Report on the investigation of

the collision of the general cargo vessel

Orade

with the Apex Beacon, River Ouse

1 March 2005

AOMS - Department of Marine Services
and Merchant Shipping
Antigua & Barbuda W.I.
Am Patentbusch 4
26125 Oldenburg
Germany

MAIB

Marine Accident Investigation Branch
Carlton House
Carlton Place
Southampton
United Kingdom
SO15 2DZ

Report No 23/2005
December 2005

Extract from

The United Kingdom Merchant Shipping

(Accident Reporting and Investigation)

Regulations 2005 – Regulation 5:

"The sole objective of the investigation of an accident under the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005 shall be the prevention of future accidents through the ascertainment of its causes and circumstances. It shall not be the purpose of an investigation to determine liability nor, except so far as is necessary to achieve its objective, to apportion blame."

NOTE

This report is not written with litigation in mind and, pursuant to Regulation 13(9) of the Merchant Shipping (Accident Reporting and Investigation) Regulations 2005, shall be inadmissible in any judicial proceedings whose purpose, or one of whose purpose is to attribute or apportion liability or blame.

The following is a joint investigation report with the Antigua and Barbuda Department of Marine Services and Merchant Shipping (ADOMS) in which the MAIB has taken the lead role pursuant to the IMO Code for the Investigation of Marine Casualties and Incidents (Resolution A.849(20)).

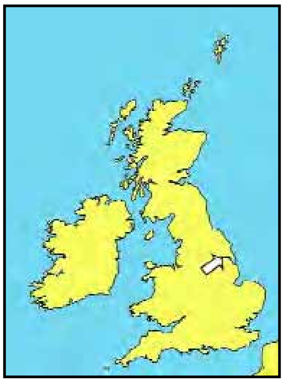
CONTENTS

		Page
GLOSSARY OF ABBREVIATIONS AND ACRONYMS		
SYNOPSIS		**1**
SECTION 1 - FACTUAL INFORMATION		**3**
1.1	Particulars of *Orade* and accident	3
1.2	*Orade*	4
1.3	Bridge layout and controls	4
	1.3.1 General	4
	1.3.2 Steering mode	4
1.4	Narrative	6
1.5	Damage to *Orade*	13
1.6	Environment	13
1.7	River Ouse, Trent and Humber	13
	1.7.1 Tidal conditions	14
	1.7.2 Riverbed topography	14
	1.7.3 Ballasting of vessels	14
1.8	Associated British Ports (ABP), Hull	16
	1.8.1 Pilotage	16
	1.8.2 Vessel Traffic Services (VTS)	16
	1.8.3 Port and Vessel Information System (PAVIS)	16
1.9	Pilot Training	16
	1.9.1 General training	16
1.10	The Humber Pilot	17
	1.10.1 Experience	17
	1.10.2 Working hours	18
	1.10.3 Training	20
1.11	The master	22
	1.11.1 Experience	22
	1.11.2 Working hours	22
SECTION 2 - ANALYSIS		**24**
2.1	The vessel's track, heading and steering mode	24
2.2	Bridge Resource Management	27
2.3	Use of the PAVIS System	28
2.4	Fatigue	29
	2.4.1 General	29
	2.4.2 The master's hours of work	31
	2.4.3 The pilot's hours of work	31
2.5	Ergonomics	32
	2.5.1 Steering mode selector switch	32
	2.5.2 Rudder angle indicator (RAI)	32
SECTION 3 - CONCLUSIONS		**33**
3.1	Safety issues	33
SECTION 4 - ACTIONS TAKEN		**35**
SECTION 5 - RECOMMENDATIONS		**36**
Annex 1 - STCW 95 and ILO 180 Conventions		

GLOSSARY OF ABBREVIATIONS AND ACRONYMS

AB	-	Able Seaman
ABP	-	Associated British Ports
AIS	-	Automatic Identification System
CHA	-	Competent Harbour Authority
DTI	-	Department of Trade and Industry
Dwt	-	Deadweight tonnes
FSA	-	Formal Safety Assessment
GPS	-	Global Positioning System
HW	-	High Water
IMO	-	International Maritime Organization
kW	-	Kilowatt – a unit of power (SI) and approximately equal to 1.34 hp
nm	-	Nautical mile
PAVIS	-	Port and Vessel Information System
PEC	-	Pilotage Exemption Certificate
PMSC	-	Port Marine Safety Code
RAI	-	Rudder Angle Indicator
Riverpilot	-	Steering mode using a combination of autopilot and rate-of-turn
SOG	-	Speed over Ground
SOLAS	-	Safety of Life at Sea
STCW	-	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers 1978 as amended (STCW 95)
UTC	-	Universal Coordinated Time
VHF	-	Very High Frequency
VTS	-	Vessel traffic services

SYNOPSIS



At 2154 on 1 March 2005, the Antigua and Barbuda registered general cargo vessel *Orade* collided with the Apex Light tower at the confluence of the rivers Ouse and Trent while outbound from Howdendyke on the River Ouse. *Orade* subsequently grounded on the stone training walls of the Rivers Ouse and Trent.

Initial attempts to refloat the vessel failed, due to the falling tide, and the vessel remained aground across the Ouse and Trent training walls with her bow protruding into a deep water pocket adjacent to the River Trent training wall. She was refloated at 0955 the following day with the assistance of two tugs.

At the time of the accident, *Orade* was under pilotage and a qualified ABP Humber pilot was at the helm. The pilot had embarked the vessel at about 2140 at Blacktoft, 1.5 miles from the Apex Light tower. The pilot had offered to steer *Orade* after the vessel left the berth, and after having been given brief instructions on her propulsion and steering controls by the master.

The pilot was uncomfortable using manual steering from the vessel's central bridge chair, partly due to the awkward position of the rudder angle indicator on the deckhead above the chair. He asked the master to change steering mode to riverpilot. The pilot had become familiar with this mode over a number of years when he had been the master of vessels using the Ouse and Trent.

After a brief discussion on the use of the riverpilot, the master changed steering mode and the vessel continued downriver. Shortly before reaching the apex, the pilot became aware that the vessel was being set bodily to starboard. He noted that the heading did not alter as he increased the helm request to 20º to port and then to hard to port. He informed the master that the vessel was not responding. The master had not been closely monitoring the navigation or the pilot's actions.

The pilot asked the master to return the steering mode to manual and, once this had been done, he pushed the manual helm control hard to port and this delivered the expected response on the rudder angle indicator. However, there was insufficient time for the rudder movement to have any effect before the vessel passed over the submerged training wall and collided with the Apex light tower.

The investigation found that there had been poor communications between the master and the pilot, and it is probable that the master had engaged autopilot and not riverpilot when requested to change the steering mode by the pilot. The master had never used riverpilot mode on the vessel, and he was also probably suffering from fatigue as he had been working a 6 hours on/6 hours off watchkeeping routine for the previous 5½ months. The pilot had not checked that the changeover had been successful, and did not notice that his initial steering requests were having no effect. The rudder angle indicator was poorly sited, the pilot was unfamiliar with this vessel and there was poor control lighting.

Recommendations have been made to the UK's Port Marine Safety Code Steering Group and the vessel operator, on safety issues identified during the investigation which relate to fatigue, bridge team management and ergonomics.

Figure 1

Orade

SECTION 1 - FACTUAL INFORMATION

1.1 PARTICULARS OF *ORADE* AND ACCIDENT

Vessel details		***Orade* (Figure 1)**
Registered owner	:	Reederei Frank Dahl
Manager(s)	:	Wagenborg
Port of registry	:	Stade
Flag	:	Antigua and Barbuda
Type	:	General cargo
Built	:	1990 Bayerische Schiffbaug
Classification society	:	GL
Construction	:	Steel
Length overall	:	77m
Gross tonnage	:	1354
Engine power and/or type	:	2 x 299kW Volvo Penta
Service speed	:	10 knots
Other relevant info	:	Twin screw, Schottel pump jet bow thruster; hull strengthened for heavy cargoes

Accident details

Time and date	:	2154 UTC 1 March 2005
Location of incident	:	53 42.02N 000 41.485W Apex beacon, River Ouse
Persons on board	:	6 including a pilot
Injuries/fatalities	:	None
Damage	:	Port propeller blading bent, indentation damage to hull bottom, minor damage to handrails

1.2 *ORADE*

Orade was a European feeder vessel designed to trade around northern European ports and specifically to ports along rivers and estuaries.

She was originally designed with a water jet main propulsion system, but was retrofitted to a more conventional twin propeller and twin rudder arrangement in 1998. The waterjet bow thruster was retained.

The hull was strengthened for heavy cargoes, and was designed to safely take the bottom at drying berths.

The vessel charterers provided the vessel with voyage and cargo information approximately two voyages (roughly 2 weeks) in advance. The cargoes were mostly steel products (80-90%), but general bulk cargoes were also carried.

Five crew operated *Orade:* a German master, a Russian chief officer, two Polish ABs and a Polish cook. The master also carried out the engineer's duties. Because of the mix of nationalities, the working language on board the vessel was English.

1.3 BRIDGE LAYOUT AND CONTROLS

1.3.1 General **(Figure 2)**

The bridge layout and equipment was of conventional design, and included a central steering position from where the engines, bow thruster, steering and communications could be controlled from a seated position. A Kelvin Hughes radar, which provided ship's head-up mode only, was sited in front of the control position. Rate-of-turn indication was provided at the top of the radar screen when the autopilot was switched to riverpilot mode. Sited on the deckhead, above the chair, was the rudder angle indicator (RAI), which provided direct angular feedback from the rudder stock.

In addition, the bridge was equipped with other instruments, including: a Furuno radar; an automatic identification system (AIS); a Global Positioning System (GPS) satellite navigator and a Transas electronic chart plotter.

1.3.2 Steering mode

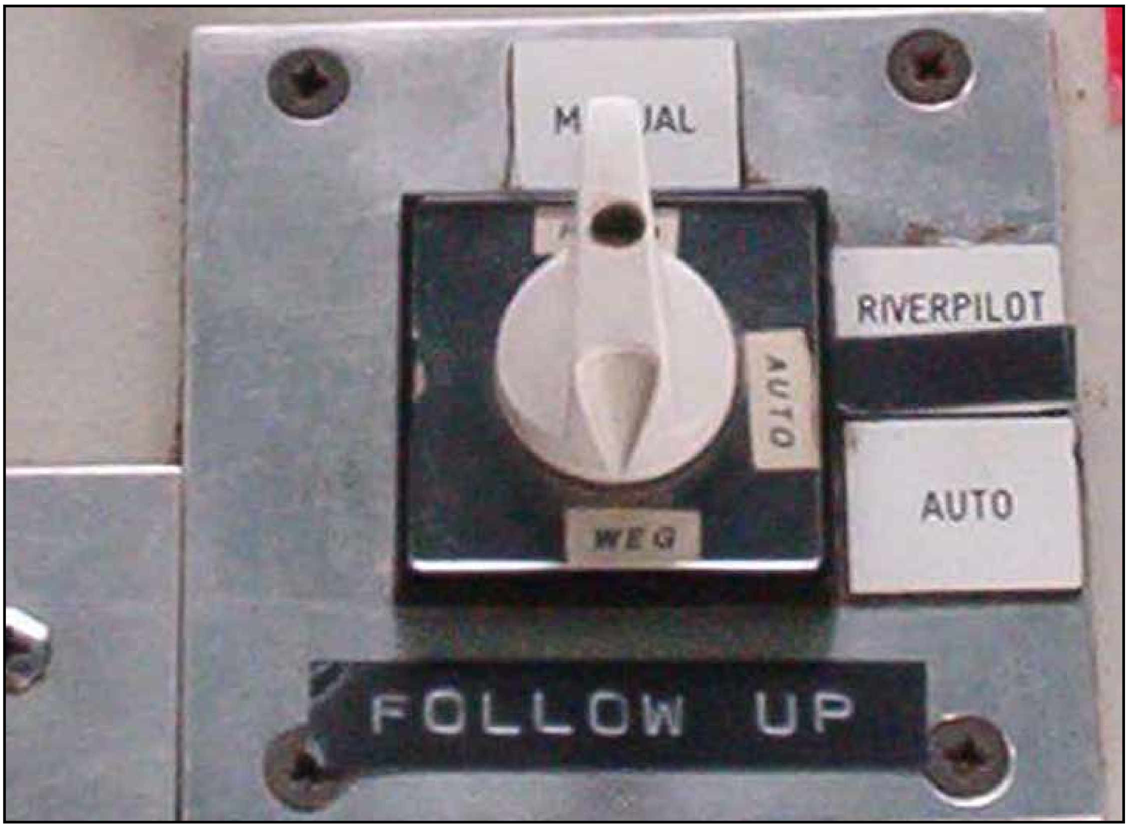
The mode of steering was controlled by a three way position switch **(Figure 3)**. The steering mode switch, which could not be illuminated, enabled manual, follow-up and autopilot steering modes to be selected.

Manual steering was selected when the switch pointed up. In this mode, the vessel could be steered using the joystick lever to the left of the centre chair. This worked in a non-follow up mode, i.e. the rudder moved in the direction requested by the lever movement until the spring-loaded lever was released. The rudder then remained in its current position until requested to move again by another lever movement. In this mode, it was necessary to frequently refer to the RAI attached to the deckhead above the central radar in order to confirm the rudder angle position.

Figure 2

Bridge layout and controls

Figure 3



Steering mode selector switch

When the switch was turned to point down, manual steering in follow-up mode was selected. In this mode, steering was accomplished with the follow-up lever **(Figure 4)** which was not spring loaded. The rudder would move to a helm order until it reached the selected angle, where it remained until the lever was moved again.

The autopilot could be engaged by moving the switch to the starboard, horizontal position. In this mode, the steering was controlled from the autopilot controls located to starboard of the central chair and midway up the console **(see Figure 2)**.

When autopilot was selected, the unit steered the vessel to maintain the gyro heading **current** at the time of changeover. The autopilot control panel also enabled the “rate-of-turn tiller” to be selected, by use of a button on the autopilot panel **(Figure 5)**.

The rate-of-turn tiller (often referred to as “riverpilot”) allowed the follow-up steering lever to be used to select changes in heading at a particular rate-of-turn. Whenever the lever was in the upright, or midships, position, the autopilot would maintain the current gyro heading as in autopilot mode. Riverpilot was often employed on river vessels, because it gave a faster and more controlled response than was possible with follow-up steering.

The master had not used riverpilot mode during his tour of duty on board *Orade.*

1.4 NARRATIVE

All times in UTC

The general cargo vessel *Orade* arrived at Howdendyke on the River Ouse on 26 February 2005. Her cargo of 1550 tonnes of phosphate had been shipped from Antwerp. The vessel waited for 2 days alongside at Howdendyke, and on 1 March the cargo was discharged.

At 2005 on 1 March, *Orade* departed Howdendyke in ballast for the return voyage to the continent. Her forward and aft draughts were 0.7m and 1.8m respectively. She carried 50000 litres of diesel fuel oil in her double bottom tanks.

The vessel carried an Ouse river pilot between Howdendyke and Blacktoft **(Figure 6)**. The pilot had direct control of the helm most of the way as the vessel moved downriver against the flood tide.

Orade was in follow-up steering, and required constant helm input by the Ouse pilot to resist the constant yawing. However, the pilot had been on board *Orade* several times before, and was aware of her sensitive steering. The stern trim of the vessel, and light draught forward, also probably affected the vessel’s steering characteristics.

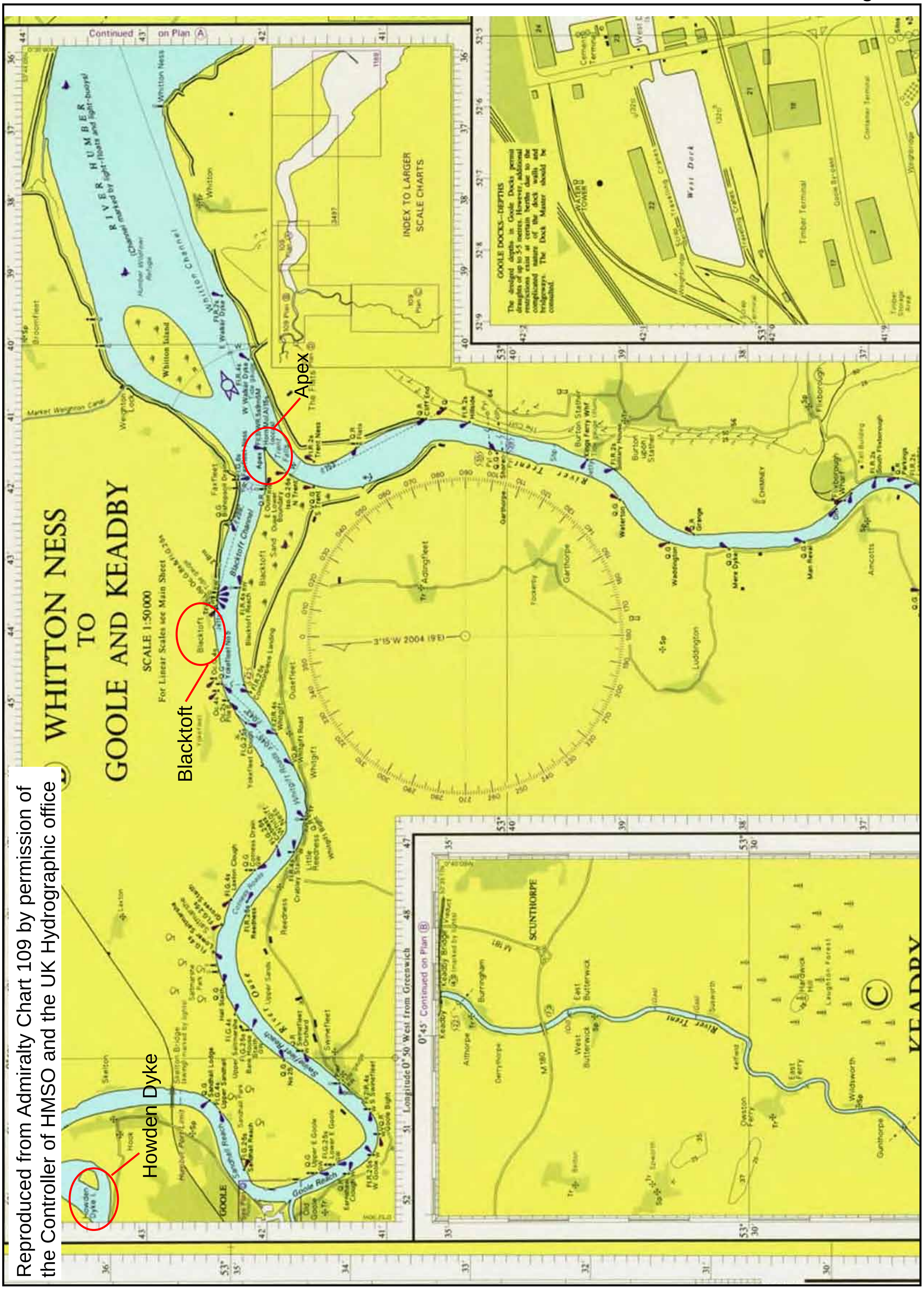
Figure 4

Follow-up / Riverpilot lever

Figure 5

Autopilot

Figure 6



Extract from chart BA 109 of rivers' Ouse, Trent and Humber

At 2140, *Orade* arrived at Blacktoft without incident. The vessel was temporarily secured by a single spring while the Ouse pilot departed and an Associated British Ports (ABP) Humber pilot embarked. No handover occurred between the pilots.

The Humber pilot had no previous experience on board *Orade,* although he had worked on a similar vessel. He brought with him a chart of the Rivers Ouse and Humber, with the latest soundings marked on it.

The master briefly explained the vessel's controls and instrumentation to the pilot.

The spring was let go at about 2142, and *Orade* began to proceed downriver, with the master at the helm and the steering on manual tiller (joystick) control. A short time after letting go, the pilot offered to take the helm, and the master, confident in the ability of ABP pilots, willingly relinquished control of the helm.

The pilot sat in the central bridge chair with the Kelvin Hughes radar, set on the 0.8nm range, in front of him. The bridge was dark.

Due to an inbound container vessel making way in the deep water channel on the northern side of the River Ouse, the pilot brought the vessel across to the middle of the river.

The pilot asked the master to switch to riverpilot as the rudder angle indicator (RAI) **(Figure 7)**, which he had to constantly refer to, was directly above his head. In addition, the pilot considered the steering response from the manual tiller to be poor, and he was generally happier in either follow-up or riverpilot steering modes.

The master commented that, in his opinion, the riverpilot was not safe to use in shallow water. The pilot disagreed, stating that, given the height of tide, and the vessel's shallow draught, they "should try it". The master then changed over steering mode using the console mounted three way switch, and the pilot changed from using the manual control joystick to the follow-up lever, which also gave control in the riverpilot mode **(see Figure 4)**.

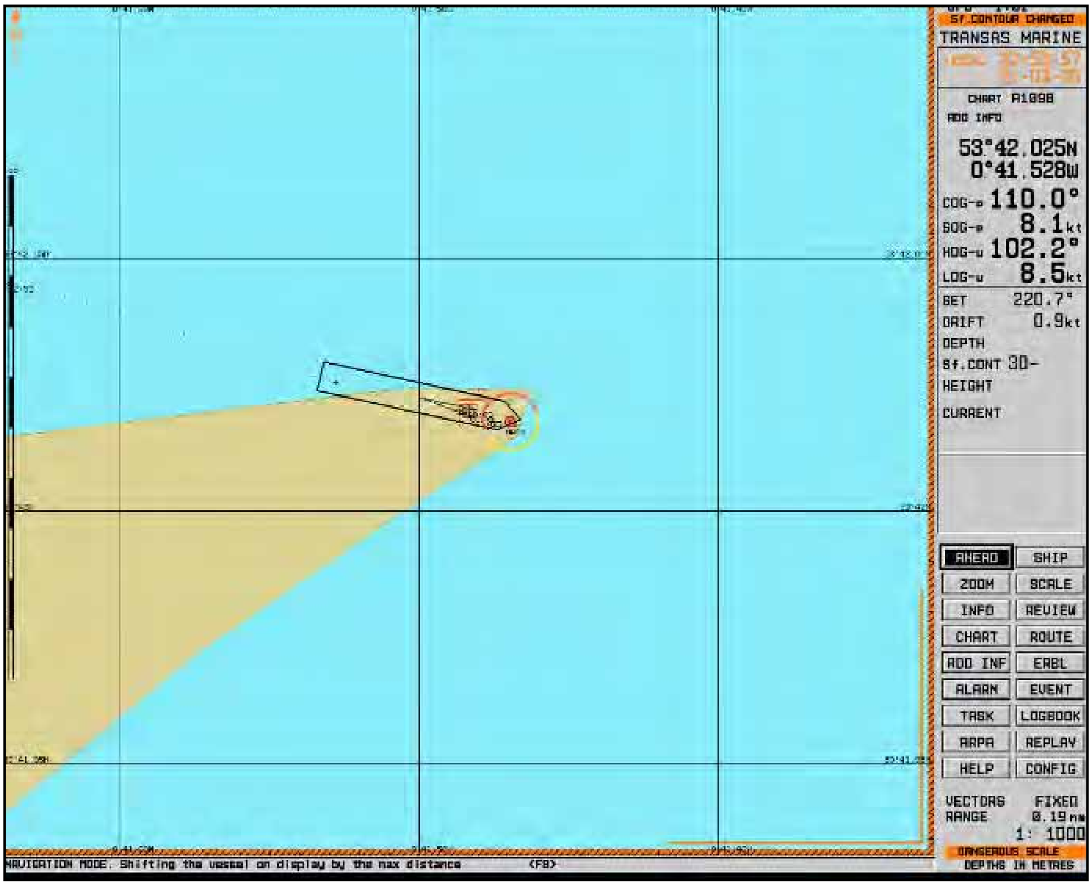
There is conflicting evidence with respect to the new position of the steering mode switch. The pilot thought that the switch had been changed to autopilot/riverpilot, whereas the master remembered that he had switched the mode to follow-up steering.

Prior to the master changing steering mode, the pilot had adjusted the heading to about 101º, a heading which approximately equated to the bearing of the West Walker Dyke light on the southern bank of the River Humber, opposite the entrance to the River Ouse. *Orade* passed the inbound container vessel at 2147.

Figure 7

Rudder angle indicator

Figure 8



Transas snapshot of *Orade* aground at Apex Light

As *Orade* proceeded downriver, the pilot made occasional adjustments to the steering lever position. *Orade* was travelling at about 8.5 knots speed over the ground (SOG).

Because of the clear night conditions, the pilot could easily see Number 2 Boundary (East Ouse Beacon) light flashing quick red on the southern side of the river, and Faxfleet Ness Beacon flashing green on the north side of the river. The triple flashing red sector of Apex Light, at the confluence of the rivers Humber, Ouse and Trent, and the flashing red West Walker Dyke beacon could also be clearly seen.

After relinquishing control of the helm, the master worked at the Transas electronic chart plotter. He began entering data to determine what time the vessel would be at the pilot departure point so that the crew could be given advance warning. He also glanced occasionally at the starboard radar which was set on either 0.25 or 0.5nm, and out of the bridge window.

Orade passed Faxfleet Ness Beacon at 2152, and the pilot began to notice that she was being set bodily to starboard and was closing on the submerged training wall at the entrance to the river Ouse. Sailing close to the wall was standard practice and, unperturbed, he set the steering lever to 10º rate-of-turn to port.

When the pilot realised that *Orade* was not responding to the 10º port rate-of-turn request, he increased it to 20º. As the distance to the training wall decreased below 100m, the pilot informed the master that the helm was not responding, and he pushed the tiller lever to the maximum (port) position.

As no obvious change in heading was apparent, the pilot asked the master to change the steering mode back to manual control. The master did as he was asked and then looked out of the bridge window and saw that the Apex Light was very close.

As soon as the change had been made, at about 2154, the pilot moved the joystick lever to the hard over to port position, and observed the RAI was indicating the requested rudder angle. Within seconds, the port bow struck the Apex Light and the hull bounced onto, and then over, the River Ouse training wall.

The master promptly stopped the engines. *Orade* moved forward slowly until her stern came to rest across the River Ouse training wall and her bow across the River Trent training wall – little of the mid length section was unsupported as the training walls merge into one almost solid structure at this point. Her bow was heading in an easterly direction into the River Trent **(Figure 8)**. Gradually, due to the effects of the remaining flood tide, the bow steadily swung to starboard, eventually heading south.

The pilot informed Humber VTS and requested assistance. He also mentioned to VTS that the vessel had been operating in riverpilot mode and had not responded to his helm order prior to the collision.

The pilot advised the master to transfer ballast into a forward tank in an attempt to free the stern. This was done, and the aft peak tank was also pumped out. A further attempt was made to free *Orade* with ahead and astern movements on the engines, and using the bow thrusters. This was unsuccessful.

Shipboard emergency procedures were implemented which, among other things, concluded that the vessel had not been holed.

As the tide dropped, the bow sat in a deepwater pocket close to the training wall. The vessel's trim was estimated at 30º by the head at low water. No pollution or injuries to those on board had occurred.

At 0955 the following morning **(Figure 9)**, on the rising tide, two tugs successfully towed *Orade* off the training wall and escorted her to Hull for inspection. She later sailed to Bremerhaven for repairs.

Figure 9

Orade aground on River Trent Training Wall, 2 March 2005

1.5 DAMAGE TO *ORADE*

An underwater engineering company was tasked to inspect the hull for damage sustained during the grounding. The port propeller was found to have several bent blades. The rudders and propeller shafts were found to be undamaged. Bottom damage was discovered forward of the bridge in two areas, with indentations over $0.5m^2$ and $0.25m^2$ respectively. Some damage was also found to the port and starboard bilge keels at approximately mid length. Further minor indentations were located forward on the port side at the turn of the bilge. Minor damage had been sustained to the handrails on the port side of the forecastle head during the collision with the Apex Light.

The Class surveyor inspected the operation of the steering system and found it to be working correctly, with no faults.

At Bremerhaven, repairs were carried out to the port propeller shaft and both propellers, and the shaft seal was renewed.

1.6 ENVIRONMENT

The weather at the time of the accident was good with a north-easterly wind of force 3 to 4. Although it was dark at the time of the accident, it was clear conditions with excellent visibility.

High water was predicted to occur at Blacktoft at 2144. The actual height of tide was 5.0 metres.

1.7 RIVER OUSE, TRENT AND HUMBER

River Humber is formed by the junction of the Rivers Ouse and Trent, 34 miles from the sea. Both the River Ouse and River Trent are navigable by sea-going ships. The River Ouse is navigable for 23 miles as far as Selby.

The changing nature of the channel, and the local knowledge required to safely navigate a vessel have led to pilotage being deemed compulsory for vessels of 60m or more in length.

The training wall at the confluence of the Rivers Ouse and Trent is made of stones, and is designed to influence the flow of the tidal streams and produce a scouring effect to prevent the river entrances from silting up. The training walls are covered at a tidal height of 4.2m, and wooden piles are spaced along the top of the walls to provide visual indication of their location when submerged.

1.7.1 Tidal conditions

Tidal streams in the River Ouse typically run at a maximum rate of 3 to 4 knots, but this can exceed 6 knots in certain conditions.

Tidal predictions are complex. During springs, there are 3.5 hours of flood tide and 8.5 hours of ebb. During neaps there are 5 hours of flood and 7 hours of ebb. Slack water occurs between 30 and 45 minutes after high water, by which time the tide has fallen 30cm.

Online tidal monitoring and recording is carried out by a series of 16 transmitting tide gauges situated throughout the estuary. These gauges are all referenced to chart datum, in order for the mariner to apply readings directly to charted depths to determine available water for navigation. The tidal gauge information is used to inform ships' masters, licensed pilots, PEC holders etc.

At the time of the accident, the remains of the flood tidal stream in the Ouse was negligible. However, the last of the flood tide in the River Humber was estimated to have been flowing at about 2 knots across the entrance of the River Ouse and into the River Trent.

1.7.2 Riverbed topography

The changing riverbed topography requires regular surveys to be carried out. The River Ouse is surveyed annually. The last surveys carried out by ABP, prior to the accident, were:

- Between the Apex Light and Blacktoft Jetty - 8 June 2004 **(Figure 10)**
- Number 34 buoy (River Humber) to the Apex Light - 17 January 2005
- The Apex Light to Burton Stather (River Trent) - 20 January 2005

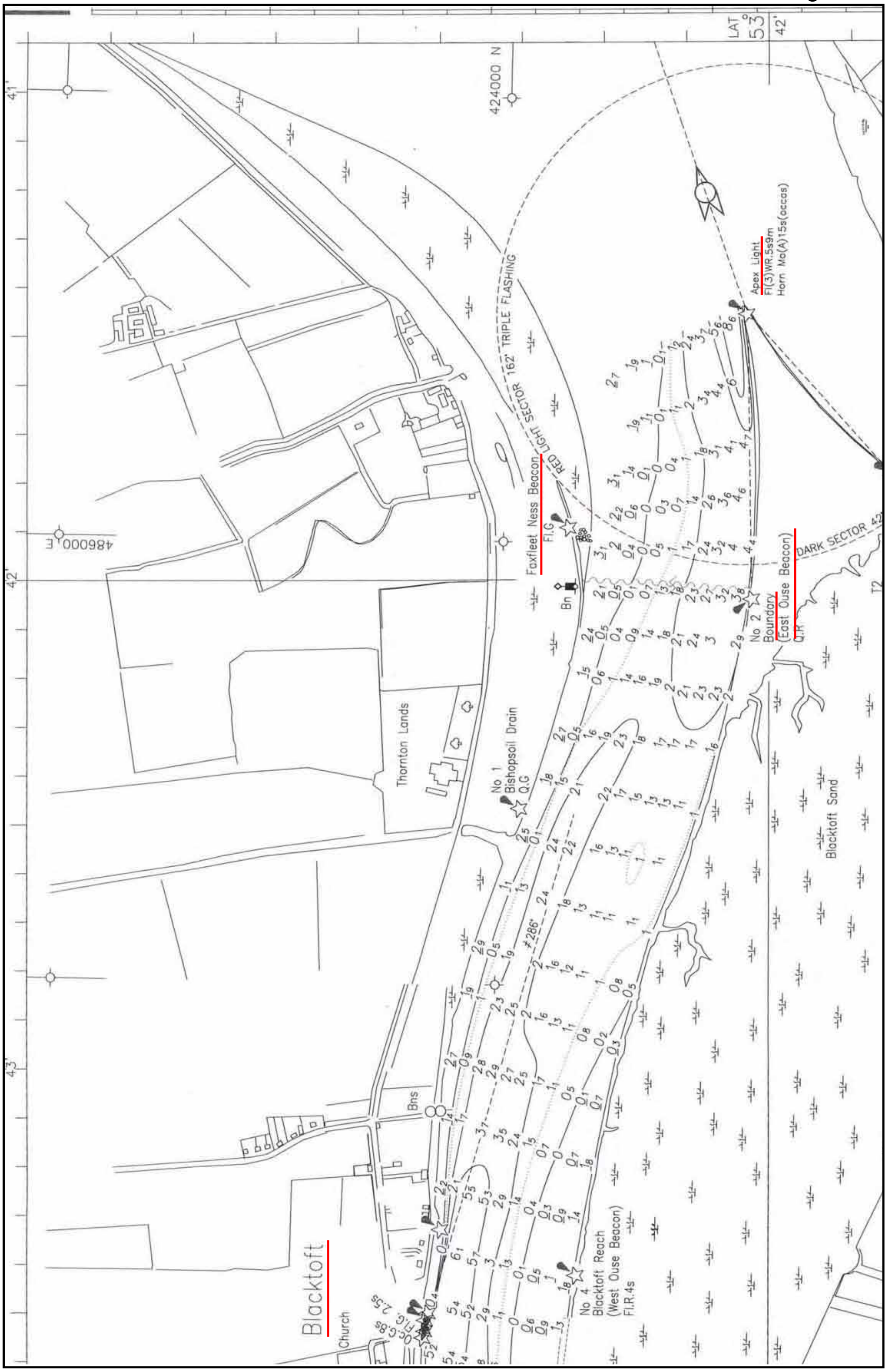
The latest surveys indicate a depth, close to the Apex Light, of 8 metres, reducing steadily to the shoal on the opposite bank.

The survey information is made available to pilots and PEC holders. The Humber pilot brought a copy of the latest survey information onto *Orade.*

1.7.3 Ballasting of vessels

The silty riverbed material and rapid tidal streams can cause problems for vessels wanting to ballast before departing their berth. Pipework blockages, pump problems and a build-up of sediment in ballast tanks can occur. Partly for this reason, and the limited flood tide window available when sailing from Howdendyke, it is not unusual for a vessel to depart with a very light draught and to take on ballast once they are in cleaner water further out into the estuary. This had been the intention on *Orade* on 1 March 2005.

Figure 10



River Ouse soundings chart extract

1.8 ASSOCIATED BRITISH PORTS (ABP), HULL

1.8.1 Pilotage

Pilotage on the River Humber, and in the lower reaches of the Rivers Ouse and Trent, is provided by the competent harbour authority (CHA), Associated British Ports, Humber Estuary Services (ABP HES).

The compulsory pilotage area extends from just seaward of the Spurn Light Float to Goole on the River Ouse and Gainsborough on the River Trent. All vessels of 60m length or more are required to carry a licensed pilot or PEC holder. All vessels over 40m are required to carry a specialist River Ouse pilot above Goole. These pilots normally change with River Humber pilots at the jetty at Backtoft.

1.8.2 Vessel Traffic Services (VTS)

A VTS system is maintained for the control of shipping in the Rivers Humber, Ouse and Trent. VTS includes radar surveillance only between the seaward approaches to the Humber Estuary as far up the river as the Humber Bridge; the area of the accident is not included.

1.8.3 Port and Vessel Information System (PAVIS)

The Port and Vessel Information System (PAVIS) is a computer-based vessel and pilot planning device. Predicted and actual arrival or departure times of vessels are logged on the PAVIS system, and pilots are organised for the vessels and logged on the system by the port authority administration staff.

In 2001, ABP carried out a Formal Safety Assessment of Marine Operations on the Humber Estuary, which fulfilled the requirement in the Port Marine Safety Code (PMSC). This included a Navigational Risk Assessment, which detailed, among other risks, those associated with ‘vessel hull shape, protrusions, overhangs etc’. It was noted that these anomalies were not recorded with vessel information, within the PAVIS database, despite the system’s capabilities to do so.

In 2002, ABP Humber issued a General Notice to Pilots in which the pilots were reminded to use PAVIS to log unusual vessel manoeuvring information that they had gained through their experience on board vessels operating in the Humber river.

1.9 PILOT TRAINING

1.9.1 General training

A review of the Pilotage Act 1987 was undertaken in 1997 as a result of the MAIB report of the *Sea Empress* accident.

The body of the review was composed of five sections, the third section being "Improving Standards". Within this section, item 13.14: Present practice of harbour authorities, states:

> *Evidence to this review suggests that authorities and pilots concentrate at present, at least so far as formal training is concerned, upon that needed by pilots to obtain their initial authorisation and to advance thereafter to unrestricted status (see para 11.09). Practice thereafter varies. Best practice requires a continuous programme of training, with special provision for any new types of ships, including tugs, with which an authority's pilots may be expected to work. An authorisation ought normally to be restricted to exclude such ships until appropriate training has been undertaken. This is not universal practice: in some ports, there seems to be a view that taking unfamiliar ships is part of the professional task of pilotage, and that their special needs can be picked up on the job…. Evidence shows that this approach is unsound and causes unnecessary accidents.*

The review additionally provided draft recommendations on Training and Certification requirements for maritime pilots within the work programme of the Standards of Training, Certification and Watchkeeping (STCW) Sub-Committee at the IMO, which included, under "Updating and Refresher Training for Pilots":

- *Courses on Bridge Resource Management for pilots to facilitate communication and information exchange between the pilot and the master, to increase efficiency on the bridge,*

and in the syllabus for "pilotage certification or licensing":

- *Manoeuvring behaviour of the types of ships expected to be piloted and the limitations imposed by particular propulsion and steering systems*
- *Master-Pilot Relationship, Pilot Card, operational procedures.*

1.10 THE HUMBER PILOT

1.10.1 Experience

The Humber pilot had sailed mostly on coastal vessels during his career at sea, eventually gaining a Class V certificate with command endorsement. He sailed as master for 12 years on vessels operating frequently along the River Ouse. These vessels often had a riverpilot or 'Rate-of-turn' method of steering, and the pilot was experienced in its use.

In 2001 he joined ABP as a Class 2 pilot, which limited him to piloting vessels up to 20,000 dwt and 8.5 metres maximum draught.

He averaged 225 acts of pilotage per year, although in 2004 he conducted 186. In 2005 he had carried out 41 up to and including that on *Orade.*

1.10.2 Working hours **(Figure 11)**

Humber pilots are contractually employed by ABP on a 13 days on/5 days off roster and, as such, are subject to the main Department of Trade and Industry (DTI) working time regulations (as applied to land based workers).

These regulations provide for a maximum 48 hour working week, calculated over 17 weeks, but there is provision for individuals to sign an opt out. In addition, the working time limits and rest entitlements do not apply if a worker can decide when to do their work, and how long they work.

Figure 11

Ships name	**Arrival/Departure**	**Date**	**Start time**	**Finish time**	**Job duration**
Helene G	Departure	28/02/05	1014	1651	6hrs 37
Ivan	Departure	01/03/05	0400	1005	6hrs 5
Orade	Shift	01/03/05	1930	1341/2nd	18hrs 11 (aground)
Star Aruba	Departure	03/03/05	0945	1637	6hrs 52
Salrix	Departure	04/03/05	1900	0048/5th	5hrs 48
Star Aruba	Arrival	05/03/05	2030	0241/6th	6hrs 11
Putford Trader	Arrival	06/03/05	1830	0011/7th	5hrs 41
Heike	Arrival	07/03/05	1700	0010/8th	7hrs 10
Atlantis Alvarado	Arrival	08/03/05	2030	0217/9th	5hrs 47
Wani Will	Arrival	10/03/05	0030	0658	6hrs 28
Lara	Arrival	11/03/05	0100	0700	6hrs
Splittnes	Departure	11/03/05	1730	0037/12th	7hrs 7

Table Explanatory Notes

Start time - Pilot called at home and allows 1 hour for preparation and travel to work at the pilot office

Finish time - Time of arrival back at the pilot office

Job duration - Time from initial call out to arrival back at pilot office on completion (actual time on board is approximately 3.5 hours less)

ABP Humber Pilot working hours

The nature of ‘pilotage on demand’ requires pilots to be contactable at all times during their duty period, and working at night is usual. The working time regulations define a night worker as someone who normally works at least 3 hours per night. Night time is defined as between 11pm to 6am within the regulations.

Considering that pilotages often begin, end or occur during the range of night time hours, pilots can be considered to be night workers. Within the working time regulations, night time workers should not work more than 8 hours daily on average, including overtime when it is part of a night worker’s normal hours of work.

A night worker cannot opt out of the night work limit. However, where a night worker’s work involves special hazards or heavy physical or mental strain, there is an absolute limit of 8 hours on the worker’s working time each day – this is not an average.

Of the 186 pilotages carried out in 2004, *Orade*’s pilot worked a total of 1033 hours, which equates to an average of 3.03 hours per job on board, and an average of 5.32 hours including travel to and from the port house. His rest time between jobs ranged from a minimum of 5.54 hours to 1 day 19.19 hours. Of the 13 days contracted work per tour of duty, he averaged 10.12 jobs per tour. The highest number of total hours worked by a Humber pilot in 2004 was just under 1250.

Although there is no minimum or maximum number of hours that a pilot can work, the pilot roster and the number of pilots employed is designed to achieve an average of one job per day or less, with average job time being fewer than 6 hours. The pilots’ turn list is monitored daily by the Pilotage Operations Manager.

Any reduction in the complement of pilots increases the workload on the remaining pilots. At the time of the accident involving *Orade,* ABP Humber was in the process of increasing the complement of pilots from 114 to 118 to keep pace with increasing volumes of shipping.

Because the volume of shipping on the Humber varies between spring and neap tides, ABP provides no guidance on working hours, accepting that the peaks and troughs are broadly balanced across the total on-call duty cycle, and allowing the pilots to determine their own levels of fatigue. Since joining ABP in 2001, the pilot on board *Orade* at the time of the accident had rejected only one pilotage request due to fatigue.

The pilot had begun a new 13 day roster on 28 February, after having been on leave for 1 week. One pilotage was carried out that day, totalling 6 hours 37 minutes from the time the pilot was called at home to the time he returned to the port office.

The following day (1 March) started with him being called at 0400. He boarded the vessel at 0600 and disembarked at 0822, before arriving back at the port office at 1005. He returned home at about 1130. The pilot had 2 to 3 hours' sleep that afternoon, before the next call-out at 1930 for *Orade.*

The pilot's passage plan showed a planned embarkation time at Blacktoft of 2130, and a disembark time of 0110 on 2 March at Spurn Light float in the Humber estuary. The actual embarkation time was logged in the pilot's passage plan as 2140 **(Figure 12)**.

1.10.3 Training

Trainee Humber pilots work for 6 months under the instruction and guidance of an authorised pilot. The trainee pilots, who are required to have achieved an STCW 95 certificate of competency and suitable experience prior to beginning training, are required to complete sufficient trips both inbound and outbound to all the berths within their pilotage area to the satisfaction of the instructing authorised pilots. The trainees are eventually subjected to an examination. Thereafter, pilots are authorised to work on certain classes of vessel in the area covered by their certificate.

Pilotage information on the three Rivers (Humber, Ouse and Trent), the ports, berths, signals, marks and other river guidance is provided in the 'Humber Estuary Services Pilotage Operations Manual' (May 2003).

The pilot training manual does briefly refer to an assessment of the capabilities of the bridge team by the pilot. No guidance is provided on whether the pilot should take the helm.

In 2003, after the grounding of a vessel on the Humber, ABP issued a General Notice to Pilots regarding bridge procedures.

The Notice stated that a contributory factor to the incident was that the pilot had the helm and was unable to devote his attention to the radar and take an overview of the situation. The Notice required pilots to ensure that a helmsman was provided in such circumstances, to enable the pilot to have the freedom to monitor the radar and overall conduct of the navigation.

The final paragraph of the Notice stated:

> *Modern vessels, in particular those designed for river transits, which have River Radar and rate of turn indicators at the helm seat, can be steered by the pilot as he gets an overview from this position*.

ABP Humber unofficially advises that pilots should provide verbal orders to a helmsman.

GOOLE OUTWARDS: PILOTAGE PASSAGE PLAN FORM

Date: 1 / 3 /2005 Pilot RW V/L Name ORADE Call sign V2MA7

Draft 1-8 m LOA 77 m Beam 11-4 m DWT .... mt V/L Type CARGO ~~Loaded~~/Ballast

Engine .... KW Prop 2x FIXED Bow Thrust 300 KW Max Manoeuvre Sp 9-5 kn Distance to destn [ ] NM

Pilot Briefing
Bridge Team / ✓ [ ]

				BLACKTOFT		BLACKTOFT			
HW Albert	2129	8-7 M	HW	2144	5-4 M	LW 0527	0-3 M	Max Draft for tide	5-8 M

Boarding time 2130 position BLACKTOFT Berth .... Destination SLF Route ~~NSH / SR~~ / RR

Goole Reach	—	m	SwineFl	—	m	YokeFl	—	m

Ruling Depth ForPassage 0-7 M Under keel clearance Calculation carried out ✓ [✓] Sufficient water for 0.2m day 0.3m night U/Keel Y N Init's RW

Where? Whittons

TIMES **HEIGHTS IN M**

	Planned	Earliest	Latest	Actual	Gauge	Predicted	Min RQ	Actual
Goole *Ocean / Victoria..Lock		✓			Goole	m	m	m
Ruling Reach		✓			Goole			
Blacktoft	2130	—	0045	2145	BLACKT	5-40	2-51	5-0
Apex (WW Dyke) VTS Ch12	2145	—	0100	2154	WW Dyke	5-31	3-1	5-45
Brough	2210	—	0130		Brough	5-64	0-8	
Humber Bridge (28A) VTS Ch 12	2240	✓	0210		Bridge	6-38	1-8	

	Planned	Latest	Actual	Gauge	Predicted	Min RQ	Actual
Albert Dock RSQ	2300			Albert	6-88 m	m	m
Paul Sand No 19 VTS 12 (Foule Holme?)	2340	✓		Immingham	4-88		
Clay Huts 13 (check speed) T/Bunkering etc	2400						
Sunk/Skeeness VTS Ch 14	0030			Spurn			
Bull Lt Float	0045						
Chequer No3	0100						
Spurn Lt Float VTS 14 Disembark	0110						

Inter Port ....

Anchoring VTS Ch12 / 14 [ ] Time [ ] Position [ ] Disembark Y N

Comments / Tugs: Lady Constance Lady Elizabeth

Anchor aweigh/ Resume Passage [ ]

Pilots Signature ....

Grounded on Apex 2154

09/20/01

Pilotage passage plan

1.11 THE MASTER

1.11.1 Experience

The master began his sea-going career in the early 1970s working on sailing and fishing vessels. He attained a bridge watchkeeping certificate in 1978, and a German home trade master's certificate in 1990. He had sailed as master since the early 1990s, mostly on European feeder vessels similar to *Orade.* He also had a marine engineer's licence with a limit of 750kW to enable him to carry out the engineer's duties on board.

He had worked for the Dahl Shipping company since 2000, and had been master on board *Orade* since August 2003, operating mainly around northern Europe.

1.11.2 Working hours **(Figure 13)**

The master's latest tour of duty on board *Orade* had begun on 15 September 2004, and was due to conclude at the end of May 2005. Nine month tours of duty, followed by approximately three months' leave, was the master's chosen routine, which he considered to be reasonable.

During his tour of duty, the master worked a 6 hours on 6 hours off watchkeeping routine opposite the chief officer. The routine was largely maintained even while the vessel was alongside in port. The master carried out the 6 – 12 watch.

Due to the level of manning on board, the normal duties of the master additionally included those of engineer, watchkeeper and lookout.

The hours of work forms required to be compiled by the master (and crew) under the Hours of Work Regulations 2002, indicate that the master regularly worked a 12 hour day. The completed forms show a very rigid work/rest pattern, which differs considerably from those of other vessels which have been examined by MAIB on previous occasions. Hours of work forms generally show a more flexible pattern, which does not adhere exactly to the basic watch system and allows for some work outside watchkeeping hours.

No information is provided within the master's hours of work forms on how often, and for how long, he might have been required to attend the engine room or receive port officials outside of his normal working hours.

Figure 13

MV Orade - V2MA7

Workingtime Sheet

last \ first name: Rank: master

birth: Month: Februar 05

Workingtime

Dat	Day		ART 00 - 06	ART 06 -12	ART 12-18	ART 18 - 24	G	R	Ü	tWH	RH	10h24D/h	6hiP	RBW
1	Di	Ws	-	W 6 - 12	-	W 18 - 24	12	12	12	12	12	OK	OKAY	OKAY
2	Mi	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
3	Do	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
4	Fr	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
5	Sa	Sa	-	W 6 - 12	-	W 18 - 24	12	0	12	12	12	OK	OKAY	OKAY
6	So	Wso	-	W 6 - 12	-	W 18 - 24	12	0	12	12	12	OK	OKAY	OKAY
7	Mo	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
8	Di	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
9	Mi	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
10	Do	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
11	Fr	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
12	Sa	Sa	-	W 6 - 12	-	W 18 - 24	12	0	12	12	12	OK	OKAY	OKAY
13	So	Wso	-	W 6 - 12	-	W 18 - 24	12	0	12	12	12	OK	OKAY	OKAY
14	Mo	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
15	Di	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
16	Mi	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
17	Do	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
18	Fr	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
19	Sa	Sa	-	W 6 - 12	-	W 18 - 24	12	0	12	12	12	OK	OKAY	OKAY
20	So	Wso	-	W 6 - 12	-	W 18 - 24	12	0	12	12	12	OK	OKAY	OKAY
21	Mo	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
22	Di	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
23	Mi	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
24	Do	h	-	W 6 - 12	-	W 18 - 24	12	8	4	12	12	OK	OKAY	OKAY
25	Fr	Ws	-	W 6 - 12	-	W 18 - 24	12	12	0	12	12	OK	OKAY	OKAY
26	Sa	Sa	-	3 - 4	-	8 - 10	3	0	3	3	21	OK	OKAY	OKAY
27	So	Wso	-	-	-	-	0	0	0	0	24	OK	OKAY	OKAY
28	Mo	h	-	8 - 12	-	13 - 17	8	8	0	8	16	OK	OKAY	OKAY
29	Di		-	-	-	-	0	0	0	0	24	OK	OKAY	OKAY
30	Mi		-	-	-	-	0	0	0	0	24	OK	OKAY	OKAY
31	Do		-	-	-	-	0	0	0	0	24	OK	OKAY	OKAY
						TOTAL hours:	311	196	127					
							G	R	Ü					

G total hours
R periodical
Ü overtime

tWH = total Workhours
RH =Resthours
10h24D/h = 10h in 24 day/hours
6hiP = 6 hours in Piece
RBW = Rest before Watch

postion \ date : ______________________

______________________ Master / 1.Off.

______________________ Crewmember

Master’s working hours

SECTION 2 - ANALYSIS

The purpose of the analysis is to determine the contributory causes and circumstances of the accident as a basis for making recommendations to prevent similar accidents occurring in the future.

1.2 THE VESSEL'S TRACK, HEADING AND STEERING MODE (Figure 14)

All times are UTC

Orade was equipped with a Transas electronic chart plotter. This was used for passage planning, and for following the track of the vessel's position using relevant electronic navigational charts loaded on to the system.

The track, speed, heading and course over the ground (CoG) are some of the parameters which are automatically saved to the system hard drive and which can be downloaded and analysed at a later date.

After the collision with the Apex Light beacon on 1 March, the electronic files for that day were copied and analysed. The track files supported the Humber pilot's and the master's general recollection of the track of the vessel after leaving Blacktoft.

Orade had arrived at Blacktoft at about 2140, departed at about 2142, and then proceeded south-easterly across to the middle of the river. At approximately 2147, she passed the incoming container vessel.

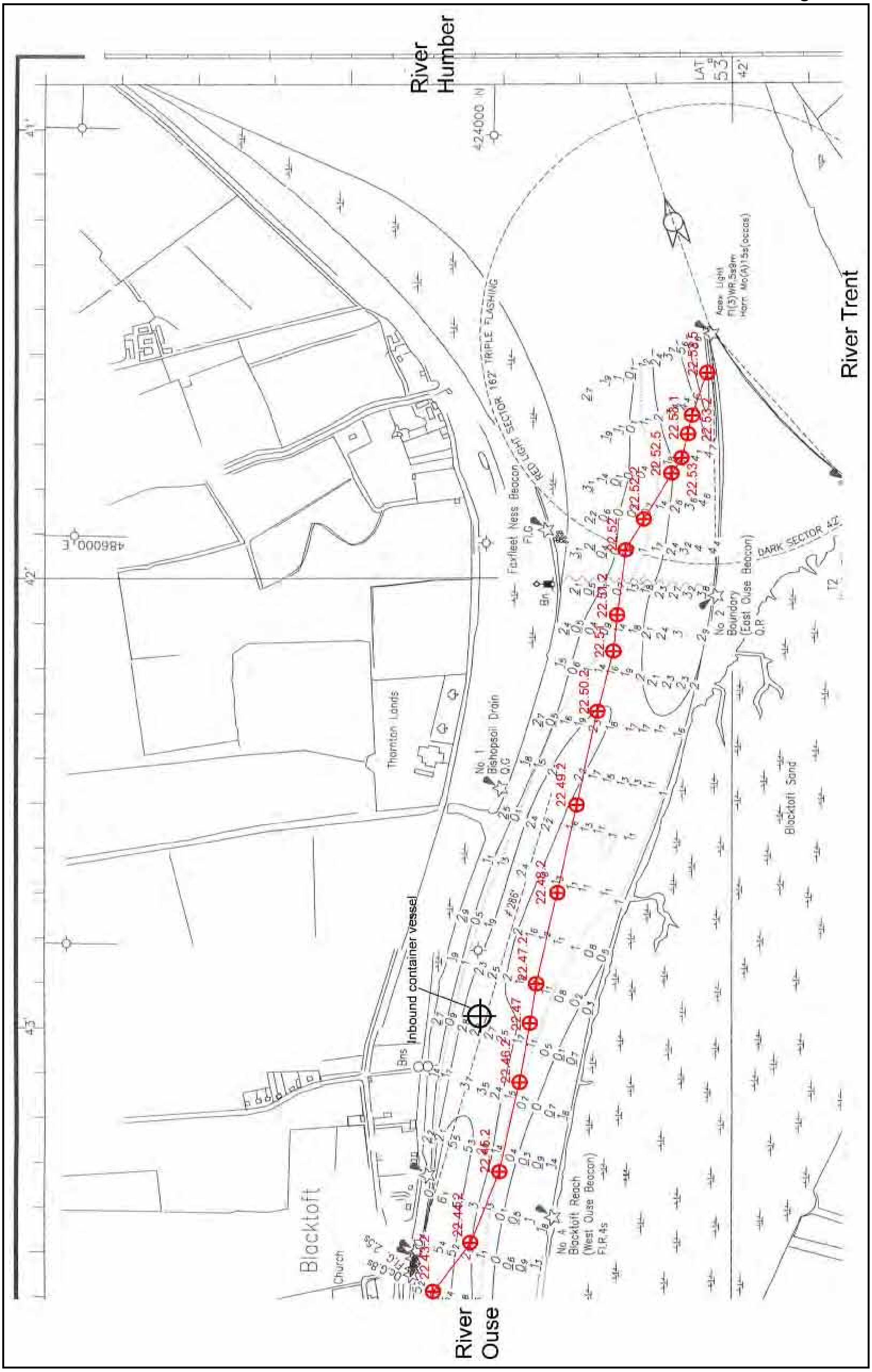
Once she had reached the middle of the river, at 2145, *Orade* continued downriver on a steady heading of between 097.4º and 103.5º, until the time of collision with the Apex Light beacon at about 2154.

The CoG during the period between 2146 and 2152 varies between 100º and 104º and, as can be seen from Figure 14, is virtually a straight track.

At 2152, with the Faxfleet Ness Beacon abeam, *Orade* began to be set bodily to starboard on a CoG of about 115º, and toward the River Ouse training wall. About 1 minute later, the CoG altered to 110º, and *Orade* proceeded on this course until the collision. No change in heading is apparent in the minutes preceding the collision.

The bodily set of *Orade* to starboard after about 2152, is probably due to the remaining flood tide in the Rivers Humber and Trent. The rate of the flood tide setting across the entrance of the River Ouse was estimated to be about 2 knots at that state of tide, and the flow might have been faster near the surface of the river as it flowed over the submerged training wall.

Figure 14



Track plot from Transas chart plotter

The consistency of *Orade's* gyro heading between about 2145 and the time of the contact with the Apex Light at 2154, indicates either that the vessel has very good directional stability, or that she was under the control of an expert helmsman or autopilot. All reports about the vessel indicate that her directional stability was very poor.

The pilot discovered, just before the time of the contact, that his helm, or rate-of-turn, orders were having no effect, and it was only after this discovery, when the master changed the steering mode selector switch to "manual steering", that manual control of the helm was regained. It is clear that, after the contact, the pilot believed he had been in riverpilot mode as he specifically mentioned it when he reported the accident to VTS. After the accident, the steering controls were tested and found to have been working correctly. With this in mind, despite the conflicting evidence, the MAIB has concluded that the vessel had probably been inadvertently in autopilot steering mode since about 2145 when the pilot had asked the master to place the steering in riverpilot mode. The pilot had not noticed that his subsequent small rate-of-turn orders had not been responded to because the rudder angle indicator was sited in an awkward position above his head, and the autopilot was successfully keeping the vessel on the required track. It was not until the pilot felt the need to apply large rate-of-turn corrections, to counteract *Orade*'s set to starboard, that a problem was recognised.

The procedure for engaging riverpilot mode from manual steering mode was as follows:

1. Select autopilot using the steering mode selector switch, and
2. Depress the rate-of-turn tiller button on the autopilot panel.

The MAIB believes that, probably, after the pilot had asked for riverpilot mode, the master carried out the first part of the above procedure, but then failed to successfully carry out the second. The evidence is conflicting on this subject, and the reason for the apparent mistake has not been determined with accuracy. However, possible factors include:

1. The master was unfamiliar with the use of riverpilot mode on this vessel
2. The master might have pressed the rate-of-turn tiller button insufficiently to make the switch
3. The master might have been affected by fatigue
4. The master might have intended to switch to follow-up mode but, in the event, had inadvertently selected autopilot on the steering mode selector switch. The bridge was dark and the selector switch could not be illuminated.

The apparent mistake was not detected immediately for the following reasons:

1. No check was made by either the pilot or the master that the changeover had been successful. It should be routine practice to check that a steering mode change has been made by adjusting the heading or helm momentarily and monitoring the effect.
2. The rudder angle indicator was not readily visible from the control position. It should be a routine procedure to check that selected helm or rate-of-turn orders are having the desired effect by monitoring rudder movements.
3. The master did not closely monitor the pilot's actions. He moved to the starboard side of the bridge to work on the chart plotter very soon after giving the pilot the con.
4. The pilot had no reason to think that he was not steering the vessel successfully, because she was maintaining the desired heading.

2.2 BRIDGE RESOURCE MANAGEMENT

Effective master/pilot team working is essential to ensure that a mistake by a single person does not go unnoticed and uncorrected. Good communication is a prerequisite of good bridge resource management. The pilot came on board *Orade* with the latest river chart and a plan for the passage. However, the conversation between the two, that occurred as the vessel was leaving Blacktoft jetty, was mainly from the master to the pilot indicating the controls and instrumentation. Very little was said about the passage, and the pilot did not indicate the detail of his plan.

It is common practice for pilots to take the helm, especially on small vessels in confined difficult waters which necessitate frequent changes of heading, and where no seaman helmsman is available. It is also common practice for pilots to navigate by eye in such areas.

On this occasion, with the master's permission, the pilot took the helm very soon after leaving Blacktoft jetty. The bridge was in darkness and the pilot was not familiar with the vessel and her instrumentation. The pilot was unaware at that stage that the vessel was difficult to steer and needed constant helm input. He had received no handover from the Ouse pilot, and no information about the vessel's manoeuvring characteristics had been entered on the PAVIS system from previous voyages.

The master, having relinquished the con, had moved to the starboard side of the bridge, where he was busy using the Transas electronic chart system for his own planning purposes. He had sight of a radar, but was not conscientiously monitoring what the pilot was doing.

The master had effectively delegated the responsibility for the passage to the pilot, who was left largely alone to carry out the role. The role of the master in this situation, where the pilot is actively steering and navigating the vessel, was not agreed by the two persons involved. The master did his own thing, and the pilot did not query this.

Had the master been fully briefed on the pilot's passage plan, he could have used his radar and other instrumentation, including the rudder angle indicator, to check that the navigation and control of the vessel was happening as planned. Had this been the case, he might have had early warning of the problem. As it was, he probably lost situational awareness and did not become aware that the vessel was being swept towards the training wall until the pilot said that the helm was not responding. By that time, it was too late to stop the accident.

Communication and team working had been poor, and this fact was a major contributory factor in the accident.

2.3 USE OF THE PAVIS SYSTEM

The Pilotage Operations Manual is somewhat vague on effective Bridge Resource Management, and does not assist the pilot in how to carry out the required assessment of the bridge team or against what criteria it should be measured.

Furthermore, the General Notice referring to bridge procedures differs from the verbal guidance issued when a pilot decides to steer the vessel. The Notice fails to provide guidance on when it is inadvisable for the pilot to steer a modern vessel designed for river transits.

One of the factors identified in 2.2 above is that the pilot had no previous experience of the vessel, and no prior warning of her steering idiosyncrasies. This situation pertained, despite the vessel being a frequent visitor to the Humber. If he had been aware that she was difficult to steer, he might have chosen to leave the master at the helm until he was fully familiar with the controls.

Although a Guidance Notice to Pilots was issued in 2002 to remind them of the need to update PAVIS on unusual vessel manoeuvring characteristics, this guidance was not applied to *Orade*.

Furthermore, anecdotal evidence suggests that PAVIS is not widely used by the pilots operating on the Humber.

The provision of information like this, to pilots, would seem to be in accord with best practice as stated in the review of the Pilotage Act (see Section 1.9.1).

2.4 FATIGUE

2.4.1 General

The hazards of fatigue, resulting from long working hours, stress, disruptive work patterns, long tour lengths, noise, vibration, poor shipboard conditions, weather and other elements are beginning to be recognised and addressed by maritime authorities.

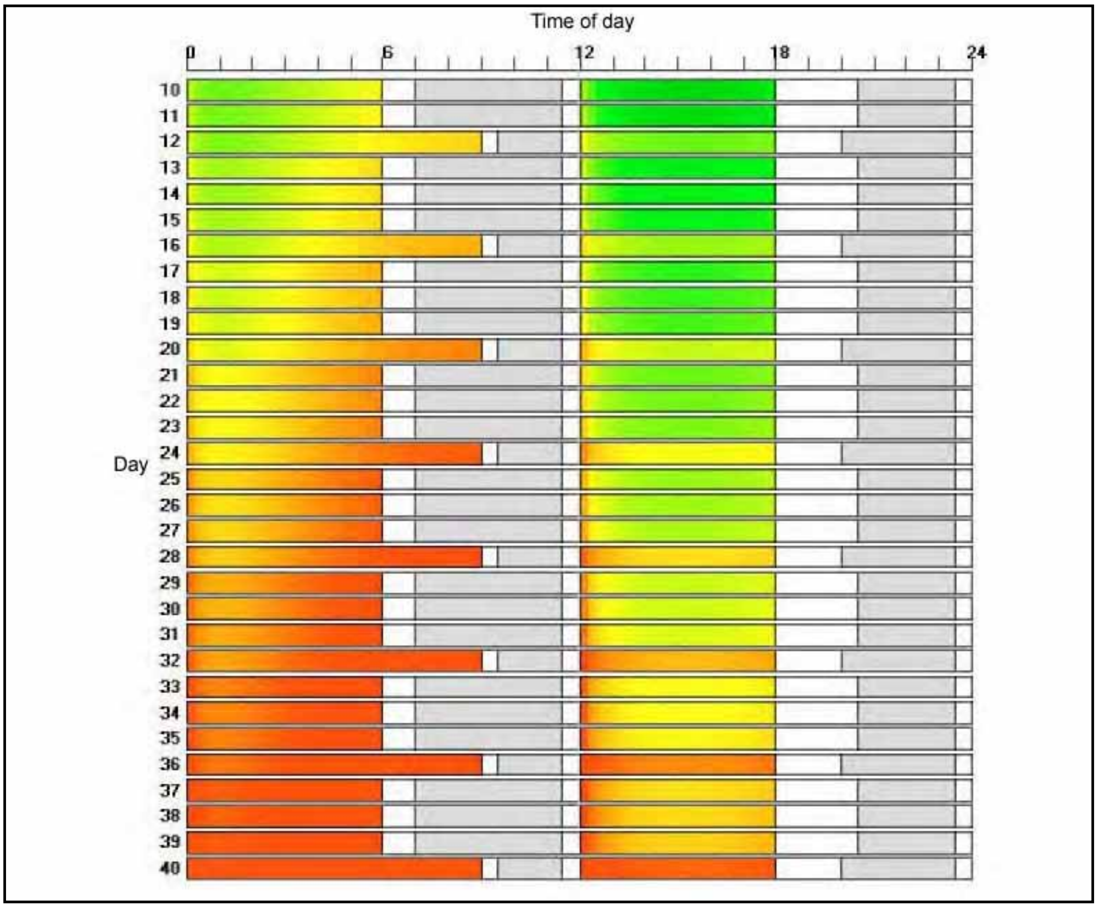
In 2004, MAIB published the Bridge Watchkeeping Safety Study, which looked at trends and anomalies from its large database of accidents and with particular relevance to collisions, groundings, contacts and near collisions. The study concluded that, among other things, watchkeeper fatigue was a major factor in many accidents, particularly in groundings.

Fatigue, affecting the watchkeeper's performance, can produce the following effects:

- Inability to concentrate, including being less vigilant than usual;
- Poor memory, including forgetting to complete a task or part of a task;
- Slow response, including responding slowly to normal, abnormal or emergency situations;
- Reduced competence in interpersonal dealings;
- Attitude change, including:
  - Being too willing to take risks;
  - Displaying a "don't care" attitude;
  - Disregarding warning signs.
- Diminished decision-making ability, including:
  - Misjudging distance, speed, time etc
  - Overlooking information required for complex decisions
  - Failing to anticipate danger.

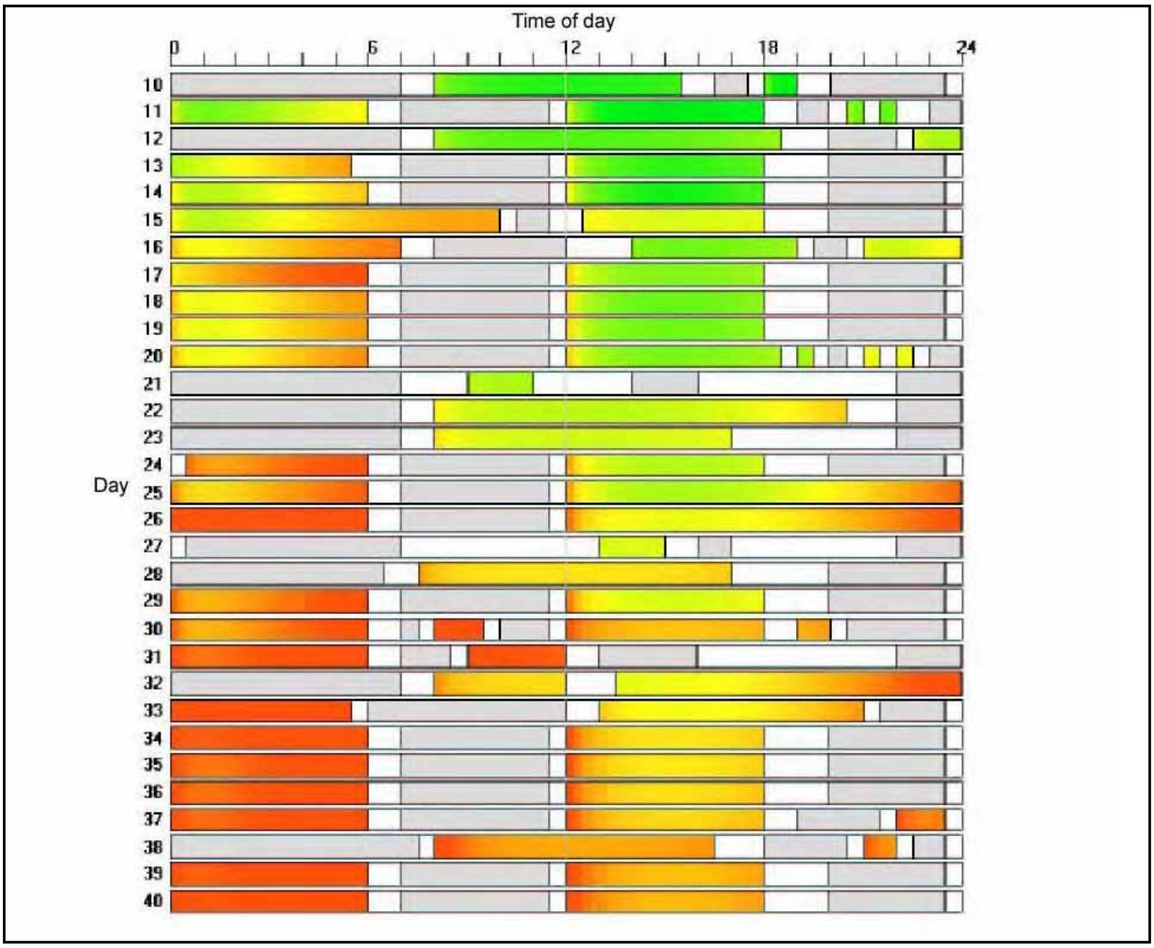
Further study has taken place with the assistance of QinetiQ Centre for Human Sciences on the effects of 6-on 6-off watchkeeping routines. The results have been highlighted in the MAIB Safety Digest edition 1/2005 (see MAIB website: www.maib.gov.uk). The study used both generic and actual hours of work routines in the short sea trade. These were analysed and compared to research data derived from experiments on air crew. The results, which were adjusted for known differences in the criteria used for analysis, indicated that the watchkeepers in question had reached dangerous levels of fatigue after just 2 or 3 weeks in the routine **(Figure 15a and 15b)**.

Figure 15a



Chief Officer based on generic data (before day ten he was well rested)

Figure 15b



Chief Officer based on actual data (before day ten he was well rested)

Duty periods are coded red for high risk, yellow for moderate risk, and green for low risk. Sleep periods are in grey.

One of the recommendations that arose from the Bridge Watchkeeping Safety Study was that:

> *Minimum safe manning levels need to be increased so that each seagoing vessel of over 500gt has at least a master and two watchkeeping officers.*

2.4.2 The master's hours of work

At the time of the accident, the master had been operating in a punishing watchkeeping routine without a substantial break for 5½ months. It appears from his hours of work records **(see Figure 13)**, that he maintained a fairly rigid 6-on 6-off routine most of the time, even during some port calls. Although the records indicate that his routine met the minimum hours of rest as required by STCW 95 and ILO 180 **(Annex 1)**, bearing in mind the master had other duties on board which could not be carried out during bridge watchkeeping, it is unlikely that the records accurately indicated his workload, which must have been substantially more.

The shortfalls in performance, that created the conditions in which the accident occurred, are consistent with some of the effects of fatigue as mentioned in 2.4.1 above. The MAIB believes, therefore, that the master's fatigued state was an underlying cause of the accident.

Fatigue builds up over time, and the master had been working the 6-on 6-off routine for 5½ months. This may be construed as contrary to the guidance contained in STCW 95 **(Annex 1**, Section B – VIII/1, 3.2**)**. It was intended that this routine would have continued for a full 9 months.

2.4.3 The pilot's hours of work

QinetiQ Centre for Human Sciences analysed the pilot's working hours and concluded that he was probably not affected by fatigue at the time of the accident. However, the investigation has highlighted that, despite pilots' hours being subject to the working time regulations, and despite the fact that some allowance is made for hours recently worked, when ordering a pilot to a particular job, much is left to the pilot's own view on whether he is fatigued and capable of safely carrying out the required task. In the MAIB's experience, the individual is not usually the best judge of that condition, and ports should proactively manage the risks associated with pilot working hours, bearing in mind relevant legislation and guidance.

2.5 ERGONOMICS

2.5.1 Steering mode selector switch

The console in the vicinity of the steering mode selector switch was not illuminated, and the switch could not easily be seen on a darkened bridge. In some emergency situations, it is necessary to operate this switch to regain manual control of the helm and, for this reason, it would be sensible for it to be lit.

The switch labelling indicated both riverpilot and autopilot in the horizontal switch position when, in fact, it only connected to the autopilot. A further selection needed to be made on the autopilot console for riverpilot mode to be active. This is misleading and could, in some circumstances, cause confusion or a misunderstanding.

2.5.2 Rudder angle indicator (RAI)

The only RAI that was visible from the central steering position was a panoramic one above the helmsman's head. This was unsatisfactory because the helmsman could only see the RAI with difficulty, by lifting his head, whereas constant reference to an RAI is needed when steering in the non follow-up mode.

SECTION 3 - CONCLUSIONS

3.1 SAFETY ISSUES

The following safety issues have been identified in the foregoing analysis. They are not listed in any order of priority.

1. The information captured on *Orade*'s Transas electronic chart plotter indicated that the vessel was probably inadvertently on autopilot from about 2145, when the master changed steering mode at the pilot's request. [2.1]

2. The pilot had not tested that the changeover had been successful [2.1]

3. The pilot had not noticed that his small rate-of-turn orders had not been responded to as the autopilot was successfully keeping the vessel on the required track. [2.1]

4. The pilot thought that he had been steering in riverpilot mode at the time of the accident, and he referred to it in his post-accident VHF communication with VTS. [2.1]

5. The pilot did not ensure that he was fully familiar with the vessel controls or characteristics prior to taking the helm. [2.2]

6. The master effectively delegated the responsibility of the pilotage to the pilot at an early stage. The subsequent role of the master in this situation was not discussed and agreed by the two persons involved. [2.2]

7. The master probably lost situational awareness due to concentrating on passage planning work using the electronic chart plotter, and he did not notice that there was anything wrong until alerted by the pilot. [2.2]

8. Communication and team working had been poor, and this was a major contributory factor in this accident. [2.2]

9. A computer system, operated by ABP Humber, capable of detailing useful vessel information for pilots prior to them embarking on a vessel, was not being used to its full advantage. [2.3]

10. The master had been working a punishing 6-on 6-off watchkeeping routine for 5½ months prior to the accident. His workload, in addition to that of master, also included duties on board which could not be carried out during bridge watchkeeping. [2.4]

11. The master's recorded hours of work complied with the requirements of STCW 95 and ILO 180. However, it is unlikely that his work records accurately indicated his actual workload, which must have been substantially higher. [2.4]

12. Although the pilot’s hours of work are subject to the working time regulations, much is left to the pilot’s own view on whether he is fatigued and capable of safely carrying out the required work. [2.4]

13. The steering mode switch could not be lit, and could not be seen clearly during the hours of darkness on an unlit bridge. [2.5.1]

14. The steering mode switch labelling indicated both riverpilot and autopilot in the horizontal switch position when, in fact, it only connected to the autopilot. [2.5.1]

15. The only RAI that was visible from the central steering position was a panoramic one above the helmsman’s head. This was unsatisfactory because the helmsman could only see the RAI with difficulty, by tilting his head, whereas constant reference to an RAI is needed when steering in the non follow-up mode. [2.5.2]

SECTION 4 - ACTIONS TAKEN

The following actions have, or are in the process of being carried out:

The **Department for Transport** and the **Maritime and Coastguard Agency** are:

- Working to bring the issue of watchkeeper fatigue to the IMO as soon as possible.

The **Maritime and Coastguard Agency** has:

- Updated its Operational Advice Note to its surveyors regarding extra attention to be paid to hours of work and watchkeeping arrangements during Port State Control inspections.

ABP Humber Estuary Services has:

- reminded its pilots of the requirement to carry, and lay out on the ship's chart table, charts of the Upper Humber, for effective monitoring of the ship's passage by ship's staff.

- issued further guidance to pilots on the use, by pilots, of a ship's propulsion and manoeuvring equipment.

SECTION 5 - RECOMMENDATIONS

The Port Marine Safety Code Steering Group is recommended to:

2005/219 Develop appropriate working hours regimes for UK pilots, taking account of current regulations and advice on working hours;

2005/220 Provide guidance on Bridge Resource Management, with particular reference to pilot/master relationship, handovers and pilot at the helm.

Reederei Frank Dahl, as owner of the vessel, is recommended to:

2005/221 Provide guidance to the officers of its vessels on effective Bridge Team Management, including master/pilot relationship, to ensure that pilotages are carried out using all available resources.

2005/222 Review the bridge ergonomics for *Orade*, specifically:

- The clarity of the signage on the steering mode changeover switch, in particular the position indicating autopilot and riverpilot, and the assistance that switch lighting might provide to pilots who may be unfamiliar with the bridge controls during the hours of darkness;

- Consider the position of the rudder angle indicator in relation to the central seating position when the helmsman is using joystick (manual) tiller control;

2005/223 Ensure that all hours of work forms accurately record all work, including ancillary work such as engineering duties, harbour inspections and routine paperwork.

Marine Accident Investigation Branch
December 2005

Safety recommendations shall in no case create a presumption of blame or liability

ANNEX A

STCW 95 and ILO 180 Conventions

Relevant sections referring to fatigue

STCW 95

Section A-VIII/1(Mandatory)

1 All persons who are assigned duty as officer in charge of a watch or seafarer on watch shall be provided with a minimum of 10 hours' rest in any 24 hour-period.

2 The hours may be divided in to no more than two periods, one of which shall be at least six hours in length.

4 Notwithstanding the provisions of paragraphs 1 and 2, the minimum period of 10 hours may be reduced to not less than 6 consecutive hours provided that any such reduction shall not extend beyond two days and not less than 70 hours of rest are provided each seven-day period.

Section B-VIII/1 (Guidance)

3 In applying Regulation VIII/1, the following should be taken in to account:

1. provisions made to prevent fatigue should ensure that excessive or unreasonable overall working hours are not undertaken. In particular, the minimum rest periods specified in Section A-VIII/1 should not be interpreted as implying that all other hours may be devoted to watchkeeping or other duties;
2. that the frequency and length of leave periods, and the granting of compensatory leave, are material factors in preventing fatigue from building up over a period of time;
3. the provision may be varied for ships on short sea voyages, provided special safety arrangements are put in place.

International Labour Organisation 180

Article 5

1. The limits on hours of work or rest shall be as follows:

(a) maximum hours of work shall not exceed:
- (i) 14 hours in any 24-hour period: and
- (ii) 72 hours in any seven-day period, or

(b) minimum hours of rest shall not be less than:
- (i) 10 hours in any 24-hour period, and
- (ii) 77 hours in any seven-day period.

2. Hours of rest may be divided in to no more than two periods, one of which shall be at least six hours in length, and the interval between consecutive periods of rest shall not exceed 14 hours.

6. Nothing in paragraphs 1 and 2 shall prevent the Member from having national laws or regulations or a procedure for the competent authority to authorise or register collective agreements permitting exceptions to the limits set out. Such exceptions shall, as far as possible, follow the standards set out but may take account of more frequent or longer leave periods or the granting of compensatory leave for watchkeeping seafarers or seafarers working on board ships on short voyages.