PORT OF TILBURY LONDON

PLANNING ACT 2008
INFRASTRUCTURE PLANNING
(APPLICATIONS: PRESCRIBED FORMS AND PROCEDURE) REGULATIONS 2009
REGULATION 5 (2) (a)

PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

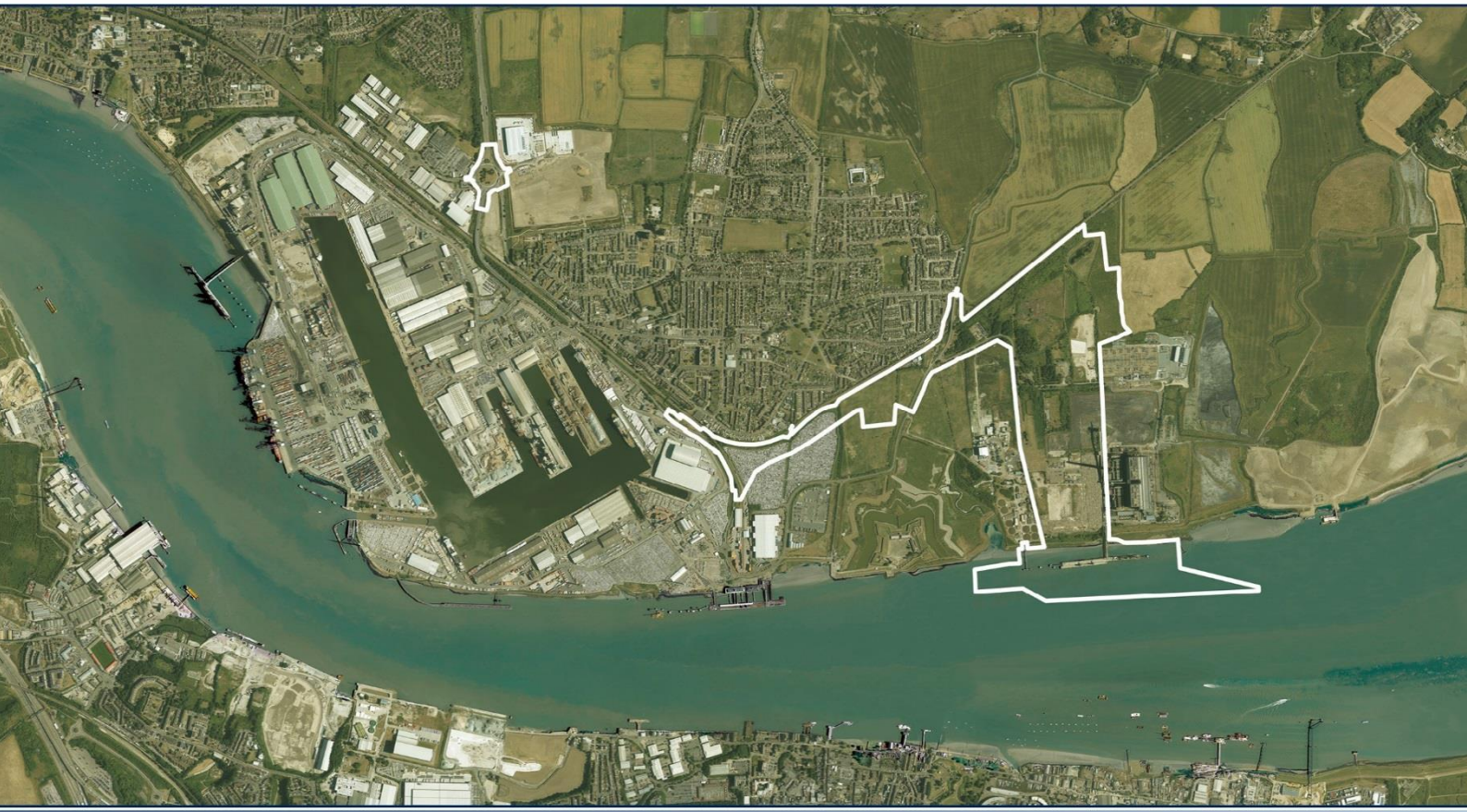
TILBURY2

TR030003

VOLUME 6 PART B

ES APPENDIX 14.A: NAVIGATION RISK ASSESSMENT

DOCUMENT REF: 6.2 14.A



TILBURY2

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Abbreviation	Description
ALARP	As Low As Reasonably Practical
CD	Chart Datum
CHA DMC FRA	Competent Harbour Authority Drennan Marine Consulting Formal Risk Assessment
GtGP	Guide to Good Practice (part of the PMSC)
HW	High Water
IMO	International Maritime Organisation
ISPS	International Ship and Port Facility Security Code
LOA	Length Overall
LW	Low Water
m	Metre(s)
MCA	Maritime and Coastguard Agency
MSC	Maritime Safety Committee (of the IMO)
NRA	Navigational Risk Assessment
OSRP	Oil Spill Response Plan
PLA	Port of London Authority
PMSC	Port Marine Safety Code
POTLL	Port of Tilbury London Ltd
RoRo	Roll on Roll Off
SHA	Statutory Harbour Authority
SMS	Safety Management System
T2	Tilbury 2 Development

1. Introduction

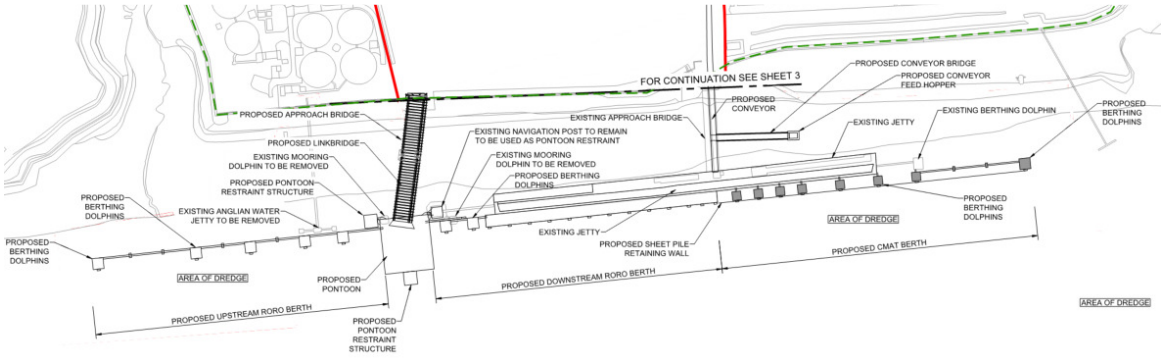
1.1. Context of the Development

Port of Tilbury London Limited (PoTLL) is proposing a new port terminal on the north bank of the River Thames at Tilbury, a short distance to the east of its existing port. The proposed port terminal will be constructed on largely previously developed land that formed the western part of the now redundant Tilbury Power Station.

The project is known as "Tilbury2." The proposed main uses on the site will be a unitised Roll-on/Roll-off (Ro-Ro) terminal and a Construction Materials and Aggregates terminal (the "CMAT"), and associated infrastructure including rail and road facilities and revisions to the existing marine infrastructure. To achieve this, the existing Tilbury Power Station jetty is being adapted, and additional berths added, to provide the following marine facilities:

- 1 x deep-water construction materials berth (CMAT), which will also accommodate export in smaller vessels / barges
- 2 x RoRo berths for conventional stern-ramp vessels. The upriver RoRo berth is being designed to also accommodate car carrier ships with a starboard quarter ramp. This is intended to provide additional resiliency and capacity to the existing Tilbury Riverside car handling facility should it be needed in the future.

Figure 1:1 Berth General Arrangement



1.2. Design Ships

The representative proposed Design Ships for the T2 berths area as follows:

Table 1-1 Design Ship information

Vessel Particulars	Design Ships		
	Ship 1	Ship 2	Ship 3
Ship Type	Stern ramp RoRo	Car Carrier	Bulk Aggregates
Proposed Berth	Both RoRo berths	Upper RoRo Berth	Aggregates berth
LOA	150 - 200m	200 - 240m	200 - 250m
Beam	20 - 26m	30 - 36m	30 - 38m
Maximum Draft	7.4m	8.8m	15m*
Deadweight	10,000 - 13,000 dwt	25,000 - 31,000 dwt	80,000 - 97,000 dwt
Main Propulsion	1 x diesel engine with a single twist flow rudder	1 x diesel engine, with a single CPP and conventional rudder	1 x diesel engine, with a single fixed pitch propeller and conventional rudder
Manoeuvring Aids	1 x B/T (1800kW CPP) 1 x S/T (900kW CPP)		1 x B/T (1800kW)

Illustrations of some representative Design Ships are shown in Appendix A.

2. Background to the NRA

All UK Statutory Harbour Authorities (SHAs) have a responsibility to comply with, inter alia, the letter and spirit of the Port Marine Safety Code (PMSC). A core requirement of the PMSC is that the Duty Holder of the SHA must:

- Assess, and keep under review, the marine risks within the waters for which the SHA is responsible;
- Develop policies and procedures to manage those risks and to employ, resource, and empower suitably competent personnel to manage marine operations and reduce risk;
- Undertake the above by means of a structured Safety Management System (SMS), which has clear objectives, clear outcomes, and has the concept of continuous improvement embedded within it.

As might be expected for a large, diverse, and high-profile port like London, the Port of London Authority (PLA) has extremely high standards of navigation and a pro-active approach to management of risk. This applies to existing “proven” marine operations and also to proposed new developments such as T2.

The NRA methodology followed is essentially the Formal Risk Assessment (FRA) process preferred and used extensively by the PLA themselves, which is based on guidance published by the International Maritime Organisation (IMO) in MSC/Circ.1180-MEPC/Circ.474 and MSC-MEPC.2/Circ.5.

3. Assessment Details

After a period of preparation, a Hazard Identification (Hazid) Workshop was convened at Leslie Ford House, Tilbury Docks, on Friday 17th March 2017. The attendees at the Hazid were:

Table 3-1 Hazid Attendees and Roles

Name	Organisation	Role
Ian Wright	POTLL	Civil Engineering Manager
Kaj Steffensen	POTLL	HS&E Manager
Geoff Holland	POTLL	Harbour Master
Steve Rushbrook	PLA	Deputy Harbour Master (Lower District)
Cerwyn Phillips	PLA	Pilotage Operations Manager
Adrian Hall	Atkins	Designer
Tom McKay	Atkins	Design Engineer
Tom Drennan	Drennan Marine Consultancy (for Atkins)	Hazid Facilitator

Prior to the Workshop, a Hazid Pack had been prepared and distributed to the attendees. The purpose of the Pack was to describe the proposed berth layouts and to confirm the methodology, terminology, and process for the Hazid. Relevant parts of the above Hazid Pack are replicated in this NRA report.

3.1. Terminology and Application

- A ***hazard*** is an unwanted and unplanned event which has the potential to cause harm to persons, the environment, property, or the reputation of key stakeholders
- Each hazard is assessed and a consensus reached in relation to the ***likelihood*** of that hazard occurring
- Each hazard is also be assessed in relation to the ***consequences***, if the hazard were to be realised
- Using previously defined criteria, the agreed values of likelihood and consequence are used to determine the ***risk score***. The above process assumes that all existing and planned risk control measures are already in place and are effective
- The above process will produce a ***base line risk score***.
- If the base line risk score lies within one of the unacceptably high bands, further risk control measures are considered and applied until the ***residual risk score*** is tolerable, as defined in the matrix.

3.2. Risk Matrix and Risk Categories

As stated above, the definitions of the likelihood and consequence of a hazard occurrence are contained within an industry standard 5 x 5 matrix, which also shows the resultant risk categorisation ranging from:

- Extreme Risk
- High Risk
- Moderate Risk
- Minor Risk
- Slight Risk

Whilst all hazards should be kept under review, it may be considered that a hazard categorised as Moderate, Minor, or Slight is already As Low As Reasonably Practicable (ALARP). Hazards categorised as Extreme or High Risk must have some suitable mitigations or risk control options (RCO's) to reduce the risk score until the residual risk is ALARP.

4. Assumptions

This NRA is limited to the hazards and risks associated with the design and operation of the T2 berths only – not the hazards and risks associated with the transit of T2 ships in the Thames Estuary as they transit between open sea and Tilbury. This is because these hazards and risks have already been subject to a robust NRA by the PLA as part of their wider responsibilities as a Statutory Harbour Authority (SHA) and, by virtue of being the pilotage service, the Competent Harbour Authority (CHA) for these waters.

Accordingly, this NRA focuses on scenarios where the T2 ship is already in Gravesend Reach, ready to berth at its nominated T2 facility, instead of how the ship arrived at that position.

In support of the overall Hazid and NRA process, it has also been assumed that the following will form part of the development of T2 once it is operating. As such, PoTLL, or its tenants as appropriate will be required to:

- Develop and implement a Maritime and Coastguard Agency (MCA) approved Oil Spill Response Plan (OSRP). The T2 plan will draw upon the MCA's Contingency Planning for Marine Pollution Preparedness and Response (Guidelines for Ports), and will be compliant with PLA approvals for oil spill response
- Develop and implement terminal-specific Waste Management Plans in accordance with the requirements of the Merchant Shipping (Port Waste Reception Facilities) Regulations and PLA requirements
- Develop and implement a terminal-specific Security Plan in accordance with the requirements of the International Port Facility and Security (ISPS) Code, and PLA requirements
- Develop and implement comprehensive Terminal Operations and Safety Plan which will reflect the policies, practices, and working methods of POTLL. Part of that plan will include a commitment to ensure that ships using T2 are fully aware of the physical and operational characteristics of the facility.

5. Summary of Results

This section summarises the results of the NRA based on the inputs given at the Hazid Workshop, and further review by Atkins and POTLL personnel.

It shall be noted that the scoring of these hazards was not actually carried out at the Hazid, because that meeting became more of a "brainstorming session" from the participants on the proposed design and the operational aspects of the berths if the berths were to be built as shown in Figure 1:1. Instead, the scores and mitigations used in the NRA spreadsheet are those of the report author, and are based on the comments from all the Hazid participants.

Table 5-1and Appendix 2 show that 24 hazards have been identified and assessed as follows:

Table 5-1 Summary of hazards and categorisation

Risk Category	All hazards (baseline risk)	All hazards (mitigated risk)
Slight	0	0
Minor	3	11
Moderate	17	13
High	4	0
Extreme	0	0

In terms of the detail, it was the consensus view of the Hazid that:

- the proposed "dog legged" configuration of the mooring dolphins at the east end of the aggregates berth and west end of the Upper RoRo berth was unnecessary and would add risk due to the need to employ mooring boats
- the proposed ship/ship separation between the Lower RoRo vessel and the Aggregates vessel (approximately 30m) was insufficient to be confident that contact between the RoRo and bulk carrier would be avoided in all weather conditions
- the dolphin and fendering arrangements for the Lower RoRo berth should be re-configured so that there was a reduced "gap" between the pontoon and the existing Tilbury Power Station berth
- the vessel access / gangway arrangements for the bulk carrier, and the smaller export vessels at the same berth, required a suitably engineered solution
- the walkway arrangements between mooring dolphins and between dolphins and the berth at the aggregates berth should be reviewed.

These issues are considered further in Section 6.

6. Conclusions and Recommendations

As described above, the initial risk assessment identified five hazards where some action was considered appropriate to optimise the T2 berth designs in ways which would mitigate the risks.

These are summarised below, along with the agreed actions which will be required to be implemented as part of the detailed design process.

Table 6-1 Hazard log and agreed actions

Hazard Ref	Description	Agreed action
7, 18	Proposed "dog legged" configuration of dolphins is not necessary. A straight alignment would negate the need for mooring boats, and so reduce the risk	This is agreed and will be incorporated into the design process
4, 5, 14, 15	Ship/ship separation between bulk carrier and Lower RoRo considered to be too tight to give confidence of repeated safe berthing and un-berthing in all conditions	A series of ship simulations are to be commissioned and the outcome of these will be used to determine the extent to which the aggregates berth should be moved further east, away from Tilbury Fort and thereby increasing the ship/ship separation
13, 17	Vessel using Lower RoRo berth requires improved dolphin / fendering arrangements to avoid the port quarter entering into the gap between the existing Tilbury Power Station berth and the new pontoon	This is agreed and will be incorporated into the design process
8, 9	Vessels using the aggregates berth require a fit-for-purpose gangway arrangement for access between vessel and berth	This is agreed and will be incorporated into the design process
10	Walkway / access arrangements for dolphins at bulk carrier berth to be improved to allow easier access between dolphins	This is agreed and will be incorporated into the design process
7, 18	Proposed "dog legged" configuration of dolphins is not necessary. A straight alignment would negate the need for mooring boats, and so reduce the risk	This is agreed and will be incorporated into the design process
4, 5, 14, 15	Ship/ship separation between bulk carrier and Lower RoRo considered to be too tight to give confidence of repeated safe berthing and un-berthing in all conditions	A series of ship simulations are to be commissioned and the outcome of these will be used to determine the extent to which the aggregates berth should be moved further east, away from Tilbury Fort and thereby increasing the ship/ship separation

Although a key part of the proposed ship manoeuvring simulations is to define the preferred distance between the Lower RoRo and large bulk carrier moored at the construction materials berth, a number of other arrival and departure scenarios will also be tested for all T2 ships.

Accordingly, the planned and future use of the PLA simulator may be regarded as part of the on-going risk control measures for marine operations at Tilbury T2.

Based on the assumption that all of the above actions will be duly implemented into the final berth design, the original hazards have been re-assessed to reflect all of the risk control options (RCOs). With these RCOs incorporated, the residual risks are reduced to a moderate / ALARP level (see Table 5-1and Appendix B).

Appendices

Appendix A. Representative Design Ships for T2 Berth

A.1. Images of Design Ships

RoRo Ships:

Car Carriers:

Bulk Carriers:

Appendix B. Hazard Scoring and Risk Assessment Results

Issue 12 (February 2016)

Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
1	5	7	Gravesend Reach	Grounding	Bulk carrier grounds whilst berthing at T2 Aggregates Berth					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Minor vessel damage		Incorrectly declared draft				1	Enhanced passage planning for a deep draft ship		Yes	50%	0%	20.0	£100,000	8.1	9.0		
							Potential for pollution (Tier 2 max)		Incorrect passage planning				2	POTLL Harbour Master and T2 Operator to hold latest bathymetric charts		Yes	20%	0%	25.0	£100,000	7.8			
							Minor injury to crew		Vessel out of position - pilot / master error				3	Consider additional AtoN to mark limit of navigable areas		Yes	40%	0%	41.6	£100,000	7.1	Baseline Level		
							Impact on traffic flow / river closure		Vessel out of position - collision avoidance				4			No	0%	0%	41.6	£100,000	7.1	Moderate		
									Loss of power				5			No	0%	0%	41.6	£100,000	7.1			
									Failure of tug or tug line				6			No	0%	0%	41.6	£100,000	7.1	Residual Risk		
									Inaccurate bathymetric information				7			No	0%	0%	41.6	£100,000	7.1	7.1		
									Adverse weather affects controllability				8			No	0%	0%	41.6	£100,000	7.1			
									Tidal cut				9			No	0%	0%	41.6	£100,000	7.1			
													10			No	0%	0%	41.6	£100,000	7.1	Residual Level		
													11			No	0%	0%	41.6	£100,000	7.1	Moderate		
													12			No	0%	0%	41.6	£100,000	7.1			
													13			No	0%	0%	41.6	£100,000	7.1	Risk Reduction		
													14			No	0%	0%	41.6	£100,000	7.1	1.9		
													15			No	0%	0%	41.6	£100,000	7.1			
2	17	14	Gravesend Reach	Collision	Bulk carrier collides with another vessel whilst manoeuvring for T2 Aggregates Berth					2	3	6.0		Baseline with no additional risk controls					100.0	£100,000	6.0	Baseline Risk		
							Moderate vessel damage		Failure to follow Collision Regulations				1	Adherence to Collision Regulations		Yes	99%	0%	1000.0	£100,000	3.0	6.0		
							Potential for pollution (Tier 2 max)		Traffic congestion				2	Active traffic management by VTS		yes	10%	0%	1000.0	£100,000	3.0			
							Moderate injury to crew		Pilot / master error				3	Adherence to fog procedures		yes	10%	0%	1000.0	£100,000	3.0	Baseline Level		
							Impact on traffic flow / river closure		Reduced visibility				4			No	0%	0%	1000.0	£100,000	3.0	Moderate		
									Vessel not under control and drifting				5			No	0%	0%	1000.0	£100,000	3.0			
									Mechanical failure				6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	3.0		
													15			No	0%	0%	1000.0	£100,000	3.0			

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3	5	11	T2 Aggregates Berth	Contact	Contact - bulk carrier contacts one of the dolphins					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Moderate damage to bulk carrier		Pilot or master misjudgement				1	Dolphins to be spaced and designed in accordance with codes		Yes	10%	0%	11.1	£100,000	8.9	9.0		
							Potential for pollution (Tier 2 max)		Inadequate tug provision				2	Comply with Tug Code recommendations		Yes	50%	50%	22.2	£50,000	7.2			
							Moderate injury to crew		Tug failure				3	Establish and adhere to wind and current berthing thresholds		Yes	50%	0%	44.4	£50,000	6.3	Baseline Level		
							Moderate damage to dolphin(s)		Towline failure				4	Additional dolphin to protect corner of TPS Jetty		Yes	10%	0%	49.3	£50,000	6.2	Moderate		
							Moderate damage to walkways		Adverse weather affects controllability				5			No	0%	0%	49.3	£50,000	6.2			
									Vessel engine or steering failure				6			No	0%	0%	49.3	£50,000	6.2	Residual Risk		
													7			No	0%	0%	49.3	£50,000	6.2	6.2		
													8			No	0%	0%	49.3	£50,000	6.2			
													9			No	0%	0%	49.3	£50,000	6.2			
													10			No	0%	0%	49.3	£50,000	6.2	Residual Level		
													11			No	0%	0%	49.3	£50,000	6.2	Moderate		
													12			No	0%	0%	49.3	£50,000	6.2			
													13			No	0%	0%	49.3	£50,000	6.2	Risk Reduction		
													14			No	0%	0%	49.3	£50,000	6.2	2.8		
													15			No	0%	0%	49.3	£50,000	6.2			
4	1	3	T2 Aggregates Berth	Contact	Contact - bulk carrier contacts RoRo on adjacent berth					4	3	12.0		Baseline with no additional risk controls					1.0	£100,000	12.0	Baseline Risk		
							Moderate damage to bulk carrier		Insufficient spacing between berths				1	Increase berth separation based on simulation outcomes		Yes	75%	0%	4.0	£100,000	10.2	12.0		
							Moderate injury to crew (bulk carrier)		Pilot or master misjudgement				2	Dolphins to be spaced and designed in accordance with codes		Yes	10%	0%	4.4	£100,000	10.1			
							Moderate damage to RoRo		Inadequate tug provision				3	Comply with Tug Code recommendations		Yes	50%	0%	8.9	£100,000	9.2	Baseline Level		
							Moderate injury to crew (RoRo)		Tug failure				4	Establish and adhere to wind and current berthing thresholds		Yes	50%	0%	17.7	£100,000	8.3	High		
							Moderate injury to T2 staff		Towline failure				5			No	0%	0%	17.7	£100,000	8.3			
							Minor damage to T2 infrastructure		Adverse weather affects controllability				6			No	0%	0%	17.7	£100,000	8.3	Residual Risk		
									Vessel engine or steering failure				7			No	0%	0%	17.7	£100,000	8.3	8.3		
													8			No	0%	0%	17.7	£100,000	8.3			
													9			No	0%	0%	17.7	£100,000	8.3			
													10			No	0%	0%	17.7	£100,000	8.3	Residual Level		
													11			No	0%	0%	17.7	£100,000	8.3	Moderate		
													12			No	0%	0%	17.7	£100,000	8.3			
													13			No	0%	0%	17.7	£100,000	8.3	Risk Reduction		
													14			No	0%	0%	17.7	£100,000	8.3	3.7		
													15			No	0%	0%	17.7	£100,000	8.3			

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5	1	1	T2 Aggregates Berth	Contact	Contact - RoRo berthing at lower berth contacts moored bulk carrier					4	3	12.0		Baseline with no additional risk controls					1.0	£100,000	12.0	Baseline Risk		
							Moderate damage to bulk carrier		Insufficient spacing between berths				1	Increase berth separation based on simulation outcomes		yes	75%	0%	4.0	£100,000	10.2	12.0		
							Moderate injury to crew (bulk carrier)		Pilot or master misjudgement				2	Dolphins to be spaced and designed in accordance with codes		yes	10%	0%	4.4	£100,000	10.1			
							Moderate damage to RoRo		Adverse weather affects controllability				3	Establish and adhere to wind and current berthing thresholds		yes	50%	0%	8.9	£100,000	9.2	Baseline Level		
							Moderate injury to crew (RoRo)		Vessel engine or steering failure				4			No	0%	0%	8.9	£100,000	9.2	High		
							Minor damage to T2 infrastructure						5			No	0%	0%	8.9	£100,000	9.2			
													6			No	0%	0%	8.9	£100,000	9.2	Residual Risk		
													7			No	0%	0%	8.9	£100,000	9.2	9.2		
													8			No	0%	0%	8.9	£100,000	9.2			
													9			No	0%	0%	8.9	£100,000	9.2			
													10			No	0%	0%	8.9	£100,000	9.2	Residual Level		
													11			No	0%	0%	8.9	£100,000	9.2	Moderate		
													12			No	0%	0%	8.9	£100,000	9.2			
													13			No	0%	0%	8.9	£100,000	9.2	Risk Reduction		
													14			No	0%	0%	8.9	£100,000	9.2	2.8		
													15			No	0%	0%	8.9	£100,000	9.2			
6	22	14	T2 Aggregates Berth	Contact	Contact - passing ship in contact with moored bulk carrier					1	3	3.0		Baseline with no additional risk controls					1000.0	£100,000	3.0	Baseline Risk		
							Moderate damage to bulk carrier		Pilot or master misjudgement				1	T2 Berths are well outside the channel		No	0%	0%	1000.0	£100,000	3.0	3.0		
							Moderate injury to crew (bulk carrier)		Mechanical failure on passing ship				2	Through shipping does not normally navigate at extreme edge of channel		No	0%	0%	1000.0	£100,000	3.0			
							Moderate damage to other ship		Severe adverse weather				3	Passing ships will have their anchor ready to let go (PLA Byelaw 18)		Yes	50%	0%	1000.0	£100,000	3.0	Baseline Level		
							Moderate injury to crew (other ship)						4			No	0%	0%	1000.0	£100,000	3.0	Minor		
							Minor damage to T2 infrastructure						5			No	0%	0%	1000.0	£100,000	3.0			
							Possible oil pollution (Tier 2)						6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	0.0		
													15			No	0%	0%	1000.0	£100,000	3.0			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
7	5	13	T2 Aggregates Berth	Mooring incident	Mooring incident					3	3	**9.0**		Baseline with no additional risk controls					10.0	£100,000	9.0	**Baseline Risk**		
							Injury to bulk carrier crew		Poor berth design				1	Align mooring dolphins to negate the use of mooring boats		yes	50%	0%	20.0	£100,000	8.1	**9.0**		
							Injury to mooring personnel		Inadequate provision of mooring points				2	Consult with candidate aggregate vessel operator (use of wires)		yes	20%	0%	25.0	£100,000	7.8			
							Minor damage to berth infrastructure		Poor leads for mooring lines				3	Install capstans at dolphins where wires are to be used		yes	50%	0%	49.9	£100,000	6.9	**Baseline Level**		
							Potential for mooring lines to foul propellers		Inadequate standards of crewing				4	Develop a standard mooring plan as part of the T2 Operation Procedures		yes	50%	0%	99.9	£100,000	6.0	**Moderate**		
									Adverse weather during mooring				5			No	0%	0%	99.9	£100,000	6.0			
									Difficulty with running and handling wires				6			No	0%	0%	99.9	£100,000	6.0	**Residual Risk**		
													7			No	0%	0%	99.9	£100,000	6.0			
													8			No	0%	0%	99.9	£100,000	6.0	**6.0**		
													9			No	0%	0%	99.9	£100,000	6.0			
													10			No	0%	0%	99.9	£100,000	6.0	**Residual Level**		
													11			No	0%	0%	99.9	£100,000	6.0	**Moderate**		
													12			No	0%	0%	99.9	£100,000	6.0			
													13			No	0%	0%	99.9	£100,000	6.0	**Risk Reduction**		
													14			No	0%	0%	99.9	£100,000	6.0	**3.0**		
													15			No	0%	0%	99.9	£100,000	6.0			
8	5	14	T2 Aggregates Berth	Vessel access	Vessel access - potential personal injury to personnel transferring between T2 Aggregates Berth and bulk carrier					3	3	**9.0**		Baseline with no additional risk controls					10.0	£100,000	9.0	**Baseline Risk**		
							Personal injury if access arrangements are inadequate		Use of ship's gangway to try and bridge gap between ship and jetty				1	T2 Aggregates berth to be equipped with bespoke jetty ,mounted gangway tower		Yes	99%	0%	998.8	£100,000	3.0	**9.0**		
									Use of ship's gangway to a berthing dolphin				2			No	0%	0%	998.8	£100,000	3.0			
									Use of some kind of inadequate ladder arrangement				3			No	0%	0%	998.8	£100,000	3.0	**Baseline Level**		
													4			No	0%	0%	998.8	£100,000	3.0	**Moderate**		
													5			No	0%	0%	998.8	£100,000	3.0			
													6			No	0%	0%	998.8	£100,000	3.0	**Residual Risk**		
													7			No	0%	0%	998.8	£100,000	3.0			
													8			No	0%	0%	998.8	£100,000	3.0	**3.0**		
													9			No	0%	0%	998.8	£100,000	3.0			
													10			No	0%	0%	998.8	£100,000	3.0	**Residual Level**		
													11			No	0%	0%	998.8	£100,000	3.0	**Minor**		
													12			No	0%	0%	998.8	£100,000	3.0			
													13			No	0%	0%	998.8	£100,000	3.0	**Risk Reduction**		
													14			No	0%	0%	998.8	£100,000	3.0	**6.0**		
													15			No	0%	0%	998.8	£100,000	3.0			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
9	5	14	T2 Aggregates Berth	Vessel access	Vessel access - potential personal injury to personnel transferring between T2 Aggregates Berth and smaller export vessel					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Personal injury if access arrangements are inadequate		Use of ship's gangway to try and bridge gap between ship and jetty				1	T2 Aggregates berth to be equipped with bespoke jetty ,mounted gangway tower		Yes	99%	0%	998.8	£100,000	3.0	9.0		
									Use of ship's gangway to a berthing dolphin				2	Access arrangements for export vessel to be considered in detail and resolved with tower gangway or a separate solution		Yes	99%	0%	1000.0	£100,000	3.0			
									Use of some kind of inadequate ladder arrangement				3			No	0%	0%	1000.0	£100,000	3.0	Baseline Level		
													4			No	0%	0%	1000.0	£100,000	3.0	Moderate		
													5			No	0%	0%	1000.0	£100,000	3.0			
													6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	6.0		
													15			No	0%	0%	1000.0	£100,000	3.0			
10	5	14	T2 Aggregates Berth	Mooring dolphin access	Mooring dolphin access potential personal injury to personnel transferring to and from dolphins					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Personal injury to mooring personnel		Inefficient provision of walkways accessing dolphins				1	Consider redesign to include walkways between dolphins, as well as between dolphins and jetty		Yes	99%	0%	998.8	£100,000	3.0	9.0		
													2			No	0%	0%	998.8	£100,000	3.0			
													3			No	0%	0%	998.8	£100,000	3.0	Baseline Level		
													4			No	0%	0%	998.8	£100,000	3.0	Moderate		
													5			No	0%	0%	998.8	£100,000	3.0			
													6			No	0%	0%	998.8	£100,000	3.0	Residual Risk		
													7			No	0%	0%	998.8	£100,000	3.0	3.0		
													8			No	0%	0%	998.8	£100,000	3.0			
													9			No	0%	0%	998.8	£100,000	3.0			
													10			No	0%	0%	998.8	£100,000	3.0	Residual Level		
													11			No	0%	0%	998.8	£100,000	3.0	Minor		
													12			No	0%	0%	998.8	£100,000	3.0			
													13			No	0%	0%	998.8	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	998.8	£100,000	3.0	6.0		
													15			No	0%	0%	998.8	£100,000	3.0			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
11	5	5	Gravesend Reach	Grounding	RoRo grounds whilst berthing at T2 Lower RoRo Berth					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Minor vessel damage		Incorrect passage planning				1	Shallower draft of RoRo (relative to bulk carrier) reduces likelihood		Yes	50%	0%	20.0	£100,000	8.1	9.0		
							Potential for pollution (Tier 2 max)		Vessel out of position - pilot / master error				2			No	0%	0%	20.0	£100,000	8.1			
							Minor injury to crew		Vessel out of position - collision avoidance				3			No	0%	0%	20.0	£100,000	8.1	Baseline Level		
							Impact on traffic flow / river closure		Loss of power				4			No	0%	0%	20.0	£100,000	8.1	Moderate		
									Inaccurate bathymetric information				5			No	0%	0%	20.0	£100,000	8.1			
									Adverse weather affects controllability				6			No	0%	0%	20.0	£100,000	8.1	Residual Risk		
									Tidal cut				7			No	0%	0%	20.0	£100,000	8.1	8.1		
													8			No	0%	0%	20.0	£100,000	8.1			
													9			No	0%	0%	20.0	£100,000	8.1			
													10			No	0%	0%	20.0	£100,000	8.1	Residual Level		
													11			No	0%	0%	20.0	£100,000	8.1	Moderate		
													12			No	0%	0%	20.0	£100,000	8.1			
													13			No	0%	0%	20.0	£100,000	8.1	Risk Reduction		
													14			No	0%	0%	20.0	£100,000	8.1	0.9		
													15			No	0%	0%	20.0	£100,000	8.1			
12	17	14	Gravesend Reach	Collision	RoRo collides with another vessel whilst manoeuvring for T2 Lower RoRo Berth					2	3	6.0		Baseline with no additional risk controls					100.0	£100,000	6.0	Baseline Risk		
							Moderate vessel damage		Failure to follow Collision regulations				1	Adherence to Collision Regulations		Yes	99%	0%	1000.0	£100,000	3.0	6.0		
							Potential for pollution (Tier 2 max)		Traffic congestion				2	Active traffic management by Vessel Traffic Service (VTS)		Yes	10%	0%	1000.0	£100,000	3.0			
							Moderate injury to crew		Pilot / master error				3	Adherence to fog procedures		Yes	10%	0%	1000.0	£100,000	3.0	Baseline Level		
							Impact on traffic flow / river closure		Reduced visibility				4			No	0%	0%	1000.0	£100,000	3.0	Moderate		
									Vessel not under control and drifting				5			No	0%	0%	1000.0	£100,000	3.0			
									Mechanical failure				6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	3.0		
													15			No	0%	0%	1000.0	£100,000	3.0			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
13	5	11	T2 Lower RoRo Berth	Contact	Contact - RoRo berthing at lower berth contacts dolphin					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Moderate damage to RoRo		Pilot or master misjudgement				1	Dolphins to be spaced and designed in accordance with codes		Yes	10%	0%	11.1	£100,000	8.9	9.0		
							Potential for pollution (Tier 2 max)		Adverse weather affects controllability				2	Take a tug in strong winds		Yes	50%	50%	22.2	£50,000	7.2			
							Moderate injury to crew		Vessel engine or steering failure				3	Establish and adhere to wind and current berthing thresholds		Yes	50%	0%	44.4	£50,000	6.3	Baseline Level		
							Moderate damage to dolphin(s)						4	Additional dolphin to prevent quarter of RoRo "seeking the gap"		Yes	10%	0%	49.3	£50,000	6.2	Moderate		
							Moderate damage to walkways						5			No	0%	0%	49.3	£50,000	6.2			
													6			No	0%	0%	49.3	£50,000	6.2	Residual Risk		
													7			No	0%	0%	49.3	£50,000	6.2	6.2		
													8			No	0%	0%	49.3	£50,000	6.2			
													9			No	0%	0%	49.3	£50,000	6.2			
													10			No	0%	0%	49.3	£50,000	6.2	Residual Level		
													11			No	0%	0%	49.3	£50,000	6.2	Moderate		
													12			No	0%	0%	49.3	£50,000	6.2			
													13			No	0%	0%	49.3	£50,000	6.2	Risk Reduction		
													14			No	0%	0%	49.3	£50,000	6.2	2.8		
													15			No	0%	0%	49.3	£50,000	6.2			
14	1	1	T2 Lower RoRo Berth	Contact	Contact - RoRo berthing at lower berth contacts bulk carrier on adjacent berth					4	3	12.0		Baseline with no additional risk controls					1.0	£100,000	12.0	Baseline Risk		
							Moderate damage to RoRo		Insufficient spacing between berths				1	Increase berth separation based on simulation outcomes		Yes	75%	0%	4.0	£100,000	10.2	12.0		
							Moderate injury to crew (RoRo)		Pilot or master misjudgement				2	Dolphins to be spaced and designed in accordance with codes		Yes	10%	0%	4.4	£100,000	10.1			
							Moderate damage to bulk carrier		Inadequate tug provision				3	Establish and adhere to wind and current berthing thresholds		Yes	50%	0%	8.9	£100,000	9.2	Baseline Level		
							Moderate injury to crew (bulk carrier)		Tug failure				4			No	0%	0%	8.9	£100,000	9.2	High		
									Towline failure				5			No	0%	0%	8.9	£100,000	9.2			
									Adverse weather affects controllability				6			No	0%	0%	8.9	£100,000	9.2	Residual Risk		
									Vessel engine or steering failure				7			No	0%	0%	8.9	£100,000	9.2	9.2		
													8			No	0%	0%	8.9	£100,000	9.2			
													9			No	0%	0%	8.9	£100,000	9.2			
													10			No	0%	0%	8.9	£100,000	9.2	Residual Level		
													11			No	0%	0%	8.9	£100,000	9.2	Moderate		
													12			No	0%	0%	8.9	£100,000	9.2			
													13			No	0%	0%	8.9	£100,000	9.2	Risk Reduction		
													14			No	0%	0%	8.9	£100,000	9.2	2.8		
													15			No	0%	0%	8.9	£100,000	9.2			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
15	1	3	T2 Lower RoRo Berth	Contact	Contact - bulk carrier contacts RoRo on adjacent berth					4	3	12.0		Baseline with no additional risk controls					1.0	£100,000	12.0	Baseline Risk		
							Moderate damage to bulk carrier		Insufficient spacing between berths				1	Increase berth separation based on simulation outcomes		Yes	75%	0%	4.0	£100,000	10.2	12.0		
							Moderate injury to crew (bulk carrier)		Pilot or master misjudgement				2	Dolphins to be spaced and designed in accordance with codes		Yes	10%	0%	4.4	£100,000	10.1			
							Moderate damage to RoRo		Adverse weather affects controllability				3	Comply with Tug Code recommendations		Yes	50%	0%	8.9	£100,000	9.2	Baseline Level		
							Moderate injury to crew (RoRo)		Vessel engine or steering failure				4	Establish and adhere to wind and current berthing thresholds		Yes	50%	0%	17.7	£100,000	8.3	High		
							Minor damage to T2 infrastructure						5			No	0%	0%	17.7	£100,000	8.3			
													6			No	0%	0%	17.7	£100,000	8.3	Residual Risk		
													7			No	0%	0%	17.7	£100,000	8.3	8.3		
													8			No	0%	0%	17.7	£100,000	8.3			
													9			No	0%	0%	17.7	£100,000	8.3			
													10			No	0%	0%	17.7	£100,000	8.3	Residual Level		
													11			No	0%	0%	17.7	£100,000	8.3	Moderate		
													12			No	0%	0%	17.7	£100,000	8.3			
													13			No	0%	0%	17.7	£100,000	8.3	Risk Reduction		
													14			No	0%	0%	17.7	£100,000	8.3	3.7		
													15			No	0%	0%	17.7	£100,000	8.3			
16	22	14	T2 Lower RoRo Berth	Contact	Contact - passing ship in contact with moored RoRo					1	3	3.0		Baseline with no additional risk controls					1000.0	£100,000	3.0	Baseline Risk		
							Moderate damage to RoRo		Pilot or master misjudgement				1	T2 Berths are well outside the channel		No	0%	0%	1000.0	£100,000	3.0	3.0		
							Moderate injury to crew (RoRo)		Mechanical failure on passing ship				2	Through shipping does not normally navigate at extreme edge of channel		No	0%	0%	1000.0	£100,000	3.0			
							Moderate damage to other ship		Severe adverse weather				3	Passing ships will have their anchor ready to let go (PLA Byelaw 18)		Yes	50%	0%	1000.0	£100,000	3.0	Baseline Level		
							Moderate injury to crew (other ship)						4			No	0%	0%	1000.0	£100,000	3.0	Minor		
							Minor damage to T2 infrastructure						5			No	0%	0%	1000.0	£100,000	3.0			
							Possible oil pollution (Tier 2)						6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	0.0		
													15			No	0%	0%	1000.0	£100,000	3.0			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
17	17	24	T2 Lower RoRo Berth	Contact	Contact - RoRo contacts pontoon whilst berthing					3	2	6.0		Baseline with no additional risk controls					10.0	£10,000	6.0	Baseline Risk		
							Moderate damage to RoRo		Pilot or master misjudgement				1	Take a tug in strong winds		Yes	50%	50%	20.0	£5,000	4.6	6.0		
							Potential for pollution (Tier 2 max)		Adverse weather affects controllability				2	Establish and adhere to wind and current berthing thresholds		Yes	25%	0%	26.6	£5,000	4.4			
							Moderate injury to crew		Vessel engine or steering failure				3	Pontoon to be designed in accordance with relevant Codes and Standards		Yes	0%	50%	26.6	£2,500	3.6	Baseline Level		
							Moderate damage to pontoon						4	Robust fendering		Yes	0%	50%	26.6	£1,250	2.8	Moderate		
							Moderate damage to Upper RoRo						5	Full suite of pontoon fenders to be held ashore for rapid replacement		Yes	0%	50%	26.6	£1,000	2.6			
													6			No	0%	0%	26.6	£1,000	2.6	Residual Risk		
													7			No	0%	0%	26.6	£1,000	2.6	2.6		
													8			No	0%	0%	26.6	£1,000	2.6			
													9			No	0%	0%	26.6	£1,000	2.6			
													10			No	0%	0%	26.6	£1,000	2.6	Residual Level		
													11			No	0%	0%	26.6	£1,000	2.6	Minor		
													12			No	0%	0%	26.6	£1,000	2.6			
													13			No	0%	0%	26.6	£1,000	2.6	Risk Reduction		
													14			No	0%	0%	26.6	£1,000	2.6	3.4		
													15			No	0%	0%	26.6	£1,000	2.6			
18	5	9	T2 Lower RoRo Berth	Mooring incident	Mooring incident					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Injury to RoRo crew		Poor berth design				1	Align mooring dolphins to negate the use of mooring boats		Yes	50%	0%	20.0	£100,000	8.1	9.0		
							Injury to mooring personnel		Inadequate provision of mooring points				2	Develop a standard mooring plan as part of the T2 Operation Procedures		Yes	50%	0%	40.0	£100,000	7.2			
							Minor damage to berth infrastructure		Poor leads for mooring lines				3	Repeated visits by same vessels results in efficient and skilled mooring operations		Yes	50%	0%	79.9	£100,000	6.3	Baseline Level		
							Potential for mooring lines to foul propellers		Inadequate standards of crewing				4			No	0%	0%	79.9	£100,000	6.3	Moderate		
									Adverse weather during mooring				5			No	0%	0%	79.9	£100,000	6.3			
													6			No	0%	0%	79.9	£100,000	6.3	Residual Risk		
													7			No	0%	0%	79.9	£100,000	6.3	6.3		
													8			No	0%	0%	79.9	£100,000	6.3			
													9			No	0%	0%	79.9	£100,000	6.3			
													10			No	0%	0%	79.9	£100,000	6.3	Residual Level		
													11			No	0%	0%	79.9	£100,000	6.3	Moderate		
													12			No	0%	0%	79.9	£100,000	6.3			
													13			No	0%	0%	79.9	£100,000	6.3	Risk Reduction		
													14			No	0%	0%	79.9	£100,000	6.3	2.7		
													15			No	0%	0%	79.9	£100,000	6.3			

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Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
19	5	5	Gravesend Reach	Grounding	RoRo grounds whilst berthing at T2 Upper RoRo Berth					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Minor vessel damage		Incorrect passage planning				1	Shallower draft of RoRo (relative to bulk carrier) reduces likelihood		Yes	50%	0%	20.0	£100,000	8.1	9.0		
							Potential for pollution (Tier 2 max)		Vessel out of position - pilot / master error				2			No	0%	0%	20.0	£100,000	8.1			
							Minor injury to crew		Vessel out of position - collision avoidance				3			No	0%	0%	20.0	£100,000	8.1	Baseline Level		
							Impact on traffic flow / river closure		Loss of power				4			No	0%	0%	20.0	£100,000	8.1	Moderate		
									Inaccurate bathymetric information				5			No	0%	0%	20.0	£100,000	8.1			
									Adverse weather affects controllability				6			No	0%	0%	20.0	£100,000	8.1	Residual Risk		
									Tidal cut				7			No	0%	0%	20.0	£100,000	8.1	8.1		
													8			No	0%	0%	20.0	£100,000	8.1			
													9			No	0%	0%	20.0	£100,000	8.1			
													10			No	0%	0%	20.0	£100,000	8.1	Residual Level		
													11			No	0%	0%	20.0	£100,000	8.1	Moderate		
													12			No	0%	0%	20.0	£100,000	8.1			
													13			No	0%	0%	20.0	£100,000	8.1	Risk Reduction		
													14			No	0%	0%	20.0	£100,000	8.1	0.9		
													15			No	0%	0%	20.0	£100,000	8.1			
20	17	14	Gravesend Reach	Collision	RoRo collides with another vessel whilst manoeuvring for T2 Upper RoRo Berth					2	3	6.0		Baseline with no additional risk controls					100.0	£100,000	6.0	Baseline Risk		
							Moderate vessel damage		Failure to follow Collision Regulations				1	Adherence to Collision Regulations		Yes	99%	0%	1000.0	£100,000	3.0	6.0		
							Potential for pollution (Tier 2 max)		Traffic congestion				2	Active traffic management by VTS		Yes	10%	0%	1000.0	£100,000	3.0			
							Moderate injury to crew		Pilot / master error				3	Adherence to fog procedures		Yes	10%	0%	1000.0	£100,000	3.0	Baseline Level		
							Impact on traffic flow / river closure		Reduced visibility				4			No	0%	0%	1000.0	£100,000	3.0	Moderate		
									Vessel not under control and drifting				5			No	0%	0%	1000.0	£100,000	3.0			
									Mechanical failure				6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	3.0		
													15			No	0%	0%	1000.0	£100,000	3.0			

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Project:	Tilbury 2	Date:	17th March 2017	Site / Location:	Tilbury 2 Aggregates and RoRo Berths	Assessor:	Tom Drennan	Revision:	0

Hazard ID	Baseline Hazard Rank	Residual Hazard Rank	Hazard Area	Hazard Category	Hazard Title	Credible Hazard Outcome ID [Consequence]	Credible Hazard Outcome [Consequence]	Hazard Causes ID [Likelihood]	Hazard Causes [Likelihood]	Baseline Risk - with existing risk controls in place: Likelihood	Consequence	Baseline Risk	Risk Reduction: Risk Control ID.	Additional Risk Control (RC) Measures	Cross-reference Consequence Likelihood	Include Risk Control	% Likelihood Reduction	% Consequence Reduction	Residual Risk Score with RC in place: Likelihood Return Period [yr]	Consequence Cost [£]	Cumulative Risk Score	Results	Control Actionee	Complete
21	5	8	T2 Upper RoRo Berth	Contact	Contact - RoRo berthing at upper berth contacts dolphin					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Moderate damage to RoRo		Pilot or master misjudgement				1	Dolphins to be spaced and designed in accordance with codes		Yes	10%	0%	11.1	£100,000	8.9	9.0		
							Potential for pollution (Tier 2 max)		Adverse weather affects controllability				2	Take a tug in strong winds		Yes	50%	0%	22.2	£100,000	8.0			
							Moderate injury to crew		Vessel engine or steering failure				3	Establish and adhere to wind and current berthing thresholds		Yes	50%	0%	44.4	£100,000	7.1	Baseline Level		
							Moderate damage to dolphin(s)						4	Additional dolphin to prevent quarter of RoRo "seeking the gap"		Yes	10%	0%	49.3	£100,000	6.9	Moderate		
							Moderate damage to walkways						5			No	0%	0%	49.3	£100,000	6.9			
													6			No	0%	0%	49.3	£100,000	6.9	Residual Risk		
													7			No	0%	0%	49.3	£100,000	6.9	6.9		
													8			No	0%	0%	49.3	£100,000	6.9			
													9			No	0%	0%	49.3	£100,000	6.9			
													10			No	0%	0%	49.3	£100,000	6.9	Residual Level		
													11			No	0%	0%	49.3	£100,000	6.9	Moderate		
													12			No	0%	0%	49.3	£100,000	6.9			
													13			No	0%	0%	49.3	£100,000	6.9	Risk Reduction		
													14			No	0%	0%	49.3	£100,000	6.9	2.1		
													15			No	0%	0%	49.3	£100,000	6.9			
22	17	23	T2 Upper RoRo Berth	Contact	Contact - RoRo berthing at upper berth contacts pontoon					3	2	6.0		Baseline with no additional risk controls					10.0	£10,000	6.0	Baseline Risk		
							Moderate damage to RoRo		Pilot or master misjudgement				1	Take a tug in strong winds		Yes	50%	50%	20.0	£5,000	4.6	6.0		
							Potential for pollution (Tier 2 max)		Adverse weather affects controllability				2	Establish and adhere to wind and current berthing thresholds		Yes	10%	0%	22.2	£5,000	4.5			
							Moderate injury to crew		Vessel engine or steering failure				3	Pontoon to be designed in accordance with relevant Codes and Standards		Yes	0%	50%	22.2	£2,500	3.7	Baseline Level		
							Moderate damage to pontoon						4	Robust fendering		Yes	0%	50%	22.2	£1,250	2.9	Moderate		
							Moderate damage to Upper RoRo						5	Full suite of pontoon fenders to be held ashore for rapid replacement		Yes	0%	50%	22.2	£1,000	2.7			
													6			No	0%	0%	22.2	£1,000	2.7	Residual Risk		
													7			No	0%	0%	22.2	£1,000	2.7	2.7		
													8			No	0%	0%	22.2	£1,000	2.7			
													9			No	0%	0%	22.2	£1,000	2.7			
													10			No	0%	0%	22.2	£1,000	2.7	Residual Level		
													11			No	0%	0%	22.2	£1,000	2.7	Minor		
													12			No	0%	0%	22.2	£1,000	2.7			
													13			No	0%	0%	22.2	£1,000	2.7	Risk Reduction		
													14			No	0%	0%	22.2	£1,000	2.7	3.3		
													15			No	0%	0%	22.2	£1,000	2.7			

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23	22	14	T2 Upper RoRo Berth	Contact	Contact - passing ship in contact with moored RoRo					1	3	3.0		Baseline with no additional risk controls					1000.0	£100,000	3.0	Baseline Risk		
							Moderate damage to RoRo		Pilot or master misjudgement				1	T2 Berths are well outside the channel		No	0%	0%	1000.0	£100,000	3.0	3.0		
							Moderate injury to crew (RoRo)		Mechanical failure on passing ship				2	Through shipping does not normally navigate at extreme edge of channel		No	0%	0%	1000.0	£100,000	3.0			
							Moderate damage to other ship		Severe adverse weather				3	Passing ships will have their anchor ready to let go (PLA Byelaw 18)		Yes	50%	0%	1000.0	£100,000	3.0	Baseline Level		
							Moderate injury to crew (other ship)						4			No	0%	0%	1000.0	£100,000	3.0	Minor		
							Minor damage to T2 infrastructure						5			No	0%	0%	1000.0	£100,000	3.0			
							Possible oil pollution (Tier 2)						6			No	0%	0%	1000.0	£100,000	3.0	Residual Risk		
													7			No	0%	0%	1000.0	£100,000	3.0	3.0		
													8			No	0%	0%	1000.0	£100,000	3.0			
													9			No	0%	0%	1000.0	£100,000	3.0			
													10			No	0%	0%	1000.0	£100,000	3.0	Residual Level		
													11			No	0%	0%	1000.0	£100,000	3.0	Minor		
													12			No	0%	0%	1000.0	£100,000	3.0			
													13			No	0%	0%	1000.0	£100,000	3.0	Risk Reduction		
													14			No	0%	0%	1000.0	£100,000	3.0	0.0		
													15			No	0%	0%	1000.0	£100,000	3.0			
24	5	9	T2 Upper RoRo Berth	Mooring incident	Mooring incident					3	3	9.0		Baseline with no additional risk controls					10.0	£100,000	9.0	Baseline Risk		
							Injury to RoRo crew		Poor berth design				1	Align mooring dolphins to negate the use of mooring boats		Yes	50%	0%	20.0	£100,000	8.1	9.0		
							Injury to mooring personnel		Inadequate provision of mooring points				2	Develop a standard mooring plan as part of the T2 Operation Procedures		Yes	50%	0%	40.0	£100,000	7.2			
							Minor damage to berth infrastructure		Poor leads for mooring lines				3	Repeated visits by same vessels results in efficient and skilled mooring operations		Yes	50%	0%	79.9	£100,000	6.3	Baseline Level		
							Potential for mooring lines to foul propellers		Inadequate standards of crewing				4			No	0%	0%	79.9	£100,000	6.3	Moderate		
									Adverse weather during mooring				5			No	0%	0%	79.9	£100,000	6.3			
													6			No	0%	0%	79.9	£100,000	6.3	Residual Risk		
													7			No	0%	0%	79.9	£100,000	6.3	6.3		
													8			No	0%	0%	79.9	£100,000	6.3			
													9			No	0%	0%	79.9	£100,000	6.3			
													10			No	0%	0%	79.9	£100,000	6.3	Residual Level		
													11			No	0%	0%	79.9	£100,000	6.3	Moderate		
													12			No	0%	0%	79.9	£100,000	6.3			
													13			No	0%	0%	79.9	£100,000	6.3	Risk Reduction		
													14			No	0%	0%	79.9	£100,000	6.3	2.7		
													15			No	0%	0%	79.9	£100,000	6.3			