Progress on Activity 3.3

Yantra River

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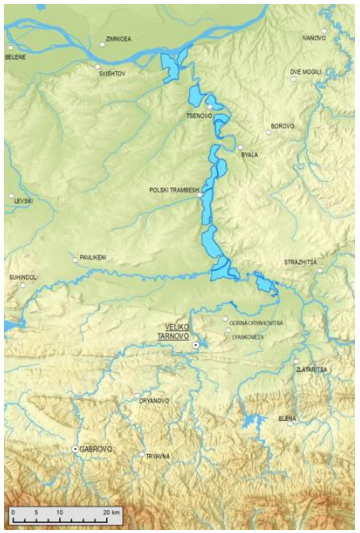
February, 2020

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

Yantra River – Floodplains identification and assessment

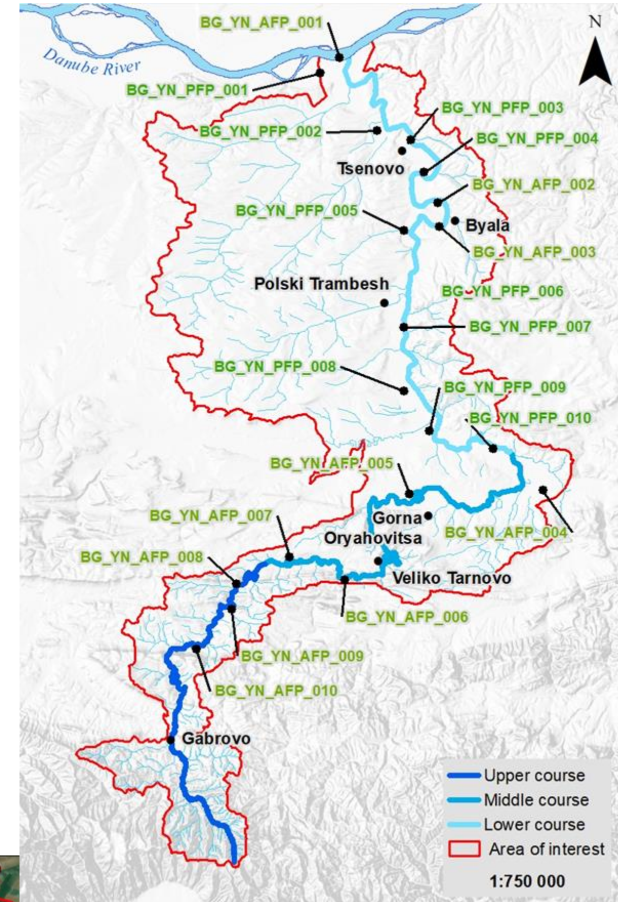
General information

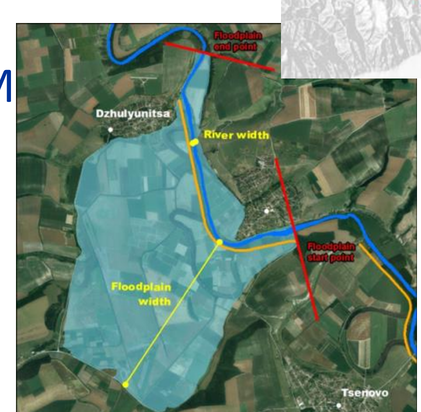
- National methodology developed and implemented
- The methodology is based on the common project methodology , incl. FEM concept and further developed according to the river characteristics and national conditions and data
- FEM parameters of minimum and medium classes used. Two additional parameters used
- Thresholds, for ranking in 5-level scale adopted and implemented for all FEM-parameters
- Approach and thresholds for overall assessment of each group of parameters in a 3-level scale were implemented



Identification of floodplains

- The entire main river course of Yantra River (223.5 km) was studied
- National thresholds for floodplain's size were defined and applied depending on which part of the river course the floodplain is located (upper, middle, lower)
- Data used: geological map (1:100 000), available flood maps (1%, 0,1%), topographic maps (1:5000); DEM (8m cell), Aero photo images (2011, 2012 and 2014), cadastral data, archive satellite images (before dikes construction); hydraulic modeling (SRH-2D model)
- 10 active and 10 potential FPs identified
- Main obstacle – the lack of a precise DEM

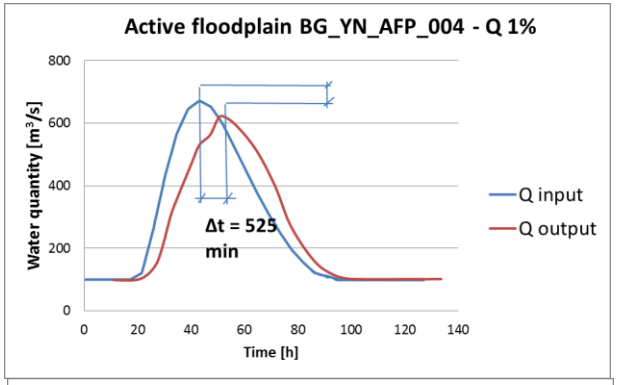

Danube River
N
BG_YN_AFP_001
BG_YN_PFP_001
BG_YN_PFP_002
BG_YN_PFP_003
BG_YN_PFP_004
Tsenovo
BG_YN_AFP_002
BG_YN_PFP_005
Byala
BG_YN_AFP_003
Polski Trambesh
BG_YN_PFP_006
BG_YN_PFP_007
BG_YN_PFP_008
BG_YN_PFP_009
BG_YN_PFP_010
BG_YN_AFP_005
BG_YN_AFP_007
Gorna Oryahovitsa
BG_YN_AFP_004
BG_YN_AFP_008
Veliko Tarnovo
BG_YN_AFP_006
BG_YN_AFP_009
BG_YN_AFP_010
Gabrovo
Upper course
Middle course
Lower course
Area of interest
1:750 000

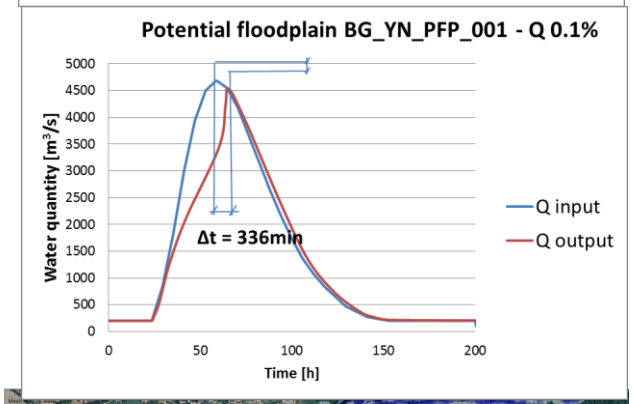


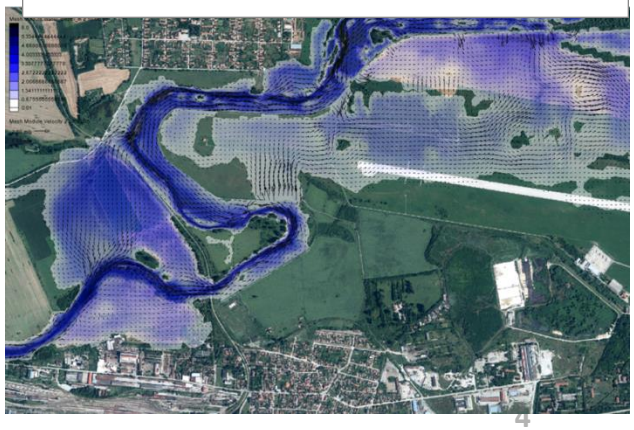
Type of river course	Minimum size of floodplain in ha
Upper course	20
Middle course	50
Lower course	100

Evaluation of hydrological and hydraulic parameters

- Based on the results of a non-stationary two-dimensional hydraulic model- hydraulic model SRH-2D was used
- All hydrological and hydraulic parameters were assessed, except the parameter "bottom shear stress" (*due to the very low quality of the available DTM and the presence of local elevations and reductions in the riverbed, the bottom tangential stresses calculated from the model are incorrect*)
- Additional national" parameter was used – "Simple hydro-morphological evaluation" – as an indicator of the effect of floodplain restoration on the stability of the river section.
- The assessment was not possible for three floodplains due to the poor DTM quality







Evaluation by hydrological parameters

	Flood peak reduction			Flood wave translation			Effect in case of extreme discharge		Simple hydro-morphological evaluation		Overall assessment of hydrological parameters
	ΔQ [m^3/s]	ΔQ_{rel} [%]	Score	Δt [min]	Δt_{rel} [%]	Score	Δt_{comp} [%]	Score	Value	Score	
BG_YN_AFP_001	792	27.67	5	25	0.35	1	16	5	1.99	4	satisfactory
BG_YN_AFP_002	3	0.12	1	14	0.39	1	118	1	1	1	unfavorable
BG_YN_AFP_003	6	0.23	1	42	0.78	1	173	1	1	1	unfavorable
BG_YN_AFP_004	48	7.21	5	525	10.94	5	98.5	2	1.33	3	satisfactory
BG_YN_AFP_005	10	1.64	3	208	4.33	4	93	2	1.11	2	satisfactory
BG_YN_AFP_006	1.5	0.21	1	32	0.89	1	96.7	2	1	1	unfavorable
BG_YN_AFP_007	54	7.5	5	360	10	5	102	1	1	1	satisfactory
BG_YN_AFP_008	4	0.57	1	70	1.94	2	163	1	1	1	unfavorable
BG_YN_AFP_009	2	0.24	1	15	0.42	1	84	2	1	1	unfavorable
BG_YN_PFP_001	145	3.1	5	336	2.2	3	892	2	1.99	4	satisfactory
BG_YN_PFP_002	183	4.18	5	375	4.8	4	411	1	1.87	4	satisfactory
BG_YN_PFP_003	91	2.01	5	247	3.74	4	803	1	1.55	4	satisfactory
BG_YN_PFP_004	11	0.25	1	67	0.93	1	176	1	1.24	4	unfavorable
BG_YN_PFP_005	190	4.01	5	70	1.17	2	1.75	5	2.48	5	favorable
BG_YN_PFP_006	20	0.41	1	72	1.2	2	156	1	1.43	3	unfavorable
BG_YN_PFP_007	73	2.44	5	174	3.64	4	52.8	3	2.04	5	favorable
BG_YN_PFP_008	23	0.49	1	87	1.44	2	5728	1	1.8	4	unfavorable

Evaluation by hydraulic parameters

	Water level		Flow velocity		Overall assessment of hydraulic parameters
	$\Delta h\,[m]$	Score	$\Delta v\,[\mathrm{m/s}]$	Score	
BG_YN_AFP_001	0.05	1	0.05	1	unfavorable
BG_YN_AFP_002	0.57	4	0.4	3	satisfactory
BG_YN_AFP_003	0.64	5	1.47	5	favorable
BG_YN_AFP_004	0.11	2	0.49	3	unfavorable
BG_YN_AFP_005	0.64	5	0.32	3	favorable
BG_YN_AFP_006	1.38	5	1.92	5	favorable
BG_YN_AFP_007	2.15	5	0.46	3	favorable
BG_YN_AFP_008	1.51	5	1.19	5	favorable
BG_YN_AFP_009	4.83	5	1.06	5	favorable
BG_YN_PFP_001	0.05	1	0.05	1	unfavorable
BG_YN_PFP_002	0.64	5	0.83	5	favorable
BG_YN_PFP_003	0.01	1	0	1	unfavorable
BG_YN_PFP_004	0.58	5	0.15	2	satisfactory
BG_YN_PFP_005	2.11	5	0.63	4	favorable
BG_YN_PFP_006	0.31	3	0.14	2	unfavorable
BG_YN_PFP_007	0.95	5	0.22	2	satisfactory
BG_YN_PFP_008	1.16	5	0.31	3	favorable

Evaluation of ecological parameters

- **Assessed parameters**: Connectivity of floodplain water bodies; Existence of protected species; Existence of protected habitats; Vegetation naturalness; Potential for typical habitats;
- **Additional** "national" parameter "*Biocorridor, "stepping stone""* was used - to evaluate the complex biocorridor potential of the floodplain
- **Data used** : satellite imagery and / or aerial photography (from the last 10 years; National Register of Protected Areas, National Register of Protected Sites of NATURA 2000, Land cover / land use layer of the Land Parcel Identification System (LPIS); Field surveys from the last 10 years, available mainly for the territories falling within Natura 2000 site

Active floodplain BG_YN_AFP_004

Species	Pi [m^2]
Lutra lutra	2301518
Emys orbicularis	5686638
Mauremys rivulata	0
Triturus cristatus	0
Triturus dobrogicus	5679880
Triturus karelinii	0
Bombina bombina	5689733
Bombina variegata	0
Coenagrion ornatum	2964118
Ophiogomphus cecilia	4461544
Leucorrhinia pectoralis	0
Lycaena dispar	4118094
Euphydryas aurinia	0
Hypodryas maturna	0

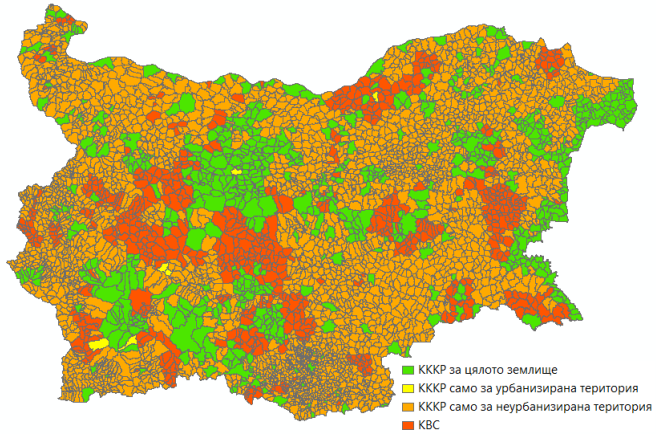
Evaluation of ecological parameters

	Connectivity of floodplain water bodies		Existence of protected species		Existence of protected habitats		Vegetation naturalness		Potential for typical habitats		Biocorridor, "stepping stone"		Overall assessment of ecological parameters
	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	Value	Score	
BG_YN_AFP_001	4	5	6.79	3	104	4	97.2	5	209.17	5	8.8	4	favorable
BG_YN_AFP_002	0	1	9.97	1	100	3	30.02	2	49.82	2	4.8	2	unfavorable
BG_YN_AFP_003	0	1	0.78	1	100	3	50.57	3	26.94	1	3.2	1	unfavorable
BG_YN_AFP_004	3	5	63.14	5	26	2	23.62	2	88.38	3	6.84	3	favorable
BG_YN_AFP_005	0	1	1.26	3	32	2	46.61	3	134.5	4	7	3	satisfactory
BG_YN_AFP_006	0	1	1.97	1	83	3	93.22	5	160.95	4	6	2	satisfactory
BG_YN_AFP_007	0	1	3.98	2	29	2	45.08	3	96.66	3	8	3	satisfactory
BG_YN_AFP_008	0	1	2.58	1	32	2	68.11	4	100.05	3	8	3	satisfactory
BG_YN_AFP_009	0	1	.7	1	93	3	99.61	5	68.06	2	8	3	satisfactory
BG_YN_PFP_001	3	5	25.2	5	35	3	19.05	1	69.45	2	8	3	favorable
BG_YN_PFP_002	3	5	5.76	3	27	2	19.91	1	64.24	2	7.2	3	satisfactory
BG_YN_PFP_003	3	5	80.1	3	63	3	37.97	2	121.4	3	7.2	3	favorable
BG_YN_PFP_004	3	5	91.32	3	35	2	27.39	2	59.48	2	6.4	3	satisfactory
BG_YN_PFP_005	3	5	68.81	2	78	3	54.17	3	94.81	3	7.2	3	favorable
BG_YN_PFP_006	2	4	145.77	4	66	4	33.78	2	105.69	3	5.6	2	favorable
BG_YN_PFP_007	3	5	140.33	4	36	2	23.84	2	96.18	3	8.8	4	favorable
BG_YN_PFP_008	3	5	249.34	5	61	3	31.21	2	110.05	3	8.8	4	favorable

Evaluation of socio-economic parameters

- **Assessed parameters**: Potentially affected buildings; Land use.
- **Data used** : Cadastral data, actual aerial photos , layer of the Land Parcel Identification System (LPIS) was used. (*The LPIS is part of the Integrated Administration and Control System (IACS), which has been developed in all EU Member States. The nomenclature of land cover follows the main elements, nomenclature and definitions of CORINE, with some changes and additions to ensure the specificity and objectives of the LPIS. The data has very high spatial resolution*)
- **Obstacles:** The cadastral data, and in particular the layer of buildings, were not available for most of the study area. Therefore, aerial photos were used to digitize the missing buildings

Cadastral map coverage as of 01.07.2019



Evaluation of socio-economic parameters

	Potentially affected buildings		Land use		Overall assessment of socio-economic parameters
	Value	Score	Value	Score	
BG_YN_AFP_001	0.2	4	1.23	5	favorable
BG_YN_AFP_002	2.3	2	3.85	2	unfavorable
BG_YN_AFP_003	1.7	3	3.03	3	satisfactory
BG_YN_AFP_004	1.3	3	4.25	2	unfavorable
BG_YN_AFP_005	2.6	2	3.62	2	unfavorable
BG_YN_AFP_006	9.4	1	2.28	4	unfavorable
BG_YN_AFP_007	1.3	3	3.44	2	unfavorable
BG_YN_AFP_008	0	5	2.73	3	favorable
BG_YN_AFP_009	4.1	2	1.48	5	satisfactory
BG_YN_PFP_001	0.7	4	4.41	2	satisfactory
BG_YN_PFP_002	0	5	4.35	2	satisfactory
BG_YN_PFP_003	0	5	3.79	2	satisfactory
BG_YN_PFP_004	0.3	4	3.99	2	satisfactory
BG_YN_PFP_005	0.5	4	3.11	3	satisfactory
BG_YN_PFP_006	2.3	2	4.03	2	unfavorable
BG_YN_PFP_007	0.7	4	4.16	2	satisfactory
BG_YN_PFP_008	0.3	4	4.03	2	satisfactory

Final map of a floodplain