MARINE INVESTIGATION REPORT
M01C0019

BOTTOM CONTACT

BY THE SELF-UNLOADING BULK CARRIER
CANADIAN TRANSFER
1.25 nm WEST OF THE GODERICH HARBOUR PIERS
GODERICH, ONTARIO
14 MAY 2001

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

Marine Investigation Report

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Report Number M01C0019

Summary

At 1318 eastern daylight time on 14 May 2001, in clear and calm weather, while outbound and fully laden, the *Canadian Transfer* struck bottom approximately 1.25 nautical miles west of the Goderich Harbour outer piers. Substantial damage was sustained by the vessel.

Ce rapport est également disponible en français.

Other Factual Information

Particulars of the Vessel

	Canadian Transfer
Official Number	323003
Port of Registry	Toronto, Ontario
Flag	Canada
Type	Self-Unloading Bulk Carrier
Gross Tonnage	11 120
Length	198 m
Draught	Forward: 7.34 m Aft: 7.625 m
Built	1965, Lauzon, Quebec, converted in 1998 at Port Weller, Ontario
Propulsion	Sulzer Type 5-RD-68 diesel engine, 4487 kW
Cargo	14 846 metric tonnes of road salt
Number of Crew	24
Registered Owner	Upper Lakes Group Inc., St. Catharines, Ontario

On 14 May 2001 at 1300 eastern daylight time[1], the *Canadian Transfer* departed Sifto Salt Dock, Goderich, Ontario, with 14 846 metric tonnes of road salt.

The propulsion machinery was tested prior to departure. The master reported that before departure from the dock the electronic chart precise integrated navigation system (ECPINS) had an offset placing the vessel south of its actual position. It was also found that the ECPINS unit was operating within its prescribed parameters upon inspection after the occurrence. The remaining navigation instruments were operating satisfactorily and there was no reported gyro error. A chart room is located aft of the bridge. There is a separate chart table, located at the forward starboard side of the bridge to assist the person(s) conning the vessel.

[1] All times are eastern standard time (Coordinated Universal Time [UTC] minus four hours).

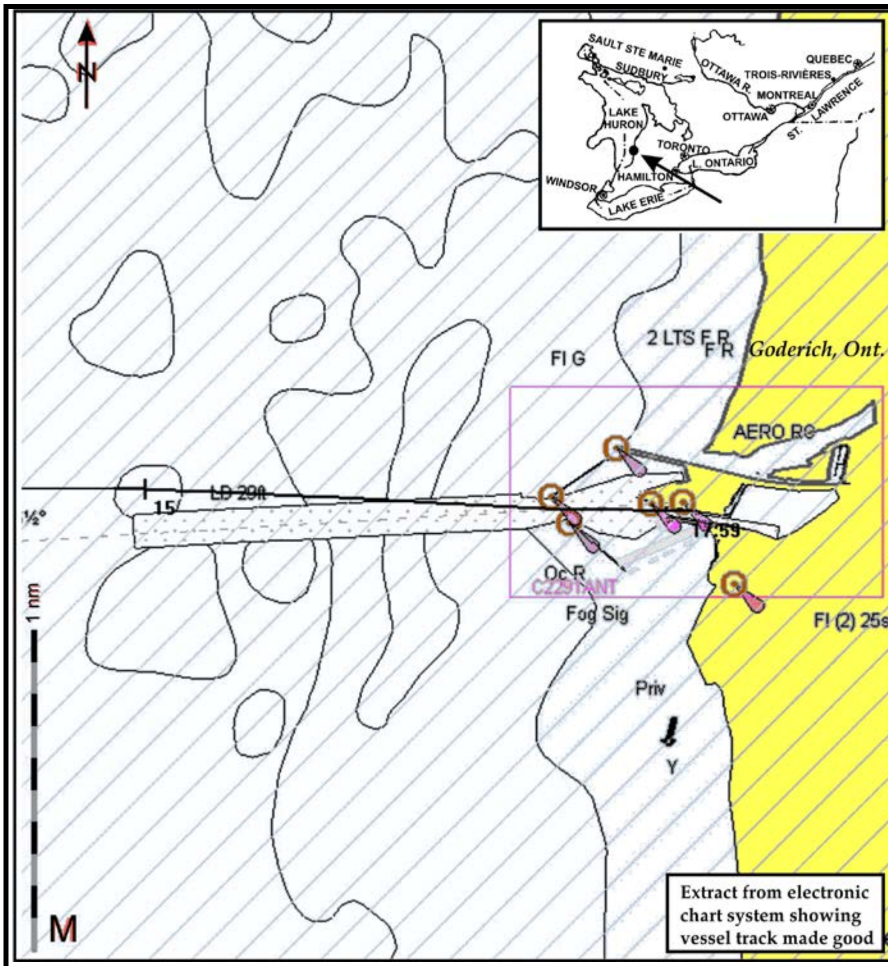
The weather was sunny and clear with light westerly winds estimated at between 5 and 10 knots. The Lake Huron water level was 0.08 metre (m) below chart datum.

Outside the harbour, there was a current of one-half to one knot running from south to north. The operating company requires their masters to have a pre-departure passage plan prepared for harbour inbound and outbound vessels. A pre-departure plan for the *Canadian Transfer* from Goderich Harbour had not been prepared.

On the bridge were the helmsman and a relief master. The relief master was aboard to gain navigational knowledge for the local harbours involved with the local salt and stone trade and would soon relieve the permanent master, who was on board. The second officer, the officer of the watch (OOW), was below on the main deck supervising the stowage of gear while the vessel was proceeding out of the harbour. Once the stowage was complete, he showered and refreshed himself in preparation for his arrival on the bridge.

At 1307, the *Canadian Transfer* passed the Goderich outer piers at slow speed and the helmsman was steering a course of 272° true. The ECPINS chart in use was the Canadian Hydrographic Service (CHS) chart 2291(A). No further course changes were given. The relief master progressively moved the controllable pitch throttle control stick ahead to a reported "9" position. At the control position setting of "10", the vessel will attain a speed of 14.5 to 15 knots.

To assist inbound and outbound vessel traffic in Goderich Harbour, the navigational aid consists of a set of ranges which indicates an outbound course of 266.5° true. In the past, buoys were marking the limits of the channel but these were removed when the Government of Canada commercialized the operation of the port of Goderich and handed over its control to the municipality. The vessel was located south of the line of ranges after passing through the outer piers and was observed by the relief master to cross to the north of the range line a few minutes later.



Extract from electronic chart system showing vessel track made good

At this time, no course correction was made. The OOW arrived on the bridge at a time estimated to be between 1309 and 1313. The relief master instructed the OOW to calculate the estimated time of arrival for the voluntary call-in point between Harbour Beach, Michigan, U.S., and Point Clark, Ontario. The OOW went to the chartroom aft of the bridge to perform the calculations and was joined briefly by the relief master. On completion of this task, the OOW moved back to the bridge and stood by a smaller chart table, located to starboard, and looked ahead. The ECPINS unit was now showing CHS Chart 2291(A) and was occasionally glanced at by the OOW and the relief master. The paper chart in use on the bridge to assist the master was CHS Chart 2228-2, showing Goderich Harbour, and a much smaller scale paper chart CHS Chart 2228, which shows the channel approach to Goderich Harbour at a scale of 1/120,000. The larger scale CHS Chart 2261, 1/80,000, shows the channel and approaches to Goderich Harbour more clearly with additional depth soundings but was not indicated as being used at the forward starboard bridge chart table. No position plotting had taken place at any time. No further instruction was given by the relief master. There were no communications between bridge team members relating to the navigation of the vessel.

Between 1314 and 1315, the watchman arrived on the bridge to transcribe tank sounding information from his rough deck log to the bridge logbook. At 1317, the relief master called Sarnia Traffic to pass on the voluntary estimated time of arrival information for mid-Lake Huron.

At 1318, while the relief master was communicating with Sarnia Traffic, the bridge personnel felt and heard a heavy “rumbling” noise, which was described by most personnel as similar to an anchor having “let go.” The watchman was sent below to find out what had occurred and he relayed to the bridge that the anchors were secured. It was now understood by the bridge crew that the vessel had struck bottom.

After several ship’s telephone calls between the relief and permanent masters, the permanent master arrived on the bridge within two minutes and took charge of vessel navigation. In this time period the *Canadian Transfer* listed six to eight degrees to port and was turning on a hard-to-port course alteration. Not knowing the full extent of the damage, the permanent master sounded the general alarm and the crew members were instructed to don their immersion suits and muster on deck. The permanent master ordered full astern and proceeded to anchor the vessel.

The speed of the *Canadian Transfer* at the time of striking bottom was estimated by the bridge officers to be between 9.5 and 10 knots. The ECPINS unit replay showed that the vessel was proceeding at 11.4 knots. The bottom contact occurred in latitude 43°44.8' N , longitude 081°46' W, some 300 m north of the centre of the channel.

Upon inspection, it was found that the No. 1 port ballast tank was filling and that the extraction pumps could not keep up with the ingress of water. The forepeak tank had also taken on water; however, the pumps were able to control the ingress.

While the first officer was accounting for all crew members, it was discovered that the chief cook had collapsed to the deck near the galley while attempting to don her immersion suit. She was transported to the open deck on a stretcher where she recovered soon afterward.

Personnel Certification and Experience

The relief master had sailed in that capacity on approximately six other vessels over the last two years for short periods of time. He had previously navigated the *Canadian Century* into and out of Goderich Harbour but considered himself still in training for this period of time. The need for additional training was recognized by the company while he was acquiring more local knowledge and experience in the salt and stone trade. The relief master was appropriately certificated for the voyage intended and had taken the five-day bridge resource management (BRM) training course in 1997 at Newport, Rhode Island. U.S.A.

The OOW was appropriately certificated for his position. However, he did not have formal BRM training.

Analysis

Pre-Departure Passage Plan

There is a combined responsibility by the navigating officer and the acting master to ensure safe navigation at all times. This is normally reinforced by adherence to a pre-departure passage plan that outlines the courses to steer, the speed of the vessel with respect to squat, shallow areas to be avoided, ranges to be kept in-line and pre-set short chronological time periods for position plotting. No pre-departure passage plan was in place at the time the *Canadian Transfer* left the dock to ensure the vessel's safe passage in deeper waters.

On clearing the dock, a lead-up course of 272° would bring the vessel onto the ranges and the course would be altered to between 266° and 267° to maintain the recommended track which would take the vessel clear of the harbour and approaches. This course adjustment was not made and the vessel was allowed to progress further to the north, eventually striking bottom.

Given the sophistication of the navigational systems of the vessels calling at the port and the relatively simple approach/departure, the buoys that had marked channel limits were not considered cost-effective after commercialization and were removed.

In calm conditions, an ideal vessel movement from Goderich Harbour would normally entail few course changes and should not have presented any difficulty. The ideal weather conditions and the simplicity of the vessel movement resulted in a casual approach to navigation. This is reflected in the vessel's position not being closely monitored during the critical period of the vessel's departure and while navigating in the narrow channel. As there was no passage plan, the bridge team was deprived of a means that would have helped it to remain focussed on the safe navigation of the vessel.

Bridge Resource Management—Non-Navigating Duties and Personnel Availability

BRM is considerably restricted when the bridge team is only the master and a wheelsman. Such was the case when the *Canadian Transfer* departed the salt dock in Goderich Harbour. Verification of courses and monitoring of the vessel movement along a safe path using BRM principles are more readily accomplished with an additional navigating officer.

On 13 April 2001, the General Manager, Operations, for the Upper Lakes Group Inc. issued circular letter 24-2001 which was addressed to all masters and deck officers for awareness and education. The letter brought attention to the TSB publication *Safety Reflexions: Marine* detailing recent marine investigations, particularly the investigation of the *Olympic Mentor* (TSB Report No. M95C0120). It emphasized the importance of effective BRM which supports the informed navigation decision process of a master/pilot by all bridge team members.

When the OOW arrived on the bridge, he was immediately assigned the task of formulating the estimated time of arrival for mid-lake; a low-priority navigational task. Once this task was completed, the OOW stood by the forward bridge chart table. He did not plot the vessel's position nor did he verify the vessel's position, either by

ECPINS, radar range and bearing, the Differential Global Positioning System, or by visual means such as alignment of the ranges astern. Instead, he made an incorrect assumption that the relief master was conducting the vessel safely to open waters.

The time when risk is typically the highest is on arrival or departure from port. However, the common practice on the Great Lakes is for the duty officer to carry out non-navigational tasks and freshen up before returning for bridge duty. In this instance, the OOW spent some 10 to 15 minutes to freshen up before proceeding to the bridge. Further, although two masters were on board, only the relief master was on the bridge. The presence of an officer / additional master on the bridge during departure dedicated to the navigation of the vessel could have increased the synergy of the bridge team. This would lead to early identification of navigational errors or developing situations to be communicated to the master for timely remedial measures.

Effective Use of Navigation Equipment and Navigational Aids

The bridge navigation equipment on board the *Canadian Transfer* was not used to advantage. The ECPINS on board the vessel was using a vector chart of Goderich Harbour. Electronic Navigation Charts (ENCs) particularly in Vector format, offer a range of alarm and indicators for route monitoring. They serve to bring the situation to the attention of the OOW so that he can intervene as required. For instance, the system can be used to determine safety parameters such as draught, cross-track error and any other relevant features as long as they are pre-set by the OOW. During the course of a voyage, the ECPINS records the ship's course changes and systematically scans vector chart data comparing variations progressively with the pre-set safety parameters. An alarm will be triggered when any of the pre-set safety limits are violated.

ECPINS can display an anti-grounding cone. This anti-grounding "look ahead" cone can "look" forward and around the next waypoint where the route bends. To display the anti-grounding cone, the OOW must enter the desired parameters. Once the values are set, the anti-grounding cone must be enabled. The *Port* and *Starboard* Extension fields add a minimum safety width to each side of the own ship. The *Stern* defines the base of the cone. The *Bow* field adds a minimum safety distance ahead of the bow. These features cannot be used with a raster chart.

Electronic chart systems such as ECPINS, as well as IMO type-approved Electronic Chart Display and Information System (ECDIS), all provide alarms or indicators when using automatic track control. Using appropriate limits (vectors as safe ship boundaries), the alarms or indicators would be triggered if:

1) The pre-set cross track limit from the planned route is exceeded;

2) The ship is within a pre-set time limit or distance from a critical point along the planned route (e.g. from wheel-over line for the next course change);

3) The route pre-set maximum course difference between the planned route and gyro indicator is exceeded.

The system was functioning satisfactorily but was not used to advantage to safely navigate the vessel.

The set of ranges in Goderich Harbour was accurate, but the bridge team did not keep the vessel in line, even after the relief master noticed the vessel crossing the projected line from south to north.

Speed of the Vessel and Squat

As a vessel moves ahead in a shallow channel, the flow of water under the hull is accelerated and causes a reduction in pressure, such that the vessel settles deeper than its static mean draught. This phenomenon is known as squat and is dependent on the vessel's speed, the ratio of its static draught to the channel depth, and the relationship of the cross-sectional areas of the hull and the channel. The squat depth increases proportionately with the square of the speed, and loaded vessels with limited under-keel clearance (UKC), when proceeding at too high a speed, may settle, make bottom contact and incur grounding damage.

Observation and analysis of several hundred vessels operating at various speeds in relatively shallow water indicate that dry-bulk carriers similar to the *Canadian Transfer*, having block coefficients (Cb) of about 0.800, tend to settle bodily and squat more by the bow.[2]

At the time of the occurrence, the water levels in Lake Huron reportedly were 0.08 m lower than the published charted depths. Consequently, when the vessel entered an area shown to have a depth of 8.23 m, the actual water depth was 8.15 m.

The vessel's forward and after loaded draughts were recorded as 7.34 m and 7.625 m, respectively, which, together with a mean draught of approximately 7.48 m, indicate a ratio of water depth to mean static draught of approximately 1.10 and a related static UKC of 0.67 m as the vessel entered the shallower area. However, in these conditions, a speed of 11.4 knots would cause the vessel to squat approximately 1.10 m which, being in excess of the static UKC, resulted in the vessel making bottom contact.

Because of its full form and a speed of 11.4 knots, the vessel would squat and tend to trim by the bow when entering the shallower water. Such characteristics are consistent with the location of the bottom shell damage actually incurred at the forward end of the vessel.

Reportedly, when loaded Great Lakes vessels depart Goderich Harbour, they routinely employ speeds of six to seven knots. It may be noted that, when similarly loaded to the same draughts, the *Canadian Transfer* would have incurred squats of 0.29 m to 0.39 m at these speeds, and that bottom contact would most likely have been avoided.

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[2] Dr. C.B. Barrass, MSc., FRINA CEng., *Ship Squat*, 1997.

Conduct of the Vessel and Safety

As the relief master was unsupervised on the bridge, this would suggest that the permanent master had confidence in the relief master's abilities to pilot the vessel out of the harbour. The fact that the relief master did not request the presence of the permanent master on the bridge would suggest that he had confidence in his own abilities to pilot the vessel out of Goderich Harbour.

Findings as to Causes and Contributing Factors

1. The vessel did not have a passage plan, bridge resource management was not implemented, and the approach to navigation was casual. This resulted in:

    - the vessel's progress not being closely monitored;
    - no corrective action being taken by the relief master to keep the vessel on a safe track although he was aware that the vessel had crossed the range line from south to north;
    - minimal communication between bridge personnel;
    - the bridge team functioning in a non-cohesive manner; and
    - the tasks assigned to the officer of the watch not being prioritized.

2. The electronic instruments for navigation, especially the electronic chart precise integrated navigation system, were under-utilized. The anti-grounding feature, with which the bridge team was familiar and which could have given warning of an impending grounding, was not used.

3. Forward bottom shell damage was incurred because the under-keel clearance was lost due to shallow water squat and trimming effects caused by the vessel's speed of 11.4 knots.

Other Findings

1. Both the master and the relief master had confidence in the latter's ability to pilot the vessel out of Goderich Harbour.

Safety Action Taken

The owners of the vessel have re-inforced safety aspects as follows:

- ECDIS or ECDIS equivalent equipment is fitted on all company ships and all masters and 1st officers have received formal ECDIS and BRM training. In addition, 2nd and 3rd officers have received in-house abbreviated BRM training.
- TSB investigation reports and magazine "Reflexions"continue to be routinely forwarded to company vessels for required reading and review by officers. BRM occurrences are highlighted for emphasis.

- Pre-arrival and pre-departure checklists, which include the requirement for passage plans, are mandatory and are in place under company standard procedures.

This report concludes the Transportation Safety Board's investigation into this occurrence. Consequently, the Board authorized the release of this report on 14 May 2003.

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

Appendix A - Glossary

BRM	bridge resource management
CHS	Canadian Hydrographic Service
Cb	block coefficient
ECDIS	electronic chart display and information system
ECPINS	electronic chart precise integrated navigation system
kW	kilowatt
m	metre
N	north
OOW	officer of the watch
TSB	Transportation Safety Board of Canada
UKC	under-keel clearance
U.S.	United States
UTC	Coordinated Universal Time
W	west
°	degree
'	minute