Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT
M13L0123

COLLISION

BULK CARRIER *HELOISE* AND TUG *OCEAN GEORGIE BAIN*
PORT OF MONTRÉAL, QUEBEC
03 AUGUST 2013

The Transportation Safety Board of Canada (TSB) investigated this occurrence for the purpose of advancing transportation safety. It is not the function of the Board to assign fault or determine civil or criminal liability.

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Summary

On 03 August 2013 at approximately 2059 Eastern Daylight Time, the bulk carrier *Heloise* and the tug *Ocean Georgie Bain* collided while transiting the St. Lawrence River near section 76 in the Port of Montréal, Quebec. There was no pollution, and there were no injuries, but the tug sustained damage.

Le présent rapport est également disponible en français.

Factual information

Particulars of the vessels

Name of vessel	*Heloise*	*Ocean Georgie Bain*
Registry / licence number	4157710	833865
IMO* number	9498224	9553892
Port of registry	Panama	Québec, Quebec
Flag	Panama	Canada
Type	Bulk carrier	Tug
Gross tonnage	19 865.00	204.21
Length[1]	186.00 m	22.91 m
Draught at the time of occurrence	Forward: 7.97 m Aft: 8.08 m	Forward: 2.00 m Aft: 4.20 m
Built	2010, Shanhaiguan Shipbuilding Industry Co. Ltd., China	2009, L'Isle-aux-Coudres, Quebec
Propulsion	1 diesel engine (7200 kW) driving 1 fixed-pitch propeller	2 diesel engines (3000 kW) driving 2 omnidirectional Z-drive propellers
Cargo	19 163 tonnes of lentils	Nil
Crew	22	2
Registered owners	Pretty Castle Shipping S.A.	Location Ocean Inc.
Managers	Parakou Shipping Ltd., Hong Kong, China	Océan Remorquage Montréal Inc., Quebec

* IMO: International Maritime Organization

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 of Units.

Description of the vessels

The Heloise

Photo 1. The *Heloise* (Photo: Marc Piché)

The *Heloise* is a dry bulk cargo vessel of steel construction, with machinery space and accommodation located aft (Photo 1). The vessel has 7 cargo holds and hatches that are serviced by three 36-tonne electric-hydraulic cranes mounted on the centreline of the vessel. The bridge is fitted with a navigation console that is offset from the vessel's centreline (Appendix A). Depending on the position of an observer on the bridge, the view out of the bridge windows can be obstructed by the cranes (Photos 2 and 3). The navigation console includes the steering helm, a telegraph from which the propulsion can be controlled, and 2 radars (3 cm and 10 cm), 1 on either side of the helm. Both radars are fitted with automatic radar plotting aids. The bridge is also equipped with an automatic identification system (AIS), 2 very high frequency (VHF) radiotelephones, and a voyage data recorder (VDR).[2] At the time of the occurrence, the crew numbered 22 and were Chinese; the working language on board among crew members was Mandarin.

Photo 2. View through bridge windows to slightly left of centreline (Appendix A)

Photo 3. View through bridge windows to right of centreline (Appendix A)

[2] After the occurrence, the data from the voyage data recorder (VDR) were retrieved successfully by the Transportation Safety Board (TSB).

The Ocean Georgie Bain

Photo 4. The *Ocean Georgie Bain* (Photo: Groupe Ocean)

The *Ocean Georgie Bain* is a harbour tug (Photo 4). The bridge is equipped with an integrated bridge system that enables one-person operation and includes propulsion- and direction-integrated controllers, radar, a global positioning system (GPS), an electronic chart system (ECS), 2 compasses (1 gyro and 1 magnetic), an AIS, an echo sounder, and 2 VHF radios. The tug is propelled by 2 Z-drive azimuth propellers and is equipped for firefighting. A seat at the conning position faces forward, and the conning position offers a 360° view. Below the bridge, the main deckhouse consists of a galley space and 3 cabins.

Fireworks and exclusion zones

Each summer, there are a series of fireworks shows held at La Ronde in the Port of Montréal.[3] In 2013, fireworks were launched on scheduled nights from 2200 to 2230 from the last weekend of June to the first weekend of August. The volume of pleasure craft traffic and number of radio communications increase gradually in the hours leading up to each fireworks show.

Since the large number of pleasure craft in or close to the navigational channel can interfere with commercial vessels, the Montréal Port Authority has established exclusion zones in which commercial and pleasure–craft navigation are prohibited for a certain period (Appendix C). The duration for which traffic is closed in each exclusion zone is minimized to reduce the impact on commercial traffic. In addition, the Canadian Coast Guard (CCG), Service de police de la Ville de Montréal, and Sûreté du Québec provide patrol craft to help keep the navigation channels safe for the passage of commercial traffic, to enforce the exclusion zones, and to assist as needed with any incidents between pleasure craft.

History of the voyage

The Heloise

On 30 July 2013, the *Heloise* departed Thunder Bay, Ontario, bound for Mersin, Turkey. By the early evening on 03 August, the vessel had reached the St. Lambert lock, Quebec, where a Corporation des Pilotes du Saint-Laurent Central (CPSLC) pilot boarded the *Heloise* and relieved the Great Lakes Pilotage Authority (GLPA) pilot on board. The CPSLC pilot boarded the vessel at 1948;[4] his assignment was to navigate the vessel to section 100 in the Port of Montréal, where the vessel would make a short stop to take on fuel.

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3 These fireworks shows are known as *L'International des Feux Loto-Québec*.

4 All times are Eastern Daylight Time (Coordinated Universal Time minus 4 hours), unless otherwise stated.

Upon disembarking, the GLPA pilot advised the CPSLC pilot that it was difficult to communicate with the bridge crew due to their minimal proficiency in English. The master and the CPSLC pilot exchanged basic information about the vessel's draught, the propeller's pitch, and the side to which the vessel was going to berth. Shortly after boarding, the pilot notified Marine Communications and Traffic Services (MCTS) Montréal that the vessel would soon be departing. MCTS reported 2 vessels upbound for the seaway.

The pilot then tried to plug in his portable pilotage unit (PPU), but had difficulty with the on-board receptacle. The pilot asked the officer of the watch (OOW) for help, but the OOW was also unable to plug in the PPU, and so it was not used. At 2003, the *Heloise* proceeded out of the lock and into the lower South Shore Canal. By approximately 2020, the vessel had reached the end of the lower St. Lambert lock approach wall, with a speed of 5.7 knots.[5] The pilot reported the vessel's position to Seaway Beauharnois[6] and MCTS. The pilot also requested the assistance of a police patrol boat from MCTS in order to clear any pleasure craft in the area just below Jacques-Cartier Bridge at the exit of the South Shore Canal. MCTS acknowledged the request and provided an updated report on vessel traffic.

At 2034, the vessel had reached calling-in point (CIP) 2,[7] and the master left the bridge. The bridge team now comprised the pilot, the OOW, and the helmsman. The pilot of the *Heloise* called MCTS again to report his position. MCTS reported 2 vessels upbound for the Seaway, and one vessel upbound for CIP 26, situated abeam of section 110 of the Port of Montréal. Additionally, MCTS reported that there were small passenger vessels in the area. This report was followed by a radio conversation between a pilot on one of the upbound vessels and the pilot of the *Heloise,* during which the pilot on the upbound vessel expressed concern about the number of pleasure craft in the area. At approximately 2040, the *Heloise* exited the lower South Shore Canal and entered the main channel of the St. Lawrence River, where it met with the first upbound vessel.

At about the same time, the tug *Ocean Georgie Bain* requested authorization from MCTS to depart section 57 to assist another vessel, the *Acadian,* with berthing. MCTS granted the authorization and reported updated vessel traffic. Six minutes later, at 2046, the tug *Ocean Pierre-Julien* called MCTS asking for the same authorization; permission was granted to proceed, and MCTS also relayed the same message concerning the upbound traffic. At that time, the *Heloise* was passing abeam of section 51 at a speed of 11.7 knots, and the *Ocean Georgie Bain* was visible at a distance of approximately 0.9 nautical miles (nm)[8] (Appendix B).

At 2050, the *Heloise* met with the second upbound vessel and, at the same time, the tug *Ocean Georgie Bain* entered the main channel at a speed of 9 knots. The pilot on the *Heloise* could see the tug and estimated it to be approximately 1 nm ahead of the *Heloise,* bearing fine on its port side. At 2054, the *Ocean Georgie Bain* had slowed down to 5.3 knots and was near the middle of the main channel, on the side used by upbound vessels, abeam of section 75. The distance

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5 All speeds are speed over the ground, unless otherwise stated.

6 This is the last point at which the pilot is required to report the vessel's position to Seaway Beauharnois.

7 Calling-in point (CIP) 2 is situated approximately 0.3 nautical mile (nm) downstream from Jacques-Cartier Bridge and 0.5 nm upstream from the exit of the South Shore Canal.

8 All distances between the *Heloise* and the *Ocean Georgie Bain* were taken from the automatic identification system (AIS) recording from Marine Communications and Traffic Services (MCTS).

separating the tug and the *Heloise* had decreased to approximately 0.6 nm, and the pilot could still see the tug fine on the port side.

At 2056, the pilot on the *Heloise*, seeing pleasure craft ahead and coming in the opposite direction, asked the OOW to turn on the forward deck lights to make the vessel more visible. This order was repeated twice, but it was not fulfilled. The pilot then requested to have someone posted forward on the forecastle deck to stand by at the anchors, and requested that the master come to the bridge. When the master arrived on the bridge, the pilot again requested that the forward deck lights be turned on, and the master turned on the lights. However, the master was not informed of the request to have someone stand by at the anchors, and this command was not executed. At that time, the OOW was standing at the starboard radar attending to the engine telegraph control, awaiting the pilot's orders.

The pilot, who was standing on the port side of the bridge, then observed 3 pleasure craft ahead of the *Heloise*, moving toward the vessel. Two of them altered course to starboard in order to meet port to port. The third altered its course to port, and, in doing so, disappeared from sight behind the *Heloise's* cranes. The pilot walked over to the starboard side of the bridge, losing sight of the *Ocean Georgie Bain*, in an attempt to see the third pleasure craft. Not being able to see the pleasure craft, the pilot altered to port, from 009° gyro, sooner than planned; the time was 2057, and the distance from the tug had decreased to 0.25 nm.

At 2057:47,[9] when the pleasure craft became visible on the starboard side, the pilot stopped the vessel from swinging to port by ordering the helm starboard 20° and then, at 2058:02, the helm hard to starboard. At 2058:30, the pilot ordered the helm to 10° to starboard. Once the swing of the vessel was stopped, the pilot ordered that the vessel be kept steady on a course of 357° true. At 2058:38, the tug was less than a 100 m away, and the pilot was on the starboard side. As the pilot walked back to the port side of the bridge, there was a screeching sound, and the pilot then saw the *Ocean Georgie Bain* on the port bow moving away from the *Heloise*.

The Ocean Georgie Bain

On 03 July, the tug *Ocean Georgie Bain* was assigned to assist the vessel *Acadian* to berth at section 74 in the Port of Montréal. The crew comprised the master and an engineer. The engineer was serving in the roles of both engineer and deckhand (hereafter referred to as the engineer). At approximately 2040, the master called MCTS on the VHF radio, requesting authorization to depart section 57 in order to proceed downriver to meet and assist the upbound vessel *Acadian*. MCTS acknowledged the request, granted authorization, and advised the master about traffic in the area, reporting 2 upbound vessels, one of which was the *Acadian*. The engineer let go of the mooring lines and, after doing so, went to check the engine room. The tug departed section 57 and proceeded downriver; shortly afterward, the engineer came up on the bridge.

As visibility was good, the master navigated visually and did not turn on the radar. The ECS was turned on, but its screen brightness was dimmed to a minimum level, and it was not used during the voyage. After leaving the basin, the tug proceeded at a speed of approximately 13 knots north of the main navigating channel until it reached section 71, at which point it entered the main channel. During this time, the engineer saw the *Heloise* at a distance, aft of the

[9] Times denoting seconds were extracted from the *Heloise*'s VDR.

tug and going in the same direction as the tug, but this was not reported to the master. At 2050, the master reduced the tug's speed to 9 knots. Between 2050 and 2056, the master continued gradually decreasing the speed until it reached 3.6 knots. When the tug was near the middle of the main navigating channel on the side used by upbound vessels and abeam of section 76, the master de-clutched both engines and let the tug drift with the current, on a northerly heading, facing the upbound vessel *Acadian*. At times, the master had to re-clutch the engines to make sure that the tug was keeping the same heading.

While the tug was drifting slowly with the current, the engineer on the *Ocean Georgie Bain* asked the master for permission to go down and get a coffee. The master agreed to this request, and the engineer left the bridge. At 2058, the tug was drifting at a speed of 2.8 knots on a northerly heading. Just before 2059, the master perceived a shadow covering the bridge. The *Heloise*'s bulbous bow then struck the tug's starboard quarter, and the port anchor broke the tug's bridge windows. The master clutched both engines and directed the Z-drive sideways at full power to port in order to move away from the *Heloise*.

Following the collision, the master and engineer on the *Ocean Georgie Bain* confirmed with one another that they were uninjured. The engineer then checked the vessel for water ingress. The pilot on the *Heloise* and the master on the *Ocean Georgie Bain* spoke over VHF radio and confirmed that they had collided. MCTS subsequently communicated with the 2 vessels to confirm that they had collided. The *Ocean Georgie Bain* then continued its assignment and assisted the *Acadian* with berthing, while the *Heloise* continued to section 100 where, after berthing, the master and pilot inspected the vessel for damage.

Damage to the vessels

A post-occurrence inspection determined that the damage sustained by the *Ocean Georgie Bain* consisted primarily of the following: the pilot house was crushed inward at the starboard aft corner, 10 windows on the bridge were broken, 7 window frames were bent and distorted, the starboard main engine exhaust pipe was disconnected from the deck, and the starboard auxiliary engine exhaust pipe was bent and broken above the deck connection. The vessel was subsequently dry-docked and was out of service for almost 7 weeks.

The *Heloise* was not damaged, but traces of black rubber from the *Ocean Georgie Bain's* fenders were apparent on the hull.

Environmental conditions

At the time of the occurrence, the weather was clear, and winds were from the west at 5 to 7 knots. Sunset was at 2020 that evening. There is no tide in the Port of Montréal, and the average rate of the current in the harbour is approximately 2 knots.

Personnel certification and experience

The Heloise

The crew of the *Heloise* were all properly certified for their positions on board. The master held a Master Mariner certificate that had been issued by the Chinese Maritime Safety

Administration (MSA) on 24 January 2009. The master had joined the company on 03 April 2013, on the same day as joining the *Heloise*.

The OOW was issued an Officer in Charge of Navigational Watch certificate on 09 January 2009. The OOW had been sailing as a deck officer since June 2013, on the same date as joining the *Heloise*. The helmsman had been sailing since 2011, and had joined the *Heloise* as a helmsman in May 2013.

The pilot on the *Heloise* held a Master Mariner certificate issued on 01 April 1997, and had sailed as a master since 2003. The pilot initially obtained an apprentice pilot permit in 2006 and, by 03 April 2008, had upgraded to a Class A, District 1.1 licence,[10] which allowed for pilotage of any size of vessel within the district. The pilot had also completed a bridge resource management (BRM) course on 16 December 2009.

The Ocean Georgie Bain

The crew of the *Ocean Georgie Bain* were all properly certified for their positions on board. The master had been issued a Master Home Trade Steamship 350 Tonnes certificate on 02 February 1989 and had held the position of master on various vessels since 1990, including on various harbour tugs similar to the *Ocean Georgie Bain* starting in 2009.

The engineer was issued a Second-Class Engineer, Motor Ship certificate on 29 April 2004. The engineer had held the position of engineer of watch on various vessels since 2004 and joined the company in January 2009, serving as an engineer / deckhand since autumn of that same year.

Vessel certification

The *Heloise* and the *Ocean Georgie Bain* were both certificated and equipped in accordance with existing regulations.

Safe manning

Inspected vessels with a gross tonnage of more than 15, such as the *Ocean Georgie Bain*, are required to comply with a safe manning document.[11] This document is based on a Transport Canada evaluation of the vessel that determines the vessel's crewing requirements, including the minimum required complement, and specifies the minimum certification requirements for each crew member. The determination of the minimum complement of a vessel (safe manning) is based on the requirements of the *Marine Personnel Regulations* (MPR).

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[10] District 1.1 is a pilotage area that spans from the St. Lambert lock to the northern limit of Île Sainte-Thérèse.

[11] Transport Canada, SOR / 2007-115, *Marine Personnel Regulations* (last amended 20 August 2013), Part 2: Crewing, Section 202.3(b).

The safe manning document ensures that the crew is sufficient and competent for the safe operation of a vessel on its intended voyage, and while responding to an emergency.[12] It also specifies the permitted voyage areas and watch arrangements. The vessel's authorized representative (AR)[13] and master[14] are responsible for ensuring that the requirements specified in the safe manning document are met.[15]

The *Ocean Georgie Bain* possessed 3 minimum safe manning documents:

- Document No. 1, valid for Near Coastal Voyage, Class 2
- Document No. 2, valid for Near Coastal Voyage, Class 2, Limited
- Document No. 3, valid for Voyage in Sheltered Waters, within 5 nm from a port of refuge.

In this occurrence, Document No. 3 was applicable. It specified that the tug must carry a minimum of 3 crew members: 1 master, 1 engineer,[16] and 1 deckhand. It also specified 2 special conditions, one being that the deckhand or engineer is required to be a part of the bridge team in conditions of low visibility and between sunset and sunrise. The MPR defines a bridge watch crew member as "part of the complement that is required for the purpose of attending to the navigation, communications, machinery and security of the vessel."[17]

Document No. 3 also included a section entitled "Limitations on the validity of the document" that stated that the tug can operate without the deckhand, thus with 2 crew members, when "the master and the vessel's AR judge that the operational conditions are safe for the vessel, the crew and the environment." On a normal basis, when engaged in harbour duties, the *Ocean Georgie Bain* and *Ocean Pierre-Julien* operated with 2 crew members on board.

Safety management system of the Ocean Georgie Bain

The objectives of the International Safety Management (ISM) Code adopted by the International Maritime Organization (IMO) are to ensure safety at sea, prevent human injury or loss of life, and avoid damage to the environment. These are addressed by implementing safe practices in vessel operations and promoting a safe working environment through establishment of

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12 Transport Canada, Ship Safety Bulletin 05/2008, Safe Manning Documents – Extension of Application Date (07 July 2008), available at http://www.tc.gc.ca/media/documents/marinesafety/ssb-05-2008e.pdf (last accessed on 24 September 2014).

13 Section 14(1) of the *Canada Shipping Act* (2001) specifies that every Canadian vessel must have a person, known as the authorized representative, who is responsible for acting with respect to all matters related to the vessel that are not otherwise assigned to another person.

14 Ibid., Section 82(2).

15 Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (last amended 20 August 2013), Section 211.

16 The minimum requirement to act as an engineer on this vessel is to hold a Small Vessel Machinery Operator proficiency certificate.

17 Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (last amended 20 August 2013), Section 1.

safeguards against all identified risks and through continuous improvement of the safety management skills of personnel ashore and on board vessels.[18]

In 2002, the company began gradually putting the ISO 9001[19] in place, along with ISM. The whole of its towing harbour activities are certified ISO 9001:2008 and ISM. The application of the ISM Code is on a voluntary basis, and the company has introduced procedures for operation and risk assessment for all of its tugs. The company had been issued a document of compliance, and the vessel had been issued a safety management certificate.

Navigational equipment

The company safety management system (SMS) required that navigational equipment on harbour tugs be tested regularly and that any defects be reported, but there was no requirement for the master to use the equipment when the tug was engaged in harbour operations.

Tug operations with two crew

In 2012, the company completed a risk assessment for the operation of automated tugs in harbour with 2 crew members. The following risks were assessed: operation during nighttime, in bad weather, and in ice; handling of towing and mooring lines; man overboard; incapacitation of the master or engineer due to illness or injury; loss of radio communication between the 2 crew members; fire on board; machinery or propulsion failure; human error; and transferring of pilots. The assessment stipulated that, when in operation with 2 crew members, the engineer should, as soon as the deck or engine tasks are over, go back on the bridge to accompany the master. However, it did not define the specific role of the engineer on the bridge. The assessment also acknowledged issues regarding ongoing training, familiarization, and communication between crew members.

Bridge resource management

BRM is the effective management and use of all resources, both human and technical, available to a bridge team to ensure the safe completion of a voyage. BRM incorporates concepts such as workload management, problem solving, decision making, and teamwork. Situational awareness and communication are key to BRM. Specifically, bridge team members have a responsibility to maintain overall situational awareness, as well as to be responsible for their individual duties. The Standards of Training, Certification, and Watchkeeping (STCW) Code[20] emphasizes the importance of an ongoing exchange of information between master and pilot. It is also important that the bridge team and pilot work cooperatively and share information.

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18 International Maritime Organization, *International Safety Management Code and Revised Guidelines on Implementation of the ISM Code by Administrations*, (London, UK: IMO Publishing, 2010).

19 ISO 9000 is a series of standards developed by the International Organization for Standardization that define an effective quality assurance system for the manufacturing and service industries. ISO 9001 specifically addresses the requirements to be fulfilled by organizations to achieve the standards.

20 International Maritime Organization, *Standards of Training, Certification and Watchkeeping, STCW Code* (2011 Edition), Annex 1, Chapter VII, Section A-VIII/2.

Language requirements

English is the international language of communication in maritime operations, and mariners are required to have and maintain a working knowledge and ability in both oral and written forms.[21] Competency in English, demonstrated through examination and assessment, enables seafarers to "use charts and other nautical publications, to understand meteorological information and messages concerning (a) ship's safety and operation, to communicate with other ships, coast stations and vessel traffic services centres and to perform with a multilingual crew, including the ability to use and understand the IMO standard marine communication phrases (SMCP)."[22]

IMO has developed an SMCP publication in order to establish a more comprehensive standardized safety language, with key phrases to cover the most important safety-related verbal communications. The aim of the SMCP is to attempt to overcome the issue of language barriers that may cause misunderstandings between bridge team members and risks to safety. The STCW Code requires that officers in charge of a navigational watch on vessels of 500 gross tonnage or above be able to understand and use the SMCP.

Pilots in the CPSLC must be able to speak and understand both the English and French languages to the extent necessary to carry out pilotage duties.[23] Those applying to be an apprentice pilot must pass a language test that demonstrates their ability to work in English and French.[24]

On board the *Heloise*, the pilot's first language was French; however, he spoke English and met the Laurentian Pilotage Authority requirement. The crew's working language was Mandarin. Research shows that comprehension of spoken English by those whose primary language is Mandarin can be reduced when they are being spoken to by non-native English speakers who have an accent and limited English vocabulary.[25]

Chinese maritime officers are required to demonstrate competency in English (speaking and listening) through written and oral examinations that are developed and overseen by China's MSA[26] and administered at the time of certification. The master and OOW on the *Heloise* were evaluated as being proficient in English at the time that they were certificated in 2009.

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21 Ibid., Annex 2, Table A-II/1.

22 Ibid.

23 Transport Canada, C.R.C., c. 1268, *Laurentian Pilotage Authority Regulations* (last amended 01 January 2013), Section 18 (a).

24 Ibid., Section 26.1.

25 W.X. Juan and M.J.Z. Abidin, "English Listening Comprehension Problems of Students from China Learning English in Malaysia," *Linguistics and Translation*, 57 (2013), pp. 14009–14012.

26 J. Xie, "Development of the Maritime English Test and Evaluation System in China," *The International Maritime English Conference IMLA-IMEC: 20th IMEC Proceedings* (Shanghai, October 27–30, 2008), I-111 to I-115, available at http://imla.co/sites/default/files/ProceedingsIMEC20.pdf (last accessed on 09 April 2014).

The TSB conducted a survey of Canadian marine pilots in 1995[27] to identify safety deficiencies associated with teamwork on the bridge, including communications between marine pilots and masters / OOWs. When pilots were asked whether language barriers make it difficult to communicate orders to the helmsman on foreign-registered vessels, 60% replied that language barriers "sometimes" affect communication with the helmsman, while 20% reported that it "often" resulted in difficulty communicating.

When pilots were asked whether language barriers prevent an effective exchange of information with the master and the OOW on foreign-registered vessels, almost 55% replied that language barriers "sometimes" prevent effective communication with the master and the OOW, and 23% stated that language barriers "often" prevent it.

A second survey in 2014[28] revealed that the opinions of pilots regarding language issues on foreign-registered vessels had remained similar. In 2014, 49% of pilots thought that language barriers "sometimes" affect communication with the helmsman, while 15% indicated that language barriers "often" result in communication difficulties. Fifty-four percent of pilots surveyed indicated that language barriers "sometimes" prevent effective communication with the master and the OOW, and 17% stated that language barriers "often" prevented it.

Marine Communications and Traffic Services Centre Montréal

MCTS provides communication and traffic services for the marine community to ensure the safe and efficient movement of vessels. It coordinates communications related to distress and safety situations, and regulates vessel traffic movements.[29]

The Montréal MCTS centre has a total of 4 work stations; 3 are for the officers, while the fourth is for the team supervisor. VHF channel 16[30] of the CCG radio station is normally staffed by 1 person, but can be staffed by 2 depending on the workload, while channel 10[31] is always staffed by 1 person. Channel 10 covers the geographical area from the Port of Montréal to Tracy on the St. Lawrence River, a distance of approximately 40 nm; the majority of the service on this channel is provided to commercial vessels but also to a large clientele of pleasure craft in the area. Normal work shifts at the Montréal MCTS are 12 hours in length; the day shift is from 0700 to 1900, and the night shift is from 1900 to 0700.

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27 TSB Marine Investigation Report SM9501, A Safety Study of the Operational Relationship Between Ship Masters / Watchkeeping Officers and Marine Pilots (1995), available at http://www.tsb.gc.ca/eng/rapports-reports/marine/etudes-studies/ms9501/ms9501.asp (last accessed on 09 April 2014).

28 An invitation to participate in an online survey was sent to the Corporation des Pilotes du Saint-Laurent Central, the Corporation des Pilotes du Bas Saint-Laurent, and the Great Lakes Pilotage Authority; these organizations then forwarded the survey invitation to pilots by email.

29 Canadian Coast Guard, Marine Communications and Traffic Services (MCTS), *Marine Communications and Traffic Services Standards Manual*, Version 1.0 (16 June 2003), Foreword.

30 Very high frequency (VHF) channel 16 is a radio frequency that is used to call vessels and shore stations. It serves as an international distress frequency and is used for broadcasting distress calls or other urgent safety messages.

31 Montréal VHF channel 10 offers an information service and traffic organization service as defined by the IMO.

MCTS officers are responsible for, among other things, identifying and resolving potentially hazardous situations, and issuing clearances, recommendations, directions or warnings to shipboard authorities. Officers also analyze and disseminate marine safety and traffic movement information, providing vessels with information on the relevant traffic that they will encounter in a given area. To analyze and determine what qualifies as relevant traffic for a particular vessel in an area of radar coverage, MCTS officers pose the following questions:

- Does a risk of collision exist?
- Is there a possibility that the intentions of other vessels are unclear?
- Is there something non-routine associated with any vessel?
- Are any vessels not in visual observation of one another?

MCTS supervising officers oversee the operational activities of the staff of the watch and provide for the safe and efficient movement of vessels in the centre's area of responsibility.

On the evening of 03 August, the MCTS team in Montréal comprised 1 supervisor, 2 officers working on channel 16, and 1 officer operating channel 10. The MCTS officer operating channel 10 was using the Information System on Marine Navigation (INNAV) to manage vessel traffic. INNAV is an operational information management tool used to display radar, mapping and communications data, and perform other functions required for waterway management.[32] The system integrates a mixture of static and dynamic marine information onto a layered, graphic display of the waterway. Details on any type of information, as well as sensor management and communication controls, can be accessed by pull-down menus or through a geo-referenced display of the waterway. INNAV also allows for mariners, MCTS centres, and participating shore-based organizations to be connected in real time.

From his workstation, the supervisor can monitor the officer operating channel 10. The INNAV at the supervisor's station is configured to provide the supervisor with an overall picture of the channel 10 officer's operations, but has fewer and smaller screens than the officer's station. On the evening of 03 August, given the traffic volume, the MCTS supervisor was primarily overseeing the 2 officers who were operating channel 16.

During the 18 minutes prior to the collision, a total of 16 calls were recorded on VHF channel 10. The calls lasted a total duration of nearly 11 minutes, and the majority of those calls were addressed to the officer, while others were exchanges between vessels.

Mental workload

Mental workload is the interaction of mental demands imposed on operators by tasks that they attend to.[33] Aspects of workload fall within the following 3 broad categories:

1. the amount of work and number of things to do,

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32 Canadian Coast Guard, Marine Communications and Traffic Services (MCTS): Information System on Marine Navigation (INNAV), available at http://www.ccg-gcc.gc.ca/eng/CCG/MCTS_Innav (last accessed on 08 April 2014).

33 B. Cain, Report No. RTO-TR-HFM-121-Part-II, A Review of the Mental Workload Literature (Toronto: Defence Research and Development Canada, Human System Integration Section, 2007), available at http://www.dtic.mil/get-tr-doc/pdf?AD=ADA474193 (last accessed on 09 April 2014).

2. the time and the particular aspect of time that an operator is concerned with, and
3. the subjective psychological experiences of the operator.[34]

Research on attention shows that individuals who are under stress or a high workload tend to reduce their use of peripherally relevant information, and tend instead to centralize or limit their focus of attention to stimuli that they perceive to be most important or most relevant to a primary task.[35] If peripheral cues are ignored when they might be relevant to an important task, performance on that task may suffer.

An important aspect of operator workload is the amount of work one has to do and the number of tasks one has to accomplish in a given period.

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[34] R.J. Lysaght, S.G. Hill, et al., *Operator Workload: Comprehensive Review and Evaluation of Operator Workload Methodologies* (Fort Bliss, Texas: U.S. Army Research Institute for the Behavioral and Social Sciences, 1989), p. 262, available at: http://www.dtic.mil/dtic/tr/fulltext/u2/a212879.pdf (last accessed on 04 April 2014).

[35] M. Staal, A.E. Bolton, R.A. Yaroush and L.E. Bourne, "Cognitive Performance and Resilience to Stress," In: B.J. Lukey and V. Tepe (eds.), *Biobehavioral Resilience to Stress* (Boca Raton: CRC Press, 2008), pp. 259–299.

Analysis

Events leading to the collision

On the evening of the occurrence, there were numerous pleasure craft in the area due to the fireworks show, increasing the difficulty of navigation for commercial vessels. While navigating, the pilot of the *Heloise* became preoccupied with a pleasure craft that had been approaching the vessel but that he had lost sight of. In so doing, the pilot lost sight of the *Ocean Georgie Bain,* which was ahead and slightly to port. When he moved to the starboard side of the vessel to look for the pleasure craft, the cranes of the *Heloise* obstructed his view of the *Ocean Georgie Bain*.

Although they had not communicated, the pilot assumed that the *Ocean Georgie Bain* was aware of the *Heloise* and would remain on the outer limits of the channel. In addition, the crew members on the *Heloise* were not actively assisting the pilot during the voyage; they did not maintain a lookout or use the navigational equipment to advise the pilot of relevant traffic. A significant factor in this lack of active assistance was likely the language barrier, which resulted in the pilot minimizing communications with the crew.

The master on the *Ocean Georgie Bain* was proceeding near the middle of the channel, on the side used by upbound vessels, and was not aware of the downbound *Heloise,* astern, because he was navigating visually and not using electronic navigational equipment. Furthermore, Marine Communications and Traffic Services (MCTS) had not reported the presence of the *Heloise,* and the engineer, who was standing on the bridge, saw the *Heloise* approaching but did not advise the master and left the bridge shortly after seeing the vessel.

The pilot of the *Heloise* altered course to port to avoid a pleasure craft. At that time, he was not looking at the *Ocean Georgie Bain,* which was stopped and drifting near the middle of the channel. Once the pleasure craft was clear of the *Heloise*, the pilot steadied the course of the vessel in the direction of the *Ocean Georgie Bain*, and the 2 vessels collided.

Mental workload

Research on attention has shown that individuals with a high workload tend to centralize or limit their focus of attention to stimuli that they perceive to be most important or relevant to a primary task.[36] They may also react by shedding or simplifying task demands and may have decreased situational awareness.[37] For example, air traffic controllers who find themselves under increased traffic load conditions tend to reduce the volume of information they provide

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[36] M. Staal, A.E. Bolton, R.A. Yaroush and L.E. Bourne, "Cognitive Performance and Resilience to Stress," In: B.J. Lukey and V. Tepe (eds.) *Biobehavioral Resilience to Stress* (Boca Raton: CRC Press, 2008), pp. 259–299.

[37] Situational awareness is "the perception of elements in the environment within a volume of time and space, the comprehension of their meaning and the projection of their status in the near future," as defined by Mica R. Endsley, in the abstract of a paper entitled "Situation Awareness and Human Error: Designing to Support Human Performance," which was part of the Proceedings of the High Consequence Systems Surety Conference in Albuquerque, New Mexico in 1999, available at http://209.238.175.8/Papers/pdf/Sandia99-safety.pdf (last accessed on 04 April 2014).

to each air crew, eventually reducing it to the minimum amount of information required for safe operations.[38]

At the time of the occurrence, the amount of traffic and the accompanying increase in radio transmissions, as compared to during normal operating periods, made the workload of the officers monitoring channels 10 and 16 more challenging. Specifically, channel 10 was occupied for 11 of the 18 minutes leading up to the collision, with the majority of the calls addressed to the officer.

When the master of the *Ocean Georgie Bain* requested authorization to depart section 57 from MCTS, the officer advised him of 2 upbound vessels. However, the officer did not mention the downbound *Heloise*. In this occurrence, the following factors may have contributed to the omission of traffic information:

- The increased workload of the officer may have led to simplification of the task of reporting and prevented notice of the collision sequence as it developed.
- The supervisor was more actively focused on monitoring the channel 16 officers.
- The channel 10 officer did not request assistance with the workload from the supervisor, nor did the supervisor offer assistance.

The MCTS officer's high level of mental workload at a critical time likely caused him to omit the downbound *Heloise* when reporting traffic to the *Ocean Georgie Bain*.

Bridge resource management

Three key elements of bridge resource management (BRM) are monitoring the vessel's progress, sharing the voyage plan, and maintaining situational awareness. Maintaining situational awareness through the practice of effective teamwork and communication between bridge team members is most important when a vessel is operating in restricted waters or areas of high traffic volume. In order to maintain overall situational awareness when navigating with a pilot, it is critical that information is exchanged regularly so that all members of the bridge team are aware of the pilot's intentions and can provide assistance or timely advice and observations.

The Heloise

Given the importance of communication among all members of a bridge team, including pilots, and that vessel crews are often from countries other than Canada, the language used by a crew can be a factor affecting BRM.

In this occurrence, when the pilot lost sight of the *Ocean Georgie Bain* while he was occupied with the task of locating the nearby pleasure craft, he did not request assistance from the bridge team, and the bridge team did not monitor the tug, maintain a lookout, or assist the pilot at that time. A significant factor in this situation was the language barrier that impeded communication. In addition, the master–pilot exchange was informal and minimal, and when

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38 J.C. Sperandio, "Variations of Operator's Strategies and Regulating Effects on Workload," *Ergonomics*, 14 (1971), pp. 571–577.

the pilot made attempts to communicate with the officer of the watch (OOW) in English, his actions indicated that he had difficulty understanding the pilot's requests.

The difficulties in communication among members of the bridge team while under way contributed to poor BRM and prevented the bridge team from serving as an effective backup for the pilot. Furthermore, in communicating only minimally with the crew and perceiving that the bridge crew was not available to assist him, the pilot essentially assumed all navigational responsibilities, including that of lookout. This situation led to an increase in the pilot's mental workload, which led him to narrow, or limit, his focus of attention to the pleasure craft at the expense of monitoring the *Ocean Georgie Bain*.

As demonstrated by this occurrence, despite the development of the standard marine communication phrases (SMCP) and requirements of the Standards of Training, Certification, and Watchkeeping (STCW) and of pilotage, there continue to be language barriers that can be problematic on board foreign-registered vessels. The 2014 survey of Canadian marine pilots that was conducted by the TSB revealed that 54% of surveyed pilots thought that language barriers "sometimes" prevent effective communication with the master and OOW, and 17% thought that language barriers "often" prevent it.

With regard to the language barrier issue more generally, 49% of surveyed pilots thought that language barriers "sometimes" affect communication with the helmsman, while 15% indicated that language barriers "often" result in communication difficulties with helmsmen. The U.S. National Transportation Safety Board (NTSB) has also recognized this issue, recommending that a segment on cultural and language differences and their possible influence on mariner performance be included in the BRM curricula of the International Maritime Organization (IMO).[39]

If language barriers on board vessels inhibit communication, there is a risk that BRM will be ineffective.

The Ocean Georgie Bain

Effective BRM requires maximizing use of all available resources when navigating, whether those resources be other members of the bridge watch team or navigational equipment.

The safe manning document on the *Ocean Georgie Bain* required a crew member to be part of the bridge watch in certain conditions. However, the role of the crew member required to be on the bridge (e.g., fulfilling the task of lookout) was not defined within the safety management system (SMS). Therefore, it was up to the master to provide such guidance.

In this occurrence, the engineer did fulfill the requirements of the safe manning document and the SMS by forming part of the bridge watch. However, he was not aware of the duties of a lookout, nor had he been trained to serve in that role. As such, when he saw the *Heloise*, he did not report the vessel's presence to the master. The master had not requested that the engineer serve as a lookout or given the engineer any other specific instructions for his duties on the bridge; in this way, he did not make effective use of the engineer.

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[39] National Transportation Safety Board (NTSB), Safety Recommendation Letter M-09-1 (08 May 2009), available at http://www.ntsb.gov/doclib/recletters/2009/M09_1_5.pdf (last accessed on 09 April 2014).

Furthermore, the master of the *Ocean Georgie Bain* chose to navigate visually; when the vessel left section 57, the radar was not turned on, whereas the electronic chart system (ECS) was turned on but not used. There was no requirement in the company's SMS for the master to use the equipment while navigating in the harbour. Such navigational equipment enables early detection and continuous monitoring of nearby vessels and can assist with collision avoidance. If available resources for safe navigation are not used, there is a risk that vessels in close proximity will not be detected, and a collision may occur.

Interpretation of safe manning

Safe manning on board a vessel is defined by the safe manning document, which is based on an evaluation of the vessel by Transport Canada, and is intended to ensure that the crew is sufficient and competent for the safe operation of a vessel on its intended voyage and when responding to an emergency.

The safe manning document of the *Ocean Georgie Bain* authorized the tug to operate without a third person when the operating conditions are judged by the master and the authorized representative to be safe for the "vessel, crew and environment". To address the feasibility and safety of navigating with only 2 persons on board under different operating conditions, the company of the *Ocean Georgie Bain* completed a risk assessment in 2012 to identify the involved risks and some mitigating strategies to manage those risks. The risk assessment emphasizes the importance of maintaining visual and verbal (including through very high frequency [VHF] radio) contact with the second person on board under challenging navigating conditions in order to maintain awareness and ensure the overall safety of navigation.

However, there was no indication that the company or the master had assessed the adequacy of manning outside of those conditions addressed within the SMS. The specific conditions at the time of the occurrence, such as the darkness at that time of day as well as the increase in vessel traffic due to the fireworks, did not trigger a risk assessment of the adequacy of manning by the master. Harbour tugs were normally operated with only 2 crew members on board, and it was not the practice of masters on board to do risk asssessments when navigating in more challenging conditions.

Furthermore, although the company's assessment of the adequacy of manning acknowledged some deficiencies with regard to familiarization and training, the engineer in this occurrence was certified. Although the engineer had received familiarization for the vessel, he was not aware of his specific duties on board, such as that of acting as a lookout, when required to be part of the bridge watch. Thus, when he spotted the *Heloise*, he did not report this to the master.

In a 2-person operation, when a member of the bridge watch is required to leave the bridge for a certain reason, such as checking the engine room, the master is left alone. In that situation, the master assumes all of the responsibilities of the bridge watch and has an increased workload that may preclude him from identifying safety-critical situations in a timely manner.

Therefore, if companies and vessel masters do not accurately interpret and apply the requirements of a safe manning document, it is possible that a vessel will be inadequately manned and/or manned by crew with inadequate training.

Findings

Findings as to causes and contributing factors

1. The pilot on the *Heloise* was not monitoring the *Ocean Georgie Bain* at the time of the collision, and the bridge crew on the *Heloise* was not assisting the pilot by maintaining a lookout or using navigational equipment to advise the pilot of relevant traffic.

2. The language barrier between the bridge crew and pilot on the *Heloise* contributed to challenges in communication and, consequently, to ineffective bridge resource management at a critical time during the voyage.

3. The Marine Communications and Traffic Services officer's high level of mental workload at a critical time likely caused him to omit the downbound *Heloise* when reporting traffic to the *Ocean Georgie Bain*.

4. The master on the *Ocean Georgie Bain* was unaware of the *Heloise* because Marine Communications and Traffic Services had not reported the downbound vessel, because the master was not using available navigational equipment, and because the engineer had not reported sighting the vessel.

5. The pilot on the *Heloise* altered course to port to avoid a pleasure craft. Once the craft was clear, the pilot steadied the course of the vessel in the direction of the *Ocean Georgie Bain*, and the 2 vessels collided.

Findings as to risk

1. If language barriers on board vessels inhibit communication, there is a risk that bridge resource managment will be ineffective.

2. If available resources for safe navigation are not used, there is a risk that vessels in close proximity will not be detected, and a collision may occur.

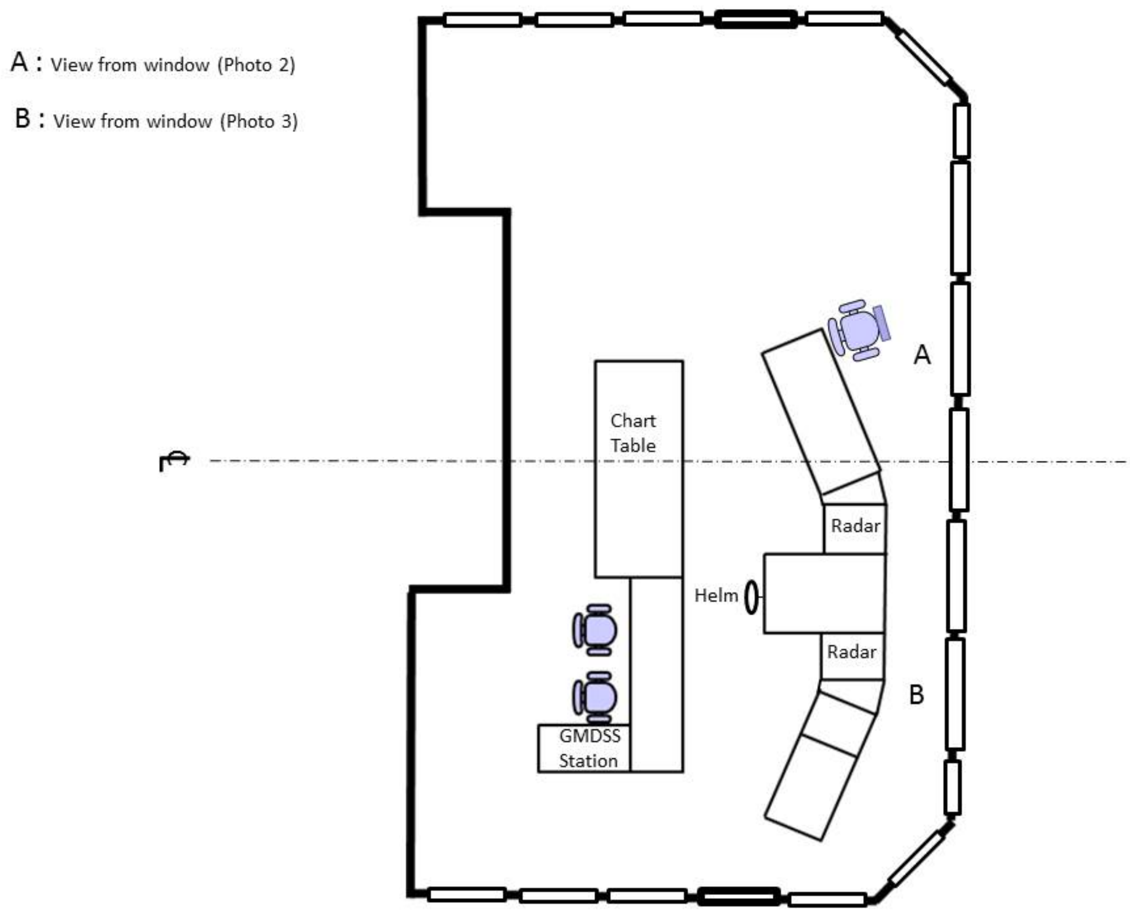
3. If companies and vessel masters do not accurately interpret and apply the requirements of a safe manning document, it is possible that a vessel will be inadequately manned and/or manned by crew with inadequate training.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 24 September 2014. It was officially released on 09 October 2014.

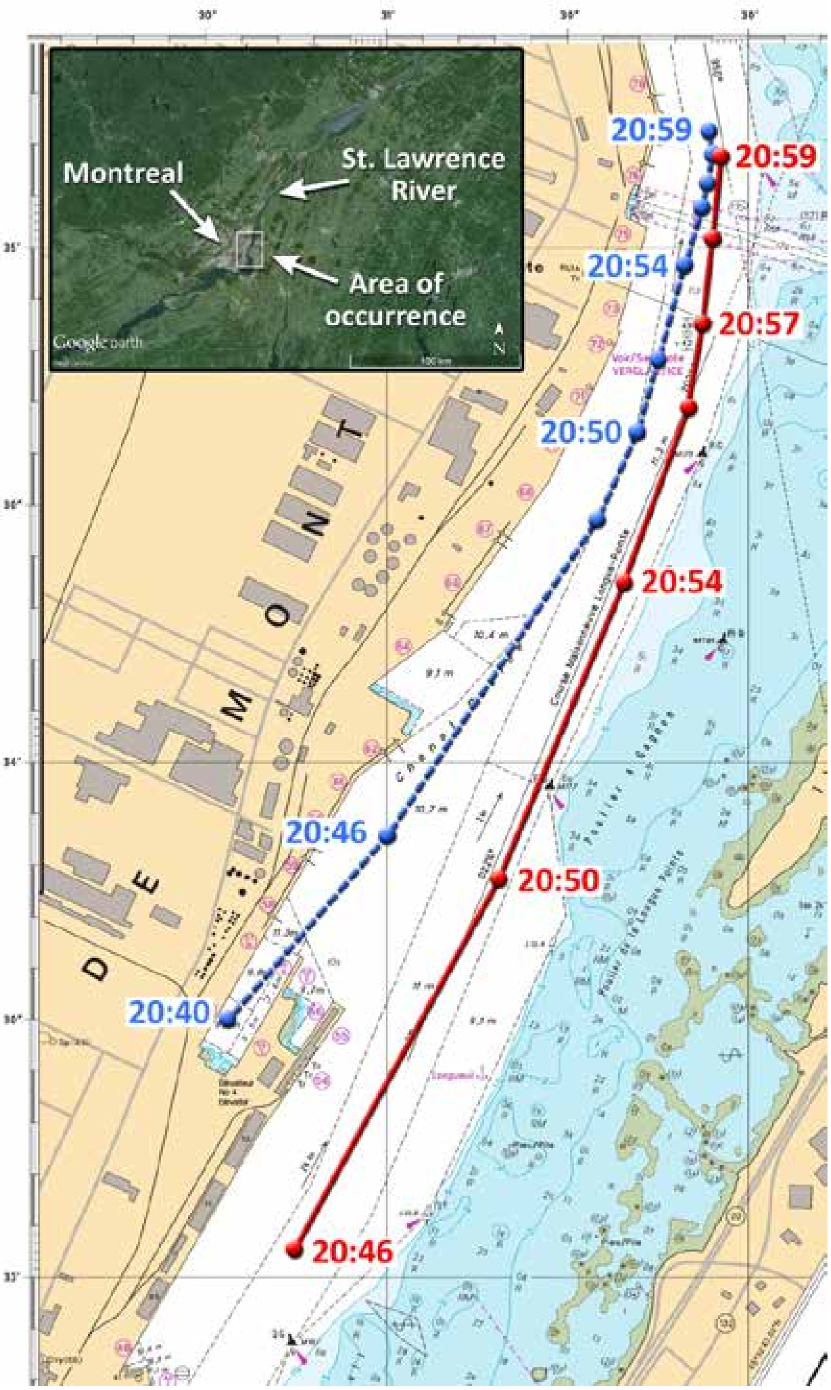
Visit the Transportation Safety Board's website (www.bst-tsb.gc.ca) for information about the Transportation Safety Board and its products and services. You will also find the Watchlist, which identifies the transportation safety issues that pose the greatest risk to Canadians. In each case, the TSB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

Appendices

Appendix A – Arrangement of the MV Heloise bridge



Appendix B – Area of the occurrence



Legend:

The blue dashed line on the left indicates the path of the *Ocean Georgie Bain*.

The red solid line on the right indicates the path of the *Heloise*.

Note: The information in this sketch was compiled by the TSB Marine Investigations Branch and is not to be used for navigation. All tracks and positions are approximate. This image is based on an electronic navigation chart [Chart No. 1310] provided by the Canadian Hydrographic Service.

Appendix C – Exclusion zones