Great Yarmouth Third River Crossing

OUTLINE BUSINESS CASE

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Supporting Document 14 – Port Operations Report

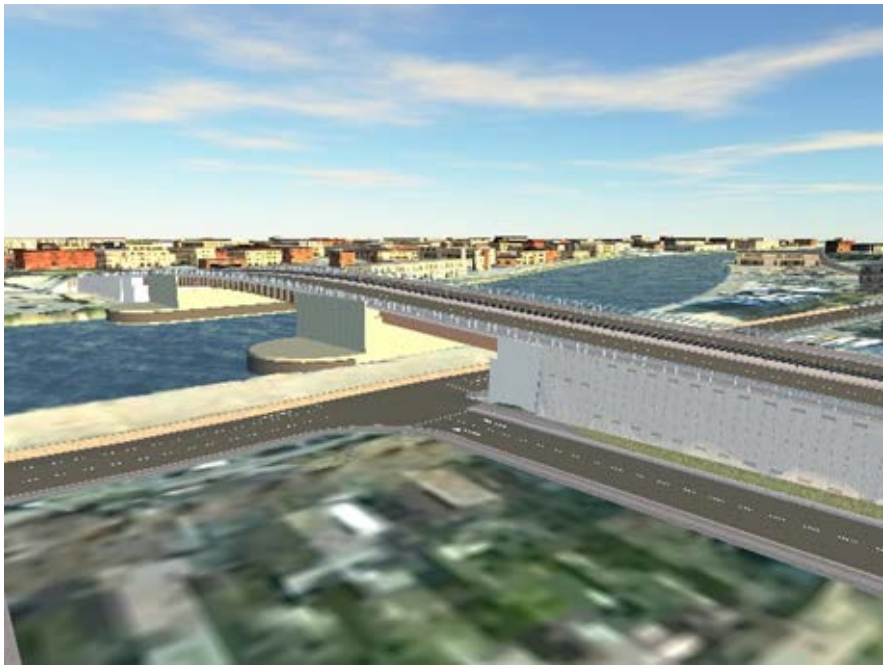
Norfolk County Council

Great Yarmouth Borough Council

NEWANGLIA Local Enterprise Partnership for Norfolk and Suffolk

Great Yarmouth Third Crossing

Existing and Future Navigation Requirements of Peel Ports Great Yarmouth and other Port Users



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Contents

Introduction

Great Yarmouth is a town in the English county of Norfolk. It is situated on the east coast of the United Kingdom and has a port with direct sea access to the North Sea. The port is owned and operated by Peel Ports Great Yarmouth and is made up of two sections; the inner harbour is formed on the banks of the River Yare whilst the outer harbour is constructed from breakwaters and comprises land reclaimed from the sea.
As can be seen in Figure 1 below the town is divided in a north south direction by the river which results in a spit of land approximately 4km long being effectively separated from the remainder of the town.

Figure 1 - Aerial photograph of Great Yarmouth Haven

To overcome this separation Norfolk County Council is proposing to construct a third river crossing approximately 1.5km south of the existing Haven Bridge, which is the most southerly of the current two crossings.
The aspirations of the scheme are to improve connectivity within the town thereby reducing traffic congestion and promoting redevelopment and growth.

1 Project Appreciation

Norfolk County Council have appointed Mouchel's Transport Planning Division to prepare an Outline Business Case for the proposed third river crossing at Great Yarmouth. The proposed scheme is a new road crossing to ease the current congestion around the town centre and the existing bridges. The type and location of the proposed new crossing has the potential to impact on existing and future maritime based operations in Great Yarmouth.

The proposals are to construct a new bascule bridge that will carry land traffic across the River Yare. The proposed bridge will cross the river near the apex of the river bend between Berths 12 and 13 on the Atlas Quay (also known as Fish Wharf) on the east bank, and Berths 31 and 32 on the Bollard Quay on the west bank, see Figure 2. With the current design parameters, when raised the bridge will have a 50m clear span for navigation and when closed it will have a clear height of approximately 4.5m above the mean high water springs level. An alternative design providing a clear height of 7.5m, the maximum achievable while still maintaining a tie-in to South Dene Road, has also been considered.

Figure 2 - Proposed Bridge Location

Ships will need to routinely pass through the raised bridge to access the various berths north of the bridge site. Furthermore, there are active berths immediately adjacent to the intended bridge's location on both sides of the river. Therefore an assessment of the likely frequency of operations and the effect of future port developments on this frequency is required.

2 Scope of Service

2.1 Scope

Mouchel's Maritime Division have been asked to provide support to Mouchel's Transport Planning Division by gathering available data on existing maritime operations based in Great Yarmouth and forecasting possible future maritime operations, that will have an influence on the proposed solutions for the third crossing. Mouchel Maritime were also requested to establish possible benefits / regeneration upsides available to Peel Ports and other port users from a third crossing. This will be achieved by completing the following tasks:

- Complete a desk top study and initial consultations to identify stakeholders
- Prepare a questionnaire to be used to gather information from stakeholders
- Schedule meetings with stakeholders in preparation for a visit to Great Yarmouth
- Collate information on existing and projected future Port usage
- Prepare a report on the existing and future requirements of the Port and other users to identify constraints and opportunities for the proposed crossing and to inform the Options Study
- Attendance at an optioneering workshop
- Ongoing support to develop and select option(s) for recommendation
- Input to final report to Client

3 Existing Stakeholders of the Port

3.1 Identification of Existing Stakeholders

Stakeholders are individuals, departments or organizations whose interests may be affected positively or negatively by the execution of the project. The identification of stakeholders was carried out using a variety of methods, electronic searches and consultations to determine individuals, departments and organizations that may be impacted by or have an impact on this project.

For the purpose of this study and the focus on the existing and future maritime operations at the Port, two levels of stakeholder were identified, primary and secondary. Primary stakeholders, those directly affected by this project, were considered to be the land owners and Port tenants who have quay operations north of the proposed bridge location. Secondary stakeholders, those indirectly affected by this project, were considered to be those who have quay operations south of the proposed bridge location or do not operate vessels from their berths north of the bridge. Table 1 below lists all stakeholders identified. Stakeholders who operate at berths falling in to both primary and secondary categories have only been consulted once.

An initial consultation meeting with Peel Ports was held on 18th October to outline the aims and nature of the proposed bridge, obtain any key concerns Peel Ports had over the scheme and to identify significant port users and others who may be affected by the bridge.

	Stakeholder Name	Status	Relationship
1	Peel Ports/Great Yarmouth Port	Primary	Land Owner and Quay User
2	G.Y. Borough Council	Primary	Land Owner
3	Asco	Primary	Port Tenant and Quay User
4	Gardline	Primary	Port Tenant and Quay User
5	Alicat	Primary	Port Tenant and Quay User
6	E-on	Primary	Port Tenant and Quay User
7	Trinity Marine Services	Primary	Port Tenant and Quay User
8	Seatrax Ltd	Primary	Port Tenant and Quay User
9	Atlantic Marine & Aviation	Primary	Port Tenant and Quay User
10	EMR	Primary	Port Tenant and Quay User
11	Brineflow Ltd	Primary	Port Tenant
13	CLS Global Solutions	Secondary	Port Tenant and Quay User
14	Silverton Aggregates	Secondary	Port Tenant

Table 1 List of Identified Stakeholders

The location of the principal operational berths of the above identified stakeholders, along with the major layby berths within the Haven, are shown on Figure 3, overleaf.

Figure 3 - Berth plan

3.2 Stakeholder Details

3.2.1 Peel Ports/Great Yarmouth Port

Peel Ports are the second largest port operator in the UK and are part of the Peel Group, one of the largest property investment companies in the UK. Peel Ports Great Yarmouth are the Statutory Harbour Authority for the Port and have statutory duties regarding safety of navigation within the port and its approaches. They are owners and operators of a number of berths within the port.

3.2.2 Great Yarmouth Borough Council

Great Yarmouth Borough Council are the land owners at berths 21 and 35. Consultation with the Borough Council is being undertaken directly by Norfolk County Council and as such they were not approached in connection with this report.

3.2.3 ASCO

ASCO are an international offshore support services business providing service vessel and crew transfers for oil and gas field operations. They currently operate from Berths 12A to 12D, 31 and 32 with additional layby at 21 when required, and have between 25 and 35 vessel movements per week.

3.2.4 Gardline Marine Sciences

Gardline provide marine geophysical and geotechnical surveys including bathymetry and operate a number of survey vessels from Berth 29. Movement rates are typically less than 1 per week.

3.2.5 Alicat Workboats

Alicat are a service vessel manufacturer and repairer based at Berths 29A and B, they are part of the Gardline Group. They have an average of 7 vessel moves per week.

3.2.6 E-on

E-on operate a wind farm maintenance base for the Scroby Sands from Berth 15, with layby facilities at Berth 29 when required. They currently operate 2 vessels with movements typically twice daily for each vessel.

3.2.7 Trinity Marine Services

Trinity Marine Services (a Dalby Offshore/Gardline joint venture company) operate an offshore supply service from Berth 16, with standby mooring at 21, running between 2 and 4 vessels on a typical daily movement pattern for each vessel.

3.2.8 Seatrax Ltd

Seatrax are an offshore crane manufacturing company, supplying lifting equipment for offshore oil and gas installations. They operate a facility at Berth 28, vessel movements are limited with an average of less than 1 per month.

3.2.9 Atlantic Marine & Aviation

Atlantic Marine & Aviation are a vessel chartering company operating in the offshore & subsea markets. They have an operations base at berth 28, and have vessel movements 2 to 3 times per month.

3.2.10 EMR

EMR (European Metal Recycling) are a global metal recycling business operating a depot on Berth 18. They have few vessel movements to the berth.

3.2.11 Brineflow Properties & Handling Ltd

Brineflow are a drilling fluid supply company who have commercial interests in 2 quays north of the proposed bridge location (berths 20 and 24) with aspirations to develop these as offshore support bases. They currently have limited ship movements within the port.

3.2.12 CLS Global Solutions

CLS Global Solutions provide engineering and project management services to the offshore oil, gas and renewables industries. They operate from berth 32C & D and 33. Vessel movements to these berths are infrequent.

3.2.13 Silverton Aggregates

Silverton Aggregates operate a material supply depot from berths 30D & E, although they have not had a vessel on berth for 4 years.

3.3 Stakeholder Consultations

In order to understand the business operations, both present and future, of the individual identified stakeholders a consultation exercise was undertaken. In the majority of cases stakeholders were contacted by telephone to explain the study and discuss details of the proposal and their opinions. Table 2 below summarises all stakeholders and the type of consultation conducted.

Stakeholder Name	Status	Meeting	Telephone	E-mail	Response
Peel Ports	Primary	✓			✓
G.Y. Borough Council	Primary	Not approached as part of this survey.			
ASCO	Primary		✓	✓	
Gardline / Alicat	Primary		✓	✓	

E-on	Primary		✓		✓
Trinity Marine / Dalby Offshore	Primary		✓		✓
Seatrax Ltd	Primary		✓		✓
Atlantic Marine & Aviation	Primary		✓	✓	
EMR	Primary		✓		✓
Brineflow Ltd	Primary		✓		✓
CLS Global Solutions	Secondary		✓		✓
Silverton Aggregates	Secondary		✓		✓

Table 2 Summary of Stakeholder Consultations

4 Results of Consultations

4.1 Stakeholder Consultations

4.1.1 Peel Ports

During the initial consultation meeting held at Peel Ports Great Yarmouth offices on 18th October, the general principles of the proposed bridge design were reviewed with representatives of the ports operational, engineering and marine management teams. A number of preliminary observations on the scheme were made by Peel Ports and a request for further detail was made to Norfolk County Council.

Peel Ports agreed to supply vessel movement data from the harbours records for a period covering 2010 to 2016, along with details of their future planning for berth redevelopments. This information was subsequently supplied on 31st October 2016, with additional information sent on 24th November 2016, and has been incorporated into the report.

Peel Ports supplied a berth occupancy plan showing operators and tenants for each berth within the harbour. This was used to confirm and refine the stakeholder consultation list and ensure the most accurate information available was used.

Amongst the items discussed during the meeting with Peel Ports, 3 potential items requiring further consideration were raised by Peel Ports; vessel navigation, channel sedimentation and land plant movements. Additional items that may provide potential benefit to the port were also discussed, including construction depth of walls for channel narrowing, potential to use the land created by the narrowing and abnormal load capacity of the new bridge in terms of both weight and height.

4.1.2 ASCO

ASCO were contacted by telephone and subsequently by e-mail. No response has been received to date.

4.1.3 Gardline/Alicat

Both Gardline and Alicat were contacted by telephone and subsequently by e-mail. No response has been received to date.

4.1.4 E-on

E-on were contacted by telephone; however their contact number reroutes to offices in Aberdeen and they no longer have operational staff in Great Yarmouth.

4.1.5 Trinity Marine Services/Dalby Offshore

No suitable contact details for Trinity Marine Services were found. Contact was made by telephone with Dalby Offshore. Following an outline of the proposal they confirmed that, provided no additional limitations on vessel sizes were caused by the new bridge, they could see no significant implications for their operations. They confirmed the extent of their shipping movements and stated that these could increase over the coming years with works on the East Anglia One Windfarm. They also stated that the improved road access for travel south would be of benefit for them as they have operations in both Great Yarmouth and Lowestoft. They requested that they be kept

informed of any additional information regarding the bridge as and when it became available.

4.1.6 Seatrax Ltd

Seatrax were contacted by telephone. Following an outline of the proposal they confirmed that, provided no additional limitations on vessel sizes were caused by the new bridge, they could see no implications for their operations. They confirmed the extent of their shipping movements and also stated that these should remain fairly consistent over the coming years. They requested that they be kept informed of any additional information regarding the bridge as and when it became available.

4.1.7 Atlantic Marine & Aviation

Atlantic Marine & Aviation were contacted by telephone and subsequently by e-mail. No response has been received to date.

4.1.8 EMR

EMR were contacted by telephone. They do not have any concerns regarding the new bridge and do not think it will have any impact on their operations in Great Yarmouth.

4.1.9 Brineflow Limited

Brineflow Limited were contacted by telephone. They raised concerns that if the bridge was constructed without sufficient clearance to allow unhindered passage of the smaller off-shore windfarm workboats it would restrict the access to the northern berths of the Port. This concern would not be present on the premise that commercial shipping movements would not be restricted, although they noted that this would increase the number of bridge operations and therefore disruption to road traffic. They estimated that, in total, around 15 movements per day passed the bridge location and believed that when the local wind farms were fully operational this could increase to 30 movements per day.

4.1.10 CLS Global Solutions

CLS Global Solutions were contacted by telephone. Following an outline of the proposal they confirmed that they could see no implications for their operations.

4.1.11 Silverton Aggregates

Silverton Aggregates were contacted by telephone. Following an outline of the proposal they confirmed that they could see no implications for their operations. They confirmed they have had no shipping movements for the past 4 years and stated they had recently surrendered their berth access agreement.

5 Options – Constraints and Opportunities

5.1 Current Operations

The inner River Port at Great Yarmouth has 97 distinctly identified berths, of these 51 are upstream of the proposed bridge location.

The assessment was initially undertaken assuming that any vessel accessing these 51 berths would require a bridge opening, which would certainly be the case for a bridge set at 4.5m above MHWS level. An additional assessment of vessel air drafts was also undertaken to quantify the benefit of constructing an elevated bridge with a clear height of 7.5m above high water. The related commentary is presented later in this section.

Peel Ports supplied copies of their vessel movement logs covering the period January 2008 through to August 2016. This data set comprised around 80,000 recorded **commercial** vessel moves. The data was filtered to identify those moves that were either to or from any of the 51 upstream berths and then further analysed to determine frequencies of bridge operation. The tables below detail the average and maximum numbers of vessels passing the proposed bridge locations by day and year, from 2010 onwards.

Year	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
2010	9.3	8.7	9.3	8.4	8.4	6.7	5.1
2011	11.4	10.3	10.7	11.5	11.2	7.3	6.3
2012	16.5	17.0	17.3	16.1	16.5	11.6	10.6
2013	10.8	10.7	11.7	10.5	11.1	6.9	5.7
2014	9.7	8.8	8.8	8.4	10.1	5.6	5.2
2015	8.9	8.1	9.2	9.0	9.4	5.7	4.5
2016	11.3	12.5	12.8	12.0	12.2	7.2	7.2

Table 3 - Average vessel movements passing proposed bridge location

Year	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
2010	18.0	19.0	22.0	15.0	17.0	14.0	20.0
2011	23.0	22.0	25.0	20.0	31.0	17.0	15.0
2012	36.0	29.0	38.0	33.0	31.0	26.0	27.0
2013	22.0	22.0	20.0	22.0	18.0	14.0	12.0
2014	23.0	20.0	21.0	18.0	19.0	17.0	12.0
2015	19.0	17.0	23.0	17.0	17.0	14.0	10.0
2016	21.0	29.0	23.0	23.0	22.0	19.0	18.0

Table 4 - Maximum number of vessel movements in a day passing proposed bridge location

Analysis was also undertaken to ascertain the distribution of numbers of vessel movements per day and the results of this are shown on Figure 4 below.

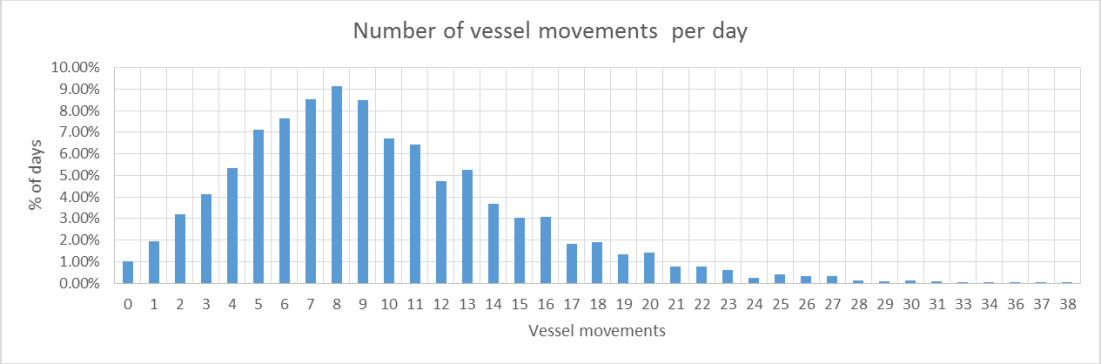

Figure 4 - Distribution of vessel movements per day

Consideration has also been given to the timing of vessel movements during the day. Figure 5, below, shows the distribution of timings of movements within the port from 2008 to 2016. This shows that the majority of movements occur during the working day, 82% between 6am and 6pm with distinct peaks occurring between 7 and 9am and 3 and 5pm.

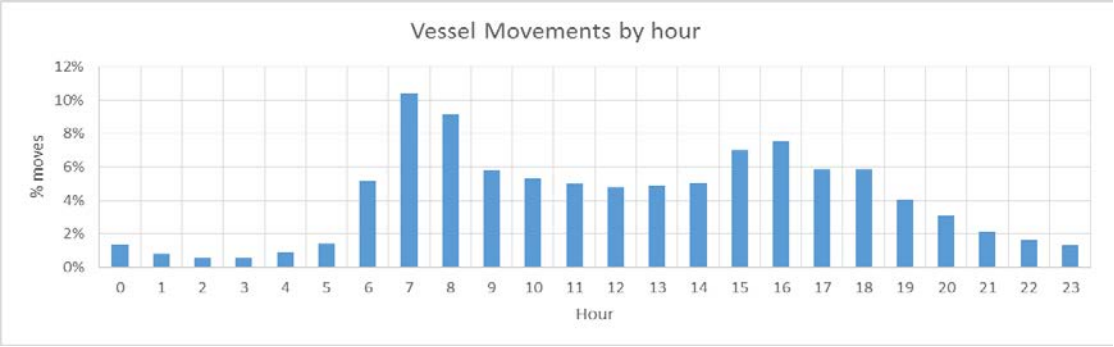

Figure 5 - % movements by hour 2010-2016

This general distribution pattern appears to hold constant for most days, Figure 6 below, showing vessel timings during August 2016, shows a good match to the overall averaged percentages.

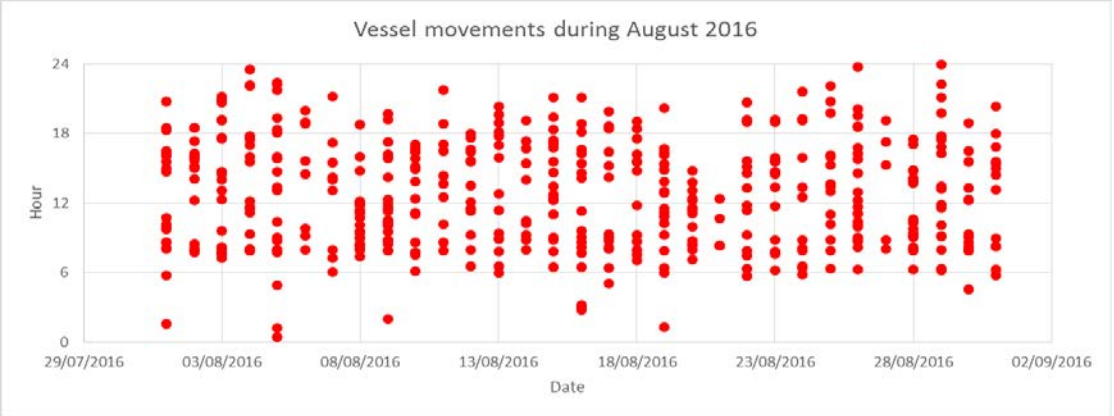

Figure 6 - Timing of vessel movements during August 2016

An analysis of vessel air drafts, for vessels historically using the port and for vessels in general, was undertaken to assess the benefits of elevating the bridge to reduce the number of openings. Constraints on the road approaches to the bridge location mean that the maximum clear height of the bridge above high water is limited to 7.5m and, allowing for safety clearance tolerances, this height would allow vessels with an air draft of less than 7m to pass under the bridge at high water without requiring an opening. Analysis of the vessels from 2008 to 2016 show that some 13% of movements past the bridge location were by vessels below 7m air draft, as shown on Figure 7, below.

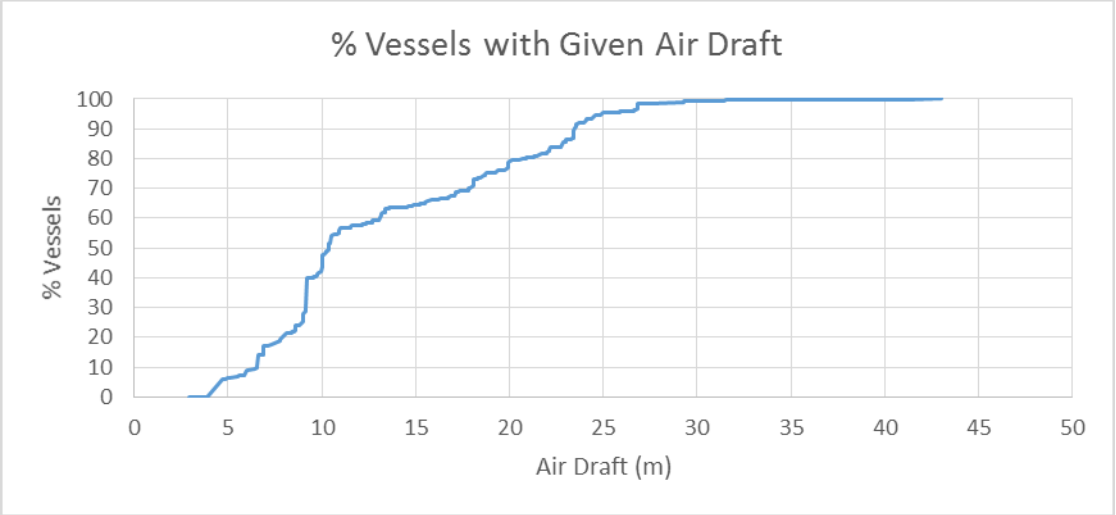

Figure 7 - Vessel passages with given air draft

Figure 8, below, shows the percentage of vessel movements with an air draft of less than 7m passing the bridge location per year. This indicates a general reduction in the number of vessels operating in the port capable of passing under a 7.5m bridge without requiring an opening.

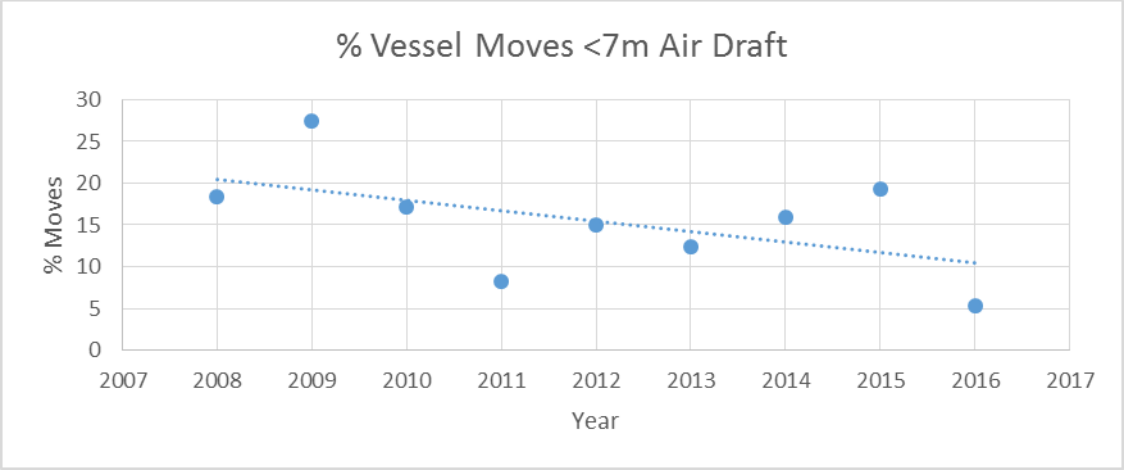

Figure 8 - Vessels <7m Air Draft per Year

A similar analysis was undertaken to assess the lengths and beams of vessels passing the proposed bridge location, this information will be used to assist in the selection of design vessels for bridge protection.

Figure 9, below, shows the percentage of vessels passing the bridge by beam, the 50%ile beam being 7.5m, the largest beam vessel to pass the location since 2008 has been the Toisa Warrior at 19m.

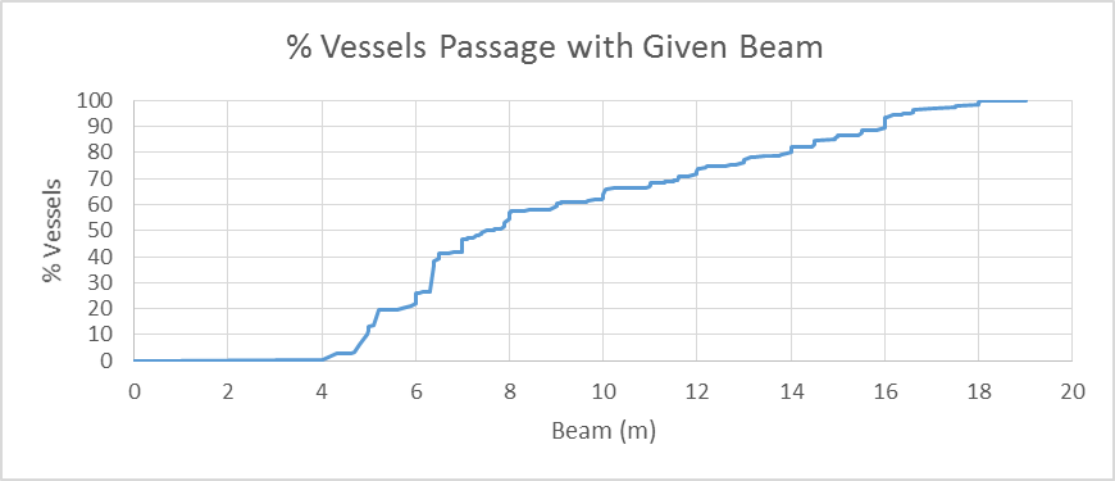

Figure 9 - Vessel passages with given beam

Figure 10, below, shows percentage passages by vessels by length, the 90%ile length being 72m and the longest vessel to transit has been the Salrix at 96.32m.

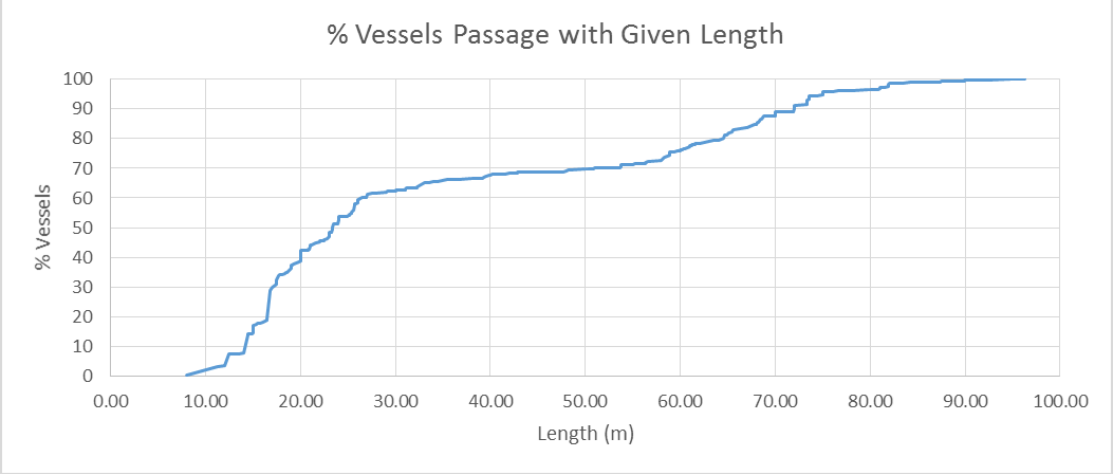

Figure 10 - Vessel passages with given length

From the data obtained and the analysis undertaken we can conclude that, currently, the long term average frequency of passage by a bascule bridge located between berths 31 and 32 would be 11 per day, with a one day per year exceedance number of 30. All of these vessel movements would require a bridge with a clear height of 4.5m to be lifted, raising the bridge to a clear height of 7.5m would reduce the openings to 87% of vessels, equating to 1 or 2 openings per day.

5.2 Future Developments

5.2.1 Vessel Size

The size of vessels entering the inner River Port is constrained by the natural width limit of the navigable channel and the length restriction of turning at the Brush Bend and, therefore, there is little prospect of the maximum size of vessels requiring transit increasing in the future. Given the existing constraints on vessel size and considering the number of berth structures that would be affected, it is not considered feasible that the depth within the river will be increased by dredging.

It is likely that the average vessel size within the port will increase, with offshore operators tending to employ larger vessels for operational efficiencies as the number of turbines serviced rises. This tendency was corroborated during the consultation with Brineflow Limited.

5.2.2 Vessel Frequency

With the future developments of further offshore windfarms in the southern North Sea, there is significant potential for an increase in the numbers of service craft accessing the port. The location of berths for these vessels clearly has the potential to affect the number of bridge openings required.

From the consultation with Peel Ports, it is apparent that there is an aspiration to increase use of the Outer Harbour Berths and it is foreseen that the provision of the new bridge will increase the potential for this by improving vehicle access to the south of the peninsular. Whether this leads to a long term reduction in the frequency of use of the Haven berths is uncertain at this stage and, as such, has not been factored into the opening frequency estimations.

From the consultation with Brineflow Limited, it is apparent that they have aspirations for the siting of two new off-shore windfarm support bases on berths north of the proposed bridge locations which could result in a significant increase in vessel movements. The vessels they envisage are the larger catamaran workboats of the 20 to 25m length class, with typical air drafts of between 10 and 14m.

5.2.3 Climate Change

The impacts of climate change on future sea levels may have an impact on the frequency of operation of the bridge, should an elevated solution be implemented. Current government models indicate a potential increase in water levels of up to +0.475m during the 21st century along the East Anglia coast. This would effectively reduce the clear height of the bridge and thus require openings for vessels with a smaller air draft than at current sea levels.

5.3 Navigation Constraints

The proposed location of the bridge, on a bend in the river, may cause visibility issues which could affect the timing of its operation. The navigation simulation, undertaken by HR Wallingford, drew certain conclusions over the operation and use of the adjacent berths during vessel transits but these were not confirmed with the Port at the time and therefore remain as potential constraints.

5.4 Bridge Operational Constraints

The opening duration of the bridge is dictated by 2 factors, bridge movement and vessel movement.

The time taken for the bridge to open and close comprises the time to clear the bridge of traffic and the time for the bridge to raise, while closing time includes the bridge lowering and the traffic controls lifting. The duration of this will vary depending on the nature of the traffic control system installed, with control of pedestrians being the probable limiting factor. In total a time of 240 seconds may be required to complete the operations of the bridge.

The vessel movement time includes the transit time, that is the time a vessel is manoeuvring through the bridge passage, and the approach time, the time taken for the vessel to approach the bridge following opening.

The initial navigation simulation, conducted by HR Wallingford, suggested an approach time equal to the travel time of a distance twice the overall length of the transiting vessel, until confirmed, or otherwise, by further simulations we have used this as a basis for calculating opening durations based on vessel lengths. Figure 11, below, shows the calculated percentage distribution of opening durations for the bridge.

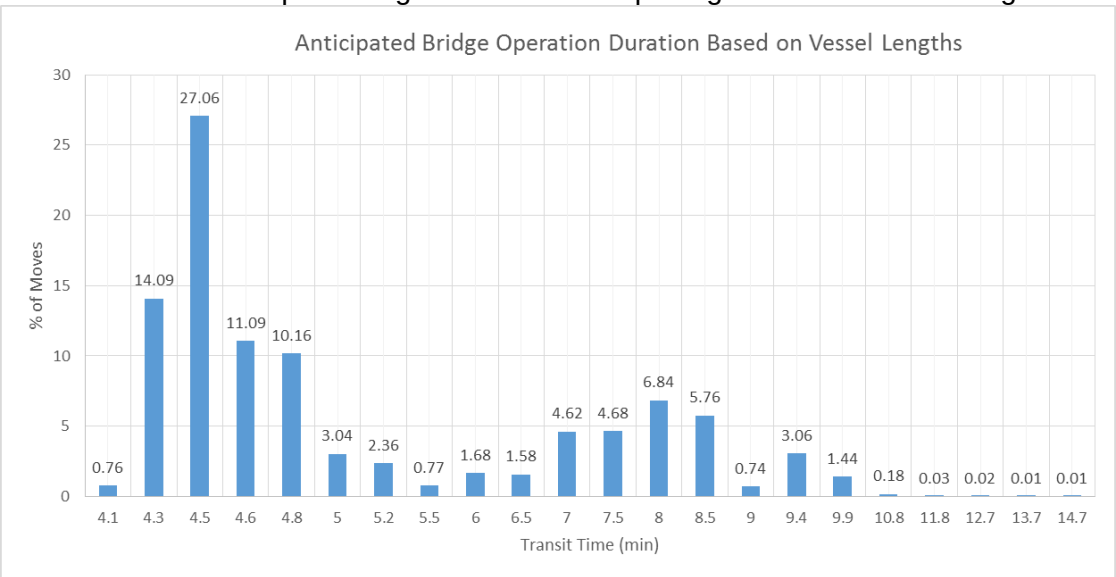

Figure 11 - Anticipated bridge operation durations

The above distribution does take into account vessels navigating with tug assistance, as determined from the vessel transit information supplied; it does not factor any platooning or marshalling of vessels outside those tug assisted manoeuvres.

This distribution has been used to produce a graph of cumulative percentage of opening durations, shown on Figure 12 overleaf. This shows that approximately 66% of bridge openings would take less than 5 minutes and 99.7% of openings would be completed in under 10 minutes. This would typically equate to only 10 moves per year taking longer than 10 minutes.

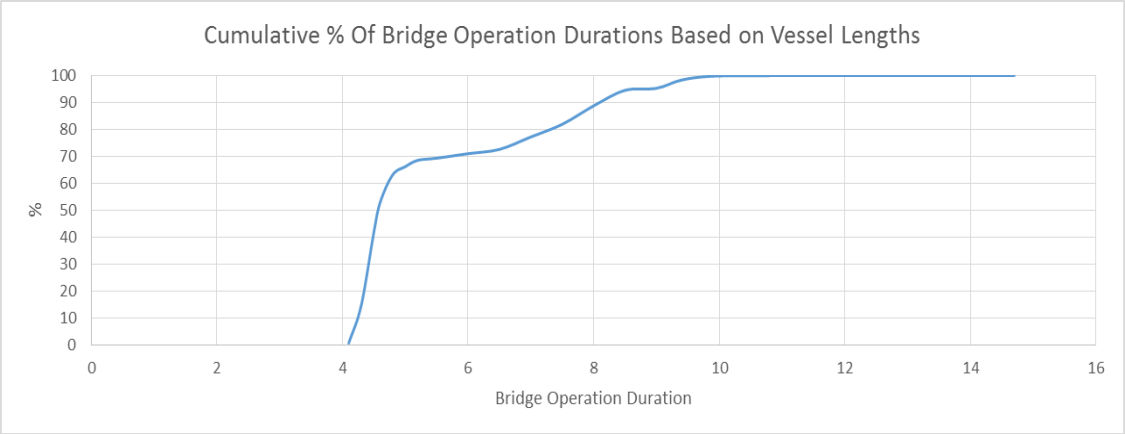

Figure 12 - Cumulative % bridge opening durations

5.5 Identified Opportunities

During the consultation process a number of potential additional benefits were identified by various stakeholder which may warrant further investigation. In particular Peel Ports enquiry on the ability of the new bridge to accommodate abnormal loads has the potential to both increase attractiveness of the port for undertaking transport of abnormal loads and reduce the traffic disruption caused during their movement.

The potential to utilise any additional land created as part of the channel narrowing may have the effect of mitigating operational land loss as a result of the bridge construction and may ameliorate the scheme for some of the affected stakeholders.

6 Summary and Conclusion

An initial assessment of the current nature and frequency of vessel movements within the River Port at Great Yarmouth has been undertaken. This assessed the vessels transiting the port between January 2008 and August 2016 in terms of dimensions and berths visited.

This assessment showed that on average 11 vessel movements per day passed the proposed location of the new bridge. All of these would require the bridge to open at the current design clear height of 4.5 while 87% were of a size that would require the new bridge to open if it were designed with a clear height of 7.5m.

A consultation exercise was undertaken with the major port stakeholders and users to ascertain the potential for increased vessel traffic within the port. This consultation showed that although the maximum size of vessels accessing the River Port was unlikely to increase due to natural constraints, the average vessel size could increase as more of the larger offshore support vessels were transferred to operations in this region.

The exercise also indicated that the number of vessels in operation and therefore the frequency of arrival and departures was likely to increase, particularly among the offshore windfarm service and support vessels.

Factoring in all potential movement increases identified in the consultation it can be estimated that the future average vessel movements at the proposed bridge location could increase to 20 movements per day. This level is a 25% increase on the maximum annual average daily movements recorded within the Port.

7 Recommendations

7.1 Navigation Simulation Modelling

While an initial navigation simulation has been carried out to assess the feasibility of the proposed bridge, it was undertaken independently of the Port Authority. From initial consultations, it is concluded that the Port Authority will require a re-run of the simulations with their own pilots, to confirm the suitability and operability of the proposed bridge. This is most likely the only way that such a proposal would be approved by Peel Ports, as the Statutory Port Authority, and the Harbour Master who have raised related concerns over the proposal. We would envisage this navigation simulation being undertaken during the next phase of the project being based on the design refinement and feeding into the scheme development prior to the application for planning permission. The principal risk associated with late commencement of a navigation simulation would be a requirement to redesign the works should the design be found to impact vessel movements more than expected, conversely a similar risk occurs with undertaking the simulations too soon as subsequent design refinements may require simulations to be re-run.

7.2 Sedimentation Transport Modelling

The effects of the new bridge on sediment transport within the Port will require further investigation to satisfy Peel Ports as the Statutory Port Authority that it will not have an adverse effect on siltation levels thus causing a hazard to navigation, or increase in their maintenance dredging requirements. We would envisage this modelling being undertaken during the next phase of the project during the design refinement and prior to the application for planning permission. As with the navigation simulation the principal risk with delaying the sedimentation transport modelling is the potential for unexpected results forcing either redesign or creating significant environmental issues requiring compensation. Likewise, the bridge design will have to have been completed to a relatively high confidence level before the modelling can be undertaken to avoid the potential for reworks due to design development.

7.3 Elevation Level of Bridge over Port Operational Areas

The elevation of the bridge while crossing operational areas of the port will need to be considered further in consultation with Peel Ports. Discussions over alternative transportation routes and plant crossings are currently being held and the outcomes will be incorporated into the design developments.

7.4 Traffic Sensitivity Analysis

Given the potential number of bridge openings required and the duration of each opening event, a worst case scenario could be used in the base case traffic assessment. A sensitivity analysis, based on various daily movement patterns, is being undertaken to establish the potential variability of effect on the road networks. It may show a potential improvement in benefits if constraints on the operation of the bridge,

in terms of proximity of openings or openings during peak road traffic times, could be discussed and agreed with the Port Operator.

7.5 Recreational Vessel Movements

This report focuses on commercial vessel movements within the Haven, there are also movements of recreational vessels from within the Norfolk Broads to the North Sea, via the River Yare, and vice versa, which will have an effect on the frequency of operations of the bridge. The number of movements of these vessels is limited and they are currently controlled over the timings at which their passage through the port can occur. Discussions have taken place with Peel Ports over the requirements for staging pontoons for holding recreational vessels intending to traverse the Haven until such time as a bridge opening can be undertaken and the cost of these pontoons are presently being included within the scheme estimates.

8 References

Great Yarmouth Port Authority Navigation (Haven) Byelaws 1997

Great Yarmouth Port Company Pilot Information (River Port and Outer Harbour)

Great Yarmouth Third Crossing Navigation Simulation Study (HR Wallingford) 2009

UK Climate Projections 2009 (UKCP09)