"The project of the Trans-European Transport Network - Trans-European Transport Network - NIF Zrt.
Design tasks related to the development of the TEN-T inland waterway"
under a design contract
2014-HU-TMC-0606-S

DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 1 TO THE ENVIRONMENTAL ASSESSMENT

Scope of the Strategic Environmental Assessment agreed and finalised with the environmental authorities

Budapest, September 2020

1. BACKGROUND AND DESCRIPTION OF THE DESIGN BRIEF

The European Union is putting a strong focus on waterborne transport, the waterborne transport industry, to ensure that it can meet the growing demand for transport in a rational and environmentally friendly way.

The Danube is part of the trans-European transport network, but it has not been maintained for decades, as a result of which the number of days of navigation has fallen below 250 days. Due to the natural state of the river, which has been affected by the construction works in the countries of the Danube's upstream section and the lack of maintenance, the Hungarian section of the Danube, as a waterway, is not able to provide reliable and sustainable transport conditions in its current state.

On the Danube-Majne-Rhine Canal and the Danube below Hungary, as far as the Black Sea, the conditions for waterway class VI/B and VI/C are already ensured by river regulation and damming. On the stretch of the Danube between the border between Bős and the south, practically on the territory of Hungary, the requirements of the AGN Convention are not met. (*The AGN Convention indirectly lays down navigation parameters for European waterways, mainly in the form of technical requirements for vessels. The Convention defines the Hungarian section of the Danube as a uniform "E" class waterway, which must at least meet the basic requirements of Class IV.*)

Hungary has submitted a project proposal for the European Commission's 2014 CEF Call for Proposals entitled "Extension of the preparation of the TEN-T inland waterway development in Hungary", based on the Government Decision 1102/2015 (III.5.). The project was declared eligible by the European Commission in its Implementing Decision C(2015) 5274 of 31 July 2015. CEF project identification number: 2014-HU-TMC-0493-W.

The aim of the development programme under environmental assessment is to examine the minimum range of development objectives that can be economically achieved within the minimum requirements of international standards (Belgrade Convention, "DB recommendations", AGN Convention), in a parameter mix that meets the requirements of water protection, water management and environmental protection and nature conservation, as laid down in a number of international conventions and EU legislation.

1.1. THE NEED FOR A STARTEGY ENVIRONMENTAL ASSESSMENT

The Strategic Environmental Assessment (SEA) is prepared taking into account the legal requirements described below.

The basis for the preparation of the SEA assessment is the Directive 2001/42/EC (Directive on the Assessment of the Effects of certain Plans and Programmes on the Environment), and the Act LIII of 1995 on the General Rules for the Protection of the Environment adopted on the basis of the Directive, and the Government Decree 2/2005 (I. 11.) on the Environmental Assessment of certain Plans and Programmes.

Pursuant to Article 1 (2) of Government Decree No. 2/2005 (I. 11.), an environmental assessment [Article 43 (6) of the Act] is always mandatory for

b) a plan or programme not listed in Annex 1 which

ba) is intended for agriculture, forestry, fisheries, energy, industry, transport, transport, waste management, water management, electronic communications, tourism, regional development and provides a framework for future public authorisation of activities or installations listed in the Annex to the specific legislation on environmental impact assessment, but without the threshold and territorial constraints set out therein for the purposes of this Regulation, or

bb) may have significant adverse effects

bba) a Natura 2000 site or

bbb) under the Government Decree on certain rules of river basin management

bbba) to designated bodies of water; or

bbbb) registered protected areas.

In the present case, both points (ba) and (bb) are relevant. Indeed, the activities subject to a water permit under the Programme are likely to be classified as activities subject to an environmental impact assessment (EIA), i.e. as listed in the table below in Annex 3 to Decree 314/2005 Coll.

Table 1: Activities listed in Annex 3 to Government Decree 314/2005

38.	Waterway	For vessels of more than 1350 tonnes deadweight
126.	River regulation or channelisation	from 1 fkm
		in the case of a bend cut or in the protection zone of a water source (if the law on the protection of water sources, remote water sources and water installations for drinking water supply does not exclude the commencement of the activity in the protection zone), in a protected natural area, in a Natura 2000 area without any size limitation
127.	Watercourse restoration (except for silt removal and gully restoration for maintenance purposes aimed at restoring the original drainage capacity, if it serves to prevent or prevent the deterioration of water status as provided for in the Government Decree on certain rules of river basin management)	1 km of watercourse length
		50 m from a watercourse in the protection zone of a water source (if the commencement of activities in the protection zone is not excluded by legislation on the protection of water sources, remote water sources and water installations for the supply of drinking water)
		in protected natural areas, Natura 2000 areas, cave protection zones without size limitation

In addition, it cannot be excluded at this stage that the activities necessary to provide the waterway may have an adverse impact on Natura 2000 sites (candidate species, candidate habitats), or on a water body designated under the Government Decree on certain rules of river basin management or a registered protected area (the significance of the adverse impacts can only be assessed in the SEA or the EIAs).

The SEA influences strategic decisions and its results determine all stages of the development process (field surveys, physical modelling, engineering design, study design, permitting procedures). The Strategic Environmental Assessment is an integral part of the planning process and underpins and influences the environmental impact assessments to be carried out at the project level. Environmental impact assessments take into account the impacts from waterborne transport, as well as the global, regional and local environmental impacts resulting from interventions.

The Strategic Environmental Assessment helps you to, among other things:

- to preserve the existing environmental values of the site,
- environmental considerations influence decisions, helping to avoid irreversible environmental problems
- institutional harmony and integration between different sectors,
- environmental damage can be prevented,
- fairness and public participation.

1.2. HISTORY

Between 2005 and 2007, a "Baseline Study" was carried out on the improvement of the navigability of the Danube, based on which between 2009 and 2011, within the framework of the project preparatory work entitled "Studies on the improvement of the navigability of the Danube", a strategic environmental assessment, water rights establishment permit plans, environmental impact assessments, environmental assessments, detailed feasibility studies and tender documents were prepared, including on the basis of the Government Decision 1001/2011 (I. 14.) on the preparation of the Hungarian programme of the European Union Danube Macro-regional Strategy. Based on the documents presented, authorisation procedures have also been launched.

Details of the studies and plans completed so far for the project are summarised in the table below.

Table 2: History of the Improving Danube Navigability Programme

<table>
<tr><th colspan="2">document title</th><th>time of preparation</th><th>author, producing organisation</th><th>Danube section studied</th></tr>
<tr><td colspan="2">"Settlement of the gas sections on the common section of the Danube (1811-1789 fkm) Provisional solution" permit and design</td><td>1996</td><td>OBSERVATOR, VIZITERV Ltd</td><td>1811-1789 fkm</td></tr>
<tr><td colspan="2">Study underpinning the project to improve the navigability of the Danube</td><td>2007</td><td>VITUKI, AQUAPROFIT, ÖKO, VTK Innosystem, Ökoplan GIS, COWI Hungary, VUVH (Sk)</td><td>full Mon. Danube</td></tr>
<tr><td colspan="2">Improvement of fairway parameters on the Danube 1811-1708 fkm to minimise river regulation works</td><td>2009</td><td>ENVIROCONSULTING</td><td>1811-1708 fkm</td></tr>
<tr><td colspan="2">SEA study of technical interventions for the improvement of navigation conditions and the rehabilitation of the Sáp-Szob tributary - Environmental Report</td><td>2009</td><td>Env-in-Cent Consulting Ltd., MAKK Hungarian Centre for Environmental Economics, Envigraph Bt., ELTE, BME</td><td>Zap-Szob</td></tr>
<tr><td rowspan="6">Studies on improving the navigability of the Danube</td><td>Strategic Environmental Assessment</td><td>2009</td><td rowspan="6">VITUKI, AQUAPROFIT, TÉR-TEAM, VTK Innosystem</td><td>Szob - southern border</td></tr>
<tr><td>Plans for the granting of water rights</td><td>December 2009</td><td rowspan="3">Dömösi constriction, Dömösi gas works, Visegrád, Vác, Sződliget, Göd, Árpád Bridge, Budafok, Százhalombatta, Dunafüred-Ercsi, Kulcs, Dunaújváros, Kisapostag, Dunaföldvár-Solt, Bölcske-Harta, Paks, Baráka, Kovácspuszta-Siótorok, Korpád, Koppány-Baja, Sárospart-Szeremle, Mohács</td></tr>
<tr><td>Environmental impact assessments</td><td>2010</td></tr>
<tr><td>Tender documents</td><td>November 2011</td></tr>
<tr><td>Detailed feasibility study</td><td>November 2011</td><td rowspan="2">Szob - southern border</td></tr>
<tr><td>Environmental assessment</td><td>November 2011</td></tr>
<tr><td colspan="2">Kisminta modelling for different stages</td><td>2010-2016</td><td>Viktória Császári, Mercédesz Láng</td><td>Dunaföldvár, Sárospart, Baja, Solt, Szentendre, Dunaszekcső, Paks</td></tr>
</table>

document title	time of preparation	author, producing organisation	Danube section studied
2016 partial wildlife survey results	October 2016	Belemnites Engineering Office Ltd.	Dömös, Visegrád, Vác, Sződliget, Göd, Árpád Bridge, Budafok, Százhalombatta, Dunafüred, Ercsi, Kulcs, Dunaújváros, Kapostag, Dunaföldvár, Solt, Bölcske, Harta, Paks, Baráka, Kovácspuszta, Siótorok, Korpád, Koppány, Baja, Sárospart, Szeremle, Mohács

The opinions and other development strategies, plans and documents collected in the table below have been prepared in connection with the above studies and documents, and are also processed in the course of this planning and strategic analysis.

Table 3: Documentation and plans related to the Improving Danube Navigability Programme

title of the related document	time of preparation	author, producing organisation	Danube section studied
Civil opinion attached to WWF's complaint on the chapters of the 'Study on the feasibility of the project to improve the navigability of the Danube'	May 2008	WWF - Gábor Guti, Zsolt Kempl, Anna Enikő Tamás, László Mrekva, Laurice Ereifej, Gábor Ungvári, Zoltán Simonffy	Szob - southern border
Expected ecological impacts of investments to improve the navigability of the Danube	2009	Szekció-tech Ltd. Viktória Kavrán	full Mon. Danube
National Environment Council:Resolution on ideas for improving the navigability of the Hungarian section of the Danube	(16 November 2009)	National Environment Council	full Mon. Danube
Position of the Parliamentary Commissioner for Future Generations on the transport development plans to improve the navigability of the Danube based on the WWF study	2010.	Parliamentary Commissioner for Future Generations	Szob - southern border
REKK - Inland waterway development proposals for the Danube from the perspective of inland waterway transport - Sectoral cost-benefit analysis	May 2010	Regional Energy Economics Research Centre - Corvinus University of Budapest: Gábor Ungvári, Balázs Édes, Zsolt Gerencsér	Zap-Szob
European Union Strategy for Danube Region	Dec 2010.	EUROPEAN COMMISSION	entire Danube
National Danube Waterway Transport Action Plan	April 2013	Produna	entire Danube
Some characteristics of the water extremes on the Danube in the Hungarian-Russian section	2013	Dr. Károly KonecsnyNational Water Authority	full Mon. Danube
NKS - Study on the development potential of waterborne transport	April 2014	UPDATE	full Mon. Danube
Large-scale river basin management plans 01NMT (consultation plans)	2014	SOLVEX-BME CONSORTIUM	1809.76-1786 fkm, 1786-1729.35 fkm, 1729.35-11699.5 fkm
Analysis of morphological changes in the Upper Hungarian Danube	2014	Varga-Lehofer Debóra Tünde BME BSc. student in Infrastructure Civil Engineering	
Environmental principles for the sustainable use of the Danube as a waterway	2016	Ministry of Agriculture	full Mon. Danube

title of the related document	time of preparation	author, producing organisation	Danube section studied
Danube fairway diversion plan 2018-2019 for the stretch 1811-1708 fkm	2018	North Transdanubian Water Management Directorate	1811-1708 fkm

1.3. THE DESIGN TASK

The planning task concerns improving the navigability of the Danube. The task is to prepare the development of inland waterways on the Hungarian stretch of the Danube in an efficient way, taking into account water and flood protection, as well as environmental and nature conservation aspects, with the ultimate aim of removing bottlenecks that hinder commercial navigation. The task will include the development of waterway concept options integrated into the European transport and freight transport system, the analysis of options and the proposal of the optimal concept option.

The planning process will include a situation assessment study, which will form the basis for the water permit plans and environmental impact assessments to be prepared for each intervention site, as well as for the tender plans.

In parallel, the "DUNAI HAJOUT DEVELOPMENT PROGRAMME" (hereinafter referred to as "the Programme"), which will be the subject of the SEA, is being prepared.

The terms of reference also require the environmental assessment to be carried out separately, in stages, as follows:

- Preparation of a SEA for the section between Sap and Sáp and Sápsk;
- Preparation of an updated SEA for the section between Szob and the southern border (taking into account the SEA prepared for the section in 2009).

Given that the two phases form a single waterway and it is not possible to separate the impacts, the documentation will be prepared in a single structure and the consultation process will be carried out simultaneously. The structure of the document will allow for interpretation by section. The task will also include the preparation of documentation and descriptive documents in foreign languages for consultation, comment and adoption of transboundary environmental impacts.

The environmental assessments for the two sections separately should take into account the cumulative impacts on the Danube as a whole.

The planning area covers the entire stretch of the Danube in Hungary, from Sap to the southern border.

NIF National Infrastructure Development Ltd., the investor, entrusted the above tasks to the UTIBER KFT - VIZITERV-CONSULT KFT - BME Consortium, which won the tender for the design tasks related to the development of the Trans-European Transport Network - TEN-T inland waterway in 2014.

In parallel with the present planning task, a consortium led by EX ANTE Kft. is preparing the National Master Plan for the Hungarian section of the Danube River, within the framework of the CEF project "Development of the Master Plan for the Strengthening of Danube Freight Transport through TEN-T Port Infrastructure Development, with Special Focus on the Port of Komárno", 2015-HU-TM-0152-S, on behalf of MAHART Shipping Ltd. This will also include a comprehensive strategic document to improve the conditions for inland waterway transport, which will mainly support the development of port infrastructure and port services along the Danube. The parallel planning work will ensure coherence between the development concepts.

1.4. THE AIM OF THE DEVELOPMENT PROGRAMME

1.4.1. CHALLENGES, DRIVERS, VISION

Challenges, drivers:

- Unfavourable shipping conditions, frequent periods of low water levels (which are expected to increase in frequency due to climate change), and the development of fording on the Hungarian stretch of the Danube have made domestic shipping unsafe, and therefore the increasing transit and domestic freight traffic has shifted to road transport.
- Despite continuous improvements in the road network, road transport capacity is increasingly limited and network capacity is being exhausted.
- The increase in road transport has generated a significant increase in environmental pressure on the national road network.
- Transport costs have been rising steadily due to the continuous road improvements in recent years.
- One of the main considerations in addressing these issues is to ensure that the development of the waterborne transport sector in a given location is carried out with the least possible environmental conflict while maintaining existing environmental capacity and values.

A vision for the future:

Increase the role of waterborne freight in the transport sector by improving navigability conditions.

European and national strategies and ideas (etc.) on waterborne transport taken into account in the preparation of the Programme:

- National Transport Strategy,
- EU Strategy for the Danube Region (EUSDR)
- EU Transport White Paper: 30% of road freight over 300 km by 2020 2030 and 50% by 2050 should be taken over by other modes such as rail or waterborne transport, also thanks to efficient green freight corridors.
- Danube River Protection Convention (ICPDR) and the objectives, measures and their impact in the river basin management plans for the domestic section.

1.4.2. OBJECTIVES, TARGET STATES

Strategic Environmental Assessment aims to improve the quality, environmental effectiveness and environmental consistency of strategic documents by integrating environmental and sustainability considerations into the preparation and planning process, in order to reduce and eliminate their negative environmental impacts and increase and strengthen their positive environmental impacts.

The strategic objective of the programme is to increase the role of waterborne freight in the transport sector by improving navigability conditions.

According to the technical specification of the design task, the basic parameters to be taken into account, which define the initial parameters of the fairway design, are:

- Decree No 17/2002 (III. 7.) of the Ministry of Transport, Innovation and Technology on the designation of natural and artificial surface waters as navigable or capable of being made navigable
- I/a. DK/TAG 77/11 - Recommendations on the minimum requirements for fairway management and hydraulic engineering and other development of the Danube
- Resolution No. 92/2 on new classification of inland waterways
- European Agreement on Waterways of International Importance (AGN).
- Danube and Tributaries Fairway Rehabilitation and Maintenance Master Plan

Based on the above legal sources and recommendations, the assessment and design of fairway development should be carried out taking into account, among others, the following parameters:

- **Depth of the waterway**: depending on the quality of the river bed, the depth of the waterway is 27 or 28 dm according to Decree 17/2002 (III.7.) KöViM.
- **Fairway width**: 120 m above the 1784 fkm section, 150 m below the 1784-1641 fkm section. The fairway width may be reduced to the minimum width necessary for safe one-way passage (maximum permitted passage of the convoy on the section), depending on the curve and morphological conditions, if a fairway width of 120-150 m cannot be provided for environmental, nature conservation, river regulation, water base protection or other reasons. The minimum width and the navigation regime of the constriction shall be determined by the designer in consultation with the navigation authority. For one-way traffic, a minimum fairway width of 80 to 120 m shall be provided, depending on the winding and other nautical conditions.
- **Turning radius**: For the turning radius, the one recommended by the DB shall be taken into account, with the possibility of reducing the values contained therein while maintaining the safety of navigation.
- **Slot height**: in the CEF fairway development project, the slot height is not a relevant issue, as the project does not address the modification of the free slot height. “

The design will examine the feasibility of the waterway to be built to the above design parameters under the current geographical and expected climatic conditions.

From a water management point of view, one of the stated objectives of the project is to prevent undesirable further deepening of the riverbed and to stabilise the riverbed. Even a small amount of subsidence is unacceptable as an effect of the intervention. In other words, the current low water levels and the bed and, indirectly, the surrounding groundwater level should not be lowered as a result of the planned interventions.

The project does not foresee any conventional damming.

2. SITUATIONAL AWARENESS, IN PARTICULAR INFORMATION RELEVANT TO THE ENVIRONMENT

2.1. GEOGRAPHICAL FEATURES AND NATURAL ENVIRONMENT FOR WATERBORNE TRANSPORT

The following is a preliminary assessment of the factors influencing shipping, compiled from literature and history.

The Danube is Europe's second longest river after the Volga. In Germany, it rises in the Black Forest at the confluence of two small streams, the Brigach and the Breg, near Donaueschingen. From this confluence point, the river is 2,845 km long (measured from the Black Sea estuary to river-km 0 at the town of Sulina in the middle reaches of the Danube Delta). It flows through ten countries to its mouth and its catchment area covers seven other countries.

Figure 1: Countries affected by the Danube

The steep gradient of the upper Danube (for about 1,055 km) in the first third of the river section makes it resemble a mountain river. Taking advantage of the high gradient, almost all the Danube's river power plants are located in this section. At Gönyű (river km 1790), it gradually changes into a lowland river following a change in gradient and a fall.

While the average drop in height of the Upper Danube is over half a metre per kilometre, the average drop on the Lower Danube is just over 4 centimetres per kilometre.

In geological terms, the Danube flows through five basins and the mountain ranges that separate them. In the basins, the Danube is alluvial in character, while its bed is generally incised (bedrock type) where it breaks through the mountain ranges.

After leaving the Dévényi gate, the Danube reaches the Kisalföld, where it breaks into several branches, builds a cone of alluvium (in its natural state), and is braided in nature. Downstream from Gönyő, other influences are also at play, and the dynamic character of the river changes slightly.

Reaching the Danube bend, it again becomes notchy: the continuous uplift of the Börzsöny-Visegrádi mountains results in terraces being left behind, while at the same time alluvial sections are formed locally, e.g. in the Pilismaróti basin.

Leaving the Visegrád-Nagymaros line, the Danube again splits into two branches, the braided character reappears, although the Szentendre branch temporarily takes on a meandering character. Braiding is still predominant, with islands of various sizes and evidence of shifts in the river bed at historical time scales. This braiding character, although decreasing, continues until the Bölcske-Paks zone, where meanders are already present (e.g. Fadd-Dombori slough).

The Hungarian section of the Danube is 417 km long, of which 140 km is part of the Hungarian-Slovak border between Dunacsúny and the mouth of the Ipoly. Its water flow at Budapest is 10,000 m^3/sec at its highest level and 600 m^3/sec at its lowest. The difference between the highest and lowest water level is 8 m. The annual variation is between 6-8 m. The fact that the Danube is fed by water from the snow-covered Alps and glaciers gives it a different character from the domestic rivers. On the Danube, after the usual winter low flows, melting and spring rains cause only relatively minor flooding. When temperatures rise and melt snow in the higher regions of the Alps and at the base of glaciers, the so-called green tide comes in May-June, which can cause much more damage than early spring floods. Flood defences are adequate, but dangerous situations can often arise during floods at or above peak levels.

The Danube has many tributaries, the most important of which are in our country:

- Mosoni-Duna Island,
- Szentendrei-Duna,

– Ráckevei-Duna.

The main or smaller tributaries may enclose one or more islands. The largest of these are Csallóköz, Szigetköz, Szentendrei Island, Csepel Island, Mohács Island and Bala Island at the Dobrudzsa bend in the Danube.

The Danube is also enriched by the waters of numerous tributaries along its 2845 km of length.

Comparing the river with the Rhine, another major waterway corridor of the Danube-Main-Rhine waterway, they are very different. The Rhine has a relatively narrow but deep riverbed, whereas the Danube has a rather wide and shallow riverbed profile. This has led to the proliferation in Western Europe of vessels with deeper draughts and thus higher carrying capacities, which can only navigate the Danube with depth restrictions (depending on water levels) and thus with reduced capacity utilisation for part of the year. In order to ensure the unhindered and rapid passage of vessels with a draught of 2.5 m and a high transport capacity on the domestic stretch of the Danube for at least 300 days of the year, the natural physical conditions of the river would have to be modified. The design and operation of a navigable waterway can have direct or indirect impacts on a number of environmental elements, which can result from construction, vessel traffic and accidental events. Therefore, the development of the Programme should be guided by the SEA preparers towards solutions that minimise the impact on these parameters and thus mitigate the expected impacts.

The environmental and ecological impacts of interventions to improve navigation conditions are closely linked to the size (depth, width) of the waterway. The following is a brief description of the main environmental factors on which the development may have a significant impact, based on the historical and literature data.

2.1.1. WATER SOURCES, WATER USES

Along the Danube there are several drinking water sources, which supply the water needs of the capital city, among others, through bank-filtered, stratified water abstraction. The closer the aquifer is to the surface, the more likely it is that surface pollutants will be present in the water, and designated aquifers around estuaries are particularly sensitive to the Danube's water level.

A certain proportion of the water extracted from coastal filtered aquifers is derived from the surface water that feeds them, and therefore interventions in the hydrogeological protection zone of these aquifers may result in damage to the upstream biochemical and mechanical filtration and transport medium. The effects generated by increased vessel traffic (e.g. turbidity) may also affect the qualitative and quantitative parameters of coastal wells.

With a few minor exceptions, industrial water abstractions on the Danube are predominantly related to thermal water use in power plants. This is particularly true for the Hungarian section of the Danube below Budapest (Csepel Power Plant, Százhalombatta Thermal Power Plant and Paks Nuclear Power Plant).

The amount of water abstracted for agriculture is currently insignificant in national terms, but in the future, taking into account the Government's irrigation development plans and the Sandhills water recharge plans, water use for agriculture may increase.

2.1.2. NATURAL AND LANDSCAPE FEATURES

The Hungarian stretch of the Danube represents a significant natural asset also on a European scale, therefore, during the planning process, increased attention should be paid to the need to plan and implement fairway interventions carefully, considering alternatives from a multidimensional perspective, taking into account environmental, economic and social aspects.

The Hungarian stretch of the Danube and its floodplain are famous for their valuable wildlife and rare and vulnerable habitats, also in Central Europe. The Danube and the floodplain and floodplain habitats directly connected to the river are home to several protected and highly protected animal and plant species, including endemic species, which usually occur in the fast-flowing shallow gravel habitats. These sites are also sometimes, but not necessarily, listed as fords. Among the habitats rich in natural values, it is worth highlighting the willow, poplar, alder and ash groves, which are highly degraded at European level and of priority importance for the Community, and which still occur in their natural state along the Danube. The forest stands, which are highly diverse due to the different natural conditions and climatic conditions, are also of considerable value from a forestry and forest protection point of view, because of their economic, nature conservation and public welfare functions.

The Danube and its floodplain affect a number of nature conservation areas:

- 7 protected natural areas of national importance (2 national parks, 2 landscape protection areas, 3 nature reserves, 4 national park directorates);
- 12 Natura 2000 sites (the entire stretch of the Danube, except the Budapest section, is part of the Natura 2000 network)
- 4 forest reserves (Erebe Islands, Lake Buvát Keszeges, South Veranka Sasfok, Kádár Island)
- 2 Ramsar sites (Gemenc, Béda-Karapancsa)
- 2 biosphere reserves (Pilis BR, Mura-Drava-Danube Transboundary BR)
- the whole Danube riverbed is part of the national ecological network, with different classifications - core area, ecological corridor, buffer area

At the same time, the areas along the Danube in Hungary also represent an outstanding landscape and settlement value, contributing to the economic importance of the adjacent areas as residential and holiday areas, as well as tourist destinations, which is also promoted by the natural healing factors and spas along the river.

2.1.3. RECREATION, TOURISM

Water tourism, including tourist water passenger transport, can be a profitable segment in the future, and our waters are attractive destinations for both domestic and foreign tourists. This should be exploited in the future by expanding the range of services and raising the quality of services.

The Danube Bend, for example, can enhance the tourist experience in Budapest by developing the Danube's fast boat service. Thanks to the shortened accessibility, the Danube and its neighbouring settlements can be included in the destination's range of experiences.

In addition to these activities, the Danube offers opportunities for many other water recreation activities (e.g. water sports, fishing, excursions, recreation, spa treatments), the conditions of which may be affected by the interventions and the increase in boat traffic.

2.1.4. POLLUTION FROM WATER TRANSPORT, WASTE GENERATION

Increasing vessel traffic is likely to have negative impacts on water quality, both in terms of specific shipping-related pollution (e.g. fuel, ballast water, bottom water discharge, hydrocarbon pollution) and the potential for accidental pollution and municipal pollution. Oil spills in the Danube basin, which is most affected by shipping, already accounted for a significant proportion of water quality incidents in the country, and this phenomenon may increase with increased traffic.

2.1.5. CLIMATE IMPACTS AND THE IMPACT OF CLIMATE ON SHIPPING

The impact of development on climate is primarily through greenhouse gas emissions (see next chapter).

As a natural resource, water is closely linked to climate and weather variability, so water abundance is a problem in some places and water scarcity in others. A striking feature of climate change affecting our water resources is that precipitation in the Danube catchment increases in the winter and decreases in the summer. The increase in the frequency and intensity of extreme high rainfall events is expected to increase the number and magnitude of heavy tidal surges in many areas, and with them the amount of damage they cause, and the cost of protection and restoration. As average temperatures rise, snowmelt floods will occur earlier. Reduced summer precipitation, coupled with increased evaporation, increases the frequency and magnitude of extreme low flows in many watercourses, and the frequency of drought years.

2.2. THE SHIPPING SECTOR AND ENVIRONMENTAL CONCERNS

Hungary's total freight transport data by transport sector, based on the 2017 analysis of the Hungarian Central Statistical Office (KSH), are shown in the following graph.

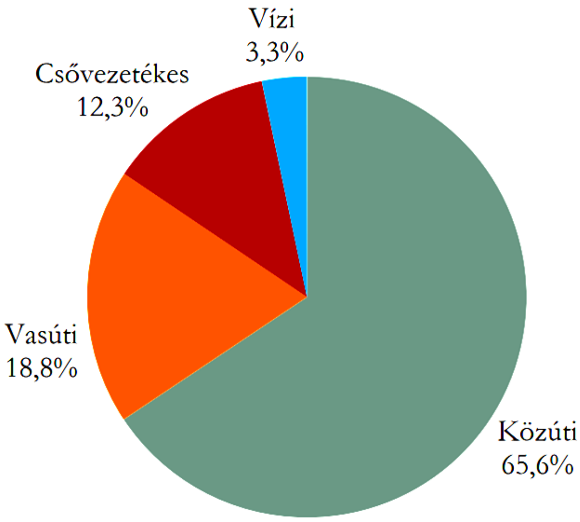

Figure 2: Breakdown of freight transport performance by tonne-kilometre of goods, 2017 (KSH)

In 2017, more than 288 million tonnes of goods were transported by the different modes of transport, of which only 9.6% of the goods on the Hungarian section of the Danube were transported by Hungarian flag vessels. The main foreign carriers were German, Romanian and Austrian vessels with 21, 20 and 9.4% respectively.

According to international statistics (Eurostat data 2012-2017, Source: Eurostat (2019): Modal split of freight transport), the share of inland waterway transport in Hungary's total freight tonne-kilometre performance in 2017 was only 4.8% (but excluding pipeline performance), while in Western countries it is significantly higher (Netherlands 44.7%; Belgium 15.6%; Germany 8.8%). This share is not only specific to our country, but can also be generalised to the other Danube States without maritime connections (Austria 2.9%; Slovakia 3.6%). For the EU-28, the rate was 6.0% in 2017. Given current trends, it is expected that by improving the navigability of the Danube, we would continue to be a transit country, i.e. despite the investment and maintenance costs and the expected hydrological and ecological impacts, our country would not be the primary beneficiary.

According to 2017 KSH data, the three major national public ports in Hungary - Baja, Csepel and Győr-Gönyűi - handled one third of the total volume of goods transported by inland waterways. A further two thirds of the traffic was shared by some 40-45 public and private ports and loading berths. Due to the nature of waterborne transport, the transport of goods by ship is only an intermediate element in a multi-modal transport chain. Immediately after unloading from the vessel, 21% of the goods were transported by road, 20% by rail, 0.2% by ship and 59% had not yet left the ports at the time of the survey. Of the goods loaded, 28% arrived by road, 5.2% by rail, 0.1% by ship and 67% had been stored in the port for some time before loading.

The environmental benefits and social benefits of waterborne freight transport can be seen by comparing the specific (per tonne of goods) emissions of pollutants and other environmental impacts by mode. Whatever the mode of transport, freight transport will have some environmental impact, but the extent to which it does so and the factors that contribute to it are not irrelevant.

The following figure shows the energy requirements of each mode of transport and freight in oil equivalent terms. (Oil equivalent is a unit of energy that represents the mass of crude oil that must be burned to produce a given amount of energy.)

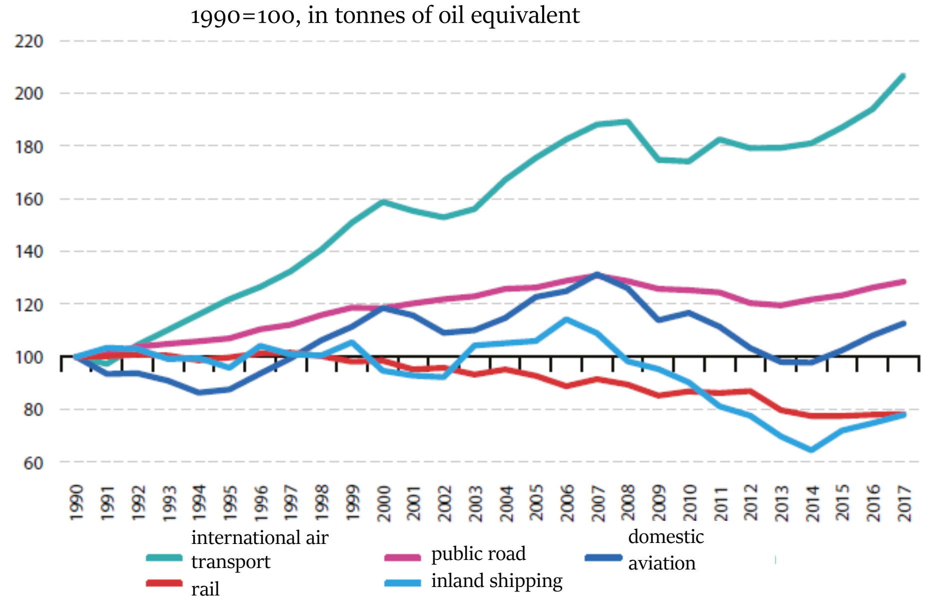

Figure 3: Energy demand in Mtoe (Million tonnes of oil equivalent) for some transport sectors in Europe

Source: Eurostat Statistical books - Energy, transport and environment indicators, 2018, Figure 1.5.6: Energy consumption by transport mode, EU-28, 1990-2016

The graph above shows that, together with railways, inland waterways became the least energy-intensive sector in 2017.

The environmental impact of the operational activities of each transport sub-sector can also be illustrated through greenhouse gas emissions. The evolution of carbon dioxide emissions from each sector is shown in the following graph (based on data published by the European Environment Agency in 2017).

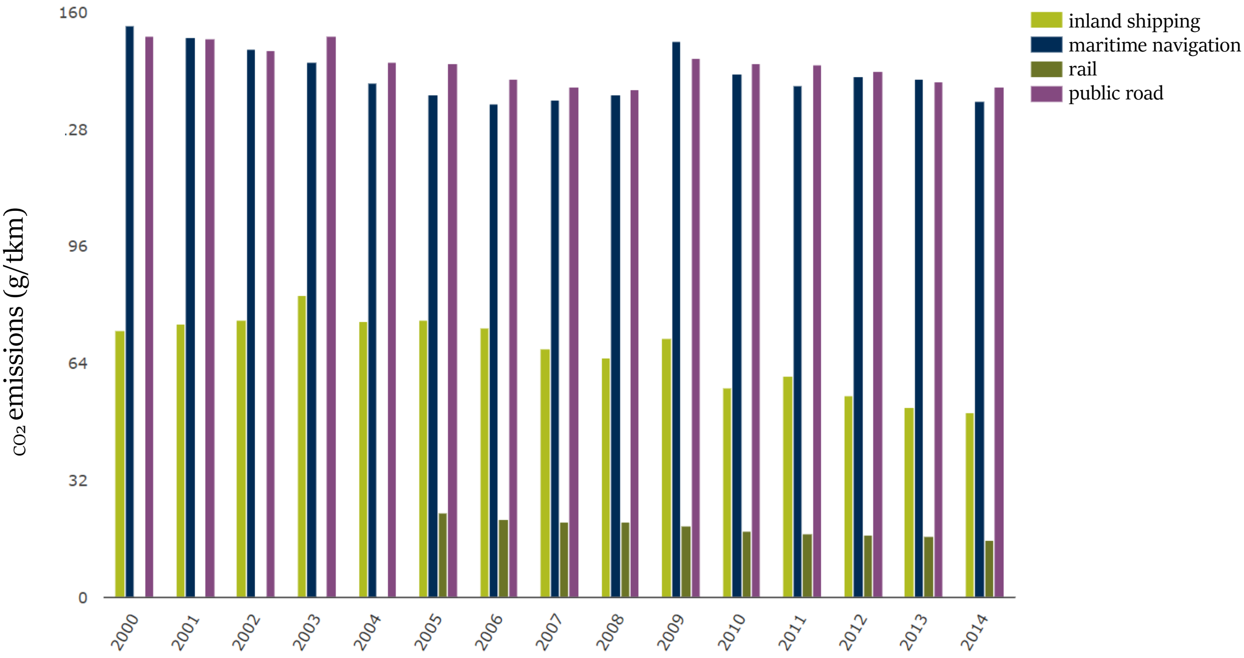

Figure 4: Evolution of carbon dioxide emissions by transport sub-sector

Source: https://www.eea.europa.eu/data-and-maps/daviz/specific-co2-emissions-per-tonne-2#tab-used-in-indicators)

The figure above shows that, based on EU averages, inland shipping is the second most favourable mode of transport in terms of carbon dioxide emissions per tonne of goods, after rail. There may be a larger variation in the ratios between countries, depending on the electrification of railways, the prevalence of diesel traction and the share of renewables in electricity generation, so that rail may be much less favourable in some countries (e.g. Hungary). Another difficulty in assessing the transport sub-sectors is that different data are available on the energy use and GHG emissions of waterborne and rail transport. For example, according to another source, "Inland waterway transport energy use per km/tonne of goods transported is about 17% of road transport and 50% of rail transport." (Source: https://ec.europa.eu/transport/modes/inland_en).

To complicate the picture, increased vessel traffic is also associated with increased environmental pollution (e.g. oily seabed water spills; port pollution; higher sulphur fuels used to operate ships; shoreline-deforming, habitat-destroying effects of wave action) and, although not frequent, the pollution of living waters in the event of certain types of accident (accident, environmental disaster, sabotage, terrorist act) can cause irreversible damage. In 2017, 31% of the goods transported by inland waterways were agricultural products, but a significant share (19% and 17% respectively) was also accounted for by the commodity group of metallic ores and other mining and quarrying products, and coke and refined petroleum products (Source: HCSO). Of the above, for example, the release of mining products, coke, petroleum and their derivatives into the environment is much more significant and widespread in terms of area for waterborne transport than for all other modes of transport examined.

The positive environmental performance of shipping is affected by the fact that waterborne freight transport alone is the least likely to reach its final destination. Transhipment is usually required (sometimes more than one) and is mostly done by mechanical means. Further road/rail transport from the ports is required. In addition to this, the development of shipping requires the creation of new ports, which can also be a major source of conflict (mainly environmental conflicts within the municipality, nature conservation conflicts outside the municipality).

The study "External Costs of Transport in Europe", commissioned by the German research institutes IWW and Fraunhofer ISI and the Swiss INFRAS, summarises the externalities of transport in Europe.

External costs include the environmental costs of accidents, air pollution, climate change risk, noise, urbanisation, loss of landscape and biodiversity, soil and water pollution, and background processes. These elements are distributed in the following proportions: As a transport mode, road transport causes the most damage, accounting for 92.4% of external costs. This is followed by air transport with 5.2% and, to a lesser extent, rail (1.2%) and waterway transport (0.3%), which are considered to be environmentally friendly alternatives in terms of external costs.

3. POSSIBLE DIRECTIONS FOR DEVELOPMENT

All the planned interventions (demolition, dismantling, construction, relocation of bank material, dredging, regulatory and ecological interventions, fairway relocation, correction, material disposal) are part of the integrated Danube fairway development programme, which aims to implement a fairway that complies with the parameters set by international treaties and EU legislation, the AGN Convention, as well as with national transport policy objectives and environmental standards.

The key aspects (principles, frameworks) for the development of possible options are:

- Temporary or permanent solution
- Compliance of the navigation parameters of the Hungarian Danube section with international and national legislation
- Conservation and enhancement of nature conservation values, including the implementation of ecological rehabilitation of tributaries
- Economic aspects, choosing a cost-effective option
- Flexibility versus determinacy (the smallest navigable route, sections allowing one-way traffic, what can we be flexible about and what not?)

In the section between 1811-1784 fkm, the width of the fairway is 120 m and the first priority is to prevent further undesirable deepening of the river bed and to stabilise it. To this end, it is necessary to consider the removal of transverse control works, the revision of the length of control works, the construction of new control works, the necessary dredging, and the possibilities for sediment recharge and bank stabilisation, while paying particular attention to habitat protection measures.

In the section between 1784 fkm - southern border, the use of 150 m regulatory width and control works will be prioritised, as well as efforts to establish stable flow conditions, minimise annual dredging and habitat protection measures. Consideration should be given to the dismantling, and sometimes addition, of transverse control works, review of the length of control works, construction of new control works and dredging as necessary.

In addition to conventional means of control (dredging, construction of stone works), the development of plans will favour the use of other, more complex river control methods, which can raise mean water levels in a way that serves both ecological and navigational interests.

Accordingly, we consider the following to be possible options at this stage:

- **Option zero:** assuming the current morphological state, navigation is only possible with significant space and time restrictions (hereafter "pessimistic" option),
- **Version I:** A version that meets the majority of the requirements with traditional river control works. Gas scooping. Height reduction of stone works, necessary additions to stone works, construction of new spurs, bank stabilisation by the installation of bottom fins or by backfilling with rolled sediment.
- **Version II: in** full compliance with the requirements, it is based on maintaining the best-performing interventions obtained in Version I, but adding innovative interventions to the spurs in some cases, replacing them with chevron-type baffles, and studying the relocation of the fairway by providing two-way navigation and creating a limited width narrowing of the channel.

- **Version III**: After evaluating versions I and II, it proposes the optimal intervention option by examining the relocation of the fairway, providing two-way navigation.
- **Variant III/A**: In addition to the interventions planned in Variant III, the creation of limited width sections in certain fords (possibly one-way navigation for nautical reasons) will be examined in order to reduce costs.

A comparative evaluation of the different versions will be carried out during the development of the Programme. The analysis of alternatives will favour those that minimise the number of new artificial facilities.

4. SIGNIFICANT TRANSBOUNDARY ENVIRONMENTAL IMPACTS

The SEA will assess the changes in the environmental conditions resulting from the planned and necessary interventions in the Programme for the improvement of the fairway. This will also be used to estimate the expected transboundary impacts on the upstream and downstream sides and their magnitude. Preliminarily, the following can be identified.

4.1.1. IMPACTS FROM THE DEVELOPMENT OF RIVER NAVIGATION

Interventions to improve navigation conditions on the Danube as an international waterway, provided that other Danube riparian countries undertake similar developments and a waterway with uniform parameters is developed, could increase the volume of waterborne transport, also depending on the level of transport demand. As waterborne transport is typically long-distance, the Hungarian development could increase waterborne traffic to Slovakia, Austria, Germany, the Benelux countries and, to the south, Serbia, Romania and Bulgaria. The countries concerned will also benefit from the economic advantages and environmental impact of this increase in traffic.

4.1.2. IMPACTS RESULTING FROM THE IMPLEMENTATION OF INTERVENTIONS

Some of the planned improvements (between Sap and Sava) concern the stretches of the Danube that also form the border between Hungary and Slovakia. Therefore, in these locations, any development impact is usually also a cross-border impact.

As an "exception", neighbouring countries are unlikely to be affected by the local impacts of the extraction, processing and transport of materials on Hungarian territory necessary for the technical implementation of the investment and maintenance.

When assessing the significance of transboundary impacts, the focus should be on long-term impacts, mainly on the Danube riverbed morphology and other water management parameters. Temporary impacts (e.g. construction air pollution, noise pollution) are generally less significant and have more technically manageable environmental consequences.

5. PROPOSAL FOR AN ENVIRONMENTAL ASSESSMENT METHODOLOGY

The applicable SEA methodology provides an analytical-assessment framework that identifies the direct or indirect effects of interventions on the environment, the expected changes in environmental conditions, the nature and extent of these changes, and the possibility of preventing or mitigating undesirable effects that are considered likely to be significant.

The following methodological tools are proposed to be used in the preparation of the environmental assessment, which is described in more detail in Section 6 of this document:

- a status report, largely based on the situation assessment of the Programme, on the entire stretch of the Danube in Hungary, covering the status of all relevant environmental elements concerned, supplemented by field surveys where necessary,
- a consistency check of the objectives of the programme being prepared,
- an analysis of the fit between the objectives of the future Programme and the principles of sustainable mobility,
- analysing the fit of the objectives and content of the Programme with relevant international environmental strategies, programmes and concepts, including:
  - EU 2020 Strategy
  - EU Strategy for the Danube Region
  - Prosperity without using up the planet - Environmental Action Programme
  - Water Framework Directive
  - Blue print
  - Flood Risk Strategy
  - Natura 2000 directives
  - European Landscape Convention
  - EU Biodiversity Strategy
  - ICPDR: Sturgeon Strategy (National Commission for the Protection of the Danube: Tokhal Strategy
- analysis of the fit of the objectives and content of the Programme with national environmental strategies, programmes and concepts, in particular:
  - National Transport Strategy
  - National Environment Programme (2015-2020)
  - National Nature Conservation Fund Plan (2015-2020)
  - National Sustainable Development Framework Strategy
  - Second National Climate Change Strategy (NÉS-2)
  - National Environmental Technology Innovation Strategy (2011-2020)
  - National Waste Management Plan (2014-2020)
  - National River Basin Management Plan
  - National Rural Strategy
  - National Water Strategy 2017-2020-(2030)
  - National Biodiversity Strategy II 2015-2020
  - National Energy Strategy
  - National Forest Strategy 2016-2030
  - National Landscape Strategy 2017-2026
  - National Tourism Development Strategy 2030 Hungary Flood Risk Management Plan
  - Environmental principles for the sustainable use of the Danube as a waterway
- analysis of expected impacts, types of impacts, and the forecasting of changes and trends in the state of the environment for individual environmental elements and systems
- predicting cumulative impacts for all environmental elements and systems, with particular attention to the candidate habitats and candidate species of the Danube Natura 2000 sites, as well as to the municipal environment and the health of the people living there
- formulating proposals to mitigate and compensate for adverse impacts

- participating in the analysis of the variants of the Programme through the environmental assessment of each variant

The impacts on surface water and groundwater in the context of the Waterway Development Programme need to be considered in particular in this context:

- carrying out targeted analyses of potential impacts on operational and prospective water sources,
- particular attention is paid to compliance with the provisions of the River Basin Management Plan and consistency with proposed measures,
- assess the likely changes in aquatic, riparian and groundwater-dependent ecosystems
- investigate the effects on medicinal factors and health spas.

Achieving the following is a priority for the strategic environmental assessment of the Programme:

- Establishing links to other parts of the planning process (the need to update the environmental assessment, present the further planning process, including the identification of tasks that should be subject to EIA)
- Incorporating the recommendations made in the environmental assessment into the Programme
- Involvement of the bodies responsible for the protection of the environment and the public concerned, taking into account their opinions and views in the preparation of the environmental assessment, summary of the reasons

The Strategic Environmental Assessment process is illustrated in the following figure.

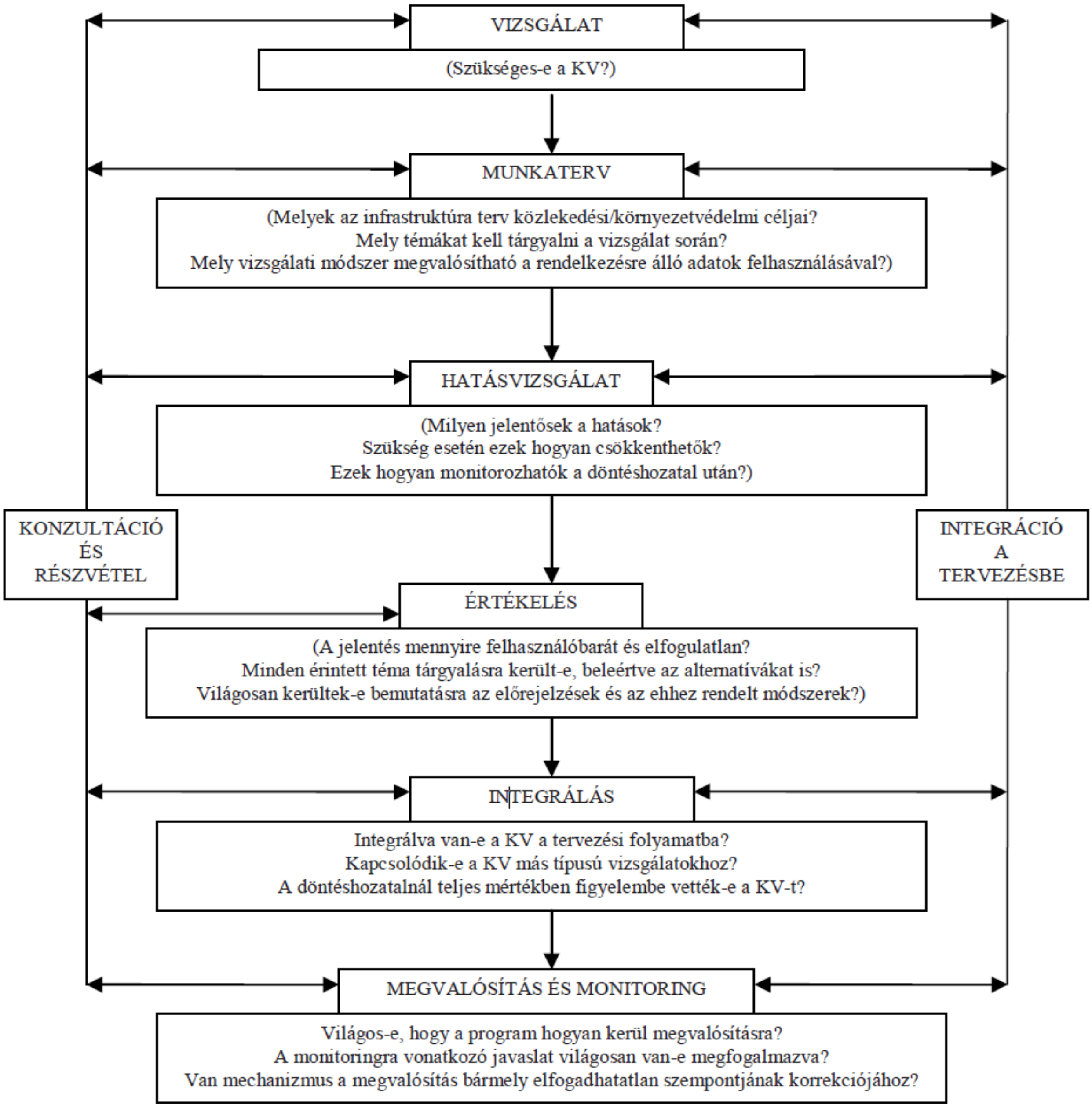

Figure 5: Flowchart of the Strategic Environmental Assessment

6. EXPECTED CONTENT OF THE ENVIRONMENTAL ASSESSMENT

I. INTRODUCTION, HISTORY, DEVELOPMENT PLAN

I./1. Description of the process of preparing the environmental assessment

Presentation of the background, in particular the previous documents on the navigability of the Danube, the evaluation of the SEA and the authorisation plans prepared between 2009 and 2013, the need to update the environmental assessment, the presentation of the further planning process, including the identification of the tasks that should be subject to an environmental impact assessment in the future.

The links with other parts of the planning process and the resulting impact of the proposals made in the environmental assessment on the Programme will be identified.

The way in which the bodies responsible for the protection of the environment and the public concerned are involved, how their opinions and views are taken into account in the preparation of the environmental assessment, and a summary of the reasons.

The source of the data used to prepare the environmental assessment, the limitations of the method used, difficulties (such as technical shortcomings, lack of certain knowledge, etc.), the limits of validity of the projections, the uncertainties encountered.

I./2. Presentation of the Programme and the versions examined in its preparation

The chapter presents the background of the development plan and provides a situation assessment, including the functioning of the Danube river basin system, the social and economic characteristics of the region, the situation without intervention (including water and land uses related to the river), the water transport situation and a summary of the problems to be solved.

The chapter summarises the objectives and content of the Programme, highlighting the parts relevant to the preparation of the environmental assessment. It presents the direct and indirect results that can be achieved by improving navigability, taking into account the potential effects of climate change on the conditions for waterborne transport.

It identifies the possibilities for development and technical interventions aimed at eliminating navigability obstacles (fords, bottlenecks) on the Hungarian stretch of the Danube, possible additional (non- or not necessarily technical) interventions to ensure the continuous operation of the waterway, as well as additional (non- or not necessarily technical) interventions related to the improvement of navigation conditions, and the linkage of the Programme with other relevant plans related to transport and water transport (see e.g. National Port Development Master Plan).

The chapter also explains the possible variants and the reasons for choosing between them, the method of variant analysis and the results of the variant analysis.

II. ENVIRONMENTAL IMPACTS AND CONSEQUENCES OF THE IMPLEMENTATION OF THE DEVELOPMENT PROGRAMME TO IMPROVE THE NAVIGABILITY OF THE DANUBE

II./1. Comparison of the objectives of the Programme with relevant international, Community, national or local environmental and nature conservation objectives

Comparison of the relevant objectives of the Programme with the relevant objectives of the relevant international, Community and national documents listed in Chapter 5 (Methodological section) and the Programme's relation with other relevant transport development plans and programmes. Reference to other sectoral strategies, including those listed in Chapter 5.

II./2. Integration of environmental objectives and aspects into the Programme

A good methodological element in the preparation of the SEA is the formulation of basic question(s) to be answered by carrying out the work. For this Programme, the following questions are considered necessary to answer:

If the measures of the Danube Waterway Development Programme are implemented

- How can consistency be ensured between EU standards for shipping and EU standards for the protection of natural assets?
- Do the measures and the expected increase in traffic as a result of their implementation pose problems for existing water uses and river management (water, sediment and ice discharge without damage, bank protection, tributary and estuary management) and if so, how can they be managed?
- Will the interventions improve effective adaptation to climate change, or will projected climate change reduce or increase the effectiveness of the measures?
- How do the measures relate to the achievability of the objectives of the Water Management Plan for the water bodies concerned (including the objectives for the status of the water bodies and the

associated WFD protected areas, in particular drinking water sources), are mitigation measures needed?

- Can interventions be combined with local environmental/natural/landscape improvement ideas and objectives?
- Is it likely and to what extent that traffic (freight transport) trends will be reorganised, and can we expect a reduction in adverse environmental impacts as a result?
- To what extent will the implementation of the interventions affect major-accident prevention tasks?

II./3. Description of the relevant elements of the current environmental situation in relation to the Programme

This chapter identifies and describes the environmental characteristics of the area of influence that are likely to be significantly affected by the proposed interventions. This should be preceded by a delineation of the area to be assessed, i.e. a definition of the geographical extent of the significant environmental effects of the proposed interventions. The environmental characteristics to be assessed include carrying capacity and carrying capacity. As a result of the assessment of the current environmental situation, the environmental conflicts/problems that may be affected by the improvement of the fairway should be identified.

The expected evolution of the status, even if the Programme is not implemented, should be predicted, i.e. the trends in the status of the individual elements/systems should be described.

II./4. Assessment of the direct and indirect environmental impacts and consequences of the implementation of the Development Programme

The chapter identifies the direct and indirect environmental impacts, consequences, drivers and causes of impacts on the environmental elements of the Programme, their systems, processes and structure, with particular reference to natural areas, the status and nature of Natura 2000 sites, the changes likely to occur in the health, social and economic situation of the people concerned. Accordingly, the chapter should include a detailed description of, inter alia, the effects of the expected increase in traffic and the resulting wave action, the effects of changes in the quality of the bed, the impact of dredging, quarrying, flow velocity, flow conditions, substrate quality, siltation of gravel beds, afforestation, the effects on the spread of invasive alien species and the effects of halting the sinking of the bed, which can be assessed as a positive effect. The impact on the biota of the main branch, in particular on protected species and species of Community importance, will also need to be assessed.

For the tributaries, the periodic variation in water cover and, where expected, changes in flow conditions will be determined. Whether and to what extent this affects the successional processes of the tributary should be addressed. The extent to which changes in the abiotic parameters of a given tributary affect current communities, faunal composition and population size should be investigated. The planning should take into account ongoing and planned compensatory habitat revitalisation projects, such as the partial dredging of the Szeremlei-Duna or the Old Danube.

The chapter should, where relevant, emphasise the impacts on the quality and quantity of the geological medium, soil and land, with particular attention to ensuring that the ecological services provided by the land are not compromised. Impacts related to the disposal of excavated sediment will also be presented.

In the case of the floodplain, groundwater conditions and the extent to which the project will affect them need to be examined. The tolerance of candidate habitats to the expected change should be addressed.

The chapter also describes the impacts of the expected freight traffic congestion and the effects of the additional burden due to port and shipping traffic changes.

In a separate section, cross-border impacts are presented, highlighting the likely significant negative impacts that are likely to be cross-border.

The assessment of impacts should cover both the process of improving the fairway and the period of operation (increased traffic) of the improved fairway, and the cumulative impacts during these periods will be explored in detail.

The impact of climate change and the resulting periods of extreme water levels on navigation and planned infrastructure needs to be examined.

In the preparation of these working parts, full account shall be taken of the content requirements set out in points 3.5. and 3.6. of Annex 4 to Government Decree No. 2/2005 (I. 11.) on the environmental assessment of certain plans and programmes.

EVALUATING THE INTERVENTIONS IN THE PROGRAMME ON THE BASIS OF THE ENVIRONMENTAL CONSEQUENCES AND IDENTIFYING ENVIRONMENTALLY ACCEPTABLE SOLUTIONS

In this section, we will examine the extent to which environmental and nature conservation aspects were taken into account in the analysis of the variants, and we will show how each variant was assessed from an environmental point of view.

To summarise the results of the detailed assessments presented in the previous chapter, the environmental acceptability of the proposed development is assessed.

IV. JAVASLATOK

An assessment of the environmental effectiveness of the measures included in the Programme to avoid, reduce or offset the adverse effects on the environment likely to result from the implementation of the Programme, and proposals for other necessary measures.

Proposing environmental measures, requirements, conditions and aspects to be taken into account in other plans or programmes affected by the Programme. These should include, in particular, consideration of the possibility of setting a maximum traffic capacity or traffic restrictions, the need for time and space limitations and timing of construction, options for preserving and enhancing habitat diversity, options for avoiding accidental incidents during construction and operation and for reducing pollution, proposals for the use of materials and waste reduction. Emphasis should also be placed on examining technical solutions to mitigate the effects of wave action.

Evaluation of monitoring proposals for the environmental impacts likely to result from the implementation of the Programme, and proposals for other necessary measures.

7. PRESENTATION OF A PUBLIC DISCLOSURE PLAN

The environmental assessment of the Programme should be subject to professional, social and international consultation.

The legal framework for social participation is provided by the Aarhus and Espoo Conventions and several Hungarian laws, in particular Government Decree 2/2005 (11 January 2005). The theme is based on the requirements and principles of these legal sources.

7.1. STEPS OF THE TECHNICAL AND SOCIAL CONSULTATION PROCESS

Coordination with the bodies responsible for the protection of the environment

- Submission of the content (subject matter) of the environmental assessment and the plan for technical and social consultation to the bodies responsible for environmental protection
- Ensuring access to information

Maintaining a website where the Thematic and Strategy and the consultation version of the Environmental Assessment are published.

Information to the public

- Press release (in the form of publication in a national newspaper) when the evaluation document is made public.
- Notify the public concerned and invite them to comment by e-mail.
- Consultation with the public and public administrations concerned and opportunities for direct public participation

Technical and social consultation of the environmental assessment document (30 days)

- Consultation of bodies responsible for the protection of the environment (in writing)
- Submission of the document to the National Environment Council
- Written comments on the environmental assessment document (will be available to download from the website) - 30 days for anyone
- Taking into account the public opinions received

The comments received will be discussed by the SEA Working Group and taken into account in the finalisation.

7.2. INTERNATIONAL CONSULTATION

Once the SEA has been prepared, the ministries responsible for the environment in the countries concerned must send:

- the Programme consultation document with the environmental assessment;
- a description of the decision-making process;
- a request for the other country to indicate within a specified time limit whether it wishes to be consulted on the significant transboundary environmental effects resulting from the implementation of the plan or programme and on the measures envisaged to mitigate or avoid such effects.

If the other country indicates within the given deadline that it wishes to be consulted, the body responsible for drafting the SEA will agree with the body representing the other country on the duration and the modalities of the consultations and will then conduct the consultations. The consultations shall also include agreement on how the authorities responsible for the protection of the environment of the other country and the public concerned will be informed and how they will be given the opportunity to express their views within a reasonable time.

If the other country does not indicate its intention to be consulted by the deadline, it shall be deemed not to have made use of the possibility of consultation.

"The project of the Trans-European Transport Network - Trans-European Transport Network - NIF Zrt.
Design tasks related to the development of the TEN-T inland waterway"
under a design contract
2014-HU-TMC-0606-S

DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 2 TO THE ENVIRONMENTAL ASSESSMENT

Opinions received on the theme and responses from the authors

Budapest, September 2020

Comments received on the theme and responses from the authors

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
National Public Health Centre, National Medical Officer	He has no objections to the theme, but proposes to include the following strategies in Chapter 5: • **National Water Strategy 2017-2020-(2030)** • **National Biodiversity Strategy II 2015-2020** • **National Energy Strategy** • **National Forest Strategy 2016-2030** • **National Landscape Strategy 2017-2026**	It is presented in the thematic and examined during the SEA. (See thematic chapter 5.)	Chapter 3.1, Annex 4
Ministry of the Interior Dr. Imre Hoffmann Deputy State Secretary for Public Employment and Water	When developing transboundary significant environmental impacts, it is recommended to consider the type of transboundary water protection impacts that are likely to occur and the countries that may be affected.	Thematic not affected. We will examine it during the SEA.	Chapter 4.3.
	When planning the investments related to the project, adequate distance between the structures and the plants dealing with hazardous substances must be ensured, and the general requirements for urban planning set out in Annex 7, point 2 of the Government Decree on Disaster Prevention must be taken into account when planning the investments. It is therefore recommended that the following should also be included in Chapter 6: • **Environmental objective: to take into account the tasks related to the protection against major accidents.** • **Purpose document:Directive 2012/18/EU on the control of major-accident hazards involving dangerous substances and amending and subsequently repealing Council Directive 96/82/EC (Seveso III Directive).** • Link: compliance with the installation regulations for developments in the vicinity of hazardous plants (see: Disaster Prevention Act and Government Decree) is essential for developments.	It is presented in the thematic and examined during the SEA. (See Chapter 6.)	The planned development does not essentially involve the construction of new buildings, but rather the dredging or conversion of existing ones. The expectation has been included in the proposals as a reminder.
Prime Minister's Office for Architecture and Building. State Secretariat.	He agrees.	Nothing to do	-
Orsz. Chief Water Officer.	He agrees.	Nothing to do	-
Ministry of Innovation and	The targeted analyses are proposed to be complemented and refined by the processing of existing aquifer diagnostic studies and, in the case of major interventions, by the application of new	Thematic not affected. We will examine it during the SEA.	At this stage, preliminary studies

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
Technology Deputy State Secretariat for Energy	hydrogeological modelling.		have been carried out (Chapter 4.2.2) for both operational and prospective aquifers. The aquifers to be further investigated in the impact assessment phase have been identified. The monitoring proposal is presented in Chapter 6.2.
	It is important to note that not only operational but also prospective coastal filtered aquifers should be considered in the assessment, as potential threats include changes in the condition of the bed of coastal filtered aquifers. This change may occur due to reduced transport of sediment, bed subsidence and gravel scour. In coastal filtered aquifers, surface water is filtered through the sandy gravel layers of the bed, and therefore the potential risk is the possible loss of the filter bed, or in extreme cases, its complete disappearance. Adequate monitoring is recommended, with regular river bed surveys to check the condition of the gravel layers. The aim is to establish a maintenance practice whereby only deposited sediment and vegetation that significantly reduces water run-off and/or fundamentally alters the natural character of the riverbed is removed. Only the removal of loose sediments with high organic matter content that cause colimatation shall be allowed in the protection zone of coastal filtered waters.	We agree. It is mentioned in chapter 5 of the thematic. We will examine during the SEA.	
Ministry of Innovation and Technology Deputy State Secretariat for Energy	Climate change has a fundamental impact on the quantity and quality of water availability and thus on navigation. We consider it important that **climate protection aspects are** emphasised in the SEA.	We agree. (Does not affect the theme. Will be examined during the SEA.)	Chapters 4.1.2.3, 4.2.11 and Annex 5
	Ecosystem assessment is mentioned, but it is proposed to add that developments should also include an assessment of the status of **groundwater-dependent ecosystems.**	We agree, we will complete the theme. (See thematic chapter 6.) We will examine during the SEA.	Chapter 4.2.5.1.
	In Chapter 5 (Proposal for the methodology of the Environmental Assessment), the **National Flood Risk Management Plan for Hungary** should be mentioned. The purpose and content of the planned interventions in the environmental assessment should also fit in with this.	The theme will be completed. (See Themes, Chapter 5.) We will examine during the SEA.	Chapter 3.1.2, Annex 4
	In the same section, it is proposed to clarify the title of the National Climate Change Strategy (Second National Climate Change Strategy 2018-2030) and to use this title and the abbreviation (NÉS-2) consistently throughout the document.	To clarify. (See Chapter 5.)	-
	In Chapter 6, in Section I/2, it is proposed to examine the potential impacts of climate change on changes in water transport conditions.	We agree. We will complete the theme. (See thematic chapter 6.) We will examine it during the SEA.	Chapters 4.1.2.3, 4.2.11 and Annex 5

Pest County Government Office	The environmental assessment should provide an overview of the technical state of the **fleet on the** Danube and an overview of its environmental impact. The current increase in vessel traffic, which is low according to the studies, will obviously entail an increase in emissions and disturbance	Danube navigation is predominantly performed by non-domestic fleets, and the	When assessing noise and air pollutant emissions from ships

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	caused by vessels, and it is therefore necessary to forecast the effects of the expected increase in traffic.	assessment of the technical condition of foreign fleets is beyond the scope of the present SEA.	on the Danube in the SKV
	The increase in water tourism may lead to additional conditions of a different nature, for example, the Government Office refers to the differences between the needs of camping tourism and the needs of larger hotel boats to use the shore.	In principle, the development of the waterway does not improve the conditions for water tourism. A separate strategy for port developments is being prepared	-
	The analysis of habitat changes in the previous intervention areas can provide a good basis for predicting the potential for habitat change in subsequent detailed planning. Among the habitats rich in natural values, the willow, poplar-alder and ash woodland forests, which are of European importance and still occur naturally along the Hungarian stretch of the Danube, should be highlighted. According to Government Decree 275/2004: 10. (1) Before approving or authorising a plan or investment which does not directly serve the nature conservation management of a Natura 2000 site or is not strictly necessary for the management of a Natura 2000 site, but which may have an impact on a Natura 2000 site, either alone or in combination with other plans or investments, the developer of the plan or the authority authorising the investment shall submit to the competent authority, together with the plan or investment, a copy of the plan or investment, or investment, the extent of the area affected by the plan or investment, its location in relation to the Natura 2000 site, and the data on the fauna present in the Natura 2000 site, the plan or investment should be assessed in the light of the information on the likely effects of the plan or investment on the Natura 2000 site designation, as set out in Annexes 1 to 4. species and habitat types identified in Annex 4. (2)_If the assessment under paragraph (1) indicates that the plan or investment may have a significant impact, an impact assessment shall be carried out. (5) The impact assessment, taking into account the provisions of § e. and § 10/A. (a) the environmental assessment procedure if the plan is subject to legislation on the environmental assessment of certain plans or programmes; (7) The plan may be approved or the investment may be authorised if the impact assessment shows that it will not have any adverse effects on the conservation status of the species and habitat types specified in Annexes 1 to 4 on which the designation of the Natura 2000 site is based, or on the Natura 2000 site, and, subject to Paragraph (1) of Article 4, it does not conflict with the objectives of the designation.	It basically draws attention to the legal requirements. Your suggestions do not affect the theme and will be taken into account in the preparation of the SEA.	Impacts on the Natura 2000 habitat network have been assessed in Chapter 4.2.5.8 and Annex 9.
Pest County Government Office	In the riparian areas of watercourses, there is a conservation risk from the advance of **invasive** alien **species, which** must be controlled. Regular monitoring studies are needed to provide a basis	Basically, it sets expectations. Its suggestions do not affect the	Invasive species monitoring proposal:

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	for the control of invasive species. Landscape value is high in those parts of the landscape where the so-called **edge effects** are multiply present (contour edges, waterfronts, vegetation edge areas). In several places along the Danube, these edge areas form valuable landscape features. The Danube bend is a unique combination of natural features, cultural traditions and built heritage, both nationally and internationally (Visegrád, Szentendre). The Tvt. Pursuant to Section 7 (2), the purpose of landscape protection is to preserve the character of the landscape, natural values, individual landscape values and aesthetic qualities, for which the Government Office is requested to prepare the landscape protection working part of the environmental assessment.	theme and will be taken into account in the preparation of the SEA.	chapter 6.2. For landscape conservation considerations see chapters 4.1, 4.2.7 and Annex 5.
	In order to avoid and reduce the adverse effects on the environment, the programme shall also take into account the provisions of Act CLXXXV of 2012 on Waste (hereinafter: the Act) and the National Waste Management Plan, in particular the enforcement of the waste hierarchy. Particular attention should be paid to the legal implementation of the transfer of the collection and treatment of waste from waterborne means of transport. It is important to note that the Ht. Pursuant to Article 1(3)(g) of the Ht., sediment and silt transferred in surface waters for the purpose of water and waterway management, flood relief, water damage control or soil recharge (soil improvement) is excluded from the scope of the Ht. if it is not covered by the Ht. 1 of Annex 1.	Basically, it sets expectations. Its suggestions do not affect the thematic scope and will be taken into account in the preparation of the SEA.	Chapters 4.1, 4.2.9 and Annex 5.
	The programme should include an analysis of the positive and negative impacts on air and present solutions to mitigate negative impacts at both the implementation and operational phases, where justified.		Chapters 4.1, 4.2.4 and Annex 5.
	The Government Office recommends that the SEA should describe the adverse noise and vibration impacts expected from the implementation of the programme and propose noise and vibration mitigation measures, if justified.		Chapters 4.1, 4.2.8 and Annex 5.
Budapest City Government Office BFKH Public Health Department - Public Health Aspects	The theme does not deal with the protection of the natural features of natural **spa areas and spas.** In the context of improving the navigability of the Danube, the protection of the natural features of the natural spa areas and health resorts that may be affected must be ensured when drawing up the individual elements. The Government Office of the Capital City of Budapest keeps a register of medicinal factors and spas (e.g. medicinal waters, mineral waters, medicinal sludge, medicinal gas, spas, thermal hotels, thermal caves and spas) and is ready to provide information on the data contained in the register at the further stages of planning.	The theme will be completed. See chapters 2.1.3 and 5. During the SEA we will examine.	

Budapest	The topic does not identify a continuous improvement need or directive for the technical condition	An expectation that goes beyond	

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Metropolitan Government Office Department of Transport - aspects of navigation authority	of floating installations, structures and their detection equipment, for the improvement of working and living conditions of personnel on board ships, or for the continuous improvement of their professional knowledge, which could help to achieve a safe and smooth operation.	the remit of the SEA. It can be formulated as a proposal, but it is far from environmental.	
	Another important area for inland waterway development in the Hungarian Danube section is the promotion of solutions to facilitate airborne assistance to shipboard. In our view, it is essential to create the conditions that will prepare all the drivers and crew members of the vessels to be rescued and of other floating installations to be rescued and to provide the most effective assistance during rescue operations.	No SKV competence	-
	On the side of the navigation authorities, we are willing to participate in technical discussions to develop technical and other development solutions for river navigation, such as the small-scale pilot project for the Chevron diversion plant specifically mentioned in the plan, which are considered incomplete and aimed at optimising waterway safety. During the demonstration of the 4 chevron diversion dams planned for the Danube between 1625 and 1613 km, our Authority observed that the last element has variable water movements in the downstream direction during low and medium water periods. These water movements may force the planned right-bank upwind convoys to execute an abnormal amount of out-of-course turning manoeuvres, which may reduce the distance of the propulsion equipment of the convoy vessels from the right bank to an extent that, given the current hydrological conditions of the indicated section, does not meet the criteria for safe navigation for all convoy sizes. When planning investments to improve the envisaged navigational conditions, great attention should be paid to the flow conditions around and in the vicinity of the regulatory structures. In many cases, computer simulations of the spatial flow conditions and sedimentation modelling for the waterway conditions in the section are considered to be particularly appropriate for environmentally sound, economical and rational decision-making. In some locations of planned development, it may be appropriate to analyse density data for the waterway to help inform the decision mechanism for optimal development implementation.	It is a technical issue, not an SEA competence, and the SEA can at most only draw attention to this problem.	-
	The theme does not address the context in which the development of waterways could lead to the development of port infrastructure, the desirable diversification, the improvement and transformation of port culture, with the possible introduction of incentives and state involvement.	A separate port development strategy is currently being prepared.	-

Budapest Metropolitan Government Office Department of	With the development of waterways, we must not only think of the development and resurgence of shipping, but also of what it can affect: logistics bases with easily available stevedoring capacity in ports, and especially in new ports based on modern concepts, which are today almost exclusively imagined alongside road transport networks and near road junctions.	A separate port development strategy is currently being prepared. (Not the competence of the present SEA.)	-

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Transport - aspects of navigation authority			
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	3. The SKV theme does not mention several important international, EU and national precedents. It would be important to review **a number of EU consultations and declarations** when developing the SEA Thematic Paper and to include them in Tables 2 or 3 of Section 1.2 of the paper. In my opinion, it would be important to indicate as a supporting document thatan SEA topic on the navigability of the Danube has already been prepared on the basis of the Government Decision 1001/2011 (I. 14.) on the preparation of the Hungarian programme of the European Union's Danube macro-regional strategy, and that a licensing procedure was also conducted in this case. As regards the impact of the modification works and dredging on the Danube riverbed on the water yields of the tributaries and on the natural habitats and wildlife, it is worth mentioning the 2012. The statement of the Government of the Republic of Hungary on the "Environmental Principles for the Sustainable Use of the Danube as a Waterway", made in Luxembourg in 2012, can be found on page 4 of the officially quoted document (https://eionet.kormany.hu/download/ 9/35/22000/A_Duna_mint%20 viziut_2016.pdf and annex).	The documents specifically mentioned can be added to the thematic, and can be examined during the preparation of the SEA. The themes and the SEA document itself are not identical. The thematic document only mentions the most important examples in this respect.	The relevant background is presented in chapter 1.1.1.2. The "Environmental principles for the sustainable use of the Danube as a waterway" are mentioned in chapter 3.1.2 and analysed in Annex 4
	5. I believe it is essential that the document addresses how it intends to **compensate for** the increased noise and air pollution, water pollution, destructive wave effects, which are explained in detail below.	Subchapter II./4. of Chapter 6 of the SEA Thematic Programme has been completed as proposed.	Chapter 4.2.
	6. Particular attention should also be paid to the increasing environmental pressures, environmental and climate footprint, and the shoreline-deforming (habitat-destroying) effects of wave action from **increased ship traffic due to** the burning of higher sulphur fuels by ships.		
	7. The document should address how it intends to compensate for the expected further fluctuations in the Danube water level due to climate change (see ICPDR Strategy on Adaptation on Climate Change https://www.icpdr.org/main/sites/default/files/nodes /documents/icpdr_climate-adaptation-strategy.pdf; page 14). One way to mitigate the fluctuations in water level and thus ensure the necessary draught depth for navigation, as described in the topic, is to dam the river. However, this is not acceptable from a conservation point of view, as the biotic communities associated with flowing water cannot tolerate a slowing of the current due to the damming, and the altered conditions would threaten the survival of many habitats and natural values. I would also point out that the SEA topic should examine/compare the advantages and disadvantages of using large vessels versus public roads, railways and smaller vessels.	The first part (water level fluctuations) is a design, technical issue, the SEA can examine the effectiveness of solutions from this point of view, and accordingly, subchapter II/4 of Chapter 6 of the SEA topic has been added. A theme does not have to test and compare anything, that can be done in the environmental assessment.	Damming of the river in the traditional sense is not covered by the Programme and thus not covered by the SEA, as such an intervention is not applicable according to the call for proposals. The advantages of bottom fins as a micro-dam are presented in the SEA in chapters 2.6 and 4.2.
Ministry of	8. It is also important to note that river regulation also causes water pollution, and	Subchapter II./4. of Chapter 6 of	Chapter 4.2.

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Agriculture Dr. Attila Szinay Minister of State for Public Administration	significantly altered conditions (e.g. slowing down the flow by damming) significantly reduce the river's self-cleaning **capacity**. As a consequence, drinking water supplies may be at risk and the ecosystem services provided by the Danube may be significantly reduced.	the SEA Thematic Programme has been completed as proposed.	
	9. The environmental assessment (and therefore its subject matter) should also include **an examination of the** so-called **'spill-over effects'.** The use of increased transport capacity will inevitably increase the environmental pressure on road transport and freight transport at nodes (service and feeder facilities, access roads and surrounding settlements), which in turn will reduce the environmental performance of waterborne transport (compared to road transport) at local and regional level.	With regard to overburdening, subchapter II/4 of Chapter 6 of the SEA Thematic Paper has been completed.	The impacts of the scenarios assumed in terms of congestion are examined by the Programme, the environmental benefits and drawbacks by the SEA (chapter 2.2.3)
	10. I would like to point out that the AGN Convention and the Danube Commission Recommendation, which define the navigation parameters of the Danube, are not binding, although they do allow for more flexible regulation of waterway classifications in ecological terms. In Hungary, the provisions of *Decree 17/2002 (III. 7.) KöViM on the designation of natural and artificial surface waters as waterways suitable for navigation and those that can be made suitable for navigation* [hereinafter: Decree 17/2002 (III. 7.) KöViM] must be applied, which is not sustainable under the current geographical and climatic conditions described above. For this reason, the AM has already proposed several times the necessary amendments to the legislation. In my view, the only solution that would be worthwhile is to develop in detail **development paths** that can respond to extreme climate change without increasing the vulnerability of natural areas and without providing compensatory measures to replace natural areas that may be damaged or permanently eradicated.	We agree that a plan will be drawn up that meets the minimum necessary and complies with the recommendations of the Danube Commission, and the SEA takes this as a basis. As proposed, chapter 1.4.2 of the SEA thematic plan has been added.	Chapter 2.3.1.
	It would be important to include in the SEA topic a detailed description of the **measures planned to prevent and avoid the expected adverse effects.** For example, dredging, alteration of river banks and the development and construction of harbours are significant interventions in the aquatic ecosystem, which may alter the properties of the original soil. Monitoring should use indicators that are suitable for tracking changes in landscape structure, changes in land cover and changes in landscape function in relation to the interventions. Given that the developments are expected to have a significant impact on the intensity of vessel traffic and the possible introduction of different types of vessels, the SEA should include an analysis of the environmental impact of the possible changes in vessel traffic and the necessary modifications to the basin.	As proposed, we have added to Chapter 6, Subchapter IV of the SCV topic, at the level of mention, the expected proposals that may emerge as a result of the detailed studies.	Traffic forecast (Chapter 2.2.3) and vessel traffic impacts (Chapter 4.2) are included in the SEA.

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Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	. I would like to highlight the point in the submission that "On the *basis of current trends, it is expected that by improving the navigability of the Danube, we would continue to be a transit country, i.e. despite the investment and maintenance costs and the expected hydrological and ecological impacts, our country would not be the primary beneficiary.* " full agreement with this, I would add that given the nature of the stretch (relatively narrow, sometimes with extremely low flows), it is fair to say that **Hungary would be one of the primary damage sufferers**. (In the case of persistently low flows, the ecological damage can be extremely significant, and in extreme cases, the entire year's fish population can be destroyed by the constant surge. These effects may be less pronounced in other countries for various reasons; to the west of Hungary, dams have completely altered the natural character of the Danube, essentially destroying what we can still protect. To the east of us, the cross-section of the riverbed and the volume of water transported are increasing significantly, which significantly reduces the adverse effects of shipping (waves, dredging, noise, sense of congestion).	Neither an opinion on the subject nor on the SEA. The Programme will be amended accordingly.	Chapter 2.1.1.2 of the SCP on the Programme.
	. When comparing modes of transport, the submission does not discuss in sufficient detail the fact that shipping is the least frequent mode of transport to the final destination. **Transhipment is** usually **required** (sometimes more than one), which is also mechanically driven and has its own emissions. Further road/rail transport from the ports takes place. In addition to this, the development of shipping creates the need for new ports, which can also be a major source of conflict (environmental damage inside the municipality, nature damage outside the municipality).	Point 2.2 of the SCV topic has been added as proposed.	SKV Chapter 2.2
	. The study should, in my opinion, show the expected impacts on both operation and design for **large vessels, road, rail** and small vessels.	This is beyond the scope of the present SEA, which is the task of the transport strategy.	-
	. **Dams are** not included in this document, but the need to build dams has been voiced by the shipping industry in a number of fora.	Not subject to planning tasks. , Section 1.4.2 of the SEA topic has been added as proposed.	Chapter 2.4
	. Impacts on the **Natura 2000** habitat network should also be assessed.	It is part of the SEA. Subchapter II./4. of Chapter 6 of the SEA Thematic Guide.	Annex 9 to the SCA
	. For the main branch, the changes in **flow velocity, depth and substrate quality should be specified** and the impact on the biota of the main branch, in particular on protected species and species of Community importance, should be assessed	Subchapter II./4. of Chapter 6 of the SEA Thematic Programme has been completed as proposed.	Chapter 4.2.5.
Ministry of Agriculture Dr. Attila Szinay Minister of State for	. For tributaries, the periodic variation in water cover and, where expected, changes in flow conditions should be determined. **Whether and to** what extent this **affects the successional processes of** the **tributary should be discussed. The** extent to which changes in the abiotic parameters of a given tributary affect current communities, faunal composition and population size	Subchapter II./4. of Chapter 6 of the SEA Thematic Programme has been completed as proposed.	Chapter 4.2.5.1.

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Public Administration	should.		
	. With regard to the floodplain, the **groundwater conditions and the extent to** which the project will affect them need to be examined. The tolerance of candidate habitats to the expected change should be addressed.		
	).I suggest that climate change and periods of **extreme water levels such** as the summer of 2018 should also be carefully examined, as these factors can have a major impact on navigation itself and the efficiency of fairway infrastructure.	Subchapter II./4. of Chapter 6 of the SEA Thematic Programme has been completed as proposed.	Water yield forecast Annex 6 + Chapters 4.1.2.3, 4.2.11 and Annex 5
	.I propose to examine whether, in addition to conventional control measures (dredging, construction of stone works), there is scope for other, **more complex river control methods**, including raising mean water levels in a way that could serve both ecological and navigational interests.	The use of innovative solutions is part of the plan. As proposed, Chapter 3 of the SEA thematic plan has been added.	Chapter 2.3.3.
	. The effects of paving include the siltation of **gravel beds**, which not only has a dubious impact on nature conservation, but also creates flooding problems. The number of new artificial structures should be kept to a minimum. Particular attention should be paid to stretches of drifted gravel or sandy shoreline (generally short - 100-1000 m), where most endemic species occur (silky dab, bucofauna, damselfish, etc.). New facilities (even chewron) should be proposed to replace old ones rather than using new sites.	Subchapter II./4. of Chapter 6 of the SEA Thematic Programme has been completed as proposed.	Chapter 2.4
	. **In a complex analysis of** transport developments, I suggest taking into account that the specific CO_2 emissions of shipping are about three times higher than those of rail *(Source: see Rail Transport and Environment - Fact & Figures page 9* http://www.cer.be/sites/default/files/publication /Facts%20and%20figures%202014.pdf); and that rail is the most energy-efficient *mode of passenger transport* ("*Rail is the most energy-efficient mode of passenger transport." Source: Energy efficiency* [*https://www.eea.europa.eu/publications/ENVISSUEN012 /page027.html*](https://www.eea.europa.eu/publications/ENVISSUEN012/page027.html))	Goes beyond the scope of the present SEA, this is a task for the transport strategy (the present SEA can only concern)	The Programme is not intended to compete with rail and waterways. The two should complement each other as much as possible in order to reduce congestion on public roads.
	. The document should explain **how it intends to compensate for the resulting groundwater subsidence.**	Point 1.4.2 has been added to the thematic programme.	The planned solutions are designed to raise the level of low water, and therefore groundwater. See chapter 2.2.2.1 of the SEA.
Ministry of Agriculture Dr. Attila Szinay	5. In the area of water uses, the theme does not consider **water uses for agricultural purposes to** be significant, but in the light of the Government's plans for irrigation development and the plans for water recharge in the Sandhills (and the construction of the Danube-Tisza canal), this position is	Water management in the RSD is not affected by the plan.	-

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Minister of State for Public Administration	not justified in the long term.		
	7. Due to the floodplain climate conditions, the **forest stands accompanying the river are of** significant value from the point of view of forest management and forest protection, and the forest habitats are important for the animal and plant species associated with the river. From a European Community point of view, the entire stretch of the Danube in Hungary, with the exception of the Budapest section, is a Natura 2000 site, with a high proportion of alder and ash groves, softwood forests and marsh woodland, and a low proportion of hardwood (oak-ash-oak-sil) forests. The forest habitat types of Community importance in the planned sections are 91F0 Hardwood coppice along large rivers *Quercus robur*, *Ulmus laevis* and *U. minor*, *Fraxinus excelsior* or *F. angustifolia* species (Ulmenion minoris) and the priority of Community importance 91E0 Light alder (*Alnus glutinosa*) and tall ash (*F. excelsior*) woodland forests (Alno-Padion, Alnion incanae, Salicion albae). In addition to Natura 2000 and other protected areas, there are also a number of forest reserves, covering a total of 254.4 ha (ID No: ER-29 Buvat Keszeges-lake [84.8 ha], ER-30 South Veránka Sasfok [54.8 ha], ER-31 Kádár-island [50.8 ha], ER-47 Erebe Islands [64.0 ha]).	We agree, it is not a question of themes, the SEA will also look at the forestry stock.	Chapter 4.2.5. natural forests, Chapter 4.2.7 describes the impact on planned forests. Annex 9 examines the impact on Natura 2000 sites.
	8. **The** environmental assessment theme of the development programme contains references that should draw my attention to **the need to protect the quantity of land**. There may be potential land use in the course of river and canal management. Quantitative protection of land means that, according to Article P of the Constitution, priority must be given to the protection of natural resources, including land. Among the principles of budgetary management, the requirement of sustainability is (also) included in Article N of the Constitution, which is a way of thinking about the future, balancing environmental, social and economic considerations in the pursuit of development and a higher standard of living. Development is sustainable if economic development leads to continued social improvement within the limits of ecological carrying capacity, while preserving natural resources for future generations. According to *OGY Decision 1/2014 (I. 3.) on the National Development 2030 - National Development and Spatial Development Concept* (hereinafter: OGY Decision), the most drastic change since 1990 is the 37% increase in the area of land set aside from cultivation, which is almost entirely due to the expansion of settlements, and the development of infrastructure and greenfield investments.	As proposed, subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been supplemented with regard to agricultural land.	The interventions will only cover the Danube riverbed, most of the construction works can be carried out from the water, the riverbed material will not be excavated but relocated within the riverbed, and the unsuitable material will be placed in the flood protection dams or on the water side as a runway, therefore no or only minimal direct impact on farmland can be expected during the project.

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Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	This process (ecological, environmental, psycho-social, health sustainability, etc.) must be halted, and therefore great emphasis must be placed on the enforcement of a sparing, coordinated use of land, the reuse of brownfield sites and the increase of building intensity in the inner areas of settlements, as well as the revitalisation of town centres and historic built-up areas. The OGY resolution set the following development policy tasks in connection with the protection of farmland: protection of farmland assets; limitation of the use of farmland for other purposes; reuse of abandoned land; greenfield investment and afforestation should only take place on lower-quality farmland; harmonious coordination of land use functions with the least possible loss of farmland; promotion of brownfield investment.	The planned interventions are mainly planned in the Danube riverbed or on its immediate banks. Thus, the land use is negligible.	-
	The **soil is** directly affected by the widening or narrowing of the river bank and the alteration of the river bed depth according to Decree 17/2002 (27.III.) KöViM. In the case of indirectly affected land, farmland may also be affected if the disposal of soil and sludge carried away from the river bank can only be economically achieved on farmland. The need for soil replacement during the rebuilding and development of the shoreline and harbours is also possible as the most economical solution. Access to the Danube riverfront construction site may require the use of dirt roads for heavy machinery, and the staging area may also be on farmland at times. In such cases, the soil may also need to be reclaimed as part of the natural environment.	As proposed, subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been supplemented with regard to agricultural land.	At this stage, the implementation by water or land, and therefore the areas to be used for transport and parades, can only be determined at the EIA stage. Impacts on the geological medium are discussed in section 4.2.3 of the SEA.
	The biotope is dominated by **soil, which has** evolved over centuries and can only perform its function in the quality it is designed for. In nature conservation and Natura 2000 areas (Csallóköz, Mosoni-Duna Szigetköz, Gemenci area), the task of preserving soil quality is particularly important. In water catchment areas, where the soil layers in the riverside tap wells (Szentendre, Budakalász, etc.) naturally filter drinking water, the preservation and protection of soil quality is of national strategic interest. The functioning of these areas will also be affected by coastal and river-bed interventions in the upper reaches of the Danube. It is therefore necessary not only to increase monitoring of drinking water but also to study soil properties. The magnitude and frequency of water level changes also affect soil quality and the living and non-living environment it supports.	We agree, it is also important to study and monitor the effects on the soil. As proposed, a condition on groundwater levels has been added to subsection 1.4.2 of the SEA topic.	The impacts on the geological medium are discussed in Section 4.2.3 of the SEA, on groundwater in Section 4.2.2 and on groundwater-dependent ecosystems in Section 4.2.5.
	Natural features, whether living or inanimate, are most influenced by the **soil** after the weather. Therefore, when significant qualitative and quantitative changes (e.g. erosion) occur in the soil, they have a direct impact on flora, fauna and human beings, and therefore soil needs to be assessed in the environmental assessment according to its dominant role.	We agree. However, the proposed development is essentially downstream, with minimal soil disturbance.	
Ministry of Agriculture Dr.	The environmental assessment should also consider the effects of increased **wind speed and wind pressure.** From a soil protection point of view, an increase in soil erosion damage is expected in	Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has	The planned works are not expected to be

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Attila Szinay Minister of State for Public Administration	particular. Soil and wind erosion can cause significant damage to port infrastructure, natural coastal features and structures. The mapping and modelling of erosion conditions in river sections will be important during the operational period, but preventive and protective engineering works should be considered at the design stage.	been completed.	affected by increased wind speeds and pressures.
	. The SEA thematic framework does not propose **specific measures to mitigate the damage to** natural areas and values caused by the application of possible development paths, but envisages their development within the methodological tools to be elaborated in the development programme, which is still under preparation. It is important that the expected impacts are identified collectively along the whole domestic Danube section. In the case of interventions involving large areas, the impacts will be cumulative. The dredging of the fords will reduce the area of a very important habitat type. Many species have breeding and nursery grounds in the fords. Their role cannot be replaced by spurs or other structures designed to adapt water levels and flow conditions to navigation. Dredging can lead to the loss of habitats and spawning grounds, so a detailed survey of the biota of the ford should be carried out prior to any dredging, especially where armoured stretches are affected. I propose that the development of the waterway should not be limited to conventional river management options. I consider it important to use the knowledge gained from international experience, to study the impact of possible river bed narrowing (such a structure is located between Nagymaros and Visegrád), and to study the 'universal' (mandatory for all vessels) use of RIS *(River Information Services)*, which would significantly change navigation patterns, substantially reducing the need for harmful interventions in the Danube riverbed.	As proposed, we have added to Chapter 6, Subchapter IV of the SCV topic, at the level of mention, the expected proposals that may emerge as a result of the detailed studies. We agree. Detailed studies should be carried out in the EIA. The use of innovative solutions is part of the plan.	Proposals to reduce adverse flows are set out in chapter 6.1. Cumulative impacts on final stakeholders in chapter 5.3. - Chapter 2.
	. Finally, I would like to point out that the last time there was a **senior management meeting on** this issue between the State Secretaries of the Ministry of Agriculture and the Ministry of National Development was in 2016, when the leaders agreed to seek the Prime Minister's views on the Danube navigability project. On the subject of the project, Prime Minister Viktor Orbán stated in a letter dated 4 July 2012, in connection with the visit of Commissioner Johannes Hahn to Hungary: Hungary *"rejects any riverbed conversion operation to make the Danube navigable. It is not the river that needs to be adapted to the ships, but the ships to the river"*. Hungary did not sign the Luxembourg Declaration of 7 June 2012 of the transport ministers of the Danube countries, because the Declaration should have committed to improving navigation conditions. To my knowledge, the Hungarian position has not changed.	The call for tender for the design task was prepared with the agreement of the ministries concerned.	The basic principle of the Programme
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public	The two ministries also agreed that some level of improvement in navigability is needed, but there is disagreement on the principle of actually identifying the 31 intervention sites identified in the previous project, which ran from 2005-2011. Not all the sites and not all the levels of intervention as indicated in the previous study are justified, given also that their identification is based on pre-2010 data.	The results of these discussions will be taken into account in the new plan.	See Programme.

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Administration	I support ideas that involve as little intervention as possible, that are adapted to the characteristics of the river and that place more emphasis on the development of navigation infrastructure.		
	There may be alleged significant transboundary environmental effects, and I consider it essential to examine them.	Agreed, see thematic area chapter 4.	Chapter 4.3.
	Ballast water and coating adhering to the bottom of the ship generate uncontrollable invasion processes. This should also be considered when assessing the conservation risks and impacts of shipping.	In SEA, we address the likely impact of planned interventions on invasion processes. [1]	Chapter 4.1.2.2, 4.2.5.3
	Interventions in the section below Mohács are likely to have an impact on the Serbian/Croatian section of the river.	We agree.	No intervention is planned during Mohács.
	In extreme weather conditions, increased river flows can cause significant soil erosion as tidal surges, with large amounts of soil silt from the eroded river bank or riverbed being carried away from the Hungarian stretch and deposited as sediment in the lower reaches of the river. In the event of a hydrological disaster, indirect soil contamination via water (e.g. oil derivatives entering the water) could occur, which could also negatively affect the soil in the neighbouring country as environmental damage. Soil contamination problems may also arise if the ship's cargo enters the river water and comes into direct contact with it. The severity of the negative environmental impact can vary greatly depending on the material, consistency and packaging of the cargo. Risk analyses should be used to deploy significant resources for prevention.	We deal with risks in the SEA.	Chapter 4.2.11.
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	In the light of the above, the AM is of the opinion that the development programme cannot be adopted without the application of the international stage of the strategic environmental assessment procedure, i.e. the *Strategic Environmental Assessment procedure of the Convention on Environmental Impact Assessment in a Transboundary Context, adopted in Espoo on 26 February 1991, and the Strategic Environmental Assessment procedure of the Convention on Environmental Impact Assessment in a Transboundary Context, adopted in Kiev on 26 February 2003*. Article 10 of the *Protocol to the Convention on Strategic Environmental Impact Assessment adopted on 21 May 2003* (hereinafter referred to as the Kiev Protocol), Article 7 of *Directive 2001/42/EC of the European Parliament and of the Council of 27 June 2001 on the assessment of the effects of certain*	Okay.	-

[1] Note: Even with the current shipping traffic, the emergence, spread and massing of invasive species is still intense. No new, previously unaffected factor will appear during the construction and operation phases of the planned interventions that would have a decisive influence on the spread, the expected change in shipping volume is difficult to estimate, so it is expected that only expert estimation will allow us to assess this problem in the SEA.

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	plans and programmes on the environment and Article 9 of *Government Decree 2/2005 (11 January 2005) are* essential before the adoption of a development programme. Please prepare the documentation for the international phase in parallel and send it to the Environmental Protection Department of the AM at the same time as the domestic SEA process, so that the National Contact Point of the Kiev Protocol can inform the neighbouring countries about the development programme under preparation. In order to ensure a smooth procedure, please have the developer contact the AM Department of Environmental Conservation directly.		
	tailed comments . In addition to the previous interventions for navigation purposes, several compensatory habitat revitalisation measures have been planned, such as the partial dredging of the Szeremlei-Duna or the Old Danube.	Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been completed.	No interventions are planned in the vicinity of the tributaries mentioned as examples, and ongoing projects have been taken into account in the technical plans in consultation with the competent National Parks.
	. Chapter 1.4.2 states that "*The width of the fairway may be reduced, depending on the sinuosity and morphology, to the minimum width necessary for safe one-way navigation (the maximum permitted passage of the convoy on the stretch), if a fairway width of 120-150 m cannot be provided for environmental, river regulation, water protection or other reasons*". order to avoid misunderstandings later on, I propose to include *nature protection in* addition to the environmental, river regulation and water protection grounds, given that the impact assessment may reveal circumstances that justify the adverse nature conservation effects of the intervention.	We agree. We have displayed it in the theme.	-
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	As discussed in Chapter **42.** 2.1.2, wave stress is an integral part of nature and landscape conservation, and may be exacerbated by increased shipping. I suggest that more detailed material be prepared on this, with possible proposals: e.g. speed limits, wave action restrictions at specific locations and specific water levels.	Agreed, it will be discussed in SKV.	Chapter 4.2.5, Chapter 6.1.2
	discussed in Chapter **43.**2.1.3, only a very narrow segment of recreation is speedboat traffic. For most recreational activities along the Danube, fast boats are a source of disturbance (wave, noise, hazards). . Page 11: Oroszvár is listed as a Hungarian-Slovak border settlement instead of Dunacsúny. . Page 12: the Little Danube is a non-Hungarian tributary, located in the Csallóköz (Slovakia). **.It is** not clear from Figure 3 on page 15 whether it refers to Hungary or Europe. It does not show the amount of goods transported by each sector, whether domestic shipping has become less energy intensive because of technological progress or because of less shipping. Nor does the graph show international shipping. The maintenance costs of continued operation are also not shown.	We have improved the theme.	-

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	7. In view of the complexity of the subject mentioned above, I propose to add the following documents to the list: • National Biodiversity Strategy 2015-2020 http://www.termeszetvedelem.hu/_user/browser/File/Stragegia/MK15083_NBS.pdf • Environmental principles for the sustainable use of the Danube as a waterway https://eionet.kormany.hu/download/9/35/22000/A_Duna_mint%20viziut_2016.pdf • National Tourism Development Strategy 2030 https://www.kormany.hu/download/8/19/31000/mtu_kiadvany_EPUB_297x210mm%20-%20preview.pdf • Act LXIV of 2001 on the Protection of Cultural Heritage https://net.jogtar.hu/jogszabaly?docid=A0100064.TV • ICPDR: Sturgeon Strategy https://www.icpdr.org/main/sites/default/files/nodes/documents/om-20_-_3.4_icpdr_sturgeon_strategy_endorsed_version_final.pdf	Added to (except the legal reference, it is not a related document)	Chapter 3.1, Annex 4
	8. In the list of European and national strategies, visions (etc.) related to waterborne transport, the thematic refers incorrectly to the "Danube Strategy", as the official name is EU Strategy for the DanubeRegion (EUSDR https://www.danube-region.eu/about).	We have improved the theme.	-
	9. Considering the fact that the development programme has a significant impact on forest areas along the entire national stretch of the Danube, **I propose and request that the listed strategies be supplemented with the National Forest Strategy (2016-2030)** (hereinafter referred to as the Forest Strategy) in order to provide a reference basis for the comments on the detailed material of the SEA with regard to issues concerning forestry and sustainable forest management. The Forestry Strategy is a long-term technical framework document that contains all the main policies and objectives related to domestic forest protection and sustainable forest management that should be taken into account in the EIA.	We have completed the theme.	Chapter 3.1, Annex 4
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	Taking into account that the development programme is expected to have direct impacts on the floodplain forest areas along the Hungarian Danube, I consider it of utmost importance to include the expected impacts on forests in the detailed elaboration of the SEA, as they may have a major impact on the implementation of the multi-level objectives set out in the Forest Strategy. The identification of the direct and indirect environmental impacts and consequences of the development programme, and the proposed measures to address them, can only be formulated in the light of these.	The proposal will be taken into account in the preparation of the SEA.	-
	10. In the light of the above, AM intends to participate in the consultation phase of the development programme under all circumstances. It is recommended that the preparers of the SEA should in any case contact the National Park Directorate concerned with their area of operation during the preparation of the environmental assessment.	We agree. Contact with NP Directorates has been made in the first phase of planning.	-

AM comments received on the revised theme and the drafters' replies

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	. "First of all, thank you for the partial revision and reproduction of the theme. I note that some of the AM's previous comments have been incorporated, but after reviewing the draft, in line with the previous AM's opinion, I consider it appropriate to further clarify and complete it before finalisation."	Thank you. The theme has been improved again.	Again, the revised thematic is Annex 1 of the SCV.
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	. "From the point of view of soil protection, I did not find any substantive additions or amendments in the amended draft. The revised topic is still very general, and the environmental elements that are decisive for the development of Danube navigability are not named and defined. Soil and farmland are not even mentioned. It is even difficult to discern the possible involvement of land, even from the context, despite the fact that the National Master Plan for Port Development, which is also currently being drafted, [2]contains a serious objective to triple the current shipping traffic on the entire 417 km long stretch of the Danube in Hungary by 2030. Achieving this target will require significant infrastructure development, not only of existing ports and planned port industrial sites, but also of the "extreme utilities" serving them, such as roads, railways and pipelines, which may directly or indirectly affect the land. The proposals made in the previous opinion of the AM have not been included in the revised thematic programme. In my opinion, in the natural conditions of Hungary, land is a strategic asset and its importance is highlighted in all strategic environmental development plans concerning land. The named role of farmland and its ecological services cannot be 'hidden' in such a major development plan as just an environmental element. It is equally important to ensure the qualitative and quantitative protection of farmland during the planning process. **I reiterate my request that AM's comments on soil protection be reflected in the final topic and that the environmental assessment be developed with this in mind.**"	The interventions for the repair of the waterway will cover the Danube riverbed, most of the works will be carried out from the water, the material of the riverbed will not be extended but relocated within the riverbed, and the unsuitable excavated material will be placed on the salvaged straw or the water side of the flood protection dams as a runway. The "Geological medium, soil" is assessed in a separate chapter in the SEA. Subchapter II / 4 of Chapter 6 of the SEA Thematic Plan has been supplemented by the addition of the term 'soil'.	The geological medium and soil are described in sections 4.1, 4.2.3 and Annex 5.
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	. "The related objective of the 2nd National Climate Change Strategy [IV. 7.2 Water management: "When managing watercourses that affect groundwater levels, it is important to give preference to solutions that avoid the groundwater level lowering effects of deepening (canals) and deepening (rivers)"] and the clarification of how to achieve this objective are still not included in the revised thematic framework. In my view, it is necessary for the draft plan and the environmental assessment that will be drawn up on the basis of it to record this environmental conflict and for the	The stated aim of the programme is to prevent undesirable further deepening of the riverbed and to stabilise the riverbed, and even a small rise in water levels is not acceptable	Programme and SCP Chapter 2.2.2.

2 It should be noted that the Programme is independent of the achievement of the objectives set out in the National Master Plan for Port Development, so the development of the Danube waterway is necessary even if the ports are not expanded and developed (the implementation of the Programme is a condition for the development of the Master Plan).

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	strategy document to set out how it intends to prevent, or at least offset, the resulting groundwater level subsidence.	as an effect of the intervention. Subsection 1.4.2 of the topic has been added.	
	Although the draft includes the correlation proposed by AM for the specific CO2 emissions of each transport mode, it does so by listing shipping as the second best CO2-emitting mode after rail. What it does not emphasise is that even in this case it has three times the CO2 emissions of rail.	We do not consider it appropriate to emphasise this, as the purpose and projected impact of the waterway development is to divert traffic away from road freight.	-
	The draft still lacks the assessment of environmental pressures and indirect environmental impacts, which was stressed in the previous position and in the oral consultation by AM	Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been completed.	Chapter 5.2
	It still does not address the fact that the water sector predicts that the frequency and length of periods of extremely low water levels will increase in the future, so that if we do not adapt navigation to the river (and its environment) but adapt the river to the parameters required by navigation, we will not be solving the problems in a sustainable way, but will only be taking on new financial and environmental burdens, while the benefits will be reaped by others.	Basically a Programme and not a SCV issue. Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been completed. [3]	Programme
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	I do not accept the response to point 5 and in relation to point 6 of AM's comments on page 5 of the document "Comments received from the authorities on the DHJP SKV 2019" (hereafter: "Authorities' comments"), which refers to the shoreline deforming and habitat destroying effects of wave action from increased vessel traffic. In my view, the issues that threaten the environment, habitats and their conservation status, which may be affected by the project, should be identified in the draft. This is necessary in order to ensure that the draft environmental assessment and the documents based on it provide the level and depth of analysis required. However, if the draft does not address certain issues - including, for example, the effects of wave action - they may be easily overlooked and missed in subsequent studies. If the draft does not address certain issues, it may be used as a reason for not addressing them. Therefore, in my view, the environmental assessment topic of the SEA should include, even if only at the level of a mention, all the expected conservation impacts among the expected environmental issues, so that they can be the subject of more detailed studies in the future and not disappear later on, or only become the focus of attention after a serious or irreversible damage has already occurred. Considering that the EIA is an environmental assessment that goes beyond individual projects, at the strategic level, at the level of programmes and plans, the environmental assessment should be	Subchapter II/4 of Chapter 6 of the SKV thematic has been completed - at the level of mention.	Chapter 4.2.3, 4.2.5

[3] It is noted that the implementation of the Programme will help to raise water levels, without which there would be a greater sinking of water levels, taking into account climate change. Thus, implementation is not just a shipping issue and benefit.

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	as broad as possible. It will be up to subsequent assessments to decide at their own level to what extent and to what extent the questions raised are relevant. Given that the impact of wave disturbance caused by shipping traffic has been shown to be significant in the experience and studies of the nature conservation sector, reference should be made to this in the draft.		
	. It is also important to stress that the SEA procedure provides an appropriate tool for assessing the cumulative effects of individual activities - particularly the shoreline-deforming effects of wave action - as their cumulative effects can be significant. In particular, cumulative impacts cannot be ignored for developments of this magnitude, as the combined effect of the individual factors may be different from the cumulative effect of each factor considered separately, and therefore the need for a more detailed environmental assessment.	A section on cumulative impacts has been added to Chapter 6, Subchapter II/4 of the SCV Thematic Paper	SKV Chapter 5.3
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	. On page 5, point 7 of the official comments should also be assessed against the previous points, so please include comments on the comments on damming as an issue to be considered, [4]or thoughts on comparison with other transport modes.	Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been completed.	Chapters 2.6 and 4.2
	I suggest that - on page 6, point 10 of the official opinions - our comments based on the recommendations of the AGN Convention and the Danube Commission, as well as the proposed development directions, should already appear in the draft as a designated issue to be examined.	The planning principle is to develop inland waterways for the next 20 years in a way that still meets expectations but with minimal intervention. Chapter 1.4.2 of the SEA Thematic Paper has been completed.	Programme, SCP Chapter 2.3
	I partly agree with the answer to point 11 on page 6 of the Authority's comments that the topic does not include the preparation of detailed analyses or proposals, as these will be part of the tasks of the SEA documentation to be prepared. However, an enumeration and collection of measures planned to prevent and avoid the expected adverse effects should be included in the thematic document as a guideline to be examined.	The need to develop proposals was already covered in the thematic paper in Chapter 6.IV, and has been added.	SKV Chapter 6
	On page 7, point 12 of the opinions of the authorities, it is precisely the nature of the SEA procedure to prove or reject the correctness of the comment made on Hungary's role as a party causing environmental and natural damage, and therefore, in my opinion, the subject matter should also contain a reference to this.	Programme can be a task, SKV can only speak tangentially about Hungarian tasks.	Chapter 2.1.1.2 of the SCP on the Programme
	On the basis of the above, it should also be borne in mind that the thematic basis for the planned SEA and the documentation to be drawn up on the basis of it is the same as the opinion given by	Thank you for your guidance. We will try to take into account	-

[4] Please note: The project does not envisage a traditional type of damming. The interventions used will raise the water level by narrowing the channel without reducing the flow velocity.

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	the AM in point 14 on page 7 of the official opinions, and that this strategic nature of the thematic basis requires the thematic basis to also provide sufficient guidance for other sectors and other sectoral strategies. The comments made by AM on pages 7 and 8, from point 15 to point 24, should be assessed in a similar way. Please include the points raised in these points, as they should be examined in detail and the results recorded in the SEA, and can be referred to and taken into account in the future. Also on the basis of the above, the AM comment made on page 10, point 33, I believe that the topic should include the lines of enquiry for both measures and innovative solutions, which together will also define the cumulative impact studies. The reflections made under point 34 are a guide for contributors -	all the points raised. However, the SKV theme cannot cope with such a level of detail, it must be the content of the SKV. Some important aspects have been added to Chapter 6, Subchapter IV, of the SEA Thematic Paper at the level of mention.	
Ministry of Agriculture Dr. Attila Szinay Minister of State for Public Administration	On page 11 of the official opinions, point 36, it is a fact that invasive species are spreading along the Danube, but the topic is expected to provide future objectives for investigation to ensure that the planned project does not increase the intensity of the spread of invasive species, and does not worsen the current situation.	Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been completed.	Chapter 4.1.2.2, , 4.2.5.3
	I consider it important to include the AM comments under the heading "Detailed comments" on page 12 of the official opinions under points 40, 42 and 50 in order to ensure that the SEA to be carried out is as comprehensive and comprehensive as possible, thus ensuring that the development to be implemented has the least possible environmental and natural impact.	We try to take into account all the points raised. However, the SEA thematic cannot cope with such a level of detail, it must be the content of the SEA. A few important aspects have been added to Chapter 6, Subchapter IV of the SEA thematic, at the level of mention.	Chapter 4.2.5, Chapter 6.1.2
	Considering that [5]the removal of material along the fairway, or its transport to a particular stretch of the waterway, or its deposition, or the land disposal of excavated material, during construction and subsequent maintenance, will have a significant ecological impact and may also affect nearby Natura 2000 sites, I request that the draft plan include the problems and possible solutions for the disposal of material.	Subchapter II./4. of Chapter 6 of the SEA Thematic Paper has been completed.	Chapters 4.2.3, 4.2.5, Annex 9
	On the basis of the above, in addition to the above, please include the following sub-headings	We have not added sub-titles to the SKV theme, but have taken into account the aspects corresponding to the titles.	The SCA contains separate titles, headings and paragraphs corresponding to the chapters
	The previous proposals concerning forest protection aspects have been incorporated in the amended document and I have no further comments to make in this respect.	-	-

[5] The sediment is not removed from the riverbed, it is only moved. This is essentially waterborne transport, so the inland Natura 2000 site is not affected.

Reviewer	Gist of the opinion	Development task/response	Appearance in SKV
	Overall, I conclude that the submitted topic has only partially taken into account the proposals made in the coordinated position of the AM. In my view, a further revision of the draft is essential before proceeding to the further planning phase.	Based on the suggestions, the SKV theme has been revised again.	SCA Annex 1

"The project of the Trans-European Transport Network - Trans-European Transport Network - NIF Zrt.
Design tasks related to the development of the TEN-T inland waterway"
under a design contract
2014-HU-TMC-0606-S

DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - Southern border)

Strategic Environmental **Assessment**

ANNEX 3 TO THE ENVIRONMENTAL ASSESSMENT

Proposed system of evaluation criteria and environmental assessment of the variants

Budapest, September 2020

Section II: Danube between Szob - Dunaföldvár (1708,0-1561,0 fkm)

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III /A version.	Evaluation
A) Technical, navigational aspects, manageability of extreme water management situations	-5+30			**8**	**18**	**20,1**	**24,1**	**25,4**	
A1) Ensuring compliance with the parameters and conditions set in the target	**-2+10**	***0+20***	A1/1) Fairway Width	**10**	**15**	**15**	**15**	**15**	For all variants, the proposed widths were tested to the minimum allowable.
		0+10	A1/2) Sailing time on the section	**0 multiplier**	**8**	**8**	**8**	**8**	The navigation time on this stretch is roughly related to the width of the fairway.
		-5+20	A1/3) Hydraulic, flow conditions (flow directions, water speed)	**5**	**12**	**13**	**15**	**15**	Flow and velocity conditions were in line with the design concept. Versions I and II are independent of each oth Version III is a hybrid of the two.
		-5+10	A1/4) Increased safety of navigation (reduced risk of collisions, run aground)	**5**	**6**	**7**	**8**	**8**	Navigation safety increases in proportion to the improvement in flow and speed conditions.
		-10+40	A1/5) Rate of water level rise	**0**	**20**	**20**	**20**	**20**	No distinction is made in the rate of water level rise. Interventions compensate for water level reductions due to dredg
A2) Risks during implementation and operation	**-1+5**	***-5+20***	A2/1) Impact on aquifers, compliance with legal requirements	**20**	**8**	**12**	**15**	**17**	The extent to which aquifers are affected is determined by the location of the quarries used in the interventions and t of dredging. Throughout the variations, we have consistently sought to find the least intrusive intervention possible.
		0+10	A2/2) Complexity of implementation	**0**	**8**	**3**	**7**	**9**	The complexity of implementation increases with the scale of the planned interventions in the fairway and the a specialised stone works (chevron dams) used
		-3+20	A2/3) Flood safety	**5**	**11**	**10**	**15**	**16**	Flood safety decreases as the number of control works increases.
		-2+20	A2/4) Hydraulic conditions for ice discharge	**5**	**10**	**13**	**15**	**17**	Ice-discharge conditions are generally improved by the development of a uniform bed, but are also to some extent rela parameters of the bed width, sinuosity
A3) Sustainability of the overall system	**-1+5**	***0+10***	A3/1) Annual amount of maintenance dredging	**0**	**3**	**7**	**10**	**10**	The most favourable option is the one with the least dredging.
		-5+20	A3/2) Navigation, navigation aspects	**5**	**12**	**13**	**15**	**14**	Navigation and navigation aspects are improved as flow and speed conditions improve
		-5+20	A3/3) Safety aspects	**5**	**10**	**12**	**15**	**16**	Operational safety is related to the flow and speed conditions, fairway width and cornering parameters
A4) Smooth operation of the planned traffic growth	**0+2**	***0 +20***	A/4) Possibility to improve and further develop the system in place	**0**	**10**	**14**	**15**	**17**	The system can only be improved if the implemented version achieves its goal with as little intervention as possible
A5) Compatibility	**-1+5**	***-5+10***	A5/1) With related development plans (port development, ship park, etc.)	**0**	**5**	**7**	**9**	**9**	Options III and III/A are the most consistent with the associated development plans
		0+20	A5/2) Compliance for river management	**5**	**10**	**12**	**16**	**17**	River management is more favourable when water levels and flow conditions are favourable, when the riverbed is as u possible.
		-5+15	A5/3) Adaptability of the variant, adaptability to local conditions, flexibility	**15**	**10**	**12**	**13**	**15**	Adaptation to local conditions has included adapting to the needs of angling and sporting clubs in terms of water intal inlets, ferry crossings
		0+5	A5/4) Flexibility to choose the date of implementation	**0**	**2**	**1**	**4**	**4**	The flexibility in the timing of implementation increases in proportion to the reduction in the volume of interventions minimising interventions in the fairway.
A6) Level of adaptation to expected climate change	**-1+3**	***-10+30***	A/6) According to the degree of water level rise.	**0**	**20**	**22**	**26**	**27**	The level of resilience to expected climate change is proportional to the levelling capacity of the variant.
B) Economic, efficiency and land management issues	-5+10			**0,8**	**0**	**0,5**	**2,2**	**3,1**	
B1) Need for investment, one-off expenditure	**0 +2**	***0 +15***	B1/1) Investment, initial expenditure Ft, the higher the amount, the lower the score	**x**	**5**	**5**	**7**	**8**	Option 0 has no investment cost. Option I has the highest investment cost (HUF 10.3 billion), while Option II is cheaper (HUF 10.2 billion). The cheapest option is III/A (HUF 7.9 billion), 23% cheaper than Option I. Variant III is more expensive (HUF 8,4 billion), about 19% cheaper than Variant I.
		0 +5	B1/2) Eligibility for funding	**x**	**2**	**2**	**3**	**4**	The lower the costs, the more realistic the affordability
B2) Operating conditions	**0 +2**	***0 +8***	B2/1) Annual evolution of operating (running and maintenance) costs Estimate in Ft, taking into account maintenance cycle times	**8**	**3**	**3**	**5**	**5**	Version 0 includes not only the actual current costs, but also the minimum IT, setting and annual dredging costs nee ensure the expected operational standard, estimated at 460 M€/year. Options I and II are also the most expensive in maintenance (total operating cost of Option I is 621 M€, Option II is only 1% less, 616 M€), while Options III and about 15% cheaper (530 M€).
		0 +8	B2/2) Financial viability and sustainability of operation	**6**	**3**	**3**	**5**	**5**	The lower the costs, the more realistic the affordability. If we look at it proportionally, option 0 would score 8 points we have also taken into account that a good part of the necessary work is not being done at the moment, so som funding problem will arise.
		0 +4	B2/3) Institutional, organisational, professional and qualification background of operation	**2**	**2**	**2**	**2**	**2**	It's the same everywhere, because it takes several specialists to run each version.
B3) Total cost, cost-effectiveness	**-1 +2**	***-5 +10***	B3/1) Present value of the sum of investment, non-recurrent expenditure and operating costs over a 20-year period.	**x**	**1**	**1**	**4**	**5**	The score for variant 0 is not meaningful, because we calculate a development margin in the variant analysis. Opt Option II are almost equally expensive (11 bn HUF) and the cheapest, 28% lower than the former, is Option III/A (8.1 with Option III slightly higher (8.5 bn HUF, 24% lower than Option I).
		-5 +10	B3/2) Cost-effectiveness, present value of costs per unit of turnover	**x**	**1**	**1**	**4**	**5**	Efficiency indicator projection based on expected traffic. forecast traffic growth can be met by all variants. Therefore of efficiency is the same as the order of the present value of costs.

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III /A version.	Evaluation
B4) Direct economic benefits (shipping, transport, GDP, etc.)	0 +2		B4) Direct economic benefits	x	2	2	2	2	The direct economic benefit is proportional to the increase in turnover, which is assumed to be the same for all variant
B5) Indirect economic and social benefits	0 +2	*0 +4*	B5/1) Impact on water sports, fishing	0	0	0	0	0	No positive impact can be expected on water sports and fishing. The users of fisheries water areas cannot expect to be improved navigability and increased boat traffic (with appropriate compensatory measures, fishing tourism attraction sales of area fishing tickets and ancillary services can be increased)
		0 +4	B5/2) Impact on tourism	2	1	1	2	2	There are both negative and positive effects. Positive for tourist navigation, negative for possible landscape degradatio
		0 +4	B5/3) Environmental benefits	0	2	3	3	4	Transfers from road transport and other environmental benefits. If traffic growth is the same, then these benefits are t Each intervention includes measures to improve the environment, but these vary from alternative to alternative.
		0 +4	B5/4) Employment benefits, contribution to the area's ability to support itself	0	4	4	2	2	Construction employment effects are temporary, permanent employment effects are the additional number operating, the higher the costs, the higher the employment benefits
		0 +4	B5/5) Economic development benefits, possibility of creating new related development programmes	0	2	2	2	3	Construction for realization the more expensive the investment, the higher the construction demand growth. If tra same across the variants, then the scale of port construction, the combined transport development demand is Variants III, IIIA have the most need for ports, so some additional port development is needed here.
B6) Indirect economic social damage	-2 0	*-10 0*	B6/1) Additional charges on the part of the persons concerned	-10	-3	-4	-6	-7	Impact on shipping businesses Inversely proportional to water depth, passage time), so the environmentally worst i economically
		-10 0	B6/2Environmental damage	x	-10	-7	-4	-2	in proportion to the potential degradation of ecosystem services.
B7) Economic risks	-2 0	*-10 0*	B7/1) Changes in shipping demand/traffic (domestic, international) do not require intervention	0	-10	-10	-7	-5	The higher the costs, the higher the economic risk
		-10 0	B7/2 Impact on certain economic activities	0	-5	-3	-2	-2	As regards the development options, the impact on the operation of the Paks NPP is questionable. In addition, how persistence of transport constraints poses some risk to development options.
C) Protection of the environment, nature and landscape	-25+15			**-1,1**	**-11**	**-9,6**	**-7**	**-5,5**	
C1) Size of the area affected by the intervention	-2 0	*-10 0*	C1/1) Total area used for works (direct and indirect)	0	-9	-10	-8	-7	Although there are differences in terms of land occupation between the different options, given that no significant ma work (neither dredging nor construction or demolition of masonry) is currently carried out on the section under stu from a few isolated sites, all intervention concepts could result in significant differences compared to the zero optic context of the project, the waterway was designed with the greatest amount of narrowing in Option III/A in order to r amount of work to be carried out in the riverbed, and therefore Option III/A is the preferred option based on our Option I contains slightly more interventions than Option A, while Option II contains significantly more interventio therefore the least favourable from the point of view of land use.
		-10 0	Dredging area (and area for disposal of dredged material)	0	-9	-10	-8	-7	Dredging is included in the variation assessment in several aspects, because this type of intervention has the most s direct impact, in terms of habitat protection, aquifer protection, soil protection, hydromorphology and, indirectly, other environmental disciplines. In terms of its impact, it is the surface area of the work in the riverbed rather than i that matters. After the zero option, in which no dredging is considered, Option III/A, which envisages the most fairway, has the least surface area of dredging and is therefore the most favourable, while Option II requires significa dredging and is therefore the least favourable.
C2) Difference in fairway width compared to the current situation	0 +2	*0+20*	C2) Difference in fairway width compared to the current situation	0	1	1	2	2	Compared to the current fairway designation, all the intervention options foresee a narrower fairway on the stretch 1791-1708 fkm (150 m width instead of 180 m), which is beneficial from an environmental (noise, habitat, social, e services) point of view. The most favourable option is Option III/A with minimum width, followed by Options I and are considered to be of equal width.
C3) Impact on aquifers	-4 0	***0 or 0 multiplier***	c3/1 Dredging in the outer/inner protection zone of an operational aquifer	0	**0 multiplier**	**0 multiplier**	**0 multiplier**	0	According to Annex 5 of the Government Decree No. 123/1997 (VII. 18.) on the protection of aquifers, remote aqu water installations for drinking water supply, it must be taken into account in the planning that no excavation work affecting the cover or aquifer) may be permitted in the inner and outer protection areas of the coastal filtered **Since dredging is planned for 27 276 m² in Option I and 23 337 m² in Options II and III in the outer pr zone of the Tófalui waterworks, the above criterion is not met for these options, and therefore only III/A is feasible from the point of view of protection of the aquifer.**
		-10 0	c3/2 Dredging [m²] in hydrogeological protection area A/B of operating aquifer	0	-2	-2	-2	-1	With the exception of Alternative 0, the same amount of bed excavation is foreseen in the hydrogeological A/B prote of the aquifer in Alternatives II and III, and slightly more in Alternative I. As the impact is between 2 and 2.5% for all all variants except 0 and III/A score -2, as they have the lowest amount of bed excavation.
		-10 0	c3/3 Maintain dredging in the protection zone of (remote) aquifers	0	0	0	0	0	The dredging volumes required to provide the depth of the fairway cannot be accurately predicted at this stage of t because the extent of the dredging is a function of a number of future shaping effects, which can be inaccurately p However, even if a 20% annual maintenance dredging rate, estimated on the basis of design experience with the f assumed, no difference can be made between the variants, as all variants have the same minimum dredging rate (less planned for the distant water protection area.
		-10 0	c3/4 Sedimentation in the protection zone of an operating aquifer	0	0	0	0	0	Based on the model calculations carried out, no sedimentation of sediment exceeding the specified criterion is expec outer or inner protection zone of the receiving water body.
		-10 0	c3/5 Sinkhole in the protection zone of an operating aquifer	0	0	0	0	0	Based on the model calculations carried out, no sedimentation exceeding the specified criterion is expected in the inner protection zone of the receiving water body.
C4) Adverse environmental impacts of the deployment of	-3 +1	*-5 0*	c4/1) Impact of deposition on air quality and noise and vibration emissions	0	-5	-4	-3	-2	The interventions planned in each version, involving the operation of machinery and transport needs, were taken into In addition to the total volume of each work, we have also tried to take into account the differences in the planned loc

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III /A version.	Evaluation
the system									a starting point, the possible impact on residential areas within a radius of 500 m was examined. Variations involvin volume of work or interventions involving work in the vicinity of more populated areas were given lower scores. option in this respect (Option I) received the lowest score (-5), against which the other options were compared. Varian 0 points.
		-3 0	c4/2) Causation, avoidability of water quality problems	0	-3	-3	-1	-1	Any construction work in a riverbed during construction has the potential to cause water quality problems, so the ext is determined by the extent of the area of construction activity in the riverbed. As a result of the analysis, it was foun most favourable options are III and III/A, while the least favourable options are I and II.
		-5 +10	c4/3) Impacts on the hydromorphological conditions of the riverbed (e.g. risk of deepening of the riverbed, risk of water level reduction)	0	-2	-1	-1	-1	From a hydromorphological point of view, the expected changes during construction can be considered in the cont way the artificial stone works are constructed and the disturbance of the natural bed by the intervention in the be temporary or long-term effects. In summary, any intervention that impairs or compromises the diversity of th conditions of the riverbed will have a negative impact on the hydromorphology of the Danube. The design of works th maintain diversity and ensure the navigational purpose with the least possible interference and use of artificial work adverse effect, and some measures, such as spur cuts, can have a positive effect on existing artificially regulated stre options of equal rank are III, III/A and II, which are equivalent, with Option II being the least favourable. In terms of the effects on bed deepening and water level changes and the actual effects on the bed morphology, no cle and scoring can be given on the basis of the current studies, however, as the degree of regulation increases and positive effects are expected, artificial works are introduced into the bed, so the effects are assumed to be rather negat
		-3 0	c4/4) Impact of the dredging activity on the geological medium	0	-2	-3	-1	-1	The most favourable variants are III and III/A, followed by I and finally II.
		-2 0	c4/5) Problems and management of waste from construction works	0	-2	-2	-1	-1	Existing data do not include information on the amount of waste generated during construction works. The on distinguish between the different options is to assume that the option that involves more material handling, con reconstruction or demolition of more river control features generates more waste. The excavated sediment is not c waste because it is deposited in its original environment, the river. Furthermore, the aim is that the material left ove dismantled hydraulic structures will be used in the construction process. The largest amount of material handled in Variant I is 625 thousand m^3, in Variant II 593 thousand m^3, in Varia thousand m^3 and in Variant III/A 472 thousand m^3.
		-3 0	c4/6) Disturbance of direct water uses	0	-3	-2	-1	-1	The disruptive impact of construction activity is related to both the land use, duration and nature of the works. Work the shipping lane are more likely to disturb navigation itself, while construction and demolition works closer to the more likely to disturb those using the areas. The area affected is known. Time is another important factor. This ma be related to the amount of work required for the variations, but also depends on, for example, how many sections a on at the same time.
		-3 0	c4/7) Summary of the effects on the settlement environment	0	-3	-2	-1	-1	The negative impacts are primarily related to specific construction activities (thus affecting coastal settlem secondarily to the expected increase in vessel traffic. There are 15 settlements in the study area where interventions ar in the vicinity of the river (residential areas, recreational areas, enclosed areas): Dömös, Vác, Göd, Szigetmonostor, D Budapest, Százhalombatta, Ercsi, Kulcs, Dunaújváros, Baracs, Dunaföldvár, Baja, Báta, Mohács. In all var municipalities are directly affected by the negative environmental impacts of construction, but in the same location larger interventions are planned in variant I. Furthermore, a distinction can also be made on the basis of the sc interventions (e.g. dredging, total amount of stone moved), on the basis of which overall, Option I is the least favo terms of dredging, there is not much difference between Option I and Option II, but the total amount of stone move of magnitude higher in Option I. There is a slight difference between variants II and III, with fewer interventions p variant III and slightly fewer residential and recreational areas directly affected. There is no significant difference in n between variants III and III/A, but the least amount of intervention is planned in III/A, so that overall, varian considered the most favourable.
		-3 0	c4/8) Archaeological and cultural heritage impacts	0	-2	-2	-2	-2	There are high levels and proportions of known sites affected, and a high level of dredging (although Option III/A is favourable in this respect), but no dredging of critical sites. In terms of other cultural heritage protection, one monum affected in all variants, as the monument also affects the Danube riverbed (Budapest, Budapest quays - dredging is p the area of District III). In addition, there are about 14 other monuments located near the coast in the areas o Visegrád, Verőce, Tahitótfalu, Dunakeszi, Szigetmonostor, Budapest, Százhalombatta and Ercsi, some of which are cl planned bunds in variants II, III and III/A, but no monuments are directly affected in any of the variants. Among t Heritage sites, the "Danube Coast and Buda Castle District", the "Borders of the Roman Empire - The Hungarian sect Danube Limes" and the "Danube Bend Cultural Landscape" are affected. Two of the protected sites of local impo located close to the coast, but neither of them is likely to be affected by either of the options (Százhalombatta: Fi Tavern, Ercsi: Monument to the Boatmen and the Victims of the Danube).
		-3 0	c4/9) Transboundary impacts	0	0	0	0	0	Due to the geographical location of the section between Szob and Dunaföldvár, the implementation of the interventi expected to have cross-border effects, but the positive and negative effects of the expected increase in vessel traffic w to e.g. Slovakia, Austria, Germany, Benelux countries, and Serbia, Romania and Bulgaria to the south. The significa increase in vessel traffic and its magnitude cannot be assessed at this stage.
C5) Conservation impacts during construction and maintenance	-7 0	-5 0	c5/1) Affected protected natural area of national importance (extent of the direct and indirect impact of the variant on protected areas)	0	-4	-4	-4	-4	There is no significant difference between the variants studied in terms of the extent to which they affect a protec national importance, as all variants typically affect the same fords and reefs, but the type and scale of intervention d also considered as protected area affected those cases where the mid-water bed itself does not belong to a protect area of national importance, but its shoreline is already directly affected by protected nature of national importanc island in the bed or the riffle area accompanying the bed). In particular, the assessment of the construction impact a for all variants, despite the small differences. The operational scope was scored -5 for all variants, as the increase i volume that can be expected during operation following development will affect the whole section and its wildlife.

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								assessment was based on the average of the scores for the construction and operational phases, rounded upwards whole number can be given. This resulted in a score of -4.
	-5 0	c5/2/1) Natura 2000 site affected (extent of the direct and indirect effect of the variant on Natura 2000 sites)	0	-4	-4	-4	-4	There is no significant difference between the variants studied in terms of the extent to which they affect a protect national importance, as all variants typically affect the same fords and reefs, but the type and scale of intervention d also considered as protected area affected those cases where the mid-water bed itself does not belong to a protecte area of national importance, but its shoreline is already directly affected by protected nature of national importanc island in the bed or the riffle area accompanying the bed). In particular, the assessment of the construction impact ar for all variants, despite the small differences. The operational scope was scored -5 for all variants, as the increase in volume that can be expected during operation following development will affect the whole section and its wildlife. assessment was based on the average of the scores for the construction and operational phases, rounded upwards whole number can be given. This resulted in a score of -4.
	-10 0	C5/2/2) Expected impact on candidate species of Community importance during construction and operation	0	-10	-8	-6	-4	In terms of Natura 2000 site impact, there is no significant difference between the variants studied, as all variants same river sections that hinder navigation in low water periods, but the type and volume of intervention differs. In p the assessment of the impact on the construction zone was -3 for all variants, despite the small differences. The op reach was scored -5 for all variants, as the increase in navigation volume assumed during operation following develop affect the entire stretch and its wildlife. The final assessment was based on the average of the scores for the constru operational phases. This resulted in a score of -4.
	-5 0	C5/2/3) Expected impact on candidate habitat types of Community importance during construction and operation	0	-2	-1	-1	-5	There are significant differences between the variants in terms of the impact on the candidate animal and plant s Community importance. The assessment typically takes into account the negative impacts associated with the constr the impacts on hydromorphological conditions and hence on organisms relevant to the operational phase associated construction, and does not weigh the impacts of increased vessel traffic. The increase in traffic may occur in the op phase as an effect independent of the variation (e.g. determined by economic factors) and, if a significant increase were assumed, the differences between the variations, independent of traffic but otherwise real, would be completely In terms of this sub-criterion, Option I clearly scores the lowest (-10 points), providing the required width for the ent of the fairway using conventional control works. In contrast, the least unfavourable rating was given to Option III includes fairway narrowings in most places and along the longest sections to minimise dredging interventions and use dikes and benthic bunds instead of conventional baffles, which are expected to have less adverse effects o conservation after construction, but which also makes the least use of conventional baffles.
	-10 0	c5/3 Number of other rare character species, number of species of special conservation concern and species of Community importance and the nature and extent of the expected impact on their populations	0	-10	-9	-8	-1	Adverse effects on candidate habitat types of Community importance are mainly associated with transport, hauling, and working on the floodplain bordering the mid-water bed. Direct impacts are likely to occur mainly in the nearsho of the traditional diversion works and in the coastal zone of the floodplain associated with the installation of guide the absence of an organisational plan, at the current planning stage, the impact has been estimated by experts on th the quantities of works to be constructed and the proportion of different types of works to be installed for each variar I, which uses the highest proportion of traditional diversion works to the middle waterway and the largest amount of engineering stone, was given the worst score (-2).
	-10 0	c5/4) Extent of habitat loss in the Danube river basin as aquatic habitat (expected extent of loss)	0	-4	-2	-1	-7	There is also a significant difference between the variants in terms of the impact on other rare character species, species and specially protected species. The assessment typically takes into account the negative impacts associated construction, or the impacts on hydromorphological conditions and hence on biota relevant to the operational ph construction, and does not weigh the impacts of increased vessel traffic. The increase in traffic may occur in the op phase as an effect independent of the variation (e.g. determined by economic factors) and, if a significant increase were assumed, the differences between the variations, independent of traffic but otherwise real, would be completely In terms of this sub-criterion, Option I scores the lowest (-10 points), providing the required width for the entire len fairway. In contrast, the least favourable score was given to Option III/a, which includes fairway narrowing in most p along the longest sections overall, and uses chevron dikes and benthic baffles instead of conventional baffles, expected to have less adverse effects on wildlife conservation after construction, in order to minimise dredging interve
	-6 0	c5/5) Nature and extent of the impact on the habitat diversity of the Danube river basin (can we say now?)	0	-6	-3	-2	-1	Many of the conventional diversion works, which reach all the way out to the mid-water margins, cause the area betw parallel works to fill up in the longer term. This phenomenon can also be observed in many places along the Danube parallel diversion works extending towards the middle of the river. As the successional processes progress, the r riverbeds become increasingly submerged and then reforested, gradually losing their habitat functions for the aquati the Danube. In terms of this criterion, Option I clearly scores the lowest (-4), as it basically uses conventional structures up to the edge of the mid-water bed, while the other options studied use chevron dams or bottom fins sections with navigational problems.
	-9 0	c5/6) Nature and magnitude of the impact on the ratio of artificial to natural soils (can we tell now?)	0	-4	-4	-4	-2	In general, habitats with higher diversity, greater small- and medium-scale heterogeneity and higher habitat-level tend to provide suitable habitat for a more diverse, species-rich community. Experience has shown that dredging installation of parallel diversion structures extending towards the middle of the bed and connecting to the shoreline o water bed will result in a more homogeneous bed and a reduction in habitat heterogeneity. In this criterion, Option I the least favourable (-6), due to the significant area of the bank affected by dredging as a result of the full-width fairwa high proportion of the bank affected by siltation after construction due to the use of conventional diversion structures III and III/a have the least negative impacts (-2). Of the two options, Option III has a slightly higher dredged materi and uses chevron dikes and bottom fins, but at the lowest possible rate, while Option III/a has the lowest dredged volume and dredged area and also uses chevron dikes and bottom fins, but at a slightly higher rate than Option differences of opposite sign cancel each other out, which is why both variants received the same score.
	-10 0	c5/7) Nature and extent of the impact on the water balance of the Danube habitats	0	0	0	0	-4	The assessment of each alternative is negatively affected by the increase in the amount of hydraulic engineering st installed, while the negative effects are mitigated by the demolition of existing stone works. The scores are derived by

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			(from tributaries to habitats further away from the Danube affected by the Danube water level)						the quantities of materials used for construction and demolition. Based on this criterion, all three options have the sa (-4). Based on available experience and survey results, the invasion of alien and invasive species is facilitated by the pr hydraulic engineering stone quarries, which are able to colonise a higher proportion of the natural substrates in th section.
C6) Environmental impacts due to traffic changes	-2+4	***-7 0***	c6/1) Consequences of emissions (air pollutants, noise) due to increased shipping traffic	**0**	**-6**	**-7**	**-7**	**-7**	All the variants are suitable for the design traffic, so there is no difference between the variants in this respect. For va III and III/A, the additional loads caused by the necessary detours due to the limited width of the fairway have been t account and these three variants have therefore been given one point less than variant I. No traffic increase was ass variant 0.
		-3 0	c6/2) Changes in bank and shore erosion (increased traffic, decreased narrower fairway)	**0**	**-3**	**-3**	**-2**	**-2**	As all options aim to improve navigability, there is no significant difference in traffic growth, with Option III havin moderate impact than the others, as the significant narrowing of the fairway in these options will discourage so traffic, but the impact of this option is not negligible, as traffic growth can be expected here as well.
		-5 0	c6/3) Landscape and land use changes	**0**	**-5**	**-4**	**-3**	**-3**	The known interventions are in the riverbed, so at this planning stage it is difficult to assess the likely transformati riparian areas. The entire Danube riverbed is part of the national landscape protection area, so it is not possible to dif between the changes on this basis. The differences between the variants in the current planning phase are mainly bas scale and location of the interventions (in particular: impact on protected natural areas). The scale of interventions in is typically larger (dredging, total stone handling) than in the other variants, but the area occupied is minimally small ha) than in Variant II. In terms of scale of intervention, variants III and III/A are the most favourable (no differenc between them), which can be considered favourable from a landscape-landscape-use point of view. In terms of natural areas of national importance, the Duna-Ipoly National Park, the Háros-sziget Ártéri-erdő TT, the Rácalmási and the Duna-Dráva National Park are affected, but in terms of the scale of interventions, variants III and III/A are c most favourable. Overall, in terms of landscape protection, options III and III/A are the most favourable, with differences between options I and II being the dredging and the total amount of stones moved, which makes optio favourable than option I.
		-5 +5	c6/4) Ecological impacts of vessel traffic (increased traffic increased, narrower waterway decreased)	**0**	**-3**	**-3**	**-3**	**-2**	Based on traffic data from the General Planner, freight traffic could reach +38% growth by 2050 and passenger tra (but not due to development). This is certainly an increase that could have a negative impact on the Danube's bio options aim to improve navigability, there is no significant difference in traffic growth, with only Option III/A havin moderate impact than the others, as the significant narrowing of the fairway in this option will discourage some vess but the impact of this option is not negligible, as traffic growth can be expected here as well.
		0 +15	c6/5) Total emissions reduction due to offsetting	**0**	**8**	**8**	**8**	**8**	All the variants are suitable for the design traffic, so there is no difference between the variants in this respect. For v and III, the impact of the diversions required due to the limited width of the fairway sections is negligible compar impact due to the road traffic generated, and therefore each variant scores the same. Based on the traffic forecast obta the General Designer, on average half of the increase in vessel traffic is due to modal shift vehicle traffic. The mod entirely shifted from road traffic. The increase in forecast growth from modal shift traffic alone (100%) would rep points in the system. Accordingly, a 50% modal shift shift represents a 7.5 point shift, rounded up to 8 points. In var congestion was expected, 0 points were scored.
		0 +10	c6/6) Change in total transport energy demand	**0**	**10**	**10**	**9**	**9**	Because of the lower energy requirements of water transport compared to road transport, all but the zero variant hav values. This is due to the fact that, in addition to the shift from road, even if no shift is expected, i.e. no more goods water than before, they can be carried by vessels with a larger draught. More draught means more energy consumptio vessel, but because fewer of them will be needed, the overall fuel consumption for transporting goods by ship will be In the case of transhipment (which is currently assumed), the effect is even more positive, the more goods are trans water, the lower the overall energy demand for transport, hence whichever option helps to transport more goods favourable in this respect. On the basis of the information available, options I, II and III can also provide the increased volume of goods transported, but options III and III/A may be less favourable in that additional energy con can be expected due to congestion and stoppages. It should be added, however, that this criterion depends to a large the modernity and energy consumption of the fleet, which does not depend on the variant with the intervention. In the way in which goods are transported may be influenced by external factors which cannot be predicted at present.
		0 +10	c6/7) Changes in land take resulting from congestion	**0**	**5**	**5**	**4**	**4**	There is not enough information available at this stage to investigate this in detail, but for the time being we can co different variants in terms of transport time, navigation aspects and fairway width, i.e. mainly throughput. At this sta the same for variants I and II, so no distinction is made between them. In the case of variants III and III/A, the p longer running time may cause some differences. In principle, however, we do not assume that land take resulting f construction is solely for reasons that can be diverted to waterways (not all routes may be so flexible), so we do n maximum score to either variant.
C7) Environmental impacts on the operation of the waterway, maintenance of the new status, impacts of the existence of the new system.	-2 +3	***-15 0***	c7/1) Effects of carrying out maintenance dredging	**0**	**-15**	**-15**	**-13**	**-12**	The dredging volumes required to provide the depth of the fairway cannot be accurately predicted at this stage of t because the extent of the dredging is a function of a number of future shaping effects, which can be inaccurately p Nevertheless, based on the design experience of the fairway, these works can be estimated approximately, and a maintenance dredging of 20% of the total design value has been calculated. Accordingly, the least favourable var variants I and II, with almost the same amount of dredging, and the most favourable variant III/A.
		0 +10	c7/2) Opportunities for improved water supply to tributaries	**0**	**4**	**4**	**4**	**4**	No distinction can be made between the alternatives, as none of the alternatives include specific tributary interventio section, while none of the alternatives worsen the recharge of the tributaries or provide for the possibility of further rehabilitation in a separate project. Minimal interventions in the tributaries are planned in the planning phase, a supply is likely to improve only minimally or stagnate.
		0 +10	c7/3) Preservation of the function of the aquatic habitat of small and medium-sized water bodies	**0**	**0**	**3**	**3**	**2**	No chevron dams are planned for Option I, but for the other options (II, III, III/A) they are. There is no major d between the number of chevron dams planned for variants II, III and III/A, with one more chevron dam planned for (7). It is important to note that Option 0 scores 0 points because the score is influenced by the number of chevron dan

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III /A version.	Evaluation
									this option there are no chevron dams on the section. However, this does not mean that in terms of the number of variant 0 is the same as predicted for variant I, even though both variants score 0. This ratio refers only to the n chevron dams.
		-5 +10	c7/4) Changes in the evolution of ecosystem services in the new state after the intervention	0	-3	-2	-1	-1	The magnitude of the impact is most influenced by the extent of interventions in the riverbed and habitats. Again, t with the least impact on ecosystem services (III/A) is considered the most favourable. Overall, ecosystem servic negatively affected by the project, but some interventions (e.g. restoration of natural habitats, eradication of invasiv may have a positive impact on services. Among the cultural services, fishing, recreation and aesthetic ecosystem servic negatively affected by the Programme, while e.g. tourism will experience a qualitative increase.
C8) Assessment under CCI 4.7	-1+2	-5 +10	c8/1) The status of the affected water bodies is expected to be downgraded in the course of the WFD 4.7 analysis	5	1	2	3	4	The intervention will negatively affect the biological and morphological characteristics of the *Danube between Szob-* *Danube-Budapest* and *Danube Budapest-Dunaföldvár in* all variants. The changes in both parameter groups a determined by dredging activities, the extent of bank deepening and the construction of hydraulic structures. A biological communities, algae are generally the most dependent on water chemistry, as water chemistry does no significantly during construction or operation, and therefore no significant changes are expected. Macroinvertebrate affected as no changes in the riparian vegetation are expected. Fish and aquatic invertebrates will be locally affected. that these negative impacts will be negligible for the whole water bodies. Negative changes are expected in some morp characteristics, regularity, bed material, but no significant changes are expected. It is unlikely that the magnitude of ch reach the category of deterioration for any of the quality parameters. Neither for biological characteristics morphological characteristics. The EIA will be the basis for a final decision on the need for a detailed assessment of th
		0 +5	c8/2) Whether appropriate mitigation measures have been applied	X	0	0	3	4	No mitigation is interpreted for version 0. There are no mitigation measures for the CCI in Versions I and II. M measures for environmental, water protection impacts are already included in Variant III. In this respect, therefore, (A is the best option.
		-5 +5	c8/3) Threatening or supporting the achievement of the objectives set for the water bodies concerned	x	-4	-2	-1	0	Not interpretable for version 0. The two water bodies concerned have different measures foreseen in VGT2. Below we the VGT2 measures whose implementation is affected by the project interventions (+ for positive, 0 for neutral or no e (1) Danube between Szob-Budapest, (2) Danube-Budapest, (3) Danube between Budapest-Dunaföldvár: 6.2 Establishment of suitable vegetation in the floodplain 0 (1,2,3) 6.3a One-off removal of silt and riparian vegetation accumulated in watercourses and standing waters 0 (1,2) 6 . 5. Dismantling of in-stream facilities that have lost their function, progressively achieving good ecological status and pot the environment + (1,2,3) 6 . 8. Reduction of the impact of deeper than natural river beds and the resulting low and medium water level + (1,3) 6.12.3 Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materia (1,2,3) 6.13 Adaptation of navigation to river or still water conditions 0 (1,2,3) 7.1 Modification of the inland drainage system 0 33.2 Special hydromorphological to improve the status of protected natural areas, including special regulation of water abstraction, water manage water recharge to meet nature conservation needs + 34.2.Ensuring water quality required for nature conservation, in addition to other water quality protection measu As there are no WFD objectives whose achievement would be compromised by the project, a detailed 4.7 assessme expected to be required due to the impediment to implementation of the measures. Overall, the difference between th is determined by the amount of dredging activity and technical interventions.
C9) Environmental risks during the operation of the established fairway	-2 0	-5 0	c9/1) Changes in the risk of shipping accidents due to traffic growth and the new fairway	0	-1	-1	-2	-2	For the assessment of this criterion, the starting point was variant 0, where the number of days per year of navigatio taken into account. The other 4 variants considered all have the same increase in traffic (as only the theoretical r traffic capacity differs between the variants, the realistic traffic volume expected to be able to pass unhindered is expe the same for all four variants), but for variants III and III/a, the fairways are also narrowed, relocated or unidirection results in a further narrowing). Hence, the traffic increases do not affect the differences between the variants, t increase itself is not so large as to multiply the probability of accident risks, so the score itself is close to 0. The between the variants is affected by the waterway narrowing, so that the variants III and III/a score worse.
		-5 0	c9/2) Dredging risks	0	-5	-5	-4	-3	The dredging volumes required to provide the depth of the fairway cannot be accurately predicted at this stage of t because the extent of the dredging is a function of a number of future shaping effects, which can be inaccurately Nevertheless, based on the design experience of the fairway, these works can be estimated approximately, and a maintenance dredging of 20% of the total design value has been calculated. Accordingly, the least favourable va variants I and II, with almost the same amount of dredging, and the most favourable variant III/A.
		-5 0	c9/3) Increased likelihood of water quality incidents (e.g. ship discharges)	0	-2	-2	-3	-3	For the evaluation of this criterion, the values and methodology of criterion C9/1) have been adopted, with the differ each variant scored one value lower. This can be explained by the fact that water pollution is not only caused by a events, but also by other types of pollution.
		-5 0	c9/4) Development of critical local air quality situations	-3	-4	-4	-4	-4	The increase in shipping traffic will inevitably affect air quality because of the increase in emissions. In location inherently less favourable for geographical or anthropogenic reasons, this may contribute to critical situations (i.e. v already unfavourable situation). In this respect, no distinction can be made between the variants, as all of them are su

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III /A version.	Evaluation
									the planned traffic. To show that there are locations on the route (especially in Budapest) where air quality is sor concern for reasons related to the vessels (e.g. forced use of generators, outdated engines), in this case, variant 0 is points instead of 0.
C10) Climate risk	-2+3	*-4 +5*	c10/1) Impact of changes in shipping traffic on GHG emissions from waterborne transport	**0**	**-1**	**-2**	**-2**	**-2**	The increase in traffic will increase the total fuel consumption of waterborne transport, thus increasing the total green emissions of waterborne transport. All of the variants are suitable for the planned traffic, however, the traffic forecast General Planner indicates that the expected increase in traffic will be much lower. There is no difference between th in this respect. The improvements will, however, allow for a much higher utilisation of the vessels' cargo space than is the case, thus allowing for a higher volume of goods to be transported without a significant increase in fuel consumpti will also result in a reduction of GHG emissions, a positive effect that has been taken into account in the scoring. Opti and III/A may have a small increase in fuel consumption due to the increase in the number of unloadings required c limited width of the fairway sections, and therefore these two options scored one lower (the lowest) than Option I. No in traffic was expected for variant 0, which scored 0.
		0 +20	c10/2) Impact of shifting road transport services to shipping on total GHG emissions from transport	**0**	**10**	**10**	**10**	**10**	Each of the variants is capable of handling up to more than twice the current traffic, but there is no difference in traffi between the variants. Based on the traffic forecast provided by the General Designer, on average half of the increase traffic would come from modal shift vehicle shifted. The modal shift is entirely shifted from road traffic. The increase i growth from modal shift traffic alone (100%) would represent 20 points in the system. Correspondingly, a 50% m traffic shift represents 10 points. However, it is proposed to further investigate the expected impacts and necessary me the future.
		-4 0	c10/3) To what extent can the navigation conditions be ensured for a 1 -7% reduction in water yield according to the model simulation results?	**-4**	**0**	**0**	**0**	**0**	Based on the results of the model simulation of the expected long-term change in water flow, a 1-6% drop in wat expected on this section of the Danube by 2050, which, in the opinion of the responsible technical designer compensated by the safety margin applied in the design and the water level drop can be managed during operation reason, no specific climate change measures are envisaged at the current design stage. Given that all intervention opt been designed using the MVSZ 2018 working level, no differences can be made between the options and therefore a have been assigned 0 points and option 0 has been assigned -4 points. However, it is recommended to further inves expected impacts and necessary actions in the future.
		-4 0	c10/4) To what extent can navigation conditions be ensured in the event of variable weather conditions expected as a result of climate change?	**-4**	**-2**	**-2**	**-2**	**-2**	In the absence of intervention, Option 0 is the most vulnerable to climate change impacts and therefore scores the lo difficult to distinguish between the intervention options in this respect, as all of them aim to have a relatively lo impact, but the changes in hydrological patterns caused by climate change cannot be accurately predicted. The varia scored -2 for the perception of improvement compared to the current situation.
		-3 +2	c10/5) Consideration of adaptation measures to climate change	**-3**	**-2**	**-2**	**-2**	**-2**	The implementation of the Programme will help shipping to adapt to changing climatic and weather conditions unde water flows, but we are not aware of any specific adaptation measure to climate change. Scoring: -2 - *low level of* cons Option 0 is scored the lowest, as no adaptation measure is considered.
		-2 0	c10/6) Degree of vulnerability of technical solutions to climate change	**-2**	**-2**	**-2**	**-1**	**-1**	The increase in the frequency of low flows has been taken into account in the determination of the working water lev variations of the fairway are considered equally vulnerable to further increases in low flow periods. Stone work considered vulnerable to further projected impacts of climate change on the area. Of the planned technical interven mainly the works involving the relocation of sediment, and in particular dredging, that are considered vulnerable t change, in the sense that they will be needed more frequently due to the significant channel-forming effect of flo frequency of extreme water levels on the Danube is expected to increase in the future, including the frequency of flood variant with the highest maintenance dredging needs is therefore the one with the lowest score. Accordingly, favourable are variants I and II, with almost the same amount of dredging, and the most favourable are variants III a In variant 0, no intervention is made to ensure minimum fairway parameters during low tides, and this variant is given the lowest score.
		-3 + 3	c10/7) Change in the extent of CO_2 sequestering, bioactive surfaces	**0**	**-1**	**-1**	**-1**	**-1**	As no vegetation clearance is planned in the Danube Basin under either option, it is only potentially related to land o and will not be significant.Furthermore, according to the studies carried out so far, a reduction in algal biomass is ex terms of CO2 sequestration, as a consequence of climate change and human interventions. However, it is doubt difference can be made between the variations based on current knowledge and information. All variants scored -1 ar 0 scored 0.
D) Social and acceptability issues	-5+5			**-0,6**	**0,3**	**0,7**	**1,1**	**1,6**	
D1) Acceptability to data subjects	-2+1	*-10 +5*	d1/1) Acceptability for angling	**-5**	**-7**	**-4**	**-2**	**-1**	Consultation with fish farmers has started. Dredging to improve navigability, the placement of dredged materia construction and modification of water management facilities are disturbing fish stocks and fishing. The expected ir boat traffic will seriously damage fish stocks and negatively affect the attractiveness of fishing tourism in fisheries ma waters. Technical interventions to improve navigability will modify aquatic habitats of importance for fisheries ma and have long-term effects on the hydromorphological processes that shape and maintain these habitats. So management facilities may limit fishing opportunities (e.g. chevron dam as a fishing access point). Interventions to co for adverse changes may improve the condition of habitats of critical importance for the survival of fish stocks.
		-10 +5	d1/2) Acceptability for water sports	**-7**	**-4**	**-3**	**-1**	**-3**	Direct contact has not yet been established with the stakeholders. The gradual increase in the number of embankn traffic will make it more difficult to use hand-powered craft and may increase the chances of accidents occur assessment is based on the volume and extent of the works carried out close to the shore (spur, guide, chev construction, etc.). On the other hand, the increase in traffic compared to the current situation and the change i width.
D2) Compliance with the preferences of the relevant	-3+3	*-10 +10*	d2/1) Expected reception in the National Park	**0**	**0**	**0**	**0**	**0**	Not yet known.

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III /A version.	Evaluation
water management organisations, the National Park and the relevant Authorities		*-10 +10*	d2/2) Acceptability for operators	2	3	4	7	7	Based on the discussions so far. Basically, it's the gradual increase in basin regulations and traffic that works best in The maintenance of the waterway is influenced by three factors: the volume and extent of the maintenance work to b out each year; and the traffic generated, which will affect the maintenance of the markers. In turn, the effec intervention works on the morphology of the riverbed will have an impact on both maintenance and markings.
		-5 +5	d2/3) Expected reception by water protection and environmental authorities	0	0	0	0	0	It is not yet known, of course.
		-5 +5	d2/4) Professional judgement in shipping, transport	5	4	5	4	4	Based on the discussions so far. The usability of the fairway is influenced by three factors: the traffic generated by c the width of the fairway and its dynamic nature - both in terms of tie size and time, and the impact of interventio traffic flow. medermorphological effects, which also have an impact on the pinning.
D3) Employment effects	**0+1**	*0 +10*	D3) Employment effects	10	8	7	7	7	The employment impact is influenced by four factors: the intervention works to be carried out, the annual maintenan the growth of the domestic fleet and its traffic, and the related increase in the labour demand of ports. The latte difficult to estimate at present, but the development options will differ little in this respect. It seems clear that Optio best option in this respect.
Total	**-40+60**			**7,1**	**7,1**	**11,7**	**20,4**	**24,6**	
				Excluded	**Excluded**	**Excluded**	**Excluded**	**Suggested**	

Stage III: Between Dunaföldvár and the border (1433,0 - 1560,5 fkm)

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
A) Technical, navigational aspects, manageability of extreme water management situations	-5+30			**10**	**22,2**	**25,3**	**26,2**	**26,5**	
A1) Ensuring compliance with the parameters and conditions set in the target	-2+10	0+20	A1/1) Fairway Width	10	20	20	14	13	In variants I and II, the fairway width is 150 m everywhere, in variants III and III/A there is a width restricti
		0+10	A1/2) Sailing time on the section	0 multiplier	10	10	9	8	~200 days in version "0", 343 days in the other cases, III and III/A versions have a cut-off
		-5+20	A1/3) Hydraulic, flow conditions (flow directions, water speed)	8	12	15	17	18	The flow and velocity conditions have evolved in line with the design concept, i.e. they have improved from version. They have not changed in version III/A
		-5+10	A1/4) Increased safety of navigation (reduced risk of collisions, run aground)	4	9	9	8	7	Safety is high at full fairway width, but decreases at fairway narrows
		-10+40	A1/5) Rate of water level rise	0	32	30	28	28	In the most critical section, all variants involve raising the water level. In the other sections, the rate of wate decreases from one variant to the next
A2) Risks during implementation and operation	-1+5	-5+20	A2/1) Impact on aquifers, compliance with legal requirements	20	16	18	20	20	By evaluating the number, extent and classification of the protected area of interventions in the vicinity of op and prospective aquifers. The impact on the aquifer is more favourable from variant to variant
		0+10	A2/2) Complexity of implementation	0	7	9	9	10	The complexity of implementation increases with the scale of the interventions planned in the waterwa amount of masonry work requiring special technology.
		-3+20	A2/3) Flood safety	15	8	12	14	14	Flood safety decreases with the increase in the number of control works, but increases with their height setba
		-2+20	A2/4) Hydraulic conditions for ice discharge	10	15	17	19	20	Ice-discharge conditions are generally improved by the development of a uniform bed, but are also to so related to the parameters of the bed width, sinuosity
A3) Sustainability of the overall system	-1+5	0+10	A3/1) Annual amount of maintenance dredging	0	3	7	9	10	The most favourable option is the one with the least dredging.
		-5+20	A3/2) Navigation, navigation aspects	5	12	16	18	18	Navigation and navigation aspects are improved as flow and speed conditions improve
		-5+20	A3/3) Safety aspects	5	10	14	15	15	Operational safety is related to flow and speed conditions, fairway width and turning parameters, and improved by track corrections
A4) Smooth operation of the planned traffic growth	0+2	0 +20	The possibility of improving and developing the system in place	0	10	15	19	20	The system can only be improved if the implemented version achieves its goal with as little intervention as po
A5) Compatibility	-1+5	-5+10	A5/1) With related development plans (port development, ship park, etc.)	0	8	10	10	10	All options are consistent with the identified related development plans.
		0+20	A5/2) Compliance for river management	8	15	17	18	19	River management is more favourable when water levels and flow conditions are favourable, when the rive uniform as possible.
		-5+15	A5/3) Adaptability of the variant, adaptability to local conditions, flexibility	15	12	13	14	14	Adaptation to local conditions has included adapting to the needs of angling and sporting clubs in terms intakes, water inlets, ferry crossings
		0+5	A5/4) Flexibility to choose the date of implementation	0	2	3	5	5	The flexibility in the timing of implementation increases in proportion to the reduction in the volume of inte required, minimising interventions in the fairway.
A6) Level of adaptation to expected climate change	-1+3	-10+30	According to the degree of water level rise.	0	21	18	16	16	The level of resilience to expected climate change is proportional to the levelling capacity of the variant.
B) Economic, efficiency and land management issues	-5+10			**0,6**	**0,7**	**3**	**3,5**	**4,7**	The overall result of the economic evaluation is that Option I is by far the worst choice, with two moderat options (II, III) with almost similar scores. The best option is clearly option III A.
B1) Need for investment, one-off expenditure	0 +2	0 +15	B1/1) Investment, initial expenditure Ft, the higher the amount, the lower the score	x	8	10	10	12	Option 0 has no investment cost. Option I is the most expensive, nearly HUF 5 billion. Option III is 19 (HUF 4 billion) and Option II 21% cheaper (HUF 3.9 billion). The cheapest is III/A (HUF 3.7 billion).
		0 +5	B1/2) Eligibility for funding	x	2	3	3	4	The lower the costs, the more realistic the affordability
B2) Operating conditions	0 +2	0 +8	B2/1) Annual evolution of operating (running and maintenance) costs Estimate in Ft, taking into account maintenance cycle times	8	4	6	7	7	Option 0 includes not only the actual current costs but also the minimum IT, signage and annual ma dredging costs needed to ensure the expected operational standard, estimated at 191 M€/year. Option I i most expensive in terms of maintenance, with a total operating cost of 245 M€. Option II is 13% cheaper a with a minimal difference between Option III (203 M€) and Option III/A (199 M€), which therefore score th
		0 +8	B2/2) Financial viability and sustainability of operation	6	2	4	5	5	The lower the costs, the more realistic the affordability. If we look at it proportionally, version 0 would score but we have also taken into account that a good part of the necessary works are not being done at the m some kind of funding problem will arise.
		0 +4	B2/3) Institutional, organisational, professional and qualification background of operation	2	2	2	2	2	It's the same everywhere, because it takes several specialists to run each version.
B3) Total cost, cost-effectiveness	-1 +2	-5 +10	B3/1) Present value of the sum of investment, non-recurrent expenditure and operating costs over a 20-year period.	x	0	5	5	8	The score for variant 0 is not meaningful, because we calculate a development margin in the variant anal present value of Option I is the highest at HUF 5.2 bn. Alternatives II and III are 25% lower at HUF 3.9 bn, (HUF 3.5 bn) being the cheapest.
		-5 +10	B3/2) Cost-effectiveness, present value of costs per unit of turnover	x	0	5	5	8	Efficiency indicator projection based on expected turnover. All variants can meet the projected traffi Therefore the order of efficiency is the same as the order of the present value of costs.
B4) Direct economic benefits (shipping,	0 +2		B4) Direct economic benefits	x	2	2	2	2	The direct economic benefit is proportional to the increase in turnover, which is assumed to be the sa

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
transport, GDP, etc.)									variants.
B5) Indirect economic and social benefits	0 +2	*0 +4*	B5/1) Impact on water sports, fishing	0	0	0	0	0	Water sports and fishing are not expected to be positively affected. The users of fisheries water areas cannot benefit from improved navigability and increased boat traffic (with appropriate compensatory measure tourism attraction and thus sales of area fishing tickets and ancillary services can be increased)
		0 +4	B5/2) Impact on tourism	2	1	1	2	2	There are both negative and positive effects. Positive for tourist navigation, negative for possible landscape degradation
		0 +4	B5/3) Environmental benefits	0	2	3	4	4	Transfers from road transport and other environmental benefits. If traffic growth is the same, then these ben the same. Each intervention includes measures to improve the environment, but these vary from alternative alternative.
		0 +4	B5/4) Employment benefits, contribution to the area's ability to support itself	0	4	3	3	1	Construction employment effects are temporary, permanent employment effects are the additional number operating, the higher the costs, the higher the employment benefits
		0 +4	B5/5) Economic development benefits, possibility of creating new related development programmes	0	3	2	2	2	Construction for realization the more expensive the investment, the higher the construction demand growth is the same across the variants, then the scale of port construction, the combined transport development the same. For variant III/A, the ports have to stand the most, so some additional port development is needed
B6) Indirect economic social damage	-2 0	*-10 0*	B6/1) Additional charges on the part of the persons concerned	-10	-3	-4	-5	-5	Impact on shipping businesses Inversely proportional to water depth, passage time), so the environmentall the best economically
		-10 0	B6/2Environmental damage	x	-10	-7	-5	-2	in proportion to the potential degradation of ecosystem services.
B7) Economic risks	-2 0	*-10 0*	B7/1) Changes in shipping demand/traffic (domestic, international) do not require intervention	0	-10	-5	-5	-3	The higher the costs, the higher the economic risk
		-10 0	B7/2 Impact on certain economic activities	-2	0	0	0	0	It is not relevant for development options in this section, but the persistence of traffic barriers poses son development opportunities.
C) Protection of the environment, nature and landscape	-25+15			**-0,9**	**-10,4**	**-6,8**	**-4,7**	**-2,9**	
C1) Size of the area affected by the intervention	-2 0	*-10 0*	C1/1) Total area used for works (direct and indirect)	0	-10	-9	-7	-6	Although there are differences in terms of land occupation between the different options, given that no s maintenance work (neither dredging nor construction or demolition of masonry) is currently carried o section under study, apart from a few isolated sites, all intervention concepts could result in significant d compared to the zero option. In the context of the project, the waterway was designed with narrowings III/A in order to reduce the amount of work to be carried out in the riverbed, and therefore Option III preferred option based on our analysis. Variant III has slightly more interventions, while Variants II ar significantly more interventions, and is therefore the least favourable from an occupancy point of view.
		-10 0	Dredging area (and area for disposal of dredged material)	0	-10	-10	-7	-5	Dredging is included in the variation assessment in several aspects, because this type of intervention has significant direct impact, in terms of habitat protection, aquifer protection, soil protection, hydromorpho indirectly, in many other environmental disciplines. In terms of its impact, it is the surface area of the w riverbed rather than its volume that matters. After the zero option, in which no dredging is considered, Opt which envisages the most narrowed fairway, has the least surface area of dredging and is therefore favourable, while Options II and I require significantly more dredging and are therefore the least favourable.
C2) Difference in fairway width compared to the current situation	0 +2	*0+20*	C2) Difference in fairway width compared to the current situation	0	0	0	1	2	The 2019 fairway designation plan already includes a 150 m wide fairway, so on this section the plan planned to relocate the fairway and narrow it in some places. However, it can be said that the width of th does not deviate significantly from the current width in any of the variants. The most favourable variant is I the minimum width, followed by III and then I and II, which are considered to be of equal width.
C3) Impact on aquifers	-4 0	***0 or 0 multiplier***	c3/1 Dredging in the outer/inner protection zone of an operational aquifer	0	**0 multiplier**	**0 multiplier**	0	0	According to Annex 5 of the Government Decree No. 123/1997 (VII. 18.) on the protection of aquifers, remot and water installations for drinking water supply, it must be taken into account in the planning that no e work (activities affecting the cover or aquifer) may be permitted in the inner and outer protection areas of t filtered **As dredging is planned for 4083 m2 in the outer protection zone of the Foktő-Barákai aquife variants I and II, the above criterion is not met in variants I and II and therefore ca implemented from a river basin protection point of view.** No dredging is planned in the outer protection zone of an operational aquifer in III and III/A.
		-10 0	c3/2 Dredging [m²] in hydrogeological protection area A/B of operating aquifer	0	-2	-2	-1	-1	With the exception of Alternative 0, the same amount of bed excavation is foreseen in the hydrogeological p area A/B of the aquifer in Alternatives I and II, slightly less in Alternative III and significantly less in A III/A. As the exposure in variants I and II is ~2% of the basin cross-section of the hydrogeological protecti for the Cape-Baraka aquifer, both variants scored -2. For variants III and III/A, the extent of the overlap small water body does not exceed 1% and therefore the minimum score of -1 was assigned.
		-10 0	c3/3 Maintain dredging in the protected area of (remote) aquifers	0	0	0	0	0	The dredging volumes required to provide the depth of the fairway cannot be accurately predicted at this st design because the extent of the dredging is a function of a number of future shaping effects, whic inaccurately predicted. However, even if a 20% annual maintenance dredging rate, estimated on the basis experience with the fairway, is assumed, no difference can be made between the variants, as all variants have minimum dredging rate (less than 1%) planned for the distant water protection area.
		-10 0	c3/4 Sedimentation in the protection	0	0	0	0	0	Based on the model calculations carried out, no significant sedimentation of sediment is expected in the oute

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
			zone of an operating aquifer						protection zone of the operating aquifer.
		-10 0	c3/5 Sinkhole in the protection zone of an operating aquifer	0	0	0	0	0	Based on the model calculations carried out, no significant sedimentation is expected in the outer or inner p zone of the operating aquifer.
C4) Adverse environmental impacts of the deployment of the system	-3 +1	-5 0	c4/1) Impact of deposition on air quality and noise and vibration emissions	0	-5	-4	-4	-3	The interventions planned in each version, involving the operation of machinery and transport needs, were t account. In addition to the total volume of each work, we have also tried to take into account the differen planned locations. As a starting point, the possible impact on residential areas within a radius of 50 examined. Variations involving a higher volume of work or interventions involving work in the vicinity populated areas were given lower scores. The worst option in this respect (Option I) received the lowest s against which the other options were compared. Variant 0 scores 0 points.
		-3 0	c4/2) Causation, avoidability of water quality problems	0	-3	-2	-1	-1	Any construction work in a riverbed during construction has the potential to cause water quality problen extent of this is determined by the extent of the area of construction activity in the riverbed. As a result of the it was concluded that the most favourable option is Option III/A, while the least favourable option is Option
		-5 +10	c4/3) Impacts on the hydromorphological conditions of the riverbed (e.g. risk of deepening of the riverbed, risk of water level reduction)	0	-2	-1	-1	-1	From a hydromorphological point of view, the expected changes during construction can be considered in th of the way the artificial stone works are constructed and the disturbance of the natural bed by the intervent bed and its temporary or long-term effects. In summary, any intervention that impairs or compromises the of the natural conditions of the riverbed will have a negative impact on the hydromorphology of the Dan design of works that help to maintain diversity and ensure the navigational purpose with the least interference and use of artificial works has little adverse effect, and some measures, such as spur cuts, c positive effect on existing artificially regulated stretches. The most favourable options are III, III/A, II, v equivalent, and finally Option I is the least fa In terms of the effects on bed deepening and water level changes and the actual effects on the bed morph clear scaling and scoring can be given on the basis of the current studies, however, as the degree of r increases and although positive effects are expected, artificial works are introduced into the bed, the e assumed to be rather negative.
		-3 0	c4/4) Impact of the dredging activity on the geological medium	0	-3	-2	-1	-1	The volume requirement for gas dredging in Option III/A is almost one third of the dredging volume fo Option I. Thus, the most favourable variant is III/A, followed by III not much more, then III, then II, and the I, which is the least favourable, since it is more than twice as much as variant II.
		-2 0	c4/5) Problems and management of waste from construction works	0	-2	-1	-1	-1	Existing data do not include information on the amount of waste generated during construction works. The to distinguish between the different options is to assume that the option that involves more material construction, reconstruction or demolition of more river control features generates more waste. The sediment is not considered waste because it is deposited in its original environment, the river. Furthermore, that the material left over from the dismantled hydraulic structures will be used in the construction process. Most of the material handling (217 thousand m^3) takes place in variant I. In Variant III 163 thousand m^3, in 160 thousand m^3 and in Variant III/A 151 thousand m^3.
		-3 0	c4/6) Disturbance of direct water uses	0	-3	-2	-2	-1	The disruptive impact of construction activity is related to both the land use, duration and nature of the worl affecting the shipping lane are more likely to disturb navigation itself, while construction and demolition wo to the shore are more likely to disturb those using the areas. The area affected is known. Time is another i factor. This may in theory be related to the amount of work required for the variations, but also depend example, how many sections are worked on at the same time.
		-3 0	c4/7) Summary of the effects on the settlement environment	0	-3	-1	-1	-1	The negative impacts are primarily related to specific construction activities (thus affecting coastal settlem secondarily to the expected increase in vessel traffic. There are 7 municipalities in the study area where inte are planned in the vicinity of the construction (residential areas or recreational areas, enclosed areas): Dun Ordas, Sükösd, Baja, Dunafalva, Mohács, Szeremle, but 6 municipalities are directly affected by the environmental impacts of the construction in the case of Option I, 3 in the case of Option II and 2 in th Options III and III/A. Furthermore, a distinction can be made on the basis of the scale of the intervent dredging, total amount of stone moved, vegetation clearance), again with Option I being the least favou Option II, the total amount of stones moved is slightly lower than in Options III and III/A, but the a dredging is more significant. Variant III/A requires the least intervention (except for the construction of where Variant II is the most favourable). Overall, there is no significant difference between variants II, III an
		-3 0	c4/8) Archaeological and cultural heritage impacts	0	0	0	0	0	There are few areas affected by dredging and intervention, the critical sites are not affected, and the iner only slightly affected. In other cultural heritage terms, one monument site is affected under all alternativ monument is located in the Danube bed (Dunafalva, Sontra Florentiam harbour fortress). However, the mon not affected in any of the options. In the case of World Heritage sites, the Roman Limes is affected. 5 of the sites of local importance are located close to the coast and are not expected to be affected by any of the optio Mádi-Kovács Castle; Őcsény, former Archbishop's summer house; Baja, István Türr memorial; Mohács, building and Selyemgyár).
		-3 0	c4/9) Transboundary impacts	0	0	0	0	0	In terms of transboundary impacts, we could not distinguish between the variations in terms of constru existence of works or changes in vessel traffic. The closest construction area to the border for all variants Mohács, more than 10 km from the border, and the closest area proposed for dredging is near Paks, 80 km border.
C5) Conservation impacts during construction and maintenance	-7 0	-5 0	c5/1) Affected protected natural area of national importance (extent of the direct and indirect impact of the variant on protected areas)	0	-4	-3	-3	-3	In terms of the impact on the protected natural area of national importance, Option I is the least favourab the option that will have the longest direct physical degradation impact on a protected natural area of importance during the construction phase. There is no appreciable difference between the other variants e since all of them affect the same sections of the river, but the type and scale of the intervention is dif

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
									particular, the assessment of the impact on the construction area was -2 for Option I and -1 for the othe examined. The operational scope was scored -5 for all variants, as the increase in the volume of navigation th expected after the development during operation will affect the whole stretch and its wildlife. The final as was based on the average of the scores for the construction and operational phases, rounded upwards as onl number can be given. This is how the scores of -4 and -3 were obtained.
		-5 0	c5/2/1) Natura 2000 site affected (extent of the direct and indirect effect of the variant on Natura 2000 sites)	**0**	**-4**	**-3**	**-3**	**-3**	Regarding the impact on Natura 2000 sites, Option I is the least favourable, as it is the option with the long physical degradation of Natura 2000 habitats during the construction phase. There is no appreciable between the other options considered, as all options affect the same sections of the river with the same reefs, but the type and scale of intervention differs. Separately, the assessment of the impact on the co impact area was -2 for Option I and -1 for the other options assessed. The operational scope was scored variants, as the increase in the volume of navigation that can be expected after the development during ope affect the whole stretch and its wildlife. The final assessment was based on the average of the score construction and operational phases, rounded upwards as only a whole number can be given. This is how the -4 and -3 were obtained.
		-10 0	C5/2/2) Expected impact on candidate species of Community importance during construction and operation	**0**	**-10**	**-8**	**-6**	**-4**	There are significant differences between the variants in terms of the impact on the candidate animal species of Community importance. The assessment typically takes into account the negative impacts assoc the construction, or the impacts on hydromorphological conditions and hence on organisms releva operational phase associated with the construction, and does not weigh the impacts of increased vessel t increase in traffic may occur in the operational phase as an effect independent of the variation (e.g. deter economic factors) and, if a significant increase in traffic were assumed, the differences between the v independent of traffic but otherwise real, would be completely masked. In terms of this sub-criterion, Optio scores the lowest (-10 points), providing the required width for the entire length of the fairway using co control works. In contrast, the least unfavourable rating was given to Option III/a, which includes m waterway narrowing to minimise dredging interventions and uses chevron dike type diversion structures conventional diversion structures, which are expected to have a more favourable impact on wildlife prote construction, while also seeking to minimise the use of these types of structures.
		-5 0	C5/2/3) Expected impact on candidate habitat types of Community importance during construction and operation	**0**	**-2**	**-1**	**-1**	**-1**	Adverse effects on candidate habitat types of Community importance are mainly associated with transpor dumping and working on the floodplain bordering the mid-water bed. Direct impacts are likely to occur ma nearshore section of the traditional diversion works and in the coastal zone of the floodplain associate installation of guide works. In the absence of an organisational plan, at the current planning stage, the i been estimated by experts on the basis of the quantities of works to be constructed and the proportion o types of works to be installed for each variant. Option I, which uses conventional diversion structures co the mid-water embankment, received a less favourable rating (-2).
		-10 0	c5/3 Number of other rare character species, number of species of special conservation concern and species of Community importance and the nature and extent of the expected impact on their populations	**0**	**-9**	**-7**	**-5**	**-3**	There is also a significant difference between the variants in terms of the impact on other rare characte protected species and specially protected species. The assessment typically takes into account the negativ associated with the construction, or the impacts on hydromorphological conditions and hence on biota relev operational phase of the construction, and does not weigh the impacts of increased vessel traffic. The i traffic may occur in the operational phase as an effect independent of the variation (e.g. determined by factors) and, if a significant increase in traffic were assumed, the differences between the variations, indep traffic but otherwise real, would be completely masked. In terms of this sub-criterion, Option I scores the points), providing the required width for the entire length of the fairway. In contrast, the least favourable given to Option III/a, which includes fairway constrictions over significant lengths to minimise dredging chevron dikes instead of conventional diversion structures, which are expected to have a more favourable wildlife protection after construction.
		-10 0	c5/4) Extent of habitat loss in the Danube river basin as aquatic habitat (expected extent of loss)	**0**	**-4**	**-2**	**-2**	**-2**	Many of the conventional diversion works, which reach all the way out to the mid-water margins, caus between these parallel works to fill up in the longer term. This phenomenon can also be observed in ma along the Danube between parallel diversion works extending towards the middle of the river. As the su processes progress, the recharging riverbeds become increasingly submerged and then reforested, gradu their habitat functions for the aquatic fauna of the Danube. In terms of this criterion, Option I is clearl favourable (-4), as it mainly uses conventional diversion structures up to the edge of the mid-water bed, other options studied use chevron dams in several sections with navigational problems.
		-6 0	c5/5) Nature and extent of the impact on the habitat diversity of the Danube river basin (can we say now?)	**0**	**-5**	**-2**	**-2**	**-1**	In general, habitats with higher diversity, greater small- and medium-scale heterogeneity and higher ha diversity tend to provide suitable habitat for a more diverse, species-rich community. Experience has s dredging and the installation of parallel diversion structures extending towards the middle of the bed and c to the shoreline of the mid-water bed will result in a more homogeneous bed and a reduction in habitat hete In this criterion, Option I is clearly the least favourable (-5), due to the significant area of the bank a dredging as a result of the full-width fairway and the high proportion of the bank affected by silta construction as a result of the use of conventional diversion structures. The least adverse effects are ob Option III/a (-1), due to the lowest volume of dredged material and the use of chevron dikes.
		-9 0	c5/6) Nature and magnitude of the impact on the ratio of artificial to natural soils (can we tell now?)	**0**	**-3**	**-2**	**-3**	**-2**	The assessment of each alternative is negatively affected by the increase in the amount of hydraulic enginee to be installed, while the negative effects are mitigated by the demolition of existing stone works. The derived by summing the quantities of materials used for construction and demolition. Based on this Alternatives II and III/a are the least negatively rated. Based on available experience and survey results, th of alien and invasive species is facilitated by the presence of hydraulic engineering stone structures, which

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
									likely to colonise than natural substrates in the affected reach.
		-10 0	c5/7) Nature and extent of the impact on the water balance of the Danube habitats (from tributaries to habitats further away from the Danube affected by the Danube water level)	0	0	0	0	0	As a result of shallowing, rivers are draining groundwater from surrounding areas at ever lower levels, resu significant drop in groundwater levels in areas along their banks. Depending on the hydrological characteris areas concerned, the magnitude of the long-range effects of groundwater level declines associated with periods can be very significant. This is also the case along the domestic Danube section. Declining groundwa have a negative impact on the water balance of groundwater-dependent ecosystems in the affected areas, water scarcity and consequent degradation of ecosystems. A key design consideration was to avoid this impact. According to the information available at the current planning stage, none of the alternatives will c adverse effects.
C6) Environmental impacts due to traffic changes	-2+4	-7 0	c6/1) Consequences of emissions (air pollutants, noise) due to increased shipping traffic	0	-6	-6	-7	-7	All the variants are suitable for the design traffic, so there is no difference between the variants in this res additional loads caused by the need for detours due to the limited width of the riverbed sections have been account for variants III and III/A, which therefore scored one point lower than the other two. No traffic inc assumed for variant 0.
		-3 0	c6/2) Changes in bank and shore erosion (increased traffic, decreased narrower fairway)	0	-3	-3	-2	-2	As each of the options aims to improve navigability, there is no significant difference in traffic growth, with c and III/A having a more moderate impact than the others, as the significant narrowing of the fairway in the will discourage some vessel traffic, but the impact of this option is not negligible, as traffic growth can be here as well.
		-5 0	c6/3) Landscape and land use changes	0	-5	-4	-3	-2	The known interventions are in the riverbed, so at this planning stage it is difficult to assess the likely trans of the riparian areas. The entire Danube riverbed is part of the national landscape protection area, so it is no to differentiate between the changes on this basis. Differences between the variants at this planning stage ca on the basis of the scale of the interventions, their location (in particular: the impact on protected natural a the expected amount of vegetation destruction. The amount of vegetation destruction in Variant I is abou high as in all other variants (which are identical). Protected natural areas of national importance are affe variants, given that the Danube riverbed and its surroundings are part of the Danube-Drava NP on t between the border with Friesland. However, the magnitude of the interventions in the national park areas I is much higher than in the other variants, which justified the lower scoring. The differences between varia III/A in terms of landscape, landscape use, the scale of dredging and the total area requirements - these decr variant II towards variant III/A, which justified the increasingly favourable scoring.
		-5 +5	c6/4) Ecological impacts of vessel traffic (increased traffic increased, narrower waterway decreased)	0	-5	-5	-5	-4	According to the Port Master Plan Strategy, the share of inland waterway freight transport could reach 10% which represents an increase of at least 2-2.5 times the current inland waterway transport. This is ce increase that could have a serious negative impact on the Danube's biota. As all options aim to improve na there is no significant difference in traffic growth, with only Option III/A having a more moderate impac others, as the significant narrowing of the fairway in this option will discourage some vessel traffic, but the this option is not negligible, as traffic growth can be expected here as well.
		0 +15	c6/5) Total emissions reduction due to offsetting	0	8	8	8	8	All the variants are suitable for the design traffic, so there is no difference between the variants in this re options III and III/A, the impact of the diversions required due to the limited width of the riverbed s negligible compared to the impact of the road traffic generated, and therefore each option scores the same. the traffic forecast obtained from the General Designer, on average half of the increase in vessel traffic is due shift vehicle traffic. The modal shift is entirely shifted from road traffic. The increase in forecast growth fr shift traffic alone (100%) would represent 15 points in the system. Accordingly, a 50% modal shift tr represents 7.5 points, rounded up to 8 points. In variant 0, no shift was considered, 0 points were assigned.
		0 +10	c6/6) Change in total transport energy demand	0	10	10	9	9	Because of the lower energy requirements of water transport compared to road transport, all but the zero va positive values. This is due to the fact that, in addition to the shift from road, even if no shift is expected, i.e goods arrive by water than before, they can be carried by vessels with a larger draught. More draught me energy consumption for each vessel, but because fewer of them will be needed, the overall fuel consum transporting goods by ship will be reduced. In the case of transhipment (which is currently assumed) the effe more positive, the more goods are transported by water, the lower the overall energy demand for transp whichever option helps to transport more goods is more favourable in this respect. On the basis of the in available, options I, II and III can also provide the necessary increased volume of goods transported, but c and IIIa may be less favourable in that additional energy consumption can be expected due to conge stoppages. It should be added, however, that this criterion depends to a large extent on the modernity a consumption of the fleet, which does not depend on the variants with each intervention. In addition, the way goods are transported may be influenced by external factors which cannot be predicted at present.
		0 +10	c6/7) Changes in land take resulting from congestion	0	5	5	4	4	There is not enough information available at this stage to investigate this in detail, but for the time bei compare the different variants in terms of transport time, navigation aspects and fairway width, i. throughput. At this stage, this is the same for variants I and II, so no distinction is made between them. In t variants III and III/a, the potentially longer running time may cause some differences. In principle, howe not assume that land take resulting from road construction is solely for reasons that can be diverted to water all routes may be so flexible), so we do not give a maximum score to either variant.
C7) Environmental impacts on the operation of the waterway, maintenance of the new status, impacts of the existence of the new system.	-2 +3	-15 0	c7/1) Effects of carrying out maintenance dredging	0	-15	-8	-5	-4	The dredging volumes required to provide the depth of the fairway cannot be accurately predicted at this st design because the extent of the dredging is a function of a number of future shaping effects, whic inaccurately predicted. Nevertheless, based on the design experience of the fairway, these works can be approximately, and an annual maintenance dredging of 20% of the total design value has been calculated. T requirement for dredging in Variant III/A is almost one third of the dredging volume foreseen in Variant I.

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
									most favourable variant is III/A, followed by III not much more, then II, and then I, which is the least fa since it is more than twice as much as even variant II.
		0 +10	c7/2) Opportunities for improved water supply to tributaries	0	4	4	4	4	No distinction can be made between the variants, because all variants include the same tributary interventio same recharge can be ensured in all variants. The reason why the variants do not score maximum points is minimal interventions in the tributaries are planned at the design stage, and water supply is likely to minimally or stagnate.
		0 +10	c7/3) Preservation of the function of the aquatic habitat of small and medium-sized water bodies	0	0	2	2	2	For variant I no chevron dams are planned, for the other variants they are, but there is no difference in the r chevron dams for these variants, so the score is the same. It is important to note that Option 0 scores 0 be score is influenced by the number of chevron dams, and in this option there are no chevron dams on th However, this does not mean that in terms of habitat number, variant 0 is the same as predicted for varia though both variants score 0. This ratio refers only to the number of chevron dams.
		-5 +10	c7/4) Changes in the evolution of ecosystem services in the new state after the intervention	0	-2	-2	-1	-1	Also in this section, the least intrusive Alternative III/A has the lowest negative impact on ecosystem servic due to the lower volume of riverbed intrusions and structures. However, similar to the above sections, ev Alternative III/A, the overall negative impacts on ecosystems and their services are still significant.
C8) Assessment under CCI 4.7	-1+2	*-5 +10*	c8/1) The status of the affected water bodies is expected to be downgraded in the course of the WFD 4.7 analysis	5	0	0	2	3	Invasions *between the Danube Danube estuary* and the Danube *Sió estuary and the* Danube *Sió border* affect the biological and morphological characteristics of water bodies in all variations. Changes in bo parameters are mainly determined by dredging activities, the extent of bed deepening and the constr hydraulic structures. Among the biological communities, algae are generally the most dependent on water as water chemistry does not change significantly during construction or operation, and therefore no s changes are expected. Macroinvertebrates are not affected as no changes in the riparian vegetation are expe and aquatic invertebrates will be locally affected. It is likely that these negative impacts will be negligible for water bodies. Negative changes are expected in some morphological characteristics, regularity, bed materi significant changes are expected. It is unlikely that the magnitude of change will reach the category of det for any of the quality parameters. Neither for biological characteristics nor for morphological characteristics will be the basis for a final decision on the need for a detailed assessment of the EIA 4.7.
		0 +5	c8/2) Whether appropriate mitigation measures have been applied	X	0	0	3	4	No mitigation is interpreted for version 0. There are no mitigation measures for the CCI in Versions Mitigation measures for environmental, water protection impacts are already included in versions III and III this point of view, Option III/A is the best.
		-5 +5	c8/3) Threatening or supporting the achievement of the objectives set for the water bodies concerned	x	-3	-2	-1	0	Not interpretable for version 0. The two water bodies concerned are subject to different VGT2 measures. measures whose implementation is affected by the project interventions are described below (+ for posit neutral or no effect). (1) Danube between the Dunaföldvár-Sió estuary, (2) Danube between the Sió estuary and the border 6.2. Establishment of appropriate vegetation in the surf zone 0(2) 6.3a One-off removal of silt and vegetation accumulated in watercourses and standing waters 0 (2) 6.5 Gradual achievement and maintenance of good ecological status and potential of watercourses and waters through maintenance works 0 (1,2) 6.6 Dismantling of in-stream facilities that have lost their function, progressively achieving good ecological s potential of the environment 0(1,2) 6.8 Improving the water supply to the floodplain and floodway + (1), 0 (2) 6.9 Reducing the impact of deeper than natural river beds and the resulting low and medium water level sub (1, 2) 6.9.a Raising the sea level by means of bottom dikes and bottom fins, with silting up of the bed between them 6.12.3 Reconstruction and maintenance of in-stream facilities, including the use of near-natural solu materials + (1, 2) 6.13. Adaptation of navigation to river or still water conditions 0 (1, 2) 7.1 Modification of the inland drainage system 0 (1) 33.2 Special hydromorphological measures to improve the status of protected natural areas, includin regulation of water abstraction, water management and water recharge to meet conservation needs + (1,2) As there are no CCI objectives that are threatened by the investment, a detailed 4.7 assessment is not expe necessary due to the barriers to the implementation of the measures. Overall, the difference between the v determined by the amount of dredging activity and technical interventions.
C9) Environmental risks during the operation of the established fairway	-2 0	*-5 0*	c9/1) Changes in the risk of shipping accidents due to traffic growth and the new fairway	0	-1	-1	-2	-2	For the assessment of this criterion, the starting point was variant 0, where the number of days per year of n was not taken into account. The other 4 variants under consideration all have the same increase in traffic (a theoretical maximum traffic capacity differs between the variants, the realistic traffic volume expected to b pass unhindered is expected to be the same for all four variants), but for variants III and III/a, the fairway narrowed, relocated or unidirectional (which is the result of an even further narrowing). Hence, the traffic do not affect the differences between the variants, the traffic increase itself is not so large as to mu probability of accident risks, so the score itself is close to 0. The difference between the variants is affect waterway narrowing, so that the variants III and III/a score worse.
		-5 0	c9/2) Dredging risks	0	-5	-3	-1	-1	The dredging volumes required to provide the depth of the fairway cannot be accurately predicted at this st design because the extent of the dredging is a function of a number of future shaping effects, whic inaccurately predicted. Nevertheless, based on the design experience of the fairway, these works can be approximately, and an annual maintenance dredging of 20% of the total design value has been calculated. Th

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
									requirement for dredging in Variant III/A is almost one third of the dredging volume foreseen in Variant I. most favourable variant is III/A, followed by III not much more, then II, and then I, which is the least fa since it is more than twice as much as even variant II.
		-5 0	c9/3) Increased likelihood of water quality incidents (e.g. ship discharges)	**0**	**-2**	**-2**	**-3**	**-3**	For the evaluation of this criterion, the values and methodology of criterion C9/1) have been adopted, difference that each variant scored one value lower. This can be explained by the fact that water pollution i caused by accidental events, but also by other types of pollution.
		-5 0	c9/4) Development of critical local air quality situations	**-1**	**-2**	**-2**	**-2**	**-2**	The increase in shipping traffic will inevitably affect air quality because of the increase in emissions. In loca are inherently less favourable for geographical or anthropogenic reasons, this may contribute to critical situa worsen an already unfavourable situation). In this respect, no distinction can be made between the options them are suitable for the planned traffic. To illustrate that there may already be locations where air sometimes a concern due to existing vessel traffic, among other reasons, option 0 has been given a score o than 0.
C10) Climate risk	**-2+3**	*-4 +5*	c10/1) Impact of changes in shipping traffic on GHG emissions from waterborne transport	**0**	**-1**	**-1**	**-2**	**-2**	The increase in traffic will increase the total fuel consumption of waterborne transport, thus increasing greenhouse gas emissions of waterborne transport. All of the variants are suitable for the planned traffic, hov traffic forecast from the General Planner indicates that the expected increase in traffic will be much lower. T difference between the variants in this respect. The improvements will, however, allow for a much higher uti the vessels' cargo space than is currently the case, thus allowing for a higher volume of goods to be tr without a significant increase in fuel consumption, which will also result in a reduction of GHG emissions, effect that has been taken into account in the scoring. Options III and III/A may have a small increa consumption due to the increase in the number of diversions required due to the limited width of the basir and therefore these two options scored one lower than the others. For option 0, no change in traffic is expec scores 0. (Note that the increase in emissions due to increased traffic will be partly compensated by the more modern, energy-efficient vessels (forced by stricter environmental requirements).)
		0 +20	c10/2) Impact of shifting road transport services to shipping on total GHG emissions from transport	**0**	**10**	**10**	**10**	**10**	Each of the variants is capable of handling up to more than twice the current traffic, so there is no differenc the variants in this respect. As far as we know at present, congestion on all roads is expected if the project i However, this is very unproven and its magnitude cannot be estimated at this stage. The planned in congestion of about 7.7 % compared to current levels may not be feasible, but on the other hand it may not b at the expense of road transport. The planned increase and its transfer from road only would represent 20 the system. Accordingly, we are now making a conservative estimate. However, it is proposed to further a likely impacts and necessary measures in the future. There is no consensus among experts working on this is
		-4 0	c10/3) To what extent can the navigation conditions be ensured for a 1 -7% reduction in water yield according to the model simulation results?	**-4**	**0**	**0**	**0**	**0**	Based on the results of the model simulation of the expected long-term change in water flow, a 1-6% drop flow is expected on this section of the Danube by 2050, which, in the opinion of the responsible technical can be compensated by the safety margin applied in the design and the water level drop can be manag operation. For this reason, no specific climate change measures are envisaged at the current design stage. C all intervention options have been designed using the MVSZ 2018 working level, no differences can be mad the options and therefore all options have been assigned 0 points and option 0 has been assigned -4 points. it is recommended to further investigate the expected impacts and necessary actions in the future.
		-4 0	c10/4) To what extent can navigation conditions be ensured in the event of variable weather conditions expected as a result of climate change?	**-4**	**-2**	**-2**	**-2**	**-2**	In the absence of intervention, Option 0 is the most vulnerable to climate change impacts and therefore s lowest. It is difficult to distinguish between the intervention options in this respect, as all of them aim relatively long-lasting impact, but the changes in hydrological patterns caused by climate change cannot be a predicted. The variants are all scored -2 for the perception of improvement compared to the current situation
		-3 +2	c10/5) Consideration of adaptation measures to climate change	**-3**	**-2**	**-2**	**-2**	**-2**	The implementation of the Programme will help shipping to adapt to changing climatic and weather conditi current water flows, but we are not aware of any specific adaptation measure to climate change. Scoring: -2 - *of* consideration. Option 0 is scored the lowest, as no adaptation measure is considered.
		-2 0	c10/6) Degree of vulnerability of technical solutions to climate change	**-2**	**-1**	**-1**	**0**	**0**	The increase in the frequency of low flows has been taken into account in the determination of the work level, but all variations of the fairway are considered equally vulnerable to further increases in low flow peri works are not considered vulnerable to further projected impacts of climate change on the area. Of the technical interventions, it is mainly the works involving the relocation of sediment, and in particular dred are considered vulnerable to climate change, in the sense that they will be needed more frequently d significant channel-forming effect of floods. The frequency of extreme water levels on the Danube is ex increase in the future, including the frequency of floods, and the variant with the highest maintenance dredg is therefore the one with the lowest score. Accordingly, Option I is the least favourable, Option II is favourable and Options III and III/A are even better. No action is taken to ensure the minimum fairway p during low tides in variant 0, which therefore has the lowest score of 0.
		-3 + 3	c10/7) Change in the extent of CO_2 sequestering, bioactive surfaces	**0**	**-2**	**-1**	**-1**	**-1**	Plant eradication is the same (and small) for variants II, III and III/a. Slightly more vegetation eradication i for Variant I, so it receives the lowest score. By definition, no such activity is found in Variant 0 (0 points). to the analyses carried out so far, a reduction in the amount of algal biomass is also expected in term sequestration, due to the effects of climate change and human interventions. However, it is doubtful that a can be made between the variations based on current knowledge and information. A monitoring plan is pr address this uncertainty and problem.
D) Social and acceptability issues	-5+5			**-0,6**	**0,7**	**0,9**	**0,9**	**1,2**	
D1) Acceptability to data subjects	**-2+1**	*-10 +5*	d1/1) Acceptability for angling	**-5**	**-7**	**-6**	**-5**	**-4**	Consultation with fish farmers has started. Dredging to improve navigability, the placement of dredged ma the construction and modification of water management facilities are disturbing fish stocks and fishing. The

Criteria groups	Point scale		Component sub-criteria	0 changes.	I. variables.	Version II.	Version III.	III/A version.	Evaluation
									increase in vessel traffic will seriously damage fish stocks and negatively affect the attractiveness of tl tourism in the fisheries management waters. Technical interventions to improve navigability will modi habitats of importance for fisheries management and have long-term effects on the hydromorphological that shape and maintain these habitats. Some water management facilities may limit fishing opportur chevron dam as a fishing access point). Interventions to compensate for adverse changes may improve the of habitats of critical importance for the survival of fish stocks.
		-10 +5	d1/2) Acceptability for water sports	0	-5	-3	-3	-2	Direct contact has not yet been established with the stakeholders. The gradual increase in the n embankments and traffic will make it more difficult to use hand-powered craft and may increase the c accidents occurring. The assessment is based on the volume and extent of the works carried out close to (spur, guide, chevron dam construction, etc.). On the other hand, the increase in traffic compared to th situation and the change in fairway width.
D2) Compliance with the preferences of the relevant water management organisations, the National Park and the relevant Authorities	-3+3	*-10 +10*	d2/1) Expected reception in the National Park	x	0	0	0	0	Not yet known.
		-10 +10	d2/2) Acceptability for operators	2	5	6	6	7	Based on the discussions so far. Basically, it's the gradual increase in basin regulations and traffic that wor this case. The maintenance of the waterway is influenced by three factors: the volume and extent of the ma work to be carried out each year; and the traffic generated, which will affect the maintenance of the marker the effects of the intervention works on the morphology of the riverbed will have an impact on both mainter markings.
		-5 +5	d2/3) Expected reception by water protection and environmental authorities	x	0	0	0	0	It is not yet known, of course.
		-5 +5	d2/4) Professional judgement in shipping, transport	-3	5	5	4	4	Based on the discussions so far. The usability of the fairway is influenced by three factors: the traffic ger changes in fairway width and its dynamic nature - both in terms of tie size and time, and the effe interventions on the morphology of the bed, which also affect the setting of the markings.
D3) Employment effects	0+1	*0 +10*	D3) Employment effects	0	10	7	7	7	The employment impact is influenced by four factors: the intervention works to be carried out, th maintenance works, the growth of the domestic fleet and its traffic, and the related increase in the labour d ports. The latter two are difficult to estimate at present, but the development options will differ little in this seems clear that Option I is the best option in this respect.
Total	-40+60			**9,1**	**13,3**	**22,4**	**25,9**	**29,5**	
				Excluded	**Excluded**	**Excluded**		**Suggested**	

System of assessment criteria for multi-criteria analysis of variance

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
A) Technical, navigational aspects, manageability of extreme water management situations	-5+30			
A1) Ensuring compliance with the parameters and conditions set in the target	-2+10	*0+20*	Fairway Width	Aim to achieve the minimum width recommended by the Danube Commission (120 m) and a limited width (100 m) on forded sections
		0+10	Sailing time on the leg	Aim to meet the Danube Commission's recommendation on durability (25 dm, 343 days, water level at 94% water yield with 94% durability calculated from the data of the 30 years of ice-free period preceding the period under consideration). **0 = 0 multiplier, the condition is definitely not achievable, positive values can be adjusted depending on the certainty of achievement**
		-5+20	Hydraulics, flow conditions (flow directions, water speed)	The flow and velocity vectors of the 2D and 3D hydrodynamic models can be used to evaluate and score the variants.
		-5+10	Increased safety of navigation (reduced risk of collisions, run aground)	Knowing the appropriate depth and width, as well as the bend radii, will help to assess the degree of navigational safety.
		-10+40	Rate of water level rise	The extent of the increase in water level due to the interventions is an important criterion for scoring. The more and over the longer stretch of water the variant increases the higher the score
A2) Risks during implementation and operation	-1+5	*-5+20*	**Impact on aquifers,** compliance with legal requirements	Non-compliance with legal requirements is a disqualifying factor, multiplier 0. The score is determined by the degree and extent of the potential for involvement.
		0+10	Complexity of implementation	The complexity of the implementation depends on the works used, their constructability on dry land or from water, and the dimensional tolerance of the works. It is also important that the construction can be carried out in or out of the waterway without disturbing navigation.
		-3+20,	Flood safety	It is essential that flood safety does not deteriorate.The Measured flood level must remain within +3 cm in all variants, which is still within the accuracy of the modelling.
		-2+20	Hydraulic conditions for ice discharge	Ice drainage can only be properly ensured if the interventions are as closely aligned as possible with the control line.
A3) Sustainability of the overall system	-1+5	*0+10*	Annual amount of maintenance age	The annual amount of maintenance dredging, the calculated intervention dredging, was determined. The less needed the higher the score.
		-5+20	Navigation, navigation aspects	The navigation and navigational aspects are favourable if the Danube Commission's fairway is prepared in accordance with the Commission's specifications, with occasional improvements to the bends. If a limited fairway width is applied, the score can be reduced in proportion to the number and length of the sections.
		-5+20	Operational safety aspects	Safety aspects can be scored in the same way as in the previous point.
A4) Smooth operation of the planned traffic growth	0+2	*0+10*	Ease of derivation of the traffic surplus considered	Based on the experience of boaters, we can estimate that the traffic increase taken into account in the design would be about three times the current one.
		0 +10	The possibility of improving and developing the system in place	The more carefully you develop the system, the more you can improve it and try to achieve the desired goal with as little intervention as possible.
A5) Compatibility	-1+5	*-5+10*	With related development plans (port development, ship park, etc.)	The interventions have been designed in coordination with the related plans and their consistency across the variants needs to be assessed.
		0+20	Compliance for river management	Compliance from a river management perspective can be assessed through the application of regulatory principles
		-5+15	Adaptability of the variant to local conditions, flexibility (water intakes, water intakes, uninterrupted operation of ferry crossings, sports clubs, fishing, beaches)	Disturbance of water intakes, water intakes, ferry crossings, sports clubs, fishing, beaches have been identified in the plan, and the adaptation of the variants to these can be assessed by scoring.

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		0+5	Flexibility to choose the date of implementation	The flexibility in the timing of interventions depends largely on the quantity of interventions planned in the waterway and, in the wider waterway, on the quantity of interventions.
A6) Level of adaptation to expected climate change	**-1+3**	***-10+30***	According to the degree of water level rise.	The climate change study showed that a 5% decrease in water yield is expected by 2050, which could mean a drop of 8-9 cm in the water level at the Komárom and Esztergom gauges by that time. Therefore, the extent to which the intervention variants increase the water level is of great importance. A variant that would lead to a water level decrease cannot be proposed.
B) Economic, efficiency and land management issues	**-5+10**			
B1) Need for investment, one-off expenditure	**0 +2**	***0 +15***	B1/1) Investment, initial expenditure Ft, the higher the amount, the lower the score	Here, the investment cost counts and all one-off costs (e.g. dredging) related to the implementation of the projects should be distinguished between direct investment costs (construction, purchase of equipment) and additional costs (complex preparation, other investment e.g. project management, site preparation, land acquisition, inspection, public procurement). The higher the investment amount, the lower the positive score. **+ 15 = 0 variant costs, only IT, signage and other non-construction interventions.**
		0 +5	B1/2) Eligibility for funding	Expected availability of EU/national funding, co-financing. Chances of obtaining potential funding.
B2) Operating conditions	**0 +2**	***0 +8***	B2/1) Annual evolution of operating (running and maintenance) costs Estimate in Ft, taking into account maintenance cycle times	Evolution of annual running costs over 30 years in real terms. The maintenance costs should be given on an annual basis, taking into account the cycle time of each maintenance work. There are annual maintenance costs and periodic maintenance costs. The higher the annual running costs, the lower the positive score. **+8 = current cost level**
		0 +8	**B2/2) Financial viability and sustainability of operation**	The current level of funding (budgetary resources), expected available resources, expected deficits. The larger the deficit, the lower the positive score. **0 = Assumption of serious financing problems means a multiplier of 0.**
		0 +4	B2/3) Institutional, organisational, professional and qualification background of operation	Stability of beneficiary and operator organisations, availability of professionals, available operational resources. Identification of problems and possible solutions The fewer the problems, the higher the score. **+4 = operational conditions are in place and uninterrupted.**
B3 Aggregate size of costs, cost-effectiveness	**-1 +2**	***-5 +10***	B3/1) Present value of the sum of investment, non-recurrent expenditure and operating costs over a 30-year period.	In addition to the annual evolution of total investment and operating costs (investment can be multiannual), the present value (later efficiency calculation) requires a schedule of expected replacements. This requires the technical composition of the investment and the expected lifetime of each component. The higher the present value, the lower the score.
		-5 +10	B3/2) Cost-effectiveness, present value of costs per unit of turnover	The unit of traffic can be vessel number, tonnes of goods or other relevant data, which can be estimated by the technicians for each variant. Efficiency: present value of turnover/cost. The lower the efficiency, the lower the scores.
B4 Direct economic benefits (shipping, transport, GDP, etc.)	**0 +2**			Qualitative and possibly quantitative assessment of impacts. **0 = if no positive impact, +2 is the best option.**
B5) Indirect economic and social benefits	**0 +2**	***0 +4***	B5/1) Impact on water sports, fishing	Qualitative and possibly quantitative assessment of impacts. **0 = if no positive impact, +4 is the best option**.
		0 +4	B5/2) Impact on tourism	Qualitative and possibly quantitative assessment of impacts. **0 = if no positive impact, +4 is the best option**.
		0 +4	B5/3) Environmental benefits	Based on the summary assessment of environmental improvements, ecosystem services assessed in C-score (there is overlap)
		0 +4	B5/4) Employment benefits, contribution to the area's ability to support itself	Separately account for impacts during construction and operation. Qualitative and possibly quantitative assessment of impacts. **0 = if no positive impact, +4 is the best option.**
		0 +4	B5/5) Economic development benefits, possibility of creating new related development programmes	Economic benefits from the impacts of ancillary transport developments (e.g. shipyard, ports). **0 = if not expected, +4 = the option that makes the best use of the opportunities.**

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
B6) Indirect economic social damage	-2 0	*-10 0*	B6/1) Additional charges on the part of the persons concerned	Based on counting the additional expenditure (not necessarily in HUF). **0= if no additional expenditure, -10 = highest.**
		-10 0	B6/2Environmental damage	Based on a summary assessment of environmental degradation, ecosystem services assessed in C-score. **-10 = the most damaging option**
B7) Economic risks	**-2 0**	*-10 0*	B7/1) Changes in shipping demand/traffic (domestic, international) do not require intervention	Estimation based on available projections. **0= zero variant. The score is proportional to the costs and benefits foregone**
		-10 0	Impact on certain economic activities	Economic damage and additional expenditure likely to occur in other activities. **0 = none**
C) Protection of the environment, nature and landscape	-25+15			
C1) Size of the area affected by the intervention	**-2 0**	*-10 0*	Total area used for works (indirect and direct)	The area occupied by the project, its immediate area of influence, is easily defined - it is the same as the area of work. The given score is the total area occupied by the construction activity, which includes not only the actual area occupied by the interventions (excavations, structures), but also the areas where the machinery is parked, storage areas and material stockpiles. The larger the total area, the lower the score, the smaller the score, the higher the score. **0 = smallest extent, -10 = largest,** (The 0 variant does not require any land take, so it is 10 points.)
		-10 0	Dredging area (and area for disposal of dredged material)	As dredging has the greatest impact on the environment of all the different interventions, it is worth highlighting its extent in a separate section. The score is a function of the extent of the proposed dredging - the greater the extent of the dredging, the smaller the extent, the greater the extent. **0 = smallest extent, -10 = largest,** (Option 0 requires no land input, so is the 10 point score.)
C2) Difference in fairway width compared to the current situation	**0 +2**	*0+20*		**If the current width scores 0 points, the narrower version scores proportionally more.**
C3) Impact on aquifers	**-4 0**	***0 or 0 multiplier***	**c3/1 Dredging in the outer/inner protection zone of an operational aquifer**	According to Annex 5 of the Government Decree No. 123/1997 (VII. 18.) on the protection of aquifers, remote aquifers and water installations for drinking water supply, it must be taken into account in the planning that no excavation work (activities affecting the cover or aquifer) may be permitted in the inner and outer protection areas of the coastal filtered aquifers. If this criterion is not fulfilled for each intervention, the alternative is not feasible from the point of view of the protection of the aquifer. **0 = unmanageable problem, 0 = no problem**
		-10 0	c3/2 Dredging [m²] in hydrogeological protection area A/B of operating aquifer	Dredging is only permitted in the area of the A and B protection zones of the aquifers subject to the results of an environmental impact assessment or an individual study with the corresponding content. Although the clear legal prohibition of dredging applies only to the outer protection area, in order to avoid the risk of a subsequent impact assessment, significant overlapping (proposed: max. 25 %) of the small water body part of hydrogeological protection zones A and B should also be avoided. This score is determined by the extent of the impact of the overlapping part of the A/B protection zones on the small water bodies by examining each water body and selecting the one with the highest percentage of impact and scoring it on a scale of 0-10. **0 = no involvement, -1-= 0-1% involvement, -2= 1-4%, -3 = 4-7%, -4= 7-10%, -7=10-13%, -6=13-16%, -7=16-19%, -8=19-21%, -10=23% or more of total involvement**
		-10 0	c3/3 Maintain dredging in the protected area of (remote) aquifers	In the protection zone of remote aquifers, only maintenance dredging that does not substantially reduce the thickness of the gravel layer may be carried out. However, once a decision is taken to put the aquifer into operation, dredging should be stopped and the filter layer may be established during the period until the development is completed. Since it is preferable to use a solution that will not cause problems later, the scoring is based on the extent of maintenance dredging planned for the future aquifers. The score is determined according to the extent of the involvement of the overlapping small water bodies in the protective dykes of the remote aquifers by examining each aquifer and selecting the one with the highest percentage of involvement and scoring it on a scale of 0-10. **0 = no involvement, -1-= 0-1% involvement, -2= 1-4%, -3 = 4-7%, -4= 7-10%, -7=10-13%, -6=13-16%, -7=16-19%, -8=19-21%, -10=23% or more of total involvement**

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-10 0	c3/4 Sedimentation in the protection zone of an operating aquifer	In the vicinity of the spurs, chevron dams, bottom fins and guide vanes, the flow velocity is reduced due to the intervention. This is expected to result in the deposition of smaller particles compared to pre-intervention conditions. The sedimentation and accumulation of the sludge fraction in the riverbed poses a potential water quality risk, as studies on the sediment quality of the Danube show the presence of hazardous substances that can reach the bank-filtered wells when dissolved. A reduction in the capacity of the aquifer can only be envisaged in the event of increased scouring (formation of a thick, packed silt layer) over a significant part of the recharge bed. This is not expected, however, especially due to the loosening effect of tidal surges. The indicator used for the assessment is the proportion of the area within the catchment protection area where silt deposition is expected to occur during periods of significant navigation flooding as a result of the interventions. The sedimentation particle size and intensity are related to the mean velocity (vf) along the contour. Sedimentation is significant (moderate) if 0.0001 < vf ≤ 0.005 m/s and substantial (high) if vf ≤ 0.0001 m/s. The impact associated with the intervention can be identified by the change being at least 0.0001 m/s, i.e. in the original state vf > 0.0051 m/s (significant sedimentation) or vf >0.0002 m/s (significant sedimentation). The velocities for the initial state and the different variations were provided by the BME 2D numerical model. The critical velocities were determined from the Hjulström diagram. The indicator refers to the navigation low flow and does not take into account that sediment discharged during the low flow period may be stirred up during higher flows. However, this neglect does not bias the results, given the persistence of low flow periods and the fact that measurements in the Danube after the 2013 surge in the JDS also indicated concentrations several times higher than the limit values. In terms of impact on aquifers, 4 categories are distinguished: significant (J) and considerable (S) deposition in the external or internal (K) and hydrogeological protection zone A or B (HB), respectively. Total exposure is the weighted average of the four categories with the following weights: KJ: 0,4, KSZ: 0,3, HBJ: 0,2, HBSZ: 0,1 The given score is determined according to the extent of involvement of the part of the outer/inner protective zone of the water bodies overlapping the small water body by examining each water body, selecting the one with the highest percentage of involvement and scoring it on a scale of 0 - -10 based on the level of risk indicated by the indicator. -10 is the score for the probable significant involvement of the water body, which is associated with a 5% value of the indicator, while the other variants are scored with a lower negative value proportional to the value of the indicator.
		-10 0	c3/5 Sinkhole in the protection zone of an operating aquifer	The flow conditions influenced by the structures may locally lead to higher velocities than currently occur. This will lead to washout, which will result in changes in the cover of the coastal filtered aquifer, and the continued flotation of the biochemically active layer will degrade the water quality efficiency of coastal filtration. In the event of significant leaching, the aquifer gravel layer itself may be damaged. The indicator refers to localised leaching associated with the structures, but not to the lowering of the water level associated with the subsidence of the bed, as the technical design conditions preclude in principle solutions with such effects. The indicator used for the assessment is the proportion of the area within the protection area of the water bodies where gravel washout is expected to occur during a significant navigation low flow event as a result of the interventions. The displaced grain size and intensity are related to the mean velocity (vf) along the contour. The sedimentation is significant (moderate) when 0.6 < vf ≤ 1.5 m/s and substantial (strong) when vf >1.5 m/s. The impact associated with the intervention can be identified by the change being at least 0.2 m/s, i.e. in the original state vf > 0.4 m/s (significant sedimentation) or vf >1.3 m/s (significant sedimentation). The velocities for the initial state and the different variations were provided by the BME 2D numerical model. The critical velocities were determined from the Hjulström diagram. The indicator refers to the navigation low water and does not take into account that the washout may be higher at higher flows, while the scoured sediment transported from the upstream section may fill the depressions. This effect cannot be assessed without detailed modelling studies. Four categories of impact on aquifers are distinguished: significant (J) and significant (S) leaching in the external or internal (K) and hydrogeological A or B (HB) buffer zones. The summed impact is the weighted average of the four categories, with the following weights: KJ: 0.4, KSZ: 0.3, HBJ: 0.2, HBSZ: 0.1. The score is determined according to the degree of impact of the part of the outer/inner protective zone of the waterbases overlapping the small water body by examining each waterbase, selecting the one with the highest proportion of impact and scoring it on a scale of 0 to -10 based on the hazard indicated by the indicator. A score of -10 indicates a likely significant impact on the water body, which is associated with a value of 20% for the indicator, while the other variants are characterised by a lower negative value proportional to the value of the indicator.
C4) Adverse environmental impacts of the deployment of the system	**-3 +1**	*-5 0*	c4/1) Air quality impacts and noise and vibration emissions from construction	Construction works, such as the extraction and disposal of sediment, the demolition of regulatory structures and the construction of new ones, generate air pollutants and noise and vibration emissions from the operation of machinery and associated transport. **0 = no impacts, - 7 = worst-case impacts**

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-3 0	c4/2) Causation, avoidability of water quality problems	The proposed development will cause adverse impacts on surface water quality primarily through changes in the condition of the riverbed and construction works locally. The extraction of sediment and the demolition of regulatory works and construction of new ones will also temporarily increase the suspended sediment content of the water. As a result of the disposal of excavated sediment, the sediment (sand and silt) already deposited at the bottom of the riverbed can be reintroduced into the water, which only locally and temporarily increases the suspended sediment content of the Danube water. During construction, accidental events may also occur which have temporary water quality consequences. **0 = no impacts to be assessed, - 3 = the highest probability of water quality problems among the options**
		-5 +10	**c4/3) Impacts on the hydromorphological conditions of the riverbed (e.g. risk of deepening of the riverbed, risk of water level reduction)**	From a hydromorphological point of view, the expected changes during construction can be considered in the context of the way the artificial stone works are constructed and the disturbance of the natural bed by the intervention in the bed and its temporary or long-term effects. In summary, any intervention that impairs or compromises the diversity of the natural conditions of the riverbed will have a negative impact on the hydromorphology of the Danube. The design of works that help to maintain diversity and ensure the navigational purpose with the least possible interference and use of artificial works has little adverse effect, and some measures, such as spur cuts, can have a positive effect on existing artificially regulated stretches. No clear scaling and scoring can be given for the effects on bed subsidence and water level changes and the actual change in bed morphology based on current studies, however, as the degree of regulation increases and although positive effects are expected, artificial works are still introduced into the riverbed, the effects are assumed to be negative.
		-3 0	c4/4) Impact of the dredging activity on the geological medium	Dredging activities can cause the erosion of the overburden, which can have a negative impact on water quality and the quantity of sediment. The score given is a function of the extent of the dredging planned - the greater the extent of dredging, the smaller the extent, the greater. **0 = smallest extent, -10 = largest,** (Variant 0 requires no land input, so is 10 points.)
		-2 0	c4/5) Problems and management of waste from construction works	Under the Waste Management Act, efforts must be made to minimise the amount of construction and demolition waste generated during the intervention. The reuse and recycling of the waste generated is an important aspect of the reconstruction and demolition of individual structures. The use of sludge and soil material resulting from the excavation of the riverbed should be managed at the intervention sites. Proper disposal of the waste generated should be ensured. **0 = the amount of waste generated is minimal and recycling is ensured, - 2 is the worst-case scenario**
		-3 0	c4/6) Disturbance of direct water uses	The construction activity itself may affect direct uses of the river such as fishing, water sports and navigation itself. This is related both to the land take of the works, their duration and their nature. Works affecting the fairway are more likely to disturb the navigation itself, while construction and demolition works closer to the shore are more likely to disturb users of these areas. **0 = no such impacts, - 5 is the worst case scenario in this respect**
		-3 0	c4/7) Summary of the effects on the settlement environment	This criterion is of a summary nature: it aggregates and thus weights the **adverse environmental impacts** [e.g. noise and air pollution caused by construction, traffic changes; (expected) changes in townscape and land use; impacts on cultural and historical values, impacts on municipal infrastructure (e.g. security of drinking water supply)] on **coastal and near-shore settlements. 0= no adverse environmental impacts, -3= impacts of the worst case scenario in this respect**
		-3 0	c4/8) Archaeological, cultural heritage, landscape impacts	The score is based on the expected impact on known archaeological sites, World Heritage sites, World Heritage candidate sites, monuments, local heritage sites, etc. at the current stage of planning. **0= no adverse environmental impacts, -3= worst-case impacts**
		-3 0	c4/9) Transboundary impacts	The development objective is of common interest with the neighbouring countries concerned. The question is whether there could be undesirable transboundary environmental impacts that could cause an appreciable problem for the other party. **0 = no such impacts, - 5 = worst-case impacts**
C5) Conservation impacts during construction and maintenance	**-7 0**	*-5 0*	c5/1) Affected protected natural area of national importance (extent of the direct and indirect impact of the variant on protected areas)	Interventions to improve navigability are essentially river management interventions. In protected natural areas of national importance, river regulation activities may be permitted without any size limitation, even on a very small scale, only subject to a prior assessment or, depending on the decision of the environmental authority in the prior assessment, subject to the outcome of an environmental impact assessment. The number of points will depend on the extent of the overlapping area of the immediate construction and operational areas of the proposed interventions with the protected natural area of national importance. Total length of river sections in protected areas of national importance affected by the construction and operation: -5 points 30 km, -4 points 20-30 km, -3 points 10-20 km, -2 points 5-10 km, -1 point 1-5 km, 0 point 1 km >

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-5 0	c5/2/1) Natura 2000 site affected (extent of the direct and indirect effect of the variant on Natura 2000 sites)	This score is determined according to the extent of the overlapping Natura 2000 area of the direct construction and operational areas of the proposed interventions and the extent of the impact on the conservation status of the species and habitat types of Community importance on which the Natura 2000 site concerned was designated. Scoring: between 0 and -5: Total length of river sections of Natura 2000 habitat network affected by the construction and operation area - 5 points 100 km, -4 points 50-100 km, -3 points 20-50 km, -2 points 10-20 km, -1 point 5-10 km, 0 point 5 km >
		-10 0	C5/2/2) Expected impact on candidate species of Community importance during construction and operation	This score is determined according to the extent of the overlapping Natura 2000 area of the direct construction and operational areas of the proposed interventions and the extent of the impact on the conservation status of the species and habitat types of Community importance on which the Natura 2000 site concerned was designated. Scoring: between 0 and -10: -10 For 3 or more candidate species of Community importance, a significant negative impact is expected during construction or subsequent operation-8 For 1 or 2 candidate species of Community importance, a significant negative impact is expected during construction or subsequent operation-6 For 5 or more candidate species of Community importance, a non-significant but appreciable negative impact is expected during construction, 4 3-4 candidate species of Community importance are not expected to have a significant, but appreciable negative impact during construction or during subsequent operation-2 1-2 candidate species of Community importance are not expected to have a significant, but appreciable negative impact during construction or during subsequent operation0 No candidate species of Community importance are expected to have a significant, but appreciable negative impact during construction or during subsequent operation
		-5 0	C5/2/3) Expected impact on candidate habitat types of Community importance during construction and operation	This score is determined according to the extent of the overlapping Natura 2000 area of the direct construction and operational areas of the proposed interventions and the extent of the impact on the conservation status of the species and habitat types of Community importance on which the Natura 2000 site concerned was designated. Scoring: between 0 and -5: -5 for 3 or more candidate habitat types of Community importance, a significant negative impact is expected during construction or subsequent operation-4 for 1-2 candidate habitat types of Community importance, a significant negative impact is expected during construction or subsequent operation-3 for 5 or more candidate habitat types of Community importance, no significant but appreciable negative impact is expected during construction, or during subsequent operation-2 for 3-4 types of candidate habitats of Community importance, no significant but appreciable negative effects are expected during construction or during subsequent operation-1 for 1-2 types of candidate habitats of Community importance, no significant but appreciable negative effects are expected during construction or during subsequent operation0 no appreciable negative effects are expected during construction or during subsequent operation for any type of candidate habitat of Community importance

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-10 0	c5/3 Number of other rare character species, number of species of special conservation concern and species of Community importance and the nature and extent of the expected impact on their populations	According to the provisions of the Nature Conservation Act, it is prohibited to endanger, destroy or damage without authorisation, endanger or damage the habitats of protected species and species under special protection. In addition, there are rare character species which, although not protected, are of considerable natural value because of their known populations and habitats. The score is determined on the basis of the number of protected, protected and non-protected rare species of conservation value that are negatively affected by the proposed interventions, the size of their populations adversely affected by the proposed interventions and their proportion of the total national population. Scoring: between 0 and -10. Expected impact on protected, specially protected and other rare character species during construction and operation-10 3 or more protected, specially protected and other rare character species with a significant negative impact during construction or subsequent operation, whose native distribution is mainly concentrated in the affected stretches of the Danube-9 1-2 protected, for protected , specially protected and other rare character species, a significant negative impact is expected during construction or subsequent operation, the domestic distribution of which is mainly concentrated in the affected stretches of the Danube-8 for 3 or more protected, specially protected and other rare character species, no significant negative impact is expected, No significant but appreciable negative impacts are expected during construction or subsequent operation for 1-2 protected, specially protected and other rare character species whose domestic distribution is mainly concentrated in the affected stretches of the Danube-7 No significant but appreciable negative impacts are expected during construction or subsequent operation, whose domestic distribution is essentially concentrated in the affected stretches of the Danube-6 5 or more protected, specially protected and other rare character species for which the affected stretches of the Danube do not play a unique role in their domestic distribution are likely to be affected by the construction or subsequent operation-5 3-4 protected, for protected , specially protected and other rare character species, significant negative impacts are expected during construction or subsequent operation, for which the sections of the Danube concerned do not have a unique role in the domestic distribution-4 for protected, specially protected and other rare character species 1-2 significant negative impacts are expected during construction or subsequent operation, 5 or more protected, specially protected and other rare character species for which the stretches of the Danube concerned do not have a unique role in the domestic distribution of the species, but for which no significant but appreciable negative impact is expected during construction or subsequent operation, and for which the stretches of the Danube concerned do not have a unique role in the domestic distribution of the species-2 3-4 protected species, for protected , specially protected and other rare character species, no significant, but appreciable negative impacts are expected during construction or subsequent operation, where the sections of the Danube concerned do not play a unique role in the domestic distribution of the species-1 for protected, specially protected and other rare character species 1-2 no significant, but significant negative impacts are expected during construction or subsequent operation, for which the sections of the Danube concerned do not play a unique role in the domestic distribution0 No negative impacts are expected during construction or subsequent operation for any protected, specially protected and other rare character species

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-10 0	c5/4) Extent of habitat loss in the Danube river basin as aquatic habitat (expected extent of loss)	In the longer term, some of the river management interventions may lead to the recharge of part of the mid-water cross-section. This phenomenon can also be observed in many places along the Danube, especially at diversion works that reach all the way to the mid-water bed. As the successional process progresses, the recharged riverbeds become less and less durable and then become overgrown with forest, gradually losing their habitat functions for the aquatic fauna of the Danube. This score is determined by the nature and extent of the medium and longer-term impacts of the planned interventions on the wetted cross-section at medium and low water levels. Scoring: between 0 and -10. Extent of the medium and small water bodies that will disappear in the longer term as a result of the planned interventions due to recharge during the operational phase. -10 points 180 ha, -9 points 160-180 ha, -8 points 140-160 ha, -7 points 120-140 ha, -6 points 100-120 ha, -5 points 80-100 ha-4 points 60-80 ha, -3 points 40-60 ha, -2 points 20-40 ha, -1 point 1-20 ha, 0 point <1 ha
		-6 0	c5/5) Nature and extent of the impact on the habitat diversity of the Danube river basin	In general, habitats with higher diversity, greater small- and medium-scale heterogeneity and higher habitat-level diversity tend to provide suitable habitat for a more diverse, species-rich community. This general statement can also be true for watercourses as habitats. Some of the river management interventions result in a more homogeneous and homogenous river section, which reduces the habitat diversity (the range of habitat types found with different substrate types and flow velocities) of the river section. This score is determined according to the direction and extent of the impact of the proposed interventions on the habitat diversity of the river reach concerned, taking into account the expected impact on the relative proportions of substrate types and the relative proportions of water body compartments with different water depths and flow velocities. Scoring: between 0 and -6. Dredging and, percentage of the total surface area of the stretch affected by the works that will become more homogeneous as a result of the control works - 6 points Long-term loss of habitat diversity due to significant dredging and significant quarrying -5 points Long-term loss of habitat diversity due to moderate dredging and significant quarrying - 5 points 3 points Long-term habitat level diversity loss due to significant dredging and moderate quarrying 2 points Long-term habitat level diversity loss due to moderate dredging and moderate quarrying 1 point Only minor habitat level diversity loss expected 0 point Negligible habitat level diversity loss expected
		-9 0	c5/6) Nature and extent of the impact on the ratio of artificial to natural substrate	Based on the available survey results and field experience, in most cases, alien native and invasive species occur in the Danube in habitat patches characterised by artificial substrate types, with higher than average species and number of individuals. The spread of alien and invasive species is known to have a negative impact on the populations of native species in the Danube. Most of the river control works are constructed of hydraulic engineering stone, which can be considered as an artificial substrate type in the Danube. This score is determined on the basis of the direction and extent to which the planned interventions will affect the extent of the artificial substrate cover in the river section concerned. Scoring: between 0 and -9. -9 points 48 ha <, -8 points 42-48 ha, -7 points 36-42 ha -6 points 30-36 ha, -5 points 24-30 ha, -4 points 18-24 ha, -3 points 12-18 ha, -2 points 6-12 ha, -1 points 2-6 ha, 0 points <2 ha

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-10 0	c5/7) Nature and extent of the impact on the water balance of the Danube habitats (from tributaries to habitats further away from the Danube affected by the Danube water level)	One of the most striking consequences of river management interventions in Hungary over the last century and a half has been the process of shallowing of the bed of small water bodies, whereby the bottom level of the small water body has been lowered to a level lower and lower than the surrounding areas. During low flow periods, rivers typically drain the groundwater resources of surrounding areas at their current water level. As a result of low-flow river bed subsidence, rivers are draining groundwater from surrounding areas at increasingly lower levels, resulting in significant groundwater level declines in areas along their beds. Depending on the hydrological characteristics of the areas concerned, the magnitude of the long-range effects of groundwater level declines associated with low flow periods can be very significant. This is also the case along the domestic Danube section. Declining groundwater levels have a negative impact on the water balance of groundwater-dependent ecosystems in the affected areas, leading to water scarcity and consequent degradation of ecosystems. The score is determined on the basis of the direction and extent to which the planned interventions will affect the evolution of the small water table and the height of the bed above sea level in the river section concerned. Scoring: between 0 and -10. The extent to which the planned interventions will have a downward impact on the groundwater level in the areas draining the riverbed. -10 points very significant shallow water subsidence and therefore a significant impact on groundwater levels-8 points significant shallow water subsidence and therefore a significant impact on groundwater levels-6 points moderate shallow water subsidence and therefore a moderate impact on groundwater levels- 4 points slight shallow subsidence of the bed and consequent reduction in groundwater level 2 points very slight shallow subsidence of the bed and consequent reduction in groundwater level 0 points no shallow subsidence of the bed and consequent reduction in groundwater level expected
		-5 0	c5/1) Affected protected natural area of national importance (extent of the direct and indirect impact of the variant on protected areas)	Interventions to improve navigability are essentially river management interventions. In protected natural areas of national importance, river regulation activities may be allowed without any size limitation, even on a very small scale, only subject to a prior assessment or, depending on the decision of the environmental authority in the prior assessment, subject to the outcome of an environmental impact assessment. The number of points will depend on the extent of the overlapping area of the immediate construction and operational areas of the proposed interventions with the protected natural area of national importance. Total length of river sections in protected areas of national importance affected by the construction and operation area: -5 points 30 km <, -4 points 20-30 km, -3 points 10-20 km, -2 points 5-10 km, -1 point 1-5 km, 0 point 1 km >
C6) Environmental impacts due to traffic changes	**-2+4**	*-7 0*	c6/1) Consequences of emissions (air pollutants, noise) due to increased shipping traffic	During the operational period, the additional pressure along the shipping route (air pollutants, noise) is due to the increase in vessel traffic resulting from the development. **0 = status quo, - 7 worst case scenario**
		-3 0	c6/2) Changes in bank and shore erosion (increased traffic, decreased narrower fairway)	Constant wave action causes bank and shore erosion, and constant wave action can lead to the collapse of thick filter layers and the loss of stability of coastal defences. Wave action increases with increasing vessel traffic. The given score is a function of vessel traffic, the higher the vessel traffic the higher the anegative value, the lower the anegative value the lower the anegative value. **0 = current state**
		-5 0	c6/3) Possibility of landscape and land use changes due to the development of the entire water transport system	It is difficult to estimate the changes in landscape and landscape use caused by the interventions expected by the development of the entire water transport system. Aspects that can be examined at this stage of the planning process: which surface coverings, protected natural areas of national importance (in particular: landscape conservation area) are affected by the planned interventions, and the extent of overlap with the national landscape conservation area (in particular: in the case of installations above the water surface). **0= no change in the current situation or changes not related to interventions for navigability, -5= significant negative trends in areas with valuable natural landscape features**

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-5 +5	c6/4) Ecological impacts of vessel traffic (increased traffic increased, narrower waterway decreased)	Vessel-induced wave action near the shore leads to significantly increased near-bottom flow velocities and bottom-slip stresses, which can threaten the biota of the seabed. If bottom-slip stresses are sufficiently high, fish crustaceans, juveniles, macroinvertebrates and other benthic organisms on the seabed may drift away from the near-shore zone of safety into areas dominated by current velocities where their survival chances are close to zero. Vessels' engines and propellers can also damage the biota of a watercourse, and not only through mechanical impacts. These components emit extremely loud noise when they are in operation and can easily damage the senses and hearing of certain fish species, for example. The adverse effects are of course amplified in the case of species that rely primarily on their hearing to find their way around and to obtain food (predatory fish). The score is a function of the vessel traffic, the width of the fairway and the structures installed, and the score should be based on these three factors. **0 = current status**
		0 +15	c6/5) Total emissions reduction due to offsetting	Transport is a major source of air, noise and vibration pollution. Road transport is the most significant, with rail and waterborne transport playing a much smaller role. This means that a major shift from road to waterway reduces the overall emissions from the transport sector. The extent of this is also influenced by the rate of fleet modernisation. This and the following two effects are the main rationale and justification for the whole development. **0 = no such impact**
		0 +10	c6/6) Change in total transport energy demand	The energy demand of the transport sector is very high and is typically met by petroleum derivatives, which are currently subject to inelastic market conditions. A slowly changing, low energy-efficient and polluting vehicle fleet is an inherent problem. The energy demand of waterborne transport is, on average, about a third of that of road transport. Plans foresee a reduction in the overall energy use of the transport sector after 2020, which could amplify the positive effects of decarbonisation. **0 = no such effect,**
		0 +10	c6/7) Changes in land take resulting from congestion	The increase in traffic constantly requires the expansion of roads, especially motorways, which leads to significant land take and loss of green spaces. With the shift of traffic to waterways, this land take may be reduced. Especially if economic growth is not accompanied by a constant increase in transport demand, so that, unlike the previous two points, only major diversions can have a positive impact. **0 = no such effect**
C7) Environmental impacts on the operation of the waterway, maintenance of the new status, impacts of the existence of the new system.	**-2 +3**	*-15 0*	c7/1) Effects of carrying out maintenance dredging	The given score is a function of the extent of the planned dredging (more precisely 20% of the planned dredging) - the greater the extent of the dredging, the lower the score, the smaller the extent, the higher the score. (Variant 0 requires no land take, so it scores 0.) **0 = no maintenance dredging, -15 = the variant with the highest dredging requirement**
		0 +10	c7/2) Opportunities for improved water supply to tributaries	Various interventions on tributaries (dredging, opening and widening of inlets and estuaries) can improve the water supply of tributaries, even during low flow periods. The score is given by the number of water supply improvement interventions per tributary. **0= No such intervention**
		0 +10	c7/3) Creation or potential creation of new wetland and aquatic habitats, potential for improvement of existing habitats potential compensatory measures	Areas disturbed by the intervention may lose their habitat function. To mitigate this impact, certain technical solutions can serve as habitat preservers. The inner, flow-protected parts of chevron dams are suitable for this function, and the score is given by the number of chevron dams to be installed. Scoring: between 0 and 10. Scoring according to the number of chevron dams to be installed: 10 points 35< units, 9 points 31-35 units, 8 points 26-30 units, 7 points 21-25 units, 6 points 16-20 units, 5 points 11-15 units, 4 points 8-10 units3 points 6-7 units, 2 points 3-5 units, 1 point 1-2 units, 0 point 0 units
		-5 +10	c7/4) Changes in the evolution of ecosystem services in the new state after the intervention	Ecosystem services are the goods and services of the living world that humans use directly or indirectly during their lives, and whose condition determines their quality of life. In our case, we are concerned with three basic types of services. Habitat regulating functions include climate regulation, flood mitigation, water purification and soil formation. (The cultural service function is not addressed, it is included under acceptability under D.) In this case, the extent and nature of the interventions are the basis for the assessment. We can take into account factors such as reproductive capacity, self-clearance, vegetation eradication, new habitats, etc. **0 = no change, compared to negative values indicating deterioration and positive values indicating improvement**. The effects of changes in turnover are not taken into account here.)
C8) Assessment under CCI 4.7	**-1+2**	*-5 +10*	**c8/1) The status of the affected water bodies is expected to be downgraded in the course of the WFD 4.7 analysis**	The hydromorphological status and biological status values should be given priority. This variant assessment should be preceded by a so-called applicability (screening) test of the VKI 4.7 assessment. It should be established whether there are any classification parameters that are likely to cause deterioration in any category. There may be an improvement compared to the current situation. **-5 = category deterioration, i.e. a multiplier of 0.**

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		0 +5	c8/2) Whether appropriate mitigation measures have been applied	It is the responsibility of the technical designers to take account of potential mitigation measures and these should be identified in the description of the variants, in our case the development of the variants themselves also constitutes mitigation. **0 is the variant with no mitigation measures, +5 is the variant with significant mitigation measures**
		-5 +5	**c8/3) Threatening or supporting the achievement of the objectives set for the water bodies concerned**	It should be determined whether the measures in VGT2 are impeded or supported by the project variant; if the impediment to the objectives is significant, the variant should be excluded. **0 = no effect, -5 = existence of significant barrier, 0 multiplier, +5 = existence of significant supporting effect**
C9) Environmental risks during the operation of the established fairway	**-2 0**	-5 0	c9/1) Changes in the risk of shipping accidents due to traffic growth and the new fairway	Inland waterway transport has accident rates that are orders of magnitude better than all modes of transport.However, increased traffic and narrower shipping lanes also increase the potential for accidents, which can lead to the release of pollutants, mainly petroleum derivatives and hazardous substances carried by ships, into living water and aquifers. Since the risk of accidents is difficult to estimate, we calculate the increase in the potential for danger, in this case the number of locations where ships are more likely to encounter each other, and thus the extent to which fairway narrowings are applied gives the score. **0 = No points considered dangerous, -5 = Worst alternative in this respect**
		-5 0	c9/2) Dredging risks	The given score is a function of the extent of the planned dredging (more precisely 20% of the planned dredging) - the greater the extent of the dredging, the lower the score, the smaller the extent, the higher the score. **0 = smallest extent, -5 = largest**, (Variant 0 requires no land input, so is a score of 0.)
		-5 0	c9/3) Increased likelihood of water quality incidents (e.g. ship discharges)	The change in surface water quality impacts associated with water transport development is mainly due to the increased number of vessels. In terms of water quality, pollution from accidents and water pollution related to shipping itself, e.g. hydrocarbon pollution related to ballast water, bottom water discharge, etc., can be highlighted. The score is partly determined by the difference between the increase in traffic and the risk of accidents. **0 = current situation**
		-5 0	c9/4) Development of critical local air quality situations	The occurrence, frequency or severity of localised critical situations in certain locations as a consequence of air pollutant emissions from increased shipping traffic. **0 = current situation, - 5 is the worst case scenario**
C10) Climate risk	**-2+3**	-4 +5	c10/1) Impact of changes in shipping traffic on GHG emissions from waterborne transport	If the investment is completed, Danube shipping traffic will increase, which will also lead to an increase in GHG emissions. We score each option according to the increase in shipping traffic and thus GHG emissions. For the scoring, the GHG emissions are indicated. Depending on the composition of traffic, the increase in emissions due to increased traffic can be partly compensated by the spread of more modern, energy-efficient ships (forced by stricter environmental requirements), which is why the scoring range is +5, which is a positive effect.
		0 +20	c10/2) Impact of shifting road transport services to shipping on total GHG emissions from transport	If the investment target is met, Danube shipping traffic will increase and transport services are expected to shift to shipping, which has lower GHG emissions. The scoring of this option is based on the extent to which road transport services are shifted to shipping, and the scoring scale is therefore positive (0-20). If 100% of the increase in traffic is due to the transfer from road, a maximum score is given, if 0%, a score of 0 is given. (1 point = 5% traffic increase from road mode shift)
		-4 0	c10/3) To what extent can the navigation conditions be ensured for a 1 -7% reduction in water yield according to the model simulation results?	According to the results of the long-range modelling of water yields, a reduction in water yield of 1-7% is expected in the 11 sections under consideration for the period 2020-2050. The alternative is scored according to the extent to which navigation conditions can be ensured under the future changes in water yield. For this reason, a range of scores from 0 to -4 is given.
		-4 0	c10/4) To what extent can navigation conditions be ensured in the event of variable weather conditions expected as a result of climate change?	The analysis so far indicates that the planned investment Danube section will experience more extreme water flows. We score each alternative according to the extent to which navigation conditions can be ensured under the extreme water conditions expected in the future. For this reason, a range of scores from 0 to -4 can be given.
		-3 +2	c10/5) Consideration of adaptation measures to climate change	The ICPDR Adaptation Strategy and the guidelines of the second National Climate Change Strategy provide guidance for the climate change assessment of each option. A variant is scored according to the extent to which any adaptation action has been taken into account, hence the range of scores from -3 to +2.
		-2 0	c10/6) Degree of vulnerability of technical solutions to climate change	Vulnerability shows the likelihood of each option to cause significant damage to the implemented facility, and also compares which of the options is best suited to mitigate the impacts. In the analysis, the vulnerability of each technical solution is evaluated and scored for each option in relation to the future. For this reason, a range of scores from 0 to -2 is given.

Criteria groups	Point scale		Component sub-criteria	Evaluation system for each criterion
		-3 + 3	c10/7) Change in the extent of CO_2 sequestering, bioactive surfaces	If the project will lead to a reduction in algal biomass (due to climate change and human interventions), which is clearly negative in terms of CO2 sequestration, the alternative is scored according to the expected reduction in algal biomass and the expected reduction in plant eradication, and is therefore scored from -3 to +3.
D) Social and acceptability issues	-5+5			
D1) Acceptability to data subjects	**-2+1**	*-10 +5*	d1/1) Acceptability for angling	Qualitative and possibly quantitative assessment of impacts, consultation with stakeholders, **-10 = unacceptable, +5 if acceptable without change.**
		-10 +5	d1/2) Acceptability for water sports	Qualitative and possibly quantitative assessment of impacts, consultation with stakeholders, **-10 = unacceptable, +5 if acceptable without change.**
D2) Compliance with the preferences of the relevant water management organisations, the National Park and the relevant Authorities	-3+3	*-10 +10*	d2/1) Expected reception in the National Park	Consultation with stakeholders to assess acceptability or ask them for a direct assessment. **highest negative value = unacceptable option, so 0 multiplier, highest negative value = acceptable without change.** Exclusionary judgement by any stakeholder, may exclude the variant if it is not modified.
		-10 +10	**d2/2) Acceptability for operators**	
		-5 +5	**d2/3) Expected reception by water protection and environmental authorities**	
		-5 +5	d2/4) Professional judgement in shipping, transport	
D3) Employment effects	**0+1**	*0 +10*		Estimation of expected employment-enhancing effects, taking into account, for example, maintenance tasks or traffic growth effects. **0 = no effect, +10 if there is a direct and indirect employment effect of significant magnitude.**
Total	-40+60			

"The project of the Trans-European Transport Network - Trans-European Transport Network - NIF Zrt.
Design tasks related to the development of the TEN-T inland waterway"
under a design contract
2014-HU-TMC-0606-S

DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 4 TO THE ENVIRONMENTAL ASSESSMENT

Transport and environmental objectives of the related documents and their relation to the objectives of the Programme

Budapest, September 2020

Table of contents

1. EUROPEAN AND NATIONALTARGETS FOR WATERBORNE TRANSPORT

1.1. TRANSPORT POLICY FRAMEWORK FOR THE DEVELOPMENT OF SHIPPING

In order to achieve a larger share of freight transport from shipping than at present, the European Union has announced several action policies:

- An integrated European action programme for the promotion of inland waterway transport - "NAIADES" (European Commission, 2002) was launched in 2006.
- For the Danube region, the European Union Strategy for the Danube Region provides the framework for transport policy (European Commission, 2010b).

The action programmes or national transport strategy plans for the development of inland waterway transport set out the objectives of transport policy on a country-by-country basis, in line with the above-mentioned programmes at European level.

1.1.1. EUROPEAN TRANSPORT POLICY FRAMEWORK

1.1.1.1. EU 2020

The EU's Europe 2020 strategy, adopted in 2010, sets out the EU's priority policy and transport policy goals and strategies for 2020. Accordingly, it provides the policy framework for the further development of inland waterway transport (European Commission, 2010a). In a rapidly changing world, the EU wants to ensure growth that

- smart (through effective investment in education, research and development),
- sustainable (thanks to decisive steps towards a low-carbon economy and more competitive industry), and
- community-friendly (with a strong emphasis on job creation and poverty reduction).

The process is guided by five policy objectives, which allow for the measurement of progress. Climate change and energy policy, together with research and development, are priorities for inland navigation.

1.1.1.2. White Book [1]

The European Commission's 2011 White Paper on Transport Policy, Roadmap to a Single European Transport Area - Towards a competitive and resource efficient transport system (European Commission, 2011), sets ambitious targets to reduce oil dependency and CO_2 emissions. For the latter, the target is a 60% reduction by 2050 compared to 1990 levels.

The White Paper recognises inland waterway transport as an energy-efficient mode of transport and encourages its increased share in the division of labour between sectors. The following objectives of the White Paper are particularly relevant for IWT:

- 30% of road freight transport over 300 km should be shifted to other modes, such as waterways, by 2030, and by 2050 this should exceed 50%.
- This can be facilitated by creating efficient and green multi-modal transport corridors.
- A fully operational and EU-wide multi-modal TEN-T core network by 2030, upgraded to a high quality service and high capacity system by 2050, with adequate information back-up. In this context, European ports will play a prominent role as a link between the different modes of transport. -Within

[1] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:HU:PDF

the EU's Trans-European Transport Network (TEN-T-), the Danube forms part of such a corridor as the 10th Strasbourg-Danube -Core Network Corridor.

- An equivalent management system (River Information Services - RIS) should be set up for inland and waterway transport.

1.1.2. EU OBJECTIVES AND STRATEGIES DIRECTLY RELATED TO SHIPPING, THE NAIADES ACTION PROGRAMME

The European Union's policy on inland waterway transport is set out in the NAIADES action programme for the promotion of inland waterway transport launched by the European Commission (European Commission, 2006). This programme was first published in 2006 and includes legislative, coordination and other support measures. NAIADES II 2013-2020 aims to make inland waterway transport a quality mode of transport.

Up to 2020, the NAIADES II action programme foresees strategic developments in five areas: infrastructure, markets, fleet, job creation and training, and river information services. The aim is to facilitate the use of the capacity provided by inland waterways while preserving the sustainability of inland waterway transport in Europe.

1.1.3. MAIN PROJECTS AND THEIR RESULTS IN IMPLEMENTING TRANSPORT POLICY

1.1.3.1. PLATINA projects

The PLATINA project (*Platform for the Implementation of NAIADES*) was set up to implement the strategies and actions of the NAIADES Action Programme in a coordinated way.

The European Commission launched the project in 2008 to effectively implement measures and actions to promote inland waterway transport. The project brought together 22 partners from 9 European countries to promote the implementation of the NAIADES European Inland Waterway Transport Programme in the following 5 areas:

- opening new markets for inland waterway transport
- stimulating innovation in the fleet
- developing better career opportunities and skills in inland waterway transport
- raising awareness and promoting a positive image of inland navigation
- the development of the infrastructure framework for inland waterway transport, taking into account environmental and safety requirements, guidelines to promote the sustainable design of projects aimed at developing waterway infrastructure.

*Manual on best practices in sustainable waterway planning (*2010), one of the project's outputs concerning the infrastructure component

PLATINA II builds on the results of the PLATINA project (2008-2012) and is in line with the NAIADES action programme. The programme is implemented by a consortium of 12 partners from seven different countries under the coordination of Viadonau and funded by the European Commission (DG MOVE) under the Seventh Framework Programme for Research and Technological Development.

Chapter 5 deals with the development of the infrastructure framework as follows:

- Support for the integration of inland waterway transport into the multimodal TEN-T corridors
- Promoting the development and implementation of river information services
- Supporting knowledge exchange in the maintenance of inland waterways

One of the project's outputs on the infrastructure component is the *Good Practice Manual on Inland Waterway Maintenance - Focus: Fairway maintenance of* free-flowing *rivers* (2016)

1.1.3.2. NEWADA projects

NEWADA (Network of Danube Waterway Administrations) is a network of Danube waterway administrations aiming to increase the efficiency of the Danube as the VII European Transport Corridor by enhancing cooperation between waterway administrations in order to promote inland navigation as a cost-effective and environmentally friendly mode of transport.

NEWADA started in April 2009 and ended in March 2012, with a duration of 36 months. The project team consisted of 12 project partners from 8 Danube countries.

- **NEWADA DUO (Data and User Orientation) project**

The main objective of the project was to achieve a uniform level of service along the Danube in all aspects of the fairway maintenance cycle, i.e. river bed monitoring and survey (hydrology and hydrography), dredging of fording areas, realignment of the fairway and customer-oriented information through various tools and services.

NEWADA Duo started in September 2012 and ended in August 2014. The project group consists of 9 project partners from 7 Danube countries (Austria, Bulgaria, Croatia, Hungary, Romania, Serbia, Slovakia and Romania). Total budget: 2 239 287,20 EUR

- **Danube STREAM project - Harmonised, integrated and smart waterway management**

The main objective of Danube STREAM is to create a harmonised, innovative, pro-active and efficient waterway management along the Danube.

In addition to the consolidation of common standards and tools (e.g. the production of depth-data navigation charts and accompanying information or the new mobile application Danube Waterway Information Services website), Danube STREAM's results and outputs include user-oriented information services that allow for the rapid transfer of information on the quality of water infrastructure. The project activities at strategic level include: cooperation with stakeholders (ecology, navigation), coordination with the political level (EUSDR).

STREAM started in January 2017 and ended in June 2019. Partners from 8 Danube countries are involved in the project, 7 of which are project partners (Austria. Slovakia, Hungary, Croatia, Serbia, Romania, Hungary, Serbia and Bulgaria), while Germany participated as an associated strategic partner. Project budget: approx. 2.2 MEUR

1.1.4. WATERBORNE TRANSPORT IN THE DANUBE REGION STRATEGIES

1.1.4.1. Danube Region Strategy Priority Area 1a[2]

The EU Strategy for the Danube Region (EU DRS) is in force from 2011 (European Commission, 2010b). This macro-regional strategy covers 14 countries along the Danube, including EU Member States, candidate countries and third countries. In addition, a number of other actors are involved in the implementation of the Strategy.

The Strategy is planned to be implemented by 2020, according to an action plan based on four pillars:

- Connecting the Danube region with other regions
- Environmental protection in the Danube region
- Creating prosperity in the Danube region
- Strengthening the Danube Region

The European Union and all the Danube countries have set firm targets and action steps for the pillars. The four pillars are further broken down into eleven Priority Areas. Austria and Romania are jointly coordinating Priority Area 1a, "Improving Mobility and Multimodality - Inland Navigation".

[2] https://dunaregiostrategia.kormany.hu/download/b/c3/70000/action_plan_danube_hu.pdf

The objectives of the Danube Region Strategy Priority Area 1a on Inland Waterways are:

- Increase freight transport on rivers by 20% by 2020 compared to 2010.
- Removing bottlenecks to navigation, taking into account the specific circumstances of each section of the Danube and its navigable tributaries, and implementing efficient waterway infrastructure management by 2015.
- Develop efficient multi-modal terminals in the ports of the Danube and its navigable tributaries by 2020, in order to link inland waterways with rail and road transport.
- Implement harmonised River Information Services (RIS) along the Danube and its navigable tributaries and ensure RIS data exchange at international level, preferably by 2015.
- Addressing the shortage of professionals and harmonising educational standards in inland navigation in the Danube region by 2020, taking into account the social implications of each measure.

1.1.4.2. Joint Statement on "Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin"

The aim of the Joint Statement is to provide guidance to decision-makers involved in inland waterway transport and environmental sustainability, as well as to water management organisations involved in the development of river navigation and environmental plans, programmes and projects. The process of developing the Joint Statement has been initiated by the International Commission for the Protection of the Danube River (ICPDR), the Danube Commission (DB) and the International Sava River Basin Commission (ISRBC).

The Joint Statement was developed in 2007 as the result of an intensive process of cross-sectoral consensus building involving stakeholders with an interest in and responsibility for navigation, river ecological integrity and water management at Danube river basin level.

In the declaration, the following recommendations were made:

An integrated planning approach for the Danube river basin: actions to improve the current status should be seen from the perspectives of inland water transport (IWT) and ecological integrity, and should focus in particular on:

- River sections requiring fairway development and associated impacts on specific ecological quality and water status.
- River sections requiring ecological conservation/restoration and associated impacts on navigation.

Integrated design principles (extract):

- Creating interdisciplinary design teams
- Identify common planning objectives.
- Establishing a transparent planning process
- Seek to avoid the effects of structural/hydraulic engineering interventions or, where this is not possible, to minimise their effects on the river system through mitigation and/or restoration, giving priority to reversible interventions.
- Ensure that climate change and its associated impacts are taken into account in the design of shipping projects.

- Implementation of best practice measures to improve navigation (PLATINA Manual on Good Practices in Sustainable Waterway Planning, PLATINA II. Good Practice Manual on Inland Waterway Maintenance Focus: Fairway maintenance of free-flowing rivers)

Criteria for river management (the above-mentioned design principles can be taken into account in the design phase of navigation projects by the following criteria):

- Use a case-by-case approach that takes into account the ecological needs of river sections and the catchment level, as well as the strategic requirements of IWT at the catchment level when determining the appropriate width and depth of the fairway.
- "In cooperation with nature", wherever possible, by implementing measures in accordance with the natural river morphological processes, respecting the principle of minimum or temporary technical intervention.
- Integrated design of control systems, taking into account hydraulic, morphological and ecological criteria in equal measure.
- Implementing measures in an adaptive way (e.g. river bed stabilisation with granulometric bank stabilisation, small water control with spurs)
- Optimal use of the river restoration potential (e.g. river bank restoration) and reconnection of tributaries.
- Ensuring that flood levels are not exacerbated and ideally are reduced.

1.1.4.3. Fairway Maintenance Master Plan

To achieve these goals, in 2012, the majority of transport ministers in the Danube region signed a declaration expressing their commitment to implementing effective water conservation measures ("Luxembourg Declaration", 2012). The "Fairway Maintenance Master Plan for the Danube and its navigabletributaries" is based on the Declaration of the Danube Region Transport Ministers.

The Master Plan provides an overview of existing critical water sections, locations, needs and actions. Experts from the waterway maintenance organisations have identified so-called common minimum service levels for different waterway maintenance activities (e.g. 2.50 m navigation depth). The document identifies, for each coastal state, the key issues and remaining action needs to achieve the different levels of service.

Service levels for maintenance refer to the minimum parameters of the fairway. The fairway depth is 2.5 m at navigable low water (ENR, LKHV), which is the water level corresponding to a water yield of 94% (343 days) of water duration calculated from the data of the ice-free period of 30 years preceding the period under consideration.

The width of the fairway (the ranges of values are due to different fairway curvature radii):

- 4080 -m in Austria
- -60100 m in Slovakia and on the Slovak-Hungarian border
- 80120 -m in Hungary
- 80 m in Croatia, Serbia, Romania and Bulgaria (including border sections).

1.1.4.4. FAIRWAY Danube project

As a first step in the implementation of the Fairway Maintenance Master Plan, the EU CEF-funded Fairway Danube project has been launched to provide up-to-date and harmonised information on ford sections, water levels and water level forecasts.

Fairway Danube wants to contribute to making inland navigation safer, more efficient and greener by taking the following steps:

1. Regularly update the national action plans on progress in implementing the Master Plan (twice a year, in October and May)
2. Modern procurement of hydrological services (water measuring stations, measuring boats with multibeam and single-beam measuring systems, display boats)
3. Carry out pilot activities and evaluate the results:
    - Collecting river basin data for all critical sections of the Danube waterway

- Analysis and evaluation of data collected as a basis for coherent monitoring of navigation status
- Harmonised water level forecasts
- Optimised guidance of the fairway based on current depth measurements
- Developing innovative approaches in the field of aerial surveillance (drone), advanced navigation aids (AtoN) and all other supporting tools for fairway rehabilitation

Fairway Duna is an ongoing project, which started in July 2015 and will end in December 2020. The partners are 7 organisations from 6 Danube countries (Austria, Slovakia, Hungary, Croatia, Bulgaria and Romania). The project budget is around €23.4 million and the lead partner is Viadonau - an Austrian waterway company.

1.1.5. THE DEVELOPMENT OF WATERWAYS IN NATIONAL TRANSPORT AND SPATIAL DEVELOPMENT STRATEGIES AND PLANS

1.1.5.1. Integrated Transport Strategy (ITS) [3]

The ECFS, the Hungarian "White Paper", is a review of the country's transport policy. The Hungarian transport policy documents have for a long time included the promotion and development of environmentally friendly modes of transport (freight and passenger transport) as an important policy objective, and since EU accession as a priority.

Hungary is promoting the development of combined transport in inland waterway transport, complemented by comprehensive logistics services and information systems. The ECFS anticipates that the volume of inland waterway freight transport on the Trans-European Core Transport Network VII, formed by the DMR waterway system, is likely to increase significantly in the context of EU enlargement. Traffic could also be boosted by an increase in East-West trade flows, port developments in the Adriatic and the Black Sea generated by EU-China trade.

The Sustainability Appraisal of the ECFS rightly states that maintaining the target of favourable work-sharing ratios and setting in motion such a process requires complex transport policy interventions. Preventing a modal split, i.e. a deterioration in the division of labour between modes of transport (further strengthening of road transport), can be achieved by **maintaining the share of environmentally friendly modes of transport**, which is a major technical, economic, organisational and legislative task. Only if all these measures are taken together will it be possible to reduce the negative social and environmental impact of transport. Increasing the modal share of rail, waterborne and combined transport is considered to be positive from an environmental and social point of view, but the expected impacts are low.

1.1.5.2. National Danube Waterway Transport Action Plan [4]

The actions included in the 2013 Action Plan aim to improve navigation on the Danube. It sets out actions in key areas (waterway infrastructure, institutional framework, ports, fleet, freight, passenger transport) identified in line with the current objectives and challenges of shipping.

Its objectives include port development and logistics to strengthen the links of inland waterways in the transport chain and to increase the role of waterborne freight in the multimodal transport chain.

Planned actions include the development of national public ports, mobilising EU and national funds, the organisation of overall port ownership, professional marketing and the involvement of advocacy organisations. Infrastructure development, fleet modernisation, regulatory framework development, enterprise development, etc. are all included to improve the volume of waterborne freight transport.

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3 http://www.terport.hu/webfm_send/2707

4 https://docplayer.hu/18926205-Nemzeti-dunai-vizi-kozlekedesi-akcioterv.html

1.1.5.3. Logistics Sector Policy Strategy

The overarching objective of the Policy Strategy (2014-2020) is to increase the contribution of the logistics sector to the competitiveness of the Hungarian economy and the national economy by promoting the development of logistics resources, connectivity and innovation in Hungary in the period 2014-2020, in line with its expected weight in the national economy.

The Policy Strategy lists only the Budapest Intermodal Logistics Centre (BILK) and the Csepel Free Port as centres of European priority. The level of development and equipment of logistics centres in Hungary is below the Western European level. The larger Hungarian ports (Baja, Győr-Gönyű, Mohács, Csepel Free Port, Dunaújváros) have the basic infrastructure and intermodal connections, but their visibility is significantly lower than that of their Western European competitors.

More emphasis should be put on marketing the services of Hungarian ports in terms of actual capacity, equipment and additional services. The strategy highlights the need to support logistics infrastructure, including the development of intermodality and transport infrastructure in industrial parks and logistics centres.

1.1.5.4. National Transport Strategy(NTS) [5]

The National Transport Infrastructure Development Strategy (hereinafter referred to as the Transport Strategy) was prepared as a result of extensive expert groundwork and public consultation under the leadership of the Ministry of National Development and the Transport Development Coordination Centre.

-The strategy for the period 2014-2050 has as its -fundamental objective to ensure that transport infrastructure contributes as much as possible to increasing Hungary's competitiveness by efficiently serving economic processes.

Strategic development instruments comprise improvements and investments, to which specific projects can be linked. The resource requirements for development instruments are significantly higher than for management instruments. The Strategy defines four priority levels, based on an assessment of social utility and feasibility risk:

1. Development instruments of primary implementation: social utility is in the two highest categories, feasibility in the two least risky categories.
2. Proposed development instruments to be implemented: implementation is proposed if the instrument (project) is properly prepared.
3. Development tools that need preparation: the development tool is less prepared, or may face several risks and problems during its preparation. As its social utility is high, its implementation is advisable.
4. Long-term potential: the content, sophistication and social utility of the development instrument are limited, so its implementation can only be a long-term objective.

The risks of waterborne freight transport are mainly related to the navigability of waterways and thus to the under-utilisation of capacity. The Danube is navigable all year round, except on icy or flooded days in winter, with reduced draught at most and therefore not at maximum capacity.

Within waterborne transport, there has been no significant change in navigability over the last decade. The navigability of the Danube as a Helsinki corridor with vessels of between 1 300 and 1 600 tonnes with a draught of 2.5 m is currently not met on the Danube section of the Danube in Hungary, as vessels are subject to draught restrictions for part of the year depending on the water conditions. Thus, one of the

[5] https://www.kormany.hu/download/b/84/10000/Nemzeti%20K%C3%B6zleked%C3%A9si%20 Infrastructure%C3%BAra-development%C3%A9si%20Strat%C3%A9gia.pdf

important tasks remains to ensure the navigability of the Danube as a Helsinki corridor in accordance with the principles of sustainable development.

Waterway development is considered to be of limited feasibility and medium social utility:

Water TEN-T network waterway, improving the parameters of the Danube to the core network level At international level, it is also important to improve the navigation parameters of the Danube as an international waterway, which can facilitate the growth of inland waterway freight transport. By developing waterborne transport to the extent permitted by the natural environment, the number of navigation days can be increased and port infrastructure can be developed on the basis of demand, taking into account water protection and ecological aspects.

1.1.5.5. National Port Master Plan Strategy [6]

A Strategy is being prepared in parallel with this work. Its basic objective is: *by 2030, the Danube freight ports will become dominant and efficient multimodal hubs in the transport system of their region, ready to transport at least 10% of domestic freight traffic by inland waterways in an environmentally friendly way.* To achieve this, it considers it necessary to:

- encouraging a change of mode
- generate additional demand
- the design of the financing system
- the development of human resources
- the development of a sustainable regulatory environment.

It sets out tools, regulatory options and development directions for each region.

1.1.5.6. National Development 2030 - National Development and Spatial Development Concept (NDPC) [7]

The Concept, adopted by OGY Resolution 1/2014 (3 January 2014), which aims to ensure a coherent contribution of the country's development policy, territorial planning and regulation to the dynamic development of the country, to set it on a growth path and to reduce territorial disparities in order to achieve a more balanced territorial development. It also aims to ensure coherence between sectoral and territorial plans and between national development policy and EU funding, providing strategic orientations for the 2014-2020 budget and planning period. It sets out a long-term vision, development policy objectives and principles, based on the country's social, economic, sectoral and territorial development needs.

Among the untapped opportunities, the OFTK mentions river transport. Among the specific policy tasks, the development policy tasks include a conceptual study of the Danube's navigability (logistics), increasing the role of the Danube in inland and international transport and the development of ports, the development of the domestic port network in line with EU standards (transport policy), and the development of the ports of Baja, Budapest, Dunaújváros, Győr-Gönyű, Mohács and Szeged. In the interests of intermodality, the combination of rail, suburban rail and cycling transport with waterborne transport should also be encouraged.

The concept emphasises the need for sustainable development of the Danube region through national and European territorial cooperation, with a clear and comprehensive economic development impact, especially in terms of tourism, water management, nature conservation and transport. Development policy tasks in this context:

- Sustainable development of the Hungarian Danube region, protection and preservation of its natural areas, landscapes and cultural values.

[6] http://www.huport.eu/hu/fooldal/
[7] http://www.terport.hu/webfm_send/4616

- To improve the quality of life, infrastructure and well-being of the people living here.
- To increase the region's economy and competitiveness and the well-being of its people in a sustainable way, and to create a prosperous, growing and attractive area.
- Implementation of the European Union's Danube Macro-regional Strategy, in particular through the projects with the "Danube Qualification" (EUDRS) in Hungary.

In the context of water management and environmental protection, the territorial priorities are "Maintenance, protection and improvement of the aquatic environment in the Danube Valley, taking into account sustainable water management and integrated Community water policy" and "Ensuring the living link between the main and tributaries of the Danube, ecological rehabilitation".

1.1.5.7. County Regional Development Programmes

The counties along the Danube are home to ports of international and national importance, ports of regional importance and passenger ports. **In their spatial development programmes, the relevant** downstream **counties** formulate their development objectives and tasks in accordance with the current and planned economic importance of waterborne transport:

- **Komárom-Esztergom county**[8]: The development of intermodal logistics linked to the European core network inland waterway port of Komárom-Komárno has been included in the measure for the development of rail, road, waterway and integrated urban transport capacity, which strengthens the integration of the county into the wider region. The programme mentions (among the county ITB projects) the construction of a freight ferry port in Esztergom and its connection to the M1 motorway, as well as the project "Development of a port for recreational craft traffic".
- **Pest County** [9]: The programme sets out transport development as a priority to improve the international, regional and inter-regional links of Pest County, with the scheduled construction of missing international transport links and the development of existing links as a separate set of projects to strengthen the role of the Danube in international transport. The planned interventions also aim at improving river navigability, developing port infrastructure suitable for freight transport, exploiting multimodal connections, and improving accessibility of ports by road and rail. The programme also sets out the need to establish a so-called Pest County Danube Strategy (PDS) (in line with the EU Strategy for the Danube Region). The PDS aims to implement the following measures: integrated development of the KAPU area in Pest county, integrated development of the Danube bend, integrated development of Ráckeve and its region, catching up the Ipoly river basin, environmental and energy development, strengthening institutional links.
- **Fejér megye** [10]: The programme addresses the exploitation of the international integrating role of the Danube as territorial priority 2. Within the framework of the measure "Linking the county to the economic, tourism (Limes), cultural, transport, environmental and water objectives of the EU Danube macro-regional strategy" (measure 2.1), it foresees, for example, the development of a broad cooperation platform and research cooperation (launching of 4 thematic scientific clusters - environment, navigability, agriculture and irrigation, energy production). Under the measure "Utilisation of the Danube transport corridor, port development" (measure 2.2), the construction of a public transport port (Dunaújváros, Adony), a passenger port (Dunaújváros) and an intermodal freight hub (Dunaújváros) are included as interventions.

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8 http://www.kemoh.hu/index.php?fmp=4&masoldal=1&oldal=statikusoldalak/soldal210.inc

9 http://www.pestmegye.hu/images/2014/Teruletfejlesztesi_dokumentumok/Program_megyei/Pest_County_Ter%C3%BClet_Development_Programme_2014-2020.pdf

10 https://www.fejer.hu/_user/browser/File/Ter%C3%BCletfejleszt%C3%A9s/Fej%C3%A9r%20County%20Ter%C3%BClet%C3%A9si%20Programme/Programme%20Documents/FMTFP_k%C3%B6zgy%C5%B1l%C3%A9s_2014_06_26.pdf

- **Tolna County**[11] : The objectives and measures of the programme are only indirectly related to the Danube navigability, e.g. the specific objective "economic growth, income, employment". The spatial development concept, e.g. increasing the economic potential of the county, strengthening entrepreneurial activity, has set the overall objective of developing regional logistics bases adapted to local raw material production needs at major rail, road and waterway transport hubs in the county (e.g. In addition, the accessibility and quality of services, both on land and water, to ports (Dunaföldvár (TEN-T networking), Paks, Bogyiszló and the Fadd-Dombori area) and ports (Dunaföldvár (TEN-T networking), Paks, Bogyiszló and the Fadd-Dombori area) should be improved. The programme mentions among its priority projects the extension of the Paks nuclear power plant, which is indirectly linked to the role of the Danube in the transport of goods.
- **Bács-Kiskun county**[12] : The programme includes as a specific objective the integrated development of the Danube region in order to exploit its natural, touristic and logistic potential ("Danube Region Spatial Development Programme"). It also states, for example, that "the development of waterways into shipping corridors must go hand in hand with the development of modern and efficient ports in order to integrate shipping with rail and road transport". The need for small-scale tourist port developments for tourism purposes is also mentioned. As part of the regional accessibility and mobility priority, the development of the Baja logistics centre and port is mentioned under the measure 'Improving accessibility' in order to better exploit the Danube shipping opportunities.
- **Baranya county**[13] : The programme includes the measure "Development of transport infrastructure ensuring the international accessibility of the county" under the priority "Improving accessibility, promoting sustainable transport systems", which aims, among others, to promote Danube navigation, to develop water transport infrastructure elements (ports for freight transport) ensuring a higher quality of logistics service for freight transport. In order to achieve this, the following activities have been identified: development of basic port infrastructure, development of external and internal port transport infrastructure, modernisation, acquisition of equipment. The programme states that the port and border port of Mohács, which is of national importance, will have a positive impact on the logistical performance of the county. At the same time, the programme sets out the objective of making better use of the recreational opportunities offered by the Danube (in the framework of the so-called cooperation programmes).

1.1.5.8. Budapest 2030 - Long-Term Urban Development Concept [14]

The 767/2013 (IV.24.) of the Hungarian Capital. According to the concept approved by Resolution No. It is also a potential "urban public space" and a trans-European market and transport corridor. It will be identified that the transport system also offers untapped potential for more environmentally friendly development in the areas of rail transport, cycling and shipping. The concept focuses primarily on passenger transport by water, as a means of establishing inter-municipal shipping and the development of hotel ships. Due to short transport distances, transhipment constraints and spatial structure, waterborne freight transport is seen as being of importance only for international and national freight transport. The following points are made in the assessment of the situation of Danube shipping:

"The Hungarian section of the Danube River is part of the Pan-European Transport Corridor VII. Despite this, Danube navigation currently plays a minimal role in providing international, peri-urban and intra-urban public transport links, with passenger navigation being primarily of tourist interest. Budapest has 78

[11] http://www.tolnamegye.hu/teruletfejlesztes_2014/2014_08_08/Tolna%20megyei%20terulet development%20programme%20HETFA_worked_out_legal.pdf
[12] http://www.bacskiskun2020.hu/files/bkm2020program.pdf
[13] https://docplayer.hu/3113020-Baranya-megyei-teruletfejlesztesi-program.html
[14] https://budapest.hu/Documents/varosfejlesztesi_koncepcio_bp2030/Budapest_2030_varosfejlesztesi_ concept.pdf

public ports, 7 other ports serve other waterborne facilities (stationary vessels) and 8 operational ports. One of the reasons for the under-utilisation of the river's environmentally friendly transport potential is the disconnecting effect of road traffic, which makes access to the ports considerably more difficult. The majority of goods transported on the Danube only passes through the Budapest section of the river, and only the Free Port of Csepel is suitable for international cargo traffic (including Ro-Ro vessels)."

The Urban Agenda sets out 17 objectives. As indicated above, the objectives identified, with the exception of the following two, relate primarily to the development of waterborne passenger transport and the related infrastructure, facilities and connections.

One of the development goals is "Living together with the Danube", one of the elements of which is "better use of the Danube as a waterway" (8.8), both for passenger and freight transport. The former is more related to the capital (where tourist use is currently dominant); the latter is more national and international (where international through traffic is currently dominant). Waterborne freight transport can play a greater role in supplying Budapest and serving its economy if there is a good road and rail infrastructure linked to the ports - multimodal transport. Possible general means of implementation: procurement of vehicles, development of freight transport links, development of port infrastructure.

Within the objective "Strengthening Budapest's international and European role", one of the sub-objectives is "Port development for international passenger and freight transport" (4.13). Possible general means to achieve objective 4.13:

- ensuring adequate coast-side transport links;
- preparation for the construction of a new passenger and freight port, at least at the level of site security.

Site-specific instruments for the implementation of sub-objective 4.13 related to the Danube area:

- relocation of the international boat station, upgrading its operational functions;
- improving road and rail connections to the Free Port of Csepel;
- the development of the DILK (= Danube Intermodal Logistics Centre) (if there is sufficient demand for transport).

1.1.5.9. Coordinated development of Danube areas Thematic Development Programme (TFP) [15]

Linked to the Budapest 2030 Long-Term Development Concept, the TFP aims to define the future development directions of the Danube riparian zone and to organise the developments that best support the realisation of the strategic objectives and the exploitation of the Danube's potential in a coordinated and coherent framework. The strategy sets out, inter alia, the following medium-term development guidelines and objectives:

3. Improving transport connections: e.g. increasing the number of interchanges

6. Development of navigation on the Danube: diversified designation and use of ports, optimisation by function and coastal area (hotel ships, yachts, tourist boats, professional traffic), integration of navigation into urban and agglomeration public transport, expansion of the water transport network and development of the infrastructure serving it, modernisation of the fleet and maintenance facilities for water transport, and acquisition of new vessels. Interventions and incentives are needed to develop transatlantic waterway connections, to develop logistics functions on the Danube (international and internal), to exploit the economic potential of ports linked to logistics and to develop the economy (industry, services) linked to shipping.

Measures proposed to achieve the objective of improving navigation on the Danube:

[15] https://budapest.hu/Documents/TFP/Duna%20menti%20ter%C3%BCletek%20%C3%B6sszehangolt%20 develop%C3%A9se%20Thematic%20Develop%C3%A9si%20Programme.pdf

- integration of shipping into the Budapest transport system (modernisation of the fleet, acquisition of new vehicles, development of ports, installation of new ports, extension of the network, modernisation of maintenance facilities; indicative total cost until 2020 HUF 19 300 M),
- development of public port infrastructure (improvement of reception conditions for tourist boat traffic, installation of new floating facilities, creation of operational marinas for off-site storage and refuelling of vessels; indicative total cost until 2020 HUF 800 million),
- the orderly development of logistics functions (creation and modernisation of infrastructure), the exploitation of the economic stimulus potential of ports related to logistics, and the development of the shipping-related economy (industry, services) (total indicative cost until 2020 HUF 18 500 million).

Long-term goals and visions include:

- creating the conditions for a competitive professional shipping industry, including in the agglomeration,
- improving the macro-regional logistics role of the capital,
- differentiated accommodation and appropriate infrastructure for hotel ships,
- strengthening the waterborne, shipping cluster.

1.1.5.10. Land use plans

According to Article 19/A (1) of Act XXI of 1996, the **levels of spatial planning are**: **national, priority regional and county** spatial plans. The national, 7 county and the Budapest agglomeration priority area spatial planning plans are relevant for the Danube region. In terms of navigability, the primary information is provided by the existing or planned ports of national and regional importance indicated in the spatial plans, but a number of other features and regulatory elements may also be related to navigability on the Danube (e.g. The location of the ports is indicated in the national and priority regional structure plans, and their regulation is indicated in the legislation (spatial planning codes) listed below.)

The **National Spatial Planning Plan and the** Spatial Planning Plan of the Budapest Agglomeration are regulated by Act CXXXIX of 2018 on the Spatial Planning Plan of Hungary and Certain Priority Regions of Hungary, and certain priority regional and national zones are regulated by Decree 9/2019 (14.VI.) of the Ministry of Transport, Innovation and Technology. Annex 4/6 of the Act lists international and national waterways, ports and border ports of national importance. Accordingly, the 1812-1641 fkm section of the Danube is a VI/B waterway and the 1641-1433 fkm section is a VI/C waterway. Existing national ports are Győr-Gönyű, Komárom, Budapest (Csepel), Dunaújváros, Paks, Baja, Mohács (which is also a border port). (The OTrT does not designate any planned national ports.) The regional technical infrastructure networks and individual structures in the Budapest agglomeration are listed in Annex 9 to the Act. According to this, an existing regional port is located in Budapest District IV [Újpest Northern Bay] and a planned regional port is located in Budapest District IX. A presentation of the relevant zones of the national structure plan and the national spatial plan is provided in the section chapters.

The county council regulations currently in force, which adopted the latest amendments to the **county land-use plans, are** listed in the table below. The county zoning plans include, for example, existing and planned ports. New regional ports are planned on the basis of the county structure plans: a new regional port for the river section under the Komárom-Esztergom county structure plan in the municipality of Pilismarót, and a new regional port under the Bács-Kiskun county structure plan near the municipalities of Tass and Solt. No new ports are planned in Pest, Fejér, Baranya, Tolna counties (neither under the current nor the new draft for Tolna county).

Table 1: Latest amendments to the county land-use plans

County Municipality	Number of county council decree in force

County Municipality	Number of county council decree in force
Baranya County Municipality	4/2020 (IV.22.)
Bács-Kiskun County Municipality	7/2020. (VII. 8.)
Fejér County Municipality	7/2020. (II. 28.)
Komárom-Esztergom County Municipality	6/2020. (VI. 25.)
Pest County Municipality	10/2020. (VI.30.)
Tolna County Municipality	11/2016 (IX.26.)

Sources: http://www.kemoh.hu/index.php?fmp=4&masoldal=1&oldal=../statikusoldalak/soldal673.inc, http://www.pestmegye.hu/pest-megyet-erinto-teruletrendezesi-tervek, http://www.baranya.hu/dokumentum/906, https://www.bacskiskun.hu/oldalak/bacs-kiskun-megye-teruletrendezesi-terve-bkmtrt, https://www.fejer.hu/index.php?pg=menu_534, http://www.tolnamegye.hu/fooldal/rendezesi-tervek/megyei-rendezesi-terv

2. RELATED INTERNATIONAL AND COMMUNITYENVIRONMENTAL OBJECTIVES

2.1. EU STRATEGY FOR THE DANUBE REGION - ACTION PLAN [16]

The European Union Strategy for the Danube Region sets out the lines of action under 4 main pillars:

A) Connecting the Danube region with other regions (priorities 1-3),

B) Environmental protection in the Danube region (priorities 4-6),

C) Creating prosperity in the Danube region (priorities 7-9),

D) Strengthening the Danube Region (priorities 10-11).

Of these lines of action, priority area 1a is directly linked to the objectives of the Programme (mobility and development of multimodality - inland waterway transport), but was included in chapter 2.3. However, one quote needs to be highlighted from an environmental point of view: *'Sustainable mobility is a clear objective of Europe 2020 and of the Common European Transport Policy. As IWT has a relatively low environmental impact (3.5 times less carbon dioxide emissions per tonne-kilometre than lorries), it can be considered an important mode of transport. (...) However, the development of waterways into shipping corridors must go hand in hand with the development of modern and efficient intermodal ports in order to integrate shipping with rail and road transport."*

The environmental pillar (B) of the Danube Region Strategy focuses on three priority issues: (4) **restoring and maintaining water quality**; (5) **managing environmental risks**; and (6) **preserving biodiversity, landscape, air and soil quality**. The measures related to Danube navigability (the so-called "actions" as defined in the strategy) formulated within each of these issues are the following:

(4) Restoring and maintaining water quality:

- Full implementation of the Danube River Basin Management Plan;
- Reducing barriers that interrupt water continuity and prevent fish migration in the Danube river basin.

(5) Managing environmental risks:

- Promoting the restoration of wetlands and floodplains as an effective means of flood protection, and more generally, examining and defining the most appropriate response to flood risk (including green infrastructure);
- Research-based prediction of regional and local impacts of climate change;
- Develop land use planning and construction activities in the context of climate change and increasing flood risk.

(6) Preserve biodiversity, landscape, air and soil quality:

- Contributing to the EU biodiversity 2050 vision and the EU 2020 target;
- Effective management of Natura 2000 sites and other protected areas;
- Protecting and restoring the most valuable ecosystems and endangered species;
- Developing environmentally friendly infrastructure to link different biogeographical regions and habitats;
- Reducing air pollutants.

The objectives of the Programme are broadly in line with the above lines of action: maintaining or partially improving the water supply of the tributaries to the current extent (in some places only raising water levels,

[16] https://dunaregiostrategia.kormany.hu/download/b/c3/70000/action_plan_danube_hu.pdf

in others rebuilding of intake structures) will help to "promote the restoration of wetlands and floodplains". The "reduction of air pollutants" can be achieved by transferring water from road to water. The objectives of the Programme also take into account nature conservation interests, and interventions to ensure the appropriate parameters for the waterway include innovative solutions that are expected to have a positive impact on biodiversity (e.g. cutting of spurs, construction of chevron dams). The prevention of further lowering of the riverbed and low water levels, which is also a priority objective of the Programme, is also beneficial from a conservation point of view.

However, some of the interventions (e.g. dredging, although the minimum possible interventions are planned) may have unavoidable negative impacts on certain species and habitats. This is described in detail in the Habitats chapters and in the Natura 2000 Impact Assessment document annexed to this SEA, together with proposals for possible mitigation measures. Measures for the Hungarian section of the Danube River Basin Management Plan are included in the National River Basin Management Plan, the context of which is presented in ***Chapter 3 of*** this Annex.

2.2. JOINT STATEMENT ON "GUIDING PRINCIPLES FOR THE DEVELOPMENT OF INLAND NAVIGATION AND ENVIRONMENTAL PROTECTION IN THE DANUBE RIVER BASIN" [17]

The "Joint Statement" is a guiding document for the maintenance of existing waterways and the development of future waterway infrastructure, adopted in 2007 by the International Commission for the Protection of the Danube River (ICPDR), the Danube Commission and the International Sava River Basin Commission. The Joint Statement aims to "*provide guidance to decision-makers involved in Inland Water Transport (IWT) and environmental sustainability, as well as to water managers involved in the development of river navigation and* ***environmental plans****, programmes and projects*".

According to the document, in order to strike a balance between shipping and ecological needs, it is necessary to review their basic requirements, which are:

- Inland waterway transport (IWT) needs
  - Design minimum fairway dimensions (depth and width) for each river section based on strategic IWT requirements for the whole river basin (depth and width of fairway, bend radius);
  - Construction and maintenance (control of low water levels with hydraulic installations, dredging and refilling with material);
  - The location of the infrastructure should take into account the physical and other factors involved (e.g. proximity to the market and connectivity to major transport networks).
- The demands of ecological integrity
  - Protected/conserved riverside landscapes, river stretches and aquatic communities of high natural or ecological value;
  - Restoring modified/impaired river sections and their associated landscapes;
  - Dynamic and type-specific river channel and floodplain environments (in terms of flow conditions, shorelines, tributaries and floodplains) that support dynamic equilibrium and adequate passage conditions;
  - The unimpeded longitudinal and transverse migration of all fish and other water-related species to ensure their natural and self-sustaining development;
  - Balanced substrate conditions.

According to the Declaration, these needs should be met through integrated concepts and plans, the basic principles of which are (extract):

[17] https://www.icpdr.org/main/sites/default/files/Joint%20Statement%20Broshure.HU.06-2010.pdf

- Creating interdisciplinary design teams;
- Identify common planning objectives;
- Establish a transparent planning process;
- Seek to avoid the effects of structural/hydraulic engineering interventions or, where this is not possible, to minimise their effects on the river system through mitigation and/or restoration, giving priority to reversible interventions;
- Ensure that climate change and its associated impacts are taken into account in the design of shipping projects;
- The application of best practice measures to improve navigation (PLATINA Manual on Good Practices in Sustainable Waterway Planning, PLATINA II. Good Practice Manual on Inland Waterway Maintenance Focus: Fairway maintenance of free-flowing rivers).

To implement the principles, the document states that the following criteria must be met:

- Use a case-by-case approach that takes into account the ecological needs of river sections and the catchment level, as well as the strategic requirements of IWT at the catchment level when determining the appropriate width and depth of the fairway.
- "Cooperating with nature", wherever possible, by implementing measures in accordance with the natural river morphological processes, respecting the principle of minimum or temporary technical intervention.
- Integrated design of control systems, taking into account hydraulic, morphological and ecological criteria in equal measure.
- Implementing measures in an adaptive way (e.g. river bed stabilisation with granulometric bank stabilisation, small water control with spurs)
- Optimal use of the river restoration potential (e.g. river bank restoration) and reconnection of tributaries.
- Ensuring that flood levels are not exacerbated and ideally are reduced.

The objectives of the Programme, and the solutions envisaged, have been developed taking into account the above needs, principles and criteria, which are clearly illustrated by the following objectives: minimised interventions, minimised environmental and natural damage; reduction of dredging and the use of innovative solutions with ecological benefits; prevention of further lowering of the river bed and water level.

2.3. CONVENTION ON COOPERATION FOR THE PROTECTION AND SUSTAINABLE USE OF THE DANUBE [18]

The Convention on the Protection of the Danube River was adopted on 29 June 1994 in order to cooperate for the protection and sustainable use of the Danube. The signatories include all the Danube countries (Austria, Bosnia and Herzegovina, Bulgaria, Croatia, Czech Republic, Germany, Hungary, Moldova, Montenegro, Romania, Serbia, Slovakia, Slovenia, Ukraine, Bulgaria, Croatia, the Czech Republic, Hungary, Moldova, Romania, Serbia, Slovakia, Slovenia, Ukraine) and the European Union. The main objective of the Convention is to ensure that the signatories cooperate on basic water management issues, using all legal, administrative and technical means to protect the Danube. Hungary has ratified the Convention by Government Decree 74/2000 (31 May 2000) on the proclamation of the Convention on Cooperation for the Protection and Sustainable Use of the Danube River, adopted in Sofia on 29 June 1994.

The main objectives of the Convention are:

[18] https://eur-lex.europa.eu/legal-content/HU/TXT/?uri=CELEX%3A21997A1212%2803%29

- Achieve the objectives of sustainable and equitable water management, including the **conservation, enhancement and wise use of surface water and groundwater** in the river basin.
- To control risks **from accidents involving hazardous substances on** water, as well as from floods on the Danube and ice hazards.
- **Reducing the pollution load of the** Black Sea from **sources** in the catchment.
- **To at least maintain and improve the** current **environmental and water quality conditions of** the Danube and the waters in its catchment area, and to **prevent and reduce adverse impacts and changes that are occurring and are likely to occur**.
- Ensuring the **sustainable use of water resources** for municipal, industrial and agricultural purposes, **protecting and restoring ecosystems and meeting** other **requirements** such as **public health**.
- Water management cooperation aims to achieve **sustainable water management**, i.e. criteria for a stable, environmentally sound development, which are aimed at:

• maintaining the overall quality of life,
• continuity of access to natural resources,
• to avoid lasting environmental damage and protect ecosystems,
• practising a preventive approach.

According to Article 3(2), the Convention covers, for example, "*planned activities and measures in the field of hydraulic engineering works, in particular the regulation of the bed, discharge and storage levels of watercourses, flood protection and ice control, and* ***installations in or along a watercourse which affect its water flow*****."**

According to Article 3(3), the ***Convention*** "***may apply to matters relating to*** *fishing and* ***river navigation in so far as it concerns protection against pollution of*** *waters* ***caused by*** *such activities*".

From a shipping perspective, the Convention focuses on the protection of ecosystems (taking into account both aquatic and riparian ecological conditions) and the quality of surface and groundwater resources. The objectives of the Programme, which include minimising environmental and natural damage; reducing the amount of dredging and using innovative solutions with ecological benefits; and preventing further lowering of river beds and water levels, are also intended to meet the Convention's objectives at the level of the target system. However, adverse ecological impacts are unlikely to be avoided through certain interventions, but the aim of this SEA is to formulate mitigation measures (see chapters on habitat protection).

2.4. CONVENTION ON THE PROTECTION AND USE OF TRANSBOUNDARY WATERCOURSES AND INTERNATIONAL LAKES [19]

The Convention was adopted in Helsinki on 17 March 1992 and entered into force on 6 October 1996. It currently (08.06.2020) has 44 signatories[20]. The European Council acceded to the Helsinki Convention by Decision 95/308/EC. Hungary has ratified the Convention by Government Decree 130/2000 (July 11) on the proclamation of the Convention on the Protection and Use of Transboundary Watercourses and International Lakes signed in Helsinki on 17 March 1992.

[19] https://eur-lex.europa.eu/legal-content/HU/TXT/?uri=celex:31995D0308
[20] https://treaties.un.org/Pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-5&chapter=27&clang=_en

The main objective of the Convention is to **protect surface water and groundwater and to reduce their adverse impacts**, recognising that the status and quality of our waters is constantly deteriorating and that almost half of Europe's population is affected by drought and low water levels, or the adverse consequences of floods, and problems with the quality and quantity of drinking water supplies. The Convention provides a framework for addressing these issues, leaving room for bilateral and multilateral agreements on the matter.

The Parties to the Helsinki Convention undertake, among other things, to **prevent and reduce pollution of boundary waters, to ensure proper management of boundary waters**, their **rational and equitable use**, the **protection of ecosystems**, exchange of information, consultation and public information, and joint monitoring activities. The Convention provides that its principles (in particular the precautionary principle and the polluter pays principle) and the integrated approach should also be applied in the development of local and regional plans and programmes for water management.

The convention covers **surface and groundwater in the territory of several countries**. Transboundary environmental impacts within the meaning of the Convention include impacts on human health and safety, flora, fauna, soil, air, water, climate, landscape, monuments and other physical structures and their interactions, and the social, economic and cultural impacts resulting from these changes.

Although the Convention does not mention shipping or waterborne transport, it does contain important objectives for the Programme. The objectives of the Programme, at the level of the target system, also seek to meet the above-mentioned objectives of the Convention, but some adverse environmental impacts from the development of waterways are unlikely to be avoided and are addressed in this SEA by identifying and, where possible, mitigating them.

2.5. PROSPERING WITHOUT USING UP THE PLANET - ENVIRONMENTAL ACTION PROGRAMME (2012) [21]

The 7th Environment Action Programme for 2020, adopted by Decision 1386/2013/EU of the European Parliament and of the Council in November 2013, is generally a comprehensive and authoritative document for environmental assessments. It summarises the expectations that have already been set out in a number of other documents in a subset of areas. Its long-term vision is as follows:

"*In 2050, we live in prosperity, respecting the ecological limits of our planet. Our prosperity and a healthy environment will come from an innovative and circular economy where nothing is lost, natural resources are managed sustainably and biodiversity is protected, valued and restored, enhancing the resilience of our society. Our low-carbon growth has long been independent of our resource use and sets the pace for a safe and sustainable global society.* "

Its priorities, which should also be taken into account in the development of the waterway, are:

- protecting, preserving and enhancing the Union's natural capital
- transform the EU into a resource-efficient, green and competitive low-carbon economy
- protect EU citizens from environmental pressures and risks to their health and well-being
- improving conditions for environment and climate-related investment and addressing environmental externalities
- better EU response to the challenges of the international environment and climate.

The EU commitments in the field of environment, which are also relevant to the present planning, are:

- Reduce greenhouse gas emissions by at least 20% by 2020 (...);
- Halt biodiversity loss and the degradation of ecosystem services by 2020;

[21] http://www.europarl.europa.eu/meetdocs/2009_2014/documents/com/com_com(2012)0710_/ com_com (2012)0710_hu.pdf

- Ensure good ecological status for all European water bodies by 2015[22](this includes rivers, lakes and groundwater within freshwater);
- achieve levels of air quality that do not give rise to significant harm and risk to human health and the environment.

It argues that the transition to a green economy requires the integration of environmental issues into other policies, such as transport.

The objectives of the Environment Action Programme may be partly supported by the Programme (e.g. reducing greenhouse gases, promoting a resource-efficient economy) and partly hindered by the Programme (e.g. impacts on biodiversity).

However, the Programme aims to take account of nature conservation interests and, with this and mitigation proposals, the impacts on biodiversity are expected to remain within acceptable levels and the environmental benefits of the wider modal shift between transport sectors are expected to outweigh any potential harm.

2.6. BIODIVERSITY STRATEGY (2011.) [23]

Based on the Convention on Biological Diversity (Act LXXXI of 1995 on the proclamation of the Convention on Biological Diversity), the EU strategy was established in 2011 with the **2020 headline target of** halting the loss of biodiversity and the degradation of ecosystem services in the EU and restoring them to the extent feasible, while enhancing the EU's contribution to efforts to prevent global biodiversity loss. The Strategy also looked ahead to 2050, stating that EU biodiversity and the ecosystem services it provides, which constitute the EU's natural capital, must be protected, appropriately valued and adequately restored by 2050, given their intrinsic value and their essential contribution to human well-being and economic prosperity, and to avoid catastrophic changes caused by biodiversity loss.

The Strategy sets out 6 headline targets and 20 actions to be completed by 2020. **Of these objectives, the following are directly or indirectly linked to the Programme under review:**

Required

- strengthen efforts to protect species and their habitats;
- maintain and restore ecosystems and the services they provide (e.g. by creating green infrastructure and restoring at least 15% of degraded ecosystems);
- protect against invasive flood species;
- increase the EU contribution to preventing global biodiversity loss.

The objectives of the Programme also take into account nature conservation interests. The technical plans include innovative solutions (e.g. cutting of spurs, construction of chevron dams) that could benefit biodiversity. Another positive aspect for nature conservation is that the underlying objective of the Programme is to prevent further lowering of the riverbed and low water levels.

However, some of the other interventions (e.g. dredging, although the minimum possible interventions are planned) may have negative impacts on certain species and habitats. This is discussed in detail in the Habitat chapters, together with proposals for possible mitigation measures.

[22] As expected by the CCI, the process is expected to continue in reality until 2027.
[23] https://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:52011DC0244&from=EN

2.7. EU BIODIVERSITY STRATEGY TO 2030 [24]

The EU Biodiversity Strategy to 2030 was published in May 2020, but has not yet been formally adopted by Member States (so it is necessary to take the previous Biodiversity Strategy into account). Its main objectives are:

- **the establishment of protected areas** on at least 30% of European land and at least 30% of European marine areas, providing more stringent protection for Europe's remaining natural and native forests and a new legal framework for nature restoration with binding targets by 2021
- **restoring damaged terrestrial and marine ecosystems**:

- increasing the share of organic production and biodiversity-rich landscapes on agricultural land,
- stopping the decline of pollinators and reversing the trend,
- reducing the use of pesticides (by 50% by 2030) and the risks they pose,
- reducing nutrient losses from fertilisers by 50%, which will result in a reduction of at least 20% in fertiliser use,
- making significant progress in the restoration of contaminated land,
- restoring at least 25,000 km of rivers to their natural, free-flowing state,
- Planting 3 billion trees by 2030,
- reduce the number of Red List species threatened by invasive species by 50%,
- cities with 20,000 inhabitants or more have an ambitious "Urban Greening Plan",
- significantly reducing negative impacts on sensitive species and habitats, including fishing and exploitation activities on the seabed, in order to achieve good environmental status,
- eliminate or reduce by-catch of species (in marine fisheries) to a level that allows the recovery and conservation of species.

In the context of the Programme under review, one of the objectives of the new biodiversity strategy is **to restore the natural functions of freshwater ecosystems and rivers in** order to meet the objectives of the Water Framework Directive. This can be done, according to the strategy, by "*removing or modifying barriers that prevent the passage of migratory fish and improving the flow of water and sediment*".

The Programme only supports habitat restoration to a limited extent directly, but contributes indirectly, for example by maintaining or partly improving the current water supply of tributaries (in some places only by raising water levels, in others by rebuilding water intake structures). The objective "preventing further lowering of the riverbed and low water level" also contributes to the long-term conservation of wetlands associated with the Danube. However, the implementation of the Programme will not directly contribute to the objective of restoring the natural state of rivers as set out in the Biodiversity Strategy.

2.8. CONVENTION ON THE CONSERVATION OF MIGRATORY SPECIES OF WILD ANIMALS [25]

The Bonn Convention of 1979 is a **framework agreement for the coordinated, international conservation of migratory species**, to which Hungary acceded in 1983. The Parties to the Convention recognise the importance of the **conservation of migratory species and the need for states that affect the range** (=all land and water areas where the migratory species lives, temporarily resides and through which it passes or flies at any time on its usual migration route) to **agree on actions to protect it**. Appendix I to the Convention lists the migratory species that are endangered and therefore require increased

[24] https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal/actions-being-taken-eu/eu-biodiversity-strategy-2030_hu

[25] https://www.cms.int/en/convention-text

protection, while Appendix II lists the so-called vulnerable species for which countries along the migratory route are to conclude joint agreements. Examples include EUROBATS, the Agreement on the Conservation of European Bat Species and the Agreement on the Conservation of African-Eurasian Migratory Waterbirds (AEWA) - to which Hungary is a signatory. Hungary ratified the Convention by Decree-Law No VI of 1986 on the proclamation of the Convention on the Conservation of Migratory Species of Wild Animals, signed in Bonn on 23 June 1979.

The Programme is only indirectly related to the Bonn Convention, but it is important to stress that the implementation of the Programme does not hinder ecological permeability, and may even improve it in some places (e.g. cutting spurs).

2.9. NATURA 2000 DIRECTIVES

The Birds and Habitats Directives are cornerstones of the EU's biodiversity policy. The aim of the ***Birds Directive*** (Council Directive 2009/147/EC on the conservation of wild birds[26]) is to maintain and restore the populations of all naturally occurring wild bird species in the European Union to ensure their long-term survival. Special Protection Areas for Birds are regions hosting large populations of migratory species listed in Annex 1 that occur regularly in the territory of a Member State and migratory species not listed in Annex 1 but which are important for nature conservation, and wetlands of international importance for waterbirds.

The main objective of the ***Habitats Directive*** (Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora, last amended in 2013[27]) is to conserve biodiversity and ensure the long-term survival of species and habitat types by maintaining or increasing their natural range. The Directive provides for the creation of a European ecological network, Natura 2000, which includes sites designated under the provisions of the Birds Directive. Special Areas of Conservation are designated for the protection of natural habitat types of Community importance listed in Annex 1 and animal and plant species of Community importance listed in Annex 2.

The impacts on habitats and species of Community importance (candidate species) of Natura 2000 sites in the domestic Danube section are described in detail in the Natura 2000 Impact Assessment document annexed to this SEA.

The objectives of the Programme, such as the principle of minimum disturbance, aim to minimise the damage to species and habitats associated with the Danube ecosystem while ensuring navigability.

2.10. WATER FRAMEWORK DIRECTIVE

The European Union's water policy is summarised in the "Water Framework Directive" (Directive 2000/60/EC[28], hereafter "WFD"), which aims to achieve "good status" for surface water, groundwater and protected areas connected to water.

The WFD aims to achieve the following environmental objectives:

- on surface water
    - preventing the deterioration of water bodies;
    - for natural surface water bodies, to maintain or achieve good ecological status and good chemical status (or maintain excellent status);

[26] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32009L0147
[27] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:01992L0043-20130701
[28] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:02000L0060-20141120

  - in the case of heavily modified or artificial surface water bodies, achieving good ecological potential (the status achieved as a result of effective remediation measures) and good chemical status;
  - progressively reduce pollution by priority substances and eliminate or phase out discharges, emissions and losses of priority substances;
- on groundwater
  - limit or prevent groundwater pollution;
  - preventing the deterioration of water bodies;
  - achieving good quantitative and chemical status of water bodies;
  - progressively reduce pollution, reversing any significant and sustained upward trend in pollution concentrations;
- general objectives
  - preventing the deterioration of aquatic and wetland habitats, protecting them and improving their condition;
  - promoting sustainable water use by protecting exploitable water resources in the long term;
  - improving water quality by reducing the discharge of pollutants and phasing out hazardous substances;
  - progressively reduce groundwater pollution and prevent further pollution;
  - mitigate the negative impacts of floods and droughts.

In addition, protected areas that are directly or indirectly linked to a water body, depending on the status of the water, should be provided with the water conditions, both in the water body and in the river basin, necessary to meet the specific requirements for the designation of the area as protected.

The measures formulated to achieve the objectives of the WFD, the timetable for their implementation, how they will be achieved, etc. are set out in the water catchment management plans. The link with the National River Basin Management Plan is described in chapter ***3.1.2 Related national documents.*** The applicability test under Article 4(7) of the WFD (and, if necessary, the detailed exemption test) is dealt with in detail in a separate working section within the framework of this SCA.

The objectives of the Programme do not prevent the achievement of good water status, and the prevention of the lowering of the river bed and the low water level may even help to achieve a better status than before. However, some interventions and increased traffic may be associated with adverse trends in water quality and ecological status. Thus the assessment is not clear and should be assessed in the indicated separate work section.

2.11. BLUEPRINT - A PLAN TO SAFEGUARD EUROPE'S WATER RESOURCES (2012) [29]

The Commission Communication "Blueprint for the conservation of European water resources", also known as the "**Blueprint**", was based on the results and data generated under the Water Framework Directive (among other assessments). The document proposes actions on land use and the ecological status, chemical status and pollution of EU waters, the efficient use of water in the EU, the vulnerability of EU waters and other comprehensive solutions.

The plan aims to achieve results in water efficiency mainly through regulatory changes. It stresses the importance of environmental impact assessment and strategic environmental assessments for water management interventions (e.g. hydropower, river navigation, etc.). It states, inter alia, that "***The strategic environmental assessment of plans to develop river navigation should also consider which waterways***

[29] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2012:0673:FIN:HU:PDF

could carry the most traffic at the lowest environmental cost and in the most sustainable combination with other modes of transport"[30].

Among its specific objectives, the preservation of ecological water yields, the reduction of flood and drought risks, the better calculation of costs and benefits, and the resolution of pollution issues are relevant for this Programme. The Programme is consistent with these objectives, e.g. preventing further lowering of the river bed and low water levels, minimising dredging.

2.12. EUROPEAN LANDSCAPE CONVENTION [31]

The European Landscape Convention, signed in Florence on 20 October 2000, laid the foundations for landscape protection at European level. One of its important "general measures" is that Member States that ratify and transpose the Convention (Hungary ratified it in Act CXI of 2007) undertake to "***integrate landscape into all policies that may have a direct or indirect impact on landscapes***" (Article 5), including transport policy relevant to this Programme.

Some of the objectives of the Programme are in line with the principles of landscape protection (e.g. the protection of natural and cultural heritage). Preventing further lowering of river beds and water levels is also important for the conservation of landscape potential, as is the use of solutions with ecological benefits and minimising interventions for natural values.

However, the development of a gas-free waterway and planned interventions to achieve this may have localised negative impacts (see the landscape chapter of this SEA). The Convention also stresses ***the importance of cross-border cooperation*** and ***public participation***, which will also play an important role in the Programme (public participation and consultation with neighbouring countries will be carried out in the course of the SEA in accordance with Government Decree 2/2005 (11 January 2005)).

Based on the European Landscape Convention, the National Landscape Strategy is a single national strategic document on landscape, which integrates landscape policy, protection, management and planning.It is described in Chapter 3 of this Annex under the heading "***Related national environmental objectives".***

2.13. EUROPE 2020 - A STRATEGY FOR SMART, SUSTAINABLE AND INCLUSIVE GROWTH (2010) [32]

Europe 2020 focuses on creating jobs and raising living standards. It focuseson three mutually reinforcing priorities:

- Smart growth: building an economy based on knowledge and innovation
- Sustainable growth: a more resource-efficient, greener and more competitive economy
- Inclusive growth: promoting the development of an economy characterised by high employment and social and territorial cohesion

It sets targets for 2020 in five areas - employment, research and innovation, climate change and energy, education and the fight against poverty - of which the EU's priority 3 is primarily related to ensuring Danube navigability (given that, for example, waterborne transport is one of the most environmentally friendly and energy-efficient modes of transport):

[30] See, for example, the International Commission for the Protection of the Danube River's "Joint Statement on Navigation": http://www.icpdr.org/main/sites/default/files/Joint_Statement_FINAL.pdf

[31] https://rm.coe.int/CoERMPublicCommonSearchServices/DisplayDCTMContent?documentId= 09000016802f3faf

32 https://ec.europa.eu/eu2020/pdf/1_HU_ACT_part1_v1.pdf

3. **Meeting the "20/20/20" climate/energy targets (including a 30% reduction in emissions in appropriate circumstances)**.

In order to achieve these objectives, it identifies seven priority initiatives, of which Danube navigation and the provision of navigability have a direct link with the following:

- Resource Efficient Europe ***aims to*** decouple economic growth from resource use, promote a shift towards a low-carbon economy, increase the use of renewable energy, ***modernise the transport sector and promote energy efficiency.***

Within the "Resource Efficient Europe" flagship initiative, the priority tasks of each actor include (only those related to Danube navigability are listed here).

European Commission:

- To put forward proposals to modernise and decarbonise the transport sector, thereby contributing to increased competitiveness. This can be facilitated by early development of electric mobility network infrastructure, intelligent transport management, better logistics, and ***efforts to reduce carbon emissions*** from road, air and ***waterborne vehicles***, including a European "green car initiative", which will lead to new technologies, including electric and hybrid car production, through research, setting common standards and creating the necessary infrastructure;
- ***Accelerate the implementation of strategic projects with European added value to address critical bottlenecks***, in particular cross-border sections and intermodal transport hubs (cities, ports, logistics platforms).

At national level, each Member State:

- Develop smart, modern and fully interconnected transport and energy infrastructure and make full use of ICT;
- ***Coordinated implementation of infrastructure projects across the EU core network***, which will make a significant contribution to making the EU transport system more efficient;
- ***Promoting energy-saving devices that could*** help energy-intensive sectors, such as those using ICTs, to become more efficient.

In line with most of the above objectives (e.g. coordinated implementation of infrastructure projects, modernisation of the transport sector and promotion of energy efficiency), the main objective of the Programme is to "achieve a gas-free waterway for the entire Hungarian Danube section with minimal interventions and in accordance with the parameters set by international and national standards". The other objectives of the strategy described above are not related to the existence of the waterway, but to, for example, waterborne vessels, over which the Programme has no real influence (in the description of the objectives it is stated that the development of an 'environmentally friendly fleet' is a task for other projects).

2.14. ROADMAP TO A RESOURCE EFFICIENT EUROPE (2011) [33]

In the context of the above documents, one of the EU 2020 flagship initiatives is "Resource Efficient Europe", whose implementation roadmap is also a relevant document for Danube navigability. The document outlines the main factors that **can help to achieve a low-carbon, competitive EU economy by 2050 as a guiding principle for EU climate policy.** It sets out the **need for innovative solutions to** mobilise investment in energy, **transport**, industry and information and communication technologies, and for a greater focus on energy efficiency policies.

Its vision for resource-efficient development states that "by 2050, the European Union economy will achieve growth while respecting the scarcity of resources and the resilience of our planet, and thereby contribute to the transformation of the global economy. Our economy is competitive, inclusive and delivers high living

[33] http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0571:FIN:hu:PDF

standards with a much lower environmental impact. Resources - raw materials, energy, water, air, land and soil - are managed sustainably. Climate change targets have been met, and ecosystem services and the biodiversity on which they depend have been conserved, valued and significantly restored."

The document states that "a policy framework is needed that creates a level playing field, recognises innovation and resource efficiency, creates economic opportunities and improves security of supply through product redesign, sustainable management of environmental resources, increased reuse and recycling of waste materials, substitution of materials and the economical use of resources".

The document therefore calls for a shift to a resource-efficient economy, in other words, a green economy. The three interconnected systems of a green economy, according to the document:

- Ecosystem (natural capital) - objective: to maintain ecological resilience
- Economy (capital goods and money capital) - goal: to increase resource efficiency
- People's wellbeing (social and human capital) - Goal: Improve social equity and fair burden sharing

The document sets out milestones to make the economy sustainable and protect natural capital and ecosystem services by 2020. To achieve a green economy, policies are needed that recognise ***the interdependence between the economy, well-being and natural capital***, seek to remove barriers to improving resource efficiency, and provide a fair, flexible, predictable and coordinated basis for business to operate.

The ***protection of natural capital and ecosystem services is*** also important because "our economic and social well-being depends on natural capital, including the ecosystems that provide us with the goods and services we need, from fertile soils to farmland and oceans, from fresh water and clean air to crop pollination, flood control and climate regulation. We use most ecosystem services almost as if they were unlimited. We treat them as "free" commodities, their economic value is not properly accounted for in the market, and therefore stocks are over-exploited or polluted, compromising long-term sustainability and our resilience to environmental shocks".

In this context, the following **milestones** are directly related to Danube navigation and navigability:

- ***Ecosystem services*:** by 2020, natural capital and ecosystem services will be sufficiently valued and taken into account by public authorities and businesses.
- ***Biodiversity*:** by 2020, biodiversity loss and the degradation of ecosystem services in the EU will have been halted and biodiversity will have been restored to the extent feasible.
- ***Water*:** by 2020, all River Basin Management Plans under the Water Framework Directive will have been implemented.In 2015, the status of water - quality, quantity and use - in the river basins of all EU rivers will be good. The effects of droughts and floods are minimal, the crops concerned have adapted, soil water retention has improved and irrigation is effective. Alternative water supply options are only resorted to once all cheaper methods have been used. Water abstraction is below 20 % of available renewable water resources.
- ***Air*:** By 2020, the EU's transitional air quality standards, including for critical urban areas, will be met, upgraded and further measures identified to achieve air quality that does not have a significant impact on the environment and health.
- ***Land and soils***: by 2020, EU policies will take into account their direct and indirect impacts on land use in the EU and globally, and expropriation will be set at levels that will ensure that by 2050, the overall amount of land expropriated will no longer increase; soil erosion will have decreased and soil organic matter will have increased, and remediation work in contaminated areas will be well underway.

The document also identified **sectors that play a key role in addressing the challenges of energy production and climate change**, which are addressed by complementary long-term strategies that should be combined with the measures in this document to maximise synergies under the flagship initiative on resource efficiency. One such key sector is transport, i.e. "**ensuring efficient mobility**". The milestone set out in this context is directly linked to waterborne transport on several points: "By 2020, **the overall efficiency of the transport sector** will create more value through the **optimal use of resources,** i.e. raw materials, energy and land, by **reducing the adverse impacts on climate change and health,** by **lowering air and noise pollution**, by **reducing accidents** and by **reducing biodiversity loss and ecosystem degradation. Transport will use less and cleaner energy**, make better use of modern infrastructure and **reduce its negative impact on the environment and key natural assets, including water, landscapes and ecosystems**. Greenhouse gas emissions from transport will be reduced by an average of 1% per year from 2012".

The objectives of the Programme are partly in line with the objectives and orientations set out in the document (apart from the timetable), e.g. most of the requirements listed in the general efficiency gains in the transport sector. However, a number of environmental elements and systems are affected by the objectives and milestones set out in the document and are examined in detail in this SEA, with the main findings being presented in the relevant sectoral chapters.

There may be some conflicts with some objectives (e.g. biodiversity restoration), but it is expected that, if mitigation proposals are followed, the adverse environmental impacts will remain within acceptable levels and the environmental benefits expected from indirect transfer of pressure between road sectors will outweigh any potential harm. At least this is what the Programme aims to achieve (e.g. the objective of minimum interventions).

2.15. ROADMAP TO A COMPETITIVE LOW-CARBON ECONOMY BY 2050 [34]

To achieve a **low-carbon**, competitive economy, the **EU must be prepared to reduce its domestic emissions by 80% by 2050 compared to 1990 levels** (domestic emissions reductions are the actual reductions within the borders of EU Member States, not those achieved through carbon market offsetting mechanisms).

Based on a modelling and scenario-based analysis (which looked at how the EU could transition to a low-carbon economy by 2050 under current conditions), it outlines a roadmap of possible actions to be taken by 2050, including milestones. Several scenarios have been developed, with a 25% reduction by 2020. The most cost-effective solution was found to be a 40% reduction by 2030 and a 60% reduction by 2040.

The **interventions** under the Roadmap **cover** the energy sector (full decarbonisation), **transport** (sustainable thanks to fuel efficiency, electrification and fair pricing), the built environment, energy-intensive industries and agriculture. Within the transport sector, waterborne transport is specifically mentioned, with the objective of "**reducing CO_2 emissions from** rail, road and **inland waterway transport to below 1990 levels by 2030**".

The Roadmap has served as a starting point for the development of sector-specific policy initiatives and roadmaps, including the Energy Roadmap 2050 and the White Paper on Transport, discussed below. It is noted that action to reduce GHG emissions, combined with existing and planned air quality measures, is expected to make a significant contribution to reducing air pollution across Europe and thus make a major contribution to protecting health.

The main objective of the Programme is to develop the Danube waterway, which will contribute to increasing the share of waterborne transport in freight transport. This will also help to achieve CO_2 emission reduction targets, provided that a reduction in the share of road freight transport can be achieved.

34 https://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:52011DC0112&from =EN

2.16. ENERGY ROADMAP 2050 (2011) [35]

The Energy Roadmap 2050 looks at the steps needed to meet the **EU's GHG emission reduction target for 2050**, while ensuring security of energy supply and competitiveness, and helping to **reduce** emissions by around **40%** by 2050. To achieve this target, the Roadmap develops scenarios for different decarbonisation options for the energy system. It aims to develop a long-term, technology-neutral European framework, with energy efficiency remaining the focus and renewables at the heart of the European energy mix. All scenarios build on the much more important role of electricity, which should contribute to **decarbonising transport** and heating/cooling, for example (this will increase final electricity demand and therefore the electricity generation system will need to undergo structural changes).

The **share of renewables increases significantly in all scenarios (by around 30% by 2030) and reaches 55% of total gross energy consumption by 2050**, and one of the scenarios examined is based on a particularly high share of renewables in total gross energy consumption (75% in 2050), with a very high share of renewables in total gross energy consumption (97% in 2050) and a share of renewables in electricity consumption (97% in 2050).

According to the document, **energy efficiency** should remain a key focus, for example "**efficient vehicles in transport and measures to encourage behavioural change**".

The above are mainly indirectly related to the Danube's navigability, but the main objective of the Programme is to develop the Danube waterway, which will contribute to increasing the share of waterborne transport in freight transport. This will also help to achieve energy efficiency and CO_2 emission reduction targets, provided that a reduction in the share of road freight transport can be achieved.

2.17. CLIMATE AND ENERGY POLICY FRAMEWORK 2020-2030 (2014) [36]

While recognising that current climate and energy policies have made significant progress towards the 20/20/20 targets, and in the light of the Energy Roadmap 2050, the Communication sets out concerns and proposals for solutions to provide a policy framework for the period up to 2030.

It proposes setting a **reduction target for** EU **greenhouse gas** emissions of **40% of 1990 levels by 2030** (a more ambitious target than the Energy Roadmap 2050, which set the same target for 2050) and a **minimum target of 27% for the share of renewables in** EU energy use.

Improving energy efficiency will continue to play a key role in achieving all the objectives of the EU's climate and energy policies (competitiveness, security of supply, sustainability and the transition to a low-carbon economy). It does not set a binding target for improving energy efficiency, which will be addressed in the revision of the Energy Efficiency Directive (but the Commission's analysis shows that a 40% reduction in greenhouse gas emissions will require an increase in energy savings of approximately 25% by 2030).

It also reviews and assesses the status of major complementary policies and their respective commitments and obligations, such as the Transport White Paper. In this context, it foresees that after 2020, greater efforts will be needed to meet the White Paper's greenhouse gas reduction targets. "**Further reductions in transport (GHG) emissions will require a gradual transformation of the whole transport system**, **including greater integration of transport modes, greater use of non-road transport options**, improved traffic management through intelligent transport systems, and major innovation and deployment of new propulsion and navigation technologies and alternative fuels."

[35] https://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:52011DC0885&from =HU

[36] https://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:52014DC0015&from=HU

The main objective of the Programme is to develop the Danube waterway, which will contribute to increasing the share of waterborne transport in freight transport. This will also help to achieve energy efficiency and CO_2 emission reduction targets, provided that a reduction in the share of road freight transport can be achieved. If the modernisation of the fleet of vessels using the river (in the framework of other projects or with changes in international standards) is also implemented, energy efficiency and CO_2 emission reductions in waterborne transport can be further reduced.

2.18. THE NEXT STEPS FOR A SUSTAINABLE FUTURE FOR EUROPE. EUROPEAN ACTION FOR SUSTAINABILITY (2016) [37]

The Framework Agreement on Sustainable Development, adopted at the 70th UN General Assembly in 2015, is designed to integrate the 2030 Agenda for Sustainable Development into the European policy framework and the Commission's priorities. The 2030 Agenda sets out 17 Sustainable Development Goals (SDGs) and assigns a total of 169 targets to them, which are globally and universally applicable. The **2030 Agenda's SDGs** (highlighted around those that are primarily related to Danube navigability) are the **following:**

Goal 1: Eradicate all forms of poverty worldwide

Goal 2: End hunger, achieve food security, promote better nutrition and sustainable agriculture

Goal 3: ***Ensuring healthy lives and well-being for all, at all ages*** (e.g. reducing environmental health problems such as air pollution)

Goal 4: Ensure inclusive and equitable quality education and lifelong learning opportunities for all

Goal 5: Achieve gender equality and empower women and girls

Goal 6: ***Make water and sanitation accessible to all and manage them sustainably*** (e.g. protect drinking water sources to ensure healthy drinking water)

Goal 7: Ensure access to affordable, reliable, sustainable and modern energy for all

Goal 8: Continuous, inclusive and sustainable economic growth, full and productive employment and decent work for all

Objective 9: ***Build resilient infrastructure, promote inclusive and sustainable industrialisation and foster innovation*** (e.g. through the CEF, the European Network Enabling Facility, which provides funding for resilience and infrastructure development in transport, telecoms and energy networks)

Goal 10: Reduce inequalities within and between countries

Goal 11: ***Making cities and human settlements inclusive, safe, resilient and sustainable*** (e.g. preventing natural disasters and climate-related risks)

Goal 12: Ensure sustainable consumption and production patterns

Goal 13: ***Immediate action to combat climate change and its impacts*** (e.g. reduce GHG emissions)

Goal 14: Conserve and sustainably use oceans, seas and marine resources for sustainable development

Objective 15: ***Protect, restore and promote sustainable use of terrestrial ecosystems, manage forests sustainably, combat desertification, halt and reverse land degradation and halt biodiversity loss*** (e.g. Natura 2000 network)

Goal 16: Promote peaceful and inclusive societies for sustainable development, justice for all and accountable and inclusive institutions at all levels

Goal 17: Strengthen means of implementation, revitalise global partnerships for sustainable development

The SDGs have been integrated into the ten priorities of the current Commission's political programme, so EU policies address all of them, and the Europe 2020 strategy plays an important role in implementing many of them.

37 https://eur-lex.europa.eu/legal-content/HU/TXT/PDF/?uri=CELEX:52016DC0739&from=HU

The objectives of the Programme are partly in line with the goals and orientations set out in the document, but there are also challenges and contradictions between the objectives. For example, increasing the share of waterborne freight transport can help to combat climate change, but the shipping sector needs to be prepared to better adapt to the impacts of climate change.

The Programme has taken into account nature conservation aspects in setting the objectives, but some interventions may have unavoidable negative impacts, e.g. on biodiversity. A number of other environmental elements and systems are affected by the impact of the development of the waterway and the increase in traffic.

These are examined in detail in the present SCV, with the main findings presented in the relevant section chapters. By following the mitigation recommendations set out in this SEA (and in subsequent planning phases, including the EIAs), it is expected that the adverse environmental impacts can be further reduced and the environmental benefits outweigh any potential harm. At least, this is what the Programme aims to achieve (e.g. to minimise interventions).

2.19. EU TRANSPORT WHITE PAPER [38]

The relevant transport policy aspects of the White Paper are described in ***chapter 1.1.2 of*** this Annex, but it is also important to highlight the environmental objectives that can be linked to shipping:

- The White Paper sets ambitious targets to **reduce** oil dependence and CO_2 emissions. For the latter, the **target is a 60% reduction by 2050 compared to 1990 levels** (a reduction of about 70% compared to 2008 levels). By 2030, greenhouse gas emissions from transport should be reduced by about 20% below 2008 levels.
- **Transport** must use less and cleaner energy, make better use of modern infrastructure and **reduce its negative impact on the environment and key natural resources, including water, landscapes and ecosystems**. At the same time, it says that reducing mobility is not the answer.
- **New transport models must emerge, in which more goods and more passengers are transported at the same time,** using the most efficient modes (or the most efficient combination of modes), e.g:

- **Improving the energy efficiency performance of vehicles** in all transport modes. Develop and introduce sustainable fuels and propulsion systems;
- **Optimising the performance of multimodal logistics chains**, including **increased use of** inherently **more resource-efficient modes of transport** where other technological innovations alone would not be appropriate (e.g. for long-distance freight transport). The White Paper recognises inland waterway transport as an energy efficient mode of transport.

The main objective of the Programme is the development of the Danube waterway, which will contribute to increasing the share of waterborne transport in freight transport, in line with the objectives of the White Paper. This will also help to achieve energy efficiency and CO_2 emission reduction targets, provided that a reduction in the share of road freight transport can be achieved. If the fleet of vessels using the river is modernised (through other projects or changes in international standards), the share of renewable energy and energy efficiency can be increased and CO2 emissions further reduced.

The implementation of the Programme will have some negative environmental impacts, however, by following the mitigation recommendations of this SEA, the negative environmental impacts are expected to remain within acceptable levels and the environmental benefits of indirect transfer of pressure between

[38] https://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2011:0144:FIN:HU:PDF

road sectors are expected to outweigh any potential damage. At least this is what the Programme aims to achieve (e.g. the objective of minimum interventions).

3. RELATED DOMESTIC ENVIRONMENTAL TARGETS

3.1. ENVIRONMENTAL PRINCIPLES FOR THE SUSTAINABLE USE OF THE DANUBE AS A WATERWAY [39]

The document was prepared by the Ministry of Agriculture in 2016 with the aim of formulating proposals to promote sustainable navigation on the Danube, including:

1. **The** environmental impact of shipping **should be considered together with the impact of the development of the infrastructure necessary to provide inland waterway transport, including the development of ports and port access infrastructure and the assessment of the emission performance of ships**. Additional pressures on the Danube ecosystem through high-cost interventions, which are also costly to maintain on an ongoing basis, and additional pressures on domestic waters from increased vessel traffic cannot be supported.
2. When assessing the improvement of navigability, **the principle of minimum intervention should be pursued and the** critical intervention points that can be addressed in order to maximise cost-effectiveness should be identified in order.
3. Although improving shipping conditions for narrow inland freight transport is expected to save freight costs, a significant part of the savings will be made in other countries using the waterway. Therefore, based on the "polluter pays" and "user pays" principles, the **costs of improving navigability and the** significant annual **maintenance and environmental costs** that are already incurred should be **financed jointly by the EU or the countries using the waterway in proportion to the use of the waterway**.
4. The **development of navigability should be achieved by selecting the most environmentally friendly alternatives**. Where possible, alternative solutions to modification of the riverbed should be chosen: the development of navigation systems should allow for flexibility in width, capacity, two-way and one-way traffic, in accordance with the geographical, ecological and economic conditions and needs of the river and the country. In the long term, it is cheaper and more environmentally friendly to develop the fleet and the navigation regime in a way that is adapted to the river's characteristics and the needs of the wildlife.
5. **The** analysis of alternatives **should address the potential for linking waterways and railways, and seek to create and develop links between different modes of transport (inland waterways, rail, road) (inter- and multi-modality), as** well as to consider possible capacity-shifting solutions on certain sections (e.g. The analysis of development options should take into account the extent to which these options represent domestic interests.
6. **The** aim is to **protect** the **Danube** (including its floodplain and floodplain) **and its tributaries, to ensure good ecological status, to preserve and restore the natural and semi-natural state, to protect natural and Natura 2000 sites, to conserve species**, including, in addition to rare species, native character species.
7. The **sustainable use of the** resources offered by the Danube and its surroundings, the so-called **ecosystem services,** can be achieved by coordinating the development of agriculture, forestry, fish and game management, tourism, environment and nature conservation, and infrastructure.
8. **The negative impacts of climate change must be taken into account**. Only technical interventions that help to adapt to changing conditions and extreme weather events, that do not increase vulnerability and that include mitigation measures, will be supported.

[39] https://eionet.kormany.hu/download/9/35/22000/A_Duna_mint%20viziut_2016.pdf

9. In **order to reduce pollution along the Danube, it is proposed to prioritise organic farming and traditional farming methods** (e.g. floodplain farming, steppe farming) **over intensive agriculture**. With the extreme weather conditions caused by climate change, high intensity rainfall and torrential downpours are becoming more frequent, leading to increased leaching of pesticides and nutrient replenishment residues into living waters.
10. As part of the TEN-T Corridor VII, the **provision of a fairway** meeting European requirements **can be supported by environmental and nature-friendly solutions based on a detailed economic and energy efficiency assessment**, which implies a fair and proportionate use of the Danube's assets and the services of its associated ecosystems.

The basic objective of the Programme is to achieve the expected parameters of the fairway with minimum interventions. From an environmental and nature conservation point of view (e.g. in connection with points 2 and 6), the basic positive objectives are to minimise environmental and natural damage, to maintain or partially improve the water supply of the tributaries to the current extent (in some places only by raising water levels, in others by rebuilding the intake structures) and to prevent further lowering of the riverbed and low water level.

A further (final) objective of the Programme is the "integration of inland waterway transport into the multimodal TEN-T corridors", which requires taking into account related projects that can be investigated on the basis of our current knowledge. The Programme's analysis of alternatives (integrating environmental aspects), the economic analysis of the navigability programme, changes in ecosystem services, climate change impacts and energy efficiency are examined in detail in this SEA.

(The measures envisaged in the Programme are not linked to the polluting effects of agricultural activity; and the need to move towards an environmentally friendly fleet is highlighted in the Programme, but it is also stated that this will be the responsibility of other projects.)

3.2. JENŐ KVASSAY PLAN - THE NATIONAL WATER STRATEGY (2017.) [40]

In 2014-2015, the water sector started the development of the Kvassay Jenő Plan (Kvassay Plan), a water strategy for general economic development, which was finally adopted in the framework of the Government Decision 1110/2017 (7.III.) on the adoption of the National Water Strategy and the action plan for its implementation.

The vision of the WFD 2030 is: *"**Water is useful and effective for the sustainable development of the nation, i.e. sufficient, safe, clean and good quality water is available for present uses and future generations and for natural values, while water uses and measures against water damage are in harmony with natural resources**. Society, economic actors and decision-makers have a stake in and a stake in achieving and maintaining this status, so that water needs and the ways to meet them are defined by consensus. **Water management and water infrastructure effectively serve these needs and can adapt flexibly to environmental and economic changes.**"*

In order to achieve this, the NRC concept has set out 4+3 long-term objectives, *4 of which are sectoral*, while the other 3 are horizontal and have an impact across all sectors:

- Water retention for better use of our waters.
- Risk prevention flood and inland water protection.
- Gradually improve the status of waters until they reach good status.
- Delivering quality water and sanitation services and stormwater management, with a tolerable burden on consumers.

[40] https://www.vizugy.hu/vizstrategia/documents/997966DE-9F6F-4624-91C5-3336153778D9/Nemzeti-Vizstrategia.pdf

- Improving the relationship between society and water (at individual, economic and decision-making levels).
- Renewing planning and governance.
- Reform the economic regulatory framework for water management.

The above can also be directly linked to the navigability of the Danube, but the ICZM also deals with river management within the framework of territorial water management: 'The classical role of river management is to ensure the discharge of water, sediment and ice without damage, as well as the management of navigation, coastal protection, tributaries and backwaters. ***As a new approach to river management beyond regulation, it focuses on the river as a discipline, prioritising good ecological status, taking into account its natural features and ensuring sustainable development***." It also stresses that "***the protection of the natural state of rivers is a priority objective in*** our country", in particular:

- Green and blue corridor concepts can provide the ***necessary natural area, continuity of migration routes,*** longitudinal and transverse permeability for the migration of aquatic organisms.
- Providing intermittent or permanent flushing of estuaries also increases the diversity of river habitats.
- ***The implementation of large-scale river basin management plans*** and the creation of conditions for recreation are also part of river management and its tools.

The ICZM also mentions navigation on the Danube: "***one of the tasks of river management (utilisation) is to ensure***, regularly survey, mark and maintain the ***fairway.*** Although the length of our country's waterways suitable for large-scale navigation is 1,638 km (including the Tisza, Bodrog, Drava and Sió), ***only the Danube is of strategic importance for sustainable development, and only the Danube is of international importance. An important aspect is the maintenance of the integrity of the natural riverbed***. The bed of the Danube in Hungary is constantly deepening, the low water levels are sinking and the associated groundwater levels are sinking. This is also causing significant ecological damage, so mitigating ecological damage without navigation will also force consideration of technical interventions."

The objectives of the Programme and the planned interventions are in line with the objectives set out in the Jenő Kvassay Plan, e.g. prevention of further lowering of the riverbed and low water levels, minimisation of interventions, use of solutions with ecological benefits, preservation or partial improvement of the water supply of the tributaries (in some places only raising water levels, in others rebuilding of the intake structures).

3.3. FLOOD RISK MANAGEMENT PLAN (FRMP) [41]

The document entitled "Flood Hazard and Risk Assessment and Management" and the flood risk management plans for 8 planning units were adopted by the Government by Government Decision 1146/2016 (25.III.) on the National Flood Risk Management Plan of Hungary.

In line with Directive 2007/60/EC of the European Parliament and of the Council, the main objective of the CCCTB is:

- reducing the risk of adverse impacts of floods, in particular on human health and life, the environment, cultural heritage, economic activities and infrastructure.

It was still a principle when the CCCTB was designed:

- In the interests of solidarity, flood risk management plans should not include measures that significantly increase the risk of flooding in sub-waters or upstream countries, unless these coordinated measures have been agreed between the Member States concerned. On the one hand, significant flood risk problems should not be transferred from one region to another and, on the

41 https://www.vizugy.hu/index.php?module=vizstrat&programelemid=145

other hand, interventions in several river basins should have the effect of reducing the overall level of risk.

- A level of "absolute safety" is not achievable, nor can it be rationally approached as a goal, but instead a level of risk that is acceptable to society must be defined, where damage that is difficult or impossible to quantify must be taken into account.
- The protection of human health and life must always be given absolute priority, even over the protection of the environment (European Parliament resolution on the adoption of a Directive on the management of flood risks, 13 June 2006).
- The implementation of measures to reduce flood risk and the operation of risk management systems should minimise any undesirable environmental impacts that may occur.

According to the national summary of the SAEFL, "***flood risk management plans should take into account*** relevant aspects such as costs and benefits, flood extent, flood propagation routes and areas with flood retention capacity, such as natural floodplains, environmental objectives under Article 4 of Directive 2000/60/EC, soil and water management, land use planning, land use, nature conservation, ***navigation and port infrastructure.***"

The **planning units for the Danube are**: the **Upper Danube** (the stretch of the Danube between the western border and the mouth of the Dömösi Mill stream), the **Middle Danube** (the stretch of the Danube from the mouth of the Dömösi Mill stream to the Tassi lock), the **Lower Danube** (the stretch of the Danube from the Tassi lock to the southern border). The summaries for the planning units include, for example, gullies and constrictions that temporarily impede navigability (1 gully in the Upper Danube section, 13 gullies in the Central Danube section, 20 gullies and constrictions in the Lower Danube section).

The design criteria of the Programme include: '*only river control works that do not cause significant local water level rise in the riverbed, have an effect only during periods of low flow and do not impair the conditions for the discharge of floods'*. Therefore, the interventions envisaged in the Programme take into account the flood protection aspects and do not impede the discharge of flood waters, and are therefore in line with the objectives of the Flood Risk Management Plan.

3.4. GREAT LAKES BASIN MANAGEMENT PLANS

The large water body management plans are regulated by the Government Decree 83/2014 (III.14.). According to this regulation, "*a large river basin management plan is a ministerial decree prepared on the basis of the planning documentation in Annex 1, which contains the necessary regulations and measures, site plans and map annexes, which set out the methods and conditions of large river basin management, in order to achieve and maintain the target status for the entire length of the river, and also defines the drainage channels and the actual impact of the individual channels on the real estate.* "

A flood channel is an area regularly covered by water during the course of flooding, and whose purpose is to discharge floodwater and ice leaving the channel (Act LVII of 1995 on Water Management, § 24). According to the legislation in force, the floodplain may only be managed, used and exploited in accordance with the flood protection regulations:

- primary drainage channel: the part of the floodplain where flood flows and ice retreat under the most favourable flow conditions,
- secondary drainage channel: is a major contributor to flood discharge,
- transition zone: the part of the territory periodically flooded by floods,
- flow hollow: area of land where there is no flow, but where the reservoir volume plays a role in the drainage of flood waters.

In accordance with the requirements of Government Decree 83/2014 (14.III.2014) (Annex 1 regulates the content requirements of the documentation of the large-scale river basin management plans), the **large-**

scale river basin management plans examine in detail the navigability of the given planning areas, e.g. the water depths of the navigation low water level at the constrictions and fords in relation to the prescribed standard navigation water levels prescribed in Decree 17/2002 (7. The **existing harbours are** also included in the analysis of the use of the basin section. The plan for the management of the large water body must also define the "**rules of navigation and mooring**" within the planned measures.

Overall, it can be seen that, from a navigability point of view, the plans for the management of large bodies of water contain detailed information and specifications. The Programme describes the content of the large-scale river basin management plans as a planning precedent, so that its aspects have been taken into account in the planning process.

3.5. NATIONAL RIVER BASIN MANAGEMENT PLAN (2015) [42]

The objectives of the River Basin Management Plan (RBMP) cannot be separated from the objectives of the WFD, which are defined separately for surface water and groundwater in general and for groundwater in particular (see related international documents).

In order to achieve the objectives set out in the WFD, the actual aim of the WFD is to identify measures per water body that will help to achieve or maintain good status or potential.

Achieving the goal of good ecological, water quality and quantity status of watercourses, standing waters and groundwater is a complex and long process. The measures needed to achieve these objectives are summarised in the revised **National River Basin Management Plan** (VGT2). The revised 2015 River Basin Management Plan of Hungary, adopted by Government Decision 1155/2016 (31.03.2016), includes the latest studies on the pressures on our waters and their status, the findings on climate change, the economic analysis of water uses and the **measures to be implemented by 2021 and 2027 to achieve good status.** VGT2 aims to address the significant water management problems identified. **Two of the planned measures specifically mention navigation**, both of which are related to action group 6 (Improving hydromorphological conditions outside longitudinal permeability: reducing the regulation of watercourses and standing waters):

- 6.7a: Dredging large rivers to improve the availability of water in the floodplain for navigation or flood protection;
- 6.13: Adaptation of navigation to river or still water conditions.

For each of the surface water bodies in the Danube section (Danube at Szigetközn, Danube between Gönyü and Szob, Danube-Budapest, Danube between Budapest and Dunaföldvár, Danube between Dunaföldvár and Sió estuary, Danube between Sió estuary and the national border, Danube between Szob and Budapest), **measure 6.13 is to be implemented by 2027**.

The measure "Adaptation of navigation to river or still water conditions" aims, in line with the provisions of the WFD for improvements, at possible modifications of the requirements for the waterway, to adapt it to the river conditions, e.g:

- **By adjusting the size and load capacity of the vessels,** the standard draught depth is reduced and so is the required water depth. The use of vessels with smaller draughts requires the provision of a transhipment station and an adequate fleet.
- In the case of our large rivers, the shore is adequately protected against wave action from shipping by the riparian buffer zone. However, it does not protect coastal shallow water and coastal wildlife, and therefore the **permissible vessel speed,** type and size of vessels should be **reviewed,** taking into account the sensitivity of coastal wildlife, and/or ecologically acceptable technical solutions for wave protection should be implemented where necessary.

[42] https://www.vizugy.hu/index.php?module=vizstrat&programelemid=149

- The **reorganisation of traffic** (management by modern means) changes the width of the fairway required and the duration of navigability.
- In rivers, dams due to navigation should be avoided.

"The aim is to apply the principle of "minimum disturbance", whereby **vessel traffic and associated facilities should be managed in a way that is as compatible with the landscape as possible, with the least possible disturbance to the water flow and the shoreline and aquatic life of the river or lake**. This shall include the designation and maintenance of waterways (maintenance dredging, damming, protection against wave action, protection distances, etc.), the selection of a fleet of facilities that also takes into account environmental/ecological aspects."

The objectives of the Programme are in line with measure VGT2 "Adaptation of navigation to river or still water conditions" due to the principle of "minimum disturbance". One of the main objectives of the Programme is the development of a gas-free waterway that meets international and national navigation parameters as far as possible, i.e. to minimise interference by adapting to the river conditions as far as possible.

The VGT2 has been used as a data source in several places in this SEA, for example: in the baseline assessment for surface groundwater. The applicability assessment (and, if necessary, the detailed exemption assessment) under Article 4(7) of the WFD is dealt with in detail in a separate working section in this SEA and in the subsequent phases of the plan in the framework of the environmental impact assessment (based on Annex 6 of Government Decree 314/2005 (25.XII.)).

3.6. IV NATIONAL ENVIRONMENT PROGRAMME (2015-2020) [43]

The 4th National Environment Programme Policy Strategy was adopted by the OGY Decision 27/2015 (17.VI.), Annex 1. The National Environment Programme (NEP-IV) has set three strategic objectives for its overarching objectives:

- Improving the quality of life and environmental conditions for human health

"The aim is to ensure a good quality of life and the immediate environmental conditions for healthy living. These include improved environmental health conditions, high quality environmental infrastructure, and an appropriate proportion, quality and harmony of the built and natural elements of the settlement and the place of residence."

- Protection and sustainable use of natural values and resources

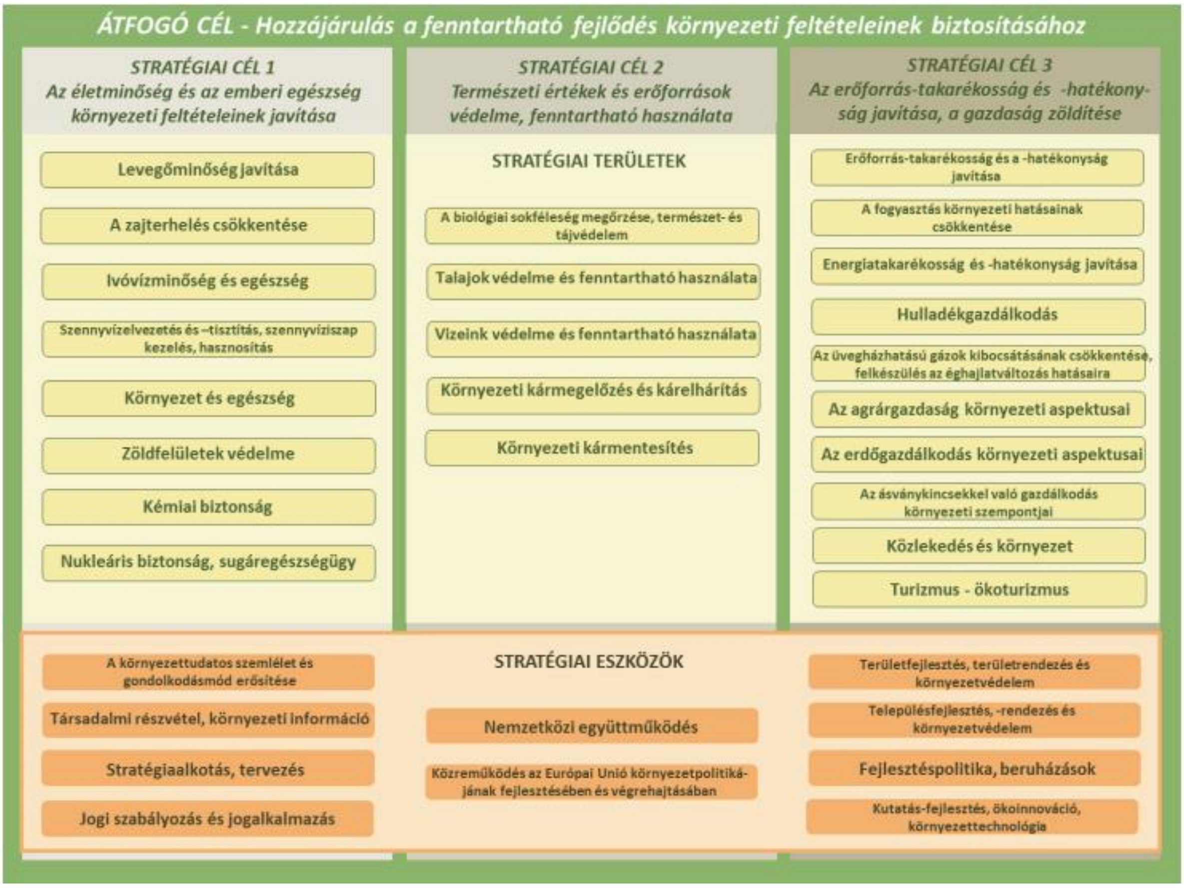
"The aim is to protect natural resources, natural values and ecosystems of strategic importance, to preserve the functioning of communities and to halt the loss of biodiversity."

- Improving resource saving and efficiency, greening the economy

"The aim is to develop the economical management of natural resources, to prevent pollution and to achieve sustainable use based on resilience/renewability. Particular attention should be paid to the decoupling of socio-economic development and environmental pressures, i.e. ensuring the increasing well-being of the population with a decreasing environmental burden..."

All three objectives are linked to improving climate change resilience and environmental security. The objectives linked to each strategic objective are shown in the figure below.

[43] http://doc.hjegy.mhk.hu/20154130000027_1.PDF



National Environment Programme target system

The NAP, in its presentation of the baseline situation, underlines, directly related to the present Programme, that "the share of waterborne transport has not increased in the recent period, but several plans have been formulated to create conditions for international (mainly transport) and ecotourism navigation (Danube, Tisza). These developments, however, require a number of interventions affecting the biota of the rivers and their riparian areas and the condition of the waters, and, once implemented, will require substantial domestic maintenance resources, so that their feasibility cannot be examined in a complex manner."

The NRP also states that, due to Hungary's geopolitical position, the development of a sustainable transport system can only be achieved through effective macro-regional cooperation. The EU Strategy for the Danube Region clearly declares the sustainability aspects of development policy among the objectives of the priority area of transport (e.g. in order to protect and restore the Danube as an ecological resource, corridor and drinking water source, it is necessary to ensure that nature conservation, drinking water source protection and flood protection aspects are taken into account not only in the domestic section of the river but also along the entire stretch, complex planning and impact assessment of developments in the course of navigation developments and other interventions; development of environmentally friendly transport connections, intermodal ports).

The objectives set out in each of the strategic target areas which are to be taken into account in the planning phase of this Programme from an environmental point of view are:

- Changes in air quality
  - Preventing the development of air pollution.
  - Protecting air quality: reducing pollution.
  - A 20% reduction in atmospheric concentrations of particulate matter less than 2.5 micrometres in diameter (PM2.5) between 2010 and 2020 (from 25 µg/m3 to 20 µg/m3).
  - Meeting the 2020 overall emission reduction targets compared to 2005 emissions in line with the Geneva Convention

- Reducing noise pollution
    - Reduction in the number of residents affected by noise above the strategic thresholds (average noise exposure (Lden) 63 dB throughout the day and 55 dB at night (Ljjjel)) along transport facilities
- Environment and health
    - Improving the safety of natural bathing waters
- Biodiversity conservation, nature and landscape protection
    - Maintaining the ecological network.
    - Maintaining the Natura 2000 network, preserving and restoring habitats and species to favourable conservation status.
    - Maintaining the network of protected natural areas of national importance (...)
    - Protecting, maintaining and enhancing sites of international importance.
    - Stopping the degradation of ex lege protected natural areas, improving their natural state, and preserving their natural and cultural heritage values in an integrated way.
    - The implementation of nature and landscape conservation objectives in land use and settlement development and planning, in sectoral planning (in particular agriculture and forestry, water management, transport and other technical infrastructure development) and in individual official procedures.
    - Maintaining landscape use that preserves landscape character and landscape character.
- Soil protection and sustainable use
    - Increased protection of the quantity and quality of soil resources and long-term maintenance of their fertility
- Protection and sustainable use of our waters
    - To achieve good status of surface and groundwater bodies and ensure their long-term and sustainable management (...)
    - Protecting the quantity and quality of water resources (promoting the rational and economical use of water, reducing the pollution load of water).
    - Reducing and preventing adverse impacts from excess or scarce water.
    - Improving water retention and storage and maintaining flood defences, particularly in the face of extreme weather events expected as a result of climate change.
    - Mitigate the impact of floods, floods and droughts, taking into account the objective of "good status".
- Waste management
    - Increase the recovery rate of construction and demolition waste (increase the mass of non-hazardous construction and demolition waste prepared for re-use, recycled and otherwise recovered for material recovery to at least 70% by 2020).
- Reducing greenhouse gas emissions, preparing for the impacts of climate change
    - Transition to a low-carbon economy by reducing greenhouse gas emissions and strengthening natural sinks
- Transport and environment
    - Reduction of transport-related environmental pressures (with a particular focus on reducing emissions of transport-related air pollutants (nitrogen oxides, small particulate matter)).
    - Reducing transport demand, promoting and developing individual, non-motorised forms of transport.

Note that the NAP does not mention the development of waterborne transport as an example of a measure: *encouraging the uptake of environmentally friendly modes of transport to reduce the environmental impact of freight transport (e.g. shifting road transit freight to rail).*

The objectives of the Programme (e.g. minimised interventions, minimised environmental and natural damage, shift from road to inland navigation) are largely in line with the objectives of the National Environment Programme described above. However, inevitably, in several cases, there are contradictions with regard to local interventions (e.g. impact of dredging on habitats and species of Community importance in the Natura 2000 network).

The main purpose of this SEA is to estimate the extent of environmental impacts at a strategic level, to highlight potential risks and to make recommendations for mitigating adverse environmental impacts, which are set out in the chapters below.

The Programme and the planned technical interventions contained in it include activities that can also be interpreted as compensatory, such as the use of innovative solutions with ecological benefits (cutting of spurs, chevron dams) or the preservation or partial improvement of the water supply of the tributaries (in some places only raising water levels, in others rebuilding of the intake structures). Thus, while minimising interventions, the Programme also seeks to increase environmental benefits.

3.7. IV NATURE CONSERVATION FUND PLAN (2015-2020) [44]

The Conservation Fund Plan was published as an annex to the NAP. Its task is to define the priority objectives to be pursued in connection with the state's nature conservation tasks, and to set out the lines of action not only for the nature conservation administrations, but for all state bodies. Among the objectives set out in the Sub-Plan, the following are the main ones to be taken into account for the purposes of this Programme:

- Biodiversity conservation (domestic implementation of the EU Biodiversity Strategy): halting biodiversity loss and further decline in ecosystem services by 2020 and improving their status where possible;
- Managing the Natura 2000 network;
- Establishing the necessary conditions for the complex protection of our country's landscape heritage and landscape diversity based on sectoral cooperation, and reviewing its legal environment.
- Meeting international nature conservation and landscape protection obligations.

The main lines of action should be highlighted because of the significant Natura 2000 site implications:

- The main objective is to operate the Natura 2000 network in line with the objectives of the Habitats and Birds Directives.
- To conserve, maintain and restore the favourable conservation status of the habitat types and species on which the designation of the sites is based, and to ensure the natural condition on which the delimitation of Natura 2000 sites is based, as well as the conditions for sustainable management.

It should be taken into account to protect the Danube's important and valuable fish stocks:

- Maintaining the natural fish fauna, the native fish population and the desirable fish species composition of waters through habitat protection, habitat reconstruction, artificial propagation and introduction of fish species where appropriate.
- Promoting the natural reproduction of fish stocks, establishing and reconstructing fish spawning grounds and fish ponds, promoting the overwintering of fish stocks (protection of spawning grounds, spawning).

[44] http://doc.hjegy.mhk.hu/20154130000027_1.PDF

To preserve and restore habitats:

- By 2020, at least 15% of degraded ecosystems with an ecological function should be subject to coordinated habitat restoration.
- Restoration should be linked to the need to help curb the processes leading to the degradation of certain natural assets, including the spread of invasive species and the rapid progress of scrub encroachment and eutrophication.
- Reviewing the sustainability of activities that do not affect the state of the environment or ecosystem services, and developing and using environmentally friendly technologies.
- Developing a suitable scheme for the continued conservation of ecologically important landscape features within the scope of nature conservation (tree lines, groups of trees, arboretums, parks and other wooded green areas, hedges, shrubs and borders, field margins), as required by the cross-compliance.
- Improving existing and potential green infrastructure, mitigating the negative impacts of climate change and promoting adaptation, improving connectivity between natural and semi-natural areas.
- For species of high ecological risk from a conservation point of view, continue protection, increase the extent of areas treated and the number of species treated, monitor and restrict trade where necessary.
- For flood species of high ecological risk from a conservation point of view, continue protection, increase the extent of the areas treated and the number of species treated, monitor and restrict trade where necessary.

There is little harmonisation between the objectives of the Programme and the objectives of the National Nature Conservation Fund Plan, and interventions in habitats have a fundamentally negative impact on habitat conditions. However, the designers have tried to use innovative technical solutions (spur cutting, Chevron dam) and compensatory interventions (improving the water supply of a tributary) that mitigate the adverse natural effects and that also have ecological benefits. It is also positive that one of the main objectives of the Programme is to implement minimal interventions to create a waterway and to prevent further lowering of the river bed and low water level to meet ecological water needs. The latter is essential in the habitats associated with the Danube, and is therefore a common objective of the Basic Plan and the Programme.

It is also important to note that, if a shift of some road traffic to waterborne transport can be achieved, it would have positive impacts on existing roadside habitats and communities (e.g. curb effects, direct impacts, etc.) and perhaps partly mitigate significant road development efforts, which could lead to a reduction of the negative ecological impacts (e.g. fragmentation, land occupation) associated with road construction in the long term.

The planned interventions for the construction of the fairway and the impacts of the increase in shipping traffic on wildlife are mostly negative, as revealed in the wildlife chapters of this SEA and the Natura 2000 impact assessment documentation.

3.8. NATIONAL NATURA 2000 PRIORITY ACTION PLAN (2014-2020) [45]

In line with Objective 1 of the EU Biodiversity Strategy to 2020, the general objective of the Natura 2000 Priority Action Plan is to create the conditions for improving the conservation status of species and habitat types of Community importance covered by the Habitats Directive and the Birds Directive and for the conservation of Natura 2000 sites designated under the Directives, using the EU development policy instruments.

45 http://www.termeszetvedelem.hu/_user/browser/File/Natura2000/PAF/PAF_kivonat_%20Magyar.pdf

In order to achieve this objective, the Action Plan identifies a total of nine national strategic conservation priorities and 41 actions along the following main areas of intervention:

- Direct (infrastructural) improvements (habitat development, reconstruction, direct species conservation interventions, development of nature conservation management tools, etc.) for the conservation of species and habitat types of Community importance and Natura 2000 sites, with special attention to the values specific to the Pannonian region, predominantly occurring in Hungary - Priorities 1-6
- Developing the knowledge base for the conservation of species and habitat types of Community importance and creating the conditions for long-term monitoring of the conservation situation (research, monitoring) - Priority 7
- Improving the institutional conditions for the conservation of species and habitat types of Community importance, laying the foundations for the planned management of Natura 2000 sites (e.g. strengthening the institutional conditions for the presence of sites, preparing maintenance plans, etc.) Improving the awareness and social acceptance of the Natura 2000 network and natural values of Community importance (presentation, awareness-raising, education) - Priority 8
- Promoting the sustainable use of the potential socio-economic benefits of Natura 2000 sites and the application of good practice in this area at home - Priority 9

The Plan is only very indirectly linked to the Programme under review. Provided that the conservation of biodiversity and the protection of Natura 2000 habitats and species are not significantly affected, the Programme can also comply with the requirements of this Plan. Improving the conditions for navigation, neither the implementation of the necessary technical interventions nor the impact of increased vessel traffic should therefore not hinder the measures set out in the Plan, which are essentially "*vulnerable wetland and floodplain habitats, and their associated species of Community importance*" (priority F1) and "*the good ecological status (water quality, water quantity, flow dynamics, morphology of the bed, etc.) of natural, modified and artificial water bodies - rivers, lakes, small watercourses in lowland and hilly areas, aquatic habitats and communities" (*priority F1).*Improving the conservation status of species of Community importance and their habitats* (priority F2).

In the latter priority, the **Plan highlights that** "(...) the *problems of bed morphological interventions resulting in changes in flow conditions, bed scouring,* (...) *for certain molluscs (e.g. blunt river mussels), two of our crayfish species of Community importance (the stone crayfish and the river crayfish) and many species of riverine fish, and that the* ***various water management interventions should be designed and implemented with conservation in mind."***

The impacts on habitats and species of Community importance (candidate species) of Natura 2000 sites in the domestic Danube section are described in detail in the Natura 2000 Impact Assessment document annexed to this SEA.

The objectives of the Programme, such as the principle of minimum intervention, minimum damage to nature, aim to protect the species and habitats associated with the Danube ecosystem as much as possible, while ensuring navigability. Maintaining or partially improving the water supply of the tributaries to the current extent (in some places only raising water levels, in others rebuilding of intake structures) and applying solutions with ecological benefits may also have a positive impact on certain habitats and species of Community importance (Natura 2000) (e.g. provision of spawning grounds). Preventing further lowering of river beds and low water levels, and raising low water levels to a minimum but almost across the entire stretch of the Danube is also desirable for the long-term conservation of the natural values of Natura 2000 sites, and this objective of the Programme is therefore in line with the National Natura 2000 Priority Action Plan.

3.9. NATIONAL BIODIVERSITY STRATEGY (NBS, 2015-2020) [46]

The new national strategy for biodiversity conservation 2015-2020 aims to halt the loss of biodiversity and the further decline of ecosystem services in Hungary by 2020 and to improve their status where possible. This requires biodiversity conservation to be integrated into cross-sectoral policies, strategies and programmes and their implementation.

The National Biodiversity Strategy, in line with the vision outlined above and to some extent aligned with the structure of the EU Biodiversity Strategy, focuses on six areas, of which those relevant to this Programme are highlighted in bold:

- to protect protected areas and species;
- maintain landscape diversity, green infrastructure and ecosystem services;
- on issues related to agriculture;
- sustainable forest and wildlife management and protection of water resources;
- to combat invasive alien species (flood species); and
    - Hungary's role in implementing its obligations under international biodiversity agreements.

Within these strategic areas, twenty objectives focus on addressing domestic biodiversity conservation challenges.

Related strategic areas and objectives are:

Strategic Area I: Preserving the protected natural areas and values of Hungary, improving their conservation status and creating the conditions for the full implementation of the European Union Birds and Habitats Directives in Hungary

- Objective 1: Improve the status of Natura 2000 sites, protected natural areas and sites covered by international nature conservation conventions and ensure appropriate conservation management
    - Habitat restoration and management infrastructure improvements will improve the conservation status of at least 95,000 hectares of Natura 2000 sites (including overlapping other protected areas).
    - In line with the EU objectives, the conservation status of the habitat types of Community importance in the Pannonian region will be significantly improved: the number of habitat types with favourable or improving conservation status will double (increase by 100%).
    - For 50% of ex lege protected sites of key biodiversity importance, conditions for their conservation will improve.
- Objective 2: Improve the conservation status of the most vulnerable species of Community interest and the most threatened protected species
    - The conservation status of species in the Pannonian region is improving significantly, with the number of species with favourable or improving conservation status increasing by 50%.
    - The situation for species with favourable status remains favourable.
    - By 2020, no new native species will have disappeared from the domestic fauna and flora.

Strategic Area II: Maintaining and restoring landscape diversity, green infrastructure and ecosystem services

- Objective 5: Preserve landscape diversity and ecological landscape potential
- Objective 6: Coordinated development of green infrastructure elements to maintain and improve the functioning of natural systems and to help adapt to the effects of climate change, including improving

[46] http://www.biodiv.hu/convention/cbd_national/nemzeti-biodiverzitas-strategia/biologiai-sokfeleseg-megorzesenek-2015-2020-kozotti-idoszakra-szolo-nemzeti

the links between areas with ecological and landscape ecological functions, reconstructing potential site elements and restoring degraded ecosystems.

- Habitats of protected species and species of Community importance most affected by habitat fragmentation and isolation will experience reduced fragmentation

Strategic Area IV: Sustainable management of forests and wildlife and the protection and sustainable use of our water resources

- Objective 14: To promote the natural reproduction and thus the renewal of fish stocks in natural aquatic fisheries, the conservation of endangered fish species and wild forms, the rehabilitation of threatened habitats, in particular the protection of spawning and nursery grounds. Ensure longitudinal and transverse waterway continuity.
  - Fish and roundnose grenadier habitat protection and rehabilitation
  - All native fish and roundnose grenadier species have stable viable populations in the country. The range of the species is not decreasing, and that of species associated with marsh habitats is increasing.
- Objective 15: Explore the role of water in aquatic and water-dependent terrestrial ecosystems; promote and coordinate water management, rational and efficient water use; *reduce* pollutant *loads to water in order to preserve biodiversity and maintain ecosystem services for water-dependent micro- and macro-level life forms.*
  - Implement the protection of terrestrial surface water and groundwater as defined in the Water Framework Directive. Achieve "good status" by 2015 and further measures by 2020 to protect and enhance terrestrial ecosystems (aquatic and terrestrial ecosystems directly dependent on aquatic ecosystems) linked to water
  - Preventing the degradation of surface and groundwater so that aquatic and terrestrial water-dependent assemblages respond appropriately to external pressures.
  - Healthy aquatic ecosystems by 2020, capable of providing the right services for the system, biodiversity and well-being.
  - A Danube sediment balance will be drawn up, on the basis of which measures will be taken to reduce the sinking of the Danube.

Strategic area V: Combating invasive alien species (invasive species)

- Objective 16: To reduce the populations of invasive alien species damaging natural and semi-natural ecosystems, to prevent their further spread and the introduction and establishment of potentially threatening invasive species in our country.

The objectives of the Programme take into account nature conservation interests. From a nature conservation point of view, it is also beneficial to prevent the lowering of the river bed and the low water level, and to use innovative interventions (e.g. cutting of spurs, construction of chevron dams). However, interventions (e.g. dredging, even if the minimum possible) will inevitably have negative impacts on certain species and habitats.

The latter is covered in detail in the chapters on wildlife protection, together with proposals for possible mitigation measures. This SEA - although not a mandatory content element according to Annex 4 of Government Decree 2/2005 (11.I.) - also deals specifically with impacts on ecosystem services.

3.10. NATIONAL LANDSCAPE STRATEGY (2017-2026) [47]

Our country's first National Landscape Strategy, adopted by the Government Decision 1128/2017 (20.III.), quotes the spirit of the Council of Europe's European Landscape Convention, and accordingly defines the goals and tasks using the threefold system of instruments of conservation-management planning. Degraded,

[47] https://www.kormany.hu/download/c/ff/f0000/Nemzeti%20T%C3%A1jstrat%C3%A9gia_ 2017-2026.pdf

degraded or degraded landscapes are covered by the strategy, as are landscapes of high conservation value or landscapes that are not protected.

From a sustainability perspective, landscape challenges exist in a system, and can therefore only be addressed at a systemic level. A landscape strategy will only fulfil its expectations if the policies, when they are next revised, incorporate the horizontal aspects that are currently missing and take a complex, landscape-level (holistic) approach.

The National Landscape Strategy takes stock of the domestic situation in terms of meeting international expectations, describes the most significant landscape change processes, the drivers of these processes and the state of the domestic landscape. The measures assigned to the objectives are primarily focused on ensuring that, in addition to sectoral professional aspects, a landscape-level approach is also properly applied when decisions are taken on the planning and design of various development, economic and regulatory instruments.

The Landscape Strategy sets out the following in relation to the **changes and challenges facing rivers and riverside landscapes:**

- In connection with the "transformation of the Hungarian landscape in the 19th-20th centuries", he points out that as a result of the water management and river regulation of the 19th century, the **water-flowing areas decreased significantly**. As a result of river regulation, the **water regime of the landscape has changed** as a historical legacy, in areas where it is a natural phenomenon that floods, inland water and drought can occur within a short period of time.
- The **expansion of settlements towards rivers**, not infrequently rows of houses within flood protection embankments, impair the drainage of flood waters, and the protection of these settlements during floods requires an extraordinary effort, sometimes far exceeding the value saved.

In relation to the water sector, it makes the following general observation: "The management and planning of landscapes not under priority nature protection is currently not generally incorporated into sectoral legislation, for example, it is not incorporated into Act LVII of 1995 on water management and the implementing regulations only formally reflect landscape protection requirements at most. **The water management regulatory instruments have no or only indirect influence on land use and spatial processes adapted to natural conditions, so that the water sector cannot currently have any significant influence on activities in the river basin**. As a result, **only follow-up and protection mechanisms are possible for** publicly managed waters**, with limited possibilities for prevention and risk reduction.** The objective of the National Water Strategy is to achieve smart water management with a stronger emphasis on prevention."

The main intention and goal of the National Landscape Strategy is to make the protection, management and planning of the landscape a socially accepted public issue. At the same time, it notes that the territoriality principle is sometimes less visible in sectoral policies, which do not always take account of the specific characteristics of each region or landscape.

The overall objective of the strategy is **responsible landscape management based on landscape assets**. To achieve this, it has three horizontal principles:

- General protection of natural resources and cultural heritage;
- Wise and economical use of land;
- Climate change mitigation, adaptation.

In order to achieve the overall objective, the strategy sets out three priority objectives, which list the sub-objectives that can be linked to Danube navigability and the interventions needed to achieve it. The measures needed to achieve the objectives under the sub-objectives, which are relevant to the present topic, are as follows:

- I. Laying the foundations for landscape-based landscape management
    - I.3. Integrating landscape-based landscape management into decision-making mechanisms

- Integrating landscape-based land use requirements into the strategic and planning documents being prepared.
- Integrating the principle of landscape-based land use into sectoral legislation.
- In the case of landscapes across administrative borders, support for co-planning, cooperation and a complex approach.

– Livable landscape - livable settlement - wise landscape management
  - Sub-objective II.1: Compact, climate-friendly, high-value settlements
  - Applying and integrating landscape-scale heritage conservation methods into planning systems.
- Sub-objective II.2: Infrastructures integrated into the landscape
  - Consideration of the use of existing elements or areas used by existing elements where infrastructure is needed.
  - Taking into account the fragmentation and regenerative capacity of ecosystems in the decision-making mechanism, avoiding ecosystems that can only regenerate in situ.
- Sub-objective II.5: Better functioning regulatory and protection functions
  - The landscape use of areas with a protective function (protection zone, conservation area, buffer area, protection zone) should be reviewed and incompatible uses should be changed, and compatible landscape uses should be established by consensus.

– Enhancing landscape identity
- Sub-Aim III.2: Increasing social participation
  - Ensuring and encouraging the participation of members of society, local and regional authorities and other stakeholders, e.g. involving local and relevant higher education institutions in the relevant planning and strategic processes.

The objectives of the Programme are in line with the objectives of the National Landscape Strategy for "landscape integrated infrastructures" and "landscape-based landscape management" through the "principle of minimum interventions", as the Programme aims, inter alia, to achieve minimum land use.

It should be stressed, however, that changes in landscape use along the river will be influenced primarily by related investments (e.g. port development, expansion of rail and road links), not necessarily by the development of the waterway itself. The landscape chapter of this SEA also examines the expected related investments based on our current knowledge, and together with these, interprets the expected impacts of the development of the waterway.

3.11. NATIONAL FOREST STRATEGY (2016-2030) [48]

Forests have an important role to play in implementing the Climate Change Convention and mitigating the effects of climate change. The European Union has no competence to develop a common forest policy, but its technical "framework" is the EU Forestry Strategy for Forests and the Forest-based Sector adopted in 2013. It provides strategic guidance for EU countries until 2020, setting out eight priority areas. Of these, priority 3 "*Forests and climate change*" and priority 4 "*Protecting forests and enhancing ecosystem services*" are relevant for this Programme.

The Strategy states that forests should be used in a way and at a pace that maintains management opportunities for future generations, while preserving their biodiversity, their proximity to nature, their productive, regenerative and vital capacity, and their triple function of forests in line with societal needs,

[48] https://www.kormany.hu/download/a/1a/d0000/Nemzeti_Erd%C5%91strat%C3%A9gia.pdf

their conservation and economic requirements, and their role in nature and environment, health and social, cultural, tourism, education and research. The forest's area, ecological and intangible value, productive capacity and, in the case of economic use, income-generating capacity must not be reduced through sustainable use.

Among the main objectives of the Strategy, the "role of forests in rural development", "development of public and private forest management" and "nature conservation in forests" objectives should be highlighted in order to protect the floodplain forests that may be affected along the Danube. The protection of forests in the context of this programme should include:

- Ensuring the long-term environmental, economic and social services of forests through multifunctional, sustainable forest management, with an appropriate balance between the multifunctional roles of forests in different areas
- (...) to reduce and prevent the effects of climate change and to meet the needs of the manufacturing industry.
- Ensuring the biological basis of forest management in a sustainable manner, targeted protection and enhancement of forest biodiversity, with a particular focus on protected and high nature value forests
- Conservation and restoration of forest potential (...), development of forest water management.
- Increasing the country's forest area covered with native tree species, afforested areas and other forest tree species for economic purposes, taking into account local conditions
- Strengthening the public welfare and tourism potential of forests

Among the conservation tasks to be highlighted in the context of this Programme:

- Ensuring the survival of forest ecosystems and organisms, preserving and, where possible, enhancing forest biodiversity
- Ensuring the possibility to adapt to changing site conditions
- Preserve or, where possible, improve the naturalness of forests

The Programme has little direct impact on forests and forestry. The expected impacts on forest stands affected by water management along the Danube are discussed in this SEA (the Natura 2000 impact assessment document covers impacts on habitats of Community importance and the landscape chapter covers impacts on planned forest areas).

At the level of objectives, the objectives of the Programme are in line with the forest protection objectives of the National Forest Strategy through the "principle of minimum interventions", but some interventions may require forest land.

3.12. NATIONAL SUSTAINABLE DEVELOPMENT FRAMEWORK STRATEGY (2012-2024) [49]

The National Sustainable Development Framework Strategy aims to contribute to building a national consensus on sustainability. The document was adopted by the National Assembly by OGY Resolution 18/2013 (28.03.2013). The first national National Sustainable Development Strategy focused primarily on the development of sustainability priorities in a sectoral approach. The focus of the present Framework Strategy is to **describe the state of our national resources, to identify the processes that are "indebting" future generations, and to develop an institutional system to support the proper maintenance of resources.** Addressing the unsustainable state of national resources requires tackling the root causes and fundamental drivers of the processes and causal links. Symptomatic treatment, while it may

[49] https://www.parlament.hu/documents/1238941/1240162/Nemzeti+Fenntarthat%C3%B3+Fejl%C5%91d%C3%A9si+Keretstrat%C3%A9gia

make the situation more bearable in the present, will not help in the long term and problems will be reproduced.

The Framework Strategy's approach to the transition towards sustainability aims to ensure the long-term delivery of public goods. ***The longer-term preservation of our resources***, which are the basis for the possibility of a good life, means governance, regulation and management that balances short-term interests. And the focus of sustainability policy must be on people and communities, rather than the sectoral approach of the past.

The overarching goal of the nation's sustainability policy is to **ensure the conditions of adaptability to an ever-changing social/human-economic-economic external environment** and to improve the quality of the cultural adaptation required. The following objectives show a direct or indirect link to Danube navigability:

- Health: the aim is to reduce mortality to catch up with the regional average in central Europe, while reducing the predominant burden of disease, including chronic non-communicable diseases, which are largely lifestyle-related, and **reducing the** proportion of health risk behaviours and **environmental risk factors**.
- Preserving the heritage of the past, developing cultural services: to strengthen social cohesion, rebuild trust, maintain viable community networks, reinforce sustainability values, revitalise cultural traditions, recognise cultural diversity, preserve the intangible, tangible and built heritage, develop its values and use it sustainably.
- Natural resources: environmental carrying capacity as a limit to management should be enforced.
- Biodiversity, renewable natural resources: maintaining the species richness unique in Europe, preserving the landscape and natural assets, preventing the depletion of ecosystem services. Maintaining soil fertility, reducing the rate of encroachment on natural areas and managing renewable resources on the basis of sustainable yields are important objectives.
- Reducing environmental pressures on humans: emissions that threaten human health and quality of life must be limited and properly regulated.

The objectives of the Programme include the protection of natural resources and the achievement of the lowest possible environmental impact (e.g. minimised interventions, minimised environmental and natural damage), and the reconciliation of "human-economic-natural" needs. At the level of the objectives, there is less contradiction, but there are also negative and positive environmental impacts of the Programme when the interventions are implemented or due to increased vessel traffic. For example, the shift from road to waterborne transport may have an indirect positive impact on the quality of human life (better air quality along roads), while increased vessel traffic may have a negative impact on, for example, riverside recreational activities.

All the environmental elements and systems are linked to the objectives of the National Sustainable Development Framework Strategy, and the impacts on these are covered in the sectoral chapters. This SEA examines impacts on natural resources separately and includes a separate sustainability analysis.

3.13. NATIONAL DEVELOPMENT 2030: NATIONAL DEVELOPMENT AND SPATIAL DEVELOPMENT CONCEPT (OFTK 2014-2020.) [50]

The aim of the OFTK, adopted by Decision 1/2014 (I. 3.) of the OGY, is to ensure the unified contribution of the country's development policy, territorial planning and regulation to the dynamic development of the country, to set it on a growth path, and to reduce territorial disparities in order to achieve a more balanced territorial development. It also aims to **ensure coherence between sectoral and territorial plans and between national development policy and EU funding**, providing strategic orientations for the 2014-

[50] http://www.terport.hu/webfm_send/4616

2020 budget and planning period. **It sets out a long-term vision, development policy objectives and principles,** based on the country's social, economic, sectoral and territorial development needs.

The overall objectives of the OFTK for 2030 are:

- Economic development that creates value and employment
- Population turnaround, a healthy and renewing society
- Sustainable use of our natural resources, preserving our values and protecting our environment
- Sustainable spatial structure based on spatial potentials

It identifies unsustainable use of resources, biodiversity loss and climate change as global challenges.

Among the specific objectives of the overarching objectives "Sustainable spatial structure based on spatial potential", the specific objective "**Connected spaces: ensuring accessibility and mobility**" is highlighted for Danube navigability. The aim is "to develop a transport structure that facilitates social mobility and rapid and easy access to different territorial levels, thus creating a dynamic spatial network that makes all services accessible to the immediate and wider environment of a municipality or area".

The OFTK points out that "the **issue of the navigability of the Danube determines the volume of freight transport**, which could be significantly increased **by modernising the domestic shipping fleet**, **using environmentally friendly means** and making the **domestic port network more EU-friendly**".

In terms of the development policy tasks identified for each sector, the OFTK states that within logistics, "**it is necessary to carry out a conceptual study of the Danube's navigability**".

Within transport policy, it states that: "*The **performance of domestic inland waterway transport is below the EU average**, and the economic crisis and the periodic navigability problems on the Danube have led to a further accelerating decline in the existing share. The **performance of navigation in less developed areas is significantly affected by natural constraints.***" Thus, it defines as a development policy task: "***In order to reap the benefits of waterborne transport, it is necessary to modernise the obsolete fleet, to bring the domestic port network up to EU standards, to develop ferries and anchorages, and to develop favourable road and rail connections for logistics centres linked to freight shipping***".

The objectives of the Programme are in line with the OFTK as set out above. Although the Programme is primarily concerned with the development of the waterway, this SEA mentions the related infrastructure developments that are expected based on current knowledge (e.g. port development, road and rail links). The need to move towards a more environmentally friendly shipping fleet is also mentioned in the Programme, but it is stated that this will be a different project task.

3.14. NATIONAL RURAL STRATEGY (2012-2020) [51]

The National Rural Strategy (NVS 2020) was adopted by Government Decision 1074/2012 (28.III.). The aim of the Strategy is to set out the objectives and principles of the country's rural policy, as well as the framework for the implementation of programmes and measures to ensure their achievement, based on a **vision of the future focusing on sustainability, viable agricultural and food production and the values of rural life,** reversing the negative trends prevailing in most rural areas of Hungary. It aims at the renewal of rural Hungary as a whole, and therefore defines the tasks to be undertaken in the **agricultural and food economy** and in **rural development,** based on the protection of natural values and the environment and the **sustainable use of natural resources.** The strategy sets out five strategic objectives to achieve the overall objective:

- Preserving the natural values and resources of our landscapes
- Diverse and viable agricultural production

[51] http://www.terport.hu/webfm_send/2767

- Food and food safety
- Ensuring the livelihoods of the rural economy, increasing rural employment
- Strengthening rural communities and improving the quality of life of rural people

It can be seen that the Rural Strategy is only indirectly related to the navigability of the Danube, but it is important to highlight a common ground, namely floodplain landscape management. One of the programmes for sustainable agricultural structure and production policy, the **sub-programme on** '**Floodplain landscape management**' within the Landscape and agri-environmental management programme, aims at smart water management.

Problem formulation:

"The *water balance of Hungary's watercourses is currently negative, meaning that more water is leaving the country than arriving. The river regulations of the 19th century have eliminated the possibility of traditional floodplain management based on water retention, and water management facilities are mainly designed to drain water as quickly as possible. In recent years, due to land-use changes in the catchment and, presumably, the effects of climate change, flood levels have increased significantly and flood protection has become a costly and expensive task every year. Traditional floodplain management has been adapted to the functioning of the river and, in addition to its benefits, has played an important role in landscape conservation. The entire water system: the tributaries, the veins, the headwaters, the permanent and temporary ponds, meadows, pastures, the typical woodland forests and the so-called fruit trees, owed their existence and survival to this form of management, just as the legendary fish quality of our once uncontrolled rivers was exploited and maintained primarily through floodplain fishing, which was operated as headwater management.* "

Strategic directions and actions:

"***The revitalisation of*** *traditional* ***floodplain management, adapted*** *to the natural functioning of rivers, living with and adapting to the flow of water, and of a* ***comprehensive water management system in suitable areas****. It can be organised where there is sufficient and regularly replenishable water and where the functioning of the river system can be restored or imitated. These* ***areas are the deeper flood plains of rivers, areas affected by the backwater of waterways, the larger open flood plains*** *(e.g. Bodrog, Gemenc), the unregulated or less regulated stretches of smaller rivers with backwaters and tributaries (Rába, Bodrog, possibly along the Sajó or Hernád). It can be implemented in detail on the floodplains of rivers, along large lakes and backwaters, sometimes used for inland water storage, where a permanent or partial link with the river can be ensured.* "

The objectives of the Programme are in line with the objective of "preserving the natural values and resources of our landscapes", and the objective of "preventing further lowering of the riverbed and low water level", as well as the preservation or partial improvement of the water supply of the tributaries (in some places only raising the water levels, in others rebuilding the water intake structures) may lead to an improvement of the conditions of floodplain management (water supply).

3.15. NATIONAL TOURISM DEVELOPMENT STRATEGY 2030. [52]

The National Tourism Development Strategy is a basic document defining the objectives and instruments of state tourism management until 2030, adopted by the Government by its Resolution No.1747/2017 (X.18.). Its task is to define the tasks of the State in the sector in the short, medium and long term by laying the foundations for a change in the approach to tourism, identifying the main points of intervention and setting

[52] https://www.kormany.hu/download/8/19/31000/mtu_kiadvany_EPUB_297x210mm%20-%20 preview.pdf

strategic objectives, and to allocate the appropriate instruments, resources and institutional system to achieve the objectives. The objectives of the Strategy are structured by defining pillars, strategic and horizontal objectives, following the motivation, vision and mission statements. One of the horizontal objectives is "**Accessible Tourism**", which aims at "physical and infocommunication accessibility and the **improvement of direct accessibility of attractions**".

The strategy is directly linked to the navigability of the Danube at several points.

On the one hand, it is important to underline that the Danube Bend is a priority tourism area according to the strategy. On the one **hand, the development of the Danube's navigability is defined as a strategic issue** "**in terms of accessibility and accessibility of the area, on the other hand, the boat trip is also a unique tourist experience due to the natural scenery it reveals.** And the **development of Danube high-speed shipping** will make the area a real alternative for extending the Budapest experience."

On the other hand, within the assessment of the situation of waterborne transport as a supporting resource for tourism, the following findings are made in relation to navigation on the Danube:

- The Danube and Lake Fertő are the main waterways in Hungary, while many rivers and lakes are suitable for water tours and water sports.
- On the Danube, international tourist boats typically stop only in Budapest, and not or only for short periods elsewhere. Therefore, there is a need to improve the system of ports receiving international cruise tourists, including the modernisation of the port infrastructure of the Budapest quays and the rethinking of the location of the ports. This should be done in such a way as to link shipping traffic to tourist sightseeing routes. The further development of boat traffic within Budapest would also be important from a tourism point of view.
- The potential of **electric propulsion** should be exploited, including in public services and by developing guest berths that can also serve as electric charging points for privately owned electric boats.
- A fast, accessible boat service should be launched in the Danube Bend to help exploit the region's tourist attractions.
- Infrastructure important for hikers should also be developed on the waterways of priority tourist development areas.

The objectives of the Programme are directly linked to the objectives of the National Strategy for Tourism Development in relation to tourism-related shipping - in this respect, the implementation of the Programme is a condition of the National Strategy for Tourism Development. However, some of the interventions envisaged in the Programme and their impacts are not conducive to the operation of certain tourism sectors (e.g. increased vessel traffic may have a negative impact on waterborne tourism).

3.16. SECOND NATIONAL CLIMATE CHANGE STRATEGY (2018-2030, LOOKING AHEAD TO 2050) [53]

The first National Climate Change Strategy adopted by the Parliament in 2008 was revised in 2013, resulting in the second National Climate Change Strategy for 2014-2025, looking ahead to 2050 (NÉS-2). It was adopted by the OGY Decision 23/2018 (X. 31.).

The NÉS-2 identifies two overarching objectives (Survival and sustainable development in a changing world, Understanding our capacities, opportunities and limits) and four specific objectives. Of the specific objectives, the most relevant **for Danube navigability** is "Decarbonisation" (transition to a low-carbon economy by reducing greenhouse gas emissions and strengthening natural absorption capacity), while

[53] https://nakfo.mbfsz.gov.hu/sites/default/files/files/N%C3%89S_Ogy%20%C3%A1ltal%20 accepted.PDF

"Adaptation and Preparedness" is the most relevant. The latter aims at "preserving the stocks and quality of national resources (natural, human and economic), **promoting resilient natural, social, economic and policy responses** to changing external conditions. The aim is to ensure that preparedness provides a coordinated response to the long-term challenges of climate, energy, food and water security and critical infrastructure security."

The NÉS-2 sees a part of the ICSP (Integrated Transport Operational Programme) projects as **mitigation interventions with investments in** transport, rail and **waterborne transport infrastructure resulting in reductions of transport emissions**.

The Second National Climate Change Strategy includes an assessment of the expected impacts, natural and socio-economic consequences of climate change in Hungary, the climate vulnerability of ecosystems and sectors, the **National Decarbonisation Roadmap** (NDRP) with targets, priorities and action lines for reducing greenhouse gas emissions by 2050, and the National **Adaptation Strategy** (NAS).

HDÚ is looking for solutions that combine emission reductions with economic growth. Its specific objectives are:

- promoting the substitution of fossil fuels, in particular in the fields of heat and electricity production, building heating and transport,
- **increasing energy efficiency** and **promoting energy savings,** in particular in the building energy and **transport** sectors, agriculture and industry, and also in electricity generation through the development of the domestic power plant fleet,
- reducing the use of natural resources and using closed material flow systems,
- decarbonisation as a green economy development tool,
- strengthening the natural carbon dioxide absorption capacity,
- **support for research, development, innovation and demonstration projects**, including in the fields of materials and energy saving technologies, the dissemination of renewable energy sources, **green transport**, sustainable architecture, heat and electricity production.

According to the HDÚ, the detailed tasks related to the decarbonisation of transport should be set out in detail in the National Transport Strategy and its implementation framework, and it gives action lines, e.g. in the medium term, "a **climate change assessment of the conditions for waterborne transport**" is needed.

The NAS sets out the domestic framework and options for adaptation to climate change. In relation to the security implications of climate change, including the security of infrastructure and public utilities, it states that "**Increasingly hectic** (sometimes extremely high, sometimes minimal) **river levels may lead to increased river basin changes**, which will threaten the condition of dams and protection works. **Damage may occur to river infrastructure, navigation** and blocked channels. The increasing risk of floods and inland waterways poses a direct threat to settlements, transport and critical infrastructure. During the winter months, country-wide snow and ice storms can develop in the Carpathian Basin, paralysing transport in regions or even the whole country. **Low river levels and lack of rainfall replenishment lead to depletion of river and groundwater aquifers**, threatening water supplies."

Areas of intervention of the NAS:

- Preserve natural and semi-natural ecosystems,
- Conservation and sustainable use of natural resources and their quality;
- Supporting the adaptability of vulnerable regions;
- Achieving flexible and innovative adaptation in vulnerable sectors (e.g. tourism, energy, transport, buildings), developing and integrating sector-specific adaptation strategy papers;
- To help prepare for and adapt to emerging risks in priority horizontal areas of national strategic importance;
- Mitigating the expected social impacts of climate change and improving society's adaptive capacity, raising awareness of adaptation options; supporting research and innovation.

The main objective of the Programme is to develop the Danube waterway, which will contribute to increasing the share of waterborne transport in freight transport. This will also help to achieve energy efficiency and CO_2 emission reduction targets, e.g. if a reduction in the share of road freight transport can be achieved. The design of interventions has taken into account the likely consequences of climate change - e.g. the need for the shipping sector to prepare for the impacts of climate change - but the temporary nature of the solutions envisaged also suggests that there are limits to adapting to change.

The expected impacts of climate change and their relation to Danube navigability are examined in this SEA.

3.17. NATIONAL ENERGY AND CLIMATE PLAN (NEKT) [54]

At the end of November 2016, the European Commission published the so-called "Clean Energy for All Europeans" package of proposals, which, alongside several new climate and energy policy regulatory proposals, called for Member States to develop a National Energy and Climate Plan (NECP), applying a common methodology and with a common content. The domestic National Energy and Climate Plan was published by the Ministry of Innovation and Technology in January 2020. The main objectives of the NEKT relevant to transport are the following (waterborne transport is not specifically addressed):

- **Greenhouse gas emissions must be reduced by at least 40% by 2030** compared to 1990. In the transport sector, GHG emissions growth is to be reduced by increasing the share of biofuels blended into transport, promoting the uptake of electric vehicles and shifting traffic towards low-emission modes.
- **In transport, Hungary is aiming for at least 14% renewable energy by 2030**. To achieve this target, Hungary will increase the share of so-called first-generation biofuels from food and feed crops to nearly 7%, and the share of so-called second-generation (or advanced) biofuels and biogas from waste to 3.5% of final energy consumption in transport. The remainder will be met through a significant increase in the use of electricity for transport.
- In order to reduce the rate of growth in transport energy use, it is a priority to **develop** and increase the use of **public transport**, and to make rail transport a realistic option for freight transport.
- **Petroleum derivatives for transport should increase by no more than 10% by 2030**. Measures identified to achieve this include: **promoting public transport and rail**, **fuel switching** (e.g. increasing the share of biofuels blended, promoting electric mobility, promoting CNG/LNG for heavy vehicles, promoting advanced (second generation) biofuel innovation).
- Transport greening programme: reducing the growth rate of GHG emissions from the sector by encouraging the uptake of electric vehicles and public transport, and increasing the use of biofuels.

It can be seen from the above that the NEKT does not emphasise the development of waterborne transport, although inland waterway transport is recognised as an energy efficient mode of transport in the White Paper, the NEKT prefers to develop rail transport. Thus, the link between the Programme and the NEKT is mainly indirect: e.g. improving the basic conditions for waterborne transport will also contribute to achieving energy efficiency and CO_2 emission reduction targets.

[54] https://ec.europa.eu/energy/sites/ener/files/documents/hu_final_necp_main_hu.pdf

3.18. NATIONAL ENERGY STRATEGY 2030, LOOKING AHEAD TO 2040 [55]

The Energy Strategy, adopted by OGY Resolution 77/2011 (X. 14.), provided the basis for Hungary's energy policy, but in January 2020 the Ministry of Innovation and Technology published a new Energy Strategy, which has not yet been adopted by resolution.

The Energy Strategy calls for interventions in areas such as: the natural gas sector, the electricity sector, the district heating sector, decarbonisation, energy innovation and economic development for competitive, sustainable and secure supply. Of these, decarbonisation in particular can be directly linked to the transport sector. The Energy Strategy sets out five **decarbonisation priorities**, one of which is the **greening of transport**. This includes, for example, "***decarbonising freight transport by shifting it towards rail and waterborne transport*** and promoting alternative low emission technologies" and "***promoting CNG/LNG in road and waterborne transport***". Overall, the **strategy envisages a 40% reduction in GHG emissions by 2030 compared to 1990 for the country as a** whole, but does not explicitly assign emission targets to specific sectors (e.g. transport).

Renewable energy is a key focus of the Energy Strategy, which **aims to achieve a minimum 14% renewable energy share in transport by 2030**. Measures to achieve this include the deployment of electric vehicles (mainly for road and rail transport), ***support for the uptake of*** rail and ***waterborne transport***, and support for CNG/LNG for road and waterborne transport.

The main objective of the Programme is to develop the Danube waterway, which will contribute to increasing the share of waterborne transport in freight transport. This will also help to achieve energy efficiency and CO_2 emission reduction targets, e.g. if a reduction in the share of road freight transport can be achieved. If the modernisation of the fleet using the river (in the framework of other projects or with changes in international standards) is also undertaken, the share of renewable energy sources and energy efficiency can be increased and CO_2 emissions further reduced.

3.19. NATIONAL CLEAN DEVELOPMENT STRATEGY (NTFS) [56]

In response to the call of the Paris Agreement, unanimously adopted by the Hungarian Parliament and promulgated in Act L of 2016, and given that Hungary is one of the few countries in the world that has been able to reduce its greenhouse gas emissions while increasing its economic performance (GDP), the present strategy aims to ensure the continuation of this "clean growth". Along these lines, Hungary can gradually become a climate-neutral country by 2050 without the transition jeopardising economic growth and social welfare. It is expected that **to achieve climate neutrality by 2050, Hungary will need to reduce its greenhouse gas emissions by about 95% compared to 1990**. The draft National Clean Development Strategy is currently available (already socialised) and is expected to be adopted by the end of the year. To reach this target, **interventions in all emitting sectors** (e.g. transport) **are needed,** and steps must also be taken to maintain absorption capacity. In Hungary, the transport sector is responsible for 20% of total GHG emissions, of which road transport is responsible for 98%. A significant reduction in total emissions could be achieved by shifting as much of the freight as possible from the transport sub-sector with higher emissions per unit of freight (e.g. road) to another sub-sector with lower emissions (e.g. rail, water).

As regards inland waterway transport, the NTFS points out that: **the Danube** and Tisza rivers **still have considerable potential for inland waterway transport, which can be considered environmentally friendly**, but **infrastructure development is needed to successfully transfer goods**. Without the **development of waterways, the environmentally friendly character of the sub-sector can only be**

[55] https://www.kormany.hu/hu/dok?page=2&source=11&type=402#!DocumentBrowse
[56] https://www.kormany.hu/hu/dok?page=2&source=11&type=402#!DocumentBrowse

exploited to a limited extent due to the low water periods, as the freight vessels can only operate with reduced loads and intermittently.

It is precisely the development of these waterways that is promoted by the Programme under consideration in the present SEA, thus facilitating the spread of this environmentally friendly mode of transport (and hopefully reducing the share of road transport).

2.1. NATIONAL STRATEGY FOR TRANSPORT INFRASTRUCTURE DEVELOPMENT (NKS) [57]

The transport policy objectives related to shipping have already been presented ***in chapter 1.2.4 of*** this Annex, but it is also important to summarise the relevant social and environmental objectives of the NCP:

– Reduction of negative impacts on the environment, climate protection aspects:

- environment, to achieve improvements in the state of the elements of the environment,
- **sustainable management of natural resources** (through energy efficiency, renewable energies, the use of materials that can be recycled and minimised impact on natural resources),
- reducing the use of non-renewable energy sources and raw materials,
- the development of transport infrastructure in a manner compatible with the preservation of wildlife and the natural landscape, with special attention to archaeological heritage and monuments.

– Improving health and safety: **reducing the number and severity of road traffic accidents** (particularly important for road transport).

– Strengthening international relations: exploiting the high level of continental links resulting from the favourable transport geography and, in the case of neighbouring countries, **harmonising and cooperating along borders,** thus contributing to strengthening international competitiveness.

– Strengthening resource-efficient modes of transport: this means giving priority to active modes of transport (walking and cycling), but **also promoting the uptake of rail and waterborne transport where socially justified (where benefits outweigh costs)**. Positive mode shares also have other positive consequences, as means with lower specific space requirements make it possible to make better use of existing infrastructure capacity, protect the environment, maintain transport safety and reduce user costs.

The Programme will contribute to the creation of a gas-free waterway, a key prerequisite for domestic waterborne transport, which would be essential to improve the competitiveness of waterborne transport and to encourage modal shift (e.g. from road to waterborne transport, especially for freight transport). Waterborne transport would be a much safer, energy-efficient alternative to road transport and cooperation with neighbouring countries is essential for the development of the Danube as a waterway. The impacts on environmental elements and systems are assessed in detail in this SEA, in some cases (e.g. in particular: wildlife protection) negative impacts cannot be avoided, but are acceptable if the identified mitigation measures are respected. The Programme also seeks to minimise environmental and natural damage at the target system level.

[57] https://www.kormany.hu/download/b/84/10000/Nemzeti%20K%C3%B6zleked%C3%A9si%20I nfrastrukt%C3%BAra-fejleszt%C3%A9si%20Strat%C3%A9gia.pdf

3.20. NATIONAL AIR POLLUTION REDUCTION PROGRAMME (OLP) [58]

The National Programme for Air Pollution Reduction prepared in accordance with the European Commission's Implementing Decision 2018/1522 was adopted by the Government in May 2020 by Government Decision 1231/2020 (15 May 2020). According to the OLP, air pollution from transport sources mainly adversely affects the environment around busy roads. The national trends in emissions of certain air pollutants that are significantly related to transport are as follows (2000 and 2005 to 2017):

- Although **total emissions of nitrogen** oxides (**NOx) are on a downward trend, transport, including road transport, is still the main source**. Within the transport sector, heavy goods vehicles, light trucks and passenger cars are responsible for nearly 95% of NOx emissions.
- Emissions of non-methane **volatile organic compounds** (NMVOCs) have been steadily decreasing since 1990. The source composition has also changed, from a dominant role of transport in NMVOC emissions, **accounting** for more than 40% in 1990, to 26% in 2005, to **nearly 10% in 2017.**
- **PM2.5 emissions** are dominated by the residential sector, but **the share of transport is steadily decreasing**: in 2005, road transport still contributed nearly 10% of emissions, but **in 2017, transport accounted for less than 3% of total annual PM2.5 emissions**.

The OLP aims to **reduce emissions of air pollutants from transport** by optimising transport demand, promoting non-motorised mobility, developing public transport, **promoting modes of freight transport that have a lower environmental impact**, increasing the share of low or zero emission vehicles and improving the technical condition of the in-service road vehicle fleet.

The OLP does not specifically mention waterborne transport, but transporting goods by ship is more emission-efficient than road transport, except for hydrocarbons. Taking this into account, the implementation of the Waterway Development Programme could be beneficial in terms of reducing total emissions of certain air pollutants (e.g. CO, NOx, CO2, particulate matter), if the shift from road to waterborne freight transport is achieved.

An assessment of local air quality impacts is included in the air quality chapter of this SEA.

3.21. NATIONAL WASTE MANAGEMENT PLAN (2014-2020) [59]

The Plan, adopted by the Government by Decision 2055/2013 (31.12.2013) for the period 2014-2020, sets out the framework and targets for the collection, treatment and recovery of all waste streams, in line with Directive 2008/98/EC of the European Parliament and of the Council.

In accordance with the waste hierarchy (the order of priority in the exercise of waste management activities), which is the basis of waste management in Hungary, and the Waste Act, which was drafted in line with the Waste Framework Directive, the OHT includes the sectoral policy objectives up to 2020 and the measures necessary to achieve the sectoral objectives. A National Prevention Programme has been prepared as part of the Plan.

The OHT Action Programme proposes actions in the following areas of intervention:

[58] https://www.kormany.hu/download/d/71/d1000/Orsz%C3%A1gos%20Leveg%C5%91terhel%C3%A9s-cs%C3%B6kkent%C3%A9si%20Program.pdf

[59] https://eionet.kormany.hu/download/f/16/71000/Orszagos%20Hulladekgazdalkodasi%20Terv%202014-2020.pdf

- reducing the generation of construction and demolition waste,
- reuse,
- green public procurement,
- environmentally responsible production and business operations,
- Attitude shaping.

The main measure directly linked to the Waterway Development Programme is the reduction of construction and demolition waste, including the following relevant measure: the widespread use of selective demolition. The **practice of selective demolition** would greatly increase the recovery of reusable units and the renewal of their functions during the demolition process.

The Programme is indirectly linked to the OWL, and the implementation of the interventions set out in the Programme and the management of waste generated on board ships must take into account the requirements of the OWL. E.g. the implementation of the interventions foreseen in the Programme should apply the practice of selective dismantling, which is included in the present SEA sectoral proposal.

"The project of the Trans-European Transport Network - Trans-European Transport Network - NIF Zrt.
Design tasks related to the development of the TEN-T inland waterway"
under a design contract
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DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 5 TO THE ENVIRONMENTAL ASSESSMENT

Description of the relevant elements of the current environmental situation in relation to the Programme

Budapest, September 2020

TABLE OF CONTENTS

1. SURFACE WATERS

1.1. CHARACTERISTICS OF THE WATER BODIES CONCERNED

1.1.1. GENERAL CHARACTERISTICS

In this chapter, the main Danube river basin affected by the project is examined on the basis of the River Basin Management Plan (hereafter VGT2). The VGT2 divides the main Danube basin into five water bodies between Siófok and the border, namely: the Danube between Siófok and Budapest, the Danube between Budapest and Budapest, the Danube between Budapest and Dunaföldvár, the Danube between Dunaföldvár and the Sió estuary, and the Danube between the Sió estuary and the border.

Of the water bodies, the Budapest-Szob section is natural, the others are heavily modified watercourses. All water bodies are characterised by low gradient, flat, calcareous and coarse riverbeds, with the exception of the Danube between the Sió estuary and the border (the latter with medium to fine riverbeds). In addition to navigation, they serve drainage and water supply purposes. Their basic characteristics are shown in the following table.

1. Table 1:Characteristics of the five surface water bodies affected by the project

Parameter	Danube				
	Between Szob and Budapest	Budapest	Budapest-Dunaföldvár between	between Dunaföldvár-Sió estuary	Between the Sió estuary and the border
Water body VOR code	AOC756	AOC752	AOC753	AOC754	AOC755
Length of watercourse (km)	77,93	37,78	85,42	63,31	64,05
Width at most frequent flow (m)	440	360	460	502	348
Depth at most frequent discharge (m)	4,6	5,5	3,5	3,8	6
Fall at most frequent water yield (‰)	0,06	0,10	0,08	0,06	0,06
Section mean speed at most frequent water flow (m/s)	0,8	0,8	0,08	0,06	0,06
Direct catchment area (km2)	336	128	428	302	213

Source: VGT2

As shown in the table above, the Danube sections studied vary in width from 348 to 502 metres and in depth from 3.5 to 6 metres. Their mean section velocity indicates that the river is much faster in the northern sections than in the southern sections.

The lowland stretch of the Danube is characterised by large bends, a wide riverbed and a decrease in the fall from Budapest southwards. The mean section velocity of the sections in the study area indicates that the river is much faster in the northern stretches than in the southern stretches. In the section south of Paks, the river meanders between a number of cut-off or truncated tributaries, whose in- and outflow created favourable conditions for the formation of fords, so that a relatively large number (37) of fords, mostly of more favourable conditions in terms of their effects, were observed between 1961 and 2003 in the section between Budafok and the southern border.

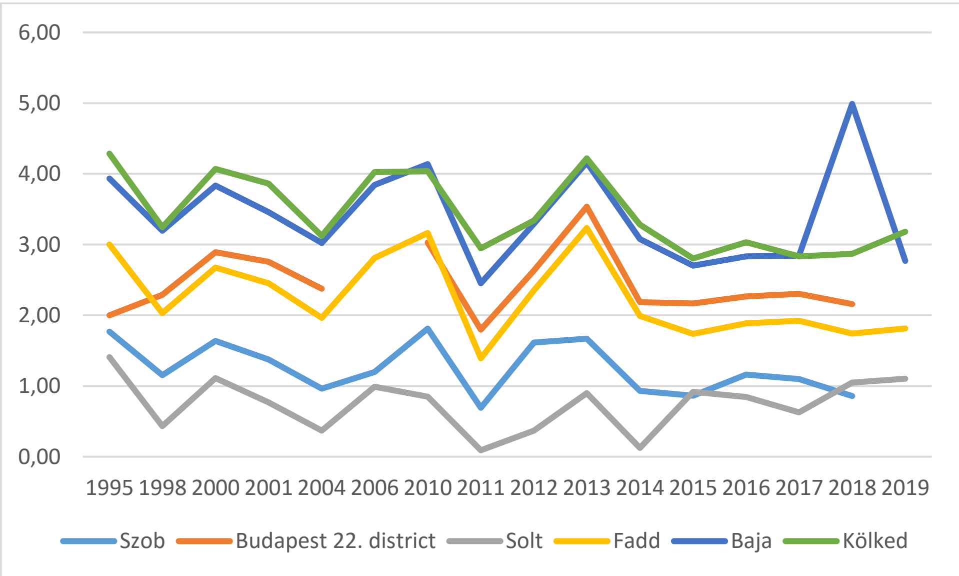
For a more detailed analysis of water flow and water quality elements, the following monitoring points were selected on the basis of the Surface Water Sectoral System Module of the National Environmental

Information System, and the results are analysed in time series and in relation to each other. The points analysed are Szob between Szob and Baja, Budapest 22nd district, Fadd, Solt and Baja, and south of that Kölked.

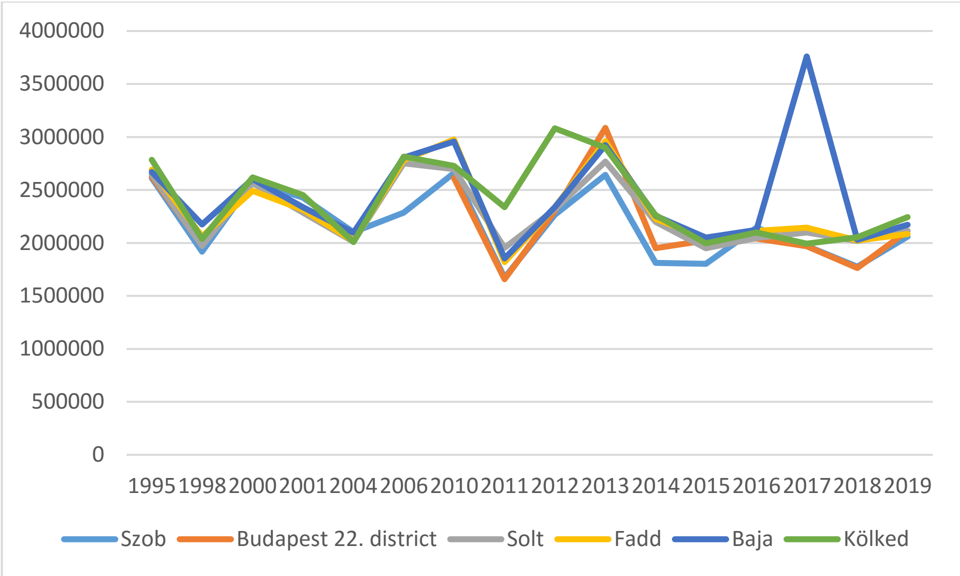
1.1.2. WATER WEATHER

The river's water flow varies and fluctuates over time, as it is greatly affected by, for example, the weather, which changes from year to year. The first of the following set of graphs illustrates the water level. It clearly shows that water levels are higher as we approach the southern border, with the values measured in Baja and Kölked exceeding those in the north. The lowest values were recorded in 2011, which was a record-breaking year of low precipitation after an extremely wet year in 2010 [1]. The average for the years under study is 3.45 metres in Kölked (with averages above 4 metres in several years), 3.41 metres in Baja, 2.46 metres in Budapest, 2.26 metres in Faddo, 1.25 metres in Sob and 0.75 metres in Sol. The water yield naturally follows the water level diagram, with the addition that there is a slight difference in the proportions between the individual gauging points, with the average water yields often varying during the year at which gauging point the average was highest. The two extreme values here are 1657500 l/s in the capital in 2011 and 3085455 l/s in 2013 (if the particularly high value for Baja is not included).

1. Figure 1:Water level (metres, top) and flow (litres per second, bottom) at the surveyed points over the last 25 years



[1] https://www.met.hu/eghajlat/magyarorszag_eghajlata/eghajlati_visszatekinto/elmult_evek_idojarasa/



*The 2006 water level for Budapest is missing from the system Source: OKIR, Fevis

1.1.3. WATER QUALITY

To examine the status of the five water bodies, it is useful to compare the status characteristics reported by VGT2 with those reported in the previous VGT1 in 2010, so that we do not have data from only one point in time. One complicating factor for comparison is that the subdivision of water bodies has changed considerably between the two plans. At the time of the VGT1, the 5 water bodies were still only divided into two sections, one from Soba to Baja and the other from Baja south to the border. The information in the two plans is therefore presented in two separate tables.

As ***Table 2***shows, at the time of VGT1 the two water bodies showed exactly the same characteristics where information was available for both. The moderate ecological status and good chemical status were maintained during both studies, but within that, variations can be found for the individual components.

In both cases, the moderate ecological status is mainly the result of the status of the biological elements, although at the time of VGT1 the hydromorphological status, which was previously uniformly good, no longer shows a uniform picture: the Danube-Budapest and Danube-Sio estuary-country border is classified as moderate, while the other water bodies are classified as good. However, all five water bodies have excellent permeability and hydrological status. In VGT2, there is also a change in the specific pollutants, with the Danube at Budapest receiving a moderate status for metals, Duna Szob to Budapest an excellent status and the other water bodies a good status compared to the previous uniformly good status (see ***Table*** 3). To explain the moderate ecological status, it is important to consider the impacts and pressures on the five water bodies.

The oxygen balance is rated excellent according to VGT2. ***Figures 2***illustrate the biochemical oxygen demand and the evolution of the chemical oxygen demand in permanganate. The latter shows a slight decrease with some fluctuation during the period under study (except for Sobot), a trend already observed in the three preceding decades. This is due to the development of wastewater treatment, which is reducing the biodegradable organic matter content of the river. The two values may be increased by periods of rainfall deficiency, which makes the water "concentrated" in terms of the organic load transported, i.e. the values are related to the flow, which may explain the fluctuations. The waveform in the biochemical oxygen demand plot shows a slight decrease in organic matter content until 2014/2015, after which values were generally higher. The lowest value of the indicator was measured in 2014 at Baja (0.00185 g/l), while the highest values were measured in 2001 at Szob (0.004858 g/l) and the record high in 2018 at Kölked (0.00475 g/l). According to the VGT2 classification, the biochemical oxygen demand is classified as excellent/good up to 2 mg/l, good/moderate up to 3 mg/l and moderate/weak up to 10 mg/l. As can be seen from the figure, nowhere do water bodies exceed 5 mg/l, but below 2 g/l only the aforementioned value is recorded. Organic matter pollution is mainly due to untreated or inadequately treated wastewater (wastewater pollution in this section of the Danube is discussed below), the main impact of which on aquatic ecosystems is the reduction of dissolved oxygen due to biochemical degradation of organic matter, and in more severe cases, changes in the composition of aquatic flora and fauna. [2]

2. Table 1:Status of two surface water bodies under VGT1

Parameter		Danube	
		Between Szob and Baja	**South of Baja**
Biology	Fitobentos	good	good
	Fitoplankton	good	good
	Macrofita	-	-
	Macrozoobenton	moderate	moderate
	Hal	moderate	moderate
	Status by biological elements	**moderate**	**moderate**
Physico-chemical elements	Organic matter	good	good
	Nutrients	good	good
	Salt content	excellent	excellent
	Acidity	excellent	excellent
	State by physico-chemical elements	**good**	**good**
Specific pollutants	**Status by metal**	**good**	**good**
Status according to hydromorphological elements		**good**	**good**
Ecological status		**moderate**	**moderate**
Chemical state		**good**	**data gap**

Source: VGT1

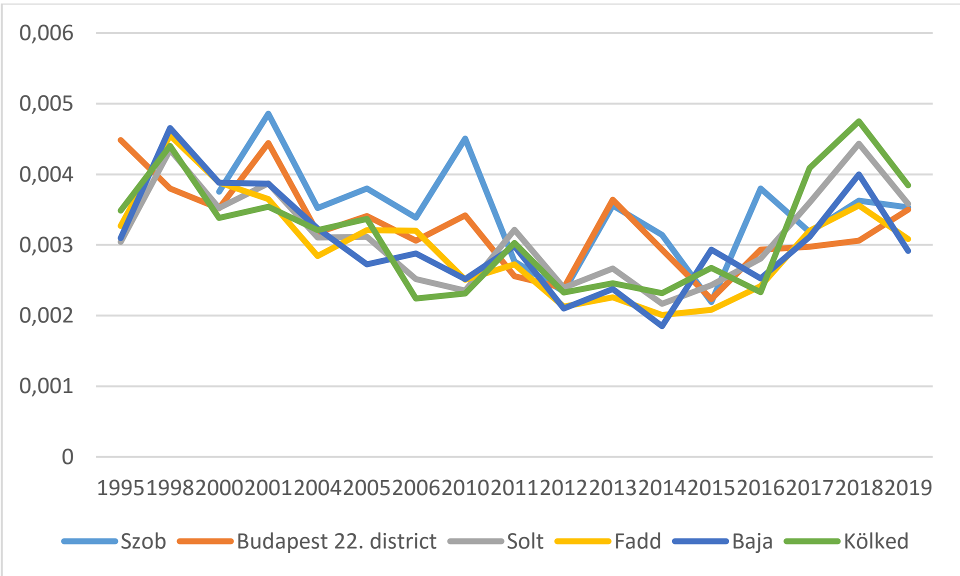
3. Table 1:Status of the five surface water bodies under VGT2

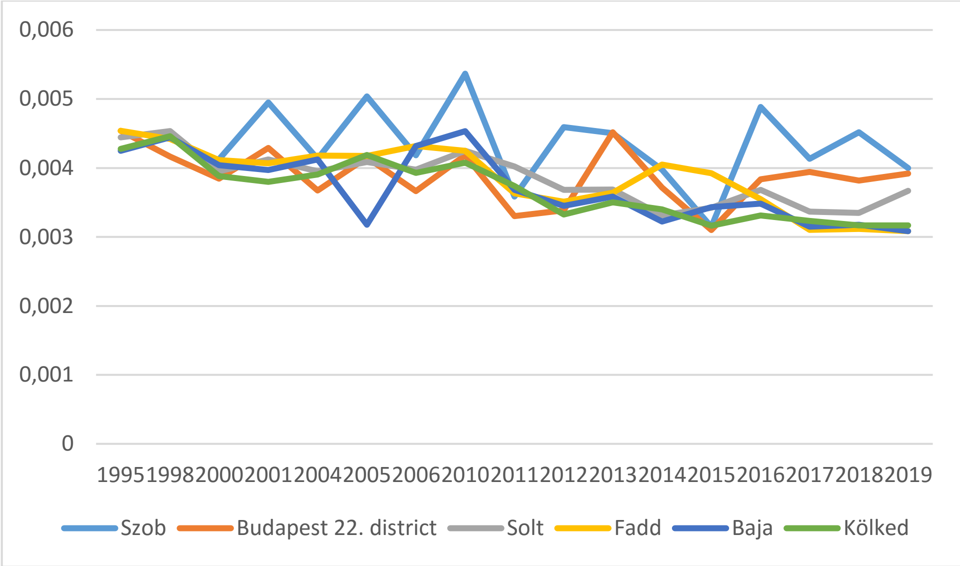
[2]http://vizeink.hu/wp-content/uploads/2020/03/HU_IC_220_Interim_Overview_SWMI_FINAL_HU.pdf

Parameter		Danube				
		Budapest	Budapest-Dunaföldvár between	between Dunaföldvár-Sió estuary	Between the Sió estuary and the border	Between Szob and Budapest
Biology	Fitobentos	moderate	excellent	good	good	moderate
	Fitoplankton	moderate	moderate	moderate	good	good
	Macrofita	-	-	-	-	-
	Macrozoobenton	moderate	good	moderate	moderate	moderate
	Hal	-	-	-	-	-
	Status by biological elements	**moderate**	**moderate**	**moderate**	**moderate**	**moderate**
Physico-chemical elements	Oxygen household	excellent	excellent	excellent	excellent	excellent
	Nutrients	good	good	good	good	good
	Salt content	excellent	excellent	excellent	excellent	excellent
	Acidity	excellent	excellent	excellent	excellent	excellent
	State by physico-chemical elements	**good**	**good**	**good**	**good**	**good**
Specific pollutants	**Status by metal**	**moderate**	**good**	**good**	**excellent**	**excellent**
Hydro-morphological elements	Morphological status	moderate	good	moderate	good	good
	Interoperability	excellent	excellent	excellent	excellent	excellent
	Hydrological status	excellent	excellent	excellent	excellent	excellent
	Status according to hydromorphological elements	**moderate**	**good**	**moderate**	**good**	**good**
Ecological status		**moderate**	**moderate**	**moderate**	**moderate**	**moderate**
Chemical state		**good**	**good**	**good**	**good**	**good**

Source: VGT2

2. Figures:Biochemical (top) and chemical oxygen demand (bottom) grams per litre

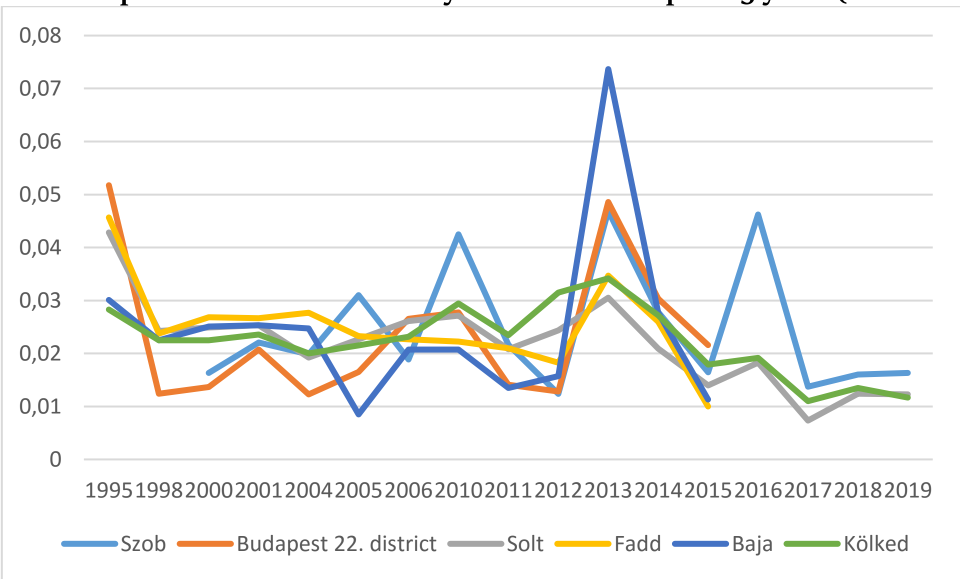




Source: OKIR/FEVISZ

High and low organic matter concentrations can occur at any suspended solids concentration[3] . For the latter, no data are available for Budapest, Fadd and Baja after 2015 (***Figure*** 3). The downward trend is also observed here, with the last measured results all falling by at least half compared to 1995. However, there are large fluctuations, with the 2013 values for Szob, Baja and Kölked well above the 1995 values mentioned as a baseline. The highest outliers were again in Baja (0.073 g/l) in 2013 and in the capital in 1995 (0.05175 g/l), generally the two years with the highest suspended solids in Danube water at all measured points, while the lowest values were measured in 2017 in Sol (0.007333 g/l) and in Baja in 2005 (0.0085 g/l).

3. Figure 1:Total suspended solids at the surveyed sites over the past 25 years (Source: OKIR/FEVISZ)

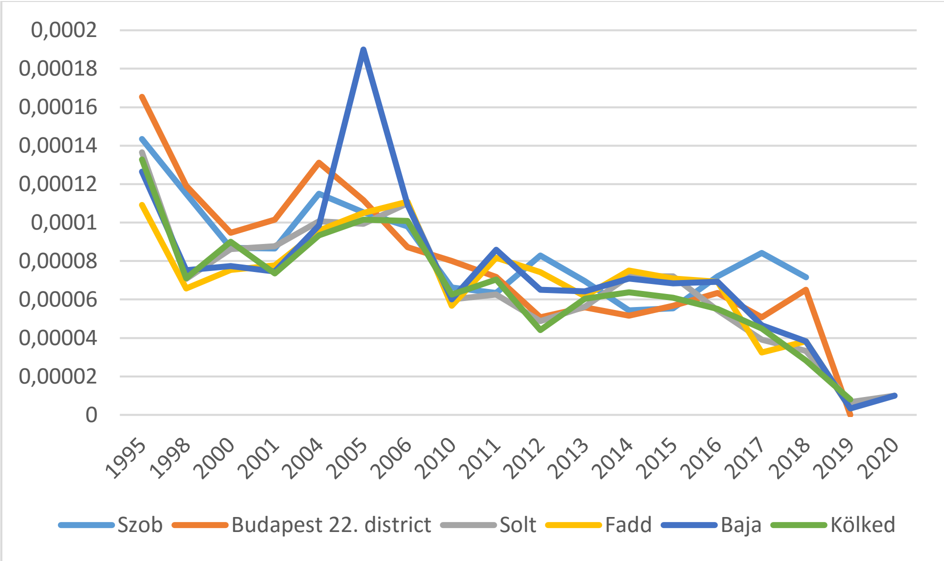


The variation in the concentration of ammonium nitrogen among the plant nutrients over the period studied is illustrated (***Figure*** 4). This is provided either by the sequestering activity of bacteria, blue-green algae, or by an external source (e.g. wastewater). It is important to examine these because nutrient accumulation can lead to eutrophication of water bodies, with a sharp increase in macrophyte strains (in the Danube, this can occur mainly in tributaries). The eutrophication process can have a significant impact on water quality, damaging ecosystems through oxygen depletion or toxicity, excessive biomass production

[3] River Basin Management Plan, 2015 - Background 6.3

and making human water use impossible. [4]Several factors may contribute to the reduction, such as nitrification/denitrification in wastewater treatment plants or the reduction of fertilizer loads from agricultural land. The decrease between the two extreme years is significant everywhere, with at least half the value everywhere, but in Cologne for example it is 21%. By 2019, the value measured is just over 1.3% of the 1992 value. However, despite the clear decrease, there is also an apparently significant fluctuation (Baja also shows an outlier). The VGT2 classification of the indicator is excellent/good up to 0.1 mg/l, with all monitoring points below this value since 2006.

4. Figure 1:Changes in ammonium nitrogen concentrations in Komárom over the last 30 years (Source: OKIR/FEVISZ)



1.2. LOADS ON WATER BODIES

1.2.1. WATER ABSTRACTIONS AND DISCHARGES

Water bodies are affected by a number of abstractions, discharges and transfers that can affect the quantitative status of water bodies, alter the natural flow and run-off conditions of surface water bodies to the extent that they can interfere with ecosystem functioning and the achievement of good ecological status.[5] For three water bodies, the Szob-Budapest stretch, the Budapest-Dunaföldvár stretch and south of the Sió estuary, VGT2 does not indicate any of these significant or important inflows, transfers or abstractions. On the Budapest section, there is 1 significant abstraction in the 21st district due to cooling water from the energy industry and 1 significant transfer at the Kvassay sluice. On the section between Dunaföldvár and Sió estuary, the Paks power cooling water withdrawal and the discharge of used cooling water from the power plant are considered significant, while two other discharges, at Kalocsa and Solt, are classified as "important". These two water bodies are classified as moderate in terms of hydromorphological status on the basis of the status tables. The following table shows the outlets, transfers and discharges that have been given a rating other than not significant.

4. Table 3:Data on significant water abstractions, discharges and transfers

Water intake location	Flow-kilo-meter	Municipality	Water intake method	Purpose of water abstraction	Allowed water abstraction [m3/year]	Significant/exact individual load

[4]http://vizeink.hu/wp-content/uploads/2020/03/HU_IC_220_Interim_Overview_SWMI_FINAL_HU.pdf

[5] The Hungarian part of the Danube river basin WATER SUPPLY AND MANAGEMENT PLAN - 2015

Left bank of the Danube (Danube-Budapest)	1638,74	Budapest 21. district.		Energy cooling water	151506849	Significant
Danube right bank	1526,04	Paks	pump	Energy cooling water	2900000000	Significant

Drainage point	Flow-kilometre	Municipality	Method of water supply	Allowed discharge [m3/year]	Significant/exact individual load
	1559,85	Solt	gravity	10000	important
from the left bank of the Sodorvonal	1517	Kalocsa	pump	195400	important
right-wing	1526,04	Paks	gravity (Power plant used cooling water)	2900000000	Significant
Water transfer facility	**Authorised water discharge [m3/year]**		**Significant/exact individual load**		
The Kvassay Bridge	18,3000		Significant		

Source: VGT2

1.2.2. NUTRIENT LOAD

In relation to the ecological status of water bodies, it is also important to consider the significant pressures they are subject to, and the following table illustrates the phosphorus and nitrogen pressures and their types. The moderate ecological status in the assessment was due to the biological elements, all biological elements being sensitive to nutrient loading.

5. Table 1:Nutrient loads in affected water bodies

Water body name (Danube)	Tapioca seed	Total load t/year	Load from point source emissions %	Diffuse load %	Diffuse load distribution %			Determining the source of the load
					From atmospheric deposition	Urban paved surfaces	Other	
Szob-Budapest	Phosphorus	45,15	77	23	12,5	44,0	43,5	point source emissions
	Nitrogen	290,8	64	36	33,5	17,1	49,4	point source emissions
Budapest	Phosphorus	259,98	92	8	2,4	97,2	0,4	point source emissions
	Nitrogen	2322,09	96	4	13,4	86,5	0,1	point source emissions
Bp-Duna-földvár	Phosphorus	87,90	82	18	9,1	62,0	29,0	point source emissions
	Nitrogen	469,26	83	17	47,3	43,1	9,5	point source emissions
Danube-Flankfort-Sio tork.	Phosphorus	24,32	69	31	15,6	48,4	36,0	point source emissions
	Nitrogen	153,91	69	31	62,6	27,0	10,4	point source emissions
Lake Sió tork.-	Phosphorus	8,70	65	35	26,9	44,6	28,4	point source emissions

Water body name (Danube)	Tapioca seed	Total load t/year	Load from point source emissions %	Diffuse load %	Diffuse load distribution %			Determining the source of the load
					From atmospheric deposition	Urban paved surfaces	Other	
country border	Nitrogen	68,60	59	41	74,9	18,7	6,5	point source emissions

Source: VGT2

Based on the above table, the most significant source of pollution for each component of each water body comes from point source discharges. For phosphorus loads, the largest share of diffuse pollution in all water bodies comes from urban paved surfaces, with a higher share from natural erosion in the section between Szob and Budapest and from Budapest to the Sió estuary from erosion of agricultural land. For nitrogen, atmospheric deposition and loads from urban paved surfaces are both significant compared to other loads, with groundwater loads (40.8%) being particularly important in the Szob-Budapest section.

For phosphorus measured at water quality monitoring points, in general, total phosphorus has decreased at all points in 2019 compared to 1995. At the two northern points (Szob, Budapest) the decrease was smaller (around 80%), while e.g. at Solt the measured phosphorus decreased to one third. For total phosphorus, the excellent rating is up to 0.1 mg/l, which is not approached by any of the points tested.

1.2.3. WASTEWATER LOAD

Based on the nutrient indicators, urban wastewater discharges are still the largest contributor to direct point source pollution of surface waters, despite the fact that the amount of nitrogen and phosphorus discharged with treated wastewater has decreased significantly by 2012, thanks to an increase in treatment efficiency. [6] Due to the large number of sites, wastewater loads are summarised in the following table. In detail, the parameters of the loads that have been assessed as other than "not significant" are discussed.

6. Table 1:Wastewater load of affected water bodies

Water body name (Danube)	Municipal wastewater load (pcs)	Impact of nutrient and organic matter loading on the host	Industrial wastewater load (pcs)	Impact
Szob-Budapest	4	not significant	6	not significant
Budapest	17	2 not significant, 15 may be significant	17	16 not significant, 1 may be significant
Bp-Dunaföldvár	12	not significant	10	1 significant, 9 not significant
Dunaföldvár-Sió tork.	7	6 not significant, 1 important	2	not significant
Lake Sió - national border	2	not significant	2	not significant

Source: VGT2

7. Table 1:Industrial wastewater priority loads

Object name, settlement	Volume of treated wastewater discharged (thousands	N (kg/year)	Total salt (natural origin) (kg/year)	Thermal load (°C/m3)	Ammonia-ammonium -N (kg/year)	Effect and cause

[6] The Hungarian part of the Danube river basin WATER SUPPLY AND MANAGEMENT PLAN - 2015

	m3/year)					
Budapest 13th district bath	n.a.	n.a.	n.a.	n.a.	n.a.	may be important
Dunaföldvár Spa and thermal bath	87	734	161 537	34	522	significant, due to heat/salt

Source: VGT2

8. Table 1:Priority urban waste water loads

Municipality, wastewater treatment plant	Volume of treated wastewater discharged (thousands m3/year)	BOI (kg/year)	COD (kg/year)	N (kg/year)	P (kg/year)	Air emissions (kg/year)	Ammonia-ammonium -N (kg/year)	Impact of nutrient and organic matter loading on the host	Impact of toxic metal release on the recipient
Budapest 11. district. (Albertfalva pumping station)	24	4872	10920	n.a.	144	367	367	may be significant	not significant
Budapest 13. district. (Angyalföld pumping station)	152	40432	65208	n.a.	973	6460	6460	may be significant	not significant
Budapest 22. district. (Háros utca pumping station)	1071	590726	867707	n.a.	10208	55432	55432	may be significant	not significant
Budapest 11. district. (Kelenföldi pump station)	365	87600	151110	n.a.	1898	11096	11096	may be significant	not significant
Budapest 13. district. (Margit Island south peak pump station)	223	27909	50325	n.a.	898	4877	4877	may be significant	not significant
Budapest 22. district. (Szabadkiömlő)	57	36386	52564	n.a.	738	3494	3494	may be significant	not significant
Budapest 11. district. (Szabadkiömlő)	45	8415	12240	n.a.	441	1103	1103	may be significant	not significant
Budapest 22. district. (Szabadkiömlő)	24	12291	18673	n.a.	233	1339	1339	may be significant	not significant
Budapest 22. district. (Szabadkiömlő)	103	28428	44187	n.a.	366	1833	1833	may be significant	not significant
Budapest 01. district. (Szabadkiömlő)	808	151904	253712	n.a.	3474	16079	16079	may be significant	not significant
Budapest 01. district. (Szabadkiömlő)	378	116802	182952	n.a.	3062	13117	13117	may be significant	not significant
Budapest 22. district. (Szabadkiömlő)	135	68760	100710	n.a.	1373	6921	6921	may be significant	not significant
Budapest 22. district Pump station	581	227085	348959	n.a.	4980	31428	31428	may be significant	not significant
Budapest 21. district. (Vas Gereben u. pumping station)	3825	1495536	2270715	n.a.	32257	222609	222609	may be significant	not significant

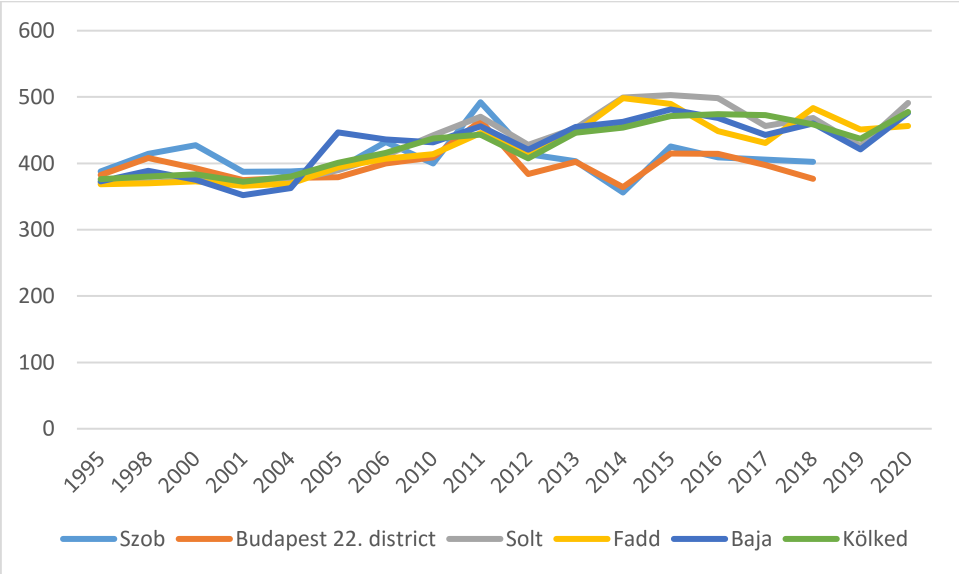
Budapest 02. district. (Zsigmond Square transfer station)	183	74399	120211	n.a.	1448	9089	9089	may be significant	not significant
Harta Waste water treatment plant	128	2125	12068	7400	519	6001	6001	important	not significant

Source: VGT2

As before, neither the Szob-Budapest section nor the section between the Sió estuary and the national border will be affected significantly or importantly in terms of wastewater loads. Urban wastewater loads mainly come from municipal wastewater treatment plants, of which 1 load is considered significant in terms of nutrient and organic matter load impact between Dunaföldvár and Sió estuary, coming from the Hartai wastewater treatment plant, and 15 loads are classified as "possibly significant" for the Budapest section (these are from districts 1, 2, 11, 13, 21 and 22). Of the industrial and other wastewater loads, the Budapest-Dunaföldvár section has one significant load from the Danube Vltava thermal baths, while Budapest has 1 "possibly significant" load from district 13, also thermal and bathing water. For the industrial loads, no data were available for any of the parameters for the Budapest load at the time of VGT2, but only for some of the parameters for the Danube Vltava load, which are included in the table.

The impact of urban waste water discharges is indicated by the conductivity, illustrated in the following figure. As can be seen from the figure, this indicator also shows strong fluctuations, which may be due to the alternation of wetter and drier periods or other weather conditions. The trend over the last 25 years has been slightly increasing, with conductivity up to 500 being in the excellent/good class according to VGT2, a category in which the Danube water was currently and in previous decades, but which is now approaching the limit in several places, typically in the stretch south of Budapest.

5. Figure 1:Annual averages of the Danube conductivity at the measured points (microSiemens/cm)



Source: OKIR/FEVISZ

For the heavy metal content of the Danube (dissolved state), data for each component are not available at the monitoring point every year, so data for 2016 are included, omitting the municipality of Fadd, as there were no data for that year. The values in the table represent the dissolved water phase, the concentration at the time of sampling. Based on the metal status, only the Danube-Budapest was classified as moderate, with the WFD limits of 0.00005 mg/l for mercury, 0.00008 mg/l for cadmium, 0.02 mg/l for chromium and 0.0072 mg/l for lead, which are not approximated by the values presented in the table. For mercury, lead and copper, the northern part of the study area (capital and above) has a higher load, while the reverse is true for chromium.

9. Table 3:Heavy metal content at the measuring points

2016	Mercury (mg/l)	Lead (mg/l)	Chromium (mg/l)	Cadmium (mg/l)	Zinc (mg/l)	Copper (mg/l)
Szob	0,000000050	0,00000064	0,0000005	0,0000001	0,0000057	0,0000029
Budapest	0,000000050	0,00000050	0,0000005	0,0000001	0,0000029	0,0000028
Solt	0,000000029	0,00000029	0,0000010	0,0000001	0,0000068	0,0000021
Baja	0,000000027	0,00000030	0,0000010	0,0000001	0,0000073	0,0000021
Kölked	0,000000031	0,00000031	0,0000010	0,0000001	0,0000046	0,0000021

Source: OKIR/FEVISZ

1.3. OBJECTIVES AND MEASURES TO BE TAKEN INTO ACCOUNT UNDER THE RIVER BASIN MANAGEMENT PLAN

VGT2 also set targets and measures to improve the status of water bodies. For natural watercourses, it set targets for achieving good status in response to moderate ecological status, and for heavily modified water bodies, it set targets for achieving good potential. In addition, it also aims to maintain good chemical status.

By 2027, it has assigned different measures to the objectives, with the following measures for several water bodies:

- Implementation of the Wastewater Programme. Establishment of new wastewater treatment plants, modernisation of existing wastewater treatment plants (capacity increase, technology upgrading, reconstruction), respecting the limits for surface water intake.
- General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas
- Reducing run-off of pollutants and sediments by grassing, afforestation, terracing on sloping land, infiltration surfaces, isolation of inland plantations
- Upgrading of livestock farms under the EU Nitrates Directive
- Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs
- Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment
- Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials
- Progressively achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works.

Sources used in chapter 1:

- National River Basin Management Plan 2015
- National River Basin Management Plan 2010
- National Environmental Information System - Surface Water Sectoral System Module
- https://www.met.hu/eghajlat/magyarorszag_eghajlata/eghajlati_visszatekinto/elmult_evek_idojarasa/
- http://vizeink.hu/wp-content/uploads/2020/03/HU_IC_220_Interim_Overview_SWMI_FINAL_HU.pdf

2. GROUNDWATER

2.1. GROUNDWATER STATUS

2.1.1. DIVISION AND STRUCTURE OF THE STUDY AREA

The study area is classified under the Revised National River Basin Management Plan (OVGT2) as 1-9. Central Danube, 1-7. Gerecse, 1-10 Danube Valley Main Canal and 1-11 Sió subdivisions. hydrogeological characteristics of each sub-unit are briefly described below.

1-7 Gerecse sub-unit

The karstic areas of the mountain range, which are crossed by a network of fractures and fissures, store a coherent karstic water system, which is integrated with the main karstic water system of the Transdanubian Central Mountains, and therefore the drinking water supply of the planning sub-unit is mainly provided by karstic water aquifers, but along the Danube river (Tat-Estergom and Pilismaró basins), in the mountain wetlands, the gravel terrace works on the karstic basement are also of great importance.

Groundwater quality is significantly affected by pollution from past industrial activity, which also threatens drinking water sources. The Pest County Government Office is currently carrying out environmental remediation in accordance with Decree 219/2004 (21.VII.) of the Government of Pest County at about 170 sites.

1-9 Central Danube sub-unit

The geological structure of the planning unit is extremely diverse. The Danube valley is situated next to the Buda Hills, the Zsámbék basin and the Pilisvörösvár-Solymár flood plain. The sub-unit is a congested, scaly, fractured, eagle-crested, stumpy, basin-divided, mid-mountainous area. The average altitude is 250-500 m. The area is poor in springs and surface watercourses, but rich in karstic waters interspersed with rising springs. The small valleys and basins of the mountain range are bounded by valleys and basins formed along structural lines. Water abstraction is mainly from surface water recharge from bank filtration and, to a much lesser extent, from strata and karst water resources in the Central Danube Basin.

In the Central Danube planning sub-unit, there are a series of bank-filtered drinking water wells on the right and left banks of the Danube and on Szentendre Island, located on the gravel terrace of the Danube, which are in a fragile geological environment and provide drinking water for the region and the capital. They are perhaps the most vulnerable because of their direct link with the Danube (water levels, riverbed interventions, pollution run-off, quality and quantity problems caused by floods) and because of background pollution pressures (e.g. sewage spills, agricultural pollution). A particular problem in the sub-region (especially for aquifers with a fragile geological environment), especially in the area of Budapest and its agglomeration, is that the drinking water sources are surrounded by built-up areas and are exposed to concentrated and more numerous pressures (agricultural, industrial, municipal).

1-10 Danube Valley Main Canal Sub-unit

In terms of groundwater use, the geological and hydrogeological characteristics of the geological formations in the sub-unit area are such that the Late Pannonian and Quaternary sediments are considered significant, consisting of a mixture of medium-grained sands with good water-bearing properties, and layers of aleurolite and clay, several tens of metres thick. These sedimentary assemblages are suitable for the extraction of hot spring water with a discharge temperature above 30 °C and drinking water quality.

Cold water aquifers, potentially capable of producing 200-900 l/min per well, are sandy layer complexes at depths of 110-330 m from the surface, mainly in the central areas of the sub-unit. The concentration of ammonium and arsenic in the extracted aquifers from some Pannonian water sources may exceed the drinking water quality limit. The concentrations considered to be high are of geological origin.

In the floodplain areas of the catchment management sub-unit, alluvial alluvial sedimentary environments were deposited by alluvial alluvial cones, alluvial reef and alluvial floodplain sediments formed during the Early and Middle Pleistocene. The heterogeneous assemblage is highly variable both horizontally and vertically, with sand and gravel layers suitable for water abruptly wedged and discontinuous over short distances.

1-11 Sió sub-unit

The Palaeozoic formations are impermeable, with the exception of the Polgárdi and Szabadbattyan limestones. The Mesozoic limestones are karstified. The Jurassic and Cretaceous strata are largely impermeable and not significant for drainage. The Miocene coarse-grained and calcareous layers are water-bearing, the marls are impermeable. Of the Pannonian strata, the Zámori Gravels are water-bearing. From the point of view of water storage, the semi-permeable strata of the Somló and Tihany Formations are impermeable. The marl layers are impermeable. Quaternary loess, slope debris and river-related gravel sediments have a significant water-bearing capacity.

2.1.2. STATUS OF SHALLOW BODIES OF WATER NEAR THE SURFACE

The proposed project is likely to have an impact mainly on shallow water bodies close to the surface, and these are described in the following table.

10. Table 1: Status of affected groundwater bodies according to the WFD

Name of water body	Water body code	Features	Cumulative quantitative status of water body	Total body of water chemical status
Northern rim of the Transdanubian Central Mountains alluvial terrace	sp.1.4.2.	porous, upflow, average roof height 5 m, average ground level 35 m	weak, cause: water balance	weak, cause: surface water pollution
Börzsöny, Gödöllő Hills - Danube water catchment	sh.1.7.	porous, mixed, average roof height 17 m, average ground level 30 m	good	good
Szentendrei Island and other islands in the Danube	sp.1.13.2.	porous, upflow, average roof height 4 m, average ground level 19 m	good but weak risk, reason: water balance	weak, reason: contaminated vb. * (Surány and Sziget monastery, NO_3)
Danube Mountains - Danube water reservoir under Budapest	sh.1.5.	porous, mixed, average roof height 5 m, average ground level 30 m	good but weak risk, reason: water balance	good
Danube right bank - Budapest-Paks	sp.1.9.1.	porous, downflow, average roof height 5 m, average ground level 15 m	good but weak risk, reason: water balance	weak, reason: contaminated vb. (Ercsi: NO_3), diffuse pollution (NO_3)
Left bank of the Danube - Vác-Budapest	sp.1.13.1.	porous, downflow, average roof height 9 m, average ground level 30 m	good but weak risk, reason: water balance	weak, reason: contaminated vb. (Fót: NO_3, atrazine, Budapest IV: NH_4, SO_4, Dunakeszi: NO_3), diffuse pollution (NO_3), surface water pollution, increasing trend (NO_3, NH_4, SO_4)
Danube-Tisza basin - Northern part of the Danube Valley	sp.1.14.2.	porous, upflow, average roof height 3 m, average ground level 22 m	weak, cause: water balance	weak, reason: contaminated vb. (Halásztelek: NO_3, SO_4, Szigetújfalu: NO_3): increasing trend (SO_4)

Name of water body	Water body code	Features	Cumulative quantitative status of water body	Total body of water chemical status
Danube right bank - below Paks	sp.1.10.1.	porous, downflow, average roof height 5 m, average ground level 20 m	good but weak risk, reason: water balance	good, but low risk, cause: diffuse pollution
Danube-Tisza basin - Southern Danube Valley	sp.1.15.2.	porous, upflow, average roof height 3 m, average ground level 28 m	weak, cause: water balance	good
Wisdom-Bogyisloi Bay	sp.1.10.2.	porous, upflow, average roof height 3 m, average ground level 30 m	good but weak risk, reason: water balance	good, but weak risk, cause: increasing trend vb.(NH_4, SO_4)
Szekszárd-Bátai and Kölkedi estuaries	sp.1.11.2.	porous, upflow, average roof height 10 m, average ground level 20 m	good	weak, reason: contaminated vb. (Szekszárd: NH_4)

* vb.= aquifer

The **quantitative status is** good for only 2 water bodies, risky for 6 and poor for 3. Both the risky and poor status are due to the water balance, indicating that changes in water balance at the spatial level due to abstraction (sometimes unauthorised abstraction) are unfavourable for FAVÖKOs, i.e. the uptake of groundwater by vegetation and/or the small water yield of watercourses has been adversely affected. This situation is not, however, the result of coastal filtered abstractions, given that neither recharge nor abstractions include the share from the Danube in the water balance determination.

Water use data for the water bodies affected by the project have been collected from the OVGT2 database, and are used to indicate the proportion of groundwater abstractions and the proportion of surface water abstractions (surface water part of the total well abstractions) compared to the total well abstractions.

11. Table 1: Water abstraction rates in the affected groundwater bodies

Water body code	Name of water body	Total well water abstraction [m^3/day]	Coastal filtration with FEV	Groundwater abstractions			
				Drinking water	Agriculture	Industry	Other all
			as a percentage of total well water withdrawals [%]				
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	15 903	65%	24%	7%	3%	1%
sh.1.5	Danube Mountains - Danube water reservoir under Budapest	600	0,7%	-	60%	4%	36%
sp.1.9.1	Danube right bank - Budapest-Paks	46 332	76%	16%	7%	0,2%	0,3%
sp.1.10.1	Danube right bank - below Paks	182	-	20%	6%	2,2%	72%
sp.1.10.2	Wisdom-Bogyisloi Bay	3 003	-	90%	0,1%	6%	3%
sp.1.11.2	Szekszárd-Bátai and Kölkedi estuaries	10 703	-	85%	0,2%	14%	1%
sh.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	21 245	84%	15%	0,03%	-	0,3%
sp.1.13.1	Left bank of the Danube - Vác-Budapest	64 076	71%	23%	0,9%	3%	2%
sp.1.13.2	Szentendrei Island and other islands in the Danube	369 057	91%	9%	-	0,01%	-
sp.1.14.2	Danube-Tisza basin - Northern part of the Danube Valley	107 922	83%	16%	0,3%	0,04%	1%
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	21 270	79%	14%	2%	0,2%	4%

The table above shows that, on average, surface water accounts for more than half (69% on average) of the daily water abstractions from each groundwater body, which is a fairly significant proportion of total abstractions.

The **chemical status of** water bodies is also critical. Of the 11 water bodies, only 3 are in good status, 2 are at risk and 6 are in poor status, and three water bodies can be identified for more than one reason. The most common cause is pollution of the aquifer (5 cases), followed by widespread diffuse pollution (3 cases), high nitrate levels in groundwater feeding small watercourses (2 cases) and an increasing trend (3 cases). The most common pollutant is nitrate, but ammonium, sulphate and atrazine are also present. Contaminated aquifers deserve particular attention: 9 of the 6 water bodies are in poor condition, including coastal filtered aquifers, but this is due to background nitrate pollution.

Groundwater contamination is caused by the excessive use of fertilisers and pesticides in some areas of agriculture and the lack of sewerage systems in settlements, especially in villages, and the consequent use of waste water collection systems that do not comply with current legislation. Because of the pollution and the high risk of contamination, groundwater cannot be taken into account as the basis for drinking water supply. For these reasons, the use of coastal filtered water (where possible) and of groundwater for drinking water purposes has been a priority for decades, since the development of public water supply systems. Unfortunately, contaminants from the surface are being transported deeper and deeper by groundwater, posing a potential threat to shallow aquifers.

The near-surface layers, especially the gravel terrace of the Danube, are highly sensitive to surface pollution, so that water quality in the near-surface layer waters is also affected by anthropogenic water quality degradation (agricultural, municipal nitrate leaching, sometimes industrial pollution).

There are also other human impacts that threaten the good status of aquifers. Based on the revised National River Basin Management Plan (OVGT2), Annex 6.7 Vulnerability of aquifers, the aquifers likely to be affected by interventions can be characterised as follows:

12. Table 1: Aquifers likely to be affected by the intervention in terms of the aspects affected by the project

Name of the aquifer	Contamination of the aquifer	Flood risk	Aquifer geological hazard risk	Climate vulnerability		Vulnerability due to surface water pollution	Total vulnerability of the aquifer
				Go.	Min.		
Tótfalui Waterworks	1	3	3	2	2	3	3
Surányi waterworks	4*	3	3	2	2	3	4
Horányi waterworks	1	3	3	2	2	3	3
Budaújlak waterworks	1	3	3	2	2	3	3
Csepel Halásztelekvm	4**	3	3	2	2	3	4
Tököl-Szigetújfalu vm	4*	3	3	2	2	3	4
Dunavecse North	1	3	3	2	2	3	3
Harta-Solt	1	3	3	2	2	3	3
Madocsa	1	3	3	2	2	3	3
Foktő-Baráka	1	3	3	2	2	3	3
Gerjen-Dombori aquifer	1	3	3	2	2	3	3
Dunafalva-Leneskert	1	3	3	2	2	3	3

* Pollution detected by monitoring at the water base: NO_3

** Pollution detected by monitoring at the water base: SO_4, NO_3

Numbers in magarithm: 1 = no risk, 2 = medium risk, 3 = significant risk, 4 = detected pollution, 5 = contaminated production well.

source: OVGT2

The test of the classification of water bodies for aquifers has already indicated that aquifer pollution is a major problem in the area. The first column of Table 2 shows that some of the water bodies affected by the project interventions are already experiencing pollution. There are 3 such aquifers:

- Surányi waterworks: 68000 m^3/day day,
- Csepel-Halásztelek waterworks: 90000 m^3/day
- Tököl-Szigetújalu,waterworks: 85000 m^3/day

The number 4 indicates that so far only monitoring wells have been found to be contaminated, while production wells have not been affected by nitrate or sulphate contamination. This pollution is background and not from the Danube.
For the development of navigation, the relevant threats are the geological environment, in our case the shoreline and the coastal zone, and polluted surface water. Their risk classification is immediately after the actual pollution: they fall into the category of "significant risk". One of the tasks of the environmental assessment of the project is to analyse whether and to what extent the development of shipping will modify these hazards.

2.2. AQUIFER PROTECTION AREAS, STATUS OF AQUIFERS

Given the fact that, based on the data presented in the previous chapter, coastal filtration is the most important water body in the affected water bodies, and the project may have an impact on it, only the status of the coastal filtered water bodies is presented below.

The retention of sediment in the riverbed, the dredging of the riverbed for industrial purposes and the commissioning of the Bős hydroelectric power plant in the second half of the last century in Germany and Austria resulted in the riverbed eroding and the water levels falling (0.5-1.5 m), a trend which is still continuing today, albeit at a slower pace. This process, which has also resulted in the lowering of the surrounding groundwater levels, has had a negative impact primarily on groundwater and groundwater-dependent ecosystems, and has caused a reduction in the recharge and exchange of water in the branches and branches of the forest and marshland that accompany the main riverbed. The Danube is having a chipping effect on groundwater conditions and the low water levels in the surrounding watercourses have also been radically reduced. The reduction in groundwater levels in the region, combined with rapid infiltration into agriculture, increases the risk of drought periods and in some cases even eliminates the flow of water in small watercourses.

Along the Danube, groundwater is significantly affected by the river's flow in addition to artificial interventions. The river taps and feeds the groundwater aquifers connected to it, and the strength of the connection determines the flow processes there to a certain extent. As it moves away from the coast, the Danube's influence diminishes, at a rate that depends on the hydrogeological characteristics of the riparian zone. The deeper the gravel layer and the more bounded the overburden, the smaller the reach and the faster the range of water level fluctuations decreases.

The Danube drains the terrace waters for most of the year with its tidal overtopping, but it modifies the natural processes when it operates a coastal filtered water base on the banks.

In these sub-units, there is also a large area of potential for water abstraction, but taking advantage of the special characteristics of the Danube, a significant part of the water demand along the Danube (especially in Budapest and its surroundings) is met from the Danube's coastal filtered supply. The country's largest operational bank-filtered aquifers are located along the stretch from the Danube bend to the bottom of Csepel Island.

Our coastal-filtered drinking water sources along the Danube are located in a vulnerable geological environment due to their near-surface location. This vulnerability is due to the fact that the wells can be affected by both Danube and background pollution in a relatively short time. The reach time from the Danube is of the order of a few days to a few weeks, but a relatively large area from the background can also be affected by the so-called hydrogeological B buffer zone with a 50-year reach time. However, mixing conditions are important for the risk of pollution. Between 60 and 90 % of the produced water in this stretch originates from the Danube. The risk from the Danube is posed by the condition of the riverbed and the potential for accidental pollution downstream. Under current legislation, the coastal filtered aquifers cannot be protected against the constant discharge of effluent from the major industrial centres above the aquifers or against the pollution that could be discharged in a matter of days in the event of an accident. (This is another reason why a water quality monitoring system along the entire length of the Danube is very much needed.) [BALASSA etal, 2010] In the background, settlements, agricultural cultivation and industrial activity are the sources of pollution that threaten water quality. The closer the aquifer is to the surface and the better the permeability of the overburden, the more likely it is that pollutants of surface origin will be present in groundwater. However, the mixing conditions mentioned above can significantly reduce the concentration of contaminants in groundwater from the background. Dilution during mixing results in background contaminant effects not even at a waterworks in an urban environment such as the Budaújlaki aquifer, which has been operating for 120 years in Budapest, surrounded by residential and industrial buildings [BALASSA etal, 2010].

In addition to the 25 riparian filtered aquifers currently in operation along the Danube between 1708 and 1433 km-1708-1433 km, there are 18 untapped remote aquifers with favourable water supply potential, also located along the river.

The following table shows the operational and prospective aquifers in the planning phase that were considered in the planning.

13. Table 1: Vulnerable Danube basins considered in the planning along the river 1708-1561 fkm

Name of the aquifer	Status of	Boundaries of the protected area [Danube fkm]	Production to be protected [m^3/day]	Valid protection order number
Shallow aquifer	Operating	1704,3 - 1704	411	KTVF:42368-14/2012.
Dömös aquifer (ÉDUVIZIG)	Operating	1702 - 1700	2332	128-4/2002.
Visegrad aquifer	Operating	1695 - 1694,7	493	KTVF: 3309-4/2013
Nagymaros aquifer	Operating	1692,4 - 1690,5	n.a.	n.a.
Kismaros-Nagymaros long-distance aquifer	remote	1692,3 - 1688,7	n.a.	n.a.
Verőce aquifer	Operating	1687,6 - 1685,3	n.a.	n.a.
Kisoroszi waterworks aquifer	Operating	1692 - 1683,7	130 000	KTVF: 6789-2/2013.
Tótfalui aquifer	Operating	1683,7 - 1680	18 000	KTVF: 62158-1/2009.
Vác Buki-szigeti aquifer	Operating	1683 - 1681,3	6 250	KTVF: 18657-1/2013.
Surányi aquifer	**Operating**	**1680 -1671**	**105 000**	**FKI-KHO: 796-2/2017**
Pócsmegyeri aquifer	Operating	1675 - 1666	n.a.	KTVF: 2959-3/2012, KTVF:35100-953-2/2017 (mod.)
Horányi waterworks aquifer	**Operating**	**1671 - 1664**	**36 000**	**FKI-KHO: 781-3/2017**
Göd aquifer	Operating	1665-1671	6 000	35100/1822-21/2019.ált
Dunakeszi Aquifer	Operating	1664,9 - 1663,9	2740	KTVF: 6337-4/2011
Dunakeszi Balpart II waterworks	Operating	1663,85 - 1660,6	45 000	FKI-KHO: 4210-12/2016.
Dunakeszi Balpart I. waterworks	Operating	1660,6-1658,5	16 700	
Sziget I.-II- waterworks	Operating	1664 - 1657,2	75 000	FKI KHO: 762-2/2017 (preliminary delimitation)
Budaújlak waterworks	**Operating**	**1653 - 1649,8**	**22 000**	**FKI KHO: 8532-2/2017 (preliminary delimitation)**

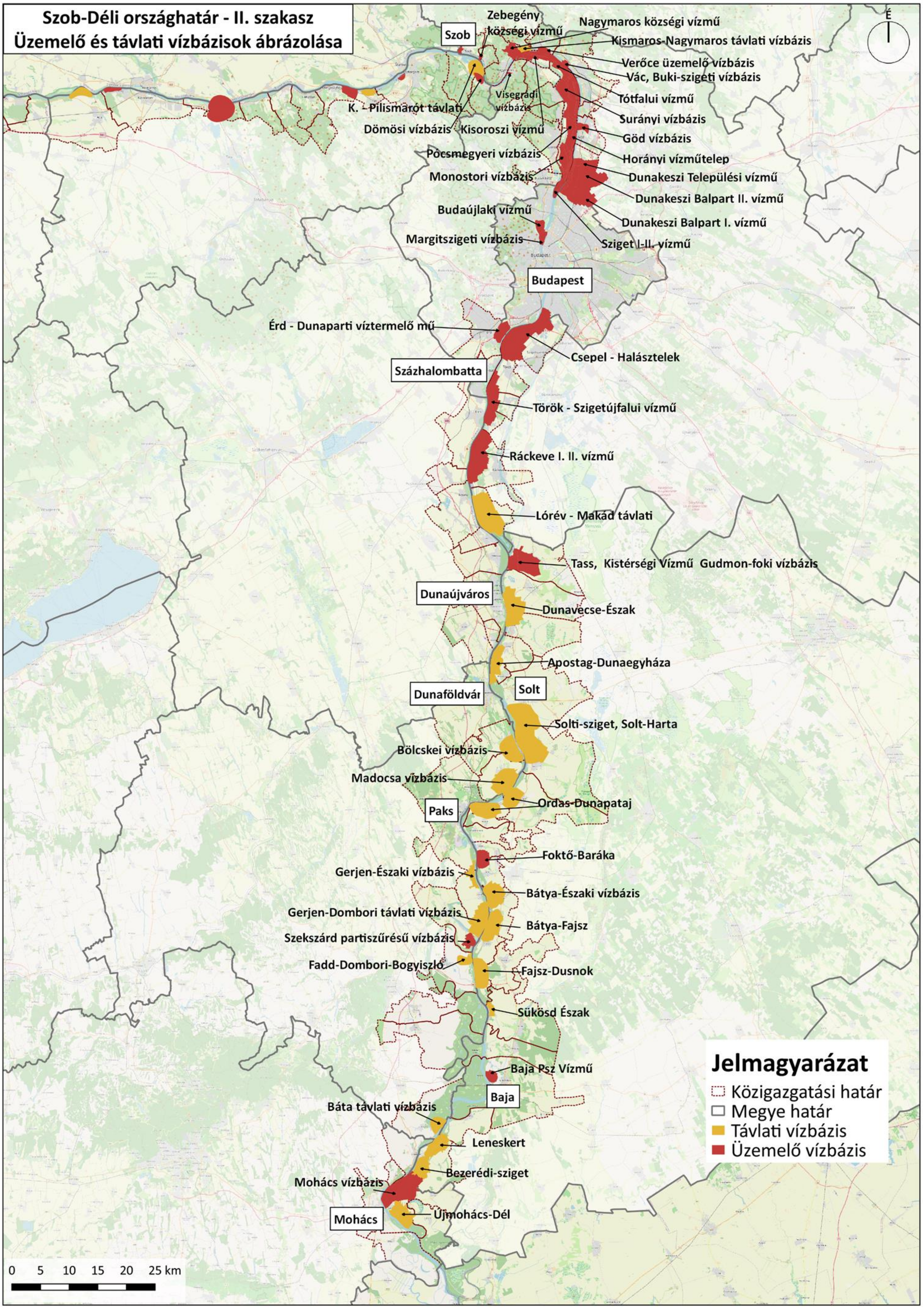
Name of the aquifer	Status of	Boundaries of the protected area [Danube fkm]	Production to be protected [m3/day]	Valid protection order number
Margaret Island aquifer	Operating	1651,8 - 1648,7	n.a.	n.a.
Csepel-Halásztelek	Operating	1637,1 - 1624,1	63 000	FKI KHO: 400-26/2016. (KTVF: 11490-3/2009, KTVF 5020-3/2008)
Érd- Dunaparti water production plant	Operating	1630 - 1626,7	3 800	KTVF: 94-1/2010 (preliminary delimitation), FKI KHO: 4230-4/2015 (amendment)
Tököl-Szigetújfalui Waterworks	**Operating**	**1621,6 - 1612**	**69 000**	**FKI KHO: 745-2/2017.**
Ráckeve I - II waterworks	Operating	1610,9 - 1600,8	I.: 95 000 II: 40 000	KTVF: 12374-2/2010 (KTVF: 9229-1/2011 correction, FKI KHO: 10891-1/2015 mod.)
Lórév-Macád	remote	1598,7 - 1591	n.a.	n.a.
Tass, Small Area Waterworks River Gudmon catchment	Operating	1583,7 - 1585,7	10 000	62.796-3/2003
Dunavecse-Season	**remote**	**1579 - 1573**	**30 000**	**H/4847-8/2003-12. V/1982**
Apostag-Dunaegyháza	remote	1563,7 - 1569,2	16000	65.002-2/2004.
Solti Island	**remote**	**1562,7- 1563,5**	**8000**	**77577-1-16/2010**
Solt-Harta	**remote**	**1557,2 - 1546,3**	**74000**	**KÖTI-H-02507-003/2003.**
Wise aquifer	remote	1552 - 1547	n.a.	n.a.
Madocsa aquifer	**remote**	**1544 - 1539,2**	**35000**	**n.a.**
Ordas-Dunapataj	remote	1541,5 - 1532,3	43.000	n.a.
Foktő-Baráka	**Operating**	**1523,4 - 1520,3**	**16500**	**59198-16/2002**
Gerjen-Northern aquifer	**remote**	**1521,6 - 1517**	**n.a.**	**n.a.**
Bátya-Northern aquifer	remote	1516 - 1513,1	27.000	ATI-H-03635-001_2003
Bátya-Fajsz	remote	1507,5 - 1511,9	52 000	ATI-H-03634-001_2003
Gerjen-Dombori	remote	1514 - 1507,3	40000	n.a.
Szekszárd shaved vb	Operating	1506,4 - 1505,5	7000	n.a.
Fadd-Dombori-Bogyiszló	remote	1504,3 - 1502,7	12000	n.a.
Fajsz-Dusnok	remote	1503,3 - 1498,1	45 000	ATI-H-00228-009/2002.
Sükösd North	remote	1492,73 - 1494,55	30 000	52068-1-1/2009
Baja Psz Waterworks	Operating	1482-1481	20 000	59.185-7/2002
Báta	remote	1468 - 1465,2	n.a.	n.a.
Leneskert	remote	1462,8-1465	30 000	52246-1-1/2009
Bezeredi Island	remote	1458,7 - 1456,4	30.000	77576-1-15/2010
Mohács aquifer	Operating	1457 - 1447,5	33000	63.216-10/2003.
Újmohács-Dél	remote	1446,3 - 1442	20.000	6878-9/2010-10997.

The interventions on the river have been designed to minimise the impact on the designated protection zones of the water bodies.

The following findings apply to keeping aquifers safe:

- The prohibitions and restrictions on the various protected areas have been established in accordance with the current Government Decree 123/1997 (VII.18.). Of these, the activity "Other interventions affecting the overburden or aquifer", which are carried out in the Hydrogeological Protection Area A or B, according to the law, is of particular importance for the regulation of small water bodies:
    - "For new or existing installations or activities, an environmental impact assessment or an environmental review, or a specific assessment with equivalent content, may be permitted, subject to the results of the environmental impact assessment or the environmental review."
    - In all cases, the holder of the permit must ensure the safety of the aquifer, which essentially consists of monitoring the water level and water quality of the wells in the monitoring system according to a set methodology. In addition, the effectiveness of the protection and the sources of pollution must be monitored in the prescribed manner and at the prescribed intervals.

The following section describes in detail the water bodies affected by the planned intervention.



6. Figure 1: Vulnerable Danube basins considered in the planning along the river 1708-1561 fkm

2.2.1. OPERATING AQUIFERS

2.2.1.1. Surányi aquifer

Decision:KTVF:62176-1/2009. then FKI-KHO: 796-2/2017.

On the basis of the diagnostic tests carried out by Smaragd GSH. in 2005 and the final safety plan documentation, the official designation of the protective dam of the aquifer was made in 2005, in accordance with Government Decree 123/1997 (VII.18.).

14. Table 1:Surányi aquifer protection areas

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Internal protection zone	is	-
Outer protection zone	is	1 246 377 ^{m2}
Hydrogeological protection zone "A"	is	1 055 124 ^{m2}
Hydrogeological protection zone "B"	is	-

2.2.1.2. Horányi waterworks aquifer

Decision:KTVF:62173-1/2009. then FKI-KHO:781-3/2017. and was previously delimited as follows

Water operating licence: KTVF: 1005-3/2010

Water permit number: D.2/1/1810

Facilities:
- Horányi I. Waterworks: 52 tube wells
- Horányi II Waterworks: 52 tube wells
- Horányi III Waterworks: 3 tap wells

The Budapest Waterworks Ltd. (Budapest).

In 2001, the Environmental Expert Office Ltd and the Budapest Waterworks Ltd carried out the diagnostic tests and the safety plan of the aquifer.

Aquifer in the Danube gravel and sand assemblage**, stratigraphic sequence** in the area of the waterworks:
- 0.0 - 0.3-0.5 m: thin humus cover
- -0,3-0,5 - 4,0-9,0 m between:casting sand clay, silt
- -4.0-9.0 -10.0-13.0 m: Pleistocene gravel, sometimes rolling coarse sand of the Danube, with sand on top
- Below -11.0-15.0 m:Oligocene-Miocene clay, sand

The hydrogeological protection boundaries defined by modelling are:
- Inner protection zone: a strip of land parallel to the Danube at a distance of 10 m from the wells.
- Outer protection zone: up to a boundary line about 100 m from the wells
- Hydrogeological "A":The area from the Danube drift line to the outskirts of Szigetmonostor, part of the resort area of Horány and the small DK part of the outskirts of Pócsmegyer
- Hydrogeological "B": not designated

The **vertical extent of** the protective barriers**:**

- Upper surface: surface topography (ground level)
- Lower surface: surface of the bed of the reservoir assembly

15. Table 1:Protection areas of the Horányi I.-II. aquifer

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Internal protection zone	is	-
Outer protection zone	is	505 189 ^{m2}
Hydrogeological protection zone "A"	is	999 359 ^{m2}
Hydrogeological protection zone "B"	none	-

16. Table 1: Protection areas of the Horányi III. aquifer

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Internal protection zone	is	22 128 ^{m2}
Outer protection zone	is	85 341 ^{m2}
Hydrogeological protection zone "A"	(shared with Horány I.-II.)	999 359 ^{m2}
Hydrogeological protection zone "B"	none	-

2.2.1.3. Budaújlak waterworks

Decision:35100-13236-3/2017 preliminary delimitation

Water operating licence: 9778-8/2012.

Water permit number: D.2/1/247

Facilities:

- 1 tap water well
- 3 manholes
- 2 tapered manholes
- 1 gallery

The Budapest Waterworks Ltd. (Budapest).

Documentation for the delimitation of the protection areas of the protection dam: Central Danube Valley Water Management Directorate - Documentation for the preparation of the establishment of the safety of the vulnerable drinking water sources - Budaújlak Waterworks.

The **aquifer is a** gravel and sandy assemblage of the Danube, **a series of strata** in the area of the waterworks:

- 0.0 - 2.0-5.0 m: alluvial rock flour, fine sand, anthropogenic fill
- -2.0-5.0 - 7.0-20.0 m: fine sand, sand, fine gravel, gravelly sand, sandy gravel
- below -7.0-20.0 m: Oligocene-Miocene clay, marl, fine sand

The hydrogeological protection boundaries defined by modelling are:

- Inner protection zone: a 760 m long and 160 m wide area parallel to the Danube (wells BU-l-5) and a 240 m long and 200 m wide area parallel to the Danube (well BU-6).
- External protection zone:Danube driftline, Lajos street. Bokor street. Wiener út. Lajos street, Árpád Fejedelem útja

- Hydrogeological "A" and "B": Danube drift line. Arpad Bridge - Western shore of Shipyard Bay. Bridge over the Danube branch. Mosaic street. Búza street- Kunigunda street. Zay út. Area bounded by Bécsi út

17. Table 1:Budaújlaki aquifer protection areas

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Internal protection zone	is	57 500 m^2
Outer protection zone	is	161 500 m^2
Hydrogeological protection zone "A"	is	43 888 m^2
Hydrogeological protection zone "B"	is	124 313 m^2

2.2.1.4. Tököl-Szigetújfalu waterworks

Decision:35100-1070-3/2017. p.s. provisionally delimited

Authorisation **number**: KTVF: 14797-5/2011.

Facilities:

- 5 tap wells (Tököli waterworks) - operating as standby wells
- 11 tap wells, of which 7 are located on the protected side of the dam and 4 on the floodplain side (Szigetújfalui waterworks)
- 2 x 42 = 84 tube wells (Tököli waterworks)

The **aquifer is a** gravely sandy assemblage of the Danube, which is a riverine sandy gravel, pebbly sand of Pleistocene age, 4-9 m below the surface, averaging 4-10 m thick below the LKV.

Layering in the waterworks area:

- 0.0 - 5.0-7.0 m: sand, sandy silt, loamy sand, loess
- 5.0-7.0 - 10.0-17.0 m: fine sandy gravel, coarse and medium gravel, fine pebbles, sandy gravel
- Below 10.0 - 17.0 m: clay

Based on the diagnostic tests carried out by the Environmental Protection Expert Office in 2003 and the final safety plan documentation, the official designation of the protective dam of the aquifer was made in 2017, in accordance with Government Decree 123/1997 (VII.18.).

The hydrogeological protection boundaries defined by modelling are:

- Inner protection zone: approx. 950 x 200 m, approx. 17 m, approx. 2150 x 160 m and 4 areas of approx. 160 x 160 m parallel to the Danube,
- Outer protection zone:Areas of about 3,000x550 m and about 4,700x1,000 m parallel to the Danube,
- Hydrogeological "A" and "B":Area covering part of the interior and exterior of the municipalities of Tököl, Szigetújfalu, Szigetszentmárton, Szigetcsép.

The **vertical extent of** the protective barriers**:**

- Upper surface: surface topography (ground level)
- Lower surface: surface of the bed of the reservoir assembly

18.table: Tököl-Szigetújfalu aquifer protection areas

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Internal protection zone	is	86 534 m^2
Outer protection zone	is	658 797 m^2
Hydrogeological protection zone "A"	is	1 612 817 m^2

Hydrogeological protection zone "B"	is	660 486 m^2

2.2.1.5. Foktő-Baráka operating aquifer

Határozat:59198-16/2002

Water permit number: I/307

Number of rooms:12

Monitoring wells: 15

The Kiskunsági Víziközmű-Szolgáltató Kft. is a party filtered drinking water base.

On the basis of the diagnostic tests carried out by Kalocsavíz Ltd. and the final safety plan documentation, the official designation of the protective dam of the aquifer was made in 2002, in accordance with Government Decree 123/1997 (VII.18.).

19. table: Baraka Aquifer Protection Areas

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Internal protection zone	is	-
Outer protection zone	is	86 200 m^2
Hydrogeological protection zone "A"	is	162 000 m^2
Hydrogeological protection zone "B"	is	433 671 m^2

2.2.2. REMOTE AQUIFERS

2.2.2.1. Dunavecse-Season

Határozat:H/4847-8/2003-12. V/1982

Volume of water to be protected: 30 000 $^{m3/day}$

Facilities:

- 1 test producer well
- 4 detector wells
- 10 monitoring wells

Based on the diagnostic studies carried out by ADUVIZIG in 2003 and the final design documentation, the official (DÉDUVIZIG) designation of the protective dam of the aquifer was made in 2003, in accordance with Government Decree 123/1997 (VII.18.).

The **hydrogeological protection zones** identified by modelling pursuant to designation decision H-6585-5/2009:

Horizontal extent:

- Hydrogeological protection zone A covers an area of 665,90 ha with the EOV coordinates of the estimated centre of gravity determined by the readings: X = 177.800 km Y = 644.450 km
- Hydrogeological protection zone B covers an area of 943,80 ha with the EOV coordinates of its estimated centre of gravity determined by a reading: X = 178.250 km Y = 646.000 km

Vertical extent:

- Dimensions of hydrogeological zone A:
  - Cover: +92.00 mBf (average 3 m below ground level)
  - Baseplate: +82.00 mBf (average 18 m below ground level)

- Dimensions of hydrogeological zone B
  - Top: +92,00 mBf (3 m below ground level)
  - Baseboard: +82.00 mBf (18 m below ground level)

20. Table 1: Dunavecse-Northern perspective aquifer protection zones

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Hydrogeological protection zone "A"	is	1 438 488 ^{m2}
Hydrogeological protection zone "B"	is	835 794 ^{m2}

2.2.2.2. Solti Island

Decision: 77577-1-16/2010

Volume of water to be protected: 8 000 $^{m3/day}$

Facilities:

- 11 monitoring wells
- 2 monitoring wells
- 2 test producer wells

A coastal-filtered, remote aquifer managed by ADUVIZIG.

On the basis of the "Solti Island Long-Term Aquifer Status Assessment and Safety Plan Documentation" prepared in 2010 by SMARAGD-GSH Environment Protection and Services Ltd. (1114 Budapest, Villányi út 9.), the official designation of the aquifer protection dam (ATIVIZIG) was made in 2010, according to Government Decree 123/1997 (VII.18.).

The designation decision defines the **hydrogeological protection zone as defined by** modelling:

Protection zone B (50-year reach) of the hydrogeological protection zone is not significantly different from protection zone A (5-year reach). The reason is that in the north and east, due to the recharge effect of the Dead Danube, the streamlines do not extend beyond 5 years. Therefore, the designation of the hydrogeological protection zone B is such that zone A of the hydrogeological protection zone includes protection zone B and the more stringent requirements of zone A apply to the protection area.

Horizontal extent:

- Hydrogeological protection zone "A": the Danube extends between 1562+150 - 1564+050 fkm from the left bank of the mid-water to a distance of 250 m towards the drift line. Area: 183 ha

Vertical extent:

- Cover: matching the terrain level
- Baseboard: 79 mBf (16 m below ground level)

21. table: Solti Island distant aquifer protection zones

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Hydrogeological protection zone "A"	is	519 100 ^{m2}
Hydrogeological protection zone "B"	is	

2.2.2.3. Solt-Harta long-term aquifer

Határozat:KÖTI-H-02507-003/2003

Water permit number: ADUVÍZIG V/1629

Volume of water to be protected: 74 000 $^{m3/day}$

Facilities:

- 10 monitoring wells
- 12 monitoring wells
- 1 test producer well

Based on the plan documentation No.294/1/1997 prepared by AQUARIUS Vízvbeszerzési és Vízvédelmi Kft. (1095 Budapest, Mester út 13. IV/10.), the official designation of the protective dam of the aquifer (KTVVIZIG) was made in 2003, according to the Government Decree No.123/1997 (VII.18.). The quality of the extractable water is: Ca-Mg carbonate with an unacceptable content of iron, manganese and ammonia.

The designation decision defines the **hydrogeological protection zone as defined by** modelling:

Horizontal extent:

- Hydrogeological protection zone A: defined as 300-800 m from the planned well site towards the background
- Hydrogeological protection zone B: defined as approximately 2500-3500 m from the planned well site towards the background

Vertical extent:

- Hydrogeological protection zone "A"
  - Cover page: 85.0 mBf(below ground level 9 m)
  - Motherboard: 65.0 mBf (below ground level 29 m)
- Hydrogeological protection zone "B"
  - Cover page: 85.0 mBf (below ground level 9 m)
  - Motherboard: 65.0 mBf (below ground level 29 m)

22. table: Solt-Harta long-term aquifer protection domain

Protective dike, protective zone	Surface section	Part of the protected area overlapping a mid-water body
Hydrogeological protection zone "A"	is	1 391 403 ^{m2}
Hydrogeological protection zone "B"	is	2 346 593 ^{m2}

2.2.2.4. Madocsa aquifer

23. table: Protective domains of the Tatar remote aquifer

Protective dike, protective zone	Surface section	Touch of intervention
Hydrogeological protection zone "A"	is	1 601 579m2
Hydrogeological protection zone "B"	is equal to A	1 601 579m2

Sources used in chapter 2:

- VGT3 - Central Danube Valley Water Management Directorate- 1-9 Central Danube River Basin Management Planning Sub-unit - Discussion paper on advanced water management issues, 22 April 2020.
- VGT3 - North Transdanubian Water Management Directorate - Danube sub-basin - Discussion paper on significant water management issues, 5 May 2020.
- VGT3 - North Transdanubian Water Management Directorate - 1-1 Szigetköz river basin management planning sub-unit, 22 April 2020.
- Zoltán GODA - Quantitative and qualitative assessment of domestic operating and distant coastal filtered drinking water sources, Military Engineer, Volume XIV, Issue 2 (2019.)
- Krisztina KÁRMÁN, József DEÁK: Investigation of the stratified water flow regime of the Szigetköz based on tritium modelling. XIX Conference on Groundwater, Abstract vol. 20 (2012).
- Géza BALASSA, Károly GONDÁR, Katalin GONDÁRNÉ Sőregi, Adorján HORVÁTH, Sándor PETHŐ - Experiences in the diagnostics of particle filtered drinking water aquifers - http://www.fava.hu/publikaciok/jubileumi_kiadvanyok/tanulmanyok_pdf/balassa_partiszures.pdf

3. GEOLOGICAL MEDIUM, SOIL

3.1. TOPOGRAPHY AND GEOLOGY

In the planning area, the Danube flows through two large areas, four medium areas and 13 small areas. The sub-areas are described in the direction of the Danube. The Visegrad-Dunakanyar sub-area is located within the Northern Hungary-Middle Mountains large area and the Visegrad Mountains medium area. The other areas of interest are all within the Great Plain. Within the Danube Plain Central Plain, the Vác-Pesti Danube Valley, the Pesti Plain, the Csepeli Plain, the Solti Plain, the Kalocsai Plain, the Tolna Plain, the Mohács Island and the Mohács Terrace Plain are concerned.Within the Mezőföld Central Plain, three small areas, the Érd-Ercsi Hájtság, the Central Mezőföld and the Southern Mezőföld are concerned. In the central part of the Bácskai Plain, one small area is concerned, the western edge of the Bácskai loess plain.

Visegrád Danube Bend

The Danube flows through the Visegrád-Dunakanyar sub-region, which is located within the large area of the North-Hungarian Central Mountains and the central area of the Visegrád Mountains. The sub-basin is a tectonically predicted, antecedent, mostly symmetrical, erosional river valley. Its altitude varies between 107 and 220 m above sea level. The average elevation of the floodplains is 120 m, with terraces ranging from 30 to 200 m in relative elevation. Intense slope degradation and slope hazards are found on the slopes between Dömös and Pilismarót and between Visegrád and Zebegény-Verőce, on the slopes towards the Danube.

The bedrock of the small area consists of Tertiary sandstones and andesitic tuff and agglomerate. About 20% of the surface and near-surface sediments are loess or slope loess, and about 40% are Holocene, mostly river sediments. Its structural orientation is characterised in places by the NW-SE lines, also marked by the Danube flow direction, and by perpendicular NE-SW lines associated with the rift-fracture fragmentation.

Vác-Pest Danube Valley

The Vác-Pesti Danube Valley is a lowland plain with a predominantly 98 m altitude, the highest point is 122 m, bordering on the E with the Pesti plain, which is characterised by higher (max. 235 m) Danube terraces, and on the W with the low and high plateau and the older terrace islands of the Danube, the border is marked by the ridge of the mountain tops.

The low and high floodplains are on average 3 and 6 m higher than the Danube at point 0, respectively. The orographic topography is a gently undulating plain. The vast majority of its landforms are related to erosion and accumulation by rivers. On the right bank of the Danube, a dense network of valleys, projected by trench fault lines, is visible.

The basement is predominantly composed of Triassic carbonate formations. On the overlying Oligocene-Miocene formations, the formation of the large Danube alluvium began in the early Pleistocene, possibly at the very end of the Pliocene. The surface is currently covered by a few metres of Holocene casting mud, but the underlying river gravels were also deposited during the Quaternary shifting and meandering of the river bed. These formations are associated with major gravel deposits (Budakalász, Kisoroszi, Szentendre, Vác). On Szentendre Island, which has been in a high archeological position since the end of the Pleistocene, quicksand formation took place. In the built-up areas, the floodplain levels were artificially filled to a thickness of 1-5 m.

Pesti-derived condensate

The Pesti alluvial plain is between 97.5 and 251 m above sea level. It rises in steps towards the east, towards the higher terraces. Their roughly north-south oriented bands are cut in a mosaic and checkerboard pattern in a west-east direction by the valleys of the Danube's left bank tributaries.

The higher terraces, formed transversely into inter-valley ridges, are very richly dissected by erosional and deressional valleys. The overwhelming majority of the surface is a medium-altitude, dissected plain.

The small area is based on Palaeozoic-Mesozoic formations and the overlying Tertiary strata. These formations were subdivided into blocks by a system of parallel NE-SE fault lines, which subsided more and more during the Pleistocene as they moved towards the lowlands. The Danube alluvial cone, formed from the very beginning of the Pleistocene, shows an orographically similar but chronologically opposite picture, as the oldest Pleistocene sediments are deposited on Pannonian sediments to the E. The Late Pannonian sediments can be traced in the Danube region down to a depth of 100-300 m. They are composed of medium-grained sands with good hydric properties, alternating with layers of aleurolite and clay, several tens of metres thick. In the Danube plain, the alluvial sedimentation of the Danube during the late Pleistocene produced a complex of layers of well-drained gravel and sandy gravel lenses with a thickness of 5-25 m, alternating with medium-coarse-grained sand layers and thin interbeds of alluvial clay and silt.

The H/a and Il/b terraces of the Danube are continuous, the surface is often raised with bank humps, quicksand and loess-like sediments. The IV is often covered with freshwater limestone, and the V and older terraces appear only in patches. The most important raw materials are gravel (Kőbánya, Duna-haraszti, etc.) and brick clay (e.g. Ecser, Budapest), which are almost in unlimited supply. Seismicity in the south-western part of the region is above average (Dunaharaszti earthquake: 5.6 magnitude in 1956).

Csepel plain

The Csepel plain is an alluvial conglomerate at an altitude of between 94.4 and 126 m above sea level, largely at floodplain level. The typical surface elevation is between 110 m N and 96-100 m S. The alluvial cone surface of the small area, which is divided into terraces, slopes gently down to the south and towards the Danube. The low terrace is 4-6 m above the Danube at 0 level, the high terrace 6-10 m above the Danube at 0 level, and the shingle terrace Il/a is 12-16 m above the Danube at 0 level. The western part of the area is predominantly formed by fluvial erosion and accumulation. The surface is covered by a dense network of abandoned meanders, often accompanied by a patchy cluster of coastal dunes. There are several poorly drained, blocked depressions in the low floodplain. Quicksand surfaces emerge from the floodplain on the eastern edge of the lowland.

The basement, which is fragmented along structural lines, has a varied rock composition, with different paleozoic-mesozoic formations. On D, the Miocene volcanism is a riolitic-dacitic sequence at depth. In the southern part, the Central-Hungarian Line is present. The Pannonian sediments are overlain by a coarse-grained fluvial sedimentary sequence of Danubian origin. The lowering of the terraces and their transformation into a normal stratification sequence are clearly visible. The gravel layer, generally 10-20 m thick, is close to the surface, is a good water reservoir and contains a significant amount of exploitable gravel. Another important occurrence of gravel sediments is the extensive, deep gravel terrace between Bugyi and Kiskunlacháza, which is 6-10 m thick and covered by thin shingle mounds. The largest gravel deposits are found in Szigetszentmiklós, Kiskunlacháza, Bugyi, Délegyháza, Adony, Dunavarsány, Halásztelek. Most of the surface is covered by Holocene formations. Due to the highly effective sedimentation activity of the Danube, the Old and New Holocene formations often accumulated in the vicinity of each other at the same level. Small Pleistocene highlands covered by quicksand are also found in the eastern part of the area and on Csepel Island.

Solti plane

The Solti Plain is a flood plain at an altitude of between 93.7 and 123.7 m above sea level. The typical altitude of the high plateaus in the western part is 100 m, from which the coastal dune series between Dunavecse and Solt rises to 6 to 8 m. The low flood plains and the low-lying salt flats of the K part are at an absolute altitude of 94-96 m. The majority of the area is classified as low flood plain and slightly flood plain (West), the remainder as flood plain and low flood plain with poor drainage (K). The topography is enriched by the depressions and meanders created by the former shoaling of the Great Plain, the series of coastal dunes, the saline lakes and the two erosion witness hills, the Solti and Tétel hills, cut off from the edge of the Plain by the Danube.

The basement is largely composed of mesozoic rocks. The Upper Pannonian layers of the overlying deposits are covered by 40-60 m thick coarse alluvial deposits of Danube origin. This sedimentary sequence gradually thins out towards the N, giving way to a sequence of river gravels and sands averaging 10-20 m thick. This vast gravel field stores large quantities of water and provides a significant mass of exploitable gravel raw material. The largest gravel deposits are found in the vicinity of Szalkszentmárton and Solt. The Holocene cast sands and sandy casts predominate at or near the surface. The filled moraines are filled with boggy, meadow clay.

Érd-Ercsi hátság

The Érd-Ercsi hiatus is a fine-grained alluvial conglomerate at an altitude of between 99 and 198 m above sea level. Its surface, which slopes downwards towards the south-east, is dissected into inter-valley ridges by tectonically predicted terraced valleys with a north-westerly strike. The NW and NE parts of the small area are low hill ridges and slopes, the S part is of undulating plain orographic relief type. Its relief, which is divided into valleys and basins, is characterised by erosion and erosion processes, with structural movements playing a major role.

Only vague knowledge exists of the basin floor, which in places has sunk to depths of several kilometres. Pannonian clay-loam sediments are present at or near the surface on the north and east margins of the basin. Part of the area is covered by loess sediments of varying thickness, partly Eolian and partly Pleistocene age. The Pannonian sediments representing the bed have been covered by a gravel layer of more than 20 m in places from the NW by watercourses. During the Pleistocene, the more or less known outcrop was fragmented and uplifted to varying degrees. As a result of denudation, the surfaces covered by thicker gravel cover have mostly maintained their original relative elevation, possibly forming erosional 'island mountains' (Ercsi and Sóskúti eskers). In other areas, the loose sedimentary rocks have denudated much more intensively and have become undulating plains covered with loess.

Central Great Plain

The Central Great Plain is an alluvial conglomerate at an altitude of between 97 and 204 m above sea level. The lowland is divided into two roughly equal parts by the structurally predicted Seregélyesi valley and the slightly dissected lowland depression area that runs parallel to it: to the north-east, the Pentelei lowland plateau, which is separated from the Danube by a 50-60 m bank, and the mid-altitude lowland plateau at 150-180 m tszf. The Sárbogárdi plateau, also 150-180 m above sea level, extends to the DN. Their surface is interspersed with a dense network of loess-induced degradation (loess dolines, loess hollows, loess wells) and erosion-derosion valleys.

The structure of the basin floor is essentially determined by the fact that it is crossed in the middle by the Central Hungarian Line: from here, the N-neu-Paleozoic and Mesozoic formations are located. To the north, Eocene subvolcanic bodies, and in the middle, a Miocene riolitic-dacitic sequence at depth and partly at the surface. The Pannonian clayey sediments of the small area were subject to fluvial erosion and accumulation during the early Pleistocene, which eroded away localised Pliocene surface roughness. During the Lower Pleistocene, the Central Plain area was mosaically fractured along the more pronounced NE-SE and the more subordinate NE-DNW structural lines, with each major block being uplifted to varying degrees and the central part of the Pleistocene basin subsiding. The Lower Miocene riolite tuff outcrops near Sárbogárd-Sárszentmiklós are associated with the intersection of the former structural trends. The blocks that emerged during the Pleistocene were covered by eolian loess 20-60 m thick in the NE (Pentelei loess plateau) and 20-40 m thick on average in the NW. The stratigraphic sequence of the Paks brickworks is a basic section for the study of Quaternary climate change in Central Europe. The middle subsidence zone of the small area is Holocene, mostly alluvial, covered with sediment.

Kalocsai-Sárköz

The Kalocsai-Sárköz area is a lowland plain at an altitude of between 89.4 and 125.6 m above sea level. The northern part is a high plateau (Kalocsai terrace) with an average altitude of 96-98 m, the southern part is a continuous low plateau with an average altitude of 91 m. The high plateau is divided mainly to the NE by saline flats, the central part by morainic and low-lying flats. Along the Red marsh, at the foot of the Kecel-Baja highland shore, a long stretch of peatland is the lowest part of the lowland. The average relative depth of the gently south-facing surface is 1 m/km2. On the right bank of the Danube, the high plateau (Madocsa terrace), partly covered by quicksand, rises above its surroundings like a wide oval headland.

The basement is of varied composition, with Lower Permian quartz porphyry, Triassic carbonate sediments and metamorphic formations. The Pannonian clayey sediments are overlain by a sandy-loamy sedimentary sequence of partly Palaeolithic and partly Danubian origin from the early Pleistocene. The area finally became a Danube floodplain after the deeper subsidence of the Kalocsa-Mohácsi depression during the Neolocene. Currently, 90% of the surface is covered by Holocene sediments. The lowland sediments are generally more compacted, silty-clayey formations. Meadow and bog clay, peat and bog soil are common on the eastern edge of the lowland. The latter are associated with significant agricultural peat and moorland deposits (Érsekcsanád, Nemesnádudvar, Hajós, Sandy Meadow). The high-marsh areas are covered with Pleistocene moulding sand, moulding silt and in places (Hajós) Pleistocene loess silt.

Southern Great Plain

The Southern Plain is a conglomerate of alluvial conglomerates at altitudes between 90 and 213 m above sea level, covered by quicksand and alluvium. It is separated from its surroundings by a sharp structural and orographic boundary to the west and east. The first is a medium-altitude dissected plain with an average altitude of between 180 and 200 m. The second is a lowland plain with a medium altitude. The first is the Györkönyi ridge, bounded by structural steps in a north-north-west to south-east direction, which is divided by erosion-derosion valleys and is characterised by the particular degradation of loess. This type is surrounded in a ring by the quicksand surface of a slightly dissected plain with an average height of 150-160 m. The surface is covered by semi-cohesive quicksand forms (wind ridge, garmada, residual ridge, sandstone ridge).

The basin floor is formed by Triassic-Jurassic formations, overlain by a Miocene riolitic-dacitic sequence in the Paks area. The surface of the basin is subducted to the Upper Pleistocene and the Pannonian strata are therefore covered by thick fluvial sediments. This sedimentary sequence is essentially a cone of alluvium of the Upper Pleistocene Ancestral Flood, mainly sand. From the Upper Pleistocene onwards, the central part of the basin (Györkönyi Ridge) was gently uplifted, forming 10-20 m thick loess, mostly of eolian character. At the end of the Pleistocene and in the Holocene, the alluvial cone was covered by a considerable area of quicksand.

Tolnai-Sárköz

The Tolnai-Sárköz sub-region is a lowland plain at an altitude of between 88.1 and 162 m above sea level. The northern part of the area is a continuous low-lying plain at a typical height of 91 m, while the southern part is a high-lying plain at an average height of 95 m, with terraced islands and, on the western edge, alluvial cones accumulated by streams from the Tolna-Baranya hills. The northern part of the area is a perfect lowland plain and the southern part is a lowland plain. The average relative depth of the surface is between 1-2 m/km2. The surface of the Tolnai-Sárköz is interwoven with a tangled network of moraines, which are deepened into the high plateau and filled and filled by natural processes and artificial intervention. The area is at risk of inland flooding and until the regulations were introduced large areas were covered by periodically waterlogged marshy surfaces. The remnants of these are the Gemenian Forest.

The basement is mainly composed of Triassic-Jurassic carbonate-fragmentary formations, but in the D part there are metamorphic rocks. In the lowlands, the Pannonian formations were overlain by alluvial cones from rivers from the Danube basin, followed by alluvial deposits from the Danube floodplain from the Neopleistocene. In the longitudinal depressions between Kalocsa and Mohács, the Danube has accumulated a 40-60 m thick river sedimentary layer, which has been refining from the bottom upwards since the mid-

Wurm. Holocene sediments are present everywhere at the surface. The low-lying floodplains are generally built up by denser silty-clayey sediments, the high-lying floodplains by silty-sandy sediments. In the high floodplain D of the basin there are also some outcrops covered by infusional loess. A unique geological formation is the Middle Triassic shell limestone outcropping in Bata.

Mohácsi Island

The Mohács Island is a floodplain at an altitude of 84 to 142 m above sea level, with a steep, 15-20 m high bank of loessy alluvial conglomerate from the west (Dunaszekcső, Bár). Its eastern boundary is the Baračka Danube branch and the terrace 11/a of Bačka. The relative depth of the surface is very low, below 2 m/km2 everywhere. The vast majority of the area is flood plain, low-lying floodplain, with flood and inland water risk, and is divided by small, mosaic-like flood-free areas of highland floodplain. Its characteristic surface forms are a reminder of the erosion and accumulation of the Danube, with moraines and morotvars often eroded by poor drainage.

Until the middle of the Würm, the small area was a cone of alluvium from the streams coming from the West, where only the finer-grained sediments reached. Holocene alluvial sediments (mainly silt) are present at or near the surface, except at the NW margin. In the vicinity of the island of Mohács (Margitta Island), the Pleistocene alluvial sediment assemblages are gravels about 20-70 m thick and coarse sandy sediments 5-10 m thick.

Typical are the NW-SE and NE-SW structural orientations, whose renewal in the Old Holocene also influenced the Danube's flow direction. The Triassic limestone surface outcrop (Váripuszta) and the Lower Pleistocene basalt of about 2 million years old near the village of Bár are specific colouring elements.

Bácska loess plain

The area is between 84 m and 165 m (average 110-120 m) above sea level, and is mainly covered with loess and loamy sand. 80% of the surface is gently undulating plain. Longitudinal depressions with watery troughs often 5-10 km long, 50-100 m wide, flat and semi-bounded sand humps are found between the loess-covered NW-SE slopes. The small area is bounded on the west by a terrace. Horizontally, the valleys are poorly dissected, with a DK-S dip, often with hummocky valleys.

The depth structure is varied: The Kunsági Trench to the west and the carboniferous granite of the Jánosfalvi Ridge to the east represent the basement at depths of about 1.5 km and less than 1 km, respectively. The rock composition is varied, with sedimentary and metamorphic rocks. It is an Upper Pannonian to Upper Pleistocene-age alluvial cone of the Upper Pleistocene margin of the watercourses from the Danube-Middle Danube and Mecsek. A varied eolian sedimentary sequence was deposited on this surface. Most of the surface is covered by a uniform loess layer of 1,5-2,5 m, which often gives way to quicksand and loamy sand downwards. The sandy material may have come partly from the sandy area to the north and partly from local sources. Even in the vicinity of the small areas of surface, semi-bound, wind-blown sand humps and beneath the thin 1-3 m mantle, loose sand and quicksand are found everywhere down to 5-10 m depth. The third group of surface sediments consists of sandy silt and meadow clay, sometimes with meadow limestone and limestone silt in the subsoil, deposited in small basins in the valley bottoms of the Körös and Kígyós lakes, which widen in places and are prone to salinisation.

3.2. HAZARDOUS AREAS AND MINES

Along the Danube, the exposure of the areas along the Danube to geological hazards (e.g. landslides, undermined areas, undercut areas, collapses, bank slides) is investigated. Areas affected by slope mass movements and other unfavourable engineering geology due to their geomorphology and geological structure may be considered as geological hazards.

According to Annex 3.12. of Pest County Municipal Decree 5/2012 (V.10.), the geological hazard zone includes the areas of Szob, Zebegény, Nagymaros, Kismaros, Verőce, Visegrád, Dunabogdány, Tahitótfalu, Vác, Sződliget, Leányfalu, Szentendre, Budakalász, Budapest (along the Buda side and the XXIII. district), Érd, Százhalombatta.

According to Annex 2.11. of the Fejér County Spatial Planning Plan, the settlements along the Danube affected by the geological hazard zone are Ercsi, Iváncsa, Adony, Kulcs, Rácalmás, Dunaújváros and Kisapostag.

Based on the ground motion hazard map, there is an area of high ground motion hazard in the vicinity of Ercsi, Rácalmás and Dunaújváros based on specific movement. Sloping terrain potentially at risk of surface movement also occurs in the vicinity of the above high risk areas along the Danube.

In the Vértes, Bakony and along the Danube, the structural features of the area mean that there are a large number of areas with surface movement. In areas with a high relief energy and a high degree of dissection, slope surface movements are common. A large number of areas with active landslides occur in the municipalities of Bakonycsernye, Rácalmás, Kulcs and Dunaújváros.

Landslides in the county typically occur along the Danube as bank slides, and in some areas as gullies. The municipalities that are administratively connected to the Danube River have in common the presence of a 30-60 m high bank wall on the western bank of the Danube.

For most of the settlements, the river bank extends all the way to the river, and away from it only in the Adony Bay. In the areas of Kulcs, Rácalmás and Dunaújváros, hundreds of cases of landslides have occurred in the Danube riparian zone.

According to the Spatial Plan of Bács-Kiskun County, the settlements of Baja and Sükösd are included in the zone of geological hazard.

According to the Spatial Plan of Tolna County, the areas of Dunaföldvár, Bölcske, Madocsa, Paks, Dunaszentgyörgy, Őcsény, Decs, Báta are included in the zone of geological hazard.

In Baranya County, two settlements along the Danube are at risk of geological movements.

The Danube bank is an active mobile area located on the banks of the Danube, and is to be treated as a geological hazard area. In the National Surface Movement Register and in the records summarising gravitational mass movements available to the Mining Inspectorate, there are several movement sites that have occurred in the last decades in the administrative area of Dunaszekcső.Although the settlement is located in an area with a risk of sliding (collapse, sliding, collapse), it ends with a high bank along the Danube.

Based on the National Surface Movement Cadastre prepared by the Hungarian Mining and Geological Survey, an interactive map of the hazardous areas of Hungary has been produced. Based on the map, the following movement events and locations are generally located directly along the Danube:

- Zebegény: landslides, landslides in slices,
- Nagymaros: stone river, underwater area,
- Visegrad: collapse,
- Verőce: landslide in slices
- Vác: landslide in slices,
- Bp. III. district, XXII. district: layer slippage,
- Bp. XXIII. district: suvadás,
- Százhalombatta: collapse,
- Ercsi: loosening, underpaved area,
- Rácalmás: sliced landslides, creep, slumping, loosening,
- Dunaújváros: crumbling, collapsing, sliver landslides, rockslides,
- Dunaföldvár: collapse, landslide in slices,

- Paks: frenzy,
- Bata: collapse,
- Danube sedimentation: collapse, bed sliding, bank sliding, creep.

In 2008, the Ministry of National Development and Economy prepared a document entitled The Domestic and International Dimensions of Tourism along the Danube, which included a study of the areas of risk along the Danube. According to the document, on the section between Szob and Budapest, there are high risk areas in the settlements of Szob, Zebegény, Verőce, Nagymaros, Visegrád, Tahitótfalu, and on the section between Budapest and Dunaföldvár, there are high risk areas in the settlements of Érd, Ercsi, Kulcs, Rácalmás, Dunaújváros, Dunaföldvár. On the stretch of the Danube between Dunaföldvár and Mohács, high banks are dangerous for movement in parts of the municipalities of Bölcske, Paks, Szekszárd, Várdomb, Báta, Dunaszekcső, Baja.

According to the current register of mining areas published by the Hungarian Mining and Geological Survey, the following mining sites are located in the Danube and its ~1 km coastal strip.

24. Table 1:Mining sites in the study area

Name of mine sites	Name of the mining contractor (beneficiary)	Mineral raw material	Status of
Zebegény I.	Malomhegyi Limestone Mining Processing and Trading Ltd.	limestone	operating
Little Rose I.	PUSCHO Trade and Service Ltd.	gravel	operating
Dunabogdány I.	Basalt-Középkő Kőbányák Kft.	andesite, clay	operating
Vác IV.	K.K.H. Bányaművelési Kereskedelmi és Szolgáltató Kft.	sand, gravel	intermittent
Iváncsa I.	sole trader	gravel	operating
Szalkszentmárton III.	RUTUR Mining and Trading Ltd.	sand, gravel, mixed minerals II.	operating
Szalkszentmárton IV.	RUTUR Mining and Trading Ltd.	sand, gravel	operating
Szalkszentmárton II*	KAVICS-KER Trade and Service Ltd.	gravel	operating
Solt II.	Soltút Road Construction, Maintenance and Trade Ltd.	sand	operating

* directly on waterfront mining sites

3.3. SOIL TYPES

The soil types concerned are characterised on the basis of literature data and agrotopographic maps. The soil value index expresses the natural fertility of different soils as a percentage of the fertility of the most fertile soil. The table below summarises which soil types are affected by the Danube, based on the agrotopographic map of Hungary.

25.Table 1:Soil types affected by the Danube

Soil type	Soil-forming rock	Physical soil type	Soil value number [%]	Soil thickness [cm]	Length of the Danube on the given soil type [m]
Quicksand	Glacial and alluvial sediments	Sand	10 - 0	> 100	~5014
Young, raw casting soils	Glacial and alluvial sediments	Sandy loam	40 - 30	> 100	~29035
Réti soils	Glacial and alluvial sediments	Agyag	60 - 50	> 100	~4292

Soil type	Soil-forming rock	Physical soil type	Soil value number [%]	Soil thickness [cm]	Length of the Danube on the given soil type [m]
Young, raw casting soils	Glacial and alluvial sediments	Sandy loam	30 - 20	> 100	~1330
Sandy soils with humus	Glacial and alluvial sediments	Sand	30 - 20	> 100	~2207
Young, raw casting soils	Glacial and alluvial sediments	Sandy loam	30 - 20	> 100	~8158
BUDAPEST	-	-	-	-	~27256
Young, raw casting soils	Glacial and alluvial sediments	Sand	30 - 20	> 100	~30845
Réti foundry soils	Glacial and alluvial sediments	Sandy loam	50 - 40	> 100	~3990
Young, raw casting soils	Glacial and alluvial sediments	Sandy loam	40 - 30	> 100	~4260
Réti chernozjomok	Loose sediments	Trough	70 - 60	> 100	~12724
Sandy soils with humus	Glacial and alluvial sediments	Sand	30 - 20	> 100	~8126
Calcareous chernozem sands	Loose sediments	Trough	80 - 70	> 100	~1578
Réti foundry soils	Glacial and alluvial sediments	Trough	50 - 40	> 100	~58347
Calcareous chernozem sands	Loose sediments	Sandy loam	80 - 70	> 100	~3014
Young, raw casting soils	Glacial and alluvial sediments	Trough	80 - 70	> 100	~10020
Réti foundry soils	Glacial and alluvial sediments	Sandy loam	40 - 30	> 100	~5517
Réti foundry soils	Glacial and alluvial sediments	Trough	50 - 40	> 100	~6598
Réti soils	Glacial and alluvial sediments	Trough	60 - 50	> 100	~4186
Réti foundry soils	Glacial and alluvial sediments	Clay-clay loam	60 - 50	> 100	~9439
Réti foundry soils	Glacial and alluvial sediments	Trough	50 - 40	> 100	~3979
Young, raw casting soils	Glacial and alluvial sediments	Trough	30 - 20	> 100	~28130
Réti foundry soils	Glacial and alluvial sediments	Clay-clay loam	60 - 50	> 100	~6832

As can be seen from the above, the presence of the Danube has a strong influence on the landscape, as the soil is built up by different river sediments and soil types that develop along rivers. This is supported by the literature, which shows that the landscape is characterised by soils formed on sediments of the Danube of different ages and of different types. The soils formed on calcareous castings are chernozem in nature at higher altitudes, because the soil-forming rocks are loess silt and are only slightly affected by water. These casting chernozems can be found both on the higher parts of Szentendrei Island and Csepel Island and on the higher river terraces along the Danube, such as Dömsöd, Szekszárd and Mohács. The lower-lying plains, built up from younger casts, are characterised by humic and meadow cast soils, which are replaced towards the D by meadow soils of increasingly clayey origin. In the old river basins, a band of saline saline soils, characterised by solonics and solonics-solonyec soils, extends along the K edge of the landscape, due to the high salinity of the groundwater near the surface and to surface evaporation. Such an area is known on the border of Apaj-puszta. The salinisation becomes less pronounced in the southern parts of the landscape, and then the marshy soils appear along the eastern margins. This is the case of the Kalocsai vörös mocsár. It should be stressed that the landscape only acquired its present appearance after the river was regulated, freeing it from the annual flooding.

These sections are dominated by soils of less than medium (<50%) soil value, but there are also areas with better than medium (>50%) soil value and areas with high (80-70%) soil value (Literature data: Stefanovits P. - Filep Gy. - Füleky Gy. - 1990. Talajtan. (Stefan-Pycky, Stefan-Pycky, Stefan-Pycky, F. F. F. F., Stefan-Pycky, F. F.)

3.4. CHARACTERISATION OF THE MEDITERRANEAN SECTION

3.4.1. MEDIA

In the section below Szob, the Danube bed is **sandy-gravelly** with continuously rising sand fractions, so the formation of the bank armour is less typical here than in the upper Hungarian section of the river. Thanks to the more easily mobilised bed material, the river is able to deepen the bed, but in many places this granular material has been completely washed away and lower, more resistant layers, e.g. marl layers, have emerged (e.g. Göd, Dunaföldvár). In this stretch of the Danube, however, there are several **gas scour thresholds** that can be considered as stable, e.g. at Dömös (~1701 fkm), Nagymaros (~1684 fkm), Budafok (~1638 fkm), Dunaújváros (~1587 fkm) and Barakka (~1523 fkm), which do not show any significant wear in terms of long-term bed changes. The material of the gas beds here is not granular, but **rocky and marly, which is** less responsive to flow conditions and their possible changes. The role of the fords is important at low water, as they act as a natural dam to raise water levels towards the upstream water level, thus creating more favourable navigation conditions.

The phenomenon of **bank armouring** can greatly influence the character of the rolling sediment transport in gravel and sand-gravel-bed rivers. Bed armouring is a selective erosion process as smaller particles wash out from larger ones to form a stable surface. This armour will not move until a tidal wave arrives to break it. When this happens, a drastic change in sediment yield occurs.

Mederpáncél on the Danube

There is no available river basin sampling data for the Danube that can be used to identify armour-affected sections of the river, but their estimated locations are described using the following approach.

Features indicating armoured basin sections:

- sections with a stable river bed,
- higher than average flow velocity and bottom-slip stress sections,
- gravel, sandy gravel (no bank armour can form in a fine gravel, sandy bed).

In the sections where all the above conditions are met simultaneously, it is assumed that there is a bankfull, but it is important to note that the approach used did not take into account that in some sections there is no or very little granular sediment on the bed bottom because the lower layers of the bedrock have emerged.

The potentially armoured sections of the basin between the Saba-South border are:

26. Table 1:Potentially armoured sections of the basin between Siófok and the southern border

From Danube fkm	Up to Danube fkm	The affected commune along the Danube
1696,5	1695,5	Visegrad
1682	1679,5	Vác
1671	1669	Göd
1652	1643	Budapest (between Margaret Island North and Rákóczi F. Bridge II)
1641	1637	Budapest (districts XI and XXII)
1624	1615	Tököl, Százhalombatta, Szigetcsép, Ercsi
1592	1589	Makado, Key
1583	1579	Rácalmás, Dunaújváros, Tass, Szalkszentmárton
1570	1562	Kiaspostag, Apostag, Dunaföldvár, Baracs, Dunaegyháza, Solt
1560	1551	Dunaföldvár, Bölcske, Solt
1541	1539	Madocsa, Dunapataj, Ordas
1532,5	1531,5	Paks, Dunaszentbenedek

No bank armour is formed in the fine gravel and sand sections of the Danube, so we assumed, based on our knowledge of the grain composition of the Danube bed material, that no bank armour is expected to form from 1530 fkm downstream.

3.4.2. SECTION TITLE

Between Esztergom and Visegrád, the Danube flows through a narrow, mountainous area. The constriction starts at the Garam gates and the actual breakthrough is at Dömös. In this section, the Danube makes a characteristic bend with insignificant bank falls. **After Visegrád** the river slows down and the Danube splits into two branches, the Váci branch and the Szentendrei-Duna branch. The Danube regains its character as a middle section only below Szentendrei Island in **Budapest, which it** retains until the southern border.

Leaving Budapest, but already partly within the capital, the river enters the Danube basin. With its lateral erosion, it washes away the loess slabs of the Mezőföld as far as Paks. As a result, the river is constantly shifting westwards. The underflow also causes large bank slides and swamps (e.g. in the Ercsi area).

The section between Dunaföldvár and the southern border can be divided into two distinctive parts. The upper part, which starts from Budapest and continues to Paks, is a section with a typically stable bed, prone to island formation and widening in its natural state. The section from Paks to the mouth of the Dráva is a typically meandering section, with only a short stretch between Báta and Mohács, where the Danube is confined to the western loess wall or high bank.

3.4.3. SEDIMENT BALANCE, BED MORPHOLOGY

After Visegrád, the river slows down and dumps some of its sediment, creating the **Szentendrei** and **Csepel islands** and the many smaller islands in between. The deeper Váci branch carries most of the water (about 70% of the volume of the middle water flowing through at Nagymaros), the main bed, which is 450-500 m wide. The 100-150 m wide Szentendrei-Dunaág currently drains less than 30% of the mean flow at Nagymaros and is expected to decrease in the future due to the silting up of the island head, if no human intervention is undertaken. In the Budapest section, sediment deposition also continues, as indicated by three major islands (**Margaret Island, Óbudai Island and Népsziget**) in the capital. In **Budapest, the** embankments between the embankments protecting the banks from lateral erosion are cutting very deep in places. The width of the basin varies between 350 and 500 m in the capital, although the narrowest and deepest section in front of Gellért Hill is only 270 m wide, but depending on the water level, the basin has a depth of 10-15 m to drain the water.

Below Budapest, along the **right bank of the** Danube, there are high, mainly loess banks, with minor interruptions. This section would be prone to island formation and widening due to its relatively low gradient and speed, which were taken into account in the 19th and 20th century regulations. The primary purpose of the regulation of the Danube between 1640 and 1560 km-1, as well as the entire stretch between the southern border of Budapest and the Danube, was to facilitate ice drainage and to relieve the left bank and, in part, the right bank of the Danube from flooding. The provision of navigation on this stretch was of secondary importance, and the regulation of the river to ensure uninterrupted ice clearance also served to improve navigation conditions (parameters). With this objective in mind, the river regulators considered the correct alignment of the riverbed, the improvement of the bends, the creation of a uniform main bed and the maintenance of the regulatory coastlines as their primary tasks. Each of these principles and control devices (guide, bank protection, cross barrier) is applied to a section of river. In this section, particular attention should be drawn to the regulation of the stretches of river bed prone to ice drift and ice drift in the recent past.

On the left bank, the Danube is accompanied by a 20-30 km wide floodplain, which was regularly flooded by the river before the regulations. As the river reaches the Great Plain, sedimentation continues, creating the largest island in the Hungarian stretch of the Danube, the 55 km long **Csepel Island.** The island caused the water to be divided between the Budafoki and Sorkosári branches, forcing the river to fill up. Today, however, the Soroksári-Dunaág can be regarded as almost stagnant water with a completely artificially controlled flow, instead of the one-third share it used to have, and therefore almost the entire volume of the water mass transported by the Danube is shaping and eroding the bed of the Budafoki branch.

The **island of Csepel is** thus separated from the northern part of the young depression of the Central Danube Valley, the Csepel plain, by the 58 km long Ráckeve (Soroksári)-Dunaág. The geological structure of the area is dominated by Quaternary sediments. Accordingly, along the Soroksári-Dunaág, there are alluvial sand of reef character deposited during the glacial period, alluvial clay-sand sequences, sandy layer groups of former interbeds and young Holocene alluvial clay, clayey aleurite, casting silt, with a patchy surface distribution. The bed of the Soroksár-Dunaág was formed in these loose, loose, mostly fine-grained sediments.

3.4.4. MEDERMORPHOLOGICAL CHANGES

Based on the data of the river bed surveys carried out in 1996, 2004, 2013 and 2016, it can be seen that in the period 1996-2004, bed deepening was observed in almost the entire stretch of the river. After 2013, a generally stable bed morphology is observed.

Volume changes show that the trend of bed deepening in the Danube below the Sób has decreased or even stopped in the recent period, and the river bed has reached a new equilibrium state. However, when drawing long-term conclusions, it is important to bear in mind that both the basic data and the method of analysis are subject to uncertainties.

In the following, the individual intervention sites are presented based on the river basin surveys of previous years:

The *Dömös-Visegrád section* (1704-1694 km) includes the Dömös upper gas locks and constriction (1701.2-1700.6 km), the Dömös gas locks (1698.7-1697.7 km), the Nagymaros gas locks (1695.8-1695.4 km) and the Visegrád gas locks (1695.1-1694.5 km). The width of the Dömös constriction is about 80 m, where a small amount of alluvial deposits were formed between 2004 and 2013. Due to the rocky bed, this phenomenon is either a temporary deposition, e.g. caused by the 2013 flood, or a bed survey error. No changes in the bed are visible in the period 2013-2016.

Based on the riverbed surveys, this area showed a slight deepening after 2004, followed by a stable riverbed in the period 2013-2016.

The *Vác section* (1683-1679 fkm) includes the Vác-upper constriction (1682.8-1682.3 fkm) and the Vác constriction (1681.0-1679.8 fkm). The section between 1682-1681 fkm in the region has experienced a drop in the waterway bed of decimetres between 2004 and 2013, after which the bed is considered stable. **Depth problems occur only in small patches** mainly in the vicinity of 1679.5 fkm.

The *Sződligeti* constriction (1675.5-1673.0 fkm) is located *on the* Sződligeti *section* (1677-1674 fkm). The constriction is about 200 m long and 90 m wide. Between 2004 and 2013, localised shoreline realignment was observed on this stretch, which did not change the basic parameters of the fairway. In the period 2013-2016, however, a permanent rise in the water level was observed, in the order of 10-20 cm, which led to a deterioration of navigation conditions.

The *Gödi section* (1669-1666 fkm) includes the Gödi gas horizon (1667.8-1666.4fkm). The ford is located in the middle of the riverbed. According to geophysical surveys, erodible, granular sediment is no longer present in the waterway in the section 1667-1668 fkm. The bed in this section has been stable in recent years, with a slight deepening of around 10 cm in places.

In the vicinity of the Árpád Bridge (1653-1650 fkm) is the Árpád-Híd gas horse (1653.0-1651.3fkm). In the period 2004-2013, a few decimetres of sediment deposition were observed in the section 1652.5-1652 fkm (below which there is a data gap), while no changes in the bedform were detected after 2013. The fairway is divided into two branches here, with **patchy areas of depth deficit in** both stretches.

In the vicinity of Budafok (1639.5-1636.5 fkm) is the Budafok gas horse (1638.6-1637.1fkm). The shape of the riverbed changed slightly between 2004 and 2013, with both depositional and subsiding patches, although overall there was a rise in the riverbed of the order of decimetres during this period. There was no detectable change in bedforms after 2013. Local deepening in the early 1980s temporarily improved the navigability of the ford during the low water period. However, according to the current bankfull and low water level calculations, coherent depth deficit sections are still visible. The bed material is limestone, according to previous studies, and it is important to note that**, due to the unknown composition of the lower layers, a detailed physical study is needed to estimate the change in the bed due to the interventions.A detailed geophysical study is currently underway in this section, the results of which will determine the type of intervention.**

The Százhalombatta constriction (1623.7-1622.5fkm) and the Dunafüred constriction (1619.1-1618.2fkm) are located *in the vicinity of Százhalombatta* (1624-1617.5fkm). Both problematic sections are caused by **sediment deposition in the middle of the riverbed**, which causes the waterway to narrow near the right and then near the left bank. In the period 2004-2013, a bed deepening of the order of decimetres occurred mainly between 1622-1620 fkm around the river's centre line. However, in the constriction areas, rather small deposition is observed during this period.

In the vicinity of Ercsi (1618.5-1614.5 fkm) is the Ercsi constriction (1616.7-1615.3fkm). In the area of the constriction, the bed was previously controlled by two right bank spurs, but despite this, in the period 2004-2013, sedimentation developed in the shipping lane on the downstream side of the constriction, resulting in a small but narrow area in the vicinity of 1615 fkm (Ercsi-lower constriction - 1615.6-1615.3 fkm). No significant changes in the basin are visible after 2013.

In its key area (1592.5-1589.5 fkm) is the Kulcsi constriction (1591.8-1591.3 fkm), followed by the gas horse (1590.5-1590.1 fkm). In this area, which is located on an inflection section, the riverbed shape is considered stable, with a deepening of the order of decimetres having been recorded in the post-2013 period. **Depth and width deficit zones nevertheless persisted around 1591.8 fkm and 1590.5 fkm.**

The Dunaújváros constriction (1582.7-1579.9 km) is located *in the vicinity of Dunaújváros (*1583-1579.9 km), at the apex of a slight left bend in the Danube. The river basin maps **show a** deepening of the river bed on the order of decimetres, but in some places, **patchy deposition of eroded material**, which has not improved navigation conditions in recent decades. Due to the dynamic nature of bed changes, areas of depth deficits occur in some places, the location of which is likely to be constantly changing.

The Baracsis constriction (1569.8 - 1569.0 fkm) and the Kisapostagi constriction (1567.3 - 1566.2 fkm) are located *in the area of the Kisapostagi* (1570.5 - 1565.5 fkm). The alignment of the Danube here is characterised by a slight left bend, but due to the significant variation in the bend along its length, significant sedimentation has developed in the middle bed, which in the **case of the Kisapostag ford shows water depths below 2.5 m in the low water navigable condition over an area of a few hundred metres**. This section is also characterised by a dynamic morphology, with both deepening and rising zones. After 2013, deepening is more dominant, especially in the shipping lane area.

3.4.5. DISTRIBUTION OF SEDIMENT

The riverbed composition of the Danube stretch between Szob and the southern border is continuously changing **from a** predominantly **sandy-gravel riverbed to a** pure **sand riverbed**. Based on the results of sediment sampling carried out in the last decades, it can be observed that the average grain diameter from Szob to Paks (~1530 fkm) varies between 0.5-30 mm, with significant variations in magnitude along the length. The large variability indicates different sediment composition in the drift line, ford and nearshore bands. In the driftline, due to the higher flow velocities, higher bottom-slip stress values and the resulting higher sediment transport force, coarser fractions tend to be present, while in the nearshore bands and in the dead flow spaces between the river control works, fine fractions can persist, e.g. in the area between the spurs in the area of Sződliget, the area between the spurs is represented by samples with fine sand fractions. In the section below Paks, a continuously refining bed material is visible, in which sand and gravel fractions are still present, but with increasing sand content. In the Baja area and downstream, only sand is present in the bed.

In contrast to the Upper-Hungarian Danube, the **phenomenon of bank armouring is becoming less and less common in the** riverbed due to the decreasing gravel and increasing sand content. The geophysical surveys carried out in the framework of the project have shown that the bed with a mobile granular structure has in many places been completely eroded and that the lower layers of different materials (marl, limestone, sandstone) have emerged, which have quite different soil mechanical properties compared to the granular material.

3.4.6. SEDIMENT QUALITY

For many hazardous substances, their physico-chemical properties are such that they can be expected to bind to the surface of solid particles and, over time, settle out and appear in river sediments. That is, they may accumulate in river sediments.

No domestic sediment monitoring results are available, but large-scale water quality surveys were carried out in 2001, 2007 and 2013 on the Danube and its major tributaries as part of the JointDanubeSurvey 1-2-3 (JDS1-2-3) monitoring programmes organised by ICPDR. The assessment relies mainly on the results of JDS-2, as it has been almost 20 years since JDS-1 and JDS-3 was carried out shortly after the Great Danube Flood of 2013 and is therefore not representative.

The data show that the inorganic micropollutants in the sediments are dominated by copper, arsenic and lead. Cadmium, chromium, zinc and nickel are significant. Mercury approached the target value at some points. Among the organic pollutants, petroleum derivatives (and PAHs) are considered to be one of the most common and abundant substances present in sediments in measurable quantities; an increasing trend was observed in the Slovak-Hungarian border section during the JDS programme. These substances can accumulate in sediments due to their chemical properties, but their density is lower than that of water. Organotin compounds are surface-coating biocidal chemicals derived from antifouling paint used on hulls and nets to prevent algae, molluscs or other organisms from attaching to the hull. It can be said that these organotin compounds are also present in the sediment in quantities exceeding the recommended limits. They pose a risk to sediment dwellers and aquatic resources because of their easy solubility. Most of the pesticides were not measured in sediments because they are highly soluble and are expected to be less able to accumulate in sediments. Dioxins and dioxin-like compounds are detectable in sediment, but their actual hazardousness cannot be assessed at this stage due to the lack of a target value. Little is known about other pollutants in sediment (e.g. pharmaceutical residues, hormones, microplastics) in the Danube.

Based on the above, the likely contamination of the sediment could potentially pose a threat to sediment-dwelling organisms and coastal filtered aquifers. However, in Hungary there is no valid limit value for the concentration of hazardous substances in sediments, so for the time being we can only use the recommendations of EU studies (as so-called target values), which have been established for the protection of sediment-dwelling organisms. According to national practice, pollutants are considered relevant if their concentrations exceed 50% of the limit/target value, even if only periodically.

Sources used in chapter 3:

- The publication "Cadastre of small lakes of Hungary" published by the Institute of Geography of the Hungarian Academy of Sciences in 2010,
- Maps of the Hungarian Mining and Geological Survey: https://map.mbfsz.gov.hu/ and the register of mining areas: https://mbfsz.gov.hu/hatosagi-ugyek/nyilvantartasok/banyaszati-teruletek,
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- National River Basin Management Plan (2016):
  - 1-1 Szigetköz Sub-region Watershed Management Plan,
  - 1-5 Lake Bakony and Concó Basin Watershed Management Plan,
  - 1-6 River Basin Management Plan for the sub-region of Által-ér,
  - 1-7 Gerecse Sub-unit Watershed Management Plan,
  - 1-9 River Basin Management Plan for the Central Danube Sub-region,
  - 1-10 River Basin Management Plan for the Danube Valley Main Canal Sub-unit,
  - 1-11 River Basin Management Plan for the Sió Sub-region,
  - 1-15 River Basin Management Plan for the Lower Danube, right bank Sub-unit,
  - 1-16 Watershed Management Plan for the Upper Bačka Sub-region.
- A study commissioned by the Ministry of National Development and Economy, Regional Development Department, and carried out in 2008 by the Hungarian Regional Development and Urbanistic Public Benefit Society VÁTI and the Institute of Sciences of the Hungarian Academy of Sciences, West-Hungary, entitled "*The domestic and international dimensions of tourism along the Danube*".
- Water Geoinformatics Portal atlas collection: https://geoportal.vizugy.hu/atlasz/,
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- Great Lakes Basin Management Plans (2014):
  - North Transdanubian Water Management Directorate:
    - Danube 1729,35 - 1699,50 fkm, 01.NMT.04.
    - Danube 1786,00 - 1729,35 fkm, 01.NMT.03.
    - Danube 1809,76 - 1786,00 fkm, 01.NMT.02.
    - Danube 1850,20 - 1809,76 fkm, State border - Mineral barrier - Győrzámoly, 01.NMT.01.
  - Central Danube Valley Water Management Directorate:

- Ipoly estuary on the left bank of the Danube, the suburban boundary of Dömös on the right bank of the Danube (1708+200 fkm) - the northern administrative boundary of Budapest (1660+600 fkm), 02.NMT.01,
- Budapest North [1660+600 fkm] - Budapest South [1628+450 fkm] Budapest,
- Southern administrative boundary of Budapest [1628+450 fkm] - section between Tassi-zsilip (1586+000 fkm), 02.NMT.02,
- Section between Tassi-zsilip (1586+000 fkm) - Dunaföldvár [1560+600 fkm], 02.NMT.03,
- Section between Kitorkollás (Visegrád) [32+000 fkm] - Budapest's administrative boundary [02+300 fkm], 02.NMT.04.

• Lower Danube Valley Water Management Directorate:
  - The section of the Danube between Dunafalva and the southern border, 03.NMT.04.

– GEOMEGA Geological and Environmental Research and Service Ltd. (July 2019) "Seismic survey of the Danube gas fields of százhalombatta, dunaföldvár, göd and gönyű" research report,
– GEOMEGA Geological and Environmental Research and Service Ltd. (January 2020) "Preliminary expert opinion on the bed conditions and the sedimentary and stratigraphic structure of the Danube in the Dömös and Budafok gas portions of the Danube",
– Katalin Mária Dudás, Tamás Nagy (January 2020) "*Hazardous substances in the Danube sediments*",
– County Land Use Plans.

4. AIR QUALITY

The air environment characteristics of the study area are described by characterising the available immission data (data from the National Air Pollution Monitoring Network (OLM)) and the main emissions (data from the National Environmental Information System Air Pollution Information System).

4.1. CURRENT MISSION SITUATION

According to the Decree 4/2002 (X. 7.) of the Ministry of Transport and Urban Development designating 1 air pollution agglomeration (zone 1: Budapest and its surroundings) and 10 air pollution zones, the settlements between Vác and Százhalombatta[7] are in zone 1 (Budapest and its surroundings), Dunaújváros and Baracs, Dunavecse, Kisapostag in zone 5 (Budapest and its surroundings). Baja as one of the designated cities belongs to zone 11, the other municipalities to zone 10 (the rest of the country - except for some cities), within which the individual priority air pollutants belong to the following zone groups.

27. Table 1:Air pollution zones concerned

Group code	Zone 1	Zone 5	Zone 10	Zone 11
Group F, i.e. an area where air pollution levels do not exceed the lower assessment threshold	PM10 arsenic, PM10 cadmium, PM10 nickel, PM10 lead	For sulphur dioxide, benzene	for sulphur dioxide, nitrogen dioxide, carbon monoxide, benzene, PM10 arsenic, PM10 cadmium, PM10 nickel, PM10 lead	Sulphur dioxide, carbon monoxide, benzene, PM10 nickel, PM10 lead
Group C, where the air pollution level is between the relevant limit value and the tolerance limit.	- –	For nitrogen dioxide	- –	- –
O-I group, i.e. where the concentrationexceeds steel value	For ground-level ozone			
Group B, where air pollution levels exceed the relevant limit value and tolerance limit.	Nitrogen dioxide, PM10, PM10 - in terms of benz(a)pyrene	for PM10 arsenic, PM10 cadmium, PM10 lead	- –	in relation to PM10
Group E, where the air pollution level is between the upper and lower assessment	For benzene and sulphur dioxide	- –	in relation to PM10	PM10 for arsenic, PM10 for cadmium

7 Vác, Tahitótfalu, Pócsmegyer. Sződliget, Göd, Szigetmonostor, Dunakeszi, Budapest, Érd, Szigetszentmiklós, Halásztelek, Tököl, Százhalombatta

thresholds				
Group D, where the air pollution level is between the upper assessment threshold and the limit value for the air pollution level	For carbon monoxide	for carbon monoxide , PM10, PM10-arsenic, PM10-nickel, PM10 - benz(a)-pyrene	PM10 - for benz(a)pyrene	Nitrogen dioxide, PM10 - for benz(a)pyrene

The air pollution zone designation indicates that problems are typically found for particulate matter (PM10), nitrogen dioxide and ground-level ozone[8]. However, this picture is nuanced by examining the actual measurement results.

Of the surveyed settlements, the manual monitoring stations belonging to the National Air Pollution Monitoring Network are located in Visegrád, Vác, Budapest, Dunaújváros, Dunaföldvár, Paks, Kalocsa, Baja and Mohács. There is an automatic monitoring point in Vác, 7 sites in Budapest (among the districts concerned), 3 sites in Tököl, Százhalombatta and Dunaújváros. In addition, temporary measurements are occasionally carried out: 4 municipalities are also sampled in the framework of the OLM's annual PM10 and $PM2_{.5}$ sampling programme (4*2 week series). The results of the last year are summarised in the table below.

28. Table 3:Evolution of air pollution indices based on measurements in the sampled settlements in 2018

Manual measuring stations	NO2	SO2	settling powder
Vác	corresponding to	-	-
Visegrad	excellent	-	-
Budapest	polluted	-	-
Dunaújváros	good	-	-
Dunaföldvár	-	-	corresponding to
Paks	-	-	corresponding to
Kalocsa	excellent	-	-
Mohács	good	-	-
Baja	good	-	good

Automatic measuring stations	SO2	NO2	NOx	PM10	$PM2_{.5}$	Benzene	CO	O3
Vác	*	good	good	good	-	*	excellent	good
Budapest, Káposztásmegyer	excellent	*	*	good	-	-	excellent	good
Budapest, Honvéd	-	*	*	good	*	-	excellent	good

[8] It is formed from the precursors of ground-level ozone (nitrogen oxides, volatile organic compounds, carbon monoxide, methane) by UV radiation far from the point of emission.

Budapest, Széna Square	excellent	polluted	polluted	polluted	good	excellent	excellent	
Budapest, Erzsébet Square	-	good	polluted	good	*	*	excellent	-
Budapest, Kosztolányi D. Square	-	corresponding to	corresponding to	good	-	-	excellent	good
Budapest, Budatétény	-	*	*	good	good	-	excellent	good
Budapest, Csepel	excellent	*	*	corresponding to	-	*	excellent	good
Cologne	excellent	good	good	good	-	*	*	good
Százhalombatta, Búzavirág Square	excellent	excellent	excellent	good	good	excellent	excellent	good
Százhalombatta, Sports field	*	*	*	good	-	-	*	-
Százhalombatta, Liszt Ferenc promenade	excellent	good	excellent	good	-	*	excellent	good
Dunaújváros	excellent	good	good	good	good	excellent	excellent	good

**not enough data for evaluation*

Measuring points of the stationary dust sampling programme	PM10	PM2.5	PM10-Arsenic	PM10 cadmium	PM10 nickel	PM10 - Lead	PM10 Benz-a-pyrene
Budapest, Széna Square	good	-	excellent	excellent	excellent	excellent	good
Százhalombatta	good	-	excellent	excellent	excellent	excellent	good
Szigetújfalu	good	-	-	-	-	-	-
Dunaújváros	good	-	excellent	excellent	excellent	excellent	good

Nitrous oxides (the greenhouse gas nitrous oxide) are also linked to photochemical (Los Angeles-type) smog, acid rain and ground-level ozone formation, nitrogen monoxide and nitrogen dioxide), limit value nitrogen dioxide exceedances were recorded at 14 automatic stations in Vác, 42-42 in Erzsébet tér and Kosztolányi tér, 155 in Széna tér, 1 in Tököl and 22 in Dunaújváros during 2018. Daily exceedances were recorded at Kosztolányi and Erzsébet (1-1) and Széna tér (2), and annual exceedances were also recorded at Széna tér. Among the manual monitoring points, there were 273 exceedances at 12 monitoring points in Baja, 10 in Budapest, 3 in Dunaújváros and 5 in Vác (and none in Mohács and Visegrád), and, with the exception of Budapest, Vác and Visegrád, which are located in the uppermost part of Section II, the average annual concentration has been increasing in recent years.

The eight-hour daily maximum for ozone was exceeded 13 times in Vác, 36 times in Tököl, 67 times in Százhalombatta and 34 times in Budapest, and 24 times in Budatétény, 10 times in Csepel and 20 times in Káposztásmegyer, while the maximum daily limit was not exceeded once in Dunaújváros and the other monitoring stations in the capital. In Káposztásmegyer and Százhalombatta, the information threshold was exceeded on 1 occasion at Búzavirág tér.

For the volatile organic compounds benzene, 10 concentrations above the 24-hour limit were measured in Dunaújváros.

There were also exceedances of the daily limit value for particulate matter not exceeding 10 micrometres: 44 of the automatic measuring stations in Vác, 27 in Káposztásmegyer, 91 in Széna tér, 6 in Honvéd and 6 in Kosztolányi Dezső tér: 6, Budatétény: 17, Csepel: 50, Erzsébet tér: 28, Tököl 33, Százhalombatta 2, 24 and 16, Dunaújváros 56 days (allowed: 35). In Vác 6, in Budapest Káposztásmegyer 3, Erzsébet tér 1, Széna tér 17, Kosztolányi 3, Budatétény 2, Csepel 10, Tököl 3, Százhalombatta 0 and 1-1, Dunaújváros 9 times the information threshold was exceeded. However, the annual average concentration exceeds the annual limit value only at one monitoring station (Budapest, Széna tér). The concentration of particulate matter ($PM2_{.5)}$ of a size not exceeding 2.5 micrometres in diameter, which is even more dangerous to health, did not exceed the limit value.

Regarding the benz-a-pyrene measured on particulate matter samples, 13 exceedances of the limit value occurred in Budapest at Széna tér and 8 in Dunaújváros in the 2018 series of measurements, and although the average concentration calculated from the results of the 4*2-week measurements remained below the annual permissible value for particulate matter, the maximum measured concentration exceeded the 24-hour health limit value (which can be exceeded 35 times a year) (Széna tér: 67.6, Szigetújfalu: 54.7, Százhalombatta: 64.5, Dunaújváros: 141.7 µg/m3).

The concentrations of particulate matter, which are no longer controlled by health limits, have been increasing in all three locations in recent years.

Concentrations of acidifying sulphur dioxide and London-type smog-inducing sulphur dioxide are, as in almost all but one case in the country, typically low, well below the relevant limit values, in line with the dramatic reduction in emissions since 1990. Concentrations of the highly toxic and ozone precursor carbon monoxide are also low, typically well below the relevant limit values at monitoring points.

The presence of forests in the Danube floodplain is beneficial for air pollutant concentrations.

4.2. CURRENT EMISSIONS IN THE AREA

4.2.1. INDUSTRIAL EMISSIONS

Along the Danube (often directly on or near the bank, see e.g. Dunaújváros, Százhalombatta) there are a number of economic and industrial areas. In addition to Budapest, Vác, Százhalombatta, Dunaújváros, Dunakeszi, Szigetszentmiklós, Dunaföldvár, Solt, Foktő, Baja and Mohács are worth highlighting.

Notifiable emitters also emit significant amounts of nitrogen oxides, particulate matter, carbon monoxide and organic compounds in the area, as well as carbon dioxide (and other greenhouse gases) that are not regulated by limits. (Nationally, the energy industry is responsible for more than a quarter of gross carbon dioxide emissions (27.9% in 2017), and industry for a further 17.8% (2017 data). The energy industry is also responsible for more than one-tenth of total nitrogen oxide emissions nationwide (10.9% in 2017) and 42.9% of the low overall sulfur dioxide emissions.)

Some of the major air pollutant emitters in the surveyed municipalities:

- In Vác, the cement factory, printing press, heating plant,
- The steel structure factory in Göd,
- In Dunakeszi, the lamp factory, the asphalt mixer,
- The small power plant in Szentendre,
- the brickworks and the heating plant and the cogeneration plant in District III,
- in District IV, in addition to the power plant, there is, for example, the iron foundry, the heating plant, the waste water treatment plant, the plastics plant, the light source factory,
- asphalt mixer, plastic processor in the IX district,
- power plant, laundry in the XI district,

- in the XXI district, a power plant, an aluminium foundry, a printing works, a sewage treatment plant,
- The insulation material factory and the gas engine in Szigetszentmiklós,
- The refinery in Százhalombatta,
- The tyre factory in Rácalmás,
- And in Dunaújváros, there is an ironworks, a cold rolling mill, a coking plant, a power plant, a gas-fired heating plant, a pulp mill, a paper mill, a hot-dip galvanizing plant, a malt works,
- In Dunaföldvár the bioethanol plant, the rubber products plant,
- The biogas plant and protein processor in Sol.

South of Dunaföldvar, the county town of Baja and Mohács are the main industrial emitters. In view of the favourable agricultural potential of the area, light industry, including the food industry, is the dominant industry in the area. The main air pollutant emitters in Mohács are the furniture factory, the fibreboard factory, the iron foundry, the aluminium foundry, the mill, the port, the gas-fired heating plant and the bio-heating plant, the gas transmission plant, the paper mill, the drying plant. Baja, an important commercial centre (grain distribution, Pick packing plant and logistics warehouse), has the highest number of emitters (33), but their emissions are less significant. The asphalt mixing plant, the gas engine power plant, the Pick Ltd. plant, the crop loading port, the district heating supplier, a warehouse, a metalworking plant, a milling plant and a carpentry plant are notable. In addition to these, the vegetable oil plant in Fokto is worth mentioning, and in Paks (where emissions are low) the nuclear power plant and the lighting factory.

In addition, of course, air quality in the area is also significantly affected by emissions from sources outside the settlements under study, but within a radius of a few (tens of) kilometres.

4.2.2. AGRICULTURE, POPULATION OUTPUT

The importance of agriculture is not negligible either, as in the uncovered period, when the weather is drier, the disturbance of arable land can be significant. In addition to methane emissions, livestock production can also be a source of localised pollution. Acidifying ammonia, which is also released into the air from fertiliser application, can also have a stinking effect alongside livestock farms.

Another source of pollution in the study area is **domestic heating. The** importance of heating in shaping air quality (through the combustion of biomass and possibly waste such as rubber, plastics, etc.) is increasing across the country and the residential sector is now seen as the main source of both PM10 (and even more so $PM2_{.5}$) and sulphur dioxide and carbon monoxide emissions, but also plays a greater role in the emission of volatile organic compounds. (In 2017, for the country as a whole, households were responsible for 42.9% of sulphur dioxide emissions, 59.4% of PM10 emissions and 83.3% of $PM2_{.5}$ emissions, 70.2% of carbon monoxide emissions, 23.2% of non-methane volatile organic compound emissions and 15.987% of gross carbon dioxide emissions.) The influence of weather conditions is significant for this reason (but also for other reasons).

Residential emissions should also include **the burning of refuse, garden waste** and possibly other waste.

In addition, large-scale construction **works** can also play a role in shaping local air quality, particularly through dust pollution.

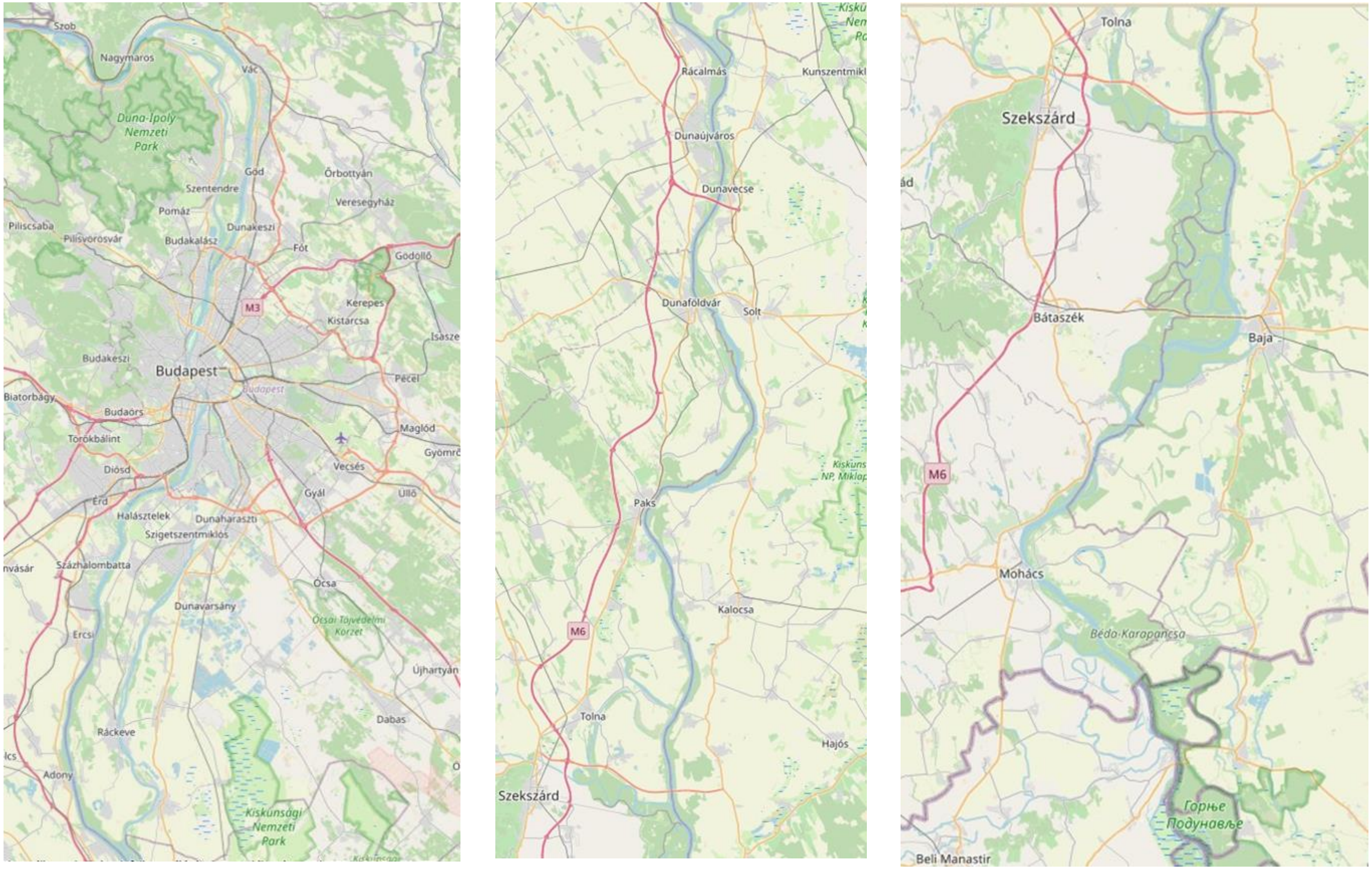
In terms of non-transport emissions, industrial emissions are dominant in the study area, with heating emissions adding up to a significant surplus in the winter period, and in particular, the impact of construction activities involving large-scale earthmoving or demolition activities (for example, in 2017, 12.4% of national small-scale particulate matter emissions were due to construction and demolition activities).

4.2.3. TRANSPORT EMISSIONS

According to data from the Hungarian Central Statistical Office (KSH), around a quarter of gross domestic CO_2 emissions (26.1% in 2017) come from transport and transport-related greenhouse gas emissions have been steadily increasing since 2013. Transport is responsible for less than one fifth of carbon monoxide emissions (18.7% in 2017, emissions are decreasing), ~10% of non-methane volatile organic compound emissions (9.9% in 2017, emissions are decreasing) and 6.25% of PM2.5 emissions[9] (PM10 is even smaller at around 5%). The role of transport in emissions of small particulate matter is decreasing. The largest share of transport in NOx emissions is transport, accounting for 50% of total emissions in 2016 according to OMSZ data. With the limitation of the sulphur content of fuels, transport emissions of sulphur dioxide are no longer significant and the share of ammonia emissions is negligible. Within transport, most emissions are related to road transport, with 95% of transport-related nitrogen dioxide emissions from heavy duty vehicles, light duty trucks and cars. Nitrous oxides are also a major contributor to ground-level ozone pollution, mainly due to their emissions.

Major roads run along both sides of the Danube in the study area. National roads are illustrated in ***Figure 7***source of transit and localised air pollution in the area (traffic on municipal road networks is of course also a contributor to transport emissions.It should be noted that unpaved, **unmade roads** can themselves be a significant source of particulate matter in dry weather.)

9 According to the National Air Pollution Reduction Programme, the share of transport is even lower, around 3%.



7. Figure 1:National roads in the area concerned

Source : www.kira.gov.hu

On the right bank, it is dominated by the second-order main road 11, followed south of Budapest by the M6 motorway (and the roughly parallel first-order main road 6), and on the left bank by the first-order main road 12, then the first-order main road 2 and the M2 motorway. To the south of Budapest is Highway 51. It is also necessary to mention the section of the M0 ring road between the M1 and the M1-11. To the south of Dunaföldvár, the M6 motorway, the 6 motorway and then the 56 secondary main road towards Mohács, and on the left bank, in addition to the 51 main road, the 55 main road connecting Szeged with Bátaszék via Baja.

According to KIRA data for 2016, the traffic on the M0 motorway, the main road 6 up to Érd, the M2 motorway from Sződliget, the main road 11 from Szentendre and on certain sections of the main road 2 also exceeds 20,000 vehicles per day.

The traffic is extremely high, between 8001 and 20,000 vehicles per day, on the main road 11 between Tahitótfalu and Szentendre, on the main road 12 from Kismaros, on the main road 2 except for a few busier sections, on the M6 motorway up to Szekszárd, on the main road 6 between Rácalmás and the M8, on the M8 motorway at the Pentele bridge and on the main road 52 in Solti.

The daily traffic volume is high, between 4001 and 8000 vehicle units, on the 5101 connecting road from Tökölig to Csepel Island, on the main road 6 between Százhalombatta and Rácalmás, on the main road 51 from Szekszárd to the M6 motorway in some sections, and on the surveyed section of the secondary main road 55.

At the same time, traffic on the lower roads is low, mostly between 1001 and 2000 vehicles/day. This traffic alone, according to our previous calculations, is not yet expected to cause significant air quality degradation in the inner parts of the municipalities.

Typically, the settlements with first and second class roads passing through their hinterland (e.g. Vác, Dunakeszi, Budapest, Paks, Baja) are heavily congested. In these agglomerations, high concentrations of air pollutants from traffic cannot be excluded due to the built-up area: primarily nitrogen oxides, secondarily particulate matter (PM10), but also volatile organic pollutants. Higher concentrations of ozone can be expected further away from the source of its precursors (nitrogen oxides, carbon monoxide, volatile organic compounds), which are (also) emitted by transport.

Budapest is one of the most important railway hubs in Central Europe, not only the national railway lines converge here, but also several European rail corridors, with about half of the total domestic rail traffic passing through the capital.

The Budapest-Szob railway line is the electrified double-track railway line No 70 of MÁV. It is one of the busiest suburban lines in Hungary, with significant professional traffic and tourist traffic at weekends.

The Budapest-Vácrátót-Vác railway line is a 71-section electrified single-track railway line of MÁV.

The Budapest-Pusztaszabolcs railway line 40a is an electrified double track line with significant freight and passenger traffic.

The Pusztaszabolcs-Dunaújváros-Paks railway line is a single-track railway line No. 42 of MÁV, which is electrified from Dunaújváros to Dunaújváros. The small but regular freight traffic between Budapest and Dunaújváros mainly serves the nuclear power plant and part of the local industrial park.The Mezőfalva-Rétszilas railway line (No 43) is a single-track, non-electrified railway line that complements this.

To the south of Budapest, the only railway crossing of the Danube is at Baja, where the Baja-Kiskunhalas railway line (No 154), a single-track, non-electrified railway line, crosses the river.

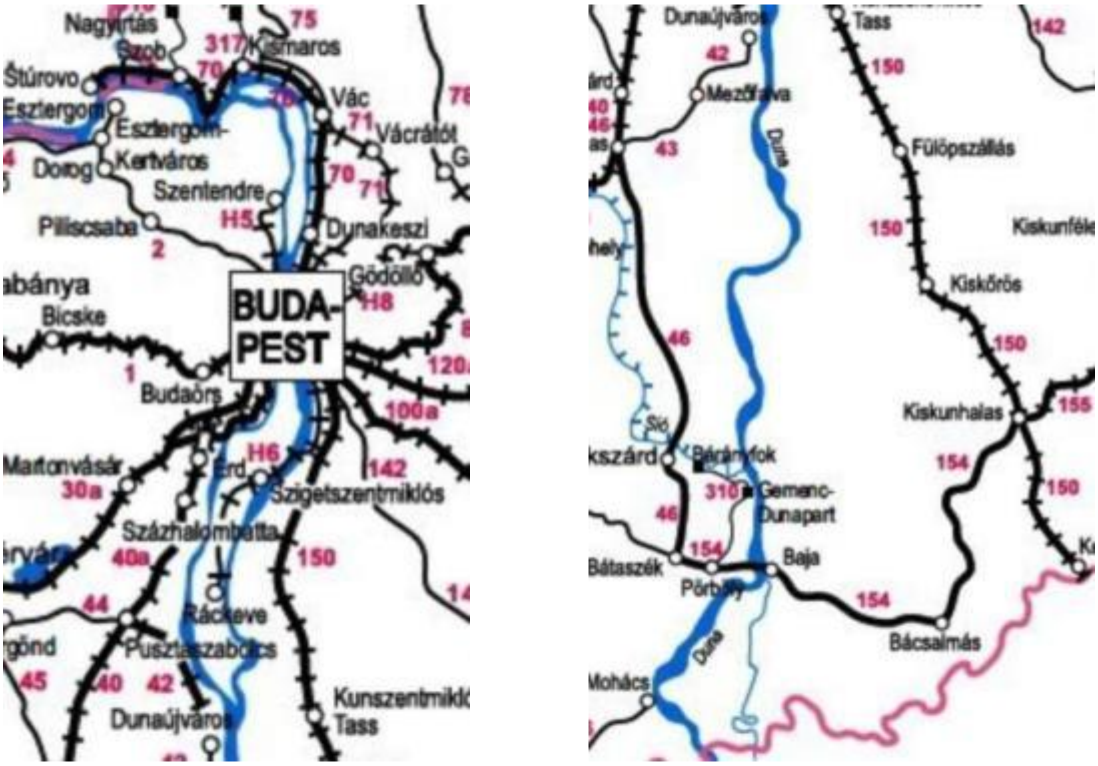
The unelectrified Sárbogárd-Bátaszék railway line (No 46), which is single track throughout, and the electrified Budapest-Kunszentmiklós-Tass-Kelebia railway line (No 150), which is typically single track, run further away from the study area.

Local air pollution is, of course, only caused by diesel trains.

The Danube is an international waterway, part of the Danube-Rhine-Main waterway, and the most important ports on the section under study are in Budapest (Csepel Free Port), Dunaújváros, Mohács (Áruforgalmi Port and Logistics Centre) and Baja. In addition to the numerous ports in Budapest, there is also a loading terminal in Ercsi and Adony, and a stone loading terminal in Visegrád.

In addition to the Budapest Liszt Ferenc International Airport, which is located further away from the study area, there are also non-public airports in Baja, Dunakeszi, Dunaújváros, Érsekcsanád, Kalocsa, Őcsény, Tököl. These airports have no significant impact on the air quality of the area.

This indicates that **road transport is responsible for the vast majority of air pollutant emissions** (mainly NOx, volatile organic compounds and to a lesser extent PM10) in **the study area**.



8. Figure 1:Rail lines in the wider area
Source : http://www.logsped.hu/vasutterkep.htm

Sources used in chapter 4:

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5. HABITAT, ECOSYSTEMS, PROTECTED NATURAL VALUES, SITES

5.1. NATURE CONSERVATION SITUATION

5.1.1. COUNTRY DATA

According to KSH data, the number of protected areas in Hungary almost doubled between 1991 and 2018, from 1072 to 2116. The area of protected areas has increased from 651.8 thousand hectares in 1991 to 891.8 thousand hectares in 2018, i.e. the area has also increased by about one third. Of this, specially protected areas increased from 85.5 thousand ha to 127.2 ha. The changes are shown in the table below.

29. Table 1Change in protected areas between 1991-2018

Year	Protected areas of national importance					Areas of local importance	Together
	national parks	protected landscape areas	nature conservation areas	natural monument	total		
Number of protected areas							
1991	5	46	142	1	194	878	1 072
2018	10	39	172	90	311	1 805	2 116
Area, thousand hectares							
1991	159,1	422,4	35,6	- -	617,1	34,7	651,8
2018	480,7	336,9	31,4	0,1	849,1	42,7	891,8
Of which: highly protected							
1991	27,9	56,1	1,5	- -	85,5	- -	85,5
2018	90,2	35,0	2,0	- -	127,2	- -	127,2

Of the 733 protected plant species:

- 77 moss
- 44 harast (specially protected 7)
- 1 open producer (this is also highly protected)
- 611 closed producers (highly protected 79)
- 58 species of mushrooms and 17 species of lichens are also protected.

Of the 1178 protected species:

- 695 invertebrates (highly protected 57)
- 483 vertebrates (128 specially protected), of which
- 2 roundmouth (these are highly protected)
- 31 fish (specially protected 7)
- 18 amphibians (specially protected 1)
- 15 reptiles (specially protected 5)
- 359 birds (highly protected 95)
- 58 mammals (18 specially protected)

It is listed in the nature conservation register of the Ministry of Agriculture (31.12.2018):

- 1542 ex lege protected heaps
- 340 ex lege protected castles
- 2 629 out of 6 607 springs (of which 1 674 springs in areas protected by specific legislation and 4 933 outside protected areas) had a yield of 5 l/min, i.e. the number of officially "ex lege" protected springs
- 795 active and intermittently active sinkholes, of which 364 are located in areas already protected by specific legislation and 431 are located outside these areas, i.e. they are protected by law ex lege
- 4 152 protected caves (145 specially protected), with a total current length of 298 km of cave passages
- 24 protected artificial cavities.

The country has 62 forest reserves (13293.5 ha) and 12 nature parks. Of the Natura 2000 sites, 479 are Special Areas of Conservation (1.44 million ha) and 56 Special Protection Areas for Birds (1.37 million ha). In addition to the areas already protected by specific legislation, 1.2 million ha have been designated as Natura 2000 sites (an overlap of 42.4%). A total of 101 bird species are designated as SPAs; 46 habitat types, 105 other animal species and 36 other plant species are designated as SPAs.

5.1.2. PROTECTED AREAS ALONG THE DANUBE BETWEEN SZOB AND THE BORDER

The **protected areas follow the Danube along its course and floodplain**, and its specific morphological, morphological and flow characteristics do not independently shape the physical and chemical environment of the Danube, thus creating a significant diversity of biota along the river. The protected natural areas and Natura 2000 sites of national importance located along the Danube and likely to be affected by the planned interventions are listed in the following tables and figures, with their main characteristics, and the section and municipalities concerned:

30. Table 1:Protected natural areas of national importance likely to be affected by the interventions

Name	Affected Danube section	Pedigree book number	Year of designation	Dig-it	Outstanding natural assets of the areas concerned	Affected municipalities
Danube-Ipoly NP (Börzsöny, Pilis)	Visegrád Strait (between Esztergom and Leányfalu) and Szentendre Island	283/NP/97	1997	60 676	Endemic snail and fish species of the Danube canyon breakthrough, river waterfowl	Budakalász, Dömös, Dunabogdány, Esztergom, Göd, Kismaros, Kisoroszi, Leányfalu, Nagymaros, Pilismarót, Pócsmegyer, Szentendre, Sziget-monastery, Szob, Sződliget, Tahitótfalu, Vác, Visegrád, Zebegény
Gellért Hill TT	Capital	275/TT/97	1997	40	remnants of ancient vegetation, the only yellowish foam sedge in the country, St. Stephen's Cave	Budapest
Mud Island Artic Forest TT	Capital	265/TT/93	1993	60	floodplain remnant forest with all the stages of floodplain succession, rare plant species, rich fauna of arthropods, birds, amphibians	Budapest
Rácalmási Island TT	Rácalmás	270/TT/96	1996	386	ash-oak forests, grasslands with rare plant and bird species	Rácalmás
Danube-Drava NP	South of the Sió Canal	271/NP/96	1996	49 752	contiguous floodplain with varied land use, floodplain forests and associated species (especially black stork, brown kite, meadow eagle)	Baja, Bár, Báta, Decs, Dunafalva, Dunaszekcső, Érsekcsanád, Fajsz, Homorúd, Kölked, Mohács, Old, Őcsény, Szeremle

On the Danube below Szob, the Börzsöny, the Danube Bend and the Gemenc - Béda-Karapancsa area are **important bird habitats** (IBA area), in addition to the previous protection.

31. Table 1: Important Bird Areas (IBAs) likely to be affected by the interventions

Name	Affected Danube section	Code	Coverage (ha)	Ornithological importance	Qualifying species
Börzsöny	Danube river Szob- Szentendre	HU18	27 839	117 species of birds, mainly forest birds	- Parlagi eagle (Aquila heliaca) - Saker Falcocherrug
Danube Bend	Danube between Szob and Budapest	HU17	15 200	210 species of birds, geese, ducks	- cormorant (Phalacrocoraxcarbo) - sowing geese (*Anserfabalis*) - cercerérce (Bucephalaclangula)
Gemenc	The Danube from the influence of the Sió to Baja	HU10	17 779	important nesting sites for herons, black storks and meadow eagles	- great egret (*Egretta alba*) - black stork (*Ciconianigra*) - sowing geese (*Anserfabalis*) - large lily (Anseralbifrons) - cercerérce (Bucephalaclangula) - golden eagle (Haliaeetusalbicilla) - Saker Falcocherrug
Béda-Karapancsa	Danube between Dunaszegcső and the border	HU09	11 900	geese, pigeons	- Capricorn (Nycticoraxnycticorax) - red heron (Ardeapurpurea) - sowing geese (*Anserfabalis*) - large lily (Anseralbifrons) - summer goose (*Anseranser*)

The main characteristics of **Natura 2000** sites are shown in ***Table 32*** below***:***

The **Gemenc and Béda-Karapancssa areas are also** designated **as Ramsar sites, and the** entire stretch of the Danube is **part of the National Ecological Network**. The [10]characteristics of **Ramsar sites are as** follows:

- **Gemenc Ramsar site** - 19770 ha: the site is a typical wetland habitat, with marshes, wet meadows, deciduous forests and oxbows. The area is characterised by a high number and diversity of species.

The gemenian wetland is home to a significant part of the gypsy mackerel (*Aythyanyroca*) population, which is in need of protection. The site is home to many potentially endangered plant and animal species. Among the plants of outstanding natural value are the amber sedge (*Carexstrigosa*), the Siberian *iris (Irissibirica*), the fairy fern (*Nymphoidespeltata*) and the snake tongue (*Ophioglossumvulgatum*).

During the migration season, the area is visited by a large number of ducks and geese species, such as the summer goose (*Anseranser*), the goshawk (*Anserfabalis*), the spoonbill (*Anasclypeata*) and the mallard (*Anasplatyrhynchos*). Among the birds of prey, the brown kite (*Milvusmigrans*), the saker (*Falcocherrug*) and the white-tailed eagle (*Haliaeetusalbicilla*) are found in the area, with a significant proportion of their native populations. Among the stork species, the grey heron (*Ardeacinerea*), the black stork (*Ciconianigra*), the buck (*Nycticoraxnycticorax*), are present in high numbers and are of value. There are also populations of otter (*Lutralutra*) and wild cat (*Felissylvestris*).

- **Béda-Karapancsa Ramsar** site - 8667 ha: The area is home to several floodplain habitats and wet meadows, with rivers, lakes, watercourses and backwaters. The floodplain is home to marshes, reedbeds, reedbeds, grasslands, oak - ash - elm groves, and is a diverse habitat for many rare and endangered plant and animal communities. The endemic black hawthorn (*Crataegusnigra*) is found in the floodplain of the Danube. Rare and endangered plant species include the curly marigold (*Carpesium abrotanoides*), Siberian lady's-flower (*Irissibirica*), summer peat-flower

[10] Source of descriptions:http://www.ramsar.hu/teruletek/9.htm

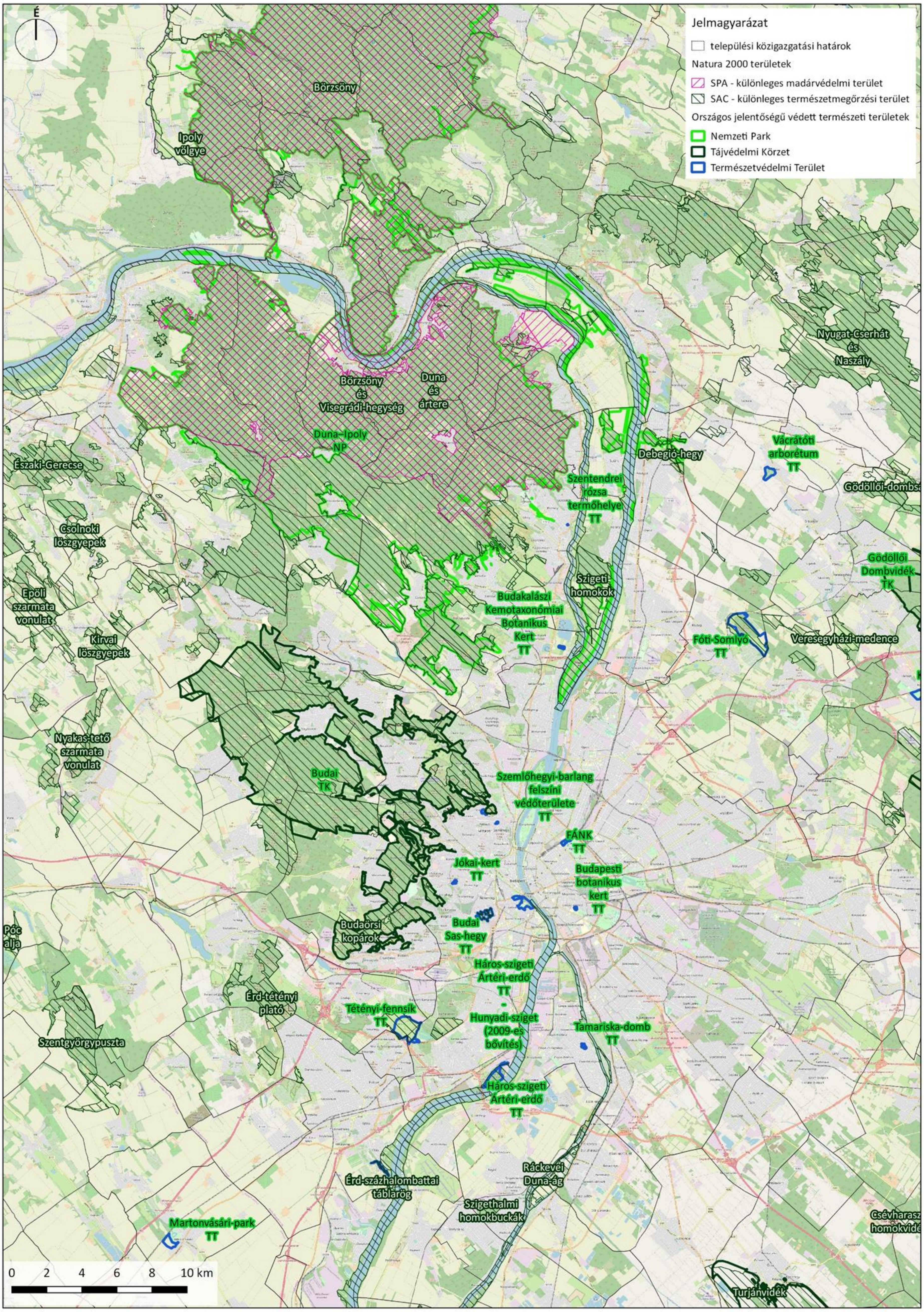
(*Leucojumaestivum*), stubble sedge (*Carexstrigosa*), fairy fern (*Nymphoidespeltata*) and snake tongue (*Ophioglossumvulgatum*).

32. Table 1: Natura 2000 sites likely to be affected by the interventions

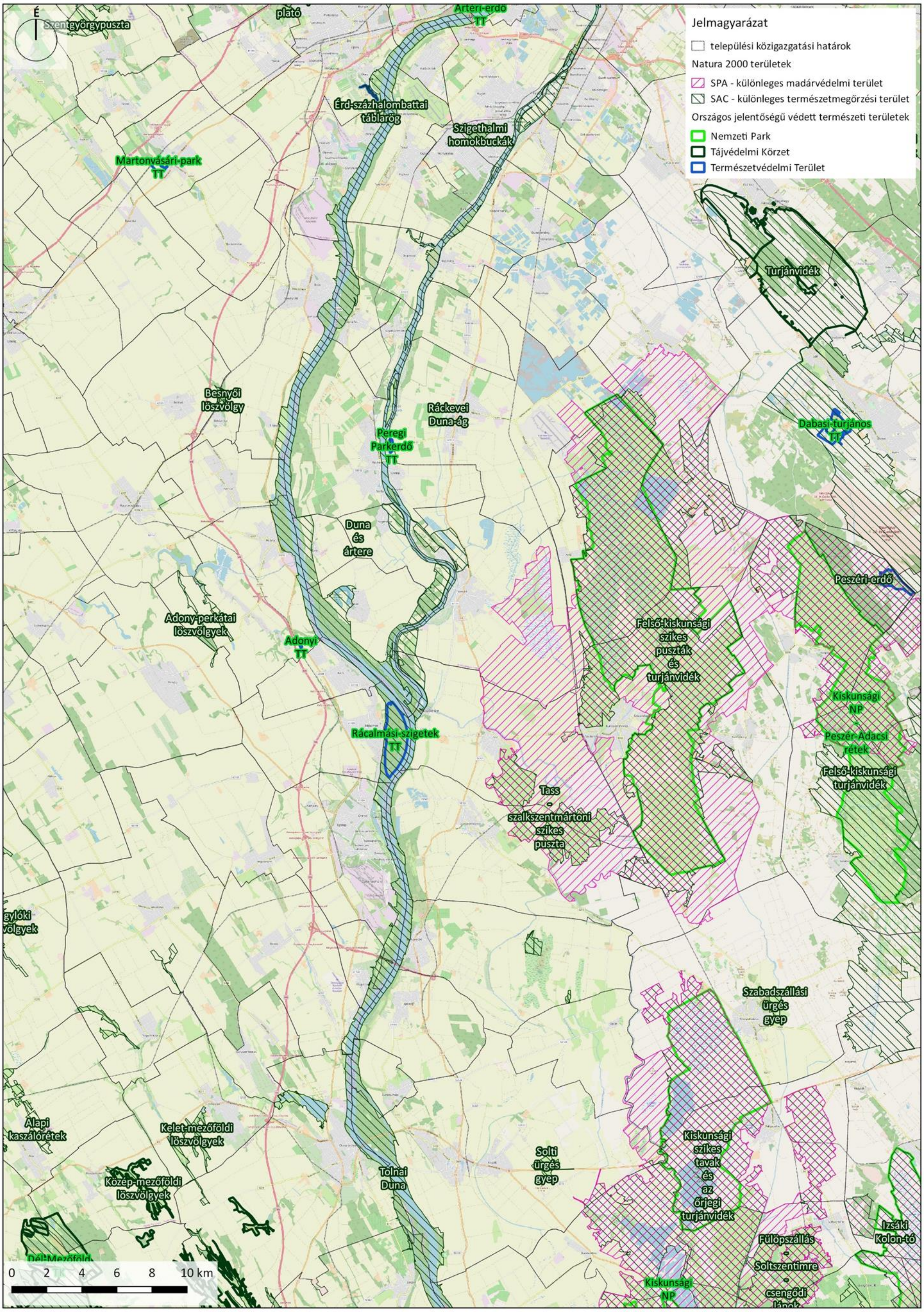
Name	Danube section	Code	Type	Extension (ha)	Indicator habitats	Number of indicator species	Affected municipalities
Danube and its floodplain	Danube coast from Nagyszent-jános to Baracs	HUDI 20034	ktt	16 574	- pannonian salt steppes and marshes (1530) - oligo-mesotrophic standing waters with Littorelleteauniflorae and/or Isoeto-Nanojuncetea vegetation (3130) - natural eutrophic lakes with Magnopotamion or Hydrocharition vegetation (3150) - natural distrophic lakes and ponds (3160) - rivers with muddy banks, partly with Chenopodionrubri and partly with Bidention vegetation (3270) - semi-natural dry grassland with calcareous substratum and shrubby vegetation (Festuco-Brometalia) (6210) - subpannonian steppe (6240) - lowland pannonic loess grasslands (6250) - pannonian sand grasslands (6260) - Blue-herbaceous fens on calcareous, peaty or clayey soils (Molinioncaeruleae) (6410) - hydrophilic highland-montane margins of plains and levels from upland to high mountain (6430) - Cnidiondubiform marshes of river valleys (6440) - lowland and hill pastures (Alopecurus pratensis, Sanguisorbaofficinalis) (6510) - Peat bogs and peat swamps (7140) - calcareous marshes with Cladium mariscus and species of Cariciondavallianae (7210) - Lichiferous blanket-meadows and grasslands (7230) - Tilio-Acerion forests of slopes and boulders (9180) - Alnusglutinosa and Fraxinusexcelsior (Alno-Padion, Alnionincanae, Salicionalbae) (91EO) - hardwood forests along large rivers with Quercusrobur, Ulmuslaevis and Ulmus minor, Fraxinusexcelsior or Fraxinusangustifolia (Ulmenionminoris) (91FO) - Euro-Siberian forest-steppe oaks with oak species (Quercusspp.) (91IO)	- plants: 2 - invertebrates: 10 - fish: 13 - amphibian: 2 - reptile: 1 - bird: - - mammal: 5	Ács, Komárom, Almás-füzítő, Dunaalmás, Nesz-mély, Süttő, Lábatlan, Nyergesújfalu, Tát, Esztergom, Plilsmarót, Szob, Dömös, Nagy-maros, Kismaros, Verő-ce, Visegrád, Kisoroszi, Dunabogdány, Tahitót-falu, Vác, Sződ, Sződ-liget, Göd, Pócsmegyer, Leányfalu, Szigetmonos-tor, Szentendre, Zebe-gény, Dunakeszi, Buda-kalász, Budapest, Érd, Halásztelek, Ráckeve, Szigetcsép, Szigetszent-miklós, Százhalombatta, Tököl, Ercsi, Adony, Lórév, Makád, Kulcs, Iváncsa, Kisapostag, Rácalmás, Dunaújváros, Duna-vecse, Baracs, Apostag, Tass
Danube Tolna	Danube coast from the Danube Land Barrier to Fajsz	HUDD 20023	ktt	4 162	- oligo-mesotrophic standing waters with Littorelleteauniflorae and/or Isoeto-Nanojuncetea vegetation (3130) - rivers with muddy banks, partly with Chenopodionrubri and partly with Bidention vegetation (3270) - lowland pannonic loess grasslands (6250) - pannonian sand grasslands (6260) - hydrophilic highland-montane margins of plains and levels from upland to high mountain (6430) - Cnidiondubiform marshes of river valleys (6440) - Alnusglutinosa and Fraxinusexcelsior (Alno-Padion, Alnionincanae, Salicionalbae) (91EO) - hardwood forests along large rivers with Quercusrobur, Ulmuslaevis and Ulmus minor, Fraxinusexcelsior or Fraxinusangustifolia (Ulmenionminoris) (91FO)	- plants: 1 - invertebrates: 5 - fish: 11 - amphibian: 2 - reptile: 1 - bird: - - mammal: 7	Dunaföldvár, Bölcske, Madocsa, Paks, Gerjen, Daruszentmiklós, Dunaegyháza, Solt, Harta, Dunapataj, Ordas, Géderlak, Dunaszentbenedek, Uszód, Bátya, Foktő, Kalocsa
						-	

Name	Danube section	Code	Type	Extension (ha)	Indicator habitats	Number of indicator species	Affected municipalities
Börzsöny-Visegrád Mountains	The Vistula-Radian Strait	HUDI 10002	kmt	49557	-	- bird: 40	Esztergom, Pilis-marót, Dömös, Visegrád, Duna-bogdány, Nagymaros
Börzsöny	The Vistula-Radian Strait	HUDI 20008	ktt	30401	- subcontinental peripannonic shrublands (40AO) - Pannonian rocky grasslands (Stipo-Festucetaliapallentis) (6190) - semi-natural dry grassland with calcareous substratum and shrubby vegetation (Festuco-Brometalia) (6210) - hydrophilic highland-montane margins of plains and levels from upland to high mountain (6430) - lowland pannonic loess grasslands (6520) - Central European mountain siliceous scree slopes (8150) - siliceous slopes with rock vegetation (8220) - szilikátsziklák a Sedo-Scleranthion vagy a Sedo-albi-Veroniciondillenii pionír növényzetével (8230) - Lime beech (Luzulo-Fagetum) (9110) - Submontane and montane beech (Asperulo-Fagetum 9130) - Tilio-Acerion forests of slopes and boulders (9180) - Alnusglutinosa and Fraxinusexcelsior (Alno-Padion, Alnionincanae, Salicionalbae) (91EO) - Pannonian hornbeam-oak forests with Quercuspetraea and Carpinusbetulus (91GO) - pannonian potted oaks (91MO)	- plants: 3 - invertebrates: 12 - fish: 1 - amphibian: 2 - reptile: 1 - bird: - - mammal: 8	Nagymaros
Pilis and Visegrád Mountains	The Vistula-Radian Strait	HUDI 20039	ktt	30146	- subcontinental peripannonic shrublands (40AO) - Pannonian rocky grasslands (Stipo-Festucetaliapallentis) (6190) - semi-natural dry grassland with calcareous substratum and shrubby vegetation (Festuco-Brometalia) (6210) - subpannonian steppes (6240) - lowland and hill pastures (Alopecurus pratensis, Sanguisorbaofficinalis) (6510) - lowland pannonic loess grasslands (6520) - Central European mountain siliceous scree slopes (8150) - limestone rocky slopes with rock vegetation (8210) - siliceous slopes with rock vegetation (8220) - caves not open to the public (8310) - Lime beech (Luzulo-Fagetum) (9110) - Submontane and montane beech (Asperulo-Fagetum (9130) - Cephalanthero-Fagion on Central European bouldery limestone of the Beech (9150) - Tilio-Acerion forests of slopes and boulders (9180) - Alnusglutinosa and Fraxinusexcelsior (Alno-Padion, Alnionincanae, Salicionalbae) (91EO) - Pannonian hornbeam-oak forests with Quercuspetraea and Carpinusbetulus (91GO) - pannonic mossy oaks with Quercuspubescens (91HO)	- Plant: 8 - invertebrates: 18 - fish: 1 - amphibian: 2 - reptile: 1 - bird: - - mammal: 12	Esztergom, Dömös, Visegrád

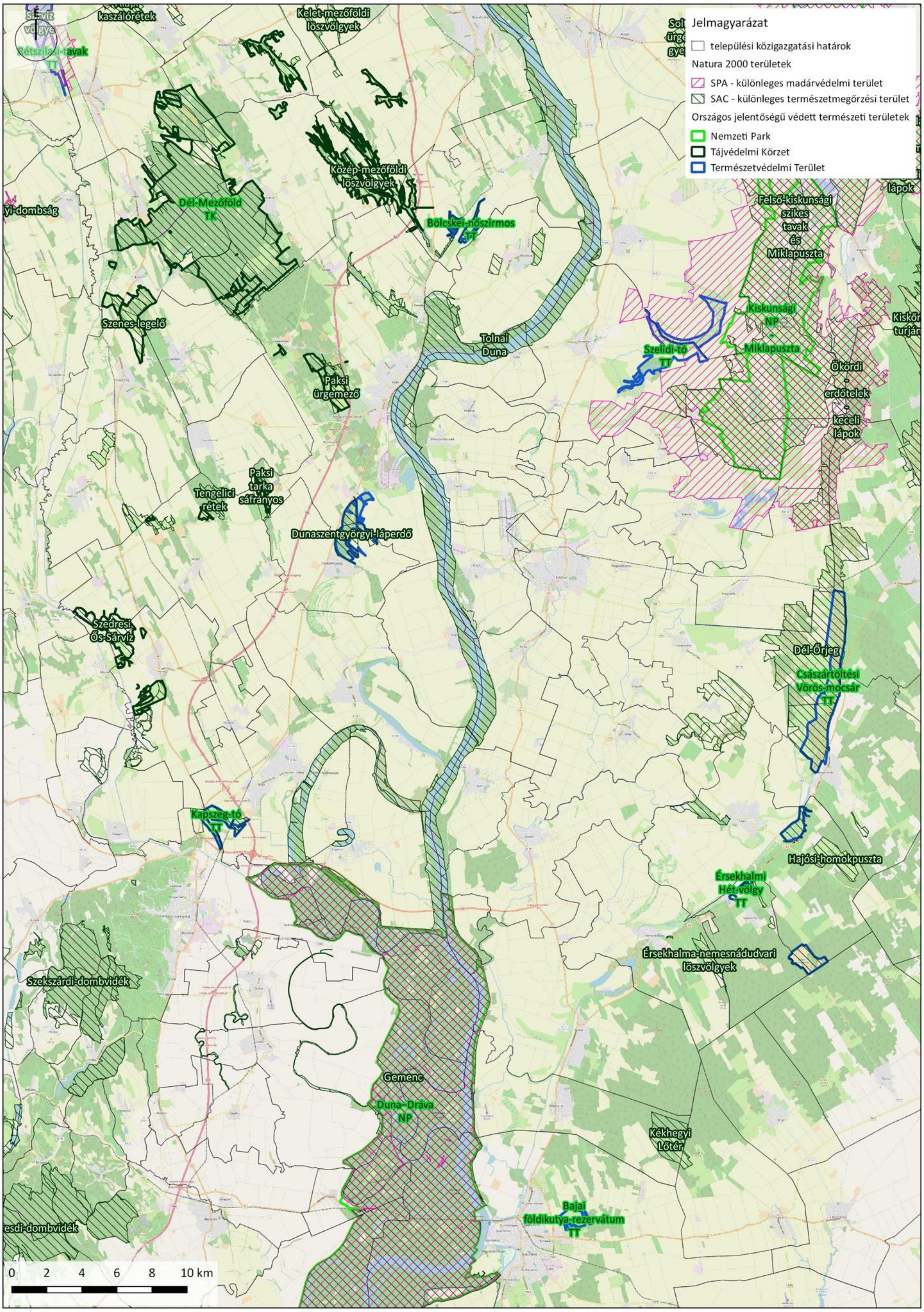
Name	Danube section	Code	Type	Extension (ha)	Indicator habitats	Number of indicator species	Affected municipalities
					- pannonian potted oaks (91MO)		
Gemenc	South of the Sió Canal	HUDD 10003	kmt	19 641	-	- bird: 45	Dombori, Fajsz, Dusnok, Bogyiszló, Öcsény, Sükösd, Decs, Érsek-csanád, Baja, Szeremle, Báta, Dunaszekcső, Bár, Dunafalva
Gemenc	South of the Sió Canal	HUDD 20032	ktt	20 704	- oligo-mesotrophic standing waters with Littorelleteauniflorae and/or Isoeto-Nanojuncetea vegetation (3130) - natural eutrophic lakes with Magnopotamion or Hydrocharition vegetation (3150) - rivers with muddy banks, partly with Chenopodionrubri and partly with Bidention vegetation (3270) - Wetlands of the river valleys of the Cnidiondubii (6440) - lowland and hill pastures (Alopecurus pratensis, Sanguisorbaofficinalis) (6510) - Alnusglutinosa and Fraxinusexcelsior (Alno-Padion, Alnionincanae, Salicionalbae) (91EO) - hardwood forests along large rivers with Quercusrobur, Ulmuslaevis and Ulmus minor, Fraxinusexcelsior or Fraxinusangustifolia (Ulmenionminoris) (91FO)	- plants: 1 - invertebrates: 4 - fish: 11 - amphibian: 2 - reptile: 1 - bird: - - mammal: 6	Dombori, Fajsz, Dusnok, Bogyiszló, Öcsény, Sükösd, Decs, Érsekcsanád, Baja, Szeremle, Báta
Beda-Karapan-csa	South of Mohács	HUDD 10004	kmt	8722	-	- bird:: 55	Mohács, Kölked, Homorúd
Beda-Karapan-csa	South of the Danube estuary	HUDD 20045	ktt	10797	- oligo-mesotrophic standing waters with Littorelleteauniflorae and/or Isoeto-Nanojuncetea vegetation (3130) - natural eutrophic lakes with Magnopotamion or Hydrocharition vegetation (3150) - rivers with muddy banks, partly with Chenopodionrubri and partly with Bidention vegetation (3270) - Wetlands of the river valleys of the Cnidiondubii (6440) - Alnusglutinosa and Fraxinusexcelsior (Alno-Padion, Alnionincanae, Salicionalbae) (91EO) - hardwood forests along large rivers with Quercusrobur, Ulmuslaevis and Ulmus minor, Fraxinusexcelsior or Fraxinusangustifolia (Ulmenionminoris) (91FO)	- plants: 1 - invertebrates: 7 - fish: 11 - amphibian: 1 - reptile: 2 - bird: - - mammal: 4	Dunaszekcső, Dunafalva, Mohács, Kölked, Homorúd



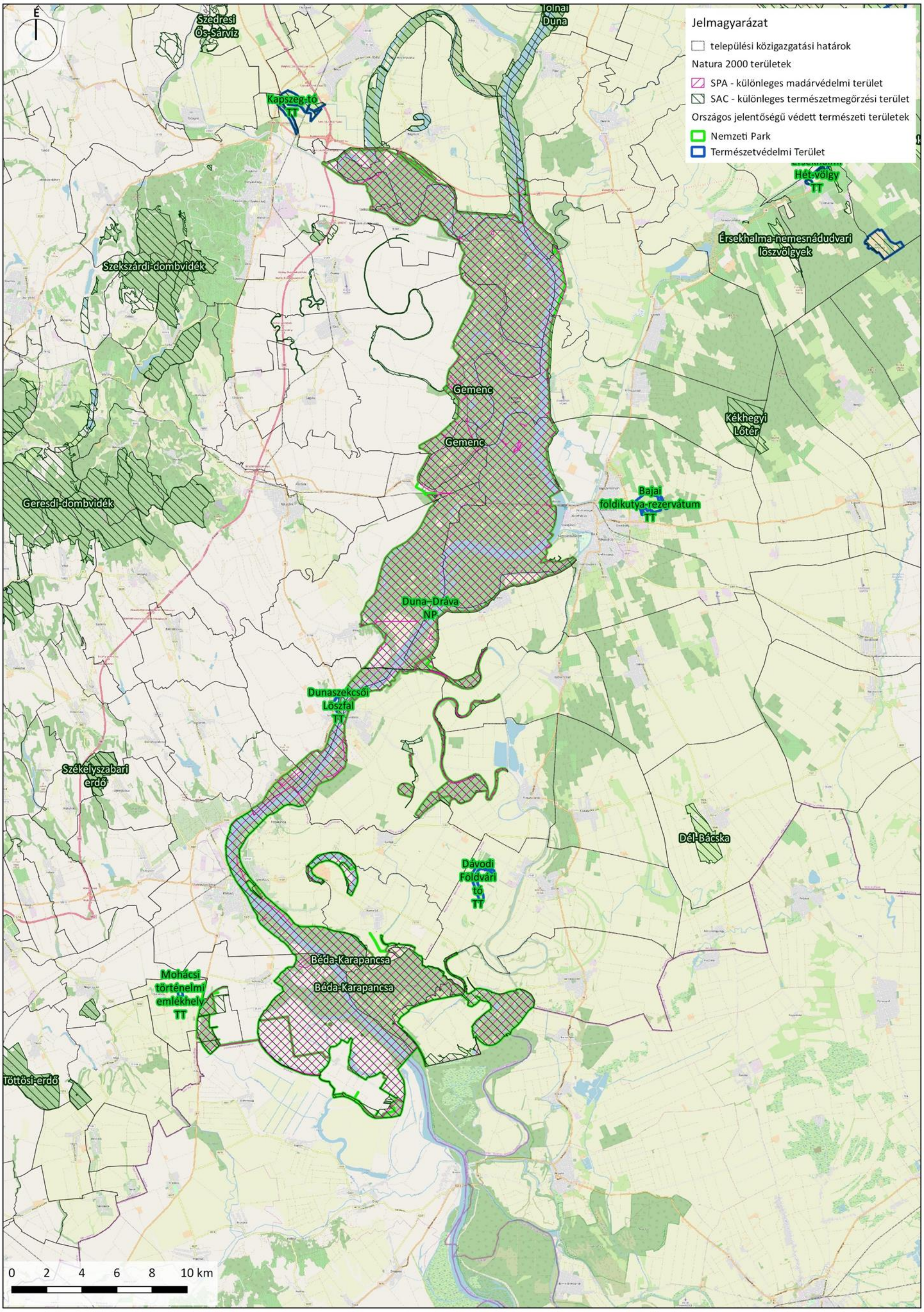
9. **Figure 1: Location of protected areas on the Danube between Szob and Budapest**



10. Figure 1: Location of protected areas on the Danube between Budapest and Solt



11. Figure 1: Location of protected areas on the Danube between Solt and Baja



12. Figure 1: Location of protected areas along the Danube between Baja and the southern border

The birdlife is also rich in protected and specially protected species, including the little egret (*Egrettagarzetta*), the buck (*Nycticoraxnycticorax*), the black stork (*Ciconianigra*), the meadow eagle (*Haliaeetusalbicilla*), the brown kite (*Milvusmigrans*), the saker (*Falcocherrug*) and the pale jay (*Hippolaispallida*). Of course, the wetland of Béda-Karapanca is also an important migratory site, a resting place for numerous protected species of ducks and waterfowl, such as the summer goose (*Anseranser*), the goshawk (*Anserfabalis*), the great crested goose (*Anseralbifrons*). Among the ducks, the most abundant are the common duck (*Aythyanyroca*), the common duck (*Aythyaferina*), the lesser teal (*Anasquerquedula*), the hen teal (Anasclypeata) and the mallard (*Anasplatyrhynchos*). Among mammals, the specially protected otter (*Lutralutra*) is a favourite habitat.

5.1.3. KEY CHARACTERISTICS OF PROTECTED NATURAL AREAS OF NATIONAL IMPORTANCE

5.1.3.1. Danube-Ipoly National Park [11]

The area of the Danube-Ipoly National Park includes the Pilis, Visegrád and Börzsöny mountain ranges, the section of the Ipoly Valley between Hont and Balassagyarmat and parts of Szentendre Island. The unique characteristic of the National Park area is the meeting of the three major landscape units, the river valleys, the mountains and the plains. Hence the great diversity of the area, which is unique within our borders.

In terms of geological and landscape values, the Danube and the mountains are most closely linked in the Danube bend. In the National Park area, volcanic and sedimentary rocks are found, together with alluvium in the river valleys, which is still changing in places, and reefs that are being built and destroyed in the gravel beds. Of particular importance are the springs and streams of varying flow rates originating in the mountainous areas, almost all of which rush into the Ipoly or the Danube.

In addition to the diversity of the national park's vegetation, its transitional character is also noteworthy. This is partly due to the diversity of the bedrock and partly to the meeting of sub-Mediterranean and continental climatic barriers. The Danube bend is a link between the flora of the Transdanubian Central Highlands and the Northern Central Highlands. Many species and associations reach the limits of their distribution here (e.g. red-horned hummingbird, beech with rabbit's tail). The vegetation is extremely complex, ranging from the characteristic plant communities of the floodplain levels, through the sand grasslands, to several types of vegetation in the middle and high mountains. The unique botanical value of the national park is the Hungarian husk. The ornamental plant of the floodplain meadows of the Ipoly Valley is the meadow rush. Due to the diversity of habitats, the fauna is also extremely complex, with many rare endangered species living in the area. The number of protected and specially protected species in the national park exceeds 700.

The rivers are of particular value for the fauna of the national park. The waters of the Danube bend, with its rapid flow and gravel bed, are a habitat for rare endemic snail species. There are also bucket snails and snails with drawings. The most valuable member of the fish fauna, the Petenia marlin, is also associated with river waters.

The dry mountain grasslands are home to the saw-whet grasshopper and the meadow grasshopper, a relict of the Russian steppes.

The amphibian fauna includes all native species. Among them, the spotted salamander, which lives in the wet valleys of the Börzsöny, is particularly colourful. Among the reptiles, the Pannonian lizard is also found in the Pilis and Börzsöny. There are many forest songbirds and birds of prey in the national park, and along the rivers there are water, shore and wading horse species. Of particular importance are the Saker Falcon, the Paraguayan Eagle and the Saker Falcon. The black stork is also common. In the older forests of the Börzsöny, the White-backed Woodpecker is significant. In the Danube waters, the tufted titmice from the north overwinter in large numbers. Occasionally, a bald eagle can be seen hunting the ducks. Caves and abandoned mine shafts are home to colonies of bats. Several protected species of shrews and elephants live

[11]source:https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/duna-ipoly-nemzeti-park

in the area, while large carnivores include the occasional lynx in the undisturbed woodland and the otter along the waterways.

In addition to the natural values, the National Park also has a large number of outstanding cultural and historical values in the caves (Pilisszántói-Kőfülke, the Legény-, Leány-, and Leány-barlang in Kesztölc, the Bivak-barlang in Pilisszentlélek), from the traces of Stone Age man to the Bronze Age castles (Árpádvár, Jelenc hegy, Rustok hegy, Godó fortress, Pogányvár) and the remains of the Roman Empire limes (Leányfalu, Dunabogdány, Visegrád Sibrik Hill, Pilismaróti Hideglelőskereszt- Peak, Esztergom), medieval castles (Visegrád, Nógrád and Drégely castles) and church buildings (Klastrompuszta, Pilisszentlélek, Márianosztra, Pilisszentkereszt) to the monuments of more recent times (small railways, art villages).

5.1.3.2. Gellérthegy Nature Reserve [12]

The eagle-hawk-shaped ridge is largely landscaped, but there are remnants of the former vegetation. It is the only habitat in the country for the yellowish foam sedge (*Sileneflavescens*). On the side of the mountain is the specially protected St. István Cave, which has been converted into a rock chapel.

5.1.3.3. Háros-island Arterial Forest Nature Reserve [13]

Today, Háros Island is only a peninsula, because the northern part was filled in and connected to the shore when the river was regulated in 1911. A botanical survey of the lush vegetation of the 'island', which is frequently flooded by the Danube, has revealed a complete succession of low and high floodplain successions, including a softwood forest dominated by willows and poplars, and a hardwood forest of oak, ash and elm. Among the botanical rarities, the occurrence of the indigenous and protected *Vitisriparia*, the *Leucojumaestivum* (summer peat) and the *Equisetumhyemale* (winter hyssop) are noteworthy. In early spring, the snowdrop (*Galanthusnivalis)* and the ligeton starflower (*Scillavindobonensis*) are interspersed with a carpet of white and purple flowers. The raised habitats of the wild vine curtains are home to a rich fauna of arthropods. In these habitats, zoologists have found specimens of two species of jumping insects, hitherto unknown in our country. The former military use of Háros Island (barracks and harbour) has completely isolated it from the outside world. The area is not open to visitors, it is still unspoilt and has not been forested or wild managed for decades, with trees either falling in storms or dying on their feet. Wild grapes, hops and blackberries cover almost the entire forest, encroaching on both living trees and dead trees, making this ancient Danube forest, which has remained a messenger, completely impenetrable. The floodplain forest provides an undisturbed nesting and migratory habitat for a rich bird fauna, but also for the riverbank's permanent inhabitants, the red-bellied nightjar, the marsh turtle and the beaver.

5.1.3.4. Rácalmási Island Nature Reserve [14]

The island, like similar areas along the Danube, was characterised by softwood and hardwood forests. Human interventions quickly transformed this situation. The higher areas of the island used to be covered by large expanses of grassland, providing grazing land for the municipality. Today, more than half of the forested areas covering the island are converted, heavily managed, artificially planted forests. Even so, there are still significant, continuous blocks of ash-oak forest. Valuable species of herbaceous vegetation include the protected *Scillavindobonensis* (*Scillavindobonensis*) and *Leucojumaestivum* (*Leucojumaestivum*), which occur in abundance throughout the area. Less common are the protected winter hellebore (*Equisetum hyemale*) and the black hawthorn (*Crataegusnigra*).

On the island, two of our protected bird species nest with varying regularity. Hundreds of duck species rest in the waters of the Danube in winter.

[12] http://www.termeszetvedelem.hu/index.php?pg=pl_275-TT-97

[13] https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/adonyi-termeszetvedelmi-terulet/haros-szigeti-arteri-erdo-tt

[14] https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/adonyi-termeszetvedelmi-terulet/racalmasi-szigetek-tt

5.1.3.5. Danube-Drava National Park south of the Sió Canal [15]

The protected area stretches along the Danube from the mouth of the Sió canal to the southern border. Here you will find Gemenc and Béda-Karapancsa, which are part of the Great Plain. The Danube's gradient is reduced along this stretch, so its speed is lower and it becomes a middle section. It meanders, building reefs of silt and sand and constantly changing its course. The overdeveloped meanders were naturally cut through, creating the backwaters and, in deeper areas, the inland lakes. The river's water regime fundamentally changed this situation. In the course of the river regulation, the bends were cut and the river was dammed in order to speed up the draining of ice prices and navigation. The riverbed was deepened by the faster flowing water and the water level was therefore lowered, resulting in a significant drop in the water table. On the stretch between the mudflats, the flood protection embankment was built relatively far from the river, on the boundary of the Archdiocese of Kalocsa. This allowed Gemenc, one of the largest contiguous floodplains in Europe, to survive.

Until the end of the 18th century, the local population did not try to block the floods, but on the contrary, they tried to integrate larger and larger areas into this natural "breathing". The enormous annual flow of water on the Danube was largely diverted by artificial channels, known as 'fens', into lakes and depressions suitable for fishing, into paddocks, pastures and orchards. In the meantime, they salvaged their valuables and livestock in parallel with the slow flooding. This method of steppe farming, which minimised the devastating impact of the flood and ensured the livelihoods of the people living there, mainly provided abundant deaths. Apart from fishing, the most important form of floodplain farming, apart from the rigid livestock farming of horses and grey cattle, is the rearing of cattle. The system was kept in operation by grades, which required considerable skill and labour to maintain.

The dominant flora communities of the floodplain flora of **Gemenc,** located in the area of the Danube Sárköz, are shrubby grasslands, softwood and hardwood forests. Its fauna is characterised by the protected kingfisher, the highly protected white-tailed eagle, the black stork and the saker. Gemenc is famous for its excellent populations of roe deer and wild boar. The area is criss-crossed by 'promontories', which are partly natural narrow channels. These were once used to flood the inland areas, helping the forest and its farmers to make a living.

The **Béda-Karapancsa** includes habitats of outstanding value in the lower Danube in Hungary. Here is one of the "most densely populated" areas of our country by eagles and black storks. Herons, egrets, egrets and spoonbills rest undisturbed in the depths of the undisturbed floodplain forests.

The reefs of the Danube are built up of coarse sand, so at low water levels the growing area is quite dry. On the banks of the muddy sands, along the estuaries, willow groves occur, which are recognisable from afar by the silvery foliage of the white willow, and are usually flooded in spring. Their typical plant is the summer peat moss, which is a picturesque sight when it blooms in masses.

In May, the gemenian backwaters are white with white fairy rose or yellow with fairy hawkweed, both protected species. The only living member of the water-lily family, it also blooms in May on the sandy bottoms of the Beda backwaters. The common rush, notable for its insect-catching habits, is also ornamental when in flower. It is a warm-weather remnant species, with rhombic leaves mosaically covering the water surface. Its fruits were once collected and eaten. Today it is protected. Two other common water ferns are the meadow fern and the reed canarygrass, which reproduce by spores, also protected species. The aquatic vegetation is bordered by marsh vegetation on the banks. The reed beds are followed by communities of reed beds.

The oak-ash-siliceous groves are found on the high floodplain, where only large tidal waves flood the area. The forest is composed of pedunculate oak, Venetian elm and Hungarian ash. Under the trees, a dense shrub layer has developed, including the protected Jericho honeysuckle and the Liget vine. In the herbaceous level we find the pinkish-reddish-brown checkered cotullium with mottled flowers. Remnants of these

[15] dnp.nemzetipark.gov.hu/national-park-duna-menti-teruletek

species-rich forests can be found in the Béda-Karapancsa area. The native protected shrub of the Lower Danube Valley is the black hawthorn.

According to the research carried out so far, 51 species of fish have been confirmed from the Danube area. Of the Danube fish, goatfish and ling are still quite common. The predatory fish of the estuaries are pike. A wide variety of amphibians live in the area. Among the reptiles, the water snake and the marsh turtle are the most common. The birdlife of Gemenc and Béda-Karapancsa is of European importance, with populations of black storks and white-tailed eagles. The protection of the largest domestic black stork population is a priority of the national park. The white-tailed eagle is one of Europe's rarest birds of prey, using its huge nest at high altitude for decades. The undisturbed nesting of both birds must be ensured, as they are the most vulnerable to disturbance. The brown kite is still common in the Béda-Karapancsa landscape and is sensitive to changes in environmental conditions, making it an indicator species. Among the herons, the reedbeds are nesting sites for little egrets, great egrets, buckeyes, red herons and a few pairs of great egrets. The common grey heron breeds in willow groves. In the southern part of the area, the summer goose is an island species. During the migration season, thousands of bird visitors find feeding and resting places in the floodplain. Ducks, geese and cormorants often winter here. Endangered bat species find refuge in undisturbed forests. In the holes of old trees, the pond bat and the little bat find roosts and daytime shelter. The otter, adapted to an aquatic lifestyle, feeds on fish. The European beaver, having become extinct in the 19th century, was reintroduced to Gemenque. It has been reintroduced to the area and is now reintroduced as a wildlife colour. Active at night, the wildcat prefers only the more undisturbed forests bordering reed beds. The deer trophies taken in Gemenc are world famous.

5.1.4. RELEVANT OBJECTIVES FOR NATURA 2000 SITES

Conservation management objectives have been set for each Natura 2000 site. These are listed below and may or may not be affected by the proposed interventions.

5.1.4.1. Site of Importance for Nature Conservation

General objectives:

- The nature conservation objective of a Natura 2000 site is to conserve, maintain and restore the favourable conservation status of the species and habitat types on which it is based, and to ensure the natural condition on which the delimitation of Natura 2000 sites is based and management conditions consistent with the favourable conservation status.
- Converting artificial habitats (e.g. ploughs, tree plantations) in the area into a natural habitat type appropriate to the production site.

Specific objectives:

Duna[16]:

- Ensure the natural river bed building and dismantling processes.
- To stop the river from sinking further and, if possible, reverse the process.
- Ensure regular periodic flooding of natural floodplains, where possible, in line with natural flows.

Watercourses on the salvaged side (Zátonyi-Duna, Nováki canal, Zsejkei canal, Szavai canal and other water bodies connected to the salvaged side water compensation system):

- Provide the necessary amount of water (no more, no less) for the development and maintenance of characteristic communities.
- To maintain and enhance habitat diversity by preserving and promoting the development of water bodies with different flows, intermittent and persistent outflows, slowing and widening stages.

[16] The objectives for the Mosoni-Duna are not listed as they are not relevant in this case.

Blue-herbaceous fens on calcareous, peaty or clayey soils (Molinioncaeruleae) (6410) and Lime-loving wetland mires (7230) -

- Ensuring the ecological water requirements of habitat types, mainly by retaining water on the site (drainage, elimination of drying) and, where necessary, by recharging.

Hardwood forests along large rivers with Quercusrobur, Ulmuslaevis and Ulmus minor, Fraxinusexcelsior or Fraxinusangustifolia (Ulmenionminoris) (91F0)

- To provide (conserve) more dead wood, dead wood on the ground and dying on the ground than is currently the case, in order to protect the associated wildlife.
- Removal, where necessary, of species (e.g. acacia, green maple, Scots pine, black pine, black walnut) that are present in stands but do not occur naturally there

Light alder (Alnusglutinosa) and tall ash (Fraxinusexcelsior) woodland (Alno-Padion, Alnionincanae, Salicionalbae) (91E0)

- Conservation of spontaneously developing shrub and willow-shrub woodlands on reefs.
- To provide (conserve) more dead wood, dead wood on the ground and dying on the ground than is currently the case, in order to protect the associated wildlife.
- Removal, where necessary, of species present in stands but not naturally occurring there (e.g. acacia, green maple, black walnut, poplar, peach, nebanthemum, hedgehog)

Red-bellied pochard (Bombinabombina) and Danube newt (Triturusdobrogicus)

- Maintain small bodies of water that are permanent or at least remain free of fish cover for a significant part of the year.

Bog turtle (Emysorbicularis)

- Conservation of standing waters rich in floating and fixed seaweed vegetation.

Marsh dragonfly (Leucorrhiniapectoralis) -

- Preserving the character of marshy waters (oxbows, bogs, some canals, some mine lakes).
- Disconnection from the flow-through water supply system, providing only intermittent inflow.

Large firefly (Lycaenadispar)

- Spare riparian vegetation along watercourses, channels and water levels in known habitats and potential occurrence areas.
- Ensure adequate water supply, eliminate drainage.

Maculineanausithous butterfly (Maculineanausithous),Maculineateleius butterfly (Maculineateleius)

- Reducing reed encroachment.
- Ensure adequate water supply, eliminate drainage.

- Reducing reed encroachment.
- Ensure adequate water supply, eliminate drainage.

Wood dragonfly (Ophiogomphuscecilia)

- To maintain and improve the water quality of watercourses with potential habitat.
- Maintaining habitat diversity, especially maintaining and promoting the development of differently flowing spaces, especially in the coarse sand-sodic fraction.
- Maintenance and conservation of coastal shad stocks.

Honeysuckle (Osmodermaeremita)

- Sparing and preserving old, dying, dead trees to the limits of sustainability.
- Preservation, maintenance and restoration of natural and semi-natural floodplain woodlands.

Dull river mussel (Uniocrassus)

- Maintain habitat diversity, in particular to maintain and promote the development of differently flowing spaces on the branches of the recharge system, especially in the coarse sand-sodic fraction.
- Maintenance and conservation of coastal shad stocks.
- Reducing nutrient loading and pollution of watercourses by maintaining and/or creating a buffer zone and eliminating point sources of pollution.

Tiny snail (Anisusvorticulus)

- It should be assured of water quality and water availability in marsh-like waters, in particular by preventing nutrient inputs, habitat eutrophication and recharge.

Balin (Aspiusaspius), cutting strip (Cobitistaenia)

- Maintaining and creating spaces with different flows on the branches of the water recharge system.

Pale spotted minnow (Gobioalbipinnatus)

- Maintaining habitat diversity, providing spaces with different flows.
- Promoting the creation and maintenance of sandbanks.

Rainbow fistlet (Rhodeussericeusamarus)

- Maintaining habitat diversity, providing spaces with different flows.
- Maintaining and protecting habitats suitable for shellfish.

Broad durbin (Gymnocephalusbaloni) -

- Maintaining habitat diversity, providing spaces with different flows.
- Preservation of stone carvings and pavements where there is no other substantial reason to remove them.

Silky durbin (Gymnocephalusschraetzer)

- Maintaining habitat diversity, providing spaces with different flows.
- Promoting the creation and maintenance of sandbanks.

Stone drill strip (Sabanejewiaaurata), Hungarian bucó (Zingelzingel)

- Maintaining habitat diversity, providing and facilitating the development of spaces with different flows, especially in the coarse gravel-sodic fraction.

German buco (Zingelstreber)

- Maintaining habitat diversity, providing spaces with different flows and promoting their development also on the branches of the recharge system, especially in the coarse gravel-sodic fraction.

Botos cologne (Cottusgobio)

- Maintaining habitat diversity, providing spaces with different flows.
- Preservation of stone carvings and pavements where there is no other substantial reason to remove them.

Galóca (Huchohucho)

- However, maintaining habitat diversity, ensuring different flow spaces and the survival of the species cannot be achieved through local measures alone.

Rutiluspigus (Rutiluspigus)

- Maintaining habitat diversity, providing spaces with different flows.

Reticulates (Misgurnus fossilis)

- Preserving the character of marshy waters (oxbows, bogs, some canals, some mine lakes).
- Disconnection from the flow-through system, providing only intermittent inflow.

European beaver (Castor fiber)

- Sparing of streamside shrub grasses.

Vidra (Lutralutra)

- Providing ecological corridors.

Myotismyotis, Barbastellabarbastellus and other bat species

- Preservation of dead trees suitable for shelter during forestry works.

Northern sowbug (Microtus oeconomusmehelyi)

- Ensure adequate water supply and water dynamics, eliminate drainage.
- Preventing habitat denudation and tanning.

Red heron (Ardeapurpurea), pocgeon (Ixobrychusminutus), bufflehead (Botaurusstellaris), great egret (Egretta alba)

- Conservation of reed and sedge stands in nesting sites such as morotvans in oxbows.
- Ensuring adequate water levels.
- Ensuring the undisturbed nature of nesting sites (restricting forestry works and hunting activities around nesting sites).

Common Cormorant (Phalacrocoraxcarbo), Common Buck (Nycticoraxnycticorax), Black Stork (Ciconianigra), White-tailed Eagle (Haliaeetusalbicilla), Grey Heron (Ardeacinerea), Black Woodpecker (Dryocopusmartius)

- Conservation of mature softwood and hardwood riparian forest stands.
- Ensuring the undisturbed nature of nesting sites (restricting forestry works and hunting activities around nesting sites).

Little cormorant (Phalacrocoraxpygmeus), little buzzard (Mergusalbellus), common moorhen (Podicepscristatus), winged teal (Fulicaatra), cuckoo (Cygnusolor), mallard (Anasplatyrhynchos), Common Teal (Aythyafuligula), Common Teal (Bucephalaclangula), Common Duck (Larusridibundus), Common Gull (Laruscanus), Common Duck (Anascrecca), Common Teal (Aythyaferina)

- Ensure the undisturbed use of gathering places (restrictions on water sports and tourism and hunting activities) in the vicinity of significant gathering places.
- Ensuring the formation and natural development of reefs.

5.1.4.2. Danube and floodplain nature conservation area of priority importance

General objectives:

- The nature conservation objective of a Natura 2000 site is to conserve, maintain and restore the favourable conservation status of the species and habitat types on which it is based, and to ensure the natural condition on which the delimitation of Natura 2000 sites is based and management conditions consistent with the favourable conservation status.

Specific objectives:

Maintaining a favourable conservation status:

- To preserve the extent, structure and species composition of the area's river banks, marshes, reclamation meadows, hardwood and softwood forests.
- To ensure the survival of populations of candidate species in the area.

- Preservation of the Danube's fluvial character, the main branch's gravel habitats with high flow velocities, and gravel and sand reefs for the Hungarian sturgeon, German sturgeon, silky durbin, pale-spotted chub, Balkan stripe, especially Dunaalmás, Nyergesújfalu, Tát, Esztergom, Szob, Nagymaros, Verőce, Vác, Göd, Szigetmonostor, Érd, Rácalmás and the Kecske reef on both sides of the Danube in the area of the Szentendrei-Dunaág above the Tachi bridge.
- Preserving the remaining natural/near-natural banks, tributaries and backwaters of the Danube, ensuring the replenishment of wetland habitats, preventing the connection of islands to the coast, the filling of side branches and floodplains, and protecting the riparian zone.
- To maintain the condition of spawning, feeding and overwintering sites for species that are at least partly water-dependent in their life cycle.
- The proportion of alien tree species in the stands of designated forest habitats must not increase.

Development needed to achieve favourable conservation status:

- Conservation of the woodlands, swamps, grasslands, invasive weeds and cultivated species (*Acernegundo, Amorphafruticosa, Ailathusaltissima, Prunusserotina, Populus x hybrida, Impatiensglandulifera, Impatiensnoli-tangere, Phytolaccaamericana, Solidagogigantea, S. canadensis, Asterspp.*, etc.) to protect habitats.
- Developing and implementing the rehabilitation of tributaries for conservation purposes, adopting a river basin approach to the currently planned tributary rehabilitation in each municipality: determining the proportion of different types of tributaries (eu-, para-, plesio- and paleopotamon) per section and then putting this into practice in the development of tributary rehabilitation and new habitats.
- In order to protect the silky wagtail, the Hungarian wagtail, the German wagtail, the pale-spotted otter, the balin, the marten, it is necessary to designate shallow reef areas as a protected area. In these areas, wave action should be limited at low tide, especially at night, especially in the following areas: Szob reefs, Zebegényi Island, Dömös reefs, the upper tip of Szentendre Island, Verőce reefs, Kompkötő Island, Vác, the area around Torda Island, the lower entrance to Égető Island, Gödi and Surányi reefs, and in the Szentendre Danube Lagoon, Kecske Reef, Kacsa Island, Lupa Island and the reefs of the Szentendre Bend.
- To carry out more accurate mapping of shallow reef areas in other stretches of the Danube. Determine the water levels in the designated areas below which the surge is causing mass mortality of spawning fish, and then take the necessary speed limit measures and communicate them by means of signs and notices to boaters.
- Creating new spawning grounds.
- To ensure the survival of the common bat (*Myotismyotis*) populations in the area, partly by maintaining the grassland and partly by maintaining the river banks and the woodland along the river banks.
- To protect the common beaver (*Castor fibre*), ensure the undisturbed presence of herbaceous and woody vegetation within a 15-metre riparian zone around its known habitats.
- Keeping the estuaries of small watercourses flowing into the Danube in a natural state, ensuring the passage of aquatic organisms.
- Preventing the Danube from sinking further in a way that benefits nature conservation.
- Removal of weeds and waste from illegally established material extraction sites and landfill sites, prevention of further dumping, reclamation by the creation of native woodland without disturbing the original landforms.
- Alignment of shipping development concepts with nature conservation objectives.
- Shaping the conservation attitudes of water users.

5.2. RESULTS OF FIELD SURVEYS

5.2.1. FIELD SURVEY METHODOLOGY

One of the most significant impacts of the planned waterway development interventions under the project is expected to be on wildlife as an environmental element, and therefore a strong emphasis has been placed on field data collection on the impacting organism assemblages. An important consideration in the selection of the habitat groups to be studied was to identify habitat groups that include species with high indicator values that are likely to be sensitive to the impacts that may occur or change as a result of the proposed interventions. An important criterion for the selection was to know as much as possible about the habitat requirements and indicator characteristics of the species concerned. The planned interventions affect water bodies covered by the Water Framework Directive (WFD) and are likely to affect their ecological status, so the assessment of the biota also covered the biological quality elements required for the ecological status assessment required by the WFD. In addition, all of the proposed interventions will take place within Natura 2000 habitat network areas, so in order to objectively assess and evaluate the effects on the designation objectives of the Natura 2000 sites concerned, the wildlife surveys have included the candidate habitat types and candidate species of the Natura 2000 sites concerned.

Considering the types of interventions envisaged, the aquatic species groups most affected are aquatic invertebrates and fish. Thus, the level of detail of the field survey is also highest for these groups.

Based on the above criteria, the habitat surveys carried out under the project covered the following groups of organisms:

- Fitoplankton
- Invasive diatoms
- Higher vegetation
- Macroscopic aquatic invertebrates, including 10 groups of organisms: higher crustaceans, leeches, water snails, mussels, dragonflies, crustaceans, pseudocrustaceans, aquatic and surface bugs, tunicates, aquatic and water-associated beetles.
- Terrestrial invertebrates, including xylophagous and saproxylic beetles of Community importance and butterfly species of Community importance, including candidate species of the Natura 2000 sites concerned.
- Fish
- Amphibians and reptiles
- Birds
- Bats
- Other mammal species of Community interest (otters and Eurasian beaver)

The sampling sites were selected with the following criteria in mind:

- The network of sampling sites covers all VKI water bodies (Danube sections) where intervention is taking place.
- The network of sampling sites should cover all Natura 2000 sites where an intervention is taking place.
- The network of sampling sites should cover as many of the intervention areas as possible.
- For each type of intervention, there should be an appropriate number of samples (at least 3, but 5 is the target) from each section with different substrate and flow conditions.

– Control samples should be taken from sites with the same or very similar planned interventions, but with a long history of interventions.

For the phytoplankton and diatom surveys, a total of 40 sampling sites were selected in the Danube section between Szob and the southern border. Sampling was carried out using the sampling protocol used in national monitoring practice according to the requirements of the Water Framework Directive. Field sampling took place in the first half of August 2019.

For the survey of macroscopic aquatic invertebrates, 44 sampling sites were selected for the coastal littoral region and 56 sampling sites were selected for the mid-bottom region. Sampling of macroscopic aquatic invertebrate organisms in the coastal littoral region using the National Biodiversity Monitoring System protocol for community-based monitoring of macroscopic aquatic invertebrates. Surveys of the intertidal benthic region were carried out using a dredge net towed from a boat. Field sampling took place between early August and late September 2019. In addition, additional sampling was conducted in August 2020 at 17 additional sampling sites in the inter-bed bottom region and 1 sampling site in the coastal littoral region.

A field survey of the fish assemblage was carried out at 74 sampling sites along the stretch between Szob and the southern border. One part of the surveys was a traditional electrofishing survey with a gill net in the coastal littoral region, while the other part was an electrofishing survey with an electric brush to investigate the fish assemblage of the inter-basin bottom region. The field research fishery took place between early August and late September 2019. In addition to the surveys planned in 2019, additional sampling was carried out in August 2020 at 17 sampling sites with electrofishing gear in the inter-basin bottom region and at 1 sampling site with conventional electrofishing gear in the coastal littoral region.

For more than 20 years, we have been carrying out surveys on the macroscopic aquatic invertebrate and fish assemblages of high importance in the Danube for various projects in the domestic section of the Danube. The survey results are stored in a database. In order to obtain a more complete picture of the composition of the species assemblages of the Danube section concerned, we have carried out a series of surveys in the Danube basin. In addition to the current surveys carried out in the framework of the present project, the results of 262 aquatic macroinvertebrate sampling and 87 research fisheries in the Danube between Sób and the southern border, dating back to 2005, were taken into account in the characterisation of the aquatic macroinvertebrate assemblages of the Danube section affected by the planned interventions and in the assessment of the expected impacts.

Surveys of phytoplankton, coated diatom, macroscopic aquatic invertebrate and fish species assemblages were typically concentrated in the waterlogged parts of the riverbed, even during the low water period. In order to investigate the areas of the Danube between the Sób and the southern border of the country, which are only periodically covered by water (e.g. reefs with varying degrees of vegetation), tributaries and the coastal margins of the mid-water bed, and which are affected by the use of land-based construction works, a total of 45 survey areas were identified in the Danube stretch between the Sób and the southern border of the country, which are representative of the habitats affected by the different types of interventions planned under the project. In these survey areas, topical field surveys were carried out on higher vegetation, terrestrial invertebrates (including xylophagous and saproxylic beetles of Community importance and butterfly species of Community importance, including candidate species of Natura 2000 sites), amphibian and reptile species assemblages, avifauna, and mammalian fauna, such as otters and Eurasian beavers. The surveys were carried out in late spring-early summer 2020. Surveys were conducted using the territory mapping method for birds, visual search for life tracks (carcass, footprints, chew marks, scat, etc.) for otters and Eurasian beavers, while the National Biodiversity Monitoring System methodology protocol was typically used for the other groups of organisms. Based on field survey experience in 45 survey areas, 17 survey areas were selected for bat surveys. These were mainly areas with a higher proportion of old trees with holes that appeared to be suitable for bats. Here we conducted surveys in the summer of 2020 using ultrasound detectors capable of recording bat calls to assess bat faunal composition and density.

5.2.2. HIGHER VEGETATION

In the northernmost part of the section, in the Vác-Pesti-Danube Valley sub-region, water-bound, identical habitat types have developed on the Danube banks. A large part of the landscape is floodplain, with pioneer reef vegetation and the entire riparian zone - shrub grassland, soft and hardwood forests - with only remnants of the latter. Some of the willow-shrub woodland is in good condition, but has been degraded by intensive use in many areas and replaced by the planting of willow-shrubs in others. Floodplain reedbeds, marshland and, rarely, boggy heaths are found along the edges of the woodland. In the late Holocene, highly calcareous quicksand of the interior of Szentendrei Island and in some areas of the Pest side, the lowland sandy vegetation is typical: open sandy shrub grasslands, closed sandy steppe meadows with rarities such as the *Ephedradistachya* or the *Colchicumarenarium*.

The Danube floodplain running along the western part of the Csepel plain and the Solti plain also has a more or less continuous floodplain vegetation, which tends to be fragmented only in the Solti plain. Their current vegetation is characterised by softwood and hardwood forests and their white aspen derivatives. There are also a high proportion of tree plantations on the site. A typical plant rarity is the native black hawthorn (*Crataegusnigra*).

In the Sárköz area, the former floodplain of the Danube is nowadays predominantly a flooded and inland flooded cultural landscape. However, the remaining floodplain is home to Gemenc, the largest floodplain forest in Central Europe. The natural forests in the area are mainly oak-ash-woodland and white ash-woodland. The white willow groves have declined, with an even smaller proportion of black ash groves, which are mainly replaced by plantations of noble poplar and willow. Black walnut and acacia plantations are also common in the higher elevations of the floodplain. On the sandy reefs of the Danube and on the mudflats along its tributaries and backwaters, shrub grasses grow. After the water recedes, pioneer dwarf cactus communities appear on the silt surfaces. A native species of the floodplain is the black hawthorn (*Crataegusnigra*), which occurs in several forest communities and also forms a stand-alone shrub. Other valuable plant species are the curly marigold (*Carpesium abrotanoides*) and the stunted sedge (*Carexstrigosa*). The marshes have a rich seaweed vegetation. In the most southerly part of the section, even in the Mohács Island small area, semi-natural vegetation is more likely to remain along the Danube. The latter is also significantly influenced by intensive forest and game management. The most significant natural forest communities are oak-ash-siliceous groves, while willow and aspen groves occupy the lower floodplain levels. However, this natural picture is often replaced by plantations of cultivated forests (black oak, noble aspen, acacia, or plantations of white willow, white aspen, and sometimes pedunculate oak).

Of the interventions planned as part of the fairway development, typically only those that affect higher vegetation will be on surfaces that are dry at low and mid-water levels. In addition, interventions that are likely to be carried out from the shore are likely to affect vegetation and will require the temporary use of a few metres of riparian strip as a staging area or work area. During the field data collection, detailed botanical surveys were carried out at a total of 45 sites where there is a likelihood of working from land, and therefore of the coastal strip being affected and the higher vegetation there being at least temporarily degraded during the construction phase of the proposed interventions.

In the following, we review the characteristics of the higher vegetation in the area of influence by habitat type, focusing of course on those habitat types whose higher vegetation is expected to have an actual impact.

5.2.2.1. Vegetation of habitats likely to be dominated by woody shrubs

The intervention areas or potential intervention areas investigated typically covered the riparian zone of the Danube's mid-water basin, where a significant proportion of *willow-grassland floodplain forests* (General Habitat Classification System habitat code - hereinafter referred to as Habitat Classification System code - J4) were found. This habitat type is a typical natural habitat of riparian areas. Habitat was found in 31 sampling areas out of 45 study areas (with some intervention areas having only a subplot for the respective intervention area). The most common habitat type within the habitat type was *white willow floodplain forest*. Among the tree and shrub stands belonging to the natural and semi-natural habitats, *hardwood floodplain forest* (SNAP code J6) and *riverine shrub woodland* (SNAP code J3) habitats were also found. The latter occurred at 3 sampling sites, while habitat type J6 occurred at 2 sites.

Taking into account the co-occurrence of these habitats, a total of 33 intervention areas contain at least 1 of the habitat types mentioned above. Potential natural and semi-natural woodland (and riverine shrub woodland), which are compatible with the habitat conditions, are therefore clearly predominant in the area of intervention. In addition to the above habitat types, there was also a significant proportion of wooded habitats belonging to the habitat group of *forests and wooded plantations dominated by alien tree species.* Most of these are *spontaneous stands of non-native tree species* (NACE code S6). These forests are dominated mostly by green maple (*Acernegundo*) and secondarily by American ash (*Fraxinuspennsylvanica*). These stands have typically been created by the 'degradation' of *willow-woodland floodplain forests.*

As the old native softwood forests become blue-stocked (replacing the fallen trees), alien and invasive tree species of North American origin appear, and as the process progresses, their cover exceeds that of native tree species. In the final phase, old, often dying native tree species (*Salix alba, Populus × canescens*, *Populusnigra* of hybrid origin) remain in the stand as isolated trees or small groups of trees for a long time, towering above the invasive species. Habitat type S6 occurs at 7 of the 45 sites sampled, where the natural and semi-natural tree and shrub stands mentioned above are absent.

Apart from these, some sampling sites were dominated by native softwood species, but a featureless forest belt (RB) was found in the intervention area. These, juveniles regenerating after timber exploitation or uncharacteristic stands at higher altitudes and drier growing conditions, not reflecting the character of a grove, or planted stands of grey ash (*Populus × canescens*) were also present.

In addition, a park-like area in a coastal recreation area and a partially maintained coastal promenade in another location are also affected by the interventions. From a conservation and botanical point of view, in terms of the tree and shrub population (which covers the majority of the intervention area), the 33 sampling sites where natural or semi-natural tree and shrub populations as discussed above occupy the intervention area (habitats J4, J6, J3) are noteworthy.

In the study areas affected by the planned interventions, *riverine shrub grasses* (SAC code J3) do not occur individually in the intervention area to any significant extent. They are generally small, species-poor stands of medium naturalness with *Salix alba* and *Salixtriandra* species. Their species composition (herbaceous) does not differ significantly from that of the surrounding white willow floodplain forests. Species present include *Rorippasylvestris, Phalarisarundinacea*, with a border of *Solidagogigantea in* many cases on the edges.

White willow floodplain forest is a common and dominant type of *willow-shrub floodplain forest* (SAC code J4). This habitat is common and widespread along the Danube. In most cases, middle-aged stands were found, but also distinctly old stands occur. In almost all cases, these forests contain significant amounts of deadwood, although there is considerable variation. Self-hibernation already results in significant amounts of deadwood in young to middle-aged stands. In several places, however, we observed that lying deadwood is almost absent in some stands, despite the apparent significant amount of self-maturation. These sites are the more frequently flooded stands, where herbaceous vegetation is also low cover (subnudumtipus). Here it is likely that the lying deadwood is 'transported' from the area by flooding. However, in middle-aged and older stands, both standing and lying deadwood are present in very high abundance (thin to thick) in most cases.

The canopy is mostly single-storey, with a canopy cover varying between 40-75%. Depending on the age of the stand, it corresponds to the height of the lower or upper canopy level. Dominated by *Salix alba*, alien tree species are present (*Acernegundo, Fraxinuspennsylvanica*) but typically do not reach a higher canopy cover. The shrub layer is typically absent or sparse. It is composed of *Acernegundo, Fraxinuspennsylvanica* or, less commonly, *Cornussanguinea* and *Acersaccharinum. Amorphafruticosa* is sporadic, but does not reach major cover. In most cases, the grassland is distinctly species-poor. The absence (and low cover) of floodplain-preferring marsh and riparian species and the (often massive) presence of the alien invasive *Solidagogigantea are* common in the stands studied. This phenomenon is the main determinant for the assessment of naturalness. For this reason, populations with a higher than medium naturalness were only rarely found. The wetland riparian species present in almost all stands are *Rorippasylvestris, Phalarisarundinacea, Irispseudacorus, Agrostisstolonifera*. *Rubuscaesius* and *Urticadioica are present in* many places and the presence of seedlings (or new growths) of the two above-mentioned invasive tree species is generally characteristic of the grassland. It was observed that in many cases these species-poor, low to medium natural white-grass floodplain forests occur along (partly on) paved bank stabilisation and in the filled areas between the spurs extending perpendicularly into the bed. It is possible that both their large extent and their medium (sometimes low) naturalness may be related to their occurrence in secondary habitats.

The tree structure of the better conditioned stands with high naturalness does not differ from the previous group, but the grassland is species-rich and the *Solidagogigantea* cover is low. In our opinion, these stands have a more even water supply, are less likely to dry out, and are moist (humid) for most of the year due to their location.

Semi-natural white willow (*Salix alba*) dominated floodplain grove of softwoods with many dead trees

Typical species (extracted, aggregated list of species from the sampling sites mentioned): *Lyrsiaorysoides, Phalarisarundinacea, Scutellariagalericulata, Ranunculusrepens, Lycopuseuropaeus, Rorippasylvestris, Urticadioica, Rubuscaesius, Myosotispalustris, Barbareastricta, Lycopuseuropaeus, Carexriparia, Carexremota, Galiumelongatum, Rumexpalustris, Scrophularianodosa, Rorippaamphibia, Symphytumofficinale, Aristolochiaclematitis, Chelidoniummajus, Glechomahederacea, Myosotonaquaticum, Lysimachianummularia, Polygonumhydropiper, Polygonumlapathifolium, Juncuscompressus, Potentillasupina, Veronicaanagallis-aquatica, Poanemoralis, Irispseudacorus, Bidenstripartita, Calystegiasepium*. In addition to these, invasive herbaceous species and weedy species (or internal weeds) not associated with marsh-coastal habitats are also present but not abundant: *Bidensfrondosa, Galiumaparine, Solidagogigantea, Rumexobtusifolius, Taraxacumofficinale, Stenactisannua,* *Impatiensparviflora, Vitisriparia, Hordeummurinum, Sonchusoleraceus*. However, these species were also found in lower natural white willow floodplain forests.

The other types of will*ow-poplar floodplain forest* (NACE code J4), white poplar floodplain forest and black poplar floodplain forest, are characterised as a single unit (hereafter referred to as poplar groves). These forests of *Populus* species are characteristic of the higher floodplain levels. The type was found at 5 sampling sites, but only 1 case was found as a stand-alone habitat. In 4 cases the habitat co-occurs with white willow floodplain forest. However, the two types are generally sharply spatially separated, with transitions less common. In many cases, the two types are clearly visible on different landforms (e.g. the willow grove in the foreground of an older paved bank revetment, while the aspen grove is on or above the pavement). The aspen groves are generally middle-aged, often thinning stands, mostly of medium naturalness. In the lower canopy and shrub layer, there is a significant cover of *Acernegundo* and *Fraxinuspennsylvanica*, but also native shrub species *Viburnumopulus, Crataegusmonogyna, Ligustrumvulgare*. The grassland layer is mostly weedy and species-poor (only the minimum species set is found), with medium (sometimes low) naturalness.

Summer-dominated riparian semi-natural riparian woodland with siliceous woodland

The habitat *Hardwood Floodplain Forests* (SAC code J6) occurs in two sampling sites. In the grassland level of the stands of medium naturalness, we found species of heath and general woodland: *Lamiummaculatum, Alliariapetiolata, Brachypodiumsylvaticum, Polygonatumodoratum, Geumurbanum*. In one of the study areas, a sparse upper canopy layer was found, mainly composed of *Populus × canescens*, but also *Quercusrobur* and *Fraxinusangustifolia*. In the other survey area *Quercusrobur is* dominant.

Habitat profile of a hardwood grove dominated by pedunculate oak (*Quercusrobur)*

5.2.2.2. Vegetation of habitats likely to be dominated by herbaceous vegetation

Barren habitats play a subordinate role in the area of intervention (although they may be extensive in some years at lower water levels). In some cases their occurrence is associated with typical land use related to human activity. Where coastal paths and footpaths are affected along coastal stretches close to residential areas, species-poor *featureless grassland* (SAC code: OB) or possibly *featureless unvegetated wetland* (SAC code: OA) may occur.

The habitat type of *herbaceous tussocks* of *Solidagogigantea* (GIS code: OD) is also common, often occurring in the clearings and riparian margins of the Willow-grass floodplain forests. In many cases *Solidagogigantea* is also the species with the highest cover at the grassland level of the forest, but in this case it does not appear as a habitat in its own right (it is, however, included in the characterisation and species list), alongside the typical habitat code of the forest.

Open habitats of higher conservation and botanical value were encountered only sporadically. This is partly due to the fact that these habitat types develop intermittently on drying riverbeds after a prolonged period of low water and typically reach their peak in the second half of summer and early autumn. Thus, the timing of the early summer survey was not optimal for surveying the habitat type of *natural pioneer wetland vegetation* (GIS code I1). The higher than average water levels at the time of the field survey did not help the detection of the habitat, but it was nevertheless found at 1 sampling site. However, in our opinion, as a habitat type of potential concern, it can be considered in almost all surveyed areas at the edge of the mid-water bed.

This habitat is often interspersed with, and sometimes difficult to separate from, the *trampled weed and ruderal mudgrass* habitat (GIS code: OG), whose stands, including natural pioneer species, are also important habitats from a conservation and botanical point of view. For the reasons described for the previous habitat, it is likely that this habitat was also under-represented in our field sampling. However, the habitat type could be considered as a potential impact habitat over a larger area.

The invasive and alien tall goldenrod (*Solidagogigantea*) is common in the edges of groves, in the undergrowth of groves and in treeless communities, and unfortunately often forms almost monodominant stands

Sporadic occurrences of 1 protected plant species were detected in the coastal study areas affected by the planned interventions. This species is the **summer peat moss (*Leucojumaestivum*), which has a** conservation value of 10,000 Ft.

5.2.3. CONSERVATION IMPORTANCE OF XYLOPHAGOUS AND SAPROXYLIC BEETLE ASSEMBLAGES

The mid-water bed of the Danube stretch between Szob and the southern border of the country affected by the planned interventions is mostly covered by woody vegetation, except for the sections crossing Budapest and other settlements. The dominant habitats with woody vegetation accompanying the bed are mainly natural softwood forest habitats. Species of xylophagous and saproxylic beetles (feeding on woody debris (xylem) of living and dead woody plants) of conservation importance are naturally expected to occur in the forest habitats affected by the proposed interventions. Although the planned interventions will mainly take place in the mid-water and mostly in the small water, the near-coastal interventions will not exclude the possibility of a banded coastal migration and work area impact, which in most cases will affect forest habitat. There are also sporadic occurrences of tree species in existing quarries affected by rebuilding, expansion or demolition, which may provide habitat for xylophagous and saproxylic beetle species.

Among the species of xylophagous and saproxylic beetles occurring along the Danube, the species of the hermit beetle (*Osmodermaeremita*), the great horned beetle (*Cerambyxcerdo*), the great horned beetle (*Lucanuscervus*) and the scarlet beetle *(Cucujuscinnaberinus) are of* Community importance and protected by law in Hungary, and are considered as candidate species in the Natura 2000 sites concerned.

Along the stretch of the Danube between the Sób and the southern border, the riparian strips affected by the planned interventions contain only a small proportion of hardwood forests with a significant amount of mature oak, which may provide suitable habitat for the great crested newt (*Cerambyxcerdo*). It was not found in the study areas during our surveys, but its occurrence and minimal impact cannot be completely excluded.

Neither the presence of the hermit beetle (*Osmodermaeremita*) nor the great horned beetle (*Lucanuscervus*) can be excluded. The great horned beetle also prefers mainly hardwood stands with oak, which are present in small proportions in the area strips affected by the planned interventions, but it also occurs in old willow stands, and is therefore sporadic in willow-dominated softwood stands. The impact of the big horned beetle is also found to be small. There is also a low probability of occurrence of the hermit beetle in the typically small patchy habitats potentially affected by the proposed interventions, as the field surveys in the intervention areas as a whole only found a few standing dead trees in a suitable stage of senescence in which the presence of larvae cannot be excluded.

Contrary to the above, suitable habitats for the scarlet beetle *(Cucujuscinnaberinus)* are common in the intervention areas, especially in the *willow-grassland floodplain forests* (SAC code J4). Larvae of the species were detected in two of the planned intervention areas surveyed. In both cases in white willow-dominated floodplain woodland

The *willow-shrub floodplain forests* (SAC code: J4) and *hardwood floodplain forests* (SAC code: J6) are considered to be important habitats for the species. The surveyed intervention areas (45 in total) were typically located along the Danube riverbanks, where a significant proportion of *willow-shrub floodplain forests* (J4) were found. Habitat was found in 31 sampling areas. *Hardwood riparian forest* (J6) habitat was found in 2 sites. These habitats occur in a total of 32 planned intervention areas (at least 1 habitat from the above mentioned with at least a sub-area). In addition to these habitats, *spontaneous stands of non-native tree species* (S6) and sporadic stands of decaying native tree species (*Salix alba, Populus × canescens*, *Populus nigra* of hybrid origin) in the form of single trees or small groups of trees in forests consisting of *groups of trees, tree-lines, forest strips* (RA) of native species are also considered as potential habitat for the scarlet tanager. In addition, the species can be assumed to occur in all coastal areas where old, decaying softwood species (including planted stands of regenerated willow species) are present.

Overall, the presence of the **scarlet beetle *(Cucujuscinnaberinus)*** can be assumed in a significant part of the intervention areas. Habitats of particular importance for this species are *willow-herb floodplain forests* (J4) and *hardwood floodplain forests* (J6). In the other habitats mentioned above, only possible (sporadic) occurrences are assumed, and these are not habitats of high importance for the species. We note that the species was detected in two of the three intervention sites of high conservation and botanical importance in the *willow-barren floodplain forests* (J4), while it was not detected in the low-medium naturalness *willow-barren floodplain forests* with similar intensity of search (sampling), thus suggesting that the lower naturalness stands may support lower single-density populations.

Larva of a scarlet beetle (*Cucujuscinnaberinus*) on a standing white willow specimen in the study area, already dying, under stripped bark

However, in our opinion, the sampling of the species is cumbersome, the sample size is not sufficiently representative, the above mentioned correlation cannot be tested on the basis of the small number of samples available, and it is not suitable for drawing far-reaching conclusions. It cannot therefore be claimed that the **scarlet beetle** does not occur in the lower natural *willow-shrub floodplain forests*.

5.2.4. MACROSCOPIC AQUATIC INVERTEBRATE ASSEMBLAGE

The term aquatic macroscopic invertebrate refers to a group of organisms with a broad taxonomic coverage, visible to the naked eye in the field, closely associated with the water at some life stage, but with different life history strategies. They are characterised by a wide range of life form types. Some species are fully attached to water, others only at certain developmental stages. They can be found in almost all types of water bodies, inhabiting the whole water space, being found in the upper layers of the sediment surface of the bed as well as in the surface membranes of the water. Their small-scale spatial variability, i.e. the diversity of habitat preferences, is well developed, making them suitable for habitat and environmental assessment.

They play a diverse role in aquatic food webs. On this basis, they can be divided into general functional groups (shredders, foragers, grazers and predators). Shredders are defined as organisms that utilise coarse-grained organic matter, foragers as organisms that filter out fine and ultrafine particulate organic matter from transported material or collect it from sediments, grazers as organisms that consume algal blooms adhering to the surface, predators as organisms that prey on self-motile organisms or suck body fluids from organisms.

They are excellent for describing water quality status, because their quantitative relationships do not represent the instantaneous state, but indicate changes over a longer time scale, due to their different generation times. It is no coincidence that aquatic macroscopic invertebrates have traditionally been used to calculate water quality indices. Due to their phenological characteristics, the examination of a group alone at a given time is not sufficient to objectively determine status, and therefore community-based studies are of paramount importance.

Aquatic macroscopic invertebrates are considered to be one of the main species assemblages affected by the proposed interventions, as the proposed interventions are typically concentrated in the small and mid-water bodies, which are the habitat of the aquatic macroscopic invertebrate assemblage.

A total of 82 sampling points were sampled in the summer of 2019 in the basin sections affected by the planned interventions. Some of the surveys were conducted in the coastal littoral region, while others were conducted in the mid-basin depth region. In addition, the results of a further 262 samples taken in the section of the Danube between the Sób and the southern border of the country dating back to 2005 in the framework of other projects were taken into account in the characterisation and assessment of the aquatic macroscopic invertebrate assemblages of the Danube section affected by the interventions planned within the framework of the project.

Rainfall on the inland stretch of the Danube typically decreases from the inter-island section towards the southern border. In parallel, the typical flow velocity decreases somewhat, and the fraction size and composition of the river bed material also changes. These changes are typically not abrupt, but rather a continuous transition. In any case, in the section below the Sió estuary, the river sand fraction dominates practically in most of the cross-section and the proportion of coarse gravel sediment is reduced to a minimum. This also has a significant impact on the composition of the aquatic macroscopic invertebrate fauna, since most of the aquatic macroinvertebrate fauna of the Danube is benthic, i.e. it lives and feeds on the surface or in the upper layer of the sediment. For this reason, the aquatic macroscopic invertebrate assemblages of the section between the Sava and the Sioen estuary and of the section between the Sioen estuary and the southern border are characterised separately.

5.2.4.1. Description of the aquatic macroscopic invertebrate assemblages of the Danube section between the Sió and the Sio estuary

Assessment of the macroscopic aquatic invertebrate assemblage of the coastal littoral region

A total of 125 macroinvertebrate taxa belonging to 10 major taxonomic groups were confirmed in the Danube sampling sections designated for study as a result of surveys carried out in the summer growing season of 2019 in connection with the impact assessment of the interventions planned in the framework of this project, and as a result of quantitative and faunistic surveys carried out in the Danube section between the Sioux-Sioux estuary before 2020 in other studies related to other projects. According to the results of the surveys, 21 water snails (Gastropoda), 23 bivalves (Bivalvia), 5 beetles (Coleoptera), 11 crustaceans (Ephemeroptera), 1 pseudocrustacean (Plecoptera), 11 dragonflies (Odonata) were found in the study units, 7 bugs (Heteroptera), 10 leeches (Hirudinea), 22 higher crabs (Malacostraca) and 15 quiver crabs (Trichoptera) (in some cases the species can only be identified to genus level).

The protected macroscopic invertebrate species of conservation value detected in the Danube between the Sava and Sioen estuaries were *Astacusleptodactylus*, *Borysthenianaticina, Ephoronvirgo, Fagotiadaudebartiiacicularis, Fagotiaesperi, Gomphusflavipes, Gomphusvulgatissimus, Pseudanodontacomplanata, Theodoxusdanubialisdanubialis*.

In the littoral region of the Danube between the Sób-Sió estuary, the composition of the riverbed is dominated by river gravel (microliths 2-6 cm) and small gravel and gravel fragments (akal 2-20 mm), which is due to the high flow velocity. The section is characterised by a high proportion of artificial habitats formed by bank protection rock scatters, in addition to naturally occurring habitat types.

As a result of the surveys, a total of 21 species of water snails were confirmed in the Danube section surveyed. The snail fauna of the Danube is based on species that are typical of rivers with coarse riverbeds and are adapted to the current (e.g. *Fagotiadaudebartiiacicularis*, *F. esperi*, *Theodoxusdanubialisdanubialis*, *T. fluviatilis*), including valuable protected fauna elements (e.g. *Fagotiadaudebartiiacicularis*, *F. esperi*, *Theodoxusdanubialisdanubialis*). In addition to these, *Ancylusfluviatilis,* which is specifically associated with firm - gravel - substrates, was also found in the main branch of the Danube. In the Danube's lower-flowing riverbeds and coastal flow dead zones, type-specific character species (e.g. *Bithyniatentaculata*, *Borysthenianaticina*, *Lithoglyphusnaticoides*, *Radix balthica*, *Valvatapiscinalis*, *Viviparusacerosus*), which prefer habitats with finer bed material and are typical of the water body type, are also represented. In addition, metaphytic gastropod species (e.g. *Galbatruncatula*, *Gyraulusalbus, Lymnaeastagnalis*, *Physellaacuta*, *Radix balthica*), which may drift from small waters in direct contact with the Danube to the main branch, are regularly found in low densities as a sintering element.

The snail (*Theodoxusdanubialis*) is a protected character species that still occurs in high densities in the Danube section between the Sio and the Sio estuary

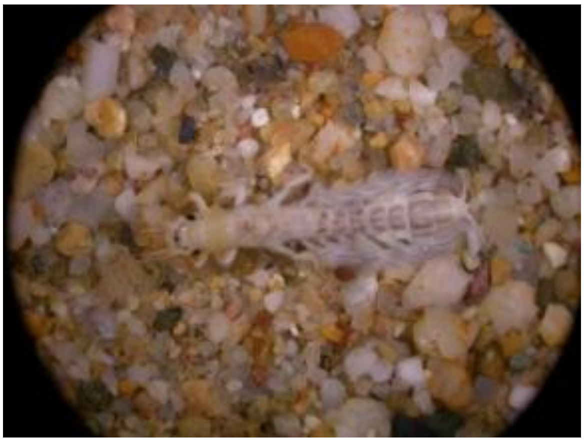
In the mussel assemblage, mainly the Danube faunal elements (e.g. *Anodontaanatina*, *C. fluminea*, *Dreissenapolymorpha*, *Sphaeriumrivicola*, *Sph. solidum*) and the mussel species typical of larger rivers with fine sediment (e.g. *Pisidiumamnicum*, *P. henslowanum*, *Uniopictorum*, *U. tumidus*) occur in higher numbers. Among the faunal elements, there is a significant proportion of alien species with high colonisation potential and typically invasive species (e.g. *Corbiculafluminalis, C. fluminea, Dreissenapolymorpha, D. bugensis*). In habitat fragments with the finest fractional size, where water flow is almost absent (e.g. along the flow-free dead zones of water diversion works), individuals of the alien mussel species *Sinanodontawoodiana* are established. It is noteworthy that specimens of the protected, native flat pond mussel (*Pseudanodontacomplanata)* were detected in several sampling sections (Foktő, Paks, Fajsz).

The leech fauna of the surveyed sampling section is very poor. The leech species *Alboglossiphoniaheteroclita*, known as ectoparasites of reptiles and amphibians, the widespread fish parasite *Piscicolageometra and the* less common *Caspiobdellafadejewi* and Italobdellaciosi species were also detected. We also detected *Dina punctata, a* predatory leech species, one of the most characteristic native leech species of the Danube, and *Barbroniaweberi*, an introduced species detected in Hungary only a few years ago, which feeds on small macroinvertebrates (e.g. crabs, small invertebrates, etc.). In addition to these, we have also confirmed the colonisation of taxa with a national distribution (e.g. *Erpobdellaoctoculata, Helobdellastagnalis, Glossiphoniacomplanata*).

The higher crayfish fauna of the Danube is very diverse in Hungary. A total of 22 species of higher crayfish have been confirmed in the Danube section studied. The fauna of the Danube high-band crayfish fauna includes populations of several alien species, which, due to their abundance, are also considered to be specific character species of the Danube water body type. Thus, the type-specific character species included *Jaeraistri of* the order Isopoda with a Ponto-Caspian distribution and a benthic lifestyle, and the *Amphipoda Corophiumcurvispinum*, *Obesogammarusobesus*, *Dikerogammarushaemobaphes*, *D. bispinosus, D. villosus* and *Echinogammarusischnus*. In addition, there are also specimens of *Gammarus* species (e.g. *Gammarusroeselii*), which are more typical of hilly and mountainous watercourses and which are most likely to have been introduced from small watercourses in the inlet. The presence of species of Ponto-Caspian origin (*Corophiumrobustum*, *Echinogammarusischnus, Obesogammarusobesus*), which are also rapidly spreading, is noteworthy, as is the occurrence of specimens of species that appeared in the domestic Danube section only a few years ago, but which have become more abundant in the Danube section since their first appearance in recent years (*Echinogammarustrichiatus*, *Hemimysisanomala, Katamysiswarpachowskyi, Paramysislacustris*). In our previous studies, we detected specimens of the native protected goatfishes (*Astacusleptodactylus*) from the Isle of Samogitsa Danube section. Of the invasive alien Decapoda species in our country, we confirmed the presence of specimens of *Orconecteslimosus in the* sampling section at Foktő.

***Dikerogammarusvillosus* is an alien crayfish species with a ponto-caspi distribution, which, thanks to its invasive spread, is nowadays widespread throughout the entire domestic Danube stretch and is one of the typical Danube flea crayfish species**

The cortical fauna of the studied section of the Danube was mainly dominated by taxa of cortical species typical of rivers with coarse riverbeds (e.g. *Baetisbuceratus*, *B. pentaphlebodes*, *Ephoronvirgo*, *Potamanthusluteus*). In addition, specimens of characteristic bark beetle species typical of hilly rivers with small gravel beds (e.g. *Baetisfuscatus*, *Ephemerellaignita*) were also detected. In addition to species associated with gravel and pebbly substrate, occasional bark beetle species characteristic of our larger rivers, mainly occurring on substrate formed by xylem (submerged twigs, roots) or plant debris (e.g. *Caenisluctuosa*, *Heptageniaflava*, *H. sulphurea*). In the flow dead zones in some areas of the main pool, on the accumulated fine-grained sediment surface and on any aquatic vegetation that may have colonised it, bark beetles of vegetated watercourses (e.g. *Ephemeralineata*) and species that are mainly characteristic of standing water (e.g. *Cloeondipterum*) are found. Among the bark beetle species, specimens of the protected *Ephoronvirgo* have been successfully caught in the Pilismaró and Göd sections of the Danube. Among the water body type-specific species with high indicator values, specimens of the crab species *Potamanthusluteus* were found.



The larva of the protected Danube flower (*Ephoronvirgo*), which also occurs in the Danube section between the Sio and Sio estuaries

The dragonfly fauna of the Danube between the Sob and Sió estuaries is represented by taxa that form the characteristic species assemblage of our lowland rivers, such as *Calopteryxsplendens*, *Platycnemispennipes*, *Gomphusvulgatissimus* and *Gomphusflavipes*. Of these, the first two Zygoptera species are mainly associated with twigs and roots that hang down into the water, so their probability of occurrence depends on the water level. At low water, these habitat patches usually become thinned and dry. The situation is similar for the two species of Gomphidae, which have a distinctly benthic lifestyle, preferring the uppermost layer of sediment, which is not accessible at high water levels in many study reaches. Specimens *of the dragonfly species Erythrommanajas* and *E. viridulum were captured* in the seaweed-strewn marginal habitat patches of the Danube section surveyed. Specimens of *Orthetrumalbistylum* and *O. cancellatum* were also detected in the shallow coastal band of the flow dead zones.

The results of a series of surveys over several years show that the water beetle fauna of the area is poor. Only four species of water beetles of common occurrence (e.g. *Cybisterlateralimarginalis, Haliplus fluviatilis, Laccophilushyalinus, Rhantusconsputus*) and the sporadic occurrence *Platambusmaculatus* were confirmed in the sampling area. It should be noted that the macroscopic aquatic invertebrate fauna of large rivers of the Danube character is less characterised by beetles, and therefore their occurrence in higher numbers was less expected.

Bug fauna is also very poor, but several sections have shown specimens of the benthic walking bug (*Aphelocheirusaestivalis*), which has a very good indicator value and a narrow ecological valence, and is mainly associated with gravel-sodic sediments. In addition, the open water surface close to the shore provides habitat for *the paludal mudflats of Aquarius*, and the accumulations of organic debris in slower flowing sections provide habitat for *Sigara falleni* and *S. lateralis*.

In the main channel of the Danube, larvae of species of tegezians typical of larger rivers (e.g. *Brachycentrussubnubilus*, *Hydropsychebulgaromanorum*, *H. contubernalisH. modesta*) were found. Due to slowing flow conditions, several species of tegument-building organisms have been found to build their burrows from organic matter of autochthonous and allochthonous origin and from sediment of smaller grain size (e.g. *Lepidostomahirtum, Neureclipsisbimaculata, Oecetisnotata, Psychomyiapusilla, Setodespunctatus*).

The coastal littoral region of the Danube between the Siob and the Sio estuary is home to a number of highly valuable, protected populations of macroscopic invertebrate species. Specimens of *the species Borysthenianaticina, Fagotiadaudebartiiacicularis*, *Fagotiaesperi*, *Gomphusflavipesand Theodoxusdanubialisdanubialis* have been recovered from several sampling sections. Our quantitative analyses show that the densities of *Fagotiadaudebartiiacicularis* (23.75 +/- 7.75 ind./m2+/-S.E.) and *Borysthenianaticina* (112.29 +/- 29.05 ind./m2+/-S.E.) are the highest in the Danube section surveyed. In contrast to the above, *Astacusleptodactylus* (0,0052 +/- 0,0052 ind./m2+/-S.E.), *Theodoxusdanubialisdanubialis*(2,03 +/- 2,5 ind./m2+/-S.E.), *Ephoronvirgo*(0,02 +/- 0,01 ind./m2+/-S.E.), Fagotiaesperi(8,6 +/- 3,03 ind./m2+/-S.E.), and Fagotiaesperi(8,6 +/- 3,03 ind./m2+/-S.E.) are the most abundant species in the Duna of the Dniester Basin.),Gomphusflavipes(1,54 +/- 0,17 ind./m2+/-S.E.),Gomphusvulgatissimus(0,03 +/- 0,02 ind./m2+/-S.E.)andPseudanodontacomplanata(0,06 +/- 0,03 ind./m2+/-S.E.) are present in much lower single-density stands in the Danube stretch between the Sioux and Sioux estuaries.

Assessment of macroscopic aquatic invertebrate assemblages in deep regions

We have also carried out a basin survey of the Danube section between the Sio and Sio estuaries, further from the shore. In the sections designated for the study of the Danube deep regions, faunistic surveys in the summer growing season 2019 resulted in the presence of 35 macroinvertebrate taxa belonging to 6 major taxonomic groups. According to the results of the surveys, 7 water snails (Gastropoda), 4 bivalves (Bivalvia), 4 leeches (Hirudinea), 13 higher crabs (Malacostraca), 1 dragonfly (Odonata) and 6 quiver (Trichoptera) taxa were found in the study units.

The protected macroscopic invertebrate species of conservation value found in the area were *Fagotiadaudebartiiacicularis, Fagotiaesperi, Gomphusflavipes, Theodoxustransversalis*.

The data presented in the previous paragraphs also show that the Danube bottom region supports a much lower number of macroinvertebrate taxa compared to the habitat structure of coastal littoral regions. Of course, the lower number of taxa is probably also due to the fact that the sampling of deep regions is more difficult, more uncertain and subject to higher sampling errors due to the high water depth and high current velocity. In the mussel fauna, we identified only four alien invasive mussel species. These were *Corbiculafluminea, C. fluminalis, Dreissenabugensis, D. polymorpha.* However, the numbers of these specimens caught were also relatively low and were probably taken from deeper basin bands slightly away from the drift line.

Corbiculafluminea, an **alien and invasive species of the basket mussel family, has become a mass species in the whole domestic stretch of the Danube**

Relatively few species of water snails were found in the samples in the study area. However, three protected species (*Fagotiadaudebartiiacicularis, F. esperi, Theodoxustransversalis*) and two invasive species (*Potamopyrgusantipodarum, Theodoxusfluviatilis*) were caught in the dredged samples. The occurrence of *F. daudebartiiacicularis in depth* regions was detected in the Paks sampling section of the Danube, while *F. esperi was* detected in the Usodi and Paks sampling sections. Specimens of *T. transversalis* were detected only in the sampling sections of the Danube section above Budapest from the regions of Vác, Göd and Pócsmegyer. The latter is also a significant result from a conservation point of view, as the species has not been found in the domestic section of the Danube for several years, but the bottom dredge has allowed sampling of sediment with a sediment fraction that is preferred by the species and probably also allows for more populous populations in patches where flow and substrate conditions are optimal for the species.

The banded pond snail (*Theodoxustransversalis*) is a very rare and sporadic species in Hungary, whose populations in the Danube between Szob and Budapest are of outstanding natural value

In the leech species assemblage of the deep region of the studied section, in addition to the characteristic fauna elements typical of the Danube (*Dina punctata*), we also detected species with a wide ecological range (*Erpobdellanigricollis*) and alien species (*Barbroniaweberi*).

The higher-order crab fauna of the Danube's deeper regions is composed of taxa associated with the more solid, larger-grained sediments that were also detected in the coastal regions. The benthonic *Jaeraistri and the amphipods Corophiumcurvispinum*, *Obesogammarusobesus*, *Dikerogammarushaemobaphes*, *D. bispinosus, D. villosus* and *Echinogammarusischnusis* were typical.

The fauna was composed of species of the reticulated web-building lizards (*Hydropsychebulgaromanorum, Hydropsychecontubernalis*) and the residential tubeworms, a typical species of the Danube, *Brachycentrussubnubilus*, and *Setodespunctatus*.

<u>Assessment of the macroscopic aquatic invertebrate assemblages of the tributaries of the Danube section surveyed</u>

As a result of the surveys carried out in the summer growing season of 2019 in connection with the impact assessment of the interventions planned in the framework of the present project, and as a result of the quantitative and faunistic surveys carried out in the Danube section between the Sioux-Sio estuary before 2020 in other surveys related to other projects, the presence of 99 macroinvertebrate taxa belonging to 9 major taxonomic groups was confirmed. According to the results of the surveys, 19 species of water snails (Gastropoda), 14 mussels (Bivalvia), 9 beetles (Coleoptera), 4 crabs (Ephemeroptera), 18 dragonflies (Odonata), 17 bugs (Heteroptera), 4 leeches (Hirudinea), 13 higher crabs (Malacostraca) and 1 quiver crab (Trichoptera) (in some cases the species can only be identified to genus level) were found in the study units.

The protected macroscopic invertebrate species of conservation value detected in the tributaries of the Danube between the Sób-Sió estuary were *Astacusleptodactylus, Borysthenianaticina, Fagotiadaudebartiiacicularis, Gomphusflavipes, Gomphusvulgatissimus*.

Considering the macroinvertebrate species composition of the tributaries, it can be said that it has a relatively species-rich macroinvertebrate community, as it has a diverse, mosaic habitat structure, which has an impact on the diversity of the macroinvertebrate communities.

In addition to the character species typical of the Danube tributaries (e.g. *Pisidiumhenslowanum, Sphaeriumrivicola, Valvatapiscinalis*), type-specific character species of the main branch fauna (e.g. *Corbiculafluminea, Dikerogammarusbispinosus, Fagotiadaudebartiiacicularis, Obesogammarusobesus*) are also found in the tributaries in proportion to the main branch connection and flow characteristics of the tributary. Other colouring elements include fauna typical of rivers with fine sediment, such as *Anodontacygnea, Borysthenianaticina, Pisidiumamnicum, Platycnemispennipes, Uniopictorum, U. tumidus* and *Viviparusacerosus*.

The molluscan fauna of the Danube tributaries between the Sió and Sob estuaries is very rich. Among the molluscs, in addition to the presence of species preferring habitats with silty-fine sandy substrates adapted to slower flow conditions (e.g. *A. cygnea, M. lacustre, Uniopictorum, U. tumidus*), alien adventive species (e.g. *Corbiculafluminea, Dreissenapolymorpha*) are also represented among the species requiring more vigorous flow conditions. In the tributary sections surveyed, *the Sinanodontawoodiana mosaic, which is a* particularly large invasive species from Asia with a very wide ecological range, was found in several sampling sections in muddy, organic debris-rich habitat patches.

The snail fauna is a mixture of species that prefer stagnant water features, with taxa of the species assemblage that prefer watercourse sections with more lively flow velocities. *Specimens of* the protected *species Borysthenianatica have been* recorded from the Adonyi, Burning Isle and Torda Isle sub-branches, while specimens of the protected species *Fagotiadaudebartiiacicularis* have been found in the Gödi Island area. In these sampling transects, a more vigorous water flow is typically detected, which also favours the colonisation of typical protected Danube fauna. The marsh vegetation in the riparian zone and the predominantly stagnant water, sometimes marsh habitat character in between, provide habitat for typical species of marsh-dwelling water species of lowlands and hilly areas (e.g.*Anisusspirorbis, Bithyniatentaculata, Gyraulusalbus, G. leavis, L. stagnalis, P. acuta, Radix auricularia*). Mollusc species indicative of the marsh-marsh habitat conditions of the lagoonal water bodies were also found in *populations of Acroloxuslacustris, Stagnicolapalustrisand Viviparuscontectus*. Among our invasive mollusc taxa, we detected populations of species such as *Theodoxusfluviatilis*, *P. antipodarum* and *Lithoglyphusnaticoides in the* more lively flowing riverbeds, which may have spread from the main Danube to the tributaries.

The water beetle fauna of the Danube tributaries between the Sio and Sio estuaries was relatively diverse, but mostly composed of taxa with a common distribution (e.g. *Gyrinusdistinctus, Haliplus fluviatilis, Hygrotusversicolor, Laccobiusminutus*). The colonisation of water beetles is largely due to the development of shallow, current-free habitat patches, which have been created by hydromorphological interventions and which warm up faster than the surrounding water surfaces, thus allowing the establishment of aquatic vegetation in the coastal zone.

The bark fauna is species-poor in these tributaries, as four taxa were detected from vegetated habitat patches where slower flow conditions can be detected (e.g. *Caenislactea, Caenisrobusta, Cloeondipterum*). These species feed on the algal coating of aquatic and marsh vegetation or submerged parts of the surface of coastal woody vegetation (e.g. submerged parts of stems of marsh plants, root systems extending into the water, dead branches that have fallen into the water). Among the specifically aquatic bark beetles, the *species Potamanthusluteus is known to* colonise the tributaries studied.

The species that make up the bug fauna were present in the near-shore habitat band with slow currents and mosaic higher vegetation in the sampling transects. Such species included in the tributaries were the nationally widespread *Ilyocoriscimicoides, Hesperocorixalinnaei, Paracorixaconcinna, Pleaminutissimaill*. species belonging to *the Micronectagenus* (*M. scholtzi, M. reticulata*). However, specimens of *Aquariuspaludumpaludum*, which choose the water surface membranes as habitat, were also detected in several sampling sections.

In addition to *Glossiphoniacomplanata, a* species that preys on molluscs, mainly small molluscs (*Pisidiumsp.), the* leech fauna was composed of *populations of Helobdellastagnalis,* present in almost all water body types, in the sampled tributary sections. In addition to these, specimens of *Caspiobdellafadejewi* and *Piscicolageometra* species, which are fish spores, were also successfully captured.

The crayfish fauna is dominated by species that are abundant in the main branch of the Danube, preferring mainly the brisker flow conditions, and are present in the largest percentage among the roots and branches of the riparian woody vegetation hanging in the water, and in the surface and niches of the sediments with a larger fractional size (natural river gravel, hydraulic engineering stone), and are also among the characteristic species of the water body type. This is true despite the fact that these species are all introduced non-native species of ponto-caspian origin. These species are *Corophiumcurvispinum,* Dikerogammarusbispinosus*, D. haemobaphes, D. villosus, Obesogammarusobesus*. Typical species of marshy, standing water habitats (e.g. *Asellusaquaticus*) also occur as colouring elements in the habitat patches, which are mainly characterised by coastal marsh vegetation. Among the invasive species with a similar ponto-caspian distribution to the Dikerogammarus species, which are abundant in the main branch, the gastropod crustaceans *Katamysiswarpachowskyi, Limnomysisbenedeni* and *Paramysislacustris* were detected in almost all the sampling sections surveyed. Among our protected, native decapod species, populations of the goat crab (*Astacusleptodactylus*) were recorded from the Adonyi-Duna branch and the Apostagi sub-basin.The North American species of the invasive crab plague species *Orconecteslimosus* (*Orconecteslimosus*) were also recorded from the Adonyi-Duna branch, the Apostagi sub-basin and the Torda Island sub-basin. It is feared that the crayfish, which is resistant to crayfish plague infection, will displace the native goat crayfish from its habitats in these tributaries.

Our protected, native decapod crab species, the goat crab (*Astacusleptodactylus*), still occurs in some Danube tributaries between the Sio and Sio estuaries, but its populations are threatened by the spread of invasive, introduced cyprinids

Among the river dragonflies, specimens of *G. vulgatissimus and Gomphusflavipes, which are* protected in Hungary and prefer habitats with a muddy-fine sandy substrate, were detected from the studied tributaries. Of our species with a wide ecological tolerance and a common distribution, *Calopteryxsplendens, Ischnuraeleganspontica and Platycnemispennipes were* the most abundant. In the tributaries surveyed, species of *Anaximperator and Sympetrumsanguineum*, which are mainly associated with standing water, with a more stagnant water habitat preference and dense aquatic vegetation with at most slow flow conditions, were also detected in the stagnant water margins, and specimens of the kelp vegetation-associated species *Erythrommaviridulum were also* captured.

Among the quiver species, the only *species of Limnephilus lunatus,* which has a common distribution and builds its living tubes from plant debris, was detected.

Taking into account our quantitative surveys, it can be concluded that in the tributaries of the Danube section studied, the protected species detected [Astacusleptodactylus (0.17 +/- 0.12 ind./m2 a.a. +/- S.D.), Borysthenianaticina (2.7 +/- 1.14 ind./m2 a.a. +/- S.D.), Gomphusflavipes (0.11 +/- 0.11 ind./m2 a.a. +/- S.D.), Gomphusvulgatissimus (0.05 +/- 0.05 ind./m2 a.a. +/- S.D.)] had relatively low single density values.

5.2.4.2. Description of the aquatic macroscopic invertebrate assemblages of the Danube section between the Sió estuary and the southern border

Assessment of the macroscopic aquatic invertebrate assemblage of the coastal littoral region

In the sampling sections of the Danube designated for testing, as a result of the surveys carried out in the summer growing season of 2019 in connection with the impact assessment of the interventions planned under this project, and in the Danube section between the Sió estuary and the southern border of the country in 2020. As a result of quantitative and faunistic surveys carried out during other studies related to other projects before 2020, a total of 66 macroinvertebrate taxa belonging to 8 major taxonomic groups were confirmed, 16 bivalves (Bivalvia), 3 crabs (Ephemeroptera), 6 dragonflies (Odonata), 2 bugs (Heteroptera), 2 leeches (Hirudinea), 19 higher crabs (Malacostraca) and 4 quetzals (Trichoptera), species (in some cases only genus level).

Protected macroscopic invertebrate species of conservation value detected in the Danube between the Sió estuary and the southern border were *Astacusleptodactylus, Borysthenianaticina, Fagotiadaudebartiiacicularis, Gomphusflavipes, Gomphusvulgatissimus, Pseudanodontacomplanata, Uniocrassus*.

As the relative relief decreases towards the lower Danube stretches, the coarse fraction of the river bed sediment typical of the upper Danube stretches is increasingly replaced by river sand. In the section below the Sió estuary, this is now the dominant sediment type in the littoral region. In this context, a decrease in habitat heterogeneity is expected, which will have a major impact on the composition of the macroscopic aquatic invertebrate fauna. The macroinvertebrate fauna is not nearly as diverse as in the section above the mouth of the Sio Lake.

Due to the large amount of fine-grained sediment and organic debris, the filter-feeding organisms, including the mussel assemblage, are the most diverse. In habitat fragments dominated by sandy-silty sediments, stable populations of native mussel species (e.g. *Anodontaanatina, A. cygnea, Uniopictorum*, *U. tumidus,*) were detected. The occurrence of the protected species of *Uniocrassus* bajai, which is of Community importance, is noteworthy, as it is the only species present in the Danube section below the Sió estuary. However, the environmental factors favoured by the flat mussel (*Pseudanodontacomplanata*) allowed the species to colonise several river basins, and it was detected at Baja, Mohács and Dunaszekcső. Among our smaller native mussels, we also caught several species that are typically found in the littoral region of our larger rivers (e.g. *Musculiumlacustre, Pisidiumamnicum, Sphaeriumcorneum, S. rivicola, S. solidum*). Unfortunately, the presence of populations of the Amur mussel (*Sinanodontawoodiana), an* invasive alien species, has been confirmed in several sampling sections in recent years. Due to its wide ecological range, the Amur mussel is able to colonise habitats where our native mussel species are no longer able to survive. The Danube below the mouth of the Sió estuary is also characterised by mass colonisation by *Corbiculafluminea* and *C. fluminalis, which are* also alien and invasive. Among the benthic mussel species typical of the artificial rocky shores of the heavily modified shorelines, the introduced adventive *Dreissenapolymorpha and D. bugensis* are common.

***Uniotumidus* is a native species of river mussel and one of the most common characteristic mussel species of the Danube below the Sió estuary**

Among the species found in the main riverbed of this stretch of the Danube, there are also significant populations of the fine-grained organic matter-rich sediment filter *Viviparusacerosus and the* detritus-eater Lithoglyphusnaticoides. There are also significant populations of the protected *Borysthenianaticina*, with densities of up to several hundred individuals in some sampling sections. Artificial rocky outcrops support populations of water snail species (e.g. *Bithyniatentaculata, Physellaacuta, Radix balthica, Theodoxusfluviatilis)* associated with solid substrate. The presence of populations of *Fagotiadaudebartiiacicularis* from the Dunaszekcső area has been confirmed thanks to our data series dating back several years. Amongst the roots of the coastal woody vegetation, in the organic matter accumulations of the flow dead zones or in the fine particulate sediments, mollusc species adapted to slower, almost stagnant water conditions can also colonise the margins of the main bed (e.g.

Lymnaeastagnalis, Physellaacuta, Planorbisplanorbis, Radix auricularia, Radix balthica, Stagnicolapalustris).

The leech fauna of this section is extremely poor, as besides the characteristic species of the Hungarian Danube, *Dina punctata,* only the *species Erpobdellaoctoculata, which* occurs in all water body types and has a wide ecological range, was recorded.

The higher crayfish fauna shows a composition typical of the upper Danube, dominated by the Ponto-Caspian benthic *Jaeraistri*, the semipedal crayfish *Corophiumcurvispinum*, *Obesogammarusobesus*, *Dikerogammarusbispinosus*, *D. villosus* and *Echinogammarusischnus*. These species are also particularly abundant in the Danube section below the Sio estuary. In addition, *Hemimysisanomala, Limnomysisbenedeni* and *Paramysislacustris, which have* appeared in recent years and are spreading rapidly, are also found in the sections above the Sio estuary. These species have also arrived in the domestic Danube section from the Black Sea. Among the decapod crustaceans (Decapoda), the presence of the cephalopod crayfish (*Orconecteslimosus),* introduced from North America and resistant to crayfish plague, was confirmed in the sampling sections of the Danube at Erzsekcsanád and Baja, while specimens of the native goat crayfish (*Astacusleptodactylus*) were captured in the sections of the Danube at Mohács and Baja.

Invasive chypre (*Orconecteslimosus) from* North America has been found in several sampling sections of the Danube section below the Sio estuary

The cortical fauna is characterised by three common riverine species (*Caenisluctuosa/macrura, Cloeondipterum, Heptageniaflava*) with high tolerance.

The dragonfly species assemblage is partly represented by a wide range of small dragonfly species (e.g. *Platycnemispennipes*, *Ischnuraeleganspontica*) with a wide ecological range found in a very diverse variety of slow-flowing and still water bodies. In addition to these, species of protected river dragonflies typical of river sections with medium to fine sediment (e.g. *Gomphusvulgatissimus*, *G. flavipes*) are found in the study area.

The typical protected river dragonfly of the Danube section below the Sió estuary is *Gomphusflavipes*, whose larvae prefer river sections with sandy, silty sediments

G. vulgatissimus was detected only in the Mohács sampling section of the Danube. In contrast, *G. flavipes* was found along almost the entire length of the surveyed section below the Sió estuary. In the habitat fragments formed by the seaweed vegetation in the main branch's pool margins, in the flow dead zones, specifically stagnant water species such as *Erythrommanajas* also occur sporadically.

In the fauna of the Danube section under discussion, only the taxa of the net-weaving lizards of the genus *Hydropsyche* (*Hydropsychebulgaromanorum*, *H. contubernalisand H. modesta*), which capture and feed on organic matter suspended by water with the help of their nets, were detected.

In the coastal littoral region of the Danube between the mouth of the Sió and the border with Hungary, populations of several valuable, protected macroscopic invertebrate species were detected, but the survey results indicate that the occurrence of *Fagotiaesperi and* Ephoronvirgo, which still form significant populations above the Sió estuary, is no longer typical in this section. *Fagotiadaudebartiiacicularisand Gomphusvulgatissimus* were also recorded at only one or two sampling sites and only by faunistic sampling, which indicates that they occur at densities below the detection threshold of the quantitative sampling method used, so that information on density and population size cannot be provided.

According to our quantitative analyses, the single density of *Borysthenianaticina* (21.46 +/- 10.76 ind./m2+/-S.E.) is the highest in the Danube section surveyed. However, the abundance of *Astacusleptodactylus* (0.13 +/- 0.07 ind./m2+/-S.E.), *Gomphusflavipes* (5.18 +/- 0.88 ind./m2+/-S.E.), *Uniocrassus* (0.04 +/- 0.04 ind./m2+/-S.E.) and Pseudanodontacomplanata (0.19 +/- 0.1 ind./m2+/-S.E.) were present in much lower single-density stands.

Assessment of macroscopic aquatic invertebrate assemblages in deep regions

We have also carried out a basin survey of the Danube between the mouth of the Sió and the southern border of the country, further from the shore. In the sections designated for the study of the Danube deep regions, faunistic surveys in the summer growing season 2019 resulted in the presence of 7 macroinvertebrate taxa belonging to 4 major taxonomic groups. According to the results of the surveys, 1 water snail (Gastropoda), 2 bivalve (Bivalvia), 3 higher crabs (Malacostraca), and 1 tegument (Trichoptera) taxon were found in the study units.

In the depth region of the Danube between the mouth of the Sió and the southern border of the country, the results of the sampling showed that the macroscopic aquatic invertebrate assemblage was very species-poor. Of course, the lower number of taxa is probably also due to the fact that sampling in the deeper regions is more difficult, more uncertain and subject to higher sampling errors due to the greater water depth and higher flow velocities. Based on our survey results, the macroinvertebrate community in the middle part of the estuary is completely lacking specimens of taxa associated with the larger grain size fraction of gravel-rock sediments. The near-driftline sediments, characterised by a sand, sometimes sandy-silt fraction, were mostly inhabited by alien species, which, due to their massive presence in the Danube, are nowadays characteristic fauna of the Danube. The fine-grained sediments contain specimens of *Corbiculafluminalis* and *C. fluminea* species, while individuals of species belonging to *the Corophium genus are found* close to the sediment surface. In the slightly slower-flowing parts of the bed, where organic matter accumulation is possible, specimens of *Hydropsychecontubernalis* teges and *Theodoxusfluviatilis* were found in the dredge net.

Assessment of the macroscopic aquatic invertebrate assemblages of the tributaries of the Danube section surveyed

As a result of the surveys carried out in the summer growing season of 2019 in connection with the impact assessment of the interventions planned in the framework of the present project, and as a result of the quantitative and faunistic surveys carried out in the Danube section between the Sioux-Sio estuary before 2020 in other surveys related to other projects, the presence of 92 macroinvertebrate taxa belonging to 9 major taxonomic groups was confirmed. According to the results of the surveys, 17 water snails (Gastropoda), 13 bivalves (Bivalvia), 5 crabs (Ephemeroptera), 16 dragonflies (Odonata), 1 beetle (Coleoptera) were found in the study units, 16 bugs (Heteroptera), 7 leeches (Hirudinea), 15 higher crabs (Malacostraca) and 2 species of quiver crabs (Trichoptera) (in some cases the species can only be identified to genus level).

The protected macroscopic invertebrate species of conservation value detected in the tributaries of the Danube between the Sió estuary and the southern reaches of the Danube were:*Borysthenianaticina, Gomphusflavipes, Hirudoverbana*.

The macroinvertebrate species assemblages of the studied tributaries show a very diverse picture, due to their varied connectivity with the main branch of the Danube, representing different stages of succession of the tributaries, and thus their overall habitat diversity is significant. As a consequence of the almost constant flow relationship with the main branch, many of the character species typical of the main branch of the Danube are also represented by species adapted to the more vigorous flow conditions (e.g.At the same time, there are also character species of smaller water body types of lower order in direct, continuous contact with the watercourse type (e.g. *Aquariuspaludumpaludum, Physellaacuta*). In addition to the above, mollusc species preferring mainly stagnant water conditions are also represented (e.g. *Lymnaeastagnalis*, *Radix auricularia*, *Radix balthica*, *Stagnicolapalustris*). The silty bed composition resulting from the slow flow conditions favours the colonisation of shellfish species (e.g. *Musculiumlacustre, Sphaeriumcorneum, Sphaeriumsolidum*). Several of our native large bivalve species were also represented, including *Anodontaanatina, Anodontacygnea, Uniopictorum and* Uniotumidus. The high coverage of seaweed vegetation in several sampling sections favours the colonisation of aquatic macroinvertebrate species such as *our dragonfly species Erythrommaviridulum* and our bug species *Microveliareticulata*. Collections in the tributaries along the Danube section studied also revealed specimens demonstrating the presence of populations of the invasive alien cyprinid *Orconecteslimosus*.

Among the macroinvertebrate assemblages detected from the tributaries, species typical of the water body type (e.g. *Ecnomustenellus, Platycnemispennipes*), which are character species of higher-elevation, lower-gradient reaches (and potential faunal components of the Danube river and its tributary system), and some other species typical of aquatic organisms of lowland, fine-bedded small rivers and canals (e.g. *Bithyniatentaculata, Ischnuraeleganspontica*).

The larvae of *Ecnomustenellus* tegusae also occur in shallow watercourses with fine sediment and in the riparian zone of standing water with marsh vegetation. Several sites from the tributaries surveyed have been found

Among the *amphipod* crustaceans (*Amphipoda*), *Corophiumcurvispinum*, *Obesogammarusobesus*, *Dikerogammarushaemobaphes*, *D. bispinosus,D. villosus* and *Echinogammarusischnus are the* most characteristic elements of the Malacostraca species complex of the affected tributaries, which is also dominant in the main branch of the Danube.

In the tributaries (e.g. Bezerédi-Duna), where there is only an intermittent connection with the main branch, the macroscopic aquatic invertebrate assemblages detected are mainly composed of standing water species and only a few species are indicative of an intermittent Danube connection (e.g. *Dreissenapolymorpha,Valvatapiscinalis,Viviparusacerosus*). Among the stagnant water species, there are mainly generalist species, found in both stagnant and slow flowing waters, which are more generalist and less related to water body type (e.g.: *Aquariuspaludumpaludum, Asellusaquaticus, Bithyniatentaculata, Cloeondipterum, Erpobdellaoctoculata, Gerrisargentatus, Gerrislacustris, Glossiphoniacomplanata, Ilyocoriscimicoides, Ischnuraeleganspontica, Lymnaeastagnalis, Musculiumlacustre, Notonectaglauca, Planorbariuscorneus, Radix balthica, Sinanodontawoodiana, Sigara falleni, Sphaeriumcorneum*) are typical. In the more semi-static sections of the basin, there is a higher proportion of shallow shallow water species (e.g. *Aeshnaaffinis, Sympetrummeridionale, Lestesviridis, Sympetrumsanguineum*), which are rapidly warming and may occasionally dry up, and in the permanent or permanently covered sections of the tributaries, there are more frequent small water species (e.g.The sampling has revealed specimens of *Piscicolaharanti*, a stagnant water fish spore, which is rare in our country. In several tributaries, the invasive crayfish (*Orconecteslimosus*), which is already common along the Danube, was found to be resistant to crayfish plague and is therefore one of the main vectors of this fungal crayfish disease, which unfortunately kills a significant proportion of our native decapod crayfish species.

Amur mussels (*Sinanodontawoodiana*) from East Asia are found in many tributaries of the Danube below the Sio estuary, often in very large specimens

In the course of our investigations, we detected the Hungarian needlefish (*Hirudoverbana), a* protected species, from the Bezerédi-Duna at Dunafalva, but due to its low density and sporadic occurrence, the occurrence of this species could only be confirmed by qualitative methods, therefore no quantitative results are available.

The Hungarian leech (*Hirudoverbana*), a protected leech species of Community importance, occurs sporadically in the more advanced successional stages of the Danube section below the Sió estuary, in the plesiopotamon and paleopotamon tributaries

Among the protected species, we detected our protected species *Borysthenianaticina* from the tributary of the Danube bypassing the Liberty Barrier, whose density in the tributaries of the studied Danube section (Sió estuary - national border) was very low (1.07 +/- 1.07 ind./m2 +/- S.E.). A similarly low density of *Gomphusflavipes* (0.95 +/- 0.61 ind./m2 +/- S.E.), a characteristic Danube river dragonfly species, was also found in the tributaries, and was recorded from the Upper Reef-Danube branch, the Kádár-Duna and the Liberty Reef.

5.2.5. FISH SPECIES GROUP

Fish (Pisces) are members of the vertebrate phylum Vertebrata and are one of the most important indicator species of the underwater world of wetlands. They spend all of their lives underwater and are excellent indicators of changes in water quality. The study of the Hungarian fish fauna began very early, in the 19th century, and even uncertain data from the Middle Ages are available, so that the evolution of fish populations can be more or less traced. Their presence or absence is important information for a water body, and their diseases are also an indicator. Different fish species have different tolerances, so the presence or absence of certain species is in itself of considerable information value. The disappearance of even the most resistant and tolerant species from a water body is a cause for serious concern. Several predatory fish species are considered to be the top predators of water bodies. These species can accumulate toxic or polluting substances such as heavy metals or halogenated hydrocarbons in their bodies, so their analysis can provide accurate information on the stress status of water bodies. By examining fish by age, we can also obtain important information. Large fish are long-lived, some species (e.g. catfish - *Silurus glanis*) can live for decades, so examining the accumulation of toxic substances in their bodies (muscle and liver) gives a longer-term view of the life of the aquatic environment. The presence or absence of fry may also be important. The absence of fry may indicate poor environmental conditions that may result in either no spawning or fry that are unable to survive.

In addition to the fundamental natural importance of fish, they also attract considerable social attention, just think of the tens of thousands of anglers in Hungary.

Fish are considered to be one of the main species assemblages affected by the proposed interventions, as the proposed interventions are typically concentrated in the small and mid-water bodies, which are the habitat of the fish assemblage.

Looking at the present-day fish fauna of the Hungarian stretch of the Danube, there is little qualitative distribution among the domestic stretches, which means that all recurrent fish species are likely to be found in any of the domestic stretches of the Danube, but the probability of occurrence and the number of individuals detected may vary greatly between stretches.

The domestic stretch of the Danube can be basically divided into two parts based on the fish levels. The section between Szap and Szob can be classified as the Marmora river basin, while the section from Szob to the southern border of the country can be classified as the Devonian river basin. The eponymous fishes of the syntaxis are also indicator species, and in addition to their presence in a given section, their population size is also a measure of the character of that section.

The domestic Danube sections south of Szob, especially below Budapest, are characterised by a looser sedimentary bank and riverbed, which, although not significantly increasing the water mass, results in a higher sediment load due to the looser banks. The bed is alternately gravel and silty up to the shoal, then typically silty. The hydromorphological characteristics and fish fauna of this section of the Danube place it in the Devonian zone. Typical and common fish species in this section are the bream (*Abramisbrama*), carp (*Cyprinuscarpio*), silver carp (*Carassiusgibelio*), carp (*Bliccabjoerkna*), flatfish (*Ballerusballerus*), and owl bream (*Abramissapa*), pale-spotted chub (*Romanogobiovladykovi*), marble (*Barbusbarbus*), balin (*Aspisaspius*), and bream (*Leuciscus idus*). The appearance of pike (*Esoxlucius*) in the Danube is predominantly more likely where there are more tributaries in advanced stages of succession. In the stretch between Paks and Mohács, due to the greater number of tributaries providing favourable spawning grounds, carp (*Cyprinuscarpio*), marble (*Barbusbarbus*) and a few specimens of goatfish (*Acipenserruthenus*) are more abundant, but are now rare in the whole of the domestic stretch. Among the German buck (*Zingelstreber*) and the Hungarian buck (*Zingelzingel*), which are common in the upper reaches, the Hungarian buck occurs in relatively high numbers, with the population size of the German buck decreasing sharply downstream. The alien species associated with bank protection pebbles are also dominated by the black-headed sparrow (*Neogobiusmelanostomus*) and the river sparrow (*Neogobiusfluviatilis*) in the lower reaches, and by the sunfish (*Lepomisgibbosus*) and the perch (*Percafluviatilis*) in the slower flowing reaches and flow dead zones. The occurrence of balin (*Aspisaspius*) accompanying shoals is likely to be similar to the occurrence of paduc (*Chondrostomanasus*) or perch (*Sanderlucioperca*) in the coastal region. The occurrence of the spotted sparrow (*Proterorhinussemilunaris*) and the cutthroat (*Cobitiselongatoides*) is expected to occur in the presence of softer sediment accumulating in places due to lower flow velocities.

In the section of the Danube between the Szob and the Sió estuary, medium river gravel and small gravel fractions dominate the composition of the river bed material, and a significant proportion of gravel is found alongside them. Towards the southern border, as the relative relief and flow velocity change, the composition of the sediment also changes, with an increasing proportion of finer sediment (silty-sandy). Below the Sio estuary, river sand becomes clearly dominant and the gravel-silty sediments almost disappear, which also affects the composition of the fish fauna. In the discussion of the survey results, the Danube below the Slough has been divided into two sections, in accordance with the current water body typology classification based on the requirements of the Water Framework Directive. Accordingly, the section of the Danube from Szob to the mouth of the Sió (Bogyiszló) and the section from the mouth of the Sió to the southern border were considered as separate units and their fish assemblages were assessed separately.

5.2.5.1. Presentation of the fish assemblages of the Danube section between Szob and the Sió estuary

In connection with the project, actual surveys were carried out in the summer of 2019 in the coastal littoral region and in the deeper regions away from the coast. In addition, we took into account the results of sampling carried out in the Danube between the Sió and Só estuaries in other projects dating back to 2005 to characterise and assess the aquatic macroscopic invertebrate assemblages of the Danube section affected by the planned interventions. Data on the fish fauna of the more than 200 km long Danube river basin between the Sob and Sió estuaries (1708 fkm - 1497fkm) are available from 109 samples taken between 2005 and 2020.

Presentation of the fish assemblages of the main Danube bed, the coastal (littoral) region

A total of 38 species of 9,531 fish were detected during the surveys carried out in the main riverbed in the main coastal region of the Danube between the Sop and Sió estuaries, the total number of species is presented in Table 33.

33. Table 1: List of species detected

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
1	*Abramisbjoerkna*	Caricace		
2	*Abramisbrama*	bream		
3	*Abramissapa*	owl bream		
4	*Acipenserruthenus*	kecsege		Appendix V
5	*Alburnusalburnus*			
6	*Ameiurus melas*	black dwarf dogfish		
7	*Aspius aspius*	balin		Appendices II and V
8	*Barbus barbus*	march		Appendix V
9	*Carassius gibelio*	silver miner		
10	*Chondrostomaniasis*	paduc		
11	*Cyprinus carpio*	carp		
12	*Esoxlucius*	pike		
13	*Eudontomyzonmariae*	Danube ingola	enhanced protection, 100000 Ft	Appendix II
14	*Gobioalbipinnatus*	pale speckled spoke	protected, 10000 Ft	Appendix II
15	*Gymnocephalusbaloni*	wide durbincs	protected, 5000 Ft	Appendices II and IV
16	*Gymnocephaluscernuus*	cutting clamp		
17	*Gymnocephalusschraetser*	silky durbin	protected, 50000 Ft	Appendices II and V
18	*Leuciscuscephalus*	moth		
19	*Leuciscus idus*	Whitefish		
20	*Leuciscus leuciscus*	ny ny ny ny ny ny ny ny ny	protected, 10000 Ft	
21	*Lotalota*	menyhal		
22	*Neogobius fluviatilis*	River Sparrow		
23	*Neogobiusgymnotrachelus*	chrysalis sparrow		
24	*Neogobiuskessleri*	Kessler-géb		
25	*Neogobius melanostomus*	round-headed (black-footed) sparrow		
26	*Pelecuscultratus*	garda		Appendices II and V
27	*Percafluviatilis*	perch		
28	*Proterorhinus marboratus*	spotted sparrow		
29	*Rhodeussericeus*	rainbow fists	protected, 5000 Ft	Appendix II
30	*Rutiluspigusvirgo*	Girlfriend	protected, 10000 Ft	Appendices II and V
31	*Routine*	bodorka		
32	*Sabanejewiabalcanica*	Balkan stripe	protected, 10000 Ft	
33	*Sanderlucioperca*	perch		
34	*Sandervolgensis*	stonefly		
35	*Silurus Glanis*	catfish		
36	*Vimbavimba*	plum-nosed bream		
37	*Zingel nerds*	German hump	enhanced protection, 100000 Ft	Appendix II
38	*Zingelzingel*	Hungarian bush	enhanced protection, 100000 Ft	Appendices II and V

Thirty-one of the 38 fish species detected are native and several of them are of significant natural value. Of the fish species detected, 7 species (*Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Leuciscusleuciscus, Rhodeussericeus, Rutiluspigusvirgo, Sabanejewiabalcanica*) were protected and 3 species (*Eudontomyzonmariae,Zingelstreber, Zingelzingel*) were protected. Thirteen of the species detected (*Acipenserruthenus*, *Aspiusaspius*, *Barbusbarbus, Eudontomyzonmariae, Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Pelecuscultratus, Rhodeussericeus, Rutiluspigisvirgo,Sabanejewiabalcanica,Zingelstreber, Z.* zingel) is a species of Community importance and is therefore included in Appendix II or V of the Habitats Directive, as shown in the table above.

In the Danube between the Sio and Sio estuaries, the most abundant species found during our surveys in the littoral region of the main riverbed was the common cyst (*Alburnusalburnus*). The second most abundant fish species in the coastal basin behind the cusk in the surveyed section was the black-mouthed sparrow (*Neogobius melanostomus*). This alien species, which is widespread in the Black Sea and Azov Sea, appeared in the domestic Danube section in 2001 and has become one of the most common fish species in the domestic Danube section in the last two decades. The conservation importance of the fish fauna of the Danube section under study is demonstrated by the fact that the third most abundant species in the littoral region of the main riverbed was the highly protected species of German Teal (*Zingelstreber*), which is of Community importance.

34. Table 1: Total number of species detected and their density per 100 m in the sampling reaches where the species occurred

	Variety name	**Individual number**	**average CPUE (ind./100m)**
1	*Abramisbjoerkna*	65	0,48
2	*Abramisbrama*	49	0,38
3	*Abramissapa*	3	0,08
4	*Acipenserruthenus*	1	0,13
5	*Alburnusalburnus*	4677	9,69
6	*Ameiurus melas*	5	0,35
7	*Aspius aspius*	246	0,53
8	*Barbus barbus*	83	0,32
9	*Carassius gibelio*	29	0,21
10	*Chondrostomaniasis*	270	0,99
11	*Cyprinus carpio*	18	0,15
12	*Esoxlucius*	20	0,17
13	*Eudontomyzonmariae*	32	0,23
14	*Gobioalbipinnatus*	351	0,89
15	*Gymnocephalusbaloni*	3	0,12
16	*Gymnocephaluscernuus*	8	0,14
17	*Gymnocephalusschraetser*	14	0,15
18	*Leuciscuscephalus*	202	0,65
19	*Leuciscus idus*	163	0,58
20	*Leuciscus leuciscus*	1	0,04
21	*Lotalota*	78	0,3
22	*Neogobius fluviatilis*	273	2,74
23	*Neogobiusgymnotrachelus*	3	0,11
24	*Neogobiuskessleri*	207	0,69
25	*Neogobius melanostomus*	1629	2,8

	Variety name	Individual number	average CPUE (ind./100m)
26	*Pelecuscultratus*	8	0,26
27	*Percafluviatilis*	52	0,52
28	*Proterorhinus marboratus*	16	0,18
29	*Rhodeussericeus*	17	1,27
30	*Rutiluspigusvirgo*	74	0,44
31	*Routine*	225	1,32
32	*Sabanejewiabalcanica*	1	0,16
33	*Sanderlucioperca*	61	0,24
34	*Sandervolgensis*	2	0,06
35	*Silurus Glanis*	11	0,28
36	*Vimbavimba*	28	0,29
37	*Zingel nerds*	558	1,89
38	*Zingelzingel*	31	0,61

In the domestic Danube between the Szob and the Sió estuary, the species richness is comparable to the upper reaches, and is typical of the entire domestic stretch. However, subtle variations in numbers of individual fish species can be observed downstream. In the upper part of the surveyed reach, the river bed is relatively poorly sedimented and flows on marly bedrock for several stretches. Sediment in the riverbed is typically river gravel. The higher flow velocities are moderated in the section above the Sobb. In this part of the river, too, the gravel and gravel sediment is interrupted by artificial pebbling for bank protection and control purposes in longer shorter stretches.

In our country, the well-disturbed common sculpin (*Alburnusalburnus*) is the most abundant fish species in the coastal region of the study area. The carp species almost inextricably linked to the cyprinid, our typical pelagic predator, the balin (*Aspiusaspius*), is found in significant numbers throughout the entire stretch. Juveniles of the balin are often found in groups with the then coexisting cyprinids, which later become their food.

The most abundant of the alien species of pointocaspian origin, which in Hungary are mainly associated with the coastal pebble beds, are the round-headed or black-headed sparrow (*Neogobius melanostomus*). The Kessler's sparrow (*Neogobiuskessleri*), the naked-throated sparrow (*Neogobiusgymnotrchelus*) and the river sparrow (*Neogobiusfluviatilis*) are typically less frequently sampled, but still have significant numbers, with the exception of the naked-throated sparrow. Native fish species formerly found on the shore shoals, such as the cutthroat shrimp (*Gymnocephaluscernuus*) and the broad shrimp (*Gymnocephalusbaloni*), which began to decline with the introduction of alien species of sparrow, are unfortunately now only found in isolated localities and typically in small numbers. The only native species of cod, the ling (*Lotalota*), feeds on the sheltering pebbles and often finds a suitable hiding place in the cavities between the rocks. Along the pebbles, the dolphinfish (*Leuciscuscephalus*) is found feeding on insect food that falls into the water from the woody vegetation along the shore.

The adventive black-mouthed sparrow (*Neogobius melanostomus*), an invasive species from the Black Sea, is the most common benthic fish species on the surface of artificial stone works in the Danube section studied

The reophilic fish of gravel stretches with high flow velocities, the sometimes considerable-sized marlin (*Barbus barbus*), is also a widespread and common species. The sturgeon (*Acipenserruthenus*), a formerly common prey species, nowadays unfortunately in decline, feeds in the bottom regions of our rivers.

The populations of goat (*Acipenserruthenus*) have also declined in the Danube between the Sio and Sio estuaries

In the near-coastal region, the sturgeon (*Rutilusrutilus*) is found in more moderate flows, sometimes in vegetated riverbeds and flow dead zones. Compared to the sections above, there is a minimal increase in numbers as the flow rate decreases.

Typical of large rivers, bream are relatively abundant in the study reach. *Abramisbjoerkna* and *Abramisbrama are* mainly found near the mouths of the tributaries, while *Abramissapa, a* typical species of large rivers, was found in small numbers, mainly further away from the bank. The bream (*Leuciscus idus*), the plum-nosed bream (*Vimbavimba*) and the damselfish (*Rutiluspigusvirgo*) prefer open water areas with a flowing surface. In deeper, more current-affected stretches, where there is less deposition of finer sediment, fine gravels predominate. It is in these stretches that the Hungarian sturgeon (*Zingelzingel*), a species typical of stretches of the Danube with similar natural conditions, occurs. The reophilic fishes of the faster, more gravely stretches are the German tench (*Zingelstreber*), the silky damselfish (*Gymnocephalusschratser*) and the pale-spotted walleye (*Gobioalbipinnatus*). Bottom-dwelling flounders prefer our smaller rivers with slower currents, so individuals are rarely seen in the main Danube bed.

In the shallower stretches of the river, especially near the mouths of tributaries, small stands of riparian marsh vegetation and sparser seaweeds may be established. It is mainly in these stretches that metaphytic fish species such as the invasive silver carp (*Carassiusgibelio*) and sunfish *(Lepomisgibbosus*), the alien razorbora (*Pseudorasboraparva*), perch *(Percafluviatilis*) and red bream (*Scardiniuserythrophthalmus*) can be found.

In addition to the species listed above, which are common or even frequent in the stretch, several species were found in only a few specimens from a single stretch. Examples include the spotted sparrow (*Proterorhinusmarmoratus*), which prefers the microhabitats provided by the roots of riparian vegetation in small inlets, and the perch (*Sanderlucioperca*), which occurs in both our standing water and our watercourses.

In connection with the stonings, we can see some of our predators, mainly juveniles of the catfish (*Silurus glanis*).

For the pike (*Esoxlucius*), which mainly hides in the vegetation, the minimal aquatic vegetation in the coastal region of the main riverbed is not ideal habitat, but in some stretches it still finds sporadic and very small numbers of animals in favourable environmental conditions. The carp (*Cyprinuscarpio*) present in the stretch concerned are presumably only a very small percentage of stocked carp, and their external markings suggest that they are more likely to be from natural reproduction.

The larvae of the highly protected Danube pendula (*Eudontomyzonmariae*) and the Balkan stripe (*Sabanejewiabalcanica*) are associated with the soft sediment that accumulates in places on the shore. Both species were found in very low numbers during sampling.

The highly protected Danube pendola (*Eudontomyzonmariae*) is a species of Community importance that occurs sporadically in the Danube section below the Sób

Inland from the shore, where the current is higher, the species *Pelecuscultratus*, *Leuciscusleuciscus* and *Salmotruttamorphafario* occur. The presence of trout is mainly associated with the spring period, when they enter the main riverbed from left bank tributaries with small floods.

The fish fauna of the Danube stretch concerned is, according to our long-term survey data, home to a very species-rich and diverse fish community. However, the occurrence of most of the species was only incidental to each sampling event, with a significant number of species occurring in small numbers and only in one or two localities at each sampling event. In some cases, species were not detected, except for the water body type where they were usually abundant.

The protected fish species found in the sampling of the section are the protected species Gobioalbipinnatus*, Gymnocephalusbaloni, Gymnocephalusschraetser, Leuciscusleuciscus, Rhodeussericeus, Rutiluspigusvirgo, Sabanejewiabalcanica*, the highly protected *Eudontomyzonmariae,Zingelstreber, Zingelzingel*, species of Community importance on their domestic protection, and thus included in the EU Habitats Directive II., and Annexes II and V of the EU Habitats Directive. In addition, the EU Habitats Directive includes in Appendices II and V the Balin (*Aspiusaspius*), the Common Goldeneye (*Pelecuscultratus*), the Goat (*Acipenserruthenus*) and the Marbled Murrelet (*Barbusbarbus*), which are in decline in Europe.

<u>Presentation of the fish assemblage in the main Danube basin, the deep region</u>

During the surveys, a total of 1517 individuals of 15 species of fish were found in the main riverbed in the deep region of the Danube between the Sio and the Sio estuary. The species totals are presented in Table 35.

35. Table 1: List of species detected

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
1	*Abramisbjoerkna*	hoop bream		

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
2	*Acipenserruthenus*	kecsege		Appendix V
3	*Alburnusalburnus*			
4	*Barbus barbus*	march		Appendix V
5	*Gobioalbipinnatus*	pale speckled spoke	protected, 10000 Ft	Appendix II
6	*Gymnocephalusschraetser*	silky durbin	protected, 50000 Ft	Appendices II and V
7	*Neogobius fluviatilis*	River Sparrow		
8	*Neogobiuskessleri*	Kessler-géb		
9	*Neogobius melanostomus*	round-headed (black-footed) sparrow		
10	*Proterorhinus marboratus*	spotted sparrow		
11	*Sabanejewiabalcanica*	Balkan stripe	protected, 10000 Ft	
12	*Sanderlucioperca*	perch		
13	*Vimbavimba*	plum-nosed bream		
14	*Zingel nerds*	German hump	enhanced protection, 100000 Ft	Appendix II
15	*Zingelzingel*	Hungarian bush	enhanced protection, 100000 Ft	Appendices II and V

Of the 15 species of fish detected, 11 are native and several of them are of significant natural value. Of the species detected, 3 species (*Gobioalbipinnatus, Gymnocephalusschraetser, Sabanejewiabalcanica*) were protected and 2 species (*Zingelstreber, Zingelzingel*) were highly protected. Of the species detected, 6 (*Acipenserruthenus*, *Barbusbarbus,Gobioalbipinnatus, Gymnocephalusschraetser, Zingelstreber, Z. zingel*) are of Community importance.

36. Table 1: Total number of species detected and their density per 100 m in the sampling reaches where the species occurred

	Variety name	Individual number	average CPUE (ind./100m)
1	*Abramisbjoerkna*	2	0,33
2	*Acipenserruthenus*	1	0,13
3	*Alburnusalburnus*	2	0,22
4	*Barbus barbus*	20	0,27
5	*Gobioalbipinnatus*	215	0,93
6	*Gymnocephalusschraetser*	6	0,25
7	*Neogobius fluviatilis*	8	2,8
8	*Neogobiuskessleri*	1	0,2
9	*Neogobius melanostomus*	663	2,56
10	*Proterorhinus marboratus*	1	0,12
11	*Sabanejewiabalcanica*	1	0,16
12	*Sanderlucioperca*	3	0,16
13	*Vimbavimba*	1	0,16
14	*Zingel nerds*	553	1,98
15	*Zingelzingel*	23	0,94

The species with the highest single density in the bottom region is the ponto-caspian species of the Black-mouthed Sparrow (*Neogobius melanostomus*), which has invaded the Danube section from the Black Sea and spread invasively. Despite the high abundance of ponto-caspic shrikes, the second highest species density in the deep region was the highly protected German shrew (*Zingelstreber*), which is a highly protected species of the Danube.

Fortunately, the fast-flowing gravel banks of the Danube between Szob and the southern border still support strong populations of the highly protected Hungarian (*Zingelzingel*) and German (*Zingelstreber*) bucats, which are of Community importance.
The picture shows the Hungarian humpback in the distance, and a specimen of the German humpback closer up

In the Danube main channel, the depth increases with varying intensity as you move away from the shore, but for all sections without exception there is a clear increase in the velocity of the water flow as you approach the drift line. In the case of the drift line, this means that the mainly gravel substrate is in constant motion. There are no significant hiding places for fish, apart from the pits resulting from the unevenness of the bed, and a fairly homogeneous habitat is created around the drift line. The environmental conditions in this deep and highly flowing part of the riverbed are mainly suitable for reophilic fish species, which prefer the current, and benthic fish species, which forage mainly on the bottom.

During our depth sampling, the largest number of individuals of the round-headed sparrow (*Neogobius melanostomus*), an alien species of pointocaspian origin, was detected. The numbers of Kessler's sparrow (*Neogobiuskessleri*), river sparrow (*Neogobiusfluviatilis*) and naked-throated sparrow (*Neogobiusgymnotrachelus*) together did not even approach the numbers of round-headed sparrows in the lowland region.

The eponymous and most distinctive fish species of the river marnazona, the marbled marlin (*Barbus barbus*) is well adapted to high flow rates, foraging mainly on the riverbed among the debris carried by the water.

Bream species that are specifically linked to our large rivers have adapted well to high water speeds. The ringed bream (*Abramisbjoerkna*) is found throughout the entire stretch and the entire cross-section, but there are no really high numbers of this species anywhere.

Among the native fish species, the German tench (*Zingelstreber*), the pale-spotted stickleback (*Gobioalbipinnatus*) and the Hungarian tench (*Zingelzingel*) were found in almost all sampling units in the deep central basin region. The silky damselfish (*Gymnocephalusschraetser*), which prefers high flow velocities but a slightly finer, sandier bed fraction, was found in only small numbers in the depth samples.

The Balkan stripe (*Sabanejewiabalcanica*), mainly associated with softer sediments accumulating in slower stretches, was found in only one specimen during surveys in the deeper parts of the estuary.

The perch (*Sanderlucioperca*) and the spotted sparrow (*Proterorhinusmarmoratus*) occur in deeper regions associated with the pebble beds, the former foraging in the latter, the latter mainly using the gaps and cavities of the pebble beds as drinking areas.

The protected fish species found in the sampling of the stretch are the protected pale-spotted stickleback (*Gobioalbipinnatus*), the silky sea bream (*Gymnocephalusschraetser*) and the Balkan striped (*Sabanejewiabalcanica*), the highly protected German *sturgeon* (*Zingelstreber*) and the Hungarian sturgeon (*Zingelzingel*), which, in addition to their national protection, are species of Community importance and are listed in Annex II., and Annexes II and V of the EU Habitats Directive. In addition, the Marbled Murrelet

(*Barbusbarbus*) and the Goat (*Acipenserruthenus*), which are in decline in Europe, are listed in Appendices II and V of the EU Habitats Directive.

Description of the typical fish assemblages of the Danube tributaries between the Sio and Sio estuaries

A total of 540 fish species of 10 species were recorded during the surveys in the coastal region of the Apostagi Basin, in the section of the Danube between the Siob and the Sio estuary.The species totals are presented in Table 37.

37. Table 1: List of species detected

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
1	*Abramisbjoerkna*	Caricace		
2	*Abramisbrama*	bream		
3	*Alburnusalburnus*			
4	*Aspius aspius*	balin		Appendices II and V
5	*Lepomisgibbosus*	sunfish		
6	*Leuciscuscephalus*	moth		
7	*Rhodeussericeus*	rainbow fists	protected, 5000 Ft	Appendix II
8	*Routine*	bodorka		
9	*Sanderlucioperca*	perch		
10	*Vimbavimba*	plum-nosed bream		

Nine of the 10 fish species detected are native. 1 species (*Rhodeussericeus*) is protected. Of the species detected, 2 (*Aspiusaspius*, *Rhodeussericeus*) are of Community importance.

38. Table 1: Total number of species detected and their density per 100 m in the sampling reaches where the species occurred

	Variety name	Individual number	average CPUE (ind./100m)
1	*Abramisbjoerkna*	2	1,29
2	*Abramisbrama*	2	1,29
3	*Alburnusalburnus*	423	272,90
4	*Aspius aspius*	1	0,64
5	*Lepomisgibbosus*	10	6,45
6	*Leuciscuscephalus*	1	0,64
7	*Rhodeussericeus*	8	5,16
8	*Routine*	89	57,41
9	*Sanderlucioperca*	2	1,29
10	*Vimbavimba*	2	1,29

Less information is available on the tributaries of the Danube between the Sio and Sio estuaries. Due to its specific nature, the Ráckeve-Soroksár branch of the Danube is not discussed in this chapter, as it is not in any way linked to the planned interventions.

In the case of the studied tributaries, the most common species was the common and widespread cyst (*Alburnusalburnus*), which is common throughout the whole domestic Danube section. A common species in the studied tributary was the common sturgeon (*Rutilusrutilus*), which is typical of mainly slower flowing or vegetated waters and partly of stagnant waters. *Aspiusaspius,* which usually co-occurs with shoals, occurred in low densities in the tributaries studied.

Among the bream species, except for the owl bream, which is mainly found in the main basin of our large rivers, the ringed bream (*Abramisbjoerkna*), the bream (*Abramisbrama) and the* plum-nosed bream (*Vimbavimba*) were also found in the Apostagi Basin.

The fresh, gently flowing water of the tributaries, the gravel substrate and the more moderate vegetation cover are favoured by the dace (*Leuciscuscephalus*) and the balin (*Aspiusaspius*). Perch (*Sanderlucioperca) are* a favourite prey species alongside the pebbles.

The soft sediment, which is more characteristic of tributaries, provides a favourable habitat for large mussel species. The rainbow frog (*Rhodeussericeus*) is strongly associated with these species because of its special reproductive strategy, whereby it shelters its eggs in the gill cavity of the mussels until they hatch.

The rainbow frog (*Rhodeussericeus*) is a typical protected species of fish of Community importance in tributaries with significant shellfish populations

The tributaries usually provide suitable habitat for several species of fish that hide in the higher vegetation or spawn on plant parts. These species do not, or only rarely, find suitable habitat patches in the main riverbed.

Of the 10 species of fish detected, 9 are indigenous. 1 species (*Rhodeussericeus*) was protected, which in addition to its national protection is also listed in Appendix II of the EU Habitats Directive. In addition, the balin (*Aspiusaspius*), a species with declining populations in Europe but widespread and common in our country, is listed in Appendices II and V of the EU Habitats Directive.

5.2.5.2. Description of the fish assemblages of the Danube section between the Sió estuary and the southern border

In connection with the project, actual surveys were carried out in the summer of 2019 in the coastal littoral region and in the deeper regions away from the coast. In addition, we took into account the results of sampling carried out in the Danube between the Sió and Só estuaries in other projects dating back to 2005 to characterise and assess the aquatic macroscopic invertebrate assemblages of the Danube section affected by the planned interventions. We have data from 70 samples from the period 2005-2020 on the fish fauna of the approximately 60 km of the Danube between the Sió estuary and the southern border (1497fkm - 1434fkm).

<u>Presentation of the fish assemblages of the main Danube bed, the coastal (littoral) region</u>

A total of 16,469 fish of 40 species were detected during the surveys carried out in the main riverbed in the coastal region of the Danube between the Sió estuary and the southern border. The species totals are presented in Table 39.

39. Table 1: List of species detected

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
1	*Abramisballerus*	flatfish		
2	*Abramisbjoerkna*	Caricace		
3	*Abramisbrama*	bream		
4	*Abramissapa*	owl bream		
5	*Alburnusalburnus*			
6	*Anguillaanguilla*	eel		
7	*Aspius aspius*	balin		Appendices II and V
8	*Barbus barbus*	march		Appendix V
9	*Carassius gibelio*	silver miner		
10	*Chondrostomaniasis*	paduc		
11	*Cyprinus carpio*	carp		
12	*Esoxlucius*	pike		
13	*Eudontomyzonmariae*	Danube ingola	enhanced protection, 100000 Ft	Appendix II
14	*Gobioalbipinnatus*	pale speckled spoke	protected, 10000 Ft	Appendix II
15	*Gymnocephalusbaloni*	wide durbincs	protected, 5000 Ft	Appendices II and IV
16	*Gymnocephaluscernuus*	cutting clamp		
17	*Gymnocephalusschraetser*	silky durbin	protected, 50000 Ft	Appendices II and V
18	*Hypophthalmic hypophthalmia*	white busa		
19	*Lepomisgibbosus*	sunfish		
20	*Leuciscuscephalus*	moth		
21	*Leuciscus idus*	Yassi		
22	*Leuciscus leuciscus*	ny ny ny ny ny ny ny ny ny	protected, 10000 Ft	
23	*Lotalota*	menyhal		
24	*Neogobius fluviatilis*	River Sparrow		
25	*Neogobiusgymnotrachelus*	chrysalis sparrow		
26	*Neogobiuskessleri*	Kessler-géb		
27	*Neogobius melanostomus*	round-headed (black-footed) sparrow		
28	*Pelecuscultratus*	garda		Appendices II and V
29	*Percafluviatilis*	perch		
30	*Proterorhinus marboratus*	spotted sparrow		
31	*Pseudorasboraparva*	razbora		
32	*Rhodeussericeus*	rainbow fists	protected, 5000 Ft	Appendix II
33	*Rutiluspigusvirgo*	Girlfriend	protected, 10000 Ft	Appendices II and V
34	*Routine*	bodorka		
35	*Sanderlucioperca*	perch		
36	*Sandervolgensis*	stonefly		
37	*Scardinius erythrophthalmus*	red-winged bream		
38	*Silurus Glanis*	catfish		
39	*Zingel nerds*	German hump	enhanced protection, 100000 Ft	Appendix II
40	*Zingelzingel*	Hungarian bush	enhanced protection, 100000 Ft	Appendices II and V

Thirty-one of the 40 fish species detected are indigenous and several of them are of significant natural value. Of the species detected, 6 species (*Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Leuciscusleuciscus, Rhodeussericeus, Rutiluspigusvirgo*) were protected and 3 species (*Eudontomyzonmariae,Zingelstreber, Zingelzingel*) were protected. Of the species detected, 11 (*Aspiusaspius*, *Barbusbarbus, Eudontomyzonmariae, Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Pelecuscultratus, Rhodeussericeus, Rutiluspigisvirgo, Zingelstreber, Z. zingel*) is a species of Community importance and is therefore included in Appendix II or V of the Habitats Directive (**Pogreška! Izvor reference nije pronađen.**.table).

In the Danube between the Sió estuary and the southern border, the most abundant species found during our surveys in the littoral region of the main riverbed was the common cyst (*Alburnusalburnus*). The second most abundant fish species in the coastal basin behind the cyprinid in the surveyed section is the invasive black-headed sparrow (*Neogobius melanostomus*), which, like the species above the Sioen estuary, is spreading invasively from the Black Sea.

40. Table 1: Total number of species detected and their density per 100 m in the sampling reaches where the species occurred

	Variety name	Individual number	average CPUE (ind./100m)
1	*Abramisballerus*	17	2
2	*Abramisbjoerkna*	100	0,41
3	*Abramisbrama*	278	1,88
4	*Abramissapa*	1	0,4
5	*Alburnusalburnus*	11183	50,5
6	*Anguillaanguilla*	1	0,05
7	*Aspius aspius*	427	1,15
8	*Barbus barbus*	20	0,16
9	*Carassius gibelio*	319	3,98
10	*Chondrostomaniasis*	48	0,2
11	*Cyprinus carpio*	169	1,99
12	*Esoxlucius*	26	0,23
13	*Eudontomyzonmariae*	11	0,15
14	*Gobioalbipinnatus*	448	2,31
15	*Gymnocephalusbaloni*	3	0,039
16	*Gymnocephaluscernuus*	24	0,72
17	*Gymnocephalusschraetser*	41	0,35
18	*Hypophthalmic hypophthalmia*	2	0,05
19	*Lepomisgibbosus*	24	0,66
20	*Leuciscuscephalus*	33	0,55
21	*Leuciscus idus*	463	2,86
22	*Leuciscus leuciscus*	1	0,04
23	*Lotalota*	239	0,97
24	*Neogobius fluviatilis*	732	7,01
25	*Neogobiusgymnotrachelus*	3	0,21
26	*Neogobiuskessleri*	232	1,04
27	*Neogobius melanostomus*	982	6,64
28	*Pelecuscultratus*	5	0,2
29	*Percafluviatilis*	35	0,2

	Variety name	Individual number	average CPUE (ind./100m)
30	*Proterorhinus marboratus*	49	0,34
31	*Pseudorasboraparva*	23	0,25
32	*Rhodeussericeus*	10	0,08
33	*Rutiluspigusvirgo*	3	0,08
34	*Routine*	436	2,06
35	*Sanderlucioperca*	41	0,3
36	*Sandervolgensis*	2	0,03
37	*Scardinius erythrophthalmus*	7	0,15
38	*Silurus Glanis*	18	0,74
39	*Zingel nerds*	11	0,29
40	*Zingelzingel*	2	0,11

The fish assemblage of the Danube stretch between the Sió estuary and the southern border is characterised by a high number of species and individuals. There is a clear downstream refinement of the bed material towards the southern border.

The disturbance-tolerant, native common sculpin (*Alburnusalburnus*) is particularly abundant in the coastal littoral region of the study area. Our carp species, which is almost inextricably linked to the cyprinids and is a typical pelagic predator, the balin (*Aspiusaspius*) is found in significant numbers throughout the entire stretch. Juveniles and juveniles of the balin are often found in groups with the cyprinids they later feed on.

Among the alien species of point-caspian origin, which in Hungary are mainly associated with the coastal protection pebble formations, the largest number of individuals was found in the round-headed or black-headed sparrow (*Neogobius melanostomus*), but the river sparrow (*Neogobius fluviatilis*), which occurs in much lower densities in the section above the Sió estuary, is not far behind. The Kessler's sparrow (*Neogobiuskessleri*) and the bare-necked sparrow (*Neogobiusgymnotrchelus*) are typically less frequently sampled, but the number of Kessler's sparrows is still significant. Native fish species formerly found on the sheltering pebbles, such as the cutthroat shrike (*Gymnocephaluscernuus*) and the broad shrike (*Gymnocephalusbaloni*), which began to decline with the introduction of alien species of sparrow, are unfortunately now only found locally and typically in small numbers. The only native species of cod, the ling (*Lotalota*), feeds on the sheltering pebbles and often finds a suitable hiding place in the cavities between the rocks. Along the pebbles, the dolphinfish (*Leuciscuscephalus*) is found feeding on insect food that falls into the water from the woody vegetation along the shore.

The adventive river sparrow (*Neogobius fluviatilis*), an invasive species from the Black Sea, is a very common benthic fish species on the surface of artificial stone works in the Danube section studied

The reophilic fish of the gravel stretches with high flow velocities, the sometimes considerable-sized marble (*Barbusbarbus*), is a rare species that occurs in low densities only in this stretch. In the more moderately flowing stretches near the shore, where there is sometimes vegetation cover, the common marlin

(*Rutilusrutilus*) is abundant. It has increased significantly in abundance in comparison with the above sections as the current speed has decreased.

In the near-coastal region, the sturgeon (*Rutilusrutilus*) is found in more moderate flows, sometimes in vegetated riverbeds and flow dead zones. Compared to the sections above, there is a minimal increase in numbers as the flow rate decreases.

Typical of large rivers, bream are relatively abundant in the study reach. *Abramisbjoerkna* and *Abramisbrama are* mainly found near the mouths of the tributaries. The higher abundance of bream can also be explained by the reduction in flow velocity. Small numbers of *Abramissapa, which* is typical of our large rivers, were recorded, mainly further away from the bank. The bream (*Leuciscus idus*), the silver-nosed bream (*Vimbavimba*) and the damsel bream (*Rutiluspigusvirgo*) prefer open water areas with a flowing surface. The Hungarian bream (*Zingelzingel*) and the German bream (*Zingelstreber*), a reophilic fish of the faster, gravelier sections, are very scarce in this section compared to the coarser, higher flowing sections above the Sió estuary. This section of the Danube is no longer an optimal habitat for them.

The yas (*Leuciscus idus*) is a common stream-favouring fish species of the Danube below the Sió estuary

In the shallower stretches of the river, especially near the mouths of the tributaries, small stands of riparian marsh vegetation and sparse kelp colonise the area. It is mainly in these patches that metaphytic fish species such as the invasive alien silver carp (*Carassius gibelio*) and sunfish (*Lepomisgibbosus*), the alien razorbora (Pseudorasboraparva), the native perch (*Percafluviatilis*) and the red bream (*Scardiniuserythrophthalmus*) can be found.

In connection with the stonings, we can see our predator catfish (*Silurus glanis*), sometimes with large specimens.

The protected fish species found in the samples from the stretch are the protected species Gobioalbipinnatus*, Gymnocephalusbaloni, Gymnocephalusschraetser, Leuciscusleuciscus, Rhodeussericeus, Rutiluspigusvirgo*, the highly protected species *Eudontomyzonmariae, Zingelstreber, Zingelzingel*, species of Community importance due to their domestic protection, and thus included in the EU Habitats Directive II, and Annexes II and V of the EU Habitats Directive. In addition, the EU Habitats Directive lists in Appendices II and V the balin (*Aspiusaspius*), the garda (*Pelecuscultratus*) and the marten (*Barbusbarbus*), which are in decline in Europe.

The broad sea bream (*Gymnocephalusbaloni*) is a protected species of Community importance, whose populations have been depleted by the invasive spread of the invasive spider crabs of Ponto-Caspian origin

<u>Presentation of the fish assemblage in the main Danube basin, the deep region</u>

During the surveys, a total of 433 fish of 9 species were detected in the main riverbed depth region between the Sió estuary and the southern border of the Danube. The species totals are presented in Table 41.

41. Table 1: List of species detected

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
1	*Abramisbjoerkna*	Caricace		
2	*Abramissapa*	owl bream		
3	*Alburnusalburnus*			
4	*Aspius aspius*	balin		Appendix II and Appendix V
5	*Gobioalbipinnatus*	pale speckled spoke	protected, 10000 Ft	Appendix II
6	*Gymnocephalusschraetser*	silky durbin	protected, 50000 Ft	Appendices II and V
7	*Neogobiuskessleri*	Kessler-géb		
8	*Neogobius melanostomus*	round-headed (black-footed) sparrow		
9	*Zingel nerds*	German hump	enhanced protection, 100000 Ft	Appendix II

Of the 9 species detected, 7 are native and several of them are of high natural value. 2 species (*Gobioalbipinnatus, Gymnocephalusschraetser*) are protected and 1 species (*Zingelstreber)* was protected. Of the species detected, 4 (*Aspiusaspius*, *Gobioalbipinnatus, Gymnocephalusschraetser, Zingel's nests*) are of Community importance.

42. Table 1: Total number of species detected and their density per 100 m in the sampling reaches where the species occurred

	Variety name	Individual number	average CPUE (ind./100m)
1	*Abramisbjoerkna*	4	0,5
2	*Abramissapa*	1	0,4
3	*Alburnusalburnus*	1	0,13
4	*Aspius aspius*	1	0,13
5	*Gobioalbipinnatus*	386	2,63
6	*Gymnocephalusschraetser*	18	0,34
7	*Neogobiuskessleri*	1	0,13
8	*Neogobius melanostomus*	12	0,28

	Variety name	Individual number	average CPUE (ind./100m)
9	*Zingel nerds*	9	0,29

In the section between the mouth of the Sió and the national border, the deeper sediment fraction is also characteristic of the Danube main riverbed.

The largest number of specimens in our depth sampling was of the nationally protected Pale-spotted Spotted Spoke (*Gobioalbipinnatus*). Only a small number of specimens of the round-headed sparrow (*Neogobiusmelanostomus), an* alien species of pontocaspian origin, were detected. The Kessler's sparrow (*Neogobiuskessleri*) was found in the samples in one specimen and the river sparrow (*Neogobiusfluviatilis*) was not detected.

The *Gobioalbipinnatus (Gobioalbipinnatus*) is a typical benthic, current-loving fish species of the Danube section below the Sió estuary, with a medium fine sediment. This protected species of Community importance is found in high densities in this stretch of the Danube

Bream species that are specifically linked to our large rivers have adapted well to high water speeds. The ringed bream (*Abramisbjoerkna*) is found throughout the entire stretch and the entire cross-section, but there are no really high numbers of this species in any part of the riverbed.

Among the native fish species, German sturgeon (*Zingelstreber*) were found in several samples in the deep central basin. This species prefers the faster flowing gravel bottom sections, but is also found in low densities in the lower part of the Sio estuary. The silky damselfish (*Gymnocephalusschraetser*), which prefers a high flow rate but a slightly finer, sandier bed fraction, is more abundant in the surveyed section, and is more favoured by the sandy substrate of this Danube section.

The species of protected fish found in the section are the protected *Gobioalbipinnatus*, the *Gymnocephalusschraetser*, the *Zingelstreber,* which are listed in Appendix II, II and V of the EU Habitats Directive and are of Community importance in addition to their national protection. In addition, the Balinese (*Aspiusaspius*), which is in decline in Europe but has strong populations in the Danube section below the Sio Estuary, is listed in Appendices II and V of the EU Habitats Directive.

Description of the typical fish assemblages of the Danube tributaries between the Sió estuary and the southern border

During the surveys, a total of 31 species of fish were detected in the riparian region of the tributaries between the mouth of the Danube and the southern border of the Sió river. The total number of species detected during the surveys is summarised in Table 43.

43. Table 1: List of species detected

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
1	*Abramisbjoerkna*	Caricace		
2	*Abramisbrama*	bream		

	Latin name	Hungarian name	Domestic immunity	Habitats Directive
3	*Abramissapa*	owl bream		
4	*Alburnusalburnus*			
5	*Ameiurus melas*	black dwarf dogfish		
6	*Aspius aspius*	balin		Appendices II and V
7	*Carassius gibelio*	silver miner		
8	*Chondrostomaniasis*	paduc		
9	*Cyprinus carpio*	carp		
10	*Esoxlucius*	pike		
11	*Gobioalbipinnatus*	pale speckled spoke	protected, 10000 Ft	Appendix II
12	*Gymnocephalusbaloni*	wide durbincs	protected, 5000 Ft	Appendices II and IV
13	*Gymnocephaluscernuus*	cutting clamp		
14	*Gymnocephalusschraetser*	silky durbin	protected, 50000 Ft	Appendices II and V
15	*Lepomisgibbosus*	sunfish		
16	*Leuciscuscephalus*	moth		
17	*Leuciscus idus*	Whitefish		
18	*Lotalota*	menyhal		
19	*Neogobius fluviatilis*	River Sparrow		
20	*Neogobiuskessleri*	Kessler-géb		
21	*Neogobius melanostomus*	round-headed (black-footed) sparrow		
22	*Percafluviatilis*	perch		
23	*Proterorhinus marboratus*	tarkagéb		
24	*Pseudorasboraparva*	razbora		
25	*Rhodeussericeus*	rainbow fists	protected, 5000 Ft	Appendix II
26	*Rutiluspigusvirgo*	for girls	protected, 10000 Ft	Appendices II and V
27	*Routine*	bodorka		
28	*Sanderlucioperca*	perch		
29	*Sandervolgensis*	stonefly		
30	*Scardinius erythrophthalmus*	red-winged bream		
31	*Silurus Glanis*	catfish		

Of the 31 species of fish detected, 23 are native and several of them are of significant natural value. Of the species detected, 5 species (*Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Rhodeussericeus, Rutiluspigusvirgo*) are protected. 6 species (*Aspiusaspius*,*Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Rhodeussericeus, Rutiluspigisvirgo)* are of Community importance.

44. Table 1: Total number of species detected and their density per 100 m in the sampling reaches where the species occurred

	Variety name	Individual number	average CPUE (ind./100m)
1	*Abramisbjoerkna*	9	0,7
2	*Abramisbrama*	43	1,95
3	*Abramissapa*	8	2,53
4	*Alburnusalburnus*	1040	40,09
5	*Ameiurus melas*	124	23,79
6	*Aspius aspius*	141	6,04

	Variety name	Individual number	average CPUE (ind./100m)
7	*Carassius gibelio*	1979	110,58
8	*Chondrostomaniasis*	1	0,68
9	*Cyprinus carpio*	3	0,65
10	*Esoxlucius*	29	1,18
11	*Gobioalbipinnatus*	16	3,49
12	*Gymnocephalusbaloni*	1	0,68
13	*Gymnocephaluscernuus*	51	0,39
14	*Gymnocephalusschraetser*	1	0,31
15	*Lepomisgibbosus*	77	8,64
16	*Leuciscuscephalus*	7	3,58
17	*Leuciscus idus*	39	1,74
18	*Lotalota*	4	0,78
19	*Neogobius fluviatilis*	370	24,41
20	*Neogobiuskessleri*	4	0,56
21	*Neogobius melanostomus*	30	2,52
22	*Percafluviatilis*	138	7,06
23	*Proterorhinus marboratus*	32	2,15
24	*Pseudorasboraparva*	70	6,02
25	*Rhodeussericeus*	72	7,72
26	*Rutiluspigusvirgo*	9	0,79
27	*Routine*	1463	73,92
28	*Sanderlucioperca*	29	1,78
29	*Sandervolgensis*	1	0,68
30	*Scardinius erythrophthalmus*	90	22,89
31	*Silurus Glanis*	3	0,49

On the tributaries of the Danube section concerned, our own collections give us a picture of a fish assemblage consisting of species that typically prefer standing water. The tributaries are generally characterised by lower flushing rates, lower flow velocities and finer bed material.

The stationary nature of the tributaries studied is reflected in the fact that the most abundant species caught were the alien silver carp (*Carassius gibelo*) and the sturgeon (*Rutilus rutilus*). The black dwarf catfish (*Ameiurus melas*), also found mainly in our standing waters, and the alien sunfish (*Lepomisgibbosus), which* preys on small fish and insects among plants, were also common.

The third most abundant species in the tributaries after the silver smelt and the sturgeon was the disturbance-tolerant walleye (*Alburnusalburnus*), which was the most abundant species in the main branch and in the tributaries, occurring throughout the whole of the river's home stretch.In addition to the bream (*Abramisbrama*), which is found in slower, often almost stagnant water sections, the red-winged bream (*Scardiniuserythrophtahlmus*), which prefers sections with a high cover of higher vegetation, was a common bream species sampled.

In the more disturbed stretches with significant shellfish populations, rainbow fistula (*Rhodeussericeus*) was found in several places associated with the larger number of large bivalves.

The balin (*Aspiusaspius*), which co-occurs with the shoals, is mainly found in the fresher tributaries, while the more vegetated, slower-flowing stretches are preyed upon by perch (*Percafluviatilis*) and pike (*Esoxlucius*). The tributaries are also characterised by the presence of bank protection pebbles, which provide breeding and hiding places for invasive species of sparrow, which are mainly better adapted to the disturbed environment. Among the alien species of sparrow, the round-headed sparrow (*Neogobius* *melanostomus*) and the river sparrow (*Neogobius fluviatilis*) are most common in the tributaries, but in contrast to the sections above the Sio estuary, the river sparrow is more numerous. *Neogobiusgymnotrachelus is* a possible species, with only small numbers.

In the case of the studied stretches, the waters of the tributaries, which in some places warm up more quickly, are also subject to organic matter loading from the water seeping into the Danube during the low-water period, which also leads to a higher incidence of algae on the fine but more compacted bed surface, which, however, provides a suitable feeding ground for the herbivorous feeding mode of the pondweed (*Chonrostomanasus*). Paducus are typically associated with the higher flow sections of the Danube, but can sometimes be found in surprisingly low flow tributaries.

In the flushed, fresher tributaries, which are partly paved with bank protection in the coastal region, you can see specimens of the menhaden (*Lotalota*). In addition to the pebbles, the perch (*Sanderlucioperca*) and the rock bass (*Sandervolgensis*) are also popular prey.

The perch (*Sanderlucioperca*) often forages in the foreground of paving stones of bank protection works and baffles and closures

Overall, it can be concluded that the total species assemblage indicates a distinctly species-rich and diverse fish assemblage in the Danube tributaries below the Sió estuary. Of the 31 fish species detected, 23 are indigenous. 5 species (*Gobioalbipinnatus, Gymnocephalusbaloni, Gymnocephalusschraetser, Rhodeussericeus, Rutiluspigusvirgo*) are protected, which are, in addition to their national protection, species of Community importance and listed in Appendix II, II and V of the EU Habitats Directive. In addition, the Balinese (*Aspiusaspius*), which is in decline in Europe but is common in the EU, is listed in Appendices II and V of the EU Habitats Directive.

5.2.6. AMPHIBIAN AND REPTILE SPECIES ASSEMBLAGE

5.2.6.1. Characterisation of the amphibian and reptile species assemblages of the potential intervention areas studied between Szob and Budapest

No amphibian or reptile species were detected in the survey units along the surveyed stretch. The main bed of the Danube section surveyed is not an ideal habitat for aquatic reptiles and amphibians. In the margins of the main channel, in the moderate current riparian zone and in coastal flow dead zones, e.g. in the flow dead zones of diversion dams, individuals of the species group of the goat frog (*Pelophylaxkl. esculentus) are* most frequently encountered, including some individuals closely related genetically to the small pond frog (*Pelophylaxlessonae).*

The surveyed stretches are habitat for the water snake (*Natrixnatrix*), but their density is typically low. The main branch of the surveyed section is slightly more frequent for the checkered gliders (*Natrixtessellata*). The occurrence of herpetological values (e.g. amphibian or reptile species of Community importance) is unlikely in the small coastal areas affected by the planned interventions in the section between Szob and Budapest.

Our surveys were supplemented with data from the website (https://herpterkep.mme.hu) of the Hungarian Ornithological and Nature Conservation Association's Amphibian and Reptile Conservation Section, which aims to map amphibian and reptile species for conservation purposes and to accurately assess their distribution, broken down by study area and its surroundings and covering the last three years. These suggest that, in addition to the above-mentioned reptile species, the coastal scree may provide habitat for the wall lizard (*Podarcismuralis*) in low abundance, as confirmed by our 2020 field survey near the main branch of Shipyard Island, Budapest. Other species, as shown on the map, are mainly associated with tributaries that are not affected by these project elements. Certain floodplain habitats (e.g. around Göd and on Palota Island) can even be considered as habitats for the forest frog (*Ranadalmatina*), which is associated with forest habitats, albeit at very low densities.

The green frog species complex (*Pelophylaxsp.* , lake frog, goat frog and small lake frog) is the most common amphibian species found along the Danube section studied

5.2.6.2. Characterisation of the amphibian and reptile species assemblages of the potential intervention areas studied between Budapest and Baracs

In the study area, species of the goatfrog species group (*Pelophylaxkl. Esculentus*), the checkered gull (*Natrixtessellata*) and the water snake (*Natrixnatrix) are* also found in the coastal areas affected by the planned interventions. Among the amphibian species, only the forest frog (*Ranadalmatina) is* likely to occur, with low numbers of individuals. In the coastal ruderal weed vegetation, some specimens of the swift lizard (*Lacertaagilis*) are also present (e.g. below the island of Háros near Nagytétény).

In areas where the main branch is in contact with a slower-moving bay (e.g. In these areas, the community-associated **bog turtle (*Emysorbicularis*)**, but also terrestrial reptiles hiding in the riparian vegetation, such as the swift lizard (*Lacertaagilis*), the green lizard (*Lacertaviridis*), or the terrestrial snake species such as the copperhead (*Coronellaaustriaca*) or the forest gliders (*Elaphelongissima*) (e.g. at Ófalu), can occur in the flow dead spaces.)

5.2.6.3. Characterisation of the amphibian and reptile species assemblages of the potential intervention areas studied between Baracs and Foktő

In terms of the number of species and the number of individuals observed, the surveyed section was similar to the Danube sections above. Where even small areas of current dead zones or small patches of emergent marsh or kelp vegetation providing hiding places were present at the edge of the main bed, there were several records of individuals belonging to the goatfrog species group (*Pelophylaxkl. esculentus*). Among the reptile species, the presence of an adult of the swamp lizard (*Lacertaagilis*) and an adult of the green lizard (*Lacertaviridis*) was recorded in the marsh vegetation on one of the open, treeless peninsulas in the area. According to the data from the herpetological website, the coastal marsh vegetation of the Moorish section is the habitat of both species with low numbers of individuals, but the more common species is the green lizard (*Lacertaagilis*), as confirmed by the presence of several individuals recorded near Dunaföldvár and Madocsa and Paks.

5.2.6.4. Characterisation of the amphibian and reptile species assemblages of the potential intervention areas between Foktő and Dunaszekcső

The habitat characteristics of the potentially affected areas of the Danube section under study, with their high water flows, lack of emergent marsh and seaweed vegetation, frequent flooding and fast currents, are also not favourable for the establishment of amphibian and reptile species. During our survey, no amphibian species were observed in the designated survey units along this stretch. The slower moving bays and the flow harbours of the quarries in the section concerned provide habitat for species of the goatfrog species group (*Pelophylaxkl. esculentus*), including some of the species closely related to the small pond frog (*Pelophylaxlessonae*), as confirmed by our previous studies on the Gemenese Danube section. As a slower branch of the Danube (e.g. Rezéti-Duna, Gemenci-Holt-Duna, Vén-Duna, etc.) comes into contact with the main branch, the number and density of amphibian species increases.

According to the data of the herpetological map for the studied section, the green toad (*Bufoviridis*) may occur alongside the goat frog species group (Érsekcsanád, Veránka). Among the reptile species, the swamp lizard (*Lacertaagilis*) (Baja, on the dam side, Szeremle), the green lizard (*Lacertaviridis*) at Fajsz and Baja, or the wall lizard (*Podarcismuralis*) (on the beach near Baja) were also reported in some places on the edge of the marsh vegetation.

Water Snakes (*Natrixnatrix*) and Chequered Snakes (*Natrixtessellata*) also occur in several places along the surveyed stretch, according to the website, in addition to the main branch. During our survey, we observed the presence of a juvenile Chequered Gull (*Natrixtessellata*) at the boat harbour of Archesekcsanád.

Young chequered gliders (Natrixtessellata) at the boat harbour of Érsekcsanád near the falconry

5.2.7. BIRD SPECIES ASSEMBLAGE

5.2.7.1. Characterisation of the bird species assemblages of the potential intervention areas studied on the section between Szob and Budapest

Our survey results in the potential intervention areas between Szob and Budapest showed that softwood forest habitats typically had a higher number of nesting species, while forest habitats dominated by invasive tree species and larger, more open, weedy young forest plantations with invasive herbaceous species had a lower number of nesting species. Around 125 individuals of 24 species were recorded in the study area, of which 18 species are likely to nest in the area directly or indirectly (disturbance) affected by the intervention. We estimate the number of nesting pairs to be between 43 and 63 pairs.

The overwhelming majority of species were associated with lomber forest habitats (83%), with only 11% of species associated with specific edge habitats and 1% associated with wetlands. The situation was different for the number of nesting pairs. Some 19% were associated with wetlands and 5.6% with edge habitats, while 75.4% were associated with woodland habitats. In terms of nesting levels, species nesting in the canopy (arboricolous) were the most abundant (39%), but dendricolous species were also significant (28%), and shrub-nesting species (fruticicolous) and terricolous species were present, accounting for the same proportion of the total (17-17%). In terms of the number of nesting pairs, the order was almost the same, but here the species nesting at the shrub level (fruticikol) gave way to those nesting at the tree trunk level (dendrikol), due to the high number of pairs of Friendly Posaic (*Sylviaatricapilla*) (~9 pairs), and the lowest number of species nesting on the ground (15%). Among the wetland-associated species in the coastal zone of the affected stretches, breeding of Mallard (*Anasplatyrhynchos*) is likely.

Overall, the largest number of species in the studied sections was found in the older woodland habitats (e.g. Göd or Szigetmonostor). The lowest numbers of nesting species were found in larger, open, weedy areas, often with invasive herbaceous species, or in areas with almost no reefs and paved banks. No evidence of nesting of a highly protected bird species was observed in the surveyed stretches above the capital. Among the nesting species, the nesting of the **Ornate Flycatcher (*Ficedulaalbicollis*)** (1 pair) and the presence of the Eurasian Cormorant (*Strixaluco*) (1 pair), a sporadic breeder of old-age riparian forests, are of particular natural value. Both species were recorded outside Göd. However, the waterside sections concerned are also noteworthy for their feeding species. The presence of feeding individuals of great cormorant (*Phalacrocoraxcarbo*), grey heron (*Ardeacinerea*), **little egret (*Egrettagarzetta*)** and **kingfisher (*Alcedoatthis*)** was observed in the affected stretches during our survey.

5.2.7.2. Characterisation of the bird species assemblages of the potential intervention areas studied between Budapest and Baracs

In the area between the capital and Baracs, there was a considerable extent of softwood forests in the coastal strips surveyed, which were potentially affected by the planned interventions. The most prominent of these is the Háros Island softwood forest habitat with its high number of nesting species. In this section, hardwood woodland strips have already been identified in two study areas. To the south, the landscaped grassland along the Danube coast of Százhalombatta was home to a rich bird fauna, with species numbers approaching those of semi-natural woodland. Afterwards, in the area of Tököl, the number of species typically declined due to a significant invasive tree population (mainly green maple). The area was less shrubby, more open and with a more pronounced anthropogenic presence (beach and fishing sites). Subsequently, in the Ercsi area, a hardwood grove forest was affected in the study area, where the number of species (lomberdean species) increased again, and then, in the Makád area, the number of nesting bird species was again much lower due to the larger invasive tree species, largely formed on a paved forest belt. In the area of Dunaújváros, softwood and hardwood forests became characteristic of the study area potentially affected by the planned interventions, so species numbers may have increased, but most of the species observed were nesting outside the affected area (on the far side of the nearby high bank). However, significant numbers of Lomberdean species were also observed here. In the Baracs area, the number of species was again low in several open habitats and in forest strips with young native softwoods and invasive tree species growing along old paved bank revetments.

Around 143 individuals of 34 species were recorded in the surveyed area bands, of which 19 species (58-78 pairs) were likely to nest in the area directly or indirectly affected by the proposed intervention. The vast majority of the species were associated with Lombardy habitats (84.21%), as in the previous section, with only 10.52% of species in habitats specifically associated with marginal habitats and 5.27% of species in habitats specifically associated with wetlands.

the situation was similar in terms of the number of nesting pairs in these stretches. The proportion of birds associated with woodland habitats was 89.71%, that associated with marginal habitats was 8.82% and that associated with wetlands was 1.47%. In terms of nesting levels, the highest proportion of nesters was found at the tree trunk level (36.84%), while the other levels (canopy, shrub level, ground level) showed an even distribution (21.05-21.05%). In terms of number of nesting pairs, shrub-level nesters were the highest (37.76%), due to the high number of pairs (~12 pairs) of Friendly Posaea (*Sylviaatricapilla),* similar to the previous section. They were followed by tree-trunk nesters (27.94%), followed slightly behind by canopy nesters (22.06%) and finally by ground nesters (13.24%), with the lowest percentage.

From all this we can conclude that however small the extent of the riverside gallery forest, if old, cavity-forming softwoods are present in the area, it may (despite even some landscaping in some places, see e.g.

Hundredths of Pileated Woodpecker) provide nesting habitat for a number of woodpecker species and thus indirectly for a number of cavity-forming and other tree-trunk nesting species (e.g. Short-toed Woodpecker (*Certhiabrachydactyla*). In the surveyed sections, wetland-associated species in the riparian zone are likely to include the nesting of the grooved dabchick (*Motacillaalba*).

Overall, the most significant number of nesting species (8 species) in the surveyed sections was found in older woodland habitats (e.g. Budapest XXII. district (Háros Island)) and the "gently landscaped" intervention area of the Danube bank in Hundreds-Halombatta, home to old willows. The lowest number of nesting species (1-2 species) was found along forest strips of invasive tree species, especially where young individuals formed the woody habitat on paving (e.g. in the Makád and Baracs areas). No evidence of nesting of a highly protected bird species was observed in the surveyed sections, nor was the presence of any species of outstanding natural value as a nesting species. The species recorded during our surveys are all common species associated with lomeberdean or parked wooded habitats. The waterside habitat strips affected by the intervention are also worth mentioning here in terms of foraging species. The presence of foraging individuals of great cormorant (*Phalacrocoraxcarbo*), grey heron (*Ardeacinerea*), **little egret (*Egrettagarzetta*),** black-headed gull (*Larusridibundus*), steppe gull (*Laruscachinnans*), **tern (*Sternahirundo*)** and **kingfisher (*Alcedoatthis*)** was observed in the affected stretches.

5.2.7.3. Characterisation of the bird species assemblages of the potential intervention areas studied between Baracs and Foktő

Among the survey units along the surveyed section, some signs of nesting wetland bird species were recorded in the Solti-Danube branch, which consists of islands and peninsulas, at Solt, followed by a grove of young willows without nesting species. In the downstream direction, there were also invasive woodlands with low numbers of species. In the Madocsa area, a taller but still thin grove of white willow was present, but again with low numbers of nesting species. Near Paks, the invasive woodland with several older softwoods provided suitable nesting habitat for many songbirds. 102 individuals of 35 species were recorded in the surveyed sections, of which 12 species (16-36 pairs) nested in the area. The vast majority of species were associated with the Lombardy habitats (66.66%), as in the previous section, but the number of species associated with wetlands was more significant (25.01%) and the number of species associated with marginal habitats was the lowest (8.33%). The above dominance pattern was also reflected in the number of nesting pairs, but wetland-associated species had a higher number of pairs, due to the high number of mallard (*Anasplatyrhynchos) pairs* (~10 pairs), so that forest-associated species accounted for 50% of the total number of pairs and wetland-associated species for 46.15%.

The former were almost dwarfed by the number of edge habitat species, which accounted for only 3.85% of the total number of pairs. In terms of nesting levels, we saw the following. In terms of the number of species, the proportion of ground-nesting (terricol) species was particularly high (41.67%), followed by canopy-nesting (arboricol) species with 33.33%, then shrub-nesting (fruticol) species with 16.67% and finally dendricol species (8.33%).

The situation was similar for the number of nesting pairs. 53.85% of the nesting pairs were ground nesting. They were followed by species nesting in the canopy (arboricol) (23.08%), then by shrub level nesters with 15.38%, and finally by tree trunk level nesters with 7.69%. The reason for these results is that there was more open coastline, some small patches of reed were present in the area, where the singing reed canarygrass (*Acrocephaluspalustris*) could enrich the range of ground nesting species, and in Solt, the lemon flycatcher (*Emberizacitrinella*), which also nests on the ground, could be present on the higher shore of the flooded area. Mallard (*Anasplatyrhynchos*) was also present as a nesting species with a very high number of pairs (~10 pairs), which may also have increased the proportion of nesting species at this level. However, it can also be seen from the above proportions that the number of species and pairs nesting at the tree trunk level was low, which is a characteristic of forests containing older, more sparse softwoods. In their absence, the presence of the species concerned was not detected.

Overall, the highest number of nesting species (6 species) was found in a grove of invasive tree species near Paks, which also contained bark trees, in the area strips potentially affected by the planned interventions assessed in the study section. The lowest number of species was found in two survey units near Solt, where thin forest habitat strips of young willows and invasive woodland dominated by invasive species were present with several open gaps, thus not suitable for nesting. In the surveyed sections, no evidence of nesting of a highly protected bird species was observed, nor was the presence of any species of outstanding natural value as a nesting species. The species recorded during our surveys were all considered to be common species associated with common lomeberdean habitats or common species associated with wetland habitats. The waterside pool sections affected by the intervention are also worthy of mention in terms of foraging species. In the affected sections, great cormorant (*Phalacrocoraxcarbo*), grey heron (*Ardeacinerea*), **great *egret* (*Egrettaalba*), little egret (*Egrettagarzetta*), black stork (*Ciconianigra*)**, **brown kite (*Milvusmigrans*)**, **eagle eagle (*Haliaeetusalbicilla*),** *Tringaochropus*, *Larusridibundus*, *Laruscachinnans*, ***Sternahirundo*** and ***Alcedoatthis***.

5.2.7.4. Characterisation of bird species assemblages in the potential intervention areas between Foktő and Dunaszekcső

In the surveyed section, a small tidal surge at Érsekcsanád, which was just passing at the time of the survey, flooded the coastal area potentially affected by the planned intervention, where no bird species were nesting. No nesting of bird species was also observed in a green maple dominated habitat in the downstream direction at Baja. In the recreation area near Szeremle, old native trees were present in the survey unit, but the number of nesting species was rather low. In the semi-natural grassland to the south of the site, the presence of several Lombardy species was recorded. Low numbers of species were also recorded in the planted bog habitat and the noble aspen habitat on the high bank near the Báta, and this was not changed in the intervention area further south, where more open habitats were present. In the Dunafalva area, several softwood woodland habitats were also low in numbers in the surveyed section, and finally high numbers of nesting species were again recorded in the semi-natural softwood woodland habitats in the sections near the Dunasek river. In the surveyed sections, 113 individuals of 29 species were recorded, of which 12 species (16-36 pairs) are likely to nest in the area.

Species associated with the Lombardy habitats also dominated in the surveyed sections. Their share of the total number of species was 85.71%. They were followed by wetland bird species, which accounted for the remaining 14.29%. The presence of typical edge habitat species was not observed in any of the areas studied. In terms of the number of pairs, the proportion of wetland species was 94.73%, while the remaining 5.27% were wetland-associated pairs.

In terms of nesting levels, the highest proportion of species (42.86%) was also found in this section for the number of species nesting at the trunk level (dendritic). They were followed by the species nesting in the canopy (arboricol) with 28.57%, and then the top nesting species were the shrub level nesters and the ground level nesters with 14.29-14.29%. In terms of the number of nesting pairs, canopy nesters led (47.37%), followed by tree-trunk nesters with 39.47%. The top breeders were shrub level nesters (7.89%) and ground level nesters (5.26%). This suggests that there are a number of older, hollow trees present in the area, providing nesting habitat for tree-trunk nesters. The lowest number of species in the surveyed section was detected in the coastal survey unit of young willows in the Archekcsanad survey unit, which was under flooding at the time of the survey (0 nesting species). The highest numbers of species were found in a grassland near Szeremle (6 species) and in a woodland habitat strip on the outskirts of the Danube River (9 species).

In the surveyed areas, no evidence of nesting of protected bird species was observed, but nesting species included the presence of the Community Important **Kingfisher (*Alcedoatthis*)** (1 pair) and the **Ornate Flycatcher (*Ficedulaalbicollis*)** (up to 4 nesting pairs), which speaks volumes about the value of the Lombardy nesting bird community in the section. The stretches of the basin parallel to the coastal survey areas affected by the intervention are of course also noteworthy for their foraging species. The presence of foraging individuals of great cormorant (*Phalacrocoraxcarbo*), grey heron (*Ardeacinerea*), **great *egret* (*Egrettaalba*), little *egret* (*Egrettagarzetta*), brown kite (*Milvusmigrans*)**, black-headed gull (*Larusridibundus*), steppe gull (*Laruscachinnans*), and **common tern (*Sternahirundo*)** was recorded in the affected sections.

5.2.8. MAMMAL ASSEMBLAGE OF CONSERVATION IMPORTANCE

In the Danube section between Szob and the southern border of the country, the mammal species of conservation concern in the typically riparian habitat bands affected by the planned interventions are the **Eurasian beaver (*Castorfiber*) and the otter (*Lutralutra*)**, therefore we searched for the habitat of these species in the investigated sections.

According to the survey results, the Eurasian beaver is present in significant densities along the Danube stretch between Sób and the southern border, with its habitat being found in 25-30% of the survey units in the areas potentially affected by the planned interventions or in their immediate vicinity.

The Eurasian beaver is often found chewing on the Danube section surveyed

During our surveys, otter tracks were only sporadically encountered in the surveyed section, but according to the literature (LANSZKI, 2014), the 5.88 km long river section can be considered as the territory of a single individual and there are probably no investment elements that do not affect the hunting territory of one or at least one individual. The main branch is characterised by open, large contiguous water surfaces with less preference for fast-flowing habitats. It prefers slower-flowing tributaries with more fragmented habitat, or the estuaries of smaller watercourses.

In the riparian zone of the Danube section studied, mainly in strips of natural softwood and hardwood woodland habitats, there are sporadic patches of old cavity trees that provide suitable roosting and roosting habitat for many species of roosting bats. These species include the lake bat (*Myotisdasycneme*) and the water bat (*M. daubentoni*). These species prefer to forage above the water surface or in the waterfront foreground of coastal woodland.

Among the Myotis species found along the Danube stretch studied, the big-eared bat (*Myotisbechsteinii*), the hooked bat (*Myotisnattereri*) and the Brandt's bat (*Myotisbrandtii*) are also known to prefer to use tree holes as shelters during the summer. Also a roosting bat is the western dirt bat (*Barbastellabarbastellus*), which also occurs along the Danube between the Sochi and southern border.

Among the early bats, the hairy-eared bat (*Nyctalus leisleri*) and the red bat (*Nyctalusnoctula*) are also typically burrow-dwelling and occur in the study area during the summer. The common *pipistrelle* (*Pipistrellus pipistrellus) is a* relatively common species in the study area, but the rough-legged pipistrelle (*Pipistrellus nathusii*) is also found in the study area and the tree canopy is also an optimal habitat for this species.

Barren tree in the section affected by the planned intervention

Sources for chapter 5:

- ksh.hu
- www.termeszetvedelem.hu
- https://www.ferto-hansag.hu/hu/termeszetvedelem/termeszetvedelmi-teruletek/tajvedelmi-korzetek/szigetkozi-tk.html
- http://fhnp.nemzetipark.gov.hu/ptk_ismerteto
- https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/duna-ipoly-nemzeti-park
- http://www.termeszetvedelem.hu/index.php?pg=pl_275-TT-97
- https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/adonyi-termeszetvedelmi-terulet/haros-szigeti-arteri-erdo-tt
- https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/adonyi-termeszetvedelmi-terulet/racalmasi-szigetek-tt
- http://www.ramsar.hu/teruletek/9.htm
- dnp.nemzetipark.gov.hu/national-park-duna-menti-teruletek

6. BUILT ENVIRONMENT (URBAN ENVIRONMENT, CULTURAL HERITAGE)

6.1. BUILT ENVIRONMENT VALUES

From the point of view of the Danube as a waterway, the built environment can be considered in terms of ports (of national, regional and local importance), navigational structures, the crossings of infrastructure networks by structures (structures crossing the waterway: bridges, ferry crossings) and the historical and other cultural built heritage located in the coastal zone (within the landward limits of the waterway development).

For the purposes of this environmental assessment, we have excluded ports (which are the subject of a separate strategy) and shipping installations (not relevant for the environmental assessment). The **bridges and ferry crossings** are summarised in tabular form in Chapter 3.5 of the Assessment Study (2020) as follows.

45. Table 1:Bridges on the Danube between the Siófok and the border

Status	Link to	Bridge
Existing road bridges	Szigetmonostor - Budapest [IV. district]	Megyeri Bridge (Mo North)
	Budapest [III. district] - [XIII. district]	Árpád Bridge
	Budapest [V. district] - [I. district]	Elisabeth Bridge
	Budapest [XI. district] - [IX. district]	Rákóczi Bridge
	Budapest [XXII. district] - Szigetszentmiklós	Deák Ferenc bridge (Mo south)
	Dunaújváros - Dunavecse	Pentele Bridge (M8)
	Dunaföldvár, main road 52	Talking Joseph Bridge
	Fajsz, M9	St László Bridge
	Baja, main road 55	István Türr Bridge
Existing railway bridges	Budapest [III. district] - Budapest [IV. district]	Northern connecting railway bridge
	Budapest [XI. district] - Budapest [IX. district]	Southern connecting railway bridge
Planned road bridges	1520+420 fkm	Paks-Kalocsa bridge
	1448+200 fkm	Mohács Danube bridge
Planned railway bridge	Ercsi - Region of Ráckeve	-

Based on Annex 4/2 of Act CXXXIX of 2018

46. Table 1:Ferry crossing points on the Danube between the border of Siófok and the border of Hungary

Title	Public administration	Water	Comment, load
Sobi ferry	Szob-Pilismarót	Danube 1707+200 fkm	comp
Pilismaróti ferry	Pilismarót-Zebegény	Danube 1703+400 fkm	person
Dömös crossing	Dömös-Nagymaros	Danube 1699+750 fkm	
Nagymarosi ferry	Visegrád-Nagymaros	Danube 1694+500 fkm	cargo comp
Váci ferry	Tahitótfalu-Vác	Danube 1679+200 fkm	cargo comp
Surányi ferry	Pócsmegyer-Göd (Upper)	Danube 1672+000 fkm	person
Horányi ferry	Szigetmonostor-Göd (Lower)	Danube 1668+500 fkm	person
Dunakeszi ferry	Szigetmonostor-Dunakeszi	Danube 1666+000 fkm	comp
Budatétény ferry	Budapest [XXI. district]-Csepel	Danube 1636+800 fkm	-
Tököli ferry	Tököl-Százhalombatta	Danube 1623+500 fkm	comp
Ercsi ferry	Ercsi-Szigetújfalu	Danube 1613+500 fkm	comp

Adonyi ferry	Adony- Lórév	Danube 1597+900 fkm	comp
Dunaújváros	Dunaújváros-Szalkszentmárton	Danube 1580+550 fkm	out of service
Paks	Paks-Géderlak	Danube 1532+750 fkm	comp
Gerjéni ferry	Gerjén-Kalocsa	Danube 1516+100 fkm	comp
Dunaszekői	Dunaszekcső-Dunafalva	Danube 1460+200 fkm	cargo comp
Mohács ferry	Mohács-Porond	Danube 1446+900 fkm	

For centuries, it has served the flow of people, products, customs, traditions and other information from the Danube headwaters to the estuary and back. It is both a cultural corridor and a network of territorially linked heritage. Along or near the river there are several "classic" settlements (e.g. Vác, Dunaföldvár, Tolna, Szekszárd, Kalocsa, Baja, Mohács) which preserve their historical traditions in scale or image and can therefore be considered rich in built heritage. Such sites are also mostly destinations of interest for recreation and tourism along the Danube. It can therefore be concluded that the link between the waterway and the built environment associated with it is reinforced by cultural practices and recreational and tourist activities.

In the wider **Danube** riparian area, the largest number of identifiable **monuments** (based on the muemlekem.hu database) are found in the areas of Nagymaros, Visegrád, Vác, Budapest, Paks, Baja and Mohács. Occasionally, some monuments can also be found in Verőce, Ercsi, Dunaújváros, Dunavecse, Dunaföldvár and Dunaszekcső. Most of the monuments are located in the inner areas of the settlements, far from the Danube riverbed, and are typically houses, churches, monuments of the Roman period, other sacral sculptures, and other monuments of local architectural heritage. Occasionally, there are also sites with a more direct link to the river (e.g. along the banks or in the floodplain) (e.g. Visegrád water bastion, remains of a Roman watchtower at Verőce, remains of a Tahitian village castellum, remains of a Roman bridgehead at Inselmonostor and the Contra Florentiam dock fortress at Danube village).

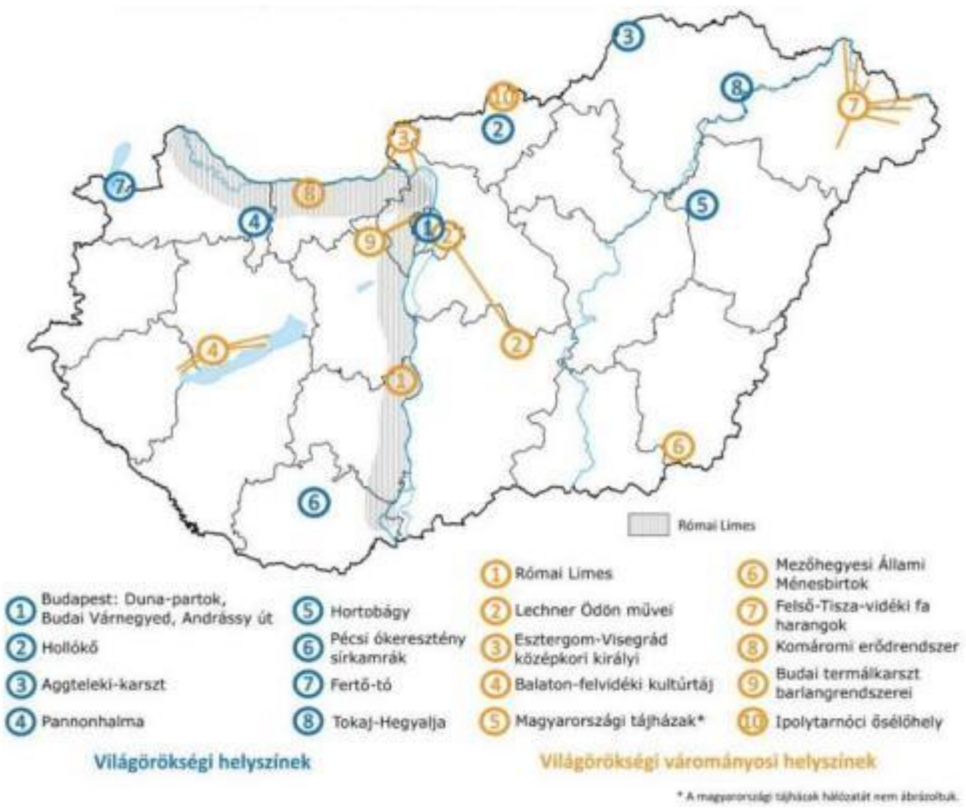
The category of **national monument has** been included in the Cultural Heritage Protection Act since 2012. There is no area designated as a national monument along the Danube in the revised section.

The Government Decree 303/2011 (XII.23.) designates **the historical monuments of** our country (49 of them). Of these, the Visegrád Castle and the Hungarian Academy of Sciences are located close to the river bank, on the stretch of the Danube between the settlements of Szob and Kölked.

Local authorities have the possibility to place worthy built and natural assets under **local protection.** According to www.muemlekem.hu, among the municipalities along the surveyed stretch, Zebegény, Nagymaros, Budapest III. district, Ercsi, Őcsény and Baja have locally protected built heritage and monuments located close to the coast.

One of Hungary's eight recognised **World Heritage Sites,** located on the stretch of the Danube between the settlements of Szob and Kölked, is the Budapest Danube scenery, the Buda Castle District, Andrássy Avenue and its historic surroundings, which was designated a World **Heritage Site in** 1987. Decree 27/2015 (2.VI.) MvM on the **List of World Heritage Triangular Sites of the** settlements along the section Pilismarót, Dömös, Visegrád, Verőce, Dunakeszi, Szigetmonostor, Göd, Budakalász, Budapest I., III, V and XXII districts, Százhalombatta, Ercsi, Kulcs, Adony, Rácalmás, Dunaújváros, Kisapostag, Baracs, Paks, Fadd, Dunafalva, Dunaszekcső, Báta, Őcsény and Kölked.

Based on the legal requirements, World Heritage management plans are prepared for the areas, which give priority to the natural and landscape features of the areas, in harmony with nature conservation standards. The sites are also priority tourist destinations. In addition to the sites already recognised, further sites are in the process of being recognised. The national point designation of sites recognised and pending recognition is shown in ***Figure*** 13. For World Heritage sites and World Heritage candidate sites, separate zoning (based on the administrative boundaries of municipalities) has been included in the National Spatial Plan (***Figure 14***).



13. Figure 1:World Heritage sites and candidate sites
Source: parlament.hu

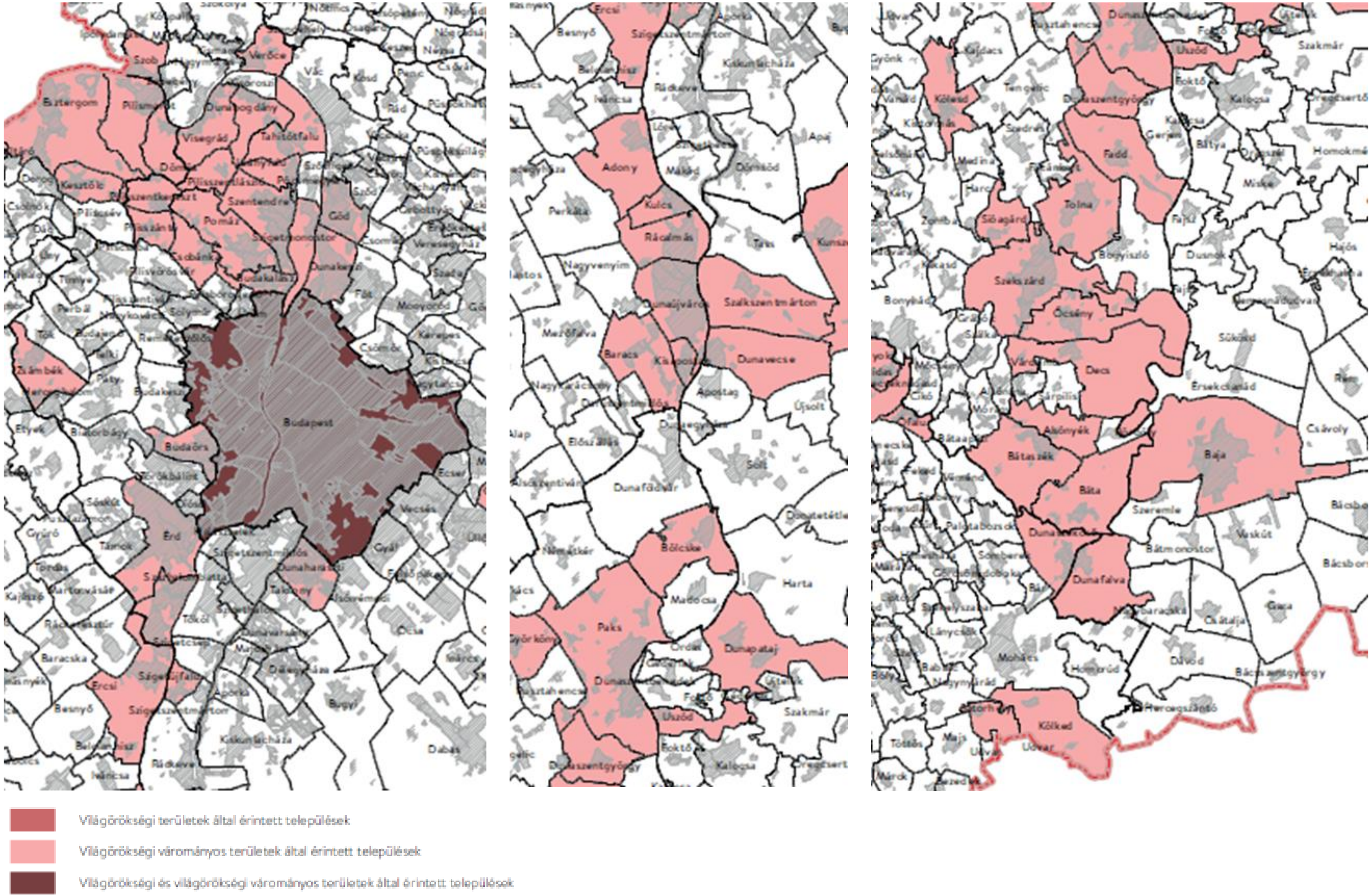
The procedure for nomination and inscription on the Hungarian **World Heritage List of Sites** is set out in the Government Decree 315/2011 (XII. 27.) on the World Heritage Management Plan, the World Heritage Complex Impact Assessment Documentation and the World Heritage Sites of Excellence. The section is also affected by three World Heritage **nominations** (indicated by a number code as shown in the figure above):

- (1) The Borders of the Roman Empire - The Hungarian section of the Danube Limes (2009) - part of an international series nomination (http://whc.unesco.org/en/list/430),
- (3) The area of the medieval Hungarian royal centres of Esztergom and Visegrád and the former Royal Forest of Pilis (1993 and 2000),
- (5) Network of country houses in Hungary (2000)

The built heritage in Hungary is of European and international standing in terms of quality and value, but often offers a limited aesthetic experience due to its condition, lack of restoration of scientific value, disorderly surroundings, incompatible or lack of use. Consequently, it is important that disused buildings and structures are registered, assessed for their suitability and their fate determined on the basis of a suitability assessment. No inventory of disused buildings, structures and blighted areas is available, neither at municipal level nor at national level.

The condition of the listed or locally protected buildings in the municipalities along the Danube varies considerably. Regardless of their condition, solutions for their preservation and survival are partly achieved through various types of reconstruction, partial maintenance, or by bringing new or old functions to life. In principle, these solutions can be provided in a complex manner by coordinating urban development and planning instruments and asset management practices.

In the long term, the current state of the cultural and built heritage may be adversely affected by tourism development and its impact on tourism, if the risks that can be identified are not properly assessed and managed. (i.e. those affected by tourist traffic exceeding the carrying capacity limit.)



14. Figure 1:Settlements covered by World Heritage and candidate sites

Source:Act CXXXIX of 2018 on the spatial planning plan of Hungary and some of its priority regions

6.2. ARCHAEOLOGICAL SITES

On the Hungarian stretch of the Danube river (between 1811 and 1450 km), the nature of the waterway means that **archaeological and aquatic archaeological sites** located directly on the banks or in the riverbed need to be taken into account. The risk analysis work part of the "Preliminary archaeological documentation risk analysis" (UTIBER Közúti Beruházó Kft. - VÁRKAPITÁNYSÁG Nonprofit Zrt.), prepared on the basis of Act LXIV of 2001 on the protection of cultural heritage and the Government Decree 68/2018 (IV. 9.) on the rules for the protection of cultural heritage, is based on the collection of data, literature and cartographic information. Sites located in the valley, within 50 m or directly affected, with different levels of archaeological/heritage risk, have been summarised in the table below.

47. Table 1: Archaeological sites along the Danube between the Siófok and the border

Name	Registration number	Basis for identification	Contact
Komárom-Esztergom county			
Dömös -Bottom of the lake	2010 highly protected	excavation, site inspection, field survey	data collection zone concerned (directly on the coast) (rkm:1701,5)
Dömös - Lake bottom protection zone	*88249*		*data collection zone concerned (directly on the coast) (rkm:1701,5)*
Dömös -Kövecses stream	2001 highly protected	excavation, site inspection, field survey	data collection zone concerned (directly on the coast) (rkm:1701,5)
Dömös -Kövecses stream protection zone	*88251*		*data collection zone concerned (in the river basin) (directly on the beach) (processkm:1701)*
Dömös -Waterworks, Danube riverbed	54508	data collection	data collection zone concerned (in the river basin) (processkm:1700,5)
Dömös - 1700 fkm	63862	on-site inspection	data collection zone concerned (in the river basin) (processkm:1700)
Pest county			
Dömös -Kövecses stream protection zone	*88251*		*data collection zone concerned (in the river basin) (directly on the beach) (processkm:1701)*
Dömös -Waterworks, Danube riverbed	54508	data collection	data collection zone concerned (in the riverbed) (river km:1700,5)
Dömös - 1700 fkm	63862	on-site inspection	data collection zone concerned (in the riverbed) (river km:1700)
Dömös -Kövecses stream protection zone	*88251*		*data collection zone concerned (in the river basin) (directly on the beach) (processkm:1701)*
Dömös -Waterworks, Danube riverbed	54508	data collection	data collection zone concerned (in the riverbed) (river km:1700,5)
Pócsmegyer -Surányitelep	11222	data collection	data collection zone concerned (within 50 m) (process km: 1672)
Szigetmonostor - Gödi-Nagy Island	11621	public register of sites	data collection zone concerned (directly on the coast) (process km: 1670)
Island Monastery -	11617	data collection	data collection zone concerned

Name	Registration number	Basis for identification	Contact
Pustamonostorok			(directly on the coast) (process km: 1669)
Island Monastery - Pusztamonostorok	11618	on-site inspection, data collection, geophysical measurement	data collection zone concerned (within 50 m) (process km: 1668)
Százhalombatta -Kácsás-sziget	94355	on-site inspection	data collection zone concerned (in the riverbed) (river km: 1620,5)
Szigetcsép -Danube shore, Tököli border	92309	on-site inspection metal detector research	data collection zone concerned (directly on the beach) (processkm: 1617,5)
Szigetcsép - North of the Csépi reef	92699	on-site inspection	data collection zone concerned (in the river basin) (riverkm: 1617)
Szigetcsép - Csépi-zátony 2.	92703	on-site inspection	data collection zone concerned (in the river basin) (processkm: 1616,5)
Szigetcsép - Csépi-zátony 1.	92701	on-site inspection	data collection zone concerned (directly on the beach) (riverkm: 1616)
Budapest			
Budapest IV. -Váci út-Megyeri-út-Szilas patak-Külső Szilágyi út-Budapest k	**66162**	excavation, site inspection, archaeological monitoring, data collection	data collection zone concerned(in river basin)(river km: 1660)
Budapest XIII. - Árpád bridge-Váci út-Szt. István krt.-Danube river (35. lh.)	**66506**	fieldwork, trial digging, data collection, archaeological monitoring, excavation	**affected (in the riverbed)** (processkm:1653-1651)
Budapest XIII. -Fürdő Island, Danube riverbed	**24009**	archaeological monitoring	**affected (in the riverbed)** (processkm:1653-1651)
Budapest III - Shipyard Island and Bay	32387 highly protected	excavation, geophysical survey, survey, archaeological supervision, trial excavation, site inspection	data collection zone concerned (in the river basin) (process km: 1653-1651
Budapest III. -Obuda and Békásmegyer	**72911**	excavation, archaeological monitoring, trial excavation, data collection	**affected (in the riverbed)** (processkm:1653-1651)
Budapest XI. -Budaörsi út-railway-Péterhegyi út-XI.ker közigazgatási h.-Fehér	**66476**	excavation, archaeological monitoring, data collection, trial excavation	data collection zone concerned(in riverbed)(processkm:1638)
Budapest XXI. -Csepel	**70009**	excavation, archaeological monitoring, trial excavation, data collection	**affected (in the riverbed)** (processkm:1638)
Budapest XXII. -Budafok	**69977**	archaeological	data collection zone concerned(in

Name	Registration number	Basis for identification	Contact
		monitoring, trial excavation, excavation, data collection, field survey	riverbed)(processkm:1638)
		Fejér county	
Dunaújváros -Salki Island	24542	excavation, site inspection, geophysical survey	data collection zone concerned (within 50 m) (river km: 1581)
Baracs -Annamatia-Castellum	21803 highly protected	excavation, fieldwork, site inspection	data collection zone concerned (directly on the coast) (riverkm: 1567)
Baracs -Annamatia-Canabae	38795 highly protected	field visits, on-site inspections	data collection zone concerned (directly on the coast) (process km: 1567)
Baracs -Annamatia military camp and civilian settlement protection zone	*89867*		*data collection zone concerned (directly on the beach) (river km: 1567)*
		Bács-Kiskun county	
Solt-Révbérpuszta, Port	**86563**	on-site inspection	**affected (partly in the riverbed)** (processkm:1558)
Solt - Danube riverbed 1558 fkm	56413	dig	data collection zone concerned (in the riverbed) (river km: 1558,5)
Solt -Alsorév, Danube riverbed	**23963**	data collection	data collection zone concerned(in riverbed)(processkm:1558)
Solt -Kalimajor-Danube estuary	**27198**	excavation field survey site inspection	data collection zone concerned (processkm:1551,5)
Baja-Pandur	**88547**	data collection	data collection zone concerned (processkm:1479.5)
		Tolna county	
Dunaföldvár -Bottyánsánc	20028	survey	data collection zone concerned (within 50 m) (process km: 1565)
Dunaföldvár -Macskalyuk	20019	excavation, site inspection, survey, aerial photography	data collection zone concerned (within 50 m) (process km: 1565)
Dunaföldvár - River barracks	20040	dig	data collection zone concerned (directly on the coast) (process km: 1564)
Dunaföldvár - Upper Rhév II.	registration pending	field trip	data collection zone concerned (directly on the coast) (process km: 1563)
Bölcske -Danube bank (E of Öreg-Szigett)	54182	on-site inspection	data collection zone concerned (in the riverbed) (river km: 1548)
Paks - Nuclear power plant 1.	85835	natural science research	data collection zone concerned (may also be concerned) (process km: 1527)
Bölcske -Danube bank (E of Öreg-Szigett)	54182	on-site inspection	data collection zone concerned (in the riverbed) (river km: 1548)
Mohács-Csele creek estuary	**24512**	public register of sites	data collection zone concerned (processkm:1451)
Mohács Waterworks	24497	site inspection, field visit	affected in the data collection zone (partly in the riverbed) (riverkm: 1451)

The planned investment can be considered special from the point of view of heritage protection, as the planned works will essentially be carried out in the Danube riverbed, under water or directly on the waterfront.With regard to the expected risks, the Hungarian Government has taken into account Act LXIV of 2001 on the Protection of Cultural Heritage and the provisions of Government Decree No.68/2018 (IV. In addition to the provisions of the Decree No. IV.9 of 2014 on the protection of the underwater cultural heritage and the regulations for the protection of cultural heritage, the Act IX of 2014 on the proclamation of the UNESCO Convention on the Protection of the Underwater Cultural Heritage (Article 1 of which authorises the Parliament to recognise the binding force of the Convention on the Protection of the Underwater Cultural Heritage) should be taken into account.

There is a high probability of a shipwreck in the channel at 1522+100 fkm.

In the planning area (1560-1433 fkm) as a whole, taking into account the planned works, there is one archaeological site declared protected, which is classified as category 1 on the basis of heritage risk, because it has heritage elements to be preserved in their original state and therefore should be avoided: the remains of a Roman watchtower at 1551+500 fkm, identified as 20004, located in the middle of the Danube bed in Bölcske. The archaeological site, which is currently causing a narrowing of the waterway, can be avoided without obstruction or interference by relocating the waterway track.

Sources used in chapter 6:

– TEIR - National Information System for Spatial Development and Planning (www.teir.hu) Műελlékemem.hu (www.muemlekem.hu) Heritage Protection (http://oroksegvedelem.kormany.hu/)
– National Tourism Development Strategy 2030 (Strategic) Environmental Assessment - https://mtu.gov.hu/documents/prod/NTS_SKV.pdf
– Danube Islands Blog (https://dunaiszigetek.blogspot.com/)
– Deputy State Secretariat for Architecture and Building

(https://www.kormany.hu/hu/miniszterelnokseg/strategiai-ugyekert-felelos-allamtitkar/epiteszeti-es-epitesugyi-helyettes-allamtitkarsag/hirek/utjara-indult-a-danurb-projekt)

– Bp. Budapest III. district, Óbuda Municipality website - Duna Cultural Corridor

(https://obuda.hu/blog/uj_szechenyi_terv/dunai-kulturalis-folyoso/)

– Preliminary Archaeological Documentation Risk Analysis Work Package - NIF Zrt for the Trans-European Transport Network - TEN-T Inland Waterways Development Design Services under Design Contract - 2014-HU-TMC-0606-S. Prepared by. Contractor: UTIBER Közúti Beruházó Zrt.

7. LANDSCAPE AND LAND USE, LANDSCAPE

7.1. SMALL FARMS IN THE STUDY AREA

The Szob-Kölked section of the Danube directly affects or directly borders 13 geographical areas(***15. Figure 15***): (1) Visegrad-Danube canyon, (2) Vác-Pesti-Danube valley, (3) Pesti-Hordes cone plain, (4) Csepel plain, (5) Érd-Ercsi-Hátság, (6) Central-Mezőföld, (7) Solti plain, (8) Kalocsai-Sárköz, (9) Tolnai-Sárköz, (10) South-Mezőföld, (11) Mohácsi-sziget, (12) Mohácsi terraced plain, (13) Bácskai loess plain. The Visegrádi-Dunakanyar belong to the Northern Hungary-Middle Mountains Landscape, the other small landscapes belong to the Great Plain Landscape.

About 20% of the **Visegrad-Dunakanyar** area is medium-altitude, gently dissected plain, about 80% valley bottom, which lies between the Börzsöny and the Visegrad Mountains. Its natural features and microclimate are favourable for forestry, recreation and water sports. The navigable stretch of the Danube between Esztergom and Vác is 32 km long. On this stretch, there are several settlements with a river passenger port, e.g. Esztergom, Zebegény, Dömös, Visegrád, Nagymaros.

The **Vác-Pesti-Duna valley** is a floodplain plain, with higher Danube terraces on the left bank of the Danube, low and high plateaus on the right bank, and older terrace islands of the Danube, with the boundary of the small area marked by the ridge of the mountain plateau on the west side. Most of the area is occupied by agricultural land, sand and gravel pits and settlements. The navigable stretch of the Danube between Vác and Budapest is 51 km long.On this stretch there are 6 settlements with a passenger port.

The **Pesti alluvial** plain is a dissected plain rising in steps towards the east, towards the higher terraces, which are cut by the left bank tributaries of the Danube in a checkerboard pattern. It is bordered to the west by the Danube. Most of the area is covered by farmland and settlements, and a smaller part by wood plantations. There is no direct Danube section, but it runs along the Vác-Budapest section of the Danube.

The **Csepel plain is a** floodplain plain with a terraced alluvial cone surface sloping gently southwards towards the Danube. Most of the area is occupied by agricultural land and settlements, and a smaller part by forests. On the left bank of the Danube (on the western border of the area), the dominant landscape is the more or less continuous floodplain vegetation of the Danube floodplain. The navigable stretch of the Danube between Budapest and Kulcs is 57 km long.

The **Érd-Ercsi-Hátság is a** rugged alluvial plain, divided by valleys and basins, bordered by the Danube to the east. The banks of the Danube are bordered by scrub, remnants of softwood and hardwood forests. Most of the area is under agricultural use due to the favourable soil conditions (calcareous chernozem). The navigable stretch of the Danube on the eastern border of the area is 22 km long, between Százhalombatta and Ercsi.

The **Central Great Plain is a** slightly dissected, alluvial conglomerate covered with loess. In the north-east, a medium-altitude loess plateau is located, separated from the Danube by a 50-60 m high bank. Most of the area is agricultural land, with smaller parts mainly settlements and forests. The navigable stretch of the Danube between Rácalmás and Bölcske is 36 km long.

The western edge of the **Solti Plain is** a high plateau, from which a series of 6-8 m high coastal dunes rise between Solt and Dunavecse. The altitude decreases towards the east, and most of the area is low flood plain. The predominant land uses are agricultural, with natural and semi-natural vegetation accounting for about 23%. In the west, the dominant feature of the landscape structure is the intermittent floodplain vegetation of the Danube floodplain. The navigable stretch of the Danube along the western border of the hamlet is 37 km long, between Kulcs and Harta.

The northern part of the **Kalocsai-Sárköz is** a high plateau, the southern part is a continuous low plateau. The high plateau (Madocsa terrace) on the right bank of the Danube is partly covered with quicksand and rises above its surroundings like a wide oval headland. The dominant land uses are agricultural. The floodplain vegetation of the Danube floodplain is scattered and degraded due to regulations, with mostly softwood forests, with shrubby grasses on the banks and islands and remnants of hardwood forests on the higher areas. The navigable stretch of the Danube along the western border of the small area is 74 km long, between Harta and Baja.

The northern part of the **Tolnai-Sárköz is** a continuous lowland plain (perfect plain), the southern part is a highland plain (flood-free plain), with terraced islands and, on the western edge, alluvial cones accumulated by streams from the Tolnai-Baranya hills. The dominant land uses are agricultural and forest land. The former floodplain of the Danube is now largely a flooded and dewatered cultural landscape. However, the remaining floodplain is home to Gemenc, the largest floodplain forest in Central Europe. The navigable stretch of the Danube between Paks and Bata is 67 km long.

A short stretch (about 3 km) of the **Southern Great Plain** touches the Danube. The landscape is a lowland alluvial plain covered with quicksand and loess, with typical land uses of agricultural and forest land. The navigable stretch of the Danube belonging to the sub-basin is 3 km long, in the area of Paks.

Most of the **island of Mohács is** low-lying, divided by smaller, mosaic-like highland flood-free areas. On its western edge (in the area of Dunaszekcső-Bár) there is a loose alluvial conglomerate, which breaks off with a steep 15-20 m shore into the low-lying areas. The dominant land uses are agricultural and forest land, with semi-natural vegetation remaining only along the Danube. The natural forest communities are oak-ash-siliceous groves and willow-shrub groves on the lower areas, but they are often replaced by cultivated forests (black oaks, noble or native aspen, acacia). The navigable stretch of the Danube belonging to the sub-region is 54 km long, between Baja and Homorúd (border), where only Mohács has a river passenger port.

The western part of the **terraced plain of Mohács** (Mohács terrace) is a low, flood-free plain, the eastern part (low and high floodplain of the Dubna) is a floodplain perfect plain. The dominant land uses are agricultural and forest areas, with semi-natural vegetation remaining rather only along the Danube, with similar characteristics to those of the island of Mohács (hard and softwood groves alternating with planted forests). The navigable stretch of the Danube belonging to the sub-region is 19 km long, between Mohács and Kölked (national border), where only Mohács has a river port.

The **Bácskai loess plain is a** small area of slightly undulating alluvial conglomerate plain covered with loamy sand, bordered by a terrace to the west. The land use is dominated by agricultural land (mainly arable land) and to a lesser extent by planted forests and settlements. The small area joins the Danube at Baja.

7.2. LAND COVER, LAND USES

The **surface cover of the 500 m wide landscape band along the main branch of the Danube is** presented in ***Table 48*** based on CorineLandCover 2018. A significant part of the 43907.03 ha landscape area surveyed consists of river, waterway (32.6%), deciduous forest (28.5%), non-irrigated arable land (11.8%), non-contiguous settlement structure (5.9%), industrial or commercial land (4.0%), and meadow and pasture (3.5%). The land cover is shown in ***Figure 166.***

48. Table 1:Surface cover of the 500 m landscape band along the Danube (based on CLC 2018)

CorineLandCover 2018 surface cover category	Area (ha)	%
1.1.1 Interconnected settlement structure	480,31	1,09
1.1.2 Non-coherent settlement structure	2609,06	5,94
1.2.1 Industrial or commercial areas	1773,58	4,04
1.2.2 Road and rail network and connecting areas	45,71	0,10
1.2.3 Ports	298,77	0,68
1.3.2 Landfills, tailings piles	50,76	0,12

CorineLandCover 2018 surface cover category	Area (ha)	%
1.3.3 Construction jobs	54,43	0,12
1.4.1 Urban green spaces	361,48	0,82
1.4.2 Sport, leisure and recreation areas	1310,01	2,98
2.1.1 Non-irrigated arable land	5198,67	11,84
2.2.1 Grapes	40,66	0,09
2.2.2 Fruit and berries	24,11	0,05
2.3.1 Grassland, pasture	1552,35	3,54
2.4.2 Complex farming structure	1251,56	2,85
2.4.3 Primarily agricultural areas with significant natural vegetation	843,20	1,92
3.1.1 Deciduous forests	12501,47	28,47
3.1.2 Coniferous forests	12,89	0,03
3.1.3 Mixed forests	2,88	0,01
3.2.1 Natural grasslands, semi-natural meadows	93,68	0,21
3.2.4 Transitional wooded-shrub areas	724,42	1,65
4.1.1 Terrestrial wetlands	53,45	0,12
5.1.1 Watercourses, waterways	14313,67	32,60
5.1.2 Public waters	309,90	0,71
Total:	43907,03	100

The land use can also be inferred from the land cover, which can be combined to give a good indication of the nature of land use (***Table 49***). In the 500 m landscape band under study, apart from the water surfaces, of which the Danube river itself is a significant part, the dominant land uses are forest (30.16%) and agricultural (20.29%), but there is also a significant proportion of urban land (10.84%).

49. Table 1:Land use of the 500 m landscape band along the Danube (based on CLC 2018)

CorineLandCover 2018 land cover aggregated by land use category	Area (ha)	%
Municipal areas (1.1.1 + 1.1.2 + 1.4.1. + 1.4.2.)	4760,86	10,84
Industrial areas, transport areas, degraded surfaces (1.2.1 + 1.2.2 + 1.2.3 + 1.3.2 + 1.3.3)	2223,25	5,06
Mezőgazdasági területek (2.1.1+2.2.1+2.2.2+2.3.1+2.4.2+2.4.3)	8910,55	20,29
Forests and shrubs (3.1.1+3.1.2+3.1.3+3.2.4)	13241,66	30,16
Natural grasslands and wetlands (3.2.1 + 4.1.1)	147,14	0,34
Water surfaces (5.1.1+5.1.2)	14623,56322	33,31
Total:	43907,03	100

The extent of the industrial areas is not negligible either (about 1770 ha), **within the 500 m landscape strip along the Danube they** are located in the districts of **Vác**, Dunakeszi, Budapest III, IV, IX, XI, XIII, XXI, XXII, Szigetszentmiklós, Tököl, Százhalombatta, Adony, Dunaújváros, Dunaföldvár, Paks, Foktő, Gerjen, Baja, Mohács. Major industrial **plants, large contiguous industrial estates near the Danube bank,** e.g. Székesdűlő industrial estate (Dunakeszi, Budapest IV. district), Szabadkikötő and the area of the former Csepel Works (Budapest XXI. district), Lesaffre Hungary Yeast Production and Production Plant, Lesaffre Hungary Yeast Production and Production Plant, Budapest, Budapest. Ltd. and Budaval Papírfeldolgozó Zrt. (Budapest XXII district), Harbor Park logistics centres (Budapest XXII district), MOL Dunai Refinery (Százhalombatta), Dunamenti Power Plant - thermal power plant (Százhalombatta), Adony Port and logistics centre, ISD DUNAFERR Zrt. steel plant and its tailings pile, blast furnace slag storage area (Dunaújváros), paper mills in Dunaújváros (e.g. Hamburger Hungária Kft. , Dunafin Zrt. , Dunapack ZRt. bio-refinery (Dunaföldvár), Normbenz Hungary Ltd. fuel trading site with its own port (Dunaföldvár), Paks nuclear power plant, Pannon Növényolajgyártó Kft. (Foktő), Györgymajor agricultural sites (Gerjen), port of Baja and related logistics centres, KRONOSPAN-MOFA Hungary Farostlemezgyártó Kft. (Mohács), industrial area between Bóly port and Mohács railway station. There are also former major industrial plants and their associated facilities, the area of which is in need of recultivation or partially recultivated (e.g. the area of the Óbuda Gas Factory, the area of the former Csepel Works, the area of the former brickworks in Mohács, the area of the former brickworks in Paks).

Areas with a coherent or non-coherent settlement structure - typically municipal inland areas - **extend to the Danube coast in the** following **municipalities**: Dömös, Nagymaros, Visegrád, Kismaros, Verőce, Vác, Sződliget, Göd, Dunakeszi, Budapest districts I, II, III, V, IX, XI, XIII, XXI, XXII, Százhalombatta, Ercsi, Dunavecse, Dunaföldvár, Ordas, Paks, Uszód, Dunaszekcső, Dunafalva, Mohács. Vác, Budapest Districts I, III, XI, Margit Island; Százhalombatta, Dunaújváros. Zebegény, Pilismarót, Dömös, Nagymaros, Visegrád, Kisoroszi, Verőce, Vác, Tahitótfalu, Pócsmegyer, Szigetmonostor, Dunakeszi, Budapest IV, XIII, XI, Szigetszentmiklós, Százhalombatta, Kulcs, Dunaújváros, Baracs, Kisapostag, Paks, Sükösd, Érsekcsanád, Baja, Mohács.

Of the landscape uses, special attention should be paid to the planned forest areas, which can be represented on the basis of the National Spatial Plan's forest zoning (***Figure 17***). According to Article 4, point 8, of Act CXXXIX of 2018 on the Spatial Planning Plan of Hungary and Certain Priority Regions of Hungary, the forest zone includes "forests and land directly serving forestry purposes as listed in the National Forest Inventory". Accordingly, **forests planted** directly **on the Danube bank are located in all the municipalities concerned, except for** Budapest districts I, II, III, V, IX, XI, Leányfalu, Dömös, Zebegény. Large areas of forest cover e.g. between Báta andŐcsény, south of Mohács (Homorúd, Kölked). The **areas registered as forest reserves** are the Buvat-Keszeges-tó **Forest Reserve** (ER-29, 262.6 ha) belonging to Decs (Decree 4/2000 (III. 24.) KöM)[17], the **Dél-Veránka, Sasfok Forest Reserve** (ER-30, 194.9 ha) [18]belonging to Baja and Érsekcsanád, and the **Kádár-sziget Forest Reserve** (ER-31, 82.3 ha) [19]belonging to Baja.

7.3. LANDSCAPE STRUCTURE

Landscape structure is determined by land use and linear landscape features, the location and extent of which are significantly influenced by natural features (e.g. topography, soil, exposure, water conditions). The landscape structure of the study area is presented on the basis of the structure plan of the National Spatial Plan (***Figure 189***). **The Danube is the dominant** landscape **feature, which is also the organising element of the settlement network.**

- In the Danube **bend, on the** stretch **from Szob to Vác,** between the left bank of the Danube and **Pilismarót-Visegrád on the** right bank of the Danube, no first-order flood protection embankment has been built. From the point of view of landscape structure, the forest areas of the Pilis-Visegrád Hills and the Börzsöny, the streams running down from the mountains (e.g. the Pilismaróti Stream, the Ágas Stream, the Lepence Stream, the Apát-kúti Stream from the Visegrád Hills; the Malom-Völgyi Stream, the Bőszobi Stream, the Hatló Stream, etc. from the Börzsöny) and the Ipoly delta are of decisive importance. In almost all cases, the settlements have a direct link with the Danube, as the topography of the area has resulted in residential and holiday areas being built on the banks of the Danube. The Pilismaróti and Visegrádi bays are characteristic structural features.
- **Between Vác and Dunakeszi, the** coastal areas are mainly occupied by settlements (mainly residential, to a lesser extent recreational), with small patches of agricultural and forestry land. The only primary flood protection dike is between Göd and Sződliget.

[17] https://www.erdorezervatum.hu/Buvat_Keszeges-to
[18] https://www.erdorezervatum.hu/Del-Veranka_Sasfok
[19] https://www.erdorezervatum.hu/Kadar-sziget

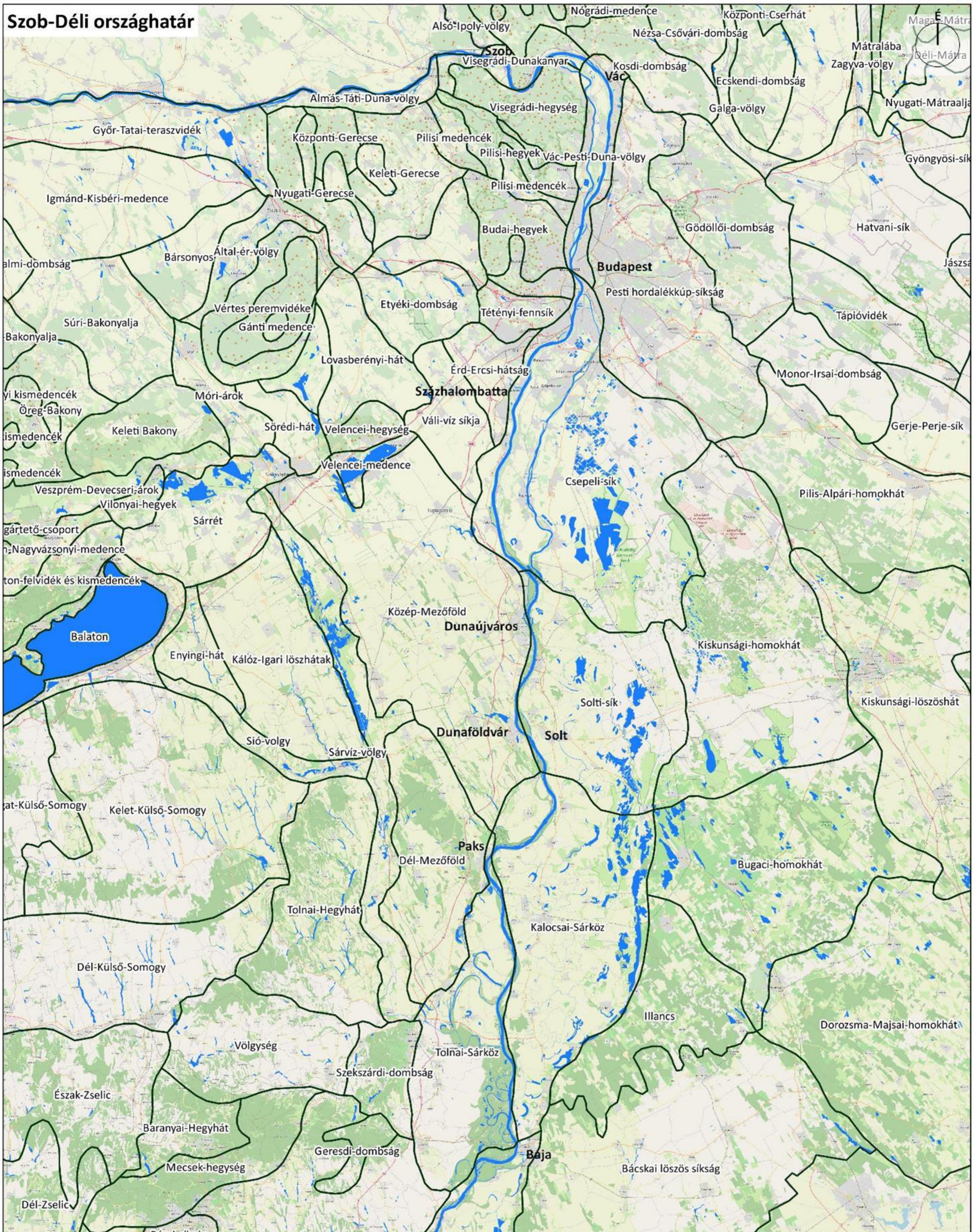
- The **settlements of Szentendrei Island are** basically further away from the coast in the case of Kisoroszi and Tahitótfalu, while in the case of Pócsmegyer and Szigetmonostor the resort areas extend to the coast. Between Tahitótfalu and Szigetmonostor there is a first-rate flood protection embankment, almost directly along the coast. Along the shore, there are mostly fields and forestry areas (partly with groves belonging to the Danube-Ipoly National Park).
- The Danube section of **Budapest** is built-up throughout, and except for a few small forest patches (e.g. Palotai Island and Népsziget in Újpest), the Danube landscape strip is shown as a settlement area in the OTrT structure plan. Óbudai Island and Margaret Island, as important public parks, are also included in the settlement area. Defining structural elements are the high points along the Danube, such as the Buda Castle Hill or the Gellért Hill, with the Buda Hills in the background. In the southern part of the Danube section of the capital and on the northern tip of Csepel Island, extensive industrial areas are the dominant structural elements on the Danube bank.
- The municipalities of **Csepel Island** (from Szigetszentmiklós to Makád) are connected to the Danube by a first-rate flood protection embankment, as the island is largely low-lying. Between Szigetcsép and Makád there are extensive areas of forest on the water side of the dike, which are of landscape importance.
- On the stretch between **Érd and Ercsi in the north, the** right bank of the Danube alternates between high banks and low-lying areas, which is why a first-order flood protection embankment has been built in sections. The settlement areas of all three municipalities - Érd, Százhalombatta, Ercsi - extend to the Danube bank, but the residential areas of Százhalombatta occupy the longest stretch of the bank. Although not directly on the bank, the MOL Oil Refinery and the thermal power plant are located close to it and are key structural elements in the landscape of Százhalombatta. In places, the Danube bank is bordered by extensive or narrow strips of forest (e.g. Beliczay Island in Érd, the coastal strip between Százhalombatta and Ercsi).
- **From the southern part of Ercsi** (approx. from the Ercsi Holt-Duna) **to Adony,** the first order flood protection embankment is located on the right bank of the Danube, further away from the shore (approx. 300-700 m), on the water side there are mainly agricultural and forestry areas, the settlement areas are mostly located on the protected side of the embankment, except for the area of the Adony port and logistics centre.
- On the stretch between **Kulcs and Bölcske, the** right bank of the Danube is largely high, so no main flood protection line has been built. Between Kulcs-Dunaújváros and Dunaföldvár, the municipalities occupy long stretches along the Danube (mainly residential and industrial areas, and to a lesser extent recreational areas, e.g. Baracs). Between Baracs-Dunaföldvár and Dunaföldvár-Bölcske, there are extensive agricultural areas, including gardens and orchards in the southern part of Dunaföldvár (separated from the Danube by a narrow strip of woodland). The industrial areas of Dunaújváros (e.g. Dunaferr and the paper mills), the forest areas of the Rácalmási Islands TT and the extensive forest areas on the islands, peninsulas and shores of the Kéményesi-Duna running between Dunaföldvár and Bölcske are also dominant elements in terms of landscape structure.
- The first order flood protection embankment runs along the left bank of the Danube between **Tass and** Dunavecse, and is relatively far from the river (about 0.7-2.6 km) in the section between Tass and Dunavecse in the north, and narrows the floodplain (about 200-400 m from the bank) between Dunavecse and Dunavecse. The area is predominantly agricultural, with extensive woodland in the Szalkszentmárton area and narrow strips of woodland between Apostag and Dunaegyháza. The gravel pits of Szakszentmárton are also a dominant feature of the landscape.
- On the section between **Solt and Dunapataj, a** first-rate flood protection embankment was built along the left bank of the Danube from the southern part of Solt, directly next to the main road 51 for a long stretch. The embankment is relatively distant from the Danube bed, and between the embankment and the river there is a large area of agricultural land, except for the extensive woodland between Harta and Dunapataj (associated with the Dunapataj tributary). No flood protection embankment has been built in the northern part of Solt, and the banks are largely used

for agriculture. A dominant landscape feature is the forested island bordered by the Solti-Danube and the main branch of the Danube. The settlement area in this section borders the Danube for a short stretch in the case of Harta, but the settlements are typically located on the levee's lee side, away from the Danube.

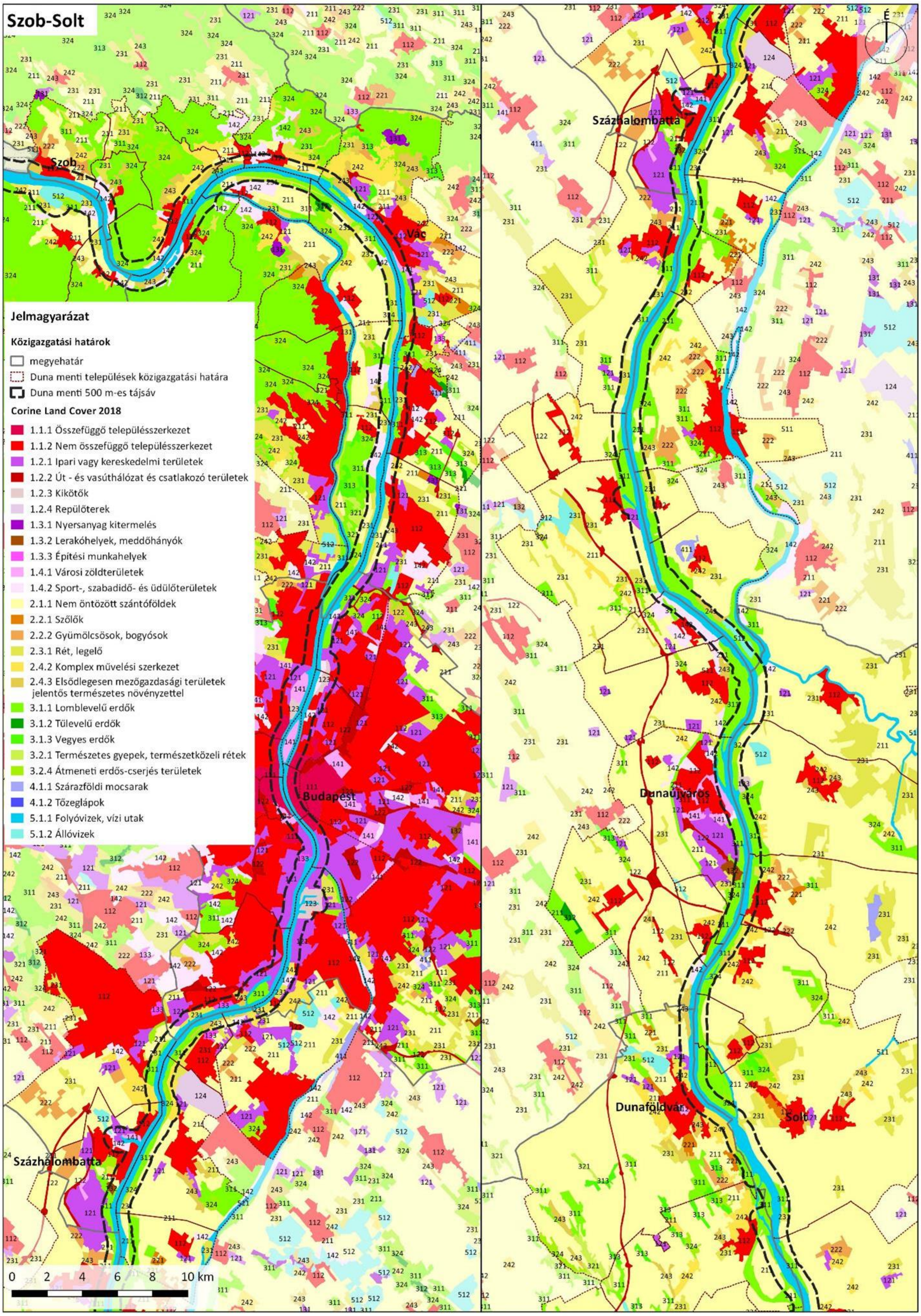
- On the bank of the **Madocsa** municipality, the primary flood protection embankment runs relatively close to the Danube riverbed, with a variable width of woodland on the water side and extensive farmland behind it. The municipality has no connection with the river, except for a short stretch of bank (with some holiday and residential buildings) around the boat station.
- In the northern part of the coastal area of the municipality **of Paks,** there are extensive forest areas and islands in the vicinity of the Danube channel. The inland parts of the municipality of Paks border the Danube coastal strip, the main flood protection line in the inland section is mainly the main road No. 6. Both residential and industrial areas can be found along the Danube bank. The Paks nuclear power plant and its associated facilities (e.g. hot and cold water channels) are a dominant landscape feature. The dominant landscape feature in the southern part of the municipality is the Uszódi Island, with the flood protection embankment on its western border, with mainly arable land behind it.
- On the section between **Ordas and Fajsz** (up to the northern border of the Danube-Drava NP), a flood protection embankment follows the Danube along the left bank of the Danube, with woodland on the water side and mostly agricultural land on the buffered side. Along some stretches of the villages of Géredlak, Foktő, Bátya, Fajsz, relatively wide strips of woodland have been preserved. The municipalities of Ordas, Uszód, the resort area of Kalocsa and the vegetable oil production plant in Foktő are located on or near the main branch of the Danube.
- On the stretch between **Gerjen and Bogyiszló,** a flood protection embankment follows the Danube along the right bank, with woodland on the water side and mostly agricultural land on the buffered side. The settlement areas of Gerjen (residential and recreational areas) are located close to the embankment, while Bogyiszló and Fadd are relatively distant, but some of the recreational areas along the Faddi-Duna are also close to the main branch of the Danube. The Faddi-Danube and the Tolna-Danube are dominant landscape features.
- On the left bank of the Danube between **Fajsz and Baja,** the flood protection embankment was built relatively close to the river (except in the southern part of Baja), and the woodland forest on the water side of the embankment is part of the Danube-Drava National Park. The protected side of the embankment is mainly agricultural land and the inner part of Baja. The dominant landscape features are Sugovica, Petőfi Island and Pandur Island, belonging to Baja, with the latter island forming a large part of the Danube-Drava National Park.
- Gemenc, part of the Danube-Drava National Park, is one of Europe's largest extensive floodplain forests, located on the right bank of the Danube between **Őcsény and Báta.** The extensive woodland is a dominant landscape feature in itself, with its extensive woodland structured by bays, tributaries, islands and peninsulas. Its western side is bordered by a first-rate flood protection dike.
- Along the section between **Szeremle and Mohács, a** first-order flood protection embankment runs along the left bank of the Danube, at varying distances from the Danube: typically closer to the river in the vicinity of the municipalities and further away from the river in the vicinity of the backwaters and tributaries. Immediately on the Danube bank, on the waterward side of the flood protection embankment, there are settlement areas in the settlements of Mohács (Újmohácsi recreation area) and Dunafalva (north of the recreation area). Apart from these, there is a strip of forest of varying widths directly on the bank. From a landscape structure point of view, the dominant elements are the tributaries of the Seremle and Dunafalva rivers and the extensive forest areas around them, which are part of the Danube-Drava National Park.
- On the stretch between the **southern part of Báta and Mohács on** the right bank of the Danube, no flood protection embankment has been built, and the river bank is high. The landscape along the Danube is largely occupied by settlements (mainly residential, to a lesser extent recreational and

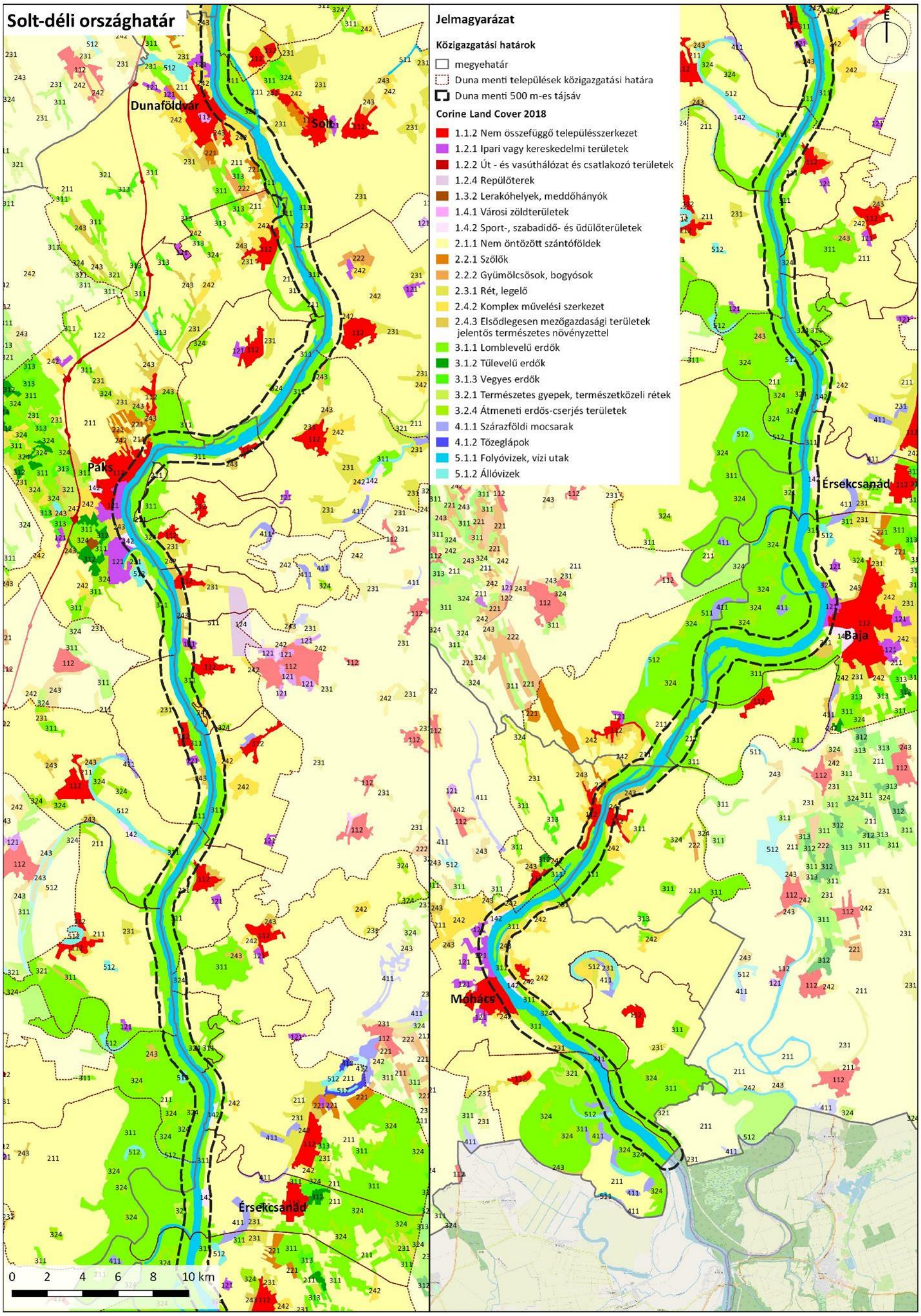
industrial) and agricultural land, and to a lesser extent by woodland. The landscape structure is dominated by the islands, peninsulas and tributaries of the Bar and Bata.

- The stretch between **Mohács and Homorúd** has extensive forested areas on both banks of the Danube, which belong to the Béda-Karapancsa landscape unit of the Danube-Drava National Park. The land use along the Danube is mostly forested, with a small part of agricultural land (grassland). Primary flood protection embankments have been built on both banks of the Danube, but leaving a relatively large area for the river. In terms of landscape structure, the main features are the estuaries, tributaries, islands and peninsulas.
- **Meghatározó vonalas művi tájelemek** az említett helyeken húzódó **árvízvédelmi töltések** mellett **a közlekedési hálózat elemei**, a szakaszosan partközelben futó 2., 6., 11., 12., 51., 52., 55. és 56. sz. főutak, a Dunát keresztező M0, M8 és M9 autópályák, autópálya-szakaszok, valamint a 70., 40a., 30a, 42, 154 and 65, which in some places limit **access to the Danube bank**.

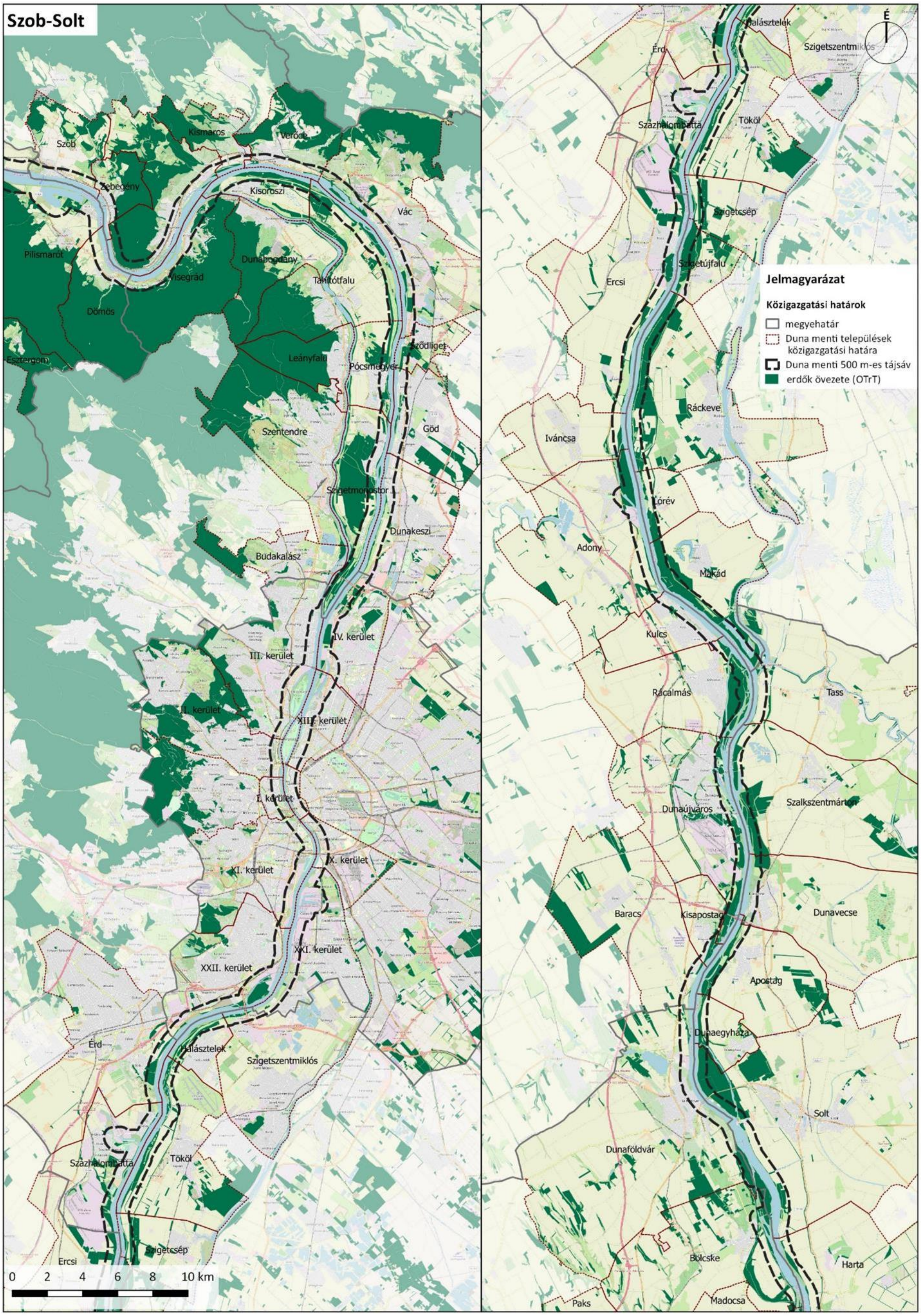


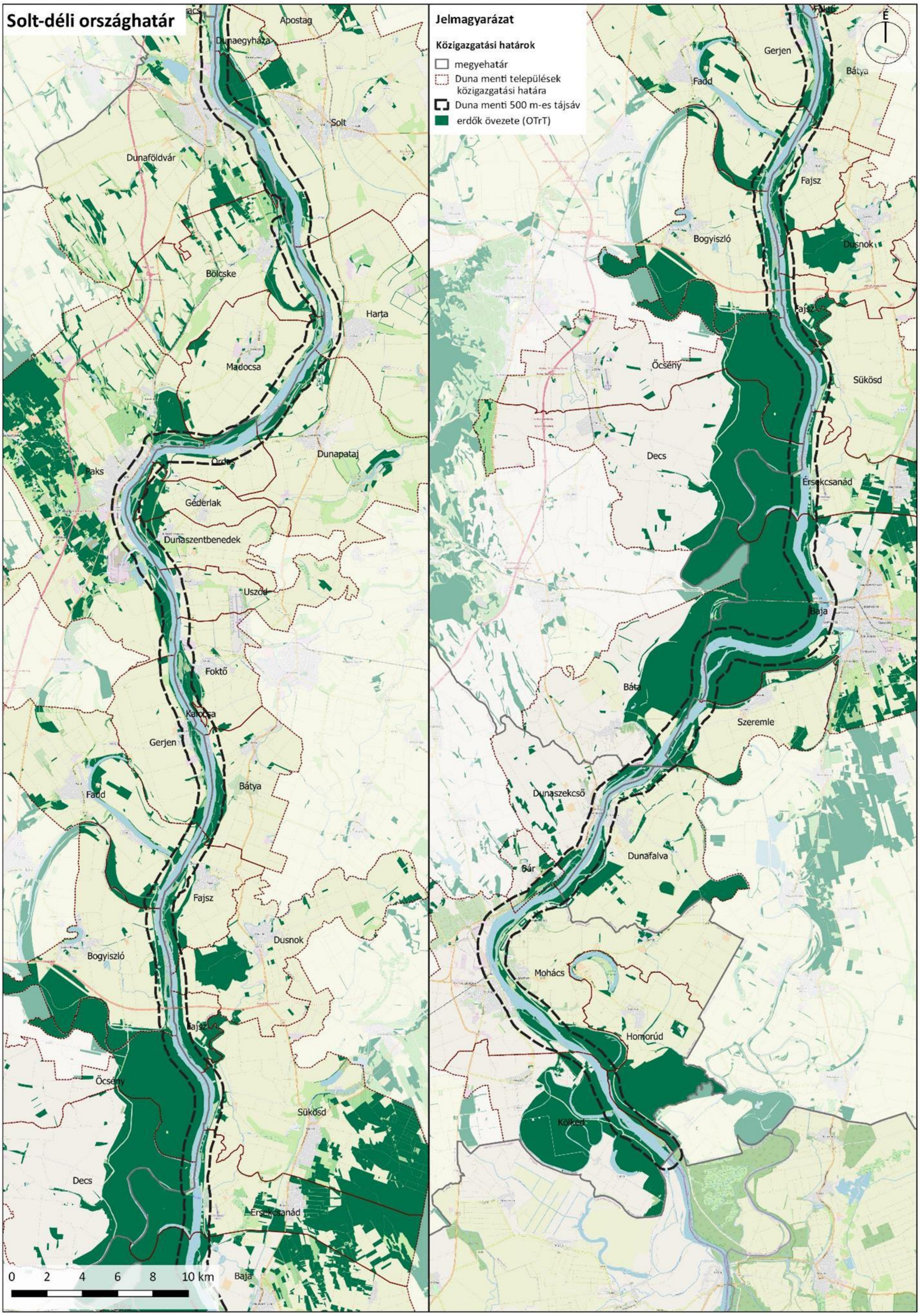
15. Figure 1: Geographical areas affected by the Danube section under study


Szob-Solt
É
Szob
Vác
Budapest
Százhalombatta
Dunaújváros
Dunaföldvár
Solt
Jelmagyarázat
Közigazgatási határok
megyehatár
Duna menti települések közigazgatási határa
Duna menti 500 m-es tájsáv
Corine Land Cover 2018
1.1.1 Összefüggő településszerkezet
1.1.2 Nem összefüggő településszerkezet
1.2.1 Ipari vagy kereskedelmi területek
1.2.2 Út - és vasúthálózat és csatlakozó területek
1.2.3 Kikötők
1.2.4 Repülőterek
1.3.1 Nyersanyag kitermelés
1.3.2 Lerakóhelyek, meddőhányók
1.3.3 Építési munkahelyek
1.4.1 Városi zöldterületek
1.4.2 Sport-, szabadidő- és üdülőterületek
2.1.1 Nem öntözött szántóföldek
2.2.1 Szőlők
2.2.2 Gyümölcsösök, bogyósok
2.3.1 Rét, legelő
2.4.2 Komplex művelési szerkezet
2.4.3 Elsődlegesen mezőgazdasági területek jelentős természetes növényzettel
3.1.1 Lomblevelű erdők
3.1.2 Tűlevelű erdők
3.1.3 Vegyes erdők
3.2.1 Természetes gyepek, természetközeli rétek
3.2.4 Átmeneti erdős-cserjés területek
4.1.1 Szárazföldi mocsarak
4.1.2 Tőzeglápok
5.1.1 Folyóvizek, vízi utak
5.1.2 Állóvizek
0 2 4 6 8 10 km

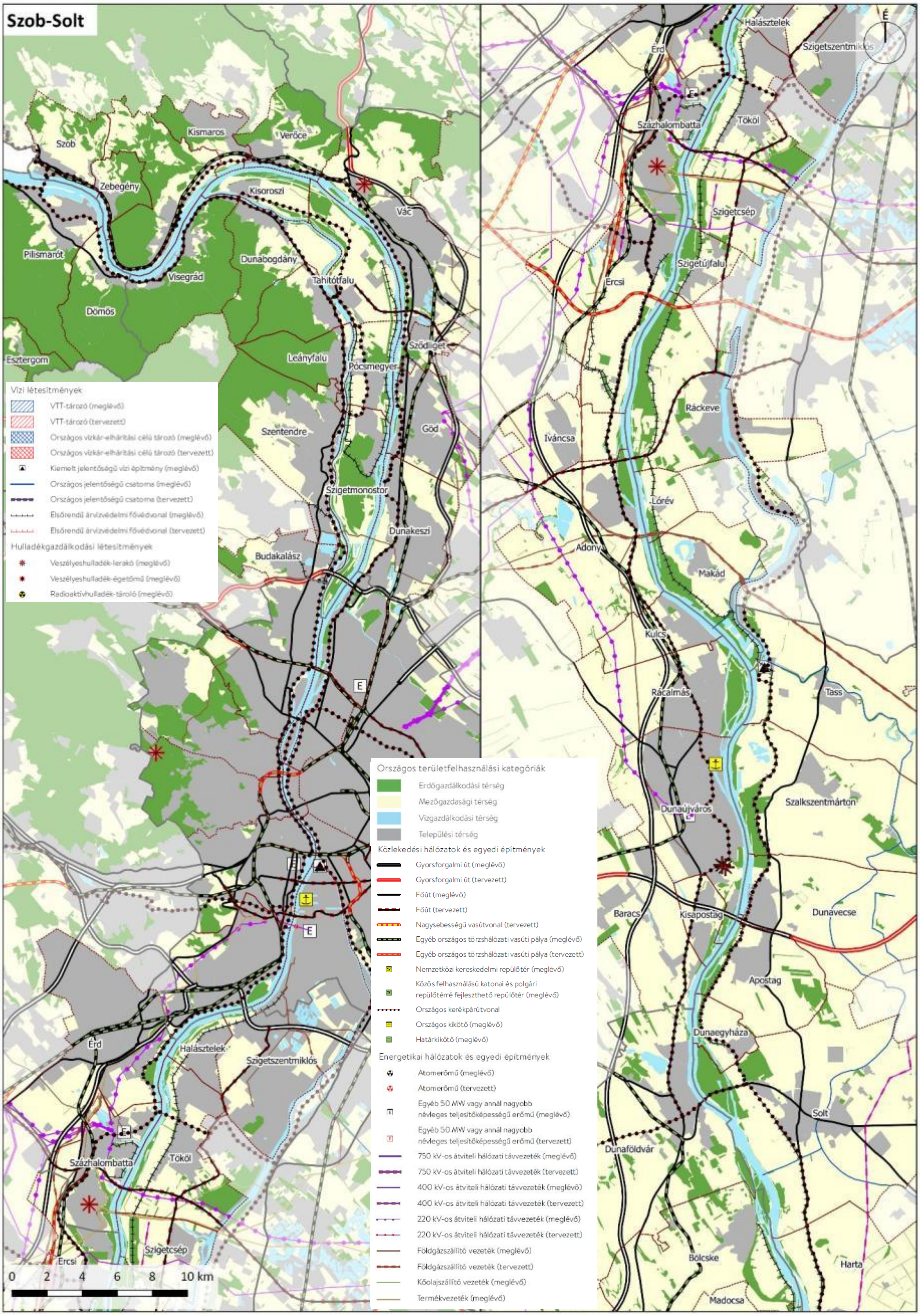


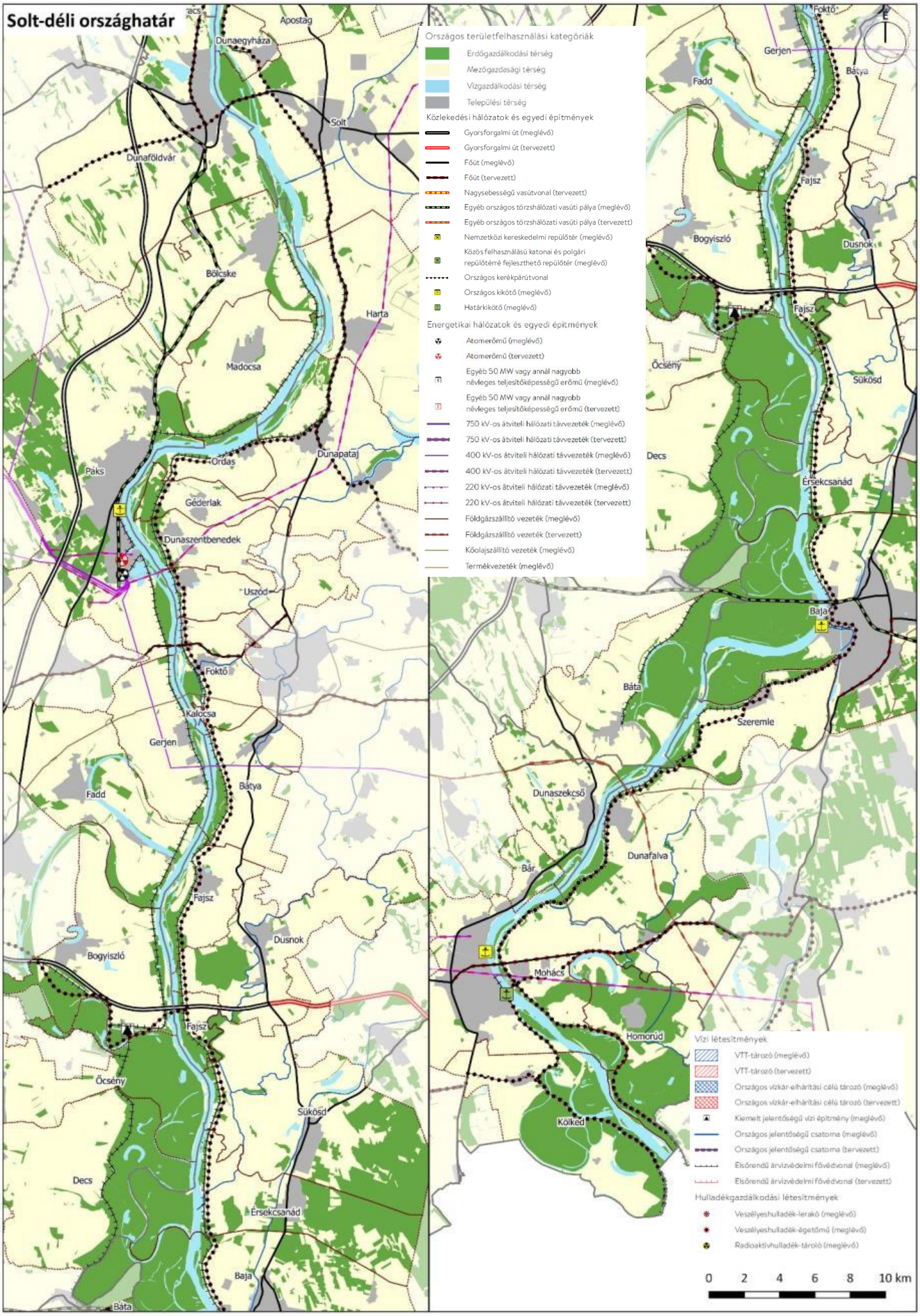
16. Figures 1 and 2: The 500 m wide landscape strip along the Danube and its surroundings


Szob-Solt
Szob
Kismaros
Verőce
Zebegény
Kisoroszi
Vác
Pilismarót
Visegrád
Dunabogdány
Tahitótfalu
Dömös
Esztergom
Leányfalu
Sződliget
Pócsmegyer
Szentendre
Göd
Szigetmonostor
Dunakeszi
Budakalász
IV. kerület
III. kerület
II. kerület
XIII. kerület
I. kerület
IX. kerület
XI. kerület
XXI. kerület
XXII. kerület
Érd
Halásztelek
Szigetszentmiklós
Százhalombatta
Tököl
Szigetcsép
Ercsi
0 2 4 6 8 10 km
É
Szigetújfalu
Jelmagyarázat
Közigazgatási határok
megyehatár
Duna menti települések közigazgatási határa
Duna menti 500 m-es tájsáv
erdők övezete (OTrT)
Ráckeve
Iváncsa
Lórév
Adony
Makád
Kulcs
Rácalmás
Tass
Dunaújváros
Szalkszentmárton
Baracs
Kisapostag
Dunavecse
Apostag
Dunaegyháza
Solt
Dunaföldvár
Bölcske
Harta
Paks
Madocsa



17. Figures 1 and 2:Planned forests in and around the 500 m wide landscape strip along the Danube

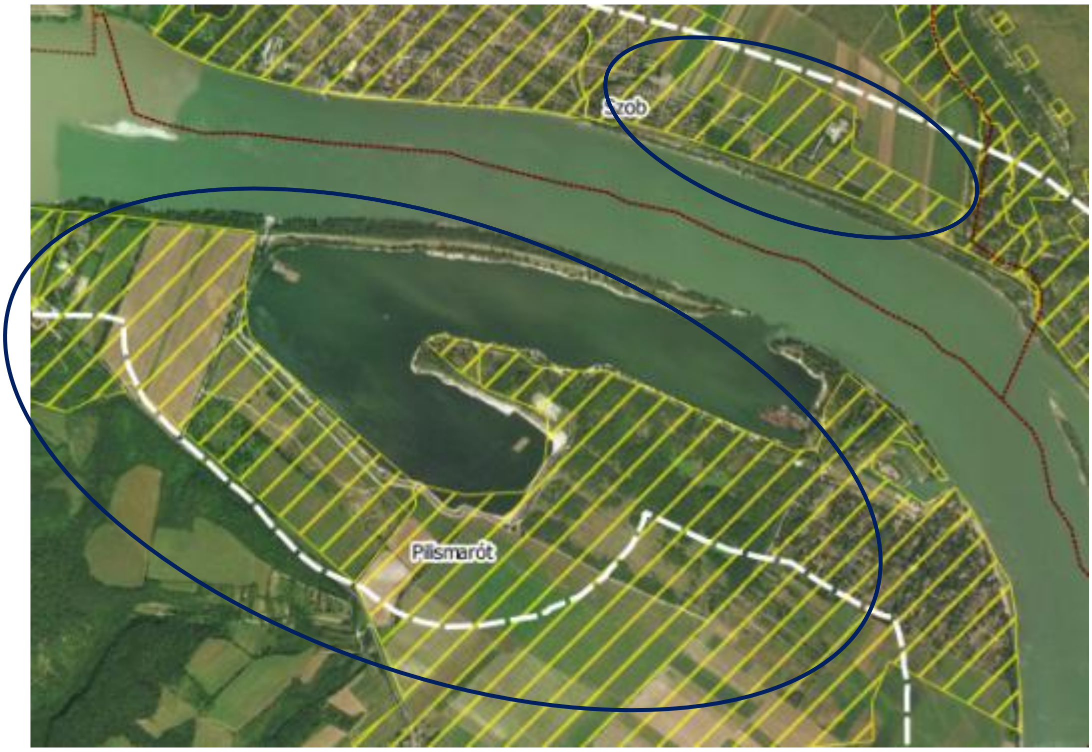

Szob-Solt
Vízi létesítmények
VTT-tározó (meglévő)
VTT-tározó (tervezett)
Országos vízkár-elhárítási célú tározó (meglévő)
Országos vízkár-elhárítási célú tározó (tervezett)
Kiemelt jelentőségű vízi építmény (meglévő)
Országos jelentőségű csatorna (meglévő)
Országos jelentőségű csatorna (tervezett)
Elsőrendű árvízvédelmi fővédvonal (meglévő)
Elsőrendű árvízvédelmi fővédvonal (tervezett)
Hulladékgazdálkodási létesítmények
Veszélyeshulladék-lerakó (meglévő)
Veszélyeshulladék-égetőmű (meglévő)
Radioaktívhulladék-tároló (meglévő)
Országos területfelhasználási kategóriák
Erdőgazdálkodási térség
Mezőgazdasági térség
Vízgazdálkodási térség
Települési térség
Közlekedési hálózatok és egyedi építmények
Gyorsforgalmi út (meglévő)
Gyorsforgalmi út (tervezett)
Főút (meglévő)
Főút (tervezett)
Nagysebességű vasútvonal (tervezett)
Egyéb országos törzshálózati vasúti pálya (meglévő)
Egyéb országos törzshálózati vasúti pálya (tervezett)
Nemzetközi kereskedelmi repülőtér (meglévő)
Közös felhasználású katonai és polgári repülőtérré fejleszthető repülőtér (meglévő)
Országos kerékpárútvonal
Országos kikötő (meglévő)
Határkikötő (meglévő)
Energetikai hálózatok és egyedi építmények
Atomerőmű (meglévő)
Atomerőmű (tervezett)
Egyéb 50 MW vagy annál nagyobb névleges teljesítőképességű erőmű (meglévő)
Egyéb 50 MW vagy annál nagyobb névleges teljesítőképességű erőmű (tervezett)
750 kV-os átviteli hálózati távvezeték (meglévő)
750 kV-os átviteli hálózati távvezeték (tervezett)
400 kV-os átviteli hálózati távvezeték (meglévő)
400 kV-os átviteli hálózati távvezeték (tervezett)
220 kV-os átviteli hálózati távvezeték (meglévő)
220 kV-os átviteli hálózati távvezeték (tervezett)
Földgázszállító vezeték (meglévő)
Földgázszállító vezeték (tervezett)
Kőolajszállító vezeték (meglévő)
Termékvezeték (meglévő)
Szob
Kismaros
Verőce
Zebegény
Kisoroszi
Vác
Pilismarót
Visegrád
Dunabogdány
Tahitótfalu
Dömös
Esztergom
Leányfalu
Szödliget
Pócsmegyer
Szentendre
Göd
Szigetmonostor
Dunakeszi
Budakalász
Érd
Halásztelek
Szigetszentmiklós
Százhalombatta
Tököl
Szigetcsép
Ercsi
Szigetújfalu
Ráckeve
Iváncsa
Lórév
Adony
Makád
Kulcs
Rácalmás
Tass
Dunaújváros
Szalkszentmárton
Baracs
Kisapostag
Dunavecse
Apostag
Dunaegyháza
Solt
Dunaföldvár
Bölcske
Harta
Madocsa
0 2 4 6 8 10 km
É

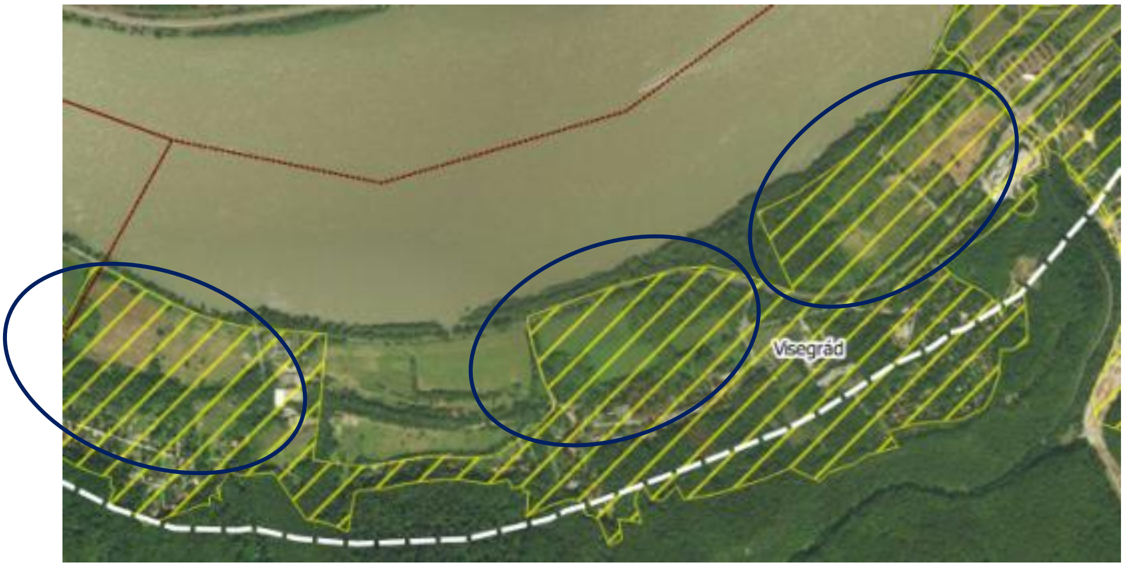


18. Figures 1 and 2: Landscape structure of the study area - based on the National Spatial Plan

- The **existing national ports** marked on the OTrT are located in the XXI. district of **Budapest**, Dunaújváros, Paks, Baja, Mohács, and the border port is located in Mohács.
- The Kvassay lock (Budapest IX and XXI districts), the Tassi lock, the Keselyűs boat lock (Bogyiszló) are included in the national structural plan **as water facilities of special importance.**

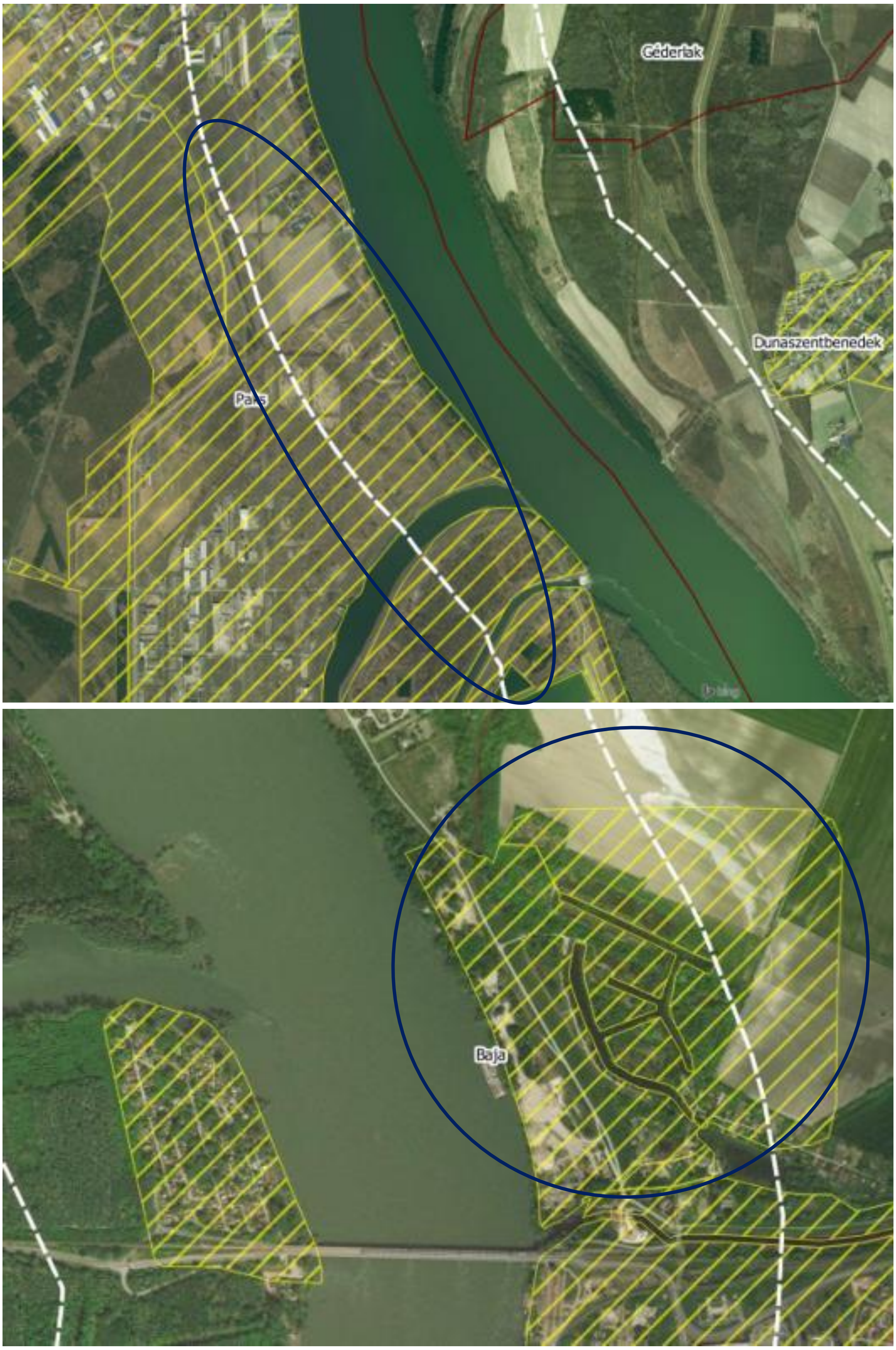
According to the structure plan of the National Land Use Plan, many municipal areas are much larger than the actual built-up areas. (According to the definition of Act CXXXIX of 2018, the municipal area includes the internal areas and the areas of municipalities intended for development - not necessarily areas intended for development, but generally the areas where future development is expected, according to the functions defined in the municipal planning instruments.) Significant areas not yet built up but belonging to the municipal area are located within 500 m of the main branch of the Danube bank in the following municipalities: Pilismarót, Szob, Visegrád, Nagymaros, Tahitótfalu, Sződliget, Dunakeszi, Százhalombatta, Dunaújváros, Dunavecse, Apostag, Dunaföldvár, Paks, Baja, Dunafalva, Dunaszekcső, Mohács. Some examples are shown in ***Figure 19*** (the yellow hatching represents the municipality area, the white dashed line is the 500 m landscape strip along the Danube, on the Bing base map).






Dunaújváros
Szalkszentmárton


Dunaújváros
Dunavecse
Apostag



19. Figures 3.1:Settlement areas along the Danube (possible future developments)

Other expected changes in the landscape structure of the study area are the **major road network improvements under construction/planned** (the list goes from N to D):

- M2 motorway [Vác - Rétság - Hont - (Slovakia)],
- Highway 213 [Gödöllő (Highway 3) - Vác area - Tahitótfalu (Highway 11)] - Tahitótfalu-Vác with a new Danube bridge,
- Mo motorway [Biatorbágy (M1) - Solymár - Pilisborosjenő - Üröm - Budapest [III. district] - Budakalász (main road 11)],
- Budapest: Galvani Bridge and Albertfalvai Bridge,
- Main road No 100 [Bicske area (M1) - Százhalombatta - Újhartyán (M5)] - Százhalombatta-Tököl with a new Danube bridge,
- Planned main road between Szabadegyháza (main road No 62) - Adony - Ráckeve - Kiskunlacháza (main road No 51), with a new Danube bridge between Adony and Ráckeve,
- M8 motorway: Balatonfőkajár (M7) - Sárbogárd - Baracs (M6); Apostag - Kecskemét - Szolnok (M4) - Baracs-Dunavecse with connection to the existing section,
- Main road No 512 [Kalocsa area (main road No 51) - Paks area (M6)] - Paks-Foktő with new Danube bridge,
- Highway 51Southeastern bypass of Baja,
- Main road No 57 [Mohács - Nagybaracska (main road No 51)] - with a new Danube bridge at Mohács.

7.4. THE RELATIONSHIP BETWEEN SETTLEMENTS AND THE DANUBE: COASTAL LAND USES

The relationship between the Danube settlements and the river also needs to be examined in more detail: coastal land uses are a key consideration, as the environmental impacts of the planned waterway development will primarily affect the coastal areas directly, both during construction and operation. In the present phase of the study, the length of the Danube coastline associated with each municipality, the typical coastal land uses, tourist attractions, recreational facilities and the natural/artificial coast ratio are presented as follows:

- shoreline length is not a legal shoreline, but the *part of the* municipality *towards the main branch of the Danube*, based on own measurements, so the values in the table are orders of magnitude,
- the typical riparian land uses are directly related to riparian uses along the main branch of the Danube (up to 100 m), which may be directly affected by the interventions and the operation of the fairway,
- tourist attractions, recreational facilities and accommodation within 500 m of the Danube bank are summarised, mainly based on information available on Google Maps,
- the natural/artificial beach ratio is determined on the basis of the dominance of the surface cover (natural/artificial dominated - with an estimated %), not on the basis of the near-natural state of the beach: artificial beaches are those with built or linear infrastructure (except flood protection embankments) and natural beaches are those with biologically active surfaces.

The results of the study are shown in ***Table50***.

50. Table 3:The Danube municipalities' connection with the river

Municipality	Length of the Danube bank	Typical coastal land uses	Tourist attractions, accommodation near the coast	Recreational facilities near the coast	Natural-artificial coast ratio
Komárom-Esztergom county (right coast)					
Szob	4,4 km	forest, promenade and associated green areas, catering facilities, railway, railway, cycle path	Ipolykapu Camping, Börzsöny Museum, Kálvária Chapel	promenade, cycle path, sports field	(narrow band in places, but) natural (100%)
Pilismarote	7,6 km	forest, field, main road 11, Pilismaróti bay, recreation area, Rév (2)	Pilismaróti Ship Cemetery (Pilismaróti Bay), Alexandra Guest House	Pilismaróti Bay is a popular fishing spot, Spicc fishing spot	natural dominant (90%)
Zebegény	2,8 km	recreation area, Rév (not in operation!), cycle path, main road 12, railway, catering facilities, forest, Zebegényi Island	Museum of Maritime History, Seven Hole Bridge, István Szőnyi Memorial Museum, Dőry Castle, Sunflower Houses, Baby Park, apartments and guest houses	Partifecske open-air beach, boat station, cycle path, Sunflower nature trail, kayak and canoe rental and bicycle rental	natural dominant (75%)
Dömös	3,7 km	waterworks, grassland, ploughland, private gardens with no ribbons, (Danube-Ipoly NP), residential and recreational area, main road No 11	Dömös Camping and Restaurant, Danube Bend	Ferry terminal, Sandy beach (open beach)	natural (100%)
Pest county					
Nagymaros	10,2 km	forest (Duna-Ipoly NP), grassland, plantation, main road 12, railway, cycle path, Rév, residential and recreational area, waterworks, Hatló estuary	Remete cave, Fűzfaliget camping, Sólyom camping and resort, guesthouses and inns, Danube Bend	Turkish Field nature trail, cycle path, Sandy beach (open beach), yacht harbour, Falcon harbour, kayak canoe and boat hire	natural dominant (70%)
Visegrad	7,5 km	forest-grassland-plot (Danube-Ipoly NP), main road 11, residential and recreational area, Rév, Waterworks, Boat station	Upper and Lower Bay, Gizellamajor (castrum), Thermal Hotel Visegrád, DMRV Zrt. Blue Danube Motor Camping, Atlantis Visegrád Club, Tree of Life, Palace House, Chapels of Mary and Calvary, King Matthias Museum, Royal Palace and Palace Garden, Water Tower, Solomon Tower of Lower Castle, Citadel, Castle Hotel, Apartments, Guest Houses	Gizellamajor riding stables, Lepence beach baths (closed!), Gokart and Adventure Park, Visegrád Sports Centre (sports fields), Plintenburg International Boat Harbour, Nagyvillámi forestry trail	natural dominant (80%)
Kisorossi	6,3 km	forest (Danube-Ipoly NP and water catchment), arable land, flood protection dike, Verőcei- and Kőgeszteli-island	Szigetcsúcs, Szigetcsúcs (Ráczkert) campsite,	Szigetcsúcs outdoor beach and football field, Hungarian Golf Club	natural (100%)
Kismaros	1,8 km	forest and grassland, Mosoni estuary, Kismarosi Island	Dunapart of Kismarosi	Sandy beach (open beach)	natural (100%)
Verőce	4,5 km	forest, grassland (aquifer), field, main road 12, railway, cycle path, waterworks	Migazzi Castle Park, Ferenc Sturm summer cottage, Seven Warriors Memorial, Burgus Roman port fortress (LIMES Pannonia)	Boat station, Kayak and canoe rentals, Verőce open-air beach, bicycle path	natural dominant (65%)
Tahitótfalu	10,2 km	forest and grassland (Danube-Ipoly NP and water base), flood protection dike, tap wells, byway 1114, Rév, Torda and Révész islands, "mini" solar power plant (on water base)	former Hell Tavern	Boat station, stables	natural dominant (98%)
Vác	11,5 km	forest and grassland (Danube-Ipoly NP and water catchment), main road 12, railway, Kompkötő and Buki Island, waterworks, flood protection dike, material loading port (Danube Gravel Plants), industrial sites, public park, cycle path, Etgető Island, Gombás Creek estuary, abandoned rubbish and debris dump	László Patay Boathouse (Municipal Rowing Club), Ligeti Lake, St. Elisabeth Promenade, restaurants and pensions (apartments), Camelot Club Hotel, V4 Festival Danube Park concert venue	Camelot Adventure Park, Nature Trail, Cycle Path, Boathouse, Sandy beach (Sóderes beach), Boat Station, Municipal Swimming Pool and Beach Bath, Kayak-Kenu Swimming House	natural dominant (70%)
Pócsmegyer	6,2 km	forest and grassland (Duna-Ipoly NP and water catchment), flood protection dike, Rév, Surányi Szakaszvédelmi Központ, riding stables, cycle path	Remonta Riding Club	riding stables, cycle path	natural dominant (85%)
Sződliget	2 km	forest (Danube-Ipoly NP), flood protection dike, boat harbour bay, Blue Danube Home for the Elderly	restaurants and bistros	Yacht Club, Sződligeti Harbour, tennis court	natural dominant (90%)
Göd	5,4 km	forest and grassland (Danube-Ipoly NP and water catchment), spring, flood protection dike, residential and recreational area, Ilka estuary, Gödi Island	Széchenyi Tavern, Dunaparti Tavern, Duna Tavern, Huzella Garden, BME Göd Measuring Farm	open-air beach (Sand Island, Alsógöd), Dunakaland Adventure Park, Kalmár Boat School Marina, Gödi SE Kayak-Kenu Department, Szakáts-kerti fishing lake	natural dominant (80%)
Island Monastery	12 km	forest and grassland (Duna-Ipoly NP and water catchment), Rév, flood protection dike, Szürkő (Horányi) Island, Horányi market, freight terminal, tap wells, premises of Budapest Waterworks Ltd.	apartments and resorts, restaurants and bistros, LIMES Pannonia (Roman port fortress)	Horányi open beach, Regatta leisure centre (Yacht Club)	natural dominant (95%)
Dunakeszi	7,1 km	forest and grassland (water catchment), flood protection dyke, residential and recreational area, public park, cycle path, sewage treatment plant, waterworks	LIMES Dunakeszi (late Roman harbour fortress), cafés and restaurants, Children's playground	cycle path, boathouse, open beach, Soldier's Hill	natural dominant (70%)
Budapest					
District IV	6,1 km	forest and grassland, main road 2, Waterworks, Surface Water Intake	bistro and pub	Sea buckthorn nature trail, Nudist	natural dominant (80%)

Municipality	Length of the Danube bank	Typical coastal land uses	Tourist attractions, accommodation near the coast	Recreational facilities near the coast	Natural-artificial coast ratio
		Plant, Palotai Island forest (Palotai Island TT), MH military harbour, Szilas creek estuary, industrial park, North Pest Sewage Treatment Plant, residential and recreational area, public park		beach, forest promenade (Palota Island), Újpest Boat Club and Kayak-Kenu Sport Club, Boat station, Népsziget Nature Park, Riding School	
District III	7,6 km	residential and recreational areas, cycle path, HÉV, Óbuda gas plant, Óbuda Island, Shipyard Island, waterworks, public park, Slachta Margit quay, residential and institutional areas	Roman beach, restaurants and bistros, Aquamarina Hotel & Event Boat, Military City Amphitheatre	bicycle path, Roman beach (boat launching sites), boathouses, Domino-Honvéd kayak-kenu department	artificial dominant (70%)
District XIII	5,8 km	Népsziget, Újpest Bay, Marina shore, Marina Bay estuary, residential and institutional area, Margaret Island, public park, Carl Lutz quay	People's Island Zoo, Restaurants and Bistros, Children and Youth Camp, Hawaii Camping, Fortuna Hotel and Restaurant boat, BKK boat stations	Boathouse, Yacht Club, Danube Arena, Dagály Spa, ELMŰ Sports Park, Moscow and Rakpart promenades, cycle paths, boat stations and harbours	artificial dominant (70%)
District XIII (Left and right shore of Margaret Island)	2,7 km 2,9 km	Margaret Island, public park, recreational and institutional area,	Széchenyi restaurant, Ensana Grand Margaret Island Health Spa, Domokos monastery, Danubius National Boat Club, restaurants and bistros	Wildlife park, promenade, running track, Margaret Island Sports Centre, large playground, Alfréd Hajós swimming pool, Palatinus beach baths, Margaret Island discus arena	natural dominant (75%)
District II	2,2 km	Angelo Rotta and Slachta Margit quay, Árpád fejedelem útja and Bem rakpart, HÉV, residential and institutional area, cycle path	Baths of Veli Bej, St. Luke's Spa, various catering facilities (e.g. restaurants, bistros and cafes), Grand Jules Boat Hotel, OnRiver Hotels - MS Maribelle	Emperor Komjád swimming pool, cycle path, boat stations and marinas	artificial (100%)
District V	3.3 km	Jászai Mari tér, residential and institutional area, Margaret Island, public park, Carl Lutz and Id. Antall József quay, Kossuth Lajuth Square, MTA, Széchenyi István Square, Jane Haining and Pesti Unter quay, Belgrade quay, Fővám Square	Kossuth Lajos Museum Boat, hotel and restaurant boats, various catering establishments (e.g. restaurants, bistros and cafés), MAHART Tours, National Library of Foreign Languages	Olympic Park, cycle path, boat stations and marinas	artificial (100%)
District I	2,4 km	Sztehlo Gábor quay, residential and institutional area, public park, Batthyány Square, Clark Ádám Square, Budavár Tunnel, Friedrich Born quay, Gellérthegy TT	Castle Garden Bazaar (palaces and gardens), Tabán, Rác Baths, Rudas Spa and swimming pool	cycle paths, boat stations and harbours, promenades on the eastern side of Gellért Hill	artificial (100%)
District XI	7,2 km	Raoul Wallenberg and Szent Gellért quays, cycle path, Gellérthegy TT, Szent Gellért Square, Valdemar and Nina Langlet quays, public park, BME and ELTE, Technological University quays, Kopaszi dam (Water Police), industrial park (Kelenföld Power Plant), Keserű-ér and Hosszúréti creek estuaries, main road No. 6, railway, abandoned and undeveloped former factory site	Arch Rock, Hotel Gellért, Barba NegraTrack stage, various catering establishments (e.g. restaurants, bistros and cafés)	cycle paths, promenades on the eastern side of Gellért Hill, boat harbours and marinas, Pázmány Péter promenade	artificial dominant (80%)
District IX	3,2 km	Szalkaházi Sára quay, Fővám tér, BCE, residential and institutional area, public park, Boráros tér, Soroksári út, HÉV, Waterworks Central Pumping Station, Athletics Stadium under construction, Ráckevei-Soroksári-Duna branch (Kvassay lock)	Bálna Budapest (Old Market Hall), Corvinus Salt House, National Theatre, Palace of Arts (Ludwig Museum)	cycle path, Nehru Coast, boat stations and marinas, Gizella Promenade	artificial dominant (75%)
XXI district	9,1 km	, Ráckevei-Soroksári-Duna branch (Kvassay sluice), forest and grassland, Budapest Central Sewage Treatment Plant, International Port (Csepel), Csepel-Gyártelep (industrial park), Waterworks (water base), recreational areas (private gardens)	-	-	artificial dominant (75%)
XXII district	10,2 km	Highway 6, railway, residential and institutional areas, economic areas (industrial park - former Hunyadi János barracks), forest (Háros-sziget Ártéri-erdő TT), grassland, Kis-Háros-sziget, Hárosi-bay, inert landfill (partly abandoned old landfill), Harbor Industrial Park, ploughland, flood protection dike	restaurants and bistros	Budafok Danube shore (sandy and pebbly beach), Yacht Club, riding stables (riding stables), boat station, boat harbour Hárosi-öböl	natural dominant (60%)
Pest county					
Szigetszentmiklós	1,9 km	forest and grassland (water catchment), flood protection dike	Árvay Tavern	Lakihegyi Bay	natural (100%)
Halasztelek	4 km	forest and grassland (water catchment), Csala Island	-	-	natural (100%)
Érd	4,1 km	forest (Kakukk-hegy TT and Beliczay Island), grassland (water catchment)	-	Tőzike nature trail, Sólya, horse farm	natural (100%)
Cologne	9,7 km	Forest and grassland, River Rév, water catchment, cycle path, recreation area (private gardens)	-	bicycle path, fishing place	natural (100%)
Százhalombatta	8,2 km	forest, grassland, Ófalu (residential and recreational area), Rév, solar park (Duna Solar Park 2), Benta estuary, waterworks, derrick, MOL Danube	Fisherman's Tavern, Roman Baths Ruins	Boating lake, boat station	natural dominant (80%)

Municipality	Length of the Danube bank	Typical coastal land uses	Tourist attractions, accommodation near the coast	Recreational facilities near the coast	Natural-artificial coast ratio
		Refinery, material loading port			
Island image	2,6 km	forest, field, flood protection dike	-	-	natural (100%)
Szigetújfalu	4,4 km	forest, Rév, recreation area (service building and private garden), building (use unknown) and boat station, "small" bay (left over from coastal mining), flood protection dike	-	sandy-pebble beach (open beach)	natural dominant (98%)
Ráckeve	10,8 km	forest, grassland (aquifer), arable land	-	Ráckeve Shooting Range (Danube Rifle Association)	natural (100%)
Lorraine	4,1 km	forest (Gyálai Park Forest and Fishpond area local TT), grassland, Rév, recreation area		sandy-pebble beach (open beach)	natural dominant (98%)
Makado	10,1 km	forest, grassland, fish pond, Fox Island, estuary of the Kengyelesi Channel	-	sandy-pebble beach (open beach)	natural (100%)
Fejér county (right coast)					
Ercsi	13,5 km	forest, grassland (water catchment), arable land, residential area and public park, Rév, material handling port (industrial park), main road 6, Váli water reservoir	Szapáry-Eötvös Chapel, Monument to the Viscount and Viziers, restaurant and pension	Ercsi Kinizsi Fishing Lake	natural dominant (99%)
Ivancsa	2,1 km	field, forest	-	-	natural (100%)
Adony	8,6 km	forest, grassland, arable land, Great Island (Adony Danube estuary), Rév, recreation area, industrial park, main road 6, material loading port (2), Dajapusztai ditch mouth	guest house, Szalma Csárda	boat harbour, Lake Czigler	natural dominant (90%)
Key	4,3 km	recreational area, forest, public park	guest house	boat harbour, sandy-gravel beach (open beach)	natural dominant (95%)
Rácalmás	6,8 km	forest (Rácalmási-szigetek TT), Nagysziget, Bay-, Gyurka- and Molnár-zátony	-	Ártéri nature trail, boathouse	natural (100%)
Dunaújváros	12,3 km	forest, recreation area, Szalki Island, boat station, material handling harbour (industrial park), Danube Ironworks (industrial area), sewage treatment plant, blast furnace slag heap, water intake plant (ironworks), Salbert farm	fish tavern, camping, restaurant	Cove open-air beach, Szalki Island, Dunaferr cocktail leisure park, sport fishing club, boathouse, kayak canoe and dragon boat classes (Dunaferr and DVSC), open-air beach	natural dominant (85%)
Little Post	1,6	forest, public park, Danube embarkation harbour (abandoned), boat harbour bay, recreation area, Kisapostagi estuary, transhipment harbour (out of service, currently parking)	-	-	natural (100%)
Baracs	2,8 km	forest, grassland (recreational park), boat harbour, plough, residential and recreational area, main road 6	guest house and pension, fish restaurant	Yacht Club, sandy pebble beach (open beach), riding school	natural dominant (95%)
Bács-Kiskun county (typically left coast)					
Tass	3,3 km	Tassi sluice, forest, aquifer, recreational area, field	Baggage lock	sports ground	natural dominant (95%)
Szalkszentmárton	7,9 km	forest, plough, marina under construction	-	-	natural dominant (95%)
Dunavecse	4,1 km	forest, lawn, material handling port, flood protection dike, residential area, garden farm	-	Dunavecse Motoross track, football field	natural dominant (95%)
Apostag	4,7 km	forest, grassland	Pilgrim accommodation, Casa Napsugár Guest House	football pitch	natural (100%)
Dunaegyháza	3,1 km	Forest	-	"Old beach", Dunaegyházi park forest	natural (100%)
Solt (left coast)	12,6 km	forest, loading and passenger port, plough	Castle of Solti, Castle Teleki, Révbér Riding Centre	Dudás open beach (next to the harbour)	natural dominant (99%)
Solt (right bank)	7 km	Forest	-	-	natural (100%)
Charter	6,9 km	forest, loading port, lawn, field, recreational area	Harta Shipwreck	NavahoRanch riding stables, Joka Harta nightclub, Dunaparti promenade, football field	natural dominant (95%)
Dunapataj	6 km	forest, recreation area	-	-	natural (100%)
Ordas	6,4	forest, harbour, Rév, flood protection dike	-	open beach (west of the town)	natural dominant (99%)
Ordas (right coast)	3,4 km	forest (Ordasi Island)	-	-	natural (100%)
Dunaszentbenedek (Géderlak)	7,3 km	forest, grassland	-	Kobolya fishing lake, Dunaszentbenedek open beach	natural (100%)
Uszód	2,9 km	flood protection dyke, harbour, grove strip	-	football pitch	natural (100%)
Foktő (and Kalocsa)	27,2 km	forest, loading port, passenger port, recreational area, industrial area,	-	(more catering units on the Danube)	natural dominant (95%)

Municipality	Length of the Danube bank	Typical coastal land uses	Tourist attractions, accommodation near the coast	Recreational facilities near the coast	Natural-artificial coast ratio
		flood protection dike			
Uncle	5,9 km	forest, flood protection dike, field	-	-	natural (100%)
Species (also under Dusnok)	13,7 km	forest (Danube-Drava NP), flood protection dike, ploughs, material loading port	Visit tour tent site, Pilgrim statue group	-	natural dominant (99%)
Dusnok	1,4 km	forest, flood protection dike	-	-	natural (100%)
Cyclades	3,7 km	forest (Danube-Drava NP), recreational area, flood protection dike	-	Rest area at Vajas-torok	natural dominant (99%)
Érsekcsanád (left p.)	5,9 km	forest (Danube-Drava NP), flood protection dike, recreation area	Archipelago airport	Focus on butter	natural dominant (95%)
Érsekcsanád (right p)	2,7 km	forest (Danube-Drava NP)	Veránka -island resort	-	natural (100%)
Baja (left coast)	17,2 km	forest (Danube-Drava NP), industrial area, recreational area, flood protection dike, water catchment	Gemenc Wandering Point, Fishing Mini Skanzen, Mazsolak Holiday Home, Pandúr Ecopark, St. John's Chapel, Sugó Pension, Békavár "tourist farm", Dunaparti Tanyacsárda Guesthouse, Szeremlei-Holt-Duna Nature Trail, Pandúr Island Nature Trail	István Türr Lookout, Hawthorn Park, Blue Lake Fishing Lake, Lake Tíztó Fishing Lake	natural dominant (95%)
Baja (right coast)	13,7 km	forest (Danube-Drava NP), recreation area	Bárka Pension, Black Stork Pension Gemenc, camping site, Pörbölyi Titan (Nagyfa)	open beach	natural dominant (95%)
Szeremle	3,9 km	forest (Danube-Drava NP), flood protection dike	-	-	natural (100%)
Dunafalva	9,8 km	forest (Danube-Drava NP), flood protection dike, Rév, recreation area, "Free port" marina	Contra Florentiam, Katica Guest House, Florentina Guest House, Fodor House, FerienhausFährblick, Farkas Guest House	Dunafalva open beach, Calvary Memorial Park	natural dominant (95%)
			Tolna county (right coast)		
Dunaföldvár	7,5 km	forest, grassland, arable land, industrial site, material loading (grain) and Lukoil tanker port, residential, recreational and institutional area, horticultural area (fruit and vegetable plantations), public park, main road 52, estuary of the Nagykarácsonyi watercourse	Bottyán chain, camping, fisherman's tavern, restaurant, wine house, calvary	sandy and pebble beach (open-air beach), boat station, boat harbour, beach promenade, tennis court, Dunaföldvár beach and spa	natural dominant (90%)
Wise	5,2 km	forest, grassland, field, flood protection dike	-	boat harbour	natural (100%)
Madocsa	7,5 km	forest, field, flood protection dike, recreational area	bistro and guest house	boat station, boat ramp	natural dominant (95%)
Paks	16,1 km	forest (Uszódi-Island), flood protection dike, Rév, material handling harbour (3), railway, main road no. 6, residential and recreational area (Paks loess wall geological section TE), industrial-economic area (industrial park), field, sewage treatment plant, cold water sewer, Paks nuclear power plant, dewatering pools, flood protection dike	restaurant, fish restaurant, water stage	boat mooring and launching ramp, boathouse, spa and swimming pool, kayak canoeing (water sports centre)	natural dominant (80%)
Gerjen	10,3 km	forest, arable land, flood protection dike, Rév, harbour bay, former state farm	guest house	boat harbour	natural dominant (95%)
Fadd	5,3 km	forest, Rév, loading harbour for grain and gravel), water catchment, residential and recreational area, Faddi-Duna	-	Faddi-Duna	natural dominant (90%)
Hazel	7,4 km	forest (Danube-Drava NP), recreation area (fishing farms), material loading port (forestry), M9 motorway, flood protection dike, Bogyiszlói main channel and Sió estuary	chalet, guest house	boat harbour bay	natural dominant (90%)
Őcsény	7,9 km	forest (Danube-Drava NP), recreation area	Guest house of Gemenc Zrt.	Lake Trout Nature Trail	natural (100%)
Decs	1,5 km	forest (Danube-Drava NP)	-	sandy-pebble beach (open beach)	natural (100%)
Báta	7,6 km	forest (Danube-Drava NP), recreation area (fishing farms)	-	boat harbour bay	natural (100%)
Báta (left bank)	0,7 km	forest (Danube-Drava NP)	-	-	natural (100%)
			Baranya county		
Dunaszekcső	9,3 km	forest (Danube-Drava NP), plantations (Dunaszekcsői Löszfal TT), Rév, harbour bay, residential areas, recreational areas	Jankovich Chapel, Berger-Ribár House (guest house), Jófogás House, Parti Guest House, LandgasthofHegau guest house	boat harbour, open beach	natural dominant (95%)
Although	1,1 km	forest (Danube-Drava NP), recreation area, main road 56	Sauska Chapel	boat harbour, football field	natural dominant (95%)
Mohács (right bank)	11,1 km	forest and meadow (Danube-Drava NP), residential and recreational area, Rév, material handling port, border port, industrial and economic area	Busóudvar Cultural Centre, Dorottya Museum of Kanizsai, St. János Hotel, Kovács Hotel and Restaurant, Duna Guest House, Green Orom Apartment	playground	natural dominant (75%)
Mohács (left coast)	15 km	forest (Danube-Drava NP), flood protection dike, recreation area, Rév	Újmohács nature trail	open-air beach (along the railway station on the Baltic coast), Újmohácsi sandbar open-air beach	natural dominant (95%)
Corona	2,4 km	forest (Danube-Drava NP), flood protection dike in places near the coast	-	-	natural (100%)
Kölked (right bank)	8,3 km	forest, grassland (Danube-Drava NP)	former border guard base (Lábasház), Nagypartosi nature trail	boat harbour	natural (100%)
Kölked (left bank)	3,9 km	forest (Danube-Drava NP)	-	-	natural (100%)

The table above shows that the typical uses of the Danube riparian zone are:

- In the **Danube bend, on the** stretch **from Szob to Vác,** between the left bank of the Danube and **Pilismarót-Visegrád on the** right bank of the Danube, residential and recreational areas extend in shorter and longer stretches to the Danube bank, where there are numerous recreational sites, tourist attractions and catering facilities. Access to the banks of the Danube is severely limited on the left bank by the main road No 12 and railway No 70 and on the right bank by the main road No 11.
- **Between Vác and Dunakeszi,** the settlement areas (mainly residential areas, to a lesser extent recreational areas) also extend along several long stretches to the Danube bank, where mainly recreational facilities, catering units and promenades are located. The area of the Danube-Ipoly National Park includes the southern part of Vác, the area around the Sződrákos stream in Sződliget and the Gödi sand island, with woodland forests along the bank. The areas of the waterworks limit the accessibility of the coast for a considerable length of the whole (southern part of Vác, Felsőgöd, southern part of Dunakeszi).
- The **settlements of Szentendrei Island,** Tahitótfalu and Kisoroszi are basically located slightly further away from the main branch of the Danube, while in the case of Pócsmegyer and Szigetmonostor the resort areas extend to the Danube shore. Approximately 40% of the Danube bank is within the area of the Danube-Ipoly National Park, with groves, water wells, and a first-order flood protection dike between Tahitótfalu and Szigetmonostor directly on the bank, which significantly restrict the use of the bank (mainly for nature and water protection purposes). The island tip of Kisoroszi (campsite, water tour point, beach) is a major recreational site.
- The **Budapest** section of the Danube is almost entirely built-up, with the exception of a small patch of forest (e.g. Palotai Island and Népsziget in Újpest, Hárosi Island TT), and is characterised by artificial bank development. In the inner-city sections, the Danube bank is mainly used for transport (e.g. the quays of Buda and Pest almost directly adjacent to the bank), and apart from the islands (Margaret Island, Óbudai Island), no significant recreational sites have been developed on the Danube bank. In the southern part of the Danube section of the capital and at the northern tip of Csepel Island, extensive industrial areas significantly limit accessibility to the coast.
- On the **Csepel Island** (from Szigetszentmiklós to Makád), the direct use of the shore is mainly forested.In the case of Halásztelek, the 4 km of the shore belonging to the settlement, and in the case of Ráckeve, 80% of the 11 km of the shore is occupied by a water body, which significantly limits the accessibility of the shore.
- On the stretch **between Érd and Ercsi (Industrial Park), the** right bank of the Danube is characterised by a truly mixed use, divided almost equally between forest areas, residential and recreational areas of the settlements, industrial areas and agricultural areas (grassland, ploughland, abandoned or still cultivated orchards). Érd's connection to the coast is severely limited by the water catchment area and Beliczay Island (the slipway next to the former brickworks and the view from Kakukk Hill). The constructed Rév crossings in Ercsi and Százhalombatta (Ófalu) provide a physical link to the Danube and the coast. The areas dominated by industrial activity are typically further away from the coastal strip, but the associated ports and landing points are still a constraint on coastal use.
- **Between Ercsi (Industrial Park) and Adony,** on the right bank of the Danube, there are mainly agricultural and forestry areas and a drinking water source. The settlement area and its associated recreational, commercial and economic areas are found only in the vicinity of the Adony port and logistics centre.
- **From Kulcs to Dunaföldvár, the** right bank of the Danube is dominated by forested areas and land use related to recreation or weekend private gardens. Sites associated with industrial and other economic activities limit the use of the banks, mainly in the southern part of Dunaújváros and on the northern edge of Dunaföldvár. Land use for recreational purposes is found within the TT of Rácalmási Islands.

- On the section between **Tass and Dunaegyháza, the** left bank of the Danube is largely bordered by woodland, with extensive forests in the area of Szalkszentmárton and narrow strips of woodland between e.g. Apostag and Dunaegyháza. There is a recreational area directly on the bank in the municipality of Tass, while other settlements are characterised by built-up areas further away from the bank. Outside the recreation area, there is a water base along almost the entire bank of the Duna, which restricts access to the bank for a relatively long stretch.
- On the stretch between **Solt and Dunapataj, the** left bank of the Danube is mostly covered by a strip of woodland along the bank, and in the case of Solt, agricultural land extends almost to the bank in places. Between Harta and Dunapataj there is an extensive grove of woodland (associated with the Danube-Pataj tributary). Recreational areas in Hatra and Dunapataj are located directly on the Danube bank.
- The coastline of the municipalities of **Bölcske and Madocsa is** almost entirely covered by woodland of varying widths, with extensive farmland behind. The settlements have no connection with the river, except for a short stretch of bank (with some holiday and residential buildings) around the boat station.
- The northern and southern parts of the coastal area of the municipality of **Paks** are covered by extensive forest areas. The inland parts of the municipality border the Danube, largely blocked by the main road No. 6 and the railway line No. 42 to the Paks power plant. In the northern part of the inner area, there are several boathouses and small boat harbours, while at the southern end of the inner area, the use of the coast is limited mainly by the presence of 3 harbours (for industrial purposes and other material handling).
- On the section between **Ordas and Fajsz** (up to the northern border of the Danube-Drava NP), the left bank of the Danube is alternated with forested areas and the flood protection embankment (in places a narrow strip of forest in the foreground of the embankment). The embankment runs almost along the shore, e.g. along parts of the banks of Ordas, Uszód, Bátya. The only recreational area is on the bank of the Danube in Kalocsa, where catering facilities have been built next to the harbour in Fajsz.
- Between **Gerjen and Bogyiszló,** on the right bank of the Danube, the land use is characterised by floodplain forests and ploughland on the floodplain, mostly forming a continuous strip. This picture is interrupted in small patches by small holiday settlements (with a marina), an agricultural site and harbour at Fadd and Bogyiszló, and a water catchment area at Fadd.
- The woodland forest on the left bank of the Danube between **Sükösd and Baja** is part of the Danube-Drava National Park, the most extensive of which is the Pandur Island in Baja. Recreational areas in all three municipalities (Sükösd, Érsekcsanád, Baja) extend to the Danube bank, and in the case of Baja, the extent of industrial areas directly on the bank is significant. Baja has the most significant tourist attractions, in some places close to the coast.
- On the stretch between **Őcsény and Báta,** on the right bank of the Danube, lies the contiguous Gemenci Forest, which is also part of the Danube-Drava National Park. Here, only the guest house of Gemenci Zrt. provides a more direct connection to the Danube.
- In the section between **Szeremle and Mohács,** forested areas are the main direct riparian use in the foreshore of the flood protection embankment on the left bank of the Danube. Directly on the Danube bank, on the water side of the flood protection embankment, recreational areas are located in the municipalities of Mohács (Újmohács recreational area) and Dunafalva (north part).
- In the section between the **southern part of Báta and Mohács, the** main bank uses along the main branch of the Danube are settlements (mainly residential areas in the case of Dunaszekcső, partly residential and partly recreational and industrial areas in the case of Mohács) and forest areas (Báta, Bár, southern part of Mohács).

- The stretch between **Mohács and Homorúd** has extensive forested areas on both banks of the Danube, which belong to the Béda-Karapancsa landscape unit of the Danube-Drava National Park.

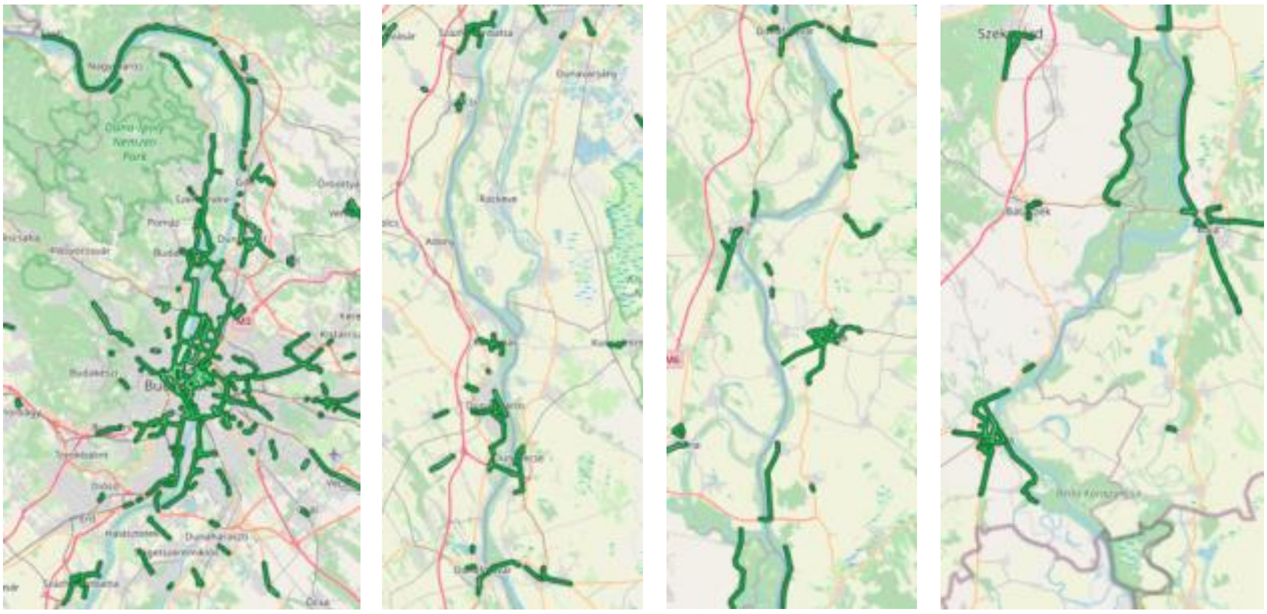
Not specifically indicated ***in Table*** 50, but most settlements have some kind of **footpath** (usually dirt roads, less frequently a paved footpath) along sections of the Danube bank, which provides a **place for everyday recreation** (e.g. walking, cycling), especially in settlements where residential or recreational areas extend to the Danube bank.

Built water tour points are in Dömös, Szob, Vác, Göd, Dunakeszi, 2 stops in Budapest (Római part, XIII. district Latorca street), Rácalmás, Szigetújfalu, Baja, Kalocsa, Dunaújváros, Bölcske[20], where you can rent kayaks and canoes. There are also **free beaches** in many settlements[21], e.g. Zebegény, Dömös, Nagymaros, Visegrád, Göd, Inselmonostor, Dunakeszi, Solt, Dunaszentbenedek, Baja, Dunafalva (for more information see ***Table 50***). The **ecotourism facilities** related to the Danube and its wildlife according to the National Environmental Information System are:

- Nyéki-Holt-Duna trail, Pörböly trail: Pörböj, Baja,
- Szeremlei-Holt-Duna nature trail, Pandur Island nature trail: Baja,
- Újmohács nature trail: Mohács,
- Nagypartosi nature trail, White Stork Museum, Boki-Duna fishing show: Kölked.

The cycle paths in the Danube region are not yet continuous (***Fig. 20***), but they have been built in sections of considerable length, e.g. in the Danube bend between Szob and Dunakeszi on the left bank of the Danube, in Budapest on both sides of the bank, and along the Gemenci forest on both sides of the Danube, further away from the bank. Typically, there are also longer existing cycle paths leading to or along the banks of the Danube near larger settlements, such as in the areas of Százhalombatta, Rácalmás, Dunaújváros, Dunavecse, Dunaföldvár, Solt, Paks, Baja, Mohács. Between Harta-Solt and Dusnok-Fajsz, there are relatively long stretches of cycle paths along the left bank of the Danube.

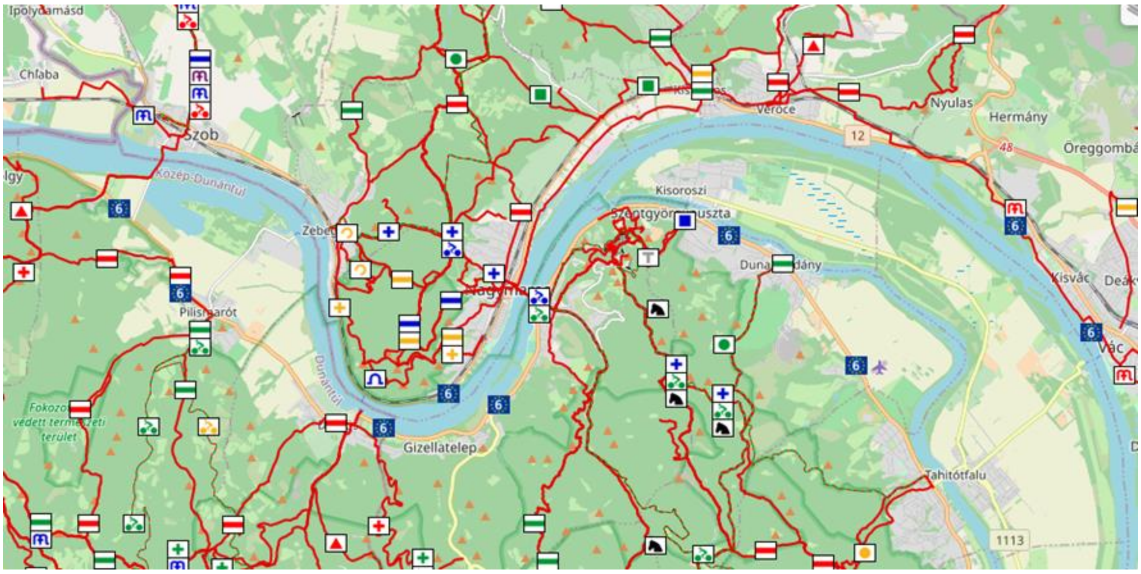
The **marked tourist routes are** mainly connected to the mountain ranges (e.g. Pilis, Visegrád Hills, Börzsöny, Buda Hills), but in some places the Danube bank is crossed or touched by marked tourist routes: e.g. in the case of Budapest, settlements. The settlements of the Danube Bend and Budapest are crossed by a relatively dense network of tourist routes, several of which also touch the Danube bank. Between Kulcs and Bölcske there is a relatively long red tourist route on the right bank of the Danube, between Paks and Gerjen the Mária-út, and between Solt-Dunapataj and Báta-Baja the Hungarian Pilgrim's Way, marked with a yellow arrow, runs along the left bank of the Danube for longer stretches. The main tourist routes along the Danube are shown in ***Figure 21.***



20 http://viziturapont.hu/
21 https://szabadstrand.blogspot.com/

20. Figures: Independent cycle paths and designated cycle lanes in the study area

Source : http://www.kenyi.hu/


Ipolydamásd
Chlaba
Szob
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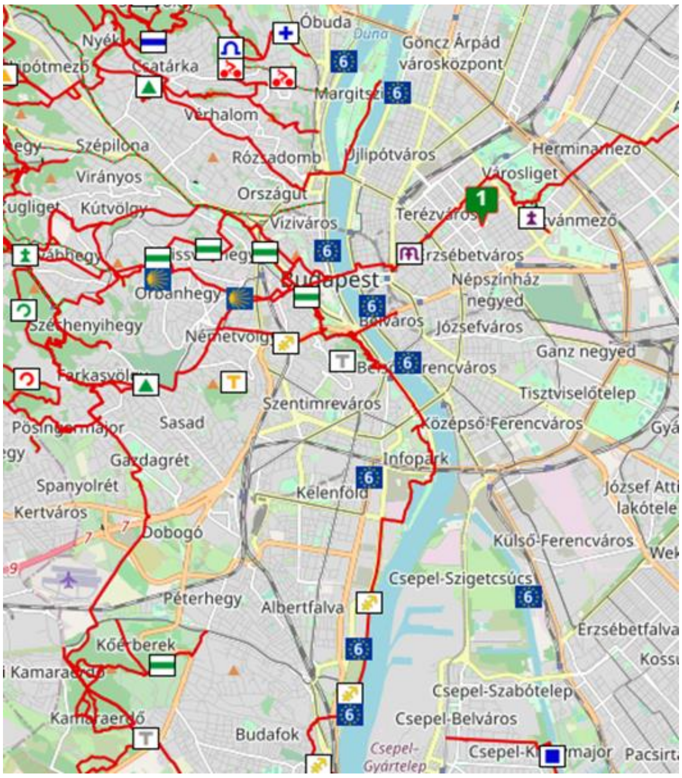
Verőce
Nyulas
Hermány
12
Pilismarót
Gizellatelep
Tahitótfalu
Vác
1113


Óbuda
Duna
Göncz Árpád
városközpont
Csatárka
Vérhalom
Szépilona
Virányos
Kútvölgy
Országút
Víziváros
Terézváros
Városliget
Népszínház
negyed
Józsefváros
Ganz negyed
Tisztviselőtelep
Orbánhegy
Németvölgy
Szentimreváros
Sasad
Gazdagrét
Spanyolrét
Kertváros
Dobogó
Kelenföld
Infopark
Középső-Ferencváros
Külső-Ferencváros
Csepel-Szigetcsúcs
Erzsébetfalva
Péterhegy
Albertfalva
Kőérberek
Csepel-Szabótelep
Csepel-Belváros
Budafok

21. Figures 1 and 2: Major tourist routes in the study area

Source : https://turistautak.openstreetmap.hu/turautvonal.php

Based on the above, it can be clearly seen that the area under study - the **Danube riparian zone** - has a **high ecological, agricultural, forestry, industrial, recreational, leisure and tourism potential**. The municipalities typically exploit the current potential as follows (taking into account the current land uses, recreational and tourist facilities, protected areas, emphasising the extent to which the potential is exploited in relation to the length of the river bank):

- In the Danube Bend (from Szob to Szigetmonostor) on both sides: high recreational, leisure and tourism potential; medium ecological and forestry potential,
- On both sides of Budapest: high industrial and tourism; medium recreational and ecological potential,
- Between Érd and Ercsi: high industrial, forest and agricultural; medium recreational and ecological potential,
- Iváncsa: high agricultural, forestry and ecological potential,
- Adony: high forestry and agriculture; medium ecological, industrial and recreational potential,
- Key: high recreational and leisure potential,
- Rácalmás: high forestry and ecological potential,
- Csepel Island municipalities: high forestry and agricultural potential,
- Dunaújváros: high industrial and forestry; medium recreational and tourism potential,
- Kisapostag: high forestry; medium ecological potential,
- Baracs: high tourism, recreation and holiday potential, medium forestry and agricultural potential,
- Dunaföldvár: high agricultural and tourism potential, medium industrial and forestry potential,
- Between Tass and Dunaegyháza: high forestry and agricultural potential,
- Between Solt and Dunapataj: high forestry and agriculture; medium recreational and tourism potential,
- Bölcske and Madocsa: high forestry and agriculture; medium recreational potential,
- Paks: high forestry, industrial and ecological potential; medium tourism and recreational potential,
- Ordas-Dusnok: high forestry and agricultural potential; Kalocsa: medium recreational potential; Fajas: medium tourism potential,
- Between Gerjen and Bogyislo: high forestry and agriculture; medium recreational and leisure potential,
- Between Fajsz (below Dusnok)-Érsekcsanád: high forestry and ecological potential; medium recreational and holiday potential,
- Baja: high potential for forestry, ecology, industry and tourism; medium potential for recreation and leisure,
- Between Őcsény and Báta: high ecological and forestry potential; medium recreational potential,
- Between Szeremle and Dunafalva: high forestry and ecological potential; medium agricultural, recreational and holiday potential,
- Dunaszekcső: high forestry and ecological potential, medium tourism, recreation and leisure potential,
- Although: high forestry and ecological potential,
- Mohács: high recreational, tourism, leisure and industrial potential; medium ecological and forestry potential,
- South of Mohács - Homorúd on both sides: high forestry and ecological potential.

7.5. LANDSCAPE

The **Landscape Protection Area of the** National Spatial Plan shows mainly those parts of the landscape that are of landscape value. The **Danube riparian strip is included in its entirety in the** SCPA for **all 72 municipalities concerned. A** larger extent of the zone is observed in the municipalities of the Danube Bend and Szentendre Island (the section between Szob and Szigetmonostor), in the areas of Fadd-Dunafalva and Kölked-Homorúd (***Fig. 22***).

Within the landscape protection area zone, the landscape areas covered by the landscape protection districts and national parks are of special landscape importance. There are no landscape protection areas in the Danube section under study (only further away from the Danube, e.g. in the Paks area of the South-Mezőföld TK), but there are national park areas: the Danube-Ipoly NP and the Danube-Drava National Parks (***Figures 23***). In the case of national parks, the protection objective is complex (see in detail: Nature Conservation Act, § 28 (2)), one element of which is the protection of landscape values, so that the **sections covered by the two national park areas (Szob-Sződliget, Szigetmonostor and Fajsz-Homorúd) are of special landscape value overall.**

The unique characteristic of the **Danube-Ipoly National Park** area **is the meeting of three large landscape units: river valleys, mountains and plains**, the resulting diversity is unique at the national level[22] (as indicated by the designation of the Special Resort Area). The national park also includes part of the floodplain forests along the Danube, the natural units of Szentendrei Island, which are rich in natural values, and other islands such as Kompkötő Island in Vác and Gödi (sand) Island. In the National Park's surroundings, there are landscape features and complexes of features of great landscape value, such as the Visegrád Citadel and the Danube landscape of Vác, and the disturbing feature of the landscape of the southern mine of Naszály, which towers above Vác.

The **Danube-Drava National ParkDanube** area includes two large floodplain forests, **Gemenc and Béda-Karapancsa**. The Danube riverbed is also part of the national park, not only the wooded forests, tributaries, backwaters and islands that accompany the river, but also the interconnected system of all these between Fays-Kölked and Béda-Dráva. The Danube's gradient decreases along this stretch, so its velocity is lower and it used to flow meanderingly, building reefs from the silt and sand it carried, constantly changing its bed. The overdeveloped bends were naturally cut through, creating backwaters and inland lakes in deeper areas. The river was cut through the bends and dammed to allow the ice to drain faster and to facilitate navigation. However, on the stretch between the mud flats, the flood protection dike was built relatively far from the river, on the boundary of the Archdiocese of Kalocsa. This is how Gemenc, one of the largest contiguous floodplains in Europe, was preserved[23]. **Its landscape value is mainly due to the extensive forests and the scenic beauty of its natural banks.**

In addition to the scenery along the Danube in the National Park, the **Budapest Danube and the Buda Castle District**, a World Heritage Site, are also worth a visit. World Heritage sites include the Buda and Pest banks of the Danube, enclosed by the Szabadság and Margaret bridges, some buildings of the Technical University and the area enclosed by the Chain Bridge, the Gellért Baths, Gellért Hill with the Statue of Liberty and the Citadel, the buildings of the Castle on Buda Hill, the Royal Palace, the Baroque churches and the Turkish baths of the Water City[24].

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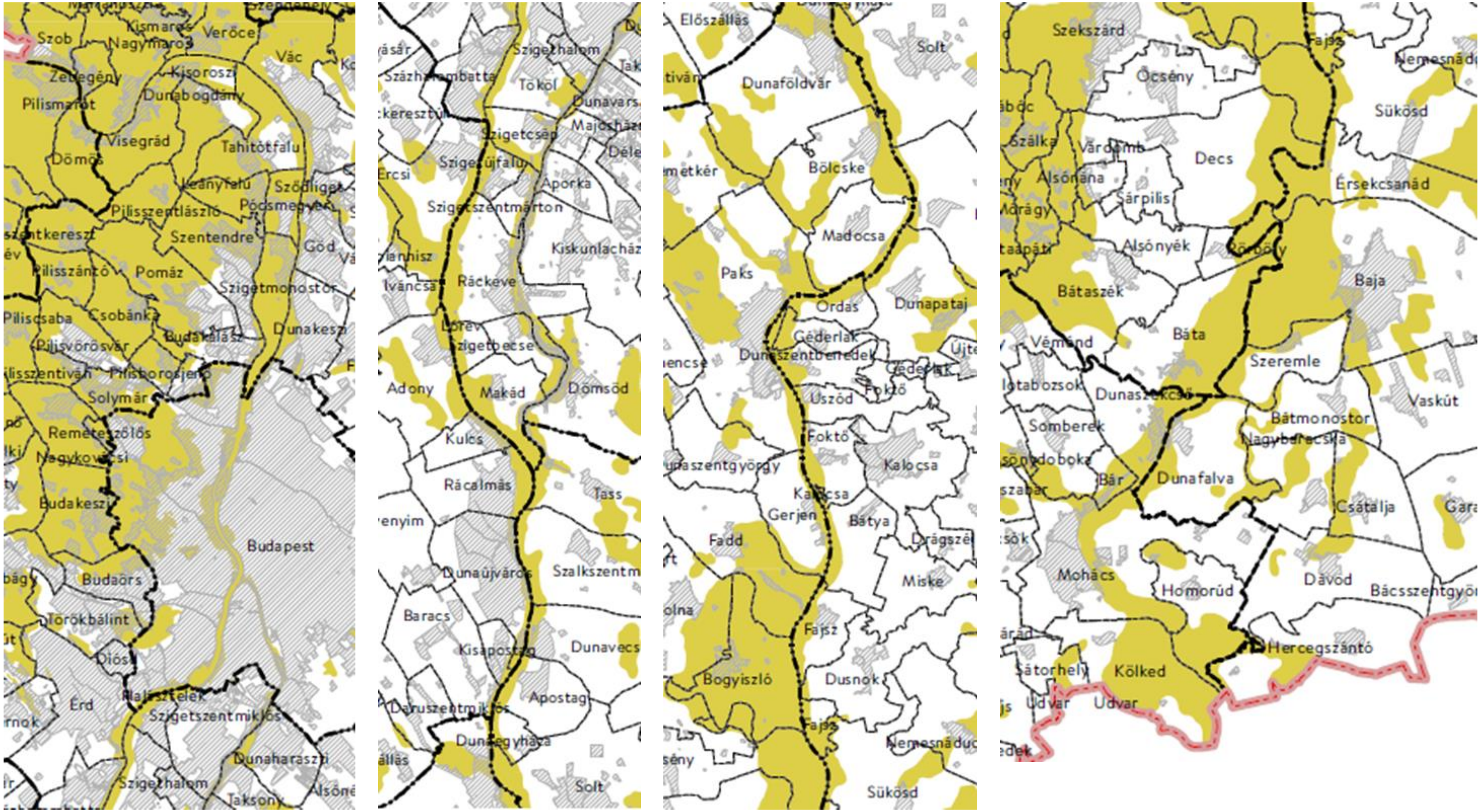
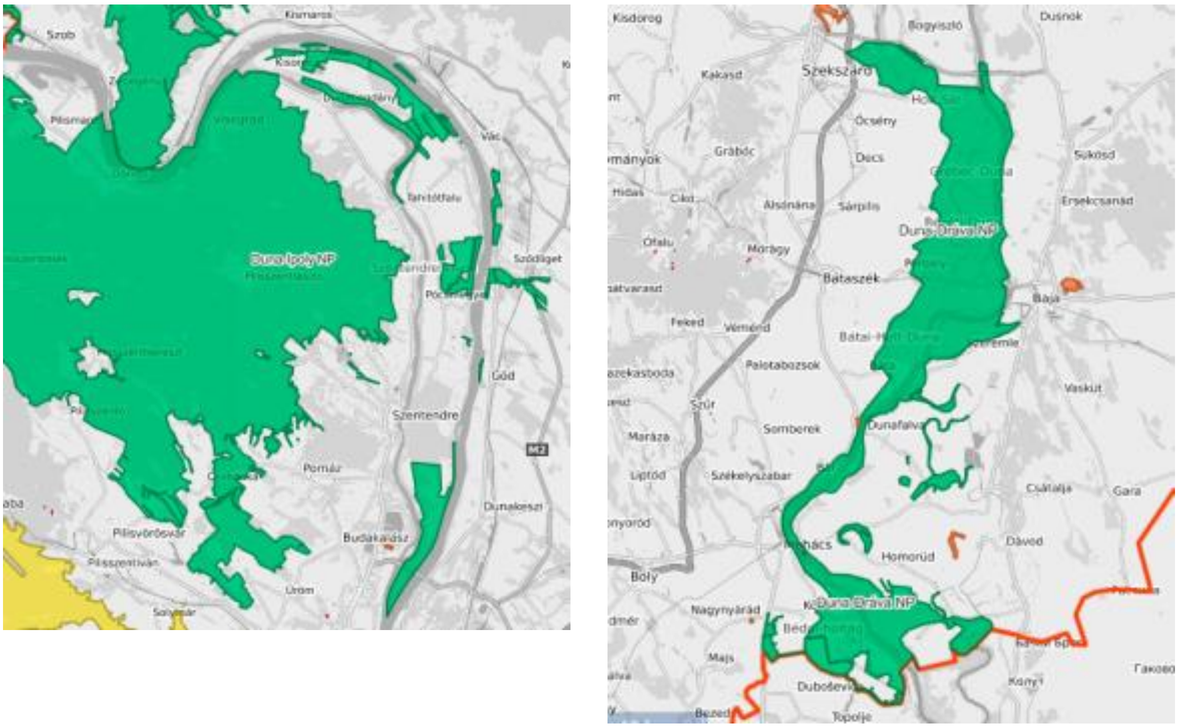
[22] https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/duna-ipoly-nemzeti-park/a-duna
[23] http://ddnp.nemzetipark.gov.hu/nemzeti-park-duna-menti-teruletek
[24] https://www.budapest.com/budapest_kalauz/latnivalok/budapest_vilagoroksegei.hu.html



22. Figures 1 and 2:Landscape protection area in the study area (OTrT)

Source: Decree No 9/2019 (VI. 14.) MvM



23. Figures 3.1:Areas of Landscape Importance: national park areas

Source : http://web.okir.hu/map/?config=TIR&lang=hu

From a landscape point of view, the varied topography is also of value: on the one hand, when viewed from the water, the diversity of the topography and the surface mobility define the landscape character and have a strong emotional impact on the viewer, and on the other hand, the higher elevations offer a potentially greater view of the Danube water surface and the gallery forests, islands and tributaries that accompany the Danube. The varied topography is mainly due to the Pilis and Visegrád Hills, the Börzsöny, the Buda Hills and their mountainous valley parts, and in the Báta-Bár area the undulating surface of the nearby South Baranja Hills (***Figure 244***).

Significant viewpoints in the study area, from which the Danube can be seen:

- Dömös: pulpit, Dobogókői lookout,
- Visegrád: Citadel, Mine Viewpoint, Salamon Tower, Zsitvay Lookout,
- Zebegény: Kós Károly lookout,
- Nagymaros: St Michael's Hill, Remetebarlangok,
- Verőce: Lookout on Fenyves Hill,
- Budapest: e.g. József Hill Lookout, Árpád Lookout, Buda Castle, Fisherman's Bastion, Gellért Hill (Citadel),
- Érd: Sánchegyi and Érdi High Coast viewpoint,
- Százhalombatta: High Coast viewpoint, south side,
- Ercsi: Szapáry-Eötvös Chapel,
- Dunaújváros: Lookout of Szoborpark,
- Dunaföldvár: Turkish Tower, Calvary,
- Paks: Gárdonyi lookout,
- Baja: Türr István lookout,
- Bátai holt-Danube lookout.

24. Figure 1: Overview of topography

Source: own colouring based on SRTM relief model

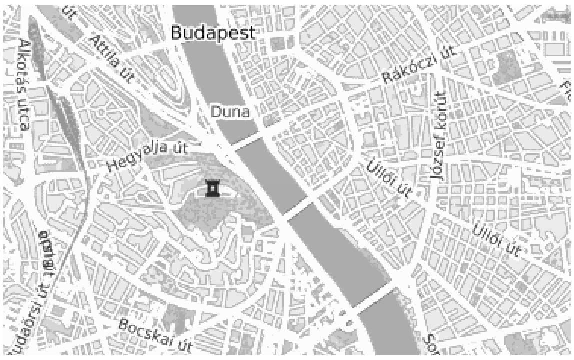
In addition to the topography and the lookout points, **the road bridges also provide a good view of the Danube**:

- Szigetmonostor - Budapest [district IV]: M0 motorway, Megyeri bridge,
- Budapest: Árpád Bridge, Margaret Bridge, Szechenyi Chain Bridge, Elisabeth Bridge, Liberty Bridge, Petofi Bridge, Rákóczi Bridge,
- Budapest [XXII. district] - Szigetszentmiklós: Deák Ferenc bridge (M0 south),
- Dunaújváros - Dunavecse: Pentele bridge (M8),
- Dunaföldvár: main road 52, Beszédes József bridge,
- Location: M9 motorway, Szent László bridge,
- Baja: main road 55, Türr István bridge.

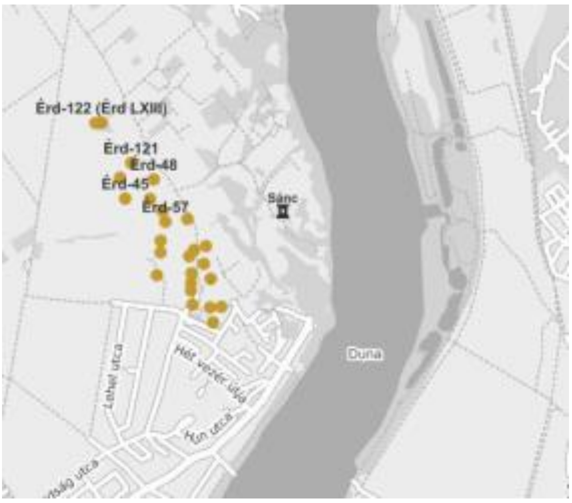
The natural, landscape and cultural-historical values may be a kind of transition between the legally - i.e. ex lege - protected **mounds and castles in the vicinity of the Danube section under study in the** following settlements: Vác, Budapest, Érd, Százhalombatta, Kulcs, Dunaújváros, Szalkszentmárton (***Figures 255***). Some of the earthwork castles are important viewpoints: e.g. Pogányvár in Vác, Gellérthegy in Budapest, Sánc-hegy in Érd. There are some earthwork castles whose tops are inaccessible (e.g. the 100 Halombatta earthwork castles are inaccessible due to the MOL Oil Refinery) or cannot be interpreted as viewpoints due to vegetation (e.g. Bolondvár in Kulcs, Kőszider in Dunaújváros).

Vác - Pogányvár

Budapest - Gellérthegy



Érd - Sánc-hegy



Százhalombatta - Castles

Key - Crazy castle

Dunaújváros, Szalkszentmárton

25.Figures 1 and 2:Mounds, castles near the Danube bank
Source : http://web.okir.hu/map/?config=TIR&lang=hu

The large halls and high towers of industrial sites are unsightly from a landscape point of view (see: *Land cover, land uses*), as well as the unused but not yet demolished buildings of former industrial sites (e.g. the area of the former Csepel Works). In the Danube landscape area under study, overhead power lines affect the landscape only in some places: the most significant existing power lines according to the OTrT are located in the areas of Százhalombatta-Tököl, Ercsi-Szigetcsép, Paks, Gerjen-Bátya, and a 400 kV transmission line is planned to cross the Danube between Paks and Mohács. In the Danube bend, the Naszály Hill limestone quarry is a visible landscape pocket from afar.

7.6. LANDSCAPE VALUES

From a landscape conservation point of view, landscape areas with multiple 'edge effects' (contour edges, waterfronts, vegetation edge areas) are of particular value. These marginal areas form valuable landscape fragments in several places along the Danube, especially in sections where the groves have been able to survive in their natural state (e.g. Szentendrei Island, Rácalmási Islands, Gemenc, Béda-Karapancsa).

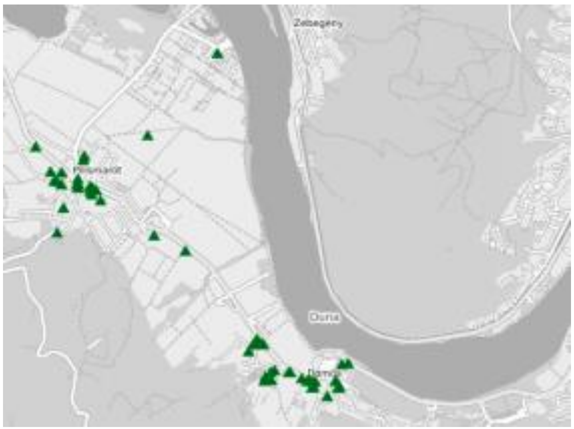
From a cultural and historical point of view, the former military installations of the Limes along the Danube and the view of the Danube bank in Budapest are of outstanding value as a World Heritage Site. The Danube bend is a unique combination of natural features, cultural traditions and built heritage, a prime holiday destination both nationally and internationally. The landscape values overlap with the cultural and historical values (see ***Chapter 6***) and the natural values (see ***Chapter 5***), and will therefore not be discussed in detail again. There is no nature park in the vicinity of the Danube section under study. In addition, it is necessary to mention the specific landscape values.

The individual landscape values can be summarized on the basis of the National Environmental Information System, but it is important to emphasize that the data of some settlements are not included in the database (e.g. Szob, Zebegény, Nagymaros, Visegrád, Verőce, Kismaros, Vác-Makád among none of the settlements, Rácalmás, Dunaújváros, etc.), so it is not complete. A detailed assessment of the specific landscape values affected by the intervention can be carried out in a later assessment phase, when the EIA is prepared. **The specific landscape values** identified in the OKIR on or in the immediate vicinity of the Danube bank are as follows (see ***Figure 26***):

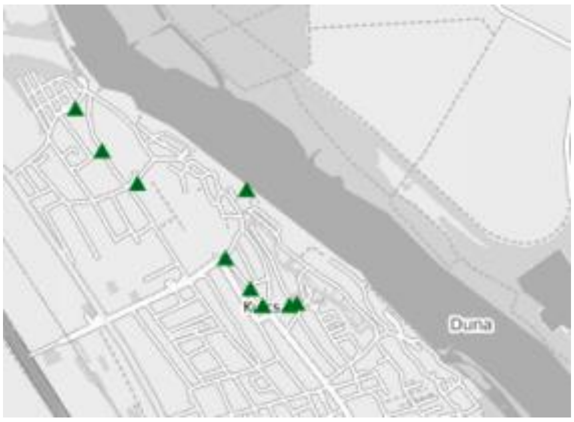
- Pilismarót: Gloch villa,
- Dömös: drinking fountain, plane tree tree alley,
- Key: "Dunapartti föveny",
- Baracs: "Dunaparti summer grove", "Dunaparti föveny", leisure park,

- Ordas: farm, harbour, Géderlaki rév,
- Dunaszentbenedek: Bum Island, Pusztalaki Point, reefs, Füzesek, Füzesek Lagoon
- Uszód: residential buildings,
- Bátya: Kopolya, Danube Lagoon, Great Kopolya, Hullámtér lagoon,
- Kölked: Nagypartosi szakadtpartos, white willow tree lane, Béda pump house, oaks of Boki forester's house.

Pilismarót, Dömös

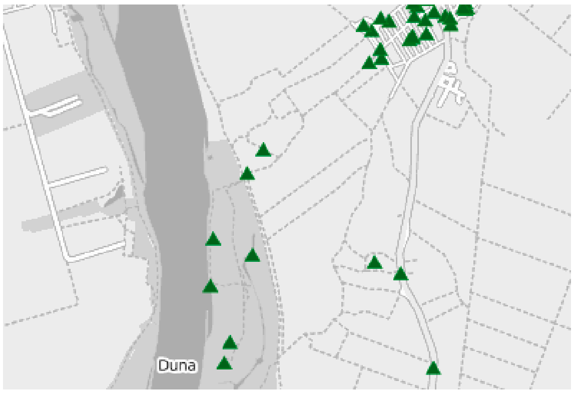


Key



Baracs

Uncle



Ordas, Géderlak, Dunaszentbenedek

Kölked

26. Figures 1 and 2:Registered unique landscape values near the Danube bank

Source : http://web.okir.hu/map/?config=TIR&lang=hu

Sources used in chapter 7:

- Geodata base file of the 1:1.000.000 scale geographic topography of Hungary, in EOV coordinate system, in ArcViewshape format (shp, shx, dbf): https://www.novenyzetiterkep.hu/node/407
- Dövényi Z. (ed.): the cadastre of the small lakes of Hungary. MTA Geographical Research Institute, Budapest, 2010.
- CorineLandCover (2018) database (shape format)
- https://www.erdorezervatum.hu/Buvat_Keszeges-to
- https://www.erdorezervatum.hu/Del-Veranka_Sasfok
- https://www.erdorezervatum.hu/Kadar-sziget
- National Spatial Plan in WMS format: https://oeny.e-epites.hu/oeny/4tr/#/wms-terkepek
- 4/2000 (III. 24.) KöM Decree on the declaration of certain protected natural areas within the jurisdiction of the Danube-Drava National Park Directorate as forest reserves
- Act CXXXIX of 2018 on the spatial planning plan of Hungary and certain priority regions of Hungary
- 9/2019.(VI. 14.) MvM Decree on the additional regulation of the preparation and application of spatial planning plans
- Nature Information System: http://web.okir.hu/map/?config=TIR&lang=hu
- http://viziturapont.hu/
- http://www.kenyi.hu/
- https://turistautak.openstreetmap.hu/turautvonal.php
- https://www.dunaipoly.hu/hu/helyek/vedett-teruletek/duna-ipoly-nemzeti-park/a-duna
- http://ddnp.nemzetipark.gov.hu/nemzeti-park-duna-menti-teruletek
- SRTM relief model: http://srtm.csi.cgiar.org/srtmdata/
- https://www.budapest.com/budapest_kalauz/latnivalok/budapest_vilagoroksegei.hu.html
- https://szabadstrand.blogspot.com/

8. NOISE AND VIBRATION

In the settlements included in the study, as in most Hungarian settlements, the noise situation is mainly determined by traffic noise, as well as by noise from service and economic (industrial and agricultural) activities, entertainment, catering, sports facilities and events. Detailed data on noise exposure from these activities are not available, but strategic noise maps based on calculations - and not suitable for comparison with limit values - have been produced for Budapest and its surrounding area (most recently based on data from 2017). In addition, the Electronic Air and Noise Repository also contains - historical - noise data for some of the major road and railway lines in some municipalities[25]The noise exposure maps are presented at the end of this chapter (see ***Figures 277-29***)***. The*** current noise situation is based on the assumption that the noise limits set out in Joint Decree 27/2008 (XII. 3.) of the Ministry of Transport, Building and Urban Affairs are met, and is nuanced by other available information and data. At the same time, of course, the noise characteristics of a given area are also affected by noise effects that do not reach the relevant limit value or for which no limit value has been set.

There are a number of economic areas along the Danube. The areas most affected by industrial activity, besides Budapest, are Vác, Százhalombatta, Dunaújváros, Dunakeszi and Szigetszentmiklós, Dunaföldvár and Solt, Foktő, Baja and Mohács. Without being exhaustive, some of the plants operating in the surveyed municipalities are listed below:

- In Vác, the cement factory, printing press, heating plant,
- The steel structure factory in Göd,
- In Dunakeszi, the lamp factory, the asphalt mixer,
- The small power plant in Szentendre,
- the brickworks and the heating plant and the cogeneration plant in District III
- in District IV, in addition to the power plant, there is, for example, the iron foundry, the thermal centre, the plastics plant, the light source factory,
- asphalt mixer, plastic processor in the IX district,
- power plant, laundry in the XI district,
- a power plant, an aluminium foundry and a printing works in the XXI district,
- The insulation material factory and the gas engine in Szigetszentmiklós,
- The refinery in Sázhalombatta,
- The tyre factory in Rácalmás,
- In Dunaújváros, the ironworks, cold rolling mill, coking plant, power plant, gas engine heating plant, pulp mill, paper mill, hot-dip galvanizing plant, malt works
- In Dunaföldvár the bietanol factory, the rubber products factory,
- The biogas plant and protein processor in Sol,
- In Mohács, the furniture factory, the fibreboard factory, the iron foundry, the aluminium foundry, the mill, the port, the gas-fired heating plant and the bio-heating plant, the gas transmission plant, the paper mill, the drying plant,
- in Baja, an important commercial centre, there is an asphalt mixing plant, a gas engine power plant, the Pick Zrt. plant, a harbour for loading and unloading crops, a district heating supplier, a warehouse, a metalworking plant, a milling plant and a carpentry plant.
- The focus is on the vegetable oil industry,
- And in Paks, the nuclear power plant and the light-body factory.

[25] Vác, Göd, Százhalombatta, Dunaújváros, Dunakömlőd, Paks, Baja, Mohács

While nowadays these activities are separated from residential areas by the creation of industrial parks, it is mostly older plants that are located close to, or even embedded in, residential areas. If an industrial plant is located close to an object to be protected, especially at night, problems may arise (for example, ventilation and extraction systems, boiler houses, compressors, refrigeration equipment are typical problems). In addition, the traffic of the installations may cause problems, even in the wider area.

The noise impact of small residential and private businesses (as well as domestic and garden activities) can be disturbing to the immediate environment, even if noise exposure limits are respected (especially in low background noise environments).) Entertainment and catering facilities can be particularly disturbing if they are located between residential (or possibly holiday) buildings. Disturbance is mainly caused by sound equipment and outdoor units of air conditioning and refrigeration equipment. Outdoor music events (festivals) can also be a source of conflict, as can large-scale or prolonged construction and development activities.

This suggests that **transport is the dominant source of noise (and vibration) in the settlements studied**, with the main impact being in areas adjacent to national roads and railways passing through the settlements. The roads and railways crossing and affecting the study area are illustrated in the Air Quality Diagrams in ***Chapter 4.***

In the north, the right bank is dominated by the second-order main road 11, followed by the M6 motorway south of Budapest (and the roughly parallel first-order main road 6), and the left bank by the first-order main road 12, followed by the first-order main road 2 and the M2 motorway. To the south of Budapest is Highway 51. It is also necessary to mention the section of the M0 ring road between the M1 and the M1-11. South of Dunaföldvár, the M6 motorway, the 6 motorway and then the 56 secondary main road towards Mohács, and on the left bank, the 55 main road, in addition to the 51 main road.

According to KIRA data for 2016, traffic on the M0 motorway, the main road 6 to Érd, the M2 motorway from Sződliget, the main road 11 from Szentendre and on certain sections of the main road 2 exceeds 20 000 vehicles per day. Traffic is particularly high, between 8001 and 20 000 vehicles/day, on the main road 11 between Tahitótfalu and Szentendre, on the main road 12 from Kismaros, on the main road 2 except for a few busier sections, on the M6 motorway up to Szekszárd, on the main road 6 between Rácalmás and the M8, on the M8 motorway and on the main road 52 in Solti.

From a noise and vibration point of view, the problem is posed by the existence of roads through settlements that were previously built and are not designed for current traffic, and by the structure of settlements.

According to our previous calculations, in the case of settlements with higher road traffic, the traffic noise of objects to be protected close to the road (a few tens of metres) may exceed the limits set in Annex 3 of Joint Decree 27/2008 (XII. 3.) of the Ministry of Transport, Building and Urban Affairs of the Ministry of the Environment, Nature Conservation and Nuclear Safety for new roads to be built or widened or upgraded - not only during the day, but also at night. Thus, in addition to Budapest, Szentendre, Vác, Dunakeszi, Paks, Baja and narrow built-up areas of smaller settlements crossed by major transport routes may be affected.

Poor quality streets without solid surfaces or in need of resurfacing can also cause localised complaints.

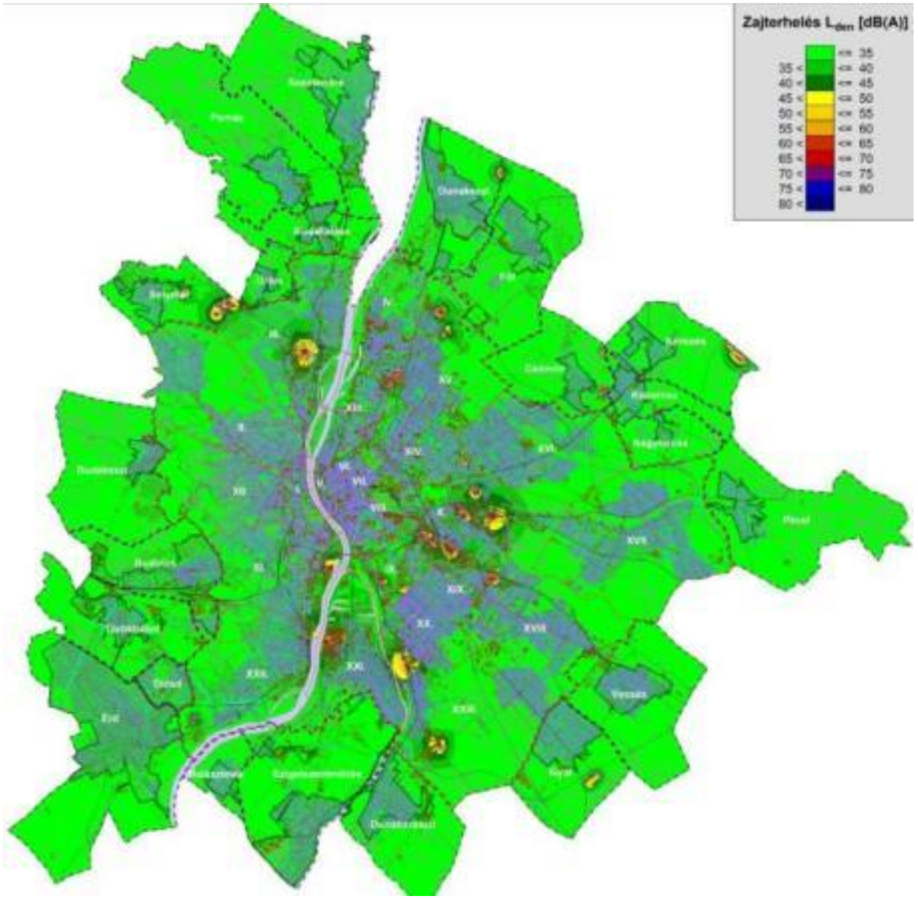
The noise situation in the settlements is also affected by rail traffic and related activities (loudspeakers, horns). Rail noise affects a much smaller area and fewer inhabitants than road noise. Typically, it is the inland section of the line that causes complaints and problems, particularly at night, despite the lower traffic volumes, and especially freight traffic. Budapest is one of the most important rail hubs in Central Europe, with around half of all domestic rail traffic passing through the capital. To the north of Budapest are lines 70 and 71 on the left bank, to the south line 40a on the right bank. In the case of the study area, the railway lines run further south from Csepel Island on the left bank and from Dunaújváros on the right bank (except for line 154, which crosses the Danube at Baja).

In the areas along the Danube, the Danube shipping traffic, especially the ports (the most significant ports are in Budapest (Csepel Free Port), Dunaújváros, Mohács (Áruforgalmi Port and Logistics Centre), Baja) are a regular source of noise (however, there is no regulation on waterborne traffic in the above-mentioned 27/2008 (XII.3.(X.20.2004) and water transport is not included in the obligation to draw up a strategic noise map regulated by Government Decree 280/2004 (X.20)). The noise and vibration pollution resulting from the typically high traffic load of ports, ferry crossings and roads leading to bridges is also significant.

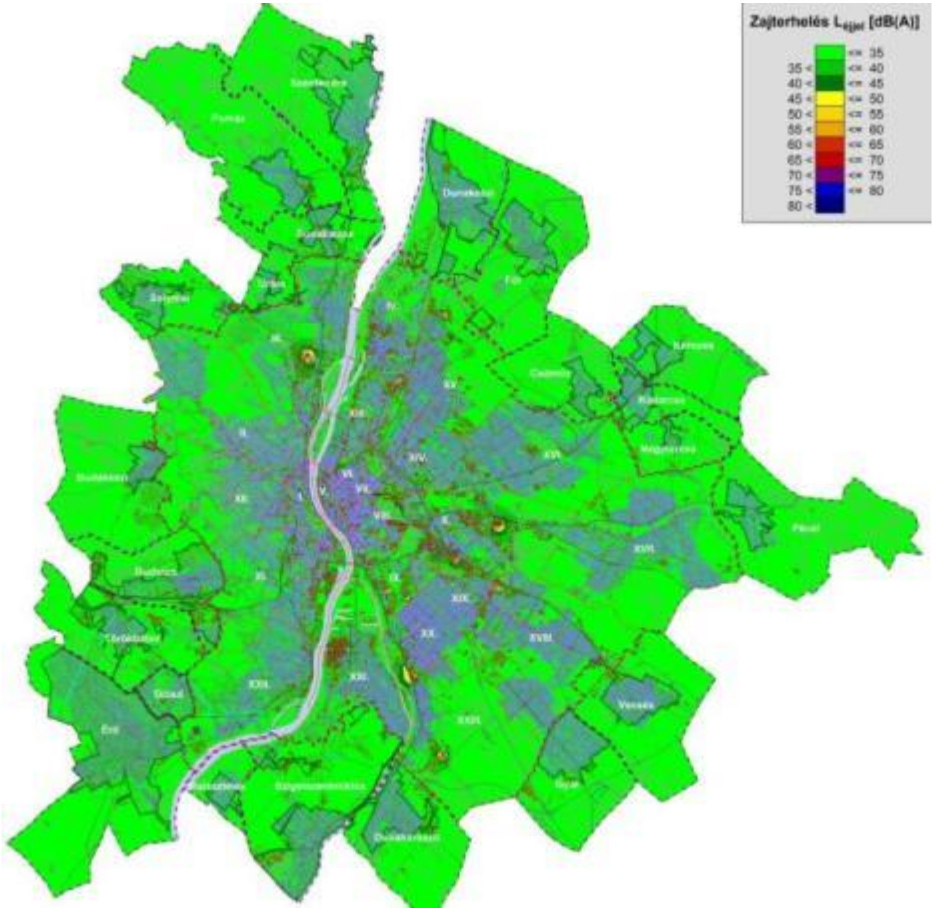
Non-public airports are operating in the area in the following municipalities: Baja, Dunakeszi, Dunabogdány, Dunaújváros, Érsekcsanád, Kalocsa, Őcsény, Tököl. The noise pollution is not significant, although it may cause local complaints.

Sources used in chapter 8:

- kira.gov.hu
- noiseterkepek.hu
- http://www.elza-altalanos.kti.hu/
- Results of the 2018 national road cross-section traffic census, 2019 (https://internet.kozut.hu/kozerdeku-adatok/orszagos-kozuti-adatbank/forgalomszamlalas/)
- http://bvs.hu/wp-content/uploads/2019/04/BRN_elsoszakcikk_v7.pdf
- http://www.kti.hu/trendek-archivum/magyarorszag-vasuthalozati-terkepe-2016/



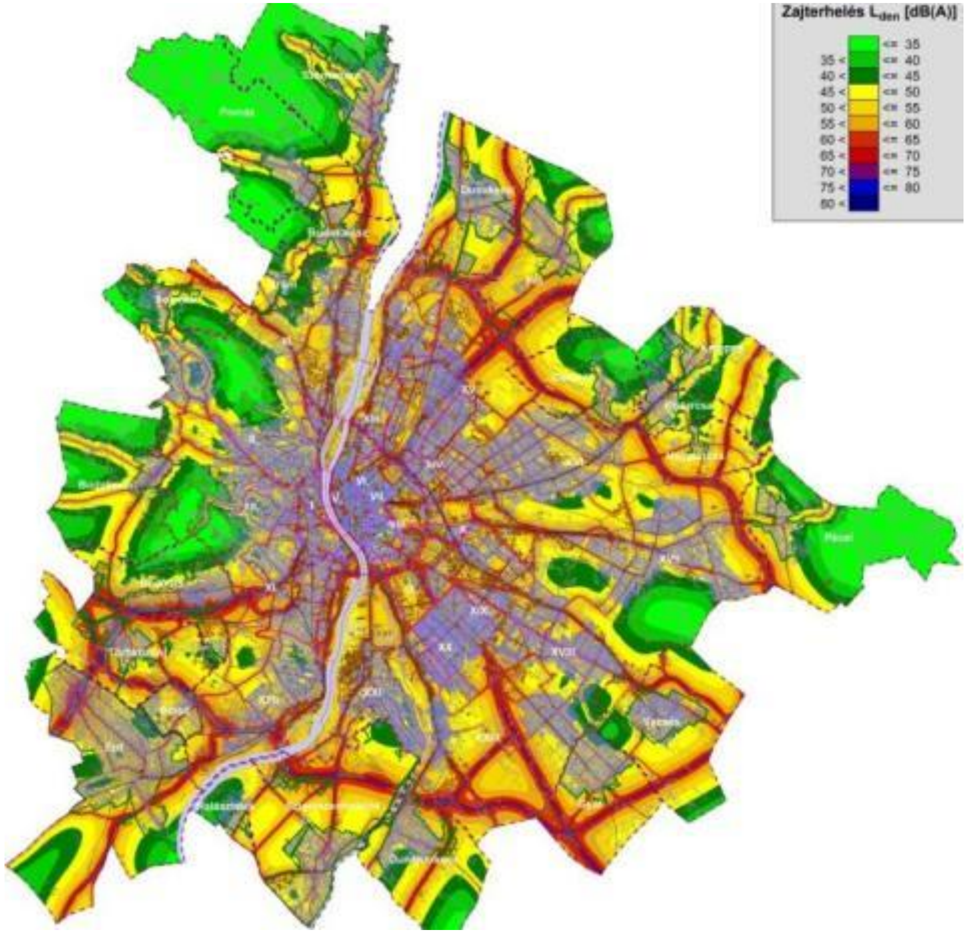
All day



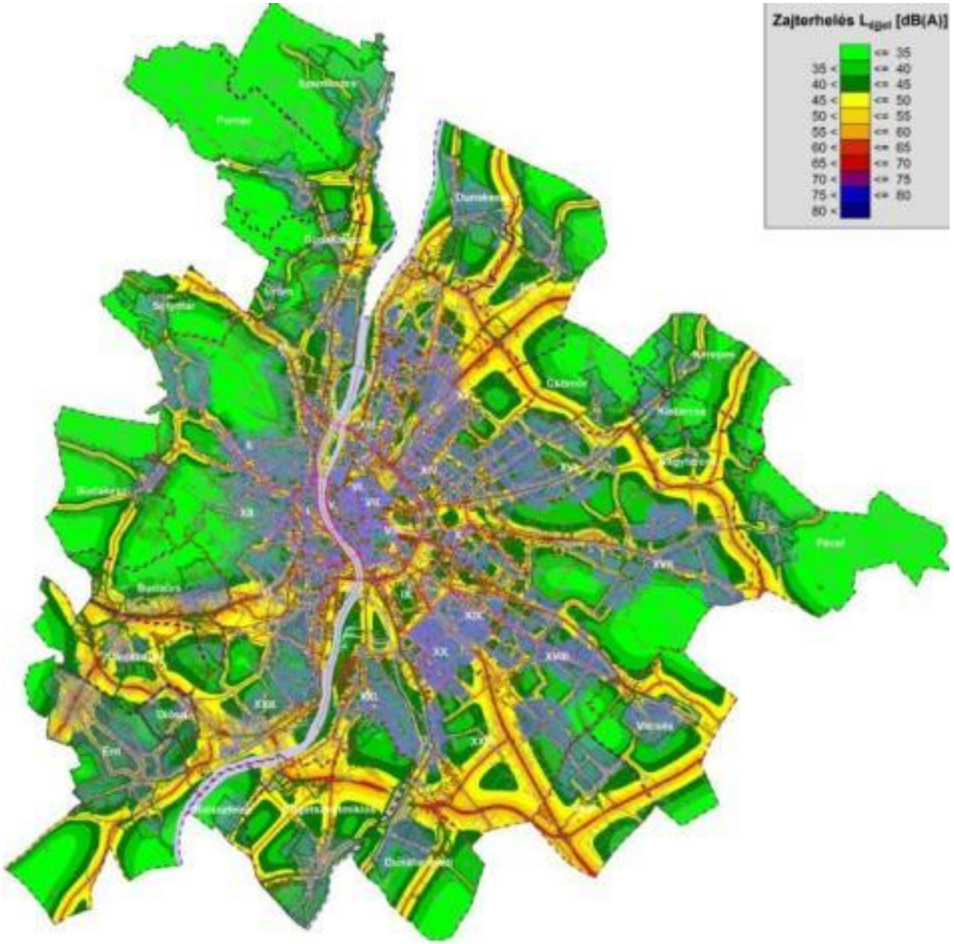
At night

27. Figure 3: Business noise exposure in Budapest and the surrounding area based on strategic noise mapping

Source: zajterkepek.hu



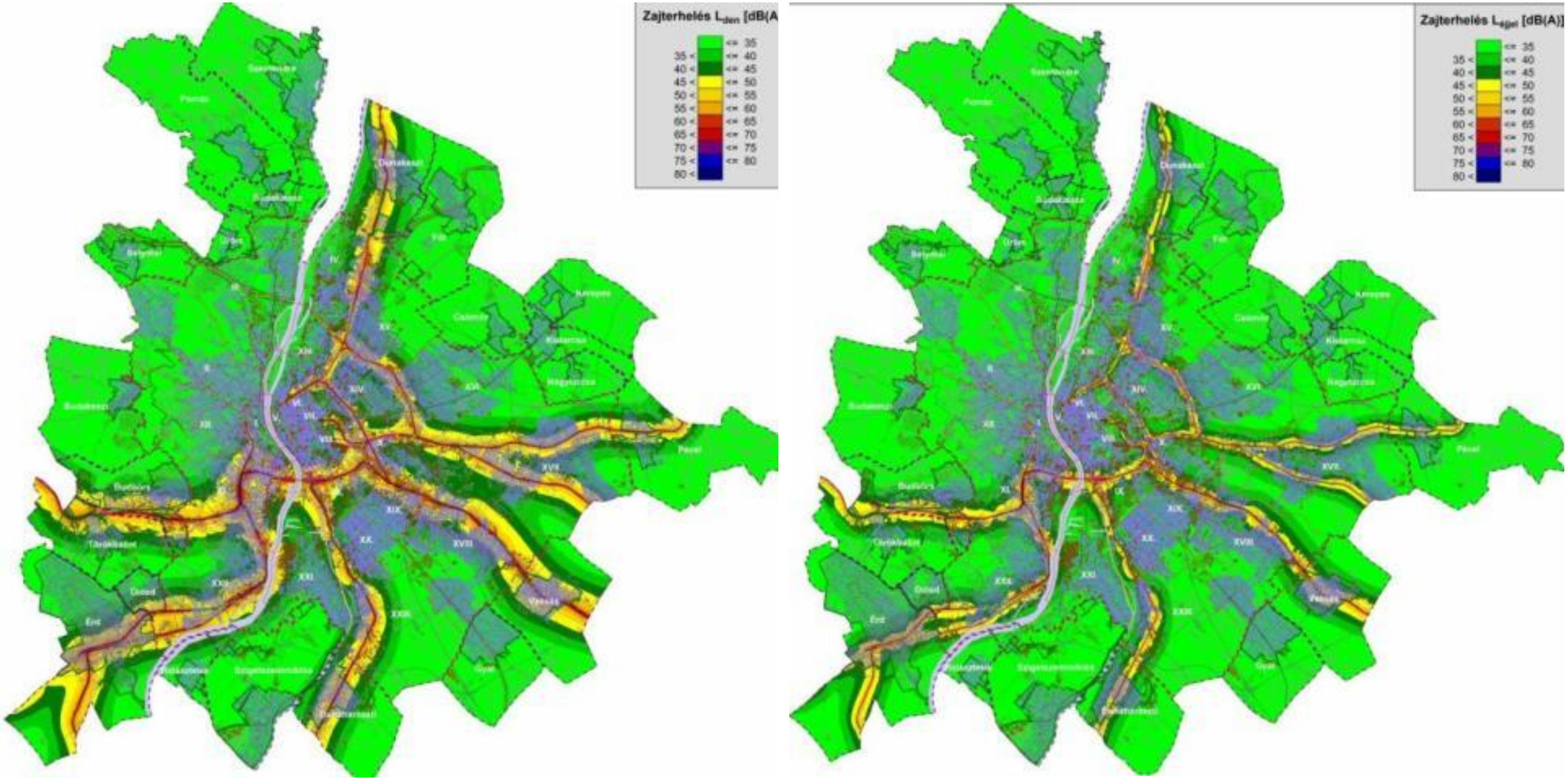
All day



At night

28. Figures 1.2:Road noise exposure in Budapest and its surrounding area based on the strategic noise mapping

Source: zajterkepek.hu



All day

At night

29. Figures 3.1:Railway noise exposure in Budapest and its surrounding area based on strategic noise mapping

Source: zajterkepek.hu

9. WASTE MANAGEMENT

In the region between Szob and the southern border there are 74 municipalities, which generated a total of 865578 t of municipal solid waste in 2018. This represents an increase of 3.7% compared to 2016. The largest amount of waste generated in the region is in Budapest, accounting for about two thirds of the total (670 817 t). The amount of waste that could be collected separately from the population in 2018 was 130 844 t. This represents 16% of the total municipal solid waste. The highest selective collection rate belongs to the municipality of Nagymaros with 49%. In Budapest, the rate was 16% in 2018 (KSH, 2020).

9.1. LANDFILLS AND THERMAL INSTALLATIONS

Within a 20 km radius of the Danube, fifteen major facilities dispose of waste. Most of them are regional landfills, mainly for the disposal of municipal solid waste. Of these, the most important in terms of capacity and size is the Pusztazámor facility. In Göd, Dunakeszi and Mohács, construction and demolition waste can be disposed of in inert landfills. Dunaújváros has the only hazardous waste disposal facility in the region. And in Rákospalota, a significant proportion of municipal waste from Budapest and the Vydra area is thermally treated in an incinerator. In addition to the regional waste disposal facilities, there are also a number of small solid waste landfills which dispose of waste from only a few municipalities. The main parameters of the waste disposal facilities are briefly summarised below.

Göd inert landfill

The distance from the Danube is 4.5 km. It is operated by Dűne Szektor Mining and Trading Ltd. It is located on the outskirts of Göd on the site 0108/3-4, which also functions as a sand mine. It received an environmental permit from the Pest County Government Office in 2015. It has a capacity of 230 000 t/y. Temporarily not in operation.

Inert waste delivered to the site is collected by type of waste in weighed depots on the site. After mechanical and manual sorting, it is separated into different fractions by crushing and sorting equipment and then graded. The classified material that emerges from the waste status, suitable for backfilling, is recycled in landscaping or sold.

Dunakeszi inert landfill

The inert landfill, located just over 2 km from the Danube, is operated by SA-HO Construction Materials Ltd. The site is located on the site of the former sand quarry in Dunakeszi, on the outskirts of the town of Göd, near the M2 motorway. It has a relatively large capacity of 1 million t/year. In recent years it has been suggested that the inert waste may include hazardous waste (e.g. asbestos). However, these assumptions have not been confirmed by official investigations.

Csömöri Regional Landfill

Ker-Hu Ltd. operates the landfill site opened in 2001 on Határ road in Csömör. The distance from the Danube is 13 km. In addition to the disposal of waste from the surrounding municipalities, it also handles non-recyclable industrial waste. Its containment meets Hungarian standards. It has a capacity of 1.8 million m^3 and is licensed by the environmental authority to treat 75 000 t/year of waste.

Ökörtelek Valley Regional Waste Management Centre in Kerepesi

The facility operated by the Green Bridge B.I.G.G. Nonprofit Ltd. is located on the left bank of the Danube, 20 km from the river, on the property parcel 0115/2. The municipal waste from the associated municipalities of Galga and Gödöllő is disposed of here.

The sorting plant will receive waste from residential, public and institutional selective collection. Sorting is carried out manually and mechanically. The mechanical sorting plant is used for shredding, screening and magnetic separation. The sorted and baled waste is sent to reprocessors and recyclers. After the process, the following materials are sent out: secondary raw materials (paper, plastic, glass, metal), fuel and compost. The heavy fraction consists mainly of inorganic waste - concrete, stone, slag, glass. It is the fraction of waste that is landfilled and transported to the landfill after collection in containers.

Organic waste is treated using an accelerated aerobic composting process. At the end of the composting process, the material is separated into different quality categories by different processes. High-quality compost is deposited on agricultural land, medium-quality compost is deposited on land removed from the food chain (e.g. energy plantations, industrial land, reclamation of tailings ponds), and low-quality compost is used for landfill or reclamation.

Budapest Waste Utilisation Plant

The Municipal Waste Utilisation Municipal Waste-fired Power Plant is located 4 km from the Danube in Rákospalota, in the 15th district, in Mélyfúró Street. Its task is to thermally dispose of about 60% of the municipal solid waste generated in Budapest. The plant was opened in 1982 and is operated by FKF Nonprofit Zrt.

The Waste Recovery Facility was renovated in 2005 and its capacity was increased to 420 thousand tonnes per year. It now produces the steam needed to heat 13,000 homes and the annual electricity for 45,000 homes.

Pusztazámori Regional Waste Management Centre

The centre, operated by FKF Nonprofit Zrt, is located about 12 km west of the Danube. Some 280 000 tonnes of municipal solid waste generated in Budapest is disposed of annually at the facility, which was opened in 2000. The sorted waste that cannot be thermally recovered at the Budapest Waste Utilisation Plant is disposed of here. It also handles waste from several municipalities in the Pest County area surrounding the landfill. It also collects and transports waste to the municipalities surrounding the landfill on individual orders.

The waste treatment centre includes a yard for the collection of waste collected and recycled by the public and some hazardous waste generated by the public.A composting plant for the recovery of green waste collected separately was commissioned in 2005 and expanded in 2013 to a capacity of 30 000 t/year. The compost produced here is used in the ongoing landfill recultivation and sold as compost products.

The waste received is identified, inspected, weighed and computer-registered before being taken to the landfill site. The landfill surface is covered with soil continuously spread from the expansion area and transported to the landfill, as well as incinerator slag from the Waste Utilisation Plant. In accordance with environmental standards, the landfill site at the Waste Treatment Centre will be continuously reclaimed, covered with prescribed layers of soil and planted with vegetation to create an aesthetic landscape.

The Centre covers an area of 91 hectares and will be filled in five phases, the first of which will be a temporary reclamation phase, with the second phase starting in 2013. It has full technical protection. Environmental monitoring is ensured by a monitoring network for soil and surface water, noise, soil protection and air quality.

In order to reduce the environmental impact, a reverse osmosis leachate treatment plant was installed as part of the Phase II investment, which produces 90 $^{m3\ of}$ clean water per day from 100 $^{m3\ of}$ contaminated water that can be discharged into the intake (Kerekdombi ditch). A recovery system for the landfill gas (methane) generated in the waste body has also been set up.

Gyáli waste treatment plant

The facility is located on the left bank of the river, 14 km from the Danube, in Gyál, on Kőrösi road, and is operated by FCC Hungary Ltd. After weighing and registering the waste received, it is sorted in a sorting hall, and after compaction, the useful material is baled separately. The organic material is composted and the high energy combustible waste is shredded to produce alternative fuel.

Százhalombatta landfill

Less than 2 km from the Danube is a landfill operated by SZÁKOM Nonprofit Ltd. The facility was expanded in 2017. It has a small landfill capacity. It disposes of municipal solid waste

Adony Regional Landfill

The distance from the Danube is 4 km. The landfill, located in Adony (cadastral parcel 0195/2), is operated by Vertikal Nonprofit Zrt. The whole process of complex treatment of mixed waste is carried out, from pre-treatment to the separation of individual fractions, secondary fuel production and storage of the material produced. The treatment of MSW, i.e. pre-sorting and recovery of as much of the material as possible, is provided by the Adony treatment plants.

Dömsöd landfill

The facility, located about 2.5 km from the Danube, on the eastern border of Dömsöd, on Vasút road (cadastral number 388/39), is operated by the Duna-Tisza Intermediate Waste Management Nonprofit Ltd. It is mainly a landfill for municipal waste, but also accepts construction and demolition waste and biodegradable waste.

Dunaújváros hazardous waste landfill

The hazardous waste treatment facility, operated by Design Ltd., is located on Papírgyári road, about 1.5 km south of the city, about 1.5 km from the river. 12 pools with technical protection have been constructed to receive the waste. Some of these have already been filled and recultivated, and a ditch, leachate collection and monitoring network has been established.

Dunaújváros landfill

The municipal solid waste landfill is located on the right bank of the Danube, 3 km from the river. It is operated by Dunanett Non-profit Ltd. A new landfill would be built partly on the site of the current landfill and partly on a new section to be developed, which would provide a safe disposal site for the city and surrounding municipalities for 5-6 years. The current landfill will be recultivated by DVG Zrt.

Paks Waste Management Centre and Waste Yard

Located on the right bank of the Danube, the facility was built in 2013. Solid waste from Paks and six other municipalities is disposed of here. It is operated by Kaposvár Waste Management Nonprofit Ltd. and is expected to be full by 2027-2028.

Vaskút Regional Landfill

It is located on the left bank of the Danube, 10 km from the river, in the village of Vaskút (cadastral parcel 0551/2). The facility is operated by FBH-NP Nonprofit Ltd. It was built in 2004 to dispose of solid waste from 45 municipalities in the region on an area of 34 hectares. It has a total capacity of 1.1 million ^{m3} and is expected to operate for another 20 years. Solid waste that has undergone mechanical-biological pre-treatment is compacted and continuously cleaned before being landfilled. Leachate from the landfill is collected and treated, and landfill gas is recovered. The environmental impact of the waste treatment facility is monitored by a network of groundwater wells and a geo-electric monitoring system.

The landfill can dispose of 55 000 tonnes of waste per year. This amount includes the amount of waste that can be disposed of by landfilling and which is not collected under a public service contract, up to a maximum of 20% of the total amount of waste that can be disposed of by landfilling, i.e. up to 11 000 t/year.

Mohács inert landfill

The plant is located right next to the Danube (at a distance of 305 m), at 24 Budapesti út in Mohács. Mohács Városgazdálkodási és Révschiffózási Kft. operates the landfill site for construction waste.

In the Danube region there are several facilities for composting green waste, in addition to landfills. This is important for the planned development, because a significant amount of green waste is expected to be generated. These green waste treatment plants are:

- Dunakanyari Green Waste Landfill, site: 2023 Dunabogdány, Kossuth Lajos utca, Ipartelep

- Göd Green waste landfill, site: 2131, Göd, Ipartelep, operator: Göd Waste Management Nonprofit Ltd. (2132 Göd, Duna út 5.)
- Technológia Kft, 1113 Budapest, Elek u. 22.
- Composting site of Főkert, located at 1106 Budapest, Keresztúri út 130., operated by Főkert Nonprofit Zrt. (1073 Budapest, Dob u. 90.)
- Compostal Ltd. composting plant, premises: 2045 Törökbálint, Hosszúréti farm 275/15.
- Gyáli composting plant, FCC Hungary Ltd, 2360 Gyál, Kőrösi út 53.
- Composting plant in Dunaújváros, operator: Dunanett Nonprofit Kft., 2400 Dunaújváros, Budai Nagy Antal út 2.

9.2. WASTE WATER TREATMENT PLANTS

The following table summarises the wastewater treatment plants in the municipalities in the area affected by the interventions. In total, 50 treatment plants have been set up in 29 agglomerations. Budapest has the largest number: 21, followed by Solt, Hartan and Dunaújváros with 2-2, and the remaining municipalities with 1-1. Their capacity depends on the number of inhabitants. Of the Budapest plants, the one in Csepel stands out with a capacity of 1.6 million population equivalents.

51. table: Urban waste water treatment plants in the region and some of their main characteristics

Waste water treatment plant name	Name of the municipality	Capacity (LE)	Nature of cleaning and disinfection	Discharged treated wastewater (thousand m3/year)	Place of issue (host)	Number of sections (fkm)
Iváncsa - Wastewater Treatment Plant	Ivancsa	3 667	mechanical, biological, N2 and P removal, chlorination	168	Chiba Valley Ditch	0,6
Adony - Wastewater Treatment Plant	Adony	3 768	mechanical, biological, N2 and P removal	124	Adonyi main channel	0,5
Home for the elderly	Budapest 03. district.	n.a.	biological	7	Pilisborosjenői stream	0,3
Dunaszekcső - Wastewater Treatment Plant	Dunaszekcső	3 750	mechanical, biological, N2 and P removal	68	Inland stream	0,9
Apostag - Wastewater Treatment Plant	Apostag	6 875	mechanical, biological, N2 and P removal, chlorination	192	Danube	1570,0
Nagytétény pumping station	Budapest 22. district.	n.a.	none	720	Danube	1630,0
Free spill	Budapest 22. district.	n.a.	none, other: fourfold dilution	131	Danube	1630,2
Dunaújváros - Wastewater Treatment Plant	Dunaújváros	75 000	mechanical, biological, N2 and P removal, chlorination	2 972	Danube	1577,2
Prison	Dunaújváros	n.a.	biological	41		
Ercsi - Wastewater	Ercsi	10 000	mechanical, biological, N2	285	Danube	1612,4

Waste water treatment plant name	Name of the municipality	Capacity (LE)	Nature of cleaning and disinfection	Discharged treated wastewater (thousand m3/year)	Place of issue (host)	Number of sections (fkm)
Treatment Plant			and P removal, chlorination			
Érd - Wastewater Treatment Plant	Érd	54 133	mechanical, biological, N2 and P removal, chlorination	2 136	Danube	1627,4
Rácalmás - Wastewater Treatment Plant	Rácalmás	3 500	mechanical, biological, N2 and P removal, chlorination	210	Little Danube Canal	1584,0
Ráckeve - Wastewater Treatment Plant	Ráckeve	34 167	mechanical, biological, N2 and P removal, chlorination	575	Danube	1603,1
Százhalombatta - Wastewater Treatment Plant	Hundred-pile cotton	35 000	mechanical, biological, chlorination	847	Danube	1619,8
Szigetszentmiklós - Wastewater Treatment Plant	Szigetszent-miklós	37 500	mechanical, biological, chlorination	1 212	Danube	1631,2
Tököl - Wastewater Treatment Plant	Cologne	28 438	mechanical, biological, chlorination	1 590	Danube	1619,1
Harta - Wastewater Treatment Plant	Charter	4 010	biological, N2 and P removal, chlorination	128	Danube	1545,6
Kalocsa - Wastewater Treatment Plant	Kalocsa	56 667	mechanical, biological, N2 and P removal, chlorination	1 063	Danube	1517,0
Madocsa - Wastewater Treatment Plant	Madocsa	14 321	mechanical, biological, N2 removal, chlorination	515	Danube	1539,9
Paks - (without Danube intake) - Wastewater Treatment Plant	Paks	16 250	mechanical, biological, chlorination	853	Danube	1528,2
Solt - Wastewater Treatment Plant	Solt	14 662	mechanical, biological, chlorination	295	Solti tide adhesive	1,9
Baja - Wastewater Treatment Plant	Baja	111 000	mechanical, biological, N2 and P removal, chlorination	2 960	Danube	1479,0
Mohács - Wastewater Treatment Plant	Mohács	20 000	mechanical, biological	889	Danube	1446,5
Szentendre - Wastewater Treatment Plant	Szentendre	71 000	mechanical, biological, N2 and P removal,	3 204	Szentendrei-Dunaág	7,2

Waste water treatment plant name	Name of the municipality	Capacity (LE)	Nature of cleaning and disinfection	Discharged treated wastewater (thousand m3/year)	Place of issue (host)	Number of sections (fkm)
			chlorination			
Vác - Wastewater Treatment Plant	Vác	116 673	mechanical, biological, N2 and P removal, UV treatment	3 368	Danube	1677,0
Free spill	Budapest 01. district.	n.a.	none, other: fourfold dilution	808	Danube	-
Free spill	Budapest 01. district.	n.a.	none, other: fourfold dilution	378	Danube	-
Zsigmond Square transfer station	Budapest 02. district.	n.a.	mechanical	183	Danube Region	1649,6
Budapest (North Pest) - Wastewater Treatment Plant	Budapest 04. district.	775 000	biological, N2 and P removal, chlorination	42 757	Danube	1655,2
Albertfala pumping station	Budapest 11. district.	n.a.	mechanical	24	Danube	1640,0
Kelenföld pumping station	Budapest 11. district.	n.a.	mechanical	365	Danube	1641,2
Free spill	Budapest 11. district.	n.a.	none, other: fourfold dilution	45	Danube	-
Angyalföld pumping station	Budapest 13. district.	n.a.	mechanical	152	Danube	1652,0
Margaret Island southern tip Pump station	Budapest 13. district.	n.a.	none	223	Danube	1648,9
Budapest (Csepel-Kp. szvtp.) - Wastewater Treatment Plant	Budapest 21. district.	1 633 333	mechanical, biological, N2 and P removal, chlorination	89 464	Danube	1641,4
Iron Gereben Street Pumping Station	Budapest 21. district.	n.a.	mechanical	3 825	Danube	-
Pumping station on Háros Street	Budapest 22. district.	n.a.	mechanical	1 071	Danube	1635,7
Free spill	Budapest 22. district.	n.a.	none, other: fourfold dilution	57	Danube	1636,6
Free spill	Budapest 22. district.	n.a.	none, other: fourfold dilution	24	Danube	1637,5
Free spill	Budapest 22. district.	n.a.	none, other: fourfold dilution	103	Danube	1637,5
Free spill	Budapest 22. district.	n.a.	none, other: fourfold dilution	135	Danube	1637,0
Free spill	Budapest 22.	n.a.	none	581	Danube	1638,0

Waste water treatment plant name	Name of the municipality	Capacity (LE)	Nature of cleaning and disinfection	Discharged treated wastewater (thousand m3/year)	Place of issue (host)	Number of sections (fkm)
	district.					
Waste water treatment plant in the central district	Charter	n.a.	biological	66	Fűzvölgyi main channel	11,6
Prison wastewater treatment plant	Solt	n.a.	biological	38	Fűzvölgyi main channel	17,3
Sződ - Wastewater Treatment Plant	Sződ	1 708	mechanical, biological, N2 and P removal, chlorination	104	Sződ-Rákos stream	4,0
Zebegény - Wastewater Treatment Plant	Zebegény	1 000	mechanical, biological, N2 and P removal	40	Malomvölgyi stream	0,1
Budapest (South-Pest) - Wastewater Treatment Plant	Budapest 23. district.	293 300	mechanical, biological, N2 and P removal, chlorination	20 383	Ráckeve-(Soroksári-) Danube	57,8
Decs - Wastewater Treatment Plant	Őcsény	4 200	mechanical, biological, N2 and P removal, chlorination	219	Szekszárd-Bátai main channel	25,5
Dunakeszi - Wastewater Treatment Plant	Dunakeszi	82 500	mechanical, biological, chlorination	3 400	Ocean trench	3,8
Tass - Wastewater Treatment Plant	Tass	4 250	mechanical, biological, N2 and P removal, chlorination	222	XXXI-4.channel	11,3

Source: VGT2 (2015)

9.3. SHIPPING ASPECTS OF WASTE MANAGEMENT

The collection and treatment of waste from Danube ships is currently largely uncoordinated and can pose a direct threat to the ecosystem. Their transfer and reception is uncontrolled along a significant stretch of the river (Simongáti, 2015). A problem is that

- not all types of waste are accepted in all countries,
- existing reception facilities are underused,
- there is no cooperation on development between the Danube countries.

Therefore, there is a high risk of illegal solutions, such as releasing oily bottom water directly into the Danube. Previous international projects, such as WANDA (WAste management forinlandNavigationtheDAnube, 2009-2012) and its continuation CO-WANDA (COnventionforWAste management forinlandNavigationtheDAbuve, 2012-2014), have been set up to address these issues. Their task is to prepare the ground for the development of a single international legal instrument and infrastructure for the collection of waste from ships on the Danube. Within the framework of WANDA, a vignette-based, indirect-fee-based system for ship-generated waste management has been developed. The

COWANDA project proposed the establishment of an international network for ship-generated waste collection.

However, the projects have made little practical progress. The results have been port improvements for waste management. However, only a few Hungarian ports have facilities for the reception and collection of ship-generated waste and the number of processing facilities is insufficient. Another problem is that some ports can only accept ship-generated waste in bulk. Another problem is the financing of waste management. Landfilling is charged for, and in many cases ships discharge into the river, which is difficult or impossible to control and trace (Berger et al., 2014).

The Hungarian legal framework for the protection of the aquatic environment and the disposal of waste generated on board ships is provided by the provisions of Chapter 10 of the Decree 57/2011 (XI. 22.) of the Ministry of Transport and Communications on the Regulation of Water Transport. Typically, the following types of waste are to be expected:

- residual cargo means any liquid cargo remaining after unloading from a tank or pipeline without the use of additional discharge systems in accordance with ADN [26]Regulations, and any dry cargo remaining after unloading from a hold without the use of manual or mechanical sweeping or suction systems;
- ship-generated waste containing oil or lubricants: used oil, bilge water and other waste containing oil or lubricants, such as used lubricants, used filters (oil and air), used wiping cotton (used rags and cotton wool), containers (empty contaminated tanks) and packaging materials used for such waste;
- waste oil: waste oil and other lubricants not used as a secondary lubricant in engines, gear drives, hydraulic mechanisms;
- bilge water: oily bilge water from the hold, engine room, bow compartment, weir or double side compartment;
- Tired lubricant: lubricant leaking from oiling cans, bearings and lubricating equipment and other lubricants not used as a secondary lubricant;
- other ship-generated waste: municipal waste water, household waste, cleaning waste, sewage and other special waste;
- cargo-related waste: waste and sewage generated on board a ship as a result of the carriage of cargo.

As required by law, waste from ships is delivered to designated port reception points by filling in forms according to strict requirements. It is forbidden to throw or discharge the above-mentioned waste into the water. Exceptions to this rule are municipal and laundry waste water, which may be discharged into the waterway in accordance with the relevant regulations.

The ship's captain must ensure the separate collection of waste containing oil or lubricants generated during the operation of the ship in special containers and the separate collection of bilge water from the engine room and its separate discharge at waste collection points. Household waste shall be separated.

Previous attempts to estimate the amount of waste generated on ships are summarised in the 2011 WANDA study. Of the types of waste, bilge water is one of the most typical and cardinal parameters, the quantity of which depends on several factors: the age, nature, equipment, technical condition and engine load of the vessel. At the end of the 1990s, the typical volume of bilge water for a cargo vessel was 4.2 ^{m3} , for a passenger vessel 2.1 ^{m3} and for a leisure vessel 0.05 ^{m3} . As the composition of the current Danube fleet is predominantly 1980s, the above data provide a good guide to the volume of bilge water produced. For the whole Danube region, the volume of bottom water formed is 15 000 $^{m3/year}$ (Phare, 2000). Calculated from these data, the volume of bottom water generated in the Danube between 1708.0 and 1433.0 km f in the project area is estimated at 1 450 ^{m3} per year.

[26] The European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN)[6]

It is not possible to accurately estimate the amount of depleted oil formed in a given river section from existing data. It is generated intermittently, mainly during the servicing of vessels during oil change periods. In an average oil change, 120-125 litres are produced. In the case of twin-engined vessels, this is 500 litres for a complete oil change (Gabriel, 2001). In Hungary, the Danube fleet consisted of 346 vessels in 2016. Of these, 131 are in service and require oil changes. Assuming that they are serviced in our country, oil changes can generate 5,000-8,000 l/year of oil fatigue per 2-3 year period. In addition, 10-20 kg of used oil filters, oil rags and tanks are generated per ship per service (Gabriel, 2001), which corresponds to 700-1000 kg of waste per year at national level.

Sewage and sewage sludge is generated in larger quantities on passenger vessels: 150-230 l/person/day on sleeping-cabin vessels and 150 l/person/day on sightseeing or other fast motor boats. On vessels equipped with a sewage treatment plant, 3% of this volume remains on board as sewage sludge, while 97% can be returned to the water after treatment (Viadonau, 2008).

Household waste is also generated on board. The amount of recyclable waste (paper, metal, plastic, organic) on board cargo ships is 700 l/person/year, which corresponds to 65 kg/person/year. Non-recyclable waste is 1 200 l/person/year (130 kg/person/year) (Gabriel, 2001).

Other hazardous waste is also generated on board ships, which is not of cargo origin. Their formation is usually linked to service periods. These include paints, varnishes, solvents, cleaning agents, batteries. On cargo vessels, they are estimated to be 5-10 kg per servicebox (Gabriel, 2001).

Wastes not only arise from the operation of the ship, but can also be of cargo origin. by the nature of the cargo, they can also be classified as either hazardous or non-hazardous waste, which determines how they are treated. Their quantity is difficult to estimate. There are three basic types:

- Residual cargo: cargo remaining in tanks, pipelines or in the hold after removal/unloading before cleaning/drying begins.
- Cargo residue: liquid cargo that cannot be removed from pipelines and tanks, or solid cargo remaining in the hold after cleaning.
- Loading residues: residues of goods that are outside the containers or the hold, usually generated during loading. Includes ballast water and rainwater accumulated in the hold.

Liquid waste includes wash water generated during the cleaning of the hold and tanks. Muddy, contaminated water is a rusty or sludgy mixture of waste and water used for cleaning, which may or may not be pumpable. The quantity is relatively small due to the enclosed holds covered with metal sheets (Viadonau, 2004). However, more precise data on the quantity are not available. It is possible that ballast water may enter the waterway.

In addition, there are other cargo wastes that are specifically derived from cargo. Diluents, paints, varnishes, aggressive chemicals and biological substances can be released from containers and tanks during improper handling. The generation of such hazardous waste is relatively low in frequency and is more accidental.

In the area affected by the planned interventions, municipal waste collected from ships can be dropped off at three urban ports - Budapest, Kalocsa and Mohács. In the Danube section under study, there is only one possibility for the disposal of hazardous waste: the oily bilge water reception site at the Green Island in Budapest, which is a floating, servicing unit. Its primary function is to supply ships with drinking water and to receive and treat and dispose of sewage, waste oil, oily dry waste, oily bilge water and kitchen waste generated during their daily operation in accordance with the strictest environmental standards. A secondary but professionally required task is the supply of fuel and lubricants to waterway vessels. The necessary energy is provided by an innovative mobile water engine, which generates electricity using the flow energy of the Danube. However, the Green Island has a limited capacity, more for occasional waste disposal. Docking for larger vessels is difficult. Significant upgrading and expansion is needed to connect it to the international system (Simongáti, 2015).

The Green Island float
Source : http://www.hajocsavar.hu/hirek-aktualitasok/?sw_12_item=2620

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10. NATURAL RESOURCES

Among the natural resources potentially used by the project in the study area, this chapter describes **the state of energy resources and the current state of domestic energy management. The** current status of other natural resources (such as water resources, aquifers, soil, land, wildlife, air, etc.) has already been described and is discussed in detail in the relevant chapters (see ***Chapters 1 to 7***).

Hungary relies on imports for both primary and secondary energy sources; 56% of gross domestic energy consumption in 2016 came from imports, a few percent higher than the EU average. Our stocks of conventional energy carriers are largely exhausted, and our primary energy production has also been declining slightly since the turn of the millennium.

Domestic energy supply is still mainly based on nuclear energy (primary energy production: ~38%, electricity generation: ~49% in 2017) and conventional fossil fuels (primary energy production: ~33.4%, electricity generation: ~40% in 2017). However, over the last decade and a half, the share of energy produced from renewable energy sources (and waste) has nearly doubled, exceeding the 14.65% target set by Hungary for 2020 already in 2012, although a decline was observed in 2014 and 2018 (13.3% in 2017).

In renewable energy production, although decreasing in share, biomass and renewable municipal waste still dominate (~three quarters of total production). The share of biofuels is rising significantly, to 13%, while the shares of geothermal and hydropower are declining, while biogas, wind and solar are increasing, but still only 11% in total in 2017. Biomass is also the most important source of electricity generation (48% in 2017), followed by wind (22%) and solar (10%), then biogas (9.6%). The share of hydropower is decreasing (6.3%). The share of renewable municipal waste is only 4.6% in 2017.

Hungary's energy intensity index (the ratio of energy use to GDP) has fallen by more than a quarter compared to the first half of the 2000s, but is still almost double the EU average. Looking at the structure of energy use, the residential sector is now the largest consumer of energy (accounting for ~32.6% of final energy consumption in 2018 (with heating accounting for a significant share of this, due in large part to the low energy efficiency of the building stock), followed by transport (which has seen significant growth over the last 2.5 decades) with 26.85%. Industry, which has undergone a significant decline after the change of regime, now accounts for ~25% of the total, with the tertiary sector responsible for ~12% of consumption. The share of agriculture is only ~3.5%.

It should also be pointed out that the rapid growth in energy use in the transport sector in our century was only halted by the economic crisis, and has been on the rise again since 2014. According to the latest data (2016), transport energy consumption per capita is 19.1 GJ, almost reaching the highest level ever recorded in 2008 (20.0 GJ). Importantly, this increase is mainly due to the energy use of road transport, which now accounts for 93% of all transport modes, and its specific energy use has increased by 49% since the turn of the millennium (while rail transport has decreased by 13% and water and air transport by 13%).

However, rail and waterborne transport are much more energy efficient than the currently dominant road transport. For this reason, and also to reduce the associated air emissions, it is important to shift longer distance (>300 km) road freight transport to rail and waterways, and to move towards lower emission solutions. (However, we have seen that non-fossil fuels dominate our energy production, but their use in transport is more limited.) While electrification is expected to play a dominant role in rail and short-distance road transport, the preferred fuel for waterborne transport (similar to long-distance road freight transport) will in future be biomethane-substituted natural gas (mainly liquefied natural gas, LNG). The share of renewable energy in the transport sector should reach 14% in Hungary by 2030. In addition, the EU requires that the share of waste-based advanced biofuels and biogases in the energy use of the transport sector should reach 0.2% by 2022, 1% by 2025 and 3.5% by 2030. In line with this, as we have seen, the production of biofuels in Hungary is also expanding significantly.

Sources used in chapter 10:

- www.ksh.hu
- Environmental State of Hungary 2017, Hermann Ottó Institute, Budapest 2018 (http://www.hermanottointezet.hu/sites/default/files/MKA_2017.pdf)
- Sustainable Development Indicators in Hungary 2018, Hungarian Central Statistical Office, 2019 (http://www.ksh.hu/docs/hun/xftp/idoszaki/fenntartfejl/fenntartfejl18.pdf)

11. CLIMATE CHANGE

One of the major challenges of the 21st century is to manage the consequences of global warming and climate change, to reduce the impact of human activity and to prepare for and adapt to the expected changes. The increase in the frequency of climate change-related warming, droughts and extreme weather events expected in our country, and hence the likely magnitude of the damage, may have unexpected and multifaceted impacts on society, the economy and the natural environment.

In Hungary, the transport sector accounts for more than 25% of total energy consumption, making it one of the most important components. Greenhouse gas emissions generated by transport therefore play a major role in climate change, and reducing emissions from transport is an important task that can be achieved by rationalising and reducing transport demand and by promoting environmentally friendly modes of transport.

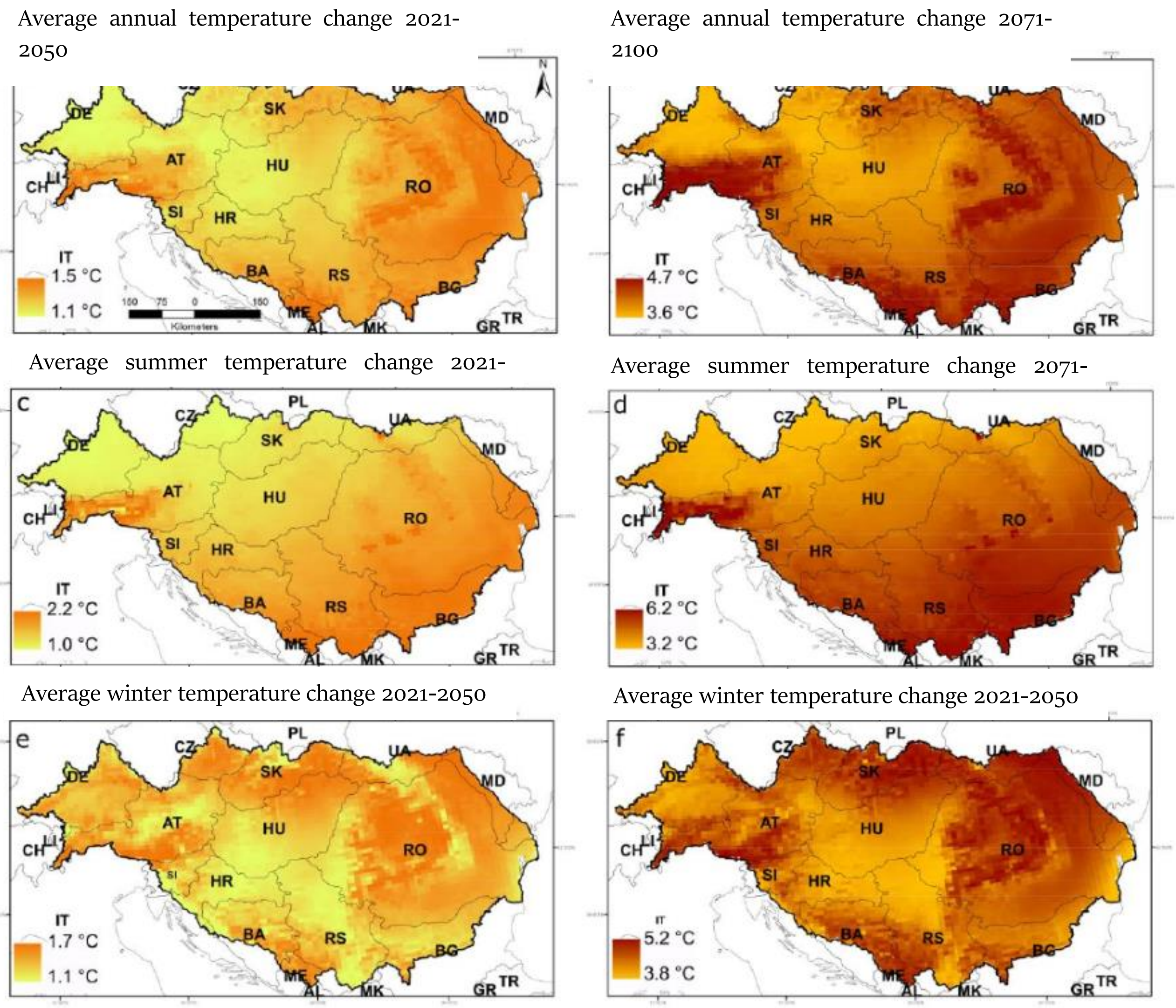
The Second National Climate Change Strategy (NÉS-2) summarises the main options for reducing emissions. It identifies as a major challenge the development of an efficient and sustainable transport system.

The International CommissionfortheProtectionof theDanubeRiver (ICPDR) is responsible for the development of sustainable and balanced water use in the Danube river basin, based on the Danube River Basin Convention. According to their Climate Change Adaptation Strategy, climate change is already being felt and its expected impacts are such that they cannot be ignored and need to be assessed for any planned intervention.

For the Danube river basin area, the results of the EURO-CORDEX projections are based on the RCP8.5 scenario for the reference period 1981-2010. According to this scenario, the range of the annual mean temperature increase is expected to be between 1.1°C and 1.5°C in the mid-21st century (2021-2050) and between 3.6°C and 4.7°C at the end of the century (2071-2100), with a north-west to south-east gradient (***Figure 30***). Outstanding warming points are shown in mountainous regions and in south-eastern Europe. The EURO-CORDEX projections also show that the annual (***Figure 30.a, b)*** and summer (***Figure 30.c, d)*** temperature increases are likely to be larger than the winter temperature increases (***Figure 30.e, f***). The increase in Danube temperature will also significantly affect aquatic biota, leading to, among other things, a rearrangement of floating algae, phytoplankton organisms, which form the basis of the aquatic food web, and a reduction in biomass.

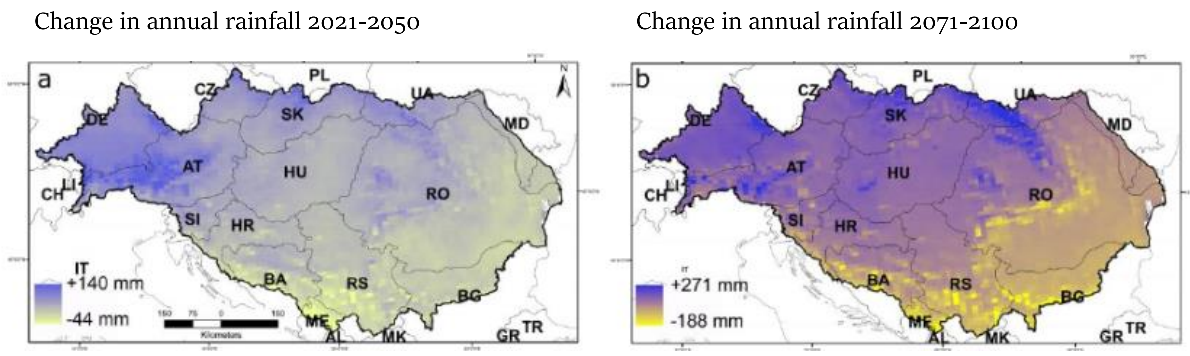
The EURO-CORDEX projections for the Danube basin under study also confirm the general trend of wetter regions and drier regions becoming wetter and drier regions becoming drier during the 21st century. This trend is more evident in the second half of the century (2071-2100). While in many regions annual precipitation is likely to remain almost constant in the coming decades, more precipitation is expected in the northern parts of the study area and less in the southern parts (***Figure 31***).

According to EURO-CORDEX projections, the more significant change is expected in the seasonal than the annual rainfall distribution (***Figures 31-33***). The summer months are likely to be drier (-58%) (***Figure 322***), while the winter months show an increase in precipitation (+34%) (***Figure 333***). Winter precipitation is increasing in mountainous regions, while summer precipitation is decreasing in already drier regions. In those regions where summer rainfall is forecast to increase, it is due to frequent thunderstorms and short periods of rainfall. And with temperatures likely to rise, winter precipitation will increase in the form of rain, which could mean an increase in winter runoff.



30. Figure 2:Annual mean temperature change (a, b), summer (JJA) (c, d) and winter (DJF) (e, f) mean temperature change in the Danube River Basin 2021-2050 and 2071-2100, based on RCP8.5 scenario, EURO-CORDEX combined results

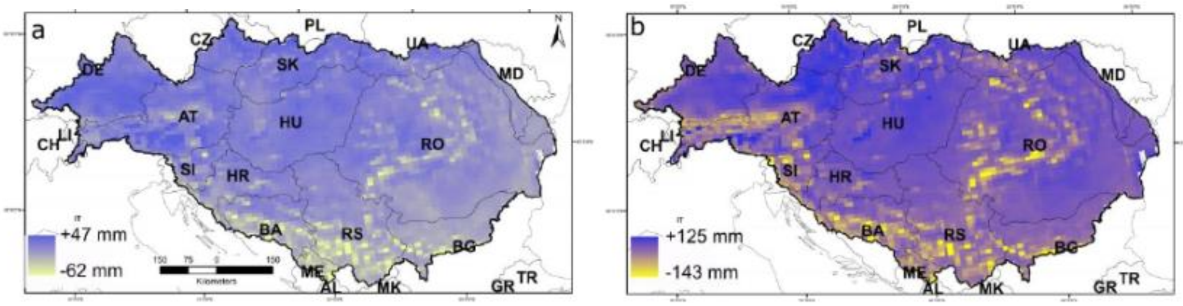
(Stolz et al., 2018)



31. Figure 1:Annual precipitation variation (a, b) in the Danube river basin 2021-2050 (a) and 2071-2100 (b), based on RCP8.5 scenario, according to EURO-CORDEX combined results

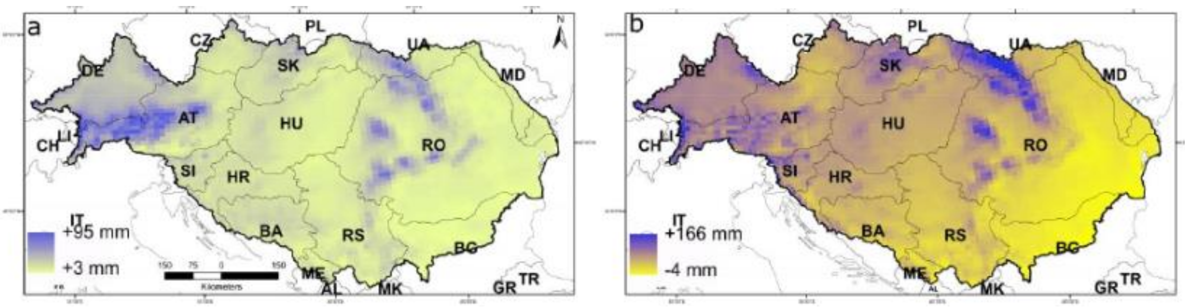
(Stolz et al., 2018)

Change in summer precipitation 2021-2050 Change in summer precipitation 2071-2100



32. **Figure 1:Summer precipitation variation (a, b) in the Danube river basin 2021-2050 (a) and 2071-2100 (b), based on RCP8.5 scenario, according to EURO-CORDEX combined results**
(Stolz et al., 2018)

Change in winter precipitation 2021-2050 Change in winter precipitation 2071-2100



33. **Figure 1:Winter precipitation variation (a, b) in the Danube river basin 2021-2050 (a) and 2071-2100 (b), based on RCP8.5 scenario, according to EURO-CORDEX combined results**
(Stolz et al., 2018)

According to the analyses carried out for the Danube river basin under study, an increase in the frequency and intensity of extreme weather events is expected. The simulations also show an increase in the intensity and frequency of droughts, hot days and heat waves, as well as an increase in heavy rainfall until the end of the 21st century. More frequent droughts are expected to lead to more frequent and longer than usual periods of low water levels, which may hamper shipping traffic. This may be interrupted by floods, which may sometimes result in higher water levels than ever before.

The extreme rainfall projected in the model simulations could lead to extreme runoff, resulting in more persistent inland flooding in lower-lying areas, higher surge flooding in watercourses and an increase in flash flooding. More intense precipitation may also increase erosion, which, through sediment transport, will have a negative effect not only where it is transported but also where it is deposited, so that the frequency of maintenance work is likely to increase in the future. All of this means an increasing risk for the management of drinking water resources, so that changes in the quantity and quality of water resources will require not only adaptation but also prevention and planning.

The Danube's (main river) flow is mainly determined by the high mountain regions, and especially by the tributaries that open up the central, highest reaches of the Eastern Alps (Inn, Traun, Enns). In this context, it can be concluded from the above that the melting of glaciers in the upper Danube catchment could thus have a significant impact on the river's flow, which is confirmed by the results of the long-term flow decline prediction carried out by Dr. József Szilágyi from the Department of Hydraulic Engineering and Water Management of the Budapest University of Technology, entitled "Application of a hybrid Markov chain-based daily flow generation time series model to the Danube". According to this study, all sections of the Danube along the stretch of the Danube examined in this document are expected to experience a decrease in discharge by the mid 21st century (2020-2050) (see ***Annex 7***).

Observations show that the Danube water temperature is rising and the duration of ice events is steadily shortening. According to the Second National Climate Change Strategy, the water temperature of the Danube (similar to the air temperature) increased by 0.6°C in the period 1926-2005 (at an accelerating rate since 1970), the duration of ice events in the Nagymaros section has decreased from 2.5 months to one month, and the groundwater in the Danube-Tisza confluence has been permanently lowered.

Sources used in chapter 11:

- Second National Climate Change Strategy - NÉS-2 (2017) Ministry of National Development, Budapest
- International Commission for the Protection of the Danube River - ICPDR (2019) ClimateChangeAdaptationStrategy, Vienna
- Stolz, R., Prasch, R., Weber, M., Koch, F., Weidinger, R., Ebner, M., Mauser, W. (2018) Climatechangeimpactsonthewaterresourcesin thedanuberiverbasin and possibilitiestoadapt - thewayto an adaptationstrategy and its update. Journal of EnvironmentalGeography 11 (3-4), pp. 13-24.
- Szilágyi József (2019) Application of a hybrid Markov chain based daily flow generation time series model to the Danube. Budapest University of Technology, Department of Water Engineering and Water Management, Budapest

12. MAN AND SOCIETY

12.1. DEMOGRAPHIC CHARACTERISTICS

In the stretch from Szob to the southern border, the main Danube riverbed touches the administrative boundaries of 72 settlements, not including those located along the Szentendre and Ráckeve-Soroksági Danube branches, whose administrative boundaries are more than 500 m from the main riverbed. These settlements may be the most affected by construction and increased boat traffic, both directly (e.g. air pollution, noise from construction works) and indirectly (e.g. disturbance of water uses such as fishing, water sports).

The Danube section of the affected area starts at the edge of Komárom-Esztergom county and runs through Pest county, Budapest, Fejér, Bács-Kiskun, Tolna and Baranya counties. This shows that it covers a large area, excluding Budapest, with a total population of just over half a million inhabitants, and the population of the capital districts concerned is over 800 000. Some basic demographic characteristics of the municipalities and districts are presented in the following two tables.

52. Table 3:Demographic characteristics, housing and water management situation of the Budapest districts concerned

Municipality	Municipal area (km2)	Population at end 2000 (persons)	Population at the end of the year (persons)	Natural reproduction (main)	Domestic migration margin	Work-at-work. indicator
Budapest 1st district	3,41	25 867	25 172	-106	27	1,06
Budapest 2nd district	36,34	91 363	89 452	-353	-246	0,89
Budapest 3rd district	39,7	131 176	130 560	-368	-413	1,24
Budapest 4th district	18,82	102 561	100 071	-272	-627	1,68
Budapest 5th district	2,59	29 043	26 013	-122	106	0,65
Budapest 9th district	12,53	62 182	59 720	-53	446	1,34
Budapest 11th district	33,49	141 163	148 517	-508	201	1,12
Budapest 13th district	13,44	111 701	121 657	-204	309	1,62
Budapest 21st district	25,75	80 681	76 092	-416	-252	1,56
Budapest 22. district	34,25	51 921	55 112	-129	-232	1,17

Source: HCSO, NFSZ data

53. **Table 3:Demographic characteristics, housing and water management situation of the municipalities concerned (excluding Budapest)**

Municipality	Municipal area (km2)	Population at end 2000 (persons)	Population at the end of 2018 (persons)	Natural reproduction (main)	Domestic migration margin	Percentage of dwellings connected to public drinking water supply (%)	Percentage of dwellings connected to the public sewerage network (%)	Work-at-work. indicator
Szob	17,97	2950	2557	-30	18	85,25	75,14	1,66
Pilismarote	44,58	1975	2061	-12	26	78,54	77,24	2,13
Zebegény	9,63	1183	1253	-6	26	86,95	61,02	1,71
Dömös	23,99	1126	1142	-6	11	79,65	73,70	3,06
Nagymaros	34,37	4451	4905	-14	103	91,39	73,84	2,58
Visegrad	33,27	1647	1879	-22	62	86,18	67,50	1,55
Kismaros	11,96	1800	2367	0	68	100,00	73,72	1,79
Kisorossi	10,94	752	974	-12	25	100,00	84,01	1,90
Verőce	20,33	2883	3963	-27	128	97,05	63,07	2,34
Vác	61,6	34 131	32828	-161	164	98,91	92,76	2,00
Tahitótfalu	39,17	4371	5795	-13	84	98,72	82,56	1,37
Pócsmegyer	13,08	1094	2399	-15	120	100,00	57,42	2,71
Sződliget	7,31	4113	4572	-31	82	94,62	90,67	0,90
Göd	24,44	15 152	19871	-31	625	100,00	91,97	1,58
Island Monastery	23,51	1508	2577	-7	64	100,00	63,31	1,58
Dunakeszi	31,06	29 026	43604	82	-10	92,01	89,79	1,16
Érd	63,31	56 058	68211	14	1177	89,99	84,93	1,05
Szigetszentmiklós	45,65	23 093	39310	72	569	100,00	86,15	1,78
Halaszztelek	8,64	6900	11096	22	455	100,00	94,14	1,41
Cologne	38,49	8622	10235	-55	76	100,00	74,70	1,55
Százhalombatta	28,06	16 826	18082	-23	-170	100,00	96,51	1,07
Island image	18,2	2298	2354	-19	36	92,14	76,63	2,13
Ercsi	65,31	8334	8065	-32	-82	93,51	87,14	4,97
Szigetújfalu	10,83	2038	2004	-21	59	90,47	86,95	2,76
Ráckeve	64,09	8829	10605	-72	218	94,38	96,01	3,30
Ivancsa	25,17	2754	2806	-3	33	99,71	53,00	3,46

Municipality	Municipal area (km2)	Population at end 2000 (persons)	Population at the end of 2018 (persons)	Natural reproduction (main)	Domestic migration margin	Percentage of dwellings connected to public drinking water supply (%)	Percentage of dwellings connected to the public sewerage network (%)	Work-at-work. indicator
Lorraine	9,88	308	291	-4	2	100,00	90,70	1,36
Adony	61,05	3791	3880	-34	127	94,18	74,22	3,17
Makado	31,77	1280	1225	-4	63	96,82	81,84	2,78
Key	16,73	1767	3085	-39	125	78,60	0,00	3,66
Rácalmás	40,64	3920	4653	3	23	100,00	87,95	3,28
Tass	74,73	2972	2702	-19	23	92,97	93,31	5,73
Dunaújváros	52,67	54 060	44200	-316	-285	99,32	96,89	3,69
Szalkszentmárton	82,08	3014	2778	-5	36	99,14	84,58	5,35
Dunavecse	66,77	4204	3806	7	28	98,51	81,09	4,52
Apostag	31,94	2099	1995	-15	-3	96,48	85,80	2,89
Little Post	9,58	1219	1407	-1	0	100,00	92,20	3,05
Baracs	55,18	3223	3393	-19	11	94,06	81,45	3,22
Dunaegyháza	10,12	1491	1410	-5	6	99,31	0,00	3,12
Dunaföldvár	111,42	9070	8443	-71	108	97,96	86,50	3,71
Solt	132,67	7092	6102	-22	-6	90,28	80,50	3,19
Wise	58,78	3016	2643	-19	-56	100,00	95,51	3,96
Charter	129,68	3781	3233	-19	9	96,24	89,85	2,87
Madocsa	43,33	2001	1863	-4	-11	100,00	97,35	2,15
Dunapataj	90,47	3691	3024	-30	-25	100,00	0,00	5,25
Ordas	16,31	511	416	-6	3	100,00	0,00	1,82
Paks	154,08	20 977	18623	-52	-229	100,00	96,46	2,57
Géderlak	18,94	1092	974	-2	-17	98,72	82,91	6,18
Dunaszentbenedek	23,24	951	767	4	-15	96,68	73,46	7,10
Uszód	24,46	1115	909	-8	-3	97,44	80,81	4,06
Cape Verde	31,46	1742	1552	-12	41	97,29	81,00	5,07
Gerjen	36,28	1336	1201	6	10	100,00	85,74	4,34
Kalocsa	53,18	18 505	15280	-101	-117	96,72	90,44	4,20

Municipality	Municipal area (km2)	Population at end 2000 (persons)	Population at the end of 2018 (persons)	Natural reproduction (main)	Domestic migration margin	Percentage of dwellings connected to public drinking water supply (%)	Percentage of dwellings connected to the public sewerage network (%)	Work-at-work. indicator
Uncle	33,86	2265	1985	-18	-15	97,02	84,56	5,55
Fadd	67,54	4469	3986	-24	-27	91,10	76,87	4,88
Species	31,99	1917	1600	-7	-13	99,17	82,46	4,89
Hazel	55,93	2391	2068	-7	-4	89,70	70,32	5,19
Dusnok	57,47	3366	2774	-22	25	100,00	89,64	4,44
Őcsény	72,6	2567	2271	-20	-16	91,73	81,44	2,90
Cyclades	94,18	4040	3434	-22	-2	100,00	87,81	3,08
Érsekcsanád	58,29	2883	2753	10	-21	94,95	90,00	3,05
Decs	94,67	4288	3728	-33	13	85,84	72,01	5,70
Baja	177,89	38 351	34495	-254	-92	93,61	83,66	2,15
Báta	66,16	1941	1500	-17	-30	92,97	47,79	6,48
Szeremle	34,06	1564	1321	-3	2	100,00	0,00	2,55
Dunaszekcső	36,75	2236	1796	-14	-10	100,00	78,52	6,21
Dunafalva	57,9	1072	903	3	-19	95,25	0,00	3,21
Although	9	612	539	-3	23	91,98	89,03	5,51
Mohács	112,23	19 182	17089	-105	-15	86,21	72,18	5,64
Corona	44,73	730	514	-7	-3	82,53	0,00	4,43
Kölked	61,94	1139	1035	-2	10	90,08	0,00	7,03

Source: 2018 KSH, 2019 NFSZ data

The tables above show the population of the areas surveyed. The tables show that, in addition to the territorial extent, the population varies between large endpoints for each municipality, from the main Danube basin, which covers municipalities with very small populations (e.g. Lórév, 291 inhabitants), to cities with more than 40,000 inhabitants (e.g. Dunaújváros), not to mention Budapest districts with more than 100,000 inhabitants. In these cases, of course, a fraction of the population may be affected (they cover an area much larger than the 500 m limit), but in the analysis of the demographic baseline we are looking at the settlement level. Since the turn of the millennium, the population of most of the municipalities has declined (44 have shrunk, 27 have grown and only 3 of the metropolitan districts have seen an increase). The main reasons for this change are, as is the case for the country as a whole, an ageing population and natural decline, i.e. deaths outnumber births. Only 9 municipalities have a positive balance in this respect. In some cases, this process is offset by the difference in inward migration (especially in municipalities close to the capital), so that as a result of these two processes, 34 municipalities saw their population decrease in 2018, while 37 saw an increase.

Based on the ageing index (which shows the number of people aged over 65 for every 100 people aged 0-14), the national average in 2019 was 132.9. In terms of counties, Tolna, Bács-Kiskun and Baranya counties have an index that is worse than the national average (Tolna county has a value of more than 150), while the counties further north have a more favourable index. There is a high fluctuation between municipalities, with values below 100 in the metropolitan agglomeration (e.g. Halásztelek, Szigetszentmiklós, Kismaros), but there are also several municipalities with values above 200 (e.g. Bár, Homorúd, Uszód, Ordas, Harta, Felsőszentiván, Dunafalva).

Due to the large number of settlements, the proportion of dwellings connected to the drinking water and sewerage networks also fluctuates strongly. The lowest values for the drinking water network are not far below 80% (Dömös, Kulcs), but the most typical values are above 90%. The connection rate to the sewerage network is lower, with some settlements where the connection rate is less than 50% (Báta) or not much higher (Iváncsa, Pócsmegyer), but there are also many settlements with values around 90% or above (e.g. larger cities such as Paks or Dunaújváros).

12.2. ECONOMY

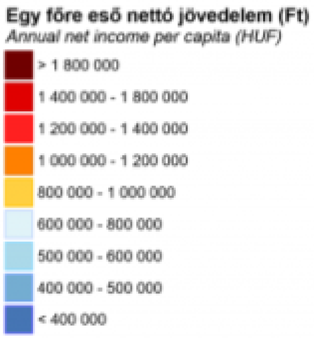
From an economic point of view, the area under study has very different characteristics. The northern region is characterised by the economic weight of the capital and its agglomeration and its rich human resources, with the Danube as an important element of tourism. South of the capital to Dunaföldvár, the Danube is dominated by its natural resource potential, and this part and Paks (which also represents a significant economic force, as will be seen in the gross per capita income) make the Danube significant primarily because of its economic exploitation from an industrial point of view. Here, Dunaújváros has a prominent role as an industrial town established under socialism. The southernmost section is no longer among the most economically developed, and it is here that the Danube is in its most natural state, which can contribute to strengthening the economy through its tourism potential.

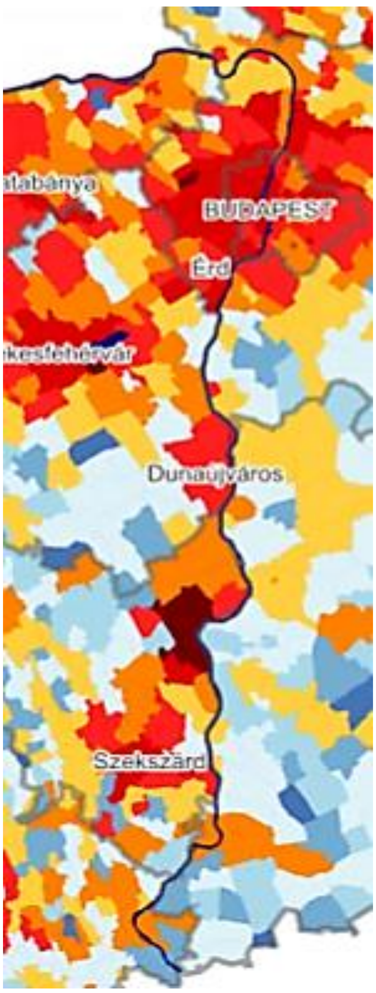
According to the 2018 data of the Hungarian Central Statistical Office (KSH), Fejér County is the county with the highest per capita gross domestic product (not counting Komárom-Esztergom, which has 2 settlements) after Budapest (3rd after Győr-Moson-Sopron), followed by Bács-Kiskun County (6th), Pest County (7th), Tolna County (9th) and Baranya County (15th). In terms of the percentage of the national average, Budapest is twice as high as the national average and Fejér county is above it (102%), but the other counties concerned are not, with Baranya county not even reaching 70% of the national average.

In 2017, slightly less than 40% of registered businesses were operating in the surveyed municipalities. The largest number of active enterprises was registered in Érd (5860), followed by Dunakeszi (4066), Szigetszentmiklós (3163) and Dunaújváros (3020). Homorúd (14.42%), Dunaegyháza (16.42%) and Géderlak (16.94%) have the lowest proportion of active enterprises, with the highest rates around 55%. On average, 95% of the enterprises in operation fall into the 1-9 persons category, with 46 of the 46 enterprises employing more than 250 persons in the surveyed municipalities (excluding Budapest), of which 21 employ more than 500 persons. These include Baja, Dunakeszi, Dunaújváros, Göd, Harta, Kalocsa, Mohács, Paks, Rácalmás, Százhalombatta, Szigetszentmiklós, Vác. Overall, most enterprises are in the sectors of trade, repair of motor vehicles and motorcycles and professional, scientific and technical activities, to which the statistics for Veszprém make a major contribution. If we exclude the listed municipalities with more than 3 000 enterprises, these two branches still employ the largest number of enterprises, with a higher proportion in construction, mining and quarrying, and manufacturing.

The relative unemployment rate in ***tables*** 52 ***and 53*** shows registered jobseekers as a percentage of the working age population. The national average was 3.66 in 2019, Budapest's indicator was 1.31, Pest county 2.11, Fejér county 2.76, Bács-Kiskun county 3.48, Tolna county 3.94 and Baranya county, which is also the worst performer in this respect, 5.3. Looking at the other municipalities, there are some where the indicator is even better than the capital (Pócsmegyer:0.9), but all the way up to 7.03 (Kölked), generally higher values are found as one moves southwards, but there are exceptions.

34. Figure 1:Municipal purchasing power, 2015





The graph on the left shows the net per capita income of the municipalities concerned. The figure shows that Paks has the highest income, but high values are found in and around the capital and in and around larger cities such as Dunaújváros. There are no settlements in the lowest earnings band, but in the 400-500 thousand HUF band we find them close to the national border, with Kölked, Homorúd, Dunafalva and Szeremle falling into this category.

Source : http://www.geoindex.hu/adatbazisok/telepulesi-vasarloero/

The provisions of the Government Decree 105/2015 (IV. 23.) No settlement from Komárom-Esztergom, Pest County and Fejér County, Báta from Tolna County, Homorúd and Kölked from Baranya County were affected, From Bács-Kiskun County, the municipalities of Bátya, Dunafalva, Dunaszentbenedek, Géderlak, Ordas, Sükösd, Szeremle, Tass and Uszód are either socio-economically and infrastructurally advantaged or have significant unemployment.

12.3. TOURISM, RECREATION

The riverside is a destination for recreation, of recreational-touristic importance. Along the banks of the Danube, there are alternating areas offering various recreational opportunities linked to the river (either water-related or linked to elements of the cultural heritage along the banks, for example) and those most used as industrial areas. However, tourism can offer alternative livelihoods in all types of settlements along the Danube, and it is therefore worth examining the development of tourism in the settlements concerned.

The following table shows the evolution of aggregated tourist flows in the relevant municipalities.

54. Table 1:Water-related tourism characteristics of the study section

Indicator	2010	2014	2018	2018/2014	2018/2010
Number of guests in commercial accommodation, persons	1 728 085	2 219 489	2 660 434	119,9%	154,0%
Number of nights spent in commercial accommodation, pcs	4 119 313	5 142 928	6 145 377	119,5%	149,2%
Number of guests in other accommodation, persons	30 192	103 077	341 934	331,7%	1132,5%
Number of nights spent in other accommodation, number	120 548	317 069	1 267 375	399,7%	1051,3%
Total number of guests in the area, persons	1 758 277	2 322 566	3 002 368	129,3%	170,8%
Total number of nights spent in the area, in units	4 239 861	5 459 997	7 412 752	135,8%	174,8%
Number of guest nights per person, number of nights	2,41	2,35	2,47	105,0%	102,4%
Average daily expenditure Ft/person	11 045	14 187	16 218	114,3%	146,8%
Revenue from tourism at current prices, HUF million	46 829	77 461	120 222	155,2%	256,7%

Source: KSH information database

The table shows that the tourist traffic of the municipalities located on the Danube river basin or in the immediate vicinity of the Danube bank has increased significantly in recent years. Tourism revenue is the sum of accommodation fees and other tourist expenditure, and although the number of overnight stays has increased, it is clear that tourism revenue has increased at a higher rate. Of the area under review, the largest increase was in other accommodation on the Szob-Budapest section, which, based on a detailed analysis of the data by municipality, can clearly be attributed to the increased tourist flows in the affected districts of Budapest. In examining the indicators, it should be added that the majority of the increase is due to the values of the capital, with 98% of the HUF 120 222 million generated by tourism being realised on the section between Budapest and Danube Vltava. The majority of the municipalities on the section between Dunaföldvár and the southern border have a value of 0. Typically, only the larger towns (Baja, Mohács, Kalocsa, Paks) have a representative value, with exceptions for smaller towns (e.g. Fadd, Kölked, Báta, Dunapataj).

In line with these indicators, the role of the capital in the area in terms of tourism should also be highlighted in relation to nautical tourism. Budapest is also one of the most popular destinations in the world for the entire hotel cruise industry, and as a result both the capital and domestic service providers generate significant revenues from serving ships and their passengers.

According to the National Tourism Development Strategy 2030, the Danube Bend is a priority tourism development area. The area has a significant cultural offer, built heritage (Esztergom, Visegrád, Szentendre, Vác, their charming streets and promenades along the Danube), and the Pilis, Börzsöny and the Danube itself allow active tourism. According to the NTS 2030, the cruise will be a unique tourist experience due to the natural scenery it will reveal, and the shorter accessibility will allow the Danube and the neighbouring settlements to be included in the destination's range of experiences. [27]

In addition to Budapest and the Danube Bend, areas of outstanding landscape value in terms of development policy, including zones with recreational functions, are [28]also a major attraction. In addition to the Danube Bend mentioned above, the study area is also affected by the Gemenc-Sárköz and, to a lesser extent, the Bugac-Kiskunság areas.

There is a yacht harbour in Sződliget, and regular excursion boats depart from the capital to Visegrád, Százhalombatta, Solt-Révbérpuszta and Kalocsa. Scheduled wing boats operate on the Budapest - Vác - Nagymaros - Esztergom and Budapest - Visegrád lines.

As part of public recreation, the domestic stretch of the Danube and its tributaries are a popular destination for anglers and water hikers, and can be used for a variety of sports, such as kayaking, canoeing, rowing, boating or motorised water sports. According to the website viziturapont.hu, created by the Hungarian Kayak-Kayak-Kenu Association, the following settlements are located on the section between Szob and the border of Hungary:Fadd-Dombori, Dunaújváros, Bölcske, Dömös, Kalocsa, Baja. In addition, the following stops are located in the study area between the Danube Bend and Budapest and its surrounding area. [29]Recreational opportunities are also enhanced by the regionally important cycle path along the right bank of the Danube (Dunaújváros - Paks - Gerjen - Bogyiszló - Keselyűs - Pörböly - Báta - Dunaszekcső), which runs along the solid flood protection embankment of the Danube in the area. [30]

Fishing is the most popular recreational sport in Hungary, and the National Fishing Register (OHA) registers 22 fishing waters covering the Hungarian stretch of the Danube, with a total of seven county fishing associations exercising the right to fish. Of these, the waters of the Pest County, Fejér County, Tolna County, Bács-Kiskun County and Baranya County Associations of Anglers' Associations are covered by the area under examination.

A special form of recreation is also important in the preservation of human health, and the spa resorts and health spas along the Danube provide the opportunity for this. The vast majority of these are water-related factors, such as thermal waters, mineral waters, spas, thermal mud and, in most cases, spa hotels. The potential for the use of most of these medicinal factors can therefore be influenced by the quantity and quality of groundwater.

55.Health factors , health resorts along the Danube section studied

Title	County	Municipality	Apply at
Thermal water	Baranya	Mohács	Saint John of Nepomuk
Thermal water	Fejér	Rácalmás	No I
Thermal water	Pest	Budapest I. district.	Rudas Hungária II.
Thermal water	Pest	Budapest I. district.	Juventus
Thermal water	Pest	Budapest I. district.	Attila Rudas II.
Thermal water	Pest	Budapest I. district.	Rad Big Spring
Thermal water	Pest	Budapest II. district.	The Source of Mercy
Thermal water	Pest	Budapest II. district.	Luke IV.
Thermal water	Pest	Budapest XI. district.	János Hunyadi 29.

27 National Tourism Development Strategy 2030
28 OFTK 2030 Chapter 3.1.6.2.
29 http://viziturapont.hu/duna
30 http://www.decs.hu/files/Decs-Terueletfejlesztesi-Koncepcio.pdf

Title	County	Municipality	Apply at
Thermal water	Pest	Budapest XI. district.	Ferencz József 2.
Thermal water	Pest	Budapest XI. district.	Gt. 1.
Thermal water	Pest	Budapest XI. district.	Gt. Well III
Thermal water	Pest	Budapest XI. district.	No I
Thermal water	Pest	Budapest XI. district.	János Hunyadi 27.
Thermal water	Pest	Budapest XI. district.	GT-VI
Thermal water	Pest	Budapest XI. district.	Ferencz József 3.
Thermal water	Pest	Budapest XI. district.	János Hunyadi 34.
Thermal water	Pest	Budapest XIII. district.	Margaret Island II.
Thermal water	Pest	Budapest XIII. district.	District XIII.
Thermal water	Pest	Budapest XX. district.	Pesterzsébeti
Thermal water	Pest	Budapest XX. district.	Salt-Iodine/B
Thermal water	Pest	Érd	Attila Fountain
Thermal water	Pest	Göd	Beach I. Well
Thermal water	Pest	Girls' village	B-4
Thermal water	Pest	Ráckeve	Beach bath Hévízkút
Thermal water	Pest	Visegrad	K-7
Thermal water	Tolna	Dunaföldvár	Beach I.
Thermal water	Tolna	Paks	I. Well
Thermal water	Tolna	Paks	No 2
Natural mineral water	Baranya	Mohács	K-232/A
Natural mineral water	Bács-Kiskun	Charter	B-84
Natural mineral water	Bács-Kiskun	Charter	K-83
Natural mineral water	Bács-Kiskun	Szeremle	B-22
Natural mineral water	Fejér	Key	K-1
Natural mineral water	Fejér	Rácalmás	K-35
Natural mineral water	Pest	Budapest II. district.	B-8
Natural mineral water	Pest	Budapest II. district.	B-60
Natural mineral water	Pest	Budapest III. district.	B-5
Natural mineral water	Pest	Budapest III. district.	B-47
Natural mineral water	Pest	Budapest III. district.	B-6
Natural mineral water	Pest	Budapest III. district.	B-3
Natural mineral water	Pest	Budapest IX.	B-43

Title	County	Municipality	Apply at
		district.	
Natural mineral water	Pest	Budapest XI. district.	B-49
Natural mineral water	Pest	Budapest XIII. district.	B-14
Natural mineral water	Pest	Budapest XIII. district.	B-18
Natural mineral water	Pest	Budapest XIII. district.	B-47
Natural mineral water	Pest	Budapest XX. district.	B-137
Natural mineral water	Pest	Budapest XXI. district.	B-19
Natural mineral water	Pest	Dunaharaszti	K-59
Natural mineral water	Pest	Érd	B-61
Natural mineral water	Pest	Érd	B-96
Natural mineral water	Pest	Göd	K-8
Natural mineral water	Pest	Halaszztelek	K-13
Natural mineral water	Pest	Ráckeve	K-77
Natural mineral water	Pest	Szigethalom	K-21
Natural mineral water	Pest	Visegrad	K-7
Spa	Pest	Budapest I. district.	Rácz Spa
Spa	Pest	Budapest I. district.	Rudas Spa and Swimming Pool
Spa	Pest	Budapest II. district.	King Spa
Spa	Pest	Budapest II. district.	St Luke's Spa and Swimming Pool
Spa	Pest	Budapest IV. district.	Újpest Spa and Swimming Pool
Spa	Pest	Budapest IX. district.	Dandar Spa
Spa	Pest	Budapest XI. district.	Gellért Spa
Spa	Pest	Budapest XIII. district.	Palatinus spa, beach and wave bath
Spa	Pest	Budapest XIII. district.	Dagály Spa, Srand Bath and Swimming Pool
Spa	Pest	Budapest XIV. district.	Medicatus Spa and Rehabilitation Kp.
Spa	Pest	Budapest XIV. district.	Paskál Spa and Beach Bath
Spa	Pest	Budapest XX. district.	Pestszenterzsébet Iodos-Salt Spa and Beach Bath
Spa	Pest	Érd	Thermal Hotel Liget Spa and Hotel
Spa	Pest	Visegrad	Thermal Hotel Visegrad Hotel and Spa
Spa	Pest	Visegrad	Visegrad Rehabilitation Hospital and Spa
Spa	Pest	Visegrad	St. Kozma and Demján Rehabilitation Hospital and Spa
Spa	Tolna	Dunaföldvár	Dunaföldvár Spa
Spa	Tolna	Paks	Paks Medical Centre Musculoskeletal Department Spa

Title	County	Municipality	Apply at
Spa hotel	Pest	Budapest XIII. district.	Thermal Hotel Helia
Spa hotel	Pest	Budapest XIII. district.	Ramada Plaza Budapest
Spa cave	Pest	Budapest II. district.	Szemlőhegy Cave "Giant Corridor"

Sources used in chapter 12:

- KSH information database
- KSH, NFSZ database
- http://www.geoindex.hu/adatbazisok/telepulesi-vasarloero/
- National Development 2030 - National Development and Spatial Development Concept
- Government Decree 105/2015 (IV. 23.) on the classification of beneficiary settlements and the criteria for classification
- National Tourism Development Strategy 2030
- http://viziturapont.hu/duna
- National Fishery Data Repository
- http://www.kormanyhivatal.hu/hu/budapest/jarasok/orszagos-nyilvantartas-gyogytenyezokrol

13. ECOSYSTEM SERVICES

Ecosystem services (ES) are the goods and services of the living world that are vital to sustaining human well-being and form the pillars of society and the economy. The [31]. The assessment of ecosystem services has been steadily expanding since the 1990s, primarily to provide decision-makers with adequate information on the complex system, value and importance of the goods and services provided by nature[32]. The assessment of ecosystem services also plays a very important role in the European Union, where various relevant policies (Common Agricultural Policy, EU Biodiversity Strategy 2020) indicate the need to assess and take into account them[33].

In the environmental assessment, three basic types of services are considered, based on the EU classification system CICES[34]: *provisioning* services (e.g. food, water supply, wood and fibre), *regulating* services (e.g. climate regulation, flood protection, soil formation) and *cultural* services. The ecosystem services related to the Danube, their group and type are shown in ***Table 55***.

56. Table 1: Danube-related ecosystem services and their type and group according to CICES

Type	GSC group	Danube-related ESC
Supplier	Feedstock, biomass	May be consumed naturally occurring or farmed animals, other raw materials of animal or plant origin, starting materials for medicinal products
	Raw materials, wood and pulp	Fibres other raw material of animal and vegetable origin (e.g. harvested wood, reeds)
	Water supply	Surface water and groundwater for drinking and non-drinking water uses (e.g. agricultural, industrial, energy, storage)
Regulator	Pollution control	Bioremediation and filtering of ecosystems and micro-organisms, algae, plants, animals, mitigation of accumulation, noise, odour and visual pollution
	Material flow and control	Erosion reduction, sediment retention
		Water system regulation
		Flood protection, storm protection
	Maintenance and regulation of biological, chemical and physical interactions	Conservation of habitats and genetic resources
		Pest control
		Soil formation and composition
	Climate control	Reducing greenhouse gases
		Regional and microclimate regulation

31 European Commission - Ecosystem goods and services. https://ec.europa.eu/environment/pubs/pdf/factsheets/Eco-systems%20goods%20and%20Services/Ecosystem_HU.pdf

32 Chaudhary, S., McGregor, A., Houston, D. and Chettri, N. 2015. The evolution of ecosystem services: a time series and discourse-centered analysis. Environmental Science and Policy 54, 25-34. DOI: http://dx.doi.org/10.1016/j.envsci.2015.04.025

33 Schleyer, C., Görg, C., Hauck, J and Winkler, K. J. 2015. Opportunities and challenges for mainstreaming the ecosystem services concept in the multi-level policy-making within the EU. Ecosystem Services 16 (2015) 174-181. DOI: http://dx.doi.org/10.1016/j.ecoser.2015.10.014

34 CICES - Common International Classification of Ecosystem Services. European Environment Agency. https://cices.eu/resources/

Cultural	Intellectual or direct interactions with the ecosystem	Tourism
		Fishing
		Research (e.g. biological, chemical)
		Education
		Cultural heritage
		Recreation
		Aesthetics, identity

13.1. SUPPLIER SERVICES

As in the upper reaches, the Danube's supply services are vital for the *provision of water in the* region. As we have seen in the previous chapters, it can be assumed that the quantity and quality of this supply service will gradually deteriorate, above all due to the expected drying and water abstraction. Due to the industrial and highly populated nature of the section, water abstraction, interference with the morphology of the river basin, untreated sewage, inland water, industrial and agricultural pollution and waste disposal are the main pressures which also[35] pose a major threat to the ecosystem services which supply it.[36] In terms of water supply, the highly modified watercourses and the high abstraction rates have a particular impact on *water supply* and groundwater levels, while the river is fed by a [37]relatively large number of streams originating in the area . The Budapest section in particular is very different from the other sections, where the pressures on the water body are significantly increased (flood protection, ecological, chemical impacts, abstraction, etc.) [38].

In the area of nutrients, biomass and other raw materials for ecosystem services, according to the latest Habitats Directive Article 17 report[39], all our Natura 2000 designated wetlands are in "unfavourable" condition (including the Danube and its floodplain HUDI20034, HUDD20023 of the Tolna Danube Natura 2000 site, HUDD20032 of the Gemenc [40]site between Fáž and Dunaszekcső, and the wetlands in the Natura 2000 site HUDD20045[41] of the Béda-Karapancsa site further south, which are linked to the river section). The hardwood forests and floodplain swampland habitats 91FO and 6440 accompanying the Danube are also in "unfavourable" condition [42]. At the same time, the proportion of forested areas is relatively high, especially in the northern area, including the areas of the Danube-Ipoly National Park [43]. One of the main problems of the habitats in this river section is also related to water scarcity[44], which affects the ecosystem

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35 River Basin Management Plan Gerecse Sub-unit. 2015. https://www.vizugy.hu/vizstrategia/documents/A7CC7625-0E04-48C8-99FE-3E2442DFD0B9/VGT2_1-7%20Gerecse_vegleges.pdf

36 River Basin Management Plan Lower Danube Right Bank Planning Sub-unit. 2015. http://www.vizugy.hu/vizstrategia/documents/B876F16D-2376-4019-A263-512B6CB31B2E/VGT2_1_15_Also_Duna_vegleges.pdf

37 River Basin Management Plan Gerecse Sub-unit. 2015. https://www.vizugy.hu/vizstrategia/documents/A7CC7625-0E04-48C8-99FE-3E2442DFD0B9/VGT2_1-7%20Gerecse_vegleges.pdf

38 River Basin Management Plan Gerecse Sub-unit. 2015. https://www.vizugy.hu/vizstrategia/documents/A7CC7625-0E04-48C8-99FE-3E2442DFD0B9/VGT2_1-7%20Gerecse_vegleges.pdf

39 Habitats Directive Article 17 report for Hungary. 2019. https://www.eea.europa.eu/themes/biodiversity/state-of-nature-in-the-eu/article-17-national-summary-dashboards

40 EEA. Standard Data Form. Gemenc. 2019. http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20032

41 EEA. Standard Data Form. Béda-Karapancsa. ACCESSED 2019. http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20045

42 http://www.terport.hu/webfm_send/146

43 http://www.terport.hu/webfm_send/146

44 River Basin Management Plan Central Danube River Basin Sub-basin. 2015. http://www.vizugy.hu/vizstrategia/documents/7CFB3C02-0909-4350-919C-496C59EA92D9/VGT2_1_9_Kozep-Duna_vegleges.pdf

services of *nutrient and basic material supply.* Shrinking habitats and species numbers, subject to increasing extremes, can provide fewer nutrients and inputs. Therefore, for example, in the Tolna Danube Natura 2000 site (HUDD20023) between Dunaföldvár and Fajsz, the main priorities are the maintenance of groves and the restoration of hardwood groves and the reduction of scrub, which also shows that wetlands are continuously degraded by water level changes and flooding[45]. Gemenc (HUDD20032)[46], between Fagas and Dunaszekcsjö, and further south, the Béda-Karapancsa area (HUDD20045), [47]comprise the largest contiguous floodplain forests in the region, where water scarcity and flooding plants are also important challenges to natural habitats. Due to the remaining natural areas and floodplain forests, *the ecosystem services for nutrients, biomass and other inputs in* this river section are presumably in a better condition, but are increasingly threatened, mainly due to drought.

13.2. REGULATORY SERVICES

The river, which is heavily regulated in the region, is also undergoing hydromorphological changes: it slows down and deposits its sediments after Visegrad[48]. This has been exacerbated by the extreme rainfall patterns, continuous warming, drying and erosion also experienced in this area, resulting in negative trends in the *ecosystem services of mass flow and mass regulation.* Increased pressures, pollution in the river reaches and artificial conversion of habitats and their degradation due to water scarcity greatly reduce the *potential for*[49] *pollution control, maintenance and regulation of biological, chemical and physical components and climate regulation.* Here, too, river channelisation and the cutting of river bends have led to significant changes in the river bed, which, together with irrigation and drying, have caused further water level reductions[50]. The reduced water level has a negative impact on the regulating ecosystem services, which may be offset by the increased naturalness of the river and the more extensive floodplain forests and natural habitats that still exist.

13.3. CULTURAL SERVICES

In addition to *fishing, water sports* and other outdoor activities, this stretch also offers outdoor *swimming areas*. River tourism and other activities linked to the river and river banks (e.g. other sports and leisure activities) are even more important because of the capital city. The river is practically inseparable from Budapest and other river-based municipalities, so the Danube also plays an important *cultural and identity* role, and is an everyday part of the life of the capital and its municipalities. The riverbanks include *parks, cycle paths, playgrounds, sports facilities, thermal baths*, several islands in the Budapest section offering cultural and leisure activities, and many tourist attractions[51]. In many places, there is an increasing focus on ecotourism based on natural values (e.g. *kayaking, cycling, visits to protected areas*)[52]. Many of the region's

45 EEA. Standard Data Form. Tolnai Duna. 2019. http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20023

46 EEA. Standard Data Form. Gemenc. 2019. http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20032

47 EEA. Standard Data Form. Béda-Karapancsa. ACCESSED 2019. http://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20045

48 River Basin Management Plan Gerecse Sub-unit. 2015. https://www.vizugy.hu/vizstrategia/documents/A7CC7625-0E04-48C8-99FE-3E2442DFD0B9/VGT2_1-7%20Gerecse_vegleges.pdf

49 River Basin Management Plan Gerecse Sub-unit. 2015. https://www.vizugy.hu/vizstrategia/documents/A7CC7625-0E04-48C8-99FE-3E2442DFD0B9/VGT2_1-7%20Gerecse_vegleges.pdf

50 River Basin Management Plan Lower Danube Right Bank Planning Sub-unit. 2015. http://www.vizugy.hu/vizstrategia/documents/B876F16D-2376-4019-A263-512B6CB31B2E/VGT2_1_15_Also_Duna_vegleges.pdf

51 György Ifjú. 2010. The value of cultural and tourist services on the Danube. http://www.jno.hu/hu/duna101020/ifju_gyorgy.pdf

52 River Basin Management Plan Lower Danube Right Bank Planning Sub-unit. 2015. http://www.vizugy.hu/vizstrategia/documents/B876F16D-2376-4019-A263-512B6CB31B2E/VGT2_1_15_Also_Duna_vegleges.pdf

major settlements are built on the Danube, with nationally significant cultural events and folk customs directly or indirectly linked to the river (e.g. the fish soup festival in Baja, the busójárás in Mohács).

13.4. COMPLEXITY OF ECOSYSTEM SERVICES

It is important to note that ecosystem services vary not only in response to external factors, but also in relation to each other. Thus, it can be assumed that changes in one ecosystem service can affect another. For example, a decline in provisioning services such as nutrients and biomass can be assumed to influence some regulating services (e.g. declining habitat and genetic resources) that affect other services (e.g. declining habitat may result in reduced erosion or flood control, pest reduction, or cultural services). However, for example, the emergence and dominance of invasive species can maintain certain ecosystem services despite a presumed overall decline in quality (for example, the emergence of some invasive fish species may not in itself change nutrient quantity, despite an overall decline in quality). It is therefore important to consider and analyse not only the direct effects but also the interrelationships and interactions between ecosystem services and their quality indicators.

Sources used in chapter 13:

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- European Environment Agency. CICES - Common International Classification of EcosystemServices. https://cices.eu/resources/
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DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 6 OF THE ENVIRONMENTAL ASSESSMENT

Hybrid, Markov chain-based, daily water yield generating time series model application to the Danube

Budapest, September 2020

Application of a hybrid Markov chain-based daily flow generation time series model to the Danube

Prepared by József Szilágyi, BME Department of Water Engineering and Water Management

1. INTRODUCTION

Among the time series generation algorithms that work with daily data, the so-called classical autoregressive models (Quimpo, 1968; Payne et al., 1969; McGinnis and Sammons, 1970) are not able to reproduce the characteristic asymmetric shape of the tidal wave (Sharma et al., 1997) during data generation. To remedy this, so-called 'shot-noise' models, originally popular in the electrical engineering literature, began to be applied in hydrological practice in the 1970s (Bernier, 1970; Weis, 1973, 1977; Cowpertwait and O'Connell, 1992; Murrone et al., 1997). In hydrological practice, these models have been developed for daily streamflows in such a way that they are able to generate realistic-looking tidal waves for a given cross-section of the river (thus retaining the so-called local statistical characteristics of the tidal waves, e.g. centre of gravity, asymmetry) while retaining the long-term statistical characteristics of the original data series (mean, standard deviation, autocorrelation function values). Models that generate daily precipitation totals and convert them into daily runoff time series using conceptual models (Kelman, 1980; Koch, 1985; Bierkens and Puente, 1990) or transfer functions (Treiber and Plate, 1977; Kottegoda and Horder, 1980) serve a similar purpose. In many cases, however, the required precipitation data are missing or not representative for a given catchment, not to mention the fact that the generation of runoff-forming precipitation is always problematic, so the use of stochastic methods that do not require precipitation data is certainly advantageous.

The present procedure for generating the water yield time series (Szilágyi et al., 2006), which also takes into account seasonal variations, is composed of elements of shot-noise models, Markov chains and conceptual models describing the ebbing branch of tidal waves, eliminating the need to know the precipitation. The central element of the method is the conditional heteroskedasticity (Engle, 1982), originally used in the so-called ARCH models, which states that the noise components of the time series are not independent of the time series values and are not uniformly distributed in time.

2. DESCRIPTION AND APPLICATION OF THE HYBRID MODEL

a) Markov state-transition probabilities

The model requires daily water yield values as input, from which it calculates the daily changes as the difference between consecutive daily values. The daily change values form a two-state Markov chain for constant flows. The first state occurs when the change is positive, called the 'wet' state, as opposed to the 'dry' state when the difference is negative. Due to rounding in the measurements, two consecutive equal values may occur on the ebb branch of the tidal wave, these zero level changes are classified as the dry state. The two states induce a total of four state transitions: wet-wet (*ww*), *wet-dry* (*wd)*, dry-wet (*dw*) and dry-dry (*dd*). The state transition probabilities (*P*) can be estimated from the measured time series within a given season as follows

$$P_{ij} = \frac{n_{ij}}{\sum_j n_{ij}}, \quad i, j = w, d \qquad (1)$$

where *nij* is the number of transitions from state *i to* state *j*. The state transition probabilities tend to vary seasonally, e.g. on the Danube, the spring-early summer tidal surge has a higher probability of subsiding than the autumn one. Xu et al. (2001, 2003) have assigned months to seasons, but this gives very similar state-transition probability values for adjacent months (thus raising questions about whether small differences are statistically significant or not), and also unduly increases the number of parameters to be estimated. In our opinion, the choice of four seasons per year is sufficient for most modelling problems.

In this work, the model was applied to 11 sections of the Danube (Table 2).

The estimated state-transition probability matrix for Budapest is presented in Table 1. It can be seen that the probability of flooding (*Pww* value) on the Danube is highest in spring (March, April, May).

Table 1.

Danube (Budapest) 1976-01-01—2017-12-31	Pdd	Pdw (= 1 - Pdd)	Pwd	Pww (= 1 - Pwd)
Winter	0,83	0,17	0,3	0,7
Spring	0,79	0,21	0,28	0,72
Summer	0,81	0,19	0,34	0,66
Autumn	0,81	0,19	0,34	0,66

b) Modelling of the flooding branch of tidal waves

To describe daily positive changes, Sargent (1979) and Aksoy (2003) proposed a two-parameter gamma distribution. However, for the present modelling purpose, the Weibull distribution was found to be more appropriate. A similar conclusion was reached by Stagge and Moglen (2013) in their stochastic modelling of the US Potomac River discharge. In Monte Carlo simulations of daily positive changes (*dQgen*), values are generated using seasonally fitted Weibull distributions. The resulting values are perturbed by an additive normal distribution noise factor [$N(m, s)$, m expected value, s standard deviation]. The actual value of the noise component, however, depends on the magnitude of the value to be perturbed in the prescribed standard deviation, i.e.

$N(m, s) = N(0, a \cdot dQgenb)$ (2)

where a and b are seasonally varying parameters to be calibrated. Generated N values that are negative and greater in absolute value than the value of *dQgen* to be perturbed are replaced by zero. The result is an asymmetric noise distribution with a positive expected value. The resulting generated daily positive water yield change values more closely approximate the distribution of observed values than the non-perturbed values obtained from the fitted Weibull distribution.

Once the positive daily yield change values are produced for a simulated wet period, the values are put in ascending order (Aksoy, 2003) to recover the characteristic of the rising branch of the tidal wave that the slope typically increases until the peak. This is true for smaller rivers only with daily sampling (e.g. upper reaches of the Tisza), on the Danube there is a distinct spillover of the surge branch the day or days before the peak (the latter for large surges). Thus, the largest generated daily increase in discharge before the peak is followed by the smallest in a chronological order, as a kind of posterior correction. The result is a tidal branch of the tidal waves that preserves the typical shape and autocorrelation of the measured tidal branches.

c) Modelling of the downstream branch of tidal waves

The ebbing branch of a flood wave is typically the result of a nonlinear process (Aksoy et al., 2001), as the pooling plays a crucial role at the beginning of the ebb, gradually giving way to groundwater recharge, which is usually a nonlinear process (Brutsaert and Nieber, 1977; Szilágyi, 1999, 2004). Often, a nonlinear reservoir approach is used in the literature to describe the ebbing branch (Q) of the tidal flow (e.g., Kavvas and Delleur, 1984), i.e., $Q = kSn$, where S is the volume of water stored in the bed, k is the reservoir coefficient, and n *is* a time-varying (t) exponent. It is simpler, however, not to vary the exponent with time, but to vary the value of the reservoir coefficient by choosing $n = 1$. In this case, the recursive relation $Q(t) = c(t)Q(t\text{-}1)$ can be written for the daily fading values. The following definition of $c(t)$ allows its value to increase logarithmically with the progress of the depletion up to a value close to unity, provided that the value of *kmin is* chosen to be sufficiently small (Szilágyi et al., 2006)

$$c(t) = 1 - k_{min} - \frac{k_{max} - k_{min}}{\ln\left(\frac{Q_{max}}{Q_{min}}\right)} \ln\left(\frac{Q(t-1)}{Q_{min}}\right) \qquad (3)$$

where *Qmax* and *Qmin* are the required values slightly higher and lower than the observed flow rates, respectively, and *kmax* and *kmin* are the parameters to be calibrated. Thus, when $Q(t\text{-}1)$ = *Qmax*, then c = 1kmax; similarly, when $Q(t\text{-}1)$ = *Qmin*, then $c = 1 - kmin$. Equation 3 provides the nonlinear property of aperture (Kavvas and Delleur, 1984).

The simple description of the evaporation above cannot take into account the interannual variability of groundwater storage, because in wet years the amount of water stored in the soil prevents very low flows in the riverbed, so it is necessary to include a stochastic groundwater component in the model. This can be expressed as $Qgw(t) = (1 - kmin)Qgw(t\text{-}1)$, where *Qgw* is the lateral soil water supply to the bed, which is a separate additive term in the section discharge values in addition to the discharge (Q). The initial value of *Qgw* (t = 0) at the transition from wet to dry is obtained as $Qgw(0) = |N[g \cdot Qgen, h \cdot Qgen]|$, where *g* and *h are* two additional parameters to be calibrated and *Qgen* is the actual daily (soil water independent) generated discharge.

The number of parameters to be calibrated for the model used is 12: four pairs of seasonally variable values *a* and *b*, *g*, *h*, *kmax* and *kmin*.

3. PRESENTATION OF RESULTS

A daily flow rate of 100 times the length of the available time series was generated for each section separately. Each season is defined as 91 days, so that each year is 364 days long. The values generated start with the winter season. The length of the generated time series allows for the occurrence of rare events that have not been observed in the past due to the limited length of the detection period. Figure 1 shows a 1000-day slice of the measured and generated Budapest streamflow series for visual comparison.

Figure 1.

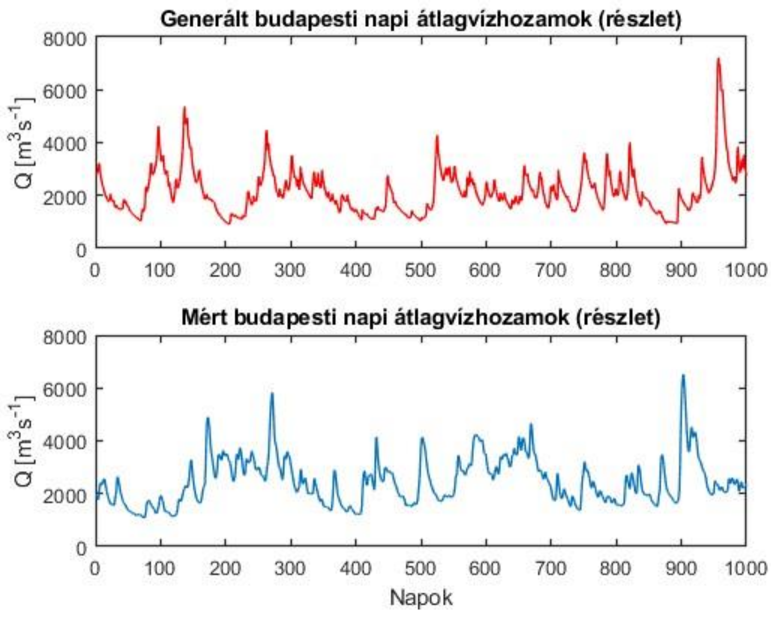


Figure 2 shows the empirical distribution functions calculated from measured and generated data for the Budapest Danube section.

Figure 2.

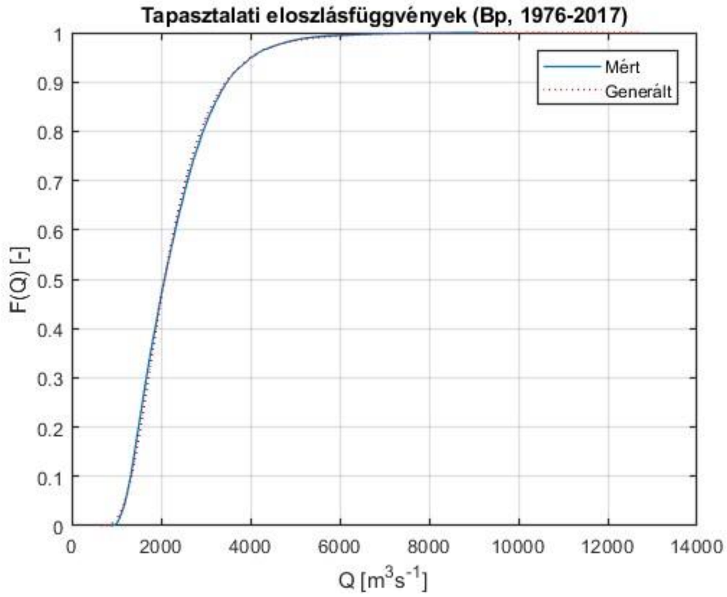


Figure 3 shows the empirical density functions.

Figure 3.

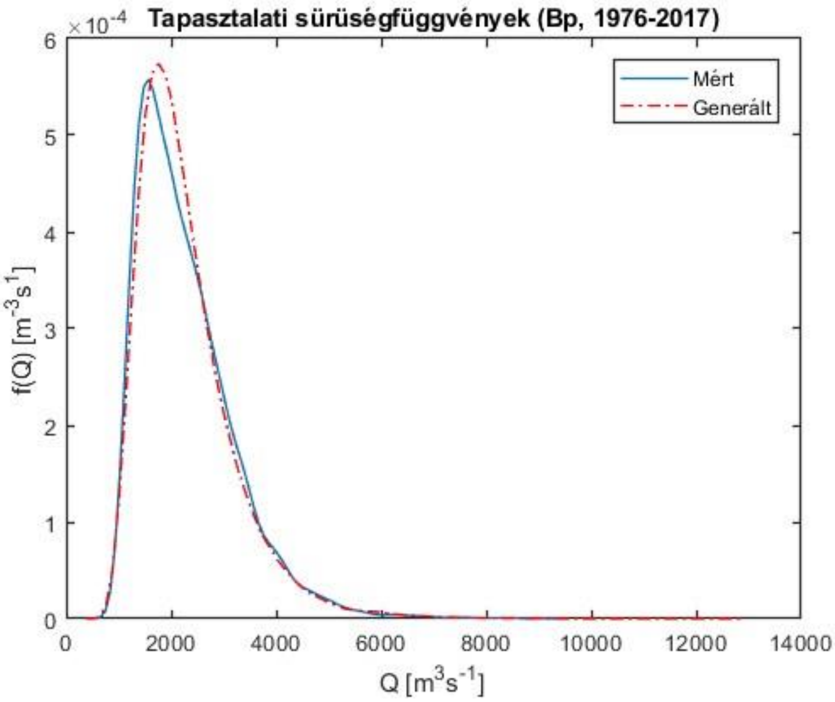
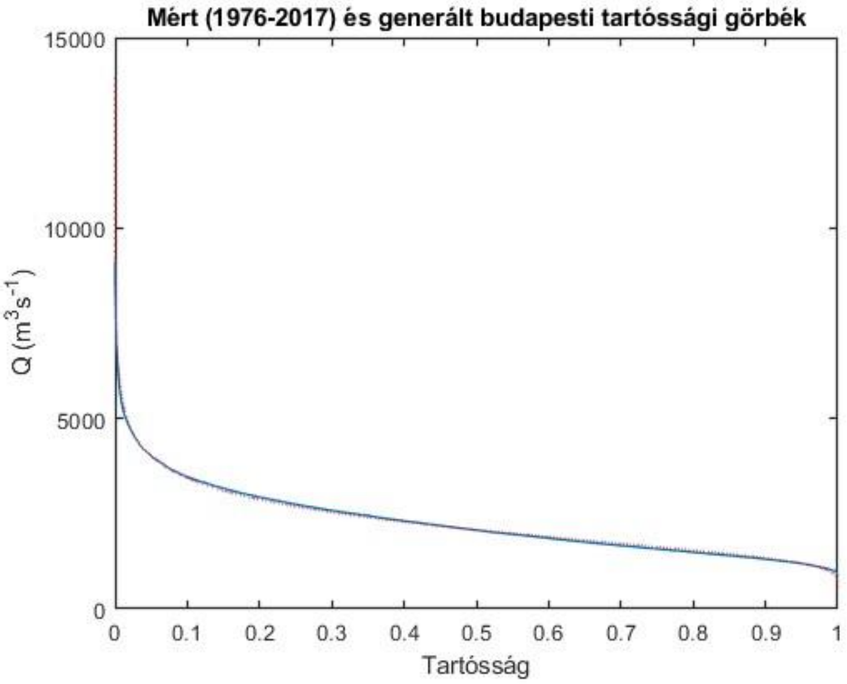


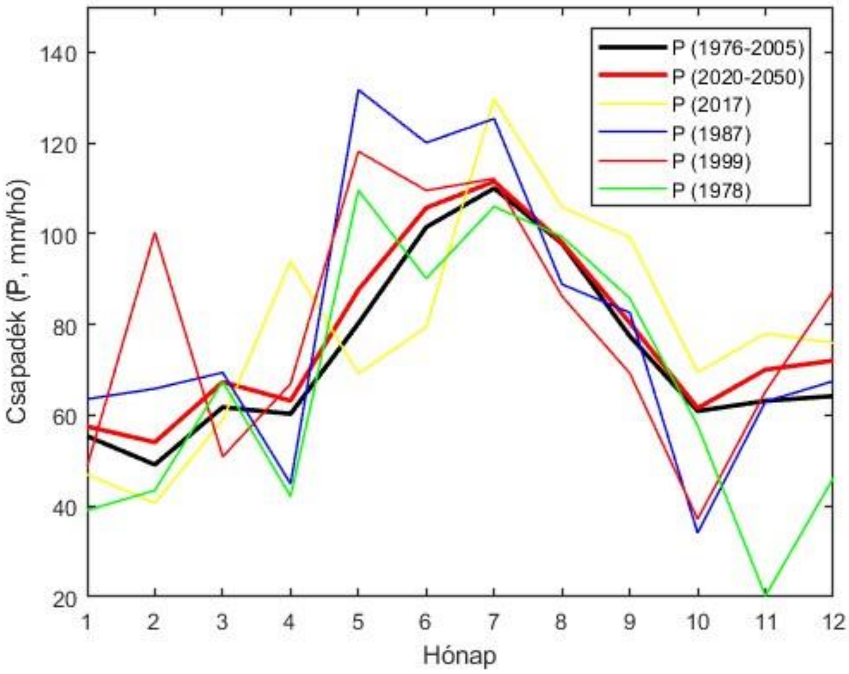
Figure 4 illustrates the durability curves of the measured and generated daily discharge values.

Figure 4.



The water yield values derived from the measured water yields with 94% durability for the 11 Danube gauging stations included in the study are presented in Table 2. To assess the impact of climate change on water yields, the National Meteorological Service (NMS) provided the percentage changes in monthly precipitation values calculated for the Danube catchment above Vámosszabadi (Nagybajcsi section) in the past (1976-2018) and in the future (2020-2050) compared to the 1976-2005 baseline period (Figure 5), when the impact of anthropogenic CO_2 emissions is assumed to be negligible.

Figure 5.



As can be seen, the average precipitation expected in the future in the upper Danube basin increases every month, in contrast to the precipitation scenarios expected in Hungary, which predict summer drought and winter precipitation increases (Pongrácz et al., 2014). It is true, however, that in the upper catchment, the summer (July, August) increase is the smallest (1.4 and 0.2 mm), with 1 mm in October, and the winter (November, December) increase is the largest (10.9 and 12.1 mm). The baseline period was then extended to the 1976-2018 time interval, which was necessary to increase the chances of finding years in the observation period when precipitation patterns most closely resemble those representative of the future. According to the least squares principle, the four years (the number of years was maximised at 10% of the extended period, as there is no sharp limit to which years can still be considered and which can no longer) when the annual pattern of monthly precipitation was closest to the climate scenario were 2017, 1987, 1999 and 1978 (in that order, Figure 5). Since the time series of the different stations have different lengths, the years and number of years of the precipitation analogy (10% of the period, but at least 3 years) may also be different for stations that only partially cover the 1976-2018 period (detailed in Table 2).

The hydrological analogy assumes that the Danube will produce flows under future changes in precipitation conditions similar to those in the past in years when the annual distribution of precipitation was similar to that expected in the future. Since a perfect coincidence between past and future monthly precipitation is not expected for each month, we extend the model behaviour by using a new Monte Carlo simulation for a period of 500 times as long as the past year (instead of the year of analogy). The only difference between the simulations that take into account the changed and the observed past climate is in the values of the state transitions due to the changed precipitation pattern (and the associated runoff), since the changes in the physical parameters of the accumulation and surge transformations are not known, but are unlikely to change significantly overall (i.e. local changes cancel each other out at the regional scale) in a large catchment such as the Danube above Vámosszabadi (Nagybajcs).

As shown in Table 2, small water yields with 94% persistence have decreased by 5% on average. The smallest modelled change (-1%) is found at Vámosfrei, while the largest (7%) is found at Mohács. With increasing precipitation (Figure 5), this is only possible if the distribution of precipitation (and hence of flows) within the year becomes more uneven, i.e. fewer precipitation events generate more precipitation per year and hence the Danube water regime becomes more extreme. This is demonstrated by the change in the probability of days with ebbing flows in Budapest from [63; 56; 64; 64] % seasonal (winter, spring, summer, autumn) to [62; 58; 65; 64] %, i.e. the expected probability of days with ebbing flows increases in spring and summer and decreases in winter, in line with Pongrácz et al. (2014).

Table 2. Observed (Q94measured), generated (Q94gen) and analogue (Q94est) Danube discharge values (m^3/s) for the period 2020-2050 with 94% persistence. The actual year of the analogy is indicated in brackets where the year of the analogy differs from the year indicated in the first row due to the limitations of the available measured time series. The root mean square differences between the observed and OMSZ-projected future monthly precipitation values in the year of the analogy increase from left to right in the table as the year of the analogy increases. The relative change is for Q94 of the two generated (past and future) time series.

	Q94means (Q94gen)	Q94th Year of analogy: 2017	Q94th Year of analogy: 1987	Q94th Year of analogy: 1999	Q94th Year of analogy: 1978	The Q94est values mean and standard deviation	Relative change (%)
Vámosszabadi (1996-2018)	982 (992)	919 (2017)	1094 (1999)	927 (2008)		980 ± 99	-1
Komárom (1976-2018)	1030 (1036)	1065	925	1133	790	978 ± 152	-6
Dunaalmás (1976-2015)	1170 (1169)	1075 (1987)	1273 (1999)	915 (1978)	1134 (1994)	1100 ± 149	-6
Esztergom (2006-2018)	1190 (1155)	1145 (2017)	1051 (2008)	1215 (2012)		1137 ± 82	-2
Nagymaros (1976-2017)	1210 (1207)	1255	1120	1169	1017	1140 ± 99	-6
Budapest (1976-2017)	1230 (1228)	1256	1157	1226	1020	1165 ± 105	-5
Dunaújváros (1976-2018)	1200 (1240)	1315	1135	1278	964	1173 ± 159	-5
Dunaföldvár (1990-2018)	1155 (1161)	1168 (2017)	1154 (1999)	983 (1994)		1102 ± 103	-5
Dombori (1989-2018)	1240 (1233)	1245 (2017)	1290 (1999)	1055 (1994)		1197 ± 125	-3
Baja (1976-2018)	1290 (1300)	1413	1178	1301	1111	1251 ± 134	-4
Mohács (1990-2018)	1300 (1311)	1276 (2017)	1265 (1999)	1110 (1994)		1217 ± 93	-7

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DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 7 TO THE ENVIRONMENTAL ASSESSMENT

BACKGROUND

Documentation supporting compliance with the Water Framework Directive

Budapest, September 2020

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1 INTRODUCTION

1.1 SCOPE AND MAIN OBJECTIVES OF THE WATER FRAMEWORK DIRECTIVE

Directive 2000/60/EC of the European Parliament and of the Council establishing a framework for Community action in the field of water policy, known as the Water Framework Directive, entered into force in the EU Member States on 22 December 2000. It aimed to achieve "good status" of surface water and groundwater bodies by 2015. If natural or economic conditions do not allow for achieving good status by 2015, the deadline for compliance can be postponed to 2021 or 2027, respectively, with a duly justified justification for the exemptions offered by the WFD.

According to the Framework Directive, "good status" means not only water purity, but also the minimum disturbance to water-related habitats and the availability of sufficient water.

The general, main objectives of the CCI are (Article 1 CCI):

- preventing deterioration, protecting and improving aquatic and wetland habitats
- promoting sustainable water use by protecting exploitable water resources in the long term,
- improving water quality by reducing the discharge of pollutants, phasing out hazardous substances
- progressively reduce groundwater pollution and prevent further pollution,
- mitigate the negative impacts of floods and droughts.

Hungary has transposed the provisions of the WFD and related directives and regulations into the Hungarian water management and water protection legislation, resulting in the establishment of the Hungarian River Basin Management Plan by December 2009. The plan summarises the measures needed to achieve the objectives of the WFD and was revised in 2015.

In order to meet international and national requirements and to ensure effective public consultation, planning has been carried out at several levels in Hungary:

- at national level, the national river basin management plan (hereinafter referred to as the RBMP)
- at sub-basin level - Danube direct, Tisza, Drava, Lake Balaton (4 sub-basin plans),
- at planning sub-unit level (42 sub-unit plans in total)
- at the level of water bodies (889 watercourse sections, 189 standing water bodies and 185 groundwater bodies delineated according to the WFD).

The measures to be implemented are set out in 37 packages of measures, with a total of 159 specific measures.

According to the Annex 7-2 of the WFD, the document "Guidance for the analysis according to Article 4(7) of the WFD", this analysis must be prepared in accordance with Articles 10 and 11 of the Government Decree 221/2004 (21.VII.) on certain rules of river basin management, for all plans, programmes, investments and activities, before their implementation, which may be assumed to endanger the achievement of the objectives of the WFD. If the plan, development or activity is found to have a significant impact on surface water or groundwater on the basis of this simplified assessment, it falls within the scope of Article 4(7) of the WFD. In this case, the exemption procedure under Article 4.7 of the WFD shall apply.

In the present preliminary phase of the study, we will examine the following on the basis of the available data:

- Is the water body or protected area likely to be significantly affected, i.e. deteriorated, i.e. is it likely to require a CCI exemption assessment?
- Whether the interventions are consistent with or hinder the implementation of the measures

Analysis to be carried out:

- Impacts on water bodies and protected areas under the WFD (drinking water sources, etc.) should also be assessed.

- The need for an impact assessment should include an assessment of the scarcity of resources, their renewable capacity and the status of the water bodies concerned as determined by monitoring measurements.

1.2 ENVIRONMENTAL OBJECTIVES

The environmental objectives of the WFD are set out in Article 4 of the Directive. The key environmental objectives for surface water are:

- Achieve good ecological status of water bodies within 15 years.
- Achieve good potential and good chemical status of heavily modified and artificial water bodies within 15 years.
- Surface water degradation must be prevented.

Key environmental objectives for groundwater:

- Groundwater degradation must be prevented.
- Significant load trends must be reversed.
- The introduction of harmful substances into waters must be prevented or limited.
- Achieve good quantitative and qualitative status in 15 years.

The European Parliament and the Council, having regard to the objectives of groundwater protection, have provided for specific measures to limit and reduce water pollution, requiring the Commission to present proposals within two years of the entry into force of the Framework Directive.

Environmental objectives for protected areas:

Member States shall comply with all the standards and objectives relating to protected areas no later than 15 years after the entry into force of this Directive, unless otherwise provided for in the Community legislation under which each protected area has been designated.

It is clear from the general and environmental objectives of the WFD, as detailed above, that the central issue of the Directive is to achieve and ensure the long-term preservation of "good status" of surface waters and groundwaters, and to halt or avoid deterioration of bodies of water with excellent and reference status.

For surface waters, the ecological and chemical status of the water body is the relevant criterion for "good status", for groundwater bodies it is the quantitative and chemical status that counts and the worse of the two is the final overall assessment. Ecological status is determined by the quality of the structure and functioning of aquatic ecosystems. Good chemical status requires that pollutant concentrations do not exceed certain specified limit values (the environmental quality requirements set out in Annex IX and Article 16(7) of the WFD and other relevant Community legislation, and environmental quality requirements established at Community level). Quantitative status is compromised by over-exploitation and is only good if the long-term average annual abstraction is consistent with the recoverable groundwater resource. Good status must be achieved at both surface and groundwater body levels.

2 PRESENTATION OF THE PROGRAMME

2.1 SHORT DESCRIPTION OF THE PROGRAMME, OBJECTIVES, FRAMEWORK CONDITIONS

This is one of the expectations of the EU's 2011 Transport White Paper:

"By 2030, 30% of road freight transport over 300 km will have to be taken over by other modes of transport, such as rail or waterborne transport, and 50% by 2050, also thanks to efficient green freight corridors" - This is why the TEN-T waterway network, the Danube, needs to be upgraded to core network level in Hungary, too, within the framework of the Danube Waterway Development Programme (hereinafter: the Programme).

The objectives and framework conditions of the Programme:

- a multimodal corridor development (upgrading of the transport infrastructure) that integrates inland navigation with environmental and ecological objectives and takes into account other - socio-economic - functions of the waterway (including, but not limited to, aquifer protection, flood protection and watershed management);
- the least environmental and ecological burden should be sought, and the reasons why the chosen option is the most environmentally preferable should be demonstrated, and the cumulative impacts should be assessed;
- to ensure that the navigation parameters set by international and national standards are met on the entire Hungarian Danube section, in terms of increasing the depth and the time availability of the waterway. Where possible, the required minimum widths should be ensured, and where this is not possible due to some unavoidable obstacle, one-way sections should be introduced. The technical interventions included in the Programme are an acceptable minimum, but still ensure a ford-free fairway;
- it should be a fundamental consideration in the design that the planned solutions should not lead to further lowering of the river bed and low water level, and that the aim should be to prevent this;
- only river control works which do not cause significant local water level rise in the riverbed, have an effect only during periods of low flow and do not impair the conditions for the discharge of flood waters or adversely affect the movement of the rolled sediment may be used;
- from a domestic point of view, it is very important and the ultimate objective of the Programme is to ensure that the positive effects of congestion reduction and environmental improvement measures outweigh the environmental and natural damage caused by the intervention and traffic growth;
- the protection of existing and future aquifers should be considered as a hard and stringent constraint in planning;
- avoid solutions that would lead to less favourable conditions for tributaries than those currently prevailing, and give priority to the supply of water to tributaries and tributary systems without adversely reducing the water yield of the 2018 WFD, in accordance with ecological and environmental needs, after consultation with the parties concerned;
- be prepared for foreseeable future climate changes;
- ensure the active participation of society from the very beginning of the planning process.

In the first phase of the planning (February 2019 - January 2020), 4 possible design options were identified and studied for the section according to the following concept.

First, using conventional intervention works (version I), and then a comprehensive set of innovative interventions (version II), complementing conventional intervention works, the expected effects were investigated by hydrodynamic modelling. Following the evaluation of the modelling studies, an optimal control option was proposed (Option III), and finally, interventions to minimise dredging and the likely ecological damage were identified, using a 100 m restricted fairway width for some fords (III/A).

The variants developed during the design process are not independent of each other, but represent individual steps in a process of improvement, rationalisation and optimisation, and to a certain extent build on each other. Consequently, the designer proposes to continue with the III/A option for this section of the Danube during the authorisation phase.

2.2 PRESENTATION OF THE SELECTED VERSION

In the Danube section between Szob and the southern border (14033,000-1708,000 fkm), there are 35 obstacles to navigation in the navigation route included in the navigation route signposting plan for 2018-2019, the total length of the river section concerned is 275 km.

Taking into account the Danube Commission's recommendation, a fairway width of 120 m is planned between sections 1784,000-1641,000 fkm and 150 m below 1641,000 fkm, which may be reduced depending on the curve and morphological conditions to the minimum width required for safe one-way navigation (maximum permitted convoy width on the section), if the required fairway width cannot be provided for environmental, river regulation, water base protection or other reasons.

The minimum navigable water level in the plan is considered as the working water level and is referred to as MVSZ 2018, which is defined by the BME with a surface curve calibrated to a low water yield of 94% duration.

Due to the different regulatory conditions, the Danube section between Szob and the southern border should be examined in two parts:

- Szob Budapest Section between 1708-1641 fkm
- Budapest - southern border between 1641-1433 fkm

In this section, the first priority is to prevent further undesirable deepening of the river bed and to stabilise the river bed. To this end, it will be necessary to examine the need to reduce the transverse control works to the level of MVSZ 2018+0.5 m or MVSZ 2018+1.0 m, to reduce the longitudinal control works to the level of MVSZ 2018+1.0 m, to review the length of the control works, to construct new control works, to dredge as much as necessary and to examine the possibilities of sediment recharge and bank stabilisation.

The types of interventions planned in this section are:

Gas scooping

Dredging in the fairway is carried out in the gravel material to a depth of MVSZ 2018-2.7 m, and in the marly, rocky sections to MVSZ 2018-2.8 m. Dredging shall be carried out at the edge of the fairway with a 1:5 slope in gravel material, and with a 1:2 slope at the edge in marly, rocky sections.

Construction, completion of spurs from quarry stone

The **spurs and guide works are** stone works along the coast. The guide works will be constructed to a height of MVSZ 2018+1.0 m, while the spurs will be constructed to a height of MVSZ 2018+0.5 m at their fairway ends between 1811 and 1798 fkm and MVSZ 2018+1.0 m between 1798 and 17981708 fkm. The geometry of the **spur is** 2.0 m crown width with a 5‰ slope towards the midline of the bed, a 1:1.5 slope on the upstream side and a 1:3 slope on the downstream side, and a rounded end. The stonework below the spur is 1,0 m thick and extends 1,0 m on the upstream side and 1,0 m on the downstream side, with varying widths, to prevent the formation of washouts (wells) at the end of the spur.

Dismantling and rebuilding of spurs

The task is to remove the spurs that are having a detrimental effect, and to make the necessary additions or convert them into a "T".

Cutting of the shore side of spurs

The nearshore end of the existing spurs will be cut back to MVSZ 2018-0.5 m at 10 m width to allow for water movement near the water's edge during low (possibly low) water (so that sediment movement can be restored along the shore). A secondary bed should be created by dredging in the spur fields between each cut.

Creation of a secondary embankment in the cut spur fields, by placing the excavated material in embankments and dam abutments

The aim is to reduce the impact on the areas between the diversion plants and to reduce sedimentation. The new spur designs will improve the hydromorphological dynamics of the river banks, which in turn will slow down the recharge process in the areas between the diversion works. By improving the structural diversity of the areas between the spurs, the existing conditions for aquatic vegetation, especially for juvenile fish, will also be improved, while the intervention will have no negative navigational consequences.

Construction, reconstruction and extension of conduit works from quarry stone or with in-works material handling

The **guideway is** a longitudinal structure, with a crown width of 2.0 m and a 1:1.5 slope on the upstream side and a 1:3 slope on the downstream side. A 1,0 m wide stone fence is constructed under the guideway, 1,0 m wide at the bottom and 2,0 m wide on the upstream side.

Demolition of power plants

There may be a need for height reduction of stone works, removal of damaging guide works or appropriate additions to those required.

Construction of buttresses

In shallow sections, bank stabilisation is achieved **by means of** gently sloping **bottom fins.** Bottom fins divert the current towards the middle of the river, thus facilitating navigation. The mid-directed flow widens the bed by erosion of the reef. The scoured sediment is deposited in front of and between the bottom ribs, preventing further deepening of the bed and thus water subsidence. A 10.0 m wide riprap 1.0 m thick will be constructed along the axis of the bottom fins below the MVSZ-2018 level to prevent adverse washout, extending 2.0 m below the actual bottom fins on the upstream side and 5.0 m on the downstream side of the proposed riprap. Geometrically, the masonry will have a crown width of 2 m with a 5‰ slope towards the fairway axis with a 1:3 slope on the upstream side and a 1:10 slope on the downstream side. The crown level of the bottom rib is up to MVSZ 2018-4.0 m. See ***Figures 1-3***.

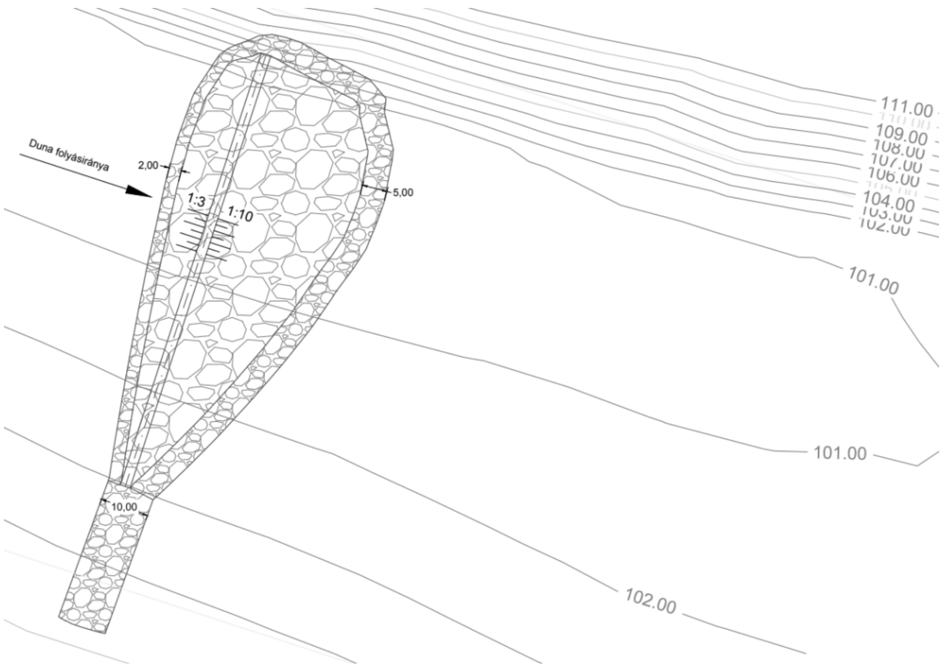

Figure 1: Top view of the buttocks

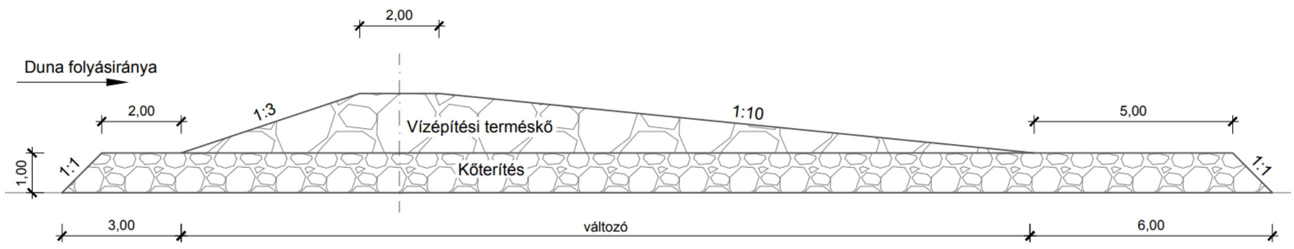

Figure 2: Bottom cross-section

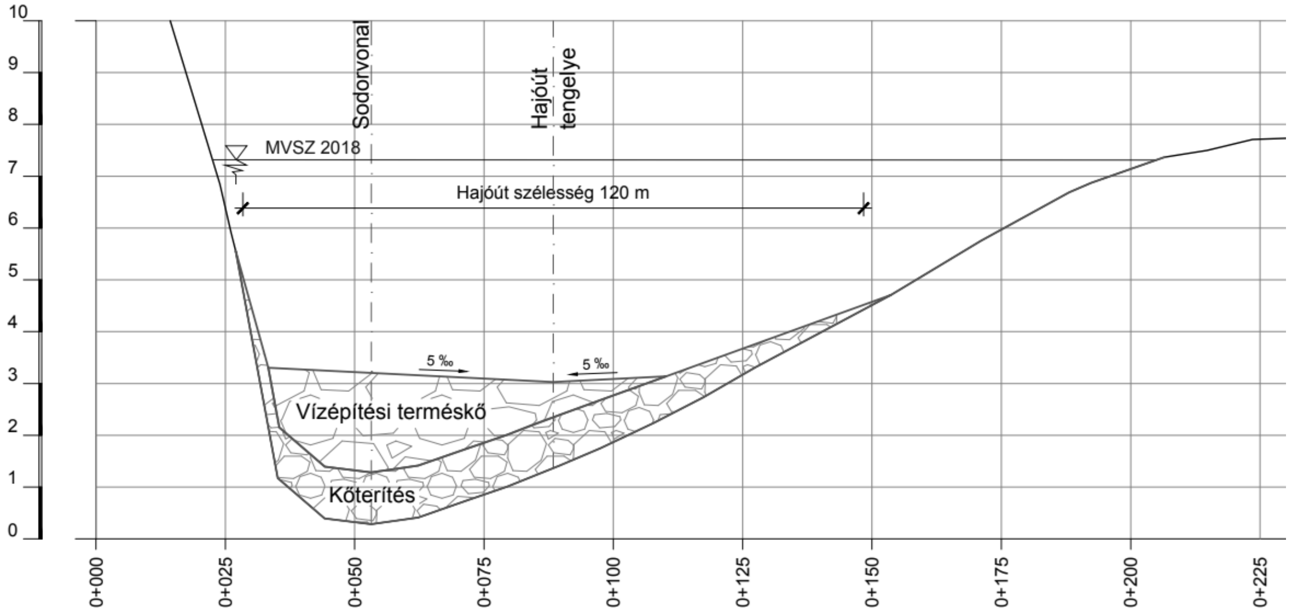

Figure 3: Longitudinal section of the buttocks

Construction of Chevron dams

Chevron dams are innovative regulatory works. The "U" shaped stone structures are built parallel to the river channel at a height of MVSZ 2018+1.0 m, separated from the bank but usually close to it. By narrowing the bed, they improve the navigability of the waterway and also ensure coastal water flow. Inside the Chevron weir, a deep wash develops where water velocity is low, providing good overwintering habitat for fish, while behind it a dynamically changing bank surface is created. In terms of geometry, the chevron opens out from a circular arch with an average diameter of 50 m to 80 m over a length of 50 m. It is built on a 1.0 m thick stone revetment, with a crown width of 2 m, a 1:1.5 outside to 1:3 inside chevron pitch and rounded stem ends. The stone fence is 2.0 m wide outside and 5 m wide inside the chevron. See ***Figures 4 and 5***.

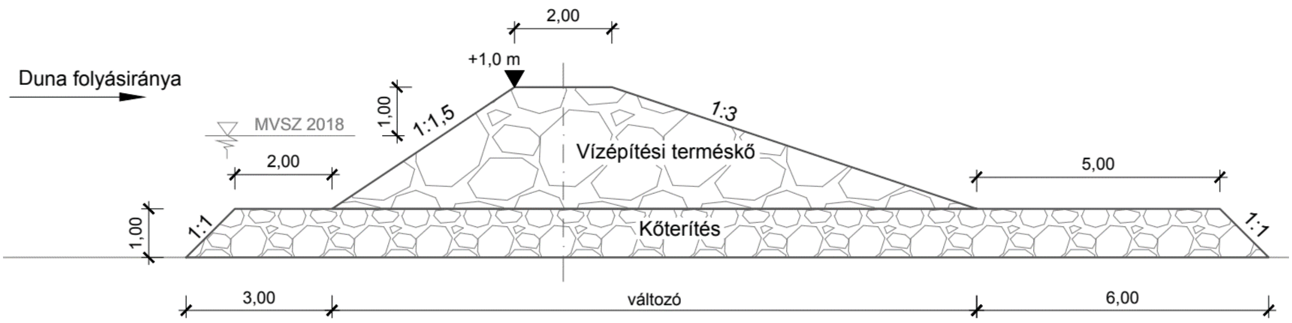

Figure 4: Chevron dam cross-section

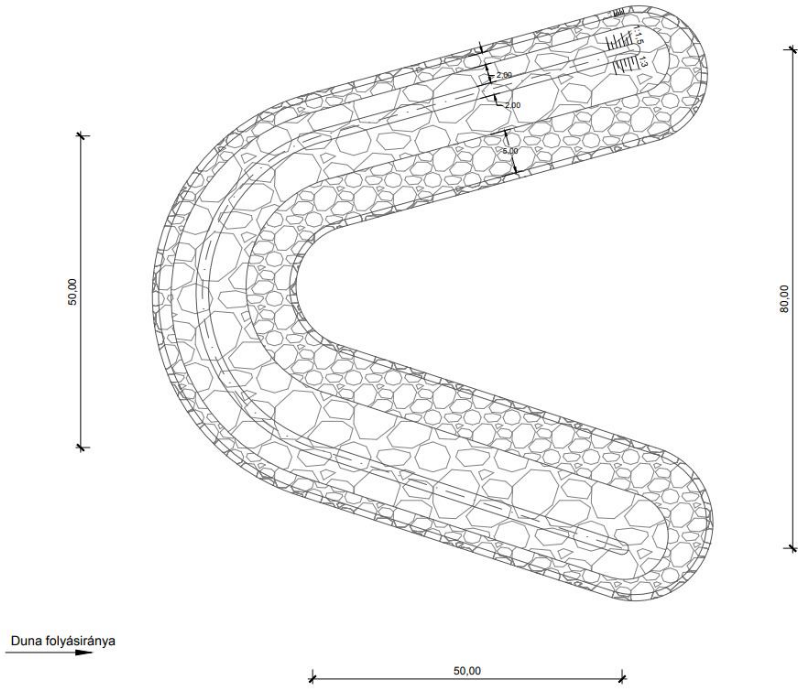

Figure 5: Chevron dam top view

Creation of a restricted width (80-100 m) fairway, relocation of fairways

If the protection of the natural and aquatic environment so requires, the possibility should be used to create a one-way (up to 60 m) or two-way (80-100 m) fairway of limited width in certain fords and narrows. This is done in order to minimise sedimentation, which may be important for the protection of nature and the water basin in the location concerned.

3 COMPLIANCE WITH THE CCI IN THE CONTEXT OF THE DANUBE WATERWAY DEVELOPMENT PROGRAMME

3.1 WATER BODIES AFFECTED BY THE PLANNED INVESTMENT AND THEIR STATUS ASSESSMENT

3.1.1 SURFACE WATER BODIES

The main Danube basin is divided into 5 water bodies between Szob and the southern border: *Szob-Budapest, Budapest section*, then *Budapest-Dunaföldvár* with a section between the *Dunaföldvár-Sió estuary and the Sió estuary.*

The water bodies are characterised by a flat, calcareous and coarse bed material, except for the water body between the *Danube and the Sió estuary*, which has a medium to fine bed material. The *Danube* between *Budapest and Dunaföldvár and the* Sió estuary at the border has a steep gradient and the other stretches have a medium gradient. In addition to navigation, they serve drainage and water supply purposes.

1.táblázat Classification of the surface water bodies concerned in the section according to Annex 1.1 of VGT2

Water body code	Name of water body	Artificial (VGT2)	Significant hydromorphological impurities (heavily modified water body)	Type code	Description of the type	Length of watercourse [km]
AOC756	Danube between Szob and Budapest	not	not	9K	lowland - medium slope - calcareous - coarse sediment - Danube size	77,93
AOC752	Danube-Budapest	not	not	9K	lowland - medium slope - calcareous - coarse sediment - Danube size	37,78
AOC753	Danube between Budapest-Dunaföldvár	not	yes	9K	lowland - low gradient - calcareous - coarse sediment - Danube size	85,42
AOC754	Danube between Dunaföldvár and Sió estuary	not	yes	9K	lowland - medium slope - calcareous - coarse sediment - Danube size	63,31
AOC755	Danube between the Sió estuary and the border	not	yes	10A	lowland - low gradient - calcareous - medium to fine sediment - Danube size	64,5

The ecological and integrated status of water bodies *is moderate* (Table X). The sections of the Danube in Budapest received an unfavourable classification for the physico-chemical elements and for the chemical status. The sections between Szob-Budapest and the Sió estuary were given an excellent classification. The potential for an *excellent* rating for the physico-chemical elements is mainly reduced by the *good* assessment of nutrients. The status of the biological elements is classified as moderate ecology. In terms of hydromorphology, the *sections between Szob - Budapest and Dunaföldvár - Sió estuary* received *a moderate* rating *and the other three sections a good* rating.

2.táblázat Classification of the surface water bodies concerned in the section according to Annex 6.1 of VGT2

Water body VOR code / Status		Danube between Szob and Budapest	Danube-Budapest	Danube between Budapest-Dunaföldvár	Danube between Dunaföldvár and Sió estuary	Danube between the Sió estuary and the border
		AOC756	**AOC752**	**AOC753**	**AOC754**	**AOC755**
Biology	Fitobentos	moderate	moderate	excellent	good	good
	Fitoplankton	good	moderate	moderate	moderate	good
	Macrophyton	data gap	data gap	data gap	data gap	data gap
	Macrozoobenton	moderate	moderate	good	moderate	moderate
	Hal	data gap	data gap	data gap	data gap	data gap
	Status by biological elements	**moderate**	**moderate**	**moderate**	**moderate**	**moderate**
Physico-chemical elements	Oxygen household	excellent	excellent	excellent	excellent	excellent
	Nutrients	good	good	good	good	good
	Salt content	excellent	excellent	excellent	excellent	excellent
	Acidity	excellent	excellent	excellent	excellent	excellent
	State by physico-chemical elements	**good**	**good**	**good**	**good**	**good**
Specific pollutants	**Status by metal**	**excellent**	**not good**	**good**	**good**	**excellent**
Hydromorphological elements	Morphological status	good	moderate	good	moderate	good
	Interoperability	excellent	excellent	excellent	excellent	excellent
	Hydrological status	excellent	excellent	excellent	excellent	excellent
	Status according to hydromorphological elements	**good**	**moderate**	**good**	**moderate**	**good**
Ecological status		**moderate**	**moderate**	**moderate**	**moderate**	**moderate**
Chemical state		**good**	**good**	**good**	**good**	**good**
Water body status	**Integrated state**	**moderate**	**moderate**	**moderate**	**moderate**	**moderate**

3.1.2 GROUNDWATER BODIES

The study area is classified under the Revised National River Basin Management Plan (OVGT2) as 1-9. Central Danube, 1-7. Gerecse, 1-10 Danube Valley Main Canal and 1-11 Sió subdivisions. hydrogeological characteristics of each sub-unit are briefly described below.

1-7 Gerecse sub-unit

The karstic areas of the mountain range, which are crossed by a network of fractures and fissures, store a coherent karstic water system, which is integrated with the main karstic water system of the Transdanubian Central Mountains, and therefore the drinking water supply of the planning sub-unit is mainly provided by karstic water aquifers, but along the Danube river (Tat-Esztergom and Pilismaróti basins), in the mountain wetlands, the gravel terrace works on the karstic basement are also of great importance.

The quality of groundwater resources is significantly affected by pollution from past industrial activity, which also threatens drinking water sources. Within the area of the Pest County Government Office, environmental remediation is currently underway at around 170 sites under Government Decree 219/2004 (21.VII.).

1-9 Central Danube sub-unit

The geological structure of the planning unit is very diverse. The Danube valley is located next to the Buda Hills, the Zsámbék basin and the Pilisvörösvár-Solymár trench depression. The sub-unit is a congested, scaly, fractured, eagle-crested, stumpy, basin-divided, mid-mountainous area. The average altitude is 250-500 m. The area is poor in springs and surface watercourses, but rich in karstic waters interspersed with rising springs. The small valleys and basins of the mountain range are bounded by valleys and basins formed along structural lines. Water abstraction is mainly from surface water recharge from bank filtration and, to a much lesser extent, from strata and karst water resources in the Central Danube sub-unit.

In the Central Danube planning sub-unit, there are a series of bank-filtered drinking water wells on the right and left banks of the Danube and on Szentendre Island, located on the gravel terrace of the Danube, which are in a fragile geological environment and provide drinking water for the region and the capital. They are perhaps the most vulnerable because of their direct link with the Danube (water levels, riverbed interventions, pollution run-off, quality and quantity problems caused by floods) and because of background pollution pressures (e.g. sewage spills, agricultural pollution). A particular problem in the sub-region (especially for aquifers with a fragile geological environment), especially in the area of Budapest and its agglomeration, is that the drinking water sources are surrounded by built-up areas and are subject to concentrated and more numerous pressures (agricultural, industrial, municipal).

1-10 Danube Valley Main Canal Sub-unit

In terms of groundwater use, the geological and hydrogeological characteristics of the geological formations in the sub-unit area are such that the Late Pannonian and Quaternary sediments are considered significant, consisting of a mixture of medium-grained sands with good water-bearing properties, and layers of aleurolite and clay, several tens of metres thick. These sedimentary assemblages are suitable for the extraction of hot spring water with a discharge temperature above 30 °C and drinking water quality.

Cold water aquifers, potentially capable of producing 200-900 l/min per well, are sandy layer complexes at depths of 110-330 m from the surface, mainly in the central areas of the sub-unit. The concentration of ammonium and arsenic in the extracted aquifers from some Pannonian water sources may exceed the drinking water quality limit. The concentrations considered to be high are of geological origin.

In the floodplain areas of the catchment management sub-unit, alluvial alluvial sedimentary environments were deposited by alluvial alluvial cones, alluvial reef and alluvial floodplain sediments formed during the Early and Middle Pleistocene. The heterogeneous assemblage is highly variable both horizontally and vertically, with sand and gravel layers suitable for water abruptly wedged and discontinuous over short distances.

1-11 Sió sub-unit

The Palaeozoic formations are impermeable, with the exception of the Polgárdi and Szabadbattyan limestones. The Mesozoic limestones are karstified. The Jurassic and Cretaceous strata are largely impermeable and not significant for drainage. The Miocene coarse-grained and calcareous layers are water-bearing, the marls are impermeable. Of the Pannonian strata, the Zámori Gravels are water-bearing. The semi-permeable layers of the Somló and Tihany Formation are important for water storage. The marl layers are impermeable. The Quaternary loess, slope debris and river-related gravel sediments have a significant water-bearing capacity.

The table on the next page also shows the groundwater bodies in the project area.

3.táblázat Characteristics of groundwater bodies in the project area

water body code	water body name	geological type	type of water tax	thermo meter supple ment	hydro-dinami-kai type	pressur ised water transm itter	morpho-logical type	surface structure of the water body	meg-turnov er point (main)	area [km2]	area of the part of the water body in surface excursio n [km2]	total water tax stocks [pcs]	averag e roof level [m]	averag e pressu re level [m]	average thickness [m]	FAV Water body of importance for water flows	FAVÖKO maturity
sp.1.10.2	Wisdom-Bogyisloi Bay	scrap	porous	cold	upstream	not	Price range	untagged	75%	334,22	334,22	1	3	30	20	base flow (Danube), wetland nourishment, groundwater evaporation	yes
sh.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	scrap	porous	cold	Mixed	not	central mountains	moderately dissected	75%	274,33	274,33	1	17	30	30	basic return , source	yes
sp.1.13.1	Left bank of the Danube - Vác-Budapest	scrap	porous	cold	downstream	not	hills	slightly dissected	75%	1 123,11	1 123,55	1	9	30	30	Base yield (Danube and medium watercourses)	yes
sp.1.9.1	Danube right bank - Budapest-Paks	scrap	porous	cold	downstream	not	hills	slightly dissected	75%	1 032,69	1 032,69	1	5	15	7	Base yield (Danube, medium watercourses)	yes
sp.1.10.1	Danube right bank - below Paks	scrap	porous	cold	downstream	not	hills	slightly dissected	75%	662,27	662,27	1	5	20	20	Base yield (Danube, medium watercourses)	yes
sh.1.5	Danube Mountains - Danube water reservoir under Budapest	scrap	porous	cold	Mixed	not	central mountains	moderately dissected	75%	610,87	610,87	1	5	30	25	basic yield, source	yes
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	scrap	porous	cold	upstream	not	cone of sediment	untagged	75%	512,14	512,14	1	5	35	30	base flow (Danube), wetland nourishment, groundwater evaporation	yes
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	scrap	porous	cold	upstream	not	cone of sediment	untagged	75%	1 594,93	1 594,93	1	3	28	25	base flow (Danube, canals), wetland nourishment, groundwater evaporation	yes
sp.1.14.2	Danube-Tisza basin - Northern part of the Danube Valley	scrap	porous	cold	upstream	not	cone of sediment	untagged	75%	1 688,31	1 688,31	1	3	22	20	base flow (Danube, canals), wetland nourishment, groundwater evaporation	yes
sp.1.11.2	Szekszárd-Bátai and Kölkedi estuaries	scrap	porous	cold	upstream	not	cone of sediment	untagged	75%	543,02	543,02	1	10	20	8	base flow (Danube), wetland nourishment, groundwater evaporation	yes

water body code	water body name	geological type	type of water tax	thermo meter supple ment	hydro-dinami-kai type	pressur ised water transm itter	morpho-logical type	surface structure of the water body	meg-turnov er point (main)	area [km2]	area of the part of the water body in surface excursio n [km2]	total water tax stocks [pcs]	averag e roof level [m]	averag e pressu re level [m]	average thickness [m]	FAV Water body of importance for water flows	FAVÖKO maturity
sp.1.13.2	Szentendrei Island and other islands in the Danube	scrap	porous	cold	upstream	not	cone of sediment	untagged	75%	96,33	96,33	1	4	19	19	basic yield (Danube)	yes

3.1.2.1 Quantitative status

4.táblázat Quantitative status of the FAV water bodies affected by the section

Water body code	Name of water body	Hydrodynamic type	Sinking test	Water balance test	Overall rating
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	upstream	good	weak	**weak**
h.1.5	Danube Mountains - Danube water reservoir under Budapest	Mixed	good	good but low risk	**good but low risk**
sp.1.9.1	Danube right bank - Budapest-Paks	downstream	good	good but low risk	**good but low risk**
sp.1.10.1	Danube right bank - below Paks	downstream	good	good but low risk	**good but low risk**
sp.1.10.2	Wisdom-Bogyisloi Bay	upstream	good	good but low risk	**good but low risk**
sp.1.11.2	Szekszárd-Bátai and Kölkedi estuaries	upstream	good	good	**good**
h.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	Mixed	good	good	**good**
sp.1.13.1	Left bank of the Danube - Vác-Budapest	downstream	good	good but low risk	**good but low risk**
sp.1.13.2	Szentendrei Island and other islands in the Danube	Mixed	good	good but low risk	**good but low risk**
sp.1.14.2	Danube-Tisza basin - Northern part of the Danube Valley	upstream	good	weak	**weak**
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	upstream	good	weak	**weak**

3.1.2.1.1 Water level subsidence

The subsidence test uses data from monitoring wells to determine where and how much subsidence has occurred in the water body. The analysis includes precipitation, monitoring well data series, spatial information on subsidence caused by overproduction, regional hydrodynamic modelling results from other projects and expert estimates, which indicate that all water bodies in the reach are considered to be in good condition.

3.1.2.1.2 Water balance

The conflict between water uses that meet human needs and the water requirements of the target status of ecosystems. The usable water resource is therefore the difference between the average recharge over many years and the estimated ecological/environmental water demand for the target status of water bodies. A comparison of direct abstractions (including unauthorised abstractions) and other indirect water uses that entail water abstraction (groundwater discharged through artificial channels, additional evaporation from mining lakes and increased base flow due to lower mean river levels) with the usable water resources shows that two water bodies are in good status (Szekszárd-Bátai and Kölkedi basins; Börzsöny, Gödöllő hills - Danube catchment), six water bodies are classified as good but at low risk, and three water bodies are classified as poor.

3.1.2.1.3 Changes in groundwater quality as a result of abstraction

No intrusion test results are available for the water bodies concerned.

3.1.2.2 Chemical state

5.táblázat Chemical status of the FAV affected by the planning phase

Water body code	Name of water body	Diffuse pollution (nitrate, ammonium) in the water body (>20%)	Contaminated drinking water source protection area (component)	Surface water status	Overall rating
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	good	good	weak	**weak**
sh.1.5	Danube Mountains - Danube water reservoir under Budapest	good	good	good	**good**
sp.1.9.1	Danube right bank - Budapest-Paks	weak (NO3)	weak (NO3)	good	**weak**
sp.1.10.1	Danube right bank - below Paks	good but low risk	good	good	**good but low risk**
sp.1.10.2	Wisdom-Bogyisloi Bay	good	good but low risk (NH4, SO4)	good	**good but low risk**
sp.1.11.2	Szekszárd-Bátai and Kölkedi estuaries	good	weak (NH4)	good	**weak**
sh.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	good	good	good	**good**
sp.1.13.1	Left bank of the Danube - Vác-Budapest	weak (NO3)	weak (NO3, NH4, SO4, atrazine)	weak	**weak**
sp.1.13.2	Szentendrei Island and other islands in the Danube	good	weak (NO3)	good	**weak**
sp.1.14.2	Danube-Tisza basin - Northern part of the Danube Valley	good	weak (NO3, SO4)	good	**weak**
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	good	good	good	**good**

3.1.2.2.1 Diffuse contaminants

The monitoring of diffuse pollution included the distribution of nitrate and ammonium concentrations in groundwater and the presence of pesticides, which showed that two water bodies were at low risk of nitrate contamination and one at good but low risk.

3.1.2.2.2 Pollutant exceedances that threaten water tables

Based on the assessment, five water bodies in the stretch were rated as poor, and one body was rated as "good but low risk". In general, nitrate pollution of municipal or agricultural origin is typical of the polluted aquifers, but sulphate, ammonium, pesticide overdoses also occur as a cause of poor status.

3.1.2.2.3 *Groundwater bodies whose chemical status is at risk*

6.táblázat Groundwater bodies whose chemical status is at risk

FA Water body code	FA Water body name	FAV effect verified	Watercourse FE Water body code	Watercourse FE Water body name	The FEV test classifies the pollution as being of FAV origin
sh.1.5	Danube Mountains - Danube water reservoir under Budapest	not	AEP312	Peace, Snake and Sajgó creeks	can be found at
		not	AEP602	Longitudinal stream	can be found at
		not	AEP994	Central St. László Water	can be found at
		not	AEQ094	Upper Váli and its catchment area	can be found at
		not	AOH637	Lower Benta Stream and Zámori Stream	can be found at
		not	AOH638	Benta Creek and Weed Creek	can be found at
		not	AEP826	Upper Great Ditch of the Devil	yes
sh.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	not	AEP352	Bőszobi stream	yes
		not	AEP521	Fungal and Cselőte streams	yes
sp.1.10.1	Danube right bank - below Paks	not	AEP833	The upper catchment area of the Nagykarácsonyi watercourse	yes
sp.1.11.2	Szekszárd-Bátai and Kölkedi estuaries	not	AEP987	Szekszárd-Bátai main channel and its tributaries	can be found at
		not	AEP314	Inland stream	can be found at
		not	AEQ103	Véménd-Bári watercourse	can be found at
		not	AOH642	Borza stream and its tributaries	can be found at
sp.1.13.1	Left bank of the Danube - Vác-Budapest	not	AEP530	Gyáli 1, 2. main channel and Szilassy channel	can be found at
		not	AEP521	Fungal and Cselőte streams	yes
		not	AEP602	Longitudinal stream	can be found at
		yes	AEQ012	Silas stream and its catchment area	can be found at
		not	AOC845	Crab Creek	can be found at
sp.1.13.2	Szentendrei Island and other islands in the Danube	not	AEP521	Fungal and Cselőte streams	yes
		not	AOC845	Crab Creek	can be found at
		not	AOH632	Friend Creek	yes
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	not	AEQ112	VII (Büdöstói) - lower channel	can be found at
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	not	AEP293	Bajóti stream	yes
		not	AEP352	Bőszobi stream	yes
		not	AEP273	By-artery lower	can be found at
		yes	AEP371	Concó bottom	can be found at
		not	AEP376	Cuha (Bakony Lake) lower	can be found at
		not	AEP680	Small-Pandzha ore	yes
		not	AEP328	Bikol Dam	can be found at
		not	AEP378	Csángota Lake and Salmavári Ditch	can be found at
		not	AEP823	Lower Great-Pandzha	yes
		yes	AEP657	Bread Loaf Creek and its tributaries	can be found at
		yes	AEQ022	Szőny-Füzitői channel	yes
sp.1.9.1	Danube right bank - Budapest-Paks	not	AEP994	Central St. László Water	can be found at
		not	AEP968	Free-House Watercourse and Hippolith-Eastern Lake	can be found at
		not	AEP996	St László water lower	can be found at

FA Water body code	FA Water body name	FAV effect verified	Watercourse FE Water body code	Watercourse FE Water body name	The FEV test classifies the pollution as being of FAV origin
		not	AEQ094	Upper Váli and its catchment area	can be found at
		not	AIP859	Adonyi main channel	can be found at
		not	AOH637	Lower Benta Stream and Zámori Stream	can be found at

The potential inputs of pollutants from groundwater to surface water bodies and whether pollutants from groundwater bodies to surface watercourses have an impact on the ecological status or threaten the Water Framework Directive can be demonstrated for two water bodies. Among the pollutants, nitrate was assessed.

3.1.2.2.4 Status of groundwater-dependent ecosystems

The assessment determines whether the contamination from the FAV body is having an impact on the groundwater dependent ecosystem that is incompatible with the Water Framework Directive or other protected area objectives. The assessment has only been carried out for the water body Duna-Tisza nebula - Danube valley north, where it has been classified as good status.

3.1.2.3 Drinking water sources

The planned project may have an impact mainly on shallow water bodies close to the surface, which is why the **Pogreška! Izvor reference nije pronađen.**The **Pogreška! Izvor reference nije pronađen.**. Based on the revised National River Basin Management Plan (OVGT2), Annex 6.7 Vulnerability of aquifers, the aquifers likely to be affected by the interventions can be characterised as follows:

7.táblázat Water bodies likely to be affected by the intervention from the point of view of the project (source: OVGT2)

Name of the aquifer	Contamination of the aquifer 1; no risk 4; detected pollution 5;contaminated producer wells	Flood risk 1;no risk 2;medium risk 3;significant risk	Aquiferous geological medium risk-risk 1;no risk 2;medium risk 3;significant risk	Climate vulnerability 1; no risk 2; medium risk 3; significant risk		Vulnerability due to surface water pollution 1;no risk 3;significant risk	Total vulnerability of the aquifer 1;no risk 2;medium risk 3;significant risk 4;detected pollution 5;contaminated producer wells
				Go.	Min.		
Tótfalui Waterworks	1	3	3	2	2	3	3
Surányi waterworks	4*	3	3	2	2	3	4
Horányi waterworks	1	3	3	2	2	3	3
Budaújlak waterworks	1	3	3	2	2	3	3
Csepel Halásztelek vm	4**	3	3	2	2	3	4
Tököl-Szigetújfalu vm	4*	3	3	2	2	3	4
Dunavecse North	1	3	3	2	2	3	3
Harta-Solt	1	3	3	2	2	3	3
Madocsa	1	3	3	2	2	3	3
Foktő-Baráka	1	3	3	2	2	3	3
Gerjen-Dombori aquifer	1	3	3	2	2	3	3

Name of the aquifer	Contamination of the aquifer 1; no risk 4; detected pollution	Flood risk 1;no risk 2;medium risk 3;significant risk	Aquiferous geological medium risk-risk 1;no risk	Climate vulnerability 1; no risk 2; medium risk 3; significant risk		Vulnerability due to surface water pollution 1;no risk 3;significant risk	Total vulnerability of the aquifer 1;no risk 2;medium risk 3;significant risk
Dunafalva-Leneskert	1	3	3	2	2	3	3

[*] Pollution detected by monitoring at the water base: NO_3
[**] Pollution detected by monitoring at the water base: SO_4, NO_3

The test of the classification of water bodies for aquifers has already indicated that aquifer pollution is a major problem in the area. The first column of Table 2 shows that some of the water bodies affected by the project interventions are already experiencing pollution. There are 3 such aquifers:

- Surányi waterworks: 68000 $^{m3/day}$ day,
- Csepel-Halásztelek waterworks: 90000 $^{m3/day}$
- Tököl-Szigetújalu,waterworks: 85000 $^{m3/day}$

The number 4 indicates that so far only monitoring wells have been found to be contaminated, while production wells have not been affected by nitrate or sulphate contamination. This pollution is background and not from the Danube.

For the development of navigation, the relevant threats are the geological environment, in our case the shoreline and the coastal zone, and polluted surface water. Their risk classification is immediately after the actual pollution: they fall into the category of "significant risk". One of the tasks of the environmental assessment of the project is to analyse whether and to what extent the development of shipping will modify these hazards.

Water use data for the water bodies affected by the project have been collected from the OVGT2 database, and are used to indicate the proportion of groundwater abstractions and the proportion of surface water abstractions (surface water portion of the total well abstractions) compared to the total well abstractions.

8.táblázat Water abstraction rates in the groundwater bodies concerned

Water body code	Name of water body	Total well water abstraction [m3/day]	FEV-loading Coastal filtration	Groundwater abstractions			
				Drinking water	Agriculture	Industry	Other all
			as a percentage of total well water withdrawals [%]				
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	15 903	65%	24%	7%	3%	1%
sh.1.5	Danube Mountains - Danube water reservoir under Budapest	600	0,7%	-	60%	4%	36%
sp.1.9.1	Danube right bank - Budapest-Paks	46 332	76%	16%	7%	0,2%	0,3%
sp.1.10.1	Danube right bank - below Paks	182	-	20%	6%	2,2%	72%
sp.1.10.2	Wisdom-Bogyisloi Bay	3 003	-	90%	0,1%	6%	3%
sp.1.11.2	Szekszárd-Bátai and Kölkedi estuaries	10 703	-	85%	0,2%	14%	1%
sh.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	21 245	84%	15%	0,03%	-	0,3%
sp.1.13.1	Left bank of the Danube - Vác-Budapest	64 076	71%	23%	0,9%	3%	2%
sp.1.13.2	Szentendrei Island and other islands in the Danube	369 057	91%	9%	-	0,01%	-
sp.1.14.2	Danube-Tisza basin - Northern part of the Danube Valley	107 922	83%	16%	0,3%	0,04%	1%
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	21 270	79%	14%	2%	0,2%	4%

The table above shows that, on average, surface water accounts for more than half (69% on average) of the daily water abstractions from each groundwater body, which is a fairly significant proportion of total abstractions.

3.2 *OBJECTIVES AND MEASURES IN THE SUB-UNIT PLANS*

The sub-unit plans set out measures for the ecological, chemical, biological, hydromorphological and quantitative status of water bodies, with the aim of achieving good status in all cases, or maintaining good status where it exists.

3.2.1 MEASURES FOR SURFACE WATERS

3.2.1.1 Danube between Szob and Budapest

Measures to improve the physico-chemical status of watercourses

Identifier according to VGT	Short description, name of measures	Final year of realisation
1. CONSTRUCTION AND MODERNISATION OF WASTE WATER TREATMENT PLANTS		
1.1	Implementation of the Wastewater Programme. Establishment of new wastewater treatment plants, modernisation of existing wastewater treatment plants (capacity increase, technology development, reconstruction), in compliance with the limits for surface water intake.	2021
2. REDUCING NUTRIENT POLLUTION FROM AGRICULTURAL SOURCES		
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas	
17. REDUCING SEDIMENT AND POLLUTANT LOADS FROM SOIL EROSION AND/OR SURFACE RUN-OFF		
17.1	Reducing run-off of pollutants and sediments by grassing, afforestation, terracing on slopes, infiltration surfaces, isolation of inland crops	
29. REDUCING PRESSURE FROM AGRICULTURAL HOLDINGS (LIVESTOCK)		
29.2	Upgrading of livestock farms under the EU Nitrates Directive	

Hydromorphological measures for water courses

Identifier according to VGT	Short description, name of measures	Final year of realisation
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.5	Gradually achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works	2021
6.9	Reducing the impact of deeper than natural river beds and the resulting low and medium water level subsidence	
6.2	Establishing appropriate vegetation in the surf zone	2027
6.3a	One-off removal of accumulated silt and in-stream vegetation in watercourses and standing waters	
6.6	Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment	
6.12.3	Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials	
6.8	Improving the water availability of the floodplain and flood zone,	

Identifier according to VGT	Short description, name of measures	Final year of realisation
6.13	Adaptation of navigation to river or still water conditions	

Nature conservation measures for water courses in addition to other measures

Identifier according to VGT	Short description, name of measures	Final year of realisation
7. IMPROVING WATER FLOW CONDITIONS AND REDUCING THE ECOLOGICAL IMPACTS OF WATER ABSTRACTIONS AND TRANSFERS TO OTHER WATER BODIES		
7.1	Modification of the inland water drainage system	2027
33. PROTECTING DAMAGED AQUATIC AND WETLAND AND TERRESTRIAL HABITATS FROM IMPACTS ON WATER FLOW, IN ADDITION TO OTHER MEASURES		
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs	

3.2.1.2 Danube-Budapest

Measures to improve the physico-chemical status of watercourses

Identifier according to VGT	Short description, name of measures	Final year of realisation
1. CONSTRUCTION AND MODERNISATION OF WASTE WATER TREATMENT PLANTS		
1.1	Implementation of the Wastewater Programme. Establishment of new wastewater treatment plants, modernisation of existing wastewater treatment plants (capacity increase, technology development, reconstruction), in compliance with the limits for surface water intake.	2021
1.4	Increasing the sludge storage capacity of the wastewater treatment plant, improving treatment technology	
2. REDUCING NUTRIENT POLLUTION FROM AGRICULTURAL SOURCES		
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas	
17. REDUCING SEDIMENT AND POLLUTANT LOADS FROM SOIL EROSION AND/OR SURFACE RUN-OFF		
17.1	Reducing run-off of pollutants and sediments by grassing, afforestation, terracing on slopes, infiltration surfaces, isolation of inland crops	
29. REDUCING PRESSURE FROM AGRICULTURAL HOLDINGS (LIVESTOCK)		
29.2	Upgrading of livestock farms under the EU Nitrates Directive	
14. RESEARCH, KNOWLEDGE BASE DEVELOPMENT TO REDUCE UNCERTAINTY		
14.2	Development and operation of monitoring systems and information systems	

Hydromorphological measures for water courses

Identifier according to VGT	Short description, name of measures	Final year of realisation
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.5	Gradually achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works	2021
6.2	Establishing appropriate vegetation in the surf zone	2027
6.3a	One-off removal of accumulated silt and in-stream vegetation in watercourses and standing waters	
6.6	Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment	
6.12.3	Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials	
6.13	Adaptation of navigation to river or still water conditions	

Nature conservation measures for water courses in addition to other measures

Identifier according to VGT	Short description, name of measures	Final year of realisation
34. PROTECTING DAMAGED AQUATIC AND WETLAND AND TERRESTRIAL HABITATS FROM IMPACTS ON WATER QUALITY, IN ADDITION TO OTHER MEASURES		
34.2	To ensure the water quality required for nature conservation, in addition to other water quality protection measures.	2027

3.2.1.3 Danube between Budapest-Dunaföldvár

Measures to improve the physico-chemical status of watercourses

Identifier according to VGT	Short description, name of measures	Final year of realisation
1. CONSTRUCTION AND MODERNISATION OF WASTE WATER TREATMENT PLANTS		
1.1	Implementation of the Wastewater Programme. Establishment of new wastewater treatment plants, modernisation of existing wastewater treatment plants (capacity increase, technology development, reconstruction), in compliance with the limits for surface water intake.	2021
2. REDUCING NUTRIENT POLLUTION FROM AGRICULTURAL SOURCES		
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas	
17. REDUCING SEDIMENT AND POLLUTANT LOADS FROM SOIL EROSION AND/OR SURFACE RUN-OFF		
17.1	Reducing run-off of pollutants and sediments by grassing, afforestation, terracing on slopes, infiltration surfaces, isolation of inland plantations	
29. REDUCING PRESSURE FROM AGRICULTURAL HOLDINGS (LIVESTOCK)		
29.2	Upgrading of livestock farms under the EU Nitrates Directive	

Identifier according to VGT	Short description, name of measures	Final year of realisation
27. TREATMENT OF THERMAL WATERS BEFORE DISCHARGE INTO WATERCOURSES		
27.2	Treatment of thermal waters used for bathing and spa treatment	2027

Hydromorphological measures for water courses

Identifier according to VGT	Short description, name of measures	Final year of realisation
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.5	Gradually achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works	2021
6.9	Reducing the impact of deeper than natural river beds and the resulting low and medium water level subsidence	
6.2	Establishing appropriate vegetation in the surf zone	2027
6.6	Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment	
6.12.3	Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials	
6.8	Improving the water availability of the floodplain and flood zone,	
6.13	Adaptation of navigation to river or still water conditions	

Nature conservation measures for water courses in addition to other measures

Identifier according to VGT	Short description, name of measures	Final year of realisation
7. IMPROVING WATER FLOW CONDITIONS AND REDUCING THE ECOLOGICAL IMPACTS OF WATER ABSTRACTIONS AND TRANSFERS TO OTHER WATER BODIES		
7.1	Modification of the inland water drainage system	2027
33. PROTECTING DAMAGED AQUATIC AND WETLAND AND TERRESTRIAL HABITATS FROM IMPACTS ON WATER FLOW, IN ADDITION TO OTHER MEASURES		
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs	

3.2.1.4 Danube between Dunaföldvár and Sió estuary

Measures to improve the physico-chemical status of watercourses

Identifier according to VGT	Short description, name of measures	Final year of realisation
1. CONSTRUCTION AND MODERNISATION OF WASTE WATER TREATMENT PLANTS		

Identifier according to VGT	Short description, name of measures	Final year of realisation
1.1	Implementation of the Wastewater Programme. Establishment of new wastewater treatment plants, modernisation of existing wastewater treatment plants (capacity increase, technology development, reconstruction), in compliance with the limits for surface water intake.	2027
2. REDUCING NUTRIENT POLLUTION FROM AGRICULTURAL SOURCES		2021
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas	
17. REDUCING SEDIMENT AND POLLUTANT LOADS FROM SOIL EROSION AND/OR SURFACE RUN-OFF		
17.1	Reducing run-off of pollutants and sediments by grassing, afforestation, terracing on slopes, infiltration surfaces, isolation of inland crops	
29. REDUCING PRESSURE FROM AGRICULTURAL HOLDINGS (LIVESTOCK)		
29.2	Upgrading of livestock farms under the EU Nitrates Directive	

Hydromorphological measures for water courses

Identifier according to VGT	Short description, name of measures	Final year of realisation
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.5	Gradually achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works	2021
6.9	Reducing the impact of deeper than natural river beds and the resulting low and medium water level subsidence	
6.6	Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment	2027
6.12.3	Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials	
6.8	Improving the water availability of the floodplain and flood zone,	
6.13	Adaptation of navigation to river or still water conditions	
23. MEASURES TO PROMOTE NATURAL WATER RETENTION		2021 and 2027
23.2	Precipitation management, retention of water within the slabs to increase infiltration and reduce run-off	

Nature conservation measures for water courses in addition to other measures

Identifier according to VGT	Short description, name of measures	Final year of realisation
7. IMPROVING WATER FLOW CONDITIONS AND REDUCING THE ECOLOGICAL IMPACTS OF WATER ABSTRACTIONS AND TRANSFERS TO OTHER WATER BODIES		
7.1	Modification of the inland water drainage system	2027
33. PROTECTING DAMAGED AQUATIC AND WETLAND AND TERRESTRIAL HABITATS FROM IMPACTS ON WATER FLOW, IN ADDITION TO OTHER MEASURES		

Identifier according to VGT	Short description, name of measures	Final year of realisation
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs	
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.2	Establishing appropriate vegetation in the surf zone	
6.9a	Raising the sea level with bottom dikes and bottom fins, by silting up the bed between them	

3.2.1.5 Danube between the Sió estuary and the border

Measures to improve the physico-chemical status of watercourses

Identifier according to VGT	Short description, name of measures	Final year of realisation
1. CONSTRUCTION AND MODERNISATION OF WASTE WATER TREATMENT PLANTS		
2. REDUCING NUTRIENT POLLUTION FROM AGRICULTURAL SOURCES		
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas	
17. REDUCING SEDIMENT AND POLLUTANT LOADS FROM SOIL EROSION AND/OR SURFACE RUN-OFF		2021
17.1	Reducing run-off of pollutants and sediments by grassing, afforestation, terracing on slopes, infiltration surfaces, isolation of inland crops	
29. REDUCING PRESSURE FROM AGRICULTURAL HOLDINGS (LIVESTOCK)		
29.2	Upgrading of livestock farms under the EU Nitrates Directive	

Hydromorphological measures for water courses

Identifier according to VGT	Short description, name of measures	Final year of realisation
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.5	Gradually achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works	2021
6.9	Reducing the impact of deeper than natural river beds and the resulting low and medium water level subsidence	
6.6	Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment	
6.12.3	Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials	2027
6.8	Improving the water availability of the floodplain and flood zone,	
6.13	Adaptation of navigation to river or still water conditions	

Identifier according to VGT	Short description, name of measures	Final year of realisation
23. MEASURES TO PROMOTE NATURAL WATER RETENTION		2021 and 2027
23.2	Precipitation management, retention of water within the slabs to increase infiltration and reduce run-off	

Nature conservation measures for water courses in addition to other measures

Identifier according to VGT	Short description, name of measures	Final year of realisation
7. IMPROVING WATER FLOW CONDITIONS AND REDUCING THE ECOLOGICAL IMPACTS OF WATER ABSTRACTIONS AND TRANSFERS TO OTHER WATER BODIES		
7.1	Modification of the inland water drainage system	2027
33. PROTECTING DAMAGED AQUATIC AND WETLAND AND TERRESTRIAL HABITATS FROM IMPACTS ON WATER FLOW, IN ADDITION TO OTHER MEASURES		
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs	
6. IMPROVING HYDROMORPHOLOGICAL CONDITIONS OUTSIDE LONGITUDINAL PERMEABILITY (REDUCING THE MORPHOLOGICAL REGULATION OF WATERCOURSES AND STANDING WATERS)		
6.2	Establishing appropriate vegetation in the surf zone	
6.9a	Raising the sea level with bottom dikes and bottom fins, by silting up the bed between them	

3.2.2 GROUNDWATER MEASURES

The VGT **sets targets for groundwater to achieve good status** as set out in Directive 2006/118/EC29 on the protection of groundwater.

In addition, in protected areas, depending on the status of the waters, directly or indirectly linked to individual water bodies, the measures necessary to achieve the objectives linked to the specific requirements for their designation as protected waters or river basins must be met.

The measures to improve groundwater status, as set out in Annex 7_1 of VGT2, which can be interpreted at the project site, are summarised in the table below. Measures that do not affect or are not affected in any way by interventions in the river bed or on the banks are not indicated, regardless of whether or not the water body is designated as a target (e.g.: Reduction of technological and network losses in public water supply, Use of water-saving solutions in crop production, Control of groundwater recharge, Reduction of stormwater connections to sewers, etc.)

The measures set out below are planned to be implemented by 2021, with the few cases where this is not the case indicated in brackets (2015). In these cases, the measure has been implemented by 2015 and its impact is expected by 2021.

9.táblázat Measures to improve groundwater status that may be affected by the investment

Water body code	Name of water body	Measure

Water body code	Name of water body	Measure
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	21.7 (2015), 21.1 (2015), 29.2 (2015), 2, 3, 21.7, 21.10, 21.9, 4.1, 21.1, 13.1, 13.2 21.9, 21.1, 21.5, 13.4, 7a.2, 7a.4, 23.2, 33.2
sh.1.5	Danube Mountains - Danube water reservoir under Budapest	21.7 (2015),29.2 (2015), 2., 3., 21.7, 21.10, 21.9, 21.1, 21.5, 7a.2, 7.1, 23.2
sp.1.9.1	Danube right bank - Budapest-Paks	21.7 (2015), 21.1 (2015), 4.1 (2015),29.2 (2015), 2., 3., 21.7, 21.10, 21.9, 4.1, 21.1, 21.5, 13.1, 13.2, 13.4, 7a.2, 7a.4, 7.1, 23.2
sp.1.10.1	Danube right bank - below Paks	21.7 (2015), 29.2 (2015), 2., 3., 21.10, 21.9, 4.1, 21.1, 21.5, 7a.2, 23.2
sp.1.10.2	Wisdom-Bogyisloi Bay	21.7 (2015), 29.2 (2015), 2., 3., 21.10, 21.9, 21.1, 21.5, 13.1, 13.2, 13.4, 7a.2, 7a.4, 23.2, 33.2
sh.1.7	Börzsöny, Gödöllő Hills - Danube water catchment	21.7 (2015), 29.2 (2015), 2, 3, 21.10, 13.1, 13.2, 21.9, 21.1, 21.5, 13.4, 7a.2, 7a.4, 23.2
sp.1.13.1	Left bank of the Danube - Vác-Budapest	21.7 (2015), 21.1 (2015), 29.2 (2015), 2., 3., 21.7, 21.10, 21.9, 4.1, 21.1, 21.5, 13.1, 13.2, 13.4, 7a.2, 23.2, 33.2
sp.1.13.2	Szentendrei Island and other islands in the Danube	29.2 (2015), 2, 3, 21.10, 21.9, 21.1, 21.5, 13.1, 13.2, 13.4, 7a.2, 7a.4, 23.2
sp.1.14.2	Danube-Tisza basin - Northern part of the Danube Valley	21.7 (2015), 21.1 (2015), 4.1 (2015), 29.2 (2015), 2, 3, 21.7, 21.10, 21.9, 4.1, 21.1, 21.5, 13.1, 13.2, 13.4, 7a.2, 7a.4, 7.1, 23.2
sp.1.15.2	Danube-Tisza basin - Southern Danube Valley	21.7 (2015), 29.2 (2015), 2., 3., 21.7, 21.8, 21.10, 21.9, 21.1, 21.5, 7a.2, 7a.4, 7.1, 23.2, 33.2
sp.1.4.2	Northern rim of the Transdanubian Central Mountains alluvial terrace	21.7 (2015), 21.1 (2015), 29.2 (2015), 2, 3, 21.7, 21.10, 21.9, 4.1, 21.1, 13.1, 13.2 21.9, 21.1, 21.5, 13.4, 7a.2, 7a.4, 23.2, 33.2

10.táblázat Short description, name of measures

Identifier according to VGT	Short description, name of measures	Year of implementation
1. CONSTRUCTION AND MODERNISATION OF WASTE WATER TREATMENT PLANTS		2021
1.5	Reducing the connection of stormwater to sewers, especially in areas of high sensitivity for surface water or groundwater	2021
2. REDUCING NUTRIENT POLLUTION FROM AGRICULTURAL SOURCES		2021
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas	2021
2.2	Actual limitation of nutrient leaching beyond the fund under a voluntary agri-environmental management (VEM) scheme	2021
2.3	Application of nutrients to arable land under agri-environmental management programmes (AEM) based on a nutrient management plan	2021
2.4	Land use conversion (field - grassland, field - forest, field - wetland conversion)	2021

Identifier according to VGT	Short description, name of measures	Year of implementation
2.5	Review of the regulation of the use of sewage sludge in agriculture (requirements and prohibitions).	2021
2.6	Promoting the use of sewage sludge in agriculture for environmentally sound nutrient management	2021
3. REDUCING PESTICIDE POLLUTION FROM AGRICULTURAL SOURCES		2021
3.1	Pesticides regulation under the EU Pesticides Directive (for arable land, plantations and pasture)	2021
3.2	Restrictions on the use of pesticides under the agri-environmental management (AE) programme	2021
7a. IMPLEMENTATION OF ECOLOGICAL CONSIDERATIONS IN THE CONSTRUCTION OF SUSTAINABLE WATER SYSTEMS		2021
7a.2	Registration, review, modification and authorisation of groundwater abstractions	2021
7a.4	Exploring alternative groundwater resources	2021
13. MEASURES TO PROTECT DRINKING WATER SOURCES (PROTECTION AREAS, BUFFER ZONES)		2021
13.1	Ensuring drinking water quality at the tap, in line with the EU Drinking Water Directive (Completion of the Drinking Water Quality Improvement Programme + monitoring)	2021
13.2	Protection of drinking water sources, designation of protection zones, regulation and modification of activities (Implementation of the diagnostic and safety programme)	2021
13.4	Preparation and application of water safety plans	2021
21. PREVENTION AND CONTROL OF POLLUTION FROM SETTLEMENTS, BUILT INFRASTRUCTURE AND TRANSPORT		2021
21.1	Proper design, operation and control of municipal landfills	2021
21.5	Elimination of illegal landfills, landfill control, fines	2021
21.7	Implementation of the Waste Water Programme (sewerage, individual waste water treatment)	2021
21.9	Promoting and implementing additional sewer connections	2021
21.10	Reconstruction of sewer networks	2021
23. MEASURES TO PROMOTE NATURAL WATER RETENTION		2021
23.2	Precipitation management, retention of water within the slabs to increase infiltration and reduce run-off	2021
29. REDUCING PRESSURE FROM AGRICULTURAL HOLDINGS (LIVESTOCK)		2021
29.2	Modernisation of livestock farms under the EU Nitrate Principle	2021

Identifier according to VGT	Short description, name of measures	Year of implementation
33. PROTECTING DAMAGED AQUATIC AND WETLAND AND TERRESTRIAL HABITATS FROM IMPACTS ON WATER FLOW, IN ADDITION TO OTHER MEASURES		2021
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs	2021

3.3 ASSESSMENT OF THE EXPECTED IMPACTS OF THE INVESTMENT

For the purpose of this document, the impact assessment should not be carried out on an environmental element-by-environment basis, but rather on a water body-by-body basis. In the case of surface water bodies, the status of a water body as interpreted in the WFD is also narrowly defined by the status of four environmental elements:

- the surface water resources (chemical and physico-chemical quality elements) that constitute the body of water,
- the geological medium forming the bed of the body of water, including bedrock immediately adjacent to the bed and sediment accumulating in the bed (hydromorphological quality elements),
- structures that form part of the built environment, such as embankments, cross barriers, paved sections (hydromorphological quality elements),
- and the aquatic biota (biological quality elements) in the mid-water bed of the water body.

For groundwater bodies, the status of a water body as interpreted by the WFD is directly determined by the status of two environmental elements:

- the quality of the groundwater body providing the body of water (e.g. chemical status assessment: diffuse test and organic pollutants test)
- quantity (e.g. quantitative status assessment: subsidence test and water balance test), and the biodiversity of surface habitats dependent on groundwater resources (e.g. chemical status assessment: FAVÖKO test and quantitative status assessment: FAVÖKO test).

For the interventions planned in the framework of the Danube waterway development programme, we distinguish between the impacts of the construction and the operation phases, in relation to the classical construction project.

Among the direct impacts of the Project, the impact on the vulnerable groundwater resources and the actual interventions in the riverbed may have impacts that need to be addressed.

3.3.1 IMPACTS ON SURFACE WATER BODIES

3.3.1.1 Effects on biological elements

The European Union's Water Framework Directive (WFD) recommends the classification of the ecological status of surface waters (rivers and lakes in our country) based on the community structure characteristics of four groups of organisms (biological quality elements) (European Commission, 2000). A monitoring and rating system based on several groups of organisms will allow a more direct and reliable assessment of the response of aquatic "ecosystems" to human impacts. The organism groups studied are algae (planktonic and benthic [periphyton] forms), macrophytes, aquatic macroscopic invertebrates and fish.

In chapter 3.1.1, the biological classifications for the water bodies concerned were presented. In the following, the methods and the sensitivities of each organism group to the interventions are described.

Fitobentos

The background material of the VGT 6.1 methodological guidance states that studies have shown that the element's classification is related to chemical variables, but it has also been confirmed that diversity, which is treated as a priority indicator for nature conservation, is not related to the load, but rather influenced by the size of the water body/reservoir under study, water level fluctuations, etc.

It is therefore confirmed that the more natural the environment of a watercourse, the less land use and the less agricultural activity in the catchment, the better the phytobenthos data indicate. The same can be said for nutrient and organic matter load levels.

The document also shows how the different types of watercourses and their co-types are related.

In section I, the Danube is a medium flatland river in the Szigetköz, and a low-gradient chalky - rough river from Gönyüt. For this type, the background data show the strongest correlation with the measured data, especially with plant nutrients (nitrogen and phosphorus forms), and this also shows the influence of agricultural activity in the catchment, as well as an inverse correlation between biological and chemical oxygen demand and conductivity. In addition, the negative effects of damming, energy discharges and heat loads were also detected.

The navigation insurance programme, as demonstrated by the hydromorphological studies, has no impact on the above factors, so no deterioration is expected for this element.

Fitoplankton

The background material of the methodological guidance VGT 6.1 states that, in accordance with the requirements of the Water Framework Directive, the assessment of the ecological status of surface waters should take into account three characteristic parameters of phytoplankton; biomass, taxonomic composition and the frequency and intensity of aquatic blooms. Each of these characteristics must be quantified, characterized by a threshold value and converted into a set of metrics that can be combined into a single number to characterize the water.

The Water Framework Directive does not consider phytoplankton as a relevant biological element in the assessment of the ecological status of watercourses. However, a significant proportion of domestic watercourses can be said to be eutrophic based on their chlorophyll-a content. Although the dynamics of phytoplankton in rivers are influenced by factors that are less relevant for lakes, such as residence time or changes in water yield and associated suspended sediment content, it is also true for these waters that the biomass of phytoplankton varies seasonally and its succession can be followed.

The provision of the waterway is not expected to lead to any significant change in flow conditions, no damming or intervention that would alter the flow conditions and residence time in the river sections. The programme is therefore not expected to have a significant impact on the natural occurrence, composition and dynamics of this element in relation to the investment.

Macrophyton

As described in the background material of the VGT 6.1 methodological guidance, the classification is based on the sampling of a specific area, which requires due care and depends on the type of watercourse. The methodology is based on a census of aquatic higher plants (macrophytes). Aquatic macrophytes are defined as those plants that are visible and identifiable in the water at the time of observation by the naked eye (Holmes & Whitton 1977). A macrophyte group of organisms is capable of indicating changes over a longer time scale, i.e. it is not able to respond immediately to changes. It is particularly sensitive to changes in hydromorphological conditions and changes in plant nutrient concentrations.

The methodology considers the analysis of macrophytons relevant for watercourses according to the guidelines in Annex 4 of the Decree 31/2004 (XII.30.) "On certain rules for monitoring and status assessment of surface waters" in the following cases:

- Watercourses with uncertain nutrient and organic matter status
- Watercourses in a precarious position due to hydro-morphological reasons: reservoir, dam cross-section alteration, dredging, casing

Large rivers of the Danube size cannot be classified using the current system of ecological status classification of surface waters for higher vegetation in Hungary. The reason for this is that for large rivers of this size, the principles of the Water Framework Directive for the assessment of higher order vegetation are relevant for the assessment of the so-called "higher order vegetation". In the "channel area", which is of relevance for the higher order vegetation assessment, seaweed vegetation and emergent marsh vegetation are not found, or only in small scattered patches, mostly in flow dead zones associated with human interventions. Consequently, higher order vegetation (macrophytes) as a biological quality element is not relevant for the ecological status assessment of the Danube.

Macrozoobenton

According to the background material of the VGT 6.1 methodological guidance, the objects of the studies are macroscopic aquatic invertebrates (macrozoobenthos), which, through their presence, mass data and distribution of their populations, provide a good indication of the ecological status of water bodies, their naturalness and degradation processes due to human interventions. With the exception of a few groups, their systematic identification is not a major problem, the environmental requirements of the majority of species are well known, and their bioindication importance is therefore widely recognised. Birk et al. (2006). In the international ecological intercalibration process, a new stressor and species-specific multimetric assessment method (HMMI) has been developed for both running and standing waters. The methodological sampling guide lists the following major steps in the assessment of macroinvertebrate assemblages (planning, sampling, sampling, determination, data entry, assessment)

The methodology considers the analysis of macrophytons relevant for watercourses according to the guidelines in Annex 4 of the Decree 31/2004 (XII.30.) "On certain rules for monitoring and status assessment of surface waters" in the following cases:

- Chemical pressures: watercourses with uncertain status due to nutrients and organic matter
- Watercourses in a precarious position due to hydro-morphological reasons: reservoir, dam cross-section alteration, dredging, casing

The methodology considers the analysis of macrozoobenton relevant for watercourses according to the guidelines of the Annex 4 of the Decree 31/2004 (XII.30.) "On certain rules of monitoring and status assessment of surface waters" in the following cases:

- Chemical pressures: watercourses with unstable nutrient and organic matter
- Chemical load: watercourses in unstable conditions due to hazardous substances
- Watercourses with hydro-morphological instability: cross-sectional alterations, effects of regulation-related alterations
- Watercourses in a precarious position due to hydro-morphological reasons: effects of dredging, paving

The dredging interventions and regulatory interventions (new quarries) planned within the project to provide a shipping lane will definitely have an impact on the macrozoobenthos species assemblage locally, in the intervention sites and their immediate vicinity. The impact of dredging is expected to be gradually eliminated within a few years after construction. No significant changes in flow conditions are expected in major river sections as a result of the regulatory interventions. Locally, significant or substantial changes in flow conditions are expected to occur in the vicinity of the quarries. These changes will be reflected locally in the sediment grain size composition and macrozoobenthos pattern, which will also affect the rating result locally. In the areas of the riverbed affected by the new quarries, the natural substrate quality will be altered, with a higher incidence of invasive alien species, which will have a clear local negative impact on the composition of the macrozoobenthos and the ecological status assessment. The increase in vessel traffic is also expected to generate longer-term negative impacts.

Fish

The importance of monitoring with fish is justified (Fausch et al., 1990; Guti, 2001) by the fact that:

- fish occupy the upper levels of the aquatic food web and are therefore well integrated with changes in the ecological status of water bodies,
- the spatial scale of their life cycle and movement patterns best corresponds to the scale of the water body, watercourse section identified as a unit of qualification in the WFD,
- are relatively long-lived and therefore the mortality and age composition of their populations are indicative of environmental stress factors over a longer period of time; a time scale that cannot be investigated using other organism assemblages,
- they are suitable for indicating human disturbance effects to which other groups of organisms are not or only to a limited extent applicable (e.g. longitudinal permeability),
- they are relatively quick and easy to collect and identify,
- fish are a priority species for economic and conservation management, and the changes in fish are also the most important social concern.

Fish-based status assessment focuses on characterising the structure and ecological functional composition of the fish stock (species composition, abundance, age class distribution, guild presence, number, weight distribution) as opposed to a more complete faunal inventory. The variables that provide information on the structure and function of the fish stock are the basic parameters of a fish-based classification index. An important requirement is that standardised sampling methods should be simple and rapid, allowing routine surveys of multiple sites.

Of the planned navigation interventions, dredging interventions and interventions involving the installation of control stone works are expected to have an impact on fish stock structure. No longer-term adverse effects are expected for the dredging interventions planned in the shipping lane. Regulatory interventions are not expected to result in changes to flow conditions in major river sections that would appreciably alter stock structure. Mostly in the vicinity of the quarries, locally significant or substantial changes in flow conditions are expected, which will also affect fish distribution patterns. Artificial substrata in the immediate vicinity of the quarries and the new quarries are expected to have a significant impact on the stock structure. An increase in the number and abundance of alien and invasive sparrow species is expected, which will negatively affect the results of the ecological status assessment based on fish in the affected areas.

3.3.1.2 Impacts on surface water resources (Chemical and physico-chemical quality elements)

In this category, no category decomposition is likely to occur as a result of the investment.

3.3.1.3 Hydromorphological impacts on the riverbed

The ecological status of surface waters is significantly influenced by the morphological status, i.e. whether the water body provides the opportunity for movement (migration) of organisms, whether the variation in bed form and velocity provides the desired diversity, and whether the water yield and associated water level fluctuations allow for adequate water supply to the different plant zones at different levels. Because of the significant interaction, it is impossible to achieve good biological status if there is a significant change in the above condition characteristics, collectively referred to as hydromorphological conditions.

The expected impacts are presented using the VGT condition assessment system.

For the assessment of the hydromorphological status of watercourses, the authors of VGT2 considered the following 9 elements:

Morphology

- Land use in the river basin
- River bed regulation, changes in longitudinal section, cross-section and channel contour
- River bank protection, artificial materials in the river bank
- Characteristics of siltation, sedimentation and incision
- Relationship between watercourse and floodplain, presence of flood protection embankments

Interoperability

- Longitudinal permeability affected by artificial structures

Hydrology

- Changes in flow conditions due to the dam effect of artificial structures in the bed of a watercourse section;
- Fluctuations in water levels due to peak operation of hydroelectric power plants;
- Diversion of ecological low flows to be maintained in the watercourse due to abstraction or excessive transfers.

The assessment of the hydromorphological status of watercourses differs significantly from the physico-chemical and biological status assessments. While the former refers to the monitoring site and is assumed to be valid for the whole water body, the hydromorphological status assessment provides data for the whole water body.

Looking at the above elements, the following conclusions can be drawn:

Interoperability

Under the VGT classification scheme, permeability is primarily understood in terms of wildlife, particularly migratory fish species, but may also be important for other groups of water-bound organisms.

The assessment of the Danube River in this respect is as follows:

1 - The structures do not cause significant groundwater level subsidence and have no or negligible impact on the migration of organisms and sediment transport. In a combined water body, if one branch is free, permeability may be good.

3 - The presence of the structure has a moderate effect on the movement of organisms and sediment (e.g. the structure is impassable in low water but not in medium and/or high water, or the structure is impassable but fish species that prefer the current can migrate outside the weir period.)) Where the water body is complex and none of the branches are passable, but there is a significant tributary system that provides free migration in small watersheds, the impact is moderate.

5 - Artifacts that usually form a barrier to the free movement of all living organisms and sediment. The

permeability of the sub-water should also be taken into account, if it is not permeable, the rating is '5'.

As mentioned above, the surface water bodies affected in this section, and indeed the entire stretch of the Danube in Hungary, have been classified as 1.

The proposed stone works will not affect the longitudinal permeability of the above classification.

Hydrology

Based on the model studies, the planned interventions are not expected to have a dam effect that would cause a significant change in flow conditions, nor are hydropower plants, abstraction and diversions planned.

Morphology

According to the rating methodology (VGT2 background material 6.4), the VGT assesses morphology in 5 categories on a scale of 1-5.

1. The following interventions can be included in the scope of river regulation: river bed straightening, reinforcement of the river bed by bank protection stone spreading, installation of baffles, modification of the natural bank profile (embankment), dredging to change the width/depth ratio, cutting of bends, straightening of the river bed, etc.
2. Occurrence of artificial materials in the riverbed and/or on the shore (coverings)
3. Splashing/flooding characterisation: this property is mainly a measure of the wide range of loads on the watercourse. Its assessment is generally based on expert judgement, taking into account the type of watercourse, the presence/absence of near-natural features, and the intensity of treatment both in the bed (e.g., alignment changes, gravel removal, dredging) and in the catchment (e.g., tunnelling that increases sediment inputs). In the lowland conditions, it is natural for the riverbeds to be silted up, while the Danube and the Drava are suffering from high incision. Knowledge of the extent of siltation is essential if the water uses they serve (agriculture, nature conservation, etc.) are to be maintained or if the conditions that can be achieved by halting succession are to be considered good status. The technique of removing deposited sediment is important for the regeneration of biota.
4. Land cover in the immediate catchment
5. Relationship between water body and floodplain

For all variants, the impact of the interventions is expected to be due to changes in morphological conditions, but the provision of a shipping route has no appreciable impact on the land use of the river basin and does not affect the relationship between the watercourse and the floodplain. Of the five categories listed above, the first three are therefore appropriate to be considered under the Danube navigability programme. The studies are based on the VGT assessments to estimate the expected changes within the categories, taking into account the values in the VGT below.

As mentioned above, our investigations are mainly focused on the following two elements caused by stone works.

- River bed regulation, changes in longitudinal section, cross-section and channel contour
- River bank protection, artificial materials in the river bank

According to the VGT2 classification, the morphological status for the 3 water bodies concerned is presented in the table in section 3.1.1.

<u>Sea regulation:</u>

1 - 0% - 5% of the length of the bank altered in the cross or length section.
2 - ≥ 5 % - 15 % of the length of the bank altered in cross-section or length section.
3 - ≥ 15 % - 35 % of the length of the bank altered in cross-section or length section.
4 - ≥ 35 % - 75 % of the length of the bank altered in cross-section or length section.
5 - ≥ 75 % of the length of the bank altered in cross-section or length section.

Each water body concerned in this category has been given the following classifications:

11.táblázat condition due to bed regulation (based on tables 3.9, 6.4 of VGT2)

Water body code	Name of water body	the rate of bed siltation	description of river regulation	Condition due to sea regulation
AOC756	Danube between Szob and Budapest	0	-	1
AOC752	Danube-Budapest	0	-	1
AOC753	Danube between Budapest-Dunaföldvár	0	-	1
AOC754	Danube between Dunaföldvár and Sió estuary	26	The Danube has been regulated mainly for flood protection and navigation,	3
AOC755	Danube between the Sió estuary and the border	29	The Danube has been regulated mainly for flood protection and navigation,	3

In the context of the above, the extent of planned dredging in the river bed was considered and the proportion of regulated lengths and numbers of works in the VGT2 classification were compared with the current situation to assess the extent of the expected changes.

Dredging will be carried out in the Szob - Budapest section in the Nagymaros and Vác areas, in the wider 100 m band in the Nagymaros section, but the width of the bed is around 700 m, so the proportion of the bed section disturbed in relation to the cross-section is less than 15% for the almost 1 km of dredged section. Dredging in the Vác area is required for a narrow length of a few hundred metres, where the proportion of the cross-section disturbed is less than 5%. It is planned that the most significant dredging on the sections will be in the narrowing sections between Budafok and Kisapostag in the middle. In Budapest, dredging is needed at the Megyeri and Árpád bridges to ensure water depth.

However, dredging typically involves the dredging of sediments deposited in the fairway due to velocity differences in the channel in already controlled sections, i.e. the removal of local sediments narrow relative to the total channel width, minimising these interventions based on the iterative design process carried out so far. On the Danube, these interventions affect individual water bodies locally over a length of a few hundred metres to a maximum of 1 km, with the most significant length in the area of Dunaföldvár. The dredging will not cause any significant cross-sectional or longitudinal changes in the bed section, taking into account the length of the watercourse.

The number of works planned on this section is low, except for the Dunaföldvár section, where the deepening of the river bed has caused serious problems in recent years. Therefore, it is planned to install bottom fins, mainly to prevent the river bed from sinking, and to narrow the river bed with spurs to deal with the problems in the section below Dunaföldvár.

The following existing structures are located on the water bodies concerned in VGT2 3/9 as shown in the Annex (number of planned structures according to the current design status)

12.táblázat Artifacts on the stretch

Name of water body	Water body length (m)	existing spur/driver	designed spur/driver (innovative)	demolition of existing works
Danube between Szob and Budapest	77930	9	4/0	2
Danube-Budapest	37780	2	0	0
Danube between Budapest-Dunaföldvár	85420	57	5/0 (4)	1
Danube between Dunaföldvár and Sió estuary	63310	84	15/4(2)	3
Danube between the Sió estuary and the border	64500	74	1/1(1)	0

In addition to the above, the Szob - Budapest water body is typically characterised by the design of bottom fins, since, as shown in Table 3.9 of VGT2, the water bodies affected by the section have significant bed deepening due to previous regulations. The stabilisation of the river bed is justified to prevent this. The layout of the bottom thresholds is described in detail in section 2.2.

By modifying existing structures to current channel conditions and flow conditions in the controlled channel sections, modelling suggests that the channel section can be stabilised, but the use of innovative control devices such as chevron dams and cutting through existing corner channels to provide behind the structure and secondary bank flows will help maintain a variety of channel flow conditions

According to Table 11, the regulation rate up to Dunaföldvár is 0%, so these 3 water bodies are classified as 1. The regulation rate in the sections south of Dunaföldvár is 26%, and south of Sió is 29%, so the sections are classified as 3 status. Based on the above results, it can be concluded that the regulation rate in the water body does not change significantly, and no diversions of the river bed or tributary diversions of the backwaters are carried out. As the new works are planned in the already regulated sections, they are an addition to the previous regulation in order to improve the resulting channel conditions and to correct harmful erosion of the riverbed, and locally they affect such a short stretch of the riverbed that their installation cannot be considered as a substantial change to the riverbed that would cause a deterioration in its condition. On this basis, it is our opinion that the status classification of the water body for the purposes of river basin management should not be affected.

<u>Occurrence of artificial sediment in the riverbed and/or on the shore</u>

1 - Shoreline 0-5% covered by artificial material, or 0-10% with natural material bank protection, or 0% -1% of water body length with artificial material in the bank.

2 - Shoreline >5-15% covered by artificial material, or >10-50% with natural material bank protection, or ≥1% to 5% of water body length with artificial material in the bank.
3 - Shoreline >15-35% covered by artificial material, or >50-100% covered by natural material, or ≥5% -15% of water body length with artificial material in the bank.
4 - >35-75% of the shoreline is covered by artificial bank protection, or ≥15%-30% of the length of the water body is covered by artificial material in the bank.
5 - Shoreline >75% covered by artificial bank protection, or ≥ 30% of water body length with artificial material in the bank.

Each water body concerned in this category has been given the following classifications:

13.táblázat Proportion of artificial sediment

Water body code	Name of water body	Coast protection rate [%]	Percentage of pavement on the water body [%]	Status due to bank and shore protection
AOC756	Danube between Szob and Budapest	69,0	0,0	4
AOC752	Danube-Budapest	100,0	0,0	5
AOC753	Danube between Budapest-Dunaföldvár	54,0	0,0	4
AOC754	Danube between Dunaföldvár and Sió estuary	44,0	0,0	4
AOC755	Danube between the Sió estuary and the border	31,0	0,0	3

There will be no embankment armouring or bank protection interventions under the programme, the proportion of artificial bank surface in the planned works area will increase, but no deterioration is likely in this category in the Budapest section, as no deterioration is expected in any of the sub-criteria. In the Sió estuary - national border water body, a total of 3 works will be added to the current 74 works, which is such a small proportion that no significant deterioration is expected. On the Szob - Budapest section, the number of works planned is high compared to the existing ones, but the category classification reaches 4 due to the rate of stream protection, so that the rate of artificial material entering the riverbed does not exceed 30% compared to the length and the current state, so that deterioration is also unrealistic. Also between Budapest and Dunaföldvár and between Dunaföldvár and the Sió estuary, the placement of a large number of artificial structures in the riverbed cannot reach a rate of more than 30% compared to category 4 due to the shore protection ratio. Thus, category degradation is unlikely here either.

<u>Spall/impact characterisation</u>

1 - Charge/expansion character reflects near-natural conditions. No significant upwelling, but no significant downwelling.
3 - Character of recharge/impact moderately different from near-natural conditions (<50% of the above effects are present over the length of the water body)
5 - Character of recharge/exposure is highly different from natural (>50% of the length of the water body)
In this category, the entire Hungarian stretch of the Danube is classified as category 1.

Significant siltation, recharge and further incision should not be expected based on the results of the model studies. For the Danube, the reduction of significant incision has also been targeted in the planning programme and preliminary studies indicate that the bank deepening of critical sections can be improved by interventions. No category deterioration is likely.

3.3.1.4 Impacts on ecological status

The interventions planned for the development of the fairway are typically interventions with a small direct construction footprint, with localised degradation impacts during the construction phase. At the same time, the water bodies designated under the Water Framework Directive requirements on the Danube are of significant size, with lengths of several 10 km (see table in chapter 3.1.1)
The negative impact of planned dredging interventions in the fairway is expected to be eliminated within one to two years through colonisation from neighbouring areas not affected by dredging.
The new stone works planned as part of the interventions will increase the proportion of artificial hydraulic engineering stone surfaces already present in the riverbed, which will facilitate the further spread of invasive alien species, which is clearly a negative effect, but such substrates are also present in significant proportions in their current state, or unfortunately alien species are also present in the natural substrates.
The interventions are not expected to result in significant changes in flow conditions (flow velocity values) of a significant magnitude that would alter the habitat conditions of a significant length of the riverbed. More significant changes are expected locally in the vicinity of the new quarries.
As a result of the planned interventions, local, essentially negative changes are expected for the groups of organisms prioritised by the Water Framework Directive for the ecological status classification of surface water bodies. These local negative changes are expected to be felt primarily for aquatic macroscopic invertebrates and the fish assemblage.
Overall, these localised, negative changes are not expected to affect the status of the water bodies concerned to such an extent as to cause a measurable, detectable deterioration in their ecological status.

3.3.2 IMPACTS ON GROUNDWATER BODIES

3.3.2.1 Effects on quantitative and chemical status

The planned interventions to improve the parameters of the waterway may have a negative impact on the quantitative and chemical status of groundwater in the Danube section of the Szob-South border. These impacts could threaten the existing and future water resources along the stretch. Therefore, the assessment of the impacts of the planned interventions on aquifers and the reduction or elimination of negative impacts to acceptable levels is a particularly important task in the planning process.

It is not worth separating interventions according to whether they cause a change in the quantitative or chemical status of groundwater, because the water quality of the Danube and the chemical status of the transported sediment may cause a quantitative change and a chemical change.

For groundwater, interventions can be divided into two main types, depending on whether material is deposited in or removed from the aquifer protection area:

- Operations involving the direct placement of material: the construction of stone works or additions to existing works will involve the placement of a fraction of material in the bed that will not cause any change to the aquifer cover (no clogging or reduction of surface area), is not expected to interfere with the biochemical filtering function of the overlying layer of 15-20 cm, and is therefore not expected to have a direct impact on the quantity or quality of the water that can be extracted from the aquifer. The placement or geometric modification of the stone works will primarily cause loads from changes in flow velocity of the river water, which may result in sedimentation of transported sediment or leaching of bed material in the protection zone of the aquifer (these are discussed under indirect effects).
- Operations involving direct removal of sediment: where sediment removal (dredging, sediment

retrieval) takes place in the aquifer protection area, it will inevitably affect the aquifer cover (or even the aquifer), so the quantity (due to increased colimation) or quality (due to damage to the biochemical filtration membrane) of the water that can be extracted may be affected.

In addition to interventions that have a direct effect, there are also interventions that indirectly cause an increase (sedimentation) or decrease (leaching) in the amount of sediment by changing the flow velocity.

According to the so-called DPSIR[1] system, which defines the methodological principles for environmental impact assessments, interventions are considered as pressures that may modify the status of the river bed and aquifer and may affect the quantity and quality of water extracted (extracted) from the aquifer, as well as the operating conditions.

The pressures and potential impacts on the aquifer for each type of intervention in the aquifer protection area are summarised in the following table.

14.táblázat Groundwater pressures and potential impacts associated with interventions

Intervention	Load	Potential impact
Cotrás	Fluffing of the colmatised sediment layer	Breaches of the biochemical filtration membrane can allow pollutants in the Danube to enter directly into the aquifer and reach the wells, causing a temporary deterioration in the quality of the produced water.→ Important mitigation factors are sequestration and/or transformation in the aquifer and mixing (i.e. the ratio of the affected catchment area to the total recharge area in the catchment). Once dredged, there is a chance of re-forming a clogged filter layer
Construction of spur, chevron dam, bilge	Sedimentation above (possibly below) the works, or between the works and the bank, leading to the formation of a new sediment layer.	The sediment in the Danube has been found to contain substances that threaten the water base. New sediment is a →new source of pollution. Persistent sedimentation between the spurs and between the guide works and the shore is causing infilling and the development of reductive conditions. Sediment infiltration reduces the seepage coefficient of the bed and thus the amount of recharge. Above the bottom ribs, mainly rolled sediment is deposited, which tends to protect the previously formed colmatized layer or leads to the formation of a new layer.
	Spalling at the ends of the works and along the guideway, which also leads to damage to the colmatized layer.	An effect similar to dredging. Presumably temporary, as the bed is expected to stabilise and a clogged filter layer may re-establish during low water periods. The leaching may be so extensive that it also affects the aquifer gravel layer.
Extension of spur, conversion to T-gear	Depending on the nature of the rebuild, settling and/or leaching may also occur.	The effect of sedimentation or leaching as described above.

The planned interventions may directly (e.g. by removing the gravel layer) and indirectly (e.g. by modifying the flow and sedimentation conditions of the river) result in changes to the physical parameters and characteristics (aquifer thickness, upstream pressure gradient, sediment permeability and quality) that determine the process of bank filtration.

Based on our investigations, it can be concluded that no interventions are planned in the stretch of the Danube between 1708 and 1433 km that would be contrary to the provisions of Government Decree 123/1997 on the protection of water basins, or to the environmental objectives and measures contained in the River Basin Management Plan, or that would pose a significant threat to the safe operation or

[1] DPSIR: a method of environmental analysis developed by the European Environment Agency, based on the identification and assessment of the relationships between Drivers, Pressures, Status, Impact and Mitigation Measures.

long-term use of the water basin that would hinder the implementation of the project. However, at the EIA stage, the detailed impact assessment will be responsible for demonstrating whether or not the interventions will lead to deterioration in the status of individual water bodies. At the current design stage, this cannot be established with certainty.

In our opinion, the investigation of the Tököl, Szigetújfalu operating water basin deserves special attention in the detailed impact assessment, where several significant (relatively large-area) interventions (dredging, chevron dam reconstruction, construction of a bottom bank) will be carried out, and we can expect leaching and sedimentation in new locations compared to the current processes, the exact area, extent and extent of which should be subject to further investigation.

Given that the construction of stone works or the addition of existing works will involve the placement of a fraction of material in the bed that does not alter the aquifer cover (does not clog or reduce the surface area), the 15 to 20 cm layer above is not expected to interfere with the biochemical filtering function of the aquifer, and the placement of the stone itself is not expected to have a direct impact on the quantity or quality of the water that can be extracted from the aquifer. However, this will require further investigation and confirmation at the impact assessment stage.

In accordance with Government Decree 123/1997 (VII. 18.), the planned dredging in the hydrogeological protection area B of the Budaújlaki operating aquifer, the Solti Island remote aquifer and the Solt-Harta remote aquifer requires an impact assessment.

3.4 INTERACTION BETWEEN THE MEASURES FORMULATED FOR WATER BODIES AND THE INTERVENTIONS PLANNED UNDER THE PROGRAMME

3.4.1 SURFACE WATER

Below we describe, by water body, the measures that are relevant to the interventions under the programme and show how the development of the waterway will affect each of these measures.

Measures to improve the physical chemistry are not addressed at all, as their implementation is not affected by the fairway development.

Accordingly, the table below lists the measures relevant to the programme, and then describes in detail how they interact with the planned interventions, using the measure sheets in Annex 8.4 of the VGT2.

15.táblázat Measures for surface water bodies in the section (those not relevant to the fairway development are marked in grey)

Identifier according to VGT	Measures	Danube Szob-Bp	Duna Bp	Danube Bp-Dunaföldvár	Danube Bp -Sio estuary	Danube Sió estuary - oh
6.9a	Raising the sea level with bottom dikes and bottom fins, by silting up the bed between them					
6.2	Establishing appropriate vegetation in the surf zone					
6.3a	One-off removal of accumulated silt and in-stream vegetation in watercourses and standing waters					
6.5	Gradually achieving and maintaining the good ecological status and potential of watercourses and standing waters through maintenance works					

Identifier according to VGT	Measures	Danube Szob-Bp	Duna Bp	Danube Bp-Dunaföldvár	Danube Bp -Sio estuary	Danube Sió estuary - oh
6.6	Demolition of in-stream facilities that have lost their function, and progressive achievement of good ecological status and potential of the environment					
6.12.3	Reconstruction and maintenance of in-stream facilities, including the use of near-natural solutions and materials					
6.8	Improving the water availability of the floodplain and floodplain					
6.9	Reducing the impact of deeper than natural river beds and the resulting low and medium water level subsidence					
6.13	Adaptation of navigation to river or still water conditions					
7.1	Modification of the inland water drainage system					
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs					
34.2	To ensure the water quality required for nature conservation, in addition to other water quality protection measures.					
6.8	Improving the water availability of the floodplain and flood zone,					

Positive effects are expected for measures 6.ga, 6.3b, 6.6 , 6.9, 6.12.3, 33.2, 6.13. marked in green.

In designing the interventions, the use of innovative solutions has specifically favoured the design of works that follow the natural riverbed processes, with existing works in the already regulated sections being reviewed and supplemented for the whole river section. By regulating flow conditions in this way, and by designing the riverbeds, the design process has also addressed the significant problems of bed deepening in this stretch. The existing culverts have been fully reviewed and will be demolished, modified in height and rebuilt in places as described in section 2.2.

Aiming for conditions that approximate to natural channel conditions by experimentally cutting through existing spurs and providing secondary flow along the banks.

The description of the programme presented in section 2.1 shows that the variants were not developed independently but as part of an evolving design process, with ecological considerations as the most important element, with the aim of minimising the number of activities in the riverbed, including dredging activities and the number of works planned

Positive effect 6.ga, 6.3b, 6.6 , 6.9, 6.12.3, 33.2,

In addition to the above, while maintaining the highest possible level of professional standards, the programme also examined the design of the waterway with narrowed parameters on critical sections - mainly in the area of water sources - and the provision of one-way navigation on certain sections, based on the consideration of other options.

Positive effect for measure 6.13, neutral effect, no obstacle to implementation for measures 6.2, 6.3.a, 6.5, 6.8, 7.1, 34.2, indicated in grey.

Overall, the measures to achieve good status are partially facilitated and in no way hindered by the investment.

3.4.2 GROUNDWATER

Below we describe, by water body, the measures that are relevant to the interventions under the programme and show how the development of the waterway will affect each of these measures.

Accordingly, the table below lists the measures relevant to the programme and details how they interact with the planned interventions.

16.táblázat Measures for groundwater bodies in the section (those not relevant to the fairway development are marked in grey)

Identifier according to VGT	Short description, name of measures	sp.1.4.2	sh.1.5	sp.1.9.1	sp.1.10.1	sp.1.10.2	sh.1.7	sp.1.13.1	sp.1.13.2	sp.1.14.2	sp.1.15.2
2.1	General set of rules to reduce nutrient pollution in agricultural production, effective limitation of nutrient application in arable and plantation areas										
2.2	Actual limitation of nutrient leaching beyond the fund under a voluntary agri-environmental management (VEM) scheme										
2.3	Application of nutrients to arable land under agri-environmental management programmes (AEM) based on a nutrient management plan										
2.4	Land use conversion (field - grassland, field - forest, field - wetland conversion)										
2.5	Review of the regulation of the use of sewage sludge in agriculture (requirements and prohibitions).										
2.6	Promoting the use of sewage sludge in agriculture for environmentally sound nutrient management										
3.1	Pesticides regulation under the EU Pesticides Directive (for arable land, plantations and pasture)										
3.2	Restrictions on the use of pesticides under the agri-environmental management (AE) programme										
4.1	Remediation of contaminated land (excavation, monitoring, insurance, clean-up)										
7.1	Modification of the inland water drainage system										
7a.2	Registration, review, modification and authorisation of groundwater abstractions										
7a.4	Exploring alternative groundwater resources										
13.1	Ensuring drinking water quality at the tap, in line with the EU Drinking Water Directive (Completion of the Drinking Water Quality Improvement Programme + monitoring)										
13.2	Protection of drinking water sources, designation of protection zones, regulation and modification of activities										
13.4	Preparation and application of water safety plans										
21.1	Proper design, operation and control of municipal landfills										
21.5	Elimination of illegal landfills, landfill control, fines										
21.7	Implementation of the Waste Water Programme (sewerage,										

Identifier according to VGT	Short description, name of measures	sp.1.4.2	sh.1.5	sp.1.9.1	sp.1.10.1	sp.1.10.2	sh.1.7	sp.1.13.1	sp.1.13.2	sp.1.14.2	sp.1.15.2
	individual waste water treatment)										
21.9	Promoting and implementing additional sewer connections										
21.10	Reconstruction of sewer networks										
23.2	Precipitation management, retention of water within the slabs to increase infiltration and reduce run-off										
29.2	Modernisation of livestock farms under the EU Nitrate Principle										
33.2	Specific hydromorphological measures to improve the status of protected natural areas, including specific regulation of water abstraction, water management and water recharge to meet conservation needs										

A positive impact is expected for measures marked in green. Neutral impact, no barriers to implementation for measures marked in grey.

13.2 Protection of drinking water sources, designation of protection zones, regulation and modification of activities

The most important measure is to protect the gravel layers that ensure the water quality of the water bodies in the long term, in such a way that the navigability of the Danube is also ensured. To this end, particular attention must be paid to assessing the condition of the gravel layers and complying with the legal requirements. Although dredging and sediment removal are planned in the protection area of the aquifers, and in some cases the overburden may be affected, the gravel layer is unlikely to be disturbed. During the planning process, all solutions that could adversely affect the aquifer have been excluded, but only at a later stage of the planning process can the absence of any impact be established with certainty.

Measure 33.2 is discussed in the presentation of the surface water measures.

Overall, the measures to achieve good status are not hampered by the investment, but further studies are needed to verify this.

4 SUMMARY OF STUDIES CARRIED OUT SO FAR AND EXPECTED IMPACTS

Based on the studies carried out so far and described in this plan, we have presented the expected impacts on surface and groundwater bodies and the measures that can be associated with the programme.

In the following, we identify and summarise the further studies we consider necessary and the plans for carrying them out.

Based on the analysis presented in Chapter 3, it was concluded that the planned interventions in the Danube river reaches concerned mainly concern the effects of physical interventions in the riverbed, mainly due to construction, dredging, placement of artificial works in the riverbed and their impact on the riverbed, or indirectly due to changes in flow and seepage conditions.

Based on the analysis of these impacts and taking into account the current classifications of water bodies and the sensitivity of the classificatory elements to certain impacts, our analysis to date has demonstrated that the proposed development is likely to have localised impacts, mainly on wildlife, which are expected to be felt primarily on aquatic macroscopic invertebrates and fish assemblages. In addition to the protection of biota, an important focus will be on the assessment of indirect impacts on the coastal filtered waters along the Danube, which will also be examined with a strong emphasis on the expected impacts of the interventions.

Based on the analyses carried out so far, the magnitude of these effects is not expected to be significant, however, to confirm this fact, we consider it necessary to carry out the following studies.

- To establish baseline conditions for the investigation of biological elements at the sites concerned, and to assess them on the basis of previous investigations of the water body concerned.
- A more accurate assessment and identification of the expected impacts depending on the interventions
- Based on more detailed hydraulic engineering plans, the exact location of each intervention
- By specifying the construction technology required for the intervention.
- Indicate the quantities of material to be extracted and incorporated.
- Detailed assessment of interventions in the vicinity of certain aquifers, combined with hydrogeological modelling, in consultation with the individual aquifer operators.

Since the planned interventions are considered as EIA activities, we consider it appropriate and necessary to carry out the above studies in the EIA phase of the project.

Based on the analysis carried out so far, the planned interventions in the water bodies concerned are not expected to cause a deterioration of the category, nor to prevent the achievement of good status, so the planned interventions in the water bodies concerned and the long-term effects of the development, subject to the implementation of the planned mitigation measures, do not justify the application of the exemption under Article 4(7) of the WFD for any of the water bodies, but this conclusion needs to be complemented and supported by the results of the detailed impact assessments.

However, the inclusion of the Danube Waterway Development Programme as a future infrastructure project (JIP) is proposed in the Third River Basin Management Plan, as covered by the CCI 4.7 study.

Fishing conditions and consequences of improving the navigability of the Danube II.

Addressing the problems - targets to be achieved

Dr. Gábor Guti

2020

Content

Overview of fishing-related problems associated with the development of the fairway

The present study is related to the situation assessment study "*Fishing conditions and consequences of improving the navigability of the Danube*", which was prepared in December 2019.The study provides an overview of the socio-economic importance of the Danube fisheries in Hungary (sport fishing, recreation, fishing tourism, fish production for fishing purposes, etc.); the ecological conditions of fishing for fishing purposes; and the effects of river regulation and vessel traffic on fishing. It is not the purpose of this study to change vessel traffic, so this issue will not be addressed here.

The Danube is populated by a species-rich fish stock, but the quantity and composition of the fish stock often does not meet angling expectations, which can affect the attractiveness of a given fishery water area for angling tourism. The current problems related to the natural fish production in the Hungarian Danube stretch can be grouped under the following headings:

1) Problems related to pressures from the socio-economic use of river water

1.1) As a result of water and land use, the Danube is now a heavily modified river, which has lost its natural character in many respects.

1.2) As the natural river regime changes, the spatial extent of the original floodplain aquatic-terrestrial transition zone has been reduced by an order of magnitude and its biological functions (e.g. fish production and reproduction) are increasingly limited.

2) Problems related to sectoral and environmental policy management of adverse environmental change

2.1) The conditions for integrated river management are partially met, but the interests of fisheries management are not sufficiently taken into account.

2.2) Managing extreme hydrological situations in a social, economic and ecological context is difficult.

3) Problems resulting from natural processes

The interconnection between ensuring the navigability of the Danube and the management of fish for angling purposes mainly concerns problem areas 1.1) and 2.1).

Current problems - changes in natural hydromorphological and ecological processes since the 19th century

As a result of the regulation of small and medium-sized watercourses, the stabilisation of the banks, the limitation of reef formation, the straightening and channelisation of the riverbed have modified the water and sediment transport of the Danube and the dynamics of the hydromorphological processes that shape the riverbed. Due to unfavourable erosion processes in the upper catchment, large quantities of suspended sediment are transported by the larger tidal waves, much of which is deposited in the floodplain between the hydraulically unfavourable flood protection embankments. Changed, more violent and extreme water dynamics reduce the duration of surge inundation, making spawning bed eggs more likely to be dried out and fry more likely to become trapped in surge flats. The construction of hydraulic structures that block tributaries has fragmented river habitats, limiting fish migration, habitat use, reproduction and food sources. Technical interventions and their consequences that are detrimental to the maintenance of the Danube's natural fish productivity:

- straightening the river bed, cutting the bends
  - increased sedimentation
  - increasing erosion and sedimentation
  - decreasing trend in low and medium water levels
  - drying up and loss of wetlands and other wetlands
  - loss of diversity in aquatic habitats
- limiting the development of sinuosity and lateral migration of the bed
  - limiting natural habitat dynamics (regeneration process)
  - ageing and loss of wetlands and other wetland habitats
  - loss of diversity in aquatic habitats
- eliminate reefs and limit their development
  - loss of diversity in aquatic habitats
- limiting direct contact between the main river bed and tributaries
  - fragmentation of habitats, limited permeability
  - slowed water flow and siltation in tributaries
  - drying up and loss of wetlands and other wetlands
  - loss of diversity in aquatic habitats
- limiting the dispersion of floods (increasing the negative impacts of fairway development)
  - rising flood levels
  - increased sedimentation of suspended sediment on the breakwaters
  - formation of belt reefs
  - the isolation and increasing drying out of some wave-front aquatic habitats
  - loss of diversity in aquatic habitats

Current problems - limited advocacy capacity of fish farmers

Extensive river regulation since the 19th century has inevitably, and in many cases irreversibly, changed the natural environment to which the Danube's biota has adapted during its evolutionary development. Since the end of the 20th century, the growing societal demand for environmental and nature protection has made it necessary to find sustainable solutions to water problems and to develop integrated river management with an ecological approach. This aims at the coordinated development and use of water, land and associated resources, while maintaining social well-being and without compromising the conservation of vital ecosystems and natural values (biodiversity, exploitable river fish stocks, etc.). Coordination does not simply place exploitation activities side by side or on top of each other, but also adapts them to the natural regulating factors of the environment. An important requirement is that ecological considerations should be incorporated as a horizontal principle in all policies, even at the conceptual planning stage. In the context of integrated river management, the protection of exploitable river fish stocks as a public asset, the maintenance and increase of natural fish production and the provision of the necessary conditions for this are of fundamental interest for river fisheries management for angling purposes. The following problems should be taken into account in this context:

- There is an over-emphasis on economic interests in water and land use (this is also the case to some extent in angling, e.g. the attempt to increase ticket sales per area, mass stocking of alien carp species, etc.)
- There is no unified management organisation for Danube fisheries, the existing county fisheries organisations have limited financial resources, fragmented intellectual resources and ineffective advocacy.
- The organisations involved in Danube fisheries management do not have a comprehensive action programme to effectively address the problems related to the sustainable exploitation and development of the river's fish stocks.

Potential problems - impact of the planned fairway development on fish stocks and fish farming

Navigation is currently only possible on the Hungarian stretch of the Danube with significant restrictions on space and time. Several solutions can be envisaged to improve the morphology of the riverbed to better meet the needs of navigation, using different technical interventions:

Version I (rule-following)

Version I (compliance), which fully meets the requirements with conventional river control works, includes the following technical interventions:

- gas scraping in the fairway area
- height demolition of previously constructed stone works
- construction of new quarries or additions to existing quarries
- bank stabilisation with bottom fins
- bank stabilisation by backfilling with rolled gravel

Version II (updated)

Option II (upgraded), which fully complies with the requirements, but complements the most beneficial traditional interventions with innovative solutions and habitat protection measures, includes some additional options:

- chevron-shaped baffle
- relocation of the fairway in some places

Version III (impact-optimising) / III /a (minimum)

A version III (impact-optimising), which is more flexible and optimises the options for intervention, and a version IV (minimum), which is even more flexible, can be developed by eliminating any errors (environmental problems, disproportionate costs, unsustainability, etc.) identified by the evaluation of the updated version. The solution proposed is, in particular, a narrowed channel width (100 m wide), not always two-way, but with a permanent navigation channel, where the required navigability period and water depth are guaranteed.

Some of the technical installations proposed for the improvement of the fairway will have a different impact on the fish stocks in the river, may affect the population dynamics of fishable species and, through this, the interests of fish farmers and the opportunities for angling as a recreational sport. The following criteria have been used to assess interventions that promote navigability:

- analysis of the hydromorphological and other physical changes expected with the implementation of the technical installation, based on available information
- analysis of the effects of expected hydromorphological and other physical changes on fish
- an assessment of the significance of the impact if the impact on fish is adverse. An analysis of the spatial and temporal extent of the impact (local or larger scale, or intermittent or long-term). Local, where the impact on fish is observed in the vicinity and immediate vicinity of the technical intervention. Larger scale, when it affects the distribution of certain fish species beyond the vicinity of the technical intervention or modifies the dynamics of certain fish populations.
- assessment of the likelihood of an adverse effect: whether a decline in population dynamics of certain fish species is expected (less likely, likely, very likely)

In assessing technical facilities, we focused on the effects on natural fish stock dynamics, as opposed to potential changes in accessibility to water areas more frequently visited by anglers.

Gas scooping

Expected hydromorphological and other physical changes

- removing the surface of gravel or marly water bodies
  - Increase in slope
  - changes in hydraulic conditions (flow velocity, bank slip stress, etc.)
- disruption of the surface armoured gravel layer,
  - the extent of soil erosion,
  - reduction of low water levels in the event of progressive encroachment
- increase in the volume and deposition of dredged suspended sediment elsewhere
- noise from dredging machines

Effects of expected hydromorphological and other physical changes on fish

- changes in hydraulic conditions due to dredging may damage potential spawning areas
- low water levels, which are lowered by bedding, may limit the availability of some intertidal areas for fish

- an increase in the amount of suspended sediment is a threat to the fry, reducing their feeding frequency and growth rate, and the sedimentation threatens spawning grounds
- loud noise from dredgers increases the production of cortisol, known as the anti-stress hormone, in fish, adversely affecting their reproduction

Spatial and temporal extent of potential negative impact on fish

- impact of hydraulic changes on spawning sites: spatially local and long term
- the impact of falling low water levels: spatially larger scale and long duration
- the effect of an increase in the volume of suspended sediment: spatially larger scale and periodic
- noise exposure of excavators: local and intermittent in space

Probability of decline in population dynamics of certain fish species

- impact on spawning areas damaged by hydraulic changes: less likely (hardly demonstrable)
- impact of limited accessibility of intertidal waters: very likely (depending on the natural conditions of the site)
- expected reduction due to fry at risk from suspended sediment: likely (no experience)
- reproductive effect of strong noise from excavators: likely

Height reduction of previously constructed stone works

Diversion plants

Expected hydromorphological and other physical changes

- an increase in the amount of suspended sediment when the stones are removed
- variation of the hydraulic conditions around the diversion plant depending on the amount of stone removed
- rearrangement of the morphology of the riverbed in response to changes in hydraulic conditions

Effects of expected hydromorphological and other physical changes on fish

- an increase in the amount of suspended sediment endangers the fry, reducing their feeding frequency and growth rate
- the slower flowing water areas and morphological formations (reefs, shoals, etc.) in the downstream reaches of diversion structures are often useful habitat structures for fish (shelter, spawning, feeding, nursery, spawning, spawning, spawning)

Spatial and temporal extent of potential negative impact on fish

- the effect of an increase in the volume of suspended sediment: spatially larger scale and periodic
- the impact of changes in habitat structures: spatially local and long-term

Probability of expected decline in population dynamics for each species

- expected reduction due to fry at risk from sediment: less likely
- impact of changes in habitat structure on populations: less likely

Transmission

Expected hydromorphological and other physical changes

- an increase in the amount of suspended sediment when the stones are removed
- variation of the hydraulic conditions around the diversion plant depending on the amount of stone removed
- slight rearrangement of the morphology of the riverbed in response to changes in hydraulic conditions
- leaching of finer-grained sediment deposited along the shore side of the powerplant

Effects of expected hydromorphological and other physical changes on fish

- an increase in the amount of suspended sediment endangers the fry, reducing their feeding frequency and growth rate
- the cavity system between the stones in the guide works is often a useful habitat structure for fish (shelter, feeding area, spawning area) - as the stones are removed, its extent is reduced
- the shore side of the guide works is a more sheltered area of water, protected from vessel waves, with favourable flow conditions and feeding opportunities for juvenile fish species - the removal of stones can affect the composition and distribution of juvenile fish assemblages

Spatial and temporal extent of potential negative impact on fish

- the effect of an increase in the volume of suspended sediment: spatially larger scale and periodic
- the effect of the reduction of the cavity system between the stones: spatially local and long-lasting
- reduction in the extent of the water body, which is more protected from wave action: spatially localised and long-lasting

Probability of expected decline in population dynamics for each species

- expected reduction due to fry at risk from sediment: less likely
- impact of changes in habitat structure on populations: less likely
- impact of changes in fry species assemblages on populations: less likely

Construction of new stone works, additions

Diversion plants

Expected hydromorphological and other physical changes

- changes in the hydraulic conditions around the diversion plant depending on the amount of stone installed
- rearrangement of the morphology of the riverbed in response to changes in hydraulic conditions
- reduction of low water levels in the event of encroachment

Effects of expected hydromorphological and other physical changes on fish

- the slower flowing water areas and morphological formations (reefs, shoals, etc.) in the downstream reaches of diversion structures are often useful habitat structures for fish (shelter, spawning, feeding, nursery, spawning, spawning, spawning)
- in the case of embeddedness, falling low water levels may limit the availability of some intertidal areas for fish

Spatial and temporal extent of potential negative impact on fish

- the impact of falling low water levels: spatially larger scale and long duration

Probability of expected decline in population dynamics for each species

- impact of limited accessibility of intertidal waters: very likely (depending on the natural conditions of the site)

Transmission

Expected hydromorphological and other physical changes

- changes in the hydraulic conditions around the guide depending on the amount of stone installed
- rearrangement of the morphology of the riverbed in response to changes in hydraulic conditions
- there may be deposition of finer-grained sediment along the shore side of the guideway

Effects of expected hydromorphological and other physical changes on fish

- the cavity system between the stones in the guideway often provides a useful habitat structure for fish (shelter, feeding area, spawning area)
- the shore side of the power plants is a more sheltered area of water, protected from the waves of ships, with favourable current conditions and feeding opportunities for juvenile fish species

- the accumulation of finer-grained sediment changes the composition of the species assemblages of fish that inhabit the area

Spatial and temporal extent of potential negative impact on fish

- the impact of the formation of a slurry basin in general(!): spatially local and long-lasting
- the impact of the formation of a rifted basin section on a case-by-case(!) basis: spatially larger scale and long term

Probability of expected decline in population dynamics for each species

- impact of local changes in species assemblages on populations: less likely
- the impact of large-scale changes in species assemblages on populations: likely

Stabilisation of riverbeds by the creation of bottom fins

Expected hydromorphological and other physical changes

- changes in the hydraulic conditions around the bottom depending on the amount of stone incorporated
- rearrangement of the morphology of the riverbed in response to changes in hydraulic conditions
- a reduction in the downward trend of low water levels as the bedding of the river bed slows down

Effects of expected hydromorphological and other physical changes on fish

- not known

Spatial and temporal extent of potential negative impact on fish

- not known

Probability of expected decline in population dynamics for each species

- less likely

Stream stabilisation by backfilling with rolled gravel

Expected hydromorphological and other physical changes

- the extraction of gravel for backfilling will result in the pressures described for gas scooping (*backfilling will require more gravel than can be provided by the planned gas scooping!*)
- changes in hydraulic conditions
- rearrangement of the morphology of the riverbed
- the increase in the amount of suspended sediment when the sediment is filled
- reduction in sedimentation of the river bed

Effects of expected hydromorphological and other physical changes on fish

- bank stabilisation by backfilling with rolled sediment can damage spawning grounds, nursery grounds, food sources and spawning grounds

Spatial and temporal extent of potential negative impact on fish

- the impact of adverse changes to important habitats: larger scale and longer-term

Probability of expected decline in population dynamics for each species

- impact of habitat change on populations: very likely

Chevron-shaped baffle

Expected hydromorphological and other physical changes

- variation of the hydraulic conditions around the chevron shaped baffle depending on the amount of stone installed
- rearrangement of the morphology of the riverbed in response to changes in hydraulic conditions
- reduction of low water levels in the event of encroachment

Effects of expected hydromorphological and other physical changes on fish

- the varied water flows and morphological formations (reefs, shoals, etc.) in the downstream section of the chevron shaped diversion can provide useful habitat structures for fish (shelter, spawning, feeding, nursery)
- in the case of embeddedness, falling low water levels may limit the availability of some intertidal areas for fish
- *we do not yet have direct experience of the effects of chevron baffles, but it can be assumed that they induce more favourable hydromorphological changes for fish than conventional baffles*

Spatial and temporal extent of potential negative impact on fish

- the impact of falling low water levels: spatially larger scale and long duration

Probability of expected decline in population dynamics for each species

- impact of limited accessibility of intertidal waters: very likely (depending on the natural conditions of the site)

Relocation of the fairway

Expected hydromorphological and other physical changes

- In the absence of technical interventions, there is likely to be no

Effects of expected hydromorphological and other physical changes on fish

- not known

Spatial and temporal extent of potential negative impact on fish

- not known

Probability of expected decline in population dynamics for each species

- not known

Narrowed fairway

A narrower waterway will involve less technical intervention and therefore presumably less pressure on river fish stocks. However, there may be questions about how the speed of navigation in the narrowed fairway is controlled. If waiting time is compensated for by faster passage through the narrowed channel, the negative effects of stronger wave action should be considered.

Address the problems identified by promoting the interests of fish farmers

Based on the problems identified in connection with the development of the fairway, it can be concluded that the species richness of the Danube's natural fish fauna and the fish population that can be exploited for fishing purposes can be maintained in the long term if the further decline in the diversity and connectivity of aquatic habitats can be halted, and the biological production of fish populations can be increased if the restoration of degraded or lost wetlands can be solved. These conditions fit well with the concept outlined in the EU Water Framework Directive. The Hungarian stretch of the Danube is classified as highly modified, where good ecological potential is considered as the target status to be achieved. The hydromorphological criteria for this can be summarised as the need to strive for any intervention that ensures the free movement, migration, feeding, reproduction and normal development of aquatic organisms, including fish.

The essential interests of Danube fisheries for angling can be served if the design of interventions to improve navigability seeks solutions to achieve the following objectives:

- increasing the area of open floodplains and floodplains that are periodically flooded and have adequate water dynamics,
- improving lateral permeability between the main riverbed and tributaries,
- improving the interoperability and connectivity of the tributaries,
- establishing links between the river and its tributaries, river flats, cubbyholes, potential wetlands, spawning areas, nursery areas,
- maintain and enhance the diversity of aquatic habitats
- taking into account biologically important periods (e.g. spawning season, winter harvesting) when designing the operation of water level control structures

In the planning process, the tasks leading to the achievement of the objectives should be defined by first analysing the feasibility of eliminating the causes of the problem and then identifying the necessary and possible interventions. Solutions that address multiple problems and improvements should be prioritised.

Increasing the area periodically flooded in open floodplains and floodplains

The technical interventions to improve the navigability of the Danube do not directly affect the floodplains and floodways, and are therefore not addressed here. However, there are a number of possibilities to compensate for the impacts of activities on fish habitats in this area.

Improving lateral access between the main riverbed and tributaries

The section of the Danube between the Sáp and the southern border is free-flowing, and therefore the problem of limited navigability is only encountered laterally, between the main riverbed and the tributaries, and between the river and the floodplains. The river's species-rich natural fish population can be maintained in the long term if fish can move freely towards the regularly submerged floodplains and open floodplains, exploiting the spawning habitats and food sources that develop there.

Technical interventions to improve the navigability of the Danube have less direct impact on lateral navigability, but maintaining navigability contributes to the gradual embedding of the main riverbed, a process that reduces the frequency and durability of the river's links with the floodplain.

The formation of reefs can be observed in several stretches where the sediment-laden floodwaters leaving the mid-water bed are slowed down by the roughening effect of riparian vegetation and therefore deposit a significant part of their sediment. The areas behind the higher reefs parallel to the shore can only be inundated by higher tides than before, thus allowing fish to reach their potential spawning grounds later. A further problem is that following a strong ebb, masses of breeding fish, and especially fry, become trapped in the deeper flats of the floodplain, where they tend to die. However, the situation can be improved by targeted opening and clearing of the reefs and the creation of a living connection between the deep areas by dredging of gradual pools. This should be done in such a way that water and fish can return to the river from the low-lying areas when the river is low.

If lateral permeability is limited by a technical facility (e.g. longitudinal guideway), the need for the basic function of the obstructing facility should be considered when designing an intervention to improve connectivity. If not, its removability should be analysed. If the basic function of the barrier is still needed, the technical feasibility of achieving the desired permeability (flat ramp with a grating made of crop stones, hall stairs, ecological corridor, etc.) should be analysed.

Figure 1: Alluvial blockage at the mouth of the Gödi tributary, limiting lateral passage between the main channel and the tributary.

Improving the interoperability and connectivity of tributaries

One of the key problems in maintaining the natural habitat diversity of the river system is the siltation, isolation and increasing drying up of tributaries and backwaters. Tributary siltation and recharge is a natural process, but unless it is accompanied by the development of new tributaries, the habitat diversity of the river system will gradually decline. River regulation since the 19th century has severely limited the natural hydromorphological processes that continuously shape the Danube riverbed, and new tributaries are no longer forming. The ageing of tributaries has become common along the Hungarian stretch of the Danube, and their long-term survival must therefore be ensured by periodic restoration interventions (opening of barriers, modification of threshold levels, cleaning of beds, dredging, etc.). The maintenance of habitats with different connectivity (eupotamon, parapotamon, plesiopotamon) is an important aspect of restoration. The rehabilitation of tributaries and estuaries is a key means of compensating for the impact on fish habitats. The details of this will not be dealt with here, but it is important to stress that a general scheme should not be applied, but that individual plans should be developed for each water body.

Figure 2: A drying up tributary in the Gemen floodplain. An important fish habitat at medium water levels.

Conserve and enhance the diversity of aquatic habitats

Due to the lowering of the Danube's low and middle water levels, the formerly mostly submerged gravel reefs have become relatively high and remain dry for longer periods, and have therefore started to colonise with terrestrial vegetation. The increased vegetation reduces the velocity of flowing water during floods, and the accumulation of suspended sediment around the plants leads to the filling and islanding of the reefs. Vegetation development and recharge are mutually reinforcing processes. As former shallow gravel reefs develop into vegetated islands, important spawning, nursery and feeding habitats for reophilic fish species (marlin, paducus, etc.) are lost. This island formation reinforces the Danube's proximity to nature. However, if the loss of former gravel reefs is not followed by the formation of new reefs, the process will be detrimental to the reproduction of many river fish (mostly fishable or protected species).

Figure 3: Gravel reef in the Vác area. Important habitat for several reophilic fish species. The reef is observed to protect the area of water on the opposite side from moderate tides.

The development of reefs into islands can reduce the capacity of a riverbed to discharge floodwaters, so one of the tasks of river basin management is to control this. This can be done by removing woody vegetation or by targeted removal of reefs and islands. The extent of the deepening of the water table should be determined in such a way as to ensure that flooding is as frequent as in the past (taking into account the extent of the fall in the low and medium water levels). The intervention will create shallow gravel reefs that can be used as spawning and nursery habitat for reophilic fish species.

In addition to cutting back the surface of the forested coastal reefs (**Figure**) that have formed in the filled spur channels, consideration should be given to creating a secondary drainage channel by cutting through the spur channels. In addition to the partial removal of the reef, efforts should be made to preserve some insular plant communities and some trees (legacy trees). The remaining part of the reef will be between the secondary bed and the main bed, parts of which will be stabilised by the retained woody vegetation. The creation of a secondary bank, partly protected from the waves generated by the ships, is justified not only from the point of view of fish farming but also from the point of view of nature conservation and landscape. The design should aim to create not a straight and homogeneous channel, but a varied bed with a variable structure, depth, bottom width and slope (1:0.5 - 1:20). This will provide a larger drainage channel with shallow reefs to increase habitat diversity.

Figure4: Forested coastal reef formed in the middle of a filled polar channel (lower left corner of the image).

Figure 5: Incipient forestation on a coastal reef in a filled polar channel. Habitat for fish when covered by water. Favoured fishing site.

The protection of natural or semi-natural habitats and hydromorphological formations and shorelines, as well as the maintenance of the hydromorphological processes that shape the habitats, are important issues in the conservation of the aquatic habitat diversity of the Danube water system. Protected areas are generally designated on the basis of conservation priorities (occurrence of rare, threatened or endemic species; species richness, etc.). Conservation-oriented habitat protection coincides to a certain extent with the interests of angling-oriented fisheries management, while the latter's approach focuses on the natural replenishment and sustainable exploitation of populations of fish species that can be fished. When identifying habitats of conservation importance, attention should be paid to areas that represent a bottleneck in the development cycle of river species (spawning, early development and overwintering).

Before the Danube's banks were regulated, large amounts of trees fell into the riverbed from wooded and grove areas as a result of bank erosion. These trees increase habitat diversity and are beneficial for fish. The occasional accumulation of sediment and the root and branch systems of riparian trees often provide shelter or spawning substrate for many species of fish. Fisheries management has an interest in retaining waterlogged trees, provided they do not impede flood flow and do not threaten recreational boating.

Figure 6: Near-natural coastline along Szentendrei Island. The wooded shoreline, which is submerged at higher water levels in spring, is used as a shelter and spawning ground by many fish species.

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DANUBE WATERWAY DEVELOPMENT PROGRAMME

Section II (Szob - southern border)

Strategic Environmental **Assessment**

ANNEX 9 TO THE ENVIRONMENTAL ASSESSMENT

BACKGROUND

Preliminary Natura 2000 assessment

Budapest, September 2020

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1 SPECIAL PROTECTION AREAS FOR BIRDS

1.1 Börzsöny and Visegrád Hills (HUDI10002) Special Protection Area for Birds

The planned interventions for the development of the navigation route on the Danube between Szob and the southern border of the country will affect the Börzsöny and Visegrád Mountains Special Protection Area (HUDI10002) between sections 1694 and 1702 fkm. The ornithological values of the Börzsöny and Visegrád Hills Special Protection Area (HUDI10002) are summarised in the ***Table 1***below.

Table 1 : Species of Community importance of the Börzsöny and Visegrád Hills Special Protection Area and migratory populations of other migratory species

Name	Scientific name	Range size (min-max)				Classification by stock size
		breeding / nesting	permanent	wintering	parade / rally	
uhu	*Bubo bubo*		3 - 5 pairs			C
cercerèce	*Bucephala clangula*			200 - 500 individuals		C
sooty clothes	*Chlidonias niger*				50 - 100 individuals	C
white stork	*Ciconia ciconia*		-			C
white stork	*Ciconia ciconia*				50 - 100 individuals	C
black stork	*Ciconia nigra*		10 - 15 pairs			B
snakebite	*Circaetus gallicus*		1 - 2 pairs			C
Blue Pigeon	*Columba oenas*		300 - 500 pairs			B
white-backed woodpecker	*Dendrocopos leucotos*	100 - 100 pairs				A
medium wood pancake	*Dendrocopos medius*	-				B
black woodpecker	*Dryocopus martius*	-				B
moustached trunk	*Emberiza cia*		10 - 30 pairs			C
peregrine falcon	*Falco peregrinus*	5 - 10 pairs				A
ornate flycatcher	*Ficedula albicollis*		500 - 500 pairs			B
small flycatcher	*Ficedula parva*		10 - 30 pairs			B
meadowlarks	*Haliaeetus albicilla*				5 - 15 individuals	C
meadowlarks	*Haliaeetus albicilla*			5 - 15 individuals		C
wood lark	*Lullula arborea*		-			C
small helmet	*Mergus albellus*				30 - 50 individuals	C
small helmet	*Mergus albellus*			30 - 50 individuals		C
mountain wobbler	*Motacilla cinerea*		30 - 50 pairs			B
Fishing Eagle	*Pandion haliaetus*				5 - 10 individuals	C
wasp buzz	*Pernis apivorus*		30 - 50 pairs			B
hamvas spokesman	*Picus canus*	20 - 20 pairs				C

Name	Scientific name	Range size (min-max)				Classification
tile trowel	*Sterna hirundo*				5 - 10 individuals	C
urali owl	*Strix uralensis*		1 - 3 pairs			C
lamb's lettuce	*Sylvia nisoria*		-			C

Among the candidate species of Community importance, the Uhu (*Bubo bubo*), the Scaup (*Circaetus gallicus*), the Peregrine Falcon (*Falco peregrinus*), the Horned Owl (*Pernis apivorus*) and the Great Grey Owl (*Strix uralensis*) are not considered to be affected, based on the data and experience of surveys and the habitat and foraging habitat preferences of the species, and therefore cannot be considered as being affected by the proposed interventions.

In the case of other migratory bird species of non-Community importance regularly occurring in the European Community, as listed in Annex 1 B) of Government Regulation No 275/2004 (including the above species, such as the wader, blue pigeon, whiskered dove, and waders), the works in the riverbed and the riverbed edge may affect the populations. These impacts are typically visual and acoustic disturbance impacts, temporary, limited to the construction/execution phase and not significant for the species concerned.

Species of Community importance include the white stork (*Ciconia ciconia*), black stork (*Ciconia nigra*) and white-backed woodpecker (*Dendrocopos leucotos*), Middle Woodpecker (*Dendrocopos medius*), Black Woodpecker (*Dryocopus martius*), Lesser Spotted Woodpecker (*Ficedula parva*), White-tailed Eagle (*Haliaeetus albicilla*), Wood Lark (*Lullula arborea*), little buzzard (*Mergus albellus*), mountain wagtail (*Motacilla cinerea*), osprey (*Pandion haliaetus*), waders (*Picus canus*), terns (*Sterna hirundo*) and widgeon (*Sylvia nisoria*), foraging or feeding individuals may be affected by works in the bed and along the edge of the bed. These impacts are typically disturbance effects through visual and acoustic stimuli (presence and noise of construction-related activities (machinery and workers actively involved in the construction)), which are temporary and limited to the construction/execution phase.

Due to the localised nature of the works and the relatively small direct impact area of the construction of the individual project elements, the candidate populations or individuals of candidate species affected by disturbance are able to avoid disturbance and move to main and tributary sections of the river that are not currently affected by construction works. In any case, these sections, which are not currently affected by the works, are within easy reach of the species concerned and their habitat characteristics are considered to be the same as those of the affected species. As a result, the disturbance impacts detailed above are not significant.

Based on the experience of the field surveys, no direct impact on the nesting sites of candidate bird species is expected.

In the case of land-based work and land-based approaches to coastal interventions, indirect disturbance of nesting sites and consequent indirect disturbance can be assumed for at most one or two species, such as the swift flycatcher and the spotted flycatcher. However, due to the proximity of roads, railways and inhabited areas to the main branch of the basin of the Börzsöny and Visegrád Hills Special Protection Area (SPA HUDI10002), which is affected by the proposed intervention, the collateral disturbance is not significant compared to the baseline condition without the project.

As a result of the planned interventions, the habitat conditions of the Danube section of the Börzsöny and Visegrád Mountains Special Protection Area (SPA HUDI10002) will not be significantly altered for the area's indicator bird species or for the indicator migratory/assemblage populations of other migratory bird species. At present, there are no data available to suggest that shipping traffic would have a significant negative impact on the designated species of Community importance and migratory/assemblage populations of the Danube section concerned, negatively affecting their feeding, breeding or population dynamics. For this reason, no direct negative impacts are expected even with the significant increase in traffic forecast. Indirect negative impacts may occur through impacts on populations of other species, e.g.

foraging organisms. The potential indirect effects are certainly negative in nature, but there are no usable data of a basic research nature available to estimate their magnitude.

Overall, based on the information available to us, **if the proposed mitigation measures for nature conservation purposes are adhered to, no significant adverse impacts on the reasons and objectives of the designation of the Börzsöny and Visegrád Hills Special Protection Area (HUDI10002) are expected, neither during the construction nor in the post-construction period.**

1.2 Gemenc (HUDD10003) Special Protection Area for Birds

The planned interventions for the development of the navigation route on the Danube between Szob and the southern border will affect the Gemenc Special Protection Area for Birds (HUDD10003) between sections 1468 and 1499 fkm. The nominated ornithological values of the Gemenc SPA are summarised in the **Table 1**

Table 1 : Species of Community importance of the Gemenc Special Protection Area and migratory populations of other migratory species occurring in the area

Name	Scientific name	Range size (min-max)				Classification by stock size
		breeding /nesting	permanent	wintering	parade / rally	
kingfisher	*Alcedo atthis*	80 - 90 pairs				A
kingfisher	*Alcedo atthis*			20 - 30 individuals		C
large lily	*Anser albifrons*			5000 - 5000 individuals		C
sowing goose	*Anser fabalis*			3000 - 4000 individuals		A
Parlagi eagle	*Aquila heliaca*				2 - 5 individuals	C
gypsy rice	*Aythya nyroca*		3 - 5 pairs			C
gypsy rice	*Aythya nyroca*				40 - 50 individuals	B
lappantyú	*Caprimulgus europaeus*		10 - 15 pairs			C
sooty clothes	*Chlidonias niger*				100 - 100 individuals	C
white stork	*Ciconia ciconia*				100 - 120 individuals	C
white stork	*Ciconia ciconia*		31 - 31 pairs			C
black stork	*Ciconia nigra*				200 - 300 individuals	A
black stork	*Ciconia nigra*		35 - 38 pairs			A
bluish teal	*Circus cyaneus*				20 - 30 individuals	C
medium wood pancake	*Dendrocopos medius*	80 - 90 pairs				C
Balkan wood pancakes	*Dendrocopos syriacus*	10 - 20 pairs				C
black woodpecker	*Dryocopus martius*	35 - 40 pairs				C
great egret	*Egretta alba*				400 - 500 individuals	B
little egret	*Egretta garzetta*				100 - 150 individuals	B

Name	Scientific name	Range size (min-max)				Classification
Saker Falcon	*Falco cherrug*		3 - 3 pairs			B
ornate flycatcher	*Ficedula albicollis*		300 - 400 pairs			C
meadowlarks	*Haliaeetus albicilla*	16 - 16 pairs				B
meadowlarks	*Haliaeetus albicilla*			60 - 70 individuals		A
Dwarfism	*Ixobrychus minutus*		5 - 10 pairs			C
Thorn-billed shrike	*Lanius collurio*		150 - 200 pairs			C
small helmet	*Mergus albellus*			20 - 40 individuals		C
brown kite	*Milvus migrans*		20 - 25 pairs			A
bakcsó	*Nycticorax nycticorax*				250 - 350 individuals	B
Fishing Eagle	*Pandion haliaetus*				5 - 10 individuals	C
wasp buzz	*Pernis apivorus*		15 - 20 pairs			B
small cormorant	*Phalacrocorax pygmeus*			50 - 70 individuals		C
spoonbill	*Platalea leucorodia*				50 - 100 individuals	C
batla	*Plegadis falcinellus*				10 - 15 individuals	B
tile trowel	*Sterna hirundo*				40 - 50 individuals	C
réti cankó	*Tringa glareola*				150 - 150 individuals	C

On the stretch of the Danube in the Gemenc Special Protection Area for Birds, only the main branch will be affected. A total of 5 project elements will be implemented in the area, three of which will consist of the dismantling of an existing spur-type stone work, while the other two will consist of the construction of a new guide (stone work) parallel to the bank. Of the five project elements, one demolition and one construction work will be carried out in practically the same location, making a total of 4 intervention sites affecting the Gemenc SPA, where the overall direct impact of the construction is small.

Species of Community importance include the imperial eagle (*Aquila heliaca*), the pochard (*Caprimulgus europaeus*), the white stork (*Ciconia ciconia*), the blue heron (*Circus cyaneus*), the saker (*Falco cherrug*), the dwarf eagle (*Ixobrychus minutus*), the thorn-backed shrike (*Lanius collurio*) and the black grouse (*Nycticorax nycticorax*), the hornet (*Pernis apivorus*), the spoonbill (*Platalea leucorodia*) and the bat (*Plegadis falcinellus*) are not affected on the basis of survey data and experience and the habitat and feeding habitat preferences of the species, and are therefore not considered to be negatively affected by the proposed interventions.

In the case of other migratory bird species of non-Community importance regularly occurring in the European Community, as listed in Annex 1 B) of Government Regulation 275/2004 (including flocks of geese and lesser white-fronted geese), the works in the riverbed and the riverbed edge may affect the populations. These impacts are typically visual and acoustic disturbance impacts, which are temporary, limited to the construction/execution phase, and not significant to the populations of the species concerned.

Species of Community importance include the kingfisher (*Alcedo atthis), the* gypsy merganser (*Aythya nyroca), the* sooty cormorant (*Chlidonias niger), the* black stork (*Ciconia nigra), the* middle woodpecker (*Dendrocopos medius), the* Balkan woodpecker (*Dendrocopos syriacus), the* great egret (*Egretta alba) and the* little egret (*Egretta garzetta),* egret (*Haliaeetus albicilla),* little egret (*Mergus albellus),* brown kite

(*Milvus migrans),* little cormorant (*Phalacrocorax pygmeus), common* tern (*Sterna hirundo)* and common egret (*Tringa glareola),* feeding or foraging individuals may be affected by works in the bed and along the edge of the bed. These effects are typically disturbance effects through visual and acoustic stimuli (presence and noise of construction-related activities (machinery and workers actively involved in the construction)), which are temporary and limited to the construction phase.

Due to the localised nature of the works and the relatively small direct impact area of the construction of the individual project elements, the candidate populations or individuals of candidate species affected by disturbance are able to avoid disturbance and move to main and tributary sections of the river that are not currently affected by construction works. In any case, these sections, which are not currently affected by the works, are within easy reach of the species concerned and their habitat characteristics are considered to be the same as those of the affected species. As a result, the disturbance impacts detailed above are not significant.

During the field survey of the riparian habitat strips potentially affected by onshore construction of the proposed interventions along the banks of the mid-water body, no black woodpecker nesting was detected in the potentially logged work area itself, but some old trees were found in the affected area strips, which could be nesting sites for the species in the coming years. Consequently, it cannot be excluded that the nesting sites of 1 pair could be directly affected by the works in case of land-based operations. Direct mortality and nest damage can be avoided by adhering to the general time restrictions proposed for the removal of woody vegetation. Field survey experience suggests that affected pairs will find new suitable mature trees in the immediate vicinity of habitat strips affected by the small area of potential work area to carve a burrow for nesting. Therefore, the expected negative effects on black woodpecker are considered negligible. In the case of the red-breasted flycatcher (*Ficedula albicollis*), we have observed nesting of this species in the vicinity of the proposed intervention sites during our surveys. Immediate mortality of the species' nesting nests can be avoided if the removal of woody vegetation is carried out in accordance with the proposed time restrictions. The potential loss of habitat affected by the works is negligible and the species will be able to find a suitable breeding burrow within 400-500 m of its former nesting site with a high degree of certainty. Therefore, the expected negative impacts on the swift flycatcher (*Ficedula albiollis*) are not considered to be significant.

In the case of the white-tailed eagle, black stork and brown kite, it cannot be excluded that, in the case of planned interventions along the shores of the mid-water body, or in the case of the. in the case of land access and transport, the protection zone (disturbance during the nesting season may negatively affect nesting success) or the maintenance zone (significant alteration of the site within the affected area, e.g. felling of trees, may negatively affect nesting success) of 1 to 1 nests may be slightly affected. For Rattlesnake, the protection zone is a circle of 400 m radius from the nest, the maintenance zone is a circle of 200 m radius, for Black Stork it is a circle of 400 m radius and 300 m radius from the nest, and for Brown Kittiwake it is a circle of 300 m radius and 100 m radius from the nest. The disturbance impact of the proposed interventions on the nesting of these priority species sensitive to disturbance can be minimised by time restrictions or, where necessary, by minimum spatial restrictions on the felling of larger trees.

As a result of the planned interventions, the habitat conditions of the Danube section of the Gemenc SPA (HUDD10003) will not be significantly altered for the area's indicator bird species or for the indicator migratory/assemblage populations of other migratory bird species. At present, there are no data available to suggest that shipping traffic would have a significant negative impact on the designated species of Community importance and migratory/assemblage populations of the Danube section concerned, negatively affecting their feeding, breeding or limiting their population dynamics. For this reason, no direct negative impacts are expected even with the projected 75% expansion. Indirect negative effects may occur through impacts on populations of other species, e.g. foraging organisms. In any case, the potential indirect effects are negative, but there are no usable data of a basic research nature available to estimate their magnitude.

Overall, on the basis of the information available to us, **if the proposed mitigation measures for nature conservation purposes are adhered to, no significant adverse impacts on the reasons for and**

objectives of the designation of the Gemenc (HUDD10003) Special Protection Area for Birds are expected, either during construction or in the post-construction period.

1.3 Béda-Karapancsa (HUDD10004) Special Protection Area for Birds

The planned interventions for the development of the navigation route on the Danube between Szob and the southern border of the country will affect the Béda-Karapancsa Special Protection Area for Birds (HUDD10004) between sections 1446 and 1452 fkm. The ornithological values of the Béda-Karapancsa Special Protection Area are summarised in the **Table 1**

Table 1: Species of Community importance of the Béda-Karapancsa Special Protection Area and migratory migratory flocks of other migratory species

Name	Scientific name	Range size (min-max)				Classification by stock size
		breeding / nesting	permanent	wintering	parade / rally	
kingfisher	*Alcedo atthis*				40 - 50 individuals	C
kingfisher	*Alcedo atthis*		10 - 15 pairs			C
capitalist duck	*Anas platyrhynchos*		100 - 100 pairs			C
capitalist duck	*Anas platyrhynchos*				3000 - 8000 individuals	C
large lily	*Anser albifrons*			6000 - 8000 individuals		C
summer goose	*Anser anser*		50 - 60 pairs			B
summer goose	*Anser anser*			1800 - 2000 individuals		B
sowing goose	*Anser fabalis*			1000 - 2000 individuals		B
Parlagi eagle	*Aquila heliaca*				2 - 5 individuals	C
red heron	*Ardea purpurea*		30 - 40 pairs			B
friendlyice	*Aythya ferina*				500 - 600 individuals	C
contyos réce	*Aythya fuligula*				500 - 600 individuals	B
gypsy rice	*Aythya nyroca*		5 - 10 pairs			C
gypsy rice	*Aythya nyroca*				100 - 150 individuals	B
bölömbika	*Botaurus stellaris*		2 - 5 pairs			C
cerceréce	*Bucephala clangula*				200 - 500 individuals	C
white stork	*Ciconia ciconia*				100 - 150 individuals	C
black stork	*Ciconia nigra*				80 - 80 Eat	B
black stork	*Ciconia nigra*		14 - 15 pairs			B
brown teal	*Circus aeruginosus*		10 - 10 pairs			C
bluish teal	*Circus cyaneus*			10 - 20 individuals		C
haris	*Crex crex*		1 - 3 pairs			C
medium wood pancake	*Dendrocopos medius*	100 - 120 pairs				B

Name	Scientific name	Range size (min-max)				Classification
Balkan wood pancakes	*Dendrocopos syriacus*	5 - 15 pairs				C
black woodpecker	*Dryocopus martius*	10 - 15 pairs				C
great egret	*Egretta alba*		30 - 40 pairs			C
great egret	*Egretta alba*			20 - 80 individuals		C
little egret	*Egretta garzetta*		10 - 20 pairs			C
ornate flycatcher	*Ficedula albicollis*		50 - 60 pairs			C
meadowlarks	*Haliaeetus albicilla*	5 - 7 pairs				B
meadowlarks	*Haliaeetus albicilla*			30 - 30 individuals		B
Dwarfism	*Ixobrychus minutus*		30 - 40 pairs			C
Thorn-billed shrike	*Lanius collurio*		20 - 30 pairs			C
Thorn-billed shrike	*Lanius collurio*				2000 - 2200 individuals	C
big goda	*Limosa limosa*				150 - 200 individuals	C
Bluefin	*Luscinia svecica*		5 - 6 pairs			C
small helmet	*Mergus albellus*			20 - 30 individuals		C
brown kite	*Milvus migrans*		13 - 13 pairs			A
bakcsó	*Nycticorax nycticorax*		150 - 200 pairs			B
Fishing Eagle	*Pandion haliaetus*				5 - 10 individuals	C
wasp buzz	*Pernis apivorus*		3 - 5 pairs			C
small cormorant	*Phalacrocorax pygmeus*		5 - 5 pairs			C
small cormorant	*Phalacrocorax pygmeus*				5 - 10 individuals	C
hamvas spokesman	*Picus canus*	20 - 20 pairs				C
spoonbill	*Platalea leucorodia*				- 20 individuals	C
little waterbabies	*Porzana parva*		20 - 25 pairs			C
speckled dippers	*Porzana porzana*		10 - 10 pairs			B
hangingcinege	*Remiz pendulinus*		10 - 15 pairs			C
partyfefecske	*Riparia riparia*					C
little tits	*Tachybaptus ruficollis*		5 - 10 pairs			C

On the section of the Danube that affects the Béda-Karapancsa Special Protection Area for Birds, only the main branch will be affected. A total of one chevron dam-type river control structure will be built in the immediate vicinity of the Mohács inland area. Overall, the direct area of impact of the construction is therefore very small.

Species of Community importance include the imperial eagle *(Aquila heliaca), the* gannet (*Botaurus stellaris*), the blue heron (*Circus cyaneus), the* harrier (*Crex crex*), the thorn-backed shrike (*Lanius collurio*), the blue tit (*Luscinia svecica) and the* horned stork (*Pernis apivorus*), spoonbill (*Platalea leucorodia*), little coot (*Porzana parva*), spotted coot (*Porzana porzana*) are not affected by the proposed interventions, based on the survey data and experience.

In the case of other migratory bird species of non-Community importance regularly occurring in the European Community, as listed in Annex 1 B) of Government Regulation No 275/2004 (including mallard, greater white-fronted goose, summer goose, goshawk, common goose, mallard, mallard, wadden, greater scaup, hanging gull, shelduck, little grebe), the works in the riverbed and the river bank may affect the populations. These impacts are typically visual and acoustic disturbance impacts, which are temporary, limited to the construction/execution phase and not significant for the species concerned.

Species of Community importance include the red heron (*Ardea purpurea*), the gypsy merganser (*Aythya nyroca*), the white stork (*Ciconia ciconia*) and the black stork (*Ciconia nigra*), Brown Egret (*Circus aeruginosus*), Middle Woodpecker (*Dendrocopos medius*), Balkan Woodpecker (*Dendrocopos syriacus*), Black Woodpecker (*Dryocopus martius*), Great Egret (*Egretta alba*), Little *Egret* (*Egretta garzetta*), white-tailed eagle (*Haliaeetus albicilla*), little buzzard (*Mergus albellus*), brown kite (*Milvus migrans*), black-backed gull (*Nycticorax nycticorax*), osprey (*Pandion haliaetus*), little cormorant (*Phalacrocorax pygmeus*), common gull (*Picus canus*), foraging or feeding species may be affected by works in the riverbed and the margins of the riverbed at the 3 sites. These effects are typically disturbance effects through visual and acoustic stimuli (presence and noise of construction-related activities (machinery and workers actively involved in the construction), which are temporary and limited to the construction/execution phase.

The interventions are therefore clearly local in nature, as the relatively small direct impact area of the construction of the three project elements means that the candidate populations or individuals of candidate species affected by disturbance are able to avoid disturbance and move to main and tributary sections of the river that are not affected by construction works. These sections, which are not currently affected by the works, are within easy reach of all the species of concern and are considered to be of the same habitat characteristics as the section affected by the works. As a result, the disturbance impacts detailed above are not significant.

The construction of the proposed chevron dam will not directly affect the nesting of species of Community importance, or, based on the information available, will not affect the nesting sparing (disturbance during the nesting season may negatively affect nesting success) or maintenance zones of species of nature of high conservation value (significant changes to the site within the affected area, e.g. felling of trees, may negatively affect nesting success).

In the case of the proposed spur removal, it cannot be ruled out on the basis of the available information that the nesting habitat of the white-tailed stork, black stork or brown kite may be affected. The protection zone is 400 m from the nest and the maintenance zone is 200 m radius for the white-tailed stork, 400 m and 300 m radius from the nest for the black stork and 300 m and 100 m radius from the nest for the brown kite. Further information on the nesting of these species in the vicinity of this intervention is required to establish the impact. With a time limitation, the disturbance impact of the proposed intervention on the nesting of these priority species sensitive to disturbance could be completely avoided.

As a result of the planned interventions, the habitat conditions of the Danube section of the Béda-Karapancsa SPA (HUDD10004) will not be significantly altered for the area's indicator bird species or for the indicator migratory/assemblage populations of other migratory bird species. At present, there are no data available to suggest that shipping traffic would have a significant negative impact on the designated species of Community importance and migratory/assemblage populations of the Danube section concerned, negatively affecting their feeding, breeding or limiting their population dynamics. For this reason, no direct negative effects are expected in the event of a significant increase in traffic. Indirect negative impacts may be through impacts on populations of other species, e.g. foraging organisms. The potential indirect effects are certainly negative, but there are no useful data of a basic research nature available to estimate their magnitude.

Overall, on the basis of the information available to us, no **significant adverse impacts on the reasons for and objectives of the designation of the Béda-Karapancsa** (HUDD10004) **Special Protection Area for Birds are expected,** either during construction or in the post-construction period.

2 SITES OF SPECIAL CONSERVATION INTEREST

2.1 Danube and its floodplain (HUDI20034) priority nature conservation area

Habitats

The Danube and its floodplain (HUDI20034) is a Priority Site of Conservation Importance (SCI) with 14 habitat types of Community importance and priority habitats of Community importance, according to the current database on the EU Commission website (https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDI20034). One of the main functions of the Danube and its floodplain (HUDI20034) SCI is to conserve these habitat types in a defined extent and in a suitable condition in the longer term, and where possible to increase their extent and improve their condition. The candidate habitat types of the site are:

3130 - Oligo-mesotrophic standing waters with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation

3150 - Natural eutrophic ponds with Magnopotamion or Hydrocharition vegetation

3270 - Rivers with muddy banks partly with Chenopodion rubri and partly with Bidention vegetation

6240 - Subpannonian steppes

6250 - Pannonian lowland loess grasslands

6260 - Pannonian sand grasslands

6410 - Blue fescue swamps on calcareous, peaty or clayey soils (Molinion caeruleae)

6430 - Plains and hydrophilic highland-highland hydrophilic margins

6440 - Cnidion dubii river valley marshes

6510 - Lowland and hill pastures (Alopecurus pratensis, Sanguisorba officinalis)

7210 - Calcareous marshes with winter marsh (Cladium mariscus) and Caricion davallianae

7230 - Lichiferous grasslands and grassland meadows

91E0 - Light alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae)

91F0 - Hardwood forests along large rivers with Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia (Ulmenion minoris)

Based on our field surveys, habitat types 3150, 6240, 6250, 6260, 6410, 6430, 6440, 6510, 7210 and 7230 are not considered to be negatively affected by the proposed intervention.

Within the priority conservation area ***HUDI20034 "Danube and its floodplain"*** (Szob-Baracs), the interventions affecting terrestrial habitats will affect 3 candidate habitat types of Community importance and 1 priority habitat type of Community importance.

Oligo-mesotrophic standing water with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation (3130): this habitat type occurs mainly on the reefs, natural banks and banks with natural channel and bank material on the main Danube riverbed and on the sections of the tributaries where there is no water cover for weeks in summer and autumn (they are left dry). According to the current inventory of the site, a total of 10.47 ha of this type of habitat is found within the Danube and its floodplain (HUDI20034) Priority Conservation Area. During the field surveys, the habitat type was detected in a survey area affected by the use of a potnecial working area, but its presence and involvement in other areas is also assumed.

Rivers with muddy banks partly with *Chenopodion rubri* and partly with *Bidention* vegetation (3270): this habitat type occurs mainly in the riparian zones of tributaries where there is no water cover for weeks in summer and autumn (they are left dry), but is also found along the main riverbed and on reefs. The habitat type is present on 259 ha in the Danube and its floodplain (HUDI20034) priority conservation area, according to the datasheet. The habitat type was not detected during the field surveys in areas affected by the planned interventions or potentially affected by land-based construction works, but its presence or impact cannot be excluded.

Hardwood forests along large rivers (91F0): the exact extent of habitat impact cannot be given at this stage of the planning process, as for several interventions the impact is only potential, as the planned interventions along the banks of the mid-water body can only be expected to involve the use of working areas and consequent felling of trees in riparian habitat strips in the case of onshore construction. The habitat type was identified in two study areas with potential workspace requirements, but the exact and actual extent of these is not yet known at this stage of the planning process. Compared to the total extent of the habitat, the expected impact on this habitat type is low, with an estimated 339.28 ha of habitat in the site area. This compares to an expected impact of less than 1% in the Natura 2000 area concerned in the "negative" case, even for the full extent of the impact of the found stands.

Mild alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae) (*91E0): the exact extent of the impact on softwood groves cannot be given at this stage of the planning. Some planned interventions are certain to affect parts of the stand. For example, the removal of existing works, which will have a small overall impact on the habitat type. For several of the interventions, the impact is only potential, as the planned interventions along the shores of the mid-water body can only be expected to result in the use of working areas and consequent tree felling in coastal habitat strips if they are carried out on land. The habitat type affected is significant for the worst case, i.e. for all coastal interventions assuming onshore construction, for both low-medium and higher naturalistic stands. Compared to the overall extent of the habitat type, the expected worst-case impact is also low, as the datasheet estimates the population of this habitat type in the Natura area concerned at 2082 ha. In comparison, the proportion of the area affected by adverse effects is expected to be less than 1% in the worst case.

Due to the good regeneration capacity of the habitats and the assumed minimal impact, the extent of the negative effect is not considered significant for the habitat "Oligo-mesotrophic stagnant water with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation" (3130) and "Muddy rivers with part *Chenopodion rubri* and part *Bidention* vegetation" (3270). The 'Mild alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) woodland (Alno-Padion, Alnion incanae, Salicion albae)' (*91E0) is affected, with habitat detected in several intervention areas (both low-medium natural and higher natural habitats of conservation-botanical importance are present). The level of negative impacts on the habitat is considered to be tolerable and not significant. The negative effects on the habitat type 'Hardwood wooded woodland along large rivers' (91F0) are also considered to be tolerable and not significant negative effects.

<u>*Plants*</u>

Plant species of the Danube and its floodplain (HUDI20034):

Colchicum arenarium (sand cocklebur) C

Iris humilis ssp. arenaria (sand daisy) C

The proposed interventions will not directly affect the habitats of the sand cockle and sand daisy candidate plant species, either during the construction phase or after construction. Indirect negative effects can also be excluded, and sand cocklebur and sand damselfly are not considered to be negatively affected by the proposed interventions.

<u>*Macroscopic aquatic invertebrates*</u>

Aquatic macroscopic invertebrate species of the Danube and its floodplain (HUDI20034):

Coenagrion ornatum (ornate aerial fowler) C

Leucorrhinia pectoralis (marsh dragonfly) C

Unio crassus (blunt river mussel) C

Of the candidate species, the ornamental air damselfly (*Coenagrion ornatum*), associated with inlet small watercourses, and the marsh dragonfly (*Leucorrhinia pectoralis*), associated with marshy, stagnant, nonflushing standing water habitats, are not considered to be negative agents of the proposed intervention, because the proposed interventions will not directly affect habitats suitable for these species and indirect negative effects can be excluded.

Based on available previous survey results and current sampling results, the blunt river mussel (*Unio crassus*) will be a negative effector of the proposed intervention. The blunt mussel is a stream-favouring species, but does not prefer the fast-flowing, coarse gravel bed material close to the drift line. It prefers sediment-rich, medium-fine sediment (fine gravel, pebbles, river sand), which is mainly found at the margins of the mid-water bed, around reefs and in tributaries. No tributary dredging or near-shore dredging is planned in the section between Szob and Baracs. The dredging works planned in the fairway are expected to have a very small impact on the dull river mussel populations along the stretch, so that physical damage and mortality is expected to be minimal. This minimal negative impact is essentially related to the construction works and is therefore considered temporary. Compared to the total extent of the habitat types preferred by the species, the proportion of habitats affected by adverse effects and temporary loss during the construction phase is certainly less than 1% of the total area of the Danube and its floodplain (HUDI20034) within the priority conservation area of conservation importance.

In the case of the blunt river mussel, the available knowledge suggests that vessel-induced wave action does not appreciably increase mortality in adults. However, it cannot be ruled out that increased wave action causes higher mortality rates in planktonic veligera larvae of this species. There are no evaluable data on this, and studies at the basic research level would be needed to clarify this putative effect. Overall, on the basis of the available information, no significant long-term negative impact on *Unio crassus* is expected in terms of a significant reduction in the marker population associated with the proposed development.

Butterflies

Butterfly species of the Danube and its floodplain (HUDI20034):

Callimorpha quadripunctaria (striped bear's-foot trefoil) C

Lycaena dispar (large firefly) C

Maculinea teleius (blood-grass buttercup) C

Based on field surveys, the proposed interventions under the project do not typically affect habitats suitable for the blood-grass moth (*Maculinea teleius*) and striped bear butterfly (*Callimorpha quadripunctaria*), and therefore these candidate butterfly species are not considered to be negatively affected by the proposed intervention, either during the construction phase or post-construction.

According to the results of the field surveys, the great spotted sandpiper (*Lycaena dispar*) occurs along the Danube riverbed in a narrow riparian strip covered with tall vegetation and riverbank herbaceous vegetation. This type of vegetation occurs mainly in the riparian region of tributaries. In the section between Szob and Baracs, the planned interventions do not affect the tributaries, so the large firecrest is not considered as a negative influence of the planned interventions.

Other invertebrates

Other indicator invertebrate species of the Danube and its floodplain (HUDI20034):

Cucujus cinnaberinus (scarlet beetle) C

Lucanus cervus (large hornbill) C

The great hornbill prefers hardwood groves with oak as at least a mixed species in habitats along the Danube. Such habitats were encountered in a total of two coastal survey areas with potential working area requirements. In the potentially affected, typically small, banded habitats with higher proportions of stands of softwood forests, the species has a relatively low probability of occurrence because softwood forests are suboptimal habitats for it. No specimens were found during our surveys. Overall, the presence of the great crested newt (*Lucanus cervus*) cannot be completely excluded in the area of the proposed interventions and in the coastal strips potentially affected by the worksite intervention, as the literature indicates that native willow species are also consumed by its larvae and there are observations of the species in grass dominated forests. For the great crested newt (*Lucanus cervus*), no significant negative effects are expected from the proposed intervention, either during the construction period or in the post-construction phase, as described above.

Contrary to the above, optimal habitats suitable for the scarlet tanager *(Cucujus cinnaberinus)* are common in the intervention areas. Not only the affected parts of softwood forests, but also the vegetation of trees growing on botanically unvaluable stone works, stone cairns or solitary old poplars and willows are suitable habitats for this species. The extent to which this species is affected will depend primarily on the actual extent of the softwood scrub edges affected, which cannot be known precisely at this stage of the design due to the uncertainty of the land or water-based design. The Natura 2000 area concerned is estimated by the datasheet to contain 2082 ha of softwood forest. Overall, the implementation of the planned interventions will affect only well below 1% of the species' habitat within the Natura 2000 site, so no significant negative impacts on the species' populations are expected during the implementation phase. According to the available information, no impacts are expected after the implementation that would have a significant adverse effect on the candidate populations of the species.

<u>Halak</u>

The fish species of the Danube and its floodplain (HUDI20034):

Aspius aspius (balin)	B
Cobitis taenia (cutting strip)	C
Eudontomyzon spp. (ingola species)	B
Gobio albipinnatus (Pale-spotted Spotted Spat)	C
Gymnocephalus baloni (broad durbin)	C
Gymnocephalus schraetzer (silky durbin)	B
Misgurnus fossilis (meadow pipit)	C
Pelecus cultratus (garda)	C
Rhodeus sericeus amarus (rainbow fist)	C
Rutilus pigus (maidenhair)	B
Zingel nerd (German *nerd*)	C
Zingel zingel (Hungarian zingel)	B

Among the candidate fish species, the meadow pipit (*Misgurnus fossilis*) can be excluded as it occurs only in the tributaries of the Natura 2000 site and only sporadically. On the other hand, the tributaries between Szob and Baracs are not affected by the planned interventions.

All other candidate fish species are considered to have a real negative impact on the proposed intervention.

The Danube and its floodplain (HUDI20034) is a priority nature conservation area, which includes the stretch of the Danube between 1786-1657 km and 1646-1566 km and its tributaries. The planned interventions do not typically involve large contiguous sections of the riverbed with a total cross-section of several kilometres, but are typically localised interventions with a relatively small direct area of impact during the construction phase. In the section between Szob and Baracs, specific interventions are planned for a small proportion of the overall riverbed area, so that the cumulative impact of small individual interventions during the construction period is relatively small in this section.

Generally speaking, the planned construction works will not typically have an adverse effect on adults if they are carried out during their active period, as they are basically fast-moving, relatively mobile animals that escape from temporary physical impacts that threaten them (e.g. excavation of excavators), and thus the construction works are more likely to be a temporary disturbance. This is true for both species associated with open water surfaces (such as the garda and the balin) and benthic species that live and feed near the surface of the seabed (such as the German pike and the silky dace). The exception to this is the cutthroat (*Cobitis taenia*), as adults of this species often move towards the upper sediment layer in times of danger, attempting to hide there and thus avoid disturbance, and are therefore less vulnerable to physical impacts such as dredging. During the winter dormant season, however, the adults of almost all species are also very vulnerable, as the cooled, slowed-down individuals move in groups to their optimal burrows and burrowing sites, and many species even burrow into the uppermost layer of sediment. For all species affected, eggs and newly hatched juveniles are very vulnerable and due to their small size (eggs) and very limited spatial escape ability (juveniles), the physical impacts associated with the construction are likely to cause injuries in the immediate construction area of the intervention.

Of the planned works, it is mainly the dredging works that are expected to have a significant negative impact on the populations of the candidate species of concern. The dredging interventions do not affect tributaries and coastal reefs, so the proposed dredging interventions are typically not, or will not be, likely to affect the coastal reefs. in the margins of the fairway, a very small proportion of shallow water-covered bank surfaces where there may be a higher proportion of eggs or mature juveniles during the breeding season, and species that are specifically associated with fine sediment-covered bank surfaces (e.g. Danube goby larvae).

Taking into account the immediate area of impact of the planned interventions and the proportion of habitats affected by adverse effects in relation to the total area of habitat types preferred by the species, the proportion of the population affected by adverse effects is not expected to reach 1% of the candidate populations for any species.

By respecting the proposed time limits for construction works, negative impacts associated with construction can be effectively reduced.

Following the construction, the forecast for the increase in vessel traffic on the Danube section concerned is up to 75% by 2050. Based on available literature and anecdotal observations, ship waves will continue to have a negative impact on fish, especially in the coastal regions of the Danube, even with current ship traffic. Adverse effects mainly affect the juveniles of fish, which are more frequently found in shallow coastal areas. Waves reaching the shore can cause physical damage and consequent mortality both on rocky shorelines and on natural material beaches. In parallel with the increase in vessel traffic, the adverse, damaging effects of wave action on coastal regions and, depending on water levels, on reefs, should be expected to increase. During our field surveys, we conducted targeted observations to determine whether the passage of a single vessel causes mortality or appreciable physical damage to juveniles in windward waters along the coast. We did not observe any signs of mortality or significant physical injury during our observations, but we cannot exclude the possibility that the passage of many successive boats and the waves they generate may cause many small, insignificant injuries that reduce the survival of juveniles. This effect could be tested by studies at the basic research level. Overall, the increase in vessel traffic is expected to increase the negative effects on the populations of candidate fish species, mainly through increased negative effects on juveniles.

Amphibians and reptiles

Identification of amphibian and reptile species of the Danube and its floodplain (HUDI20034):

Bombina bombina (red-bellied poppy) C

Emys orbicularis (bog turtle) C

Triturus dobrogicus (Danube turbot) C

Based on available historical data and our field surveys, the populations of candidate amphibian species and the marsh turtle in the Danube and its floodplain (HUDI20034) are mainly associated with the advanced successional stage of the tributaries. In the section between Szob and Baracs, the planned interventions will not affect the tributaries, so that no adverse effects on the species of amphibian or bog turtle are expected during or after the project.

Mammals

The mammal species of the Danube and its floodplain (HUDI20034):

Castor fiber (common beaver) C

Lutra lutra (otter) C

Spermophilus citellus (worm) C

The wolverine is not a negative effect of the interventions planned under the project, because the habitat suitable for the species will not be affected by the construction works of the planned interventions and negative impacts on the suitable habitat for the species can be excluded in the post-construction phase.

During our surveys, we encountered Eurasian beaver habitats along the stretch of the Danube between Szob and Baracs, which is part of the HUDI20034 priority conservation area, and which is affected by the planned interventions, which clearly indicates that the species has a significant single population density. Otter tracks were encountered with much lower frequency during the surveys, but based on the literature (LANSZKI, 2014), the species is present practically along the whole length of the domestic section of the Danube. As described in the species impact assessment chapter, no direct damage or mortality associated with the construction is assumed. Mainly disturbance impacts are expected during the construction phase, which the individuals are able to avoid effectively. No post-construction impacts associated with the proposed intervention are expected to have a significant negative impact on the marker populations of Eurasian beaver and otter.

2.2 Tolnai Danube (HUDD20023) priority nature conservation area

Habitats

The Tolna Danube (HUDD20023) Priority Nature Conservation Site has 7 habitat types of Community importance and priority habitats of Community importance according to the current fact sheet available on the EU Commission website (https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20023). One of the main functions of the Tolna Danube SCI (HUDD20023) is to conserve these habitat types at a defined extent and in a suitable condition in the longer term, and where possible to increase their extent and improve their condition. The candidate habitat types of the site are listed below:

3130 - Oligo-mesotrophic standing waters with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation

3270 - Rivers with muddy banks partly with Chenopodion rubri and partly with Bidention vegetation

6250 - Pannonian lowland loess grasslands

6260 - Pannonian sand grasslands

6440 - Cnidion dubii river valley marshes

91E0 - Light alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae)

91F0 - Hardwood forests along large rivers with Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia (Ulmenion minoris)

Based on our field surveys, habitat types 6250, 6260, 6440 and 91F0 are not considered to be negatively affected by the proposed interventions.

Within the Tolna Danube Priority Conservation Area (Baracs-Gerjen), the interventions affecting terrestrial habitats will affect 2 habitat types of Community importance and 1 habitat type of priority Community importance.

Oligo-mesotrophic standing water with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation (3130): this habitat type occurs mainly on the reefs, natural banks and banks with natural channel and bank material on the main Danube riverbed and on the sections of the tributaries where there is no water cover for weeks in summer and autumn (they are left dry). The current inventory of the site indicates that a total of 4.07 ha of this type of habitat is found within the Tolna Danube Priority Conservation Area (HUDD20023). The habitat type was not detected during field surveys in areas potentially affected by the proposed interventions or by land-based construction, but its presence/impact, albeit small, cannot be excluded.

Rivers with muddy banks partly with *Chenopodion rubri* and partly with *Bidention* vegetation (3270): this habitat type occurs mainly in the riparian zones of tributaries where there is no water cover for weeks in summer and autumn (they are left dry), but is also found along the main riverbed and on reefs. The habitat type is present on 4.17 ha of the Tolna Danube Priority Conservation Area (HUDD20023), according to the datasheet. The habitat type was detected at 1 sampling site during field surveys in areas potentially affected by planned interventions or by land-based construction, but its presence/concern can be assumed to be higher.

Mild alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae) (*91E0): the exact extent of the impact on softwood groves cannot be given at this stage of the planning. Some planned interventions are certain to affect parts of the stand. For example, the removal of existing works, which will have a small overall impact on the habitat type. For several of the interventions, the impact is only potential, as the planned interventions along the shores of the mid-water body can only be expected to result in the use of working areas and consequent tree felling in coastal habitat strips if they are carried out on land. The habitat type affected is the worst case, i.e. for all coastal interventions, assuming onshore construction, a significant area of low to medium naturalness is affected. Compared to the overall extent of the habitat type, the expected worst-case impact is also low, as the datasheet estimates the population of this habitat type in the Natura area concerned at 1114.49 ha. In comparison, the proportion of the area affected by adverse effects is expected to be less than 1% in the worst case.

Due to the good regeneration capacity of the habitats and the expected minimal area affected based on the surveys, the extent of the negative impact is not considered to be significant for the habitat type "Oligo-mesotrophic stagnant water with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation" (3130) and the habitat type "Muddy rivers with part *Chenopodion rubri* and part *Bidention* vegetation" (3270). The habitat type 'Alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) woodland (Alno-Padion, Alnion incanae, Salicion albae)' (*91E0) is affected, and has been detected in several areas affected by land-use activities (mainly low to medium natural stands). The extent of negative effects on the habitat is considered to be tolerable and not considered to be a significant negative effect.

<u>Invertebrates</u>

Indicator invertebrate species of the Tolna Danube High Priority Conservation Area:

Cucujus cinnaberinus (scarlet beetle) C

Lucanus cervus (large hornbill) C

There is little chance of the large hornbill occurring in the typically small, banded habitats potentially affected by the proposed interventions, as the species prefers forests containing oak as at least a mixed species and softwood forests are suboptimal habitats for it. No specimens were found during our surveys. However, the presence of the great horned beetle (*Lucanus cervus*) cannot be completely excluded in the area of the proposed interventions and in the coastal areas potentially affected by the works, as the literature indicates that its larvae also feed on native willow species and there are observations of the species in grass-dominated forests. For the great crested newt (*Lucanus cervus*), no significant negative effects are expected from the proposed intervention, either during the construction period or in the post-construction phase, as described above.

Contrary to the above, optimal habitats suitable for the scarlet tanager *(Cucujus cinnaberinus)* are common in the intervention areas. Not only the affected parts of softwood forests, but also the vegetation of trees growing on botanically unvaluable stone works, stone shelters or solitary trees are suitable habitats for this species. The extent to which this species is affected will depend primarily on the extent to which the softwood forest edges are actually affected, which cannot be known precisely at this stage of the design due to the uncertainty of the land or water-based design. The Natura 2000 area concerned is estimated to contain 1114 ha of softwood forest according to the datasheet. Overall, the implementation of the planned interventions will only affect well below 1% of the species' habitat within the Natura 2000 site, so no significant negative impacts on the species' populations are expected during the implementation phase. According to the available information, no impacts are expected after the implementation that would have a significant negative impact on the candidate populations of the species.

Halak

The indicator fish species of the Tolna Danube Priority Conservation Area:

Aspius aspius (balin)	C
Eudontomyzon spp. (ingola species)	C
Gobio albipinnatus (Pale-spotted Spotted Spat)	C
Gymnocephalus baloni (broad durbin)	C
Gymnocephalus schraetzer (silky durbin)	C
Rhodeus sericeus amarus (rainbow fist)	C
Rutilus pigus (maidenhair)	C
Umbra krameri (marsh toad)	C
Zingel nerd (German *nerd*)	C
Zingel zingel (Hungarian zingel)	C

Among the candidate fish species, the marsh spider mite (*Umbra krameri*) is not considered to be negatively affected by the proposed intervention, because suitable habitats for this species will not be adversely affected by the project's proposed interventions, either during or after construction. In the Danube floodplain, the species may occur sporadically at most in the highly advanced successional stage of the floodplain, in the stagnant water, marshy tributaries, but in the section between Baracs and Gerjen the interventions will not affect the tributaries.

All other candidate fish species are considered to have a real negative impact on the proposed intervention.

The Danube of Tolna Priority Conservation Area includes the stretch of the Danube between 1566-1509 km and its tributaries. The planned interventions do not typically involve large contiguous sections of the riverbed with a total cross-section of several km, but are typically localised interventions with a relatively small direct area of impact during the construction phase. In the section between Baracs and Gerjen, specific interventions are planned for a small proportion of the total length of the riverbed, so that the cumulative impact of small individual interventions during the construction period is relatively small in this section. The exception to this is the section between Baracs and Bölcske, where the proportion of the riverbed affected by interventions is locally most significant within the section between Baracs and Gerjen.

Generally speaking, the planned construction works will not typically have an adverse effect on adults if they are carried out during their active period, as they are basically fast-moving, relatively mobile animals that escape from temporary physical impacts that threaten them (e.g. excavation of excavators), and thus the construction works are more likely to be a temporary disturbance. This is true for both species associated with open water surfaces (such as the balin) and benthic species that live and feed near the surface of the seabed (such as the German pochard and the pale-spotted otter). During the winter dormant season, however, the adults of almost all species are also very vulnerable, as the cold, slowed-down individuals move in groups to their optimal burrows and burrowing sites, and many species even burrow into the uppermost layer of sediment. For all species affected, eggs and newly hatched juveniles are very vulnerable and due to their small size (eggs) and very limited spatial escape ability (juveniles), the physical impacts associated with the construction are likely to cause injuries in the immediate construction area of the intervention.

Of the planned works, it is mainly the dredging works that are expected to have a significant negative impact on the populations of the candidate species of concern. The dredging interventions do not affect tributaries and coastal reefs, so the proposed dredging interventions are typically not, or will not be, likely to affect the coastal reefs. in the margins of the fairway, a very small proportion of shallow water-covered bank surfaces where there may be a higher proportion of eggs or mature juveniles during the breeding season, and species that are specifically associated with fine sediment-covered bank surfaces (e.g. Danube goby larvae).

Taking into account the immediate area of impact of the proposed interventions and the proportion of habitats affected by adverse effects compared to the total area of habitat types preferred by the species, the proportion of the population affected by adverse effects is not expected to reach 1% of the candidate populations for any species.

By adhering to the proposed time constraints for construction works, the negative impacts associated with construction can be effectively reduced to a small scale.

Following the construction, the significant increase in shipping traffic will also increase the waves caused by ships. Based on available literature and sporadic observations, this will continue to have a negative impact on fish, especially in the Danube coastal regions, even with the current vessel traffic. Adverse effects mainly affect the juveniles of fish, which are more abundant in shallow coastal areas. Waves reaching the shore can cause physical damage and consequent mortality both on rocky shorelines and on natural material beaches. In parallel with the increase in vessel traffic, the adverse, damaging effects of wave action on coastal regions and, depending on water levels, on reefs, should be expected to increase. During our field surveys, we conducted targeted observations to determine whether the passage of a single vessel causes mortality or appreciable physical damage to juveniles in windward waters along the coast. We did not observe any signs of mortality or significant physical injury during our observations, but we cannot exclude the possibility that the passage of many successive boats and the waves they generate may cause many small, insignificant injuries that reduce the survival of juveniles. This effect could be tested by studies at the basic research level. Overall, the increase in vessel traffic is expected to increase the negative effects on the populations of candidate fish species, mainly through increased negative effects on juveniles.

Amphibians and reptiles

Indicator amphibian and reptile species of the Tolna Danube Priority Conservation Area:

Bombina bombina (red-bellied poppy) C

Emys orbicularis (bog turtle) C

Triturus dobrogicus (Danube turbot) C

Based on the available historical data and our field surveys, the populations of candidate amphibian species and the populations of the marsh turtle in the Tolna Danube SCI are mainly associated with the tributaries in an advanced state of succession. In the section between Baracs and Gerjen, the planned interventions will not affect the tributaries, so no adverse impacts on the candidate amphibian species or the bog turtle are expected during or after the project.

Mammals

Mammal species of the Tolna Danube High Priority Conservation Area:

Barbastella barbastellus (Western Pisces) C

Castor fiber (Eurasian beaver) C

Lutra lutra (otter) C

Myotis blythii (pointed-nosed bat) C

Myotis dasycneme (lake bat) C

Myotis myotis (common bat) C

During our surveys, we encountered Eurasian beaver habitats along the stretch of the Danube between Baracs and Gerejen, which is affected by the planned interventions and is part of the Tolna Danube Priority Conservation Area, which clearly indicates that the species has a significant single population density here. Otter tracks were encountered at much lower frequencies during the surveys, but based on the literature (LANSZKI, 2014), the species is present practically along the whole length of the home stretch of the Danube.

As described in the species impact assessment chapter, no direct damage or mortality associated with the construction is assumed. Mainly disturbance impacts are expected during the construction phase, which the individuals are able to avoid effectively.

Among the bat species of the Tolna Danube SCI, the common bat and the tip-nosed bat are essentially arboreal species, often migrating to caves to hibernate in winter. The species uses the wider environment of the areas affected by the proposed intervention (forest edges, groves) as feeding habitat. The interventions planned under the project will not significantly alter the character and physiognomic characteristics of the floodplain, nor the spatial proportions of the different habitat types. The species is also not tied to the water surface and riparian areas for foraging. Overall, no significant negative impacts on the common bat and the sharp-nosed bat marker population are expected as a consequence of the proposed project interventions, either during the construction or post-construction phase.

The western dirt bat and the pond bat are typically roosting bat species, so negative impacts are expected from construction-related tree felling. In the riparian zone of the proposed interventions, woody vegetation is present in a significant proportion of cases. If the interventions are carried out from the shore close to the edge of the mid-water bed, the work area may be affected by the use of the mid-water bed riparian zone, which may involve tree felling. The results of the field surveys indicate that these potential riparian working strips may also contain mature dead trees that provide roosting habitat for roosting bats. The felling of these trees during the winter hibernation or pupping period can have a particularly damaging effect on the populations concerned, as it can result in injury and mortality of individuals. If the proposed time restrictions on felling of dead trees that harbour bats and the method of felling are observed, direct damage and mortality can be avoided. A negative effect after the implementation in this case is that the number of trees suitable for bats will be lower than before the intervention. Overall, the areas potentially affected by tree felling are small for this priority conservation area. The proportion of potentially affected deadwood is not significant in relation to the number of suitable deadwood for bats in the whole study area. Overall, it can be concluded that the proposed restrictions and requirements for the felling of suitable deadwood for bats in the small areas of intervention will not result in significant negative impacts on western dirt bat and pond bat populations.

At present, there is no information that vessel traffic would have a significant negative impact on populations of mammal species of conservation importance, negatively affecting their feeding, reproduction or limiting their population dynamics. For this reason, no appreciable direct negative effects are expected even with the significant increase in traffic forecast.

Indirect negative impacts can be through impacts on populations of other species, e.g. food organisms. Such impacts may include adverse effects on juvenile fish from ship waves and adverse effects on amphibian insects in the littoral region. Indirect negative impacts on otter feeding on fish cannot be excluded for a 75% increase in vessel traffic. The potential indirect impact is certainly negative, but there are no usable data of a basic research nature available to estimate its magnitude. Among the candidate bat species, the common bat consumes mainly beetles, often including ground beetles, the western dusky bat consumes almost only nocturnal moths, while the sharp-nosed bat consumes both larger beetles and moths, whose reproduction is not typically linked to the main bed used by ships, so no significant indirect negative impacts are expected for these two species in relation to increased ship traffic. However, the lake bat specifically hunts above the water surface and its prey includes a significant proportion of amphibian insect larvae (e.g. crabs, tegetes) whose larvae develop in the water. Consequently, the negative impact on amphibian insects due to the increase in shipping may also have an indirectly measurable negative impact on the lake bat population. The magnitude of this indirect negative impact cannot yet be estimated on the basis of the available information and literature.

2.3 Gemenc (HUDD20032) priority nature conservation area

Habitats

The Gemenc (HUDD20032) Priority Site of Conservation Importance (PSCI) has 6 habitat types of Community importance and priority habitats of Community importance according to the current datasheet available on the EU Commission website (https://natura2000.eea.europa.eu/Natura2000/SDF.aspx?site=HUDD20032). One of the main functions of the Gemenc SCI is to conserve these habitat types at a defined extent and in a suitable condition over the longer term, and where possible to increase their extent and improve their condition. The candidate habitat types of the site are listed below:

3130 - Oligo-mesotrophic standing waters with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation

3150 - Natural eutrophic ponds with Magnopotamion or Hydrocharition vegetation

3270 - Rivers with muddy banks partly with Chenopodion rubri and partly with Bidention vegetation

6440 - Cnidion dubii river valley marshes

91E0 - Light alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae)

91F0 - Hardwood forests along large rivers with Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia (Ulmenion minoris)

Based on our field surveys, habitat types 3150, 6440 and 91F0 are not considered to be negatively affected by the proposed interventions.

On the stretch of the Danube in the Gemenc Priority Area of Conservation, only the main branch will be affected. A total of 4 project elements will be implemented in the area, two of which will consist of the dismantling of an existing spur-type stone structure and the other two of the construction of a new guide (stone structure) parallel to the bank. Of the four project elements, one demolition and one construction work will be carried out in practically the same location, making a total of 3 intervention sites in the Gemenc SAC, where the overall direct impact of the works is also very small.

Within the priority conservation area of Gemenc (HUDD20032) (Gerjen-Báta section), the interventions affecting terrestrial habitats will affect 2 habitat types of Community importance and 1 priority habitat type of Community importance.

Oligo-mesotrophic standing water with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation (3130): this habitat type occurs mainly on the reefs, natural banks and banks with natural channel and bank material on the main Danube riverbed and on the sections of the tributaries where there is no water cover for weeks in summer and autumn (they are left dry). According to the site's current datasheet, a total of 10.35 ha of such habitats are present within the Gemenc (HUDD20032) Priority Conservation Area. The habitat type was not identified during field surveys in areas potentially affected by the proposed interventions or by land-based construction, but its presence/concern, with a minimum (300 ^{m2} >) extent, cannot be excluded in the case of onshore construction of coastal stone works.

Rivers with muddy banks partly with *Chenopodion rubri* and partly with *Bidention* vegetation (3270): this habitat type occurs mainly in the riparian zones of tributaries where there is no water cover for weeks in summer and autumn (they are left dry), but is also found along the main riverbed and on reefs. The habitat type is present on 207.04 ha of the Gemenc (HUDD20032) Priority Nature Conservation Area, according to the datasheet. The habitat type was not detected during field surveys in areas potentially affected by the planned interventions or by land-based construction, so its presence is unlikely, but its presence/extent of influence cannot be excluded in the case of land-based construction of coastal stone works, where it is present in a minimum area (500 ^{m2} >).

Mild alder (*Alnus glutinosa*) and tall ash (*Fraxinus excelsior*) groves (Alno-Padion, Alnion incanae, Salicion albae) (*91E0): the exact extent of the impact on softwood groves cannot be given at this stage of the planning. 1 of the 4 project elements in the Gemenc SAC may be affected by land-based activities to a small extent (4000 ^{m2} >). The impact is only potential, as only terrestrial construction is likely to result in the use of working areas in coastal habitat strips and consequent felling. Compared to the total extent of the habitat type, the worst-case impact is also negligible, as the population of this habitat type in the Natura area concerned is estimated at 3105.61 ha according to the datasheet. In comparison, the proportion of the population affected by adverse effects is expected to be less than 1 thousandth in the worst case.

Due to the good regeneration capacity of the habitats and the assumed minimal impact, the expected negative impact is considered negligible for all three habitat types, even under the worst-case scenario. A significant negative impact can be clearly excluded.

Plants

It is a candidate plant species for the Gemenc Site of Special Conservation Interest:

Apium repens (creeping celery) C

In the areas affected by the planned interventions and, in the case of land-based works, in the strips of land potentially affected by the use of the working area in the coastal zone of the mid-water bed, botanical survey results and species occurrence data from the literature indicate that the candidate plant species creeping celery (*Apium repens*) will not be directly affected by the negative impacts of the planned interventions. Based on the nature of the habitat types concerned, the possibility of the species being affected cannot be completely ruled out, but the likelihood is very low.

Butterflies

The butterfly species of the Gemenc Site of Special Conservation Interest:

Hypodryas maturna (ornate cranesbill) C

Based on the field surveys, the planned interventions under the project will not typically affect habitats suitable for the ornamental fritillary, as the species is typically associated with the edge of hardwood forests in the Gemenc Priority Conservation Area, where the species' primary larval food plants are native ash species and frost. Such habitats are not affected by the proposed interventions in the Gemenc SCI and therefore this candidate butterfly species is not considered to be negatively affected by the proposed intervention, either during the construction phase or post-construction.

Other invertebrates

Other candidate invertebrate species of the Gemenc Priority Conservation Area:

Cerambyx cerdo (large mantis shrimp) C

Lucanus cervus (large hornbill) C

Based on the experience of our field surveys, hardwood forest habitats containing native oaks suitable for the great crested newt (*Cerambyx cerdo*) at least as a mixed species are not affected by the proposed interventions, and therefore this species is not considered to be negatively impacted.

There is little chance of the large hornbill occurring in the typically small, banded habitats potentially affected by the proposed interventions, as the species prefers forests containing oak as at least a mixed species and softwood forests are suboptimal habitats for it. No specimens were found during our surveys. However, the presence of the great horned beetle (*Lucanus cervus*) cannot be completely excluded in the area of the proposed interventions and in the coastal areas potentially affected by the works, as the literature indicates that its larvae also feed on native willow species and there are observations of the species in grass-dominated forests. For the great crested newt (*Lucanus cervus*), no significant negative effects are expected from the proposed intervention, either during the construction period or in the post-construction phase, as the number of potentially suitable tree sites affected is very small, negligible compared to the number of suitable tree sites in the entire Gemenc Priority Conservation Area.

Halak

The candidate fish species of the Gemenc priority conservation area:

Aspius aspius (balin) C

Cobitis taenia (cutting strip) C

Eudontomyzon spp. (ingola species) B

Gobio albipinnatus (Pale-spotted Spotted Spat) C

Gymnocephalus baloni (broad durbin) C

Gymnocephalus schraetzer (silky durbin) C

Misgurnus fossilis (meadow pipit) C

Pelecus cultratus (garda) C

Umbra krameri (marsh toad) B

Zingel zingel (Hungarian zingel) C

Among the candidate fish species, the marsh spider mite (*Umbra krameri*) is not considered to be negatively affected by the proposed intervention, because suitable habitats for this species will not be adversely affected by the project's proposed interventions, either during or after construction. In the Danube floodplain, the species may occur sporadically at most in the highly advanced successional stage of the floodplain in the marshy, stagnant water tributaries, but in the section between Gerjen and Báta the interventions will not affect the tributaries.

Among the candidate fish species, the meadow pipit (*Misgurnus fossilis*) can also be excluded as it occurs only in the tributaries of the Natura 2000 site, and only sporadically.

All other candidate fish species are considered to have a real negative impact on the proposed intervention.

The Gemenc (HUDD20032) priority conservation area includes the stretch of the Danube between 1509-1464.5 km and its tributaries. On this section of the Danube, only the main branch is planned to be affected. The interventions will typically be of a masonry demolition and installation nature, and the total area of small and medium-sized water bodies affected by the disturbance will not exceed 1.5 ha in the three areas. Consequently, the scale of the expected impacts is small.

Generally speaking, the planned construction works will not typically have a detrimental effect on adults if they are carried out during their active period, as they are basically fast-moving, relatively mobile animals that escape from temporary physical impacts that threaten them (e.g.: the spoon of construction machinery), so the construction works are more likely to be a temporary disturbance. This is true for both species associated with open water surfaces (such as the balin and the garda) and benthic species that live and feed near the surface of the seabed (such as the Hungarian sturgeon and the pale-spotted otter). The exception to this is the cutthroat (*Cobitis taenia*), as adults of this species often move towards the upper sediment layer in times of danger, attempting to hide there and thus avoid disturbance, and are therefore less vulnerable to physical impacts such as dredging. During the winter dormant season, however, the adults of almost all species are also very vulnerable, as the cooled, slowed-down individuals move in groups to their optimal burrows and burrowing sites, and many species even burrow into the uppermost layer of sediment. For all species affected, eggs and newly hatched juveniles are very vulnerable and due to their small size (eggs) and very limited spatial escape ability (juveniles), the physical impacts associated with the construction are likely to cause injuries in the immediate construction area of the intervention.

Dredging works on larger areas of the riverbed are not included in the planned interventions.

Considering the very small area of direct impact of the planned interventions and the small proportion of habitats affected compared to the total area of habitat types preferred by the species, the proportion of the population affected is not expected to reach 1 thousandth of the candidate population for any species.

By respecting the proposed time limits for construction works, the negative impacts associated with construction can be reduced to negligible levels.

The projected increase in vessel traffic after the construction is estimated to be around 75% by 2050 in terms of the number of vessels on the Danube section concerned. Based on available literature and anecdotal observations, vessel-induced wave action will continue to have a negative impact on fish, especially in the coastal regions of the Danube, even with current vessel traffic. Adverse effects mainly affect the juveniles of fish, which are more frequently found in shallow coastal areas. Waves reaching the shore can cause physical damage and consequent mortality both on rocky shorelines and on natural material beaches. In parallel with the increase in vessel traffic, the adverse, damaging effects of wave action on coastal regions and, depending on water levels, on reefs, should be expected to increase. During our field surveys, we conducted targeted observations to determine whether the passage of a single vessel causes mortality or appreciable physical damage to juveniles in windward waters along the coast. We did not observe any signs of mortality or significant physical injury during our observations, but we cannot exclude the possibility that the passage of many successive boats and the waves they generate may cause many small, insignificant injuries that reduce the survival of juveniles. This effect could be tested by studies at the basic research level. Overall, the increase in vessel traffic is expected to increase the negative impacts on candidate species stocks, mainly through increased negative impacts on juveniles.

Amphibians and reptiles

The candidate amphibian and reptile species of the Gemenc Priority Conservation Area:

Bombina bombina (red-bellied poppy) C

Emys orbicularis (bog turtle) C

Triturus dobrogicus (Danube turbot) C

Based on the available historical data and our field surveys, the populations of candidate amphibian species and the populations of the bog turtle in the Gemenc SCI are mainly associated with the tributaries in an advanced state of succession. In the section between Gerjen and Báta, the planned interventions will not affect the tributaries, so that no adverse effects on the species of amphibian or bog turtle are expected either during or after the construction of the project.

Mammals

The mammal species of the Gemenc Special Area of Conservation:

Barbastella barbastellus (Western Pisces) C

Castor fiber (Eurasian beaver) A

Lutra lutra (otter) C

Mustela eversmannii (polecat) C

Myotis dasycneme (lake bat) C

The newt is not negatively affected by the interventions planned within the framework of the project, because the construction works of the planned interventions do not affect open grasslands and grassland-grassland habitat complexes suitable for the species, and negative impacts on habitats suitable for the species can be excluded in the post-construction phase.

During our surveys, the Eurasian beaver can be found along the entire stretch of the Danube between Gerjen and Báta, which is part of the Gemenc Priority Conservation Area, and is affected by the planned interventions, which clearly indicates that the species has a significant single population density. Otter tracks were encountered with much lower frequency during the surveys, but based on literature (LANSZKI, 2014), the species is present practically along the whole length of the home stretch of the Danube. As described in the species impact assessment chapter, no direct damage or mortality associated with the construction is assumed. Mainly disturbance impacts are expected during the construction phase, which the individuals are able to avoid effectively. The expected disturbance effects are not significant, as only a few individuals will be affected due to the small number of disturbance sites and the overall small area of direct impact.

The western dirt bat and the pond bat are typically roosting bat species, so direct negative impacts are likely to occur in the case of construction-related tree felling. Woody vegetation is present in the riparian zone of the 3 sites affected by the proposed interventions. If the interventions are carried out from the shore close to the edge of the mid-water bed, the work area may be affected by the use of the mid-water bed riparian zone, which may involve tree felling. The results of the field surveys indicate that some older roosting trees potentially hosting roosting bats are present in these potential riparian work areas. The felling of these trees during the winter hibernation or pupping period could have a particularly damaging effect on the populations concerned, as it could result in damage and mortality of individuals. If the proposed time restrictions on felling of dead trees that harbour bats and the method of felling are observed, direct damage and mortality can be avoided. With compliance with the proposed restrictions, the magnitude of adverse effects on the candidate populations of western dirt bat and pond bat species following construction is not expected to be significant due to the very small number of potentially affected tree species.

At present, there is no information that vessel traffic would have a significant negative impact on populations of mammal species of conservation importance, negatively affecting their feeding, reproduction or limiting their population dynamics. For this reason, no appreciable direct negative impacts are expected under the projected expansion.

Indirect negative impacts can be through impacts on populations of other species, e.g. food organisms. Such impacts may include adverse effects on juvenile fish from ship waves and adverse effects on amphibian insects in the littoral region. Indirect negative impacts on otter feeding on fish cannot be excluded for a 75% increase in vessel traffic. In any case, the potential indirect impact is negative, but there are no usable data of a basic research nature available to estimate its magnitude. Among the candidate bat species, the western dusky bat feeds almost exclusively on nocturnal moths, whose reproduction is not typically linked to the main bed used by vessels, so no significant indirect negative impacts on the species are expected in relation to increased vessel traffic. However, the lake bat specifically hunts above the water surface and its prey includes a significant proportion of amphibian insect larvae (e.g. crabs, tegetes) whose larvae develop in the water. Consequently, the negative impact on amphibian insects due to an increase in the volume of shipping may also have an indirectly measurable negative impact on the lake bat population. The magnitude of this indirect negative impact cannot yet be estimated on the basis of the available information and literature.

2.4 Béda-Karapancsa (HUDD20045) priority nature conservation area

Habitats

The Beda-Karapancsa SPA (HUDD20045) has 6 habitat types of Community importance and priority habitats of Community importance according to the current fact sheet available on the EU Commission website (https://natura2000.eea.europa.eu/Natura2000/ SDF.aspx?site=HUDD20045). One of the main functions of the Béda-Karapancsa SCI is to conserve these habitat types at a defined extent and in a suitable condition over the longer term, and where possible to increase their extent and improve their condition. The candidate habitat types of the site are listed below:

3130 - Oligo-mesotrophic standing waters with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation

3150 - Natural eutrophic ponds with Magnopotamion or Hydrocharition vegetation

3270 - Rivers with muddy banks partly with Chenopodion rubri and partly with Bidention vegetation

6440 - Cnidion dubii river valley marshes

91E0 - Light alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae)

91F0 - Hardwood forests along large rivers with Quercus robur, Ulmus laevis and Ulmus minor, Fraxinus excelsior or Fraxinus angustifolia (Ulmenion minoris)

Based on our field surveys, habitat types 3150, 6440 and 91F0 are not considered to be negatively affected by the proposed interventions.

On the section of the Danube in the Béda-Karapancsa priority nature conservation area, only the main branch will be affected. One is the construction of a chevron-type river control dam in the immediate vicinity of the Mohács inland area, and the dismantling of an existing spur-type dam on the section above Baja. In total, 2 project elements will therefore be implemented in the area, with a small overall direct impact area.

Within the Béda-Karapancsa priority conservation area (the section between Báta and the southern border), the interventions affecting terrestrial habitats will affect 2 habitat types of Community importance and 1 priority habitat type of Community importance.

Oligo-mesotrophic standing water with Littorelletea uniflorae and/or Isoeto-Nanojuncetea vegetation (3130): this habitat type occurs mainly on the reefs, natural banks and banks with natural channel and bank material on the main Danube riverbed and on the sections of the tributaries where there is no water cover for weeks in summer and autumn (they are left dry). According to the site's current datasheet, this habitat type is found in a total area of 2.16 ha within the Beda-Karapancsa (HUDD20045) Priority Conservation Area. Based on our field surveys, the occurrence of this habitat type and its consequent impact on the right bank reef cannot be excluded for the proposed chevron dam in section 1446 fkm. The impact is not significant compared to the cumulative extent of similar reefs, tributaries and riparian habitat strips providing suitable surfaces for the habitat type.

Rivers with muddy banks partly with *Chenopodion rubri* and partly with *Bidention* vegetation (3270): this habitat type occurs mainly in the riparian zones of tributaries where there is no water cover for weeks in summer and autumn (they are left dry), but is also found along the main riverbed and on reefs. The habitat type is present in the Béda-Karapancsa (HUDD20045) priority conservation area, which covers 107.98 ha according to the datasheet. Based on our field surveys, the occurrence of the habitat type and its consequent impact cannot be excluded in the case of the planned quarry dismantling from the land in section 1464.5 fkm. The impact is not significant compared to the cumulative extent of similar reefs, tributaries and coastal habitat strips providing suitable surfaces for the habitat type.

Mild alder (Alnus glutinosa) and tall ash (Fraxinus excelsior) groves (Alno-Padion, Alnion incanae, Salicion albae) (*91E0): the exact extent of the impact on softwood groves cannot be given at this stage of the planning. In 1 of the 3 project elements in the Béda-Karapancsa SCI, 1 of the 3 project elements may be affected by land-based activities to a small extent (4000 ^{m2} >). This impact is only potential, as only in the case of terrestrial construction can the use of working areas in coastal habitat strips and the resulting felling of trees be expected. Compared to the total extent of the habitat type, the worst-case impact is also negligible, as the population of this habitat type in the Natura area concerned is estimated at 755.83 ha according to the datasheet. In comparison, the proportion of the population affected by adverse effects is expected to be less than 1 thousandth in the worst case.

Due to the good regeneration capacity of the habitats and the assumed minimal impact, the expected negative impact is considered negligible for all three habitat types, even under the worst-case scenario. A significant negative impact can be clearly excluded.

<u>Plants</u>

The Béda-Karapancsa is a candidate plant species for a priority conservation area:

Marsilea quadrifolia (four-leaved marsilea) C

In the areas affected by the planned interventions and, in the case of land-based works, in the strips of land potentially affected by the use of the working area in the coastal zone of the mid-water bed, botanical survey results and species occurrence data from the literature indicate that the four-leaved meadow grass (*Marsilea quadrifolia*) candidate plant species will not be directly affected by the negative impacts of the planned interventions. Based on the nature of the habitat types concerned, the possibility of the species being affected cannot be completely ruled out, but the likelihood of negative impacts on the candidate population of the species associated with the proposed interventions is very low.

<u>Macroscopic aquatic invertebrates</u>

The aquatic macroscopic invertebrate species of the Beda-Karapancsa Priority Conservation Area:

Graphoderus bilineatus (broad planarian beetle) C

Unio crassus (blunt river mussel) C

Among the candidate species, the broad pond beetle is not considered to be a negative effect of the proposed intervention because the proposed interventions will not affect habitats suitable for this species, which occurs only in the advanced successional stage of the floodplain in the Beda-Karapancsa SCI. Such habitats will not be affected by the planned interventions along the stretch of the Danube between the Báta and the southern border. Indirect negative impacts on the species as well as negative impacts in the post-construction period can be excluded in relation to the proposed interventions.

Based on available previous survey results and current sampling results, the blunt river mussel (*Unio crassus*) will be a negative effector of the proposed intervention. The blunt mussel is a stream-favouring species, but does not prefer the fast-flowing, coarse gravel bed material close to the drift line. It prefers sediment-rich, medium-fine sediment (fine gravel, pebbles, river sand), which is mainly found at the margins of the mid-water bed, around reefs and in tributaries. No dredging is planned on the stretch between Báta and the border. A total of 2 interventions are planned on the stretch concerned, of which the construction of the chevron dam will affect suitable habitats for the species. The immediate impact area affected by the construction will not be suitable for the species after the construction, as it is not able to colonise the stone works. The area of the riverbed affected by the construction of the quarry is not significant and therefore no significant negative impact is expected. Compared to the total extent of the habitat types preferred by the species, the proportion of habitats affected by adverse impacts and loss of habitat during the construction phase is certainly less than 1 thousandth of the total area of the Beda-Karapancsa Priority Conservation Area.

In the case of the blunt river mussel, the available knowledge suggests that vessel-induced wave action does not appreciably increase mortality in adults. However, it cannot be ruled out that increased wave action causes higher mortality rates in planktonic veligera larvae of this species. There are no evaluable data on this, and studies at the basic research level would be needed to clarify this putative effect. Overall, on the basis of the available information, no significant long-term negative impact on *Unio crassus* is expected in terms of a significant reduction in the marker population associated with the implementation of the project.

<u>Butterflies</u>

The butterfly species of the Béda-Karapancsa priority conservation area:

Lycaena dispar (large firefly) C

According to the results of the field surveys, the great spotted sandpiper (*Lycaena dispar*) occurs along the Danube riverbed in a narrow riparian strip covered with tall vegetation and riverbank herbaceous vegetation. This type of vegetation occurs mainly in the riparian region of tributaries. In the stretch between the Báta and the southern border, the planned interventions do not affect the tributaries, so the great crested newt is not considered to be a negative influence of the planned interventions.

<u>Other invertebrates</u>

Other candidate invertebrate species of the Beda-Karapancsa priority conservation area:

Lucanus cervus (large hornbill) C

Osmoderma eremita (hermit crab) C

Of the 2 interventions affecting the Béda-Karapancsa SCI, the demolition of the existing spur-type masonry near the 1464.5 fkm transect may affect trees suitable for the two candidate species of xylophagous and saproxylic beetles, if carried out from land. For this site, the likelihood of construction from the water is much higher. In this case, neither of the beetle species can be considered as a negative impact agent. In the case of low probability of land-based export, only a few potentially suitable trees for both species are affected, so only a very small potential impact can be assumed in the worst case scenario.

<u>Halak</u>

The indicator fish species of the Béda-Karapancsa priority conservation area:

Aspius aspius (balin) C

Cobitis taenia (cutting strip) C

Gymnocephalus baloni (broad durbin) C

Gymnocephalus schraetzer (silky durbin) C

Misgurnus fossilis (meadow pipit) C

Pelecus cultratus (garda) C

Rhodeus sericeus amarus (rainbow fist) C

Rutilus pigus (maidenhair) C

Zingel zingel (Hungarian zingel) C

Among the candidate fish species, the meadow pipit (*Misgurnus fossilis*) can be excluded as it occurs only in the tributaries of the Natura 2000 site and only sporadically. On the other hand, the tributaries between Báta and the southern border are not affected by the planned interventions. All other candidate fish species are considered to have a real negative impact on the proposed intervention.

The Béda-Karapancsa (HUDD20045) priority nature conservation area includes the stretch of the Danube between 1464.5-1434.8 km and its tributaries. On this section of the Danube, it is planned to carry out interventions only on the main branch. On this stretch, 1 new quarry is planned to be constructed and 1 existing quarry is planned to be dismantled. The total area of the small and medium-sized riverbed affected by the construction of these works will not exceed 2.5 ha in the three areas. Therefore, the magnitude of the expected impacts is small.

Generally speaking, the planned construction works will not typically have a detrimental effect on adults if they are carried out during their active period, as they are basically fast-moving, relatively mobile animals that escape from temporary physical impacts that threaten them (e.g.: the spoon of construction machinery), so the construction works are more likely to be a temporary disturbance. This is true for both species associated with open water surfaces (such as the balin and the garda) and benthic species that live and feed near the surface of the seabed (such as the Hungarian warbler and the silky dace). The exception to this is the cutthroat (*Cobitis taenia*), as adults of this species often move towards the upper sediment layer in times of danger, attempting to hide there and thus avoid disturbance, and are therefore less vulnerable to physical impacts such as dredging. During the winter dormant season, however, the adults of almost all species are also very vulnerable, as the cooled, slowed-down individuals move in groups to their optimal burrows and burrowing sites, and many species even burrow into the uppermost layer of sediment. For all species affected, eggs and newly hatched juveniles are very vulnerable and due to their small size (eggs) and very limited spatial escape ability (juveniles), the physical impacts associated with the construction are likely to cause injuries in the immediate construction area of the intervention.

Dredging works on larger areas of the riverbed are not included in the planned interventions.

Considering the very small area of direct impact of the planned interventions and the small proportion of habitats affected compared to the total area of habitat types preferred by the species, the proportion of the population affected is not expected to reach 1 thousandth of the candidate population for any species.

By respecting the proposed time limits for construction works, the negative impacts associated with construction can be reduced to negligible levels.

The projected increase in vessel traffic after construction is estimated to be around 75% by 2050 in terms of the number of vessels on the Danube section concerned. Based on available literature and anecdotal observations, vessel-induced wave action will continue to have a negative impact on fish, particularly in the coastal regions of the Danube, even with current vessel traffic. Adverse effects mainly affect the juveniles of fish, which are more frequently found in shallow coastal areas. Waves reaching the shore can cause physical damage and consequent mortality both on rocky shorelines and on natural material beaches. In parallel with the increase in vessel traffic, the adverse, damaging effects of wave action on coastal regions and, depending on water levels, on reefs, should be expected to increase. During our field surveys, we conducted targeted observations to determine whether the passage of a single vessel causes mortality or appreciable physical damage to juveniles in windward waters along the coast. We did not observe any signs of mortality or significant physical injury during our observations, but we cannot exclude the possibility that the passage of many successive boats and the waves they generate may cause many small, insignificant injuries that reduce the survival of juveniles. This effect could be tested by studies at the basic research level. Overall, the increase in vessel traffic is expected to increase the negative impacts on the populations of candidate species, mainly through increased negative impacts on juveniles.

Amphibians and reptiles

Species of amphibians and reptiles of the Béda-Karapancsa priority conservation area:

Bombina bombina (red-bellied poppy) C

Emys orbicularis (bog turtle) C

Based on the available historical data and our field surveys, the red-bellied pine marten and the swamp turtle populations in the Béda-Karapancsa SCI are mainly associated with the tributaries in an advanced state of succession. In the stretch between Báta and the southern border, the planned interventions will not affect the tributaries, so that the red-bellied pine marten and the swamp turtle are not expected to be adversely affected by the project, either during or after the construction.

Mammals

The mammal species of the Béda-Karapancsa priority conservation area:

Barbastella barbastellus (Western Pisces) C

Lutra lutra (otter) C

Myotis dasycneme (lake bat) C

During our surveys, we did not encounter any otter tracks at the 2 sites affected by the planned interventions. However, based on the literature (LANSZKI, 2014), the species occurs practically along the whole length of the Danube, so its presence can be assumed. As described in the impact assessment chapter for this species, no direct damage or mortality associated with the construction is assumed. Impacts during the construction phase are expected to be primarily of a disturbance nature, which the individuals are able to avoid effectively. The expected disturbance effects are not significant, as the small number of disturbance sites and the overall small area of direct impact means that only 1-2 individuals are likely to be affected.

The Western Dirt Bat and the Pond Bat are typically roosting bat species, so only construction-related tree felling is likely to have a direct negative impact. Of the 3 proposed interventions in the Béda-Karapancsa SCI, only the removal of the existing spur-type stone work near section 1464.5 fkm is likely to affect trees if the works are carried out from land. For this site, the likelihood of construction from the water is much higher. In this case, none of the bat species are considered to have a direct negative impact. In the case of low probability of land-based construction, only a few patches of potentially suitable bark for both species are affected, so only a very small potential impact can be assumed, even in the worst case.

Felling during the winter hibernation or pupping period can have a direct detrimental effect on the populations of trees containing bat roosts, as it can result in damage and mortality of individuals. Direct damage or mortality can be avoided if the proposed time restrictions on felling of trees with bat roosts and the method of felling are respected.

At present, there is no information that vessel traffic would have a significant negative impact on populations of mammal species of conservation importance, negatively affecting their feeding, reproduction or limiting their population dynamics. For this reason, we do not expect any significant direct negative impacts even with the projected 75% expansion.

Indirect negative impacts can be through impacts on populations of other species, e.g. food organisms. Such impacts may include adverse effects on juvenile fish from ship waves and adverse effects on amphibian insects in the littoral region. Indirect negative impacts on otter feeding on fish cannot be excluded for a 75% increase in vessel traffic. In any case, the potential indirect impact is negative, but there are no usable data of a basic research nature available to estimate its magnitude. Among the candidate bat species, the western dusky bat feeds almost exclusively on nocturnal moths, whose reproduction is not typically linked to the main bed used by vessels, so no significant indirect negative impacts on the species are expected in relation to increased vessel traffic. However, the lake bat specifically hunts above the water surface and its prey includes a significant proportion of amphibian insect larvae (e.g. crabs, tegetes) whose larvae develop in the water. Consequently, the negative impact on amphibian insects due to an increase in the volume of shipping may also have an indirectly measurable negative impact on the lake bat population. The magnitude of this indirect negative impact cannot yet be estimated on the basis of the available information and literature.

UTIBER

VIZITERV CONSULT KFT

MŰEGYETEM 1782

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THE DANUBE WATERWAY DEVELOPMENT PROGRAM

Section III./B (From the Sió estuary to the southern state border, i.e. planned interventions between Baja and Mohács)

TRANSBOUNDARY ENVIRONMENTAL IMPACTS

Budapest, May 2021.

NIF

THE DANUBE WATERWAY DEVELOPMENT PROGRAM

Section III./B (From the Sió estuary to the southern state border, i.e. planned interventions between Baja and Mohács)

TRANSBOUNDARY ENVIRONMENTAL IMPACTS

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Gabor Guti

Budapest, May 2021

1. INTERVENTIONS OF THE PLANNED WATERWAY DEVELOPMENT

During the planning and the variant analysis of the interventions such **a version was chosen that minimizes the interventions by applying the waterway regulations with the maximum flexibility** that resulted in the most cost-effective solution. **The selected variant meets the requirements of the river training principles, i.e.:**

- In low water periods (WWL 2018) the minimum parameters of the navigation channel recommended by the Danube Committee are ensured:
    - depth: 2,7-2,8 m,
    - width of navigation channel: 100-150 m (two-way navigation), 60-80 m (one-way navigation)
    - curve radius: min. 1000 m;
- adapts to the existing mid-water training plan, to the existing river training structures, and to the riverbed shape (with the adjustments included in the present plans), creates a unified riverbed, which helps in ice and flood conveyance;
- of the applied training structures the chevron dikes are important for preventing shoal creation.
- the interventions prevent further lowering of the riverbed and the current low water levels, and improve flow conditions;
- interventions prevent shoal creation; in some places, minimal water level rise is expected as a result of river training works;
- river training interventions, channel gradient conditions, bends, low water riverbed depths, and the management of shoals also help to improve the conditions of flood and ice conveyance.

Based on the 2-Dimensional and 3-Dimensional hydrodynamic models, the stone structures adapted to the low water training lines will have a beneficial effect on the flow conditions at all sections, and provide the required fairway by minimizing maintenance costs. The river training interventions, channel gradient conditions, bends, low water riverbed depths, the management of shoals and floodplains will also help to improve the conditions for ice conveyance. The stone structures based on the criterion of low water regulation are also efficient in the case of mid-water levels (2 200 m^3/s).

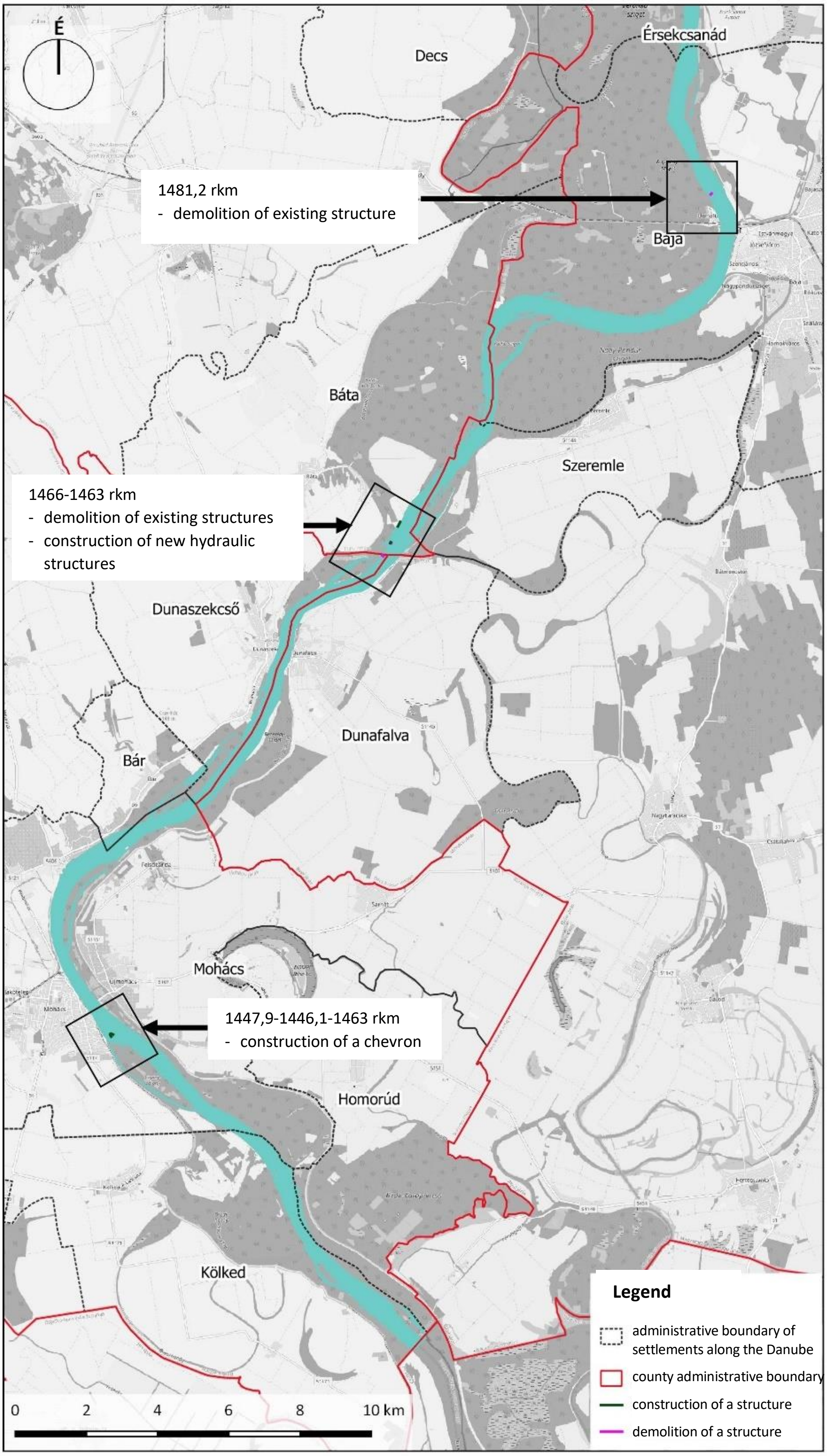
1.1. Interventions planned on the examined river section (Sió - National border)

In the river section below the Sió estuary, the main objective of the river training work is to maintain or improve the processes experienced in the recent period, i.e., **maintaining the water level rise below Baja.**

To achieve this goal, it is essential, that the planned solutions:

- disturb the wildlife of the river and its surroundings as little as possible;
- do not result in processes detrimental to operating and perspective water reserves;
- should be coupled with simple construction and cost-effective maintenance.

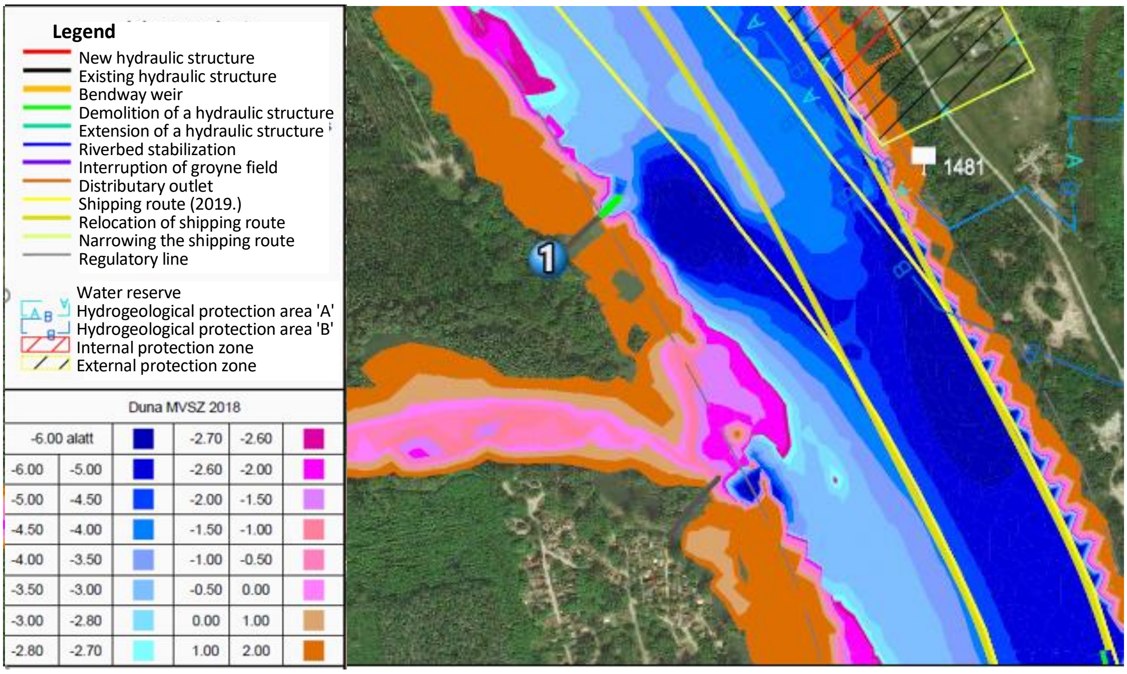
Figure 1 below shows an overview of the planned intervention sites and the technical solutions planned in the examined section.



1. figure Overview site plan of the interventions

Surrounding of Baja

North of Baja, 48 km from the Hungarian-Croatian border, only a partial demolition of a transverse river training work is planned on the right bank. This means dismantling the spur to the water training line, located at 1481 + 200 rkm. The location of the site is shown in figure 2. below, the spur to be demolished is indicated by the number 1. The required amount of demolition work is 2351 m³. The demolished stone can be used in the southern locations.



2. figure Location of the planned intervention near Baja

Surrounding of Báta

In the administrative area of Báta, 31 km from the Hungarian-Croatian border, the following interventions are planned on the right bank of the Danube (the location of the planned interventions is also marked with numbers in the following figure):

Partial dismantling of transverse river training works:

1. Dismantling of spur to the water training line on the right bank, at 1464 + 950 rkm, volume to be demolished is 1524 m³
2. Dismantling of spur to the water training line on the right bank, at 1464 + 400 rkm, volume to be demolished is 1725 m³

The amount of stone removed will be installed at the site of the transformation into a “T” river training structure at 1464 + 950 rkm.

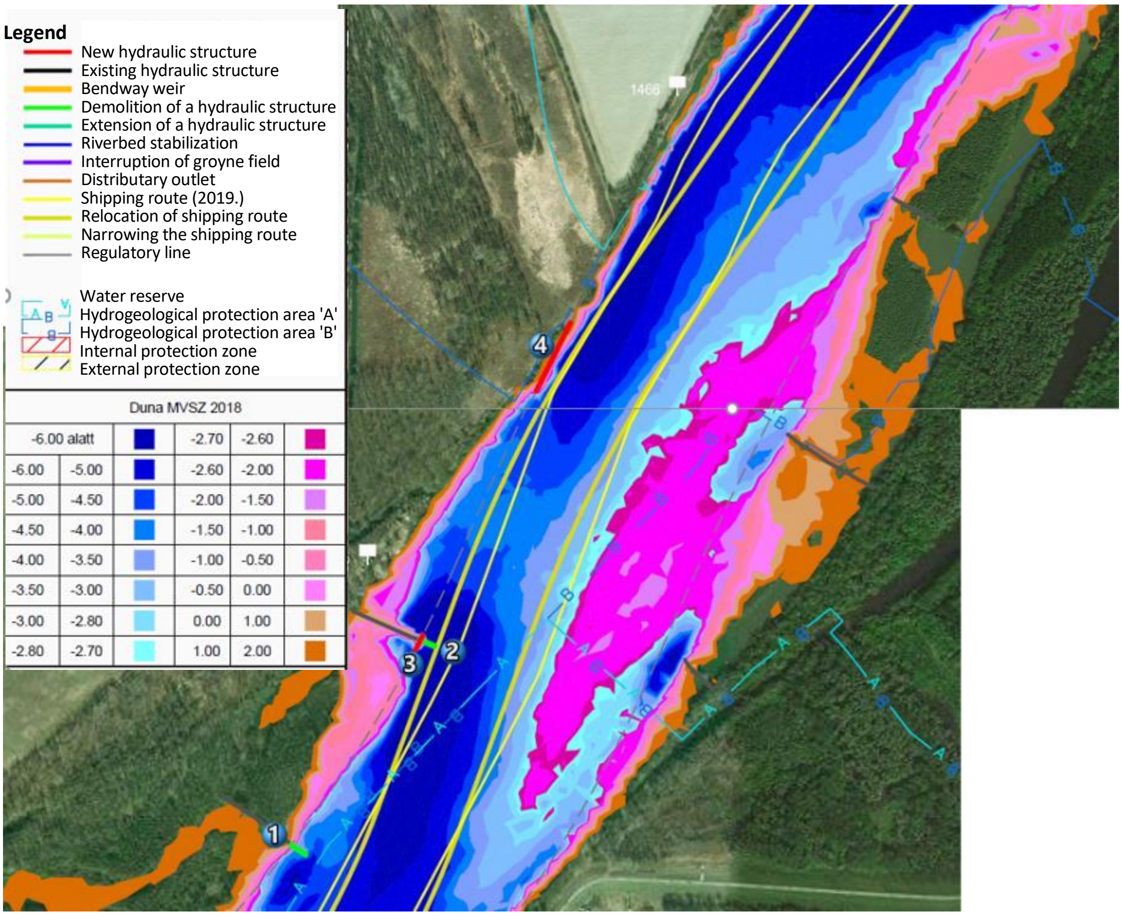
Construction of transverse river training works:

3. At 1464 + 950 rkm, the conversion of existing spur into a “T” structure is planned on the right bank. The amount of stone to be installed is 3005 m³. The length of the “T” structure’s head is 30 m, the crown level is 82.70 mBf (metres above Baltic sea level).

Construction of longitudinal river training works:

4. Between 1465 + 500-1465 + 400 rkm, a construction of a guide bank is planned on the right bank. The required volume of stone is 4869 m³. Height 2.34 m, length 140 m, crown level: 82.10 mBf.

The required amount of stone is expected to be transferred by water, partly from the amount of stone released at the northern intervention sites, and partly from the Dunabogdány mine as needed.



3. figure Location of the planned interventions near Báta

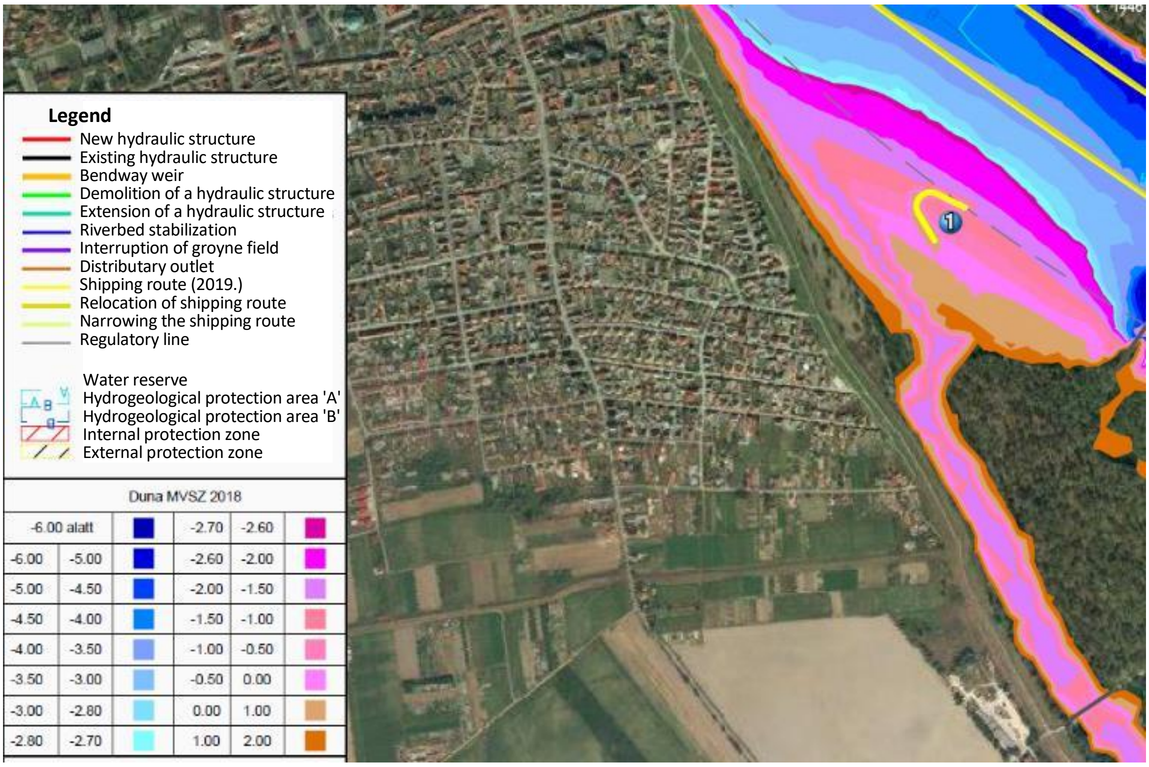
Surrounding of Mohács (Mohač)

The intervention in Mohács is the closest planned activity to the national border, therefore it is presented in more detail.

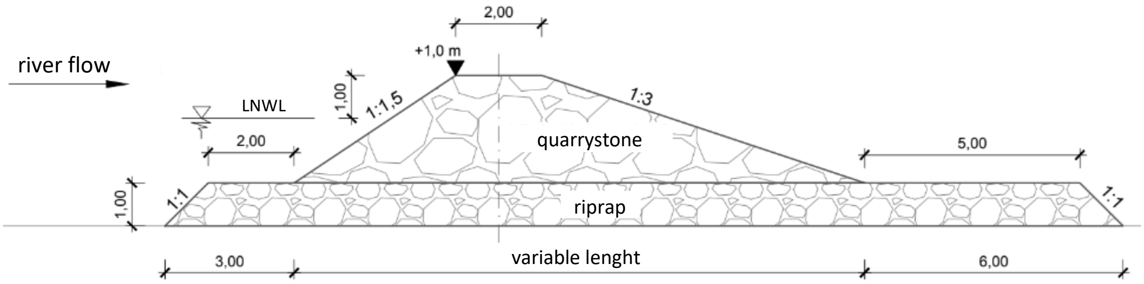
In the southern part of Mohács, 13 km from the Hungarian-Croatian border, the construction of a chevron-type structure is planned. This would be installed on the right side at 1446 + 050 river kilometres. Its axis is located 230 m from the edge of the navigation channel. About 4200 m^3 stone material is required for its construction. Height: 1.28 m; length 181 m; crown level: 81.70 mBf (metres above Baltic sea level).

Chevron dike is an innovative river training structure in Hungary. The "U" shaped stone structure will be built parallel to the flow direction, at WWL 2018 + 1.0 m level, separated from the shore, but close to it. These stone structures improve the navigability of the fairway by narrowing the riverbed while also ensuring coastal water flow. Based on the consistent results of foreign experience and hydrodynamic modelling, inside the chevron dike washing out develops where the water velocity is low, making it a good wintering place for fish, while behind it a dynamically changing bed surface is created. **See Figure 5.**

In terms of geometry, the chevron opens 80 m from a 50 m diameter circular arc with a length of 50 m. The stone structure is built on a 1.0 m thick stone pavement with a crest width of 2 m, and with a slope inclination of 1: 1.5 on the outside and a slope inclination of 1: 3 inside, and with rounded stem ends. The stone paving is 2.0 m outside and 5 m wide inside the chevron.



4. Figure Location of the planned chevron dike near Mohács



5. figure Cross section of the planned chevron dike

The required amount of stone is expected to be transferred by water, partly from the amount of stone released at the northern intervention sites, and partly from the Dunabogdány mine as needed.

It can be clearly seen that in its current state, a bay is beginning to form at the design site: The waterway is currently being trained by a spur on the south bank. The planned dike will reduce the formation of the bay.

6. figure Location of the planned chevron dike in the southern part of Mohács

Wooded floodplain forests can be found on the edge of the right bank, with different widths. To the north of the dike, it is very narrow, only 20-40 m wide. There are a couple of fishing piers in the woodland. On the south of the dike, an island-like forested area can be found 400-500 m wide.

The area of Újmohács is on the left bank (in the area beyond the dike). Here, the shoreline is typically 200-250 m wider. There are also floodplain forests here.

7. figure View of the planned chevron's location from the bank

8. figure View of the planned chevron's location from the water surface

1.2. Volume of activity

The volume of the planned works for the section is summarized in ***Table 1***:

1. table Volume of work at each intervention site

Planned works	Baja	Báta	Mohács	Total
Construction, extension of spurs from quarry stone m^3		3005		3005
Construction, extension of spurs from crushed stone m^3	2351	3249		5600
Construction, extension of guide banks from quarry stone m^3		4869		4869
Construction of Chevron dikes m^3			4209	4209
Total	**2351**	**11123**	**4209**	**17683**

1.3. Other planned interventions

To reduce the rate of dredging, the designers applied fairway route relocation in the following locations:

Between 1553 + 000-1550 + 400 rkm the fairway shifts to the right, max. 195 m,

Between 1498 + 500-1497 + 500 rkm the fairway shifts to the right, max. 35 m,

Between 1487 + 500-1486 + 600 rkm the fairway shifts to the right, max. 35 m,

Between 1482 + 350-1480 + 900 rkm the fairway shifts to the left, max. 100 m,

Between 1472 + 200-1471 + 300 rkm the fairway shifts to the right, max. 32 m,

Between 1465 + 500-1464 + 800 rkm the fairway shifts to the right, max. 40 m,

Considering the change of the riverbed, the route of the fairway must be constantly monitored.

1.4. Traffic prognosis

The traffic estimates are based on the data of the Hungarian Central Statistical Office, the EU statistics and were prepared in accordance with the EU reference scenario. The prognosis is based on a consensual assessment of the EU's economic development prospects.

The main goal of the development is to increase the performance of freight transport, primarily to achieve favourable environmental impacts due to traffic load rearrangement.

The expected increase in traffic by 2050 is quite moderated in terms of water freight traffic, even in the case of optimistic estimates. Although transport capacity will increase by 80% in terms of freight tonne-kilometres but considering the higher capacity utilization possibilities for freight transport (compared to the current 60%, it is 80% in 2050, including empty runs), the number of vessels could increase only by 37%. (See the table below.) The shipping period also increases from 240 days to approx. 340 days. This increase is likely to largely disappear in the daily traffic due to the extra shipping days. **So, overall, no serious increase in daily traffic can be expected in terms of freight transport**.

2. ***table*** ***Expected increase in freight traffic***

Inland freight water transport (billion freight tonne-kilometres/ year)	**2008-2019 meridian**	**2030**	**2040**	**2050**
Delivery performance	**1,92**	**3,07**	**3,42**	**3,73**
of which transit	**1,07**	**1,72**	**1,92**	**2,09**
of which export-import	**0,84**	**1,35**	**1,50**	**1,64**
mode shifting traffic		**1,15**	**1,50**	**1,81**
Freight transport: number of vessels				
Total vessel (vessel pcs / year) transit and export-import with separate average distances	**7 857**	**10 059**	**10 505**	**10 783**
of which transit (calculated with 380 km)	**2 945**	**3 770**	**3 938**	**4 042**
of which export-import (avg. 179 km)	**4 912**	**6 289**	**6 568**	**6 742**
cargo space utilization	***60%***	***75%***	***80%***	***85%***
Change in the number of cargo ships base year 2019				
Increase in total number of vessels		**28%**	**34%**	**37%**
of which transit		**28%**	**34%**	**37%**
Average load of vessels, tonnes / vessel	***960***	***1 200***	***1 280***	***1 360***

In the case of **passenger transport**, higher traffic growth has already been estimated, the number of vessels on the section could increase by 50 % by 2050. Although **this increase is not a consequence and the goal of the development under discussion, but it is largely related to tourism development goals and prognosis. The lack of development is likely to have little effect on its development because the dimensions and parameters of cruise ships allow them to navigate at low water levels (and therefore at present) almost unlimited.** Furthermore, the rate of growth is already the result of an optimistic tourism development plan from pre-pandemic times.

When describing the environmental effects, the increase in turnover of both transport sectors must be considered, regardless of the intentions. Data on estimated vessel numbers and peak hours for 2050 are provided in the following table.

3. ***table*** ***Estimated daily vessel numbers***

year	Passenger ships		Cargo ships		TOTAL ships	
	daily number	peak hour number	daily number	peak hour number	daily number	peak hour number
2020	4	1	33	8	37	9
2050	8	2	33	8	40	10

2. ENVIRONMENTAL IMPACTS

The southernmost planned intervention is at Mohács, 13 kilometres away from the national border. Therefore, we will cover this intervention in more detail while presenting the environmental impacts. However, it is important to emphasize that **neither the cumulative effects of the planned structures on the section nor the effects of the Mohács intervention affect or extend to the territory of the neighbouring countries**.

Air quality

The air load of construction/ demolition works is mainly due to the operation of the construction machines. Dusting is not expected to be significant here due to the wet environment. According to a preliminary estimate, the impact zone may cover an environment of 200 - 250 m outside the intervention areas.

Delivery of the most transport-intensive stone material is expected to take place by water; thus the impact area of the transport will extend to the Danube at most to its riparian zone. During operation, only a few 10 meters load increase is expected in the impact zone due to water transport compared to the current traffic.

Although during the operational period, the increase of ship traffic is regardless of the project, it represents a detectable surplus (1 passenger ship at peak hours, 3 passenger ships per day) at this stage. However, its impact on the impact zone of water transport is also negligible.

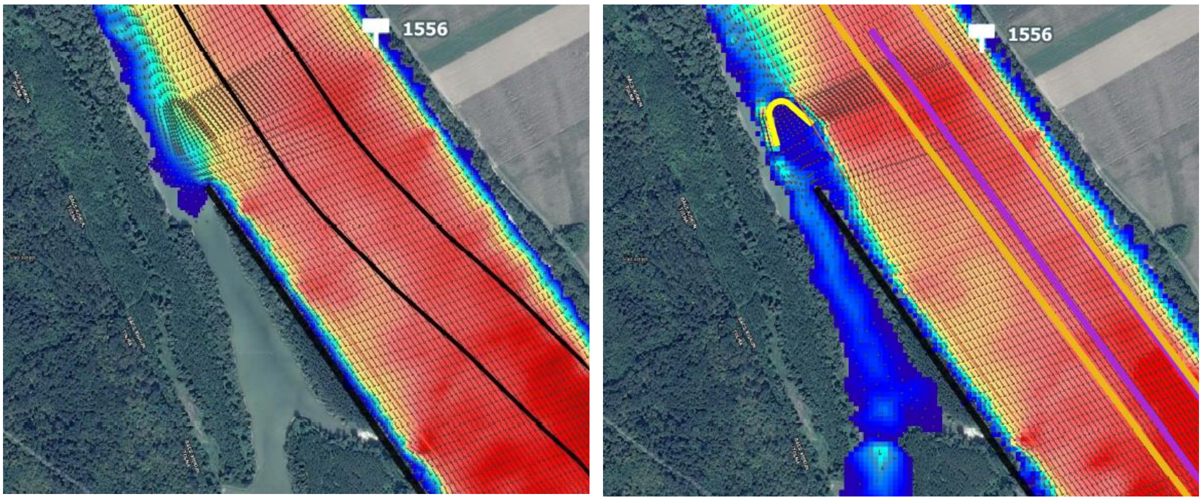
Surface water and groundwater

In terms of surface water and groundwater, the construction and demolition of stone structures can lead to temporary, local changes in water quality. Due to the increased mixing of water in the river, the dilution of substances and pollutants from the sediment may enter or mix with the water. The settling of particles can take place relatively quickly within the local environment of the work areas, within a few tens or hundreds of meters.

After the implementation of the planned development, the water flow conditions in the local environment of the stone structures will also change. This affects both the river section above and below a structure. Based on the hydrological model studies and experience, in case of mid-waterbed training, the effect of transverse structures has been proven to extend upwards to a length corresponding to one-bed width and downwards one and a half bed widths. In case of a low water training structure, this effect is approx. one-third of the above given lengths to both directions. Therefore, taking into account the 5-600 m mid-water bed width, the impact of the intervention in the surface water extends towards the border to 300 m. Looking at the interventions as a whole, no significant interpretable and evaluable impact can be expected in the border section neither in terms of discharge nor water quality.

The designed chevron dike will have a local water level rising effect on the upper part of the structure. The location of the new chevron dike is intended to improve the water supply to the Cigány Island tributary due to its narrowing effect and local flow acceleration. In addition to the narrowing of the riverbed and the local water-level rising effect, this stone structure is expected to improve the flow conditions towards the right bank, thus improving the water supply of the tributary. The result of 2D flow modelling is shown in the following figure at Mohács.

No transboundary impacts occur from the project on surface water and on groundwater.



10. figure Changes in velocity conditions near Mohács without the planned modifications (left) and with them (right) in the hydrodynamic model

Accidents, during the construction or operational phase, might directly endanger the condition of the water. However, if professional protection and remediation measures are implemented during construction, cross-border transmission of any pollution can be prevented.

Geological medium, soil

The most important change related to geological medium is land use. This is the direct area of the environmental impact zone, i.e., the area used by the planned river training structures and interventions (e.g., spurs) within the riverbed and additional coastal deployment and landfill areas to be developed during construction.

According to the plans, the interventions will be carried out, transported, marched from or by water. Even when working from shore, the procession is feasible by water. It is also not necessary to establish stone deposits on land, the storage is also feasible on ships. Ergo, land use is limited.

The indirect geological impact zone of the project is caused by flow velocity changes in the area of the deposition and sedimentation of the bed sediment. Since we basically expect smaller-sized particle riverbed sediment deposition in this section, the length of the impact zone can be hundreds of meters, and the tiniest particles could be transported up to 900-1000 m.

Sediment deposition is expected in the upstream area around the chevron dike. Here, the deposition of gravel and coarse sand are expected rather than sludge, causing fewer water quality problems. In the underlying area of the dike, various flow conditions are expected that generate a variety of sedimentation and depression areas locally.

A changed sediment balance can have an effect on both local habitats and groundwater. However, overall, the intervention is not expected to have a significant impact on the longitudinal movement of the sediment. According to the results of the hydrological modelling, the interventions are not expected to cause bed intrusion.

Additional environmental impact zone does not arise if the waste is generated and treated in accordance with the law. During the planned reconstructions, recycling as much of the demolished material (basically stone material) as possible is planned.

No transboundary impacts occur from the project on the geological medium and soil.

Wildlife

During the construction, living creatures associated with the bed surface and those species that unable to escape quickly are affected. They may be significantly damaged during the construction or in many cases, they might be destroyed locally.

As far as the land species are concerned, the black stork (Ciconia nigra) and the white-tailed eagle (Haliaetus albicilla) are particularly sensitive to potential disturbance in the vicinity of the constructions. The actual disturbing effect can occur within 400 meters of their nest.

The planned interventions will be carried out mostly from water by ships and barges. Therefore, the expected work areas will be small in the direction of the nesting sites, and the work area will typically be well covered. Currently, there is regular boat traffic in the river, so flying and feeding species in the vicinity of the main riverbed are used to the appearance and passage of ships.

During operation, mainly due to tourism development reasons, an increase in vessel traffic is expected on the fairway. Resulting adverse effects (e.g., increased hydrodynamic impact of ship waves on river banks, more frequent noise effects, visual stimuli) will occur in the main riverbed of the entire length of the affected Danube section. Negative impacts will affect aquatic insects, including amphibious insects flying out of the water during the last larval shedding, and mainly the offspring of fish.

To mitigate adverse environmental effects, it is necessary to set a maximum traffic capacity for the Danube waterway and use it as an upper limit.

Urban environment, noise

From an urban environment point of view, one of the most important environmental factors is the noise and vibration load. This can mainly occur during the construction/demolition phase and the related transportation. During the planned works, noise can be one of the marked determinants of the environmental impact zone because it can spread over hundreds of meters of the work areas. In the case of building material transport (by water), the water surface and the waterfront can be assumed to be the impact zone. However, in the absence of an emission limit value for water transport, a specific impact zone cannot be established.

During operation, the noise load from long-distance vessel traffic was determined at a uniform distance of 25 m from the navigation channel, similar to the current situation: the noise load of the projected 40 vessels operating daily is LAeq, 25m = 91 dB (for the daily assessment period), which means an increase of 0.3 dB compared to the current state, i.e. the change is not significant. In the absence of an emission limit value for water transport, neither compliance nor the impact zone can be determined.

Landscape

The impact on the landscape is mainly due to construction and demolition works, the existence of the completed structures, and the increase in the ship traffic resulting from the use of the fairway.

From a landscape perspective, local removal of vegetation (in the case of existing structures) and the newly planned structures will cause lasting change. The height of the stone structures varies, and their visibility is determined by the current water levels, but in the case of design water level, they will appear approx. 0,5-1,1 m above the water level.

No transboundary landscape impacts occur from the project.

2.1. Environmental impact zones

Taking into account the above mentioned information on the elements of environment, the estimated impact zones can be summarized as follows:

Establishment (construction/demolition):

Air protection (based on PM10): 235m

Noise: 700m

Wildlife: 200m

Water: mid-water riverbed (uniformly over 500 m above and below the intervention sections)

The abovementioned areas include all direct and indirect environmental impact zones related to other environmental element, or system.

Operation:

Air (NO_2): 210 m from the planned fairway in terms of traffic in 2050

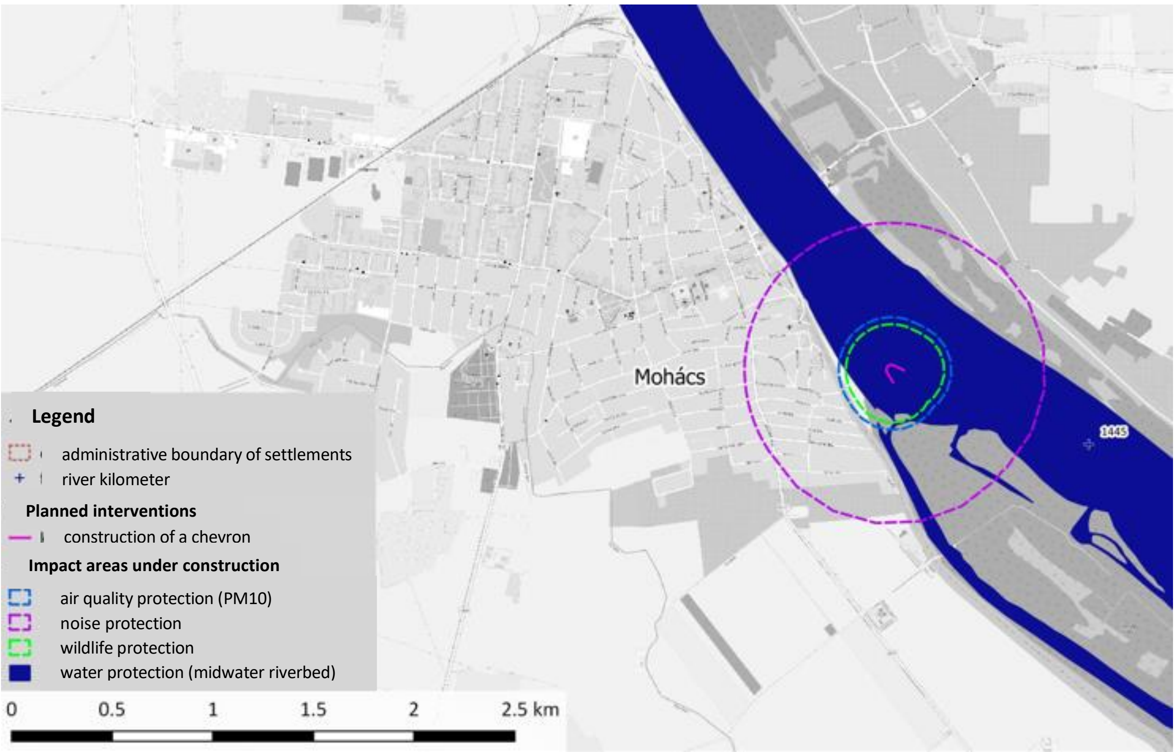
Wildlife: the whole riverbed

Water: mid-water riverbed

No impact zone related to noise protection could be designated due to the absence of an emission limit value for water transport.

The total environmental impact zone of the construction and operation is a 300 m band from the edge of the mid-waterbed, complemented by a 700 m zone at the intervention sites. The impact zone does not approach the border, which is 13 km away. The environmental impact zone of the establishment of the planned activities is localized to the environment of the interventions. The following figure illustrates the impact zone for the Mohács site, which is the closest project site to the national border.

Due to the change in traffic, the impact area of the operation is to be interpreted for the entire Danube section, therefore we do not show it.



11. figure Environmental impact zone under construction at Mohács

3. SUMMARY OF TRANSBOUNDARY ENVIRONMENTAL IMPACTS

In summary, the following findings can be made in relation to the development.

The southernmost and closest planned intervention to the Hungarian-Croatian border is a chevron-type training structure at the 1446.1 river kilometre that takes place 13 river-kilometres away from Croatia. The second nearest intervention is planned at Báta, 31 km from the border.

The chevron dike planned at Mohács improves the navigability of the fairway by narrowing the riverbed and ensures coastal water flow. However, its hydrological effect is local, only a few hundred meters. Therefore, we cannot expect significant hydrological or environmental impact in the boundary section, neither in terms of discharge nor water quality.

Transboundary effects are expected in terms of two environmental elements that are noise and wildlife. Firstly, an increased load of noise will be a possible cross-border effect that is related to the increase of long-term ship traffic. The estimated change of load is so small (0.3 dB) that it is negligible. Secondly, mainly due to tourism development reasons, the increased hydrodynamic impact of ship waves on riverbanks will result in adverse effects on wildlife that will occur in the main riverbed of the entire length of the affected Danube section. This impact on wildlife is expected to occur independently of the project in the future (due to tourism development).

With the implementation of the planned interventions on the Danube as an international waterway, conditions of navigation could improve - provided that all other countries along the Danube also meet the required navigation parameters – and a uniform navigation channel can be developed. Currently, there are narrow sections along the Danube in other places as well similar to the Hungarian ones (in Germany, in Austria under Vienna, on the Romanian-Bulgarian section under the Iron Gates), and the potential for increasing water transport demand is limited (i.e. the transport performance is determined not only by the parameters of the provided waterway but also by the quality and size of the economic relations determining the transport demand).

Indirect impacts of the development are expected to arise in Slovakia, Austria, Germany, the Benelux countries, Croatia, Serbia, Romania, and Bulgaria. The countries concerned can benefit economically from the project and can be affected by the favourable and unfavourable environmental effects also (favourable effects are expected along the roads occurred from the diversion of freight traffic; unfavourable effects are expected along the waterway, i.e., along the Danube). The prognosis for the growth of freight traffic optimally does not mean a significant increase in daily vessel traffic.

Overall, significant cross-border impact, permanent change, or significant long-term deterioration cannot be assumed as a result of the implementation of the project. Therefore, we do not consider it necessary to examine the transboundary effects in more detail.