Strategic Environmental Assessment of the Gabčíkovo-Nagymaros Project

DRAFT ENVIRONMENTAL REPORT
FOR THE DANUBE REACH SAP - BUDAPEST

(Background document for Slovak-Hungarian negotiations)

Bratislava, July 2012

Commissioned by:

Governmental delegation of the Slovak Republic for negotiation with the Hungarian Party on the implementation of the Judgement of the International Court of Justice in the case of the Gabčíkovo - Nagymaros Hydropower Project

and

Plenipotentiary of the Slovak Republic for construction and operation of the Gabčíkovo - Nagymaros Hydropower Project

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LIST OF ABBREVIATIONS

DISR	*Danube Information and Emergency System*
DMR	*Danube/Main/Rhine (DMR) waterway*
EAFRD	*European Agricultural Fund for Rural Development*
EEOP	*Environment and Energy Operational Programme*
GWC	*Ground Water Consulting Ltd.*
EU	*European Union*
ICJ	*International Court of Justice*
ICPDR	*International Commission for the Protection of the Danube River*
NAIADES	*Navigation and Inland Waterway Action and Development in Europe*
NBMS	*National Biodiversity Monitoring System*
NCCS	*National Climate Change Strategy*
NDPC	*National Development Policy Concept*
NEP	*National Environmental Programme*
NHDP	*New Hungary Development Plan*
NHRDP	*New Hungary Rural Development Programme*
NIENW	*National Inspectorate for Environment, Nature and Water*
NMVOC	*non-methane volatile organic carbons*
NRDPC	*National Regional Development Policy Concept*
NSDS	*National Sustainable Development Strategy*
SCI	*Sites of Community Importance*
SEA	*Strategic Environmental Assessment*
SPA	*Special Protection Area*
TEN	*Trans European Network*
TOP	*Transport Operational Programme*
WFD	*Water Framework Directive*
GNHP	*Gabčíkovo - Nagymaros Hydropower Project*

INTRODUCTION

The governmental delegation of the Slovak Republic and the governmental delegation of the Republic of Hungary, negotiating on the implementation of the Judgment of the International Court of Justice in The Hague (hereinafter the ICJ) rendered in the case of Gabčíkovo - Nagymaros Hydropower Project (hereinafter the GNHP), at their meeting held on March 7, 2007 in Bratislava, agreed that a joint strategic environmental assessment (hereinafter SEA) will be conducted in this issue. Governmental delegations agreed that the aim of the joint SEA will be the assessment of proposed human interventions in relation to the objectives of the 1977 Treaty, and that the SEA will be conducted on the Danube stretch between Bratislava and Budapest. This assessment should have been driven by Joint Hungarian-Slovak Steering Committee. The Parties also agreed that the preparation of background materials necessary for conducting the assessment (background papers, proposals, preliminary assessments and other documents) would be realised by both parties separately. The task of the Steering Committee according to the Statute should have been the coordination of both parties during the preparation of materials. In order to conduct the strategic environmental assessment, both sides agreed to exchange the existing information from the monitoring of natural environment, and that the special monitoring of the natural environment on the Danube stretch between Sap and Budapest (additional monitoring to monitoring according to the Intergovernmental Agreement of 1995) will be performed for at least two years (years 2008 and 2009).

Works on the background materials and the evaluation itself, started after the approval of the Statute of the Steering Committee in August 2008. The Slovak Party, due to significant reduction of funding in 2009, ensured the natural environment monitoring only. The Hungarian Party on December 21, 2009 sent to the Slovak Party the background material and the Draft Environmental Report for the Danube stretch between Sap and the mouth of the river Ipeľ. On request of the Hungarian Party from April 2010 for elaboration of a standpoint on the submitted, but not yet complete materials the Slovak Party in May 2010 announced that its opinion will be elaborated by July 15, 2010 and at the same time informed about getting started the work on SEA with an expected date of completion in December 2011. Due to the absence of the counterpart after the April elections in Hungary, the head of the Slovak Governmental delegation in the end handed over the Standpoint of the Slovak Party to the Embassy of the Republic of Hungary in Bratislava in November 2010.

The main objective of the Hungarian proposal of the Draft Environmental Report on the variants of the structural measures for the improvement of navigability and the rehabilitation of side arms of the Danube section between Sap and Szob was:

- to give the Slovak Party information regarding the working process of the Hungarian Strategic Environmental Assessment,
- to give the Slovak Party the possibility to make comments and proposals on the completed elements of the SEA Environmental Report, and
- to engage the Slovak Party into the determination of inter-boundary impacts and compensating and reconstructing proposals of SEA.

During negotiations with the Slovak Party the Hungarian party, in accordance with subsection (3) of paragraph 7 of the Hungarian Governmental Decree No. 2/2005 (I.11) on the SEA, wants to assure a discussion on the Environmental Report and proposed measures with the Hungarian public. The environmental assessment should be completed after taking the Slovak and Hungarian comments and proposals into consideration.

The main objective of the present Slovak Draft Environmental Report is:

- to harmonize the report with the Slovak legislation to some extent,
- to complete the text by variants of the Slovak Party,
- to propose additional evaluation criteria and to re-evaluate the proposed solutions, and
- to create a relevant basis for elaboration a joint SEA for the whole Danube stretch between Sap and Budapest.

According to the opinion of the Slovak Party it is crucial for this document that the ICJ adjudged that the 1977 Treaty is still in force and consequently governs the relationship between the Slovakia and Hungary. It is essentially important that the factual situation, as it has developed since 1989, shall be placed within the context of the preserved and developing treaty relationship, in order to achieve its objectives and purpose in so far as it is feasible. Treaty of 1977 was not only a joint investment project for the production of energy, but it was designed to serve other objectives, from among the main are:

- the improvement of navigability of the Danube,
- the protection against floods and regulation of ice-discharge,
- the protection of natural environment,
- the exploitation of natural resources.

The ICJ stated that none of objectives has lost its importance even at present and none of the objectives has been given absolute priority. Through the production of energy other objectives and benefits of 1977 Treaty can be funded. The European Community emphasizes the importance of integrated complex projects with various synergic results

The Hungarian Party in its document places great emphasis on the Water Framework Directive (hereinafter the WFD) and its application in all activities that are planned or anticipated on the Danube. The reading of the Hungarian material can give the impression that WFD is the goal to be achieved, and not the instruction how to deal with potential environmental impacts of various activities at fulfilling the objectives of 1977 Treaty. Such an interpretation of the WFD role is misleading, which was confirmed at the meeting of Water Directors of the EU Member States. (for details see the background material named „Position of the Slovak Party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest").

The use of hydroelectric power has strong support of the European Community, because it contributes to the objectives of various Community policies and the use of natural resources. As regards the promotion of construction, the small and large hydroelectric power stations in accordance with the EU directives, as well as with the conclusions from the meeting of Water Directors of the EU Member States, must be treated in the same way. In this sense two EU Directives are important for this strategic assessment, the Water Framework Directive (WFD) and the Directive on the promotion of the use of energy from renewable sources, including hydropower. Therefore it is necessary to use both directives together, using a common and comprehensive integrated approach, and to avoid inconsistent and distorted debates and consequently results (for details see the background material named „Position of the Slovak Party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest"). This procedure should be used even in the case of other relevant EU Directives. The Slovak Party in this evaluation uses and promotes such a procedure.

The objectives of the 1977 Treaty and therefore the Joint Contractual Plan comply with the international agreements mentioned below. For example, the navigation conditions correspond to the recommendations of the Danube Commission.

The Slovak Party has the opinion that non-use of natural resources in this stretch of the Danube is at least unwise and non-use of renewable sources (water, waterway, hydropower, soil, etc.) means that their unused benefits are lost forever. It addition, the specific natural conditions and risks have to be taken into account. Natural sources of the Danube corridor are detailed in the background material named „Position of the Slovak Party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest".

The Strategic Environmental Assessment or the Environmental Report are not a project task or project. These activities were carried out during the preparation of GNHP. Similar activities were also carried out recently on the Hungarian side by VITUKI, whose results were used as possible alternatives for comparison.

The assessment given in this report describes the possible variants of activity including the zero variant (status quo preservation) and compares the original project according to the Joint Contractual Plan with proposals of VITUKI. Key problems, which the proposed variants have to deal with, have not changed. In this stretch of the Danube they primarily are:

- improper conditions for navigation,
- addressing the flood protection,
- polluted environment,
- lack of use of natural resources,
- not using the possibility to produce electricity from the hydropotential of the river.

Regarding the traditional way of regulation of the Danube and the maintenance of navigation conditions all river processes, in principle, are developing as so far (erosion and sedimentation, ford creation, rock sills, decrease of surface and groundwater levels, and shift of biota towards xerophilous species, etc.).

The Slovak Party in the negotiations so far did not change anything in the basic engineering principles on which the valid Treaty of 1977 is based, or on the objectives of the Treaty, which shell be achieved. The Slovak experts are still convinced that the solution according to the 1977 Treaty and the Joint Contractual Plan is the best in terms of fulfilling the objectives of the 1977 Treaty. These objectives on the relevant stretch of the Danube primarily are:

- to solve of improper navigation conditions (including ports) by impoundment, for example by the Nagymaros step, or by other downstream step of similar parameters (Pilismarót), to link the Danube to the Váh river waterway;
- to stabilize the riverbed by impoundment and appropriate measures and to prevent its deepening;
- to save on the maintenance of the navigation fairway;
- to use the impoundment for production of electricity and this way to pay back the cost of the project;
- contribute to the improvement of flood protection by hydroengineering works;
- to increase the surface and ground water level, restore wetlands, rehabilitate side arms, and increase soil moisture by impoundment and other measures;
- to realize the preservation of protected ecosystems by management of surface and ground waters.

Other benefits, such as the development of infrastructure and development of recreation, are mentioned in the background material named „Position of the Slovak Party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest".

This material is intended to serve as background material for negotiations with the Hungarian Party on the implementation of the ICJ Judgement, and how to best meet the objectives of the 1977 Treaty and the expectations of European Union expressed in the Danube Strategy.

Text in italics in blue is the original text of the Hungarian Party, which was taken over without change to characterize the situation in Hungary, or to illustrate the opinions and proposals of the Hungarian Party. Since the Slovak Party does not intervene to the text taken over, this may not be fully acceptable for the Slovak Party.

1. BASIC INFORMATION ON CONTRACTING PARTY AND THE STRATEGIC DOCUMENT

1.1. Basic information on Contracting Party

1.1.1. Name

1.1.2. Address

1.1.3. Contacts

Will be determined by agreement of the Slovak and Hungarian Parties.

1.2. Basic information on Strategic document

1.2.1. Name

Strategic environmental assessment of the variants of structural measures for the improvement of navigability and the rehabilitation of side arms of the Danube section between Sap and Budapest

1.2.2. Area

Slovak republic

County: **Trnavský kraj**
District: Dunajská Streda

County: **Nitriansky kraj**
District: Komárno
District: Nové Zámky

Hungary

County: **Győr - Moson - Sopron**
Subregion: Mosonmagyaróvár
Subregion: **Győr**

County: **Komárom - Esztergom**
Subregion: Komárom
Subregion: Tata
Subregion: Esztergom

County: **Pest**
Subregion: Szentendre
Subregion: Szob
Subregion: Vác
Subregion: Dunakeszi

1.2.3. Concerned municipalities

Slovak republic

Trnavský kraj, district Dunajská Streda:

Kľúčovec, Medveďov, Ňárad, Sap

Nitriansky kraj, district Komárno:

Búč, Číčov, Iža, Kameničná, Klížska Nemá, Kolárovo, Komárno, Kravany nad Dunajom, Marcelová, Moča, Nová Stráž, Patince, Radvaň nad Dunajom, Trávnik, Virt, Veľké Kosihy, Vrbová nad Váhom, Zlatná na Ostrove

Nitriansky kraj, district Nové Zámky:
Chľaba, Leľa, Kamenica nad Hronom, Malé Kosihy, Mužla, Obid, Salka, Štúrovo

Hungary

County Győr - Moson - Sopron

Subregion Mosonmagyaróvár:
Ásványráró

Subregion: **Győr**
Dunaszeg, Gönyű, Győrladamér, Győrzámoly, Kisbajcs, Nagybajcs, Nagyszentjános, Vámosszabadi, Vének

County Komárom – Esztergom

Subregion Komárom:
Ács, Almásfüzitő, Komárom

Subregion Tata:
Dunaalmás, Neszmély

Subregion Esztergom:
Dömös, Esztergom, Lábatlan, Pilismarót, Süttő, Tát

County Pest

Subregion Szentendre
Dunabogdány, Kisoroszi, Leányfalu, Pócsmegyer, Szentendre, Szigetmonostor, Tahitótfalu, Visegrád

Subregion Szob:
Ipolydamásd, Ipolytölgyes, Letkés, Szob, Zebegény

Subregion Vác
Kismaros, Nagymaros, Sződliget, Vác, Verőce

Subregion Dunakeszi
Dunakeszi, Göd

The list of the municipalities may not be final. Concerned communities are all the municipalities where a potential impact of implementation of the assessed strategic document is assumed.

1.2.4. Concerned authorities

Slovak republic

Government Office
Ministry of Transport, Construction and Regional Development
Ministry of Economy
Ministry of Foreign Affairs
Ministry of Finance
Ministry of Environment
Ministry of Agriculture
Trnava Self-governing Region
Nitra Self-governing Region
State Navigation Administration

Hungary

Ministry of Rural Development
Ministry of Foreign Affairs
Ministry of National Development
Ministry of Economy
County Government Gyõr - Moson - Sopron
County Government Komárom - Esztergom
County Government Pest
National Transport Authority

The list of the authorities may not be final. Concerned authorities are all the public authorities whose binding opinion, endorsement, position or statement issued under separate regulations is required for permission of the assessed strategic document, or whose expression is required before its adoption or approval.

1.2.5. Approving Authority

The Government of the Slovak republic

The Government of Hungary

2. CONTENTS AND MAIN OBJECTIVES OF STRATEGIC DOCUMENT

2.1. Background information

2.1.1. The scope and the legal framework of Strategic Environmental Assessment

The Slovak Party prepared this Draft Environmental Report in accordance with the agreement of Governmental delegations of the Slovak Republic and the Republic of Hungary from March 7, 2007 and the Statute of Steering Committee approved on August 12, 2008.

Strategic Environmental Assessment (SEA) evaluates the proposal of variants of **interventions and measures for the improvement of navigability of the Danube stretch between Sap and Budapest** and technical solutions for the rehabilitation of side arms. The Slovak Party its proposals aimed at assessing the present situation, one of the variants proposed by Hungarian Party and the solution according to the original Gabčíkovo - Nagymaros Hydropower Project. According to opinion of the Slovak Party the evaluation of these three proposals is a prerequisite to accept a responsible decisions on technical interventions on this stretch of the Danube. The elaboration of the assessment must provide an overview of positive and negative impacts of each variant with respect to all objectives of the 1977 Treaty, as they were confirmed by the ICJ judgment of 1997.

The legal framework for elaboration of the SEA is the Directive 2001/42/EC of the European Parliament and of the Council on the assessment of certain plans and programs (hereinafter the SEA Directive) itself and its transposition into the national legislation of each country. Other legal documents that affect the scope of the SEA is primarily the 1977 Treaty and the related Joint Contractual Plan on constructing the Gabčíkovo - Nagymaros Hydropower Project, which were confirmed by the ICJ Judgement, and the ICJ Judgment from 1997 itself.

According to the opinion of the Slovak Party two other EU Directives are important for this Strategic Environmental Assessment as well, the Water Framework Directive (WFD) and the Directive on the promotion of the use of energy from renewable sources, including hydropower. Therefore the Slovak Party uses these directives together, using a common and comprehensive integrated approach. In this way it is possible to avoid inconsistent and distorted debates and consequently biased results as well.

The other EC directives and documents related to the issue of protection of water and natural environment, climate protection, as well as documents and conclusions of Water Directors workshops are very valuable legal materials as well.

2.1.2. Main objectives of the Strategic Environmental Assessment

In this point it is possible to agree with the opinion of the Hungarian Party, that *„the main objective of the Strategic Environmental Assessment is to perform the scientific analysis of* *extensive and complex technical environmental interventions regarding the implementation of the Judgment of the International Court of Justice at The Hague. The assessment, based on scientific and technical approaches, must also consider environmental, social, economic and sustainability criteria, and must provide a complex, systematic and transparent evaluation in order to give assistance to decision process".*

In accordance with the Hungarian Party also the Slovak Party uses the Water Framework Directive in order to meet best the environmental objectives. However, unlike the Hungarian Party, it assigns equal weight to the objectives on the Danube stretch between Sap and Budapest as defined by the 1977 Treaty. This means that the Water Framework Directive and the Directive 2009/28/EC on the promotion of the use of energy from renewable sources are implemented along with the other directives by complex and integrated manner.

This view of the Slovak Party is also supported by the Consolidated version of the Treaty on European Union, the objectives of the Strategy for the Danube region and the pursuit of synergistic and integrated comprehensive solution of problems together with a prudent and rational use of natural resources.

*According to the sustainable development policy of the EU the **Strategic Environmental Assessment is an instrument of proactive environmental protection;** it shows the interventions and measures with their possible environmental risks even at the strategic phase of the programming process. The starting point of the elaboration of the SEA is that the **measures and technical solutions** (and all the complementary measures in the fields of nature conservation, improvement of river navigation etc.) proposed for the implementation of the Judgement of the International Court of Justice at The Hague **should also be useful in environmental terms** and the adverse impacts on the individual environmental elements and systems should be minimised.*

The purpose of the SEA for the Danube stretch between Sap and Szob **is the preparation of an Environmental Report, which will provide the basis for selection of viable variants, in order to point out the environmental impact of solutions and measures. During the assessment it is necessary to bear in mind the sustainable development in the given area.** The result should be an overview of positive and negative impacts of different solutions in relation to the environment, natural environment, transportation, infrastructure, economics (costs/benefits), and public health.

2.2. The basic position of the Slovak Party in the elaboration process of the Strategic Environmental Assessment

Slovak proposals are based on the Consolidated version of the Treaty on European Union (Articles 9 and 191), which emphasize the prudent and rational use of natural resources. Without the use of natural resources, there is no development.

The proposal of the Environmental report is focused on the priorities of the European Union and the Danube region, on creation of synergistic results with minimal financial costs and the synergistic participation of various benefits.

This is consistent with the objectives of the Danube Region Strategy, as defined in Ulm (February 2010) and on the Conference on issues of transport, energy and environment in Vienna and Bratislava (April 19-21, 2010), as well as in Budapest Declaration (Declaration of the Danube Summit of February 25, 2010 in Budapest). As outlined in the Strategy of the European Union „EU 2020" (a European strategy for smart, sustainable and inclusive growth), these objectives are very important. The basic tool is a rational and prudent use of natural resources and activities to minimize risks. Non-utilization of natural resources is at least unwise and non-use of renewable sources means that still unused benefits were lost forever (like water for various purposes, waterways, hydropower, agriculture, etc.).

The aim is to move from words to action and set up specific priorities for the Danube stretch between Sap and Budapest.

According to experiences of the Slovak Party the impacts of measures for large multi-purpose projects, which have different cross-synergies (as in this case: renewable energy + substantial improvement of navigation conditions + improvement of conditions at ports + contribution to the flood protection + direct and indirect contribution to reduction of greenhouse gas emissions + improvement of recharge of groundwater reserves and improvement of the quality of surface and ground waters + tourist attractions and water sports + benefits for agriculture, forestry, water regime + support of protected natural areas, valuable habitats and landscapes + other synergistic benefits), are searched for and assessed in advance. To this the Slovak Party uses its experiences from the long-term joint Hungarian-Slovak monitoring (Agreement 1995). The synergy, in addition, will also create values that would otherwise not be created or would otherwise be expensive or unattainable (e.g. white water stadium, improvement of navigation conditions, cycle routes along the levees, infrastructure improvements, and many others).

A comprehensive and integrated infrastructure projects linking many synergistic elements are the main pillars of the European Union Strategy.

Brussels Initiative (26.1.2011) - Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions is called „A resource-efficient Europe - Flagship initiative under the Europe 2020 Strategy". This initiative stated that „Natural resources underpin the functioning of the European and global economy and our quality of life".

The Slovak Party mainly uses the Water Framework Directive - Directive 2000/60EC and its amendments, Directive 2009/28/EC - supporting renewable energy sources; Issue Paper (Final version) „Water management, Water Framework Directive and Hydropower - Common Implementation Strategy Workshop (Brussels, 13-14 September 2011) and Common Implementation Strategy for the Water Framework Directive - directive No. 20.

The Slovak Party relies on its experiences and long-term and comprehensive joint-Slovak Hungarian monitoring (Agreement 1995). It takes into account the current economic situation in Europe and the impact of Fukushima tragedy on European policy, which in the energy sector gives to Member States the possibility to take a closer look at hydropower.

Hydropower has the longest and best records of all technologies of renewable energy sources. Hydropower is a renewable, clean, highly efficient and non-waste source of energy.

Both directives, Water Framework Directive and the Directive on the promotion of the use of energy from renewable sources deal with the hydropower. For this reason, the two Directives should be implemented together through a comprehensive and integrated approach to avoid inconsistent and biased discussion and results.

2.3. Synergy in the Danube corridor

Large multi-purpose infrastructure projects promising all mutual synergies (such as flood protection, water transport, use of hydropower, municipal water supply, irrigation and drainage for agriculture and forestry, hygiene and diseases resulting from water, recreation, reducing greenhouse gas emissions, etc.), in our experience, assess and provide effective and protective measures in advance. It should not be neglected nor their financial and social impact.

Synergy and integrated comprehensive solution is the only way how to achieve progress. Synergy generally means mutual support between the various activities and systems that work together and create better and cheaper results.

Engineering integration means the combination of subsystems components into one system and ensures that all the subsystems function together as one system. System integration is also the added value to the system and the potential, which is possible due to the interactions between subsystems (synergy).

The main prerequisite for all system measures is to bear in mind that it is impossible to optimise all parameters of the system. Optimum of a functional system is not the sum of the optimal conditions for all of its components, but their optimal combination (synergy).

In this case we are looking for synergy between and within ecology, geology, engineering, economics and various human activities in order to optimise the environment, use of natural resources, further investments and the development of territory and its infrastructure, including the main goal: the prudent and rational utilization of natural resources.

The main substantial impact on the prudent and rational utilization of natural resources in our proposal is the water regime and water management. Every human activity, whether it's agriculture, forestry, mining, engineering, urbanization, flood protection, etc., to some extent, changes the previous water regime.

The water regime management is therefore the main tool for restoration measures, the preservation of ecosystems, immediate action against climate change and the main instrument of positive or negative impact on the ecosystem. Moreover, it is a precondition for the preparation of functional inundation, for supporting the nature-close eupotamal and its system of side arms, self-cleaning processes in the water, flood protection, energy, transportation, hygienic protection, etc.

Synergy and integrated comprehensive solution is therefore a strategy how to achieve economic success and noticeable progress.

2.4. Description of the proposed interventions and measures

The Slovak Party in the Danube stretch between Sap and Budapest considered three variants of technical interventions and measures, which aim is to provide a basis for a decision on how to implement the judgment of the International Court of Justice in The Hague. The first variant is actually the preservation of the present state and an overview of expected technical interventions and measures necessary for its maintenance. At this variant it should be noted, that it does not solve the problems of navigation on this stretch of the Danube, or the possible revitalization of branches. The second variant, which was considered by the Slovak Party, is identical with the variant proposed by the Hungarian Party as the variant of „VITUKI Base-1". The goal of this variant is partial improving of the parameters of waterway by dredging, construction of spur-dykes and guiding walls and the supplementation or reduction of existing spur-dykes. This variant also includes measures for rehabilitation of river arms. The third represents a water level impoundment according to the original project of Nagymaros dam or other water works with comparable parameters. It should be noted that the technical elaboration of particular variants is not the on same level. All variants are intended to improve the navigability of the Danube between Sap and Budapest, but according to the opinion of the Slovak Party, each variant fulfil this objective on a different level. At defining the technical interventions and measures the Belgrade Convention (1948), the Danube Commission recommendations (1988), the AGN Agreement (1996), the Decision of the European Parliament and Council. 1692/96/EC (1996) and the Joint Statement by the ICPDR, Danube Commission and the International Commission for the Sava river on navigation and environmental sustainability in the Danube catchment (2007) and the final version of the Issue Paper from Workshop on Common Implementation Strategy for Water Management, Water Framework Directive and hydro energy (2011) were taken into account.

2.4.1. First variant of interventions: „Preservation of the Present State“

The first variant of intervention represents the preservation of the present state on the Danube stretch between Sap and Budapest, and it considers minimal interventions and technical measures, which are necessary to mitigate the current negative development of the riverbed and to ensure conditions for safe navigation. Proposals of interventions and measures are based on a WRI study from 2006[1]. It should be noted that neither the present state nor its maintaining does ensure navigability for vessels with draught of 2.50 m and the width of waterway 120-150 m on the whole stretch. It can be assumed that this situation is not sustainable and will lead to further degradation of the riverbed.

[1] WRI (VÚVH), 2006: „Impact evaluation of the realized Danube adjustments on the current state and the riverbed development in relation to the changes in water regime“. Final report. Water Research Institute, December 2006

Interventions in the Danube section between Sap and Gönyű (1811-1793 rkm)

In this section some of the negative consequences associated with the operation of the Gabčíkovo Power Station appear, which come up mainly due to incompletion the Gabčíkovo -Nagymaros Hydropower Project. In order to mitigate the progressive riverbed degradation limitation of dredging in this section is suggested, restricted to necessary riverbed adjustments to ensure the navigation conditions in the area of fords (1796.3-1795.1 rkm; 1790-1788 rkm) or in the area with moderate siltation (1790-1780 rkm). Equally it is necessary to limit the construction of spur-dykes and longitudinal structures. Commercial dredging of the bottom material should be completely eliminated.

In the section of the tailrace canal downstream the Gabčíkovo power plant it is necessary to take steps to stabilize the riverbed by fortification of the bottom with coarse gravel fraction. The bed erosion below the confluence of the tail-race canal and the Danube old riverbed can be reduced by lowering the transport capability of the flow by partial increasing of the riverbed capacity by its widening.

Interventions in the Danube section between Gönyű and Szob (1793-1708 rkm)

Also in this section the interventions should be restricted only to necessary adjustments of the riverbed to ensure the navigation conditions in the area of fords (1763.4 rkm at Komárno, 1734.8-1733.8 rkm and 1732.5-1732.0 rkm at Nyergesújfalu, 1725.2-1724,0 and 1722.4-1721.0 rkm at Obid, 1714.2-1712.8 rkm at Kamenica nad Hronom and 1711.2-1710.6 rkm downstream the Chľaba island (Helemba).

In case of fords at Komárno, Nyergesújfalu, Obid and Kamenica nad Hronom the fords are formed by gravel or gravelly-marl that can maintain by dredging. The restriction of commercial dredging of the bottom material should also be emphasized in this section and the dredging in the section Gönyű Komárno should be completely eliminated.

In case of the second ford at Nyergesújfalu and the ford downstream the Chľaba island (Helemba) the bottom material of the ford section is formed by marl. The measures in this case would require considerable interventions in the form of building spur-dykes and/or expensive deepening of the rocky bottom. This means that in this variant of interventions these sites will constitute permanent obstacles for safe navigation at lower water levels.

Interventions in the Danube section between Szob and Budapest (1708-1640 rkm)

There are four major ford sections in the Danube stretch between Szob and Budapest. In terms of navigation the most critical stretch of the Danube is at Dömös, where the bottom is formed by hard andesite rock. Fords at Vác (1680.5-1679.1 rkm), Göd (1668.1-1666.7 rkm) and Budapest (1653.1-1651.5 rkm) can be partially maintained by dredging. The Slovak Party is not familiar with quantitative indicators of interventions for maintaining the present state. However, the dredging in any case is not advantageous for bank-filtered well systems exploiting groundwater.

2.4.2. Second variant of interventions: „VITUKI Base - 1“

The technical description of interventions and parameters are taken from the proposal of the Hungarian Party. *According to this variant, entitled „VITUKI Base-1”[2] the improvement of the parameters of the waterway are to be realized by dredging, the construction of spur-dykes and guiding walls and the supplementation or reduction of spur-dykes. This variant assures navigability for vessels with a 2.50 m draught, the width of the waterway being 120-150 m. The planned interventions were elaborated for the conditions of the riverbed between 2005 and 2007. It should be noted that the changes to the riverbed may change the extent of the interventions.*

Interventions in the Danube section between Sap and Gönyű (1811-1793 rkm)

The appropriate conditions of navigability in the section between Sap and Gyönyű may be assured by the complex regulation of the section, not by the separate elimination of the shallow fords and bottlenecks.

At the bottleneck of Patkósziget a longitudinal bar projects into the waterway on the Slovak side by 30-50 m, its width being 40-50 cm. This gravel bar may be eliminated by dredging. At the bottleneck at Medve the width of the waterway may be broadened by the shortening of a spur-dyke and the completion of another spur-dyke and by a 400 m long by about 1 m wide dredging operation. At the bottleneck at Szőgye, between the sections of 1800.3 -1799.7 rkm, widening should be carried out on the convex side and in the waterway near the right bank for about a 600 m long section and 20-30m width. Below this, also on the convex side, between sections 1799.1-1798.7 rkm, widening should be carried out along a section about 400 m long by 20-30m width, in the waterway near the left bank. The thickness of the gravel dredging is about 50 cm.

For the regulation of the bottleneck at Csicsó – considering the results of former experimental models and plans – the supplementing of the spur-dyke in the right bank, and the construction of a guiding wall is needed. In order to assure the 120 m wide waterway a gravel bar should be dredged in the left bank between sections 1797.76-1786.60 rkm, along an average width of 60 m. The waterway courses next to the left bank at the section of the bottleneck at Vének, between 1796.5-1795.6 rkm. On the right convex side of the bend (next to Kolera Island) deposition creates a bottleneck. Another bottleneck was formed along the left bank between 1794.8-1795.2 rkm. According to the proposed regulation plan, between 1796.5-1795.6 rkm dredging should be carried out along the right bank of the waterway, and a spur-dyke should be reduced by 50 m and another by 20 m on the Slovak side; also between 1795.2-1794.4 rkm a dredging process should be executed on the left bank and two dredging operations on the right bank. The predicted amount of the dredging is 74,000 m^3 gravel.

The waterway is very close to the left bank and forms a great bow from the confluence of the Mosoni-Danube to the section at 1791.5 rkm. There is a guiding wall on the right side of the riverbed, which is connected to the bank by cross-dykes. A part of the area is a silted

[2] For details see the VITUKI, 2007: Study to establish the project entitled: “Improvement of the Navigability of the Danube” 7th September 2007., http://www.vituki.hu

island. For the dredging processes at the upper bottleneck at Gönyű a detailed dredging plan was elaborated. The amount of the dredging is 10,200 m^3. The sediment picked up near Sap is deposited at the lower ford at Gönyű. According to the actual record of the riverbed survey a shallow ford was formed in this section. This navigation block has already been dredged; but as a result of the permanent sedimentation, regular gravel dredging processes should be carried out in the future.

Interventions in the Danube section between Gönyű and Szob (1793-1708 rkm)

The interventions improving the parameters of the waterway may be planned separately in this Danube section.

The elimination of the ford at Szőny may be carried out by dredging. Other river training works (apart from to the present guiding wall) should not be built because of the mooring places. The expected amount of the dredging is 10,000 m^3. The ford at Almásfüzitő is limited in extent, having a 1 dm shortfall in depth, which could be removed by a single dredging process. The expected amount of the dredging is 7,000 m^3. The bottleneck at Karva is also of a limited extent, having a 1 dm shortfall in depth, which again could be cleared by a single dredging process. The expected amount of the dredging is 7,000 m^3.

The most dangerous shallow ford of the section between Gönyű and Szob is the ford at Nyerges in terms of navigability, as the riverbed is uneven, its bed being rocky-marly with marly peaks. According to the mathematical model used in the examination of the variants, the clearing process in this rocky-marly ford will have a relatively slight impact on the low flow water level, the deepening of the water level will be only 2.5-3 cm. As a result of the dredging process, the maximum value of the decrease of medium velocity will be only 7 cm/s. The planned intervention will be the dredging of the marly-rocky riverbed between 1735.1–1733.7 rkm. The expected amount of dredging is 21,000 m^3. The highest shallow ford of this section is the ford at Nyerges. The improvement of the bottleneck at Nyerges is closely connected to the ford of Nyerges. The material of the bottleneck is marl and marly gravel. In addition to dredging, the lower tip of the Nyerges Island should be protected. The improvement of the bottleneck and the connected measures for the protection of the tip of the island on the left bank should be carried out by the incorporation of 4,000 m^3 of stone, and by the dredging of the shallow ford (marl and marly-gravel), the expected amount from which being 4,000 m^3.

The main material of the ford at Ebed is gravelly-marl and coarse gravel.

It can be projected from the hydraulic tests that dredging of the ford will assure the good conditions of the waterway, it moderately reduces the water level, and the increase in the extent of the cross section will not result in a harmful decrease of the flow velocity. The proposed intervention is the dredging of the ford, its expected amount being 13,000 m^3. As a result of the hydraulic tests, the dredging of the ford at Istenhegy will assure the good conditions of the waterway, it moderately reduces the water level, and the increase in the extent of the cross section will not result in a harmful decrease of the flow velocity. The proposed intervention is the dredging of the ford, its expected amount being 31,000 m^3.

According to the hydraulic tests, by dredging the ford at Garamkövesd the projected results may come about. The impacts related to the sinking of the water level are relatively limited and the increase in the extent of the cross section will not result in a harmful decrease of the flow velocity. The dredging is actually a riverbed-cleaning process, its expected amount being 13,000 m^3. The material of the ford at Helemba Island is marl. According to the former examinations and the mathematical model mentioned in the case of the ford at Nyerges, dredging is seen as the best method for the regulation of this shallow ford. The expected amount of the planned dredging is 40,000 m^3. The supplementing of the riverbed is also needed at the closure of the side-arm by the use of 15,000 m^3 of stone.

Table 1. The summary of the quantity parameters of the interventions of variant „VITUKI Base-1"

Section between Sap and Gönyű	
Dredging of fords in total	*152,100 m^3*
Refurbishment of river training works	*57,500 m^3*
Demolition of present spur-dykes	*34,700 m^3*
Demolition of present guiding walls	*83,600 m^3*
Predicted amount of regular dredging for maintenance per year	*100 – 150,000 m^3*

Section between Gönyű and Szob	
Dredging of fords in total	*148,000 m^3*
of which rocky-marly riverbed material	*78,000 m^3*
Refurbishment of river training works	*35,000 m^3*
Reconstruction of stone structures	*37,300 m^3*
Demolition of stone structures	*10,000 m^3*

Other features of the variant „VITUKI Base-1"

According to the results of the examinations of the different alternative interventions on the Danube section between Sap and Szob, and the one-dimensioned mathematical model of VITUKI, the depth of the river needed for the good parameters of the waterway may be assured by the realization of the proposed interventions. As a result of the mathematical model, the increase of the extent of the cross section will result in about a 2-3 cm drop of the water level at low flow. The highest decrease of flood velocity will be only 7 cm/s. According to experience gained, in order to assure the good conditions of the waterway, the different river training works should be maintained and the evolution of waterway bottlenecks should be prevented in the future, which would involve an estimated amount of about 100-150 thousand m^3 dredging of shallow fords per year. Certain changes of the riverbed structure may occur in the future in the Gönyű section, which can occasion the construction of some new river training works in the future.

Deficiencies of the variant „VITUKI Base-1"

Variant does not consider adjustments of riverbed on the Danube stretch between Szob and Budapest - Hungarian stretch of the Danube. This section shall be in accordance with the agreement of Governmental delegations of Slovakia and Hungary jointly assessed. According to the information of the Slovak Party the most problematic sites on this stretch of the Danube in terms of navigation are fords between 1697.8-1698.9 rkm - the ford at Dömös, 1680.5-1679.1 rkm - the ford at Vác, 1668.1-1666.7 rkm - the ford at Göd and 1653.1-1651.5 rkm - the ford at Árpád bridge in Budapest.

2.4.3. Third variant of interventions: „Water level impoundment by a dam“

In the variant „Water level impoundment by a dam“ the Slovak Party started from the original Nagymaros dam project[3]. The core of this variant is the construction of a dam in the Pilismarót-Nagymaros area, which would increase the level of the Danube. The most appropriate level of impoundment can be further examined. By the impoundment of water level a significant improvement of waterway parameters would be reached and the branches would by filled by water. A detailed description of proposed measures is given in the overall documentation of the Joint Contractual Plan

The original Nagymaros Hydropower Project counted upon synergistic elements: electricity production, with the possibility of peak electricity production, with an increase of groundwater levels decreased in the past, bridging the Danube River and many other benefits, including benefits to the natural environment. At the same time it would also significantly reduce maintenance costs of the fairway, and would improve the safety and economy of navigation.

Interventions in the Danube section between Sap and Budapest (1811-1640 rkm)

The riverbed in the Danube stretch between Sap and Budapest has deepened, either by erosion or dredging of fords, banks were fortified. There were guiding walls constructed in the Danube riverbed to collect the water, behind which islands were created. Up to the present the fairway is being expensively adjusted by conventional techniques, including construction of spur-dykes and dredging of fords. The bottom of the Danube, and thus the water level as well, has dropped and continues in dropping (**Fig. 3.7**), lots of branches in the space between the longitudinal dykes in the Danube and the banks were closed at least in the upper part and almost all of them are not through flowing at non-flood discharges. Their levels decreased and in a strip along the river and further along the branches also decreased the levels of groundwater. These branches on the Hungarian side are often used for waste deposition or are otherwise degraded, many of them were fulfilled and at present they are clogged and dry.

The flow of the Danube in the stretch from Sap to Nagymaros had not breaded into number of arms in the alluvial cone in the wide alluvium, as it did in the section downstream of Bratislava. Here the Danube meandered minimally because from south it was bounded by uprising upland and from north by the Danube plain. The water here had flow and flows naturally „geologically" concentrated in one riverbed. Danube in this section is characterized by relatively small slope, greater width of the flow, creation of fords (also rocky fords), changing the main streamline in the riverbed and the formation of islands (often with the

[3] Joint Contractual Plan, 1978: „Gabčíkovo-Nagymaros Hydropower Project, Joint Contractual Plan, Overall documentation 0-3-2.1, Nagymaros Waterworks - Protective measures on Czechoslovak territory", Hydroconsult Bratislava, VIZITERV Budapest, 1978.
„Gabčíkovo-Nagymaros Hydropower Project, Joint Contractual Plan, Overall documentation 0-3-2.2, Nagymaros Waterworks - Protective measures on Hungarian territory", VIZITERV Budapest, Hydroconsult Bratislava, 1978.

assistance of man behind the dykes guiding the flow of the Danube). The Danube riverbed is the only bed transferring flood discharges, it has not a broad alluvium for transferring floods. At the same time the riverbed is also used for navigation and recreational use. The Danube is used as a conventional sewer and its arms as waste disposal sites. Despite this its ecological value is similar to that in other sections. Its branches are actually not real alluvial branches.

Water Works in Pilismarót-Nagymaros area by the impoundment of the water level upstream the dam provides:

- optimal use of discharges to produce a basic or potentially peak energy,
- fairway parameters according to the recommendation of the Danube Commission and sufficient water depth in ports,
- appropriate water levels in the tailrace canal downstream of the Gabčíkovo hydropower station,
- permanent connection with river branches,
- favourable effects for recreational and tourist utilization of this river section.

Operating conditions arising from the Joint Contractual Plan are as follows (elevation point of the upper water level upstream of the dam):

- at the flow rate up to 1000 $m^3.s^{-1}$ 107.83 m a.s.l.
- between 1000-2300 $m^3.s^{-1}$, continuous operation 107,83 m a.s.l.
- between 2300-3760 $m^3.s^{-1}$ the impoundment can decrease to 107,33 m a.s.l.
- between 3760-6000 $m^3.s^{-1}$ the impoundment is 107,33 m a.s.l.
- at the discharge more than 6000 $m^3.s^{-1}$ gates open max. 107,65 a.s.l.
- the potential peak operation ranges between 107,1-107,83 a.s.l. ± 0,2 m

The height of impoundment can be adjusted depending on results of the environmental impact assessment.

Other features of the variant „Water level impoundment by a dam“

Projected measures for the whole area provide full flood protection. The measures consist of the following objects:

- protective dykes, reconstruction of the original ones, construction of new ones on the Danube and its tributaries,
- banks adjustment, fortification of banks and slopes, sealing walls,
- seepage canals and drains, channels for inland waters drainage,
- pumping stations for inland waters removal and regulation of groundwater levels,
- peripheral canals and adjustment of small flows,
- relocation of waterworks facilities, their protection and development of new,
- construction of sewer systems,
- relocation, reconstruction of transportation facilities,
- protection of industrial plants,
- relocation of long-distance transmission and telecommunication lines.

Technological and hydro-mechanical facilities include pumping and re-pumping stations, waterworks and distribution networks, sewage facilities, water gates on canals and flows. Measures pertaining to the Slovak Party were almost all carried out.

2.4.4. Intervention for the rehabilitation of side arms

The proposed interventions in side arms are taken from the proposal of the Hungarian Party and will be applied in varying degree in case of all three variants. The most important interventions are as follows:

The river ecosystem at Tát has significant importance, it is a significant habitat in the section between Sap and Szob. After its rehabilitation it may be an important fish-cradle and also a feeding place for several bird species. The water supply of the habitat may be assured by the proposed interventions for the most part of the year and this may improve the sustainability and the biological activity. The rehabilitation may improve the water quality in the side-arm, which can protect the future subsurface drinking water sources.

A line of bars, which is situated below the Helemba Islands, is one of the most important and internationally significant spawning grounds of the Danube. The rehabilitation of the side-arm system is particularly actuated by the prevention of sediment deposition and the compensation of the disturbing impacts of the interventions. In case of the third variant „Water level impoundment by a dam“ part of the island could be flooded. The level of impoundment, however, could be reappraised.

The limited deepening of the riverbed near the Nagy Erebe Islands and the connected side-arm system may improve the conditions of the wintering places for different fish species.

Table 3. Main features of the regulations in the side-arms

Name of intervention	***Place of intervention (rkm)***	***Main features of the intervention,*** *the method of regulation, the length of the affected river section, the area of the intervention, etc.*
Táti Island and side-arms	*1728.1-1721.8*	*opening of the upper closures of the side-arms up to DB 2004 level, dredging of 252,404 m^3 of silt and 34,958 m^3 of gravel*
Helemba–Déda-Törpe Islands and side-arms	*1713.0-1710.3*	*no dredging is needed in the Helemba side-arm, dredging of 4,060 m^3 of silt and 42,274 m^3 of gravel in the Déda side-arm, dredging 8,544 m^3 of silt and 27,794 m^3 of gravel in the Törpe side-arm*
Nagy Erebe Islands and side-arms	*1789.5-1785.5*	*opening of the closures of the side-arms up to DB 2004 level, dredging of 8,917 m^3 of silt and 5,794 m^3 of gravel*

2.5. Relationship between the interventions and the River Basin Management Planning process

Generally, the results of plans of new infrastructural interventions should be used during the planning process of the River Basin Management Plans. In the case of those interventions and investments having a high risk of negative impacts on the conditions of natural water bodies the main function of the River Basin Management Plans is to check that Article 4.7 Test of the WFD was carried out by the planners, and that they have drawn the correct conclusions in accordance with the results of the analysis. The planners of new infrastructural interventions and investments shall take all such information from the River

Basin Management Plans that is connected to the status of those water bodies, which may have negative impacts caused by the proposed interventions.

The River Basin Management Plans should not carry out detailed examinations regarding the new infrastructural interventions – for example improvement of navigability – which may have negative impacts on the status of water bodies. These examinations and analyses are very expensive and labour-intensive. Generally, it can be stated, that such examinations have not been conducted in the development process of River Basin Management Plans even in other Member States and the analyses and examinations remained mainly at the strategic level. If there is no concrete plan for the new infrastructural interventions and investments, the River Basin Management Plan shall make statements only on the basis of the estimations of special experts.

In accordance with the WFD, a River Basin Management Plan shall contain only summarized information on the different topics, but the sources of the detailed information should be referenced. Experience concerning public debates on River Basin Management Plans is that the stakeholders would like to obtain more detailed information concerning the plans, which the summarizing character of the plans does not offer. The detailed information may only be found in background papers. Detailed information regarding the plans for the improvement of navigability was not present in several cases in different public forums related to River Basin Management Plans. In the River Basin Management Plans a short summary should be written on the proposed interventions and investments that improve navigability; the planners of the navigability plans shall provide detailed information regarding these planning processes. The planners of navigability plans shall provide information for the planners of River Basin Management Plans concerning the planned interventions and their possible impacts and about the results of environmental assessments and the results of the WFD Article 4.7 Test, in particular.

We remark, that – although not required by the SEA Decree – if the special tests determined by the WFD are conducted during the planning process of the different alternatives of the proposed interventions, it may improve the professional utilization of the SEA documents.

Proposal 4.	*In the framework of the confirmation process of the proposed technical solutions the following examinations shall be taken in accordance with the WFD criteria:* *a) examinations to be undertaken for the qualification (for example revising as heavily modified water body) of the water body (Art. 4.3. test),* *b) the confirmation of moderate, less stringent environmental objectives (Art. 4.5. test)* *c) the socio-economic and environmental feasibility of the planned technical solutions and measures (Art. 4.7. test)*

Note	The Slovak Party is of that opinion that the River Basin Management Plans are made with objectives set out in the Water Framework Directive. The main general objective is the water quality, quality of the natural environment and fulfilling the requirements of EU directives. It follows that in the Management Plans a realistic state of factors characterizing the natural environment must be defined, which is in details described in the Annexes of Directive 2000/60/EC. If some parameters do not meet required condition it is necessary to define the desired state in the Management Plans. If the Management

	Plan shall be realistic, the conditions and measures must be well defined, how to achieve such a state. At the same time the Management Plans must also utilize the existing possibilities of water structures for implementation of Management Plans and simultaneously must take into account the measures taken to implement the EU's objectives and the Danube strategy as well. This includes the flood protection, protection of man, navigation and utilization of natural resources, including agriculture and forestry. These Management Plans must take into account the overall impact on the basin and vice versa. Most of the factors of the status are formed in the basin, at the beginning of water circulation. WFD (Water Framework Directive, 2000/60/EC) and RED (Renewable Energy Directive 2009/28/EC), as well as the other directives shall be used in an integrated and comprehensive way in order to obtain common synergy, and not conflictingly and inconsistently to thwart the synergistic result.

2.6. Relationship between the measures and the relevant European Community and national policies

2.6.1. Water policy of the European Union

The objectives and the measures of the EU water protection policy are determined and obligated by the Water Framework Directive. The regulations of the Water Framework Directive are the main criteria and tools of the water protection policy. The feasibility of those projects which may improve the main parameters of waterways is significantly determined by the specifications of the Water Framework Directive. A project, the objective of which is to improve navigability, shall be realized if the analyses determined by Paragraph 7 of Article 4 of the Water Framework Directive are conducted by the planners (i.e. 4.7 test), and it is confirmed that the interventions or investments are in compliance with the requirements concerned.

The European Commission's experts, during special meetings regarding the improvement of the navigability of the Danube, have drawn attention to the fact that the Commission will monitor new infrastructural investments – including new investments improving navigability – in order to ascertain that they are in compliance with the River Basin Management Plans and the requirements of Paragraph 7 of Article 4 of the Water Framework Directive. They have also emphasized that the examinations determined by Paragraph 3 and 4 of Article 6 of the Habitats Directive should also be conducted. They have also attracted attention to the fact that Paragraph 7 of Article 4 of the Water Framework Directive determines strict conditions for the realization of new investments with sustainable water management features. The following facts and criteria shall be confirmed:

- *in environmental aspects there are no better technical solutions,*
- *the cancellation of the proposed intervention or investment would injure public interest, or, the economic benefits of the realization of the proposed intervention or investment would exceed the ecological benefits which could be achieved by its cancellation,*
- *all measures are to be taken, which may reduce the negative environmental impacts,*
- *the main parameters of the intervention or investment and the reasons for its realization were formerly introduced in the River Basin Management Plans,*
- *the interventions will not have negative impacts on other water bodies and the realization of other environmental objectives.*

The Slovak Party at this place reiterates that the objective of the EU policy on water protection (RSV) is not to hinder the implementation of development projects, but to assure that the realized investments will take into account the environmental aspects in maximal possible extent, that they will implement measures to mitigate environmental impacts, and that the realized investments will meet the prerequisites for sustainable water management. Documents such as the Directive 2000/60EC, the Directive 2009/28/EC, the Common Implementation Strategy for the Water Framework Directive - Directive No. 20, the final document from the Workshop on Common Implementation Strategy „Water management, Water Framework Directive and Hydropower" from 2011, fully support the Slovak position. The aim of the directives and regulations is to promote joint synergy of investment projects and not to seek conflicts.

The impoundment of water level can significantly help in solving the decreased groundwater levels, in ensuring the groundwater recharge, in supporting aquatic and hygrophilous habitats, and in creating spawning grounds for fish and conditions for nesting waterfowl. Rehabilitation of branches can help in elimination of disposal sites in arms behind the islands and in solving other environmental problems. Significantly better navigation conditions can contribute to reducing air pollution generated by road transport and the waterway development will contribute to relieve the road network.

2.6.2. European, Hungarian and Slovak energy policies and specific policies in relation to renewable energy sources

- *European policies regarding the development of renewable energy sources*

According to the 2001/77/EC Directive on the promotion of electricity produced from renewable energy, the European Union made progress towards achieving the 21% target by 2010, which is equivalent to the national indicative target of 12 % regarding the gross national energy consumption. Pursuant to the Directive, all Member States should be required to set and make progress towards achieving national indicative targets for the fulfilment of the Community target. ***The methods used to achieve the national indicative targets, i.e. the share of different energy sources, should be determined at Member State level.*** *Thus, each Member State can determine the most convenient method for achieving the indicative targets.*

The need for the moderation being global climate change, the European Union, in December 2008, set out an ambitious target. According to this objective, the European Union is to make progress towards achieving the 20% target of overall share of energy from renewable sources by 2020. These objectives were laid down in the 2009/28/EC Directive. Member States – similarly to former regulations supporting the use of renewable energy sources – shall determine their strategies and action plans according to their possible sources, geographical conditions and other relevant aspects. The Directive – except for the special rules for bio-fuels used in transportation processes – does not differentiate between possible methods and has no preference for any methods of renewable energy production.

Financial support for the investments is guaranteed by the European Union, mainly from the Cohesion Funds and Structural Funds, but there are special institutions – for example the Strategic Energy Technology Plan, the Framework Programme for Research and Technological Development and the Programme of Intelligent Energy for Europe – which can give financial support for research and technology transfer processes.

- *The role of the renewable energy sources in the Hungarian energy policy*

In accordance with the 2001/77/EC Directive Hungary determined to achieve the national indicative target of 3.6 % by 2010 which should be fulfilled (at the date of the determination of the national indicative target the actual share was about 0.5% in Hungary).

The national renewable energy action plan should be established in 2010 in accordance with the requirements of the 2009/28/EC Directive. The principles of this action plan are determined by the 40/2008 Resolution of the Hungarian Parliament which defines the energy policy for the period of 2008-2020. In this Resolution Parliament calls upon the Government to establish an energy policy and prepare the strategy for increasing the use of renewable energy sources in accordance with the requirements of the European Union, taking into consideration the natural and economic conditions of Hungary, the capacity of the population and the principles of cost minimizing and sustainability. The strategy should also contribute to the objectives of decreasing the emission of greenhouse gases in Hungary. This Resolution has not defined any concrete directions in the field of the use of renewable energy sources. Parallel to the elaboration process of this Parliament Resolution a working paper was also elaborated by the competent Ministry, on the strategy of increasing the share of the use of renewable energy sources. This working paper, however, has not been determined as an official document by either the Government or by Parliament.

In the aspects of the present SEA paper, only water energy would be relevant among the renewable energy sources. However, the share of water energy will not be significant in the domestic renewable energy use over the long term, as water energy shares only 14.4 PJ potential (meaning less than 1%) from the estimated overall domestic value of renewable energy sources potential (2600-2700 PJ). According to the estimates of the energetic department, the share of water energy from the 163 PJ potential, which can be utilized by 2020, may be only about 1 PJ value. The strict European environmental law – for example the rules and regulations regarding the protection of river ecosystems, natural values and water quality standards – make the increase of the share of water energy production more difficult.

- *The role of the renewable energy sources in the energy policy of the Slovak Republic*

The Slovak Republic, like other EU member countries, for strengthening the energy independence puts increasing emphasis on utilization of renewable energy sources. To promote the use of renewable energy sources it has been created a number of institutional and financial instruments and schemes. The biggest boom reaches the use of wind energy and biomass. Renewable energy sources are an important component of the structure of energy sources, but their ability to substitute other energy sources in coming years is limited.

The Slovak Republic almost 90 % of **primary energy resources** ensures by purchase outside the territory of the EU internal market. The only significant domestic energy source is brown coal, because the extraction of natural gas and crude oil is insignificant. For this reason continuously increase the importance of renewable energy sources (biomass, water, geothermal energy, solar energy, wind energy).

At present 5.2 TWh of electricity is produced annually from renewable energy sources, including the utilization of the hydropower potential of large hydroelectric power plants, which represents about 16 % of domestic electricity consumption. The total exploitable potential of individual types of renewable energy provides opportunities to increase their share in total electricity generation to 24 % in 2020 and 27 % in 2030. Most promising renewable source for heat production is the biomass, where the total annual potential suitable for energetic utilization is about 75.6 PJ. The biomass is a promising source of electricity generation.

Nevertheless, the most used source remains the utilization of hydropower potential. As for the other renewable sources (wind energy, geothermal energy, solar energy) their utilization will only be an additional resource due the safety and reliability of electricity and heat supply, while an important factor remains the issue of price of electricity and heat from renewable sources.

2.6.3. European, Hungarian and Slovak transport policies

- *International commitments on the improvement of river navigability*

Transport by inland waterways is regulated by the legal rules of the European Union and other international commitments. The main rights and obligations concerning the Danube, as an international waterway are determined by the Belgrade Convention (Convention Regarding the Regime of Navigation on the Danube). The Convention, which has been a matter of re-codification for years, regulates that the Danubian member states shall maintain their sections of the Danube in a navigable condition for river-going vessels, to carry out the works necessary for the maintenance and improvement of navigation conditions. The concrete parameters (such as the depth, the width and the availability) of the waterway have not been defined by the Convention. These parameters are drawn up by the Danube Commission, the executive body of the Convention.

The European Agreement on Main Inland Waterways of International Importance (hereinafter AGN Agreement) was adopted in Geneva, on 19th January 1996, under the aegis of the United Nations Economic Commission for Europe, which determines that the Danube is a part of the European International waterway system (marked by E-80). Annex III of the AGN Agreement sets out the minimum technical and operational characteristics of inland waterways of international importance. Section 2 of Article 11 of Decision No 1692/96/EC of the European Parliament and the Council repeats the requirements of the AGN Agreement, thus it can be considered as acquis communautaire.

- *Transport development programmes of the European Union*

Since 1990, the EU has devoted significant consideration to the development of the standardization of the traffic and transporting infrastructure (TEN programmes). The main objectives of these programmes are to establish a platform for the identity of interests for the Member States and to give financial support for the common development processes.

The TEN-T projects (Trans-European Transport Network) include all modes of transport and organised by axis and corridors. The Danube/Main/Rhine (DMR) waterway system is called Corridor VII. A basic principle of the programme is that this corridor contains several shallow fords and bottlenecks. The programme does not recommend any methods for the elimination of these bottlenecks and does not define any obligations, but the national governments have preferred the river control methods for the development of the waterway. In Hungary the Ministry of Economy and Transport has commissioned the consortium lead by VITUKI to elaborate the supporting study „Improvement of the navigability of the Danube" with a 50% EU contribution, in order to fulfil the criteria relevant for class VI/b by the methods of traditional river training.

The development of inland navigation in the European Union is also supported by the NAIADES (Navigation and Inland Waterway Action and Development in Europe). The main objective of this programme in addition to the development of waterways is to improve the communication, informatics, markets, and the fleet and to assist in special vocational training courses to increase the educational level of the human resource.

- *The Hungarian domestic regulations on river navigation*

The basic principle of the Hungarian regulations is Governmental Decree No. 151/2000, which declares the statements of the AGN Agreement. The detailed parameters of the regulation are proclaimed by the 17/2002 (III.7.) Decree of the Ministry of Transport and Water on „registering the navigable waterways or canals and waterways or canals, which can be made navigable". The Decree has accepted the recommendations of the Danube Commission, for example the minimum dimension of the waterway level must be ensured compared to the water level of water discharges with a 94% durability, or when the Danube is classified into class VI/b (between 1812 and 1641 rkm) and class VI/c (between 1641 and 1433 rkm). The Decree unambiguously contains the reference that the recommendations of the Danube Commission are to be applied during the establishment process of the waterway.

It is important to mention that the standpoint of the Hungarian National Council on the Environment considers the recommendation of the Danube Commission on the 94% durability of the design discharges too high (the minimum dimensions of the waterway must be based on the water discharges with a 94% durability).

- *The transport policy of the Slovak Republic*

The Transport policy of the Slovak Republic is based on the common EU transport policy as defined in the White Paper „European transport policy for 2010: Time to Decide" (COM 2001/370). European transport policy has a major impact on other horizons and direction of transport development in Europe. It is important that its basic objectives of orientation, particularly harmonious development of the individual components of transport, revitalization of railways, removing bottlenecks, focus on the user as a centre of transport policy and the management of traffic globalisation were factored in conditions of the Slovak Republic.

The transport policy of the Slovak Republic also takes into account the EU's Lisbon Strategy, whose strategic goal for the next decade is to build the most dynamic and competitive economy. This goal in terms of transportation will be provided in particular by the development of transport infrastructure, encouraging the liberalization of services and development of information and communication technologies.

In terms of greening the transport it is necessary to introduce and develop the use of alternative, renewable sources of energy for transport, to focus on the promotion and development of non-motorized and ecological transport modes. The reduction of negative impacts of transport on the environment need to be ensured also by an optimal balance in utilization of the potential of particular transport modes through the transfer of transport performances towards environmentally advantageous transport modes (railway, waterway, intermodal, public mass passenger transport, etc.) by performance-related charging of the road infrastructure based on distance travelled.

Currently there is an increasing tendency of road transport in the Slovak Republic, mainly freight and individual car transport, while the railway transport, urban and suburban bus mass transportation is in decline. This negative development in transportation contributes to an increasing burden of the environment by emissions of pollutants and noise from the traffic.

The reduction of negative impacts on the environment is one of basic prerequisites for achieving sustainable mobility, taking into account the objectives of EU documents and targets on national level. By ratification of the Kyoto Protocol on reducing greenhouse gas emissions, the Slovak Republic committed itself to reduce emissions by 8 %. This commitment is necessary to fill in all sectors, hence also in the field of transport.

The international water transport is practically operated only on the watercourse of the Danube River (by the AGN convention labelled E-80, belonging to the TEN-T and it is also a part of the European Transport Corridor VII (Danube-Main-Rhine). This waterway allows connections to ports in Northern and Black Sea and the connection to the west European network of waterways. The waterway development largely depends on the development and completion of public ports on the Danube and upgrading their technical facilities so that the expected industrial development activities of the state were increasingly executed by waterway transport and particularly by utilization of the Danube watercourse (the completion of projects under the TEN-T, part Vienna-Bratislava and the cross-border part of Sap-Mohács). **Development of water transport infrastructure is now and in the future will oriented on completing the existing waterways and public ports. The realization of constructions of water transport infrastructure, particularly inland waterways is always a multi-purpose water-management investment.**

The main advantage of the inland waterway transport is the high level of transport safety. The vessels are required to meet the strictest standards and undergo regular tests performed by classification societies and inspectors. The concept of River Information Services (RIS) focuses on the implementation of information services to support the planning and management of transport and traffic activities. The water transport is one of the important components of transport and there are large reserves in it.

2.6.4. European, Hungarian and Slovak policies on environmental protection and nature conservation

The environmental policy of the European Union has been determined since 1973 by the environmental action plans, which involve the key elements of the nature conservation policy. Between 2001 and 2010, the Sixth *Environment* Action Programme is in force. The nature conservation policy of the Community is based on two directives of crucial importance.

- *the Birds Directive (79/409/EEC) on the conservation of wild birds, which lays down the principles of the determination of Special Protection Areas (SPAs), and*
- *the Habitats Directive (92/43/EEC) on the conservation of natural habitats and of wild fauna and flora, which lays down the principles of the determination of Special Areas of Conservation (SAC).*

The Natura 2000 network of the European Union for nature conservation is based on these two directives and is comprised of Special Areas of Conservation and additionally incorporates Special Protection Areas designated by Member States. The Community has determined principal restrictions for the modification and intervention of the good environmental conditions of the Natura 2000 areas. Although the main objective of the environmental policy of the EU is the protection of wild habitats and species it also takes measures on special management processes on environmental protection, which should be carried out by the Member States. The objective of these activities is to maintain the affected habitats and species in good condition, or, in the event of deterioration, to adopt conservation measures involving appropriate management plans and other measures, if needed, which correspond to the ecological requirements of the natural habitat types, and the species. The conservation objectives should be met while taking account of economic, social, cultural, regional and recreational requirements. It is for the Member States to establish the most appropriate methods and instruments for implementing the directives and for achieving the conservation objectives of Natura 2000 sites.

The Natura 2000 network refers to the community nature conservation and environmental protection aspects at regional level. It has great significance in the arrangements of the legal debate concerning the investments of the Gabčíkovo-Nagymaros Project, as several areas under the protection of the Natura 2000 network are affected by the project. In relation to the Natura 2000 areas the community law sets out the necessary protecting provisions for active management on the one hand, and absolute restrictions and limitations on the other. According to the community law, the Natura 2000 network is defined as „common European heritage" and it is declared that the protection of different areas and the integrity of the whole network is the common responsibility of the Member States. Meanwhile, the Member States shall provide for both the appropriate environmental and legal protection of the Natura 2000 area.

One of the main fields affected by the Community environmental law is nature conservation, which has direct impacts on the realization of the Gabčíkovo-Nagymaros Project. The priority of protecting targets is one of the most important aspects of the objectives on nature conservation. The Hungarian policy on nature conservation is determined by the community law, which means that the Member States should adopt all of the different international agreements integrated into the Community law, such as the following agreements: The Convention on Wetlands of International Importance especially as Waterfowl Habitat i.e. Ramsar Convention (Ramsar, 1971); Convention on the Conservation of European Wildlife and Natural Habitats (Bern, 1979); Convention on the Conservation of Migratory Species and Wild Animals (Bonn, 1979); the Convention *on Biological Diversity (Rio de Janeiro, 1992);* Convention *on Cooperation for the Protection and Sustainable Use of the Danube River (Sofia, 1994).*

The share of areas under the Natura 2000 network is 21% of the total territory of Hungary and 50% of them are under national protection. After Hungary's accession to the European Union, it was obligatory to determine appropriate management plans and other measures for the areas under the Natura 2000 network and to implement the habitat reconstruction programmes specified by the two directives of the Community on environmental protection and nature conservation. The adoption and harmonization of the environmental laws and regulations of the Community have not created any legal or institutional problems in Hungary, as there are regulations that are more stringent and measures already in Hungarian law. However, in other respects, the integration of the environmental protection aspects into the agricultural and rural development policies involves a more serious challenge for the policy makers

The Natura 2000 network in Slovakia consists of Special Areas of Conservation (Sites of Community Importance), taking up 11.89 % of the whole territory of Slovakia, and Special Protection Areas (i.e. Bird Areas), which occupy 25.2 % of the whole territory of Slovakia. These areas are sometimes overlapping. 55.15 % of all of these areas overlap the current network of protected areas. The principle of the protection of Natura 2000 sites is to protect their natural values, taking into account scientific, economic, social and cultural requirements and regional and local circumstances. The aim is not to suppress human activities on these territories. The essence of Natura 2000 is not a restrictive protection of sites, but the active cooperation of environmentalists, water managers, farmers and foresters and other interested parties.

2.6.5. Relationship between the proposed interventions and the document „Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin"

The Joint Statement of ICPDR, Danube Commission, and International Sava River Basin Commission contain recommendations for the improvement of the conditions for inland waterway transport in consistency with the criteria of environmental sustainability. The recommendations cover the integrated planning principles and the criteria for river engineering.

The EC supports the implementation of the recommendations of the Joint Statement among others through the financing of the PLATINA project and establishing the Working Group on Rivers initiated by DG ENV and DG TREN.

The consistency of the planning process of the measures with the recommendations of the Joint Statement is assessed in Table 4.

Table 4. Recommendations of the Joint Statement for the principles of integrated planning, and implementation of those for the planning of measures to improve the navigability of the Danube between Szap and

1. Integrated planning principles

Recommendations for the Joint Statement	***Consistency of the planning process with the recommendations***
Establish interdisciplinary planning teams involving key stakeholders, including Ministries responsible for transport, for water management and environment, waterway administrations, representatives of protected areas, local authorities, non-governmental organizations, tourism, scientific institutions and independent (international) experts.	*The planning process is consistent.*
Define joint planning objectives.	*The planning process is consistent*
Set-up a transparent planning process (information/participation) based on comprehensive data and including the environmental benchmarks and current standards required for Strategic Environmental Assessment (SEA – for qualifying plans, programmes and policies) and for Environmental Impact Assessment (EIA – for projects).	*According to the Work Plan the planning process will be consistent*
Ensure the comparability of alternatives and assess the feasibility of a plan (including the costs and benefits) and/or project (including a reflection of the status quo, alternatives and nonstructural measures as well as environmental and resource costs).	*The planning process is consistent*
Assess if the IWT project has a basin wide/transboundary impact.	*The planning process is consistent*
Inform and consult the international river commissions in the Danube river basin (ICPDR, Danube Commission, International Sava River Basin Commission) before deciding on new developments, as well as other possibly affected countries..	*According to the Work Plan the planning process will be consistent.*
Respect the Danube River Basin Management Plan 2009, including its Joint Programme of Measures, and the respective sub-basin and national river basin management plans and programmes of measures as the basis for integrated planning and implementation of IWT infrastructure projects, in the meantime respecting already existing environmental legislation requirements.	*According to the Work Plan the planning process will be consistent*
Define and ensure the prerequisites and goals of IWT as well as river/floodplain ecological integrity, followed by a consideration of the need to prevent deterioration, possible mitigation and/or restoration measures to achieve all environmental requirements.	*According to the Work Plan the planning process will be consistent*
Ensure that there are no technically viable, environmentally better and not disproportionally costly alternative means to achieve the required objective, in line with the requirements of Article 4(7) of the EU WFD.	*According to the Work Plan the planning process will be consistent.*
Seek to avoid or, if this is not possible, to minimize the impacts of structural/hydraulic engineering interventions in the river system through mitigation and/or restoration, giving preference to reversible interventions.	*According to the Work Plan the planning process will be consistent*
Ensure that, when planning navigation projects, the issue and respective effects of climate change are taken into account.	*According to the Work Plan the planning process will be consistent*

Recommendations for the Joint Statement	***Consistency of the planning process with the recommendations***
Use of best practice measures to improve navigation	*The planning process is consistent*
Carry out a priority ranking of possible measures to ensure the best possible environmental as well as navigation development effect and use of financial resources.	*According to the Work Plan the planning process will be consistent*
Ensure flexible funding conditions for projects to enable integrated planning (including the involvement of all stakeholder groups) and adaptive implementation as well as monitoring.	*According to the Work Plan the planning process will be consistent*
Monitor the effects of measures and – if relevant- adapt them.	*According to the Work Plan the planning process will be consistent*

2. Criteria for river engineering

Recommendations for the Joint Statement	***Consistency of the planning process with the recommendations***
Use a case-by-case approach which considers both the ecological requirements for river sections and the basin-wide scale and the strategic requirements of IWT at the basin-wide scale when deciding on adequate fairway width and depth.	*The planners are intended to follow this recommendation.*
'Working with nature' wherever possible through implementation of measures according to given natural river-morphological processes following the principle of minimum or temporary engineering intervention,	*According to the Work Plan the planning process will be consistent*
Integrated design of regulation structures, equally regarding hydraulic, morphological and ecological criteria,	*The planning process is consistent.*
Implementation of measures in an adaptive form (e.g. river bed stabilisation by granulometric bed improvement, low water regulation by groynes),	*According to the Work Plan the results of the planning process will be consistent*
Optimal use of the potential for river restoration (e.g. river banks restoration) and side channel reconnection.	*The planning process is consistent*
Ensuring that flood water levels are not exacerbated and, ideally, are reduced.	*The planning process is consistent*

The Slovak Party can generally agree with the above criteria and recommendations, but it does not consider them appropriate on the given section of the Danube. The principal environmental problems in this section of the Danube is the river regulation for shipping purposes by traditional means such as dredging of fords and construction of guiding walls concentrating the water into the fairway. This leads to much higher flow velocities and results in gradual incision of the riverbed and drop of water level, closure of branches and decimation of inundation area (see detailed in the background material named „Position of the Slovak Party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest"). In this context subsequently follows the drying up of wetlands, soils, river branches and the negative impact on agriculture and forestry. The process leads to mummification of the previous alluvial areas and river branches. The proposed measures are expensive and are not suitable for remediation of the water regime towards the nature-close state. Paving the river bottom is not a green solution, neither for the river, nor for the adjacent terrestrial areas.

The Slovak proposal is complex, integrated, with a variety of synergies, including financial and socio-economic issues.

2.7. Relationship of the proposed interventions and measures to other relevant plans, programmes and strategies

2.7.1. The Strategy for Sustainable Development of the Slovak Republic

The National Strategy for Sustainable Development of the Slovak Republic (NSSD) was approved by the Governmental Resolution No. 978/2001[4]. NSSD was based on EU documents. The European Union declared in the draft Declaration on Guiding Principles for Sustainable Development that the sustainable development is a key factor in all European Community policies established by the Treaty. This paper sets out key objectives such as environmental protection, social equity and cohesion, economic prosperity and fulfilment of international obligations. In implementing these objectives, the European Union should follow these political principles:

- promotion and protection of fundamental rights,
- social and intergenerational equity,
- openness and democratic society,
- participation of citizens,
- participation of social and business partners,
- political cohesion and management,
- political integration,
- more efficient use of available knowledge, the precautionary principle and the imposition of fines to polluters

Based on the strategy strategies and action plans have been developed:

- National Strategy for Operational Programmes,
- National Strategy for Biodiversity Conservation and its update for the years 2012-2020,
- National Tourism Development Strategy,
- National Regional Development Strategy,
- many other strategies and plans.

The Slovak Republic acceded to the majority of fundamental global environmental conventions in late 2005. The Slovak Republic ratified the UNECE Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental

[4] www.tur.vlada.gov.sk

Matters (Aarhus Convention). **The issue of climate change, biodiversity protection and sustainable use of its components, and the protection of soil and land from degradation are declared as a priorities of the Government of the Slovak Republic** and are included in the principal conceptual documents of relevant departments. **The initial environmental document in the Slovak Republic is the Strategy, principles and priorities of the State Environmental Policy** (1993). The Strategy declares five basic priorities, which include tasks directly related to the Rio Conventions. It is the UN Convention on **Biological Diversity** (CBD, 1992), the UN Framework Convention on **Climate Change** (UNFCCC, 1992) and the UN Convention to Combat **Desertification** in those countries experiencing serious drought and/or desertification, particularly in Africa (UNCCD, 1994).

The priorities mainly are:

- protection of **air and global environmental safety** (including health)
- **soil protection** from degradation and ensuring food safety (including forests),
- conservation of **biological diversity** (including anthropogenic agricultural biodiversity and forest biodiversity)
- **reasonable use of natural resources** (including renewable sources of renewable energy, mineral resources, land use and protection of cultural heritage and wealth)
- optimisation of the spatial structure and **land use (including connectivity - transport, infrastructure)**.

The assessment of the Sap-Budapest Danube stretch concerns just right these priorities.

2.7.2. Energy Security Strategy of the Slovak Republic

Key challenges in the field of energy of the Slovak Republic:

- climate change and its consequences,
- high energy demand of the economy,
- relatively low share of use of renewable energy sources,
- high dependence on import of primary energy sources and the need of ensuring the reliability of supply,
- rising energy prices on world markets and the competitiveness of economy,
- research and development and innovation.

Priorities:

- to continue in utilization of nuclear energy,
- effective usage of domestic energy resources,
- to increase the utilization of renewable energy sources.

In the frame of electricity production is needed to focus mainly on utilization of hydropower and biomass. Under the proposal of measures it is necessary to support the preparation and construction of large hydropower plants and pumped storage power plants, and to create a supportive environment, as in the case of small hydropower plants. Due to the absence of power reserves is necessary to temporarily minimize the construction of wind power plants or even solar power plants, which increase the demand for power reserves.

Pumped storage power plants can help solve this problem. The conception of utilization of hydropower potential of watercourses of the Slovak Republic by 2030 was approved by Governmental Resolution No. 178 of March 9, 2011. Preparation of large hydroelectric power plants is dealt with individually and is not subject to this concept.

The proposed major projects for the long-term horizon:

- Power plant at Bratislava (e.g. Wolfsthal-Bratislava (Danube)	1000 GWh/year
- Nagymaros Power plant (Danube)	1040 GWh/year
- Sereď-Hlohovec (Váh river)	360 GWh/year
- Hydropower project Žilina - Lipovec (Váh river)	100 GWh/year
- Pumped storage power plant on Ipeľ river with peak power generation	900 MW
- Pumped storage power plant at Devín quarry (Danube)	1100 MW

2.7.3. Transport Development Strategy of the Slovak Republic

The water transport on the Danube is operated under the AGN agreement, identified as E-18, which belongs to the TEN-T and is part of the Pan-European Corridor VII (Danube-Main-Rhine and the TEN-T project No. 18 (priority projects: Waterway Rhine-Danube, Vienna-Bratislava and Sap-Mohács). The proposal of the procedure of the Slovak Republic in the Danube Commission in the matter of navigation conditions on the Danube stretch Sap-mouth of the river Ipeľ was adopted by the Government Resolution No. 222/2008.

„The General Program of Implementation of the Integrated European Action Programme for Inland Waterway Transport NAIADES in the Slovak Republic" was approved by the Government Resolution No. 642/2009. The NAIADES Program besides the Danube is also focused on the Váh river waterway.

The priority in waterway transport is the modernization of waterways on the Danube and River Váh and achieving the required criteria of transport.

Achieving of these objectives through an **integrated comprehensive principle** will be in accordance with the Water Directive and other directives **in the interest of the common synergistic result.**

2.7.4. Other strategic programs and documents of the Slovak Republic

- National Strategic and Reference Framework 2007-2013
- National Plan of Regional Development
- National Strategic Plan of Rural Development
- National Development Plan of the Slovak Republic
- National Strategy of Biodiversity Protection in Slovakia
- National Environmental Action Programme III (NEAP III)
- The Concept of Water Management Policy of the Slovak Republic until 2015
- The Concept of Territorial Development of Slovakia
- The Tourism Development Strategy of the Slovak Republic
- The Strategy and the Concept of Forestry Development in Slovakia

- National Climate Programme of the Slovak Republic
- The Rural Development Programme of the Slovak Republic 2007-2013

2.8. Stakeholders' involvement in the elaboration process of the Environmental Report

2.8.1. The concept of the professional and public consultation process

This chapter will be elaborated following the conclusion of the partnership consultation process.

2.8.2. Involvement of the authorities for environmental protection

This chapter will be elaborated following the conclusion of the partnership consultation process.

2.8.3. Involvement of the public concerned

This chapter will be elaborated following the conclusion of the partnership consultation process.

2.8.4. Comments and their consideration

This chapter will be elaborated following the conclusion of the partnership consultation process.

3. BASIC INFORMATION ON THE PRESENT STATE OF THE ENVIRONMENT OF THE AFFECTED AREA

The affected area in terms of the immediate impact of proposed structural measures for improvement of navigability and the rehabilitation of the side arms is the Danube stretch between Sap and Budapest and its surroundings, which may potentially be affected by possible changes in water regime. This chapter provides a brief overview of geological and geomorphologic conditions, the state of air, water and riverbed, soil, and conditions for flora and fauna in the area of the investigated section of the Danube. Individual chapters characterizing the current state of the environment could be complemented by recent data from the Hungarian side, and in particular the characteristics of the environment on the Danube section between the mouth of the river Ipeľ and Budapest. The environmental status of the Danube stretch between Sap and the mouth of the river Ipeľ is given in more details in the background paper entitled „State of the environment in Danube stretch between Sap and the mount of the river Ipeľ (Szob)".

3.1. Basic characteristics of the area of interest

3.1.1. Neotectonic structure

The complexity of the Pre-Tertiary basement of the Danube basin (**Fig. 3.1**) results from a complex fault zone Rába-Hurbanovo-Diósjenő, which separates the Inner Western Carpathian tectonic units from the units of Hungarian Central Highlands. In the southern part of the basin the units of the Hungarian Central Highlands are represented partly by Palaeozoic, but mostly by Mesozoic, which is well exposed on the surface at Tatabánya. The formation of the Danube basin was in progress from the end of Palaeogene, with the dominant development in Neogene and Quaternary. Siliciclastics sediments dominate in the sedimentary filling, locally with the occurrence of evaporites and coal layers with variable thickness. Sediments constitute an accumulation with thickness of several thousand meters. Sedimentation proceeded mainly in the marine environment, which gradually changed to marine-brackish, lake and river environment. The surface is represented by Quaternary in terms of stratigraphy, only in the eastern part also occur older horizons.

Important information is the impact of geological structure, and not only of the surface structure, but also of the bedrock, on ecology of the country in the south-eastern part of the Danube Basin.

3.1.2. Geologic structure

The geological structure of the area (**Fig. 3.2**) consists of Pre-Tertiary basement rocks, and sediments of Palaeogene, Neogene and Quaternary.

<u>Pre-Tertiary bedrock</u> is formed by Cristallinic (mainly crystalline shales) and Mesozoic (Triassic-Jurassic-Cretaceous), but these are not exposed on the surface in the area of

interest, or in the wider surroundings on the Slovak territory. The Pre-Tertiary bedrock is significantly disrupted by folding and tectonic faults. The faults separates each other several slide-block structures. Exposed Mesozoic rocks are documented on the Hungarian side of the Danube, where is the infiltration area of Mesozoic waters.

In the Palaeogene three sedimentation cycles occurred gradually. Each cycle began with multifarious lacustrine-fluvial sandy-clayey complex with dark coal-bearing clay strata. The sedimentation continued by deposition of shoreline sandy sediments of the shallow sea and ended up with homogeneous grey and greenish-grey clays and marls, which were at the end covered with sediments of the retreating sea represented by sandy marls and marly sandstones. Palaeogene sediments, which do not appear on the surface in the area of interest and were detected only in wells in the vicinity of Kravany nad Dunajom and Štúrovo, lay on Mesozoic rocks.

Neotectonic structure, 1:500 000, Landascape Atlas of the Slovak Republic
J. Maglay, R. Halouzka, V. Baňacký, J. Pristaš, J. Janočko
Ministry of Environment of the Slovak Republic, Bratislava 2002, pg.78

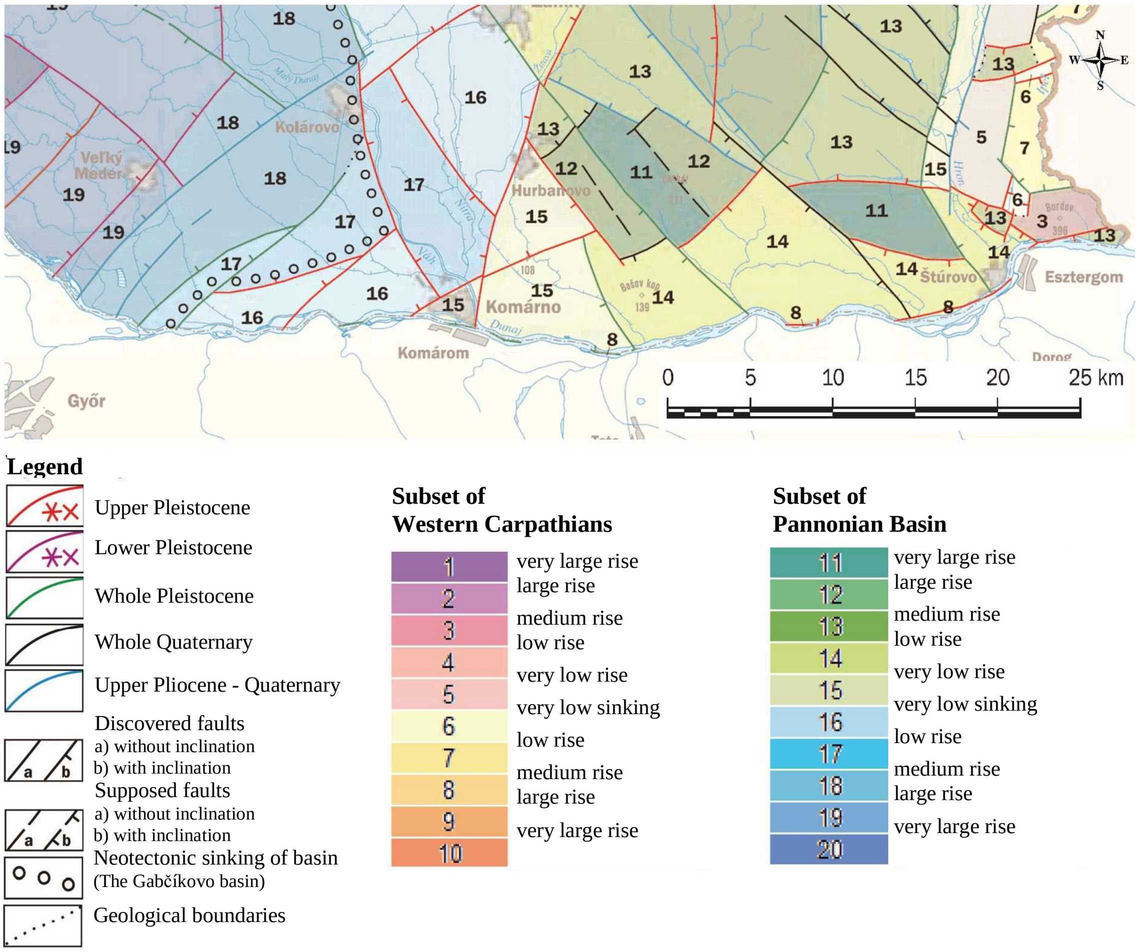
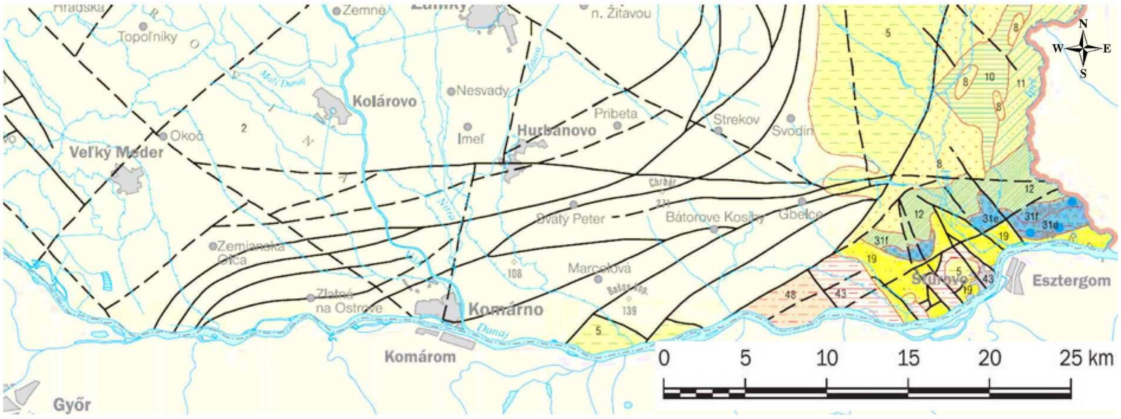


Fig. 3.1: Neotectonic structure of the area of interest

In the Neogene, the area has been risen up again and the relief denudation was in progress from the beginning. After sinking the area back, sediment deposition continued in a brackish and semi-brackish sea environment. In the shallow sea it continued the sedimentation of sands, sometimes cemented into sandstones, sandy, marly and silty clays of dark colour, but there exist also layers pure plastic clays or fine-grained sands. The colour spectrum moves from blue-grey to greenish-grey colour, at the surface sometimes with rusty stains and calcic. The consistency of clays ranges from solid to hard. The Upper Miocene (Pannonian) is represented by layers of gravels, sands, sandy and clayey loams. In the overlying Pannonian layers there are freshwater-brackish greenish-grey sandy clays with slabs of lignite, fine-grained sands and clays belonging to Pontic.

The Upper Neogene is represented by Dacian and Ruman age. At the lower part of the Žitný ostrov area it is represented by the fluvio-lacustrine sediments deposited on the so-called „coal series". The sediments in the area east of Medveďov are formed by layers with cyclic alternating of sandy-gravelly sediments with frequent silt, clay and loamy positions - i.e. „Kolárovo formation". In the Quaternary the river Váh above this series created a flat alluvial cone.

Geologic structure, 1:500 000, Landascape Atlas of the Slovak Republic
A. Biely, V. Bezák, M. Elečko, J. Vozár, A. Vozárová et. al.
Ministry of Environment of the Slovak Republic, Bratislava 2002, pg.74



Legend

2	grey and multifarious clays, silts, gravels, layers of lignite, freswater limestones and tuff layers; Dacian-Ruman
5	grey, mostly calcious clays, silts, sands, gravels, layers of lignite and freshwater limestones; Pannonian-Pontic
8	gray calcious clays-claystones, siltstones, sands-sandstones, pudding stones, acidic tuffs, bentonite, organogenic limestones; Sarmatian
10	grey calcious claystones, siltstones, sandstones, pudding stones, coal layers, acidic tuffs; Upper Baden
11	grey calcious siltstones, claystones, sandstones, sands, pudding stones, evaporites, algal limestones; Middle Baden
12	grey calcious siltstones, claystones, sandstones, pudding stones, algal limestones, rhyolitic and andesitic tuffs; Lower Baden
19	grey calcious siltstones (Lučenské formation); Eger
31	pyroxenic and amphibolic-pyroxenic andesites; Lower Baden
e	epiclastic volcanic breccia and conglomerates
f	epiclastic volcanic conglomerates and sandstones
d	epiclastic volcanic breccia
	sandstones, claystones, marlstones; Oligocene
43	limestones, claystones, marlstones,coal layers; Eocene
48	

Fig. 3.2: Geological structure of the area of interest

The Palaeogene and Neogene surface is also tectonically affected and divided by faults into individual blocks. The Neogene sediments throughout the area create the subsoil of Quaternary sediments. They are exposed on the surface only in higher-lying areas in the eastern and south-eastern parts of the territory. The uppermost part of the sediments is represented by Quaternary, which reaches various thicknesses in the area of interest. Mainly fluvial, fluvio-lacustrine and eolian sediments form it. Fluvial sediments are represented mainly by fluvial sediments of the Danube, Váh, Žitava and Hron rivers. They are created mainly by Holocene gravels, sandy gravels and sands. Sandy positions are often formed by fine and silty sands. Loams of various types form the covering layer.

3.1.3. Geomorfologic conditions

From the geomorphologic point of view the area of interest is part of the Alpine-Himalayan system, a subset of the Pannonian Basin. It is part of the province of West Pannonian Basin and subprovince of Little Danubian Basin. On the Slovak territory in the southern and south-eastern and eastern parts of the Danubian lowland geomorphologic units lay the units of Danubian Plain, Danubian Hills and Burda Mountain.

Geomorphologic structure, 1:500 000, Landascape Atlas of the Slovak Republic
Ministry of Environment of the Slovak Republic, Bratislava 2002, pg.86

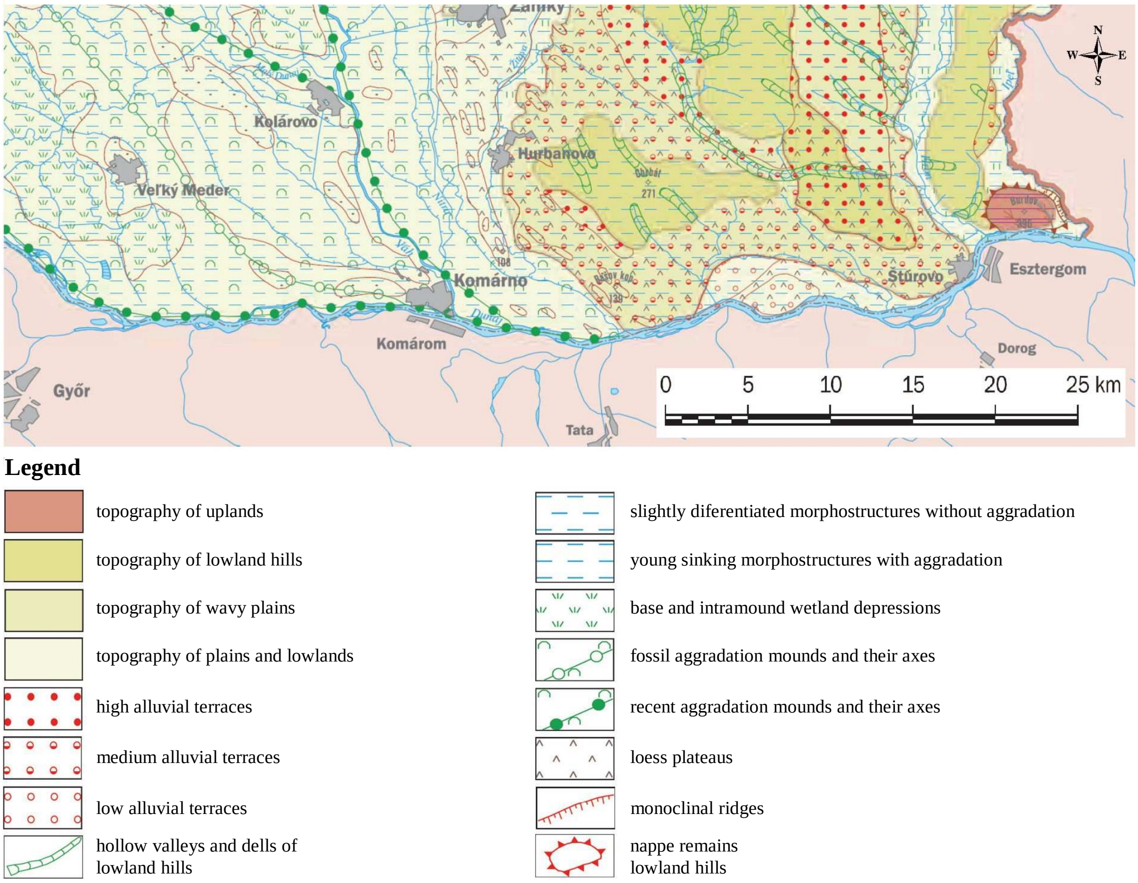


Fig. 3.3: Geomorfological conditions of the area of interest

Part of the area of interest is located in the floodplain of the Danube in the lower part of the Žitný ostrov area - the southeast part of the Danube Plain geomorphologic unit (**Fig. 3.3**). From the south it is bounded by the river Danube, from the east by the river Váh and an imaginary line between the village Klížska Nemá and the town Kolárovo creates the north-western boundary. The Danube river plain is only slightly morphologically structured and is characterized mainly by fossil aggradation mounds. The recent aggradation mound stretches along the river Danube. The area of interest continues on the Danube river plain between the city of Komárno and the mouth of the Old Žitava river (Žitava village) - this is the east part of the Danubian Plain geomorphologic unit. From the south side it is bordered by the Danube, from west by the river Váh and is from the northeast it is bounded by significant morphological structure, consisting mostly of fluvial sediments of the middle level terrace

(Hurbanovské terraces). The development of topography was substantially affected by erosion and accumulation activity of the Danube. In this area there are not only fossil aggradation mounds and their axes, but also the recent aggradation mound, which roughly follows the axis line of the river Váh and connects to the recent aggradation mound along the river Danube.

Another part of the area of interest is the Danube river plain between village Moča and city of Štúrovo - southern part of the Danube Hills geomorphologic unit, sub-unit Čenkov floodplain and southern part of the sub-unit Hron river plain. The river Danube bound the area from south, from the west, north and east by a middle level terrace (Búčske terraces) and by Ipeľ Hills. The river plain has a wavy surface with height differences of 1-3 m.

The last part of the area of interest is the Burda Mountain, which forms the left bank of the Danube from about Štúrovo to the mount of the river Ipeľ.

The slope of the investigated area is imperceptible from north to south (less than 10 cm/km), the average altitude is 110 m a.s.l. The landforms that are present in the given area belong to the relief of undulating planes, and to relief of planes and plains, which form the basic type of erosive-denudation relief, connecting to the recent aggradation mounds and their axes. In the area of Čenkov forest it has characteristic eolic relief of sandy dunes and drifts.

3.1.4. Characteristics of the quaternary and covering layers

The geological development of the area of interest during the Quaternary is very complicated. While in the eastern part of the area of interest intensive sinking of the area continued (Žitný ostrov area - Gabčíkovo basin), in the western part, at the end of Pliocene regional rising of the wider area occurs, and complete regression of the sea happens. For both areas it is typical that the role of leading actor of exodynamic erosion and accumulation takes the running water, especially the already formed stream of the Danube. Forming flows of Váh, Nitra, Žitava and Hron rivers played an important role. Crucial importance at weathering in the Pleistocene had also the changing of the ice and interglacial periods that promoted the intense weathering of rocks. In the sinking part it was reflected by the supply and sedimentation of large quantities of material brought by the Danube from the Alpine region. In the rising part had these processes great importance at transformation of the character of the landscape. Erosion in the western part resulted in removals of upper Pliocene and older Pleistocene sediments. In contrast to the intensively sinking Little Danube Basin, which includes the Danubian lowland, due to the incision of the Danube to the relatively raised substrate were the older fluvial sediments deposited in several terraced levels above the present level of the Danube. The youngest terrace forms a natural border of the area of interest (Hurbanovské and Búčske terraces). The Quaternary sediment filling and covering of the area consist mainly of fluvial sediments of rivers, transitional fluvio-limnic strata, proluvial and diluvial sediments at the foot of the mountains, coverings of loess, loessial loams, blown sands and soil horizons. The Quaternary sediments in the area are classified into the era of Lower, Middle and Upper Pleistocene and to the Holocene period. In the Quaternary of the Danubian plain the fluvial and fluvio-limnic sediments have the dominant position, forming the sedimentary filling of the central depression of the Danube Basin. They had developed superpositionally. Besides the fluvial sediments, eolic loess and sands, organogenic sediments, peat bogs and diluvial, eluvial and diluvial-fluvial sediments at the edges were developed.

3.1.5. Holocene

Relatively high temperatures, melting glaciers and raising the sea level by about 120 m, characterized the Holocene period after the Ice Age. The present civilization has developed most during the climate optimum practically from the Neolithic, thanks to the development of agriculture. The human activity has had a substantial impact on the change of biodiversity, particularly in agriculture and forestry. Cultural landscape and our present cultural and land heritage came into the existence. Also this development was influenced by climate change. The recent climate changes were exceptionally noticeable during the so-called. little ice age from about 1500 to about 1850, which was preceded by a very suitable warm climate. Since about 1850 the climate warms again. These changes have also contributed to the creation of the specific biodiversity of the given area, including agricultural and forestry sectors.

3.2. Air quality

3.2.1. Hungarian territory[5]

Hungary is among the moderately polluted regions of Europe according to the air quality data. Based on the results of a survey carried out in the areas near the Danube section between Sap and Szob, it can be stated that the ***nitrogen-dioxide concentration*** *exceeds the air pollution limiting values in the neighbouring zones of the towns of Győr, Komárom and Esztergom. In the mid 1990's a Programme for Intersectional Measures on the Protection of the Air Quality was realized for the areas near the river-bend of the Danube (the zone of the towns of Esztergom, Lábatlan, Komárom, and Nyergesújfalu). The gas programme conducted at county-level and the different environmental investments of industrial enterprises have resulted in only partial results. Nevertheless, dust pollution has decreased significantly following the installation of the electro-filters at the cement-industrial plants of Lábatlan, and a decrease is expected as a result of the modernization of the Dorog-Esztergom power plant. The emission of non-conventional air pollutants is significant in the case of the dissolvent emission of the Magyar Suzuki Corporation in Esztergom. The air pollution level derived from different diffuse sources – for example airborne ashes, refuse dumps, red sludge reservoirs and non-recultivated extraction fields – is also significant in the area of Komárom-Esztergom County. As a consequence of the special atmospheric conditions the air pollution originating in Slovakia (paper plant and power plant in Sturovo) affects the region of Komárom-Esztergom.*

[5] Pozn. Maďarská strana sa otázkou kvality ovzdušia a klimatickej zmeny zaoberá len okrajovo. Niektoré formulácie sú dosť všeobecné a nie sú podložené citáciami, niekedy platia pre územie Maďarska, ale sú aplikované na vodný režim Dunaja v predmetnej oblasti štúdie. Tvrdenie o znečistení pochádzajúcom zo Slovenska v okolí mesta Ostrihom nie je podložené žiadnymi údajmi o znečisťovateľoch a podľa názoru slovenskej strany navodzuje negatívnejší dojem ako skutočnosť a nepriamo preceňuje negatívne vplyv zo SR.

*The **sulphur-dioxide concentration** has slightly increased in recent years in the neighbouring area of the towns of Esztergom, Győr and Lábatlan. This process should be observed in the future, as this pollutant can cause special harmful impacts; for example, in the form of acidic rain, it can endanger the environment, may cause illnesses of the respiratory tract and is the main component of winter smog. In spite of this increasing process, the level of sulphur-dioxide has not yet reached the critical level in the region.*

3.2.2. Slovak territory

The European Commission as one of the major environmental problems finds the air pollution. Despite the fact, that significant progress in improvement of the air quality in Europe (including Slovakia) was achieved, it is necessary to take effective measures, especially for reducing PM_{10} and $PM_{2.5}$ particles in the air. The transport is considered as one of the most serious impacts on air quality in Europe. The European Commission published in March 2011 the so-called White Paper - Roadmap to a Single European Transport Area, whose principles largely affect the reduction of PM_{10} and $PM_{2.5}$ particles.

The Slovak Hydrometeorological Institute in the National Air Quality Monitoring Network observes the air quality in Slovakia. The basis for the assessment of air quality is the results of concentration measurements of air pollutants at particular measuring stations of the monitoring network. For spatial evaluation of air quality the mathematical modelling is used in relation to measurements.

The Area of interest in terms of air quality assessment belongs to two areas - Trnava and Nitra region county governments, which also coincide with zones of air quality management. Since in the area of interest there are no large industrial zone or agglomeration, no measuring stations of the National Monitoring Network are situated here. The assessment is therefore based on data from various pollution sources and in particular the results of mathematical modelling. It can be concluded that the entire area of interest is mainly agricultural area and from among the industry food production dominates. The only larger concentrations of other industries are the cities of Komárno and Štúrovo, where are also the largest sources of pollution.

Based on the results of monitoring of basic air pollutants (particulate matter (PM_{10} and $PM_{2.5}$), SO_2, NO_x, CO, ΣC, ozone, heavy metals (Pb, As, Cd, Ni), PAH (benzo (a) pyrene, benzene), it can be concluded that the amount of pollutants in recent years systematically decreases. The most significant declines are registered for particulate solid matter (PM_{10}) and SO_2. For other pollutants is the reduction of emission less pronounced, but these do not reach the limit values.

On the basis of the evaluation of quality management zones in 2010 it can be stated that in the area of interest only the particulate solid matter (PM_{10}) and ozone exceed the limit value. Other pollutants do not exceed the thresholds, or limit or target values.

The main local sources that contribute most heavily to air pollution are particularly the transport, winter sanding of roads, suspension and resuspension of particles from the insufficient cleaning of roads, construction sites, storage sites of loose materials, home heating with solid fuels and agriculture, which directly affect the local pollution level. Based on the analysis for determination of the share of individual sources of particulate solid matter on air pollution it has been found that the contribution of local sources on air pollution by PM10 does not exceed 10-20 %. The share of the regional background may constitute 30-50 % of the total concentration, while a substantial part of the regional background is represented by the cross-border transmission.

In terms of this environmental impacts assessment the largest positive impact in the Danube stretch Sap - Budapest has the transfer of the freight transport from road to water. In this case stands, the better the waterway will be in the whole navigable stretch of the Danube, the greater will be the contribution to air quality in regional terms.

3.3. Status of the surface and ground waters

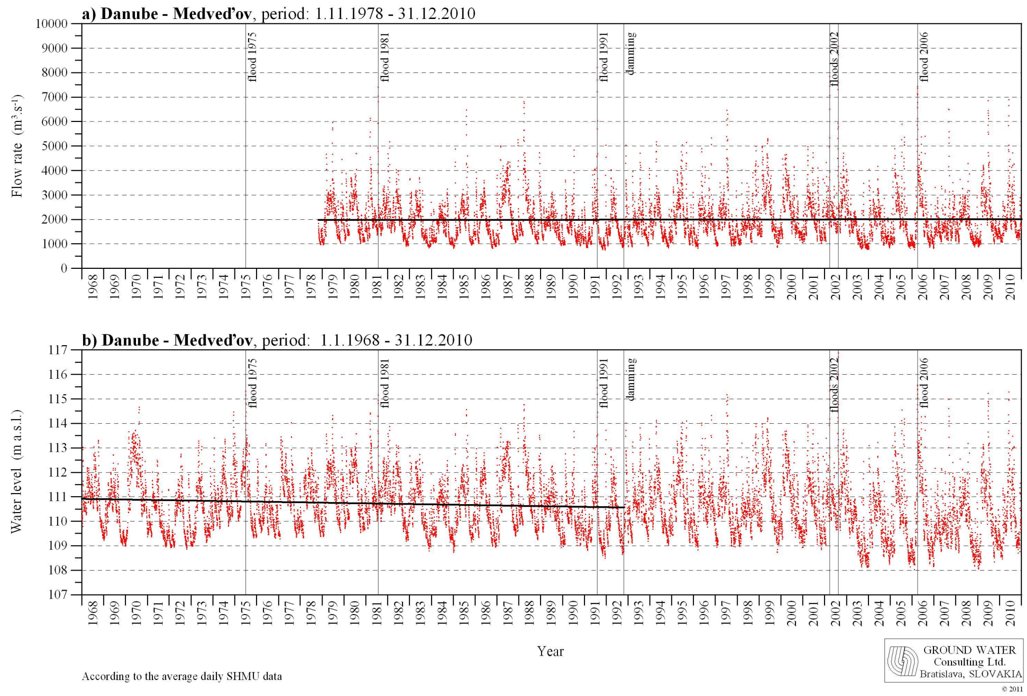
3.3.1. Surface water flow rates and levels

- *Danube*

The flow rate and the level regime of the Danube in the Sap - Budapest section can be characterized by water levels and flow rates determined at the gauging station No. 1252 - Medveďov (**Fig. 3.4**) and at the station No. 001020 - Nagymaros (**Fig. 3.5**). In the stretch between these gauging stations four major tributaries flow into the Danube, from among which the river Váh, including the Little Danube, and the river Hron can significantly affect the flow rate and the water level regime of the Danube, the Mosoni Danube and the river Ipeľ affect the water level and the flow regime of the Danube only very slightly. Other gauging stations on the Danube on the Slovak side are the station No. 1504 - Sap, 1505 - Klížska, Nemá, 1506 - Zlatná na Ostrove, 1600 - Komárno, 1507 - Iža, 2556 - Radvaň nad Dunajom and 1254 - Štúrovo. On the Hungarian side there are stations No. 3383 - Gönyű, 3358 - Komárom, 3370 - Esztergom, 3367 - Szob, 3374 - Nagymaros and 3375 - Budapest.

Based on the graphical representation of flow rates and levels for the period of past forty-three years it can be stated that at all gauging stations on the Danube decreasing tendency in water levels can be seen (**Fig. 3.4, 3.5**). This trend, expressed by the linear regression line, integrates all the changes taking place in the riverbed during the evaluated period, of which the most significant is the reduction in sediment supply (gravels) from the upper stretch of the Danube, the processes of erosion and sedimentation, dredging of the riverbed due to navigation, adjustments and maintenance of the riverbed. The largest changes were registered in the area of municipalities Sap and Gönyű (**Fig. 3.4**), where during the evaluated period the water level decrease exceeded 1 m, and in the area of municipalities Štúrovo and Nagymaros (**Fig. 3.5**), where the decline exceeded 0.5 m. The smallest decline was recorded at the village Szob, where it reached only 10 cm in the evaluated period. This is due to the existence of almost not-erodible rocky threshold, located on the Danube stretch downstream from the village Szob. At other documented places the decline of water level varied about 40-50 cm.

Fig. 3.4 **Flow rates and water levels**

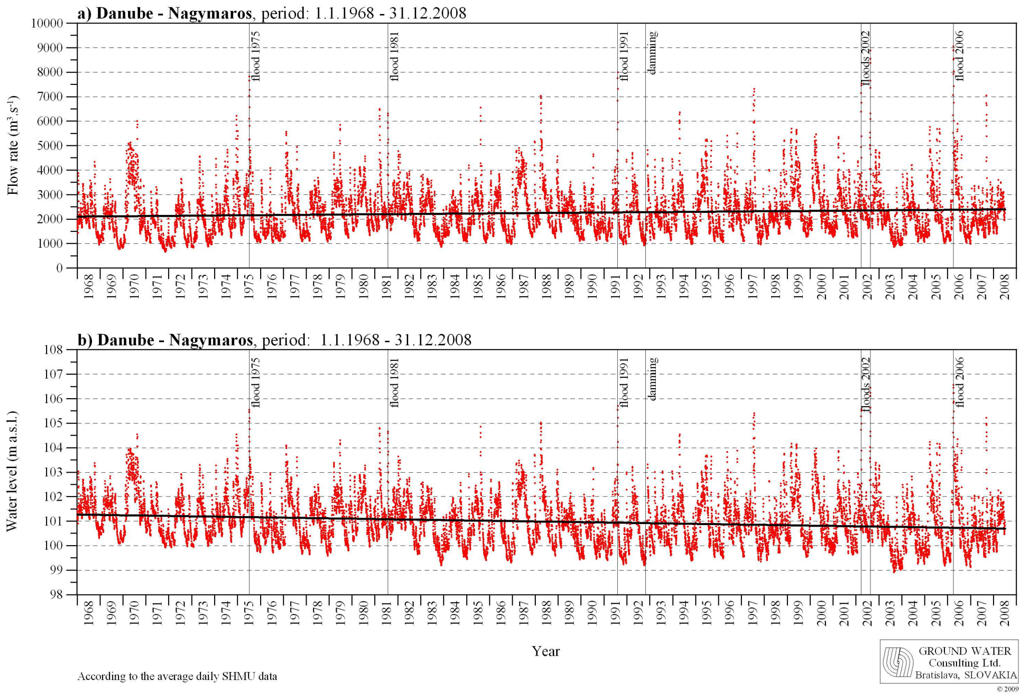


From the flow rates point of view it can be concluded that unlike the water level the flow rate at every gauging station, where it is calculated, marginally or more considerably increased. Nearly constant flow rate in the long run can be observed at gauging stations No. 1252 - Medveďov and 1507 - Iža (**Fig. 3.4**). A slight increase of flow rate, which can be identified at the gauging station No. 3358 - Komárom, based on the linear regression line, is more the reflection of the influence of the river Váh, which flows into the Danube app. 2.3 km downstream of this gauging station. However, in case of the flow rate at gauging station No. 3374 - Nagymaros, the flow rate for the last forty-one years increased by 289 $m^3.s^{-1}$, what is more than 12 % of the long-term average flow rate (**Fig. 3.5**). A similar tendency can be observed also at gauging station in Budapest.

Contrary to the average annual flow rates in Bratislava or Medveďov the average annual flow rates at Nagymaros gauging station are mainly affected by the Danube tributaries (Mosoni Danube, the river Váh, including the Little Danube, the rivers Hron and Ipeľ). However, unlike the average annual flow rate at gauging station Bratislava-Devin, the average annual flow rate for the last ten years corresponds to the long-term average annual flow rate.

The highest flow rate at gauging station Medveďov (**Fig. 3.4**) in the period of last twelve hydrological years occurred in August 2002, when the highest average daily flow rate reached 9067 $m^3.s^{-1}$, with the culmination of about 10,140 $m^3.s^{-1}$. Flood flow rates (over 6000 $m^3.s^{-1}$) during that period occurred six times: in March and August 2002, in March/April 2006, September 2007, June 2009 and June 2010. The lowest flow rate occurred in February 2006, when it reached 772.5 $m^3.s^{-1}$. Flow rates below 800 $m^3.s^{-1}$ also occurred in September and December 2003 and in January 2004, when low flow rates occurred for several weeks. The highest average daily flow rate at gauging station in Nagymaros (**Fig. 3.5**) occurred in April 2006, when the highest average daily flow rate reached 9050 $m^3.s^{-1}$. Flood flow rates (over 6000 $m^3.s^{-1}$) during the last ten years occurred four more times: in March and August 2002, March/April 2006 and September 2007. The lowest flow rate occurred in August 2003, when it reached 862 $m^3.s^{-1}$. Flow rates varied below 950 $m^3.s^{-1}$ also in September and December 2003.

Fig. 3.5 **Flow rates and water levels**



Based on the comparison of average monthly flow rates for particular years of the last thirteen hydrological years (1998-2010) with the long-term average monthly values (1901-2000) at the gauging station Bratislava/Bratislava-Devin it is possible to state that the overall run-off regime on the Danube has probably changing. The distribution of the amount of run-off water in individual months is changing, when most of the water from snow melting flows away in late winter and in the spring (February, March, partly May) and the runoff in the summer months reduces (July and August). Some reduction in runoff can also be reported in November. These changes obviously have an impact on groundwater levels and consequently on the biota. They can also influence the development of biological life connected to surface water - higher runoff during the cooler months, overheating of the surface water in late spring and summer months. Of course, these effects are reinforced or mitigated by the current climatic conditions.

- *Mosoni Danube*

Mosoni Danube is one of the right-side tributaries of the Danube, which flows into the Danube at rkm around 1794, app. 1.7 km upstream from the gauging station Klížska Nemá. Since June 1995, based on the „Agreement between the Government of the Slovak Republic and the Government of the Republic of Hungary concerning certain temporary technical measures and discharges in the Danube and Mosoni branch of the Danube", it is continuously supplied by amount of water of 40 $m^3.s^{-1}$ through the intake object at Čunovo at rkm 1851.75. Greater part of this water is guided through an artificial riverbed into the original riverbed of Mosoni Danube on the Hungarian territory. In terms of the flow rate ratio in the Mosoni Danube and the Danube main stream, the flow rate inflowing into the Danube insignificant. The long-term average daily flow rate at gauging station in Mecsér in the period of hydrological years from 1981 to 2007 is 32.06 $m^3.s^{-1}$.It should be noted however, that until 1995, i.e. during the hydrological years from 1981 to 1994, the average daily flow rate was only 24.79 $m^3.s^{-1}$. After the introduction of continuous water supply during the year 1995 the average daily flow rate for the period of hydrological years from 1996 to 2007 reached 39.81 $m^3.s^{-1}$.

- *Little Danube*

The Little Danube is like the Mosoni Danube permanently supplied by amount of water of 30-40 $m^3.s^{-1}$ through intake structure downstream of Bratislava. The water taken from the Danube at Bratislava (app. rkm 1865.3), after passing some 128 km on the left boundary of the Žitný ostrov, flows into the river Váh and then returns to the Danube at Komárno (app. rkm 1766). The flow rate regime of the Little Danube is artificially maintained, and flow rates during the year mostly range between 30-40 $m^3.s^{-1}$. The long-term average daily flow rate in gauging station at Trstice during the period of hydrological years from 1991 to 2010 is 30.24 $m^3.s^{-1}$.

- *The river Váh*

The river Váh River is the most important left-side tributary of the Danube on the Slovak territory. The flow rate regime on the lower stretch of the river cannot be characterized simply, since this stretch of the river is strongly influenced by the flow regime of the Danube. The course of flow rates for the period 1992-2008 is shown in **Fig. 3.6**[6].

The flow rate regime of the river Váh slightly differs from the flow rate regime of the Danube. The difference is mainly that, that the flow rate is dependent on climatic conditions and rainfall on the Slovakia territory. From this results that the most water-rich months are usually March and April, the most water-poor months use to be June, August, September, October, November, December and January. In July, due to higher rainfall in the Slovak mountains, the flow rate in the river Váh usually increases. The long-term average daily flow rate based on calculated values for the river Váh at Komárno for the period of hydrological years from 1996 to 2010 is 176.9 $m^3.s^{-1}$.

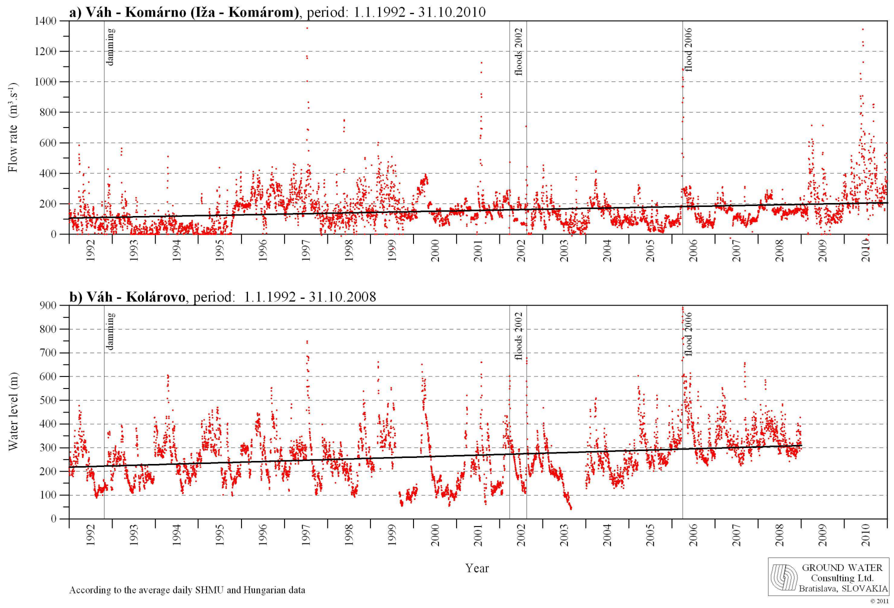
- *The river Hron*

Another important left-side tributary of the Danube on the Slovak territory is the river Hron. The flow rate regime is similar to the flow rate of the river Váh. The most water-rich

[6] The flow rate regime in the river Váh is determined by the difference in flow rates at gauging stations No. 1507 - Iža and No. 3358 - Komárom. In this case we can obtain also negative values from the difference of flow rate, which represent the amount of water flowing from the Danube into the river Váh at higher flow rates and flood waves on the Danube. For purposes of this evaluation the negative flow rate was replaced by value of „0“.

months use to be March and April, partially January, February, May and June. The most water-poor are usually months from July to December. The long-term average daily flow rate for the period of hydrological years from 1991 to 2007 is 43.19 $m^3.s^{-1}$. The lowest recorded average daily flow rate occurred on August 24, 1993 and reached 7.04 $m^3.s^{-1}$, the highest recorded average daily flow rate occurred on March 20, 2005 and reached 516.5 $m^3.s^{-1}$.

Fig. 3.6 **Flow rates and water levels**



- *<u>The river Ipeľ</u>*

Another left-side tributary of the Danube, forming the boundary between Hungary and the Slovak Republic is the river Ipeľ. The flow rate regime is similar to the flow rate of the river Hron. The most water-rich months use to be March and April, partially January, February, May and June. The most water-poor are usually the months from July to December. The long-term average daily flow rate for the period of hydrological years from 1991 to 2007 is 13.92 $m^3.s^{-1}$. The lowest recorded average daily flow rate occurred on September 2, 1990 and reached 0.21 $m^3.s^{-1}$, the highest recorded average daily flow rate occurred on June 24, 1999 and reached 268 $m^3.s^{-1}$.

3.3.2. Main features of the riverbed

The Danube section below Sap ***cannot be considered as a natural water flow****, as it was modified by the high water river training processes carried out in the 19th century, and the low-flow and mean-flow regulations in later decades. Significant morphological impacts resulted from the sediment retaining impact of the series of dams built in the German and Austrian section of the Danube; the situation being worsened by the significant increase in dredging during the second half of the 20th century. These interventions have led to a significant bed incision process. The structure of the ford sections has also been changed,* *namely, earlier the ford material was formed by the bed-load transported by the river while, at present, it is formed by the rearranging of the materials of the riverbed.*

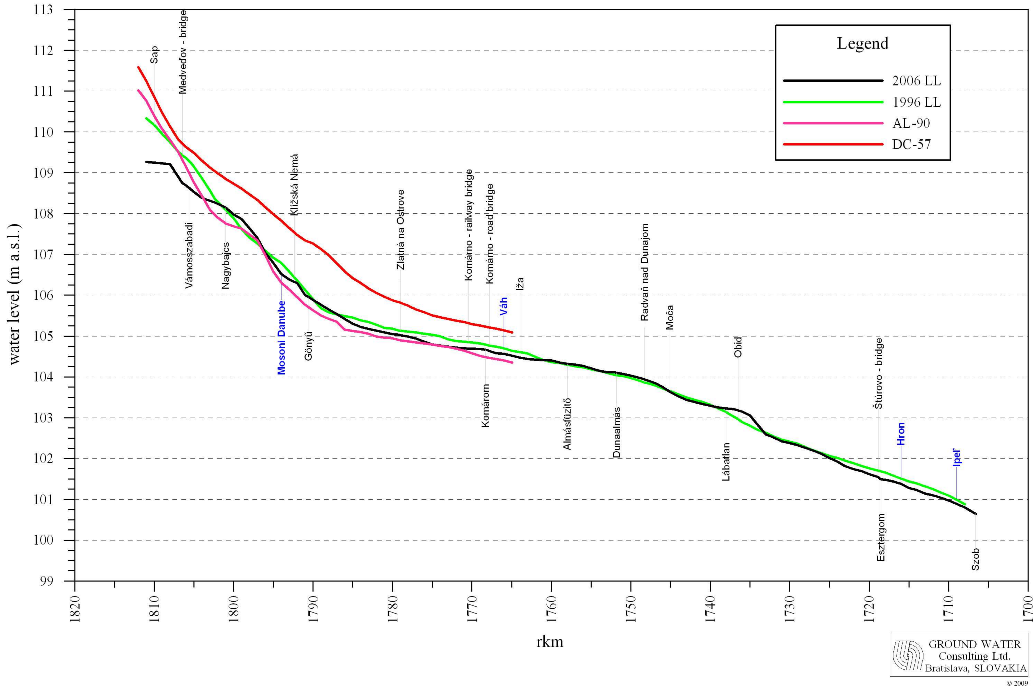
The first 20 km long section below Sap – the lower reach of the Hungarian Upper Danube (between 1850-1791 rkm) – flows through a large alluvial fan, formed due to a sharp break in the slope near Gönyű. During the centuries, ***several side-arms and islands were formed in this section, which made perfect conditions for the formation of long-lasting fords****. The Danube section between Gönyű and the constriction at Visegrád (1695 rkm) may be considered as transitional. The lowland features become more typical (in such parameters as topographic features of the river valley, the riverbed pattern and the flow regime features), but are also determined by the weir impact of the Visegrád breakthrough. As a result of this impact seven fords can be found in the 40 km long section above the breakthrough gate, the formation of which was also influenced by the confluences of the river Hron and the Ipel. There are endangered riverbank lines with high river walls in the region, which represents a danger of severe collapse (near Gönyű, Nyergesújfalu and Esztergom).*

- *Changes of the Danube riverbed morphology*

Changes in the Danube riverbed morphology on the Danube stretch Sap - Budapest mainly relates to erosion and sedimentation processes and the works carried out on maintenance of the fairway. The erosion and sedimentation processes depend primarily on the natural conditions and especially on slope of the areas. While the slope of the Danube riverbed in the upper section from Bratislava to about Sap (rkm 1851-1811) reaches up to 0.4 m/km, from Sap to the mouth of the river Ipeľ this slope changes significantly. Approximately from Sap to Medveďov (rkm 1811-1806) reaches about 0.23 m/km, from Medveďov to Klížska Nemá (rkm 1806-1792) drops to 0.2 m/km, from Klížska Nemá to Veľké Kosihy (rkm 1792-1785) the slope further decreases to 0.12 m/km, and approximately from Veľké Kosihy to Szob (the mouth of the river Ipeľ) (rkm 1785-1706) the slope achieves an average value of only 0.06 m/km.

These facts strongly influence also the flow velocity of water in the river and thus affect its transport capacity. While on the section from Bratislava to Sap erosive activity prevailed, on the section downstream of Sap coarser sediments were deposited. In addition, the whole section has been influenced for decades by the change in the supply of sediment from the German and Austrian stretch of the Danube. After the gradual construction of power plants in the Upper Danube, gradually decreased the volume of sediments transported by water. In recent decades, it can be stated that erosion began to prevail over sedimentation and the Danube riverbed in its entire length (from Bratislava to Budapest) began to deepen (**Fig. 3.4, 3.5**). Moreover, these processes were reinforced and accelerated by commercial gravel dredging and dredging and adjustment of the riverbed for navigational purposes. The rate of riverbed deepening on different sections varies. The processes of erosion and sedimentation are significantly affects by the occurrence of large floods, which are largely involved in shaping the morphology of the Danube riverbed.

Fig. 3.7 Changes of low navigation level in the Danube stretch Sap - the mouth of the river Ipeľ



An illustrative example of the ongoing changes in the morphology of the Danube riverbed are the fixations of low navigation and regulation water level (LNRWL), which are carried out on that stretch of the Danube in co-operation of Slovak and Hungarian water management experts (**Fig. 3.7**). The aim of these fixations is to document the development of water levels over the time and highlight the sections where it is necessary to carry out technical intervention in terms of navigability of the river and navigational safety. The technical interventions generally consist of dredging of ford sections, bolstering of banks and building guiding structures (spur-dykes), whose task is to concentrate the water into the fairway. However, these adjustments necessarily evoke further changes in morphology, because after the dredging and deepening of ford, the sediments in the upstream section of the ford become gradually mobile. With the concentration of water into the fairway by construction elements in the riverbed increase of flow velocity occurs, which also results in an increased transport capacity of water and subsequently leads to erosion of the river bottom. Of course, large floods do the largest changes in such an unstable riverbed; during which transferring of large amounts of bottom material occur.

3.3.3. Surface water quality

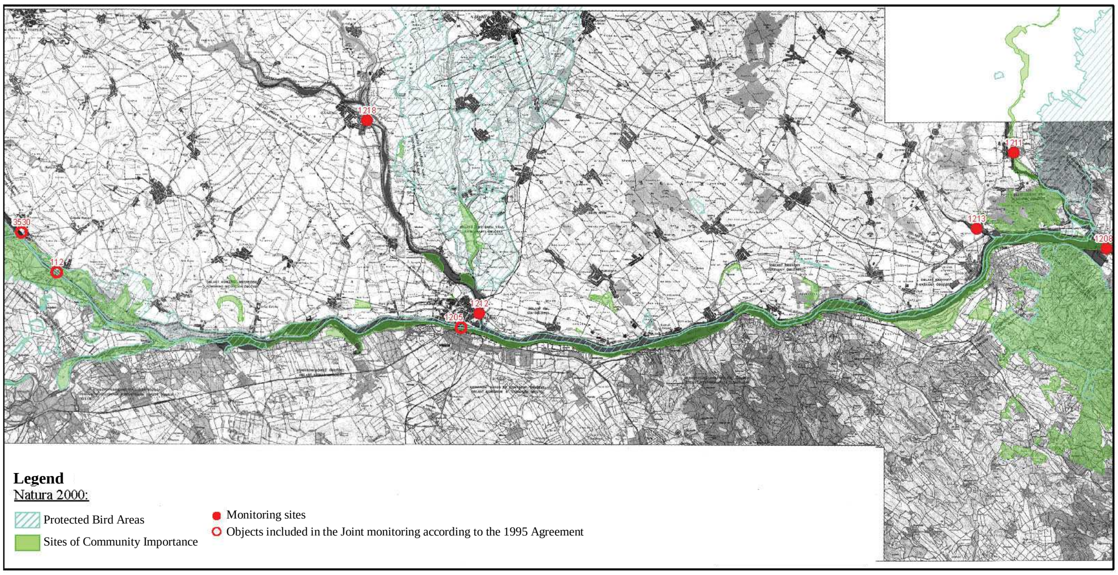
The surface water quality was monitored at four sampling sites on the Danube and at four locations on the left-sided tributaries of the Danube (rivers Váh, Hron and Ipeľ) - **Fig. 8.3**. The key sampling sites for assessing the quality of surface water of the Danube were the sampling sites at Medveďov and at Szob (boundary cross-section).

<u>The sampling site at Medveďov (112)</u> represents the quality of surface water coming from the Gabčíkovo hydraulic structure area - entry to the area of interest, and <u>the sampling site at Szob (1208)</u> represents the quality of surface water, which leaves the area of interest and

simultaneously leaves the Slovak territory. The comparison of observed data at key sampling sites gives a picture of the impact of wastewaters directly or indirectly discharged into the Danube from the settlements on both sides along the flow, the influence of surface water quality in tributaries on the Danube water quality and other processes that may take place in the examined section. Changes in surface water quality over the time are caused by many factors, three of which are primary: hydrometeorological factors (changes in flow rate, the water temperature, sunshine etc.), anthropogenic activities, and natural processes in the flow (e.g. self-purification).

Fig. 3.8 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Groundwater quality monitoring



- *<u>The evaluation of surface water quality</u>*

The surface water quality at key sampling sites (Medveďov and Szob) of the assessed stretch of the Danube between the Sap and the mouth of the river Ipeľ is similar and differs only slightly in some indicators.

The surface water quality in left-side tributaries of the Danube (rivers Váh, Hron and Ipeľ) in comparison with the Danube water is similar in some parameters, in some parameters slight, but also more significant differences were registered. The water temperature in tributaries reached higher maximums and lower minimums. The conductivity values were higher in the tributaries and the highest values were recorded in the river Ipeľ, where also significantly higher concentrations of manganese occurred. The development of oxygen regime parameters is similar in all water flows, but in the tributaries there has been a higher spread of values, and in case of BOD_5, COD_{Mn} and TOC the values were also higher (especially in the river Ipeľ). In the river Ipeľ significantly higher concentration, compared to other flows, also occurred in other water quality indicators: sodium, potassium, calcium, magnesium, chlorides, sulphates, bicarbonates, and also in case of dissolved solids.

The pollution by nutrients in the tributaries is higher than in the Danube water. This is reflected mainly in ammonium ions, nitrites, phosphates and total phosphorus. The most polluted surface water in terms of nutrient content seems to be the water in the river Ipeľ, where the highest concentrations of nitrates, phosphates, total phosphorus and total nitrogen were recorded. The highest concentration of ammonium ions and nitrites were measured at sampling sites in the river Váh.

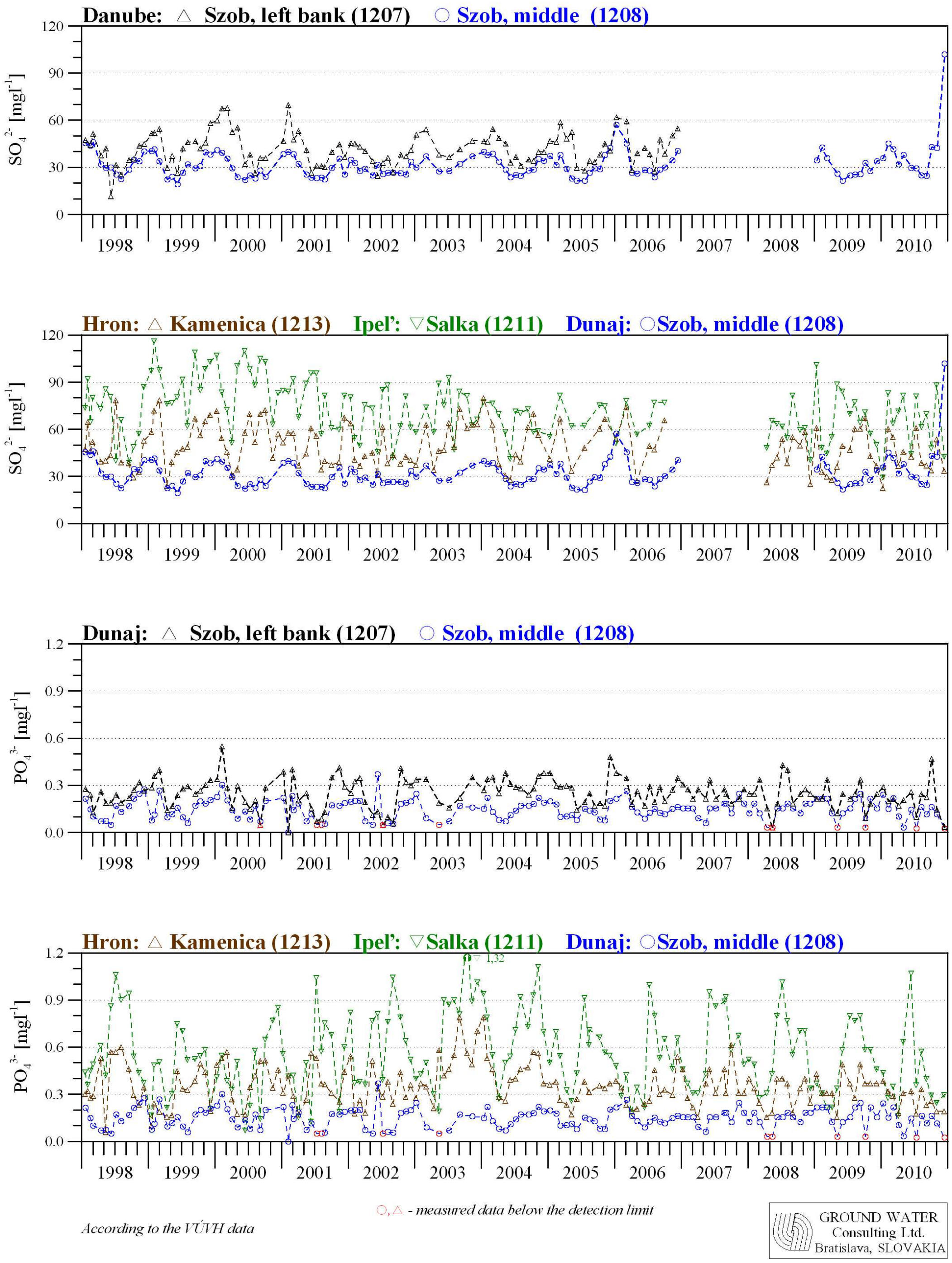


Fig. 3.9 The influence of tributaries on the water quality in Danube

The content of most heavy metals in the left side tributaries was similar to that in the Danube. The exception was arsenic, whose concentrations in the water of river Hron reached significantly higher values than in the Danube water. In the river Ipeľ there were recorded the highest contents of cadmium and zinc.

The highest contents of chlorophyll-a were recorded at the sampling site Salka on the river Ipeľ. Values of saprobe index of bioseston in rivers varied mostly in the range of beta-mesosaprobity, which corresponds to the natural organic matter load. Values corresponding to alpha-mesosaprobity occurred sporadically in left side tributaries of the Danube.

The Danube water quality sampling at key sampling sites is very similar. The impact of left side tributaries would likely be reflected first of all at sampling site on the left bank of the Danube at Szob. On the **Fig. 3.9** the possible influence is documented by higher contents of phosphates and sulphates in the samples taken from the left bank of the Danube, in comparison to their values in samples taken in the middle of the flow, as the result of inflow of water from the river Hron and Ipeľ with higher concentrations of these parameters. Similar differences in case of other water quality parameters were not seen.

- *The evaluation of monitored sampling sites according to principles of WFD*

The evaluation of the overall ecological status of waters in the year 2009[7]

The evaluation of the ecological status of waters in the year 2009 was aimed to sampling sites and not to water bodies. To the evaluation of the overall ecological status of waters from among the biological quality elements the benthic invertebrates, phytobenthos, macrophytes and phytoplankton were included. From among the supporting elements the general physico-chemical quality elements and synthetic and non-synthetic specific substances relevant for Slovakia were included. For particular biological quality elements classification schemes were developed that include limit values for classification into the corresponding class in the range of I.-V. quality class, with corresponding ecological status I. - high, II. - good, III. - moderate, IV. - poor, V. - bad. Results are transparently summarized in **Tab. 3.1**, with the overall biological status. The **Tab. 3.2** provides an evaluation of overall ecological status in the year 2009 for observed sampling sites on the basis of evaluation results of individual quality elements. In determination of the resulting ecological status the „worst case approach“ has been used.

According to the biological quality elements the surface water at sampling sites on the Danube, Hron, Ipeľ and Váh rivers was classified into moderate status (III. quality class). At all sampling sites the mean level of reliability was determined.

[7] The evaluation of status of waters in the Slovak-Hungarian boundary rivers in the year 2009

Tab. 3.1: The evaluation of ecological status for selected biological quality elements in the year 2009 (based on results of Trans-boundary Water Commission)

Sampling site	macrozoo-benthos	phyto-benthos	macro-phytes	phyto-plankton	reliability (r)	overall biological status
Danube, Medveďov	III.	I.	III.	I.	M	III.
Danube, Komárno	x	x	x	x	x	x
Danube, Szob	III.	I.	III.	I.	M	III.
Váh, Komárno	III.	II.	III.	I.	M	III.
Hron, Kamenica	II.	II.	III.	II.	M	III.
Ipeľ, Salka	III.	II.	III.	II.	M	III.

x – not classified M – mean level of reliability

Tab. 3.2: The evaluation of the overall ecological status in the year 2009 (based on results of Trans-boundary Water Commission)

flow, sampling site	GPH CHQE	r	relevant substances	r	overall biological status	r	overall ecological status	r
Danube, Medveďov	II.	M	Y	H	III.	M	III.	M
Danube, Komárno	x	x	x	x	x	x	x	x
Danube, Szob	III.	M	Y	H	III.	M	III.	M
Váh, Komárno	II.	M	Y	H	III.	M	III.	M
Hron, Kamenica	II.	M	Y	H	III.	M	III.	M
Ipeľ, Salka	III.	M	Y	H	III.	M	III.	M

x – not classified M – mean level of reliability of the evaluation
r – level of reliability H – high level of reliability of the evaluation
Y – in accordance with the National Environmental Quality Standard
GPHCHQE - general physico-chemical quality elements

Based on the results it can be concluded that in 2009 the Danube water according to the physico-chemical quality elements at the sampling site at-Medveďov was classified into good status (II. class) and at the sampling site at Szob into the moderate status (III. class) with a mean level of reliability. The relevant substances for Slovakia were in accordance with the National Environmental Quality Standards with high level of reliability. In the assessment of the overall ecological status priority shall be given to biological quality elements, according to which the Danube in the Medveďov - Szob section was classified into moderate status with a mean level of reliability. Similar situation was on the three left side tributaries of the Danube, the rivers Váh, Hron and Ipeľ (**Tab. 3.2**), where the overall ecological status was moderate, similarly to the Danube, with a mean level of reliability.

The evaluation of the chemical status of waters in the year 2009

The basic principle of evaluation of the chemical status is to determine the compliance, or inconsistency of the calculated statistical value of a specific priority substance with the relevant environmental quality standards established on the level of the European Union in the Directive 2008/105/EC.

Based on the evaluation of observed priority substances in the year 2009, it can be stated that in the Danube was not achieved the good chemical status at the sampling sites Medveďov and Szob, because the organic substance DEHP was not in compliance with the environmental quality standard. In tributaries of the Danube the good chemical status has been achieved, because all observed priority substances were in compliance with the environmental quality standards. In the evaluation of chemical status in 2009 the mean level of reliability of the assessment was determined.

3.3.4. Groundwater levels

The evaluation of the groundwater levels was performed on the basis of data observed on an extensive network of observation objects (**Fig. 3.10**). From this network of observation objects were selected 10 documentation objects. Each of these objects represents a certain area with certain groundwater regime. Groundwater levels in these objects are plotted in **Fig. 3.11** and **3.12**. For comparison, on **Fig. 3.13** the precipitation regime was plotted as well (as the second major factor affecting the groundwater regime).

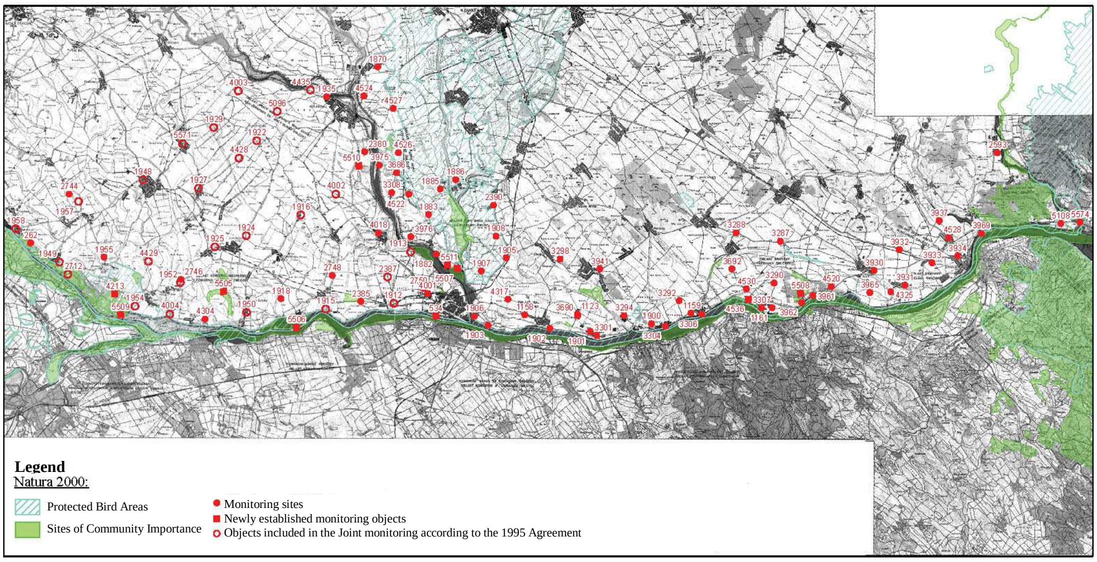
The assessed area, which is under evaluation in this report, can be divided into several separate parts:

- *<u>The area of the lower part of Žitný ostrov between Sap and Komárno</u>*

Typical for the groundwater levels in the area near the Danube is the significant fluctuation, for example at village Medveďov (object No. 1949) and downstream at village Čížov (object No. 1954 and 4304), see **Fig. 3.11**. At these objects it is necessary to point out the decrease of groundwater levels caused by erosion of the Danube riverbed bottom downstream of the Gabčíkovo Hydropower Plant. It is possible to track the significant decrease of minimal groundwater levels, that is around Medveďov about 0.6 meters, which is directly caused by the decrease of water level in the Danube.

Fig. 3.10 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Groundwater levels monitoring



In the Čížov area the lowest groundwater levels dropped by about 0.2 m. This decrease towards Komárno reduces, because of the reduction of water level decline in the Danube and the diminishing effect of water level fluctuations in the Danube to the groundwater. In the inland of the lower part of Žitný ostrov (object No. 4001) and in the area of Komárno substantially less influence of the Danube water level fluctuation can be observed. The overall attenuation of water level fluctuation is in addition caused by the construction of measures related to the Nagymaros hydraulic structure, especially by the construction of underground sealing walls in this area (**Fig. 3.11**).

Fig. 3.11

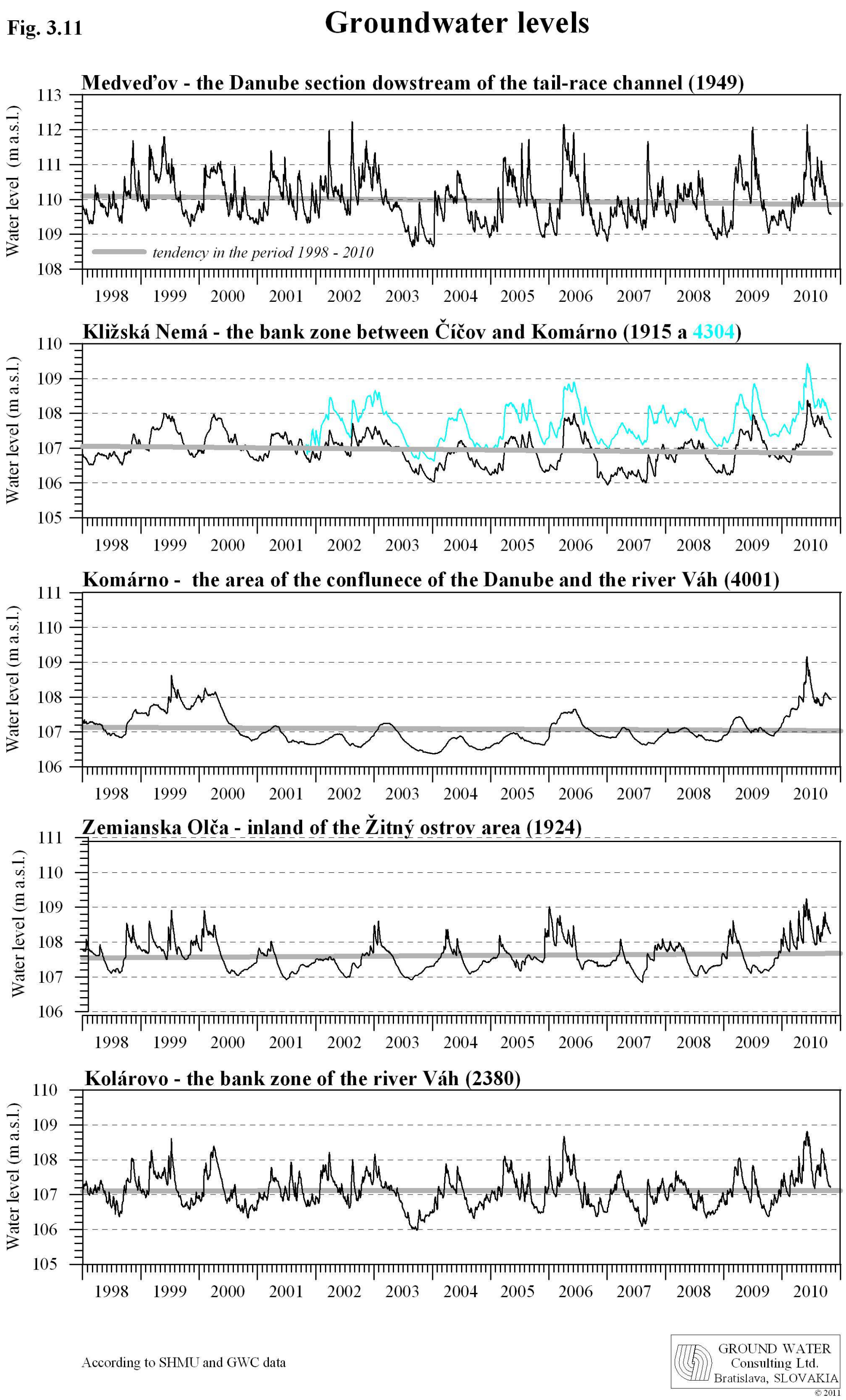
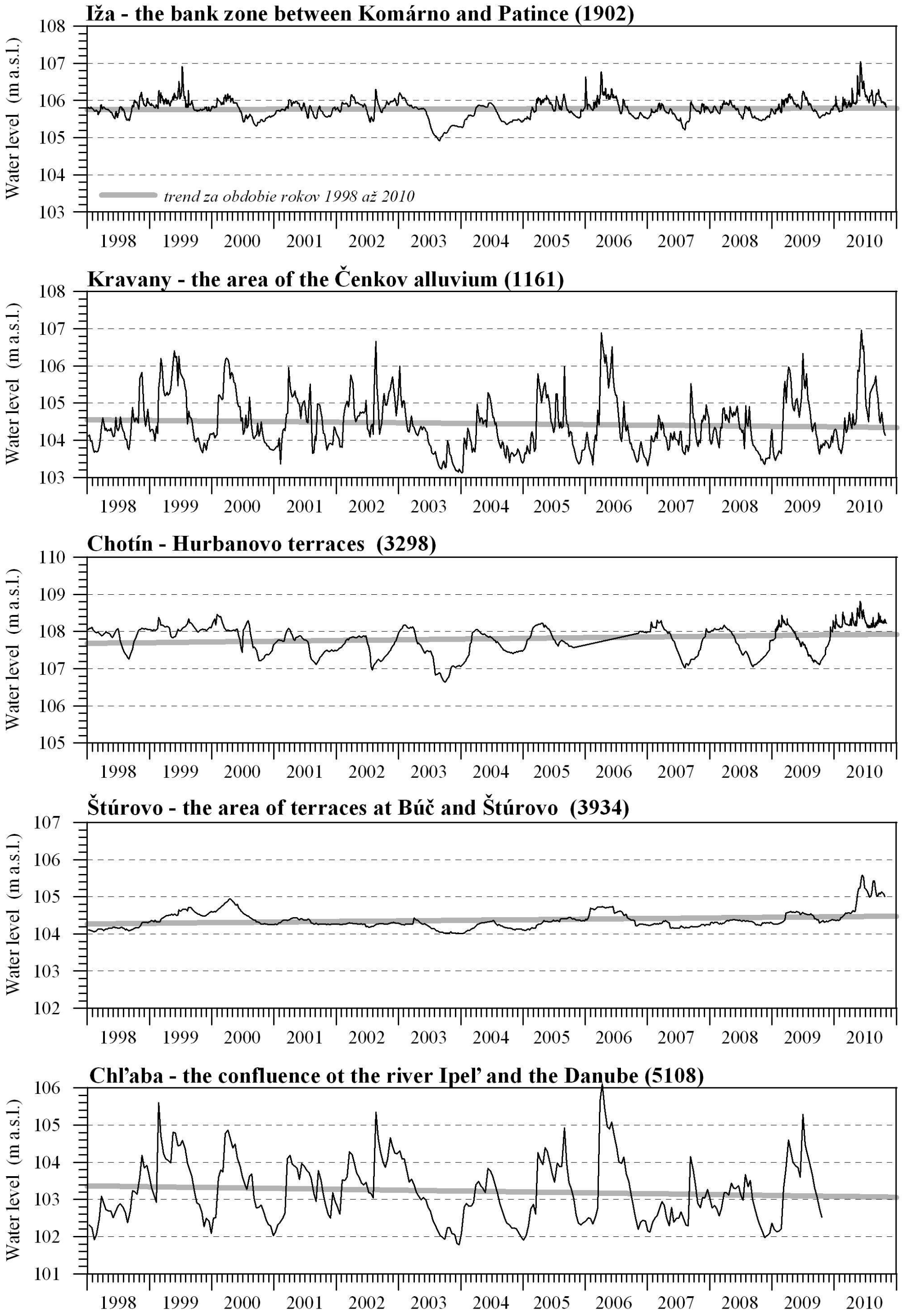


Fig. 3.12

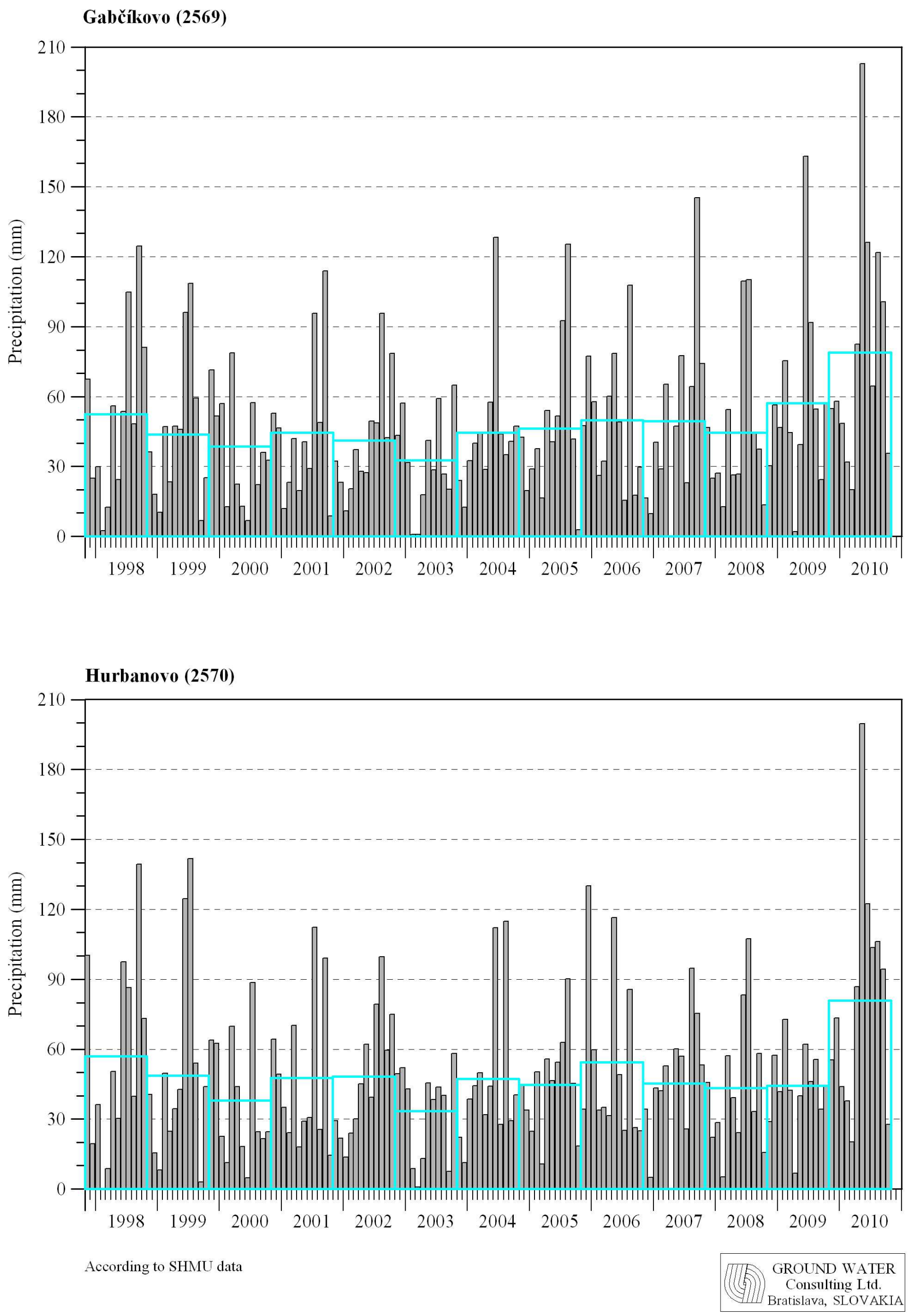
Groundwater levels



According to SHMU and GWC data

GROUND WATER Consulting Ltd. Bratislava, SLOVAKIA © 2011

Fig. 3.13 **Monthly precipitation**



- *__The area along the Danube bank between Komárno and the confluence with the river Ipeľ__*

In the area downstream of Komárno the measures related to the construction of Nagymaros hydraulic structure and the stabilizing effect of operation of drainage canals and pumping stations has expressed significantly.

On the object at the village Iža (object No. 1902, **Fig. 3.12**) can be seen, that in spite of its immediate vicinity to the Danube the water levels are stable and influenced by rainfall. The water levels in the alluvium of Čenkovská Niva (object No. 1161), where underground sealing walls were built, only partially fluctuates dependently on the water levels in the Danube. This area is also significantly influenced by the inflow of water from the area of terraces at Búč, what can be seen in the fact that the ground water level depends also on rainfall. In the alluviums at the confluence of the Danube and the river Hron and at the confluence of the Danube and the river Ipeľ (object No. 5180) it can be seen a groundwater level fluctuation according to the fluctuation of water level in the Danube, and simultaneously an apparent decreasing tendency, which is caused by the decrease of the Danube bottom.

- *The area of Hurbanovské and Búčske terraces*

In the area of terraces the water level fluctuates above the Danube level and is not influenced by his regime. It can be seen that the individual objects respond primarily to precipitation (object No. 3298) and total rainfall in particular years. In the area at Štúrovo (object No. 3934), it can be seen mainly the large impact of periods with high total amount of precipitation and only very small effect of high levels in the Danube.

3.3.5. Characteristic states of groundwater

To illustrate the typical course of groundwater levels and groundwater flow directions, and their possible changes, selected dates (July 27, 2007 and June 8, 1998) are displayed on **Fig. 3.14** and **3.15**, in which the groundwater levels can be considered as typical. This situation corresponds to flow rate conditions in the Danube with average daily flow rate in the Danube at Medveďov about 2000 $m^3.s^{-1}$. Also the summer period is similar and the total wateriness of given years was similar as well, in terms of precipitation the first half of both hydrological years was similarly dry.

From the characteristic state are clear the prevailing flow directions in the area. However, since the water level in the Danube varies considerably, it is evident that during high levels in the Danube the infiltration of water from the Danube to the groundwater occur in the entire length of the flow, except the locations where the elevated places are directly at the bank of the Danube (area of Štúrovo).

In the map of equipotential lines in **Fig. 3.14** the characteristic groundwater levels in 2007 are displayed. From the map it can be primarily seen that water infiltrates from the Danube into the area of the lower part of Žitný ostrov mainly in the section from Sap to Medveďov. It is also clear that the great part of groundwater flows from the upper part of Žitný ostrov. The surface water also infiltrates in the section of the river Váh between Kolárovo and Kameničná. Downstream of this section the river Váh, similarly as the Danube mostly drains the groundwater. From the figure it is also clear that the main element of the drainage is the channel system. A similar situation also exists on the left side of the river Váh, where the water that infiltrated from river Váh at Kolárovo or from the area of terraces, flows along the riverbed of the river Váh and is drained by the old flow of river Nitra and adjacent channels down to the seepage channels at the vicinity of Iža village. It is obvious that this whole area will be largely influenced by the operation of drainage channels and pumping stations.

Fig. 3.14 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Characteristic groundwater levels on June 27, 2007

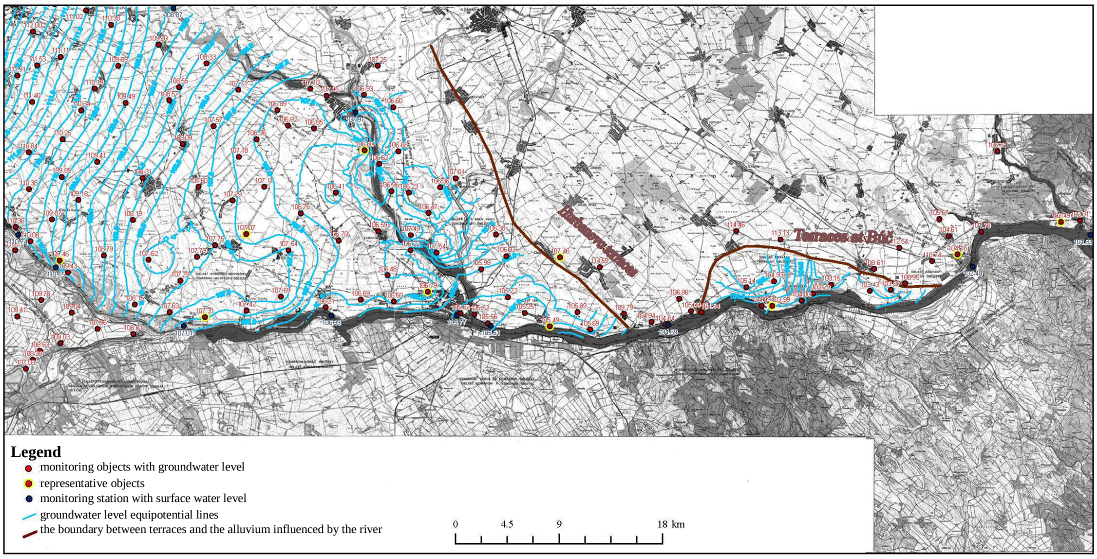
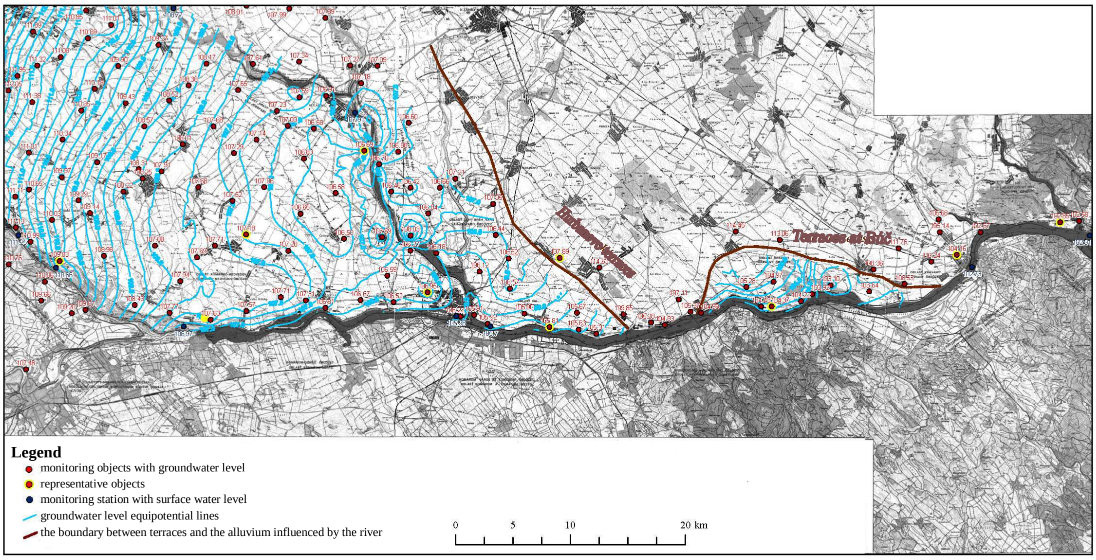


Fig. 3.15 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Characteristic groundwater levels on July 8, 1998

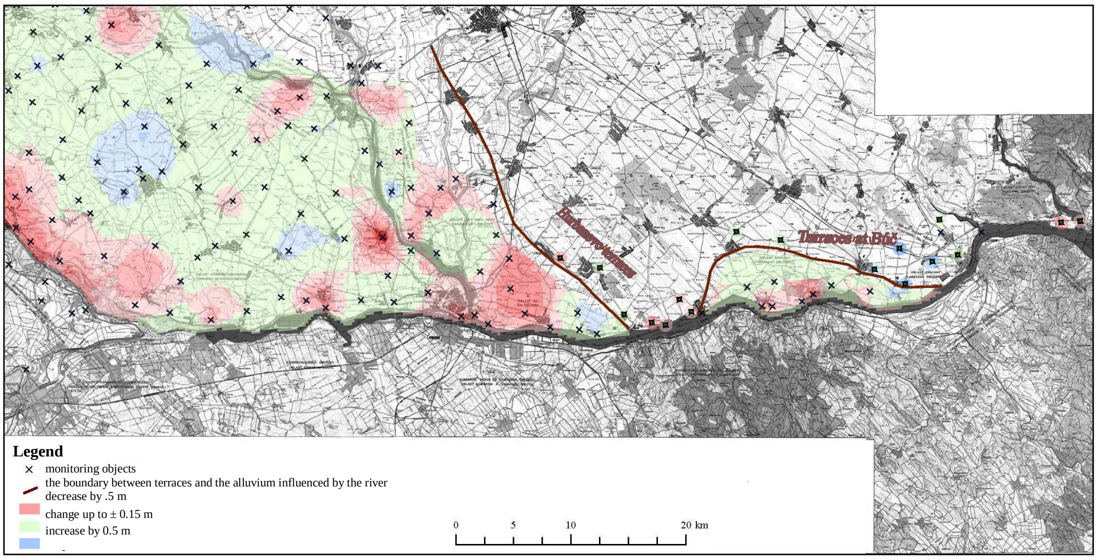


In the river bank zone of Čenkovská Niva it can be seen that the water runs from the terraces at Búč, where the water levels are higher of about 5-10 m, and flows towards the Danube and the seepage channels, which drain it. In the alluviums at the confluence of the Danube and the river Hron and at the confluence of the Danube and the river Ipeľ there are several wells that are located directly at the Danube and their regime is directly influenced by the Danube, the other wells have higher water levels and are probably located on higher terraces, so no equipotential lines were constructed. The **Fig. 3.15** shows a comparable characteristic state in the year 1998. It is seen that the basic flow directions remains preserved.

The **Fig. 3.16** shows the differences between these states, that represents the groundwater level changes during nine years. The red colour represents a decline in groundwater levels, the blue colour an increase and the light green shows insignificant changes up to 15 cm. From the comparison of these figures it is clear that in the area of tailrace channel of Gabčíkovo Hydropower Plant down to Medveďov a significant decrease of groundwater level occurred, and simultaneously the gradient between the surface and groundwater was reduced. Thus in the years 2007 and 2008 there was lower infiltration of surface water in this area than it was in 1998. Other location where groundwater level decrease can be seen is in the vicinity of Komárno and Iža. This is connected with a decrease of the bottom in this section of the Danube and probably with changes in the operation of seepage channels. The slight decrease of groundwater levels on the left side of the river Váh is probably related to the water level changes in the channel system.

Fig. 3.16 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Differences of characteristic groundwater levels between 2007 and 1998

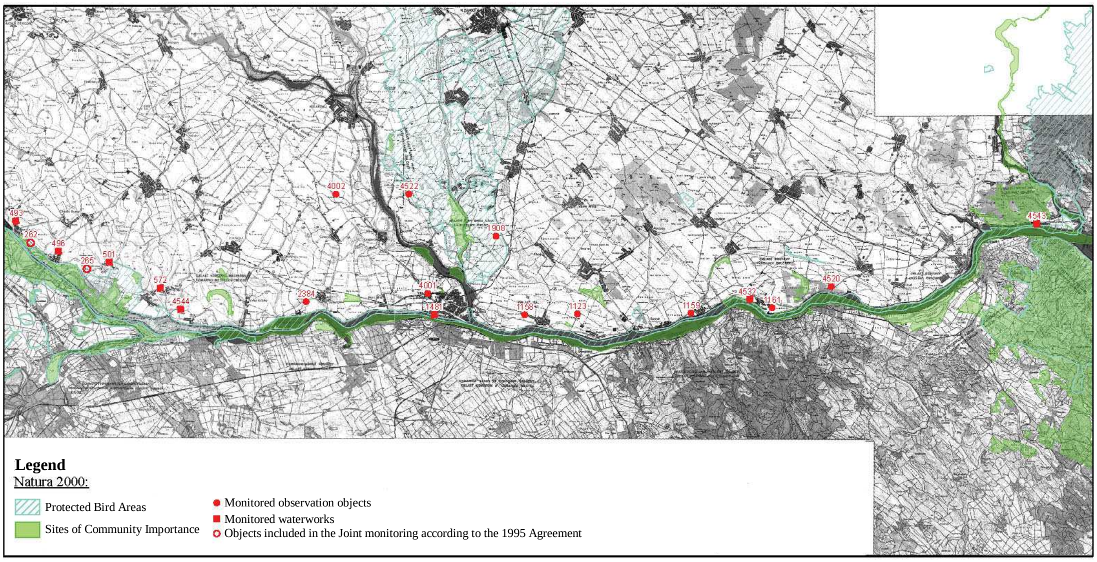


3.3.6. Groundwater quality

The evaluation of groundwater quality was based on data from objects in the lower part of Žitný ostrov area and along the Danube in the section from Sap to the mouth of the river Ipeľ. For the evaluation, objects used for drinking water supply - waterworks, and observation objects that are part of the monitoring system in this area, were selected. The situation of monitored objects is shown in **Fig. 3.17**. For the groundwater quality assessment, the objects of waterworks used for drinking water supply are considered as the most representative.

Obr. 3.17 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Groundwater quality monitoring



The quality of groundwater in the area of interest is influenced by:

- saturation regime of alluvia by water from surface streams;
- quality of the water infiltrated from the surface flow (in the riverbank zone of the area);
- infiltration of atmospheric precipitation;
- output of water (springs) from Mesozoic a Tertiary structures along faults;
- leaking water from the upper terraces;
- mineralogical and petrografic character of the rock environment, and physico-chemical conditions of that environment;
- geochemical processes present in the rock environment (dissolution, oxidation, reduction, leaching of salts from Tertiary sediments in relation to the slow water cycle, etc.);
- granulometric composition of sediments in the aquifer, and also by the retention time in the aquifer and overall intensity of water flow (exchange of water);
- agricultural, industrial and operation activities of man (agricultural pollution, waste deposits, construction of dikes, drainage an irrigation channels, treatment of riverbeds, and other technical works).

- *The groundwater quality on water supply sources*

From among the water supply sources, which are located in the area of interest, eight objects was selected, that are used for supplying the population by drinking water (**Fig. 3.22**). Most of them are only small waterworks that supply the nearest municipality. The waterworks at Sap - HP-2 (493), Medveďov - HG-2 (496), Kľúčovec - HK-2 (501), Číčov-Trávnik - HT-1 (572) and Klížska Nemá - HKN-1 (4544) are located in the southern part of the Žitný ostrov. In the area from the Komárno to the mouth of the river Ipeľ the waterworks at Kravany nad

Dunajom (4532) and Kováčov (4543) were chosen for the evaluation of the groundwater quality. Larger waterworks in the monitored area is the water supply source Komárno - Alžbetin ostrov (1481), which is located on the Danube island. The groundwater quality in this waterworks depends mainly on the water quality in the Danube.

The water quality of waterworks in most of the parameters meets the requirements for drinking water quality. The exception was the manganese and iron. The highest contents of manganese and iron are characteristic for the waterworks at Klížska Nemá - HKN-1 (4544), where most of the measured concentrations were higher than the limit values. On the other observed waterworks occasional exceeding of iron and manganese limit values has occurred. The waterworks at Klížska Nemá show the worst quality from among the monitored waterworks, because except the iron and manganese the ammonium ions exceeds the limit for drinking water and the content of phosphates is two to three times higher than in other water supply sources. In the high mineralisation, typical for objects in Kováčov and Kravany nad Dunajom, mainly participate the high concentrations of calcium, magnesium, bicarbonates and sulphates. Increased contents of these parameters can occur in the monitored area as a result of hidden springs of Mesozoic and Tertiary water along faults, with higher dissolved solids contents.

- *The groundwater quality on observation objects*

The groundwater quality was monitored at 12 observation objects (**Fig. 3.22**). Downstream the confluence of the tailrace canal and the Danube old riverbed the observation object 262/1 at Sap and the observation object 265/1 at Kľúčovec are situated on the left side. The quality of groundwater in these objects is similar to the quality at neighbouring waterworks in Sap - HP-2 (493) and in Kľúčovec - HK-2 (501). Differences exist only in few parameters.

The groundwater quality on observation object in the vicinity of the river Váh - Kameničná - Piesky (4002), Vrbová nad Váhom - Veľký Kindeš (4522), Komárno (4001) and Komárno - Komočín (1908), located in the alluvial sediments of the rivers Váh, Nitra and Danube, in the vast majority of indicators comply with the limits, except for the parameters of iron and manganese.

In the riverbank zone of the Danube between Komárno and Klížska Nemá, near the municipality Zlatná na Ostrove is situated the observation object 2384/2. The water quality in this object is characterized by higher values of conductivity, sulphates, sodium bicarbonates, manganese and iron. In the case of manganese all measured concentrations exceeded the limit value of 0.05 $mg.l^{-1}$ and most of the iron concentration exceeded the limit of 0.2 $mg.l^{-1}$.

The territory from Komárno to Štúrovo is characterized by the occurrence of highly mineralised waters, which may occur in the monitored area as a result of the hidden springs of Mesozoic and Tertiary higher mineralised waters along faults. Locally increased mineralisation may be caused by salinisation of soils. Due to poor water quality the waterworks in this area occur only sporadically. On the high mineralisation participate the high concentrations of bicarbonates, sulphates, chlorides, calcium, magnesium and sodium. Also the organic pollution, expressed as COD_{Mn}, in this area varied in higher concentrations, but only at one object exceeding of the limit value occurred.

3.4. Climatic conditions

The average annual temperature of 10 °C ranks this area among the hottest areas in the country. The coldest month is January when the average temperature vary around 0 °C (Hurbanovo -1.5 °C). The average date of first frost day is October 20, the last date of frost day is April 18. In the long-term average the highest values occurs in July and vary around 20 °C. The number of summer days with maximal temperature above 25 °C is more than 50 days a year, and in the southeast part of the Žitný ostrov more than 70. The average daily temperature below 0 °C occurs in the Žitný ostrov area for 50 to 60 days. The snow cover occurs for around 88 to 90 days and its maximum thickness reaches 20-25 cm in average. The average annual absolute minimum temperatures range between -18 to -19 °C.

Based on the average daily temperature data for the last 18 years (1990-2008) in the station at Hurbanovo, the average daily temperature varied in the range from -14.9 to 31.3 °C, and the average annual temperature reached 11.3 °C. In January, the coldest month, the average monthly temperature has not changed in comparison with the long-term value, but in the warmest month of July it reached 21.9 °C, which might point to the ongoing climate change.

The annual amount of precipitation in the area of interest ranges from 530-650 mm. In the long-term average, the highest rainfalls are achieved in months from May to August. In summer rainfall at the time of the highest average temperatures very intense loss of water going on by evaporation from the soil surface. The lowest rainfall occurs in autumn and winter months (from October to February). The variability of annual and monthly totals is high, in extremely dry years it decreases to 300 mm, in wet years the total rainfall could reach up to 1000 mm.

The potential evapotranspiration, or the evaporation in the area of interest, in relation to the amount of precipitation plays an important role in the process of salinisation of soils. The average annual totals of actual and potential evapotranspiration reach 700-750 mm. During the summer half of the year the potential evaporation is higher than in winter. The deficit of rainfall in the area of interest is 150-200 mm in average. From the comparison of the potential evapotranspiration and the total precipitation in summer months, results that the rainfall deficit achieves 340 mm. On the other hand, in the winter period the total rainfall slightly exceeds the potential evaporation, what is manifested by infiltration of rainfall through the soil cover to the groundwater level. It follows that the replenishment of groundwater by rainwater takes place mainly in winter period, especially in the months from January to March and from September to December. In the remaining months of the year the evaporation is higher than precipitation.

Based on long-term observations it can be concluded that the northwest wind prevails. On the second place is the wind in the opposite direction, so the southeast wind. The lowest occurrences have the east winds. The calm is also common. The entire area along the Danube is quite windy. The windiest period is the end of winter and the beginning of spring; autumn is the calmest. Winds play a significant role in evaporation from the soil surface, which plays an important role at formation of salt soils. Regarding the relationship between rainfall and potential evaporation mainly the summer winds have character of drying winds.

In the long run it is possible to follow the tendency of air temperature increase. The average annual temperature for the monitored period increased by 0.8 °C and in the growing season by 0.9 °C. Extraordinary warm are mainly the last 12 years, when since 1997 it was not recorded lower average annual temperature, or temperature in the growing season, than the long-term climate normal. Similarly as in the Hungary, decrease of spring rainfall is observed in the south of the Danubian lowland.

3.5. Agricultural soils

3.5.1. Water regime of soils

The water regime of soils in the monitored area reflects the spatial and temporal distribution of soil water (soil moisture) in the unsaturated zone of soil cover, i.e. between the soil surface and groundwater level for several consecutive years or growing seasons. For the purposes of the evaluating data on soil water regime were available at observed sites MP-12, 14, 16 and 18 in the years 1990-2007, MP-23 and MP-27 in the years 1991-1997 and at the site MP-29 in 1991-1992 and the course of soil moisture from mid-May to the end of 2008. Situation of the monitored sites is shown in **Fig. 3.18**.

Obr. 3.18 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Monitoring of soils

The soil moisture at stands MP-12, 14, 16 and 18 was influenced by the capillary rise of groundwater during the entire period. The soil moisture at stands MP-12 and 14 increased in the spring months above the field water capacity. Contrary to this at stands MP-16 and 18 the soil moisture decreased during from April to September, with the exception of July, below the level of reduced availability. In the subsoil the soil moisture was high on these sites - MP-

14, 16 and 18, above the level of field water capacity, and at MP-12 in the range from the level of reduced availability to field water capacity.

The monitoring results confirm that the soil water regime of the observed area is besides the rainfall also affected by groundwater level, with its variation during the year and by its contact with upper-lying fine-grained sediments, that allow the capillary rise into the soil profile. Soils in the area of the tailrace channel, where the groundwater level depends on the water level in the tailrace channel, have specific water regime. This is reflected in the frequent and large fluctuations.

The development of groundwater levels at monitoring sites MP-23 and MP-27 during the years 1991 to 1997 had clearly increasing tendency. The average groundwater level depth at the site MP-23 decreased from 2.1 m to 1.6 m, so the water level increased by 0.5 m. At the site MP-27 this tendency was even more pronounced and groundwater has increased by 0.9 m, from the depth of 1.5 m in 1991 to a depth of 0.6 m in 1996. In the following, not observed period, however, it likely felt back, since in 2008 the average groundwater level at the site MP-23 was at the level from 1991, thus it decreased by 0.5 m. At the site MP-27 it decreased by 0.6 m compared to 1997. At the site MP-29, where the observation was performed for only two years, the groundwater level decreased by 0.5 m compared to 1991.

At all three monitoring site soils with permanent influence of groundwater occur, also known as hydromorphic soils. At these sites the groundwater level is permanently in fine-grained upper-lying sediments, which allows the capillary rise of the water into the soil profile. The groundwater level in these soils is relatively high (1.2 to 3.1 m) and the soil above the groundwater level saturates up to uvidic interval.

The water regime in these soils are characterized by the fact, that the moisture in topsoil varies in the semi-uvidic and semi-arid range for the most part of the year, and during dry summer months it often falls into the arid interval, especially in heavy soils at sites MP-23 and MP-27. The bottom layer of the soil profile (from 0.3 to 1.0 m) has the moisture content at every location in the semi-uvidic interval for the most part of the year, but especially at the site MP-23 with heavy soil it falls in the dry summer months, below the level of decreased availability, into the semi-arid range.

3.5.2. Evaluation of the development of saline soils

The processes of salination of soils depend on the geological composition of the subsoil, the soil position to river flow, local particle size composition, hydrogeological conditions of the shallow and deeper groundwater circulation, evaporation, precipitation, surface runoff, vegetation, irrigation and drainage, the possibility of groundwater exchange (e.g. during snow melting), local morphological conditions, and other influences. For these reasons, the salination of soils is very variable in space and time, and sensitive to various changes, including human activities, agriculture and forestry. Moderately and highly mineralised ground waters, evaporative water regime of soils, emerging global warming and the presence of salt soils in the area of interest creates conditions for spreading of salt soils. From the existing results of monitoring of salt soils in the years 1990-1995 and in the year

2008 it is known that the in the monitored area both processes, the salinisation and sodification, are present (Dodok R. et al., 2008).

- *Salinisation of soils*

The salinisation as a process of accumulation of sodium salts in the soil indicate salt contents above the limit (above 0.10 %). Higher salt contents were recorded in soil profiles at locations MP-23, 27 and 29. Increased salt content in the lower soil horizons was present in the soil profile at sites MP-16 and 18, however, in soils at MP-16 and 18 slightly higher salt content was also in the topsoil horizon. The salt contents above the limit (above 0.10 %), indicating the presence of salinisation, were recorded in 2008 throughout the whole soil profile at the site MP-14.

- *Sodification of soils*

The sodification as a process of binding the exchangeable sodium (Na^+) on the soil colloidal complex was detected in the monitored soils at locations MP-14, 16, 18, 23, 27 and 29. The content of the exchangeable sodium in the soil (ESP 5-10 %) indicates that slight alkalisation of soils is present in the bottom, substrate horizons of these soils. Such soils are classified as deeply alkalinised. In terms of the development of soil sodification, this process is every year present in soils at sites MP-14, 16, 18 and 27, in other soils (MP-23 and 29) it is sporadic.

- *The groundwater chemical composition*

Because the main reason of formation and spreading of salt soils is the groundwater, its chemical composition on the monitored sites is regularly monitored. The chemical composition is observed by a laboratory determination of chemical elements and substances important for the formation of salt soils, as well as by direct measurement of electrical conductivity, mineralisation and temperature in the field in monthly frequency. The measurement is performed on the groundwater level, which is in direct contact with he soil, and in the vertical profile at whole meters below the ground water level.

The results of the groundwater chemical composition show significant differences between the individual monitored sites. The site MP-23 is characterized by moderately mineralised groundwater, at the site MP-27 is the groundwater already highly mineralised and the site MP-29 the indicators of salinisation in the water are approximately twice as high (value of ECe above 300 $mS.m^{-1}$, mineralisation close to 2000 $mg.l^{-1}$, and the SAR values well above 1).

3.5.3. Evaluation of physical properties of soils

According to the density values, which are an integral indicator of the physical condition of the soils, compacted soils in 2006 were on following locations: MP-14 throughout the whole profile and MP-12 and 18 in the subsurface horizon. Compared with the initial state, compaction of subsurface horizons of medium and heavy soils can be stated at locations MP-12 and 14. Soils on the other locations do not show any significant trends in physical properties. The density is closely related to other physical properties. The increase of density means a decrease in total porosity and air capacity, and an increase in capillary porosity, and a maximal and water retention capacity.

Based on analyses of the physico-chemical properties for the period 1989-2006 it can be reported the worsening of physical condition of six medium and heavy soils in the subsurface horizons. Considering the unchanged nature of the water regime of these soil horizons, these processes can be more associated with imperfections in land management. Other variations fluctuate within the normal spatial variability.

3.5.4. Evaluation of content and quality of humus

The content and quality of soil organic matter is mainly dependent on soil type, grain size composition and agricultural land use. The highest content of humus on all monitoring sites occurs in the topsoil and gradually decreases with depth. From the typological point of view the fluvisoils have the lowest content of humus. The highest content of humus have haplic luvisols, located mainly in the lower part of the Žitný ostrov (sites MP-12 and MP-18). Haplic luvisols belong to the category of moderate to severe humic soils.

In the last period (analyses were performed in the years 1989-1990, 1995 and 2001) it can be stated stabilization, or slightly decreasing trend in the content of organic matter in soils. However, this decline is likely not related to changes in water levels (in areas where the topsoil could be affected, no changes in groundwater levels were recorded), but has more to do with the reduction of supply of high quality organic matter to arable soils. In the second half of the 90's the usage of organic fertilizer represented only 50 % of the previous amounts (Jurčová, 2000 in Dodok R. et al, 2007). In the last sampling carried out during the year 2006 almost on all locations were recorded the highest values of humus for the entire monitoring period (**Tab. 3.3**).

Tab. 3.3 The development of organic carbon (Cox) and humus contents

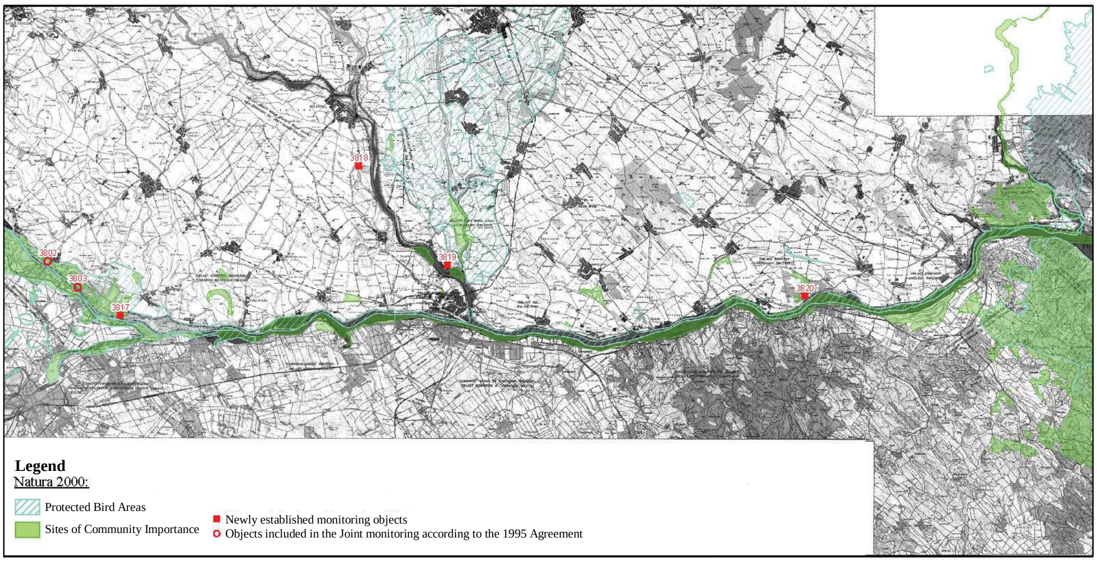
Locality	Depth(cm)	**Cox** (%)				**Humus** (%)			
		1989	1995	2001	2006	1989	1995	2001	2006
MP-12	0-10	-	-	1.98	**2.55**	-	-	3.41	**4.39**
	10-20	2.30	2,.5	1.85	**2.59**	-	4.05	3.19	**4.46**
	35-45	1.50	**1.58**	1.52	**1.58**	-	**2.72**	2.62	**2.72**
MP-14	0-10	-	-	1.21	**1.67**	-	-	2.09	**2.87**
	10-20	**1.63**	1.22	1.08	**1.63**	-	2.10	1.86	**2.81**
MP-16	0-10	-	-	1.02	**2.23**	-	-	1.75	**3.84**
	10-20	1.70	1.48	1.50	**2.25**	-	2.55	2.59	**3.88**
MP-18	0-10	-	-	1.27	**2.19**	-	-	2.19	**3.77**
	10-20	1.87	1.68	1.41	**2.46**	-	2.90	2.43	**4.24**
	40-50	0.67	0.76	0.41	**1.89**	-	1.31	0.71	**3.25**

3.6. Forestry

The forest management in the Danube stretch between Sap and the mouth of river Ipeľ is concentrated mainly in the inundation area of the Danube and river Váh. On the Danube stretch Sap - Komárno forests can be assessed on the basis of observations at monitoring sites at Medveďov, Kľúčovec and Číčov. In the vicinity of the river Váh it is the site at Kolárovo - Čergov and Komárno - Kava. In the Danube stretch from Komárno to the mouth of the river Ipeľ there are no cultivated forest stands, they were removed due to the upcoming construction of Nagymaros Hydropower Project. The only area in this section is located in the area of Čenkov forest-steppe. With the exception of two areas at Medveďov and Kľúčovec, the other stands were observed only in 2008. The situation of observed stands is shown in **Fig. 3.19.**

Obr. 3.19 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Forest monitoring

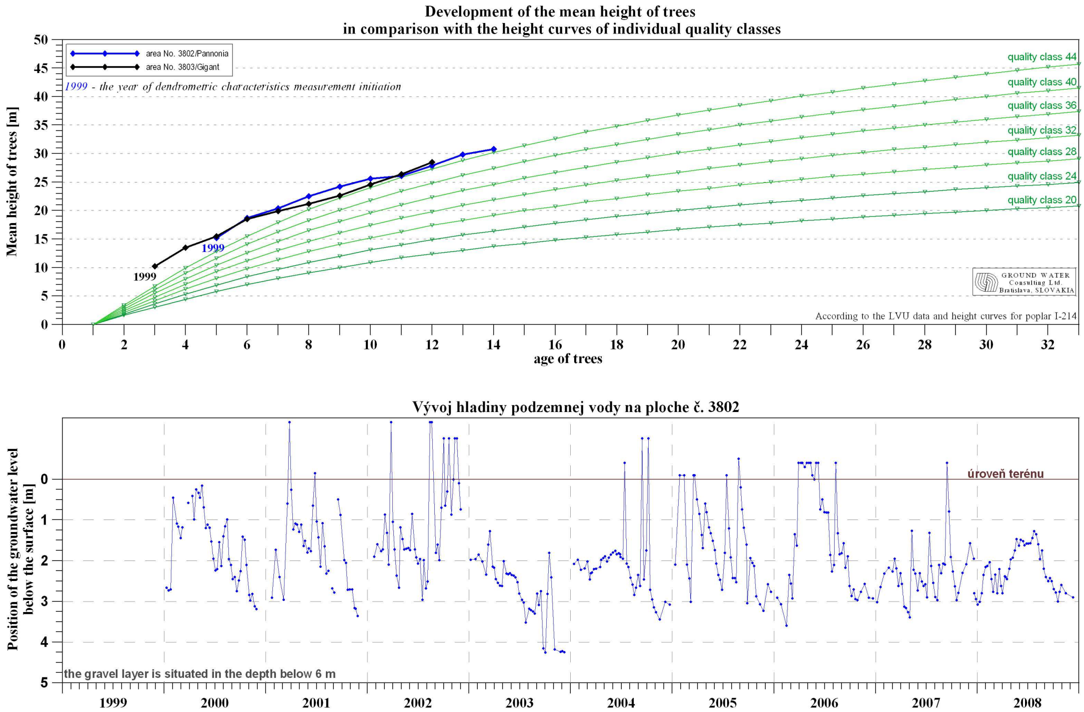


The development of the groundwater level in the area downstream of the confluence of the Danube old riverbed with the tailrace channel is in accordance with the hydrological regime of the Danube. This area is represented by plots No. 3802, 3803 and 3817. These plots use to be repeatedly flooded, except the very dry years (e.g. 2000, 2003). Favourable moisture conditions are ensured also thanks to the big thickness of the soil cover. The gravel layer on plots No. 3802 and 3803 was not found even at a depth of 6 m. Slightly decreasing tendency in groundwater level was recorded in this area after an extremely dry year 2003. This tendency remained similar even after a slight improvement in moisture conditions in 2004, and it has not improved even after the presence of high water levels in 2005 and 2006. This unfavourable tendency probably relates to the erosion of bottom of the Danube riverbed. However, thanks to the big thickness of the soil profile, the habitat conditions can be considered for the time being as favourable.

- *The Danube stretch Sap - Komárno*

Forest stands in this section of the Danube are situated in the inundation area. At all three observed monitoring sites (No. 3802, 3803 and 3817) cultivated poplar stands occur (*Populus x euroamericana Pannonia* and *Giant*). The development and the increments of these stands during the entire period are characterized by high values.

Fig. 3.20



The height increment of trees exceeds the height curves of quality categories from 40 to 44 for poplar I-214 (**Fig. 3.20**). These height curves were used due to the absence of similar curves for poplar „Pannonia". In older observed stands it can be stated that they probably overcome the period of growth culmination.

In terms of health condition the stands are characterized by signs of resistance against pests and against the infection by diseases. In most of evaluated years, the occurrence of pests and diseases on trees was sporadic; their spreading was slightly more abundant in the extreme drought of 2003. In years with higher summer precipitation amount (for example in years 2008 and 2010) a slight increase of infection by fungal diseases of leaves can be observed in the second half of the growing season.

- *Forest stands around the river Váh*

The monitoring plots are located outside the inundation area of the river Váh, in the distance up to 1 km from the flow (No. 3818, 3819). The groundwater level was located 1.5 to 2.5 m below the surface. Forest stands are comprised by cultivated poplars (mostly *Populus x euroamericana Pannonia*). The height increment of stands ranged between the quality categories from 32 to 44 for poplar I-214.

Also these stands are highly resistant against pests and against the infection by diseases. Since 2008, the development of stands is not monitored.

- *The Danube stretch Komárno - the mouth of the river Ipeľ*

In the Danube stretch from Komárno to the mouth of the river Ipeľ there are no cultivated forest stands in the inundation, because they were removed due to the upcoming construction of Nagymaros Hydropower Project. Forest stands are located only in the area of Čenkov forest-steppe. Sandy dunes and drifts form the soil cover, the groundwater level is located in a relatively big depth of about 4 m. The status of forest stands indicates that the roots of planted trees do not reach the ground water level. For the existence and growth they use only atmospheric precipitation, which uses to be insufficient. Due to less favourable moisture conditions the increment of the observed oak stand is relatively slow. Due to the deeply located groundwater level, the yellowing of leaves, as well as the increased defoliation of trees are already recorded in June. Since 2008, the development of stands is not monitored.

3.7. Biology

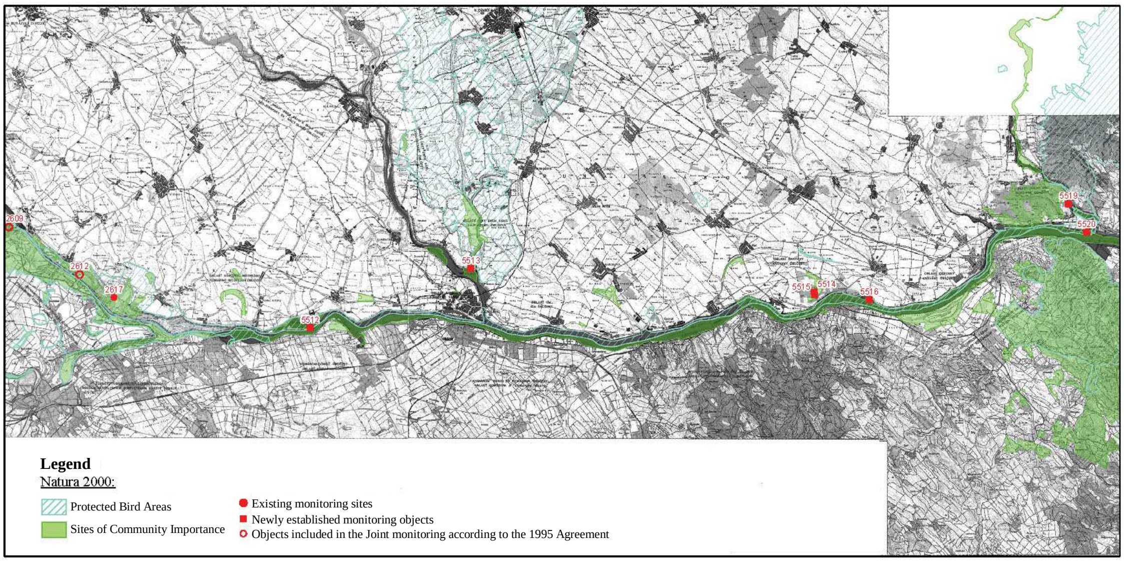
The monitoring of biota in the Danube stretch Sap - Budapest on the Slovak side was carried out at ten monitoring areas (**Fig. 3.21**). Three of these monitoring areas (No. 2609, 2612 and 2617) were established in 1990 and the observation goes on continuously also at present. These areas are assessed from the long-term point of view. From the other monitoring areas (No. 5512, 5513, 5514, 5515, 5516, 5519 and 5520) data are available from the years 2008, 2010 and 2011. The assessment of these areas contains only the characteristics of the current state of the biota.

The development of plant communities on areas No. 2609, 2612 and 2617 is evaluated on the basis of average eco-values development of plant communities, the percentage of plants with different water demands, and the percentage of plants indicating the moisture fluctuation and flooding. The assessment on these areas is further based on the floristic inventory, the statistical processing of phytocoenological records and of samples of observed groups of animals, reflecting the development of plant and animal communities.

Among the evaluated group of animals there are terrestrial molluscs (*Gastropoda*), water fleas (*Cladocera* and *Copepoda*), mayflies (*Ephemeroptera*), caddisflies (*Trichoptera*), fish (*Osteichtyes*), dragonflies (*Odonata*), aquatic molluscs (*Aquatic Mollusca*), amphibians (*Anura*), ciliates (*Ciliophora*), earthworms (*Oligochaeta*), paddle-footed annelids (*Polychaeta*), pillbugs (*Isopoda*), amphipods (*Amphipoda*) and shrimp-like crustaceans (*Misidacea*).

Obr. 3.21 **Monitoring of the natural environment on the Sap - Budapest Danube stretch**

Monitoring of biota



3.7.1. Danube section Sap - Komárno

- *<u>Long-term evaluation</u>*

The monitoring area No. 2609 - Erčed, 2612 - Sporná sihoť and 2617 - Starý les are located below the Gabčíkovo hydraulic structure, from the confluence of the tail-race channel and the Danube old riverbed to approximately rkm 1799, thus about 20 km below the Gabčíkovo hydropower plant. After putting the Gabčíkovo hydraulic structure into operation no decrease of groundwater levels occurred along this section of the Danube, and the presence of frequent flooding remained preserved. As a result of unfinished lower hydraulic structure and the absence of countermeasures, there is a gradual erosion of the Danube riverbed bottom and consequently a decrease of surface and groundwater levels. Therefore, the area may become vulnerable, especially during long-term low water levels.

<u>Monitoring area No. 2609 – Erčed</u>

<u>Development of plant communities</u>

The site is located at the confluence of the original Danube and the tailrace channel of the Gabčíkovo hydraulic structure (rkm 1811). On the area occurs a lowland stand of soft willow-poplar forest (alliance *Salicion albae*, association *Salici-Populetum*). Trees are mainly represented by the white willow (*Salix alba*), crack willow (*Salix fragilis*), white poplar (*Populus alba*) and black poplar (*Populus nigra*). In the shrub layer prevailed the red dogwood (*Swida sanguinea*), elderberry (*Sambucus nigra*), common spindle (*Euonymus* *europaeus*), common hawthorn (*Crataegus monogyna*) and the ordinary bird cherry (*Padus avium*). On the observation area a total of 101 taxa of vascular plants was recorded. In intensively wet habitats stands of sedge-ash woods association *Carici (acutiformis tripariae)-Fraxinetum angustifoliaie* (Berta 1970) occur, with the pond sedge (*Carex acutiformis*), greater pond sedge (*Carex riparia*), bladder sedge (*Carex Vesicare*) and slim sedge (*Carex gracilis*).

Fig. 3.22

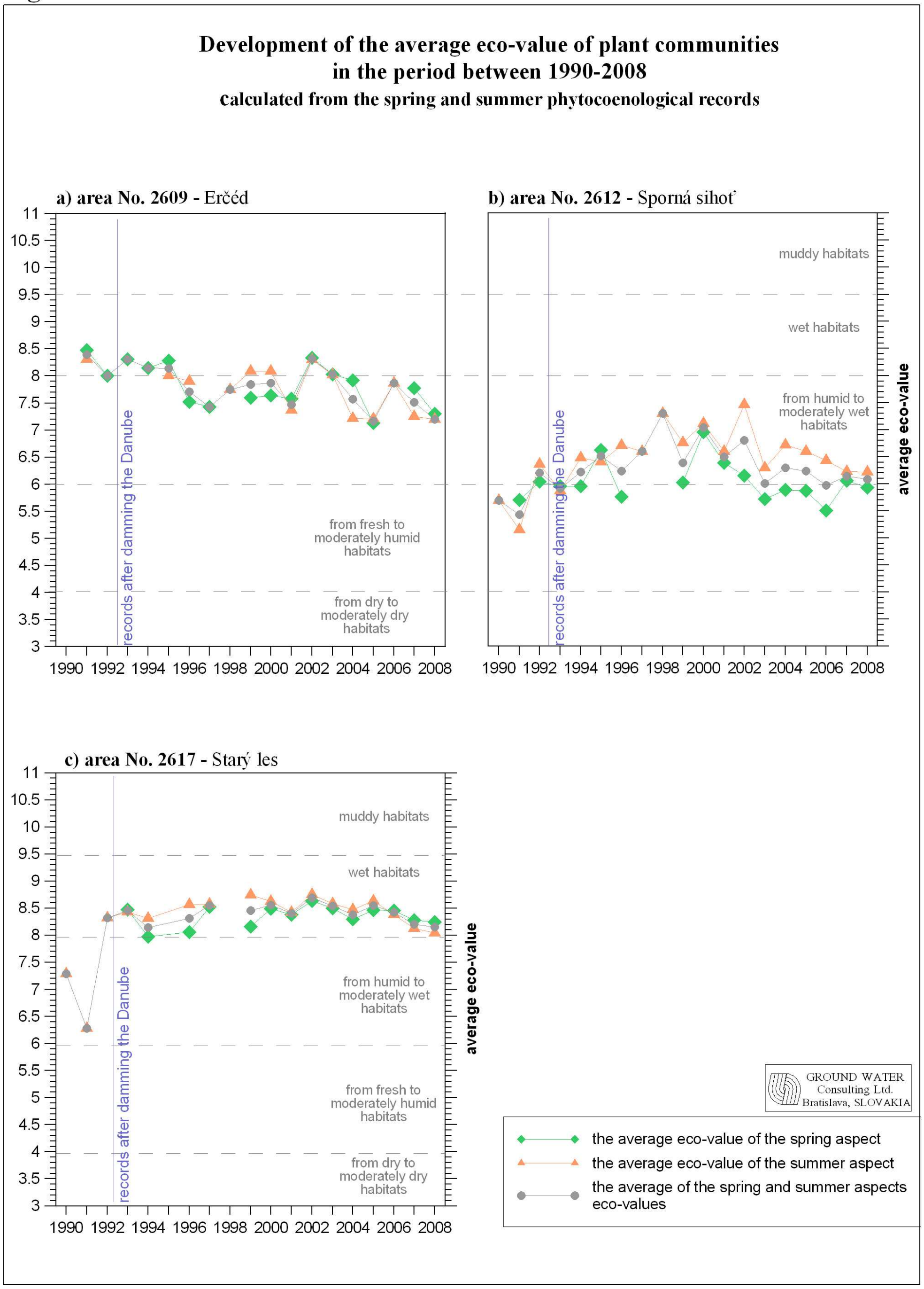
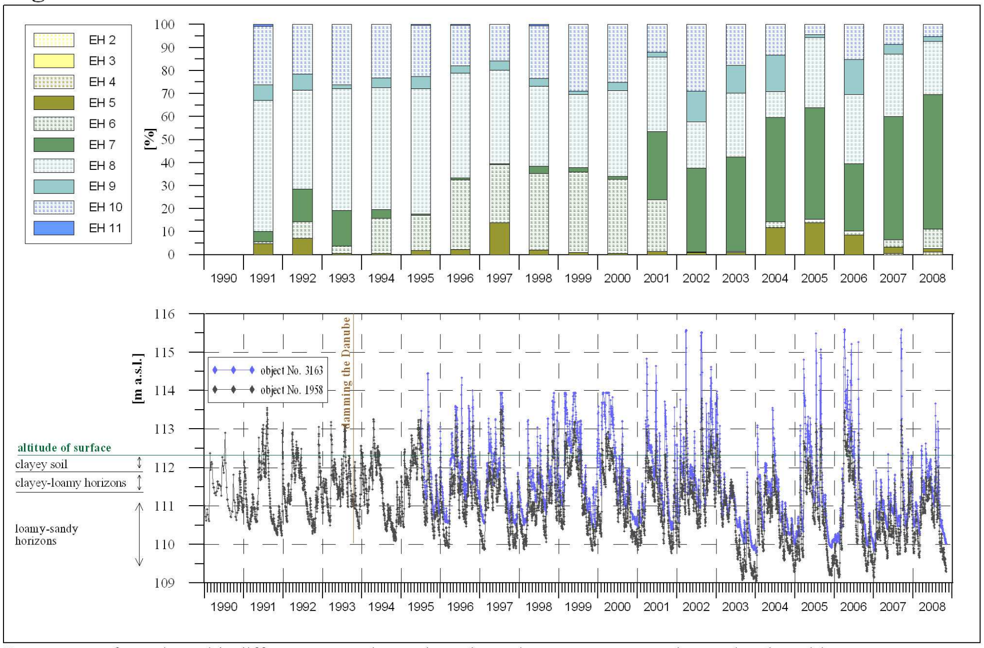
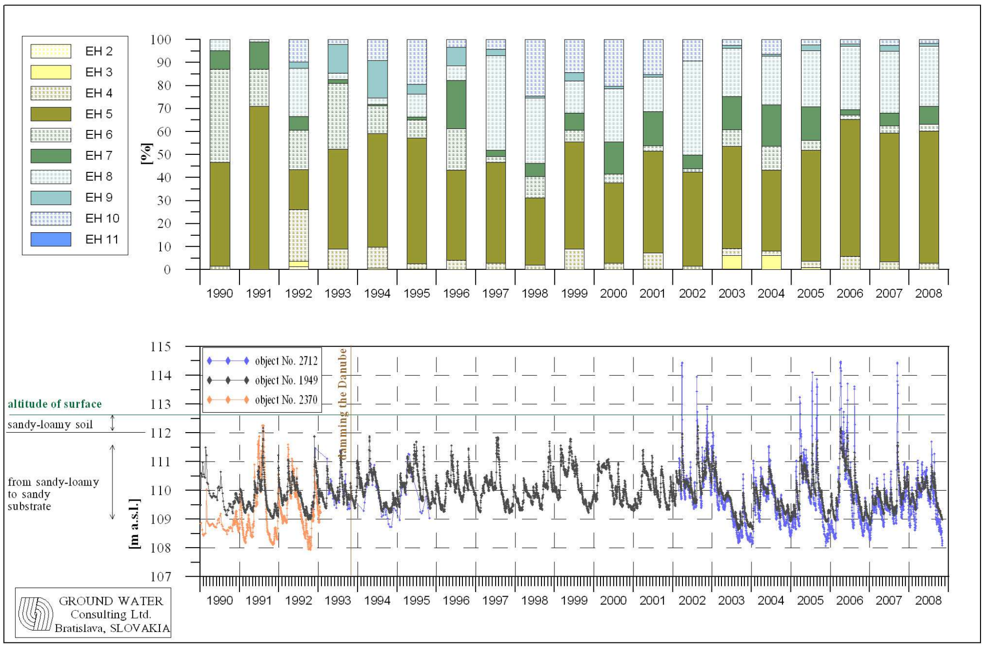


Fig. 3.23



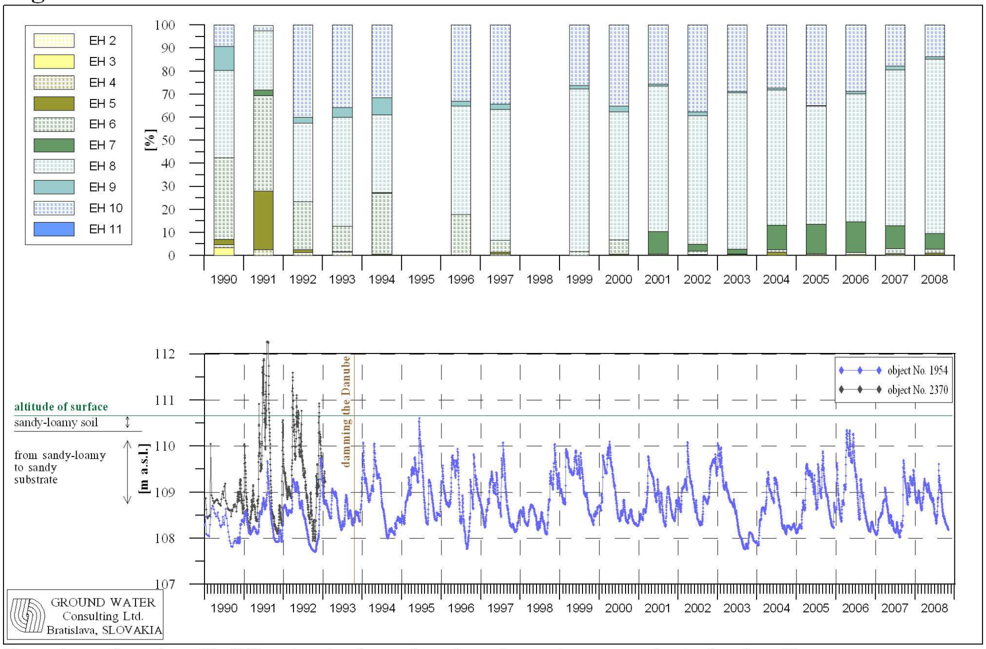
Percentage of species with different water demands and requirements on groundwater level position near to Erčed - area No. 2609



Percentage of species with different water demands and requirements on groundwater level position near to Sporná sihoť - area No. 2612

In the often flooded depressions also marshy and hygrophilous species were recorded: water forget-me-not (*Myosotis palustris*), small-flowered forget-me-not (*Myosotis laxiflora*), water speedwell (*Veronica anagallis-aquatica*), water starwort (*Callitriche palustris*), water dock (*Rumex hydrolapathum*), seashore dock (*Rumex maritimus*), lanceleaf water plantain (*Alisma lanceolatum*), yellow iris (*Iris pseudacorus*), yellow marsh marigold (*Caltha palustris*), summer snowflake (*Leucojum aestivum*), bittercress (*Cardamine dentata*), great yellowcress (*Rorippa amphibia*), common marsh bedstraw (*Galium palustre*), greater water parsnip (*Sium *latifolium*) and others. In the middle of the area an extensive and continuous of common reed stand (*Phragmites australis*) is situated.

Fig. 3.24



Percentage of species with different water demands and requirements on groundwater level position near to Starý les - area No. 2617

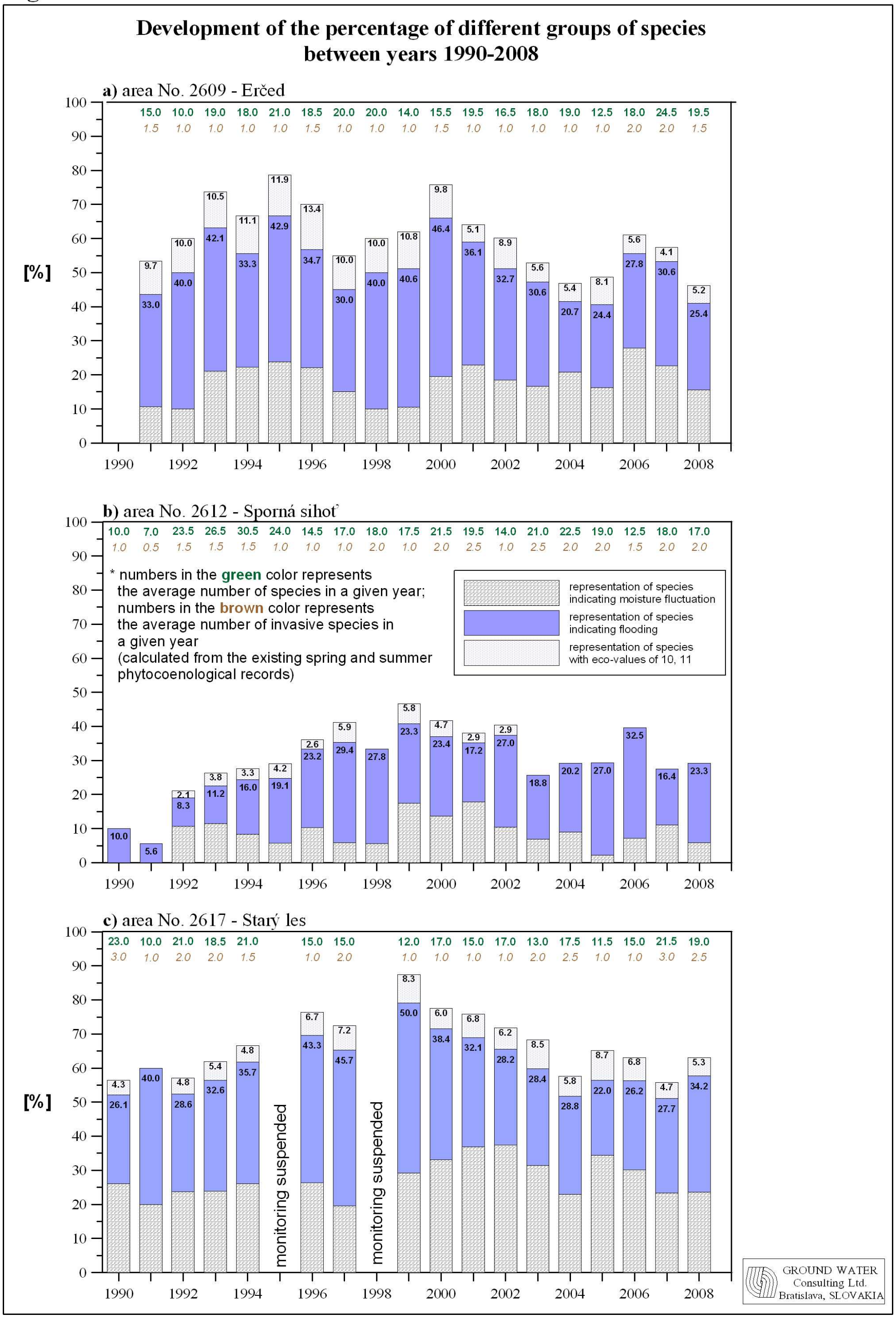
From among the endangered taxa on the area the following species were recorded: small-flowered winter-cress (*Barbarea stricta*), water starwort (*Callitriche palustris*), bittercress (*Cardamine dentata*), summer snowflake (*Leucojum aestivum*), common meadow-rue (*Thalictrum flavum*) and fen ragwort (*Senecio paludosus subsp. angustifolius*).

Based on the development of average eco-value of plant communities it can be observed a shift from the community of wet habitats to the community of slightly wet habitats (**Fig. 3.22**). Similar tendency is also seen in the graphical presentation of the percentage of species with different water demands and requirements on groundwater level depth. In the representation of species indicating the moisture fluctuation and flooding regular variation can be observed throughout the whole monitoring period. In terms of species indicating flooding the lowest values were recorded in 2004 and 2005 (probably due to the extremely dry year 2003), but the values in 2007 again approached the level before damming. In the area there is a visible change in the increase in the proportion of species indicating the moisture fluctuation and the share of species with eco-value of 10 and 11, since the damming their quantity dropped to about half of the previous amount (**Figs. 3:23 to 3:25**).

<u>Development of terrestrial fauna</u>

The species diversity of <u>terrestrial molluscs</u> (*Gastropoda*) in the area was high in most of the years and consisted of species with different ecological demands, from polyhygrophilous to euryoecious species. This broad diversity of species is formed by mixing of populations during regular floods. The malakocoenosis in dry years can be characterized by a significant decrease in population densities of some hygrophilous forest species (e.g. in 2003). In the community no spreading of mesohygrophilous and eurytopic species occur, the hygrophilous and polyhygrophilous representatives remain dominant (*Pseudotrichia rubiginosa, Carychium minimum Zonitoides nitidus, Succinea putris*, and others). Status of the malakocoenosis represents a typical stage of drier types of softwood floodplain forest. Generally, in conditions of large dynamics of surface water there exist frequent exchange of significant part of the community.

Fig. 3.25



Monitoring area No. 2612 – Sporná sihoť

Development of plant communities

The monitoring area is located in the inundation area of the Danube at Kľúčovské river arm (rkm 1805). The total number of taxa found on the site is 105. From among the invasive species occur the common ragweed (*Ambrosia artemisiifolia*), lance-leaved aster (*Aster lanceolatus*), purple jewelweed (*Impatiens glandulifera*), smallflower jewelweed (*Impatiens parviflora*), a giant goldenrod (*Solidago gigantea*) and annual fleabane (*Stenactis annua*).

A gradual increase of average eco-values of the plant community can be observed in the area, which represent a shift from slightly wet habitats to wet habitats (**Fig. 3.22**). Until 1999 there was a continuous increase of the cumulative proportion of indicative species monitored in this area. In subsequent years, the values have begun to decline, but they did not fall below the level of the period before damming. Similar tendency is seen in the graph representing the percentage of species with different water demands and requirements on groundwater level depth. Since 1992, an increase of species indicating more wet conditions can be seen (increase of species indicating flooding and moisture fluctuation and decrease of more xerophilous species). The influence of the dry and warm year 2003 was reflected in a temporal decline of species indicating flooding and moisture fluctuation (**Fig. 3:23 to 3:25**). Although the coverage of the herb layer in individual samplings varies depending on the occurrence of floods, but its character is year-round mostly determined by the nitrophilous species as the stinging nettle (*Urtica dioica*) and european dewberry (*Rubus caesius*). In some years slight increase in invasive species occurs, in recent years there were mostly two species recorded at individual samplings.

In various river arms on the monitoring area No. 2612 a wide range of aquatic macrophytes is present. Open water areas are mostly covered by population of following species: common duckweed (*Lemna minor*), giant duckweed (*Spirodela polyrhiza*), floating fem (*Salvinia natans*) and water chestnut (*Trapa natans*), in the submerged layer the most frequent is the hornwort (*Ceratophyllum demersum*) and the invasive neophyte western waterweed (*Elodea nuttalii*). The progressively overgrown river arm is occupied by marshy plant communities (helophytes) with the domination of common reed stand (*Phragmites australis*). On the bare bottoms mainly species of the knotweed genus (*Polygonum*) occur.

Development of terrestrial fauna

The species diversity of terrestrial malakocoenosis (*Gastropoda*) is typical for flooded wetlands. Depending on the configuration of the surface and the physical parameters of soils the floods have devastating or less devastating effect on the structure of molluscs community. In the year 2011 there were 14 molluscs species recorded in the area, with the dominance of forest hygrophiles *Arianta arbustorum*, *Cepaea hortensis* and *Clausilia pumila*.

Development of aquatic communities of the Danube

This section of the Danube main flow at present is characteristic by relatively poor community of aquatic animals. Until 2002, the fauna of aquatic molluscs (*Mollusca*) was quite multifarious. The dominant species were *Ancylus fluviatilis*, *Lymnaea ovata*, *Bithynia* *tentaculata*, *Lithoglyphus naticoides*, *Potamogyrus antipodarum*, *Dreissena polymorpha* and *Sphaerium corneum*. Since 2002, a significant decline in abundance of molluscs is registered. In 2005, the first occurrence of invasive species *Theodoxus* fluviatilis has been recorded. Since 2008, this species, together with the species *Dreissena polymorpha* dominates.

Also the mayfly (*Ephemeroptera*) and caddisfly (*Trichoptera*) communities are very poor, their representatives are currently caught only occasionally (*Heptagenia sulphurea*). The ciliate community (*Ciliophora*) (microzoobenthos) retains its original character with low species diversity and relatively low abundance. This is mainly because of the gravelly bottom substrate, which does not provide favourable conditions for the development of microzoobenthos. The community is dominated by planktonic species (*Rimostrombidium humile, Coddonella Crater*).

Direct relation to the construction and operation of Gabčíkovo hydraulic structure cannot be demonstrated and other interactions, e.g. trophic factors cannot be excluded.

Development of aquatic communities of the river branch system

In the observed river arm relatively high number of water fly species (*Cladocera*) (54 species) and copepods (*Copepoda*) (34 species) occur. In the shallow river arm the dominance of tychoplanktonic phytophilous species continues, particularly the species *Simocephalus vetulus*, from among the pelagic species the *Bosmina longirostris* dominates. At high water levels on the Danube and the connection with the main stream also pelagic species of the genus *Daphnia* occur. From among the copepods the euplanktonic species *Thermocyclops oithonoides, Thermocyclops crasus, Cyclops vicinus* and *Eurytemora velox* dominate.

The population of mayfly (*Ephemeroptera*) and caddisfly (*Trichoptera*) communities is very poor and irregular in long run. The dominant species is *Cloeon dipterum*, the subdominant are *Caenis robusta*, *Caenis horaria*, and *Anabolia furcata*. In the individual years irregularly occur stagnicolous species, or species strongly bound to expanding macrophytes.

The dragonflies' community (Odonata) is relatively rich and in total 28 species were found on the area. Their frequency varies significantly from year to year depending on water levels and climatic situation. The dominant species were the blue-tailed damselfly (*Ischnura elegans*) and ruddy darter (*Sympetrum sanguineum*). The rich variety of species is formed by eurytopic, semireophillic species and species tolerant to drying up.

Occasional connection of river arms with the main flow of the Danube during floods ensures the revitalization of ichtyocoenosis. The species diversity from year to year fluctuates from 3-4 species to 10 species of fish. In total up to 19 fish species were recorded that got into the river arm during flooding the inundation at floods. Permanently recorded species were the goldfish (*Carasius auratus*) and weatherfish (*Misgurnus fossilis*), which belong to the endangered species. The ichtyocoenosis consists of other eurytopic and limnophilous species. A negative phenomenon is the occurrence of invasive species black bullhead (*Ameiurus melas*).

The species diversity and the abundance of ciliates (*Ciliophora*) (microzoobenthos) depend on the state of water levels in individual years. A rare species *Disematostoma buetschlii* has also been recorded.

In the community of amphibians (*Amphibia*) in 2011 was found 6 species of frogs, with a mass occurrence of marsh frog (*Rana ridibunda*), the green frog (*Rana esculenta*) and fire-bellied toad (*Bombina bombina*). The area is particularly suitable for the occurrence of amphibians.

Monitoring area No. 2617 – Starý les

Development of plant communities

The monitoring area is located in the inundation area of the Danube at Číčov (rkm 1799). In the monitoring area 122 taxa of vascular plants was found. The south end of Číčovské dead arm represents a habitat with stagnant water and wetland communities together with communities of open water areas and coastal marsh vegetation. In terms of conservation of natural habitats of water and marshy vegetation it represents a valuable site. From among the endangered and protected species the following species were recorded here: small-flowered wintercress (*Barbarea stricta*), fen ragwort (Senecio paludosus) and common meadow-rue (*Thalictrum flavum*). From among the invasive species the common ragweed (*Ambrosia artemisiifolia*), lance-leaved aster (*Aster lanceolatus*), New York aster (*Aster novi-belgii*), purple jewelweed (*Impatiens glandulifera*), smallflower jewelweed (*Impatiens parviflora*), giant goldenrod (*Solidago gigantea*) and annual fleabane (*Stenactis annua*) were found.

The development of average eco-values of plant community is shown in **Fig. 3.22**. Similarly as on the monitoring area No. 2612 there was a rise of the cumulative proportion of monitored indicative species in 1999. In subsequent years, the values have begun to decline, but they did not fall below the level of the period before damming. Graphical representation of the percentage of species with different water demands and requirements on groundwater level depth is shown in **Fig. 3.24** and **3.25**.

Similarly as on the area No. 2612 wide range of aquatic macrophytes was recorded on the monitoring site No. 2617. In the river arms with permanent hydroecophasis also a strong zonation of communities was observed. Populations of following species mostly cover the open water areas: giant duckweed (*Spirodela polyrhiza*), water chestnut (*Trapa natans*), floating fem (*Salvinia natans*) and yellow floating hearth (*Nymphoides peltata*). In the submerged layer most frequent is the hornwort (*Ceratophyllum demersum*), species of the watermilfoil genus (*Myriophyllum*), and the occurrence of various broad-leaved and narrow-leaved species of the pondweed genus (*Potamogeton*), crowfoot genus (*Batrachium*) and the invasive neophyte western waterweed (*Elodea nuttalii*). The progressively overgrown river arm is occupied by marshy plant communities (helophytes) with the domination of common reed stand (*Phragmites australis*), sedge (*Carex*) and species tolerant to periodically fluctuating water level (especially the association of great yellowcress and fine-leafed water dropwort (*Rorippa amphibiae-Oenantheum aquaticae*)).

Development of terrestrial fauna

The community of terrestrial molluscs (*Gastropoda*) in the area is stabilized with a high evenness. In 2011 it consisted of 12 species. In the community consistently dominate hygrophilous and polyhygrophilous species (*Carychium tridentatum, Carychium minimum, Succinea putra*). The moisture values vary on high level. This site represents a well-preserved softwood forest.

Development of aquatic communities of the river branch system

In the observed river arm 40 species of water fleas (*Cladocera*) were found. Similarly as in the monitoring area No. 2612 tychoplanktonic species prevail, mainly *Simocephalus vetulus* and *Chydorus sphaericus*. From among the pelagic species *Bosmina longirostris* dominated, less prevailing were *Daphnia galeata* and *Daphnia longispina*. In case of copepods (*Copepoda*) (overall 37 species), euplanktonic species dominate in long-term: *Thermocyclops oithonoides, Thermocyclops crassus, Cyclops vicinus, Eudiatomus gracilis* and *Acanthocyclops robustus*.

The number of species in the community of aquatic molluscs (*Mollusca*) ranged in individual years from 15 to 18. To the most abundant species, which were eudominant in some years, belonged *Physa fontinalis*, *Lymnaea stagnalis*, *Viviparus contectus*, *Anisus vorticulus*, *Planorbarius corneus* and *Bithynia tentaculata*. The occurrence of some rare species, with sporadic occurrence in the Danube region, has also been registered in the area: *Anisus vorticulus, Bithynia Leach, Physa fontinalis, Planorbis carinatus, Segmentina nitida* and *Gyraulus laevis*.

The inundation area and the river arms in the Danube section between the villages Sap and Klížska Nemá (rkm 1811-1790) are extremely valuable in terms of the occurrence of rare and endangered species. In the monitoring area No. 2612 the occurrence of the triangular club-rush (*Schoenoplectus triqueter*) has been reaffirmed at the beginning of 90's, which was missing in Slovakia. Stable occurrence in this area has the community of sharp club-rush (*Scirpetum radicantis*), which is the only known stand of this association in the inundation of the Danube.

Monitoring area No. 5512, Veľký Lél

Development of plant communities

The monitoring area is located on Danube island (rkm 1800.5-1802.5), which belongs to the Protected Landscape Area Danube floodplains. The area is part of the wetlands under the Ramsar Treaty. Within the island a floodplain forest occurs, with the highest degree of protection (Nature Reserve Zlatniansky luh). Area is usually flooded during high flow rates.

In the area 160 species of vascular plants were recorded during a floristic inventory in 2008. In the area 4 taxa protected by law has been confirmed: shining spurge (*Euphorbia lucida (syn. Tithymalus lucidus)*), water chestnut (*Trapa natans*), fen violet (*Viola stagnina*) and helleborine species (*Epipactis sp.*). In the category of rare and endangered species is 10 taxa, 6 of which vulnerable: common meadow-rue (*Thalictrum flavum*), summer snowflake (*Leucojum aestivum*), shining spurge (*Euphorbia lucida (syn. Tithymalus lucidus)*), water chestnut (*Trapa natans*), fen violet (*Viola stagnina*) and rough cockleburr (*Xanthium strumarium*). Nearly endangered are four species: spiny naiad (*Najas marina*), floating fem (*Salvinia natans*), water figwort (*Scrophularia umbrosa*) and strawberry clover (*Trifolium fragiferum*).

Trees are represented by 13 taxa, 3 of which are alochtonous, invasive. The most abundant is the native white poplar (*Populus alba*). Further occur: white willow (*Salix alba*), field maple (*Acer campestre*), narrow-leafed ash (*Fraxinus angustifolia*), pedunculate oak (*Quercus robur*), european white elm (*Ulmus laevis*), apple tree (*Malus domestica*), common pear (*Pyrus communis*), black mulberry (*Morus nigra*), common hackberry (*Celtis occidentalis*) and black walnut (*Juglans nigra*). Bushes are made up of 11 native species: common dogwood (*Cornus sanguinea*), common hawthorn (*Crataegus monogyna*), common spindle (*Euonymus europaea*), common privet (*Ligustrum vulgare*), blackthorn (*Prunus spinosa*), common buckthorn (*Rhamnus cathartica*) dog rose (*Rosa canina*), purple willow (*Salix purpurea*), almond-leaved willow (*Salix triandra*), elderberry (*Sambucus nigra*) and european cranberrybush (*Viburnum opulus*). From among creepers 3 species occur: hedge bindweed (*Calystegia sepium*), old man's beard (*Clematis vitalba*) and common hop (*Humulus lupulus*). The stand can be classified as oak-elm-ash forest (F*raxini-pannonicae-Ulmetum*) (Oberdorfer, 1953).

The water surface of the river arm is richly overgrown by submersible and floating hydrophytes, in the littoral helophyte stands occur, which smoothly continues on the banks of the river arm. The water depth in the river arm reaches 50-120 cm. In the open water area dominates the hornwort (*Ceratophyllum demersum*) and eurasian watermilfoil (*Myriophyllum spicatum*). Besides these also occur spiny naiad (*Najas marina*), whorled watermilfoil (*Myriophyllum verticillatum*) and curly-leaf pondweed (*Potamogeton crispus*). The water surface is continuously covered by the water chestnut (*Trapa natans*). Along the littoral zone and in some sections also on the whole surface abundantly occurs the floating fem (*Salvinia natans*), whose presence in particular years significantly affects the air and water temperature. In the littoral the slim sedge (*Carex gracilis*) prevails, closer to the open water are the common spikerush (*Eleocharis palustris*).

Development of terrestrial fauna

In the terrestrial malakocoenosis (*Gastropoda*) 14 species of molluscs was recorded in years 2008 and 2011. The dominant species are the hygrophilous forest snail *Arianta arbustorum* and eurytopic and mesohygrophilous forest species *Monachoides incarnatus* and *Alinda biplicata*. Their abundance is more than 60 % of the total abundance of the community. Other species ecologically also belongs mostly to eurytopic and mesohygrophilous forest species. Generally the community of terrestrial mollusc can be assessed as relatively natural and stable. It is characteristic for hygric, regularly flooded habitats.

Development of aquatic communities of the Danube

With the ichthyologic survey in 2008 7 fish species were recorded in the monitoring area. The identified species represents a typical ichtyofauna of the Danube , which is the most frequently registered in the littoral zone paved with quarry-stone. Dominant species was the common bleak (*Alburnus alburnus*) and the invasive round goby (*Neogobius melanostomus*).

From among the aquatic malakocoenosis (*Mollusca*) 6 molluscs species were found in the years 2010-2011: snails *Theodoxus fluviatilis, Lithoglyphus naticoides, Potamopyrgus antipodarum* and clams *Dreissena polymorpha, Unio tumidum* and *Corbicula fluminea*.

The mayfly (*Ephemeroptera*) and caddisfly (*Trichoptera*) communities are relatively poor in the observed section of the Danube. The reason is probably the gravel bottom, which is unstable in terms of their occurrence. In the years 2010-2011 from among the mayflies occurred the species *Procleon ornatum*, *Potamanthus luteus*, which belongs to the indigenous species of the main flow of the Danube, and the rare siberian species *Xantoperla apicalis*. From among the caddisflies the *Hydropsyche incognita* and *Brachycentrus subnubilus* species occurred. Similarly poor is the odonatocoenosis. The community water flies (*Cladocera*) was represented by 6 species in 2010: *Bosmina longirostris, Chydorus sphaericus, Pleuroxus aduncus, Pleuroxus denticulatus, Alona afinis* and *Alona guttata*. In the copepods community (*Copepoda*) only 2 species were recorded in years 2010-2011: *Acanthocyclops trajani* and *Ectinosoma abrau*.

Macrozoobenthos in the Danube was represented by 17 taxa, from which the earthworms (*Oligochaeta*) dominated. The most abundant species were *Nais elinguis* and *Nais bretscheri*. From among the amphipods (*Amphipoda*) the *Dikerogammarus bispinosus* was dominant. The pillbugs (*Isopoda*) were mainly represented by the species *Jaera istrii*. Also the microzoobenthos species diversity in the main flow of the Danube is relatively poor. In the spring of 2008, 9 species were registered, in the autumn only one species (*Holosticha pullaster*). In the year 2010, 5 species were recorded in the autumn, in the spring of 2011, 10 species. In the community omnivorous and bacteriovorous species dominated. The mentioned situation is typical also for other locations in the main flow of the Danube, what is related to the prevailing gravel substrate, which is not favourable for micro fauna development.

Development of aquatic communities of the river branch system

In the ichtyocoenosis of the river arm 14 fish species were recorded in 2008. Habitat suits both the limnophilous as well the rheophilous species. From among the limnophilous species the european weatherfish (*Misgurnus fossilis*), european bitterling (*Rhodeus sericeus amarus*) and northern pike (*Esox lucius*) were recorded, from the rheophilous species the common bleak (*Alburnus alburnus*), ide (*Leuciscus idus*) and freshwater bream (*Abramis brama*) occurred.

Aquatic molluscs (*Mollusca*) were represented by 5 species in 2011: the gastropod *Viviparus acerosus*, which had a mass occurrence, and *Lymnaea stagnalis* and clams *Anodonta cygnaea*, *Unio pictorum* and *Sinodonta woodiana*.

The mayfly (*Ephemeroptera*) and caddisfly (*Trichoptera*) communities were poor. Mayflies' species were represented by *Cloeon dipterum, Caenis horaria* and *Caenis robusta*, the caddisflies were represented by the species *Leptocerus tineiformis*. From among the water flies (*Cladocera*) 15 species were found in the river arm in 2008, 9 of which were in the medial, and 13 in the littoral zone. In both environments the species *Chydorus sphaericus* prevailed, in the littoral zone also the species *Scapholeberis mucronata*. The rich species diversity was also proved in the period 2010-2011, when 16 species were recorded. In the copepods community (*Copepoda*) a total of 17 species were recorded in the period of observation, which represents a relatively abundant species composition. The most stable species of the river arm were *Acanthocyclops einslei* and *Macrocyclops albidus*.

The monitoring area in terms of dragonflies' community (*Odonata*) represents a habitat with a variety of conditions. In dragonfly taxocoenosis 8 species were recorded in 2008. The semireophilous species white-legged damselfly (*Platycnemis pennipes*) was recorded here, the lenitic places are characterized by the occurrence of stagnophilous species: red-eyed damselfly (*Erythromma Najas*), common blue damselfly (*Enallagma cyathigerum*), scarse blue-tailed damselfly (*Ischnura pumilio*), broad-bodied chaser (*Libellula depressa*), and eurytopic species: black-tailed skimmer (*Orthetrum cancellatum*) and blue-tailed damselfly (*Ischnura elegans*). In the period of years 2010-2011, a total of 7 species were recorded, including downy emerald (*Cordulia aenea*).

Amphibians (*Amphibia*) are represented by 6 frog species: the fire-bellied toad (*Bombina bombina*), marsh frog (*Rana ridibunda*), agile frog (*Rana dalmatina*), moor frog (*Rana arvalis*), common toad (*Bufo bufo*) and european treefrog (*Hyla arborea*).

Macrozoobenthos in the river arm in 2008 was represented by 18 species, 17 of which were earthworms (*Oligochaeta*). Only one the *Limnomysis benedeni* species belonged to shrimp-like crustaceans (*Mysidacea*). In years 2010-2011, 13 species of earthworms (*Oligochaeta*) were recorded and one species *Asellus aquaticus* represented pillbugs (*Isopoda*). In the river arm extremely high species diversity of microzoobenthos was found. The ciliates (*Ciliophora*) were mainly represented by species *Loxophyllum meleagris, Monilicaryon monilatus* and *Zosterodasys transversa*.

The floristic and faunistic valuable site retains good conditions for the variety of multifarious species of biota.

3.7.2. Floodplain of the river Váh

Monitoring area No. 5513, Komárno - Apáli

The monitoring area is located in the inundation area at the confluence of the rivers Váh and Nitra, north of Komárno. In the observed area the National Wildlife Reserve Apáli is situated. The main subjects of protection are the softwood forests and the nesting places of rare species of waterfowl.

Development of plant communities

The total number of taxa of vascular plants, including aquatic, recorded during the floristic inventory in 2008 is 69. In the tree layer 11 tree taxa were found, they were mainly represented by the black poplar (*Populus nigra*), white poplar (*Populus alba*), white willow (*Salix alba*) and maple ash (*Acer negundo*). In the shrub layer occurred 6 taxa, mainly the elderberry (*Sambucus nigra*), common dogwood (*Cornus sanguinea*), the ordinary bird cherry (*Padus avium*), european cranberrybush (*Viburnum opulus*) and rejuvenating maple ash. From among creepers 3 taxa were present: old man's beard (*Clematis vitalba*), common hop (*Humulus lupulus*) and the alochtonous virginia creeper (*Parthenocissus quinquefolia*). From among herbs significant is the occurrence of rare species summer snowflake (*Leucojum aestivum*) in terrain depressions and along the shore of the river arm. Other species of lowland forest are the common chickweed (*Stellaria media*), ivyleaved speedwell (*Veronica hederifolia*), smallflower jewelweed (*Impatiens parviflora*), western jewelweed (*Impatiens noli-tangere*), common hemp nettle (*Galeopsis tetrahit*), rough bluegrass (*Poa trivialis*), spotted deadnettle (*Lamium maculatum*), stinging nettle (*Urtica dioica*), european dewberry (*Rubus caesius*), yellow iris (*Iris pseudacorus*), common bedstraw (*Galium aparine*), common marsh bedstraw (*Galium palustre*), marsh hedgenettle (*Stachys palustris*), reed canarygrass (*Phalaris arundinacea*), common reeds (*Phragmites australis*).

From among the aquatic plants in the river arm mostly the eurasian watermilfoil (*Myriophyllum spicatum*), hornwort (*Ceratophyllum demersum*) and yellow pond-lily (*Nuphar lutea*) occur. To the rare species, besides the yellow pond-lily (*Nuphar lutea*) and spiny naiad (*Najas marina*), also belongs the whorled watermilfoil (*Myriophyllum verticillatum*) and floating fem (*Salvinia natans*).

<u>Development of terrestrial fauna</u>

In the terrestrial molluscs community (*Gastropoda*) 13 mollusc species were found in 2008. The ecological structure of malakocoenosis is characterized by the dominance of hydrophilic forest species *Arianta arbustorum* and *Trichia hispida*, subdominant species is the eurytopic hygrophilous species *Cochlicopa lubrica*. During the research inventory in autumn 2008, 41 species were found in the wider vicinity of the area, what represents 63 % of all terrestrial species in the Slovak part of the Danube region. In 2011, 13 species were recorded again. The dominant species was again the hydrophilic species *Arianta arbustorum*, subdominant species were *Carychium minimum* and *Pseudotrichia rubiginosa*, what indicates good moisture conditions typical for flooded river plains.

<u>Development of aquatic communities</u>

In the monitoring area river arm of the river Váh is situated, where the old Nitra river flows. The ichtyocoenosis of the river arm consisted of a total 11 <u>fish</u> species. The high number of mostly limnophilous species was confirmed. Among the species there were also protected species the crucian carp (*Carassius carassius*) and european weatherfish (*Misgurnus fossilis*).

From among the <u>aquatic mollusc</u> community (*Mollusca*) 3 snail species were recorded in 2008: *Physa acuta, Bithynia tentaculata* and *Theodoxus fluviatilis*, and one species of clams: *Dreissena polymorpha*. In years 2010-2011, 3 snail species were also registered: *Bithynia tentaculata, Viviparus acerosus* and *Planorbarius corneus*, and one clam species: *Dreissena polymorpha*.

From among the <u>mayfly</u> community (*Ephemeroptera*) 5 species were found, with the dominance of *Caenis robusta*. In case of <u>caddisflies</u> (*Trichoptera*) one species of *Cyrnus flavidus* was recorded. Thanks to the year-round developed macrovegetation in the river arm a relatively diverse fauna of <u>water flies</u> (*Cladocera*) was observed. A total of 25 species were registered, in the medial zone there were 21 species and in the littoral 19 caddisfly species.

In both environments the pelagic species *Bosmina longirostris* dominated. The fauna of copepods (*Copepoda*) was represented by 15 species. Common species ordinary for the Danube catchment area occurred, but the rare and less frequent species *Thermocyclops dybowskii* was also found.

There are suitable conditions for dragonflies (*Odonata*), especially for species favouring locations with overheated water, tolerant to muddy substrate. The presence of submerged, emerged and amfibic macrophytes create good conditions for sheltering and breeding of dragonflies. In 2008, 12 species of dragonflies were recorded. In the monitoring area the semireophilous white legged damselfly (*Platycnemis pennipes*), and simultaneously the thermophilic scarlet dragonfly (*Crocothemis erythraea*), and the *Orthetrum albistylum* and *Orthetrum cancellatum* dragonfly species were found. In years 2010-2011, 8 dragonfly species were recorded, including the emperor dragonfly (*Anax imperator*). From the species diversity results that the area provides good habitat conditions for species with different ecological demands.

Amphibians (*Amphibia*) are represented by 6 frog species. The fire-bellied toad (*Bombina bombina*) and the marsh frog (*Rana ridibunda*) dominated. Other species were the common toad (*Bufo bufo*), green toad (*Bufo viridis*), moor frog (Rana arvalis) and the european treefrog (*Hyla arborea*).

From among the macrozoobenthos 22 species were recorded (earthworms (*Oligochaeta*), paddle-footed annelids (*Polychaeta*), shrimp-like crustaceans (*Mysidacea*), pillbugs (*Isopoda*), amphipods (*Amphipoda*)), with the dominance of earthworms (*Oligochaeta*). The shrimp-like crustaceans were represented by one species *Limnomysis benedeni*. The microzoobenthos community was characterized by high species diversity of ciliates (*Ciliophora*), without any significant dominance of recorded species. In 2008, 34 species were registered, in years 2010-2011, 39 species. Stable species composition of the ciliates community characterizes a stabilized river arm system.

3.7.3. Danube section Komárno - the mouth of the river Ipeľ

Two types of habitat represent the area. The first is the dry forest steppe habitat at Čenkov (areas No. 5514 and 5515). The second type is a typical river inundation (areas No. 5516, 5519 and 5520).

Monitoring areas No. 5514 a 5515, Čenkov

Development of plant communities

On the forest-steppe habitat type a total of 67 taxa of vascular plants were found. The tree community consists of 8 taxa, of which only 3 are autochthonous. From among the native species the most common is the white poplar (*Populus alba*). In shrub layer a total of 10 taxa were found, including 1 invasive. From among the creepers the old man's beard (*Clematis vitalba*) and the common hop (*Humulus lupulus*) were present. In the herb layer occurrence of 48 taxa of herbs and grasses was recorded. The most interesting finding in the area is the protected by law and critically endangered alkanet bugloss (*Alkana tinctoria*) - a taxon with sub Mediterranean extending with the northernmost occurrence at Čenkov.

Development of terrestrial fauna

This coenosis is from the malacologic point of view poor in species and structure, which is characteristic by occurrence of indicatively insignificant euryhygric forest species and eurytopic and euryoecious species of terrestrial molluscs (*Gastropoda*). In the year 2008, 10 species were found. From the coenological point of view it is one of the driest habitat type of the Danubian region. At the inventory a total of 34 species were identified in the area and its surroundings. These were mostly ecologically undemanding mesohygrophilous forest species (*Monachoides incarnatus, Cepaea hortensis, Cochlodina laminate, Petasina unidentata*), xerotolerant species (*Xerolenta accused, Cecilioides acicula, Truncatellina cylindrica, Cochlicopa lubricella*) or euryhygric species (e.g. *Euconulus fulvus*, *Deroceras sturanyi,* etc.). In the wider area relatively abundant population of rare steppe mollusc *Helicopsis striata* was registered, which is a typical native resident species of cold Pleistocene periods. Its presence indicates a high level of preservation of steppe and forest-steppe parts of the Čenkov surroundings. From the faunistic point of view it is worth to note the occurrence of steppe-calcific species *Granaria frumentum*.

Monitoring area No. 5516, Mužlianska sihoť

The monitoring area is located in the alluvium of the Danube near the village Mužla and Obid. The area is regularly flooded at high water levels.

Development of plant communities

In the area a total of 115 taxa of vascular plants were identified in the year 2008. In the tree layer 13 taxa of trees occur, 9 of which are autochthonous (indigenous), which were mostly represented with white willow (*Salix alba*), white poplar (*Populus alba*), black poplar (*Populus nigra*) and aspen poplar (*Populus tremula*). In the shrub layer 11 indigenous shrubs are present. The most frequent are the elderberry (*Sambucus nigra*), common dogwood (*Cornus sanguinea*), common hawthorn (*Crataegus monogyna*) and alder buckthorn (*Frangula alnus*). From among the creepers 4 taxa are present - 3 native common species and one alochtonous frost grape (*Vitis vulpina*). The herb layer mainly consists of stinging nettle (*Urtica dioica*) and common bedstraw (*Galium aparine*). There are also softwood floodplain forest moisture demanding species, for example: common marsh bedstraw (*Galium palustre*), fowl bluegrass (*Poa palustris*), reed canarygrass (*Phalaris arundinacea*), creeping bentgrass (*Agrostis stolonifera*), wild angelica (*Angelica sylvestris*), spiny plumeless thistle (*Carduus acanthoides*), slim sedge (*Carex gracilis*), yellow iris (*Iris pseudacorus*), spotted deadnettle (*Lamium maculatum*), water forget-me-not (*Myosotis palustris agg.*) and water chickweed (*Myosoton aquaticum*). The most valuable finding was the taxon of orchid family (*Orchidaceae*), the protected vulnerable helleborine species (*Epipactis muelleri*). In addition 4 rare and endangered species were registered, to which belong the spring snowflake (*Leucojum aestivum*) and european lily of the valley (*Convallaria majalis*). The vegetation can be classified into the association *Salici-Populetum*, alliance *Salicion albae*.

There is also a river arm on the monitoring area, which is in advanced stage of siltation. In 2008, there were 7 taxa of aquatic macrophytes registered. The common duckweed

(*Lemna minor*) and giant duckweed (*Spirodela polyrhiza*) dominated. In 2011, 14 taxa were registered, with the dominance of common duckweed (*Lemna minor*).

Development of terrestrial fauna

In the terrestrial molluscs community (*Gastropoda*) during the inventory on the monitoring area and its surroundings a total of 41 species were registered in the year 2008. From 17 species found on the monitoring area forest hydrophilic species - *Arianta arbustorum, Trichia hispida* and *Fruticicola fruticum* were the dominant species of the mollusc's community, which altogether created 60 % of the abundance of the community. Polyhygrophilous species were less abundant, but they were represented on the subdominant to recedent level (the *Pseudotrichia rubiginosa, Cochlicopa lubrica* and *Carychium minimum* mostly dominated). No remarkable species from the faunistic or ecosozological point of view were found. In years 2010-2011, 15 species were recorded, while the forest hydrophilic species *Arianta arbustorum*, and hygrophilic species *Carychium minimum* and *Cochlicopa lubrica* dominated again. The terrestrial molluscs community can be considered as typical for flooded wetlands of the association *Salici-Populetum*.

Development of aquatic communities in the Danube

In the ichtyocoenosis of the Danube in the monitored area, which is formed by a weir in the riverbed, 15 fish species were recorded in 2008. Mostly rheophilous species were registered. Besides the endangered balon's ruffe (*Gymnocephalus baloni*) also the european perch (*Zingel zingel*), grass carp (*Ctenopharyngodon idella*) and common carp (*Cyprinus carpio*) were registered. The dominant species were the common bleak (*Alburnus alburnus*) and the invasive round goby (*Neogobius melanostomus*).

From the aquatic malacofauna (*Mollusca*) only one snail species (*Theoduxus fluviatilis*) and one species of clam (*Dreissena polymorpha*) were recorded in 2008. In years 2010-2011 2 species snails *(Theodoxus fluviatilis* and *Lithoglyphus naticoides*) and 2 species of clams (*Dreissena polymorpha* and *Corbicula fluminea*) were recorded.

In the mayfly community (*Ephemeroptera*) the species *Proceum bifidum* and the rare *Potamanthus luteus* were recorded on the sandy-gravel substrate. The caddisflies species (*Trichoptera*) were represented by *Brachycentrus subnubilus, Hydropsyche bulgaroromanum* and *Hydropsyche contubernalis*. In the water flies community (*Cladocera*) a total of 11 species was recorded in the main flow, all of which occurred in the medial. In the littoral only 5 species of them were registered. Interesting was the occurrence of species *Daphnia galeata, Daphnia longispina* and *Daphnia cucullata* in the main stream, which proves the influence of side branches on the plankton in the main stream. The dominant species were *Bosmina longirostris* and *Daphnia galeata*. The copepods fauna (*Copepoda*) was relatively poor. In years 2008, 2010-2011 only 6 species were recorded, from among which just the species *Eurytemora velox* occurred constantly.

Macrozoobenthos in 2008 was represented by 9 species. The most abundant were amphipods (*Amphipoda*) with the species *Dikerogammarus bispinosus*. In years 2010-2011, 23 species were recorded, 10 species of which were earthworms (*Oligochaeta*) and 6 species amphipods (*Amphipoda*). Furthermore the paddle-footed annelids (*Polychaeta*), shrimp-like crustaceans (*Mysidacea*) and pillbugs (*Isopoda*) occurred. Microzoobenthos on the typical gravel-sandy substrate was represented with low, but balanced diversity and abundance of ciliates (*Ciliophora*).

Development of aquatic communities in the river arm

In the dragonfly taxocoenosis (*Odonata*) in side arm the thermophilic small red-eyed damselfly (*Erythromma viridulum*) was captured in 2008. In year 2011 the blue-tailed damselfly (*Ischnura elegans*) and the four-spotted chaser (*Libellula quadrimaculata*) were registered.

In the mayfly community (*Ephemeroptera*) the species of *Caenis robusta*, *Caenis horaria* and *Cloeon dipterum* were registered. From among caddisflies (*Trichoptera*) only one species *Mystacides longirostris*.

The amphibians (*Amphibia*) were represented by 6 species: the fire-bellied toad (*Bombina bombina*), european treefrog (*Hyla arborea*), moor frog (*Rana arvalis*), agile frog (*Rana dalmatina*), pool frog (*Rana lessonae*) and the marsh frog (*Rana ridibunda*).

Monitoring area No. 5519, Chľaba-Ipeľ

The monitoring area is located in the alluvium of the river Ipeľ upstream of the village Chľaba, about 4 km from the mouth of the river Ipeľ to the Danube. The monitoring area is formed of a strip of lowland forest on the right bank of the river Ipeľ.

Development of plant communities

In the frame of the inventory in 2008, 135 taxa of vascular plants were recorded on the area. The trees consisted of 15 taxa, 9 species of which were autochthonous and 6 alochtonous. The native tree species were represented by the lowland forest species as the white willow (*Salix alba*) and the european white elm (*Ulmus laevis*), as well as with mesophilic species - the field maple (*Acer campestre*) and common pear (*Pyrus communis*), and thermophilic species - tatarian maple (*Acer tataricum*) and turkey oak (*Quercus cerris*). The shrub layer was formed by 11 taxa. Among them occurred the species common buckthorn (*Ramnus cathartica*), common dogwood (*Cornus sanguinea*) and field maple (*Acer campestre*). From among the creepers 4 taxa were registered. The most valuable species was the protected helleborine species (*Epipactis muelleri*) of the orchid family (*Orchidaceae*). Macrophytes were monitored in the adjacent section of the Ipeľ riverbed. Since this is an eupotamon with permanent flow, the development of macrophytes is limited. In 2088, 6 species were recorded, among them the rare and endangered species brittle waternymph (*Najas minor*) and longleaf pondweed (*Potamogeton nodosus*).

Development of terrestrial fauna

In the community of terrestrial molluscs (*Gastropoda*) in the frame of inventory on the monitoring area and near surroundings a total of 40 species were recorded in 2008, 13 from these on the monitoring area. The dominant species was the species *Pseudotrichia rubiginosa*, subdominant species were hygrophilous *Cochlicopa lubrica* and *Carychium minimum*. In years 2010-2011, 11 species were confirmed, with the dominance of forest eurytopic species *Monachoides incarnatus, Alinda biplicata* and hygrophilous species *Succinea putris* and *Zonitoides nitidus*.

Monitoring area No. 5520, Chľaba-the mouth of the river Ipeľ

The monitoring area is located in the mouth of the river Ipeľ into the Danube, upstream of the confluence at the Chľaba.

Development of aquatic communities

The ichtyofauna in the mouth of the river Ipeľ in 2008 consisted of 14 fish species. High number of identified species indicates an area with very diverse habitats. Species living in organic sediments were registered such as the ukrainian brook lamprey (*Eudontomyzon Mariae*), typical limnophilous species such as the crucian carp (*Carassius carassius*), but also typical rheophilous species such as the common nase (*Chondrostoma nasus*) or the european chub (*Leuciscus cephalus*). In 2011 occurrence of 13 fish species was confirmed.

In the aquatic molluscs community (*Mollusca*) 12 species were recorded in 2008, 5 species of which were snails and 7 species were clams. The most frequent was the highly endangered species *Theodoxus danubialis*, further the species *Bithynia tentaculata* and *Dreissena polymorpha*. More sporadic were the species *Physa acuta, Unio crassus* and *Unio tumidus*.

The communities of mayflies (*Ephemeroptera*) and caddisflies (*Trichoptera*) were observed in the eupotamon of the river Ipeľ, where stagnant species occur as well - *Cloeon dipterum* and *Caenis luctuosa*. In the strong flow despite the pebbles and rocks overgrown by filamentous algae a number of rare rheophilous mayfly species occur: *Ephemera lineata*, *Procloeon ornatum* and *Electrogena affinis*. The total of 24 mayfly and caddisfly species were found. In the water flies community (*Cladocera*) 17 species were detected in the river Ipeľ, 15 species of which were littoral and only two species, *Bosmina longirostris* and *Daphnia cucullata* were pelagic. In the Danube in 2011, only 3 water fly species were registered: *Bosmina longirostris, Simocephalus vetulus* and *Chydorus sphaericus*. The copepod community (*Copepoda*) was relatively poor. A total of 8 copepod species were found.

In the community of dragonflies (*Odonata*) 8 species were recorded in 2008. In terms of the occurrence of dragonflies the lower section of the river Ipeľ represents a very interesting site, because there exists well-preserved community of rheophilous dragonfly species of the *Gomphus* and *Calopteryx* genus, with coenobitic species the river clubtail (*Gomphus flavip*es), and cenophilic species common club-tail (*Gomphus vulgatissimus*), banded demoiselle (*Calopteryx splendens*) and white-legged damselfly (*Platycnemis pennipes*). Accompanying eurytopic species were: the blue-tailed damselfly (*Ischnura elegans*) and black-tailed skimmer (*Orthetrum cancellatum*). Surprising was the occurrence of stagnophilous species red-eyed damselfly (*Erythromma najas*) and small red-eyed damselfly (*Erythromma viridulum*).

From the amphibians (*Amphibia*) 5 species were recorded at the area: the fire-bellied toad (*Bombina bombina*), green toad (*Bufo viridis*), european treefrog (*Hyla arborea*), edible frog (*Rana esculenta*) and the marsh frog (*Rana ridibunda*).

In the macrozoobenthos 14 species of earthworms (*Oligochaeta*) and one species of amphipods (*Amphipoda*) were recorded in the river Ipeľ. In the Danube 13 species of earthworms (*Oligochaeta*) and 2 species of amphipods (*Amphipoda*) were registered. From among the earthworms the species *Potamothrix moldaviensis* and *Potamothrix hammoniensis*, and species of *Limnodrilus* genus dominated, from the amphipods the species *Dikerogammarus bispinosus*. The river Ipeľ is very valuable site from the microzoobenthos point of view, with high organic content in the water and with high self-purification ability of the flow. In the year 2008, 30 species were recorded in the river Ipeľ, in years 2010-2011 up to 35 species of ciliates (*Ciliophora*). in the Danube 12 ciliate species (*Ciliophora*) were registered in years 2010-2011.

3.8. Nature conservation, flora and fauna

3.8.1 Hungarian side

In the area of the Danube section between Sap and Szob there are four areas, which are under the Natura 2000 network, denoted as ***Special Areas of Conservation:***

- *Börzsöny Mountains (HUDI20008),*
- *Alsó-Ipoly-völgy (Lower Ipel Valley) (HUDI20026),*
- *Pilis and Visegrád Mountains (HUDI20039),*
- *Danube and Danube floodplain (HUDI20034).*

Three areas are ***Special Protection Areas:***

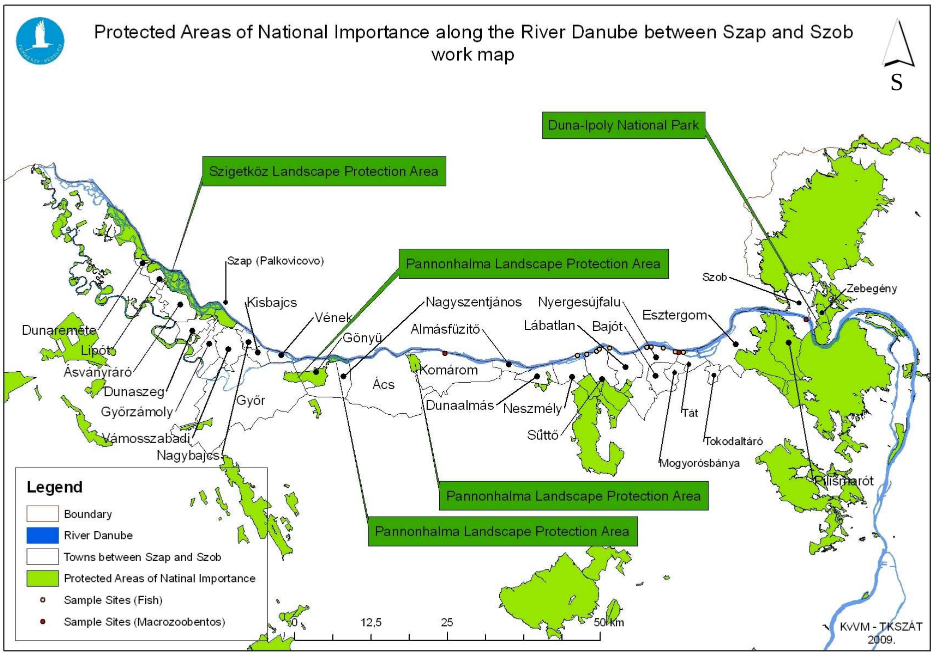
- *Börzsöny and Visegrád Mountains (HUDI10002),*
- *Gerecse Mountains (HUDI10003),*
- *Öreg Lake at the town of Tata (HUDI10006).*

The Danube section examined is bordered by four ***Special Areas of Conservation:***

- *Duna-Ipoly National Park,*
- *Herkályi Forest,*
- *Erebe Islands,*
- *Chalky-sandy plain of Kisalföld.*

The whole area of the Danube section examined is under the protection of the Natura 2000 nature conservation network. A Habitats Directive squarely determines that the main objective of the designation of Natura 2000 areas is not to hinder economic growth and to form closed reserves, where all human activities are forbidden. In the areas under Natura 2000 network, some defined activities of production may be practiced, if they can be harmonized with nature conservation. Conservation should exclusively be assured for those species and habitats, for which the area was designated. The majority of the natural and ecological values of the riverine areas are centred in the island and side-arm system of the river.

Fig. 3.26: Protected areas of Natural Importance along the River Danube between Sap and Szob



Source: Ministry for Environment and Water

There are 18 islands and side-arms in the Danube section between Sap and Szob, where the permitted land-use activities are dependent on their natural features. The forests of Nagy-Erebe-Macska Island and side-arm are strictly protected forest reserves, where no timber production exists. The habitats of the Szőnyi Island and side-arm are under protection, but it is not a protected forest reserve (the reassignment of the area should be taken into consideration). The right side of the side-arm is a popular recreation area for anglers, but this activity does not cause negative impacts on the flora and the fauna of the islands. The gravel bars near the Helemba Island have also significant natural value. The total area of Patkó Island is designated to be used exclusively for nature conservation activities. The area of the Monostori Island may be used for recreational activities, but for the protection of the water extracting wells in the central areas of the island the protection of the soil and the groundwater should be assured.

The Ramsar Convention on Wetlands of International Importance establishes international cooperation for the conservation and wise use of wetlands and their resources, with regard mainly to wetland habitats for water birds. The sandy area near Gönyű is one of the Ramsar areas.

The Danube section between Sap and Szob are in the territory of the Pannonhalma Protected Area and the Gerecse Protected Area, which areas are very rich in specific natural and landscape values. The main objective of the Protected Areas is to protect and conserve landscape and natural values of high importance. A huge black poplar tree (Populus nigra) situated in the Macska Island has special natural value. In the area of the side-arms – mainly at the eastern end of the islands – an important population of almond-leaved willow scrubs (Polygono hydropiperi-Salicetum triandrae) can be found. In the deeper, muddy areas of the *islands a huge population of willow groves (Leucojo aestivi-Salicetum albae) grow, which jungle-like population can be found in the western part of the Macska Island.*

An ecological assessment evaluating the flora, fauna and habitats of the Danube section between Sap and Szob[8] makes the following statements:

- *As elements of water quality, phytoplankton composition and biomass primarily indicate eutrophication. Assessment of water quality according to the Water Framework Directive (WFD) requires at least four sampling dates per year; one measurement is therefore non-conclusive for classification using phytoplankton. Both chlorophyll-a and phytoplankton biomass concentration remain at low levels and fall into water quality class I. in the Sap – Szob section.*
- *For assessment of the ecological status, a modular system was used consisting of an index for organic pollution and an index for general degradation. The assessment of the ecological status indicated “good ecological status” at 60% of the sites along the whole stretch of the Danube. In the Sap – Szob section, all of the sites were evaluated as “good”.*
- *A true classification of the biological integrity of the fish fauna in the Danube, or even the sample sites, cannot be made by using data from just one day’s sampling. However, based on the classification by European Fish Index (EFI) and Fish Index of Austria (FIA), a rough indication of the ecological status can be made. The fish assessment indicated “moderate ecological status” at most of the sites along the whole stretch of the Danube. In the Sap – Gönyű section 2 sites (Medvedov and Szob) were evaluated. The ecological status was “good” and “bad” at Medvedov and “good” and “moderate” at Szob according to the EFI and FIA respectively.*

3.8.2 Slovak side

Protection of habitats and species is defined by the Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora, which is transposed into the legislation of the Slovak Republic by act No. 543/2002 on nature and landscape protection. The main objective of this Directive is to contribute to ensuring the biodiversity by protection of natural habitats, wild fauna and flora in the territory of the Member State. The Slovak National list of proposed Sites of Community Importance (SCI) has been issued by the Ministry of Environment Decree No. 3/2004/5.1. of July 14, 2004.

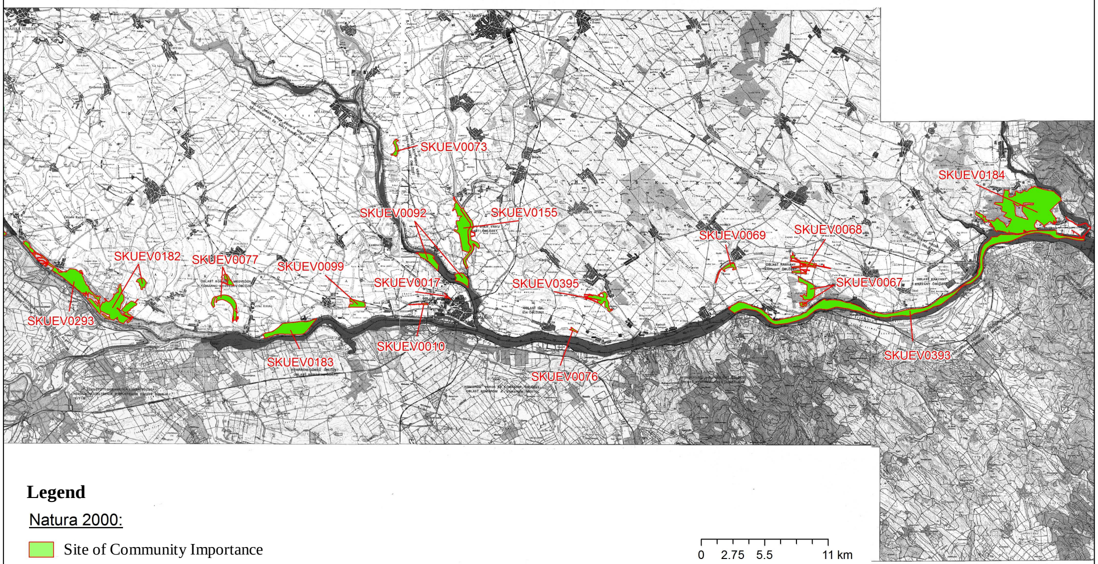
On the Slovak side of the Danube stretch between Sap and the mouth of the river Ipeľ is situated 15 territories within the Natura 2000 network, designated as Sites of Community Importance:

- Kľúčovské rameno *(Kľúčovské river arm)* (SKUEV0293),
- Číčovské luhy *(Číčov meadows)* (SKUEV0182),
- Dunajské trstiny *(Danubian reeds)* (SKUEV0077),
- Veľkolélsky ostrov *(Veľkolélsky island)* (SKUEV0183),
- Pavelské slanisko *(Pavelské saline soil)* (SKUEV0099),

[8] Guti Gábor, 2009. Ecological value and potential of the Danube section between Sap and Szob (r.km 1811-1708)”

- Komárňanské slanisko *(Komárňanské saline soil)* (SKUEV0010),
- Pri Orechovom rade (SKUEV0017),
- Dolnovážske luhy *(Meadows at lower section of the Váh river)* (SKUEV0092),
- Listové jazero *(Listové lake)* (SKUEV0073)
- Alúvium Starej Nitry *(Alluvium of the old Nitra river)* (SKUEV0155)
- Bokrošské slanisko *(Bokrošské saline soil)* (SKUEV0076),
- Búčske slanisko *(Búčske saline soil)* (SKUEV0069),
- Jurský Chlm (SKUEV0068),
- Čenkov (SKUEV0067),
- Dunaj *(The Danube)* (SKUEV0393),
- Burda (SKUEV0184).

Sites of Community Importance in the Danube stretch between Bratislava and Budapest on the Slovak side



The Council Directive 79/409/EEC on the conservation of wild birds transposed into the act. No. 543/2002 on nature and landscape protection requires Member States to determine, inter alia, on its territory a sufficient number of areas designated for the protection of selected species of birds, so called Bird Areas. Bird Areas are promulgated to maintain the favourable status of bird species population for which this area was declared.

In the Danube stretch between Sap and the mouth of the river Ipeľ, including tributaries, there are 3 Bird Areas.

- Dunajské luhy (Danubian meadows) (SKCHVU007),
- Dolné Považie (Lower Váh area) (SKCHVU005),
- Dolné Pohronie (Lower Hron Area) (SKCHVU004).

Protected Bird Area Danubian meadows stretches along the whole Danube section from Bratislava to the mouth of the river Ipeľ. In terms of national legislation the territory belongs to the protected landscape area of Danube floodplains, which consists of 11 National Nature Reserves, 42 Nature Reserves, 18 Natural Monuments, and 35 Protected Areas. It should be noted that not all areas are under the direct influence of the Danube water regime.

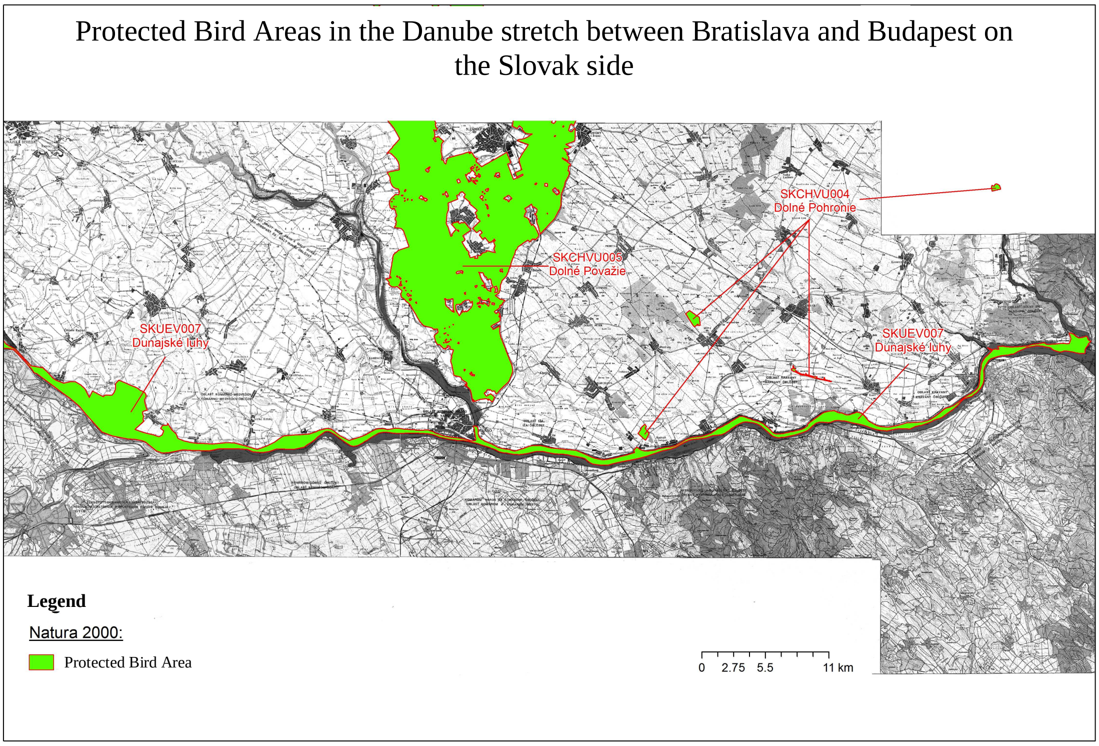


Fig. 3.28 Protected Bird Areas on the Slovak side

3.9. Environmental problems

3.9.1 Pollution of surface water

The organic pollution in surface waters can originate from natural or anthropogenic sources. Natural organic substances originate mainly from the decomposition processes of organic material and from soil runoff. The organic matter derived from anthropogenic sources is a product of various human activities, which enter the surface water by wastewater discharge. The organic pollution of surface waters is characterized through oxygen regime parameters, which are: the dissolved oxygen (O_2), the oxygen saturation (%), the biochemical oxygen demand (BOD_5) and the chemical oxygen demand (COD_{Cr}, $CHSK_{Mn}$).

The inorganic pollution in surface waters may also have a natural origin and is expressed mainly by increasing concentrations of mineral substances in the water runoff in the basin. Much more important, however, is the inorganic pollution, which has its origin in human activities. Such pollution can be represented by increased content of heavy metals, as well as ions of soluble salts (e.g. from application of winter sanding).

The impact of pollution on aquatic ecosystems can be detected by biological analysis of water status indicators - particularly macroinvertebrates.

The main sources of pollution are:

- diffuse sources,
- settlement agglomerations (towns and villages),
- Industry (industrial parks, manufacturing facilities),
- agriculture,
- linear sources of pollution (roads) and
- point sources of pollution (wastewater treatment plants, larges landfills, storages of industrial waste on the Hungarian side).

The pollution of surface waters is regulated by the following legislation:

- act No. 364/2004 on Waters, as amended by the act No. 384/2009 and its implementing regulations
- act No. 442/2002 on Public Water Supply and Sewerage, as amended by the act No. 276/2001 on regulation in network industries as amended by later regulations,
- act No. 245/2003 concerning the integrated pollution prevention and environmental pollution control, and amendment of certain acts.

A special issue is the pollution of surface waters by municipal wastewater. In the Danubian sub-basin 12 agglomerations above 2000 people equivalent were defined[9]. From among these 9 agglomeration, including Gabčíkovo, are situated in the examined Danube stretch. From the wastewater treatment data from 2005 results that in the agglomerations of the Danube sub-basin 76.7 % of wastewater is taken by canalisation and treated in wastewater treatment plants. About 12 % of wastewater is treated in individual systems and the rest of wastewater is not sufficiently taken by canalisation. Moreover, according to data from the Report on Water Management in 2005 about 49.5 % of the population in the Danube sub-basin is living in small municipalities with less than 2000 people equivalent. In the immediate vicinity of the Danube, or at the mouth of the rivers Váh, Hron and Ipeľ into the Danube, 23 villages with less than 2000 population equivalent are situated. These settlements are sources of diffuse pollution of surface and ground waters.

From the industrial sources of pollution only one major source of pollution in Štúrovo is situated in the examined Danube stretch.

An important aspect of surface water pollution is the pollution by nutrients. For the characterization of surface water pollution by nutrients indicators of total nitrogen and total phosphorus are used. The sources of nutrients are wastewaters from agglomerations and municipalities, waste water from industry - especially food and paper production, and last but not least the agriculture and forestry. The most significant impact of the high nutrient content is the water eutrophication, which can be formed under appropriate conditions (light, water

[9] The Danube Sub-basin Management Plan, Ministry of Environment of the Slovak Republic, December 2009

temperature, air temperature, wind, water transparency). In relation to the Danube surface water it should be noted that the nutrient content is not a limiting factor for eutrophication.

3.9.2 Hydromorphological changes

The most important hydromorphologic changes in the Danube section between Sap and Budapest are the changes caused by flood protection and river regulation for navigation purposes.

Also on this section the natural inundation area of the Danube was narrowed with the construction of flood control dams, although in a lesser extent than in the Danube section between Bratislava and Sap. When building flood control dams some river arms were cut off from the inundation area and at present they are located in the flood-protected area.

With the development of navigation it was necessary to ensure conditions for safe passage of ships. In practice this means marking out and maintaining the fairway with sufficient draught and width. In the Danube section downstream of Sap there is a sudden change of slope, what causes changes in velocity and evokes increased sedimentation. Fords emerged this way need to be dredged, what consequently has evoked changes further downstream. Besides constantly emerging gravelly fords, there are also some solid rock fords on the Danube section between Sap and Budapest.

The sufficient navigation depth and width of the fairway can be maintained only by concentration of water into the fairway by guiding structures. Concentration of water into the middle of the riverbed causes increasing flow velocity, what results in increased erosion of the riverbed. Erosion of the riverbed and dredging of fords leads to a gradual deepening of the riverbed causing the decrease of water level in the river. Decrease in water level and the effort to concentrate the water in the river led to gradual closing of river arms, especially in the upper estuaries. Some of the river arms on the Hungarian side downstream of Komárno were subsequently filled by industrial waste.

From an environmental point of view the above changes cause the disruption of the lateral connection between the river and its branches, river and its inundation, and induce morphological changes in the riverbed. The sinking of the riverbed and the associated decrease of water level in the river have resulted in a decline in groundwater levels, which leads to a gradual desiccation of wetlands.

From the hydrological point of view the narrowing of inundation led to an increase in the amplitude of water level fluctuation in the river and an increase of the number of high floods. The concentration of water in the riverbed leads to increased flow velocity.

3.10. Main driving forces influencing the environmental condition

The objective of this chapter is to identify the main driving forces and tendencies, which may influence the environmental and ecological status of the Danube area and, in addition, may determine the efficiency of the implementation of the proposed interventions and *measures. Those phenomena, correlations and tendencies are to be described by the exploration of the driving forces, which are outside the range of the local planning and organizational issues of the proposed interventions and measures.*

3.10.1 European and domestic efforts on the improvement of the navigability of the Danube

The improvement of the waterway between the North Sea and the Black Sea has been officially determined by the European Union as a development plan of significant importance: this is designated as Corridor VII of the Pan-European Transport network. ***Improving the conditions of navigability*** *and assuring the navigability conditions in certain periods of the year, and complying with the environmental regulations* ***are among the most important priorities of the EU Transport Policy.*** *The main objective of the European inland waterway transport policy, among others, is to establish the conditions for the minimum draught level (at least 2.50 m) in all sections.*

Intensive preparatory examinations are being conducted at the end of 2009, in order to improve the navigability of the whole navigable section of the Danube*. This project has been initiated by the EU and is supported from the financial sources of the Community. The main objective of these examinations is to assure the draught level specified or suggested by international arrangements of the planned variants, but there are also certain variants in which the narrower width of the waterway is determined by modern traffic regulation methods. An* ***EU guideline[10] is under elaboration for the consideration of the environmental and sustainability aspects of this planning project,*** *which is intended to be published by the end of 2009. In the framework of the Priority Project[11] co-financed by the EU a project was commenced in 2009 in Hungary bearing the title "Studies on the improvement of the navigability on the Danube" which deals with the possible methods of improving the navigability of the Danube section between Szob and the Southern state border. This project sets out the details up to the preparation level needed for the completion of the executive plans. It deals with the planning process and the Environmental Impacts Assessment (EIA) of the proposed interventions improving navigability and also includes the Strategic Environmental Assessment (SEA) of the assorted variants.*

The interventions proposed for the improvement of navigability may have negative impacts on the ecological status of the Danube. *In connection with the improvement of the inland navigation fairway in the Danube River Basin it is a key starting point to state that the whole* ***Hungarian Danube section has outstanding natural values*** *(for detailed information see Chapter 4.2.3.). The proposed interventions (in the whole Hungarian Danube section, not only between Sap and Szob) should be planned in such a way, that the natural values of the Danube catchment area should be protected. Therefore,* ***in the course of the planning process, the water traffic and transport policy of the EU regarding the Danube should be enforced circumspectly, by the making of a multicriterial balance of the different alternatives, and bearing in mind the environmental, economic and social aspects.***

[10] EU PLATINA Project (DG-TREN). Platform for the Implementation of NAIADES (www.naiades.info/platina)
[11] Improvement of the navigability on the Danube. TEN-T EA Priority Project 18,2007-HU-18090-S (www.tentea.ec.europa.eu)

3.10.2 Obligations under international treaties and conventions

To ensure the prospective development of transport on the Danube and the development of Danube fleet the **Danube Commission** in 1963 issued a **„Recommendation on the establishment of fairway parameters, hydrotechnical and other facilities on the Danube"**, where the following parameters of the fairway for the Slovak-Hungarian stretch of the Danube are in force:

Section	Depth (m)	Width (m)	Radius of curvature (m)
Section Devín (rkm1880) - Klížska Nemá (rkm 1790):			
free-flowing section	2,5	100	1000
impounded section	3,5	180	1000
Section Klížska Nemá (rkm 1790) – the mouth of the river Ipeľ (rkm 1708):			
free-flowing section	2,5	150	1000
impounded section	3,5	180	1000

The recommended fairway parameters were not possible to ensure by river-training structures, as also confirmed by the practice. The improvement of navigability on the Danube section between Bratislava and Budapest was completely solved in bilateral **Treaty on the construction and operation of the Gabčíkovo - Nagymaros Barrage System** (1977 Treaty). The navigability on the section Bratislava - Sap was resolved by building of the Gabčíkovo hydraulic structure. Putting the Gabčíkovo hydraulic structure into operation has ensured the smooth sailing throughout the year on this section, except the emergency situations such as floods or ice. Due to the rejection of the Hungarian Party to complete the Nagymaros hydraulic structure, there further exist obstacles to navigation on the Danube stretch between Sap (rkm 1811) and the mouth of the river Ipeľ (1708). The Danube Commission at its meeting in December 1992 noted the improvement of navigation conditions on the stretch Bratislava - Sap, and it asked Czechoslovakia and Hungary to propose a method for improving the navigation conditions also on the lower section between Sap and Budapest. Slovakia still considers as the most effective to build the Nagymaros hydraulic structure, what was the task of Hungary in the frame of the division of labour under the 1977 Treaty. If the Hungary selects another solution, it should ensure the parameters according to the Danube Commission recommendations.

The Danube stretch Sap - Budapest is currently in a state that the navigation conditions correspond to fairway parameters recommended by the Danube Commission only few days in a year, and navigation of vessels in this section during a large part of the year is limited.

Proposal 1.	*1) The interventions proposing the improvement of the navigability of the Danube should be harmonized within the framework of international and European agreements.* *2) The methods in order to assure, to improve and to maintain the conditions of sustainable inland navigation are under elaboration for the Danube Basin. These methods should be used during the realization process of the interventions improving navigability.* ***The principle of precaution should be considered, the interventions should be made gradually and should be divided into short, pilot sections.***

Note	The improvement of Danube navigability, as the most important corridor and the only passageway from east to west, must be such as to meet the basic requirement that ships travelling on the Danube with the draught of 2.5 meters must pass from the Danube-Main-Rhine channel to the mouth at the Black sea. Navigation does not make sense, unless in this stretch there will be a section that is not navigable at this draught. Such sections are just a few. It is mainly the section Vienna - Bratislava, the stretch Sap - Budapest, and the section downstream of Budapest. It is not ecological to move goods to railway or road in these sections of the Danube. It is not an interest of the Slovak Republic, neither the EU nor the other Danube countries to avoid traffic on the Danube.

The ecological impacts of the interventions improving navigability are closely connected to the dimensions of the waterway (depth, width). The national requirements for the parameters of the waterway are laid down by the 17/2002 (III. 7) Decree of the Ministry of Transport and Water. ***According to the opinion of the SEA Panel, the present Hungarian requirements regarding the parameters of the waterway are more stringent than the requirements suggested by the international agreement.***

Regarding the improvement of navigability as a motivating factor, the evaluation of the following ***two economic aspects*** *is also needed****:***

- *The proposed improvement of the conditions of navigability may result in savings on transporting costs, but a large element of these savings will be realized in other Member States and third countries, which also use the waterway.* ***Thus, it is important to achieve that an important portion of the investment, environmental and maintenance costs will be covered by the EU or shared, according to rate of use, among those countries that benefit from the waterway.*** *This idea is justified by the fact that the incision of the Danube riverbed and the deterioration of the navigability and ecological status are generated mainly by the barrages and reservoirs built in the upper catchment areas of the Danube, by decreasing the sediment transport of the river.*

  The opinion of the Slovak Party is explained in more detail in the background paper entitled „Position of the Slovak party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest". On the incision of the riverbed has a primary influence its slope (gradient), which has doubled in a number of Danube sections, further also the concentration of water into one straightened channel, thus the substantially increased velocity of water flow, and even more increased the transport capacity of the flow of the water. The principal hydraulic anti-erosion measure in this case is the slowdown of the flow by reducing the hydraulic gradient. Dams prevent the transport of gravel. The gravel filling downstream of the Freudenau hydraulic structure without slowing down the flow of water did not prevented the incision of the Danube riverbed.

  The Slovak experts are of the opinion that the benefits are not only lower costs on transport, but particularly for the Slovak Republic the partial unburdening of road network from the transport from east to west, and a general reduction of CO_2 emissions. Of course, on the other hand, it will reduce the profits from road toll and the state tax on fuel.

- *The* ***macro-economic importance*** *of the increasing demand for Danube waterway transport* ***in Hungary*** *is uncertain. The relationship between the expected composition of inland waterway transport and the national priorities for the improvement of the national* *economy has not been properly determined and there is no available information regarding the impacts of Danube waterway transport on domestic employment and competitiveness. It may be expected that the improvement of navigability will not have significant impacts on the national economy of Hungary. The economic analysis will be significantly important in such cases, where inland waterway transport may be used as an alternative method in the place of road transport.*

Proposal 2.	*The present and future demand for waterway transport should be evaluated at national and international level, the impacts of waterway transport on employment, competitiveness and regional cohesion processes should be explored. These investigations should be extended for other transport methods, as well.*

Note	The Slovak experts are of the opinion that until there exists one place on the Danube, which does not meet the conditions of navigation depth of 2.5 m, to that time there cannot be a demand for goods transport on the Danube waterway. It is not imaginable that ships passing the Danube-Main-Rhine channel, and entering the Danube, could not count on smooth navigation to Bratislava, Budapest and further to the mouth at the Black Sea for almost half of the year.

3.10.3 Local efforts on the land-use issue in the area of side arms

***Most of the settlements** situated along the Danube section between Sap and Szob **consider the improvement of navigability and water sports as local development possibilities.** The unilateral, exclusively tourism-centred development of the areas along the riverbank may lead to several environmental impacts. The reconstruction of ports, the development of the infrastructure of services and the organization of special touristic programmes in the riverbank area may lead to the increase of communal waste and wastewater. Developments of the touristic infrastructure will involve the development of the road system leading to the tourist attractions, which may increase the traffic burden. The motorised water sports may cause direct environmental damage, and ultimately, the contamination of the water of the main river branch and the side-arms of the Danube may discourage the tourists.*

***It is important that the local plans for land use, regarding the floodplains in particular, should emphasize the importance of environment-friendly farming methods and the development of new conditions for floodplain farming,** reconstruction of the natural flora of catchment areas and floodplains, and the re-connection of natural floodplains. In addition to the evident ecological advantages, by these measures the flood danger of the lower sections and the extreme flow regimes can be reduced, thus, environmentally friendly land use may contribute to protection against flood and summer droughts.*

Proposal 3.	*In the course of the authorization process of the local plans for land use and the environmental authorization of touristic and infrastructural developments the following aspects should be taken into consideration:* *a) the manifestation of the ecological self-regulating mechanisms should be considered.* *b) in the course of forestation the native species should be preferred, and the existing natural forests and woodland should be protected.*

It is also important to create a balance between the interests of local governments and the entrepreneurs to assure environmentally friendly, nature conserving development methods (for example ecological, rural and bicyclist tourism) of the areas along the riverbank.

3.10.4 Other important driving forces

*Another important factor is the **bed incision process of the Hungarian Danube section,** which reduces the low flow water levels. The main reason for this process is that the sediment is not carried towards Hungary by the Danube, which is caused by the barrages along the upper sections of the Danube. These barrages block a significant amount of the bed load transport. This deficiency is compensated from the riverbed in the section downstream of Gabčíkovo, which has caused continuous incision of the riverbed. As a result of the bed incision, the degradation process of the side-arms has increased and the groundwater level has decreased, which has resulted in adverse conditions for the bank filtered drinking water wells, and also those ecosystems whose existence depends on the groundwater level (for example the forests at Gönyű). In order to abate these adverse processes some technical interventions should be put in place even if the interventions regarding the improvement of navigability will not be implemented.*

The opinion of the Slovak Party on processes of incision of the Danube riverbed is presented in background paper of the Slovak Party, entitled „Position of the Slovak party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest" and in the above text. Bsic technical intervention is the reduction of transport ability of the river. Removal of all dams would not provide any improvement in navigation or erosion-sedimentation processes. Navigation conditions on the Danube downstream of Gabčíkovo hydraulic structure are primarily affected by the situation downstream of Bratislava, where since Mindel (geological era of the creation of the Danube river about 400,000 years ago) a huge alluvial cone was created, filled with fluvial sandy gravels of the Danube. Its maximum depth is from 20 to 400 m, and its width ranges from about Mosoni Danube to Little Danube. It is obvious, that by changing of ice and interglacial periods tremendous changes happened in the drifting abilities and transporting of gravel. The transport of gravels persists to present days, but their quantity decreased significantly after the construction of dams in the Austrian and German sections of the Danube. This geologically conditioned alluvial cone ends at Klížska Nemá. Till making the Danube navigable (adjustment of the Danube for navigation, including its straightening downstream of Bratislava) the river meandered on alluvial cone and imposed its sandy-gravelly deposits. These coarser sediments practically end at Klížska Nemá area. The territory of alluvial cone is also a territory with geological processes of bending and tectonic subsidence. Downstream of the alluvial cone was a geological barrier (seen as rocky fords at present) and upstream there were sedimentation basins of the rivers from Carpathian Mountains. This barrier and river sediments (especially of the river Váh) caused that there was significantly smaller slope at the end of the alluvial cone. In the Holocene (the last app. 12,000 years), it seems that everything is in a balance (the climate, sea level, flow rates in rivers, river slopes, riverbed incision, meanders and everything else). However, the opposite is true. The Danube in Holocene is unstable even without the interference of human activities. During the period of the first half of Holocene the sea level has raised by over 120 m, there were drought and floods. And to this situation a new factor has entered during the last 1000 years - a man. During the past 100 years the man has built up the flood levees, straightened the Danube riverbed on alluvial cone, adjusted the riverbed for navigation. However, most of all he bound the flood flows, pouring over almost 40 km wide alluvial cone, into the present inundation between the dykes, while flood flows remained practically unchanged. Basically, by the river straightening the section between the rocky fords (at Bratislava, and at Štúrovo) has shortened, gradient of the river increased, the water was concentrated into a single riverbed and this was adjusted by groynes, what significantly increased the transport ability of river.

These earlier interventions caused various problems. In particular, in the whole stretch of the Danube erosion-sedimentation relationships has changed, in terms of navigation the problem of ford creation arisen, new situation also arisen in flood protection and the like. Today's navigation conditions on the Danube section Sap - mouth of the river Ipeľ are influenced mostly by incompleted Gabčíkovo - Nagymaros Hydropower Project and further are influenced mainly by „solid fords" (Klížska Nemá - Gönyű rkm 1788-1790; Nyergesújfalu rkm 1732-1735; Štúrovo - Esztergom rkm 1721-1729; Chľaba (Helemba) rkm 1711) (**Fig. 3.29**), which were created in this area during long geological periods. The solid ford at Klížska Nemá - Gönyű results from a significant reduction of the slope of bottom. Other three solid fords are formed by „hard rock bottom". These „solid fords" have a decisive influence on morphological evolution of longitudinal profile of the Danube riverbed - predetermine the development of longitudinal profile of the Danube, and divide the Danube into subsections with different characteristics (slope changes and dynamics of flow), while the morphological development of the riverbed has been formed just on these subsections. Solid fords hinder the navigation and due to the fact that they are made up of hard sediments (in some cases also by bedrock) their removal would be technically and economically very difficult.

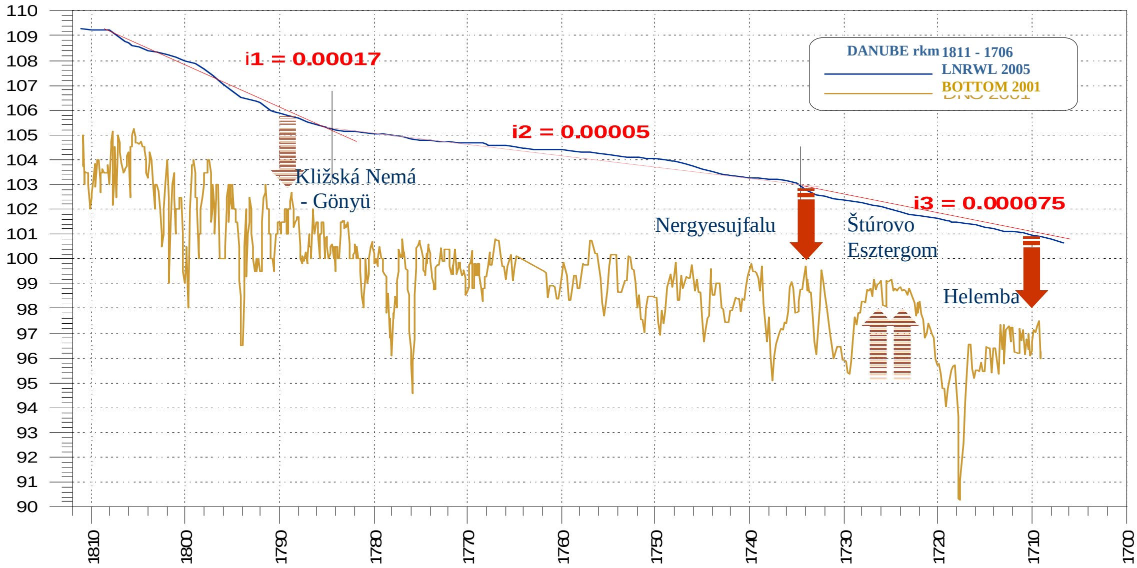


Fig. 3.29 Longitudinal profile of the Danube riverbed in the stretch Sap - mouth of the river Ipeľ and gradients of LNRWL´95[12] (low navigation and regulation water level)

[12] Holubová, Capeková, Lukáč, 2006: Evaluation of impacts of realized adjustments of the Danube on the current state and the development of riverbed in relation to changes of water regime, VÚVH Bratislava, december 2006

Besides the solid fords, in sections between them unstable ford areas „moving Fords" are formed, that develops according to the dynamics of flow (floods) and sediment transport. Moving fords represent an obstacle to the navigation, but the navigation conditions can be maintained by dredging and other river-training measures (groynes). In terms of navigation the most critical area are the „solid fords". Successful and long-term solution of navigation conditions on the Danube in the area Sap - the mouth of the river Ipeľ must provide the required navigation conditions just right on these critical sections.

The adjustments of the Danube riverbed in the area downstream of Sap influences the river processes - flow conditions and sediment transport, what consequently affects the navigation conditions and flood protection. Due to the deficit of sediments caused by the construction of dams on the upper (German and Austrian) stretch of the Danube, significant changes in riverbed morphology goes on in the Danube riverbed (erosion/silting), which adversely affect the navigation conditions. Therefore, in regard to the provision of navigation conditions many adjusting measures were implemented in the Danube riverbed: dredging (due to navigation), guiding structures, construction of new and reconstruction of existing groynes, adjustment of riverbank fortification, etc. Although the purpose of these measures was different, the most extensive adjustments of the riverbed (dredging, groynes, guiding structures) were carried out for the needs of the required navigation conditions.

<u>Groynes systems</u> were built in the area (rkm 1810-1793) where the most significant erosion exists today, because the projected modifications, that have had achieve stable bottom in the long term (the most significant degradation of bottom), were not carried out. Under their influence is the water concentrated into the narrowed active part of the riverbed at low water levels, what improves navigation conditions.

On the other hand, the flow conditions modified by groynes contribute to an increased flow velocity and erosion, increased sediment transport and deepening in the narrowed part of the riverbed, while the area upstream and between groynes is silted. Increased transport of bed load material from the area of groynes is negatively reflected in the section downstream of groynes systems, where it is deposited and thus aggravates the navigation conditions. Groynes situated in the area with higher slope together with sediment deficit has negative impact on the water level - decline of the low navigation and regulation water level LNRWL"95 (**Fig. 3.30**) and a decrease of this level reduces their effectiveness in relation to the navigation. If there were no sediment deficit, it would be even worse. Reduced effectiveness of groynes necessitates the reconstruction of existing and construction of new groynes systems. This process is shifted in time along the flow direction. Therefore, the further construction of groynes in this section of the Danube is inefficient and contributes to further erosive-sedimentation imbalance in the riverbed shifted downstream, to riverbed degradation and degradation of navigation conditions in the section downstream the groynes systems. In other words, due to non-completion of the projected riverbed adjustments and the impoundment form the Nagymaros hydraulic structure, forced changes of natural hydraulic conditions occur at present in the relevant section. In this section, however, long ago, at least since the beginning of adjustments of the Danube for navigation, these processes are not natural. Groynes do not even contribute to groundwater quality at bank-filtered well systems.

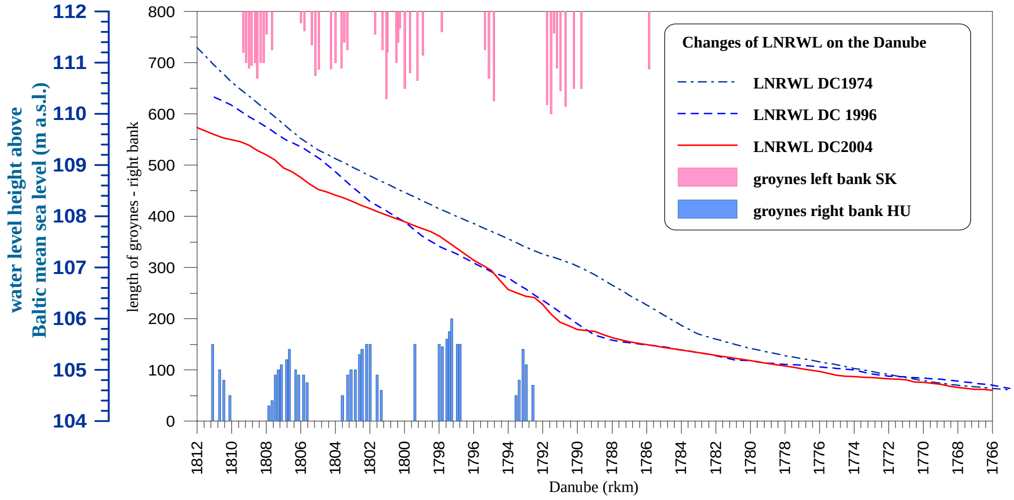


Fig. 3.30 System of groynes in the Danube riverbed in the area downstream of Sap[12]

<u>The dredging of bottom material</u> is another important intervention in the morphological development of the riverbed, because it promotes the degradation of the bottom. The use of the term „degradation" without its definition, is misleading in this case. The dredging once affects the stability of the bottom positively, at another time negatively. The dredging is an adjustment process that is carried out in advance and with certain purpose defined by the goal. The Danube is excavated with the aim to ensure the navigation conditions. From the analysis of excavated volumes of bottom material in particular sections of the Danube in the period from 1992 to 2007 (**Fig. 3.31**) it is evident, that the largest amount of material was excavated in the area of rkm 1790 - Klížska Nemá. This is a stretch of the Danube, where the significant change of the in bottom slope takes place (the slope changes from id=0.00017 to id=0.00005), and end the groynes systems, because of what the bed load are deposited here in high volumes, and creates bars that are obstacles to navigation. Therefore, this area requires constant riverbed maintenance (removal of silting by dredging). This situation would be even worse without the Gabčíkovo hydraulic structure, and there would be much more deposits.

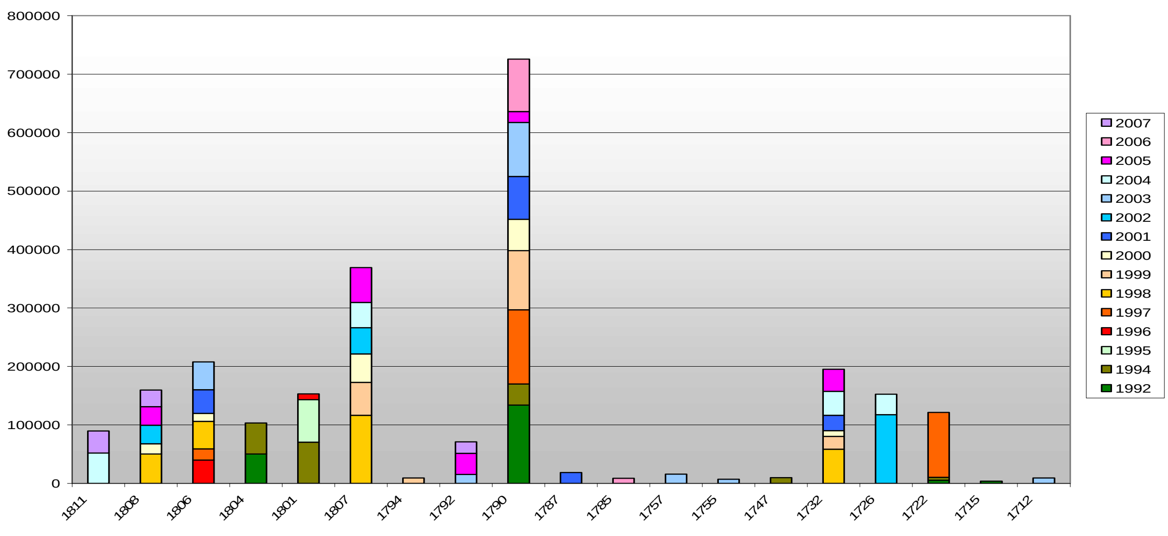


Fig. 3.31 Dredged quantities (m^3) in particular Danube sections in given period[12]

From the **Fig. 3.31** it is evident, that besides the area where the significant change in slope of the Danube bottom takes place (around rkm 1790), the largest quantities of bed load material were excavated in the area with the most significant erosion of the bottom (rkm 1811-1807). Dredging in this area also contributes significantly to the progressive deepening of the bottom. However, it should be stressed that just right in this area, the dredging should not be performed at all, regarding the high dynamics of morphological changes and continuous degradation of the bottom. In **Fig. 3:32** the volume of excavated material in the period 1992-2007 is presented. Until no comprehensive solution will be taken, for example the implementation of the Joint Contractual Plan, the dredging and riverbed adjustments will be continuously needed because of the maintenance of navigation conditions.

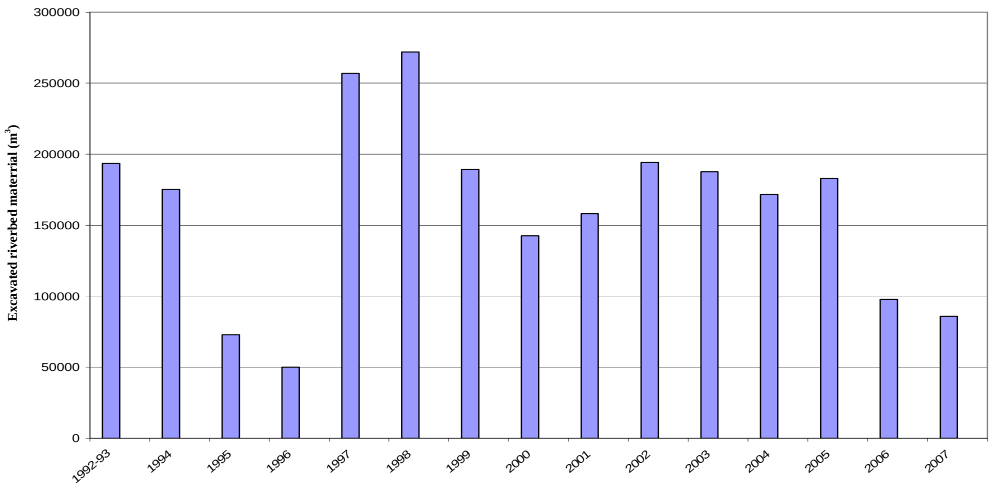


Fig. 3.32 The volume of excavated riverbed material in the period 1992-2007

The problem of climate change also means an important long-term motivating factor. *According to certain estimations the low flow water discharges of the Danube may decrease by 15-30% compared to the present level by the period between 2025 and 2030.*

The impact of climate change is mainly reflected in an increase in temperature, thereby in shifting the snow and ice melting in the Alps from the summer towards spring. In addition an increase of extreme weather events such as drought and torrential rains are expected. The distribution of precipitation and evaporation within the year will change as well.

4. ANTICIPATED SIGNIFICANT IMPACTS OF THE PROPOSED INTERVENTIONS AND MEASURES ON THE ENVIRONMENT AND SUSTAINABILITY

4.1. The direct and indirect environmental impacts of the proposed interventions and measures on the status of surface and groundwaters

The status of surface and groundwaters are defined and discussed by the definitions and methodology used in the Water Framework Directive. *According to the Framework Directive:*

- *the good status of surface waters should be achieved by the good chemical and good ecological status,*
- *the good status of groundwaters should be achieved by the good quantitative status and good chemical status.*

The good quantitative status and hydro-morphological conditions of surface waters should also be ensured; however, they are not determined by the above definition, because the ecological status of natural waters can be good only if their quantitative status and hydro-morphological status are also good.

4.1.1. Impacts on ecological and chemical status of surface waters

Based on the evaluation of the status of surface water bodies in Slovakia[13], it can be stated that in the stretch of the Danube between Sap and the mouth of river Ipeľ the **ecological status** was rated as **average**. As the reason of this status is generally referred mainly the existence of dams and reservoirs on the upper section of the river, and the dredging due to ensuring the flood protection and the maintenance the navigation conditions. The result is a continuous progressive decrease of the bottom of the Danube riverbed (**Fig. 3.7**). In connection to this decreases also the water level in the Danube (**Fig. 3.4, 3.5**). *These two processes may deteriorate the navigability of the river and they cause significant damage in the ecological status of the main branch and its connected wetland habitats, the side-arms and the islands. In addition to the processes mentioned above the decreasing of the groundwater level resulting from the deepening of the riverbed may adversely influence the natural conditions of the water-connected ecosystems* (**Fig. 3.11, 3.12**)*. This basically means the degradation of communities (such as changes in biodiversity, the repression and extermination of the native species of flowing water courses and floodplain habitats and the appearance of invasive species).* Similar evaluation of ecological status also applies in case of the lower sections of major tributaries (rivers Váh, Hron, Ipeľ) in this stretch of the Danube.

[13] Makovinská a kol., 2009: Evaluation of the status of surface water bodies in Slovakia in years 2007-2008. Final report, Bratislava, December 2009.

At evaluation of the chemical status of the Danube stretch between Sap and the mouth of river Ipeľ it can be stated that **the water in the Danube** on the whole stretch **achieves a good status**. Good status has been achieved also in the case of major tributaries, except **the lower section of the river Váh, where the good status was not achieved** due to exceeding the limit concentrations of mercury and its compounds and bis(2-ethylhexyl)-phthalate (DEHP).

Based on the requirements of the WFD for improvement of the ecological status of the river certain measures for mitigation and/or stopping of environmental damages need to be taken. According to the opinion of the Hungarian Party *„certain ecological interventions should be carried out in compliance with the requirements of the WFD, even if the interventions for the improvement of navigability were not to be realized. The proposed interventions for the improvement of navigability should not generate harmful changes in the state of the environment.*[14] *The fact that ecological status was taken into consideration during the planning process of the interventions improving navigability, should be demonstrated by the execution of the 4.7 test of the WFD."*

The Slovak Party is of the opinion that environmental interventions implemented to meet the requirements of the WFD cannot be done independently on the interventions for navigability improvement. Questionable is also the resultant effect of such interventions. According to the Slovak Party the problems of this stretch of the Danube must be addressed **in a comprehensive and integrated manner**, and the result should be the stabilization of the riverbed and an increase of water level in the river. It is obvious that interventions in any case must not worsen the flood protection of adjacent areas.

- *Interventions in side arms*

According to the Hungarian Party, the environmental damages resulting from interventions in the main riverbed should be solved by rehabilitation of side arms and islands. The Hungarian Party plans the rehabilitation of side arms by opening of upper closures of side arms to the level of DB 2004 and by deepening of arms by dredging.

The Slovak Party is of the opinion that the river arms, which were filled with industrial or other waste must be thoroughly cleaned down to the gravel subsoil. In case that contaminated gravel would be removed from the arms, it is necessary to replace the dredged contaminated material with river gravel. This is particularly relevant in areas with operating or prospective drinking water sources with bank filtration. The Slovak Party does not agree that the side arms should be deepened by dredging in order to achieve greater water depths. Opening of side arms and their deepening will result in a decrease in surface water level in the Danube and in the side arms as well as a decrease of ground water in riverine areas.

Further decrease of surface water level is to be expected with continuing degradation of the riverbed. As stated also by the Hungarian Party, constant works can be expected on Danube riverbed maintenance, maintenance of fairway, as well as dredging of ford sections.

[14] *Hungarian National Council on the Environment: Standpoint on the proposals regarding the improvement of the navigation in the Hungarian Danube section. November, 2009.*

In terms of environmental status on the affected stretch of the Danube, the Slovak Party regards the renewal and the restoration of flow in branches as positive benefit.

Proposal 14.	*In the course of the environmental authorization process of the proposed interventions, it should be required that the interventions and measures for improving the navigability **should be realized in parallel** to the interventions related to the prevention, dissolving or the decreasing of the adverse ecological impacts of the proposed interventions.*

- *Interventions in the main river branch*

In relation to the ecological status of the Danube main riverbed, the Hungarian Party states that *„the interventions planned for improving the waterway will possibly have negative impacts on the eupotamon-like habitats and their ecosystems in the main river branch. The proposed interventions may change the composition of the phyto- and zooplankton and the composition of fish populations typical for flowing watercourses. The share of meso-eutrophic and eutrophic species may increase in the phytoplankton and the introduction and the extension of invasive species may also be increased.*[15] *The dredging of the main branch may result in the degradation of spawning areas and change in the conditions of reproduction."* Also the eventual refilling of material in the main riverbed can change habitats and the diversity of ecosystems typical for this stretch of the Danube.

The Slovak party agrees with the Statement of the Hungarian Party *that „the proposed interventions for the improvement of the waterway will cause significant disturbance (with considerable spatial extent) for the water ecosystems. In the case of disturbances concentrated in the main branch, the rehabilitated side-arms in neighbouring areas of the shallow fords may be functioning as a „sheltering site" or „escape route" for the species disturbed. The time period for the interventions may be between 3 and 5 years, but in certain areas it may continue for 25 years with interventions undertaken twice-yearly.*[16] *The proposed interventions will cause a medium/permanent disturbance in terms of the time element for the ecological systems during the period of interventions."*

The Slovak Party is therefore of the opinion that the impoundment of water level with continuous operation, as envisaged in the original project, will cause less damages and more contributes to solving of environmental problems of the Danube between Sap and Budapest.

In terms of the impact of proposed variants on ecological and chemical status the Slovak Party supposes the following:

1. Preservation of the present state

   Since this concerns the preservation of the present state, it can be assumed that the interventions made in the interest of maintenance of the riverbed, or for maintaining the current (inconvenient) navigation conditions in the present extent, will not affect either the ecological or chemical status of water bodies, potentially this impact will be similar to the existing one, i.e. moderate. This assumption can be expected on the

[15] VITUKI.: Study to the project entitled: „Improvement of the Navigability of the Danube" September, 2007., Chapter 7.11. 4.. 214. p.

[16] VITUKI.: Study to the project entitled: "Improvement of the Navigability of the Danube" September, 2007. Chapter 7.2.2, 190. p.

whole examined section of the Danube. During these interventions temporary degradation of the chemical and ecological status on the influenced sections of the Danube can be expected. While preserving the present state it is very unlikely that the improvement of ecological status will happen. Existing arms will remain cut-off from the main branch and they will be gradually silted. In side arms a gradual deterioration can be expected comparing to the present ecological status.

2. VITUKI Base - 1

The Slovak Party agrees with the assessment of the Hungarian Party, which states that during the process of construction the material of the riverbed may be disturbed and may cause a periodic deterioration of water quality, but its extent will not be so great as to need intervention. In terms of the ecological status the proposed interventions in the riverbed and banks may have negative impacts on the ecological status of the river and consequently on the adjacent parts of groundwater. From the long term point of view the Slovak Party expects a gradual deterioration of ecological status compared with the present days, like in the variant with the preservation of the present state.

The Hungarian Party, in case of all variants it proposed, considers the same interventions in the side arms - opening of upper closures of side arms, deepening of side arms by dredging. From the rehabilitation of side arms the Hungarian Party expects the restoration of supply of side arms habitats with water, the improvement of sustainability and biological activity. Further improvement of water quality in the side arms, prevention of sediment deposition and improvement of wintering conditions for different types of fish.

At this variant the Slovak Party expects, that due to the removal of existing waste deposits or fine sediments with high organic matter, improvement of ecological status of arms in short term. Similarly, the restoration of flow in side arms after the removal of closures will have a positive impact on the ecological status. The disadvantage the Slovak Party sees in the limited possibility of restoration of flow in side arms because of the need to concentrate the Danube water in the fairway, especially at lower flow rates, and because of the likely decrease of surface water level, whether as a result of planned interventions or continuation of the Danube riverbed erosion.

3. Water level impoundment by a dam

In case of variant with water level impoundment by a dam permanent increase of surface water level can be expected. At the continuous operation, which is assumed in the original project, a slight improvement of the current moderate ecological status can be expected even without major interventions in the main riverbed. A significant impact can be expected at the site of dam construction, which should be limited to the time of the construction period. Time limited degradation of ecological and chemical status can be also expected in the stretch of the river below the dam. After construction of the dam and impoundment of the stretch of river above the dam this section, in accordance with the WFD criteria will change to a heavily modified body, but changes in water level, reestablishment of flowing water in river branches and the reconnection should help to create and maintain a good ecological potential. The creation of a good ecological potential can be supported also by the fact, that the continuous dredging of fords and the building of regulation structures will not be needed. In case of chemical state no change is anticipated to the good status at present. Cleaning and restoration of flow in side arms will greatly improve the ecological status in the side arms, without the need of their deepening. In the new conditions in the lower half of the impounded section probably some of existing habitats disappear, but new ones will be created, which can the old ones fully replace. In the upper half of the impounded section significant improvement of conditions for aquatic, littoral and hygrophilous habitats occur. In terms of navigation no continuous disturbing interventions in the Danube riverbed would be needed, the water level regime will be sustainable also in case of unfavourable flow rate regime.

It should be added that the total daily flow rates would not change. In case of certain extent of peak-power operation changes in flow rate and water level fluctuation occur along the river and in the adjacent area in groundwater as well. These changes will be also observed in changes of flow velocity, which should help to eliminate the sedimentation of fine-grained fractions and the creation of clean, sandy-gravel shores.

4.1.2. Impacts on level of surface waters

1. Preservation of the present state

When preserving the present state further erosion of the riverbed can be anticipated, particularly downstream of the Gabčíkovo dam (the Danube stretch Sap-Medveďov). Realization of interventions concerning the improvement of flood protection can also be expected in this section. In the stretch from Klížska Nemá approximately to Kravany nad Dunajom ford sections have to be removed by dredging, as up to now, in order of riverbed maintenance or preservation the current (inconvenient) navigation conditions in present extent. These interventions will lead to a gradual deepening of the riverbed and thus to decrease of the surface water level. On stretch from Kravany na Dunajom no significant decrease of water level is expected, because there are two rocky fords (the ford at Nyerges and the ford at Chľaba island (Helemba).

2. VITUKI Base - 1

In this variant on the stretch Sap-Klížska Nemá continuation of Danube riverbed erosion is assumed below Sap and subsequent deposition of sediments in the ford section at Gönyű. Considered dredging of gravel benches due to the widening of the existing navigation way, and the removal of sediments in the ford sections as well, will result in a decrease of water level in this stretch. In the future regular dredging of gravel is expected to be carried out. Also in the stretch between Klížska Nemá and Kravany nad Dunajom removal of fords by dredging is expected. These adjustments will inevitably lead to gradual deepening of the bottom of riverbed and along with this to decrease of water level. In this section regular dredging of gravel is expected to be carried out as well in the future. In the section between Kravany nad Dunajom and the mouth of river Ipeľ the Hungarian Party in this variant anticipates the removal of rocky-marly peaks of the bottom by their clearing. As a result a slight drop of water level can be expected, but unlike the previous two sections it is possible to assume some stabilization of the riverbed and in future only a very slight decrease of bottom.

3. Water level impoundment by a dam

At the variant with water level impoundment by a dam the completion of works in the Danube riverbed downstream of Gabčíkovo is to be expected, which together with flood control measures will lead to a further decrease in water levels in comparison with the current situation. Unlike the first two variants, the adjustments should lead to a certain stabilization of the riverbed. In the stretch between Klížska Nemá and Kravany nad Dunajom significant increase of water level occurs due to impoundment, allowing the connection and reestablishment of flowing water in side branches in this section. The area between the dikes and the existing islands should not be flooded. In the stretch between Kravany nad Dunajom and the mouth of the river Ipeľ most of the existing islands will be flooded due to the water level impoundment. The water level on some sections could reach the base of the flood protection dike. For a more accurate estimate of the extent of flooding is necessary to know the altitude of the islands and course of banks. If necessary it could also be considered the adjustment of the level of impoundment. During flood discharges the impoundment would be lower than up to now. The level of impoundment in the middle and upper sections can be adjusted by hydraulic measures (modification of cross sections).

4.1.3. Impacts on surface water level fluctuation

1. Preservation of the present state

Since this variant preserves the present state no changes in surface water level fluctuation can be expected.

2. VITUKI Base - 1

Neither the interventions under the variant VITUKI Base - 1, owing to their nature should affect the fluctuation of water level. Water level fluctuations will remain dependent on the actual flow rate changes.

3. Water level impoundment by a dam

In this variant, the fluctuation of water level in the stretch Sap-Klížska Nemá should not change in comparison with the present state. On a part of this section only a very slight impoundment of water level occur and the water level fluctuation will depend on the actual flow rate. In the stretch from Klížska Nemá down to Kravany nad Dunajom reduction of the amplitude of the water level fluctuation can be assumed. More significant reduction of the amplitude can be expected in the stretch between Kravany nad Dunajom and the mouth of the river Ipeľ. These statements apply to the operation without peak-power production. In the case of peak power operation the rate of the water level fluctuation will rise. The extent of water level fluctuation can be controlled.

4.1.4. Impacts on surface water flow velocity

1. Preservation of the present state

   As for the water flow velocities in case of preservation of the present state no changes are expected. Flow velocities will vary depending on the actual flow rate.

2. VITUKI Base - 1

   In the case of variant VITUKI Base - 1 change in flow velocity occur only locally. At sites with widening of the navigation way slight decrease in flow velocities can be expected, while at sites with construction of guiding structures the flow velocities will slightly increase. From the view of the whole stretch of the Danube, or the subsections it can be concluded that the surface water flow velocity will not change.

3. Water level impoundment by a dam

   At the variant with water level impoundment by a dam it is expected that on the stretch between Sap and Klížska Nemá the flow velocities will not change significantly. In the stretch from Klížska Nemá down to Kravany nad Dunajom the flow velocities can drop by one third, depending on height of the impoundment and the flow-profile. In the stretch from Kravany nad Dunajom to the mouth of the river Ipeľ the decrease of the flow velocities will vary from one third to one half. The flow velocities according to the needs can be controlled also by adjustment of cross sections. These statements are valid for the projected state at about 2300 $m^3.s^{-1}$. Currently, the average flow velocities vary approximately in the range 0.8 to 1.6 $m.s^{-1}$ (valid for flow rates from about 1500 to 7-8000 $m^3.s^{-1}$). Compared with the estimated changes the flow velocities can be for low flow rates even lower, while at higher flow rates significantly higher. At flow rates during floods and at fully opened gates on the lower dam the flow velocities will correspond to the current ones.

4.1.5. Impacts on the riverbed condition

Impacts on the riverbed condition are assessed in terms of stability and sustainability of particular interventions, as well as in terms of expected future development.

1. Preservation of the present state

   The present situation represents an alternative with a permanent gradual degradation of the riverbed. Adjustments of the riverbed and the maintenance of current (inconvenient) navigation conditions means further deepening of the riverbed. Dredging of fords will lead to instability of the riverbed. The durability of performed works will be at best only to the nearest major flood.

2. VITUKI Base - 1

In this variant, the Hungarian Party states that *in the short term the proposed interventions improving the parameters of the waterway may result in slight (2-3 cm) changes of the water level only. The* ***bed incision process of the Hungarian Danube section,*** *generated mainly by the barrages and reservoirs built in the upper catchment areas of the Danube and the long-term maintenance dredging, however, may result in the lowering of bed levels with detrimental effects on groundwater levels, floodplain habitats and inshore zones. Considering the severe lack of bed load at the confluence of the Danube and the tailrace canal,* ***a sediment management plan should be elaborated*** *identifying reaches with disturbed equilibrium of sedimentation, deposition and transport.*

The siltation resulting from dredging and the river training construction works may change the infiltration processes in short sections, but it may not cause the decrease of groundwater level. Thus, the proposed interventions will not have impacts on the soil even in situations where the groundwater level is near the surface.

In addition, the water may be accelerated by the propellers of the vessels, which may lead to the erosion of the riverbed in the waterway to an unknown extent.

Proposal 8.	*Long-term evolution of the river bed profile associated with measures should be studied intensively using latest technologies, e.g. bed load transport models in order to establish a sediment management plan The ecological impact of measures should be evaluated by taking into account relevant EU experiences.*

3. Water level impoundment by a dam

Although in this variant no interventions in the riverbed are expected, measures for riverbed stabilization need to be taken in the stretch of the Danube between Sap and Gönyű. Measures could be in the extent, which is considered in the variant „VITUKI Base - 1". The status of riverbed banks on the Slovak side was modified to the impoundment in the frame of GNHP construction, including the realization of seepage canals and re-pumping stations. The stabilization of the river bed together with the navigation depth were solved in the Joint Contractual Plan by partial dredging of the riverbed and modification of banks and levees.

4.1.6. Impacts on the status of flood protection

The Hungarian Party in its material states that in the stretch of the Danube upstream of Szob there are certain areas where the main flood protection system should be improved, so in this stretch new projects supported by funding under the program „Development of state owned flood prevention works" may be initiated.

Works related to flood protection in the Danube stretch between Sap and the mouth of the river Ipeľ on the Slovak side were implemented as part of works on the Nagymaros hydraulic structure. In terms of flood protection just the section downstream of Sap, where works related to the Danube riverbed adjustment were not carried out in the expected extent, can be considered as problematic on the Slovak side.

1. Preservation of the present state

   Works related to flood protection are always implemented in the frame of navigational adjustments on the Danube. The status of flood protection structures should be reviewed after every major flood. In this variant it must be stated that the level of flood protection in the stretch of the Danube from Sap to Medveďov is not satisfactory. In this section and the adjacent inundation (especially on the Hungarian side) will be necessary to realize significant interventions in order to increase safety at flood flow rates.

2. VITUKI Base - 1

   The Hungarian Party in the frame of flood protection projects contemplates the following works:

   - *Measures and technical interventions for the conservation and improvement of the flow regime in, and the flowing conditions of, the riverbed in the case of medium and high water level;*
   - *Construction, development and reconstruction of flood prevention dykes;*
   - *Interventions for the stability of the riverbed, the reparation of the unsafe sections;*
   - *Development and reconstruction of flood protecting forest belts;*
   - *Reconstruction of supporting walls;*
   - *Construction and reconstruction of cross-dykes;*
   - *Development of the infrastructure of the flood protection system (developments in telecommunication and informatics and the road system).*

3. Water level impoundment by a dam

   In this variant it will be necessary to complete works in the Danube riverbed contemplated in the frame of the Nagymaros hydraulic structure (the majority of works has already been implemented). The works mainly consist of the completion of Danube riverbed deepening to the designed level. On the Slovak side the inspection and maintenance of flood protection works and flood control measures for seepage and inland waters removal will be necessary to carry out. The original project GNHP fully addressed the flood safety, any adjustments of the flood protection measures have to be re-assessed. It should be noted that during the flood in 1965 just on this section of the Danube were the dikes broken through and the Slovak territory flooded.

Proposal 9.	*The realization process of proposed interventions for the improvement of the parameters of the waterway and for rehabilitation in the main branch and the side-arm system should be harmonized with the construction works for the development of flood protection.*

4.1.7. Impacts on formation and discharge of ice

1. <u>Preservation of the present state</u>

   Preservation of the present state on this stretch of the Danube should not have any effect on the formation and discharge of ice.

2. <u>VITUKI Base - 1</u>

   Interventions implemented in the frame of the variant VITUKI Base - 1 should not influence the formation and transport of ice

3. <u>Water level impoundment by a dam</u>

   In the case of variant with water level impoundment it can be assumed that the long-lasting frosts in the winter period may create a continuous ice. If necessary, this ice cover can be broken-up with icebreakers and freed ice floes will be discharged through the dam. This situation is most likely in the section upstream the dam. Adverse impact refers only to a certain increase of operating costs when using icebreaker, and only in the case of extremely cold winters.

4.1.8. Impacts on the status of groundwater

Like on the Hungarian side, in the stretch of the Danube between Sap and the mouth of river Ipeľ bigger or smaller drinking water sources are situated on the Slovak side as well. Variants of structural measures proposed by the Hungarian or Slovak Party may have negative impacts on quantitative status and chemical status of ground waters in the Danube section between Sap and Szob. These impacts may endanger the present or prospective drinking water sources in this section. Therefore, the Slovak Party agrees with the Hungarian Party, that in order to quantify these impacts in-situ examination and mathematical modelling should be carried out during the planning process.

It should be noted that for the case of water level impoundment by the Nagymaros hydraulic structure sealing carpets on dikes, and seepage canals were already built and measures at waterworks exploiting the water infiltrated from the Danube were already implemented on the Slovak side.

In terms of the impact of proposed variants on the status of ground waters the Slovak Party for particular variants assumes the following:

1. <u>Preservation of the present state</u>

   In terms of further development it may be assumed that the alternative of preservation of the present state will lead to a gradual degradation of drinking water sources. Due to the riverbed maintenance and the insurance of the current (inconvenient) navigation conditions dredging in the riverbed and construction of guiding structures will be necessary. These interventions may result in increase of finer sediments accumulation in the area behind the guiding structures or in decrease of water level in the riverbed and subsequently also a decline in groundwater levels, which will reduce the available amount of groundwater. Since no impact on the ecological or chemical status of water bodies is anticipated, the groundwater quality should be preserved.

2. VITUKI Base - 1

The Slovak Party to some extent agrees with the assessment of the Hungarian Party, which states that the siltation process in case of spur-dikes may cause a reduction in abstraction and degrade the water quality in bank-filtered wells. In the case of dredging the Hungarian Party states *the risk of damage to the filtration and transportation media, which have important functions in the bank filtering process in the hydro-geological protection area of the subsurface drinking water source. As a result of dredging the water transport capacity of the aquifer can be reduced, which may decrease the water abstraction of the wells along the riverbank.* On the other hand it argues that *clearing of the mostly silted top layer may increase infiltration, but in such cases the water quality may be deteriorated, because the biologic filtering layer would be damaged and its regeneration would take a long period.*

3. Water level impoundment by a dam

Under this variant no big interventions in the riverbed are expected. After the construction of the dam impoundment of water level occurs, but the water remains in the riverbed. Due to increase of water level the flow velocity may slightly decrease, which could lead to increased sedimentation of fine sediments, especially in the vicinity of existing guiding structures. In the frame of operation of the hydraulic structure during flood and increased flow rates the gates of he dam are opened and naturally high flow velocities arise. At these velocities mobilization and removal of the fine-grained sediments and bottom erosion may be expected, as it happens at present. It may also be assumed that many of the existing guiding structures will be removed from the riverbed, which will create conditions for reduction of the bottom erosion. At the increase of water level in the river increase of groundwater recharge by infiltration from the Danube can be expected. No change regarding the present good status is assumed at chemical status, which means that not even the quality of infiltrated water should change. In addition, there exist methods and ways for influencing the groundwater quality during its exploitation by bank-filtered well systems.

Proposal 5.	*1. In order to estimate the impacts on the subsurface drinking water sources complex hydraulic and biochemical processes should be examined both above and beneath the surface. For this process in situ examinations and the use of mathematical models are needed, which should be conducted during the planning process. The results of the examinations and the measures taken for the protection against possible negative impacts or for reducing them should be detailed in the environmental authorization process.*

4. Rehabilitation of the river branches

At the re-opening and re-establishing of flowing water in river branches it is necessary to consider carefully the impact on ground waters. River arms, which were filled up with industrial or other waste must be thoroughly cleaned down to the gravel subbase, possibly replace the contaminated dredged material with gravel, particularly in areas with operated or prospective drinking water sources with bank-filtration. In the old, fulfilled river arms there is sediment rich in fine fraction with high content of organic matter (sapropel) in the bottom. If these arms are located near operated or prospective drinking water sources it is necessary to carry out all the interventions very carefully. This solution was successfully implemented in front of the waterworks at Rusovce. It has to be assured that the revitalized and permanently through-flowing arms will not be used as waste disposal sites.

4.1.9. Impacts on the status of habitats connected to surface waters

The natural and ecological values of the area along the river are concentrated mainly in its inshore zones, side-arm and island system Thus, the issues of ecological rehabilitation should be determined for this area. The length of the side-arm system represents 164 km of the 417 km of the length of the total Hungarian Danube section.[17] The changes in the features of sediment transport, the closures and the siltation of the side-arms have resulted in severe changes in the wetland habitats because of the fact that the functioning of the ecosystems of wetland habitats are influenced by the dynamics of the flow regime and sediment transport.

The surface water flows have significant importance in the conservation of water and wetland habitats and the exchange processes between surface water and ground waters are also important. In the case of wetland habitats all economic and social activities should be carried out in such a way that may secure the long-lasting existence of all the protected objects.

In all river hydro-systems there are basic interactions between the land and the river. These transition zones, and their dynamic changes resulting from the fluctuation of water levels represent the most significant ecological value of the floodplains; they also play an important role in the functional processes, such as production, degradation, food stocks and the food chain. Considering these aspects the most important objectives of integrated river management are the following:

- *the conservation of the landscape function of the river both in the natural and artificial landscape*
- *the conservation of the natural conditions of the flow regime in order to secure the appropriate conditions of the riverbank and riverbed habitats, in the event of the regulation of water and riverbed conditions the environmental damage should be minimised;*
- *the conservation or improvement of the natural or close to natural status of water and wetland ecosystems[18].*

[17] *VITUKI.: Study to the project entitled: "Improvement of the Navigability of the Danube" September, 2007. Chapter 3.3.1.3., 122.p*

[18] *VITUKI.: Study to the project entitled: "Improvement of the Navigability of the Danube" September, 2007. Chapter 3.1.3. , 115. p*

In terms of impacts of the proposed variants on the status of habitats connected to surface waters the Slovak Party for particular variants assumes the following:

1. Preservation of the present state

   According to the opinion of the Slovak Party the alternative of preservation of the present state will mean continuation of current processes and thus further degradation of habitats connected to surface water. Maintenance of the Danube riverbed and the interventions for preservation of at least current (inconvenient) navigation conditions will result in continuation of gradual, albeit relatively slow, dropping of the Danube riverbed. Decrease of water level in the river is associated with dropping of the riverbed, what will evoke also a decrease in groundwater level along the riverbed. The decline of groundwater level may be expressed by further drying of former wetlands areas and more frequent isolation of side branches yet interconnected. This negative development will be most apparent at low flow rates in the river. The interventions in order to rehabilitate the side arms will be hardly feasible during preservation of the present state.

2. VITUKI Base - 1

   The Hungarian Party states that *interventions in the main branch may endanger the conservation of riverbank wetland habitats and may cause heavy disturbance for the species living there. Interventions improving the parameters of waterway* considered by the Hungarian Party *may result in changes of water level in the order of only centimeters. The siltation resulting from dredging and works on guiding structures may change the infiltration processes in short sections.* The Hungarian Party points out that *at present there exist no results from scientific research and monitoring of future environmental impacts of these relatively minor changes caused by the extreme sensitivity of the populations of wetland habitats.*

   Dredging, riverbed reconstruction, demolition of closures carried out in the side arms, in order to exchange the water of stagnant water bodies and improve water quality, may significantly improve the conservation status of wetlands, in the case of all variants proposed by the Hungarian Party. *By the help of certain rehabilitation measures and interventions the hydro-morphological conditions, essential for the conservation and development of the Danube wetland habitats and their populations, may be restored. The unique and diverse features of these wetland habitats are key elements of biodiversity.*

Proposal 7.	*Prior to the environmental permitting procedures of the proposed interventions the following aspect should be taken into consideration:* *(a)* ***Are the proposed interventions for the improvement of navigability in compliance with the requirements*** *of Paragraphs 3., 7., 8 and 9 of Article 4 of the Water Framework Directive and Paragraphs 3 and 4 of Article 6 of the Habitats Directive* ***in ecological aspects?*** *(b)* ***What complex and permanent future impacts should to be considered as a result of the proposed interventions*** *for the improvement of navigability* ***in the present ecological status of the Hungarian Danube section?***

3. Water level impoundment by a dam

   Under this variant impoundment of water level in the river occurs after the previous long-term decrease. Water remains in the riverbed, but the lower section (approximately from Radvaň nad Dunajom) is necessary to count on total or partial flooding of existing islands. In the immediate vicinity of the riverbed significant increase in surface and groundwater levels occur, which will support the restoration of wetlands. By the increase of water level in the river re-connection and reestablishment of flowing water in side arms can be achieved. Shoreline habitats will change towards more hygrophilous, thus aquatic and wetland ecosystems, as well as hygrophilous terrestrial ecosystems in the vicinity will be promoted.

4.2. The direct and indirect environmental impacts of the proposed interventions and measures on other environmental elements and environmental systems

4.2.1. Impacts on air quality

1. Preservation of the present state

   In terms of air quality when preserving the present state no improvement or deterioration can be expected in the vicinity of the river. From a global perspective, however, it can be stated that when preserving the present state no development of shipment is possible, and thus at unchanged legislation the majority of goods will be transported on roads, what except the deterioration of air quality will result in overloading the road traffic and significant worsening of the road traffic safety.

2. VITUKI Base - 1

   The Hungarian Party in the frame of impact assessment on air has taken into consideration three aspects:

   - *the local impacts of waterway traffic (CO, NO_x and PM10 emissions) on the local air quality and noise burden,*
   - *impacts of waterway traffic as a change of transportation methods (modal split) on the emissions of other traffic emissions,*
   - *impacts of waterway traffic as a change of transportation methods (modal split) on the emissions of greenhouse gases (CO_2 and NMVOC emissions).*

   The Hungarian Party stated that *the increased waterway traffic will result in a moderate deterioration of the local air quality and an increase in the noise pollution of the river bank.* In particular, the air quality in the rehabilitated arms could be determined by the features of recreational use, thus a deterioration of air quality and an increased level of CO_2 may be a potential risk.

The Slovak Party, however, assumes that even at certain development of recreational use, the induced air pollution will be negligible.

Furthermore, the Hungarian Party stated that *waterway cargo transport will probably not be the alternative to road transport in the Hungarian Danube section, it will rather be an alternative to railway cargo transport. In this aspect, it canot be predicted whether the change from railway transport to waterway transport will have positive impacts on the quality of air or not. But it is obvious that the improvement of waterway transport - as a consequence of its more favourable fuel efficiency features (CO_2 emission/tonne-km) - will moderate the emission of greenhouse gasses.*

3. Water level impoundment by a dam

   In this variant there is a great assumption, that the transportation of goods by water will be more utilized. Certain non-significant deterioration of air quality and an increased level of CO_2 can be expected in the shipping route. On the other hand, shifting the transportation of goods from road to water will improve the air quality in a much greater extent. This way of air quality protection and development of transport is moreover supported by the EU policy. The question of usage of the waterway transport potential is more a matter of setting the legislation, provided that convenient conditions for sailing to the mouth in the Black Sea will be created and permanently secured.

4.2.2. Impacts related to climate change

*The annual mean temperature has increased by more than 0.5°C **in certain areas of Hungary** over the last twenty years, while the share of intensive precipitation in the annual precipitation total has also increased. Floods, summer droughts and heat waves have become more frequent in Hungary. **The annual precipitation has decreased significantly during the 20th century**, mainly in the spring period: the share of the seasonal amount of precipitation in spring is only 75% of the amounts seen in the early years of the century. It should be emphasized that the decrease of precipitation is the largest in the North-Western parts of Hungary, including the area of the Danube section between Sap and Szob.*

*There is a special feature of the impacts of climate change on the natural waters in Hungary, namely, that **precipitation shows an increase in the winter period, while it decreases in the summer period. This applies to the whole catchment area of the Danube.** As a result of warming, the snowfall period is reduced in the winter, meaning that winter precipitation is increased, but a reduced share falls in the form of snow. The amount of ice in the rivers and lakes may also decrease as a result of warming, which is confirmed by observations over recent decades. Global warming may increase the risk of floods caused by winter precipitation and the snow-melt floods may occur earlier.*

Based on results published in the Fifth National Communication of the Slovak Republic on Climate Change, the average annual air temperature in Slovakia in the period 1881-

2008[19] increased by 1.6 °C, and in the same period the annual rainfall has decreased by 3.4 %, even in southern areas by more than 10 %. From the analysis of data from meteorological station at Hurbanovo, that best characterizes the climate conditions of the area on Danube stretch between Sap and the mouth of river Ipeľ, it follows that the average annual temperature in the period 1991-2000 increased by 0.9 °C and in the period 2001-2009 it has increased by 1.3 °C above the normal from the period 1901-1990. In case of the rainfall this tendency, however, is not so clear. While in the period 1991-2000, the annual rainfall varied about the long-term normal, in the period 2001-2009 increase of rainfall by more than 3 % over the normal from the period of 1901-1990 is expected.

According to various climate scenarios, it can be assumed that the air temperature will continue to grow and in the summer months the long-term average values can be exceeded by 1.5-2 °C. The increase of temperatures in the winter months it is also expected, causing that precipitation in this region will also be in the form of rain over winter period. According to some forecasts the amount of summer rainfall could decrease by 25-35 %, and the amount of winter precipitation should increase. A major change is that the water amount in the snow cover will be smaller and the water flows away earlier. From this also results the decrease of soil moisture reserves at the beginning of the growing season.

In any case, changes that can be expected in this area will appear in increase of air and water temperature, especially during the summer months, in the time distribution of precipitation, in the changes of the duration of snow cover, and in the shift of the spring melting of snow in the Alps. All of this will be necessarily reflected in the change of flow rate and water level regime in the Danube.

In the Danube section concerned it can be presently observed that the straggling of smaller water flows and the decrease in the groundwater level may cause damage in both the water and wetland habitats.

*The occurrence and the extent of heavy floods may grow as a result of the **increase of the frequency and intensity of extreme precipitation,** which will probably increase the damage and the costs of protection and reparation.*

*The decrease of summer precipitation, supplemented by the increase of evaporation raise the frequency and the extent of the **extremely low water levels (at low flow)** and the frequency of **summer droughts**. In Hungary climate change may presumably lead to the*

[19] **Note:** The Year 1881 belongs to years of the small ice age (1500-1880). If we would choose the as an optimal climate period around the time of Samo's Empire, Great Moravia, the Vikings, the arrival of the Hungarians (the medieval warm period around the years 700 to 1100) the results of warming would be completely different. As an evidence it may serve the historical records on the collection of taxes on grain and wine in non-traditional wine-producing regions today (Baďurík J., Benková E., 2011: Viticulture in Slovakia in the last centuries of the Middle Ages, Vine and Wine). The favorable development of medieval agriculture and viticulture at the end of the 15th century began to stagnate. One of the reasons was the emergence of a small ice age. The period between the years from 1820 to 1880 was the worst period in the Central Europe. This period was so bad that people were dying of hunger and since about 1850 begins the emigration to America (Podolák J., et al., 1999: Heľpa; Matica slovenská). This, however, also indicates that the climate is changing, and even independently on human activity. Climate changes accompanied the mankind since the beginning of its existence, and were even before its existence. Climate changes also caused changes in the flow and occurrence of surface and groundwaters. Climate changes caused the migration of people, the appearance of agriculture and they occur also today (Haarmann H., 2010: The Europäer - Herkunft Sprachen, Kulturen, C. H. Beck – Wissen; Mithen S., 2003::After the Ice, Weidenfeld & Nicolson, GB).

decline of the mean runoff, i.e. the renewable water stock of the water courses. According to different scenarios the ***low flow water supply of the Danube in the summer period may be lower by 15-30% than present values, by the period between 2025 and 2030.***

The reduction of the low flows in the summer period and the warming of the water temperatures may bring about several problems:

- *the amount of natural utilizable water stock may decrease,*
- *the possibilities of water extraction are worsened,*
- *the conditions of navigability may worsen,*
- *the self-purification capacity of water courses may deteriorate,*
- *the flora and the fauna of the watercourses may change,*
- *the landscape may be degraded.*

Mentioned modifications in the distribution of flow rates and in the water temperature are best to be seen within the course of flow rates and water temperature in 2002 and 2003 compared with other measured data or long-term average (**Fig. 4.1**). For example, the average daily flow rates at station in Bratislava in 2003, from April until mid-September, moved almost entirely below the long-term daily average values. So it was in 2002 from April to end of July. Moreover, in 2002, the first greater flood from snow melting occurred already in the second half of March. As regards the Danube water temperature it is seen that in the summer months, especially June and July, the average daily water temperature significantly exceeds the long-term daily average values.

1. Preservation of the present state

In terms of climate change the preservation of present state does not mean any benefit because it does not allow to regulate the water level in the river, more likely further deterioration in conditions associated with decrease of water level in the river can be expected, which will cause a decrease in ground water levels along the riverbed. The decline of groundwater level can be expressed by further drying of areas of former wetlands and more frequent isolation of yet interconnected side branches. This negative development will be most pronounced at low flow rates in the river, which may be more frequent also in summer months.

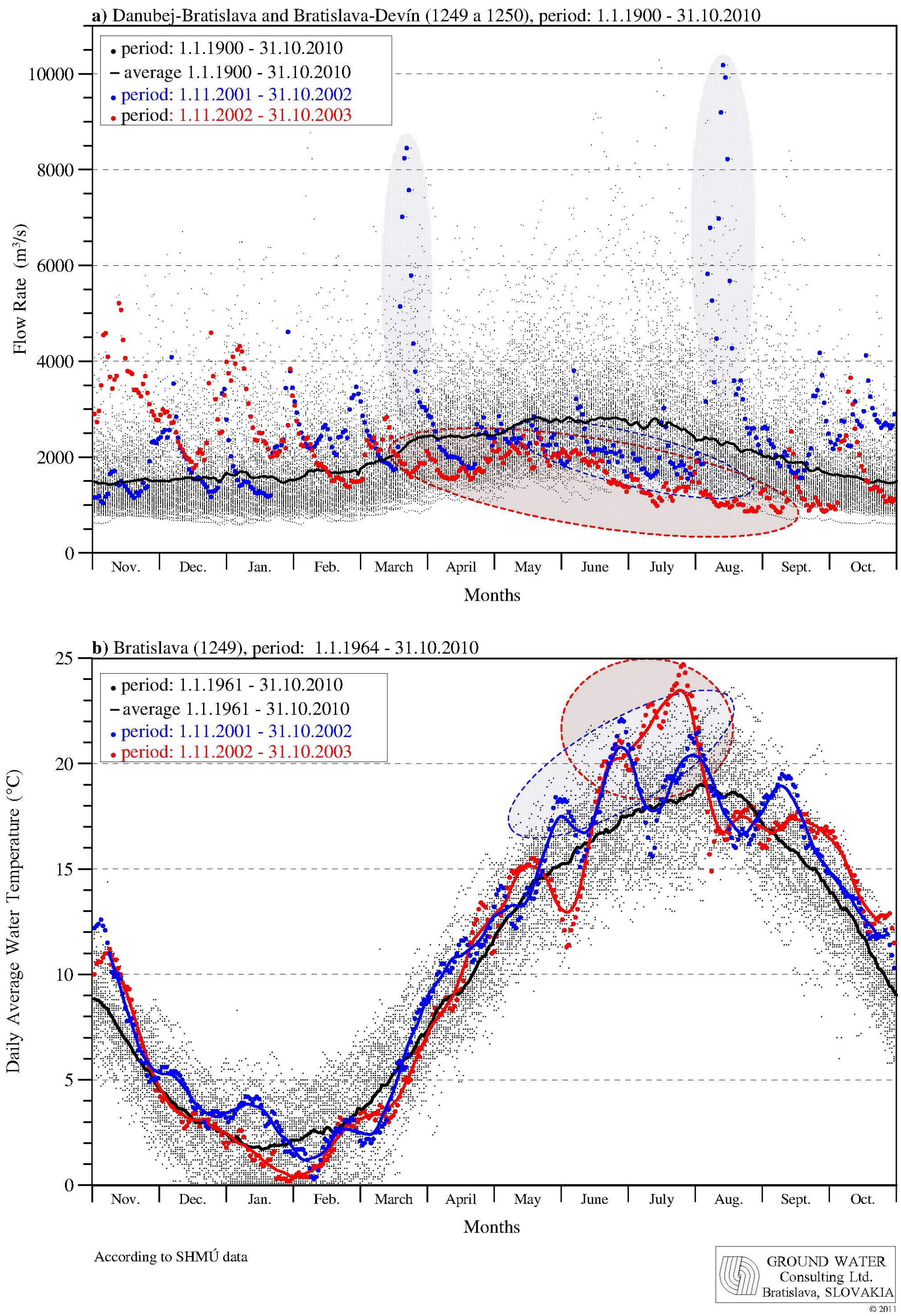
2. VITUKI Base - 1

The above-mentioned statements apply also to the variant VITUKI Base - 1.

3. Water level impoundment by a dam

In this variant is likely to be possible to largely eliminate the adverse impacts of climate change and extreme weather events. The impoundment of water level ensure a sufficiently high water level in the river as well as higher levels of groundwater and capillary rise during periods of low rainfall or during low flow rates in the Danube. In a limited way it even allows short-term retention of water in the country. From the climate point of view this variant means a support for increase of humidity, local decrease of air temperature, support for agriculture and forestry in the shoreline territories. The impoundment of water level as the only variant allows the preparation for climate change through water management measures.

Fig. 4.1 Flow Rate and Water Temperature at Bratislava



Proposal 11.	*The impacts of climate change* *a) on the navigability of the Danube* *b) on the touristic utilization of the side-arms,* *c) on the ecological status of the Danube, and* d) on the shoreline country *should be examined.*

4.2.3. Impacts on conditions of areas under environmental protection and areas of the Natura 2000 network

The Hungarian side:

The total area of the Hungarian Danube section (except for the section at Budapest), as a continuous water body, and the connected side-arm systems and islands are under the Natura 2000 network. The whole section is part of the national ecological network as core areas or ecological corridors and it is also part of the ecological network of the European Union. The Danube is a determining ecological corridor of the European Union. The Danube has been functioning as a combination of intercontinental, continental, regional and local corridor for different habitats and species.

*In the section between Sap and Szob there are **two SCI areas** (Sites of Community Interest) and **one SPA area** (Special Protection Area)[20]. The SCI areas are: the Danube and its floodplain; the Pilis and the Visegrádi Mountains. The SPA areas are: the Börzsöny and the Visegrádi Mountains. The section above Vének is a part of the Szigetköz SCI and SPA. The total section between Vének and Szob is a part of the Danube and its floodplain SCI.*

*The area concerned starts at Sap which is situated at the end of the **side-arm system at Bagomér,** thus, it is under protection as a part of the **Szigetköz Protected Area.** The **area below Gönyű (Erebe Island)** is a part of the **Pannonhalma Protected Area.** The riverbank area between Esztergom and Szob is part of the **Duna-Ipoly National Park.** The gravel bars below **Helemba Island** have outstanding natural value in international terms, as this type of habitat is very rare and the valuable fish species living there are disappearing (for example Zingel zingel, Zingel streber, Gymnocephalus schaetser)[21].*

*While a high proportion of the native flora and fauna still exist, a large number of formerly common species show declining populations. **Many taxa have become threatened and are on the Red List due to habitat alterations and loss**[22].*

*The dredging of the **side-arms** for nature conservation purposes and the opening of closures **may contribute to the conservation of protected and Natura 2000 areas and, in certain areas, their natural value may be increased**. The deepening of the side arms and the creation of some deeper holes in the bed are required for an **improvement in the wintering habitats of fish**.[23] Some small scale interventions in the riverbed are needed for ensuring the appropriate conditions and water supply for the water and wetland habitats.*

*The **possible ecological impacts of interventions in the main branch** (dredging, stone works, spur-dykes, gravel filling) **are mainly negative**.[24] The disturbances resulting*

[20] Guti Gábor, 2009. Ecological value and potential of the Danube section between Sap and Szob (r.km 1811-1708), Chapter 5., 15-16 pp.

[21] VITUKI.: Study to the project entitled: "Improvement of the Navigability of the Danube" September, 2007., Annex, Chapter 9.1., 12-13. p.

[22] Guti Gábor, 2009. Ecological value and potential of the Danube section between Sap and Szob (r.km 1811-1708)" Chapter 3. 3., 12. p.

[23] Guti Gábor, 2009. Ecological value and potential of the Danube section between Sap and Szob (r.km 1811-1708)" Chapter 6.4. , 20-21. pp.

[24] VITUKI.: Study to the project entitled: "Improvement of the Navigability of the Danube" September, 2007., Chapter 11.4., 204-216. p.

from the proposed interventions may have negative ecological impacts[25]*. The water and wetland ecosystems are very vulnerable; their ecological balance is very unstable.* ***As a consequence, small scale interventions may easily upset this balance, which may start a cumulative process of extinction or migration of certain species, which may lead to a decrease of diversity.*** *The rehabilitation process of the side-arms was planned to compensate for the predicted deterioration of the ecological status in the main river branch. Nevertheless, in the main river branch certain ecosystems may deteriorate which cannot develop in the side-arms, for example certain phyto- and zooplankton which can live only in flowing water courses.*

The Slovak side

The Slovak side of the Danube in the stretch Sap - the mouth of river Ipeľ is also a part of the Natura 2000 network. Continuous protection of the area is provided within the Protected Landscape Area „Danube floodplains" and Protected Bird Area „Danube floodplains", which partially overlap. Within these areas there are 15 sites of Community interest, four of which are located on the Danube and in its inundation - Kľúčovské rameno (the river arm at Kľúčovec) (SKUEV0293) Číčovské luhy (Meadows at Číčov) (SKUEV0182) Veľkolélsky ostrov (The Island at Veľký Lél) (SKUEV0183) and the Danube (SKUEV0393). Others are in located in the area behind the levees at different distances from the Danube or along its tributaries. One of the sites is not dependent on the Danube water regime, the rate of dependence of the other sites varies according to local conditions.

On the issue of side branches dredging the Slovak Party agrees with the Hungarian Party only insofar, when it concerns the removal of deposited waste and fine sediments with high content of organic matter. The Slovak Party does not consider the side branches dredging with the aim of their deepening, to have got water in them, as appropriate. Improving of ecological conditions is to be achieved mainly by the increase of water level and water flow. Such measures will also have a positive impact on the supply of water and wetland habitats by water.

With regard to fish population, the Slovak Party proposes to investigate the care of fish and their spawn in the period before 1992 and today, as well as the way of legal and illegal fishing. The proposal of the Slovak and Hungarian Parties to revitalize the branch system in the upper stretch of the Danube (between Čunovo and Sap) supports the spawning of fish, and thus fish populations in the lower stretch of the Danube.

An important fact is that the habitats and ecosystems should be not only protected, but above all a care should be taken about them. The care in this case can be expressed by meeting the requirements for water, soil moisture, condition of zoo- and phytocoenosis or by implementation of measures encouraging individual ecosystems or communities. For example, almost in every village in mountainous areas in the past there were fish hatcheries, forest nurseries, seed stations, menageries and so forth.

[25] *VITUKI.: Study to the project entitled: "Improvement of the Navigability of the Danube" September, 2007, Chapter 7.2.2. , 190. p.*

1. Preservation of the present state

Conditions in areas that are environmentally protected and in Natura 2000 areas largely depend on water regime in the Danube and on the height of surface and groundwater levels. Maintenance the of the Danube riverbed and the navigation conditions with present method will result in a continuation of gradual decrease of the Danube riverbed, which is connected to the continuation of surface and groundwater levels decrease. The decrease in water level in the river may be expressed by further drying of areas of former wetlands what will lead to further degradation of habitats linked to water, thus primarily habitats to be protected. The process of isolation of side branches will also continue. This negative development will be most pronounced at low flow rates in the river.

2. VITUKI Base - 1

According to the material of the Hungarian Party, the interventions in the main branch may threat the conservation of coastal wetland habitats, and can cause intense disturbance of the species living there. Since the interventions are needed in almost the whole stretch of the Danube from Sap to Budapest, works must be carried out with maximum respect to protected habitats, what may be reflected in the schedule of works to be realized, and ultimately it may affect the total amount of costs.

3. Water level impoundment by a dam

In case of realization of the variant with impoundment the works are concentrated on a relatively short stretch of the Danube, above and below the dam construction site. On the remaining, more than one hundred kilometres long stretch of the Danube the works will be mostly limited to the sites of connections of the revitalized side branches or to places where the existing guiding structures will be removed. Produced impoundment will strongly support the change of habitats towards hygrophilous, namely water and wetland ecosystems, as well as hygrophilous terrestrial ecosystems in the near vicinity. As negative impact may be the extinction of some terrestrial or transitional habitats, on the other hand the impoundment of water level will support the creation of new water and transitional habitats.

Proposal 12.	***We propose the elaboration of special sustainability aspects for those habitats and ecosystems with an outstanding natural value in order to conserve the diversity of the main river branch, the side-arms and the islands.*** *In these special sustainability aspects it should be emphasized that the touristic and intensive recreational use of protected areas of natural importance and intensive angling activities are not recommended.*

4.2.4. Impacts on forests

Forests (commercial and natural) on the Danube stretch Sap - Budapest occur in the inundation on both banks of the Danube, or on islands, arising from the gravel benches. On the Slovak territory more significant forests are also found along the lower part of the river Váh.

The prevailing part of economically exploited forests is located in the inundation of the Danube in the section from Sap to about the mouth of the Mosoni Danube. From the mouth of the Mosoni Danube the inundation tapers and does not provide considerable areas for commercial forests. Larger areas for economical exploitation of forests moreover provide the islands in the Danube, which arose from the gravel benches. Most of these islands is hardly accessible and therefore there evolved relatively not much disturbed forest communities, which are now often protected.

In the gravel bars the plant communities of Rumici crispi-Salicetum purpureae grow and, in slower sections (where sandy and muddy islands have formed) Polygono hydropiperi-Salicetum triandrae plant communities developed. Willow scrubs are common in low tree layer along the banks of side branches.

In lower areas, where the regular inundation period lasts for 1-2 months, ***softwood gallery forests*** *grow**,** with mainly willow and poplar species. In areas that are regularly inundated Leucojo aestivi-Salicetum albae plant communities live, while the Carduo crispi-Populetum nigrae plant communities are common in the regularly overflowed natural woodland communities. In higher parts of the floodplain, which may be inundated only by huge floods, the Senecioni sarracenici-Populetum albae plant communities grow.*

In the economically exploited forest stands cultivated poplars of *Populus x euroamericana* prevail.

1. <u>Preservation of the present state</u>

Preservation of the present state, thus continuation of the gradual decrease of surface and consequently ground water levels, will lead to further drying of terrestrial habitats. In case of forests this change may take several decades. However, in combination with unfavourable hydrological situation (e.g. the year 2003), lack of rainfall during the growing season and the expected increase in temperature the drying process can significantly accelerate. The most vulnerable will be stands that are located on gravel substrate with a low thickness of soil cover (gravel benches, islands, banks).

2. <u>VITUKI Base - 1</u>

Even in this variant further drying of terrestrial habitats can be expected. The rate of change will depend on the efficiency and sustainability of measures implemented in order to stabilize the riverbed.

3. <u>Water level impoundment by a dam</u>

The variant with water level impoundment ensures the increase and stabilization of surface and ground water levels. In many places it will strongly support the change of habitats towards more hygrophilous ones. In the lower part of the dammed section permanent flooding of islands, where protected forest stands are currently located, can be assumed. The current riparian vegetation will be also flooded. On the other hand, formation of new riparian vegetation can be expected.

Hungarian Party states that **the interventions planned for the rehabilitation of side arms will improve the ecological status of the floodplain forests in the case of each of the planned variants it has proposed**. However, in order to ensure flooding and water flow, which is necessary for relevant ecological status, modification of the riverbed for flow rate conditions with low water level is necessary to carry out. For restoring flowing water in branches, except the demolition of upper closures and guiding structures, dredging of side branches is necessary. Slovak Party is of the opinion that dredging of branches should be carried out only to that extent so the waste deposits and fine sediments, that settled in arms due to the water level decrease and the subsequent closure of branches, were removed.

4.2.5. Impacts on biodiversity

The Slovak Party, like the Hungarian Party, considers the conservation of biodiversity and preservation of habitats and species of European importance as one of the most important objectives of the European Community. Diversity of an ecosystem is given by species diversity and structural diversity. To meet this objective it is necessary to maintain a variety of habitats, so the preservation, protection and restoration of various populations and their habitats are of considerable importance. The human habitat - agricultural and urbanized country - is also important. From this view the support of agricultural land by water management measures is extraordinarily important.

The landscape diversity on the one hand depends on a number of ecosystems in the region, on the other hand it depends on the number and relative abundance of habitat types and landscape areas. *Landscape diversity is important not only in geographical, ecological and nature conservation aspects, but also in terms of aesthetics. The diversity is determined not only by the natural environment, but also by the socio-economic environment, mainly at regional level. As a consequence, the diversity of land use types should also be taken into consideration.*

*The **Danube is an important ecological corridor for the native biota**, and is also an **important migration route for the non-native, so-called alien, species.** Some of them may become invasive species, which will endanger the original ecosystems of the given region. The modification of natural habitats may increase the invasion of alien species.*

The different features of habitat types in the main branch, in the side-arms and in the islands change dynamically in time and space; this is the main prerequisite for the diversity of the area. *The conservation of the biodiversity of natural and nature-related ecological systems is also important because the development of the self-supporting system of ecological network is the basic condition for the conservation of Natura 2000 areas.*

The aim of measures from an environmental perspective is to support the hygrophilous flora and fauna, which means an increase in soil moisture and permanent maintenance of littoral zones. Such support and care provides the increase of surface water levels and their fluctuation. By the transfer through the groundwater is supported the soil moisture. Where the groundwater level raises the process of habitat changes proceeds to hygrophilous ones, and to xerophilous ones where it drops. The monitoring of groundwater level is therefore crucial for the subsequent management of groundwater level fluctuation and for interpretation of monitoring of terrestrial biota (fauna and flora).

*In the **side-arms**, as a result of the dominant riverbed morphologic processes, sediment has accumulated. The depth of this sediment layer is only 10-30 cm in some areas (for example in the Véneki, Erebe and Macska Islands), but in other areas the layer of the accumulated sediment is more than two meters (for example in the side-arms at Bácsamagla and Tát).* [26] *The reduction in the water supply and the increased deposition of floating sediment in the side-arms has altered the eupotamon- and parapotamon-type habitats and the connected ecosystems.*

Due to the accumulation of mud on the gravel bottom, in the deeper parts of the side branches, loss of breeding and feeding sites of several types of benthic invertebrates and fish occurs. On the other side *the new sediment layers along the riverbanks provide a good substrate for wetland and terrestrial macrovegetation, or spontaneous forestation.*[27]

The Hungarian Party is of the opinion that the protection of side branches and islands, and their natural value can potentially improve, after the implementation of Hungarian proposals. Potential impacts on landscape and habitats in each variant are positive. The Slovak Party, considering the long-term problems with fine sediments, prefer rather a combination of cleaning of arms and increasing the water level, so as the water flow in arm was adequate . **Increased (impounded) water level** will contribute to creation of wintering sites for fish, even at low flow rates, and will support also other environmental requirements.

1. Preservation of the present state

In case of preservation of the present state, regarding the presumable continuing of water level decrease, decrease of desired biodiversity can be more expected. The decrease of biodiversity will be caused by the loss of wetland and wet habitats. On the other hand, the real values of biodiversity need not lead to one way decline of species, because new species, less demanding on moisture, or invasive species, may appear.

2. VITUKI Base - 1

The implementation of interventions under this variant could a certain period of time contribute to the stabilization of biodiversity. However, the measures taken under this variant (or similar ones) cannot prevent the adverse trends in the event of unfavourable hydrological and meteorological conditions. In long term it can be assumed that development of water level and biodiversity, will be similar as in case of preservation of the present state.

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[26] *VITUKI.: Study to the project entitled: „Improvement of the Navigability of the Danube" September, 2007.6., pp. 197-199. Annex 7, Chapters 1.2, 2.1, 3.1. 8.1.*

[27] *Guti Gábor, 2009. Ecological value and potential of the Danube section between Sap and Szob (rkm 1811-1708)" Chapter 3.,10.p.*

3. <u>Water level impoundment by a dam</u>

In case of the variant with impoundment an effective tool for water regime regulation will be at disposal. In terms of biodiversity there is a potential for long-term improvement of the present state. In the immediate vicinity of the river also a change in biodiversity can be expected comparing to the current situation due to shrinking of xerophilous species. As a negative impact can be the decline of rheophilous species in the lower part of the dammed section, due to the impoundment and thus slower flow. The rheophilous species, however, may find suitable habitats in bigger tributaries (the river Ipeľ, river Hron) or in the upper half of the dammed section. As a positive effect will be the creation of new habitats for aquatic organisms, thereby also the increase of species diversity in side arms and in areas with increased ground water level. Backwater water levels and other measures envisaged in the Joint Contracting projects contribute to the development of agricultural land. The water level impoundment and other measures envisaged in the Joint Contractual Plan contribute to the development of agricultural land.

Proposal 13.	*1. In the course of the interventions, the water-related status of the flora and the fauna should be conserved, or their ecological value should be improved.* ***The expansion of terrestrial ecosystem types, the reduction of biodiversity and the increase of the invasive species should be avoided.*** *2. The ecological monitoring system of the Danube section between Sap and Szob should be broadened; the biological surveys are constrained to smaller areas and only for a few species at the present. We propose to conduct* ***a long-lasting monitoring survey in order to assure traceability of the changes of the typical ecosystems and populations.***

4.2.6. Impacts on the conditions of human health and the quality of life

The Hungarian Party states that *the proposed interventions improving the navigability of the Danube section between Sap and Szob have both direct and indirect impacts on human health. Some of these impacts may induce risk or negative impacts on the health conditions of the population of the region, while other impacts may improve their living conditions.* The Slovak Party is of the opinion that the potential risks arising from increased traffic of vessels can be considerably reduced by stricter controls and consistent requirement of abiding by the regulations related to the operation and traffic of vessels.

- *<u>Impacts of proposed interventions in the main river branch</u>*

The Hungarian Party in its material states that *as a consequence of the improvement of navigability the emission of some air pollutants and the noise emission may be locally increased which can have slightly disadvantageous impacts on the health and life-quality of the human population of the area. Some interventions – such as the improvement of the fords by dredging and other regulation methods – may be a possible risk for the present and future subsurface drinking water abstraction sites.*

The most significant negative impact may be the bacterial contamination, which emanates from the communal waste and wastewater emission produced by the

***vessels**. The microbiological contamination means risks to human health, and may decrease the quality of drinking water extracted from the bank-filtered wells.*

The Slovak Party is of the opinion that the biggest source of pollution in the Danube is municipal and industrial wastewaters. Due to the gradual building of the infrastructure of sewage treatment plants since the early 90's, a gradual improvement in water quality in the Danube occurs. Further improvement of water quality in the Danube stretch between Sap and Budapest can be expected after the completion of infrastructural development projects. Potential threat to water quality by discharging sewage produced by vessels can be effectively reduced with consistent requirement of abiding by the regulations related to the operation and traffic of vessels. Modern large passenger ships are already at present equipped with sinks and oil separators. The increase of emissions of some air pollutants and noise emissions considered by the Hungarian Party is according to the opinion of the Slovak Party negligible. If the goods transport on roads would be restricted by legislation and transferred to water and rail the probable profit from the air pollution decrease will highly exceed the negative consequences considered. According to the Slovak Party a positive impact on quality of life, as in the case of rehabilitation of side arms, will also be the increase of tourist attraction, supported by options for technical water sports, by building harbours for yachts and motor boats, and by development of tourist attractions on the river banks.

- *Impacts of proposed interventions in side arms*

In case of interventions proposed in the side arms the Hungarian party assumes *positive, or significantly positive, impacts on the health and life-quality of the human population. In the course of the ecological rehabilitation process of the side-arms, the quantity and quality of surface waters may be improved, and the increasing level of recreational possibilities will have positive impacts not only on local inhabitants, but also for other elements of the population. In certain side-arms, where it is permitted by the land-use regulations, the touristic appeal of the area may be improved by the possibilities for technical water sports, the construction of ports for yachts and motorboats, and, on the beaches or riverbanks by touristic sights and special touristic programmes. As a consequence of these possibilities, the retaining capacity and attractiveness of the area may be strengthened, the life-quality may be improved, but, on the contrary, the air pollution and the quantity of wastes may also be increased.*

Also in the opinion of the Slovak Party the rehabilitation of side arms will have positive effect from the health and quality of life point of view for people living in this region. Cleaning of side arms will contribute to elimination of environmental burden of individual sites and restoration of flow in arms will contribute to the improvement of water quality. Activities related to construction of harbours and infrastructure for technical water sports, yachts and motor-boats, according to the Slovak Party, should by preferably concentrated in the main riverbed and not in side arms.

In terms of the population health, the Slovak Party with relation to the ongoing climate change notes that the assessed area was a malaria endemic area at the beginning of last century. The care of habitats means also a care about hygiene and prevention against water-born diseases and diseases carried by insects.

1. Preservation of the present state

In terms of impacts on human health conditions and quality of life of the population in case of the variant with the preservation of the present state is not possible to expect positive or negative changes. Potential adverse effect from the long-term point of view is the decrease of surface and ground water levels, and the resulting risks to existing or potential sources of drinking water.

2. VITUKI Base - 1

In case of the variant VITUKI Base - 1 the Hungarian Party draws attention to the risks associated with interventions in the main branch or side arms (particularly dredging), potentially threatening the present and future subsurface drinking water abstraction sites. As the most important negative impact the Hungarian Party considers bacterial contamination from the communal waste and wastewater produced by the vessel. On the other hand Hungarian Party highlights the positive or very positive impacts on the health and life-quality of the human population in case of interventions in the side arms.

The Slovak Party agrees with the opinion of the Hungarian Party, which relates to the potential threat to bank-filtered water resources with dredging of the main riverbed and as well as with contamination from municipal waste. As an effective tool for prevention of risks arising from interventions in the main riverbed and in side arms, it considers the detailed modelling of surface and ground water flow and environmental impact assessment prior to the implementation of particular proposed interventions. The potential risk arising from the discharges of communal wastewater must be eliminated by the completion of sewerage network and sewage treatment plants at all sites located along the main stream and at least along the lower sections of tributaries. Regarding the wastewater produced by vessels the Slovak Party believes that the potential risk should be minimized by inspections and consistent requirement of abiding by the regulations related to the operation and traffic of vessels. From the overall point of view the Slovak Party expects no, or only slightly positive impact of the proposed interventions on conditions of human health and the quality of life, with the prospect of a slight deterioration due to further decrease of surface and ground water levels.

3. Water level impoundment by a dam

In case of the variant with water level impoundment by a dam, in the opinion of the Slovak Party, positive effects on conditions of human health and the quality of life should prevail due to increased surface and ground water levels. In the Danube main riverbed the possibilities for building of harbours for yachts and motor-boats will improve, and the possibilities for technical water sports gets better, thereby the tourist attractiveness of the area arises. The development of tourist attractions on the banks of rehabilitated river arms will be possible. However, also in this variant still stands that before the implementation of particular interventions, especially in side arms, it is necessary to carry out detailed modelling of the surface and ground water flow. Similarly it is necessary to eliminate the potential risk arising from the discharge of communal wastewater by completion of the sewerage network and wastewater treatment plants.

Proposal 15.	*1. The infrastructure for the treatment of the communal waste and the dangerous waste originating from navigation sources should be determined; the control of the authorities concerned should be intensified. These aspects should be taken into consideration in the environmental permission procedures of ports.* *2. In order to decrease the microbiological contaminations, the sewage system should be developed in the settlements situated along the riverbanks* 3. In case of dredging in the main riverbed and in side arms it is necessary to carry out detailed modelling of surface and ground water flow before the implementation of interventions.

4.2.7. Impacts on the landscape, on its carrying capacity, the natural and cultural landscape resources and landscape values

The main principle of the European Landscape Convention[28] is to achieve sustainable development based on the balanced relations of social demand, economic activities and the environment. The most important objective of the Convention is to improve the protection, the management and the planning of the landscape.

Landscape management *is a tool for the development and promotion of traditional production technologies and methods, which can characterize the given land or region. Landscape management uses the natural and cultural landscape values as a resource, in a sustainable way. It has to comply with the local natural conditions, which should not have been modified by the management methods in use, and it shall protect the natural and cultural values and heritage. Landscape management serves the maintenance and conservation of the supporting capacity of the given region, in terms of both the environment and local society. Some of the resources of landscape management can negatively affect the landscape values, for example, certain constructions, which are non-conforming and do not have a local landscape character (spur-dykes).*

It is to be feared, that some construction works for river regulation and the infrastructure for the improvement of touristic attractions may contribute to the degradation of ***landscape values*** *and the natural character of the Danube.*

The ***renewal of the natural resources*** *may be promoted by parallel interventions, for example, in parallel to improving navigability the increase of the water supply in the side-arms may be undertaken by opening their upper closures. The higher the water surface, the better the microclimatic effects, which may create better ecological status for certain plants. The filtration movement of the water bodies of the side-arms may also assist renewal as the infiltrated water may supply the plants living there. This process may also be advantageous in the case of the water supply of wetland habitats and it may particularly be important in the conservation of the habitats of specific and particularly protected species.*

The Slovak Party with most of the above opinions of the Hungarian Party agrees, but does not share the concerns of the Hungarian Party regarding the degradation of landscape values and the natural character of the Danube by construction works. It should be borne in

[28] Act No. CXI./2007 on the Ratification of European Landscape Convention

mind that we are in a cultural landscape transformed by the man for long time. The Slovak Party is of the opinion that all interventions and structural modifications can be made with regard to landscape and natural values.

1. Preservation of the present state

The variant with preservation of the present state would not have a direct impact on the landscape, its carrying capacity, natural and cultural landscape resources and landscape values. The potential adverse effect from long-term point of view is the decrease of the Danube riverbed bottom and the need for implementation of further guiding structures. More significant effect may have the ongoing climate changes that can affect the landscape, its carrying capacity, natural and cultural landscape resources and landscape values, at the expected temperature rise and simultaneous decrease of surface and ground water levels. In the current state there are no tools to mitigate that impact.

2. VITUKI Base - 1

The Hungarian Party in its proposal expresses concerns that construction works on river regulation and building the infrastructure for improving the tourist attractions can contribute to the degradation of landscape values and the natural character of the Danube. On the other hand, it did not even try to suggest other solutions. In connection with the expected effect of the proposed interventions in the side arms the Hungarian Party states that the positive effects will be the increased supply of water into the side arms, the large water area and the water movement in the bodies of side arms. However, in connection with the proposed variants it also notes that further interventions will be needed for maintaining the state.

Slovak Party agrees that interventions in side arms will contribute to certain revitalization of arms and to an increase of the proportion of water areas. It can be assumed an increase of the number of aquatic and wetland habitats at the expense of terrestrial ones, with a potential for wider use of the country. Land use (groundwater, fishery, tourism) must be provided by the landscape management in a sustainable manner.

According to the opinion of the Slovak Party, interventions in the main branch will result in continuing decrease of the riverbed bottom and thus also of the levels of surface and ground water. The resulting effect is similar to the variant with the preservation of the present state. Similarly it can be stated that even this variant does not provide any tools to mitigate the expected impact of climate change.

3. Water level impoundment by a dam

In terms of impacts on the landscape, its carrying capacity, natural and cultural landscape resources and landscape values the variant with water level impoundment is the most advantageous according to the opinion of the Slovak Party. Such solution sets up conditions for more efficient landscape management of the lower section of the Danube, with a possibility to regulate the water regime. The negative effect of this variant in terms of landscape values will likely be the disappearance of some islands in lower section of the impoundment. The most appropriate level of impoundment, however, may be a subject of further investigation. On the other hand, this variant will ensure the increase of surface and ground water levels, without the necessity of construction works in the Danube riverbed, the increase of water supply into side arms and the increase of water flow in them, and the increase of water surface. A very important aspect is the possibility to mitigate the impact of expected climate change with the regulation of water level. In terms of natural resources, this variant will contribute to improving and sustaining the water infiltration to the bank-filtered systems of wells. The site of the dam construction is possible to incorporate into the country without significant interference. The development of local infrastructure will increase the tourist attraction of the surrounding of the dam. A significant benefit will also be the fact that the need for construction works in the Danube riverbed, which would contribute to the degradation of landscape values, decreases.

Generally, in order of an comprehensive territorial development it is necessary to harmonize the particular integrative planning systems - landscape planning, spatial planning and socio-economic development planning - with partial or sectoral planning activities (river-basin management plans, forest management plans, spatial plans of municipalities, plans and programs for waste management, land care programs, etc.

Proposal 16.	1. *In areas with significant landscape values,* ***those touristic developments should be preferred, which takes the landscape protection aspects*** *into consideration.* 2. In case of variant with water level impoundment it is necessary to embed sensitively the objects into the landscape, in order to mitigate its disruptive impact as much as possible. With the appropriate development of infrastructure it is necessary to increase the tourist attractiveness of the surroundings (pedestrian malls, bridge connection between the banks of the Danube, etc.).

4.2.8. Impacts on the land-use and spatial structure

The land use and spatial structure have significant importance in terms of landscape diversity and the ecological stability of landscape.

1. Preservation of the present state

While preserving the present state and without significant investment incentives the land-use remains without changes, and dynamic changes in landscape structure also cannot be assumed. The ongoing process of deepening of the Danube riverbed will lead to a decrease of aquatic and wetland habitats and the subsequent terrestrialisation of some parts of river arms and riparian areas of today's inundation area.

2. VITUKI Base - 1

In case of the variant VITUKI Base - 1 the Hungarian Party states that the technical solutions (construction of river training works, dredging of the riverbed, reconstruction of the bars and the building of new spur-dykes) can influence the methods of land-use by disturbing the natural vegetation. Regarding the spatial structure it states that the interventions proposed in the main branch, as they are adjusted to the features of the area, will not have impacts on the spatial structure and will not endanger the landscape characteristics. In case of interventions for rehabilitation of side arms improvement of the ecological and socio-economic sustainability of the landscape can be expected. Interventions for the rehabilitation of side arms may assure positive changes in land use and in the development of spatial structure by ensuring the natural character and conservation of natural species, the conservation of the natural landscape and the development of tourist destinations and attractions. Accompanying negative effects of construction activities (such as vacation homes, bungalows, ports, piers, etc.) that may endanger ecological corridors should be compensated by interventions, which are directed at improving the landscape.

According to the opinion of the Slovak Party, interventions in the main flow of the river in case of variant VITUKI Base - 1 will not have much greater impact, than in case of the preservation of the present state, which means that the land use and the spatial structure remains almost unchanged. The increase of water level will not be significant, and thus no rise of aquatic habitats area comes up. In case of the rehabilitation of side arms the Slovak Party agrees with the opinion of the Hungarian Party, that interventions may assure positive changes in land use and in the development of spatial structure. Modifications of side arms can lead to an increase in the area of aquatic habitats. For an increase in wetland areas more significant rise of surface and subsequently of ground water levels would be necessary. The Slovak Party also agrees with the statement that the accompanying negative effects of construction activities can be easily mitigated and compensated by interventions aimed at improving the landscape (basically the rehabilitation of side arms itself is already such an intervention).

3. Water level impoundment by a dam

The variant with water level impoundment in terms of land use has clearly positive impact. The increase of water level in the main riverbed allows the navigation of vessels without barriers and time restrictions. Permanently increased water level will affect the development of infrastructure along the main river branch, as well as on the banks of rehabilitated river arms. The Infrastructure development and construction interventions must be implemented in accordance with the nature of the landscape. Possible negative effects of such intervention are necessary to mitigate and compensate by interventions aimed at improving the landscape.

Also the changes in terms of spatial structure according to the view of the Slovak Party will be mostly positive. Increased water level in the main riverbed will contribute to restoration of riparian and wetland habitats. There will be a permanent increase of the water area, thereby the area of terrestrial or occasionally flooded sites decreases. Some of today's islands will be below the water level. The negative impacts in terms of spatial structure can be expected at the site of the dam construction. However, these impacts can be mitigated by suitable embedding of the object into the landscape structure. On the other hand, at the site of the dam the possibilities for land use and infrastructure development will significantly improve.

4.2.9. Impacts on the quality of the environment and the safety of the environment at settlement level

At settlement level the historical values, the interventions influencing the conservation of landscape values and the measures connected to the development of natural and cultural *values may have positive impacts. The positive impacts on environmental quality may be experienced in the settlements along the side-arm system, as a consequence of the proposed ecological rehabilitation process*

In terms of the safety of the environment the flood protection is the most important for the Slovak Party. In 1965 just on this section of the Danube a flood occurred. As mentioned above, the health protection is also important, especially within the expected climate changes. This relates particularly the whole Danube area downstream of Bratislava, because this area is a malaria endemic area, with occurrence of malaria even after World War II. The safety of the environment applies also to all water-borne diseases, hygiene and dustiness of the environment.

1. Preservation of the present state

In the frame of this variant it can be stated that the present state in terms of flood protection is not completely satisfactory. Especially the area in the stretch of the Danube from Sap to the mouth of the Mosoni Danube is the most vulnerable to flooding. Similarly, deterioration in the quality and the safety of the environment can be expected due to climate changes. Conversely, improving of the quality of the environment can be expected in relation to the gradual completing of the sewerage network and sewage treatment plants. These projects, however, does not relates to the interventions necessary for maintenance of the present state.

2. VITUKI Base - 11

The Hungarian Party states that *the environmental quality of the settlements may be influenced by the local air and noise pollution resulting from the increased vessel traffic and those touristic developments in which the supporting and tolerance limit of the environment have not been considered. This may be compensated for by the modernisation of the shipping fleet following on from the improvement of the waterway.*

The elimination of the obstructions in the waterway of the main river branch, dredging and the construction of new spur-dykes will improve the safety of navigation, thus, it may have positive impacts on environmental safety through protection against the possible havaria-type contaminations.

According to the opinion of the Slovak Party, in case of the variant VITUKI Base - 1 a slight improvement or at least preservation of the current level of quality and safety of the environment can be expected. But from the long-term point of view the situation will be similar to that of the variant with preservation of the present state, i.e. worsening of navigation conditions, vulnerability in terms of flood protection and degradation of quality and safety of the environment due to climate changes.

3. Water level impoundment by a dam

Improvement of the quality and the safety of the environment according to the opinion of the Slovak Party may be expected even in case of the variant with water level impoundment. The implementation of impoundment according to the Joint Contractual Plan on this stretch of the Danube includes the improvement of flood protection. The increased water level makes it possible to mitigate the impacts of climate change by means of water management. Unlike the variant VITUKI Base - 1 this variant is sustainable in long-term, without the need of substantial investments in the future.

Potential adverse effects in terms of the environment (local air pollution, noise pollution, pollution by sewage water from vessels) resulting from the increased traffic of vessels, due to a significant improvement of navigation conditions, can be effectively reduced by consistent requirement of abiding by the regulations related to the operation and traffic of vessels and by modernization of vessels. On the other hand, the navigation safety will increase and the air pollution originating from road traffic will decrease.

4.2.10. Sustainability impacts (impacts on the sustainable social and economic conditions at regional level)

The interventions assuring the environmental, social and economic sustainability of a given region may be considered as positive, if they do not work against each other but by using the local synergies can improve the conditions of the given region.

As a result of the improvement of the navigability of the Danube ***favourable impacts may be expected in the spatial structure*** *of the Danubian region (economic development, improvement of trade and profitability),* ***but the section examined between Sap and Szob may have less benefits.*** *Safer and more reliable navigation may establish the appropriate conditions for the marketing of local products in the domestic and international markets, and may improve the development of the ports and logistics sector. The infrastructure of navigation may also be improved, which can serve to decrease the time and costs of waterway transport, thus, it may have positive impacts on the whole transportation sector.*

The ***planned interventions for the ecological rehabilitation of the side-arms may establish good conditions for sustainable regional development, especially if they also improve the development of environmentally-friendly forms of tourism, which is based on local conditions and infrastructure.*** *The local income generation may also be developed, therefore the social structure of the affected region may also be improved.*

Sustainable development is targeted process of changes for achieving the highest sustainable quality of life and meeting the needs of society with an environmentally sustainable economy and with environmental quality for the society.

1. <u>Preservation of the present state</u>

Regarding the sustainability (sustainable social and economic conditions at the regional level) is the preservation of the present state very costly solution. Moreover, in view of expected further degradation of the Danube riverbed and the associated decrease of surface and ground water levels, this situation is not sustainable in the long-term. The same statement also applies to the situation in the side arms. This solution does not adequately ensure the sustainability of the region and does not guarantee a stable and sustainable development of environmental quality.

2. VITUKI Base - 1

According to the Hungarian Party the proposed interventions will have positive impacts on environmental, social and economic sustainability of the given region. From the improvement of the navigability economic development and improvement of trade may be expected, although on the local level the Hungarian Party expects it in a lesser extent. Development of infrastructure, ports and logistics sector may establish appropriate conditions for marketing of local products in the domestic and international markets. Positive impact on sustainable regional development is also expected from the interventions for ecological rehabilitation of side arms.

The Slovak Party agrees with this view of the Hungarian Party, however in the long-term sustainability of this variant it sees disadvantages. The Hungarian Party in its material mentions that interventions for the maintenance of navigation conditions need to be repeated. It can be expected a gradual degradation of the riverbed and lowering of surface and ground water levels, similarly to the variant with the preservation of the present state. This variant will partially contribute to sustainable development in connection with the rehabilitation of side arms. Their subsequent use in the development of tourism needs to be aligned with the interests of nature conservation.

According to the opinion of the Slovak Party this variant is also not sustainable from the social and economic point of view in long-term, and it will require high maintenance costs.

3. Water level impoundment by a dam

Contrary to the variant VITUKI Base - 1 this variant will ensure long-term improvement of navigation conditions and without additional cost to maintain the achieved status. Investors, in case of the variant with water level impoundment, may rely on sustainable state in long-term and therefore on greater certainty of return of investments. Along the entire section development of local infrastructure can be expected. Significant improvement of navigation conditions and their predictability will allow an extensive development of navigation infrastructure and reduction of time and costs of water transportation. The development of local infrastructure, tourism and development of water transport will contribute to the local income generation, which will lead to an improvement in social structure and economic conditions in the influenced area.

4.2.11. Impacts on the renewal and the spatial use of natural resources

As a natural resources in terms of renewability and utilization the Slovak Party considers the groundwater storage, that are or could be used for drinking water supply, the wood mass in commercial forest stands, the agricultural potential of the surrounding areas used for agricultural purposes and the hydro-power potential of the Danube stretch between Sap and Budapest. Some impacts are detailed in chapter 5.

1. Preservation of the present state

In terms of renewability and utilization of natural resources the Slovak Party considers the variant with the preservation of the present state as slightly negative or negative. Due to the expected further riverbed degradation and the related decrease of surface and ground water levels this variant will have a negative impact on the groundwater storage, and the possibility and effectiveness of forestry and agriculture. The hydropower potential cannot be utilized at all in the frame of this variant.

2. VITUKI Base - 1

According to the opinion of the Hungarian Party *the proposed interventions and measures for the ecological rehabilitation of the side-arms will definitely improve the renewal of the natural resources, namely the renewal of the groundwater and surface waters. The increase in water flow may be a result of the proposed interventions, which will improve the renewal of water and sustainable water management.*

The Slovak Party, however, is of the opinion that the variant VITUKI Base - 1 will improve the renewability of natural resources only in a small extent and only temporarily. The water level increase in the main stream of a few centimetres will not have a significant impact on groundwater levels and consequently on the potential to improve the groundwater resources. In the long term, even in case of this variant decrease of surface and ground water levels can be expected, and thus also a negative impact on groundwater storage, forestry and agriculture. Neither in the frame of this variant is possible to utilize the hydropower potential.

3. Water level impoundment by a dam

The water level impoundment by a dam will ensure a permanent increase of surface and ground water levels. Higher surface water level will improve the ground water supply and in certain areas the exploitable groundwater storage may increase. Higher groundwater levels will support the forestry and agriculture in surrounding areas. The variant with water level impoundment by a dam will allow the utilization of hydro-potential in the dam construction site. In terms of renewability and utilization of natural resources, the Slovak Party considers this variant as a positive.

4.2.12. Promotion of environmental consciousness and the principles of sustainable life-style

Most of the proposed interventions and measures are in compliance with the requirements of sustainable development. However, four sectors and the connected sustainability aspects should be emphasized, namely tourism, fisheries and angling, water management and waste management.

It is important, that in the planning, construction and management processes of the interventions the fact, that the supporting capacity of the region is limited should be taken into consideration. The local ecological and cultural values should be preferred, the regional products should be connected into the local services and, in addition, the use of renewable energy sources should be preferred.

There is a very important task for the local governments, educational institutions and civil organizations, namely, to draw attention to the importance of the environment-friendly and sustainable life-style. It is also important to establish the conditions for social processes, *which take environment awareness and responsibility for future generations into consideration. The active element of the local society should be drawn into this process. The most important objectives are the following: environment-friendly transport methods, selective waste collection, development of the sewerage system, water, economic use of water and the maintaining of traditions.*

Promotion of environmental consciousness and the principles of sustainable life-style are important also according to the opinion of the Slovak Party. The Slovak Party agrees with the Hungarian Party also in that, that this is mainly a task for local governments, educational institutions and civil organizations.

Regarding the objectives set up by the Hungarian Party (*environment-friendly transport methods, selective waste collection, development of the sewerage system, water, economic use of water and the maintaining of traditions*), the Slovak Party is of the opinion that all these objectives can be achieved in any of the variants considered.

The Slovak party points out that all these objectives, except the maintaining of traditions, are part of the Gabčíkovo - Nagymaros Project in force. Many of these objectives were met on the Slovak side. On the other hand, it should be emphasized that GNHP has got also additional objectives defined. Some objectives of the Project cannot be fulfilled with variants without water level impoundment without additional costs and investments (for example: navigational connection between the Danube and the river Váh, gaining the water for irrigation at the area upstream of the mouth of river Ipeľ, improving of navigation conditions as recommended by the Danube Commission, etc.).

The Hungarian Party in its proposal provides a variety of activities (water sports, tourism, fishing, recreation, etc.) as important sources of the area development. It also indicates the need to evaluate the carrying capacity of the area in terms of particular activities, in order to respect the principles of sustainable development. The Slovak Party is of the opinion that the environmental carrying capacity for each activity would be beneficial in this area.

Proposal 20.	1. In case of any of variants it is necessary to conduct an evaluation of carrying capacity of the area for planned activities (water sports, tourism, fishing, recreation, etc.) in order to respect the principles of sustainable development.

5. OTHER SIGNIFICANT IMPACTS OF PROPOSED INTERVENTIONS AND MEASURES

5.1. Impacts on transport

The transport policy of the European Community is oriented on mobility, focusing on the sustainable development of efficient, reliable and safe transportation with the lowest possible environmental impact. Well-developed transport network is an essential prerequisite for economic development of particular regions. For this reason, one of the cornerstones of EU transport policy is the Trans-European Networks (TEN-T), which aim is to create quality infrastructure interconnecting all European Union countries. TEN-T networks consist of road, rail, air and water transport networks. The proposed interventions on the stretch of the Danube between Sap and Budapest are mainly aimed at solving the problems of freight transport. A solution of these tasks provides the multimodal transport, which in integration of the road and rail transport, or road and water transport, or with cumulation of all three modes of transport provides opportunities to use their benefits. The development of multimodal transport can reduce the intolerable load of the road network, as well as the number of accidents, makes it possible to reduce the negative effects of the transport on the environment, and with application of transport systems provides qualitatively new conditions for improving the quality of transport of goods. The development of multimodal transport is supported by regulations of the European Community, the European Commission and resolutions of the European Conference of Ministers of Transport.

The uneven development of different transport modes is one of the biggest challenges (**Table 5.1, 5.2**). The aim of the EC transport policy is also to increase the share of environmentally friendly modes of transport in total transport volume (**Table 5.3**). In order to achieve this aim measures on reviving the railway transport, the development of inland navigation and linking all transport modes should be taken.

Table 5.1. The share of particular transport modes in the European Union on the total volume of freight transport

Mode of transport	Share in %	
	inland	total
road transport	73.8	46.6
railways	15.8	10.0
inland water transport	5.2	3.3
sea transport	-	36.8
air transport	-	0.1
pipelines	5.2	3.3

Source: Statistical Pocketbook 2011 – EU Transport in Figures, 2011

Table 5.2. The share of particular transport modes in the European Union on the total volume of passenger transport

Mode of transport	Share in %
road transport (cars, motorcycles, bus and coaches)	83.7
railways	6.2
tram and metro	1.4
sea transport (within EU)	0.6
air transport (within EU)	8.0

Source: Statistical Pocketbook 2011 – EU Transport in Figures, 2011

Table 5.3. The share of particular transport modes in the European Union on the total energy consumption and greenhouse gas emissions

Mode of transport	Energy consumption	Emissions
	share in %	share in %
road transport	81.3	70.8
railways	2.5	0.6
total navigation (including maritime)	1.7	15.2
total civil aviation	14.5	12.7
other transportation	-	0.8

Source: Statistical Pocketbook 2011 – EU Transport in Figures, 2011

5.1.1. Impacts on navigation

The Danube is a major corridor of the TEN-T network. It is used but well below its capacity options. The amount of cargo transported on the Danube is only 10 to 20 % of the amount of cargo transported on the Rhine. Because the inland water transport has a significant benefit in terms of environment and effectiveness, its potential need to be used in a sustainable manner.

The impacts of water transport under ideal conditions for sailing would be expressed principally in goods and transit traffic in the East - West direction by transfer of freight from road to water. In Slovakia it is mainly the freight traffic towards the Black Sea and into the Western Europe via the Danube-Main-Rhine channel. To this transport corridor the transport in the north-south direction is linked along the river Morava and Váh to the Czech republic and Poland.

The navigation on the Danube is covered by the Convention on Navigation on the Danube (Belgrade, 1948) (hereinafter „the Convention"). The Convention was concluded in order to ensure freedom of navigation on the Danube in accordance with the interests and rights of sovereign Danubian countries. Parties to the Convention agree that it is in the public interest to keep the Danube in good navigable condition.

Determination of parameters of the fairway, hydraulic structures and other facilities on the Danube, were gradually suggested on meetings of the Danube Commission (DC) - XVIII, XX, XXI, XXXIII, XXXVIII and XLV. The last recommendation of DC regarding the parameters of the fairway was adopted by the document No. CD/SES 45/13 in 1988, which states:

- in the article 4.1.4: *„The minimal depth in the stretch Vienna - Braila (rkm 1920.3 to 170.0) will be in the sections with free flow of the river not less than 25 dm and the sections of the river under the influence of the backwater not less than 35 dm."*
- in the article 4.2.5 and 4.2.6: *„The minimal width in the stretch Devin - Gönyű (rkm 1880.2 to 1791.0) in the sections with the free flow of the river is not less 150 m, on rock-bottom sections no less than 100 m, on ford sections with easily scouring bottom not less than 120 m, and in the river sections under the influence of the backwater (reservoir) not less than 150 m. In the stretch Gönyű - Georgijevskij Čatal (rkm 1791.0 to 62.97) in the sections with the free flow of the river not less than 180 m, on rock-bottom sections with no less than 100 m, on river sections with easily scouring bottom not less than 150, and on the impounded sections of the river (reservoir) not less than 180 m with an increase in the curvatures of this section to 200 m."*
- in the article 4.3.6: *„The minimal radius of curvature of the stretch Devin - Sulina (rkm 1880.26 to 0.0) as an exception to sections with unfavourable geomorphologic conditions will be not less than 750 m."*

Following the preparation of the „European Agreement on Main Inland Waterways of International Importance" (AGN Agreement) the Danube waterway was classified by the Danube Commission as follows:

- the stretch Kelheim – Regensburg	class Vb,
- the stretch Regensburg – Vienna	class VIb,
- the stretch Vienna – Beograd	**class VIc,**
- the stretch Belehrad – Sulina	class VII.

This classification allows the creation of an uniform system of hydraulic structures on the Danube with optimised parameters to enhance the safety of navigation and to achieve appropriate navigation conditions for establishing satisfactory arterial connection between the Black Sea on the one hand, the North and Baltic Sea on the other hand, and the linkage of waterway networks of the Western Europe through Rhine basin to the Danube and the Central and Eastern Europe. At the same time the basic dimensions and arrangements of fleets are determined by this classification.

The list of problematic sections of the Danube waterway is contained in the document of the Danube Commission No. 160/VI-2003 of June 10, 2003. In relation to the navigation depth in the Danube stretch between rkm 1810 and 1708.2 (Sap - the mouth of river Ipeľ) it is stated that the river in dry seasons has low depth (up to 1.7 m) and it’s deepening to 2.5 m is required. The stretch of the Danube from rkm 1708.2 to 1652 (mouth of the river Ipeľ - Budapest) has small navigation depths (1.5 to 1.7 m). In addition, during low water levels the width of the fairway is also not satisfactory.

1. Preservation of the present state

In case of the variant with preservation of the present state the current inadequate navigation conditions remains preserved as well. On the Danube section between Sap and Gönyű (rkm 1811-1788) there are several narrowings. The section of the Danube from Gönyű to Komárno (rkm 1788-1766) is less problematic, the navigation depth and width are acceptable for the time being. On the Danube section between Komárno and the mouth of the river Ipeľ (rkm 1766-1708) there are several fords, some of which are rocky, consisting of marl. Besides fords there are also narrowings on this section, with insufficient width of the fairway. On the Danube section from the mouth of river Ipeľ to Budapest (rkm 1708-1652) there are several fords again, some of which are also rocky, consisting of andesite. Maintenance of the Danube riverbed and the fairway will lead to further degradation of the riverbed and it can be assumed that the navigation conditions will deteriorate further. According to the data of the Danube Commission on the Danube section Sap - Szob the navigational depths for example during the period 1.4.1995-31.3.1996 were less than 25 dm for 166 days, while the average flow rate on the Danube was slightly above the average in this period. During the year 2003 the navigational depth of 25 dm was not reached for 175 days, while the lowest navigation depth was only 11 dm (the average flow rate was slightly below the average, but especially in the summer period flow rates significantly below the average occurred in long-term). The same applies also to the section Szob-Budapest, where in 2003 a depth of less than 25 dm occurred for 174 days and the lowest depths reached only 13 dm.

2. VITUKI Base - 1

The Hungarian Party under the variant VITUKI Base - 1 indicates that improvement of the waterway parameters will be achieved by dredging, constructing of spur-dykes and guiding walls, and by addition or reduction of spur-dykes. This variant would guarantee the navigability for vessels with draught of 2.50 meters, with the width of waterway of 120-150 m.

Although the Hungarian Party in its material indicates that the appropriate navigation conditions can be ensure only by **comprehensive regulation of the section**, and not by isolated removing of shallow fords and narrowings, the Slovak Party considers this solution as inadequate and its effect limited in time. According to the Slovak Party the improvement of navigation conditions will be slight only, and at lower water levels the navigation conditions will be still unsatisfactory. In addition, following a certain stabilization of the riverbed, worsening of navigation conditions can be assumed again in the near future.

The Hungarian Party itself admits that changes in riverbed arrangement can occur in the future, which need to be solved by constructing new river regulation structures. Moreover, it is necessary to count on with annually recurring costs of the riverbed and fairway maintenance.

3. Water level impoundment by a dam

In case of the variant with water level impoundment by a dam significant improvement of navigation conditions will occur on the Danube stretch between Sap and Budapest.

Parameters of the waterway on the whole Danube section from Bratislava to Budapest will meet the recommendations of the Danube Commission (navigation depth of 3.5 m and the fairway width 180 m). This means that every ford sections and narrowings on the whole stretch will be eliminated and the safety of navigation will increase. The reduction of fuel consumption at the upstream navigation, what will result in a significant reduction of emissions and reducing of navigation costs, can be counted to related benefits.

Unlike the first two variants, this solution in terms of long-term sustainability is sustainable at minimum costs of fairway maintenance.

5.1.2. Impact on the Váh waterway

The waterway on the river Váh is according to the AGN Agreement integrated into main inland waterways of international importance with the identification code E 81, and with possible links to the Odra river. By signing of AGN Agreement, the Slovak Republic has committed to ensure the parameters of the Váh waterway in class VIa in the section Komárno - Sereď and in class Va in the section Sereď - Žilina, in the sense of classification of European inland waterways of international importance. On the stretch between Žilina and the mouth of the river Váh into the Danube this is the last impassable part of the river on the lower section of the river Váh. According to the Joint Contractual Plan the impoundment of the water level in the Danube should ensure the navigation depth on the lower section of the river Váh in the sense of the AGN Agreement.

In case, that the impoundment of the Danube water level would not be implemented, the navigability of the lower stretch of the river Váh could be realized only by an additional investment to build a hydraulic structure.

1. <u>Preservation of the present state</u>

In case of preservation of the present state on the Danube no changes are anticipated on the lower section of the river Váh. In order to make the Váh waterway navigable an additional investment would be necessary to build a hydraulic structure.

2. <u>VITUKI Base - 1</u>

Not in the case of variant VITUKI Base - 1 can be changes expected on the lower section of the river Váh. To make navigable the Váh waterway will require an investment to build a hydraulic structure.

3. <u>Water level impoundment by a dam</u>

In case of impoundment of the Danube water level, the water level will rise also on the lower section of the river Váh. Increase of the level is expected up to Kolárovo and after some adjustments of the Váh riverbed in the lower section, the connection of the Váh waterway with the Danube will be ensured.

5.2. Impacts on electricity production

5.2.1. Production of electricity

According to the Joint Contractual Plan there is a 1040 GWh per year[29] usable hydropotential on the Danube stretch from Sap to Budapest. The hydropotential, which is in this stretch available, represents clean, waste less, renewable energy with minimal operating costs. The stated amount of energy can be produced at an average annual flow rate of 2300 $m^3.s^{-1}$ in at continuous operation of the hydroelectric power plant. The total amount of energy is about 5 % of total annual electricity consumption in Slovakia.

1. <u>Preservation of the present state</u>

The preservation of the present state does not allow using the hydropotential. Resources spent on maintenance of the fairway and the riverbed is just the costs without any return.

2. <u>VITUKI Base - 1</u>

Not the variant VITUKI Base - 1 does allow the use of hydropotential. Funds invested in the riverbed adjustment in order to improve the navigation conditions and the subsequent maintenance costs are similarly to the variant with the preservation of the present state with no return.

3. <u>Water level impoundment by a dam</u>

In the frame of this variant it is assumed according to the Joint Contractual Plan, that at the location of the dam a hydropower plant will be constructed. The hydropower plant should be operated in continuous mode, and at an average annual flow rate of 2300 $m^3.s^{-1}$ it should allow the production of 1040 GWh of electricity per year. Revenue from electricity sales is the only income, which will ensure the return of investments, whether the construction of the dam, the necessary maintenance of the fairway, or environmentally oriented investments (e.g. the rehabilitation of river arms, and the like).

5.2.2. Peak-power production

1. <u>Preservation of the present state</u>

The variant with preservation of the present state does not allow the production continuous or peak-power.

[29] At present, the market price of 1 MWh of about 60 euros, which at an annual production of 1,040 GWh represents around 62.4 million euros a year (valid for Germany). The retail price for a households is about 250 million euros. In case of the use of the entire system for production of peak energy the cost of energy produced during peak is overvalued by about 40-50 %. Even at continuous operation it is possible to „store" the energy in pumped storage hydroelectric plants and produce peak energy in these hydroelectric plants. Teh amount of electricity produced with pumped storage power plants is about 75 % of the amount of energy consumed for pumping. The energy „stored" this way can be used during peak hours, or as an alternative production for the wind and solar power plants.

2. VITUKI Base - 1

Similarly, the variant VITUKI Base - 1 does not allow using the hydropotential for production of base or peak-power.

3. Water level impoundment by a dam

The variant with water level impoundment by a dam, assuming the construction of hydroelectric power plant at the location of the dam, allows in cooperation with the Gabčíkovo Hydropower Project the production of peak-power. The need and the extent of peak-power operation, with the least impact on the natural environment, can be considered. Even in case of continuous operation of the whole system of hydraulic structures, the peak-power production is possible in cooperation with pumped storage power plants.

5.3. Impacts on economic development

5.3.1. Investments

The economic development of the region largely depends on the inflow of investments. Investments are again dependent on infrastructure, which is represented mainly by transport and energy networks.

1. Preservation of the present state

It is not possible to count on increased investments when preserving the present state. The capacity of transport networks remains at the current level. The costs of maintaining the navigation conditions and the Danube riverbed are only expenses. Great part of the available funding is expended on the maintenance of the current (inadequate) navigation conditions. The current navigation conditions do not trigger the need of supporting investments in the development of navigational infrastructure. The present state in the side arms is an obstacle to investment in tourism development.

2. VITUKI Base - 1

The variant VITUKI Base - 1 represents certain investments on the Danube stretch between Sap and Budapest, relating to the improvement of navigation conditions. Since the invested resources do not generate income, the investments and maintenance costs represent only expenses. Partial improvement of navigation conditions and their stabilization for some time, however, in the opinion of the Slovak Party will not lead to significant change in terms of the volume of goods transported. This will be henceforth hampered by restrictions on some sections at lower flow rates, and also by obstacles in the navigability upstream and downstream of the Danube stretch between Bratislava and Budapest. In addition, there will be no pressure to solve these problematic sections. Certain investments can be expected in connection with the rehabilitation of side arms, but also these investments, according to the opinion of the Slovak Party, will be in a limited extent, since the established water level regime will not be stable and decrease of surface and groundwater levels can occur.

3. Water level impoundment by a dam

The variant with water level impoundment by a dam is an investment itself. The hydro-potential in the location of dam construction can be used for electricity generation. The income from sale of electricity can not only ensure the return of funds spent on hydroelectric power plant, but also the return of other funds spent on improving the navigation conditions, rehabilitation of side arms and the development of basic infrastructure. Significant improvement and stabilization of the navigation conditions create good conditions for further investments. From the long-term point of view the investment produces profit. Although the increase of the volume of goods transported on water cannot be expected immediately, due to the obstacles in the navigability upstream and downstream of the Danube stretch between Bratislava and Budapest, it can be assumed that increase will occur in the near future. It could be accelerated with legislation supporting the transfer of freight transport from road to water. Rehabilitation of side arms will create conditions for investments supporting the local development and increase of tourist attractiveness of the area.

5.3.2. Employment

1. Preservation of the present state

In terms of employment in case of preservation of the present state it is not possible to expect any changes. Works on maintaining the navigation conditions and the maintenance of the riverbed will be carried out in the existing extent.

2. VITUKI Base - 1

In case of the variant VITUKI Base - 1 a slight increase in labour demand is possible to expect for the time of implementation of the Danube riverbed adjustments and the rehabilitation of side arms, but after completion of works the employment probably returns to the initial level. Subsequent works on maintaining the established status will be carried out in the existing extent. Slightly increased employment can remain in the event of smaller investments in the development of local infrastructure and tourist attractions in relation with the rehabilitation of side arms.

3. Water level impoundment by a dam

In case of water level impoundment by a dam, significant increase of employment can be expected, particularly at the location of the dam construction. The employment will decrease after completion of works, but it should remain on higher level in comparison with other variants (employment-related to the operation and maintenance of the dam and power plant). At the same time it is possible to count with an increase in employment in the settlements along the flow, resulting from the induced investments into the development of local infrastructure, development of tourist attractions, and the like. Similarly as in the previous variant VITUKI Base - 1, increased employment can be expected in relation with the rehabilitation of side arms. However, the likelihood of investments into the development of local infrastructure and the tourist attractions is higher, compared to the variant VITUKI Base - 1 due to significant and sustainable improvement of navigation conditions and the permanent increase of water level in the main branch and side arms.

5.3.3. Competitiveness

1. Preservation of the present state

The variant with preservation of the present state will have no impact on competitiveness. The transport capacities and the opportunities to sale the local products will not change.

2. VITUKI Base - 1

In case of the variant VITUKI Base - 1, the competitiveness could slightly increase in the event of development of navigation infrastructure and ports along the river. The development of local infrastructure and tourist attraction of the area, in relation to certain improvement of navigation conditions and especially the rehabilitation of side arms, may contribute mainly to increased sales of local products.

3. Water level impoundment by a dam

The variant with water level impoundment by a dam will ensure a permanent increase of surface water level, and will greatly improve the navigation conditions. Taking into consideration the assumed investments into the infrastructure and ports, rise in competitiveness of the region can also be expected. Similarly as in the variant VITUKI Base - 1, it can be expected the development of local infrastructure and the tourist attractiveness of the area along the main branch, as well as around the rehabilitated side arms. As a result of local development, an increased sale of local products can also be expected. Implementation of this variant brings many synergistic benefits.

6. PROPOSED INTERVENTIONS AND MEASURES IMPROVING THE ENVIRONMENTAL PERFORMANCE AND SUSTAINABILITY

This chapter summarizes the proposals made by Hungarian Party in its material concerning the variant VITUKI Base - 1, as well as the proposals amended by the Slovak Party in the previous chapters of the Environmental Report (the number before the proposal is the proposal number, the number of item is in brackets).

6.1. Proposed interventions and measures improving sustainability

1(2) The methods in order to assure, to improve and to maintain the conditions of sustainable inland navigation are under elaboration for the Danube Basin. These methods should be used during the realization process of the interventions improving navigability. The principle of precaution should be considered, the interventions should be made gradually and should be divided into short, pilot sections.

4 In the framework of the confirmation process of the proposed technical solutions the following examinations shall be taken in accordance with the WFD criteria:

- *a) examinations to be undertaken for the qualification (for example revising as heavily modified water body) of the water body (Art. 4.3. test),*
- *b) the confirmation of moderate, less stringent environmental objectives (Art. 4.5. test)*
- *c) the socio-economic and environmental feasibility of the planned technical solutions and measures (Art. 4.7. test).*

8 Long-term evolution of the river bed profile associated with measures should be studied intensively using latest technologies, e.g. bed load transport models in order to establish a sediment management plan. The ecological impact of measures should be evaluated by taking into account relevant EU experiences.

9 The realization process of proposed interventions for the improvement of the parameters of the waterway and for rehabilitation in the main branch and the side-arm system should be harmonized with the construction works for the development of flood protection.

12 We propose the elaboration of special sustainability aspects for those habitats and ecosystems with an outstanding natural value in order to conserve the diversity of the main river branch, the side-arms and the islands. In these special sustainability aspects it should be emphasized that the touristic and intensive recreational use of protected areas of natural importance and intensive angling activities are not recommended.

13(2) The ecological monitoring system of the Danube section between Sap and Szob should be broadened; the biological surveys are constrained to smaller areas and only for a few species at the present. We propose to conduct a long-lasting monitoring survey in order to assure traceability of the changes of the typical ecosystems and populations.

18 We propose that – considering the possible conflicts between navigation, land-use and environmental protection and nature conservation – Local Monitoring Groups should be created by the participation of experts and the civil organizations for the monitoring of the planning, the realization and the operation process of the interventions.

19(1) The monitoring system should be elaborated in accordance with the requirements of the WFD, and it is proposed to supplement this by including indicators on nature conservation, landscape protection and environmental protection. In the elaboration of this monitoring system, the obligations of international and national legal rules (for example Convention on Biological Diversity Agreement, Habitats Directive, Birds Directive, Natura 2000, Ramsar Convention) should also be taken into consideration.

19(2) The Slovak Party proposes to realize the monitoring of environmental impacts on the Danube stretch between Sap and Budapest in the extent of monitoring according to the Intergovernmental Agreement of 1995. It is possible to adjust the extent of monitoring according to the specifics of the given stretch Danube.

20 In the event of any variant it is necessary to conduct an assessment of carrying capacity of the area in terms of planned activities (water sports, tourism, fishing, recreation, etc.), in order to respect the principles of sustainable development.

6.2. Proposed interventions and measures on reducing the possible impacts

3 In the course of the authorization process of the local plans for land use and the environmental authorization of touristic and infrastructural developments the following aspects should be taken into consideration:

a) the manifestation of the ecological self-regulating mechanisms should be considered.

b) in the course of forestation the native species should be preferred, and the existing natural forests and woodland should be protected.

5(1) In order to estimate the impacts on the subsurface drinking water sources complex hydraulic and biochemical processes should be examined both above and beneath the surface. For this process in situ examinations and the use of mathematical models are needed, which should be conducted during the planning process. The results of the examinations and the measures taken for the protection against possible negative impacts or for reducing them should be detailed in the environmental authorization process.

7 Prior to the environmental permitting procedures of the proposed interventions the following aspect should be taken into consideration:

(a) Are the proposed interventions for the improvement of navigability in compliance with the requirements of Paragraphs 3., 7., 8 and 9 of Article 4 of the Water Framework Directive and the Paragraph 3 and 4 of Article 6 of the Habitats Directive in ecological aspects?

(b) What complex and permanent future impacts should to be considered as a result of the proposed interventions for the improvement of navigability in the present ecological status of the Hungarian Danube section?

13(1) In the course of the interventions, the water-related status of the flora and the fauna should be conserved, or their ecological value should be improved. The expansion of terrestrial ecosystem types, the reduction of biodiversity and the increase of the invasive species should be avoided.

14 In the course of the environmental authorization process of the proposed interventions, it should be required that the interventions and measures for improving the navigability should be realized in parallel to the interventions related to the prevention, dissolving or the decreasing of the adverse ecological impacts of the proposed interventions.

15(1) The infrastructure for the treatment of the communal waste and the dangerous waste originating from navigation sources should be determined; the control of the authorities concerned should be intensified. These aspects should be taken into consideration in the environmental permission procedures of ports.

15(2) In order to decrease the microbiological contaminations, the sewage system should be developed in the settlements situated along the riverbanks.

15(3) In case of dredging in the main riverbed and in side arms it is necessary to carry out detailed modelling of surface and ground water flow before the implementation of interventions.

16(1) In areas with significant landscape values, those touristic developments should be preferred, which takes the landscape protection aspects into consideration.

16(2) In case of variant with water level impoundment it is necessary to embed sensitively the objects into the landscape, in order to mitigate its disruptive impact as much as possible. With the appropriate development of infrastructure it is necessary to increase the tourist attractiveness of the surroundings (pedestrian malls, bridge connection between the banks of the Danube, etc.).

17 The following priorities should be taken into consideration during the planning and authorization process of the developments in the area of the side-arms and their neighbouring vicinities:

(a) Establishing local marketing possibilities for locally produced products

(b) Preferring eco-tourism instead of mass tourism

(c) Supporting services demonstrating landscape values and cultural heritage

(d) Development of a bicycle route system.

The proposed procedures and measures to mitigate the potential impacts must be based on the previous long-term negative trend and the definition of the target state. Future impacts must be considered not only as negative but also positive. Besides this it is also necessary to consider the positive effects of the proposed measures and water management possibilities.

6.3. Proposed interventions and measures to align the variants with other strategic documents

1(1) The interventions proposing the improvement of the navigability of the Danube should be harmonized in the framework of international and European agreements.

2 The present and future demand for waterway transport should be evaluated at national and international level, the impacts of waterway transport on employment, competitiveness and regional cohesion processes should be explored. These investigations should be extended for other transport methods, as well.

10 The use of a life-cycle approach is suggested for those examinations, the objective of which is to explore the impacts of the change from railway to waterway transport, on the emissions of air pollutants (generated in areas outside the waterway).

11 The impacts of climate change
a) on the navigability of the Danube,
b) on the touristic utilization of the side-arms, and
c) on the ecological status of the Danube,
d) on the shoreline country
should be examined.

7. SUBSTANTIATION OF CONSIDERED VARIANTS AND THE DESCRIPTION OF EVALUATION

7.1. Selection of considered variants

The main objective of strategic environmental assessment is **to evaluate variants of interventions and measures for the improvement of navigability of the Danube stretch between Sap and Budapest** and technical solution for the rehabilitation of side arms. The Hungarian Party in its document assessed three variants, which should lead to an improvement of navigability. („VITUKI Base - 1", „VITUKI Base - 2", „Realignment of the navigation channel"). <u>The Slovak Party its proposals aimed at assessing the current situation, one of the variants proposed by the Hungarian Party, and the solution according to the original Gabčíkovo - Nagymaros Hydropower Project.</u>

The first variant of the Hungarian Party named „VITUKI Base - 1" is trying to improve the parameters of the waterway by dredging, building spur-dykes and guiding walls, and by addition or reduction of spur-dykes. This variant would guarantee the navigability of vessels with draught of 2.50 m, and with a waterway width of 120-150 m.

The second variant of the Hungarian Party named „VITUKI Base - 2" seeks to improve the parameters of the waterway in the same way as the variant „VITUKI Base - 1", but in addition it wants to prevent the future deepening of the riverbed with planned refilling of gravel. This variant should also ensure the navigability of vessels with draught of 2.50 m, and with a waterway width of 120-150 m.

The third variant of the Hungarian Party named „Realignment of the navigation channel" aims to improve the parameters of the waterway by dredging, newly set up and corrected waterway, and by narrowing of the waterway by buoys. This variant should guarantee the traffic of ships with draught of 2.50 m, and with a waterway width of 100-150 m.

The first variant of the Slovak Party is „Preservation of the present state". In this variant it should be emphasized, that it does not solve the current problems of navigation on this stretch of the Danube, or the possible revitalization of arms. It counts on minimal interventions and technical measures necessary to mitigate the current negative development of the riverbed and to ensure safe navigation conditions.

The second variant of the Slovak Party is identical to the first variant of the Hungarian Party „VITUKI Base - 1", but his assessment takes into account the views of the Slovak Party.

The third variant of the Slovak Party named „Water level impoundment by a dam" is a variant, which solves the improvement of the parameters of the waterway with an impoundment of water level by a dam. The basic source of this variant is the project of Nagymaros hydraulic structure. This variant should guarantee the traffic of ships with draught of 3.50 m, and with a waterway width of 150-200 m. In addition, this variant counts on synergistic elements: improvement of the parameters of the waterway, electricity production, infrastructure development, increase of groundwater levels, benefits to the natural environment.

According to the opinion of the Slovak Party, the assessments of the first and third Slovak variant are the essential prerequisite for the acceptance of responsible decisions on technical interventions in this stretch of the Danube. **Elaboration of the assessment have to provide an overview of positive and negative impacts of particular variants with respect to all objectives of the 1977 Treaty, as they were confirmed by the ICJ judgment from 1997.**

7.2. Methodology of the assessment

7.2.1. Impact assessment of proposed variants according to the Hungarian Party

Methods of the assessment according to the Hungarian Party *„are based on the GRDP Handbook*[30] *and provide an evaluation-analysis framework able to explore the direct and indirect impacts of the planned measures on the environment, the possible environmental changes derived from these impacts, the characteristics and extent of the impacts and the possible ways of preventing or reducing the harmful impacts or damages. The methodology of evaluation is based on the formerly developed*[31] *and applied*[32] *approach that measures planned for the implementation of the Judgement of the International Court of Justice at The Hague shall be* ***evaluated in a uniform evaluation scheme for environmental performance and sustainability.*** *In the elaboration of the methodology of this assessment, the international SEA documents on water resources management and development are also taken into consideration*[33]*."*

The environmental performance and sustainability of the proposed interventions and measures are examined through the following methods:

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[30] Handbook on SEA for Cohesion Policy 2007-2013, Greening Regional Development Programmes Network February 2006, Exeter, UK

[31] Pálvölgyi T., Tombácz E. (2004) Methodology for the Strategic Environmental Assessment for Regional Development. National Society of Conservationists, Budapest,

Fleischer T., Szlávik J., Baranyi R., Branner F., Nagypál N., Füle M., Kósi K. Pálvölgyi T., Princz-Jakovits T., Szlávik P. (2005) Strategic Environmental Assessment of the Hungarian Transport Policy. Közlekedéstudományi Szemle LV. évfolyam 2. szám, 47-55

[32] Strategic Environmental Assessment of the New Hungary Rural Development Strategy and Plan PriceWaterhouseCoopers Kft. and Env-in-Cent Ltd. 2006,

Strategic Environmental Assessment of the Fisheries Operational Programme. Env-in-Cent Ltd. 2007

Strategic Environmental Assessment of the Development Strategy and Plan of the Balaton Region. VÁTI Plc. and Env-in-Cent Ltd. 2008

Strategic Environmental Assessment of the Regional Operational Programmes. VÁTI Plc. és Env-in-Cent Ltsd 2008

[33] Strategic Environmental Assessment Draft Practical Guidance for Practitioners on How to Take Account of Water, SNIFFER (on behalf of the Environment and Heritage Service and the Scottish Environment Protection Agency, 2008,

Strategic Environmental Assessment and Integrated Water Resources Management and Development Economic and Sector Work Environment Department World Bank, 2007

Strategic Environmental Assessment and Climate Change: Guidance for Practitioners, 2007, UK Climate Change Programme

1. *The aspects of the* ***evaluation of environmental performance and sustainability (see below)*** *were determined based on the relevant environmental policy documents*[34]*, which are suitable for the evaluation of the proposed interventions and measures in connection with the improvement of navigability and the ecological development of the side-arms. This set of objectives takes not only the environmental priorities of prevention, re-cycling (re-use) and disposal into account, but also the relevant natural, social and economic aspects of sustainable development.*
2. *The proposed interventions and measures (see Chapter 3) were compared to the environmental performance and sustainability aspects by a collective evaluation of the experts, where the environmental performance of each measure was characterized by values between -2 and +2.*

2 points	*when the proposed interventions and measures promote the fulfilment of the objective in a definite, direct, and significant way*
1 point	*when the proposed interventions and measures promote the fulfilment of the objective in an indirect and non-significant way*
0 point	*when the proposed interventions and measures promote the fulfilment of the objective in a neutral way*
NR	*when the proposed interventions and measures are not related to the fulfilment of the objective*
?	*when the impacts of the proposed interventions and measures cannot be judged*
PR	*"possible risk", when the indirect impacts of the proposed interventions and measures mean environmental or ecological risk for the fulfilment of the objective*
-1 point	*when the proposed interventions and measures mean a non-significant or indirect risk for the fulfilment of the objective*
-2 points	*when the proposed interventions and measures mean a definite, direct and significant risk for the fulfilment of the objective*

3. The Hungarian Party states *„that this evaluation method does not serve as a general judgement on the environmental performance of the different measures. It – complying with the proposal-formulating features of the SEA – draws attention with its negative values to those environmental aspects, where the environmental aspects of the proposed interventions and measures should be represented in a more definite way (for example in the case of technical plans of construction, documents of environmental authorization etc.). Namely,* ***these methods do not seek to place the priorities and objectives into the dimension of 'environment friendly – environment damaging', rather it shall be used as a planning tool for decision making at strategic level,*** *and would aim to provide clear guidelines for integrating the environmental and sustainability aspects into the different interventions. The* ***scientific examinations*** *based on objective indicators, monitoring and modelling methods* ***cannot be replaced*** *by the evaluation of environmental performance and sustainability, but they can attract attention to the importance of different analyses and areas of research.*

The Slovak Party has given its view on the way of the assessment of particular variants in Chapter 2 of this Environmental Report and in the background paper entitled „Position of the Slovak Party on the process of Strategic Environmental Assessment regarding the Danube section between Sap and Budapest." However, it has tried to evaluate its variants based on criteria proposed by the Hungarian Party. Evaluation results are shown below.

[34] *National Environmental Programme II and III., National Regional Development Policy Concept, National Waste Management Plan, National Sustainable Development Strategy, National Climate Change Strategy*

7.2.2. Evaluation criteria of environmental performance and sustainability proposed by the Hungarian Party

1) The relations between the proposed interventions and measures and the improvement of the navigability and the general objectives of regional sustainability

S1 PROMOTING THE MARKETING OF THE REGIONAL PRODUCTS IN LOCAL AND INTERNATIONAL MARKETS
*It should promote the **development of local small and medium enterprises**, the **marketing possibilities of the Hungarian products**, the improvement of the competitiveness at local and international markets and the improvement of the use of Hungarian raw materials.*

S2 ENSURING THE CONSERVATION OF THE LOCAL POPULATION OF THE REGION
*It should promote the local **employment** and the touristic features and appeal of the region*

S3 ENSURING THE SOCIAL COHESION AND THE IMPROVEMENT OF THE DIFFERENTLY DEVELOPED RURAL AREAS OF THE DANUBE REGION
*It should contribute to the **improvement of the living circumstances of the rural population of the Danube region**, action aimed at relieving poverty and the betterment of socially disadvantaged groups*

S4 CONTRIBUTION TO THE MODERNIZATION OF THE INFRASTRUCTURE OF NAVIGATION
*It should contribute to the **modernization of vehicles, the establishment and modernization of harbours and logistics centres** and to promote the **change of transportation methods (modal split)***

S5 CONTRIBUTION TO THE ADAPTATION TO CLIMATE CHANGE
It should contribute to reducing the risks of extreme weather events (for example floods and storms) regarding both ecological (side-arms) and navigability aspects

S6 REDUCING THE WATERWAY TRANSPORTATION COSTS

S7 MINIMIZING THE SOCIAL (EXTERNAL) COSTS OF THE PROPOSED INTERVENTIONS

S8 MINIMIZING THE CROSS-CONTAMINATION BETWEEN DIFFERENT ENVIRONMENTAL SYSTEMS
The proposed interventions and measures should not injure the values and interests of other communities (i.e. the neighbouring regions of the affected Danube section); they should not lead to an increase in territorial differences.

2. The impacts of the proposed interventions and measures and the improvement of the navigability on the environment and nature

AIR

*E1 IMPROVING THE CONDITIONS OF NAVIGABILITY MAY DECREASE THE **LOCAL** AIR POLLUTION AND NOISE POLLUTION*
local impacts of waterway traffic (CO, NOx and PM10 emissions) on the local state of air quality and noise burden

*E2 IMPROVING THE CONDITIONS OF NAVIGABILITY MAY DECREASE THE **REGIONAL** AIR POLLUTION*
impacts of waterway traffic as a change of transportation methods (modal split) on the emissions of road transporting vehicles (CO, NOx and PM10 emissions)

E3 IMPROVING THE CONDITIONS OF NAVIGABILITY MAY DECREASE THE EMISSION OF GREENHOUSE GASES
impacts of waterway traffic as a change of transportation methods (modal split) on the emissions of road transporting vehicles (CO2 and CH4 emissions)

SURFACE AND GROUNDWATER, RIVER BED, SOIL

*E4 CONTRIBUTION TO THE PROTECTION OF THE QUALITY AND QUANTITY OF **SURFACE WATERS***

*E5 CONTRIBUTION TO THE PROTECTION OF THE QUALITY AND QUANTITY OF **GROUNDWATER** (SUBSURFACE DRINKING WATER SOURCES)*
impacts on the bank-filtered wells, on the protection of the aquifers and on the yield of river side wells

E6 WILL NOT INCREASE EROSION PROCESSES
dredging of river beds contributes to the surfacing process of the local erosion bases (ledges), thus deepening can start a new realignment process in the previous section

E7 FAVOURABLE IMPACTS ON RIVERBED STABILITY
the buildings and constructions by the river-banks and the structure of the curves of the connected sections should be protected; the durability of the facilities should be improved

E8 IMPROVING THE PREVENTION OF HAVARIA-TYPE DISASTERS AFFECTING WATER QUALITY
improving the fairway attenuates the risk of havaries

E9 IMPROVING THE LOCAL WATER MANAGEMENT PROCESSES
for example, protection against inland waters, water supply, irrigation, etc. Presumably, the proposed interventions and measures will not have significant impacts on the protection against inland waters, water replacement or irrigation.

E10 IMPROVING THE FLOOD-PREVENTION AND TRANSPORTING THE ICE
receiving the flood waves and transporting the ice and bed load

E11 PREVENTING THE DEPRESSION OF GROUNDWATER LEVEL
depression of groundwater level, the drying process and the separation of side-arms as a result of riverbed erosion

E12 PREVENTING THE INCREASE OF WASTE DISPOSAL EFFECTED BY NAVIGATION
for example, refuse oil, non-dangerous industrial waste, communal waste of harbours

E13 PREVENTING RIVERBED EROSION RESULTING FROM SHIP PROPELLERS
The water is accelerated during the operation of the propeller. The acceleration increases by the decrease of the distance between the riverbed and the ship's keel. The movement of bed load is increased by the acceleration of the water.

ENVIRONMENT, FLORA AND FAUNA, LANDSCAPE

E14 IMPROVING THE CONDITION OF WETLAND HABITATS AND THE PROTECTION AND CONSERVATION OF BIODIVERSITY
Impacts on the protection and conservation of the natural conditions in aquatic ecosystems and wetland and overland habitats connected directly to aquatic ecosystems; conservation and improvement of biodiversity at community or local level

E15 MINIMIZING THE SPATIAL AND TEMPORAL NEGATIVE IMPACTS OF ANTHROPOGENIC ORIGIN ON THE AQUATIC ECOLOGICAL SYSTEMS AND WETLAND HABITATS

E16 CONTRIBUTION TO THE PROTECTION AND CONSERVATION OF PROMINENT BOTANICAL AND ZOOLOGICAL VALUES AND FORESTS
Impacts on the presence and endangerment of protected, habitat-specific botanical and zoological values in the side-arms, islands and flood-plains

E17 CONTRIBUTION TO THE PROTECTION AND CONSERVATION OF PROMINENT ICHTHYOLOGICAL VALUES

E18 IMPROVING THE PROTECTION AND CONSERVATION OF LANDSCAPE VALUES AND LIVING HABITAT STRUCTURES
The protection and conservation of the landscape impacts of the river in the natural and built environment, the natural and landscape values

7.2.3. Impact assessment tables of proposed variants according to the Hungarian Party

Table 7.1. *Environmental evaluation matrix of the planned measures*

Measures in Sap - Szob DANUBE section		*Criteria of environmental performance assessment*																	
		AIR			*SURFACE AND GROUND WATER, RIVERBED, SOIL*										*FLORA, FAUNA, LANDSCAPE*				
		E1	*E2*	*E3*	*E4*	*E5*	*E6*	*E7*	*E8*	*E9*	*E10*	*E11*	*E12*	*E13*	*E14*	*E15*	*E16*	*E17*	*E18*
		improving the conditions of navigability may decrease the local air pollution and noise pollution	*improving the conditions of navigability may decrease the regional air pollution*	*improving the conditions of navigability may decrease the emission of greenhouse gases*	*contribution to the protection of the quality and quantity of surface waters*	*contribution to the protection of the quality and quantity of groundwater (drinking water bases)*	*will not increase erosion processes*	*favourable impacts on river-bed stability*	*improving the prevention of havaria-type disasters affecting water quality*	*improving the local water management processes*	*improving the flood-prevention and transporting the ice*	*preventing the depression of groundwater level*	*preventing the increase of waste disposal effected by navigation*	*preventing river-bed erosion resulting from agitated water*	*improving the condition of wetland habitats and the protection and conservation of biodiversity*	*minimizing the spatial and temporal negative impacts of anthropogenic origin on the aquatic ecological systems*	*contribution to the protection and conservation of prominent botanical and zoological values and forests*	*contribution to the protection and conservation of prominent ichthyologic values*	*improving the protection and conservation of landscape values and living habitat structures*
Variant VITUKI Base - 1	*main channel*	*-1*	*?*	*1*	*NR*	*PR*	*NR*	*1*	*1*	*NR*	*1*	*NR*	*-1*	*-1*	*-1*	*-1*	*NR*	*-1*	*-1*
Variant VITUKI Base - 2	*main channel*	*-1*	*?*	*1*	*NR*	*PR*	*NR*	*2*	*0*	*NR*	*1*	*NR*	*-1*	*-1*	*-2*	*-2*	*-1*	*-1*	*-1*
Variant „Realignment of the navigation channel"	*main channel*	*-1*	*?*	*1*	*NR*	*PR*	*NR*	*?*	*0*	*NR*	*1*	*NR*	*-1*	*-1*	*NR*	*NR*	*NR*	*NR*	*NR*
Side arms *(rehabilitation measures)*	*side arms*	*PR*	*NR*	*PR*	*2*	*NR*	*NR*	*NR*	*NR*	*NR*	*NR*	*NR*	*PR*	*NR*	*2*	*1*	*1*	*2*	*1*
Preservation of the present state	main channel	-1	-1	-1	-1	-1	-1	-2	-1	-1	-2	-1	0	-1	-1	-1	-1	-1	0
	side arms	NR	NR	NR	-1	-1	NR	NR	NR	NR	NR	-1	NR	NR	-1	-1	-1	-1	-1

VITUKI Base - 1	main channel	0	0	0	0	0	-1	0	-1	0	0	-1	PR	-1	-1	PR	0	0	0
	side arms	PR	NR	PR	1	1	NR	NR	NR	NR	NR	PR	PR	NR	1	PR	1	2	1
Water level impoundment by a dam	main channel	2	1	1	1	1	2	2	1	1	1	2	PR	1	1	PR	1	PR	1
	side arms	PR	NR	PR	2	2	NR	NR	NR	1	NR	2	PR	NR	2	PR	2	2	2

Note.: The Slovak Party also performed the evaluation for the variant VITUKI Base - 1, and its evaluation differs from the evaluation of the Hungarian Party in most of the criteria. In the same way the expected impacts of particular variants in case of side arms were evaluated. The above evaluation should serve as a basis for realization of joint assessment based on mutually agreed criteria. In a similar way it also applies to the table of evaluation matrix of sustainability, but there is bigger concordance in the evaluation.

Table 7.2. *Sustainability evaluation matrix of the planned measures*

Measures in Sap - Szob Danube section		Criteria of sustainability assessment							
		S1	S2	S3	S4	S5	S6	S7	S8
		promoting the marketing of the regional products in local and international markets	ensuring the conservation of the local population of the region	ensuring the social cohesion and the improvement of the differently developed rural areas of the Danube area	contribution to the modernisation of the infrastructure of navigation	contribution to the adaptation to climate change	reducing the waterway transportation costs	minimizing the social (external) costs of the proposed interventions	minimizing the cross-contamination between different environmental systems
Variant VITUKI Base - 1	main channel	1	NR	NR	1	?	1	2	NR
Variant VITUKI Base - 2	main channel	1	NR	NR	1	?	1	2	NR
Variant „Realignment of the navigation channel"	main channel	1	NR	NR	1	?	1	2	NR
Side arms *(rehabilitation measures)*	side arms	NR	1	1	1	1	NR	?	NR
Preservation of the present state	main channel	0	-1	NR	-1	-1	-1	-2	NR
	side arms	NR	NR	NR	-1	-1	NR	-1	NR
VITUKI Base - 1	main channel	0	1	NR	1	0	0	-2	NR
	side arms	1	NR	1	1	0	NR	?	NR
Water level impoundment by a dam	main channel	1	1	NR	2	2	2	2	NR
	side arms	1	1	1	1	2	NR	2	NR

7.2.4. Impact assessment of proposed variants according to the Slovak Party

The Slovak Party in the assessment of variants started from the objectives of the 1977 Treaty in force, as they were confirmed by the International Court of Justice, and the pursuit of synergistic, comprehensive and integrated solution of problems together with a prudent and rational use of natural resources. In addition to the criteria of environmental impact and sustainability the assessment provides an overview of positive and negative impacts of particular solutions in relation to the transportation, infrastructure, economics (costs/benefits), public health, and so like.

The main tool of restoration measures, preservation ecosystems, immediate action against climate change and the main instrument of positive or negative impact on the ecosystem is the water regime management. In addition, the water regime management is a precondition for preparation of functional inundation, side arms, self-cleaning processes in water, flood protection, energetics, transportation, hygienic protection, etc.

The Slovak Party is of the opinion that the implementation of measures should allow:

- ensuring the flood protection of the area,
- ensuring of navigation conditions according to the requirements of the Danube Commission,
- improvement and stabilization of the riverbed status,
- increasing of surface and ground water levels
- preservation or improvement of surface and ground water quality,
- preservation or improvement of the status of habitats, protected areas and areas of the NATURA 2000 network,
- utilization of the hydropotential for electricity production,
- taking measures against climate change,
- preservation or improvement of water regime in relation to the land-use,
- preservation or improvement of the quality and safety of the environment,
- improvement of conditions for social and economic development of the area,
- renewing and utilization of natural resources,
- improvement of the status of side arms,
- ensuring the conditions for development of infrastructure, tourism and recreation.

Considered impacts of assessed variants were evaluated by a collective assessment of experts. The individual impacts were characterized by scoring in the range from -2 to +2.

2 points	proposed interventions and measures improve the current situation or support the achievement of the goal clearly, directly and significantly
1 point	proposed interventions and measures improve the current situation or support the achievement of the goal indirectly and insignificantly
0 point	when the proposed interventions and measures affect the current situation or support the achievement in a neutral way
-1 point	proposed interventions and measures represent insignificant worsening of the current status or low risk for achievement of the goal
-2 points	proposed interventions and measures represent clear, direct and significant worsening of the current status or high risk for achievement of the goal

Contrary to the assessment according to the Hungarian Party, the scoring is expressed numerically only, that it can be numerically evaluated. Based on the proposed scoring the Slovak Party attempted to evaluate the criteria proposed by the Hungarian Party. Values of „NR" and „?" were replaced by „0" and the value „PR" with value of „-1".

The Slovak Party in this evaluation used the same weight for each criterion. The Slovak Party, however, considers it necessary to agree on various criteria, as well as their weight with Hungarian experts.

7.2.5. Evaluation criteria of environmental performance and sustainability proposed by the Slovak Party

1) Direct and indirect environmental impacts of proposed interventions and measures on the status of surface and ground waters

- impacts on ecological and chemical status of surface waters
- impacts on level of surface waters
- impacts on the surface water level fluctuation
- impacts on surface water flow velocity
- impacts on the riverbed condition
- impacts on the status of flood protection
- impacts on formation and discharge of ice
- impacts on the status of ground waters
- impacts on the status of habitats connected to surface waters

2) Direct and indirect environmental impacts of proposed interventions and measures on other environmental elements and environmental systems

- impacts on air quality
- impacts related to climate change
- impacts on conditions of areas under environmental protection and areas of the Natura 2000 network
- impact on forests
- impacts on biodiversity
- impacts on the conditions of human health and the quality of life
- impacts on the landscape, on its carrying capacity, the natural and cultural landscape resources and landscape values
- impacts on the land-use and spatial structure
- impacts on the quality of the environment and the safety of the environment at settlement level
- sustainability impacts (impacts on the sustainable social and economic conditions at regional level)
- impacts on the renewal and the spatial use of natural resources
- promotion of environmental consciousness and the principles of sustainable life style

3) Other significant impacts of proposed interventions and measures

- impacts on navigation
- impacts on the Váh waterway
- impacts on electricity production
- impacts on peak-power production
- impacts on investments
- impacts on employment
- impacts on competitiveness

7.2.5. Impact assessment tables of proposed variants according to the Slovak Party

Table 7.3. Impact assessment of proposed variants by sections according to the Slovak Party

Variant	**Preservation of the present state**			**VITUKI Base - 1**			**Water level impoundment by dam**		
Danube section / considered impacts	Sap-Klížska Nemá 1811-1791	Klížska Nemá-Kravany n/D 1791-1740	Kravany-mouth of Ipeľ 1740-1708	Sap-Klížska Nemá 1811-1791	Klížska Nemá-Kravany n/D 1791-1740	Kravany-mouth of Ipeľ 1740-1708	Sap-Klížska Nemá 1811-1791	Klížska Nemá-Kravany n/D 1791-1740	Kravany-mouth of Ipeľ 1740-1708
Direct and indirect environmental impacts of proposed interventions and measures on the status of surface and ground waters									
impacts on ecological and chemical status of surface waters	0	0	0	-1	-1	0	0	0	-1
impacts on level of surface waters	-2	-1	0	-2	-1	0	-1	2	2
impacts on the surface water level fluctuation	0	0	0	0	0	0	0	-1	-2
impacts on surface water flow velocity	0	0	0	0	0	0	0	-1	-2
impacts on the riverbed condition	-2	-1	0	-2	-1	0	1	2	2
impacts on the status of flood protection	-1	0	0	0	0	0	2	1	1
impacts on formation and discharge of ice	0	0	0	0	0	0	0	0	-1
impacts on the status of groundwater	-2	-1	0	-2	-1	0	2	2	2
impacts on the status of habitats connected to surface waters	-1	-1	0	-1	-1	0	1	2	1
Direct and indirect environmental impacts of proposed interventions and measures on other environmental elements and envirosystems									
impacts on air quality	0	0	0	0	0	0	0	1	1
impacts related to climate change	-1	-1	-1	-1	-1	-1	0	1	1
impacts on conditions of areas under environmental protection and areas of the Natura 2000 network	-2	-1	0	-2	-1	0	2	2	2
impact on forests	-2	-1	0	-2	-1	0	1	2	1
impacts on biodiversity	-1	-1	0	-1	-1	0	1	1	1

Variant	**Preservation of the present state**			**VITUKI Base - 1**			**Water level impoundment by dam**		
Danube section / considered impacts	Sap-Klížska Nemá 1811-1791	Klížska Nemá-Kravany n/D 1791-1740	Kravany-mouth of Ipeľ 1740-1708	Sap-Klížska Nemá 1811-1791	Klížska Nemá-Kravany n/D 1791-1740	Kravany-mouth of Ipeľ 1740-1708	Sap-Klížska Nemá 1811-1791	Klížska Nemá-Kravany n/D 1791-1740	Kravany-mouth of Ipeľ 1740-1708
impacts on the conditions of human health and the quality of life	0	0	0	0	0	0	0	1	1
impacts on the landscape, on its carrying capacity, the natural and cultural landscape resources and landscape values	0	0	0	0	0	0	0	1	1
impacts on the land-use and spatial structure	0	0	0	0	0	0	0	1	1
impacts on the quality of the environment and the safety of the environment at settlement level	-1	0	0	-1	0	0	1	1	1
sustainability impacts (impacts on the sustainable social and economic conditions at regional level)	0	0	0	0	0	0	0	1	1
impacts on the renewal and the spatial use of natural resources	-1	0	0	0	0	0	0	1	1
promotion of environmental consciousness and the principles of sustainable life style	0	0	0	0	0	0	0	0	0
Other significant impacts of proposed interventions and measures									
impacts on navigation	-2	-2	-2	-1	-1	-1	2	2	2
impacts on the Váh waterway	-2	-2	-2	-2	-2	-2	2	2	2
production of electricity	-2	-2	-2	-2	-2	-2	2	2	2
peak-power production	-2	-2	-2	-2	-2	-2	1	1	1
investments	0	0	0	0	1	1	0	1	2
employment	0	0	0	0	0	0	0	1	1
competitiveness	0	0	0	0	0	0	0	1	1

7.2.6. Impact assessment tables of all variants proposed by the Hungarian and Slovak Party

Table 7.4. Impact assessment of all proposed variants

	Considered variants	**Variants according to Hungarian Party**				**Variants according to Slovak Party**		
		VITUKI Base-1	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Evaluation criteria of environmental performance and sustainability proposed by the Hungarian Party								
AIR	*Improving the conditions of navigability may decrease the local air pollution and noise pollution*	-1	-1	-1	-1	-1	0	2
	Improving the conditions of navigability may decrease the regional air pollution	0	0	0	0	-1	0	1
	Improving the conditions of navigability may decrease the emission of greenhouse gases	1	1	1	-1	-1	0	1
SURFACE AND GROUND WATER RIVERBED, SOIL	*Contribution to the protection of the quality and quantity of surface waters*	0	0	0	2	-1	0	1
	Contribution to the protection of the quality and quantity of groundwater (drinking water bases)	-1	-1	-1	0	-1	0	1
	Will not increase erosion processes	0	0	0	0	-1	-1	2
	Favourable impacts on river-bed stability	1	2	0	0	-2	0	2
	Improving the prevention of havaria-type disasters affecting water quality	1	0	0	0	-1	-1	1
	Improving the local water management processes	0	0	0	0	-1	0	1
	Improving the flood-prevention and transporting the ice	1	1	1	0	-2	0	1
	Preventing the depression of groundwater level	0	0	0	0	-1	-1	2
	Preventing the increase of waste disposal effected by navigation	-1	-1	-1	-1	0	-1	-1
	Preventing river-bed erosion resulting from agitated water	-1	-1	-1	0	-1	-1	0

	Considered variants	Variants according to Hungarian Party				Variants according to Slovak Party		
		VITUKI Base-1	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
FLORA, FAUNA, LANDSCAPE	*Improving the condition of wetland habitats and the protection and conservation of biodiversity*	-1	-2	0	2	-1	-1	1
	Minimizing the spatial and temporal negative impacts of anthropogenic origin on the aquatic ecological systems	-1	-2	0	1	-1	-1	-1
	Contribution to the protection and conservation of prominent botanical and zoological values and forests	0	-1	0	1	-1	0	1
	Contribution to the protection and conservation of prominent ichthyologic values	-1	-1	0	2	-1	0	-1
	Improving the protection and conservation of landscape values and living habitat structures	-1	-1	0	1	0	0	2
SUSTAINABILITY	*Promoting the marketing of the regional products in local and international markets*	1	1	1	0	0	0	1
	Ensuring the conservation of the local population of the region	0	0	0	1	-1	1	1
	Ensuring the social cohesion and the improvement of the differently developed rural areas of the Danube area	0	0	0	1	0	0	0
	Contribution to the modernisation of the infrastructure of navigation	1	1	1	1	-1	1	2
	Contribution to the adaptation to climate change	0	0	0	1	-1	0	2
	Reducing the waterway transportation costs	1	1	1	0	-1	0	2
	Minimizing the social (external) costs of the proposed interventions	2	2	2	0	-2	-2	2
	minimizing the cross-contamination between different environmental systems	0	0	0	0	0	0	0

	Considered variants	**Variants according to Hungarian Party**				**Variants according to Slovak Party**		
		VITUKI Base-1	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Evaluation criteria of environmental performance and sustainability proposed by the Slovak Party								
Impacts on the status of surface and ground waters	impacts on ecological and chemical status of surface waters	0	0	0	2	0	-	0
	impacts on level of surface waters	-1	-1	-1	0	-1	-	2
	impacts on the surface water level fluctuation	0	0	0	0	0	-	-1
	impacts on surface water flow velocity	0	0	0	0	0	-	-1
	impacts on the riverbed condition	-1	-1	0	0	-2	-	2
	impacts on the status of flood protection	1	1	1	0	-1	-	2
	impacts on formation and discharge of ice	0	0	0	0	0	-	0
	impacts on the status of groundwater	-1	-1	-1	0	-1	-	2
	impacts on the status of habitats connected to surface waters	-1	-2	0	2	-1	-	1
Impacts on other environmental elements and environmental systems	impacts on air quality	0	0	0	0	0	-	1
	impacts related to climate change	-1	-1	-1	1	-1	-	1
	impacts on conditions of areas under environmental protection and areas of the Natura 2000network	-1	-1	-1	1	-1	-	1
	impact on forests	-1	-1	0	1	-1	-	1
	impacts on biodiversity	-1	-2	0	2	-1	-	1
	impacts on conditions of human health and the quality of life	0	0	0	1	0	-	1
	impacts on the landscape, on its carrying capacity, the natural and cultural landscape resources and landscape values	0	0	0	1	0	-	1
	impacts on the land-use and spatial structure	0	0	0	1	0	-	1
	impacts on the quality of the environment and the safety of the environment at settlement level	0	0	0	1	-1	-	1
	sustainability impacts (impacts on the sustainable social and economic conditions at regional level)	0	0	0	1	0	-	1
	impacts on the renewal and the spatial use of natural resources	0	0	0	1	0	-	1
	promotion of environmental consciousness	0	0	0	0	0	-	0

	Considered variants	**Variants according to Hungarian Party**				**Variants according to Slovak Party**		
		VITUKI Base-1	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Other significant impacts	impacts on navigation	0	0	0	0	-1	-	2
	impacts on the Váh waterway	-2	-2	-2	0	-2	-	2
	production of electricity	0	0	0	0	0	-	2
	peak-power production	0	0	0	0	0	-	1
	investments	1	0	0	1	0	-	2
	employment	0	0	0	1	0	-	1
	competitiveness	0	0	0	0	0	-	1

7.3. The overall evauation of proposed variants

The main objective of all proposed variants, except the variant with preservation of the present state, is the improvement of navigation conditions in the Danube stretch between Sap and Budapest. The variant with preservation of the present state serves for comparison of proposed variants with the so-called alternative of „doing nothing", in which only the necessary works on riverbed and fairway maintenance are carried out.

The Hungarian Party based its three variants on traditional methods of river regulation, i.e. works mainly consist of dredging the riverbed and constructing of cross and longitudinal guiding structures. A special part of all three variants is the rehabilitation of side arms. The goal of the rehabilitation of side arms is to remove the waste deposits or thick siltation of fine-grained sediments with high share of organic matter, and the re-opening of arms and restoration of flow. All three variants, however, can be realized without works on rehabilitation of side arms, since the works carried out, as also stated the Hungarian Party, will have minimal effect on water level in the main riverbed, i.e. the water level will remain at current level.

According to the opinion of the Slovak Party, the durability of works carried out is also questionable, it may vary in particular variants, and in addition the Hungarian Party states the necessity to carry out regular maintenance of the riverbed. Since the implementation of variants will not result in an increase of water level in the river, the opening of branches may again lead to a water level decrease and thus to further works aiming the concentration of the water in the fairway.

As the biggest disadvantage of variants proposed by the Hungarian Party, the Slovak Party considers the fact, that the works carried out basically do not eliminate the obstacles hampering the undisturbed navigation, so the lack of depth and width of the fairway in some sections and the limitation of navigation during the year due to low flow rates.

The variant proposed by the Slovak Party, based on the Joint Contractual Plan, eliminates the disadvantages resulting from the lack of depth and width of the fairway by a significant increase of water level in the river. At the same time it provides year-round navigation also in case of low flow rates. The relative disadvantage of this variant is, that the works related to the rehabilitation of side arms must be carried out before putting the variant into operation. Contrary to the previous three variants, the variant with water level impoundment cannot be implemented without cleaning and adjustment of side arms. The advantage is that the arms need not be deepen in order to restore the flow in them, and their re-connection with the main stream is guaranteed at any flow rates.

A certain disadvantage of the variant with water level impoundment by a dam is the fact, that flooding of some islands in the lower section, that were created over the past decades and currently are covered with relatively intact forests, will likely occur. On the other hand, the increased water level will ensure the revitalization of wetland and hygrophilous habitats along the impounded section.

Based on impact assessment according to **Table 7.3** and **7.4** it can be stated the following:

- According to the criteria proposed by the Hungarian Party and after the modification of values as mentioned in section 7.2.4, as the most advantageous variant seems to be the variant with water level impoundment by a dam. As the second variant in the ranking is the variant with „Realignment of the navigation channel". Even in the variant VITUKI Base - 1 still prevails the positive impact. The alternative with rehabilitation of side arms is also quite strongly positive, but it is not connected with the main objective of particular variants, which is the improvement of navigation conditions. As the variant with the most negative impact appears to be the variant with the preservation of present state.

variant / **evaluation**	*VITUKI Base-1*	*VITUKI Base-2*	*Realignment to the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Total	+1	-3	+3	+10	-24	-7	**+25**
Coefficient*	0,038	-0,115	+0,115	+0,384	-0,923	-0,269	+0,961

Note. the coefficient is the quotient of the obtained scoring and the total number of criteria (26)

It should be noted that the criteria proposed by the Hungarian Party take into account only the effect of variants on the environment and sustainability.

- According to the criteria proposed by the Slovak Party, as the most advantageous variant appears the variant with water level impoundment by a dam again. Since the criteria proposed by the Slovak Party take into account the synergistic effect of individual variants, such as navigation, power generation, and wider socio-economic impacts, in other variants, except the rehabilitation of side arms, the negative impact prevail. The alternative with rehabilitation of side arms is quite strongly positive also under the criteria of the Slovak Party.

variant / **evaluation**	*VITUKI Base-1*	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Total	-8	-11	-5	+17	-14	-	**+29**
Coefficient*	-0,285	-0,392	0,178	+0,607	-0,500		+1,035

Note. the coefficient is the quotient of the obtained scoring and the total number of criteria (28)

As described in section 7.2.4 the Slovak Party used the same weight for each criterion in the evaluation. At the joint assessment it is necessary to agree on the individual criteria and their weight with the Hungarian Party.

8. PROPOSAL FOR MONITORING OF ENVIRONMENTAL IMPACTS

8.1. Proposals for the monitoroing system and indicators

The Hungarian Party in its document proposes ***„the elaboration of monitoring and indicator systems which considers the following aspects:***

- *All the data and information pertaining to the results, the benefits and the costs and negative impacts should be published.*
- *The intensity of data collection and data processing should be determined in relation to the severity of the predicted, calculated and justified impacts.*
- *In order to minimise costs and improve the efficiency of data collection and data processing the formerly elaborated databases and monitoring results should be used where possible.*
- *As the interventions affect those areas (water management, water quality, natural values, habitats) the control of which is regulated by European and national legal rules, these legal rules should be taken into consideration in the monitoring process."*

The Slovak Party in the issue of monitoring the environmental effects in the Danube stretch Sap - Budapest believes that the monitoring of this stretch would be appropriate to carry out in the extent of monitoring according to the Intergovernmental Agreement from 1995. According to the opinion of the Slovak Party, the monitoring under the 1995 Agreement meets the above aspects proposed by Hungarian party.

The Slovak Party at the same time does not exclude the adjustment of the monitoring in the stretch between Sap and Budapest according to the specifics of this section by mutual agreement. Similar monitoring was implemented in this section in the frame of data exchange for the strategic environmental assessment in 2008 and 2009.

Proposal 19.	1. *The monitoring system should be elaborated in accordance with the requirements of the WFD, and it is proposed to supplement this by including indicators on nature conservation, landscape protection and environmental protection. In the elaboration of this monitoring system, the obligations of international and national legal rules (for example Convention on Biological Diversity Agreement, Habitats Directive, Birds Directive, Natura 2000, Ramsar Convention) should also be taken into consideration.* 2. The Slovak Party proposes to conduct the monitoring of environmental impact in the Danube stretch between Sap and Budapest in the extent of monitoring according to the Intergovernmental Agreement from 1995. At the same tine the extent of monitoring may be adjusted according to the specifics of this stretch of the Danube.

The Slovak Party agrees with the opinion of the Hungarian Party, that it is important to make efforts to engage in this process - i.e. the measurement process, data collection and processing, and their evaluation - activities of other professional institutions (such as national parks and environmental directorates), as well as subjects responsible for hydrological observations.

The Hungarian Party sees in connection with the improvement of navigability of the Danube three main objectives on the collection and evaluation of natural-environmental indicators:

- *to share information on environmental problems in order to give information to the decision makers responsible for estimating the seriousness of the given problem;*
- *to support policy makers by exploring the primary causes of the environmental burden or the negative impacts which endanger natural values;*
- *to explore the impacts of the transport and waterway development policies.*

In connection with these objectives it has proposed the monitoring of following indicators:

Table 5. Indicator core established for the traceability of the environmental impacts of proposed interventions

Factors	***Data / Indicator***	***Source of data / Indicators***	***Comments***
Quality of the waterway	*depth, width, availability*	*responsible state institutions and authorities for water and transport*	*On the basis of these three groups of data a cost-benefit analysis should be carried out for the determination of the economically operated waterway*
Transporting output of navigation	*volume of the transported goods*	*EuroStat*	
Investment and maintenance costs of the waterway	*investment and maintenance costs*	*state and institutional budgets*	
Conditions of the valuable/protected natural environment in general	*according to the methodology of National Biodiversity Monitoring System*	*National Biodiversity Monitoring System*	
Status of the wetland habitats	*special indicators for WFD monitoring, the methodology and the monitoring institution should be determined*		
Impacts of side-arm rehabilitation	*special indicators for demonstration of the ecological improvements resulting from the rehabilitation and the increased anthropogenic impacts resulting from the rehabilitation process; the methodology and the monitoring institution should be determined*		

The Slovak Party is of the opinion that monitoring must also provide the basis for water management and management of respective facilities. In addition, the information provided by monitoring before the implementation of interventions should provide to policy and strategy makers for the area development, as well as for decision-making also other information. The Slovak Party therefore proposes to extend the observed indicators with:

- the potential for electricity production (MWh) and the produced energy;
- the contribution to the reduction of greenhouse gas emissions from the conversion to the equivalent of t/km for road transport;
- other indicators.

9. SUPPOSED SIGNIFICANT TRANS-BOUNDARY IMPACTS

9.1. Trans-boundary impacts

Since the proposed variants concerns the Danube stretch between Sap and Budapest, whose prevailing part creates the boundary between the Slovak Republic and Hungary, it can be stated that almost all interventions will have a cross-boundary impact. The same can be stated in relation to the variant with the preservation of the present state. Also in this case the activity or inactivity will have impact on both sides of the boundary.

As the most significant impacts the Slovak Party, in accordance with the Hungarian Party, considers the impact resulting from the improvement of river navigation.

The volume of waterway transport may increase – depending on the demand for transporting facilities – by the realization of the interventions improving navigability on the international waterway of the Danube, if such interventions were also to be carried out by other Danubian states and the technical parameters of the waterway were to be uniform. As waterway transport is mainly used for long distances, as a consequence of the Hungarian developments waterway traffic may increase with the Slovak Republic, Austria, Germany and the Benelux States and, in the South, to Serbia, Romania and Bulgaria. ***These countries may have advantageous economic impacts resulting from the increased level of waterway transport.***

The Hungarian Party in its document notes, that due to the existence of other problematic sections in Germany, in Austria downstream from Vienna, and in the Romanian-Bulgarian section downstream of the Iron Gate, the demand for water transport will be limited. It further states that the potential of waterway transport is determined not only by the parameters of the waterway, but also by the quality and the volume of economic relationships, which determine the demand for waterway transport. For these reasons, the Hungarian Party states that the effects from the improvement of inland navigation may be marginal in short-term and maybe in their medium-term aspects.

Contrary to the Hungarian Party the Slovak Party is of the opinion, that the creation of appropriate and particularly permanent and predictable conditions for navigation will make pressure on other Danubian Countries to proceed to the improvement of navigation conditions on the other problematic sections as well. The stretch of the Danube between Bratislava and Budapest was one of the longest problematic stretches in terms of water transport. After constructing the Gabčíkovo hydraulic structure and after the eventual improvement of navigation conditions in the stretch Sap - Budapest there exist is a big prerequisite that the water transport on one of the major waterways of Europe will be resolved in the near future.

Some part of the impacts resulting from proposed measures, arising from their nature, need not have cross-boundary character.

These are particularly effects on local production, processing and transportation of raw materials for technical solutions and maintenance of developments on the Hungarian territory, and local environmental impacts resulting from the rehabilitation of side arms. To such impacts can be included the improvement of local landscape or the improvement of inland tourism, or noise pollution resulting from increased local traffic of motorized vessels.

9.2. Environmental conflicts

According to the opinion of the Hungarian Party *„the proposed interventions and measures in the main* ***river branch will probably not generate conflicts*** *at authority and society level."*

The ***rehabilitation of the side-arms*** *is essential and should be carried out in parallel with the interventions in the main river branch. In this process, some professional and economic conflicts may be considered. The good ecological status of the side-arms and the increase in the natural values will improve the touristic and recreational potential of the region. As a consequence of this process, the appearance of new investors and touristic services may be expected. In addition to this, the development of the infrastructure and the creation of new employment possibilities are highly needed. Ensuring the balance between ecological and economic advantages is a key aspect. Local governments and authorities should consider that only those investments should be realized whose ecological and environmental damages are lower than the expected economic and social profits.*

In the course of land use activities, some conflicts may also occur, which should be managed through the co-operation of local governments, civil organizations and the local society. Different side-arms have different utilization possibilities. In such areas, which have possibilities not only for the development of ports or other touristic and recreational infrastructure (for example camping sites or road system) but also for angling activities, a spatial compromise should be taken between the interests of the local anglers and fishermen and the touristic attractions.

Proposal 17.	*The following priorities should be taken into consideration during the planning and authorization process of the developments in the area of the side-arms and their neighbouring vicinities:* *(a) Establishing local marketing possibilities for locally produced products* *(b) Preferring eco-tourism instead of mass tourism* *(c) Supporting services demonstrating landscape values and cultural heritage* *(d) Development of a bicycle route system,* (e) Considering the extent of the commercial fishing as in the main stream, so in the side arms.

Proposal 18.	*We propose that – considering the possible conflicts between navigation, land-use and environmental protection and nature conservation – Local Monitoring Groups should be created by the participation of experts and the civil organizations for the monitoring of the planning, the realization and the operation process of the interventions.*

10. (NON-TECHNICAL) SUMMARY

10.1. Summary in terms of the needs of the European Union

This Draft Environmental Report has been prepared in accordance with the agreement of the Government Delegations of the Slovak Republic and the Republic of Hungary from March 7, 2007, and the Statute of Steering Committee approved on August 12, 2008. The Environmental Report evaluates the proposal of variants of **intervention and measures for the improvement of the navigability of the Danube stretch between Sap and Budapest** and technical solutions for the rehabilitation of side arms.

The Slovak Party its proposals aimed at assessing the current situation, one of the variants proposed by the Hungarian Party, and the solution according to the original Gabčíkovo - Nagymaros Hydropower Project. According to the opinion of the Slovak Party, the assessment of these three variants are the essentials prerequisite for the acceptance of responsible decision on technical interventions in this stretch of the Danube. Elaboration of the assessment have to provide an overview of positive and negative impacts of particular variants with respect to all objectives of the 1977 Treaty, as they were confirmed by the ICJ judgment of 1997.

The Slovak Party in this Environmental Report relies on the Consolidated version of the **Treaty on European Union**, articles No. 9 and 191, which speaks about prudent and rational use of natural resources, on the main objectives of the Strategy for the Danube Region, and on the objectives of the EU's Strategy **„Europe 2020"** (Strategy for smart, sustainable and inclusive growth). The basic tool is the rational and prudent use of natural resources and activities to minimize risks.

The main objective of the Strategic Environmental Assessment is to find a comprehensive and integrated solution of problems in the Danube stretch between Sap and Budapest on the basis of scientific analysis of extensive and complex technical environmental interventions related to the implementation of the Judgment of the International Court of Justice in The Hague. The assessment, based on scientific and technical approaches, must also consider environmental, social, and economic criteria and criterion of sustainability, and must provide a comprehensive, systematic and transparent assessment with the aim to assist the decision-making process. An important criterion is the maximum utilization of synergy effects of the proposed measures and interventions.

The legal framework for elaboration of the Environmental Report is the Directive 2001/42/EC of the European Parliament and the Council on the assessment of certain plans and programs itself and its transposition into the national legislation of each country. Other legal documents that affect the scope of the Environmental Report is primarily the 1977 Treaty and the related Joint Contractual Plan on constructing the Gabčíkovo - Nagymaros Hydropower Project, which were confirmed by the ICJ Judgment, and the ICJ Judgment from 1997 itself. For the Strategic Environmental Assessment two other EU directives are also important, the Water Framework Directive (WFD) and the Directive on the promotion of the use of energy from renewable sources, including hydropower, as well as other relevant directives and documents.

The Slovak Party from these reasons promotes the achievement of following objectives:

- **Development of transport infrastructure**, mainly the development of continual Danube waterway and the ensuring the navigability of the Danube as a part of the West-Eastern European waterway network in accordance with the parameters recommended by the Danube Commission and UNECE (the Blue Book and AGN Agreement). This will create conditions for the realization of north-south transport connections by waterways.
- Along with the development of waterway, priority attention should be given to the development of **multimodal corridors** in the Danube region (five different modes of transport).
- The Danube River is a **major transport corridor** for the energetic raw materials and other goods, and is also a **source of clean, waste less** renewable energy.
- At utilization of natural resources an adequate attention need to be paid to **the protection and sustainable use of ecosystems**, including lowland forests management, protection of biodiversity of the region, and the care of protected ecosystems.
- Equally important is **the protection of the surface and ground waters**.
- A part of the integrated approach to utilization of the Danube natural resources is **the flood protection** and the integrated water management.

10.2. Summary of the assessment of proposed variants

The Hungarian party in its draft Environmental Report assessed three variants of **interventions and measures for the improvement of navigability of the Danube stretch between Sap and Budapest** and one technical solution for the rehabilitation of side arms, which is the same for all proposed variations.

On the basis of provided background materials by the Hungarian Party, the Slovak Party for its variants have chosen one variant, proposed by the Hungarian Party, for detailed review. As further variant the Slovak Party has chosen the variant with preservation of the present state, to enable the comparison of individual variants with the so-called „initial state". Since the Slovak Party is convinced that the best solution of problems of navigability on the Danube stretch between Sap and Budapest is a solution according to the existing 1977 Treaty, as a third variant it has chosen the variant with water level impoundment by a dam.

First variant of the Hungarian Party named „VITUKI Base - 1" is trying to improve the parameters of the waterway by dredging, building spur-dykes and guiding walls, and by addition or reduction of spur-dykes. This variant would guarantee the navigability of vessels with draught of 2.50 m, and with a waterway width of 120-150 m.

Second variant of the Hungarian Party named „VITUKI Base - 2" seeks to improve the parameters of the waterway in the same way as the variant „VITUKI Base - 1", but in addition it wants to prevent the future deepening of the riverbed with planned refilling of gravel. This variant should also ensure the navigability of vessels with draught of 2.50 m, and with a waterway width of 120-150 m.

Third variant of the Hungarian Party named „Realignment of the navigation channel" aims to improve the parameters of the waterway by dredging, newly set up and corrected waterway, and by narrowing of the waterway by buoys. This variant should guarantee the traffic of ships with draught of 2.50 m, and with a waterway width of 100-150 m.

First variant of the Slovak Party is „Preservation of the present state". In this variant it should be emphasized, that it does not solve the current problems of navigation on this stretch of the Danube, or the possible revitalization of arms. It counts on minimal interventions and technical measures necessary to mitigate the current negative development of the riverbed and to ensure safe navigation conditions.

Second variant of the Slovak Party is identical to first variant of the Hungarian Party „VITUKI Base - 1", but his assessment takes into account the views of the Slovak Party.

Third variant of the Slovak Party named „Water level impoundment by a dam" is a variant, which solves the improvement of the parameters of the waterway with an impoundment of water level by a dam. The basic source of this variant is the project of Nagymaros hydraulic structure. This variant should guarantee the traffic of ships with draught of 3.50 m, and with a waterway width of 150-200 m. In addition, this variant counts on synergistic elements: improvement of the parameters of the waterway, electricity production, infrastructure development, increase of groundwater levels, benefits to the natural environment.

According to the opinion of the Slovak Party, the assessments of the first and third Slovak variant are the essential prerequisite for the acceptance of responsible decisions on technical interventions in this stretch of the Danube. **Elaboration of the assessment have to provide an overview of positive and negative impacts of particular variants with respect to all objectives of the 1977 Treaty, as they were confirmed by the ICJ judgment from 1997.**

The main objective of all proposed variants, except the variant with preservation of the present state, **is the improvement of navigation conditions in the Danube stretch between Sap and Budapest.**

The Hungarian Party based its three variants on traditional methods of river regulation, i.e. works mainly consist of dredging the riverbed and construction of cross and longitudinal guiding structures. A special part of all three variants is the rehabilitation of side arms. The goal of the rehabilitation of side arms is to remove the waste deposits or thick siltation of fine-grained sediments with high share of organic matter, and the re-opening of arms and restoration of flow. All three variants, however, can be realized without the works on rehabilitation of side arms, since the works carried out, as also stated the Hungarian Party, will have minimal effect on water level in the main riverbed, i.e. the water level will remain at current level.

According to the opinion of the Slovak Party, the durability of works carried out is also questionable, it may vary in particular variants, and in addition the Hungarian Party states the necessity to carry out regular maintenance of the riverbed. Since the implementation of variants will not result in an increase of water level in the river, the opening of branches may again lead to a water level decrease and thus to further works aiming the concentration of the water in the fairway.

As the biggest disadvantage of variants proposed by the Hungarian Party, the Slovak Party considers the fact, that the works carried out basically do not eliminate the obstacles hampering the undisturbed navigation, so the lack of depth and width of the fairway in some sections and the limitation of navigation during the year due to low flow rates.

The variant proposed by the Slovak Party, based on the Joint Contractual Plan, eliminates the disadvantages resulting from the lack of depth and width of the fairway by a significant increase of water level in the river. At the same time it provides year-round navigation also in case of low flow rates. The relative disadvantage of this variant is, that the works related to the rehabilitation of side arms must be carried out before putting the variant into operation. Contrary to the previous three variants, the variant with water level impoundment cannot be implemented without cleaning and adjustment of side arms. The advantage is that the arms need not be deepen in order to restore the flow in them, and their re-connection with the main stream is guaranteed at any flow rates.

A certain disadvantage of the variant with water level impoundment by a dam is the fact, that flooding of some islands in the lower section, that were created over the past decades and currently are covered with relatively intact forests, will likely occur. On the other hand, the increased water level will ensure the revitalization of wetland and hygrophilous habitats along the impounded section.

For the assessment of impacts of individual variants the Slovak Party used 5-point rating system in the range from -2 to +2. Considered impacts of assessed variants were evaluated by a collective assessment of experts similarly to the Hungarian side.

The Slovak Party attempted to evaluate also the criteria proposed by the Hungarian Party. Values of „NR" and „?" were replaced by „0" and the value „PR" with value of „-1".

In this evaluation the Slovak Party used the same weight for each criterion. The Slovak Party, however, considers it necessary to agree on various criteria, as well as their weight with experts of the Hungarian Party.

The Hungarian Party in its assessment of the impacts of individual variants on the environment and sustainability proposed 24 criteria. The Slovak Party within the impact assessment of variants besides the criterions assessing the impact on the environment also proposed criterion for navigation, power generation and socio-economic criteria, a total of 28 criteria.

In **Tables 7.1** and **7.2** the Slovak Party evaluated its variants by the methodology and according to the criteria proposed by the Hungarian Party. The evaluation for the variant VITUKI Base - 1 by the Slovak Party differs from the evaluation of this variant by the Hungarian Party. As for the point scores of individual impacts proposed by the Hungarian Party is not possible to make a summary assessment, the Slovak Party modified the evaluation of the Hungarian Party as described above. The rating is given in **Tab. 4.7**.

According to the criteria proposed by the Hungarian Party and after the modification of values as mentioned in section 7.2.4, as the most advantageous variant seems to be the variant with water level impoundment by a dam. As the second variant in the ranking is the variant with „Realignment of the navigation channel". Even in the variant VITUKI Base - 1 still prevails the positive impact. The alternative with rehabilitation of side arms is also quite strongly positive, but it is not connected with the main objective of particular variants, which is the improvement of navigation conditions. As the variant with the most negative impact appears to be the variant with the preservation of present state.

variant / evaluation	*VITUKI Base-1*	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Total	+1	-3	+3	+10	-24	-7	**+25**
Coefficient*	0,038	-0,115	+0,115	+0,384	-0,923	-0,269	+0,961

Note. the coefficient is the quotient of the obtained scoring and the total number of criteria (26)

It should be noted that the criteria proposed by the Hungarian Party take into account only the effect of variants on the environment and sustainability.

According to the criteria proposed by the Slovak Party, as the most advantageous variant appears the variant with water level impoundment by a dam again. Since the criteria proposed by the Slovak Party take into account the synergistic effect of individual variants, such as navigation, power generation, and wider socio-economic impacts, in other variants, except the rehabilitation of side arms, the negative impact prevail. The alternative with rehabilitation of side arms is quite strongly positive also under the criteria of the Slovak Party

variant / evaluation	*VITUKI Base-1*	*VITUKI Base-2*	*Realignment of the navigation channel*	*Side arms*	Present state	VITUKI Base-1	Water level impoundment by a dam
Total	-8	-11	-5	+17	-14	-	**+29**
Coefficient*	-0,285	-0,392	0,178	+0,607	-0,500		+1,035

Note. the coefficient is the quotient of the obtained scoring and the total number of criteria (28)

As it is clear from the evaluation of criteria proposed by the Hungarian and Slovak Parties, as the most advantageous variant seems to be the variant with water level impoundment by a dam. Of course, by mutual agreement of particular criteria and their weights, this assessment may be modified.

According to above text in sections 2.1 and 2.2 and as shown in section 7.4.2 the Slovak Party is of the opinion that the implementation of measures should allow mainly:

- ensuring the flood protection of the area,
- ensuring of navigation conditions according to the requirements of the Danube Commission,
- improvement and stabilization of the riverbed status,
- increasing of surface and ground water levels
- preservation or improvement of surface and ground water quality,
- preservation or improvement of the status of habitats, protected areas and areas of the NATURA 2000 network,
- utilization of the hydropotential for electricity production,
- taking measures against climate change,
- preservation or improvement of water regime in relation to the land-use,

- preservation or improvement of the quality and safety of the environment,
- improvement of conditions for social and economic development of the area,
- renewing and utilization of natural resources,
- improvement of the status of side arms,
- ensuring the conditions for development of infrastructure, tourism and recreation.

All of these goals and mutual synergies are best met with the variant with water level impoundment by a dam situated at the hard rock threshold between Pilismarót and Visegrád.

This variant, in the opinion of the Slovak Party provides a comprehensive and integrated solution to achieve the objectives of the 1977 Treaty on this stretch of thee Danube.

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