Data Collection, hydraulic and morphological modelling of the Danube River and the Sava River in the Republic of Serbia
Lot 1: Hydraulic and morphological modelling of the SRB-HRV common stretch of the Danube River

404-02-00086/2022-06

NAVIGATION BOTTLENECKS CATALOGUE

Version: **Final**
Date: 05 November 2024
Author: Nikola ROSIC
Approval: Marko JABLANOVIC

Content

Tables

Figures

Abbreviations

Abbr.	Meaning
1D	One dimensional (model, modeling)
2D	Two dimensional (model, modeling)
AD	*Akcionarsko društvo* (Joint-Stock Company)
AGN	European Agreement on Main Inland Waterways of International Importance
CA	Contracting Authority
CEF	Connecting Europe Facility
cm	centimeter
EIB	European Investment Bank
ENR	Etiage navigable et de régularisation
EU	European Union
HNQ	Discharge at high navigation level
HNWL	High Navigation Water Levels
HRV	Croatia
km	Kilometer
LNQ	Discharge at low navigation level
LNWL	Low Navigation Water Levels
m	Meter
m^3/s	Cubic meters per second
m.a.s.l.	Meters above sea level (Trieste/Adriatic See)
MoCTI	Ministry of Construction, Transport and Infrastructure
N/A	Not applicable
SRB	Serbia
TBR MDD	The Transboundary Biosphere Reserve Mura-Drava-Danube
WFD	Water Framework Directive

Introduction

The Contract "Data Collection, hydraulic and morphological modelling of the Danube River and the Sava River in the Republic of Serbia, Lot 1: Hydraulic and morphological modelling of the SRB-HRV common stretch of the Danube River" is financed by the European Union under the Connecting Europe Facility (CEF) Programme and the European Investment Bank, under the Finance Contract Serbian Inland Waterway Infrastructure between the European Investment Bank and the Republic of Serbia. The Contracting Authority (CA) is the Ministry of Construction, Transport and Infrastructure (MoCTI) of the Republic of Serbia. The service contract was concluded between the MoCTI and the Hidrozavod DTD AD Novi Sad (hereinafter referred to as the Consultant).

The overall objective of the project is to contribute to the creation of competitive transport system by the improvement of infrastructure alongside the Danube River, in accordance with the national policy and strategy provisions and with the respect of EU transport system development plans in order to ensure fast, safe, reliable and environmentally friendly transportation, smooth flow of freight and mobility of people. Integrated planning approach and inter-sectoral cooperation through the Stakeholders' Forum platform is planned throughout the process.

The Activity 2 of the Contract deals with the update of the bottlenecks catalogue and prioritization of bottlenecks in order to select sections of the SRB-HRV common stretch of the Danube River to be the subject of 2D modeling under the Activity 4 of the Contract, in order to analyze alternative solutions for improvement of navigations conditions during low water periods.

Chapter 1 of this report contains list of identified navigation bottlenecks on the SRB-HRV common stretch of the Danube River, while Chapter 2 provides details on identified navigation bottlenecks.

1. List of identified navigation bottlenecks

Based on the results of the 1D modeling report, including the Hydrological Study, the Consultant calculated new reference water levels (Etiage navigable et de régularisation – ENR, or Low Navigation Water Levels - LNWL) for the entire project area (SRB-HRV common stretch of the Danube River). After application of the official designed fairway axis (provided by the CA), the Consultant applied designed 2.5m depth and different widths of the fairway (100m, 120m, 150m, and 200m, in line with the Level of Service approach) to calculate the volume of sediment within the fairway in the critical sectors. The Level of Service approach is related to different quality levels of services which waterway administrations are providing to waterways users, in this case in the terns of available fairway parameters (the higher values of fairways parameters provided corresponds to the higher level of services, and vice versa). The Consultant applied those different fairway parameters throughout the project area (the common SRB-HRV stretch of the Danube River). Additionally, the Consultant used historical hydrographic data provided by the Contracting Authority, to add additional perspective on the characteristics of historical morphological development of those sectors. List of analyzed navigation bottlenecks, as stretches of the Danube River with potentially limited fairway parameters during low water periods, is presented in the Table 1.

Table 1: List of Analyzed navigation bottlenecks

No.	Sector	Chainage (from km to km)	Quantity of sediment (m^3) within fairway of 2.5m depth &			
			Width 100m	Width 120m	Width 150m	Width 200m
1	Bezdan / Batina	1,429.0 – 1,425.0	0	0	0	4,745
2	Siga Kazuk	1,424.2 – 1,414.4	0	0	0	1,106
3	Apatin	1,408.2 – 1,400.0	7,035	14,635	26,821	54,311
4	Civutski Rukavac / Zidovski Rukavac	1,397.2 – 1,389.0	343	1,494	8,164	52,977
5	Drava Confluence	1,388.8 – 1,382.0	0	441	4,221	22,013
6	Aljmas	1,381.4 – 1,378.2	0	0	0	0
7	Staklar	1,376.8 – 1,373.4	733	1,571	3,823	14,781
8	Erdut	1,371.4 – 1,366.4	0	0	0	0
9	Bogojevo	1,366.2 – 1,361.4	0	0	0	330
10	Dalj	1,357.0 – 1,351.0	0	0	0	344
11	Borovo 1	1,348.6 – 1,343.6	0	415	5,431	26,555
12	Borovo 2	1,340.6 – 1,338.0	0	346	6,863	40,353
13	Vukovar	1,332.0 – 1,325.0	0	0	0	2
14	Sotin	1,324.0 – 1,320.0	0	0	0	85
15	Opatovac	1,315.4 – 1,314.6	0	0	0	37
16	Mohovo	1,311.4 – 1,307.6	93	177	368	748
17	Backa Palanka / Ilok	1,302.0 – 1,300.0	0	0	0	0

Figure 1: Analyzed navigation bottlenecks

Compared to the existing list of bottlenecks identified by the SRB and HRV authorities a decade ago, the updated list of bottlenecks contains 13 sectors. This means that 4 sectors from the previous list —**Aljmaš**, **Erdut**, **Vukovar**, and **Ilok**— are no longer considered critical for navigation, as the full fairway parameters are now available. The updated list of navigation bottlenecks is presented in the Table 2.

Table 2: Updated list of navigation bottlenecks

No.	Sector	Chainage (from km to km)	Quantity of sediment within the fairway of 2.5m depth &			
			Width 100m	Width 120m	Width 150m	Width 200m
1	Batina/Bezdan	1,429.0 – 1,425.0	0	0	0	4,745
2	Siga Kazuk	1,424.2 – 1,414.4	0	0	0	1,106
3	Apatin	1,408.2 – 1,400.0	7,035	14,635	26,821	54,311
4	Židovski/Čivutski Rukavac	1,397.2 – 1,389.0	343	1,494	8,164	52,977
5	Drava Confluence	1,388.8 – 1,382.0	0	441	4,221	22,013
7	Staklar	1,376.8 – 1,373.4	733	1,571	3,823	14,781
9	Bogojevo	1,366.2 – 1,361.4	0	0	0	330
10	Dalj	1,357.0 – 1,351.0	0	0	0	344
11	Borovo 1	1,348.6 – 1,343.6	0	415	5,431	26,555
12	Borovo 2	1,340.6 – 1,338.0	0	346	6,863	40,353
14	Sotin	1,324.0 – 1,320.0	0	0	0	85
15	Opatovac	1,315.4 – 1,314.6	0	0	0	37
16	Mohovo	1,311.4 – 1,307.6	93	177	368	748

For the sake of traceability, the Consultant preserved the numbering established by the SBR and HRV authorities in all tables throughout this and other reports.

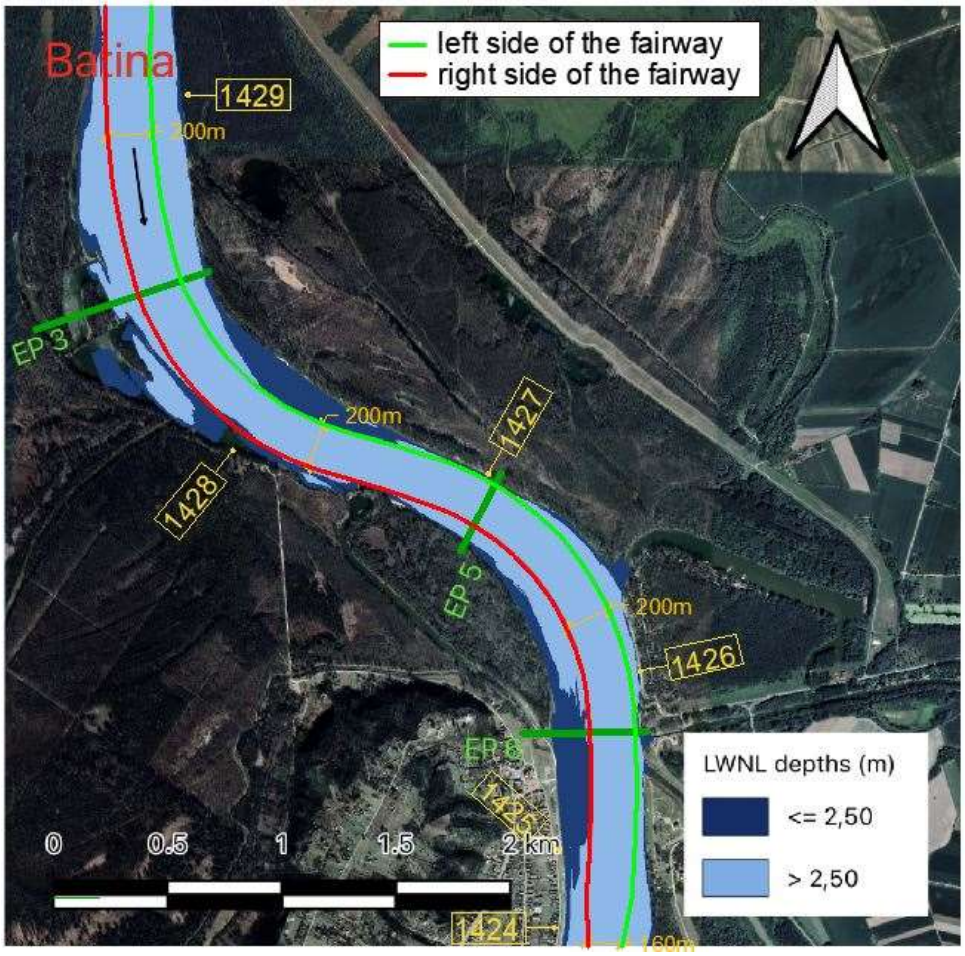
2. Details on the identified navigation bottlenecks

For the purpose of uniform presentation of the characteristics of the identified bottlenecks, the Consultant has prepared a template containing basic location information, visualization of the bottlenecks, information on navigation obstacles and imitations, historical information (in the sense if the location is known as the navigation bottleneck from before, or the location is newly identified navigation bottleneck), as well as basic ecological and hydrological information.

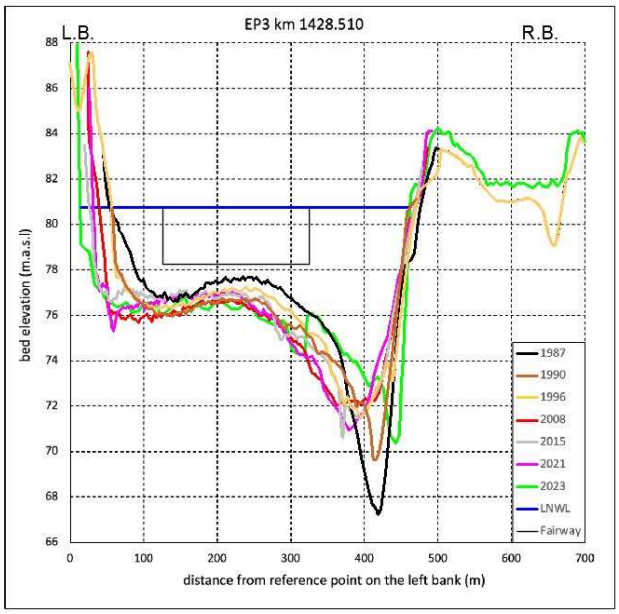
2.1. Bezdan

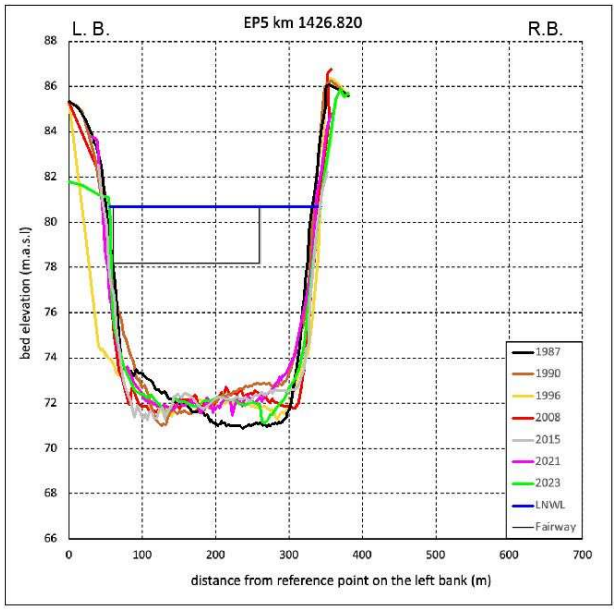
Basic location info			
Name of the bottleneck	**Bezdan**	Alternative name	**Batina**
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,429.00	To (km downstream)	1,425.00
Total length (km)	4,00	River bed	sand

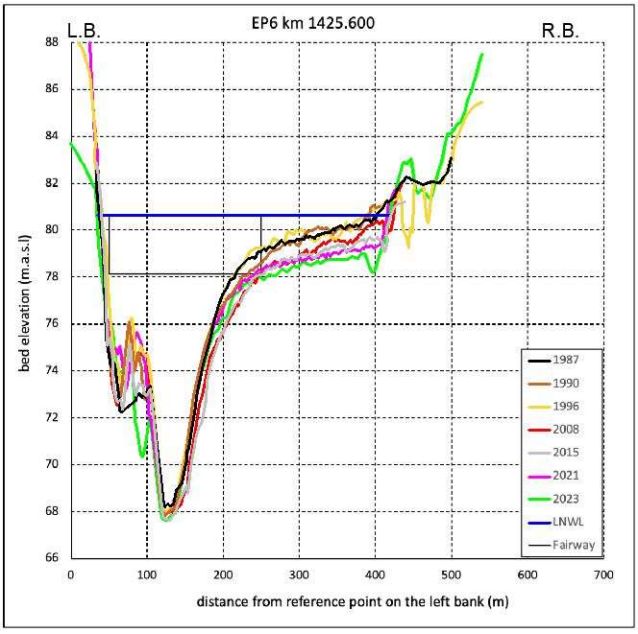
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube north from Kopacki rit (HR2001309) Natura 2000 site - Special Nature Reserve Gornje Podunavlje - Gornje Podunavlje (RS000001) Emerald site				

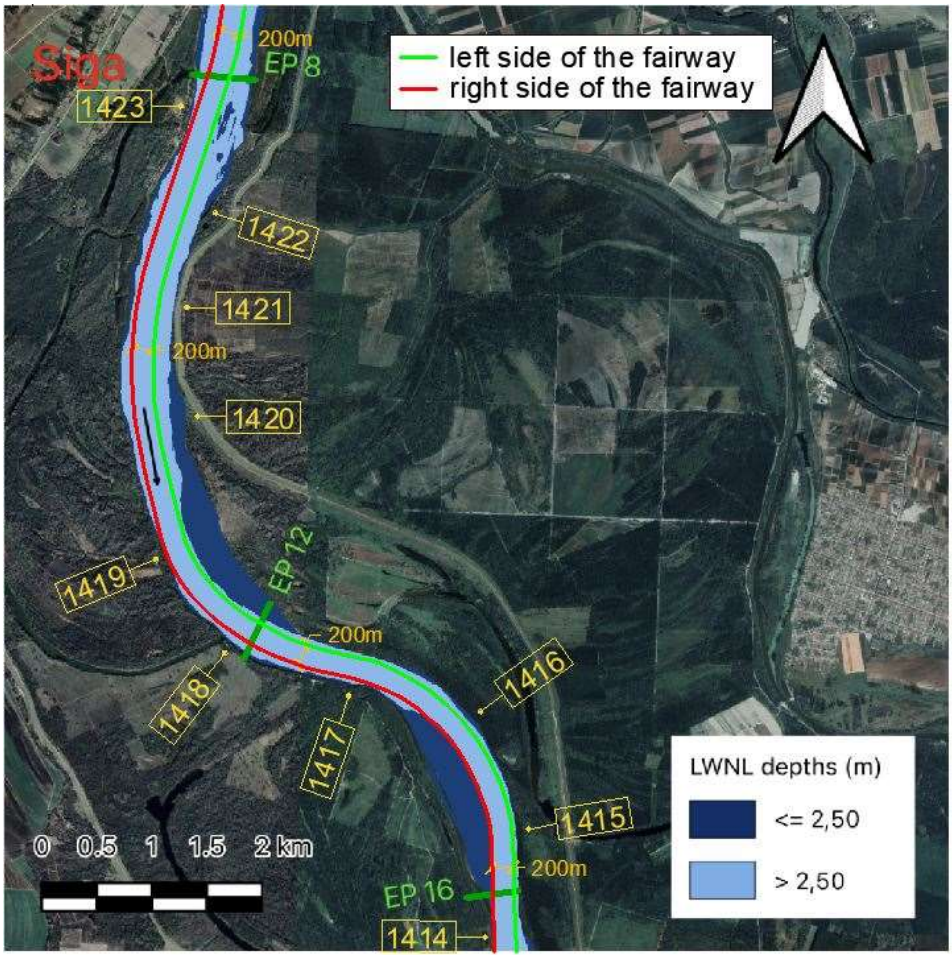
Basic hydrological information				
Name of the reference gauging station			Bezdan	
Year of the establishment of the gauging station			1856	
Location of the gauging station			km 1.425,59	
Distance to the (center of the) bottleneck			1.41 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*80.54 m.a.s.l.*	*-10 cm*	*LNQ*	*1.180 m^3/s*
HNWL	*86.66 m.a.s.l.*	*602 cm*	*HNQ*	*5.280 m^3/s*
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	80.63 m.a.s.l.	-1 cm	LNQ	1.344 m^3/s
HNWL	86.13 m.a.s.l.	549 cm	HNQ	4.920 m^3/s
Name of the reference gauging station			Batina	
Year of the establishment of the gauging station			2001	
Location of the gauging station			km 1.424,60	
Distance to the (center of the) bottleneck			2.40 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*80.53 m.a.s.l.*	*8 cm*	*LNQ*	*1.180 m^3/s*
HNWL	*86.60 m.a.s.l.*	*615 cm*	*HNQ*	*5.280 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	80.62 m.a.s.l.	17 cm	LNQ	1.349 m^3/s
HNWL	85.96 m.a.s.l.	551 cm	HNQ	4.940 m^3/s

Note: m.a.s.l. here and elsewhere in the document is with reference to the Trieste zero.

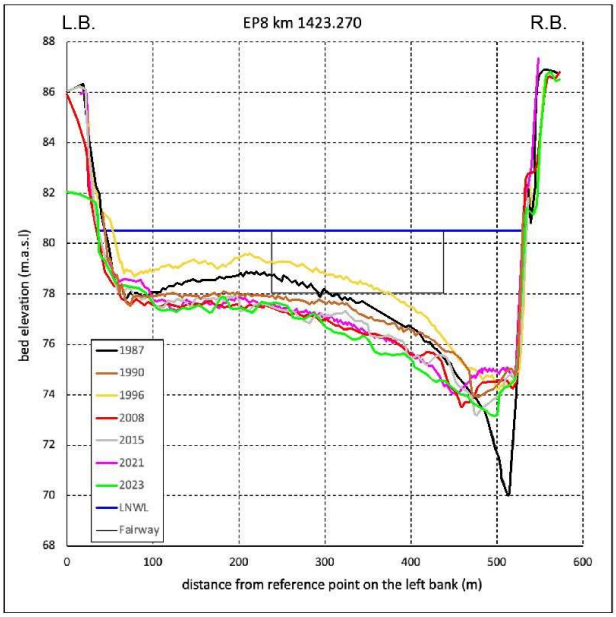
2.2. Siga Kazuk

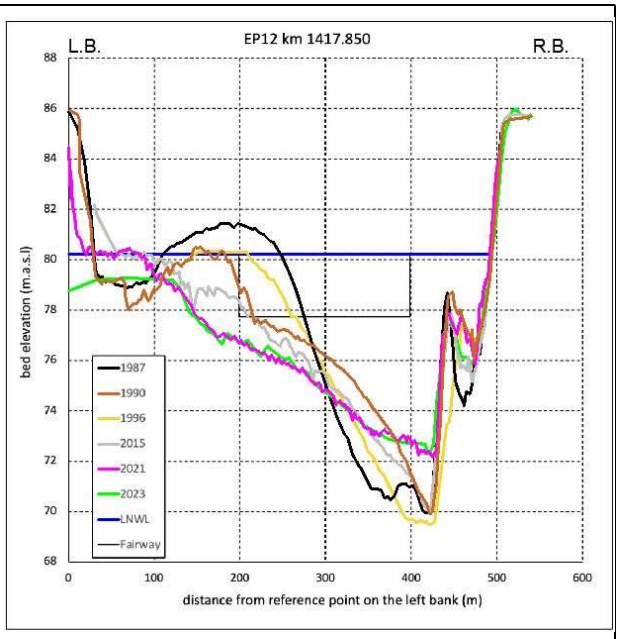
Basic location info			
Name of the bottleneck	**Siga Kazuk**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,424.20	To (km downstream)	1,414.40
Total length (km)	9,80	River bed	sand

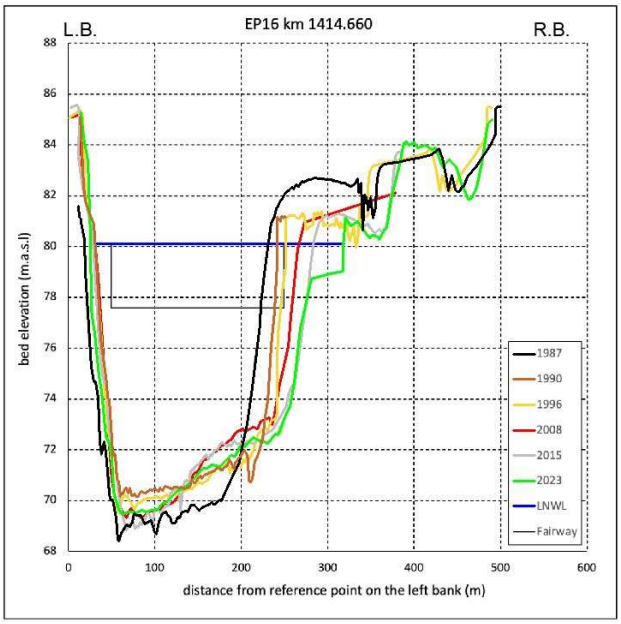
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube north from Kopacki rit (HR2001309) Natura 2000 site - Special Nature Reserve Gornje Podunavlje - Gornje Podunavlje (RS000001) Emerald site				

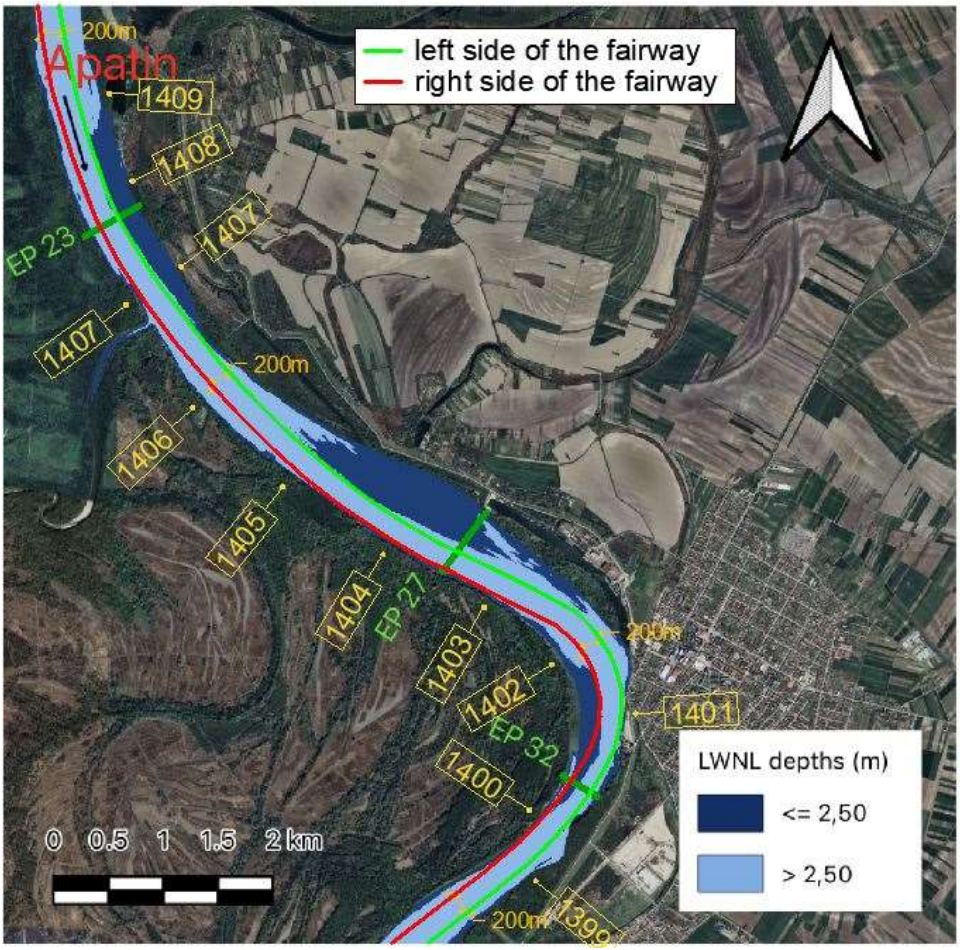
Basic hydrological information				
Name of the reference gauging station			Bezdan	
Year of the establishment of the gauging station			1856	
Location of the gauging station			km 1.425,59	
Distance to the (center of the) bottleneck			6.29 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	80.54 m.a.s.l.	-10 cm	LNQ	1.180 m^3/s
HNWL	86.66 m.a.s.l.	602 cm	HNQ	5.280 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	80.63 m.a.s.l.	-1 cm	LNQ	1.344 m^3/s
HNWL	86.13 m.a.s.l.	549 cm	HNQ	4.920 m^3/s

Name of the reference gauging station			Batina	
Year of the establishment of the gauging station			2001	
Location of the gauging station			km 1.424,60	
Distance to the (center of the) bottleneck			5.30 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*80.53 m.a.s.l.*	*8 cm*	*LNQ*	*1.180 m^3/s*
HNWL	*86.60 m.a.s.l.*	*615 cm*	*HNQ*	*5.280 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	80.62 m.a.s.l.	17 cm	LNQ	1.349 m^3/s
HNWL	85.96 m.a.s.l.	551 cm	HNQ	4.940 m^3/s

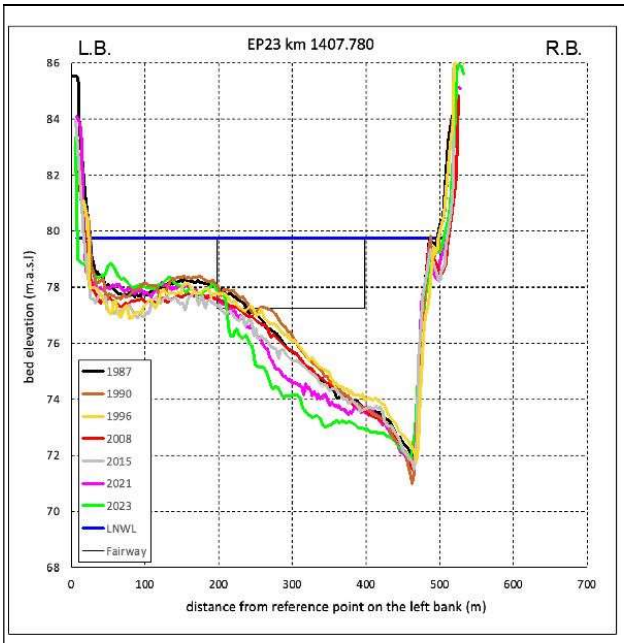
2.3. Apatin

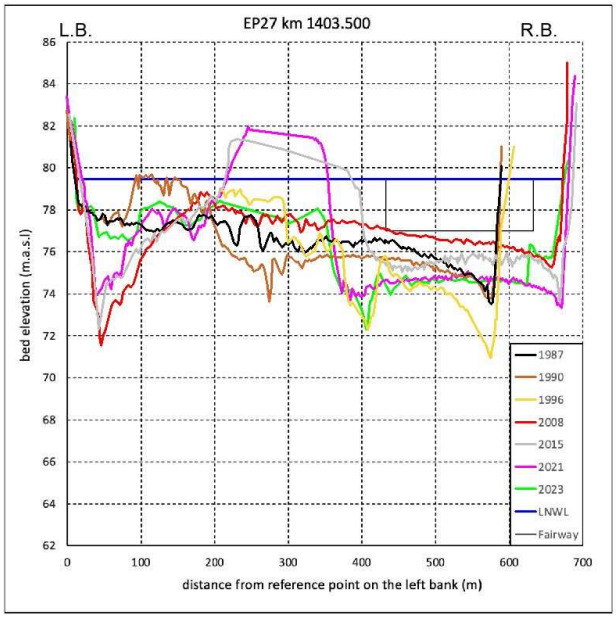
Basic location info			
Name of the bottleneck	**Apatin**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,408.20	To (km downstream)	1,400.00
Total length (km)	8,20	River bed	sand

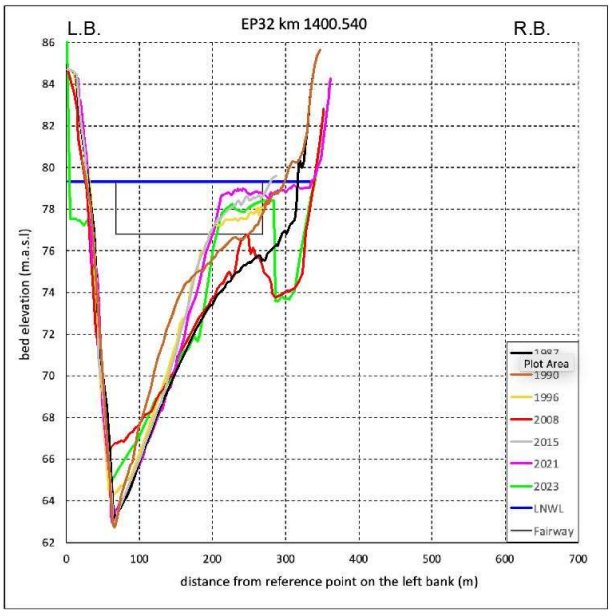
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☒ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Special Nature Reserve Gornje Podunavlje - Kopacki Rit Nature Park - Kopacki rit (HR2000394) Natura 2000 site				

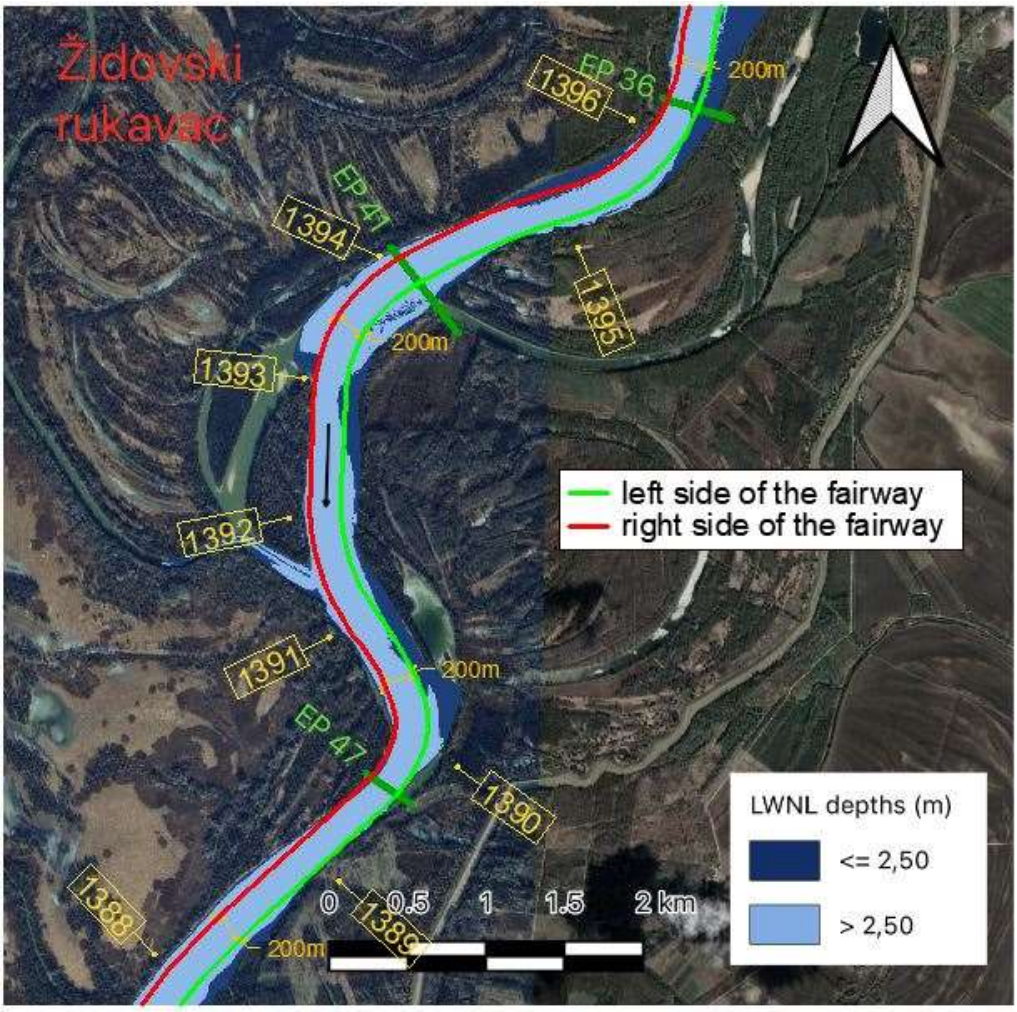
Basic hydrological information				
Name of the reference gauging station			Apatin	
Year of the establishment of the gauging station			1876	
Location of the gauging station			km 1.401,90	
Distance to the (center of the) bottleneck			2.20 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	79.31 m.a.s.l.	47 cm	LNQ	1.180 m^3/s
HNWL	85.58 m.a.s.l.	674 cm	HNQ	5.280 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	N/A	N/A	LNQ	N/A
HNWL	N/A	N/A	HNQ	N/A

Name of the reference gauging station			Batina	
Year of the establishment of the gauging station			2001	
Location of the gauging station			km 1.424,60	
Distance to the (center of the) bottleneck			20.50 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*80.53 m.a.s.l.*	*8 cm*	*LNQ*	*1.180 m^3/s*
HNWL	*86.60 m.a.s.l.*	*615 cm*	*HNQ*	*5.280 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	80.62 m.a.s.l.	17 cm	LNQ	1.349 m^3/s
HNWL	85.96 m.a.s.l.	551 cm	HNQ	4.940 m^3/s

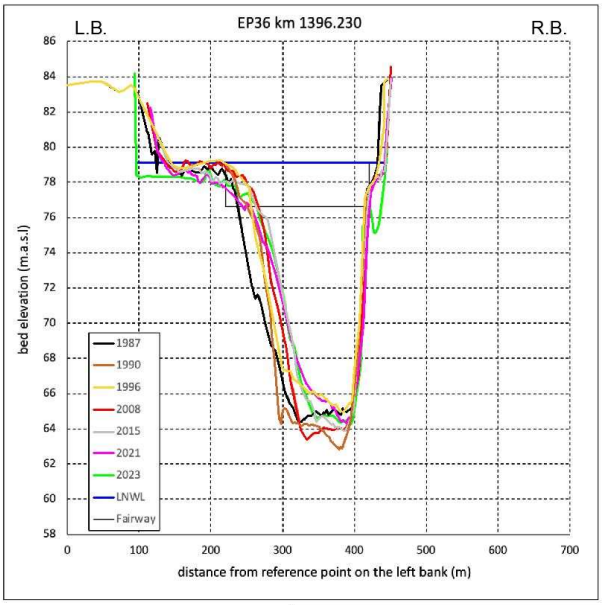
2.4. Civutski Rukavac

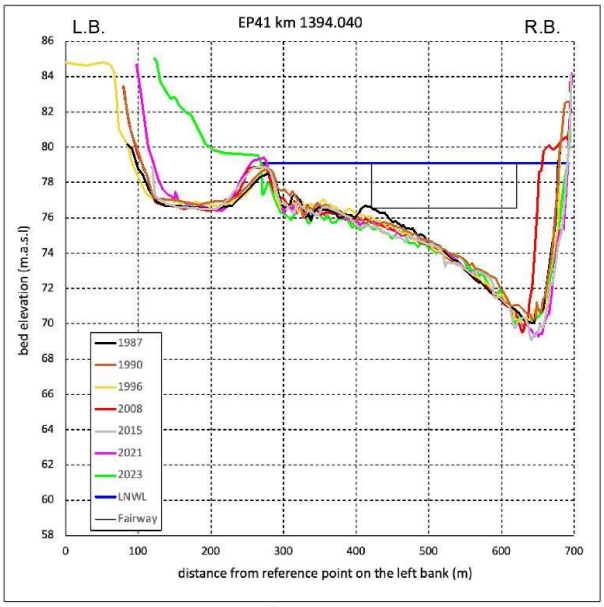
Basic location info			
Name of the bottleneck	**Civutski Rukavac**	Alternative name	**Zidovski Rukavac**
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,397.2	To (km downstream)	1,389.0
Total length (km)	8,20	River bed	sand

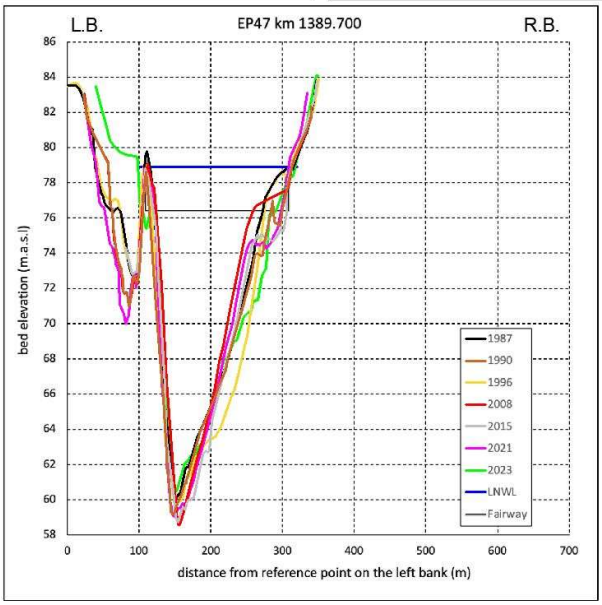
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☒ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information

Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Special Nature Reserve Gornje Podunavlje - Kopacki Rit Nature Park - Kopacki rit (HR2000394) Natura 2000 site - Gornje Podunavlje (RS000001) Emerald site				

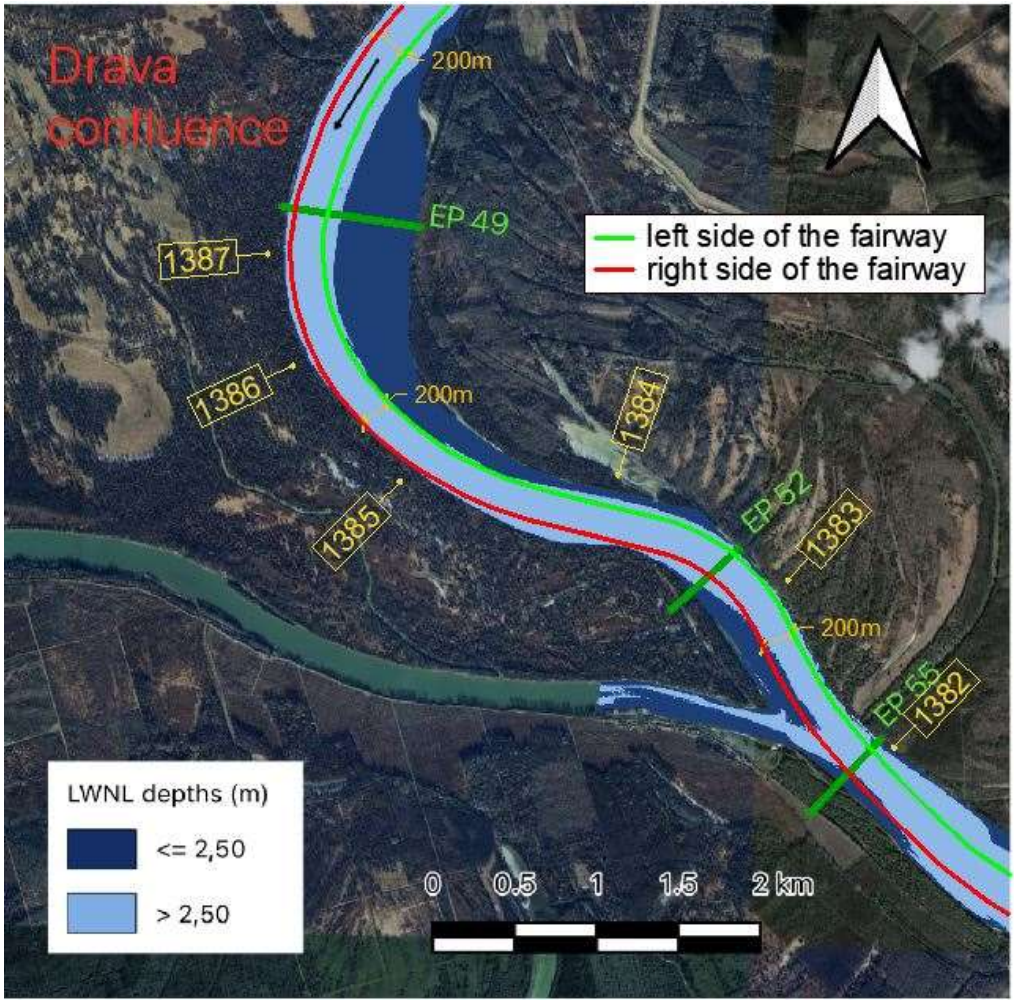
Basic hydrological information				
Name of the reference gauging station			Apatin	
Year of the establishment of the gauging station			1876	
Location of the gauging station			km 1.401,90	
Distance to the (center of the) bottleneck			8.80 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	79.31 m.a.s.l.	47 cm	LNQ	1.180 m^3/s
HNWL	85.58 m.a.s.l.	674 cm	HNQ	5.280 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	N/A	N/A	LNQ	N/A
HNWL	N/A	N/A	HNQ	N/A

Name of the reference gauging station			Aljmas	
Year of the establishment of the gauging station			1909	
Location of the gauging station			km 1.380,25	
Distance to the (center of the) bottleneck			12.85 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*78.18 m.a.s.l.*	*10 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*84.18 m.a.s.l.*	*610 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	78.58 m.a.s.l.	50 cm	LNQ	1.707 m^3/s
HNWL	83.79 m.a.s.l.	571 cm	HNQ	5.395 m^3/s

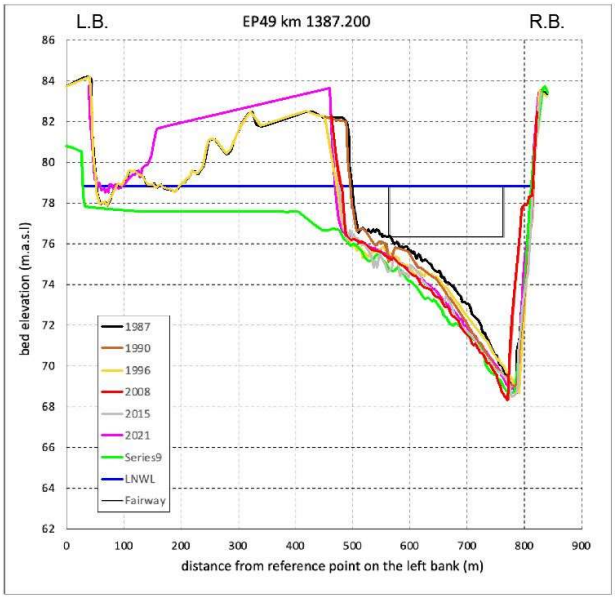
2.5. Drava Confluence

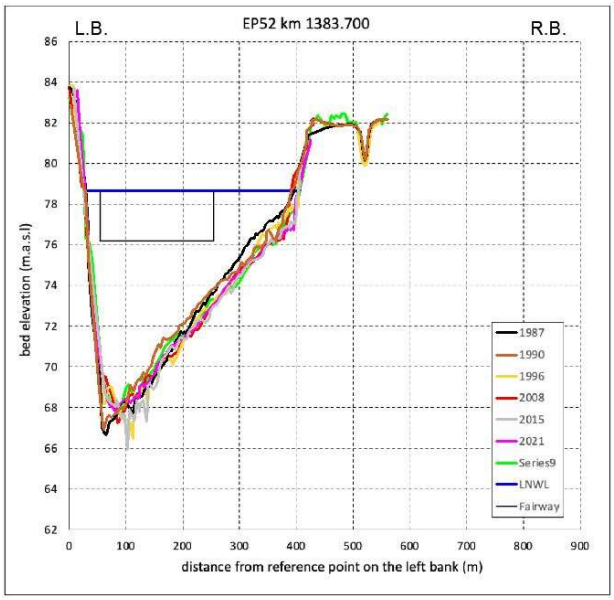
Basic location info			
Name of the bottleneck	**Drava Confluence**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,388.8	To (km downstream)	1,382.0
Total length (km)	6,80	River bed	sand

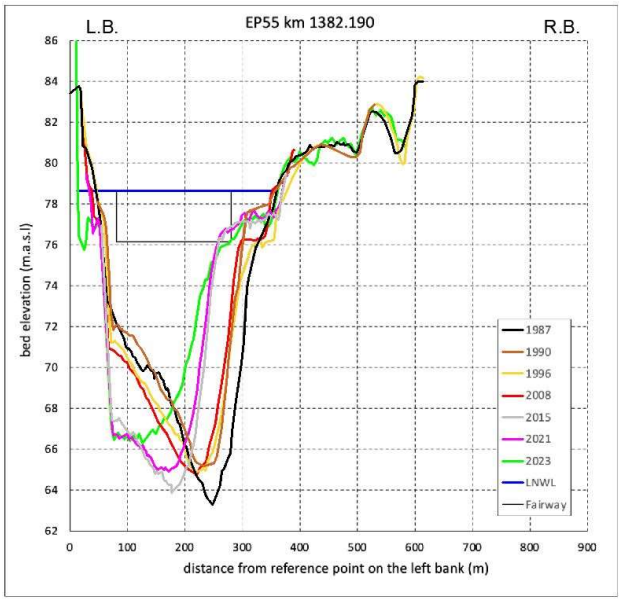
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☒ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Special Nature Reserve Gornje Podunavlje - Kopacki Rit Nature Park - Kopacki rit (HR2000394) Natura 2000 site - Gornje Podunavlje (RS000001) Emerald site				

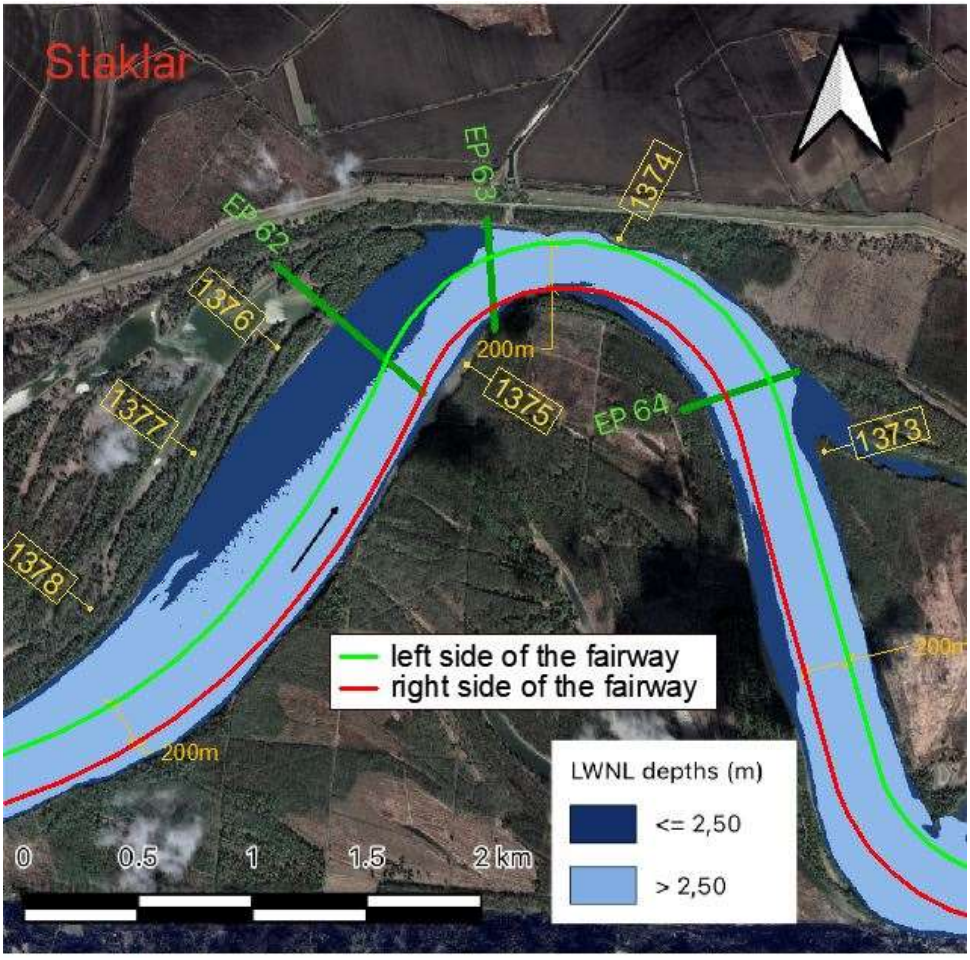
Basic hydrological information				
Name of the reference gauging station			Apatin	
Year of the establishment of the gauging station			1876	
Location of the gauging station			km 1.401,90	
Distance to the (center of the) bottleneck			16.50 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	79.31 m.a.s.l.	47 cm	LNQ	1.180 m^3/s
HNWL	85.58 m.a.s.l.	674 cm	HNQ	5.280 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	N/A	N/A	LNQ	N/A
HNWL	N/A	N/A	HNQ	N/A

Name of the reference gauging station			Aljmas	
Year of the establishment of the gauging station			1909	
Location of the gauging station			km 1.380,25	
Distance to the (center of the) bottleneck			5.15 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*78.18 m.a.s.l.*	*10 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*84.18 m.a.s.l.*	*610 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	78.58 m.a.s.l.	50 cm	LNQ	1.707 m^3/s
HNWL	83.79 m.a.s.l.	571 cm	HNQ	5.395 m^3/s

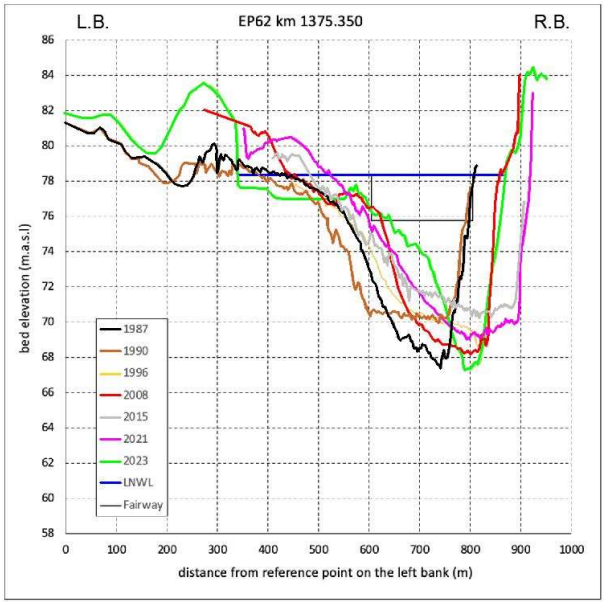
2.6. Staklar

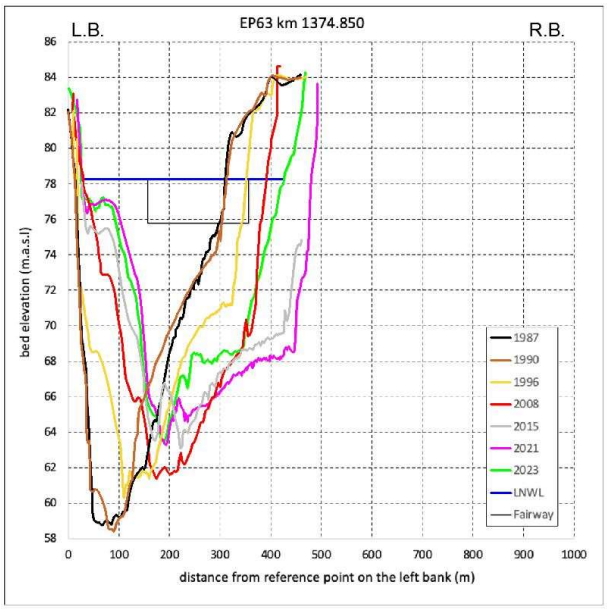
Basic location info			
Name of the bottleneck	**Staklar**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,376.8	To (km downstream)	1,373.4
Total length (km)	3,40	River bed	sand

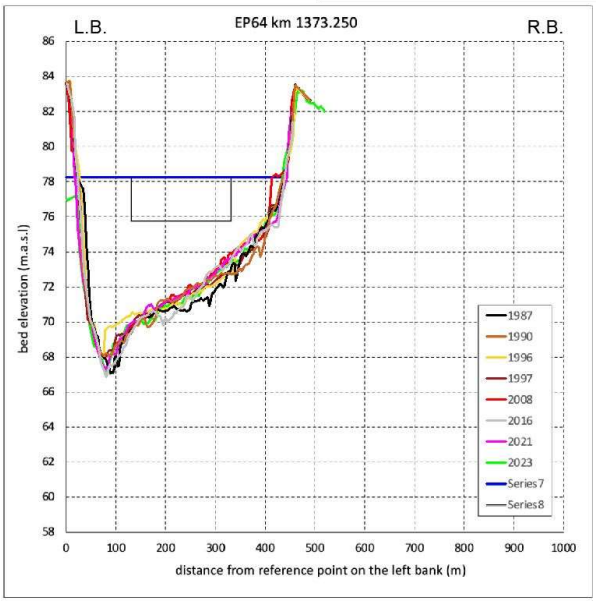
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☒ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Special Nature Reserve Gornje Podunavlje - Danube - Vukovar (HR2000372) Natura 2000 site - Gornje Podunavlje (RS000001) Emerald site				

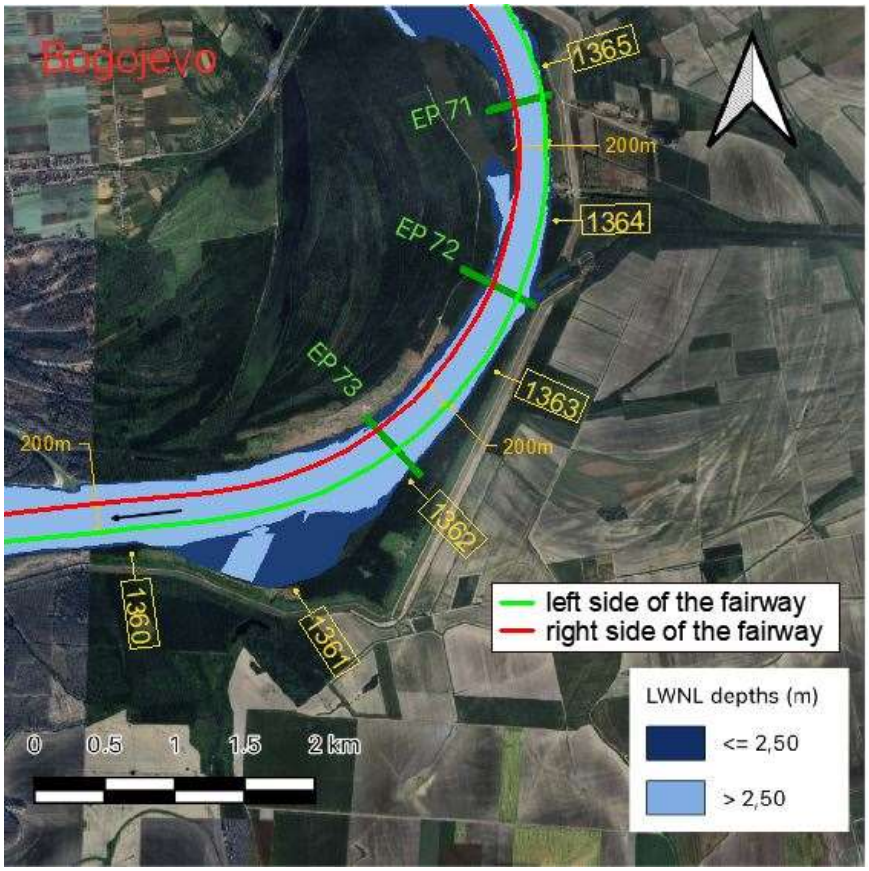
Basic hydrological information				
Name of the reference gauging station			Bogojevo	
Year of the establishment of the gauging station			1871	
Location of the gauging station			km 1.367,30	
Distance to the (center of the) bottleneck			7.80 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	77.57 m.a.s.l.	11 cm	LNQ	1.435 m^3/s
HNWL	83.42 m.a.s.l.	596 cm	HNQ	5.850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	77.73	27 cm	LNQ	1.707 m^3/s
HNWL	83.01 m.a.s.l.	555 cm	HNQ	5.395 m^3/s

Name of the reference gauging station			Aljmas	
Year of the establishment of the gauging station			1909	
Location of the gauging station			km 1.380,25	
Distance to the (center of the) bottleneck			5.15 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*78.18 m.a.s.l.*	*10 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*84.18 m.a.s.l.*	*610 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	78.58 m.a.s.l.	50 cm	LNQ	1.707 m^3/s
HNWL	83.79 m.a.s.l.	571 cm	HNQ	5.395 m^3/s

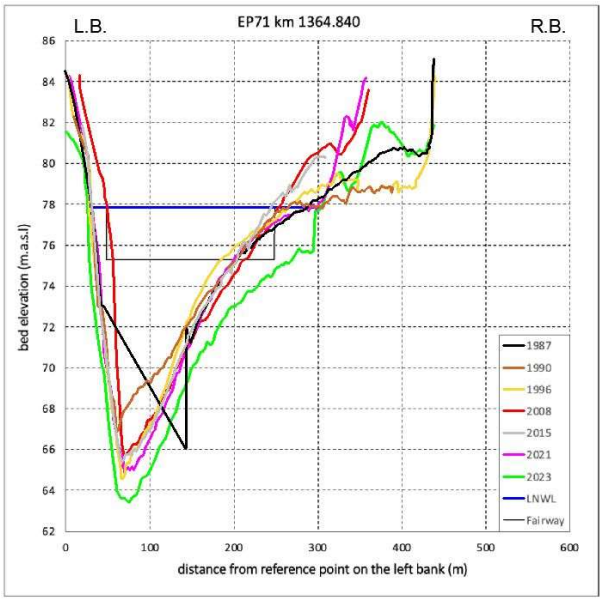
2.7. Bogojevo

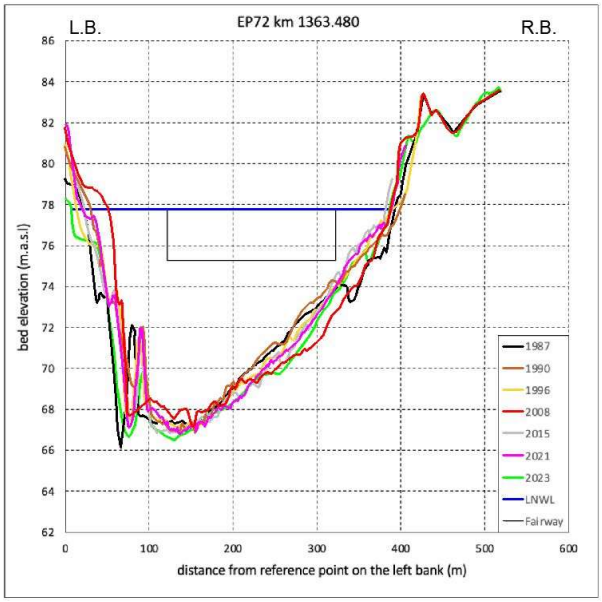
Basic location info			
Name of the bottleneck	**Bogojevo**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,366.2	To (km downstream)	1,361.4
Total length (km)	4,80	River bed	sand

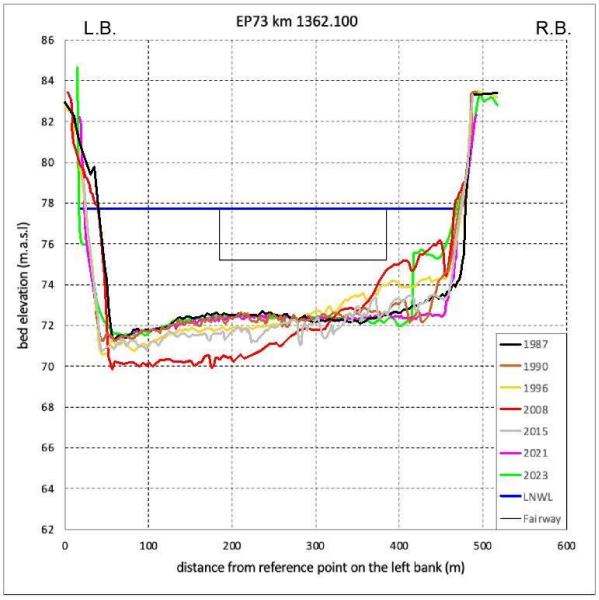
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information

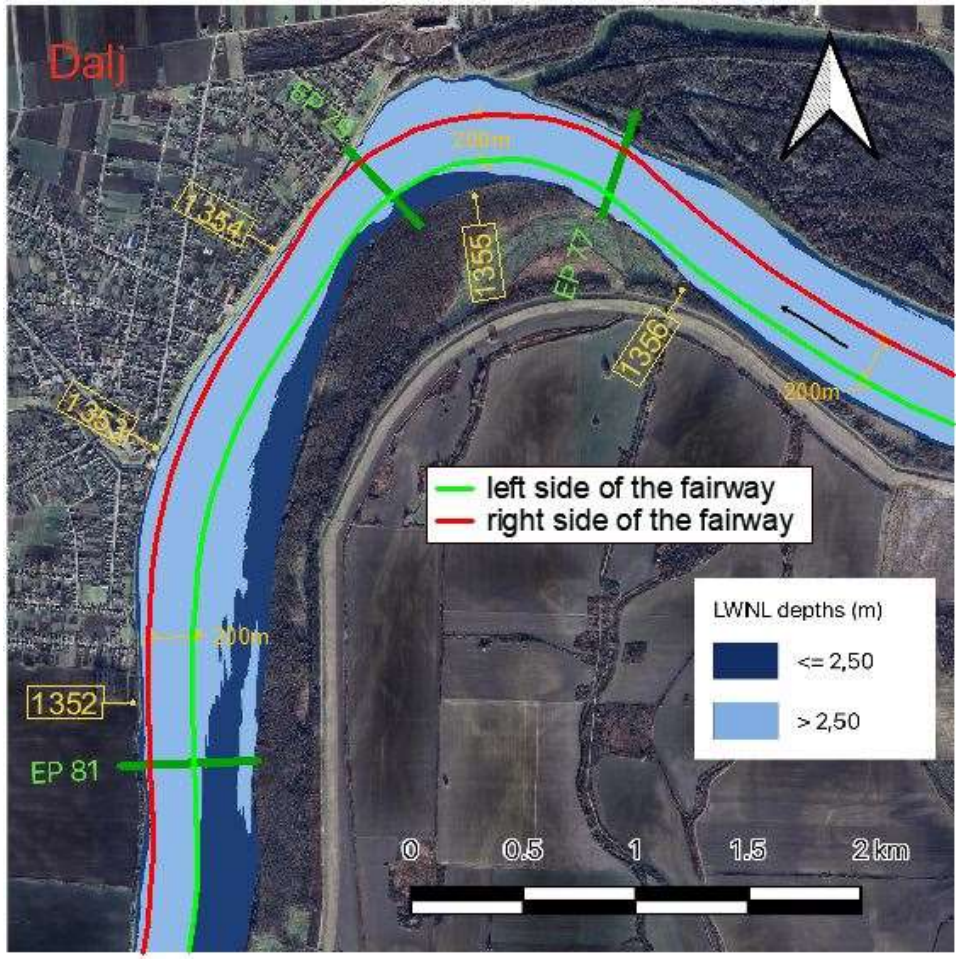
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube - Vukovar (HR2000372) Natura 2000 site				
Basic hydrological information				
Name of the reference gauging station			Bogojevo	
Year of the establishment of the gauging station			1871	
Location of the gauging station			km 1.367,30	
Distance to the (center of the) bottleneck			4.00 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	77.57 m.a.s.l.	11 cm	LNQ	1.435 m^3/s
HNWL	83.42 m.a.s.l.	596 cm	HNQ	5.850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	77.73	27 cm	LNQ	1.707 m^3/s
HNWL	83.01 m.a.s.l.	555 cm	HNQ	5.395 m^3/s

Name of the reference gauging station			Dalj	
Year of the establishment of the gauging station			1985	
Location of the gauging station			km 1.353,70	
Distance to the (center of the) bottleneck			10.10 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*77.09 m.a.s.l.*	*189 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*82.74 m.a.s.l.*	*754 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	77.43 m.a.s.l.	223 cm	LNQ	1.768 m^3/s
HNWL	82.23 m.a.s.l.	703 cm	HNQ	5.395 m^3/s

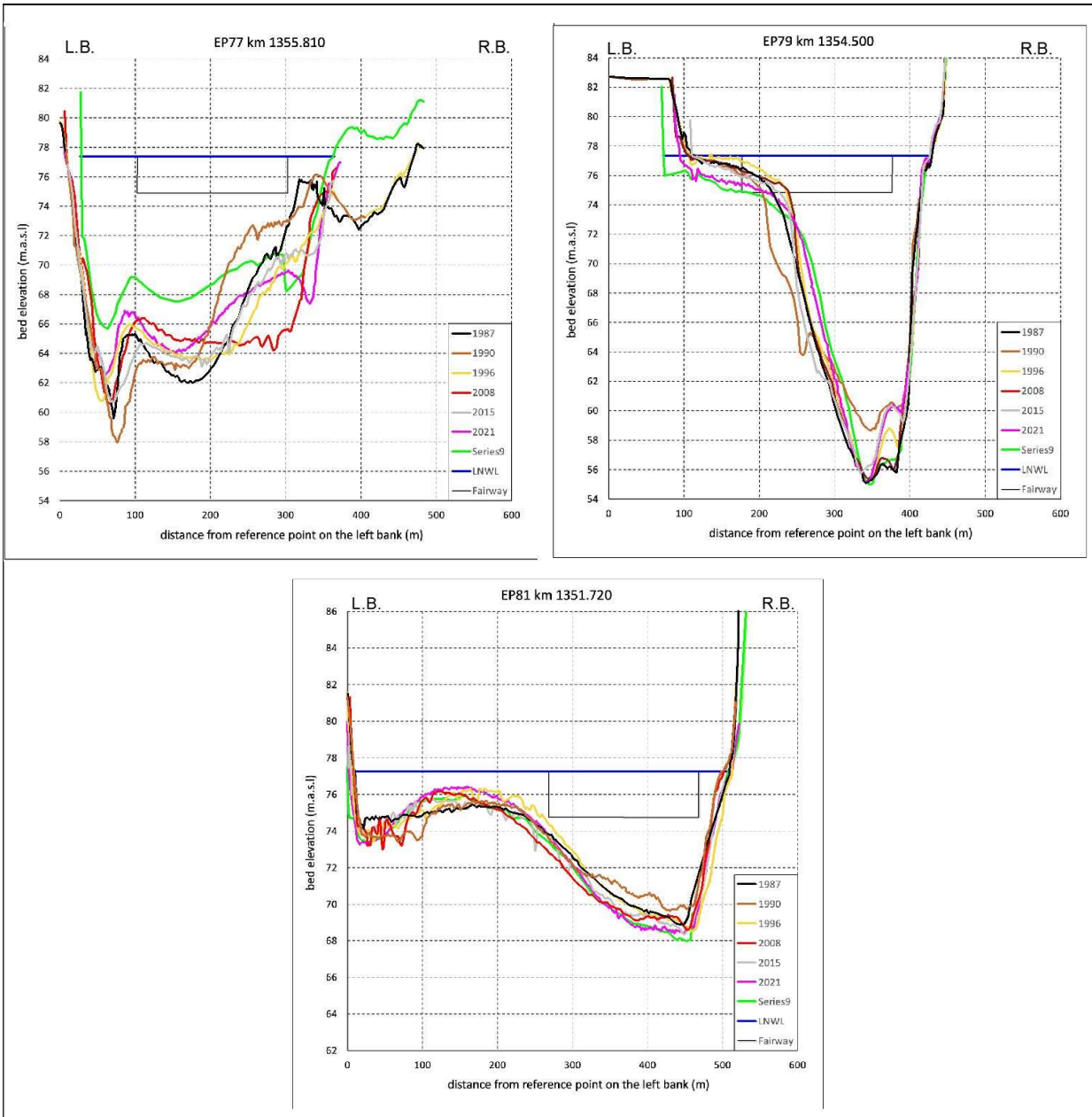
2.8. Dalj

Basic location info			
Name of the bottleneck	**Dalj**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,357.0	To (km downstream)	1,351.0
Total length (km)	6,00	River bed	sand

Visualization



Layout view of the critical sector



Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

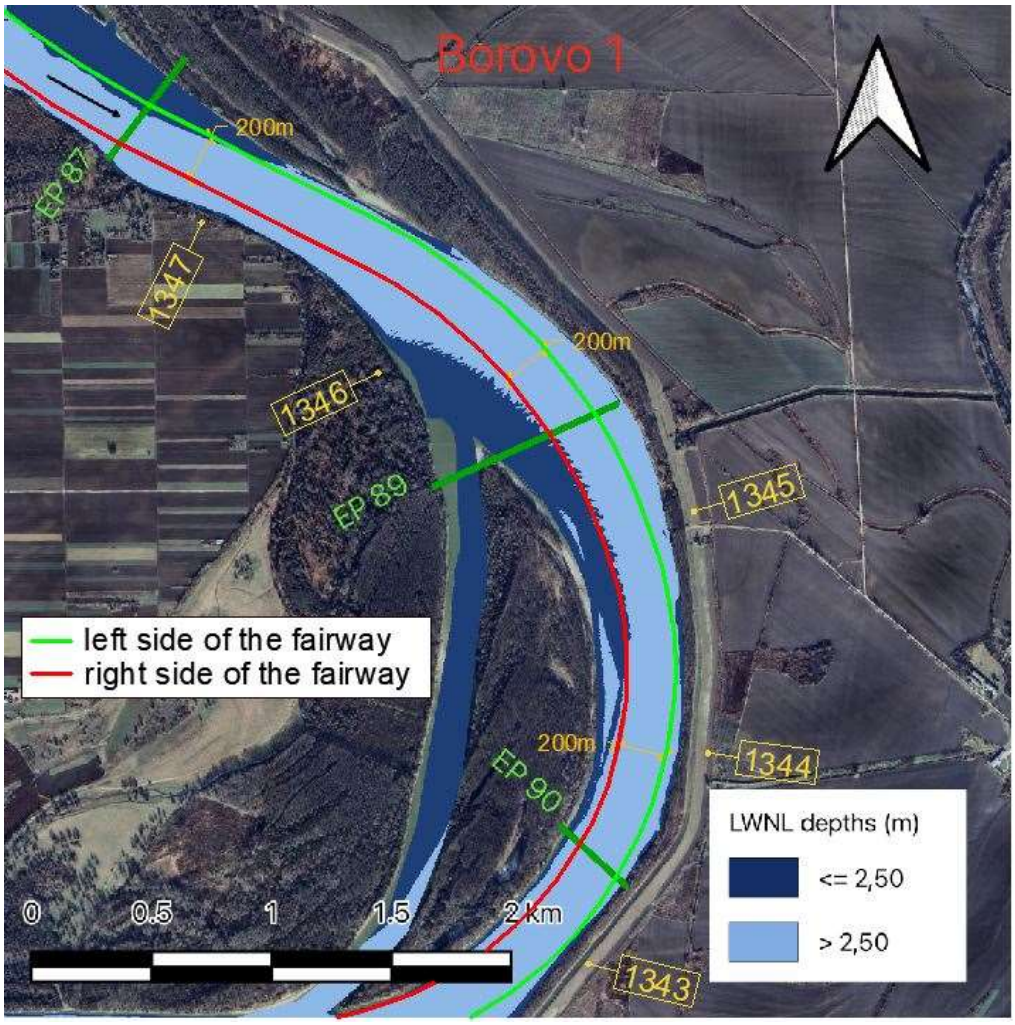
Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube - Vukovar (HR2000372) Natura 2000 site				

Basic hydrological information				
Name of the reference gauging station			Bogojevo	
Year of the establishment of the gauging station			1871	
Location of the gauging station			km 1.367,30	
Distance to the (center of the) bottleneck			13.30 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	77.57 m.a.s.l.	11 cm	LNQ	1.435 m^3/s
HNWL	83.42 m.a.s.l.	596 cm	HNQ	5.850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	77.73	27 cm	LNQ	1.707 m^3/s
HNWL	83.01 m.a.s.l.	555 cm	HNQ	5.395 m^3/s
Name of the reference gauging station			Dalj	
Year of the establishment of the gauging station			1985	
Location of the gauging station			km 1.353,70	
Distance to the (center of the) bottleneck			0.30 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*77.09 m.a.s.l.*	*189 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*82.74 m.a.s.l.*	*754 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	77.43 m.a.s.l.	223 cm	LNQ	1.768 m^3/s
HNWL	82.23 m.a.s.l.	703 cm	HNQ	5.395 m^3/s

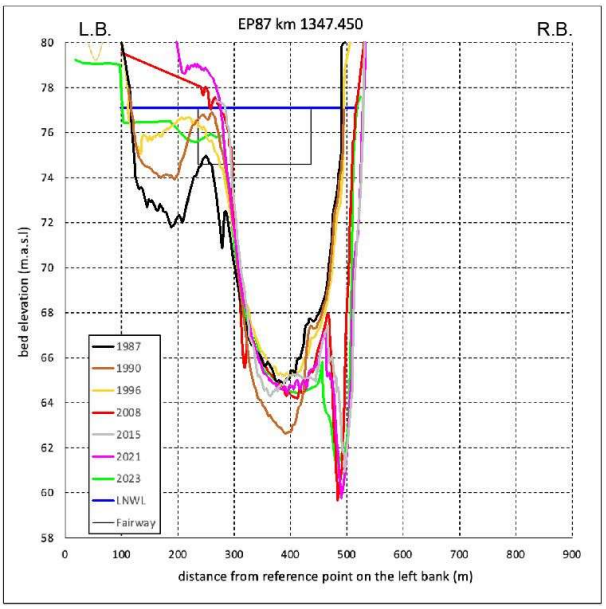
2.9. Borovo 1

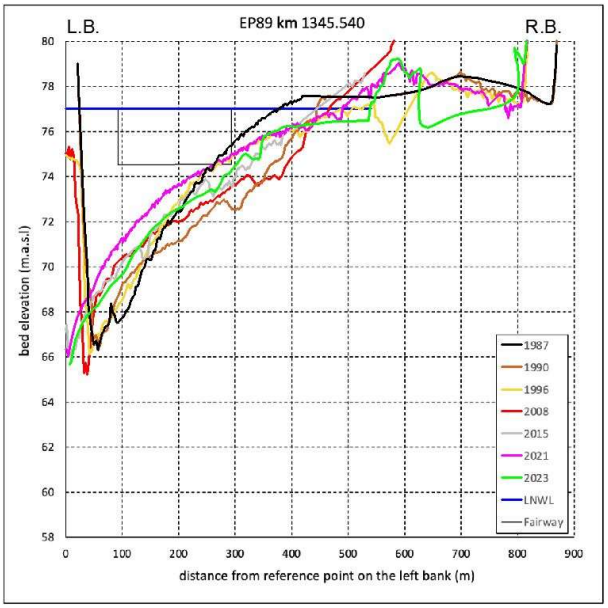
Basic location info			
Name of the bottleneck	**Borovo 1**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,348.6	To (km downstream)	1,343.6
Total length (km)	5,00	River bed	sand

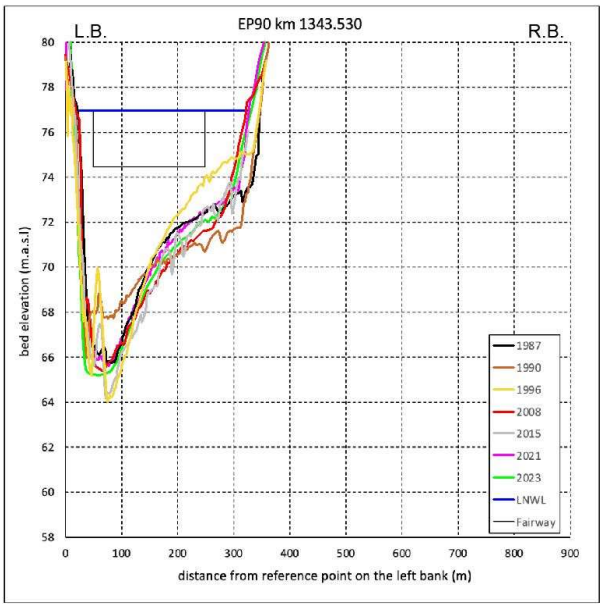
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☒ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

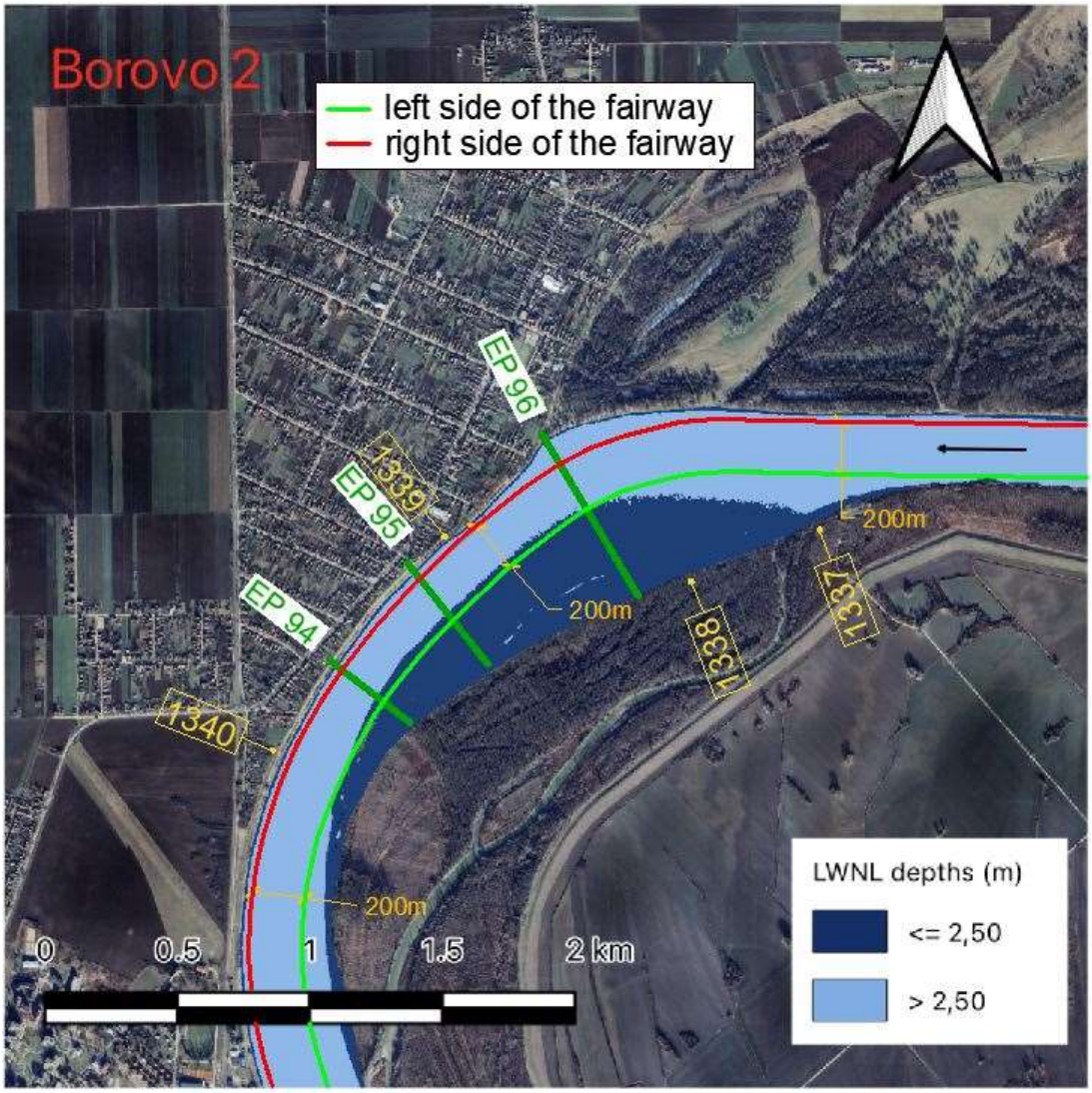
Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube - Vukovar (HR2000372) Natura 2000 site				

Basic hydrological information				
Name of the reference gauging station			Bogojevo	
Year of the establishment of the gauging station			1871	
Location of the gauging station			km 1.367,30	
Distance to the (center of the) bottleneck			21.20 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	77.57 m.a.s.l.	11 cm	LNQ	1.435 m^3/s
HNWL	83.42 m.a.s.l.	596 cm	HNQ	5.850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	77.73	27 cm	LNQ	1.707 m^3/s
HNWL	83.01 m.a.s.l.	555 cm	HNQ	5.395 m^3/s
Name of the reference gauging station			Dalj	
Year of the establishment of the gauging station			1985	
Location of the gauging station			km 1.353,70	
Distance to the (center of the) bottleneck			7.60 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*77.09 m.a.s.l.*	*189 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*82.74 m.a.s.l.*	*754 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	77.43 m.a.s.l.	223 cm	LNQ	1.768 m^3/s
HNWL	82.23 m.a.s.l.	703 cm	HNQ	5.395 m^3/s

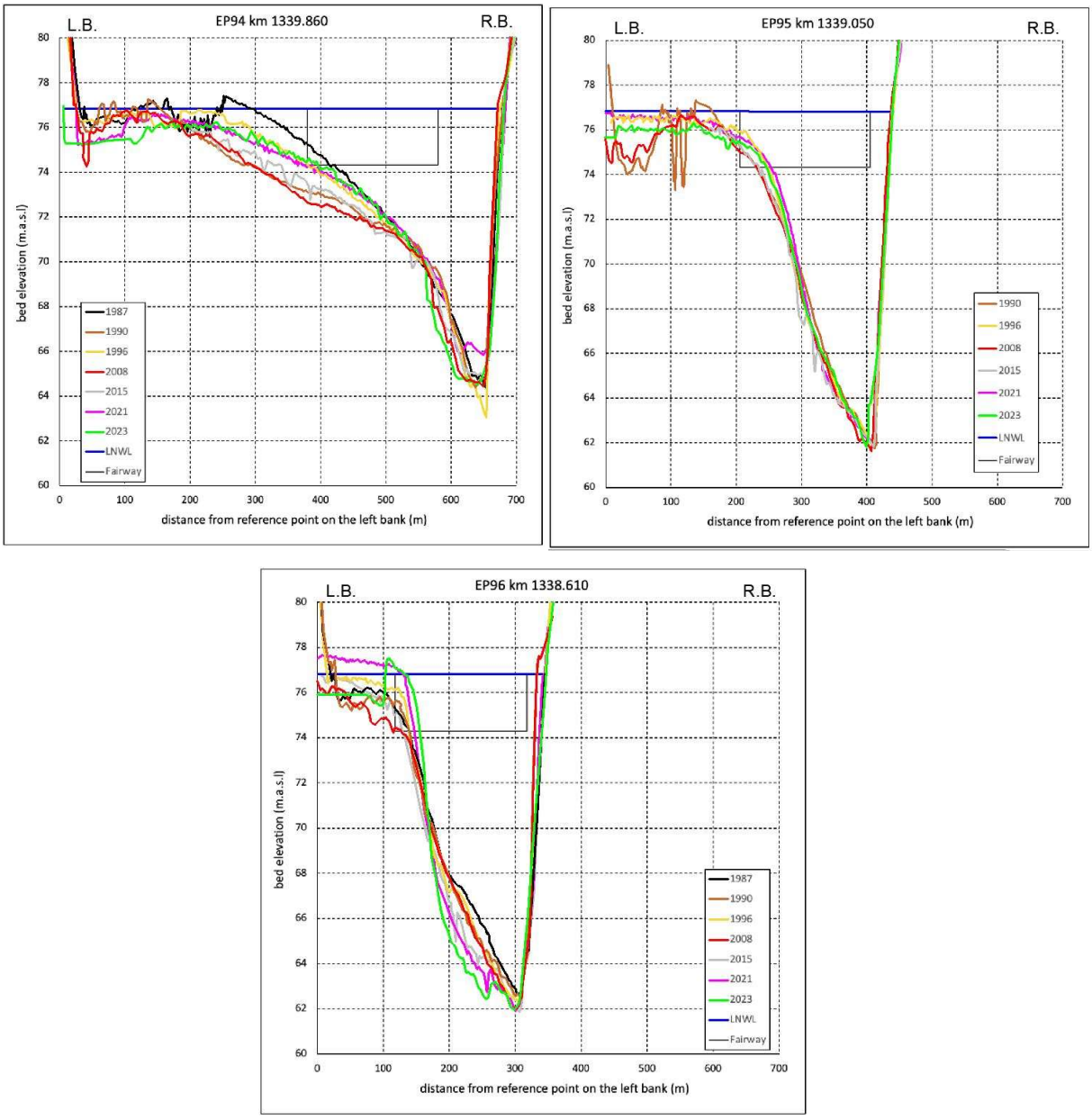
2.10. Borovo 2

Basic location info			
Name of the bottleneck	**Borovo 2**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,340.6	To (km downstream)	1,338.0
Total length (km)	2,60	River bed	sand

Visualization



Layout view of the critical sector



Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☒ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

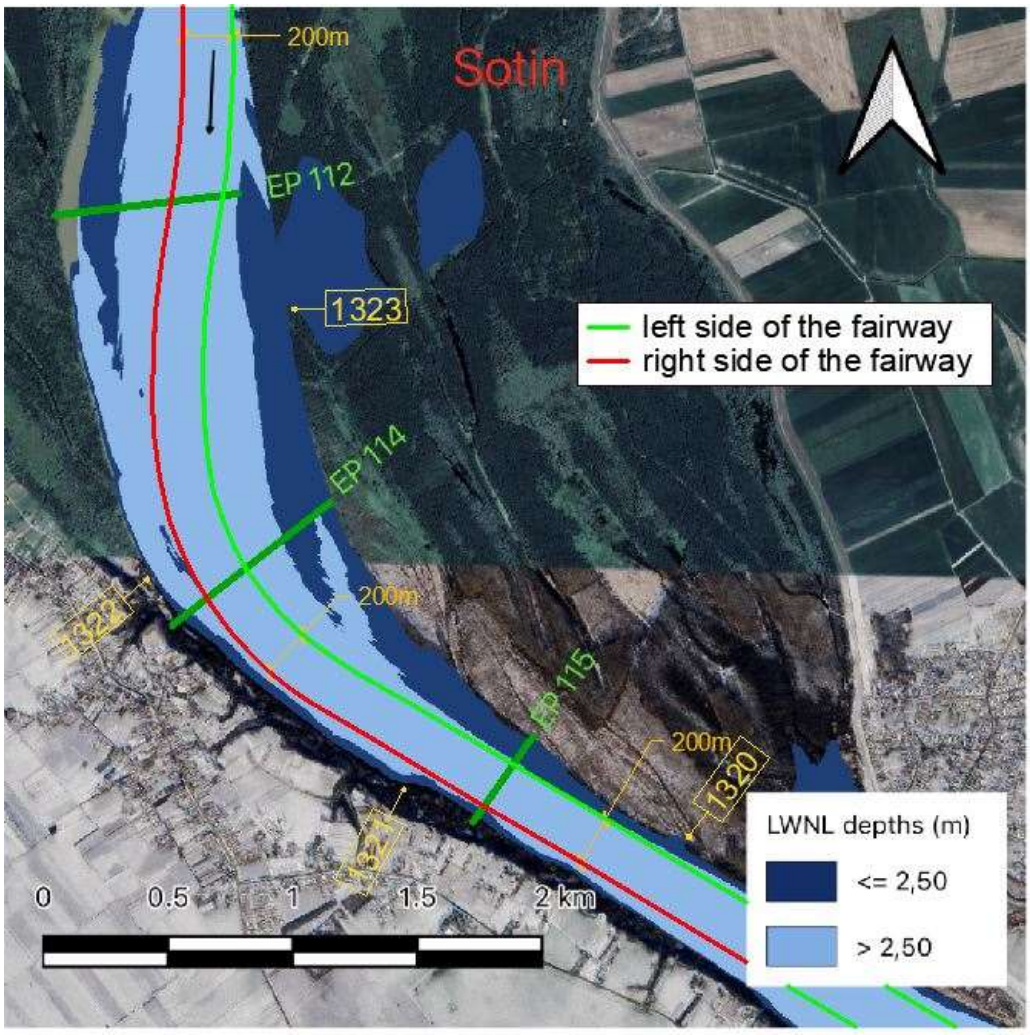
Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube - Vukovar (HR2000372) Natura 2000 site				

Basic hydrological information				
Name of the reference gauging station			Bogojevo	
Year of the establishment of the gauging station			1871	
Location of the gauging station			km 1.367,30	
Distance to the (center of the) bottleneck			28.00 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	77.57 m.a.s.l.	11 cm	LNQ	1.435 m^3/s
HNWL	83.42 m.a.s.l.	596 cm	HNQ	5.850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	77.73	27 cm	LNQ	1.707 m^3/s
HNWL	83.01 m.a.s.l.	555 cm	HNQ	5.395 m^3/s
Name of the reference gauging station			Vukovar	
Year of the establishment of the gauging station			1856	
Location of the gauging station			km 1.333,40	
Distance to the (center of the) bottleneck			5.90 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*76.36 m.a.s.l.*	*17 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*81.63 m.a.s.l.*	*544 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	76.68 m.a.s.l.	49 cm	LNQ	1.769 m^3/s
HNWL	81.14 m.a.s.l.	495 cm	HNQ	5.395 m^3/s

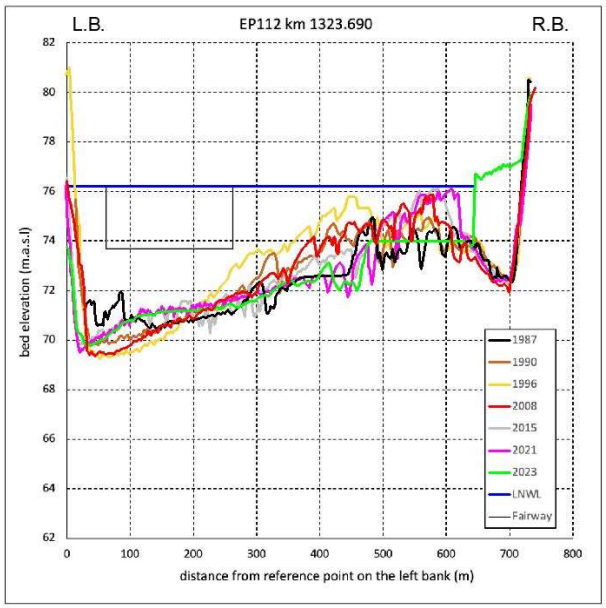
2.11. Sotin

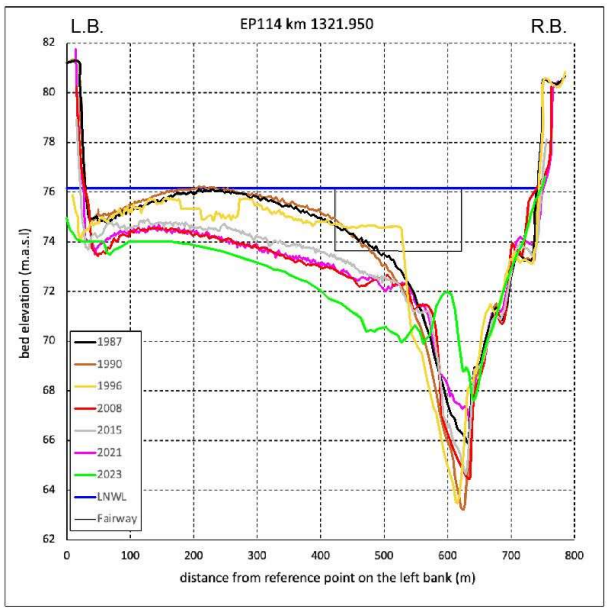
Basic location info			
Name of the bottleneck	**Sotin**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,324.0	To (km downstream)	1,320.0
Total length (km)	4,00	River bed	Sand

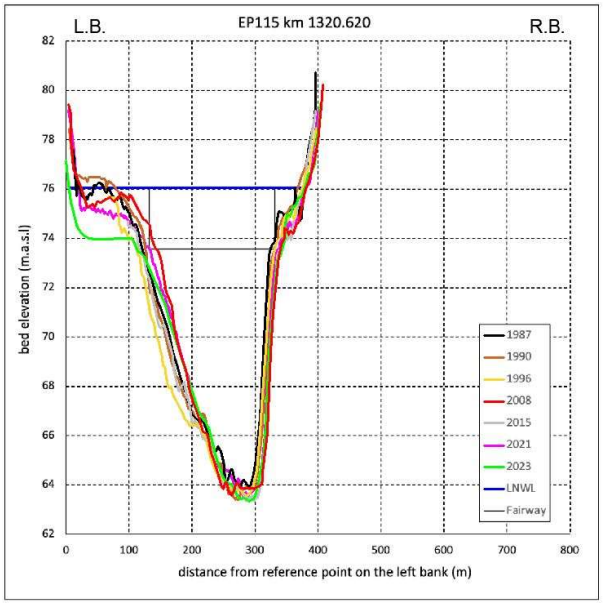
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube - Vukovar (HR2000372) Natura 2000 site				

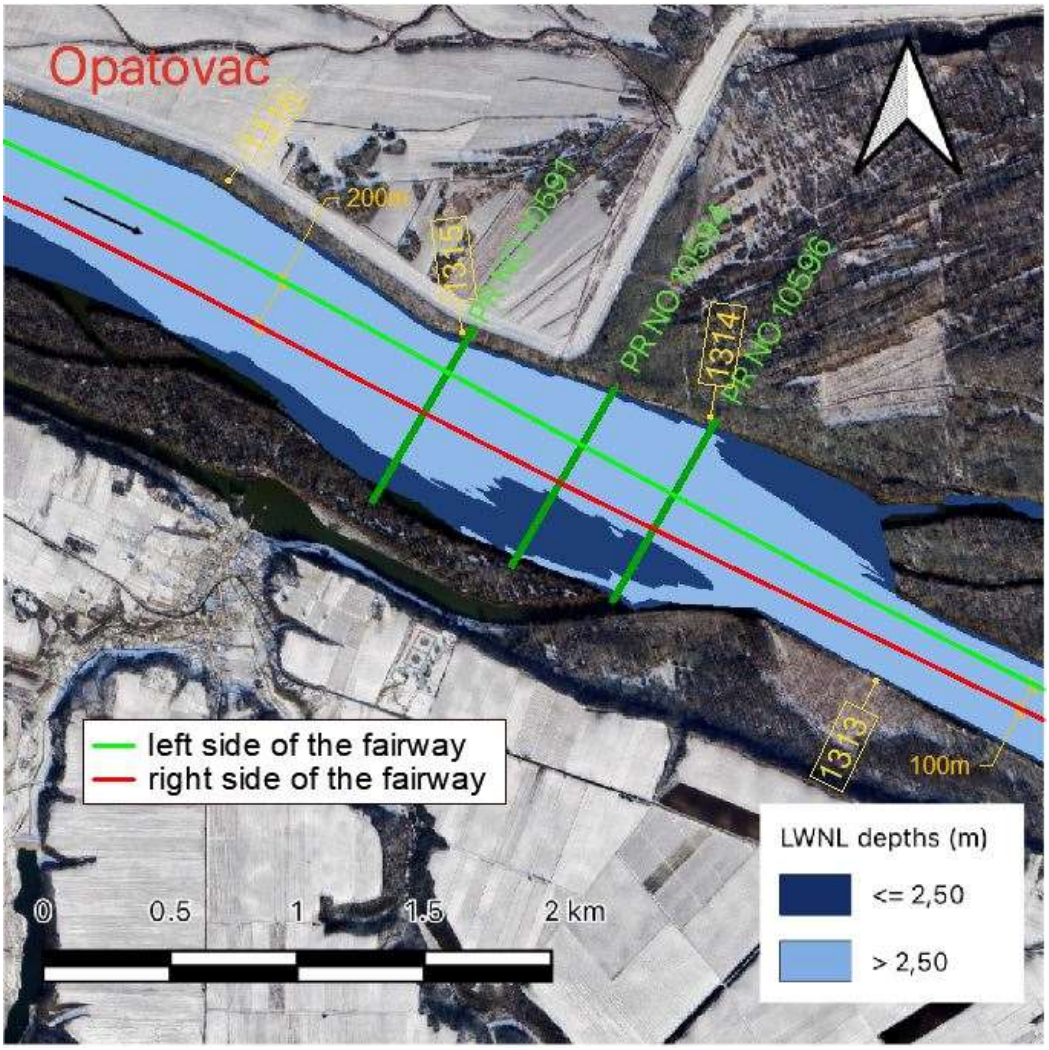
Basic hydrological information				
Name of the reference gauging station			Backa Palanka	
Year of the establishment of the gauging station			1888	
Location of the gauging station			km 1.298,60	
Distance to the (center of the) bottleneck			23.40 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	74.44 m.a.s.l.	47 cm	LNQ	1,435 m^3/s
HNWL	79.75 m.a.s.l.	578 cm	HNQ	5,850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	74.86	89 cm	LNQ	1,778 m^3/s
HNWL	78.98 m.a.s.l.	501 cm	HNQ	5,173 m^3/s

Name of the reference gauging station			Vukovar	
Year of the establishment of the gauging station			1856	
Location of the gauging station			km 1.333,40	
Distance to the (center of the) bottleneck			11.40 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*76.36 m.a.s.l.*	*17 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*81.63 m.a.s.l.*	*544 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	76.68 m.a.s.l.	49 cm	LNQ	1.769 m^3/s
HNWL	81.14 m.a.s.l.	495 cm	HNQ	5.395 m^3/s

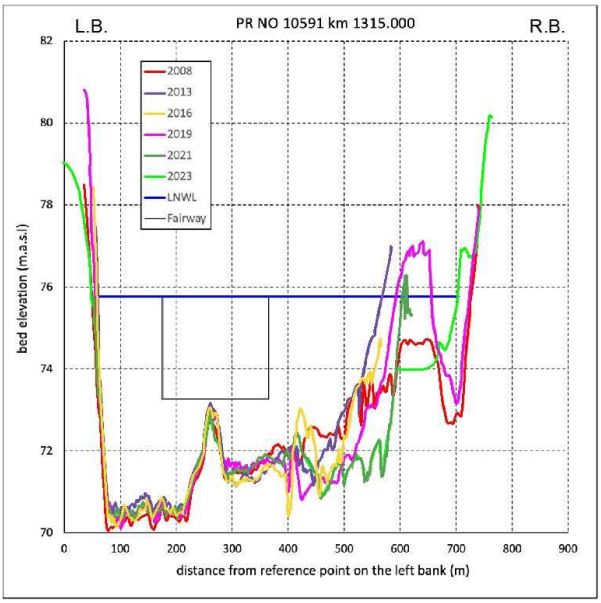
2.12. Opatovac

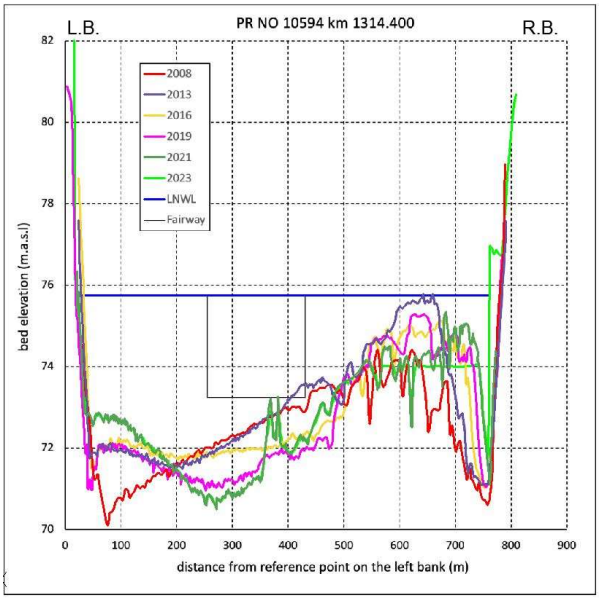
Basic location info			
Name of the bottleneck	**Opatovac**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,315.4	To (km downstream)	1,314.6
Total length (km)	0,80	River bed	Gravel

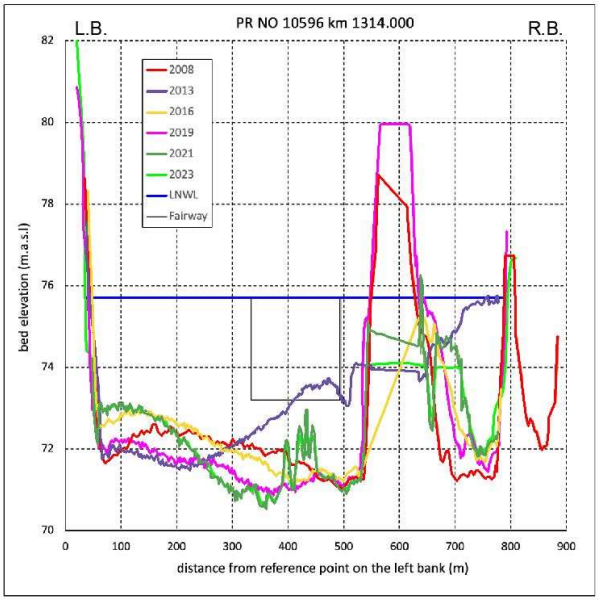
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information

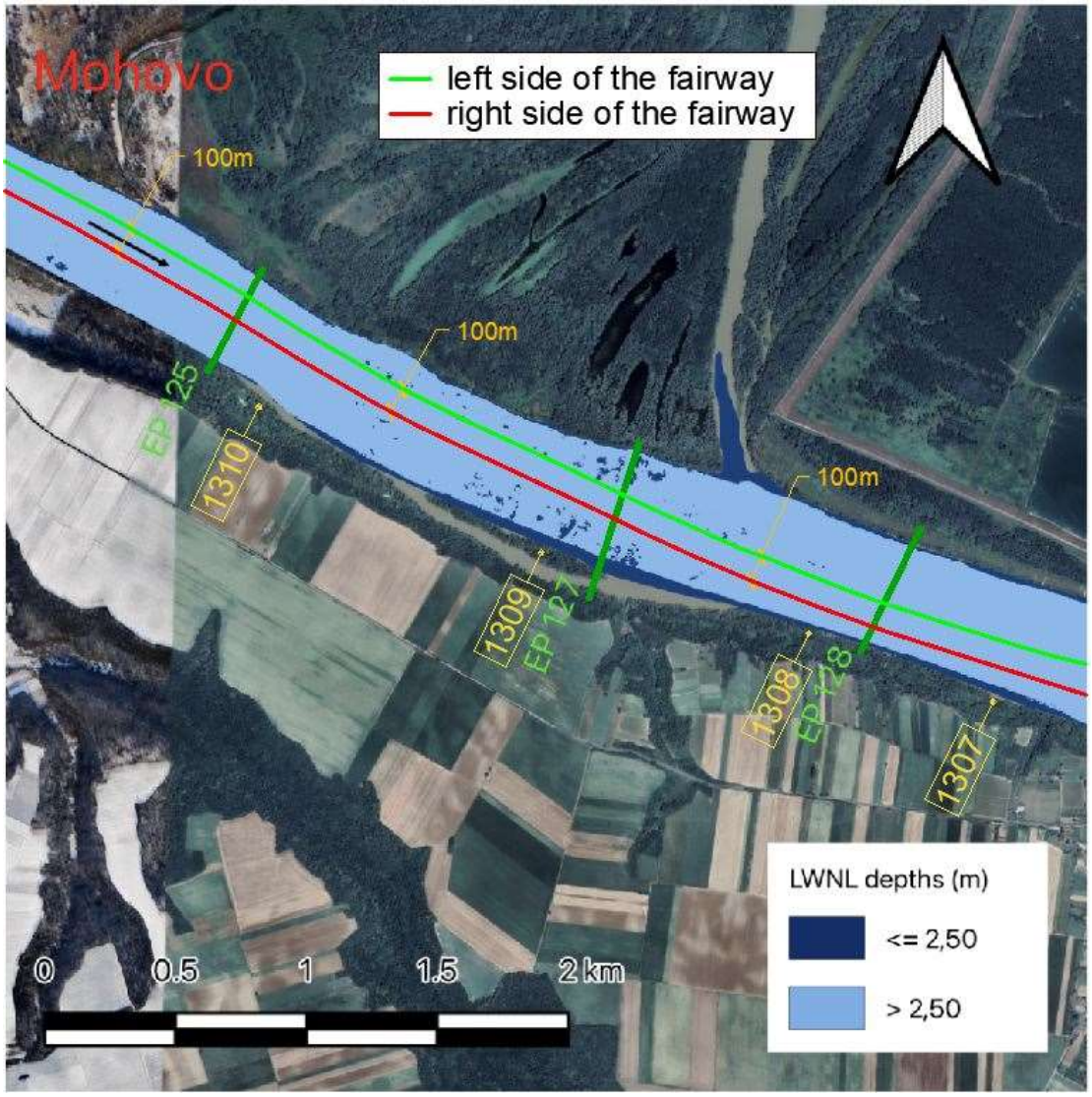
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Danube - Vukovar (HR2000372) Natura 2000 site				
Basic hydrological information				
Name of the reference gauging station			Backa Palanka	
Year of the establishment of the gauging station			1888	
Location of the gauging station			km 1.298,56 see email from Lidyja	
Distance to the (center of the) bottleneck			16.40 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	74.44 m.a.s.l.	47 cm	LNQ	1,435 m^3/s
HNWL	79.75 m.a.s.l.	578 cm	HNQ	5,850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	74.86	89 cm	LNQ	1,778 m^3/s
HNWL	78.98 m.a.s.l.	501 cm	HNQ	5,173 m^3/s

Name of the reference gauging station			Ilok / Ilok most	
Year of the establishment of the gauging station			2019	
Location of the gauging station			km 1.298,70	
Distance to the (center of the) bottleneck			16.30 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*74.44 m.a.s.l.*	*47 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*79.74 m.a.s.l.*	*577 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	74.68 m.a.s.l.	71 cm	LNQ	1.778 m^3/s
HNWL	79.15 m.a.s.l.	518 cm	HNQ	5.449 m^3/s

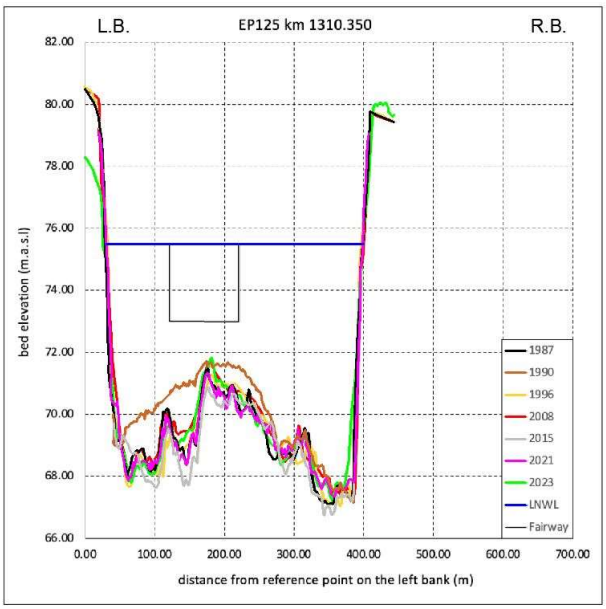
2.13. Mohovo

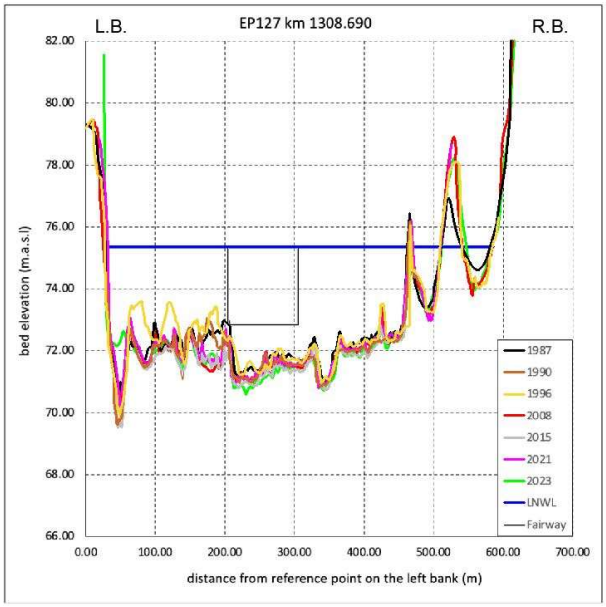
Basic location info			
Name of the bottleneck	**Mohovo**	Alternative name	N/A
Waterway	Danube River	Waterway class (AGN)	VI
From (km upstream)	1,311.4	To (km downstream)	1,307.6
Total length (km)	3,80	River bed	Gravel, rock

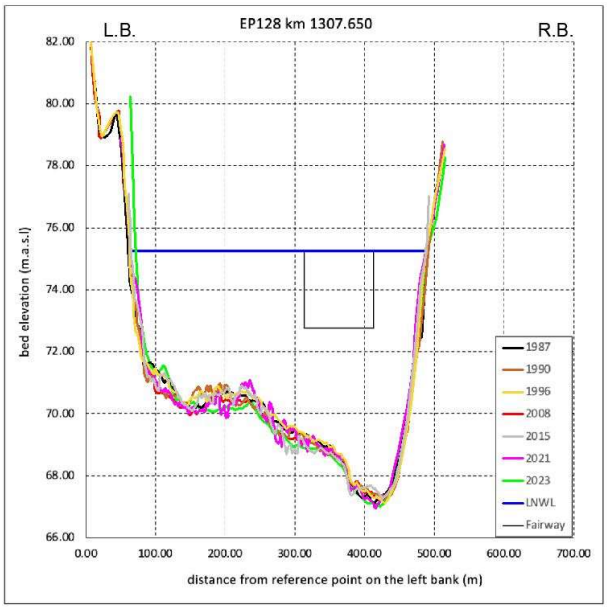
Visualization



Layout view of the critical sector







Cross sections of the critical sector

Basic information on the navigation obstacle(s)			
☐ depth	☒ width	☐ radius	☐ height
☐ other (to be specified if selected)			

Historical information	
☒ The location is known as the navigation bottleneck from before	☐ The location is newly identified navigation bottleneck

Basic ecological information				
Overall ecological status of the water body (ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9)				
☐ high	☐ good	☒ moderate	☐ poor	☐ bad
Protected areas information: - The Transboundary Biosphere Reserve Mura-Drava-Danube - Special Nature Reserve Karadjordjevo - Danube - Vukovar (HR2000372) Natura 2000 site - Karadjordjevo (RS0000038) Emerald site				

Basic hydrological information				
Name of the reference gauging station			Backa Palanka	
Year of the establishment of the gauging station			1888	
Location of the gauging station			km 1.298,60	
Distance to the (center of the) bottleneck			10.90 km	
Period for the calculation of the reference levels			1981-2010	
ENR (LNWL)	74.44 m.a.s.l.	47 cm	LNQ	1,435 m^3/s
HNWL	79.75 m.a.s.l.	578 cm	HNQ	5,850 m^3/s
Period for the calculation of the reference levels			1994-2023	
ENR (LNWL)	74.86	89 cm	LNQ	1,778 m^3/s
HNWL	78.98 m.a.s.l.	501 cm	HNQ	5,173 m^3/s
Name of the reference gauging station			Ilok / Ilok most	
Year of the establishment of the gauging station			2019	
Location of the gauging station			km 1.298,70	
Distance to the (center of the) bottleneck			10.80 km	
Period for the calculation of the reference levels			*1981-2010*	
ENR (LNWL)	*74.44 m.a.s.l.*	*47 cm*	*LNQ*	*1.435 m^3/s*
HNWL	*79.74 m.a.s.l.*	*577 cm*	*HNQ*	*5.850 m^3/s*
Period for the calculation of the reference levels			1994-2023*	
ENR (LNWL)	74.68 m.a.s.l.	71 cm	LNQ	1.778 m^3/s
HNWL	79.15 m.a.s.l.	518 cm	HNQ	5.449 m^3/s

Sources

1. ICPDR, Danube River Basin Management Plan, Update 2021, Annex 9 - Detailed Results of Classification of all Assessed Surface Water Bodies According to Particular Biological, Hydromorphological and Chemical Quality Elements.
2. https://www.hidmet.gov.rs/.
3. https://meteo.hr/.