



AVIATION



HIGHWAY



MARINE



RAILROAD



PIPELINE

April 30, 2026

MIR-26-15

Contact of *Mackenzie Rose* Tow with Norfolk and Portsmouth Belt Line Railroad Bridge

On June 15, 2024, about 1626 local time, the towing vessel *Mackenzie Rose* was pushing the loaded deck barge *Weeks 281* while transiting the southern branch of the Elizabeth River in Chesapeake, Virginia, when the barge's raked bow struck the Norfolk and Portsmouth Belt Line Railroad Bridge (see figure 1 and figure 2).¹ There were no injuries, and no pollution was reported. The railroad bridge was severely damaged; total damages were \$15.8 million.



Figure 1. *Mackenzie Rose* underway in January 2026. (Jim Roy Photography, marinetraffic.com)

¹ (a) In this report, all times are eastern daylight time, and all miles are statute miles. (b) Visit [ntsb.gov](https://www.ntsb.gov) to find additional information in the [public docket](#) for this NTSB investigation (case no. DCA24FM049). Use the [CAROL Query](#) to search investigations.

Casualty Summary

NTSB casualty category	Contact
Location	Elizabeth River, Chesapeake, Virginia 36°48.71' N, 076°17.42' W
Date	June 15, 2024
Time	1626 eastern daylight time (coordinated universal time -5 hrs)
Persons on board	5 (<i>Mackenzie Rose</i>)
Injuries	None
Property damage	\$15.8 million
Environmental damage	None
Weather	Visibility 10 mi, clear, winds northeast 9 mph, air temperature 82°F, water temperature 74°F
Waterway information	River; width 300 ft, depth 30 ft, flood current 0.1 kts

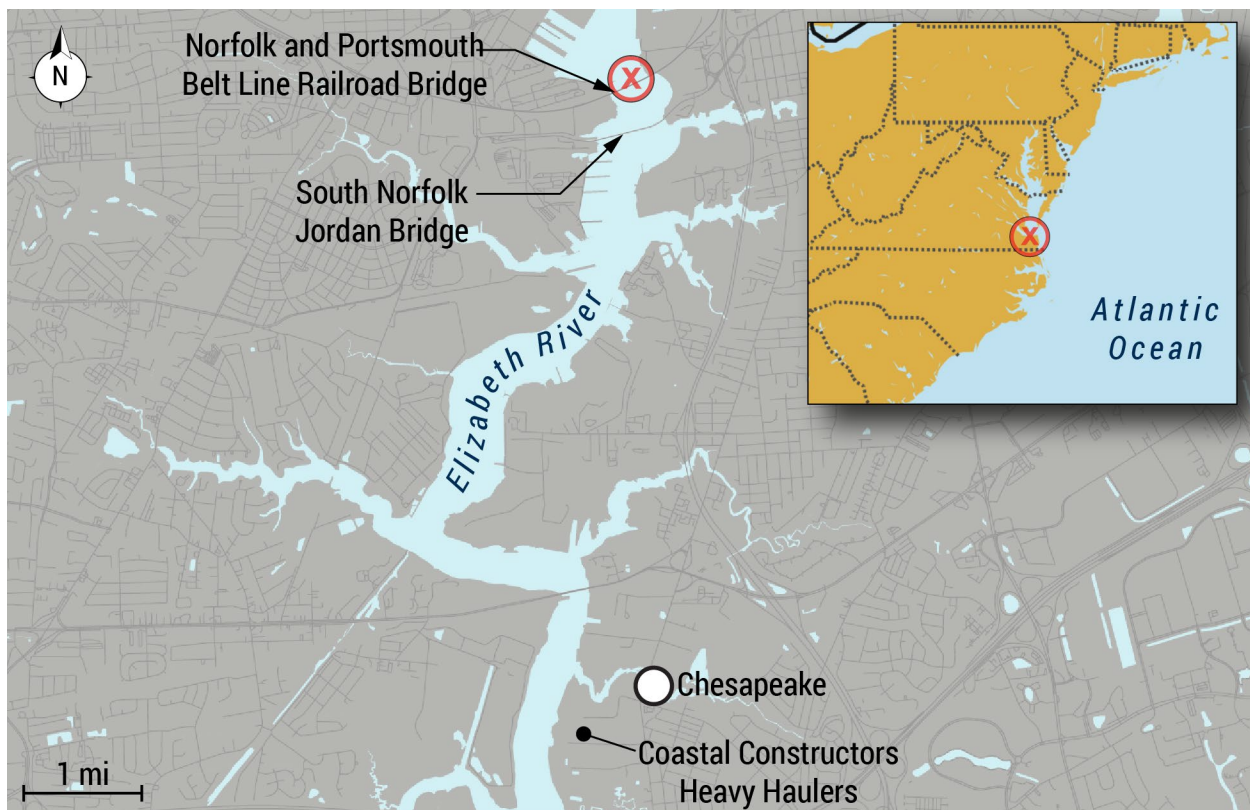


Figure 2. Area where the *Mackenzie Rose* tow struck the Norfolk and Portsmouth Belt Line Railroad Bridge, as indicated by a circled X. (Background source: Google Maps)

1 Factual Information

1.1 Background

The 96.4-foot-long *Mackenzie Rose* was a steel-hulled towing vessel built in 2000 by SeaBoats Incorporated in Fall River, Massachusetts, as the *Vernon C.* In 2020, the vessel was acquired by Coeymans Marine Towing LLC, of Coeymans, New York, and renamed the *Mackenzie Rose*. The *Mackenzie Rose* was powered by two 2,400-hp, four-stroke marine diesel engines, each connected to a reduction gear (4.25:1 ratio) driving a stainless steel, fixed pitched propeller. The towing vessel could be navigated from either the upper or lower wheelhouse.

The *Mackenzie Rose* had a valid US Coast Guard-issued certificate of inspection, issued on June 30, 2020, documenting compliance with Title 46 *Code of Federal Regulations* Subchapter M. The operating company also had a towing safety management system for the vessel approved by a third-party organization (Towing Vessel Inspection Bureau).

The Norfolk and Portsmouth Belt Line Railroad Bridge, also referred to as the Elizabeth River Lift Bridge, was a lift bridge built in 1958, and was owned and operated by the Norfolk and Portsmouth Belt Line Railroad Company. The bridge was an active railroad crossing over the Southern Branch of the Elizabeth River connecting the cities of Portsmouth and Chesapeake, Virginia.

When lifted, the bridge's 378-foot-long lift span provided 300 feet of horizontal clearance and 145 feet of vertical clearance for vessel traffic through the navigational channel (see figure 3).² The lift span typically remained in the lifted position to allow free movement of waterway traffic. Concrete pilings and foundation piers anchored the approach to the railroad bridge from the eastern and western sides of the river. Arched protective wooden fendering and pilings shielded the main span's concrete pilings and foundation piers that paralleled the navigational channel.

² *Vertical clearance*, also known as charted height, is the vertical distance between the water level at mean high water and the lowest point of the bridge structure span over a navigation channel, indicating how much space a vessel has to pass underneath without hitting the bridge.

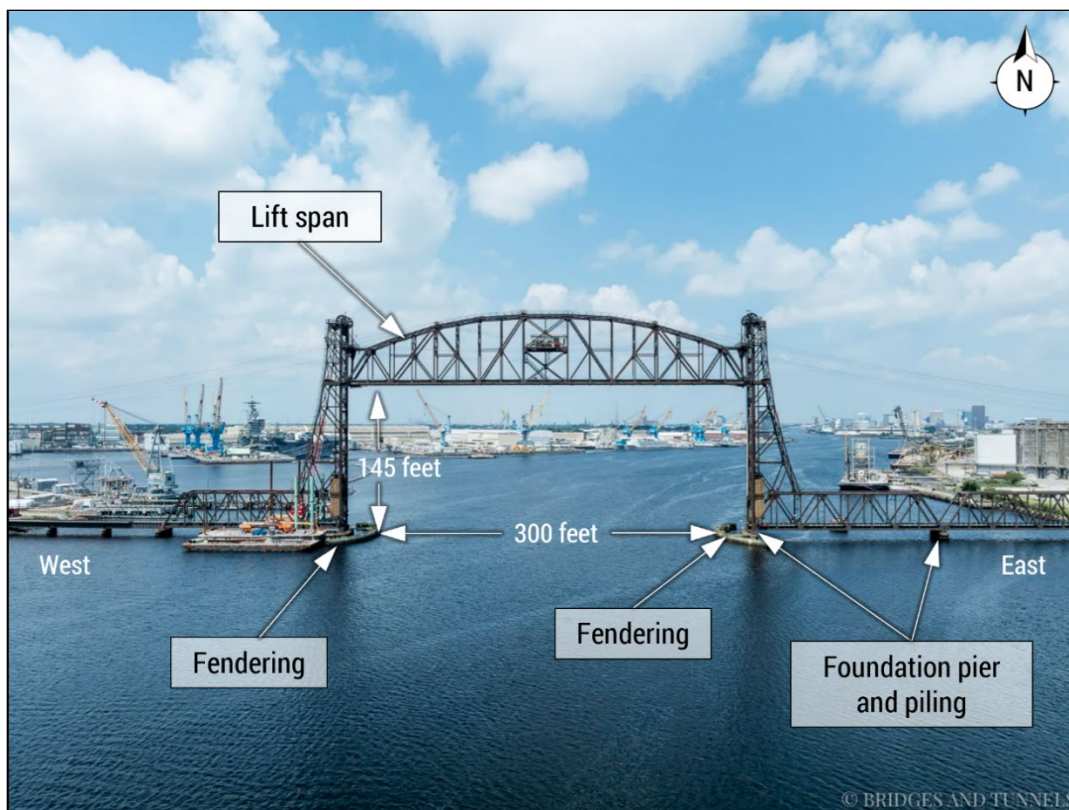


Figure 3. North-facing view of the Norfolk and Portsmouth Belt Line Railroad Bridge with the lift span raised. (Background source: bridgestunnels.com)

The bridge was typically operated remotely from the Belt Line Berkley yard office, 0.5 miles away from the bridge; however, local control stations were available at the western and eastern approaches to the bridge. Rail crossings typically occurred Monday through Friday but were not regularly scheduled. Whenever a rail crossing necessitated the bridge being lowered, a local bridge operator would proceed to the Belt Line Berkley yard office and notify mariners via VHF channel 13 about 30 minutes before lowering the bridge.

1.2 Event Sequence

On June 15, 2024, the towing vessel *Mackenzie Rose* was approaching Chesapeake, Virginia, on the Elizabeth River, with the captain navigating the vessel. The vessel was en route to the Coastal Precast Systems facility along the river to pick up the 191-foot-long deck barge *Weeks 281*, which was loaded with precast concrete materials. There were 5 crewmembers aboard the vessel: a captain, mate, lead deckhand, junior deckhand, and engineer. (Crew rotation was 2 weeks on and 2 weeks off; the mate had served as captain of the vessel during the previous 2-week rotation)

While the vessel was underway, the captain stood the 1800–2400 and 0600–1200 watches, and the mate stood the 0000–0600 and 1200–1800 watches. Each navigation watch had an assigned deckhand. The lead deckhand was assigned to the front watch (with the captain), and another (junior deckhand) was assigned to the back watch (with the mate). The engineer worked days and started at 0600; he would also typically be awake for docking and undocking and the starting and stopping of main propulsion systems.

At 1018, the mate relieved the captain of the navigational watch as the *Mackenzie Rose* arrived at the facility. This was about 2 hours earlier than the normally scheduled turnover. The mate maneuvered the vessel alongside the pier without incident, and all lines were secured at 1130. Shortly thereafter, a marine surveyor boarded to record the loaded condition of, and lashings on, the barge *Weeks 281*. The total length of the tow was 287.4 feet, and the widest part of the tow was the barge, which had a beam of 54.6 feet. According to the vessel's logbook, the loaded deck barge drafts were 4 feet 6 inches at the bow and 6 feet at the stern, and the *Mackenzie Rose's* draft was 14 feet.

At 1500, the *Mackenzie Rose* and tow departed the facility, en route to New York, with the mate at the helm in the upper wheelhouse. The mate used autopilot while transiting outbound (north) in the Elizabeth River toward the Atlantic Ocean.³ The mate said he started using the autopilot between Money Point and Paradise Creek. The mate told investigators that he typically would not use autopilot while navigating inland, but he used it for this transit because the barge was "smaller" and "handling really well."

At 1600, the junior deckhand completed a routine check of the barge lashings and push gear system and an inspection of the engine room and bilges. He notified the mate on watch that he was going to head to the galley to start preparations for the evening meal, which he routinely performed as part of his duties.

About 1624, according to recorded Rose Point data, the *Mackenzie Rose* tow was centered in the Elizabeth River channel and proceeding through the South Norfolk Jordan Bridge with a course over ground of 020°, a speed over ground of 4.8 knots, and no rate of turn.

About a minute later, about 1625, the vessel and tow passed successfully through the South Norfolk Jordan Bridge. The mate told investigators that, after the

³ The marine autopilot system on board the *Mackenzie Rose* was designed to hold the vessel's heading, which was set by the operator. It did not have the capability to automatically steer a course, nor did it account for set or drift.

tow passed under the bridge, he was still steering on autopilot, squaring up the tow for the approach to the Norfolk and Portsmouth Belt Line Railroad Bridge.

The tow continued to approach the bridge, and about 1625:25, the vessel's heading began swinging to port, with a rate of turn at 12° per minute (according to Rose Point data) (see figure 4). The mate told investigators that within a couple of minutes, when the tow was "getting too close to the bridge," he realized the autopilot "had switched" (turned off) without alarming.

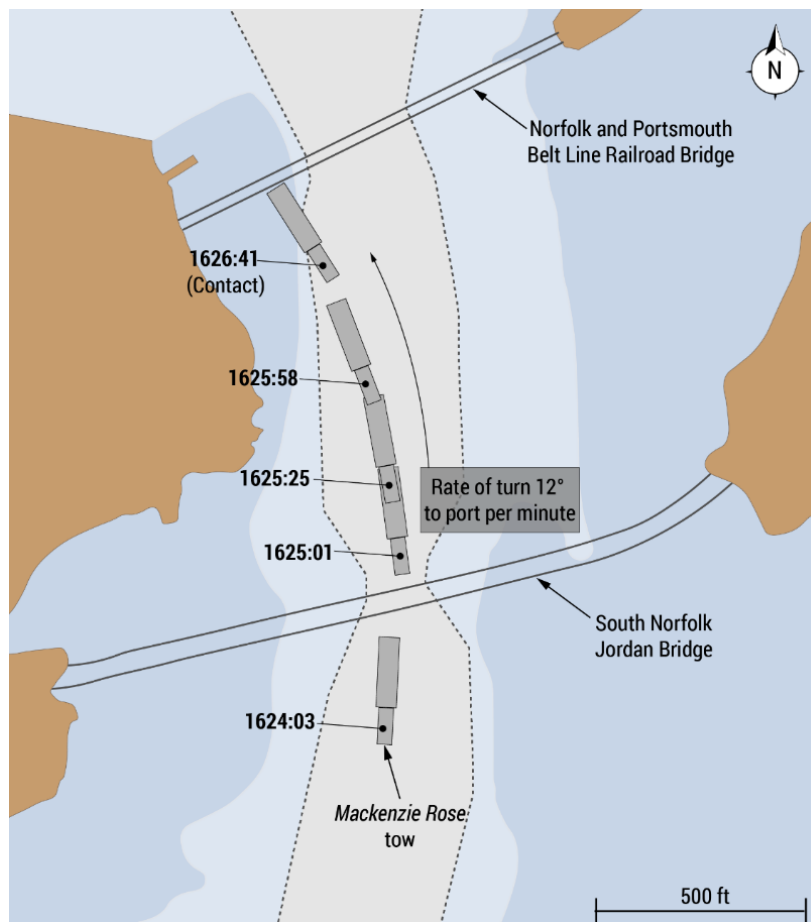


Figure 4. *Mackenzie Rose* tow track as it transited through the South Norfolk Jordan Bridge and toward the Norfolk and Portsmouth Belt Line Railroad Bridge (tow not to scale). (Vessel position source: Rose Point data)

The mate stated that he took control by switching from autopilot to non-follow-up (NFU) hand steering about two barge lengths from the bridge. He then pulled back on the two throttles to neutral (8 seconds) and engaged the throttles in reverse (another 8 seconds) to back the vessel. However, he stated he was unable to do so without "touching up on the bridge." He told investigators, "Before I hit the bridge, I was already in reverse. I had clutched in earlier and then I backed, as soon as I could back full, I backed full."

At 1626:41, the bow of the *Weeks 281* contacted the western portion of the Warren through-truss approach span of the Norfolk and Portsmouth Belt Line Railroad Bridge (see figure 5). The tow's speed over ground at the time of the contact was 4.8 knots. The bridge was not staffed by a local bridge operator at the time of the casualty.



Figure 5. Area of the bridge struck by the tow. (Background source: H&H, Norfolk and Portsmouth Belt Line Railroad Bridge)

When the contact occurred, the captain was sleeping in his stateroom, and the engineer was in his stateroom completing daily logbook entries. The engineer stated that the contact was "noticeable" but "it wasn't a very hard impact." None of the crew recalled hearing any audible alarms at the time of or after the contact.

The crew went to the upper wheelhouse to check on the mate. The engineer told investigators that, when he arrived in the wheelhouse, the mate was in the process of backing away from the railroad bridge, which was about 20 feet from the bow of the tow when he arrived. The mate did not provide any instructions to the engineer. The engineer stated that because the mate was busy, he proceeded to the engine room to check on main propulsion, steering, and auxiliary systems. He did not find any damage, flooding, or issues with propulsion or steering.

The vessel continued outbound with the mate navigating in NFU hand steering. The captain contacted the vessel operating company's port captain to inform him of the contact and that he wanted to call the US Coast Guard.⁴ The crew also told the port captain that there was no visible damage to the bridge, *Mackenzie Rose*, or barge *Weeks 281*, and sent photos of the barge and bridge to the port captain to review (see figure 6).

The port captain then relayed the information to the company's general manager via text messages. In a text message with the *Mackenzie Rose* crew, the port captain stated, "I'm on with CG [Coast Guard] now, continue on the slow bell, I'll let know what they wanna do shortly." This message was followed by another message that stated, "Okay I'm sending the CG statements and photos- they are allowing us to continue our voyage ... Please proceed as planned." (The local Coast Guard sector did not receive a phone call on the day of the casualty.)



Figure 6. Photo of bridge taken by *Mackenzie Rose* crew after contact. (Source: *Mackenzie Rose* crew)

The captain told investigators after receiving approval from the port captain, the *Mackenzie Rose* tow proceeded along with the intended voyage to New York Harbor without incident or issue with steering (the tow arrived in New York Harbor on June 18). None of the crew or the port captain notified the local Coast Guard of the incident nor did they contact the Norfolk and Portsmouth Belt Line Railroad.⁵

⁴ [Title 46 Code of Federal Regulations Part 4.05-1](#) requires the operator of a vessel involved in an unintended bridge strike to immediately notify the nearest Coast Guard office.

⁵ A bridge operator could be reached any time of day by telephone at the numbers provided in its operating regulation, 33 *CFR* 117.997. The operating company's safety management system identified the bridge but did not include any contact information.

On the afternoon of June 17, a CSX train crew arrived at the Portsmouth (western) side of the bridge for a crossing, discovered damage to the bridge, and informed the Belt Line operations supervisor. The train was unable to cross, and the bridge was immediately taken out of service. After observing the damaged condition of the bridge, the railroad superintendent contacted the Coast Guard to determine which vessel had struck the bridge. After reviewing automatic identification system (AIS) data and bridge CCTV footage, the Coast Guard determined the *Mackenzie Rose* tow had struck the bridge.

The operating company did not perform postcasualty testing for alcohol and other drugs on the *Mackenzie Rose* crewmembers.

1.3 Additional Information

1.3.1 Damage

As a result of the contact, the western section of the Norfolk and Portsmouth Belt Line Railroad Bridge superstructure was sheered at the base of the pilings. The section was dislodged at the bearings and shifted north 6 feet 6 inches from bridge alignment (see figure 7 and figure 8). Bottom lateral bracings were buckled and ruptured at the point of contact, as well as gusset plate deformation and horizontal sweep damage. The lift bridge sustained damage to several members of the western structure to include buckling and extreme deformation in counterweight guide track, posts and top of posts being buckled, as well as bottom chord buckling and ruptured members, and rail decking and timber damage.



Figure 7. Norfolk and Portsmouth Belt Line Railroad Bridge in raised position after contact, looking east, showing rail and bridge structure misalignment. (Source: Coast Guard)

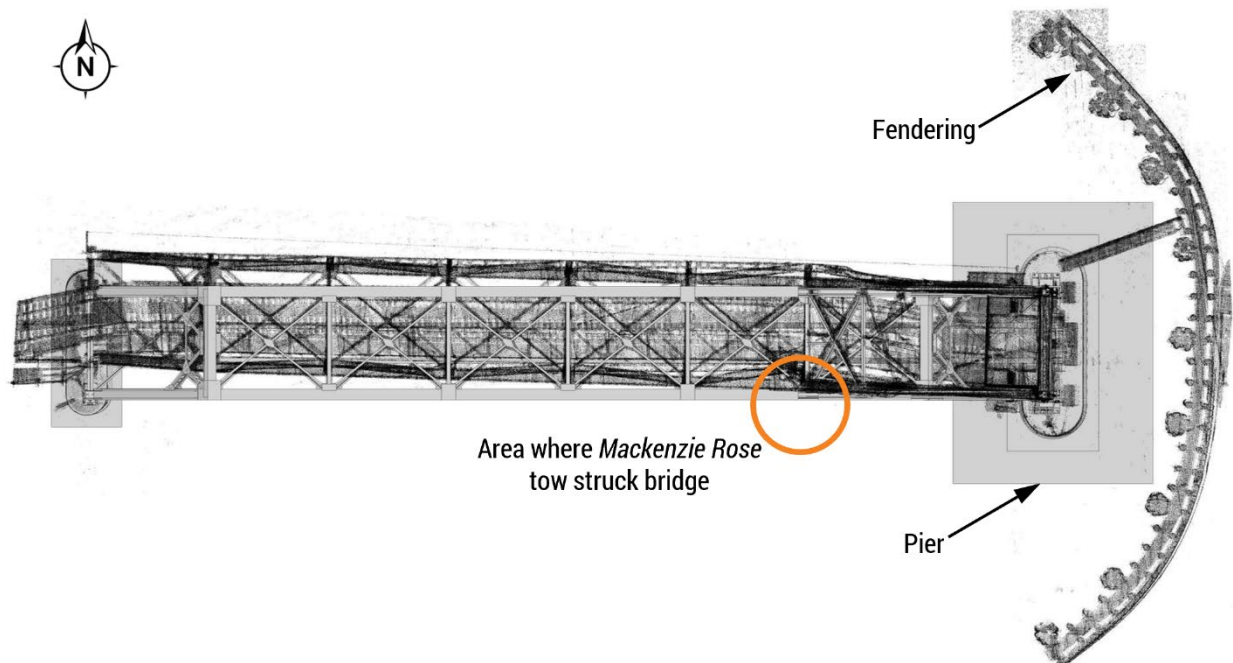


Figure 8. LiDAR image showing western span's misalignment compared to the designed alignment. The area where the tow struck the bridge is circled. (Background source: Norfolk and Portsmouth Belt Line Railroad Company)

Costs to repair the bridge exceeded \$15.8 million and the bridge returned to service on November 6, 2024, with reduced-speed, manual operations. It returned to full-speed service with remote operation by the end of March 2025. No damage was reported to the *Mackenzie Rose* or barge *Weeks 281*.

1.3.2 Autopilot

1.3.2.1 General

The *Mackenzie Rose*'s autopilot controller unit was installed on November 22, 2023, on the starboard side of the operating console in the upper wheelhouse (where the mate was conning the vessel at the time of the contact). A screen on the left side of the unit displayed the vessel's heading, ordered heading, course, speed, autopilot operating mode, and compass source (see figure 9). Four buttons below the screen allowed the user to select the autopilot mode (standby, auto, track, or work modes). The right side of the unit had other controls, including a rotary knob and buttons used to adjust vessel heading while the autopilot was active.



Figure 9. Starboard side of *Mackenzie Rose* upper wheelhouse with autopilot controller after the casualty.

To operate the vessel in autopilot mode, the operator would press the “AUTO” key once and then press the starboard button (green arrow) to confirm. The rotary knob was used to change the set heading and could also be pressed to re-activate auto mode with the current heading as reference. The starboard and port keys could also be used to set the heading/course. In addition, a rudder angle display, located on forward facing windows, centerline, provided the operator rudder angle indicator, and heading repeater.

According to the mate, there were two buttons an operator had to press to disengage the autopilot, and they had to be pressed in sequence. (The mate did not specify which buttons had to be pressed.)

According to the autopilot system’s operating manual, to put the vessel in hand steering mode, the operator would press the standby key and use the NFU lever (tiller) to adjust the rudder. The system display would then show an “S” to indicate the system was in standby mode.

To put the autopilot system in NFU mode—and use the port and starboard keys on the controller to operate the rudder—the operator would press the standby key, then either the port or starboard key. When the autopilot system was in NFU mode, the operator would hold either the port or starboard key to adjust the rudder; if the operator did not hold either key, the rudder would stay at the last command input. The system display would then show an “NFU” to indicate the system was in NFU mode.

To put the autopilot system in FU mode—and exclusively use the rotary knob to control the position of the rudder—the operator would hit the “Standby” key and then press and hold the rotary knob. The system display would then show an “FU” to indicate the system was in FU mode. The vessel would hold the rudder angle based on where the rotary knob was left. The operator could also switch from NFU to FU mode by pressing and holding the rotary knob.

1.3.2.2 Towing Safety Management System

The *Mackenzie Rose*’s towing safety management system contained guidance regarding the use of autopilot, which stated:

When an automatic pilot is used in areas of high traffic density, conditions of restricted visibility, or any other hazardous navigational situations, the master must ensure that:

- It is possible to immediately establish manual control of the ship’s steering;

- A competent person is always ready to take over steering control; and
- The changeover from automatic to manual steering and vice versa is made by, or under, the supervision of the officer in charge of the navigational watch.

1.3.2.3 Troubleshooting and Investigation

From February to April 2024, vessel crews reported issues with the autopilot system, including the autopilot going into standby without audible warning and veering to port and starboard without warning. In March 2024, technicians boarded the vessel to troubleshoot but could not replicate the reported issue. In April 2024, technicians again boarded the vessel to troubleshoot the reported issues. Technicians updated the autopilot software and installed a battery backup on the autopilot system. They also replaced the 24-volt solid state relays with mechanical relays and replaced a controller area network bus terminal to ensure proper communication.

On May 21, at 0008, the captain filed an incident report with the operating company to describe an incident when the “steering went hard left” while in autopilot. The incident report did not provide clarifying information or indicate any corrective actions taken. The designated person ashore closed (declined approval) the incident report on June 24, 2025, with a note stating, “Form has sit [sic] in this inbox for months with the prior DPA [designated person ashore].”

The crew on board the vessel at the time of the casualty did not report experiencing issues with the autopilot during the vessel’s lightboat transit from Baltimore, Maryland, to Chesapeake the day before the casualty (June 14).

After the casualty, National Transportation Safety Board and Coast Guard investigators examined the autopilot system and could not replicate the issue described by the mate or find any technical issues with the system. The vessel’s operating company also had technicians from the autopilot system manufacturer inspect the system; the technicians found no issues. The autopilot system manufacturer had not issued any service bulletins relating to the issue described by the mate.

The port captain filed an incident report with the operating company for the casualty on June 19. The report stated, “When changing over from auto pilot to hand steering it is critical that the knob for the auto pilot be clicked into the ‘off’ position and that in this instance it was not.” The report indicated there was also a discussion with both the captain and mate on watch at the time of the incident that, “...in

accordance with both company policy and *CFR [Code of Federal Regulations] 40.670* the auto pilot should not be used in areas of high traffic density, conditions of restricted visibility, or any other hazardous navigational situations.”

1.3.3 Electronic Data

After the casualty, investigators reviewed the recorded Rose Point data for the *Mackenzie Rose* tow on the day of the casualty. According to Rose Point data, the tow had a port rate of turn at 12° per minute that remained constant from 1625:25 until the time of the contact at 1626:41. Rose Point data showed that the tow’s speed over ground (4.8 knots) also remained constant up from 1625:01 until the point of contact with the bridge. AIS data showed the *Mackenzie Rose* tow centerline was 70 feet outside of the Elizabeth River channel at the point of contact.

The *Mackenzie Rose*’s onboard navigation systems and main propulsion control system did not record parametric data of command inputs/response, engine RPMs, or rudder commands, nor were they required to.

Investigators also reviewed recorded CCTV footage from the Norfolk and Portsmouth Belt Line Railroad Bridge, facing south, which showed the tow as it approached the bridge. The footage showed the tow heading’s rate of turn began to swing to port after the tow passed through the South Norfolk Jordan Bridge (see figure 10).

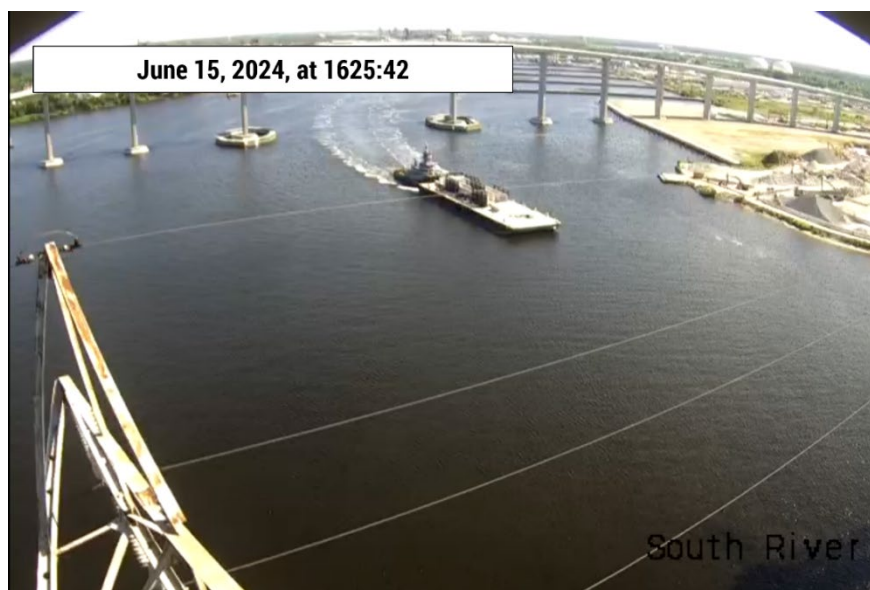


Figure 10. CCTV footage showing *Mackenzie Rose* tow passing through South Norfolk Jordan Bridge. (Source: Norfolk and Portsmouth Belt Line Railroad Bridge)

CCTV footage showed the *Mackenzie Rose* tow making contact with the bridge.⁶ The video showed the lift bridge superstructure shaking immediately after the contact, as well as the *Mackenzie Rose* tow continuing to push ahead on the bridge structure for 9 seconds following the initial contact. Forward thrust (propeller wash) was visible from the stern of the vessel during this timeframe. About 9 seconds after the contact, gray particulate matter was visible emanating from the main engine's exhaust stack.⁷ Shortly thereafter, the *Mackenzie Rose* tow was shown backing away from the bridge (see figure 11).



Figure 11. From left to right: CCTV footage of *Mackenzie Rose* tow at time of contact, and 9 seconds after the contact, showing propeller wash and gray exhaust particulate matter from vessel's exhaust stack. (Background source: Norfolk and Portsmouth Belt Line Railroad Bridge)

1.3.4 Mate Cell Phone Use and Work/Rest History

The mate had two cell phones with him in the wheelhouse at the time of the casualty: a company phone and a personal phone. He told investigators that he had

⁶ The time of the contact on the CCTV footage (1622:40) was about 4 minutes behind when compared to the vessel's AIS data (1626:41). Because AIS is based on GPS and VHF signals and is thus more accurate, investigators used the vessel's AIS for casualty event times.

⁷ When a vessel's diesel engine experiences variation in load due to high fuel injection, a lack of combustion air, or incomplete combustion, particle emissions, such as black smoke or soot, may be visible from the engine's exhaust. Particles—or particulate matter—emitted may be comprised of different compounds, such as particulate sulfate, black carbon, ash, or heavy metals associated with the consumption of fuel and lubrication oil.

not made or received any calls, sent or received any texts, searched the internet, or otherwise used either phone during the watch.

Investigators reviewed the cell phone records for both the vessel phone (located in the wheelhouse) and the mate's personal phone. Records for the mate's personal phone showed no text or call activity between 1624 and the time of the contact; there were no internet connection activity records. Records for the vessel phone showed no call activity between 1624 and the time of the contact; there were text records. Records for the vessel phone showed internet connection activity (mobile data use) between 1615:50 and 1729:01; however, the records did not differentiate between automatic background data activity, such as software updates, and user-initiated data activity, such as internet browsing or scrolling on social media.

The mate was the senior permanent captain for the *Mackenzie Rose's* other crew. He had 14 months' experience on the *Mackenzie Rose* and had been a towing vessel captain for 28 years and a mariner for 40 years. He completed a 2-weeks-on/2-weeks-off contract on June 12. Because there was no other relief mate available, he remained aboard the vessel and assumed the mate's duties and responsibilities. Before the crew change, the mate stood the navigation watches from 0600 to 1200 and from 1800 to 2400 each day. After the crew change, the mate stood the opposite watches (0000-0600 and 1200-1800, reversing his previous work/rest periods).

The mate stated that he received about 8 hours of sleep during each 24-hour period while on the vessel, split between his two off-watch periods. He stated that he slept well during his rest period but also stated he "felt a little bit tired." The mate did not provide any indication that he fell asleep during the casualty watch.

1.3.5 Pilothouse Alerter System

At the time of the casualty, the *Mackenzie Rose* was equipped with a pilothouse alerter system.⁸ At the time of the casualty, the system was active, in the "Manual ON / AUTO" mode of operation, and the watch time interval countdown timer was set at 3 minutes, according to the operating company. There were no company policies or procedures regarding the pilothouse alerter system.

⁸ A *pilothouse alerter system*, when used as intended, is an effective tool that can help ensure a towing vessel operator remains awake and vigilant while on duty (and notify another crewmember if the pilothouse alarm is not acknowledged).

2 Analysis

The towing vessel *Mackenzie Rose* was pushing the loaded deck barge *Weeks 281* ahead, outbound in the southern branch of the Elizabeth River when the tow veered to port and struck the Norfolk and Portsmouth Belt Line Railroad Bridge. At the time of the casualty, there was minimal current, and wind conditions were calm.

According to the mate, as the tow transited outbound in the Elizabeth River, he navigated using autopilot by using the rotary knob to increase or decrease the heading setpoint. (There were no company policies that prevented the *Mackenzie Rose* mate from steering in autopilot while transiting the Elizabeth River.) The mate told investigators that, when the tow got close to the railroad bridge, the autopilot “tripped” without alarming, and he lost steering without realizing it. Based on the vessel’s AIS data and CCTV footage from the Norfolk and Portsmouth Belt Line Railroad Bridge, the tow began turning to port at a rate 12° per minute about a minute before the bridge strike. If the mate had been actively monitoring the tow’s approach to the bridge, the tow’s rate of turn should have been an indication that the tow was not aligned to be able to successfully pass through the bridge.

The mate stated that the *Mackenzie Rose* had issues with steering, including the autopilot, in the past. Past crews had reported issues with the autopilot going into standby without audible warning and veering to port or starboard without warning about 3-4 months before the accident. Technicians updated the system’s connections and software, and the crew on board the vessel at the time of the casualty did not report experiencing issues with the steering or propulsion systems during the vessel’s lightboat transit from Baltimore to Chesapeake the day before the casualty. There were no records of alarms or other indications the autopilot switched off, nor were there any service bulletins from the system manufacturer relating to the described issue. Investigators examined the autopilot system after the casualty but were unable to replicate the issue. As such, investigators could not confirm the mate’s assertion that the autopilot had “tripped.” The operating company also had technicians review the system after the contact, but they found no issues, and no repairs were made to return the vessel to service.

The mate also stated that he put the engines in full astern to attempt to stop the tow from contacting the bridge. However, CCTV footage showed propeller wash coming from the stern of the *Mackenzie Rose* immediately after it struck the bridge, indicating forward propulsion. There was no indication of a change in engine load—and thus a change from forward propulsion—until about 9 seconds after the contact. At that time, particulate matter, which typically results from high load demand on the engine, could be seen emanating from the main engine’s exhaust. Therefore, the

evidence does not support the mate's claim that he backed the vessel before the contact.

Based on the vessel's AIS data and CCTV footage from the Norfolk and Portsmouth Belt Line Railroad Bridge, the tow's rate of turn (12° per minute to port) and speed (about 4.8 knots) remained constant for about 1 minute 15 seconds after passing through the South Norfolk Jordan Bridge and as the tow approached the Norfolk and Portsmouth Belt Line Bridge. Investigators attempted to determine how the tow's change of heading to port occurred if the autopilot had not "tripped," as the mate asserted. It is possible that the mate attempted to switch to hand steering for the approach to the bridge or the autopilot did not respond as the mate expected. In either scenario, he would have changed the steering mode using the autopilot system controls. The mate told investigators that an operator would have to press two buttons in sequence to disengage the autopilot. However, according to the autopilot system manual, an operator would only have to press "Standby" to disengage the autopilot and use the NFU lever to hand steer the vessel.

If the mate had pressed "Standby" and then either the port or starboard keys, he would have inadvertently put the autopilot system in NFU mode, meaning he would not be able to use the NFU lever to steer the vessel. However, the rudder would have returned to midships, and the tow's rate of turn likely would have been reduced. If the mate had pressed "Standby" and then the rotary knob, he would have put the autopilot system in FU mode, and the rudder would have remained fixed at the rotary knob's set position. Therefore, if the mate had inadvertently put the system in FU mode, the tow's rate of turn would have remained constant, as it did on the day of the casualty. The immediacy of the situation (potential loss of steering in a confined waterway) likely would have added additional stress, quickly created a high level of workload for the mate, and may have overwhelmed his understanding of the system. This could have led to errors, such as steps in the process being omitted or executed incorrectly. Such errors, known as slips or lapses, can occur even if an individual is highly experienced and familiar with a particular task.

Alternatively, the mate could have been experiencing the effects of fatigue. The mate, who was the senior permanent captain for the other crew, completed his 14-day hitch, stayed on board, and assumed the mate's duties and responsibilities. The crew worked a 6-hours-on/6-hours-off watch schedule, and the mate stated that he slept well during his off-watch rest periods, averaging about 4 hours of sleep during each rest period. However, research has shown that this watch rotation leads

to shorter sleep durations and more instances of excessive sleepiness when compared to a 4-hours-on/8-hours-off watch rotation or 12-hour watches.⁹

Before the crew changeover on June 12, about 3 days before the accident, the mate stood watch from 0600 to 1200 and from 1800 to 2400. When the crew changed over, he switched his schedule to work the opposite watches from 1200 to 1800 and 0000 to 0600. When a person changes awake/sleep cycles in order to stand night watches or work night shifts, the person's circadian rhythm, or biological clock, is not synchronized to their new awake/sleep cycle, a condition known as circadian misalignment. The effect is similar to jet lag and may result in increased fatigue, reduced attention, and excessive sleepiness until the body has adjusted to the change. This adjustment can sometimes take more than a week for the body to fully adjust and resynchronize. Further, the mate relieved the captain almost 2 hours earlier than his scheduled watch start time and had been standing watch for over 6 hours (1018 to 1626) at the time of the casualty.

Due to the limited and fragmented sleep from the 6-hours-on/6-hours-off watch schedule and the noted disruption to the mate's circadian rhythm, it is likely that the mate was experiencing the effects of fatigue during the casualty transit. Such effects can include slowed reaction time, inattentiveness, drowsiness, and an increased desire to sleep. As such, it is possible that the mate experienced an attentional lapse or a brief episode of sleep and thus was not monitoring the tow's position as it approached the bridge.

A pilothouse alerter system is a tool that can help ensure a towing vessel operator remains awake and vigilant while on duty. The *Mackenzie Rose* was outfitted with a pilothouse alerter system, which was active while the mate was navigating the vessel through the two bridges. The system was set to alarm after 3 minutes if it did not detect motion. However, less than 3 minutes passed between the time the tow passed through the South Norfolk Jordan Bridge and when it struck the Norfolk and Portsmouth Belt Line Railroad Bridge. This was not sufficient time for the system to alarm and awaken the mate if he had fallen asleep or alert him if he experienced a lapse in attention.

Coast Guard regulations require marine casualties to be reported. The mate and crew were aware that the tow had struck the bridge, as evidenced by the texts exchanged with the company port captain. Although the port captain told the crew via text that he was in contact with the Coast Guard, the local sector did not receive

⁹ Mikko Härmä et al., "Effects of 6/6 and 4/8 Watch Systems on Sleepiness among Bridge Officers," *Chronobiology International* 25 no. 2-3 (April 2008): 413-423.

any phone calls about the bridge strike on the day of the casualty, indicating the operating company was not actually in contact with the Coast Guard.

The damage to the bridge was so severe that when a train crew stopped at the bridge 2 days later, it was evident they would not be able to lower the lift span and cross the bridge (the western end was displaced over 6 feet). Given how obvious the damage was, it was unlikely that a train would have crossed in the 2 days between the casualty and when the damage was discovered. However, the time immediately after a bridge is struck is typically used to examine the damage, alert authorities and users, perform an engineering exam, and begin stabilizing the bridge. Fortunately, in this case, the failure of the *Mackenzie Rose* operating company to report the casualty did not have repercussions. Regardless, marine casualties, such as bridge strikes, should be reported immediately to reduce possibility of negative outcomes.

3 Conclusions

3.1 Probable Cause

The National Transportation Safety Board determines that the probable cause of the contact of the *Mackenzie Rose* tow with the Norfolk and Portsmouth Belt Line Railroad Bridge was a loss of control of the tow by the mate at the helm, possibly due to his error in switching from autopilot to hand steering or impairment by fatigue.

3.2 Lessons Learned

Safe Navigation with Autopilot

Navigating in channels and harbors requires quicker reaction times due to traffic, currents encountered, and frequent course changes, and more rudder due to slower speeds. Therefore, autopilot use is often discouraged or prohibited in a harbor entrance or narrow channel. If autopilot must be used, it is critical that vessel operators be fully trained in all features and functions of a vessel's systems so that they can quickly adjust the modes of the autopilot system or disengage the autopilot to return to hand steering as needed.

Vessel Particulars

Vessel	<i>Mackenzie Rose</i>	<i>Weeks 281</i>
NTSB Vessel Type	Towing/Barge (Towing vessel)	Towing/Barge (Deck barge)
Owner/Operator	Coeymans Marine Towing LLC	Weeks Marine
Flag	United States	United States
Port of registry	Coeymans, New York	New York, New York
Year built	2000	2021
Official number	1098224 (US)	13112242 (US)
IMO number	8968765	N/A
Classification society	N/A	N/A
Length (overall)	96.4 ft (29.4 m)	191.6 ft (58.4 m)
Breadth (max.)	33.5 ft (10.2 m)	54.6 ft (16.6 m)
Draft (casualty)	14.0 ft (4.3 m)	4.5 ft (1.4 m) forward 6.0 ft (1.8 m) aft
Tonnage	157 GRT	1,340 GRT
Engine power; manufacturer	2 x 2,400 hp (2,237 kW); ALCO 12-251E four-stroke marine diesel	N/A

NTSB investigators worked closely with our counterparts from **Coast Guard Sector Virginia and Coast Guard Sector New York** throughout this investigation.

The National Transportation Safety Board (NTSB) is an independent federal agency charged by Congress with investigating every civil aviation accident in the United States and significant events in other modes of transportation—railroad, transit, highway, marine, pipeline, and commercial space. We determine the probable cause of the accidents and events we investigate, and issue safety recommendations aimed at preventing future occurrences. In addition, we conduct transportation safety research studies and offer information and other assistance to family members and survivors for any accident or event investigated by the agency. We also serve as the appellate authority for enforcement actions involving aviation and mariner certificates issued by the Federal Aviation Administration (FAA) and US Coast Guard, and we adjudicate appeals of civil penalty actions taken by the FAA.

The NTSB does not assign fault or blame for an accident or incident; rather, as specified by NTSB regulation, “accident/incident investigations are fact-finding proceedings with no formal issues and no adverse parties ... and are not conducted for the purpose of determining the rights or liabilities of any person” (Title 49 *Code of Federal Regulations* section 831.4). Assignment of fault or legal liability is not relevant to the NTSB’s statutory mission to improve transportation safety by investigating accidents and incidents and issuing safety recommendations. In addition, statutory language prohibits the admission into evidence or use of any part of an NTSB report related to an accident in a civil action for damages resulting from a matter mentioned in the report (Title 49 *United States Code* section 1154(b)).

For more detailed background information on this report, visit the [NTSB Case Analysis and Reporting Online \(CAROL\) website](#) and search for NTSB accident ID DCA24FM049. Recent publications are available in their entirety on the [NTSB website](#). Other information about available publications also may be obtained from the website or by contacting—

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