Departmental investigation into the collision between the Australian flag bulk carrier RIVER YARRA and the tug W J TROTTER in Moreton Bay, Queensland on 31 August 1997

MIIU

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Contents

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investigation into the collision between the

Australian flag bulk carrier

RIVER YARRA and the tug W J TROTTER

in Moreton Bay, Queensland on 31 August 1997

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Summary

The Australian bulk carrier *River Yarra* sailed from Cairncross dry dock, Brisbane at 0736 on 31 August 1997, with two tugs assisting. A licensed pilot was in charge of the navigation through the pilotage district. The vessel manoeuvred to mid stream where the engine was tested for about eight minutes, initially astern and then ahead.

Although there were some fluctuations in engine revolutions, this was identified as a minor problem with the governor, which could be adjusted when clear of the Brisbane River. Following the engine trials the tugs were dismissed.

Through Brisbane Harbour Control, it was known that the tanker *Girraween* was inbound for the Ampol crude oil berth at Fisherman Islands and that the two vessels would pass in the approach channel. In view of the fluctuations in *River Yarra's* engine revolutions, the Pilot asked the Pilot on *Girraween* to delay entry into the Bar Channel until about 0900 when *River Yarra* was expected to clear the entrance beacons.

As *River Yarra* passed Fisherman Islands the tug *W J Trotter* was seen alongside the container berth. At about this time *River Yarra's* engine revolutions dropped for no apparent reason and, as a precautionary measure, the Pilot called the tug on VHF radio, asking it to escort *River Yarra* through the Bar Channel.

A few moments later *River Yarra* lost all engine power. The ship was making about 10 knots and was able to maintain steerage way for 2 miles. The crew of *W J Trotter* cast off to follow *River Yarra* along the Bar Channel and the Tugmaster, advised of the engine failure, was requested to take a tow from *River Yarra's* forecastle so the bulk carrier could clear the Bar Channel.

The tug arrived at *River Yarra* and passed a line from its bow to the bow of the bulk carrier. *W J Trotter* is a stern drive omni-directional tug with the ability to tow with nearly equal power and manoeuvrability in any direction, at least at low speeds.

The tug took the weight on the towline and started to tow *River Yarra* along the Bar Channel. Shortly after the tug made fast, *River Yarra's* engine was restarted, however the tug was retained in case of further problems. The two vessels picked up speed and cleared the entrance beacons twenty minutes later. *River Yarra* then started to alter course to starboard and after an alteration of about 10°, the two vessels collided causing damage to *W J Trotter's* hull on the port side, just aft of its mid-length.

Radio contact between the two vessels established that, although damaged, *W J Trotter* did not require assistance and would make its way back to its berth. *River Yarra* continued on its voyage.

Sources of Information

The Tugmaster and Crew of *River Yarra*

The Pilot

The Master and Crew of *W J Trotter*

Queensland Tug and Salvage Co Pty Limited

Brisbane Harbour Control

Acknowledgment

The Inspector particularly acknowledges the assistance of the Tugmaster and crew of the tug *Austral Salvor* in conducting manoeuvring trials.

Portion of chart Aus 237 reproduced by permission of the Hydrographic Office, RAN.

Narrative

River Yarra

The Australian flag ship *River Yarra* is a self-discharging bulk carrier of 31,698 tonnes summer deadweight at a draught of 10.851 m. The ship, built in 1984, is owned by Haruko Pty Ltd and managed by ASP Ship Management of Melbourne. The ship has four holds and is 182.85 m in length with a beam of 27.69 m and a moulded depth of 15.12 m. *River Yarra* is powered by a 6-cylinder B&W diesel engine developing 8,238 kW.

At sea the bridge is manned in the traditional four-on/eight-off watchkeeping system. The engine room is an unmanned machinery space (UMS), with engineers working during the day and a duty engineer on call during the silent hours. The ship's machinery space control room is manned during manoeuvring operations.

The ship's complement of 22 is made up of the master, three watch keeping mates, a chief engineer and three other engineer officers, seven integrated ratings, catering staff and three trainees. Two crews operate the ship on a "swing" system of six weeks on duty, six weeks on leave.

W J Trotter

The motor tug *W J Trotter* was built and entered service in 1986 for Queensland Tug and Salvage Co. Pty Limited of Brisbane. It is 33.92 m in length, has a beam of 10.82 m, a moulded depth of 5.39 m and a light displacement of 613 tonnes. The two eight-cylinder Yanmar diesel engines, each generating 1790 kW at 720 rpm, drive two "Z" drive Duckpeller assemblies with two 4-blade propellers in Kort nozzles aft. The bollard pull generated is 64 tonnes when towing from the stern hook and 61 tonnes when connected over the bow, their normal mode of operation when manoeuvring ships in port. The engine room is unmanned during towing operations.

The tug has a complement of four, a master, an engineer and two integrated ratings.

The Incident

River Yarra entered the Cairncross dry dock in August 1997. Consistent with normal practice a list was drawn up of the machinery space valves closed before water was pumped from the dock.

The main dry dock work in terms of main engine repair and overhaul involved the removal and overhaul of the Woodward governor and two main engine units were overhauled.

On Friday 29 August, the Masters changed swings. There was a comprehensive exchange of information between the two men. In the preceding days a number of routine meetings between representatives of the shipyard and ASP Ship Management had discussed the undocking procedure and everybody was confident that they were properly briefed. It was agreed that an engine trial following the docking would not be conducted alongside the berth, but would be completed in midstream with a tug in attendance. The understanding

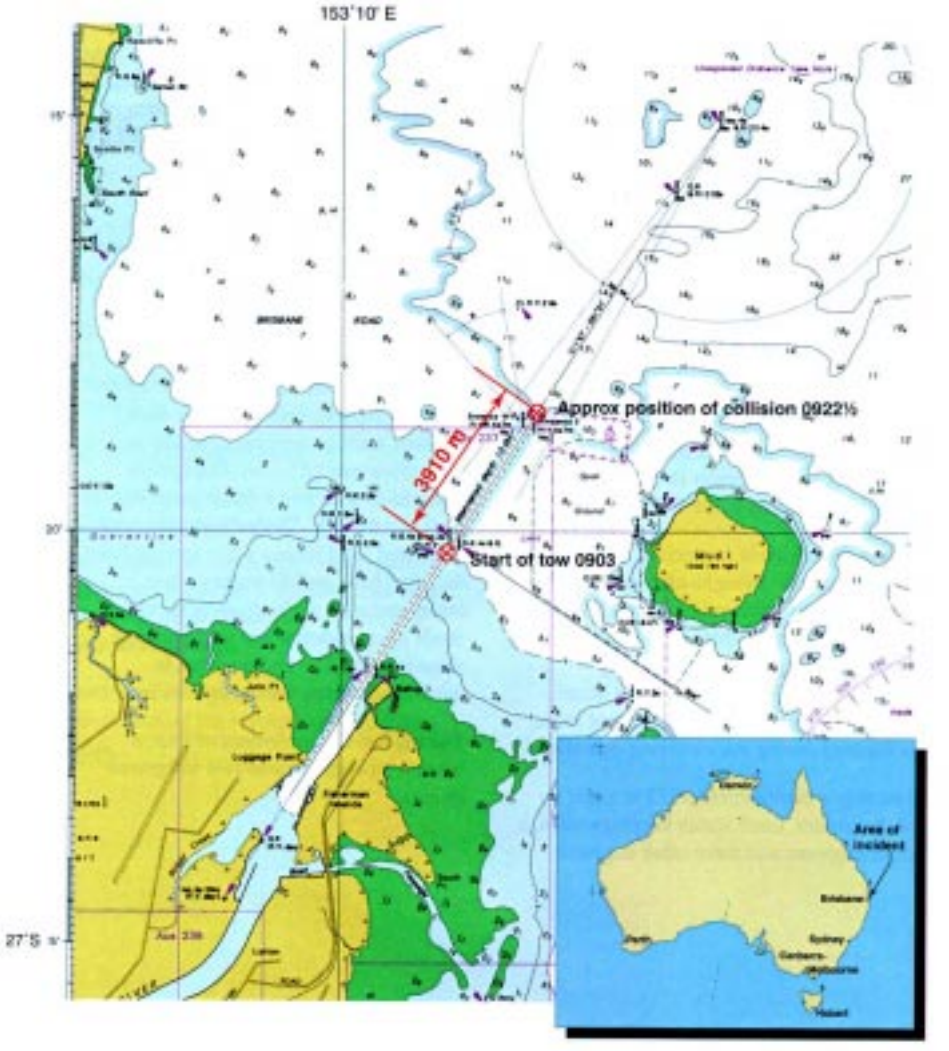

Chart Aus 237 showing entrance location

was that if there were any problems with the engine, the ship could return to a berth outside the dry dock.

Repair work was completed in the evening of 30 August and sailing time was fixed for about 0700 on Sunday 31 August.

The ship's staff started work at about 0400 on 31 August, progressively preparing the vessel for refloating. The engineers, under the direction of the Chief Engineer and assisted by Cairncross personnel, checked all the overboard discharges and pipework for leaks. The valves closed at the start of the dry dock were opened and checked against the list of closed valves. The main engine was made ready for sea following a set procedure for warming through and the dock was flooded. The ship's draught was read as 5.3 m forward and 6.2 m aft.

Testing of the bridge equipment had been completed when the Pilot boarded a little after 0630. At about 0703 the caisson gate was opened and the engine was turned on air. "Stand by engine" was rung at 0706 and engine control was passed to the bridge.

Under the direction of the Cairncross Dock Master, *River Yarra* with the tug *Austral Salvor* made fast aft and using the vessel's mooring lines, was manoeuvred clear of the dock by about 0737. The tug *Barbary* was then made fast on the bulk carrier's port shoulder. Control of the navigation passed to the Pilot and, with the aid of the tugs, *River Yarra* was manoeuvred to the centre of the river.

At 0742, the engine was run dead slow astern for three minutes and it was noted that the revolutions were "hunting" between 45 and 55 rpm. At 0745, the engine was stopped and put to slow ahead revolutions. Again the revolutions hunted but in a range between 58-66 rpm. Concerned with the reliability of the engine, the Master phoned the Chief Engineer asking for a report and whether it was safe to continue the river passage. Other than the steady hunting of the governor, all parameters including engine temperatures and pressures, and fuel pressures as well, were normal. The Chief Engineer told the Master that the engine governor required adjustment but it was quite safe to proceed to sea and the necessary adjustments could be made later. At 0748, the after tug had been released and the forward tug was let go but requested to stand-by. The engine was recorded as hunting between 52 and 70 rpm. At 0753, the engine was put to half ahead.

After *River Yarra* had run on half ahead for a while, the tug *Barbary* was dismissed at about 0804. At 0805, *River Yarra* passed beneath the Gateway Bridge and at about this time the Pilot called the inbound tanker *Girraween* on VHF. He explained that *River Yarra* was experiencing some engine problems and requested that, as a precautionary measure, the tanker should not enter the Bar Channel until the bulk carrier was clear, at about 0900.

The passage down river proceeded without incident although the engine continued hunting between 80 to 86 rpm. At 0829, when off Fisherman Islands, the engine was put to full ahead and the revolutions were noted as hunting between 91 and 95 rpm.

At 0834 the engine revolutions dropped to 36 rpm and the engine room informed the bridge of a fuel starvation problem. With the loss of revolutions the engineers checked the fuel supply system. It was found that the valve on the fuel oil settling tank had not been opened and the ship had been operating on fuel contained in the piping and the fuel return chamber. By 0838, the engine revolutions had dropped to 18 rpm.

At about this time, the Pilot noticed the tug *W J Trotter* tied up alongside a berth at Fisherman Islands. He called the tug on VHF channel 16, requesting that the tug get under way and escort *River Yarra* through the Bar Channel.

At 0841, *River Yarra*, now abeam of no. 4 berth, Fisherman Islands, lost all engine power. The Master, who a few moments before had stood-down the 3rd Mate from his duties forward, called him on the radio and instructed that the starboard anchor should be walked back and that he and the Chief Integrated Rating were to remain on the forecastle head. The Master sent the Cadet, who had been on the bridge maintaining the movement book, to the forecastle to assist.

On hearing the call, *W J Trotter's* Tugmaster went to the bridge and established contact with *River Yarra.* The tug's Engineer went to the engine room to start the engine, assisted by an integrated rating. When the engine was running they left the space and closed the watertight doors. Within a few minutes *W J Trotter* left the quay in pursuit of *River Yarra* and the tug was informed of the bulk carrier's engine failure. The Pilot requested a "long line" but the Tugmaster told the Pilot that they did not have one and that they would have

to make one up. The Pilot suggested that instead the tug should lash up on the starboard shoulder. The Tugmaster also inquired whether they would need a second tug, but the Pilot stated that this would not be necessary. Following this interchange the Pilot informed Harbour Control of the situation.

At 0849, *River Yarra* was abeam of the inner bar beacons. At this time the speed indicated by the Global Positioning System monitor was noted as 5.5 knots. Steerage way was maintained although the engine was not running.

Between 0841 and 0851 three attempts were made to restart the engine. All failed and at 0858 engine control was passed from the bridge to the engine control room and a further, unsuccessful attempt was made to start the engine. Checking within the engine room, the engineers found that the three-way change-over valve between the fuel oil settling tank, the diesel oil tank and the engine was open to the diesel oil tank, but the diesel tank valve was shut. The three way valve was then opened to the fuel oil system and the bridge was informed that the fuel valves required bleeding.

At about 0851, *W J Trotter* closed on *River Yarra.* There was a further discussion between the Pilot, Master and Tugmaster as to how *W J Trotter* should be secured. The Master stated that he suggested that the tug should take a ship's line from the forecastle to the tug's stern towing hook and tow the ship through the channel. He later recalled the Tugmaster was hesitant about using a ship's line given the bollard pull of the tug and the size and strength of the ship's mooring lines. The Tugmaster suggested that he should pass a rope bow-to-bow and that *W J Trotter* could manoeuvre stern first towing *River Yarra* with virtually the same efficiency as a more conventional stern tow. This method of towing was agreed upon. The tug arrived at *River Yarra* at about 0853 and the towrope on the tug's forward towing winch was passed to the ship's forecastle.

The Pilot told the Tugmaster that it would be another ten minutes before *River Yarra's* engine would be available and that the tug would be required to take them "all the way out".

There was some delay in pulling the heavy 96 mm line on to the forecastle and putting the eye on to the bitts. However, the tug was all fast at 0903. *River Yarra* by this time was marginally to the west of beacons no. 13 and no. 14, making some headway, possibly one or two knots. Once made fast the tug worked

quickly to about half power. The length of the towline was estimated to be about 30 m. Over the next few minutes, the Tugmaster steadily increased power to 600 rpm. At about this time *W J Trotter's* engineer left the tug's wheelhouse to check the engine room.

At 0906, *River Yarra's* engineers rectified the problem in the engine room, restarted the engine and ran it at dead slow ahead. Although the fuel pressures and other parameters were normal the engine revolutions continued hunting. As this was attributed to the governor requiring adjustment it was considered safe to run the engine and transfer the engine control to the bridge.

At 0908, the Master accepted a towage agreement with the tug. At this time engine control was passed back from the engine control room to the bridge. At 0909, the engine was put to dead slow ahead and then increased to slow ahead at 0911.

W J Trotter's engineer left the engine room and went to the after deck where he saw that the stern wave was level with the top of the permanent fendering. He returned to the bridge and reported to the Tugmaster, specifically mentioning the stern wave. At about this time the Doppler log was seen to be reading 9.5 knots, however, the Tugmaster considered that this speed was inaccurate and estimated the speed to be between 7 and 8 knots.

At 0912 the Pilot called Brisbane Harbour Control to confirm that they should clear the channel in 10 or 15 minutes and stated he would give an update when clear of the channel. The Tugmaster asked what the ship's plans were once they had cleared the channel.

As the *River Yarra* was approaching the Bar Channel entrance beacons, the Pilot called the tug by VHF, informing the Tugmaster that the ship would be altering course to starboard to allow the tanker *Girraween* more room in its approach to the channel.

Shortly after 0920 the Pilot notified the Tugmaster by VHF that *River Yarra* had started to alter course from 032° to 045° and this was acknowledged by the Tugmaster.

A little after 0921, when *River Yarra's* bridge was passing between the entrance beacons, with *W J Trotter* slightly on the starboard bow, the Pilot called the tug on his hand held VHF radio. The Tugmaster

responded saying:

“We will want you running straight when we come to let go or I will have trouble steering otherwise”.

The tug was then seen to take a sheer across *River Yarra’s* bow and the Tugmaster shouted on the radio:

“Too much way”.

Concerned at the tug’s apparent manoeuvre and the likelihood of collision the Master ordered the Third Mate to let go the tug. With the distance between the two vessels reduced, the weight came off the towrope and the crew were able to release the tow. At about the same time, or very shortly afterwards, the tug came into contact with *River Yarra’s* port bow, with the ship’s bulbous bow striking the tug’s hull on the port side just about amidships. None of those on the forecastle head saw the collision as they were engaged in clearing the towrope.

At 0923, *River Yarra’s* engine was stopped and then put to half astern. The tug was trapped for a few seconds before the Tugmaster was able to manoeuvre *W J Trotter* clear.

Once clear, the tug’s engineer and one of the ratings went to the engine room to assess the damage. They found the hull plating heavily set in, about 1 m aft of where the overboard discharges pierce the hull. The sewage tank and associated bracket, just inboard of the hull were bent inwards and twisted. The machinery was intact and the hull’s watertight integrity had not been affected. At about 0930, the Tugmaster reported to *River Yarra* that he did not require assistance but would proceed at reduced revolutions to the tug base. Having been released, *River Yarra* continued its voyage to Adelaide, after disembarking the Pilot off Caloundra Head.

W J Trotter returned to its berth at the Queensland Tug and Salvage depot at Whyte Island, where further assessment of the damage was carried out.

Comment and analysis

The collision between the tug *W J Trotter* and *River Yarra* was the culmination of a chain of events which included the ship's engine failure. This led to the requirement for a tow and the eventual collision.

Engine failure

When *River Yarra* left dry dock, trials to ensure the engine was operational were carried out in the river. The ship had a contingency plan to put alongside the breasting wharf, should the engine display any unreliability or fault. The trials consisted of running the engine dead slow astern for about three minutes and then running it slow ahead for two minutes, before the tugs were let go. During the trials it was seen that the engine revolutions were slowly hunting. On slow ahead the hunting was between 52 rpm and 70 rpm instead of being steady on 55 rpm, the setting for slow ahead.

Hunting of the engine revolutions can be caused by a faulty main engine governor, or a governor in need of adjustment, or fuel starvation. During the engine trials and immediately after, the engineers checked all the parameters of temperature and pressure and diagnosed the cause of the hunting as the governor requiring adjustment. It appeared that at the time of leaving the dry dock and the initial passage down river, this was a correct diagnosis and the decision to proceed, was justified.

River Yarra's main engine runs on heavy fuel oil. Heavy fuel oil, to remain pumpable, is heated at all stages through the system. From fuel oil bunker tanks, oil is transferred to settling tanks then purified and transferred to a service tank, from where it is pumped through heaters and filters to the main engine fuel rack supplying the individual cylinder fuel valves or injectors. Oil not used in the firing sequence is circulated to a return chamber. The engine can also be run on diesel oil and there is a three way pneumatic valve, which closes off the heavy fuel oil line and opens the diesel oil line. Each of the settling and service tanks and the diesel oil outlet to the main engine has an "Instanta" valve for stopping the engine in an emergency. *River Yarra's* engine is not normally operated on diesel oil at any time.

The hunting in the engine revolutions at 0834, about 50 minutes after the first engine movement in the river and 5 minutes after the engine control was put to full ahead, was compounded by the governor sensing a drop in fuel flow. Within 4 minutes the revolutions were fluctuating between 18 and 40 rpm. Investigating the possible cause, the engineers found that the "emergency shut off valve" from the fuel oil service tank was closed. Opening this valve did not cure the problem and subsequent examination showed that the three way pneumatic valve was open to the diesel oil system, but the diesel oil tank itself was shut off.

It was known that some work was done on the three-way valve assembly during dry dock. The evidence is that the three-way pneumatic valve had been switched to the diesel tank at some time while in dry dock, without the knowledge of the ship's engineers. The emergency shut-off "Instanta" valve on the service tank had also been closed, again without the knowledge of the ship's staff. As the two valves, situated about one metre apart, were not altered or shut when docking earlier in August they appeared on the engineer's check list as "open". They were not checked when the ship was prepared for sailing, on the false assumption that the status of all valves would be the same as when the vessel entered dry dock.

There was sufficient fuel oil in the piping and return chamber to allow the engine to operate at low power for the initial fifty minute passage down river.

Fuel oil had been circulating within the system for a few days before the ship left the dry dock to ensure that both the engine and fuel were properly warmed through. The circulation of oil had been from, and back to, the return chamber and the service tank had been closed during this process. Before sailing the engineers went through the two hour main engine warm through routine, which includes draining any accumulated water from the fuel oil settling and service tanks. The procedures, however, do not identify the need to check the valves on the fuel oil system and the on board procedures did not cover this basic safeguard.

The Collision - Objective evidence

On board *River Yarra* the engine movements were recorded manually and the course recorder was inoperative. *W J Trotter* did not carry any remote recording device to measure speed or engine movements - for a tug to do so manually is impractical.

Brisbane Harbour, Moreton Bay and the approach channels are under constant radar surveillance. Unfortunately, however, there is no means of recording the radar plot for analysis in the event of an incident.

The radio channels and telephone lines monitored by the Port Control Centre are recorded on a 26 track tape. This tape, synchronised for time**, was made available to the Inspector. The recording system does not monitor Channel 74 VHF, the channel used by the tugs when talking between themselves and with their base. Unfortunately, the tape, between 0802:45 and 0811 on 31 August is over-recorded by a partial recording dated 16 September. It was therefore not possible to verify objectively the discussions between the Pilot, Harbour Control and the tanker *Girraween* or any messages passed between the tugs *Barbary* and *W J Trotter.*

The remaining tape is intact. There is no evidence from the tape recordings that the Pilot specifically discussed *River Yarra's* engine movements with either Harbour Control or *W J Trotter.* The Pilot and tug were operating on VHF channels 12 and 8. Sometimes the Pilot used the ship's VHF set and at other times used his hand held personal set, which, because of its limited range, was not within range of the VHF repeater station and hence was not picked up by the monitoring system. A number of responses from the tug confirm messages were passed by VHF but as the Pilot was using his hand held VHF, records of the conversations are one-sided.

The tape records much of the initial contact between *River Yarra, W J Trotter* and Harbour Control.

At 0903, the Pilot reported to Harbour Control that the tug was just about to be made fast and thirty seconds later the tug called the ship saying that it was about to take the weight.

The tape recording clearly picks up the Tugmaster reporting to the Pilot that *W J Trotter* was "up to half power – nearly three quarters" just after 0906 and then calling the ship at 0907 and reading the conditions of towage. This is one of the conversations in which only the Tugmaster is heard. At 0911, the Pilot called Harbour Control stating that *River Yarra* should be clear of the channel in 15 minutes and that he would

*** * Times given by radio recordings seem to be about 2 minutes 30 seconds slow of ship's time - times have been adjusted to ship's time.**

provide an updated report at that time. There was no mention that *River Yarra* was under its own power. This was followed by a series of exchanges where only the Tugmaster is recorded. These dealt with an explanation of why he suggested a "bow-to-bow tow" and some comments about engineers. At a little after 0918, *River Yarra's* Pilot called *Girraween* telling the tanker that *River Yarra* would be clear of the channel "shortly" and would alter to starboard to pass "red to red". *The Girraween* confirmed the arrangement.

At 0920:30 there is an exchange with the Tugmaster replying " . . .come round with you", followed by a message by the Pilot to Harbour Control " Brisbane Harbour – *River Yarra*: entrance beacon – north bound".

At about 0921 the Pilot called the Tugmaster. Much of the conversation is indistinct but the Tugmaster said "we will want you running straight when we come to let go or I will have trouble steering otherwise".

At 0921:30 the Pilot broadcast an "all ships" message that *River Yarra* was outbound. A few seconds after this an unidentified brief broadcast on VHF, evidently from the Tugmaster, said "too much way".

About 90 seconds later a voice reported the collision with the bulbous bow; this also evidently came from the Tugmaster. About 5 minutes later the Pilot on board *River Yarra* called Brisbane Harbour Control to confirm that the vessel was proceeding to sea. Just after 0930, the Tugmaster reported that *River Yarra's* bulbous bow had given the tug "a good old touch below the water line" and the tug was proceeding back to its berth.

Tug trials

On 19 November, Queensland Tug and Salvage Co Pty Limited made *W J Trotter's* sister tug *Austral Salvor* available for speed trials. The trials took place in the river to the east of the Gateway Bridge at slack water. Speeds were taken from the GPS plotter and were not timed by watch.

Initially the tug was run astern to observe the build up of water at the stern. At
650 rpm the stern wave was close to the top of the stern bulwark and a significant volume of water came through freeing ports and fairleads on the after deck. A speed of 7.5 knots was achieved after a short period of such running at these revolutions.

At 600 rpm a speed of 7.2 knots was achieved quickly. After sustained running a speed of 8.2 knots was achieved. The stern wave was clearly visible and was about level with the top of the stern fendering.

The speed reached when moving ahead at 600 rpm was 10.8 knots.

The trials showed that directional stability astern at 600 rpm was difficult to maintain and movement of the uni-lever control was critical. Any overcorrection had a cumulative effect in the yaw of the tug's stern movement, which could easily result in brief loss of control. Steering astern at speeds of over six knots required intense concentration, even by an experienced Tugmaster. The restriction of the bow by the tow rope would only increase the difficulties in maintaining a safe position and direction relative to the ship under tow.

The tow

As *W J Trotter* was on its way to assist *River Yarra*, there was some discussion between the various parties as to the way in which the tug could best aid the bulk carrier. The first reaction on the part of the Pilot and Master was for a conventional tow from the tug's after towing hook. However, because it normally operated "over the bow" the tug did not have a suitable towrope of its own readily available aft. A composite rope would have had to be made up and this would have taken some time. The Tugmaster was reluctant to take a ship's mooring rope. In his experience ship's ropes were not necessarily reliable and given the potential bollard pull of the tug, he advised against this option.

The Pilot then suggested that *W J Trotter* should tie up on the port shoulder, similar to the position adopted for manoeuvring in port. This at least would maintain the ship's position in the channel and prevent it from grounding. However, at this stage, it was not known when the ship's engine would become serviceable and the Tugmaster suggested that the *W J Trotter* could tow from its bow, given its directional capabilities. The Master and Pilot accepted this idea.

W J Trotter has an operational bollard pull over the stern of 64 tonnes and a bollard pull over the bow of 61 tonnes. A standard safety feature allows quick release of the towing hook aft and disengaging of the forward tow rope drum. Omni-directional tugs typically "work over the bow", utilising their manoeuvrability to tow in any direction.

W J Trotter was in position at the bulk carrier's bow at 0856, and a 96 mm diameter bow towline, with a breaking force of 1226 kN (about 125 tonnes), was passed to *River Yarra's* forecastle. There was a delay in passing the heavy (5.85 kg/m) tow line, as there was not sufficient manpower on *River Yarra's* forecastle to handle the heavy towrope. By the time
W J Trotter made fast to *River Yarra*, the ship was marginally to the west of no. 13 and no. 14 beacons. The vessel was heading about 030° and steerage had virtually been lost. The estimates of *River Yarra's* speed ranged from stopped in the water to 1 or 2 knots ahead.

At 0903, *W J Trotter* started to take the weight. The length of tow line passed by the tug was variously estimated to be between 15 m and 50 m, the consensus being that it was a little under a tug's length, about 30 m.

Within three minutes, the Tugmaster confirmed that the tug was on just over half power and about 30 seconds later he confirmed that the tug was nearly on ¾ power (600 rpm). After three minutes of towing, the engineers restarted *River Yarra's* engine, which ran at dead slow for one minute before being stopped and control passed from the engine control room to the bridge. With the tow stabilised, the Tugmaster negotiated the company's towage agreement with *River Yarra's* Master. As the tow progressed the tug engineer and the Tugmaster commented on how well the operation was proceeding.

Initially, the Tugmaster envisaged that *W J Trotter* would tow the bulk carrier to an anchorage in Moreton bay. Once clear of the Bar Channel he planned to lengthen the bow tow line and take the ship to an anchorage as directed by the Pilot.

On *River Yarra's* bridge the engine was put to dead slow ahead for two minutes. The hunting of the revolutions continued. At 0911 the engine revolutions were increased to slow ahead. The Master and Pilot discussed the ship's speed and agreed that the engine should be kept at slow ahead, which gave a speed of 5.5 knots to 6 knots. This, it was considered, would allow the tug to take the weight and have two or three knots in reserve. At this stage they considered that the operation had been successful.

There is a difference between the accounts of the Pilot and the Tugmaster as to whether the tug was informed that *River Yarra* had restarted the engine after the tow had started. The Pilot stated that he informed the tug that *River Yarra* had started its main engine and was under power. The Tugmaster stated

that he did not realise the bulk carrier's engine had started although he was told that the bulk carrier's engine was operational.

There is no evidence from the tape recording of the VHF conversations that the Tugmaster was told that *River Yarra's* engine was running. However, the Pilot stated categorically that the tug was informed, using his portable VHF set. It is possible that one or more of the messages not picked up by the monitoring system may have referred to engine movements on board *River Yarra.* But whatever messages may have been passed, it does seem that the Tugmaster was not conscious of the fact that the ship was under its own power at the entrance beacons.

The other members of the tug crew had seen the exhaust from *River Yarra's* funnel when the engine was started and the ship's wake could also be seen from the deck and bridge wings of the tug. None of the crew pointed this out to the Tugmaster, who could see neither the funnel nor the stern of *River Yarra* from his position on the centre line of the tug's wheelhouse.

The Entrance beacons were passed at 0922 and the engine stopped at 0923, when the collision occurred.

Suitability of W J Trotter

In submission, the Pilot stated that he only became aware of the availability of tug *Barbary* when *W J Trotter's* Tugmaster informed him that a second tug was available. The Pilot also emphasised that his first preference was for a conventional tow from the tug's stern or, failing that, for the tug to lash up to the bulk carrier's bow. The Tugmaster, however, seemed confident that a tow from *W J Trotter's* bow was a viable alternative.

W J Trotter is an omni-directional tug with a stern drive configuration (rather than tractor drive[1]) used for all types of towage, including salvage and similar operations. Each azimuth propeller is contained in a Kort nozzle and can rotate through 360°. Under normal operating conditions the two propellers, controlled by a single lever control, work through a microprocessor to give directional drive, while the port and starboard engine throttles control the revolutions of each engine. The ability of the propulsion units to produce thrust

[1]Tractor tugs have their propellers mounted in the foreppart of the tug's hull.

in any direction gives the tug a very high degree of manoeuvrability, enabling significant increases to be made in the efficiency of ship handling operations.[2]

However, in choosing to tow *River Yarra* from its bow a number of limiting factors were introduced into the operational equation. Although working over the bow is highly effective for berthing and unberthing operations at relatively low speeds, as the tug's speed astern increases so its directional stability is decreased. Although the tug's maximum speed, free running, is 13 knots, the maximum speed that the tug can achieve astern is limited to about 600 rpm in calm water, giving a speed of about eight knots.

A conventional tow over the stern would have overcome these problems; however, *W J Trotter* did not have a stern towrope readily available.

The tug *Barbary, a* conventional tug with a stern towline, had followed *River Yarra* down river and could have been with *River Yarra* in a shorter time than the *W J Trotter.* The Tugmaster of *Barbary* called *W J Trotter* on VHF channel 74 and offered the services of *Barbary*. When this was relayed to the Pilot on *River Yarra*, he stated a preference for the more powerful tug.

Ship speed

Critical issues in the collision are the speed of the two vessels at the entrance beacons, the length of the towline and the method of releasing the tow.

According to the bridge/engine movement book, when starting the river passage, *River Yarra's* engine was put to half ahead revolutions at 0753. The Pilot Card shows that revolutions for half ahead should be 80 rpm giving a speed of 10.4 knots while in ballast. The bulk carrier passed under the Gateway bridge at 0803 with the rpm fluctuating between 80 and 86 rpm. The distance between the Gateway Bridge and the Port Control Office, which was passed at 0826, is 7180 m (3.88 miles) giving an average speed of 10.1 knots. Times of passing points in the river seem to have been recorded to the nearest minute and based on this, the average speed was probably between 9.3 knots and 10.1 knots.

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[2] Brander, P.A., May 1993, Research into the Capabilities of Australian Omni- directional stern Drive Tugs in Port Kembla.

The engine revolutions were then increased at 0829 to full ahead (92.5 rpm) until the engine failure. Between 0829 and passing the Inner Bar beacon at 0843 the vessel covered about 4100 m in 14 minutes at an average speed of 9.5 knots, and ten of those minutes were at severely reduced revolutions. When passing the Inner Bar Beacons the ship's speed by GPS was logged as 5.5 knots and when between no. 20 and no. 18 beacons the speed was recorded as 3.7 knots by GPS. However, nobody looked at the GPS speed after the tug was made fast.

The distance from the Entrance Beacons to where the tug was made fast is 3910 m. The tow covered this distance, from what was virtually a standing start, in 19 minutes at an average speed of 6.7 knots. At one stage, when the engineer aboard *W J Trotter* looked at the tug's doppler log, it was showing about 9 knots. This, he felt, was not accurate as the tug was going stern first and the log would have been affected by turbulence. However, based on the wave created by the tug's stern motion, the speed when approaching the Entrance Beacons would support the Tugmaster's view that the speed of the two vessels was well in excess of 7 knots.

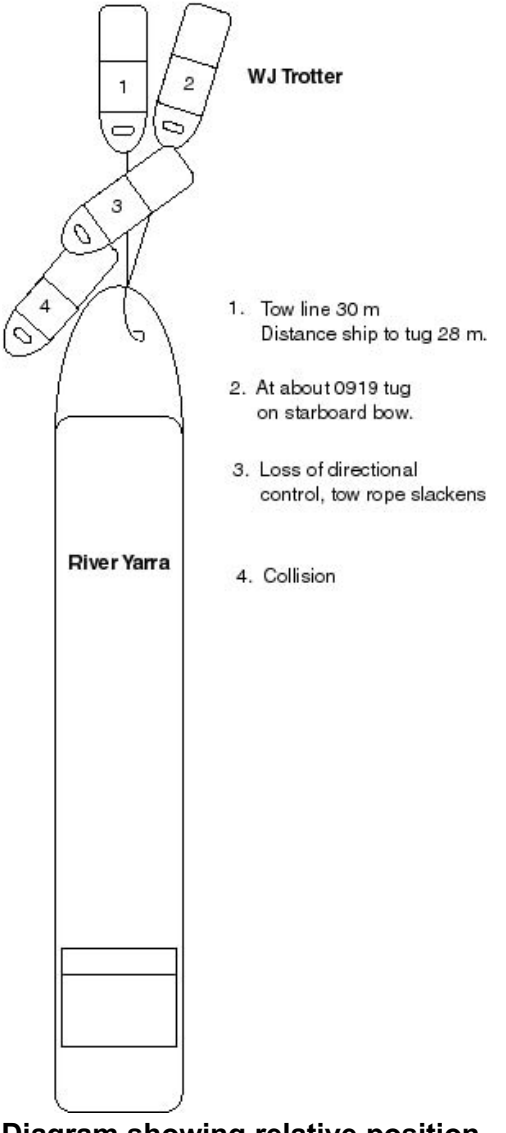

Diagram showing relative position fof tug and ship

The Collision

The Pilot and the remainder of the bridge team on *River Yarra* had two immediate priorities; firstly, to prevent the ship grounding in the vicinity of beacons 13 and 14 and, secondly, to clear the channel to allow *Girraween* to enter. The Tugmaster of *W J Trotter* also had two immediate priorities; firstly to take *River Yarra* under tow and, secondly, to clear the channel. Both sets of aims were achieved.

The Pilot's plan was to clear the channel, alter course to allow *Girraween* to enter and to slow down to allow the tug to be let go. The Pilot stated that he called the tug on his VHF set when approaching the entrance beacons and told the Tugmaster that once the tow was clear of the entrance beacons course would be altered to starboard and, providing there was no further problem with the engine, the tug would be let go. There is no recording of this message, however the timing would fit with the Tugmaster's response at 0920:30 where he says ".....come round with you".

The statements by those on *River Yarra's* bridge indicated that as the vessel cleared the Bar Entrance beacons and was about halfway through the 13° alteration from 032° to 045°, the tug was seen to suddenly cross the bow from starboard to port without any warning, creating great concern for the Master and Pilot. The Master told the ship's crew on the forecastle to let the tug go. There is some confusion as to whether there was an order from *River Yarra* to the tug to let go. The ratings aboard the tug, however anticipated releasing the tow. No whistle signal was given by the ship to indicate to the tug that the tow should be released, which would have been normal when handling tugs in Brisbane. The balance of the evidence is that no direct order was given to let go the tug, until the tug was seen to sheer across *River Yarra's* bow.

For the tug to allow the release of the tow, the tug Master had three options:

1. To pay out the tow rope from the tug's forward tow winch by either walking back on the winch; or,

2. To utilise the emergency release; or,

3. To take the weight off the tow line by reducing the distance between the two vessels.

The tug's ratings did not use the forward towing winch controls, nor did the Tugmaster use the emergency release system, to provide slack on the towrope.

There was an impression by the tug crew that the tug had taken some speed off. However, the Tugmaster could not recall touching the throttle controls and reducing speed. Controlling the tug was a "high skill" operation whereby many of the routine tasks are second nature (similar to changing gear or manipulating the accelerator when driving a car). A reduction in speed by *W J Trotter* can not be ruled out, but any speed reduction that may have occurred was not, of itself, the only factor leading to the collision.

The decision to let go the tow rope did not contribute to the collision. The order to let go the tug was made after the collision became inevitable.

The evidence is that the slack on the tow rope resulted from a decrease in distance between the vessels, caused by the uncontrolled sheer of the tug across the bows of *River Yarra*.

At a speed of about seven knots, the tug itself was at or near maximum speed astern and the danger of being overrun was very real. As shown on the trials, it was very easy to lose control and even a momentary loss of control was difficult to correct quickly. Given the triangulation as a result of the difference in heights between the tug's forward deck and the ship's fairlead, the actual distance between the tug and ship was about 28 m. At a speed differential of one knot, the ship would override the tug in less than one minute.

The Tugmaster stated that at the time he was attempting to manoeuvre the tug ahead of *River Yarra*, so that the bulk carrier and the tug were aligned fore and aft before attempting to let go. The recordings of the VHF radio traffic between the ship and tug between 0920 and 0923 would suggest that this was the Tugmaster's primary aim.

The Tugmaster realised that towing at speed while manoeuvring astern did have inherent dangers, but he did not realise the extent of such hazards. It would seem that in attempting to realign *W J Trotter,* the Tugmaster lost immediate directional control of the tug. The tug then sheered over to *River Yarra's* port side, resulting in the collision.

Personnel

The Inspector is totally satisfied that neither drugs nor alcohol played any part in the incident.

The Pilot, although with Brisbane Pilots for a little under a year at the time of the incident, had experience as a pilot/berthing master over a period of seven years. The *River Yarra* pilotage was the first ship assigned to the Pilot after a spell of eight days off duty and the Pilot was well rested.

River Yarra's Master and officers had just completed a dry dock schedule, and followed a conventional sleep pattern. The evidence is that the Master, the Chief Engineer and all other officers were properly rested when starting duty on the morning of 31 August.

The Tugmaster was widely experienced and had been in command of tugs for twenty years and of omni-directional stern drive tugs for eleven years. He was five days into a two-week operational roster and he had spent the night at home and was rested in preparation for duty. The call to *River Yarra* followed the first rostered job for the crew, which was assisting a container ship to sail. The remainder of the tug crew were also experienced and fit for duty.

Fatigue, particularly in terms of sleep deprivation was not a factor in this incident.

Safety systems and documentation

The Brisbane Marine Pilotage Company has a training program under which pilots are assessed at various stages of their training, all of which is documented. The training regime is rigorously followed and includes pilots going on the tugs and observing their operation. However, these are normally confined to berthing and sailing operations and do not include atypical operations such as the tow of *River Yarra* by *W J Trotter.* Neither the Pilot, nor the Master had any concept of the problems the Tugmaster was likely to experience when manoeuvring his vessel at high speed astern.

The Brisbane Marine Pilotage Company has addressed this issue in an amendment to its training program.

The vessels operated by the Queensland Tug and Salvage Co Pty Limited adhere to a set of clear operating procedures, which are produced for each individual tug under their management. The operating procedures cover all aspects of the tug operation (towage and salvage) and the company safety requirements. However, a maximum safe towing speed was not included in the operating instructions nor were there any recommendations for the towing configuration in circumstances such as faced *W J Trotter* on 31 August.

The Queensland Tug and Salvage Co Pty Limited addressed these issues immediately after the incident.

Conclusions

These conclusions identify the different factors contributing to the incident and should not be read as apportioning blame or liability to any particular organisation or individual.

The following factors are considered to have contributed to the collision:

1. The initial requirement for a tow at short notice, which arose from a lack of appropriate engine room procedures on board *River Yarra*.
2. A feeling by all involved that, once the ship was under tow, the critical operation to prevent *River Yarra* taking the ground had been completed successfully, before the tug let go.
3. A lack of precise communications as the vessel cleared the channel between those on the bridge of *River Yarra* and the Tugmaster of *W J Trotter.*
4. The speed of the tow, particularly in the bow-to-bow configuration at the time of letting go.
5. The short length of the towline increased the risk of being overrun with any slackening in speed by the tug.
6. The lack of appreciation by the Pilot and Master of the difficulty in controlling the directional stability of *W J Trotter* when towing stern first at speed.
7. The absence from Pilot training of a full knowledge of tug manoeuvring capabilities.
8. The lack of a mutually agreed procedure for letting go the tug.
9. Inexperience by both the Pilot and Master of releasing a tow at relatively high speed.
10. The absence from the tug's standard operating procedures of information on the limitations of the tug's performance when towing astern.

Submissions

Under sub-regulation 16(3) of the Navigation (Marine Casualty) Regulations, if a report, or part of a report, relates to a person's affairs to a material extent, the Inspector must, if it is reasonable to do so, give that person a copy of the report or the relevant part of the report. Sub-regulation 16(4) provides that such a person may provide written comments or information relating to the report.

The final draft of the report, or relevant parts thereof, was sent to the following:

The Pilot, the Pilot in charge of training, Brisbane Marine Pilots, the Master and the Chief Engineer of River Yarra, the Tugmaster and Queensland Tug and Salvage Co Pty Limited.

A submission was received from the Pilot. Where appropriate his submissions have been reflected in the text where this has not been done his submission is reproduced below.

Conclusion 3

Almost all communications between River Yarra and Trotter were through the Pilot. I consider the information passed to Trotter to be reasonably precise. Had this not been the case, I would have sought clarification.

Conclusion 4

A procedure for letting go the tug was not discussed because it was not known whether or not the River Yarra would continue her voyage or anchor.

Once clear of the channel, Trotter would have been released or retained for assistance with anchoring. In either event the release would have complied with the tug Skipper's request, as there would have been sufficient sea room to manoeuvre as required.

Conclusion 7

It was never intended to release the tow at high speed, the tug was released because of the problem which had developed.

Conclusion 9

As previously stated, this matter has now been addressed.

A submission was also received from the Tugmaster. Where appropriate his submissions have been reflected in the text of the report, he also submitted the following comment.

To my knowledge this was only the fourth request in ten years for a line off the hook. So the synthetic towline had been removed from the deck racks and stowed below for protection. The "making-up" comment is because the line is in two parts to allow for differing situations. One could expect generally sufficient advice to prepare a tow, but in this instance time was a criteria. On the only instance of a ship's mooring line being accepted it unfortunately parted, but it must be acknowledged that it was not from an Australian flag vessel.

Details of River Yarra

Former name(s)	Audax, Star Kanda
IMO No.	8010934
Flag	Australia
Classification Society	Lloyd’s Register of Shipping
Ship type	Bulk carrier (self-unloader)
Owner	Haruko Pty Ltd
Operator	ASP Shipmanagment
Year of build	1984
Builder	Kanda Zosensho K.K. - Kawajiri.
Gross tonnage	22,931
Net tonnage	11,367
Summer deadweight	31,698 tonnes
Length overall	182.85 m
Breadth extreme	27.69 m
Draught (summer)	10.851 m
Engine	B&W 2SA 6Cyl 670 X 1700
Engine power	8238 kW
Crew	22

Details of W J Trotter

Flag	Australia
Classification Society	American Bureau of Shipping
Ship type	Stern drive omni-directional tug
Owner	Queensland Tug and Salvage Co Pty
Operator	Queensland Tug and Salvage Co Pty
Year of build	1986
Builder	Carrington Slipway, Newcastle
Gross tonnage	470
Net tonnage	141
Light displacement	613 tonnes
Displacement max	966 tonnes
Length overall	33.92 m
Breadth moulded	10.82 m
Depth moulded	5.39 m
Draught (summer)	5.3 m
Engine	Two Yanmar 8Z280-ET (280 x 360)
Engine power	2 x 1790 kW
Bollard pull (stern hook)	64 tonnes
Bollard pull (bow)	61 tonnes
Crew	4