Transportation Safety Board of Canada

Bureau de la sécurité des transports du Canada

MARINE INVESTIGATION REPORT
M06M0110

CAPSIZING

BARGE *OTM* 3072
OFF BAS-CARAQUET, NEW BRUNSWICK
29 OCTOBER 2006

Canada

Marine Investigation Report

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Report Number M06M0110

Summary

On 29 October 2006, at approximately 0045 eastern standard time, the barge *OTM 3072*, carrying a cargo of bulk wood chips, capsized while under tow by the tug *Ocean Foxtrot* in a strong gale about six nautical miles north of Bas-Caraquet, New Brunswick. There was no injury, but the barge was declared a constructive total loss.

Ce rapport est également disponible en français.

Other Factual Information

Particulars of the Vessels

Name	*Ocean Foxtrot*	*OTM 3072*
Official Number	343013	820539
Port of Registry	Québec, Quebec	Québec, Quebec
Flag	Canada	Canada
Type	Supply vessel – tugboat	Barge
Gross Tonnage	699.9	2706
Length[1]	52.12 m	90.07 m
Breadth	11.80 m	21.95 m
Depth	3.63 m	5.94 m
Draught (departure)	Forward: n/a Aft: n/a	Forward: 4.53 m Aft: 5.11 m
Built	Selby, England, 1971	Madisonville, Louisiana, United States, 1972
Propulsion	Two 3864 kW diesel engines with two propellers each	None
Cargo	None	Wood chips in bulk
Crew	8	None
Owner	Océan Remorquage Trois-Rivières, Inc.	Groupe Océan, Inc.[2]
Managing Owner	Océan Navigation, Inc.	Océan Navigation, Inc.

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

2 Groupe Océan, Inc. is the owner of the *OTM 3072* and also a holding company grouping together companies managed independently, comprising Océan Remorquage Trois-Rivières, Inc. and Océan Navigation, Inc. In this document, the term “parent company” designates Groupe Océan, Inc.

Description of the Vessel

The barge *OTM 3072* was made of steel. The hull was subdivided by three longitudinal bulkheads and six transverse bulkheads into 26 watertight compartments[3] (see Appendix A). Uprights and wire mesh form a 12.19 m-high enclosure around the outside of the deck to contain dry bulk cargo.

Photo 1. The barge *OTM 3072* loaded with wood chips and being towed by the tug *Ocean Foxtrot* in December 2005 (source: Kruger Inc.)

History of the Voyage

On 19 October 2006, the tug *Ocean Foxtrot* sailed from Cacouna, Quebec, for Sheet Harbour, Nova Scotia, with eight crew members on board and the empty barge *OTM 3072* in tow.

On October 25, when the two vessels arrived in Sheet Harbour, a private marine surveyor conducted a draught survey of the barge for chartering purposes. The master of the *Ocean Foxtrot* left the first mate and a supernumerary mate in training to supervise the loading. No stability calculations for the barge load were carried out before or after loading. The draughts were measured a second time once loading was completed, and it was determined that 5563 tonnes of bulk wood chips had been loaded on deck (see Figure 2).

On October 26 at 0240,[4] the tug and barge sailed from Sheet Harbour, bound for Cap-de-la-Madeleine, Quebec. Because of the time of year and to avoid forecast high waves and strong winds in Cabot Strait and Northumberland Strait, the master chose a route across the Strait of Canso (see Appendix B). The tug and barge arrived safely at Mulgrave, Nova Scotia, and were secured overnight.

On October 27 at approximately 1030, the tug and barge sailed from Mulgrave into northwesterly headwinds of 20 to 25 knots and waves of approximately 2 m. Because the barge was towing well and the weather was forecast to improve, the master decided to continue on a course to the north of Prince Edward Island.

The next day, October 28, the tug and barge received a new weather forecast predicting southeasterly winds varying from moderate to storm force. The tug and tow then altered course to seek shelter behind Miscou Island, New Brunswick. At approximately 1850, the vessels were

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3 The watertight compartments were designed to remain empty at all times and had no ballast tank system or ventilation.

4 All times are eastern standard time (Coordinated Universal Time minus five hours).

about seven miles north of Bas-Caraquet, New Brunswick (see Figure 1, position A). In order to manoeuvre within an area off Bas-Caraquet (see the circle in Figure 1), the crew found it helpful to alternate between heading into the wind and then running with it.

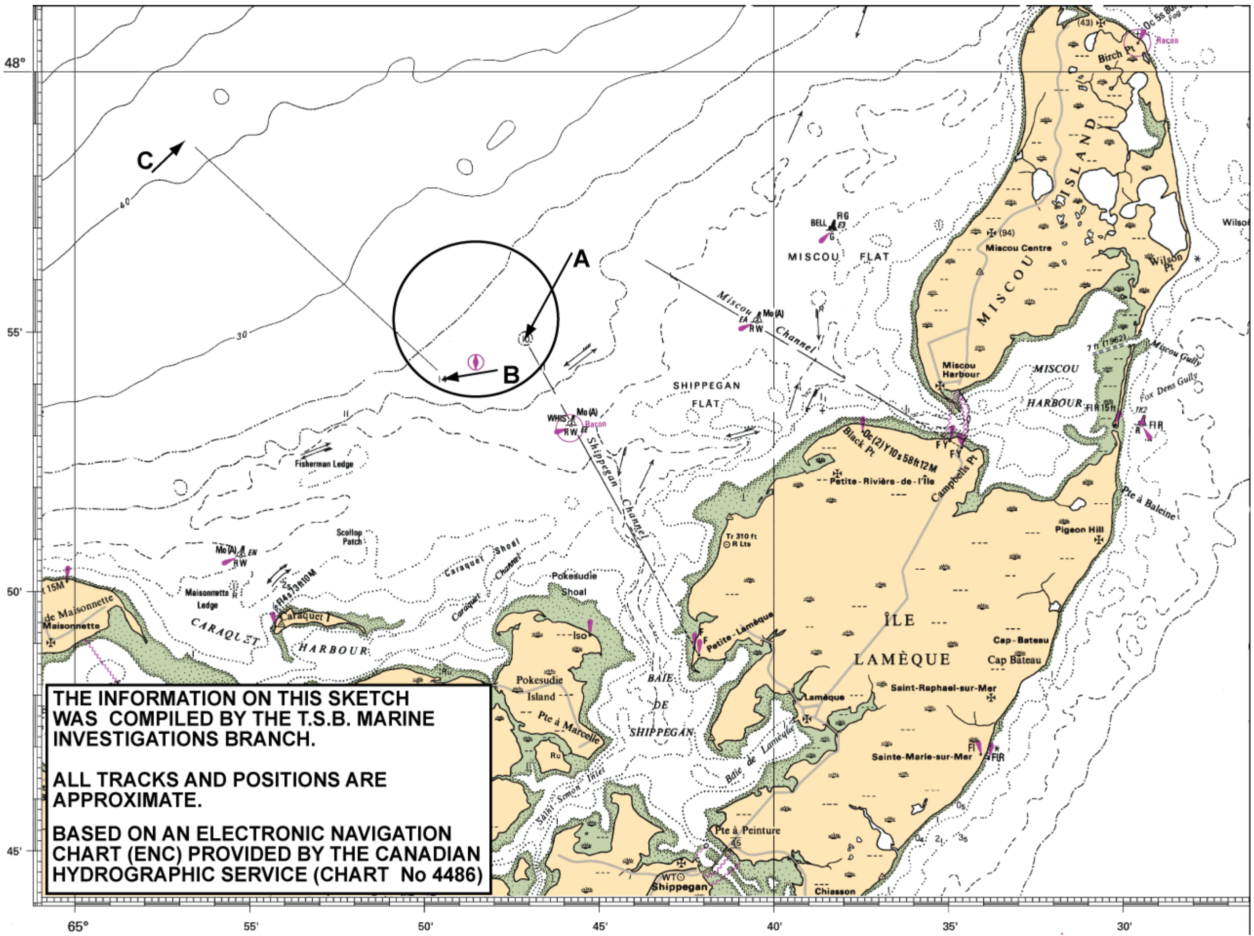

Figure 1. Map of the occurrence area

At the start of the manoeuvre, the winds were southeasterly with gusts up to 28 knots. During the evening, the weather conditions worsened; the steady winds increased to 24 knots with gusts up to 50 knots. At reduced speed, the tug was rolling and pitching in 1 to 2 m seas. Heavy rain was scrambling the barge's echo on the radar to the point where the crew had difficulty monitoring the barge.[5]

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5 Mentioned wind speeds were measured on the tug by the crew. The weather observations taken by Environment Canada land stations, located in the area of operation of the tug, showed that 12 mm of rain fell in the hours preceding the capsizing, with easterly winds gusting to 41 knots.

At midnight on October 28, the master handed the watch over to the first mate. The navigation lights on the barge were visible, and the tow was under control. At 0040 on October 29, at 47º53.99' N, 064º49.43' W (see Figure 1, position B), the tug swung to port to head northeast. At 0045, the first mate noted that the tug and barge were becoming increasingly difficult to handle and the barge's navigation lights were no longer visible.

At about 0100, the first mate informed the master of this situation, adding that both vessels were drifting. At daybreak (approximately 0400), when the tug was at position 47°58.5' N, 064°57.4' W (see Figure 1, position C), the crew discovered that the barge had capsized and the towline was still attached to it. At 1015, after consulting with the managing owner on shore, the tug towed the capsized barge to Gaspé, Quebec, where both vessels arrived at about 2000 on 30 October 2006. The barge remained anchored and capsized at that location until being righted in May 2007.

Load Details

The *OTM 3072* was loaded on 26 October 2006 at Sheet Harbour as follows (see Figure 2):

- wood chips were loaded to a maximum height of 13.72 m, for a total of 5563 tonnes;
- the port and starboard No. 5 outer compartments were partially filled and the port and starboard after peaks were completely filled, giving a total of 458 tonnes of ballast water;
- two power shovels used for unloading, weighing 47 and 49 tonnes respectively, were stowed on the cargo in the after part of the barge, more than 7 m above the deck;
- the mean draughts at the forward and aft marks were 4.53 m and 5.11 m, respectively.

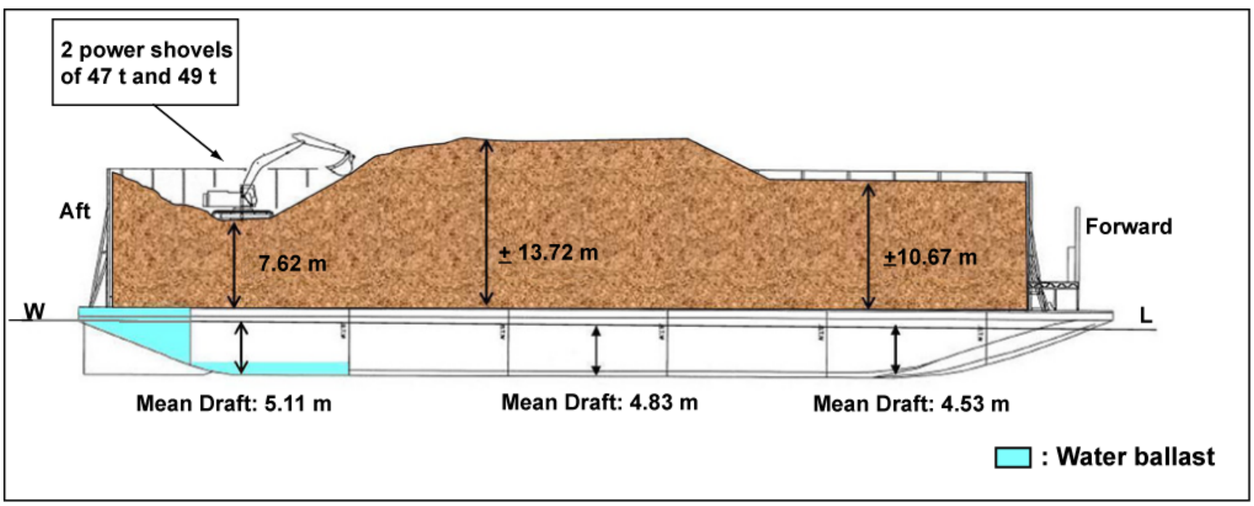

Figure 2. Loading plan on departure from Sheet Harbour

Damage to the Barge and the Environment

The two power shovels and cargo were lost when the barge capsized.

A post-occurrence underwater inspection found significant damage to the base of the reinforcing and support structure of the uprights around the deck. Afterward, the barge was declared a constructive total loss.

In May 2007, during operations to right the barge, cracks were observed on several welds on the bottom plates. Manhole covers on deck were found not fully tightened.

Certification and Crew Experience

Tug and Barge Certification

At the time of the occurrence, the *Ocean Foxtrot* had a valid inspection certificate, as a non-passenger ship, issued by Transport Canada (TC).

The *OTM 3072* was not subject to any TC inspection.

Crew Certification and Experience

The master held a master mariner certificate of competency and had 29 years of experience in towing activities, but only a few voyages with a load of wood chips.

The first mate held a watchkeeping mate certificate of competency. He had 8 years' experience in towing activities and had been sailing on the *Ocean Foxtrot* since 2004.

The supernumerary mate in training held a command endorsement for the watchkeeping mate certificate of competency. This was his first voyage on the *Ocean Foxtrot*. Before this, he served as captain on the *Ocean Echo II* with the barge *Betsiamites*.

Company Structure

The managing owner of the *Ocean Foxtrot* and *OTM 3072* is part of a holding company grouping together companies that offer the following complementary services on Canada's East Coast: towing, naval and industrial construction and repair, marine salvage, wreck salvage, underwater intervention, and dredging.

The parent company owns, maintains, and operates a fleet of 26 tugs and about 150 barges. Each subsidiary is responsible for hiring and training its crew and developing its own operating procedures.

At the time of the occurrence, the managing owner operated two tug/barge configurations to carry wood chips: the *Ocean Foxtrot* with the barge *OTM 3072*, and the *Ocean Echo II* with the barge *Betsiamites*.

Barge Modifications and Stability

After its construction in 1972, load lines were assigned to the barge by the classification society American Bureau of Shipping. In order to comply with United States stability standards,[6] a letter from the classification society, appended to the load line certificate, limited the height of the cargo's centre of gravity, depending on the draught,[7] as set out in the following table:

Draught	Maximum Height of the Centre of Gravity of the Cargo Above the Deck
From 4.572 to 4.667 m (15 feet to 15 feet 3 ¾ inches)	2.286 m (7 feet 6 inches)
From 4.496 to 4.572 m (14 feet 9 inches to 15 feet)	2.591 m (8 feet 6 inches)
Less than 4.496 m (14 feet 9 inches)	2.896 m (9 feet 6 inches)

In 1998, the managing owner acquired the *OTM 3072* in the United States and registered it in Canada on 18 October 1999. Over the next few years, the barge was contracted to carry logs. In 2003, 7.62 m uprights were added around the outside of the deck to retain cargo. The amount of cargo carried was then gradually increased over a period of several years without the assistance of a loading manual or stability booklet.

Following the addition of the uprights, ballast water was added to lower the centre of gravity and improve the barge's trim and stability. The barge, however, was not equipped with a ballast system. Ballasting of the compartments was done using a portable pump that was moved from compartment to compartment around the edge of the barge, outside the uprights. The Nos. 4 and 5 outer watertight compartments and the aft port and starboard peaks thus became ballast tanks.[8]

In the summer of 2005, a new contract to transport 17 500 m^3 of wood chips was obtained and the *OTM 3072* was further modified. Plans and summary stability calculations to increase the height of the uprights—to 12.19 m—were first done by the managing owner's technical department. These calculations made it possible to establish the approximate value of the initial metacentric height above the keel (KM), the height of the barge's centre of gravity above the keel (KG), and the metacentric height (GM), which gave an indication of the stability in the upright condition only, but no indication of the stability at large angles of heel.

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6 *Code of Federal Regulations*, 46CFR Ch. I – Part 174—Special Rules Pertaining to Specific Vessel Types—Section 174.015, Intact Stability

7 At the time of the occurrence, the mid-barge mean draught was 4.83 m, and the height of the centre of gravity cargo above the deck was 5.69 m.

8 By early 2006, adding ballast water to these tanks had become a standard procedure. Although the watertight compartments were designed to remain empty, the crew considered that adding ballast was essential to improving stability.

The managing owner then gave a consulting naval architect the data on the barge's characteristics and the planned structural modifications so that the naval architect could do more detailed stability calculations for fully loaded conditions—estimated at 5950 tonnes of cargo. Without waiting for a response, however, the company modified the barge according to the summary plans and calculations.

The naval architect's calculations were based on an estimate of the weight of the structural modifications. Moreover, because no internal inspection of the compartments had been done, the calculations were also based on a summary verification of the lightship displacement. The results of these calculations showed that the barge's stability was below the criteria specified in STAB 8.[9]

This standard, however, did not apply to the *OTM 3072*;[10] the naval architect therefore sent a letter to the managing owner to inform that the standard could only serve as a guide for assessing vessel stability. Similarly, the naval architect issued an opinion that the barge's stability was sufficient for "average" weather,[11] with the final decision to sail up to the master, who was urged to consider the following points:

1. weather conditions, particularly wind, waves and spray (which can wet cargo and reduce stability), and the effect of specific wind strengths on list;
2. the need to keep watertight compartments dry;
3. the loaded vessel will need to be even keel and without list;
4. a minimum freeboard of 1.3 m will need to be maintained; and
5. the vessel should never heel more than 5°—the point at which water would flow onto the deck and rapidly decrease stability. (In such a case, the master would have to find a "point of sailing" that minimizes heel, and seek out a port of refuge.)

The naval architect's calculations—which were based on preliminary data—showed that the area under the GZ curve was 0.05 metre-radians, which is about 62 per cent of the area required by STAB 8. However, a post-occurrence examination by the TSB revealed that the area under the GZ curve was 0.02 metre-radians, which is about 25 per cent of the area required by the standard.

The fall of 2005 was a test period for the barge's new operations. During this period, the managing owner realized that the barge had a smaller cargo capacity than planned.

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[9] Interim Standard for the Intact Stability of Unmanned Barges, from the TC publication *Stability, Subdivision and Load Line Standards* (TP 7301)

[10] The barge had been built before 01 September 1977 and did not carry oil; therefore, the assignment of load lines was not mandatory in Canada.

[11] The naval architect provided no clarification as to the meaning of this term.

A copy of the naval architect's letter was given to the master of the *Ocean Foxtrot* only after the first voyage under the new contract, which was made from 20 to 22 October 2005. On 27 October 2005, in a memorandum addressed to the managing owner's operations supervisor, the master expressed doubts as to the accuracy of the data given to the naval architect. The master suggested providing the naval architect with more precise data because, in his experience, stability was likely being affected by this inaccuracy and the barge was already operating at the limits of its capacity.

The managing owner did not act on the master's memorandum, the naval architect was not informed that calculations might have to be revised, and no stability booklet or loading instructions were given to the master. In addition, the naval architect's recommendations regarding the operational limitations were not followed, particularly those concerning the ballast, list, trim, and freeboard.

Following this occurrence, the TSB assessed the barge's stability from its arrival at Sheet Harbour on 25 October 2006 until capsizing on 29 October 2006.[12] The loading condition upon departing Sheet Harbour was found to be as follows:

- the wood chips weighed 5902 tonnes (not 5563 tonnes);
- the No. 5 compartments and the after peaks contained 513 tonnes of ballast water (not 458 tonnes);
- a "constant" of 356 tonnes, representing all unidentifiable weights, had to be considered in order to comply with the most recent lightship displacement, established in October 2005; and
- the load distribution was such that the barge had a trim by the stern of 0.57 m and a list to port of more than 2°; the effect of the trim and list reduced the freeboard, in particular on the port quarter, to 0.28 m.

Barge Stability Calculations

Each master was free to load the barge as he felt was best, though the managing owner sought to maximize loading per voyage and closely monitored the amount of cargo carried.

In 2003, the master in charge of the *OTM 3072* undertook to increase the amount of cargo carried. With no stability data other than a deadweight scale, he prepared a calculation sheet to help determine the approximate GM. The result, approximately 2 m, reassured him of the barge's stability. The GM value was the only stability assessment that this master made until he left the company in 2006.

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12 The TSB stability report is available upon request.

In June 2006, his replacement, who was uncomfortable with stability calculations, asked for assistance with this task. Using the basic information available for the barge—which was the deadweight scale, volume and centre of gravity of each of the compartments, and an estimated block coefficient—a customized electronic spreadsheet was created by the managing owner for this second master.[13] The electronic spreadsheet's accuracy was not verified by a naval architect, classification society, or by TC.

For the voyage departing 26 October 2006, a third master—who was aware of the electronic spreadsheet's limitations—chose not to use it to determine the barge's stability.

Safety Management System

It is generally recognized that the functional requirements of a good safety management system include:

- a safety and environmental-protection policy;
- instructions and procedures to ensure safe operation of ships and protection of the environment in compliance with relevant legislation;
- defined levels of authority and lines of communication between and among shore and shipboard personnel;
- procedures for reporting accidents and non-conformities;
- designation of a person or persons ashore to monitor the safety- and pollution-prevention aspects of the operation of each ship. Such a person would require direct access to the highest level of management;
- procedures to prepare for and respond to emergency situations; and
- procedures for internal audits and management reviews.

At the time of the occurrence, the parent company had obtained ISO 9001-2000 accreditation and had voluntarily begun complying with the ISM Code. However, that approach had not yet been adopted group-wide by subsidiary companies such as the managing owner of the tug and barge. As a result, the master was responsible for safety management on board the *Ocean Foxtrot*. There were no directives or procedures to guide shore-based and shipboard personnel.

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13 This spreadsheet ignored several factors, among them modifications to the waterplane caused by bodily sinkage and by water on deck. The spreadsheet also provided only an approximate GZ and had an uncertainty of 330 tonnes on the lightship displacement.

Prior Occurrences

Before this occurrence, the *OTM 3072* was involved in three occurrences of note.

In July 2005, the barge *OTM* 3072 struck the wharf in a mooring manoeuvre, damaging its starboard skeg. The barge continued operations, but the master noticed that it had a tendency to drift strongly to port. Although the master reported this to the managing owner, no repairs were made.

On 31 October 2005, the tug *Ocean Foxtrot,* towing the *OTM 3072*, caused two close-quarters situations in the same day. The TSB and TC attended. While on board, TSB investigators were able to observe the condition of the load and questioned the barge's stability. In January 2006, in a Marine Safety Information (MSI) letter, the TSB suggested that the managing owner undertake appropriate measures to ensure the barge's safety in terms of stability.[14]

The master of the *Ocean Foxtrot* was not immediately informed of TSB's MSI letter. It was not until 29 May 2006 that he became aware of it via TSB representatives. On 14 June 2006, in response to TSB's MSI letter, the master stated in a letter addressed to the managing owner that he would limit the height of the cargo to 12.19 m (the height of the wire mesh/uprights) and keep the barge's trim at the United States–assigned load lines.

Tug and Barge Working Group

In 2005, TC informed the TSB that a working group had been formed to examine tug/barge issues. This group presented its findings to the TC Marine Safety Executive Committee (MSE)[15] in 2005 and to the Canadian Marine Advisory Council (CMAC) in May 2006, noting in particular the following issues:

- certification of winches and towing equipment, and standardization of bollard pull ratings;
- construction standards for barges not covered by the Oil Barge Standards (TP 11960);
- operational practices for tug/barge combinations, including occupational health and safety standards;
- operational practices for tug/barge combinations in ice;
- safe crewing of tug/barge combinations; and
- lighting of push-mode tug/barge combinations under the *Collision Regulations*.

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[14] Marine Safety Information Letter 01/06

[15] The MSE is a forum to develop and implement TC Marine Safety's strategic direction, policies, and practices.

Statistics

According to the information gathered from TC and Statistics Canada, more than 1450 barges with a tonnage exceeding 100 are currently registered in Canada. These carry 30 to 40 million tonnes of cargo per year in Canada and the United States.

According to the TSB database, 21 capsizings involving barges have been reported since 1998.[16] The majority of these were due to:

- limited transverse stability, resulting in improper loading; or
- a loss of transverse stability in rough weather, downflooding of one or more of the watertight compartments, or improper cargo stowage.

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16 None of the reported 21 capsizing occurrences involved barges carrying oil as cargo.

Analysis

Barge Stability

Given the absence of accurate information on the lightship condition, possible water ingress in the watertight compartments, and the difficulty in determining the height of the cargo's centre of gravity, the TSB performed post-occurrence calculations to establish best- and worst-case stability scenarios.[17] The results, when compared against STAB 8 and International Maritime Organization (IMO)[18] standards, are presented in Table 1.

		Standards – STAB 8 and IMO Criteria	IMO Criteria
	Loading conditions	Area under the GZ Curve (percentage of minimum criteria of 0.08 metre-radians)	Range of Positive Stability (minimum 20°)
1.	At arrival at Sheet Harbour	1.22 metre-radians	More than 20°
2.	At departure with a pessimistic KG[19]	0.0049 metre-radians (6%)	10.5°
3.	At departure with a pessimistic KG, rain and spray	0.0028 metre-radians (4%)	10.2°
4.	At departure with an optimistic KG	0.015 metre-radians (19%)	12.5°
5.	At departure with an optimistic KG, rain and spray	0.0121 metre-radians (15%)	12.5°
6.	At departure with an optimistic KG, rain, spray and steady wind	0.0120 metre-radians (15%)	12.0°

Table 1. Transverse stability calculations from arrival at Sheet Harbour until capsizing

17 Both the TSB stability report and Table 1 refer to the scenarios as "optimistic" and "pessimistic."

18 International Maritime Organization, *Code on Intact Stability*, Second Edition, 2002, Section 4.7.3

19 KG: height of the centre of gravity above the keel

At the time the barge left Sheet Harbour on 26 October 2006, its stability was very limited. Before the weather was taken into consideration, the barge did not comply with the minimum (albeit non-mandatory) STAB 8 and IMO stability criteria. The weather then had the following effects:

- The cargo absorbed the rain and spray. This was probably intensified by the reduced freeboard and the list at departure from Sheet Harbour. This added an estimated 90 tonnes. It also would have increased the draught another 0.05 m, reduced the freeboard by the same amount, and slightly increased the KG.
- The steady wind caused the barge to heel another 0.5°, further reducing freeboard and submerging the port quarter of the deck shortly before capsizing.
- Wind-driven waves flooded the deck, increasing water absorption.

When the steady wind is taken into account (see Table 1, condition 6), stability decreases further, even with an optimistic KG. In a worst-case scenario, the righting arm is less than the heeling arm, causing the loss of all positive stability.

Gusting winds and increased wave action further contributed to the complete loss of positive stability. It is likely that the barge capsized when the wind was gusting at its strongest.

In short, the barge capsized when the range of stability, which was already low at departure from Sheet Harbour, was reduced in deteriorating weather conditions.

Stability Booklet

Good seamanship includes verifying a vessel's stability to determine, inter alia, how it will react to various external forces.

When the barge left Sheet Harbour, it did not have a stability booklet, nor was one required. Moreover, no stability calculation had been done by the crew—before or after loading—and the master did not have any loading instructions from the company. The crew loaded the *OTM 3072* based on past experience, even though doubts about the vessel's stability had earlier been expressed and the company had received a TSB safety communication to that effect. Consequently, when the barge left Sheet Harbour, the master did not have the necessary information to assess the barge's transverse stability.

Modifications to the Barge

Before a vessel is built or modified, the designer and owner determine the type of vessel desired, the main routes and ports that will be served, and the type of services to be provided. Once these have been established, the designer determines the main characteristics of the vessel, including the stability.[20]

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20 Adapted from *Ship Construction*, D.J. Eyres, 1972, reprint 1975, Chap. 1, page 4

Data submitted to the naval architect in 2005 were never verified; the resulting stability assessment was therefore not representative of the anticipated operations. Moreover, although the barge's lightship displacement was verified in the fall of 2005, this was done without an internal inspection of the compartments. Then, following modifications, the barge did not undergo an inclining experiment to determine the new lightship characteristics.

When the barge started operations again on 20 October 2005, the master and the managing owner were not aware of the fact that the range of stability was limited for the type of service to be provided. Therefore, despite preliminary calculations showing limited stability, no comprehensive study of its stability characteristics was done before the barge was modified.

Safety Management System

Sound safety management practices are essential to identify and reduce/eliminate the risks and dangers associated with a vessel's operation. These include a safety policy, appropriate procedures to safeguard the operation of the vessel, and training of personnel. Before the occurrence, the company's safety management policies, procedures, and practices were limited and, as a consequence, the company was unable to identify and reduce stability-related risks.

- The load lines assigned to the barge before it was put in service in the United States were not mandatory in Canada and were not used as operational limits essential to stability and safety.

- The amount of cargo loaded was increased on a trial-and-error basis, as opposed to a more systematic approach based on specific stability data.

- The high GM values, obtained in summary calculations, were interpreted as an indication of good stability, when they were merely an indication of stability in an upright condition, in contrast to stability at large angles of heel.

- The naval architect's recommendations regarding the operational limitations to maintain the barge's stability and buoyancy were ignored, particularly regarding the ballast, list, trim, and freeboard.

- There was no follow-up on the concerns of the crew of the *Ocean Foxtrot* regarding the accuracy of the data given to the naval architect in October 2005, and shore-based personnel took no corrective action.

- Shore-based personnel performed no control or monitoring to ensure the implementation of the naval architect's recommendations, and allowed the installation of a ballast system for compartments that were supposed to remain dry.

- The barge was modified without a detailed analysis of the impact on its stability. After the modification, no inclining experiment was done, which would have made it possible to establish the barge's lightship displacement and its KG.

- Although the TSB issued an MSI letter regarding the barge's stability, no corrective action was taken.

The organizational structure of the parent company encompasses several independently managed companies. Although not required, the parent company was in the process of implementing the ISM Code for some of its subsidiaries. However, the managing owner was not part of this process. Policies, procedures, and practices implemented through a safety management system increase the chances that stability-associated risks are identified, reduced, or eliminated.

In the absence of a systematic and integrated safety management system, it is likely that managing owners will not be able to identify all operational risks and take the appropriate corrective action.

Regulatory Framework

Carriage of cargo by barges represents a significant part of Canada's transportation industry, and there have been numerous occurrences involving this type of transport. However, with the exception of barges carrying oil in bulk, the operation of barges falls largely outside of the current regulatory framework.

Regulatory oversight, such as initial/regular inspection regime, could have made it possible to identify deficiencies such as:

- the height of the barge's uprights being increased twice without a complete stability analysis;
- ballast water being regularly added in the ballast tanks without a complete stability analysis;
- the damaged skeg not being repaired in a timely manner;
- the barge being regularly loaded such that the load line was submerged.

Although such a regime does not exist in Canada, United States regulations require that barges be inspected, meet minimum stability standards, show load lines, and hold a load line certificate.

TC has initiated a study of the tug and barge industry and has tasked a working group to examine this issue.[21] However, as long as this work is incomplete and a suitable regulatory framework has not been adopted—one that provides an equivalent level of safety as that afforded to conventional vessels—some managing owners may continue to operate barges beyond their structural and stability limits, thereby compromising the safety of this type of vessel.

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[21] The mandate of the Tug and Barge Working Group is to implement the recommendations of the TC Marine Safety Tug and Barge Working Group and examine the issues identified by the TC Marine Safety Executive Committee and by the tug and barge industry.

Findings as to Causes and Contributing Factors

1. The barge capsized when the range of stability, which was already low at departure from Sheet Harbour, was reduced in deteriorating weather.

2. The master did not have the necessary information to assess the barge's transverse stability.

3. Despite preliminary calculations showing limited stability, no comprehensive study of its stability characteristics was done before the barge was modified.

Findings as to Risk

1. In the absence of a systematic and integrated safety management system, it is likely that managing owners will not be able to identify all operational risks and take the appropriate corrective action.

2. As long as a suitable regulatory framework has not been adopted, some managing owners may continue to operate barges beyond their structural and stability limits.

Safety Action

Action Taken

Transport Canada

On 10 January 2006, the TSB sent Marine Safety Information letter 01/06 (Dangerous Navigation in Confined Waters on the St. Lawrence River with an Unsteady Cargo of Wood Chips on Board the Barge *OTM 3072*) to Groupe Océan, Inc. (the parent company), and copied Transport Canada (TC) and other stakeholders.

In response to this letter, TC included the following information, which was further addressed at the Canadian Marine Advisory Council (CMAC) conference in November 2007:

- definition of an integrated tug and barge combination;
- standards versus regulations for tug and barge combinations;
- inspection of barges whether or not they are carrying oil;
- assessment of bollard pull; and
- certification of barge masters and mates.

In addition, a special working group was tasked to initiate discussions based on the aforementioned points and to propose recommendations at the next CMAC conference, in May 2008. This working group comprises members from the industry, central labour bodies, the St. Lawrence Seaway, and TC. As of July 2008, no significant progress had been made, and these issues still await resolution.

With the entry into force of the *Canada Shipping Act, 2001*, new safety requirements have been introduced. Under Subsection 106(1) of the Act, authorized representatives must ensure that the vessel and its machinery and equipment meet the regulatory requirements. They must also develop procedures for the safe operation of their vessels, for dealing with emergencies, and for ensuring that the crew and passengers receive safety training. Additionally, Section 206 of the *Marine Personnel Regulations* requires that crew members receive on-the-job training and be familiarized with their operational roles and responsibilities.

To assist operators to comply with these new requirements, TC is in the process of developing a safety management system that is tailored to the specific needs of the Canadian domestic fleet and that will be known as a domestic safety management system. The guidelines for this system are currently under development and are being drafted in collaboration and consultation with TC regional service centres and industry. A draft domestic safety management system will be tested during a pilot project with the Council of Marine Carriers, an industry association in British Columbia, in which five towboat companies have volunteered to participate. The pilot project is anticipated to start in early 2009, and will run for a period of two years.

With the development of a domestic safety management system, TC will support the Canadian domestic fleet to strengthen its safety culture and meet the full intent of the *Canada Shipping Act, 2001*. A domestic safety management manual that is currently under development will eventually be made available to all operators, and will become an option they may pursue in order to comply with these new regulatory requirements.

Division 2, Subsection 108(3) of the new *Cargo, Fumigation and Tackle Regulations*, which came into force on 01 July 2007, states that the master of a vessel—where a barge is considered a vessel—is required to have comprehensive stability information on the effects of loading, carrying and unloading solid bulk cargo, or must comply with Regulation 7.2.1 of Chapter VI of the International Convention for the Safety of Life at Sea, 1974 (SOLAS), which requires a vessel to have a booklet that includes among other things, stability data.

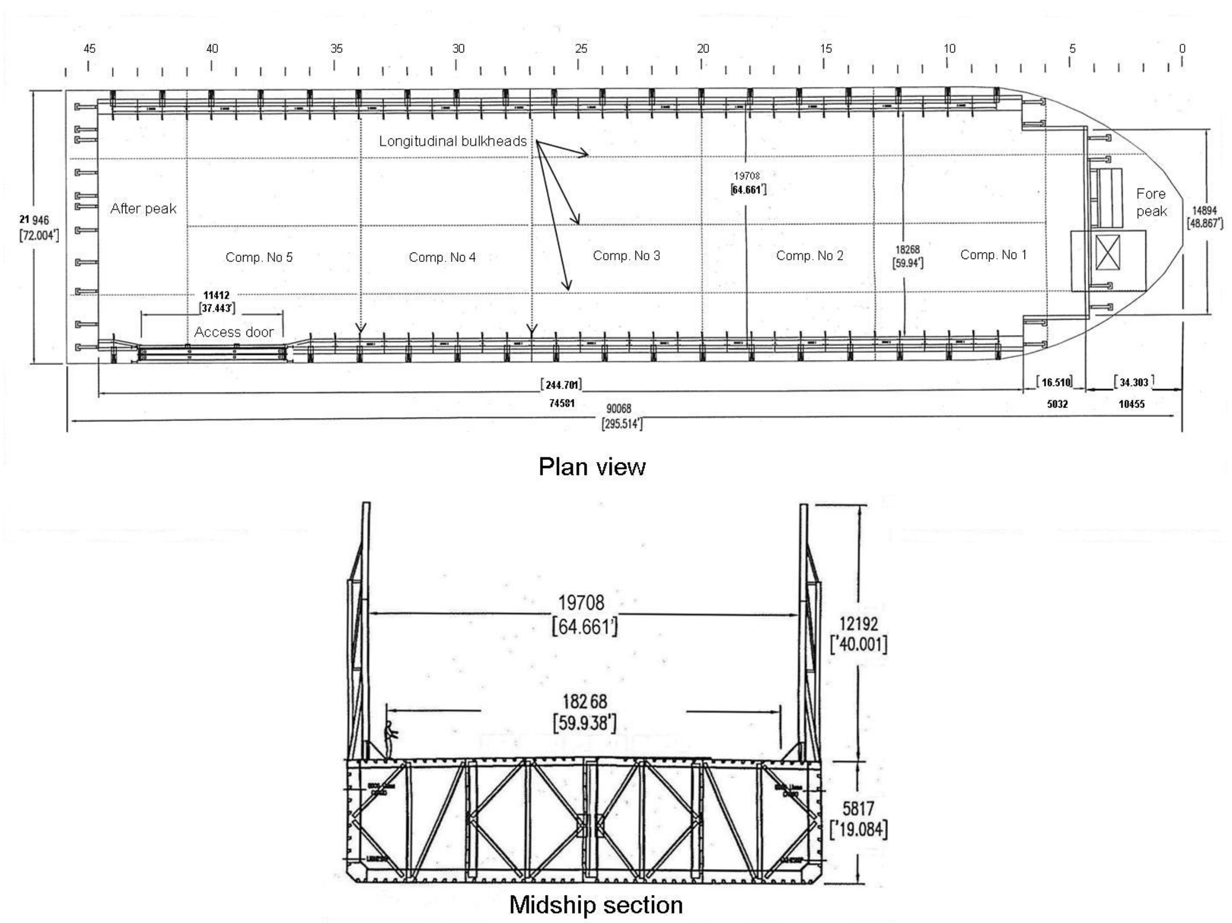
Parent Company

Since the occurrence, the parent company has obtained its document of compliance under the International Safety Management Code (ISM Code). Many tugs belonging to the parent company's different subsidiaries now have a safety management certificate. However, the managing owner of the tugs *Ocean Foxtrot* and *Ocean Echo II* does not have a document of compliance and these vessels do not have a safety management certificate.

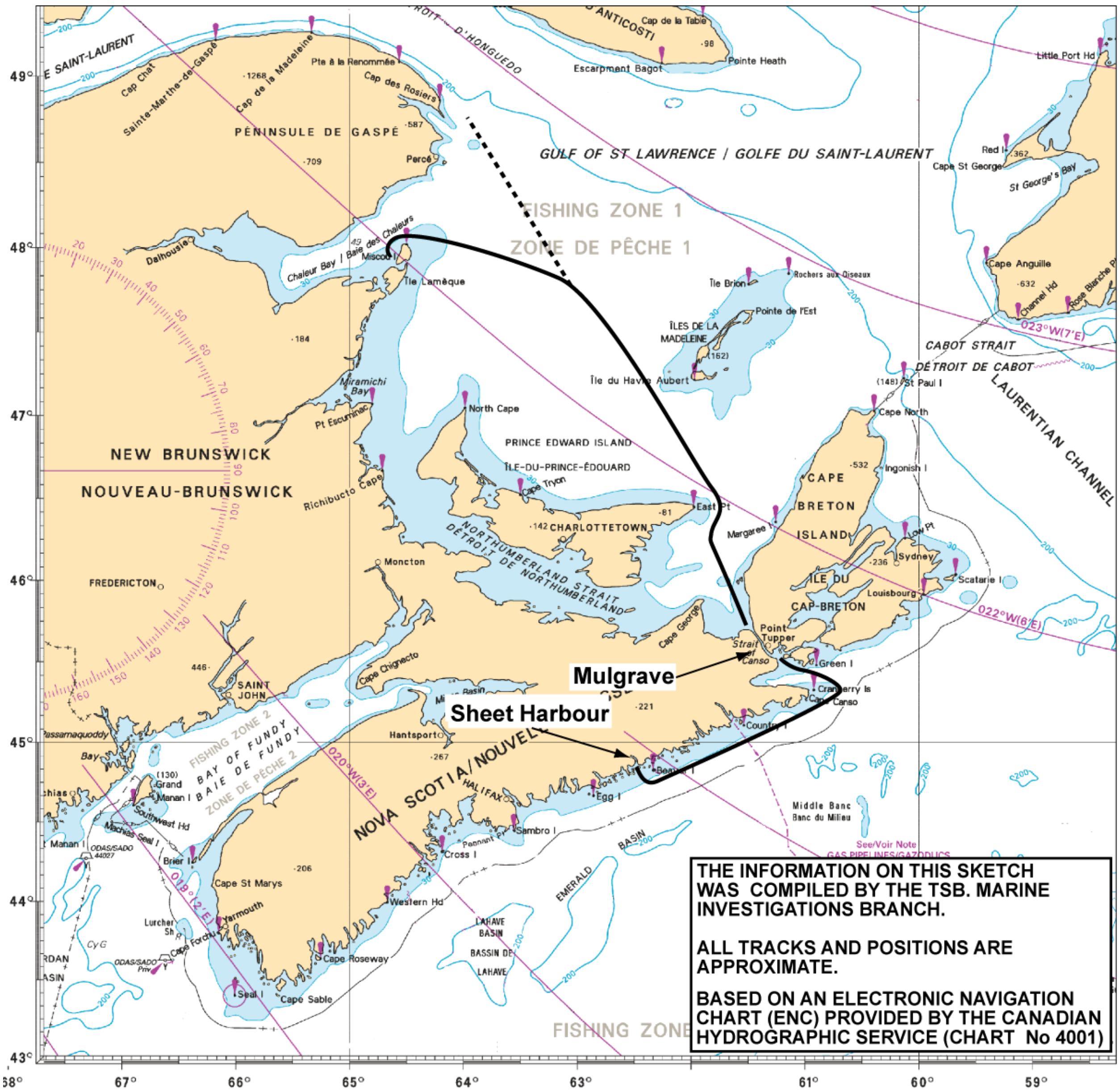
This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 26 February 2009.

*Visit the Transportation Safety Board's Web site (**www.tsb.gc.ca**) for information about the Transportation Safety Board and its products and services. There you will also find links to other safety organizations and related sites.*

Appendix A – Barge OTM 3072



Appendix B – Sketch of Approximate Course



Straight line: route of the *Ocean Foxtrot* and *OTM 3072*

Dotted line**:** projected track