

THE IMPACT ON LANDSCAPE GENERATED BY WORKS OF IMPROVING THE NAVIGATION CONDITIONS ON DANUBE BETWEEN CALARASI - BRAILA

PETRONELA-SONIA NEDEA, EMILIA PASCU, OANA MARIA MILEA

Faculty of Touristic and Commercial Management, "Dimitrie Cantemir" Christian University, Bucharest, Unirii Blvd, no 176, district 4, Bucharest, ROMANIA

petronela844@mail.com, pascu.emilia@ucdc.ro, o_rez@yahoo.com

Abstract:

The Danube is a strategic transport corridor for Inland Water Transport in Eastern and Central Europe. The section of the Danube, between Calarasi and Braila is an important section of the Pan-European Transport Corridor no. VII. It also ensures the connection of the Fluvial Danube with the Navigable Canal Danube - Black Sea and also with the Maritime Danube. On the Calarasi - Braila sector, the recommendations of the Danube Commission are to ensure a minimum navigation depth of 2.5 m and a width of the navigation channel of 160-180 m. The project called "Improvement of navigation conditions on the Danube between Calarasi and Braila" tries to combine creating optimal conditions of navigation on the above mentioned sector of the Danube with the preservation of the natural state of river. It also tries to ensure a reasonable use of a river through minimum human impact works. The proposed river improvement measures will eliminate navigational bottlenecks on a number of sections on the Danube. As a result, inland waterway traffic flows using one of these sections will be able to realise savings in transport costs. Landscape is dominated by Danube River, with a wide river bed, limited by banks covered with specific vegetation (deciduous trees, grasslands, together with sedges, riverside coppices with poplars and willows). Works designed for the improvement of shipping conditions along the Danube are developed in the minor river bed and are not extended to coterminous areas, but nevertheless damage of the natural environment cannot be denied.

Key words: Pan-European Transport Corridor no. VII, navigation improvement works, the impact on landscape

JEL classification: R, R4

1. Introduction - Danube: a strategic transport corridor

The Danube river basin is the heartland of central and Eastern Europe. The main river is among the longest in the world and the second longest in Europe. It has a total length of 2,857 km from its source at a height of 1,078 m in the Black Forest, Germany, to its delta on the Black Sea, Romania.

The watershed of the Danube covers 817,000 km² and drains all or significant parts of Germany, Austria, the Czech Republic, the Slovak Republic, Hungary, Croatia, Slovenia, Bulgaria, Romania, Moldova, Ukraine, Serbia, Montenegro, Bosnia and Herzegovina. The watershed represents 8 per cent of the area of Europe, and nearly 98% of the Romanian hydrographic network.

Between the source and the delta, the main Danube river falls a total height of 678 m and its character varies, therefore, from a mountain stream to a lowland river. Upstream of the Danube delta the mean flow of the river is about 6,550 m³/s with maximum and minimum discharges of 15,540 m³/s and 1610 m³/s respectively. About 120 rivers flow into the Danube, such as the Tisza and Sava which have their own significant flow. The section of the Danube, between Calarasi and Braila is an important

section of the Pan-European Transport Corridor VII, a unimodal Corridor and a part of the TEN-T priority axis no. 18 – Rhine/Meuse-Main-Danube inland waterway.

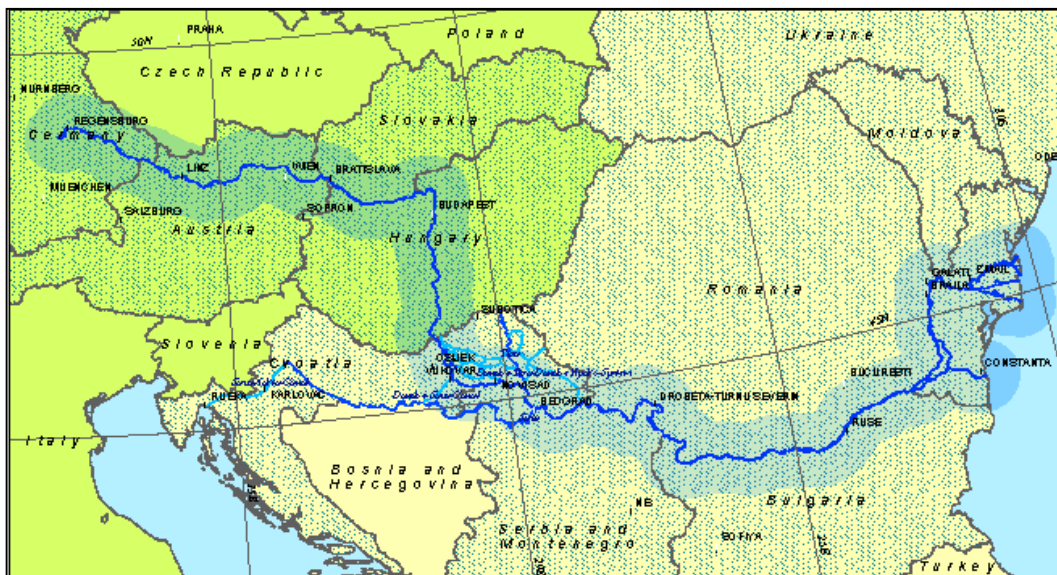


Figure 1. Pan-European Transport Corridor VII

Source: Pan-Eurostar. Pan-European Transport Corridors and Areas Status Report, Final Report, HB-Verkehrsconsult GmbH, Germany, VTT Technical Research Centre of Finland, 31 Jan., 2006, page 111

2. Geographical and administrative location

The section of the Danube, between Calarasi and Braila, is situated in the south-eastern part of Romania and represents the last 200 km of the fluvial Danube. More precisely, it begins on the Danube 5 km upstream the splitting of the Borcea branch, near the localities, Chiciu, on the Romanian bank and Silistra, on the Bulgarian bank. The end of the sector is also located on the Danube, right downstream from the confluence of the main branch: Cremenea (main Danube) with Macin branch.

From administrative point of view the studied Danube sector is located on the territory or on the borders of the counties: Calarasi, Ialomita, Braila and Constanta.

3. Morpho-hydrographical state of the studied region

The Danube sector situated between Chiciu - Calarasi and Braila, known also under the name of *the moors of Ialomita and Braila*, represents a particular area of the Danube valley, with a great morpho-hydrographical diversity. As a general aspect it's an alluvial plain, with a width that can reach 20 km.

Braila Moor is located between the Dobrogea tableland in the east, that dominates it with heights of 50 - 100 m and the Romanian Plain in the west situated 20 - 30 m higher than the river bed. The absolute altitude of the alluvial plain is between 6 - 7 m near Braila and utmost 14 - 16 m at Ialomita hydrant. So, in transversal profile the Danube valley in this sector has an asymmetric aspect, the altitudes decreasing from east to west.

In natural regime, the morpho-hydrographical structure of the moors is the consequence of a long river erosion and sedimentation action, having as result the development of a network of natural levees, bogs and channels, most of them having grounds that close basin areas in different sedimentation stages, invaded by vegetation and permanent or temporary covered with water.

The embankments in the alluvial plain area and the agricultural activities rushed the accumulation processes, manifesting the tendency of constructing alluvial flats, with a high decrease of the barrier basins. After the embankments a great part of the

lacustrine basins were drained, and in the lower areas where the infiltrations are abundant, fish farming basins were arranged.

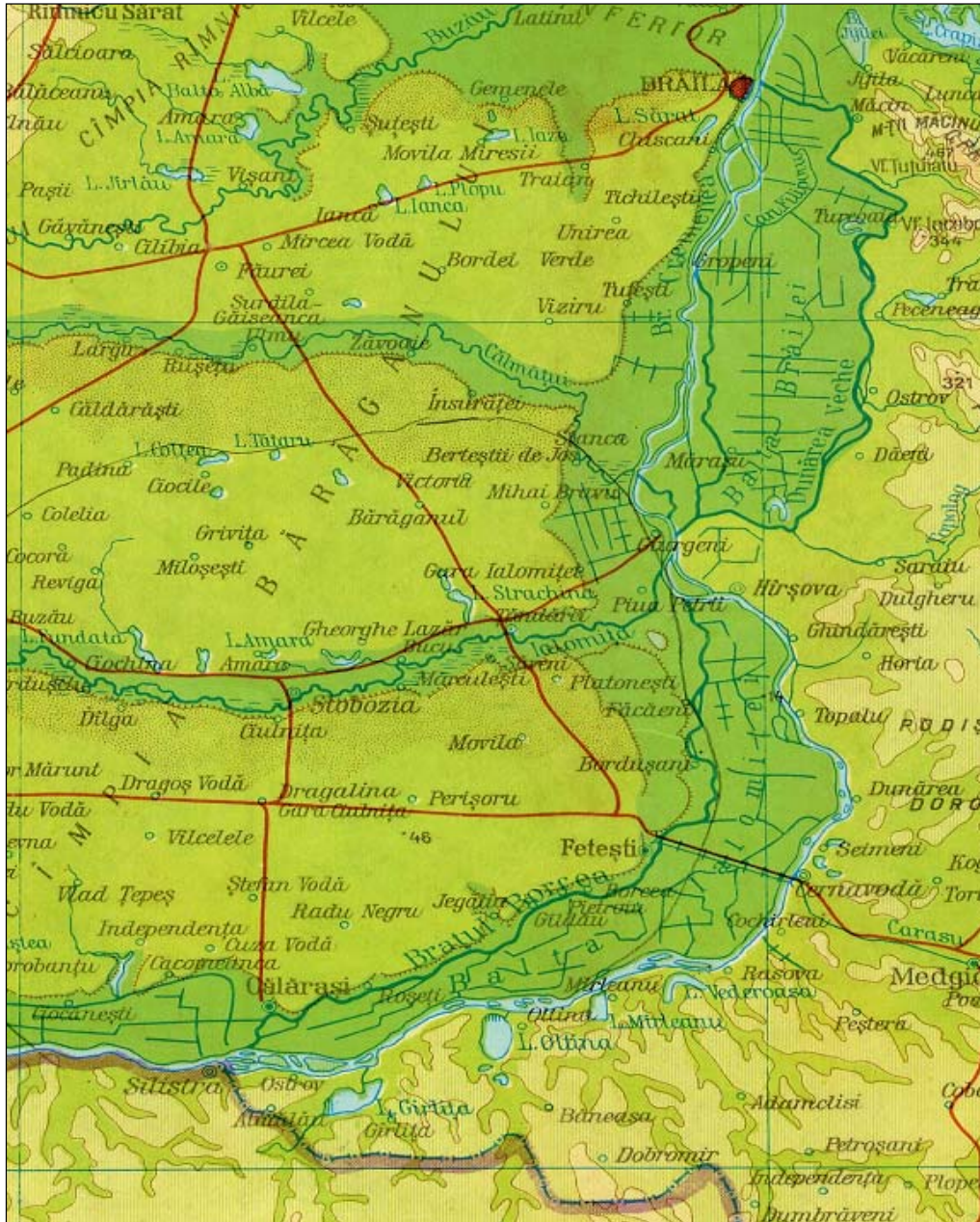


Figure 2. The map of the hydrographic areas Balta Ialomitei and Balta Brailei
Source: graphic processing according to the National Institute of Hydrology and Water Management

4. Sectors and their the main branches between Calarasi and Braila

The sector between Calarasi and Braila ensures the connection between river/fluvial Danube and the navigable channel Danube-Black Sea and with the seagoing Danube (downstream of Braila). It splits into two major sectors, each of them having several important branches:

□ **The sector Calarasi - Vadu Oii** is situated between Dobrogea tableland at east and the high plain of Hagieni at the west. This sector of the Danube, known under the name of Balta Ialomitei or Balta Borcei (which is located between the Borcea branch at west and the Old Danube branch at East) splits into the following main branches:

➤ **Borcea branch** in the west side, with a length of 110 km and an average width of 165 m on upper the Borcea and 350 m on the lower Borcea. The upper sector of the

branch is in an advanced stage of ageing, becoming navigable after incorporating with the Bala branch (on Borcea branch).

➤ **Old Danube branch**, on the east side of the moor; after detaching from Bala branch, the Old Danube manifests an evident tendency of atrophying decreasing slowly and continuously on the transversal area as well as on the depths. The change of the water flow in favor of the Bala branch and continuing on the lower Borcea, decreases the power of erosion and transport of the Old Danube branch. The alluvial activity is pointed out through the many islands that populate it as well as through the sand banks forming crests that make navigation more difficult. The morphometric elements of the bed are significantly different on the two sectors made by the detachment of Bala branch. The average width of the bed is 480 m at Izvoarele (upstream) and 380 m at Harsova (downstream), the looping coefficient is 1,45 and the unplinting coefficient is 2,00. The average depths are 12 m at Izvoarele and 8 m at Harsova.

➤ **Bala branch** detaches from the Old Danube; Bala branch has a length of 11 km, average breadth of 90 m and an average depth of 7.5 m. It is an active branch on which predominate the transport processes.

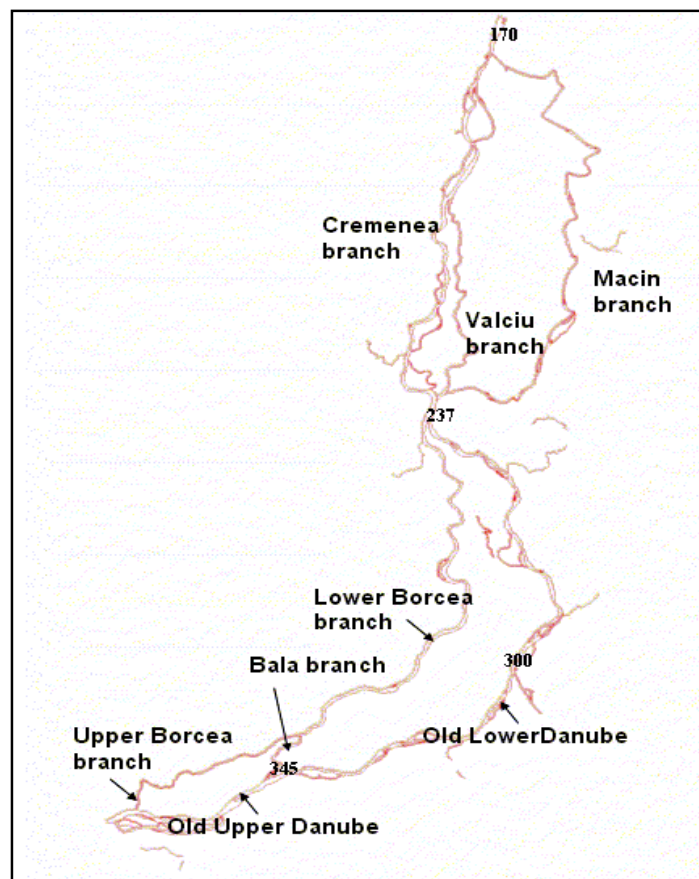


Figure 3. Names of most important branches on the Danube between Calarasi and Braila

Source: E.I.A., Technical assistance for the improvement of navigation conditions on the Romanian - Bulgarian common sector of the Danube and accompanying studies, Ministry of Transports of Romania

❑ **The sector Vadu Oii - Braila** is located between the Dobrogea tableland in the east and the down plain of Braila in the west, and has an elongated course from south to north. It is situated between Cremenea branch in the west and Old Danube or Macin branch in the east. This sector is known under the name of Balta Brailei or the Big Island of Braila and its main branches are:

➤ **Cremenea branch** in the west side, it is a navigable branch, with 70 km length and 550 m average width; From the Cremenea branch smaller branches are detaching,

that unite quickly with the main branch, like the Manusoaia branch with 9.3 km length and 120 m width and the Pasca branch with 17 km length and 250 m width.

➤ **Old Danube branch (Macin)** it spreads on a 96 km length and it unites with the Cremenea branch. The Macin branch is also in an advanced ageing stage; it is looped and has a great unplaining degree. Along it, many islands and submersible sand banks develop, that make navigation difficult.

➤ **Valciu branch**, the most important branch inside Balta Brailei, it detaches from the Macin branch at 3 km downstream Vadu Oii and unites the Cremenea branch at Gropeni. It has a length of 40 km and an average width of 220 m. Transporting a great amount of water, about 20% of the unique (main) Danube at Vadu Oii, Valciu branch had an intense alluvial activity, marked by the reinforced river ground (on the right side of the branch) with heights of 5-10 m above the bed, facts that allowed the development of localities inside the area: Marasu, Bandoiu, Ticau.

5. Necessity of taking measures to improve navigation conditions on the Danube between Calarasi and Braila

The section of the Danube, between Calarasi and Braila is an important section of the Pan-European Transport Corridor number VII. It also assures the connection of the Fluvial Danube with the Navigable Canal Danube - Black Sea and also with the Maritime Danube. On the Calarasi - Braila sector, the recommendations of the Danube Commission are to ensure a minimum navigation depth of 2.5 m and a width of the navigation channel of 160-180 m.

In the periods of summer-autumn, the water flows are considerably lowering on this river section, so that the navigation conditions are worsening very much. So, on the main branch of the Danube, namely the Lower Old Danube (between upstream river mouth of the Bala Branch, near Izvoarele and the river mouth of the Navigable Canal Danube-Black Sea, near Cernavoda), the minimum depth criteria is not met for an average period of 160 days/year, with an average navigation depth lowering at some critical points to 1.50 to 2 m.

For this reason, during these periods, the navigation can pass along the secondary branch of Bala-Borcea, which has a higher discharge and more water depth than the main branch, but which is also more restricted in width and more curved.

Using this by-pass, increases the distance between Calarasi and Cernavoda by about 105 km for traffic going to and from the Black Sea Canal. At the same time, because of the reduced dimensions of the navigation channel on Bala and Borcea and because of its sinuosity on some portions, the navigation must be carried out in a single direction. In addition, large convoys have to be disconnected and barges have to be passed, sometimes one by one.

Also, in the period of summer-autumn, at small and medium levels of the Danube waters, the navigation is carried out in difficult conditions because of the navigable constrains at the critical points from Cernavoda, Fasolele island, Alvanesti, Hirsova and Lupu islet.

For this reason, the ships assuring freight transport between the fluvial maritime harbours (Braila, Galati, Tulcea) as well as the Ukrainian harbours on the Danube and the Navigable Channel Danube-Black sea and Constanta Harbour, can not be loaded at their full capacity for a period of about 5 months a year.

This unfavourable situation for navigation is primarily caused by morphological and hydrological phenomena that take place in the zone of the branching off the Bala arm and have the following negative effects:

➤ evolution in time of the distribution of water flows between Bala arm and the Old Danube which influences negatively the main arm of the Danube (Old Danube) – towards Cernavoda - this takes over only 25- 40% of the total flow in draughty periods;

➤ continuous degradation of the Danube river bed (Cernavoda- Hirsova- Braila route) as result of the reduction of the water current energy and its capacity to transport sediments, which determined the formation of sand banks, eyots, secondary arms and the continuous reduction of the section of navigable channel;

➤ degradation of the Bala arm together with considerable bank erosion as result of a very powerful current.

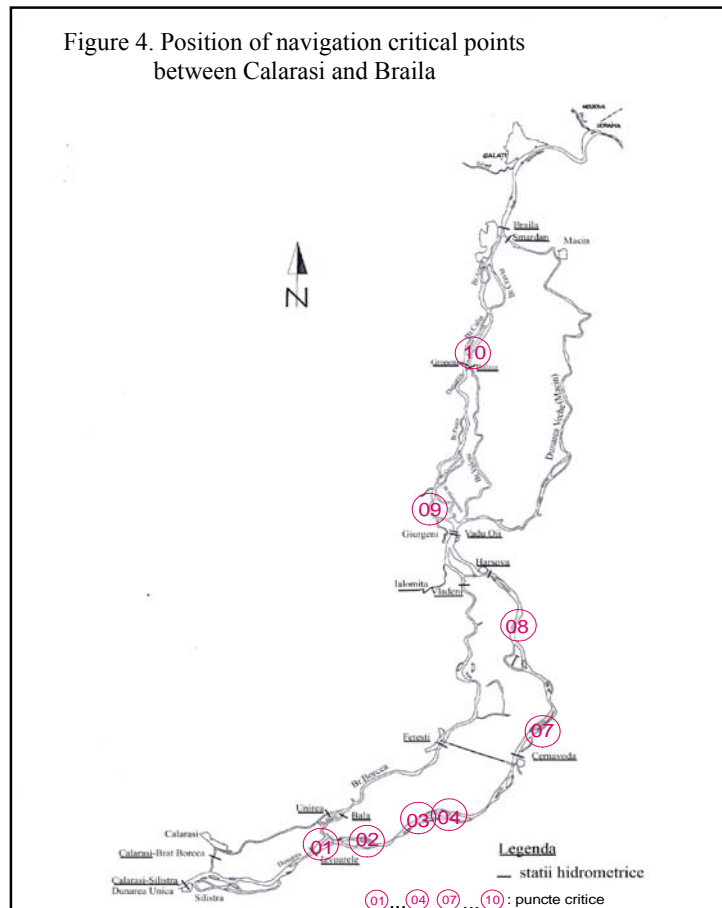
These phenomena are most probably accentuated by the existence, on the right bank of the Danube, of the Pirjoaia underwater rock outcrop, which triggers the orientation of the river flow towards the Bala branch. These phenomena were also favoured by the non-performance, in the last 50-60 years, of some necessary river training works as well as very limited maintenance dredging works in the mid nineties, in order to keep under control the evolution of Bala and Lower Borcea and of others sectors of Danube bed.

It shall be mentioned the fact that the reduction of the national and international traffic for the last 10 years have led to the reduction of the navigable depth on the Danube in these sectors as well as in others.

6. Position of navigation critical points between Calarasi and Braila

Location of navigation bottlenecks and available channel width and navigation depth are:

- | | |
|--|--------------------|
| 1. Caragheorghe Sand Bar | 6. Cernavoda |
| 2. Lebada | 7. Fasolele Island |
| 3. Marleanu | 8. Alvanesti |
| 4. Fermecatui Island (upstream and downstream) | 9. Harsova |
| 5. Cochirleni | 10. Giurgeni |
| | 11. Ostrovo Lupu |



The position of the 11 critical points that were identified (mentioned above) is presented in figure 4.

7. Natural setting characteristic to the Danube corridor

Landscape is dominated by Danube River, with a wide river bed, limited by banks covered with specific vegetation (deciduous trees, grasslands, together with sedges, riverside coppices with poplars and willows). Danube river meadow (between Braila and Giurgeni) is made up of slopes with numerous active or abandoned arms and lakes; the altitude increases from 5 m to 12 m.

The southern region of Balta Brăilei has the highest slopes (6-7 m) having the aspect of plains of 6-7 km and lacustrine regions are reduced. In the northern region, slopes have a width of 0.5 km, but there are a lot of streams and lakes. A great part of the river meadow was dyked between 1964-1970, named Insula Mare a Brăilei.

Limestone massifs, remainders of an old reef atoll are located in the region of Harsova. Podisul Oltinei (plateau) is made up of inter-fluviatic bridges with heights of 50-100 above the low river meadow of the Danube. Balta Ialomitei is developed on the left bank of the Danube, between Calarasi and Giurgeni, having arms with high slopes which enclose central dingles, divided into smaller basins.

8. The impact concerning the landscape and measures to eliminate or to reduce it

Firstly it should be mentioned that the works for improving the navigation conditions along the Danube between Calarasi - Braila sector are intended mainly to bring back this Danubian sector at the previous natural situation, environmentally more favourable. This situation will be accomplished in a first stage from the point of view of the flow regime and then of the landscape.

The area where the direct impact generated by the designed works is felt, is limited to the minor bed and banks of Lower Dunarea Veche, Bala and Borcea branches and are not extended to coterminous areas, but nevertheless damage of the natural environment cannot be denied.

So, the impact concerning the landscape consists mainly in:

- Works designed for the improvement of shipping conditions along the Danube are developed in the minor river bed and are not extended to coterminous areas;
- Sites for dredged material disposal represent a negative impact on the landscape;
- Bank protection works will bring an anthropization character to natural landscape; the bank protection works affect the riparian biodiversity and natural landscape, but the negative effects are compensated by stopping the land losses in the consolidated areas.

A measure to reduce the impact is planting decorative bushes ("hedge", for example) could be developed, in order to reduce the impact on the landscape, to reduce the visibility towards these regions, until natural vegetation is developed.

During the execution period the measures for eliminating or reducing the impact refer strictly to the compliance with the legal environmental protection provisions on the construction activity. These provisions include regulations on the yard development, domestic waste management, fuel storage, equipment supplyng, staff training, etc.

During the operation period a hydromorphological monitoring of the Danube bed on the developed sector is necessary. Such monitoring is very important for assessing the efficiency of developed works as well as for identifying and solving other critical points. The designed work execution is absolutely necessary to improve the navigation conditions and hydromorphological situation on the analysed sector.

9. Conclusions

The analyse of this important region of the Danube led to the conclusion that the works are necessary to establish a sustainable development of the area, by creating the previous natural condition more favourable to the natural landscape, due to a new distribution of the water flow between Bala and Lower Dunarea Veche branches as well as due to the waterway calibration dredging. Moreover, adequate shipping conditions with favourable economic conditions are ensured.

The improvement of navigation conditions on the Danube between Calarasi and Braila tries to combine creating optimal conditions of navigation on the above mentioned sector of the Danube with the preservation of the natural state of river.

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