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Flood issues and climate changes Integrated Report for Tisza River Basin

Deliverable 5.1.2

May, 2018

Project co-funded by the European Union (ERDF, IPA funds)

DANUBE REGION strategy

Acknowledgements

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Contents

Annexes

Abbreviations

AIMS TISZA	Joint Ukrainian-Hungarian *Automated Information-Measuring System* for flood forecasting and management in the Tisza River basin in Transcarpathian region
APV	Autonomous Province of Vojvodina
APSFR	Areas with Potentially Significant Flood Risk
CARPATCLIM	Climate of the Carpathian Region, the regional project financed by the Joint Research Center of the European Commission – JRC
CC	Climate Change
CCCM	Canadian Centre for Climate Modelling
CC-WARE	Integrated transnational strategy for water protection and mitigating water resources vulnerability, the transboundary project funded by ERDF (European Regional Development Fund) and IPA (Instrument of Pre-Accession Assistance)
CCWaterS	Climate Change and Impacts on Water Supply, the transboundary project funded by ERDF and IPA
CLENIAM - III43007	Studying climate change and its influence on the environment: impacts, adaptation and mitigation (CLENIAM - III43007), funded by the Ministry of Education and Science of the Republic of Serbia
ClimWatAdapt	Climate Adaptation–modeling water scenarios and sectoral impacts, funded by the European Commission - DG Environment
CORINE Land Cover	Coordination of Information on the Environment Land Cover, CLC
Danube Transnational Programme (DTP)	The Danube Transnational Programme is a financing instrument of the European. Territorial Cooperation (ETC), better known as Interreg. The Danube Transnational Programme finances projects for the development and practical implementation of policy frameworks, tools and services and concrete small-scale pilot investments
DFWL	Designed Flood Water Level
DTD	Danube–Tisa–Danube Canal
DTP	Danube Transnational Programme
EC	European Comission
e.g.	exempli gratia/ for example
EEA	European Environmental Agency
EU	European Union
GRASS-GIS	Geographic Resources Analysis Support System - Geographic Information System
HEC-RAS	Hydrologic Engineering Center's (CEIWR-HEC) River Analysis System
HORIZON 2020	Programmes created by the European Union/European Commission to support and foster research in the European Research Area (ERA)
HUF Hydromet	State Hydrometeorological Service of Ukraine
ICPDR	The International Commission for the Protection of the Danube River
i.e.	in essence
IED	Industrial Emissions Directive
INTERREG Europe	Interreg Europe helps regional and local governments across Europe to develop and deliver better policy. The programme supports: interregional cooperation projects & policy learning platforms, financed by the ERDF
ITRMB Plan	Integrated Tisza River Basin Management Plan
LB	Left bank
LIDAR	Light Intensity Detection and Ranging
LIFE	LIFE is the EU's financial instrument supporting environmental, nature conservation and climate action projects throughout the EU
MCM	Million cubic metres
MEL	Maximum Exploitation Level
MIKE 21 FM HD	Comprehensive modelling system for two dimensional water modelling developed by DHI (FM - flexible mesh; HD - Hydrodynamic Module)
NATURA 2000	Network of nature protection areas in the territory of the European Union

NNP	National Nature Park
NP	National park
NRL	Normal Retention Level
OMIT	National Technical Committee Hungary
OrientGate	A network for the integration of climate knowledge into policy and planning
OVF	General Directorate of Water Management Hungary
PHARE programme	Poland and Hungary Assistance for Restructuring Economies, pre-accession instrument financed by the European Union for 10 states
PLA	Protected Landscape Areas
PROMITHEAS-4K	Knowledge Transfer and Research Needs for Preparing Mitigation/Adaptation Policy Portfolios
RBA	River Basin Administration
RB	Right bank
SACs	Special protected area
SAWR	State Agency of Water Resources Ukraine
SCI	Sites of Community Importance
SEE Forum on CCA (CCAFORUM)	South East European Forum on Climate Change Adaptation
South East Europe (SEE) Programme	The South East Europe Programme is a unique instrument which, in the framework of the Regional Policy's Territorial Cooperation Objective, aims to improve integration and competitiveness in an area which is as complex as it is diverse. The Programme is supporting projects developed within four Priority Axes: Innovation, Environment, Accessibility, and Sustainable Growth Areas - in line with the Lisbon and Gothenburg priorities, and is also contributing to the integration process of the non-EU member states
SEERISK	Joint Disaster Management Risk Assessment and Preparedness in the Danube macro-region
SPAs	Special area of conservation
SR	Slovak Republic
SSES	State Service of Emergency Situations Ukraine
TIKEVIR	Tisza–Körös Valley Management System
TRB	Tisza River Basin
UNDP	United Nations Development Programme
UNESCO	United Nations Educational, Scientific and Cultural Organization
WATCAP	Water and Climate Adaptation Plan for the Sava River Basin funded by World Bank

Chapter 1 Introduction

The purpose of this report is to show as far as possible the flood defence activity in the Tisza river basin.

In the following it will be presented the national aspects of the five countries geographically, geologically, water resources, soil, population, human settlements, land use, economic activities, biodiversity, protected areas, cultural heritage, flood defence infrastructure, flood hazard and risk areas, climate change impact and cooperation which have settled bilaterally between countries, as well as at the level of the international organizations they are part of.

Chapter 2 National responsible institutions for flood management in the Tisza River Basin countries

In **Ukraine** there are two main organizations at national level involved in the flood risk management:

- **State Agency of Water Resources of Ukraine (SAWR)** which belongs to the system of the Ministry of Ecology and Natural Resources of Ukrane and
- **State Service of Emergency Situations (SSES)**, which belongs to the system of the Ministry of Internal affairs.

SAWR through its river basin authorities manages and operates flood protection constructions and jointly with SESS in the times of flood. SSES through its Oblast Hydrometeorological services is responsible for prognosis of precipitation and water levels and preliminary flood risk assessment. SSES is designated responsible for the implementation of EU Flood Risk Directive.

In **Romania** flood risk management is mainly provided by:

- Ministry of Water and Forest, at **central level**;
- National Administration "Romanian Waters" through 11 River Basin Authorities (Someş-Tisa RBA, Crişuri RBA, Mureş RBA, Banat RBA, Jiu RBA, Olt RBA, Argeş-Vedea RBA, Buzău-Ialomiţa RBA, Siret RBA, Prut-Bârlad RBA, Dobrogra-Litoral RBA) at the catchment level and National Institute of Hydrology and Water Management which offers the scientific support and methodological guidance needed for implementation of European Directives **at national level.**
- Ministry of Internal Affairs, General Inspectorate for Emergency Situations at central level (at the level of the 41 counties), which intervene in case of emergency situation;
- Local and County Comittees for emergency situations.

Flood risk management in line with EU Flood directive is going through its first cycle. The Preliminary flood risk assessment for the territory of **Slovak Republic** was finished in 2012, flood hazard and flood risk maps are prepared only for some rivers (none of them in the Tisza river basin) and the Flood risk management plan for the territory of the Republic of Serbia is under development (1st phase was finished in 2015, including Catalogue of measures).

a. Flood protection is regulated by the Act. 7/2010 Coll. on flood protection and it is carry out by

b. flood protection authorities in accordance with § 22,

c. other bodies of state administration,

d. authorities of territorial self-government,

e. flood commissions,

f. water management authority of significant watercourses and water management authorities of small watercourses,

g. owners, land managers and users of land, buildings, facilities or structures located in a watercourse or floodplain,

h. construction builders, which intervene with the watercourse or floodplain; other persons.

The government, flood protection authorities and municipalities established the flood commissions as its advisory and executive body. The flood commissions are:

a. central flood commission,

b. regional flood commission,

c. district flood commission,

d. flood commissions of municipalities.

In **Hungary**, the General Directorate of Water Management (OVF) was established in 1953 as an independently operating institute and a central government body in water issues, currently operates under the direction and supervision of the Minister of Interior. The OVF is responsible for supervising and coordinating the professional activities of the 12 Regional Water Directorates. The OVF is also responsible for the flood risk management planning at national, sub-regional and cross-border level, as well. At the country level the flood protection activities are being coordinated by National Technical Committee (OMIT) which is a flood control organization in the General Directorate of Water Management of which operated if several Water Directorates have flood protection activates in the same time. It is necessary to better flow of information, and moving flood resources (human, machines, materials). The OMIT coordinate the flood protection activities of 12 Regional Water directorate. In regional level the leading of the flood protection actives is the Regional Water Directorate. The head of the regional flood protection is the director. Under the director operating the Technical Committee, hydrological group, and some groups like at National Committee. The protection system is built up by the flood protection lines (30-50 km), dyke keeper's section (5-8 km).

Flood risk management issues in **Serbia** are regulated by the Water Law. The institutions involved in flood risk management are:

- Ministry of Agriculture, Forestry and Water Management of the Republic of Serbia - Republic Directorate for Water – Belgrade (national level);
- Provincial Secretariat for Agriculture, Water Management and Forestry - Novi Sad (provincial –regional level);

- Public Water Management Company "Vode Vojvodine" - Novi Sad (provincial - regional level);
- Local water management companies (local level);
- Republic Hydrometerological Service of Serbia (national level); and
- Municipalities (local level).

Chapter 3 General description of the Tisza River Basin

Geographic characterization

Area of the Tisza River Basin can be characterized as dissected terrain with different relief with the main form of relief being represented by mountains (figure III.1).

Tisza River Basin is located in the Carpathian Mountains area in Ukraine, Romania and Slovakia, and Northern Mountains in Hungary. It includes also parts of Pannonian lowlands in Ukraine, Slovakia, Hungary and Serbia. Hills area is represented by The Plateau of Transylvania Unit, Western Hills and Depressions, Western Plain in Romania.

In **Ukraine**, Tisza basin is cut by three groups of mountain range: central is Polonynsky mountains, north from them – Gorgany, south – Vygorlat Gutynsky (volcanic) range. At southern east, there are Hutsul Alps. The mountains show a variation of heights from 2000 m.a.s.l. up to 700-800 m.a.s.l. The Hungarian lowland occupies about 35% of the basin. This area is a flat land with separate ridges and hills.

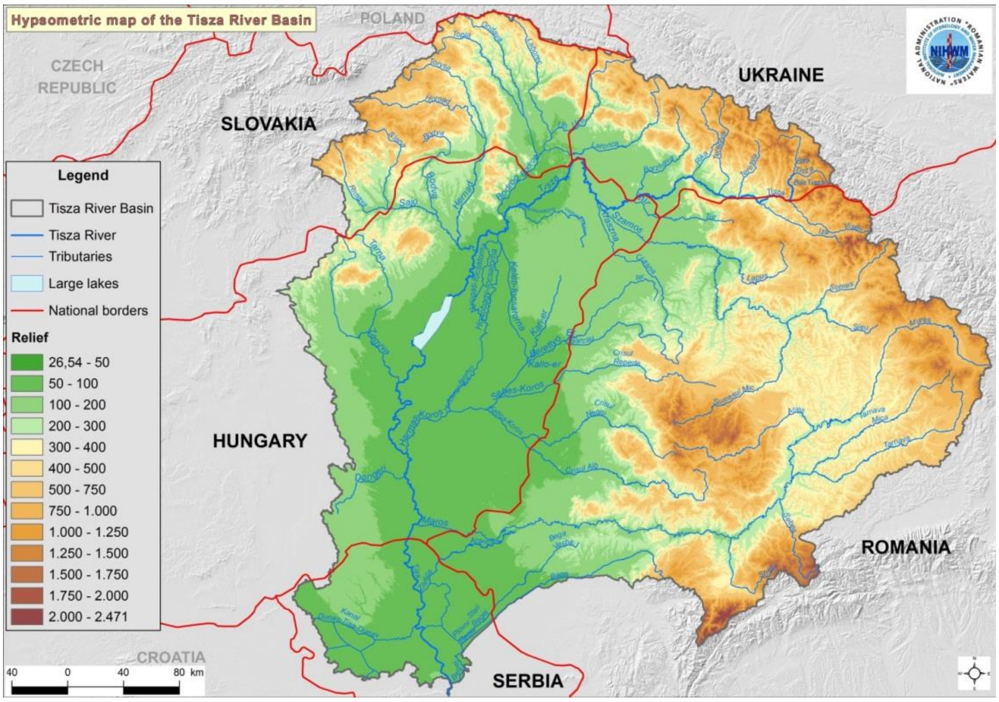

Figure III.1 Hypsometric map of the Tisza River Basin

In **Romania** the relief shows a great variety from the plain to the mountains (the minimum altitude is 75 m in the Western Plain, and the maximum of 2,509 m in the Retezat Mountains).

In **Slovakia** the largest part of the basin area lies at altitude of 300-500 m above Adriatic sea level and the smallest area takes up an altitude from 1,000 to 1,500 m.a.s.l. Significant particularity in the southern part of the basin in Slovakia is Slovenský kras, which is formed by a system of karst highlands separated by deep valleys that created an extensive system of over 1,000 caves and chasms.

In **Hungary** Tisa river basin reaches the lowest altitude at Szeged-Gyálarét – 75.8 m, and the highest altitude in Kékes – 1,014 m.

In **Serbia** there are different geomorphological elements in relief (as alluvial plains, loess plateaus, sandy areas), with elevation reaching 74 - 143 m above Adriatic sea level.

Geology

Geology of Tisza river basin is composed from crystalline and magmatic rocks, crystalline prehercinal shale, hercinic crystalline shale, ololytic magmatite, prelaramic sedimentary deposits, larma magmat in the area of Carpathians.

In **Ukraine**, Tisza River basin is situated within the new Alpine folding of the Carpathians and covers the central part of the Ukrainian segment of the Folded Carpathians with the Zakarpattya internal trough. The central suture zone (Zakarpattya area or otherwise Perypeninskyi deep-seated fault) divides these two main longitudinal segments.

Two structural levels take part in formation of geological structure of the territory. The lower structural level forms the basement of the Transcarpathian trough and the Folded Carpathians. The intensively deployed sedimentary, volcanogenic and metamorphic formations of the Paleozoic and the Mesozoic-Cenozoic are developed in the basement of the trough. The Folded Carpathians are formed by the carbonate-terrigenous and terrigenous mesozoic-cenozoic formations, which make several structural-facial zones. They are intensively dislocated and form a package of overlapped structures.

In Ukraine, in general, Tisza river basin has high seismicity.

The **Transylvanian Depression** is an area of active sedimentation and subsidence that emerged at the end of the Lower Miocene. The Western Hills have a crystalline foundatio, which is affected by different elevations and dives, represented by blocks at different depths, over which are sediment.

Pannonian Depression consists of a base made up of crystalline shale traversed of penetration and solidification of the magma and sedimentary shell.

Tisza River Basin geology in **Slovakia** consists of paleogene, neogene and neogeneous volcanites. Neogene is represented by deposits with young vulcanite’s, older palaeozoic rocks, medium triasma limestones and dolomites have a very low permeability. Quaternary deluvium of loamy-clay character form an impermeable barrier and silty, respectively clayey loam with organic admixture in overburden are laying. Paleozoic rocks are represented by granite rocks, gneis and paragneis. The volcanic neogene rocks are formed by andesites, rhyolites, tuffs and tuffites that are only slightly waterlogged. Fluvial sandy gravel form the bottom panel and low river terraces.

Great and Little Plains from **Hungary** were formed only 19 million years ago, in the Miocene. Their formation was affected by two factors: by an earlier extensional lengthening of the crustal and mantle lithospheres and by a later mantle diaper. Basaltic lava originating from the mantle formed several volcanic cones in the vicinity of the Balaton Highlands such as the Badacsony, Kab-hegy, Somló, etc. and in northern Hungary around Salgótarján (Karancs, MedvesDue to this Hungary is very rich in geothermal energy).

In **Serbia** the alluvial sediments dominate wider zones of the basin, while the central part of Banat is dominated by loesses - terrestrial sediments, north and central part of Bačka are mainly dominated by loess and eolian sands, while the southern part of Bačka are dominated by loesses -terrestrial sediments and alluvial sediments. Salinated land covers small areas mainly in alluvial terrace in wider zone of TRB.

Climate

Tisza river basin is situated in moderate continental climate with ocean, western, mediterranean and submediterranean influences.

The average air temperature in **Ukraine** in July is about +21 °C and in winter -4 °C (at the high mountain range is about -10 °C). The highest temperature is +40 °C (recorded in 2010), and the absolute minimum is -41 °C (recorded in 1993). The average annual temperature in the lowland areas is about +9.5 °C. The long-time average annual amount of precipitations per year in the upper reach of the mountainous part of the catchment basin of the Tisza River, Teresva, Tereblia and Rika is remarkable and is about 1,200-1,400mm, and in the catchment basins of the Bila Tisza and the Chorna Tisza rivers it is about 1,100-1,200 mm. In the foothills, amount of precipitations is reduced to 800-1,000 mm, and in the flatland to 530-700 mm. Within the mountainous area, amount of precipitations increases to 100mm per day and the rains last for more than 2-3 days and are accompanied by the rapid formation of catastrophic river floods, landslides and floods. The Ruska Mokra is considered as a peculiar “humidity pole” in the Tiachivskyi rayon; average annual amount of precipitations per year is 2,499 mm.

The annual average temperature in **Romania** varies between: 11-9°C In the West Hills area, 10-8°C in the Western Hills, 9-6°C in intra-mountainous depressions, 8-6°C in the Transylvanian Plateau, 6-0°C In the Western Carpathians, 6 and -2°C in the Eastern Carpathians, 0 and -2°C in the Meridional Carpathians.

Annual average quantities rainfall ranges between 1,200-800 mm in the Oriental Carpathians and the Southern Carpathians, 1,200-700 mm in the Western Carpathians, 800-650 mm in the West Hills, 800-600 mm in the Transylvanian Plateau and in the intramountain depressions, and 650-550 mm in the Western Plain.

In **Slovakia** long-term average annual air temperature in the The Tisza River Basin is ranging from 4°C in higher and northern locations, up to 10 °C in lower southern locations. In the middle part of the basin, the long-term average annual temperature varies from 6 to 8°C. Total long-term average annual precipitation in the The Tisza River Basin in Slovakia is ranging from 550 to 700 mm in the southern lower locations, 700-900 mm in the middle and 1,000 mm in the highest locations.

There are four climatic zones in Tisza river basin in **Hungary**: the Northern Mountains, the northeast part of the Great Plain, the middle part of the Great Plain, and the southeast part of the Great Plain. The Hungarian part of Tisza sub-basin has the warmest summer; the mean temperature is around

21°C in July. The amount of rainfall is average in domestic terms; it is between 550 and 700 mm. The average annual temperature in the mountains is 8-9°C. In the middle of the Great Plain, the annual average temperature is between 10-11°C. In the south-eastern borderline it reaches 12°C.

The climate in the **Serbian** part of the Tisa river basin is moderate continental. The annual average temperature in Serbia part of Tisza river basin is 11.1°C. Average yearly precipitation is lower than country average - 730 mm).

Water Resources

The Tisza River Basin covers territoire from five countries as follows: Ukraine (12,732 km^2), Romania (72,620 km^2), Slovakia (15,247 km^2), Hungary (46,213 km^2) and Serbia (10,374 km^2).

Main tributaries of the Tisza River with cathment areas over 1000 km^2 is provided in Table III.1.

Table III.1 Main tributaries of the Tisza River with cathment areas over 1.000 km^2

Country	Water body name
Ukraine	Bodrog, Latorica, Uzh, Tur, Borzhava, Rika, Teresva
Romania	Vișeu, Iza, Tur, Someș, Șieu, Someșul Mic, Lăpuș, Crasna, Crișul Alb, Crișul Negru, Crișul Repede, Barcău, Ier, Mureș, Arieș, Târnava, Târnava Mică, Sebeș, Strei, Aranca, Bega, Bega Veche
Slovakia	Bodrog, Uh, Laborec, Latorica, Topla, Ondava, Hornád, Torysa, Rimava, Slaná, Bodva
Hungary	Túr, Szamos, Kraszna, Hernád, Sajó, Bódva, Zagyva, Tarna, Hármas-Körös, Fehér-Körös, Fekete-Körös, Kettős-Körös, Sebes-Körös, Berettyó, Dong-éri-főcsatorna, Kálló-ér, Maros
Serbia	Zlatica, Begej, Stari Begej

In the Hungarian territory of the Tisza River Basin, 5 standing water are also highlighted at sub-basin level (ICPDR). All of them are larger than 10 km^2 with one exception: Csaj-Tó, Begécsi-Halastavak, Szegedi-Fehér-Tó, Hortobágyi-Öregtavak, Tisza-Tó.

In the Hungarian territory of the Tisza River Basin are many groundwater bodies, which are significant at the Tisza level, or 1000 km^2 larger are the following: Alsó-Tisza-Völgy, Bükk, Orsodi-Dombság - Sajó-Vízgyűjtő, Délkelet-Alföld, Dél-Alföld, Észak-Alföld, Északi-Középhegység peremvidék, Nyírség déli rész, Hajdúság, Maros-Hordalékkúp, Szatmári-Sík, Nyugat-Alföld.

Soil

In **Ukraine**, in the basin within the low-land area, the variety of sod-podzolic soils prevail, mountain-forest and meadow-forest soils prevail in the mountainous area, meadow and meadow gley soils prevail in the flood-plain bench of the rivers.

Within the mountainous area of the territory, the vertical differentiation of soils is clearly monitored. In the high mountain tier, the mountain-meadow brown soils are common at altitudes of 1,100-1,200 m; on small treeless areas - the mountain valleys sod-brown soils are widespread.

Flat mountainous slopes are covered with clay brownified ashen-gray soils. Smooth slopes and river valleys are formed by meadow-brownified soils.

The Zakarpattya lowland is covered with sod-podzolic soils and gley or brownified gley soils. The marsh-gley and meadow-gley soils prevail in the valleys of the rivers Borzhava and Irshava. The clay-coloured forest soils were formed in the river sources of Uzh, Latorica and Rika, and the brown mountain forest soils were formed in the river sources of Borzhava, Tereblia, Teresva, Bila Tisza and Chorna Tisza. The main soil type in the mouth parts of Uzh, Latorica and Borzhava rivers are sod-podzolic gley soils.

In the **Romanian** Oriental Carpathians and Southern Carpathians classes of spodosols and cambisols are present, while in the Western Carpathians are more present the classes of umbriosols with nigrosol and humosiosol.

Transylvanian Plateau soils cover consists mainly of cernisols class with cernizom cambic types, and in the Western Hills of Romania the predominant soils are part of the class of luvisols with the types of planosols, brown argillaceous, brownish luvic and white luviosols; Class cernisols with chernozem types and rarer rendzines. Hydromorphic soils appear in humid areas, and alluvial protosols appear in low meadows.

In the Western Plain of Romania the predominant soils are those of cernisols class with cambic chernozems, argillaceous chernozems and black soils; Class luvisols with brown argillaceous, brownish lucius and white luvisols. Halomorphic (salisodisols), hydromorphic (hydrousols), sandy and alluvial soils appear on salty areas.

In western part of the **Slovak** Tisza River Basin there are soil types from chernozem to podzolic soil, in southern part of river basin are dominating alluvial soils, alluvial gleysols, also areas of illimerized, while in central part of river basin are dominating varieties of cambisols with rankers. Very expanded is stagni-eutric cambisol.

In the **Hungarian** Tisza sub-basin, the lofty sedimentary rocks dominate in the top 10 m caprock formations. The most sedimentary rocks are clay and sand and between the Danube and Tisza are located the most blown sand. Most of the soils are typically well-productive, so a significant part of the sub-basin area is suitable for agricultural activity and for forestry. The typical genetic soil type in the Tisza sub-basin is the chernozem (27%). The best quality black earth developed in Bácska, Hajdúság and Körös-Maros.

For soil fertility, physical, chemical and biological properties are good, adverse soil damage is relatively low, country soil conditions are more favorable than in some Western European countries. In this sub-basin the most typical is salinisation of soils, with this fertility inhibiting factor we can found almost everywhere. Areas threatened by wind erosion occur in the Nyírség and the Danube-Tisza.

Analysis of soil types in Tisza River Basin in **Serbia** is based on the Digital Soil Map of Autonomous Province of Vojvodina (APV) in 1:50.000. The dominant types of soil are groups of chernozems and cherzonem-like medow soils which cover 700 thousands of hectares. All other soil types, like alluvial soil, antropic soil, deluvial soil, regosol, brown steppe soil, salinized soil, peaty soli, hydromorphic mineral gleyed soil, hydromorphic black soil and hydromorphic smonitza soil covers about 315 thousands of hectares.

Population and human settlements

The Tisza River Basin, the largest catchment area of the Danube River, is inhabited by aroximately 12,637,264 people table III.2). Among the major urban agglomerations we mention Uzhorod, Mukachevo, Khust, Beregovo, Chop in **Ukraine**, Cluj - Napoca, Timisoara, Oradea in **Romania**; Košice, Prešov, Michalovce in **Slovakia**; Debrecen, Miskolc and Szeged in **Hungary**; Subotica, Zrenjanin , Sombor in **Serbia**.

Table III.2 Number of inhabitants in the Tisza River Basin

Aspect	Ukraine	Romania	Hungary	Slovakia	Serbia
Number of inhabitants in the Tisza River Basin	1,256,900	4,972,912	4,048,562	1,502,890	856,000

Land use

Land usage is influenced both by physical and geographic conditions and by the anthropic factors, thus distinguishing an uneven distribution of forests, pastures, arable land, urban and industrial land. Land in the TRB is mainly used for agriculture, forestry, pastures (grassland), nature reserves, as well as urbanized areas (buildings, yards, roads, railroads).

The land reserves of the **Ukrainian** territory of TRB are equal to 1,275.3 thousand hectares, of which 451.3 thousand hectares (35.4 percent) are occupied by agricultural land, of which 199.7 thousand hectares are arable land. More than a half of the territory is covered with forest (51 percent).

In **Romania** land use share it is almost equal for arable land and forests, those being the main categories, followed by the pastures.

The area of the Tisza River Basin in **Slovakia** is predominantly forested. Forests represent almost half (45.6%) of the river basin, important parts being protected areas. The forestry sector mainly uses the northern and northeastern part of the river basin. The southern and central Tisza River Basin is used extensively for agricultural purposes (48.7%) – mainly arable soil (30%) and other agricultural areas (18.7%).

The size of the agricultural land is the largest in **Hungary** in the Tisza sub-basin, but from agricultural ecological point of view this land use is considered to be the most unfavorable structure. Typical arable land is too high and they are low proportion of intensive cultures (vegetables, fruits). A significant part of the agricultural area consists of arable land (56%) and lawn (16%), while the share of the garden, fruit and grapes represent only about 5%.

The land in the **Serbian** part of the TRB is predominantly used for agriculture. According to the CORINE Land Cover (European Environmental Agency (EEA), 2012) agricultural areas cover 84% of the TRB in Serbia, artificial surfaces (including urban fabric and industrial or commercial units), forests and semi natural areas (mainly natural grasslands and broad-leaved forests) and water bodies, each cover 5%, and the remaining 1% is under wetlands (inland marshes).

Economic activity

Regarding economic activity, in the **Ukrainian** part of TRB, the focus is on the development of priority sectors of economy, i.e. agriculture, trade, timber and woodworking industry, consumer goods industry and food industry, near-border cooperation, recreation, and etc. The main attention is paid to attracting domestic and foreign investments into the economy, small and medium enterprises development and efficient use of natural resources potential.

Recreational resources of the oblast comprise 5.2% of the volumetric and 5.1% of the value resource potential of recreation of Ukraine. Zakarpattya Oblast is known as one of the best places in Ukraine for treatment and recreation of people. A network of sanatorium and resort complexes, tourist bases is developed, able to accommodate up to 4000 tourists.

Natural resources (mineral deposits): more than 30 kinds of minerals have been explored in 150 deposits. These are polymetallic, perlites, zeolites, liparites, and deposits of barium ore, kaolin and other, which are uncommon for the country. Extraction of rock salt, marble limestone, dolomite and others is performed.

There are 75 types of mineral waters explored and 38 types of mineral waters included in the state water cadastre of Ukraine with a flow rate of 3.3 thousand m^3 per day that are unique and correspond to the water of the Shayanska, Essentuki, Borjomi types and their chemical composition and curative properties are not inferior to the well-known waters of the Caucasus, the Czech Republic, Poland and France.

The distribution of the main economic activities in the Tisza river basin in **Romania**, represented by the range of industrial and agricultural products, is as follows:

- Industrial products: garments, timber, PVC products, polyethylene products, glassware, prefabricated reinforced concrete, knitwear, textiles, footwear, metal fabrications, furniture, thermal energy, etc.
- Agricultural products: bakery products, meat and meat products, edible oils, dairy products, etc.

There has been also an unprecedented increase in the IT&C industry, with a number of companies focusing on the production of electronics and home electronics components or equipment.

Industry in the **Slovak** Tisza River Basin is diverse without significant orientation on some industries. An important representation have metalworking, woodworking, food, construction, electrotechnic, engineering, chemical industry, textile and clothing sector. The industry is concentrated mainly in larger cities. In the area of the Slovenské Rudohorie is developed the mining and metallurgy. The natural beauties of the area and appropriate climatic conditions have created positive conditions for the development of tourism. Among the most visited sites are national parks, Bardejov city, Levoča city and Spiš Castle as a part of UNESCO sites and others.

The Central **Hungarian** region is the most dynamically developing region in the Tisza sub-basin, in contrast, the Great Plain regions and Northern Hungary are the most underdeveloped micro-regions in the Tisza sub-basin. 26% of all gross domestic product of the country is produced in this sub-basin, while 40% of the population lives here.

In the northern regions of the sub-basin, the industry is much larger, whereas agriculture in the southern regions is the driving force.

Due to the natural features, the main economic activity within the Tisza River Basin in **Serbia** is agriculture, followed by food industry. Also, fish farming and livestock farms are present. The oil and natural gas reserves are mainly located in North East region - Banat (Mokrin, Kikinda, Elemir, etc.) and their extraction is significant economic activity in this part of TRB.

Biodiversity and Protected areas

The current distribution of plant and animal species in the Tisza basin is the result of climate, relief, human activity interference.

The vegetation is represented by: conifer forests, alpine and secondary meadows, mixed forests (Pinophyta, Fagus sylvatica; Quercus frainetto, Tilia), beech floors (Quercus petraea, Carpinus betulus, Fraxinus), Pinus mugo forests, oak forests (Quercus pedunculata, Quercus cerris,) shrubs

(Corylus avellana, Cornus mas) to which the meadow vegetation (black acacia - Robinia pseudoacacia, Populus tremula, Salix alba, Alnus and salty plants) etc.

The vegetation is complemented by species of great phytogeographical interest, such as: Nelumbo nucifera, Onosma tornense, Dianthus diutinus, Dianthus, Leontopodium alpinum, Dryas octopetala, Arctostaphylos uva-ursi, Cypripedium calceolus, Nigritella rubra, Gentiana lutea, iris pumila, bohemica, Tithymalus sojakii, Arbuscular Daphne, Ligularia sibirica, Linaria alpina, Dianthus glacialis.

The fauna is diverse and rich, represented by species of great hunting interest among which: Rupicapra rupicapra, Cervidae, Lynx, Ursidae, Capreolus capreolus, Sus scrofa domesticus, Canis lupus, Felis silvestris, Marmota marmota, Sciuridae, Martes, Tetrao urogallus, Lepus europaeus, Cricetus cricetus, lacerta viridis, Aquila pomarina, and many birds including: Fringilla coelebs, Aquila pomarina, Bubo bubo, Turdus merula, Falco peregrinus, Perdix perdix, Phasianus colchicus, Garrulus glandarius, Upupa epops etc.

Ichthyological researches of recent years have revealed the existence of many species of fish in the rivers and lakes of the interior: Salmo trutta fario, Thymallus thymallus, Hucho hucho, Squalius cephalus, Barbus barbus, Abramis brama, Esox lucius etc.

In **Ukraine**, there are 456 sites of the natural-reserved fund. There are 4 national wide sites: the Carpathian Biosphere Nature Reserve, Uzhansky National Nature Park (NNP), the NNP “Synevyr” and the NNP “Zacharovanyi Krai” (6.101 hectares). The NNP “Uzhansky” is a part of the international biosphere reserve “Eastern Carpathians” (213 thousand hectares), which was included by the UNESCO Commission in the World Network of Biosphere Reserves, as well as the Carpathian Biosphere Reserve. The Regional Landscape Park also has two regional landscape parks, i.e. the Prytysianskyi Regional Landscape Park and Syniak Regional Landscape Park, 19 national significance landscape preserves, 47 landscape preserves of the local importance, 9 nature reserves, 9 national natural monuments and 329 natural monuments of the local importance. There are 8 Ramsar sites (wetlands of international importance): Lake Synevyr (NNP Synevyr), Lake Brebeneskul (Carpathian Biosphere Nature Reserve), Lake Fornosh, the Narcissus Valley (Carpathian Biosphere Nature Reserve), “Druzhba” Cave (Carpathian Biosphere Nature Reserve), “Chorne Bagno” Bog (NNP “Zacharovanyi krai”), the Atak Borzhavske (the Prytysianskyi Regional Landscape Park), the Verkhivia Uzha (the NNP Uzhansky). The identification of the natural biotopes in the Natura 2000 database has begun as defined by the Habitats Directive and the Birds Directive.

In **Romania** there are 40 sites of S.P.A. type (Dealurile Târnavelor şi Valea Nirajului, Piemontul Munţilor Metaliferi şi Vinţului, Lunca inferioară a Turului, Câmpia Nirului - Valea Ierului, Câmpia Crişului Alb şi Crişului Negru, Câmpia Nirului - Valea Ierului, Teremia Mare - Tomnatic, Mlaștinile Murani, Uivar-Diniaș, etc.), 170 SCI type sites (Defileul Mureșului; Munții Călimani – Gurghiu, Valea Izei și Dealul Solovan, Câmpia Careiului, Câmpia Ierului, Pajiștea Cenad, Pădurea Paniova, etc.), about 355 natural parks.

In **Slovak Republic** there are 9 protected areas, 4 protected landscape areas (PLA Cerová vrchovina, PLA Latorica, PLA Vihorlat, PLA Východné Karpaty) and 5 national parks (NP Muránska planina, NP Poloniny, NP Slovenský kras, NP Slovenský raj, NP TANAP). Special protected areas (SPAs) are included in 26 as protected bird areas and Special areas of conservation (SACs) are included in § 28 as areas of European interest. In the Tisza River Basin are 13 protected bird areas and 118 areas of European interest.

In **Hungary** the size of protected areas is significant, there are the national parks Bükk, Aggtelek, Hortobágy, Kiskunság and Körös-Maros and there are several important landscaping areas. Ramsar areas can also be found here (for example, Upper-Tisza, Hortobágy). The largest continuous Natura 2000 sites (SCI, SPA) are also located in this sub-basin, which connects the beaches of Szatmári, Bodrogköz, Zemplén, Tisza and Körös.

In **Serbia** protected natural resources are classified into 5 categories: National Parks, Nature Parks, Areas of Exceptional Features and Beauty, Nature Reserves (general and specific), and Natural Monuments, such as: Slano Kopovo, Stara Tisa kod Bisernog Ostrva, Jegrička, Palić, Subotička Peščara, Selevenjske Pustare etc.

Cultural heritage

Cultural heritage is represented by settlement sites, churches, monasteries, treasures, etc. Among the most important cultural objectives there are: the Sighisoara Historical Center, including the area listed on the World Heritage List, the remains of Porolissum, the ruins of the Cice Fortress, from the 11th-12th centuries from Oradea, the Alba Iulia archaeological site, the Potaissa archaeological site, the Apulum ancient city, the Dacian Fortress of Capalna, the Morisena Fortress, the Apollo Palace, Castle of the Premonstratens Order in Sânmartin, Obelisk dedicated to Horea, Cloşca and Crişan, Custozza Monument; Traian Vuia Museum, Crișan Country Museum, Iancu de Hunedoara House, George Coşbuc and Liviu Rebreanu Memorial Houses, Recea Monastery, St. John the Evangelist Church of the Prislop Monastery, Stâna de Vale Monastery, The old church of Ineu (XIII - XIV centuries), Wooden temples in the Slovak part of the Carpathian Arc, the the historic core of Bardejov city, Levoča city, Spiš Castle and monuments of the surrounding area, the Old Village of Hollókő and its surroundings, the Tokaj Wine Region, the Toldalagi Palace, the Nakó Castle, the Bella Fay Castle etc.

In **Ukraine** there are 1637 cultural heritage objects in the TRB, including: 494 of archaeology, 523 of history, 93 of monumental art, 302 of architecture and 19 of urban development, 341 of garden art, 175 of landscape, 9 of science and technology. 177 sites among them are of national significance, they include medieval castles and unique objects of sacral wooden architecture. There are 28 public museums with the title “national”.

In **Serbia** the protection program includes 266 monuments of culture, 5 spatial cultural and historical units, 11 archaeological sites and 5 famous sites.

Chapter 4 Flood risk at Tisza River Basin level

Flood protection infrastructure

In **Ukraine**, flood protection infrastructure includes: dams 770.1 km, bank enforcement facilities 318.8 km, canalized water ways, channels 1339 km, hydraulic engineering units 1108, drainage on-site pump stations 30, multi-purpose reservoirs 8, with the total volume capacity 25.3 MCM, water level and discharge measuring stations 69, automatic hydrometeorological stations (AIMS “TISZA”) 50, drainage system 318.8 km.

Eight water reservoirs are multi-purpose: for seasonal flow regulation and fish breeding. Four of them belonging to the drainage system of Chornyi Mochar are intended for accumulation of flood flows (9.5 million m^3) and spring runoff (18.6 million m^3) and fish breeding. The largest water reservoir is the Tereble-Ritske. It is used for hydropower, so the Tereble-Ritske HPP does not make any significant influence on the flood transformation. The melioration systems Slavinska, Verkhniolatorytska and Khustska make less significant influence (about 1 million m^3) to the flood protection.

The Scheme of complex flood prevention was developed. It provides comprehensive approach to the flood control with the means of flood protection facilities and polders combined with enhancement and development of flood wall system, river regulation and construction of regulating hydraulic engineering structures (dams and dikes), implementation of forest-protection measures as a general direction to solve the issue of flood prevention.

In the **Romanian** part of the Tisza catchment as flood protection infrastructure are: embankments works (with a total length of 3,634.778 km), 273 permanent reservoirs with a total attenuation volume of 378.841 MCM, 87 temporary reservoirs with a total volume of 199.623 MCM, 19 polders with a total volume of 153.888 MCM, 621.71 km of diversion channels with a derived discharge of 843.83 m^3/s and 9 hydraulic complex facilities with a total maximum discharges of 714.8 m^3/s.

The repartition of flood protection works on Tisza's subbasins is presented below (table IV.1).

Table IV.1 Flood protection infrastructure of Tisza's subbasins in Romania

No.	Subbasin	Dikes (km)	Permanent reservoirs (no.)	Attenuation volume in permanent reservoirs (MCM)	Temporary reservoirs (no.)	Attenuation volume in temporary reservoirs volume (MCM)	Polders (no.)	Attenuation volume in polders (MCM)	Diversion canals (no.)	Diversion channels length (km)	Diversion channels discharge (m^3/s)	Hydraulic complex facilities (no.)	Hydraulic complex facilities (m^3/s)
1	Someș-Tisa	1132.708	72	133.66	9	4.963	3	6.013	11	69.695	59.62	0	0
2	Crișuri	1334.065	37	97.404	58	84.064	13	124.475	27	376.17	335.05	0	0
3	Mureș	879.469	14	101.761	8	72.66	2	19.4	12	160.626	9.16	5	64.3
4	Bega	288.536	10	46.016	12	37.936	1	4	2	15.270	440	4	650.5
Total		**3634.778**	**133**	**378.841**	**87**	**199.623**	**19**	**153.888**	**52**	**621.71**	**843.83**	**9**	**714.8**

The total length of the dikes in the **Slovak** part of the Tisza River Basin is 748.32 km. Dikes were put into operation within years 1931 - 2015 and the status of these dikes is predominantly "in operation". Most of the dikes in Tisza River Basin are dimensioned to Q_{100}.

The sum of the volume of permanent reservoirs is nearly 660 MCM. The largest of this reservoirs is Zemplínska Šírava with total volume 325 MCM. The highest dam has Ružín I reservoir with 63 m. Most of dams of large permanent reservoirs in Slovakia have earth dams, except two, which are from concrete.

In the Tisza River Basin there are 6 polders with a total volume nearly 53.4 MCM. The largest polder - Beša (53 MCM) is located in the southern part of the basin.

The pumping stations (25) and hydraulic structure (1) are listed in the table 3-5 "Hydraulic complex facility". The value of maximum derived discharge of pumping stations is from 0.02 to 18.90 m^3/s. The highest value of maximum derived discharge has pumping station Stretávka and pumping station Streda nad Bodrogom. The highest number of pumping stations is on the Ondava watercourse.

With close to 25% of the country comprising floodplains, most of the rivers in **Hungary** having a very dynamic water regime and 25% of the population living in reclaimed floodplains, flooding is a major issue. 21.712 km^2 of Hungary's floodplains are below the rivers' flood level. This area includes 1.8 million ha arable land, 32% of the railway network, 15% of the road network and more than 2000 industrial plants. The highest flood discharge in the Danube is 20 times higher than low flow. In smaller rivers, such as those of the Körös system, this ratio is several hundred to one and floods can develop in a few hours. On larger rivers, they can last several months. Devastating, fast-rising ice-jam floods are especially dangerous. Technical and financial components make up the complex operation of flood protection. The objective is to recover as well as decrease the loss caused by flood.

The main flood protection infrastructures in Hungary (the existing flood protection structures built since the middle of the 19th century) are:

- the main-line levees of 4.200 km total length (3.973 km earth embankment, 30 km flood wall) along the rivers. The total volume of the embankments is approximately 120 million m^3;
- floodways on three rivers to split the flood discharge among them and to transfer it into the valley of another stream, serving other purposes (road and railway embankments);
- low-land emergency storage reservoirs to retain flood peaks on flashy rivers carrying relatively smaller discharges (with 223 km^2 total area and 389 million m^3 aggregate capacity);
- secondary defenses to confine inundation in the event of a levee failure. For this purpose suitable terrain features, or existing structures.

Flood control efforts over past centuries have resulted in the construction of 4,181 km of defenses (consisting mainly of earthen embankments). Ten lowland emergency flood reservoirs, of 360 million m^3 total volume, relieve flood load on the levees and protect 97% of the floodplains.

Most of our flood protection dykes in Tisza valley followed the rising of flood water levels has been continuously developed. The continuous developing has created an "onion" structure at the flood protection structures that causes dangerous flood phenomenon. It can also cause more harmful flood phenomenon if the subsoil stability is poor, and also the oxbow flood protection dyke crossings. Further problems are caused by the lack of height and cross-sectional flood protection dykes. The General Directorate of Water Management assessed the current level of building of the flood protection system in the Tisza valley. There are 2,942. 9 km length flood protection dyke along the Tisza River, 2,826 km of which is lack of height. It means that 96 % of the Tisza valley's flood protection dykes don't reach the Designed Flood Water Level + safety.

Flood protection dykes in Tisza valley (References: Hungarian Flood Risk and hazard mapping – Country report, General Directorate of Water Management, 2015) are presented in the table below (table IV.2).

Table IV.2 Flood protection dikes in Tisza valley in Hungary

	Flood protection dykes in Tisza valley		
	Length (km)	Length of lack of height flood protection dykes (km)	Average lack of height Designed Flood Water Level (DFWL) + Safety (m)
Upper-Tisza	724.5	724.5	0.9
Middle-Tisza	1314.7	1215.0	1.1
Lower-Tisza	903.1	886.5	1.0
Summarized:	2942.9	2826	1.0

The Tisza–Körös Valley Management System (TIKEVIR) – figure IV.1, is a system of natural watercourses, dams, sluice gates, inter-basin diversion canals transferring and distributing water resources of the Tisza–Körös rivers over an area of 15.000 km^2. The original purpose of the system was to provide irrigation water with the additional benefit of hydropower generation. In the last 20 years, recreational uses and nature conservation have had a limiting effect on the use of the water resources. The average inflow to the system is 680 m^3/s, while the summer low flow is 157 m^3/s. The permitted intake from the Tisza is 114 m^3/s, although the actual annual average intake is about 25 m^3/s. The flow rate is managed or controlled to some extent, as water systems are partially regulated. (References: http://www.oecd.org/hungary/Water-Resources-Allocation-Hungary.pdf)

Figure IV.1. Water management scheme in Tisza River Basin in Hungary (TIKEVIR)

There are 11 temporary reservoirs in the Tisza valley. They are built in Framework Vasarhelyi Plan.

System of flood protection levees along the **Serbian** section of the Tisza River is built along both river banks, in a total length of 314.8 km. Levees were built in XVIII century, and heightened and improved after every large flood. After a long-lasting, hard and costly flood defense in 1970, a systematic approach was applied to resolve the problem. Reconstruction of the existing and building of some new, reallocated levees were grounded on equal standard - to enable the protection from the floods with hundred year return period (4.100 m^3/s), with 1m additional freeboard above the design flood level. Reconstruction of the last remaining old levee on the right bank (between km 21 and km 36) started after 2006 flood, and recently finished. The Table III-1 synthesises information and data with respect to hundred year flood events dikes within the TRB in Serbia. Only D.16.1.2 in Đala is designed based on 25 year return period since it is "summer dike". The additional "summer dikes" located within the TRB floodplains in Serbia are designed based on 10 year return period. The Dykes in Tisza River Basin in Serbia are presented in figure IV.2

The DTD, one of the biggest multi-purpose systems in Europe, interconnects the rivers in Vojvodina. The concept of DTD was finalized after the 2nd World War. DTD enables management of waters within the Bačka and the Banat region, encompassing the following tasks: flood protection, drainage of excess interior waters, convey of water for the irrigation of agricultural land; water supply for industry, farms and fisheries; navigation; receiving and convey of waste waters, with protection of water quality; recreation, sports and tourism. All rivers in north and middle Banat region are incorporated into eastern part of DTD, while watercourses in the Bačka region are incorporated in its western part.

The Dam on the Tisza River is the key structure in DTD, as it enables the gravitational entry of 120 m^3/s of water into the channel network which may be used for the irrigation of agricultural land in the Banat and the northern part of the Bačka region. Useful volume of the lake at the normal water stage is about 50 x 106 m^3. The dam is 520 m long.

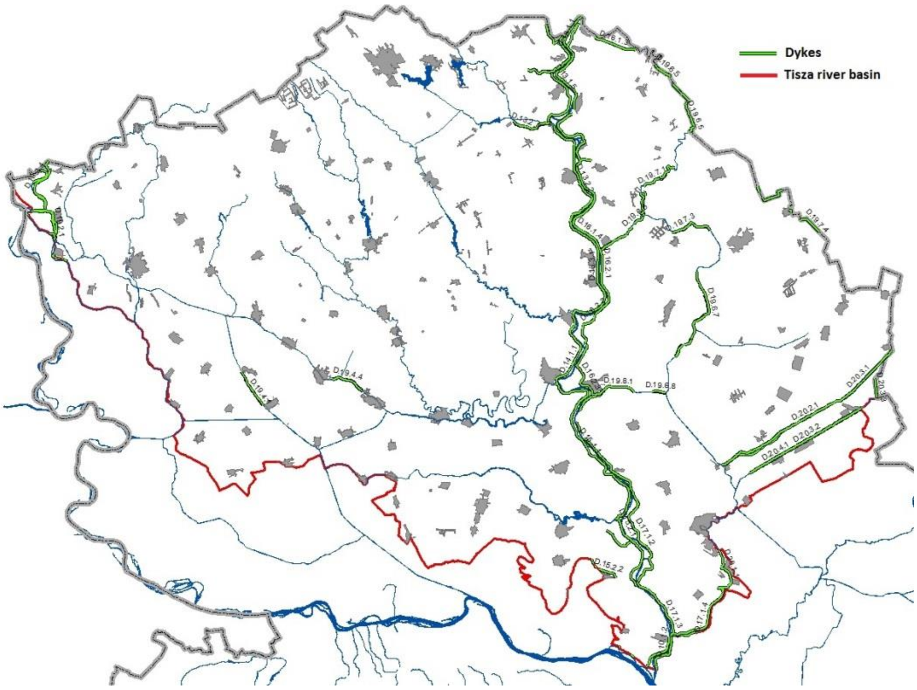

Figure IV.2 Dykes in Tisza River Basin in Serbia

The flood protection infrastructure at the Tisza River Basin with main elements are presented in Annex IV.1 to Annex IV.7, with some specifications:

- dikes related to the rivers with catchment over 1.000 km^2 (for Ukraine, Romania, Slovakia, Hungary and Serbia);
- the permanent reservoirs with the following criteria: height over 15 m and volume over 1 MCM or height between 10 and 15 m and volume over 3 MCM (for Ukraine,Romania, Slovakia and Hungary);
- all temporary reservoirs with volume over 1 MCM (for Romania);
- all polders with a volume over 1 MCM (for Romania, Slovakia and Hungary);
- the diversion channels with a derived flow over 1 m^3/s (for Ukraine, Romania and Hungary);
- all hydraulic complex facilities in Tisza River Basin (for Ukraine, Romania, Slovakia and Hungary).

Drainage systems

There are five drainage systems in **Ukrainian** part of the Tisza basin:

- **Beregove drainage system** is located in Beregove, Uzhgorod and Mukacheve rayons of Zakarpattya Oblast and it is international polder system (Ukraine-Hungary). The advantages of the system is not only that the water from the area of 50.2 thousands ha is drained into Tisza and Latorica, but also because its channels can be filled out with water through the sluice-regulator in Verke channel from Borzhava river;
- **Latorica drainage system** is located in the right bank valley of Latorica within Uzhgorod and Mukachevo rayons. For effective use of meliorated lands, the system protects them from inundation by flood waters, as well as removes excess surface and groundwaters;
- **Salvinska drainage system** is located at right bank of floodplains of Tisza and Salva at the territory of Vynogradiv rayon of Zakarpattya Oblast. In order to protect floodplain lands from inundation by flood waters and establishment of needed conditions for their drainage in the period from 1965 to 2005, river Salva and their tributaries got regulated;
- **Batar drainage system** is located in left bank floodplain of Tisza, which act as water receiver and includes drained lands, located within 11 village councils of Vynogradiv rayon of Zakarpattya Oblast. This system depends on water levels in Tisza, during the floods, the agricultural fields got flooded;
- **Drainage system «Chorny Mochar»** is located in Mukacheve and Beregovo rayons. In old times, this land is mentioned as giant wetland. In the end of XIX – beginning XX century, there is a network of water discharge channels and magistral channel Vysokoberezhny (30 km) to redirect water into Latorica River.

Drainage systems in **Romania** (figure IV.3) are referring to internal water leakage through drainage cannals and through valleys and depressions, by maneuvering of weirs and the operation of pumping stations serving for this purpose from internal water systems and subsystems.

The discharge of internal waters to the maximum discharge capacity will be achieved through collection and evacuation systems in the emissaries as well as through the existing cannals.

The discharge of internal waters from areas where they can not be collected by existing systems, as well as of exceptional domestic waters that exceed the maximum discharge capacity of these systems, will be done both through canals, valleys and depressions. The limitation of internal water flows will be done by weirs, riverbed restraints or other ways.

In the **Slovak** part of the Tisza River Basin there are 14 drainage systems in total. Their primary function is the removal of internal waters. All drainage systems are in the level range of 92.5 – 103.5 m.a.s.l. According to the table in the Annex III.7, the total length of the drainage systems in the Slovak part of the Tisza River Basin is approximately 218 km. The drainage system in the Tisza River Basin has a flow capacity of 1.6 to 18.9 m^3/s.

45% of the area of **Hungary** is endangered by inland (excess) water. The total length of drainage canals in Hungary is 48,513 km, out of this irrigation and with dual function are 4,326 km. Most endangered area is located in the Tisza River Basin due the low terrain. In the Tisza River Basin we have 59 main drainage systems, 17,704 km of canals, which are operated in exclusive state ownership. There are 395 inland water pump stations in the Tisza River valley.

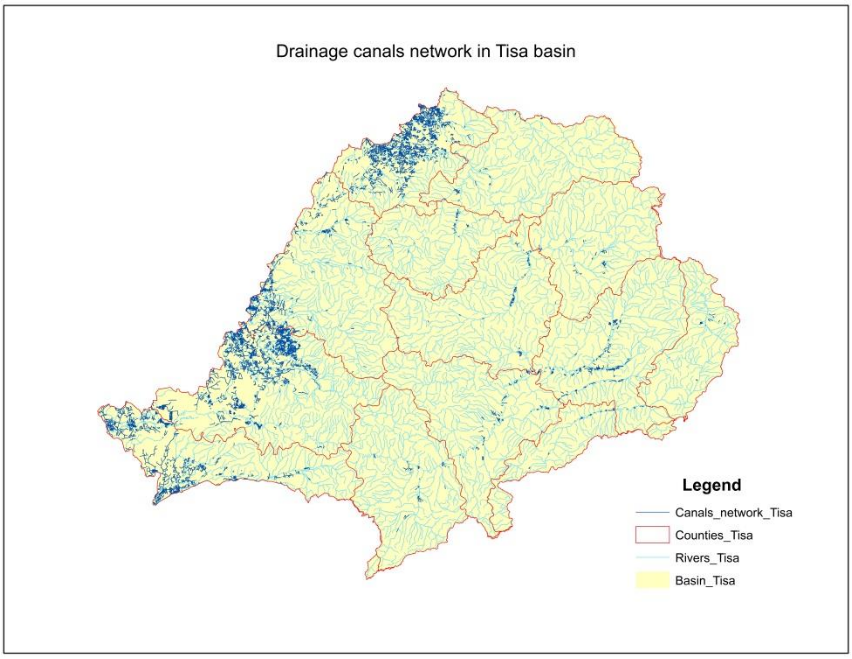

Figure IV.3 Drainage canals network in Tisa River Basin in Romania

In **Serbia**, within the drainage tasks, the DTD serves as a primary infrastructure system, on which local drainage systems rely on. Development of drainage systems on 762,000 ha (339,000 ha in the Bačka and 423,000 ha in the Banat region) and routing of drainage waters through main channels towards two main recipients - the Danube and the Tisza river was planned. Presently, there are 134 drainage systems with 82 pumping stations in operation, as well as about 460 km of primary and 9.019 km of secondary drainage channels (see figures IV.4 and IV.5). Also, there are about 3,500 other water structures, as a sluices, ship-locks, bridges, cascades, siphons, etc.

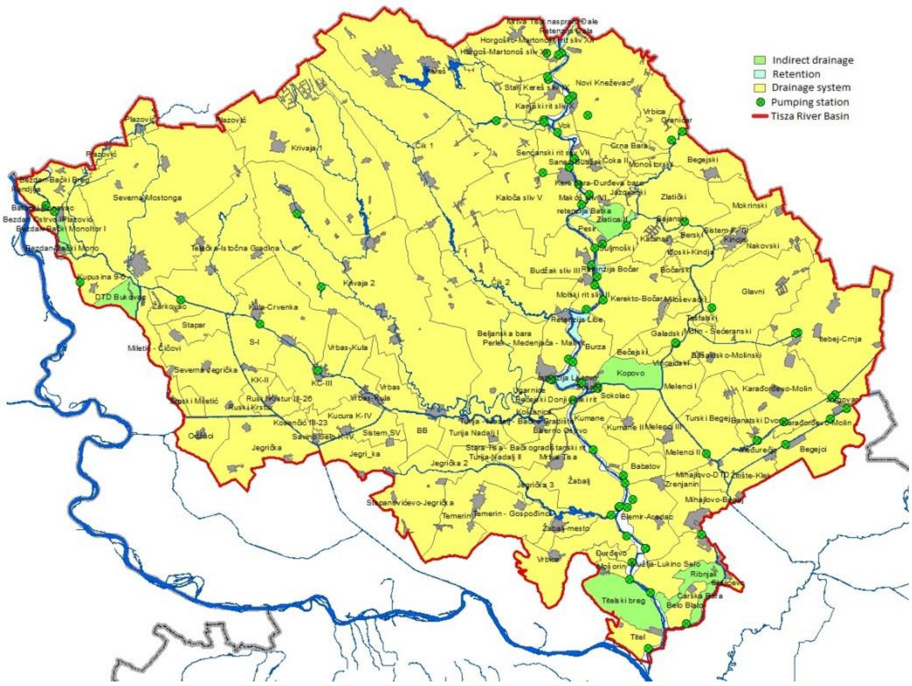

Figure IV.4 Drainage systems and pumping stations in Tisza River Basin in Serbia

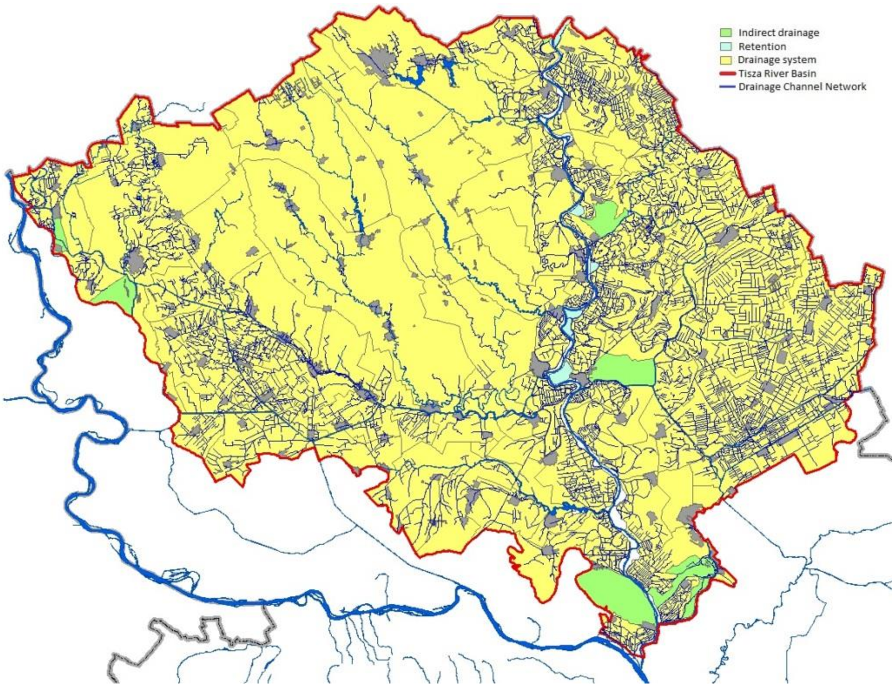

Figure IV.5 Drainage channel network in Tisza River Basin in Serbia

The drainage systems in Tisa River basin in Ukraine, Romania, Slovakia, Hungary and Serbia are presented in Annex IV.7.

Significant historical floods and Areas with Potentially Significant Flood Risk

On the surface of the Tisza River Basin, floods were recorded in all seasons of the year and can be showery, snowy and snow-flurry by origin, but the most significant are formed in the winter, spring and summer season, the phenomenon being influenced by the moisture intake brought by the air masses.

The floods generated in Ukraine, Romania and Slovakia are mainly rapid floods and last from 2-20 days. Large floods on the Tisza in Hungary and in Serbia, in contrast, can last for as long as 100 days or more (the 1970 flood lasted for 180 days). This is due to the very flat characteristic of the river in this region and multi-peak waves which may catch up on the Middle Tisza causing long flood situations. Also characteristic of the Middle Tisza region is that the Tisza floods often coincide with floods on the tributaries, which is especially dangerous in the case of the Someş/Szamos, Crasna/Kraszna Bodrog, Criş/Körös and Mures/Maros Rivers. Following a relatively dry decade, a succession of abnormal floods has annually set new record water levels on several gauges over the last four years.

Over 28 months, between November 1998 and March 2001, four extreme floods travelled down the Tisza River. Large areas were simultaneously inundated by runoff and rapid floods of abnormal height on several minor streams.

The extreme Tisza flood in Aprilie 2006 was preceded by several floods in February and March generated by melting snow and precipitation. The situation was worsened on the lower Hungarian stretch and in Serbia by the extreme flood on the Danube that very seldom coincides with that of the Tisza.

Regarding the implementation of the EU Floods Directive in the TRB, Ukraine and Serbia are about to develop the products for the first cycle, while Romania, Slovakia and Hungary have just finished this cycle.

The schedule of the implementation of the EU Flood Risk Directive, stated in the EU-**Ukraine** Association agreement, is as follows:

- adoption of national legislation and designation of competent authorities (Nov 2016) - in progress;
- the law *"On Amendments to Some Legal Acts of Ukraine regarding the introduction of integrated approaches in water resources management following the river basin principle"* № 3603 was adopted in autumn 2016 and came in force from 2017. The document gives legal definitions to the number of terms used in Flood Risk Directive (2007/60/EC), namely "flood risk management plan".
- undertaking preliminary risk assessment (Nov 2018) – in progress Order *"On Approving the Methodology of the Preliminary Flood Risk Assessment"* is being drafted;
- preparation of flood risk and flood hazard maps (Nov 2020) – in progress Order *"On Approving the Methodology of the Flood Risk and Flood Hazard Maps Development"* is being drafted;
- establishment of flood risk management plans (Nov 2022) – in progress Resolution of Cabinet of Ministers *"On Approving the Procedure for the Development of Flood Risk Management Plans"* is being drafted.

Ukraine is at the stage of legal approximation to the EU Flood Risk Directive, whereas implementation (preparation of flood risk and flood hazard maps and development of the Flood Risk Management Plan) is planned for later.

The long-term observations suggests that significant and heavy flood flows have been observed in **Ukraine** in 1913, 1927, 1933, 1941, 1947, 1948, 1955, 1957, 1968, 1970, 1980, 1992, 1993, 1995, 1998, 2001, provided that the flood flows in 1947, 1957, 1968, 1970, 1992, 1998 and 2001 years had the most catastrophic consequences. The high floods usually are accompanied by negative devastating consequences for the local population and households of Zakarpattya.

For the last two decades (1990-2010), particularly substantial damages were caused by the catastrophic floods in 1998 and 2001 within the territory of the oblast. In the post-war years, the flood flows occurred in the catchment basin of the Tisza River almost every year and even several times per year. In total, more than 150 flood flows took place for the period from 1946 to 2001.

The most catastrophic floods (Annex III.8) during the analysed period (50 years) took place in May of 1970, in October of 1974, in July of 1980, in November of 1998 and in March of 2001 (Figure III.6), in June of 2008 (Figure III.7) and in December of 2010 (Figure III.8).

The March flood in 2001 is one of the most catastrophic for the last 200 years in Zakarpattya Oblast. The water level on the 3-5th of March, 2001 exceeded by 20-75 cm the floods in the Verkhnia Tisza, Teresva and Tereblia in 1998. In the Ukrainian and Hungarian parts of the Tisza River (Vylok-Tisabech-Tivadar), the water level exceeded by 30-40 cm the flood in November of 1998. This was also facilitated by the additional construction of water protection dams within Hungarian territory, and as well as the absence of a breakthrough of dams within Ukrainian territory (as it was in November of 1998 on the site of the Vynohradiv-Vylok). The way of flood flows in the Tisza River accompanied by the breakthrough of the right bank dam on the Tarp-Bodolov area has changed. As a result, the increase in water levels in the area of Vasharoshnamen has stopped. The water level stabilized at the maximum point in 1998. As a result of the breakthrough of the dam, the water outflow of the Tisza River has reached up to 80-90 m^3/s. And the total volume of water entering our territory (Berehove, Mukachevo, Uzhhorod rayons) is equal to 70-90 mln m^3.

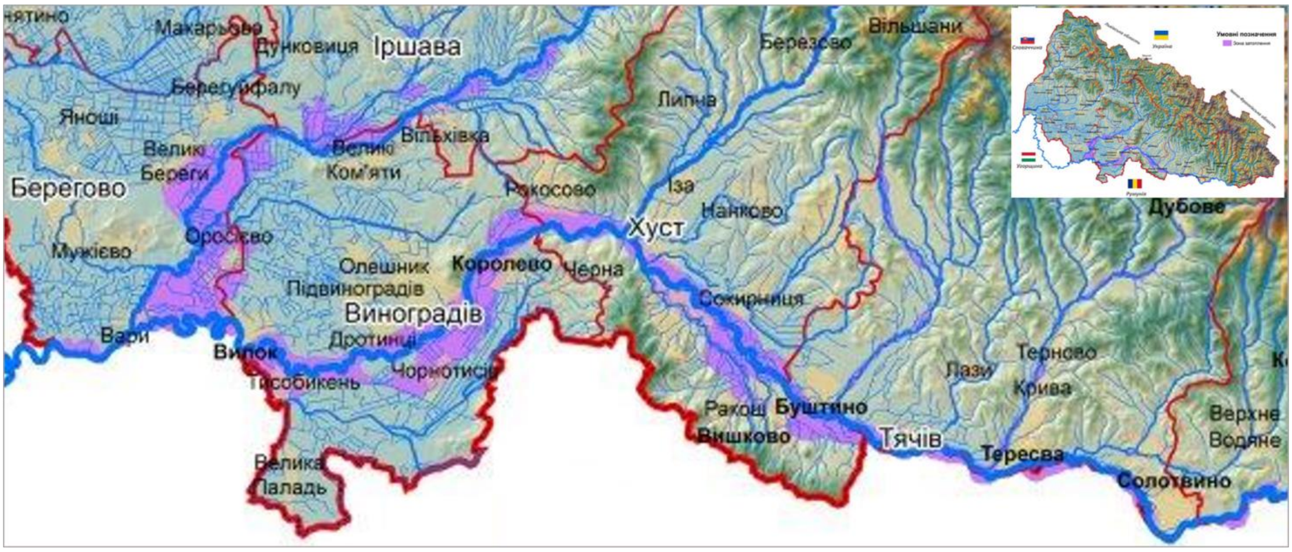

Figure IV.6 Map with significant historical floods in Tisza River Basin in Ukraine in 2001

Figure IV.7 Map with significant historical floods in Tisza River Basin in Ukraine in 2008

Figure IV.8 Map with significant historical floods in Tisza River Basin in Ukraine in 2010

In Romania, among the most known floods is mentioned those from: 1912, 1932, 1941, 1966, 1970, 1974, 1975, 1978, 1979, 1980, 1981, 1989, 1993, 1995, 1996, 1997, 2001, 2005, 2006, 2008 and 2010. Many major floods occurred also on the Serbian part of the Tisza River Basin (1919, 1924, 1932, 1940, 1944, 1947, 1965 and 1970), but the protection system resisted.

In 1970 have occurred important floods that had as a triggering factor a heavy rain regime, recording significant water flows in almost all the big watercourses in Romania. The maximum recorded flows had values of: 576 m^3/s at the Oradea gauging station on Crişul Repede River, 626 m^3/s at the Tinca gauging station and 517 m^3/s at the Zerind both on the Crişul Negru gauging station , 466 m^3/s at the Bocsig gauging station on the Crişul Alb River, 1.580 m^3/s in Ocna Mureş, 2.450 m^3/s in Alba Iulia, 2.320 m^3/s in Arad and 700 m^3/s in Topa (Târnava Mare).

The main cause of flood formation in 1975 is the extremely heavy rainfall from July 1 to July 3 on a high percentage of saturation soil. At short intervals, precipitation was sometimes extremely torrential, with 2,5 mm/min in Odorheiul Secuiesc. The maximum recorded flows had values of: 900 m^3/s in Mediaş, 851 m^3/s in Blaj, 630 m^3/s in Târnăveni and 950 m^3/s in Turda.

The floods formed between December 1995 and January 1996 resulted in the rapid warming and melting of the snow layer, an event overlaid with significant liquid precipitations falling under a frozen soil, unable to allow infiltration, and runoff on the slopes into the riverbeds. The probability of exceeding the maximum flows was between 5 and 30% on the rivers in Maramures and Someş river basin. The maximum recorded flows had values of: 605 m^3/s at the Chişineu Criş gauging station on Crişul Alb River, 548 m^3/s at Zerind on the Crişul Negru River, 1,125 m^3/s at Glodeni gauging station on Mures River, Alba-Iulia – 1,247 m^3/s and Arad – 1,046 m^3/s. On the Arieş River the maximum flow was recorded at Baia de Arieş hydrometric station - 805 m^3/s.

In 2006, on the territory of Romania, there were floods that had the effect of exceeding the defense level, at the gauging station Criseştii Ciceului having a maximum flow of 212 m^3/s, resulting in 13 losses of human lives and large material damage.

In Romania, the identification/selection of significant historical floods was made considering the hydrological criteria (to identify significant floods in terms of hazard) but also the extent of their effects (criteria for identifying significant historical floods in terms of damage). The criteria for the number of victims and the economic ones (number of homes, km of affected roads) were considered as priority.

Thus, 39 significant historical events were selected at the Tisza River Basin (Tisza and its tributaries with catchment over 1,000 km^2) for period from 1970 to 2010 for Romaina (Figure IV.9, Annex IV.8).

In **Slovakia**, the significant historical floods are the ones registered in 1395, 1813, 1845, July 1998, July 2004, May 2010 and June 2010 (Figure IV.10, Annex IV.8).

The catastrophic floods of the last decades **in Hungary** have been caused not only by the major rivers (Danube and Tisza), but by their tributaries as well. For instance, high water stages during the last 15 years in the catchment area of Tisza River proved to be critical in 1998,1999, 2000, 2001, 2006 and 2010.

In 2001 there are two dike failures occurred on the left hand side of the River Túr among unique hydrological conditions during the Upper Tisza flood of 2001. Although the level of the water was decreasing in the river itself, volumes of water were retained in the reservoirs of the River Túr on the Romanian side upon Hungarian request, thereby reducing water level in the vicinity of the failure so as to prevent the breaches from widening and to allow blocking as soon as possible.

In 2006 the series of floods in February and March, from the teritorry of Hungary, had already filled the Tisza riverbed and its tributaries prior to the period of intensive warming and raining at the beginning of April. Due to flooding on the Hármas-Körös River, the Hortobágy-Berettyó floodgate at Mezőtúr had to be closed on 2 April. In order to control the Hortobágy-Berettyó, water arriving from the Hortobágy River was diverted firstly, closing the Ágota gate to the Nagyiván detention basin (64 million m^3 capacity) and secondly, evacuating water into the Hármas-Körös using mobile pumps at the Mezőtúr flood gate. The Tisza flood culminated at Tokaj at 892 cm on 8-10 April, almost reaching the recorded historic maximum of 1999. Flooding on the downstream part of the Tisza was heavily influenced by backwater from the Danube, having also reached a new historical record on the Serbian stretch thus blocking the conveyance of the Tisza flood. At Titel the Tisza flood culminated at 818 cm, exceeding the historical record by 27 cm. Although the Danube water levels started falling in the middle of April, a series of heavy rainfall episodes triggered repeated floods on the Körös/Crisul and Maros/Mures rivers, which led to new flood records along the Lower Tisza.

In XX century, many floods occurred on the **Serbian** part of the TRB (1919, 1924, 1932, 1940, 1944, 1947, 1965 and 1970), but the protection system resisted.

The first important flood on the Tisza River after the major reconstruction of the levees was in 2000, also without any consequences.

The most recent flood on the Tisza River, on Serbian territory, occurred in 2006, almost simultaneously with the Danube flood. Water levels on the most downstream section of the Tisza River were very high, due to the influence of the Danube backwater. The flood protection unit, citizens and the Army made extreme efforts to prevent overtopping of the right levee, and levee breaching at the weak points.

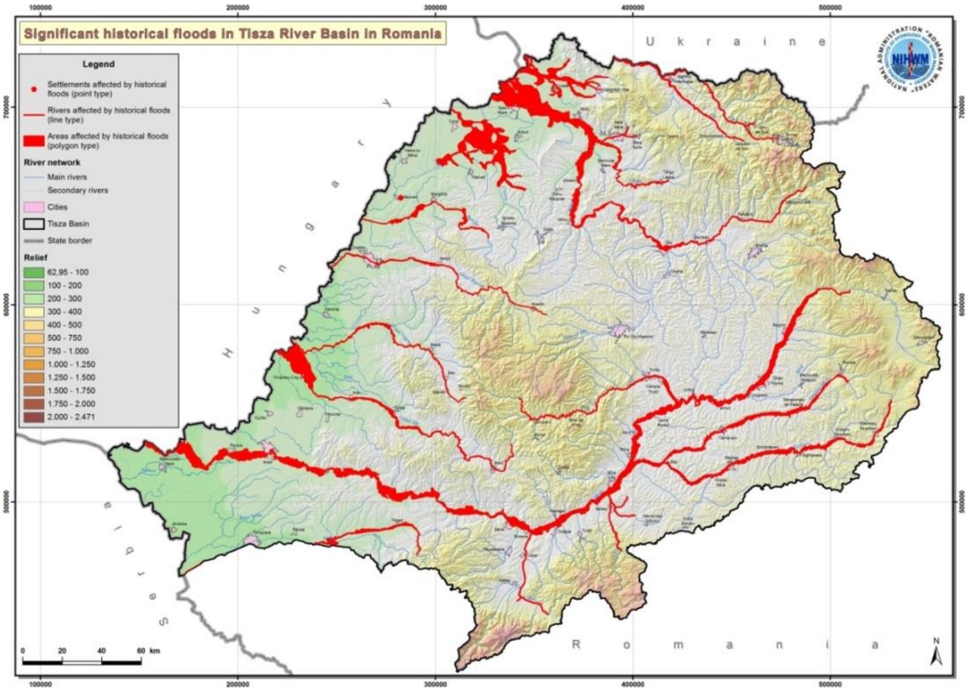

Figure IV.9 Map with significant historical floods in Tisza River Basin in Romania

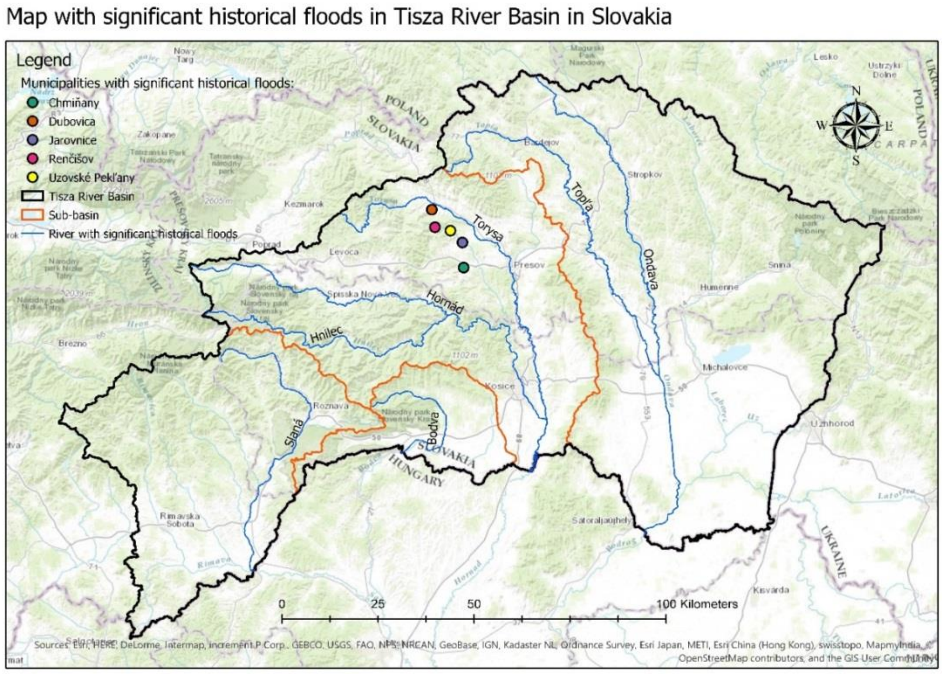

Figure IV.10 Map with significant historical floods in Tisza River Basin in Slovakia

For **Romania**, the areas with Significant Potentially Flood Risk were defined after consulting the information available at the moment, within the *Projects Prevention and protection against floods, dangerous meteorological phenomena, hydrotechnical accident and accidental pollution* and the results of *PHARE 2005 /017-690.01.01 Contributions to the development of the flood risk management strategy*. At the same time, has been taken into account the flood-protected areas with hydrotechnical works, considering all the floods that have occurred in the past and which had a significant negative impact, without removing from that list those floods that can occur on sectors that have been hydrotechnically arranged (impounded). In the Tisza River Basin in Serbia, the Areas with Potentially Significant Flood Risk (APSFR) were identified based on the potential adverse consequences which future floods may cause for human health, the environment, cultural heritage and economic activity.

Areas with Significant Potentially Flood Risk related to Tisza river and its tributaries with a catchment size over 1,000 km^2 are presented in the figures IV.11 for Romania, IV.12 for Slovakia, IV.13 for Serbia and listed in Annex IV.9.

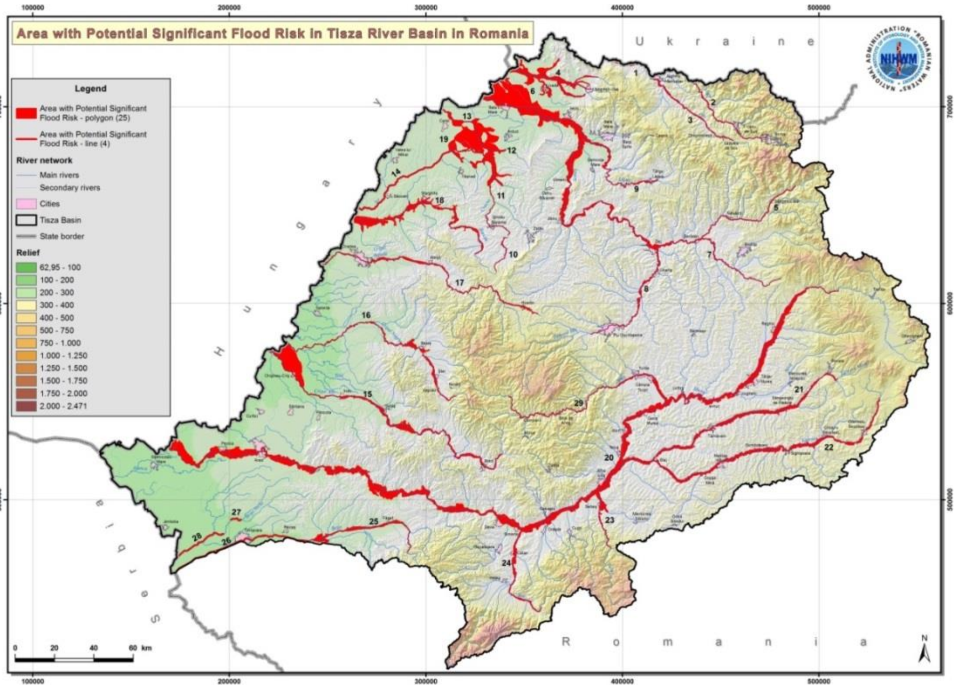

Figure IV.11 Map with A.P.S.F.R. in Tisza River Basin in Romania

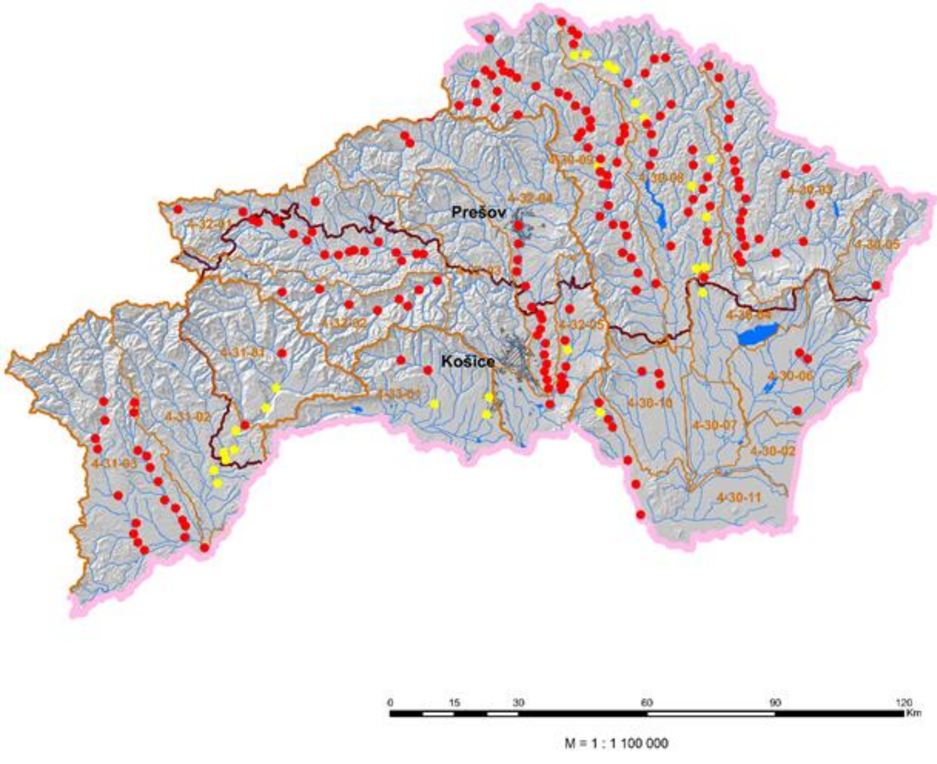

Figure IV.12 Map with APSFR in Tisza River Basin in Slovakia

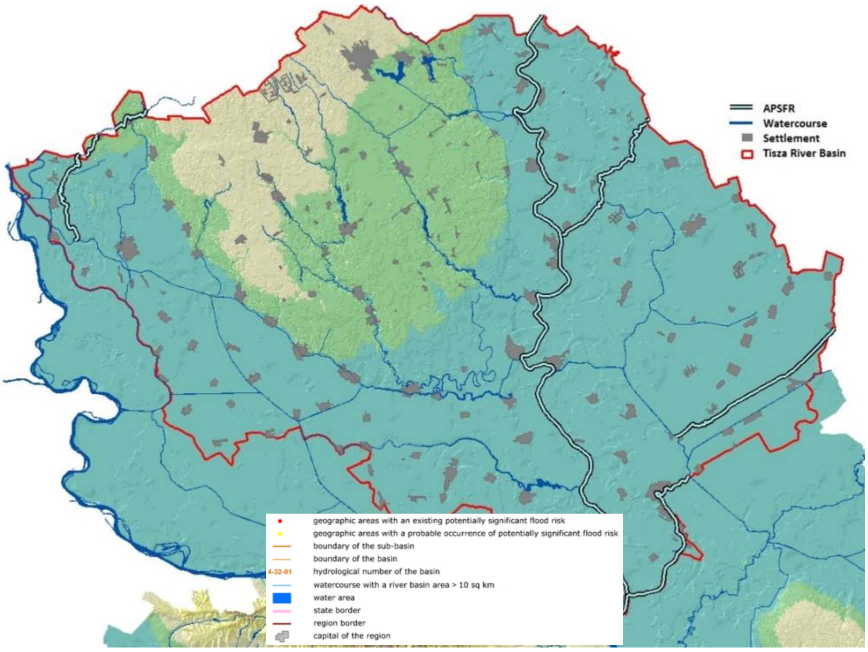

Figure IV.13 Map with APSFR in Tisza River Basin in Serbia

National Flood Hazard Maps and Flood Risk Maps for Tisza River Basin

According to EU-**Ukraine** Association Agreement, preparation of flood risk and flood hazard maps should be done by November 2020. At present, the Order *"On Approving the Methodology of the Flood Risk and Flood Hazard Maps Development"* is being drafted.

The project *„Identification of zones of possible inundation at rivers of Zakarpattya Oblast"*, was implemented by „Ukrwodproject" in 2009 in frame of implementation of state programme of integrated flood protection in Tisza basin. The project has identified maximum calculated water levels and possible inundation zones in times of floods with 1%, 5% and 10% probability in conditions of future infrastructure projects:

- Tisza from Rakhiv town to state border with Hungary;
- Kisva from Kosivska Polyana village to confluence with Tisza;
- Shopurka from Kobyletska Polyana village to confluence with Tisza;
- Teresva from Ust-Chorna village to confluence with Tisza;
- Teresva from Synervirska Polyana village to confluence with Tisza;
- Borzhava from Kushnyatsya village to confluence with Tisza;
- Irshava from Zagattya village to confluence with Borzhava;
- Uzh River from Kamyanystya village to state border.

In **Romania**, most of flood hazard maps reported to EC were elaborated through the national project "Plan for Protection, Prevention and Mitigation of the floods effects in the river basin" as a result of hydrological and hydraulic studies, for a high probability scenario (maximum discharge with probability of exceeding of 10%), for a low probability scenario (maximum discharge with probability of exceeding of 0,1%) and for a medium probability scenario (maximum discharge with probability of exceeding of 1%). For the rest of the areas simplified methods (based on fuzzy systems modeling – GrassGis and approximate modeling with HEC-RAS) were developed (figure IV.14).

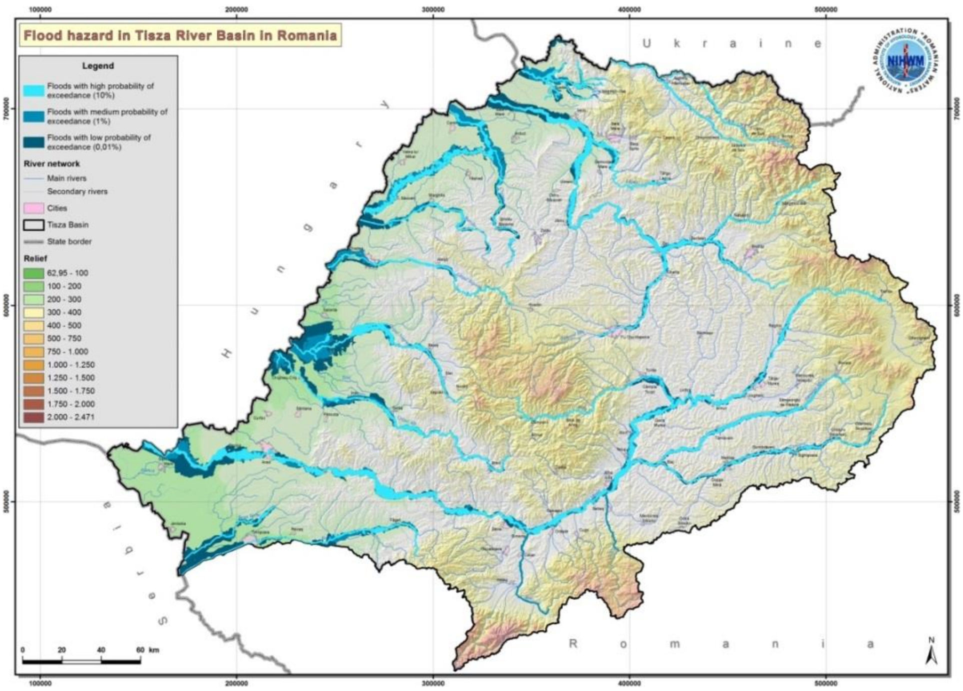

Figure IV.14 Flood hazard map of Tisza River Basin in Romania

Based on a methodology developed by National Institute of Hydrology and Water Management and National Administration ”Romanian Waters” – headquarters, quality flood risk maps have been elaborated, taking into consideration three classes of flood risk (high, medium and low risk). This involved, first of all, identifying risk receptors, and then assessing the vulnerability of the identified and exposed flood risks, taking into account the depth of water and potential damage to the flooded objectives, and the impacts on the considered risk receptors (figure IV.15).

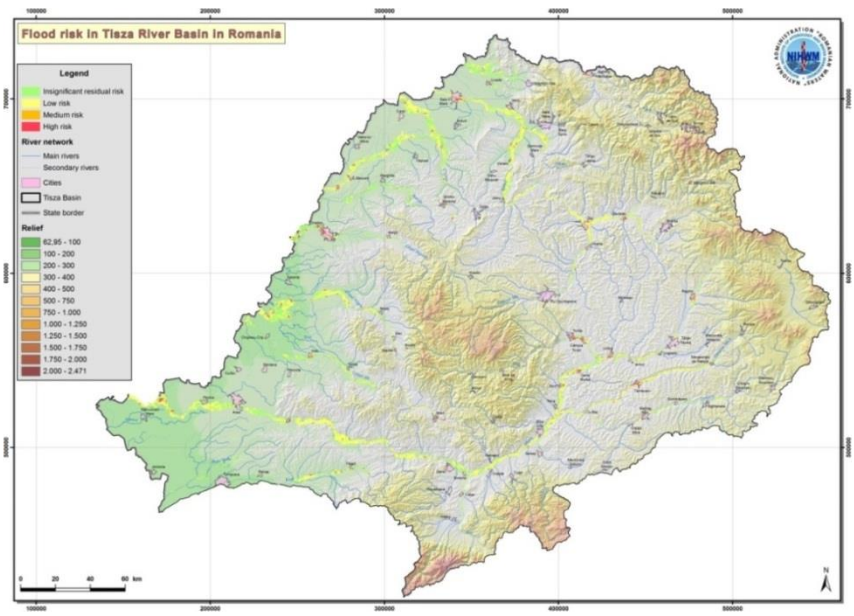

Figure IV.15 Flood risk map of Tisza River Basin in Romania

In **Slovakia**, the Slovak Water Management Enterprise was responsible for ensuring the elaboration of flood hazard and flood risk maps.

Flood hazard maps, resulted after mathematical hydrodynamic modeling of steady and unsteady flow, were elaborated for the geographic areas in which the preliminary flood risk assessment identified the existence of a potential significant flood risk and for areas where probable occurrence of significant flood risk can be assumed. On the maps is displayed the flood range, which could cause floods with an average return period from once in 5 years to once in 1000 years, or other flood with an exceptionally dangerous (figure IV.16).

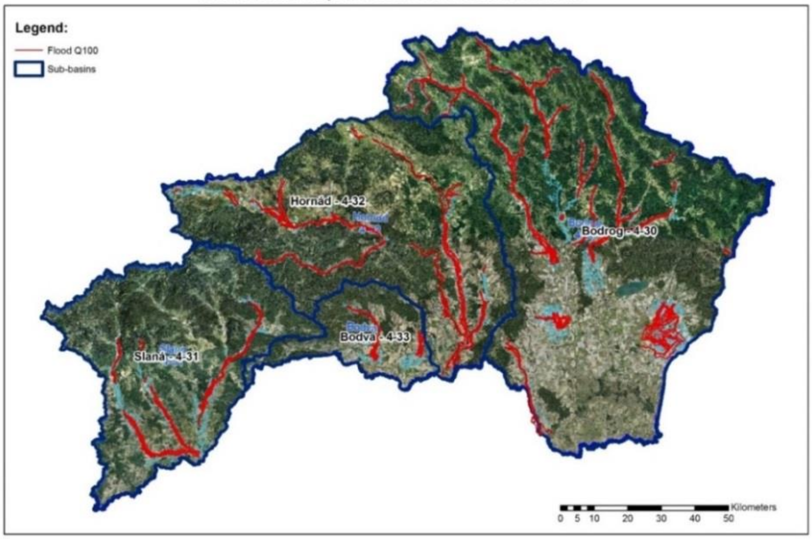

Figure IV.16 Flood hazard map in Tisza River Basin in Slovakia

Flood risk maps (figure IV.17) contain data of potential negative consequences of floods, which are displayed on flood hazard maps. On the maps are mentioned data about estimated number of potential affected inhabitants by floods and other economic activities in flood potential endangered areas. Additional data included on flood risk maps were:

- locations with industrial activities, which may cause accidental pollution of water during flood;
- location of potential endangered areas for water collection for human consumption and for recreational activities;
- locations with water for swimming;
- information on other significant sources of potential water pollution during floods;
- areas which form the national system of protected areas and the European system of proposed and declared protected areas (NATURA 2000).

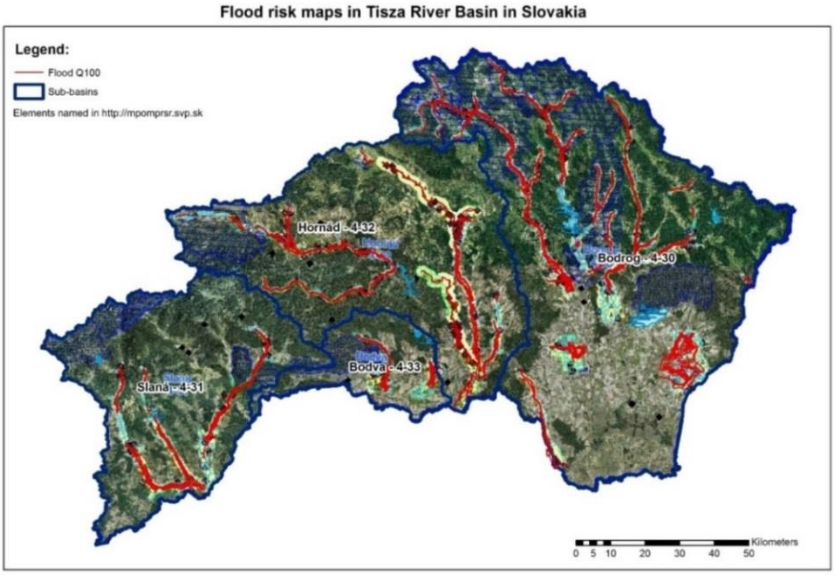

Figure IV.17 Flood risk map in Tisza River Basin in Slovakia

In **Hungary**, flood hazard maps were prepared for floodplains which are protected by dykes and for unprotected floodplains (figure IV.18).

During the flood mapping process there were prepared terrain models and 2D hydrodynamic models for 120 floodplains. In Hungary, for the total of 745 flood protection dyke breaking points in eight designed areas (three designed areas are located in Tisza River Basin) 1367 scenarios were calculated. During the 2D hydraulic modeling process the Mike 21 FM HD model was used for 50 m x 50 m square grid. The result of the 2D hydraulic modeling consisted in the inundation maps. MIKE 21 FM models were used for modeling the unprotected floodplains. 1‰, 1%, and 3% probability flood hazard maps were reported to EC.

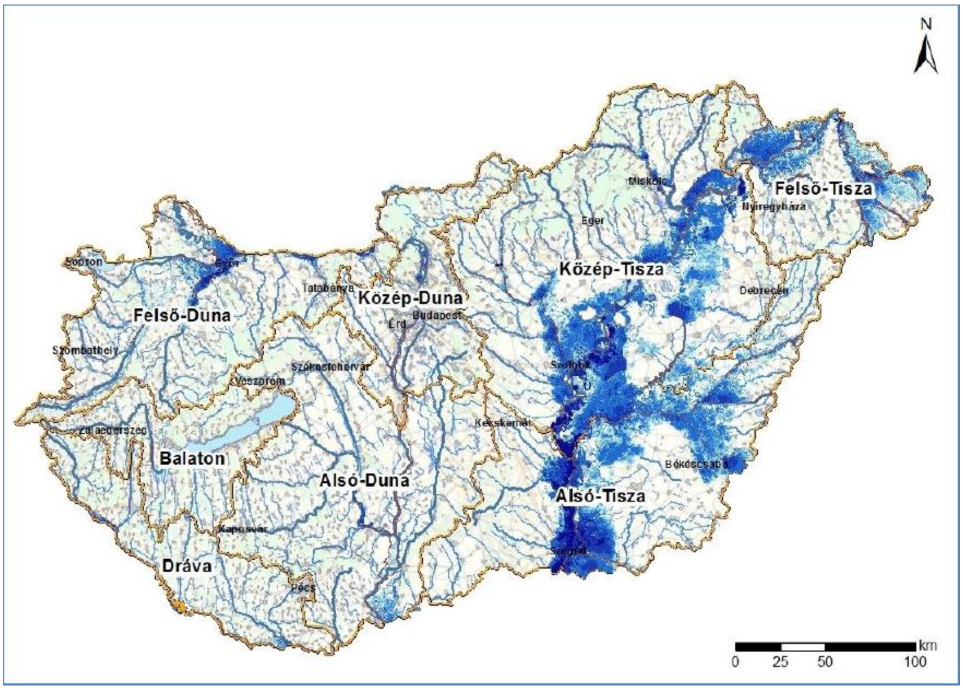

Figure IV.18 Flood hazard map in Tisza River Basin in HUNGARY – medium scenario

The risk maps are produced in 50 m x 50 m square grid. The flood risk assessment results are expressed in financial risk, human life risk, evaluation of cultural heritage and environmental effects (figure IV.19).

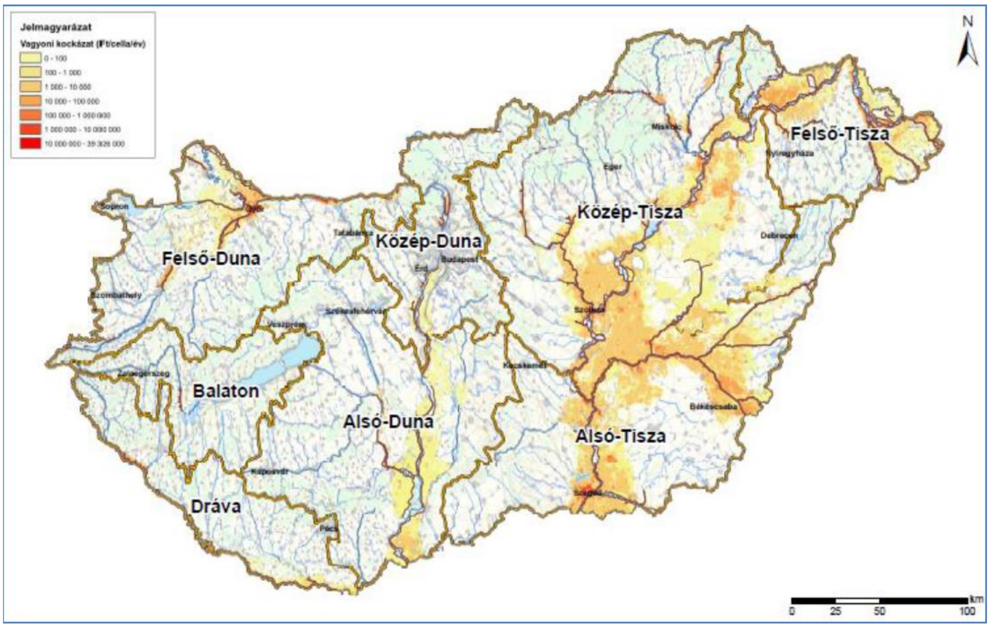

Figure IV.19 Flood risk (financial risk) map in Tisza River Basin in Hungary

In **Serbia**, flood hazard and flood risk maps are to be developed taking into account that 2000 km^2 are situated in flood prone areas. An official national methodology developed within the project "Study of Flood Prone Areas in Serbia" will be used (figure IV.20).

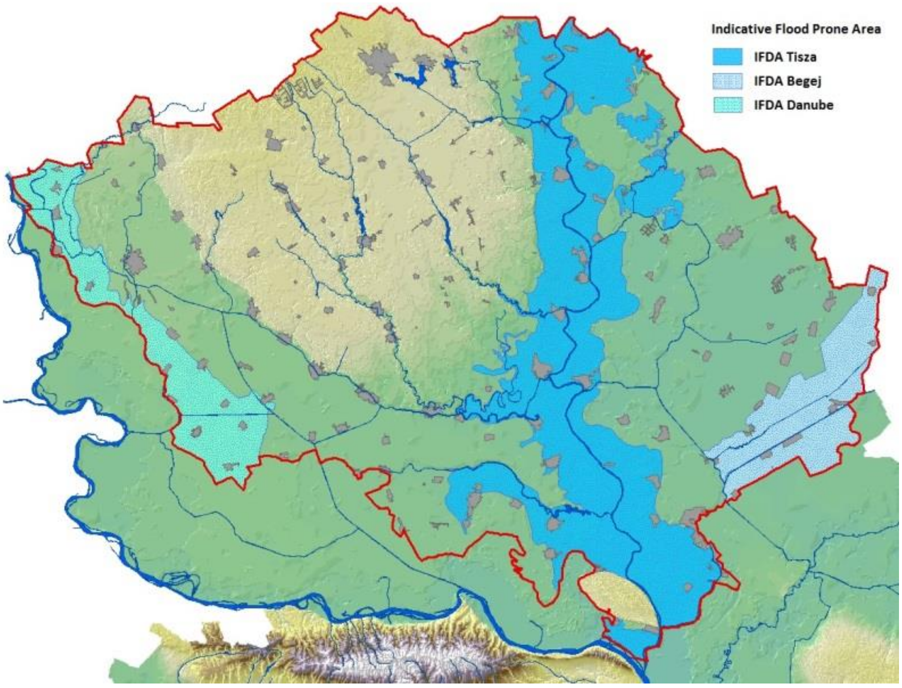

Figure IV.20 Flood hazard map in the Tisza River Basin in Serbia

Potential adverse consequences

In **Ukraine**, no consequences have been assessed yet, as it was mentioned before, the flood hazard and the flood risk maps will be done by November 2020 and the Flood Risk Management Plans by November 2022.

In **Romania**, in line with the provisions of the Floods Directive 2007/60/EC, 4 types of potential adverse consequences were determined based on flood hazard and flood risk maps in case of medium scenario (flood with maximum discharge with probability of exceeding of 1%): social, economic, environmental and cultural heritage.

For the Romanian part of Tisa River basin resulted 392,787 possible affected inhabitants, approximately 514 km of railway and 1,405 km of national/European, county and communal roads, 29 SPA areas, 49 SCI areas, 70 protected for the abstraction of water intended for human consumption, 17 IED installations, 228 churches, 9 museums and 3 cultural monuments.

In **Slovakia**, risk indicators that describe the principal potential adverse consequences (economic, social, environment, cultural heritage) were identified for each area with potential significant flood risk. The indicators were coded taking into account the nature of damage. With regard to economic consequences, the risk assessment took into consideration the flood effects on properties (including homes), to uses of the land, to agricultural activity, forestry, mineral extraction and fishing, to manufacturing, construction, retail, services, other sources of employment etc. Environmental consequences refer to pollution sources (IPPC and Seveso installations, point or diffuse sources). Adverse consequences for cultural heritage included the elements of cultural heritage and the ones of cultural assets (archaeological sites/monuments, architectural sites, museums, spiritual sites and buildings).

In **Hungary**, the four categories of assessed damages in case of major floods were: financial, human life, cultural heritage and ecological ones. The total amount of financial damages are estimated of about 136,343 million HUF/year. The human life risk values were determined as a function of flooding probability, density and load class. Regarding the cultural heritage, about 8,288 ha which contain elements of cultural patrimony may be affected. Regarding the ecological impacts of flood, 30 plains may be affected with a total area of ecological damages of about 1,0435 ha.

In **Serbia**, the approximately 2.000 km^2 potentially endangered by flooding is predominantly under agricultural land while there are numerous settlements with accompanying infrastructure, economic activities, cultural heritage, as well as nature protected areas. Precise data will be obtained after completion of flood risk maps.

Forecasting and warnings

The European Flood Awareness System (EFAS)

The European Flood Awareness System is a European Commission initiative to increase preparedness for riverine floods across Europe. The disastrous floods in Elbe and Danube rivers in 2002 confronted the European Commission with non-coherent flood warning information from different sources and of variable quality, complicating planning and organization of aid. In response to this event, the European Commission initiated the development of a European Flood Awareness System (EFAS) to increase the preparedness for floods in Europe. Following a Communication of the Commission in 2002 on the Elbe and Danube floods in 2002, the Joint Research Centre of the European Commission was assigned with the task to develop EFAS. Its development has been financially supported by DG ENTR, DG ECHO, the European Parliament as well as Germany, the Czech Republic, Austria, Hungary and Slovakia through detachment of National Experts.

The aim of EFAS is to gain time for preparedness measures before major flood events strike particularly for trans-national river basins both in the Member States as well as on European level. This is achieved by providing complementary, added value information to the National hydrological services and by keeping the European Response and Coordination Centre informed about ongoing floods and about the possibility of upcoming floods across Europe.

From 2005 to 2010 EFAS was tested in real-time mode, first with the National hydrological services and later also with the European Civil Protection. In 2011 EFAS became part of the Emergency Management Service of the COPERNICUS Initial Operations and in support to European Civil Protection. The operational components have been outsourced to Member State organisations. EFAS is running fully operational since autumn 2012.

The European Flood Awareness System (EFAS) is the first operational European system monitoring and forecasting floods across Europe. It provides complementary, flood early warning information up to 10 days in advance to its partners: the National/Regional Hydrological Services and the European Response and Coordination Centre (ERCC).

Accident Emergency Warning System (AEWS)

In some cases a transboundary flooding is maybe followed by an accidental pollution. For this reason, the Accident Emergency Warning System (AEWS) of the Danube River Basin is activated whenever there is a risk of transboundary water pollution, or threshold danger levels of certain hazardous substances are exceeded. The AEWS sends out international warning messages to countries downstream to help the authorities put environmental protection and public safety measures into action.

The Accident Emergency Warning System (AEWS) is activated whenever there is a risk of transboundary water pollution, or threshold danger levels of hazardous substances are exceeded. The AEWS sends out international warning messages to countries downstream. This helps the authorities to put environmental protection and public safety measures into action.

The AEWS operates on a network of Principal International Alert Centres in each of the participating countries. These centres are made-up of three basic units:

- Communication Unit (operating 24 hours a day), which sends and receives warning messages;
- Expert Unit, which evaluates the possible transboundary impact of any accident using the database of dangerous substances and the Danube Basin Alarm Model;
- Decision Unit, which decides when international warnings are to be sent.

The first stage of the AEWS came into operation in April 1997 in Austria, Bulgaria, Czech Republic, Croatia, Germany, Hungary, Romania, Slovakia and Slovenia. Ukraine and Moldova entered the system in 1999 and Bosnia-Herzegovina and the Republic of Serbia are on board since 2005.

Ice issues

In 2018 the International Commission for the protection of the Danube River published a report regarding the ice event in 2017 in the Danube River Basin (Danube and its main tributaries).

In January-February 2017 many countries in the Danube Basin faced with the similar situation. On the Danube and some of the main tributaries ice drift appeared and aggregated into ice jams. This event highlighted the need for basin-wide development of technical and human resources for sustainable ice-management.

In 2017 an extremely cold, dry air mass of Siberian origin arrived in the Danube River Basin on the 6th of January 2017, bringing sunny weather and record breaking low temperatures. The cold weather was dominant until the 12th of January, when a cyclone brought warmer and wetter air to the region. From the 15th of January until the very end of the month an anticyclone determined the weather by blocking the cyclones from the west and the colder weather became dominant again.

The ice was reported on the Tisza River in Ukraine, Hungary and Serbia.

During January very cold weather was observed in the Tisza basin in Ukraine: from -200 to -270 C in mountains and from -130 to -180 C in lowlands. The thickness of ice on the rivers was up to 35-40 cm. As a result of a rapid temperature increase and heavy rainfall, snow melts occurred causing strong ice-breaking and ice-drifting. On the Tisza section in Ukraine the ice drift started on 2-3 February, with water level increasing up to 4.7 m in lowlands. Ice jams formed at more than 50 locations. On 9th February the maximum ice flood level formed, reaching 10 m in Chop (only 30 cm below the water level of the 2001 catastrophic flood).

Because of the relatively lower discharges and velocities certain sections of the Upper Tisza and its tributaries in Hungary, strong ice drift or ice cover appeared already by the end of December. On 9th of January the complete Hungarian section of river Tisza and most sections of its tributaries were covered by ice. The ice cover started to break up in the first week of February, and Hungarian section of Tisza became free of ice on February 19th. The icy period in 2017 was much longer than the multi-annual average.

Ice on the Serbian section of the Tisza lasted for a long time, from the beginning of January to the beginning of February (and for a somewhat shorter time only near the mouth to the Danube). A long-lasting ice cover and ice drifts of short duration were typical.

Ice monitoring and forecasting

The increased and continuous monitoring of the conditions is very important but difficult. Airborne survey or satellite images provide the best perspectives but they cannot replace the manmade visual observations. Moreover the icy conditions could hinder the water level remote sensing and that need to be provided as well.

In **Slovakia** the relevant messages on Navigation measures and particular recommendations were available at the webpage of the Transport Authority http://plavba.nsat.sk/plavebna-bezpecnost/plavebne-opatrenia .

During winter periods the **Hungarian** Hydrological Forecasting Service (HHFS) receives daily data on river ice conditions from Hungarian and other European hydrological services. River ice reports for the Danube, Tisza, Drava rivers and their tributaries are summarized every morning. HHFS produces the Daily Ice Regime Map (DIRM) based on the observations of ice phenomena each day between 15th of November and 15th March each year from 2011. The Ice Regime Map summarizes the current ice conditions on the river network in Hungary, similarly to the Daily Water Regime Map (DIRM) which presents the current hydrological situation (http://www.hydroinfo.hu/en/hidinfo/vt.html .

The ice cover on the Danube and its tributaries in **Serbia** was monitored on a daily basis by expert teams from Vode Vojvodine, Srbijavode, Beogradvode, RHMZ and Jaroslav Černi Institute. All the collected data were compiled in daily reports, which described iced river reaches. To provide a better insight, the river reaches were classified based on ice conditions, endangered reaches were identified, and icebreaker deployment was planned accordingly.

In **Romania** the National Institute of Hydrology and Water Management (NIHWM) www.hidro.ro produces information, forecasts and warnings on floods and ice phenomena and their transmission to the Operational Center for Emergency Situations within the Ministry of Waters and Forests, to the

Operational Center of the National Administration "Romanian Waters" (NARW) as well as other stakeholders. In January 2017 NIHWM did not issue any hydrological warning, but in February six warnings were issued, mainly on the rapid melting of the snow, the predicted rainfall as well as the evolution of ice formations that can lead to increase of water levels and possible local floods on some river sectors, along with the associated map.

On the basis of the information provided by NIHWM and the water basin administrations, the National Administration ”Romanian Waters” compiled daily a national map describing the ice phenomena on the Romanian rivers, which was published also on the NARW website www.rowater.ro

Ice control measures in the Danube tributaries

In the **Upper-Tisza River** section in **Ukraine** the ice jams broke naturally or were removed by blasting. The pyrotechnical teams performed 58 explosions at 9 ice jams. 17 pumping stations have pumped 28,000 m3 of water during the flood period, draining it out of irrigation systems. The volume of water accumulated in reservoirs was 19.3 million m3. In total 770 persons and 151 machines participated in prevention of ice flood, steaming from the ice jamming. 3500 sandbags were used for flood prevention purposes.

In the **Hungarian** section of the Tisza River there were many sections where remarkable measures had to be taken place to avoid serious damages. They were required due to the ice cover of the Tisza and the approaching flood from upstream.

From Tiszabecs to Vásárosnamény the ice plates were able to convey with 100% ice drift however downstream to the Szamos confluence the load from the two rivers created several ice jams. Between Zsurk and Györöcske a 22 km long section was stucked with average 100-120 cm ice thickness that in some areas reached even 250 cm. It caused sudden and remarkable water level elevations at Vásárosnamény (+8,5 meters) and Záhony (+10 m). At Zámoly the water level exceeded the ever recorded third highest water level (highest two happened in 2001 and 1998).

The surrounding river stretches of the Tiszalök powerplant was covered with permanent ice cover. The drift from upstream needed to hold back until the downstream stretch (Tiszadob-Tiszalök) would have been cleaned by the icebreakers. The segment gates were operated with lower outflow. Explosives were deployed if the prudent operation fails and a successful test blasting took place. The icebreaker executed the task finally indeed.

At the Tisza Lake the controllers operated the Kisköre dam in a way to slow back and stop the ice accumulation which was already contained mass of drift wood, wreckage and other rubbish. Despite the efforts they could not halt the conglomerate and they needed to pass through the gates. The jams at the structure were treated by icebreakers.

Upstream Szolnok the construction of the new M4 highway bridge was in place. The vessels in the riverbed and the floating crane needed to be secured. At Csongrád a pontoon bridge had to be protected.

In **Hungary** on 11th February 2017 the ice jam from the Tisza River drifted up to the Bodrog River. This resulted in damages generated on ships and port structures. Fortunately no personally injury occurred. Due the flowing ice flood the affected Water Directorates warned the floating structure owners to do the necessary activities avoiding serious damages.

Lessons learned

In **Hungary** for better ice protection it is recommended to:

- review the winter operation rules of the Tiszalök and Kisköre barrages and propose measures, which should be considered in the Tisza operation control work;

- propose river sections where it is advisable to use preventive icebreaking;
- determine the flood levels with 1% probability for winter months (December, January, February, and March), and include these the ice protection plans;
- examine the use of the ice blasting jointly with the responsible body (Police) and develop the protocol of ice blasting;
- review the ice protection plans including the hydraulic structure's operation of the regulatory facilities and also potential loading of the bridges;
- review the ordering rules of the point defences alert and need to set up a clear rule system for the ice protection;
- integrate the communication for the society into the ice protection plans, in particularly the vulnerability of floating structures and coastal facilities..

To improve the operation of ice breaker ship fleet it is recommended to:

- recruit new crew of the icebreaker ships;
- dvelop a method of winter marking (navigation signs) and ordering of navigation break due the ice events;
- revise the placing of the icebreaker ships and the suitability of winter homeports;
- investigate the reconstruction needs of the available ice breaker fleet, and the reconstruction work must be carried out in case of supporting.

Also it is necessary to review the applicability of existing drones, and to propose the drone technical parameters for its use in case of ice flood. The legal background of the immediate deployment of drones must be drawn up, and if it is necessary to do the amendment of legislation. The applicability of aerial reconnaissance (planes, helicopters) should be pre-investigated and the expectations should be composed.

The international conventions should be reviewed for the better information flow. (ice blasting on the common interest of river section).

Based on the experiences from 2017 the professional visual reporting of such unconventional events brings high attention from the media and the society as well. This serves the aim of increase awareness.

Principles and strategy of ice defence in **Serbia** were defined on the basis of the study, which was completed in 2010. According to the adopted strategy, permanent ice monitoring is the first precondition for the ice control. Preparatory activities for flood defence on the levees should be done, and flood defence starts if due to ice jamming water levels rise above the prescribed ones. Operational measures for ice control include preparations for blasting of ice jams and engagement of the existing icebreakers. The construction of new, multi-functional icebreakers is planned (outside of the ice period they may be used in various emergency situations on the waterway, such as firefighting, rescue, etc.).

Romanian experience in annual actions to reduce the damage caused by ice on the inland rivers and especially on the Danube shows that the following actions are necessary: Improvement of basin, county and local flood defence plans with adequate provisions for anti-ice actions; Better material endowment of the institutions responsible for counteracting the harmful effects of ice (especially icebreakers) as well as Danube harbours with adequate housing and repairs structures; A better study of the phenomenon, especially since it has a profound uncertainty, especially in the context of climate changes; Better inter-institutional cooperation (including the Romanian Space Agency) and inter-state cooperation because the Danube is a border between Romania and Serbia, Bulgaria, Moldova and Ukraine (updating of water management conventions).

Ukraine would like to: Improve ice forecast and monitoring; Implement measures foreseen by Complex Plans of actions for safe floods and ice drift passing; Build the capacities on all levels of government to improve information dissemination, communication and notification before, during and after the emergency situations; Enhance the experience on the use of explosives in ice jams blasting.

Estimation of the impact of Climate Change on flood risk

In **Ukrainian** part of Tisza basin, as probably in the other parts of Tisza, for the last twenty years (1991-2010) one can observe the tendency increase of air temperature during the whole year. During this period, the annual average temperature of air increased by 0.7 – 0.8 ^{0}C comparing with the climatic norm of 1961-1990. It is especially seen in summer and winter – their average temperature has increased by 1.4 ^{0}C and 0.8 ^{0}C accordingly.

The change of temperature regime goes hand in hand with change of regime of precipitation. The annual sum of precipitation has changed insignificantly, but it got redistributed differently between seasons: in summer – by 10% less, in autumn – by 20% more. There is also a shift of maximum number of precipitation from June to July.

The number of cases of heavy and very heavy rains got increased as well as the period, during which they reach their maximum. The significant amount of heavy and very heavy rains is observed not only in July, but also in August, during some years in September as well. The number of dangerous rains in cold period increase, especially during the autumn.

The climate affects the hydrological regime of rivers. Reduction of the number of precipitation in summer and significant increase of the air temperature, which lead to increased evaporation, led to the reduction of river flow discharge by 18%. Increase of the river discharge in autumn by 13-24% corresponds to increase of precipitation during this season by 20%. Insignificant (by 5-6% in average in Tisza basin) increase of the average water flow are seen in winter and in spring.

Among months, the most rich for water at present period comparing with 1961-1990 are January, March and November. During these months, river water discharge in different parts of Tisza increased by 5-19%, 15-25% and 36-39%.

Having analysed the number of floods during year for the periods 1961-1990 and 1991-2011, it was found out that there are no significant deviations regarding increase or reduction of their frequency. In modern periods, high maximums are more frequently observed in cold period of the years – in average for 4-5% more, than during warm periods. In winter and spring, the number of floods get almost unchanged, in summer they got reduced by 4-5%, in autumn – increase for the same percentage.

In **Romania**, the results of some climate models with increasingly fine spatial resolutions to capture the complex orography of each region allowed the development of scenarios for different river basins with regard to the impact assessment on water resources.

The CONSUL hydrological model was used, which allows simulation of discharge hydrographs on sub-basins, their routing and composition on the main river and tributaries, and attenuation by reservoirs.

Until now, the methodology for estimating variations at 6 hours time step of precipitation and temperatures as well as the maximum discharges from the future period compared to the reference period was applied to 6 river basins in Romania, among which Crişul Alb and Mureş. The following results were obtained for the analyzed river basins:

- Crişul Alb: an increase of maximum discharges in January, April, July, September and December and a decrease in the other months of the year;
- Mureş: an increase of maximum discharges in the winter months as well as in March and July and a decrease in the other months of the year.

For multiannual maximum discharges, the simulations indicated:

- Crişul Alb: decrease of about -22,7 % (between a minimum of -35,0% and a maximum of 7,6%);
- Mureş: decrease of about -11,3 % (-39,0 % and 16,6 %).

With regard to the variation of maximum discharges with different probabilities of exceedance in sections of hydrometric stations on main river courses resulted:

- Crişul Alb: maximum discharges with probabilities of exceedance 0,1%, 1%, 2%, 5% and 10% have a decreasing trend of up-to -14% in the upper zone and maximum -10% in the lower zone;
- Mureş: maximum discharges with probabilities of exceedance 0.1%, 1%, 2%, 5% and 10% have a decreasing trend of up to -7% in the upper zone and maximum -9% in the lower one, and a tendency of increase of up to 7% in the middle zone.

In **Slovakia**, the National Communication on Climate Change is prepared every four years. The Fifth National Communication on Climate Change states that between 1881 and 2008, the average annual air temperature increased by 1.6 °C.

According to the CCCM97 scenario, it is possible, despite the possibility of increasing the amount of precipitation, to expect a decrease in run-off from the whole area of Slovakia.

In comparison with the reference period from 1951 to 1980, it can be assumed, that in 2030 it will be 21% and in 2075 84% of the area of Slovakia in the zone of decreased of the long-term average runoff from -5 to - 20%. The assessment of run-off scenarios over the year indicates that, in contrast with the reference period from 1951 to 1980, changes in the distribution of long-term average monthly runoff across the whole Slovakia may be expected over the 2075 (2051-2100) horizon:

- In western part of Slovakia – increase runoff in winter and spring, in December and January ranging from 30 to 60% and in July a decrease runoff from -20 to -40%;
- In northern part of Central Slovakia - increase in winter and spring runoff, from November to March, with the highest increase in February or January from 80 to 120%. In the Dunajec River sub-basin and Poprad river sub-basin, can be expected increasing of runoff from 20 to 40%. On the contrary, the decrease in runoff can be expected in the period from april to september, with the largest decreasing in may, in the Dunajec and Poprad river sub-basins in april and july from -20 to -40%;
- In southern regions of central Slovakia will be shorter periods of runoff in winter and spring, but the period of long-term decrease of average monthly runoff will be longer. The largest increase in runoff can be expected in February from 20 to 90% and the most significant decrease could be in July and August from -30 to -70%.

In **Hungary**, The General Directorate of Water Management assessed the impacts of climate change on floods in connection with the Flood Risk Management Project. The following changes can be observed for the territory of Hungary:

- in Danube River a rearrangement of annual run-off can be observed which means decreasing summer low water, increasing water temperature and decreasing of ice formation;
- in between the Danube and the river Tisza also experienced the decreasing of run-off and the ground water level;
- in the Tisza River basin the annual run-off is decreasing, the flood events are more frequent;
- another result of the climate change is the increasing frequency of high intensity of rainfall events, which increase the local water damage events. If the precipitation of summer decade decrease and precipitation of the winter time increase we will have to count by decreasing of infiltration and increasing of run-off. In addition to the usual spring floods, sudden and significant floods must be prepared at the most unexpected times.

In summary the impact of climate change on the smaller streams and the flash floods seem clear. Larger rivers have a much greater risk uncertainty.

Estimation of the Climate Change impacts on floods in **Serbia** within the Tisza River Basin has not been studied in details. However, based on available data and information the high flow frequencies will likely increase in the future, but statistically significant trends are not detected in evaluated time series. The floods in the most downstream Tisza country are greatly influenced by upstream countries hydrology, measures and land use practices in country and beyond. Given the high level of uncertainty associated with flood events CC projections the recently finalized Second National Communication to the United Nation Framework Convention on Climate Change for Serbia (funded by UNDP) in report on the Vulnerability Assessment and Adaptation Action Plan for Water Sector (Deliverable 7) specific measures for adaptation with respect to flood events are proposed and classified with low regret, no regret etc. attributes given to the identified problems/issues.

Transnational projects that address climate change and water resources have been implemented or are ongoing in Serbia and some of them addressed various aspects of climate change impact on water resources, including vulnerability assessment, mitigation issues, and adaptation measures recommendations to reduce the water and other sectors vulnerability in Serbia: CARPATCLIM, CCWaterS, WATCAP, CC-WARE, ClimWatAdapt, Modelling of climate change impacts on water fluxes and states in the Kolubara and Toplica catchments in Serbia, Further Improvement and Development of Flood Forecasting Service in Serbia, SEERISK, OrientGate, PROMITHEAS-4K, CCAFORUM, Assessment of climate change impacts on the water resources of Serbia, Climate Change Impacts on River Hydrology in Serbia – National Study in Serbian, Weather extremes and climate change in Serbia, CLENIAM - III43007 etc.

At the Danube River Basin level it was initiated through a request by the Danube Ministerial Conference 2010, the International Commission for the Protection of the Danube River developed a climate adaptation strategy as one of the first major transboundary river basins worldwide. Based on a scientific study on Climate Change in the Danube Basin, the adaptation strategy was adopted in 2012.

Germany was nominated as Lead Country for this activity in the frame of the ICPDR. In this function, the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety supported a meta-study with the aim of providing foundations for a common, Danube-wide understanding of future impacts of climate change on water resources and suitable adaptation measures as a basis for the development of the Danube Climate Adaptation Strategy.

This study was elaborated by Professor Doctor Wolfram Mauser and his team of the Ludwig-Maximilians-University Munich. It is solely based on existing studies and projects, no further scenarios or model calculations were carried out.

At a glance, main conclusions include the following:

- Impacts on water related sectors are triggered by temperature and precipitation changes;
- Higher temperature is expected with a gradient from northwest to southeast;
- Generally, seasonal precipitation changes with a decrease in summer and an increase in winter precipitation are expected;
- Regarding floods, although local and regional increased heavy rainfall might occur, there is no clear picture for changes in flood magnitude and frequency;
- An increase of water temperature and increased pressures on water quality are expected;
- Changes for ecosystems and biodiversity are predicted with shifts of the aquatic and terrestrial flora and fauna;
- But also positive effects are projected, such as a reduction of ice days on rivers or longer vegetation periods.

The study also includes an indication of the uncertainty of the predicted changes and impacts next to a summary of possible adaptation measures, what is considered as a further key element for the future discussions in the frame of the ICPDR.

Possible adaptation measures for water management include preparatory measures for adaptation such as improving forecasting warning systems, ecosystem-based measures such as the restoration of water-retention areas, managerial measures such as the promotion of water-saving behaviour, technological measures such as the development of more efficient irrigation systems in agriculture, and policy approaches such as supporting institutional frameworks to coordinate all of these activities.

The ICPDR and its contracting parties are using the adaptation strategy to decide on adaptation measures as part of the Danube River Basin Management Plan Update 2015, the 1st Floodrisk Management Plan as well as national management plans.

A Revision and Update of the Danube Study was initiated by the German Federal Ministry for the Environment, Nature Conservation and Nuclear Safety to revise the findings of the first Danube study conducted 2010-2011. The new study supported a Danube wide understanding of the impact of climate change on hydrology and water availability in the light of the new IPCC report AR5. The outcomes of the study should provide an analysis of projects conducted between 2012 and 2016/2017 and a comparison between the findings of the two projects.

It started in January 2017 and lasted 13.5 month and developed with a close collaboration with experts in the Danube River Basin.

The study Integrating and editing new scientific results in climate change research and the resulting impacts on water availability to revise the existing adaptation strategies in the Danube River basin" is divided into the following four parts.

- 1. Compilation of results and data of research and development projects, conducted between 2012 and beginning of 2017, as well as adaptation activities in relation to the water related impacts of climate change in the Danube River Basin.

- 2. Analysis of the data collection to comprise

    a) communalities, contradictions in results and approaches

    b) dependencies, competing interests and possible conflicts

    c) deficits of knowledge

- 3. Comparison of the results with the findings of the study from 2011.
- 4. Analysis of the effectivity of adaptation measures and / or the definition of necessary measure adjustments. Suggestions as basis for an adjustment of the basin-wide adaptation strategy to climate change in water related issues in the Danube River Basin with / for the ICPDR team of experts.

The final form of the study and the updated Strategy on climate change adaptation will be adopted by ICPDR countries in December 2018.

International Cooperation in the Tisza River Basin

Bilateral agreements

Ukraine has acting bilateral agreements with neighbouring countries:

- Agreement between government of Ukraine and government of Slovak Republic on issues of water management in boundary waters – June 15, 1994;
- Agreement between the Government of the Republic of Hungary and the Government of Ukraine on water management issues related to frontier waters – November 11, 1997;
- Agreement between the Government of Ukraine and the Government of Romania on co-operation in the field of water management on transboundary waters – September 30, 1997.

On the occasion of the ministerial meeting of the ICPDR 2004 in Vienna, the Tisza countries signed a Memorandum of Understanding: *"Towards a River basin. Management Plan for the Tisza river supporting sustainable development of the region"*.

On 11 April 2011, the five Tisza River Basin countries Hungary, Romania, Serbia, Slovakia and Ukraine entered a new stage in joint water management to ensure good water quality. The ministers and high-level representatives signed a *Memorandum of Understanding* and endorsed the implementation of the Integrated Tisza River Basin Management Plan (ITRBM Plan), which has been proposed in full compliance with the EU Water Framework Directive.

The **Romanian** International Cooperation with the countries which are parts of the Tisza basin, is developing as bilateral as in the frame of international bodies such as the International Commission for the Protection of the Danube River (ICPDR).

Within ICPDR, the Tisza Group has been established for strengthening coordination and information exchange related to international, regional and national activities and to ensure harmonisation and effectiveness of related efforts.

Bilateral agreements.

- Romania – Ukraine

Cooperation shall be conducted under the Agreement between the Government of Romania and the Government of Ukraine on cooperation in border water management (Galati, 30 September 1997), ratified by the Romanian Parliament by Law no. 16 of 11 January 1999.

- Romania – Hungary

The first agreement in water field between Romania and Hungary was signed in Bucharest on 14 April 1924 and was in force until 1945. This was followed by 4 cycles of cooperation, 1945-1961, 1962-1965, 1965- 1970, 1970 to 1986, the agreement was renewed every time. On 25 June 1986 was signed in Bucharest Convention between the Government of Romania and the Republic of Hungary on the regulation of issues related to hydraulic structures on water which form or cross the border. The Convention entered into force November 20, 1986.

Currently, cooperation is performed under the Agreement between Romania and the Republic of Hungary on cooperation for the protection and sustainable use of water in the border region (Budapest, September 15, 2003), ratified by Government Decision no. 577/15.04.2004.

The agreement applies to the following rivers: Tur, Someș, Crasna, Barcău, Ier, Crișul Repede, Crișul Negru, Crișul Alb and Mureș by hydrotechnical Romanian - Hungarian Commission.

- Romania – Serbia

Cooperation is achieved under the Agreement between the Romania and FPR Yugoslavia on hydraulic problems in hydraulic systems and watercourses that cross the border or are the border (Bucharest, April 7, 1955), ratified by Decree no. 242 / 06.17.1955. The agreement applies to the following rivers: the Danube, Nera, Moravița, Aranca, Bega Veche, Bega Channel, Timiș, Caraș and Nera by hydrotechnical Romanian-Serbian Commission.

It is currently negotiating text of the new Agreement between Romania and Serbia on cooperation in the sustainable management of transboundary waters.

Bilateral cooperation of the **Slovak Republic** on the border sections of the rivers – valid intergovernmental treaties and agreements:

- Intergovernmental agreement between Czechoslovak Socialist Republic and People´s Republic of Hungary on the regulation of water management issues at the border waters (signed 31 May 1976 in Budapest, valid since 31 July 1978, inherited with partners after the formation of the SR in 1993, Treaty between SR and Republic of Hungary currently in the ratification process).

  *** An example is polder Beša, which is only flooded in extreme flood situations in Medzibodrožie and when the territory is in risk in the Bodrog river basin in the Republic of Hungary. According to the bilateral agreement between the Slovak Republic and Republic of Hungary, the polder is flooded when the height of the Bodrog river in Streda nad Bodrogom reaches 936 cm (equivalent 101.10 m.a.s.l. - Adriatic)

- Intergovernmental agreement between SR and Ukraine on the water management issues at the border waters (signed 14 June 1994 in Bratislava, valid since 15 December 1995).

The Slovak Republic uses various funding instruments for the environment and climate action e. g.: Danube Transnational Programme, INTERREG, Horizon 2020, LIFE, SOUTH EAST EUROPE PROGRAMME etc.

The Slovak Republic also joined to several international conventions such as: Ramsar Convention on Wetlands, Carpathian Convention, Convention on the Protection and Use of Transboundary Watercourses and International Lakes.

For the implementation of the EU Biodiversity strategy by 2020, EU commision has launched new biogeographic process-non formal process with EU member states aimed at exchanging information and experience, good practice and improving cross-border cooperation for the management of Natura 2000 sites, in which the Slovak Republic is also involved.

Flood protection issues on transnational level are coordinated within the frame of the specific bodies –Border Waters Commission and within the Danube River Basin within ICPDR.

In order to ensure the safety against of floods in **Hungary** the cross-border connections are very important. That is why our country has all of the seven adjacent states with a Bilateral Water management Agreement. The conventions are based on an intergovernmental agreement for which they are responsible for the implementation of trans boundary committee or their leaders, the two co-operating government nominated and authorized alternates. The General Directorate of Water Management roles in the Hungarian-Slovakian and in the Hungarian-Serbian trans boundary committees is deputy of government agent in the Hungarian-Slovakian, Hungarian-Serbian and in Hungarian-Croatian trans boundary committees is subcommittee leader. The cross-border cooperation covers all areas of water management activities which besides the professional guidance of the General Directorate of Water Management, belong to the activities of Regional Water Directorates (flood protection, regulations, developments, EU projects, maintenance and operation of water related/hydraulic structures, hydrological data collection, data exchange, forecasts, joint reviews, etc. In the Tisza River Basin we cooperated with Ukraine, Romania, Slovakia, and Serbia.

Organization of trans boundary committees (related to Tisza River Basin):

- Hungarian-Slovakian trans boundary committee:
  - Duna Subcommittee
  - Ipoly Subcommittee
  - Tisza and tributaries Subcommittee
  - Common Water Quality and Hydrologic Subcommittee
  - Financial Subcommittee
- Hungarian-Ukrainian trans boundary committee:
  - Protection against water damages group
  - Hydrology and water management group
  - Protection against water quality damages group
- Hungarian-Romanian trans boundary committee:
  - Flood protection and protection against excess water subcommittee
  - Water management and hydrological subcommittee
  - Water quality subcommittee
  - Expert group of Water Framework Directive
- Hungarian-Serbian trans boundary committee:
  - Protection against Water damages subcommittee
  - Water management subcommittee
  - Protection against water quality damages subcommittee

Bilateral agreements related to Tisza River basin (Table IV.4) are:

Table IV.4 Intergovernmental agreements related to Tisza River basin signed by the Government of Hungarian Republic

Name of the bilateral agreement	Date and place of sign	Announcement of bilateral agreement
Between the Government of Hungarian Republic and the Government of Czechoslovakian on regulating water management issues	Budapest, 31st May 1976	55/1978 (XII.10.) Ministerial Decree
Between the Government of Hungarian Republic and the Government of Ukraine on trans boundary water management issues	Budapest, 11th November 1997	117/1999 (VIII 6.) Governmental Decree
Between the Government of Hungarian Republic and the Government of Romania on protection of trans boundary water courses and sustainable water management	Budapest, 15th September 2003	196/2004 (VI.21.) Governmental Decree
Between the Government of Hungarian Republic and the Government of Yugoslavia on water management issues	Belgrade, 8th August 1955	Applicable from 19th August 1955

- Citation from the Tisza Declaration signed in Szolnok, 03. 30.2011:

„The Tisza Valley has a key role in the Carpathian Basin from hydrogeographical point of view. River Tisza is the most significant tributary of the Danube River Basin, and its largest sub-basin in the same time. 90% of the water flow - which originates from Slovakia, Ukraine, Romania and discharges into the Danube in Serbia - runs through our country. Most of Hungary's water management and water quality problems are related to River Tisza.

The Tisza River Basin forms a unified water system and shared by several countries. Thus the work to find common and effective answers on water management problems is essential. The only possible way of solving these problems is to cooperate within a unified framework. Different interests caused by fragmentation must be solved within the basin by responsive cooperation of countries and stakeholders, in accordance with the regulations of the European Union and with the adaptation of the subsidiarity principle.

Due to its high magnitude, an independent group within the International Commission for the Protection of the Danube River (ICPDR) deals with the integrated water management of the Tisza River Basin as a sub-basin, furthermore it appears as a separate unit in the Danube River Basin Management Plan as well. The Integrated Tisza River Basin Management Plan has been developed with the aspects of water damage prevention and integrated management of water quality and quantity, that goes beyond the requirements of the Water Framework Directive and mutually important for the five interested countries. Coordination and supervision of the implementation, avoidance of parallelisms and reinforcement of synergies are important tasks of the plan."

„Further objectives are to facilitate the implementation of the EU Strategy for the Danube Region in the Tisza River Basin, the integrated management of water quantity and quality issues, elaboration of proposals concerning the mitigation of effects of climate change."

Bilateral cooperation between **Republic of Serbia** and neighbouring countries in the TRB (Hungary and Romania) exists more than 60 years:

- Bilateral cooperation between RS and Hungary is based on the Agreement between the Government of the People's Republic of Hungary and the Government of Federal People's Republic of Yugoslavia on water management issues, signed in Belgrade in 1955. The Agreement binds the parties thereto to review and jointly resolve all issues, measures, and activities related to flood and ice control; obligates coordinated management and operation of structures and equipment; requires the Committee, set up pursuant to the Agreement, to generate joint flood and ice control rules. In 1998, the Committee adopted new Rules for external and internal flood and ice control related to border or cross-border watercourses and hydro-technical systems in sectors of joint interest to RS and HU, as well as rules on hydrologic cooperation, which also has an important function in the domain of flood control. The new bilateral agreement, based on fruitful past cooperation and EU legislation is in preparation.

- Bilateral cooperation between RS and Romania is based on the Agreement between the Government of Romania and the Government of the Federal Republic of Yugoslavia on hydro-technical issues from the hydro-technical systems and watercourses on the boundary or crossing the state boundary, signed in Bucharest in 1955. The parties agreed to review and jointly resolve all issues, measures, and activities related to flood and ice control; each party on its territory and the parties jointly along the border should adequately maintain riverbeds, hydro-technical systems, structures, and installations etc. The Joint Flood Control Rules for border or cross-border watercourses and hydro-technical systems were approved in 1971. Timely dissemination of hydro-meteorological information of significance for flood and ice control, as well as information on flood control phases and any accidents, is also an obligation under the Joint Flood Control Rules. The new bilateral agreement, based on fruitful past cooperation and EU legislation is in preparation.

Inside international organizations

The International Commission for the Protection of the Danube River (ICPDR)

The International Commission for the Protection of the Danube River (ICPDR) works to ensure the sustainable and equitable use of waters in the Danube River Basin. The work of the ICPDR is based on the Danube River Protection Convention, the major legal instrument for cooperation and trans-boundary water management in the Danube River Basin.

The International Commission for the Protection of the Danube River (ICPDR) is a transnational body, which has been established to implement the Danube River Protection Convention. The ICPDR is formally comprised by the Delegations of all Contracting Parties to the Danube River Protection Convention, but has also established a framework for other organisations to join.

In 2000, the ICPDR contracting parties nominated the ICPDR as the platform for the implementation of all transboundary aspects of the EU Water Framework Directive (WFD). The work for the successful implementation of the EU WFD is therefor high on the political agenda of the countries of the Danube river basin district. In 2007, the ICPDR also took responsibility for coordinating the implementation of the EU Floods Directive in the Danube River Basin.

Today national delegates, representatives from highest ministerial levels, technical experts, and members of the civil society and of the scientific community cooperate in the ICPDR to ensure the sustainable and equitable use of waters in the Danube River Basin.

Since its creation in 1998 the ICPDR has promoted policy agreements and the setting of joint priorities and strategies for improving the state of the Danube and its tributaries.

The goals of the ICPDR

- Safeguarding the Danube’s Water resources for future generation
- Naturally balanced waters free from excess nutrients
- No more risk from toxic chemicals
- Healthy and sustainable river systems
- Damage-free floods

Tisza Group

In countries sharing the largest sub-basin of the Danube Basin have a long history of cooperation resulting among others in signing the Agreement on the protection of the Tisza and its tributaries in 1986 or in establishing the Tisza Forum to address flood issues in 2000. The Tisza cooperation has been given a new perspective in line with the development of the Danube cooperation and the EU water policy.

At the first ICPDR Ministerial Meeting in 2004, ministers and high-level representatives of the five Tisza countries signed the Memorandum of Understanding towards a River Basin Management Plan for the Tisza River supporting sustainable development of the region.

The Tisza Group, which has been established by the ICPDR, is the platform for strengthening coordination and information exchange related to international, regional and national activities and to ensure harmonisation and effectiveness of related efforts. The Tisza countries agreed to prepare a sub-basin plan - the so called Tisza River Basin Management Plan - by 2009. This plan integrated issues on water quality and water quantity, land and water management, flood and drought.

The first step towards this objective is the preparation of the Tisza analysis report (Anaylsis of the Tisza River Basin – 2007), which is the first milestone in implementing the Memorandum of Understanding. It characterises the Tisza River and its basin, identifies the key environmental and water management problems. Following the identification of the key water management issues, the next milestone was the preparation of an integrated Tisza River Basin Management Plan until 2010.

The European Union Strategy for the Danube Region

The EU Strategy for the Danube Region (EUSDR) is a macro-regional strategy adopted by the European Commission in December 2010 and endorsed by the European Council in 2011. The Strategy was jointly developed by the Commission, together with the Danube Region countries and stakeholders, in order to address common challenges together. The Strategy seeks to create synergies and coordination between existing policies and initiatives taking place across the Danube Region.

The EU Strategy for the Danube Region, endorsed in June 2011 by the European Council, is the second EU macro-regional strategy after the EU Strategy for the Baltic Sea Region.

The strategy brings together 14 countries along the Danube and covers an area where 112 million people live, that is one fifth of the EU population: nine EU Member States: Austria, Bulgaria, Czech Republic, Croatia, Germany (Baden-Württemberg, Bayern), Hungary, Slovak Republic, Slovenia and Romania and five non-EU countries: Bosnia and Herzegovina, the Republic of Moldova, Montenegro, Serbia and Ukraine (Odessa, Ivano-Frankivsk, Chernivtsi and Transcarpathia).

The strategy focuses on four pillars, and within each pillar there are concrete cooperation measures that specify the priority areas:

1st Pillar - Connecting the region:

- improving mobility and transport links (priority area 1);
- encouraging a more sustainable energy system (priority area 2);
- Promoting culture and tourism (priority area 3);

2nd Pillar - Protecting the environment:

- restoring and maintaining the quality of water (priority area 4);

- environmental risk management (priority area 5);
- conservation of biodiversity, landscapes and air and soil quality (priority area 6);

3rd Pillar - Growing prosperity:

- developing the knowledge society (priority area 7);
- supporting the competitiveness of enterprises (priority area 8);
- investing in people and skills (priority area 9);

4th Pillar - Strengthening the region:

- increasing institutional capacity and enhancing cooperation (priority area 10);
- collaboration to promote security and combat organized crime and serious crime (priority area 11).

The Global Water Partnership (GWP)

The Global Water Partnership (GWP) is a global action network with over 3,000 Partner organisations in 183 countries. The network has 87 Country Water Partnerships and 13 Regional Water Partnerships.

The network is open to all organisations involved in water resources management: developed and developing country government institutions, agencies of the United Nations, bi- and multi-lateral development banks, professional associations, research institutions, non-governmental organisations, and the private sector.

GWP's action network provides knowledge and builds capacity to improve water management at all levels: global, regional, national and local. Its networking approach provides a mechanism for coordinated action and adds value to the work of many other key development partners.

Four Tisza countries: Ukraine, Slovakia, Hungary and Romania are members and cooperate inside of GWP Central and Eastern Europe Region.

The Carpathian Convention

The Carpathian Convention is a subregional treaty to foster the sustainable development and the protection of the Carpathian region. It has been signed in May 2003 by seven Carpathian States (Czech Republic, Hungary, Poland, Romania, Serbia, Slovak Republic and Ukraine).

In order to bring the Convention and it's main aims alive, the Convention's bodies develop different activities for each thematic area of cooperation.

The activities range from the development of new Protocols and the establishment of strategic partnerships with key actors in the region, towards the realization of strategic projects and initiatives within the Carpathians and beyond.

For some areas of cooperation specific Working Groups have been established by the Conference of the Parties (COP). Where synergies are possible and reasonable, the Convention cooperates with other organizations and initiatives in order to guarantee a comprehensive approach that is able to reach the people in the region.

Chapter 5 Transboundary projects on flood risk management for 2014-2020

Danube Sediment project

The main objective of this project is to improve Water and Sediment Management as well as the morphology of the Danube River. To close existing knowledge gaps, sediment data collection will be performed providing information to the sediment data analysis and will lead to a handbook on good practices of sediment monitoring methods. Furthermore, a baseline document on the Danube Sediment Balance will be prepared, which explains the problems, which arise with sediment discontinuity negatively influencing flood risk, inland navigation, ecology and hydropower production. Possible answers to these problems will be be provided by a catalogue of measures. The main outputs of the project are the first Danube Sediment Management Guidance comprising measures to be implemented and a Sediment Manual for the stakeholders consisting of approaches how to implement the measures, which deliver key contributions to the Danube River Basin Management Plan and the Danube Flood Risk Management Plan.

Project duration is January 2017-June 2019 (30 months). Project Budget is 3.56 mn. euro. The Lead Partner is Budapest University of Technology and Economics. ICPDR is an Associated Strategic Partner (ASP) in this project.

Danube Floodplain project

In the Danube Declaration the Danube Ministers supported the preparation ongoing in the framework of the EUSDR of a “Danube Floodplain Project” with the aim to reduce the flood risk through floodplain restoration along the Danube and other rivers in the basin while at the same time contributing to the integration of the EU Floods Directive, EU Water Framework Directive and EU nature protection legislation as well as biodiversity and climate policies.

The project main objective is to strengthen transnational water management and flood risk prevention. The project specific objectives are (i) Improved knowledge on floodplain restoration and preservation; (ii) Agreement of further actions on floodplain restoration, preservation, and (iii) Improved stakeholder cooperation in floodplain management in DRB.

The project budget is 3,672,655.88 mn. euro. The expected project start is in June 2018.

DAREnet

The DAREnet project is to support flood management practitioners across the Danube River region and from different disciplines to deepen and broaden their Research, Development and Innovation related collaboration (=RDI). DAREnet will build a multi-disciplinary community of practitioners, operating in a network of civil protection organisations, and supported by a broad range of stakeholders from policy, industry and research. Together they will build a transnational and interdisciplinary ecosystem to foster synergies, innovation and its uptake.

The DAREnet project received funding from the European Union’s Horizon 2020 research and innovation programme under the grant agreement No. 740750. The supervising authority of the project is DG HOME.

DAREFFORT – Danube River Basin Enhanced Flood Forecasting Cooperation

The project shall create a system that would be not possibly to be established without a common project in the catchment. The end product has multi-layer relevance:

- Nation-wide benefits for forecasting

- Cross-border issues can be solved via the system
- Basin wide unified system would be created
- EU Flood Directive measure is applied at once along the Danube

The project will result in a cheaper, easier and flexible data exchange system and long-term sustainability is guaranteed through the ICPDR. The project would use the existing tools and materials, not much new purchases are needed (mainly IT).

The main goal of the project is to enhance the access to the recorded data and to provide coherent distribution to all countries in the Danube catchment. The aim is to support the development of the Danube Hydrological System (HIS) (ICPDR) and provide a long-term development perspective for the sufficient conditions of proper basin-wide hydrological forecasting.

The project outputs are as follows:

- Evaluation report on flood and ice forecasting in the DRB;
- Policy recommendations for exchange of data;
- Observed data exchange software;
- Expert workshops on knowledge exchange (9x);
- Pilot action on limited external model access (Iron Gate stretch);
- Guidelines on data management;
- E-learning on flood and ice forecasting practices;
- Danube Forecasting Forum (DAFF) events (2x).

Project duration is 36 months; expected start of the project is June 2018. The estimated project budget is 1,351,898.63 EUR . 24 partners are involved; ICPDR is an Associated Strategic Partner (ASP) in this project.

DANICE/DEVICE Danube

The DANICE ("DANube river basin ICE conveyance investigation and icy flood management") project preparatory activities have been submitted to the DTP SMF call as "Ice management along the Danube – DEVICE Danube". The main outputs are the national and basin-wide operative resource management plan for icy flood together with mitigation measures and harmonization of ice management planning methods and recommendations for Ice Management Master Plan.

LAREDAR

The project idea "Hazard and risk mapping, risk management planning of the LAkes and REservoirs in the DAnube River basin" covers the following topics:

- Inventory of potential flood-problematic lakes and reservoirs (L&R), realization of problems, GIS database and bed geometry data with supplying rivers (sub-catchments)
- Hydrologic assessment of the events that cause inundation around the lake or failure of defense system
- Hazard and risk mapping of the L&R, risk management strategies for L&R

- International consequences and conditions in the operation, good practice or agreements for the future

The funding sources for this project have been explored and the Priority Area 5 Danube Transnational programme topic "Safety of the critical water infrastructure on shared river basins, contingency planning for failure" was found to be the most appropriate. The main target of the project is to review the reservoirs, dams and lakes avaliable for water storage and retention with cross-border influence and the mapping of them. As part of the project, partners would survey reservoirs and a hydrological evaluation of possible events (for exampe levee break). An IT-based platform for continous change of information is a concrete target of the project.

MUNIPARE

Potential project concept development for EEA and Norway Grants 2014-2021 supported by EUSDR Priority Area 5 Hungary coordination. The priority sectors are: Environment, Energy, Climate Change and Low Carbon Economy / Climate Change Mitigation and Adaptation or priority sector: Justice and Home Affairs/Disaster Prevention and Preparedness

The potential outputs are as follows:

- Harmonized municipality risk management plans, commond databases
- Cooperative information network, regional resource management plans
- Best practices and transferable methods for municiplaity protection, content and format
- UNISDR campain trial for the DRB: Disaster Resilience Scorecard for Cities, Quick Risk Estimation-QRE investigation

InterFloodCourse project

The project objective is to develop a harmonized, international postgraduate course on flood and flood risk management which integrates the knowledge of all participating partners and involves expertise of Danube region professionals during this process. The expected result is a comprehensive flood management curriculum that offers a professional development possibility for Civil engineers.

REVITAL I

The project on 'Environmental Assessment for Natural Resources Revitalization in Solotvyno to prevent the further pollution of the Upper-Tisza Basin through the preparation of a complex monitoring system' is the first activity that aims gradually bringing the environmental proposals for this target into practice.

The main goal of the REVITAL I. is to set the foundation for the establishment of the revitalization process of the Solotvyno mine and surrounding area through deepened cross-border cooperation.

Three specific objectives have been identified:

- to examine and evaluate the current environmental state
- to set up an investigative monitoring and to prepare a future complex monitoring system
- to raise awareness and promote the results of the project on different levels.

Chapter 6 Conclusions

In Ukraine there are two main organizations at national level involved in the flood risk management: State Agency of Water Resources of Ukraine (SAWR) and State Service of Emergency Situations (SSES).

Tisza basin within Ukraine fits to administrative borders of Zakarpattya oblast and is located within two orographic rayons (Carpathian Mountains and Hungarian lowland – about 35% of the basin). There are two structural level that take part in formation of geological structure of the territory (the lower structural level and the Folded Carpathians). The climate is a moderate continental with preponderant influence of the Atlantic. The main tributaries of Tisza with river basin surfaces more than 1000 km^2 are Bodrog, Latorica, Uzh, Tur, Borzhava, Rika, Teresva, Bila Tisza, Chorna Tisza. In the basin within the low-land area, the variety of sod-podzolic soils prevail, mountain-forest and meadow-forest soils prevail in the mountainous area, meadow and meadow gley soils prevail in the flood-plain bench of the rivers.

Zakarpattya Oblast includes 13 rayons and 11 cities, 5 of them are the cities of oblast sub-ordinance, i.e. Uzhhorod, Mukachevo, Khust, Beregovo and Chop and 6 of them are the cities of rayon sub-ordinance, and a total number of 579 rural settlements.

The population from Tisza River sub-basin is about 1.257 million inhabitants. Economic activities comprise branches of industry and agriculture.

Regarding the protected areas, there are 456 sites of the natural-reserved fund, 4 national wide sites, 19 national significance landscape preserves, 47 landscape preserves of the local importance, 9 nature reserves, 9 national natural monuments, 329 natural monuments of the local importance, 8 Ramsar sites.

The cultural heritage is represented by churches, monasteries, museums, cultural monuments etc.

Flood protection infrastructure is constituted from dams of about 770.1 km, bank enforcement facilities - 318.8 km, canalized water ways, channels - 1339 km, 1108hydraulic engineering units, 30 drainage on-site pump stations, 8 multi-purpose reservoirs with the total volume capacity 25.3 MCM, 69 water level and discharge measuring stations, 50 automatic hydrometeorological stations (AIMS “TISZA”), drainage system - 318.8 km.

The most important floods that occurred in Tisza River sub-basin during the analysed period (50 years) were the ones from May 1970, October 1974, July 1980, November 1998, March 2001, June 2008 and December 2010.

Ukraine is at the stage of legal approximation to the EU Flood Risk Directive, whereas implementation is planned for later (preliminary flood risk assessment – Nov 2018, preparation of flood risk and flood hazard maps – Nov. 2020 and development of the Flood Risk Management Plan – Nov. 2022).

The conclusions after studying the data from 1961 till now is that the climate affects the hydrological regime of rivers.

Bilateral agreements regarding the water resources management have been signed with Romania, Slovakia and Hungary.

Flood risk management issues in **Romania** are regulated by the Water Law and the National Strategy for Flood Risk Management in medium and long term (2010 - 2035). The institutions involved are organized at national (Ministry of Water and Forests through National Administration “Apele

Române”), regional (through 11 River Basin Authorities) and local level (Water Management Systems).

The physical - geographic features of the Tisza River sub-basin on the territory of Romania are influenced by the specific relief which includes all major relief forms, with altitudes between 75 to 2509 m.a.s.l., overlaid over crystalline and magmatic rocks, mesozoic and neozoic sedimentary rocks, with temperate continental climate and whose features take into account the relief forms, and a wide range of soils (predominant soils in the mountains – spodosols and umbriosols, luviosols in the hills and cernisols in Transylvanian Plateau and in plains). The main tributaries of Tisza with river basin surfaces more than 1000 km^2 are Vișeu, Iza, Tur, Someș, Șieu, Someșul Mic, Lăpuș, Crasna, Ier, Barcău, Crișul Repede, Crișul Negru, Crișul Alb, Mureș, Arieș, Târnava, Târnava Mică, Sebeș, Strei, Aranca, Bega and Bega Veche (Old Bega). Bârzava, Moravița and Caraș are tributaries of the Danube-Tisza-Danube Channel System (DTD).

The population from Tisza River sub-basin is about 5 million inhabitants, with an about equal distribution in the urban (about 80 urban centers) and rural areas (about 875 rural centers). Economic activities comprise branches of industry and agriculture.

Regarding the protected areas, there are 40 sites of S.P.A., 170 SCI type sites, about 355 natural parks.

The cultural heritage is represented by churches, monasteries, museums, cultural monuments etc.

Flood protection infrastructure is constituted from embankments works (about 3634.8 km), 273 permanent reservoirs with a total attenuation volume of 378.841 million m3, 87 temporary reservoirs with a total volume of 199.623 million m3, 19 polders with a total volume of 153.888 million m3, 621.71 km of diversion canals with a derived discharge of 843.83 million m3 and 9 hydraulic complex facilities with a total maximum discharges of 714.8 million m3.

Drainage systems are referring to internal water leakage through drainage canals and through valleys and depressions, by maneuvering of weirs and the operation of pumping stations serving for this purpose from internal water systems and subsystems. It contains 89 drainage systems.

Taking into account hydrological criteria and the impact of the floods in terms of damages, 37 historical significant floods were selected for reporting in the first cycle of Floods Directive 2007/60/EC implementation. 29 areas with potential significant flood risk were designated along Tisza river and its major tributaries (with river basin surfaces more than 1000 km^2), based on available data analyzed through the national projects ”Plan for Protection, Prevention and Mitigation of the floods effects in the river basin” and ”Contributions to the development of the flood risk management strategy”, and on river sectors where breaches in dykes can occur.

Most of flood hazard maps reported to EC were elaborated through the national project ”Plan for Protection, Prevention and Mitigation of the floods effects in the river basin” as a result of hydrological and hydraulic studies, for a high probability scenario (maximum discharge with probability of exceeding of 10%), for a low probability scenario (maximum discharge with probability of exceeding of 0.1%) and for a medium probability scenario (maximum discharge with probability of exceeding of 1%). For the rest of the areas simplified methods (based on fuzzy systems modeling – GrassGis and approximate modeling with HEC-RAS) were developed.

Based on a methodology developed by National Institute of Hydrology and Water Management and National Administration ”Apele Române” – headquarters, quality flood risk maps have been elaborated, taking into consideration three classes of flood risk (high, medium and low risk).

Potential adverse consequences consists in: 392,787 possible affected inhabitants, about 514 km of railway and 1405 km of national / European, county and communal roads, 29 SPA areas, 49 SCI areas, 70 protected for the abstraction of water intended for human consumption, 17 IED installations, 228 churches, 9 museums and 3 cultural monuments.

The results of some climate models with increasingly fine spatial resolutions to capture the complex orography of each region allowed the development of scenarios for different river basins on the territory of Romania (among them Crișul Alb and Mureș river basins) regarding the impact assessment on water resources.

Bilateral agreements regarding the water resources management have been signed with Ukraine, Hungary and Serbia.

Flood risk management issues in **Slovakia** are regulated by the Act. 7/2010 Coll. on flood protection and the institutions involved are organized at national (Ministry of Environment through Slovak Water Management Enterprise), provincial and local level.

The physical - geographic features of the Tisza River sub-basin on the territory of Slovakia are influenced by the specific relief, respectively lowlands and hillsides in the south of the area, and highlands and mountains in the central and northern part of the area. The largest part of the basin area lies at altitude of 300-500 m.a.s.l. and the smallest area takes up an altitude from 1000 to 1500 m.a.s.l. In the Tisza River Basin in Slovakia are following geological structures: neogene deposits with young vulcanite's, the older palaeozoic rocks, paleozoic rocks and Tertiary, represented by deposits of paleogene, neogene and neogeneous volcanites. The climate is temperate continental and soils are the ones from cernisole to spodisoil class. In the Tisza River Basin are 4 main watercourses with their tributaries: Slaná, Bodva, Hornád and Bodrog.

The population from Tisza River sub-basin is about 1502890 inhabitants that lives in 1175 municipalities. Economic activities comprise branches of industry and agriculture.

Regarding the protected areas, there are 5 National Parks, 9 protected areas, 13 protected bird areas and 118 areas of European interest.

The cultural heritage consists of 3819 national cultural monuments, 5 spatial cultural and historical units, 9 monument zones, 4 monument reservations, 5 World Heritage Sites.

Flood protection infrastructure is constituted mainly from dykes (784, 32 km), most of them built for maximum discharges of 1% probability of exceeding, 13 permanent reservoirs (with a total volume of about 660 million m3), 6 polders (with a total volume of about 54.4 million m3), 25 pumping stations and 1 hydraulic complex facility.

In the Slovak part of the Tisza River Basin there are 14 drainage systems in total. Their primary function is the removal of internal waters. The drainage system in the Tisza River Basin has a flow capacity of 1.6 to 18.9 m3/s.

The most important floods that occurred in Tisza River sub-basin were the ones from 1395, 1813, 1845, July 1998, July 2004, May 2010 and June 2010, the source of flooding being fluvial, pluvial and groundwater (in 2010). The areas with potential significant flood risk were designated at locality level and resulted a total number of 222 river sectors. There are two types of areas with potential significant flood risk: with an existing potentially significant flood risk (195) and with a probable occurrence of potentially significant flood risk (27).

Flood hazard maps, resulted after mathematical hydrodynamic modeling of steady and unsteady flow, were elaborated for the geographic areas in which the preliminary flood risk assessment identified the existence of a potential significant flood risk and for areas where probable occurrence of significant flood risk can be assumed. On the maps is displayed the flood range, which could cause floods with an average return period from once in 5 years to once in 1000 years, or other flood with an exceptionally dangerous.

Flood risk maps contain data of potential negative consequences of floods, which are displayed on flood hazard maps. On the maps are mentioned data about estimated number of potential affected inhabitants by floods and other economic activities in flood potential endangered areas.

In the Fifth National Communication of the Slovak Republic on Climate Change, the results of the modeling according to the CCCM97 scenario shows that it is possible, despite the possibility of increasing the amount of precipitation, to expect a decrease in runoff from the whole area of Slovakia.

Bilateral agreements regarding the water resources management have been signed with Hungary and Ukraine.

Flood risk management issues in **Hungary** are the responsibility of the General Directorate of Water Management (OVF) under the direction and supervision of the Ministry of Interior. The OVF supervise and coordinates the 12 Regional Water Directorates.

The physical - geographic features of the Tisza River sub-basin on the territory of Hungary are influenced by the specific relief, which has two major relief forms: the lowland section, characterized by a very low altitude (78-140 m.a.s.l.) and poor morphological fragmentation, and, in contrast, the mountainous regions, with relatively high altitudes. This river basin has the lowest (Szeged-Gyálarét – 75.8 m.a.s.l.), and the highest (Kékes – 1014 m.a.s.l.) points in Hungary. In the Tisza sub-basin dominate are the lofty sedimentary rocks in the top 10 m caprock formations. The most sedimentary rocks are clay and sand and between the Danube and Tisza are located the most blown sand.The climate is temperate continental and the predominant soils are the ones from cernisole class. Major tributaries of the Hungarian section are: Túr (Tur), Szamos (Somes), Kraszna (Crasna), Bodrog, Sajó (Slaná), Zagyva, Körös (Crus) and Maros (Mures). The distribution system (TIKEVIR) built on the Tisza River Basin supplies water from the Tisza to the Körös. This system can supply the Jászság, the Nagykunság, and a part of the region between the Körös and Maros river with water for irrigation, and also for the ecological water supply of the Körös River.

The population from Tisza River sub-basin is about 4048562 inhabitants, the population density being 87.3 persons/km^2. In the northern regions of the sub-basin, the industry is much larger, whereas agriculture in the southern regions is the driving force.

Regarding the protected areas, there are 5 National Parks and there are several significant landscape protection areas.

Hungary has 8 World Heritage Sites, and 4 of these are located on the Tisza River basin: the Caves of Aggtelek Karst, the Hortobágy National Park, the Old Village of Hollókő and its surroundings, and the Tokaj Wine Region.

Flood protection infrastructure is constituted mainly from dykes. There are 2942, 9 km length flood protection dyke along the Tisza River, 2826 km of which is lack of height. It means that 96 % of the Tisza valley's flood protection dykes don't reach the designed flood water level and the safety. There are also one permanent reservoir, Tisza-tó, 11 temporary reservoirs, 11 polders with a volume > 1.000.000 m^3, 3 diversion cannals and 2 hydraulic complex facility. The Tisza–Körös Valley Management System (TIKEVIR) is a system of natural watercourses, dams, sluice gates, inter-basin diversion canals transferring and distributing water resources of the Tisza–Körös rivers over an area of 15000 km^2. The average inflow to the system is 680 m^3/s, while the summer low flow is 157 m^3/s. The permitted intake from the Tisza is 114 m^3/s, although the actual annual average intake is about 25 m^3/s. The flow rate is managed or controlled to some extent, as water systems are partially regulated.

In the Tisza River Basin there are 59 main drainage systems, 17704 km of canals, which are operated in exclusive state ownership. There are 395 inland water pump stations in the Tisza River valley.

The catastrophic floods of the last decades have been caused not only by the major Tisza river, but also by its tributaries. High water stages during the last 15 years in the catchment area of the Tisza River proved to be critical in 1998, 1999, 2000, 2001, 2006 and 2010.

During the flood mapping process there were prepared terrain models and 2D hydrodynamic models for 120 floodplains. In Hungary, for the total of 745 flood protection dyke breaking points in eight designed areas (three designed areas are located in Tisza River Basin) 1367 scenarios were calculated. During the 2D hydraulic modeling process the Mike 21 FM HD model was used for 50 m x 50 m square grid. The result of the 2 D hydraulic modeling consisted in the inundation maps. MIKE 21 FM models were used for modeling the unprotected floodplains. 1‰, 1 %, and 3 % probability flood hazard maps were reported to EC.

The risk maps are produced in 50 m x 50 m square grid. The flood risk assessments were expressed as financial risk (resulted an amount of financial risk of 136343 million HUF/ year), human life risk, evaluation of cultural heritage (an area of 8288 ha containing cultural heritage may be affected) and environmental effects (30 floodplains of 10435 ha may be affected).

The General Directorate of Water management assessed the impacts of climate change on floods. In the Tisza River basin the annual run-off is decreasing, the flood events are more frequent. Another result of the climate change is the increasing frequency of high intensity of rainfall events, which increase the local water damage events. Regarding the degree of uncertainty of the analysis, the impact of climate change on the smaller streams and the flash floods seem clear, but for larger rivers have there is a greater risk uncertainty.

Bilateral agreements regarding the water resources management have been signed with Slovakia, Ukraine, Romania and Serbia.

Flood risk management issues in **Serbia** are regulated by the Water Law and the institutions involved are organized at national (Ministry of Agriculture, Forestry and Water Management through Republic Directorate for Water), provincial and local level.

The physical - geographic features of the Tisza River sub-basin on the territory of Serbia are influenced by the specific relief of the plain area, with low altitude planes overlaid over loess and wind sands, with temperate continental climate and soils predominantly of the cernisole class. The main tributaries of Tisza are those on the left bank coming from Romania – Old Bega and Bega Channel, the right bank tributaries having small catchments and almost all are incorporated into the Danube-Tisza-Danube Channel System (DTD).

The population from Tisza River sub-basin is about 856000 inhabitants, the majority living in settlements with less than 5000 inhabitants. The main economic activity is agriculture.

Regarding the protected areas, there are 1 National Park, 2 Nature Parks, 1 Area of Exceptional Features and 5 Special Nature Reserve.

The cultural heritage consists of 266 monuments of culture, 5 spatial cultural and historical units, 11 archaeological sites and 5 famous sites.

Flood protection infrastructure is constituted mainly from dykes built for maximum discharges of 1% probability of exceeding and from the DTD, which interconnects the rivers in Vojvodina. The Dam on the Tisza River is the key structure in DTD and has an useful volume at the normal water stage of about 50 million m^3.

Drainage system is developed and contains 134 drainage systems and DTD serves as a primary infrastructure system.

The most important floods that occurred in Tisza River sub-basin after the dykes system development were the ones from 2000 and 2006. Most of the areas with potential significant flood risk are related to the state border with Romania and Hungary, and are considered as lines corresponding to river sectors.

Flood hazard and flood risk maps are to be developed taking into account that 2000 km2 are situated in flood prone areas.

Estimation of the Climate Change impacts on floods has not been studied in details, a high level of uncertainty being associated with Climate Change effects on flood events. There are implemented and ongoing projects related to climate change impact on water resources.

Bilateral agreements regarding the water resources management have been signed in 1955 with Romania and Hungary.

General conclusions

The Integrated Report for Tisza River Basin provides an overview of flood risk for Tisza River Basin, describing how water management is done nationwide, the river basin geographical features, the flood protection infrastructure, the drainage system, the criteria took into account for designation of significant historical floods and of the areas with significant potential flood risk, the elaboration of national hazard and flood risk maps, the estimation of the impact of Climate Change on high flow, the risk indicators, the Climate Change reports based on available studies at EU/ national level.

The Integrated Report for Tisza River Basin is based on the 5 Country Reports that were developed by Ukraine, Romania, Hungary, Slovakia and Serbia.

Due to the fact that Tisza is a transboundary river, a rigorous transboundary flood management is necessary, in accordance with the principles of European Directives 2000/60/EC and 2007/60/EC:

- ”Effective flood prevention and mitigation requires, in addition to coordination between Member States, cooperation with third countries. This is in line with Directive 2000/60/EC and international principles of flood risk management as developed notably under the United Nations Convention on the protection and use of transboundary water courses and international lakes, approved by Council Decision 95/308/EC (4), and any succeeding agreements on its application.” (Art. (6) of the the Floods Directive Preamble);
- ”With a view to avoiding and reducing the adverse impacts of floods in the area concerned it is appropriate to provide for flood risk management plans. The causes and consequences of flood events vary across the countries and regions of the Community. Flood risk management plans should therefore take into account the particular characteristics of the areas they cover and provide for tailored solutions according to the needs and priorities of those areas, whilst ensuring relevant coordination within river basin districts and promoting the achievement of environmental objectives laid down in Community legislation. In particular, Member States should refrain from taking measures or engaging in actions which significantly increase the risk of flooding in other Member States, unless these measures have been coordinated and an agreed solution has been found among the Member States concerned.” (Art. (13) of the the Floods Directive Preamble);
- ”The solidarity principle is very important in the context of flood risk management. In the light of it Member States should be encouraged to seek a fair sharing of responsibilities, when measures are jointly decided for the common benefit, as regards flood risk management along water courses.” (Art. (15) of the the Floods Directive Preamble);
- ”In the case of international river basin districts, or units of management referred to in Article 3(2)(b) which are shared with other Member States, Member States shall ensure

that exchange of relevant information takes place between the competent authorities concerned.” (Art. (4) point 3 of Floods Directive);

- ”The preparation of flood hazard maps and flood risk maps for areas identified under Article 5 which are shared with other Member States shall be subject to prior exchange of information between the Member States concerned.” (Art. (6) point 2 of Floods Directive);
- ”In the interests of solidarity, flood risk management plans established in one Member State shall not include measures which, by their extent and impact, significantly increase flood risks upstream or downstream of other countries in the same river basin or sub-basin, unless these measures have been coordinated and an agreed solution has been found among the Member States concerned in the framework of Article 8.” (Art. (7) point 4 of Floods Directive);
- ”Where an international river basin district, or unit of management referred to in Article 3(2)(b), falls entirely within the Community, Member States shall ensure coordination with the aim of producing one single international flood risk management plan, or a set of flood risk management plans coordinated at the level of the international river basin district. Where such plans are not produced, Member States shall produce flood risk management plans covering at least the parts of the international river basin district falling within their territory, as far as possible coordinated at the level of the international river basin district.” (Art(8) point 2 of Floods Directive);
- ”Where an international river basin district, or unit of management referred to in Article 3(2)(b), extends beyond the boundaries of the Community, Member States shall endeavour to produce one single international flood risk management plan or a set of flood risk management plans coordinated at the level of the international river basin district; where this is not possible, paragraph 2 shall apply for the parts of the international river basin falling within their territory.” (Art(8) point 3 of Floods Directive);
- ”The flood risk management plans referred to in paragraphs 2 and 3 shall be supplemented, where considered appropriate by countries sharing a sub-basin, by more detailed flood risk management plans coordinated at the level of the international sub-basins.” (Art.(8) point 4 of Floods Directive).

In all countries the activity regarding flood risk management is coordinated at national level by a Ministry through a national water management authority who coordinates the institutions with responsibilities in water management at regional level.

The geographical features of Tisza river basin is related to the fact that it comprise all the major relief form. An important fact is that the number of inhabitants of Tisza river basin is about 12.6 million.

A common methodology regarding the designation of historical significant floods and of areas with potential significant flood risk should be developed for Tisza River, in accordance with the national laws from each country and with the European Directives, in the present each country has treated the Tisza River sectors separately.

Flood hazard and flood risk maps were elaborated only in Romania, Hungary and Slovakia as a requirement of Floods Directive 2007/60/EC implementation.

Ukraine and Serbia are about to implement the first cycle of Floods Directive 2007/60/EC.

Generally, the risk assessment was done as a qualitative estimation (exception Hungary, were a quantitative risk estimation was done), based on the exposure of the elements to floods, in different scenarios. For further studies, common scenarios must be agreed and a quantitative method should be developed, taking into account the hazard in terms of probability of exceedance of maximum discharge, water depth, type of element, degree of damage etc.

For the estimation of the impact of Climate Change on flood risk for Tisza River additional studies are needed, for similar scenarios, in all countries. There are at national level studies regarding the climate change effects, but they are not dedicated to Tisza River basin.

All countries have Agreements with the neighbours regarding the water management of Tisza River.

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Dikes in Ukraine

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
1.	Right bank dike St.Batar	Batar	RB	Korolevo	35200		1970	1%		moderate
2.	Left bank dike Tisza river	Tisza	LB	Korolevo	31900		1954	1%		very good
3.	Right bank dike Latorica river	Latorica	RB	Vinkovo	27840		1939	5%		moderate
4.	Left bank dike St.Batar	Batar	LB	Korolevo	24800		1970	1%		moderate
5.	Right bank dike Tisza river	Tisza	RB	Vylok	23000		1977	1%		moderate
6.	Left bank dike Latorica river	Latorica	LB	Solomonovo	21900		1967	1%		bad
7.	Left bank dike Latorica river	Latorica	LB	Chomonyn	20900		1939	5%		moderate
8.	Right bank dike Tisza river	Tisza	RB	Solomonovo	18400		1893	1%		moderate
9.	Right bank dike Latorica river	Latorica	RB	Palad Komarivtsi	17600		1967	1%		bad
10.	Right bank dike Sernianskyi channel	V. Sernianskyi	RB	Bakosh	13500		1899	5%		moderate
11.	Left bank dike Sernianskyi channel	V. Sernianskyi	LB	Bakosh	13500		1899	5%		moderate
12.	Right bank dike Sypa-Charonda channel	Sypa-Charonda	RB	Geten	13200		1899	5%		moderate
13.	Right bank dike Vysokoberezhyi channel Zhniatyno_1	Vysokoberezhyi	RB	Chomonyn	12930					moderate
14.	Left Bank Cavalier Channel Kidiosh	Kidiosh	LB		11700					
15.	Left bank dike Vysokoberezhyi channel 1 (from Chomonyn to railway bridge)	Vysokoberezhyi	LB	Chomonyn	11330					moderate
16.	Left bank dike Borzhava river Part 2	Borzhava	LB	Bene	11000		1954	1%		moderate
17.	Left bank dike Borzhava river (polder)	Borzhava	LB	Kvasovo	10200		1984	1%		moderate
18.	Right Bank Cavalier Channel Mertse (Mukachevo Rayon)	Mertse	RB		10000					
19.	Left bank dike N.Batar	N.Batar	LB	Pyiterfolvo	9100		1954	1%		moderate
20.	Right bank dike N. Batar	N.Batar	RB	Pyiterfolvo	9100		1954	1%		moderate
21.	Left bank Sypa-Charonda channel	Sypa-Charonda	LB	Petrivka	9000		1967	1%		bad

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
22.	Right bank dike Sypa-Charonda channel	Sypa-Charonda	RB	Petrivka	9000		1967	1%		bad
23.	Left bank dike Stara river	Stara	LB	Drahynia	8700		1981	5%		moderate
24.	Right bank dike Tisza river	Tisza	RB	Vary	8600		1954	1%		moderate
25.	Right bank dike Tisza river	Tisza	RB	Vary	8200		1954	1%		moderate
26.	Left bank dike Borzhava river Shalanky	Borzhava	LB	Shalanky	8120		1990	1%		moderate
27.	Left bank dike Teresva river	Teresva	LB	Ternovo	8100		1987	1%		very good
28.	Left bank dike Borzhava river (polder)	Borzhava	LB	Nyzhni Remety	8100		1987	5%		moderate
29.	Right bank dike Borzhava river	Borzhava	RB	Beregy	8000		1968	5%		moderate
30.	Right bank dike Borzhava river Part 2	Borzhava	RB	Bene	7900		1954	1%		moderate
31.	Left bank dike Slatina channel	Slatina	LB	Velyki Geivtsi	7900		1967	1%		moderate
32.	Right Bank Cavalier Channel Kidiosh	Kidiosh	RB		7670					
33.	Right bank dike Slatina channel	Slatina	RB	Velyki Geivtsi	7500		1967	1%		moderate
34.	Right bank dike Iaruga channel	Iaruga	RB	Cherveniovo	7400		1939	5%		moderate
35.	Left bank dike Palad	Palad	LB	Palad	7200		1969	1%		bad
36.	Right bank dike Kamarochi channel	Kamarochi	RB	Palad Komarivtsi	7100		1967	1%		moderate
37.	Left bank dike Kamarochi channel	Kamarochi	LB	Siurte	7100		1967	1%		moderate
38.	Right bank dike Stara river	Stara	RB	Drahynia	7000		1982	5%		moderate
39.	Left bank dike Vysokoberezhnyi channel	Vysokoberezhnyi	LB	V. Dobron	7000		1976	1%		bad
40.	Left bank dike Latorica river Mukachevo (from the Sadova-Monastery Bridge to railway bridge)	Latorica	LB	Mukachevo	6855					moderate
41.	Left bank dike Latorica river Mukachevo (from the railway bridge to the road bridge)	Latorica	LB	Mukachevo	6855					moderate
42.	Left Bank Cavalier Channel Mertse	Mertse	LB		6700					
43.	Right bank dike Irshavka river	Irshavka	RB	Kamianske	6270		1994	5%		moderate
44.	Left bank dike Iaruga channel	Iaruga	LB	Cherveniovo	5900		1966	5%		moderate
45.	Left bank dike Solotvynskyi channel	Solotvynskyi	LB	Dovhe Pole	5900		1967	10%		moderate

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
46.	Right bank dike Solotvynskyi channel	Solotvynskyi	RB	Dovhe Pole	5800		1967	10%		moderate
47.	Right bank dike Koropetskyi channel Mukachevo (from the road bridge to Franko Str.)	Koropetskyi	RB	Mukachevo	5580					moderate
48.	Left bank dike Salva river	Salva	LB	Vynogradiv	5500		1954	1%		moderate
49.	Right bank dike Salva river	Salva	RB	Vynogradiv	5500		1934	1%		moderate
50.	Right bank dike Charonda-Latorytsa channel	Charonda-Latorytsa	RB	Chervone	5500		1976	1%		moderate
51.	Left bank dike Charonda – Latorica channel	Charonda-Latorytsa	LB	Chervone	5500		1976	1%		moderate
52.	Left bank dike Turia river	Turia	LB	Rakovo	5300		1986	1%		moderate
53.	Right bank dike Tisza river	Tisza	RB	Tiachiv	5280		2008	1%		very good
54.	Right bank dike N. Sernianskyi channel	N. Sernianskyi	RB	Dobron	5100		1976	1%		moderate
55.	Left bank dike N. Sernianskyi channel	N. Sernianskyi	LB	Demechi	5100		1976	1%		moderate
56.	Right bank dike Latorica river Mukachevo (from the Sadova-Monastery Bridge)	Latorica	RB	Mukachevo	5013					moderate
57.	Left bank dike Polui river	Polui	LB	Chopivtsi	4750		1967	5%		moderate
58.	Left bank dike K-3 channel	K-3	LB	Kamianske	4600		1994	1%		moderate
59.	Right bank dike Stara river	Stara	RB	Zniatsevo	4600		1967	1%		moderate
60.	Right bank dike Vella river	Vella	RB	Serednie	4600		1967	10%		moderate
61.	Left bank dike N. Sernianskyi channel	N. Sernianskyi	LB	Batiovo	4500		1901	5%		moderate
62.	Right bank dike Polui river	Polui	RB	Chopivtsi	4350		1968	5%		moderate
63.	Right bank dike Turia river	Turia	RB	T.Pasika	4220		1987	1%		moderate
64.	Left bank dike Uzh river	Uzh	LB	Storozhnytsa	4200		1967	1%		moderate
65.	Right bank dike Uzh river	Uzh	RB	Nevytske	4180		1967	1%		moderate
66.	Right bank dike Uzh river №2	Uzh	RB	Uzhgorod	4130			5%		moderate

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
67.	Left bank dike Koropetskyi channel Mukachevo (from the Palanok road bridge to Franko Str.)	Koropetskyi	LB	Mukachevo	4010					moderate
68.	Right bank dike Vysokoberezhnyi channel	Vysokoberezhnyi	RB	V. Dobron	4000		1976	1%		bad
69.	Right bank dike Borzhava river	Borzhava	RB	Hreblia	3800		1973	1%		moderate
70.	Right bank dike Borzhava river	Borzhava	RB	Verkhni Remety	3750		1983	5%		moderate
71.	Left bank dike Tisza river (upstream the bridge)	Tisza	LB	Vyshkovo	3610		2001	1%		moderate
72.	Right bank dike Tereblia river	Tereblia	RB	Dragovo	3560		2004	1%		very good
73.	Right bank dike Hashparka river	Hashparka	RB	V.Kopania	3500		1987	1%		moderate
74.	Left bank dike Borzhava river V.Komiaty	Borzhava	LB	V.Komiaty	3400		1971	1%		moderate
75.	Left bank dike Charonda-Tisza channel	Charonda-Tisza	LB	Esen	3400		1976	1%		bad
76.	Left bank dike Rika river	Rika	LB	Iza	3390		1995	3%		moderate
77.	Left bank dike Tisza river (downstream the bridge)	Tisza	LB	Vyshkovo	3300		2002	1%		very good
78.	Right bank dike Rika river	Rika	RB	Koshelevo	3300		1985	1%		moderate
79.	Left bank dike Salva river	Salva	LB	Kvasovo	3300		1968	5%		moderate
80.	Right bank dike Charonda -Tisza channel	Charonda -Tisza	RB	Esen	3300		1976	1%		bad
81.	Left bank dike Luzhanka river	Luzhanka	LB	Shyrokyi Lug	3200		1983	1%		very good
82.	Left bank dike Irshavka river	Irshavka	LB	Kamianske	3200		1983	5%		moderate
83.	Right bank dike Turia river	Turia	RB	Simer	3200		2008	1%		very good
84.	Left bank dike Turia river	Turia	LB	Simer	3200		2008	1%		very good
85.	Left bank dike Tisza river	Tisza	LB	Kryva	3152		2010	1%		very good
86.	Right bank dike Tisza river V.Kopania	Tisza	RB	V.Kopania	3000		1986	1%		moderate
87.	Right bank dike №2 Tisza river	Tisza	RB	Velykyi Bychkiv	2930		1963	1%		moderate
88.	Right bank dike Tur river	Tur	RB	Fertesholmash (Zabolottia)	2900		1963	1%		bad
89.	Water reservoir dike “Boroniava”	Boroniava		Boroniava	2900		1970	1%		moderate

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
90.	Left bank dike Teresva river	Teresva	LB	Kalyny	2900		2008	1%		very good
91.	Left bank dike Tisza river	Tisza	LB	Iablunivka	2840		2007	1%		very good
92.	Left bank dike Hashparka river	Hashparka	LB	V.Kopania	2800		1987	1%		moderate
93.	Left bank dike Uzh river	Uzh	LB	Zarichevo	2800		2012	1%		very good
94.	Right bank dike Uzh river (state border)	Uzh	RB	Uzhgorod	2770		1967	1%		moderate
95.	Right bank dike Tereblia river	Tereblia	RB	Dylovo	2760		2010	1%		very good
96.	Right bank dike Tisza river	Tisza	RB	Bedevlia	2760		2008	1%		very good
97.	Right bank dike Bezimianka river V.Kopania	Bezimianka	RB	V.Kopania	2750		1989	1%		moderate
98.	Right bank dike Tisza river (Kozari)	Tisza	RB	Khust	2730		2002	1%		very good
99.	Right bank dike №2 Teresva river	Teresva	RB	Vilkhivtsi	2700		1987	1%		moderate
100.	Left bank dike Turia river	Turia	LB	Mokra	2700		1978	1%		moderate
101.	Right bank dike Khustets river	Khustets	RB	Khust	2692		2010	1%		very good
102.	Right bank dike №2 Tereblia river	Tereblia	RB	Tereblia	2645		1993	1%		moderate
103.	Left bank dike Tisza river	Tisza	LB	Veliatyn	2600		1972	1%		moderate
104.	Left bank dike Teresva river	Teresva	LB	Teresva	2600		2008	1%		very good
105.	Right bank dike Shopurka river	Shopurka	RB	Velykyi Bychkiv	2600		1966	1%		bad
106.	Left bank dike Latorica river	Latorica	LB	Bystrytsa	2450		1948	5%		moderate
107.	Right bank dike Tereblia river	Tereblia	RB	Bushtyno	2400		1987	5%		moderate
108.	Right bank dike Teresva river	Teresva	RB	Neresnytsa	2400		2009	1%		very good
109.	Right bank dike Luzhanka river	Luzhanka	RB	Neresnytsa	2400		1987	1%		very good
110.	Left bank dike reclamation channel Vilkhivka	reclamation channel	LB	Vilkhivka	2380		1995	10%		moderate
111.	Left bank dike Tereblia river	Tereblia	LB	Krychevo	2350		2008	1%		very good
112.	Left bank dike Teresva river	Teresva	LB	Hanychi	2300		2008	1%		very good
113.	Right bank dike Rika river (upstream the bridge)	Rika	RB	Lypcha	2200		1970	1%		very good
114.	Right bank dike №1 Tereblia river	Tereblia	RB	Chumalevo	2200		2010	1%		very good
115.	Right bank dike №2 Teresva river	Teresva	RB	Dobrianske	2200		2009	1%		very good
116.	Left bank dike Tereblia river	Tereblia	LB	Bushtyno	2150		1983	5%		moderate

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
117.	Right bank dike Tisza river	Tisza	RB	Khust	2140		2003	1%		moderate
118.	Right bank dike Palad	Palad	RB	V.Palad	2100		1969	1%		moderate
119.	Left bank dike Borzhava river Borzhavske	Borzhava	LB	Borzhavske	2000		1986	1%		moderate
120.	Right bank dike Tisza river	Tisza	RB	Teresva	2000		2009	1%		very good
121.	Left bank dike Shopurka river	Shopurka	LB	Velykyi Bychkiv	2000		1966	1%		moderate
122.	Left bank dike Tsyganivka channel	Tsyganivka	LB	Kholmtsi	2000		1967	10%		moderate
123.	Right bank dike Tsyganivka channel	Tsyganivka	RB	Kholmtsi	1900		1967	10%		moderate
124.	Left bank dike Tereblia river	Tereblia	LB	Kolochava	1850		2010	1%		very good
125.	Left bank dike Bezimianka river V.Kopania	Bezimianka	LB	V.Kopania	1820		1989	1%		moderate
126.	Left bank dike Teresva river	Teresva	LB	Kryve	1800		2002	1%		very good
127.	Left bank dike Tereblia river	Tereblia	LB	Ruske Pole	1800		2009	1%		very good
128.	Right bank dike №1 Teresva river	Teresva	RB	Vilkhivtsi	1800		1987	1%		moderate
129.	Right bank dike Uzh river	Uzh	RB	Dubrynychi	1780		1933	5%		bad
130.	Right Bank Cavalier Channel Kvasovo, part 2	reclamation channel	RB		1700					
131.	Left Bank Cavalier Channel Kvasovo, part 1	reclamation channel	LB		1670					
132.	Right bank dike Tisza river (downstream Veliatynskyi bridge)	Tisza	RB	Khust	1640		2003	1%		very good
133.	Right bank dike Teresva river	Teresva	RB	Bilovartsi	1600		1987	5%		very good
134.	Right bank dike Latorica river	Latorica	RB	Kolchyno	1600		1936	5%		moderate
135.	Left bank dike Tereblia river	Tereblia	LB	Dragovo	1440		2004	1%		very good
136.	Right bank dike Rika river (downstream the bridge)	Rika	RB	Lypcha	1320		1985	1%		very good
137.	Right bank dike Borzhava river	Borzhava	RB	V.Komiaty	1300		2001	1%		moderate
138.	Right bank dike Borzhava river	Borzhava	RB	Zarichia	1300		2003	1%		moderate
139.	Right bank dike Osava river	Osava	RB	Koshelevo	1300		1971	1%		moderate
140.	Right bank dike Tereblia river	Tereblia	RB	Vonigovo	1300		1991	5%		moderate
141.	Right bank dike Borzhava river Kvasovo	Borzhava	RB	Kvasovo	1300		1983	5%		moderate
142.	Right bank dike Rika river (Ekoz)	Rika	RB	Khust	1290		1984	1%		moderate
143.	Right bank dike №1		RB	Orikhovytsa	1260		1967	1%		moderate
144.	Left bank dike Borzhava river V.Komiaty №2	Borzhava	LB	V.Komiaty	1254		2009	1%		very good

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium height (m)	YFO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (p_c%)	Q (m^3/s)	
145.	Right bank dike №3 Tiachivets river	Tiachivets	RB	Tiachiv	1200		1986	5%		moderate
146.	Right bank dike Teresva river	Teresva	RB	Kobyletska Poliana	1200		2010	1%		very good
147.	Right bank dike Hlybokyi channel	Hlybokyi	RB	Kholmtsi	1180		1967	10%		moderate
148.	Left bank dike № 1 Tisza river	Tisza	LB	Tiszobyken (Bobove)	1173		2009	1%		very good
149.	Right bank dike №1 Tiachivets river	Tiachivets	RB	Tiachiv	1150		1990	1%		moderate
150.	Left bank dike Boroniavka river	Boroniavka	LB	Khust	1100		1967	1%		moderate
151.	Right bank dike Borzhava river	Borzhava	RB	Zarichia	1100		2003			very good
152.	Right bank dike Teresva river	Teresva	RB	Pidplesha	1100		2008	1%		very good
153.	Right bank dike Teresva river	Teresva	RB	Bedevlia	1100		1993	5%		moderate
154.	Right bank dike №1 Teresva river	Teresva	RB	Dobrianske	1100		2008	1%		very good
155.	Right bank dike №2 Tereblia river	Tereblia	RB	Chumalevo	1080		2010	1%		very good
156.	Left bank dike №3 Tisza river	Tisza	LB	Rakhiv	1050		2000	1%		very good
157.	Right bank dike Tisza river (Khmeliv)	Tisza	RB	Dilove	1022		2010	1%		very good
158.	Left bank dike Tiachivets river	Tiachivets	LB	Tiachiv	1020		1986	5%		moderate
159.	Right bank dike Teresva river	Teresva	RB	Hanychi	1000		2009	1%		very good
160.	Right bank dike №2 Tisza river	Tisza	RB	Rakhiv	1000		1988	1%		moderate
161.	Right bank dike Vela river	Vela	RB	Zniatsevo	1000		1940	5%		moderate
162.	Left bank dike Hlybokyi channel	Hlybokyi	LB	Kholmtsi	1000		1967	10%		moderate

[1]- left bank (LB) or right bank (RB)

[2] – YFO year of function operation

[3] – technical status: very good, moderate, bad /bad.

Dikes in Romania

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m^3/s)	
	Someș-Tisa subbasin									
1	Someș River in Dej	Someș	LB	Dej	1700	3	1981	5	1570	satisfying
2	Someș River in Cuzdrioara	Someș	RB	Cuzdrioara	2100	3	1964	5	1500	Satisfying
3	Someș River in Mica	Someș	LB	Mica	1600	2	1964	5	1500	Satisfying
4	Someș River in Cetan	Someș	LB	Cetan	3800	0.7	.2001	5	1660	Satisfying
5	Someș River in Vad	Someș	LB	Vad	700	1.5	2001	5	1660	Satisfying
6	Someș River in Vad	Someș	LB	Vad	1500	1.5	2001	5	1660	Satisfying
7	Someșul Mic River in Gherla	Someșul Mic	RB	Gherla	5800	3	1981	1	700	Satisfying
8	Someșul Mic River in Mintiu Gherlii	Someșul Mic	RB	Mintiu Gherlii	1000	1.3	1982	-	-	Satisfying
9	Someșul Mic River in airport Cluj Napoca	Someșul Mic	RB	Cluj-Napoca	2400	2	1961	5	350	Satisfying
10	Someșul Mic River in Hășdate	Someșul Mic	RB	Hășdate	500	1.5	1961	5	460	Satisfying
11	Someșul Mic River in Dej	Someșul Mic	LB	Dej	300	2	1983	5	450	Satisfying
12	Someșul Mic River in Răscruci	Someșul Mic	LB	Răscruci	1800	1.4	1960	5	365	Satisfying
13	Someșul Mic River in Bontida	Someșul Mic	LB	Bontida	1640	2	2007	5	400	satisfying
14	Someșul Mic River in Nima	Someșul Mic	LB	Nima, Salatiu	5900	2.2	1965	5	445	satisfying
15	Someșul Mic River in Mintiu Gherlii	Someșul Mic	RB	Mintiu Gherlii	2400	1.5	1962	5	445	Satisfying
16	Someșul Mic River in Livada	Someșul Mic	LB	Livada	1340	2	2007	5	425	Satisfying
17	Upstream Tur river	Tur	RB	Negrești Oaș / Tur	4600	2.2	1974	5	-	Satisfying
18	Embankment	Tur	RB	Călinești Oaș - Turulung	15950	2.6	1973	5	-	Satisfying
19	Embankment	Tur	RB	Turulung – Ukraine border	16000	3	1956 1973	2	275	Satisfying
20	Upstream Tur river	Tur	LB	Negrești Oaș / Tur	3980	1.7	1974	5	-	Satisfying
21	Embankment	Tur	LB	Călinești Oaș - Livada / Adrian	11500	3.3	1973	5		Satisfying
22	Embankment	Tur	LB	Livada / Adrian – Hungary border	25090	3.3	1973	2	275	satisfying
23	Embankment	Someș	RB	Apa / Someșeni - Medieș / Băbășești	18705	3.5	1973	5	2400	Satisfying
24	Embankment	Someș	RB	Odoreu/Berindan - Satu Mare	13900	3.5-4	1972-1975	1	3400	Satisfying
25	Embankment	Someș	RB	Satu Mare – Hungary border	15000	4	1918-1973	1	3400	Satisfying
26	Embankment	Someș	LB	Pomi / Aciua	2300	2	1986	5	2400	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m^3/s)	
27	Embankment	Someș	LB	Culciu / Cărășeu - Satu Mare	18343	4	1975	1	3400	Satisfying
28	Embankment	Someș	LB	Satu Mare - Hungary border	19000	4	1973-1975	1	3400	Satisfying
29	Embankment	Crasna	RB	Supur / Giorocuta - confl. cu Cerna	6286	2	1980-1988	5	175	Satisfying
30	Embankment	Crasna	RB	Confl. cu Cerna - Confl.cu Maria	14520	2.5	1980-1988	5	210	Satisfying
31	Embankment	Crasna	RB	Confl. cu Maria - Moftin / Ghilvaci	15580	2.5	1980-1988	5	280	Satisfying
32	Ring Dike	Crasna	RB	Moftin / Ghilvaci	1260	2	1980-1988	5	280	Satisfying
33	Embankment	Crasna	RB	Moftin /Ghilvaci - Hungary border	23200	3.5	1901	5	280	Satisfying
34	Embankment	Crasna	LB	Supur / Supuru de Sus - Cerna confl.	7000	2	1980-1988	5	175	Satisfying
35	Embankment	Crasna	LB	Confl. cu Cerna – Maria confl.	14600	2.5	1980-1988	5	210	Satisfying
36	Embankment	Crasna	LB	Confl.cu Maria - Moftin / Ghilvaci	15400	2.5	1980-1988	5	280	satisfying
37	Dike road	Crasna	LB	Moftin / Moftinu Mare	4310	2	1980-1988	5	280	Satisfying
38	Embankment	Crasna	LB	Moftin / Ghilvaci - Căpleni	15100	3	1980-1988	5	280	Satisfying
39	Embankment	Crasna	LB	Căpleni / Căpleni	1300	3	1996	5	280	Satisfying
40	Circular Dike Căpleni	Crasna	LB	Căpleni / Căpleni	3450	3	1901	5	-	Satisfying
41	Embankment	Crasna	LB	Căpleni / Hungary border	9400	3	1980-1988	5	280	Satisfying
42	Agerdo Dike	Crasna	LB	Berveni / Lucăceni	600	2.5	1942	5	280	Satisfying
43	Circular Dike Lucăceni	Crasna	LB	Berveni / Lucăceni	1300	1.5	1942	5	280	Satisfying
44	Complex Improvement Craidorolț - Vârșolț	Crasna River and tributeries L=34900 ml	RB	Sărmășag Măieriște Bobota	16400	1.5-2.0	1982	10	5%	Satisfying
			LB	Sărmășag Măieriște Bobota	15800	1.5-2.0	1982	-	-	Satisfying
45	Improvement of Someș River and affluents in Jibou	Someș	LB	Jibou	5200	2.0-2.5	1982	10	D1=2% D2=1%	Satisfying
46	Dikes Crasna River	Crasna	LB,RB	Crasna	4200	1.5 -2.0	1980	10	-	Satisfying
47	Vârșolț reservoir Dike interriver, Dike backwater	Crasna	RB	Crasna	2100	2.0-2.5	1979	10	1%	Satisfying
			RB	Crasna	800	2.0-2.5	1979	10	1%	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
48	Lăpuş River in Remetea Chioarului	Lăpuş	LB	Remetea Chioarului, Sacalaseni, Coltau, Recea	16600	2	1973	5	660	Satisfying
49	Lăpuş River in Târgu Lăpuş	Lăpuş	RB	Târgu Lapuş	590	3	1976	5	-	Satisfying
50	Lăpuş River in Târgu Lăpuş	Lăpuş	LB	Târgu Lapuş	500	1	1976	5	-	Satisfying
51	Vişeu River in Vişeu de Sus (Vişeu de Mijloc)	Vişeu	LB	Vişeu de Sus	1750	2	1984	5	480	Satisfying
52	Vişeu River in Vişeu de Jos	Vişeu	LB,RB	Vişeu de Jos	1700	2	1984	5	480	Satisfying
53	Vişeu River in Leordina	Vişeu	LB	Leordina	1550	1.2	1984	5	690	Satisfying
54	Vişeu River in Petrova	Vişeu	LB	Petrova	2850	2	1984	5	-	Satisfying
55	Vişeu River in Vişeu de Sus (Eastern Vişeu)	Vişeu	RB	Vişeu de Sus	600	2.5	1981	5	480	Satisfying
56	Vişeu River in Petrova	Vişeu	LB	Petrova	285	2.4	1981	5	690	Satisfying
57	Improvement of Viseu River in Petrova -Leordina - V. Vişeului area – Petrova area	Vişeu	LB	Petrova	1005	2	2004	5	690	Satisfying
58	Vişeu River in Petrova	Vişeu	LB	Petrova	1290	3	2012	5	690	Satisfying
59	Vişeu River in Valea Vişeului	Vişeu	LB	Leordina	550	3.5	2009	5	690	Satisfying
60	Improvement of Vişeu River in Petrova -Leordina - V. Vişeului - OB area - V. Vişeului area	Vişeu	LB	Petrova	550	2	2009	5	690	Satisfying
61	Iza River in Bogdan Voda	Iza	RB	Bogdan Voda	1400	2	1983	5	330	Satisfying
62	Iza River in Bârsana	Iza	RB	Bârsana	750	2	1989	5	540	Satisfying
63	Iza River in Rozavlea	Iza	RB	Rozavlea	2100	2	1990	5	330	Satisfying
64	Iza River in Sighetu Marmaţiei	Iza	LB	Sighetu Marmaţiei	2000	1.5	1990	5	-	Satisfying
65	Iza River in Onceşti Năneşti	Iza	RB	Onceşti	3050	1.7	1989	5	540	Satisfying
66	Iza River n Bârsana (between bridges)	Iza	RB	Bârsana	1100	2	1970	5	540	Satisfying
67	Iza River in Sighetu Marmaţiei	Iza	RB	Sighetu Marmaţiei	3050	1.8	1943	5	-	Satisfying
68	Iza River in Bârsana	Iza	RB	Bârsana	1300	2	1989	5	540	Satisfying
69	Iza River in Rozavlea	Iza	RB	Rozavlea	925	2	2004	5	330	Satisfying
70	Tisa River in Sighetu Marmaţiei	Tisa	LB	Sighetu Marmaţiei	4900	3	1964	1	1645	Satisfying
	Crişuri subbasin									
1	Sâniob – Sălard	Barcău	RB	Sâniob	4100	2.50	1991	5		Satisfying
2	Marghita – Abrămuţ	Barcău	LB	Marghita	8000	2.50	1991	5	215	Satisfying
3	Abrămuţ – Sâniob	Barcău	LB	Sâniob	1300	2.50	1991	5		Satisfying
4	Marghita – Abram	Barcău	LB	Marghita	4000	2.00	1991	5	215	Satisfying
5	Abramuţ – Sâniob	Barcău	RB	Sâniob	9800	2.50	1991	5		Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
6	Sântimbreu	Barcău	RB	Sântimreu	16000	3.00		5	255	Satisfying
7	Marghita – Chiribiş	Barcău	LB	Marghita	2300	2.00	1983	5	215	Satisfying
8	Marghita – Abrămuţ	Barcău	RB	Marghita	7500	2.00	1991	5	215	Satisfying
9	Ciuhoi – Sălard	Barcău	LB	Sâniob	7100	2.50	1987	5		Satisfying
10	Ciuhoi – Sâniob	Barcău	RB	Sâniob	2600	2.50	1991	5		Satisfying
11	Marghita – S.I.R.D.E.S.C.	Barcău	LB	Marghita	100	2.50	1975	5	215	Satisfying
12	left bank Barcău river in Ip	Barcău	LB	Ip	1830	2.00	2001			Satisfying
13	Barcău river right bank – Zăuan	Barcău	RB	Zăuan	3000	1.00	1959			Satisfying
14	Cohani – Suiug	Barcău	RB	Cohani	1400	2.00	1991	5		Satisfying
15	Marghita – Chiribiş	Barcău	LB	Marghita	300	2.00	1983	5	215	Satisfying
16	Sălard – Frontieră	Barcău	LB	Sălard	1750	3.00	1967	5	255	Satisfying
17	Marghita – I.T.A.	Barcău	LB	Marghita	400	2.50	1975	5	215	Satisfying
18	Ghida – Balc	Barcău	RB	Ghida	7000	2.00	1991	5		Satisfying
19	right bank Barcău river in Ip	Barcău	RB	Ip	1320	1.50	2001			Satisfying
20	Brad	Crişul Alb	RB	Brad	4190	0.00	2011			Satisfying
21	Brad	Crişul Alb	LB	Brad	220	0.00	2011			Satisfying
22	Mesteacăn	Crişul Alb	LB	Mesteacăn	1000	1.50	1976			Satisfying
23	Bocsig – Ineu	Crişul Alb	LB	Bocsig	5700	1.50	1924	1	880	Satisfying
24	Sicula – Vărşand	Crişul Alb	LB	Andcula	47620	3.50	1924	1		Satisfying
25	Vaţa de Jos	Crişul Alb	LB	Vaţa de Jos	300	2.50	1970			Satisfying
26	Crişcior	Crişul Alb	RB	Crişcior	200	2.50	1920			Satisfying
27	Brad	Crişul Alb	LB	Brad	2200	2.00	1976	2		Satisfying
28	Brad	Crişul Alb	RB	Brad	510	0.00	2011			Satisfying
29	Ineu – Şicula left bank 0+000-5+900	Crişul Alb	LB	Şicula	5900	2.00	1924	1		Satisfying
30	Crişcior left bank	Crişul Alb	LB	Crişcior	100	1.00	1920			Satisfying
31	Gurahonţ left bank	Crişul Alb	LB	Gurahonţ	800	2.00	1980	1	680	Satisfying
32	Brad	Crişul Alb	RB	Brad	3400	2.00	1976	2		Satisfying
33	Brad	Crişul Alb	LB	Brad	430	0.00	2011			Satisfying
34	Brad	Crişul Alb	RB	Brad	900	0.00	2011			Satisfying
35	Bocsig Vărşand	Crişul Alb	RB	Bocsig	66900	4.00	2011			Satisfying
36	left bank right affl. Crişul Alb river – Revetiş	Crişul Alb	RB	Revetiş	160	2.00	2002			Satisfying
37	Zdrapţi	Crişul Alb	LB	Zdrapţi	1200	1.20	1920			Satisfying
38	Grădinari	Crişul Negru	RB	Grădinari	2500	2.50	1982	5		Satisfying
39	Uileacu de Beiuş	Crişul Negru	RB	Uileacu de Beiuş	3200	2.50	1943	1		Satisfying
40	Tărcaia	Crişul Negru	LB	Tărcaia	2300	2.50	1982	5		Satisfying
41	Finiş	Crişul Negru	LB	Finiş	2700	2.50	1982	5	510	Satisfying
42	Tărcaia	Crişul Negru	LB	Tărcaia	620	2.00	1968	1		Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
43	Iermata – Talpoș	Crișul Negru	LB	Iermata	36600	4.00	1900	5		Satisfying
44	Tărian – Tămașda right bank (CC)	Crișul Negru	RB	Tărian	56600	4.00	2010	5		Satisfying
45	Dike right bank Tinca	Crișul Negru	RB	Tinca	1030	2.00	2000			Satisfying
46	Dike right bank Râpa	Crișul Negru	RB	Râpa	610	1.00	2000			Satisfying
47	CN right bank upstream – downstream pod Tinca	Crișul Negru	RB	Tinca	1420	2.00				Satisfying
48	Dike right bank Căpâlna	Crișul Negru	RB	Căpâlna	1200	2.00	1980	5		Satisfying
49	left bank Crișul Negru la Șoimi – Borz	Crișul Negru	LB	Borz	1300	2.50	2010	5		Satisfying
50	Cucuceni - Valea Mare left bank	Crișul Negru	LB	Cucuceni	2600	1.80	1982	5		Satisfying
51	Beliu – Berechiu left bank	Crișul Negru	LB	Beliu	31100	3.00	1900	1		Satisfying
52	Dike left bank Tăut - Batar	Crișul Negru	LB	Tăut	3160	4.00	2000			Satisfying
53	Beliu – Berechiu	Crișul Negru	RB	Beliu	30000	3.00	1970	2		Satisfying
54	Tinca left bank upstream bridge	Crișul Negru	LB	Tinca	600	1.20	1984			Satisfying
55	Dike right bank Tinca	Crișul Negru	RB	Tinca	380	1.00	2000			Satisfying
56	Water Plant Beiuș	Crișul Negru	RB	Beiuș	1000	1.20	1968	1	750	Satisfying
57	Tăut – Ant right bank	Crișul Negru	RB	Ant	46200	4.00	1900	2		Satisfying
58	Tprian – Tămașda left bank	Crișul Negru	LB	Tărian	56250	4.00	2010	5		Satisfying
59	Beiuș	Crișul Negru	RB	Beiuș	1100	2.20	1982	5	510	Satisfying
60	Tileagd	Crișul Repede	LB	Tileagd	5000	1.80	1966	5		Satisfying
61	Oradea	Crișul Repede	LB	Oradea	4100	2.30	1971	5	690	Satisfying
62	Bucea	Crișul Repede	LB	Bucea	300	1.00	1971	10		Satisfying
63	Aleșd	Crișul Repede	RB	Aleșd	400	3.50	1935	1		Satisfying
64	Fughiu	Crișul Repede	LB	Fughiu	2400	3.00	1969	5		Satisfying
65	City Strand	Crișul Repede	RB	Oradea	200	1.30	1977	5	690	Satisfying
66	Bulz	Crișul Repede	RB	Bulz	400	1.00	1955	10		Satisfying
67	Fughiu	Crișul Repede	RB	Fughiu	1345	3.00	1974	1		Satisfying
68	upstream railway bridge right bank Vadu Crișului	Crișul Repede	RB	Vadu Crișului	300	3.20	1949	5	565	Satisfying
69	Aleșd right bank	Crișul Repede	RB	Aleșd	1200	1.00	1969	1		Satisfying
70	Oradea	Crișul Repede	RB	Oradea	3200	3.70	1963	5	690	Satisfying
71	Șuncuiuș left bank upstream LP	Crișul Repede	LB	Șuncuiuș	300	1.00	2011	5		Satisfying
72	Gheghie – Aușeu	Crișul Repede	RB	Gheghie	300	3.00	1980	5		Satisfying
73	right bank Oradea upstream BROOK CET I	Crișul Repede	RB	Oradea	1600	3.50	1963	1	1000	Satisfying
74	Cacuciu Vechi	Crișul Repede	LB	Cacuciu Vechi	800	1.20	1968	10		Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
75	Oradea – Border	Crişul Repede	RB	Oradea	23500	4.00	2010	5	690	Satisfying
76	Tărian – Border	Crişul Repede	LB	Tarian	11600	4.00	2010	5		Satisfying
77	Bucea left bank	Crişul Repede	LB	Bucea	200	1.00	1970	10		Satisfying
78	Şuncuiuş right bank downstream LP	Crişul Repede	RB	Şuncuiuş	700	2.50	1959	5		Satisfying
79	left bank Crişul Repede river upstream BROOK CET 1	Crişul Repede	LB	Oradea	1600	35.00	1993	1	1000	Satisfying
80	Gheghie – Auşeu	Crişul Repede	RB	Gheghie	600	3.00	1979	5		Satisfying
81	Gheghie – Auşeu	Crişul Repede	RB	Gheghie	400	2.00	1979	5		Satisfying
82	Şuncuiuş right bank upstream LP.	Crişul Repede	RB	Şuncuiuş	300	1.00	1952	5		Satisfying
83	Diosig – Sălacea	Ier (Eriu)	LB	Sălacea	48000	3.00	1970	5		Satisfying
84	Andrid left bank	Ier (Eriu)	LB	Andrid	16550	2.00	1970	5	65	Satisfying
85	Căuaş – Ady Endre	Ier (Eriu)	RB	Ady Endre	16550	2.60	1970	5		Satisfying
86	Adoni – Cherechiu right bank (Anticar Channel)	Ier (Eriu)	RB	Cherechiu	3450	2.00	1970	5		Satisfying
87	Adoni - Cherechiu left bank (Anticar Channel)	Ier (Eriu)	LB	Cherechiu	3900	2.00	1970	5		Satisfying
88	Diosig	Ier (Eriu)	RB	Sălacea	48000	2.50	1970	5		Satisfying
89	Diosig – Sălacea left bank	Ier (Eriu)	LB	Sălacea	48000	3.00	1970	5		Satisfying
	Mureş subbasin									
1	Improvement of Mureş river and affluents in Lalaşinţ	Mureş	LB	Bârzava	2720	2.2	1979	5	1750	Satisfying
2	Mureş river in Chelmac	Mureş	LB	Conop	6000	2.7	1976	20	1120	Satisfying
3	Improvement of Mureş river and affluents in Chelmac	Mureş	LB	Conop	3000	2.0	1979	5	1750	Satisfying
4	Improvement of Mureş river and affluents in Ususău	Mureş	LB	Ususău	2900	2.8	1980	5	1750	Satisfying
5	Mureş river in Lipova	Mureş	LB	Lipova	4740	4.0	1981	2	2300	Satisfying
6	Mureş river in Baraţca	Mureş	RB	Păuliş	850	2.1	1980	5	1650	Satisfying
7	Improvement Mureş river in Păuliş -Sâmbăteni	Mureş	RB	Păuliş	9850	2.6	1978	5	1650	Satisfying
8	Partition Dike right bank Mureş river in CICH Arad	Mureş	RB	Vladimirescu	2500	3.0	1976	1	2600	Satisfying
9	Mureş river in Pecica - Vladimirescu	Mureş	RB	Vladimirescu, Arad, Pecica	36993	6.0	1975 1981	1	2600	Satisfying
10	Dike left bank Mureş river in Arad	Mureş	LB	Arad	9930	5.0	1976	1	2600	Satisfying
11	Partition Dike left bank Mureş river in Arad	Mureş	LB	Arad	2100	1.5	1969	5	1720	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
12	Mureș river in Bodrogul Nou	Mureș	LB	Zădăreni	2131	3.0	2009	5	1720	satisfying
13	Arad – Pecica Channel	Mureș	LB	Pecica	1350	1.5	1969	1	2600	Satisfying
14	Arad - Pecica Channel	Mureș	RB	Pecica	1350	1.5	1969	1	2600	Satisfying
15	Mureș river in Pecica	Mureș	RB	Pecica	6691	3.5	1975	1	2600	Satisfying
16	Mureș river Felnac - Periam harbour	Mureș	LB	Felnac, Secusigiu	22365	4.5	1975	2	2050	Satisfying
17	Mureș river in Semlac	Mureș	RB	Semlac	1350	4.5	1968	5	1720	Satisfying
18	Mureș river in Seitin	Mureș	RB	Seitin	2150	3.0	1968	1	2600	Satisfying
19	Mureș river in Nadlac - Seitin	Mureș	RB	Nadlac, Șeitin	17400	3.0	1989	2	2050	Satisfying
20	Mureș river Nadlac	Mureș	RB	Nadlac	4375	4.0	1968	1	2600	Satisfying
21	Partition Dike left bank Mureș river in Periam	Mureș	LB	Periam	2500	2.5	1932	10	1310	Satisfying
22	Mureș river in Cenad	Mureș	LB	Periam Sânpetru Mare Cenad	43374	4.5	1932	2	2050	Satisfying
23	Târnava Mică river in Ghindari	Târnava Mică	RB	Ghindari	2400	2	1977-1981	5	240	Satisfying
24	Târnava Mica river in Sângeorgiu de Pădure	Târnava Mică	RB	Fântanele	1046	1.2	1987	5	185	Satisfying
25	Târnava Mică river in Coroi	Târnava Mică	RB	Coroi	1630	1.3	2010	5	127	Satisfying
26	Embankment and regulation of Târnava Mică river and affluents in Târnăveni	Târnava Mică	RB	Cuștelnic	596	3	1972 1982	1	444	Satisfying
		Târnava Mică	RB	Târnăveni	3850	3	1972-1982	1	444	Satisfying
		Târnava Mică	RB	Dâmbău	2517	3	1972-1982	1	444	Satisfying
		Târnava Mică	LB	Seuca	4968	3	1972-1982	1	444	Satisfying
		Târnava Mică	LB	Adămuș	2244	3	1972-1982	1	444	Satisfying
27	Improvement of Târnava Mică river in Suplac, Adămuș, Cornești, Crăiești	Târnava Mică	RB	Suplac	2489	1.2	2001	5 & 1	240	Satisfying
		Târnava Mică	LB	Adămuș	1130	2	2002	5	240	Satisfying
		Târnava Mică	RB	Crăiești	1984	2	2004	5	240	Satisfying
		Târnava Mică	LB	Cornești	4510	2	2009	5	240	Satisfying
28	Embankment and regulation of Mureș river in Gheorgheni depression	Mureș	RB	Suseni	300	2	1984	5	112	Satisfying
		Mureș	LB	Suseni	300	2	1984	5	112	Satisfying
		Mureș	RB	Ciumani	1220	2	1984	5	112	Satisfying
		Mureș	LB	Ciumani	1800	2	1984	5	112	Satisfying
		Mureș	LB	Borzonț	500	2	1984	5	105	Satisfying
29	Mureș river in Toplița	Mureș	RB	Toplița	1100	2	2007	5	353	Satisfying
		Mureș	LB	Toplița	1200	2	2007	5	353	Satisfying
30	Improvement of Mureș river in Răstolița	Mureș	LB	Răstolița/Iod	2610	2	2004	5	559	Satisfying
		Mureș	LB	Răstolița/Iod	1130		2014			Satisfying
31	Mureș river in Lunca Mureșului	Mureș	LB	Aluniș/Lunca Mureșului	2430	2	2000	5	523	Satisfying
32	Embankment and regulation	Mureș	LB	Reghin/Reghin	4730	2.25	1979	1	895	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
	of Mureș river in Reghin		RB	Reghin/Reghin	10620	2.25				Satisfying
33	Regulation and Embankment right bank of Mureș river in Suseni	Mureș	RB	Suseni / Suseni	315		2008			Satisfying
34	Improvement of Mureș river in Iernut DJ 152 A Iernut-Lechința	Mureș	LB	Iernut	2040		2011	2	1135	Satisfying
35	Mureș river in Sânpaul	Mureș	LB	Sânpaul	857	1	1968	1	1548	Satisfying
36	Mureș river in Iernut D2	Mureș	LB	Iernut	3070	3	2004-2008	2	1135	Satisfying
37	Embankment and regulation of Mureș river and affluents in Târgu Mureș	Mureș	LB	Tg. Mureș	11000	3	1977	1	1110	Satisfying
		Mureș	RB	Sântana	15230	3	1982	1	1110	Satisfying
		Mureș	LB	Tg. Mureș	480		1982	1	1110	Satisfying
38	Embankment and regulation of Mureș river in Luduş	Mureș	LB	Luduş	7650	5	1982	1	1560	Satisfying
39	Mureș river in Şibot	Mureș	LB	Şibot	290	0	1974	5	1700	Satisfying
		Mureș	LB	Şibot	5840	2.7	1974	5	1700	Satisfying
40	Blandiana - upstream confluence Mureș river	Mureș	RB	Blandiana	1600	2.5	1975	10	1310	Satisfying
41	Mureș river in Blandiana - Acmariu	Mureș	RB	Blandiana	4960	2.5	1975	10	1310	Satisfying
42	Târnava river in Mihalţ	Târnava	LB	Mihaţ	2550	2.5	1977	5	645	Satisfying
43	Mureș river in Cistei	Mureș	LB	Cisteiu de Mureș	2400	2	1977	5	1215	Satisfying
44	Mureș river in Drâmbar	Mureș	LB	Drâmbar	1260	3.5	1980	1	2600	Satisfying
45	Mureș river in Rădeşti	Mureș	LB	Rădeşti	2380	1.8	1981	10	948	Satisfying
46	Dike right bank and regulation of Târnava Mare river in Blaj	Târnava	RB	Blaj	4170	2.5	1981	2	745	Satisfying
47	Improvement of Târnava Mare river and Tiur la Blaj	Târnava	LB	Tiur	6990	2.5	1981	2	745	Satisfying
48	Dike right bank Mureș river in Vurpăr	Mureș	RB	Vurpăr	4900	2.8	1982	5	1420	Satisfying
		Mureș	RB	Vurpăr	470	2.8	1982	5	1420	Satisfying
49	Improvement of Mureș river and Affl. Alba Iulia area	Mureș	LB	Ciugud	2610	4.4	1984	5	1404	Satisfying
		Mureș	RB	Alba Iulia	4940	6.5	1984	1	2600	Satisfying
		Mureș	LB	Oarda	2020	6.5	1984	5	1404	satisfying
		Mureș	LB	Oarda	720	3	1984	5	1404	Satisfying
		Sebeș	LB	Oarda	1550	4.5	1984	5	1404	Satisfying
		Sebeș	RB	Oarda	1290	4.5	1984	5	1404	Satisfying
50	Improvement of Mureș river and V. Blandiana	Mureș	LB	Mereteu	3750	1.5	1986	10	1310	Satisfying
51	Improvement of Târnava Mică river in Cetatea de Baltă - Jidvei	Târnava Mică	RB/LB	Cetatea de Baltă	340	3.5	2009	5	345	Satisfying
		Târnava Mică	LB	Cetatea de Baltă	2500	3	1989	5	345	Satisfying
		Târnava Mică	LB	Jidvei	1900	2	1998	5	345	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
		Târnava Mică	RB	Jidvei	3290	2.3	1998	5	345	Satisfying
		Târnava Mică	RB	Şona	4780	2	1989	10	205	Satisfying
		Târnava Mică	RB/LB	Cetatea de Baltă	70	0	2009	5	345	Satisfying
		Corund (Târnava Mică)	RB/LB	Jidvei	160	0	2009	5	345	Satisfying
52	Dike right bank and regulation of Arieş river in Mihoieşti	Arieş	RB	Mihoeşti	800	2.5	1987	5	350	Satisfying
53	Improvement of Arieş River right bank Section 8 - Viişoara	Arieş	RB	Viişoara	2100	2.5	1985	1	1100	Satisfying
54	Improvement of Arieş River 6 and 7 Sections - Poiana - C.Turzii	Arieş	RB	Turda	5660	2	1987	1	1100	Satisfying
55	Improvement of Arieş River Section 4 - Turda	Arieş	RB	Turda	480	2	1987	1	1100	Satisfying
56	Improvement of Arieş river Section 5 - Oprisan	Arieş	RB	Turda	1200	2	1987	1	1100	Satisfying
57	Improvement of Arieş river section 2 – Cement Manufacture	Arieş	RB	Turda	720	2	1987	1	1100	satisfying
58	Improvement of Arieş river section 1 - Mihai Viteazu	Arieş	RB	Mihai Viteazu	5380	2.5	1988	1	1100	Satisfying
59	Improvement of Arieş river section left bank - Electroceramica	Arieş	LB	Turda	590	2.5	1988	5	670	Satisfying
60	Improvement of Arieş river section right bank - Electroceramica	Arieş	RB	Turda	1000	2.5	1988	1	1100	Satisfying
61	Improvement of Arieş river Left bank section 8 - Viişoara	Arieş	LB	Viişoara	310	1.5	1988	5	670	Satisfying
		Arieş	LB	Viişoara	500	2	1988	5	670	Satisfying
62	Dike backwater Câmpia Turzii	Arieş	RB	Câmpia Turzii	1250	2	1988	1	1100	Satisfying
63	Closing Dike Cheia	Arieş	RB	Mihai Viteazu	1550	2	1988	1	1100	Satisfying
64	Dike LB and consolidation of Mureş river in Ocna Mureş	Mureş	LB	Ocna Mureş	1760	1.8	1971	5	1215	Satisfying
65	Dike and consolidation of Arieş river zone Baia de Arieş	Arieş	RB	Baia de Arieş	170	1.2	2002	2	536	Satisfying
66	Mureş river in Vinţu de Jos	Mureş	LB	Vinţu de Jos	3930	2.5	1973	5	1420	Satisfying
		Mureş	LB	Vinţu de Jos	900	2.5	1973	5	1420	Satisfying
67	Improvement of Mureş river and affl. Coşlariu-Sântimbru	Mureş	RB/LB	Sântimbru	6260	3.5	2012	5	1475	Satisfying
68	Improvement of Arieş river in	Arieş	RB	Câmpeni	450	2.2	2004	2	450	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
	Câmpeni	Arieş	LB	Câmpeni	240	2.2	2004	2	450	Satisfying
69	Dike right bank Mureş river in Sărăcsău	Mureş	RB	Sărăcsău	430	0	2011	5	1550	Satisfying
		Mureş	LB	Sărăcsău	430	0	2011	10		Satisfying
		Mureş	RB	Sărăcsău	1130	0	2011	5		Satisfying
70	Embankment right bank in Lunca Arieş	Arieş	RB	Lunca	2200	2	1997	5	638	Satisfying
71	Embankment and regulation of Mureş river at Ilia - Ilia Dike	Mureş	RB	Ilia/Ilia	5260	5	1981	2	2530	Satisfying
	Embankment and regulation of Mureş river in Ilia - Brâznic Dike	Mureş	LB	Ilia/Brâznic	1600	3	1981	5	1875	Satisfying
72	Mureş river in Lăpuşnic	Mureş	LB	Dobra/Lăpuşnic	6520	3	1971	5	1850	Satisfying
73	Mureş river in Stretea	Mureş	LB	Dobra/Stretea	4600	2	1972	5	1850	Satisfying
74	Embankment and bank protection of Strei river in Covragiu	Strei	RB	Bretea Română/ Covragiu	1100	2.5	1976	5	430	Satisfying
75	Embankment and regulation of Strei river in Simeria-Batiz	Strei	LB	Băcia/Batiz	7500	2	1981	5	386	Satisfying
76	Embankment and regulation of Mureş river in Homorod - Gelmar Dike	Mureş	LB	Geoagiu/Gelmar	3080	4	1981	5	1410	Satisfying
77	Embankment and regulation of Mureş river in Homorod- Aurel Vlaicu Dike	Mureş	LB	Geoagiu/ Aurel Vlaicu	2650	3	1981	5	1410	Satisfying
78	Embankment and regulation of Mureş river in Homorod- Suinprod Orăştie Dike	Mureş	LB	Orăştie/ Orăştie	2060	3.3	1981	5	1410	Satisfying
79	Embankment and regulation of Mureş river in Deva	Mureş	LB	Deva/Deva	8830	5	1981	1	2640	Satisfying
80	Mureş river in Brănişca	Mureş	RB	Brănişca/ Brănişca	4690	2	1985	5	1850	Satisfying
81	Improvement of Mureş river in Folt	Mureş	RB	Rapoltu Mare/Folt	1840	3	2002	5	1710	Satisfying
82	Improvement of Mureş river in Turdaş,Pricaz,Folt zone - Pricaz Dike	Mureş	LB	Orăştie/Pricaz	5160	2.5	2007	5	1710	Satisfying
83	Improvement of Mureş river in Turdaş,Pricaz,Folt zone - Turdaş Dike	Mureş	LB	Turdaş/Turdaş	1270	1	2007	5	1710	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m³/s)	
84	Improvement of Mureș river in Turdaş, Pricaz, Folt Zone - Bobâlna Dike	Mureș	RB	Rapoltu Mare/Bobâlna	3170	1.4	2007	5	1710	Satisfying
85	Dileul Nou/Sânpaul	Mureș	RB	Sânpaul/Dileu	1820	2	12/31/1968			Satisfying
86	SC AGRIM, Sânpaul farm	Mureș	LB	Sânpaul	1800	2	12/31/1968	5		Satisfying
87	Ocna Mureș Dike	Mureș	RB	Ocna Mureș	900	1.3	12/23/1987	10		Satisfying
88	Mureș river Dike in Aiud	Mureș	RB	Aiud	2250	2.7	12/30/1979	5	1021	Satisfying
89	Mureș river Dike in Leorinţ	Mureș	LB	Leorinţ	1130	1.5	12/30/1972	10		Satisfying
90	Mureș river Dike in Beldiu	Mureș	RB	Beldiu	3940	1.4	12/30/1976	10		Satisfying
91	Mureș river Dike in Totoi Sat	Mureș	LB	Totoi	2200	1.8	12/30/1982	10		Satisfying
92	Mureș river Dike in Totoi	Mureș	LB	Totoi	800	2	12/30/1976	10		Satisfying
93	Mures river Dike La Vinţu De Jos Downstream	Mureș	LB	Vinţu de Jos	1840	1.8	12/30/1982	10		Satisfying
94	Mures river Dike in Vinţu De Jos Câmpu Goblii	Mureș	RB	Vinţu de Jos	1500	2	12/30/1981	10		Satisfying
95	Dike Blandiana	Mureș	RB	Blandiana	2080	2.5	12/30/1984	10		Satisfying
96	Dike Blandiana	Mureș	RB	Blandiana	830	1.8	12/30/1983	5	638	Satisfying
97	Dike Blandiana	Mureș	RB	Blandiana	3600	2.7	12/30/1984	1		Satisfying
98	Dike right bank Câmpia Turzii – downstream purge station	Arieş	RB	Câmpia Turzii	1970	0	06/17/2008	10		Satisfying
99	Embankment Sântămărie	Târnava Mică	LB	Sântămărie	2100	2.5		10		Satisfying
100	Embankment downstream Bridge B.A. Biia	Târnava Mică	LB	Biia	940	1.5				Satisfying
101	Embankment Biia- Sântămărie	Târnava Mică	RB	Biia	2500	2.7		10		Satisfying
102	Embankment Şona - upstream	Târnava Mică	RB	Şona	980	2.2		0		Satisfying
103	Embankment Biia - Sânmiclauş	Târnava Mică	RB	Biia	1750	2.5		10		Satisfying
104	Embankment Electrocentrale Branch Deva in Mintia	Mureș	LB	Veţel/Mintia	2900	3.5	1969	1	2640	Satisfying
105	Embankment Electrocentrale Branch Deva in Mintia	Mureș	RB	Veţel/Mintia	2400	3.5	1969	1	2640	Satisfying
106	Embankment Mureș river in Sălciva	Mureș	LB	Dobra/ Sălciva	2200	1	1958	10	999	Satisfying
Banat subbasin										
1	Navigable Bega river	Bega	LB	Timișoara, Peciu, Uivar	37340	3	1915	5	47,00	Satisfying
2	Navigable Bega river	Bega	RB	Timișoara, Sinmihaiul Roman, Uivar	39595	3	1915	5	47,00	Satisfying
3	Dike unnavigabile Bega river	Bega	RB	Topolovat, Remetea	12865	3	1915	2	72	Satisfying

No.	Dike name	Water course	Dike position	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (%)	Q100 (m^3/s)	
4	Unnavigable Bega river	Bega	LB	Topolovat, Remetea	20375	3	1915	2	72	Satisfying
5	Bega river	Bega	RB	Balint, Belint, Chizatau	10051	3	1860	2	365	Satisfying
6	Bega river	Bega	LB	Bethausen, Balint, Chizatau	26285	3	1860			Satisfying
7	Bega Veche river	Bega Veche	LB	Sacalaz, Becicherec, Cenei	33360	4	1898	5	47	Satisfying
8	Bega Veche river	Bega Veche	RB	Sacalaz, Becicherec, Cenei	32080	4	1898	5	47	Satisfying
9	Discharge Dike Bega channel right bank	Bega	RB	Topolova	5758	4	1910	2	350	Satisfying
10	Discharge Dike Bega channel left bank	Bega	LB	Topolovat	5777	4	1915	2	350	satisfying

Dikes in Slovakia

No.	Dike name	Water course	Dike position (rkm)	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (pc%)	Q100 (m³/s)	
1		Slaná	RB 1.470 – 23.000		4.740		1962	1	355	insufficient capacity (not transfer current Q100)
1		Slaná	RB 6.210 – 16.005		9.795			1	336	lower part of the segment has insufficient capacity, the dyke need to be increased
1		Slaná	RB 16.005 – 18.047		2.042		1962	1	275	insufficient capacity, the dyke need to be increased
1		Slaná	RB 18.047 – 23.216		5.169		1970	1	245	insufficient capacity, the dyke need to be increased
1		Slaná	RB 23.216 – 26.250		3.034			1	220	insufficient capacity, the dyke need to be increased
1		Slaná	RB 26.250 – 28.820		2.570			1	180	insufficient capacity, the dyke need to be increased
1		Slaná	RB 28.820 – 30.139		1.319			5	Q20=130 m3/s	insufficient capacity
1		Slaná	RB 30.139 – 30.699		0.560			1	220	insufficient capacity
1		Slaná	RB 31.451 – 35.786		4.335			1	140	insufficient capacity
1		Slaná	RB 35.786 – 49.312		13.526		1982	1	145	lower part of the segment has insufficient capacity
1		Slaná	RB 44.801 – 49.865		5.064			1	192	sufficient capacity
1		Slaná	RB 50.166 – 56.340		6.174			1	120	insufficient capacity
1		Slaná	RB 66.925 – 67.160		0.235			1	35 -70	r.km 56,340-78,312 - partial modifications with capacity 35-70 m3/s
1		Slaná	LB 0.625 – 1.965		1.340		1963	1	510	sufficient capacity
1		Slaná	LB 1.470 – 6.210		4.740		1962	1	355	insufficient capacity (not transfer current Q100)
1		Slaná	LB 6.210 – 16.005		9.795			1	336	lower part of the segment has insufficient capacity, the dyke need to be increased
1		Slaná	LB 16.005 – 18.047		2.042		1962	1	275	insufficient capacity, the dyke need to be increased
1		Slaná	LB 18.047 – 23.216		5.169		1970	1	245	insufficient capacity, the dyke need to be increased
1		Slaná	LB 23.216 – 26.250		3.034			1	220	insufficient capacity, the dyke need to be increased
1		Slaná	LB 26.520 – 28.820		2.570			1	180	insufficient capacity, the dyke need to be increased
1		Slaná	LB 30.139 – 30.699		0.563			1	220	insufficient capacity
1		Slaná	LB 34.986 – 35.786		0.800			1	175	insufficient capacity
1		Slaná	LB 35.786 – 49.312		13.526			1	145	lower part of the segment has insufficient capacity

No.	Dike name	Water course	Dike position (rkm)	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (pc%)	Q100 (m³/s)	
1		Slaná	LB 49.312 – 50.166		0.854			1	192	sufficient capacity
1		Slaná	LB 50.166 – 52.990		2.824		1971	1	120	insufficient capacity
1		Slaná	LB 66.925 – 69.352		2.427			1	35 – 70	insufficient capacity
2		Muráň	RB 0.000 - 0.349		0.349			1	68	insufficient capacity
2		Muráň	RB 9.470 – 10.824		1.354		1978			insufficient capacity
2		Muráň	RB 22.067 – 23.306		1.239			1	110	insufficient capacity
2		Muráň	LB 0.000 – 0.349		0.349			1	68	insufficient capacity
2		Muráň	LB 22.067 – 23.533		1.486			1	110	insufficient capacity
3		Turiec	RB 0.000 – 0.349		3.490		1962-1968			insufficient capacity
3		Turiec	RB 0.000 – 1.652		1.652			1	76	insufficient capacity
3		Turiec	RB 1.652 – 4.630		2.978			1	110	sufficient capacity
3		Turiec	LB 0.000 – 0.349		3.490		1962-1968			
3		Turiec	LB 0.000 - 1.652		1.652			1	76	insufficient capacity
3		Turiec	LB 1.652 – 4.630		2.978			1	110	sufficient capacity
4		Blh	RB 0.000 – 9.153		9.153			1	82	sufficient capacity
4		Blh	RB 9.153 – 17.406		8.253			1	73	sufficient capacity
4		Blh	RB 17.406 – 20.485		3.079			1	65	sufficient capacity
4		Blh	RB 30.650 – 31.165		0.515		1980			
4		Blh	LB 0.000 – 9.153		9.153			1	82	sufficient capacity
4		Blh	LB 9.153 – 17.406		8.253			1	73	sufficient capacity
4		Blh	LB 17.406 – 20.485		3.079			1	65	sufficient capacity
4		Blh	LB 30.650 – 31.165		0.515		1980			
5		Rimava	RB 1.993 – 2.550		0.557		1961-1964	1	160	insufficient capacity
5		Rimava	RB 2.550 – 18.323		15.773		1961-1964 1972-1975	1	to 17.265 r.km Q100=160, from 17.265 r.km Q100=140	insufficient capacity
5		Rimava	RB 18.323 – 22.455		4.132		1972-1975	1	140	insufficient capacity
5		Rimava	RB 22.455 – 27.100		4.645		1972-1976	1	140	insufficient capacity
5		Rimava	RB 30.614 – 30.765		0.151		1974-1976	1	140	insufficient capacity
5		Rimava	RB 30.795 – 32.413		1.618			1	to r.km 31.198 Q100=140, from r.km 31.198 Q100=206	
5		Rimava	RB 40.308 – 40.491		0.183		1980-1982	1	160	
5		Rimava	RB 42.057 – 42.787		0.730		1931			
5		Rimava	RB 51.036 – 51.459		0.423		1971 to r.km 51.385	1	115	insufficient capacity
5		Rimava	LB 0.000 – 0.150		0.150		1960-1961	1	200	
5		Rimava	LB 0.240 – 1.765		1.525		1961-1964	1	160	insufficient capacity

No.	Dike name	Water course	Dike position (rkm)	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (pc%)	Q100 (m³/s)	
5		Rimava	LB 3.540 – 7.995		4.455		1961-1964	1	160	insufficient capacity
5		Rimava	LB 11.683 – 15.,250		3.567		1961-1964	1	160	insufficient capacity
5		Rimava	LB 15.897 – 18.323		2.426		1961-1964 1972-1975	1	to 17.265 r.km Q100=160, from 17.265 r.km Q100=140	insufficient capacity
5		Rimava	LB 18.923 - LB 22.455		3.532		1972-1975	1	140	insufficient capacity
5		Rimava	LB 22.455 - LB 27.655		5.200		1972-1976	1	140	insufficient capacity
5		Rimava	LB 30.614 - LB 32.665		2.051		1974-1981	1	to 31.198 r.km Q100=140, from r.km 31.198 Q100=206	insufficient capacity
5		Rimava	LB 34.449 - LB 37.727		3.278		1978-1980	1	140	insufficient capacity
5		Rimava	LB 36.123 - LB 37.411		1.288		1978-1980	1	140	insufficient capacity
5		Rimava	LB 40.308 - LB 40.491		0.183		1980-1982	1	140	insufficient capacity
5		Rimava	LB 51.036 - LB 52.677		1.641		1971 to r.km 51.385	1	115	insufficient capacity
6		Bodva	LB 0.320 – 10.000		9.680	2.4	1964	2	150-85	in operation
6		Bodva	RB 0.000 – 10.300		10.300	2.4	1964	2	150	in operation
6		Bodva	LB 10.300 – 13.800		3.500	2.4	1964	2	68	in operation
6		Bodva	RB 10.300 – 13.800		3.500	2.4	1964	2	68	in operation
6		Bodva	RB 17.600 – 18.600		1.000	2.4	1964	2	38	in operation
6		Bodva	RB 18.750 – 19.310		0.560	2.0	1980	2	38	in operation
7		Ida	LB 11.400 – 12.000		0.600	2.0	1988	2	67	in operation
8		Turňa	RB 0.000 – 1.200		1.200	2.0		2	80	in operation
8		Turňa	LB 0.000 – 1.200		1.200	2.0		2	80	in operation
9		Hornád	RB 9.000 – 17.000		8.000	2.4		1	700	in operation
9		Hornád	RB 22.700 – 25.200		2.500	2.4		1	550	in operation
9		Hornád	LB 12.900 – 21.300		8.400	2.4		1	550	in operation
9		Hornád	RB 29.100 – 38.500		9.400	2.4		1	507-572	in operation
9		Hornád	LB 22.700 – 37.900		15.200	2.4		1	550-572	in operation
9		Hornád	RB 133.343 – 135.003		1.660	2.0		5	225	in operation
10		Svinka	LB 28.555 – 28.974		0.419	2.0		5	110	in operation
10		Svinka	LB 28.066 – 28.189		0.123	2.0		5	110	in operation

No.	Dike name	Water course	Dike position (rkm)	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (pc%)	Q100 (m³/s)	
10		Svinka	LB 27.000 – 27.311		0.311	2.0		5	110	in operation
11		Sekčov	RB 0.645 – 1.090		0.445	2.0	1981	5	225	in operation
12		Torysa	RB 9.100 – 9.560		0.460	2.4		5	360	in operation
12		Torysa	RB 49.500 – 50.100		0.600	2.0		5	410	in operation
12		Torysa	RB 49.250 – 51.846		2.596	2.0 2.0		5	410	in operation
12		Torysa	RB 52.670 – 53.849		1.179	2.0		5	410	in operation
12		Torysa	RB 62.850 – 63.934		1.084	2.0		5	300	in operation
12		Torysa	RB 73.450 – 75.000		1.550	2.0		5	283	in operation
12		Torysa	RB 92.200 – 93.180		0.980	2.0		5	200	in operation
12		Torysa	LB 77.294 – 78.555		1.261	2.0		5	341	in operation
12		Torysa	RB 77.294 – 78.555		1.261	2.0		5	341	in operation
12		Torysa	LB 78.555 – 79.055		0.500	2.0		5	341	in operation
13		Latorica	LB 0.000 – 32.084		32.084	4.0	1971	1	730	in operation
13		Latorica	RB 0.000 – 29.249		29.249	2.4	1971	1	730	in operation
14		Laborec	RB 0.000 – 36.400		36.400	2.4	1967	1	320	in operation
14		Laborec	LB 0.000 – 36.400		36.400	2.4	1967	1	320	in operation
14		Laborec	LB 39.950 – 40.310		0.360	2.0	1967	1	320	in operation
14		Laborec	RB 36.000 – 36.400		0.400	2.0	1967	1	320	in operation
14		Laborec	RB 44.690 – 47.981		3.291	2.4	1967	1	320	in operation
14		Laborec	RB 58.050 – 60.150		2.100	2.4	1967	1	320	in operation
14		Laborec	RB 39.950 – 40.250		0.300	2.0	1967	1	320	in operation
14		Laborec	LB 58.050 – 59.150		1.100	2.4	1967	1	320	in operation
14		Laborec	LB 65.000 – 66.730		1.730	4.0	1936	1	730	in operation
14		Laborec	RB 65.950 – 66.775		0.825	4.0	1936	1	730	in operation
14		Laborec	LB 67.140 – 67.520		0.380	4.0	1936	1	730	in operation
14		Laborec	RB 67.161 – 69.075		1.914	4.0	1936	1	730	in operation
14		Laborec	RB 83.300 – 83.600		0.300	4.0		1	440	in operation
14		Laborec	RB 99.964 – 101.125		1.161	2.0		1	240	in operation
14		Laborec	LB 109.000 – 111.700		2.700	2.0		1	240	in operation
14		Laborec	RB 109.000 – 111.700		2.700	2.0		1	240	in operation
15		Udava	RB 14.900 – 15.700		0.800	2.0		1	240	in operation
15		Udava	LB 4.300 – 4.940		0.640	2.4		1	300	in operation
16		Cirocha	RB 22.100 – 26.472		4.372	2.4		1	230	in operation
16		Cirocha	LB 22.100 – 26.472		4.372	2.4		1	230	in operation
17		Ulička	LB 1.740 – 1.875		0.135	1.0	1967	1	205	in operation

No.	Dike name	Water course	Dike position (rkm)	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (pc%)	Q100 (m^3/s)	
17		Ulička	LB 1.875 – 2.693		0.818	1.0	1967	1	205	in operation
17		Ulička	RB 1.155 – 1.455		0.300	3.0	1967	1	205	in operation
17		Ulička	RB 1.455 – 1.875		0.420	2.0	1967	1	205	in operation
17		Ulička	RB 1.875 – 2.765		0.890	1.0	1967	1	205	in operation
17		Ulička	LB 9.150 – 9.300		0.150	2.0	1967	1	205	in operation
18		Kanál Veľké Revištia - Bežovce	RB 0.000 – 23.600		23.600	2.4	1964	1	46	in operation
18		Kanál Veľké Revištia - Bežovce	LB 0.000 – 23.600		23.00	2.4	1964	1	46	in operation
19		Okna	LB 0.650 – 0.664		0.014	2.0	1974	1	48	in operation
19		Okna	RB 0.650 – 0.654		0.004	2.0	1974	1	48	in operation
19		Okna	RB 1.990 – 2.000		0.010	2.0	1974	1	48	in operation
19		Okna	LB 2.550 – 2.780		0.230	2.0	1974	1	48	in operation
19		Okna	RB 3.017 – 3.200		0.183	2.0	1974	1	48	in operation
19		Okna	RB 4.150 – 4.175		0.025	2.0	1974	1	48	in operation
19		Okna	LB 4.250 – 4.500		0.250	2.0	1974	1	48	in operation
19		Okna	LB 5.126 – 5.139		0.013	2.0	1974	1	48	in operation
20		Čierna voda	RB 0.000 - 6.100		6.100	2.4	1964	2	65	in operation
21		Uh	RB 0.000 – 21.500		21.500	2-4,.4	1967	1	1310	in operation
21		Uh	LB 0.000 – 18.500		18.500	2.4	1967	1	1310	in operation
22		Ondava	RB 0.000 – 26.000		26.000	2-4.4	1967	5	830	in operation
22		Ondava	LB 0.000 – 37.300		37.300	2-4. 4	1967	5	830 (710)	in operation
22		Ondava	LB 106.900 – 107.500		0.600	2.4		5	513	in operation
22		Ondava	LB 116.960 - 118.850		1.890	2.4		5	320	in operation
23		Ladomírka	RB 0.000 – 3.700		3.700	2.4		20	270	in operation
23		Ladomírka	LB 0.000 – 1.150		1.150	2.4		20	270	in operation
24		Chotčianka	LB 9.250 – 10.025		0.775	1.2	1987	5	245	in operation
25		Kamenec	LB 0.000 - 0.220		0.220	2.4	1968	5	24	in operation
26		Topľa	RB 0.000 – 6.150		6.150	2.2-4		5	560	in operation
26		Topľa	RB 19.000 – 19.922		0.922	2.4	1973	5	685	in operation
26		Topľa	LB 19.000 – 19.922		0.922	2.4	1973	5	685	in operation
26		Topľa	LB 60.000 – 60.712		0.712	2.4	1979	5	500	in operation
26		Topľa	RB 103.550-105.010		1.460	1.2	2015	1	330	in operation
26		Topľa	LB 103.550-105.10		1.460	1.2	2015	1	330	in operation
27		Chlmec	RB 0.000 – 3.800		3.800	2.4		1	45	in operation
27		Chlmec	LB 0.000 – 3.800		3.800	2.4		1	45	in operation

No.	Dike name	Water course	Dike position (rkm)	Locality Name	Length (km)	Medium high (m)	YCO	Normal operating conditions		Status
								Probability of exceeding (pc%)	Q100 (m^3/s)	
27		Chlmec	RB 4.000 – 10.108		6.108	2.4	1967	1	38	in operation
27		Chlmec	LB 4.000 – 10.108		6.108	2.4	1967	1	38	in operation
28		Trnavka	RB 0.000 – 23.200		23.200	2.4		5	87	in operation
28		Trnavka	LB 0.000 – 22.500		22.500	2.4		5	87	in operation
29		Bodrog	RB 0.000 – 6.200		6.200	2-4. 4	1963	1	1 480	in operation
29		Bodrog	LB 0.000 – 13.925		13.925	2-4. 4	1963	1	1 480	in operation
30		Roňava	LB 0.000 – 0.860		0.860	2.4		1	60	in operation

[1] left bank (LB) or right bank (RB)
[2] Year of Commissioning
[3] technical status: very good, satisfying, non- satisfying/bad.

Dikes in Hungary

No.	Dike name[1]	Water course	Dike position[2]	Locality name[3]	Length (m)	Medium high (m)	YCO[4]	Normal operating conditions		Status
								Probability of exceeding (%)	Q (m^3/s)	
1	07.01	Tisza	LB	Nagyhalász-Vencsellő-buji	24469	3	n.r.	0		satisfying
		Lónyay	LB		2113	3	n.r.	0		satisfying
2	07.02	Tisza	LB	Veresmart-nagyhalászi	22727	3.5	n.r.	0		satisfying
3	07.03	Tisza	LB	Zsurk-veresmarti	27773	3.5	n.r.	0		satisfying
4	07.04	Tisza	LB	Vásárosnamény- zsurki	31240	3.5	n.r.	0		satisfying
5	07.05	Tisza	LB	Szatmárcseke-olcsvaapáti	31300	3.5	n.r.	0		satisfying
6	07.06	Batár-patak	LB	Magosliget-tiszakóródi	9940	3.5	n.r.	0		satisfying
		Tisza	LB		16082	3.5	n.r.	0		satisfying
7	07.07	Tisza	RB	Vásárosnamény-lónyai	31000	3.5	n.r.	0		satisfying
8	07.08	Tisza	RB	Tarpa- vásárosnaményi	29469	3.5	n.r.	0		satisfying
9	07.09	Lónyay	LB	Kótaj-vencsellői	9654	3	n.r.	0		satisfying
		Lónyay	RB		7566	3	n.r.	0		satisfying
10	07.10,07.11	Lónyay	LB	Berkesz-kótaji	24738	3	n.r.	0		satisfying
11	07.12	Kraszna	LB	Mérkvállaj- vásárosnaményi	59777	3	n.r.	0		satisfying
12	07.13	Kraszna	RB	Ágerdőmajor-olcsvai	40482	3	n.r.	0		satisfying
13	07.14	Szamos	LB	Csenger-olcsvai	46650	3	n.r.	0		satisfying
14	08.01	Laskó	LB	Sarud-négyesi	4600	3	n.r.	0		satisfying
		Tisza	RB		12944	3	n.r.	0		satisfying
		Rima	LB		7826	2.5	n.r.	0		satisfying
		Rima	RB		7955	2.5	n.r.	0		satisfying
		Eger	LB		1100	2.5	n.r.	0		satisfying
		Eger	RB		1045	2.5	n.r.	0		satisfying
		Csincse	LB		4159	2.5	n.r.	0		satisfying
		Csincse	RB		4200	2.5	n.r.	0		satisfying
15	08.02	Tisza	RB	Négyes-tiszakeszi	25332	3	n.r.	0		satisfying
16	08.03	Tisza	RB	Tiszakeszi-sajószögedi	24451	3	n.r.	0		satisfying
		Sajó	RB		6051	3	n.r.	0		satisfying
17	08.04	Tisza	RB	Inérhát-tokaji	45381	3.5	n.r.	0		satisfying
		Bodrog	RB		1394	3.5	n.r.	0		satisfying
18	08.05	Tisza	RB	Zalkod-tiszacsermelyi	31600	3.5	n.r.	0		satisfying
19	08.05 II	Tisza	RB	Tiszacsermely-zemplénagárdi	36342	3.5	n.r.	0		satisfying
20	08.06	Sajó bp.	LB	Bánréve-felsőzsolcai	30263	3.5	n.r.	0		satisfying
		Névtelen	LB		947	2.5	n.r.	0		satisfying
		Névtelen	RB		950	2.5	n.r.	0		satisfying
		Keleméri	RB		764	2.5	n.r.	0		satisfying
		Keleméri	LB		950	2.5	n.r.	0		satisfying
		Szörnyűv.	LB		414	2.5	n.r.	0		satisfying

No.	Dike name[1]	Water course	Dike position[2]	Locality name[3]	Length (m)	Medium high (m)	YCO[4]	Normal operating conditions		Status
								Probability of exceeding (%)	Q (m^3/s)	
		Szuha	RB		1400	2.5	n.r.	0		satisfying
		Szuha	LB		1500	2.5	n.r.	0		satisfying
		Vörös	RB		1300	2.5	n.r.	0		satisfying
21	08.07	- Nagycsécsi	RB	Miskolc-sajópüspöki	1094	3	n.r.	0		satisfying
		- Ónodi	RB		2642	3	n.r.	0		satisfying
		Sajó	RB		26281	3.5	n.r.	0		satisfying
		Szinva	RB		300	2.5	n.r.	0		satisfying
		Szinva	LB		450	2.5	n.r.	0		satisfying
		Mercse	RB		977	2.5	n.r.	0		satisfying
		Hangony	RB		840	2.5	n.r.	0		satisfying
		Hagony	LB		837	2.5	n.r.	0		satisfying
22	08.08	Hernád	RB	Hernádnémeti-hernádszurdoki	27240	3	n.r.	0		satisfying
		Vadász	RB		1300	2.5	n.r.	0		satisfying
		Vadász	LB		1580	2.5	n.r.	0		satisfying
		Garadna	RB		1832	2.5	n.r.	0		satisfying
		Garadna	LB		1800	2.5	n.r.	0		satisfying
23	08.09	Hernád	LB	Hidasnémeti-bőcsi	26424	3	n.r.	0		satisfying
		Gönci	RB		870	2.5	n.r.	0		satisfying
		Gönci	LB		1000	2.5	n.r.	0		satisfying
24	08.10	Sajó	LB	Inérhát-taktaföldvári	8000	3.5	n.r.	0		satisfying
		Takta	LB		28643	3	n.r.	0		satisfying
		Takta	RB		6706	3	n.r.	0		satisfying
25	08.11	Bodrog	LB	Viss-felsőberecki	39799	3.5	n.r.	0		satisfying
26	08.12	Tarna	LB	Jászjákóhalma-káli	36214	3	n.r.	0		satisfying
27	08.13	Tarna	RB	Jászdózsa-káli	35728	3	n.r.	0		satisfying
		Ágói	RB		5417	2.5	n.r.	0		satisfying
		Ágói	LB		5392	2.5	n.r.	0		satisfying
		Gyöngyös	RB		6827	2.5	n.r.	0		satisfying
		Szarvágy	LB		3010	2.5	n.r.	0		satisfying
		Szarvágy	RB		3019	2.5	n.r.	0		satisfying
		Gyöngyös	LB		6826	2.5	n.r.	0		satisfying
		Gyangya	RB		1705	2.5	n.r.	0		satisfying
		Gyangya	LB		1619	2.5	n.r.	0		satisfying
		Bene	LB		8845	2.5	n.r.	0		satisfying
		Bene	RB		8857	2.5	n.r.	0		satisfying
		Tarnóca	RB		11931	2.5	n.r.	0		satisfying
		Tarnóca	LB		11969	2.5	n.r.	0		satisfying
28	08.14	Bodrog	RB	Bodrogkeresztúr - sátoraljaújhelyi	10175	3	n.r.	0		satisfying
		Ronyva	RB		2327	3	n.r.	0		satisfying

No.	Dike name[1]	Water course	Dike position[2]	Locality name[3]	Length (m)	Medium high (m)	YCO[4]	Normal operating conditions		Status
								Probability of exceeding (%)	Q (m^3/s)	
		Ronyva	LB		1811	3	n.r.	0		satisfying
29	09.01	Tisza	LB	Tiszafüred-tiszakeszi	41000	3.5	n.r.	0		satisfying
30	09.02	Tisza	LB	Tiszatarján-rakamazi	66820	3.5	n.r.	0		satisfying
		Keleti-fcs. (main channel)	RB		4755	3	n.r.	0		satisfying
		Keleti-fcs. (main channel)	LB		4725	3	n.r.	0		satisfying
31	09.03	Berettyó	RB	Kálló menti	1587	3	n.r.	0		satisfying
		Kálló	RB		11210	3	n.r.	0		satisfying
32	09.04	Berettyó	RB	Darvas-pocsaji	44500	3	n.r.	0		satisfying
		Kálló	LB		1925	3	n.r.	0		satisfying
		Ér	RB		8700	3	n.r.	0		satisfying
33	09.05	Sebes-Körös	RB	Szeghalom-darvasi	10187	3	n.r.	0		satisfying
		Berettyó	LB		25000	3	n.r.	0		satisfying
34	09.06	Berettyó	LB	Darvas-kismarjai	47365	3	n.r.	0		satisfying
35	09.07	Berettyó	RB	Érmelléki	5820	3	n.r.	0		satisfying
		Ér	LB		8100	3	n.r.	0		satisfying
36	09.08	Sebes-Körös	RB	Szeghalom-körösszakáli	32265	3	n.r.	0		satisfying
37	09.09	Hortobágy-Berettyó	LB	Bucsa-nádudvari	24119	3	n.r.	0		satisfying
		Holt-Kösely	LB		9811	3	n.r.	0		satisfying
38	10.01	Tisza	RB	Lakitelek-tószegi	55 637	3.5	1984	0	584	satisfying
		Közös-főcsatorna (main channel)	RB		4 500	2	1984	0	0.69	satisfying
		Közös-főcsatorna (main channel)	LB		4 500	2	1984	0	0.69	satisfying
39	10.02	Tisza	RB	Szolnok-Újszász-szórói	27 458	4	1984	0	584	satisfying
		Zagyva	RB		23 928	4	1984	0	9.89	satisfying
		Zagyva	LB		22 643	4	1984	0	9.89	satisfying
		Tápió	RB		6 320	3	1984	0	0.25	satisfying
40	10.03	Tisza	RB	Doba-kanyari	49 406	5	1984	0	584	satisfying
41	10.04	Tisza	RB	Kiskörei - tározó menti	22 900	4.5	1984	0	571	satisfying
		Tisza	LB		32 200	4.5	1984	0	571	satisfying
42	10.05	Tisza	LB	Kunszentmárton-nagyrévi	48 100	5.5	1984	0	584	satisfying
		Hármas-Körös	RB		25 166	4.5	1984	0	103	satisfying
43	10.06	Tisza	LB	Tiszaföldvár-pityókai	56 980	5	1984	0	584	satisfying
44	10.07	Tisza	LB	Fegyvernek-ledencei	33 500	4.5	1984	0	584	satisfying
45	10.08	Hármas-Körös	RB	Öcsöd-bánrévei	32 354	4	1984	0	101.5	satisfying
46	10.09	Hortobágy-Berettyó	RB	Mezőtúr-himesdi	30 500	3	1984	0	4.05	satisfying
47	10.10	Hortobágy-Berettyó	RB	Pusztaecseg - őzesi	39 980	3	1984	0	4.05	satisfying
		Német-ér	RB		3 300	2.5	1984	0	0.056	satisfying
		Német-ér	LB		9 100	2.5	1984	0	0.056	satisfying

No.	Dike name[1]	Water course	Dike position[2]	Locality name[3]	Length (m)	Medium high (m)	YCO[4]	Normal operating conditions		Status
								Probability of exceeding (%)	Q (m^3/s)	
48	10.11	Zagyva	LB	Százberek-jászberényi	45 380	2.5	1984	0	3.9	satisfying
		Zagyva	RB		43 422	2.5	1984	0	3.9	satisfying
		Tápió	LB		10 912	2	1984	0	0.25	satisfying
49	11.01	Tisza	RB	Gyála-Szeged-Algyői	31 512	5	n.r.	0		satisfying
50	11.02	Tisza	RB	Algyő-dongéri	23 759	4.5	n.r.	0		satisfying
		Dong-ér	RB		4 693	5	n.r.	0		satisfying
51	11.03	Tisza	RB	Dongér-Csongrádi	35 233	4.5	n.r.	0		satisfying
		Dong-ér	LB		4 693	4	n.r.	0		satisfying
52	11.04	Tisza	LB	Marostorok-Mártélyi	29 598	4.5	n.r.	0		satisfying
		Maros	RB		5 406	4.5	n.r.	0		satisfying
53	11.05	Tisza	LB	Mindszent-Szentesi	31 764	4.5	n.r.	0		satisfying
54	11.06	Maros	LB	Torontáli	12400	4.5	n.r.	0		satisfying
		Tisza	LB		28640	4.5	n.r.	0		satisfying
55	11.07	Maros	RB	Maros jobb parti	44800	4	n.r.	0		satisfying
		Sámson-Apátfalvi	RB		9510	4	n.r.	0		satisfying
		Sámson-Apátfalvi	LB		9510	4	n.r.	0		satisfying
56	11.08	Hármas-Körös	LB	Szentes-öcsödi	35913	4	n.r.	0		satisfying
57	12.01	Hármas-Körös	LB	Szarvasi	49117	4	n.r.	0		satisfying
58	12.02	Kettős-Körös	LB	Mezőberényi	35040	4	n.r.	0		satisfying
		Fehér-Körös	LB		9286	4	n.r.	0		satisfying
59	12.03	Hármas-Körös	RB	Zsófiamajori	28413	4	n.r.	0		satisfying
60	12.04	Kettős-Körös	RB	Dobozi	36193	4	n.r.	0		satisfying
		Fekete-Körös	RB		15829	3.5	n.r.	0		satisfying
61	12.05	Fehér-Körös	RB	Mályvádi	9475	4	n.r.	0		satisfying
		Fekete-Körös	LB		20490	4	n.r.	0		satisfying
62	12.06	Hortobágy-Berettyó	RB	Ecsegfalvai	43000	3.5	n.r.	0		satisfying
63	12.07	Sebes-Körös	RB		14013	3.5	n.r.	0		satisfying
		Berettyó	RB		21313	4	n.r.	0		satisfying
64	12.08	Sebes-Körös	LB	Fokközi	57966	3.5	n.r.	0		satisfying

[1] Dike name is the number of the flood protection line. The first number represent the Regional Water Directorate which operating.
[2] left bank (LB) or right bank (RB)
[3] Year of Commissioning; in many case not relevant for the flood protection method. In Hungary the operation doesn't connected to discharge. The flood protection alert is ordered by water levels.
[4] technical status: very good, satisfying, non- satisfying/bad. – we indicated "satisfy" the whole flood protection system, because the technical status is good, but the the Tisza valley's flood protection dykes don't reach the Designed Flood Water Level + safety.

Dikes in Serbia

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium high (m)	YCO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (%)	Q (m^3/s)	
1	D.10.1.2	Tisza	RB	Titel	7710	5.00		1		satisfying
2	D.12.3.3	Bajski kanal	LB	Bački Breg	530	6.00		1		satisfying
3	D.13.1.1	Tisza	RB	Horgoš	5200	5.50		1		satisfying
4	D.13.1.2	Tisza	RB	Martonoš	8680	5.50		1		satisfying
5	D.13.1.3	Horgoš-Martonoš channel	LB	Martonoš	4500	5.50		1		satisfying
6	D.13.1.4	Horgoš-Martonoš channel	RB	Martonoš	4500	6.00		1		satisfying
7	D.13.1.5	Tisza	RB	Kanjiža	13300	5.50		1		satisfying
8	D.13.1.6	Kereš	LB	Adorjan	7500	2.50		1		satisfying
9	D.13.2.1	Kereš	RB	Adorjan	7500	2.50		1		satisfying
10	D.13.2.2	Tisa	RB	Senta	22820	5.00		1		satisfying
11	D.13.3.1	Tisa	RB	Ada	21800	6.00		1		satisfying
12	D.14.1.1	Tisa	RB	Bečej	31580	4.70		1		satisfying
13	D.15.1.1	Tisa	RB	Čurug	18540	6.00		1		satisfying
14	D.15.2.1	Tisa	RB	Mošorin	16970	5.00	2008	1		satisfying
15	D.15.2.2	Tisa	RB	Mošorin II line	12500	3.00	2009	1		satisfying
16	D.16.1.1	Tisa	LB	Novi Kneževac	24990	5.00		1		satisfying
17	D.16.1.2	Tisa	LB	Đala	6210	5.00		4		satisfying
18	D.16.1.3	Tisa	LB	Đala II line	7580	1.50		1		satisfying
19	D.16.1.4	Tisa	LB	Čoka	30500	5.00		1		satisfying
20	D.16.2.1	Tisa	LB	Padej	4950	5.00		1		satisfying
21	D.16.2.2	Tisa	LB	Novo Miloševo	14700	5.00		1		satisfying
22	D.16.2.3	Tisa	LB	Novi Bečej	11280	5.00		1		satisfying
23	D.17.1.1	Tisa	LB	Sokolac	11140	5.00		1		satisfying
24	D.17.1.2	Tisa	LB	Taraš-Elemir	29570	6.00	2010	1		satisfying
25	D.17.1.3	Tisa	LB	Belo Blato	12100	6.00	2010	1		satisfying
26	D.17.1.4	Begej	RB	Perlez	8850	3.00	2010	1		satisfying
27	D.17.2.1	Begej	LB	Perlez	3910	4.50	2010	1		satisfying
28	D.17.2.2	Tisa	LB	Knićanin	9450	6.00	2010	1		satisfying
29	D.19.1.3	Vrbas-Bezdan channel	RB	Bački Monoštor	18400	4.00		1		satisfying
30	D.19.2.1	Vrbas-Bezdan channel	RB	Bezdan	18200	4.50		1		satisfying
31	D.19.2.4	Bajski channel	LB/RB	Bezdan-Bački Breg	14640	4.00		1		satisfying
32	D.19.4.1	Kosančić-Mali Stapar channel.	RB	Bački Gračac	7000	2.00		1		satisfying
33	D.19.4.2	Kosančić-Mali Stapar channel	LB	Kruščić-Ruski Krstur	7000	2.00		1		satisfying
34	D.19.4.4	Vrbas-Bezdan channel	RB	Vrbas-Kula	6000	3.00		1		satisfying
35	D.19.4.5	Vrbas-Bezdan channel	LB	Vrbas-Kula	6000	3.00		1		satisfying
36	D.19.6.2	Zlatica	RB	Padej	900	2.50		1		satisfying

No.	Dike name	Water course	Dike position[1]	Locality name	Length (m)	Medium high (m)	YCO[2]	Normal operating conditions		Status[3]
								Probability of exceeding (%)	Q (m^3/s)	
37	D.19.6.3	Zlatica	RB	Jazovo-Banatski Monoštor	9970	3.00		1		satisfying
38	D.19.6.5	Zlatica	RB	Vrbica-Granični	4380	1.50		1		satisfying
39	D.19.6.5	Zlatica	RB	Majdan-Granični	3640	1.50		1		satisfying
40	D.19.6.5	Zlatica	RB	Banantsko Arandjelovo-Granični	4020	1.50		1		satisfying
41	D.19.6.6	Zlatica	LB	Padej	10000	3.00		1		satisfying
42	D.19.6.7	Kikindski channel	RB	Kikindski kanal	19700	3.00		1		satisfying
43	D.19.6.8	Banatska Palanka-Novi Bečej channel.	LB	Novi Bečej	4430	3.00		1		satisfying
44	D.19.7.1	Zlatica	LB	Jazovo	8910	3.00		1		satisfying
45	D.19.7.3	Kikindski cnl	LB	Kikindski kanal	17600	3.00		1		satisfying
46	D.19.7.4	Zlatica	LB	Nakovo-Granični	12160	3.00		1		satisfying
47	D.19.8.1	Banatska Palanka-Novi Bečej	RB	Novi Bečej	9400	3.00		1		satisfying
48	D.20.1.1	Begej	RB	Zrenjanin	18550	3.00		1		satisfying
49	D.20.2.1	Stari Begej	RB	Stari Begej	37040	3.50		1		satisfying
50	D.20.3.1	Stari Begej	LB	Stari Begej	34690	3.00		1		satisfying
51	D.20.3.2	Plovni Begej	RB	Plovni Begej	27060	2.50		1		satisfying
52	D.20.3.3	Plovni Begej	RB	Itebej-Granični	3300	1.50		1		satisfying
53	D.20.4.1	Plovni Begej	LB	Plovni Begej	29000	2.70		1		satisfying

[1] left bank (LB) or right bank (RB)
[2] Year of Commissioning, [3] technical status: very good, satisfying, non-satisfying/bad.

Permanent reservoirs in Ukraine

No.	Reservoir name	Water course	Nearest locality name	Height dam (m)	Type of dam[1]	Volume at NRL (MCM)	Volume at MEL (MCM)	Attenuation volume (MCM)	Use[2]
1	"Gorbok" , Farm «Mochar»	Roman-Potik. Reclamation system "Chornyi Mochar"	village Gorbok, Irshava rayon			3,69		3,69	Short-term regulation during floods, seasonal for horizon
2	"Babichka"	Babichka river. Reclamation system "Chornyi Mochar"	village Zaluzh, Mukachevo rayon			2,9		2,9	
3	Fornosh"	"Fornosh" channel. Reclamation system "Chornyi Mochar	village Liskove, Mukachevo rayon			2,5		2,5	
4	"Mochyla"	Mochyla river	village Pistrialovo, Mukachevo rayon			1,5		1,5	
5	NN	Stara river	village Andriivtsi, Uzhgorod rayon			1,35		1,35	Seasonal regulation
6	"Bobovyschanske	Salva river	Vynogradiv			2,113		2,113	
7	NN	Polui river	village Bobovysche, Mukachevo rayon			1,0		1,0	
8	NN	Boroniava river	village Boroniavo, Khust rayon			1,5		1,5	
9	Water-energy reservoir Tereble-Ritska hydroelectric power station	Tereblia river				24		24	Hydropower

[1] –arch/gravity from concrete/earth/embankment, etc.
[2] – flood protection, water supply, industry, irrigation etc.
NRL normal retention level
MEL – maximum exploitation level

Permanent reservoirs in Romania

No.	Reservoir name	Water course	Nearest locality name	Height of the dam (m)	Type of dam	Volume at NRL (MCM)	Volume at MEL (MCM)	Attenuation volume (MCM)	Use
Someș-Tisa subbasin									
1	Fântânele	Someșul Cald	Beliș	92	AM	213	250.42	37.42	HVR
2	Tarnița	Someșul Cald	Someșu Cald	97	A	70.3	77.4	7.1	A,H,V,R
3	Someșul Cald	Someșul Cald	Someșu Cald	34	G	7.47	9.53	2.07	A,H,V,R
4	Gilău	Someș Mic	Gilău	23	G+AM	2.44	3.525	1.085	A,H,
5	Vârșolț	Crasna	Vârșolț	14	PM	16.070	39.388	23.318	A,V,P
6	Strâmtori - Firiza	Firiza	Firiza	51,5	C	15.77	17.52	1.75	AH
Crișuri subbasin									
1	Leşu	Iad	Remeţi	60,5	AM	28.3	33.8	4.2	AHVR
2	Tauţ	Cigher	Tauţ	22	PM	15.21	33.7	18.49	VR
3	Suplacu de Barcău	Barcău	Suplacu de Barcău	11	PM	6.2	15.849	13.649	AV
4	Mihăileni	Crişul Alb		34	A		10.33		AHV
5	Cărăsău	Valea de Izvor	Cociuba Mare/Cărăsău	15	PM	1.148	1.920	0.772	IV
6	Lugaşu	Crişul Repede	Lugaşu de Jos	37	PM	63.500	74.500	11	H
7	Tileagd	Crişul Repede	Tileagd	37	PM	52.900	63.300	10.4	H
8	Drăgan	Drăgan	Lunca Vişagului	120	A	112.000	127.050	15.1	H
Mureș subbasin									
1	Zetea	Târnava Mare	Zetea	48	PA	16.50	44.10	18.40	VH
2	Bezid	Cuşmed	Sangeorgiu de Pădure	29	PA	15	31	16	VH
3	Ighiş	Ighiş	Mediaş	36	PA	5		6.27	VA
4	Mihoeşti	Arieş (Arieşul Mare)	Câmpeni/Mihoieşti	25.35	PM	6.25	9.45	3.25	V,A,H
5	Cinciş	Cerna	Teliucu Inferior/Cinciş Cerna	48.00	A	24.910	32.086	7.176	A,H,V
6	Gura Apelor	Râu Mare	Râu de Mori/Brazi	168.00	AA	200.000	226.180	26.180	H
7	Ostrovu Mic	Râu Mare	Râu de Mori/Ostrovu Mic	32.50	G	9.200	10.20	0.820	H
8	Păclişa	Râu Mare	Toteşti/Păclişa	32.50	G	9.100	10.420	1.320	H
9	Haţeg	Râu Mare	Haţeg/Haţeg	32.50	G	11.580	13.480	1.900	H
10	Subcetate	Strei	Sântămărie Orlea/Subcetate	23.50	G	6.070	6.600	0.530	H
11	Obrejii de Căpâlna	Sebeș	Căpâlna	42	A	3.92	4.46	0.54	H,A,V
12	Petrești	Sebeș	Petrești	22	SBB	1.35	1.68	0.33	H,A,V
13	Cugir	Cugirul Mare	Tău Bistra	48	A	1	1.770	0.785	H,V
14	Tău	Sebeș	Tău Bistra	78	A	21.3	23.79	2.49	H,V
15	Oașa	Sebeș	Obârșia Lotrului	91	AM	136.2	147.615	8.5	H,V
Banat subbasin									
1	Surduc	Gladna	Surducu Mic	34.0	AM	24.225	50.000	25.775	V,H,R,A

*	Type of the dam	** Uses	*	Type of the dam	** Uses
A	Arch dam (or gravity arch)	V – flood protection	PO	Earthfill homogenous dam	R – recreation
G	Concrete Gravity Dam	I - irigation	PA	Earthfill dam sealed with clays	X – other uses
C	Concrete Buttress Dams	H - hydroenergy	PM	Earthfill dam sealed with upstream mask	
AA	Rockfill dam sealed with clays	P – pisciculture	SS	Weir with surface weirs	
AM	Roclfill dam sealed with upstream mask	A – water supply	SBB	Weir with closing concrete dam	
			SBML	Weir with closing dam or earth perimeter dam	

Permanent reservoirs in Slovakia

No.	Reservoir name	Water course	Nearest locality name	High dam (m)	Type of dam[1]	Volume at NRL (m^3)	Volume at MEL3 (m^3)	Attenuation volume (m^3)		Use2
1	Miková	Slaná	Revúca	7.1	E-HO	1100000	949520	0	150480	water reservoir
2	Klenovec	Slaná	Rimavská Sobota	32.5	E	8431443	7473387	0	958056	water reservoir
3	Gemerský Jablonec	Slaná	Rimavská Sobota	9.0	E	2490000	2049514	0	440486	water reservoir
4	Hostice	Slaná	Rimavská Sobota	6.6	E	1010000	774930	0	235070	water reservoir
5	Teplý Vrch	Slaná	Rimavská Sobota	14.1	E	5282000	4757000	0	525000	water reservoir
6	Bukovec	Bodva	Košice-okolie	56.0	Se-E/LS	21760000	20780000	0	980000	water reservoir
7	Palcmanská Maša	Hornád	Rožňava	34.0	C-G	10354936	10360000	0	0	water reservoir
8	Ružín I	Hornád	Košice-okolie	63.0	Se-E/LS	49451400	49145000	0	3500000	water reservoir
9	Ružín II	Hornád	Košice-okolie	27.0	C-G	4430000	3770000	0	780000	water reservoir
10	Starina	Bodrog	Snina	50.0	E-HO	56950000	48790000	0	8170000	water reservoir
11	Zemplínska Šírava	Bodrog	Michalovce	12.0	E-HO	324889000	269000000	35000000	65000000	water reservoir
12	Veľká Domaša	Bodrog	Vranov nad Topľou	35.0	E-HO	172722000	157520000	0	20760000	water reservoir
13	V. Ozorovce	Bodrog	Trebišov	9.3	E-HO	1158100	973500	0	0	water reservoir

(E-Earth, Se-Stone embankment, C-concrete, HO-homogenous, HE-heterogenous)
G-Gravity, LS-with loam seal
[1] – arch/gravity from concrete/earth/embankment, etc.
[2] – flood protection, water supply, industry, irrigation etc.
[3] Normal Retention Level
[4] Maximum Exploitation Level

Permanent reservoirs in Hungary

No.	Reservoir name	Water course	Nearest locality name	High dam (m)	Type of dam	Volume at NRL (MCM)	Volume at MEL (MCM)	Attenuation volume (MCM)	Use
1	Tisza-tó	Tisza	10.04 Kiskörei - tározómenti	8	ferro-concrete, steel	155	170	not relevant	Agricultural, ecological, and tourist water storage

[1] – arch/gravity from concrete/earth etc.
[2] – flood protection, water supply, industry, irrigation etc.
[3] Normal Retention Level
[4] Maximum Exploitation Level

Permanent reservoirs in Serbia

No.	Reservoir name	Water course	Nearest locality name	High dam (m)	Type of dam1	Volume at NRL (MCM)	Volume at MEL[3] (MCM)	Attenuation volume (MCM)	Use[2]
1	Brana na Tisi	Tisza	Novi Bečej	0-9	Gravity from concrete		50.000		water supply

[1] – arch/gravity from concrete/earth/embankment, etc.
[2] – flood protection, water supply, industry, irrigation etc.
[3] Normal Retention Level
[4] Maximum Exploitation Level

Temporary reservoirs in Romania

No.	Reservoir name	Water course	Type of dam	Hight dam (m)	Total volume (attenuation volume) (MCM)
Someş-Tisa subbasin					
1	V. Vinului	Rodina	PO	7.9	1.7
2	Crucisor III	V. Vinului	PO	7.0	1.13
Crişuri subbasin					
1	1 Mai	Peţa	PO	10.2	1.212
2	Felix	Hidişel	PO	13.5	2.48
3	Adona	Adona	PO	8.5	2.024
4	Ciutelec	Bistra	PO	7.7	3.4
5	Egher	Cheţ	PO	7	1.561
6	Sânnicolau de Munte	Sânnicolau	PO	8	2.30
7	Uileacul de Munte	Cosmo	PO	6	2.75
8	Hodişel	Hodişel	PO	12.55	1.879
9	Cărand – Răpsig	Teuz	PO	6	20.20
10	Cârpeştii Mici	Cârpeştii Mici	PO	7.2	2.60
11	Galoşpetreu I	Rât	PO	5	3.84
12	Gepiu II	Gepiu	PO	8.15	1.59
13	Bicaciu	Corhana	PO	7.6	3.59
14	Andpot	Afl. Valea Nouă	PO	7	1.04
15	Andrid	Ier	PO	6	17.5
Mureş subbasin					
1	Cladova	Cladova	PO	10.0	1.01
2	Şiştarovăţ	Andştarovăţ	PO	9.0	2.1
3	Acumulare Drauţ	Drauţ	PO	10.0	1.16
4	Vânători	Tânava Mare	G/PO	24	25.5
5	Bălăuşeri	Târnava Mică	G/PO	19	24.5
6	Nemşa	brook Moşna	PO	21.3	7.94
7	Valea	Niraj	PO/G	14	6
8	Tăul Ceanului	Valea Caldă Mare	PO	8.5	4.45
Banat subbasin					
1	Cosarii II	Chizdia	PO	7.6	2
2	Repas	Repas	PO	7.6	1.6
3	Pischia	Bega Veche	PO	10.4	13.3
4	Manastur	Apa Mare (Rat)	PO	8	10.15
5	Izvorin	Slatina (Izvorin)	PO	8.05	6.64

Type of the dam

PO	*Earthfill omogenous dam*
PA	*Earthfill dam sealed with clays mask*
PM	*Earthfill dam sealed with upstream mask*
SS	*Weir dam with surface weirs*

Polders in Romania

No.	Polder name	Water course	Locality name	Dike type	Length (km)	High dike (m)	Total surface (ha)	Total volume (attenuation volume, (MCM)
	Someș-Tisa subbasin							
1	Moftin	Crasna	Moftin/Ghilvaci	Lateral	7596	3.50	294.00	Total 5.686 (2.052 comp,I+3.634 comp,II)
2	Supur	Crasna	Supur/Supuru de Jos	Contour	5943	5.00	134.23	5.88
	Crişuri subbasin							
1	Tămaşda	Crişul Negru	Tămaşda	Perimeter Enclosure Partition	9.779	2.3 - 7	507	22.12
2	Coşdeni	Holod	Coşdeni	Lateral Contour	4.635	9	148	2.9
3	Ginta	Holod	Ginta	Contour	7.800	4		17.3
4	Sâmbăta	Topa	Sâmbăta	Contour, enclosure	6.822	3	104	4.5
5	Sălard	Barcău	Sălard	Contour	10.960	4		15
6	Chier	Valea Mare	Chier	Contour	6.940	4	404	9.95
7	Zerindu Mic	Crişul Negru	Avram Iancu/Tămaşda	Lateral Partition	12.680	2.40 - 7	475	23.38
8	Beliu	Beliu	Beliu	Parimeter Enclosure Partition	4,440	2.15 - 3,9	143	2.7
9	Sartiş	Sartiş	Cermei	Parimeter Enclosure Partition backwater	7,360	1.5 – 3.2	210	3.6
10	Frunziş	Frunziş	Apateu/ Berechiu	Perimeter Enclosure backwater	9.250	2 – 3.3	405	6.2
11	Şes Inand	Corhana	Cefa	Perimeter	2.117	3		2.325
12	Andcula	Crişul Alb	Andcula	Perimeter backwater Enclosure	10.052	4 – 4.5	680 (2%)	6.5
13	Cigher	Crişul Alb	Zărand	Perimeter backwater Ring	13.771	4.5	1.000 (2%)	8
	Mureș subbasin							
1	Vânători	Tânava Mare	Albești	Contour and partition	6500; 2090	10	350	8
2	Balăușeri	Târnava Mică	Bălăușeri	Contour and partition	7300; 3670; 2330	0.5-12; 2.4-6.6; 2	325	11.4
	Banat subbasin							
1	Cenei	Bega Veche	Cenei	Lateral	3200	3	193	4

Polders in Slovakia

No.	Polder name	Water course	Locality name	Dike type1	Length (km)	High dike (m)	Total surface (ha)	Total volume (attenuation volume) (m3)
1	Beša	Laborec in km 6,800	c. a. Beša (Veľké Raškovce, Oborín)	Earthy left shore perimeter dike; Right shore protection dike of Laborec; Protection dike of Latorica perimeter dike; Dividing dike	6.200; 2.660; 3.200; 6.800	4.5; 3.5	1,568.00	53,000,000
2	Vranov nad Topľou polder no. 1	Vranovský potok no. 1 in km 2.106	c. a. Vranov nad Topľou	Earthy homogenous dike	0.035	6.6	0.77	8,612
3	Vranov nad Topľou polder no. 2	Vranovský potok no. 1 in km 2.309	c. a. Vranov nad Topľou	Earthy homogenous dike	0.033	8.8	0.40	13,000
4	Frička	Kamenec in km 12.800	c. a. Frička	Earthy homogenous dike	0.093	9.4	2.05	78,700
5	Vyšný Tvarožec	Sveržovka in km 5.800	c. a. Vyšný Tvarožec	Earthy homogenous dike	0.117	11.3	1.90	68,900
6	Borša	Boršiansky potok in km 0.000	c. a. Borša	Earthy perimeter dike	0.578	2.0	12.99	207,900

[1] lateral/contour/partition/perimeter/enclosure etc.
Note: c. a. = cadastral area

Polders in Hungary

No.	Polder name	Water course	Locality name	Dike type	Length (km)	High dike (m)	Total surface (ha)	Total volume (attenuation volume, (MCM)
1	Tiszaroffi	Tisza	10.07 Fegyvernek - Ledencei	lateral	14	2.9	2280	97
2	Nagykunsági	Tisza	10.07 Fegyvernek - Ledencei	lateral	25	4	4000	99
3	Hanyi-Tiszasülyi	Tisza	10.03 Doba - Kanyari	lateral	32	2.9	5570	247
4	Jásztelki	Zagyva	10.11 Szászberek - Jászberényi	lateral	27	1.5	2000	13
5	Borsóhalmi	Zagyva	10.11 Szászberek - Jászberényi	lateral	24	2	2000	23.5
6	Beregi	Tisza	07.08./T Beregi tározói	lateral	50.7	2.11	2470	58
7	Szamos-Kraszna közi	Szamos	07.14./T Szamos-Kraszna közi tározói	lateral	21	3.2	5110	126
8	Cigándi	Tisza	08.05/II-T. Cigándi-Tiszakarádi Árvízi tározó	lateral	24	4.5	2470	94
9	Mályvád	Fekete-Körös	12.05. Mályvádi	lateral	8.9	2.27	3470	75
10	Kisdelta	Fehér-Körös	12.02. Mezőberényi	lateral	3.6	4.2	550	26
11	Mérges	Kettős-Körös, Sebes-Körös	12.07. Körösladányi	lateral	7.8	3.8	1820	87.2

[1] lateral/contour/partition/perimeter/enclosure etc.

Annex IV.5

No.	Name	Locality name	Derived stream	Receiver water course	Length (km)	Derived discharges (m^3/s)
1	Mertse	Hat	Roman Potok	Vysokoberezhnyi	17.0	
2	Babichka	Zaluzhia	Water reservoir "Babichka"	Mochylo	8,6	
3	Mochylo	Pistrialovo	Water reservoir "Mochylo"	Fornosh	6,9	
4	Fornosh	Fornosh	Mochylo	Mertse	6,9	
5	Lypnytsa	Fornosh	Water reservoir "Fornosh"	Fornosh	2,8	
6	Polui	Rakoshyno	Water reservoir ”Bobovyschanske"	Stara	13,3	
7	M-3	Makariovo		M-2	6,32	
8	K-II	Makariovo		Fornosh	5,5	
9	GD-1	Chomonyn		150	1,04	
10	GD-1 Vyznytsia	Verkhnia Vyznytsia		Vyznytsa	2,64	
11	K-4	Vinkove		Latorica	8,0	
12	k-4 Serne	Barkasovo – Rafailovo - Chomonyn	MK-1Serne	Nyzhe-Sernianskyi M-1	5,9	
13	Vysokoberezhnyi	Gat-Velyka Dobron	Mertse	Latorica	26.0	
14	K-300	Horonda	K-550	Vysokoberezhnyi	7,5	
15	K-500	Shenborn-Nyzhniy Koropets		Mertse	15,4	
16	K-100	Pavshyno-V.Luchky-Chomonyn		Vysokoberezhnyi	20,1	
17	K-150	Kliucharky- V.Luchky-Chomonyn		K-100	12,6	
18	MK-6	Chomonyn	Dobronskyi	Nyzhe-Sernianskyi M-1	3,8	
19	K-1 Drysyno	Nyzhniy Koropets		K-500	4,4	
20	K-4 Drysyno	Dertsen		Fornosh	3,8	
21	Iaruga	Cherveniovo	Iaruga	Stara	3,5	
22	Stara	Zniatsevo	Stara	Latorica	8,8	
23	Dobronskyi	Serne	Vysokoberezhnyi	Nyzhe-Sernianskyi	3,8	
24	Staryi Batar	Vynogradiv rayon, Tisza left bank		Tisza	43	
25	Novyi Batar	Diula-Chepa-Pyiterfolvo	Staryi Batar	Staryi Batar	9,3	
26	Palad	Velyka Palad	Valia-Fekete	Tur	7,2	
27	M.Eger	Diakovo		Fekete-Viz	4,4	
28	Klynovskyi	Diakovo		Staryi Batar	10,0	
29	MK-1 Feketeviz	Diakovo - Pyiterfolvo		Staryi Batar	10,7	
30	MK-1	Tekovo-Sasovo-Chornotiszovo	Village Tekovo	N. Batar	12.5	
31	MK-2	Tekovo-Sasovo-Chornotiszovo	Village Tekovo	N. Batar	11.1	
32	MK-2	Zabolottia – Velyka Palad	Village Zabolottia	MK - 1(river Fok)	6.1	
33	K-8	Gudia- Sasovo-Chornotiszovo	Village Gudia	N. Batar	8	
34	K-3	Sasovo-Chornotiszovo	Village Sasovo	N. Batar	5.5	
35	UK-1	Pyiterfolvo -Zatyszivka - Diakovo	N. Petrovo (river Tisza)	Staryi Batar	7.3	
36	MK-II-0	Tekovo-Sasovo-Chornotiszovo-Chepa	Village Tekovo	N. Batar	9.5	
37	MK-II-2	Sasovo-Chornotiszovo	Village Sasovo	N. Batar	5.1	
38	MK-1	Tekovo-Sasovo-Chornotiszovo	Village Tekovo	N. Batar	12.5	
39	Velia-Fekete	Velyka Palad		Palad	4,7	

No.	Name	Locality name	Derived stream	Receiver water course	Length (km)	Derived discharges (m³/s)
40	Boroniava	Boroniava - Khust		Tisza	8,3	
41	MK Semerdek	Pidvynogradiv		Verbovets	8,9	
42	MK Onok	Onok		Salva	5,3	
43	Mk Salva	Vynogradiv		Borzhava	16,5	
44	MK Belva	Vynogradiv		Salva	6,6	
45	K-9	Chornyi Potok		Salva	3,4	
46	Karachynskyi	Matievo, Nove Selo, Perekhestia		Kodach	10,0	
47	K-14	Velyki Komiaty		Borzhava	7,5	
48	Mk-1	Perekhestia		Karachynskyi	4,5	
49	Sypa-Charonda	Horonglab		Charonda - Latorica	11,0	
50	N.Serniznskyi	Velyka Dobron-Batrad	Vysokoberezhnyi	Charonda - Latorica	16,5	
51	V. Serniznskyi	Batrad	Mertse	Sypa-Charonda	28,0	
52	Sypa	Borzhava		Charonda (Hungary)	12	
53	Verke	Borzhava	Borzhava	Verkhne-Sernianskyi	36,6	
54	Gat-Potok	Horonglab	MK-2	Verkhne-Sernianskyi	8,5	
55	Didivskyi Myts	Dyida		Charonda (Hungary)	7,56	
56	Kosyno-Bovtratskyi	Zapson		Verkhne-Sernianskyi	10,4	
57	Kovach-Potok	Vary		Sypa	7,74	
58	Kodach	Orosievo		Borzhava	11,1	
59	Raffaailivskyi	Rafainovo	HD-1	Verkhne-Sernianskyi	7,5	
60	Barabash-Myts	Koson	Kosyno	Sypa-Charonda	17,65	
61	MK-1	Mala Byigan		Verke	6,67	
62	MK-II "Ukraine"	Bakosh	Hat-Potok	Verkhne-Sernianskyi	7,22	
63	Kidiosh	Kidiosh		Mertse	10,4	
64	K-2	Dyida	Didivskyi Myts	Kosyno-Bovtratskyi	5,14	
65	K-7 "Chornyi Mochar"	Bereguifalu		Kidiosh	7,4	
66	Solotvynskyi	Kholmtsi		Slatyna	5,2	
67	Vella	Serednie		Stara	6,8	
68	K-4	Kholmtsi		Slatyna	7,7	
69	MK-1 Horkogo	Kontsovo	KD-1	Uzh	4,64	
70	Kd-1	Palad-Komarivtsi		Komarochi	4,4	
71	Sypa-Charonda	Petrivka		Charonda -Latorica	5,0	
72	MK-1	Chervone		Charonda -Latorica	9,6	
73	MK "Dobronskyi"	Velyka Dobron		Nyzhe-Sernianskyi	5,4	
74	Charonda-Tisza	Esen	Sypa-Charonda	Tisza	3,34	
75	MK-1	Salovka		Sypa-Charonda	5,89	
76	Charonda -Latorica	Chervone	Sypa-Charonda	Latorica	6,8	
77	Storichia №1 Demichevo	Demechi	Esen-Lonianskyi	MK-2	3,4	
78	Komarochi	Palad-Komarivtsi	KD-1;KD-2	Latorica	7,5	
79	Slatyna	Velyki Geivtsi	Tova	Latorica	5,9	

No.	Name	Locality name	Derived stream	Receiver water course	Length (km)	Derived discharges (m^3/s)
80	K-1	Tyiglash		Latorica	8,85	
81	K-2	Tyiglash		Karna	8,0	
82	MK-3 Avangard	Salovka		Tisza	4,6	

Diversion channels in Romania

No.	Name	Locality name	Derived stream	Receiver water course	Length (km)	Derived discharges (m^3/s)
	Someș-Tisa subbasin					
1	Someşul Rece I	Măguri Răcătău	Someşul Rece	Someşul Cald (Fântânele reservoir)	7.206	17.8
2	Negruța	Măguri Răcătău	Pârâul Negru	Someşul Rece (Someşul Rece I reservoir)	4.018	1
3	Dumitreasa	Măguri Răcătău	Dumitreasa	Someşul Rece (Someşul Rece I Reservoir)	1.060	1.6
4	Răcătău	Măguri Răcătău	Răcătău	Someşul Cald (Fântânele Reservoir)	3.637	5
5	Someşul Rece II	Măguri Răcătău	Someşul Rece	Someşul Cald (Tarnița Reservoir)	3.339	10
6	Colibița dam – Colibița HPP	Bistrița Bârgăului/Colibița	Bistrița (Colibița reservoir)	Bistrița	6.385	15.5
7	Repedea	Bistrița Bârgăului/Mita	Repedea	Bistrița	0.880	3.92
8	Straja	Tiha Bârgăului/Straja	Bârgau	Bistrița	5.380	4.8
	Crişuri subbasin					
1	Beliu – Tăut Pipeline	Beliu	Beliu	Crişul Negru	31.8	66
2	Pipeline Canalul Morilor (Buteni – Pilu – Vărşand)	Crişul Alb	Canalul Morilor	Crişul Alb	92	2.5
3	Diversion CPE2	Ant	Crişul Negru	Crişul Negru	8.8	3.5
4	Vad – Aștileu Pipeline	Vadu Crişului	Crişul Repede	Crişul Repede	14.5	10
5	Pipeline Tileagd – Săcădat – Fughiu	Tileagd	Crişul Repede	Iad	11	90
6	Canal Colector (Tărian – Tămașda)	Tamașda	Crişul Repede	Crişul Negru	61.8	3.5
7	Remeţi – Munteni Pipeline	Remeţi	Dasor	Iad	2.1	49
8	Derivaţie Drăgan – Remeţi	Lunca Vişagului	Drăgan	Iad	4.3	40
9	Leșu – Remeţi Pipeline	Remeţi	Iad	Iad	8.1	8.5
10	Iad – Cârligate – Drăgan Pipeline	Remeţi	Iad	Iad	4.67	1.16
11	Iad – Drăgan Pipeline	Remeţi	Iad	Iad	4.7	2.8
12	Munteni – Bulz Pipeline	Munteni	Iad	Iad	4.3	49
13	Matca Pipeline	Andrei Şaguna	Mureș	Cigher	41.2	3
14	Săcuieu – Drăgan Pipeline	Săcuieu	Săcuieu (Henţ)	Iad	16.6	4.76
	Mureș subbasin					
1	Cannal Batiz - Simeria	Băcia/Batiz	Strei	Mureș	15.500	7.93
2	Şoimu	Valea Ierii/Măguri - Racătău	Şoimu	Someşul Cald	5.079	1.75
3	Lindru	Valea Ierii/Caps	Lindru	Someşul Cald	0.884	1.03
	Banat subbasin					
1	Discharge Cannal Bega - Timiș	Topolovăț	Bega	Timiș	5.570	400
2	Supply Cannal Timiș - Bega	Costei	Timiș	Bega	9.700	40

No.	Name	Locality name	Derived stream	Receiver water course	Length (km)	Derived discharges (m^3/s)
1	Nagykunsági-főcsatorna	Abádszalók, Kunhegyes,Kenderes, Fegyvernek Örményes,Kisújszállás,Kuncsorba,Török szentmiklós,Kétpó, Mezőhék,Öcsöd	Tisza-tó	Hármas-Körös	74.36	10.1
2	Nagykunsági-főcsatorna Keleti-ág	Kisújszállás, Kuncsorba, Mezőtúr,Túrkeve	Nagykunsági-főcsatorna	Hortobágy-Berettyó	17.988	2.3
3	Nk.III-2. fürtfőcsatorna	Kunhegyes,Karcag	Nagykunsági-főcsatorna	Karcagi II.	26.805	2.34

Hydraulic complex facilities in Ukraine

No.	Name	Water course	Locality name	Maximum derived discharges (m^3/s)
1	Drainage pumping station (PS) -17	MK-1	village Barkasovo Mukachevo rayon Latorica drainage system	1.38
2	Drainage PS -4	K-5	village Dragynia Mukachevo rayon Latorica drainage system	4.8
3	Drainage PS -18	K-150	village Chomonyn Mukachevo rayon Latorica drainage system	4.1
4	Irrigation PS -6	K-4-1	village Velyki Luchky Mukachevo rayon Latorica drainage system	4.14
5	Drainage PS -29	1-5 GD	village.Chopivtsi Mukachevo rayon Latorica drainage system	2
6	Drainage PS -2	K-2 near the dike	village Tyiglash Uzhgorod rayon Latorica drainage system	4.4
7	Drainage PS -2	MK-3	village Velyka Dobron Uzhgorod rayon Beregovo drainage system	1.19
8	Drainage PS -6	N.Sernianskyi	village Velyka Dobron Uzhgorod rayon Beregovo drainage system	0.67
9	Drainage PS -9 Б	K-1	village Demechi Uzhgorod rayon Beregovo drainage system	0.93
10	Drainage PS -27	K-2 near the dike	village Tyiglash Uzhgorod rayon Latorica drainage system	4.83
11	Drainage PS -5	K-2-2 Heivtsi	village Mali Geivtsi Uzhgorod rayon Latorica drainage system	1
12	Drainage PS -3	K-4	village Geivtsi Uzhgorod rayon Latorica drainage system	4.4
13	Drainage PS -1	K-1-A	village Tyiglash Uzhgorod rayon Latorica drainage system	2.2

No.	Name	Water course	Locality name	Maximum derived discharges (m^3/s)
14	Drainage PS -7	Kd-1-1(a)	village Solomonovo Uzhgorod rayon Beregovo drainage system	1.54
15	Drainage PS -14	K-1	village Beregyifalu Beregovo rayon Beregovo drainage system	0.97
16	Drainage PS -12	K-1	village Kvasovo Beregovo rayon Beregovo drainage system	0.69
17	Drainage PS -13	MK Charonda	village Esen Uzhgorod rayon Beregovo drainage system	8.4
18	Drainage PS -21	MK-1 Salovka	village Solovka Uzhgorod rayon Beregovo drainage system	8.47
19	Drainage PS -1	Charonda -Latorica	village Chervone Uzhgorod rayon Beregovo drainage system	15
20	Drainage PS -8Б	MK-1	village Svoboda Beregovo rayon Beregovo drainage system	2.07
21	Drainage PS -10Б	MK-2 "Ukraine"	village Svoboda Beregovo rayon Beregovo drainage system	1.38
22	Drainage PS -16	K-70	village Batrad Beregovo rayon Beregovo drainage system	5.32
23	Drainage - Irrigation PS -24	Didivskyi Myts	village Dyida Beregovo rayon Beregovo drainage system	2.35
24	Drainage PS -15	MK-II	Beregovo Beregovo drainage system	1.8
25	Drainage - Irrigation PS -26	K-1	village Nyzhni Remety Beregovo rayon Beregovo drainage system	2.31
26	Drainage PS -20	GD-1 "Kolos"	village Nyzhni Remety Beregovo rayon Beregovo drainage system	0.69
27	Irrigation PS Tekivska	river Tisza	village Tekovo Vynogradiv rayon Batar drainage system	4.02

No.	Name	Water course	Locality name	Maximum derived discharges (m^3/s)
28	Drainage - Irrigation PS Paladska	MK-1	village Velyka Palad Uzhgorod rayon Batar drainage system	2.38
29	Irrigation PS Petrivska	river Tisza	village Pyiterfolvo Vynogradiv rayon Batar drainage system	3.33
30	Drainage PS -12 Б	MK-1	village Demechi Uzhgorod rayon Beregovo drainage system	2.2
31	Drainage PS -22	K-3-7	village Kholmtsi Uzhgorod rayon Latorica drainage system	2.76
32	Drainage PS -23	Komarochi	village Palad-Komarivtsi Uzhgorod rayon Latorica drainage system	4.4
33	Drainage PS -11	MK-2	village Chervone Uzhgorod rayon Beregovo drainage system	0.08
34	Drainage PS -28	K-4	village Velyki Geivtsi Uzhgorod rayon Beregovo drainage system	4,8
35	Dam on river Borzhava	Borzhava	village Borzhava Beregovo rayon	

Hydraulic complex facilities in Romania

No.	Name	Water course	Locality name	Maximum derived discharges (m³/s)
	Mureș subbasin			
1	Regulation of Ditrău and Martonka brooks in Ditrău, Harghita county (right arm of HCF 1)	Ditrău	Ditrău	6.2
2	Regulation of Ditrău and Martonka brooks in Ditrău, Harghita county (left arm of HCF 2)	Ditrău	Ditrău	1.6
3	Gurghiu	Gurghiu	Reghin	0.5
4	Water intake and turbine cannal	Mureș	Târgu Mureș	56
5	Niraj	Niraj Mic	Miercurea Nirajului	
	Banat subbasin			
1	Sânmartinu Maghiar	Bega	Sânmartinu Maghiar	83.5
2	Topolovăţ	Bega	Topolovăţ	400
3	Sânmihaiu Roman	Bega	Sânmihaiu Roman	83.5
4	Bega – dam and water intake	Bega	Timișoara	83.5

Hydraulic complex facilities in Slovakia

No.	Name	Water course	Locality name	Maximum derived discharges (m³/s)
1	Pumping station Jenkovce I	Kanál V.Revištia-Bežovce	Jenkovce	1.60
2	Pumping station Jenkovce II	Kanál V.Revištia-Bežovce	Jenkovce	0.88
3	Pumping station Bežovce	Kanál V.Revištia-Bežovce	Bežovce, Záhor	2.00
4	Pumping station Stretávka I	Uh	Stretávka	18.90
5	Pumping station Stretávka II	Uh	Pavlovce nad Uhom	
6	Pumping station Veľké Raškovce I.	Duša	Veľké Raškovce	11.50
7	Pumping station Veľké Raškovce II.	Duša	Veľké Raškovce	
8	Pumping station Zalužice I	Waste channel	Zalužice	0.88
9	Pumping station Zalužice II	Waste channel	Zalužice	0.88
10	Pumping station Beša	Laborec	Veľké Raškovce	0.08
11	Pumping station Kamenná Moľva	Latorica	Kucany	10.81
12	Pumping station Hraň	Ondava	Hraň	8.20
13	Pumping station Streda nad Bodrogom	Bodrog	Streda nad Bodrogom	16.40
14	Pumping station Boľ	Latorica	Boľ	5.50
15	Pumping station Čičarovce	Latorica	Čičarovce	10.00
16	Pumping station Pavlovo	Bodrog	Zemplín	6.80
17	Pumping station Milhostov	Trnávka	Milhostov	0.19
18	Pumping station Ladislav	Ondava	Hradištská Moľva	5.50
19	Pumping station Július	Ondava	Trebišov	5.50
20	Pumping station Ptrukša	Latorica	Ptrukša	6.20

No.	Name	Water course	Locality name	Maximum derived discharges (m³/s)
21	Pumping station Pavlovce nad Uhom	Oxbow of Laborec	Vojany	4.00
22	Pumping station Brehov I (old)	Ondava	Brehov	0.20
23	Pumping station Brehov II (new)	Ondava	Brehov	0.16
24	Pumping station Nová Kelča	Ondava	Nová Kelča	0.02
25	Pumping station Bžany	Ondava	Bžany	0.04
26	Hydraulic structure Palcmanská Maša (Hornád River Basin)	Hnilec	Rožňava	50
		Slaná		9

Hydraulic complex facilities in Hungary

No.	Name	Water course	Locality name	Maximum derived discharges (m³/s)
1	Kisköre hydropower plant	Tisza	10.04 Kiskörei - tározó menti	1700
2	Tiszalök barrage and hydropowerplant	Tisza	09.02. Tiszatarján-rakamazi	4000

Drainage system in Ukraine

No.	Name	Function	Levels	Length (km)	Q (m³/s)	Art works, confluent, defluent	Purpose
1	Beregovo drainage system	International drainage system (UA-HU)		378.06			Flood protection, drainage, water supply for agriculture
2	Latorica drainage system			177.9			Drainage, flood protection
3	Salva drainage system			118.6			Flood protection
4	Batar drainage system			201.9			Flood management, agriculture
5	Drainage system “Chornyi Mochar”			113.83			Flood regulation in the mountainary part

Drainage system in Romania

No.	Name	Function	Drained area (km²)	Receiver river
	Someş-Tisa subbasin			
1	Tarna Bătarci	Internal water evacuation	22.15	Tarna Mică
2	Tur-right bank	-”-	97.93	Tur
3	Turulung-Negreşti	-”-	139.39	Tur
4	Tur-left bank	-”-	96.3	Tur
5	Aluniş-Potău	-”-	75.16	Someş
6	Someş-right bank	-”-	274.17	Sar, Tur, Someş
7	Homorod-right bank	-”-	91.71	Someş
8	Someş-Crasna	-”-	383.17	Crasna
9	Crasna-left bank	-”-	275.02	Crasna
10	Terebeşti-Gelu	-”-	63.37	Crasna
11	Craidorolţ-Vârşolţ	-”-	161.54	Crasna
12	Cărăşeu-Valea Vinului-Pomi	-”-	97.86	Someş
13	Iojib-Seini	-”-	50.41	Someş
	Crişuri subbasin			
1	Teuz-right bank	-”-	249.16	Crişul Negru
2	Teuz-left bank	-”-	203.77	Crişul Negru
3	Cermei -Tăuţ	-”-	68.15	Crişul Negru
4	Sistem Hanios Vărşand	-”-	234.89	Crişul Alb
5	Cigher	-”-	99.22	Crişul Alb
6	Budier	-”-	204.96	Canalul Morilor
7	Vărşand	-”-	37.44	Crişul Alb

No.	Name	Function	Drained area (km^2)	Receiver river
8	Chişer	-”-	170.08	Canalul Morilor
9	Morilor I-left bank	-”-	50.32	Crişul Alb
10	Gut	-”-	38.09	Crişul Alb
11	Canalul Morilor	-”-	118.04	Crişul Alb
12	Teuz right bank	-”-	104.87	Crişul Negru
13	Canal Colector –left bank Inand	-”-	450.77	Crişul Negru
14	Canal Colector+right bank-Cefa	-”-	446.18	Crişul Negru
15	Peţa-Hidişel	-”-	20.61	Crişul Repede
16	Valea Bistra	-”-	11.05	Barcău
17	Valea Inot	-”-	12	Barcău
18	Barcău right bank upstream Marghita	-”-	10.27	Barcău
19	Barcău right bank downstream Sălard	-”-	26.12	Barcău
20	Barcău left bank downstream Sălard	-”-	76.21	Barcău
21	Cermei-Tăuţ	-”-	18.91	Crişul Negru
22	Crişul Repede-right bank upstream Oradea	-”-	29.7	Crişul Repede
23	Crişul Repede right bank upstream Tileagd	-”-	13.27	Crişul Repede
24	Crişul Repede right bank donstream Oradea	-”-	98.6	Crişul Repede
25	Crişul Repede left bank downstream Tileagd	-”-	42.68	Crişul Repede
26	Valea Holod	-”-	49.3	Crişul Negru
27	Valea Ierului	-”-	274.62	Ier
28	Valea Nouă-Guberdiu	-”-	22.75	Crişul Negru
29	Valea Rătăşel	-”-	48.43	Crişul Negru
30	Ier	-”-	27.37	Ier
	Mureș subbasin			
1	Şard Ighiu	-”-	21.57	Ampoi
2	Secaş Mic	-”-	15.5	Secaș
3	Orăştie - Romos - Aurel Vlaicu	-”-	30	Vaidei-Romos-Mureș
4	Sibişel - Beriu	-”-	19.19	Sibișel
5	Boţărod - Bretea	-”-	18.5	Luncanilor
6	Bretea - Vâlcele - Băţălar	-”-	14.38	Strei
7	Haţeg - General Berthelot - Tuştea	-”-	34.15	Galbena
8	Ier Arad frontieră, subbazin Cutaș, Țiganca, Dorobanți, Hathaz-Putri	-”-	239.38	Mureș river right bank upstream Pecica
9	Ier Arad frontieră subbazin Pe sub vii	-”-	11.5	Mureș river right bank downstream Pecica
10	Crac, subbasin Crac	-”-	121.04	Mureș river right bank upstream Nădlac
11	Crac, subbasin Crac	-”-	145	Mureș river right bank upstream Nădlac
12	Ier-Arad frontieră Subbasin Forgacea	-”-	32.49	Mureș river right bank upstream Pecica
13	Aranca-Secusigiu, subbasin Secusigiu	-”-	64.08	Mureș river, left bank downstream Secusigiu
14	Mureș right bank 1	-”-	48.1	Mureș river,right bank upstream Arad
15	Mureș right bank 2	-”-	88	Mureș river right bank upstream Arad
16	Sânnicolau-Saravale	-”-	26	Mureș river left bank

No.	Name	Function	Drained area (km²)	Receiver river
	Banat subbasin			
1	Aranca	-”-	555.82	Aranca
2	Galațca	-”-	82.8	Galațca-Giucașin
3	Beheiu Vechi-Vest Timișoara	-”-	105	Bega Nouă-Bega Veche
4	Beregsău Amonte	-”-	15.13	Beregsău Vechi
5	Răuți-Sânmihaiu German	-”-	51.28	Bega navigabilă
6	Vinga-Biled-Beregsău	-”-	255.3	Bega Veche
7	Checea-Jimbolia	-”-	544.51	Bega Veche
8	Behala	-”-	16.62	Behala
9	Mureșan	-”-	60.4	Mureșan
10	Sânnicolau-Saravale	-”-	199.98	Aranca
11	Râu-Glavița	-”-	84.86	Bega-Glavița
12	Uivar-Pustiniș	-”-	54.03	Bega Veche-Bega

No.	Name	Function	Levels	Length (km)	Q (m³/s)	Works of Art, confluent, defluent
1	Somotorský kanál	Discharging of internal waters	92.56 m.a.s.l. (inflow into PS)	26.48	16.4	km 3.600 – Road bridge; km 12.600 – Road bridge; km 13.000 – Road bridge; km 15.513 – Railway bridge; km 24.700 – Road bridge; km 27.100 – Road bridge
2	Pavlovský kanál (Divý kanál, northern Radský kanál)	Discharging of internal waters	93.60 m.a.s.l. (inflow into PS)	7.22	6.8	km 0.188 – Road bridge
3	Eastern Leleský kanál	Discharging of internal waters	95.30 m.a.s.l. (inflow into PS)	16.26	5.5	km 8.500 – Road bridge
4	Udoč	Discharging of internal waters	95.60 m.a.s.l. (inflow into PS)	15.24	10.0	km 2.900 – Road bridge; km 5.050 – Road bridge; km 5.100 – Railway bridge; km 6.500 – Railway bridge; km 6.600 – Road bridge
5	Oxbow of Latorica (Ptrukšiansky kanál)	Discharging of internal waters	96.40 m.a.s.l. (inflow into PS)	Oxbow of Latorica - 0.04 Ptrukšiansky kanál – 10.00	6.0	Ptrukšiansky kanál: km 8.200 – Road bridge
6	Approaching canal + Lower canal	Discharging of internal waters	96.00 m.a.s.l. (inflow into PS)	2.94	4.0	
7	Confluence of drainage canals Kopaný jarok a Hranský kanál Length of inlet part–50 m	Discharging of internal waters	96.30 m.a.s.l. (inflow into PS)	Kopaný jarok - 15.79 Hranský kanál to Julov kanál – 5.90	8.2	Kopaný jarok: km 4.360 – Road bridge; km 5.460 – Road bridge; km 11.800 – Road bridge; km 12.200 – Railway bridge; Hranský kanál: km 4.200 – Road bridge; km 5.200 – Road bridge
8	Julov kanál	Discharging of internal waters	96.00 m.a.s.l. (inflow into PS)	1.20	5.5	
9	Interconnection canal-Ladislav	Discharging of internal waters	96.10 m.a.s.l. (inflow into PS)	1.20	5.7	
10	Čierna voda	Discharging of internal waters	96.60 m.a.s.l.	23.00	18.9	Gas pipeline: 8 x Road bridge
11	Duša	Discharging of internal waters	97.49 m.a.s.l.	28.80	11.5	Gas pipeline rkm 1.100; Oil pipeline rkm 6.28; 20 x Road bridge; 3 x Railway bridge
12	Canals – Moľviansky kanál, Brehovský kanál, Kuciansky kanál	Discharging of internal waters	94.42 m.a.s.l. (inflow into PS)	Moľviansky kanál – 19.50; Brehovský kanál – 25.65; Kuciansky kanál – 8.19	10.9	Moľviansky kanál: km 2.800 – Road bridge; km 10.000 – Road bridge; km 19.300 – Railway bridge. Brehovský kanál: km 5.800 – Road bridge; km 12.300 – Road bridge; km 22.200 – Railway bridge; km 22.500 – Railway bridge; km 24.100 – Road bridge
13	Canal along intercepting canal above Jenkovce	Discharging of internal waters	103,50 m.a.s.l.	2.33	1.6	1 x Road bridge
14	Canal along intercepting canal under Jenkovce, Bežovský kanál	Discharging of internal waters	103.40 m.a.s.l.	3.51; 5.20	2.0	1 x Road bridge; 2 x Road bridge

No.	Name	Function	Drained area (km²)	Receiver river
1	Vajai (III.sz.) főfolyás völgye	Drainage	344	Lónyai main channel
2	Kállói (VII.sz.) főfolyás völgye	Drainage	451	Kállói vízfolyás, Lónyai main channel
3	Tisza-Túr-Szamosközi	Drainage	442	Szamos
4	Felsőszabolcs felső	Drainage	655	Lónyai main channel, Tisza
5	Kraszna balparti	Drainage	688	Kraszna
6	Érpatak (VIII.sz.)-Simai (IX.sz.)főfolyások völgye	Drainage	727	Érpatak-vízfolyás
7	Máriapócsi (IV.sz.)-Bogdányi (V.sz.)-Sényői (VI.sz.) főfolyások völgye	Drainage	421	Máriapócs főfolyás
8	Felsőszabolcs alsó	Drainage	292	Belfő main channel, Tisza
9	Szamos-Krasznaközi	Drainage	416	Kraszna, Szamos
10	Beregi	Drainage	378	Tisza
11	Felsőszabolcs középső	Drainage	176	Tisza
12	Tisza-Túrközi	Drainage	213	Gögő-Szenke, Tisza
13	Inérhát-tiszadobi	Drainage	110	Tisza
14	Prügy-taktaföldvári	Drainage	146	Tisza
15	Rigós-Sajózugi	Drainage	301	Tisza
16	Tiszavalk-sulymosi	Drainage	281	Tisza
17	Bodrogzug-Törökéri	Drainage	307	Bodrog
18	Laskó-csincsei	Drainage	463	Tisza-tó, Tisza
19	Tiszakarád-ricsei	Drainage	300	Tisza
20	Alsónyírvíz-Nagy-éri	Drainage	512	Nagyér
21	Tiszai-középső	Drainage	401	Tisza
22	Kálló	Drainage	623	Nagyér
23	Kösely-felső	Drainage	520	Kondoros, Tocó
24	Kösely-alsó	Drainage	724	Keleti main channel
25	Tiszai-felső	Drainage	325	Keleti main channel, Tisza
26	Hamvas-sárréti	Drainage	951	Keleti main channel, Hortobágy-Berettyó
27	Tiszai-alsó	Drainage	728	Tisza
28	Berettyó-felső	Drainage	375	Berettyó
29	Kadarcs-Karácsony-foki	Drainage	935	Keleti main channel
30	Alsónyírvíz-Kati-ér	Drainage	297	Nagyér
31	Berettyó-alsó	Drainage	521	Berettyó, Sebes-Körös
32	Jászberényi	Drainage	606	Zagyva
33	Kiskörei	Drainage	639	Tisza
34	Ceglédi	Drainage	1 115	Tisza/Zagyva
35	Mezőtúri	Drainage	832	Hortobágy-Berettyó
36	Tiszakécskei	Drainage	784	Tisza
37	Karcagi	Drainage	424	Hortobágy-Berettyó
38	Kunhegyesi	Drainage	378	Tisza
39	Cibakházi	Drainage	596	Tisza, Hármas-Körös

No.	Name	Function	Drained area (km²)	Receiver river
40	Kisújszállási	Drainage	787	Tisza
41	Jászkiséri	Drainage	752	Tisza
42	Torontáli	Drainage	251	Tisza
43	Dong-ér-Kecskeméti	Drainage	992	Dong-ér, Tisza
44	Dong-éri	Drainage	976	Dong-ér, Tisza
45	Kurcai	Drainage	1 193	Kurca main channel, Tisza, Hármas-Körös
46	Vidreéri	Drainage	252	Tisza
47	Algyő-Tápé-Gyála-Körös-éri	Drainage	2 028	Tisza
48	Sámson-Élővízi	Drainage	1 649	Maros
49	Mártély-Tisza-Maroszugi	Drainage	963	Tisza
50	Gyomai	Drainage	484	Hortobágy-Berettyó, Hármas-Körös
51	Réhelyi	Drainage	166	Hortobágy-Berettyó
52	Holt-sebes-körösi	Drainage	355	Sebes-Körös
53	Dögös-káka-foki	Drainage	817	Élővíz main channel
54	Kettős-Körös jobb parti	Drainage	287	Kettős-Körös
55	Szeghalmi	Drainage	256	Berettyó
56	Mezőberényi	Drainage	470	Hármas-Körös
57	Hosszú-foki	Drainage	454	
58	Fehér-Fekete-Körös közi	Drainage	87	Fehér-Körös, Fekete-Körös
59	Élővíz-csatornai	Drainage	733	Kettős-Körös
60	Körös-ér	drainage	475.60	Tisza
61	Csukás-ér	drainage		Kőrös-ér
62	Körös-ér-Nyilas-ök. cs.	drainage		Kőrös-ér
63	Peitsik-cs.	drainage	302.90	Tisza
64	Határmenti	drainage	172.30	Zagyva
65	Kisgyepi-cs.	drainage		Zagyva
66	Eresztőhalmi-I. cs.	drainage		Zagyva
67	Közös-cs.	drainage	865.90	Tisza
68	Gerje	drainage		Közös-cs.
69	Perje	drainage		Közös-cs.
70	Gerje-mellékcs.	drainage		Gerje
71	Perje-felső	drainage		Perje
72	Rekettyés-ér	drainage	333.58	Zagyva
73	Kunere-cs.	drainage		Zagyva
74	119	drainage	44.30	Zagyva
75	Sajfoki-cs.	drainage	570.60	Tisza
76	12. cs.	dual operation		Sajfoki-cs.
77	12-28. ök. cs.	dual operation		12. cs
78	Hanyi-cs.	drainage		Tisza
79	Hanyi-Sajfoki ök. cs.	drainage		Sajfoki-cs.

No.	Name	Function	Drained area (km²)	Receiver river
80	14. cs.	drainage		Hanyi
81	Csátés-cs.	dual operation	617.30	Tiszasülyi-28.cs.
82	Tiszasülyi-28. cs.	dual operation		Tisza
83	22. cs.	dual operation		Tiszasülyi-28.cs.
84	Tiszasüly-Sajfok-ök. cs.	drainage		Tiszasülyi-28.cs.
85	Millér-cs.	dual operation		Tisza
86	33. cs.	dual operation		Millér-cs.
87	Doba-cs.	dual operation	175.60	Tisza
88	19. cs.	drainage		Doba-cs.
89	Tiszaderzsi-3. cs.	drainage	256.60	Tisza
90	Nagyfoki-I. cs.	drainage		Tiszaderzsi-3. cs.
91	Nagyfoki-II. cs.	drainage		Tiszaderzsi-3. cs.
92	Kisfoki-cs.	drainage		Bal parti szivárgó
93	Érfűi-cs.	drainage		Tisza
94	Mirhó-Gyólcsi-cs.	dual operation	163.10	Tisza
95	Tiszabői-cs.	dual operation		Tisza
96	Kakat-cs.	dual operation	947.60	Hortobágy-B.
97	Kisújszállási-II. cs.	drainage		Kakat-cs.
98	Villogó-cs.	dual operation		Hortobágy-B.
99	Karcagi-I. cs.	drainage		Hortobágy-B.
100	Karcagi-II. cs.	dual operation		Karcagi-I.cs.
101	Német-ér	drainage		Hortobágy-B.
102	Karcagi-III. cs.	drainage		Hortobágy-B.
103	Szajoli-I. cs.	drainage	381.40	Tisza
104	Büdös-ér	drainage		Tisza
105	Cibak-Martfűi-cs.	dual operation	146.80	Cibaki-HT.
106	Tégláslaposi-cs.	drainage		Tisza
107	Túrkevei-cs.	drainage	354.60	Hortobágy-B
108	Álomzugi-cs.	drainage		Hortobágy-B
109	Mezőtúri-VI. cs.	dual operation		Hármas-Körös
110	Kútréti-I. cs.	dual operation		Mezőtúri-VI. cs.
111	Mezőtúri-XIII. cs.	dual operation		Hortobágy-B
112	Harangzugi-I. cs.*15638	dual operation	398.40	Hármas-Körös
113	Harangzugi-I-c. cs.	dual operation		Harangzugi-I. cs.
114	Kungyalui-I. cs.	dual operation	256.90	Hármas-Körös
115	Máma-Tőkefoki-cs.	drainage		Hármas-Körös
116	Tóköze cs.	drainage		Hármas-Körös

Drainage system in Serbia

No.	Name	Function	Drained area (km²)	Receiver/river

No.	Name	Function	Drained area (km²)	Receiver/river
1	Kendjija	Drainage system	21.86	Hs DTD Vrbas - Bezdan
2	Bezdan-Bački Breg	Drainage system	40.06	Hs DTD Vrbas - Bezdan
3	Bezdan-Bački Monoltor I	Indirect Drainage	9.55	Hs DTD Vrbas - Bezdan
4	Severna Mostonga	Drainage system	530.76	Hs DTD Vrbas - Bezdan
5	Plazović	Drainage system	109.12	Hs DTD Vrbas - Bezdan
6	Horgoško-Martonoški rit sliv XII	Drainage system	36.3	Tisza
7	Horgoš-Martonoš sliv XI	Drainage system	90.84	Tisza
8	Stari Kereš sliv IX	Drainage system	20.76	Tisza
9	Kanjiški rit sliv X	Drainage system	26.82	Tisza
10	Kereš	Drainage system	426.42	Tisza
11	Senćanski rit sliv VII	Drainage system	41.75	Tisza
12	Kaloča sliv V	Drainage system	185.95	Tisza
13	Makoš sliv VI	Drainage system	2.75	Tisza
14	Budžak sliv III	Drainage system	159.46	Tisza
15	Molski rit sliv II	Drainage system	22.09	Tisza
16	Čik 2	Drainage system	161.53	Tisza
17	Čik 1	Drainage system	496.31	Tisza
18	Perlek - Medenjača - Mali rit	Drainage system	46.02	Tisza
19	Ugarnice	Drainage system	14.37	Hs DTD Bečej - Bogojevo
20	Beljanska bara	Drainage system	335.23	Hs DTD Bečej - Bogojevo
21	Krivaja 2	Drainage system	735.35	Hs DTD Bečej - Bogojevo
22	Krivaja 1	Drainage system	423.49	Hs DTD Bečej - Bogojevo
23	Vrbas	Drainage system	58.71	Hs DTD Vrbas - Bezdan
24	Vrbas-Kula	Drainage system	97.34	Hs DTD Vrbas - Bezdan
25	Kula-Crvenka	Drainage system	157.66	Hs DTD Vrbas - Bezdan
26	Telečka-Istočna Gradina	Drainage system	246.71	Hs DTD Vrbas - Bezdan
27	Bezdan Ostrvo I	Drainage system	12.09	Hs DTD Vrbas - Bezdan
28	Bezdan-Bački Monoštor	Indirect Drainage	5.51	Hs DTD Vrbas - Bezdan
29	Kupusina 9-6	Drainage system	51.86	Hs DTD Prigrevica - Bezdan
30	DTD Bukovac	Indirect Drainage	28.28	Hs DTD Prigrevica - Bezdan
31	Miletić - Čičovi	Drainage system	42.33	Hs DTD Odžaci - Sombor
32	Žarkovac	Drainage system	38.59	Hs DTD Vrbas - Bezdan
33	Stapar	Drainage system	39.62	Hs DTD Vrbas - Bezdan
34	Srpski Miletić	Drainage system	15.78	Hs DTD Bečej - Bogojevo
35	Severna Jegrička	Drainage system	158.53	Hs DTD Bečej - Bogojevo
36	Ruski Krstur	Drainage system	16.39	Hs DTD Bečej - Bogojevo
37	S-I	Drainage system	62.76	Hs DTD Vrbas - Bezdan
38	KK-II	Drainage system	20.62	Hs DTD Kosančić - Mali Stapar
39	KC-III	Drainage system	98.11	Hs DTD Vrbas - Bezdan
40	Ruski Krstur III-26	Drainage system	25.59	Hs DTD Kosančić - Mali Stapar
41	Kosančić III-23	Drainage system	16.71	Hs DTD Kosančić - Mali Stapar

No.	Name	Function	Drained area (km^2)	Receiver/river
42	Savino Selo K-IV	Drainage system	6.69	Hs DTD Bečej - Bogojevo
43	Kucura K-IV	Drainage system	57.85	Hs DTD Bečej - Bogojevo
44	Jegrička	Drainage system	72.49	Jegrička
45	Sistem SV	Drainage system	33.04	Hs DTD Bečej - Bogojevo
46	Jegrička 2	Drainage system	51.27	Jegrička
47	BB	Drainage system	43.2	Hs DTD Bečej - Bogojevo
48	Turija Nadalj I	Drainage system	59.14	Hs DTD Bečej - Bogojevo
49	Turija-Nadalj II	Drainage system	9.63	Jegrička
50	Stara Tisa - Bačkogradištanski rit	Drainage system	47.4	Tisza
51	Turija - Nadalj - Bačko Gradište	Drainage system	25.95	Hs DTD Bečej - Bogojevo
52	Jegrička 3	Drainage system	36.31	Jegrička
53	Koštanica	Drainage system	2.34	Hs DTD Bečej - Bogojevo
54	Bečejski Donji veliki rit	Drainage system	28.34	Tisza
55	Biserno Ostrvo	Drainage system	19.88	Tisza
56	Žabalj	Drainage system	119.33	Tisza
57	Odžaci	Drainage system	54.78	Hs DTD Bečej - Bogojevo
58	Jegrička	Drainage system	139.04	Hs DTD Bečej - Bogojevo
59	Stepanovićevo-Jegrička	Drainage system	123.05	Jegrička
60	Temerin	Drainage system	127.88	Jegrička
61	Temerin - Gospođinci	Drainage system	96.93	Jegrička
62	Žabalj-mesto	Drainage system	34.03	Jegrička
63	Vrbica	Drainage system	114.12	Tisza
64	Đurđevo	Drainage system	21.14	Tisza
65	Titel	Drainage system	37.29	Tisza
66	Mošorin	Drainage system	15.24	Tisza
67	Titelski breg	Indirect Drainage	84.44	Tisza
68	Novi Kneževac	Drainage system	228.1	Tisza
69	Vok	Drainage system	11.5	Tisza
70	Crna Bara	Drainage system	44.4	Zlatica
71	Sanad-Budžak	Drainage system	6.8	Tisza
72	Kere bara-Đurđeva bara	Drainage system	52.65	Tisza
73	Pesir	Drainage system	15.68	Tisza
74	Zlatica II	Indirect Drainage	27.19	Zlatica
75	Jazovački	Drainage system	25.92	Zlatica
76	Čoka II	Drainage system	22.78	Tisza
77	Monoštorski	Drainage system	19.26	Zlatica
78	Vrbica	Drainage system	73.52	Zlatica
79	Graničar	Drainage system	9.11	Zlatica
80	retenzija Batka	Retention	3.45	Tisza
81	Retenzija Đala	Retention	3.85	Tisza
82	Šuljmoški	Drainage system	27.89	Zlatica

No.	Name	Function	Drained area (km²)	Receiver/river
83	Kerekto-Bočar	Drainage system	161.91	Tisza
84	Burza	Drainage system	51.56	Tisza
85	Vranjevo	Drainage system	2.25	Tisza
86	Šušanj	Drainage system	3.19	Hs DTD Ban. Palanka - Novi Bečej
87	Kopovo	Indirect Drainage	50.49	Hs DTD Ban. Palanka - Novi Bečej
88	Bečejski	Drainage system	23.38	Hs DTD Kikindski kanal
89	Galadski	Drainage system	41.61	Hs DTD Kikindski kanal
90	Miloševački	Drainage system	22.15	Hs DTD Kikindski kanal
91	Bočarski	Drainage system	14.77	Hs DTD Kikindski kanal
92	Iđoski-Kindja	Drainage system	28.96	Hs DTD Kikindski kanal
93	Berski	Drainage system	12.67	Hs DTD Kikindski kanal
94	Katahat	Drainage system	51.95	Hs DTD Kikindski kanal
95	Retenzija Bočar	Retention	2.12	Tisza
96	Retenzija Libe	Retention	8.16	Tisza
97	retenzija Ljutovo	Retention	9.01	Tisza
98	Zlatički	Drainage system	109.78	Hs DTD Kikindski kanal
99	Sajanski	Drainage system	9.99	Hs DTD Kikindski kanal
100	Begejski	Drainage system	63.74	Zlatica
101	Mokrinski	Drainage system	80.68	Hs DTD Kikindski kanal
102	Sistem K- III	Drainage system	4.05	Hs DTD Kikindski kanal
103	Kindja	Drainage system	15.9	Hs DTD Kikindski kanal
104	Nakovski	Drainage system	104.74	Hs DTD Kikindski kanal
105	Glavni	Drainage system	211.92	Hs DTD Kikindski kanal
106	Tašfalski	Drainage system	6.1	Hs DTD Kikindski kanal
107	Bašaidsko-Molinski	Drainage system	81.29	Hs DTD Kikindski kanal
108	Vincaidski	Drainage system	6.87	Hs DTD Kikindski kanal
109	Melenci I	Drainage system	54.19	Hs DTD
110	Turski Begej	Drainage system	98.57	Hs DTD
111	Banatski Dvor	Drainage system	20.7	Stari Begej
112	Karađorđevo-Molin	Drainage system	174.05	Stari Begej
113	Itebej-Crnja	Drainage system	292.82	Stari Begej
114	Sokolac	Drainage system	38.67	Hs DTD
115	Kumane	Drainage system	58.48	Tisza
116	Kumane II	Drainage system	57.02	Tisza
117	Melenci III	Drainage system	28.5	Hs DTD
118	Melenci II	Drainage system	49.85	Hs DTD
119	Babatov	Drainage system	37.57	Tisza
120	Elemir-Aradac	Drainage system	94.27	Tisza
121	Zrenjanin	Drainage system	62.14	Begej
122	Mihajlovo-DTD	Drainage system	20.64	Hs DTD
123	Mihajlovo-Begej	Drainage system	17.41	Begej

No.	Name	Function	Drained area (km^2)	Receiver/river
124	Mužlja-Lukino Selo	Drainage system	78.93	Tisza
125	Ribnjak	Indirect Drainage	36.11	Tisza
126	Belo Blato	Drainage system	28.28	Begej
127	Carska Bara	Indirect Drainage	11.15	Begej
128	Međurečje	Drainage system	46.61	Stari Begej
129	Jorgovan	Drainage system	39.95	Stari Begej
130	Stajićevo	Drainage system	10.93	Begej
131	Žitište-Klek	Drainage system	33.95	Plovni Begej
132	Begejci	Drainage system	100.7	Plovni Begej
133	Mrtva Tisa naspram Đale	Indirect Drainage	2.47	Tisza
134	Molin - Šećeranski	Drainage system	23.07	Hs DTD Kikindski kanal

Significant historical floods in Ukraine

No.	Event name	Source, characteristics, mechanism of flood[1]	Date of flood
1	Historical flood at Tisza (from Rakhiv to Vylok) and its right tributaries	Source: snow melting, heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection + Outburst	December 1947 - January 1948
2	Historical flood at Tisza and all its tributaries in Zakarpattya Oblast	Source: snow melting, heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection	December 1957
3	Catastrophic flood at Tisza and tributaries (Rakhivsky, Tyachivsky, Khust and Vynogradiv rayons)	Source: snow melting, heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection + Outburst	May 1970
4	Historical flood at Tisza and Uzh and Latorica	Source: snow melting Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection	November 1992
5	Catastrophic flood at Tisza and all its tributaries	Source: snow melting, heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection + Outburst	November 1998
6	Catastrophic flood at Tisza and all its tributaries	Source: snow melting, heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection + Outburst	March 2001
7	Histrocal flood at Tisza and its tributaries	Source: heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection	June 2008
8	Historical flood at Tisza and its tributaries	Source: snow melting, heavy rains Characteristics: Riverbed Mechanism: Natural exceedance +Exceedance of level of protection	December 2010

Significant historical floods in Romania

No.	Event name	Source, characteristics, mecanism of flood[1]	Date of flood
1	Tisa River - downstream Bocicoiu Mare locality, upstream Teceu Mic locality	A11, A21, A36, A38	May 1970
2	Vişeu River - downstream confluence with Ţâsla River	A11, A12, A21, A31, A36, A38	May 1970
3	Iza River - downstream Săcel locality	A11, A12, A21, A31, A36, A38	May 1970
4	Tur River	A11, A12, A21, A31, A36, A38	May 1970
5	Someş River - downstream confluence with Şieu River	A11, A21, A38	May 1970
6	Lăpuş River - downstream confluence with Suciu River	A11, A15, A21, A31, A38	May 1970
7	Crasna River – Ier River	A11, A13, A15, A21, A24, A38	May 1970
8	Mureş River - downstream Neagra locality	A11, A21, A32, A38	May 1970
9	Târnava River - downstream Sub Cetate locality	A11, A12, A21, A31, A32	May 1970
10	Târnava Mică River - downstream Praid locality	A11, A12, A21, A31, A32	May 1970
11	Strei River - downstream confluence with Crivadia River upstream Călan locality	A11, A21, A32, A38	May 1970
12	Mureş River - downstream Glodeni locality	A11, A21, A38	July 1975
13	Arieş River - downstream Albac locality	A11, A21, A38	July 1975
14	Târnava River - downstream Cristuru Secuiesc locality	A11, A21, A38	July 1975
15	Târnava Mică River - downstream Praid locality	A11, A21, A38	July 1975
16	Strei River - Ohaba de Sub Piatră locality and Sălaş River	A11, A21, A38	July 1975
17	Crişul Negru River – downstream confluence with Criştior River	A11, A21, A22, A23, A32, A38	July 1980
18	Crişul Repede River – downstream Izvoru Crişului locality	A11, A21, A32, A38	July 1980
19	Barcău River – downstream confluence with Valea Mare River	A11, A21, A22, A32, A38	July 1980
20	Crişul Alb River – downstream Criş locality, upstream Ţipar temporary reservoir	A11, A21, A32, A38	December 1995
21	Barcău River – downstream Marca locality	A11, A21, A38	June 1997
22	Ier River – Săcueni locality	A11, A12, A21, A22, A31	June 1997
23	Mureş River - downstream confluence with Arieş River	A11, A12, A23, A38	June 1998
24	Târnava River - downstream confluence with Vişa River	A11, A21, A38	June 1998
25	Târnava Mică River - downstream Crăieşti locality	A11, A21, A38	June 1998
26	Sebeş River - downstream confluence with Dobra River and Secaş River	A11, A21, A38	June 1998
27	Strei River - downstream confluence with Crivadia River	A11, A21, A38	June 1998
28	Crişul Alb River – downstream Mihăileni locality	A11, A13, A21, A32, A38	April 2000
29	Crişul Negru River – downstream Poiana locality	A11, A21, A22, A32, A38	April 2000
30	Bega River - downstream Luncanii de Jos locality, upstream Topolovăţu Mare locality	A11, A21, A32	April 2000
31	Tisa River - downstream Bocicoiu Mare locality, upstream Teceu Mic locality	A11, A21, A22, A36, A38	March 2001
32	Vişeu River - downstream confluence with Vaser River and Vaser River	A11, A12, A21, A22, A31, A36, A38	March 2001
33	Iza River - downstream confluence with Boicu River	A11, A12, A21, A22, A31, A36, A38	March 2001
34	Someş River - Şanţ - Valea Luncii localities sector	A11, A21, A38	March 2001
35	Lăpuş River – downstream confluence with Craica River and tributaries Săsar, Firiza	A11, A21, A36, A38	March 2001

No.	Event name	Source, characteristics, mecanism of flood[1]	Date of flood
36	Bega River - downstream Luncanii de Jos locality, upstream Topolovăţu Mare locality	A11, A21, A38	April 2005
37	Tisa River - downstream Bocicoiu Mare locality	A11, A21, A36, A38	July 2008
38	Vişeu River - downstream confluence with Ţâsla River	A11, A12, A21, A23, A31, A36	July 2008
39	Iza river - downstream Dragomireşti locality	A11, A12, A21, A23, A31, A36	July 2008

Significant historical floods in Slovakia

No.	Event name	Source, characteristics, mechanism of flood[1]			Date of flood
		Source	Characteristics	Mechanism of flood	
1	Chminiansky potok - Chmiňany	data unavailable			1395
2	Rivering floods on Hornád, Hnilec, Torysa a Bodva	data unavailable			1813
3	Rivering floods on Hnilec, Torysa a Bodva	data unavailable			1845
4	Rivering flood on Svinka	data unavailable			July 1998
5	Rivering floods on Hornád, Torysa, Topľa, Ondava	data unavailable			July 2004
6	May floods on Slaná, Torysa, Hornád, Ondava, Topľa	Fluvial; Pluvial	Flash Flood; Debris Flow; High Velocity Flow	Natural Exceedance; Defence Exceedance; Defence or Infrastructural Failure; Other	May 2010
7	June floods on Slaná, Torysa, Hornád, Ondava, Topľa	Fluvial; Pluvial; Groundwater	Flash Flood; Debris Flow; High Velocity Flow	Natural Exceedance; Defence Exceedance; Other	June 2010

[1] –use the cods established in the Guidance for Reporting under the Floods Directive (2007/60/EC) - Guidance Document No. 29 A compilation of reporting sheets adopted by Water Directors Common Implementation Strategy for the Water Framework Directive (2000/60/EC)

Annex IV.9

Areas with Significant Potentially Flood Risk in Romania

Nr. crt.	APSFR name	Representation type	Lenght/Surface (km)/(km²)
1	Tisa River - downstream Bocicoiu Mare locality	Poligon	25.6
2	Vişeu River – downstream confluence with Ţâsla River	Poligon	10.8
3	Iza River - downstream Săcel locality	Poligon	17.8
4	Tur River - downstream Negreşti-Oaş locality	Poligon	142.1
5	Someş River - downstream Şanţ locality, upstream Roşiori locality	Poligon	230.9
6	Someş River - downstream Roşiori locality	Poligon	334.5
7	Şieu River	Poligon	10.8
8	Someşul Mic River - downstream Floreşti locality	Poligon	23.9
9	Lăpuş River - downstream confluence with Suciu River	Poligon	28.1
10	Crasna River - upstream Vârşolţ locality	Poligon	2.8
11	Crasna River - downstream Vârşolţ locality, upstream Acâş locality	Poligon	40.2
12	Crasna River - downstream Acâş locality, upstream Moftinu Mare locality	Poligon	125.9
13	Crasna River - downstream Moftinu Mare locality	Poligon	36.9
14	Ier River – downstream Mihăieni locality	line	64.3
15	Crişul Alb River – downstream confluence with Valea Satului River	poligon	242.79
16	Crişul Negru River - downstream Poiana locality	poligon	53.77
17	Crişul Repede River – downstream confluence with Șipot River	poligon	50.02
18	Barcău River – downstream Subcetate locality	poligon	132.85
19	Ier River - downstream Unimăt locality, upstream confluence with Checheţ River	poligon	114.61
20	Mureș River - downstream Neagra locality	polygon	906.69
21	Aries River – downstream Albac locality	polygon	38.66
22	Târnava Mică - downstream Praid locality	polygon	110.41
23	Târnava - downstream Sub Cetate locality	polygon	151.96
24	Sebeş River – downstream confluence with Dobra River	polygon	26.05
25	Strei River – downstream Petros locality	polygon	32.37
26	Bega River - downstream Luncanii de Jos locality, upstream confluence with Iosifalău River	polygon	54.97
27	Bega River - downstream Topolovăţul Mic locality	line	77.5
28	Bega Veche River - Sânandrei locality	line	31.6
29	Bega Veche River - downstream Săcălaz locality	line	7.2

APSFR name	Representation type	Length/Surface (km)/(km²)
Slaná - Betliar	existing	1.20
Slaná - Brzotín	probable	1.90
Slaná - Slavec	probable	3.40
Slaná - Plešivec	existing	2.60
Slaná - Gemerská Hôrka	probable	2.21
Slaná - Čoltovo	probable	0.81
Slaná - Bretka	probable	1.10
Slaná - Gemerská Panica	probable	1.98
Slaná - Gemer	probable	2.30
Slaná - Tornaľa	probable	5.50
Blh - Rovné	existing	1.80
Blh - Potok	existing	0.60
Blh - Drienčany	existing	0.80
Blh - Teplý Vrch	existing	1.05
Blh - Veľký Blh	existing	2.10
Blh - Uzovská Panica	existing	1.20
Blh - Bátka	existing	2.30
Blh - Žíp	existing	0.90
Blh - Cakov	existing	0.70
Blh - Ivanice	existing	1.80
Rimava - Hnúšťa	existing	3.25
Rimava - Rimavské Brezovo	existing	2.10
Rimava - Rimavské Zalužany	existing	1.40
Rimava - Kociha	existing	0.80
Rimava - Rimavská Sobota	existing	5.40
Rimava - Pavlovce	existing	1.30
Rimava - Jesenské	existing	2.20
Rimava - Širkovce	existing	2.00
Rimava - Šimonovce	existing	1.00
Rimava - Rimavská Seč	existing	1.50
Rimava - Vlkyňa	existing	0.50
Ida - Košice - Šaca	probable	3.00
Ida - Velká Ida	probable	2.50
Bodva - Medzev	existing	4.00
Bodva - Jasov	existing	2.70
Bodva - Moldava nad Bodvou	probable	5.00
Brusník - Letanovce	existing	0.80
Brusník - Smižany	existing	3.20
Levočský potok - Levoča	existing	3.00
Levočský potok - Harichovce	existing	3.00
Levoský potok - Spišská Nová Ves	existing	0.40

APSFR name	Representation type	Length/Surface (km)/(km^2)
Levočský potok - Markušovce	existing	1.00
Branisko - Spišské Vlachy	existing	2.00
Hnilec - Hnilec	existing	4.40
Hnilec - Nálepkovo	existing	6.50
Hnilec - Švedlár	existing	4.00
Hnilec - Mníšek nad Hnilcom	existing	3.00
Hnilec - Helcmanovce	existing	1.60
Hnilec - Prakovce	existing	3.00
Hnilec - Gelnica	existing	4.70
Hnilec - Jaklovce	existing	2.50
Kučmanovský potok - Šarišské Dravce	existing	2.20
Kučmanovský potok - Torysa	existing	0.40
Šebastovka - Prešov	existing	3.20
Torysa - Haniska	existing	1.40
Torysa - Kendice	existing	5.50
Torysa - Drienovská Nová Ves	existing	2.00
Torysa - Drienov	existing	4.50
Torysa - Bretejovce	existing	2.00
Torysa - Ploské	existing	0.60
Torysa - Kráľovce	existing	1.00
Torysa - Vajkovce	existing	1.20
Torysa - Beniakovce	existing	1.00
Torysa - Rozhanovce	existing	2.50
Torysa - Košické Oľšany	existing	0.80
Torysa - Sady nad Torysou	existing	1.30
Torysa - Košická Polianka	existing	1.60
Torysa - Vyšná Hutka	existing	1.20
Torysa - Nižná Hutka	existing	2.10
Trstianka - Trsťany	existing	1.00
Trstianka - Ďurďošík	probable	1.50
Olšava - Kecerovce	existing	1.30
Olšava - Olšovany	existing	1.50
Olšava - Vyšný Čaj	existing	0.60
Olšava - Blažice	existing	0.70
Olšava - Nižný Čaj	existing	0.90
Olšava - Bohdanovce	existing	0.50
Olšava - Nižná Myšľa	existing	2.00
Hornád - Vikartovce	existing	1.50
Hornád - Spišský Štiavnik	existing	2.70
Hornád - Betlanovce	existing	1.80
Hornád - Hrabušice	existing	1.00
Hornád - Spišská Nová Ves	existing	6.00
Hornád - Markušovce	existing	3.50

APSFR name	Representation type	Length/Surface (km)/(km^2)
Hornád - Matejovce nad Hornádom	existing	1.70
Hornád - Chrasť nad Hornádom	existing	1.70
Hornád - Vítkovce	existing	0.50
Hornád - Olcnava	existing	1.00
Hornád - Spišské Vlachy	existing	1.50
Hornád - Kolinovce	existing	1.80
Hornád - Krompachy	existing	4.00
Hornád - Richnava	existing	2.00
Hornád - Kluknava	existing	3.70
Udava - Osadné	existing	2.80
Udava - Nižná Jablonka	existing	1.20
Udava - Vyšný Hrušov	existing	1.50
Udava - Udavské	existing	3.00
Pčolinka - Pčoliné	existing	2.10
Pčolinka - Snina	existing	3.00
Cirocha - Snina	existing	0.70
Cirocha - Dlhé nad Cirochou	existing	7.30
Ublianka - Ubľa	existing	3.00
Sobranecký potok - Sobrance	existing	3.20
Kanál Veľké Revištia-Bežovce - Nižná Rybnica	existing	1.00
Kanál Veľké Revištia-Bežovce - Sobrance	existing	3.00
Kanál Veľké Revištia-Bežovce - Bežovce	existing	5.80
Ladomirka - Krajná Poľana	existing	1.30
Ladomirka - Hunkovce	existing	1.50
Ladomirka - Ladomirová	existing	2.00
Ladomirka - Svidník	existing	2.70
Chotčianka - Bukovce	existing	1.90
Chotčianka - Chotča	existing	2.00
Chotčianka - Stropkov	existing	3.00
Sitnička - Závada	existing	1.50
Sitnička - Ruská Poruba	existing	1.00
Sitnička - Vyšná Sitnica	probable	1.60
Sitnička - Nižná Sitnica	existing	1.20
Oľka - Oľka	probable	1.50
Oľka - Ruská Kajňa	existing	0.20
Oľka - Pakostov	existing	0.50
Oľka - Košarovce	existing	2.00
Oľka - Žalobín	existing	1.00
Ondavka - Turcovce	existing	1.70
Ondavka - Baškovce	probable	1.40
Ondavka - Ohradzany	existing	2.00
Ondavka - Slovenská Volová	existing	1.50
Ondavka - Závadka	probable	1.00

APSFR name	Representation type	Length/Surface (km)/(km²)
Ondavka - Topoľovka	probable	2.00
Ondava - Vyšná Polianka	existing	1.00
Ondava - Varadka	existing	1.20
Ondava - Nižná Polianka	existing	0.50
Ondava - Mikulášová	existing	1.00
Ondava - Cigla	probable	0.50
Ondava - Dubová	probable	1.00
Ondava - Vyšný Orlík	probable	1.20
Ondava - Nižný Orlík	probable	1.20
Ondava - Svidník	probable	3.20
Ondava - Stročín	probable	1.60
Ondava - Duplín	probable	1.40
Ondava - Tisinec	existing	2.90
Ondava - Stropkov	existing	1.90
Ondava - Breznica	existing	1.00
Ondava - Miňovce	existing	1.40
Slatvinec - Kríže	existing	0.90
Slatvinec - Bogliarka	existing	2.30
Slatvinec - Kružlov	existing	1.70
Kamenec - Petrová	existing	0.70
Kamenec - Sveržov	existing	1.00
Kamenec - Tarnov	existing	1.40
Šibská voda - Šiba	existing	6.50
Šibská voda - Bardejov	existing	3.90
Kamenec - Bardejov	existing	0.70
Radomka - Šarišský Štiavnik	existing	1.00
Radomka - Radoma	existing	1.70
Radomka - Okrúhle	existing	1.20
Radomka - Matovce	existing	2.50
Radomka - Giraltovce	existing	2.60
Lomnica - Vechec	existing	1.50
Lomnica - Vranov nad Topľou	existing	0.90
Topľa - Livovská Huta	existing	0.90
Topľa - Livov	existing	1.30
Topľa - Lukov	existing	2.50
Topľa - Gerlachov	existing	1.40
Topľa - Tarnov	existing	0.50
Topľa - Rokytov	existing	1.00
Topľa - Mokroluh	existing	5.30
Topľa - Bardejov	existing	1.50
Topľa - Bardejov	existing	1.30
Topľa - Komárov	existing	1.50
Topľa - Hrabovec	existing	0.80

APSFR name	Representation type	Length/Surface (km)/(km²)
Topľa - Poliakovce	existing	2.00
Topľa - Dubinné	existing	2.70
Topľa - Kurima	existing	1.00
Topľa - Kučín	existing	1.00
Topľa - Porúbka	existing	0.70
Topľa - Harhaj	existing	2.00
Topľa - Marhaň	existing	1.30
Topľa - Brezov	existing	1.50
Topľa - Kalnište	probable	2.50
Topľa - Lužany pri Topli	existing	3.00
Topľa - Giraltovce	existing	0.50
Topľa - Železník	existing	1.50
Topľa - Mičakovce	existing	2.00
Topľa - Ďurďoš	existing	2.00
Topľa - Hanušovce nad Topľou	existing	1.00
Topľa - Bystré	existing	1.20
Topľa - Skrabské	existing	1.50
Topľa - Vyšný Žipov	existing	2.30
Topľa - Hlinné	existing	
Topľa - Jastrabie nad Topľou	existing	2.00
Topľa - Čaklov	existing	4.00
Topľa - Vranov nad Topľou	existing	5.00
Trnávka - Sečovce	existing	0.80
Trnávka - Hriadky	existing	1.50
Trnávka - Vojčice	existing	1.80
Terebľa - Kalša	probable	1.30
Terebľa - Slivník	existing	1.50
Roňava - Slanské Nové Mesto	existing	1.20
Roňava - Slivník	existing	2.00
Roňava - Kuzmice	existing	1.80
Roňava - Michaľany	existing	1.00
Roňava - Čerhov	existing	1.70
Roňava - Slovenské Nové Mesto	existing	2.20
Laborec - Čertižné	existing	2.30
Laborec - Habura	existing	7.50
Laborec - Medzilaborce	existing	1.50
Laborec - Krásny Brod	existing	3.30
Laborec - Čabiny	existing	1.20
Laborec - Volica	existing	3.00
Laborec - Radvaň nad Laborcom	existing	1.20
Laborec - Brestov nad Laborcom	existing	1.00
Laborec - Hrabovec nad Laborcom	existing	1.00
Laborec - Zbudské Dlhé	existing	1.50

APSFR name	Representation type	Length/Surface (km)/(km²)
Laborec - Koškovce	existing	1.50
Laborec - Hankovce	existing	1.50
Laborec - Ľubiša	existing	1.00
Laborec - Veľopolie	existing	1.30
Laborec - Udavské	existing	1.30
Laborec - Kochanovce	existing	0.70
Laborec - Lackovce	existing	1.00
Laborec - Brekov	existing	2.50
Laborec - Strážske	probable	

[1] type of representation can be: line or polygon.

Areas with Significant Potentially Flood Risk in Serbia

APSFR name	Representation type	Length (km)
Tisza from the mouth to the state border with Hungary	line	164
Begej Channel (DTD) from the mouth to the Banatska Palanka – Novi Bečej Channel (DTD)	line	36
Stari Begej the mouth to the state border with Romania	line	38
Zlatica from the mouth to the state border with Romania	line	35
Plazović from the mouth to the state border with Hungary	line	44

Project co-funded by the European Union (ERDF, IPA funds)

Partners: General Directorate of Water Management, Hungary | Global Water Partnership Central and Eastern Europe, Slovakia | International Commission for the Protection of the Danube River | Ministry of Water and Forests, Romania | Ministry of Foreign Affairs and Trade, Hungary | National Administration "Romanian Waters", Romania | National Institute of Hydrology and Water Management, Romania | Public Water Management Company "Vode Vojvodine", Serbia | Regional Environmental Center for Central and Eastern Europe, Hungary | The Jaroslav Černi Institute for the Development of Water Resources, Serbia | Water Research Institute, Slovakia | World Wide Fund for Nature Hungary

Associated Partners: Interior Ministry, Hungary | Republic of Serbia Ministry of Agriculture and Environmental Protection – Water Directorate | Secretariat of the Carpathian Convention (SCC), Austria | State Agency of Water Resources of Ukraine | Tisza River Basin Water Resources Directorate, Ukraine