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NEWADA

"NETWORK OF DANUBE WATERWAY ADMINISTRATIONS"

South-East European Transnational Cooperation Programme

STATUS QUO REPORT ON WATERWAY MAINTENANCE

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1. LIST OF ABBREVIATIONS

ABBR.	Abbreviation
EAEMDR	Executive Agency for Exploration and Maintenance of the Danube River
LNRL	Low navigation and regulation level

2. LIST OF FIGURES

3. SCOPE OF DOCUMENT

The main objective of Sub work package 4.1 is the preparation of a general status quo report on waterway maintenance. All partners have to prepare their national status quo reports and present them on a common meeting. Based on the final report the WP Team will identify the best practice cases in waterway maintenance.

The national status quo reports on waterway maintenance should contain information about river stretch characterisation, fairway parameters, hydrology, river bed measurements, signalization, dredging works, waterway maintenance during ice, low and high water level periods, etc.

4. INTRODUCTION

4.1. Responsibility for waterway, institutions – manage the navigational conditions

The Bulgarian stretch of the Danube River is from km 845.650 to km 375.000, enclosed between the right bank of the river and the demarcation line of the border between the Republic of Bulgaria and Romania (according to the Convention for determining the river border between Bulgaria and Romania of 1908).

Figure 1 - Danube River between Bulgaria and Romania

According to the bilateral agreement between the governments of the Republic of Bulgaria and the Republic of Romania regarding the maintenance and improvement of the navigational way in the Bulgarian-Romanian section of the Danube River, Sofia, 1955, the maintenance of navigational way in the common Bulgarian-Romanian section is performed by the competent authorities of the two countries as follows:

- Bulgaria is maintaining the section between km 374.5 and km 610;
- Romania is maintaining the section between km 610 and km 845.5.

The activities related to the maintenance and exploration of the river are conducted by the Executive Agency for Exploration and Maintenance of the Danube River (EAEMDR), which is a public authority within the Ministry of Transport, Information Technology, and Communications. EAEMDR is the only specialized organization in Bulgaria that carries

out the entire range of supporting activities for the maintenance of the waterway, the aquatory of the ports and the winter camps to ensure safe navigation in the Bulgarian section of the river.

The supervision of the shipping in the Bulgarian section of the Danube River is a responsibility of Executive Agency “Maritime Administration”, which is a public body within the Ministry of Transport, Information Technology, and Communications.

5. CHARACTERISTIC OF WATERWAY

5.1. River stretch characterisation

The Bulgarian stretch of the Danube, which is part of the Lower Danube, is along the right bank of the river starting from the outfall of the Timok river and reaching the city of Silistra downstream the Danube with total length of 471 km. This is the northern border of Republic of Bulgaria with Republic of Romania. The river in this section is typical lowland river, it becomes shallower and broader and has a big seasonal difference of water levels – more than 9 m. Steep sediment walls, in some places up to 150 m, characterise the Bulgarian river bank. The catchment area of the river increases with 105 000 km² 43 000 km² from which are in the Bulgarian sector (the Predbalkan Mountains, the north slopes of the Balkan Mountain and a part of the Rila Mountain).

Figure 2 – Danube River Basin

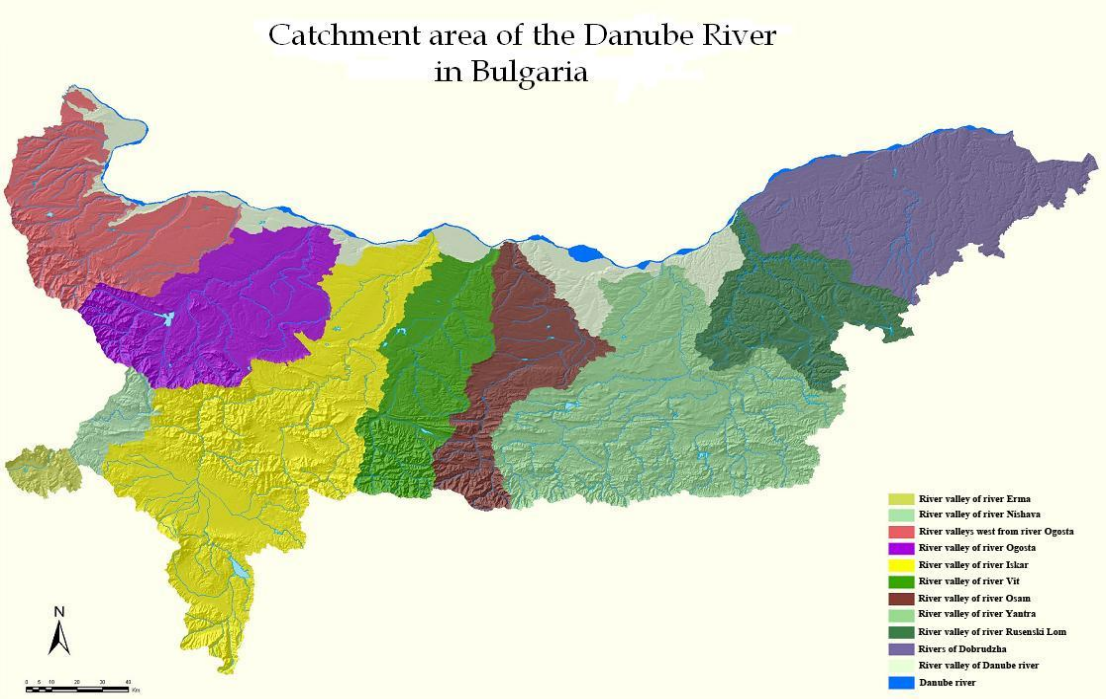

Figure 3 - Catchment area of the Danube in Bulgaria

The catchment area of the Danube River in Bulgaria includes the following river valleys:

- River valley of Erma River
- River valley of Nishava River
- River valleys west from Ogosta River
- River valley of Ogosta River
- River valley of Iskar River
- River valley of Vit River
- River valley of Osam River
- River valley of Yantra River
- River valley of Rusenski Lom River
- Rivers of Dobrudzha

The width of the riverbed in the Bulgarian section varies from 600m to 720m and is subject to constant changes. The influence of the local meteorological conditions, the existing soil types through which river passes, the riverbed configuration, the increase and decrease of the water and hard flow, the different river flow velocity influenced by the water formations, the hydrotechnical facilities and other natural forces and human

factors define the active hydromorphological processes of the river in this section. As a result of their activity the riverbed constantly changes its geometrical and hydrological parameters (situation of the midstream, direction and velocity of the flow, structure of the flow, terrain shapes in the riverbed, etc.). The average multiannual water quantity at the city of Silistra is 6300m³/s. The quantities, coming from the tributaries, are very small and don't have significant influence on the water levels. The major amount of water quantities, coming from the tributary rivers, is formed in the Upper and Middle Danube and the big feeders Sava, Drava, Tisa and Velika Morava. During low and average water periods, the water quantities in the upper Bulgarian – Romanian section are directly dependant on the mode of operation of the hydrotechnical complex Iron Gates and are characterised with large daily fluctuation. In some cases the differences between the water levels registered at 8 a.m. and the midnight water levels are more than 1 m.

About 15 critical for the navigation points appear during the low water periods. The most critical of them are in the regions of Belene, Vardim, Batin, Kosui and the village of Popina, where the riverbed is very wide and during the low water periods the water flow meanders, as a result of which a huge amount of sedimentation appears. As a whole the bottlenecks in this area are formed from fine sandy sediments because of which the mobility is very characteristic for them.

In compliance with the recommendations of the Danube Commission the parameters of the navigational way of the Bulgarian stretch of the Danube River stretch at LNRL are as follows:

- minimal depth – 25 dm;
- minimal width – 180 m; at the bottlenecks – 150 m;
- minimal radius of the curve – 1000 m; at the bottlenecks – 750 m;

6. WATERWAY MAINTENANCE

6.1. Main activities for waterway maintenance

6.1.1. General information about hydrology

There are 6 hydrometeorological stations located along the Bulgarian sector of the Danube River where a full range of meteorological and hydrological observations are performed. The locations of these stations are as follows:

- Novo selo – km 833.6;
- Lom – km 743.3;
- Oriahovo – km 678.0;
- Svishtov – km 554.3;
- Ruse – km 496.5;
- Silistra – km 375.5.

Figure 4 - Hydrometeorological station in Ruse

All these stations are within the Hydrology and Hydrometeorology Department of EAEMDR.

Figure 5 - Network of the hydrometeorological stations along the Bulgarian section of the Danube

The parameters that are collected and the frequency of the measurements are the following:

- Atmospheric pressure – 12 times per day;

- Speed and direction of the wind – 12 times per day and permanently in cases of decreased visibility;
- Visibility – 12 times per day and permanently in cases of decreased visibility;
- Type and quantity of clouds – 12 times per day;
- Air temperature – 12 times per day;
- Humidity – 12 times per day;
- Type and quality of penetration – minimum 6 times per day when it is raining;
- Water level – 1-3 times per day; in cases of flood threats more frequently;
- Ice appearance – permanently when appear;
- Water quantities – minimum 5 times per year;
- Water temperature – daily.

The data is submitted to the competent authorities in the other Danube riparian countries and to other interested users upon request. It is published every day on the website of EAEMDR (www.appd-bg.org), which is the owner of the data and is also stored on a digital bearer in ASCII and xls formats. On the basis of the collected data daily, monthly, annual and multi-annual prognosis are prepared. Daily forecasting of the expected water levels is done for Ruse and Silistra. These are short term forecasts – concerning the next two days. Every Wednesday a weekly forecast is prepared for the expected tendency in water levels change and the expected highest and lowest water levels for Ruse and Silistra.

6.1.2. General information about river bed measurements

The river bed measurements of the Bulgarian section of the river are performed by an expert team in the Hydrotechnical and Projects Department within the Executive Agency for Exploration and Maintenance of the Danube River.

Every year detailed hydrographical surveys of the critical sections are performed during the low water periods. If necessary, these sections are measured twice a year. Complete topographical and hydrographical surveys of the entire Bulgarian-Romanian section of the Danube River are performed every ten years not including the cases when it is needed. The last complete surveys were performed in the period 2004 –

2005. In order to monitor the hydrotechnical facilities (in the area of Ruse – Giurgiu Bridge) surveys are performed twice a year – during high and low water levels.

The surveying is done with the measurement positioning DGPS Novatell with positioning accuracy ±0.30 m and a single-beam echo sounder Marimatech with measurement accuracy ±0.01 m. Combining of the measurements is immediately done with the HydroNavigation module of the software product Trimble HidroPRO 1.0, which is installed on a laptop.The data is acquired and digitally stored in MS Excel and *.TXT formats. They are also entered in the data base server of the Agency. The information gathered for every site is stored in a special register as well.

The follow-up processing of data is done at the office using the HidroEdit module (Trimble HidroPRO 1.0), through which the gross measurement errors are removed and the necessary corrections regarding water temperatures and others are entered in the data.

The numerical terrain model is elaborated with the software packages AutoDesk Land Desktop 3.0 and Pythagoras. The terrain is displayed by levels and/or depths and the respective lines (horizontal and isolines) related to zero elevation of the closest gauge station on the Bulgarian riverbank and taking into account the incline of the water surface.

The so called Danube polygon is formed along the entire Bulgarian riverbank. The polygonal points are within the Bulgarian national coordinate and height systems. They are included in the National triangulation network. Currently EAEMDR is initiating a project related to the update of the supporting network for topo-hydrographic measurements for applying the GPS technology. The DGPS technology helps the survey needs by allowing the determination of additional supporting points for the referent station at locations which are suitable for the survey.

There is very good cooperation established with the Romanian side with regard to surveying activities related to river bed measurements. When there is need joint teams of Bulgarian and Romanian experts are formed. These joint teams carry out the surveys after which each side processes the measurements in the relevant geodesic systems of

its country and the result are approved by the Joint Bulgarian-Romanian Commission for the Danube River.

6.1.3. Bottlenecks

The navigation conditions in Lower Danube create significant navigation problems. As the river flows it carries a certain amount of silts, consisting of different in size and composition solid fragments, which form the sedimentation on the riverbed and the flooded riverbanks. The river silts are formed by the erosion products from the river bottom and the riverbanks. As a result of the river flow concaving in the riverbed, the depth erosion reaches its border balance which is characterized with the alternation of deep river sections and shallow ones representing sandbars and ridges. The bottlenecks in the Bulgarian section appear in the regions of islands and groups of islands, where the width of the riverbed suddenly increaces and during low water periods the river meanders and shifts a substantial ammount of floating and bottom silts.

Experience shows that there are no problems for ensuring the minimal parameters of the fairway in the regions where the width of the riverbed is up to 750 m.

A distinctive feature of most bottlenecks is the formation of sandbars towards the two riverbanks opposite to one another along the river. They are connected with bank silt called a saddle.

About 15 critical sections for navigation are located in the river section maintained by Bulgaria. Regular sailings and measurements at these sections are performed as the intensity reaches more than 240 days per year. The surveying and measurements of the depths are carried out by the hydrographic ship “Vit”, through visualizing the critical section and making pictures which show the depths of the relevant section, its width and the exact location of the minimal depths. On the basis of these measurements of the minimal depths the marking of the fairway in the critical sections is done. The following sections are the most critical and are demonstrated during different conditions:

- Region Somovit (km 610 – km 608) – This critical section is characterized with stability due to the influence of the Vit River estuary. The sandbars are stable.

According to the data gathered in 2008, the minimal depth has reached 18 dm and depths less than 25 dm were registered for a total of 10 days during 2008.

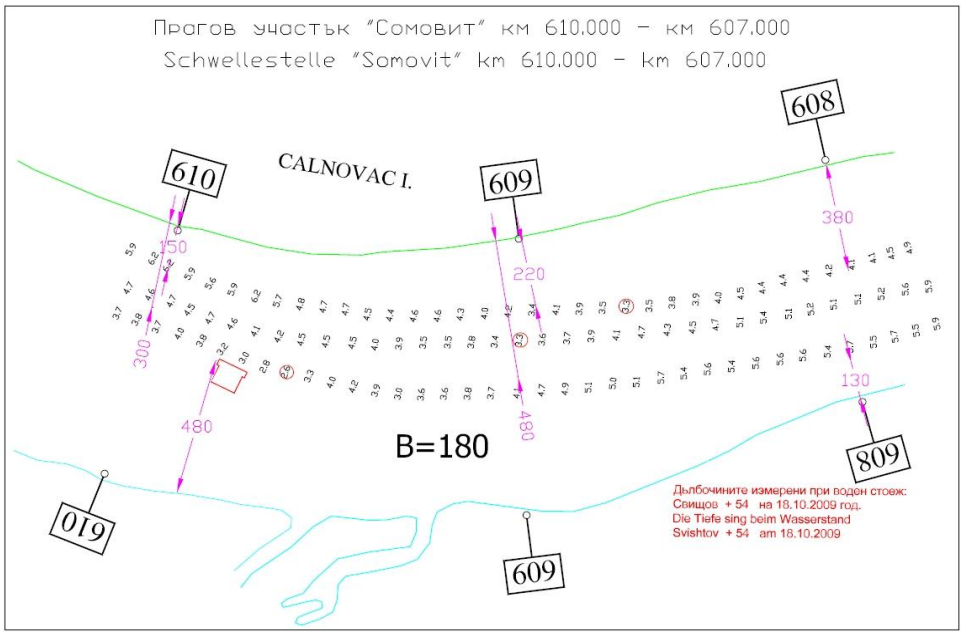

Figure 6 – Critical section Somovit

- Region Paletz (km 586 – km 584) – it is characterized with river bottom stability in the lower end of the Lakat Island. The minimal depth measured in 2008 is 17 dm. 22 days were registered with depths less than 25 dm in the region.

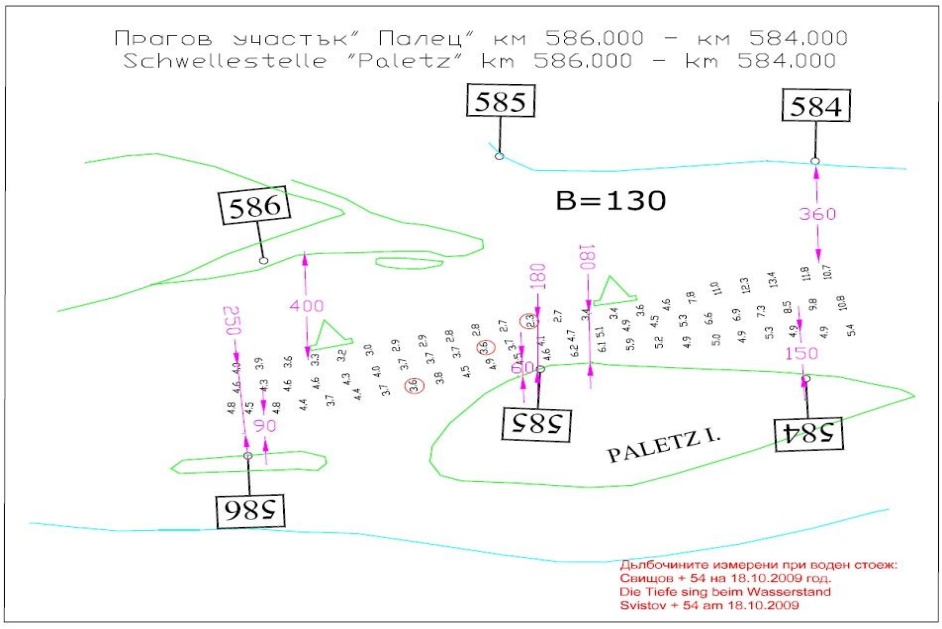

Figure 7 – Critical section Paletz

- Region G. Barzina (km 576 – km 573) – it is characterized with river bottom stability as the minimal depth for 2008 has reached 23 dm. 5 days with depths less than 25 dm were registered during 2008.

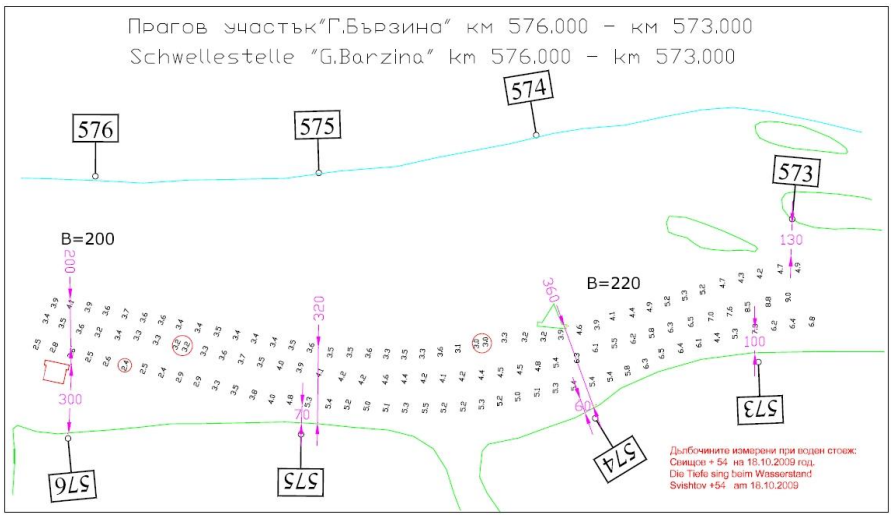

Figure 8 – Critical section G. Barzina

- Region Belene Island (km 568 – km 564) – the multiple control depth measurements have shown that despite the great mobility of sandbars forming the silts at km 564 the underwater relief configuration is generally the same which means that there is a relative balance between washing out and accumulation of silts. This critical section is a significant difficulty for navigation during the low water period. The minimal depth has reached 16 dm according to data from 2008 and there were 66 days registered with depths less than 25 dm during the same year.

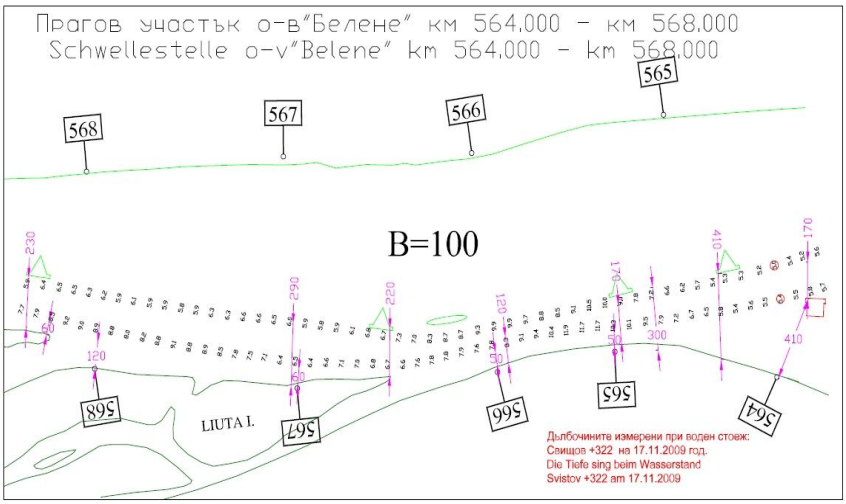

Figure 9 – Critical section Belene Island

- Region Condur Island (km 564 – km 560) – the control depth measurements show that the underwater relief configuration is preserved which means that there is a relative balance between washing out and accumulation of silts. According to data form 2008 there were 76 days registered with depths less than 25 dm as the minimal depth has reached 15 dm.

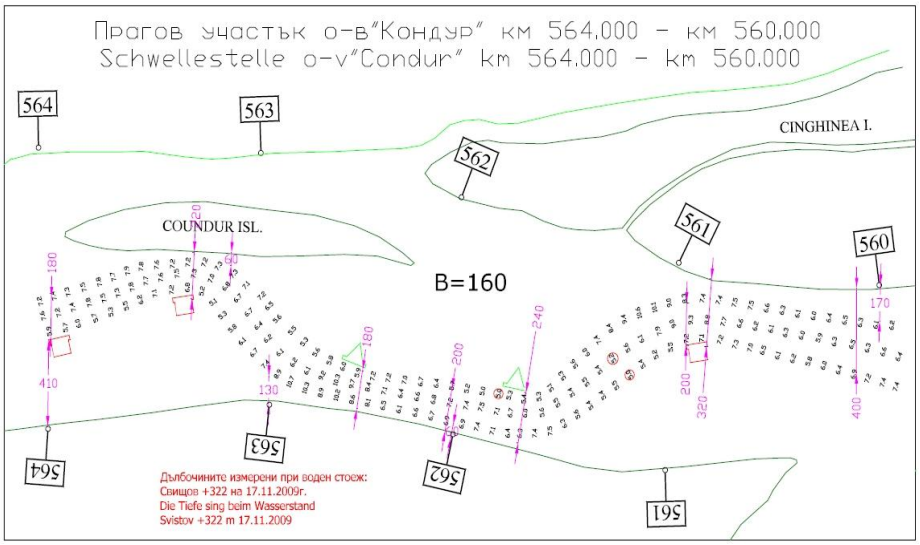

Figure 10 – Critical section Condur

- Region Vardim (km 546 – km 544) – this region is characterized with relatively stable sandbars. 74 days with depths less than 25 dm were registered during last year as the minimal depth has reached 16 dm.

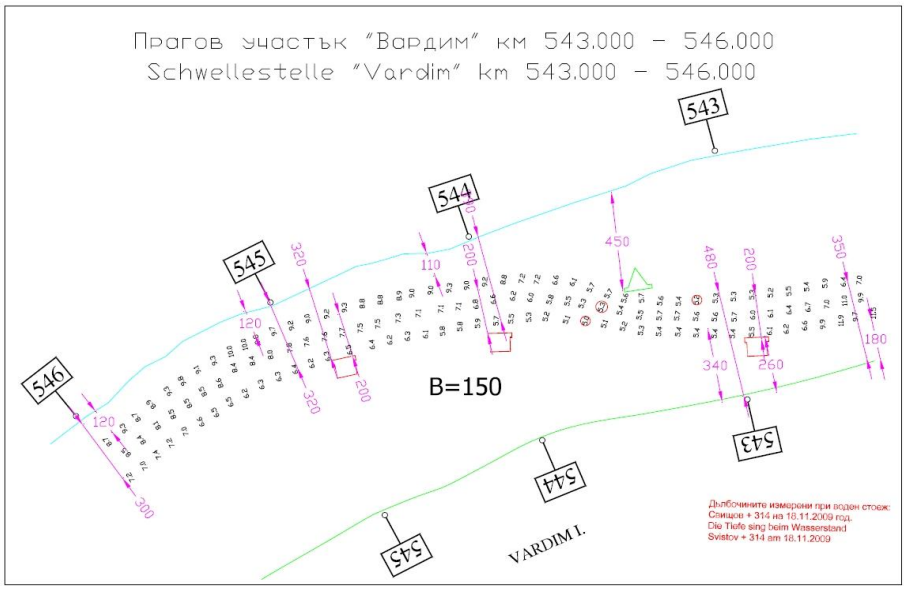

Figure 11 – Critical section Vardim

- Region Batin Island (km 526 – km 522) – It is characterized with relatively stable sandbars. 52 days were registered with depths less than 25 dm during 2008 as the minimal depth has reached 18 dm.

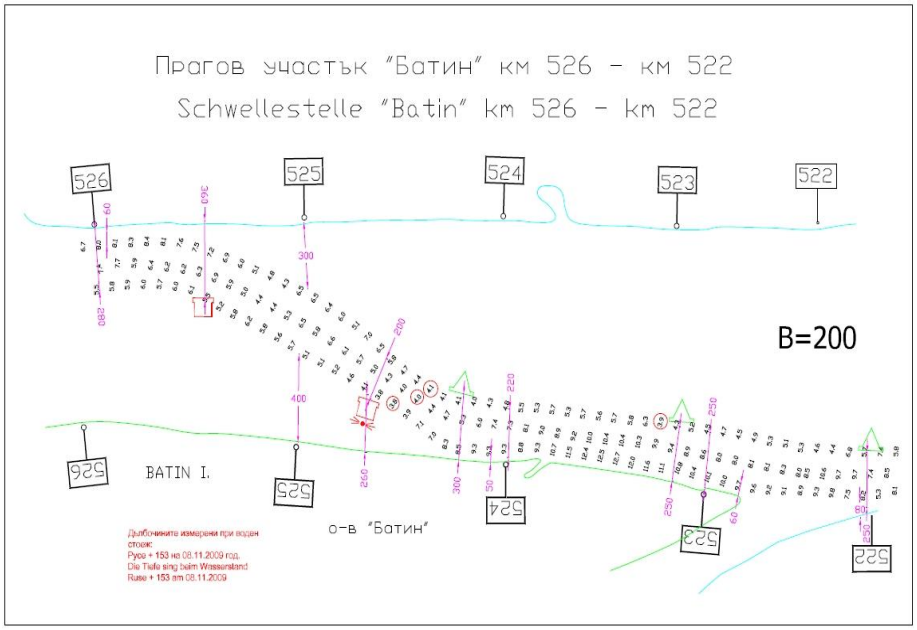

Figure 12 – Critical section Batin Island

- Region Kosui (km 426 – km 424) – the performed echo sounder measurements show accumulation of sandbars. During the last year 63 days with depths less than 25 dm were registered as the minimal depth has reached 15 dm.

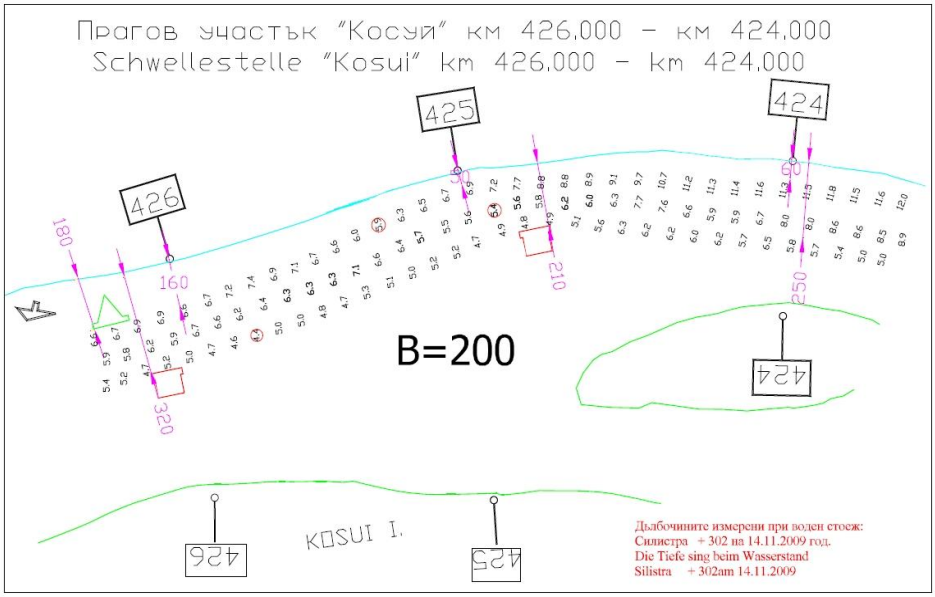

Figure 13 – Critical section Kosui

- Region “Popina” (km 407 – km 402) – there are serious morphological changes regarding the sills accumulation along the fairway as well as on the lower end of Garvan island. The sandbars are generally stable with little changes. The minimal depth reached last year is 20 dm and 44 days with depths less than 25 dm were registered.

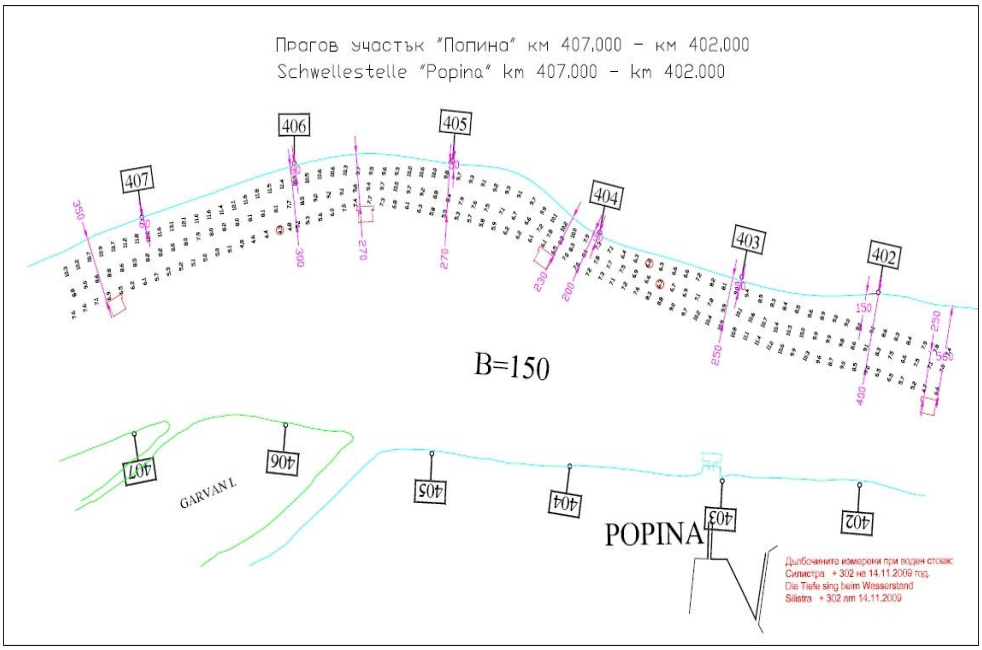

Figure 14 – Critical section Popina

EAEMDR owns a dredger and three self-propelled barges. The “Vida” dredger has a capacity of 150 m^3 per hour and the barges have load capacity of 381 tones. This equipment is used to perform dredging works at dangerous locations and access channels of ports.

The dredging data for 2008 are the following:

- Along the fairway – not performed
- Ports – 106 630 m^3
- Gaining of inert materials – 649 500 m^3
- New construction works – not performed

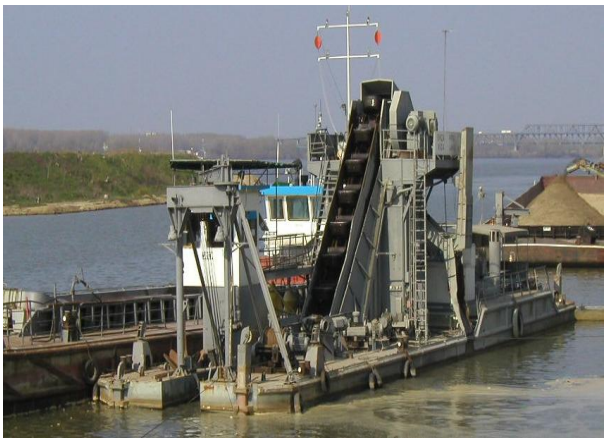

Figure 15 – The Vida dredger

EAEMDR considers that it is necessary to be developed a model for determination of the movement of the floating silts, their accumulation, quantity and type. As a beginning 10 samples from the river bottom in the “Belene Island” region have been taken and sent for processing to the laboratory of the University for Architecture, Construction and Geodesy. It is necessary to be provided equipment for gathering of water samples in order to determine the water turbidity and the quantity of the floating silts. It is also necessary to be provided a suction-tube dredger with bigger capacity in order to optimize the quantity of silts along the fairway and especially in the critical sections.

6.1.4. Signalization

The lateral signaling system (bilateral) is used at the Danube River as it is for most of the other rivers. The floating and coastal signs for maintenance of the navigational conditions are produced in the workshop of EAEMDR. Their production and installation are in compliance with the Danube Commission instruction for distribution and placing of navigational signs. Depending on the hydrological and meteorological conditions the optimal number of signs is determined which is sufficient to guarantee the safety of navigation and preservation of the signs themselves.

Concrete anchors and reinforced concrete posts needed for installation of the coastal signs are produced in the workshop of EAEMDR as well. Two concrete anchors are used for fixing the luminous floating buoys and only one for the non-luminous buoys. The concrete anchors are fixed with steel rope (13mm diameter), as the length of the rope is determined according to the depth of the section for which the buoy is used.

There is need the accumulators used for luminous buoys to be replaced with solar panels. To the current moment EAEMDR has bought several of these solar panels as the tendency is replacing most of the buoys accumulators with solar panels.

The hydrographic ship “Vit” is used to maintain the navigational conditions and if necessary the following ships are also used: “Dunav”, “Yantra”, “Kableshkov” and “Vidbol”.

Figure 16 – Installation of buoys

The mounting and dismounting of navigational signs on the navigational way is performed through the hydrographic ship “Vit” and for this purpose a notice for skippers is issued where all changes of the navigational conditions are described. On the basis of these notices a bulletin for the navigational conditions is prepared. Both the notice and the bulletin are published on the website of EAEMDR. Since this year the navigational signs are mounted through GPS positioning.

NOTICE TO SKIPPERS

№ 36

The skippers are notified that, from 16.11.2009 to 18.11.2009 there has been change of the navigational conditions in the bulgarian sections of the Danube

Area	Kilometre	Sign	Distance from coast		Depth to the sign	Water stage	Observation post	Date
			Left	Right				
Dismounted signs								
Batin isl.	522.000	green buoy	990	250			Rousse	16.11.2009
Batin isl.	523.200	green buoy	940	230			Rousse	16.11.2009
Batin isl.	524.200	green buoy	870	300			Rousse	16.11.2009
Batin isl.	528.000	red buoy	300	800			Rousse	16.11.2009
Iantra riv.	535.600	red buoy	480	440			Svishtov	18.11.2009
Gaska isl.	538.900	red buoy	600	570			Rousse	18.11.2009
Vardim isl.	542.700	green buoy	730	340			Svishtov	16.11.2009
Belene isl.	563.300	red buoy	170	500			Svishtov	17.11.2009
G.Barzina isl.	574.000	green buoy	610	360			Svishtov	17.11.2009
Paletc isl.	584.900	green buoy	480	180			Svishtov	17.11.2009
Sredniak isl.	589.800	green buoy	600	660			Svishtov	17.11.2009
Mounted signs								
Batin isl.	523.200	green buoy	1010	200	7.6	339	Rousse	16.11.2009
Belene isl.	563.300	red buoy	220	460	5.6	322	Svishtov	17.11.2009

Figure 17 – Notice to skippers published on EAEMDR website

Navigation condition

area	kilometre	sign	distance from coast		depth	water stage	observation post	date
			left	right				
Silistra	375.300							
Aidemir p.st.	382.000							
Chaika isl.	382.700		110	220	4.9	261	Silistra	17.06.09
Chaika isl.	384.000		520	180	7.4	341	Silistra	07.03.09
Aidemir p.st.	388.000							
Aidemir p.st.	388.000							
Aidemir p.st.	388.200							
Aidemir p.st.	388.300							
Vetren isl.	390.000		320	300	9.0	341	Silistra	07.03.09
Vetren isl.	391.200		560	200	3.0	118	Silistra	31.08.09
Vetren isl.	392.000		560	200	3.0	118	Silistra	31.08.09
Vetren isl.	393.400		300	320	9.1	341	Silistra	07.03.09
Vetren isl.	396.000							
Vetren isl.	396.000							
Vetren isl.	396.000							
Vereshti isl.	399.600		350	430	7.1	316	Silistra	06.03.09
Popina	401.000		570	560	3.6	223	Silistra	19.08.09
Popina	401.600		560	460	3.8	223	Silistra	19.08.09
Popina	401.900						Silistra	

Figure 18 – Bulletin for navigational conditions published on EAEMDR website

Regular sailings and measurements at critical sections are performed as the intensity reaches more than 240 days per year. The optimization of the navigational way is attained through the maintenance of adequate navigational conditions, surveying and timely corrections of the fairway. The navigational conditions are provided (at site) through an average of 90 floating and 734 coastal signs (including kilometrical), as well as through 14 beacons on the right side riverbank. During low water level periods the number of floating signs is increased. The fairway corrections are done by installing and dismantling of floating navigational signs as the last year numbers are:

- Installation of floating signs – 190 items;
- Dismantling of floating signs – 114 items;
- Water surveys for distribution and location of signs – 338 items.

In order to perform the water surveys a special software product has been developed for collection and visualization of data along the Danube River. The system for collection and visualization of data is intended for automatic production and correction

of geographical maps of rivers and coastal lines. Navigational equipment including a radar, echo sounder and GPS is used as a source of primary data. The final results are exported to AutoCad for further graphical processing. The data received is duly published on the Agency website.

6.2. Report for river engineering constructions and execution

In the Bulgarian section of the Danube several riverbank reinforcement works have been done within a Project for bank strengthening and prevention of the erosion. The following are currently under construction: reinforcement and additional quay wall construction of the town of Lom and construction of a Winter Camp (Stage III) in Ruse (km 491 – km 491.600). The winter camp is a project of EAEMDR. Stages I and II are completed.

The following areas ware included in the Project for bank strengthening and prevention of the erosion:

- Area I, Kutovo (km 803.500 – km 799.500) – dikes of stone bulks along the bank;
- Area II, Gorni Tsibar – Dolni Tsibar (km 713 – km 722) – dikes of stone bulks along the bank and transverse groynes;
- Area III, Cherkovitsa – Zagrajden (km 600 – km 631.500) – dikes of stone bulks along the bank;
- Area IV, Batin – Vardim (km 539.250 – km 530) – dikes of stone bulks along the bank and transverse groynes;
- Area V, Brashlyan (km 449 – km 454) – dikes of stone bulks along the bank;
- Area VI – VII, Vetren – Popina (km 389 – km 404) – dikes of stone bulks along the bank.

6.3. Common sector, waterway maintenance

Regarding the common section of the Danube River between Bulgaria and Romania, there is a bilateral agreement signed in 1955 which defines responsibilities of both countries. According to this agreement, the maintenance of the navigation way in the common Bulgarian-Romanian section is performed by the competent authorities of the two countries as follows:

- Bulgaria is maintaining the section between km 374.5 and km 610;
- Romania is maintaining the section between km 610 and km 845.5.

Each country submits information about the navigational conditions in the section that it is maintaining and is obliged to maintain and improve them. The installation and maintenance of the riverside navigational signs is performed by the competent authorities of the country on the territory of which the signs are located.

For coordination of all activities related to the hydrographic and hydrological observations and the maintenance of the navigational way in the common Bulgarian-Romanian section of the Danube River a Joint Bulgarian-Romanian Commission for maintenance and improvement of the fairway was established. The Commission has regular sessions twice a year as they are held on a successive base on the territory of each country. The mutual exchange of information and documents is done according to the Regulations for Organization and Work of the Joint Bulgarian – Romanian Commission.

6.4. Waterway maintenance in the ice period

Regarding the navigational safety and due to the frequent loss of floating signs of “schwemmer” type, during the recent years ice periods EAEMDR has used non-luminous type of buoys to signal the navigational way. During ice periods the luminous type of signs are replaced with non-luminous.

During ice formation over 70% and continuous decrease of air and water temperatures all floating navigational signs are removed in order to prevent them from losses and damages.

6.5. Waterway maintenance in the lowest level period

During low water level periods, the depth and flow speed measurements are performed closer to each other and more frequently in the areas that are critical for navigation. The number of the navigational signs is increased especially in the critical sections. The Agency website contains daily updated data about the fairway dimensions and its current state.

6.6. Waterway maintenance in the highest level period

The measurements and river surveys are performed more rarely during high water levels.

During high water level periods the floating navigational signs are in danger of being displaced due to the floating on the river trunks and chunks thus the observation of the signs is performed more frequently.

6.7. Report about the prevention and restoration of flood damages

During a flood danger the number of gauge stations is increased. The water level observations are performed on an hourly base and at the automatic stations this is a permanent process. Updated information regarding the river water levels is distributed through the EAEMDR website, e-mails, fax transmissions and telephone calls. A permanent connection is maintained with the Civil Defense authorities, Maritime Administration, Regional institutions and aquaculture organizations that are responsible for the dykes' maintenance.

6.8. Planning for lock maintenance and repairing

There are no locks in the Bulgarian section of the Danube River.

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