Flood Action Plan in the Morava River Basin

The ICPDR Flood Action Programme

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Prepared by:

Austria

Federal Ministry of Agriculture, Forestry, Environment and Water Management
Freiland Umweltconsulting ZT GmbH
REVITAL Ziviltechniker GmbH

Czech Republic

Czech Hydrometeorological Institute
Ministry of Environment
Morava River Board, s.e.

Slovak Republic

Ministry of Environment
Slovak Hydrometeorological Institute
Slovak Water Management Enterprise, s.e.
Water Research Institute

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1. INTRODUCTION

In response to the danger of flooding and in line with its Joint Action Programme, the ICPDR decided in 2000 to establish the long-term Action Programme for Sustainable Flood Prevention in the Danube River Basin. The whole process was accelerated after disastrous floods in 2002 and resulted in adoption of the Action Programme at the ICPDR Ministerial Meeting on 13 December 2004.

The overall goal of the ICPDR Action Programme is to achieve a long term and sustainable approach for managing the risks of floods to protect human life and property, while encouraging conservation and improvement of water related ecosystems. Given the area, the complexity and the internal differences in the Danube River Basin, the Action Programme represents an overall framework, which needs to be specified in further detail for sub-basins. Therefore, the targets of the ICPDR Action Programme include preparation of flood action plans for all sub-basin in the Danube catchment area.

In September 2007 a Directive of the European parliament and of the Council on the assessment and management of flood risks (EFD) was adopted by the European Council. The aim of the Directive is to reduce and manage the risks that floods pose to human health, the environment, cultural heritage and economic activity. The Directive requires Member States to first carry out a preliminary flood risk assessment by 2011 to identify areas at risk of flooding. For such areas they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention, protection and preparedness by 2015.

As the ICPDR Action Programme was designed in full coherence with EFD the flood action plans for sub-basins are an important part of implementation of the EFD and they summarize the key actions towards preparation of the flood risk management plans. Therefore, the preparation of the flood action plans for sub-basins can be considered as an interim step in implementation of EFD.

This action plan for the **Morava river sub-basin** reviews the current situation in flood protection and sets the targets and the respective measures aiming among others to reduction of damage risks and flood levels, increasing the awareness of flooding and to improvement of flood forecasting. The targets and measures are based on the regulation of land use and spatial planning, increase of retention and detention capacities, technical flood defenses, preventive actions, capacity building, awareness & preparedness raising and prevention and mitigation of water pollution due to floods.

It is foreseen that this planning document will be further refined as appropriate and necessary by the bilateral river commissions.

2. CHARACTERISATION OF CURRENT SITUATION

2.1 Review and Assessment of Current Situation

2.1.1 Natural conditions

The Morava River basin lies on the territories of three countries: the Czech Republic, Austria and Slovak Republic (since 1.1.1993). The major part of this catchment belongs to the Czech Republic. The river Morava is a left-hand tributary of the Danube river entering it at the border cross-section between Austria and Slovak Republic. The Morava river forms the border between both countries from the point of confluence with the river Dyje (Thaya - river name in German).

The Morava river basin

The river Morava is one of the most sifgnificant tributaries of the Danube. According to its total length of 353 km (284 km on the Czech territory) it is listed as the twelfth, according to the long-term average discharge (118,7 $m^3.s^{-1}$) as the fourteenth, and according to the drainage area (26 658 km^2) the seventh most important tributary of the whole Danube drainage basin. The part of the Morava catchment found in the Czech Republic is about 81,4 % of the total catchment area, 8,6 % is in the Slovak Republic and 10 % in Austria. Morava river basin is created by two hydrological units – western fan-shaped drainage basin of Dyje river and eastern, oblong drainage basin of the Morava river with a dominant tributary, the Becva river.

The Morava River basin at the territory of Slovakia consists from the following main parts (sub-basins):

- The area on the left side bank of the Morava River from the state border with Czech Republic (near the town Skalica in the western Slovakia) to the mouth of the river into the Danube River in the village Devin (suburb of the capital Bratislava),
- River basins of the Chvojnica, the Myjava, the Rudava and the Malina rivers.

The Morava River basin at the territory of Austria consists from the following main parts (sub-basins):

- The area on the right side bank of the Morava River from the state border with Czech Republic (near the town Hohenau) to the mouth of the river into the Danube River + river basins of Zaya, Sulzbach, Weidenbach
- The area on the right side bank of the Dyje river to the mouth of the river into the March + river basins of Deutsche Thaya and Pulkau.

Geomorphological conditions of the Morava catchment are characterized by the development of the relief features on the marginal West-European platform, and young Carpathian folded mountain ranges and of the Pannonian basin. The present geo-relief in this territory is substantially polygenetic, characterized by alternating period of quiet develpment (with relative stable tectonic and climatic conditions) and by periods of abrupt changes.

The catchment consists of four morpho-structural units:

- the structure of the Czech Upland, an old system of Hercynian massif formed by folding in the Primary era (Carbon),
- the structure of Outer West-Carpathians, developing at the end of the Secondary era and formed by folding in the Tertiary /between Paleogene and neogene systems),
- subsidence structures of the inner Carpathian subsidence zones (basins) created in front of the folding Carpathians due to morion of tectonic fractures of the Czech Massif) and
- subsidence structures of the Low-Moravian Dale which belongs to the Pannonian Basin (the Dale is filled with neogene and quaternary sediments).

Every important morphological structure is found within the geo/relief of the Morava drainage basin, distinguishing geomorphological structures according to shapes, climatic and other conditions. The effect of geological influences is evident in warm humid and dry climate of the Tertiary, in the cold and mild climate of the Pleistocene, and in the mild and humid climate of Holocene. With respect to this the Morava drainage basin is polygenetic and all more significant groups may be found there: plains, slope formations fluvial formations, cryogenic and eolic morphostructures, forms of weathering and transportation of sediment.

The western part of the territory is formed by the Czech Massif, geologically consolidated late in Paleozoicum. The present character is chiefly due to the called saxonian moves in Cenozoic Era and the Quaternary. The most important range of mountains within the Czech Massif in the Morava drainage basin is the *Jeseniky* mountains (on the north).

The Western Carpathians spread in the eastern part of the territory. They form a part of the Alpine-Carpathian range in Europe. They were formed by the Alpine folding in Mesozoic era and Cenozoic era. The most significant range of mountains in the Western Carpathians are the Moravian-Silesian *Beskydes*.

About 54 % of the area is made up by agricultural land (45% of it being arable land), 34 % is covered by forest, 1,5 % are urbanized areas and 1,4 % is covered by water. In the upper part of

the catchment coniferous forests prevail. The agricultural production in the southern part is oriented to termophilic species growing – grapes, apricots, peaches.

There are important floodplain forests in the valleys of the lower Dyje and lower Morava rivers on the area of 16 000 ha. They represent the part of former regional community of the alluvial type.

Stream network

The Morava river originates at the Jeseníky Mountains below the Kralicky Sneznik mountain in the altitude of 1380 m a.s.l. and flows from the north to the south. On the common Czech-Slovak-Austrian border it takes in a right-hand tributary, the Dyje river. It joints the Danube river at an altitude of 136 m a.s.l. Another significant river in the Morava river basin, upstream of the confluence with Dyje, is the Becva river, which drains the waters from the western part of the Beskydy Mountains. The Dyje river is made up initially by two individual streams: the Moravian Dyje, originating in the Brtnická Highlands at an altitude of 635 m a.s.l., and the German Dyje, which originates near Schweigers, in Lower Austria. Both Dyje rivers join and continue to flow from the west to the east through the Dyje-Svratka Valley and the Lower-Moravian Valley. The Dyje catchment is larger (13 426 km^2) than the part of the Morava river catchment found upstream of the confluence with the Dyje (10 691 km^2). Nevertheless, the average discharge of the Morava at the confluence with the Dyje is 65,1 $m^3.s^{-1}$, and the average discharge of the Dyje into the Morava river is only 43,7 $m^3.s^{-1}$. Other important streams in the Dyje River Basin are the Svratka (4 115 km^2) and Jihlava (2 998 km^2) rivers, which drain the Czech-Moravian Highlands, together with the Brno Highlands, and the northern part of the Dyje-Svratka Valley, respectively. The most important tributary on the Austrian part of the Dyje river is Pulkau.

The most important tributaries on the Slovak part of the Morava river basin are the rivers Chvojnica (125 km^2), Myjava (745 km^2), Rudava (418 km^2) and Malina (517 km^2), on the Austrian part Zaya, Sulzbach and Weidenbach.

The long-term average discharge of the Morava river at the confluence with Danube river is 119 $m^3.s^{-1}$. The total catchment area of the Morava river is 26 658 km^2.

The important water reservoirs in the Morava River Basin

Name	River	Country	Catchment area	Volume	
				Total	Retention
			[km^2]	[$10^6 \cdot m^3$]	[$10^6 \cdot m^3$]
Vranov	Dyje	CZ	2211,3	132,7	11,157
Brno	Svratka	CZ	1586,2	21,0	2,6
Vír	Svratka	CZ	410,5	56,2	5,286
Dalesice	Jihlava	CZ	1138,3	126,9	4,7
Nové Mlýny	Dyje	CZ	11853,07	133,95	26,0
Brestovec	Myjava	SK	17.7	0.454	0.127
Buková	Hrudky	SK	10.8	1.420	0.185
Kunov	Teplica	SK	93.6	3.050	0.760
Lozorno	Suchý potok	SK	18.9	2.051	0.140

2.1.2. Conditions of flood forecasting and warning

In the Czech part of the Morava river basin the Czech Hydrometeorological Institute (CHMI) is responsible for both meteorological and hydrological forecasting and warning in the Czech Republic. Central Forecasting Office (CFO) and six Regional Forecasting Offices (RFO) have meteorological and hydrological offices cooperating closely together.

The hydrological service of the CHMI monitors the actual situation on the rivers in the Morava river basin by its some 145 gauging stations which are providing regular information together with the data from the River Basin Authorities on the flow regulation in reservoirs which are impacting the flood transit.

Forecasting methodology was improved mainly after the big flood in 1997 by developing and introducing hydrological models into the forecasting service. The hydrological forecasting system is connected to the meteorological forecasting system. Rainfall-runoff and routing models were calibrated for all main river basins and river reaches in the Morava river basin. Data on observed precipitation and quantitative precipitation forecast (QPF) enter to the models and it allowed to extent the lead time to 48 hours. In winter period the snow melting model is used in the system.

The flood forecasting service regularly provides hydrological forecasts to the River Basin Authorities and other stakeholders and publics them on the CHMI WEB site. In case of flood it informs the flood protection authorities and other participants involved in the flood protection about flood danger and flood evolution. Warning messages are disseminated if extreme meteorological or hydrological conditions are being forecasted, and during floods are accompanied by information on the flood evolution and its further prediction.

Except of downstream part of the Morava River the time of runoff concentration and channel travel times are very short. Therefore 48 hours Quantitative precipitation forecast (QPF) of meteorological model ALADIN inputs automatically the hydrological forecasting system (HFS) HYDROG to provide 48 hours hydrological forecast even for small streams. However there is a possibility to change or correct the QPF input in SOMDATA - database tool that prepares one complete input file for Hydrog. For that purpose, meteorologists prepare daily estimation of precipitation based not only on ALADIN forecast but also other NWP models.

Hydrog is hydrological forecasting system that includes reservoir operation routine for optimalization of future operations. System has rainfall runoff procedure based on computation of direct runoff and its transformation to river runoff. For calculation of snow melting the modified degree-day method is used which needs input of observed snow water equivalent data as initial conditions.

At present time the HYDROG model is running every weekday, the results are available up to 10 a.m. The forecasting discharges are handed on to the dispatching centre of the Morava River Board, s.e.

For the future we are considering a greater lead time (5 days) providing the precipitation forecasts will be abailable.

The exchange of all information related to flood protection and actual flood routing is realised by the **Directivies for the forecasting, reporting and warning duty** on the Czech-Slovak border

waters and Czech-Austrian border waters. According to these directivies CHMI must sent warning reports when the degrees of the flood protection activities are exceeded in the selected gauging stations.

Basic hydrological information on the current situation in the Morava river basin is available on the internet.

By the Hydrological Services of the Czech Republic and Lower Austria was drawn the **Memorandum of understanding (2007).**

In the framework of this Memorandum between the CHMI and the Hydro NÖ, the CHMI regional office in Brno provides prognoses data for the sites Swarzenau – Deutsche Thaya and Raabs – Thaya in the Austrian part of the Dyje river catchment for internal usage of the Hydro NÖ. The hydrological prognoses with lead time of 48 hours are produced normally once a day, depending on the particular hydrological situation.

The hydrological model should be extended to the profile Hohenau – Moravsky Svaty Jan (Morava river) – the profile underneath the confluence of the Morava and Dyje rivers on the Austrian-Slovak border (by the year 2010). The prognoses will be prepared in the regional office of the Czech Hydrometeorological Institute in Brno.

The Hydrological Forecasts and Warning Department of the Slovak Hydrometeorological Institute is responsible for providing operational information on the hydrological situation on the territory of Slovakia. The SHMI monitors the actual situation on the rivers in the Morava river basin by 25 gauging stations which are providing regular information. The network on the Morava river consists of 2 hydrological forecasting stations – Moravsky Svaty Jan and Zahorska Ves. The hydrological information contains the following parameters: water stages, discharges, water temperatures, the appearance of ice effects and the relation of current water stages / discharges to their long-term means. Apart from these instantaneous values, the Department provides set of various types of forecasts – numerical forecasts for selected stations, trends in water stages, information on snow conditions (snow depth, water equivalent of snow cover, information on the water supply in the snow for selected profiles utilized for reservoirs operation).

In Austria a flood forecasting system for all larger main rivers and affluents is being developed step by step in Lower Austria. On the Thaya the calculation of the forecast is carried out by means of physics-based models at intervals of one hour for a forecasting period of up to 48 hours. The forecast for the tributary catchment areas is calculated based on the Unit Hydrograph Procedure.

Within the Danube sub-basin of the March in Austria, the Hydrographic Service has at its disposal 44 precipitation, air temperature and evaporation gauges, which have remote transmission, as well as 15 surface water and solids gauges, which have remote transmission.

Continuous data on selected water courses and reservoirs are available on these WebPages:

CZ: www.chmi.cz, www.pmo.cz, www.voda.gov.cz

A: http://www.noe.gv.at

SK: www.shmu.sk, www.povodia.sk

2.1.3 Recent awareness of flooding

The floods which occur in the Morava river catchment can be divided into several main types as follows:

Winter and spring floods caused by snow melting which can be combined with rain. This type of flood is most frequent in under-mountain areas but these floods can also affect lower reaches of the rivers.

Summer floods caused by long-lasting regional precipitation. These floods usually occur on all watercourses in the area exposed to the precipitation with highest impacts along middle or large-size rivers.

Summer floods caused by short high-intensity storms (frequently over 100 mm during several hours) affecting relatively small areas. These floods can occur anywhere on small rivers with catastrophic consequences mainly in those basins that are highly declined and fan-shaped.

Winter floods caused by ice phenomena, which can occur also during the periods when the flows are relatively low. These floods occur in those river reaches which are exposed to formation of ice jams, etc.

The largest and most destructive flood on the river Morava occurred in **1997**, when the Dyje catchment was not affected.

Floods historically comparable with the 1997 flood on the river Morava occurred in **June 1883** and **July 1891**. Altogether, the amount of rainfall for the five days in June 1883 was about one quarter lower than for the first five days in July 1997. The July 1891 flood did not reach the magnitude of the 1883 flood.

In the past, floods occurred on the river Morava with peak discharges greater than 50 years Average Return Interval (ARI) in **1930** and **1938**, and in **1917** a peak discharge occurred with a 20 year ARI.

In **July 1997** the basins of most rivers in Moravia, Silesia and the northeast part of Bohemia were struck by extensive precipitation of exceptional duration of In lower parts of the middle and lower reaches of the Morava river the flood wave overflowed into inundation areas reaching several kilometers in width in some places. In the upper and middle part of the Morava river catchment the peak discharges overstepped 100 ARI. In the lower part in the Slovak Republic the flood wave was transformed due to inundation areas to a discharge with 5-10 year ARI. The peak discharge of the Morava river at the confluence with Danube river was about 1 500 $m^3.s^{-1}$.

The main consequences:
There were 50 casualties during the destructive floods.
An area of 1248 km^2 was inundated.
538 cities and municipalities were affected
The total amount of damages was estimated at 900 million Eur.

In the Dyje catchment, large floods were comparatively frequent at the beginning of the 20th century. Afterwards, their occurrence comparatively diminished and the second half of the 20th century did not see many great regional floods occurring. The flood in **August 2002** was according to the size of peak discharge (ARI of 200 years in the upper part of the catchment) the

fourth greatest flood that was evaluated. Larger peak discharges were recorded in **1862, 1900** and **1909.**

The flood of August 2002 was characterized by two extensive precipitation waves that arrived in the course of three days only and covered large areas (the first wave hit the South and the West Bohemia only while the second wave gradually spread all over Bohemia and then moved eastwards). The volume of the rainfall in the Czech territory from 6th to 15th August 2002 was gigantic. The second precipitation wave fell on the saturated basins and triggered a very quick and extreme run-off. The relative magnitudes of the 1997 and 2002 floods are comparable. Austria was affected by this flood, as well.

In March **2006** the above-normal snow water storage occured in the Morava and Dyje rivers catchments. As a result of a sudden temperature rise and rich rainfall activity at the end of March it came to the fast snow cover melting. The peak discharges were reached in the days from 29.3. to 1.4. 2006 and in some profiles the discharges reached up the values with return period of 100 years. In the 80 years´ history of the discharge monitoring in the Morava river basin, the Dyje river catchment and Morava river catchment were struck by the flood simultaneously first time, (also Austria and Slovak Republic)

Extreme flood caused by heavy rainfall occurred at Dyje River the **30 July 2006**.
The Austrian part of the Dyje river catchment and the municipality Podhradi on the Czech territory were affected by this flash flood.

The Myjava river basin (SK) also was several times affected by the flood. In July 1997 there was the flash flood which affected Myjava town and numerous smaller settlements, in June 1999 also flash flood caused by local intensive rainfall, in March 2005 floods caused by snowmelt in Myjava and Chvojnica river basins, in May 2005 flash floods cause by local rainfall in Myjava river basin and in February 2006 flood caused by combination of snowmelt and rainfall in Malina river basin.

2.1.4 Institutional and legal framework

Basic legislation for the flood protection in the **Czech Republic** is Water Act No. 254/2001 Coll. which for example specified in more details the characteristics and delimitation of the flooding areas, appointed responsibility of the both legal entities and natural persons and government in the field of flood prevention and defined organization for flood protection. Amendment of the Act No. 20/2004 Coll. brought the change of the structure of the flood protection authorities – changed the flood committees of the river basins into the regional flood protection committees.

Assuring rescue or prevention works is still based on the Act No. 238/2000 Coll. concerning Fire Rescue Crops and on the Act No. 239/2000 Coll. concerning Integrated Rescue System. In case of crisis situation, when suggested parameters of flood protection measures are significantly exceeded and flood committees are not able to take necessary measures, management passes on the crisis bodies according to the Act No. 240/2000 Coll., on crisis management. Impacts of the floods are resolved in the Act No. 12/2002 Coll., concerning governmental support during restoration of the areas afflicted by natural or other disaster.

As the new Directive No 2007/60/EC on the assessment and management of flood risks was adopted, all the activities in the area of the flood protection are focused on its implementation.

The framework for coordination of the land use and spatial planning with flood protection generates the Water Act in the **Slovak Republic** (Act Nr. 364/2004). This Act defines the notion of the floodplains and principles of their determination and approval. The area of floodplain is suggested by the administrator of watercourse and proposal is submitted to the competent water law state authority. The state authority makes the decision about the proposal of the floodplain area and afterwards the map of floodplain to the territorially relevant building bureau. The Flood Protection Act (Act Nr. 666/2004) contains the rules for permitted activities in the floodplains. The Flood Protection Act and connected bylaws will be amended (2009) in order to achieve accordance with the Directive 2007/60/EC. Regulations for activities in the floodplains are stricter in the ongoing proposal of the amended law.

The Water Act and the Flood Protection Act create a legal framework for regulation of activities in the territories that are endangered by floods only. Neither from them has power to order the modification of the land use or change of spatial plans.

The flood news services represent the basic precondition for smoothly-functioning flood risk management. When issued at an early stage, advance warnings make it possible to carry out preventive measures in time. For this purpose, the Offices of the Regional Governments in **Austria** must, commensurate with their responsibility, set up news services in the event of flooding, in accordance with the Water Rights Act. Any announcements will immediately be passed on to the regional warning centres and other emergency services.

The regional Hydrographic Services of the Federal Hydraulic Engineering Administration provide information concerning the current precipitation and discharge values at the individual gauging stations in the region to all interested citizens, free of charge, by telephone, teletext and via the homepages of the regional governments. The discharge situation on the larger rivers, subdivided into flood danger levels, can likewise be accessed at the Hydrographic Service at any time.
The flood warning systems of the provinces are based on close cooperation between Hydrography and the Central Institute for Meteorology and Geodynamics. The torrential rain forecasts and torrential rain warnings issued by the Central Institute for Meteorology and Geodynamics meteorological service are analysed by the Hydrographic Service. A flood standby service is set up in Lower Austria whenever the Central Institute for Meteorology and Geodynamics (ZAMG) warns of heavy precipitation (> 30 mm/d). If occasion demands, the Hydrographic Service in Lower Austria also sets up a water-level news service at short notice. Activation in the event of flooding then takes place once the flood signal marker (~ HQ_{1-2}) has been reached at one of the telecommunicating water gauging stations. In addition, the Hydrographic Services in Austria function as a hub for all the information and data. Based on these, flood warnings are, if necessary, issued for the affected regions.

The flood news services in Austria have set themselves the goal of developing and improving the information system further. This is to be done by means of automatic data gathering and data transmission, and also based on forecasting models in conformity with cutting-edge technology. Improved data material will thus be available for both the experts and citizens affected by flooding in the future to be able to quickly carry out the right decisions and measures in case of emergency.

2.2 Review and assessment of the predictable long term developments

Long term developments in flood protection in the **Czech Republic** follows the National Strategy of flood protection as well as European Directives (Water Framework Directive and Floods Directive) that is currently implementing. Important part of implementation will be River Basin Management Plans and Flood Risk Management Plans that will set the targets and give the frame for all prevention activities and measures in water management and espetially in flood protection.

In planning of long term developments we have to consider also climate change.

The United Nations Framework Convention on Climate Change (UNFCCC or FCCC) is an international environmental treaty produced at the United Nations Conference on Environment and Development (UNCED), informally known as the Earth Summit, held in Rio de Janeiro from 3 to 14 June 1992. The treaty is aimed at stabilizing greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system.

The Czech Republic ratified the treaty in 1993. The principal update is the Kyoto Protocol, which was signed by the Czech Republic 23.11.1998 and ratified 15.11.2001.

Results of studies of climate change impacts on water resources in basins of the Czech Republic support water management planning at different levels, which include central planning carried out by the Ministry of Agriculture, planning at regional level and water management activities of individua water users.

Climate change impact on water resources was studied in monthly time step also for Czech parts of Danube River basins. The study was performed for four alternative climate change scenarios that were derived from two types of climate models and two types of emission scenarios.

The results of the study showed that the climate change would be mainly reflected in a decrease in mean annual runoff, which applies to all of the basins except for several basins in southern Moravia and simulations of there hydrological conditions.

For most of the months the runoff also decreases, except for winter period from December to February when outflows increase or only moderately decrease. This is caused by higher winter temperature (monthly temperature below zero is predicted only for December), which is reflected in an increase in runoff and a decrease in snow storage. Consequently, spring and summer outflows decrease significantly in some basins, even to their current minimum values.

The results of the Model simulation also indicate that groundwater storage and base flow could be also highly reduced by the impacts of climate change.

The results of these studies show that mean annual runoff and monthly runoff in spring, summer and autumn can significantly decrease consequently to climate change. These impacts can be reflected in a risk of insufficiency of the existing retention capacities inwater resources for meeting the water supply requirements in future.

The **Slovak Republic** ratified UNFCCC in 1994. The first preliminary scenarios of the climate change were elaborated in Slovakia in 1993. Totally nine General circulation models from four world climate centres have been utilized in Slovakia up to 2005. The most important are models CCCM 2000 and GISS 1998. The method of statistical downscaling is used in regional modification of the GCMs outputs. Climate scenarios are provided with regard to annual development of individual climate elements for certain time horizons.

Adoption measures to mitigate negative impacts of the climate change are formulated generally only. It is due to the uncertainties of impact assessment. In addition, the political, social, ecological, economic and technological considerations are necessary. Currently, it is recommended to prefer decisions that decrease the risk of negative impacts of the climate change and in mean time, approaches towards the sustainable development should be applied. The latter includes integrated water resources management.

The strategic objectives set for the Danube sub-basin of the March and its tributaries in **Austria** aim to achieve a combined approach. With regard to future measures, increasing efforts are being made to rapidly push ahead with the preservation as well as the expansion of natural retention areas. A series of important measures to set up semi-natural flood retention areas are to be implemented within the period from 1998 to 2027, thus pursuing the aim of reducing the discharge peaks to fit the structural capacity of the consistently regulated waters within the catchment area of the March. To complement these measures, efforts are being made to implement flood protection, morphological and ecological river bed improvements by means of creating more free space in the discharge profile.

A second special focus in the catchment area of the March is the implementation and adaptation of targeted flood protection measures in the areas of settlement and infrastructure. In addition, the maintenance of the existing protective structures is gaining increasing importance.

3. TARGET SETTINGS

Floods are, under the conditions of Morava river basin, the most serious natural disastersexposing to threat both the lives of the inhabitants and their property. The anticipated climate change may in the Morava river basin result in an increased occurence of flood discharge.

Basic approach to deal with flood protection must be based on respect to the natural character of these extreme phenomena and on the need to mitigate their impact. It is necessary to prefer such measures that are of multipurpose features and help to increase the retention capacity of landscape and to stabilize landscape water regime.

The point of departure of the appropriate flood protection is respecting the following knowledge:

- floods are a natural phenomenon which cannot be prevented
- irregular occurence of floods results in underestimation of flood hazard
- areas with flood occurence do not depend on administration borders
- floods are a part of natural processes and for river ecosystems are important factor of their natural development
- changes in landuse in the river basin and in floodplain areas affect the rainfall – runoff conditions and bring the risk of runoff acceleration and increase
- expected climate changes may increase the frequency of occurence as well as the intensity of extreme floods

- absolute level of flood protection is impossible, there is always risk of a larger flood than the design flood and a risk of occurence of phenomena that can reduce the functionality of the elements of protection systems.

With regard to effective proposals for preventive flood protection measures it is important to look for a suitable combination of measures increasing the natural water retardation in the territory and technical measures affecting flood runoff.

3.1 Regulation on Land Use and Spatial Planning

Land use and land management practices can affect the rainfall-runoff condition in the river basin. For example the forests and agriculture land in good contitions are very valuable in the flood protection. It is known that water capacity of forests is higher than the water capacity of deforested area and the forests and plants can reduce surface runoff and also to prolong the time of flood peak. Of course the vegetation can not retain the runoff in the case of very extreme raifall occurence. Also the availability of natural flood plain along the rivers can have positive effect on floods.

On the other side the growing of urban areas in the flood plain creates a lot of problems in the flood protection. Impervious land surface like roads and roofs causes intensive concentrated surface runoff during rain events and the flood waves influenced by urban areas are faster and higher.

Proposed targets are following:

- to complete the designation of inundation areas along major watercourses with regard to built-up areas, in areas suitable for building on according to the general land use planning documentation or also in other areas for the purpose of determining the size of potential flood hazard areas

- to delimit in land use plans areas exposed to flood hazard risk, including the regulatory provisions, using the prepared flood hazard and flood risk maps as mandatory basis

- to complete the identification of all flood hazard zones

- to reduce the existing housing and production functions of areas in the active zones of inundation areas and to explore rehabilitation of buildings and structures destroyed by flood with the exceptionof the necessary transport and technical infrastructure

- to allow to convert the use of farmland in inundation areas important for retention of flood runoff to permanent grassland

- to increase interdisciplinary cooperation between the individual specialisations.

3.2 Reactivation of former, or creation of new, retention and detention capacities

The natural inundation areas along rivers are important part of flood protection and can reduce the flood by flood wave transformation. The floods are milder in the ecologically stable land. Also new retention capacities are very welcome and they can help to protect settlement areas below the retention storage.

Proposed targets are following:

- to prepare measures in the landscape implemented in a nature friendly manner, like natural overflows, polders, watercourse channel improvements in built-up areas of municipalities

- to optimize landscape hydrological regime by improving the retention capacity of landscape and by reducing the occurence and the impacts of flood situation through implementaion of measures favourable to nature conservation and landscape protection by rehabilitating the natural hydrological regime of landscape and by water erosion protection (especially revitalizing inappropriately regulated watercourse channels, inappropriate drainage and other interventions having adverse impacts on landscape water regime, reducing the occurence of adverse water erosion impact and decreasing the adverse impacts of surface runoff using infiltration zones and seeping depressed areas, renewal of flood storage)

- to prepare detention along rivers and their tributaries, creation of new polders, dry flood reservoirs or multipurpose reservoirs with flood retention capacity

- relocation of flood embankments to make more space to rivers

- to establish protective water management, morphological and ecological improvements in the riverbed – widening measures.

3.3 Technical Flood Defences

Technical flood defence measures are one of most important measures in the flood protection. Technical measuers can be prepared according to actual needs in flood protection and usually are used in built-up settlement areas. All technical measures should meet the requirements of good ecological status of water bodies.

Proposed targets are following:

- to prepare technical flood protection measures with retention (creating new flood storage capacity on watercourses, refurbishment and improvements of water reservoir structures with retention effect to increase the level of area protection, construction and refurbishment of building and structures in inundation areas)

- to prepare technical flood protection measures along watercourses to increase watercourse discharge capacity (the channel and the surroundings in its close proximity) in urban areas including its stabilization, to build and refurbish flood banks designed for local protection of the relevant area, to construct relieving channels and tunnels and to increase flow capacity of weirs

- to improve the safety of hydraulic structures (refurbishment of outlet structures and emergency spillways and increase of their capacity, refurbishment of weirs)

- flood protection and management of natural hazards on the torrents

- flood protection by means of area-and-space effective measures

- removal of obstacles in the rivers like bridges of insufficient flow capacity, improperly designed culverts and other similar barriers.

3.4 Preventive Actions

Preventive actions are very important in the whole flood protection system and the most effective form of protection.Effective preventive measures must be implemented in a systemic manner in hydrological catchment areas and with regard to interconnection of the impacts of individual measures along watercourses.

Proposed targets are following:

- to evaluate and to submit for approval to the competent water authority rules of operation for hydraulic structures significantly affecting flood flow and allowing the respective operation

- to elaborate the studies of rainfall-runoff conditions in watercourses constituting documents to be used for obtaining information for proposals designating new inundation areas, flood hazard maps and flood risks maps as the basis of of implementation of regulatory provisions in the land use planning documentation regarding the areas exposed to flood hazard and also for building permit procedure regarding construction in these areas.

- to permanently improve hydrological forecast systems, their reliability and informative capacity and to extend the forecast period. To use to this end area information on precipitation to detail the rainfall-runoff modelling and to improve the quality of operating forecast

- to optimise flood warning and flood warning systems

- to create conditions for accelerated allocation of funds for rehabilitation os state owned property fit by floods, for provision of state aid to other entities after floods during the crisis periods declared in compliance with the effective legal regulations and as appropriate also for provision of state aid in the course of rehabilitation of the respective area

- to initiate a process leading to a generally higher standard of elaborated flood plans of municipalitities and companies and to ensure operational flexibility allowing to update information in the respective flood plan and its availability for the responsible entities and concerning certain information also for the public

- to lay down the obligations in the process of estimating the value and keeping records of flood damages and their analysis in relation to flood extremity.

3.5 Capacity Building of Professionals

Proposed targets are following:

- to provide for regular training of flood protection bodies including suitable simulators of potential flood situations

- to support a long-term research and development programme dealing with extreme hydrological floods

- to support an overall involvement of professional institutions in relevant branches in international cooperation aimed at the research and development of the fields affecting improvement of flood protection

- to produce, in connection with operating measures components (flood forecsting and warning service, the intergated rescue system activity etc.) an outline of practical operating rules for flood protection systems – information transfer and management directives transfer

- to ensure the obligation of crisis bodies to proceed in accordance with flood plans and to consult with the competent river basin administrator and riverboard administrator decision making on all measures in the course of floods that may affect rainfall-runoff condirion in the river basin in a broader scale

- to add the process of receiving and submitting reports of flood forecasting and warning service also by integrated rescue system operation and information centres

- to promote the national and international exchange of knowledge between all specialisations of integrated flood management

- to build capacity of professionals and institutions responsible for flood management.

3.6 Raising Awareness and Preparedness of General Public

Proposed targets are following:

- to pay systematic attention to the process of informing and educating the public by preparing focused programmes and notifications in writing for mass media as wel as by arranging conferences and workshops focused primarily on popularization of the purpose and the function of management system for flood protection

- to inform the public about the causes of floods, the principles of mimimizing the damages, the importance and the possibilities of water retention in landscape as well as other flood prevention measures

- to make the map of inundation areas available for the public to obtain information on flood hazard

- to pay attention to installing information boards near major hydraulic structures, revitalization measures and structures designed to increase water retention in landscapewith the aim to inform the public on the importance and the purposes of these structures and measures

- to introduce a single system for education and training of the population exposed to flood threat

- to optimise and to develop advance disaster control and emergency planning.

3.7 Prevention and Mitigation of Water Pollution Due to Floods

Floods can have considerable environmental consequences in the case of contaminated sites, fertilizer storages, industrial sites or infastructure necessary for sanitation in flood plain.

Proposed targets are following:

- to identify in the flood plain facilities designed for treatment or neutralization of wastewaters and sewerage systems or industrial sites or contaminated sites that pose risks in the case of extreme floods and to prepare the suitable measures to reduce the risks.

4. MEASURES TO ACHIEVE TARGETS

4.1 Regulation on Land Use and Spatial Planning

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
In the Czech Republic					
Comprehensive Land Improvement in the river basin	Legal	Land Registry Authority	n.a.	2015	
Embankment vegetation improvement in the Morava river basin	natural	Forests of the Czech Republic, Agricultural Water Management Authority, Morava River Board	n.a.	2015	
Strategy of protection against negative impacts of floods and water erosion by natural friendly measures in the Czech Republic	administrative	Ministry of the Environment	10 000	in preparation	analyse hydromorphology, hydropedology, climate forecast in case of flood, erosion and drought risks in the scale of small catchments, define priority areas prepare conceptual measures
Identifying flood plain - Inundation areas definition in Dyje river basin	administrative	Forests of the Czech Republic, Agricultural Water Management Authority, Morava River Board, Regional Authorities, municipalities	212	2015	
Identifying flood plain - Inundation areas definition in Morava river basin	administrative	Forests of the Czech Republic, Agricultural Water Management Authority, Morava River Board, Regional Authorities, municipalities	584	2015	

Developing flood hazard and flood risk maps	research, elaboration	Ministry of the Environment, Water Research Institute T.G.M., Forests of the Czech Republic, Agricultural Water Management Authority, Morava River Board,		2013	according to EU Flood Directive
Promotion of closer interdisciplinary cooperation	strategy	Ministry of the Environment, Ministry of the Agriculture		ongoing	
Assure suitably-adapted area utilisation through spatial planning	strategy	Ministry of the Environment, Ministry of the Agriculture, Regional Authorities		ongoing	
In the Austria					
Flood Risk Zoning Austria (HORA)	Prevention Raising Awareness	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW)		Ongoing	To be worked out in cooperation with the Austrian Insurance Association. In certain sub-areas (informing the public, flood-endangered areas), this already corresponds to the EU Directive on the assessment and management of flood risks.
Adoption of the objectives and principles of the EU Floods Directive	Administration	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW)			
Full-coverage identification on hazard zone maps in the relevant settlement and infrastructure areas. Flood Discharge Analyses	Hazard zone mapping	Administrative offices of the Federal Hydraulic Engineering Administration Sections of the Forest		Ongoing until 2010 or 2020	Complete identification of all hazard zones in the sphere of competence of the Federal Hydraulic Engineering Administration will take place by 2020. Complete identification of all hazard zones in the sphere of competence of the Forest

		Engineering Service in Torrent and Avalanche Control (WLV) (both BMLFUW)			Engineering Service in Torrent and Avalanche Control will be completed by 2010.
Identification of reserved and indicated areas	Hazard zone mapping	Sections of the Forest Engineering Service in Torrent and Avalanche Control (WLV)		Ongoing	In this way, existing hazards are indicated and also important areas are kept free for further protective measures.
Promotion of closer interdisciplinary cooperation between protective water management, spatial planning, disaster control and the legislative process	Strategy	Federal government, provinces and municipalities Specialist departments		Ongoing	Efforts are being made not only to increasingly integrate the threat from natural disasters in the mapping process, but also to identify space for the natural area. Example: Flood Risk Study
Assure suitably-adapted area utilisation through spatial planning. Coordinate planning projects carried out by the public authorities.	Strategy Protective water management land-use planning	Provinces (Lower Austria Land-Use Planning Law)		Ongoing	Land designation, land provision and protective water management instruments for keeping areas clear.
In the Slovak Republic					
Transposition of EU Directive 2007/60/EC on the assessment and management of flood risks to the Slovak national Flood Protection Act	Legal	Ministry of the Environment		2009	
Implementation of the Slovak national Flood Protection Act (i.e. also EU Directive 2007/60/EC on the assess-ment and management of flood risks)	Administrative/ Technical	Ministry of the Environment, Slovak Water Management Enterprise, Slovak Hydrometeorological Institute, municipalities		continuous	
Introduction of flood maps into spatial plans of regions, districts, municipalities	Administrative	Ministry of the Environment, Slovak Water Management Enterprise, the Environment Protection District Office, Slovak			

		Hydrometeorological Institute, municipalities			
Application of Land use limitations introduced in spatial plans	Technical	the Environment Protection District Office, municipalities		continuous	

4.2 Reactivation of former, or creation of new, retention and detention capacities

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
In the Czech Republic					
Areas designed for flood retention in Dyje river basin (small polders, dry reservoir)	Natural	Forests of the Czech Republic, Agricultural Water Management Authority	6 500		proposal, organizational difficult tasks
Inundation reconstruction below water reservoir Nove Mlyny (priority area 5)	natural and technical		43 304		conceptual proposal
Retention increasing on Morava and Dyje rivers junction (priority area 6)	natural and technical		8 965		conceptual proposal
Svratka river – flood plain revitalization	natural and technical	Morava River Board	13 462	2015	feasibility study
Litava river - flood plain revitalization	natural and technical	Morava River Board	11 538	2015	feasibility study
Moravska Dyje river - flood plain revitalization	natural and technical	Morava River Board	1 154	2015	feasibility study
Areas designed for flood retention in Morava river basin (small polders, dry reservoir)	Natural	Forests of the Czech Republic, Agricultural Water Management Authority	7 702		proposal, organizational difficult tasks
Flood protection in the Litovel area (priority area 2)	natural and technical		11 008		conceptual pro posal
Controlled inundation in Kromeriz area (priority area 7)	natural		33 623		conceptual proposal

Controlled inundation in Mohelnicka brazda area (priority area 8)	natural		50 850		conceptual proposal
Juhyne river - flood plain revitalization	natural	Morava River Board	5 769	2015	feasibility study
in the Austria					
Prevention of existing retentions areas	Flood retention Strategy	Departments of the Federal Hydraulic Engineering Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	Targeted flood retention in the catchment areas. Passive flood protection takes priority over active flood protection.
Reactivation and creation of retention capacities	Flood retention Strategy	Departments of the Federal Hydraulic Engineering Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	Implementation by the Federal Hydraulic Engineering Administration and the Forest Engineering Service in Torrent and Avalanche Control.
Recognition of negative flood-relevant developments	Strategy Research	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW)		Ongoing	
Implementation of protective water management, morphological and ecologically valuable measures in the riverbed (restructuring, revitalisation, renaturation)	Strategy Flood protection	Departments of the Federal Hydraulic Engineering Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	
in the Slovak Republic					
Tighten the rules applied during giving permission	Administrative/	Ministry of the		continuous	

for activities within whole sub-basin	legal	Environment, Slovak Water Management Enterprise, the Environment Protection District Office, municipalities			
Design and building of new polders, retention reservoirs	Technical	Slovak Water Management Enterprise , Slovak Hydrometeorological Institute, municipalities		continuous	
Reassessment of rivers retention and detention capacities	Technical	Ministry of the Environment, Slovak Water Management Enterprise		continuous	
Updating and implementation of results of the study "The survey of water courses in towns and villages (Slovak Water Management Enterprise)".	Administrative/ Technical	Slovak Water Management Enterprise		continuous	

4.3 Technical Flood Defences

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
In the Czech Republic					
Water reservoirs reconstruction in Dyje river basin	technical	Morava River Board	21 154		proposals, missing funds
Svitava river, Spesov – protection dikes	technical	Morava River Board	335	2010	Czech Programme Support of Flood Prevention II.
Svitava river, Letovice – discharge improvement	technical	Morava River Board	3 085	2010	Czech Programme Support of Flood Prevention II.
Jihlava river, Trebic – discharge improvement	technical	Morava River Board	6 115	2012	Czech Programme Support of Flood Prevention II.
Flood protection in Svratka river basin (priority area 9)	technical	Morava River Board	5 611		conceptual proposal

Flood protection measures on rivers in forests and agricultural land in Dyje river basin (several local measures)	technical	Forests of the Czech Republic, Agricultural Water Management Authority	4 726	2012	Czech Programme Support of Flood Prevention II.
Water reservoirs reconstruction in Morava river basin	technical	Morava River Board	30 385		proposals, missing funds
Water reservoir Bystricka – spillway reconstruction	technical	Morava River Board	3 058	2010	Czech Programme Support of Flood Prevention II.
Morava river, Olomouc – discharge improvement, stage II.A	technical	Morava River Board	11 727	2012	Czech Programme Support of Flood Prevention II.
Morava river, Olomouc – discharge improvement, stage II.B	technical	Morava River Board	33 846	2013	Czech Programme Support of Flood Prevention II.
Flood protection in the Olomouc area (priority area 1)	natural and technical		119 627		conceptual proposal
Flood protection in the Uherske Hradiste area (priority area 3)	natural and technical		24 643		conceptual proposal
Flood protection measures in the junction of Morava and Becva rivers (priority area 4)	natural and technical		82 250		conceptual proposal
Oslava river, Dlouha Loucka – dike reconstruction	technical	Morava River Board	608	2011	Czech Programme Support of Flood Prevention II.
in the Austria					
Maintenance and adaptation of the protective measures and protective structures	Maintenance Flood protection Strategy	Departments of the Federal Hydraulic Engineering Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	Due to the increasing volume of protective water management construction work on the waters, maintenance is gaining increasing importance.
Implementation of measures for flood protection where necessary	Flood protection	Departments of the Federal Hydraulic Engineering Administration		Ongoing	Basic principles: Passive flood protection takes priority over active flood protection. Measures in the catchment area take priority

		Sections of the Forest Engineering Service in Torrent and Avalanche Control			over measures on the main channel of a watercourse. Retention measures take priority over linear construction measures.
Upkeep and improvement of floodwater passability on watercourses	Flood protection	Departments of the Federal Hydraulic Engineering Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	Improvement of passability (outlets, channels, bridges…) in the course of the project activity
Coordination between planning projects of public authorities and the relevant special fields.	Strategy Integrated flood management	Departments of the Federal Hydraulic Engineering Administration Departments of the relevant special fields.		Ongoing	
Recognition of negative flood-relevant developments	Strategy Research	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW)			
Measures for bed load and dead wood retention in torrent catchment areas	Protection from natural hazards	Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	
Implementation of area management measures in the catchment areas	Protection from natural hazards	Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	
Creation and enlargement of retention areas and basins	Flood protection	Departments of the Federal Hydraulic Engineering		Ongoing	Main strategic focus: retention measures take priority over linear construction measures. Regarding implemented and planned

		Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control			measures.
Controlled retention	Flood protection	Departments of the Federal Hydraulic Engineering Administration		Ongoing	Regarding controlled retention, greater potentials for the future lie in the continual further development of prognosis and forecasting models. For protective water management are important aspects in the operating regulations of power stations, valley dams or lake reservoirs
in the Slovak Republic					
Regular maintenance of dams, water courses and water structures, e.g.: - recovery of water courses embankment vegetation protection - technical-farming activities at embankments and in river beds - maintenance of natural river beds - removal of obstacles from river beds - removal of sediments etc.	Technical	Slovak Water Management Enterprise, owners		continuous	
Systematic technical monitoring of key water structures	Technical	Slovak Water Management Enterprise, owners		continuous	
Morava River, - Reconstruction of internal waters pumping station in Kopčany	Technical	Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		2010	the Slovak National Flood Protection Plan
Myjava River, Turá Lúka - discharge improvement	Technical	Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		2011	the Slovak National Flood Protection Plan

Morava River, Suchohrad – sealing up of bank well sub-soil	Technical	Slovak Water Management Enterprise		2009	the Slovak National Flood Protection Plan
Malina River – embankment modification	Technical	Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		2009	the Slovak National Flood Protection Plan
Morava River, rkm 79,066 – 79,500 - dike reconstruction	Technical	Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		2010	the Slovak National Flood Protection Plan
Smíchov creek, Myjava – polder construction	Technical	Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		2011	the Slovak National Flood Protection Plan
Water reservoir Hlboké - reconstruction	Technical	Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		2010	the Slovak National Flood Protection Plan

4.4 Preventive Actions

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
in the Czech Republic					
Operative measures in Dyje river basin (gauging station improvement)	technical	Morava River Board, Regional Authorities	1 054	2015	
Operative measures in Morava river basin (gauging station improvement)	technical	Morava River Board, Regional Authorities	1 458	2015	

Improving flood forecast service	technical	Czech Hydrometeorological Institute	12 000	2010 2014	Improving technical support (new supercomputer for more precious weather forecast in Central Europe Region, boosting of telecommunication network)
Enhancing of early warning systems, building of new forecast at warning profile, precipitation check stations and technical support of flood committees	technical	Municipalities and regional authorities, river basin authorities		2013	Operational programme Environment cofinanced from EU Structural Funds
Digital flood management plans	administrative	Ministry of the Environment, regional Authorities and Municipalities		Ongoing	Czech Republic has digital flood management plan since (www.dppcr.cz)
Flood information system POVIS	administrative	Ministry of the Environment		Ongoing since 2006	www.povis.cz includes database of: flood committies, information of flood events, legislation, methodologies and best practice documents, digital flood management plans
updating of water law	administrative	Ministry of the Environment and Ministry of the Agriculture		2010	Includes transposition of EU directives
in the Austria					
Development of flood forecasting and prognosis models	Prevention Research Strategy	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW)		Ongoing	Gradual development of flood forecasting systems for all major main rivers and tributaries in Lower Austria (Danube sub-basin of the March). Model on the March is in trial operation in cooperation with Czech Republic, and already in full operation on the Thaya.
Networking of regional and international systems	Cooperation Research Strategy	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW) Neighbouring states (Czech, Slovakia)		Ongoing	The intended result is to be an international flood forecasting and flood warning system that not only covers the entire Danube river basin, but also responds to the respective needs and requirements of the individual regions.

Adaptation and development of the gauge network	Maintenance	Hydrographic Services of the Federal Hydraulic Engineering Administration		Ongoing	Further development of, in particular, the basic network of telecommunicating gauges. Deployment of state-of-the-art technical devices and systems.
Optimisation of flood warning and the flood warning systems (improved early warning)	Prevention Strategy Disaster Control	Provinces (Hydrographic Services, disaster control departments)		Ongoing	Well-functioning early warning systems and flood news services (improved data gathering and transmission process) represent the basic prerequisite for well-functioning flood risk management.
in the Slovak Republic					
Implementation of the Slovak national Flood Protection Act (i.e. also EU Directive 2007/60/EC on the assess-ment and management of flood risks)	Administrative/ Technical	Ministry of the Environment, Slovak Water Management Enterprise, Slovak Hydrometeorological Institute, the Environment Protection District Office, municipalities		continuous	
Regular updating and implementation of the Slovak National Flood Protection Plan	Administrative	Ministry of the Environment, Slovak Water Management Enterprise, Slovak Hydrometeorological Institute		continuous	
Implementation of flood forecasting and early warning system POVAPSYS	Administrative/ Technical	Ministry of the Environment, Slovak Hydrometeorological Institute		ongoing	
Introduce directive for emergency situations response	Legal	Ministry of the Interior + Ministry of the Environment,			

Bring into force bilateral agreements	Administrative	Ministry of the Environment		continuous	
Improvement and formalizing of international basin wide online flood related meteorological and hydrological data and operative flood defense information exchange	Administrative/ Technical	Ministry of the Environment, Slovak Hydrometeorological Institute, Slovak Water Management Enterprise			

4.5 Capacity Building of Professionals

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
in the Czech Republic					
Training of flood committees and state administration in Morava river basin	Information exchange	Ministry of the Environment		ongoing	Workshops on digital flood management plans
Project CEFRAME – Central European Flood Risk Assessment and Management in CENTROPE	Technical and administrative	Czech project partners: Ministry of the Environment, Southern Moravian Region Authority	3 500	2012	Transnational project of Austria, Czech Republic, Slovakia and Hungary
in the Austria					
Improvement of international cooperation in flood management	Cooperation Research	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW)		Ongoing	Action Programme for sustainable flood protection in the catchment area of the Danube Action Programme on Flood Prevention, Protection and Mitigation of the European union (Floods Directive of the European Parliament and Council)
International cooperation within the framework of water agreements or bi- and multilateral water commissions	Cooperation	Federal Ministry of the Agriculture, Forestry, Environment and Water Management (BMLFUW) Representatives of		Ongoing	Sustainable flood protection that is fit for the future can only be tackled in cooperation with the riparian states in the individual river basins, including active collaboration and the exchange of knowledge and strategies.

		the participant countries			
Execution of transnational projects; partner of international platforms	Cooperation	Federal government, provinces Participant neighbouring countries and various organisations		Ongoing	For example, through INTERREG pilot projects an effort has been launched to develop river management schemes internationally in the direction of a river basin management plan. The intention is to thus boost structured cooperation and the exchange of knowledge between all the administrative departments working in the river basin, starting with hydrology, and then involving spatial planning, water rights, nature conservation, agricultural and forestry departments, etc
in the Slovak Republic					
Support scientific base for flood management	Technical	Ministry of the Environment, Water Research Institute			
Organize vocational retraining for water professionals of Slovak Water Management Enterprise, Slovak Hydrometeorological Institute, Water Research Institute, Environment Protection District Offices and municipalities that participate in flood protection	Technical	Ministry of the Environment, Water Research Institute			

4.6 Raising Awareness and Preparedness of General Public

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
in the Czech Republic					
Project "Flood Prevention" in Brno fairs	Technical and administrative	Czech flood protection association in cooperation with Ministry of the Environment and Ministry of the Agriculture		ongoing	public presentation of various forms of the flood protection by means of practical examples and shows

in the Austria					
Keeping the public continually informed	Public Relations Raising Awareness	Federal government, provinces and municipalities Disaster control departments, emergency organisations, insurance companies…		Ongoing	Brochures, folders, information sheets on the subject of flood protection Internet platforms Information and events designed for different age and person groups Flood news service, online services
On-the spot informative events held by the Federal Hydraulic Engineering Administration and Torrent and Avalanche Control	Public Relations Raising Awareness	Departments of the Federal Hydraulic Engineering Administration Sections of the Forest Engineering Service in Torrent and Avalanche Control		Ongoing	Informative events within the framework of detailed planning projects, hazard zone mapping or river development schemes
Identification and publication of potential flood hazard areas within the framework of Floor Risk Zoning Austria (HORA)	Information Raising Awareness	Federal Ministry of the Agriculture, Forestry, Environment and Water Management		Ongoing	Assessment of the flood risk. Making already complete-coverage, public information available to the general public. Basic possibility of online risk appraisal. Elaboration in cooperation with the Austrian Insurance Association.
The carrying out of disaster control exercises	Disaster control	Provinces Disaster control organisations		Ongoing	
Streamlining and optimisation of the emergency response chain	Disaster Control	Provinces Disaster control organisations		Ongoing	
Creation of disaster control plans and special alarm plans	Disaster Control	Provinces Disaster control organisations		Ongoing	
Promotion of incentive systems to encourage people to take their own precautions	Prevention Disaster Control	Federal government, provinces		Ongoing	
Securing financial provision	Prevention Disaster Control	Federal government, provinces		Ongoing	

in the Slovak Republic					
Introduce and carry on the web sites focused on floods and flood risk management	Technical	Ministry of the Environment, Slovak Hydrometeorological Institute, Slovak Water Management Enterprise		ongoing	

4.7 Prevention and Mitigation of Water Pollution Due to Floods

Measures	Type of intervention	Institution in charge	Costs (k€)	Deadline	Comment
in the Czech Republic					
Implementation of EU Water Framework Directive, Flood Directive and Priority Substances Directive	administrative	Ministry of the Environment, Morava River Board, Regional Authorities		ongoing	Building database and GIS layers with endangering areas sites due to floods
Building and modernization of waste water systems and plants		municipalities		2013	Separation waste waters of rain waters
in the Austria					
Greater integration of spatial planning in protective water management planning projects	Prevention and reduction of water pollution	Federal government, provinces		Ongoing	
Directives and specifications given by the legislator	Prevention and reduction of water pollution	Federal government, provinces		Ongoing	Building Code, Building Technique Ordinance (uplift-resistant heating oil tanks; positioning of storage containers)
Information on flood-proof building	Prevention and reduction of water pollution	Federal government, provinces			Information on constructing flood-proof heating systems
in the Slovak Republic					
Implementation of EU Water Framework Directive and Priority Substances Directive	Administrative	Ministry of the Environment		Ongoing	
Building and modernization of waste water treatment plants	Technical	Municipalities			

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ABBREVIATIONS

A	Austria
CZ	Czech Republic
SK	Slovak Republic
ICPDR	International Commission for the Protection of the Danube River
EFD	European Flood Directive
CHMI	Czech Hydrometeorological Institute
SHMI	Slovak Hydrometeorological Institute
CFO	Central Forecasting Office
RFO	Regional Forecasting Office
QPF	Quantitative Precipitation Forecast
HFS	Hydrological Forecasting System
NÖ	Lower Austria
UNFCCC	United Nations Framework Convention on Climate Change
UNCED	United Nations Conference on Environment and Development
BMLFUW	Federal Ministry of the Agriculture, Forestry, Environment and Water Management