



REPUBLIC OF SERBIA, CENTER FOR INVESTIGATION OF ACCIDENTS IN
TRANSPORT, SECTOR FOR INVESTIGATION OF ACCIDENTS IN
WATERBORNE TRAFFIC
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ANNUAL REPORT FOR 2023



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The Center for Investigation of Accidents in Transport (hereinafter: the Center) is a special organization which includes the Sector for Investigation of Accidents in Waterborne Traffic, responsible for performing professional tasks related to the investigation of very serious maritime accidents, serious maritime accidents, maritime accidents, maritime incidents, serious inland navigation incidents and inland navigation incidents in waterborne traffic.

Pursuant to the Article 7 of the Law on the Investigation of Accidents in Air, Railway, and Waterborne Traffic ("Official Gazette of the Republic of Serbia" Nos. 66/15 and 83/18), the Sector for Investigation of Accidents in Waterborne Traffic submits the Report for 2023.



1. The Center

The Center has been established in accordance with the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic (“Official Gazette of the Republic of Serbia” No. 66/15).

Within the Center, the following basic internal units are established: Sector for Investigation of Accidents in Air Traffic, Sector for Investigation of Accidents in Railway Traffic and Sector for Investigation of Accidents in Waterborne Traffic and General Affairs Department. (the structure of the Center has been presented in Figure 1.1.)

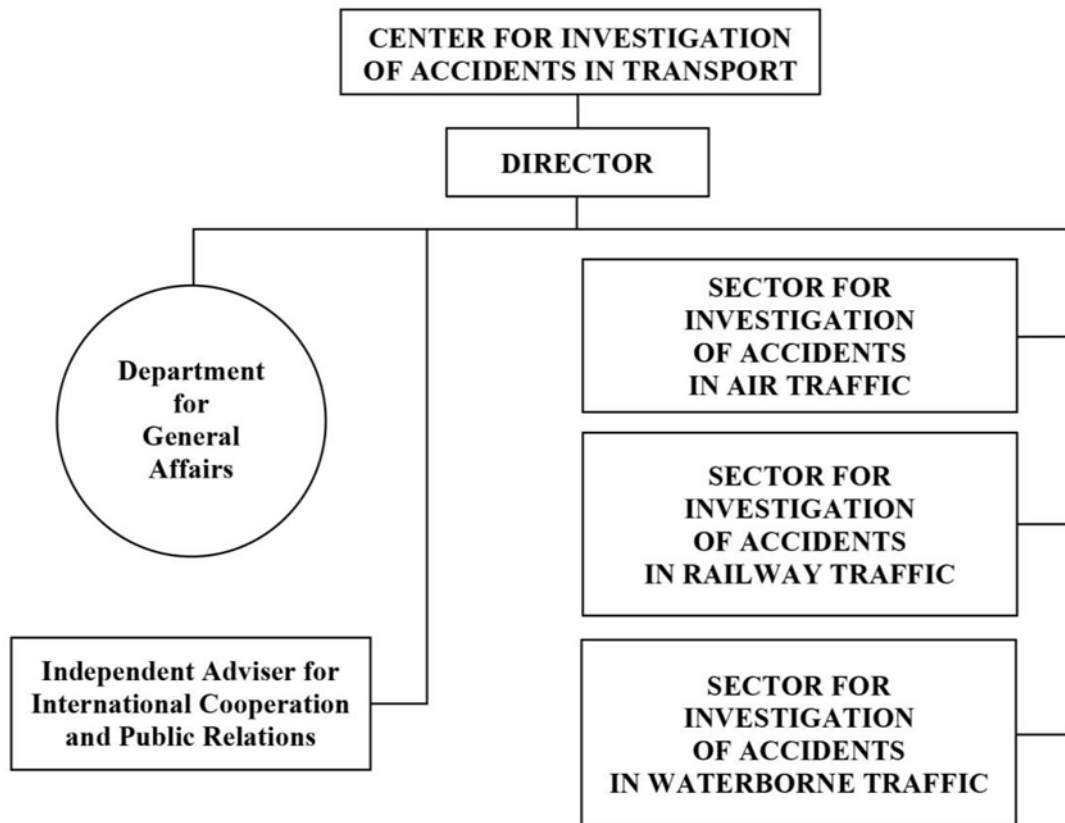


Figure 1.1. The structure of the Center

The Sector for Investigating Accidents in Waterborne Traffic began operations on June 1, 2017. It consists of the Main Investigator in Waterborne Traffic, a Senior Advisor for Coordination of Investigations and Accidents Analysis in Waterborne Traffic, and an Independent Advisor for Coordination of Investigations and Accidents Analysis in Waterborne Traffic.

The Center, Sector for Investigations of Accidents in Waterborne Traffic, is independent in its work and independent of all other bodies and organisations competent for waterborne traffic, as well as of all legal and natural persons whose interests may be in conflict with the tasks and entitlements of the Center.

Professional work related to investigation is independent of criminal investigations or other parallel investigations that determine liability or the degree of guilt.

The investigation and determining the causes of accidents does not aim to establish criminal, economic, misdemeanour, disciplinary, civil, or other liability.



Basic tasks of the Center, Sector for Investigation of Accidents in Waterborne Traffic, are:

- Investigation of very serious maritime accidents, serious maritime accidents, maritime accidents, maritime incidents, serious inland navigation incidents, and inland navigation incidents on the inland fairways.
- Preparation of final reports on conducted specific investigations that may contain safety recommendations aiming to improve safety of waterborne traffic.

The Center performs other tasks stipulated by the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic (“Official Gazette of the Republic of Serbia” Nos. 66/15 and 83/18).



2. Investigative procedure in the field of waterborne traffic

2.1. Types of navigation accidents and incidents

According to the Law on Investigation of Accidents in Air, Railway and Waterborne Traffic ("Official Gazette of the Republic of Serbia" Nos. 66/15 and 83/18), the accidents and incidents may be:

1. **Very serious maritime accident** is an accident which has, as a consequence, a total loss of the vessel, fatality or serious pollution of the marine environment caused by the functioning of the vessel.
2. **Serious maritime accident** is a maritime accident which involves a fire, an explosion, a collision, stranding, damage to the hull or freeboard or a defect on them caused by severe weather conditions, ice, fracture of a hull or presumed fault at production which has, as a consequence, the inability to operate the main propulsion devices, major damage to the superstructure or severe structural damage (rupture of the submerged part of the hull) which in turn incapacitates the vessel and pollutes marine environment (serious leakage: when over 50 tons of oil and oil derivatives or similar hazardous substances are released into the sea) or a fault which requires the vessel to be tugged or provided with assistance from the coast;
3. **Maritime accident** is an event or series of events occurred as a direct consequence of the vessel management or operation of the vessel, resulting in any of the following consequences: fatality or serious injury of a person, loss or presumed loss or abandonment of the vessel, major damage to the vessel, stranding or incapacitation of the vessel or its participation in a collision, major damage to marine infrastructure which can endanger the vessel, the other vessels or a person, major damage to marine environment caused by damage to a vessel or to vessels.
4. **Maritime incident** is an event or series of events, differentiating from a maritime accident, that have occurred as a direct consequence of the vessel operation which is endangered or which can endanger the vessel safety, persons on the vessel or maritime environment.
5. **Serious inland navigation incident** is an unexpected accident in the inland waterborne traffic or usage of a vessel, fairway or facilities along it which leads to a total loss of the vessel, fatalities or injuries to persons aboard or major damage to the environment caused by leakage of over 50 tons of oil and oil derivatives and other hazardous substances;
6. **Inland navigation incident** is an emergency in internal waters which occurred during navigation or exploitation of an internal navigation vessel, fairway or facilities along it which leads to material damage, pollution of environment fatalities or injuries to persons aboard.



2.2. Obligation to notify

Authorities and organizations, shipowners, maritime companies, the master of the vessel or the person who replaces him, other members of the vessel's crew, persons who participated in a very serious maritime accident, serious maritime accident, maritime accident, maritime incident, serious inland navigation incident and inland navigation incident, as and all other legal and natural persons who have information about the occurrence, must inform the Center without delay.

2.3. Obligation to investigate

After a very serious maritime accident and a maritime accident, a safety investigation must be conducted if maritime vessels flying the flag of the Republic of Serbia were involved or if the state has an important interest regardless of the location of the very serious maritime accident and maritime accident.

In the case of serious maritime accidents, before making a decision to initiate a safety investigation, the Center performs a preliminary assessment of the need to undertake a safety investigation. If it decides that there is no need to conduct a safety investigation, it must record the reasons for such a decision and submit it to the European Commission. In the case of maritime accidents, the Center makes a decision on the need to undertake a safety investigation.

After every serious inland navigation accident in inland navigation, a safety investigation must be conducted, if it occurs on the fairway of the Republic of Serbia, regardless of the flag of the vessel flying.

In the case of navigation incidents, the Center, before making a decision to initiate a safety investigation, assesses the need to undertake a safety investigation, taking into account the severity of the inland navigation accident, the type of vessel and its cargo, as well as the possibility that the results of the safety investigation may affect the prevention of inland navigation incidents.

2.4. Safety investigation

The safety investigation in waterborne traffic is carried out with the aim of increasing the safety of navigation, preventing pollution of the marine environment, fairways from the vessel and reducing the risk of a very serious maritime accident, serious maritime accident, maritime accident, maritime incident, serious inland navigation accident and inland navigation incident.

The Rulebook on the method of conducting the investigation of accidents and incidents in maritime navigation ("Official Gazette of the Republic of Serbia" No. 50/16) prescribes the method of conducting the investigation of very serious maritime accidents, serious maritime accidents, maritime accidents and maritime incidents in maritime navigation, as well as way of monitoring the implementation of safety recommendations. The provisions of the aforementioned Rulebook are also applied to the investigation of serious inland navigation incidents and inland navigation incidents in inland navigation, except for the provisions related to notification and data entry into the European Information Platform for Maritime Accidents (ECIP).

For the purpose of investigating every accident and incident in maritime navigation, every serious inland navigation incident and inland navigation incident in inland navigation, the Director of the Center establishes a Working group, led by the Main Investigator in waterborne traffic. The members of the Working group are other employees of the Center, that is, the Sector for the Investigation of Accidents in Waterborne Traffic who participate in the investigation of accidents and incidents, as well as experts from outside the Center.



2.5. Investigation Report

The Rulebook on the content of the safety investigation report, the content of the notification, the content and the way of keeping the database on the safety investigation of accidents and incidents in waterborne transport ("Official Gazette of the Republic of Serbia" No. 26/16) prescribes the content of the safety investigation report in more detail.

After the safety investigation in waterborne traffic, the Center prepares and publishes a report on the investigation, which in particular contains data on the vessel, data on navigation, data on maritime accidents and incidents, data on navigation incidents in inland navigation, the involvement of coastal services and emergency actions in maritime navigation, event description, analysis, conclusions and safety recommendations and appendices. The report does not contain personal data. The investigation report can be: simplified report, final report and interim report.

2.6. Safety recommendations

The Center issues safety recommendations based on data analysis and the overall results of the conducted investigation in waterborne transport.

Safety recommendations are sent to the parties to which they are issued, to competent authorities and organizations in the Republic of Serbia, as well as to competent authorities and organizations of interested states and international organizations.

Bodies and organizations to which safety recommendations have been sent, except for competent bodies and organizations of other interested states, are obliged to take appropriate measures in order to implement them, and to submit a report to the Center at least once a year on the measures taken or planned to be taken.

Adopting safety recommendations aims at prevention and improvement of all technical and operational elements in the function of navigation safety.



3. Safety investigations initiated in 2023

In 2023 a total of 3 (three) investigations have been opened. Basic data on investigations initiated is given in Table 3.1.

Table 3.1. Review of the initiated safety investigations

S. No.	Type	Date	Description	Location	Fatally injured	Seriously injured
1.	Inland navigation incident of the vessel "LEGET III"	14.1.2023.	the impact of the motor cargo vessel into the floating object	Left bank of the Sava River 10 km + 950 m	0	0
2.	Inland navigation incident of the vessel "BEO"	6.4.2023.	the sinking of a cargo pusher barge	Right bank of the Danube River 1051 km + 300 m	0	0
3.	Inland navigation incident of the vessel "PODUNAVLJE"	30.10.2023.	water ingress into a cargo motor vessel	Right bank of the Danube River 1106 km + 200 m	0	0

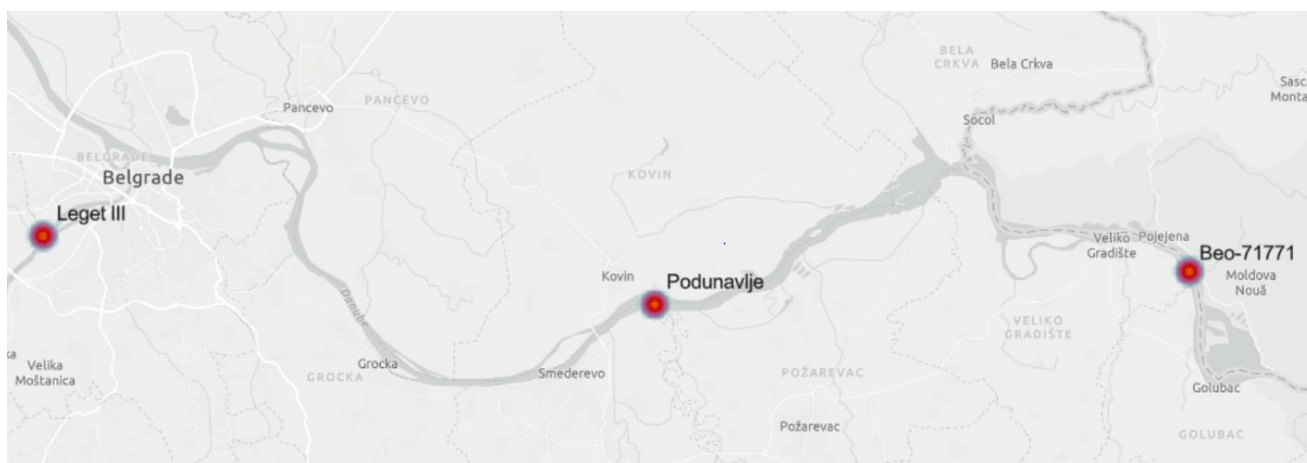
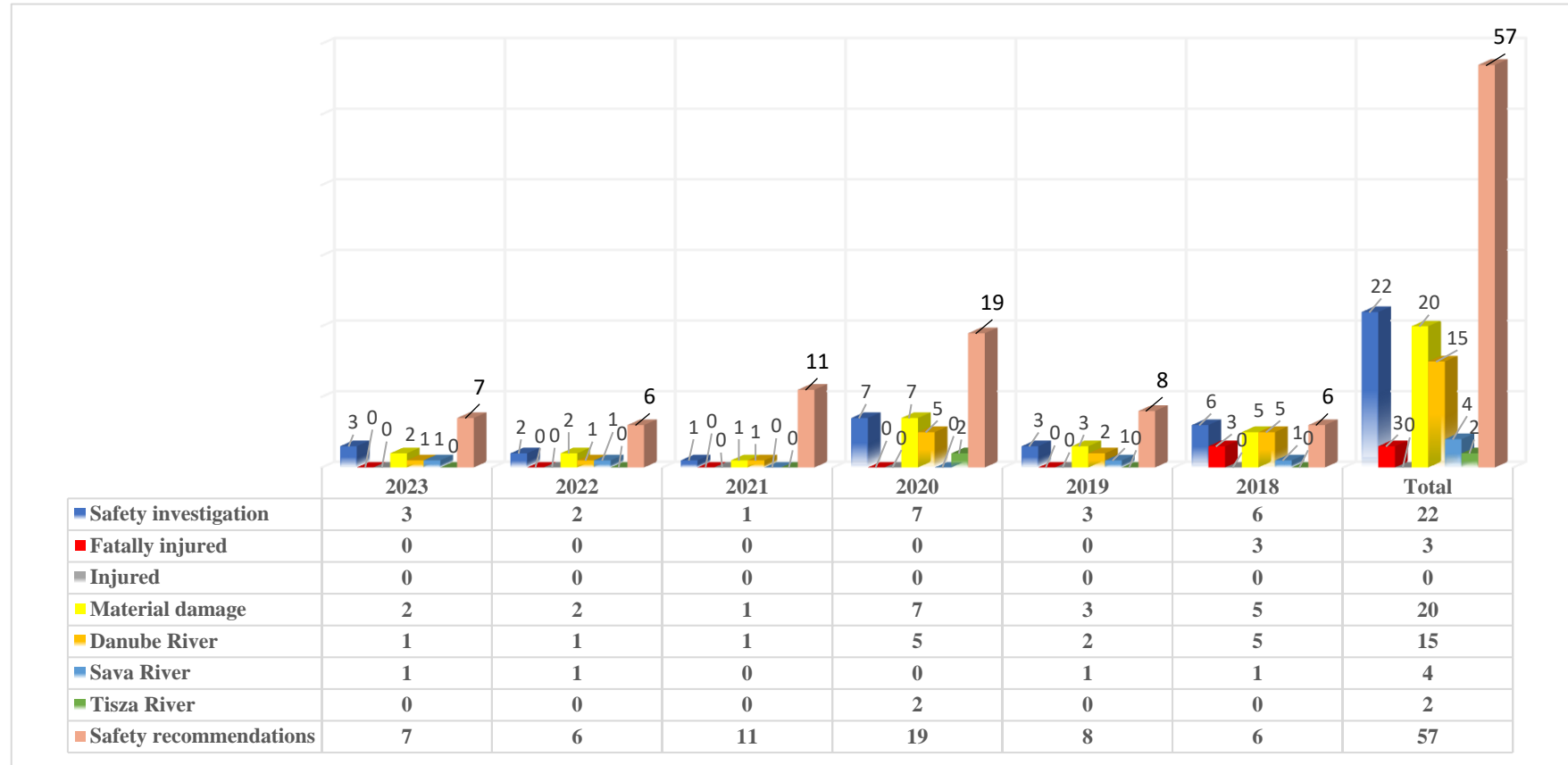


Figure 3.1. Location of navigation incidents

Graphic 3.1 provides a comparative overview of safety investigations initiated by year on the Danube, Sava, and Tisza rivers, along with the total number of fatalities, injuries, material damage, and issued safety recommendations.



Graphic 3.1. Comparative overview of initiated safety recommendations for the period from 2018 to 2023



3.1. Inland navigation incident of the vessel “LEGET III“

On January 14, 2023, at approximately 20:00, the motor cargo vessel "LEGET III" (flying the flag of the Republic of Serbia), loaded with natural sand and navigating downstream, deviated from the navigable route, resulting in a collision with its starboard side against a floating structure (a recreational houseboat on barrels, for recreation) with the registration No. "BG-P-263A". The mentioned vessel was moored along the left bank of the Sava River at position 10 km + 950 m. Due to the lateral impact on the upstream side of the floating structure "BG-P-263A", damage occurred to the downstream terrace on barrels, which had no registration No.



Figure 3.1.1. Motor cargo vessel “LEGET III“

The Center was informed about the inland navigation incident on January 14, 2023, at 23:14 by the Head of the Department for Navigation Safety Inspection Affairs.

The Center investigative team arrived at the scene of the inland navigation incident on January 15, 2023, at 09:00.

During the inspection, it was determined that the navigation incident did not result in any casualties or serious bodily injuries, no damage was caused to the environment, no hazardous substances were spilled into the watercourse, and there were no other consequences that could affect the regular flow of vessel traffic in the given sector.

3.2. Inland navigation incident of the vessel “BEO“

On April 6, 2023, at approximately 12:30, at river kilometer 1051 + 300 m of the Danube River, an inland navigation incident occurred, involving water ingress into the cargo barge with registration No. "71771", which was part of the upstream composition of the motor cargo vessel "BEO". Following a maneuver to ground the barge on the right bank in an attempt to prevent sinking, the operational maneuver did not yield a positive result, and the barge ultimately sank on April 8, 2023, at approximately 5:30.



Figure 3.2.1. Motor cargo vessel “BEO“



Figure 3.2.2. Pushed barge of registration No. “71771“

The Center for Investigation of Accidents in Transport of the Republic of Serbia was notified of the inland navigation incident at 13:53 on April 6, 2023, by the Navigation safety inspector.

There is material damage to the pushed barge with registration No. "71771", the extent and nature of which will be determined after the barge is recovered.

There were no fatalities or injuries.

There was no spillage of hazardous substances into the fairway.

3.3. Inland navigation incident of the vessel “PODUNAVLJE“

On October 30, 2023, at approximately 05:00, at river kilometer 1106 + 200 m along the right bank of the Danube River, a navigation incident occurred involving the partial sinking of the anchored motor cargo vessel "PODUNAVLJE" (see Figure 3.3.1). The vessel flies the flag of the Republic of Serbia and is registered in the Ship Register of the Smederevo Port Authority.

The motor cargo vessel "PODUNAVLJE" was navigating upstream, loaded with 738 tons of natural gravel (according to the accompanying cargo document – bill of lading). The loading was carried out on October 29, 2023, at km 1065 of the Danube River under the dredger "BUKOVAC".



Figure 3.3.1. Motor cargo vessel “PODUNAVLJE“ at 1106 km + 200 m of the Danube River

There were no fatally injured or injured among the crew members.

There was no spillage of hazardous substances into the watercourse.

The Center was informed about the inland navigation incident on October 30, 2023, at 08:26 by the inland navigation safety inspection.

The Center investigative team arrived at the scene of the inland navigation incident on October 30, 2023, at 12:05 to conduct an on-site inspection and gather all necessary information.



4. Safety investigations conducted in 2023

4.1. Inland navigation incident of the vessel “LEGET III“

4.1.1. Short description

Inland navigation incident, contact (lateral impact) of the downstream motor cargo vessel “LEGET III“ into the floating structure, moored along the left bank of the Sava River at position 10 km + 950 m, occurred on January 14, 2023, at approximately 20:00.

As part of the investigative actions aimed at gathering relevant facts regarding the examined navigation incident, sufficient information has been collected to fully reconstruct the trajectory of the motor cargo vessel “LEGET III“ in the period preceding and at the time of the navigation incident.

A review of the Vessel’s Logbook reveals that the usual activities of the motor cargo vessel “LEGET III“ from December 3, 2022 (the first available record), until January 14, 2023, when the navigation incident occurred, involved transporting sand (“dunavac“) between the loading dredger located at river kilometer 1172 of the Danube and the depot in Makiš at river kilometer 12 of the Sava River. This leads to the conclusion that the crew was well acquainted with the navigation sector, as they sometimes completed multiple trips in a single day, depending on weather and other conditions.

For a more objective assessment and a clearer presentation of the results, the conducted analysis consists of several sections, as presented in this report:

- A general overview of the deviations in the course of the motor cargo vessel “LEGET III“ compared to the optimal course during upstream navigation from the entry point from the Danube into the Sava River, covering river kilometers 0 to 11 of the Sava River watercourse;
- A depiction of the upstream navigation of the motor cargo vessel “LEGET III“ along a section of the Sava River which may be considered critical, specifically between river kilometer 0 + 800 m and 4 + 200 m. This section contains six road and/or railway bridges;
- An analysis of the upstream navigation trajectory of the motor cargo vessel “LEGET III“ preceding the maneuver for downstream navigation via the starboard side at position 11 km + 200 m;
- An analysis of the downstream navigation trajectory up to the moment of the navigation incident—contact between the motor cargo vessel “LEGET III“ and a floating structure at position 10 km + 950 m;
- An analysis of the downstream navigation trajectory of the motor cargo vessel “LEGET III“ after the navigation incident.

Based on the available data obtained from the Directorate for Fairways, an analysis was conducted of the upstream navigation of the loaded motor cargo vessel “LEGET III“ while en route to the unloading site, specifically on the Sava River navigation sector from river kilometer 0 to 11, preceding the navigation incident. It is important to note that the AIS (Automatic Identification System) transmitter, which is used for vessel tracking, is located in the steering compartment of the vessel.

The available data on the movement of the motor cargo vessel “LEGET III“ clearly and unequivocally indicate the vessel's position, speed, and navigation course at all times. This data also provides insight into all the measures taken by the Ship Master during navigation, which ultimately led to the mentioned inland navigation incident.



An examination of the trajectory of the motor cargo vessel “LEGET III“, based on the available data, reveals a significant deviation of the vessel's course from the designated fairway throughout the voyage. Specifically, for most of the time, the vessel was navigating outside the boundaries of the fairway, predominantly closer to the left riverbank, with frequent and pronounced changes in course angle. In this regard, the general overview of the navigation characteristics includes a comparison of the course angle changes (Ψ) of the motor cargo vessel “LEGET III“ relative to the optimal (required) course angle that follows the designated fairway along the analyzed sector. Given the length of the sector (11 km) and the significant fluctuations in course changes, this sector has been divided into several shorter sections, with the comparison results presented in Figures 4.1.1.1, 4.1.1.2, and 4.1.1.3.

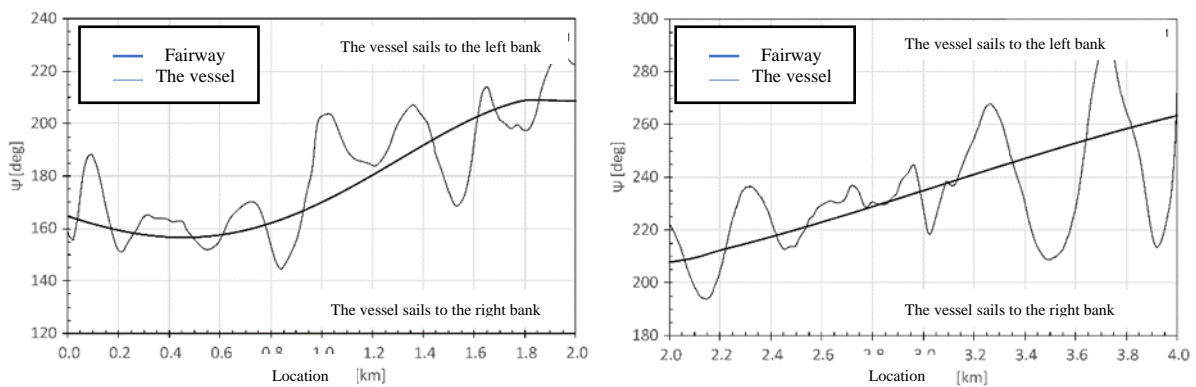


Figure 4.1.1.1. Deviation of the vessel course in relation to the fairway course on the section from 0 km – 4 km of the Sava River fairway

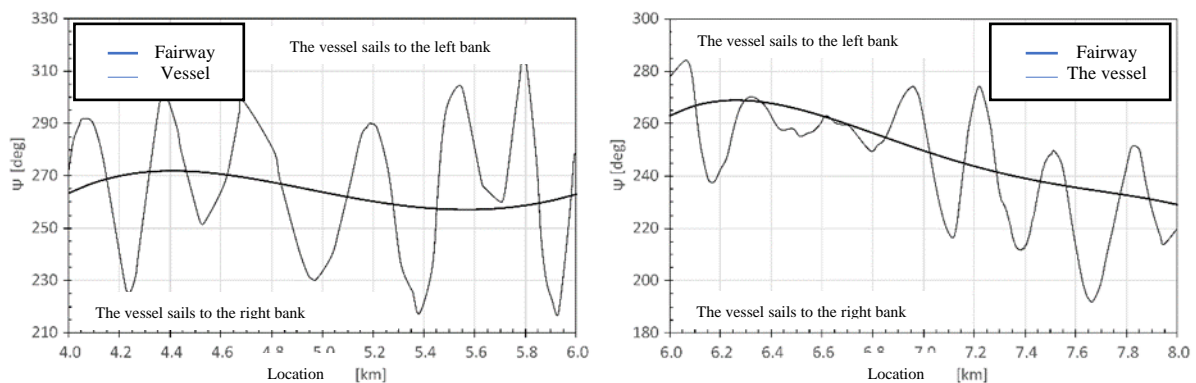


Figure 4.1.1.2. Deviation of the vessel course in relation to the fairway course on the section from 4 km – 8 km of the Sava River fairway

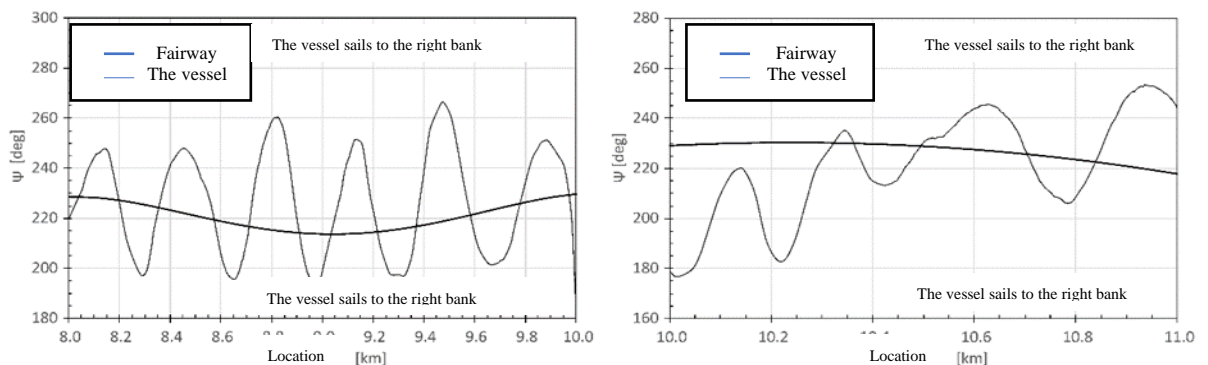


Figure 4.1.1.3. Deviation of the vessel course in relation to the fairway course on the section from 8 km – 11 km of the Sava River fairway

The thick line in images 4.1.1.1 – 4.1.1.3 represents the required course angle for the vessel to follow the river's fairway while navigating upstream, while the thin line represents the recorded course change of the vessel during navigation. Moderate changes in the fairway direction, depicted by the thick line, characterize the river's natural meandering. The obtained results show that the motor cargo vessel "LEGET III" rarely follows the direction of the fairway, while for most of the time, it deviates significantly—sometimes by more than 45 degrees from the required course (the direction of the fairway). It is important to emphasize that the overlapping of the vessel's course and the fairway direction (points where the curves intersect) does not necessarily mean that the vessel is within the fairway boundaries. These are moments when the vessel briefly aligns with the required course, usually while meandering outside the fairway limits.

Considering that the Ship's Master was under the influence of alcohol, as confirmed immediately after the inland navigation incident occurred, the attached diagrams reveal a gradual decline in the Ship Master's attentiveness over time. Consequently, the deviations of the vessel's course from the direction of the fairway became increasingly significant.

Alongside the deviations from the required course, the speed of the vessel relative to the riverbed also changed, which will be presented in the next section of the report.

In the section of the fairway between 0 km + 800 m and 4 km + 200 m of the Sava River, there are six bridges: "Branko's Bridge", "Road-Tramway Bridge", "Gazela", the Old and New Railway Bridges, and the road/rail bridge "Ada Bridge". Given the established nature of navigation and the fact that the motor cargo vessel "LEGET III" frequently navigates outside the fairway boundaries in the area of several bridges, such navigation can be considered extremely risky. In this regard, a representation of the vessel's navigation under each of the aforementioned bridges is provided here.

Based on the provided navigation data, it is observed that at 16:45:44 (Figure 4.1.1.4.), the vessel is located about 300 meters downstream of the bridge and is navigating within the fairway boundaries, along the left edge, at a speed of 3.9 km/h. Over the next 300 meters, while navigating upstream, the vessel briefly leaves the fairway and then, at 16:48:03, at a speed of 4.4 km/h, returns to the fairway boundaries. Just before the bridge, the vessel sharply changes course and turns to the right – towards the left bank. Thus, it passes under the bridge at 16:50:24 along the left edge of the fairway and, at a speed of 4.4 km/h, continues navigation towards the left bank, outside the fairway boundaries.

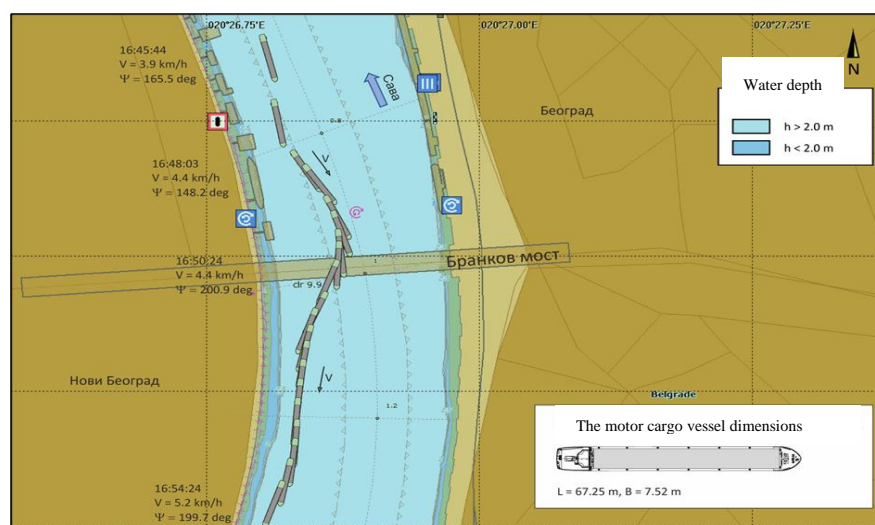


Figure 4.1.1.4. Trajectory of the motor cargo vessel "LEGET III" upon upstream navigation under the Brankov bridge

About 200 meters upstream from the bridge, approximately 40 meters from the left bank, the vessel establishes a course parallel to the bank, which can also be seen in Figure 4.1.1.1 (position 1 km + 200 m), and continues to navigate upstream for about 100 meters. Then, at 16:54:24, the vessel further turns to the right and, at a speed of 5.2 km/h, approaches the left bank at about 15 meters. This navigation can be considered potentially dangerous, considering that the ship is traveling far outside the safe boundaries of the fairway.

The trajectory of the motor cargo vessel “LEGET III” during its upstream navigation under the road-tram bridge is shown in Figure 4.1.1.5. The vessel passes under the bridge at 16:56:02, traveling at a speed of 5 km/h. At that moment, it is only about 15 meters away from the left bank. Here, the vessel is on the edge of a zone characterized by a depth of less than 2 meters. Such navigation can be considered extremely risky. In this sense, it can be concluded that this moment was actually the first instance when an inland navigation incident could have occurred.

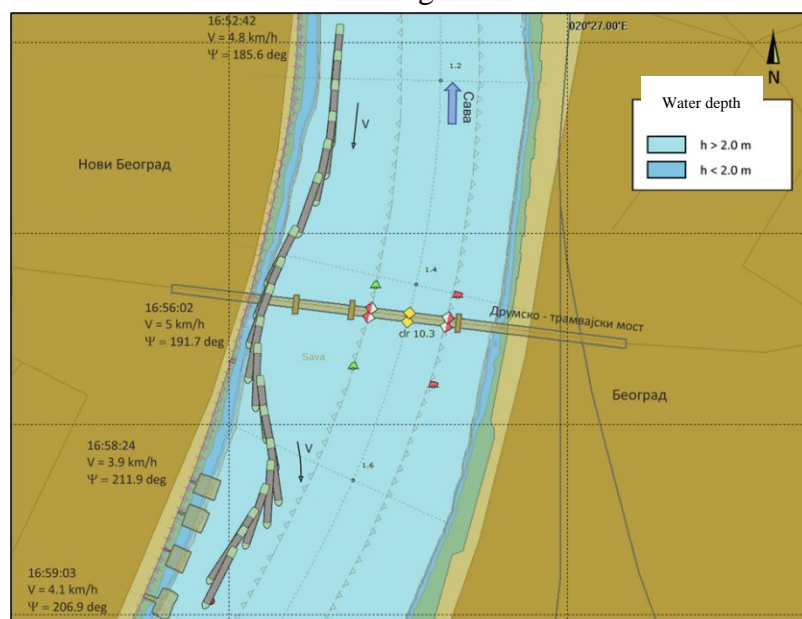


Figure 4.1.1.5. Trajectory of the motor cargo vessel “LEGET III” upon upstream navigation under the road-tram bridge

The position of the motor cargo vessel “LEGET III” in relation to the bridge profile and the fairway (which is located in the middle of the bridge span) at the moment of passing under the bridge is shown in Figure 4.1.1.6. Here, it becomes clearer how close the vessel actually passed to the shore and how far it was from the safe boundaries of the navigable fairway.

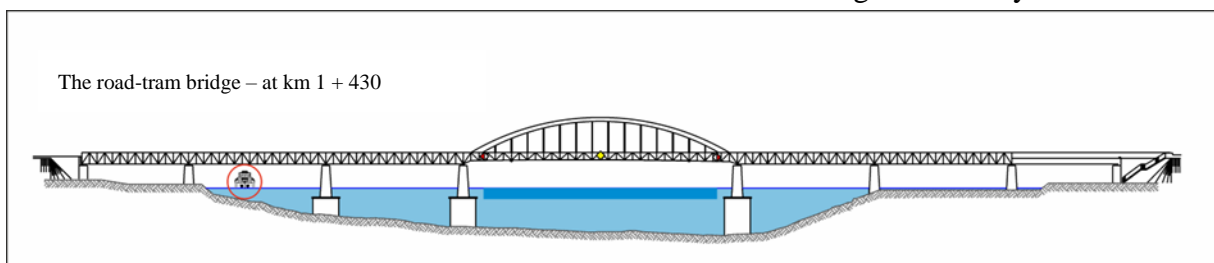


Figure 4.1.1.6. Position of the motor cargo vessel “LEGET III” in relation to the bridge profile and in relation to the fairway

Figure 4.1.1.7 shows the trajectory of the motor cargo vessel “LEGET III” along the section of the Sava River fairway between 2 km + 300 m and 3 km + 400 m. On this section, while navigating upstream, the vessel passes under three bridges: the road bridge "Gazela" (2 km + 520 m), the old railway bridge (2 km + 730 m), and the new railway bridge (3 km + 000 m).

From the reconstructed trajectory, based on the obtained data, it is clearly observed that the vessel continuously navigates outside the fairway boundaries, closer to the left bank. Between 17:09:45, when the vessel passes under the first bridge, and 17:15:14, when it passes under the last bridge (approximately 500 meters of navigation), it is noticeable that the vessel moves more steadily, without significant speed variations and following a course that does not deviate considerably from the optimal path aligned with the fairway.



Figure 4.1.1.7. Trajectory of the motor cargo vessel “LEGET III” upon upstream, navigation under the road bridge “Gazela” and the railway bridges

Slightly greater course deviations from the river flow direction are observed before the first bridge and after passing under the third bridge. At 17:20:15, while navigating upstream at a speed of 5.2 km/h, the motor cargo vessel “LEGET III” approaches the left bank to approximately thirty meters, as shown in Figure 4.1.1.7.

Changes in the vessel's speed relative to the riverbed (v) and the course angle (Ψ) along the examined section are shown in Figure 4.1.1.8. Although the recorded speed of the vessel while passing under the bridges is 4.6 km/h (see Figure 4.1.1.7), it can be observed that between the bridges, the vessel's speed fluctuates between 4.6 and 5.2 km/h. Similar to the course angle variations, slightly greater changes in speed are noticed after passing under the new railway bridge.

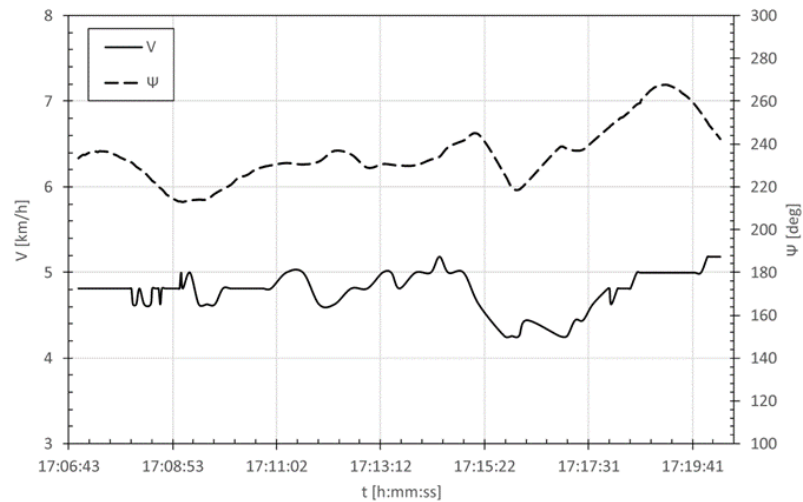


Figure 4.1.1.8. Changes in speed and course angle of the vessel on the observed section of the fairway

Such navigation—outside the designated boundaries of the fairway and in close proximity to the bridge piers—can be considered risky, especially given that this section requires special attention due to navigation near structures of vital importance.

In this regard, in accordance with the general duty of caution, the Ship Master was obliged to take all necessary precautionary measures required by the general duty of due diligence and navigation practice, especially when passing under bridges, in order to avoid: endangering human lives, damaging vessels, banks, structures, installations, or other facilities on the fairway, as stipulated in Article 48, Paragraph 2 of the Law on Navigation and Ports on Inland Waters ("Official Gazette of the Republic of Serbia," Nos. 73/10, 121/12, 18/15, 96/15, 92/16, 104/16, 113/17, 41/18, 95/18, 37/19, 9/20, and 52/21).

After passing under the new railway bridge, the motor cargo vessel "LEGET III" continues its upstream navigation, as shown in Figure 4.1.1.9. After approaching the shore to about thirty meters, at 17:20:51, while traveling at a speed of 5.4 km/h, the Ship Master makes a sharp turn to the left toward the right bank. At position 3 km + 580 m, the motor cargo vessel "LEGET III" reenters the fairway boundaries. However, although in this section the vessel mostly navigates within the fairway (compared to previously examined sections), the next 700 meters of upstream navigation are characterized by pronounced oscillations in movement, accompanied by alternating changes in speed and course. While navigating in this manner, with alternating turns to the left and right, at 17:27:23, traveling at a speed of 4.6 km/h, the vessel passes under the road-rail bridge "Ada Bridge" along the left edge of the fairway. Such navigation could be characterized as extremely unsafe.

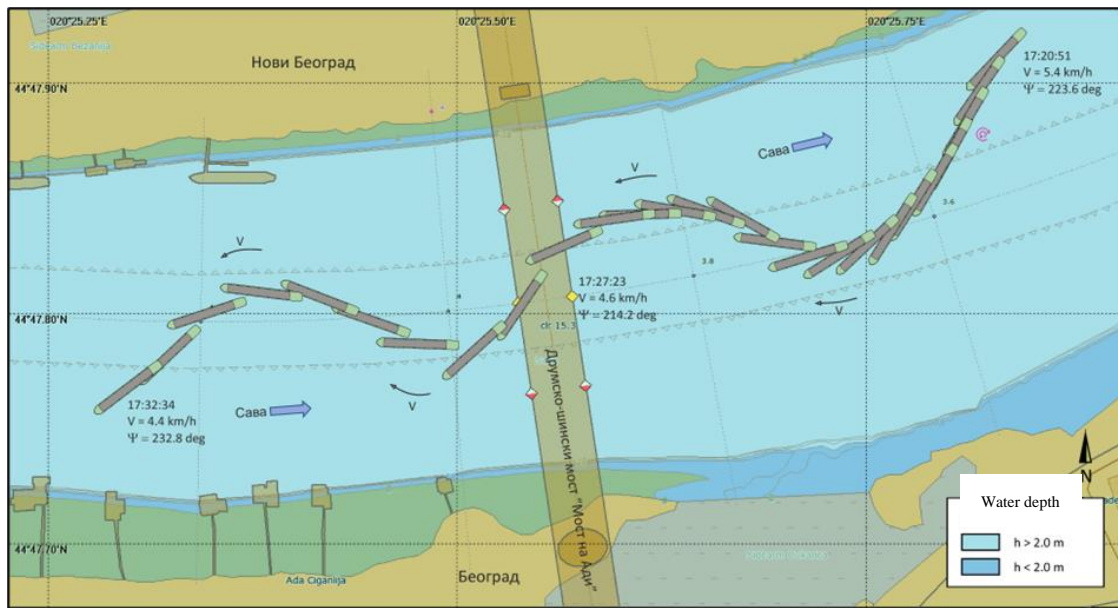


Figure 4.1.1.9. Trajectory of the motor cargo vessel “LEGET III” upon upstream navigation under the road bridge “Ada Bridge”

Given the length of the examined section and the direction of the fairway span, which features a very gentle curve, such navigation indicates a significant loss of control over the vessel, which could have had far more severe consequences. The described navigation pattern, with speed fluctuations ranging between 3.5 and 5.5 km/h, also suggests a considerable loss of attention by the Ship Master or an inability to safely operate the vessel.

Continuing upstream toward the unloading position—at the depot in Makish (12 km)—the motor cargo vessel “LEGET III” proceeds with frequent changes in direction and speed. Throughout most of the time, the vessel navigates outside the boundaries of the fairway.

Special attention was also given to analyzing the navigation immediately before the location where the inland navigation incident occurred. At 19:00:39, while traveling upstream at a speed of 5.37 km/h, the motor cargo vessel “LEGET III” was navigating outside the fairway boundaries, closer to the right bank, at position 10 km + 500 m. With frequent changes in direction, alternating between the starboard and port sides (see Figure 4.1.1.10), the vessel reached position 11 km at 19:07:11, where a significant speed drop to 2.78 km/h was observed. In the next 8 minutes, the vessel’s movement was characterized by a sharp turn to the right (toward the left bank), crossing the fairway entirely, followed by a turn to the left (toward the right bank), again crossing the fairway, while gradually reducing speed. By 19:15:39, the speed had dropped to just 0.56 km/h. All of this occurred approximately 800 meters to 1 km downstream from the unloading depot position.

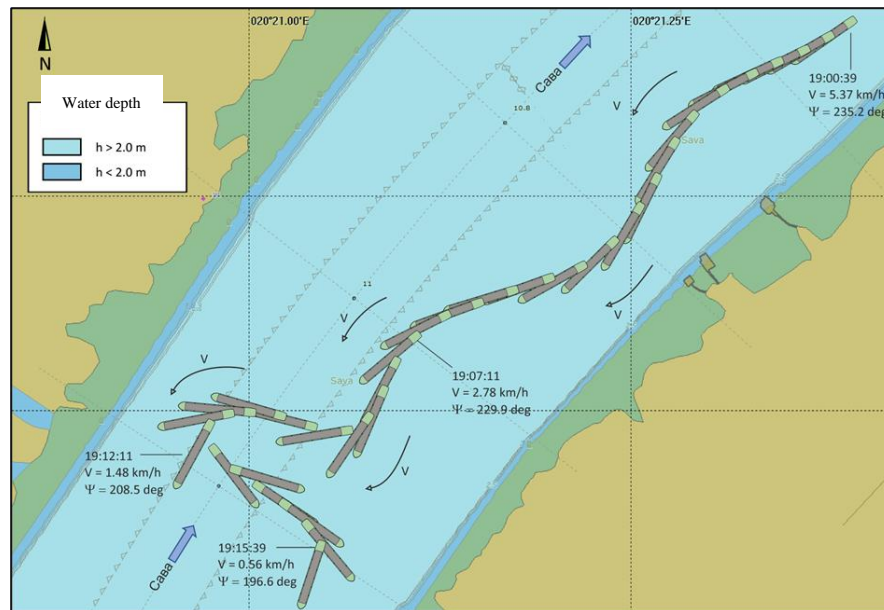


Figure 4.1.1.10. Trajectory of the motor cargo vessel "LEGET III" at the section between 10 km + 500 m and 11 km + 200 m

After approximately one and a half minutes, at 19:16:59, the motor cargo vessel "LEGET III" begins downstream navigation.

As observed in Figure 4.1.1.11, after turning to starboard, at 19:16:59, the vessel "LEGET III" starts its downstream voyage at position 11 km + 200 m. This maneuver by the Ship Master is illogical, as the unloading location (the depot in Makish) is located 800 meters upstream. The vessel, navigating downstream from the right bank toward the left, once again crosses the fairway while gradually increasing speed.

At 19:19:49, traveling at a speed of 3.9 km/h, the vessel crosses the corridor axis, and less than a minute later, at 19:20:43, at a speed of 4.44 km/h, it exits the fairway boundaries and continues navigation toward the left bank at an angle of approximately 40 degrees relative to the shore. At that moment, the vessel's bow was approximately 45 meters from the shore. Without changing course, the vessel continued navigating toward the left bank, increasing its speed to 4.63 km/h. At 19:21:47, the first speed reduction was observed, dropping to 4.44 km/h. Fourteen seconds later, at 19:22:01, the vessel's recorded speed was 3.15 km/h. From this, it can be concluded that during this time interval, the bow of the motor cargo vessel "LEGET III" made contact with a floating structure moored along the left bank. This was also when a change in the vessel's course angle occurred, as it had previously been navigating at $\Psi=1.8^\circ$ (practically northbound, or directly toward the shore)

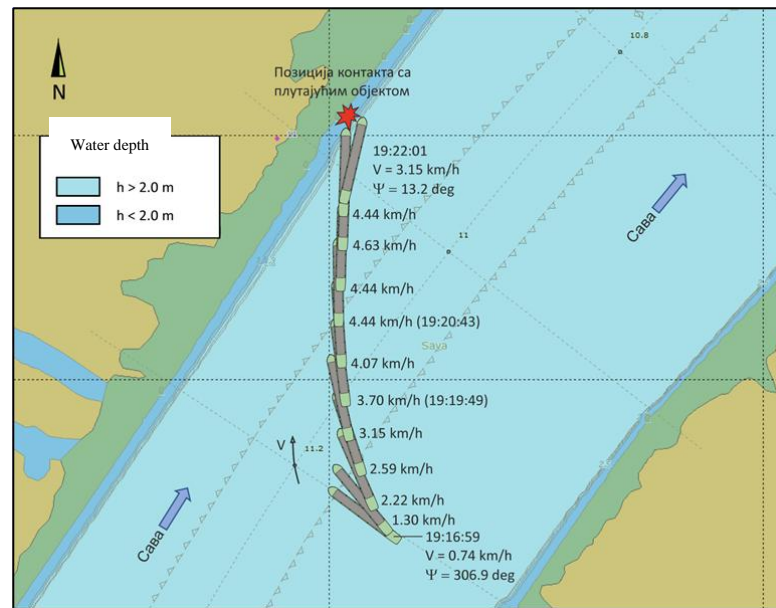


Figure 4.1.1.11. Trajectory of the motor cargo vessel “LEGET III” in the zone of the inland navigation incident

After the impact with the floating structure, a decrease in the vessel’s speed was observed, but it did not come to a stop. Considering that the speed dropped from 4.44 km/h to 3.15 km/h at the moment of impact and then began to increase again (see Figure 4.1.1.12), it could be concluded that the observed speed reduction was actually a consequence of the vessel’s collision with the floating structure, rather than a measure taken by the captain to control the engine’s RPM.

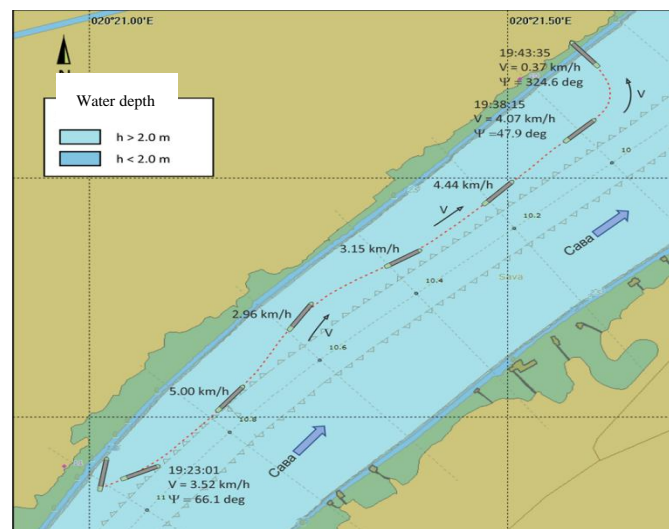


Figure 4.1.1.12. Trajectory of the motor cargo vessel “LEGET III” after the inland navigation incident

As observed from Figure 4.1.1.12, following the inland navigation incident – as the bow of the vessel "slid" down the floating object, the vessel began to move away from the left bank and experienced a slight increase in speed. At position 10 km + 780 m, the motor cargo vessel "LEGET III" was already sailing downstream at a speed of 5 km/h along the left edge of the fairway, moving away from the site of the navigation incident. The vessel then turned again towards the left bank at position 10 km + 700 m, and around 19:30, its speed dropped below 2.5 km/h. After this speed reduction, the vessel's speed began to increase again. However, now (downstream from position

10 km + 400 m), the vessel was sailing steadily – maintaining its course, outside the boundaries of the fairway, but following the general direction of the fairway.

The motor cargo vessel "LEGET III" continued sailing downstream for approximately 400 meters before turning to the left, towards the left bank, where it stopped at position 9 km + 900 m.

Due to the initial lateral impact of the vessel "LEGET III" against the floating object with the registration No. "BG-P-263A", a visual inspection identified the following damages:

- On the upstream lateral side of the impact, the deck railing, made of metal tubular profiles, suffered longitudinal bending deformation along the entire length of the side, $L = 11.5$ m (Figure 4.1.1.13.);
- Five (5) vertical supports, each $L = 0.9$ m in length and welded to the deck structure, experienced longitudinal bending stress (Figure 4.1.1.13.).



Figure 4.1.1.13.

- A segment of the access bridge (metal structure), $L = 9$ m in length, which connects to the previous segment, detached and fell into the water. The other end became separated from the deck structure of the floating house and is now suspended above the water surface (Figure 4.1.1.14.).



Figure 4.1.1.14.

- Along the downstream side of the floating house, two pontoon walkways on barrels were damaged (Figure 4.1.1.15.).

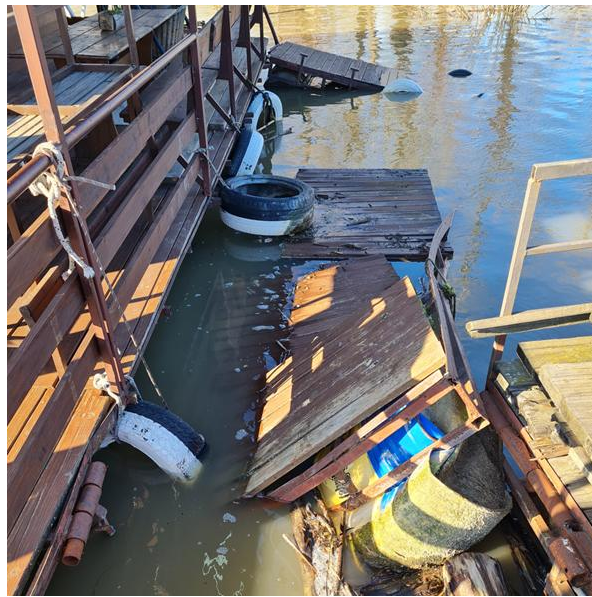


Figure 4.1.1.15.

- The entrance opening with a metal gate structure suffered deformation, along with the vertical structure, which, together with the vertical supports, holds the edge of the roof structure (Figure 4.1.1.16).



Figure 4.1.1.16.

- The downstream terrace on barrels, without a registration No, sustained damage to the support point of the double-post bollard structure and deformation of the structure to which it was welded (Figures 4.1.1.17. and 4.1.1.18.).
- Upon inspection of Floating Permit No. 342-24-263/08-02, issued on June 25, 2008, by the Belgrade Harbor Master's Office, it was found that the permit was valid until September 8, 2012.

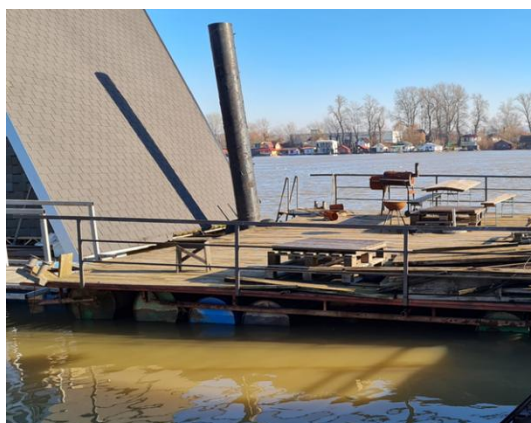


Figure 4.1.1.17.



Figure 4.1.1.18.

A visual inspection of the hull and equipment on the motor cargo vessel "LEGET III" revealed no damage resulting from the lateral impact with the floating structure "BG-P-263A".

Based on official written data and video recordings, it is possible to determine the blood alcohol concentration (BAC) at the time of the inland navigation incident, as well as to make an appropriate assessment of its effects on the health of the crew members in terms of their ability to operate the vessel.

Calculating BAC at the time of the inland navigation incident:

Table 4.1.1.1. Blood alcohol concentration (BAC) among the embarked persons

	Ship Master	Steersman
Gender	male	male
Body mass (kg)*	80-90	75-80
Time of the inland navigation incident	19:43	
Blood sampling time	21:20-21:21	21:22-21:23
Calculated BAC value ((expressed in g ethanol/L))	2,520	1,930
Elapsed Time from Incident to Sampling (in hours)	1 h 38 min (1,63)	1 h 40 min (1,66)
Calculated BAC Value at Time of Incident (at 19:43) ¹		
Calculated BAC value (expressed in ‰, g ethanol/L)	2,522	1,932

*The range of body mass of the embarked persons is given based on observational assessment.

Using Widmark's equation (W.E.), the BAC values at the time of the navigation incident were calculated. The elimination rate value $b = 0.015$ g/100 mL/h was used, as adopted by Widmark's equation (an approximated or averaged elimination rate value based on BAC levels and the type of elimination kinetics: zero or first order).



The elapsed time from the navigation incident to blood sampling of 1 h 38-40 min indicates that the intoxicated crew members were in the initial or advanced phase of alcohol elimination, and the calculated values are almost identical to the measured ones (the difference is only in the third decimal place).

BAC-effects on health:

A tabular representation of the BAC-effect relationship for intoxicated crew members is provided. Both intoxicated crew members fall into the same category of BAC-effect/symptoms.

Table 4.1.1.2. Dose-effect reaction for ethanol on people

BAC	Effects on health
1.5–3 ‰	<ul style="list-style-type: none">• Cannot walk without assistance• Apathetic, drowsy• Difficulty breathing• Unable to remember events• Loss of bladder control• Possible loss of consciousness

Health Risk: "Heavy intoxication" corresponds to an intake of more than 54.4 g of ethanol/day (about 4 drinks, with one drink being 10 g of ethanol), and the corresponding Margin of Exposure (MOE) value is 0.48; "Light intoxication" corresponds to an intake of less than 27.2 g of ethanol/day for men, and the corresponding MOE value is 0.96. The lower the MOE value, the higher the health risk. Both intoxicated crew members consumed excessive amounts of alcohol, significantly beyond "heavy intoxication": The Ship Master likely consumed between 140.67-158.25 g of ethanol/day (corresponding to an MOE of 0.18-0.16). The steersman likely consumed between 101.03-107.77 g of ethanol/day (corresponding to an MOE of 0.26-0.24).

Toxicological evaluation conclusions:

1. The calculated BAC values at the time of the incident (19:43) are:
Ship's Master: 2.522 ‰
Steersman: 1.932 ‰
2. The effects of heavy intoxication, as presented in the table, confirm that the intoxicated individuals in this state were not capable of responsibly operating the vessel.
3. The amount of alcohol consumed, as indicated by the calculated BAC, falls under the "heavy intoxication" category.
4. The individuals who committed the offense are at significant health risk due to excessive alcohol consumption.

According to the tabular data (Table 4.1.1.2.), both intoxicated individuals were not capable of responsibly operating the vessel and its equipment due to the altered mental state caused by the intake of ethanol.

¹ When determining the health risk of excessive alcohol consumption, the new BMD (Benchmark Dose) methodology, based on epidemiological data, is used to calculate the MOE (Margin of Exposure). This approach represents the "practically safe threshold" based on the allowable daily intake (ADI), which is equal to BMDL 1.5 of 2.6 g of ethanol/day, corresponding to an MOE value of 10. For reference, one drink contains 10 g of ethanol. 90% of individuals who consume more than 60 g of ethanol/day, which is approximately six drinks, develop steatosis, while significant fibrosis or cirrhosis develops in only 30% of this population.



Based on the conducted safety investigation and analysis of the navigation incident involving the motor cargo vessel "LEGET III", as well as the toxicological expert opinion from the Faculty of Pharmacy – University of Belgrade, Department of Toxicology, the following can be concluded:

The Ship Master, while performing his duties, due to the intake of an excessive amount of alcohol, significantly beyond "heavy intoxication", was operating the vessel and navigating contrary to the navigation rules. His actions put the vessel, other participants in traffic, and the safety facilities on the Sava River mouth sector at risk, leading to the inland navigation incident. This is in violation of Article 48, Article 135, and Article 140, paragraph 1 of the Law on Navigation and Ports on Inland Waters ("Official Gazette of the Republic of Serbia", Nos. 73/10, 121/12, 18/15, 96/15, 92/16, 104/16, 113/17, 41/18, 95/18, 37/19, 9/20, and 52/21).



4.1.2. Issued safety recommendations

Shipowner/Owner

LEGET AGREGATI LLC Sremska Mitrovica

SR_01/23 It is recommended, for the sake of navigational safety, that the Ship Master "LEGET III", who was intoxicated while performing his duties as the navigator on the command bridge and caused the inland navigation incident to:

- During the performance of duties, the Ship Master, that is, a member of the vessel's crew, while performing duties on the vessel must not be in a state of intoxication, in accordance with Article 140, paragraph 1, of the Law on Navigation and Ports on Inland Waters ("Official Gazette of the Republic of Serbia", Nos. 73/10, 121/12, 18/15, 96/15, 92/16, 104/16, 113/17, 41/18, 95/18, 37/19, 9/20 and 52/21), hereinafter: Law;
- The motor cargo vessel "LEGET III" during navigation did not have a crew onboard whose number and ranks allow for safe navigation in the "A1" model, according to the Rulebook on the Minimum Number of Crew Members for Safe Navigation, which must be followed by ships and other vessels of the merchant navy ("Official Gazette of the Republic of Serbia", Nos. 28/2015, 99/2015, 3/2017, and 8/2019).
- The Ship Master is obligated to take care of the vessel's administration, including checking the vessel's logbooks and documents, as well as the personal documents of the crew members, in accordance with Article 144 of the Law.

SR_02/23 Considering the analysis and conclusion of the final investigation that the inland navigation incident occurred due to the vessel "LEGET III" being operated by the Ship Master - navigator who was intoxicated, and for the purpose of prevention and navigational safety, **it is recommended** that the shipowner, based on Article 14, paragraph 1, and Article 15, paragraph 1, item 10 of the Occupational Safety and Health Act ("Official Gazette of the Republic of Serbia", Nos. 101/2005, 91/2015, and 113/2017), in relation to Article 140 of the Law on Navigation and Ports on Inland Waters ("Official Gazette of the Republic of Serbia", Nos. 73/10, 121/12, 18/15, 96/15, 92/16, 104/16, 113/17, 41/18, 95/18, 37/19, 9/20, and 52/21), adopt a Rulebook for performing alcohol tests on crew members.

To the Ministry of Construction, Transport and Infrastructure Waterborne Transport Sector

SR_03/23 Based on the conducted safety investigation and the final report, **it is recommended** to urgently establish a Vessel Traffic Service (VTS), in accordance with Article 197 of the Law on Navigation and Ports on Inland Waters ("Official Gazette of the Republic of Serbia", Nos. 73/10, 121/12, 18/15, 96/15, 92/16, 104/16, 113/17, 41/18, 95/18, 37/19, 9/20, and 52/21) and the Rulebook on Vessel Traffic Service ("Official Gazette of the Republic of Serbia", No. 76 of August 9, 2017).