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)
  – List of navigational constraints
• 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

Distance [km]
Depth [m]
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

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  - General principles of preliminary proposed strategies
  - Definition of scenarios
  - Alternative Development Strategies
- Conclusions
## Traffic Study

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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
- 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)
• 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!
Contents

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• Partial results
  – General principles of preliminary proposed strategies (type of measures)
  – Definition of scenarios
  – Alternative Development Strategies
• Conclusions
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 Opjinen, The Netherlands)
• 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)
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

- Autonomous Scenario (AS)
- No overdepth Scenario (NOS)
- Basic Scenario (BS)
- Climate Change Scenario (CCS)
- Enhanced Engineering Scenario (EES)

Effect of climate change:
- CCS

Effect of overdepth:
- BS

Effect of dredging:
- AS

Effect of structures:
- NOS

Variants:
- Variant 1
- Variant 2
- Variant 3
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 m$^3$

• Basic scenario (BS)
  – ENR-2.5m and foresee an over-depth of 0.50m
  – Capital dredging 2.2 million m$^3$
Scenarios

- **Enhanced Engineering Scenario** (EES)
  - ENR-2.5m and NO OVERDEPT 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 OVERDEPT 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

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### Cat 0
- Nothing

### Cat 1
- Realignment n/a.

### Cat 2
- Realignment n/a.

### Cat 3
- No significant dredging.
- Significant dredging.

### Notes
- No significant capital dredging.
- Significant capital dredging.
Critical sectors with significant works
Effects on water levels. Variant 1

26 Mishka Island

17 Vardim Island
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.