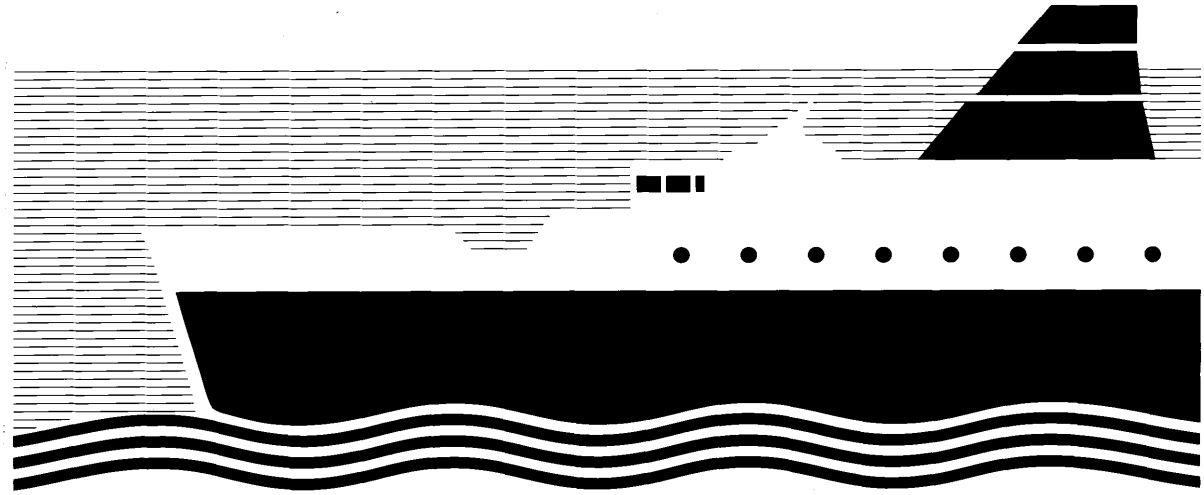
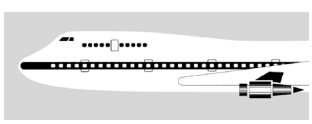
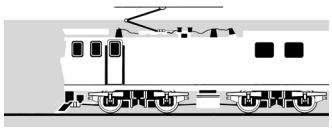
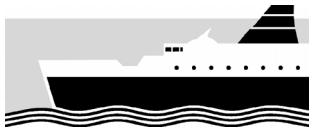


MARINE OCCURRENCE REPORT

05-211 **container ship *Spirit of Resolution*, collision with bridge, Onehunga** **8 October 2005**

TRANSPORT ACCIDENT INVESTIGATION COMMISSION
NEW ZEALAND

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.

Report 05-211

container ship
Spirit of Resolution

collision with bridge

Onehunga

8 October 2005

Abstract

On Saturday 8 October 2005 at about 1312, the container ship *Spirit of Resolution* collided stern first with the Old Mangere Bridge as the ship departed Onehunga when control of the unberthing manoeuvre was lost during high winds. There were no injuries. The ship, old road bridge and wharf all sustained damage during the incident.

Safety issues identified included:

- bridge resource management
- contingency planning for emergency situations on board
- ambiguities in the pilotage exemption requirements and training for Manukau Harbour.

Safety recommendations were made to the Chief Executive of Pacifica Shipping and the Director of Maritime New Zealand to address these safety issues.

The *Spirit of Resolution* leaving Onehunga

Contents

Figures

Abbreviations

ARC	Auckland Regional Council
BRM	Bridge resource management
CIR	Chief Integrated Rating
DPA	designated person ashore
GT	gross tonnage
ISM	International Safety Management
km	kilometre(s)
kW	kilowatt(s)
Lt. Bn.	light beacon
m	metre(s)
m^2	square metre(s)
m/s	metres per second
MetService	New Zealand Meteorological Service
mm	millimetre(s)
MSA	Maritime Safety Authority (former name of Maritime New Zealand)
nm	nautical mile(s)
t	tonne(s)
TEU	20-foot equivalent unit
POAL	Ports of Auckland Limited
STCW-95	the International Convention on Standards of Training, Certification and Watchkeeping, 1978 as amended in 1995
UHF	ultra high frequency
UKC	under-keel clearance
UTC	co-ordinated universal time
VHF	very high frequency

Glossary

athwartships	transversely across a ship
Becker rudder	a rudder with an active trailing edge, or flap, that increases its turning efficiency
bight	part of a rope or hawser bent into a loop
bollard pull	a measure of the static pull a vessel can exert
bow thruster	a small athwartships propeller mounted in a tunnel at the forward part of a ship, used to manoeuvre a ship at slow speeds
designated person ashore	a designated person or persons ashore having direct access to the highest level of management, with responsibility to ensure the safe operation of each ship and to provide a link between the company and those on board. Their responsibility and authority included monitoring the safety and pollution prevention aspects of the operation of each ship and ensuring that adequate resources and shore-based support are applied, as required
dolphin	an iron or wood structure, in harbours, for the mooring of ships
gross tonnage	a measure of the internal capacity of a ship; enclosed spaces are measured in cubic metres and the tonnage derived by formula
head line	a hawser leading forward from the bows of a ship to a point outside the ship. May be used for mooring or warping
heaving line	small line that is thrown so that one end reaches a position outside the ship, and allows connection to be established
ISM code	International Management Code for the Safe Operation of Ships and for Pollution Prevention adopted by the International Maritime Organization (IMO) by resolution A.741(18), as amended from time to time
neap tide	tidal undulation that has the highest low water, and lowest high water, in a series
panama lead	circular fairleads. Necessary when being towed by shore locomotives in the Panama Canal
perigee	the point in a body's orbit at which it is nearest the Earth
pitch (of propeller)	the angle that a propeller blade makes with the propeller shaft. It is this pitch that produces the propulsion to drive a ship ahead or astern
port	left-hand side when facing forward
quarter	that part of a ship between the beam and the stern
spring line	a mooring rope leading aft from the bow or forward from the stern
spring tide	tidal undulation that has the lowest low water, and highest high water, in a series
starboard	right-hand side when facing forward
TEU	an industry standard unit to express the number of containers based on an equivalent size of 20-foot-long, 8-foot-wide, 8-foot-high dry-cargo containers, for example a 40-foot container = 2 TEU
tidal stream	the horizontal movement of the water due to tide

Data Summary

Vessel Particulars:

Name:	*Spirit of Resolution*
Type:	container ship
Class:	✠ 100 A5 E, container vessel ✠ MC E AUT
Limits:	unlimited
Classification:	Germanischer Lloyd
Length:	100.72 m
Breadth:	16.50 m
Gross tonnage:	3850
Built:	1997, Estaleiros Navais, Portugal
Propulsion:	MaK 8 M 32 C diesel engine producing 3500 kW driving a single controllable-pitch propeller through a reduction gearbox
Service speed:	15.0 knots
Owner	Harren & Partner, Bremen, Germany
Charterer/Operator:	Pacifica Shipping (1984) Limited
Port of registry:	Lyttelton
Minimum crew:	10
Date and time:	8 October 2005 at about 1312[1]
Location:	Onehunga
Persons on board:	crew: 11
Injuries:	nil
Damage:	extensive to wharf, old road bridge and ship
Investigator-in-charge:	Captain Iain Hill

[1] Times in this report are New Zealand Daylight Time (UTC + 13 hours) and are expressed in the 24-hour mode.

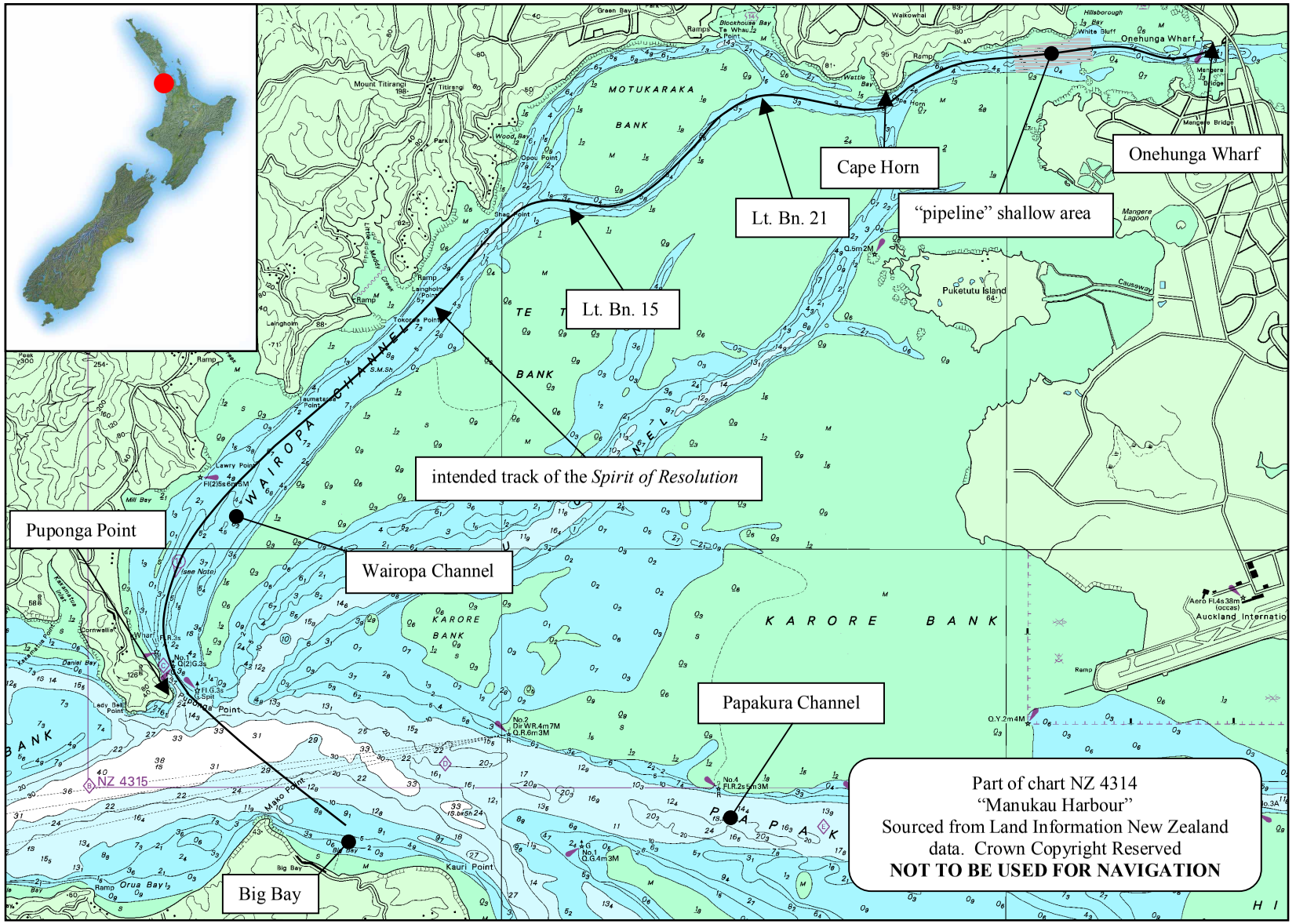


Figure 1
General area of the accident

1 Factual Information

1.1 Narrative

1.1.1 On Thursday 6 October 2005 at about 1100, the *Spirit of Resolution* arrived off the Manukau Bar. The Bar had been closed earlier that day due to bad weather and a heavy swell. However, because the ship had arrived near high water and was entering the Harbour, the Bar closure was temporarily lifted to allow the ship to enter.

1.1.2 The *Spirit of Resolution* successfully crossed the Bar without incident, the Master reporting a 3 m swell occasionally rising to 4 m to 5 m. The ship proceeded across Manukau Harbour, along the Wairopa Channel to Onehunga (see Figure 1), where the Master berthed port side to the Wharf at "B" berth, on an ebb tide (see Figure 2).

1.1.3 The discharge of cargo was completed by Friday morning. If the ship had berthed port side to the Wharf, normal practice, when the ship was light after discharge, was to let the lines go and swing the ship using the main engine and tug and re-berth starboard side to the Wharf prior to the commencement of loading. However, due to routine maintenance, the main engine was unavailable during this time, and the ship remained port side to the Wharf.

1.1.4 On Saturday 8 October at about 0900, the Master of the *Spirit of Resolution* advised the Onehunga Wharf Assistant Co-ordinator that the ship's departure had been scheduled for 1300 and that he required the assistance of the tug.

1.1.5 Shortly afterwards the Master telephoned the signal station at South Head to ascertain the weather and swell conditions at the entrance to the Harbour. The signalman informed the Master that the wind speed was 45 knots gusting to 80 knots, sea very rough with a 5 m westerly swell and that the Bar would be closed from 1000.

1.1.6 At about 1021, the South Head signalman issued the Bar closure message by email and fax to the Port of Onehunga, Auckland Harbour Control, the Ports of Auckland Limited (POAL) Marine Manager and the Auckland Regional Council (ARC) Harbourmaster. On receipt of the message at Onehunga, the Assistant Co-ordinator telephoned the *Spirit of Resolution* to advise it of the closure. The Duty Officer on board the *Spirit of Resolution* advised him that they were already aware that the Bar had been closed.

1.1.7 The Master later stated that he decided to depart from Onehunga using the available tidal window to cross the shallows in the region of a pipeline (see Figure 2) in order to transit the Wairopa Channel and then anchor in the area of Big Bay or elsewhere in the Papakura Channel and await the Bar opening. He also stated that the company wished him to go and "have a look at the Bar", although he had no intention of crossing the Bar and his plan was to go to anchor.

1.1.8 Cargo loading was completed in time for the ship to sail as scheduled and at about 1240 the Master tested the bridge, engine room and steering gear in accordance with the pre-departure checklist. No deficiencies were noted. The Master stated later that he estimated the wind to be 20 to 25 knots [10.3 m/s to 12.9 m/s] from the southwest.

1.1.9 At about 1253, the tug *Tika* was made fast using one of the tug's towing lines on a bight through a panama lead forward of the break of the ship's accommodation about 30 m from the stern. The aft mooring party secured the line on the horns attached to the panama lead.

1.1.10 As the tug was being made fast the First Mate arrived on the navigating bridge for standby after completing the necessary pre-departure paperwork and trimming the vessel with ballast. The Master then held a briefing with the First Mate and tug Skipper on his plan for departure. Communication with the tug Skipper was by means of very high frequency (VHF) radio channel 11.

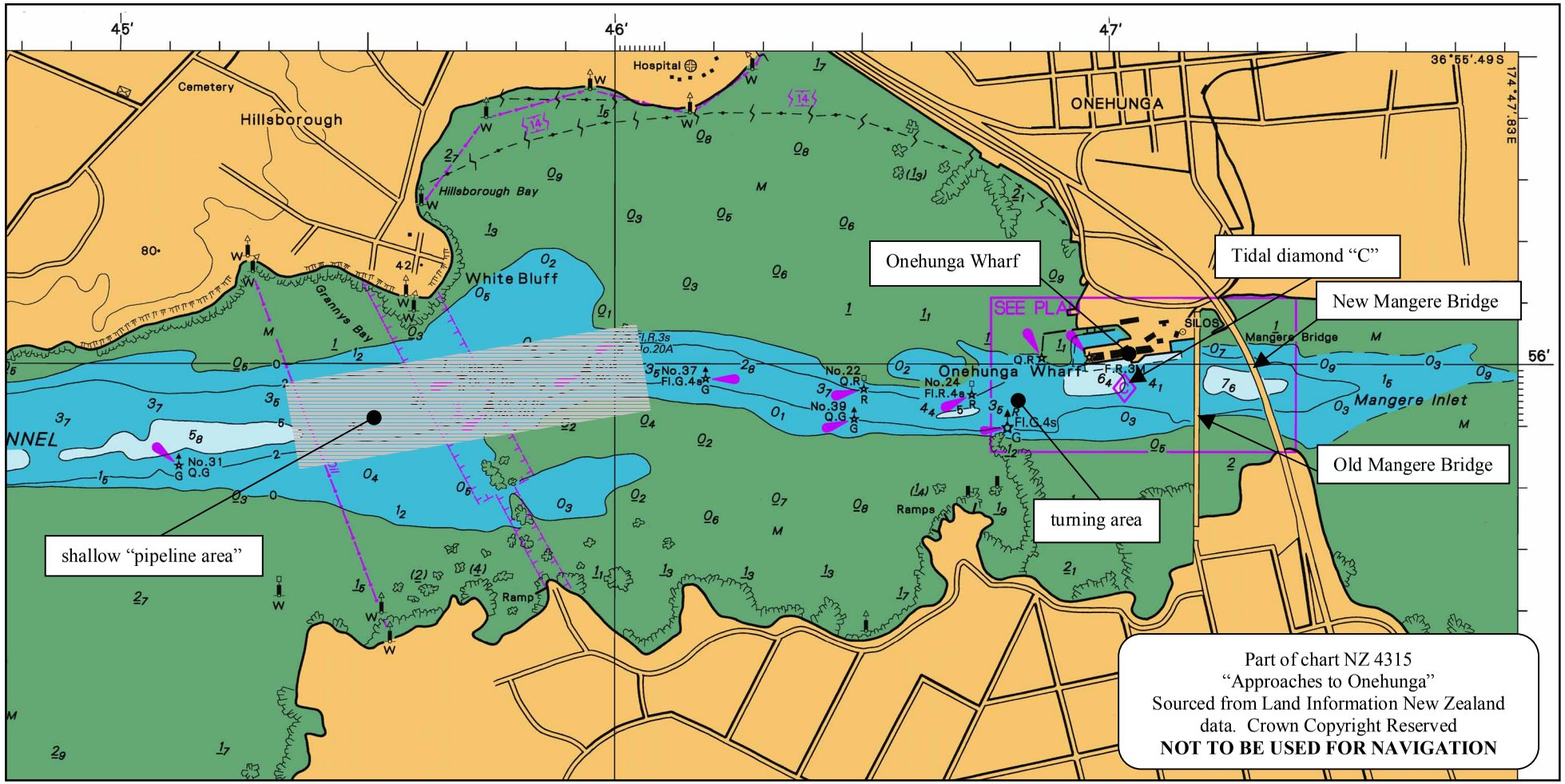


Figure 2
Onehunga Wharf and approaches

1.1.11 The Master's plan was to let go the mooring lines, use the tug and bow thruster to move the ship off the Wharf, manoeuvre the ship stern first to the first pair of beacons that mark the start of the channel and at that point turn the ship and proceed out (see Figure 3). The Master stated later that this was not a manoeuvre he had done before, however it was a manoeuvre the ship had completed previously although he did not know when or in what weather conditions.

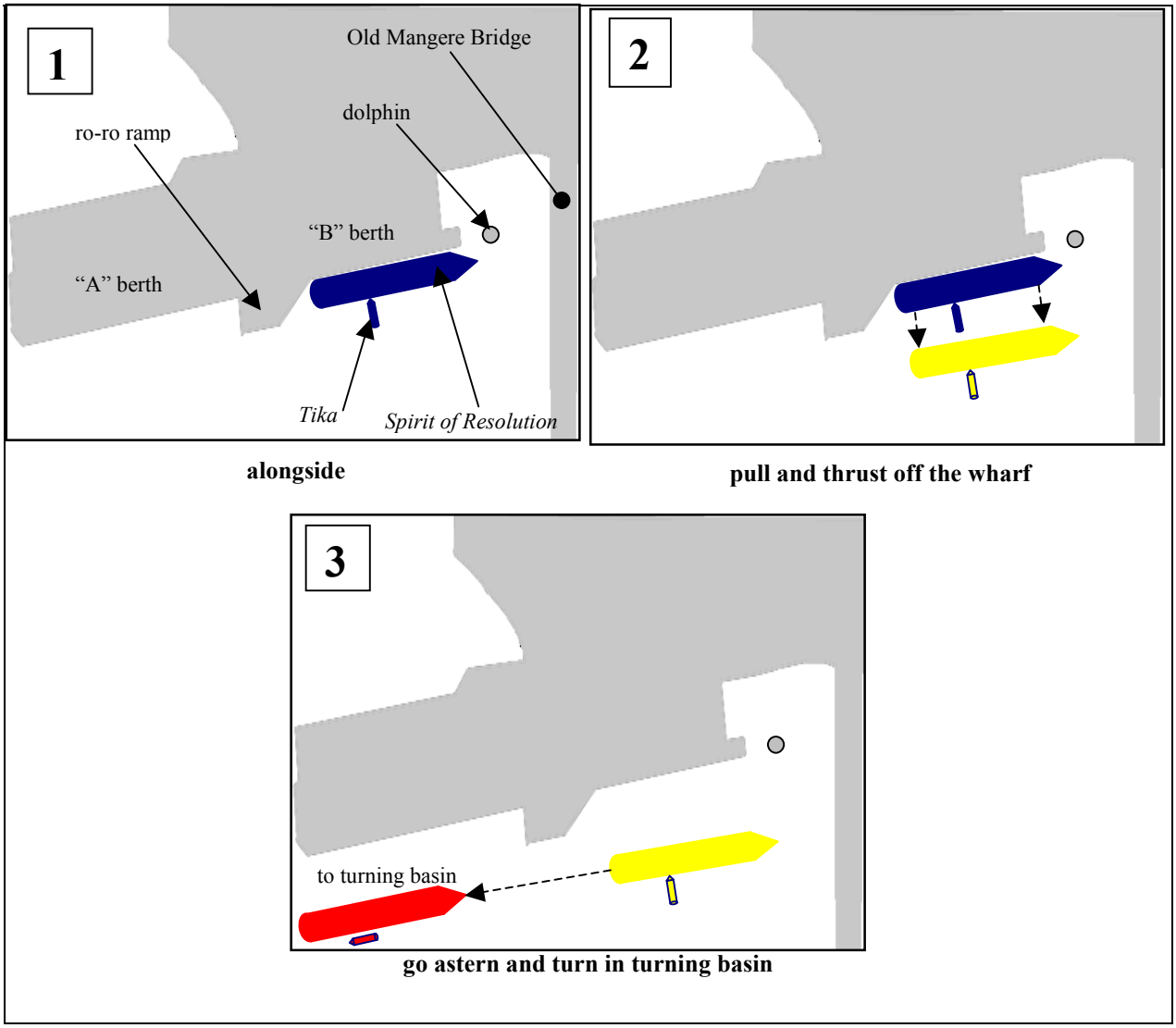


Figure 3
Diagram of Master's intended departure plan

1.1.12 At about 1255, the Master rang stand-by for the engines and engine control was transferred from the engine room to the navigating bridge. The bridge team then tested the engine and bow thruster controls at the centre console before transferring control for the engines, bow thruster and steering to the port bridge wing. Communications using ultra high frequency (UHF) radio were established between the bridge team and the forward and aft mooring parties.

1.1.13 At about 1258, the Master ordered the forward and aft mooring parties to let go all mooring lines. As the lines were let go, the Master ordered the tug Skipper to pull off with full weight, and increased the thruster power to full to starboard. The ship slowly came clear of the Wharf. The Master found that he had to increase the pitch on the controllable-pitch propeller to 50% astern thrust to maintain the ship's position in relation to and parallel to the Wharf (see Figure 4, diagram 2).

1.1.14 At about 1303 the Master realised that he was not in full control of the ship, and after a short discussion with the First Mate, made a clear decision to re-berth the ship. He used the portable VHF and UHF radios to inform the 2 mooring parties and the tug Skipper of his decision.

1.1.15 The Master then told the 2 mooring parties to attempt to run some mooring lines as soon as possible. He also told the tug Skipper to push on, and adjusted the bow thruster to full to port.

1.1.16 The bow of the *Spirit of Resolution* started to move to port and the forward mooring party was able to send a head line ashore where a shore-side worker fastened it to the bollard on the dolphin. They also managed to send a spring line ashore that was fastened to a bollard on the Wharf (see Figure 4, diagram 3).

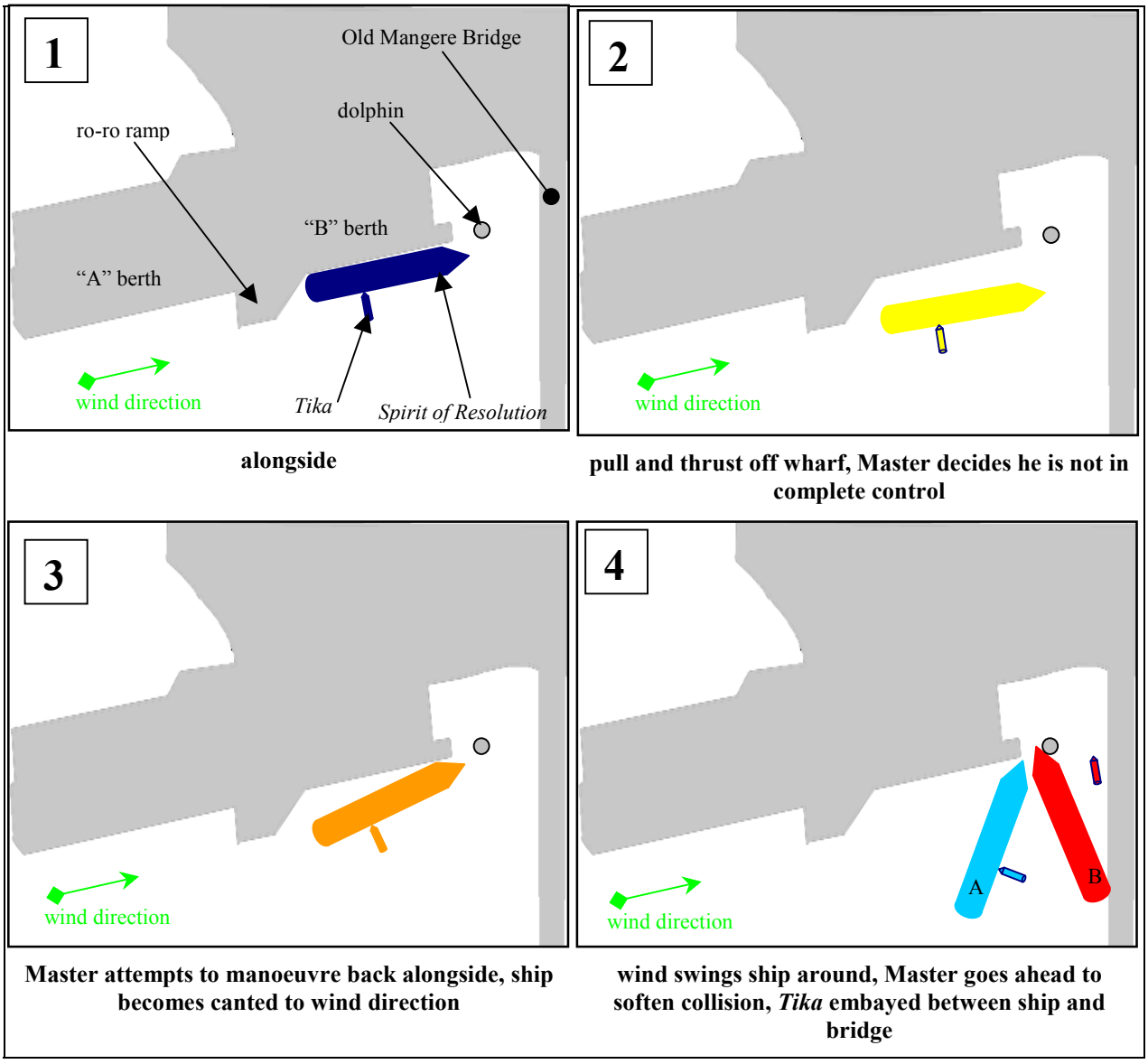


Figure 4
Diagram showing sequence of actual events

1.1.17 The *Tika* was unable to push the stern of the vessel back towards the Wharf. The Chief Integrated Rating (CIR) in charge of the aft mooring party made several attempts to get a heaving line ashore but was thwarted by the wind carrying the line away.

1.1.18 As the bow of the *Spirit of Resolution* closed with the Wharf, the ship became canted to the line of the Wharf (Figure 4, diagram 3). This cant allowed a gust of wind to get onto the port side of the ship. The combined effect of the wind and the incoming tidal stream on the now more

exposed port side of the ship increased the speed of the swing of the ship's stern to starboard, overpowering the thrust of the tug.

1.1.19 Seeing the speed of the swing increasing, the after mooring party gestured to the tug Skipper to slip his line and went to where the *Tika* was made fast to assist in letting the tug go. Once the *Tika*'s line had been released, the tug Skipper saw that he did not have enough room or time to get clear around the stern of the *Spirit of Resolution,* and so conned the tug into the clear water towards the bow of the *Spirit of Resolution*.

1.1.20 Realising that the stern of the *Spirit of Resolution* was going to collide with the Old Mangere Bridge, the Master applied full starboard helm and adjusted the pitch on the propeller to give a strong kick ahead in an attempt to soften the impact of the starboard quarter with the Bridge. As a result the bulbous bow was pushed between one of the piles supporting the dolphin walkway and the dolphin itself. The starboard side of the bulbous bow finally rested against the side of the dolphin, with the starboard quarter of the ship against the Bridge. The ship was held in this position by the flood tide and westerly wind, embaying the tug (Figure 4, diagram 4, B).

1.1.21 High water at Onehunga was at about 1430 and at about 1528 the stern of the *Spirit of Resolution* lifted off the Bridge as the strength of the outgoing tidal stream overcame the strength of the wind. As soon as there was enough clear water at the stern of the ship the Skipper of the *Tika* conned the tug around the stern of the *Spirit of Resolution* and into clear water.

1.1.22 The Master of the *Spirit of Resolution* requested the *Tika* to be made fast as far aft as possible then, using combinations of the tug's power, ship's rudder, engines and remaining moorings attempted to manoeuvre the ship back alongside, port side to the Wharf. However, these attempts were unsuccessful.

1.1.23 On being informed of the incident, the designated person ashore (DPA) assembled the company's emergency response team to provide help and advice as required. The *Spirit of Resolution*'s other Master, who had been appointed to the ship for longer, was currently on leave and lived nearby. The DPA requested him to come to Onehunga and provide whatever support and help he could to the incumbent Master.

1.1.24 In consultation with the on-leave Master, the Master in command formulated a plan using the available resources and more substantial engine and bow thruster movements than he had applied before. He succeeded in swinging the ship until the bow was pointing towards the exit channel and into the wind. Once the ship was clear of the Wharf and Bridge, the Master ordered the port anchor to be dropped, and using this as a dredge and pivot point in conjunction with the tug and mooring lines manoeuvred the ship back alongside "B" berth, starboard side to the wharf.

1.2 Vessel information

1.2.1 The *Spirit of Resolution* was a geared container ship owned by Harren & Partner of Bremen, Germany. The ship was bareboat chartered and operated by Pacifica Shipping (1984) Limited (Pacifica) trading on a regular service between Lyttelton, Nelson and Auckland (Onehunga). It was capable of carrying 382 TEU and was strengthened for heavy cargoes. The ship was in class with Germanischer Lloyd and was built in Portugal in 1997. At the time of the accident, the *Spirit of Resolution* had a draught of about 5.7 m forward and 5.8 m aft, less than the maximum load draught of 5.90 m.

1.2.2 The *Spirit of Resolution* was powered by a MaK 8M 32C diesel engine, developing a power of 3500 kW driving a single controllable-pitch propeller through a reduction gearbox, giving a service speed of about 15 knots. A "Becker" type rudder provided steering and was located directly aft of the propeller. In addition the ship was equipped with a bow thruster with a maximum power rating of 350 kW, equivalent to 4.69 t bollard pull.

1.2.3 At the time of the accident, the Becker rudder was inoperative, the trailing flap having been disabled. The rudder therefore operated similarly to a conventional rudder.

1.2.4 After the incident the windage area of the ship including the deck cargo was calculated to be about 954 m^2. The force of the wind acting on this area can be calculated from the formula[2]: Force (t) per 1000 m^2 = wind speed^2 (m/sec)/18. Thus the strength of the wind force on the *Spirit of Resolution* varies exponentially to the speed of the wind in metres per second (see Figure 5).

1.2.5 The *Tika* was a twin-screwed tug built in Whangarei in 1971, and owned and operated by POAL. It was powered by 2 Caterpillar D 343 TA diesel engines producing a total power of 544.2 kW. Each engine drove a fixed-pitch propeller through a reduction gearbox. The *Tika* had a static pull of 7.95 t and was crewed by a skipper and a deckhand.

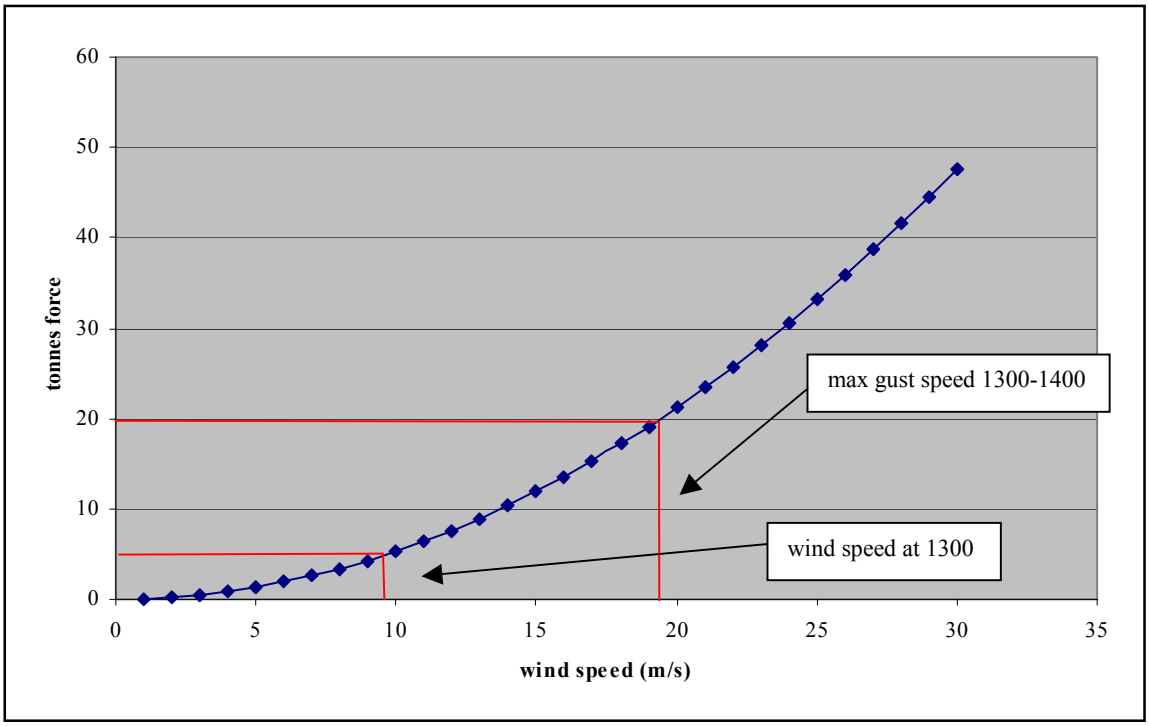


Figure 5
Graph of wind force on the beam windage area of the *Spirit of Resolution*

1.3 Personnel information and company procedures

1.3.1 The Master first went to sea in 1986, gaining his Master's foreign going certificate in 1995. He had been employed by Pacifica since 1995 and was promoted to Master in 2002, serving on several of the company's ships. He held pilotage exemptions for Wellington, Manukau, Nelson and Lyttelton Harbours. The Master had not attended a specific bridge resource management (BRM) course, his BRM training being incorporated in the certificate of competency training. He had been re-appointed, on a permanent basis, as Master of the *Spirit of Resolution* in late September 2005, about 2 weeks prior to the accident. In the previous 2 years the Master had been in command of the *Spirit of Resolution* for 4 periods, totalling 57 days.

1.3.2 The First Mate first went to sea in 1965, gaining his Master's foreign going certificate in 1979. He had been employed by Pacifica since 1999 and had sailed as relieving Master on several of the company's ships since then. The First Mate had re-validated his Master's certificate to an STCW-95 compliant certificate at the appropriate time, and had attended a BRM course as part of that revalidation. He held pilotage exemptions for Manukau, Wellington and Lyttelton Harbours.

[2] Captain R.W. Rowe, FNI, *The Shiphandler's Guide*, The Nautical Institute, 1996, p43.

1.3.3 The Second Mate went to sea in 2000, gaining his Second Mate's certificate in 2003. He had been employed by Pacifica since early 2005. Part of his training for his certificate of competency as a Second Mate included a module on BRM.

1.3.4 The CIR's career at sea had spanned the previous 43 years, and he had been CIR on board the *Spirit of Resolution* for the previous 2 years.

1.3.5 The tug Skipper was one of the relieving skippers on board the *Tika*. He first went to sea in 1963 and held a New Zealand Coastal Master's certificate. He had skippered tugs on numerous occasions throughout his seagoing career.

1.3.6 Pacifica considered that the masters on board its vessels held a responsible management position within the company. To ensure that Pacifica had the correct calibre of person for the position of Master, promotion to that position was usually from within the ranks of seagoing staff already employed by the company. Only those who showed the correct professional, technical and commercial skills were considered.

1.3.7 Normal practice within Pacifica was for a shipboard management meeting to be held fortnightly at which the DPA was present. Subjects covered would include health and safety procedures, International Safety Management (ISM) code topics, and cargo and scheduling topics.

1.3.8 On any vessel there is a degree of commercial pressure on its master to maintain schedules on each particular voyage. Pacifica and its masters were mindful of such pressure and the commercial realities of running such an operation. However, the Chief Executive of Pacifica stated that, although the masters were aware of the commercial realities, it was understood that the safety of the ship, its crew and cargo came first and such safety-related decisions were up to the masters.

1.4 Climatic and environmental conditions

1.4.1 POAL produced tide tables for different areas in Manukau Harbour. The area relevant to this investigation was Onehunga, which the Master used to calculate the under keel clearance (UKC) for the ship in the upper part of the Harbour. The POAL tidal predictions were based on a 1989 Royal New Zealand Navy survey. From this survey a suitable datum was derived to which the soundings could be reduced, and also 36 tidal constituents, which were used to compile the annual tidal predictions.

1.4.2 The tides for Onehunga on 8 October 2005 around the time of the occurrence as predicted by POAL were:

Onehunga			
Time	**Height**	**Time**	**Height**
1230	3.2 m	1430	3.9 m
1300	3.5 m	1500	3.8 m
1330	3.7 m	1530	3.7 m
1400	3.8 m	1600	3.4 m

1.4.3 Land Information New Zealand was the national hydrographic authority. It was responsible for providing official hydrographic information for navigational purposes such as navigational charts and nautical information, which included tidal predictions and Notices to Mariners. All information and documents were produced according to International Hydrographic Organisation standards. The New Zealand Nautical Almanac contained the tidal information for standard and secondary ports throughout New Zealand. Onehunga was a standard port.

1.4.4 The tides for Onehunga as predicted in the New Zealand Nautical Almanac for 8 October 2005 were:

Onehunga							
High Water		Low Water		High Water		Low Water	
0206	3.9 m	0821	0.8 m	1430	3.9 m	1942	1.0 m

1.4.5 On navigational charts, tidal stream rates were shown for specific geographical positions designated by a magenta diamond shape enclosing a letter, known as a tidal diamond. The rates shown were for average spring or neap tides referred to high water. If the tidal range is greater than normal (e.g., full or new moon coinciding with perigee) the rates will be increased roughly in proportion. The spring rates for diamond "C" in Manukau Harbour as shown in Figure 2 were:

Position	Time	Direction	Rate
Diamond "C"	1230	120º	1.7 kts
	1330	126º	0.6 kts
	1430	230º	0.5 kts
	1530	235°	1.4 kts
	1630	235°	1.6 kts

1.4.6 The force of the tide can be immense. Water is several hundred times denser than air and if any attempt is made to restrict its flow, such as by holding a ship with moorings or tugs, the tide can generate an enormous force. The magnitude of the force is influenced by:

- the draught of the ship and the depth of available water
- the ship's bow configuration
- the velocity of the tide
- the under keel clearance (UKC).

The force of the tide upon a ship in tonnes is directly proportional to the square of the velocity of the tide[3]. Thus, even for a small increase in the velocity of the tide there is an enormous increase in the force exerted upon a ship. However, the single greatest influence on the magnitude of the tidal force is the UKC. This is due to the blocking effect of a ship. With a depth-to-draft ratio of 1.05 the tidal force is 3 times stronger than with a depth to draft ratio of 3.0[3]. The *Spirit of Resolution* had a depth-to-draft ratio of about 1.37 at the time of the accident.

1.4.7 The New Zealand Meteorological Service (MetService) issued close inshore "recreational" weather forecasts for the Auckland region that included Manukau Harbour at regular well documented intervals. This forecast included mention of current warnings of gales or storms for the adjacent coastal marine area.

1.4.8 The recreational marine waters forecast for the Auckland area issued at 0438 on 8 October 2005 was as shown below:

> **Marine Weather Situation and Forecast issued at 0438 Saturday 08-Oct-2005 by MetService**
>
> Gale warning in force for all areas.
>
> **Situation:**
>
> A disturbed westerly flow over the north of the country is expected to ease tonight. A narrow ridge is expected to move onto the country on Sunday. A low, moving east, should cross the North Island late Monday and early Tuesday. Another ridge is expected to lie over central New Zealand by the end Wednesday.

[3] Captain R.W. Rowe, FNI, *The Shiphandlers Guide*, The Nautical Institute, 1996, p81

Forecast issued at 0438 Saturday 08-Oct-2005. Valid to midnight Saturday:

For the Manukau and Waitemata Harbours:
Today:
Westerly 35 knots gusting 45 knots easing to 25 knots gusting 35 knots this evening. Very rough sea easing to rough this evening. Squally showers with poor visibility, becoming less frequent from evening.

Swell forecast to midnight Tuesday:
East Coast: No significant swell.
West Coast: Southwest 2.5 metres rising to 5 metres today, easing 2 to 3 metres on Monday.

High tide at Auckland:
Saturday 1137 3.0 metres.
Saturday 2351 2.9 metres.

High tide at Onehunga:
Saturday 1430 3.9 metres.
Sunday 0247 3.7 metres.

A MetService consultant meteorologist provided the following comment on the forecasts:

A gale warning had been in force for all areas from Tuesday 4 October. In the 11am issue of the forecast for the Auckland Harbours, gale force westerly winds (25 to 35 knots) were specifically forecast for Saturday.
The forecast for Saturday remained more or less the same (gale force winds) throughout.

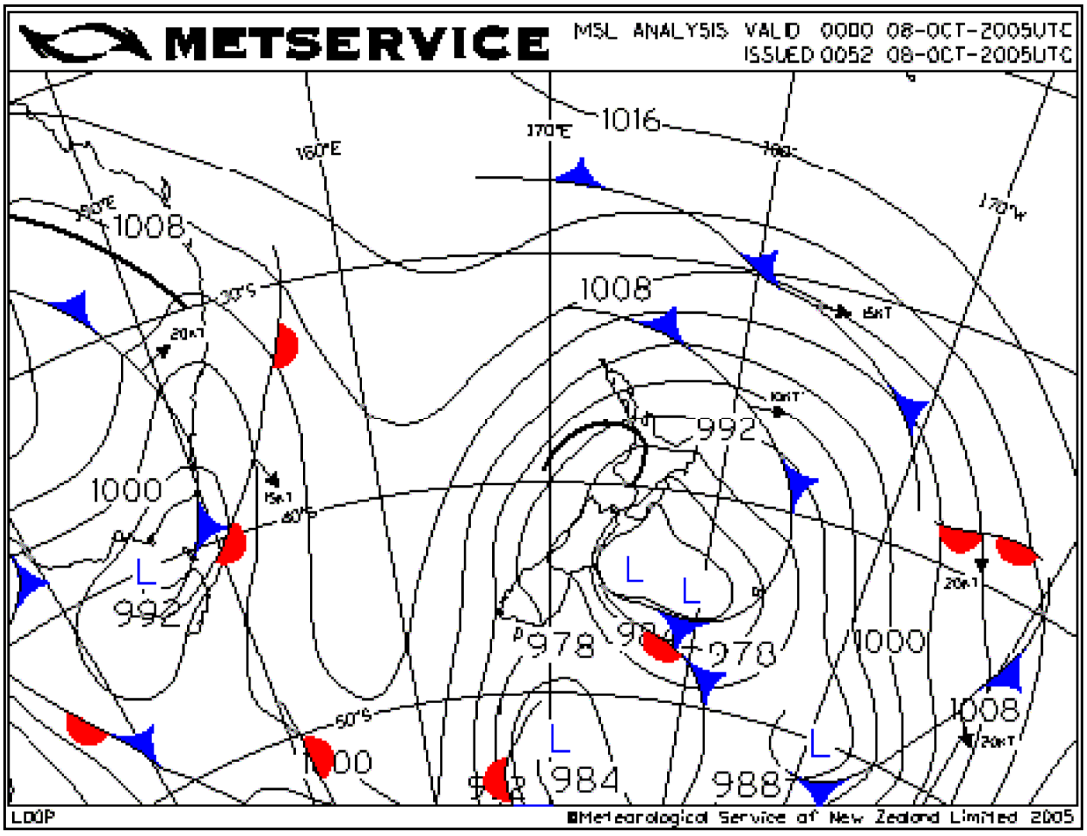


Figure 6
Mean sea level analysis synoptic chart for 1300 8 October 2005

1.4.9 MetService provided an aftercast of the weather that would have been experienced in the area at the time of the incident as shown below:

Situation: On 8 October 2005 a deep depression was moving quickly eastwards across the South Island. A very strong westerly air stream covered the northern half of the North Island. The steep pressure gradient on the northern side of the

depression, together with the eastward translation of the whole system combined to produce gale force winds in many places from Northland to northern Waikato from mid-morning to evening on 8 October 2005

Weather conditions: The sky was cloudy, and there were more or less continuous light or moderate showers all day. Visibility was moderate to good (15 to 30 kilometres) most of the time, but occasionally visibility was reduced to 3000 m for short periods in the showers.

Wind: This was blowing from the west between 8am and 11pm. During this time the direction was very slowly backing from about 280° to 250° True. The wind speed was strong (21 to 26 knots) between 8am and about 10am. From about 10am until about 7pm the wind speed was near gale force (27 to 33 knots) and possibly full gale (over 33 knots) at times. Wind gusts were above 50 knots around 2 and 3pm.

1.4.10 MetService also provided details of the wind experienced at Auckland Airport weather station about 8 km to the south of Onehunga Wharf as shown below:

Wind					
Time	Direction (°T)	Speed		Maximum gust speed	
		(m/s)	knots	(m/s)	knots
1300	260	17.49	34.00	24.69	47.99
1400	270	14.92	29.00	27.78	53.99
1500	260	17.49	34.00	27.78	53.99
1600	260	14.40	27.99	23.66	45.99

1.4.11 Data on the wind force and direction was also obtained from an ARC automatic weather station situated about 1.4 km to the east-northeast of Onehunga Wharf as shown below:

Wind						
Time	Direction (°T)	Speed (m/s)		Max. gust direction (°T)	Max. gust speed	
		(m/s)	knots		(m/s)	knots
1300	269	9.7	18.85	273	19.5	37.90
1400	271	9.3	18.07	293	23.7	46.07
1500	265	11.0	21.38	263	21.6	41.98
1600	256	9.6	18.66	271	21.3	41.40

1.5 Damage

1.5.1 The *Spirit of Resolution* sustained a hole, about 100 mm square, above the waterline to the starboard quarter plating, and the shell plating on the flare of the bow in way of the forepeak tank was set in about 40 mm to 50 mm.

1.5.2 The Old Mangere Bridge sustained damage to the concrete capping on the edge of the roadway, and to the handrail over a distance of about 20 m.

1.5.3 Onehunga Wharf sustained considerable damage as detailed below:

- the launch landing steps stringer connecting bolt was pulled from the Wharf, and the steps damaged
- the catwalk between the Wharf and the mooring dolphin was destroyed at its eastern end, and the complete walkway rendered unsafe
- the mooring dolphin was leaning inwards from impact with the ship and the steel supporting piles were overstressed and bent below seabed level. The concrete cap on the dolphin was cracked and its lateral capacity reduced.

1.5.4 The tug *Tika* sustained no damage during the incident.

1.6 Port information

1.6.1 Manukau Harbour provides access to Auckland from the west coast of New Zealand. At the entrance to the Harbour is a shifting sand bar with banks and shoals extending 5 miles to seaward. Inside the bar, the harbour is almost filled with mud and sandbanks that dry at low water. On the landward side of the bar there is a natural channel up to Huia Bank that splits at Puponga Point into 4 navigable channels. The 2 main channels are Wairopa Channel, giving access to Onehunga, and Papakura Channel, giving access to a liquefied gas facility.

1.6.2 Wairopa Channel was about 11 nm long. There were 3 areas where the water depth was less than 4 m at chart datum:

- from the berth at Onehunga to an area of 3 submerged pipelines about 1.3 nm away
- from Cape Horn to about light beacon (Lt. Bn.) 21, and
- in the vicinity of Lt. Bn. 15.

Outbound from the submerged pipelines the channel was relatively wide for the size of ship that transited and was marked by a combination of light beacons and buoys.

1.6.3 The main wharf at Onehunga consisted of 2 berths (see Figure 3), "A" berth to the west with a length of 135 m and "B" berth to the east with a length of 95 m. The berths were separated by a roll on - roll off ramp, which extended 18 m into the Harbour. Extending from the eastern end of "B" berth was a catwalk that led to a dolphin, about 20m from the Wharf that was used for securing mooring lines. The eastern end of "B" berth was about 50 m from the Old Mangere Bridge, an old road bridge used only for pedestrian traffic. Chart NZ 4315, indicated a depth of 5.5 m alongside both berths in 1999.

1.6.4 Manukau Harbour was administered by POAL and managed by a port co-ordinator based at Onehunga. Movements within the Harbour were organised and monitored by the port co-ordinator, who was contactable 24 hours by telephone, facsimile and mobile phone. Situated on South Head at the entrance to the Harbour was a signal station manned by a signalman who resided on site. His main function was to advise vessels of the bar conditions and monitor their progress when crossing the bar. He kept a fixed radio schedule and was available 24 hours on request.

1.6.5 When the Auckland Harbour Board was disestablished in 1989 the duties of the Auckland Harbourmaster, whose jurisdiction included Manukau Harbour, were passed to the ARC. The Harbourmaster worked closely with POAL, the commercial arm of the port, to put in place legislation to maintain navigational safety.

1.6.6 In the interests of maintaining navigational safety within the Manukau pilotage area the ARC Harbourmaster and POAL had set certain limits on vessels transiting the area. these included:

- compulsory pilotage for all vessels greater than 500 gross tonnage (GT), unless the master held a pilotage exemption certificate
- all commercial vessels should monitor VHF channel 11 when transiting Manukau Harbour
- all vessels greater than 500 GT or vessels under pilotage should comply with all reporting requirements
- vessels should not exceed 8 knots in areas where the static UKC is less than 1.2 m
- no vessel greater than 500 GT should transit the Bar without relevant and up-to-date information
- no vessel greater than 500 GT should transit the Bar when the estimated swell height is 4.0 m or more

- no vessel greater than 500 GT should transit the Bar during the hours of darkness unless specifically approved by POAL and the ARC Harbourmaster
- when the wind speed was in excess of 25 knots, the tug had to be used for all departure movements of vessels greater than 80 m in length overall. The tug may be used at the master's/pilot's discretion for departures not requiring to be turned
- all vessels should complete under keel clearance calculations as part of their passage plan prior to arrival or departure transits.
- all vessels greater than 5.5 m maximum draught were defined as deep draught vessels when transiting Manukau Harbour.

1.6.7 POAL had carried out an initial risk assessment of Manukau harbour in 2001. The assessment identified the possibility of a collision between a ship and the Old Mangere Bridge. Although not categorically stated in the assessment, it was envisaged that such a collision would be caused by a ship losing motive power or steering and drifting into the Bridge.

1.6.8 In August 2004, the Maritime Safety Authority[4] (MSA) published the New Zealand Port and Harbour Marine Safety Code that obliged regional councils to undertake harbour risk assessments and port companies to undertake port risk assessments, to be included in the harbour risk assessment. Pilotage and pilotage exemption were included in this risk assessment and the decision to establish pilotage districts, compulsory pilotage and exempt pilotage must take into account the harbour risk assessment.

1.6.9 At the time of the occurrence, POAL and the ARC Harbourmaster, in conjunction with other interested parties, were about to commence a risk assessment study under the Port and Harbour Marine Safety Code.

1.7 Pilotage history

1.7.1 Prior to 1998, pilotage on Manukau Harbour and Manukau Bar was not compulsory for any ships. In 1998, when foreign ships started to use the liquefied petroleum gas terminal in Manukau Harbour, it was recognised that it was necessary to make pilotage compulsory for them. As a result separate pilotage licences were developed for Manukau Harbour and Manukau Bar.

1.7.2 For other ships using Manukau Harbour, pilotage was not compulsory and their masters did not require a pilot exemption but relied on local knowledge and assistance from the signal station. Pilots were available for all ships on request from POAL. The pilots provided were Waitemata Harbour pilots who also held Manukau Harbour and Manukau Bar licences.

1.7.3 On 1 April 2003 Maritime Rule Part 90, Pilotage came into force. Part 90 provided an interim pilotage regime for New Zealand pending the completion of a wide-ranging first principles review of port risks, including pilotage.

1.7.4 Maritime Rule Part 90 defined the Manukau pilotage area and the limit at or above which compulsory pilotage was applied as:

Area	Limit
All waters bounded to seaward by the arc of a circle radius 4 miles centred on Paratutae Island (37° 02'.9S, 174°30'.6E)	500 gross tons

1.7.5 Maritime Rule Part 90.10 allowed for ship masters to gain exemptions from the requirement to ensure the carriage of a pilot on the ship in a pilotage area and stated:

> **90.10 Master's pilotage exemption issue and endorsement**
> (1) An applicant is entitled to a master's pilotage exemption if—

[4] On 1 July 2005 the Maritime Safety Authority changed its name to Maritime New Zealand. Maritime Safety Authority or MSA has been used throughout this report for consistency.

(a) the application is made in accordance with section 35 of the Act; and
(b) the Director is satisfied that the requirements specified in —
(i) rules 90.11 and 90.12; and
(ii) section 41 of the Act
have been complied with.

(2) Every master's pilotage exemption issued must be endorsed with –
(a) a pilotage area or areas; and
(b) the type and size of ship, and any propulsion and steering arrangements to which the exemption applies, which limitations must be no more permissive than those applicable to the pilotage area or areas concerned under bylaws made under the Harbours Act 1950 and in place at 31 March 2003; and
(c) exercise-of-privilege conditions determined by the Director under rule 90.10(3).

(3) Subject to rule 90.10(4), the Director must specify exercise-of-privilege conditions that include the minimum number of pilotages that that master must undertake under specified operating conditions within a defined period of time and any other requirements that the Director considers appropriate in the interests of maritime safety.

(4) In determining exercise-of-privilege conditions for a pilotage area, or size or type of ship, the Director must –

(a) have regard to the specific operational and environmental conditions of the pilotage area or areas concerned, including –
(i) the complexity of navigation; and
(ii) the traffic density; and
(iii) the environmental sensitivity; and
(iv) factors influencing the consequences of any accidents, including the density of adjacent populations and the proximity of significant commercial and recreational values; and
(b) take into account any recommendations on the matters described in rule 90.10(4)(a) made by the owner of any ship subject to compulsory pilotage in that area, the chief executive of the relevant regional council (based on nautical advice to that chief executive), the port company and any other affected owner of significant port assets.

1.7.6 Maritime Rule 90.15 allowed for transitional provisions for existing pilots and masters and stated:

90.15 Transitional provisions
(1) In this rule an **existing pilot** is a person who at 31 March 2003 held a valid pilot's licence continued by section 15(2) of the Local Government Amendment (No 2) Act 1999 or issued under rule 90.4 of Part 90 of the maritime rules dated 4 October 1999; and an **existing master** is a person who at 31 March 2003 held a valid pilotage exemption continued by the same section or issued under rules 90.6 or 90.7(2) of the same rules.

(2) Rules 90.7(1)(b) and 90.13(1) (a) (which relate to medical certificates) do not apply to existing pilots until 1 November 2004.

(3) Any existing pilot who applies for a licence under rule 90.6 before 30 September 2003 is deemed to have met the other requirements of rules 90.7, 90.8 and 90.9.

(4) An existing pilot is deemed to hold a pilot's licence under rule 90.6 with all privileges and limitations of that pilot's current licence until whichever is the sooner of –
(a) the issue of a pilot's licence under rule 90.6; or
(b) 31 March 2004.

(5) Any existing master who applies for a master's pilotage exemption under rule 90.10 before 30 September 2003 is deemed to have met the requirements of rules 90.11 and 90.12.

(6) An existing master is deemed to hold a master's pilotage exemption under rule 90.10 with all privileges and limitations of that pilotage exemption until whichever is the sooner of –
(a) the issue of a master's pilotage exemption under rule 90.10; or
(b) 31 March 2004.

1.7.7 As pilotage had not been compulsory for ships transiting Manukau Harbour other than ships carrying dangerous cargoes, pilotage exemption certificates had not been issued. The MSA issued pilotage exemption certificates to those masters who could show that they had transited Manukau Harbour on a regular basis prior to Maritime Rule 90 coming into force. This was to ensure that no master regularly trading to Manukau Harbour was disadvantaged. The Master of the *Spirit of Resolution* was issued with a pilotage exemption certificate under this "grandfathering" scheme. The First Mate had been issued with an exemption certificate after being audited by a qualified pilot and completing a written examination.

1.7.8 The MSA requested submissions from interested parties as to the frequency of exercising the privilege to maintain the currency of a master's pilotage exemption. Submissions were received from Pacifica and from the port administrator, POAL. Whereas Pacifica suggested a frequency of 4 transits, 2 in and 2 out, POAL suggested 8 transits, 4 in and 4 out, to maintain currency. The MSA as arbitrator set the frequency at 6 transits in any 12-month period with at least one in and one out during the hours of darkness. The Master's pilotage of the *Spirit of Resolution* on arrival at Onehunga was his sixth transit in 12 months and his third arrival. However, none of these transits was completed during the hours of darkness.

1.7.9 A POAL licensed pilot had audited the Master's competency on an outbound transit in February 2005 in accordance with the regulations.

1.7.10 In 2004, POAL produced a Pilot Exempt Master Familiarisation Manual for Manukau Harbour. This document was approved by the MSA for training masters who wished to become pilot exempt and contained the following reference to maintaining the currency of a master's pilotage exemption:

> In order to maintain standard pilot exemption currency, the following must be completed:
> - at least 8 exempt pilotage acts conducted per annum (at least 4 shall be arrivals)
> - at least 1 peer review per annum by Grade A pilot licensed for area (vessels over 1,000 GT)
> - attend Emergency Simulator Training Course at least every 4 years (vessels over 1,000 GT).

1.7.11 At the time of the accident the MSA was undertaking a wide-ranging review of Maritime Rule 90 for the Minister's consideration with a view, amongst others, to incorporating the results of the first principles review of port risks, including pilotage.

1.8 Bridge resource management

1.8.1 BRM is the use and co-ordination of all the skills and resources available to the bridge team to achieve the established goal of optimum safety and efficiency.

1.8.2 The use of BRM helps eliminate the potential for one-person error, and aids the flow of information between members of the bridge team, and between the bridge team and the outside world. Part of the flow of information between members of the bridge team is challenge and response and the use of closed-loop communications to ensure that orders and information are correctly heard and understood.

1.8.3 When challenge and response is encouraged, the other members of the bridge team can reasonably challenge an order or information to ensure that it is correct and that the most suitable option available has been chosen.

1.8.4 When used effectively, BRM ensures that all the bridge team members share a common view of the intended passage, maintain situational awareness, anticipate dangerous situations, acquire all relevant information and act upon it in a timely manner, avoid an error chain being formed, and avoid preoccupation with minor problems.

1.8.5 BRM training emphasises the need to recognise "hazardous thoughts" and replace them with opposite "safe thoughts". Four hazardous thoughts and their opposite safe thoughts, as used in BRM concepts, were relevant to the Master of the *Spirit of Resolution* when he decided to depart Onehunga wharf.

Hazardous Thought	Safe Thought
I can do it	Why take chances?
It won't happen to me	It could happen to me
We've always done it this way	It's about time we changed
It's not my job	We're all on the same ship

1.8.6 Human factors is that branch of science and technology that includes what is known and theorised about human behavioural, cognitive and biological characteristics that can be validly applied to the specification, design, evaluation, operation and maintenance of products, jobs, tasks and systems to enhance safe, effective and satisfying use by individuals, groups and organisations[5].

1.8.7 Humans can suffer from hazardous attitudes from which hazardous thoughts develop and affect the standard of their decision-making. These attitudes depend upon an individual's characteristics and the type of environment in which they are operating. Factors that can influence decision-making are commercial pressure, peer pressure and the corporate environment in which the decisions are made.

1.8.8 Local conditions are conditions associated with the immediate context or environment in which operational events occur. In terms of individual actions, these conditions include characteristics of individuals, the task and/or the environment. When such conditions are safety issues or increase accident risk, they can be termed local hazards or local threats. Local conditions can influence incident development by increasing the likelihood of a particular individual action or increasing the likelihood of another local condition.

1.8.9 Almost all teams require some degree of authority gradient, which can be defined as the balance of decision-making power or the steepness of command hierarchy in a given situation, otherwise roles are blurred and decisions cannot be made in a timely fashion. However, members of a crew or organisation with a domineering, overbearing or dictatorial team leader experience a steep authority gradient where expressing concerns, questioning, or even simply clarifying instructions requires considerable determination on the part of the team members who perceive their input as devalued or unwelcome. Conversely, members of a crew or organisation where the authority gradient is too low or "flat" have a overly relaxed attitude toward crosschecking each other's actions or confirming other information. Effective team leaders consciously establish a command hierarchy appropriate to the training and experience of the team members.

1.8.10 Decision-making, the assimilation of information before an action is carried out, and the associated behaviour can be separated into 2 basic types: analytical and intuitive. Analytical decisions are knowledge based and exhibit themselves in rule-based and knowledge-based behaviour. They tend to be slower and take a large proportion of the available cognitive processes, leaving less time for other tasks. Intuitive decisions are skill based and are based on experience gained over many years. They are rapid and take less of the available cognitive processes but they are susceptible to biases, which may result in an incorrect decision.

[5] Christensen, Topmiller, and Gill 1988. Human factors definitions revisited. *Human Factors Society Bulletin,* 31, 7-8.

1.8.11 Skill-based behaviours are those that rely on stored routines or motor programmes that have been learned with practice and which may be accomplished without conscious thought. Ideally, operators exercising a skill would make the decision to do so and then monitor their own behaviour to ensure that the correct skill was exercised. However, if the central decision-maker, the brain, is busy with another activity (for example being preoccupied with another problem, possibly far removed from the immediate task) they may make the correct initial decision, inadvertently exercise the wrong skill but then fail to monitor their own activity and remain completely unaware of the mistake they have made.

1.8.12 Rule-based behaviours are those for which a routine or procedure has been learned. The components of a rule-based behaviour may comprise a set of discrete skills. Rule-based behaviours or procedures are common in any complex system. Rule-based behaviours are not stored as patterns of motor activity but as sets of rules and are thus stored in long-term memory. When actioned these skills involve both the central decision-maker and working memory.

1.8.13 Knowledge-based behaviours are those for which no procedure has been established. They require the operator to evaluate information and then use their knowledge and experience to formulate a plan to deal with the situation.

1.8.14 When an unexpected event occurs, an individual's workload suddenly increases as they react to the situation. The effect of this sudden increase in workload can be minimised by having practised contingency plans in place, thus saving the need to go through the involved cognitive process of forming a plan, evaluating whether it would be successful and then implementing it. Contingency planning reduces an individual's workload and the likelihood of load shedding.

2 Analysis

2.1 The *Spirit of Resolution* berthing port side to the wharf in Onehunga was not an unusual occurrence and procedures had evolved to swing the ship during its stay at Onehunga so that the bow was pointing down the Harbour. However, the carrying out of routine maintenance that immobilised the main engine, and therefore made it impossible to turn the ship, could not be considered a usual event. The maintenance was by definition routine and therefore could be expected to happen from time to time in Onehunga. This contributed to the sequence of events.

2.2 Had the ship been turned around to point seaward during the lull in cargo operations on the Friday, the required departure un-berthing manoeuvre would have been simpler and may have been successfully completed.

2.3 The Master contacted the signalman at South Head in plenty of time to abort the decision to sail. He was informed of the wind speed and the fact that the Bar was going to be closed. The position of South Head signal station, although considerably more exposed to the wind and weather than the berth at Onehunga, was not geographically or meteorologically far removed from the berth at Onehunga. It would therefore be reasonable to assume that the high winds being experienced at South Head, if not already present at Onehunga, could be expected in the very near future. In such circumstances it would have been prudent not to have attempted the departure manoeuvre.

2.4 The Master was aware that the Bar was going to be closed, and he would have been aware that his ship was not allowed to cross during the hours of darkness without special permission. This permission was probably unlikely to be granted due to the signalman being unable to see the state of the already high sea and swell on the Bar. Therefore, he had no need to depart the berth at the time he did, the ship being very unlikely to be allowed to cross the Bar until the high tide during daylight hours of the next day, Sunday. In the event this became the time that the ship actually crossed the Bar.

2.5 In every venture there will be a certain aspect of commercial pressure to maintain or improve the viability of the operation. In this case there may have been direct or indirect pressure on the

Master to sail on time and vacate the berth to show that an attempt was being made to maintain the schedule. However, given the prevailing forecast and conditions, the Master should have had sufficient fortitude to delay the ship's departure until such a time that it could safely negotiate the unberthing manoeuvre, and the Wairopa Channel. It would be reasonable, in such weather conditions, for the Master to expect the support of the company if he decided to delay his departure.

2.6 This pressure may have been evidenced by the company suggesting that, although the Bar was closed and there was little chance of it opening until at least the next day, he depart the berth and go and "have a look at" the state of the Bar from further down the Harbour.

2.7 The Master requested the use of the tug *Tika* for the unberthing manoeuvre, as the tug was always used when the ship was turned. However, the tug was made fast closer to amidships than to the stern and as such would not have had as much effect as it would have if positioned closer to the stern. Other fairleads were available for attaching the tug closer to the stern but the tug Skipper, who was relieving the usual Skipper, may have been unused to the fairlead configuration on the *Spirit of Resolution* and may have chosen this particular lead for its convenience and positioning relative to the waterline of the ship, rather than one further aft which was further from the waterline. It would have been prudent for the Master to have required the tug to be positioned further aft to increase the turning moment.

2.8 Although when loaded for departure the *Spirit of Resolution* had containers 2 high for almost the complete length of the ship, the greatest windage area was still at the stern because the accommodation block was at the stern. Therefore when the wind acted on the port side, the greatest force was exerted at the stern.

2.9 The Master had formulated a plan for departure and he communicated this to the remainder of the bridge team, the First Mate, and the heads of the mooring parties and to the tug Skipper. This showed appropriate BRM at this point. However, the Master had never accomplished the manoeuvre he was about to attempt. The ship had completed the manoeuvre before so the Master may have been under the belief that "it's been done before so I can do it".

2.10 The Master was conning the ship and was working the controls for the engines, steering and bow thruster. He was also operating the UHF and VHF radios to communicate with the mooring parties and the tug Skipper. However, the other member of the bridge team, who was as qualified as the Master, was left in virtual isolation, only able to provide a little support to the Master. It may have been more prudent and shown better BRM for the Master to have delegated some of the procedures and operations to the First Mate to allow himself time to oversee the operation and to reduce the likelihood of one-man error. The First Mate, as he was as qualified as the Master, should have been able to challenge the Master's action and decision to depart as there should have been very little authority gradient to overcome. By remaining in isolation the First Mate may have been suffering from the hazardous thought of "it's not my job" rather than the safer thought of "we're all on the same ship".

2.11 Both members of the bridge team and the Second Mate in the forward mooring party had been trained in BRM as part of their certificates of competency. However, BRM, like all skills learnt, is susceptible to biases and errors such as "cutting corners" that can creep into actions when teams work together. Although the bridge team exhibited some use of BRM it would be advantageous to have a programme of training and practice to reinforce BRM techniques amongst members of bridge navigation teams.

2.12 The Master's estimation of the wind gave the direction too much southerly component; this may have been caused by local eddies around the ship and Wharf. The wind's general direction was later determined as being nearly parallel to the line of the Wharf face. His estimation of the speed of the average wind, however, was accurate. However, he should have been aware from his training that the speed of the wind in the gusts could be expected to be about double that of the average wind speed.

2.13 As the ship came off the Wharf the Master concluded that he was not in complete control of the manoeuvre and appropriately took the decision to re-berth. He was able to get the bow of the ship, where the windage was minimum, back alongside using the bow thruster but this canted the ship, allowing the wind to push against the then exposed port side of the ship.

2.14 Calculation showed that the force of the wind on the beam acting on the side of the ship was under the force that could be expected from the tug at full power, and even less than the combined forces of the tug, rudder and bow thruster. When acting originally at an acute angle to the beam, the wind force would have been even more diminished. However, the force exerted in the gusts was shown to be considerably higher and could have been in excess of the reaction forces of the ship and tug combined. When the ship started to swing it presented a steadily increasing broadside to the wind that could account for the steadily increasing speed of the swing.

2.15 When the ship had completed the manoeuvre before, the weather was possibly not as adverse as it was on this occasion, and the Becker rudder may have been operational. An operational Becker rudder would have provided the Master with more turning force at the stern where it was needed.

2.16 The tide also had a considerable effect on the ship, especially as the depth-to-draft ratio was only 1.37 at high water. As the ship swung and presented a greater aspect to the flood tide, the speed of the swing increased, with the ship eventually being pinned against the old road bridge by the combined strength of the wind and tide, showing that the strength of the tide plus the wind was in excess of the combined strengths of the tug, rudder and bow thruster. The strength of the tide alone was in excess of the strength of the wind as shown by the ebb tide pushing the ship's stern clear of the road bridge at about 1528, one hour after high water, when it had attained a strength of 1.4 knots [0.7 m/s].

2.17 The after mooring party showed considerable concern for the fate of the tug and its crew when they realised that the swing was increasing and the tug was in danger. However, their efforts in releasing the tug were not in enough time to prevent the tug becoming trapped. The Master's action in giving the ship a "kick ahead" in an attempt to soften the collision of the stern with the bridge probably forced the bow of the *Spirit of Resolution* between the mooring dolphin and the catwalk pile and the bow lodged against the dolphin, thus creating a space of water for the tug to lie in. Had the bow not gone between the pile and the dolphin the ship probably would have been bodily blown down onto the Bridge and would most likely have crushed the tug between the Bridge and the ship. Had the tug been crushed, it is probable that the tug's crew would have sustained serious, or possibly fatal, injuries.

2.18 The on-leave Master who attended and provided support had been appointed to the *Spirit of Resolution* for considerably longer than the incumbent Master and could be considered more experienced, but not better qualified, at handling the ship than the incumbent Master. That between them the 2 Masters were able to formulate a plan that enabled the ship to be re-berthed safely is indicative that the level of experience brought to the situation by the on-leave Master was influential in resolving the situation in the shortest possible time.

2.19 When the on-leave Master attended the ship, the incumbent Master was no longer working in isolation and less prone to one-person error. The First Mate was similarly qualified to the Master and should have been able to provide similar help and backup to the on-leave Master. However, he may have been affected by the authority gradient prevalent on the bridge at the time, either too steep or too flat, making it difficult for the First Mate to express his thoughts and concerns. The incumbent Master may also have been suffering from the hazardous attitude of "I can do it" brought on by underlying corporate and peer pressure.

2.20 The weather had been forecast to be bad since Tuesday 4 October and the forecasts were both well documented and easily available. Therefore the Master should have been aware of the conditions prior to making his decision to leave. However, he may have been subconsciously

influenced in his decision to sail by the fact that he had managed to cross the Bar on the Thursday when the weather had moderated for a short period and this may have happened again as he approached the Bar on his departure.

2.21 The Master of the *Spirit of Resolution* had received his pilotage exemption for Manukau Harbour under the "grandfathering" scheme. As such, no formal assessment of his abilities, other than the record that he had successfully piloted ships into Manukau Harbour on a regular basis, had been conducted. However, he had been successfully audited by a licensed pilot in February 2005.

2.22 The Master, having been recently appointed to the *Spirit of Resolution,* could not be expected to be as experienced in handling the ship as another master who had sailed on the ship for a longer period of time. He may have been over-confident in his own and the ship's manoeuvring characteristics and, understanding that the ship had completed the same manoeuvre successfully before, considered that "I can do it".

2.23 More prudent action by the operator may have been to ensure that its masters, especially those newly appointed to different vessels, had undergone emergency simulator training for conditions such as high winds and loss of steering, etc. so that the masters better understood the handling capabilities of their ships in situations that were not normally encountered. Had the Master undergone this training he may have realised that the manoeuvre on which he was to embark was too risky to undertake in the conditions prevailing at the time. Such training was now a requirement of POAL for pilotage exemption currency.

2.24 As there was no formulated contingency plan for the scenario that unfolded in this accident, the Master, as he was working in isolation with little task delegation to and a low level of challenge from the First Mate, was required to formulate a plan, evaluate whether it would be successful and then implement it in a very short period of time. This suddenly increased his workload and the need for a large proportion of his cognitive processes to be involved.

2.25 The currency requirement of the Master's pilotage exemption certificate as issued by the MSA stipulated a minimum of 6 transits to be undertaken in any year, whereas the POAL familiarisation manual, which had been approved by the MSA, stipulated a minimum of 8 transits to be undertaken in any year. The POAL familiarisation manual also included a requirement for the Master to undertake emergency simulator training at least every 4 years, however this requirement was not included on the exemption certificate. The Master having been granted his pilotage exemption through the "grandfathering" scheme would not necessarily be in possession of or have seen the POAL familiarisation manual and could have been unaware of the Maritime New Zealand approved requirements. However, it would be reasonable to expect Pacifica as a company using the port to be cognisant of the requirements for its ships to enter the port and have promulgated these requirements to its masters and crews.

2.26 The Master complied with the regulations governing the annual number of pilotage acts to keep his exemption current, but none of these acts had been undertaken in the hours of darkness as stipulated on his exemption certificate. Although the ship was precluded from crossing the Bar during the hours of darkness, which would suggest that the Master was unable to comply with the requirement to pilot the ship in darkness, the ship could, and did, cross the Bar at first or last light, with the Harbour transit being completed in darkness.

2.27 The Master could be placed in an invidious position of having a current pilotage exemption certificate issued by the MSA but being denied access to the facilities of POAL due to non-compliance with the differing approved standards of POAL. The review of Maritime Rule 90 should remove all ambiguity and provide consistency across the platform of pilotage exemption taking into account the differing risks associated with pilotage in each port as stipulated in the current Maritime Rule 90.10(4)(a) for pilot exempted Masters and 90.6(4)(a) for pilots.

3 Findings

Findings are listed in order of development, not in order of priority.

3.1 The *Spirit of Resolution* collided with the Old Mangere Bridge as the ship departed Onehunga Wharf when the local environmental conditions overcame the Master's planned unberthing manoeuvre.

3.2 It was improbable, due to the prevailing weather conditions, that had the Master's planned unberthing manoeuvre been successful he would have been permitted to cross the Manukau Bar before the time he actually crossed on Sunday 9 October.

3.3 The necessity to carry out main engine maintenance was a contributing factor to the failure sequence.

3.4 The standard of BRM was less than optimal.

3.5 There was no contingency plan available for the situation the Master and First Mate encountered, thus their workload suddenly increased at a critical part of the voyage.

3.6 Had the Master undergone emergency simulator training he would have been better placed to evaluate whether his planned manoeuvre would have been successful.

3.7 The Master, from his knowledge of the commercial aspect of the company, may have been under subconscious commercial pressure to depart on time.

3.8 There was a wealth of information on the current and forecast weather conditions available to the Master on which to base his decision to sail.

3.9 There were differing standards between the regulatory and the POAL, MSA-approved, criteria for currency of the Master's pilotage exemption certificate.

3.10 Owing to the method under which the Master was granted his pilotage exemption certificate he was possibly unaware of the differing standards.

3.11 The ship was correctly certified and manned at the time of the incident.

4 Safety Recommendations

Safety recommendations are listed in order of development, not in order of priority.

4.1 On 23 March 2006 the Commission recommended to the Chief Executive Officer of Pacifica Shipping (1985) Limited that he:

4.1.1 instigate a programme of training and practice to reinforce bridge resource management techniques amongst members of bridge navigational teams on board the company's vessels. (008/06)

4.1.2 instigate a programme of training and practice amongst members of bridge navigational teams, especially masters, in ship handling and manoeuvring for their specific ships in simulated abnormal situations in safety critical areas for their standard voyages. Such situations should include but not be limited to, bad weather, engine failure, steering failure. (009/06)

4.2 On 31 March 2006 the Chief Executive Officer of Pacifica Shipping (1985) Limited replied:

> Please be advised that Pacifica Shipping (1985) Limited has after the conclusion of its own investigations already instigated a programme of training similar to your final safety recommendations. Specifically commenting on your recommendation (009/06) this training will take place on the simulator operated by the Navy and is envisaged to be completed by the end of May.
>
> In relation to (008/06) the Master involved in your report 05-211 is currently undertaking training and practice with our senior Master to reinforce BRM techniques. He will also attend the BRM refresher course at the Manukau Technical Institute in the latter part of this year
>
> At the completion of this training I will send evidence that these recommendations have been implemented.

4.3 On 28 March 2006 the Commission recommended to the Director of Maritime New Zealand that he:

4.3.1 as part of the current review of Maritime Rule Part 90 resolve any ambiguities that may exist between the regulatory and port-specific requirements for the issuance and continued currency of pilotage exemption certificates to ensure a standardised application. (010/06)

4.4 On 5 April 2006 the Acting Director of Maritime New Zealand replied:

> Maritime NZ is prepared to accept a recommendation for a review of currency requirements for pilot and pilot exempt masters for the port, with due consultation with all parties.
>
> We anticipate that this work would occur concurrently with, but separate to, the revision of Rule Part 90.

Approved on 27 April 2006 for publication

Hon W P Jeffries
Chief Commissioner

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