Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT M16P0062

Grounding of barges

Tug *H.M. Scout* towing barges *HM Blue Horizon* and *HM Tacoma*
Victoria, British Columbia
02 March 2016

Canada

Transportation Safety Board of Canada
Place du Centre
200 Promenade du Portage, 4th floor
Gatineau QC K1A 1K8
819-994-3741
1-800-387-3557
www.tsb.gc.ca
communications@bst-tsb.gc.ca

Marine Investigation Report M16P0062

Cat. No. TU3-7/16-0062E-PDF
ISBN 978-0-660-08464-0

This report is available on the website of the
Transportation Safety Board of Canada at www.tsb.gc.ca

Le présent rapport est également disponible en français.

Marine Investigation Report M16P0062

Grounding of barges
Tug *H.M. Scout* towing barges *HM Blue Horizon* and *HM Tacoma*
Victoria, British Columbia
02 March 2016

Summary

On 02 March 2016, at 1730 Pacific Standard Time, the tug *H.M. Scout* departed Victoria, British Columbia, en route to Bamberton, British Columbia, with the barges *HM Tacoma* and *HM Blue Horizon* in tandem tow. During the passage, the tug encountered severe weather, the tow line between the barges parted, and the *HM Blue Horizon* grounded near Clover Point, British Columbia. During the recovery attempt, a piece of the parted tow line fouled the tug's propeller, partially disabling the tug. The *HM Tacoma* subsequently grounded near Finlayson Point, British Columbia, and the disabled tug released the tow line and returned to Victoria. There were no injuries, but some of the scrap construction material from the *HM Blue Horizon* was lost overboard.

Le présent rapport est également disponible en français.

Table of contents

1.0 Factual information

1.1 Particulars of the vessels

Table 1. Particulars of the vessels

Name of vessel*	*H.M. Scout*	*HM Tacoma*	*HM Blue Horizon*
Official number	313915	839752	329198
Port of registry	Vancouver, BC	Victoria, BC	Victoria, BC
Flag	Canada	Canada	Canada
Type	Tug	Barge	Barge
Gross tonnage	13.88	532.39	818.82
Length	12.01 m	45.56 m	53.34 m
Built	1961	1966	1968
Propulsion	1 V-12 diesel engine (387.8 kW) driving a 3-blade fixed-pitch propeller	Non-propelled	Non-propelled
Cargo	Tow	Lifting equipment and construction equipment	Scrap construction materials and piles from a dock
Crew	2	None	None
Registered owners**	Heavy Metal Marine Ltd., Victoria, BC	Heavy Metal Holdings Ltd., Victoria, BC	Heavy Metal Marine Ltd., Victoria, BC

* Names of vessels appear in the report exactly as recorded in the Transport Canada Canadian Register of Vessels or the Small Vessel Register (Commercial).

** The companies are jointly owned by a business development person and an operations person.

1.2 Description of vessels

1.2.1 H.M. Scout

The *H.M. Scout* (Figure 1) is a single-screw steel hull tug of closed construction[1] built in 1961. It has a plumb stem[2] and rounded transom stern. The hull below the open main deck is subdivided by 3 transverse watertight bulkheads that enclose 4 compartments (from forward): a void space, a crew accommodation space, the engine room, and the lazarette.

---

1 A vessel of closed construction has a fixed structural deck covering the entire hull above the deepest operating waterline and that is not endangered when the open wells or cockpits fitted in the deck of the ship are flooded.

2 A plumb stem is a bow that is nearly perpendicular to the waterline.

The wheelhouse is flush with the main deck and can be accessed via doors on the starboard and port sides. The wheelhouse is equipped with engine controls, an autopilot, radar, a global positioning system (GPS), a very high frequency radiotelephone with digital selective calling (VHF/DSC), and 2 electronic chart display units. There is a conning position on top of the wheelhouse where life-saving equipment such as an emergency position indicating radio beacon (EPIRB), life raft, and life buoys are stowed. The conning position can be accessed via a fixed ladder on the port side of the wheelhouse or a portable ladder secured on the back side of the wheelhouse.

Figure 1. *H.M. Scout*

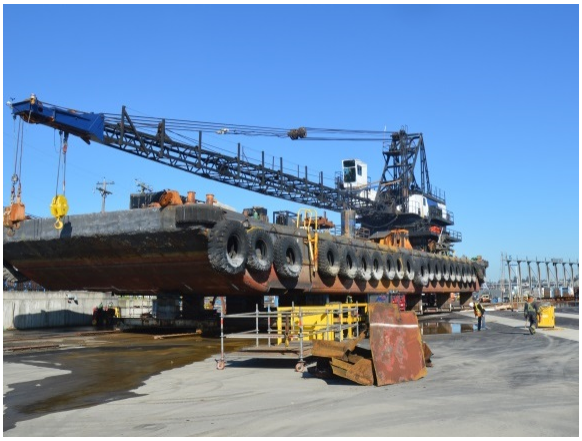
The engine room is accessed through a hatch with a coaming located aft of the wheelhouse at the main deck level. It can also be accessed through the crew accommodation space via a door in the transverse bulkhead. Within the engine room, 2 diesel tanks are located on the port and starboard sides. Above the engine is an expansion tank with a check valve. The expansion tank holds additional coolant for the engine. The engine room alarm panel, located in the wheelhouse, includes low level and high temperature alarms for the engine coolant.

The tug is fitted with a single-drum hydraulically driven towing winch and spooling gear. The winch is operated from the main deck using control levers located on the starboard side of the winch. In an emergency, the winch brake can be released from the main deck, the wheelhouse, or the conning position on top of the wheelhouse.

1.2.2 HM Tacoma

The *HM Tacoma* (Figure 2) is a welded steel barge with a flat deck and raked bow and stern. The barge is subdivided into 11 compartments by way of 2 longitudinal and 4 transverse watertight bulkheads. A 37-ton revolving crane is fitted aft and is powered by a diesel engine. Fuel for the diesel engine is stored in an independent storage tank located inside the crane housing.

Figure 2. *HM Tacoma*



The barge has 2 steel mooring spuds located on the starboard and port sides. The forward corners of the barge are each fitted with

12-inch bitts.[3] These bitts are affixed at an angle (45 degrees from the centreline) to facilitate towing. On the aft end of the barge, there are bitts on both the port and starboard sides. The bitts on the port side are aligned parallel to the vessel's centreline. The aft-most bitt on the port side is 25 cm from the stern. The bitts on the starboard side are aligned perpendicular to the vessel's centreline and are 75 cm from the stern.

At the time of the occurrence, the *HM Tacoma* had an estimated draft of 1.5 m and a freeboard of 1.55 m. Since it had operated in the United States, the barge had draft marks painted on the hull to comply with United States Coast Guard (USCG) regulations.[4]

1.2.3 HM Blue Horizon

The *HM Blue Horizon* (Figure 3) is a welded steel barge with a flat deck and raked bow and stern. The barge is subdivided into 8 compartments by way of 1 longitudinal and 4 transverse watertight bulkheads. At the forward end of the barge, there are 8-inch towing bitts fitted on the port and starboard sides. These bitts are welded at an angle (45 degrees from the barge's centreline) to facilitate towing. There is an 8-inch bitt fitted on each side of the barge's aft end. Ladders are affixed to each side of the barge for boarding and disembarking of personnel.

Figure 3. ***HM Blue Horizon***

The barge has a design draft of 2.9 m; the draft marks are not marked on the hull, nor is this required by regulation. At the time of the occurrence, the barge had an estimated draft of 0.6 m and a freeboard of 2.69 m.

1.3 Company operations

The *H.M. Scout, HM Tacoma,* and *HM Blue Horizon* are owned by a marine construction and pile driving company that operates out of Bamberton, British Columbia. The company, which has been in operation since 2004, also owns 6 other vessels.

At the time of the occurrence, the company was nearing completion of a contract with a ferry line to upgrade a terminal in the Victoria inner harbour, and was transporting construction materials and equipment from Victoria to Bamberton. The *HM Blue Horizon* and *HM Tacoma* had been moored at the terminal to help with construction and storing of scrap material. The

---

3 A bitt is an iron post used for securing ropes, cables, mooring lines, etc. Bitts are usually in pairs named according to their uses.

4 United States Coast Guard *46 Code of Federal Regulations,* Load Lines – Subchapter E, Subpart 42, available at https://www.uscg.mil/d13/cfvs/acsa/ACSA_References/46CFR_SubchapterE.pdf (last accessed on 04 April 2017).

tug *H.M. Scout* was being used to tow barges between Bamberton and the worksite. On the day of the occurrence, the *H.M. Scout* had towed a smaller company barge from Bamberton to Ogden Point in Victoria, and was returning to Bamberton with the *HM Tacoma* and *HM Blue Horizon*.

1.4 History of the voyage

On 02 March 2016, at 1730,[5] the *H.M. Scout*, with a master and a deckhand on board, began towing the 2 barges, *HM Tacoma* and *HM Blue Horizon*, to Bamberton. Both crew members were wearing personal flotation devices.

About an hour into the voyage, the deckhand noticed that the *HM Blue Horizon* was no longer aligned behind the *HM Tacoma*, but was angled off to one side. The deckhand alerted the master and began continuously monitoring the tow. At this time, the tug was on a southeasterly heading with maximum ahead power on the engines, and was making about 1 knot over the ground with a following current. The wind was 37 knots[6] from the south-southeast (Appendix A), and the tug and tow were encountering steep waves of approximately 2 to 3 m.

At approximately 1858, the ropes connecting the *HM Tacoma* and *HM Blue Horizon* parted. The *HM Blue Horizon* started drifting toward the shore at Clover Point, which was 0.1 nautical mile (nm) away (Appendix B). The master turned the tug around and, with the *HM Tacoma* still in tow, began pursuing the *HM Blue Horizon*. He called the owner[7] by cell phone and informed him that he had lost one of the barges. The owner began making calls to find a commercial tug to assist. At approximately 1903, the *HM Blue Horizon* grounded on the southwest side of Clover Point. At 1905, Marine Communications and Traffic Services (MCTS) attempted to contact the *H.M. Scout* by VHF radiotelephone but received no reply.

At 1907, the *H.M. Scout,* with the *HM Tacoma* in tow, reached the grounded barge. The shallow water and breaking waves along the shore caused the tug to rock violently. The deckhand connected 2 spare rope couplers[8] together and climbed onto the *HM Blue Horizon* to connect the barge with the rope couplers. Once the deckhand had reboarded the tug and entered the wheelhouse, the master made an attempt to pull the *HM Blue Horizon* off the beach; however, the coupler parted during this attempt. The master phoned the owner and informed him that the effort to recover the barge had been unsuccessful.

At approximately 1910, the parted coupler from the recovery attempt slipped overboard and fouled the tug's propeller. The deckhand informed the master and then called the owner on his cell phone to inform him. The tug became partially disabled, with reduced propulsion and steering problems. Soon after, the engine high temperature alarm sounded in the

---

5 All times are Pacific Standard Time (Coordinated Universal Time minus 8 hours).

6 As recorded at the Trial Island weather station, located 1.8 nautical miles east-southeast of Clover Point. Appendix A shows the recorded wind speeds throughout the day of 02 March 2016.

7 The owner who predominantly acts as the operations person.

8 A rope coupler is a rope with a spliced eye at each end. Each rope coupler was 5.5 m in length.

wheelhouse and smoke started emanating from the engine room space. The master instructed the deckhand to enter the engine room space and open the check valve for the main engine coolant expansion tank. Around this time, the sustained wind speed was over 40 knots, gusting to 47 knots.

At 1918, MCTS contacted the tug by VHF radiotelephone.[9] The master asked MCTS to stand by and, for the next 30 minutes or so, the tug and *HM Tacoma* were pushed toward the shore at Finlayson Point by inclement weather. Between 1948 and 1953, a series of VHF radiotelephone transmissions ensued between the master and MCTS. MCTS relayed the messages to the Joint Rescue Coordination Centre; it was determined that the master was holding position off Clover Point while waiting for another tug to come out and assist,[10] that one barge was aground, and that the master was maintaining the other.

At 1953, the master asked MCTS for assistance. The tug and barge were very close to the shore, and around this time, the *HM Tacoma* went aground. To prevent the tug from grounding as well, the master released the barge's tow wire. The wire did not pay out all the way, so the deckhand manually paid out the remainder. The master called MCTS and reported that the *HM Tacoma* tow wire had been released and the second barge was aground. The master also reported that the tug engine was overheating and that he was planning to head back to Ogden Point.

Meanwhile, the owner, unable to secure an assist tug, proceeded toward Ogden Point to assist the *H.M. Scout* on board another company tug, the *C07567BC.* At 2033, the owner met up with the *H.M. Scout* at Ogden Point. At this point, the *H.M. Scout*'s engine became inoperable and the *C07567BC* towed the *H.M. Scout* to Fisherman's Wharf in Victoria.

On 03 March, the *HM Tacoma* was pulled off the beach by a commercial tug. The following week, the *HM Blue Horizon* was lightened up and pulled off the beach by a commercial tug.

1.5 Damage to the vessels

1.5.1 H.M. Scout

Following the occurrence, the tug's main engine was inoperative due to overheating and required a complete overhaul. The propeller shaft was bent and the propeller's blade tips were damaged.

---

9 In the 13 minutes prior, MCTS had made 5 attempts to contact the master, but had received no reply.

10 At this time, the owners were still attempting to secure an assist tug.

1.5.2 HM Blue Horizon

The barge sustained a breach in the hull, as well as indentation and punctures in several compartments. There was water ingress into the compartments due to the punctures. The skeg[11] was also damaged.

1.5.3 HM Tacoma

The barge sustained indentations and punctures to several compartments and to the skeg. Some of the transverse and longitudinal bulkheads were buckled.

1.6 Environmental conditions

At 1019 and 1548 on the day of the occurrence, Environment and Climate Change Canada had issued a severe weather warning stating that

> A frontal system will cross BC waters tonight. Gale to storm force southeasterly winds will prevail over most BC waters tonight ahead of the front. Winds will become gale force southwesterlies behind the front.

At 1930, the Trial Island lighthouse observation station, located 1.8 nautical miles east-southeast of Clover Point, recorded a maximum wind speed of 48 knots with sustained winds of 40 knots.

The Tidal Current Atlas indicates that the current along the coast at Clover Point was flooding in an east-northeasterly direction at 1 knot at the time of this occurrence.[12]

The Gulf Islands and Adjacent Waterways Chart Atlas includes the following cautionary message:

> Steep seas dangerous to small vessels when wind opposes strong tidal currents S of Clover Point, Trial Islands, Discovery Island, along E side Discovery Island.[13]

The information in this cautionary message is not noted on the navigation chart or in the sailing directions.

The owner and the master of the *H.M. Scout* had discussed the weather forecast on the morning of 02 March. They concluded that the protection offered by the Southern Gulf Islands, the southwesterly wind, and the fact that the *HM Blue Horizon* was lightly loaded would result in the tug and tow making good speed.

---

11 A skeg is a tapering or projecting extension from the stern section of a vessel's keel, intended to give directional stability to the vessel.

12 Canadian Hydrographic Service, Current Atlas (1987), Juan de Fuca Strait to Strait of Georgia.

13 Canadian Hydrographic Service, 3313 Gulf Islands and Adjacent Waterways Chart Atlas (January 2009).

1.7 Personnel certification and experience

The master held a certificate to work as master on passenger and towing vessels with a gross tonnage (GT) of less than 60, operating in coastal areas of British Columbia not more than 25 nautical miles from shore. The certificate was issued in 2008 after the master claimed 60 days of sea service as a deckhand on board the tug *Donmarel*, attended an 80-hour course on navigation safety, and passed an oral examination. The master had been working in the marine industry on the west coast since 2007, and the majority of his experience involved yarding barges[14] and handling log sections on the Fraser River.

The master had started working for this company in November 2015.

The deckhand had been working in the coastal towing industry since 2002, primarily towing logs in the Fraser River. The deckhand had joined this company approximately 1 month before the occurrence.

The owner/operator of *C07567BC* had taken courses on navigation for the Master, Limited for a Vessel of Less than 60 Gross Tonnage certificate, but had not completed the Transport Canada (TC) certification process.

1.8 Vessel certification and inspection

The *H.M. Scout* was equipped and certified in accordance with existing regulations. As a tug with a GT of less than 15, it was not inspected by TC, nor was it required by regulation to be inspected.

The barges *HM Blue Horizon* and *HM Tacoma* were not inspected by TC, nor were they required by regulation to be inspected.

The tug *C07567BC* was not inspected by TC, nor was it required by regulation to be inspected. TC suspended its small commercial vessel registration in November 2009 due to a change of ownership resulting from the company restructuring, and the company had not subsequently renewed it.

1.9 Safe manning

Under the *Marine Personnel Regulations* (MPR), the *H.M. Scout* was required to have at least 2 people on board to maintain the deck watch. Additionally, for emergency situations, sufficient people are required to be on board to simultaneously handle emergency situations such as launching survival craft, handling fire extinguishing equipment, and maintaining communications and a deck watch while under way.[15]

---

14 "Yarding" refers to moving barges around within short distances.

15 Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (last amended on 03 February 2017), Part 2: Crewing, Section 207.

With respect to hours of work and rest, the MPR require masters of Canadian vessels engaged on domestic voyages to ensure that

> (a) the master and every crew member have
>
> (i) at least six consecutive hours of rest in every 24-hour period, and
>
> (ii) at least 16 hours of rest in every 48-hour period; and
>
> (b) not more than 18 hours but not less than 6 hours elapse between the end of a rest period and the beginning of the next rest period.[16]

TC publication (TP) 14070E also states that if the vessel does not return to port at night to allow time for rest, at least 2 people who hold the certificate required to operate the vessel must be on board to meet the requirements for the deck watch, in addition to any other personnel required to meet minimum crew requirements.[17]

On the day of the occurrence, the deckhand began work at 0700 and the master began work at 0930. The tug and barge departed Ogden Point at 1730, and the return leg of the voyage was approximately 30 nautical miles. With the tug and tow proceeding at a speed of 1 to 3 knots, the remaining voyage time was estimated at a minimum of 10 hours.

1.10 Preparation for towing and towing arrangements

The owner had prepared the *HM Blue Horizon* and *HM Tacoma* to be towed. He used 4 synthetic ropes—2 on the port side and 2 on the starboard side—to connect the forward bitts on the *HM Blue Horizon* to the aft bitts on the *HM Tacoma*. The configuration of the bitts on the *HM Tacoma* was dissimilar, with 1 being closer to the aft end and side of the barge than the other.[18] The approximate distance between the 2 barges under tow was 1.2 m, with the foredeck of the *HM Blue Horizon* about 1 m higher than the after deck of the *HM Tacoma* (Figure 1). The owner then towed the 2 barges in tandem behind the *C07567BC* within sheltered waters from the ferry terminal in Victoria to Ogden Point. At Ogden Point, the tow was switched over to the *H.M. Scout*. The deckhand on the *H.M. Scout* climbed on board the barges to assist with the tow swap.

The *HM Tacoma* was connected to the tug *H.M. Scout* by a wire tow rope and wire rope bridles. The complete wire tow rope aboard the *H.M. Scout* was 198 m long, and an unknown length was paid out upon departure from Ogden Point. For benign and sheltered areas, Det Norske Veritas – Germanischer Lloyd (DNV–GL), formerly GL-Noble Denton, recommends that "the minimum deployable length shall not be less than 500 m and shall not include the

---

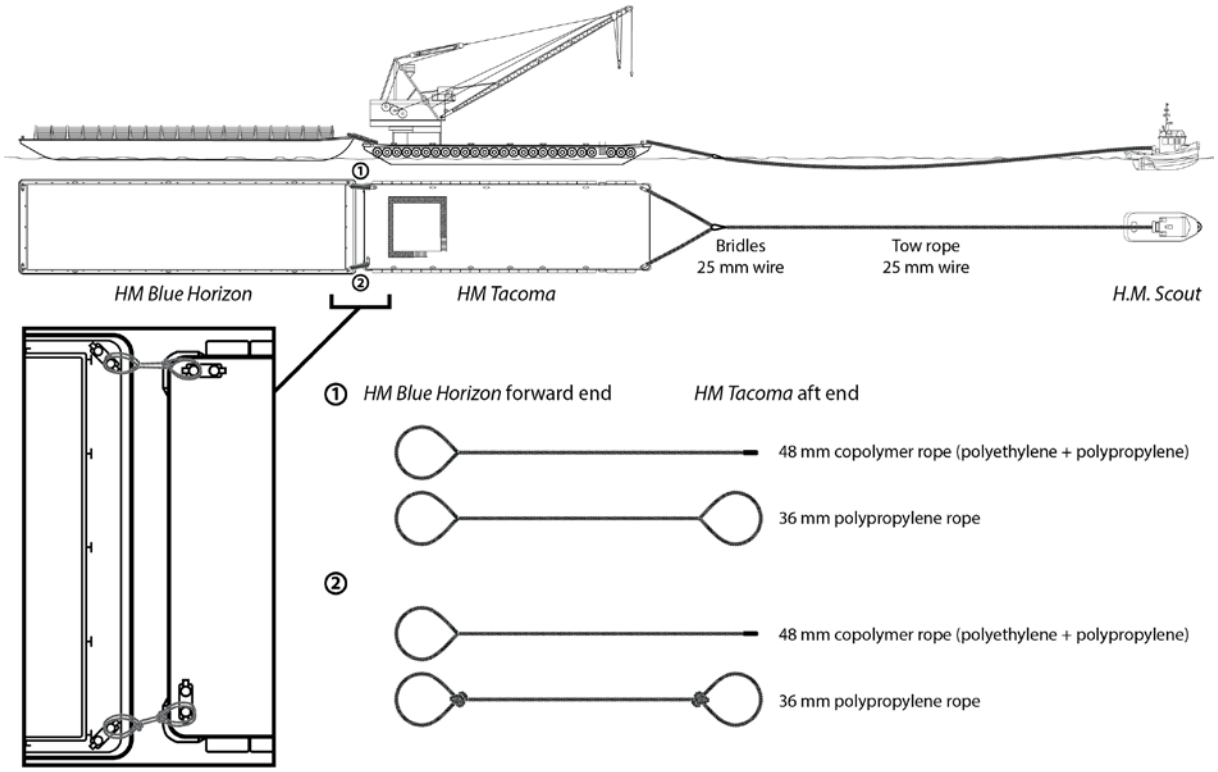
16 Ibid., Part 3: Maritime Labour Standards, Division 2, Section 320.

17 Transport Canada, TP 14070E, *Small Commercial Vessel Safety Guide* (2010), Chapter 4: Assure a Competent Crew.

18 A barge fitted with bitts that are configured identically on both the port and starboard sides facilitates proper load distribution.

minimum remaining turns on the winch drum, and the distance from the drum to the stern rail or roller."[19]

Figure 4. Towing arrangement



1.11 Guidance on towing arrangements

TC currently has standards with respect to the towing arrangements for oil-carrying barges, but does not have standards for the towing arrangements used with general cargo barges such as the *HM Blue Horizon* and *HM Tacoma*. To assist Canadian towing operators, TC advises that they "should use, where appropriate, the annexed International Maritime Organization (IMO) recommendations to supplement Canadian towing measures."[20] This guidance is intended for ocean towing but is useful for other types of towing operations as well. The IMO annex, *Guidelines for Safe Ocean Towing*,[21] has several recommendations for operators, including the following:

---

19 GL-Noble Denton (now DNV-GL), *Guidelines for Marine Transportations*, 0030/ND, revision 10 (14 December 2015), Section 6: Towing Equipment.

20 Transport Canada, Ship Safety Bulletin 13/1988: "Safety of Towed Ships and Other Floating Objects" (07 September 1988), available at http://www.tc.gc.ca/eng/marinesafety/bulletins-1988-13-eng.htm (last accessed on 03 April 2017).

21 International Maritime Organization, *Guidelines for Safe Ocean Towing*, MSC/Circ.884 (21 December 1998), available at http://www.imo.org/blast/blastDataHelper.asp?data_id=1798&filename=884.PDF (last accessed on 03 April 2017)

- There should be a contingency plan to cover the onset of adverse weather.
- The towing arrangements and procedures should be such as to reduce to a minimum any danger to personnel during the towing operation.
- The towing arrangements should be suitable for the particular tow and of adequate strength.
- The design and arrangement of towing fittings should take into account both normal and emergency conditions.
- Sufficient spare equipment to completely re-make the towing arrangements should be available, unless impractical.
- Secondary or emergency towing arrangements should be fitted on board the tow so as to be readily recoverable by the towing ship in the event of a failure of the main towing system or ancillary equipment.
- The tow should be at a suitable draft for the intended voyage.
- The tow should not proceed to sea until a satisfactory inspection of the towage has been done by the master or a competent person.

The IMO annex also indicates that, should the tow break adrift and pose a danger to navigation or the coastline, the master of the towing vessel is bound to communicate the information by all means at his disposal to the vessels in the vicinity and to the competent authorities.

Industry guidance[22] is also available to assist towing operators with towing best practices, the adequacy of the elements used in a tow, and how to best arrange those elements. According to this guidance, in exposed waters, a long all-wire towing arrangement is preferred. To minimize the surging action between the towed vessels, the tow lines must be of an appropriate length to allow for an adequate catenary[23] effect. The catenary effect of the curve of a towing wire of a certain length increases the ability of the tow to absorb the shocks caused by severe environmental conditions, by acting as a kind of spring that relieves peak dynamic tensions.[24] Synthetic ropes offer no catenary effect and do not dampen the movement of the tow, as the ropes float and are relatively short.

A number of arrangements can be employed when a tug is towing multiple barges in exposed waters; see Appendix C for 3 examples.

With respect to the draft of the barge, DNV–GL guidance recommends that the draft be small enough to give adequate freeboard and stability, and large enough to reduce motions and slamming. Typically, for barge towages, the draft will be between 35% and 60% of hull

---

22 GL-Noble Denton (now DNV-GL), *Guidelines for the Approval of Towing Vessels* (22 June 2013), 0021/ND, revision 09; GL-Noble Denton (now DNV-GL), *Guidelines for Marine Transportations* (14 December 2015), 0030/ND, revision 10.

23 The International Maritime Dictionary defines "catenary" as the curve assumed by a chain or rope hanging freely between two points of support.

24 United States Department of the Navy, Naval Sea Systems Command, *U.S. Navy Towing Manual*, revision 03 (July 2002), Chapter 3, Section 4.2.

depth. The guidance also states that the draft should be marked fore and aft in a manner that is readable.

DNV-GL guidance also recommends that a risk assessment be carried out that considers the actual tow arrangement, towed objects, route, and season.[25]

Finally, the Canadian Standards Association (CSA) provides standards and guidance on tow line arrangements. This guidance is intended for the various sea operations involving fixed and floating offshore structures, but is relevant to other types of towing operations as well.[26]

While the guidance from TC is available on its website, relevant sections of industry guidance usually must be purchased by owners/operators. Standardized Canadian guidance is not available to assist towing operators with assessing the suitability of their towing arrangement.

1.12 Towing rope

A number of factors affect a rope's suitability for use in a towing arrangement. These include the rope's age, condition, intended use, minimum breaking strength,[27] working load limit,[28] and design factor.[29] It is good practice for towing operators to regularly inspect rope for signs of aging and wear, and to maintain a log that documents the rope's history of use.[30]

The U.S. *Naval Ships Technical Manual* provides some guidance on towing rope selection, indicating that non-rotating ropes, such as 12-strand braided ropes or 8-strand plaited ropes, are best suited for towing, and that a double braided rope provides a maximum bearing area that results in more gripping surface and ability to disperse heat and abrasion over a larger area to reduce wear.[31] The manual also cautions that "three strand ropes are easier to splice and are generally good at withstanding stretching and abrasion; however, they tend to rotate under load, leading to kinking and cockling, and therefore are not recommended as towing

---

25 Det Norske Veritas, DNV-OS-H202, *Sea Transport Operations* (VMO Standard – Part 2-2) (October 2015), Section 4.2.2.

26 Canadian Standards Association, CSA ISO 19901-6, *Petroleum and natural gas industries – Specific requirements for offshore structures*, 1st edition (01 January 2010), Part 6: Marine Operations.

27 This is the force that a new rope is required to meet under laboratory conditions.

28 This is a guideline for the maximum force that can be allowed on a rope. Any force exceeding the working load limit might stress the rope and damage the fibres, resulting in premature rope failure.

29 This is a ratio between the minimum breaking strength and the working load limit. It represents a margin of safety required for an application. For a particular application, the design factor is decided based on expected use of the rope. For example, ropes that are used for lifting people have a higher design factor compared to a rope used for mooring vessels. Design factor is typically in the range of 5 to 12, with 12 being used for work associated with greatest risk.

30 GL-Noble Denton (now DNV-GL), *Guidelines for the Approval of Towing Vessels*, 0021/ND, revision 09 (22 June 2013), Section 6: Towing Equipment.

31 *Naval Ships Technical Manual* (S9086-TW-STM-010 CH-582R2), revision 02 (01 December 2001), Chapter 582: Mooring and Towing, pp. 582–85.

hawsers."[32] Standardized Canadian guidance is not available to assist towing operators with towing rope selection.

There were 2 types of towing ropes used to connect the *HM Blue Horizon* and the *HM Tacoma.* One was a 48 mm twisted copolymer rope and the other was a 36 mm twisted polypropylene rope. Both were of 3-strand right-hand lay.

1.12.1 Post-occurrence examination of towing ropes

Following the occurrence, the 48 mm copolymer ropes were recovered from the *HM Blue Horizon* and were sent to a private test facility to check for residual strength.[33] One of the ropes failed at 16.9 tons and the second rope failed at 12.9 tons. A new 48 mm copolymer rope has a breaking strength of 35.3 tons.

Visually, the ropes appeared weathered and discoloured due to prolonged exposure to sunlight. There were numerous broken filaments all over the rope, which is consistent with abrasion and cyclic tension wear.[34] The fibres were stiff, brittle, and fused, which is consistent with shock load[35] or sustained high load. The eye splices had semi-permanent circular deformation similar to the width of bitts and signs of chafing, fusion, and discolouration where the rope was wrapped around the bitts. The eye splices were intact and the 4 ropes had separated closer to their midpoints than to their eye splices (Appendix D).

The 36 mm polypropylene ropes that were recovered were not of sufficient length to be tested. Visually, the 36 mm ropes showed signs of aging and wear similar to the 48 mm copolymer ropes. One of the 36 mm ropes had a knot in it that was used to make the eye.

1.13 Bollard pull

Bollard pull, which measures a tug's power, is the maximum continuous pull obtained from a tug during a static pull test. Knowing the bollard pull is integral for performing calculations to determine if a tug is sufficiently powered for a particular tow, and for assisting operators in determining the appropriate towing gear.

The *H.M. Scout*'s bollard pull had not been ascertained, nor is there a requirement for it to be ascertained for towing operations of this type. Following the occurrence, the investigation could not determine the bollard pull of the tug because of the damage that the engine and propeller shaft had sustained.

---

32 Ibid.

33 Residual strength is a measure of the rope's strength post-occurrence and may not reflect its exact strength at the time of the occurrence.

34 Cyclic tension wear occurs when the rope is cycled through periods of loaded and unloaded condition and can cause a rope to weaken due to fatigue.

35 Shock load occurs when an external force is suddenly placed on the rope, as may be the case in towing, when environmental conditions act on the tug and tow.

DNV-GL provides guidelines on the recommended bollard pull for tugs. In the absence of a measured bollard pull, DNV-GL recommends estimating the bollard pull as 1 tonne/100 brake horsepower (BHP) of the engines. DNV-GL then suggests that bollard pull be further reduced by 1% per year for a tug of age greater than 10.[36]

The main engine of the *H.M. Scout* delivered 520 BHP, which calculates to 5.2 tonnes bollard pull. The tug was built in 1961; therefore, in the absence of a measured bollard pull, the investigation estimated the *H.M. Scout*'s bollard pull to be 2.86 tonnes.

1.14 Regulatory oversight

1.14.1 Transport Canada

TC is responsible for ensuring that Canadian-flagged vessels are inspected in accordance with the *Canada Shipping Act, 2001* (CSA 2001) and associated regulations. Under the CSA 2001,[37] a vessel's authorized representative is responsible for

- ensuring the vessel and its machinery and equipment meet the requirements of regulations set out by the CSA 2001;[38]
- developing procedures for the safe operation of the vessel and for dealing with emergencies; and
- ensuring that the crew receive safety training.

Supporting documentation and records must be available to any person or organization authorized under the CSA 2001 to carry out inspections. TC currently does not have an inspection program for general cargo barges or for tugs less than 15 GT.

1.14.2 WorkSafeBC

Marine vessel operations are subject to both provincial and federal jurisdiction. WorkSafeBC[39] has jurisdiction over the occupational health and safety of provincial employers engaged in marine operations, including general safety equipment and procedures on these vessels, general supervision and training of the crew, and general hazards. Its jurisdiction does not extend to matters relating to the shipping and navigation aspects of such operations. WorkSafeBC's prevention officers provide safety oversight within the framework of provincial WorkSafeBC legislation, and are allocated to offices that are assigned to inspect workplaces within specific geographical areas. The oversight is either

---

36 GL Noble Denton Technical Standards Committee, publication 0021/ND, *Guidelines for the Approval of Towing Vessels*, revision 10 (14 December 2015), section 3: Definitions & Abbreviations.

37 *Canada Shipping Act, 2001* (S.C. 2001, c. 26), Section 106: Authorized Representatives.

38 Ibid., Section 120: Regulations.

39 WorkSafeBC, *Guidelines Workers Compensation Act*, Part 3, Division 1: Interpretation and Purposes, G-D1-108-8, Jurisdiction Over Marine Operations, available at https://www.worksafebc.com/en/law-policy/occupational-health-safety/searchable-ohs-regulation/ohs-guidelines/guidelines-for-workers-compensation-act (last accessed on 03 April 2017).

planned around identified risk-based work activities or in response to an accident or complaints. Officers provide an inspection report, issue compliance orders[40] if safety issues are present, and ensure that the employer submits an investigation report.

WorkSafeBC also promotes safety awareness through Hazard Alerts, information booklets, and a voluntary financial incentive program called the Certificate of Recognition. Employers like the owners of the *H.M. Scout* can earn a Certificate of Recognition by successfully implementing and maintaining a health and safety management system that exceeds regulatory requirements and meets a set of audited standards.

1.14.3 Tug and barge inspection requirements in the United Kingdom and the United States

In the United Kingdom (UK), small workboats (which include tugs) engaged in commercial activity are regulated under *The Merchant Shipping (Small Workboats and Pilot Boats) Regulations 1998* and the *Workboat Code*.[41] Under these regulations, vessels under 24 m in length or with less than 150 GT are required to undergo inspection by the certifying authority. A successful inspection results in issuance of a certificate valid for not more than 5 years. In addition, the Code informs owners/managing agents that possession of a certificate of competency, on its own, should not be regarded as evidence of ability to serve in a particular position on a specific vessel. The owner/managing agent must ensure that there are sufficient trained personnel on board to work on the vessel with due regard to the nature and duration of the voyage.

Barges or other floating objects are required to be surveyed, and are issued a Load Line Certificate or exemption certificate for a towed voyage.

The U.S. *Coast Guard and Maritime Transportation Act of 2004* reclassified towing vessels as vessels subject to inspection.[42] Accordingly, the USCG has established comprehensive safety regulations governing the inspection, standards, and safety management system (SMS) of towing vessels 26 feet or more in length. The regulations give owners/managers a choice between 2 inspection regimes:

- A towing SMS option where the routine inspections of towing vessels are performed by third-party organizations
- A Coast Guard inspection option where routine inspections are conducted by the USCG.

---

40 Compliance orders are WorkSafeBC's primary tools to address non-compliance with the occupational health and safety provisions of the *Workers Compensation Act* and the *Occupational Health and Safety Regulation*.

41 Maritime and Coastguard Agency, *The Workboat Code*, Industry Working Group Technical Standard (2014), available at https://www.gov.uk/government/publications/workboat-code (last accessed on 03 April 2017).

42 United States Department of Homeland Security, Coast Guard, *Federal Register*, Inspection of Towing Vessels; Final Rule, Docket No. USCG–2006–24412 (20 June 2016), available at https://www.uscg.mil/hq/cg5/TVNCOE/Documents/SubM/SubchapterMFinalRule.pdf (last accessed on 04 April 2017).

1.15 Safety management

The principal objective of an SMS on board a vessel is to ensure safety at sea, prevent human injury or loss of life, and avoid damage to property and the environment. Safety management involves individuals at all levels of an organization and requires that a systematic approach be taken in identifying and mitigating operational risks.

Some elements of an effective SMS are:

- Operating procedures for the vessel and the use of checklists
- Maintenance procedures for the vessel and its associated equipment
- Documentation and record-keeping procedures
- Procedures for identifying hazards and managing risks
- Procedures to prepare for and respond to emergency situations
- Drills, training, and familiarization for the vessel's crew.

The company involved in this occurrence had a health and safety policy for its on-shore and pile driving operations, as required and enforced by WorkSafeBC, but the health and safety policy did not cover marine activities such as towing and yarding of barges, hours of work and rest, hiring and training of employees, or operations. The company did not have written procedures for the safe operation of the vessels or for dealing with emergencies.

In 2010, TC began formal consultations on a regulatory proposal to introduce safety management regulations to Canadian non-convention vessels, including those less than 15 GT. However, industry expressed concerns, primarily regarding costs and feasibility, stating that implementing the new regulations would be too onerous for small companies that operate small vessels. In response to stakeholders' concerns, TC amended its regulatory proposal in 2012 to include only vessels greater than 24 m in length and those carrying more than 50 passengers.[43]

At the national Canadian Marine Advisory Council meeting in November 2014, TC updated industry on the proposed *Safety Management Regulations*.

These proposed changes would not apply to tugs the size of the *H.M. Scout*.

1.16 Mandatory vessel reporting

Under the *Vessel Traffic Services Zones Regulations*, the master of a towing vessel is required to report information such as name, call sign, position, estimated time of entering a Vessel Traffic Service Zone, destination, and estimated time of arrival at destination, and whether dangerous goods or a pollutant are carried on board.[44] This reporting is so that MCTS has the information readily available in the event of an emergency.

---

43 Canadian Marine Advisory Council, "Proposed Safety Management Regulatory Requirements for the Canadian Fleet," Discussion Paper (2012).

44 *Vessel Traffic Services Zones Regulations* (SOR 89/98), Section 6: Reports.

Upon departure, the master called MCTS to inform them about his departure from Victoria and his intended route, but did not inform MCTS about the next reporting point or the fact that the *HM Tacoma* had 2000 litres of fuel for the crane on board.

The *Vessel Traffic Services Zones Regulations* further require that a report be made to MCTS as soon as the vessel is involved in a collision, grounding, or striking, or sustains any defect in the vessel's main propulsion systems. The Canadian Coast Guard (CCG) recommends that

> in the interest of ensuring the highest level of safety, mariners should immediately notify the CCG, through any MCTS centre, of any situation which is or may be developing into a more serious situation requiring assistance from the SAR [Maritime Search and Rescue] system. The need for the earliest possible alerting of SAR authorities to potential maritime emergencies cannot be over-emphasized.[45]

In this occurrence, the *HM Blue Horizon* went aground at 1903, and MCTS was informed 48 minutes later by the master after multiple attempts by MCTS to contact the tug. The *H.M. Scout* developed propulsion and engine overheating problems at 1910, but informed MCTS after 47 minutes.

The owners began making calls to try and find an assist tug as soon as the barge *HM Blue Horizon* was adrift. They made multiple calls and were able to establish contact with 3 tug owners/operators who had tugs in the region, but none could get a tug out to assist at short notice.

1.17 Training and certification requirements for towing masters

To work as a towing master on a tug such as the *H.M. Scout*, a seafarer must hold, at a minimum, a Master, Limited for a Vessel of Less than 60 GT certificate, as well as other required certificates.[46] To obtain this master's certificate, TC requires[47] a candidate to have acquired at least 2 months of sea service on board one or more vessels of a gross tonnage at least equivalent to that of the vessel for which the certificate is sought, on voyages that correspond to those permitted by the certificate being applied for.

The syllabus for the Master, Limited for a Vessel of Less than 60 GT certification covers a number of topics, including navigational skills, operation of the vessel, and dealing with emergency situations. With regard to towing operations, the syllabus includes the following:

- Cables used for towing and their required length
- Towing bitts and hooks

---

45 Canadian Coast Guard, *Notices to Mariners 1 to 46* (Annual Edition, April 2016 to March 2017), Section D: Search and Rescue, subsection 29A.

46 These include Marine Emergency Duties (MED) A1 certificate, Marine Basic First Aid, and a radio operator certificate (if the vessel is equipped with a VHF radiotelephone).

47 Transport Canada, TP 14070E, *Small Commercial Vessel Safety Guide* (2010), Chapter 4: Assure a Competent Crew.

- Events that may result in the capsizing of the tug
- Use of emergency towing line.

In addition to completing the required 2 months of sea time, the candidate must pass a written examination on subject matter appropriate to the area of operation and the type and gross tonnage of the vessel to which the certificate relates, as set out in *Examination and Certification of Seafarers*.[48] Candidates must also complete a practical examination on board the vessel. In 2007, however, candidates had the option of either doing a written exam that assessed their knowledge of the syllabus or attending an 80-hour approved course covering the syllabus for the Master, Limited for a Vessel of Less than 60 GT certification.

While completing the required 2 months of sea time, the candidate performs deck duties under the supervision of a certified master(s). There is no specific guidance on the practical tasks to be performed during the sea service, nor does the MPR specify the rank in which the sea service needs to be done, except that it has to be deck service. The MPR states that the 2 months of sea service can be reduced to 1 month of sea service if an approved program of on-board training is taken.

There is currently no on-board training program approved in Canada for this purpose. TC is in the process of developing a transport publication for approved on-board training that will outline the practical tasks to be performed and the criteria for evaluating competence. It will require the signature of the vessel's representative confirming that the required competence has been achieved.

The on-board training program will provide the candidate with a reduction of sea service, but will not exempt the candidate from examinations. This program consists of on-board practical work and theoretical learning that prepares the candidate for TC examinations. On completion of on-board training, the candidate may need additional classroom courses to pass the required TC examinations.

The UK already has a framework in place so that operators provide training according to established guidance based on specific skills required for towing vessels. The British Tugowners Association, in agreement with UK's Maritime and Coastguard Agency, has launched the Tug Training Record Book and Apprenticeships Scheme.[49] This requires candidates to complete specific towing tasks before becoming eligible to obtain a tugboat certificate and establishes a training record book for tug masters that can be used to demonstrate experience in towing operations.

---

48 Transport Canada, TP 2293E, *Examination and Certification of Seafarers*, revision 5 (July 2007)

49 British Tugowners Association, "BTA Launches Tug Training Record Books & Apprenticeships Scheme," http://britishtug.com/bta-launches-tug-training-record-books-apprenticeships-scheme (last accessed on 04 April 2017).

1.18 Previous occurrences

Since 2013, at least 6 other occurrences[50] involving failure of towing gear that resulted in loss of tow(s) have been reported to the Transportation Safety Board of Canada (TSB). The TSB conducted investigations into 2 of these occurrences, involving the tugs *Andre H.* and *Charlene Hunt*.

In December 2013, the tug *Andre H.* was towing a barge and 2 service vessels—*I.V. No. 8*, *I.V. No. 9*, and *I.V. No. 10*—one behind the other. During the transit through the Gulf of St. Lawrence, the weather worsened and the couplers connecting *I.V. No. 9* to the stern of *I.V. No. 8* parted. *I.V. No. 9* and *I.V. No. 10* broke free and later went aground near L'Anse Pleureuse, Quebec. No injuries or pollution were reported. The investigation[51] found that

- the towing arrangement was inadequate for the environmental and operational conditions. The synthetic rope couplers employed in the towing arrangement were in a degraded condition, and they parted during the voyage; and
- the master underestimated the risk posed by the northeasterly winds forecast for the area and chose to continue the voyage.

In January 2013, the tug *Charlene Hunt* lost its tow off Cape Race, Newfoundland and Labrador, when the towing arrangement failed in heavy weather. The investigation[52] found that

- the available guidelines respecting the design and construction of towing arrangements were not followed;
- the towing arrangement was inadequate for the intended voyage; and
- the relief master did not adequately prepare to compensate for the environmental conditions that were encountered.

In that investigation, the TSB also found that TC had developed a draft policy on the inspections of tugs and tows bound for international voyages out of Canada. The policy provides TC inspectors with a framework to assess the tugs and tows, and specifies that TC would assess each towing operation to ensure compliance with sections 111 and 189 of the CSA 2001.

Another similar occurrence took place in British Columbia in November 2004, when the tug *Manson*, with a crew of 2, was towing the crane barge *McKenzie* and the deck barge *M.B.D. 32*. During the transit through the Strait of Georgia, British Columbia, the couplers connecting the *M.B.D. 32* to the stern of the *McKenzie* parted, and the *Manson* was unable to recover the *M.B.D. 32*. The *Manson* capsized and sank, with the loss of both crew members. The TSB investigation[53] found that

---

50 TSB marine investigation reports M13N0001 and M13L0185, as well as TSB marine occurrences M13M0291, M13M0118, M14C0227, and M16P0109.

51 TSB Marine Investigation Report M13L0185.

52 TSB Marine Investigation Report M13N0001.

53 TSB Marine Investigation Report M04W0235.

- the towing arrangement was inadequate; and
- the use of shorter, synthetic rope couplers instead of a longer all-wire arrangement, while towing in open waters, resulted in the parting of the couplers.

1.19 TSB Watchlist

The TSB Watchlist identifies the key safety issues that need to be addressed to make Canada's transportation system even safer.

Safety management and oversight is a Watchlist 2016 issue. As this occurrence demonstrates, some transportation companies are not managing their safety risks effectively, and many are not required to have formal safety management processes in place. Transport Canada oversight and intervention have not always been effective at changing companies' unsafe operating practices. The solution will require all operators in the marine industry to have formal safety management processes, with oversight by TC. When companies are unable to effectively manage safety, TC must not only intervene, but do so in a manner that succeeds in changing unsafe operating practices.

Safety management and oversight will remain on the TSB Watchlist until

- Transport Canada implements regulations requiring all commercial operators in the air and marine industries to have formal safety management processes and effectively oversees these processes;
- transportation companies that do have SMS demonstrate that it is working—that hazards are being identified and effective risk-mitigation measures are being implemented; and
- Transport Canada not only intervenes when companies are unable to manage safety effectively, but does so in a way that succeeds in changing unsafe operating practices.

2.0 Analysis

2.1 Factors leading to the grounding of the barges

The *H.M. Scout* departed Victoria with the *HM Tacoma* and *HM Blue Horizon* in tandem tow. The 2 barges were connected using short, degraded synthetic fibre ropes of different diameter, length, and material. The ropes were made fast to bitts that were not aligned properly for towing and were not equidistant from the *HM Tacoma*'s hull. The tow line between the tug and the first barge was also too short and did not provide catenary to dampen the effects of the dynamic motions between the tug and barge.

Gale- to storm-force southeasterly winds had been forecasted in the area of the occurrence since the early morning of 02 March, and the Trial Island weather station recorded sustained winds in excess of 30 knots for most of the afternoon. Additionally, the tidal current was flowing counter to the direction of the wind. The effect of the wind and countercurrent produced large, steep waves that the tug and tow encountered.

During the earlier inbound voyage to Ogden Point, the tug was towing just 1 smaller barge and the wind was on its stern, allowing it to make good speed. Because at that time the tug and tow were proceeding in the same general direction as the deteriorating sea conditions, the worsening conditions may not have been apparent to the crew. On the return voyage, however, the tug was towing a heavier load against the weather and was making slow progress through the water just before the occurrence.

Although the master and the owner had discussed the feasibility of the voyage and had made a casual assessment of the weather prior to departure, they did not use a formal method to assess the risks associated with this voyage. As a consequence, they did not appreciate the combined effect of the wind and waves on the 2 barges that were of a different size, deadweight, draft, and freeboard, nor did they identify the inadequacies in the towing equipment that allowed the *HM Blue Horizon* to break free and drift away.

Further, without emergency procedures for loss of tow, the master pursued and attempted to recover the *HM Blue Horizon* with the *HM Tacoma* still in tow without full consideration of the risks this might entail (for example, girding, capsizing, grounding). Because there was no emergency towing equipment on board, the deckhand devised a makeshift emergency towing arrangement that was insufficient for the recovery operation. Additionally, the efforts to recover the tow placed the deckhand at risk: he had to climb between the tug and barge in rough seas to fasten both parts of the towing arrangement, and he had to go out on the tug's open deck where the *HM Tacoma*'s wire tow rope was located. Without a contingency plan to guide the crew's actions, they made ad hoc decisions and placed themselves at risk in attempting to recover the *HM Blue Horizon*.

The parted towing rope fouled the tug's propeller, causing the engine to overheat. With reduced propulsion and the *HM Tacoma* in tow, the tug was pushed toward the shore at Finlayson Point by the sea conditions. Thirty minutes later, the *HM Tacoma* grounded. The

partially disabled *H.M. Scout* aborted the tow to avoid grounding as well, and returned to Victoria leaving both barges aground.

During this time, the master updated the owner[54] regularly, yet neither of the 2 owners nor the master informed MCTS of the developing situation. Informing MCTS at an early stage would have allowed the Canadian Coast Guard to deploy resources for assistance.

2.2 *Adequacy of the towing arrangement*

Vessels experience a variety of motions that include pitching, rolling, yawing, surging, heaving, and swaying while under way at sea. These dynamic motions are more pronounced in severe wind or waves of changing height and frequency. In towing operations, each vessel experiences these motions independently of the other(s), causing complex tensile forces on the towing gear, in addition to the existing tension from towing. Dynamic forces can be extreme and can cause tow line failure, even if the average tension for towing is within acceptable limits at the beginning of the voyage.[55] To ensure a safe passage, the gear used to connect a tug with its tow needs to be strong, yet flexible enough to withstand the forces likely to be encountered during a voyage.

In this occurrence, there were a number of issues with the towing arrangements that compromised the safety of the towing operation:

- Short, 3-strand synthetic fibre ropes (copolymer and polypropylene) were used.
- The synthetic fibre ropes were in poor condition.
- The towing bitts on the *HM Tacoma* were fitted dissimilarly, making it difficult for the crew to ensure that the ropes were of equal length and therefore that the load was distributed equally.
- The length of the tow wire between the tug and the *HM Tacoma* did not allow for sufficient catenary.
- The ropes between the barges did not allow for sufficient catenary.
- The tug's bollard pull had not been established, nor had the towing force of the barges been calculated to assess whether the tug and tow could safely complete the voyage in the forecasted weather conditions.

The towing arrangement was determined by the owner, who held no formal marine certifications and had not referred to industry guidance for towing operators. Although the arrangement may have been adequate for navigating the short voyage from the ferry terminal in Victoria's inner harbour to Ogden Point in sheltered waters, there was no consideration given to changing the towing arrangement based on the environmental conditions and sea states that the tug and tow might encounter on the voyage to Bamberton, nor were there company procedures requiring this to be done. Without an overall assessment

---

54 The owner who predominantly acts as the operations person.

55 George H. Livingstone and Grant H. Livingstone, *Tug Use Offshore in Bays and Rivers: The Towmaster's Manual* (London: The Nautical Institute, 2006), p. 31.

of the adequacy of the towing arrangement for the forecasted voyage conditions, an inadequate towing arrangement was used. If towing vessel owners and operators do not implement procedures and do not adopt standards to ensure the adequacy of their towing arrangement and the condition of their towing equipment, there is an increased risk of the towing equipment failing, resulting in the loss of tow.

Since 2013, the TSB has identified at least 6 other occurrences where the adequacy of towing arrangements has been a factor. Specifically, the investigations determined that the towing arrangements were inadequate for the environmental and operational conditions encountered, and that the towing arrangements used components that were in a degraded condition.

If TC does not provide easily understandable standards and guidance to assist towing vessel owners and operators to ensure the adequacy of their towing arrangement and the condition of their towing equipment, including the selection of tow ropes, there is an increased risk of the towing equipment failing, resulting in the loss of tow.

2.3 Managing risk in towing operations

Towing operations are subject to unique risks that must be managed effectively to ensure the safety of the vessel, the crew, and the environment. To assist in managing risk, it is the company's responsibility to develop safe operating procedures, establish emergency procedures, and provide the crew with the guidance necessary to assess each specific towing operation for risk. As industry guidance recommends, this assessment should consider the actual tow arrangement, towed objects, route, and season.[56]

In this occurrence, the company had not developed any documented procedures or guidance for its marine operations, which left the crew without the benefit of

- procedures, standards, and/or checklists to assess the adequacy of the towing arrangement for the voyage. This may cover items such as required catenary, the type or condition of tow wire, the rope securing arrangements, the tug–tow match, an evaluation of the effects of windage and water resistance on a tandem tow, etc.;
- emergency procedures and a contingency plan to follow in the event of a loss of tow or loss of engine propulsion situation. This may include items such as an emergency contact list and the procedure for notifying rescue services in the event of an emergency;
- emergency equipment and a contingency plan, including guidance or checklists for signalling distress;
- a means to assist masters in the decision-making process for routine and extraordinary circumstances, as well as a master's responsibility and authority statement, which provides the master with the authority to take the measures necessary to ensure the safety of the crew and the vessel; and

---

56 Det Norske Veritas, DNV-OS-H202, Sea Transport Operations (VMO Standard – Part 2-2) (October 2015), Section 4.2.2.

- a process for documenting the working history of the components, such as the ropes, that were employed in the towing arrangement.

While the owner and master had informally considered the potential effects of the weather and current on the tug and tow for the occurrence voyage, a more systematic approach to risk management might have helped them obtain a better understanding of the risks. A systematic approach would involve identifying, analyzing, and correlating the combined effects of the operating environment, the condition of the towing arrangement, the availability of rescue services, and the potential consequences of an accident. At this point, risk elimination or mitigation strategies, such as delaying departure until the weather improved, changing the towing arrangement, or towing a single barge, could be employed.

One method for assessing and managing risk in marine operations is a safety management system (SMS). Although widely recognized as being effective for risk management, SMS are not required on all vessels. Tug and barge operations are currently not required to operate under SMS despite the fact that the combined size and tonnage of the vessels may be similar to that of a conventional cargo-carrying vessel, and the risks associated with such an operation can be greater given the complexities of connecting and operating the tug–barge combinations. In this occurrence, an SMS may have been useful to help the company identify and manage risks present in their marine operations.

If a comprehensive risk assessment of a towing operation is not carried out, there is a risk that hazards that endanger the tug and tow, the crew, and the environment may go unidentified.

2.4 Minimum safe manning

A minimum safe manning document is based on a TC evaluation of the vessel that determines the vessel's crewing requirements, including the minimum required complement and competency requirements for each crew member. The determination of the minimum complement of a vessel is based on the requirements of the MPR. Inspected vessels with a GT of more than 15 are required to comply with a minimum safe manning document.[57]

In contrast, tugs less than 15 GT are not inspected, nor are they required to have a minimum safe manning document. Instead, TC leaves the authorized representative to determine how many additional crew are needed on board to operate the vessel safely and deal with an emergency. However, existing guidance on minimum manning is cumbersome and difficult to follow for operators with limited knowledge of the MPR and limited resources at their disposal. In this occurrence, the MPR required the *H.M. Scout* to have a minimum of 2 people aboard, and it was the practice for the tug and tow to be operated with a crew of 2: the master and a deckhand.

---

57 Transport Canada, SOR/2007-115, *Marine Personnel Regulations* (last amended on 03 February 2017), Part 2: Crewing, paragraph 202.3(b).

For the occurrence voyage, there was no indication that the company had done an assessment to determine if more than the minimum number of crew members was required for the operation involving a tandem tow in severe weather conditions. This meant that the tug and tow departed with the usual complement of 2.

During the recovery attempt of the *HM Blue Horizon,* the deckhand left the tug and boarded the barge in darkness, alone, and in rough weather conditions to attach the couplers to the barge. Meanwhile, the master was alone on the tug while manoeuvring in rough sea conditions in close proximity to land, as well as tending to the mooring wire of the *HM Tacoma,* which was still under tow. In the event that something had gone wrong on either the tug or the barge, neither crew member was in a position to quickly assist the other. Also, there was no consideration given to work and rest hours to ensure compliance with the MPR. In the event that the tug and tow had been able to continue the estimated 10-hour return voyage to Bamberton, the total time in operation since commencing work in Bamberton that morning would have been approximately 22 hours, and they would have required additional certificated crew.

TC leaves the safe manning of tugs less than 15 GT to authorized representatives without providing clear guidance about how to determine the number of crew required. As a result, circumstances may arise where the minimum crew are not able to effectively manage a developing emergency, especially when complicating factors emerge, such as adverse weather. Further, there is a possibility that commercial factors or other operational considerations override concerns about safety, resulting in situations where vessels are operating with an insufficient number of crew.

In the absence of safe manning requirements presented in a simple, clear, and practicable format for end users, especially those who operate vessels that are not routinely inspected, there is a risk that vessels will proceed to sea with an inadequate number of crew on board.

2.5 Regulatory oversight

Owners and operators of small commercial vessels in domestic waters are subject to regulations from different government regulators. While each regulator encourages operators to be proactive in complying with regulations, regulators must also intervene periodically to ensure that vessel owners and operators comply with the safety-critical regulations concerning their respective fields. Although TC and WorkSafeBC both regulate marine vessel operations for their respective areas of jurisdiction, neither has an inspection program in place to check that owners and operators of tugs less than 15 GT are complying with safety-critical regulations.

In this occurrence, there were a number of shortcomings with respect to the company's adherence to regulatory requirements. For example:

- The company had not provided written safe operating procedures as required by the CSA 2001.
- The *C07567BC* was being operated despite its registration being suspended.

- The owner operating the *C07567BC* did not hold the required operating certificate for this type of vessel.
- The pyrotechnics on the *H.M. Scout* were past their expiry date.
- The fire extinguishers on the *HM Tacoma* were in poor condition, with overdue inspection stamps.
- There was a portable ladder at the back side of the wheelhouse secured in a manner that may have impeded the life raft from floating free in an emergency.

If tugs with a GT of less than 15 are not subject to adequate regulatory oversight to ensure compliance with regulations, there is a risk that shortcomings in operations will go unresolved.

2.6 Practical training for towing masters

The investigation determined that the on-board training regimen for a Master, Limited for a Vessel of Less than 60 GT certificate does not provide any structure for the content to be covered during a candidate's 2 months of required sea time. Although candidates must also pass a written and practical exam, the lack of structure for the 2 months of sea time means that the tasks involved in practical training could differ significantly from one candidate to another, and that some candidates may get only a minimal amount of practical experience in certain tasks, such as towing.

Recognizing the risks associated with unstructured practical training, the UK established the Tug Training Record Book and Apprenticeships Scheme, whereby candidates must complete specific tasks before being issued a tugboat certificate. TC has also recognized that this gap exists in the current training regimen and is in the process of developing a similar training regimen.

If the training regimen for marine personnel does not require candidates to obtain specific practical experience in the operations permitted by the certificate, and does not verify that candidates have gained this knowledge, there is a risk that certificate holders will be limited in their knowledge and ability to safely carry out these operations.

3.0 Findings

3.1 Findings as to causes and contributing factors

1. The master and owner, operating without procedures or a systematic assessment of the risks, unintentionally made decisions that contributed to the barges going aground.

2. The overall adequacy of the towing arrangement had not been assessed in the context of the voyage conditions and an inadequate towing arrangement was used.

3. The tug and tow encountered the forecasted gale-force winds and rough sea conditions, and the combined forces of these movements caused the ropes between the barges to part; the *HM Blue Horizon* drifted free and went aground.

4. There was no contingency plan to guide the crew, so they made ad hoc decisions and placed themselves at risk in the attempt to recover the *HM Blue Horizon*.

5. During the recovery attempt, a rope fouled the tug's propeller and partially disabled the vessel; the tug and *HM Tacoma* drifted toward the shoreline and the barge grounded.

6. The master requested assistance from Marine Communications and Traffic Services when the tug was at risk of grounding, but the timing of this request prevented resources from possibly being able to assist.

7. The partially disabled *H.M. Scout* aborted the tow of the grounded *HM Tacoma* in order to avoid grounding.

3.2 Findings as to risk

1. If towing vessel owners and operators do not implement procedures and do not adopt standards to ensure the adequacy of their towing arrangement and the condition of their towing equipment, there is an increased risk of the towing equipment failing, resulting in the loss of tow.

2. If TC does not provide easily understandable standards and guidance to assist towing vessel owners and operators to ensure the adequacy of their towing arrangement and the condition of their towing equipment, including the selection of tow ropes, there is an increased risk of the towing equipment failing, resulting in the loss of tow.

3. If a comprehensive risk assessment of a towing operation is not carried out, there is a risk that hazards that endanger the tug and tow, the crew, and the environment may go unidentified.

4. In the absence of safe manning requirements presented in a simple, clear, and practicable format for end users, especially those who operate vessels that are not routinely inspected, there is a risk that vessels will proceed to sea with an inadequate number of crew on board.

5. If tugs with a gross tonnage of less than 15 are not subject to adequate regulatory oversight to ensure compliance with regulations, there is a risk that shortcomings in operations will go unresolved.

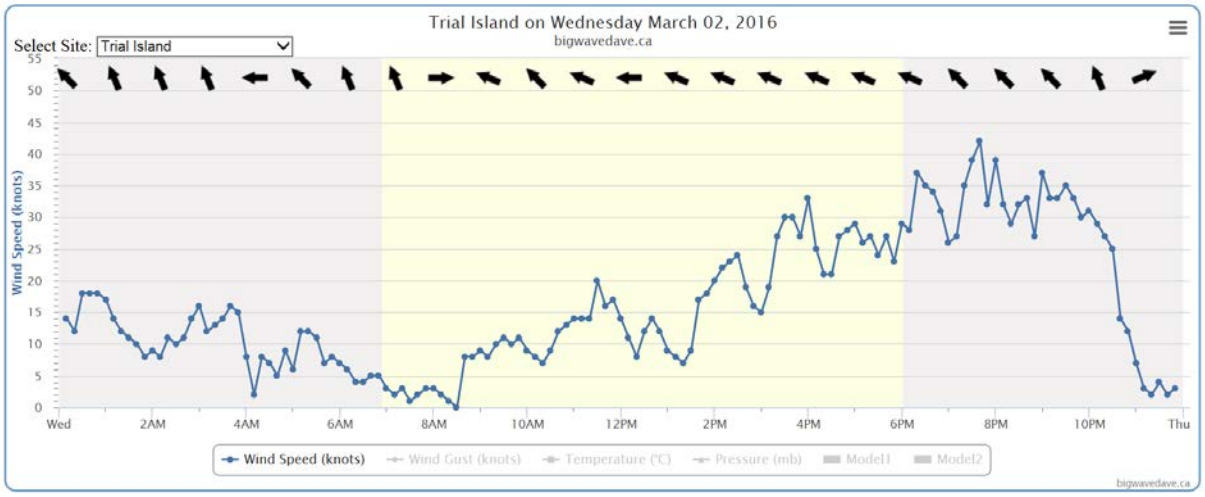
6. If the training regimen for marine personnel does not require candidates to obtain specific practical experience in the operations permitted by the certificate, and does not verify that the candidates have gained this knowledge, there is a risk that certificate holders will be limited in their knowledge and ability to safely carry out these operations.

This report concludes the Transportation Safety Board's investigation into this occurrence. The Board authorized the release of this report on 29 March 2017. It was officially released on 10 May 2017.

Visit the Transportation Safety Board's website (www.tsb.gc.ca) for information about the TSB 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.

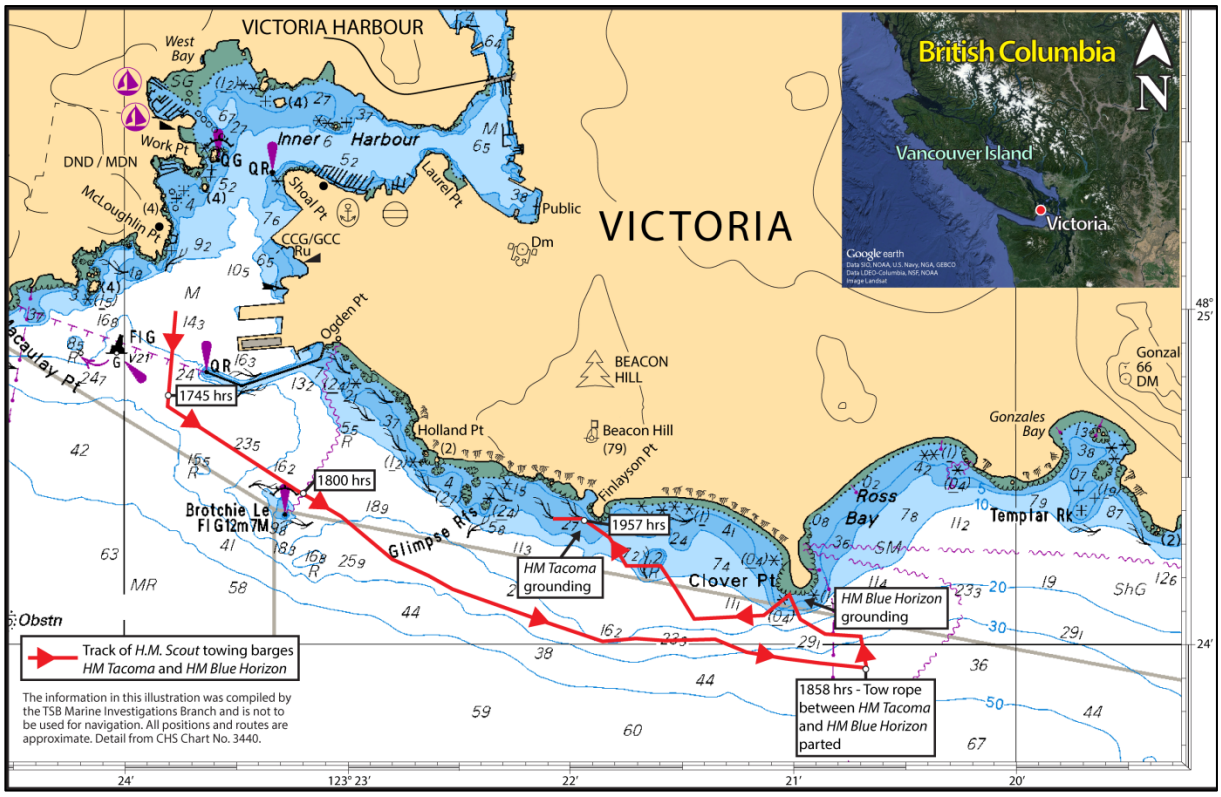
Appendices

Appendix A – Recorded wind speeds on 02 March 2016

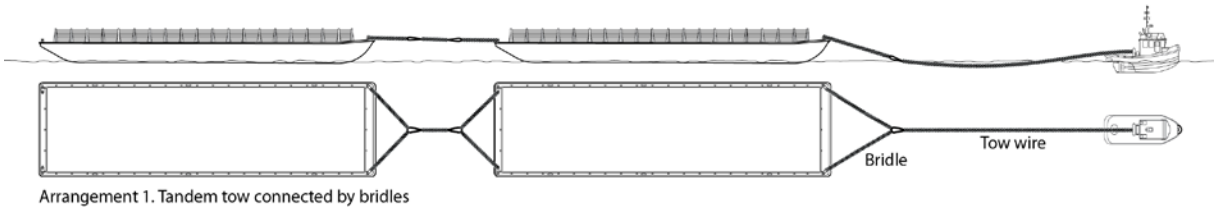


Source: Screen capture from Bigwavedave.ca, Latest Reports, Trial Island on Wednesday 02 March 2016, available at http://www.bigwavedave.ca/latest.php?site=31 (last accessed on 19 September 2016).
Note: The lighter (yellow) shading indicates daylight hours.

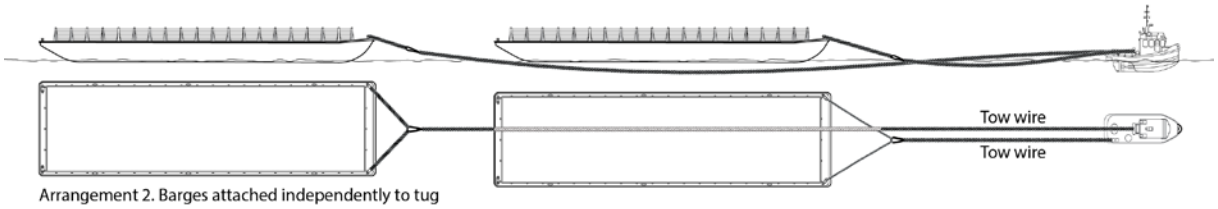
Appendix B – Area of the occurrence



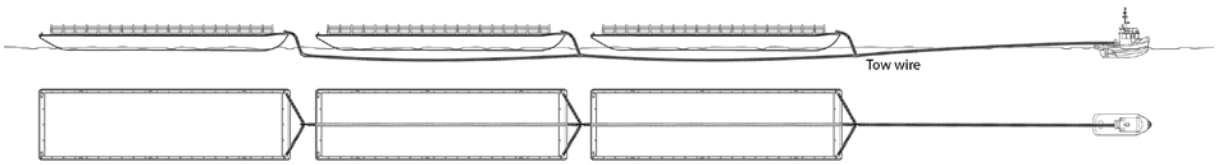
Appendix C – Arrangements for towing multiple barges



Arrangement 1. Tandem tow connected by bridles



Arrangement 2. Barges attached independently to tug



Arrangement 3. Barges connected to an under-rider tow wire

Appendix D – Recovered rope pieces

Recovered 48 mm copolymer and 36 mm polypropylene rope pieces used for testing

48 mm copolymer rope found on the *HM Tacoma*

Deformed eye splice on 48-mm rope and knot in 36-mm rope

Parted 48 mm copolymer rope with frayed end on the *HM Tacoma*