MARINE INVESTIGATION REPORT
M00L0039

STRIKING

OF THE BULK CARRIER *TECAM SEA*
BY THE BULK CARRIER *FEDERAL FUJI*
PORT OF SOREL, QUEBEC
27 APRIL 2000

Marine Investigation Report

Striking

of the Bulk Carrier *Tecam Sea* by the Bulk Carrier *Federal Fuji* in the Port of Sorel, Quebec 27 April 2000

Report Number M00L0039

Summary

On 27 April 2000, the Panamanian bulk carrier *Federal Fuji* was calling at the Port of Sorel, Quebec, to offload reinforcing bars at berth 15. Commencing its final approach to the dock under the conduct of a pilot, the vessel struck the bulk carrier *Tecam Sea,* moored at berth 19. There were no injuries or pollution as a result of this occurrence.

Ce rapport est également disponible en français.

Other Factual Information

Particulars of the Vessels

	Federal Fuji	*Tecam Sea*
Official Number	730963	730927
Port of Registry	Nassau, Bahamas	Nassau, Bahamas
Flag	Bahamas	Bahamas
Type	Bulk carrier	Bulk carrier
Gross Tonnage	17 814	17 056
Length[1]	182.8 m	178.21 m
Draught	Forward: 10.08 m Aft: 10.09 m	Forward: 9.3 m Aft: 9.4 m
Built	1986, Nippon Kokan Shimizu, Japan	1984, Hitachi Innoshima, Japan
Propulsion	One Sulzer diesel, 6RTA58, 6988 kW	One Sulzer diesel, 6RTA58, 8474 kW
Crew	22	21
Owners	Viken Lakers, Bergen, Norway	Sea Quality, Athens, Greece

Description of the Vessels

The *Federal Fuji* is a bulk carrier with a deadweight capacity of 29 536 tons. The bridge, accommodation, and engine room are aft of the five cargo holds. Four deck cranes are used to handle cargo at the cargo holds. The ship is powered by one main engine, driving a right-hand fixed-pitch propeller. The bow thruster develops 660 kW.

The *Tecam Sea* is a bulk carrier with a deadweight capacity of 27 631 tons. The bridge, accommodation, and engine room are aft of the five cargo holds. Four deck cranes are used to handle cargo at the cargo holds.

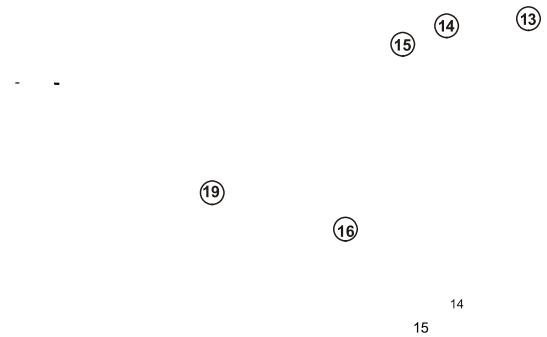
History of the Voyage

[1] Units of measurement in this report conform to International Maritime Organization standards or, where there is no such standard, are expressed in the International System of units.

On 27 April 2000 around 1502 eastern daylight time,[2] the tugs *Océan Golf* and *La Prairie* were made fast by the bow to the starboard shoulder and quarter, respectively, of the *Federal Fuji*. The bulk carrier, with 18 813 tons of reinforcing bar on board, was preparing to move from the anchorage in the mouth of the Richelieu River to berth 15 in the Port of Sorel, Quebec. On the bridge were the master, the officer of the watch, the helmsman, a company representative, and a pilot, who was conning the vessel using visual observations. The crew noted that the weather was clear. The winds were from the northwest at about eight knots.

At 1509, off the danger buoy for Sorel basin, the pilot ordered slow ahead. The vessel headed toward the mouth of the Richelieu River, while visual contact was maintained with the front of wharf 15. After establishing visual contact with the front of wharf 16, the pilot ordered port 20 helm. The tug *Océan Golf* assisted the vessel to swing to port. At 1512, the main engine was stopped, and the tug *La Prairie* applied astern power to deaden the vessel's headway, estimated at two knots.

When the yaw had slowed, the pilot directed the navigation personnel to use the bow thruster to assist the tug. The vessel stopped swinging to port, then suddenly swung to starboard. At 1513, the pilot ordered dead slow ahead and hard-a-port helm, but the speed of the swing to starboard increased and the vessel moved away from berth 15. Two "kicks" ahead were ordered, including full ahead at 1516. The vessel crossed the river and approached the *Tecam Sea,* moored at berth 19.



When the navigation personnel confirmed to the pilot that the bow thruster was already operating at full power and the helm was still hard-a-port, he ordered both anchors dropped. At 1517, he ordered half astern, then full astern. The port anchor was dropped, then the starboard anchor. At 1518, the starboard shoulder of the *Federal Fuji* struck the port quarter of the *Tecam Sea*. The main engine was stopped immediately, and the *Federal Fuji* moved away from the *Tecam Sea.*

At 1524, the anchors were weighed and manoeuvres were commenced to allow the *Federal Fuji* to stem the current again off berth 15. Both tugs were ordered to push the *Federal Fuji* into berth 15, but the manoeuvre was unsuccessful. At 1532, the tug *La Prairie* was cast off and then ordered to push on the forward section of the *Federal Fuji*, together with the tug *Océan Golf*. The *Federal Fuji* swung to port and approached the wharf. Around 1546, the *Federal Fuji* was moored at berth 15 without further incident.

No injuries were reported.

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2 All times are eastern daylight time (Coordinated Universal Time minus four hours).

Damage to Vessels

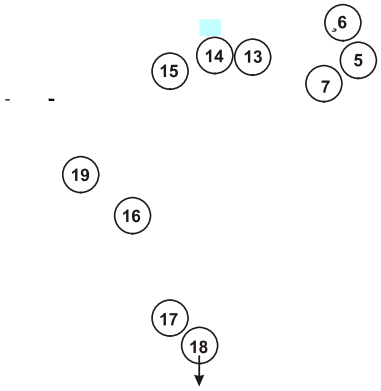
The *Federal Fuji* sustained damage to the starboard shoulder. The shell plating and the forecastle deck plating and associated girders in way of the forecastle bulwark and boatswain's locker were cropped and renewed. One roller chock, one landing boom, one navigation mast and the access platform also required repairs.

The *Tecam Sea* sustained damage to the port quarter. The shell plating was stove in way of the quarterdeck.

Port Information

Currents

At the mouth of the Richelieu River, the current vector on the St. Lawrence River indicates a current of 1.5 knots running at 075°. A current of approximately 1 knot is indicated along the axis of the Richelieu River. The current is slightly weaker near berth 15. Flow rates in the St. Lawrence and Richelieu rivers vary with the seasons. During spring runoff, the current is stronger than the average current indicated on the chart. The pilot estimated that the current in the Richelieu River was 2 to 3 knots at the time of the occurrence.



Silting Advisory

The mouth of the Richelieu River is prone to silting. The following silting advisory appears in the reference box of Nautical Chart 1312, *Port of Sorel*, published by the Canadian Hydrographic Service (CHS):

> Owing to continual silting, dredging is carried out periodically to the depths shown but mariners are cautioned that varying amounts of refilling must be expected.

Sounding and Dredging

Because of silting, soundings were taken in the mouth of the Richelieu River in 1987, 1988, 1993, 1997, 1998, 1999, and 2000. Most soundings were done alongside the berths, including berths 14, 15, and 19. Apart from the natural sedimentation deposited by currents at the mouth of the river, deposits of toxic substances have also been reported, and no disposal site has yet been found for these deposits. The government of Quebec released funding for a dredging impact study.

The shipping channel in the Port of Sorel is dredged to a depth of 11.7 m, but the centre of the estuary is dredged less often. The chart inset on CHS Nautical Chart 1312 indicates that a shoal is located off berth 15, reducing the usable water depth to 9.4 m above chart datum.

Usable Water Depth

The Sorel tide register for April 27 indicates that, around 1515, the water depth was 1.32 m above chart datum. Consequently, at the 9.4 m shoal off berth 15, the *Federal Fuji,* drawing 10.09 m, had an under-keel clearance of at most 0.63 m.

Port Operations

The major activities at the Port of Sorel are the trans-shipment of mineral ore, grain, and steel. In previous years, vessels that had loaded grain on the Great Lakes would complete their loads at berth 15 in the Port of Sorel before proceeding to the Atlantic.

Around 1990, Fagen Dock Services Inc. started trans-shipping steel at berths 5 and 6 of wharf 2. The holding area at wharf 2 was eventually too small, and around 1995, Fagen Dock Services Inc. started to use the land to the west of the mouth of the Richelieu River at Pointe-aux-Pins. In 1996, berth 19 was rebuilt to handle general cargo. Now, steel accounts for about 95 per cent of all cargo handled at this berth. Because of restrictions related to usable water depth at berths 5 and 19, deep-draught vessels are partially lightened at berth 15 before moving to berth 19 to finish offloading.

Statistics on Pilot Assignments

Pilots can be assigned to some 140 vessels a year. In 1999, for example, the Laurentian Pilotage Authority (LPA) recorded 787 assignments to the Port of Sorel. In the Richelieu River in particular, the 53 pilots available between Trois-Rivières and Montréal carried out a total of 290 assignments involving vessel movements:

Table 1						
Berth	Number of Assignments		Average Draught		Average of Averages	Usable Water Depth (Chart Datum)
	Arrival	Departure	Arrival	Departure		
No. 14	26	30	6.18 m	7.27 m	6.72 m	7.00 m (6.10 m)
No. 15	57	55	9.21 m	7.67 m	8.44 m	10.9 m
No. 16	3	2	5.79 m	5.18 m	5.48 m	8.60 m
No. 17	1	0	4.50 m	-	4.50 m	8.50 m (4.60 m)
No. 18	2	1	5.72 m	7.16 m	6.44 m	8.80 m
No. 19	71	65	7.19 m	8.18 m	7.68 m	9.00 m

In 1999, pilots completed 11 assignments involving a transfer from berth 15 to berth 19. During the winter, two pilots may be aboard the same vessel.

Tugs Available

Table 2 lists some key details of the tugs most often used in the Port of Sorel.

Table 2				
Tug Name	Power	Gross Tonnage	Propulsion	Bollard Pull
Océan Golf	1567 kW	159	2 propellers	27 t
La Prairie	1120 kW	109.58	2 propellers	12 t
Omni St-Laurent	896 kW	160.84	2 propellers	17 t
Omni Richelieu	672 kW	144.16	1 propeller	15 t
Jerry G.	1119 kW	201	1 propeller	18.4 t
Salvage Monarch	985 kW	219	1 propeller	21 t

The *Océan Golf* and the *La Prairie* assisted the *Federal Fuji* during the approach manoeuvre. The *Omni St-Laurent* and the *Omni Richelieu,* the tugs based at the port, were sometimes relieved by the *Jerry G.,* the *La Prairie,* and the *Salvage Monarch*.

Other Occurrences

Several pilots who belong to the Corporation des pilotes du Saint -Laurent central (corporation of pilots serving the Montréal to Québec sector) reported having been involved in such marine occurrences as near strikings and near groundings in the Port of Sorel. Other pilots were involved in marine accidents. The following information is from some *Reports of a Shipping Casualty* made by pilots to the Laurentian Pilotage Authority:

- During a docking manoeuvre assisted by two tugs with bollard pull of 15 tons and 17 tons, respectively, a bulk carrier with a deadweight capacity of 18 668 tons and a draught of 7.48 m suddenly swung to starboard. The bridge team were unable to control the swing, and the vessel grounded on a shoal in the river.

- When swinging off the river mouth with the assistance of two tugs, each with a bollard pull of about 15 tons, a bulk carrier with a deadweight capacity of 24 105 tons and a draught of 10.61 m was driven by the wind and current. The tug was unable to keep the vessel away from the channel bank, and the vessel grounded.

- During a docking manoeuvre assisted by a tug with a bollard pull of 15 tons, a general cargo vessel with a deadweight capacity of 21 894 tons and a draught of 8.4 m suddenly swung to starboard, crossed the river, and struck the front of wharf 19.

- During a docking manoeuvre assisted by a tug with a bollard pull of 17 tons, a vessel with a deadweight capacity of 6266 tons and a draught of 5.8 m suddenly swung to starboard, crossed the river, and struck the front of the opposite wharf, No. 19.

- During a docking manoeuvre assisted by two tugs with bollard pull ratings of 15 tons and 17 tons respectively, a bulk carrier with a deadweight capacity of 28 086 tons and a draught of 10.48 m grounded about 30 m off berth 15.

- During a docking manoeuvre assisted by two tugs with bollard pull ratings of 15 tons and 17 tons respectively, a bulk carrier with a deadweight capacity of 36 563 tons and a draught of 9.27 m struck wharf 19.

Analysis

Problems Identified

Because of its concern about the frequency and potential consequences of occurrences at the Port of Sorel, the Board did a preliminary analysis of the above occurrences. The Board identified the following problems:

- Shoals reduce the manoeuvring area available and limit vessel manoeuvrability.

- The tugs available did not provide sufficient assistance under the circumstances.

Shoals

Material in suspension in the Richelieu River causes silting. Over the years, the accumulated sediment has formed shoals in the estuary and in the St. Lawrence River on both sides of the mouth of the Richelieu River.

To assess the gravity of the silting problem, soundings were taken and dredging was done in the area. In the 10 years preceding this occurrence, the situation had been monitored regularly by sounding. However, efforts to deal with the silting problem have not produced the results expected. Dredging operations were concentrated alongside the wharfs and rarely included the central portion of the estuary. In the absence of a dredging program covering the entire mouth of the Richelieu River, sedimentation on the shoals will tend to flow toward the dredged areas alongside the wharfs. Silting, therefore, will continue to affect the hydrodynamic behaviour of vessels stopping in this section of the port.

Room to Manoeuvre

By limiting their dredging operations to the area just off the wharfs that they operate, the berth operators have considerably reduced the manoeuvring zone. As a result, at the mouth of the Richelieu River, the access channel in the St. Lawrence River is divided into two lanes to provide access to the Richelieu River: one lane on the west side leads to berth 19; another leads to berths 14 and 15. Only shallow-draught vessels can use the middle of the Richelieu River to reach berths 16, 17 and 18.

Squat Effect

Shoals affect a vessel's hydrodynamic performance. The water that should flow under the hull encounters resistance due to low under-keel clearance. The water flowing under the bow moves faster, creating a low-pressure area. This results in a loss of flotation, causing the vessel to squat by the bow.

The mass of water that builds up in front of the vessel increases resistance and shifts the pivot point[3] aft. As a result, the steering lever is shorter, and more propeller thrust and/or greater rudder deflection is required to maintain a heading. The manoeuvrability of a vessel in this condition is sometimes unpredictable.[4]

In this occurrence, the speed of the vessel over the ground plus the speed of the countercurrent, estimated at two and three knots respectively, produced a speed through the water of about five knots during the approach. At this speed, the vessel tended to squat over the shoals. Pilots who execute approaches in this area have often observed this phenomenon. Mariners and pilots use a chart and a worksheet to calculate under-keel clearance as a standard for vessels transiting the confined waters of the St. Lawrence River.[5] Marine traffic regulators use this under-keel clearance standard to evaluate the squat effect on vessels.

Converging Currents

To navigate safely, mariners must have a good knowledge of the local currents and constantly monitor a current's direction and strength.

The currents of the Richelieu and St. Lawrence rivers meet in the mouth of the Richelieu. Consequently, a vessel proceeding toward a berth at the entrance to the Richelieu must stem both currents simultaneously. The Richelieu current pushes against the port shoulder, and the St. Lawrence current pushes against the starboard quarter. The combined effect of the two forces applies a yawing moment on the vessel, causing it to swing to starboard.

The investigation established that the majority of pilots use the Richelieu River current to induce sideways movement towards the berths. By ordering kicks ahead or slow forward propulsion with the main engine, it is possible to stem the current by maintaining the pivot point in the fore part of the vessel. This ensures that the steering lever is adequate to manoeuvre and control the vessel. However, if the pivot point is allowed to shift further forward, the moments produced by the bow thruster and the forward tug, in relation to the pivot point, will decrease accordingly.

However, the vessel must not be positioned too far crosswise of the current. If the angle between the vessel's heading and the current is too great, considerable propeller thrust will be required to turn the vessel back into the current. If the water's resistance (created by the current's striking the shoulder of the vessel) is too great, the main engine will be unable to produce enough thrust to overcome that resistance. Unless a great deal of manoeuvring room is available, the vessel will swing out of control in the wrong direction.

Loss of Manoeuvrability

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3 The *pivot point* is the point at which the resultant of two forces acts; one force is created by the vessel's headway, the other by the longitudinal resistance offered by the mass of water in front of the vessel.

4 Captain R. W. Rowe, *The Shiphandler's Guide*, The Nautical Institute.

5 Notices to Mariners 462/95 and 479/95.

The effect of low under-keel clearance can be insidious and violent. If the vessel is placed athwart the current, the swing will be even greater. When this happens, mariners tend to reduce the vessel speed or even stop the main engine to shift the pivot point aft. This shortens the steering lever and the vessel will not answer properly to the wheel. To regain control of the vessel, power must be increased to maintain torque and apply propulsion forward and helm hard-over in the desired direction. However, if in this case the pivot point shifts further aft, the moments produced by the bow thruster and the forward tug in relation to the pivot point will increase accordingly.

In this occurrence, the manoeuvres ordered by the pilot did not produce the expected results. Off berth 15, the combined thrust of the bow thruster and the *Océan Golf* was initially insufficient. The vessel's speed was reduced to complete the drift into the berth. A swing to port was begun but, as the vessel was too far athwart the current, a swing to starboard ensued. Even the full thrust of the vessel's propeller, combined with that of the forward tug and the bow thruster, was not enough for the vessel to stem the current. In other words, the moment produced by the thrust of the vessel's propeller, the bow thruster, and the tug in relation to the pivot point was not enough to overcome the moment produced by the current on the hull.

Tug Assistance

When berth 19 at Pointe-aux-Pins was rebuilt to accommodate the trans-shipment of steel products, marine traffic increased on the Richelieu River in the Port of Sorel. Of the 313 pilotage assignments for marine traffic on the Richelieu in 1999, 136 were for this maritime terminal. In addition, departures were made by vessels drawing 8.18 m on average, the second-highest average.

Despite this growth in traffic on the Richelieu, the tug service has remained unchanged in the port. When several pilots experienced unexpected yaw occurrences over the years, they started to make more frequent requests for tugs with higher bollard-pull ratings. This service was provided by tugs from the Port of Montréal.

Keeping a vessel on heading in a current is difficult without adequate tug assistance. The limited space available in the estuary does not provide sufficient manoeuvring room to regain control of the vessel.

For many years, and until quite recently, the *Omni St-Laurent* and the *Omni Richelieu* provided towing services in the Port of Sorel. Even though these conventional tugs and their replacements, whose manoeuvrability and performance were comparable, may be economical to operate, their manoeuvrability and performance is now considered limited. The tugs are slow and, at times, their manoeuvring is restricted when repositioning in relation to a vessel. When made fast to the bow of a vessel, these conventional tugs tend to increase the vessel's headway and push on the ship's side, because they only rarely push at

right angles to the hull. In this occurrence, the forward component of the push from the forward tug and the vessel's propeller thrust increased the headway of the *Federal Fuji* and drove it toward the *Tecam Sea*.

Findings as to Causes and Contributing Factors

1. The presence of shoals in the port reduced the under-keel clearance of the vessel and adversely affected the vessel's hydrodynamic behaviour.

2. The manoeuvres ordered by the pilot on the *Federal Fuji* did not produce the expected results. The thrust of the propeller, the bow thruster, and the forward tug was not enough to overcome the effect of the current's pushing against the port shoulder of the *Federal Fuji*.

3. The forward component of the thrust of the forward tug and the vessel's propeller increased the headway of the *Federal Fuji* and drove it toward the *Tecam Sea*.

Findings as to Risks

1. Ongoing silting at the mouth of the Richelieu River creates shoals. The existing dredging program does not fully cover the river mouth.

2. Conventional tugs with a low bollard pull are unable to maintain a vessel on heading when the vessel is athwart the current.

Safety Action

Action Taken

On 21 June 2000, representatives of the Laurentian Pilotage Authority, Fednav International Limited, and the Corporation of Mid-St. Lawrence River Pilots met to review the operating procedures for the Port of Sorel. Solutions under consideration include dredging the mouth of the Richelieu River off berths 14, 15, and 19, soundings, and using a tug more powerful than *La Prairie*.

In June 2001, the Ocean Group took delivery of the 360° azimuth-drive 3040 kW tug *H-9901* to operate permanently in the Port of Sorel. This tug offered greater directional stability and, since its arrival, the number of reportable occurrences decreased substantially. However, in August 2001, it was sold and replaced by the variable pitch, twin screw, 4829 kW *Ocean Hercule*.

According to the Navigable Waters Protection Division of Fisheries and Oceans Canada, only one dredging operation at the mouth of the Richelieu River has been approved since this accident, namely a dredging operation to a depth of 7.4 m carried out in September 2002 off section No. 14.

A dredging project is to be submitted to the Quebec provincial department of environment by the Société des parcs industriels Sorel-Tracy. The sea bottom at the mouth of the Richelieu River would be dredged to a depth of 8.5 m off the docks and to a depth of 11.0 m in the centre of the river. It is expected this project could become a reality in the fall of 2003.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 17 December 2002.