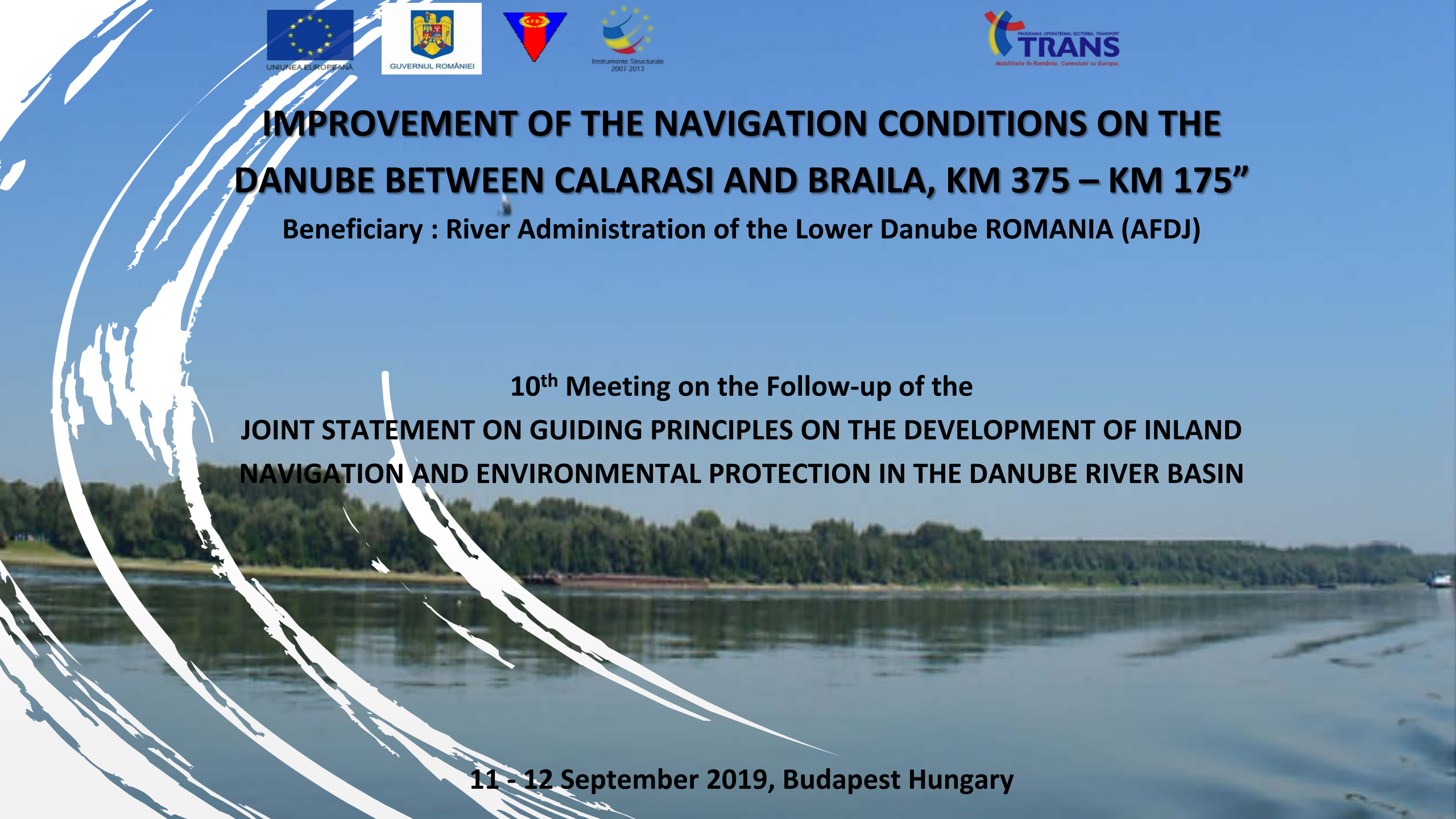
IMPROVEMENT OF THE NAVIGATION CONDITIONS ON THE DANUBE BETWEEN CALARASI AND BRAILA, KM 375 – KM 175”

Beneficiary : River Administration of the Lower Danube ROMANIA (AFDJ)



10th Meeting on the Follow-up of the JOINT STATEMENT ON GUIDING PRINCIPLES ON THE DEVELOPMENT OF INLAND NAVIGATION AND ENVIRONMENTAL PROTECTION IN THE DANUBE RIVER BASIN

11 - 12 September 2019, Budapest Hungary

Main objective of the project / Location

Improvement the navigation conditions on Danube between Calarasi and Braila:

Ensure minimum depths of 2.5 m of the fairway as recommended by the Danube Commission during the entire year, including the dry season.

Feasibility study (2005)

10 critical points (CP) in the initial, 3 critical points PC01, PC02, PC03

PC 01 - Bala Branch area and Caragheorghe sand

- banks protection
- guiding dyke
- bottom sill
- Dredging

PC 02 - Epuraşu Island Area

- banks protection
- submersible guiding dyke

PC 10 - Caleia Branch (Ostrovul Lupu)

- banks protection
- bottom sill
- dredging

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PROGRAMUL OPERAȚIONAL SECTORIAL TRANSPORT TRANS Mobilitate în România. Conexiuni cu Europa.

Funding

(Cohesion Fund) – 85%, National Funding 15 %, Operational Programme Transport (SOPT)

WORKS CONTRACT

RO Ministry of Transport as Contracting Authority

Consortium:

INTERCONSTRUCT Ltd., CANAL SERVICE Ltd., SUPERQUATRO GRUP Ltd. and G&G Ltd

AFDJ has taken over the project through a Novation Contract in December 2011

Contract Price: 38.671.752,12 Euro

The Restarting Date: 02.08.2011

Completion Period: initially 32 months and then was extended till 29 February 2016

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Project adaptive management approach

2007
Environmental Permit

2009
Works Contract Signed

2009
EC Conditionality Monitoring Program -MP

2011
MP Contract INCDPM

2011
Works resumed after 4 months of MP

2013
Restructure 50% bottom sill level

2015
EGIS Consortium Contract Bala FS

2016
Works Finalized

2017
EGIS alternative solutions results

2018
INCDPM final results

2018 - 2019
Environmental procedures

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TRANS
Mobilitate în România. Conexiuni cu Europa.

Outcome of the project

In all 3 critical points the works were executed - 100%.
Taking Over Procedures took place between 2014 - 2016

In Critical Point 10 - Caleia Branch (Ostrovul Lupu)
Due the redistribution of discharges between Caleia Branch and Danube produced by the bottom sill, the navigation was reopened on the Danube after 20 years.
Reduction of banks erosion on Caleia Branch.

In Critical Point 01 Bala – the works produced an increase of discharge on Old Danube of:

17% - 2000 cm/s
30% - 4000 cm/s
38% - 6000 cm/s
42% - 8000 cm/s (***EGIS 3D Modelling Report)***

CP 01- BALA, km 347–km 343 – THE GUIDING DYKE - 100%

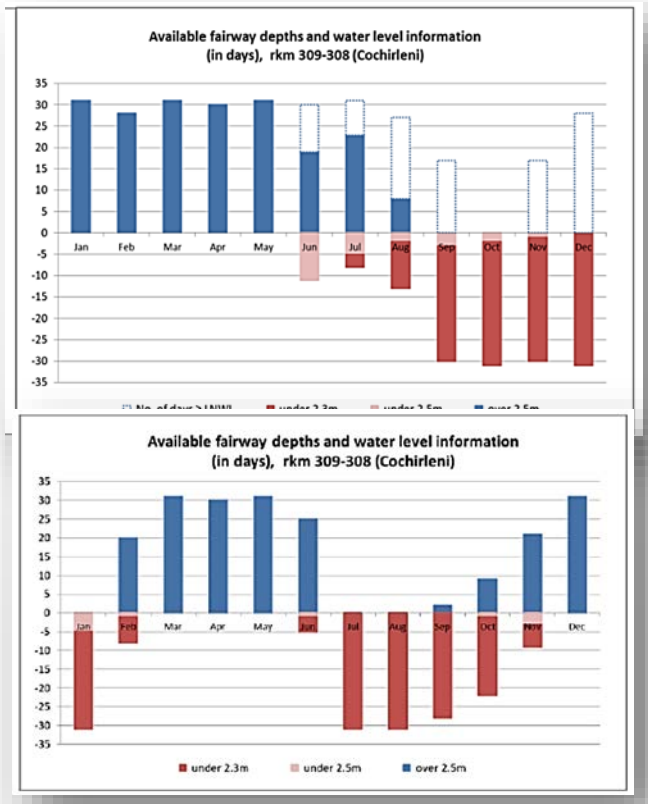
CP 01- BALA, km 347–km 343 - THE GUIDING DYKE - 100%

CP 10 CALEIA BRANCH (OSTROVUL LUPU), km 197 - km 195

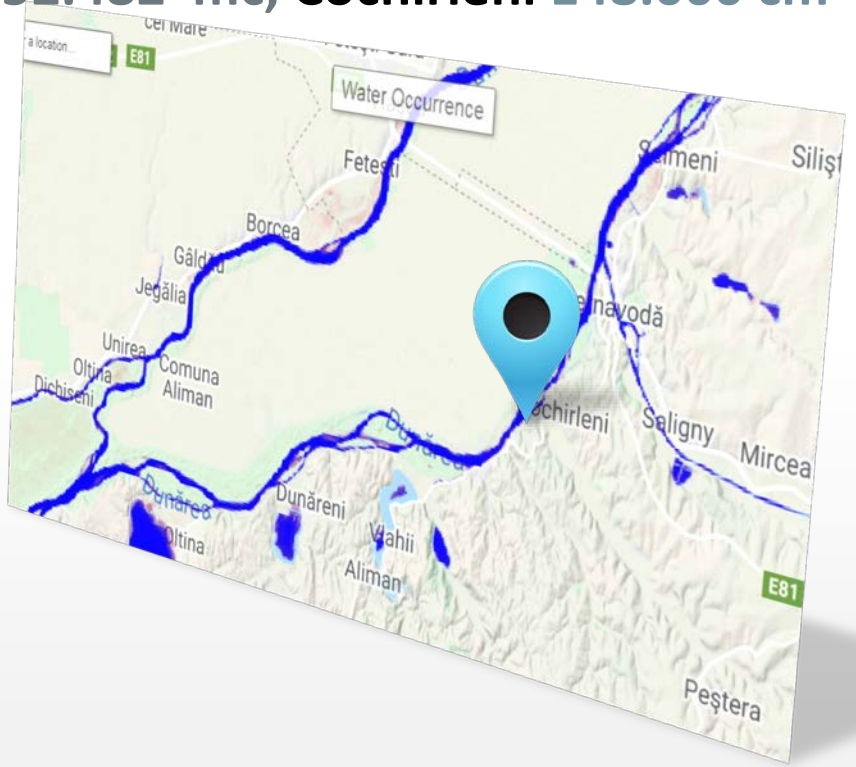
AFDJ Galati Maintenance dredging

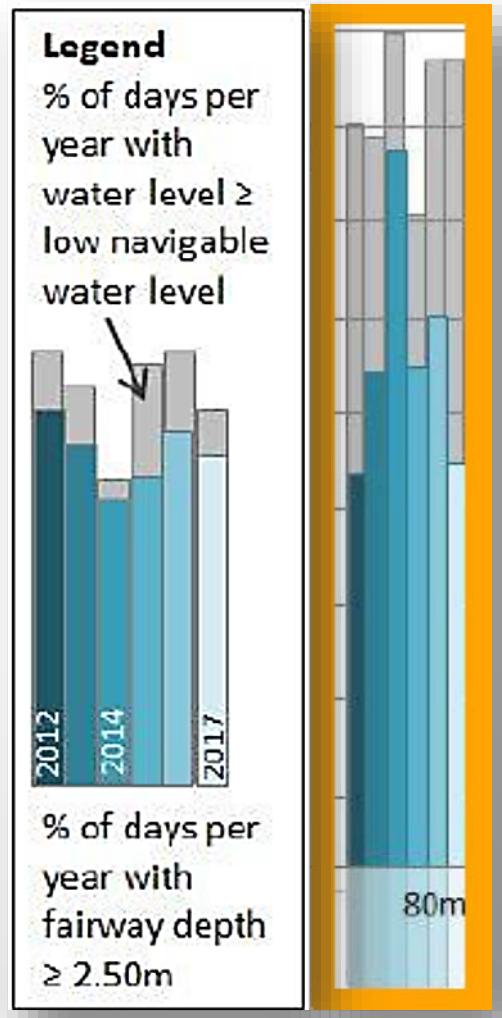
In 2019 – total amount of volume dredged:

- **Mm 75 – km 155 - 651.003 cm**
- **Km 678 – Km 246: 403.118 cm**
  - ☑ **Especially on Km 375 – Km 175, Calarasi-Braila project area**
  - **Caragheorghe Km 342 – Km 345 - 52.482 mc, Cochirleni 148.000 cm**



Cochirleni 2017, 2018: Available fairway: days





Cochirleni 2012 - 2017

EUSDR related developments -The Fairway Rehabilitation and Maintenance Master Plan for the Danube and its navigable tributaries

2015 - Bala -Feasibility study contract

Objectives

- **Improve the navigation conditions on the Danube River:**
  - ✓ **Balanced discharge distribution between Bala arm & Danube River during low flows**
  - ✓ **Increase of the Danube's level with up to 1.20 m in the area of the bifurcation with the Bala branch**
- **Design a technical solution with reduced environmental impact**
- **Maintain suitable conditions for sturgeon migration.**

Requirement

Design a consensus-based technical solution involving the stakeholders.

The contract was concluded in February 2015 with the Consortium EGIS EAU France, EGIS Romania, Compagnie Nationale du Rhone.

Contract Price: 794.786,81 Euro

Starting Date: 27th February 2015

Completion Period: 16 months

Main tasks of the Consultants: topographical and hydrographical surveys, 3D mathematical modelling of 2 scenarios of the technical solutions, EIA, AA, permanent communication with the stakeholders.

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J.S. PRINCIPLES … interdisciplinary planning teams

Participation of stakeholders in identification and analysis of alternative solutions

9 alternative solutions were identified and analysed (SWOT, multicriterial analysis):

Participation of stakeholders in two working groups (environment and navigation)

The proposals: EGIS Consortium but also:

- **IAD, Jürg Bloesch – Alternative solution no. 1**
- **WWF, Georg Rast - Alternative solution no. 2**
- **BOKU, H. Habersack (2015) - Alternative solution no. 9 (Alternative A was modelled and then recommended)**

J.S. PRINCIPLES … interdisciplinary planning teams

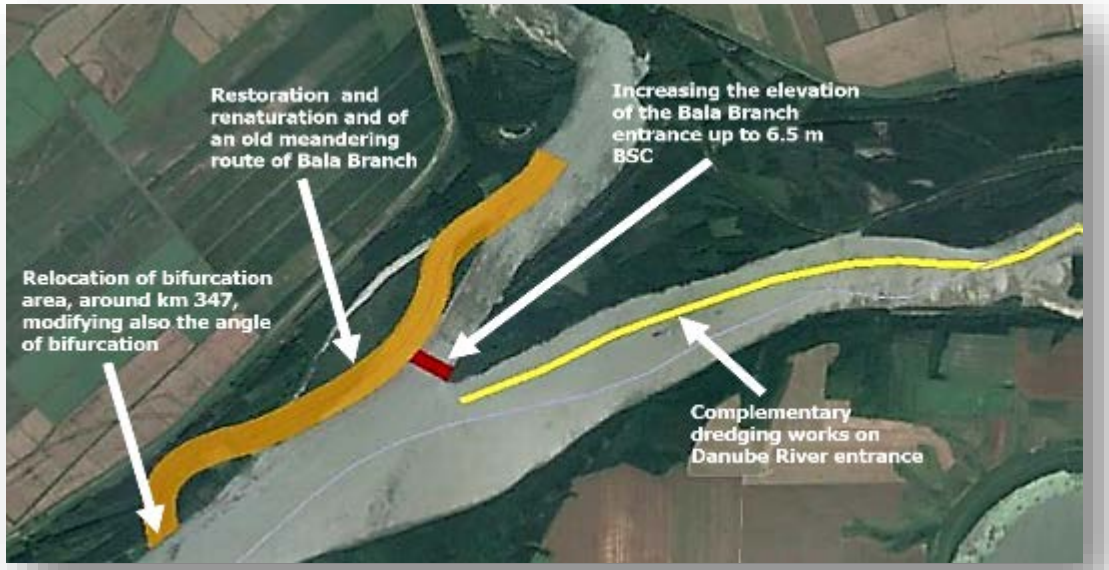
Alternative 1 - Extra roughness on the guiding wall + reduction of Bala inlet attractiveness

Jürg Bloesch (IAD, 2013) proposed alternative solution

Alternative 2 - Redesign and optimisation of the bifurcation, with a hydraulic control structure on Bala inlet

Georg Rast (WWF, 2014) proposed alternative solution

J.S. PRINCIPLES … interdisciplinary planning teams



Alternative 9 – Renaturation and restoration of Bala diversion area

BOKU team 2015 through following references:

- **Glock, K., Tritthart, M., Gmeiner, P., Pessenlehner, S., Hauer, C., Habersack, H. (2015): Numerical analysis of the effects of engineering measures on the Lower Danube. 36th IAHR World Congress, Den Haag, Netherlands, 28th June – 3rd July, 2015**

- **Habersack, H. (2015): River Engineering Alternatives. 2nd Stakeholder Workshop Bala Branch, Bucharest, Romania, 7th October, 2015**

J.S. PRINCIPLES … transparent planning process

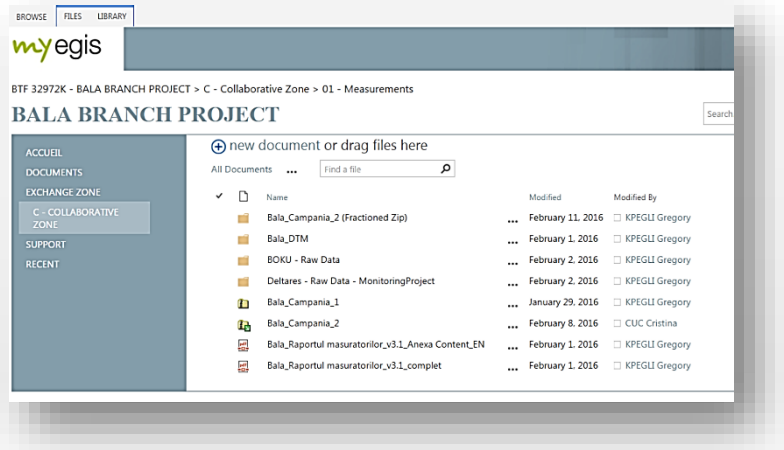
7 Workshops: EC, Romanian authorities,

ICPDR, NGOs, Industry:

- **June 2012**
- **February 2013**
- **July 2013**
- **October 2013**
- **May 2015**
- **October 2015**
- **May 2017**

EGIS team have created since February 2016 an online platform -information and COLLABORATIVE ZONE :

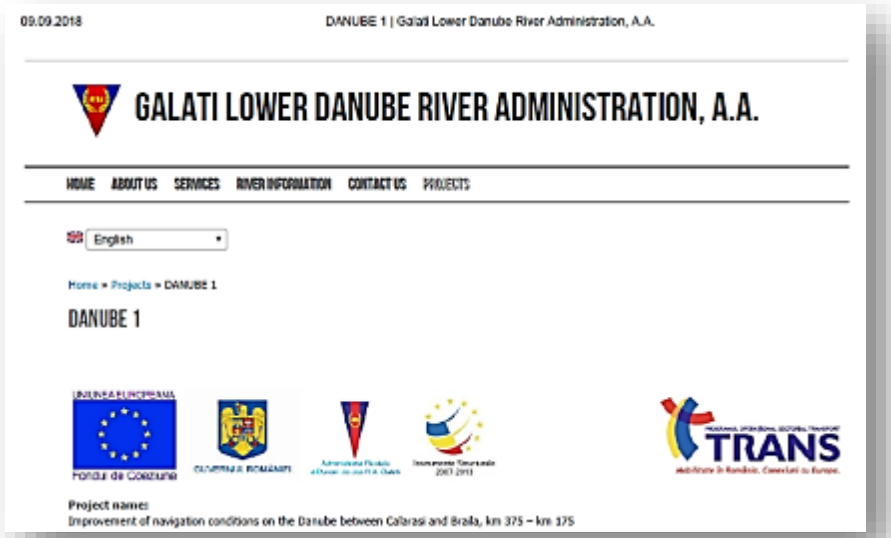
- **Alternative solutions reports**
- **Measurements data**
- **Consultant (EGIS – CNR) measurements data**
- **Measurements report**
- **BOKU Raw data**
- **DELTARES Raw data**



https://pro-europe.egis.fr/water/ROU/BALA/C__Collaborative_Zone

download or upload content, or review and comment documents online.

J.S. PRINCIPLES … transparent planning process



AFDJ Galati.
http://www.afdj.ro/en/content/danube-1

http://www.afdj.ro/en/content/romomed

all environmental reports of the monitoring team are on the AFDJ website: http://www.afdj.ro/ro/content/romomed, ro/eng,

all presentations from the 2nd and 3rd Workshop held on 2015 and 2017 http://www.afdj.ro/ro/content/dunare-1, ro/eng,

other relevant information on the INCDPM website www.incdpm.ro

J.S. PRINCIPLES … ensure the comparability of alternatives

Criteria analysis of the 9 alternative solutions –25 criteria:

- ✓ 10 for navigation
- ✓ 10 for environment
- ✓ 5 combined

Navigation issues:

- ✓ Minimization of navigation disruption during construction works
- ✓ Control of water flow distribution for a wide panel of discharges
- ✓ Conservation of navigation on the Bala branch
- ✓ Conservation of navigation on the Danube
- ✓ Limitation of construction complexity and costs
- ✓ Limitation of operation & maintenance complexity and costs
- ✓ Minimization of uncertainties in terms of effective hydraulic efficiency
- ✓ Minimization of construction-related hazards
- ✓ Availability of needed technology
- ✓ Ability to self-functioning

J.S. PRINCIPLES … ensure the comparability of alternatives

3

Environmental issues:

- ✓ Conservation/restoration of fish migration
- ✓ Limitation of impacts on fish habitats in Bala branch
- ✓ Limitation of impacts on fish habitats in Danube
- ✓ Limitation of poaching risks
- ✓ Conservation/restoration of fluvial annexes
- ✓ Improvement of ecological conditions at Bala branch inlet
- ✓ Conservation/restoration of sediment continuity on the Bala branch
- ✓ Conservation/restoration of favourable morphological conditions on the Danube
- ✓ Conservation/restoration of favourable morphological conditions on the Bala branch
- ✓ Limitation of visual impacts and potential for landscape integration

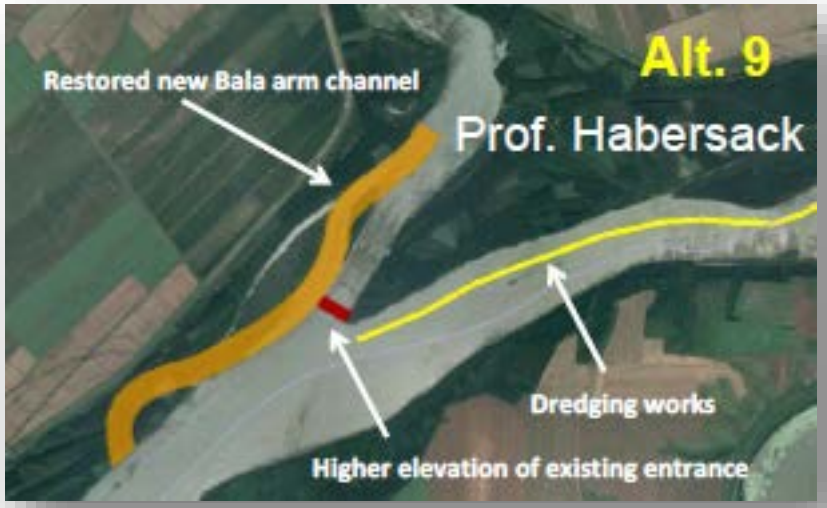
Mixed issues:

- o Control of sediment flow distribution
- o Limitation of dredging needs in the long run
- o Control of Bala branch channel incision
- o Control of Danube channel aggradation
- o Flexibility and adaptation capacity of the structure throughout time

J.S. PRINCIPLES … ensure the comparability of alternatives

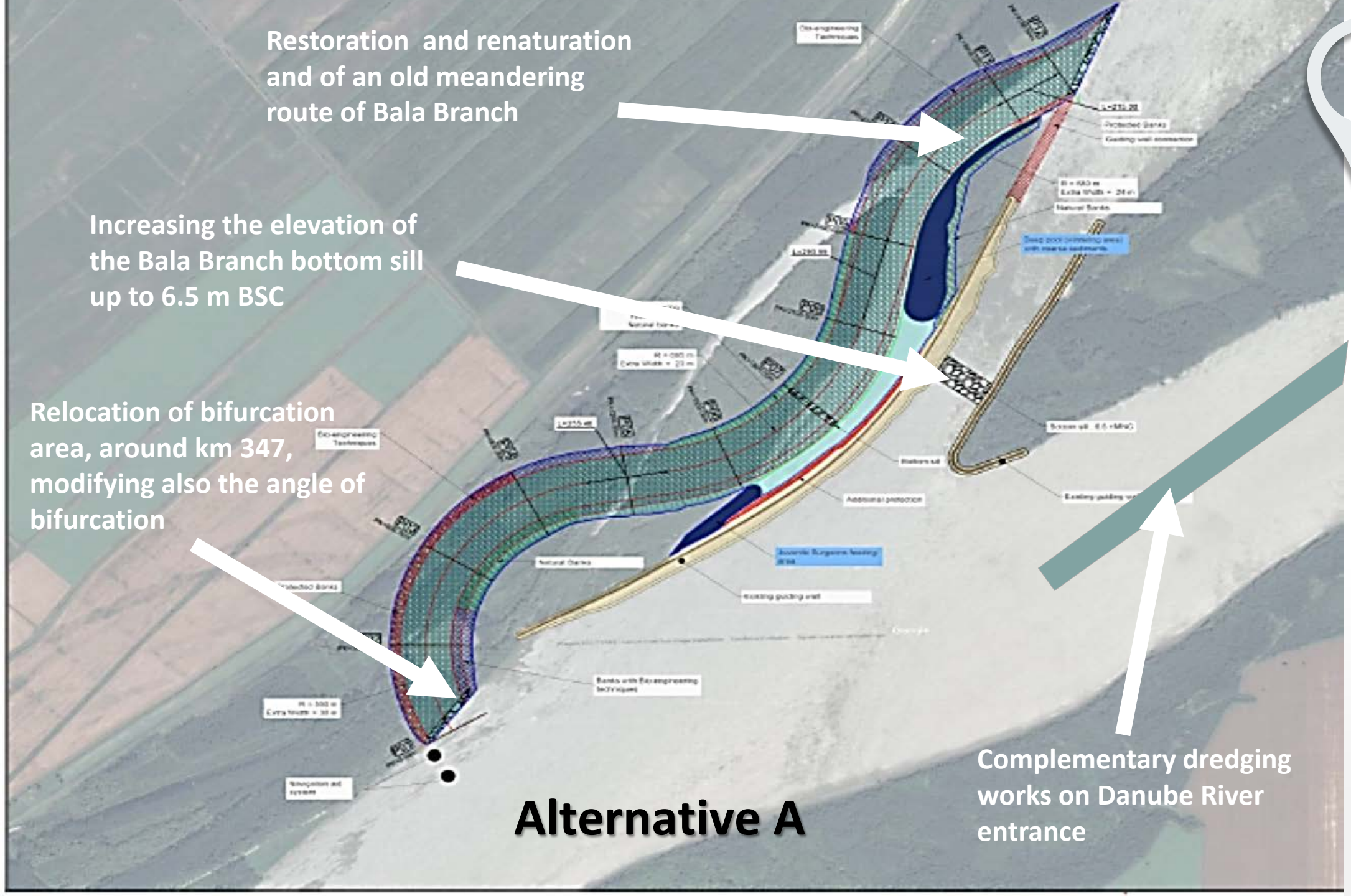
2 Preferred solutions derived from SWOT & multicriteria analyses have been modelled 3D:

Alternative A



Alternative B

Restoration and renaturation of the Bala branch bifurcation to ensure navigation and environmental protection



J.S. PRINCIPLES … depth and width of fairway

continuity availability of sustainable and efficient navigation conditions

4

Restoration and renaturation of the Bala branch bifurcation to ensure navigation and environmental protection –**outcomes according to 3D modelling :**

- ✓ **increase of the discharge towards the Old Danube by about 168% for Q = 2000 m3/s. This percentage decreases with increasing upstream discharges. Based on comparison with 2015, this alternative ensures up to 51% increase of the discharge into the Lower Old Danube at a discharge of Q = 2000 m3/s**

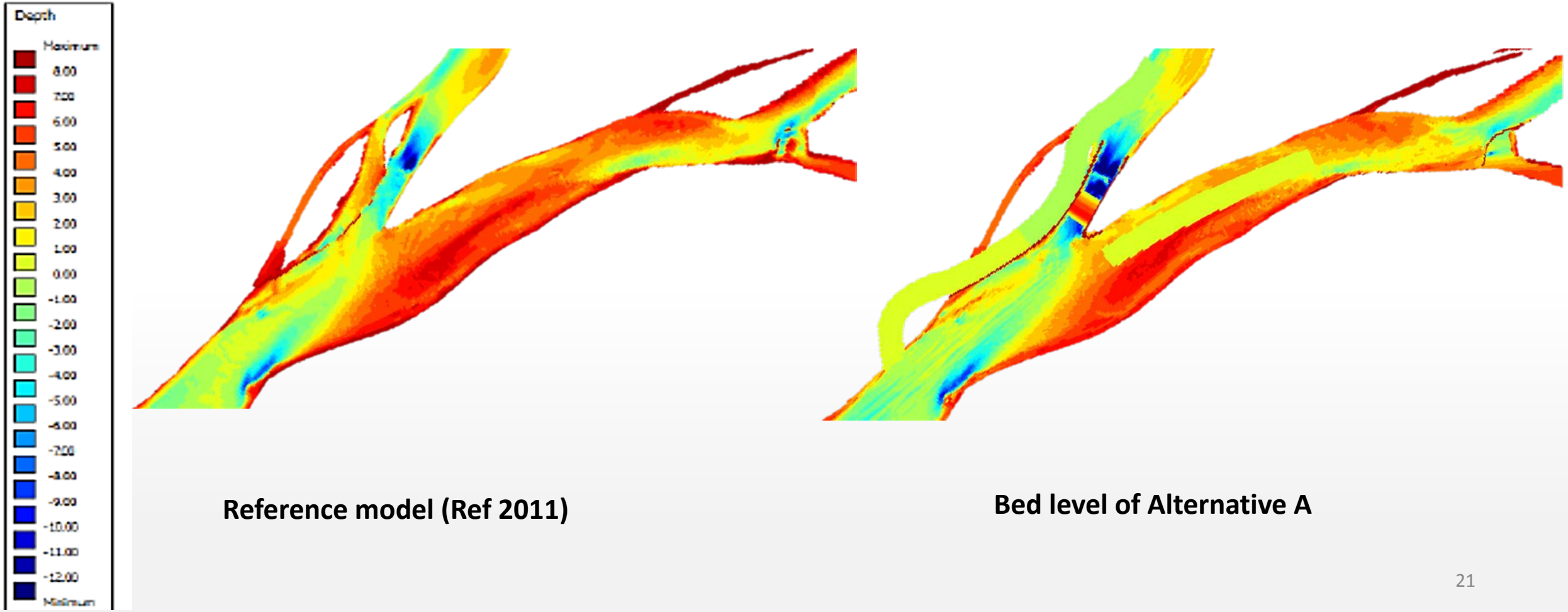
- ✓ **the water level and flow depth in the Lower Old Danube also increase up to 1.05 m on the Old Danube.**

- ✓ **an increase in depth-averaged velocity in the Lower Old Danube.**
- ✓ **The higher the discharge, the less the increase.**

J.S. PRINCIPLES … depth and width of fairway

continuity availability of sustainable and efficient navigation conditions

Restoration and renaturation of the Bala branch bifurcation to ensure navigation and environmental protection –outcomes according to 3D modelling :



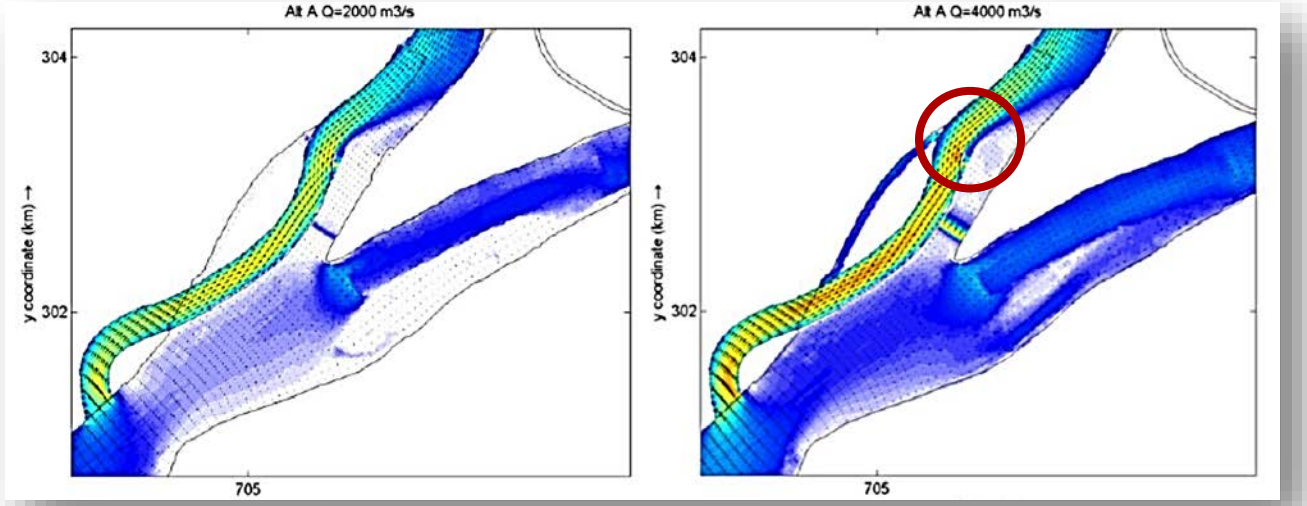
Reference model (Ref 2011)

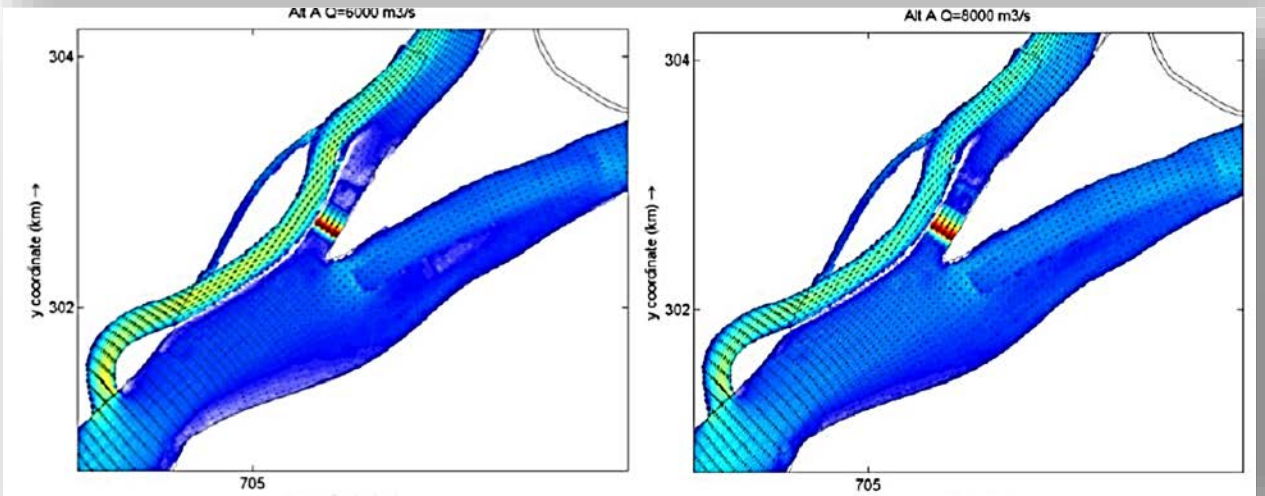
Bed level of Alternative A

J.S. PRINCIPLES … depth and width of fairway

continuity availability of sustainable and efficient navigation conditions

Restoration and renaturation of the Bala branch bifurcation to ensure navigation and environmental protection





VELOCITIES m/s–outcomes according to 3D modelling : Between 1.0 to 1.8

During the discharge of 4000 m3/s the velocities can reach in some locations 2 m/s.

J.S. PRINCIPLES … depth and width of fairway

continuity availability of sustainable and efficient navigation conditions

Renatured branch:

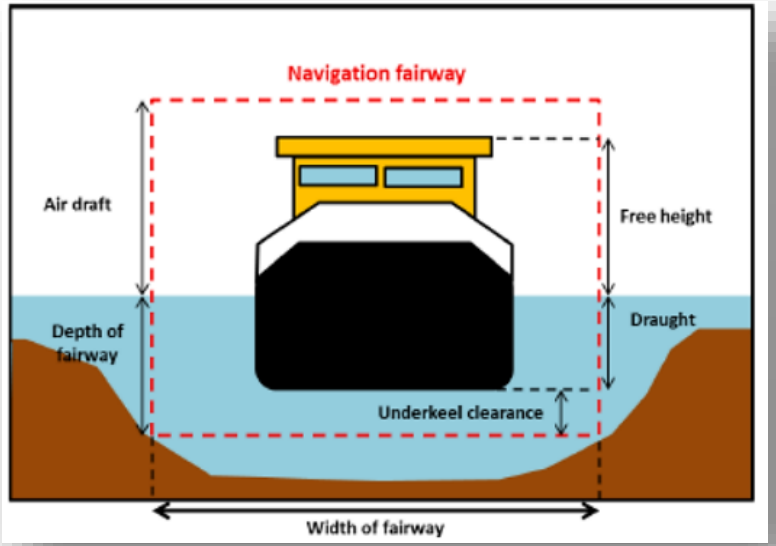
- Length ~3200 m;
- Bottom channel width : 200 m;
- Bank slope fixed at 3H/1V;
- Inlet elevation : 0 m BSC;
- Outlet elevation : -0.5 m BSC;
- Roughness coefficient Strickler 25.

For navigation:

Branch layout characteristics:

- Minimal curvature radius R = 550 m
- Extra width in the curve 16000/R;
- Straight alignment between 2 curves 255 m

Navigation fairway and branch characteristics for class VI (length: 185 m, breadth: 11,4 m)



Characteristics	Value
Navigation fairway	
Width of fairway	38 m
Depth	4 m
Channel	
Width at the bottom	34 m
Depth	4.50 m
Bank slope	3H/1V

LESSONS LEARNT

in project implementation

1. “Doing nothing is not an option”

- ✓ maintenance dredging performed even consistently doesn’t solve the problem
  - 7 m difference between Bala Branch and Old Danube bed levels (modelling 3D Results: Prof. H. Habersack and Boku Team, DELTARES),
  - independent tendency of Old Danube for sedimentation (DELTARES: in 50 years simulation period: the river won’t reach equilibrium, the discharge distribution at the Bala bifurcation is not stable and does not become stable, the discharge in Lower Old Danube may decrease by 25%)
- ✓ the ecological flow needed for the sturgeon’s habitats on Old Danube can be affected (km 310 spawning habitat for stellate sturgeon)

2. Have a good and open planning

3. Listen to stakeholders opinions/proposals, consider their options

4. Assure the communication and transparency (half of information may lead to mistrust)

5. Fair play of the people involved

6. In the meantime, keep an eye on time, it’s passing quickly

Present Status: Environmental procedures

01 Notification of EPA - environmental permit July 2018;

02 EIA and AA reports - June 2019, EPA hasn't yet formulated observations ;

03 WFD Assessment WFD Article 4(7);

04 Revision of the Bala FS : new legislation, the alternative solutions proposed by NGOs and the ship owners will be 3D modelled together with other proposals.

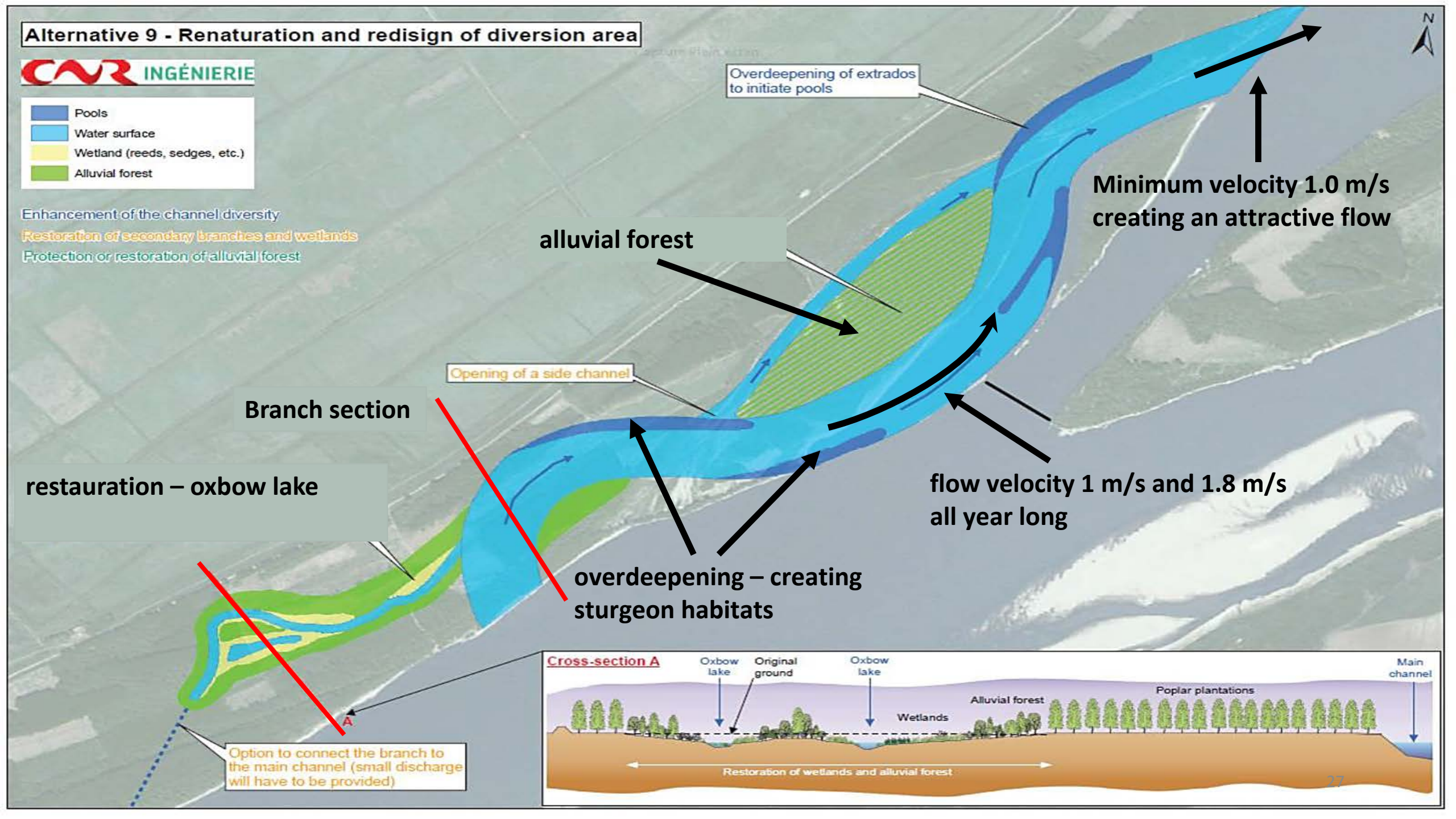
J.S. PRINCIPLES … dynamic equilibrium and adequate

connectivity conditions, longitudinal and lateral migration of fish

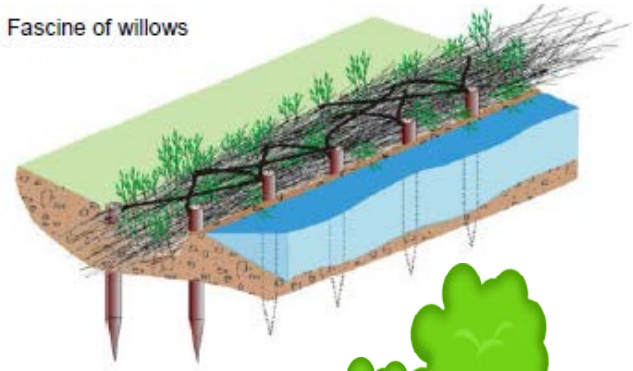
Project design key elements for sturgeons

The renatured branch – a good diversity for the flow, attractive flow velocities, water depths and areas adapted for reproduction, feeding and winter periods.

- ➔ Ichthyofauna exigencies, the flow velocity in the new branch must be between 1 m/s and 1.8 m/s all year long.
- ➔ Flow velocity under 1.8 m/s for sustained speed of upstream migration;
- ➔ Minimum velocity 1.0 m/s creating an attractive flow;
- ➔ A constant flow (i.e. with few turbulences) including resting areas during sturgeons migration as well as more lotic patterns;
- ➔ Channel bottom made of coarse sediments, with a wide grain size distribution (from about 20 mm to 300 mm and a median diameter around 150 mm).


Alternative 9 - Renaturation and redisign of diversion area
CAR INGÉNIERIE
Pools
Water surface
Wetland (reeds, sedges, etc.)
Alluvial forest
Enhancement of the channel diversity
Restoration of secondary branches and wetlands
Protection or restoration of alluvial forest
Overdeepening of extrados to initiate pools
Minimum velocity 1.0 m/s creating an attractive flow
alluvial forest
Opening of a side channel
Branch section
restauration – oxbow lake
flow velocity 1 m/s and 1.8 m/s all year long
overdeepening – creating sturgeon habitats
A
Option to connect the branch to the main channel (small discharge will have to be provided)
Cross-section A
Oxbow lake
Original ground
Oxbow lake
Main channel
Poplar plantations
Alluvial forest
Wetlands
Restoration of wetlands and alluvial forest

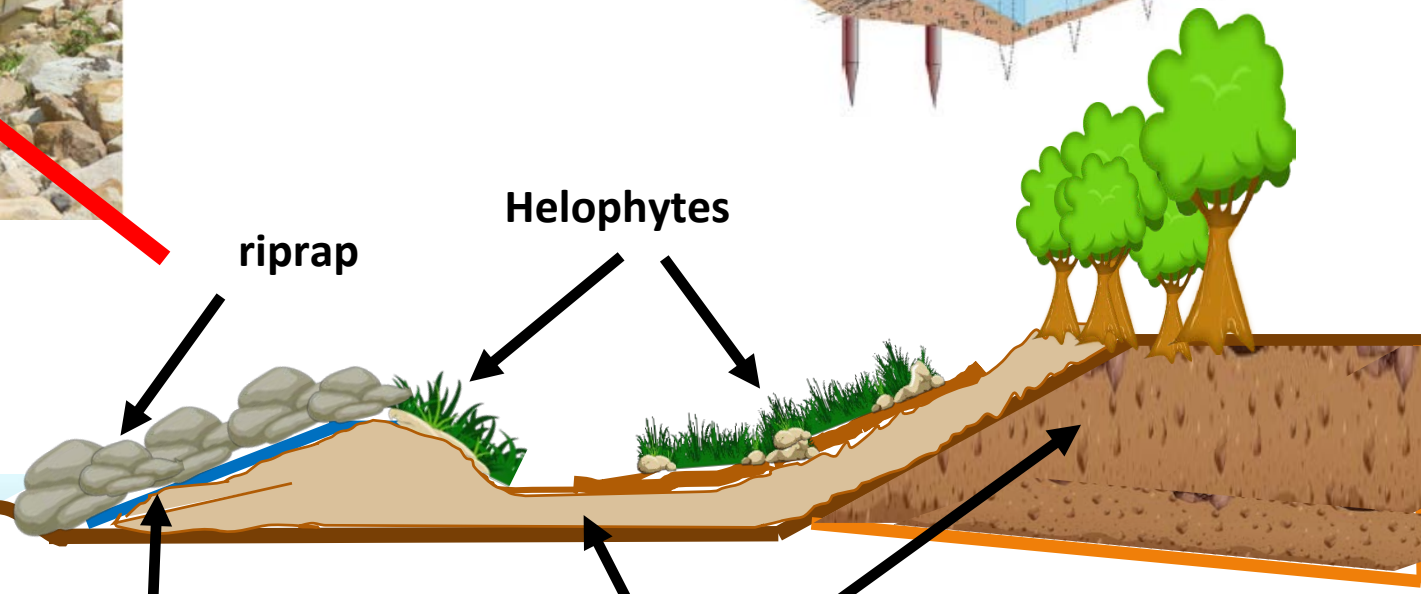
Fascine of willows



Not a fish pass nor a concrete based navigation channel.

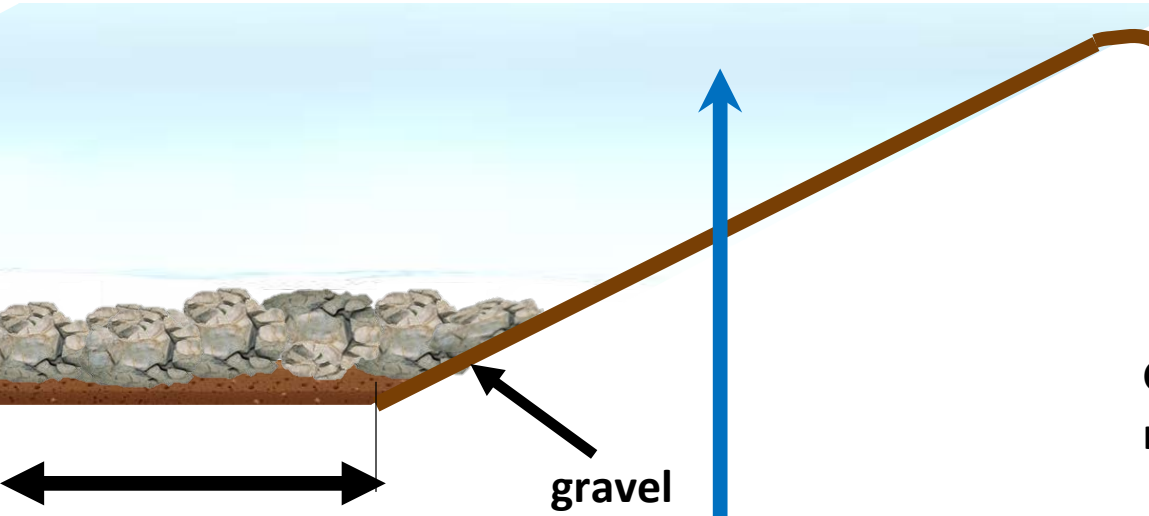
riprap

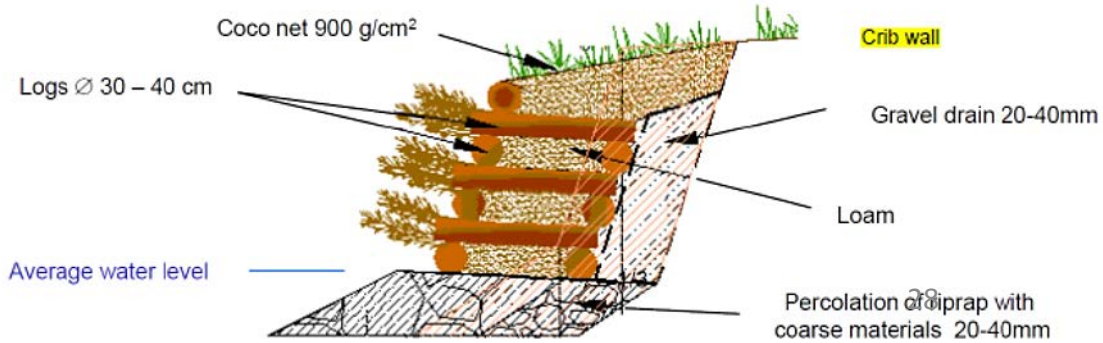
Helophytes

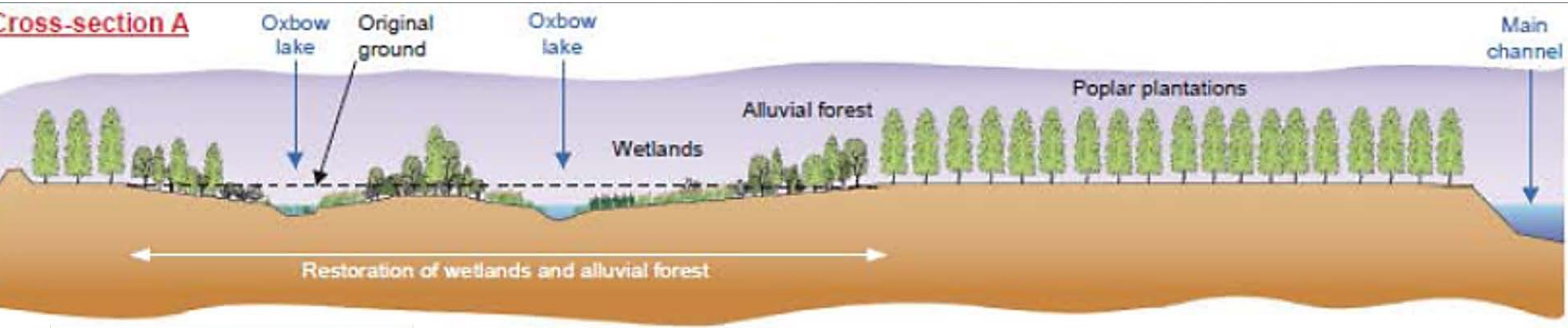


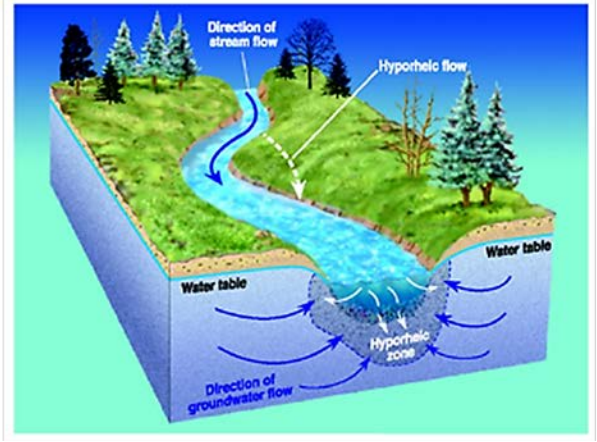
fine sediments

Geotextile membrane

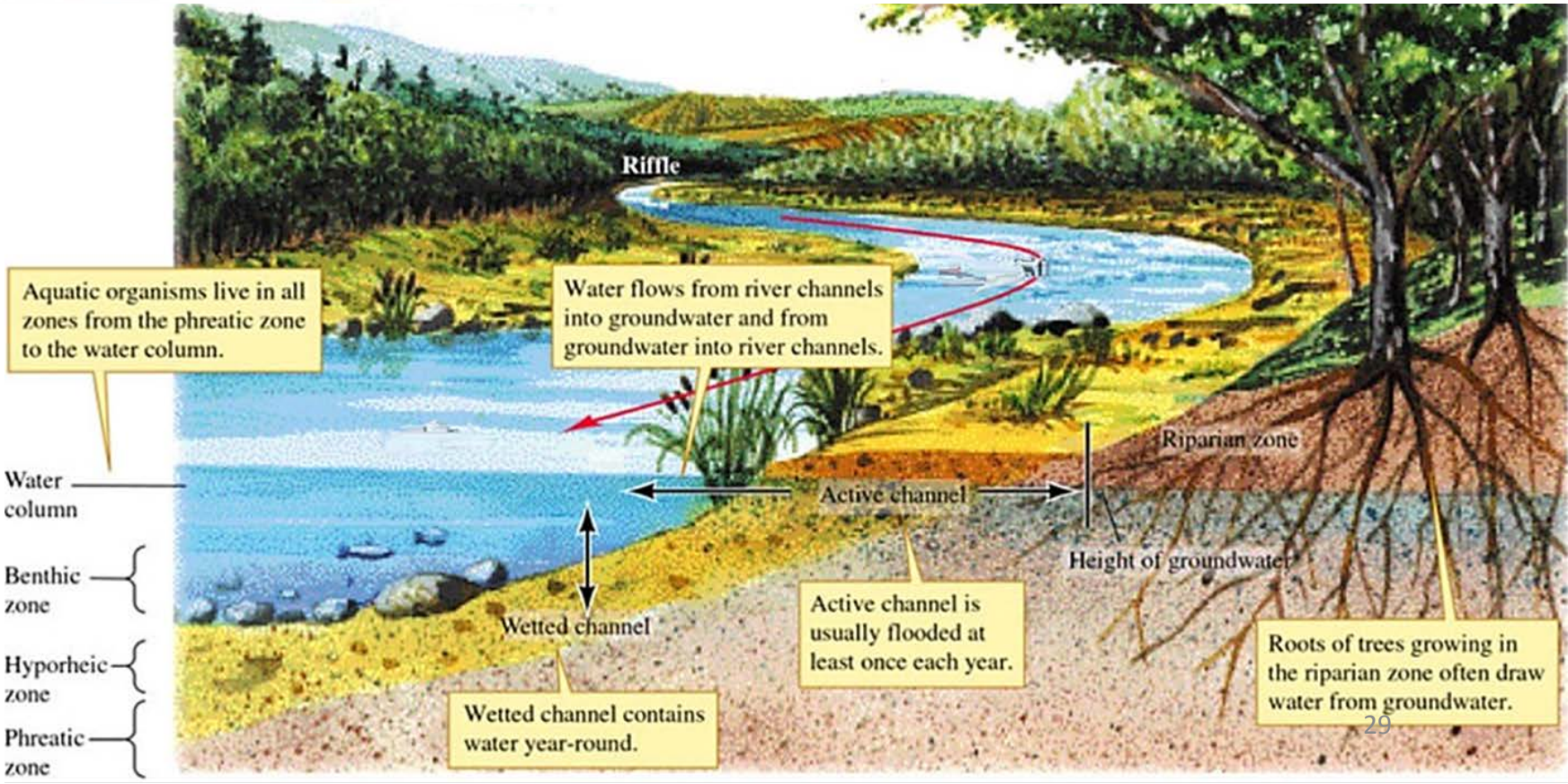




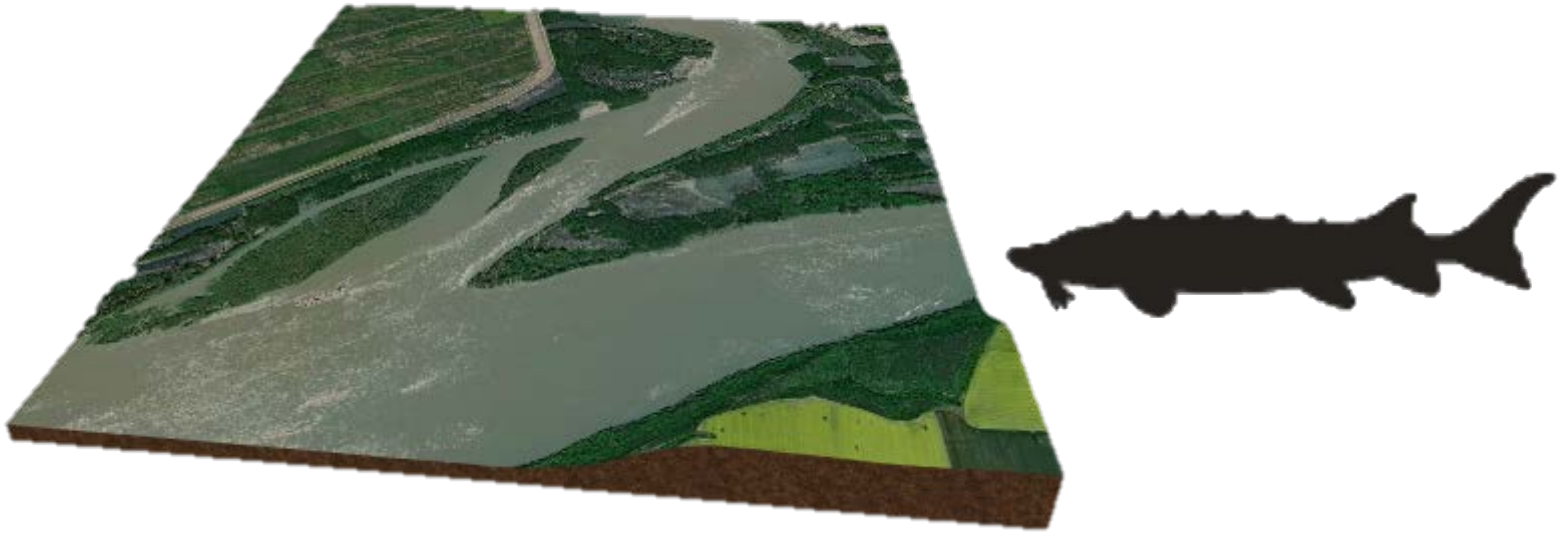




Hyporheic zone - portion of the groundwater interface in streams where a mixture of surface water & groundwater can be found (Bencala 1993)



Evolution of Danube Delta



THANK YOU FOR YOUR ATTENTION !

Catalina DUMBRAVA
Carmen ANDREI
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Galati 32, Portului St., Galati, Romania
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