lessons learnt from flood events Insurance policies
	Other
M61	Other

Catalogue of Natural Water Retention Measures (NWRM)

NWRM cover a wide range of actions and land use types. Many different measures can act as NWRM, by encouraging the retention of water within a catchment and, through that, enhancing the natural functioning of the catchment. The catalogue developed in the NWRM project represents a comprehensive but non prescriptive wide range of measures, and other measures, or similar measures called by a different name, could also be classified as NWRM.

To ease access to measures, the catalogue of measures hereunder is sorted by the primary land use in which it was implemented: Agriculture; Forest; Hydromorphology; Urban. Most of the measures however can be applied to more than one land use type.

Table B2 List of NWRMs

Agriculture	Forest	Hydro Morphology	Urban
A01 Meadows and pastures	F01 Forest riparian buffers	N01 Basins and ponds	U01 Green Roofs
A02 Buffer strips and hedges	F02 Maintenance of forest cover in headwater areas	N02 Wetland restoration and management	U02 Rainwater Harvesting
A03 Crop rotation	F03 Afforestation of reservoir catchments	N03 Floodplain restoration and management	U03 Permeable surfaces
A04 Strip cropping along contours	F04 Targeted planting for 'catching' precipitation	N04 Re-meandering	U04 Swales
A05 Intercropping	F05 Land use conversion	N05 Stream bed re-naturalization	U05 Channels and rills
A06 No till agriculture	F06 Continuous cover forestry	N06 Restoration and reconnection of seasonal streams	U06 Filter Strips

Agriculture	Forest	Hydro Morphology	Urban
A07 Low till agriculture	F07 'Water sensitive' driving	N07 Reconnection of oxbow lakes and similar features	U07 Soakaways
A08 Green cover	F08 Appropriate design of roads and stream crossings	N08 Riverbed material renaturalisation	U08 Infiltration Trenches
A09 Early sowing	F09 Sediment capture ponds	N09 Removal of dams and other longitudinal barriers	U09 Rain Gardens
A10 Traditional terracing	F10 Coarse woody debris	N10 Natural bank stabilisation	U10 Detention Basins
A11 Controlled traffic farming	F11 Urban forest parks	N11 Elimination of riverbank protection	U11 Retention Ponds
A12 Reduced stocking density	F12 Trees in Urban areas	N12 Lake restoration	U12 Infiltration basins
A13 Mulching	F13 Peak flow control structures	N13 Restoration of natural infiltration to groundwater	
	F14 Overland flow areas in peatland forests	N14 Re-naturalisation of polder areas	

Source: www.nwrm.eu