ACCIDENT REPORT

Report on the investigation of the

collision, capsize and foundering of the tug

# ***Chiefton***

with the loss of one crewmember

at Greenwich Reach, River Thames

on 12 August 2011


MAIB
MARINE ACCIDENT INVESTIGATION BRANCH

VERY SERIOUS MARINE CASUALTY REPORT NO 12/2012 May 2012

**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 purposes is to attribute or apportion liability or blame.



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## GLOSSARY OF ABBREVIATIONS, ACRONYMS AND TERMS

| | | |
|---|---|---|
| AIS | - | Automatic Identification System |
| BTA | - | British Tugowners Association |
| B.V. | - | Besloten Vennootschap |
| CG | - | Her Majesty's Coastguard |
| CoC | - | Certificate of Competency |
| COG | - | course over the ground |
| COSWP | - | Code of Safe Working Practices for Merchant Seamen |
| DfT | - | Department for Transport |
| DHM(U) | - | Deputy Harbourmaster (Upper) |
| GPS | - | Global Positioning System |
| kW | - | kilowatt |
| m | - | metre |
| "Mayday" | - | The international distress signal (spoken) |
| MCA | - | Maritime and Coastguard Agency |
| MGN | - | Marine Guidance Note |
| mm | - | millimetre |
| MOD | - | Ministry of Defence |
| MRSC | - | Maritime Rescue Sub-Centre |
| MSN | - | Merchant Shipping Notice |
| NI | - | The Nautical Institute |
| NWA | - | National Workboat Association |
| P&I | - | Protection and Indemnity |
| PLA | - | Port of London Authority |
| plc | - | Public limited company |
| PMSC | - | Port Marine Safety Code |
| RNLI | - | Royal National Lifeboat Institution |
| rpm | - | revolutions per minute |
| SAR | - | Search and rescue |
| SCV Code | - | The Small Commercial Vessel and Pilot Boat Code |

SOG - speed over ground

T - True

t - tonne(s)

TBNC - Thames Barrier Navigation Centre

UTC - Universal Time, Co-ordinated

VHF - very high frequency

VTS - Vessel Traffic Services

**LIST OF DEFINITIONS**

Besloten Vennootschap – Dutch legal term associated with company liability and the equivalent to the English “Ltd”.

Conventional tug – a tug with its propulsion aft and towing point near to midships.

Girting – risk of capsizing, especially with conventional tugs, due to high athwartships tow line forces. Also known as girding, girthing or tripping.

Parbuckle – A device, usually of ropes or fabric, that is made fast at one end. The opposite end is passed under the object to be moved and then passed back for the purposes of hauling or lowering.

Spud leg – a tubular construction that can be lowered, usually through the hull of a barge or other floating structure, and driven into the river or seabed to anchor it into position.

**Times:** All times used in this report are UTC+1 unless otherwise stated.

Image courtesy of Palmer Marine Services Ltd


Chiefton

## SYNOPSIS

At 1052 on 12 August 2011, the tug *Chiefton* capsized and foundered following a collision with a crane barge she was towing on the River Thames, resulting in the loss of one crewman.

The 60m-long *Skyline Barge 19* had been used for installation work at St George Wharf and was to be towed to Gravesend. At about 0900, the tug *Steven B* was secured to the barge's stern in a "push" mode and *Chiefton* was connected forward in a "pull" mode. Two pilots and the barge owner's representative were positioned forward on the barge. After the tow had successfully completed the slow-speed downriver bridge transit, *Chiefton*'s and *Steven B*'s engine powers were increased to 95% and 70-75% respectively.

As the tow approached Greenwich Ship Tier, it was set to the south under the influence of the flood tidal stream. Manoeuvring action was taken to prevent the barge hitting one of the buoys, but this was unsuccessful. The barge then collided with *Chiefton*, causing the tug to capsize and founder. *Chiefton*'s skipper and mate were subsequently rescued from the river but the engineer/deckhand, who was a non-swimmer and was not wearing a lifejacket, was lost. His body was found and recovered 3 days later.

Action to avoid the buoy was inappropriate and taken too late. *Chiefton*'s lack of reserve power and short tow ropes then made collision with the barge inevitable.

The following factors contributed to the accident:

- The pilot and *Chiefton*'s skipper lost situational awareness.
- The Port of London's (PLA) tow-specific risk assessment and passage plan focused on the bridge transit and did not cover the subsequent downriver tow.
- All of those involved had very limited experience with the specific tug configuration used.
- No one had been nominated to be in overall charge of the towing operation.

The PLA is developing its towage planning requirements, risk assessment process and pilot training procedures for craft towage.

Recommendations have been made to the:

- Owner of *Chiefton* to comply with the PLA's Code of Practice for Craft Towage Operations on the Thames 2011 with respect to risk assessments, watertight integrity, towing hook maintenance and the use of lifejackets.
- Maritime and Coastguard Agency (MCA) to review its towing hook survey requirements and provide additional guidance on combined push/pull towage operations.

# SECTION 1 - FACTUAL INFORMATION

## 1.1 PARTICULARS OF *CHIEFTON*, *SKYLINE BARGE 19* AND *STEVEN B* AND ACCIDENT

### SHIP PARTICULARS

| | | | |
|---|---|---|---|
| Vessel's Name | *Chiefton* | *Skyline Barge 19* | *Steven B* |
| Flag | United Kingdom | The Netherlands | United Kingdom |
| Certifying Authority/ Classification Society | Mecal Ltd | Lloyd's Register | Port of London Authority |
| Official/IMO number | Official No - 911449 | IMO No - 9600695 | Official No - 905789 |
| Type | Tug | Crane barge | Tug |
| Registered owner | Palmer Marine Services Limited | Ravestein B.V. | Bennett's Barges |
| Manager | Palmer Marine Services Limited | Ravestein B.V. | Bennett's Barges |
| Built | 1963 - Thorne, Yorkshire | 2010 - Deest, The Netherlands | 1971 - Moinkendam, The Netherlands |
| Construction | Steel | Steel | Steel |
| Length overall | 18.77m | 60m | 23.37m |
| Breadth | 5.13m | 22m | 5.5m |
| Displacement | 91.5t | 2500t | 54.12t |
| Authorised cargo | Not applicable | Not applicable | Not applicable |

## VOYAGE PARTICULARS

| | *Chiefton* | *Skyline Barge 19* | *Steven B* |
|---|---|---|---|
| Port of departure | London, St George Wharf | London, St George Wharf | London, St George Wharf |
| Port of arrival | Intended at Gravesend | Deest, The Netherlands | Intended at Gravesend |
| Type of voyage | Internal waters | Short international waters | Internal waters |
| Cargo information | Not applicable | Not applicable | Not applicable |
| Pilot embarked | No | 2 | No |

## MARINE CASUALTY INFORMATION

| | | | |
|---|---|---|---|
| Date and time | 1052 on 12 August 2011 | | |
| Type of marine casualty or incident | Very Serious Marine Casualty | | |
| Location of incident | 51º 29.085'N 00 00º.85'W at Greenwich Reach, River Thames, London | | |
| Place on board | Contact made by barge on port side causing capsize | Contact made by tug on forward section of barge | Not applicable - connected to the stern of the barge |
| Injuries/fatalities | 1 fatality | 0 | 0 |
| Damage/ environmental impact | Constructive total loss, no environmental impact | No material damage or environmental impact | No material damage or environmental impact |
| Ship operation | Towing | Under tow | Pushing |
| Voyage segment | Transit | Transit | Transit |
| External environment | Sheltered waters, westerly F3, dry, good visibility | | |
| Persons on board | 3 | 5 | 4 |

## 1.2 BACKGROUND

### 1.2.1 Development at St George Wharf

The specialist marine construction engineering company Red7Marine was contracted to develop an outline pier design to service a new residential complex at St George Wharf near Vauxhall Bridge on the River Thames.

The shipyard and construction company Ravestein B.V., based at Deest in The Netherlands, was sub-contracted to fabricate and install the pier's linkspan. It was also contracted to transport the linkspan on its towed crane barge *Skyline Barge 19* from Deest to St George Wharf. The company provisionally planned the upriver tow for 3 August 2011 during spring tides.

Ravestein B.V. employed an experienced director of a number of River Thames pleasure and commercial boat companies as its consultant and to act as its local representative (from hereon referred to as the "owner's representative"). His primary role was to provide an owner's presence and to liaise with the stakeholders to help ensure safe transit through the bridges on the river (referred to hereafter as 'bridge transits') and the timely arrival of the crane barge at St George Wharf.

### 1.2.2 Planning meeting

On 20 July 2011, a towage planning meeting was held under the chairmanship of the Port of London Authority's (PLA) Deputy Harbourmaster (Upper) (DHM(U)). Attendees included PLA pilots and representatives of Red7Marine and Ravestein B.V.

Pending confirmation that their total bollard tow was sufficient for the tow, it was agreed that the tug *Chiefton* would assume a "pull" mode and the tug *Steven B* would act as a "pushing" and "braking" tug. It was also agreed that manoeuvring trials would be carried out soon after the tow started and that an escort vessel would be required for both the upriver and downriver tows. It was determined that *Skyline Barge 19*'s draught would be at 2.4-2.5m, the same as *Steven B*'s, and that the barge's passage upriver and downriver would take place on an ebb and flood tide respectively.

It was decided that two qualified PLA bridge pilots were needed for the bridge transits to and from the installation site. Because of the uniqueness of the tow, and the training opportunity it provided, it was planned to have on board *Skyline Barge 19* a total of up to four bridge pilots. For the purpose of this report, the pilots are identified as "pilots 1, 2, 3 and 4".

The need to nominate a towmaster or other person to be formally in charge of the tow was not covered during the meeting.

Concerned that the barge might not clear the bridges, the DHM(U) requested additional cross-sectional details of the crane barge, complete with the embarked pier linkspan, to confirm the air draught and side clearances during the bridge transits. To give time for the provision of this information and to allay concerns about conducting the operation during spring tides, the tow was planned for 9 August 2011, which was coincident with neap tides. During the intervening period, DHM(U) developed a tow-specific risk assessment.

On 29 July, PLA staff calculated the total bollard pull required for the tow and confirmed that the nominated tugs had the combined power necessary for the task.

## 1.3 NARRATIVE

### 1.3.1 Tow from Broadness Buoy to George's Stairs Tier

At about 1130 on 1 August 2011, *Skyline Barge 19* arrived off Gravesend with the pier linkspan secured to its deck **(Figure 1)**. After releasing the deep sea tug *Vengeance,* the barge was manoeuvred by the tugs *Chiefton* and *Svitzer Brenda* and secured to Red7Marine's Broadness Buoy[1]. The barge remained at the buoy while Ravestein B.V. collated the barge cross-sectional information required by DHM(U).


**Figure 1:** *Skyline Barge 19* with the pier linkspan secured on deck

At 0600 on 8 August, the owner's representative, three bargemen and pilots 1 and 3 boarded the barge, which was at the previously agreed 2.4m draught. There was a brief discussion concerning the plan for the towing arrangement, manoeuvring trials and the upriver bridge transits which had been prepared by pilots 1 and 3 and verified by pilot 2. *Steven B* towed the barge away from the buoy and was then secured to push at the barge's stern using two steel wire ropes and two polypropylene ropes, which effectively made *Steven B* and the barge a composite unit.

*Chiefton,* which was manned by a skipper, a mate, and Darren Lacey, who was a deckhand/engineer, was secured to the forward end of the barge by two polypropylene ropes. The port rope's spliced eye was passed over the tug's towing hook and the rope's loose end was turned up on the barge's forward port side bitts. The starboard rope was configured differently in that the eye was passed over

[1] The buoy was under long-term rent from PLA.

the barge's forward starboard side bitts and the rope's loose end turned up on the tug's towing hook[2]. The owner's representative, noting the towing configuration, considered it safe for the first stages of the tow and confirmed to the pilots that he was content. A schematic of the River Thames, showing the key upriver transit points, is at **Figure 2**.

At 0630, the tow got underway on the flood tide, with Palmer Marine Services Limited's tug *Horton* acting as the contracted tow escort. Pilot 1 assumed conduct and maintained communications with both tugs using his hand-held very high frequency (VHF) radio, set on channel 8. Pilot 3 managed communications with PLA's Vessel Traffic Services (VTS) on VHF channel 14. An initial manoeuvring trial was carried out soon after the tow started, which was completed to the satisfaction of the pilots, tug skippers and owner's representative.

*Chiefton* and *Steven B* were operating at about 95% and 70-75% engine power respectively as the tow made its way through "D" span of the Thames Barrier. At about 1030, additional slow-speed manoeuvring trials were carried out in Limehouse Reach, on the now ebbing tide, again to the satisfaction of all involved. Details of both sets of trials are at Section 1.18.

At about 1100, *Skyline Barge 19* and *Chiefton* were secured to George's Stairs Tier to await the ebb tide on 9 August for the bridge transit. A "wash up" meeting was held at the owner's representative's offices. It was proposed that *Chiefton*'s tow configuration would be changed so that both rope eyes were passed over the towing hook and the loose ends turned up on the barge's bitts to facilitate their quick release in an emergency. It was also proposed that, because the tow's lateral stability was good, the planned draught for the bridge transit could be reduced from 2.4m to 2m. This would still provide sufficient air draught clearance for a safe transit and would allow for a greater flow of water under the barge where under keel and bridge side clearances were tight, and so maintain the tow's manoeuvrability.

### 1.3.2 George's Stairs Tier to St George Wharf

At 1150 on 9 August, pilots 1, 2 and 3, the owner's representative, the barge foreman and DHM(U) held a meeting on board *Skyline Barge 19* to discuss the bridge transit phase[3]. A barge draught of 2m was agreed as was the proposed change to *Chiefton*'s towing arrangement. It was also agreed that the Westminster Bridge transit posed the highest risk because of the minimal side and air draught clearances. Consequently, it was decided that pilot 2, who was the most experienced, would take conduct for the transit.

At 1243, the tow got underway on the ebb tide with the tug *Horton* and Red7Marine's workboat *Assassin* in attendance.

The tow handled well, and an average speed over the ground (SOG) during the bridge transit of 1.5 knots was achieved. *Steven B* was released after clearing Vauxhall Bridge and, at 1620, *Chiefton* assisted mooring *Skyline Barge 19* to piles at St George Wharf. The barge's spud legs were then lowered to firmly position it in preparation for the pier linkspan installation work.

[2] This would have made it extremely difficult to release it from the barge in an emergency, especially when there was weight on the rope.

[3] Other PLA staff were also on board as observers.

Reproduced from The Port of London Authority's '*Recreational Users Guide*'

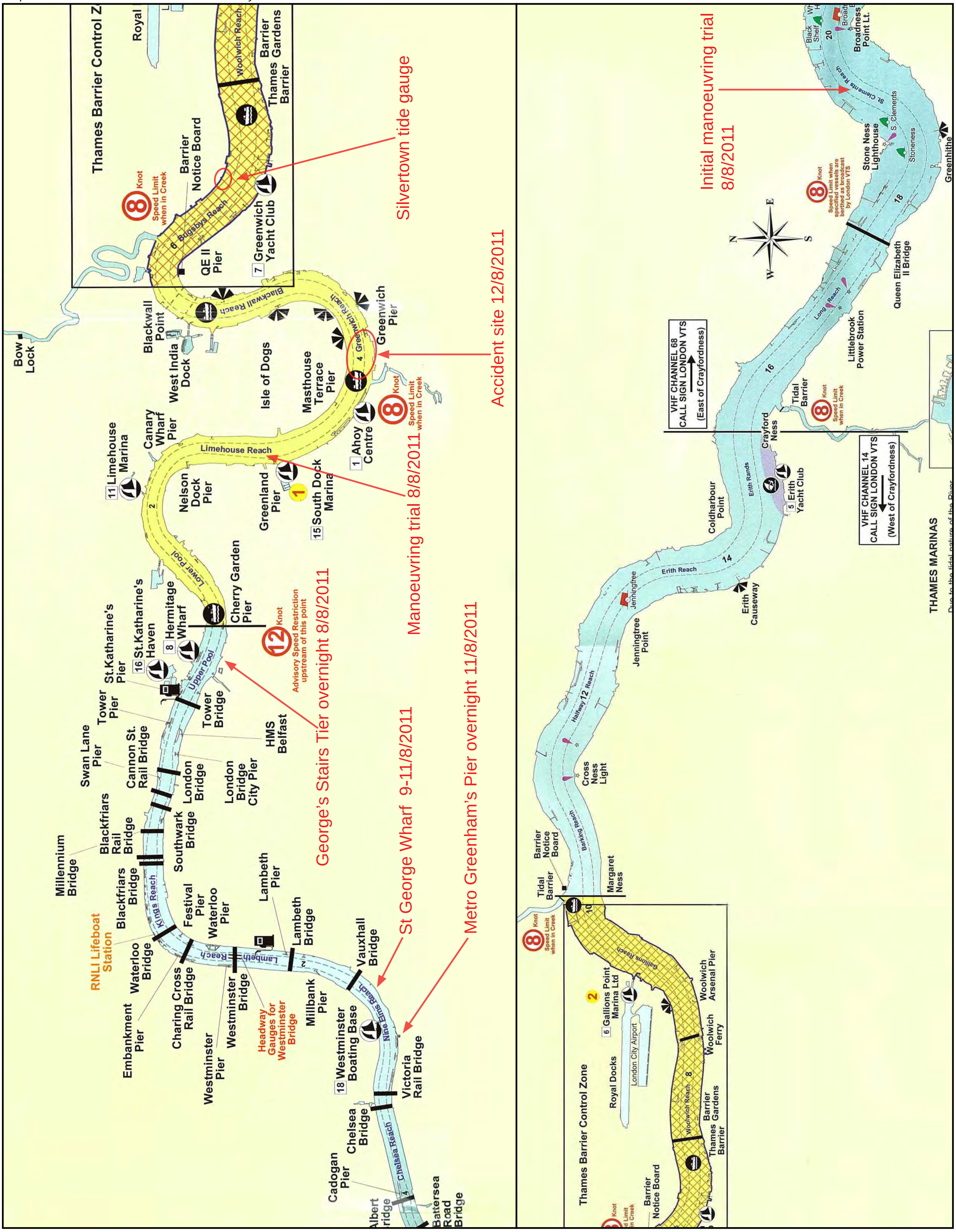


**Figure 2:** Schematic of the River Thames showing the key upriver transit points

With the exception of waiting 30 minutes for sufficient air draught clearance to transit Westminster Bridge, the barge's passage to St George Wharf went without mishap.

### 1.3.3 Pier linkspan installation

The pier linkspan installation took place during 10-11 August **(Figure 3)**. *Chiefton* remained alongside *Skyline Barge 19* throughout. During the late afternoon on 11 August, *Chiefton* moved the barge to Metro Greenham Wharf in Nine Elms Reach in readiness for the downriver tow the following day.

**Figure 3:** Installation of the pier linkspan at St George Wharf

### 1.3.4 Downriver tow

At 0810 on 12 August, pilots 1, 3 and 4 (a trainee bridge pilot) met with the owner's representative and the skippers of *Chiefton* and *Steven B* to discuss the written passage plan, which comprised the intended bridge arrival timings. It was agreed that pilot 4, DHM(U) and other PLA staff, who were observers for the bridge transit, would leave the tow via a PLA launch at Tower Bridge.

It was also decided to use the same tow configuration **(Figure 4)** and communication arrangements as for the upriver bridge transit, but with *Skyline Barge 19* at a reduced draught of 1.8m so that the tow could depart at low water and proceed against the tide throughout. At the owner's representative's suggestion, it was agreed that once past Tower Bridge, *Chiefton* would be slipped and the barge crew could de-ballast the barge in readiness for her intended sea passage later that day.

At 0855, *Chiefton* and *Horton* moved the barge from her moorings into mid-river. *Steven B* was then secured aft and *Horton* was slipped. *Assassin* was nearby and ready to undertake her escort duties. The owner's representative checked the towing arrangement and informed the pilots that he was satisfied with it. Pilot 1 and


**Figure 4:** Tow configuration

the owner's representative positioned themselves on the crane's sheave platform which provided maximum visibility ahead. At the same time, pilots 3 and 4 and DHM(U) positioned themselves forward on the crane's counterweight **(Figure 5)**. Pilots 1 and 3 were not wearing lifejackets. At 0913, with pilot 1 having conduct, the tow passed under Vauxhall Bridge on the flood tide.

The tow handled well and averaged 1.5 knots SOG. Chiefton's skipper intermittently adjusted the tug's helm to maintain a mid-river line. Pilot 1 gave regular helm orders of up to 10º to *Steven B*'s skipper but had no reason to give any to *Chiefton*'s skipper as he was content with the heading adjustments made by the forward tug. At 0954, the tow passed under Southwark Bridge, some 10 minutes ahead of schedule.

At 1008, the tow passed under Tower Bridge. *Horton*'s escort duties were now completed and she departed to undertake another contract at Thames Wharves. The speed of the tow was reduced while DHM(U), pilot 4 and the observers were transferred to one of PLA's launches.

Soon afterwards, pilot 1 handed over conduct to pilot 3, who then positioned himself on the crane's sheave platform. The tow was now making about 4 knots SOG with *Chiefton* and *Steven B* at 95% and 70-75% engine power respectively. As previously agreed, the two bargemen started to de-ballast the barge in readiness for its sea passage but, contrary to the earlier decision, it was decided to retain *Chiefton* as a pulling tug to provide a contingency against *Steven B* suffering a machinery failure while passing through the Thames Barrier. In addition, *Chiefton*'s skipper intended to return to Denton Wharf, which was in the vicinity of the position where the tow would be transferred to a deep-sea tug for the barge's subsequent sea passage.

During this part of the passage downriver, *Chiefton*'s mate and deckhand/engineer spent time in the wheelhouse with the skipper and also regularly went on deck to monitor the tow ropes. Pilot 3 and the owner's representative also regularly checked with both tug skippers to confirm they were content with the tow; neither raised any concerns. At about 1025, while opposite Cherry Garden Pier, the skipper of *Steven B* telephoned *Chiefton*'s skipper*.* The mate took the call and confirmed with the skipper that he had no concerns with the progress of the tow. At about 1040, the owner's representative and pilot 1 were on the crane counterweight, having refreshments. Neither of them was facing forward, consequently they were not in a position to readily see the river ahead of the barge.

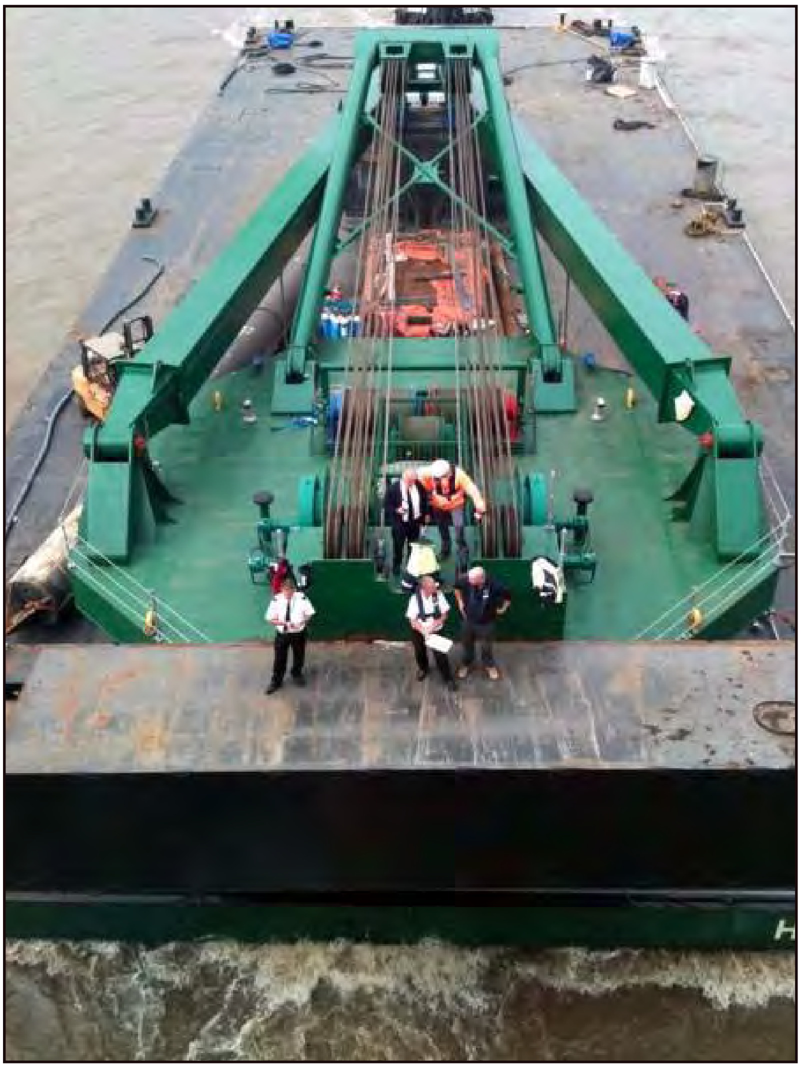

Image courtesy of Luke Dillon

**Figure 5:** Positions of the DHM(U), pilots and owner's representative on the crane counterweight and sheave platform

The barge's mean draught was by now about 1.2m. The tow was handling well and making 4.7 knots SOG (about 7.7 knots speed through the water) as it entered Greenwich Reach. Pilot 1, who was maintaining a listening watch on VHF channel 14, noted that the passenger ferry *Typhoon Clipper* was making her approach to Greenwich Pier. There was no other river traffic in the immediate vicinity.

### 1.3.5 Collision and capsize

As the tow approached Greenwich Ship Tier, the buoys were clearly visible **(Figure 6)** and, at about 1050, *Chiefton*'s skipper estimated that his tug was positioned mid-river and the western group of buoys were passing about 40m to starboard.

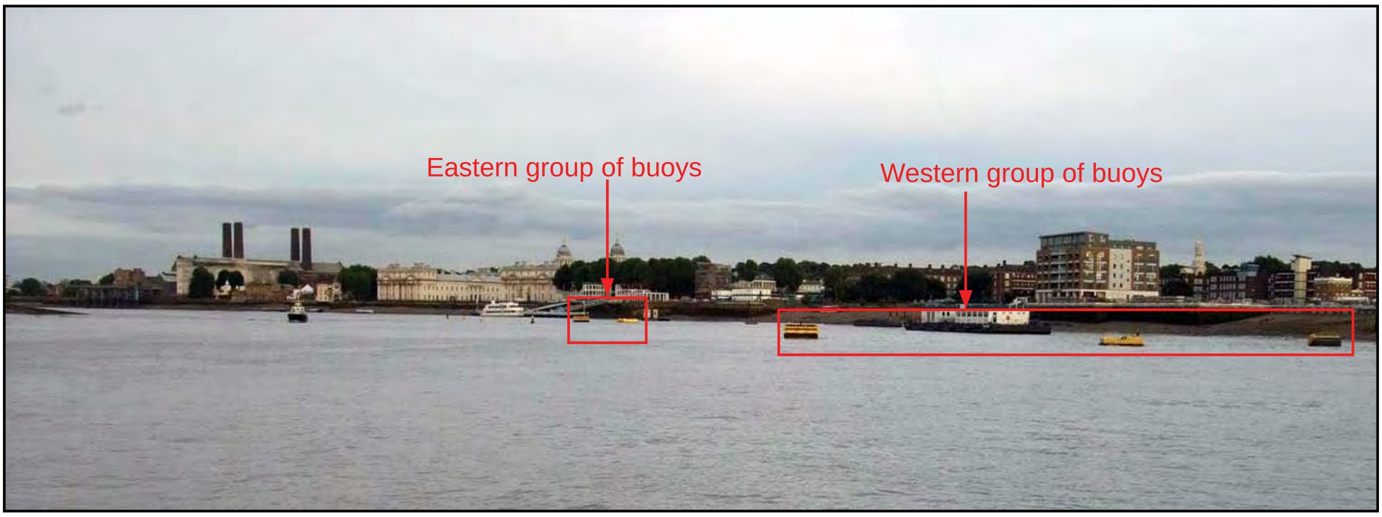


**Figure 6:** Approach to Greenwich Ship Tier viewed from the north-west

The skipper, mate and deckhand/engineer were in the wheelhouse as *Chiefton* began being set to the south, towards the northernmost buoy of the eastern group of buoys **(Figure 7)**. *Chiefton*'s skipper assessed that the barge was unlikely to clear the buoy and, at an estimated distance of 70m from the buoy, he applied port helm to try to pull the barge away from it. As all the weight was now being taken on the starboard tow rope, the mate went on deck and pulled the now slack port tow rope inboard. At the same time, pilot 1 assessed that the tow was out of position, and shouted to pilot 3 that he was setting too far to the south.


**Figure 7:** Greenwich Ship Tier - northernmost buoy of the eastern group of buoys viewed from the north side of the river looking south

Pilot 3 also noticed the tow was getting close to the buoy. He jumped down onto the crane's counterweight for a better view of the buoy and instructed *Chiefton*'s skipper to pull to port. Immediately afterwards, he ordered *Steven B*'s skipper to apply 10º of starboard helm, in an attempt to "lift" the barge bodily to port to clear the buoy. *Chiefton*'s skipper shouted to pilot 3, over the VHF radio, that the barge was going to hit the buoy. He anticipated that the barge would continue to turn to starboard under the influence of *Steven B'*s starboard helm and applied full starboard helm in an attempt to realign *Chiefton* with the barge. The barge made contact with the buoy as it turned to starboard and then overran it, causing the buoy to submerge.

Pilot 3 then went to the forward end of the barge's deck. He met with the owner's representative and pilot 1 who had run forward with the two bargemen in case they needed to let go the forward tow ropes. They saw *Chiefton* on her starboard beam alongside the forward end of the barge. The tug remained briefly on the surface before capsizing and, at 1052, foundering with her tow ropes still attached. A schematic of the collision and capsize sequence is at **Figure 8**.

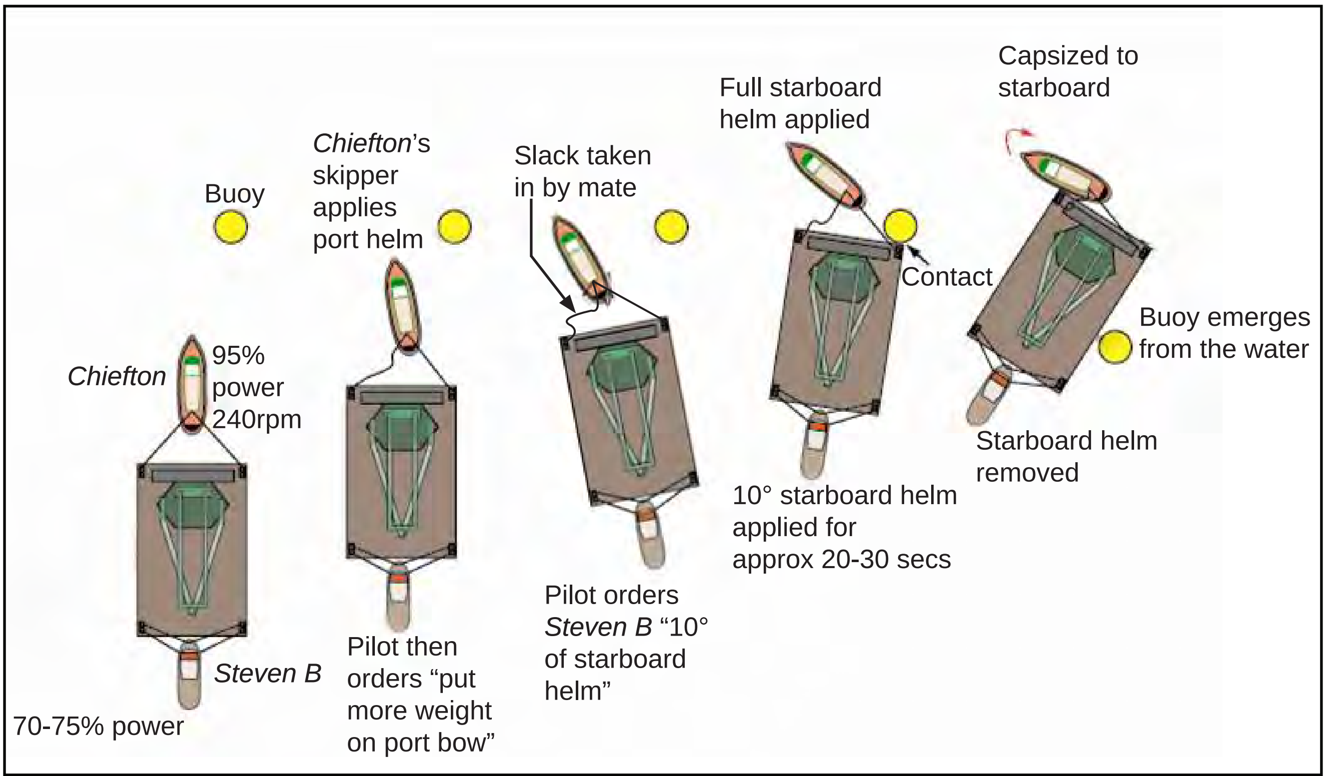


**Figure 8:** Schematic of the collision and capsize sequence of events

*Steven B*'s skipper removed the starboard helm after about 20-30 seconds when he glimpsed *Chiefton*'s wheelhouse rolling to starboard. Realising that the barge was forcing *Chiefton* under the water, he applied full astern propulsion as two of *Steven B*'s crew transferred onto the barge to offer assistance. The skipper of *Steven B* then saw the submerged buoy leap out of the water to starboard, exposing its mooring chains.

As *Chiefton* rolled to starboard, the mate was thrown into the water. The skipper told the deckhand/engineer to get out of the wheelhouse. As the tug started to submerge, the skipper, who was initially trapped in the wheelhouse, managed to swim out of the one open wheelhouse window. The skipper and mate then swam towards the barge. The mate managed to hold onto the port tow rope as the skipper grasped a line passed to him from the barge **(Figure 9)**.

The mate shouted to those on the barge that the engineer/deckhand was a non-swimmer. The engineer/deckhand, who was not wearing a lifejacket, briefly surfaced and then submerged before anyone could throw him a line or a lifebuoy.

Image courtesy of Christopher Chapman

**Figure 9:** *Chiefton*'s skipper and mate holding onto lines immediately after the accident

### 1.3.6 Immediate post-accident actions

At 1053, HM Coastguard's Maritime Rescue Sub-Centre (MRSC) London received a "Mayday" initiated by pilot 1 on VHF channel 14 and by the master of *Typhoon Clipper.* Other emergency calls were received from the general public and a full search and rescue (SAR) operation was initiated. The skippers of *Horton* and *Assassin* immediately responded to the "Mayday". The Thames Barrier Navigation Centre (TBNC) closed the river to navigation, except to SAR vessels, between Pipers Wharf and Masthouse Terrace Pier.

On hearing the "Mayday", the coxswain of an inflatable boat from the nearby Ahoy sail and boating centre immediately made his way towards the barge. He recovered *Chiefton*'s skipper and mate who were still holding onto the ropes, and then completed several sweeps of the area in an unsuccessful attempt to find the deckhand/engineer  He transferred the skipper and mate onto *Steven B* before joining other search assets. These included a police helicopter, lifeboat and other small craft.

*Chiefton*'s skipper and mate, and pilot 3, were transferred ashore at Greenwich Pier. They were breath-tested by the Metropolitan Police, the results of which were negative. The skipper and mate were then transferred to hospital for health checks[4] and the pilot made his way to the PLA's offices at Gravesend.

### 1.3.7 PLA's actions

Following the accident, *Chiefton* was lying on the riverbed in the Authorised Channel with *Skyline Barge 19* effectively anchored above the tug by the still-attached tow ropes. It was not known whether *Chiefton*'s towing hook was in the 'released' position, in which case the tow ropes could at any time have released under the

[4] The skipper was retained in hospital but released late the following day.

effects of the tide and cause the barge to float free. In view of this uncertainty, PLA determined that it was safer to cut the ropes and secure them to the PLA's workboat *Driftwood*.

At 1250, the river was re-opened to navigation with PLA's launch *Kew* conducting local control in the vicinity of the wreck site.

At 1300, the PLA gave approval for the tow to continue under the conduct of pilot 1 with *Steven B* continuing in its "push" mode. At approximately 1545, the tow arrived off Denton Wharf, where the barge was moored to a buoy to await further investigation.

PLA's survey vessel *Galloper* completed a wreck survey at 1425 and recorded that *Chiefton* was lying on her starboard side, bows east, in approximately 8m of water **(Figure 10)**. The wreck site was marked with four cardinal buoys a short time later.

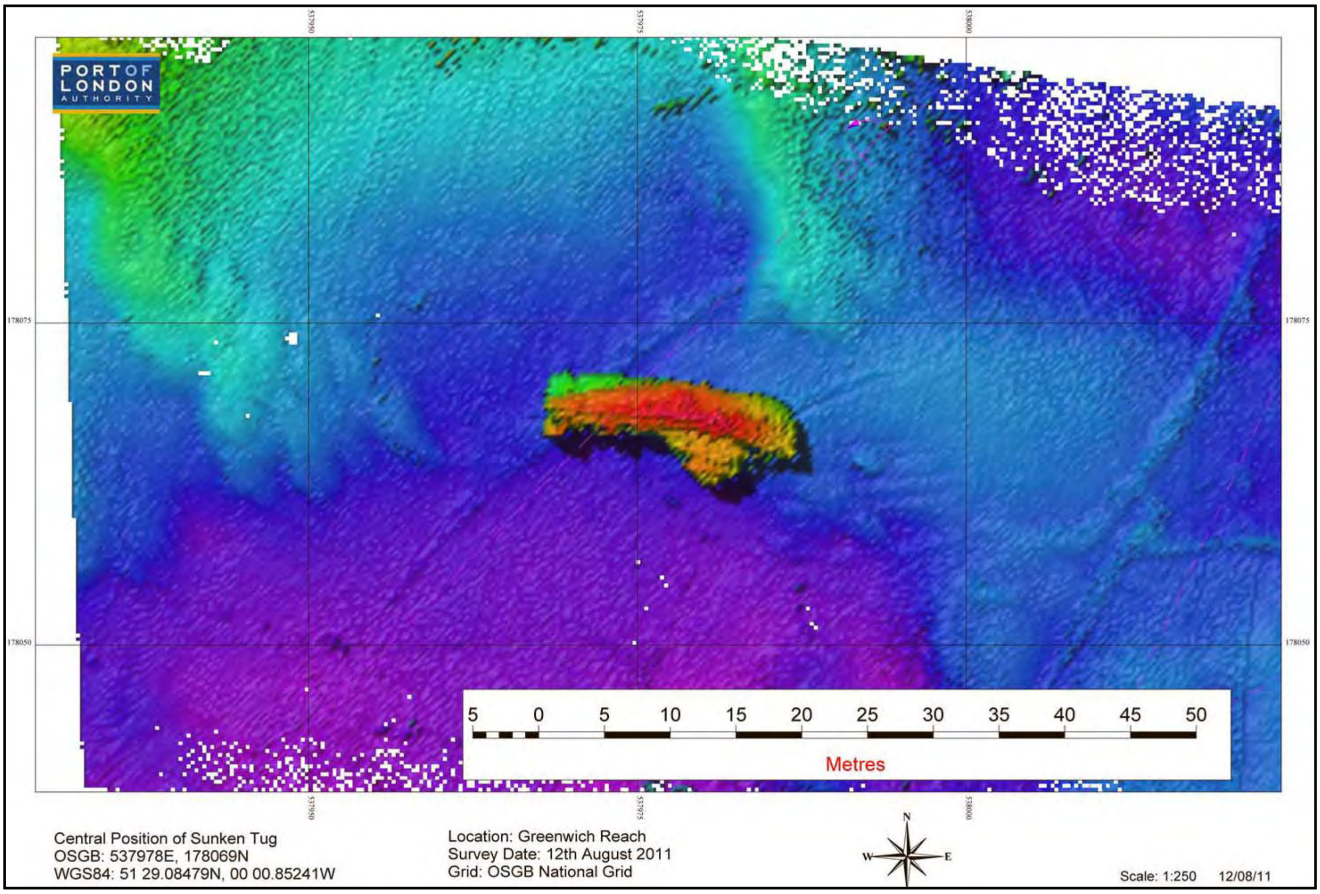


Image courtesy of The Port of London Authority

**Figure 10:** Image from the wreck survey conducted at 1425 on 12 August 2011

### 1.3.8 Missing persons search

The multi-asset search for the engineer/deckhand was called off at 1415, although shoreline searches continued for the next 24 hours. The engineer/deckhand's body was found on the shoreline close to Convoy's Wharf at 1700 on 15 August. The subsequent postmortem examination determined that he had drowned.

## 1.4 SALVAGE OPERATION

### 1.4.1 Programme

Chatham-based GPS Marine Contractors Ltd (hereon referred to as “GPS Marine”) was contracted by *Chiefton*’s Protection and Indemnity (P&I) insurers to conduct an underwater survey, recovery and transportation of *Chiefton* to Chatham.

During the evening of 15 August, an initial diver’s survey was carried out. Although the visibility was extremely poor, it was possible to confirm that *Chiefton* was lying on her starboard side; the rudder was hard over to starboard and many of her doors and hatches were in the open position. None of the wheelhouse controls, hatches or door positions was altered by the diving team.

On 16 August, GPS Marine’s 400 ton, heavy-lift barge *Apollo* was positioned adjacent to the wreck to begin the salvage. Late on 17 August, *Apollo* moved *Chiefton* towards the north shore of the River Thames while she was still submerged. During the morning of 18 August, *Chiefton* was moved further onto the drying north shore **(Figure 11)** in preparation for parbuckling her into an upright position and then hoisting her clear of the water.

**Figure 11:** *Chiefton* on the north shore of the River Thames

At 1600, *Chiefton* was recovered clear of the water and remained supported in *Apollo*’s crane slings **(Figure 12)**. Once the wreck was confirmed to be stable, and following a safety survey by a PLA surveyor, a more detailed survey was conducted.

**Figure 12:** *Chiefton* supported on slings from the salvage barge *Apollo*

Later on 18 August, *Chiefton* was moved to Galleon's Reach at Woolwich to await a barge and sea fastenings to be fitted in preparation for her to be towed, in the barge, to GPS Marine's base at Chatham. She arrived there on 22 August. On 26 September, the owner's P&I insurers determined that *Chiefton* was a constructive total loss and gave approval for GPS Marine to break her up.

## 1.5 POST-ACCIDENT SURVEY – 18 AUGUST 2011

### 1.5.1 Observations from the north shore of the River Thames

*Chiefton* was lying on her starboard side with her rudder set hard to starboard. There was a large area of detached marine growth under the starboard shoulder and at the turn of bilge below the trailing edge of the port bilge keel, which itself had suffered impact damage. Marine growth detachment on the port side of the hull extended for much of the length of the skeg. There was also evidence of heavy scouring to the port side of the hull, just aft of the wheelhouse, and damage to the port rubbing strake **(Figure 13)**.

The remains of both polypropylene tow ropes were recovered. Both ropes had a spliced eye at one end and had been cut at the other end. The remains of the 45mm diameter port rope and the 58mm diameter starboard rope were 22.4m and 24m long respectively.

### 1.5.2 Deck observations – position of openings

*Chiefton*'s mess room skylight and the accommodation port watertight door, which also provided access to the wheelhouse stairs, were in the closed position. The wheelhouse watertight door and the wheelhouse starboard forward window were open. The aftermost window was partially broken; all other windows were closed.

**Figure 13:** Hull damage and evidence of contact

Upper deck access hatches to the engine room and store room were open[5], as were the engine room port and starboard skylight hatches. The bolted cover plate for the shallow steering gear compartment was found lying on the steering gear compartment deck recess[6].

The door and hatch positions are shown on the general arrangement drawing at **Figure 14**.

### 1.5.3 Wheelhouse observations

*Chiefton*'s combined engine throttle and gearbox selector lever was set at about the 95% ahead position, and the rudder self-centring tiller lever was in its default central position. The pneumatic control valve for the towing hook remotely-operated release system, which was fitted to the after bulkhead of the wheelhouse, was found in its normal position, i.e. it had not been operated.

## 1.6 ENVIRONMENTAL CONDITIONS

When the manoeuvring trials were carried out in Limehouse Reach, at about 1030 on 8 August 2011, the tide was ebbing and it was approximately 1.5 hours after high water at London Bridge. The PLA's hydrographic tidal rate model for 0930 UTC is at **Figure 15**, and shows a tidal rate of about 1.1 knots.

[5] It is known that the store room hatch was in the closed position during the downriver tow, but indications suggest it was not fully clipped shut. The hatch was probably opened either during the capsize or during salvage.

[6] The cover had been removed some days earlier in preparation for inspection of the steering gear and compartment preservation coating.

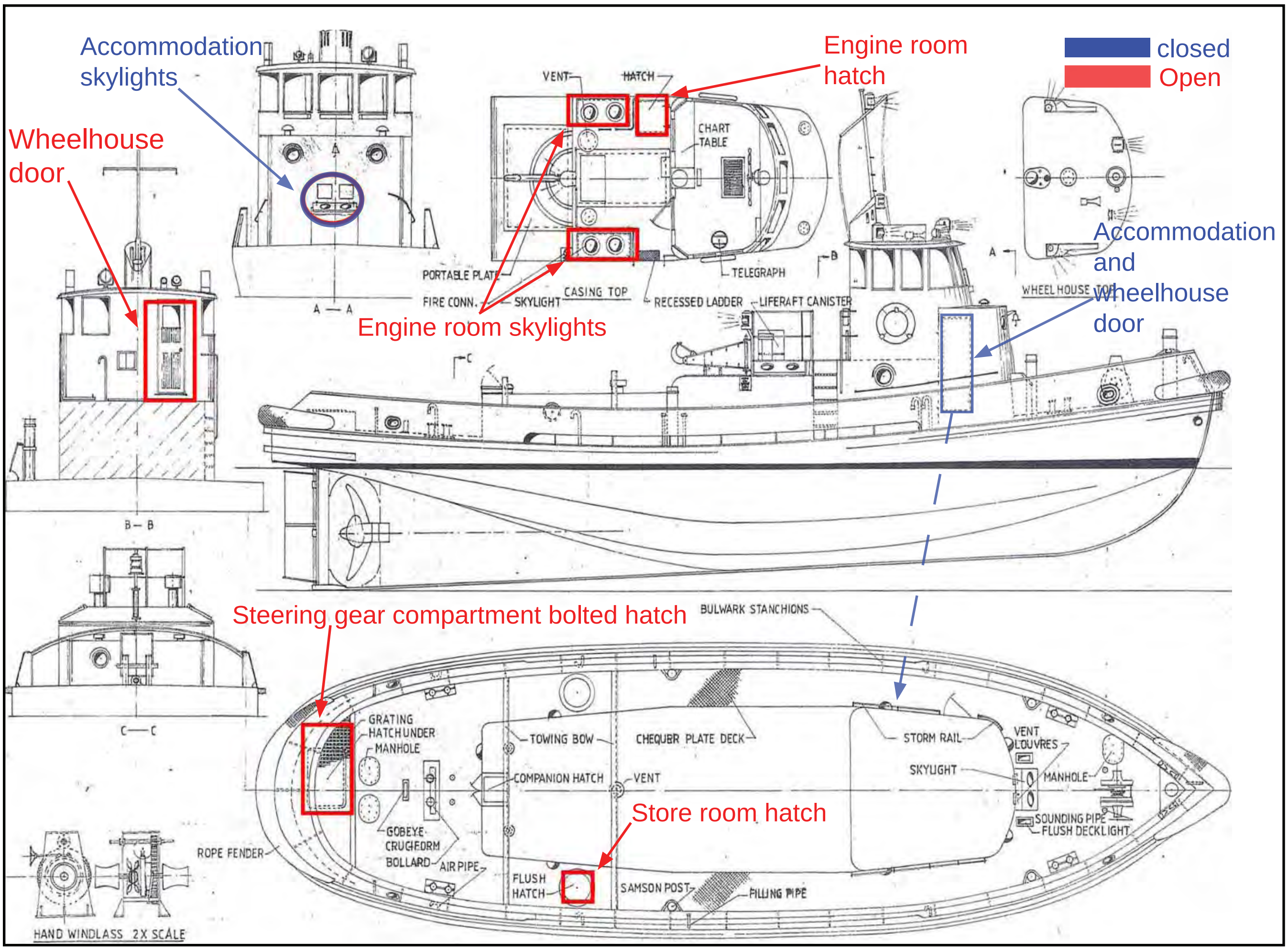


**Figure 14:** General arrangement showing door and hatch positions

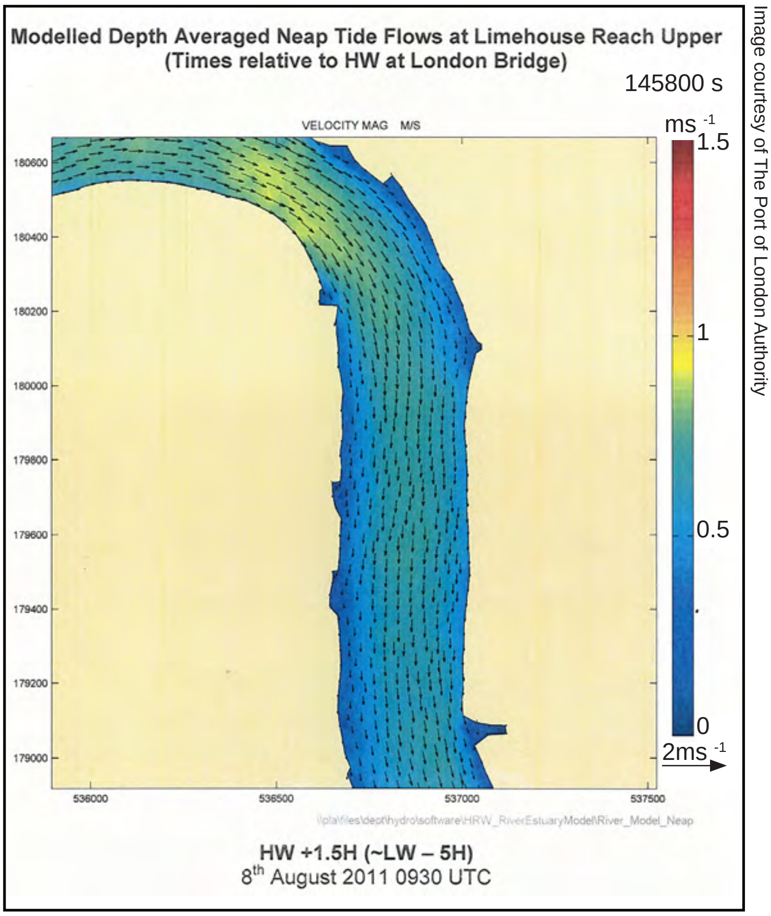


**Figure 15:** PLA's hydrographic tidal rate model for Limehouse Reach for 0930 UTC on 8 August 2011

At the time of the accident, the Thames Barrier meteorological facility recorded the wind as westerly (268º) at 8 knots (F3). It was dry and the visibility was good.

It was one day from a full spring tide. Low water at London Bridge was predicted to be at 0656 UTC with a height of tide of 1.1m; high water was predicted to be at 1257 UTC with a height of tide of 6.6m.

The Silvertown tide gauge recorded a height of tide of 5.67m at the time of the accident. The PLA's hydrographic tidal rate model for 3 hours before high water at London Bridge shows a tidal rate of between 2 and 3 knots at Greenwich Reach **(Figure 16)**.

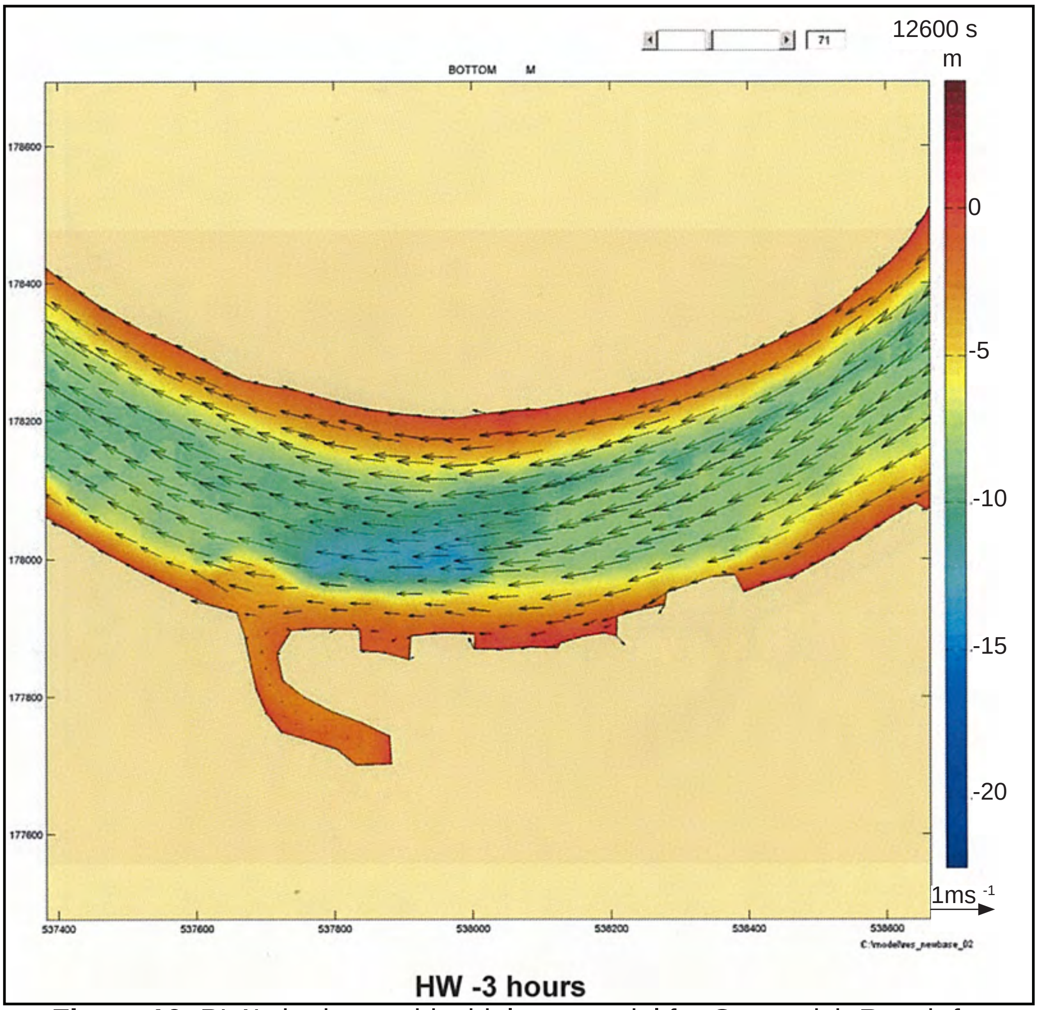


Image courtesy of The Port of London Authority

**Figure 16:** PLA's hydrographic tidal rate model for Greenwich Reach for 3 hours before high water at London Bridge on 12 August 2011

## 1.7 OPERATIONAL TOWAGE GUIDANCE

### 1.7.1 PLA guidance

The PLA has published the "Code of Practice for Ship Towage Operations on the Thames 2010" and the "Code of Practice for Craft Towage Operations on the Thames 2011" (from hereon referred to as the "PLA's Craft Towage Code"). Both publications provide extensive towage guidance for pilots, owners, operators and crew of tugs operating on the River Thames.

### 1.7.2 DfT and MCA guidance

The Port Marine Safety Code (PMSC) lays out operational safety standards which competent harbour authorities are required to comply with. The DfT's publication "A Guide to Good Practice on Port Marine Operations" is intended to supplement the PMSC. It contains useful general information and detailed guidance on a number of issues relevant to harbour operations. Section 9 – Ship Towage Operations – provides wide-ranging guidance on ship towage and also provides electronic links to MAIB accident reports.

Chapter 25 of the MCA's Code of Safe Working Practices for Merchant Seamen (COSWP)[7] provides practical advice on anchoring, mooring and towing operations.

The MCA, in conjunction with the British Tugowners Association (BTA) and the National Workboat Association (NWA) has drafted updated towage endorsement procedures for the crews of tugs and workboats. The draft Marine Guidance Note (MGN) includes detailed information on the "underpinning knowledge" requirement for the award of endorsements for:

- Towing and pushing
- Ship assist towage
- Sea towage

### 1.7.3 BTA guidance

In response to previous MAIB recommendations, the BTA has developed a "Best Practice Guidance – Pre-Towing Tasks Checklist[8]" **(Annex A)**. The checklist is in four parts:

- Prior to undertaking tow and during passage
- Fitness for purpose and verification of documentation prior to commencement of towage
- Verification of internal and external communications
- Review of emergency procedures

### 1.7.4 Nautical Institute guidance

The Nautical Institute's (NI) publication - "Tug Use In Port – A Practical Guide", Second Edition by Captain Henk Hensen, provides comprehensive guidance on all aspects of tug operation theory and practice. While the publication focuses on ship towage, many of the principles described are equally applicable to craft towage operations.

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[7] A copy of COSWP can be downloaded from the MCA's website at www.mcga@gov.uk

[8] The checklist is available on the BTA's website at www.britishtug.org

## 1.8 PLA LICENSING REQUIREMENTS, SURVEY AND OPERATIONAL COMPLIANCE AND SURVEY

### 1.8.1 PLA licensing requirements

In accordance with Section 124 of the Port of London Act 1968 and the Port of London Craft and Boat Registration and Regulation Byelaws 2000, commercially operated vessels on the tidal River Thames are (unless exempted under the provisions of Section 124 above) required to be licensed by the PLA.

It is a condition of licensing that such vessels are periodically surveyed by the PLA. In the case of tugs, the requirement was for an annual survey. *Chiefton* was not licensed by the PLA. She was exempt from the requirements of Section 124 because she was surveyed and certificated against the standards set out in the Maritime and Coastguard Agency's (MCA) Marine Guidance Note 280 (M) – Small Vessels in Commercial Use for Sport or Pleasure, Workboats and Pilot Boats – Alternative Construction Standards, which is known as the Small Commercial Vessel and Pilot Boat (SCV) Code.

### 1.8.2 Survey

*Chiefton*'s last annual survey was carried out on 22 October 2010 by the Certifying Authority, Mecal Ltd, on behalf of the MCA, against the requirements set out in the SCV Code. At the time, three defects were identified, none of which contributed to the accident.

The vessel was certified to operate in MCA's Category 3 Area (up to 20 miles from a safe haven). *Chiefton*'s Small Commercial Vessel certificate was due to expire on 20 October 2011.

### 1.8.3 Operational compliance

Operational compliance with the SCV Code comes into force when a vessel, subject to the Code, is operating at sea. As *Chiefton* was operating in categorised waters at the time of the accident, she was obligated to comply only with PLA's requirements. However, as *Chiefton* was surveyed against the SCV Code it was MCA's expectations that she would comply with its requirements although this was not mandatory.

## 1.9 GENERAL DESCRIPTIONS OF *STEVEN B* AND *SKYLINE BARGE 19*

### 1.9.1 *Steven B*

*Steven B* was a conventional tug built in The Netherlands in 1971. Following a post-accident refit in 1996, her length overall was extended from 21.4m to 25.4m **(Figure 17)**.

*Steven B* was equipped with two hydraulically-powered winches. They were fitted on the port and starboard sides and just aft of the wheelhouse to enable her to be firmly secured when engaged in a towage "push" mode.

A 927kW Caterpillar 3512 main engine drove a single, fixed pitch propeller capable of providing a bollard pull of 14.2t. A bow thruster was also driven from the main gearbox.

Image courtesy of Bennett's Barges

**Figure 17:** *Steven B*

*Steven B*'s skipper held a Boatmaster's Licence with the appropriate towage endorsements and had been engaged in towing on the River Thames since 1977. While he had wide experience in operating all types of tugs in various configurations, he had not in the past 25 years been engaged in the specific tow configuration in use at the time of the accident. This is dealt with in greater detail at Section 2.8.2.

### 1.9.2 *Skyline Barge 19*

Completed in September 2010, *Skyline Barge 19* was 60m length overall and 22m wide, with a maximum hull depth of 3.5m. The barge was designed as a submersible pontoon and was equipped with four spud legs.

The installed crane was fitted with a large water-filled counterweight, which although not fitted with guardrails, provided an ideal platform from which the pilots for the river passage could obtain a good all round view. The crane had a safe working load of 250t at a radius of 13.5m **(Figure 18)**. The barge displaced 2500t and was classified with Lloyd's Register.

## 1.10 *CHIEFTON* – GENERAL DESCRIPTION, OWNERSHIP, CREW, SURVEY AND CERTIFICATION AND STABILITY

### 1.10.1 General description

*Chiefton* was a conventional Girl Class tug and was built in 1963 for the Royal Maritime Auxiliary Service for use within Her Majesty's naval dockyards.


**Figure 18:** *Skyline Barge 19*

The single, 364kW, Lister Blackstone, ERS6MGR main engine drove a cropped 4-bladed, fixed pitch propeller through a reversing gearbox. The tug's bollard pull was rated at about 4.5t.

*Chiefton*'s communication and navigation equipment included a NAVMAN tracker 950 chart plotter and a Furuno Model 1623 radar. Two fixed and two portable VHF radios were also on board. *Chiefton* was also fitted with a Thames Automatic Identification System (AIS) in compliance with PLA River Byelaws.

### 1.10.2 Ownership – Palmer Marine Services Limited

Palmer Marine Services Limited, based in Gravesend, Kent, acquired *Chiefton* in August 2007 for general towage work. *Chiefton*'s skipper and his brother, who was also a tug skipper, were the company's directors. The company had five full-time employees; other self-employed crew were contracted as required.

In addition to *Chiefton,* the company owned two other small tugs, two workboats and three dumb barges.

### 1.10.3 Crew

*Chiefton*'s skipper had been a tug skipper on the River Thames for 35 years. The mate, who was the skipper's son, had 15 years' river experience. Both men were Watermen, and both held Boatmasters' Tier 1 Level 2[9] licences with several

[9] Qualified to operate on all UK inland waterways (Category A-D) and limited coastal tidal areas.

endorsements[10], including the relevant Towing and Pushing Specialist Endorsement. They also held current Sea Survival, Basic Fire Awareness and First Aid at Work certificates. Although the skipper and mate had experience of slow-speed push/pull techniques, these were without a stern tug connected to the barge and predominantly conducted upriver of Tower Bridge. They had never been engaged in a river tow employing the towage configuration in use at the time of the accident.

The 40-year old deckhand/engineer was well known to the skipper and mate. He had spent a short period with Palmer Marine Services Limited a number of years previously, before working in the building trade. He returned to Palmer Marine Services Limited as an employee in October 2008. He had attended a 1-day Sea Survival Refresher Course at the National Sea Training Centre at Gravesend on 20 March 2009. His attendance was reduced to ½ day because he chose not to participate in the "wet drill" practical part of the course, probably because he was a non-swimmer. No evidence has emerged that he attended any other sea/river or vessel-related safety or professional training courses.

### 1.10.4 Stability

In December 2006, Mecal Ltd carried out an inclining experiment on *Chiefton*. The results were used by MCG Technical Services Ltd of Plymouth in its preparation of the vessel's Stability Information Report dated 6 March 2007. The report determined that the vessel's stability characteristics met the criteria set out in the SCV Code.

## 1.11 LIFESAVING EQUIPMENT

### 1.11.1 Lifejackets

*Chiefton* carried six lifejackets. Three Cosalt Premier 150N solid lifejackets, as required by the SCV Code, were stowed in the accommodation. Additionally, the skipper and mate had their own high-visibility foul weather coats with an integral 300N lifejacket. At the time of the accident, the skipper's coat was in the wheelhouse and the mate's coat was in the accommodation.

It was reported that the deckhand/engineer had several of his own personal lifejackets on board. However, when *Chiefton* was inspected after recovery from the riverbed, only a Seago Yachting Ltd manual inflation 150N lifejacket, marketed as a Seago 150, was found. The lifejacket, which was found in the accommodation, had "Darren" written on one of the harness strap labels. The age of the lifejacket and the extent to which it had been maintained is unknown.

### 1.11.2 Liferaft and lifebuoys

An 8-man liferaft with a hydrostatic release system was secured in a cradle, on *Chiefton*'s starboard side, just aft of the wheelhouse. The liferaft released and self-inflated when *Chiefton* capsized and foundered, and was later recovered by the workboat *Assassin*.

There were three lifebuoys fitted, one at either side of the wheelhouse and one adjacent to the liferaft. None of the lifebuoys were onboard when the wreck was recovered.

[10] London Thames Waterman Local Knowledge, Passenger Operations Specialist, Cargo Specialist, Oil Cargo Specialist and Dredging Specialist endorsements.

## 1.12 WATERTIGHT INTEGRITY ARRANGEMENTS

*Chiefton* was fitted with clipped watertight/weathertight doors and hatches to the accommodation, wheelhouse, engine room, store and engine room skylights. A bolted plate was fitted on the main deck over the steering gear compartment. The arrangements are shown in the composite at **Figure 19**.

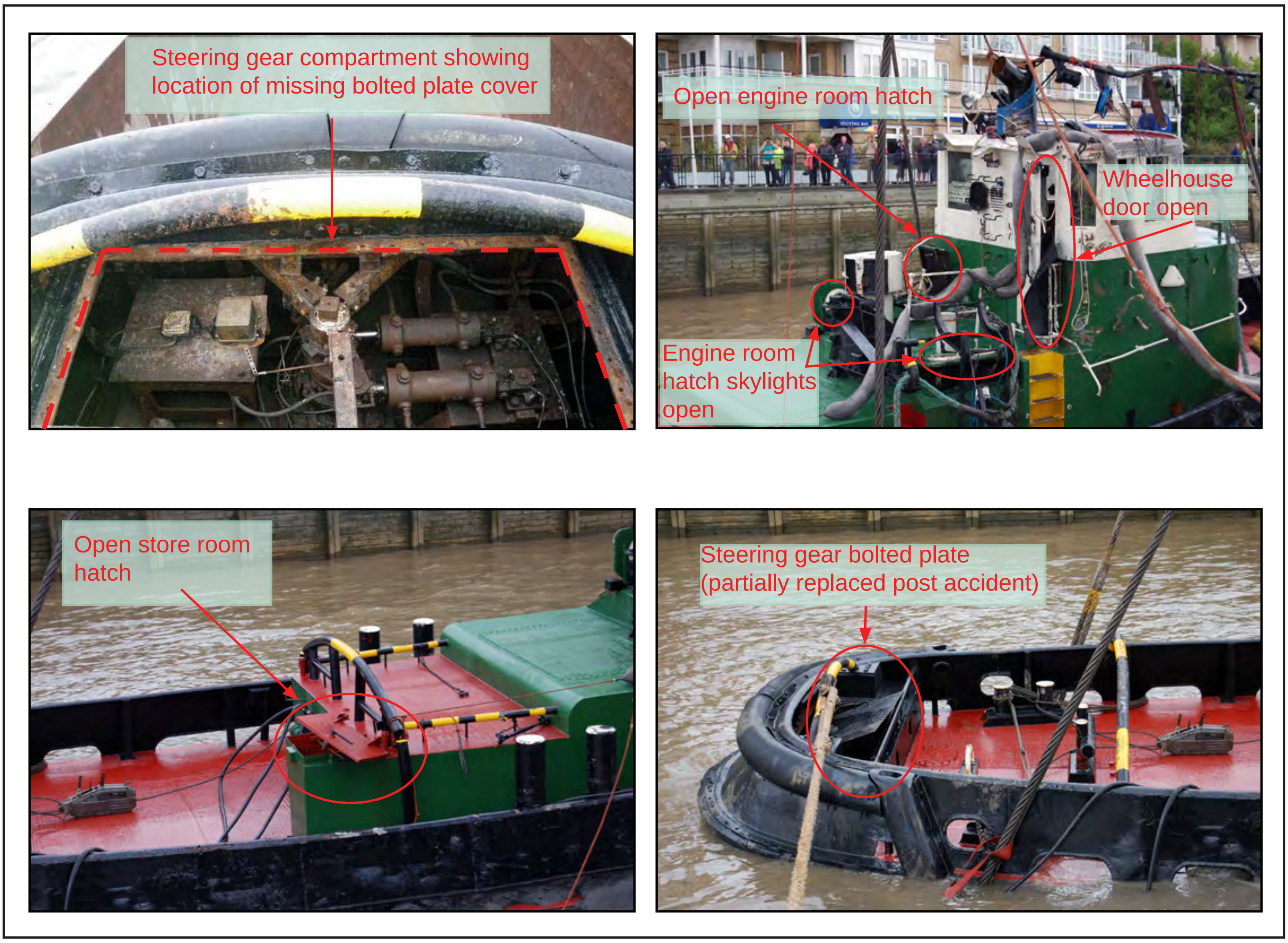


**Figure 19:** Composite showing watertight/weathertight closures

## 1.13 TOWING HOOK ARRANGEMENT

### 1.13.1 General description

The single, “Clyde” towing hook was fitted immediately aft of *Chiefton*’s wheelhouse. It was supported by a single vertical post which allowed for wide-ranging port and starboard transverse movement. The system was designed so that in an emergency the towing hook could be dropped remotely to release the tow rope(s). The emergency release system was pneumatically-operated by opening a control valve located at the after end of the wheelhouse on the starboard side. This allowed air into a piston that disengaged a locking pin on the hook cheek plate, permitting the spring-assisted release mechanism to drop the towing hook. The system could also be operated manually, at the hook itself, by pulling on the locking pin.

A spring-loaded lower preventer pin was located in the hook cheek plate. Once the hook had been released, the pin was designed to secure the mechanism in the tripped position to prevent unintentional re-securing of the hook.

The components of the towing hook are shown in **Figure 20**. The figure shows the locking arrangement in the released position although the towing hook has not dropped.

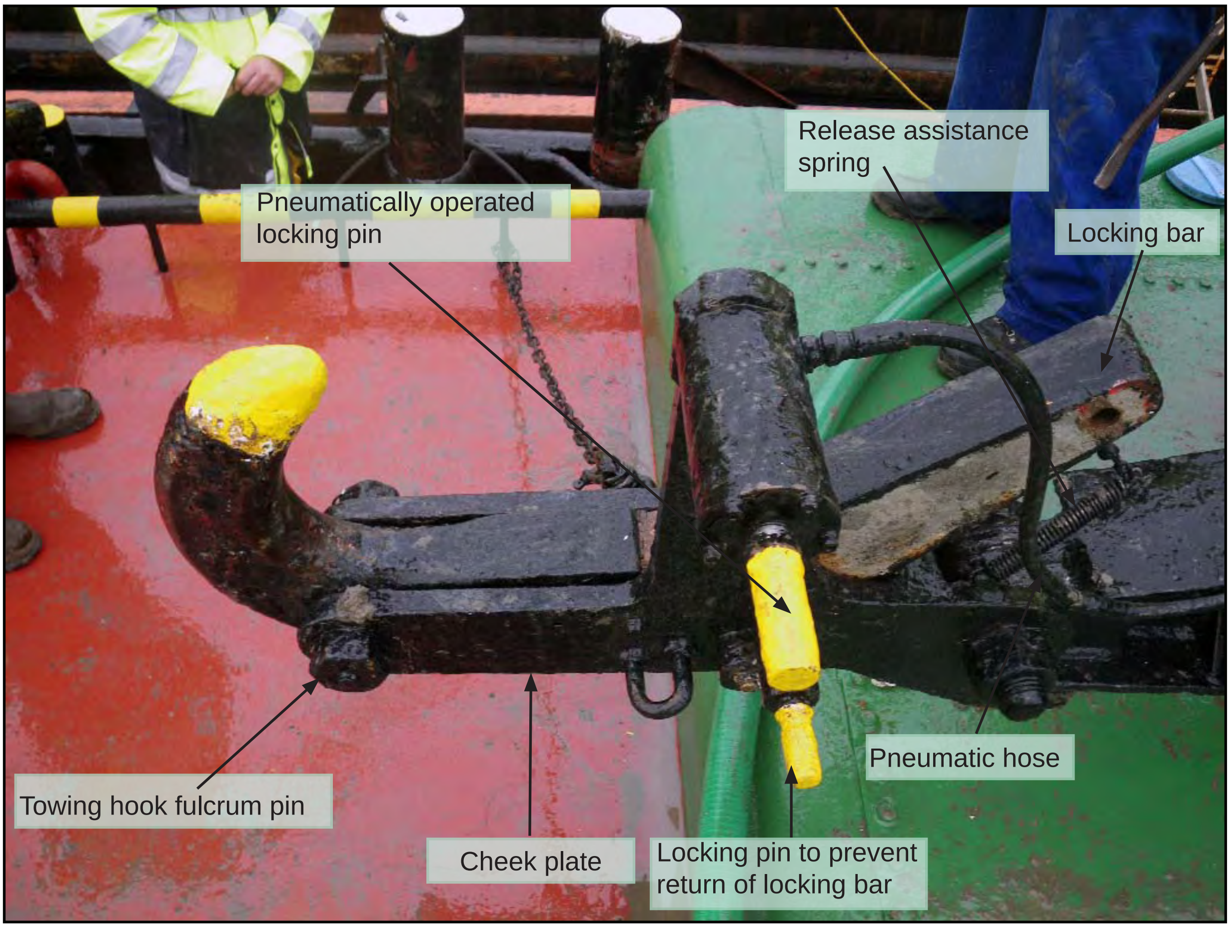


**Figure 20:** Towing hook components

### 1.13.2 Post-salvage survey

Immediately following *Chiefton*'s salvage, the towing hook arrangement was inspected. The hook system had its full range of transverse movement, and the greased towing hook emergency release pin was found to be engaged and in the normal towing position. The hook fulcrum point was heavily painted and debris was jammed between the hook itself and its supporting cheek plates.

The compressed air reservoirs in the engine room had sufficient air remaining to successfully operate the towing hook emergency release piston and to prove the disengagement of the emergency release pin and automatic engagement of the lower preventer pin. However, the hook itself did not drop. Despite the application of mechanical force using long levers, it was not possible to move the towing hook to its intended released position.

### 1.13.3 Inspection and maintenance

Section 4 of PLA's Craft Towage Code covers the "testing, inspection and maintenance of towing equipment" **(Annex B)**. *Chiefton* was subject to the guidance provided in the Code.

*Chiefton* was also subject to Section 25.2.2 of the SCV Code, which covers towing arrangements **(Annex C)**.

While *Chiefton*'s skipper and mate carried out intermittent functionality checks of the towing hook release system, there was no record of the arrangement having been subjected to regular periodic testing or planned maintenance, other than greasing, or evidence of a structured inspection and testing system having been in place.

## 1.14 TOW CONFIGURATION

A schematic of the tow configuration at the time of the accident is at **Figure 21**.

*Skyline Barge 19* was fitted with a traditional Panama fairlead and a bespoke fairlead on the port and starboard sides at the bow[11] and stern. A set of bitts was fitted adjacent to each of the bespoke fairleads.

*Chiefton* acted as the pulling tug and was connected to the barge using two dissimilar sized, 8-strand, polypropylene braided ropes; the port tow rope being of 45mm diameter and the starboard tow rope of 58mm diameter. Each rope was led from *Chiefton*'s towing hook, through the barge's forward bespoke fairleads, and secured on the adjacent bitts by 2-3 turns. The length of both tow ropes from the towing hook to the bitts was 22.5m. The overall length of both ropes, determined from photographic evidence and mathematical calculations, was approximately 28m. The distance from *Chiefton*'s stern to the bow of the barge was 8.4m, and the downward angle of the ropes at the towing hook was 5º. Two other ropes were carried on board *Chiefton,* which were stowed on the deck, but were not used during the towing operation.

*Steven B*'s bow was firmly secured to the stern of the barge by two 25mm steel wire ropes that passed through the barge's after bespoke fairleads and onto the adjacent bitts. The wires were tensioned using *Steven B*'s port and starboard hydraulic winches. Additionally, a 45mm polypropylene rope from each side of the tug was secured to the barge's bitts. In this configuration, the pilots considered the barge and *Steven B* to be a single composite unit, with propulsion, steering and "braking" capability.

## 1.15 METHOD STATEMENT

A method statement is a document that specifies how a task or process is to be undertaken. The statement usually includes an outline of the hazards and includes a step-by-step guide on how to do the task safely.

[11] In this case, the crane counter weight end of the barge is considered to be the bow.

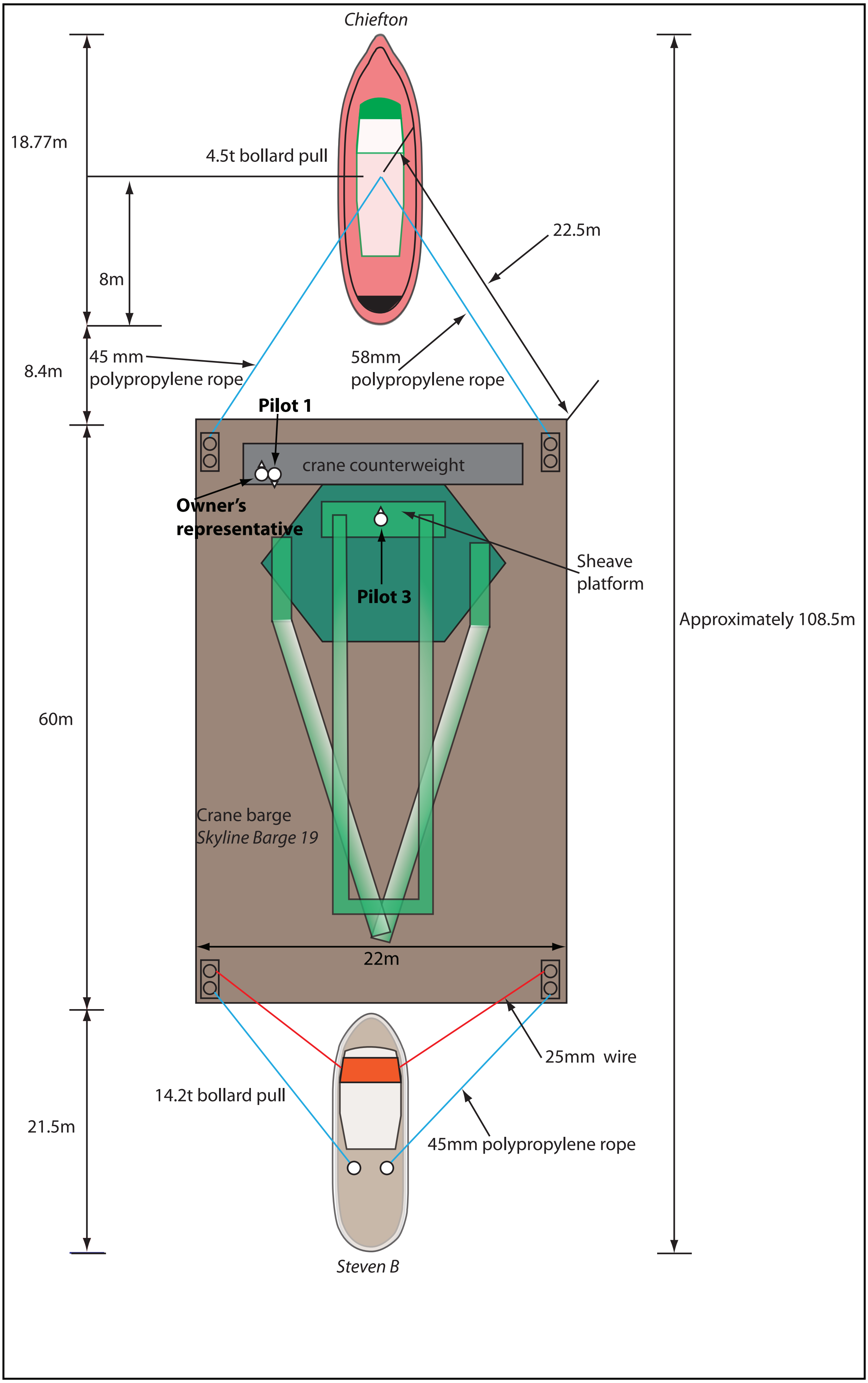


**Figure 21:** Schematic of the tow configuration immediately before the accident

Ravestein B.V. submitted a Transport and Installation Plan to the PLA, which included a method statement covering site information and equipment for the transport, installation and testing of the pier linkspan.

The Plan briefly described the fastening arrangements for the loaded linkspan for *Skyline Barge 19*'s sea passage from Deest to the River Thames. It also stated that the upriver transit would take 2 days using two tugs, and would include an overnight berth. Appendix 2 to the Plan provided predicted barge clearance data for the passage under the bridges. No planned details of the upriver or downriver tows were included.

In the absence of a method statement for the river towage, planning took the form of an initial meeting and the development of a tow-specific risk assessment.

## 1.16 RISK ASSESSMENTS

### 1.16.1 Risk assessments - general

Statutory Instrument 1997 No 2962 – The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 and Marine Guidance Note (MGN) 20 (M+F) – Implementation of EC Directive 89/391 – Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 promulgate an employer's duty to ensure the health and safety of workers. Integral to this is the need to carry out risk assessments.

The COSWP promotes health and safety best practice on board UK registered vessels. The Code provides a description of the regulatory framework relating to an employer's health and safety responsibilities and the need to conduct risk assessments.

The PLA was required to conduct risk assessments in support of its management of marine operations in accordance with the Port Marine Safety Code (PMSC).

The PLA's Craft Towage Code Section 1.2 – Responsibilities **(Annex D)**, a copy of which was on board *Chiefton,* required that appropriate risk assessments be conducted by the tug master and vessel operator. In particular, bullet point 6 of Sub-section 1.2.2 – The Vessel Operator's Responsibility - states:

> *"…Undertake separate risk assessments where an unusual towing operation is to be undertaken or where a standard operation is to be changed (i.e. introducing a new facility, barge, tug or route)."*

### 1.16.2 PLA's generic risk assessments

The PLA had conducted 117 generic navigational risk assessments to identify the hazards to navigation in accordance with Section 7.5 – Risk Assessment Standards - of its Navigation Safety Management System (SMS) Manual.

Although risk assessment No 87 dealt with tug girting situations, there were no specific risk assessments relating to the craft towage configuration applicable at the time of the accident, or the risk of tug overrun. However, assessments No 21 (Contact – navigation/mooring buoy (River)) and No 86 (Contact – Tug with jetty/other obstruction) were relevant. The assessments covered areas from Sea Reach No1 Buoy to Teddington and from Sea Reach No1 Buoy to London Bridge respectively. The assessments are shown at **Annex E**.

### 1.16.3 Tow-specific risk assessments

On 28 July, the DHM(U) completed his first draft, tow-specific, risk assessment following the planning meeting that was held on 20 July. The assessment covered only the bridge transit phase as required by PLA's General Directions for Navigation in the Port of London 2011 - General Direction 32 - Navigation Above Tower Bridge – Limitations on Vessels Towing. The General Direction applied to tows in excess of 60m in length.

The assessment identified a risk that *Chiefton* might have been underpowered for the task, and a medium, bordering on high, initial risk factor of 12 was determined. The residual risk was reduced to a score of 3 (low risk[12]) as a result of the manoeuvring trials carried out on 8 August.

Following the experience gained during the upriver tow, the risk assessment was refreshed and a final risk assessment was issued on 9 August. A copy of the three risk assessments is at **Annex F**.

There was no separate risk assessment for the downriver phase of the tow. The following note was included at the end of the three risk assessments:

> *"NB For the out bound passage the risk and controls are the same except the tide will be flooding, increasing the consequence of the barge being stuck under a bridge. However the improved management of the tow BY navigating against the tide is considered to mitigate better against the risk overall THAN THE ISOLATED CONSEQUENCE".* [sic]

### 1.16.4 Ravestein B.V. – risk assessment

Section 2 of the Transport and Installation Plan detailed a "General Site Risk Assessment", which covered the unloading and installation phases for the pier linkspan. There were no risk assessments relating to either the sea or river passages.

### 1.16.5 Palmer Marine Services Limited

Palmer Marine Services Limited did not have any written risk assessments for the tow or for any of the company's operations. A mental, ad hoc risk assessment of the towage operation was conducted during discussions with stakeholders about the configuration to be used before the start of the upriver and downriver tows.

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[12] PLA recorded the residual risk score as 6. This was a numerical error – the actual residual risk was 3 based on a "likelihood" score of 1 and a "consequence" score of 3.

## 1.17 PILOTAGE AND PASSAGE PLANNING

### 1.17.1 Pilotage

Section 4 (2) of the PLA's Pilotage Directions 2010, lays out the circumstances when compulsory pilotage is required for operations to the west of Sea Reach No 1 Buoy. Sub-section 4 (2) a) states the rule is applicable to:

> *"Vessels or Tugs and Tows of 80 metres or more in Length Overall"* [sic]

The overall length of the tow was approximately 108.5m, so pilotage was required. The subsequent risk assessments carried out by the DHM(U) identified that two pilots would be required for both the upriver and downriver tows.

### 1.17.2 Passage planning

On 15 July, Ravestein B.V.'s local agent e-mailed DHM(U) with an outline passage plan. However, this covered only the allocation of tugs and a broad programme of the key events, including an early proposal for an overnight berth at Orchard Buoy. More detailed passage planning was carried out by pilots 1 and 3, which centred almost entirely on the upriver and downriver bridge transit phases and was based on *Skyline Barge 19*'s initial draught of 2.4m. The written plan, verified by pilot 2, comprised the intended bridge transit timings and gave consideration to bridge span distances, the predicted height of tide, vessel draughts, air draughts and under-keel clearances to ensure that the tow passed safely under the bridges.

Although not documented, it was also planned to carry out manoeuvring trials during the upriver tow.

## 1.18 TOW MANOEUVRING TRIALS

### 1.18.1 General

Manoeuvring trials were planned for the passage from Broadness Buoy to George's Stairs Tier. The results of the trials were to be reported by pilot 1 to the DHM(U) so that the tow risk assessment for the bridge transit could be reviewed to determine the suitability of the tow configuration. The trials were carried out to determine the:

- Ability of *Chiefton* to tow the barge on her own.
- Steering and lateral stability of the tow.
- Suitable power settings for *Chiefton* and *Steven B.*
- Emergency stopping distance.
- Ability to "lift" the tow (i.e. bodily move the tow sideways) if set towards a bridge buttress or other obstruction.
- Ideal draught of the barge.

### 1.18.2 Trials in the vicinity of Broadness Buoy

The initial trials were carried out soon after the tow started. *Chiefton*'s ability to tow the barge on her own, and the steering and lateral stability of the tow, proved to be satisfactory.

The tow was immediately responsive to *Chiefton*'s changes of helm. It was only necessary to apply occasional port and starboard helm, of about 10º, to *Steven B* to maintain the tow's heading. Different power settings were tried and the skippers of *Chiefton* and *Steven B* were both content with 95% and 70-75% engine power settings respectively.

### 1.18.3 Trials in Limehouse Reach

Emergency stop trials were carried out while making approximately 5.6 knots speed through the water. It was found that *Steven B* was able to bring the tow to a stop in less distance than the barge's length i.e. about 40-50m.

A "lifting" trial was carried out while the tow was making virtually no SOG against a 1.1 knot ebbing tide. Application of port helm to *Chiefton* and starboard helm to *Steven B,* together with an increase in engine power on both tugs, caused a "kick", which had the desired effect of "lifting" the barge to port. Similarly, application of opposite helm was successful in "lifting" the barge to starboard.

## 1.19 BOLLARD PULL CALCULATION

PLA's Deputy Harbourmaster (Safety Management Systems) carried out a tow bollard pull calculation at the request of DHM(U). The requirement was identified at the towage planning meeting, held on 20 July, to confirm the suitability of *Steven B* and *Chiefton* to manage the tow.

Calculations were made using an empirical formula, and were based on a requirement to make 6 knots through the water with a barge displacement of 2100t and a draught of 1.8m for the bridge transits.

The calculation **(Annex G)** determined that a combined bollard pull by *Chiefton* and *Steven B* of 14.9t was required. PLA assumed that the combined bollard pull of *Chiefton* and *Steven B* was 15-16.5t, and therefore the tow was safe to proceed using the two tugs.

## 1.20 GREENWICH SHIP TIER

### 1.20.1 General description

The large ship mooring known as Greenwich Ship Tier was situated at the southernmost section of Greenwich Reach. It comprised an eastern and western group, each of three yellow mooring buoys. The groups of buoys were approximately 650m apart as shown in chartlet 3337 at **Figure 22**. The central buoy of each group was a 1.8m high, low profile "Stayrite" 4-chamber buoy **(Figure 23)**. The remainder were 4.4m-long, 2m-diameter Admiralty MOD Standard Class 1 buoys. The buoys

Reproduced from Admiralty Chart 3337 by permission of the Controller of HMSO and the UK Hydrographic Office

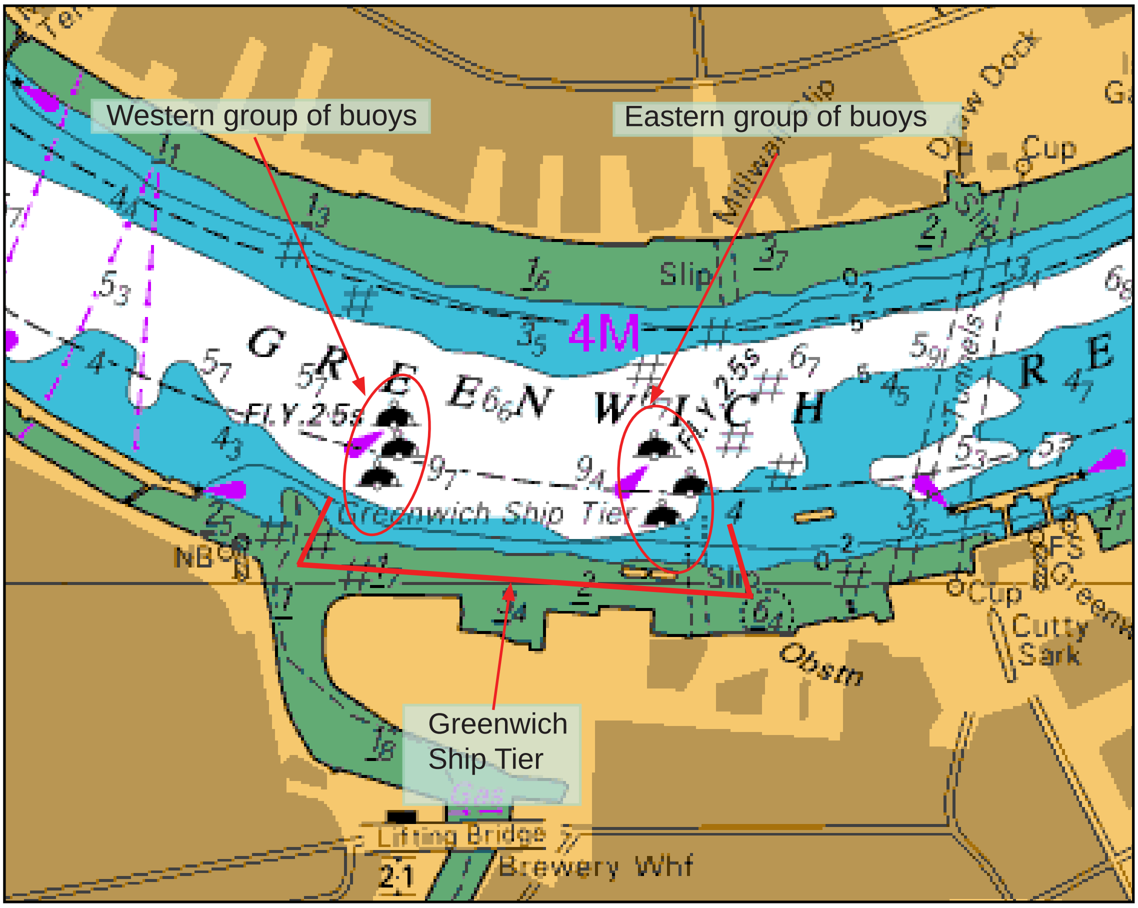


**Figure 22:** Chartlet 3337 showing Greenwich Ship Tier

Image courtesy of The Port of London Authority

**Figure 23:** "Stayrite" buoy

were highly visible in daylight conditions. The northernmost buoy of each tier was fitted with a fixed blue light[13] and was charted as lying 15m inside the designated channel.

### 1.20.2 Survey

Following the accident, the PLA removed the northernmost buoy of the eastern group (the buoy with which the barge made contact) for survey.

It was found that there was scoring on the underwater section of the buoy, although some of the marking had been made during the slinging procedure. A chain and fender supporting lug, which was just above the waterline, had been set back and had clear evidence of paint transfer which matched that of the hull coating of the barge **(Figure 24)**. There was also evidence of rubber fender and support damage directly under the damaged lug, although it could not be confirmed whether this was old or new damage.

**Figure 24:** Contact buoy - fender support lug damage and (inset) evidence of paint from barge

[13] The 'Moorings' Note on the chart states that certain mooring buoys can be lit with a fixed blue light, although the chart **(Figure 22)** shows the buoys as having flashing yellow lights.

## 1.21 PILOT ARRANGEMENTS

### 1.21.1 General

At the time of the accident, the PLA employed 97 pilots. Of these, 74 were sea pilots, and 8 were in training. There were 15 river pilots, three of whom were qualified as bridge pilots and one of whom was a trainee bridge pilot. River pilots were recruited from a pool of sea pilots who had at least 2 years' experience as a Class 1 unrestricted sea pilot[14]. Bridge pilots were recruited from the pool of river pilots. Bridge pilots, by default, were also employed as river pilots.

There was an operational overlap between pilotage areas, but the specialist bridge pilots' area of operation was, broadly, between Sea Reach No 1 Buoy and Putney Bridge.

### 1.21.2 Pilot continuation training

All PLA pilots underwent authorisation revalidation every 5 years and, in the interim, undertook a variety of continuation training elements. These included marine resource management, specialised tug application, systems and electronic chart display and information training as well as regular "tool box" talks.

Acts of pilotage between Sea Reach No 1 Buoy and Putney Bridge were infrequent, so bridge pilots transited the entire London Bridge to Putney district on PLA craft approximately every month to maintain their working knowledge of the area.

Each pilot carried out simulator training every 24-30 months which focused on general pilotage and ship towage aspects. The simulator, which did not cover the area upriver of London Bridge, had a limited craft towage capability and was not used for training in relation to combined push/pull craft towage techniques.

### 1.21.3 Pilot qualification

Pilot 1 qualified as a sea pilot in 1991, as a river pilot in 1998 and as a bridge pilot in 1999. He had experienced two broadly similar tows during the previous 3 years.

Pilot 3 qualified as a sea, river and bridge pilot during 1997, 2001 and 2010 respectively. Other than witnessing the upriver transit, pilot 3 had no experience with a push/pull tow.

### 1.21.4 Wearing of lifejackets

PLA's Health and Safety Notice No 2 of 2006 required that all PLA personnel, including pilots, wear approved lifejackets when on the deck of PLA vessels, when adjacent to the river and when working on any other vessels.

[14] In this case a sea pilot would have had at least a total of 6 years experience overall, which includes 4 years before being awarded the "unrestricted" qualification.

## 1.22 THE BRITISH TUGOWNERS ASSOCIATION AND THE NATIONAL WORKBOAT ASSOCIATION

The BTA promotes the interests of port towage operators, representing their views on legislative and economic issues, and advancing safety and technical development within the industry.

Formed in 1994, the National Workboat Association (NWA) is charged with representing its membership's views on legislative and economic issues. To this end, the NWA has been active in assisting the MCA in developing various codes of practice.

Palmers Marine Services Limited was not a member of either the BTA or NWA.

## 1.23 SIMILAR ACCIDENTS

### 1.23.1 Overview of UK registered tug accidents in 2005

During the first 4 months of 2005, the MAIB was notified of three significant collisions involving harbour tugs as a result of loss of control. One of these resulted in the tug's hull being holed, with a consequent risk of capsize.

While none of these cases resulted in loss of life, their seriousness caused the Chief Inspector of Marine Accidents to publish Safety Bulletin 2/2005 - "Collisions and contacts between tugs and vessels under tow or escort in United Kingdom ports" **(Annex H)**.

Among other safety lessons, the Chief Inspector identified that harbour authorities should ensure that each towing task is supported:

> *"…with a local appraisal of the intended operation to ensure the "tug to task" allocation is appropriate before the tow or move begins".*

### 1.23.2 Recent accidents 2007-2010

Between 19 December 2007 and 1 March 2010, there were a further three major accidents involving UK tugs and workboats, or in UK waters. They resulted in the loss of four lives as follows:

- *Flying Phantom*[15]

On 19 December 2007, *Flying Phantom* girted and sank with the loss of three of her crew while acting as a bow tug in thick fog. The tow rope parted during the capsize because the emergency release system was slow to operate. The investigation also found the engine room watertight door had been left open, which allowed rapid downflooding, and that the port's related risk assessments were poor, with few effective control measures identified.

[15] http://www.maib.gov.uk/publications/investigation_reports/2008/flying_phantom.cfm

- *Ijsselstroom*[16]

  On 14 June 2009, *Ijsselstroom* was acting as a stern tug, running astern, with a single wire connected over the tug's stern to the stern of a large barge. The skipper intended to maintain the tug's position and heading relative to the barge by using differential ahead power on his two engines. As the tug towing the barge increased speed, *Ijsselstroom's* skipper was unable to control his tug's yaw. The tug took a large sheer, girted and sank. It was found that the tow speed was too high, the tow line emergency release system was not operated when the tug got into difficulties, and the pilot had no knowledge of the tug's operational limitations or of *Ijsselstroom's* skipper's intended method of operation.

- *Llanddwyn Island*[17]

  The workboat, *Llanddwyn Island,* was towing a dumb dredger when one of the crew moved into the tensioned towing hawser "snap-back zone". The hawser parted and struck the crewman, who died at the scene. The investigation identified the limitations of existing training and qualifications required to operate workboats and recognised the important work of the BTA, NWA and the MCA in developing three towing endorsements for tug and workboat crews (see Section 1.7.2).

### 1.23.3 Germany's Federal Bureau of Maritime Casualty Investigation Report - Harbour Tug *Julius*

On 16 December 2004, *Julius* was acting as a steering and braking tug while connected to the stern of a large pontoon on the River Elbe. Ropes were led from the tug's forward towing post and from the after end of the tug to the pontoon. The ropes from the post slackened, and the tug sheered to port, causing the port after rope to become wrapped around the wheelhouse. The tug heeled and foundered quickly because watertight doors had not been closed. The skipper lost his life.

[16] http://www.maib.gov.uk/publications/investigation_reports/2010/ijsselstroom.cfm

[17] http://www.maib.gov.uk/publications/investigation_reports/2010/llanddwyn_island.cfm

# SECTION 2 - ANALYSIS

## 2.1 AIM

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.

## 2.2 ACCIDENT OVERVIEW

There is no doubt that *Chiefton* capsized and foundered as a result of being overrun by *Skyline Barge 19.* The fast-moving sequence of events was initiated by a delay in action being taken to address the tow's set to the south under the influence of the flood tidal stream. *Chiefton*'s skipper took instinctive, independent action in an attempt to prevent the barge making contact with the northernmost buoy of the Greenwich Ship Tier's eastern group of buoys. Pilot 3's subsequent manoeuvring action was inappropriate in the circumstances and served to increase the risk of the barge contacting the buoy. *Chiefton*'s skipper then attempted to turn the tug away from the approaching bow of the barge, but he was unsuccessful. The barge collided with the port side of *Chiefton*, causing the tug to capsize and founder. The time taken from the point at which the pilot ordered *Steven B* to apply starboard helm, to *Chiefton* becoming submerged, was about 30 seconds.

A number of factors contributed to the accident and are analysed in this section of the report. The investigation identified a number of other safety issues, which are also discussed.

## 2.3 SITUATIONAL AWARENESS

As the tow approached Greenwich Ship Tier, recorded AIS data for *Chiefton* shows the tug mid-channel. However, her course over the ground (COG) was 112º(T), indicating that she was setting to the south under the influence of the flood tidal stream **(Figure 25a** to **25d)**. Had port helm been applied on both *Chiefton* and *Steven B* at this time, the tow would probably have cleared the eastern group of buoys.

It has been suggested that *Chiefton*'s skipper had recognised that corrective action was needed, but had delayed taking any action himself because he was waiting for instructions from the pilot. However, up to this point, pilot 3 had given no specific helm instructions to *Chiefton*'s skipper, who had been making independent decisions on the course to be steered. It is therefore probable that the skipper did not immediately recognise that the tow was being set to the south. The mate and the engineer/deckhand were both in the wheelhouse at this time, and it is possible that the skipper, who was navigating by eye, was temporarily distracted.

Pilot 3 was also navigating by eye and did not recognise that the tow was being set to the south until he was alerted by pilot 1. Pilot 3 had an unobstructed view of the river from his position on the crane's sheave platform, and the visibility was good. There were no ongoing communications, river traffic movement, or other activity in the immediate vicinity of the tow to particularly distract him.

Both *Chiefton*'s skipper and pilot 3 were of the view that the difficult bridge transit phase had been completed, and judged the remainder of the passage to be routine. Both would therefore have been experiencing a sense of relief, probably resulting in

Image courtesy of the Port of London Authority

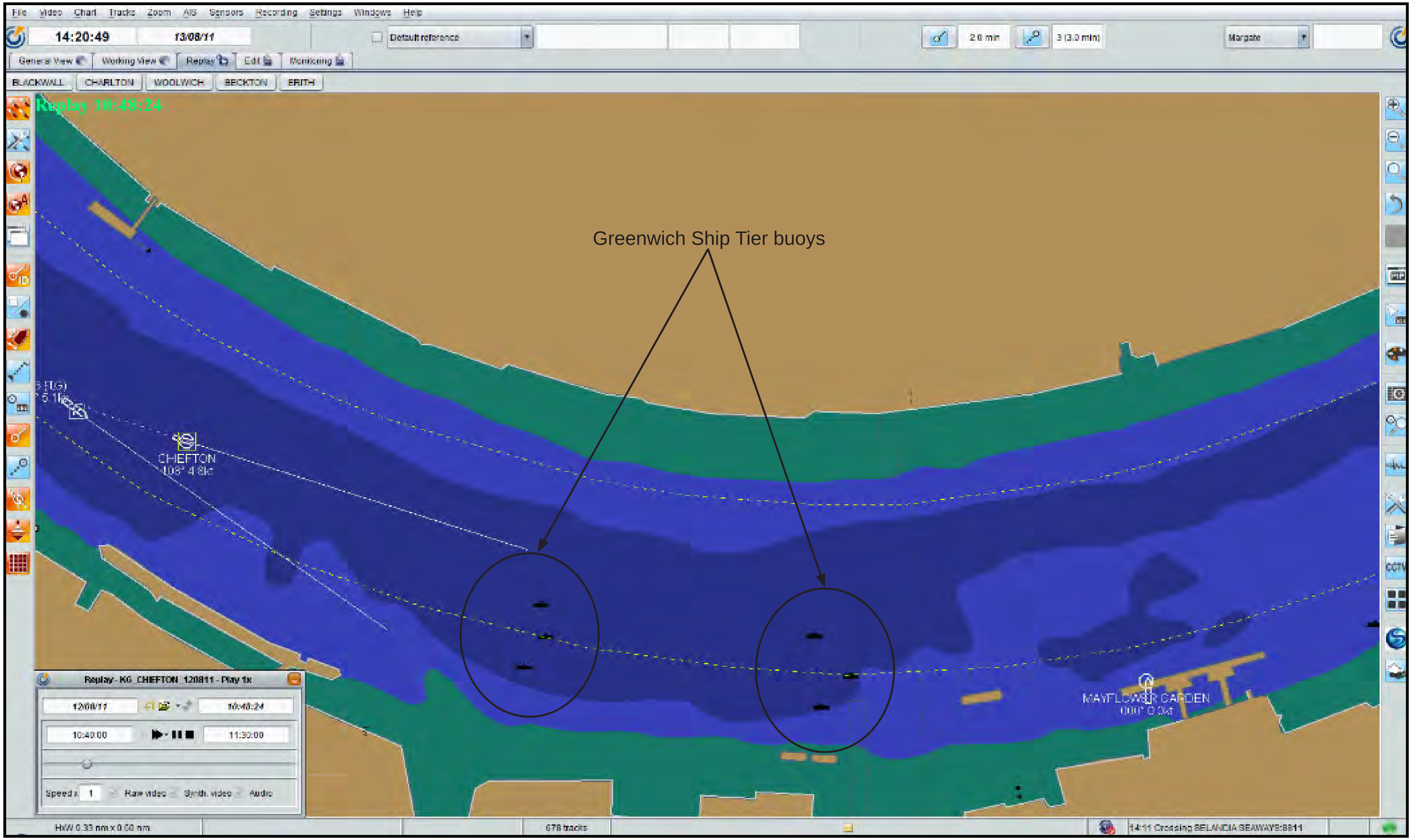


**Figure 25a:** *Chiefton*'s AIS track - approach to the western group of buoys of Greenwich Ship Tier

Image courtesy of the Port of London Authority

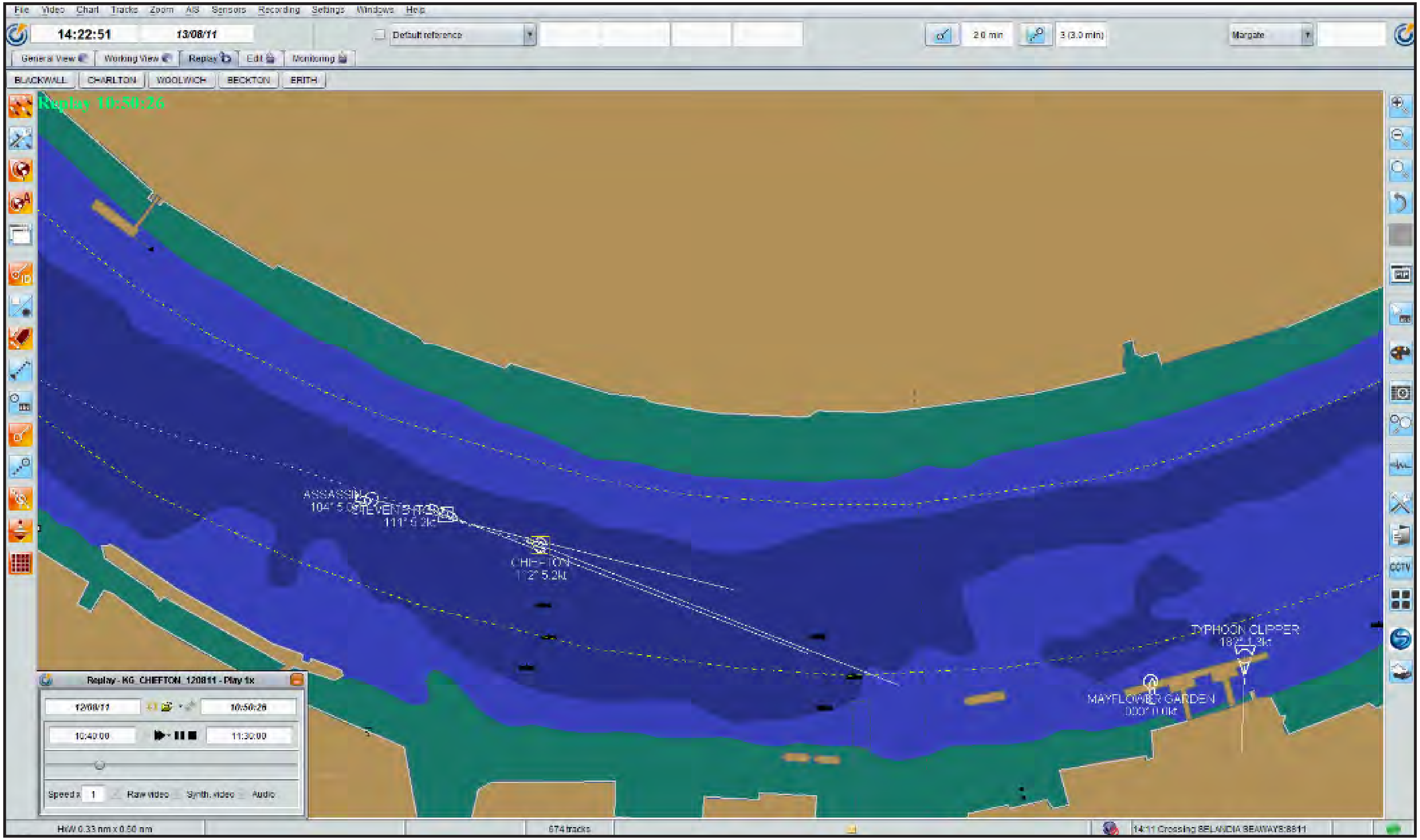


**Figure 25b:** *Chiefton*'s AIS track - abeam of the western group of buoys of Greenwich Ship Tier

Image courtesy of the Port of London Authority

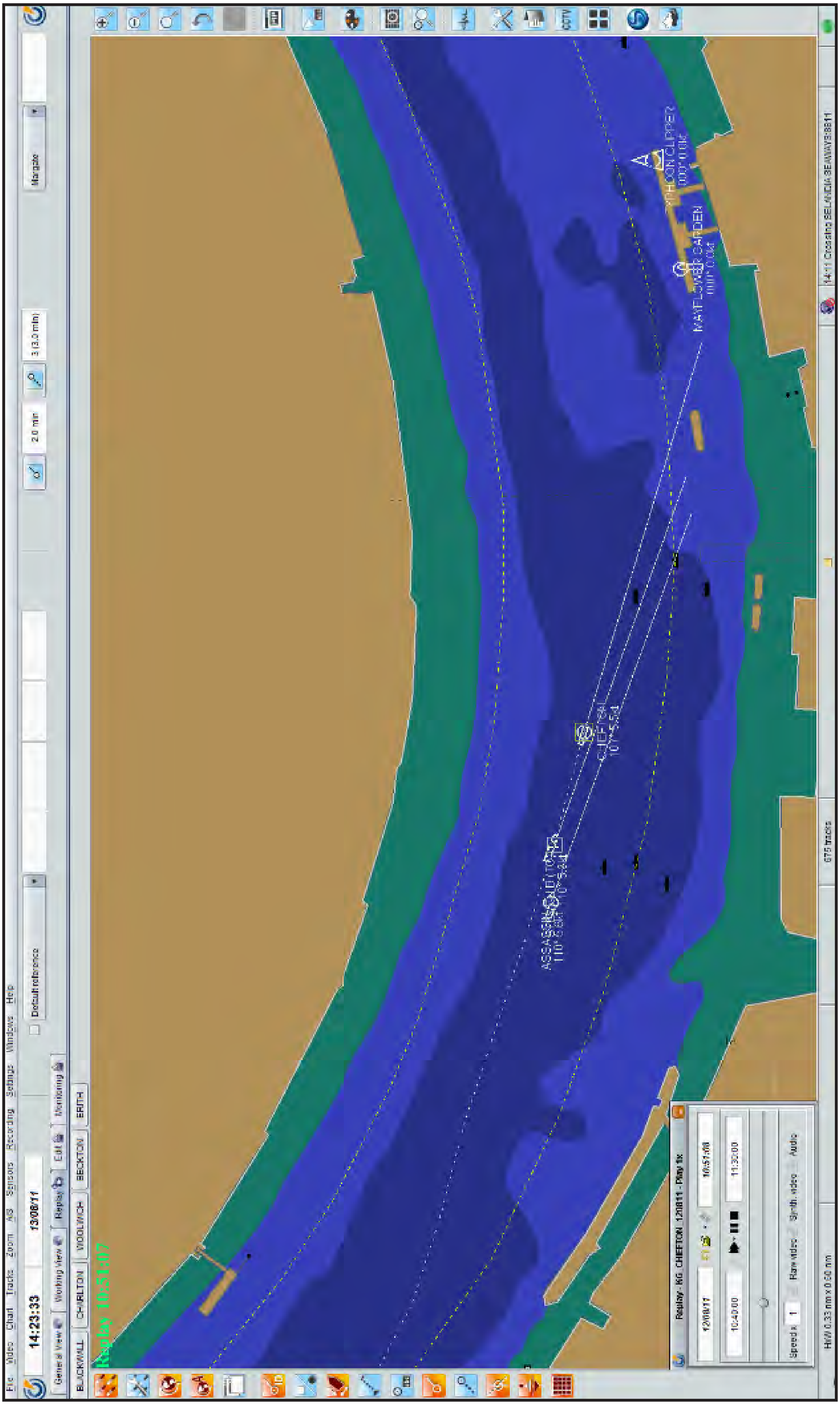


**Figure 25c:** *Chiefton*'s AIS track - midway between the western and eastern groups of buoys of Greenwich Ship Tier

Image courtesy of the Port of London Authority

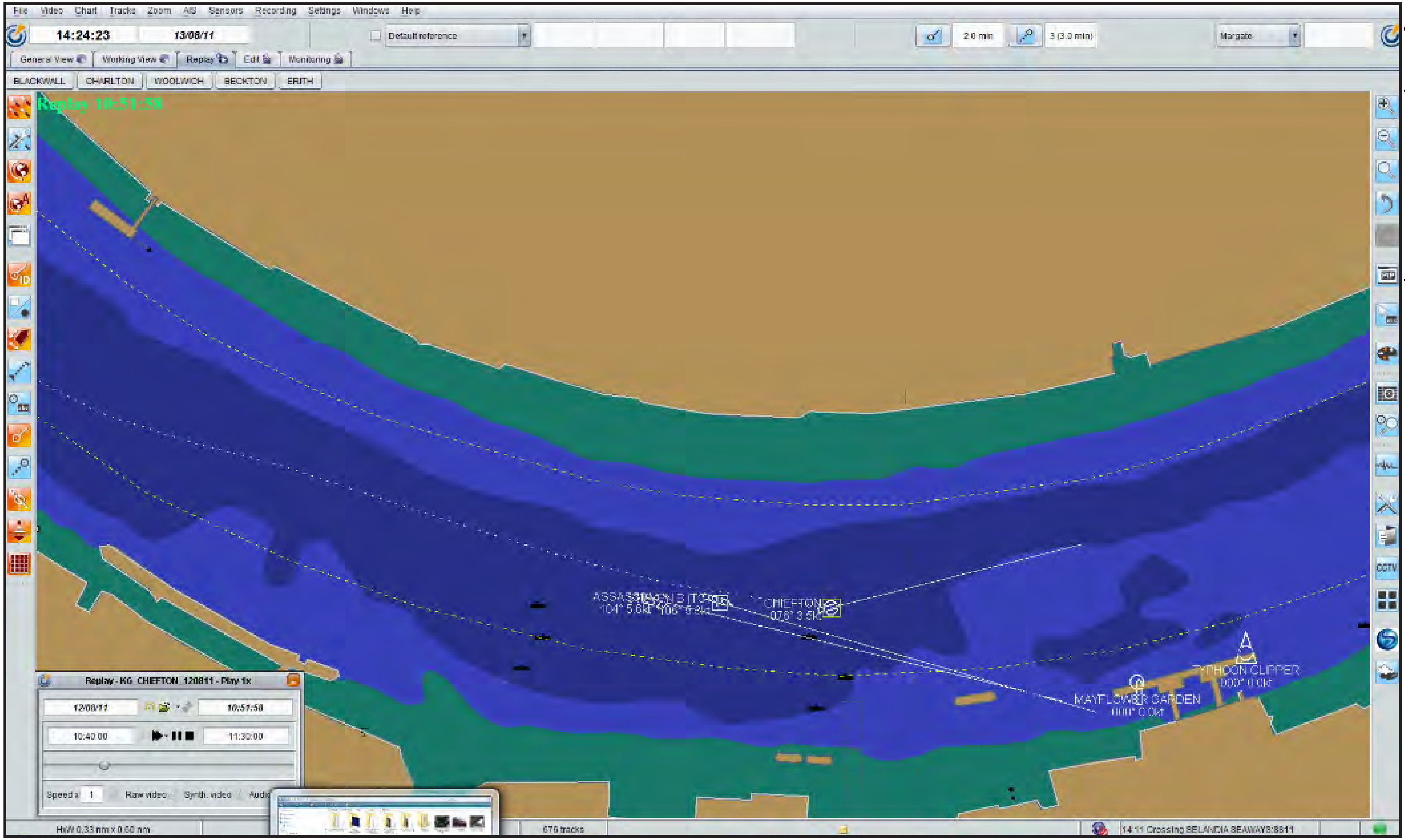


**Figure 25d:** *Chiefton*'s AIS track showing the barge about to make contact with the northernmost buoy of the eastern group of buoys of Greenwich

a reduced level of vigilance. This would have contributed to their loss of situational awareness in terms of position monitoring and of anticipating the effect of the flood tidal stream.

Pilot 3 had been content for *Chiefton*'s skipper to make independent helm adjustments without the need for his intervention. This might have also resulted in him maintaining a reduced level of vigilance, leading to an over-reliance on the skipper to correct any deviation of the tow from mid-channel.

Pilot 3 had not appreciated that the tow had already passed the western group of buoys of Greenwich Ship tier. Had he done so, he ought to have foreseen the increasing effect of the flood tidal stream as the tow proceeded eastwards through Greenwich Reach, and have been ready to take immediate action.

The risk control measure of having a second pilot on board was not optimised. Had pilot 1 been positioned adjacent to pilot 3 and monitoring his actions, he would have had visibility of the developing situation and have been able to advise or intervene immediately.

## 2.4 PILOT 3'S MANOEUVRE

In taking action to prevent *Skyline Barge 19* from striking the buoy, pilot 3 based his manoeuvre of applying port helm on *Chiefton* and starboard helm on *Steven B* on the results obtained from the manoeuvring trial carried out in Limehouse Reach on 8 August. He anticipated that the manoeuvre would "lift" the barge to port and so enable it to clear the buoy, or in the worst case, make minimal contact with it.

While the "lift" manoeuvre conducted at the trial was successful, it had been carried out at slow speed, and the dynamics at the time of the accident were entirely different. The tow was moving at a significantly higher speed through the water, and *Chiefton*'s lack of reserve power prevented her from providing a "kick" to assist the "lift" manoeuvre. *Skyline Barge 19*'s draught was reduced by 1.2m and the tidal stream rate was twice that at the trial. Consequently, the effect of applying starboard helm on *Stephen B* was that the barge turned to starboard, and the front of the barge moved away from *Chiefton* instead of following it.

The manoeuvre was inappropriate in the circumstances. Had the pilot ordered port helm or no helm at all on *Steven B*, it is possible that the barge might have cleared the buoy to starboard or have made only minimal contact with it.

## 2.5 MANOEUVRING ISSUES – *CHIEFTON*

With the barge draught at about 1.2m and a tow speed of 7.7 knots through the water, against the flood tide, *Chiefton* had to maintain 95% engine power in the general direction of the tow. Anything other than a small deviation from the direction being followed by the barge caused a reduction in *Chiefton's* speed relative to the speed of the barge, and carried a risk of her being overrun by the barge, which was being propelled by the pushing power of *Steven B*.

Although the action taken by *Chiefton*'s skipper, in applying port helm to avoid the barge contacting the buoy, carried such a risk, the manoeuvre, if carried out in isolation, might have been successful. However, the turning effect of *Steven B*'s starboard helm only served to exacerbate the difference between the headings of the two vessels, which resulted in *Chiefton* being overrun.

The situation is covered by Captain Henk Hensen in The Nautical Institute's second edition publication of "Tug Use in Port - A Practical Guide - Section 4 – Tug Capabilities and Limitations" as illustrated at **(Figure 26)**. The reference states:

> *"When the angle between the tug's heading and incoming water flows becomes too large a tug may not be able come back in line with the assisted ship and, as a consequence, athwartships towline forces may get too high. …towline forces might overturn the tug (girting) if the towline cannot be released in time."*

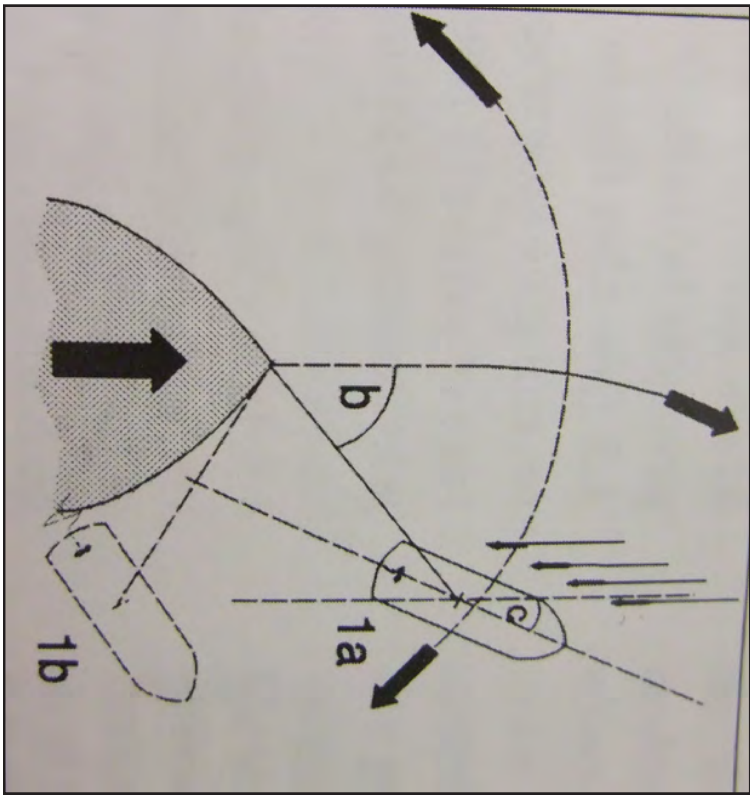


Image courtesy of The Nautical Institute

**Figure 26:** Schematic showing relationship between tug and waterflow forces

The above explains why *Chiefton*'s skipper's application of full starboard helm in an attempt to turn the tug away from the approaching bow of the barge, ultimately had no effect. A point had been reached when the changing direction of incoming water flows created too large an angle with *Chiefton*'s heading, preventing *Chiefton* from returning in line with the direction of the barge, as illustrated at **Figure 27**. The girting condition did not occur because the short length of the starboard tow rope prevented *Chiefton* from passing down the port side of the barge; instead, she was held captive in front of it. Had *Chiefton* passed down the port side of the barge, it is possible that she would have girted, unless her towing hook was released.

This high-risk situation was not properly considered during either the planning or execution of the tow.

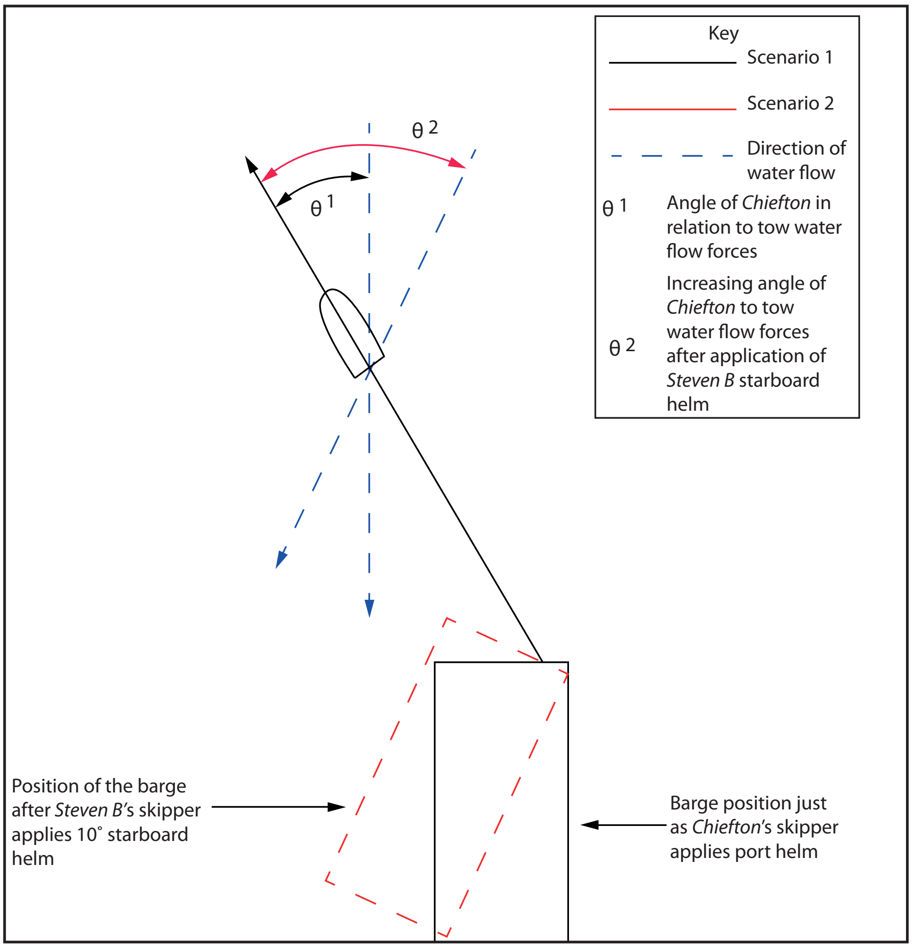


**Figure 27:** Schematic showing relationship between tug and tow water forces applicable at the time of the accident

## 2.6 TOW CONFIGURATION

### 2.6.1 Interpretation and communications

The tow configuration of *Skyline Barge 19* and *Steven B* can be likened to a conventional ship with the tug providing propulsion power, steering and "braking" functions.

The dangers of overrun and girting are well recognised in the case of a tug pulling a ship at speed. However, no one involved recognised the similar dangers associated with *Chiefton* towing the composite unit of *Skyline Barge 19* and *Steven B* at almost 8 knots through the water with *Chiefton* operating at 95% of available engine power.

Frequent and clear communications between the pilot, master and tug skippers are essential to alert those involved to the dangers related to towage. In this case, checks were made with both tug skippers by the pilots and by the owner's representative. Neither of the tug skippers raised concerns about the tow configuration, or of the engine power settings or risks of overrun.

### 2.6.2 Tow rope issues

The distance between *Chiefton* and the barge was only 8.4m. However, the path width is smaller when tugs work on short tow ropes rather than long ones because the towed object does not have much time to sheer and drift. As soon as it does, then the pilot and/or tug skippers can react very quickly. In this case, the tow length was appropriate for the tight, slow-speed bridge transits when rapid manoeuvring responses were required to prevent damage to the barge and bridge structures, which, had it occurred, would have caused significant impact to London's river and road traffic flows.

While appropriate for the bridge transits, the short tow ropes presented considerable risk when the tow was making almost 8 knots speed through the water during the downriver tow. Had *Chiefton* suffered any form of propulsion or steering failure, she would have been overrun before either the pilots or *Steven* B's skipper would have been able to react. Although the Limehouse Reach emergency stop trials showed that the tow could be stopped within about 40-50m, this was meaningless in relation to safeguarding *Chiefton* as she was towing only 8.4m in front of the barge.

Contrary to good practice, *Chiefton*'s skipper opted to use dissimilar sized tow ropes which had different strength characteristics. Furthermore, the overall length of the port and starboard tow ropes was only approximately 28m. This did not allow the option of lengthening the ropes for the downriver tow as the distance between the barge's bitts and *Chiefton*'s towing hook was approximately 22.5m. Had the ropes been capable of being lengthened, or had they been changed for longer ones, and had this been done before the tow increased speed, the risk of overrun would have been reduced. However, this had not been considered.

The safest option would have been for *Chiefton* to release her tow ropes entirely after passing through Tower Bridge, and to allow *Steven B* to complete the tow downriver on her own. This option was put forward by the owner's representative before the start of the downriver tow. However, it was later decided to retain *Chiefton* for the Thames Barrier transit. Instead of keeping *Chiefton* connected, however, it would have been preferable to have disconnected her from the barge during the higher speed river transit, and to have reconnected her, once the speed was reduced, for the transit through the Thames Barrier.

### 2.6.3 Other experience with push/pull tow configurations

The push/pull tow configuration is sometimes used on the River Mississippi, USA, where specially designed barges are built with recesses to accommodate the pushing tug. The system is also used on the River Trent, UK, mainly for "dead" ship moves. Because of the narrowness and bends of the river, tug operators emphasise the need for good communications and instant propulsion response in maintaining the forward tug's towing distance.

The investigation of the fatal accident involving the German tug *Julius* (Section 1.23.3) related to the combined push/pull tow configuration. The German Waterways and Shipping Administration forbids this type of operation unless express approval is given, because of the inherent high risks involved. These relate to the effect of river currents, risk of overrun, communication problems, matching of tug powers and manoeuvrability issues.

### 2.6.4 Conclusion

The risks associated with the short tow, inability to readily lengthen the tow ropes and appropriateness of the emergency stop trials to determine a safe tow were not fully recognised.

The late and inappropriate action taken to avoid the northernmost buoy of the eastern group of buoys of Greenwich Ship Tier, coupled with *Chiefton*'s lack of reserve of power and short tow ropes, made the collision between the barge and the tug inevitable.

## 2.7 TUG SELECTION

### 2.7.1 General

The importance of selecting appropriate tugs for a particular operation is highlighted at Section 1.2.2 – The Vessel Operator's Responsibility – in the PLA's Craft Towage Code. The reference states that it is prudent for vessel operators to:

> *"Ensure through risk assessment that the vessels being used in towing operations are the most suitable taking into account likely conditions, physical restrictions, limitations of vessels, competency of crew and provision of onboard equipment."*

The initial reason for selecting *Chiefton* and *Steven B* was that they satisfied the maximum draught criterion of 2.5m to provide sufficient under keel and air draught clearances for the bridge transit. The planning meeting held on 20 July, and PLA's subsequent risk assessment, identified the need to confirm that the tugs' power limitations were appropriate to the tow by determining the total bollard pull requirement. Although the crews held the appropriate qualifications, no consideration was given to their experience, or that of the pilots, with this type of tow.

### 2.7.2 Bollard pull calculations

PLA staff calculated that the total bollard pull requirement for the bridge transit was 14.9t[18] using a recognised empirical formula. A safety margin of approximately 50% was factored into the calculation by opting to use the upper limit of 1.5 for the "Sheltered Water" constant. It was further assumed that the combined bollard pull capability of *Chiefton* and *Steven B* was between 15 and 16.5t and, as such, the tugs had sufficient shared power to cope with the demands of the tow. Although the PLA recognised that the calculation would require *Chiefton* to be at near maximum power, the 50% safety margin was deemed sufficient for a safe bridge transit.

No calculation was made, or was considered, for either the upriver or downriver tows. The MAIB calculated the bollard pull requirement for the river tows, using a tow speed through the water of 7.7 knots (speed at the time of the accident), a "Sheltered Water" constant of 1.0 and the same barge draught and air draught used in PLA's original calculation. In this case, it was calculated that a bollard pull of 15.67t was required, which was very close to the combined bollard pull limit.

Had the bollard pull requirement for the downriver tow been determined, it should have been possible to identify that *Chiefton* would have been on the limit of her power which, as a result, offered virtually no safety margin. In this case, it is possible that another, more powerful, pulling tug would have been selected.

[18] MAIB calculations based on the identified PLA criteria determined the bollard pull requirement as 15.29t.

## 2.8 EXPERIENCE AND PILOT ISSUES

### 2.8.1 Frequency of the push/pull configuration

Push/pull towage operations are used on the River Thames, and there are examples of two tugs pushing while connected one on either side of a vessel, and of one tug connected safely to the side of the vessel. However, the particular configuration that was used on this occasion, with a pulling tug connected forward and a pushing tug connected as a composite unit to the vessel's stern, was rare.

This investigation has identified that the last time a broadly similar configuration was used for an upriver and downriver tow on the River Thames was on 12 April 2004. On that occasion the owner's representative and the skipper of *Steven B* were involved when the specialist, 80m-long, 6.5m-wide barge *Terra Marique,* which displaced 2211t, was used to transport British Airways' Concorde G-BOAA. The PLA tug *Impulse* was used as the pulling tug, and *Steven B* was the pushing tug.

However, there were a significant number of differences when compared to the configuration used at the time of the accident. In the case of the downriver *Terra Marique* tow from Iselworth to Dartford, pilots were used but they departed at Putney Bridge after which the owner's representative took over the role. After passing Tower Bridge, *Impulse* was released and *Steven B* assumed the pulling role until arrival at Dartford. This meant that for the majority of the downriver passage there was no pilot involvement, and only a pulling tug was connected.

### 2.8.2 Experience of tug skippers and pilots

*Chiefton*'s and *Steven B*'s skippers had wide-ranging experience of River Thames towage operations. However, neither had undertaken a combined push/pull river tow, under the direction of pilots, and with the pushing tug secured hard up against the barge's stern downriver of Tower Bridge. Although *Chiefton*'s skipper had been involved in a number of slow-speed push/pull tug operations during the previous year, pilots were not involved, the pushing tug had no wires secured to the barge and the operations were undertaken upriver of Tower Bridge.

Pilot 1 had experience with two broadly similar push/pull tows but pilot 3 had no such "hands on" experience.

There is no evidence that the planning and risk assessment processes had identified that all those engaged in the tow lacked experience in the specific push/pull configuration to be used. It is probable that this was overlooked because the pilots and tug skippers involved all had a wide range of generally appropriate experience. It is possible that had the issue of relevant experience been explored, the benefit of employing a specific towmaster to advise and take charge of the tow would have been recognised.

### 2.8.3 Pilot training

The PLA had a comprehensive pilot training and revalidation process which included simulator training. Although the system had a rudimentary craft towage simulator capability, it was seldom used.

While the craft push/pull configuration is not commonly used on the River Thames, there are nevertheless benefits to including it in the periodic simulator training package. In addition, had such a simulation been developed sufficiently, it could have been used as a pre-tow assessment tool to help identify the hazards.

### 2.8.4 Pilots – wearing of lifejackets

It was noted that, despite the crane's counterweight being unguarded and extending almost to the full beam of the barge, neither pilot 1 nor pilot 3 opted to wear a lifejacket, contrary to PLA's policy. Had either pilot lost his footing, he would have been at risk of falling overboard.

## 2.9 PLANNING – RISK ASSESSMENTS, PASSAGE PLANNING

### 2.9.1 General

Thorough and complete risk assessments are an integral part of a company's procedures for ensuring it fulfils its health and safety obligations. By identifying the risk, appropriate control measures can be put in place to minimise hazards to personnel and equipment.

The BTA's "Best Practice Guidance – Pre-Towing Checklist" covers the need for risk assessments to be undertaken. Section 3.1 of the PMSC specifically requires harbour authorities to conduct formal assessment of hazards and risks. Section 9.3.10 of "A Guide to Good Practice on Port Marine Operations" states:

> *"Dead tows and unusual objects – The proper use of tugs on such objects requires special consideration and proper planning should be given to the movement of such vessels or floating objects".*

In addressing the above requirement, the PLA recognised that the method statement contained in Ravestein B.V.'s Transport and Installation Plan was incomplete in that the included risk assessments did not cover moving *Skyline Barge 19* from Broadness Buoy to St George Wharf and vice versa. Consequently, the PLA decided to conduct its own risk assessments in accordance with the PMSC and its own General Directions for Navigation rather than require the contractor to undertake these for subsequent review and validation by the PLA. In this case, PLA's risk assessment process would have been more complete if it had been accompanied by a comprehensive method statement against which it could have been assessed.

### 2.9.2 Risk assessment – tow-specific

With the exception of some numerical errors, PLA staff correctly carried out the tow-specific risk assessments for the bridge transits. The assessment of residual risks following the imposition of the control measures was appropriate for the slow-speed bridge transits, which were carried out safely. However, none of PLA's regulations or guidance covered the need for the risks for the whole passage to be assessed.

Although there were no generic risk assessments relating specifically to the tow configuration at the time of the accident, or the risk of tug overrun, other risk assessments applied to the river passages below Tower Bridge. These covered the risks of making contact with a buoy and identified causes as tidal set, misjudgement and, notably, a failure to follow procedures; especially keeping a lookout, position monitoring and passage planning. Had these been referred to in the tow-specific risk assessment then the need for full passage planning, particularly in light of the tow configuration, should have been identified and extra caution taken.

### 2.9.3 Risk assessment – Palmer Marine Services Limited

Palmer Marine Services Limited was not required to have a formal written health and safety policy because the company did not have more than five employees. However, The Merchant Shipping and Fishing Vessels (Health and Safety at Work) Regulations 1997 did require an assessment of the risks to workers' health and safety from their work activities to be undertaken. MGN 20 (M+F) provides guidance on the planning, conduct and revision of risk assessments as does Section 1.2.2 – The Vessel Operator's Responsibilities - of PLA's Craft Towage Code. The MGN also advises that employers record significant findings of their risk assessments, although this is not mandatory.

Despite the company reportedly having a good safety record, there was no evidence that the company had recorded or undertaken any formal risk assessments, including any specifically for the tow (see Section 1.16.1). However, informal, unwritten risk assessments were routinely conducted during operations such as keeping clear of tow rope snap-back zones, rope-handling techniques, and accessing and leaving the vessel.

### 2.9.4 Passage planning

The passage plan produced by the pilots concentrated almost entirely on the bridge transit phases. Neither the upriver nor the downriver tows attracted the same level of detailed planning. The undocumented river passage plan covered only the tow configuration, the manoeuvring trials on departing Broadness Buoy and those conducted in Limehouse Reach, and the overnight berth at George's Stairs Tier.

Although the river passages were routine, the proposed tow was unique and warranted greater planning emphasis.

## 2.10 PERSON IN CHARGE

The importance of having a recognised person in charge of an operation is an essential element of good management, as it provides the focal point necessary for effective decision-making. In unusual activities, it is particularly important to ensure that the person has the necessary professional experience and can make decisions, or provide advice, based on the overall situation.

Ravestein B.V.'s Transport and Installation Plan clearly laid out who was in charge of the pier linkspan installation. None of the stakeholders applied the same clarity to the towage plan and so the importance of having a person in charge was not recognised.

In the case of a ship tow, the pilot may have conduct, but the person in charge is the ship's master, who is also the owner's representative. In this case, the key personnel were the two tug skippers, the two pilots and the owner's representative;

but none was considered to be the master of the barge. While no one formally had the responsibility, all those involved considered the pilot who had conduct, to be in charge. Notably, the pilots themselves also considered themselves to be in charge.

However, this interpretation presents a dilemma. Section 31 of the Pilotage Act 1987 defines a pilot as a:

> *"person not belonging to the ship who has the conduct thereof"*

A pilot cannot therefore be a master, and vice versa.

In cases of craft pilotage acts and during non-standard towage operations it would be prudent for the PLA and other harbour authorities to consider the requirement for a person to be in charge, such as a towmaster. This would avoid compromising the role/responsibility of the pilot and would provide all involved with a source of expert advice, during both planning and operational stages of towage.

## 2.11 ISSUES RELATING TO THE OPERATION OF *CHIEFTON*

The investigation identified the following safety issues relating to the safe operation of *Chiefton*.

### 2.11.1 Watertight integrity

Tug towage operations present far higher risk to tugs than many other maritime operations because of their necessary, close proximity to the towed vessel. Consequently, there is a real risk of overrun or girting resulting in downflooding and foundering. While watertight integrity can be readily maintained, the investigation found that the practice of tugs operating on the River Thames with many of their doors and hatches open is widespread.

The SCV Code - Section 25.2.3 – Weathertight Integrity, and PLA's Craft Towage Code - Section Five – Preparations Before Commencing Towing Operations, both emphasise the importance of maintaining a tug's watertight integrity during towage operations. The latter instruction states:

> *" …When a tug is engaged on any towage operation, all watertight/weathertight openings should be securely fastened and openings marked with a sign stating that they are to remain closed during towage operations."*

*Chiefton*'s Stability Information Report identified that the hull would flood at the first immersion of the accommodation/wheelhouse access, port watertight door. Provided that the door was properly secured watertight, flooding of the hull and superstructure would not occur at heel angles less than the required minimum of 40°. The Stability Information Report emphasised that, *"Compliance with the stability criteria was therefore dependent on the door being kept closed and secured watertight"*.

The watertight integrity discipline on board *Chiefton* was weak. Although the port wheelhouse/accommodation access door was shut, it is unclear whether it was fully clipped to ensure it was watertight. In addition, photographic evidence shows that the store room hatch was in the closed position during the tow. However, the clip position indicated that it was not fully secured and is likely to have allowed the ingress of water in the capsize situation. It is known that almost all other doors, hatches and skylights were open. As *Chiefton* was rolled to starboard, downflooding happened very quickly through the open, engine room hatch and skylights, and steering gear compartment opening, leading directly to her rapid capsize and foundering. Consequently there was no possibility of *Chiefton* recovering to the upright position when way was taken off the barge as *Steven B* went astern.

It is unknown whether *Chiefton* would have survived if all the doors and hatches had been closed because the full extent of the initial roll is unclear (although ultimately this was far greater than 40º), and flooding could still have occurred through the ventilators and possibly the funnel. However, the chances of survival would have been significantly improved had appropriate watertight integrity been maintained.

### 2.11.2 Towing hook functionality and survey

Tug skippers and crew must have confidence that tow ropes can be quickly released in an emergency, such as an impending girting. To this end, it is essential that the tug towing hook and associated emergency release systems are properly maintained and regularly tested.

*Chiefton*'s skipper did not consider operating the towing hook emergency release because his priority and focus was to attempt to re-align the tug with the advancing barge. Had he attempted to do so, it is unclear whether the system would have functioned correctly. It is acknowledged that dynamic testing of a hook release system, when under a towing load, is different to that of a static test. However, despite the release system being apparently tested every 4-6 weeks, it was reportedly "stiff" to operate, and at the post-accident survey it was found to be seized (see Section 1.13.2), raising doubts as to whether it would operate in an emergency.

The SCV Code and PLA's Craft Towage Code required that the condition of the towing hook arrangements was regularly monitored, especially to ensure the smooth and efficient action of the quick release system. It also required that the results of related inspections should be recorded and that there should be an appropriate, recorded towing equipment maintenance system for each vessel.

Specifically, Section 25.2.2.5 of the SCV Code required that:

> *"Towing arrangements should be appropriate to the task in hand and maintained to ensure that they are in an efficient working condition."*

Palmer Marine Services Limited did not have in place any structured or documented procedure for either the maintenance or routine testing of its vessels' towing equipment, including the towing hooks and emergency release system.

While the SCV Code lays down the above conditions, the MCA's Certifying Authorities' survey checklists did not require any checks to be carried out relating to towing hooks, even where towing was the main function of the vessel being surveyed. This is at variance to the comprehensive towing hook checks required for PLA surveyed vessels.

### 2.11.3 Use of lifejackets

National and local regulations, codes or company procedures may require tug crews to wear lifejackets on deck while at sea, or when operating on rivers or inland waters.

*Chiefton* carried the correct number of lifejackets on board as required by the SCV Code. In addition, the skipper and mate had their own personal lifejacket. It was also reported that the engineer/deckhand had several of his own lifejackets on board. However, only one was found, in the accommodation, during the post-salvage survey. It is possible that any lifejackets stowed in the wheelhouse may have been washed out of it as the tug capsized and foundered.

Merchant Shipping Notice (MSN) 1731 (M+F) – The Merchant Shipping and Fishing Vessels Personal Protective Equipment Regulations 1999 is applicable regarding the use of lifejackets. The Regulations require an employer to ensure that workers wear a lifejacket when there is a risk of a person falling or being washed overboard. The basis for making this judgment is through risk assessments (See Section 2.9.3).

Section 6.2 – Safety of Personnel – of PLA's Craft Towage Code states:

> *"When on deck personnel involved in craft towage **should**:*
>
> - *Wear approved and in-date self-inflating lifejackets and other appropriate PPE…throughout the operation"* [sic]

On 14 February 2011, the engineer/deckhand signed a Palmer Marine Services Limited memorandum stating that he would read and follow the company instructions contained in a series of safety memoranda. One of these covered the wearing of lifejackets by the crew while on the deck.

It was reported that the engineer/deckhand wore his lifejacket on deck while *Chiefton* was underway. Photographs taken during the upriver and downriver tows support this. However, it is apparent that lifejackets were not routinely worn while in the wheelhouse and there is also evidence that the mate did not always wear his while on the deck. Given that the engineer/deckhand was in the wheelhouse immediately before the collision and that neither he nor any of the other crew were wearing a lifejacket as they surfaced, it is highly unlikely that any were worn by the crew immediately before the accident.

The engineer/deckhand was a non-swimmer. He attended a sea survival course, the syllabus of which stressed the importance of wearing a lifejacket. He may have perceived that, while in the wheelhouse, the risk of going overboard was negligible. Consequently, he may well have removed his lifejacket while in the wheelhouse.

There is no doubt that had he been wearing a fully functional and properly adjusted lifejacket at the time of the accident, he might well have survived. Rescue craft were very quickly on the scene, and the bright orange colour of the lifejacket's inflatable bladder would have made him conspicuous in the water and directed rescuers to his position for his recovery.

### 2.11.4 Conclusion

Had Palmer Marine Services Limited formally conducted risk assessments, then the safety issues identified above, relating to the safe operation of *Chiefton,* might have been identified and control measures imposed. These would not have prevented the collision with the barge, but might have reduced the severity of the consequences in this case or other circumstances.

## 2.12 GUIDANCE

With the exception of the PLA's Craft Towage Code there is very little guidance specifically covering craft towage operations. Although the Code is comprehensive, it does not cover the combined push/pull towage operation.

DfT's "Guide to Good Practice on Port Marine Operations" provides comprehensive advice on ship towage operations. However, it does not specifically include craft towage or the explicit dangers associated with the combined push/pull configuration when both tugs are connected to the towed vessel/craft. As craft towage is often a large element of a port's commercial business, its inclusion in the publication could be considered.

MCA's draft MGN – Towage Endorsements – has been developed to improve the knowledge of towage best practice. The Annexes to the MGN define the underpinning knowledge required for the award of the Towing and Pushing, Ship Assist Towage and Sea Towage endorsement. In common with the PLA's Craft Towage Code, the underpinning knowledge requirement does not include the combined push/pull configuration.

The combined push/pull tow configuration is one of the higher risk towage operations. The operation, together with the safety issues identified during this investigation, merits inclusion in both the PLA's Craft Towage Code and MCA's draft MGN and related publications.

## 2.13 FATIGUE

The tug skippers and pilots were well rested before undertaking the downriver tow. Although the pressures relating to the high-risk bridge transit might have brought on a degree of fatigue, this is not considered to have contributed to the accident.

# SECTION 3 - CONCLUSIONS

## 3.1 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION LEADING TO RECOMMENDATIONS

1. The late and inappropriate action taken to avoid the northernmost buoy of the eastern group of buoys of the Greenwich Ship Tier, coupled with *Chiefton*'s lack of reserve power and the short tow ropes, made *Skyline Barge 19*'s collision with *Chiefton* inevitable [2.6.4]

2. The risks associated with the short tow, inability to readily lengthen the tow ropes and appropriateness of the emergency stop trials to determine a safe tow were not fully recognised. [2.6.4]

3. There was no evidence that Palmer Marine Services Limited had conducted formal risk assessments of their vessels' operations. [2.9.3, 2.11.4]

4. The watertight integrity discipline on board *Chiefton* was weak. The open doors and hatches enabled rapid downflooding, leading to the tug foundering. [2.11.1]

5. The functionality of *Chiefton*'s towing hook release system was in doubt. It was found to be seized following salvage and there was no evidence of regular, planned testing or maintenance other than greasing of the release pin. [2.11.2]

6. The MCA's Certifying Authorities' survey checklists do not require checks to be made on towing equipment even if the surveyed vessel's primary role is towage. [2.11.2]

7. *Chiefton'*s mate did not always wear his lifejacket while on deck [2.11.3]

8. Neither the PLA's Craft Towage Code nor MCA's draft MGN – Towing Endorsements, cover the combined push/pull craft towage configuration or the dangers associated with it. [2.12]

## 3.2 SAFETY ISSUES IDENTIFIED DURING THE INVESTIGATION WHICH HAVE NOT RESULTED IN RECOMMENDATIONS BUT HAVE BEEN ADDRESSED

1. The turning effect of *Steven B*'s starboard helm on *Skyline Barge 19* compounded the risk of *Chiefton* being overrun by the barge following *Chiefton*'s skipper's application of port helm. [2.4]

2. Pilot 3's manoeuvre to prevent *Skyline Barge 19* from striking the buoy was inappropriate in the circumstances. It was based on trials conducted earlier in Limehouse Reach when the dynamics were entirely different and no consideration was given to *Chiefton'*s lack of reserve of power. [2.4]

3. The dangers of overrun, due to variation in speeds between the barge and *Chiefton* were not recognised or properly considered during either the planning or execution of the tow. [2.5, 2.6.1]

4. The lack of experience of all those involved with the combined push/pull configuration was not recognised during the planning or risk assessment phases, so the need for a towmaster or other person in charge was not identified. [2.8.1, 2.8.2, 2.10]

5. The PLA's navigation simulator had a limited craft towage simulation capability, but it was seldom used. Despite its limitations, the simulator was not used in preparation for the tow. [2.8.3]

6. A method statement covering all phases of the towage operation, including cross-referencing to all other risk assessments, was not provided, nor was the need for it considered. [2.9.1, 2.9.2]

7. The passage plan centred almost entirely on the bridge transit phases and did not properly consider the need for river passage planning or its related risks. [2.9.4]

8. Pilot 1 and pilot 3 did not wear lifejackets, contrary to PLA's policy and despite being at risk of falling overboard because the crane's counterweight was unguarded and extended almost to the beam of the barge. [2.8.4]

## 3.3 OTHER SAFETY ISSUES

1. Both pilot 3 and *Chiefton*'s skipper lost their situational awareness in terms of positioning monitoring and of anticipating the effect of the flood tidal stream, probably through a reduced level of vigilance following completion of the difficult bridge transits. [2.3]

2. Pilot 3 was content for *Chiefton*'s skipper to make independent helm adjustments. This might have led him to maintaining a reduced level of vigilance, resulting in an over-reliance on the skipper to correct any deviation of the tow. [2.3]

3. The risk control measure of having a second pilot on board the barge was not optimised because he was not positioned adjacent to pilot 3, in an area that allowed him a good all round view of the tow. [2.3]

4. The evidence indicates that none of the crew of *Chiefton* were wearing lifejackets at the time of the accident. Had the casualty done so, he might well have survived. [2.11.3]

## SECTION 4 - ACTIONS TAKEN

The **Port of London Authority** has:

- Taken action to develop procedures for "non-routine" towage operations, in addition to existing risk control measures, that:
    - Define "non-routine" towage operations;
    - Identify and declare who is in overall command of the towage operation. Once determined, that person is to be known as the Tow Master; and
    - Require the provision of an overall method statement, which includes: securing arrangements for the tow and for the cargo (where applicable); how the tow will be conducted; and a berth-to-berth passage plan to be submitted in good time before the operation starts.
- Initiated a review of the port's risk assessment process to ensure that:
    - The Tow Master conducts and submits his own risk assessment to the Port of London Authority, for review and comment, well in advance of the start of the proposed tow.
    - Reference is made to all other relevant risk assessments, including those required for compliance with the Port Marine Safety Code.
- Commenced a review of the Port of London's Code of Practice for Craft Towage Operations on the Thames to reflect the safety issues identified during the investigation and to include the combined push/pull craft tow configuration.
- Enhanced its simulator training for all grades of pilot with respect to the combined push/pull towage configuration. This will include, where possible, the attendance of a tug master to provide professional advice and realism.
- Issued a Pilotage Department Operational letter, OP/37/2011 dated 21 December 2011 **(Annex I)**, mandating the occasions when pilots must wear lifejackets or Sea Safe coats.

The **Marine Accident Investigation Branch** has:

- Produced an accident related Safety Flyer **(Annex J)** detailing the safety issues identified during the investigation. The Flyer will be promulgated to the towage industry and to port authorities.

# SECTION 5 - RECOMMENDATIONS

The **Maritime and Coastguard Agency** is recommended to:

2012/116 Advise Certifying Authorities to ensure their survey checklists reflect the content of Sub-section 25.2.2 of the Small Commercial Vessel and Pilot Boat Code, by including a requirement to check the efficient operation of the emergency release system from all operating positions.

2012/117 Provide additional guidance relating to the following elements of combined push/pull towage operations:

- Tug selection to ensure that bollard pull is appropriate for the intended operation.
- The importance of effective communications to ensure control of towing operations at all stages.
- The assessment and adjustment of tow length to avoid the risk of overrun,

and, specifically, include these elements in the "Underpinning Knowledge" syllabi of the draft Marine Guidance Note – Towage Endorsements.

The **British Tugowners Association, National Workboat Association, British Ports Association,** and **UK Major Ports Group** are recommended to:

2012/118 Promulgate MAIB's Safety Flyer at **Annex J** to their membership.

**Palmer Marine Services Limited** is recommended to:

2012/119 Review its procedures to ensure compliance with the PLA's Code of Practice for Craft Towage Operations on the Thames 2011 and the MCA's Small Commercial Vessel and Pilot Boat Code in respect to:

- Towing hook testing, maintenance and record keeping
- Use of lifejackets
- Maintaining watertight integrity
- Conduct of risk assessments.

**Marine Accident Investigation Branch**
**May 2012**

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

Marine Accident Report

INVESTORS IN PEOPLE