Office of Transport Safety Investigations

FERRY SAFETY INVESTIGATION REPORT

FERRY *FRESHWATER* COLLISION

WHARVES 4 & 5 CIRCULAR QUAY, NSW

4 JANUARY 2018

FERRY SAFETY INVESTIGATION REPORT

FERRY *FRESHWATER* COLLISION WITH WHARVES 4 & 5 CIRCULAR QUAY, NSW 4 JANUARY 2018

Cover photo: *Freshwater*

Released under the provisions of
Section 45C (2) of the *Transport Administration Act 1988 and*
Section 137 of the *Passenger Transport Act 2014*
Investigation Reference 04793

Published by: The Office of Transport Safety Investigations
Postal address: PO Box A2616, Sydney South, NSW 1235
Office location: Level 17, 201 Elizabeth Street, Sydney NSW 2000
Telephone: 02 9322 9200
Accident and incident notification: 1800 677 766
Facsimile: 02 9322 9299
E-mail: info@otsi.nsw.gov.au
Internet: www.otsi.nsw.gov.au

THE OFFICE OF TRANSPORT SAFETY INVESTIGATIONS

The Office of Transport Safety Investigations (OTSI) is an independent NSW agency whose purpose is to improve transport safety through the investigation of incidents and accidents in the rail, bus and ferry industries. OTSI investigations are independent of regulatory, operator or other external entities.

Established on 1 January 2004 by the *Transport Administration Act 1988*, and confirmed by amending legislation as an independent statutory office on 1 July 2005, OTSI is responsible for determining the contributing factors of accidents and to make recommendations for the implementation of remedial safety action to prevent recurrence. Importantly, however, OTSI does not confine itself to the consideration of just those matters that contributed to a particular accident; it also seeks to identify any transport safety matters which, if left unaddressed, might contribute to other accidents.

OTSI's investigations are conducted under powers conferred by the *Transport Administration Act 1988* and *Passenger Transport Act 2014.* Additionally, all OTSI publications that are considered investigation reports are also conferred by this Act. OTSI investigators normally seek to obtain information cooperatively when conducting an accident investigation. However, where it is necessary to do so, OTSI investigators may exercise statutory powers to interview persons, enter premises and examine and retain physical and documentary evidence.

It is not within OTSI's jurisdiction, nor an object of its investigations, to apportion blame or determine liability. At all times, OTSI's investigation reports strive to reflect our balanced approach to the investigation, that properly explains what happened, and why, in a fair and unbiased manner.

Once OTSI has completed an investigation, its report is provided to the NSW Minister for Transport and Roads for tabling in Parliament. The Minister is required to table the report in both Houses of the NSW Parliament within seven days of receiving it. Following tabling, the report is published on OTSI's website at www.otsi.nsw.gov.au.

CONTENTS

TABLE OF FIGURES

EXECUTIVE SUMMARY

On the morning of Thursday 4 January 2018, the ocean liner *Explorer of the Seas* berthed at the Overseas Passenger Terminal in Sydney Cove. At the same time, Harbour City Ferries vessel *Freshwater* entered Sydney Cove making way for Wharf 3 Circular Quay. As *Freshwater* passed the ocean liner, turbulent wash from the ocean liner's thrusters struck *Freshwater,* unsettling its approach, resulting in the ferry colliding with wharves 4 and 5 Circular Quay.

There were no injuries reported from the collision. *Freshwater* suffered minor plating damage to the bow and sponson. Wharves 4 and 5 also sustained damage. The damage to a pile of Wharf 5 led to the pile collapsing and striking a vessel 12 days after the initial incident. In this second incident, there were no injuries but the vessel sustained damage.

The investigation found that *Freshwater* was in sailing mode as opposed to manoeuvring mode, when it approached the wharf. The ocean liner berthing at the Overseas Passenger Terminal had its thrusters operating which created turbulence in Sydney Cove. This turbulence affected *Freshwater's* approach to Wharf 3, which made it more difficult to maintain control.

The report makes a number of recommendations including procedures stipulating that crew should carry out verbal crosschecking. The report also recommended that operators provide improved communications to vessels navigating in the vicinity of ocean liners.

Another recommendation for all operators of vessels in Sydney Cove is for the need to assess the impact on their vessel when ocean liners are berthing at the Overseas Passenger Terminal.

Full details of the Findings and Recommendations of this ferry safety investigation are contained in Parts 3 and 4 respectively.

PART 1 FACTUAL INFORMATION

Introduction

1.1 At approximately 0637[1] on Thursday 4 January 2018, ferry *Freshwater* entered Sydney Cove making way for Wharf 3 Circular Quay. Aboard the ferry were the master, engineer, four general-purpose hands (GPH) and 46 passengers.

1.2 At the same time, the ocean liner *Explorer of the Seas* was utilising its thrusters to assist in berthing at the Overseas Passenger Terminal. At the time of the incident, *Freshwater*'s control mode was set to sailing mode, rather than manoeuvring mode, as per the company's Vessel Operating Procedure for berthing.

1.3 As *Freshwater* made its way past the ocean liner, the wash from the liner's stern thruster pushed *Freshwater* off course. The wash pushed *Freshwater's* bow first to port[2], then struck *Freshwater's* stern, swinging the bow to starboard[3] as the master attempted to maintain control.

1.4 *Freshwater's* master managed to realign the ferry with his intended berth just as *Freshwater* sailed into wash from the liner's bow thruster. The wash pushed *Freshwater* off course again in a similar manner. This resulted in the ferry striking Wharf 4 and coming into contact with Wharf 5.

Location

1.5 The incident occurred at wharves 4 and 5 at Circular Quay. Circular Quay is within Sydney Cove, located at the northern end of Sydney's central business district, and is the main hub for waterborne passenger transport on Port Jackson (see *Figure 1*).

[1] All times referred to in this report are Australian Eastern Daylight Time.

[2] Port is the left side of a vessel when viewed from behind.

[3] Starboard is the right side of a vessel when viewed from behind.

Source: Google

Figure 1: Location Sydney Cove

1.6 Sydney Cove is a high volume traffic area and users must comply with Schedule 6 of the *Marine Safety Regulation 2016 (NSW)*[4].

1.7 The speed limit in Sydney Cove is 8 knots within the area defined in Schedule 6 (see *Figure 1*).

The Incident

1.8 The master described the day as cloudy with good visibility and little or no breeze. He reported that the vessel was operating normally as he returned from Manly to Circular Quay.

1.9 As *Freshwater* passed Fort Denison, the master took control from the helmsman, and noted that *Explorer of the Seas* was berthing at the Overseas Passenger Terminal. With this in mind, the master contacted the ferry's engineer, instructing him to bring the *Freshwater's* second engine online. The second engine provided increased power, which improved the vessels response to command input.

[4] http://www.legislation.nsw.gov.au/#/view/regulation/2016/308

1.10 Shortly after 0630, *Freshwater* was approaching Bennelong Point, when several events occurred concurrently as follows.

1.11 The master was conversing with the engineer on the internal phone regarding the status of the second engine. The engineer requested the master slow the ferry to facilitate the engagement of the second engine. The master slowed *Freshwater* to approximately 11 knots and the second engine came online.

1.12 During the phone call with the engineer, the master began his turn to port; Sydney Vessel Traffic Service (VTS[5]) broadcast a general warning on VHF[6] radio channel 13, that the liner was engaging its side thrusters in Sydney Cove.

1.13 As the VTS announcement was concluding, HCF control room repeated the warning on the HCF's private radio network, informing masters that the ocean liner was currently berthing at the Overseas Passenger Terminal.

1.14 At the same time that the radio broadcasts took place, the master received a routine call from a crewmember on the ferry's portable VHF radio. The master acknowledged the crewman's call and continued the phone conversation with the engineer.

1.15 *Freshwater's* speed decreased to 8.2 knots as it passed Bennelong Point and began turning into Sydney Cove. During the turn, the master increased the throttle setting, which resulted in *Freshwater* increasing speed to approximately 10 knots as it entered Sydney Cove.

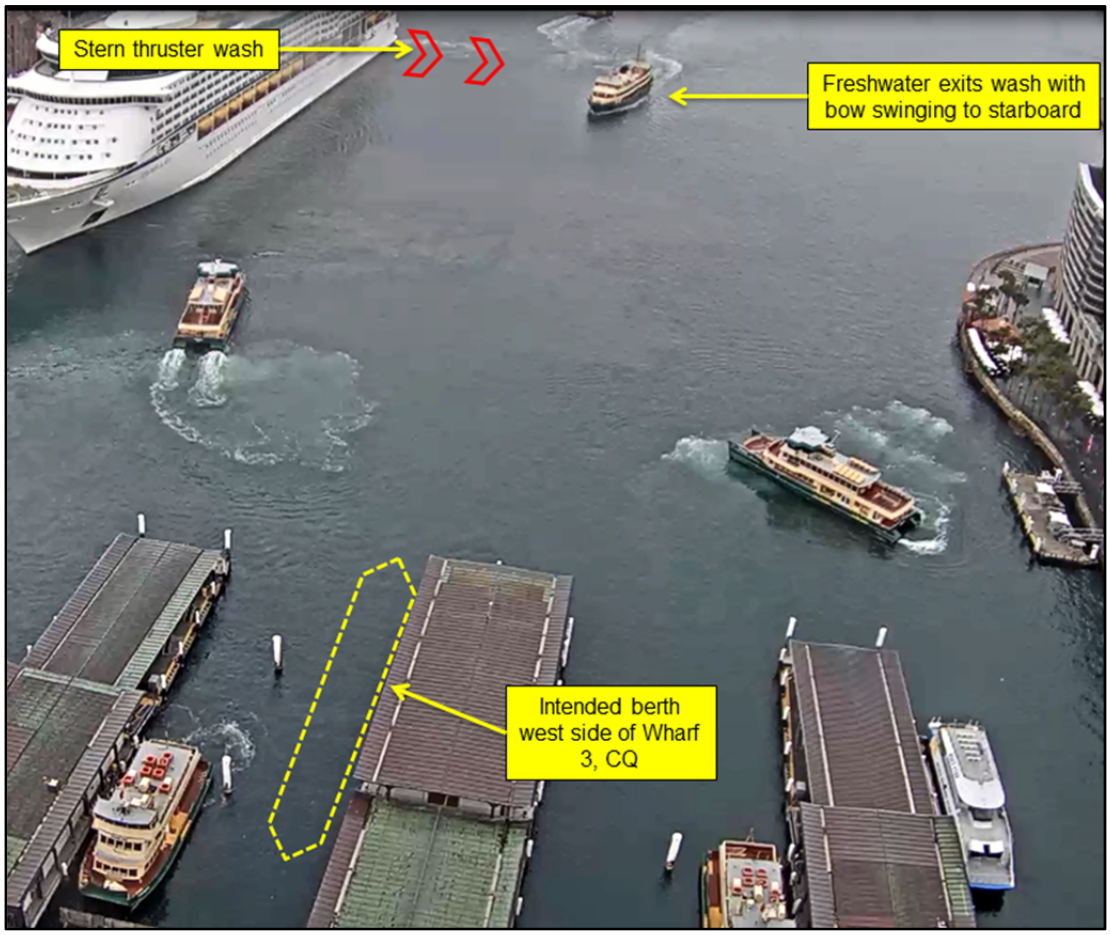
1.16 When *Freshwater* passed the stern of the ocean liner, it entered the turbulent wash made by the liner's stern thruster. The wash struck the starboard side of *Freshwater* and pushed the ferry's bow to port.

1.17 The master responded by turning the rudder to starboard, resulting in *Freshwater's* bow slowly swinging back to starboard. As *Freshwater* passed through the thruster wash, the wash began to apply force on *Freshwater's* stern. The force on *Freshwater's* stern resulted in the ferry's bow increasing

[5] VTS or Vessel Traffic Service is a navigational service provided by Ports Authority of NSW. It provides active monitoring and navigational advice for vessels in confined and busy waterways. In Port Jackson VTS utilises VHF channel 13 as the nominated working channel.

[6] VHF or very high frequency is the designation for the range of radio frequency electromagnetic waves from 30 to 300 megahertz, with corresponding wavelengths of ten metres to one metre.

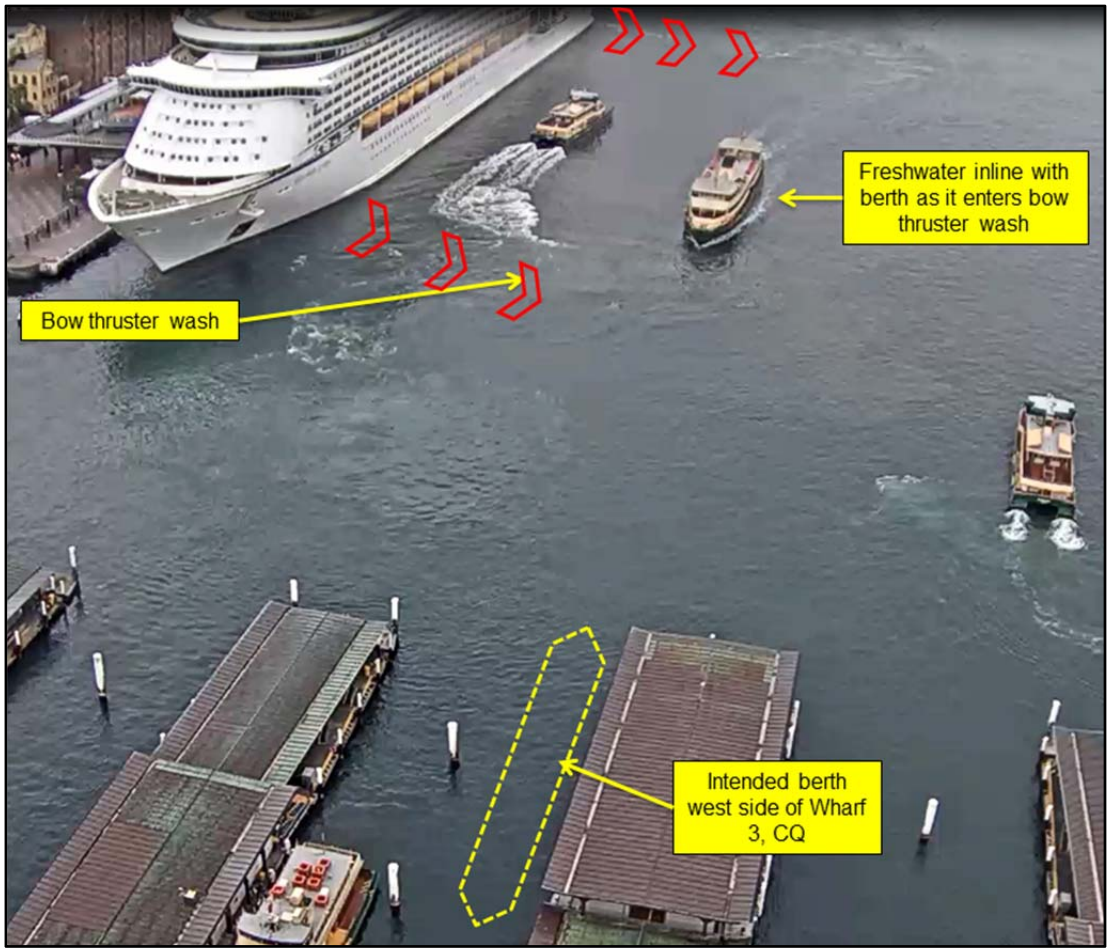
its rate of turn to starboard. The master slowed this rate of turn by entering a command for the rudder to turn to port (see *Figure 2*).



Source: HCF CCTV of incident

Figure 2: *Freshwater* exiting stern wash

1.18 The master managed to realign *Freshwater*, now travelling at 8 knots, with Wharf 3 after passing through the stern thruster wash. *Freshwater* continued to slow as it moved forward. As *Freshwater* entered the liner's bow thruster wash, the ferry slowed to approximately 7.5 knots (see *Figure 3*). This wash, as before, turned *Freshwater* to port, then starboard.



Source: HCF CCTV of incident

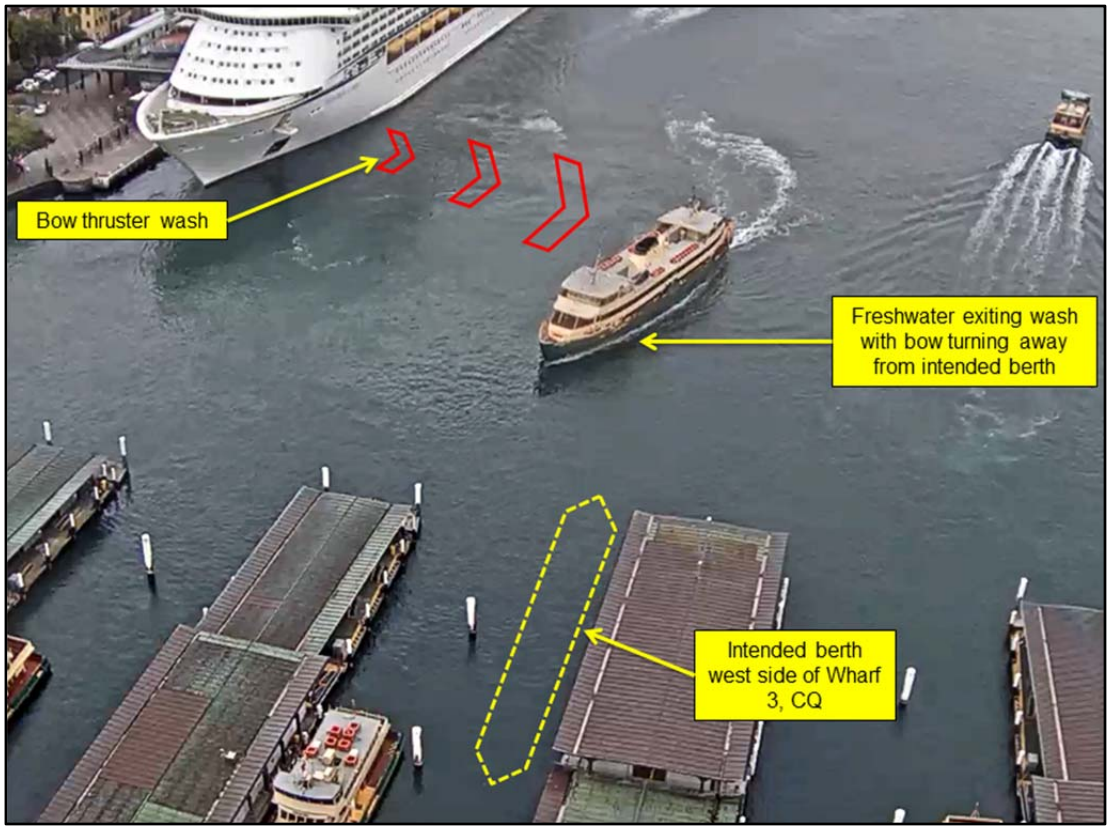
Figure 3: *Freshwater* realigned with Wharf 3 prior to entering bow thruster wash

1.19 The master attempted to steer through the wash again, but this time was closer to the wharves with little room to manoeuvre (see *Figure 4*). The master recognised that a collision with the wharf was imminent. The ferry was travelling at 6.9 knots when the master selected full astern using the X-Y lever.

1.20 In order to slow *Freshwater* in a shorter distance, the master engaged the Back-Up control. This allowed him to manually control the pitch of the propeller, which can increase thrust.

1.21 At this stage, the master realised that *Freshwater* was in sailing mode, so he switched the dashboard control to manoeuvring mode. Shortly after, the master switched back to sailing mode as he realised the change of modes would not occur before *Freshwater* struck a wharf.

1.22 Other smaller ferries in the vicinity, departing Circular Quay at the time, were less affected by the thruster wash due to their size and power settings.



Source: HCF CCTV of incident

Figure 4: *Freshwater* exiting bow thruster wash turning to starboard

1.23 *Freshwater* slowed, to approximately 4.7 knots, swinging its bow further to starboard before striking Wharf 4 a glancing blow, knocking over the wharf's north-west pile. The ferry continued to slow, eventually contacting Wharf 5 at approximately 0.5 knots. *Freshwater* came to rest across the face of the Wharf 4 (see *Figure 5*). No injuries resulted from the incident.

1.24 The master did not activate the automatic public address message or sound the ferry's whistle to warn of an impending collision.

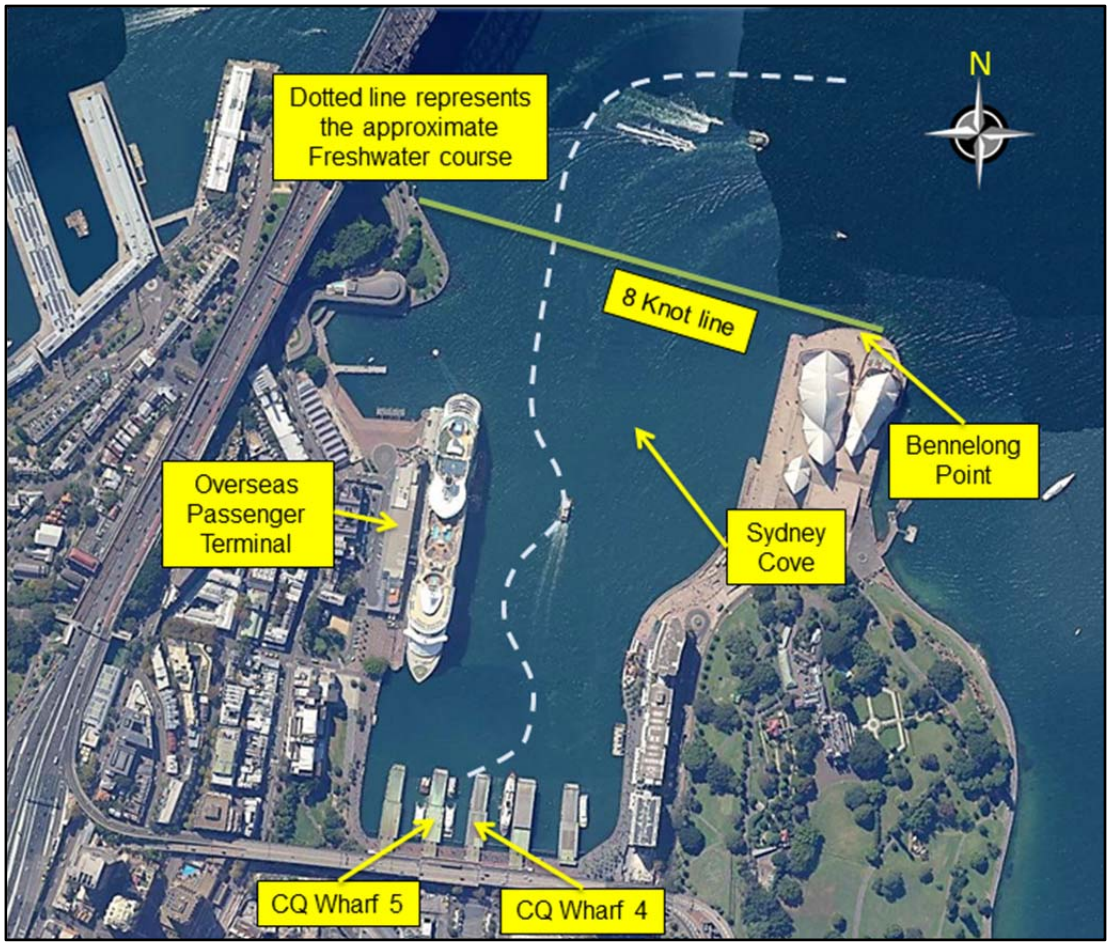
Source: HCF CCTV of incident

Figure 5: *Freshwater* makes contact with Wharf 5

1.25 *Freshwater* suffered minor damage to hull and bulwark[7] plating from the collision. For an overview of the *Freshwater's* course in Sydney Cove see *Figure 6.*

1.26 Wharf 4 suffered damage to its crash barrier and to the north-western pile, which was knocked over. The loss of the pile allowed the crash barrier to float free.

[7] A barrier at the outboard edge of the main or upper deck to prevent or inhibit entry of the sea.



Source: Google maps

Figure 6: *Freshwater* movements in Sydney Cove

1.27 The master engaged manoeuvring mode and navigated the vessel away from the wharves then safely alongside Wharf 3.

1.28 Wharf 5 also suffered damage as a result of *Freshwater's* low speed impact. The crash barrier and both its supporting piles at the northern end of Wharf 5 were displaced to the west. Wharf 5 was re-opened later that same day following the completion of temporary repairs and an inspection by Roads and Maritime Services (RMS). However, on 16 January, the western pile unexpectedly toppled onto a berthing ferry. The heavy pile damaged the berthing ferry. However, there were no injuries to crew or passengers.

Environmental Information

1.29 Conditions at the time of the incident as recorded by the Bureau of Meteorology were:

Tide: Fort Denison high tide at 1043 (1.9m). It was a flood tide (0.84 m) at the time of the incident.

Visibility: It was bright with overcast skies.

Wind: A light south-westerly wind of 5-10 knots[8] strength.

1.30 OTSI determined it was unlikely that environmental conditions contributed significantly to the incident.

Vessel Information

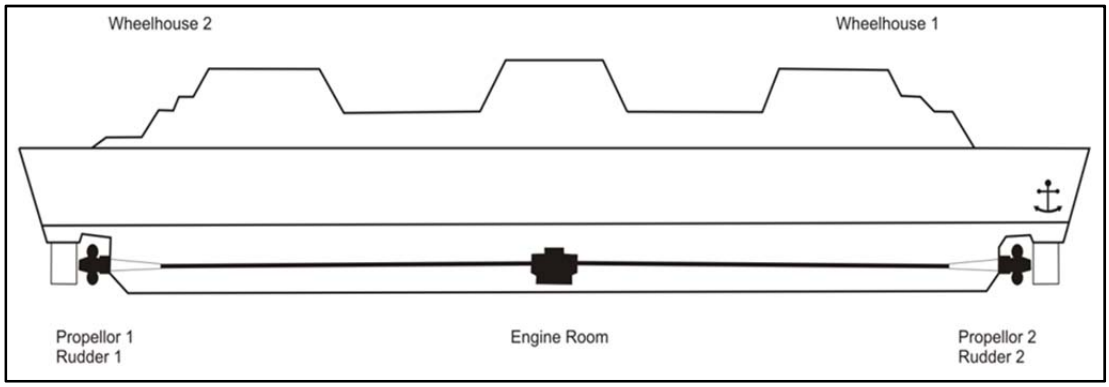
Source: OTSI

Figure 7: *Freshwater*

1.31 *Freshwater* is a 70 metre (m) long double-ended ferry with a 12.5 m beam[9] and a displacement of 1140 tonnes (see *Figure 7*). The vessel has a steel hull and aluminium on steel superstructure. It is powered by two 2206 kW diesel engines which drive fully feathering, controllable pitch propellers at either end of the vessel. A rudder is fitted to each end and normal service speed is 14 knots on one engine (see *Figure 8*).

[8] 1 knot, or 1 nautical mile per hour equals 1.852 km/h.

[9] The beam of a vessel is its width at the widest point.



Source: OTSI

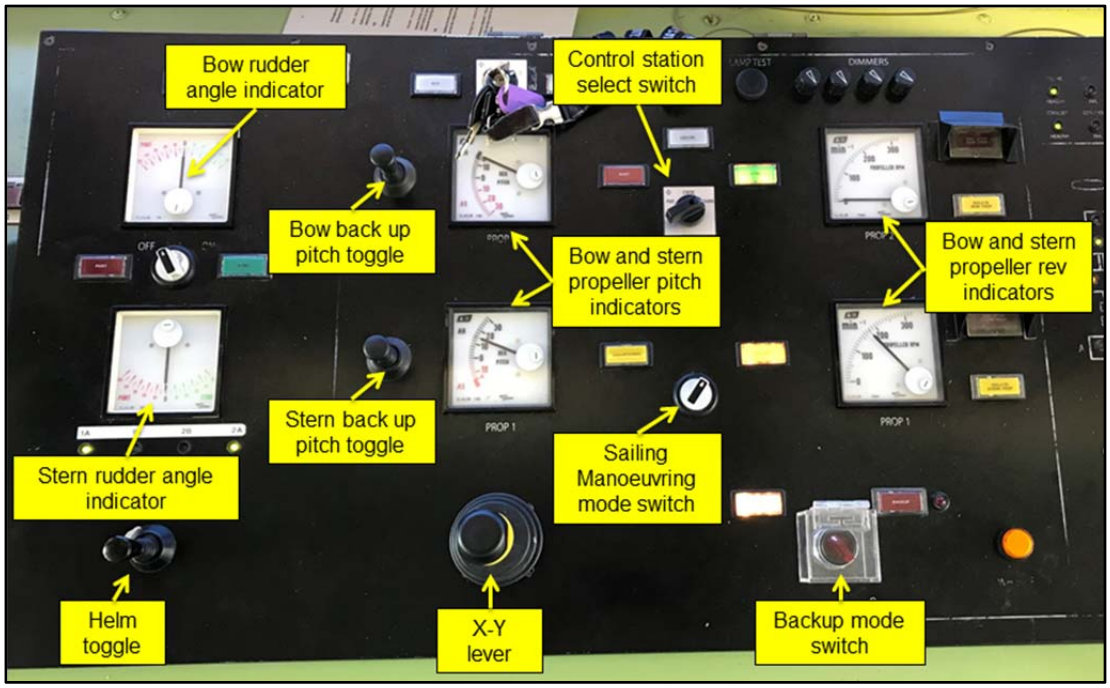
Figure 8: *Freshwater* Double ended controls

1.32 *Freshwater* has an identical wheelhouse at each end, designated No.1 wheelhouse and No.2 wheelhouse. This double-ended configuration allows the ferry to be operated on return trips from Circular Quay to Manly without having to turn around.

1.33 Once the ferry has departed a wharf, a helmsman, under the master's direction, navigates *Freshwater* from the wheelhouse at the bow of the direction they are travelling. When the ferry nears its destination, the master takes over direct control of the ferry. When the ferry begins the final stages of berthing, the master moves to a wing position to control the ferry. The wing positions, located either side of the wheelhouse, provide a superior view of the wharf and crew during the berthing process (see *Figure 7*).

1.34 Once relieved by the master, the helmsman moves to the wing position to prepare it for berthing.

1.35 The master navigates the ferry by entering steering commands to a helm toggle. Engine power and direction of travel are entered via a single telegraph lever, known as the "X-Y lever". These commands are transmitted electronically to the engines and rudders (see *Figure 9*).



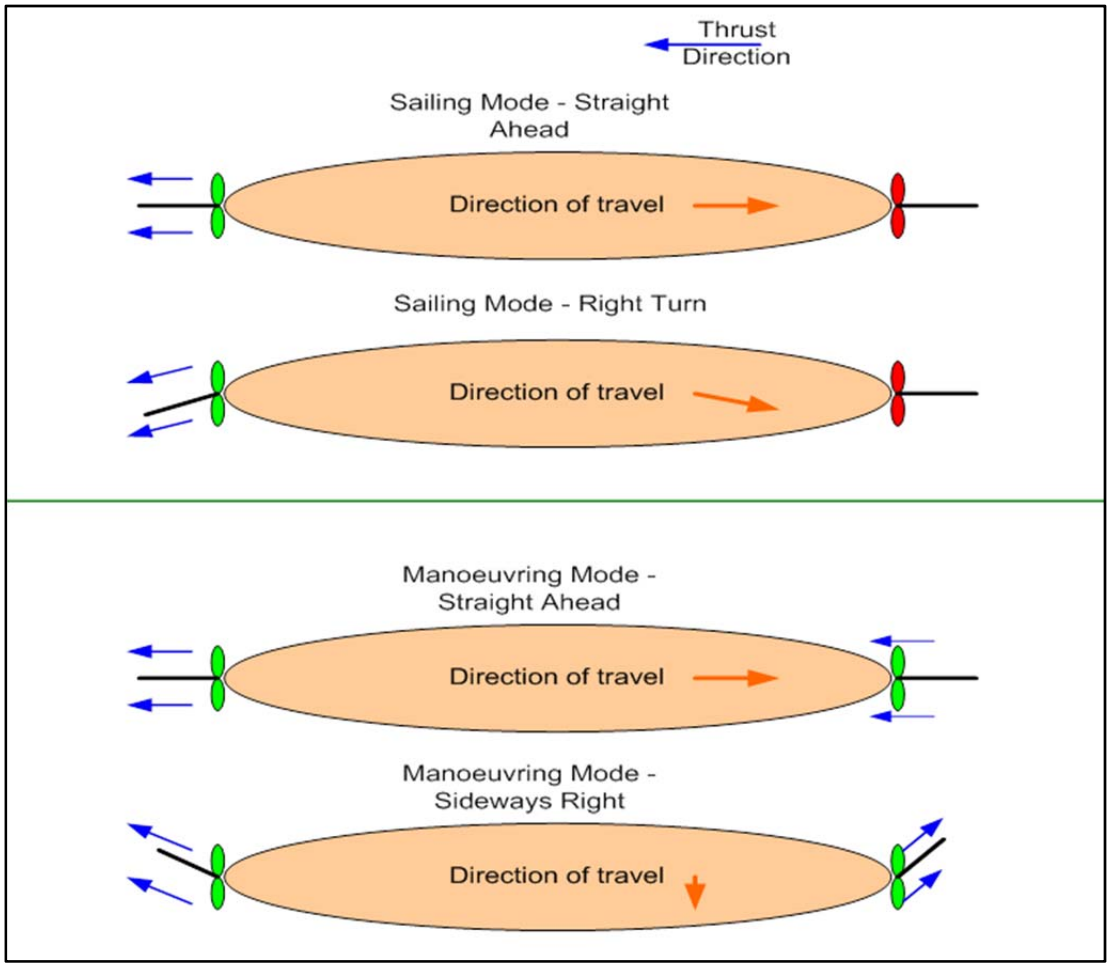
Source: OTSI

Figure 9: Main control panel

1.36 The ferry can be operated in either sailing or manoeuvring modes. When in sailing mode, the stern rudder steers the vessel and engine power is directed to the stern variable pitch propeller, which provides thrust. The bow propeller is feathered and the bow rudder is locked at 0^{o} (midships). In the feathered position, the blades of the bow propeller rotate to a position in line with the direction of water flow (to minimise drag). Sailing mode produces the most streamlined propeller configuration and is utilised for the majority of a journey.

1.37 Manoeuvring mode is engaged when the vessel is required to be berthed or otherwise manoeuvred in close proximity to objects at low speed. In manoeuvring mode, the bow propeller blades are rotated from the feathered position to a coarse pitch. The rotation of the propeller blades to a coarse pitch causes the propeller shaft to rotate, due to the force of the water flowing over the blades. Once the propeller blades fully rotate to a coarse pitch, the clutch is engaged allowing both bow and stern propellers to provide thrust.

1.38 In manoeuvring mode, both rudders and propellers work in conjunction to increase manoeuvrability (including sideways movement) and stopping performance (see *Figure 10*). The transition from one mode to the other takes approximately 17 seconds.



Source: OTSI

Figure 10: *Freshwater* propulsion modes

1.39 The ferry has a Back-Up mode available to the master, providing redundancy in the case of a failure of the primary control system. Engaging Back-Up mode increases engine revs and gives the master direct control of the pitch of both propellers.

1.40 In the event of total wheelhouse control failure, the engineer can take control of engine and propeller pitch controls from a panel in the engine control room. The master gives verbal commands by phone or intercom, which the engineer then inputs directly.

1.41 The ferry was in current survey with the Australian Marine Safety Authority (AMSA)[10] and certified to carry 1100 passengers in Class 1D survey[11].

[10] AMSA is a statutory authority and Corporate Commonwealth Entity and was established under the *Australian Maritime Safety Authority Act 1990* (the AMSA Act). It is a legislative requirement that a domestic commercial vessel in Australia have a current survey applicable for its intended operations.

1.42 *Freshwater* is fitted with Vessel Data Recording System (VDRS)[12] and Automatic Identification System (AIS)[13]. At the time of the incident, AIS data was not recording on the VDRS. No other operational faults were logged by the VDRS.

1.43 *Explorer of the Seas* was a 311 m long, 39 m beam ocean liner that displaced 137,308 tonnes. The liner had a passenger capacity of 4290 and 1185 crew (see *Figure 11*).

Source: OTSI

Figure 11: *Explorer of the Seas* with a Freshwater class ferry in the foreground

1.44 Three Azipod[14] type propellers (two steerable, one fixed) provide thrust to *Explorer of the Seas* during normal sailing. During berthing, the two stern mounted steerable Azipods in combination with four forward mounted thrusters allow the master to manoeuvre the ship alongside the wharf.

[11] For an explanation of survey classes see: https://www.amsa.gov.au/vessels-operators/domestic-commercial-vessels/vessel-classes-and-service-categories.

[12] VDRS records and stores important data from vessel operating systems. This data can be downloaded and used to analyse vessel performance, faults and incidents.

[13] AIS automatically identifies vessels electronically. It exchanges data with nearby vessels and shore based stations and supplements marine radar as an aid to navigation.

[14] Azipod is a marine propulsion unit consisting of a fixed pitch propeller mounted on a steerable gondola ("pod") which also contains an electric motor driving the propeller.

The Crew

1.45 *Freshwater* was normally operated with a crew of six: the master, engineer and four GPHs. Two of the GPHs travel on the passenger decks, while one, known as a greaser, works in the engine room with the engineer.

1.46 The fourth GPH works with the master in the wheelhouse and is known as the helmsman. The role of helmsman is shared between the GPHs and is normally rotated every time the ferry leaves Circular Quay.

1.47 The crew of six held the appropriate Certificates of Competency[15] issued by AMSA applicable to the *Freshwater's* operation.

1.48 The master held Master <35 m and Marine Engine Driver 3 certificates of competency. The master operated varying classes of ferries for more than 24 years. Following the successful completion of training, the master was deemed competent on Freshwater class ferries in 2002. He worked occasionally in the outer harbour service (Circular Quay to Manly) until transferring there full time in 2014.

1.49 The master had extensive experience operating Freshwater class vessels and was a senior master in the HCF fleet.

1.50 The master was in a leave relief roster at the time of the accident, which meant he had no full time vessel or crew. Rather he would fill in as masters went on leave, moving from boat to boat and crew to crew.

1.51 The helmsman was new to the company having joined 29 November 2017. The helmsman held an appropriate GPH certificate and had successfully completed the '*Freshwater* & *Collaroy* Vessel Class Endorsement' on 15 December 2017. The helmsman had limited experience in the role and was working with the master for the first time.

Harbour City Ferries

1.52 HCF was a privately owned company and the main provider of passenger ferry services on Port Jackson. HCF operated regular timetabled ferry

[15] A Certificate of Competency issued by AMSA shows a seafarer's capability to master a vessel and its passengers. It is a legislative requirement that a seafarer have a Certificate of Competency before they can work on a domestic commercial vessel in Australia.

commuter services across Port Jackson under contract for Transport for New South Wales. They operated a fleet of 32 ferries of varying classes. The four Freshwater class operated solely on the Circular Quay to Manly service.

Vessel Operating Manual – *Freshwater* Class

1.53 HCF had an established and documented Safety Management System (SMS). The SMS for the Freshwater class ferries comprised of two main documents, the Fleet Generic Operations Manual (FGOM) and the Freshwater class Vessel Operating Manual (VOM). When combined, the two manuals provide instructions and procedures for a safe and reliable service.

1.54 The FGOM contained procedures and work instructions that applied generically throughout the HCF fleet and shore based operations.

1.55 The individual VOMs contained class specific descriptions and operating instructions. Included in the Freshwater class VOM were procedures for entry to Sydney Cove and berthing at Circular Quay.

1.56 These procedures instructed the master to ensure that prior to entering Sydney Cove:

a. Open communication is established with the engineer and the engineer is placed on standby.

b. That the appropriate wing control station is selected.

c. Manoeuvring mode is selected, has engaged, and that the forward propeller is tested astern.

d. If all systems are operational, then the master can proceed to berth the vessel.

e. Berthing speed is normally 4-5 knots, subject to environmental conditions.

1.57 The SMS contained procedures for the familiarisation, endorsement and assessment of GPHs on the Freshwater class of vessels. The endorsement included a section for the GPH to be endorsed in the role of helmsman. This document, the *General Purpose Hand Freshwater & Collaroy Vessel Class Endorsement,* included instructions for the helmsman to observe when the

master relieved them of control of the vessel. These included that they should observe if the master switches to manoeuvring mode and switches the wing control to standby.

1.58 Following the confirmation that the master had completed these actions, the helmsman was to move to the appropriate wing station and prepare it for the master to use.

1.59 It did not describe what the GPH was to do if they did not see the master complete this task.

HCF Control Room

1.60 HCF operated a radio control room at the northern end of Wharf 3. The control room assisted in the daily operations of the HCF fleet by providing running and berthing information to the ferries.

1.61 The control room was active while the HCF fleet operated. It had access to radios, digital aids and cameras, which it utilised to co-ordinate ferry movements.

Overseas Passenger Terminal and Port Authority NSW

1.62 The Overseas Passenger Terminal provides berthing facilities for large ocean going vessels including ocean liners. The berthing of these large vessels at the Overseas Passenger Terminal can cause significant disruption to other vessel movements in Sydney Cove. The disruptions are due to the physical presence of the large ships and the turbulence created by manoeuvring thrusters. The use of tugboats when berthing a ship can also add to these disruptions, by further reducing the navigable channel.

1.63 In order to mitigate the disruption caused by the berthing operations, the Harbour Master has applied time of day restrictions on when a ship may enter or leave the Overseas Passenger Terminal. These are contained in the Harbour Master's Directions[16].

[16] https://www.portauthoritynsw.com.au/media/1100/harbour_masters_directions_2016_final_v01_19_07_16.pdf

1.64 The directions include preference for starboard sided berthing, positioning on the wharf and a curfew for movements in Sydney Cove (between 0645 hours and 0930 hours or 1630 hours and 1830 hours Monday to Friday).

1.65 The Harbour Master issues all ships that berth in Sydney Harbour with documented berthing instructions. These instructions detail actions a visiting ship's master must undertake before activating the ship's side thrusters.

Port Authority Operational Procedures (PAOP)

1.66 The Harbour Master provides instructions for the movements of ships in Sydney Harbour through the PAOP. These procedures provide instructions for the pilotage of ships in Sydney Harbour and Botany Bay. They include specific procedures for Pilots and the VTS to follow during the berthing at the Overseas Passenger Terminal.

1.67 The instructions include a direction for the pilot to notify VTS both prior to operating thrusters and after they are disengaged. When VTS receives this notification, it is required to broadcast an all ships safety notification on VHF channel 13.

Harbour Master's Berthing Requirements

1.68 Ships that visit Sydney Harbour receive detailed instructions to follow during their stay. When berthed at the Overseas Passenger Terminal, these requirements include a specific procedure for the use of thrusters.

1.69 In the 93-day period (25.11.17 to 25.2.18) of summer 2017-18, 89 ocean liners berthed at the Overseas Passenger Terminal.

1.70 In the corresponding 93-day period (25.11.2019 to 25.2.20) over summer 2019-20, 80 ocean liners were booked to berth at the Overseas Passenger Terminal.

Navigation of vessels in Sydney Cove

1.71 Schedule 6 of the *Marine Safety Regulation 2016 (NSW)* regulates the navigation of vessels within Sydney Cove. It provides a number of instructions, which masters of vessels follow while operating in Sydney Cove. These include:

- Vessels must be authorised to enter the cove
- A speed limit of 8 knots
- The north / south rule
- Vessels must not pass beyond a ‘waiting line’ unless their berth is vacant and there are no vessels hindering their approach.[17]

[17] For more information go to https://www.legislation.nsw.gov.au/#/view/regulation/2016/308

PART 2 ANALYSIS

Introduction

2.1 The investigation focussed principally on the factors that contributed to *Freshwater* colliding with wharves 4 and 5 Circular Quay.

Master's Actions

2.2 *Freshwater's* master reported that as he returned from Manly, he was monitoring the movements of *Explorer of the Seas*. He did this, as he understood the challenges of navigating the ferry in the turbulence created by a berthing ocean liner.

2.3 As *Freshwater* passed Fort Denison, the master called the engineer on the ferry's internal intercom and requested the engineer start the second engine. The master decided to start the second engine to provide *Freshwater* with increased power.

2.4 The engineer started the engine at 0634:34[18], and then called the master back on the intercom, requesting the master reduce power to allow the second engine to engage.

2.5 The VDRS shows the master reduced throttle setting to 0% at 0635:20 and the second engine engaged successfully at 0635:34. *Freshwater* was turning to port towards Wharf 3 as the second engine engaged, with the speed recorded as 8.2 knots.

2.6 The master felt that the ferry's rate of turn was a little slow after he reduced power, so he increased the throttle setting to 39%. While the ferry increased its rate of turn, it also increased its speed through the water to approximately 10 knots as it entered Sydney Cove.

[18] Time taken from the VDRS in HHMMSS format.

2.7 The master, satisfied that the second engine was engaged, transferred his attention to safely navigating the stern thruster wash. The master overlooked the fact that *Freshwater* was still in sailing mode as it entered Sydney Cove.

2.8 The company procedure required a master to establish communication with the engineer and engage manoeuvring mode after passing Kirribilli Point. The procedure also required the bow propeller be tested astern prior to entry to Sydney Cove. The passage from Kirribilli Point to entering Sydney Cove takes approximately one and half to two minutes.

2.9 As *Freshwater* passed Kirribilli Point, the master said he was focused on bringing the second engine online. While the master communicated with the engineer, he also listened to the VTS transmission on VHF channel 13. The master listened to the VTS transmission as it provided an update on the movements of the *Explorer of the Seas*.

2.10 At the time that the master would have normally switched to manoeuvring mode, as per the company berthing procedures, he was preoccupied with ongoing communications, rather than the primary task of navigating the vessel. The master then received a further radio call, when the HCF control room broadcast a transmission on the private company radio channel, warning *Freshwater* of the ocean liner's movements.

2.11 The master continued the approach to Sydney Cove, listening to the radio communications and liaising with the engineer. As the radio transmissions concluded, the master received a further radio call from a crewmember. The call was a routine status update following a deck patrol.

2.12 The master was interacting with three separate radios and the intercom when the helmsman reported that it was clear to turn into Sydney Cove.

2.13 Human factors experts have studied the effect of multiple stimuli on human performance. One such study, by Wickens[19], offered a model which describes how multiple cognitive inputs can lead to a reduction of attention capacity, resulting in errors.

[19] Wickens, CD. Engineering Psychology and Human Performance, Harper Collins, New York 1992.

2.14 The master's decision to engage the second engine provided *Freshwater* with more power. The timing of the decision, late in the journey and at critical time when the master would normally be selecting manoeuvring mode, increased his workload. If the master had made the decision prior to passing Fort Denison, it most likely would have allowed him to deal with the subsequent increased communications while operating the vessel.

2.15 In this incident, the error occurred when the master diverted his attention from his primary task of operating the vessel. This resulted in a lapse of attention that led to a subsequent deviation from established procedure.

Helmsman's Actions

2.16 The GPH, acting as helmsman, had recently joined HCF and was deemed competent on Freshwater class vessels two weeks prior to the incident. At the time of the assessment, it was noted on the endorsement document that the trainee "…*was green but keen to learn..."* and *"…definitely require more shifts to gain further experience*..."

2.17 The *General Purpose Hand Freshwater & Collaroy Vessel Class Endorsement* document included a section covering the helmsman's duties. One of the topics required the helmsman to observe if the master had switched to manoeuvring mode and switched the port wing control to standby. The master said that on the day of the incident the helmsman did not say anything to him about not switching to manoeuvring mode.

2.18 The helmsman's omission could be attributed to a number of factors. The first is that he may not have known to interject or question the master's actions. While the training for GPHs on *Freshwater* class vessels identifies that a helmsman must observe a master engage manoeuvring mode, it does not instruct what the helmsman is to do.

2.19 Other possible factors for this omission include; a lack of confidence, limited experience in the role, working with a senior master who was more than 30 years his senior and in a high workload situation.

2.20 It is possible that an authority gradient[20] existed between the helmsman and the master. Accident investigation agencies have identified that authority gradients between crew is a contributory factor to many accidents.

HCF Freshwater Class Berthing Procedures

2.21 The Freshwater class VOM provided instruction for masters to follow during berthing. These instructions did not acknowledge or address risks faced by ferries berthing while ocean liners were berthing at the Overseas Passenger Terminal. This resulted in masters assessing risks posed by thrusters on a case-by-case basis.

2.22 The presence of ocean liners in the Sydney Cove was a likely event (89 of the 93 days in summer 2017-18 had an ocean liner arrive and depart the Overseas Passenger Terminal). The VOM did not assess or provide mitigating controls to assist a ferry master in balancing safe operations with on-time running during times when an ocean liner was manoeuvring in Sydney Cove.

2.23 A review of the ocean liner arrivals in Sydney Cove from 2017-18, indicates that it was highly likely an ocean liner would be present at the Overseas Passenger Terminal.

[20] The term "authority gradient" is used in other industries such as aviation when it was observed that pilots and co-pilots may not communicate effectively in stressful situations if there is a significant difference in their experience, perceived expertise, or authority.

PART 3 FINDINGS

3.1 From the available evidence, the following findings are made with respect to the collision of *Freshwater* with wharves 4 and 5 Circular Quay on 4 January 2018.

Contributory Factors

3.2 *Freshwater* was in sailing mode when it approached the wharf at Circular Quay. Company procedures stipulated that the master engage manoeuvring mode.

3.3 The ocean liner berthing at the Overseas Passenger Terminal had its thrusters operating which created turbulence in Sydney Cove. This turbulence affected Freshwater's approach to Wharf 3 and meant that the master had to make adjustments to his line of approach.

3.4 The master was communicating with the engineer about the activation of the second engine at a time he would normally be preparing for berthing.

3.5 The master was carrying out multiple tasks during the entry to Sydney Cove. While he communicated with the engineer, he was also receiving radio calls, crew radio reports and verbal reports from the helmsman. This increased workload likely affected his concentration and lack of awareness of being in sailing mode. This likely distracted him from the primary task of navigating the vessel safely.

3.6 The HCF SMS did not contain any procedure relating to the berthing of their ferries during the presence of ocean liners at the Overseas Passenger Terminal.

3.7 The HCF procedure for the helmsmen required them to observe the master engage manoeuvring mode, but did not contain any instructions on what to do if this did not occur. A pre-berth crosscheck by the helmsmen or engineer, may have detected that *Freshwater* was in sailing mode rather than manoeuvring mode.

Other Issues Affecting Safety

3.8 Wharves 4 and 5 were damaged by the impact with Freshwater. One pile on Wharf 4 collapsed immediately following the collision, while a pile on Wharf 5 collapsed 12 days after the event.

3.9 Both wharves 4 and 5 were recommissioned as safe for operations following inspection after the incident. The below waterline damage to the Wharf 5 pile went unnoticed during the inspection.

Remedial Actions

3.10 Post incident, Harbour City Ferries (now Transdev Sydney Ferries) informed OTSI that the following actions had taken place to reduce the likelihood of a recurrence.

- An assessment of ferry operations in the vicinity of ocean liners in Sydney Cove was conducted, with procedures developed and implemented.
- Procedures were developed for crew regarding crosschecking to confirm vessel status. New training content was developed and implemented regarding crew communication.
- Developed and implemented new procedures for control room / ferry operations.
- An ongoing analysis of ferry operations, utilising Forward Looking Infra-Red (FLIR) and the VDRS information.

PART 4 RECOMMENDATIONS

Ferry operators in Sydney Cove

4.1 Operators of vessels in Sydney Cove need to assess the impact of ocean liners berthing at the Overseas Passenger Terminal. Their policies and procedures need to address this risk.

Harbour City Ferries (now called Transdev Sydney Ferries)

4.2 Add to current procedures the stipulation that crew should carry out verbal crosschecking to ensure the vessel is in manoeuvring mode when berthing. This can be reinforced through enhanced Crew Resource Management (CRM) training.

4.3 Develop and implement procedures for the control room operators to notify vessels entering Sydney Cove of turbulence created by ocean liners.

4.4 Develop and implement procedures to limit crew communications and activities at critical times (such as berthing), to those concerned with the safe operation of the vessel only. Communications should be prioritised and timely to allow for a “sterile wheelhouse” environment.

SUBMISSIONS

The Chief Investigator forwarded a copy of the Draft Report to the Directly Involved Parties (DIPs) to provide them with the opportunity to contribute to the compilation of the Final Report by verifying the factual information, scrutinising the analysis, findings and recommendations, and to submit recommendations for amendments to the Draft Report that they believed would enhance the accuracy, logic, integrity and resilience of the Investigation Report. The following DIPs were invited to make submissions on the Draft Report:

- Transport for NSW
- Port Authority NSW
- Harbour City Ferries (Transdev Sydney Ferries)