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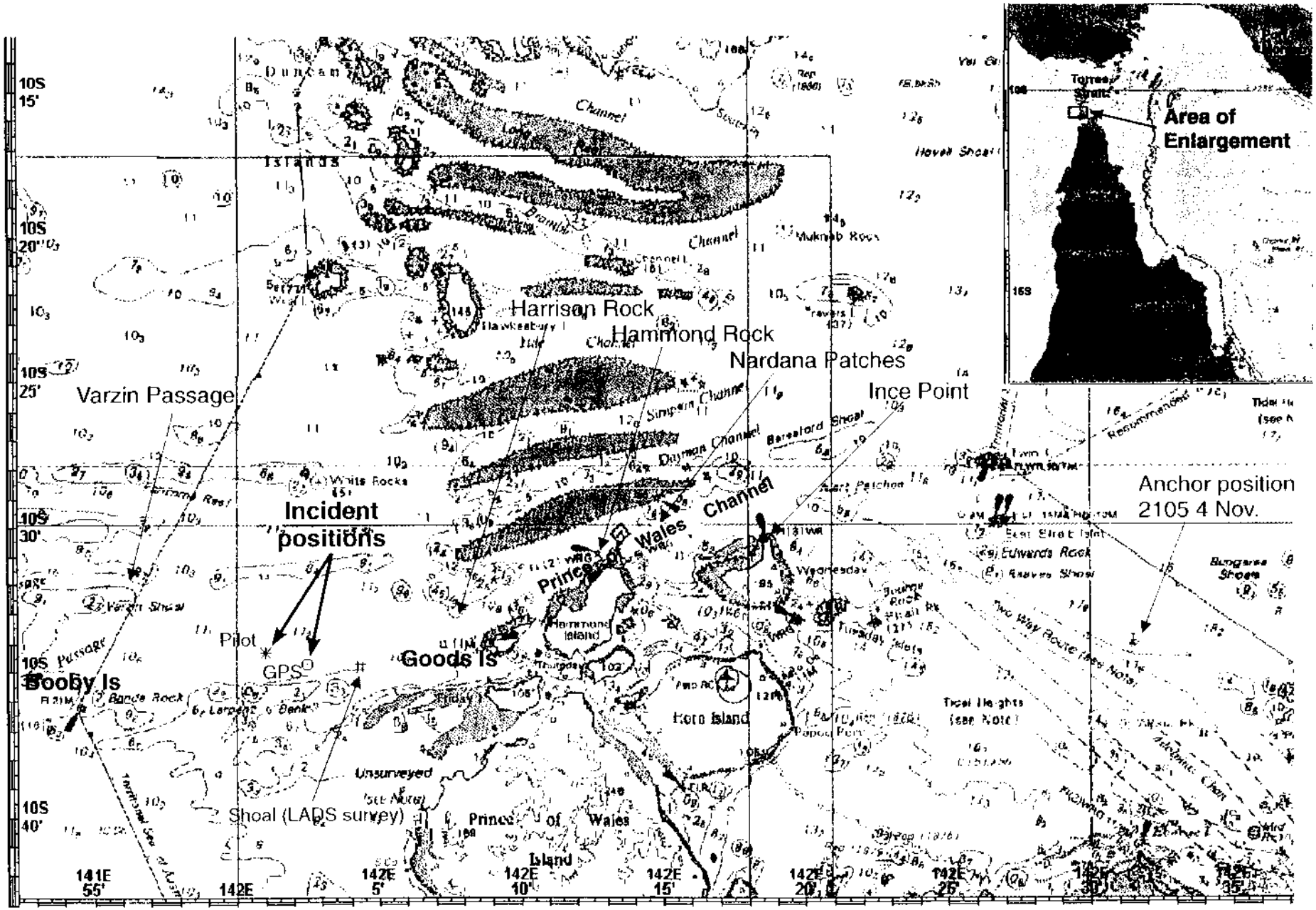


Western Torres Strait
showing area of incident

Summary

The Turkish flag bulk carrier M Nuri Cerrahoglu, sailed from Hay Point on 2 November 1994, loaded with about 52,500 tonnes of coal, bound for Singapore and Turkey by way of the inner route of the Great Barrier Reef and Torres Straits. The vessel had a maximum draft of about 11.0m and required a suitable "tidal window" to navigate the Prince of Wales Channel and Varzin Passage of the Torres Straits.

At Hay Point a licensed pilot joined the ship, to take charge of the navigation for the passage through the Reef.

On the evening of 4 November, the vessel anchored on the eastern side of Prince of Wales Channel, awaiting a sufficient rise in the sea level to safely navigate Varzin Passage on the western side. At about 2330, the vessel weighed anchor and transited the Prince of Wales Passage. When approaching Varzin Passage at about 0200, the broadcasting tide gauge at Booby Island indicated there was insufficient water for the ship to pass safely.

The Pilot decided to delay the ship by turning a wide circle to port. When almost half way through the turn, the vessel stopped swinging despite port rudder being applied. The ship was travelling slowly and, concerned that the ship might be touching the seabed, the engines were put astern. After 20 to 30 minutes the vessel had gained sufficient stern way to take into safe water where the ship was checked for possible damage before passing through Varzin Passage.

Nobody was hurt as a result of the incident, no damage was reported to the ship and no pollution resulted.

Information sources

The Inspector acknowledges the cooperation of:

The Pilot.

Cerrahogullari Umumi Nakliyat Varpurculuk ve T.A.S., Istanbul.

The Bureau of Meteorology.

The Hydrographer, Royal Australian Navy (RAN).

Acknowledgement

Portions of the charts covering the Torres Strait are reproduced by permission of the Hydrographic Office, RAN.

Introduction

The Turkish flag bulk carrier M Nuri Cerrahoglu, formerly under the Norwegian flag as Berge Charlotte, is owned by Cerrahogullari T.A.S. of Istanbul*. M Nuri Cerrahoglu was built in 1984 with a summer deadweight of about 69,000 tonnes at a summer draught of 13.126m, it has 9 cargo holds, is 248.93m in length and has a beam of 32.31m.

On 22 October 1994, the vessel entered the Great Barrier Reef through Hydrographer's Passage with a licensed pilot, as required as a condition of port entry under the Great Barrier Reef Marine Park Act 1975. The vessel was anchored off Hay Point for some days before loading about 52,500 tonnes of coal for Turkey. On 2 November 1994, the vessel completed loading and a draught survey by an independent marine surveyor confirmed a draught of 11.0m forward and aft, and a deepest draught of 11.01m amidships.

The vessel's route was to take it through the inner route of the Great Barrier Reef to Singapore, where it was to take on bunker fuel and thence, via the Suez Canal, to Turkey. M Nuri Cerrahoglu was a "regulated" ship within the meaning of the Great Barrier Reef Marine Park Act, 1975 and, as a ship over 70m in length navigating the Reef between Cape York and Cairns, was required to take a duly licensed pilot.

The Pilot boarded on the morning of 2 November; coincidentally, it was the same pilot that had charge of the navigation through Hydrographers Passage. With the sea conditions at Hay Point it was not easy for the Pilot to read the draft himself and he accepted the draft as provided by the ship's staff of 11.0m even keel.

* A vessel of this name appears as a tanker in Lloyd's Register of shipping, this vessel has recently been sold and the name transferred.

The Incident

The vessel sailed at 1005 on 2 November 1994. Once clear of Fitzroy Island and the Whitsunday Group, the Pilot had limited duties until the vessel approached Low Isles at the southern end of the compulsory pilotage area of the inner route.

The Pilot showed the Master a passage plan detailing the tidal data and estimated times of passing various positions. The ship had about 860 miles to run to clear Torres Strait at Varzin Passage. Because of the tidal constraints in Torres Strait, there were two options, either to try and clear Torres Strait before 2100 on 4 November (requiring an overall average speed of at least 14.58 knots), or to be prepared to reduce speed or anchor and wait for the "tidal window" of the early morning of 5 November, when, theoretically there would be sufficient water at the critical point, Varzin Passage, from about 0220 until about 2130 on 5 November.

The vessel passed Low Isles at 1339 on 3 November, having made good a speed of about 14 knots from Hay Point. The Pilot stated that the passage through the Reef progressed routinely. The ship's officers were able to communicate in English and the crew were proficient in their navigational duties and routinely checked the ship's position, mainly by GPS satellite, although not as frequently as in some other ships. The Pilot was able to rest at appropriate legs of the passage, as and when shipping or the absence of course alterations allowed.

The gyro compass was one degree low throughout the passage. The covers on the bridge wing gyro compass repeaters were removed and the Pilot was able to use these repeaters which were also one degree low. On passage through the Reef the port repeater seized up, but the starboard repeater remained operational throughout the passage and while one of the two radars tended to overheat, the other performed well. The Helmsmen did not have a strong command of English, but performed well under the Pilot's supervision.

As the passage progressed it became clear that the chances of clearing Varzin Passage on the tide of the evening of 4 November were marginal, particularly as the vessel would lose time through the Prince of Wales Channel, stemming a tidal stream with a predicted maximum rate of 5.2 knots. Booby Island tidal predictions are used as the data for the passage through Varzin Passage.

Tidal predictions in metres for the stations in the Prince of Wales Channel and Varzin Passage, from 1800, 4 November

Time/ Station	Ince Point	Turtle Head	Goods Island	Booby Island
1800	1.42	1.60	2.69	3.25
1900	1.03	1.23	2.30	2.77
2000	0.85	0.93	1.77	2.16
2100	1.02	0.87	1.29	1.51
2200	1.35	0.93	1.06	1.04
2300	1.61	0.86	0.97	0.88

M Nuri Cerrahoglu, with a draught of 11.0m, required a minimum of 1.0m under keel clearance and hence a minimum depth of water of 12.0m at any point in the passage.

The chart datum for the areas of least depth

Place of least depth	Chart datum	Height of tide required
Ince Point	11.9	0.1
Nardana Patches*	11.6	0.4
Goods Island	11.3	0.7
Booby Island (Varzin)	10.5	1.5

* An area midway between Ince Point and Turtle Head.

Early in the evening of 4 November, the Pilot decided that they should anchor to the east of the Prince of Wales Channel to wait for the tide to start rising.

Through the inner route M Nuri Cerrahoglu had maintained a speed marginally under 14 knots and passed Wyborn Reef at 1912 on 4 November. From about 2000, the Pilot monitored the broadcasting tide gauges, which give the "real time" height of the water above datum at four stations in Torres Strait, Ince Point, Turtle Head, Goods Island and Booby Island. The real height of tide at three of the four stations was below that predicted.

The vessel passed Alpha Rock at 2048 and at 2105 it was brought up to its anchor in a position 3 miles north of Alpha Rock and just outside the two-way route to wait for the tide to start to rise within the Strait.

At 2330 on 4 November, the vessel weighed anchor, with the tidal broadcast transmissions indicating that the tide at Ince Point had started to rise. The Master, an officer of the watch and a helmsman were on the bridge, remaining there throughout the transit of the Prince of Wales Channel, until the vessel cleared Varzin Passage sometime later. The vessel proceeded at slow speed to Herald Patches, passing Herald buoy at 0018 on 5 November and Ince Point at 0030. The tidal stream through Prince of Wales Channel was west-going and M Nuri Cerrahoglu passed Hammond Rock at 0057, while the tidal stream was running at its maximum rate, predicted to be 6.7 knots. Although the pilot wanted to proceed at a minimum speed, safe steerage way could not be maintained at revolutions below slow ahead.

On slow ahead, between Herald Patches and Harrison Rock, the vessel made good a speed of 13.74 knots over the ground, the maximum speed being attained between Nadana Patches and Harrison Rock. The vessel reached Harrison Rock, at the western end of the Prince of Wales Channel at 0120, with the vessel on a course of 250° on the mainland side of the channel, at an estimated speed between 10 and 12 knots.

The speed was increased to half ahead and, according to the Pilot, he altered to a course of 270°, putting the Goods Island high light right astern. When about 4.3 miles from Goods Island high light, at about 0135, course was altered to 285° to pass between "C3" and "C4" buoys at the eastern end of Varzin Passage. This route was followed to ensure that the ship kept well clear of the shoal water to the east of Varzin Passage.

The heights of tide given by the broadcasting tide gauges during this time indicated that, if the M Nuri Cerrahoglu maintained its course and speed, there would be insufficient water in Varzin Passage to maintain the minimum under keel clearance of 1.0m. At 0200, the tide gauge at Booby Island was indicating 0.9m, 0.6m below the minimum depth required for transiting the passage.

Predicted tidal height compared with the record made by the Pilot of the broadcast tidal heights at Booby Island and Goods Island were as follows:

Record of tidal heights

Time/Station	Goods Is	Booby Is
2300 Predict	0.97	0.88
Transmit	0.8	0.7
0000 Predict	0.92	0.86
Transmit	0.8	0.6
0100 Predict	0.95	0.99
Transmit	0.9	0.8
0200 Predict	1.11	1.4
Transmit	---	0.9

After altering course to 285°, the Pilot explained to the Master that there was insufficient water and that they would need to waste some time. At, or shortly after 0200, the Pilot ordered port rudder and altered the speed from half to slow ahead. The ship swung readily and the rudder was eased to 10 degrees with the engine on slow ahead.

Although the initial turning position was not accurately plotted by the Pilot, he did monitor the ship's position in terms of latitude by taking bearings of Goods Island and Booby Island lights with the starboard bridgewing compass. He was not concerned for any shoal water to the west or east of M Nuri Cerrahoglu, but was conscious of the south to south-west tidal stream and Larpent Bank to his south. His plan was to ensure that the vessel stayed north of, and on no account crossed, the imaginary line joining Goods and Booby Island light houses (080.5/260.5 degrees).

At about 0220 the ship had altered through about 170 degrees, when, with the ship's head on 117° the Pilot sensed a drop in the engine pitch and the swing stopped. There was no sensation of taking the ground, but it seemed that the vessel was sensing the bottom or was lightly touching an obstruction in an area of water where the least charted depth was 11.6m at a time when the tide was at least 0.9m above that datum. The wind at the time was from the east at about 4 to 6 knots with a slight sea.

The position was reported by the Pilot as 10°34.3′S 142°01′E, which was fixed by visual bearings taken with the starboard bridgewing gyro repeater. The ship, using a GPS plot, and radar bearings and distances, stated that the position was 10°34.7′S 142°02.5′E. Goods Island bore 084° and Booby Island 257°. According to the Pilot, at no time was the line between Booby Island and Goods Island crossed.

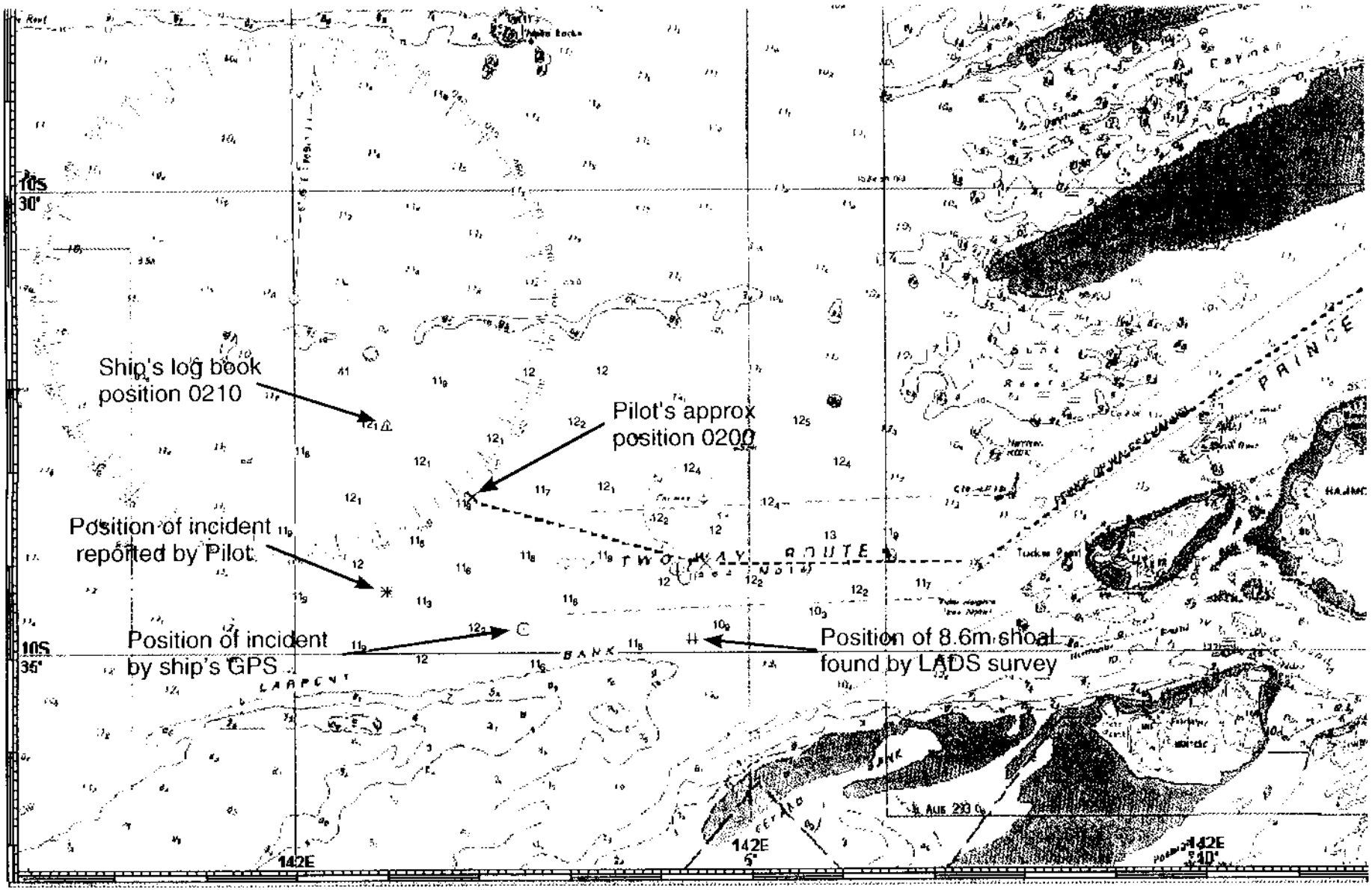
The Pilot ordered the engine stopped and then slow astern. Over the side of the ship considerable sand was being churned up. The engines were kept at slow astern until, in a position reported

by the Pilot as 10°34.8′S 42°01.5′E and, at about 0300, sternway was gained and allowed to build up, before the engine was stopped and put half ahead with full starboard rudder. The vessel was considered to be clear of any shoal water by 0310.

The Pilot asked whether or not the Master wanted to go to anchor to allow for an external inspection of the hull. The Master instructed that all spaces be sounded and, when no ingress of water was reported and he had discussed the incident with his owners by radio telephone, it was decided to continue to Singapore, where a full inspection would be undertaken.

M Nuri Cerrahoglu resumed its voyage and cleared Varzin Passage at 0520 on 5 November 1994. The Pilot disembarked at 0550.

In Singapore an underwater inspection of the ship found no visible sign of damage in the bow section, except a minor indentation of about 2 to 2.5cm near the middle of the bow section and some superficial scratch marks on the flat bottom platting. The propeller and rudder were observed to be intact. There is no evidence to indicate whether or not the scratches or the indentation found during the under water survey was caused by the grounding of 5 November.



Section covered by chart Aus 296
(Goods Island to Proudfoot Shoal)

Comment and Analysis

Torres Strait is an area of shoal water and of a complex tidal regime. Ships transiting the area are limited to a maximum draught of 12.2m. For vessels drawing less than 11.9m the recommended minimum under keel clearance is 1.0m throughout the Torres Strait. The passage of any ship transiting the straight drawing more than 9.5m draught may be constrained by tidal height.

Ships constrained by draught must time their passage to ensure that the minimum under keel clearance is maintained, taking into account any properties of "squat"* that the vessel may experience with speed through the water.

A pilot has a duty to the Master to conduct a ship safely, using his local knowledge of depths, hazards, wind and tide. Where a ship is navigating in relatively shallow water a pilot must ensure that sufficient under keel clearance is maintained to ensure a safe passage. Where a ship is constrained by draught and relies upon tidal height for its passage, the pilot must ensure that the under keel clearance is maintained at a safe minimum, while ensuring the ship is delayed to the least extent possible.

M Nuri Cerrahoglu left Hay Point on 2 November with a draught of 11.0m forward and aft and a displacement of 71,200 tonnes. At this draught the tonnes per centimetre immersion is 69.43 (tonnes) and the moment to change trim one centimetre 1115 (tonnes/cm). On passage between 1005 on 2 November and 0200 on 5 November, the ship consumed about 100 tonnes of fuel oil from no. 7 topside tank (longitudinal centre of gravity 50.59m from the after perpendicular). The ship's drinking and other fresh water was made on board by an evaporator, resulting in no net change in the quantity of water on board, and diesel oil consumption was minimal, at an estimated 0.5 tonnes.

The vessel's draught would therefore have changed marginally with the consumption of 100 tonnes from no.7 fuel tanks resulting in a general decrease in draught of 1.44 cm and a change in trim resulting in an increase in the forward draught to 11.017m.

In shallow water, ships experience a phenomena known as squat. While there seems to be some difference in expert opinion on the exact extent of squat and how it should be calculated, the tendency to squat exists and is an important element in navigating the Torres Strait. M Nuri Cerrahoglu carried an indicative squat table for confined (with banks) or open waters, calculated on formulae developed by Dr C B Barras**. Based on a vessel block coefficient of 0.833, the vessel may have experienced a squat of 0.67m at a speed of between 8 and 9 knots.

It is therefore possible, that at 0220 on 5 November, when the ship's turn to

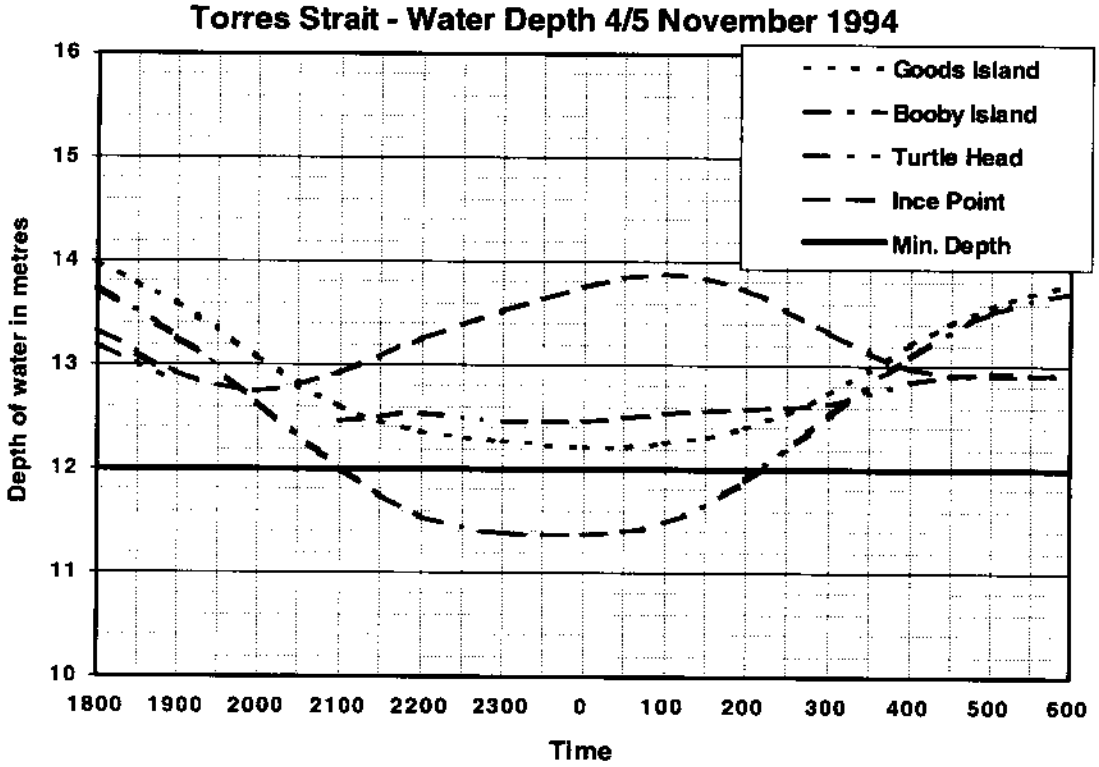
* The term squat refers to the tendency of a ship to sink lower in the water and change trim withan increase of forward speed.

** For open waters, squat= Cb x $V^2/100$ (where Cb is the block coefficient at a given draught and V is the speed.

port stopped, the actual draught forward was 11.687m. This would have been an absolute maximum. It is more likely that the speed at the time was not more than 6 knots and the maximum draught, because of squat (taken from the ship's information), would have been no more than 11.32m.

When formulating the voyage plan, working on a draught of 11.0m, the predicted hourly tidal heights, plotted by the Pilot, indicated that there would be sufficient water to the Prince of Wales Channel at any time, with more than the 12.0m of water required to maintain the required under keel clearance. But in Varzin Passage the predictions showed that, between 2100 on 4 November and 0212 on 5 November, there was less than the 12.0m required to maintain a 1.0m under keel clearance. A "tidal window" was open before 2100 on 4 November and after 0212 on 5 November. The ship was unable to make the tidal window of 4 November and the pilot anchored the ship, weighing anchor to arrive at Varzin Passage after 0215, the area of least depth of water (10.5m sounding) being located towards the eastern end of the passage.

The Pilot stated that he waited at anchor until he considered the tide had started to rise before getting under way at 2330. However, based on the tidal predictions, the tide should have been still falling at both Goods Island (L.W. 0007 on 5 November) and Booby Island (L.W. 2344 on 4 November). The Pilot's notes show that the transmitted tide heights at Ince Point (at the eastern end of the Prince of Wales Channel) had started to rise, but both the transmissions from Turtle Head and Booby Island were static and below the predicted height, and the tide at Booby Island indicated that it had not changed while the ship was at anchor, and subsequently broadcast a



further drop in height between 2330 and midnight, after the passage had been resumed.

The recorded data from the transmitting tide gauges at Booby Island, Goods Island and Ince Point was recovered by the Navigational Services Business Unit of the Australian Maritime Safety Authority and passed to the Inspector. The record of tidal heights from Turtle Head was corrupted and could not be used for comparison.

The records from Booby Island, Goods Island and Ince Point, confirm the transmitted tide gauge broadcasts from all three stations were consistently below the predicted height of tide. For the critical period 2300 on 4 November to 0300 5 November, all three varied between 0.09m and 0.35m below the predicted height, based on the hourly records. Based on the broadcast tide gauge reading, as recorded by the Pilot at 0200, the depth of water was 0.5m below the height predicted.

Although there was less water than predicted, there was at all times sufficient water in the Prince of Wales Channel to maintain the minimum under keel clearance.

At Varzin passage the lower than predicted height of tide delayed the tidal window until about 0240.

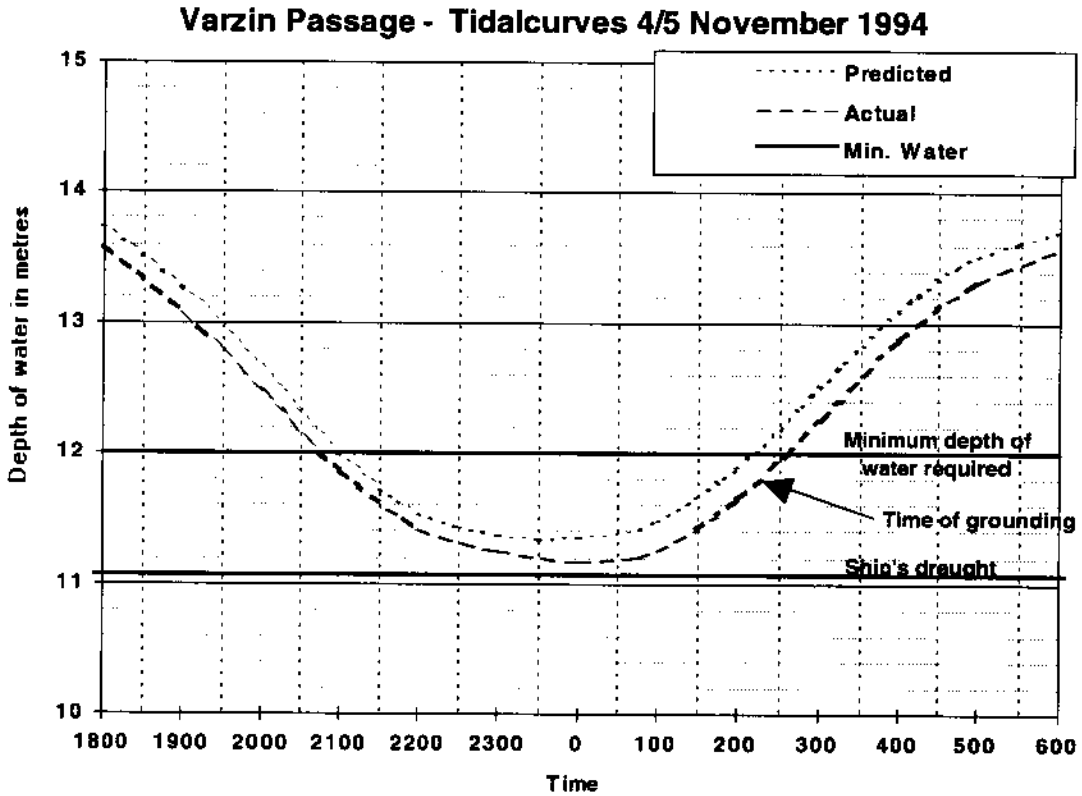
The Pilot realised that it would be necessary to waste some time and he had a number of options:

To stop the ship and take all way off and wait.

To anchor the ship in the designated anchoring area.

To turn the ship slowly, keeping control of the ship.

With a strong south-westerly current it would have been hazardous to take the



way off the ship, as it would take time to build up sufficient speed to regain control. Similarly the option of anchoring in very shallow water runs the risk of a ship running over its own anchor with the possible hazard of puncturing the hull.

The Pilot, in consultation with the Master decided to turn the ship slowly to allow time for the tide to rise in Varzin Passage.

At a time that was probably a little after 0200, the Pilot ordered port wheel and the turn to port was started, after the Master and Mate had examined the chart and satisfied themselves that the plan was safe. The ship's log book and the Master's report recorded a time of 0210 for the order to turn to port and a position of 10°32.5′S 142°01′E at an engine speed of 30 r.p.m., and the Master reported that the rudder was put hard to port.

The Pilot did not plot the position at the start of the turn but he stated that he followed his normal route, putting Goods Island light astern on 270° until about 4.3 miles from Goods Island, when he altered course for Varzin Passage.

Based on times recorded by the Pilot and his description of the courses he followed it seems that the ship, having passed Harrison Rock buoy at 0120, altered from a course of about 235° to 270° and at about 0142 altered to 285° to head between buoys "C3" and "C4" at the eastern end of Varzin Passage. If he followed his normal procedure the timings of the alteration would indicate a speed of about 10.4 knots, which would have decreased as the ship cleared into the more open water.

To start the turn, the Pilot also stated that he ordered half ahead and then slow ahead and 15 degrees of port rudder initially which was eased to 10 degrees when the ship started to swing.

This would indicate that the ship's position was at or near 10°33.3′S 142°01.9′E, about 1.9 miles (3520m) north of Larpent Bank when it started the turn, about 1.2 miles south and east of the position reported by the Master. The ship's recorded position for the start of the turn is not consistent with the time, and the position in which, the ship appeared to be stopped. If the time of alteration was 0210, the ship would have to have travelled about 3.5 miles, to the position of the incident, in ten minutes. From the position based on the Pilot's evidence, the distance travelled would have been about 2 miles in just under twenty minutes, requiring a speed of a little over 6 knots over the ground.

For these reasons the Inspector is satisfied that the alteration of course occurred closer to 0200, rather than 0210. Also, given the tidal set to the south-west and the respective distances involved in the turn to port, the Inspector is satisfied that the ship was in a position close to 10°33.6′S 142°02.9′E when the course was altered to port to take a turn through 360 degrees.

Over a period of about 20 minutes, from a course of 285°, the vessel swung through 168 degrees to a heading of 117° (8.4 degrees/min), when the vessel stopped its swing.

The Pilot and ship's staff recorded different positions for the apparent grounding. The Pilot did not fix the

position accurately but maintains that the ship was north of a direct line between Goods Island and Booby Island lighthouses. He recorded initial bearings of Goods Island 087° and Booby Island light 252°. After the engines were stopped and the engines were running slow astern, the bridge wing compass bearings had changed to 084° and 257° respectively. Both sets of bearings were compass bearings, requiring one degree to be added to make them true bearings, and both sets formed an oblique angle, giving a good indication of latitude but poor indication of longitude. He put the position as 10°34.´S 142°01.0´E and stopped in 10°34.8´S 142 01.5´E. This would indicate that while the vessel may not have maintained its turn to port, it did maintain some headway for about another 0.5 miles over a ten minute period, while the engine was turning at slow astern.

It is therefore hard to assess whether or not the vessel stopped in the water as a result of coming into contact with the seabed, or whether the vessel was actually stopped by putting the engine astern. What ever happened, the vessel's turn to port was arrested and, if there was any under keel clearance, it must have been minimal.

Advice contained in the legend of chart Aus 296, Goods Island to Proudfoot Shoal, states:

"Positions obtained from Satellite navigation systems are normally referred to WGS Datum; such positions should be moved 0.09 minutes SOUTHWARD and 0.06 minutes WESTWARD to agree with this chart."

The reported ship's position by GPS, was 10°34.7´S 142°02.5´E, which adjusted gives a position of 10°34.8´S 142°02.46´E. The position was also checked by radar bearings and distances taken from Goods Island (Tucker Point, 082° at 6.2 miles) and Friday Island (north extreme of Potts Point 098° at 6.3 miles). The radar positions are consistent with the GPS position.

The bow of the ship was about 205m from the radar scanner and the ship's heading was about 117°. When the vessel appeared to stop in the water it was about 450m from the shoal water off Larpent Bank. Had the vessel not stopped, but maintained a steady rate of turn, the closest point of approach to the 10m contour off Larpent Bank would have been approximately 420m. The least depth indicated on or close to the track of the turn to port was 11.6m.

When M Nuri Cerrahoglu appeared to stop at about 0220, the charted depth of water was about 11.6m. The tide at Booby Island was about 1.0m above datum and there should have been at least 1.0m clearance under the keel, given a ship's maximum draught of 11.62m while underway. There was no detectable swell that would decrease the effective depth of water.

If this was the case, then the ship may have touched an isolated obstruction, although this seems unlikely in the absence of anything other than the scratches on the paint on the ship's bottom plating reported by the underwater hull inspection in Singapore.

It is not clear what caused the ship to stop its turn to port. Discussions with

the Harbour Master, Cairns, who had been stationed for three years in Thursday Island and who had been involved in a salvage operation in the general area between Goods and Booby Island, reported that the seabed in the area is relatively firm sand and there is no mud.

There is no evidence that the vessel was south of the position stated and that it came into contact with Larpent Bank. The only reference point was the stated final position taken from the ship's GPS plotter, the position was not plotted at the start of, or during the turn, despite the presence of shoal water to the south. The Inspector regards this as reflecting poor bridge procedure and providing inadequate monitoring of the Pilot's actions.

The Hydrographic Office, Royal Australian Navy, undertook an aerial survey of the area of the incident by Laser Airborne Depth Sounder (LADS) on 9 December 1994. The area surveyed was just over 5 square miles in extent (about 23 km2) in an area previously surveyed in 1971 to 1973 by echo sounder with sounding lines 60m apart and a depth accuracy of 0.5m.

The LADS survey "illuminated" or sounded the seabed, to an accuracy of ±0.3m, in a grid pattern at 10m intervals over the area of the survey. The survey confirmed depths of 11.6 metres and deeper in the area of the incident. One patch of shoal water of 8.6m was identified in waters charted as 10.9m, but this was adjacent to the eastern end of Larpent Bank, about 1.9m east of the area in which M Nuri Cerrahoglu stopped.

It may be that, with the minimal under keel clearance, in some way the ship built up a temporary sand bank, sufficiently large enough to stop a ship of M Nuri Cerrahoglu's displacement, but sufficiently restricted in area not to have been detected by the airborne survey, or ephemeral in nature to have quickly dispersed.

Pilot's experience

The Pilot had been at sea since 1960 and held a certificate of competency as a Master Class 1 and had over 7 years experience in command. He obtained his Great Barrier Reef Pilotage Licence in January 1992 and had piloted over 130 ships through the Reef. Initially he piloted shallow draught ships only, but with experience was assigned deep draught ships. To the time of this incident he had piloted over 40 deep draught ships.

The Pilot planned the passage in an efficient manner and anticipated that the ship would need to anchor to the east of the Prince of Wales Channel. However, his decision to weigh anchor at 2330 was premature given that, although the tide had started to rise at Ince Point, there was still at least an hour before Booby Island reached its predicted low and the broadcast tide gauges were transmitting tidal heights below those predicted, which could reasonably have been anticipated to result in the "tidal window" being delayed.

Although it is not uncommon for real time tidal heights to be significantly less than those predicted, the particular set of circumstances in terms of meteorological conditions and tide,

may not have been experienced by the Pilot.

Meteorological conditions

The Inspector engaged the Bureau of Meteorology to compare the weather pattern of 4/5 November 1994 with 4 October 1991, when a fully loaded bulk carrier became tide bound between Varzin Passage and the Prince of Wales Channel, with insufficient water to either retrace its course through Varzin Passage or continue through the Prince of Wales Channel. On this occasion, also, tidal heights were significantly below those predicted.

The report (Attachment 1) concluded that:

Higher than normal atmospheric pressure would have contributed to a depressed sea level during early October 1991 and early November 1994. The effect of wind stress as a contributing factor in these incidents are unknown, however, [as indicated above] wind stress may have also contributed to the depressed sea level during these periods.

Under keel clearance

The accepted static under keel clearance of 1.0m for vessels drawing 11.9m or less has proved a safe minimum margin for vessels which follow the direct course lines, particularly in the area between Booby Island and Goods Island.

In taking a wide turn to port, M Nuri Cerrahoglu was significantly further south than the direct route between Goods Island and Varzin Passage or the route between Goods Island and Gannet Passage. The vessel was therefore probably in waters where ships of similar size and draught had not been before.

In the absence of any known obstruction upon which the ship may have grounded, mariners must bear in mind Annual Australian Notice to Mariners no.24, "Under-keel Clearance - Reliance on Charts and Predicted Tides":

1. Prudent mariners navigate with adequate under-keel clearance at all times, making due allowance for all the factors that are likely to reduce the depth beneath their keel. To ensure adequate under-keel clearance throughout a passage an under-keel clearance may be laid down by a competent authority or determining on board when planning the passage. The factors to be taken into account when determining this allowance are given in The Mariners Handbook (NP100) 6th Edition.

2. It has become increasingly evident that economic pressures are causing mariners to navigate through waters of barely adequate depth, with under-keel clearance being finely assessed from the charted depth and predicted tide levels.

3. Hydrographic surveys have inherent technical limitations, due partly, in offshore areas, to uncertainties in the tidal reductions. Furthermore, in some areas the shape and hence depth of the seabed is constantly changing. Nautical charts

can seldom, therefore, be absolutely reliable in their representation of depth and when the tidal predictions are applied to the chart as if they were actual tide levels the uncertainties are clearly compounded.

4. The limitations of hydrographic surveys are discussed at length in The Mariners Handbook and factors affecting tide levels are described in the introduction to the Australian National Tide Tables.

5. It cannot be too strongly emphasised that even charts based on modern surveys may not show all the seabed obstructions or the shoalest depths and actual tide levels may be appreciably lower than those predicted.

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.

1. There is no clear evidence that the vessel actually took the ground, although it is probable that the ship did touch the seabed. Whatever happened, the ship was in water where the depth was such that it was unable to maintain forward movement in safety and there was insufficient under keel clearance.

2. The Master's statement that the ship's deepest draft of 11.0m was accurate within acceptable limits.

3. Atmospheric conditions resulted in the depth of water being less than that predicted and lagging in time.

4. The Pilot's passage plan took into account the need to anchor to the east of the Prince of Wales Channel, however, in view of the actual tidal conditions as broadcast by the "real-time" tide gauges, M Nuri Cerrahoglu left the anchorage north of Alpha Rock prematurely in view of the tidal conditions within the Prince of Wales Channel.

5. The ship's speed made good over the ground between Alert Patches and Harrison Rock buoy was faster than that anticipated from the allowance made for the tidal stream and the ship's propeller revolution setting.

6. There is no evidence that M Nuri Cerrahoglu was closer to Larpent Bank than the position fixed by the Master and Mate.

7. The evidence, provided by the survey conducted by Laser Airborn Depth Sounder, is that the charted depths shown on the chart in the immediate area of the grounding were accurate, within the tolerances published by the Hydrographic Office.

8. The turn to port started at or just after 0200 on 5 November in a position 1.9 miles north of Larpent Bank, was to allow time for the tide to rise in Varzin Passage, it was therefore reasonable to use only ten degrees of rudder and to proceed at a slow speed, providing the ships turn was monitored to ensure safe passage.

Submission

As required under the provisions of Regulation 16 of the Navigation (Marine Casualty) Regulations, the draft report was circulated for comment and written submission.

The Pilot in written submission made the following observations with regard to the conclusions detailed on page 19:

Conclusion 4. *"On the information to hand at the time and place I feel the action was not necessarily premature and it was reasonable to proceed with Booby remaining at 0.7m at both 2300 and 2330.*

At 0000 5 November, with Booby now at 0.6m below, I considered turning the vessel to the east of Alert Patches was not an option in view of the strong tidal conditions. In hindsight, however, a later departure would have facilitated an easier passage, with no waiting time between Harrison Rock and Varzin passage."

Conclusion 5. *"The speed over the ground between Alert Patches and Harrison Rock was estimated at 11.4 knots overall allowing for various rpm settings and the expected ground effect. The vessel was on prediction passing Ince Point and came forward from them on, passing Harrison Rock at 0210, ten minutes ahead.*

It had been intended to reduce to "dead slow" from Ince Point to West of Nardana and then from Hammond to Harrision, however "slow" ahead was maintained. On experience, I would expect the current to ease somewhat after Hammond Rock, however a flow of about 7 knots was experienced."

Conclusion 7. *"While the evidence is that the charted depths shown on the chart were accurate within the tolerances published by the Hydrographic Office within the general area of the incident, the LADS survey did pick up a new 8.6m shoal 1.9 miles east, just 0.84 miles from the pilot boarding ground."*

Details of vessel

Name	M Nuri Cerrahoglu
Flag	Turkey
Lloyd's Number	7915656
Year of build	1984
Type	bulk carrier, nine holds
Owner	Cerrahogullari T.A.S.9
Builder	Stocznic im "Komuny Paryskiej" - Gdynia
Classification	Det Norske Veritas
Length overall	248.93m
Breadth	32.31m
Summer draught	13.126m
GRT	36659
NRT	27673
Summer deadweight	69397
Engines	2 SA 6Cy.

Attachment 1

AN INVESTIGATION OF SURFACE WIND AND ATMOSPHERIC PRESSURE IN THE VICINITY OF TORRES STRAIT

1st to 5th October 1991

and

1st to 5th November 1994

Prepared for the

DEPARTMENT OF TRANSPORT

MARINE INCIDENT INVESTIGATION UNIT

by the

BUREAU OF METEOROLOGY

SPECIAL SERVICES UNIT

BRISBANE

December 1994

AN INVESTIGATION OF SURFACE WIND AND ATMOSPHERIC PRESSURE IN THE VICINITY OF TORRES STRAIT OCTOBER 1991 AND NOVEMBER 1994

AVAILABLE INFORMATION

Figures 1 and 2 show the sequence of Australian Region weather charts for 9 am on each of the first seven days of October 1991 and November 1994 respectively. These weather charts display isobaric patterns with 4 hectopascal spacing between isobars. For better detail of the Torres Strait area extracts of operational synoptic charts are provided at Appendices 1 - 10 and for a simple comparison of pressure and wind variations from day to day, through the periods in question, tabulated data is provided at Table 1.

SYNOPTIC SITUATIONS

Figure 1 indicates that high pressure cells are located in the Tasman Sea with weak ridges extending northwestwards to Torres Strait throughout the period 1st through to 5th october 1991. Figure 2 similarly indicates a weak ridge over the Coral Sea and Torres Strait. The weaker surface pressure gradients in the November 1994 situation suggest that wind speeds, from this evidence alone, should be marginally lighter than for the October 1994 case.

WIND SPEED

In either case the strongest 10 minute-mean wind recorded through both of these periods is a SE wind of 15 knots. (Encoding standards require that a surface synoptic wind speed varying between 13 and 17 knots should be reported as 15 knots, thus for any 15 knot wind one may read that the wind speed lay between the values 13 to 17 knots inclusive. Reports of 5 knots and 10 knots may similarly be read as (3-7) knots and (8-12) knots respectively.

In the simplified case of a persistent wind blowing at right angles to a strait barrier the wind stress will cause water to "pile up" on the windward side of a barrier and be "drawn down" on the leeward side of the same barrier. In the complicated case of the waterways through Torres Strait no simple conclusion can be drawn. The effect of the wind could be considerable, but whether to cause an increase or decrease in sea level at a given location cannot be determined at this point in this investigation.

ATMOSPHERIC PRESSURE

The daily atmospheric pressure variation at Weipa between 1st - 5th of October 1991 is (1016.0 - 1014.7) hPa and the diurnal range did not exceed 6 hPa. Similarly the daily variation at Weipa between 1st - 5th November 1994 is (1015.1 - 1014.1) hPa. Pressure readings at the Bureau's Thursday Island station, October 1991, showed similar variation. Regrettably barometric readings are not available at Thursday Island for the November 1994 incident.

The long term average pressure for early October and early November at Weipa is 1013.6 and 1012.0 hPa respectively. Thus pressures at Weipa were (1.1 - 2.4) hPa above average for the October 1991 incident and (2.1 - 3.1) hPa above average for the November 1994 incident. The long term average pressure at Thursday Island for early October is 1013.0 hPa. The atmospheric pressure at Thursday Island during early October 1991 was therefore (1.3 - 2.9) hPa above average.

The effect of higher than average atmospheric pressure is to depress the sea level below its average height for that time of year.

WEATHER CONDITIONS

The months October and November invariably produce fine dry weather through Torres Strait. The synoptic situation and surface evidence suggests that, for the two incidents, the weather was fine with some trade wind cumulus and light to moderate though occasionally fresh southeast winds.

COMBINED EFFECT OF WIND AND PRESSURE

Wind and pressure can act in tandem to depress or raise the sea level and they may act to cancel the effect of one another, depending upon wind direction, wind speed, shoaling effects and barrier position and alignment. A high-resolution three-dimensional ocean model with detailed bathymetry could be utilised to run experiments to determine the effect of wind and pressure through Torres Strait. Such a model and the experiments would not only assist in this investigation but also provide the means to assist sea level forecasts for Torres Strait in the future.

CONCLUSION AND RECOMMENDATION

Higher than normal atmospheric pressure would have contributed to a depressed sea level during Early October 1991 and early November 1994. The effects of wind stress as a contributing factor in these incidents are unknown, however, as indicated above wind stress may have also contributed to the depressed sea level during these periods.

The Bureau of Meteorolgy's Special Services Unit is well placed to develop a high-resolution three-dimensional ocean model which could be driven by our global atmospheric model (or a mesoscale model nested within the global model) to assist further with this investigation. The models would simulate the meteorological conditions which existed during early October 1991 and early November 1994 and these could then simulate the sea levels which were reported at those times. Upon successfully completing these simulations the model could be employed to routinely assist with the fine tuning of sea level forecasts which in turn could contribute to sea safety in Torres Strait.

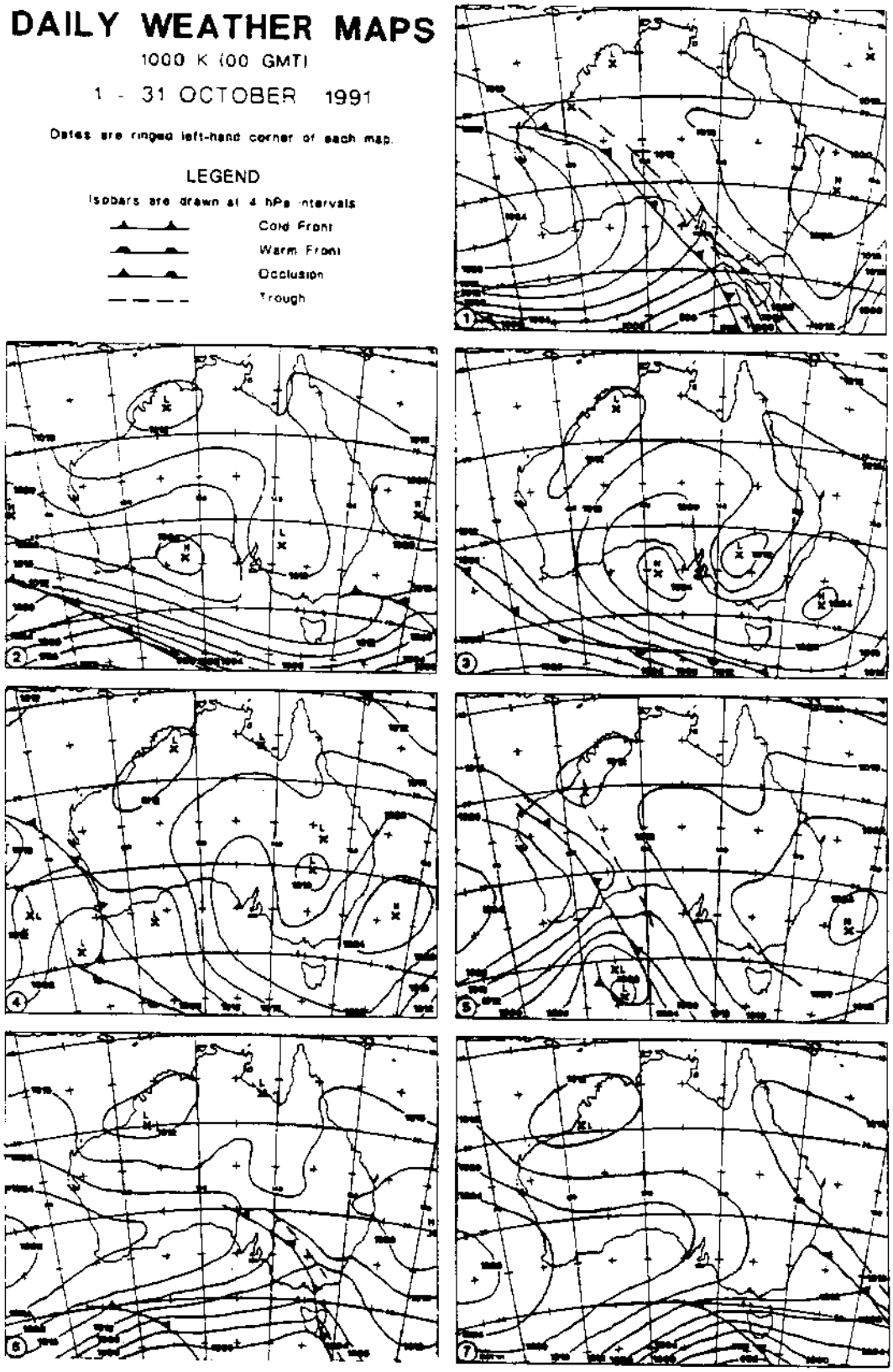


Figure 1 Synoptic Charts for 9 am 1st to 7th October 1991

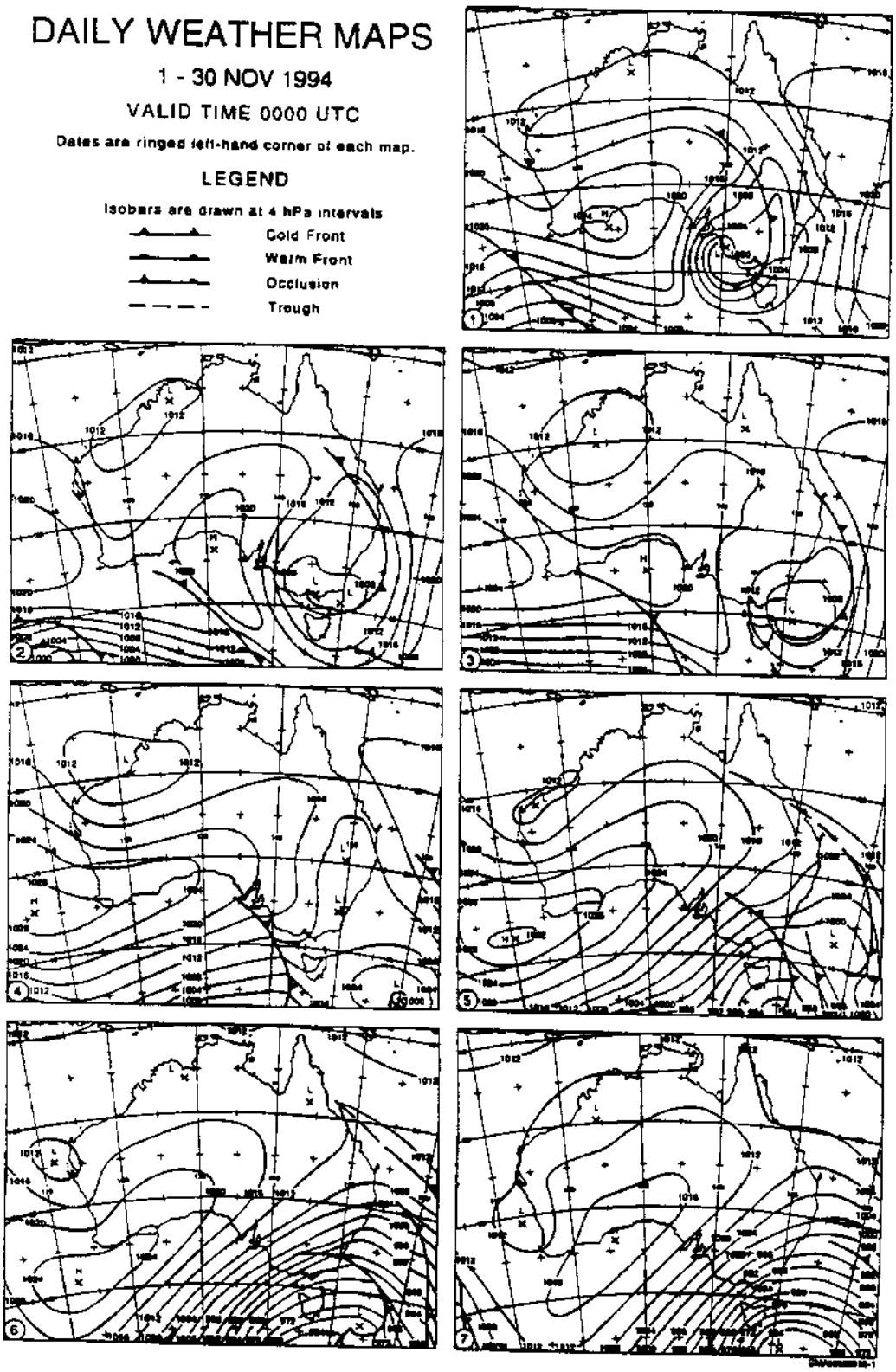


Figure 2 **Synoptic Charts for 9 am 1st to 7th November 1994**

WEATHER CONDITIONS IN TORRES STRAIT
1st to 5th November 1994 and 1st to 5th October 1991

The table below provides wind direction and speed (knots) and atmospheric pressure (hPa) observations at weather stations adjacent to Torres Strait. They have been copied from the Bureau of Meteorology's synoptic charts for those times. "nil" indicates that no observation of this element is available for this time.

		WEIPA		DARU		PT MORESBY		THURSDAY IS	
Date	**Time**	**Wind**	**Press**	**Wind**	**Press**	**Wind**	**Press**	**Wind**	**Press**
1 Nov	9 am	NE 10	1015.6	ESE02	1014.0	SW 05	1012.7	SE 05	nil
2 Nov	9 am	E 05	1014.9	E 05	1014.4	Calm	1013.4	Calm	nil
3 Nov	9 am	NE 05	1014.4	nil	nil	Calm	1012.6	Calm	nil
4 Nov	9 am	E 10	1014.8	SE 05	1013.3	SW 05	1012.1	SE 05	nil
4 Nov	3 pm	S 10	1009.7	E 05	1011.4	SE 15	1009.2	SE 10	nil
4 Nov	6 pm	W 10	1009.7	nil	nil	nil	nil	nil	nil
4 Nov	9 pm	NE 05	1013.0	nil	nil	E 05	1011.0	nil	nil
5 Nov	3 am	Calm	1012.2	nil	nil	Calm	1010.8	nil	nil
5 Nov	9 am	SE 05	1014.1	E 05	1012.0	Calm	1012.5	nil	nil
1 Oct	9 am	SE 05	1016.0	nil	nil	Calm	1014.1	SE 15	1015.9
2 Oct	9 am	SE 05	1015.7	SE 05	1014.9	SE 10	1014.3	SE 15	1015.7
3 Oct	9 am	SE 05	1014.8	SE 05	1013.7	Calm	1013.0	SE 15	nil
3 Oct	3 pm	SE 05	1008.8	nil	nil	S 10	1010.1	E 15	1010.3
3 Oct	6 pm	NW05	1010.5	nil	nil	SE 10	1009.7	SE 15	1010.5
3 Oct	9 pm	nil	nil	Calm	1011.7	SE 10	1011.5	nil	nil
4 Oct	3 am	Calm	1012.3	SE 05	1011.4	SE 05	nil	SE 10	1011.7
4 Oct	6 am	Calm	1013.5	SE 05	1011.6	SE 05	1011.2	SE 10	1012.6
4 Oct	9 am	SE 05	1014.7	SE 05	1012.9	SE 05	1012.3	SE 15	1014.3
4 Oct	Noon	SE 05	1012.5	SE 05	1012.1	SE 10	1011.3	nil	nil
4 Oct	3 pm	W 05	1009.1	nil	nil	SE 10	1009.8	nil	nil
4 Oct	6 pm	NW05	1010.0	SE 05	1010.9	SE 10	1009.4	nil	nil
5 Oct	3 am	Calm	1012.0	SE 05	1010.8	SE 02	1010.4	nil	nil

Table 1 Weather Observations in the Vicinity of Torres Strait during October 1991 and November 1994

Tidal Data

4 - 5 November 1994

Tidal Information from the Australian National Tide Tables

Predicted heights

(metres)

	Ince Point*		Turtle Head*		Goods Island		Booby Island	
	time / height		time / height		time / height		time / height	
High water	1256	3.0	1528	2.3	1606	3.0	1615	3.6
Low water	2001	0.9	2159	0.9	0007	0.9	2344	0.9
High Water	0102	2.0	0459	1.3	0714	2.6	0646	3.3
Low water	0445	1.0	0732	1.2	1013	2.4	1102	2.4

* Tidal heights at Nardana Patches is taken as the mean between Ince Point and Turtle Head.

Hourly tide predictions compared with actual tide heights*

	Ince Point		(Datum 11.9m)	Turtle Head		(Datum.11.6m)
Time	Predict	Actual	P-A	Predict	Actual**	P-A
1800	1.42	1.31	0.11	1.60		
1900	1.03	0.90	0.13	1.23		
2000	0.85	0.66	0.19	0.93		
2100	1.02	0.88	0.14	0.87		
2200	1.35	1.29	0.06	0.93		
2300	1.61	1.51	0.10	0.86		
0000	1.85	1.75	0.10	0.87		
0100	1.98	1.82	0.16	0.94		
0200	1.83	1.58	0.25	0.97		
0300	1.43	1.14	0.29	1.04		
0400	1.09	0.82	0.27	1.24		
0500	1.01	0.88	0.13	1.34		
0600	1.02	0.80	0.22	1.28		

* Predicted hourly tide heights are taken from the Torres Strait Tide Tables 1994, issued by the Australian Maritime Safety Authority. The Actual height is taken from the records of tidal heights from the respective tide gauges. All readings are in metres.

** No data avaliable

Next page records of tidal height prediction/actual for Booby and Goods Island

Records of tidal heights

	Goods Island	(Datum 11.3m)		Booby Island	(Datum 10.5m)	
Time	Predict	Actual	P-A	Predict	Actual	P-A
1800	2.69	2.65	0.04	3.25	3.08	0.17
1900	2.30	2.24	0.06	2.77	2.58	0.19
2000	1.77	1.66	0.11	2.16	1.98	0.18
2100	1.29	1.17	0.12	1.51	1.36	0.15
2200	1.06	1.05	0.01	1.04	0.92	0.12
2300	0.97	0.88	0.09	0.88	0.76	0.12
0000	0.92	0.80	0.12	0.86	0.67	0.19
0100	0.95	0.79	0.16	0.99	0.75	0.24
0200	1.11	0.89	0.22	1.40	1.15	0.35
0300	1.44	1.25	0.19	2.01	1.75	0.26
0400	1.91	1.80	0.11	2.60	2.38	0.22
0500	2.27	2.16	0.11	3.02	2.82	0.20
0600	2.49	2.46	0.03	3.21	3.08	0.13

	Goods Island	(Datum 11.3m)		Booby Island	(Datum 10.5m)	
Time	Predict	Actual	P-A	Predict	Actual	P-A
1800	13.99	13.95	0.04	13.75	13.58	0.17
1900	13.60	13.54	0.06	13.27	13.08	0.19
2000	13.07	12.96	0.11	12.66	12.48	0.18
2100	12.59	12.47	0.12	12.01	11.86	0.15
2200	12.36	12.35	0.01	11.54	11.42	0.12
2300	12.27	12.18	0.09	11.38	11.26	0.12
0000	12.22	12.10	0.12	11.36	11.17	0.19
0100	12.25	12.09	0.16	11.49	11.25	0.24
0200	12.41	12.19	0.22	11.90	11.65	0.35
0300	12.74	12.55	0.19	12.51	12.25	0.26
0400	13.21	13.10	0.11	13.10	12.88	0.22
0500	13.57	13.46	0.11	13.52	13.32	0.20
0600	13.79	13.76	0.03	13.71	13.58	0.13