

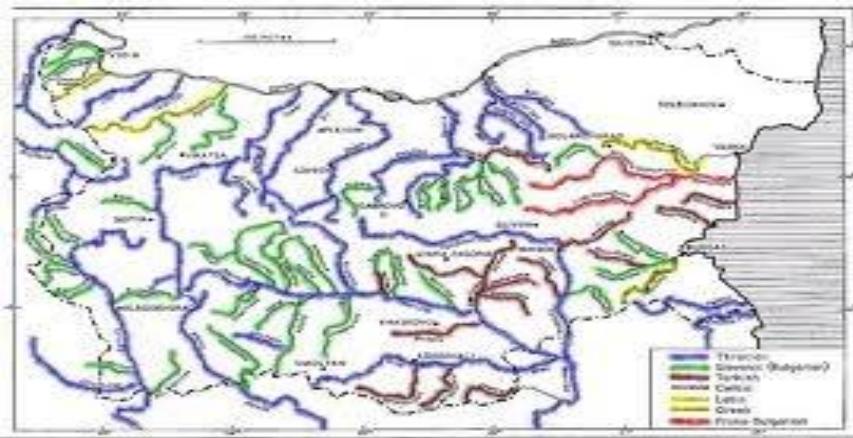
Flood risk mapping approach in Smart Water project for municipal area of Svilengrad, Bulgaria

Assoc. Prof. Dr. Nina Dobrinkova

Center for National Security and Defense Research
Bulgarian Academy of Sciences

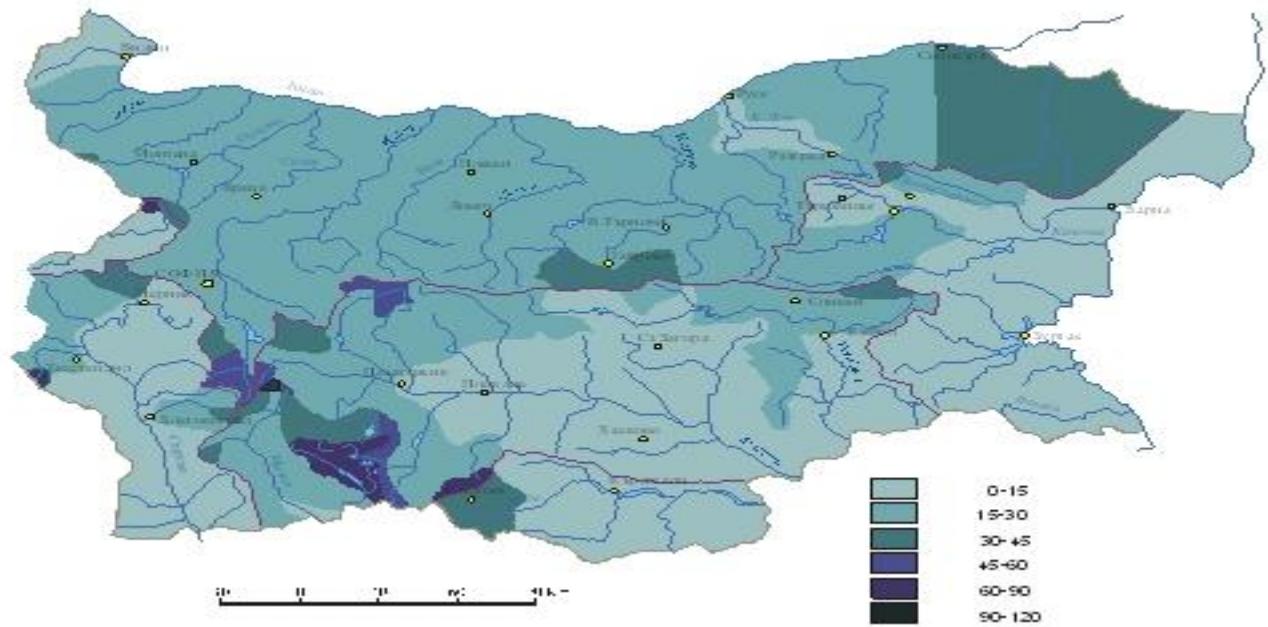


Rivers in Bulgaria

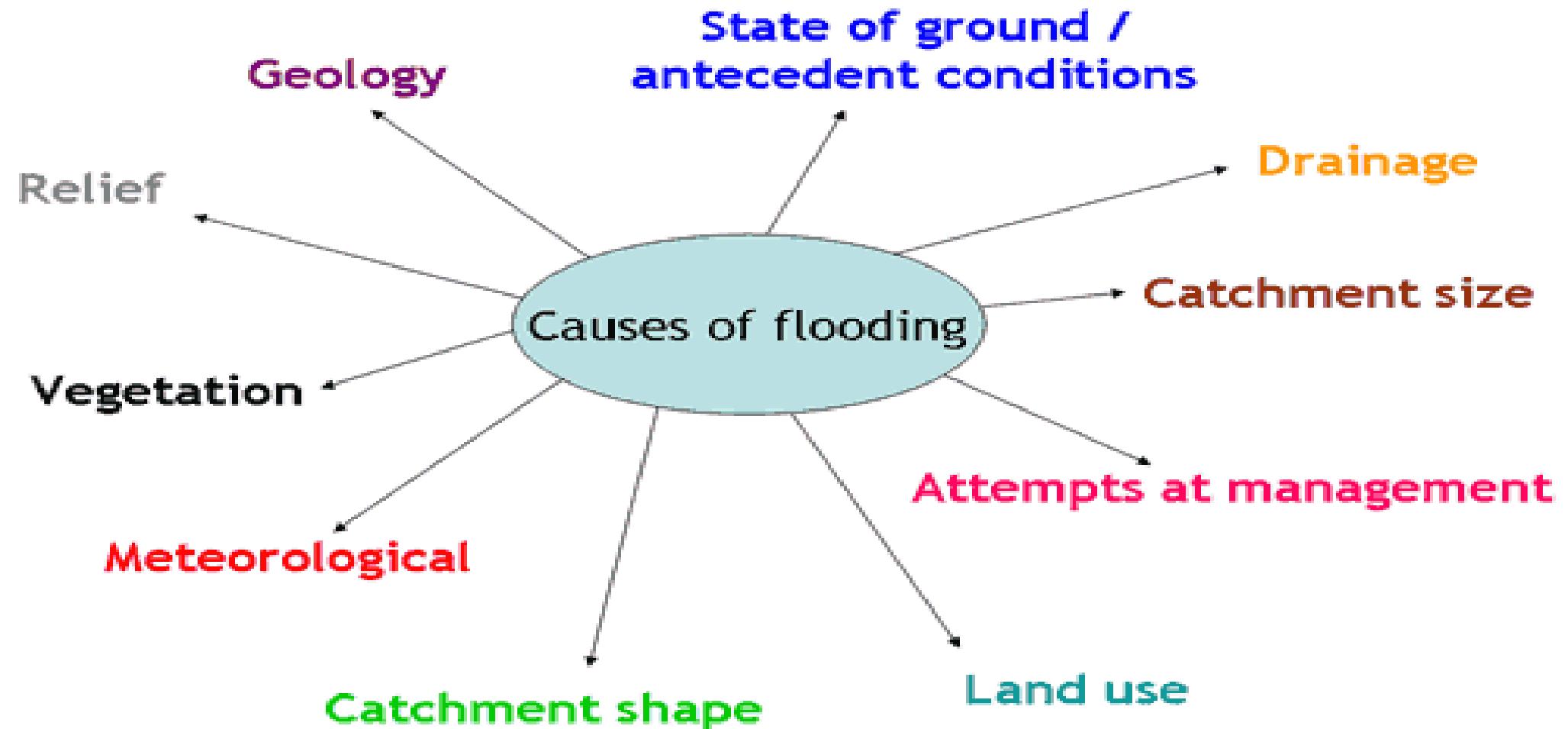


Bulgaria's total land is 111 000 square kilometers. 680 000 kilometers are rivers and 400 kilometers are Black Sea coast.

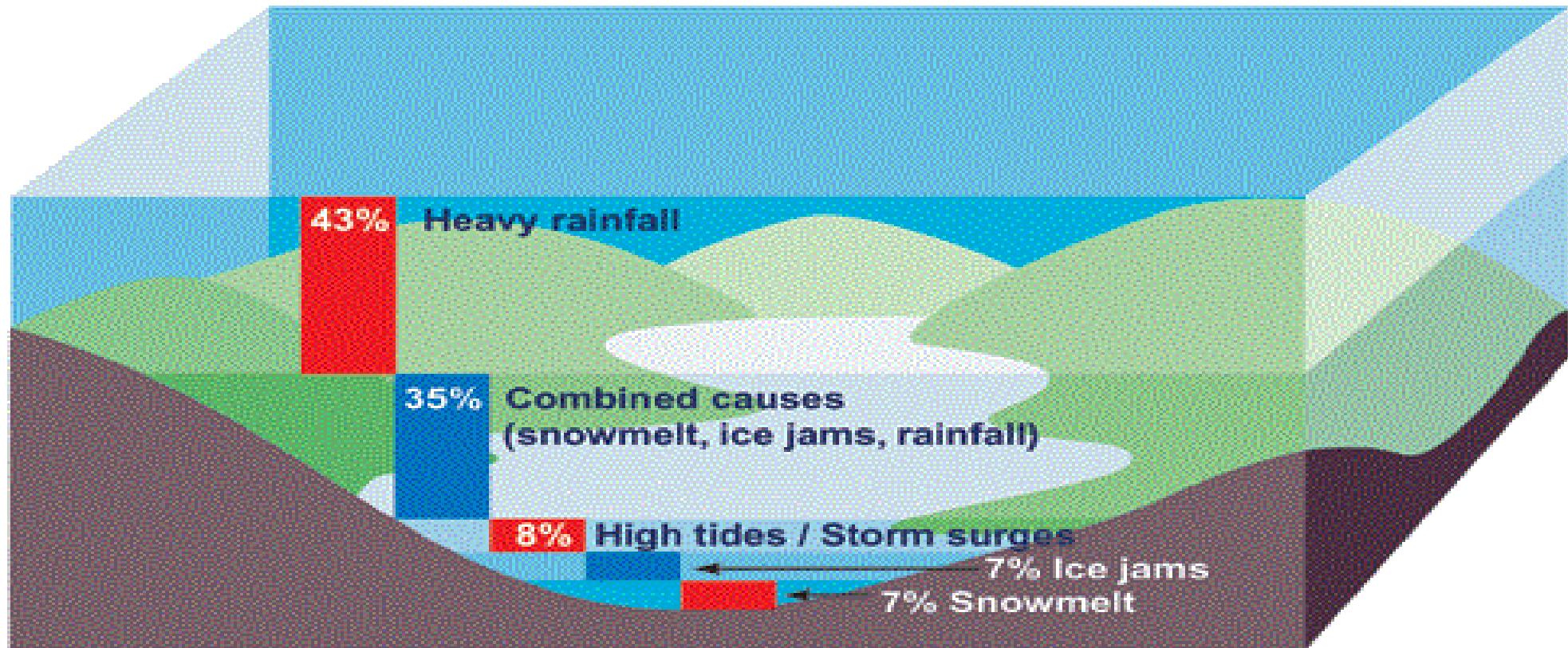
Ice regime of the rivers in Bulgaria range from 10 to 80 days in the mountain areas.



General reasons for flood event to occur

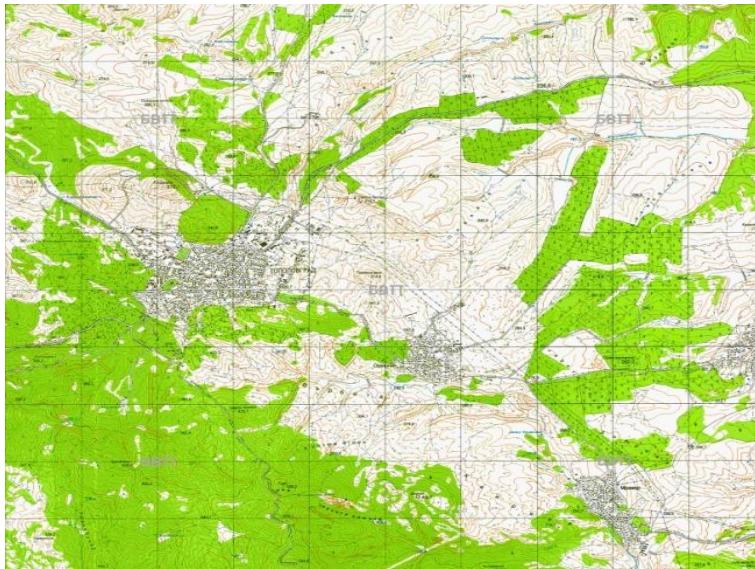


Floods in Bulgaria occur mainly in spring



Available Data

- All information provided by the municipality of Svilengrad were paper maps 1:1000, 1: 5000 and 1: 25 000 scale precision along the River Maritsa and its tributaries and in the populated areas



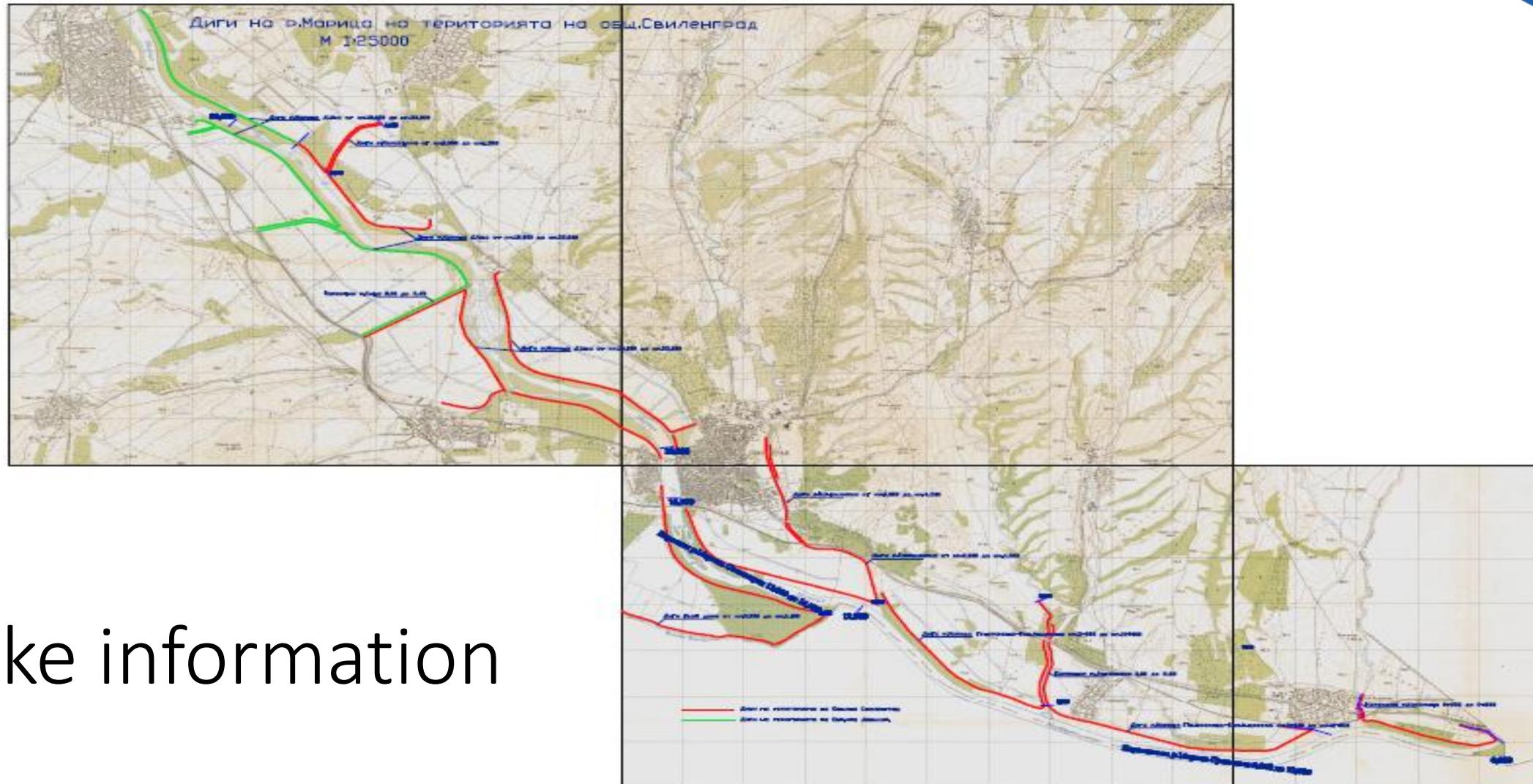
1: 25 000



1: 5 000



1: 1 000



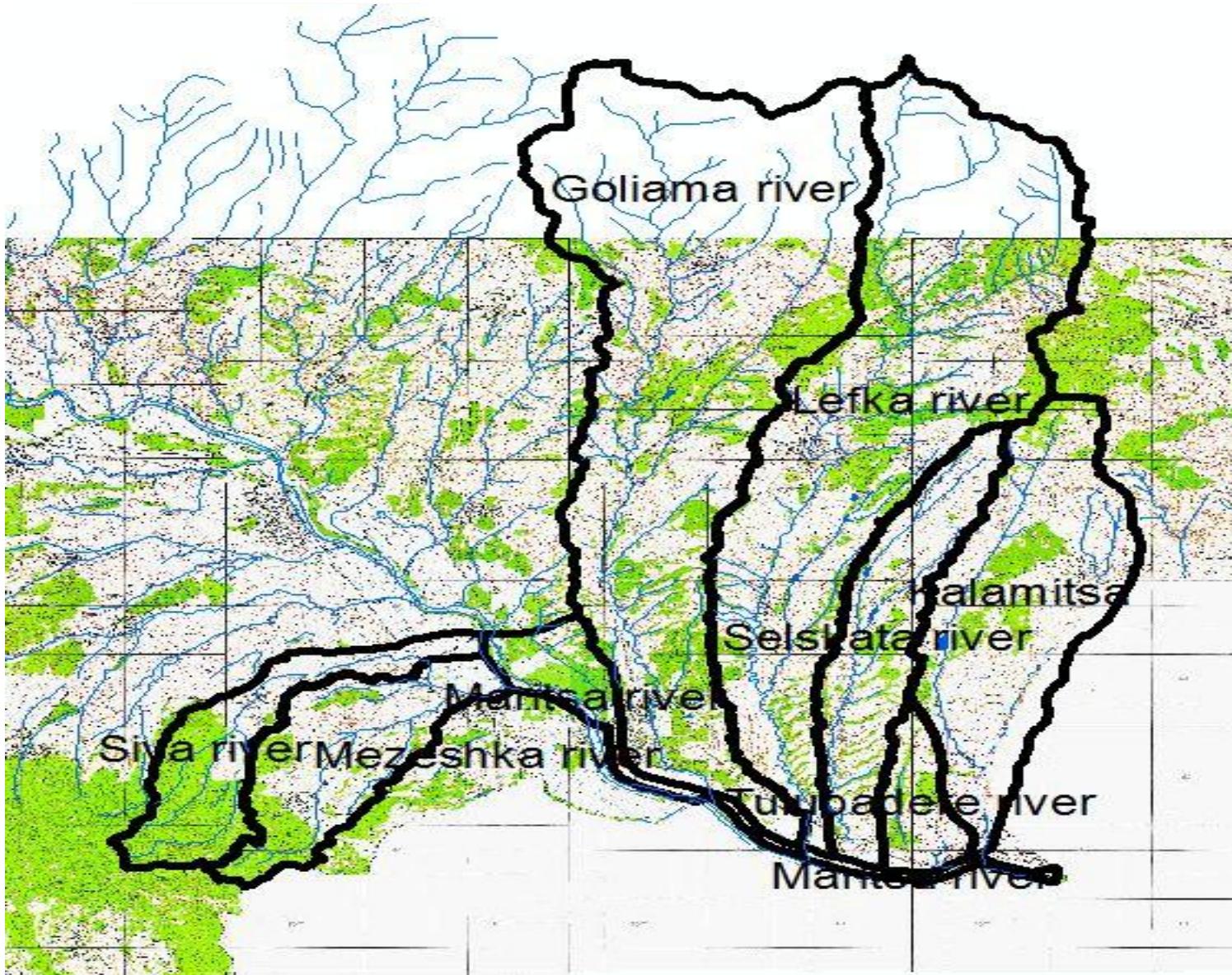
Dyke information

Rivers in the scope of Smart Water project

No	Name	Feeder	Area Sq. km	Altitude m
1	2	3	4	5
1	Siva river	right	28,512	359
2	Mezeshka river	right	34,716	315
3	Maritza		20840,00	582,00
4	Goljiamata rekar	left	171,762	399
5	Levka	left	144,121	449
6	Selskata reka	left	38,424	230
7	Kalamitza	left	65,437	211,25

Maritza River information

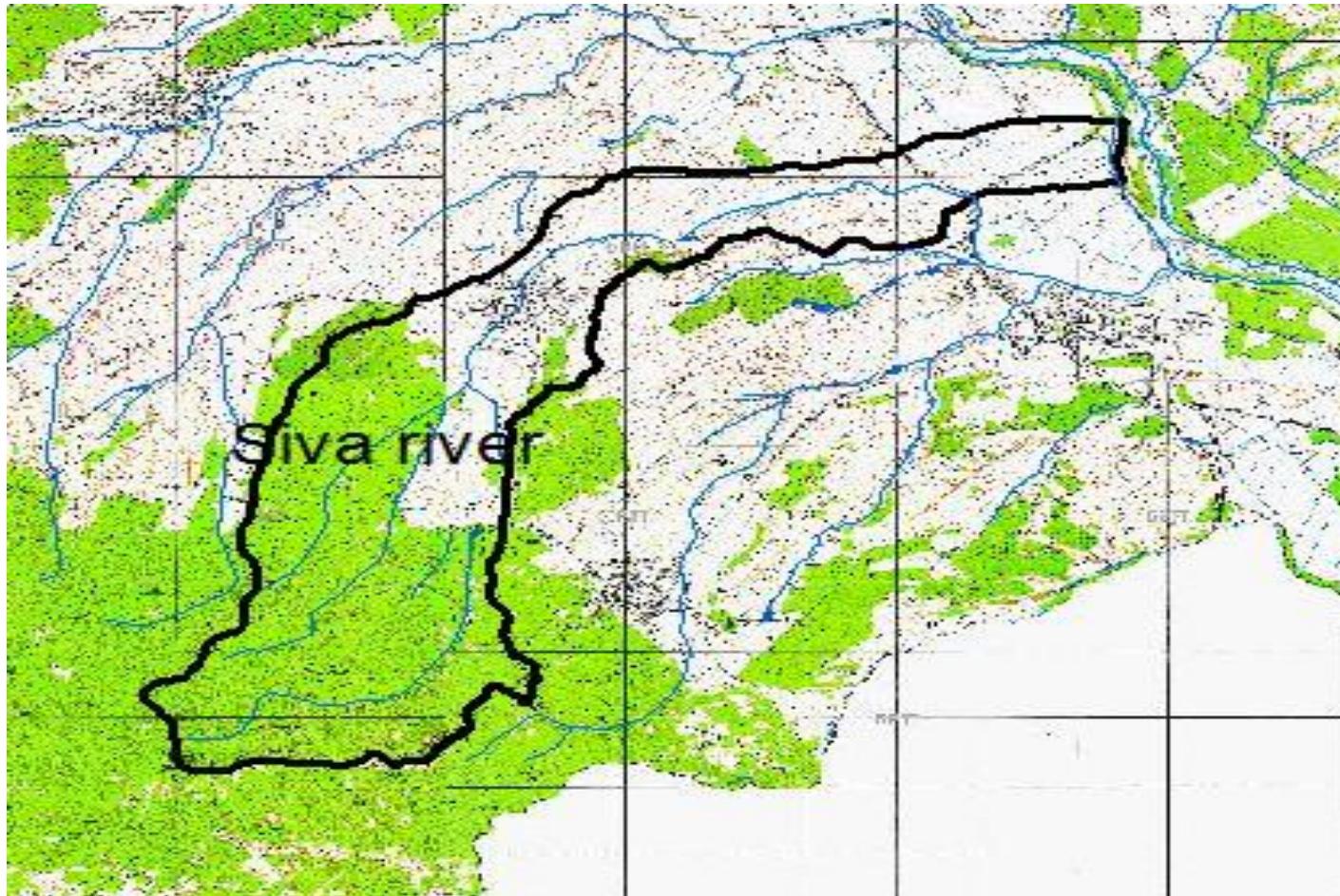
No	Characteristic	Unit	Value
1.	River length	km	301,94
2.	Average river slope	-	0,0077
3.	Catchment area	km ²	20840
4.	Average altitude level of the water area	m	582
5.	Average slope of the catchment area	-	0,125
6.	Density of the river system	km/km ²	0,74
7.	Forestation	%	39,9
8.	Elevation “O” of the HM station	m	46,64
9.	Distance to the boundary	km	19,7



Maritsa River
watershed on the
territory of Svilengrad
Municipality

Siva River information (1)

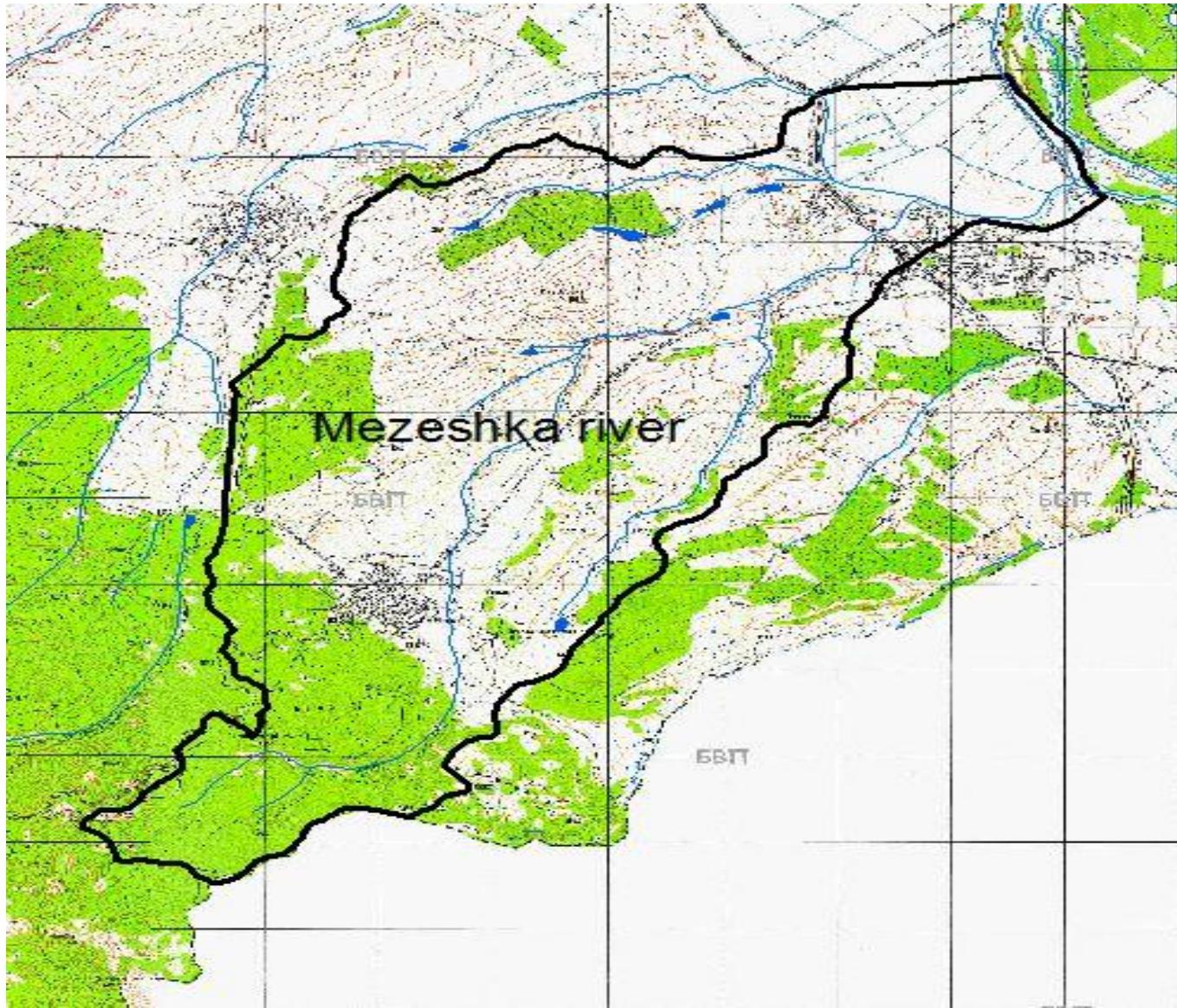
No	Characteristics	Unit	Value
1.	Length of the main river along this section	km	16,250
2.	Length of feeders	km	13,000
3.	Height of springs	m	510
4.	Height of Maritsa river	m	60
5.	Total length of rivers	km	29,250
6.	Average river slope	-	0,027692
7.	Water catchments area	km ²	28,512
8.	Average above sea-level of the water catchments area	m	359
9.	Water catchments area average slope	-	-
10.	River system density	km/km ²	1,071429
11.	Forestation	%	50



Sava River information (2)

Mezeshka River information (1)

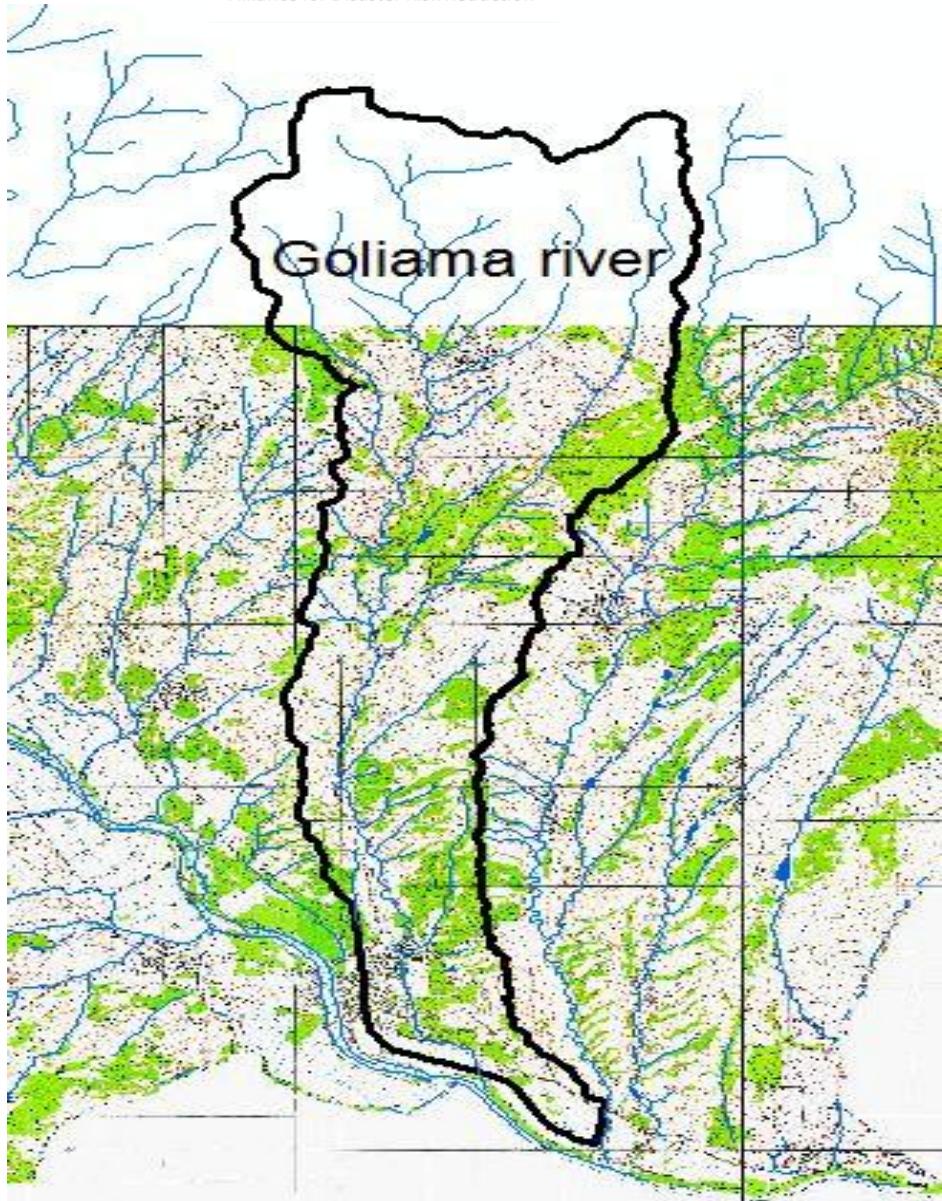
No	Characteristics	Unit	Value
1.	Length of the main river along this section	km	12,250
2.	Length of feeders	km	11,500
3.	Height of springs	m	410
4.	Height of Maritza river	m	59
5.	Total length of rivers	km	23,750
6.	Average river slope	-	0,028653
7.	Water catchments area	km ²	25,188
8.	Average above sea-level of the water catchments area	m	175,742
9.	Water catchments area average slope	-	-
10.	River system density	km/km ²	0,945537
11.	Forestation	%	25



Mezeshka River
information (2)

Goliama River information (1)

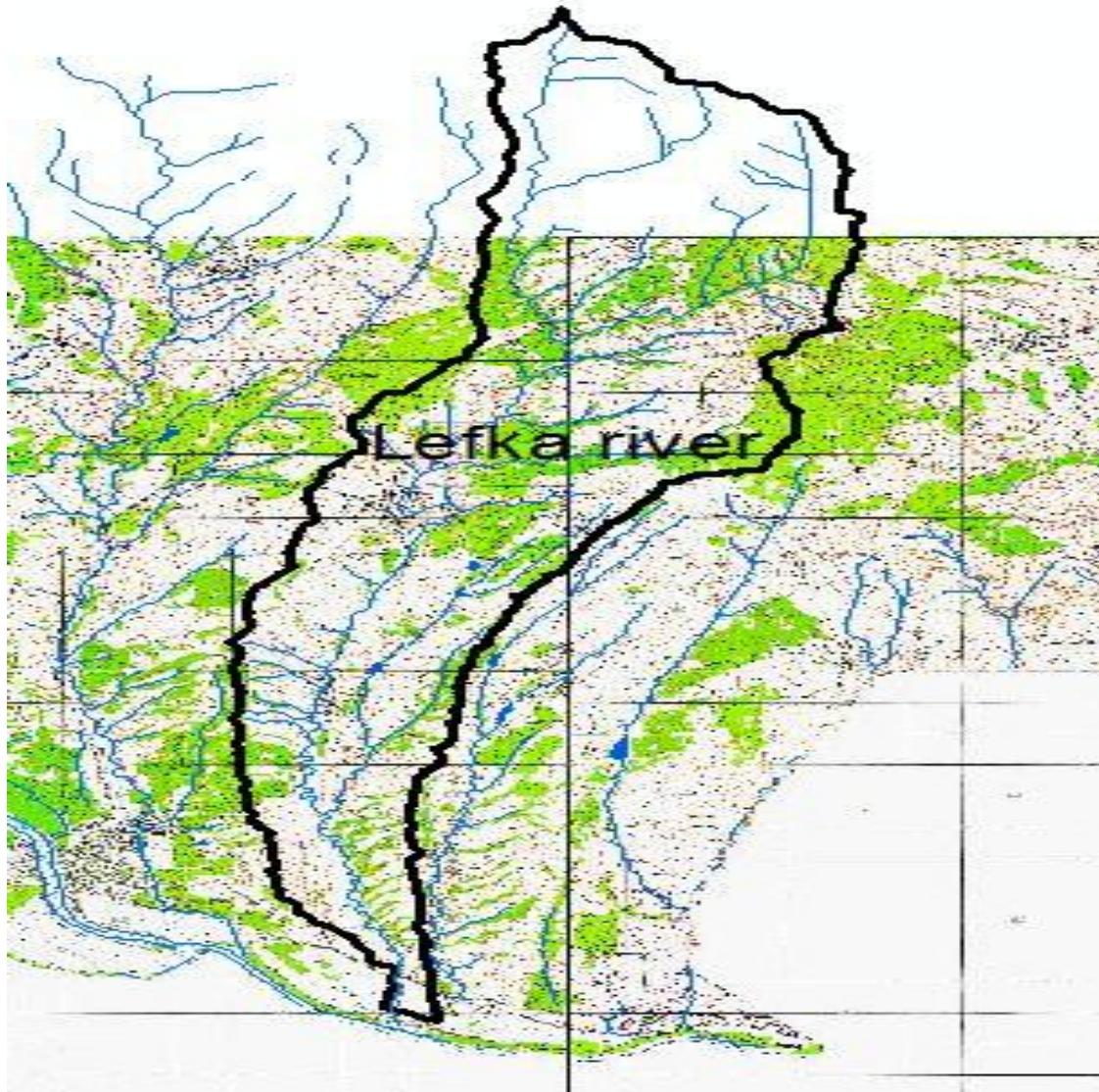
No	Characteristic	Unit	Value
1.	Length of the main river in the region	km	34,75
2.	Length of the feeders	km	74,25
3.	Total length of the rivers	km	109,00
4.	Spring altitude	m	564,5
5.	Maritza river bed level	m	47,50
6.	Average river slope	-	0,014878
7.	Catchment area	km ²	166,83
8.	Average above sea level of the water area	m	311,74
9.	Average slope of the catchment	-	113,45
10.	River system density	km/km ²	0,65336
11.	Forestation	%	40



Goliama River information (2)

Levka River information (1)

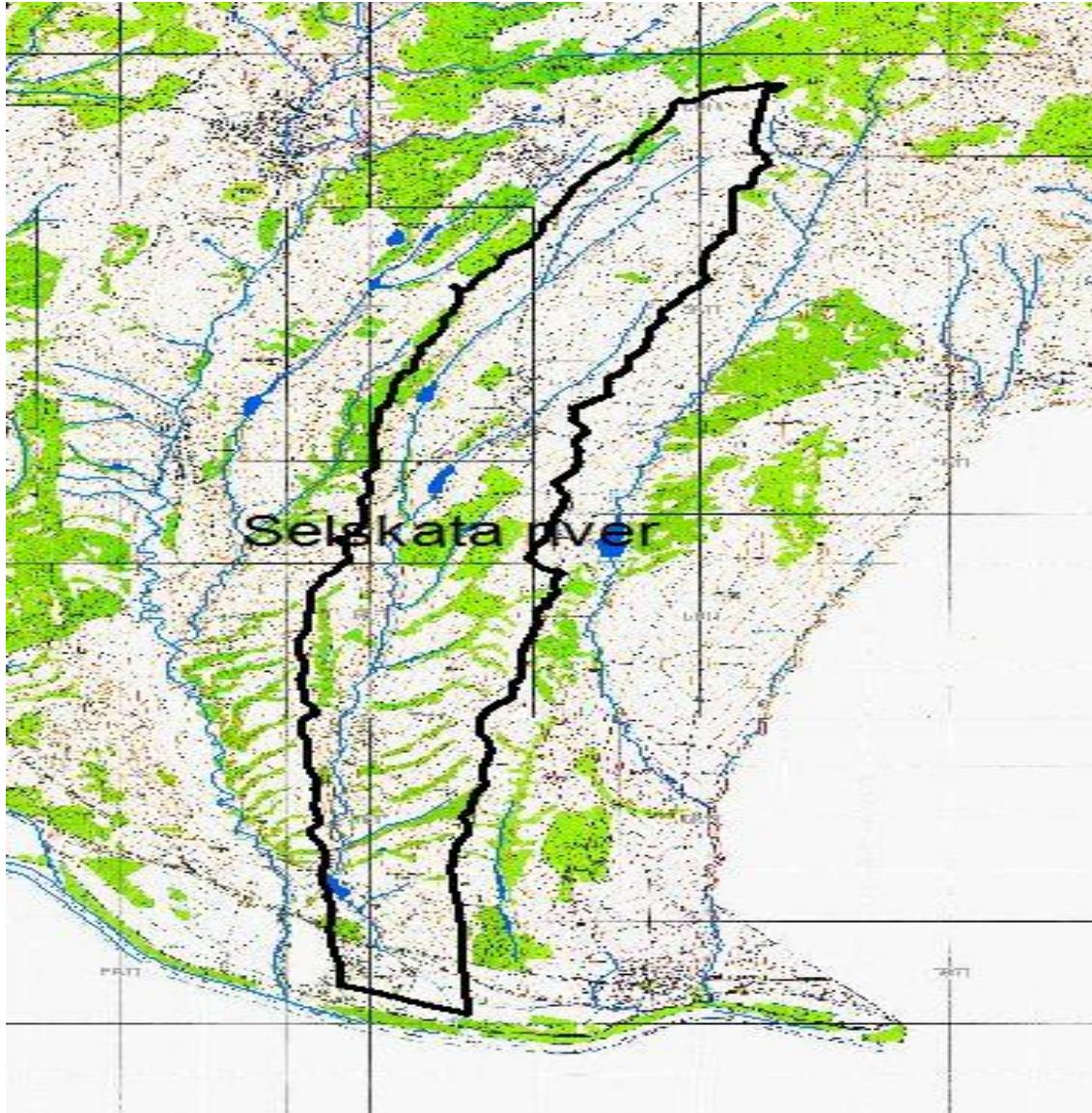
No	Characteristic	Unit	Value
1.	Length of the main river in the region	km	39,8
2.	Feeders length	km	79,0
3.	Total length of the rivers	km	118,8
4.	Spring level	m	755
5.	Level of Maritsa bed	m	46
6.	Average slope of the river	-	0,017814
7.	Catchment area	km ²	147,33
8.	Average above sea level water area	m	332,65
9.	Average slope of the catchment area	-	121,515
10.	Density of the river system	km/km ²	0,806353
11.	Forestation	%	38



Levka River information (2)

Selska River information (1)

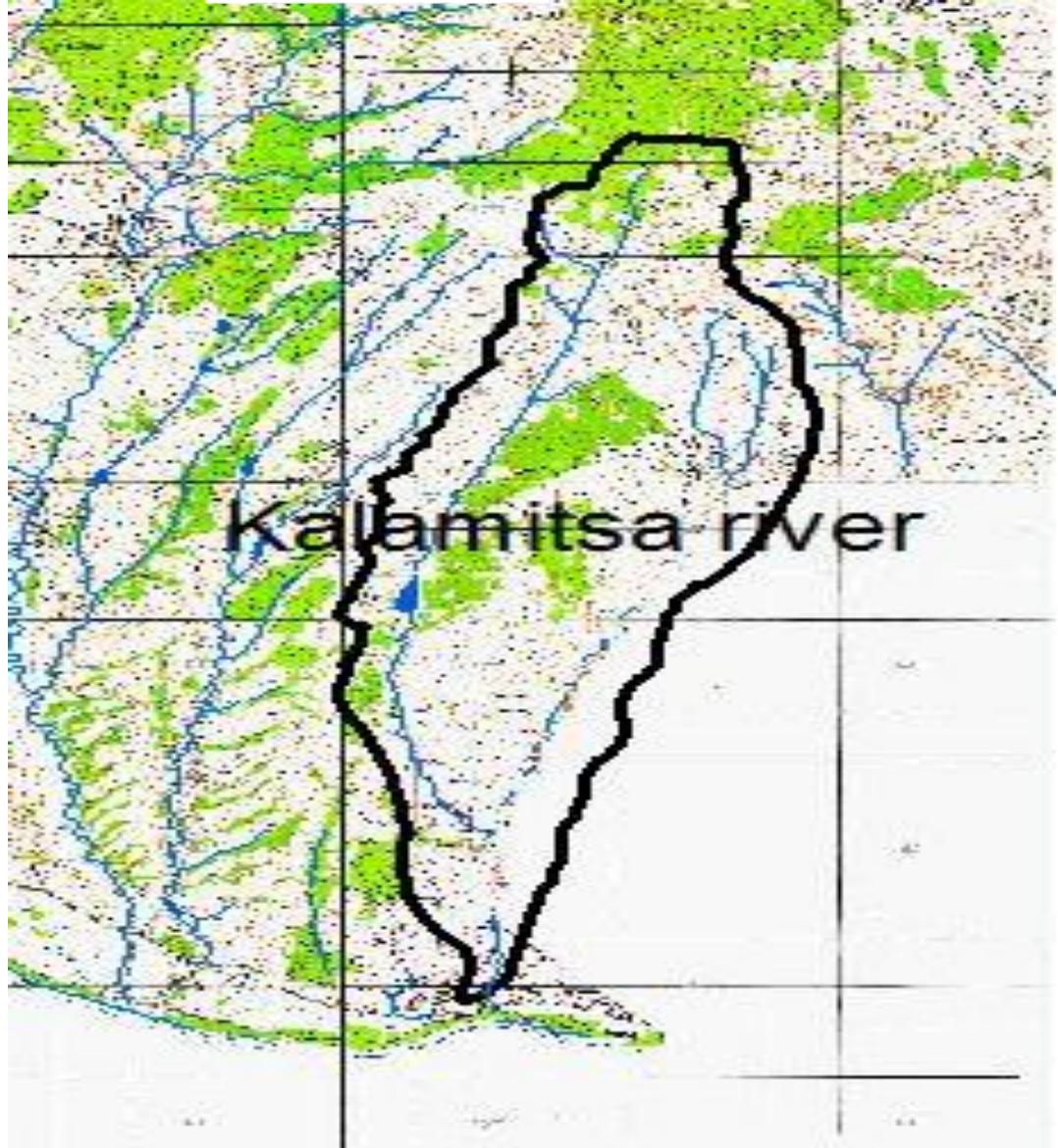
No	Characteristic	Unit	Value
1.	Length of the main river in the region	km	19,10
2.	Feeders length	km	13,00
3.	Total length of the rivers	km	32,10
4.	Spring level	m	230
5.	Level of Maritsa bed	m	45,5
6.	Average slope of the river	-	0,00966
7.	Catchment area	km ²	38,33
8.	Average above sea level water area	m	192,45
9.	Average slope of the catchment area	-	74,67
10.	River system density	km/km ²	0,837464
11.	Forestation	%	



Selskata River information (2)

Kalamitza River information (1)

No	Characteristics	Unit	Value
1.	Length of the main river in the region	km	20,752
2.	Feeders length	km	29,871
3.	Total length of the rivers	km	50,623
4.	Level of the river	m	418
5.	Level of Maritza river	m	44
6.	Average slope of the river	-	0,018022
7.	Catchment area	km ²	68,98
8.	Average above sea level water area	m	211,25
9.	Average slope of the catchment area	-	75,986
10.	River system density of	KM/KM ²	0,73388
11.	Forestation	%	20



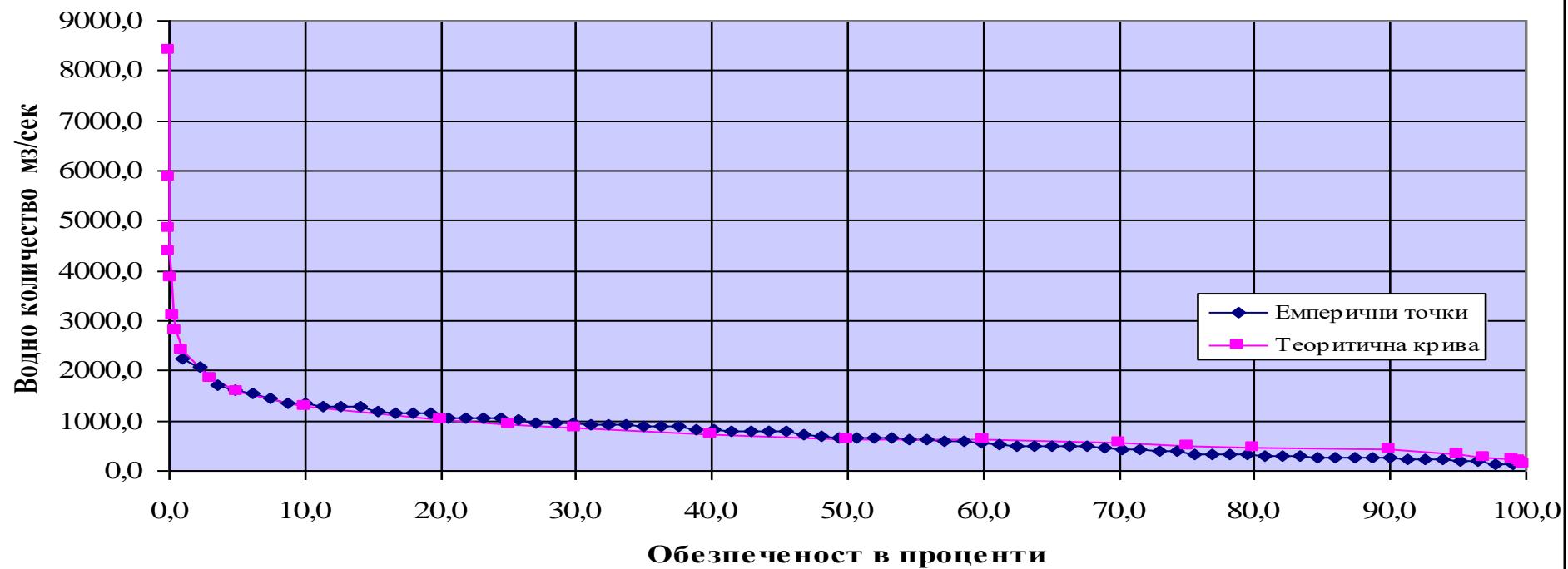
Kalamitsa River information (2)

Calculated probability according to water flow information from the year from 1936 to 2012

Probability	0,01 %	0,1 %	0, 5%	1 %	3 %	5 %
Q max B m ³ /s	5868,65	3855,74	2801,11	2404,33	1847,52	1596,68

Max water quantity in river Maritsa

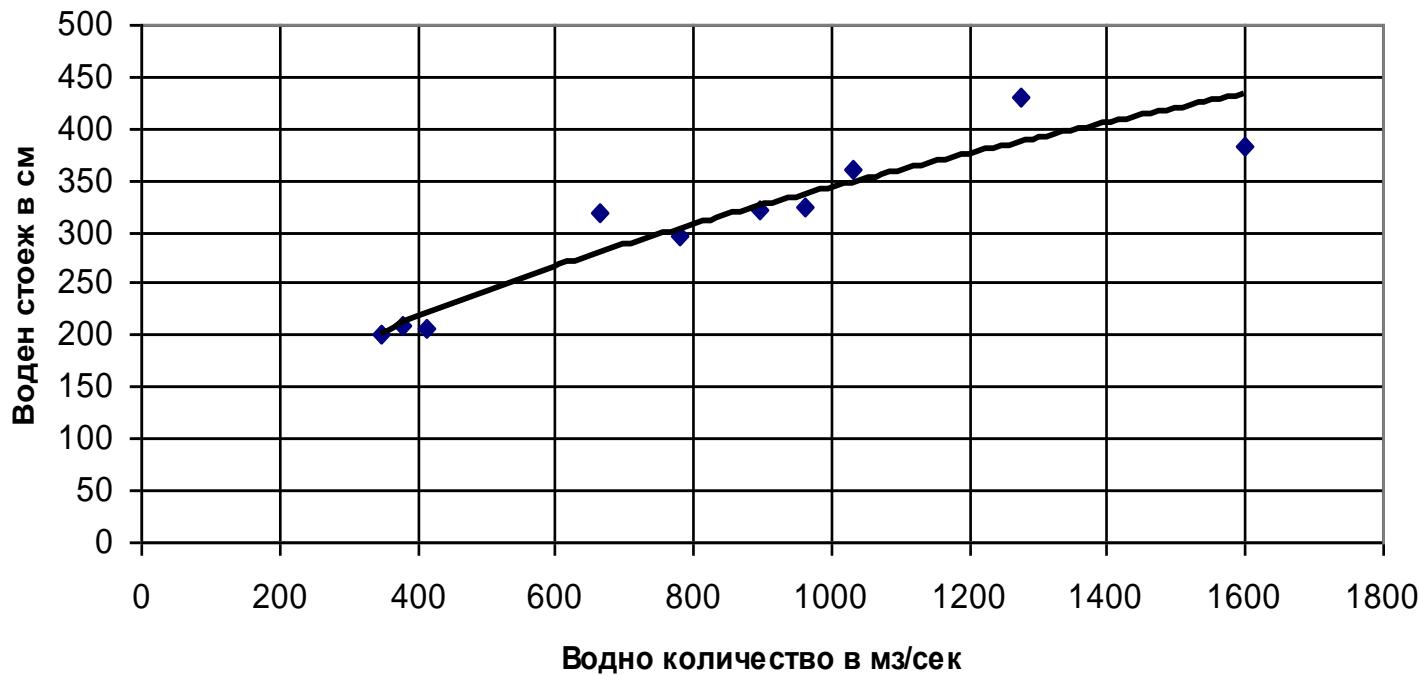
**Крива на обезпеченост на максималните в годината водни количества в р.Марица
ХМП 73850 р.Марица при Свиленград Qср.мах= 754,02 м³/сек Cv= 0,604446 Cs = 0,931922**



Year	Water height cm	Water quantity m^3/s
1976	297	752
1977	346	976
1978	216	441
1979	250	600
1980	275	690
1973	469	1350
1963	585	1695
1966	451	1460

Statistical correlation

Зависимост между водното количество и водните стоежи в р.Марица в ХМП
 73850 гр.Свиленград $H = 10,916 \cdot Q^{0,4988}$ при коеф.на дитерминация 0,9246



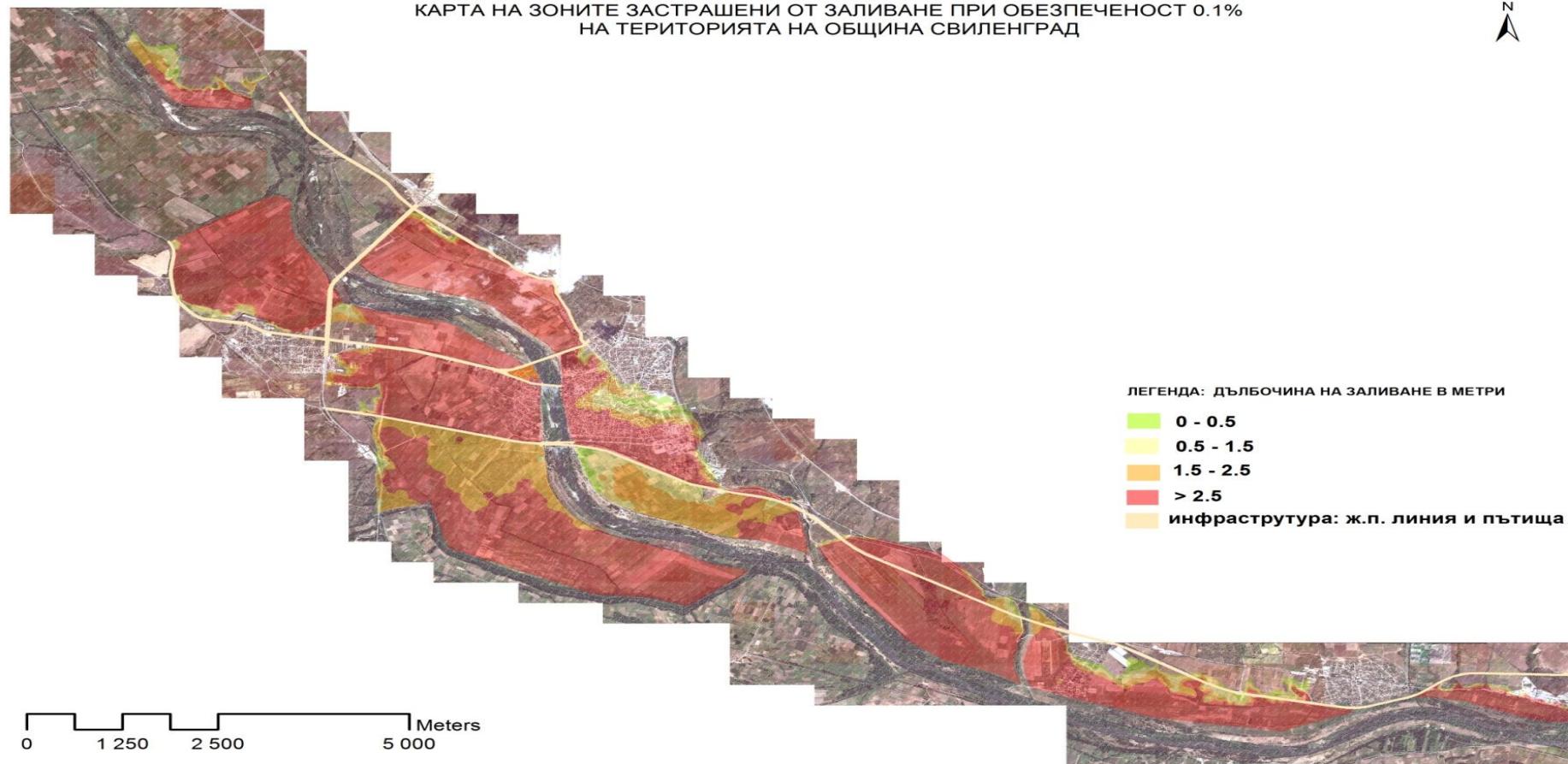
Statistical correlation

We define dependencies between elevation of the maximum water level and the 'high' waves with probabilities 0.1 %, 1 %, 3 % и 5 %.

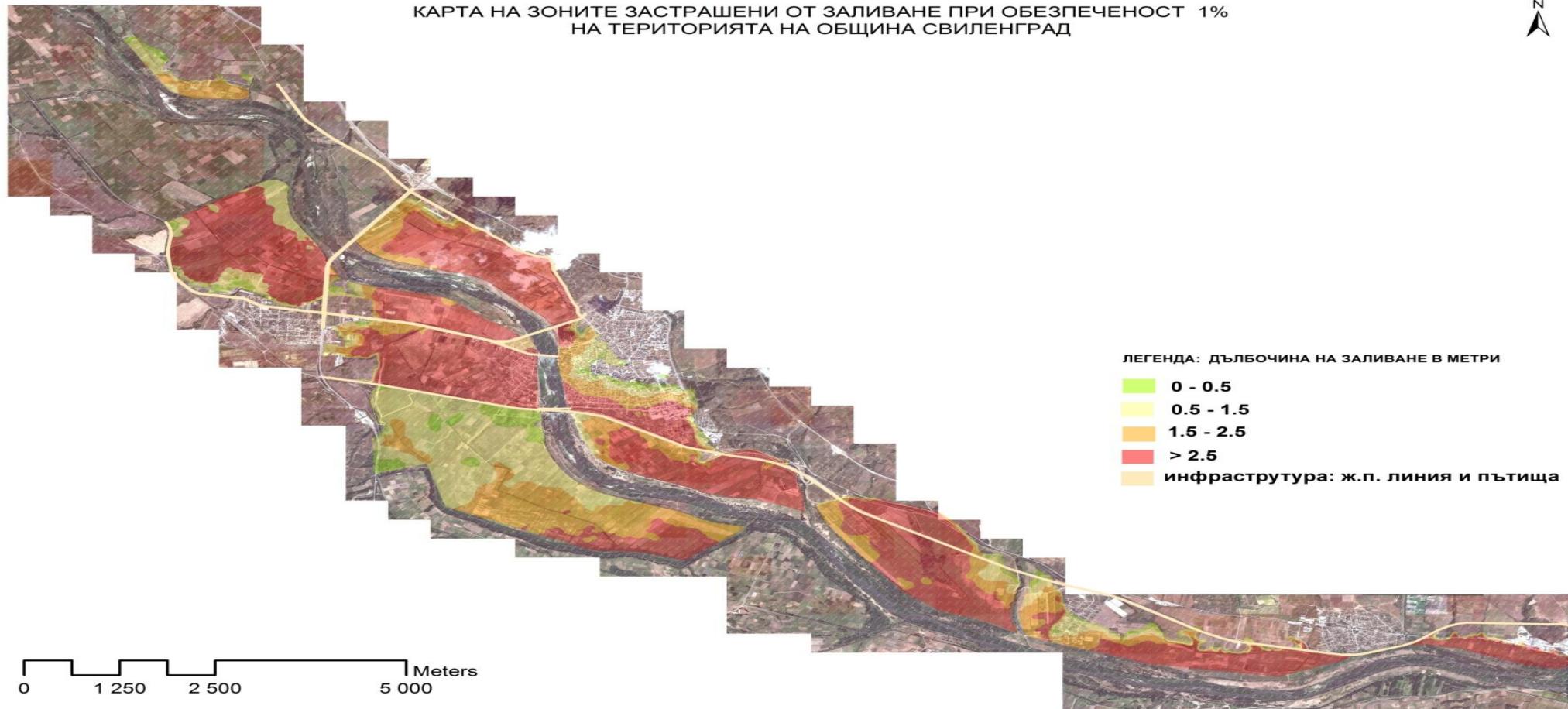
Element	Measure	Probability			
		0,1%	1 %	3 %	5 %
A		10,916	10,916	10,916	10,916
n		0,50	0,50	0,50	0,50
Water quantity	m ³ /s	3855,74	2404,33	1847,52	1596,68
Water Height	cm	671,14	530,28	464,98	432,34
Level “0” in water	m	48,59	48,59	48,59	48,59
Leve of the real water	m	55,30	53,89	53,24	52,91

№	Cross-sections	Distance between points	Elevation	Difference	Slope	In meters the height which the river can have in elevation				Elev. Crown height
						0,10%	1%	3%	5%	
1	Siva river		50,68			57,610	56,200	55,550	55,220	56.40
		1473		0,680	0,0004616					
2	The bridge for Greece		50,00			56,930	55,520	54,870	54,540	54.60
		670		0,410	0,0006119					
3	Sross-section 1		49,59			56,520	55,110	54,460	54,130	54.44
		953		0,390	0,0004092					
4	Sross-section 2		49,20			56,130	54,720	54,070	53,740	54.33
		1508		0,230	0,0001525					
5	New concrete road bridge		48,97			55,900	54,490	53,840	53,510	53.39
		485		0,600	0,0012371					
6	Old Turkish bridge		48,37			55,300	53,890	53,240	52,910	53.10
		1043		0,910	0,0008725					
7	Old train bridge		47,46			54,390	52,980	52,330	52,000	53.55
		45		0,030	0,0006667					
8	New train bridge		47,43			54,360	52,950	52,300	51,970	53.55
		38		0,030	0,0007895					
9	Stairs concrete in the river		47,40			54,330	52,920	52,270	51,940	53.55
		1133		1,540	0,0013592					
10	Sross-section 4		45,86			52,790	51,380	50,730	50,400	52.05
		1655		0,860	0,0005196					
11	Sross-section 5		45,00			51,930	50,520	49,870	49,540	52.05
		1575		0,670	0,0004254					
12	Kanakliiska river		44,33			51,260	49,850	49,200	48,870	50.90
		3784		1,040	0,0002748					
13	Levka River		43,29			50,220	48,810	48,160	47,830	50.01
		5340		2,760	0,0005169					
14	Kalamitza river		40,53			47,460	46,050	45,400	45,070	46.60
		19702		10,150	0,0005152					

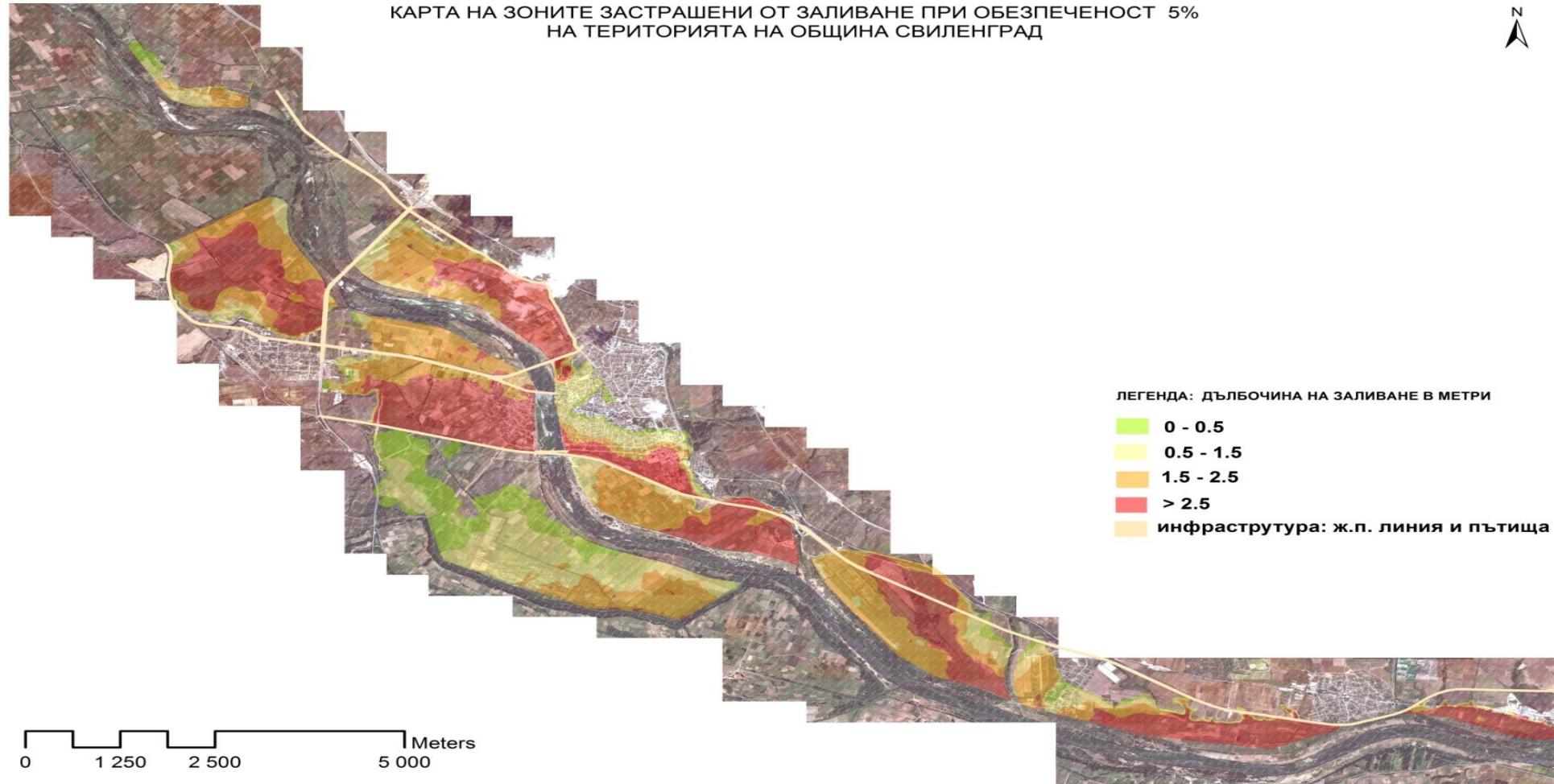
Smart Water Tool Layer 0.1% yr. wave



Smart Water Tool Layer 1% yr. wave

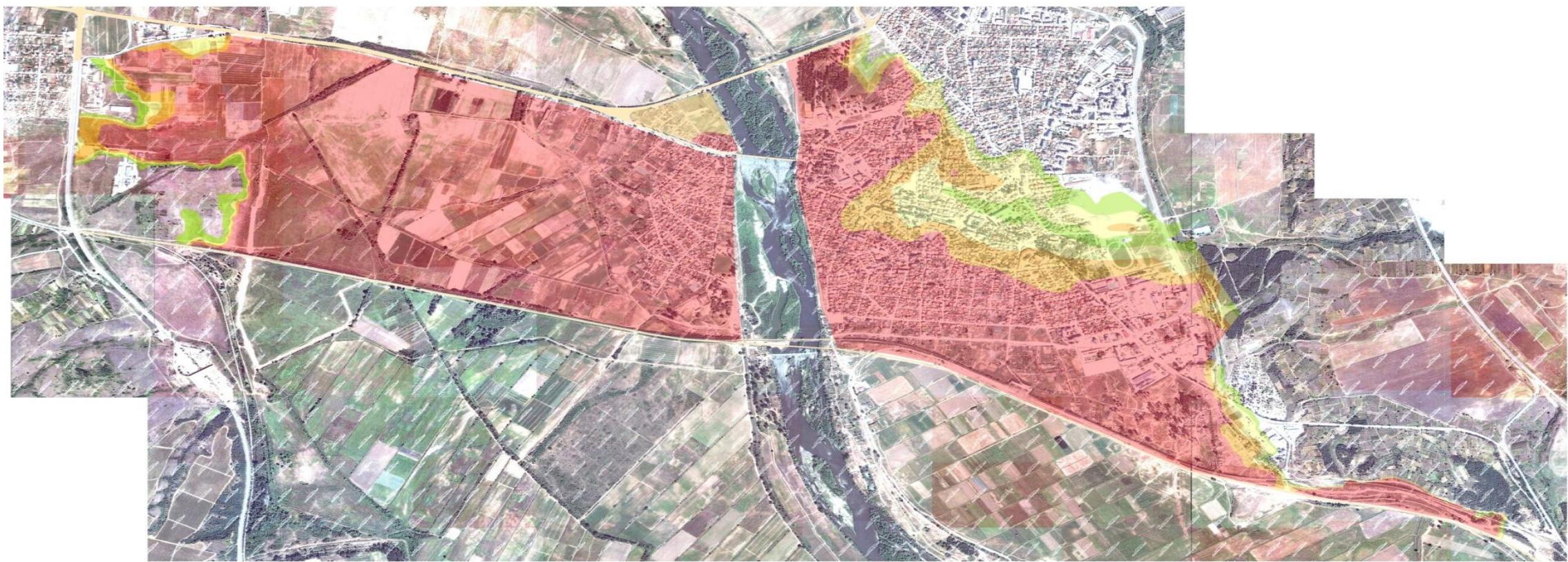


Smart Water Tool Layer 5% yr. wave



Smart Water Tool Layer 0.1% yr. wave in the city of Svilengrad

КАРТА НА ЗОНИТЕ ЗАСТРАШЕНИ ОТ ЗАЛИВАНЕ ПРИ ОБЕЗПЕЧЕНОСТ 0.1%
НА ТЕРИТОРИЯТА НА ОБЩИНА СВИЛЕНГРАД



0 250 500 1 000 Meters

ЛЕГЕНДА: ДЪЛБОЧИНА НА ЗАЛИВАНЕ В МЕТРИ

0 - 0.5 0.5 - 1.5 1.5 - 2.5

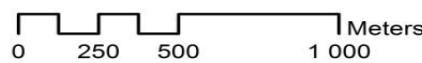
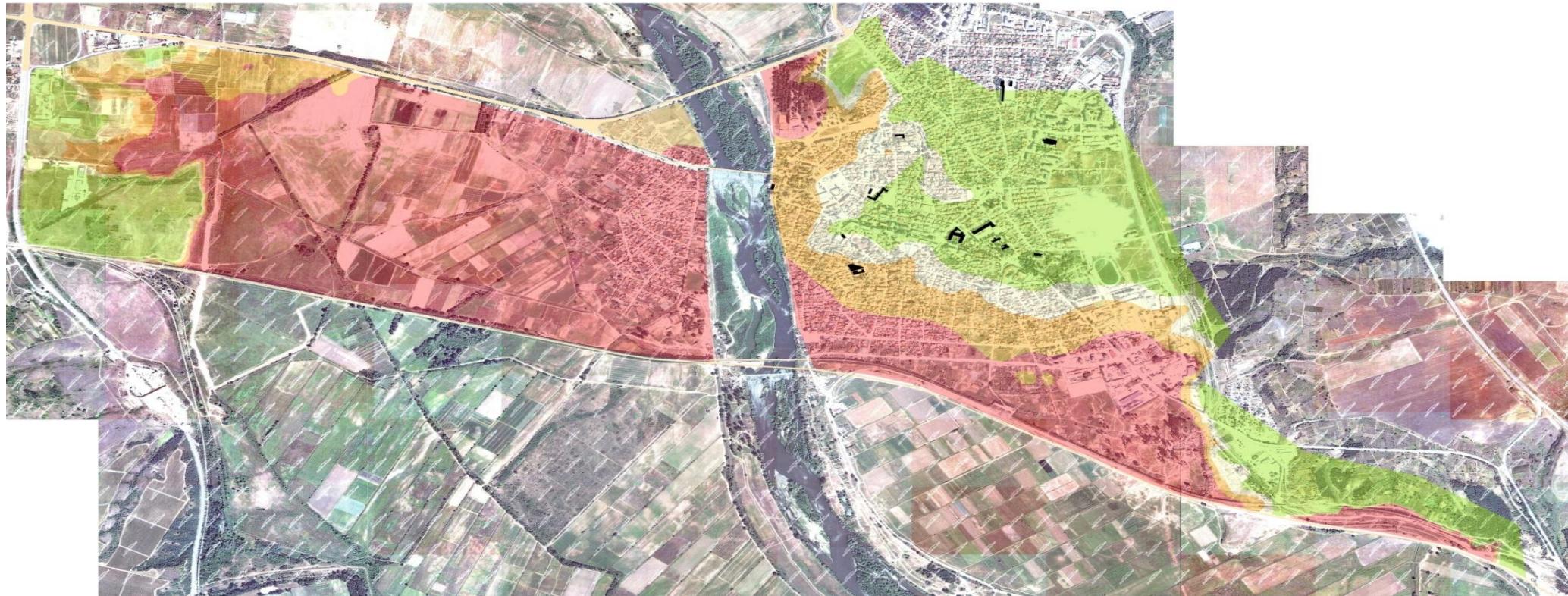
мвр, болница, училища, дет. заведения

> 2.5

инфраструктура: ж.п. линия и пътища

Smart Water Tool Layer 1% yr. wave in the city of Svilengrad

КАРТА НА ЗОНИТЕ ЗАСТРАШЕНИ ОТ ЗАЛИВАНЕ ПРИ ОБЕЗПЕЧЕНОСТ 1% НА ТЕРИТОРИЯТА НА ОБЩИНА СВИЛЕНГРАД



ЛЕГЕНДА: ДЪЛБОЧИНА НА ЗАЛИВАНЕ В МЕТРИ

0.0 - 0.5 0.5 - 1.5 1.5 - 2.5 > 2.5

■ мвр, болница, училища, дет. заведения

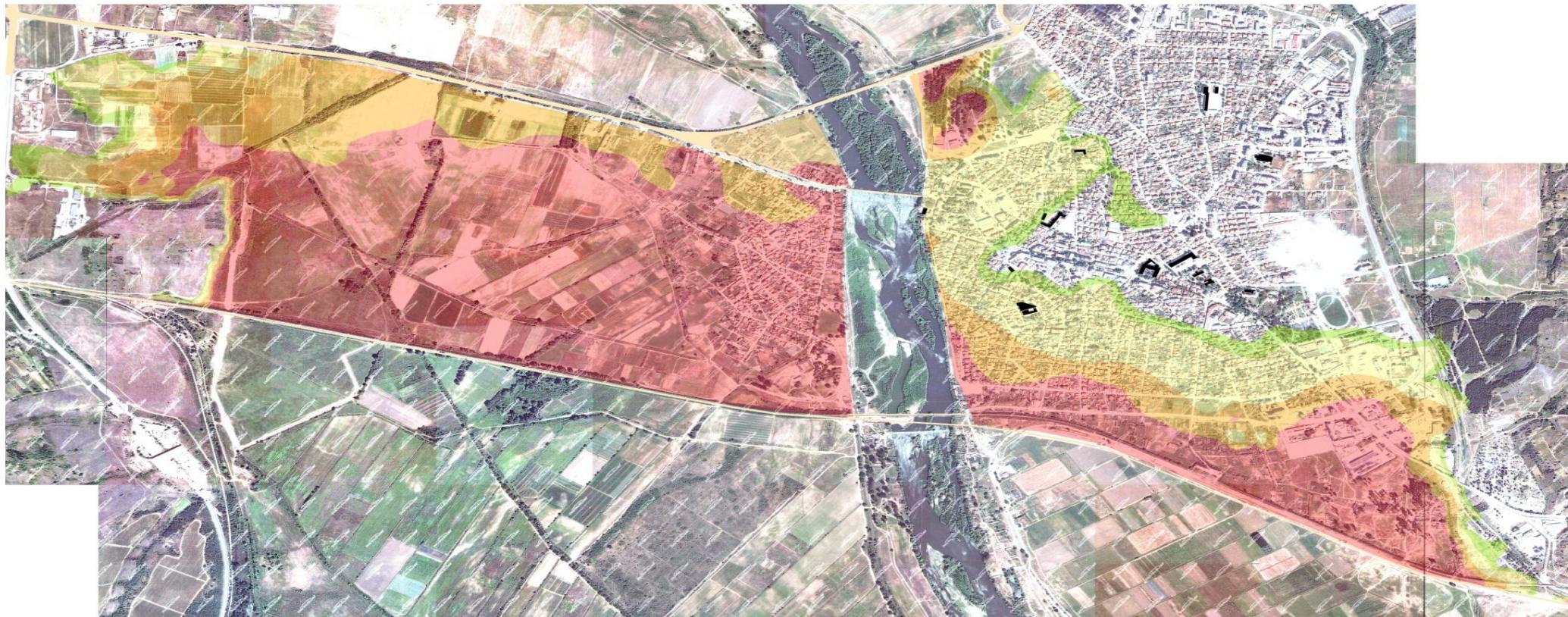
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инфраструктура: ж.п. линия и пътища

Smart Water Tool Layer 5% yr. wave in the city of Svilengrad

КАРТА НА ЗОНИТЕ ЗАСТРАШЕНИ ОТ ЗАЛИВАНЕ ПРИ ОБЕЗПЕЧЕНОСТ 5%
НА ТЕРИТОРИЯТА НА ОБЩИНА СВИЛЕНГРАД

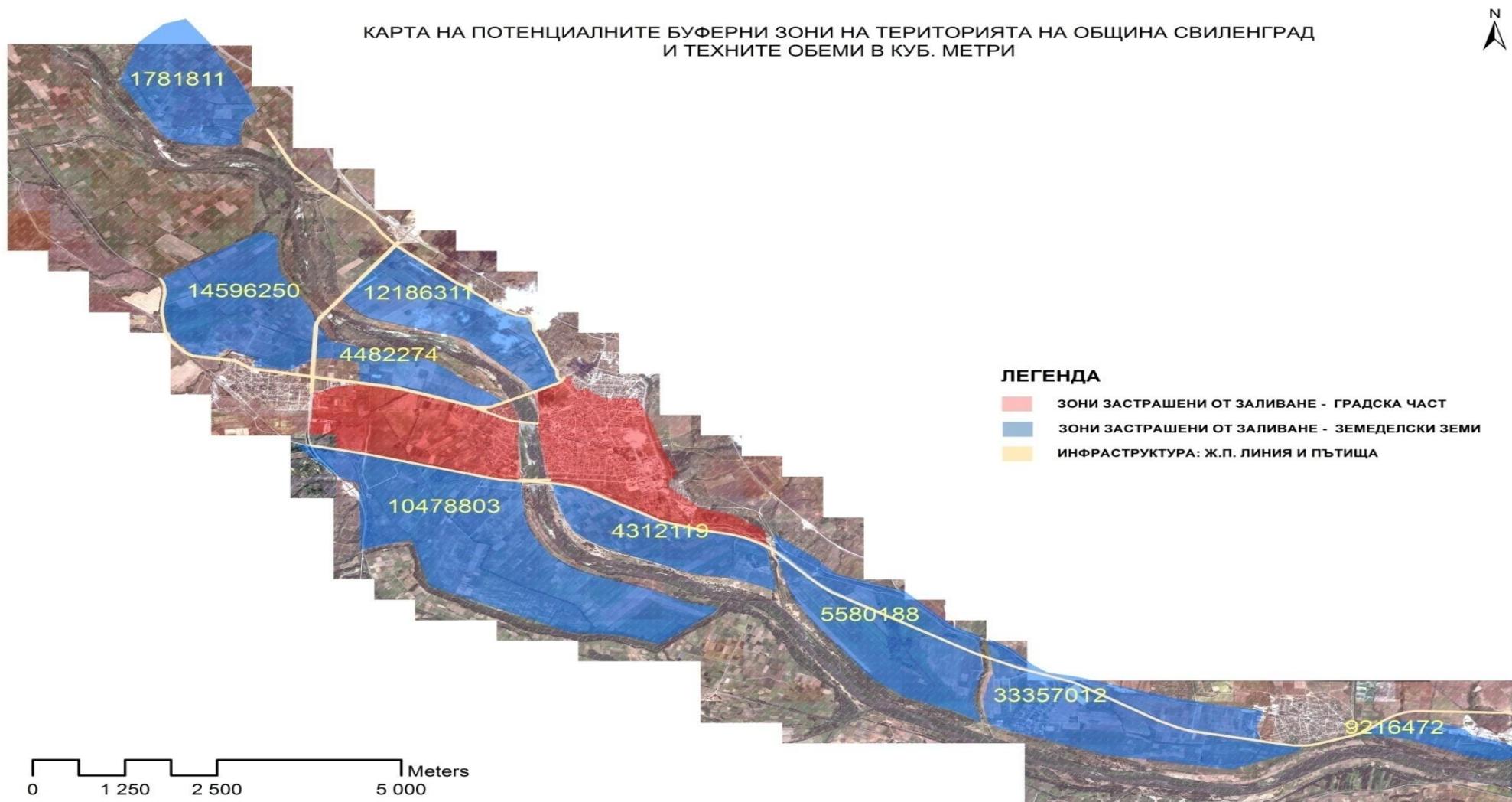
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0 250 500 1 000 Meters

ЛЕГЕНДА: ДЪЛБОЧИНА НА ЗАЛИВАНЕ В МЕТРИ
0.0 - 0.5 0.5 - 1.5 1.5 - 2.5 > 2.5
■ мвр, болница, училища, дет. заведения
■ инфраструктура: ж.п. линия и пътища

Smart Water Tool Layer Dyke breake options



Thank you!

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ninabox2002@gmail.com

