Demonstration of harmonized and cost-effective monitoring - Annex I

Deliverable D.T1.2.1 - Final selection and description of pilot areas

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1 INTRODUCTION

HS management in the Danube River Basin (DRB) currently suffers from a lack of data and understanding about pollution amount, sources and pathways.

In this study, we want to demonstrate through a pilot action what is necessary to create a reliable inventory of sources, pathways and pollution extent at catchment level. The resulting inventory shall be sufficient to carry out and validate detailed emission modelling, which in turn will be used to assess a set of management scenarios.

The pilot action will include regions that shall be located in different Danubian countries and that should present distinctive traits with respect to climate, hydrology, land-use and pollution pressure.

The project partners TU Wien, UBA, BME, BWA and NARW are responsible for the pilot action. During the preparation of the project proposal they agreed on common criteria for the selection of the pilot areas (PAs), they identified two to three catchments in each of their national territories which fulfilled such criteria and provided a harmonized description of the catchments and respective sub-catchments.

2 SELECTION PROCEDURE

The PAs were selected taking into consideration the following criteria:

- The emissions situation of hazardous substances should
  - be of national relevance (or complete background situation),
  - be typical for a broader region in the country (no singularities),
  - show a strong predominance of one emission sector (e.g. municipal, industrial, agricultural, mining) at sub catchment level and show a mixed situation at total catchment level.
- The size of the catchment and sub catchment should be
  - small enough to allow the investigation of important emission sources and pathways,
  - large enough to be of relevance on national and Danube wide level,
  - therefore between 400 and 2000 km² in total possibly with 2-4 sub catchment with a few 100 km².
- At the outlet of the catchment and the sub catchments the following prerequisites for HS-measurements should be available:
  - continuous flow monitoring (river gauge),
  - space for sampler installation (if possible with power supply) close to the river gauge,
  - personal for conducting the sampling in the proximity.
- Inventory of main industrial and municipal emitters should already exist.
- Preexisting monitoring results for some of the selected substances should be used.
- The range of precipitation and land use available in the Danube basin should be covered by different test catchments.

At last, Austria, Hungary and Romania is represented by two pilot areas (PAs) each whereas Bulgaria with one PA. So a total of 7 PAs were decided to include in the project. The selection is shown in Figure 1.

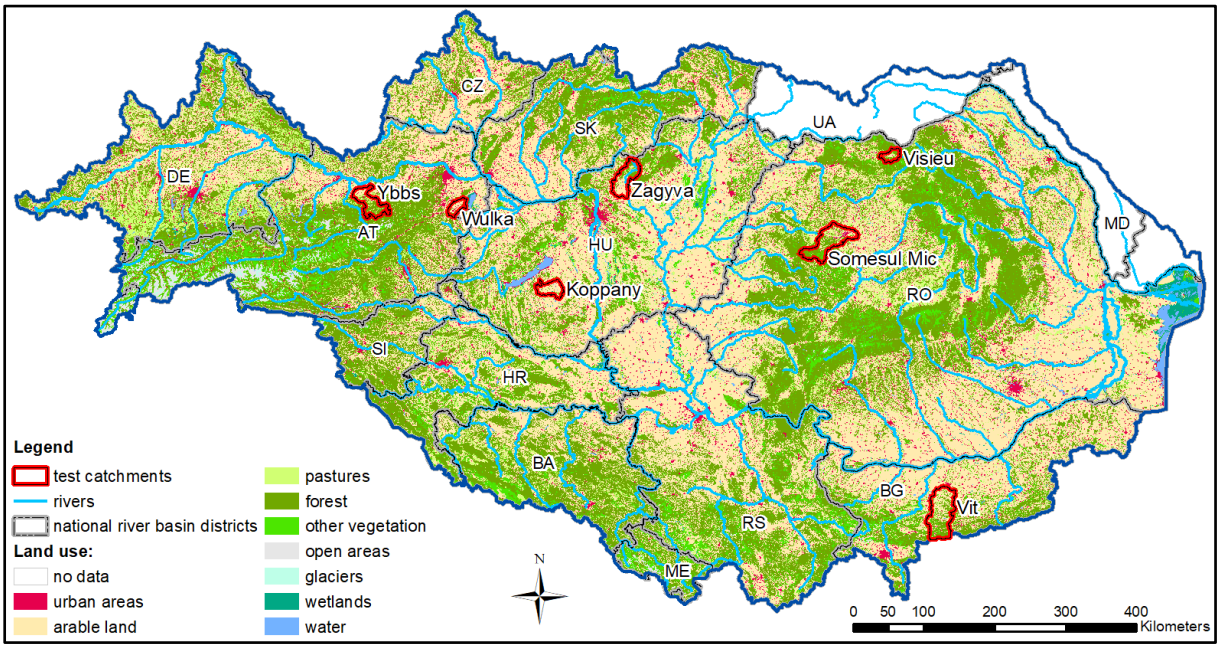

Figure 1: Location of the test catchments in the Danube basin.

3 DESCRIPTION OF THE PILOT AREAS (PA)

This chapter provides the detailed description of the pilot areas (from west to east).

1.1 Ybbs (Austria)

General description

The Ybbs is a right-hand tributary of the Danube with a length of about 140 km. In the past, the lower part of the river was one of the heaviest polluted rivers in Austria. The Ybbs down to the last river gauge ("Greimperdorf") was taken as a test catchment and it was divided into three sub catchments: The headwater in the Alps, the tributary "Urlbach" and the lower part (Figure 2).

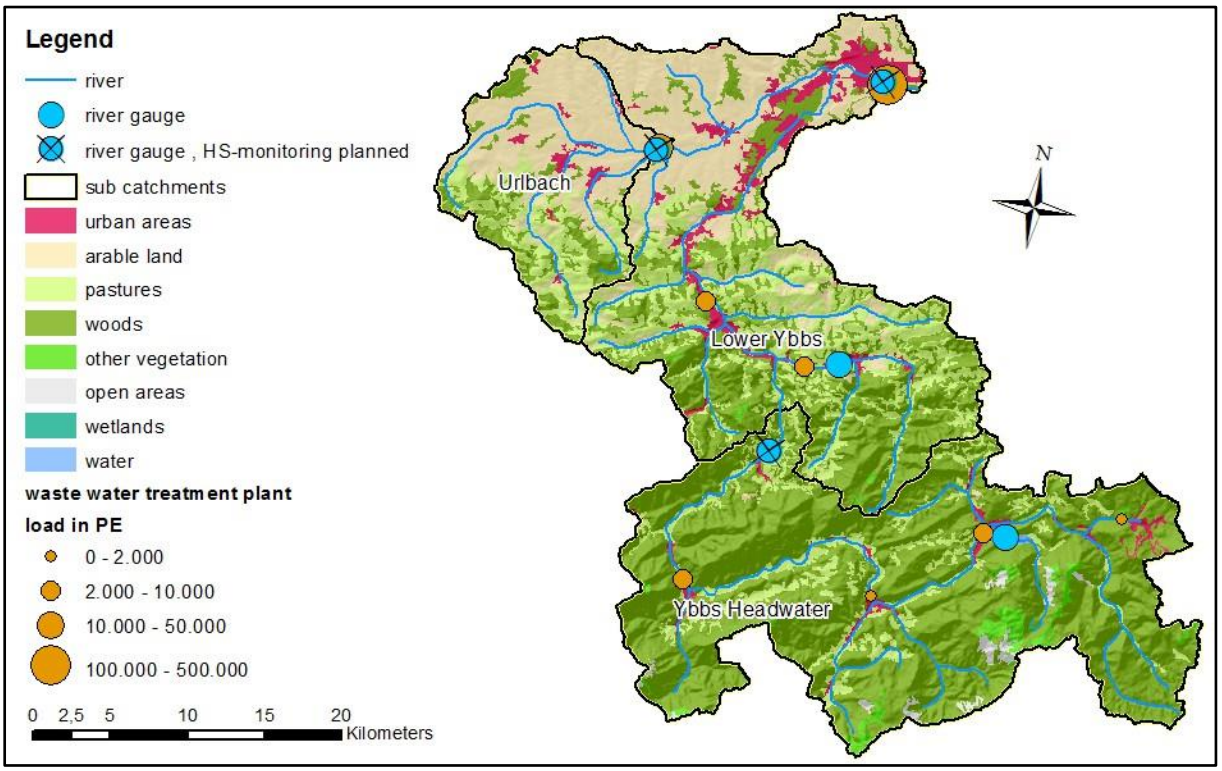

Figure 2: Map of the Ybbs test catchment.

The total catchment area is 1,100 km² and the runoff is 31 m³/s (long term average). A total of 76,500 inhabitants live on the catchment area (Table 1).

Table 1: Main characteristics of the Ybbs and its sub catchments

name catchment/sub catchments:	**Ybbs, total**	**Headwater Ybbs**	**Urlbach**	**Lower Ybbs, netto**
catchment outlet point (river gauge)	Greimpersdorf	Opponitz (Mirenau)	Krenstetten	Greimpersdorf
(sub) catchment area (km²):	1,110	503	159	448
Land use:				
arable land	12%	0%	34%	17%
pastures	25%	16%	34%	33%
forests and natural vegetation	59%	82%	27%	44%
urban areas	2%	1%	3%	4%
Climate & Topography:				
mean annual temperature (°C)	7.3	6.4	8.5	7.9

name catchment/sub catchments:	Ybbs, total	Headwater Ybbs	Urlbach	Lower Ybbs, netto
mean annual precipitation (mm/a)	1,489	1,816	1,036	1,282
mean altitude above sea level (m)	684	914	437	514
Hydrology:				
mean annual flow (m³/s)	31.3	21	3	31.3
specific runoff (mm/a)	890	1,304	595	530
Point sources influence:				
total inhabitants	76,530	9,379	12,213	54,938
share of WW (municipal and industrial) in river LMQ at the catchment outlet	1%	0%	0%	1%
population density (inh./km²)	69	19	77	123

Subcatchment Headwater Ybbs

The headwater catchment has a strong alpine influence: low air temperatures, high precipitation and a high share of surface runoff. Woods and natural vegetation dominate the land use. The population density is comparable low. Only four small WWTP (up to 2600 PE) can be found in the headwater catchment. Thus, we expect the headwater to show background concentrations. No data on HS pollution are available previous to the start of the project.

The river gauge “Opponitz (Mirenau)” will be a the base for a water quality measuring station.

Subcatchment Urlbach

The Urlbach is a left tributary of the Ybbs. The hydrologic regime in the catchment shows intermediate values. This catchment has a strong agricultural land use, with high animal densities. No WWTP is located in the catchment. No data on HS pollution are available previous to the project.

A measuring station will be installed at the river gauge “Krenstetten”, which covers the upper part of the Urlbach catchment. The Urlbach catchment will serve as case study for other agricultural/animal breeding used catchments with wet climate.

Subcatchment Lower Ybbs

The lower Ybbs catchment is hilly with a precipitation above average. The land use is a mixture between agriculture and forest. Some towns lie within the catchment, the biggest of two WWTPs has an influent load of 8583 PE. The city “Amstetten” lies within the catchment, but their WWTP is downstream the river gauge. Thus, urban emissions from rainwater inputs might be relevant, but not from WWTP. The only data on HS pollution currently available are from one surveillance monitoring station. Substances detected are Cu, Ni and Zn.

The river gauge at Urlbach will serve as measuring station.

1.2 Wulka (Austria)

General description

The Wulka is the main tributary of the Lake Neusiedl. The catchment will be split into three parts, the Wulka River itself and the two tributaries Nodbach and Eisbach. While the Nodbach has no input from WWTP, the Eisbach usually mainly consists of WWTP effluent (Figure 3).

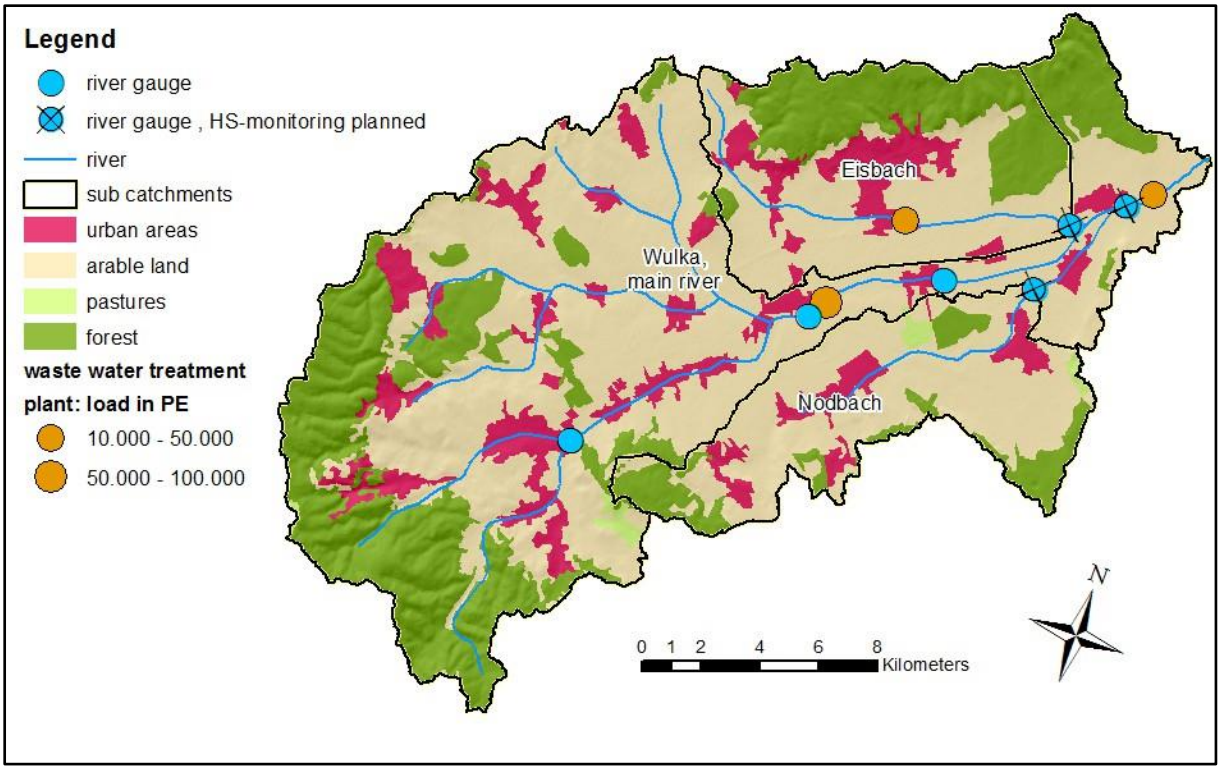

Figure 3: Map of the Wulka test catchment.

The Wulka catchment is rather flat, and used mainly as arable land. The population density in the catchment is high. Only a small part of the precipitation is contributing to surface runoff. Therefore, the considerable high inputs of WW (WWTP Wulkerprodersdorf with 60,000 PE) contribute significantly to the runoff (Table 2).

Table 2: Main characteristics of the Wulka and its sub catchments

name catchment/sub catchments:	**Wulka, total**	**Wulka, main river, netto**	**Nodbach**	**Eisbach**
catchment outlet point (river gauge)	Schützen am Gebirge	Schützen am Gebirge	St. Margarethen	Oslip
catchment area (km²)	389	233	76	80
Land use:				
arable land	50%	47%	61%	49%
pastures	2%	2%	3%	1%
forests and natural vegetation	40%	43%	30%	42%
urban areas	5%	5%	5%	6%
other land use	3%	4%	1%	2%
Climate & Topography:				
mean annual temperature (°C)	9.6	9.5	9.9	9.8
mean annual precipitation (mm/a)	695	719	640	678
mean altitude above sea level (m)	256	263	195	202
Hydrology:				
mean annual flow (m³/s)	1.2	1.2	0.22	0.3
specific runoff (mm/a)	96	54	92	118
Point sources influence:				
total inhabitants	58 516	31 134	9 382	18 000

share of WW (municipal and industrial) in river LMQ at the catchment outlet	39%	39%	0%	63%
population density (inh./km²)	150	133	124	225

The river gauge “Schützen am Gebirge” is the outlet of the catchment. Here we will monitor the discharge and emissions from the whole catchment, including Nodbach and Eisbach (Figure 4).

Figure 4: The river gauge "Schützen am Gebirge" with a suspended sediment sampler in 2017.

Historical measurements

In 2017 water and suspended solids were analyzed for HS pollution. Furthermore, for some heavy metals (Pb, Cu, Ni, Zn) data from the national surveillance monitoring are available from one station in the catchment. Additionally, one groundwater well and 2 soil samples from arable land in the catchment were already investigated for HS concentrations.

Subcatchment Nodbach

The catchment of the Nodbach is used as arable land with a considerable share of urban areas. Nevertheless, there are no WWTP in this catchment.

The catchment will serve as a case study for agricultural emissions in a flat terrain, where erosion might not be the most important emission pathway. These conditions can be found in a large part of the Danube basin.

Nothing is known about HS pollution in the Nodbach catchment by the start of the project. The measuring site will be located at the automated river gauge at the catchment outlet.

Subcatchment Eisbach

The Eisbach catchment is a catchment with strong urban influence. The population density is about 150 inhabitants per km², mainly because of the state capital Eisenstadt. The discharge of the WWTP of Eisenstadt contributes about 63% to the mean annual runoff.

No data on HS pollution of the Eisbach catchment are available by the start of the project. The measuring site will be located at the automated river gauge at the catchment outlet.

1.3 Koppány (Hungary)

General description

River Kapos is the largest river in the Transdanubian region of Hungary, a 2nd order tributary of the Danube. The largest tributary of the Kapos: the Koppány-creek (a 3rd-order tributary of the Danube) and it's catchment was selected as a PA. Total area of the test catchment is 661 km². Elevation on the catchment ranges between 188–288 m a.s.l., mean elevation is 181 m a.s.l. Long term mean annual temperature is 11 °C. Total annual precipitation in the last 17 years was between 390–1040 mm, the mean of the annual value being 630 mm (Figure 5).

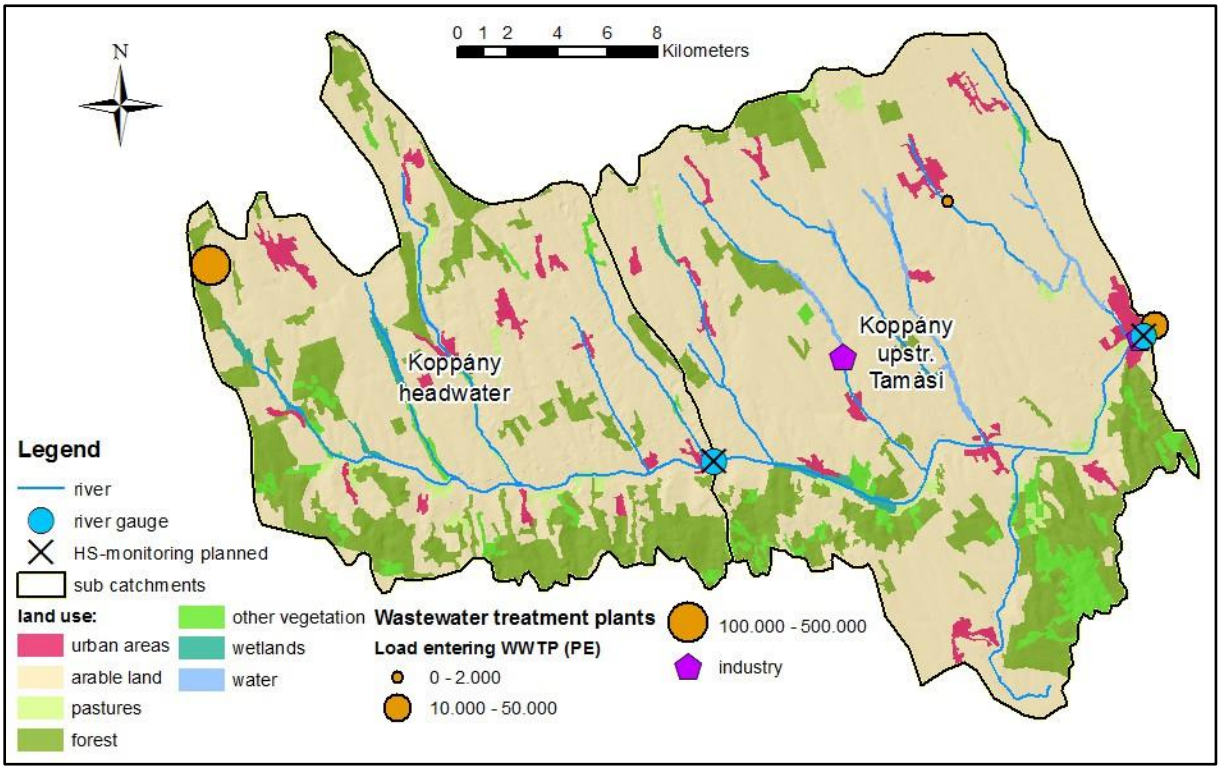

Figure 5: Map of the Koppány test catchment

There are 11 river water bodies on the catchment with a total length of 147 km. There are three lake water bodies on the catchment, the "Értényi-halastavak", "Iregszemcse–Nagykónyi-tározók" and the "Tamási Gonozdi-patakon lévõ halastavak", with a total area of 2.9 km². Outlet of the test catchment is at Tamási, where an automatic flow gauge has been operating since 1981. Yearly LMQ at the stage varied between 0.6 – 3.0 m³/s throughout the last decades (Table 3).

Table 3: Main characteristics of the Koppány test catchment.

name catchment/ sub catchments	**Koppány total**	**Koppány headwater**	**Koppány upstr. Tamási, netto**
catchment outlet point (river gauge)	Tamási	Törökkoppány	Tamási
catchment area (km²)	661	269	392
Land use:			
arable land	79%	75%	81%
pastures	1%	1%	1%
forests and natural vegetation	18%	20%	17%

name catchment/ sub catchments	Koppány total	Koppány headwater	Koppány upstr. Tamási, netto
urban areas	1%	2%	1%
Climate & Topography:			
mean annual temperature (°C)	11	11	11
mean annual precipitation (mm/a)	629	639	622
mean altitude above sea level (m)	181	197	171
Hydrology:			
mean annual flow (m³/s)	1.2	0.54	1.2
specific discharge (mm/a)	55	64	50
Point sources influence:			
total inhabitants	19,000	5,900	13,100
share of WW (municipal and industrial) in river LMQ at the catchment outlet	8%	15%	2%
population density (inh./km²)	29	22	33

Arable land covers 79% of the catchment area, while forests cover 18%. The rest is pastures and municipal, industrial areas. There is no real industrial effluent on the test catchment. On the NE part of the catchment several fisheries (reservoirs) operate. The erosion potential is generally high in the area.

Historical measurements

In the recent years water quality was monitored at several sites in the catchment. The measurements of HS were not continuous, sampling is occasionally, therefore based on the fragmented data sets conclusions cannot be drawn. In general, concentrations of toxic metals were detectable (> LOQ) in every site. Pesticides – if they are measured – usually did not exceed the detection limit. There are very scarce observations for PAH compounds. PFOS and Diclofenac were not measured at all.

Subcatchment Headwater Koppány

The Headwater Koppány subcatchment has an area of 269 km² and covers the western part of the PA. The main land use category is arable (covering 75% of the subcatchment) whereas forests and natural vegetation covers 20%.

The water quality is strongly influenced by the Balatonlelle WWTP. This town is outside the catchment, however, it's WW is redirected into the upper-most part of the Koppány in order to protect the lake Balaton. The share of WW in the LMQ is 15% at the subcatchment outlet but >90% at the upper part of the Koppány (the creek here is ephemeral).

Subcatchment Lower Koppány

The lower Koppány subcatchment has an area of 392 km². Land use shares are similar to those of the Headwater subcatchment with slightly less forests and more artificially covered areas. On this part of the PA, the fishing ponds have a big effect on water quality.

The largest town in the catchment is Tamási (~10,000 inhabitants), it's municipal WWTP treats ~900 m³/d; there is also a bath, with ~250 m³/d effluent water. However, these outlets are downstream the river gauge Tamási. Thus, urban emissions from rainwater outflows might be relevant, but not from these WWTPs.

1.4 Zagyva (Hungary)

General description

The Zagyva River is the largest river whose whole catchment area is inside Hungary. It is a 1st order tributary of the Tisza River and a 2nd order tributary of the Danube. The total catchment of the Zagyva River (together with the Tarna River) is 5561 km². The Zagyva River upstream to Hatvan was selected as a PA, which is the upper (and northern) part of the Zagyva basin. The total PA is 1216 km². The average elevation is 270 m, the upper region is located at 600 m a.s.l., whereas the hilly parts are between 250 – 350 m a. s. l. (Figure 6).

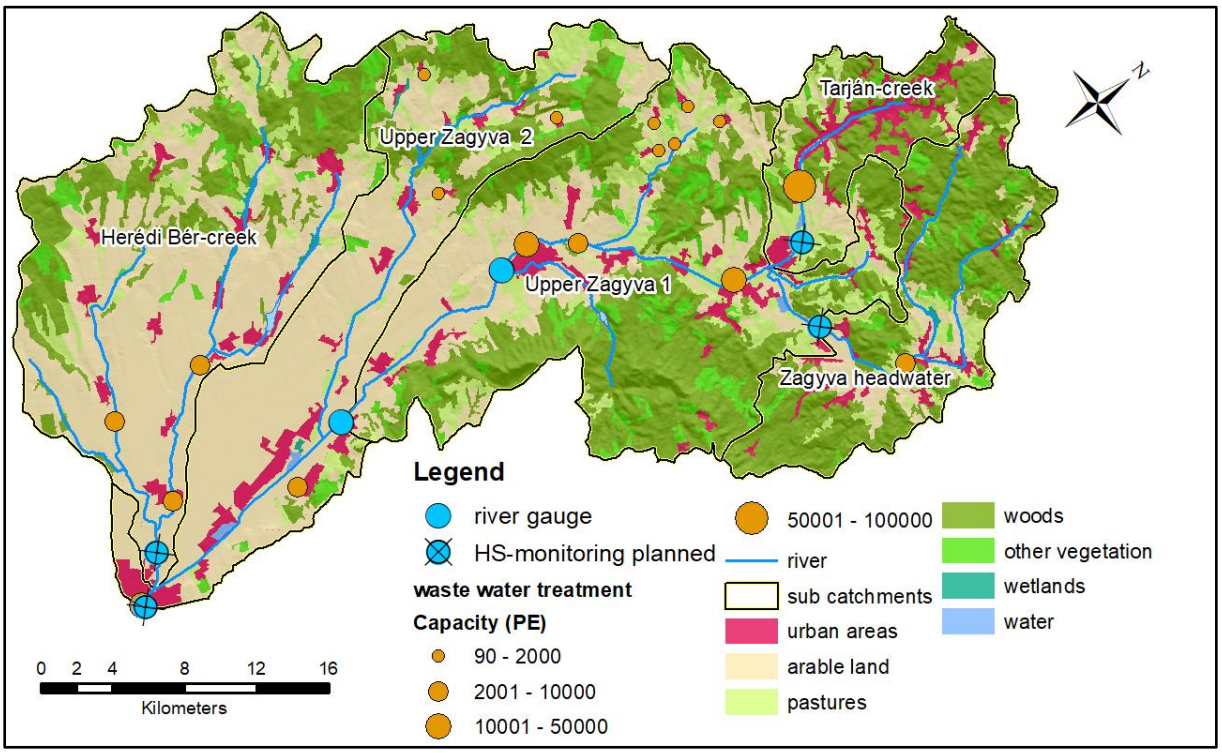

Figure 6: Map of the Zagyva test catchment.

There are 22 river water bodies and 2 lakes on the catchment. Lakes are artificial reservoirs, which were established on small watercourses with dams (one of them is used for drinking water supply). The Zagyva-creek and the other small water courses on the headwater areas are hilly, small rivers. Zagyva is a lowland, medium size river. The Zagyva drains the Cherhát hills and the Mátra mountain which is the highest mountain in Hungary. The typical soil type in the region is silty and clay, with small proportion of sandy areas. The average precipitation in the region is 650 mm/year, but due to the high evaporation, LMQ at the outflow is only 1.5 – 2.0 m³/s (Table 4).

Table 4: Main characteristics of the Zagyva test catchment.

name catchment/ sub catchments	**Zagyva, total**	**Herédi Bér-creek**	**Tarján-creek**	**Headwater Zagyva**	**Zagyva, netto**
catchment outlet point (river gauge)	Hatvan	Hatvan	Kisterenye	Nemti	Hatvan
catchment area (km²)	1210	327	88	159	636
Land use:					
arable land	43%	60%	12%	15%	44%
pastures	10%	8%	19%	10%	12%
forests and natural vegetation	42%	27%	50%	68%	37%
urban areas	5%	4%	19%	7%	7%

name catchment/ sub catchments	Zagyva, total	Herédi Bér-creek	Tarján-creek	Headwater Zagyva	Zagyva, netto
Climate & Topography:					
mean annual temperature (°C)	12	11	12	12	12
mean annual precipitation (mm/a)	650	594	694	651	672
mean altitude above sea level (m)	270	200	290	355	282
Hydrology:					
mean annual flow (m³/s)	1.7	0.4	0.2	0.1	1.7
specific discharge (mm/a)	44	41	69	33	50
Point sources influence:					
total inhabitants	110 000	15 800	30 000	5 500	58 700
share of WW (municipal and industrial) in river LMQ at the catchment outlet	5.7%	2.6%	30%	0%	5.7%
population density (inh./km²)	90	48	343	57	92

The total population of the PA is 110,000 inhabitants. Most of the settlements are small villages. The largest town is Salgótarján (30,000 inhabitants). Further settlements with more than 10,000 inhabitants are Hatvan, Pásztó and Bátonyterenye. About half of the population are living in small villages. In the last century, Salgótarján was a typical heavy industrial area of the country (mining, metallurgy) with strong industrial activity in the region. Nowadays agriculture (farming, fishing) and light industries are dominant.

There are 16 WWTPs in the PA; most of them are small plants (discharge < 300 m³/day). The largest WWTP is Salgótarján, the capacity of the plant is 6,000 m³/day and there is tertiary treatment. Hatvan WWTP treats 4,000 m³ /day, Pásztó WWTP works with 1,200 m³/day treatment capacity.

Historical measurements

In the recent years water quality was monitored at several sites in the catchment. Just as in the case of the Koppány PA, the measurements of HS were not continuous, sampling is occasionally, therefore based on the fragmented data sets conclusions cannot be drawn. In general, concentrations of toxic metals were detectable (> LOQ) in every site. Pesticides – if they are measured – usually did not exceed the detection limit. There are very scarce observations for PAH compounds. PFOS and Diclofenac were not measured at all.

Subcatchment Headwater Zagyva

The Headwater Zagyva subcatchment covers the NE 159 km² of the PA. More than two thirds of the area is covered by forests and natural vegetation, and only 15% by arable land. Thus, the Upper-Zagyva creek is representing natural background load from forested areas. The measuring station will be located at Nemti, where an automatic water level register along with regular revision of stage-discharge curves has been operating since 1987.

Subcatchment Tarján-creek

The Tarján-creek subcatchment covers the NW part of the PA, it's area is 88 km². The main land use category is forests and natural vegetation, however the share of artificially covered areas is share compared to the other subcatchments: it is almost 20%. This small water course receives the significant WW discharge of the town of Salgótarján: share of WW in river LMQ at the catchment outlet is 30%.

Thus, this subcatchment is intended to represent the emission from urban and industrial areas. The measuring station will be located at Bátonyterenye, where an automatic (hourly) flow registrator is operated by the water directorate.

Subcatchment Herédi-Bér

The Herédi-Bér creek subcatchment covers the western 327 km² of the PA. The upper part is hilly whereas the lower, bigger part is flat. This creek drains the Gödöllő and Cserhát hills. Almost two thirds of the area are used as arable land, thus this subcatchment is intended to represent agricultural land use. There is an automatic flow gauge at the subcatchment outlet (at the edge of the city Hatvan), however, it is mudded. The measuring station will be located here or at a more upstream point of the catchment.

Subcatchment Lower Zagyva

The lower Zagyva subcatchment covers the southern part (636 km²) of the PA. It's outflow point is identical to that of the PA (Hatvan). An automatic flow gauge (with hourly registration of water levels) is operating in the city of Hatvan. Outlet of the WWTP is downstream of the gauge. Thus, urban emissions from rainwater outflows of the city of Hatvan might be relevant, but not from it's WWTP.

For modeling purposes it will be divided into two parts: Lower Zagyva 1 and lower Zagyva 2. The division happens at the Apc gauge of the Zagyva River. There is flow gauge at Apc operated by the water directorate. However, no HS measurements will be done here within the project.

1.5 Someșul Mic (Romania)

General description

The Someșul Mic River PA is one of the two PAs in Romania. The Someșul Mic River catchment is part of the Somes River Basin, which latter is a 1st order tributary of the Tisa River and thus a 2nd order tributary of the Danube. The Somesul Mic River has a total length of 114 km. It flows down from the Apuseni Mountains and crosses the Somes hilly area. The average altitude of the hydrographic basin is 973 m.

On the PA mainly mining activities, human agglomeration and landfill represent the significant pressures on water quality. The Somes River Basins represents a typical catchment in Romania and, at the same time, it's Headwater represents the background pollution levels (Figure 7).

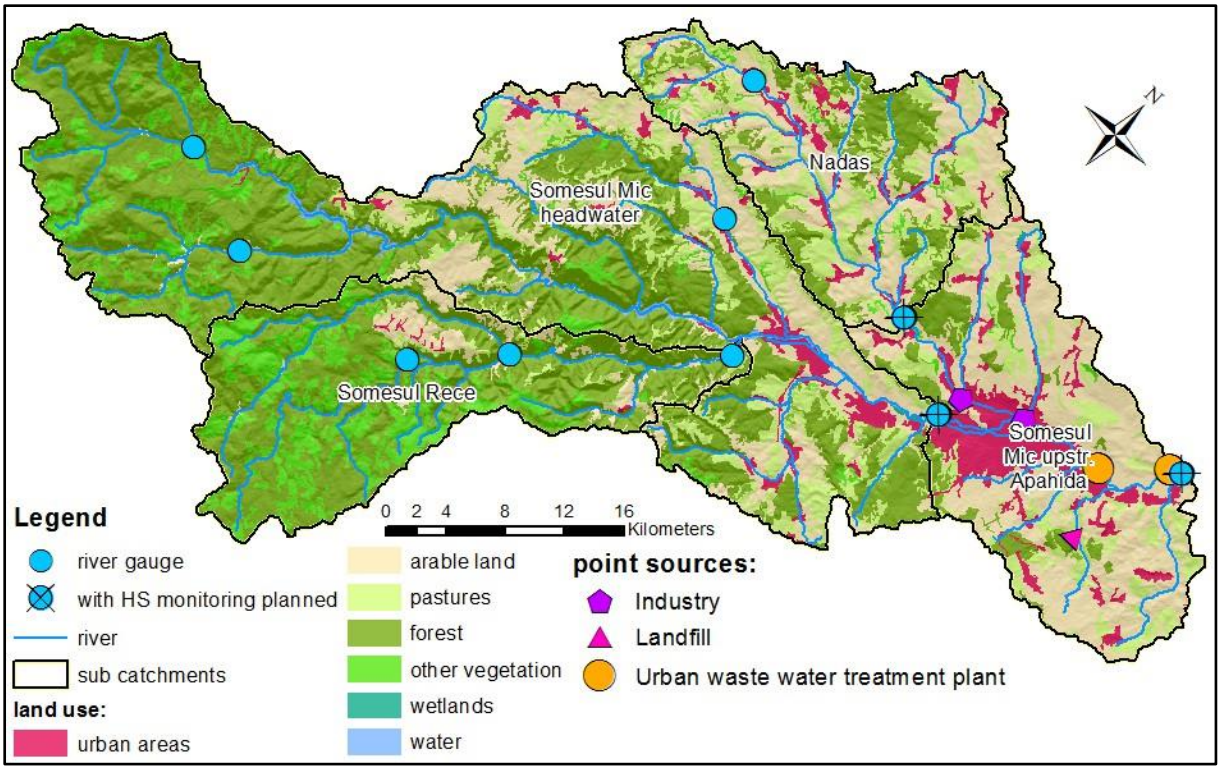

Figure 7: Map of the Someșul Mic test catchment.

The LMQ registered at hydrometric stations is: Smida 3.5 m³/s, Poiana Horea 1.9 m³/s, Racatau 1.1 m³/s, Somes Rece sat 0.57 m³/s, Capusu Mare 0.64 m³/s, Aghiresu 0.21 m³/s, Cluj-Napoca 14.1 m³/s, Radaia 0.96 m³/s and Apahida 17.8 m³/s (Table 5). The main important point sources are the municipal emission - urban WWTP Cluj Napoca (> 150,000 PE) and Apahida (< 10,000 PE), treated WWs from from PARCT INDUSTRIAL TETAROM-JUCU, Cluj.

Table 5: Main characteristics of the Someșul Mic test catchment.

name catchment/ sub catchments	**Someșul Mic River, total**	**Someșul Mic headwater**	**Nadas**	**Someșul Mic upstr. Apahida, netto**
catchment outlet point (river gauge)	Apahida	Cluj-Napoca	Radaia	Apahida
catchment area (km²)	1,847	1,197	290	361
Land use:				
arable land	26%	15%	39%	53%
pastures	18%	17%	27%	16%
forests and natural vegetation	48%	64%	26%	11%
urban areas	7%	3%	8%	19%
Climate & Topography:				
mean annual temperature (°C)	6-7	6-7	6-7	6-7
mean annual precipitation (mm/a)	700	600-800	600-800	600-800
mean altitude above sea level (m)	973	987	506	802
Hydrology:				
mean annual flow (m³/s)	18	14	1.0	18
specific discharge (mm/a)	304	372	105	240
Point sources influence:				
total inhabitants	392,000	40,000	7,000	345,000

name catchment/ sub catchments	Someșul Mic River, total	Someșul Mic headwater	Nadas	Someșul Mic upstr. Apahida, netto
share of WW (municipal and industrial) in river LMQ at the catchment outlet	10%	0.02%	0.7%	10%
population density (inh./km²)	212	33	24	957

Historical measurements

For the Someșul Mic River there are known information about heavy metals and organic micro pollutants, which are expected to be relevant in the catchment and are also included in the projects HS-list. Furthermore, the SOLUTIONS project produced data on micro pollutant concentrations in the outlet of Cluj Napoca WWTP[1].

Data on concentrations in the Someșul Mic River are available for heavy metals and organic micro pollutants: alachlor, atrazine, benzene, carbon tetrachloride, chlorfenvinphos, chlorpiriphos, cyclodiene pesticides, DDT total, para-paraprim-DDT, 1,2- dichloroethane, dichlormetane, diuron, endosulfan, hexachlorobenzene, hexachlorobutadiene, hexachlorocyclohexane, isoproturon, pentachlorobenzene, PAHs, simazine, tetrachloroethylene, trichloro ethylene, trichlorobenzenes, trifluralin.

For the groundwater body (ROSO10) monitoring data for organic micro pollutants (chlorbenzene, organochlorine pesticides, N and P pesticides, PAHs, BTEX, chlorinated solvents, thioureas - screening 2015) exist.

The sampling frequency for priority substances respects the requirements of the WFD and it depends on monitoring program and category of waters, as following:

- Surveillance programs in these river monitoring sites on water bodies with good chemical status and operational programs in these river monitoring sites on water bodies with chemical status other than good, with a frequencies of 12/year in water.
- Surveillance programs in groundwater bodies, with a frequencies of 1-2/year.

The hydrological conditions are monitored by NARW together with his research institute (NIHWM), and database and information are shared between them. NARW has an internal electronic water information system (WIMS – Water Information Management System) and makes real time information about hydrologic situation for rivers and lakes available online.

The main knowledge gaps concern monitoring of point source emissions. These are performed monthly and only for the parameters that are indicated in the WWTP's permit license. Monitoring of the inlet of pollution sources is totally missing.

In each monitoring point at the catchment outlet above mentioned concentrations of heavy metals exceeding the environmental quality standard were found: Ni, Cd, Pb, Hg in the water leading to the failure of the good chemical status of the rivers water bodies.

Subcatchment Headwater Somesul Mic

The Someșul Mic headwater subcatchment is located upstream the Cluj-Napoca river gauge. It covers almost 1200 km². This catchment consists of the real headwater of the Someșul Mic River, the sub catchment of the Someșul Rece tributary (which will be used as separate catchment only for the

[1] http://norman-data.eu/EWW_DANUBE

modelling) and the lower part of the catchment with noteworthy settlements and agriculture. Sampling will take place at the Cluj Napoca river gauge.

Subcatchment Nadas

The Nadas subcatchment represents the northern 290 km² of the PA. The Nadas is a tributary of the Somesul Mic. The subcatchment shows mixed land use. Sampling will take place at the Radaia river gauge.

Subcatchment Somesul Mic upstr. Apahida

The agglomeration Cluj Napoca has a strong influence on the water quality of the Somesul Mic. The main land uses on the Lower Somesul Mic subcatchment are arable land, followed by urban settlement. The main big city is Cluj Napoca with 345,000 inhabitants. Measuring station will be installed at the Apahida river gauge which is the outflow point of the PA.

1.6 Vișeu (Romania)

General description

The Vișeu-catchment is a part of the Somes River Basin. It is a left tributary of Tisa River and is flowing from Rodeni Mountains at 1409 m altitude. Its total catchment is 1555 km^2. The Vișeu River upstream the confluence with the Vaser River was selected as a PA, it covers 375 km^2. This area includes several cadastral watercourses with a total length of 132.7 km (Figure 8).

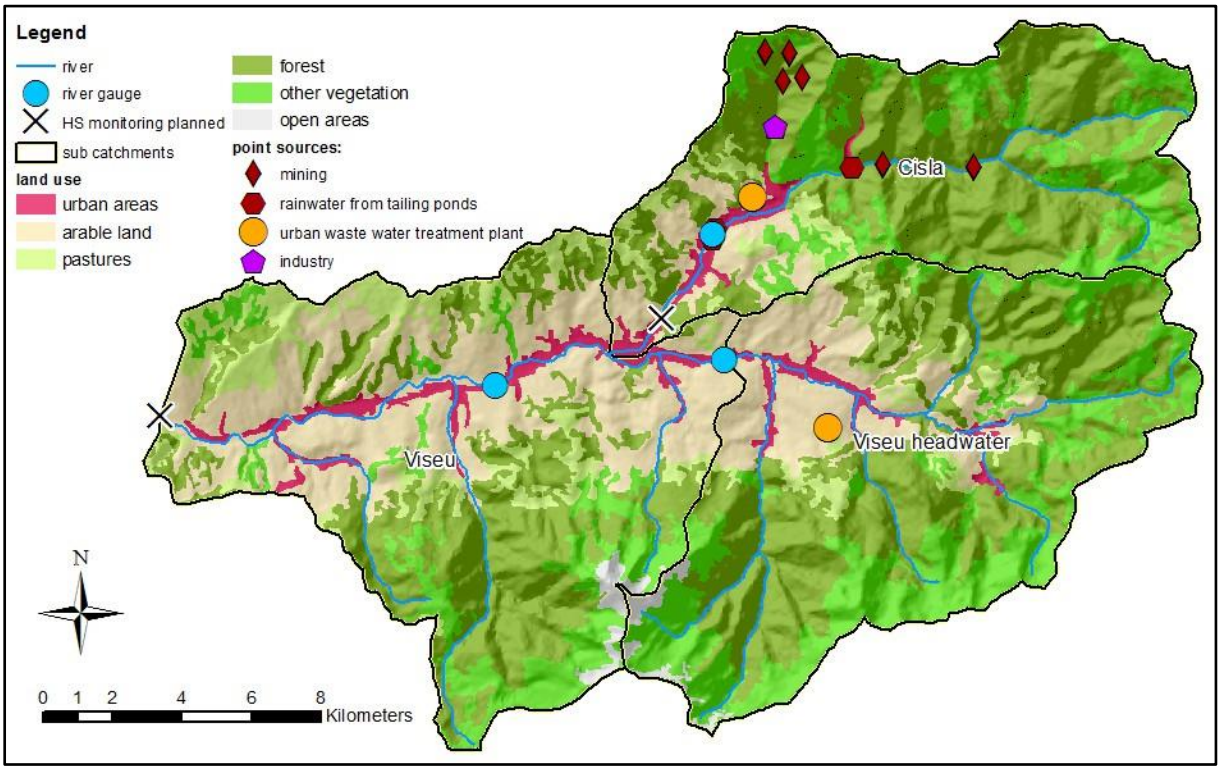

Figure 8: Map of the Vișeu test catchment.

The multiannual average flow registered at hydrometric stations: Poiana Borsa - 3.7 m³/s, Baia Borșa – 2.0 m³/s and Moisei - 6.9 m³/s (Table 6). The main important point sources in the sub-catchment Vișeu River are the mining activities of Gura Băii, Burloaia, Colbu and Toroioaga.

Table 6: Main characteristics of the Vișeu test catchment.

name catchment/ sub catchments	**Vișeu, total**	**Cisla**	**Vișeu, netto**
catchment outlet point	upstream conf. Vaser River, quality monitoring station "Moisei"	downstream Baia Borsa	upstream conf. Vaser River, quality monitoring station "Moisei"
river gauge	Moisei (10 km upstream)	Baia Borsa (3 km upstream)	Moisei (10 km upstream)
catchment area (km²):	375	104	271
Land use:			
arable land	21%	9%	26%
pastures	16%	9%	19%
forests and natural vegetation	59%	79%	52%
urban areas	4%	4%	4%
Climate & Topography:			
mean annual temperature (°C)	1-6	1-6	1-6
mean annual precipitation (mm/a)	1000–1400	1000–1400	1000–1400
mean altitude above sea level (m)	1150	1212	1126
Hydrology:			
mean annual flow (m³/s)	6.9	2.0	6.9
specific discharge (mm/a)	578	595	572
Point sources influence:			
total inhabitants	42,021	26,984	15,037
share of WW (municipal and industrial) in river LMQ at the catchment outlet	1.6%	4%	1,6%
population density (inh./km²)	112	261	55

Historical measurements

There are known information about heavy metals and organic micro pollutants, which are expected to be relevant in the catchment and are also included in the proposed project HS-list.

For the two planned monitoring points already some data exists for heavy metals and organic micro pollutants (alachlor, atrazine, benzene, carbon tetrachloride, chlorfenvinphos, chlorpiriphos, cyclodiene pesticides, DDT total, para-paraprim-DDT, 1,2-dichloroethan, dichloromethane, diuron, endosulfane, hexachlorobenzene, hexachlorobutadiene, hexachlorocyclohexane, isoproturon, pentachlorobenzene, PAHs, simazine, tetrachloroethylene, trichloroethylene, trichlorobenzenes, trichlormethan, trifluralin). In each monitoring point at the catchment outlet above mentioned concentrations of heavy metals exceeding the environmental quality standard were found: Ni, Cd, Pb, Hg in the water leading to the failure of the good chemical status of the rivers water bodies.

For the groundwater body in the area (ROSO02) data on heavy metals and organic micro pollutants (chlorbenzene, organochlorine pesticides, N and P pesticides, PAHs, BTEX, chlorure solvents, thioureas - screening 2015) exist.

The sampling frequency for priority substances respects the requirements of the water framework directive and depends on monitoring program and category of waters, as following:

- Surveillance programs in these river monitoring sites in water bodies with good chemical status and operational programs in these river monitoring sites on water bodies with chemical status other than good: 12 samples per year in water
- Surveillance programs in groundwater bodies with a frequencies of 1-2 /year.

The hydrological conditions are monitored by National Administration „Romanian Waters" (NARW) together with his research institute National Institute for Hydrology and Water Management – (NIHWM), and database and information are shared between them. NARW has an internal electronic water information system (WIMS – Water Information Management System) and makes real time information about hydrologic situation for rivers and lakes available online.

The main knowledge gaps concern monitoring of point source emissions. These are performed monthly and only for the parameters that are indicated in the permit license. Only the treatment plant of Toroioaga mine has automated monitoring with a frequency of once per 3 months for Cu, Fe, Mn, Ni, Pb and Zn.

Subcatchment Viseu

The Vișeu River has a length of 41 km. It crosses the Maramureș intra-mountain depression. This influences the land use in the area where the forest and natural vegetation prevail, following by arable land and pastures. The main big city is Borșa with 27,000 inhabitants.

The Viseu subcatchment will be split into two subcatchments for modelling purposes only. HS measurement is planned only at Moisei in the main river Vișeu. This point is a few km downstream the river gauge, thus remote data transmission will be necessary.

Subcatchment Cisla

The Cisla subcatchment shows strong influence from mining activities. The subcatchment outlet point is downstream Baia Borsa – near the confluence Vișeu. The monitoring station will be located downstream Baia Borsa to catch the mining pollution sources. It is a few km downstream the river gauge, thus remote data transmission will be necessary here also.

1.7 Vit (Bulgaria)

General description

The Vit River starts from the north parts of the Balkans with Ribaritza River which is formed at about 2030 m a.s.l. The main tributaries upstream are Beli Vit River and Cherni Vit river which merge near the settlement of Polaten at about 367 m a.s.l. and afterwards the river is called Vit. At the upstream it runs in the valley between Vasiljovska mountain and Lisets mountain ridge. After Sadovets village it enters in Danube Plain. Near the Dolni Vit village it flows into Danube river at about 22 m a.s.l. The total length of Vit River is 189 km and the total catchment area is 3227 km² (Figure 9).

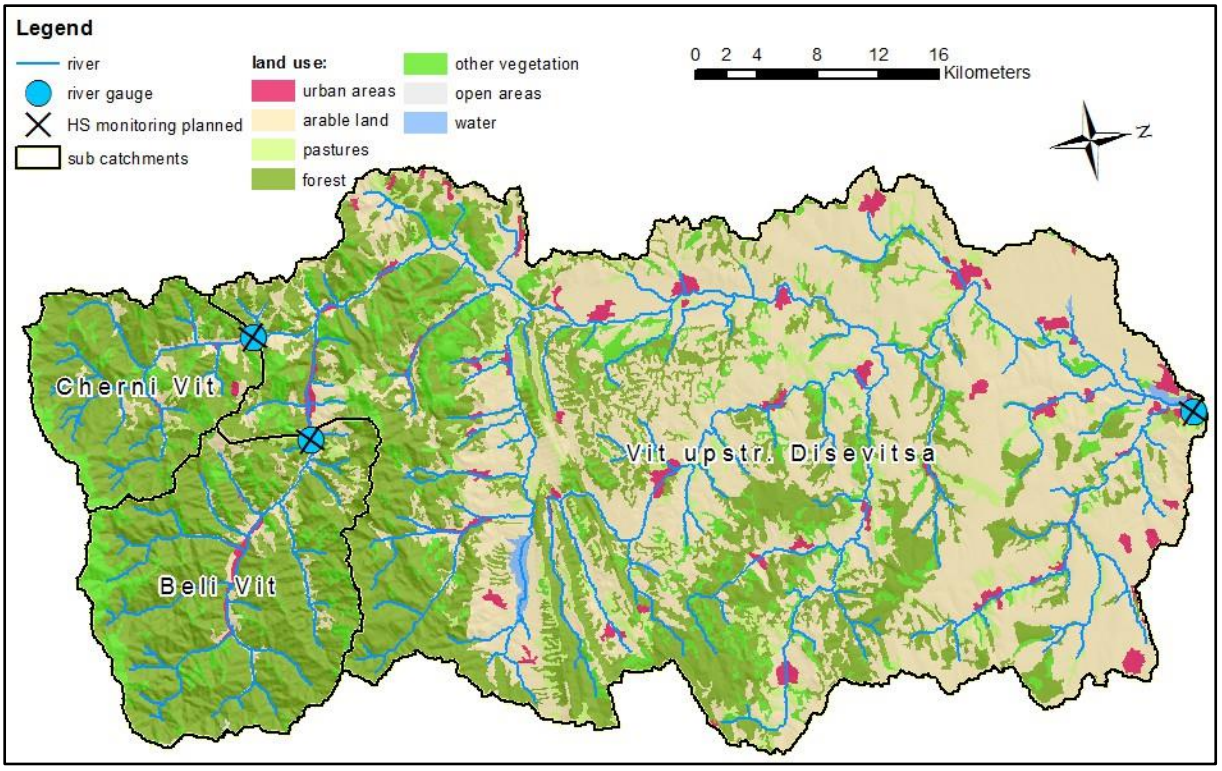

Figure 9: Map of the Vit test catchment.

The selected sub catchments are:

- Test catchment Beli Vit river – from the springs down to the HMS Teteven, situated before the town of Teteven;
- Test catchment Cherni Vit River - from the springs down to the HMS at the Cherni Vit village;
- Test catchment Vit river at Disevitsa - from the beginning of Vit River down to the the HMS at the Disevitsa village;

The hydrometrical stations are not automated. Two times per day (at 8.00 and 20.00) the water level at the gauge is recorded. The daily water flow is calculated through a key curve. The key curve is updated annually (Table 7).

Table 7: Main characteristics of the Vit test catchment.

name catchment / sub catchments	**Vit upstr. Disevitza, total**	**Cherni Vit**	**Beli Vit**	**Vit upstr. Disevitza, netto**
catchment outlet point (river gauge):	Disevitza	Cherni Vit village	Teteven	Disevitza
catchment area (km²)	2,236	155	306	1,775
Land use:				
arable land	44%	10%	8%	53%
pastures	5%	1%	1%	6%
forests and natural vegetation	48%	88%	89%	38%
urban areas	3%	1%	1%	3%
Climate & Topography:				
mean annual temperature (°C)	11	10.5	10.5	11.7
mean annual precipitation (mm/a)	664	982	982	581
mean altitude above sea level (m)	598	1,032	1,007	489

name catchment / sub catchments	Vit upstr. Disevitza, total	Cherni Vit	Beli Vit	Vit upstr. Disevitza, netto
Hydrology:				
mean annual flow (m³/s)	12	2.7	4.9	12
specific discharge (mm/a)	169	543	503	78
Point sources influence:				
total inhabitants	49,314	674	1,405	47,235
share of WW (municipal and industrial) in river LMQ at the catchment outlet	1.3%	0%	0.1%	1.3%
population density (inh./km²)	22	4	5	27

Historical measurements

Within the Cherni Vit River catchment there is one water quality sampling point after the Divchovoto village. The monitored priority and specific hazardous substances are : *Alachlor, Anthracene, Atrazine, Chlorpyrifos, Cyclodien pesticides and DDT, as well as Phenols, Oils.*

Subcatchment Beli Vit at HMS Teteven town there are two water sampling point located after Ribaritsa village (acc. to the VIT RBMP). It is reported, that 34 priority substances are monitored and several specific contaminants (e.g. *Phenols, Oils, Copper and free Cyanides and others.)*

In the Subcatchment Vit at Disevitsa village there are 5 sampling points within the catchment according to the Vit River RBMP. It is reported that in total 34 priority substances are monitored and several specific contaminants (e.g. *Phenols, Oils, Copper and free Cyanides and others.)*

Subcatchment Cherni Vit at HMS Cherni Vit village

The springs of Cherni Vit river are at around 1980 m a.s.l. and the total length of the river is about 27 km. There are few villages in the catchment area with population below 1000 residents. The sewerage is collected mostly through septic cesspits. *According to the Vit RBMP there is wood processing activities in the catchment.*

Subcatchment Beli Vit at HMS Teteven town

The Beli Vit river runs through the Ribaritsa village, which is a popular touristic destination with high season in the summer. The village has no municipal WWTP, so it is supposed that the hotels have local WWTPs that discharge into the river. There are no other settlements in the catchment.

Subcatchment Vit at Disevitsa village

The test catchment encompass several rivers (e.g. Kalnik, Kamenitsa Iskar). In total 47 settlements are located in the catchment area, most of them below 1000 residents. The biggest one is Teteven (around 9,800 residents). There is centralized sewer network in the town of Teteven and a municipal WWTP. The smaller settlements are mostly with septic cesspits. The industrial branch is presented mostly by food processing industries (oil and milk factories).

4 ABBREVIATIONS AND ACRONYMS

BME	Budapest University of Technology and Economics
BTEX	benzene, toluene, and three xylene (ortho-, meta- and paraxylene) hydrocarbons
BWA	Bulgarian Water Association
DDT	Dichlorodiphenyltrichloroethane
HS	Hazardous substance(s)
inh.	Inhabitants
LMQ	Long term mean flow
N	Nitrogen
NARW	National Administration of Romanian Waters
NE	Northeast, northeastern
NIHWM	National Institute for Hydrology and Water Management (Romania)
NW	Northwest, northwestern
P	Phosphorus
PA	Pilot area
PAH	policyclic aromatic hydrocarbons
PE	Population equivalent
SE	Southeast, southeastern
SW	Southwest, southwestern
TU Wien	Technical University Vienna
UBA	Umweltbundesamt – Environment Agency Austria
WIMS	Water Information Management System Romania
WW	Wastewater
WWTP	Wastewater treatment plant