Report 99-201

bulk woodchip vessel *Prince of Tokyo*

grounding

Port Otago harbour entrance

12 February 1999

Abstract

At about 2135 on Friday, 12 February 1999, the bulk woodchip carrier *Prince of Tokyo* was outward bound with 20 crew and a harbour pilot on board when it grounded on the western mole at the entrance to Port Otago harbour. The grounding occurred when the bridge team became distracted and were not monitoring the progress of the vessel. Initial attempts to re-float the vessel were unsuccessful. It was eventually re-floated with the assistance of 3 tugs on Sunday, 14 February 1999. There were no injuries, but the vessel suffered extensive underwater damage.

Safety issues identified included:

- the standard of bridge resource management being practiced on the bridge of the *Prince of Tokyo*
- the pilot resources available to Port Otago Limited
- the lack of documented port company guidelines and procedures
- the need for structured operational and safety meetings for port company staff
- the chief pilot having sole management of the shipping services division with little input from the port company.

Safety recommendations were made to the chief executive officer of Port Otago Limited and the director, operations department of Tokai Shipping Limited.

The Transport Accident Investigation Commission is an independent Crown entity established to determine the circumstances and causes of accidents and incidents with a view to avoiding similar occurrences in the future. Accordingly it is inappropriate that reports should be used to assign fault or blame or determine liability, since neither the investigation nor the reporting process has been undertaken for that purpose.

The Commission may make recommendations to improve transport safety. The cost of implementing any recommendation must always be balanced against its benefits. Such analysis is a matter for the regulator and the industry.

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(photograph courtesy of Garry Bain)

***Prince of Tokyo*, aground on the western mole at the entrance to Port Otago harbour**

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List of Abbreviations

ARPA	automatic radar plotting aid
GPS	global positioning system
kW	kilowatt
m	metres
m^3	cubic metres
mm	millimetres
MSA	Maritime Safety Authority
NZDT	New Zealand Daylight Time (UTC + 13 hours)
NZST	New Zealand Standard Time (UTC + 12 hours)
rpm	revolutions per minute
SOLAS	International Convention for Safety of Life At Sea
t	tonnes
UTC	universal time (co-ordinated)
VHF	very high frequency

Glossary

aft	rear of the vessel
amidships	middle section of a vessel, mid-length
anemometer	device that measures wind speed
aweigh	when an anchor is broken out of the ground and the cable is vertical
bilge	space for the collection of surplus liquid
bridge	structure from where a vessel is navigated and directed
class	category in classification register
conning	directing the course and speed of a ship
deckhead	nautical term for ceiling
double bottom	tank at the bottom of a ship formed by the inner and outer bottom plating of hull
draught	depth in water at which a ship floats
forefoot	lower extremity of stem, where it joins the keel
fore peak tank	tank between collision bulkhead and stem plating
frame	rigid profile providing strength to the hull of a vessel
freeboard	distance from the waterline to the deck edge
gross tonnage	a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula
keel strake	longitudinal bottom plating on each side of keel
knot	one nautical mile per hour
leading light(s)	light(s) that identify the safest track in a channel
longitudinal	pertaining to length. Applied to any fore and aft member of a ship structure
nett tonnage	derived from gross tonnage by deducting spaces allowed for crew and propelling equipment
pivot point	imaginary point around which a vessel turns under helm
port	left hand side when facing forward
range of tide	difference in height between successive high and low waters
shackle	marked length of anchor cable measuring 27.4 m
sounding	measure of the depth of a liquid
starboard	right hand side when facing forward
strake	a continuous line of plating or planking extending along a hull from forward to aft
telegraph	device used to relay engine commands from bridge to engine room
windlass	winch used to raise an anchor

Marine Accident Report 99-201

Data Summary

Vessel particulars:

Name:	*Prince of Tokyo*
Type:	bulk woodchip carrier
Classification:	Nippon Kaiji Kyokai NS*MNS*M0
Class:	VII: foreign going cargo vessel (SOLAS)
Length overall:	195 m
Breadth moulded:	32.2 m
Summer draft:	10.57 m
Summer displacement:	52 781 t
Gross tonnage:	36 712 t
Deadweight:	43 980 t
Cargo capacity (grain):	91 140 m^3
Construction:	steel
Built:	Sanoyas Hishino Meisho Corporation Kurashiki Japan, September 1997
Propulsion plant:	one 9396 kW, Mitsubishi 7UEC52LS diesel engine
Service speed:	15.5 knots
Owner:	Papyrus Diamond S.A., Panama
Operator:	Tokai Shipping Company Limited, Japan
Registry:	Panama

Persons on board:	crew: 20 pilot: 1
Injuries:	nil
Damage:	extensive to bottom plating in fore part of vessel
Location:	western mole, entrance to Port Otago
Date and time:	Friday, 12 February 1999, at about 2135[1]
Investigator-in-Charge:	Captain Billy Lyons

[1] All times in this report are in NZDT (UTC+13 hours) and are expressed in the 24 hour mode

1. Factual Information

1.1 History of voyage

1.1.1 The bulk woodchip carrier *Prince of Tokyo* departed Bluff at 2120 on Monday, 8 February 1999, having loaded 13 190 t of bulk woodchips.

1.1.2 The *Prince of Tokyo* arrived at the Port Otago pilot boarding ground at 0830 on Wednesday, 10 February 1999. The chief pilot of Port Otago Limited (the company) boarded the vessel 1.5 miles north-east of the fairway buoy at 0850, using a pilot ladder in conjunction with the starboard gangway.

1.1.3 When the chief pilot arrived on the bridge he ascertained the position of the vessel before having a brief discussion with the master regarding the positioning of the tugs and the berth the vessel was going to. The master showed the chief pilot the pilot card which contained the vessel particulars, draught, details of the bridge equipment that had been tested prior to arrival, and the manoeuvring data. No further exchange of information took place between the chief pilot and the master.

1.1.4 The vessel proceeded inwards without incident and berthed, port side to Beach Street Wharf, in Port Chalmers at 1040. The loading of woodchip commenced at 1125.

1.1.5 The vessel completed loading 23 359 t of bulk woodchip at 1825 on Friday, 12 February 1999. The crew secured the hatches and prepared the vessel for sea. Both gangways were left turned out but raised up level with the main deck. The departure draught was 9.38 m forward and 9.71 m aft.

1.1.6 At 1910 the third mate tested the bridge equipment, engine controls and steering gear, which he found to be operating correctly. He then completed and signed off the arrival/departure checklist and altered the pilot card to reflect the departure condition. The engine was put on stand-by at 2020.

1.1.7 The chief pilot boarded the *Prince of Tokyo* at 2025, by which time the tugs were made fast, the *Rangi* on the starboard bow and the *Karetai* through the centre lead aft. The chief pilot was shown the updated pilot card, but no further information was exchanged between him and the master.

1.1.8 The bridge was manned by the chief pilot, master, first mate and helmsman. The second mate was stationed forward and the third mate aft.

1.1.9 The moorings were singled up to a head-line and backspring forward and a stern-line and backspring aft. The chief pilot ordered the last line to be let go at 2034.

1.1.10 With the aid of the tugs the *Prince of Tokyo* was manoeuvred astern into the swinging basin and turned to starboard in order to line up with the channel.

1.1.11 The *Rangi* was let go and at 2050, the chief pilot ordered dead slow ahead on the engine; this was increased to slow ahead at 2053 and half ahead at 2055. At 2056, when the *Prince of Tokyo* was lined up with the channel, the *Karetai* was let go and both tugs were then dismissed. At the same time the chief pilot requested harbour full ahead and the speed increased to about 8 knots.

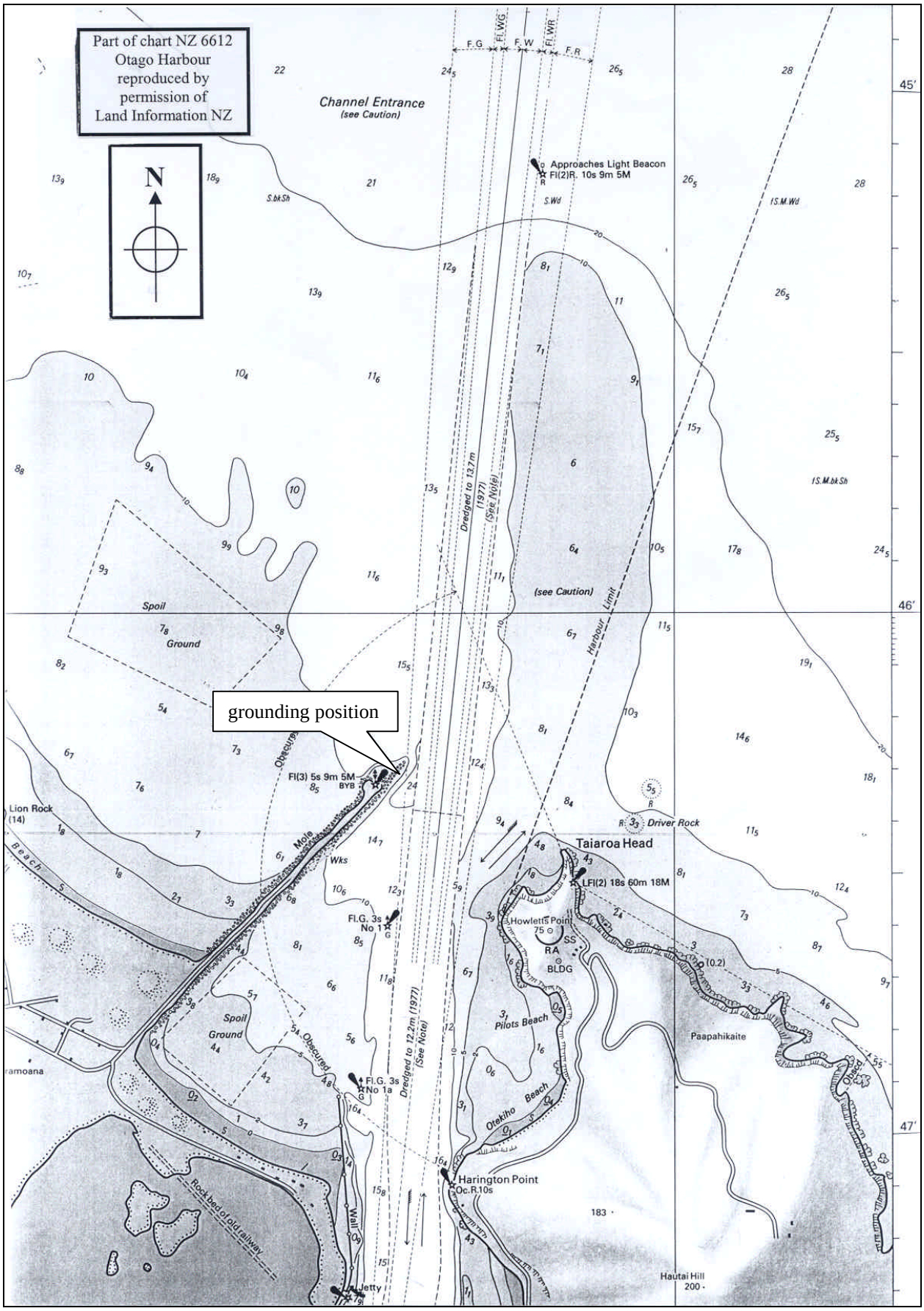


Figure 1
Part of chart NZ6612 showing relevant information

1.1.12 The vessel proceeded down the channel without incident. The chief pilot later stated that the helmsman had steered the vessel within acceptable limits and had repeated the helm orders back to him verbally. At 2108 the chief pilot requested the engine revolutions be increased to attain more speed, the master ordered what he called navigational full ahead, which increased the speed to about 10 knots.

1.1.13 The chief pilot informed the master that he would not need to reduce speed to disembark and asked that the pilot ladder be rigged on the port side. This request was passed to the bosun on deck. As the starboard gangway would no longer be required, the deck crew began to stow and secure it for sea.

1.1.14 The *Prince of Tokyo* continued down the channel at about 10 knots. As the vessel approached the fixed directional leading light at the entrance to the harbour, the chief pilot ordered port helm and steadied the vessel on a course of 006 degrees true, in the white sector of the light. (See Figure 1.)

1.1.15 When the vessel was off Harington Point the third mate arrived on the bridge to relieve the first mate as officer-of-the-watch. The first mate informed the third mate that the engine was on navigation full ahead and then proceeded to the radio room, which was adjacent to and open to the bridge, to complete some paperwork. After the accident the first and third mates both stated that they were not officer-of-the-watch at the time of the accident.

1.1.16 When the vessel was approaching number 1A beacon, the chief pilot went out to the port bridge wing, looked astern and verified that the vessel was still in the white sector of the leading light. At this stage the pilot launch was approaching the *Prince of Tokyo* with the intention of overtaking on the port side of the ship.

1.1.17 As the chief pilot was walking back into the wheelhouse he heard a bang that sounded to him like a wire snapping, but he did not know the source of the noise. The third mate immediately went to the extremity of the starboard bridge wing and began communicating with the deck crew by portable very high frequency (VHF) radio.

1.1.18 At about this time the vessel was abeam of number one beacon, where the chief pilot ordered 10 degrees of port helm in order to alter the course a “few degrees” to increase the passing distance off the Approaches Light Beacon.

1.1.19 At the same time the chief pilot heard “a lot of hurried, rapid, alarming talk,” in Filipino, over the portable VHF radios. During this exchange the master went out to the starboard bridge wing to observe what had happened. The first mate remained in the radio room.

1.1.20 The chief pilot could see from the wheelhouse that the gangway was hanging vertically. He was not sure if anyone had fallen overboard so proceeded out to the bridge wing to see for himself what had happened, leaving the helm on port 10 degrees. (See Figures 2 and 3.)

1.1.21 While on the bridge wing the chief pilot had a brief discussion with the master about the gangway. The master informed the chief pilot that the crew would attend to the problem once the vessel was clear of the channel. The chief pilot later estimated he was on the bridge wing for no longer than a minute. During this time the third mate went back into the wheelhouse.

1.1.22 The chief pilot looked up and observed that the rate of turn of the vessel was much faster than he had expected. He immediately ran back into the wheelhouse and ordered the helm 20 degrees to starboard, followed closely by hard to starboard. He left the engines on navigational full ahead to obtain the maximum turning effect from the rudder.

Figure 2
View of gangway from starboard bridge wing

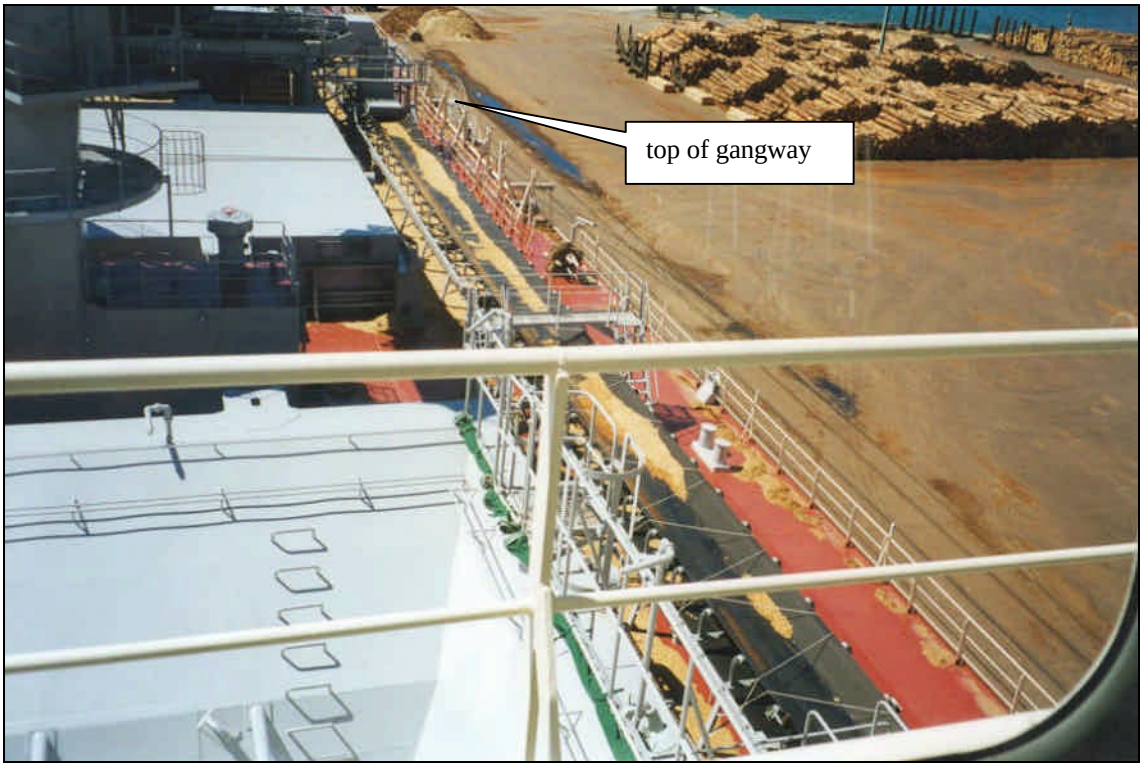


Figure 3
View of top of gangway from the centre window of the bridge

1.1.23 The heading of the *Prince of Tokyo* appeared to steady, so the chief pilot ordered the helm to amidships, to prevent the stern swinging on to the rocks. However, the vessel grounded on the underwater extension of the mole on a heading of 348 degrees true. The time was logged as 2135.

1.1.24 After the grounding the chief pilot stopped the engine and called the harbour tugs on VHF radio and requested they proceed to the vessel immediately. He did not attempt to re-float the vessel as the tide was rising and had it come free, he felt that he would have had difficulty manoeuvring it back into the channel without tug assistance. The starboard anchor was dropped at the chief pilot's request.

1.1.25 The master instructed the crew to sound the tanks and check for damage and pollution. It was established that the fore peak tank was taking water, but there was no sign of pollution.

1.1.26 At 2250, the *Karetai* arrived and made fast forward, while the *Rangi* arrived at 2320 and was made fast aft. At 0102 on Saturday, 13 February 1999, with the aid of the tugs and the main engine the chief pilot attempted to re-float the vessel, but was unsuccessful. The forward tug line parted twice.

1.1.27 At 0156, the company dredge *New Era* arrived to assist. It made fast to the *Prince of Tokyo* through the centre lead aft using a line provided by the ship. The chief pilot continued to coordinate the attempt to re-float the *Prince of Tokyo* to no avail. The attempt was abandoned at 0353.

1.1.28 For the remainder of the night the chief pilot remained on board the *Prince of Tokyo* with the 2 tugs and the dredge standing by. At 0935 the chief pilot was relieved by the company senior pilot.

1.1.29 Divers inspected the hull of the *Prince of Tokyo* between 1230 and 1300, during which time the Timaru based tug *Te Maru* arrived to assist. The starboard anchor was weighed and the *Te Maru* ran it out to 8 shackles.

1.1.30 At 1300 the chief pilot returned to the *Prince of Tokyo* to assist the senior pilot with the next attempt to re-float the vessel. At 1342 the 3 tugs and the dredge were made fast and they started to apply power in conjunction with the ships main engine.

1.1.31 The attempt was unsuccessful and at 1600 the vessels ceased pulling and were let go but remained standing by. At 1605 the 2 pilots disembarked from the *Prince of Tokyo*. At 1925 a salvage team, made up of a salvage master and a naval architect, boarded the vessel to assess the situation and prepare for the next attempt to re-float it. The salvage master requested that the company provide a pilot to be in attendance when the salvage attempt was to be made.

1.1.32 At 1200, on Sunday, 14 February 1999, the chief pilot again boarded the *Prince of Tokyo*. Divers re-inspected the hull and the tugs made fast again for another attempt to re-float the vessel on the high water predicted for 1411.

1.1.33 At 1245 the tugs began pulling on the tow lines, increasing power at the salvage master's request. The vessels engine was put to slow astern at 1402 and the power of the tugs and ships engine was slowly increased as the tide rose. At 1448 the vessel was re-floated. The chief pilot then took the con of the vessel from the salvage master.

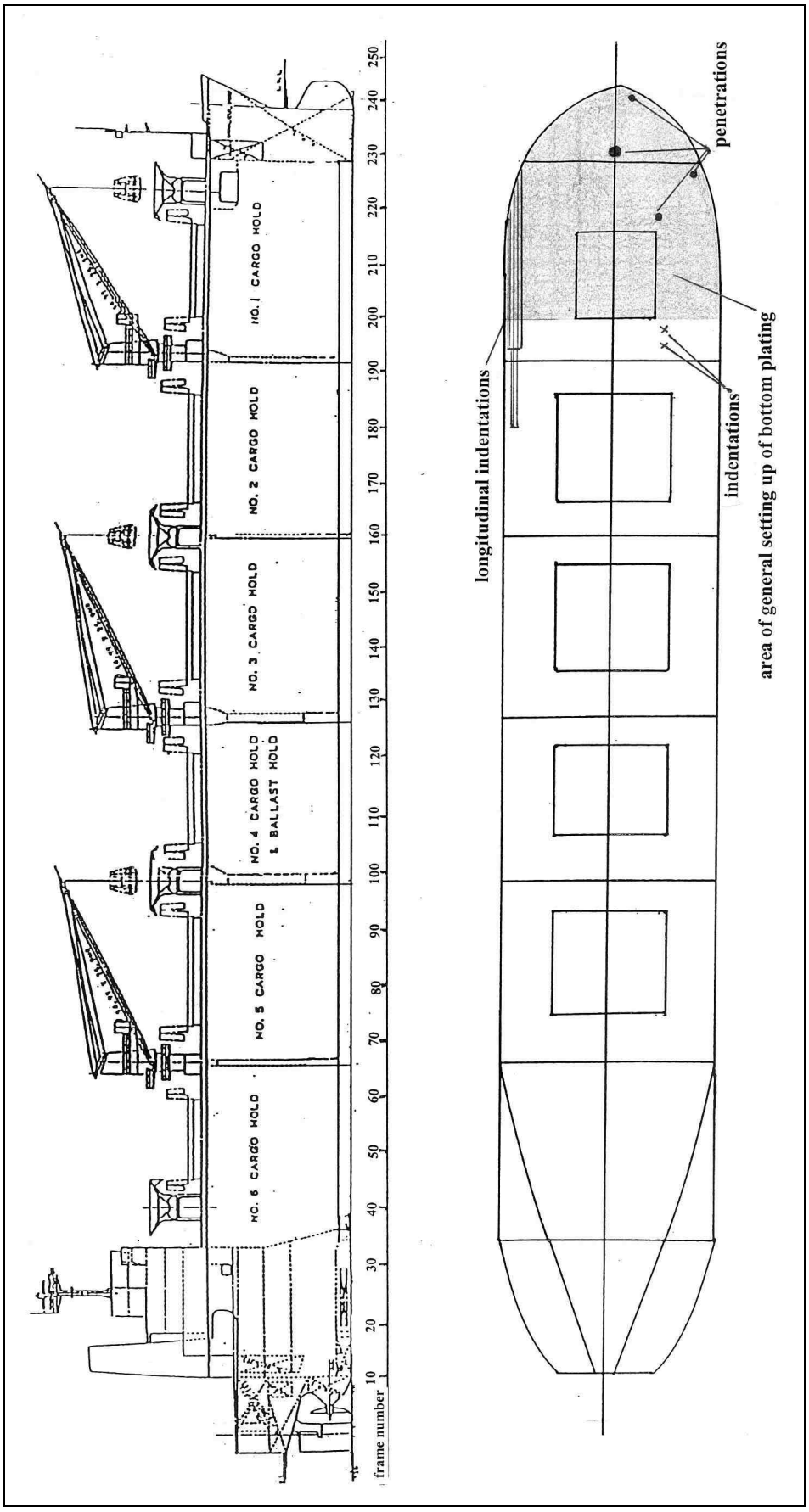


Figure 4
Diagram showing areas of damage

1.1.34 The tugs held the *Prince of Tokyo* in the channel while the crew attempted to weigh the starboard anchor. When they had retrieved about 4 shackles the anchor fouled the bottom and could not be cleared. The chief pilot in conjunction with the salvage master made the decision to cut the cable at the windlass with gas cutting equipment. This was completed at 1605.

1.1.35 The chief pilot then ordered the tugs to be released and the *Prince of Tokyo* proceeded to the anchorage off the harbour entrance. The port anchor was let go at 1637 and the chief pilot disembarked shortly after. The divers then commenced an overall damage survey of the hull.

1.1.36 The company required an assurance that the *Prince of Tokyo* would remain seaworthy before they would allow it to re-enter the port. The vessel remained at anchor on Monday, 15 and Tuesday, 16 February, while the divers completed the damage survey and commenced temporary repairs to the damaged areas.

1.1.37 At 0537, on Wednesday, 17 February 1999, the anchor was aweigh. The senior pilot boarded at 0552 and the *Prince of Tokyo* proceeded back into Port Chalmers to complete the temporary repairs.

1.1.38 The anchor and cable was subsequently recovered and returned to the vessel. The crown of the anchor had broken off about midway along the shank.

1.2 Damage

1.2.1 A preliminary damage report was made by the salvors on 15 February 1999, after the initial inspections by divers. It found that the *Prince of Tokyo* had grounded from the forefoot, back to about the middle of number 2 hold, on a bottom consisting of rock, gravel, rubble and large cast concrete tetrahedrons.

1.2.2 The tank soundings after the grounding indicated that the fore peak and number one starboard double bottom tank were taking water.

1.2.3 From about frame 200 forward the damage was extensive, with general setting up and indenting of the plating to a depth of up to 100 mm, extending right across the flat bottom between the frames and longitudinals.

1.2.4 There were 4 places, all on the starboard side of the centreline, where the shell plating was penetrated; 3 of these were small splits running longitudinally, the other was a larger hole. (See Figure 4.)

1.2.5 There was no pollution as a result of the grounding.

1.2.6 The broken wire on the starboard gangway was inspected after the accident. It was found to be squashed and stranded, consistent with being jammed between the sheave and the cheek plate of one of the permanently fitted blocks. The exact position the wire was in when it parted could not be established. The wire was relatively new and showed no other signs of damage. The test certificate was dated 6 January 1999.

Figure 5
View inside wheelhouse looking to starboard bridge wing

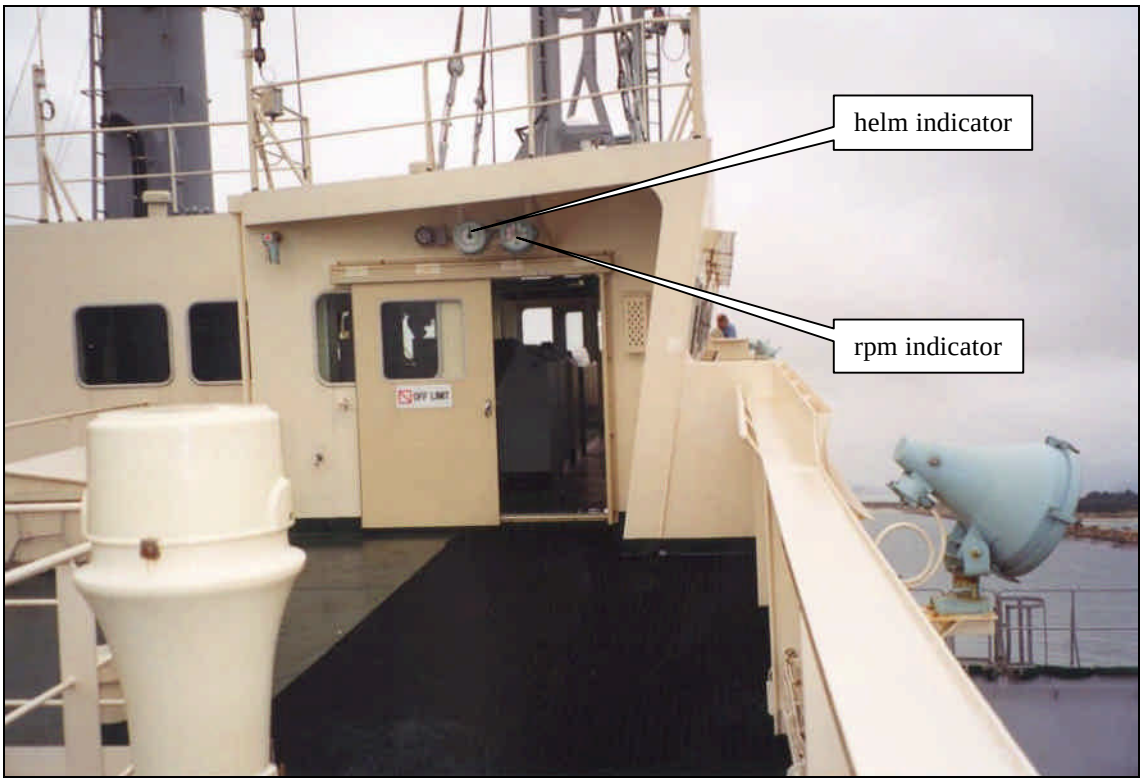


Figure 6
Starboard bridge wing

1.3 Vessel information

1.3.1 The *Prince of Tokyo* was a bulk woodchip carrier, 195 m in length with 6 cargo holds. On deck were 3 cranes and 4 cargo hoppers. These did not significantly impair the visibility from the bridge.

1.3.2 The bridge equipment included:

- 2 Antritsu ARPA radars
- 1 Tokimec gyro compass (no apparent error)
- 2 bridge wing repeaters (properly aligned)
- 1 Tokimec auto pilot
- 1 Tokimec course recorder
- 1 JRC echo sounder
- 1 JRC 6800 global positioning system (GPS)
- 2 VHF radios
- 1 weather facsimile
- 1 engine movement recorder.

1.3.3 Propulsion was by a single, bridge-controlled Mitsubishi 2-stroke diesel engine, producing 9396 kW at 120 rpm, driving a single right-handed, fixed-pitch, 4-blade propeller. The maximum speed attained at sea trials was 16.9 knots. The service speed was 15.5 knots.

1.3.4 The manoeuvring speeds as detailed on the pilot card were as follows:

engine setting	**rpm**	**speed (knots)**	
		loaded	**ballast**
full ahead	78.0	11.1	11.3
half ahead	64.0	9.3	9.4
slow ahead	54.0	7.7	7.9
dead slow ahead	37.0	5.3	5.4

1.3.5 The engine setting for navigational full ahead was not listed but the master estimated that the vessel could attain a speed of about 13 knots at this setting.

1.3.6 The vessel was fitted with a streamline, hanging type, semi-balanced rudder. The steering gear consisted of 2 electric steering motors but the manufacturer recommended that only one be running at a time, as was the case when the vessel grounded. One motor was capable of moving the rudder from hard to port to hard to starboard (35 degrees each side) in 23.7 seconds.

1.3.7 The bridge of the *Prince of Tokyo* was spacious (see Figure 5). The wheelhouse was about 12 m wide, the distance from each door to the extremity of the bridge wing was about 10 m. From the wheelhouse windows there was an uninterrupted view of the top of the gangways on each side of the maindeck.

1.3.8 Inside the wheelhouse situated on the centre-line at deckhead height was a console consisting of an anemometer, helm indicator, inclinometer, engine revolution counter, speed log and clock. On the deckhead was an engine telegraph indicator. When the vessel was turning, the gyrocompass made a distinctive clicking sound to indicate the rate of turn.

1.3.9 Above each wheelhouse door, facing out to the bridge wings was a helm indicator and an engine revolution counter. On each bridge wing was a gyrocompass repeater. (See Figure 6.)

1.3.10 The *Prince of Tokyo* had a Safety Management Certificate issued by Nippon Kaiji Kyokai on 26 May 1998. Part of the requirement for the issue of this certificate was to have a documented safety and procedure manual.

1.3.11 Contained in the manual were the operator's requirements with regard to port arrival and departure and the pilot/master exchange of information.

1.3.12 Prominently displayed on the bridge was a pilot card, turning circle information and the manoeuvring characteristics of the vessel. The pilot card contained the relevant information for the departure from Port Otago.

1.3.13 The vessel had undergone a Maritime Safety Authority port state inspection while in Bluff. There were no deficiencies noted at the time.

1.3.14 The *Prince of Tokyo* was fitted with a permanently positioned aluminium gangway on each side of the main deck at about mid-length of the vessel. Each gangway was about 12 m long and hinged at the forward end.

1.3.15 Each gangway was raised and lowered by an electric winch with a 12 mm diameter wire rope running through a series of sheaves fitted to a hinged davit, the deck and the gangway. The hinged davit was positioned at the lower end of the gangway and supported the weight when the gangway was hanging.

1.3.16 When in the stowed position the gangway was horizontal and turned inboard into a recessed area at main deck level.

1.3.17 There were electrical limit switches fitted to stop the winch once the gangway was in the stowed position. The starboard gangway switches were tested and found to be in working order.

1.3.18 Even when loaded the *Prince of Tokyo* had a freeboard of more than 9 m. To comply with the Shipping (Pilot Ladder) Rules, and to facilitate easier access to and from the vessel for the pilot, the gangway was used in conjunction with the pilot ladder.

1.3.19 The master and crew reported that they had not experienced any problem with the gangways in the past. The starboard gangway was used in conjunction with the pilot ladder when the vessel arrived at Port Otago.

1.4 Port, weather and tidal information

1.4.1 The western mole was a man-made breakwater, constructed from rocks and cast concrete tetrahedrons. It was about 50 m wide and extended about 900 m in a north-easterly direction from the shore at Aramoana. On the end of the mole was a light beacon.

1.4.2 From the end of the mole, extending about 150 m out to sea the construction tapered off to a depth of 18 m. The *Prince of Tokyo* grounded about halfway along this extension.

1.4.3 The entrance channel to Port Otago harbour was maintained to a minimum depth of 12.2 m. From number one beacon to the end of the western mole, the depth of the channel steadily increased from about 14 m to 20 m.

1.4.4 The weather conditions at the time of the grounding were reported as light winds, a slight sea with no significant swell and good visibility. The weather conditions during the preceding days had been similar.

1.4.5 On the day of the grounding sunset was at 2056.

1.4.6 The corrected predicted times for high and low water at the harbour entrance were as follows:

date	high water	height (m)	low water	height (m)
12 February	0022	1.7	0702	0.3
	1247	1.7	1918	0.2
13 February	0106	1.8	0749	0.2
	1329	1.7	2005	0.2
14 February	0149	1.8	0834	0.2
	1411	1.8	2052	0.2
15 February	0231	1.9	0919	0.1
	1452	1.9	2139	0.1

1.4.7 The grounding occurred about 2 hours after the predicted time of low water at the harbour entrance. The corrected reading from the tide gauge at Port Chalmers indicated that the height of the tide in the area at the time of the grounding was about 0.8 m.

1.4.8 Around the time of the grounding the company was researching the tidal flows at the harbour entrance. The preliminary results indicated that for the tidal conditions at the time of the grounding, the flow in the centre of the channel would have averaged about 0.6 knots and increased to about 0.9 knots at the sides of the channel. The direction of the flow would have been parallel to the mole up to number one beacon and then along the line of the channel.

1.4.9 The New Zealand Pilot (NP51) contains a caution for vessels navigating in the entrance to Otago Harbour which states:

> Near the harbour entrance, vessels may be set west by the in-going tidal stream and east by the out-going stream.

1.5 Personnel information

1.5.1 The chief pilot started his career as a deck officer cadet and remained with the same shipping company for his entire time at sea. He was employed on a variety of vessel types, serving his last year at sea as first mate. He gained a master foreign going certificate in 1982.

1.5.2 He was employed by the company in August 1983 as relief tug and berthing master and was promoted to junior pilot in September 1984 and to chief pilot in April 1998.

1.5.3 He estimated that he had piloted about 3000 movements in Port Otago harbour since he commenced his employment with the company.

1.5.4 The chief pilot had taken 6 days leave between 1 February and 7 February. On 8 February he was duty pilot but there were no shipping movements, so he worked in the office. He was to be on rostered days off for the following 3 days, but due to the number of shipping movements and the grounding he had worked the following hours:

date	time	activity
Tuesday 9 February	0400-0730 1900-2100	piloted a passenger vessel in piloted a passenger vessel out
Wednesday 10 February	0900-1100 1100-1300	piloted *Prince of Tokyo* in in office
Thursday 11 February		day off
Friday 12 February	0800-1100 1100-1300 1430-1730 2000 2135-2400	piloted a tanker in in office in office piloted *Prince of Tokyo* out *Prince of Tokyo* aground
Saturday 13 February	0000-0353 0353-0935 1300-1605	first attempt to re-float vessel remained on board *Prince of Tokyo* second attempt to re-float vessel
Sunday 14 February	1200-1640	*Prince of Tokyo* re-floated
Monday 15 February	0500-0745 0900-1300	piloted passenger vessel in interviewed about grounding

1.5.5 The chief pilot later stated that he had not felt tired or fatigued at the time of the grounding.

1.5.6 The senior pilot was rostered on duty for 20 of the 24 days preceding the accident, as it was necessary for him to assume the duties of the chief pilot while the chief pilot was on leave and rostered time off. During one of the 4 days the senior pilot was not on duty he was called back to pilot a vessel.

1.5.7 The *Prince of Tokyo* had a complement of 20, all from the Philippines. They were all contracted for one year on the vessel before being signed off for leave.

1.5.8 The master of the *Prince of Tokyo* started his sea-going career in 1964 and was promoted to master in 1987. He held a Philippine master mariner qualification and a Panamanian licence. He joined the *Prince of Tokyo* about one month prior to the grounding. This was his first visit to New Zealand.

1.5.9 The deck officers on the *Prince of Tokyo* all held Philippine qualifications commensurate with their rank. They also held Panamanian licences. The first and third mates had completed 11 and 5 months respectively on the vessel.

1.6 Pilot information and training

1.6.1 The company had previously employed one chief pilot, 2 senior pilots and one junior pilot; however, in December 1997 a senior pilot resigned, leaving the company with the chief and one senior pilot and a junior pilot. The decision was made by the chief pilot, after consultation with the chief executive officer (CEO) of the company, not to employ another experienced pilot. They decided to accelerate the training of the junior pilot instead, to enable him to be classed as an intermediate, and promote one of the existing tug skippers to junior pilot.

1.6.2 At the time of the accident the company employed 4 full-time pilots. The chief and senior pilots were authorised to handle any vessel that called at the port. The third was classed as an intermediate pilot who was authorised to handle vessels up to about 20 000 t. The fourth was a junior and he handled fishing and other smaller vessels. The intermediate and junior pilots often accompanied the senior pilots as part of their training.

1.6.3 The company employed one full-time tug skipper. All the pilots were trained as tug skippers and were expected to operate the tugs as required by the chief pilot. The intermediate and junior pilots undertook the majority of the tug skipper duties in conjunction with the dedicated tug skipper. One of the pilot launch skippers was also trained as a tug skipper and was used as such, when necessary.

1.6.4 If there were no shipping movements on weekdays the chief and senior pilots worked in the office, and the intermediate and junior pilots were engaged in maintenance and other tasks. There was no requirement for the pilots to undertake office duties in the weekend.

1.6.5 Part of the training of the junior and intermediate pilots was to attend a 3 day course at the Australian Maritime College in Launceston, accompanied by the chief pilot. This training included lectures on shiphandling and practical exercises using the ship simulator, which was completed in November 1998.

1.6.6 The company also planned to develop a specific model of Otago Harbour that could be used on the ship simulator for further training. The company estimated that it previously took 3 to 4 years to train a junior pilot up to senior status, but by developing a specific simulator model of the harbour and using it as part of the training, that period could be significantly reduced.

1.7 Company organisation

1.7.1 In 1989 the Otago Harbour Board was discontinued and the company was formed to conduct the day-to-day operation of the port. The Otago Regional Council was a 100% shareholder in the company and had a commercial board of 6 directors to whom the CEO of the company reported.

1.7.2 The Otago Regional Council appointed a harbourmaster on a part time basis. He was responsible for navigation and safety within the harbour, which included licensing the pilots. These responsibilities were detailed in the Otago Harbour Bylaws 1994.

1.7.3 The section of the company responsible for shipping movements within the port was called the shipping services division. The division operated under a self management regime with the chief pilot responsible for its management. The chief pilot reported to the CEO on an as required basis. The company recognised that pilots were trained professionals and felt it appropriate for them to organise and operate the pilotage and associated services themselves.

1.7.4 The shipping services division broadly comprised the pilots, tug crews and pilot launch crew. Members of the dredge crew were utilised as required. Part of the chief pilot's duties was to plan the work roster and allocate the workload for the division. The CEO had no input into the roster, but monitored the completed work records at the end of each month.

1.7.5 The company's requirement with respect to the organisation and coverage of the roster was contained in section 6 of the pilots and tugmasters collective employment contract.

1.7.6 The roster was broadly structured around 5 days on and 2 days off, but was flexible depending on the amount of shipping movements. It was not unusual for the chief and senior pilot to work on their rostered days off if there were a large number of movements, especially if they were vessels that only they could handle. The chief pilot had worked on rostered days off on 5 occasions in the 6 weeks prior to the grounding.

1.7.7 The shipping services division had no written operating procedures or guidelines in force at the time of the grounding. In November 1998, the CEO had requested that the chief pilot in conjunction with his staff, prepare a comprehensive set of procedures and guidelines.

1.7.8 Since the resignation of one of the senior pilots the workload of the chief and remaining senior pilot had increased. As a result the chief pilot said that he had difficulty finding time to compile the procedures and guidelines. On 18 January 1999, the CEO expressed his concerns to the chief pilot over the lack of progress with the manuals.

1.7.9 Meetings between the CEO and chief pilot were held "as required". There was no company requirement for regular operational or safety meetings either between the chief pilot and his staff or the chief pilot and the CEO. Other shipping services division staff had expressed to the CEO that they wanted regular meetings with the chief pilot. The CEO had brought this to the attention of the chief pilot.

1.8 Recorder information

1.8.1 The course recorder trace from the *Prince of Tokyo* was referenced to UTC (NZDT-13 hours). For simplicity these times have been converted to NZDT.

1.8.2 Beach Street wharf lies in a true direction of 072/252 degrees. The course recorder trace indicated that when the *Prince of Tokyo* was alongside the wharf, the heading was recorded as 250 degrees true. Therefore it was assumed that the course recorder was set up reading 2 degrees low.

1.8.3 The only entries made in the bridge movement book and deck log book with regard to the transit of the harbour were:

- 2036 last line
- 2054 first engine movement ahead
- 2130 gangway wire parted
- 2135 vessel aground.

1.8.4 The engine movement recorder indicated the following engine movements, once clear of the berth:

- 2050 dead slow ahead
- 2053 slow ahead
- 2054 half ahead
- 2055 full ahead
- 2108 navigation full ahead
- 2137 stop (vessel aground).

1.8.5 The senior pilot who piloted the *Prince of Tokyo* out of Port Otago after the temporary repairs were completed conducted the following test: while the vessel was travelling at a speed of approximately 10 knots in open water he ordered 10 degrees of port helm to be applied and found it took 82 seconds for the vessel to change heading by 15 degrees.

1.9 Interaction

1.9.1 When a vessel is travelling in calm, open, deep water the water pressure system around the hull reaches equilibrium. If the vessel moves into shallow or confined water this equilibrium can become upset as the pressure system around the hull interacts with the seabed or sides of a channel.

1.9.2 Squat is the term given to the increase in draft and/or trim a vessel can experience due to its movement through shallow water. The water accelerates as it flows past the hull to fill the hole the vessel has left in its wake. This increase in velocity causes a decrease in water pressure under the vessel and a resultant loss of buoyancy. The effect of squat on loaded vessels with an even keel, like the *Prince of Tokyo* departing Port Otago, often causes the vessel to trim by the head. A vessel squatting by the head in shallow water can experience an over-steering phenomenon caused by the pivot point shifting aft, together with an increase in lateral resistance forward; however, in shallow water a vessel does not attain as large a drift angle as it would in deep water, which has the counter effect of slowing the rate of turn.

1.9.3 In much the same way as a vessel squats towards the seabed, a vessel travelling close to the side of a channel can experience bank effect. An increase in water pressure at the bow forms a cushion between the bow and the bank, deflecting the bow towards the centre of the channel. At the same time, aft of the pivot point the flow of water accelerates between the bank and the side of the vessel, drawing the stern of the vessel towards the bank. The resultant forces may cause the vessel to sheer across the channel if not compensated for.

1.9.4 The influence that squat and bank effect have on a vessel varies with the square of the speed of the vessel. Therefore, a small reduction in speed will dramatically reduce the effects of squat and bank effect.

1.10 Other information

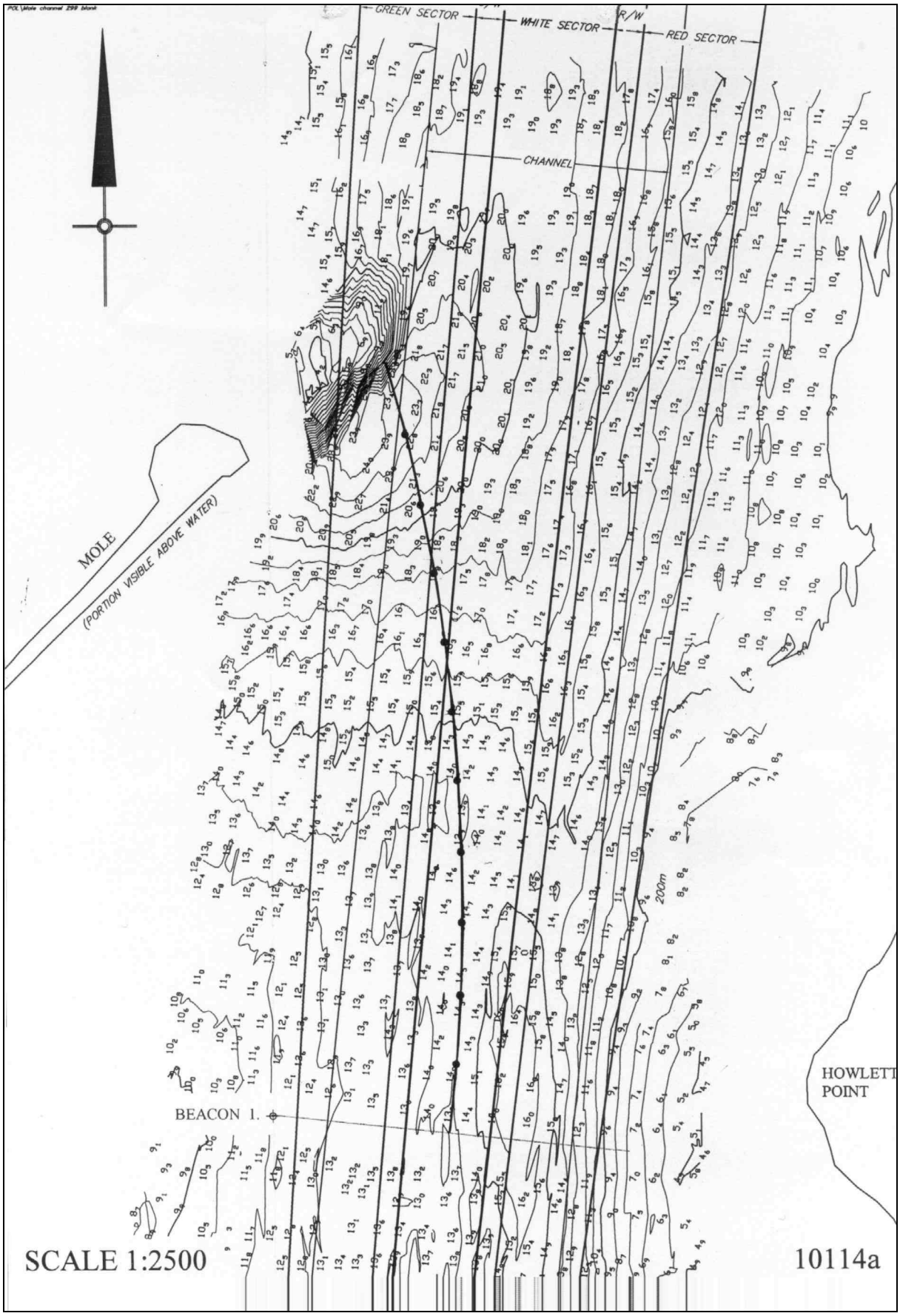
1.10.1 In November 1998 the *Prince of Tokyo* was proceeding down the Mississippi River with a pilot on board when it took a sheer to starboard and although counter helm was applied the vessel collided with a mooring dolphin. The fore peak tank was punctured in the collision.

1.10.2 The United States Coast Guard investigation into this accident found the cause to be pilot error. The vessel was apparently being navigated too close to the extreme left hand side of the channel at too high speed and was subjected to bank effect that could not be sufficiently countered with helm and engine manoeuvring.

2. Analysis

2.1 The starboard gangway wire parting was in itself a potentially serious incident, particularly as the wire supported the gangway when it was used in conjunction with the pilot ladder. It was not possible to determine either what position the gangway was in or where on the gangway the wire parted. The gangway had been lowered and raised when the chief pilot boarded so it was assumed that the wire was rigged correctly. The wire was relatively new and in good condition apart from the damaged section, which appeared to have been caught between a sheave and the cheek plate either before or at the time of breaking. A crew member could have been standing on the gangway when the wire parted; therefore, the degree of concern by the bridge team was not excessive.

2.2 Even though the first mate was in the radio room, both he and the third mate thought the other was still officer-of-the-watch at the time of the accident. Due to this confusion the third mate went out to the starboard bridge wing to observe the problem with the gangway, leaving the engine control unattended.



(chart courtesy of Port Otago Limited)

Figure 7
Plot of probable track of *Prince of Tokyo*

2.3 With the first mate in the radio room and the third mate on the bridge wing, only the master was left to assist the chief pilot and monitor the progress of the vessel. When the master also went out to the bridge wing the pilot was effectively left alone with the helmsman.

2.4 The chief pilot gave the port 10 helm order after hearing the wire part and then became distracted by the commotion he heard over the handheld VHF radio. Although he could see the top of the gangway from inside the wheelhouse, and the master and third mate were already on the bridge wing assessing the situation, the chief pilot chose to go out to the bridge wing himself, leaving the helmsman in the wheelhouse alone.

2.5 The chief pilot was concerned that someone may have fallen overboard. If this had been the case it would be expected that the third mate would have informed the chief pilot and master straight away. In any case the chief pilot had few options available to him at that stage of the passage had there been a man overboard, other than raising the alarm and calling for assistance from the pilot launch or the shore.

2.6 While the chief pilot was on the bridge wing discussing the situation with the master they were both looking down at the gangway and the chief pilot briefly lost awareness of the rate of turn of the vessel. At this time the vessel was proceeding at about 10 knots in confined waters virtually unmonitored. By the time he looked up the vessel was already swinging towards the end of the mole.

2.7 As there were no times recorded for the vessel passing landmarks or beacons, an accurate assessment of the speed of the vessel could not be made. However, the course recorder trace indicated that the heading first passed 090 degrees true at about 2114. On this heading the vessel would be about midway between numbers 14 and 16 beacons. From this position to the grounding position the vessel travelled about 3.3 miles in 21 minutes, which equated to an average speed of 9.5 knots.

2.8 The chief pilot stated that the *Prince of Tokyo* was abeam of number one beacon, on a heading of 006 degrees true when he ordered 10 degrees of port helm. Immediately before the vessel grounded the speed was estimated to be about 10 knots and the heading 348 degrees true.

2.9 The vessel changed heading from 006 to 348 degrees true before grounding, a total of 18 degrees. Using the figures from the senior pilot's test, it would take 98 seconds for the heading to change 18 degrees. At a speed of 10 knots the vessel would travel 504 m in 98 seconds. This equates to a change of heading of 2 degrees for every 56 m travelled.

2.10 By plotting these figures on a sounding chart of the harbour entrance the approximate track of the *Prince of Tokyo* immediately before the grounding can be seen. (See Figure 7.)

2.11 The chief pilot estimated that he was on the bridge wing for about a minute. Using the rate of turn calculated from the trial that the senior pilot conducted after the vessel sailed, the head would have changed about 11 degrees during this time. To achieve his aim of opening up the distance the vessel would pass off the fairway buoy ("a few degrees") the port 10 helm would have only needed to be applied for a short period of time.

2.12 The loss of situational awareness by the bridge team and the chief pilot was enough to allow the *Prince of Tokyo* to reach a point where the grounding was inevitable. The chief pilot realised the vessel was heading for danger and regained situational awareness quickly. Although his actions to try an avert the grounding were commendable, they were too late.

2.13 It was stipulated in the Tokai Shipping Company procedures manual that the pilot and master must exchange information. This was not carried out by the master of the *Prince of Tokyo* as the only information he gave to the chief pilot was contained on the pilot card. As the master did not request any information from the chief pilot he had no knowledge of the chief pilot's intentions and therefore could not brief his crew.

2.14 Neither the chief pilot, master or crew of the *Prince of Tokyo* had attended a Bridge Resource Management (BRM) course. On the bridge of the *Prince of Tokyo* the principles of BRM were not being followed in the following respects:

- inadequate pilot/master exchange on both the inward and outward passages
- no sharing of information between pilot, master and crew
- inadequate monitoring of the vessel's progress
- no plans for unforeseen problems
- no allocation of specific tasks for each person
- confusion between the chief and third mates over who was officer-of-the-watch.

As the *Prince of Tokyo* had run aground only a few months earlier due to "pilot error" it would be assumed that the master and officers would be keeping a particularly vigilant watch on the navigation of the vessel while under pilotage.

2.15 The weather conditions at the time of the accident were favourable and therefore did not contribute to the grounding. Although the tide may have been setting the vessel towards the mole at the time of the accident, the rate would have been negligible and the pilot would have been aware of its effect on the vessel, having piloted some 3000 movements in and out of the harbour entrance.

2.16 A vessel with the size and hull form of the *Prince of Tokyo* would have been affected by interaction with the seabed to some extent but any bank effect would have pushed the bow of the vessel away from the mole. From the time the chief pilot ordered the port 10 helm order the depth of water under the keel was increasing, so the effects of squat would have been decreasing. Any effect that squat may have had on the vessel would have tended to slow the rate of turn, rather than accelerate it.

2.17 There was no language problem between the chief pilot and the master and crew of the *Prince of Tokyo*; they all spoke and understood English well. However, there was a problem when in the heat of the moment the third mate and the deck crew reverted to Filipino over the VHF radio, a language the chief pilot could not understand. If the chief pilot had ignored this conversation and waited until the master or third mate informed him of any problems the grounding would probably have been averted.

2.18 The chief pilot's attention being drawn to a problem that had already distracted the master and third mate is considered a normal human reaction to the situation. The principles of BRM are designed to cater for such events without affecting the safe passage of the vessel.

2.19 Three attempts over the subsequent 2 days were made to re-float the *Prince of Tokyo*. On each occasion the chief pilot was in attendance. He piloted a passenger vessel in to Port Chalmers on the third day, 15 February 1999, and was interviewed that same day with regard to the grounding. The grounding, followed by this series of events would have left the chief pilot fatigued and under considerable stress.

2.20 During the same period, the senior pilot was on board the *Prince of Tokyo* for 7½ hours, which included one attempt at re-floating it. He spent 4 hours in the office and piloted 3 other movements. The total number of hours worked by the chief and senior pilot over the period following the grounding would have been too much for one person to safely cope with.

2.21 It would have been prudent for the company to stand the chief pilot down after the initial grounding, but due to the lack of a second senior pilot it did not have the resources to do so. This increased the potential for further incidents or accidents involving the *Prince of Tokyo* and other vessels.

2.22 The chief pilot had a wide variety of responsibilities in excess of piloting; these included:

- the day-to-day running of the SSD
- co-ordinating pilotage and tug services
- compiling the working roster for the SSD
- reporting to the CEO as required
- organising maintenance of plant
- compiling an operating procedures manual
- liaising with contractors
- staff training.

2.23 The decision not to replace the senior pilot who resigned in 1997 with another experienced pilot undoubtedly resulted in a higher workload for both the chief and the senior pilots. The situation had affected their ability to take uninterrupted rostered days off and leave.

2.24 Having only 2 pilots capable of handling large vessels left little margin for situations where one pilot was not available, or when the port was busy. Even though the company were sending the intermediate and junior pilot for simulator training it was not envisaged that the intermediate pilot would be given senior pilot status for at least one more year. On occasions 3 of the 4 pilots were engaged with one shipping movement at the same time, one piloting and 2 as tug skippers. The senior pilot being rostered on for 20 consecutive days out of 24 immediately prior to the grounding and then being called back to work on one of his 4 rostered days off is an example of the kind of pressure the chief and senior pilots were working under.

2.25 The chief pilot had been employed by the company for about 16 years, during which time he had only attended one practical training course; he had not undergone any form of peer review, other than accompanying the other pilots to Launceston. He had attended an international pilotage conference on one occasion. Due to the way safety management of ships and ports is changing pilots need to be kept informed of changes in their field of work. Pilots attending courses, workshops and undergoing peer reviews are essential to the safe operation of a port.

2.26 Although the chief pilot was probably not fatigued at the time of the grounding, he was likely to have been suffering from the long-term effect of being under pressure to perform his role as manager of the shipping services division as well as chief pilot. It is possible that this pressure affected his judgement and allowed him to be more easily distracted shortly before the grounding.

2.27 Under the international safety management regime it is required that all masters ensure that the pilotage section of each voyage is planned. Consequently it should be a requirement for every maritime pilot to have a pilotage plan to discuss with the master of every ship entering a port, and for the pilot and the crew to form an effective bridge team to monitor all aspects of the progress of the vessel against that plan. In this case neither the pilot nor the crew had done so and a grounding resulted.

3. Findings

Findings and safety recommendations are listed in order of development and not in order of priority.

3.1 The master and crew of the *Prince of Tokyo* held the appropriate qualifications for their respective positions.

3.2 The chief pilot was adequately qualified and experienced for his position, but he had not attended sufficient courses to keep him informed of developments and trends in the pilotage industry, nor had he been subjected to any form of review from time to time.

3.3 All statutory certificates for the *Prince of Tokyo* and its crew were valid and in accordance with flag state and convention requirements.

3.4 Mechanical or equipment failure did not directly contribute to the grounding.

3.5 The weather and tidal conditions did not contribute to the grounding.

3.6 The effects of interaction between the ship and the seabed did not contribute to the grounding.

3.7 The master, crew, and pilot were all adequately rested and not fatigued at the time of the grounding.

3.8 The pilot and master did not have an adequate information exchange on either the in or out bound passages for each to understand fully the other's intentions.

3.9 The master, officers and pilot did not follow the principles of good bridge resource management. If they had the grounding probably would have been averted.

3.10 The company had no procedures or guidelines in force to set minimum standards for their employees to maintain, nor did it have any guidelines for the pilot/master exchange of information.

3.11 By limiting the number of pilots it employed, the port company exposed itself to a high risk of their pilots operating in a fatigued state during periods of peak workloads.

3.12 The chief pilot should not have been required to take control or assist with the salvage of the *Prince of Tokyo* over the ensuing days.

3.13 The master of the *Prince of Tokyo* was not following the instructions of his company as laid down in their procedures manual with regard to the navigation of his vessel while under pilotage.

3.14 Although the master and crew had a reasonable standard of English, their lapse into their native tongue during a period of high activity left the pilot out of the communication loop and contributed to the grounding.

3.15 The *Prince of Tokyo* grounded when the pilot and crew became distracted and did not continue monitoring the progress of the vessel after the gangway wire parted.

3.16 The actions of the pilot in trying to avert the grounding were prompt and correct under the circumstances, but were too late.

3.17 The company did not have sufficient management control of the daily running of the shipping services division.

4. Safety Actions

4.1 Since the grounding all pilots employed by the company have attended a bridge resource management course.

4.2 Port Otago Limited is developing procedures, training, auditing and peer reviews to a level where ISO accreditation can be achieved.

5. Safety Recommendations

5.1 On 13 December 1999 the Commission recommended to the chief executive of Port Otago Limited that he:

5.1.1 review the piloting requirements for the Port of Otago and ensure that sufficient resources are available for all operations to be undertaken safely, particularly with regard to the avoidance of pilot fatigue (071/99); and

5.1.2 as a matter of urgency, ensure the company procedure manuals are completed (072/99); and

5.1.3 ensure all pilots employed by the company review, and where appropriate, adopt changing trends and developments in the industry and implement a system of peer review for them (073/99); and

5.1.4 critically review the management structure between the company and the shipping services division and ensure that sufficient management control is established and maintained (074/99).

5.2 On 1 December 1999 the Commission recommended to the director, operations department, Tokai Shipping Limited that he:

5.2.1 ensures bridge resource management principles are being practiced within the Tokai Shipping fleet (075/99); and

5.2.2 ensures that crew on his company vessels adhere to the guidelines set out in the company procedures (076/99).

Approved for publication 1 December 1999

Hon. W P Jeffries
Chief Commissioner