



Workshop

Follow-up of the Joint Statement on Inland Navigation and Environmental Sustainability

Current state of IWT bottleneck projects in Danube Countries

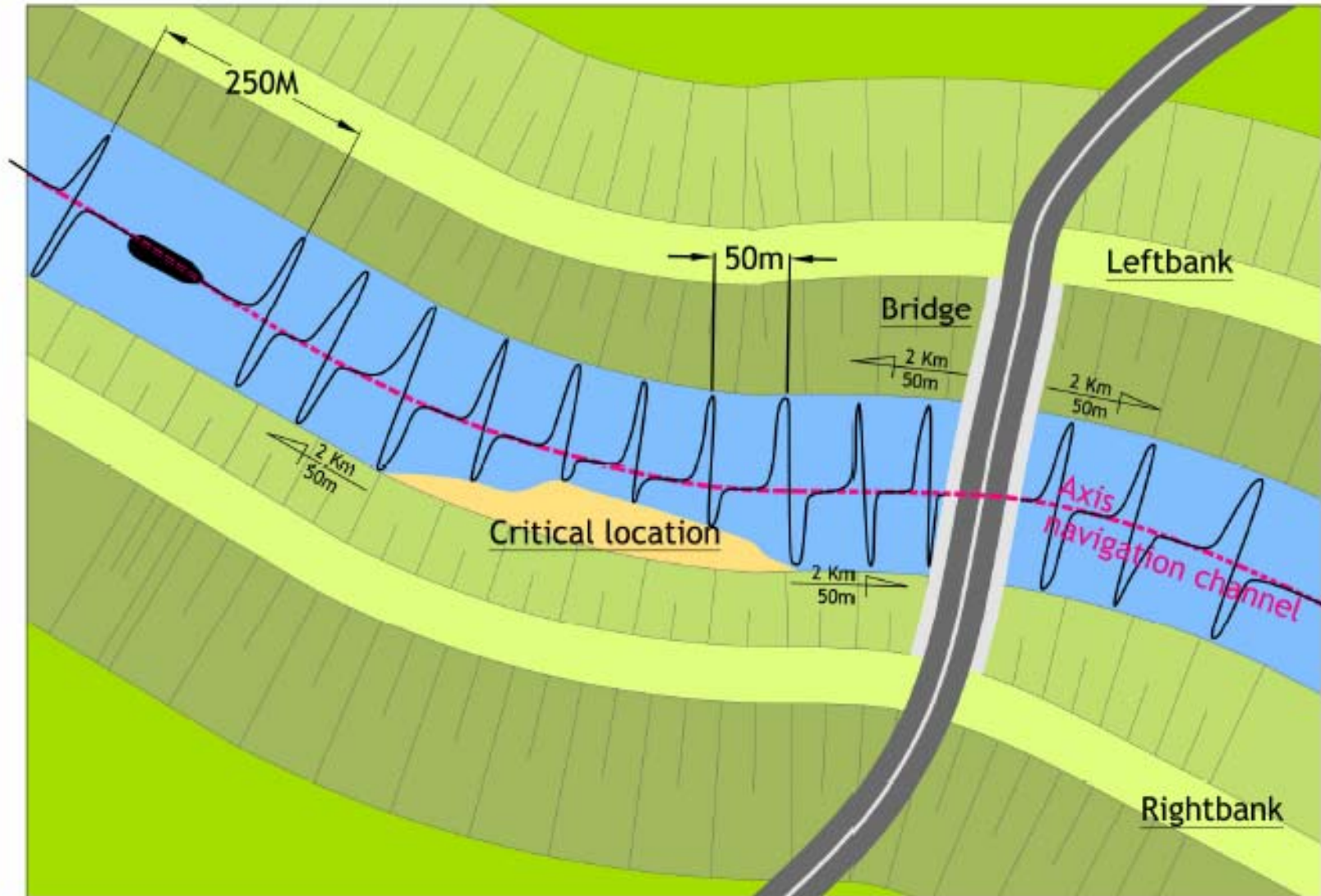
ISPA 2: Danube River between Iron Gate II (rkm863) and Calarasi (rkm375)

Contents

- Assessment of the actual situation
 - Field investigations (topo-bathymetry, hydrographic and sediment investigations, morphology and banks, climate change, ice, dredging, flooding)
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- Methodology followed during the study that is running at present
 - Traffic study
 - Numerical model
 - Environmental aspects
- Partial results
 - General principles of preliminary proposed strategies
 - Definition of scenarios
 - Alternative Development Strategies
- Conclusions

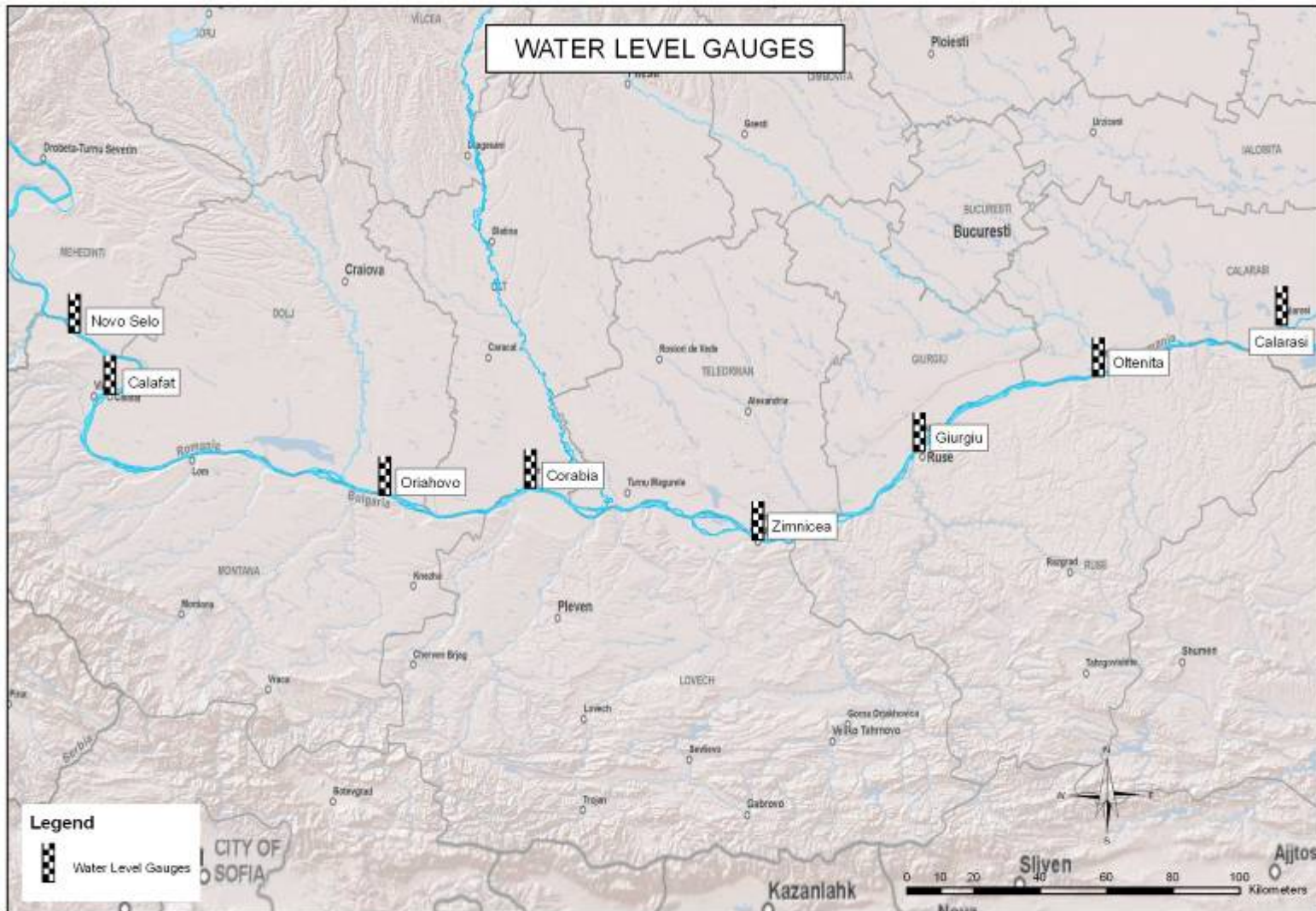


Field investigations. Topo-bathymetry survey 500km

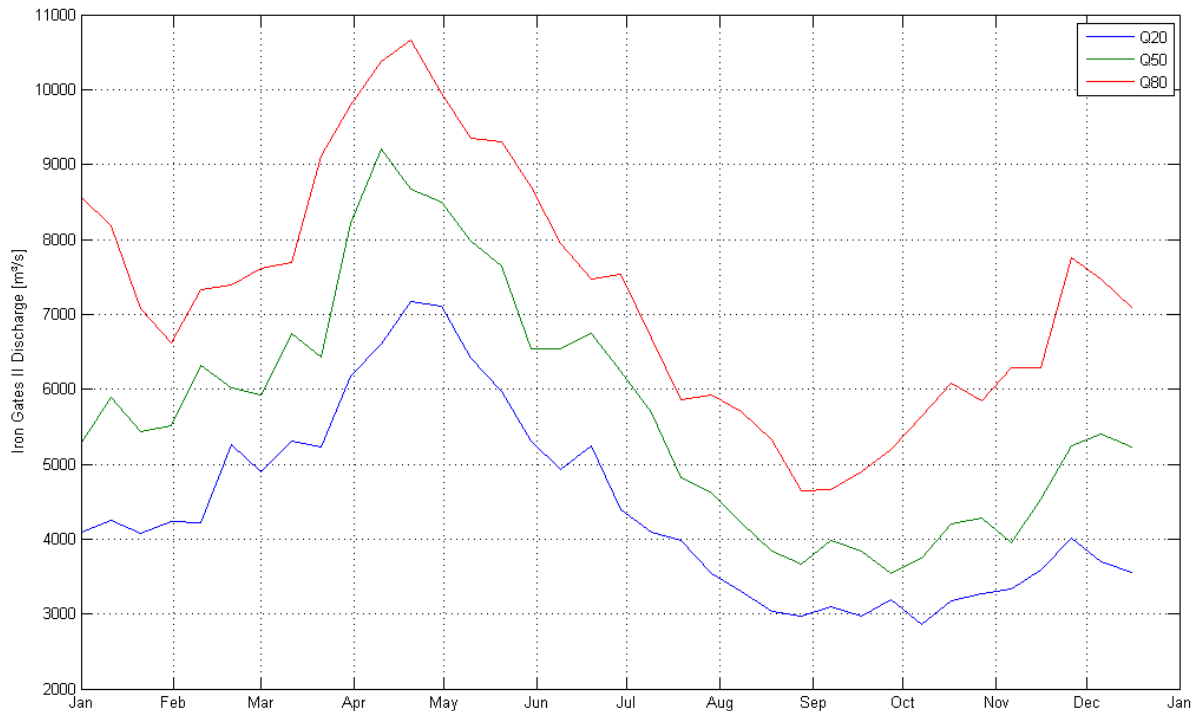




Field investigations. Hydrographic data



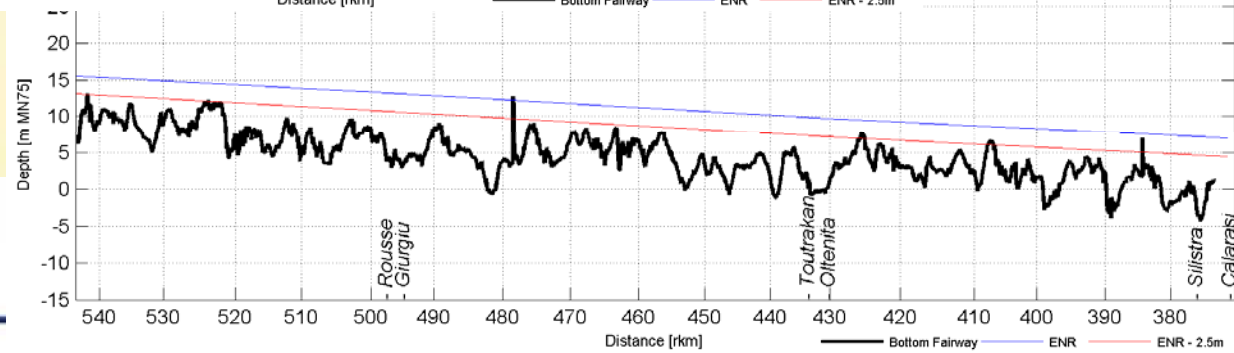
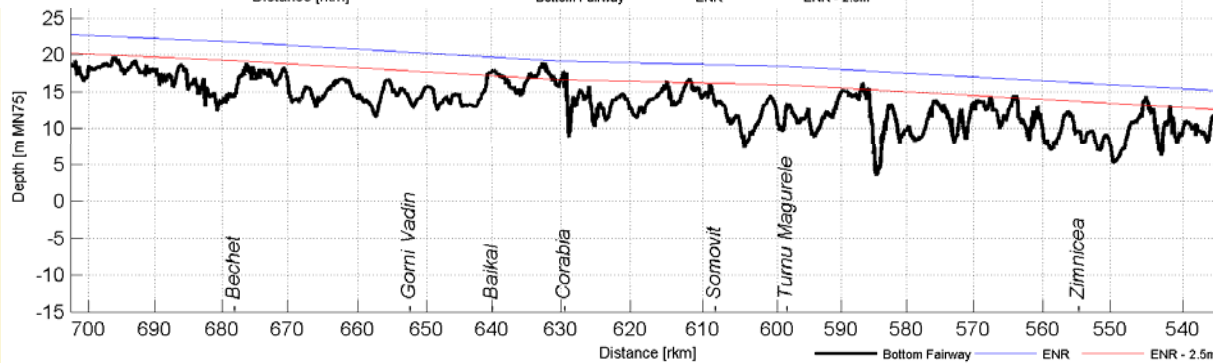
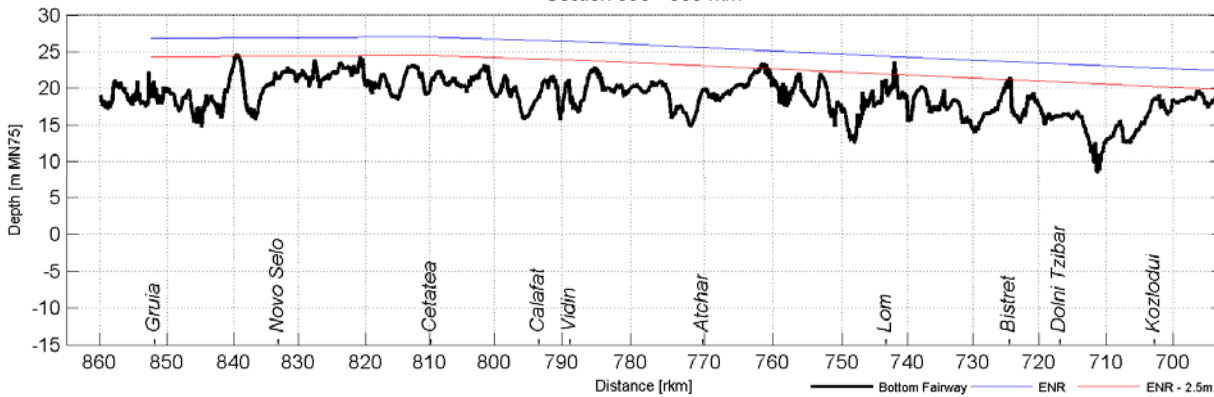
Field investigations. Hydrographic data



20, 50 and 80 percentile of 10-day-averaged discharge at Iron Gates II

Hydrographic data and bathymetry

Longitudinal profile of Danube fairway - New axis
Section 690 - 860 rkm



Workshop. ISPA 2 project
Budapest, January 29-30, 2009

Field investigations. Banks stability

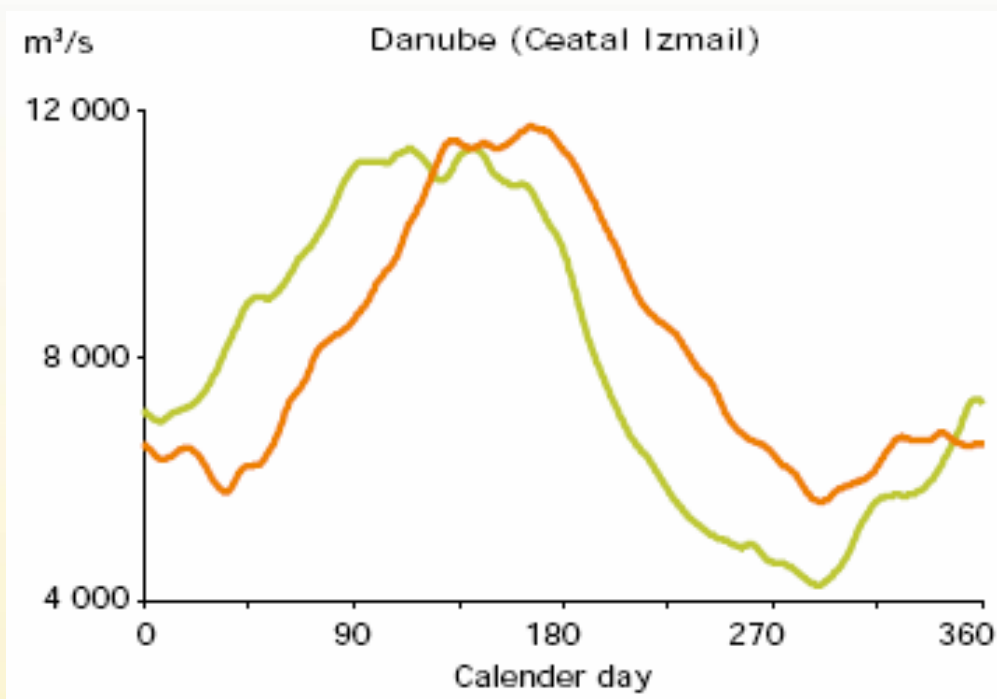


Erosion on the left bank, Romania
(e.g. rkm529)



Protected right bank, Bulgaria
(e.g. rkm536)

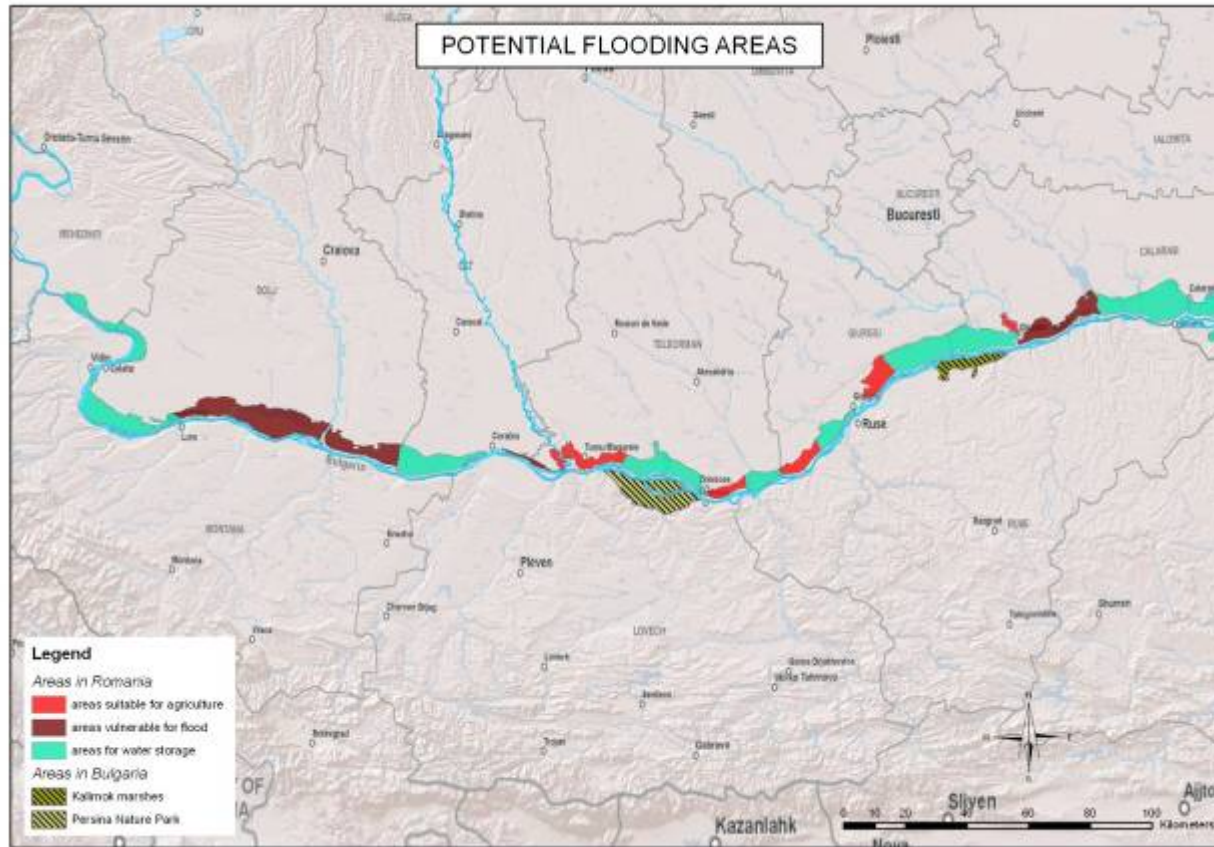
Field investigations. Climate change



Projected river flow
2071–2100 (green line) and
the observed river flow
1961–1990 (orange line).

(Source: Dankers and Feyen, 2008)

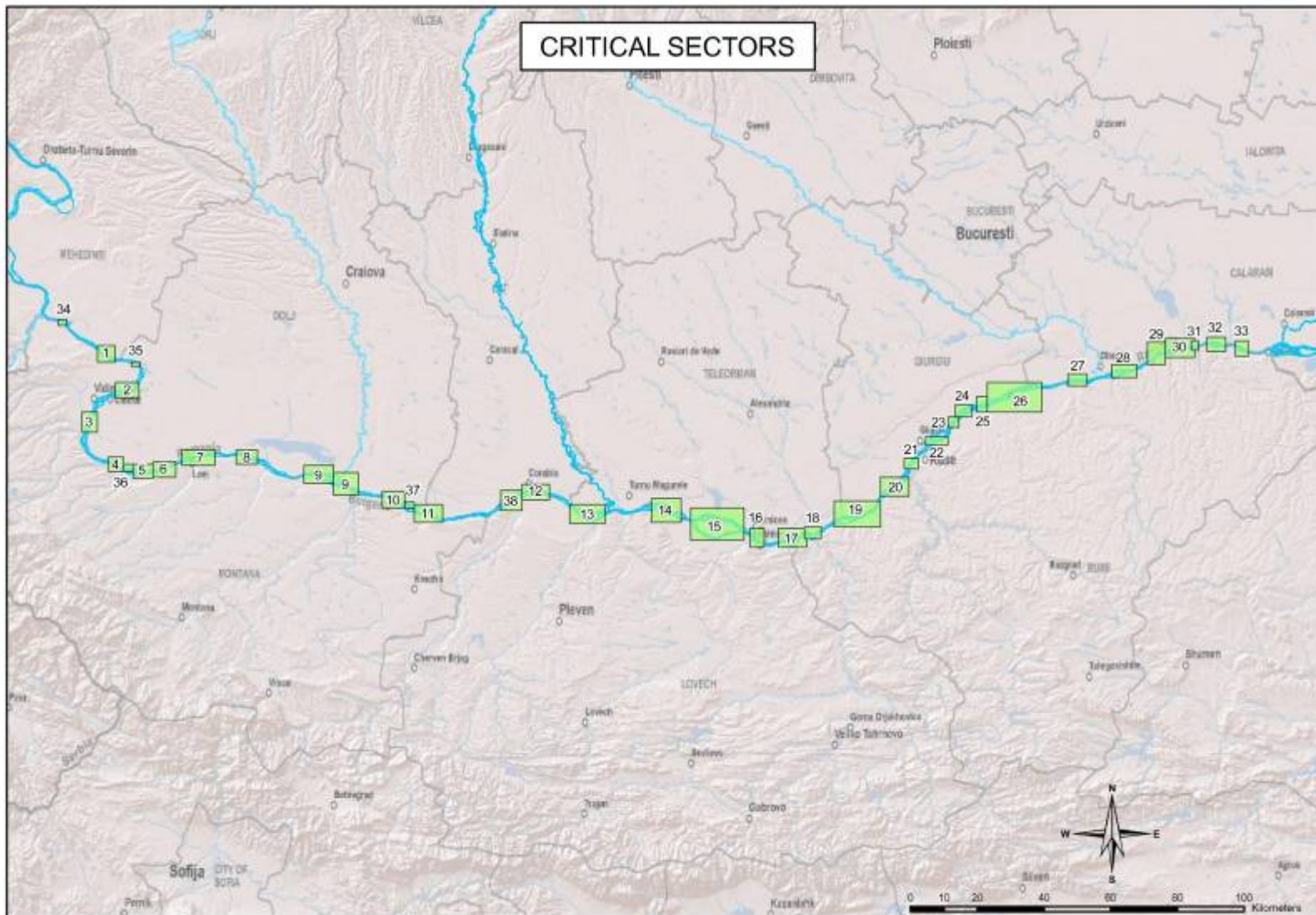
Field investigations. Flooding areas



Study of the floodplains and risk of floods in the Danube Basin in Romania prepared in 2007 by the Danube Delta National Institute for Research & Development for the Ministry of Environment and Sustainable Development. The study was conceived to give assistance to the Romanian Government for the definition of national long-term strategies for flood risk management . Within this study were taken into account 53 embanked areas that affect the Hydrogeomorphological system of the Danube River



List of navigational constraints





List of navigational constraints

Nr.	rkm	Location name	Critical sector at present
34	rKm 840-838		No
1	rKm 825-819	Salcia	Yes
35	rKm 813-811		No
2	rKm 804-797	Basarabi	Yes
3	rKm 787-781	Bogdan / Seceanu Island	Yes
4	rKm 768-764	Artchar	Yes
36	rKm 763-761		No
5	rKm 760-755	Pietrisul Island	Yes
6	rKm 760-755	Nebuna Island	Yes
7	rKm 745-735	Lom – Linovo Island	Yes
8	rKm 728-721	Archar Outlet - Alimanu	Yes
9	rkm 705+300-696	Kozlodui and Kopanita Islands	No
10	rKm 679-673	Carabulea: Bechet / Oriahovo	Yes
37	rKm 671-669		No
11	rKm 668-666	Ostrov	No
38	rKm 641-634		No
12	rKm 633 – 625	Corabia – Baloiu branch (Bulgarian)	Yes
13	rKm 615-607	Kalnovats	Yes
14	rKm 591 – 581+500	Lakat/ Paletz Island	Yes
15	rKm 577 - 560	Belene Island upstream	Yes
16	rKm 557 - 553	Zimnicea/Svistov	No
17	rKm 548 - 540	Vardim Island	Yes
18	rKm 540 - 536	Gaska – Vardim Island	Yes
19	rKm 530 - 515	Batin Island - Stilpiste	Yes
20	rKm 512 – 504	Kama and Dinu Islands	Yes
21	rKm 500 – 497	Slobozia	No
22	rKm 490 – 486+500	Giurgiu	Yes
23	rKm 481 – 478	Ostrovul Alek	No
24	rKm 477-473	Gostinu Island	No
25	rKm 470-467	Lungu Island	Yes
26	rKm 467-450	Mishka Island	No
27	rKm 441-435	Radetzki Island	No
28	rKm 426-420	Kosui	Yes
29	rKm 415-410	Albina	No
30	rKm 409-400	Popina	No
31	rKm 400-399	Varasti Island	Yes
32	rKm 395-390	Vetren	No
33	rKm 386-382	Chayka Island	No

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Traffic Study

Year	Traditional markets	IWW	Emerging markets	IWW	Total
2010	19.761		763		20.524
2015	24.125		1.317		25.442
2020	29.487		1.678		31.165
2025	33.579		2.035		35.614
2030	38.256		2.302		40.558

Traffic estimation on Section 1 (Iron Gate II-Calarasi) as a result of traditional and emerging IWW cargo categories.

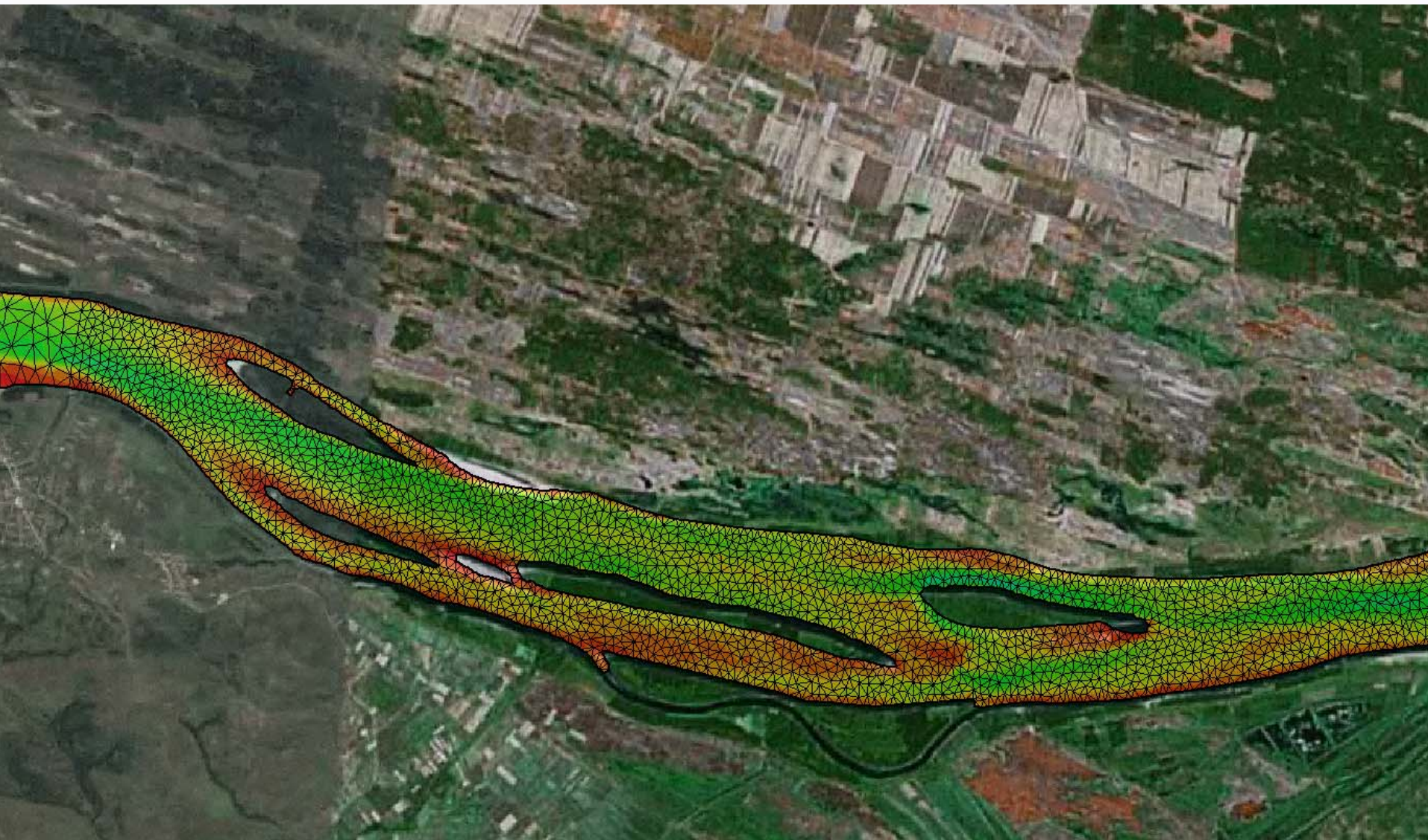
(Figures in thousand tonnes)

Numerical Model

- Finite element model
- RMA software
- 2D model
- 150,000 nodes
- 68,000 triangular elements
- Boundary conditions: upstream flow discharges Iron Gate II and downstream water levels Calarasi
- Calibration: extreme low water year (2003)
- Validation: extreme high water and change(2004)



Numerical model (model grid Artchar, rkm 768)



Environmental aspects

Legal framework:

- Danube River Protection Convention (29/06/1994)
- Council Directive 85/337 of 27 June 1985 «on the assessment of the effects of certain public and private projects on the environment»
- 79/409/EEC Bird Directive and 92/43/EC Art. 6 Habitat Directive: Natura 2000
- 2000/60/EC European Water Framework Directive

Environmental aspects

- Other important legislation and Conventions:
 - Joint Statement on Guiding Principles for the Development of Inland Navigation and Environmental Protection in the Danube River Basin
 - Bern Convention on protection of European Wildlife and natural habitats;
 - Ramsar convention on wetland protection;
 - Convention on Biological Diversity;
 - World Heritage Convention;
 - Belgrade Convention on free navigation on the Danube.

Environmental aspects

The study is on the way at present!

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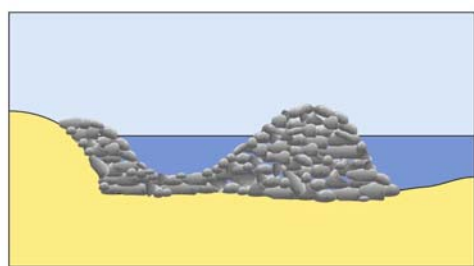
Type of measures

- Constriction of the river width
 - Groins/ Directional groins
 - Chevrons
 - Bottom sills
 - Bank protection
- Dredging



Groins

- Alternative groins with poor connection with the river bank

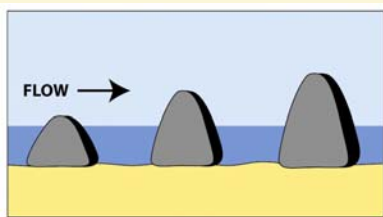
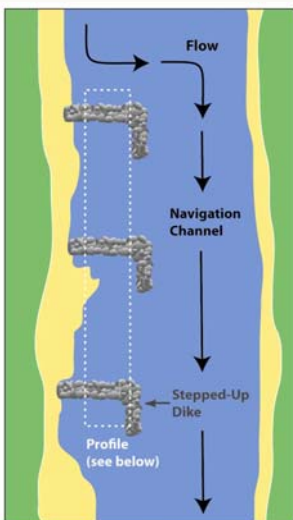


(Groins with off-bank protection Opijnen, The Netherlands)



Groins

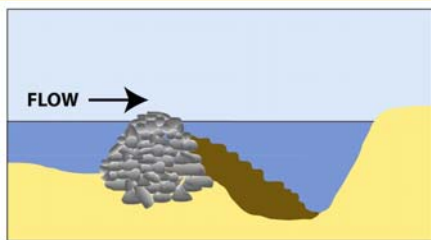
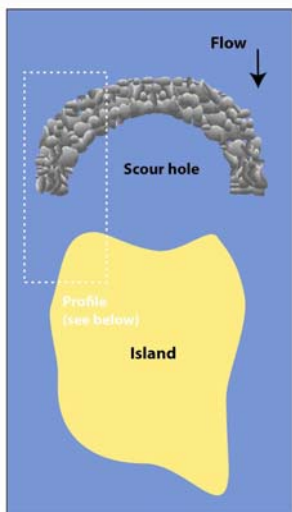
- Alternative L-shaped groins



(L-shaped groins with island creation St. Louis, USA)



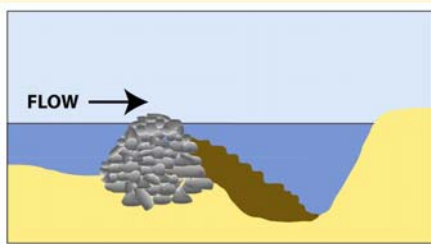
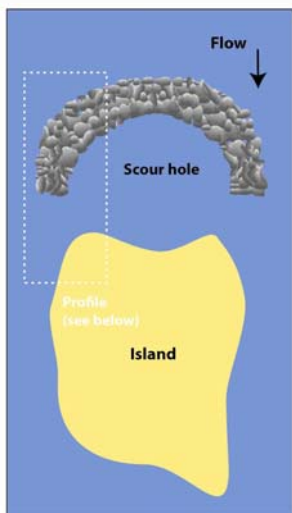
Chevrons



(Source: US Army Corps of Engineers)



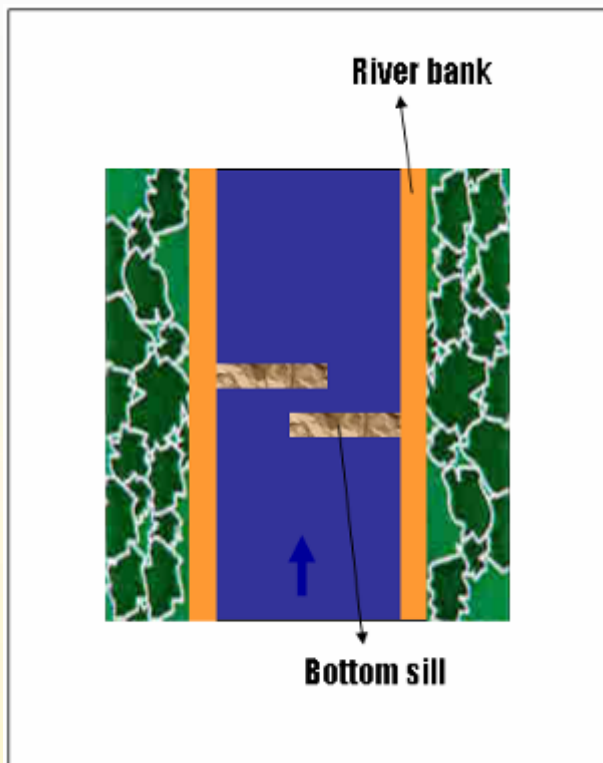
Chevrons



(Source: US Army Corps of Engineers)



Bottom sills



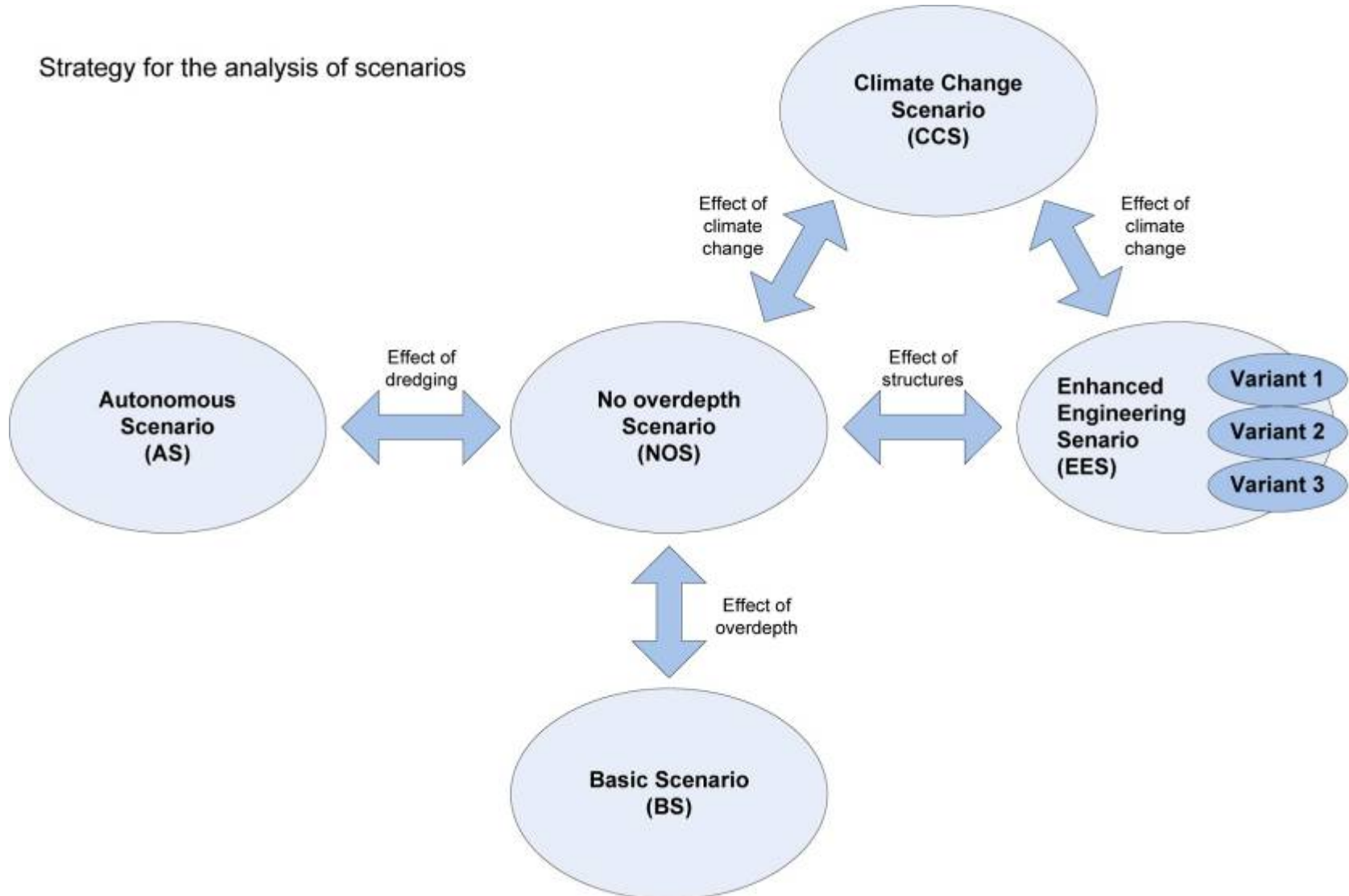
Two partial bottom sills

Type of measures

- Aspects to be taken into account during construction
 - Phasing of dredging taking into account fish spawning/migration
 - Phasing of larger training works to reduce environmental impact
 - Keep impact on deep areas as low as possible (spawning sites)
 - Dredging technique should be BATNEEC (Best Available Technology) in order to minimize environmental effects (e.g. turbidity)
 - Useful application of dredged material

Definition of scenarios

Strategy for the analysis of scenarios





Scenarios

- **Autonomous Scenario** (AS)
 - Present conditions
- **No Over-depth Scenario** (NOS)
 - ENR-2.5m and no over-depth of 0.50m
 - Capital dredging 0.9 million m³
- **Basic scenario** (BS)
 - ENR-2.5m and foresee an over-depth of 0.50m
 - Capital dredging 2.2 million m³

Scenarios

- **Enhanced Engineering Scenario (EES)**
 - ENR-2.5m and **NO OVERDEPTH** of 0.50m
 - Capital dredging 0.9 million m³
 - **3 Alternative** engineering measures (length, height and # str.).
- **Climate Change Scenario (ACC)**
 - ENR-2.5m and **NO OVERDEPTH** of 0.50m
 - Capital dredging 0.9 million m³
 - **Predicted boundary conditions for 2071-2100**

Fine-tuning critical sectors

- Present critical sector for navigation versus tendency to become critical sector in future
- Bottleneck solved with re-alignment navigation channel
- Bottleneck solved with only dredging
- Bottleneck solved with dredging + training works

Variants and categories

Critical sector	Name	rlm	Cat0	Cat1	Cat2		Cat3 variant 1		Cat3 variant 2		Cat3 variant 3	
					NS	S	NS	S	NS	S	NS	S
34		840-838			I							
1	Galca	825-819					I		I		I	
35		813-811	I									
2	Baraboi	804-797					I		I		I	
3	Bogdan / Gecanu Island	787-781					I		I		I	
4	Arldhar	768-764			I							
36	Arldhar	763-761			I							
5	Pietrusi Island	760-755					I		I		I	
6	Mebuna Island	754-748					I		I		I	
7	Lom - Unovo Island	745-735					I		I		I	I
8	Arhar Oulet - Alimanu	728-721					I		I		I	I
9	Kozloduzh / Kopanița Islands	705-687		I								
10	Carabulea: Beche / Orshovo	679-673					I		I		I	
37		671-669	I									
11	Ozirov	668-666		I								
38	Corabia - Balotu branch (Bulgarian)	641-634					I		I		I	I
12	Corabia - Balotu branch (Bulgarian)	633-625					I		I		I	I
13	Kalnazits	615-607					I		I		I	I
14	Lakal' Paleiz Island	591-581					I		I		I	I
15	Belene Island upstream	577-560					I		I		I	I
16	Zimnicea/Goltskov	557-553	I									
17	Vardim Island	548-540					I		I		I	I
18	Gaska - Vardim Island	540-536					I		I		I	I
19	Balin Island - Gijule	530-515					I		I		I	I
20	Kamian / Dnu Islands	512-504					I		I		I	I
21	Stobozia	500-497	I									
22	Giunglu	490-486			I							
23	Ozirovul Alek	481-478			I							
24	Gorlinu Island	477-473			I							
25	Lungu Island	470-467					I		I		I	
26	Mishka Island	467-450					I		I		I	
27	Radebki Island	441-435		I								
28	Kosul	429-420					I		I		I	
29	Albina	415-410		I								
30	Popina	409-400					I		I		I	
31	Varasii Island	400-399		I								
32	Veihen	395-390	I									
33	Chayka Island	386-382					I		I		I	
		Total	5	5	10	7	11	11	11	11	5	6

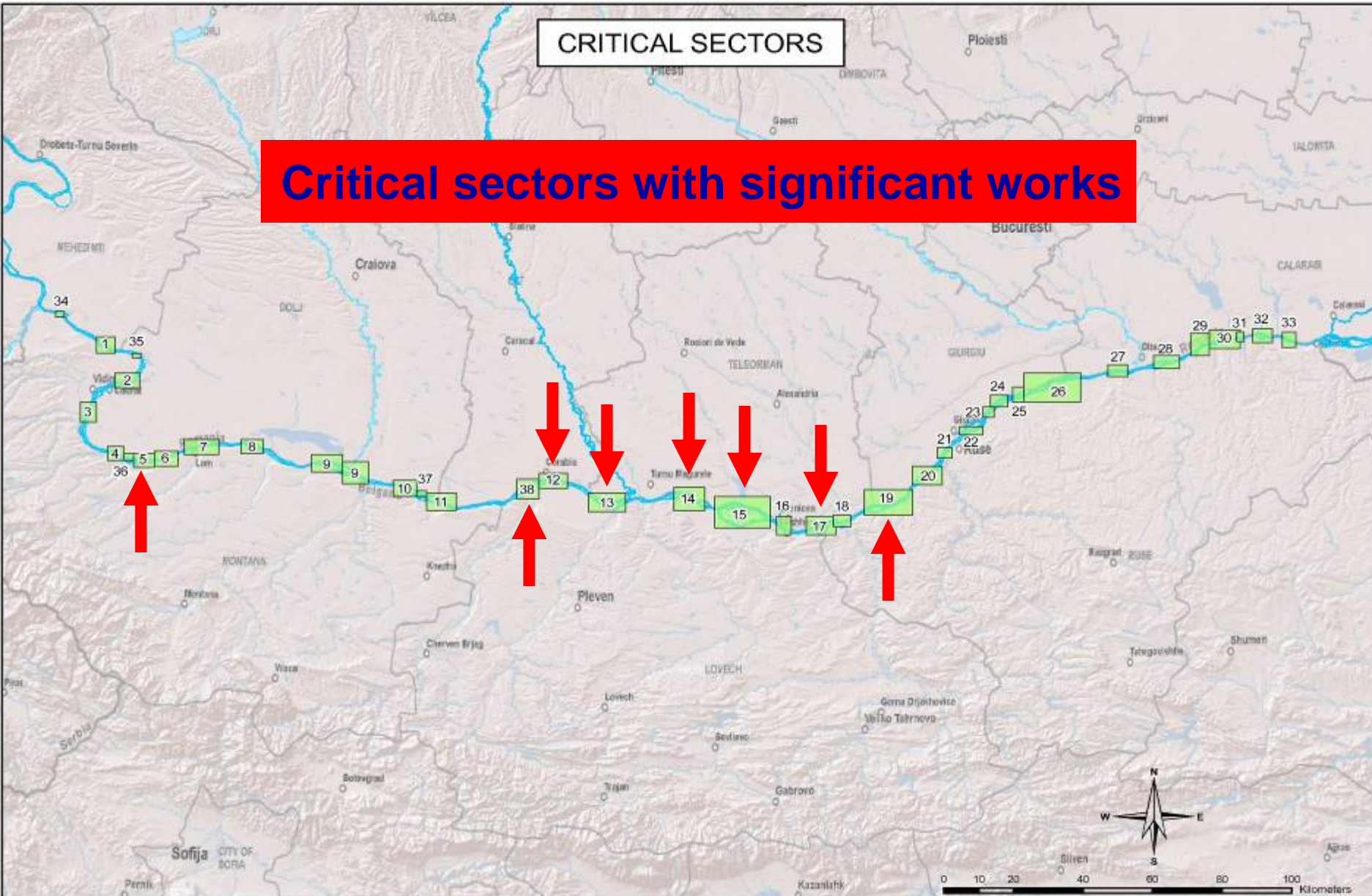
Cat 0	Nothing	
Cat 1	Realignment nav. Channel	
Cat 2 NS	Realignment nav. Channel	No significant dredging
Cat 2 S	Realignment nav. Channel	Significant dredging
Cat 3 NS	Realignment nav. Channel	No significant Engineering measures
Cat 3 S	Realignment nav. Channel	Significant Engineering measures
	No significant capital dredging	NS < 10000m ³
	Significant capital dredging	S >= 10000m ³

no measures so no actual variant 3 so assessment as in category 2
variant 3 with measures

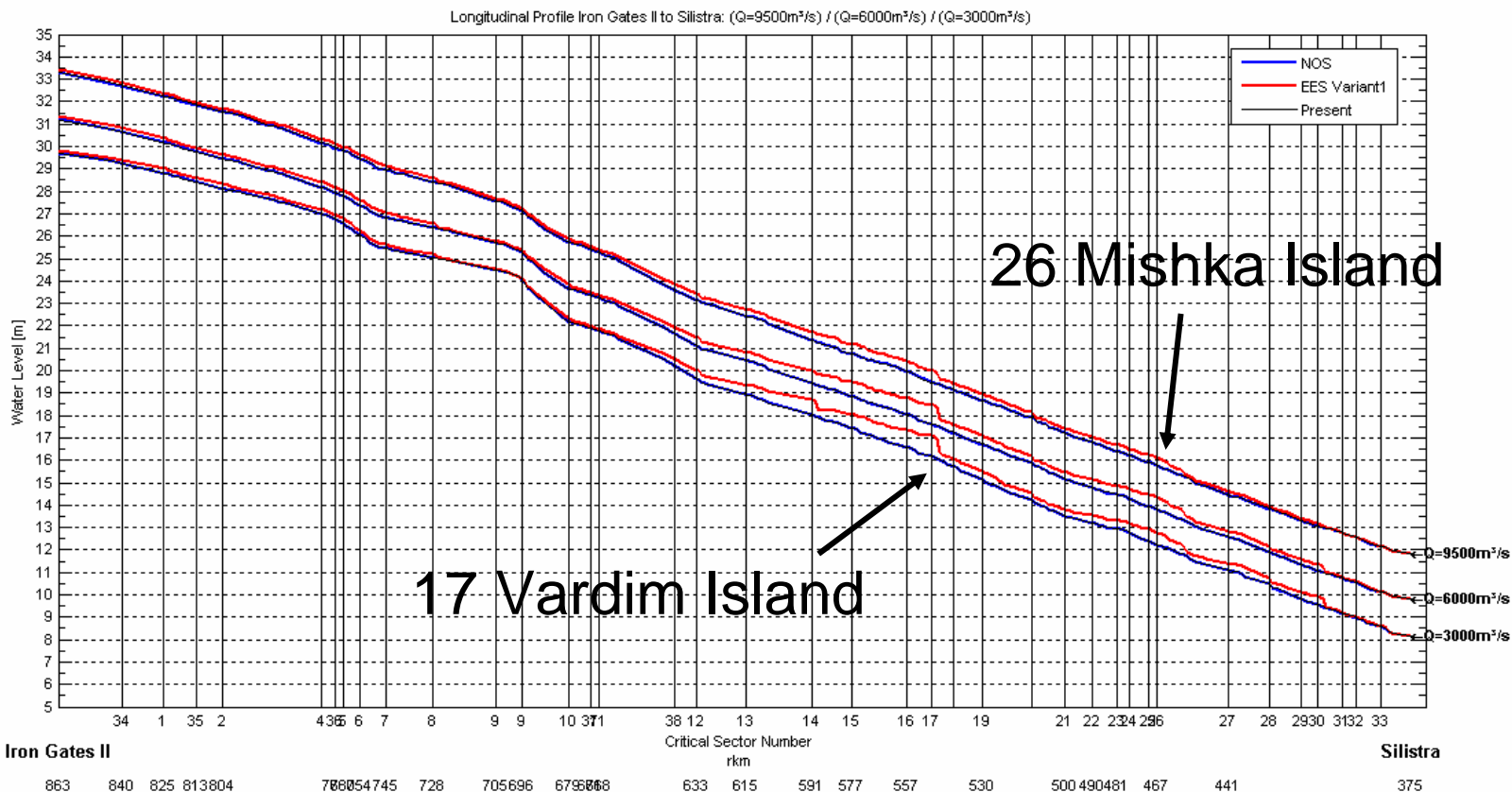
no variant 3 IT
maintenance dredging lower than 10000m³
or
measures of variant 1 and 2 did not improve maintenance dredging

CRITICAL SECTORS

Critical sectors with significant works

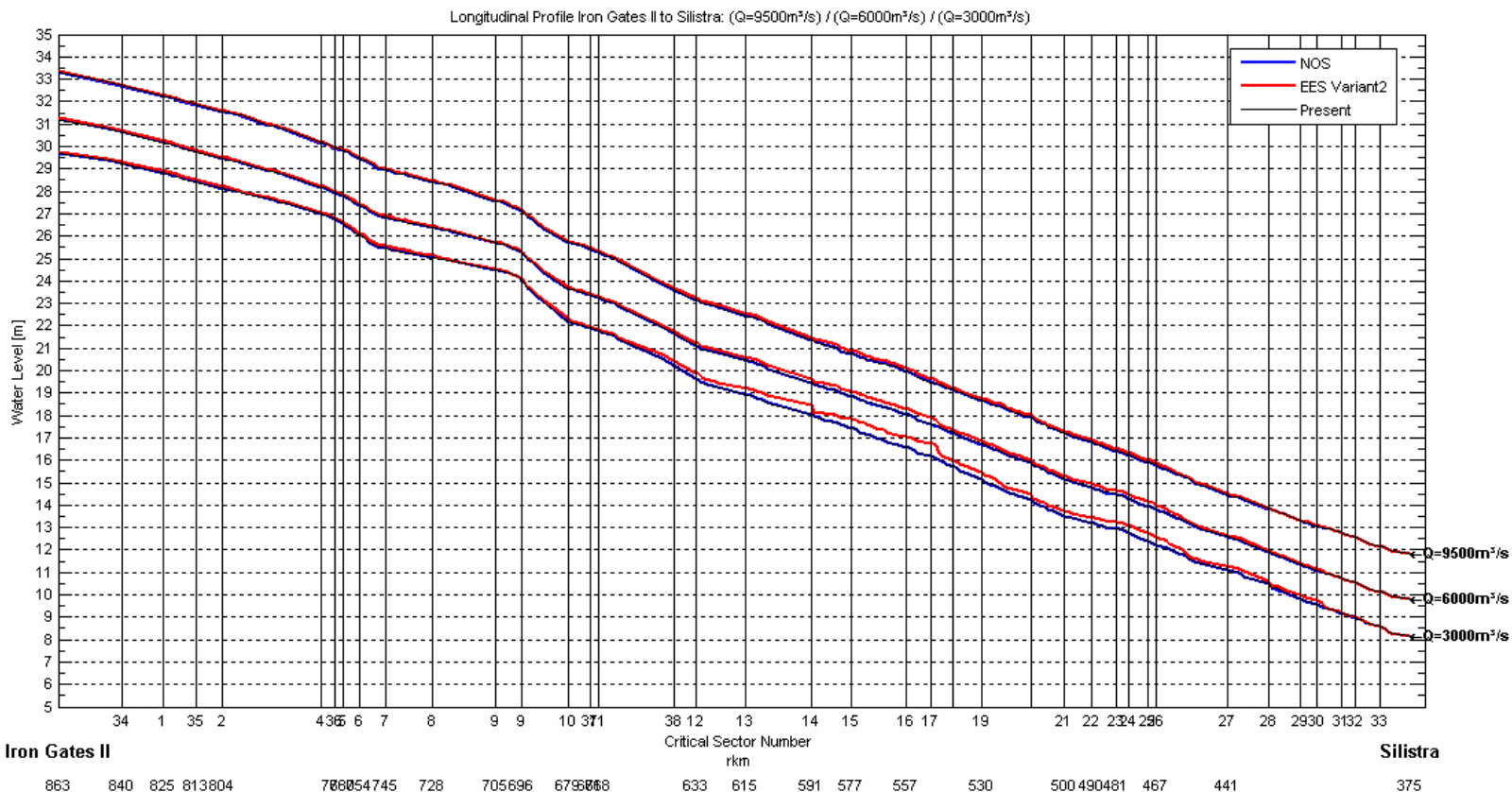


Effects on water levels. Variant 1

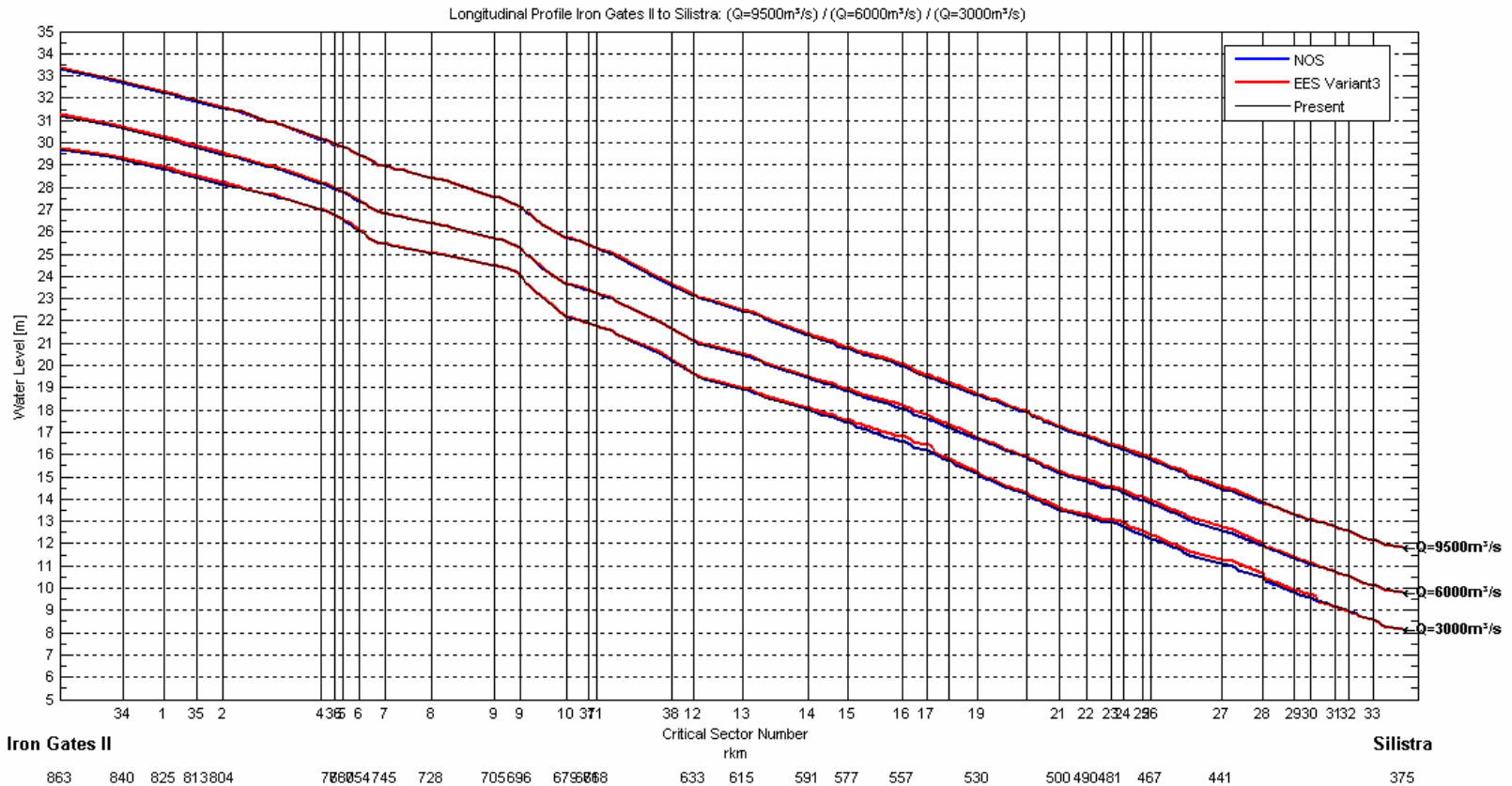




Effects on water levels. Variant 2



Effects on water levels. Variant 3



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Conclusions

- A technical study has been made using the latest information (bathymetry 2008) and the state-of-the-art techniques (numerical modelling, GIS).
- 38 critical sectors reported:
 - 5 sectors need no measures
 - 5 sectors need realignment of the navigation channel
 - 17 sectors need realignment + dredging
 - 11 sectors need realignment + dredging + measures
- The effect of the measures during high water levels periods is being studied at the moment taking into account the effect on other studies (i.e. study of floodplains Ministry of Environment).
- Several alternative development strategies are proposed for the improvement of the navigation conditions.
- Environmental friendly engineering measures are proposed.
- **The study is still ongoing and entered to the EIA phase.**