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## ANNEX 9

### *Along Danube Bend (PA3.2)*

#### SET-UP OF PILOT-SPECIFIC MANAGEMENT PRACTICES

#### D.T2.1.2 Transnational case review of best management practices in pilot actions

# BEST MANAGEMENT PRACTICES REPORT IN PILOT ACTION

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***“ALONG DANUBE BEND”***

FINAL VERSION

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## 1. Introduction

In this report best management practices are presented on the level of PA3.2 ALONG DANUBE BEND (Pilot Action Bank-filtered drinking water resources from Szob to Tass along Danube Bend), regarding potential conflicts of interest between land use management and water protection.

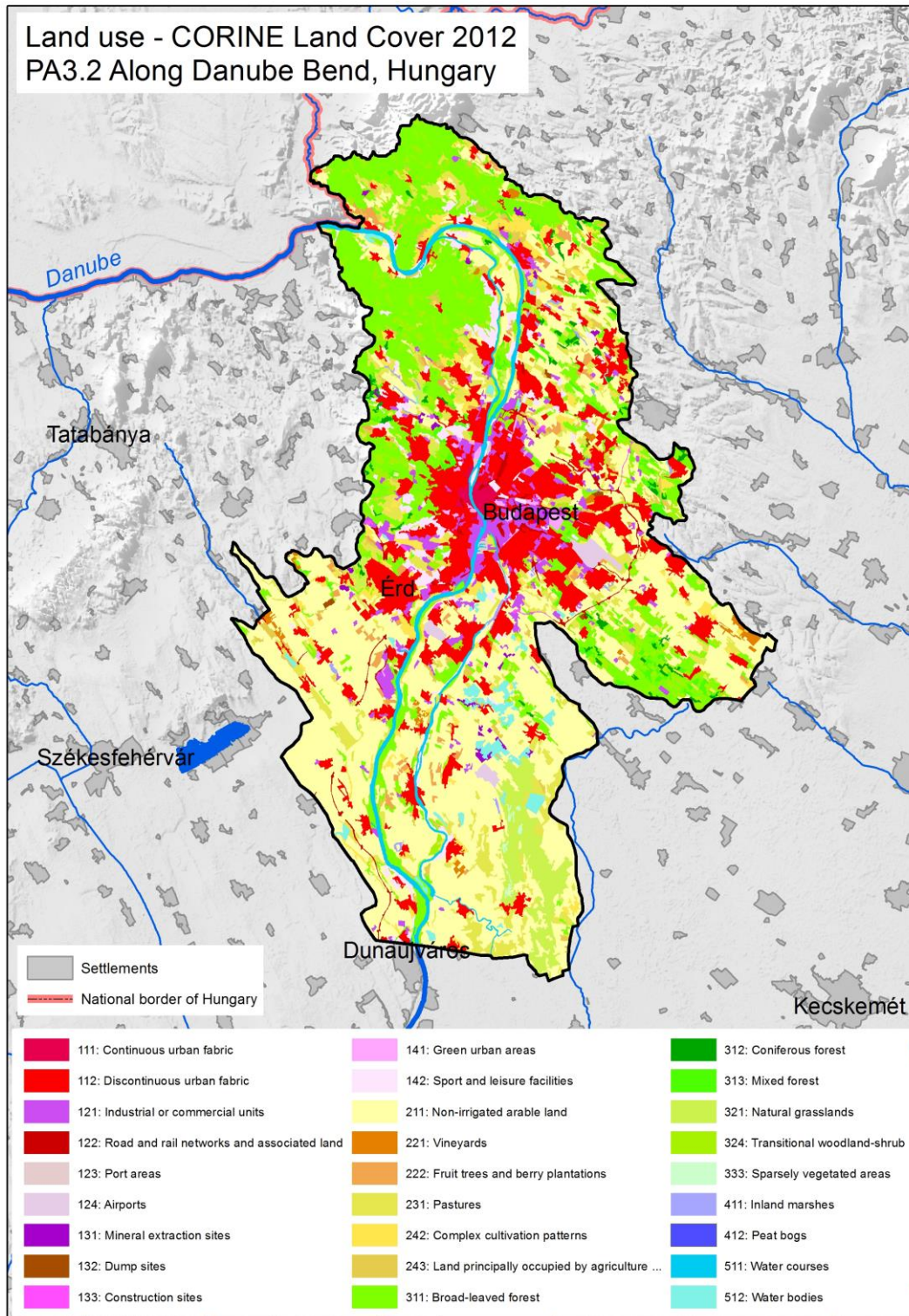
The aim of this report is to provide the review of best practices regarding different types of land use (agriculture, grassland, forestry) respectively vegetation cover (wetland), aiming at water protection and mitigating floods in the Pilot Action.

For this, first of all human activities have to be identified, which are posing risk to water quality and quantity; flooding and consecutive to water management. Finally, review of best management practices in the Pilot Action is presented.



## 2. Land use, drinking water and flood protection in the Pilot Action

### 2.1. Land use





CLC code	LABEL 3	Surface area (%)	Surface area (km <sup>2</sup> )	Pressures to drinking water quality	Pressures to drinking water quantity
111	Continuous urban fabric	0,34	13,71	- discharge of surface pollutants (e.g. from traffic, - construction sector) areas without waste water treatment plants - limited drainage capacity - centralized rainwater infiltration: contamination of surface waters in case of overflowing sewers -impact of transport (traffic)	- decreased infiltration capacity - centralized rainwater infiltration - decreased infiltration capacity
112	Discontinuous urban fabric	14,06	559,85		
121	Industrial or commercial units	3,27	130,39	- emissions of pollutants to ground and surface waters - decreased infiltration capacity - accidental pollution, Emission to surface and/or groundwater	- decreased infiltration capacity
122	Road and rail networks and associated land	0,75	29,84	emission of fuel, oil and other dangerous substances	
123	Port areas	0,07	2,86		
124	Airports	0,55	21,92		
131	Mineral extraction sites	0,32	12,64		
132	Dump sites	0,08	3,33		
133	Construction sites	0,14	5,47		
141	Green urban areas	0,38	15,19	pesticides and fertilizer leaching	
142	Sport and leisure facilities	2,51	99,99		
211	Non-irrigated arable land	35,42	1 410,24	pesticides and nutrient leaching	
213	Rice fields	0	0		
221	Vineyards	0,58	23,06		
222	Fruit trees and berry plantations	1,04	41,55		
231	Pastures	6,44	256,57		
242	Complex cultivation	3,03	120,48		
243	Land principally occupied by agriculture, with significant areas of natural vegetation	1,71	68,04		
311	Broad-leaved forest	17,36	691,31		
312	Coniferous forest	0,71	28,25		
313	Mixed forest	1,08	42,99		
321	Natural grassland	2,81	111,98		
324	Transitional woodland shrub	3,39	135,16		
331	Beaches, dunes, and sand plains	0	0		
333	Sparsely vegetated areas	0,1	3,81		
411	Inland marshes	0,25	10,02		
412	Peat bogs	0	0,18		
511	Water courses	2,43	96,57		
512	Water bodies	1,17	46,54		

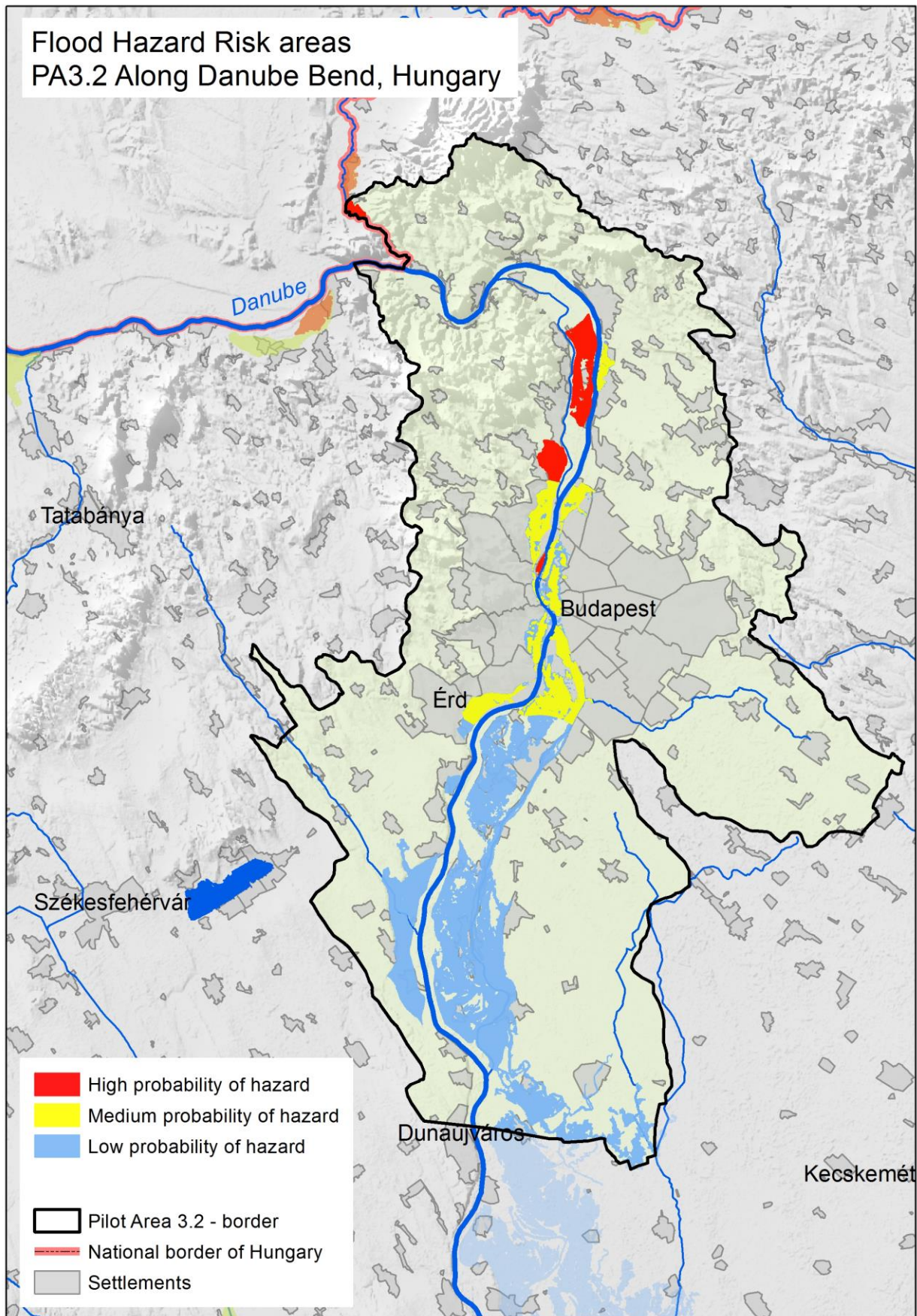


Land use only on the bank-filtered drinking water protective zones (DWPZ)

clc2012	LABEL_3	CLC12 area on bankfiltered DWPZ km <sup>2</sup>	Proportion from DWPZ-s area (%)
111	Continuous urban fabric	0,75	0,19
112	Discontinuous urban fabric	44,35	11,39
121	Industrial or commercial units	12,11	3,11
122	Road and rail networks and associated land	1,78	0,46
123	Port areas	0,22	0,06
124	Airports	4,23	1,09
132	Dump sites	0,14	0,03
133	Construction sites	0,83	0,21
141	Green urban areas	0,51	0,13
142	Sport and leisure facilities	14,61	3,75
211	Non-irrigated arable land	150,03	38,54
221	Vineyards	2,19	0,56
222	Fruit trees and berry plantations	3,44	0,88
231	Pastures	25,35	6,51
242	Complex cultivation	12,70	3,26
243	Land principally occupied by agriculture, with si*	9,36	2,40
311	Broad-leaved forest	42,63	10,95
312	Coniferous forest	0,40	0,10
313	Mixed forest	1,83	0,47
321	Natural grassland	3,02	0,78
324	Transitional woodland shrub	6,42	1,65
411	Inland marshes	1,08	0,28
511	Water courses	36,57	9,39
512	Water bodies	3,19	0,82

The bank-filtered drinking water protective zones area on the Pilot Area is 389 km<sup>2</sup>. The highest rate is represented by the non-irrigated arable land (38,5%), the discontinuous urban fabric (11,4%), broad-leaved forest (11%) and the pasture (6,5%).







The bank filtered drinking water sources are situated along the Danube, so the importance of flood protection is very significant on the PA. The probability of flood hazard on the Szentendre Island is high, in the Budapest urban area is medium, and on the south plain part of the PA is low.

In aspects of drinking water protection the non-structural flood protection measures (modify land use in floodplain and inundation areas, vegetation conversion and reservation) are favourable, because the flood does not remain on the DWPA's for a long time.

From the structural flood protection measures there are several ones which effect negatively the bank-filtered system. The dredging risks eliminating the natural filter (gravel and film layer) of the riverbed which is the base of natural purification of bank filtering. Further negative effect is the modification of river line.

In case of bank-filtration the particular challenge is the necessity of protection from both the river side and the background. In the same time the wells are shallow drilled, so the system is exceptional vulnerable. Due to the dual endangering there is conflict of interest with flood protection, so solving this conflict it is necessary secure strong expert background and multipoint consultations.

## 2.2. Drinking water protection

Government Regulation 123/1997 (VII.18.) on the protection of the actual and potential sources, and the engineering structures of drinking water supply defines the criteria of water protection zones.

Protection is understood to mean the determination, designation, establishment and maintenance of a protective block or area or zone. Protection is realised by the implementation of part, or all of the safety measures. The boundaries of the protective zones shall be determined by observing the particular hydrological and hydrogeological conditions considering the permitted rate of abstraction or in the case of future sources of supply the full capacity of the aquifer(s).

The protective measures set forth in the regulation serve the following purposes:

- a) The inner protective block, zone: protection of the abstraction works and the water supplies from direct pollution and damage,
- b) The outer protective block, zone: protection against refractory, further bacterial and other decomposable pollutants,



- c) The hydrology or hydrogeological block, zone: Protection against refractory pollutants by measures prescribed for the entire, or part of the catchment (recharge) area of the abstraction. The hydrogeological protective block or area is subdivided to "A", "B" and "C" protective zones.

The delineation of the protection zones is based on the estimation of the travel time, assuming steady seepage flow.

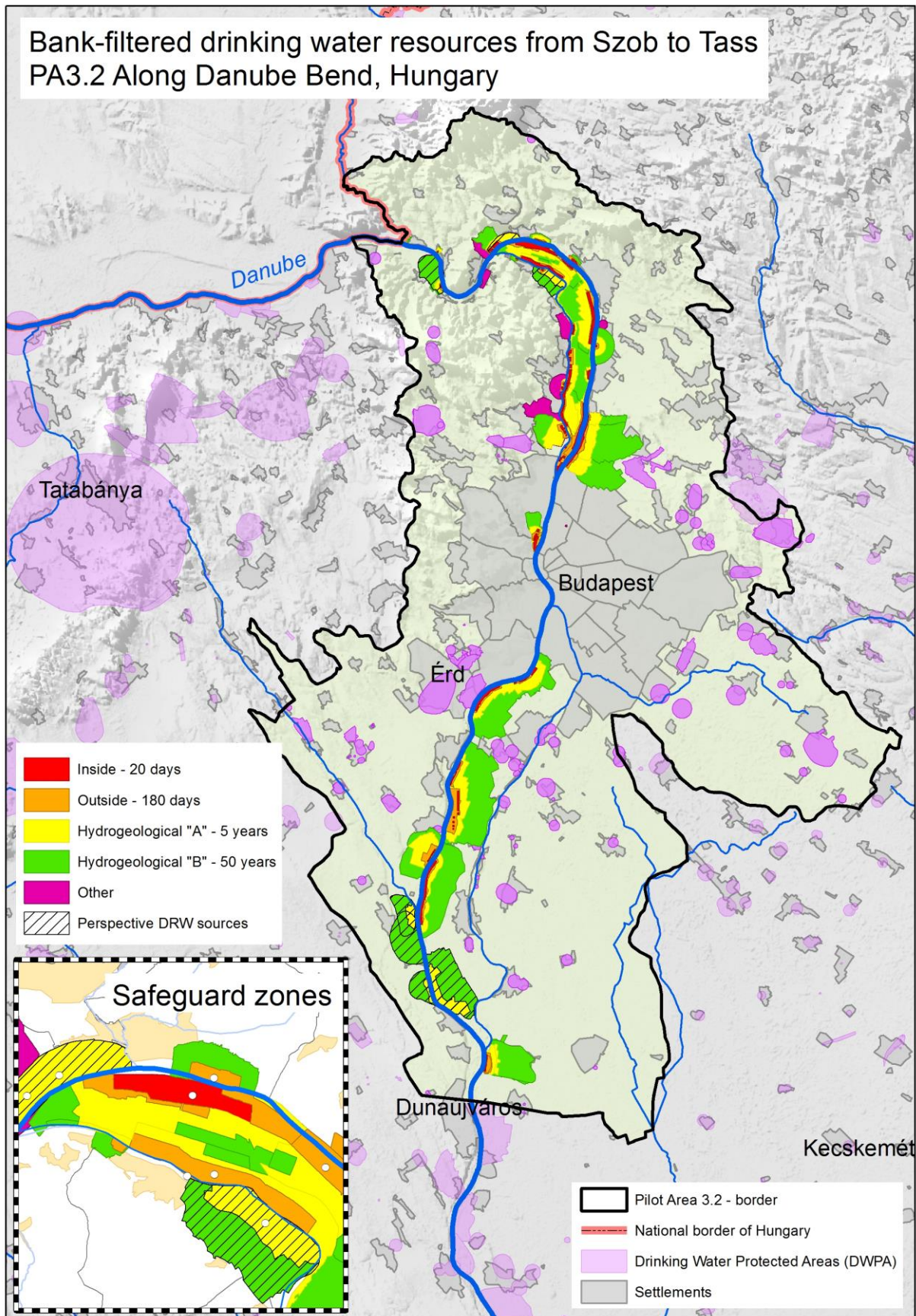
There are total 121 drinking water resources on the Pilot Area. From these there are 45 bank filtered resources (34 working, 7 perspective and 4 reserve resources), 59 groundwater, 9 shallow groundwater and 8 karst drinking water resources. The size of protected areas and protected production of drinking water resources are summarized in the table below.

	Working		Perspective		Reserve		Total	
	Protected m <sup>3</sup> /day	Protected Area km <sup>2</sup>	Protected m <sup>3</sup> /day	Protected m <sup>3</sup> /day	Protected Area m <sup>2</sup>	Protected Area km <sup>2</sup>	Total protected m <sup>3</sup> /day	Total protected Area m <sup>2</sup>
Bank filtered water supply	1 200 192	306	146 000	17 284	8,3	75	1 363 476	389
Groundwater supply	42 429	109		28	0,3		42 457	110
Shallow groundwater supply	11 513	36					11 513	36
Karst water supply	6 860	18					6 860	18
<b>Total</b>	<b>1 260 994</b>	<b>470</b>	<b>146 000</b>	<b>17 312</b>	<b>8,6</b>	<b>75</b>	<b>1 424 306</b>	<b>553</b>
Bank filtered water supply/Total	<b>95%</b>	<b>65%</b>	<b>100%</b>	<b>100%</b>	<b>97%</b>	<b>100%</b>		

The production of bank filtered water represents 95% of extracted water from the Pilot Area, while their protection areas account 65% of the total protection areas.

In the inner zone of Budapest there is minimal drinking water protection area. The two great islands of the Danube, the whole of Szentendre Island (55 km<sup>2</sup>) situated in north of the capital city, and more than 50% area of Csepel Island (256 km<sup>2</sup>) situated in south of Budapest, are drinking water protection areas.

The total surface of the Pilot Area is 3982 km<sup>2</sup>, of which is 14% covered by drinking water protection areas, and from that is 10% bank filtered drinking water protection area.





## 2.3. Other protection areas

According to the Directive 2000/60/EC, ANNEX IV: The register of protected areas required under Article 6 shall include the following types of protected areas:

- areas designated for the abstraction of water intended for human consumption under Article 7;
- areas designated for the protection of economically significant aquatic species;
- bodies of water designated as recreational waters, including areas designated as bathing waters under Directive 76/160/EEC;
- nutrient-sensitive areas, including areas designated as vulnerable zones under Directive 91/676/EEC and areas designated as sensitive areas under Directive 91/271/EEC; and
- areas designated for the protection of habitats or species where the maintenance or improvement of the status of water is an important factor in their protection, including relevant Natura 2000 sites designated under Directive 92/43/EEC(1) and Directive 79/409/EEC(2).

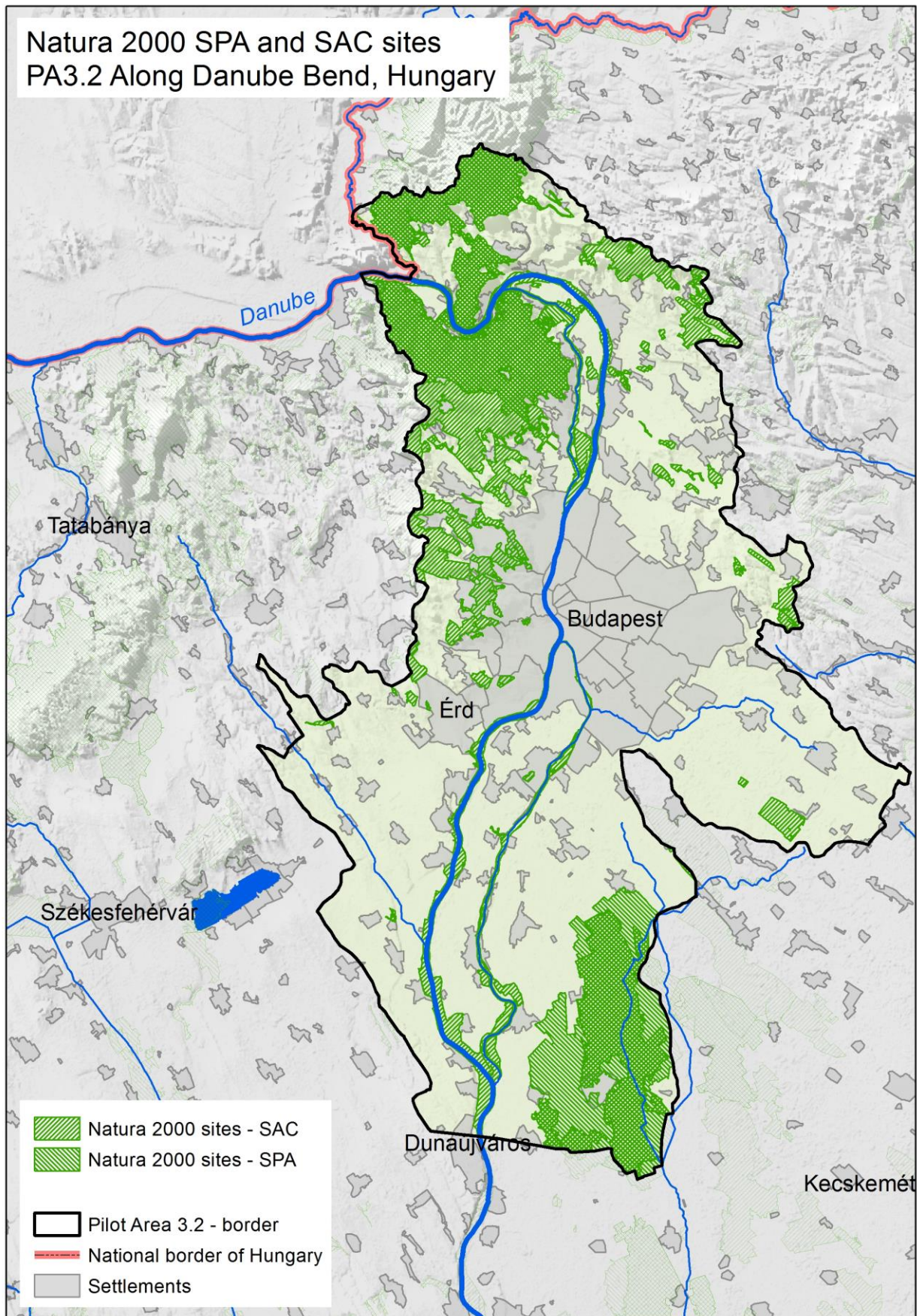
### Natura 2000 SPA and SAC sites along Danube Bend from Szob to Tass

OBJECTID	Name	Identification	Type
1	Felső-kiskunsági szikes puszta	HUKN20001	SAC
2	Tass-szalkszentmártoni szikes puszta	HUKN20005	SAC
3	Budai-hegység	HUDI20009	SCI, SAC
4	Budaörsi kopárok	HUDI20010	SAC
5	Csévharaszi homokvidék	HUDI20012	SCI, SAC
6	Debegió-hegy	HUDI20014	SAC
7	Gödöllői-dombság peremhegyei	HUDI20040	SAC
8	Szigeti homokok	HUDI20047	SAC
9	Érd-Százhalombattai táblarög	HUDI20052	SAC
10	Veresegyházi-medence	HUDI20055	SAC
11	Nyugat-Cserhát és Naszály	HUDI20038	SAC
12	Besnyői löszvölgy	HUDI20007	SAC
13	Börzsöny	HUDI20008	SAC
14	Ipoly-völgy	HUDI20026	SAC
15	Szentgyörgypuszta	HUDI20049	SAC
16	Ráckevei Duna-ág	HUDI20042	SAC
17	Duna és ártere	HUDI20034	SAC
18	Szigethalmi homokbuckák	HUDI20045	SAC
19	Érd-tétényi plató	HUDI20017	SAC
20	Turjánvidék	HUDI20051	SCI, SAC
21	Pilis és Visegrádi-hegység	HUDI20039	SAC
22	Gödöllői-dombság	HUDI20023	SAC
23	Felső-Kiskunsági szikes puszták és turjánvidék	HUKN10001	SPA
24	Börzsöny és Visegrádi-hegység	HUDI10002	SPA



There are large areas of Natura 2000 on the northern and south-eastern parts of the Pilot Area. The SAC types cover 837 km<sup>2</sup>, the SPA types covers 587 km<sup>2</sup>, between them there are overlaps.

The national protected areas (National Parks, Landscape Protection Areas and Nature Conservation Areas) cover altogether 586 km<sup>2</sup>, and there are 129 km<sup>2</sup> Ramsar areas on the Pilot Area. Natural bathing waters are also protected, of which 29 are located on the Pilot Area. A significant part (84%) of the Pilot Area is nitrate-sensitive, an area of 3362 km<sup>2</sup>, of which 1030 km<sup>2</sup> (26%) is nutrient-sensitive area also.

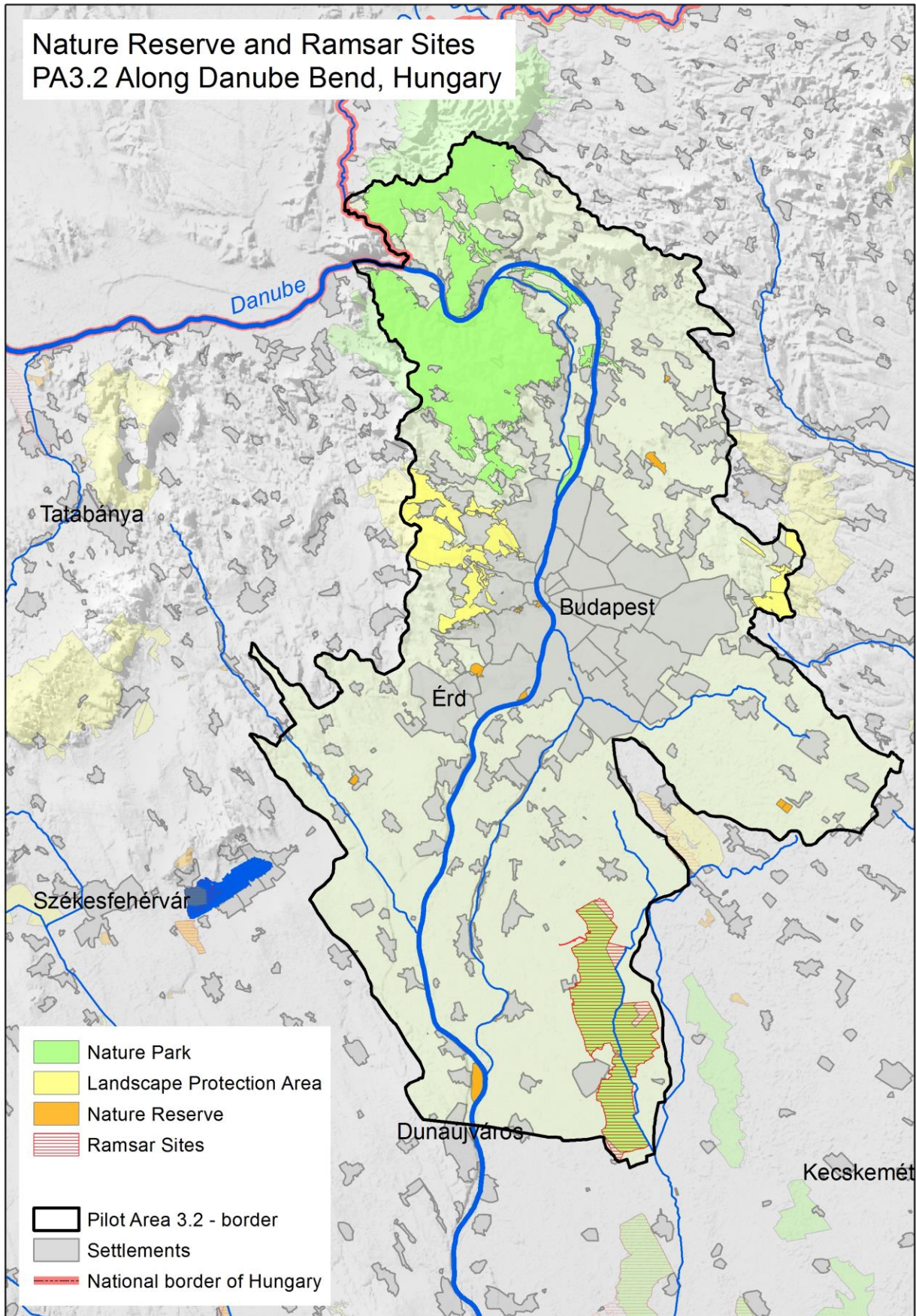


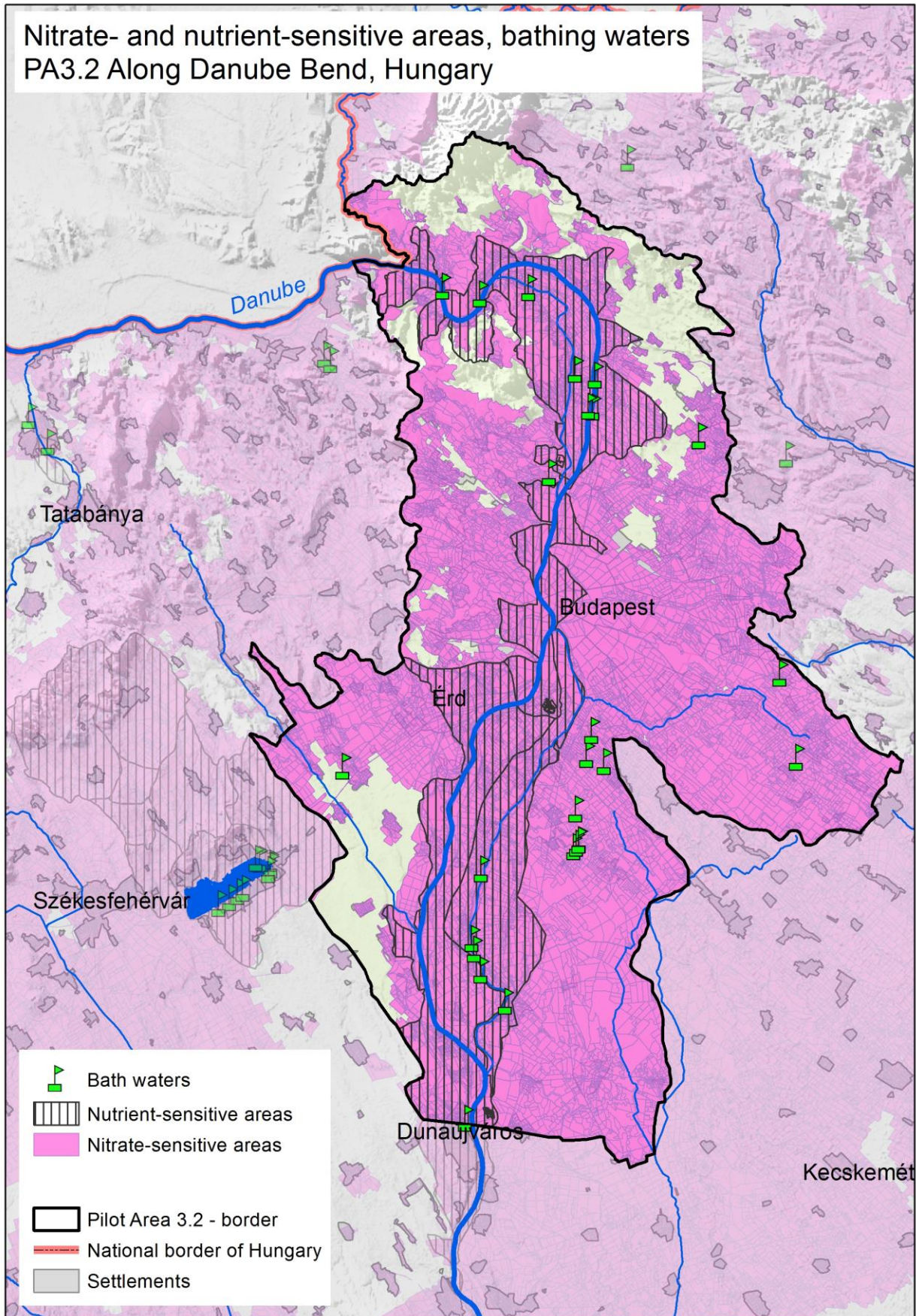


### Nature Reserve and Ramsar Sites along Danube Bend from Szob to Tass

OBJECTID	Name	MOSAIC	Nature_Park	Code	Type
1	Rácalmási-szigetek Természetvédelmi Terület	Rácalmási-szigetek TT	Duna-Ipoly NPI	270/TT/96	NP
2	Adonyi természetvédelmi terület	Adonyi TT	Duna-Ipoly NPI	192/TT/87	NR
3	Gödöllői Dombvidék Tájvédelmi Körzet		Duna-Ipoly NPI	231/TK/90	LPA
4	Fóti-Somlyó természetvédelmi terület	Fóti-Somlyó TT	Duna-Ipoly NPI	46/TT/53	NR
5	Ócsai Tájvédelmi Körzet		Duna-Ipoly NPI	112/TK/75	LPA
6	Csévharaszi-borókás természetvédelmi terület		Duna-Ipoly NPI	2/TT/40	NR
7	Csévharaszi-borókás természetvédelmi terület		Duna-Ipoly NPI	2/TT/40	NR
8	Peregi Parkerdő Természetvédelmi Terület		Duna-Ipoly NPI	269/TT/96	NR
9	Duna-Ipoly Nemzeti Park		Duna-Ipoly NPI	283/NP/97	NP
10	Szemlőhegyi-barlang felszíni védőterülete természetvédelmi terület		Duna-Ipoly NPI	61/TT/57	NR
11	Pálvölgyi-barlang felszíni védőterülete természetvédelmi terület		Duna-Ipoly NPI	14/TT/44	NR
12	Budai Sas-hegy természetvédelmi terület	Budai Sas-hegy TT	Duna-Ipoly NPI	64/TT/57	NR
13	Tétényi-fennsík Természetvédelmi Terület		Duna-Ipoly NPI	321/TT/11	NR
14	Budakalászi Kemotaxonómiai Botanikus Kert Természetvédelmi Terület	Budakalászi Kemotaxonómiai Botanikus Kert TT	Duna-Ipoly NPI	297/TT/03	NR
15	Kiskunsági Nemzeti Park	Felső-kiskunsági puszta	Kiskunsági NPI	109/NP/74	NP
16	Budai Tájvédelmi Körzet		Duna-Ipoly NPI	163/TK/78	LPA
17	Budapesti botanikus kert természetvédelmi terület	Budapesti botanikus kert TT	Duna-Ipoly NPI	75/TT/60	NR
18	Jókai-kert természetvédelmi terület		Duna-Ipoly NPI	115/TT/75	NR
19	Gellérthegy Természetvédelmi Terület	Gellérthegy TT	Duna-Ipoly NPI	275/TT/97	NR
20	Vácrátóti arborétum természetvédelmi terület		Duna-Ipoly NPI	27/TT/51	NR
21	Szentendrei rózsza termőhelye természetvédelmi terület		Duna-Ipoly NPI	5/TT/42	NR
22	Martonvásári-park természetvédelmi terület		Duna-Ipoly NPI	47/TT/53	NR
23	Érdi Kakukk-hegy természetvédelmi terület	Érdi Kakukk-hegy TT	Duna-Ipoly NPI	307/TT/07	NR
24	Háros-szigeti Ártéri-erdő Természetvédelmi Terület	Hunyadi-sziget	Duna-Ipoly NPI	265/TT/93	NR
25	Háros-szigeti Ártéri-erdő Természetvédelmi Terület	Háros-szigeti Ártéri-erdő	Duna-Ipoly NPI	265/TT/93	NR
26	Tamariska-domb természetvédelmi terület		Duna-Ipoly NPI	329/TT/12	NR









## 3. Best Management Practices

### 3.1. Forest

#### BP MF1 Continuous forests cover (CFC)

CFC systems involve continuous and uninterrupted maintenance of forest cover and avoid clearcutting.

In the mountainous northern part of the PA3.2 there are forest areas which are specifically managed for protecting the soil or drinking water. These CFC protects bank filtered water sources from the background.

##### Measure advantages

CFC is a true alternative to simple timber production and provides the basis for an economical strategy in forestry with the overall purpose of drinking water protection and/or flood prevention. It ensures the soil and water protection functionality of forest ecosystems over space and time.

##### Challenges

In Hungary only a few forestry has started establishing CFC systems yet. The application of CFC requires specific knowledge and understanding of long term benefits.

#### BP MF2 Pro-Silva movement

Pro Silva Hungaria was established in 1999 as a non-governmental organization, it's made for stakeholders of the forest sector for forestry practice.

It promotes sustainable and profitable forest management strategies. As a result of the discussions silviculture includes not only wood production but an emphasis on maintaining forest biodiversity, recreational, landscape, soil, air and water protective functionalities as well as socio-economic and cultural functions.

##### Measure advantages

It ensures the soil and water protection functionality of forest ecosystems, ensures up-to-date knowledge transfer.



## Challenges

In Hungary the thinking on Pro Silva principles has started only a few years ago. The NGOs have minor impact on daily practice of forestry.

## BP MF3, BP PF1 Protective forest management and afforestation of DWPA

Protective forests are especially important for the protection of the bank filtered systems. These forests mitigate or prevent the impact of a natural hazard, including soil erosion, landslide or flooding. The protective effect consists in maintaining the 'natural' flow regime. With regard to floods forests reduce stormflow peaks and delay. Protecting stream and river banks from undue horizontal erosion is function of a buffer zone of trees along both sides of a watercourse. The buffer area also acts as a filter and depository for sediment, pesticides and fertilizers from upslope land use, thus preventing them entering to the DWPA's.

The forest cover (nearly 19%) of the Pilot Area is improving but at international level it is still low when compared to the average of the EU (34.2%) despite of that the northern part of the PA is hilly area covered by continuous forests. The problem is that in the southern and the eastern part of the PA the forests disappeared after the deforestation of the plains for agricultural reasons in the previous century.

The significance and necessity of afforestation can be characterized by favourable impacts on the soil, water, air and biodiversity, in short on the environmental state, in addition to the economic benefits.

### Measure advantages

- Mainly the mountainous protective forests have established for protecting against landslides and rock crumbling. These are forests on steep slopes or banks of waters, forests in torrential type areas withhold excessive discharge of water and thus protect the land from erosion. Protective forests also form forest belts, which protect forests and land from wind, water, snowfall.
- Establishing protective forests at banks of waters or in DWPA's prevents leaching of agricultural pollution to waters. Planting trees can be effective in increasing water infiltration, and reducing and slowing runoff.
- The main aims of the measure are to increase the forest cover of the PA's plain sites; by developing the forestry sector, to enable the agricultural restructuring, by the help of



alternative use of areas. Objectives of forestry also include the establishment of high biodiversity natural forests.

- The whole area of afforestation contributes to protection against erosion (water or wind erosion) and combating climate change mitigation.

### Challenges

In Hungary the management of forests depends on the owners. The good practices in forests management ensured if waterworks can treat the protective areas of drinking water sources.

It is a challenge, that the provisions and the criteria for selecting afforestation areas to ensure that the planned measures are in line with the local conditions and the environment protection/biodiversity requirements particularly on the DWPA's.

The afforestation of protected grasslands and wetlands may not comply with local conditions and environment requirements.

## BP SR1 Protective forest management on floodplain

Riverine forests (mainly alders, willows and poplars) have been heavily transformed but important areas remain along the large rivers, like the Danube. The most of them show rather pristine state and they are Natura 2000 sites. Only a few "relicts" show the original natural vegetation because of the spread of invasive species of non-native plants and of weeds (IUCN, 1993).

Man-made flood defenses - engineered embankments, flood walls and temporary structures - are an essential part of the fight against flooding. However forests/trees can provide a sustainable and low maintenance solution to lessening the risk of flooding as well as delivering other environmental and economic benefits when combined with other flood defenses on floodplain.

Establishing protective forests at banks of waters or in DWPA's prevents leaching of agricultural pollution to waters. Planting trees can be effective in increasing water infiltration, and reducing and slowing runoff. Woodland located on floodplains can mitigate large flood events by absorbing and delaying their progress downstream. Trees and green space could play a critical role in adaptation to climate change in addition to reducing flood risk.



## BP MF4 Prohibition or restriction of grazing in forests

According to the Hungarian actually Forest Law grazing in the forests has been prohibited for the last decades. The grazing in forests was maintained until the middle of the 20th Century, but it had been regulated by laws since the early times. After the date of 01.09.2017 the law will cancel the prohibition of the grazing in forests, it will be allowed with restrictions. Only horses, cattles and sheeps are allowed to be grazed or rested in forest.

The reasons of prohibition were to protect soil from degradation, increase game production and biodiversity as well. Compaction of soil can reduce plant growth, inhibit root penetration, restrict water and air movement in the soil and, ultimately, reduce yields.

Overgrazing can occur when undergrowth is exposed to intensive grazing for extended periods of time, or without sufficient recovery periods. The only thing to stop overgrazing is to limit the animals space to roam around. Overgrazing reduces the usefulness, productivity, and biodiversity of the land and is one cause of desertification and erosion. Overgrazing is also seen as a cause of the spread of invasive species of non-native plants and of weeds.

### Measure advantages

Negative impacts of overgrazing can be prevented and/or reversed by proper forest management.

### Challenges

Undergrowth management have to solve by forestry. The quality of forest management depends on the owners of the forest.

## BP PF2 Forestry administration and control

The Directorate of Forestry of the National Food Chain Safety Office (NFCSO FD) carries out tasks in general of forestry administration. The main activity is to ensure, through its administrative functions, the sustainable forest management in the country.

It must be stressed again that forestry authority organizations do not carry out any forest management activities in Hungary, independently of the ownership type.

On the PA in terms of forest management, it can be distinguished between state-owned and non-state-owned forests, mostly private ones. The non-state-owned areas are managed mostly by private management companies. These must be recorded by the forestry authorities. The management of the state forests is mainly carried out by the state forest management companies. However, there are also other state organizations - e.g. Water Management



Authorities, National Parks - managing state forest areas. The share of community ownership on forests is low, usually municipal, town and city councils are the forest managers.

#### Advantages

- The control on Foresters ensures to reach sustainable forest management objective.
- Clear legislative background system

#### Challenges

Not managed forests also exist in Hungary most of them being in private property. At these areas there is no forest manager recorded in the register of the forestry authority. It is a key objective of forest policy in Hungary to further reduce the size of unmanaged forests.

### BP PF3 Establishment of agro-forestry systems (grazing) and wood-pastures

The agro-forestry systems are extensive land use systems where trees are attended and agricultural activities are pursued simultaneously, thus a mosaic of agricultural and forestry systems is created. They combine extensive agricultural and forestry systems aimed at the production of excellent quality wood and other forestry products.

Introducing agro forestry system in special regions of PA (floodplains) are expected to achieve major positive environmental effects.

#### Advantages

- The agro-forestry systems have major importance in reintroducing sustainable landscape management and the strengthening of the mosaic character on plain areas.
- The measure aids the protection of rural natural resources and improves their state.
- The measure provides a good opportunity for integrated and ecological farming, decreasing the conflict of interest between agriculture and drinking water protection.
- For farmers on the DWPA the agro-forestry systems are perfect for making the rural area more attractive, for maintaining jobs and creating new ones, and for improving the living conditions.

#### Challenges

The traditional use of woodlands and its essential influence on the land's structure and dynamics have become commonly known among the Hungarian ecologists only in the past few years. The



abandoned wood-pasturing occurred in all types of forests. In all cases the decrease of pasturing livestock was the reason for the abandonment of the areas.

Although, wood pasturing which is based on the traditional knowledge has a great importance in conserving nature and landscape but for re-establishment of agro-forestry systems a lot of obstacles have to defeat, for example: intensive husbandry has replaced grazing.

It would be necessary evolving a consciously controlled and sustained wood pasturing system again.

## 3.2. Grassland

### BP MG1 Protective grassland management

In karstic areas of Budai hills and Pilis mountain grasslands are managed for protecting grassland ecosystem and drinking water resources.

### BP PG1 Regulation of suitable locations and proportion of grassland cover inside DWPA, selection of the appropriate management type

The Government Regulation 123/1997 prescribes, that within the inner protective zone, the terrain shall be levelled to prevent surface runoff from accumulating in stagnant pools. The terrain should be planted as continuously as practicable with grass. No fertilisers, manure and pesticides must be spread. The surfaces on which no grass can be planted shall be paved with durable, non-polluting material. Over aquifers close to the surface, further in the vicinity of pipelines and structures no trees and shrubs with roots reaching down to these must be planted.

#### Advantages

- Clear legislative background system
- Grassland may reduce quantitative and qualitative vulnerability of groundwater and surface water resources by retaining water, filtering and attenuating pollutants, reducing erosion.





## BP PG2 Special good practices of grazing in protected areas

A significant portion of grasslands are over utilized by livestock. Although a parcel of land is not overgrazed there are some parts where signs of degradation can be found. These special areas are attractive for ungulates because there is water, added by salt sources, shelters. Overgrazing has detrimental effects on soil and vegetation but changes are reversible. High grazing pressure negative influences the ecosystems. Moreover, overgrazing increases area covered by no vegetation, reduces infiltration, soil moisture and fertility, accelerates runoff increases soil ammonia and nitrate content and changes soil microbial activity. If this befalls on DWPA the drinking water aquifer can be polluted.

Nevertheless, all these negative impacts can be prevented and/or reversed by proper grassland management practices. According to the Government Regulation 123/1997 within the inner protective zone is prohibited grazing, but in particular instances (e.g. groundwater table deeper than 2 m) grazing may also be allowed inside the outer protective zone, only watering and noontime rest of the animals shall be outside the protective zone.

### Advantages

- The measure preserves retention capacity, consequently ESSs, in the frame of general grassland management without considerable additional cost or loss of production: so increases cost efficiency.
- Appropriate grazing can efficiently contribute to weed control.

### Challenges

- the correct information of farmers
- need increased awareness of the farmers



### 3.3. Agriculture

There is no significant agriculture in the mountains regions of PA.

#### BP PA1 “Good Agricultural Practice” guidelines

On Szentendrei or Csepel Island water protection areas managed by Budapest Waterworks (BW) by establishment of a farm advisory system.

There are more than 150 wells on Csepel Island and several hundred on Szentendrei Island producing potable water for Budapest and its agglomeration. The long-term sustainability of the excellent quality of that water depends on a number of impacts: the local waste and sewage management, the local industry, its locations and environmental status, mining, presence of open and/or stagnant water and the agricultural activities.

Inappropriate agricultural use of land and use of fertilizers and pesticides can cause significant pollution endangering the quality of potable water. Thus Budapest Waterworks Company created a good practice guideline for farmers to support the protection of drinking water in an agricultural area and at the same time to help farmers making their livelihood in the water protection zones. In the guidelines clear explanation is given on the connection between land use and the drinking water base and there are suggestions for appropriate and “water-friendly” soil preparation, use of fertilizers and pesticides, sowing and planting, irrigation, husbandry and livestock breeding, as well as administrative obligations. The guideline was especially designed for farmers working in water protection zones and considers all aspects of water protection needs, as well as the need of the farmers.

The maps of the protection zones with various levels of restrictions and the detailed description of regulations are also available at the local governments.

The appropriate agricultural use considers also soil and water protection, as well nature conservation and do not expose the environment to unnecessary load from irrigation, use of fertilizers and pesticides. Substances not absorbed by plants will be washed out and sink to the ground water, thus they are not only pollute the drinking water, but also they are wasted from the farmers' point of view.



### Advantages

- Farmers are considered as partners and they are positively motivated for water-friendly farming, which is much more positive than only the use of rules
- If well-targeted, the information can reach many farmers and may cause significant improvement in water-base management on long term complementing the regulations
- “Good Agricultural Practice” can be applied also in other areas
- Water-friendly land use favours also nature conservation and human health, thus it is a multi-aspect approach

### Challenges

- The number of farmers reached
- The willingness of farmers to follow the guideline
- It is difficult to measure its effectiveness

## BP PA2 Prohibition or restriction of application of manure in high-risk areas

The “Government Regulation 123/1997 (VII.18.) on the protection of the actual and potential sources, and the engineering structures of drinking water supply” define the rules of the application of manure, of dissolved fertiliser and liquid manure and the release of liquid manure on the DPWZs. On the inner zone of the surface and groundwater resources it is strictly prohibited, on the outer and on the hydrogeological “A” protective zones it is allowed depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. The dissolved fertiliser and liquid manure land application to agricultural land within the inner, outer and hydrogeological “A” protective zones is prohibited, inside the hydrogeological “B” protective zone is allowed depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. Release of liquid manure on the DPWZs is strictly prohibited.

### Advantages:

- NO<sub>3</sub> (plus ammonium and nitrite) leaching losses and indirect and direct NO<sub>2</sub> emissions would be reduced by a small amount.
- Soluble and particulate P losses would be reduced by a small amount.
- Organic load losses would be reduced by a small amount.
- It should be used in other sensitive areas



### Challenges

- It is difficult to verify

## BP PA3 Controlling storage of manure

The impermeable base and leachate collection prevents the direct loss of pollutants in surface runoff and drain flow.

There are a number of tender opportunities for farmers to construct storage infrastructure for solid manures with an impermeable base. Those who engaged in organic farming, or manage on nitrate vulnerable zones, get extra points in the tender evaluation.

This method is applicable to all livestock farms that produce or import solid manure.

### Advantages:

- continuous tender opportunities

### Challenges

- Relatively high investment cost
- Need of high own contribution

## BP PA4 Controlled application of manufactured fertilizer in high-risk areas

According to the Government Regulation 123/1997 inside the inner protective zone is prohibited the fertilizer application, within the outer, hydrogeological “A” and hydrogeological “B” zones it is allowed depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation.

All drinking water protected areas are designated as nitrate sensitive areas as well. To protect the nitrate sensitive areas, and to protect waters, the use of artificial fertilizers and plant protection chemicals shall be reduced. In order to protect waters and to diminish the existing nitrate pollution, the rules of Good Farming Practice have to be observed in the affected agricultural areas. The sound use of soil, which takes into consideration the perspectives of the nutrients and the soil management, has to be fostered.

Rural Development Program supports conversion arable land farming practices into less intensive land use near vulnerable water resources. This measure has provided for areas in the protection



zone of vulnerable drinking water resources, or on land with a slope steeper than 12%, or in areas affected by floods to preserve and improve the condition of the environment.

The specifications referring to the sustainability of “good agricultural and environmental condition” are displayed in the national legislation. The minimum requirements referring to nutrient management and application are imposed in the pieces of national legislation below. These minimum requirements must be met by the beneficiaries of RDP in the complete areas of their agricultural lands.

- The amount of nitrogen from organic manure disposed in an agricultural area on an annual basis cannot exceed 170 kg/ha.
- Manure cannot be applied on frozen ground, land filled with water or covered completely with snow.
- Manure shall not be spread in prohibited period
- Manure cannot be applied in a radius within the protection zone of surface water, source, and wells whose water is used for human consumption or watering animals.
- Improvement of acidic, saline and sand grounds can be undertaken in line with ground protection authority permit and complying with regulations of relevant legislation.
- Treated wastewater, sewage sludge and slurry application shall be done in accordance with the permit issued by soil protection authority and meeting specifications of relevant legislation.

#### Advantages

- Clear legislative background system
- Controlled nutrient use by authorities
- The measure prevents the pollution of water resources, so reduces quality vulnerability of drinking water supply.

#### Challenges

- Need of professional knowledge, permanent education of farmers/users of fertilizers.



## BP PA5 Controlling the use of pesticides

The Agricultural Office designated as the plant protection and soil conservation competent authority.

According to the Government Regulation 123/1997 within the inner protective zone of the drinking water resources is prohibited the use of pesticides. Inside the outer, hydrogeological “A” and hydrogeological “B” zones it is allowed only depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. The pesticide application from aircraft is prohibited within the inner, outer and hydrogeological “A” protective zone, within the hydrogeological “B” zone it is allowed only depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation. The pesticide storage and residues disposal and washing pesticide equipment, effluent disposal within the inner, outer and hydrogeological “A” zones is allowed. The washing pesticide equipment, effluent disposal within the hydrogeological “B” zone is allowed only depending on the outcome of an EIA, or environmental audit, or a special equivalent investigation.

### Advantages

- Clear legislative background system
- Strictly controlled pesticide use by authorities
- The measure prevents the pollution of water resources, so reduces quality vulnerability of drinking water supply.

### Challenges

- Uses of not registered pesticides (illegal activities)
- Need of professional knowledge, permanent education of farmers/users of pesticides

## BP PA6 No-chemicals and organic farming

Recent years in Hungary have seen the rapid rise of organic farming, although domestic demand for fresh and processed organic produce has increased at a slower pace. One reason is the higher consumer price of organic products; another is the lack of organization in the internal markets. Most of them deal with wine production, processing of fruits, vegetables; milk and meat.

This allows the producers to process an increasing portion of their organic products in their own facilities, under strictly supervised conditions.



#### Advantages:

- strictly supervised productions
- no-chemicals farming does not effects negatively the drinking water quality

#### Challenges

- Relatively high cost
- Need of professional knowledge

## BP PA7 Agro-environmental payments under Rural Development Programme of Hungary

Agro-environmental payments contribute to the development of rural areas and provide environmental services for the whole of society. These payments encourage producers of agricultural lands to adopt farming and production methods which are compatible with the sustainable use of environment, landscape, and natural resources and with the preservation of genetic resources.

At the establishment of agro-environmental actions close attention is devoted to the alleviation and reduction of agro-environmental problems typical in Hungary, and to the promotion of such environmentally friendly farming practices which prevent certain environmental problems to occur. In line with the above, the following specifications have been laid down in accordance with agro-environmental priorities and have been integrated into various schemes:

- Soil protection: the amelioration of effects of various soil degradation procedures (land erosion, acidification, soil compaction) by the adoption of a variety of agrotechnical methods. As environmentally friendly nutrient management practices are promoted, the negative balance of land nutrients is restored, and this is one of the key objectives.
- Protection of surface- and ground waters: with the help of the promotion of restructuring land use and the practices of environmentally friendly nutrient management and plant protection, the quality of water resources shall be protected and possible contaminations shall be reduced.
- Nature conservation: in all areas of agricultural land use (arable farming, grassland management, plantations) the target is the development of an active nature conservation system.
- Genetic conservation.



- Reducing air pollution: via extensive farming along with management methods and plant groups requiring low external input schemes contribute to the reduction of contamination produced by agriculture.

**Advantages:**

- Support the sustainable development of rural areas, to preserve and improve environmental conditions, to reduce load on environment from agricultural sources, to offer environmental protection services, and to promote agricultural practice based upon the sustainable use of natural resources.
- Support the preservation of biodiversity on farm,
- Support the protection of waters and soil with the establishment of farming structures adequate for production area features, environmentally aware farming
- The establishment of sustainable land use is also strongly supported.

**Challenges**

- Relatively high cost
- Need of professional knowledge

### 3.4. Urban areas (settlements)

#### Construction of the sewage system and devices for waste water treatment

Construction of new or modernization of already present sewage treatment plant and sewage network is important on this area. In case of heavy rainfalls the wastewater treatment plants are overloaded, so it would be necessary separate the rainwater from the sewage systems. The capital of Hungary (Budapest) is nearly on the centre of the PA, with agglomeration the urban area extent is significant (12%). There are 2.5 million residents on the PA, so the waste water treatment is realised by regional sewage plants. The treated waste water discharges into the Danube, where the bank filtered drinking water supplies are located, so the efficiency of the plants is really important.

**Advantages:**

- Prevent the deterioration of groundwater quality
- Increase the level of human health





- Decrease the emission of microbiological pollutants, nutrient N&P compounds and priority substances
- Decrease the contamination of surface waters in case of overflowing sewers

#### Challenges

- Increase the connection to the sewage network
- Improve the waste water treatment technology
- Prevent incoming rainwater to the sewage system - needs of separated systems

### Set up of individual waste water treatment plants for individual houses

Only the settlements higher than 2000 PE (population equivalent) are involved to the national sewage program, the others need to find individual solutions for waste water treatment. There are many known technologies, but actually their applications are on low level in Hungary because of the higher prices. At the households without connection to the sewage network there are usually septic tanks and the waste water is transported to the sewage plants.

#### Advantages:

- Prevent the deterioration of groundwater quality
- Increase the level of human health
- Decrease the emission of microbiological pollutants, nutrient N&P compounds and priority substances
- Decrease the charging of the sewage network

#### Challenges

- Improve the waste water treatment technology
- Need of professional knowledge
- Increase the environmental awareness of residents

### Implementation of decentralized rainwater infiltration

The centre of the PA is mostly covered by urban area (Budapest and agglomeration), so the importance of the urban rainwater management is significant. It needs decreasing sealed artificial surfaces to prevent the further quality and quantity degradation of groundwater.

#### Advantages

- Decreased pollution deposition from air
- Increased water quantity and recharge, increased infiltration and drainage capacity



### Challenges

- Increase the amount of green surfaces

## 3.5. Industrial areas

### More stringent persecution of contaminated site remediation

On the PA there are on national level well-known industrial contaminated areas which affect some drinking water resources. These contaminations provide from old industrial locations (Szentendre: abandoned Russian army fort; Csepel-works: historical industrial area). The soils and the groundwater were contaminated with industrial sector-specific pollutants (heavy metals, organic pollutants). The remediation has been going on a long time ago. It needs significant material cost, high level skills and know-how and stringent authority controlling. After the remediation the areas can be used newly for other activities.

### Advantages

- The areas can be used newly for other activities.
- Increase the human health quality.
- Increase the value of real estate.

### Challenges

- Implementation of the remediation and recultivation
- Increase the level of controlling by authorities
- Increase the level of know-how

## 3.6. Tourism

e.g. ski lifts, mountain huts in mountainous sites ....

## 3.7. Wetland

On the south part of the PA there is a wetland, but it is not connected to the bank filtered drinking water system.



### 3.8. Floodplain

The bank filtered drinking water sources are situated along the Danube, so the importance of flood protection is very significant on the PA. The probability of flood hazard on the Szentendre Island is high, in the Budapest urban area is medium, and on the south plain part of the PA is low.

In Hungary the preliminary flood risk assessment has been done based on the readily available information. Hazard and risk maps were supervised and strategic risk management plan was also prepared (2015).

On the PA, along the nearly total length of Danube flood protection dykes have been built. Their establishment and protective ability are on different levels, so the hazard of flooding in the areas they protect varies as well.

Risk management plans include several structural and non-structural measures, like preparation of Flood Riverbed Management Plans.

#### BP SR2 Non-structural flood defense measures

The aims of the Flood Riverbed Management Plans (FRMP) are reducing flood levels, keeping or repairing capacity of riverbed and ensure the flood protection safety. FRMP includes

- Identification of flood hazard zones and consideration of their limitations;
- Identification, development and protection of flood retention volumes;
- Development of individual flood protection measures;
- Revision of the existing constructive flood protection measures;
- Maintenance of the watercourses, hydraulic works and river banks;
- Adequate management of hydraulic structures.

FRMP includes some measures on land use as well including changing, optimization of plant cultivation or land use on floodplain. In aspects of drinking water protection these non-structural measures (modify land use in floodplain and inundation areas, vegetation conversion and reservation) are favourable, because the flood does not remain on the DWPA for a long time.



## BP SR3 Structural flood defense measures

The Flood Riverbed Management Plans relied on technical viewpoints, hydrodynamic modeling which determine the flood river bed and indicate the flow zones.

There are several structural measures to reduce flood risk, like

- Deepening of riverbed by dredging
- Storage, and water retention in river bed
- Dyke relocation, building dykes, developing flood protection dykes
- Building flood channels or spillways
- Deepening of floodplains
- Demolition of river regulation structures
- Removal of buildings and other constructions from the flood area.
- Dredging and restoration of side branches
- Removal of summer dams from the flood area.
- River reef or river bend regulation

From these structural measures there are several ones which effect negatively the bank-filtered system. The dredging risks eliminating the natural filter (gravel and film layer) of the riverbed which is the base of natural purification of bank filtering. Further negative effect is the modification of river line.

## 4. Conclusions

The most important water supply area in the country is the bank-filtered water resources on the right and left bank of the Danube, on the Szentendre and Csepel Islands. The bank-filtered water resources located on the pilot area supply with drinking water mainly Budapest and about 150 settlements in the agglomeration, about 2.5 million inhabitants.

The land use of the pilot area is very complex, in the north is mountainous, in the middle there are densely urban areas and the capital, in the south plain area and on the islands agricultural lands are found.

Our goal with using good practices is to prevent the quality and quantity deterioration of drinking water sources. In case of bank-filtration the particular challenge is the necessity of protection from both the river side and the background. In the same time the wells are shallow drilled, so the system is exceptional vulnerable. Due to the dual endangering there is conflict of



interest with flood protection, so solving this conflict it is necessary secure strong expert background and multipoint consultations.

In Hungary there are a lot of best practices, included in national plans (River Basin Management Plan, Flood Risk Management Plan in regards of drinking water protection) and legislation (Government Regulation on the protection of the actual and potential sources, defines the criteria of water protection zones) in order to minimise the negative impact of agriculture and industry on the DWPZs. Despite of the legislation the implementation and authority inspection is insufficient. Further problem is the low willingness to cooperate between farmers, other stakeholders and some water suppliers to ensure water protection. Despite of this national level insufficiency, there is a very good cooperation practice on this PA. Budapest Waterworks Company created a good practice guideline for farmers to support the protection of drinking water in an agricultural area and at the same time to help farmers making their livelihood in the water protection zones. The greatest drinking water sources are situated on the Szentendre or Csepel Island, and their water protection are managed by Budapest Waterworks (BW). These islands are not covered by urban area, the main land use is agriculture and nature reservation is also significant.

The DWPAs are situated on high-value real estates; this facility makes more difficult the procedure of designation by authorities.

On the PA there are detected contaminated sites, on which remediation has been going on. On the DWPAs there are professionally built monitoring systems which are controlled regularly (water quality and water level), so in case of a contamination mind happened it is possible starting the intervention.

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