Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT

M11W0091

STRIKING OF A BRIDGE

TUG *F.W. WRIGHT* AND BARGE *EMPIRE 40*
FRASER RIVER
QUEENSBOROUGH RAILWAY BRIDGE, BRITISH COLUMBIA
28 JUNE 2011

Canada

Marine Investigation Report

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Queensborough Railway Bridge, British Columbia
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Report Number M11W0091

Summary

On 28 June 2011 at 0410 Pacific Daylight Time, while under tow of the tug *F.W. Wright,* the loaded gravel barge *Empire 40* struck the Queensborough Railway Bridge in the Fraser River, British Columbia. The bridge centre swing span and protection pier sustained extensive damage. This resulted in the bridge being inoperable for a period of 2 months after the striking, causing major disruptions to railway and river traffic. No one was injured and there was no pollution as a result of this occurrence.

Ce rapport est également disponible en français.

Factual Information

Particulars of the Vessels

Names of vessels	*F.W. Wright*	*Empire 40*
Official number	807707	372638
Port of registry	Victoria, British Columbia	Vancouver, British Columbia
Flag	Canada	Canada
Type	Tug	Barge
Gross Tonnage	8.17	1674
Length [1]	12.59 m	61.57 m
Breadth	5.49 m	17.71 m
Draught	3.0 m	4.23 m
Built	1987	1977
Propulsion	Twin diesel engines (328 kilowatts each), twin fixed-pitch propellers	Non–propelled
Cargo	N/A	3600 tons paving aggregate
Crew	3	Unmanned
Registered owners	Mercury Launch & Tug Ltd.	Lafarge Canada Inc.

Description of the Vessels

The *F.W. Wright* is a tug of steel construction (Photo 1). The navigation bridge is located on the fore part of the main deck. There is a conning position with steering and engine controls inside the wheelhouse, another on the top of the wheelhouse with similar controls, and a third immediately on the starboard side of the winch on the after deck.

Photo 1. *F.W. Wright*

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

All 3 conning positions are equipped with a pneumatic abort system to allow the tow cable to run freely off the winch drum in the event of an emergency.

There is a cabin for the crew below the main deck in the forecastle.

The tug is equipped with a hydraulically-operated winch on the after deck, as well as a 400 m-long steel wire towing cable and a 12 m towing bridle, both 28 millimetres in diameter.

The tug is powered by twin diesel engines, driving twin fixed-pitch propellers with twin rudders for each propeller.

The *Empire 40* is a flat-decked non-propelled barge of steel construction (Photo 2). At the time of the occurrence, it had an approximate load of 3600 tons on board.

Photo 2. Barge *Empire 40*

Description of the Bridge

The Queensborough Railway Bridge is located east of Poplar Island on the North Arm of the Fraser River. It connects the railway line between New Westminster, British Columbia, and Richmond, British Columbia. It is owned and operated by Southern Railway Limited of British Columbia and is under the jurisdiction of Port Metro Vancouver.

Photo 3. Queensborough Railway Bridge

The bridge consists of a centre swing span that is fitted atop a circular concrete pier (Photo 3). The concrete is protected by treated wood piling, timber and a wood-sheathed protection pier. When the bridge is swung open, the north channel is 26 m wide and the south channel is 29 m wide. Due to the extensive silting of the north channel over time, all upriver and downriver vessels transit through the bridge via the south channel. [2] The protection pier extends both upriver and downriver approximately 40 m from the center of the concrete pier and is tapered at both ends. The tapered ends are fitted with formed steel protection plates. There are lights fitted at the tapered ends: green indicates that the swing span is open and red indicates that the span is closed. The north and south rail line approaches to the swing span are protected, upriver and downriver, with cement pilings and 12 m-long wing walls (Photo 4 and Appendix A).

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2 Fisheries and Oceans Canada, *Sailing Directions,* Vol. 1, Seventeenth Edition, 2004, pages 158 -159.

Photo 4. Queensborough Railway Bridge approach

Approaches

The Port Metro Vancouver's June 2010 *Harbour Operations Manual* contains practices and procedures for transiting the bridges along the Fraser River (Appendix B). It is available to all vessel owners and operators. The procedures in the manual [3] request that vessels transiting the Queensborough Railway Bridge make a security call on very high frequency radiotelephone channels 06 and 74 to determine if there is any opposing traffic. The bridge is usually left open. If it is closed, the vessel's crew is advised to contact the bridge operator well in advance to request that it be opened. A tug towing a barge loaded with more than 4500 short tons [4] is advised to either stem the current or use an assist tug while transiting the bridge. If the barge has a beam in excess of 18 m in width, an assist tug is also required and the barge must stem the current.

The crew of the *F.W. Wright* was not aware of these guidance procedures in the *Harbour Operations Manual*.

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3 *Harbour Operations Manual*, Sections 3.8 and 3.8.2.

4 A short ton is a unit of mass equal to 907.2 kg (2000 pounds).

A local tug operator, Seaspan, has also set out procedures for its tugs, which prohibit the towing of loaded barges downstream through the Queensborough Railway Bridge when the current exceeds 4 knots.

Once clear of the bridges at New Westminster, the standard downriver approach to the Queensborough Railway Bridge is for the tug and tow to favour the western shore of the Fraser River. The approach would require the tug to steer towards the northeast tip of Lulu Island, approximately 230 m east of the Queensborough Railway Bridge. As the tug and tow near the northeast tip, the deflection of water caused by a submerged weir between the tip and Shoal Point, put in place years ago to limit silting, sets the tow to the north as it nears the bridge. This is counteracted by steering for the south-side opening (see Photo 4 for typical track).

Damage History of the Bridge

This was the 5th occurrence [5] involving strikings of the Queensborough Railway Bridge to be reported to the TSB in the last 10 years. With the exception of the significant damage incurred in this occurrence, damage was minor in the other strikings, limited to the protection pier, its pilings, and the bridge structure.

History of the Voyage

At 0800 [6] on 27 June 2011, the master and deckhand returned to work after a week off and joined the tug at the company dock in Richmond. They fuelled up the *F.W. Wright* and departed the dock at around 0915 with the master at the con.

The *F.W. Wright* was performing work subcontracted by Harken Towing to Mercury Launch & Tug Ltd., which included the tow of log booms. It was to continue working overnight and throughout the next day, thus requiring the presence of an additional person on board. [7] As a result, at 0820, the owners made arrangements for a mate to join the tug later that day.

At 0940, the *F.W. Wright* arrived at the booming grounds at the entrance to the North Arm of the Fraser River to start its first towing assignment, which was to tow a 22-section log boom upriver to the Harken booming grounds, just downriver from the Pattullo Bridge, Fraser River, British Columbia. At 1040, the tug and tow departed. The *F.W. Wright* proceeded upriver, passing by the company dock on its way to the Harken booming grounds to pick up the mate. The mate had boarded the 1245 ferry from Duke Point on Vancouver Island, British Columbia, to Tsawwassen, British Columbia, on the mainland (a 2-hour trip during which the mate had a short nap). Therefore, the mate was not at the company dock as planned, and the master continued on.

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5 TSB occurrence numbers M01W0039 (*Sea Imp II*), M04W0080 (*Bering Straits*), M04W0100 (*Ocean Warlock*), M11W0030 (*Storm Crest*) and M11W0091 (*F.W. Wright*).

6 All times are Pacific Daylight Savings Time (Coordinated Universal Time minus 7 hours) unless otherwise noted.

7 *Marine Personnel Regulations,* Section 207, for non-convention vessels.

The *F.W. Wright*, having already transited the Queensborough Railway Bridge at approximately 1915, arrived at the Harken booming grounds at 1945. The tow upriver was uneventful, averaging a speed over the ground (SOG) of 1.8 knots against the freshet. [8]

The mate eventually joined the tug at 2030. This was the first time that the mate and the deckhand had worked with this master.

After delivering its tow, the *F.W. Wright*, as well as the assist tugs from Harken Towing, rearranged sections of the log boom for the next hour in preparation for the trip to Port Kells, approximately 15 miles upriver. By this time, the master had been on watch for 12 hours. Shortly after rearranging the log boom, the tug resumed towing the boom upriver against the tide and freshet.

At approximately 2100, the mate offered to take over the watch. The master declined the offer and continued to remain at the con. The deckhand retired to his bunk below, but understood that the vessel would be in operation throughout the night and that he might be needed later.

At approximately 2300, the night shift dispatcher for Harken Towing contacted the master of the *F.W. Wright* to inform him that his next assignment would be to tow the barge *Empire 40* from Pitt River Quarry to a gravel company located at the eastern side of Mitchell Island, in the North Arm of the Fraser River, west of the Queensborough Railway Bridge. This type of last-minute change of assignment was not uncommon.

On 28 June at 0045, at the request of the Harken Towing dispatcher, the *F.W. Wright* transferred the log tow to another tug in order to be at the Queensborough Railway Bridge between 0400 and 0430. [9]

The dispatcher informed the master of the time to transit the Queensborough Railway Bridge.

The *F.W. Wright* then proceeded to the Pitt River Quarry, arriving at 0145. On arrival, the mate boarded the barge *Empire 40,* untied it, and connected the tug's towing bridles. At 0155, the tug and barge departed Pitt River Quarry, bound for Mitchell Island. The master remained at the helm.

Once the tug and barge transited the Pitt River Railway Bridge, the mate again offered to take the helm; the master declined.

At approximately 0315, the tug and tow passed the Port Mann Bridge, and the master, who had been awake for almost 22 hours, handed over the con of the tug to the mate. The master remained in the wheelhouse, sitting on the settee immediately behind and to the right of the helm station.

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8 The term *freshet* is used to describe a spring thaw resulting from snow and ice melt in rivers located in the northern latitudes of North America, particularly in Canadian rivers that are frozen each winter and thaw during the spring.

9 The predicted tide indicated slack water just after 0323. During high freshet, the current is at its minimum during slack water.

The mate called the New Westminster Railway Bridge to request an open swing. The tug and barge transited the bridge at 0351.

After clearing the New Westminster Railway Bridge, the *F.W. Wright* was contacted by the master of the *Harken No. 8*, who informed the mate that the *Harken No. 8* would be the assist tug for the transit through the next bridge, the Queensborough Railway Bridge. The *Harken No. 8* joined the *F.W. Wright* within ½ mile south of the New Westminster Railway Bridge.

The mate confirmed with the master that there was no need to shorten the towline and that his approach was appropriate for the transit through Queensborough Railway Bridge. At some point shortly after this, the master fell asleep at the settee.

The mate then steered the tug past Shoal Point Light towards the northeast tip of Lulu Island. As the tug neared the island, the mate altered course to starboard to place the tug and tow just south of the transit line through the south channel of the bridge. The *Harken No. 8* positioned itself at the port quarter of the barge to ensure that the barge stayed clear of the submerged weir and of the island.

As the tug and tow neared the bridge, the mate noticed that the barge was not following the intended track, but setting to the north of the transit line through the south channel of the bridge. After confirming that the *Harken No. 8* was not pushing the barge, the mate attempted to alter course to port to re-align the barge for the transit and simultaneously increased engine power.

The master was awakened by the increased noise from the engine. Noticing that the barge was about to strike the protection pier, the master immediately took over the con of the vessel and put the throttles into neutral. The mate yelled to the deckhand to wake up. The *Harken No. 8* tried to get to the starboard side of the barge to provide assistance, but the barge had set too far to the north.

At 0410, the barge hit and damaged the protection pier. The barge continued on while the swing span drove 10 m into the gravel pile on the barge deck. The master then activated the abort switch for the towing winch to pay out the towline and moved the tug away from the barge. The barge finally came to a stop after the current pushed it against the south rail line approach.

The master then manoeuvred the tug alongside the barge, and the mate and deckhand boarded and released the towing bridle from the barge. At 0420, the master reported the incident to the Marine Communications and Traffic Services (MCTS) centre in Victoria, and also informed them that the south channel of the Queensborough Railway Bridge was blocked by the barge *Empire 40.*

Vessel Certification

Neither the *F.W. Wright* nor the *Empire 40* were required by regulations to undergo inspections, [10] nor were any carried out by Transport Canada. As such, no certificates were issued.

Personnel Certification and Experience

The master had 40 years of experience within the towing industry and had been working as a master on board tugs since 1983. He also had extensive experience on the Fraser River, especially with towing log booms on the river. He had been employed by Mercury Launch & Tug Ltd. since 27 April 2011. He held no formal marine certificate of competence or Marine Emergency Duties (MED) certification. As a master of a tug less than 10 gross tons, he was required to have a certificate of competency [11] and MED training. [12] The master did not have a valid medical certificate.

The mate had approximately 13 years of experience within the towing industry, working with various companies on a full-time and part-time basis. Prior to joining Mercury Launch & Tug Ltd. in 2008, the mate worked for 18 months with a towing company mostly as a mate and, for the most part, on the Fraser River.

In April 2008, the mate was issued a Master 500 Gross Tonnage, Near Coastal certificate of competency with a command endorsement. From March 2008 to May 2010, he worked full-time for Mercury Launch & Tug on the Fraser River and in the open waters along the coast of British Columbia. During this time, he transited the Queensborough Railway Bridge on 2 occasions as a mate. In August 2010, he returned to Mercury Launch & Tug on a part-time basis. Before the time of the occurrence, he had worked 303 hours; none of these hours, however, included transits of the Queensborough Railway Bridge or operating on the Fraser River upstream from the bridge.

The deckhand, although not required to hold a certificate, held a 350-ton Masters certificate of competency.

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10 Tugs of 15 gross tons or more require an inspection once every 4 years, as per *Canada Shipping Act (CSA), 2001* regulations.

11 *Marine Personnel Regulations*, Section 212(2).

12 *Marine Personnel Regulation*s, Section 205.

Damage

There was no reported damage to the *F.W. Wright*. The *Empire 40* sustained damage to its top bow rail, where it collided with the bridge's swing span.

Photo 5. Barge *Empire 40* and Queensborough Railway Bridge after striking

There was extensive damage to the protection pier and to the swing bridge gear mechanism (Photo 5). The leading 20 to 25 m of the protection pier for the swing span, as well as some portions of the protection pier pilings on the south side of the south channel, were extensively damaged as a result of the striking. The bridge's open swing span initially collided with the barge, before driving itself 10 m deep into the first pile of gravel, eventually stopping the barge. The current then caught the stern of the barge and swung it to port, stripping and damaging the gear mechanism of the swing span section. As it moved south, the barge took part of the swing span that was embedded in the gravel pile with it, thereby seperating the span from its adjoining section.

The barge then damaged the southeast wing wall before coming to rest on the cement protection piling of the south rail approach.

Tide and Current/Freshet in the Fraser River

The Canadian Hydrographic Service (CHS) *Tide and Current Tables*, Volume 5, indicate that, on 28 June 2011, high slack water occurred at 0323 at the New Westminster Railway Bridge, which is situated 1 mile upriver from the Queensborough Railway Bridge. At the time of the occurrence, a high freshet was running within the Fraser River due to run-off from unusually dense snow packs in the upper Fraser River watershed. As a result, the flow of the current ran continuously downstream, although it may have reduced in speed during the rise of the tide. The peak of the freshet occurs during the summer months. The CHS Fraser River water level and velocity predictions [13] indicated that the mid-channel speed of the current at New Westminster was 4.1 and 4.3 knots at 0300 and 0400, respectively. The maximum predicted speed for that day was 5.6 knots at 1000, and the minimum was 3.4 knots at 1800. These predictions are also used by mariners at the Queensborough Railway Bridge, as there are no current-measuring devices near the bridge.

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13 Predictions are based on the volume of water discharge at Hope, British Columbia.

Environmental Conditions

The local Environment Canada weather station in Vancouver indicated winds of between 4 and 11 km/h from the southeast between the hours of 0400 and 0500. Local weather was reported to be mostly cloudy with a temperature of 16°C.

Operating Procedures and Crew Familiarization

Established in 1987, the company that owns the tug operates out of Horseshoe Bay, British Columbia. It has 4 water taxis, with capacities of 12 to 40 passengers, that provide scheduled services throughout Howe Sound, British Columbia, and the Gulf of Georgia, British Columbia. It also has a fleet of 4 tugs that operate throughout the Gulf of Georgia to Puget Sound, Washington, United Sates, and provide towing of freight, bulk, and ramp barges. The company also has 4 ramp barges that haul lumber, aggregate, disposal bins, fuel, propane, and heavy equipment.

There were no formal [14] written company policies or procedures in place for either critical or routine shipboard or shore-based operations. However, when one of the company's tugs was to be operational on a continuous 24-hour basis, the practice was to assign a mate to the vessel. It is left up to the master to manage the work/rest periods of the crew. If crew were fatigued, it was expected that the master would tie up the vessel so that they could rest.

The *Canada Shipping Act, 2001*, requires that authorized representatives of Canadian vessels develop procedures for the safe operation of the vessel and for the management of emergencies. [15] Furthermore, the *Marine Personnel Regulations* require that a vessel's master be provided with written instructions ensuring that crew members become familiar with safety equipment, operations, and duties, and that they be provided with vessel-specific familiarization training. [16]

Work/Rest Requirements

Minimum rest and maximum work periods are defined in the *Marine Personnel Regulations.* [17] The master and every crew member are to have at least 6 hours of rest in every 24-hour period, and at least 16 hours of rest in every 48-hour period. Furthermore, the time between 2 rest periods must not be more than 18 hours, and not less than 6 hours.

Circadian rhythms are physical, mental, and behavioral changes that roughly follow a 24-hour cycle, responding primarily to light and darkness in an individual's environment. Circadian rhythms can change sleep-wake cycles and are often referred to as the body clock. During a prolonged period of sleep deprivation, the effects are more pronounced, yet sleepiness still increases and decreases within a period of approximately 24 hours.

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14 Memos from the owner were emailed to vessels when safety-critical issues were identified.

15 *Canada Shipping Act, 2001*, Section 106.

16 *Marine Personnel Regulations*, Section 206.

17 *Marine Personnel Regulations*, Sections 319 and 320.

The circadian nadir usually occurs during the early hours of the morning, between 0300 and 0600, when the body's metabolism is at its slowest. It corresponds to times associated with circadian minimums, where reaction time, vigilance, and forward planning skills are likely to be reduced.

Management of Safety

The principal objectives of safety management on board vessels are to ensure safety at sea, prevent human injury or loss of life, and avoid damage to the environment. These objectives are met by providing safe practices, vessel operation procedures and/or policies, a safe working environment through the establishment of safeguards against all identified risks, as well as by continuously improving the safety management skills of personnel ashore and on board vessels.

Effective safety management requires large and small organizations to be cognizant of the risks involved in their operations, to competently manage those risks, and to be committed to operating safely.

In order to accomplish this, a vessel operator must evaluate existing and potential risks, establish safety policies and related procedures to mitigate the identified risks, and provide a means to continuously gauge performance through audits, so as to improve organizational safety where necessary. The resulting documented and systematic approach helps to ensure that individuals at all levels of the organization have the knowledge and the tools to effectively manage risk, as well as the necessary information to make sound decisions in any operating condition, in both routine and emergency operations.

On 14 June 2012, the Board released an updated Watchlist, identifying 9 critical safety issues investigated by the TSB that pose the greatest risks to Canadians. Among these was the implementation of safety management systems (SMS) on board small commercial vessels. Implemented properly, SMS allow vessels and marine transportation companies to identify hazards and manage risks, as well as develop and follow effective safety processes.

Analysis

Events Leading up to the Bridge Striking

When the mate was given con of the vessel, the tug and tow were 4.7 miles (approximately 45 minutes) upstream from the Queensborough Railway Bridge. The master, who by this time had been awake for almost 22 hours, fell asleep on the settee some time after confirming that there was no need to shorten the towline and that the approach was appropriate for the transit of the Queensborough Railway Bridge. As a result, the master was not in a position to continuously monitor the progress of the vessel, especially at the critical stage of the passage.

Although the mate was aware of the standard approach to transit the Queensborough Railway Bridge, this would have been his first time transiting the bridge in at least 1 year, and under freshet conditions. However, after having confirmed his approach to the bridge prior to Shoal Point, at no time did he inform the master that he was in proximity to the entrance of the bridge. The approach taken by the vessel was routine, intended to counteract the setting of the barge to the north caused by the current. The mate did not anticipate the extent of the set resulting from the current and freshet. By the time he noticed that the barge had set too far to

the north, it was too late to take any corrective action to avert the striking, and the barge struck the protection pier.

Timing of the Transit Through the Bridge

It is preferable to transit through a bridge opening during an opposing tide or current or at slack water. In this occurrence, the presence of the freshet resulted in a continuous current flowing to the mouth of the river (i.e., from east to west through the bridge opening). The lowest predicted speed of the current at the New Westminster Railway Bridge, which is also used at the Queensborough Railway Bridge, was 3.4 knots and was to occur at 1800 on the date of the occurrence. The predicted speed of the current at the time of the occurrence was about 4.3 knots. An approximate 1-knot difference in the speed of the current at the time of the transit was likely not a factor in this occurrence.

Fatigue and Performance

Ensuring that crew members are well rested makes good sense. In this occurrence, a risk factor related to fatigue was present for both the master and the mate: continuous wakefulness. As time progressed towards the early hours of the morning, both the master and mate were approaching their circadian minimum (between 0300 and 0600), where reaction time, vigilance, and tracking performance were expected to reach a minimum. [18] In the absence of a comprehensive sleep history and other fatigue-related factors, a complete fatigue analysis for the master and mate could not be conducted.

At the time of the striking of the bridge, however, the master had been awake for a continuous 22-hour period, and the mate had been awake for 21 hours, with the exception of a short nap taken during the ferry crossing to join the tug. The need for sleep typically recurs after about 15 or 16 hours of being awake, even for someone who is well rested. A person who does not obtain the required sleep will develop a sleep debt and will be subject to performance degradation.

Performance degradation as a result of fatigue manifests itself in many ways, including falling asleep against one's will (microsleeps), failure to respond, slowed reactions (physical reactions and the speed of thought processes), incorrect actions, flawed logic and judgement, increase in false responses, increase in memory errors, vigilance decrement, reduced motivation, laxity, and an increased propensity for risk taking. [19]

In this occurrence, the master declined to hand over the con of the vessel to the mate and missed an opportunity to monitor the skill and competency of the mate after he boarded the vessel. He handed over the con only after deciding he needed to rest. The master eventually fell asleep just prior to a critical stage in the passage—the transit of the Queensborough Railway Bridge.

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18 A. Fletcher, N. Lamond, et. al. "Prediction of Performance during Sleep Deprivation and Alcohol Intoxication using a Quantitative Model of Work-Related Fatigue," *Sleep Research Online*, 5(2), 67-75 (2003).

19 D.F. Dinges, "Performance Effects of Fatigue," Fatigue Symposium Proceedings, National Transportation Safety Board and NASA Ames Research Center, November 1995.

Given that the master had been awake for an extended period at the con of the vessel throughout that day, evening, and early morning, it is likely that he had been experiencing feelings of fatigue by the time he handed over the con to the mate.

Managing Safety of Operations

To effectively manage the safety of their operations, owners and operators must be cognizant of the risks involved in their operation, competent to manage those risks, and committed to operating safely. Generally, organizations have 2 ways of effectively managing risks. For non-routine tasks, the organization may rely on a high level of expertise and training to ensure that tasks are completed safely. For routine operations, procedures may be provided to prescribe how tasks will be carried out.

This occurrence revealed that the company's operations were undocumented and informal, as illustrated by the following:

- It was left up to the masters and crew members to ensure that they got the appropriate amount of rest when needed.
- The management of day-to-day operations on board the tug was left to the discretion of each master.
- Familiarization with safety equipment, operations and on-board duties was left up to each master and crew member.

Furthermore, no verifications were made as to whether the master had appropriate certification and a valid medical certificate.

This lack of formalized procedures put the onus on each tug master to make decisions based on experience, judgment and available information at the time.

Given the dynamic nature of the towing industry, where last-minute assignments or changes to assignments are not uncommon, it is not unusual for owners to have to make last-minute crewing arrangements. In this occurrence, it was the first time the master had worked with the mate, and he was reluctant to hand over the watch, leaving him at the helm for an extended period.

The particular risks associated with small tug operations in the Fraser River, such as the manoeuvring of tows through narrow bridge openings and the effects of the tide and freshet on the tow, could be mitigated by the establishment of documented policies and practices. This is a fundamental aspect of an SMS. An SMS would also allow for a systematic approach to safety, where crew members who might be unfamiliar with one another have a common point of reference with respect to how a company wants its vessels to be operated. Furthermore, the company can verify the effectiveness of the measures put into place by determining whether the procedures are being followed.

In Canada, however, small vessels operating domestically are not required to implement SMS. As such, many small vessel operators elect not to institute an SMS and do not realize the degree of risk mitigation that such a system provides. In the absence of an SMS for small commercial vessels, there is an increased probability that risks will remain unidentified and that vessels will be operated in an unsafe manner.

Communications During Towing Operations

A safe towing operation requires continuous monitoring of, and updating on, the tug and tow's track, especially during high freshets resulting in unusual heavy sets, as well as clear and timely communications between the tug engaged in tow and the tugs providing assistance. This is particularly important when the towing operation involves a precise manoeuvre, such as transiting through a narrow bridge opening.

In this occurrence, the assist tug was positioned along the port quarter of the barge, and there was little or no sharing of information concerning the lining up of the barge through the bridge opening. Furthermore, given that the assist tug was unable to confirm the lining up of the barge because of the size of the barge and its cargo, there was an increased need for the lead tug, in the vantage position, to instruct the assist tug as required. In this case, little information was shared, and, as such, an opportunity was lost to position the assist tug along the starboard side of the barge once the port side was cleared for the opening.

When the progress of the towing operation is not continuously monitored and no updates are provided on this operation, as well as when this information is not shared, there is an increased risk that a developing situation, such as an unusual set, may not be identified in time for corrective action to be taken.

Conclusions

Findings as to Causes and Contributing Factors

1. The master had been awake for approximately 22 hours and was likely experiencing feelings of fatigue when he handed over the con to the mate prior to a critical stage in the passage.

2. The master did not take advantage of the opportunity to rest and sleep after the mate joined the tug and fell asleep at a critical stage in the passage.

3. The mate had limited experience transiting the Queensborough Railway Bridge, and, after having confirmed his approach to the bridge prior to Shoal Point, attempted the transit on his own without seeking assistance from the master.

4. The setting of the barge to the north by the high freshet was underestimated during the approach, and resulted in the barge striking the bridge.

Findings as to Risk

1. In the absence of a safety management system for small commercial vessels, there is an increased probability that risks will remain unidentified and that vessels will be operated in an unsafe manner.

2. When the progress of the towing operation is not continuously monitored and no updates are provided on this operation, as well as when this information is not shared, there is an increased risk that a developing situation may not be identified in time for corrective action to be taken.

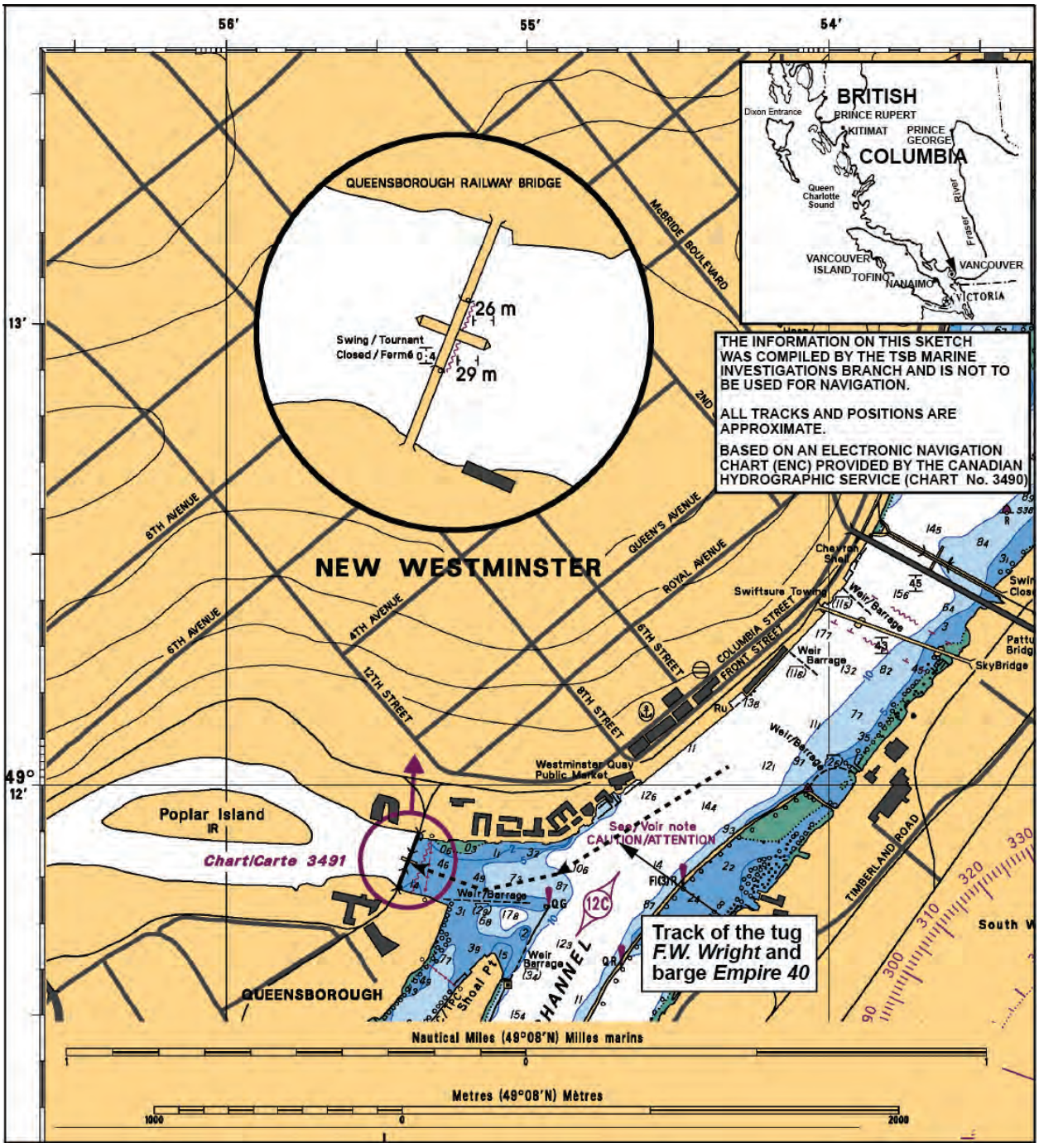
Other Finding

1. An approximate 1-knot difference in the speed of the current at the time of the transit was likely not a factor in this occurrence.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 21 November 2012. It was officially released on 12 December 2012.

Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB has found that actions taken to date are inadequate, and that industry and regulators need to take additional concrete measures to eliminate the risks.

Appendix A – Area of the Occurrence



Appendix B – Port Metro Vancouver Harbour Operations Manual [20]

3.8 Bridge Transits – Fraser River

3.8.1 General Practices

1) Due regard is to be given to all dangers of navigation and potential collision and to any special circumstances, including the limitations of the vessels involved, that may make a departure from the following practices necessary to avoid immediate danger.

2) Detailed bridge specifications are provided within the Authority's Technical Specifications Handbook. The Handbook can be obtained by contacting the Authority or downloaded from the website.

3) Early and clear communications between the vessel and Bridge Operator must be established. The Master and Bridge Operator must establish a point beyond which the vessel will not proceed if prior confirmation that the bridge will open has not been received. The Master must also have a predetermined point at which action must be taken if the bridge is not open.

4) Communication can be established on either VHF channel 74 or by phone (see specific bridge sections for contact information).

5) Once radiotelephone contact has been established with the Bridge Operator, a listening watch is to be maintained on VHF channel 74 until the vessel has cleared the bridge.

6) When visibility is less than 300 metres, a vessel towing loaded or empty barges is to transit the swing span only when stemming the current.

7) Where a vessel is towing logs in excess of 20 sections (400 metres), it is to have an assist tug.

8) Where unusual conditions, loads, or circumstances exist, the towing company or the Master of the vessel is to advise the Harbour Master's office, prior to the transit, of the compensatory measures to be taken during the transit.

…

3.8.2 Queensborough Railway Bridge

CONTACTS: VHF channel 74 and 06; Bridge Operator Telephone: 604-522-3729

1) Every vessel transiting the Queensborough Railway Bridge is to make a safety call on VHF channel 74 and 06 to determine if there is opposing traffic.

2) The Bridge is typically left in the open position and attended by a Bridge Operator. The Bridge is unattended at the following times:

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[20] Port Metro Vancouver, *Harbour Operations Manual*, June 2010.

a) Monday to Friday, 08:00 – 16:00

b) Saturday 08:00 – Sunday 08:00

…

4) The Master must attempt to establish contact with the Bridge Operator well in advance of the need for opening. An opening procedure will be established, taking into account weather and river conditions as well as procedures specified by the Bridge Operator.

5) Under most conditions, both the upriver and downriver vessels are to transit the draw on the Queensborough side of the bridge.

6) A vessel towing a loaded barge with a carrying capacity of 4,500 short tons or more, or an empty barge with a carrying capacity of 5,500 short tons or more, is to stem the current or use an assist tug while transiting the span. If over 7,000 short tons, shall use an assistant tug.

…

8) A vessel towing a barge that has a beam or a load in excess of 18 metres in width is to use one (1) assist tug, and two (2) assist tugs if over 22 metres. In both cases, the vessel is to stem the current while transiting the swing span.