Suffolk County Council

LAKE LOTHING THIRD CROSSING

Navigation Risk Assessment Update

1069948-WSP-MAR-LL-RP-MA-0016
FEBRUARY 2021

PUBLIC

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Navigation Risk Assessment Update

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1 INTRODUCTION

1.1 GENERAL

WSP Limited have been commissioned by Suffolk County Council to progress approvals, designs and agreements for a third crossing (referred to as “Gull Wing Bridge”) at Lake Lothing, Lowestoft.

1.2 SCOPE

Requirement 11 of the draft Development Consent Order requires the preliminary Navigation Risk Assessment (NRA) to be updated prior to the commencement of construction, following consultation with the harbour authority and the PMSC Stakeholder Group.

It is anticipated that the overall methodology and process for both phases will be same though evidently the risk assessments and associated mitigation will be tailored to the phase under consideration.

This document sets out the development of the NRAs based on the agreed methodology (originally detailed and agreed in WSP Report: 1069948-WSP-MAR-LL-RP-MA-0014 and replicated in this report) for further consultation with ABP and the PMSC Stakeholder Group before submitting a final NRA for approval by ABP.

1.3 OBJECTIVES

The objectives of the NRAs are to establish;

- The existing control and mitigation measures in place within the Port
- The baseline vessel traffic data relevant to movements through and near the Scheme, including any changes since the pNRA,
- The hazards to navigation created by the presence of the scheme bascule bridge, both during construction (including associated construction vessel movements), operation and any significant maintenance activities.
- The risk levels associated with the identified hazards, and
- Any control or mitigation measures that are required to ensure the risks are “as low as reasonably practicable”.

2 PROJECT DESCRIPTION

2.1 OVERVIEW

Lowestoft is a port town on the east coast of England, in the county of Suffolk. The town is divided in two by a natural sea inlet, Lake Lothing, which forms Lowestoft Harbour and provides access via Oulton Broad and Oulton Dyke to the River Waveney and the Broads.

Lake Lothing is currently crossed by two road bridges, one carrying the A47 across the passage between the inner and outer harbours and a second carrying the A1117 at the Mutford Bridge, Oulton Broad. These bridges open to allow shipping to access the port, causing significant traffic disruption.

The scheme is a new road crossing over Lake Lothing, improving access to the lake area as well as relieving congestion in, and around, the town centre.

2.2 LOCATION OF SCHEME

The proposed location for the new bridge is shown on Figure 1, below.

Figure 1 – New bridge location

2.3 BRIDGE DESIGN

The bridge will comprise a single counterweighted, rolling-lift bascule leaf, actuated via below deck hydraulic cylinders, supported on 2 reinforced concrete piers. The bridge will be constructed to provide a clear navigational channel, central in the lake, of 32m between fenders and 35m between the pier faces. The bridge deck will have a clear height over water of at least 12m above highest astronomical tide when lowered and raise to provide infinite clearance across the whole of the navigation channel. The fixed over water sections of the bridge will be protected from navigation impacts by passage and approach fendering. The opening bridge will be connected to the existing

road network by a series of fixed approach spans. An indicative section showing the bridge outline in both the “raised” and “lowered” position is shown in Figure 2, below.

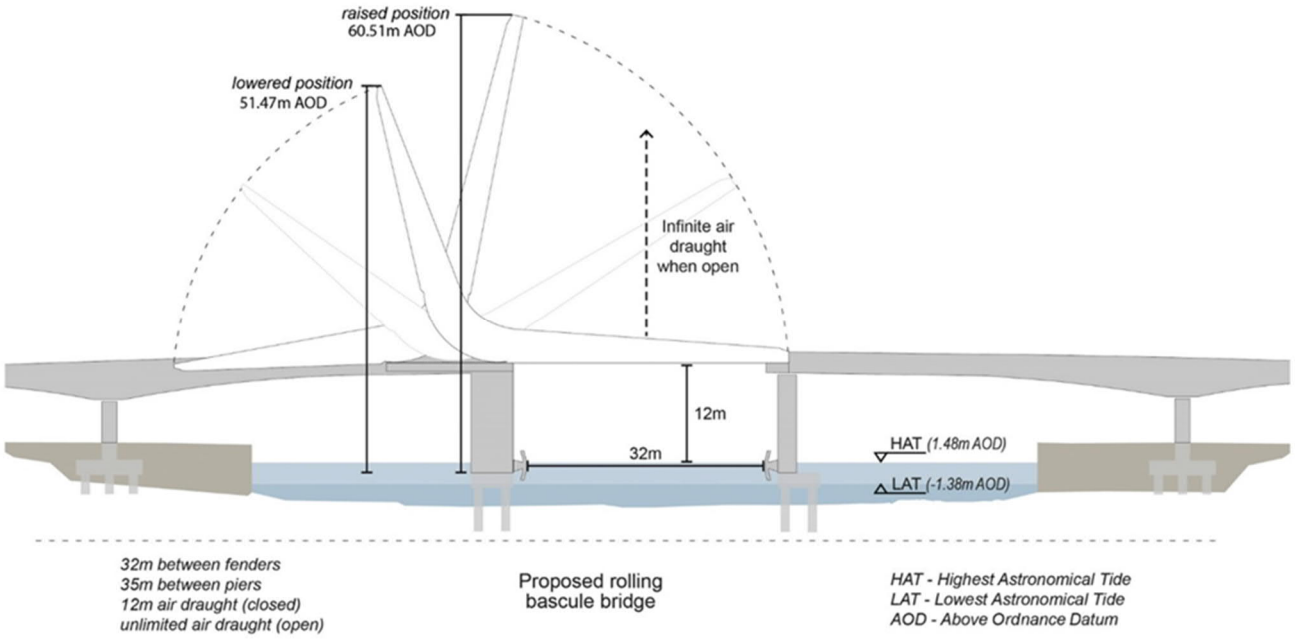

Figure 2 – Bridge outline (looking west)

2.4 CONSTRUCTION METHODOLOGY

The following is a brief description of the main marine construction activities associated with the bridge, fuller details are contained in the Contractors construction method statements which have been presented to the PMSC working group during navigation Hazid Workshops.

The main piers for the bascule and Marine spans of the approach viaducts will be constructed within Lake Lothing. They are formed using a steel piled combi wall cofferdam, installed utilising the conventional marine steel piling technique of forming temporary piling gates to guide the steel piles into their designed position while driving using vibratory and impact hammers slung from a crane. Works will be serviced by a land-based crane, a crane barge and a lay barge to store the piles and piling equipment (pile hammers etc). Once the steel piled cofferdam is formed, a temporary platform will be constructed on top of the cofferdam to support a piling rig for rotary bored pile construction. Rotary bored piles will be installed within the tubes of the cofferdam, the rig will be serviced utilising the crane and lay barges.

Once piling works are compete the material within the cofferdam will be excavated to the required level and dewatered to allow the construction of the reinforced concrete pier foundations.

The viaduct steelwork will be lifted into place using land-based cranes, and the concrete deck will subsequently be constructed in situ.

The main bascule span will be brought to site by sea. Once arrived on site and prior to installation, it will be rotated through 90deg and utilising the approved closure of the navigational channel, the bascule span will be jacked up on SPMTs and floated into position. The hydraulic lifting cylinders will be connected and commissioned to allow full opening of the bascule prior to reopening the channel for navigation.

2.5 PORT OPERATIONS

The location of the scheme crosses the navigation waterway within Lake Lothing. The Inner Harbour at the Port of Lowestoft has commercial quays both east and west of the Scheme bascule bridge location, along with a number of marina facilities located west of the bridge. Access to these berths will require an opening of the Scheme bascule bridge should the air draft of the vessel exceed the available headroom, including a suitable safety clearance, with the bridge in the lowered position.

3 METHODOLOGY

3.1 ASSESSMENT PROCESS

The NRA has revisited the pNRA prepared as part of the DCO Application (and ABPmer's comments thereon) and considers any changes to the proposed scheme, including any additional information on construction methodology, that have occurred since revision preparation. It assesses the additional risks to vessel navigation that will arise during and following construction of the proposed bridge. It has not assessed existing risks present during navigation or risks outside the areas of influence of the bridge and its operation, as these are assumed to be covered by existing risk assessments.

The process to be adopted will follow the general principals of risk assessment as set out in "A Guide to Good Practice on Port Marine Operations", that being a 5-stage process comprising;

- Data Gathering
- Hazard Identification
- Risk Analysis
- Risk Assessment
- Risk Control

3.2 CONSULTATION

In order to ensure a robust risk assessment process during the DCO process, a Navigation Working Group was established by the Council, consisting of the principal marine stakeholders and port users (both commercial and recreational) and ABP.

During the course of the Examination, ABP requested that the future role of the Navigation Working Group was instead fulfilled by its Port Marine Safety Code (PMSC) Stakeholder Group and the Order was amended accordingly. To that end, the PMSC Stakeholder Group must be involved in the preparation of the NRAs. In accordance with the agreed procedure the NRA has been developed by the Council (and its contractor(s) as relevant). A PMSC Stakeholder Group has been convened, at the Councils request, to consider, and input in to, the Hazard identification, risk analysis and risk control phases as described in sections 3.4 to 3.6 in particular. The first of these workshops was undertaken, virtually (utilising Microsoft Teams) due to prevailing COVID 19 restrictions, on Friday 11th December.

This workshop was attended by representatives of the following organisations;

- Suffolk County Council
- Farrans (Gull Wing Bridge Construction Contractor)
- WSP Ltd
- Shipmove Limited
- Associated British Ports
- ABPMer
- Cauldwell Marine
- Petersons UK Limited
- Royal Yachting Association
- Lowestoft Cruising Club
- RNLI

- Norfolk and Suffolk Boating Association

The workshop considered the hazards identified in the pNRA and their continued relevance to the scheme, the risk ratings in terms of both likelihood and severity, the existing mitigation measures present at the Port which would contribute to a reduction in risk and the additional mitigation measures that should be implemented to ensure the risks are reduced to As Low As Reasonably Practicable.

In addition to the review of previously identified hazards, the workshop gave consideration to any additional hazards that required assessment based on the finalised design and construction methodology. This has resulted in 7 additional hazards being incorporated into the NRA, 5 related to the construction phase and 2 related to the operation of the bridge.

A review meeting was held on 15th January 2021 to discuss the comments received on the updated NRA created following the December workshop. This was attended by representatives of the same organisations as previously. Prior to the meeting comments were received from ABP / ABPmer only, during the meeting all other parties confirmed they had no further comments on the NRA. The comments from ABP / ABPmer have been addressed in this final revision, including the inclusion of a single additional risk associated with the construction phase.

3.3 GUIDANCE AND REFERENCES

The NRAs have been prepared with reference to the following documents;

- Port Marine Safety Code, DfT/MCA Nov 2016
- A Guide to Good Practice on Port Marine Operations, DfT/MCA Feb 2018
- MGN 543 (M+F) – Safety of Navigation: Offshore Renewable Energy Installations (OREI's) – Guidance on UK Navigational Practice, Safety and Emergency Response, DfT/MCA Jan 2016
- The National Contingency Plan - A Strategic Overview for Responses to Marine Pollution from Shipping and Offshore Installations, DfT/MCA
- Methodology for Assessing the Marine Navigational Safety & Emergency Response of Risks of Offshore Renewable Energy Installations, DfT/MCA
- Lowestoft Harbour Bye-Laws 1993, ABP Ports (as amended by the draft Development Consent Order)
- Lowestoft Harbour Pilotage Directions, ABP Ports
- Draft Development Consent Order (including Part 4 Operational Provisions)

3.4 DATA GATHERING

For the NRA the following information sources were reviewed and assessed for any changes since the production of the pNRA;

- Existing operational arrangements,
- Previous studies and assessments,
- Scheme studies and assessments,
- Vessel traffic density,
- MAIB incident reports,
- RNLI incident reports,
- ABP recorded SHA Accident-Incident Records.

3.5 HAZARD IDENTIFICATION

The following hazards resulting specifically from navigation in the vicinity of an opening bridge were identified in the previous revision of the pNRA;

- Collision
- Contact
- Grounding

The NRAs considered the continued applicability of these hazards and their causes in relation to the final scheme design and construction methodology and if any further hazard types require consideration.

The Council acknowledges ABPmer's previous comment that all hazards suggested by OREI guidance should be included, however only those hazards that are materially increased by the Scheme or created by its construction activity are considered by the NRAs. This is because other hazards associated with general vessel operations are not within the ability of the scheme to control and should therefore form part of the existing Port NRAs. A scoping exercise using the OREI Hazard Identification Checklist has been undertaken to ensure all appropriate hazards have been considered.

3.6 RISK ANALYSIS AND ASSESSMENT

It was agreed that the updated Navigation Risk Assessments would be conducted using the same methodology as adopted for the preparation of the DCO pNRA, that being a likelihood x severity matrix. The likelihood assessment considers the expected frequency of an event, based on the applicable vessel movement frequencies, compared to the overall project design life, or the duration of the construction phase (as relevant). The severity assessment considers both the worst-case outcome and the most probable outcome for any given hazard. The assessment is made considering the potential effects on People, Property, Environment and Reputation, as follows;

- Likelihood;
  - Remote – occurrence frequency greater than project design life,
  - Unlikely – occurrence frequency between 2 years and project life,
  - Possible – occurrence frequency less than annual,
  - Likely – annual occurrence frequency,
  - Frequent – multiple occurrences expected annually.
- Severity;
  - Minor – no injuries or damage to property, environment or businesses,
  - Serious – injury not requiring hospitalization, damage not affecting operations, Tier 1 pollution incident, local negative publicity or minor business costs,
  - Major – injury requiring hospital treatment, damage requiring repair, localised Tier 2 pollution, national negative publicity or significant business costs,
  - Severe – single fatality, structural damage affecting operation, widespread Tier 2 pollution, national negative publicity affecting future business or severe business costs,
  - Catastrophic – multiple fatalities, structural collapse/sinking, Tier 3 pollution, international negative publicity or severe business costs to multiple parties.

(Pollution Tiers are as defined in “The National Contingency Plan - A Strategic Overview for Responses to Marine Pollution from Shipping and Offshore Installations”).

The two values are used to form the Risk Matrix. Finally, the Risk Matrix score is assigned one of the five colour coded classifications, Slight, Low, Moderate, High and Intolerable, as shown below.

	Minor	Serious	Major	Severe	Catastrophic
Remote	1	2	3	4	5
Unlikely	2	4	6	8	10
Possible	3	6	9	12	15
Likely	4	8	12	16	20
Frequent	5	10	15	20	25

This Risk Classification indicates the magnitude and acceptability of the risk and guides to the extent that additional mitigating control measures may be required to bring the risk to ALARP (As Low As Reasonably Practicable) principles.

The risks have been assessed for the following classification of vessel Traffic Type;

- Commercial (Large/Other) – any commercial vessel requiring compulsory pilotage.
- Commercial (Small) – any commercial vessel below the pilotage threshold.
- Recreational (Motor) – any non-masted recreational vessel.
- Recreational (Sail) – any masted recreational vessel.

Additionally, for the construction phase assessment the contractors proposed marine plant has been considered either within the relevant Traffic Type or via a separate assessment as most appropriate (in particular Jack-Up Barge operations and movements have been considered as a separate Type).

The outputs from the Assessment are presented in the following format;

ID	Hazard	Cause	Phase	Traffic Type	Receptor	Pre-Mitigation					Existing Controls	New Mitigation	Post Mitigation				
						L	S	R	H	Ra			L	S	R	H	Ra
					People												
					Environment												
					Reputation												
					Asset												

Where;

L – Likelihood, S – Severity, R – Risk, H – Highest Risk, Ra - Rank.

3.7 RISK CONTROL

The NRAs consider the validity of the previously identified mitigation measures for each of the risks in the pNRA along with any potential additional mitigation measures identified during the HAZID update workshop and reassess the post-mitigation risk gradings based on this updated information.

3.8 COST BENEFIT ANALYSIS

For any potential additional mitigation measures identified where there are questions over the cost effectiveness of its implementation, a cost benefit analysis will be undertaken to assess the proportionality of their implementation. The cost benefit analysis will be produced in line with guidance from the HSE, an appropriate Disproportion Factor for each risk will be developed for the calculations in consultation with ABP.

4 HAZARD IDENTIFICATION

4.1 GENERAL

The following section outlines the hazards resulting specifically from navigation in the vicinity of an opening bridge and the primary causational effect which lead to such hazards.

4.2 COLLISION

Collision is the uncontrolled coming together of two vessels. It is applicable to all sizes and types of vessels. Collision hazards are present during every vessel movement where other vessels are or could be present. The main factors affecting occurrence likelihood are vessel density, navigation constraints and vessel control.

4.3 CONTACT

Contact is the uncontrolled coming together of a vessel and a fixed structure (such as a bridge). It is applicable to all sizes and types of vessels. Contact hazards are present whenever vessel movements occur in proximity to fixed structures and during berthing operations. The main factors affecting occurrence likelihood are navigation constraints and vessel control.

4.4 GROUNDING

Grounding is the unintentional coming together of a vessel and the bed of the river, sea or dock. While applicable to all types of vessel it is more significant for larger deeper draughted commercial vessels. Grounding hazards are more likely for vessels as under keel clearance decreases. The main factors affecting occurrence likelihood are navigation chart accuracy, navigation planning, traffic density, vessel control and weather.

4.5 MAJOR CAUSE OF HAZARDS

4.5.1 COLLISION

Vessel Proximity

Restrictions on the width of navigable water inherently increases the proximity at which vessels will need to navigate.

Visibility

Reductions in visibility will increase the risks of Masters not seeing other vessels in sufficient time to navigate safely.

Equipment Failure

Failure of on-board equipment can render vessels adrift and unable to maintain navigational control thereby increasing the risks of collision. Failure of bridge operating equipment can result in vessels needing to perform evasive manoeuvres increasing the risks of collision.

Human Error

Human error and misjudgements are a contributory cause in a significant number of incidents and their potential requires consideration in all assessments.

4.5.2 CONTACT

Knowledge of Structure

A Masters lack of knowledge of the presence and nature of structures constraining navigation will increase the risk of contact between their vessel and a structure.

Current Pattern Changes

Familiarity with existing conditions and a failure to allow for potential changes caused by the presence of new structures will increase the risks of contact.

Wind Sheltering

Changes to the levels of wind exposure felt by a vessel navigating within the bridge passage can lead to an increased risk of contact, this risk increases as wind speed from the critical directions increases and vessel dimensions increase.

Projections or Roll

Vessels with projecting cargo or flying bridges have greater potential to contact structures, similarly high vessels with a susceptibility to roll or traveling with a list produce a higher risk.

Visibility

Reductions in visibility will increase the risks of Masters not seeing structures in sufficient time to navigate safely.

Equipment Failure

Failure of on-board equipment can render vessels adrift and unable to maintain navigational control thereby increasing the risks of contact. Failure of bridge operating equipment can result in vessels needing to perform evasive manoeuvres increasing the risks of contact.

Human Error

Human error and misjudgements are a contributory cause in a significant number of incidents and their potential requires consideration in all assessments.

4.5.3 GROUNDING

Changes in Sedimentation Patterns

Changes to the patterns of current flow during and following construction of new structures can lead to changes in sediment deposition areas and rates with a subsequent reduction in accuracy of available navigation chart data. This will tend to increase the risk of groundings particularly for deeper draughted vessels.

Dropped Objects

Objects dropped or deposited within the navigable waterbody have the potential to reduce the available water depth, should these objects be of a size and in a location such that a vessel could strike them then they would create a navigation hazard. The likelihood of this increases for deeper draughted vessels and if objects were dropped either in the main navigation channel or within berthing pockets adjacent to quays.

Human Error

Human error and misjudgements are a contributory cause in a significant number of incidents and their potential requires consideration in all assessments.

Equipment Failure

Failure of on-board equipment can render vessels adrift and unable to maintain navigational control thereby increasing the risks of grounding. Failure of vessel-based navigation equipment can result in mispositioning of vessels leading to grounding.

Failure to achieve published depths

Failure to achieve the published depths in navigation areas during dredging (or as a result of sedimentation between dredging campaigns) can contribute to grounding events.

4.6 INCIDENT FREQUENCIES

4.6.1 MAIB REPORTABLE INCIDENTS

The Merchant Shipping (Accident Reporting and Investigation) Regulations 2012 (and preceding regulations), require Harbour Authorities (among others) to report certain marine incidents to the MAIB. Further guidance is included in Marine Guidance Note (MGN) 564 Marine Casualty and Marine Incident Reporting.

These include (but are not limited to) incidents that cause;

- The death of, or serious injury to a person,
- The loss of a person from a ship,
- The loss or abandonment of a ship,
- Pollution,
- Material damage to a ship; disabling it or affecting its structural integrity,
- An event or sequences of events that endangered, or if not corrected would endanger the safety of a ship, its occupants or any other person or the environment.

Note that such reportable incidents would generally, in the methodology used for this NRA, be classed as Major (3), Severe (4), or Catastrophic (5)

On receiving such a report the MAIB will conduct a preliminary assessment and if the incident is significantly serious will undertake a safety investigation and produce a report onto the incident.

Note that such MAIB investigated incidents would generally, in the methodology used for this NRA, be classed as Severe (4), or Catastrophic (5)

During the preparation of the pNRA a review of Marine Accident Investigation Branch (MAIB) incident investigation reports during the period 1999 to 2018 identified 10 events related to bridge structures. Of these 9 were contacts, with the remaining one being a collision. Of the 10 recorded events, five were on the Thames in Central London, two each on the Ouse and Trent and the final one on the Mersey.

No bridge related incidents leading to an MAIB investigation and report have been recorded from the Port of Lowestoft.

4.6.2 LOCALLY REPORTABLE INCIDENTS

During the period 2008 to 2018 there were 24 bridge incidents, 20 involving contact, 5 involving bridge failure to open / delay to vessel and 3 leisure craft near misses, reported within the Port of Lowestoft Marine Safety Management System.

7 of these were reported to the MAIB, though as previously stated none resulted in a follow up investigation.

4.6.3 TRAFFIC FREQUENCY

An assessment of the traffic frequency for each class of vessel was also undertaken as part of the scheme preparation. This assessment indicated that the anticipated annual number of vessel passages through the Scheme bridge could be around 10,000. This compares to 11,000 for the existing A47 bridge i.e. a 10% reduction. Of these movements around 25% will require the new bridge to open with the remaining 75% possible with the bridge closed. In total around 60% of recorded movements are commercial traffic with the remaining 40% recreational.

5 EXISTING MITIGATION MEASURES

5.1 NAVIGATION CONTROL

Navigation within the Port is managed by the Divisional Harbour Master under the auspices of the Port Marine Safety Code via a Local Port Service (LPS). Control of vessels is governed by Port Bye-Laws, Special Directions, general guidance notes and Notice to Mariners issued as required by the Harbour Master or Deputy as appropriate.

Navigation marks and lighting are used on the approach to the port and at the existing A47 bridge to control vessel movements, the current aids to navigation are in accordance with IALA system A.

Commercial Vessels

Commercial vessels are categorised as any vessel operating on a commercial basis; they are generally motor driven as opposed to sail and range from small to very large, the largest vessels for normal acceptance in the inner harbour being 125m Length, 22m Beam and 6.0m draught (larger vessels may be accepted subject to Harbour Master approval).

Piloted Vessels

Pilotage is required for the following vessels (with a few exemptions);

- All vessels or tows of 60.0 metres LOA or more.
- All vessels or tows of over 20.0 metres LOA carrying;
- Dangerous or noxious liquid substances in bulk,
- Explosives
- All vessels or tows of over 30.0 metres LOA carrying;
- More than twelve passengers
- All vessels of less than 60 metres LOA, deemed to be a potential hazard to safe navigation.

Non-Piloted Vessels

Vessels falling outside the abovementioned requirements and vessels whose Master holds a Pilot Exemption Certificate are not required to take a pilot although some may still choose to do so.

Recreational Vessels

Recreational vessels are those used by private individuals for personal or entertainment purposes; they are typically very small to small (less than 5m LOA, up to 30m LOA) and can be either motor, sail or non-propelled (paddle). It is very rare for recreational vessels using the port to take pilots.

5.2 VESSEL CONTROL

All vessels are required to notify the port of arrival or departure in advance.

The Port of Lowestoft have assessed and determined that a Local Port Service (LPS) and not a formal Vessel Traffic Service (VTS), is appropriate for the port. This LPS is designed to improve port safety and co-ordination of port services within the port community by dissemination of port information to vessels and berth or terminal operators. It is mainly concerned with the supply of information on berth and port conditions.

While establishing a LPS does not confer in itself on a port the power to control traffic, other powers are available to the port and its staff to direct vessels. These include;

- Lowestoft Harbour Byelaws 1993. Specifically;
  - *8. All vessel must observe the harbour control signal lights and those relating to the opening of bridges*
- International Regulations for Preventing of Collisions at Sea (IRPCS)
- The Harbours Act 1964. Which allows designated harbours (Lowestoft by the Harbour Directions - Designation of Harbour Authorities Order 2015 is one) to give written directions to ships relating to the movement of, mooring and unmooring of and manning of ships. Also requiring a ship to provide information.
- The Harbours, Docks and Piers Clauses Act 1847. Specifically;
  - *52. Powers of harbour, dock, or pier master. The harbour master may give directions……. For regulating the time at which and the manner in which any vessel shall enter into, go out of, or lie in or at the harbour*
- The Dangerous Vessels Act 1985
- The Merchant Shipping Act 1995
- The Dangerous Goods in Harbour Areas Regulations 2016

Large commercial vessels are required to have their own safety processes in place these include The International Safety Management (ISM) Code and IMO requirements for Bridge Resource Management (BRM) / Human Element Leadership and Management (HELM) training for ships crew and pilots.

5.3 BRIDGE CONTROL

The existing A47 Bridge is controlled from the main Port control room which overlooks the bridge. The bridge operates on an on-demand basis for all commercial vessels over 50t gross registered tonnage, with a restriction on operations between 8:15am and 9am, 12:30pm and 1pm, and 5:00pm and 5:45pm, and on a pre-booked scheduled opening basis for recreational traffic.

5.4 DEPTH CONTROL

Bed levels within the Port are monitored via biannual bathymetric surveys and maintained via dredging campaigns as required (currently biannually).

The SHA publishes depths for vessel passages and produces bathymetric charts detailing the surveyed bed levels for vessel Masters to plan movements.

5.5 INCIDENT RESPONSE CONTROLS

The port has a range of emergency response procedures in place that are designed to minimise the impacts of any navigation incident that does occur. The procedures include Lowestoft - Major Incident Plan, Oil Spill Contingency Plan, Flood Contingency Plan, and Business Continuity plans.

6 ADDITIONAL MITIGATION MEASURES

6.1 CONSTRUCTION PHASE

Monitoring

Monitoring of potential changes in the level of risk to navigation caused by the construction of the new bridge should be undertaken, and early interventions to prevent risk to navigation becoming higher than As Low as Reasonably Practicable should be carried out should any potentially hazardous conditions be seen to be developing.

Contractor/Port Liaison

A Contractor/Port communications protocol will be prepared to ensure transfer of information on activities that may affect or be affected by the construction activities, this will include site meetings at weekly intervals when required.

Notifications

Prior to commencement of construction ABP Lowestoft should issue a comprehensive Notice to Mariners and distribute this widely to users of the port, ships, their agents, frontagers / tenants and leisure craft organisations and publications.

As well as outlining the construction, its phases and timing, it should include details of where to find timely up-to-date information on the works (such as on the internet), and any reporting requirements.

This should be supplemented from time to time by updated Notices to Mariners as the construction progresses, should any changes arise, or as deemed necessary.

The port should also inform the UK Hydrographic Office / Admiralty of any planned, intended and actual changes. This by means of Hydrographic Notes H102 / H102A, and following instructions given in the Mariners Handbook (NP100) section 4.

The UKHMO will decide on the most appropriate method and publications in which to promulgate the changes notified to them.

Lights and Markings

During the Construction Phase all plant and works that could present a hazard to navigation should exhibit suitable marks and lights as may be required by the General Lighthouse Authority (GLA – Trinity House) in conjunction with the Local Lighthouse Authority (LLA – Port of Lowestoft as the Statutory Harbour Authority.

The lights and marks will be to IALA requirements and monitored via an inspection and maintenance process implemented by the contractor.

These new or changed lights would be notified to all local operators via a Notice to Mariners, and, as detailed in the Notifications paragraphs above, to the UKHMO.

Updates to existing navigation guidance

Prior to commencement of marine construction, the ports published guidance, in particular the Guidance for Small Craft, will be updated to highlight the bridge construction and inform mariners of the potential hazard created by it.

Navigation information broadcasts via LPS

The SHA have confirmed that they will implement navigation information broadcasts by VHF, via the existing LPS system, to provide daily information on construction activities to vessels during the construction phase.

Social media communications

It is recommended that social media feeds be used to disseminate information on construction operations as a means to inform recreational boaters of upcoming operations.

Provision of safety boat during marine construction operations

The provision of a safety boat during construction operations can provide mitigation and emergency response in the event of an incident.

Provision of additional oil spill response equipment

The provision of additional oil spill response equipment will provide mitigation in the event of a spill.

Updates to emergency response procedures

Existing emergency response procedures, including emergency contact information lists, will be updated to take account of the construction and the availability of any additional equipment provided by the scheme.

6.2 OPERATION PHASE

Notifications

Prior to the operational phase a Notice to Mariners will be prepared and distributed detailing the Scheme of Operation for the bridge. This will include all necessary details to ensure port users are adequately aware of the methods of communicating with the bridge operations and the meanings of any directions and light signals associated with the bridge.

In this the relevant provisions of the DCO in respect of the Scheme of Operation must be followed.

This information will, as detailed in section 6.1, be transmitted to the UK Hydrographic Office for inclusion in the relevant publications

ABP should prior to the operation determine if changes to the Ports Bye-laws are required, and if so follow the correct process to make the necessary changes.

Surveys and Inspections

Monitoring of potential changes in the level of risk to navigation caused by the operation of the new bridge will be undertaken, and early interventions to prevent risk to navigation becoming higher than As Low as Reasonably Practicable should then be carried out should any potentially hazardous conditions be seen to be developing.

Lights and Markings

During the Operation Phase the bridge will be identified with suitable marks and lights, as agreed with the GLA and LLA. The final lighting and marking scheme will be notified to all local operators via a Notice to Mariners issued by the SHA and information passed to UKHO for incorporation into the relevant Admiralty Charts. All navigation lights will be included within the Ports AtoN monitoring and availability statistics.

Scheme of Operation and Bridge Operational Procedures

The Scheme of Operation for the bridge and all associated Bridge Operational Procedures will be developed and reviewed to ensure safety of navigation, this will include Bridge resourcing and operator competency.

The enforcement of the requirements of the Scheme of Operation, in accordance with the DCO and Port bye-laws, forms one of the key safety elements of the operation of the bridge. All bridge operators should be aware of these requirements and take appropriate actions should vessels fail to adhere to them.

Maintenance

A suitable and sufficient inspection and maintenance regime will be established to ensure the mechanical reliability of the bridge. Suitable training will be given to operational staff to allow them to safely manage the operation of the bridge.

Provision of additional oil spill response equipment

The provision of additional oil spill response equipment will provide mitigation in the event of a spill.

Updates to emergency response procedures

Existing emergency response procedures, including emergency contact information lists, will be updated to take account of the bridge and the availability of any additional equipment provided in consequence of the scheme.

Provision of wind indicator

A windsock will be installed, in a suitable unsheltered location visible to approaching vessels, to provide a visual guide to the direction and strength of wind conditions.

Provision of emergency cabinets at waiting pontoon

An emergency cabinet containing first aid provisions and fire extinguishing equipment will be provided on the waiting pontoon, this is in addition to the lifesaving equipment that will be provided.

Provision of escape ladders

Ladders extending from the piers and dolphins to below LAT will be provided to permit escape from the water in the event of a Man overboard incident. These ladders will be painted or otherwise identified to be easily located by persons in the water. Additionally, means of egress from the water will be provided at the waiting pontoon.

Illumination of bridge passage

The bridge passage will be provided with low level illumination separate to the navigational lighting. This will either be via LED strip lighting on the pier face or via floodlamp downlights mounted on the abutments.

CCTV coverage of bridge passage

The CCTV system installed at the bridge will be able to provide the operators with views of vessels as they transit through the bridge passage. This will permit observation and identification of any incidents that may occur that would otherwise be out of line of sight of the operator.

Risk Reviews

All navigational risk assessments are live documents and must be reviewed and revised in light of any changes in conditions to remain effective. The bridge NRA will be reviewed toward the end of the construction phase in advance of the bridge being put into operation to identify any changes that may have occurred during the construction phase and confirm the operational phase risks. The final bridge operational NRA will be used to inform a revision of the SHA's Port Navigation Risk Assessment which is revised and updated in line with the Ports Marine Safety Management System. The construction phase hazards will be reviewed in the event any incidents occur.

6.3 MITIGATION MEASURES NOT CONSIDERED REQUIRED

In addition to the additional mitigation measures to be implemented as part of the scheme, identified in the NRA Risk Register and described above, consideration was given to the need for other mitigation measures which have at present been assessed to be not required.

Vessel Height Detection

Consideration was given to the installation of a vessel height detection system to identify vessels that are unable to pass under the bridge without an opening. This could provide additional mitigation against the risk of a vessel striking the bridge while attempting passage without an opening. Following discussions around the other mitigation measures present for these risks, in particular the requirement in the Bridge operational procedures for vessels requesting transit to state their sailing air draft, and investigations into the effectiveness of available systems, for example the limits of accuracy on detection and available locations a system could be installed, it is considered that such a system would not provide a measurable reduction in risk.

To further validate this a Cost Benefit Analysis has been undertaken on the provision of such a system. This more detailed assessment examined the cost of installing and maintaining a system, the effectiveness of the system in terms of risk mitigation and the anticipated benefits resulting from any risk reduction. This analysis suggested that the cost benefit ratio that could be achieved by the system was greater than 5 (implementation costs exceed benefits by a factor of 5x), it also highlighted potential issues with reliability of detection which could in themselves contribute to an incident which the system is supposed to mitigate. Based on the outcomes of this assessment it remains the case that installation of a vessel height detection system is not considered to provide a reliable and cost-effective mitigation to the risk.

SCC, as bridge owner, understand that this may result in occasional openings of the bridge for vessels that may have been able to pass without an opening if accurate air draft measurements were available, however this is considered to be the most reliable way of mitigating the hazard.

Appendix A - Construction Phase NRA Risk Register

Lake Lothing Third Crossing - Construction Phase Navigation Risk Assessment

							Pre-Mitigation							Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
1	Collision	Increased traffic proximity and vessel numbers due to construction	General cargo vessel heading for NQ7 collides with a wind farm vessel berthed on NQ5 while passing bridge site.	Construction	Commercial (Large/Other)	People	3	4				LPS System, Port regulations, Navigation directions, Compulsory Pilotage, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, UKHO Notice to Mariners, Navigation information broadcasts from LPS.	2	4			
						Environment	2	4						1	4			
						Reputation	2	3		12	2			2	3		8	1
						Asset	3	4						2	4			
2	Collision	Increased traffic proximity and vessel numbers due to construction	Two wind farm CTV's collide attempting to pass each other adjacent to the bridge site.	Construction	Commercial (Small)	People	4	4				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, amendments to Navigation Directions (Guidance for Small Craft), Navigation information broadcasts from LPS.	2	4			
						Environment	3	3						1	3			
						Reputation	2	3		16	1			1	3		8	1
						Asset	3	4						2	4			
3	Collision	Increased traffic proximity and vessel numbers due to construction	A sail boat collides with a vessel berthed on NQ4 while passing bridge site	Construction	Recreation (Sail)	People	4	3				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, amendments to Navigation Directions (Guidance for Small Craft), Avaiablility of waiting pontoon, Navigation information broadcasts from LPS, Social media network communications.	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		12	2			1	2		3	16
						Asset	2	2						1	2			
4	Collision	Increased traffic proximity and vessel numbers due to construction	As 3 but for motorboat	Construction	Recreation (Motor)	People	4	3				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, amendments to Navigation Directions (Guidance for Small Craft), Availablity of waiting pontoon, provision of safety boat during works, Navigation information broadcasts from LPS, Social media platform	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		12	2			1	2		3	16
						Asset	2	2						1	2			
X	Collision	Increased traffic proximity and vessel numbers due to construction	Construction Jack-up barge collides with a CTV while moving position	Construction	Jack-up Moves	People	3	4				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Contractor/port liaison process, Navigation information broadcasts from LPS	1	4			
						Environment	3	3						1	3			
						Reputation	2	3		12	2			1	3		4	7
						Asset	3	4						1	4			
22	Contact	Equipment failure - Failure of navigation lighting	An offshore supply vessel makes contact with the part constructed bridge due to the lights marking the edge of the channel failing.	Construction	Commercial (Large/Other)	People	3	4				LPS System, Emergency Response Processes, Compulsary Pilotage.	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Contractor inspection and maintenance process, IALA compliant lights, safety boat, approval by SHA/Trinity House.	1	4			
						Environment	3	3						1	3			
						Reputation	2	2		12	2			1	2		4	7
						Asset	3	2						1	2			
23	Contact	Equipment failure - Failure of navigation lighting	A CTV makes contact with the part constructed bridge due to the lights marking the edge of the channel failing.	Construction	Commercial (Small)	People	3	4				LPS System, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Contractor inspection and maintenance process, IALA compliant lights, safety boat, approval by SHA/Trinity House.	1	4			
						Environment	3	2						1	2			
						Reputation	2	2		12	2			1	2		4	7
						Asset	3	2						1	2			
24	Contact	Equipment failure - Failure of navigation lighting	A sail boat makes contact with the part constructed bridge due to the lights marking the edge of the channel failing.	Construction	Recreation (Sail)	People	3	3				LPS System, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Contractor inspection and maintenance process, IALA compliant lights, safety boat, approval by SHA/Trinity House.	1	3			
						Environment	2	1						1	1			
						Reputation	2	3		9	11			1	3		3	16
						Asset	2	2						1	2			
25	Contact	Equipment failure - Failure of navigation lighting	A motorboat makes contact with the part constructed bridge due to the lights marking the edge of the channel failing.	Construction	Recreation (Motor)	People	3	3				LPS System, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Contractor inspection and maintenance process, IALA compliant lights, safety boat, approval by SHA/Trinity House.	1	3			
						Environment	2	2						1	2			
						Reputation	2	3		9	11			1	3		3	16
						Asset	2	2						1	2			
34	Contact	Lack of knowledge of presence of structure	A general cargo vessel contacts a recently constructed section of the bridge not knowing works had commenced.	Construction	Commercial (Large/Other)	People	3	3				LPS System, Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Navigational information Broadcasts. Additional Pollution response equipement and updates to plans, update of emegency contact lists.	1	3			
						Environment	1	2						1	2			
						Reputation	2	3		9	11			1	2		3	16
						Asset	2	3						1	2			
35	Contact	Lack of knowledge of presence of structure	As 34 but for CTV	Construction	Commercial (Small)	People	3	3				LPS System, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Navigational information Broadcasts. Additional Pollution response equipement and updates to plans, update of emegency contact lists.	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		9	11			1	2		3	16
						Asset	2	2						1	2			
36	Contact	Lack of knowledge of presence of structure	As 34 but for sail boat	Construction	Recreation (Sail)	People	4	2				LPS System, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Update to Guidance for small craftNavigational information Broadcasts. Additional Pollution response equipement and updates to plans, update of emegency contact lists.	2	2			
						Environment	2	1						1	2			
						Reputation	2	3		8	20			1	3		4	7
						Asset	2	2						1	2			
37	Contact	Lack of knowledge of presence of structure	As 34 but for motorboat	Construction	Recreation (Motor)	People	4	2				LPS System, Emergency Response Processes	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, Navigational information Broadcasts. Additional Pollution response equipement and updates to plans, update of emegency contact lists.	2	2			
						Environment	2	2						1	2			
						Reputation	2	3		8	20			1	3		4	7
						Asset	2	2						1	2			
42	Contact	Loss of control due to changes in current patterns	A general cargo vessel contacts the bridge pier due to currents around the temporary works for the structure.	Construction	Commercial (Large/Other)	People	3	4				Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes	Undertaking vessel simulations for construction phase, Issue of Notice to Mariners, Additional oil spill responses.	1	4			
						Environment	3	3						1	3			
						Reputation	3	3		12	2			1	3		4	7
						Asset	3	4						1	4			
43	Contact	Loss of control due to changes in current patterns	A CTV vessel contacts the bridge pier due to currents around the temporary works for the structure.	Construction	Commercial (Small)	People	2	4				Emergency Response Processes	Issue of Notice to Mariners, Additional oil spill responses.	1	4			
						Environment	2	3						1	3			
						Reputation	2	3		8	20			1	3		4	7
						Asset	2	3						1	3			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Lake Lothing Third Crossing - Construction Phase Navigation Risk Assessment

							Pre-Mitigation							Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
44	Contact	Loss of control due to changes in current patterns	A sail boat contacts the bridge pier due to currents around the temporary works for the structure.	Construction	Recreation (Sail)	People	4	2										
						Environment	2	1		8	20	Emergency Response Processes	Issue of Notice to Mariners, Additional oil spill responses.	2	1		4	7
						Reputation	2	3						2	2			
						Asset	2	2						2	2			
45	Contact	Loss of control due to changes in current patterns	A motorboat contacts the bridge pier due to currents around the temporary works for the structure.	Construction	Recreation (Motor)	People	3	3						2	2			
						Environment	3	2		9	11	Emergency Response Processes	Issue of Notice to Mariners, Additional oil spill responses.	1	2		4	7
						Reputation	2	3						2	2			
						Asset	3	2						2	2			
66	Contact	Human error - Vessel operator	A general cargo vessel passing the construction site applies bow thruster in wrong direction and contacts the works.	Construction	Commercial (Large/Other)	People	2	4						2	4			
						Environment	2	3		8	20	Emergency Response Processes, Marine Safety Management System (Company policies (ABP), Compulsory Pilotage, STCW, PRM Training.)	implementation of temporary lights and marks, Navigation information Broadcasts.	2	3		8	1
						Reputation	2	2						2	2			
						Asset	2	4						2	4			
67	Contact	Human error - Vessel operator	A CTV contacts the works through misjudging the proximity while passing.	Construction	Commercial (Small)	People	2	3						2	3			
						Environment	2	2		6	26	Emergency Response Processes, Marine Safety Management System (Company policies (ABP), STCW, PRM Training.)	implementation of temporary lights and marks, Navigation information Broadcasts.	2	2		6	4
						Reputation	2	2						1	2			
						Asset	2	3						2	3			
68	Contact	Human error - Vessel operator	As 67 but for a sail boat	Construction	Recreation (Sail)	People	2	3						2	3			
						Environment	2	2		6	26	Emergency Response Processes	implementation of temporary lights and marks, Navigation information Broadcasts, provision of safety boat (potential to use as additional guidance for errent vessels?).	2	2		6	4
						Reputation	2	1						2	1			
						Asset	2	2						2	2			
69	Contact	Human error - Vessel operator	As 67 but for a motorboat	Construction	Recreation (Motor)	People	2	3						2	3			
						Environment	2	2		6	26	Emergency Response Processes	implementation of temporary lights and marks, Navigation information Broadcasts, provision of safety boat (potential to use as additional guidance for errent vessels?).	2	2		6	4
						Reputation	2	2						2	2			
						Asset	2	2						2	2			
74	Grounding	Change in sediment regime leads to shoaling	Installation of temporary works in the water creates a shallowing of the water in the navigation channel.	Construction	Commercial (Large/Other)	People	3	4						2	4			
						Environment	3	3		12	2	Bathymetric surveys and navigational charts, Maintenance dredging, Emergency Response Processes, Compulsory Pilotage.	Modelling during design, additional surveying and control dredging (if required)	2	3		8	1
						Reputation	3	2						2	2			
						Asset	3	3						2	3			
75	Grounding	Change in sediment regime leads to shoaling	Installation of temporary works in the water creates a shallowing of the water at one of the berths.	Construction	Commercial (Small)	People	2	3						1	3			
						Environment	2	2		6	26	Bathymetric surveys and navigational charts, Maintenance dredging, Emergency Response Processes	Modelling during design, additional surveying and control dredging (if required)	1	2		3	16
						Reputation	2	2						1	2			
						Asset	2	3						1	3			
76	Grounding	Change in sediment regime leads to shoaling	Installation of temporary works in the water creates shallowing in an area sail boats could previously manoeuvre.	Construction	Recreation (Sail)	People	2	2						1	2			
						Environment	2	1		4	33	Bathymetric surveys and navigational charts, Maintenance dredging, Emergency Response Processes	Modelling during design, additional surveying and control dredging (if required)	1	1		2	25
						Reputation	2	2						1	2			
						Asset	2	1						1	1			
80	Grounding	Objects dropped into navigation channel during construction	A tubular pile is dropped from the jack-up barge and lies across the navigation channel.	Construction	Commercial (Large/Other)	People	3	3						1	3			
						Environment	2	3		9	11	Statutes and Bye-laws preventing deposition of objects in water, Emergency Response Processes, LPS System, CCTV and security patrols	Anti-pollution contract requirements and notification procedures, Scheme RAMS (review under Harbour Works Consent), Navigation Information Broadcasts.	1	2		3	16
						Reputation	3	2						1	2			
						Asset	2	3						1	1			
81	Grounding	Objects dropped into navigation channel during construction	As 80 but for CTV.	Construction	Commercial (Small)	People	2	3						1	3			
						Environment	2	2		6	26	Statutes and Bye-laws preventing deposition of objects in water, Emergency Response Processes, LPS System, CCTV and security patrols	Anti-pollution contract requirements and notification procedures, Scheme RAMS (review under Harbour Works Consent), Navigation Information Broadcasts.	1	2		3	16
						Reputation	2	2						1	2			
						Asset	1	3						1	2			
82	Grounding	Objects dropped into navigation channel during construction	As 80 but for sail boat.	Construction	Recreation (Sail)	People	3	2						1	2			
						Environment	2	1		6	26	Statutes and Bye-laws preventing deposition of objects in water, Emergency Response Processes, LPS System, CCTV and security patrols	Anti-pollution contract requirements and notification procedures, Scheme RAMS (review under Harbour Works Consent), Navigation Information Broadcasts.	1	1		2	25
						Reputation	2	2						1	2			
						Asset	2	1						1	1			
83	Collision	Restricted Visibility	Failure to detect objects or other craft in the vicinity of the bridge leads to increased risk of collision or contact	Construction	All	People	3	3						2	3			
						Environment	3	3		9	11	LPS System, Port regulations, Navigation directions, Emergency Response Processes, Compulsory Pilotage (if required).	Issue of Notice to Mariners and Harbour Works Consent, implementation of temporary lights and marks, amendments to Navigation Directions (Guidance for Small Craft), Availablity of waiting pontoon, provision of safety boat, Navigation information broadcasts from LPS, Social media platform communications.	2	2		6	4
						Reputation	2	3						1	3			
						Asset	3	3						2	3			
84	Collision	Barge Movements for piles and span	A recreational vessel collides with the span barge while it is being moved into the port.	Construction	All	People	2	4						1	4			
						Environment	2	3		8	20	LPS System, Non-Routine Towage Process, Emergency Response Processes.	Issue of Notice to Mariners and Harbour Works Consent, Navigation Information Broadcasts, Contractor/port liaison process, provision of safety boat during works.	1	3		4	7
						Reputation	2	3						1	3			
						Asset	2	3						1	3			
85	Contact	Barge Movements for piles and span	A pile transfer barge contacts the port berth while mooring causing damage to the infrastructure	Construction	Construction Barge	People	2	2						1	2			
						Environment	1	2		6	26	LPS System, Non-Routine Towage Process, Emergency Response Processes.	Issue of Notice to Mariners and Harbour Works Consent, Contractor/port liaison process, provision of safety boat during works, Contractor's Marine Operations Management.	1	2		4	7
						Reputation	1	2						1	2			
						Asset	3	2						2	2			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Lake Lothing Third Crossing - Construction Phase Navigation Risk Assessment

							Pre-Mitigation							Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
86	Collision	Barge Movement for span installation with vessels on waiting pontoon	A recreational vessel collides with the span barge while it is being moved into the port.	Construction	Recreational	People	3	3		9	11	LPS System, Non-Routine Towage Process, Emergency Response Processes.	Issue of Notice to Mariners and Harbour Works Consent, Navigation Information Broadcasts, Contractor/port liaison process, provision of safety boat during works.	1	3		3	16
						Environment	2	2						1	2			
						Reputation	2	2						1	2			
						Asset	2	3						1	3			
87	Other	Vessel failure of construction plant	A jack-up barge engaged on the construction suffers a failure resulting in an oil spill.	Construction	All	People	2	2		9	11	Emergency Response Processes.	Construction Method Statements and Risk Assessments, Marine Plant Maintenance, Additional Oil Spill Equipment, Contractors Vessel Spill Kits.	1	2		4	7
						Environment	3	3						2	2			
						Reputation	2	2						1	2			
						Asset	2	2						1	2			
88	Other	Effect of passing vessel wash on construction barges.	A general cargo vessel passes the construction and creates wash that causes the construction barge to move and the cargo on deck to shift.	Construction	Construction Barge	People	3	4		12	2	LPS System, Emergency Response Processes.	Issue of Notice to Mariners and Harbour Works Consent, Navigation Information Broadcasts, Contractor/port liaison process, Construction Method Statements and Risk Assessments.	2	3		6	4
						Environment	2	3						1	2			
						Reputation	2	3						1	2			
						Asset	2	3						1	2			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Appendix B - Operational Phase NRA Risk Register

Lake Lothing Third Crossing - Operational Phase Navigation Risk Assessment

							Pre-Mitigation							Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
5	Collision	Increased traffic proximity through bridge	General cargo vessel heading for NQ7 collides with a wind farm vessel waiting out passage around NQ5 following passage through bridge.	Operation	Commercial (Large/Other)	People	3	4				LPS System, Port regulations, Navigation directions, Compulsory Pilotage, Emergency Response Processes, Vessel Bridge Resouce Management	Bridge Operational procedure, Bridge vessel control lights (both when raised and lowered), CCTV cameras to observe bridge passage	1	4			
						Environment	2	4						1	4			
						Reputation	2	3		12	3			1	3		4	10
						Asset	3	4						1	4			
6	Collision	Increased traffic proximity through bridge	Two wind farm CTV's collide attempting to pass through the bridge in opposite directions at the same time.	Operation	Commercial (Small)	People	4	4				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Bridge Operational procedure, Bridge vessel control lights (both when raised and lowered), CCTV cameras to observe bridge passage	1	4			
						Environment	3	3						1	3			
						Reputation	2	3		16	1			1	3		4	10
						Asset	3	4						1	4			
7	Collision	Increased traffic proximity through bridge	A sail boat collides with a CTV travelling in the same direction while manoeuvring for a bridge transit	Operation	Recreation (Sail)	People	4	3				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Bridge Operational procedure, Bridge vessel control lights (both when raised and lowered), CCTV cameras to observe bridge passage	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		12	3			1	2		3	28
						Asset	2	2						1	2			
8	Collision	Increased traffic proximity through bridge	A motor boat collides with a sail boat attempting to pass through the bridge in opposite directions.	Operation	Recreation (Motor)	People	4	3				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Bridge Operational procedure, Bridge vessel control lights (both when raised and lowered), CCTV cameras to observe bridge passage	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		12	3			1	2		3	28
						Asset	2	2						1	2			
9	Collision	Obstruction to visibility	An offshore support vessel collides with a CTV obscured by the bridge pier	Operation	Commercial (Large/Other)	People	3	4				LPS System, Port regulations, Navigation directions, Emergency Response Processes, Pilotage, Vessel Bridge Resourse Management	Bridge Operational procedure, Bridge vessel control lights, CCTV cameras to observe bridge passage	1	4			
						Environment	3	3						1	3			
						Reputation	2	3		12	3			1	3		4	10
						Asset	3	4						1	4			
10	Collision	Obstruction to visibility	A CTV passing the bridge collides with another leaving NQ4 unable to see it departing.	Operation	Commercial (Small)	People	3	4				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Bridge Operational procedure, Bridge vessel control lights, Observation from Bridge Operator/CCTV system. Ladder access to dolphins and pier from water (Man over board) (to be painted yellow or similar)	1	4			
						Environment	3	3						1	3			
						Reputation	2	2		12	3			1	2		4	10
						Asset	3	2						1	2			
11	Collision	Obstruction to visibility	A sail boat is struck by a CTV passing through the bridge passage unable to see it manoeuvring behind the bridge pier.	Operation	Recreation (Sail)	People	3	3				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Bridge Operational procedure, Bridge vessel control lights, Observation from Bridge Operator/CCTV system. Ladder access to dolphins and pier from water (Man over board) (to be painted yellow or similar)	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		9	14			1	2		3	28
						Asset	2	2						1	2			
12	Collision	Obstruction to visibility	As 11 but for a motorboat	Operation	Recreation (Motor)	People	3	3				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Bridge Operational procedure, Bridge vessel control lights, Observation from Bridge Operator/CCTV system. Ladder access to dolphins and pier from water (Man over board) (to be painted yellow or similar)	1	3			
						Environment	3	2						1	2			
						Reputation	2	2		9	14			1	2		3	28
						Asset	2	2						1	2			
13	Collision	Proximity of waiting pontoon to turning area	A general cargo vessel collides with a vessel waiting on the pontoon	Operation	Commercial (Large/Other)	People	2	4				LPS System, Compulsory Pilotage, Emergency Response Processes, Vessel Bridge Resourse Management	Lights and Marks, Update of navigation charts, Issue of Notice to Mariners	1	3			
						Environment	1	3						1	3			
						Reputation	2	3		8	28			1	3		3	28
						Asset	2	3						1	3			
14	Collision	Proximity of waiting pontoon to turning area	A CTV collides with a vessel on the waiting pontoon	Operation	Commercial (Small)	People	2	4				LPS System, Emergency Response Processes	Lights and Marks, Update of navigation charts, Issue of Notice to Mariners	1	3			
						Environment	1	2						1	2			
						Reputation	2	2		8	28			1	2		3	28
						Asset	2	2						1	2			
15	Collision	Proximity of waiting pontoon to turning area	A sail boat collides with another while attempting to berth on the pontoon	Operation	Recreation (Sail)	People	2	3				LPS System, Emergency Response Processes	Lights and Marks, Update of navigation charts, Issue of Notice to Mariners, update to Guidance to Small Craft.	1	3			
						Environment	1	2						1	2			
						Reputation	2	2		6	35			1	2		3	28
						Asset	2	2						1	2			
16	Collision	Proximity of waiting pontoon to turning area	A motorboat collides with another while attempting to berth on the pontoon	Operation	Recreation (Motor)	People	2	3				LPS System, Emergency Response Processes	Lights and Marks, Update of navigation charts, Issue of Notice to Mariners	1	3			
						Environment	1	2						1	2			
						Reputation	2	2		6	35			1	2		3	28
						Asset	2	2						1	2			
17	Collision	Requirement to hold awaiting bridge opening	Two sail boats collide while manoeuvring to hold station awaiting a bridge lift	Operation	Recreation (Sail)	People	3	2				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Provision of waiting pontoon, bridge operational procedure, scheduled bridge opening times	1	2			
						Environment	1	2						1	2			
						Reputation	2	2		6	35			1	2		2	44
						Asset	3	2						1	2			
18	Collision	Requirement to hold awaiting bridge opening	Two motorboats collide while holding station awaiting a bridge lift	Operation	Recreation (Motor)	People	3	2				LPS System, Port regulations, Navigation directions, Emergency Response Processes	Provision of waiting pontoon, bridge operational procedure, scheduled bridge opening times	1	2			
						Environment	1	2						1	2			
						Reputation	2	2		6	35			1	2		2	44
						Asset	2	2						1	2			
19	Contact	Equipment failure - Bridge fails to open	The bridge fails to lift with a general cargo vessel approaching	Operation	Commercial (Large/Other)	People	3	3				LPS System, Emergency Response Processes, Compulsory Pilotage, Port Regulations, Navigation Directions, Vessel Bridge Resourse Management.	Mechanical redundancy within design, PUWER Assessment, operating and emergency protocols, bridge maintenance procedures	2	3			
						Environment	2	3						1	3			
						Reputation	2	3		9	14			2	3		6	2
						Asset	3	3						2	3			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Lake Lothing Third Crossing - Operational Phase Navigation Risk Assessment

							Pre-Mitigation						Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
20	Contact	Equipment failure - Bridge fails to open	The bridge fails to lift with a CTV approaching	Operation	Commercial (Small)	People	3	3				LPS System, Emergency Response Processes	Mechanical redundancy within design, PUWER Assessment, operating and emergency protocols, bridge maintenance procedures	2	3			
						Environment	2	2		9	14			1	2		6	2
						Reputation	2	2						2	2			
						Asset	3	3						2	3			
21	Contact	Equipment failure - Bridge fails to open	The bridge fails to lift with a sailboat approaching	Operation	Recreation (Sail)	People	3	2				LPS System, Emergency Response Processes	Mechanical redundancy within design, PUWER Assessment, operating and emergency protocols, bridge maintenance procedures	2	2			
						Environment	2	2		9	14			1	2		6	2
						Reputation	2	2						1	2			
						Asset	3	3						2	3			
26	Contact	Equipment failure - Failure of navigation lighting	The channel marker lights fail in advance of an offshore supply vessel passage resulting in contact with approach dolphin.	Operation	Commercial (Large/Other)	People	3	3				LPS System, Emergency Response Processes, Trinity House inspections, PMSC Compliance (reporting AtoN), Vessel Bridge Resourse Management	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact protection fendering. Additional Lighting Through Passage, GSM monitoring of nav lights.	2	2			
						Environment	2	3		9	14			1	2		4	10
						Reputation	2	2						1	2			
						Asset	3	3						2	2			
27	Contact	Equipment failure - Failure of navigation lighting	The dolphin hazard marks fail and a CTV attempts to berth on NQ4 contacting the protection dolphin.	Operation	Commercial (Small)	People	3	3				LPS System, Emergency Response Processes	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact protection fendering. Additional Lighting Through Passage, GSM monitoring of nav lights.	2	2			
						Environment	2	2		9	14			1	2		4	10
						Reputation	2	2						1	2			
						Asset	3	2						2	2			
28	Contact	Equipment failure - Failure of navigation lighting	The bridge control lights fail during a bridge lift and a sailboat contacts the structure while holding station for instruction.	Operation	Recreation (Sail)	People	3	3				LPS System, Emergency Response Processes	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact protection fendering. Additional Lighting Through Passage, GSM monitoring of nav lights.	2	2			
						Environment	1	2		9	14			1	1		4	10
						Reputation	1	1						1	1			
						Asset	1	1						1	1			
29	Contact	Equipment failure - Failure of navigation lighting	A motorboat makes contact with the approach dolphin due to the channel marker light failing.	Operation	Recreation (Motor)	People	3	3				LPS System, Emergency Response Processes	Mechanical redundancy within design, operating and emergency protocols to be established, maintenance regime, impact protection fendering. Additional Lighting Through Passage, GSM monitoring of nav lights.	2	2			
						Environment	1	2		9	14			1	1		4	10
						Reputation	1	1						1	1			
						Asset	1	1						1	1			
30	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operator fails to see approach of a general cargo vessel and doesn't open bridge.	Operation	Commercial (Large/Other)	People	2	4				LPS System, Emergency Response Processes	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV. Scheme of Operation, bridge operational procedures.	1	4			
						Environment	2	3		8	28			1	3		4	10
						Reputation	2	2						1	2			
						Asset	2	4						1	4			
31	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operator doesn't see a second CTV passing bridge and initiates closing sequence.	Operation	Commercial (Small)	People	2	4				LPS System, Emergency Response Processes	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV. Scheme of Operation, bridge operational procedures.	1	4			
						Environment	2	2		8	28			1	2		4	10
						Reputation	2	2						1	2			
						Asset	2	3						1	3			
32	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operator doesn't see the final sail boat in a flotilla and initiates closing sequence in advance of passage.	Operation	Recreation (Sail)	People	2	3				LPS System, Emergency Response Processes	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV. Scheme of Operation, bridge operational procedures.	1	3			
						Environment	1	2		6	35			1	2		3	28
						Reputation	1	2						1	2			
						Asset	1	1						1	1			
33	Contact	Equipment failure - Operator fails to see vessel during bridge passage	Operator fails to see a motorboat in the channel and instructs a CTV to pass the bridge.	Operation	Recreation (Motor)	People	2	3				LPS System, Emergency Response Processes	Ensure adequate visibility of approaching vessels from control location, contact mechanism for vessels detailed in Notice to Mariners, provision of CCTV. Scheme of Operation, bridge operational procedures.	1	3			
						Environment	1	2		6	35			1	2		3	28
						Reputation	1	2						1	2			
						Asset	1	1						1	1			
38	Contact	Lack of knowledge of presence of structure	An offshore support vessel contacts the protection dolphins while berthing on NQ1/2 unaware of offset from bridge	Operation	Commercial (Large/Other)	People	3	3				Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes, Vessel Bridge Resourse Management	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering	2	2			
						Environment	2	3		9	14			1	3		4	10
						Reputation	2	2						1	2			
						Asset	3	3						2	2			
39	Contact	Lack of knowledge of presence of structure	A CTV unfamiliar with the operation of the bridge fails to request an opening and contacts the structure waiting instruction	Operation	Commercial (Small)	People	2	3				LPS System, Emergency Response Processes	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering	2	2			
						Environment	2	2		6	35			1	2		4	10
						Reputation	2	2						1	2			
						Asset	2	3						2	2			
40	Contact	Lack of knowledge of presence of structure	A sail boat unfamiliar with the operation of the bridge fails to request an opening and contacts the structure waiting instruction	Operation	Recreation (Sail)	People	4	2				LPS System, Emergency Response Processes	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering, Update of Guidance for Small Craft, Bridge operational procedures.	3	1			
						Environment	2	1		8	28			2	1		3	28
						Reputation	2	2						2	1			
						Asset	4	2						3	1			
41	Contact	Lack of knowledge of presence of structure	A motorboat unfamiliar with the operation of the bridge fails to request an opening and contacts the structure waiting instruction	Operation	Recreation (Motor)	People	4	2				LPS System, Emergency Response Processes	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, impact protection fendering, Update of Guidance for Small Craft, Bridge operational procedures.	3	1			
						Environment	2	1		8	28			2	1		3	28
						Reputation	2	2						2	1			
						Asset	4	2						3	1			
46	Contact	Loss of control due to changes in current patterns	A general cargo vessel contacts the bridge pier due to currents around the structure.	Operation	Commercial (Large/Other)	People	3	3				Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes, Vessel Bridge Resourse Management	Undertake simulations to assess the extent of potential changes to navigation, Issue Notice to Mariners, impact protection fendering	2	2			
						Environment	2	3		9	14			1	2		4	10
						Reputation	2	2						2	1			
						Asset	3	3						2	2			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Lake Lothing Third Crossing - Operational Phase Navigation Risk Assessment

							Pre-Mitigation							Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
47	Contact	Loss of control due to changes in current patterns	A CTV contacts the bridge pier due to currents around the structure.	Operation	Commercial (Small)	People	2	3		6	35	Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, current modelling during detailed design	1	1		1	52
						Environment	2	2						1	1			
						Reputation	2	2						1	1			
						Asset	2	3						1	1			
48	Contact	Loss of control due to changes in current patterns	A sailboat contacts the bridge pier due to currents around the structure.	Operation	Recreation (Sail)	People	4	3		12	3	Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, current modelling during detailed design	1	1		1	52
						Environment	3	2						1	1			
						Reputation	2	2						1	1			
						Asset	4	1						1	1			
49	Contact	Loss of control due to changes in current patterns	A motorboat contacts the bridge pier due to currents around the structure.	Operation	Recreation (Motor)	People	3	2		6	35	Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, current modelling during detailed design	1	1		1	52
						Environment	3	2						1	1			
						Reputation	2	2						1	1			
						Asset	3	1						1	1			
50	Contact	Loss of control due to wind sheltering	An offshore supply vessel is blown into contacts with the bridge pier while transiting the bridge passage.	Operation	Commercial (Large/Other)	People	3	3		9	14	Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, provision of wind indicator at bridge.	1	2		2	44
						Environment	2	3						1	2			
						Reputation	2	2						1	1			
						Asset	3	3						1	2			
51	Contact	Loss of control due to wind sheltering	A CTV is blown onto the bridge pier while transiting the bridge passage.	Operation	Commercial (Small)	People	2	3		6	35	Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, provision of wind indicator at bridge	1	2		2	44
						Environment	1	2						1	2			
						Reputation	2	2						1	2			
						Asset	2	2						1	1			
52	Contact	Loss of control due to wind sheltering	A sailboat is blown onto the bridge pier while transiting the bridge passage.	Operation	Recreation (Sail)	People	4	2		8	28	Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, provision of wind indicator at bridge	1	2		2	44
						Environment	2	2						1	1			
						Reputation	2	2						1	1			
						Asset	4	1						1	1			
53	Contact	Loss of control due to wind sheltering	A motor boat is blown onto the bridge pier while transiting the bridge passage.	Operation	Recreation (Motor)	People	3	2		6	35	Emergency Response Processes	Issue Notice to Mariners, impact protection fendering, provision of wind indicator at bridge	1	2		2	44
						Environment	2	2						1	1			
						Reputation	2	2						1	1			
						Asset	3	1						1	1			
54	Contact	Proximity of waiting pontoon to turning area	An offshore supply vessel makes contact with the waiting pontoon	Operation	Commercial (Large/Other)	People	2	3		6	35	Emergency Response Processes, Compulsory Pilotage, Port Regulations, Navigation Directions.	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Update to Navigation Directions (guide for small craft). Wind indicators at bridge.	1	3		3	28
						Environment	1	3						1	3			
						Reputation	2	2						1	2			
						Asset	2	2						1	2			
55	Contact	Proximity of waiting pontoon to turning area	A CTV makes contact with the waiting pontoon	Operation	Commercial (Small)	People	2	3		6	35	Emergency Response Processes	Location selected to minimise risk, Navigation Simulation, Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Update to Navigation Directions (guide for small craft). Wind indicators at bridge.	1	3		3	28
						Environment	1	2						1	2			
						Reputation	2	2						1	2			
						Asset	2	2						1	2			
56	Contact	Vessel contact with bridge attempting to proceed without an opening	A general cargo vessel attempts to transit the bridge without a lift and strikes the deck	Operation	Commercial (Large/Other)	People	1	4		4	53	LPS System, Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes, Vessel Bridge Resourse Management	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Provision of air draft boards, Bridge operations procedure, Enforcement of bridge control navigation lights.	0	4		0	55
						Environment	1	2						0	2			
						Reputation	1	2						0	2			
						Asset	1	4						0	4			
57	Contact	Vessel contact with bridge attempting to proceed without an opening	A CTV vessel attempts to pass under the bridge and the tide level is higher than anticipated.	Operation	Commercial (Small)	People	3	4		12	3	LPS System, Emergency Response Processes, Existing tide boards and data.	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Provision of air draft boards, Bridge operations procedure, Enforcement of bridge control navigation lights.	1	4		4	10
						Environment	1	2						1	2			
						Reputation	3	2						1	2			
						Asset	1	2						1	2			
58	Contact	Vessel contact with bridge attempting to proceed without an opening	A sail boat underestimates their mast height and strikes the bridge deck.	Operation	Recreation (Sail)	People	4	3		12	3	LPS System, Emergency Response Processes	Issue of Notice to Mariners, update of Navigational Charts, implementation of lights and marks, Provision of air draft boards, Bridge operations procedure, Enforcement of bridge control navigation lights.	3	3		9	1
						Environment	2	1						1	1			
						Reputation	2	2						1	2			
						Asset	4	2						3	2			
59	Contact	Vessel projections or roll causes contact with bridge superstructure	An offshore support vessel with bow helipad contacts the raised bridge structure	Operation	Commercial (Large/Other)	People	4	3		12	3	Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes, Navigation Directions, Port Regulations, Vessel Bridge Resourse Management.	Bridge designed with no oversailing when open, impact protection fendering	2	3		6	2
						Environment	3	3						2	3			
						Reputation	3	2						2	2			
						Asset	4	3						2	3			
60	Contact	Vessel projections or roll causes contact with bridge superstructure	A wind farm CTV rolls sufficiently to strike the bridge pier.	Operation	Commercial (Small)	People	2	2		4	53	Emergency Response Processes	Bridge designed with no oversailing when open, impact protection fendering	2	2		4	10
						Environment	2	2						2	2			
						Reputation	2	2						2	2			
						Asset	2	1						2	1			
61	Contact	Vessel projections or roll causes contact with bridge superstructure	A sail boat transiting the bridge rolls and the mast strikes the bridge pier	Operation	Recreation (Sail)	People	3	2		6	35	LPS System, Emergency Response Processes	Bridge designed with no oversailing when open, impact protection fendering	1	2		2	44
						Environment	2	1						1	1			
						Reputation	2	2						1	1			
						Asset	3	1						1	1			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

Lake Lothing Third Crossing - Operational Phase Navigation Risk Assessment

							Pre-Mitigation							Post-Mitigation				
Hazard ID	Hazard Type	Cause	Example Scenario	Phase	Traffic Type	Receptor	Likelihood	Severity	Rating	Highest Rate	Rank	Existing Controls	Additional Mitigation	Likelihood	Severity	Rating	Highest Rate	Rank
62	Contact	Vessel equipment failure	A general cargo vessel looses steering on approach to bridge.	Operation	Commercial (Large/Other)	People	1	4		4	53	Emergency Response Processes, Vessel defect reporting, Master/Pilot exchange, Vessel Bridge Resourse Management.	Impact protection fenders, Additional oil spill equipment.	1	3		3	28
						Environment	1	4						1	3			
						Reputation	1	3						1	2			
						Asset	1	4						1	2			
63	Contact	Vessel equipment failure	A CTV suffers engine failure while transiting the bridge.	Operation	Commercial (Small)	People	2	3		6	35	Emergency Response Processes	Impact protection fenders, Additional oil spill equipment.	2	2		4	10
						Environment	1	3						1	2			
						Reputation	1	2						1	2			
						Asset	2	2						1	1			
64	Contact	Vessel equipment failure	A sail boat suffers equipment failure and looses control during a bridge transit.	Operation	Recreation (Sail)	People	2	3		6	35	Emergency Response Processes	Impact protection fenders, Additional oil spill equipment, waiting pontoon, provision of emergency cabinet on waiting pontoon (fire extinguishers & first aid).	2	2		4	10
						Environment	1	1						1	1			
						Reputation	2	2						1	2			
						Asset	1	1						1	1			
65	Contact	Vessel equipment failure	As 64 but for a motorboat.	Operation	Recreation (Motor)	People	2	3		6	35	Emergency Response Processes	Impact protection fenders, Additional oil spill equipment, waiting pontoon, provision of emergency cabinet on waiting pontoon (fire extinguishers & first aid).	2	2		4	10
						Environment	1	1						1	1			
						Reputation	2	2						1	2			
						Asset	1	1						1	1			
70	Contact	Human error - Vessel operator	A general cargo vessel approaches the bridge too fast and impacts the dolphins	Operation	Commercial (Large/Other)	People	4	4		16	1	Compulsory Pilotage and Pilot Exemption Certification, Emergency Response Processes, Vessel Bridge Resourse Management	Impact protection fenders, Bridge operator can provide information on other vessels.	2	3		6	2
						Environment	3	4						2	3			
						Reputation	2	3						1	2			
						Asset	3	4						2	3			
71	Contact	Human error - Vessel operator	A CTV vessel fails to observe the bridge control lights and contacts the dolphins taking avoiding action.	Operation	Commercial (Small)	People	4	3		12	3	Port regulations, Navigation directions, Emergency Response Processes	Impact protection fenders, Bridge operator can provide information on other vessels.	2	3		6	2
						Environment	3	3						2	2			
						Reputation	2	2						1	2			
						Asset	3	3						2	1			
72	Contact	Human error - Vessel operator	A sail boat drifts onto the dolphins while manouvering	Operation	Recreation (Sail)	People	3	3		9	14	Port regulations, Navigation directions, Emergency Response Processes	Impact protection fenders, Bridge operator can provide information on other vessels.	2	3		6	2
						Environment	2	1						2	1			
						Reputation	2	2						2	1			
						Asset	3	1						3	1			
73	Contact	Human error - Vessel operator	A motorboat contacts the bridge pier due to the master being distracted.	Operation	Recreation (Motor)	People	3	3		9	14	Port regulations, Navigation directions, Emergency Response Processes	Impact protection fenders, Bridge operator can provide information on other vessels.	2	3		6	2
						Environment	2	1						2	1			
						Reputation	2	2						2	1			
						Asset	3	1						3	1			
77	Grounding	Change in sediment regime leads to shoaling	An offshore support vessel grounds approaching NQ1/2 due to shoaling.	Operation	Commercial (Large/Other)	People	3	4		12	3	Bathymetric surveys and navigational charts, Maintenance dredging, Emergency Response Processes, Pilotage.	Modelling during design.	1	4		4	10
						Environment	2	2						1	2			
						Reputation	3	3						1	3			
						Asset	2	2						1	2			
78	Grounding	Change in sediment regime leads to shoaling	A wind farm CTV grounds at NQ4 due to shoaling	Operation	Commercial (Small)	People	2	3		6	35	Bathymetric surveys and navigational charts, Maintenance dredging, Emergency Response Processes	Modelling during design.	1	3		3	28
						Environment	1	1						1	1			
						Reputation	2	2						1	2			
						Asset	1	2						1	2			
79	Grounding	Change in sediment regime leads to shoaling	A sail boat grounds at the waiting pontoon.	Operation	Recreation (Sail)	People	2	2		4	53	Bathymetric surveys and navigational charts, Maintenance dredging, Emergency Response Processes	Modelling during design.	1	2		2	44
						Environment	1	1						1	1			
						Reputation	2	2						1	2			
						Asset	1	1						1	1			
89	Other	Risk of small vessels passing between dolphins and navigating under fixed spans.	A small motorboat passes between the protection dolphins to transit the bridge	Operation	Recreational (motor)	People	3	2		6	35	LPS System	Illuminated "No Entry" signage, Bridge bye-laws, Bridge operating procedures, Operator Training, CCTV cameras to observe bridge passage	2	2		4	10
						Environment	3	1						2	1			
						Reputation	3	2						2	2			
						Asset	3	1						2	1			
90	Other	MOB incident in vicinity of bridge	Crew on a sailboat falls overboard while the vessel is passing the bridge	Operation	All	People	3	4		12	3	LPS System, emergency response processes, Lifeboat	Escape ladders on dolphins, CCTV cameras to observe bridge passage	1	4		4	10
						Environment	0	0						0	0			
						Reputation	2	3						1	3			
						Asset	0	0						0	0			

Note: Only risk combinations with a pre-mitigation rating of >3 are shown in the table.

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