



Transport for London

Northern Line Extension to Battersea

Preliminary Navigation Risk Assessment for Nine Elms Reach for River Transport at Battersea

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Transport for London

Northern Line Extension to Battersea

Preliminary Navigation Risk Assessment for Nine Elms Reach for River Transport at Battersea

Halcrow Group Limited
Elms House, 43 Brook Green, London W6 7EF
tel +44 20 3479 8000 fax +44 20 3479 8001
halcrow.com

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Appendix

Appendix A – Preliminary navigation risk assessment for Nine Elms Reach

A.1 Preliminary NRA for Nine Elms Reach

1 Introduction

1.1 In April 2013 a Transport and Works Act Order (TWAO) was submitted by TfL that proposes to extend the Northern line from Kennington Station to Battersea. The Northern Line Extension (NLE) works would include the construction of twin running tunnels linking Kennington to Battersea, an intermediate station at Nine Elms and a terminal station, with adjacent crossover box at Battersea. Whenever practicable excavated material from the construction of these works would be exported by river from the Battersea Power Station coal jetty to a suitable receptor location. The excavated material to be exported will be that arising from the Battersea station and cross over box, from the running tunnels which will be driven from the Battersea crossover box towards Kennington, and from the over-run tunnels at Battersea.

1.2 A preliminary Navigation Risk Assessment (NRA) has been developed to support the proposals and demonstrate that the use of the river Thames to transport excavated material is appropriate and viable. The preliminary navigation risk assessment has assessed whether the additional river traffic generated by the export of excavated material can be accommodated safely by the river and can be accommodated alongside other known/committed river traffic and fixed installations. This preliminary navigation risk assessment covers the section of river between Victoria Railway Bridge and Vauxhall Bridge, known as Nine Elms Reach.

1.3 Halcrow commissioned sub consultants Marine and Risk Consultants Ltd (Marico) to prepare the preliminary NRA for Nine Elms Reach and this is attached at Appendix A.

2 Brief Summary

2.1 General

2.1.1. This section describes the amendments to the Engineering Design Report as a result of the revised proposals discussed in Section 1.

2.1.1 The purpose of the preliminary NRA report is to consider navigation risk associated with the removal of excavated material generated by the construction of the NLE from the old Battersea Power Station Jetty (BPSJ) to a downstream disposal site.

2.1.2 This assessment aims to ensure that there are no critical navigation risks associated with the additional river traffic generated by the export of the excavated material, and that this additional traffic will not be in conflict with other river traffic or fixed installations.

2.1.3 Since the contractor's methods of working will not be known and the disposal site not selected until after the contractor has been appointed, the geographical limit of this assessment is Nine Elms Reach.

2.1.4 Details of the disposal site will be determined once the Design & Build contractor has been appointed but it is intended that the excavated material will be put to beneficial use at a site or sites approved by the Environment Agency in a similar manner to that used by Crossrail at Wallasea Island.

2.1.5 This preliminary NRA is based on the following assumptions:

2.1.5.1 Based on available information from Thames Tideway Tunnel (TTT), the NLE removal of excavated material operation from BPSJ will be completed before the start of the TTT export of excavated material from their proposed Kirtling Street jetty;

2.1.5.2 The NLE removal of excavated material operation from BPSJ includes material excavated from the BPSD site;

2.1.6.3 The contractor will use barges of a capacity of approximately 1,000 tonnes (although the contractor will be free to determine his own mode of marine transport);

2.1.5.7 Up to two barges could be loaded over a tidal cycle;

2.1.5.8 Sufficient conveyor capacity will be provided to allow two barges to be loaded per tide;

2.1.5.9 Barges may be berthed two deep but will not incur into Port of London Authority (PLA) Authorised Channel; and

2.1.5.10 At peak periods it is expected that up to 20,000 tonnes of excavated material will be produced per week and loaded into barges from the two berths on BPSJ.

2.1.6 The methodology used is based on the Formal Safety Assessment approach to risk management as adopted by the International Maritime Organisation and follows the requirements of the Port Marine Safety Code.

2.1.7 The study relies on analysis of data, liaison and consultation with Port of London Authority, other stakeholders in Nine Elms Reach and expert judgement.

2.1.8 The report provides background information on traffic operations in Nine Elms Reach, including passenger vessels, freight vessels and recreational craft. It also provides results from the consultation with stakeholders.

2.1.9 The risk assessment results are presented in terms of:

2.1.9.1 "Baseline" risk of NLE removal of excavated material operations – Risk assessed with standard risk controls in place (e.g. existing PLA risk control measures); and

2.1.9.2 "Residual" risk of NLE removal of excavated material operations – Risk assessed with the standard risk controls in place and also "Possible Additional Mitigation" risk controls in place which are identified as part of this assessment.

2.2 Conclusions

2.2.1 The report identifies that collar barges may be required on the north side of the Thames. Collar barges are barges tethered at both ends and when used as lay-by berths, the moored barge is tied up to tethered barge and not to the mooring buoy. Whether these collar barges are required would depend on the marine craft selected by the contractor. Collar barges would be installed by the contractor or PLA at the contractor's expense under a PLA River Works Licence.

2.2.2 No critical navigation risks associated with the additional river traffic generated by the NLE removal of excavated material operations have been identified in Nine Elms Reach, nor will the additional river traffic conflict significantly with other river users or fixed installations.

2.2.3 Should the additional risk mitigation measures be implemented, then the risks from all the navigation hazards in Nine Elms Reach related to the NLE removal of excavated material operations could be mitigated to the "Low Risk" category and hence there is no reason why the proposed strategy for removing excavated material should not be implemented.

2.2.4 The key to a safe NLE removal of excavated material operation lies in the competence of the marine contractor selected as part of the "Design and Build" contract.

2.3 Recommendations

2.3.1 The preliminary NRA recommends that:

2.3.1.1 Marine safety issues are directly addressed in the "Design and Build" contractor requirements;

2.3.1.2 Marine expertise is utilised to vet contractor proposals; and

2.3.1.3 This preliminary NRA is further developed using then-current river traffic data when details of the contractor's proposed operations and the location of the disposal site become known.

2.4 Actions for ITT brought forward from Appendix A

2.4.1 The preliminary NRA recommends that further work be carried out when details of the contractor's proposals become known. It is therefore recommended that the following requirements be included in Invitation to Tenderers (ITT) for the Design & Build (D&B) contract and these requirements would then become actions for either TfL or the D&B contractor:

2.4.1.1 The marine safety issues involved in the removal of excavated material are addressed fully in the ITT for the contract for the Marine Contractor [Action: TfL];

2.4.1.2 Disseminate the results of this assessment to the tenderers (ITT) for the "Design and Build" contract to facilitate hazard identification and further develop detailed risk assessment [Action: TfL];

2.4.2 Establish mode of marine of operations for removal of exported material from BPSJ
[Action: Contractor]

2.4.3 Determine disposal site for excavated material [Action: Contractor];

2.4.4 Determine a passage plan and undertake a comprehensive Navigation Risk Assessment on the whole NLE removal of excavated material operation (from Battersea, through central London, to the final disposal destination) using river traffic data current at the time [Action: Contractor];

2.4.5 The NRA shall include an assessment of the in-combination and cumulative effects of NLE operations and other construction and barge operations in central London which may be affected by river traffic associated with the removal of NLE excavated material by river [Action: Contractor];

2.4.6 Determine the requirement (if any) for collar barges on the north side of the Thames [Action: Contractor];

2.4.7 Develop a contingency strategy to cover the possibility that the NLE removal of excavated material operation over-runs into the Thames Tideway Tunnel (TTT) excavated material removal operations at the nearby Kirtling Street jetty [Action: Contractor];

2.4.8 Liaise with other users of Nine Elms Reach whose activities may have an impact on the NLE D&B contractor's operations at and from the NLE Battersea Power Station jetty (BSPJ) [Action : Contractor].



Appendix A

Appendix A – Preliminary Navigation Risk Assessment for Nine Elms Reach for River Transport at Battersea as prepared by Marico

Appendix A – Preliminary navigation risk assessment for Nine Elms Reach

A.1 Preliminary NRA for Nine Elms Reach

Preliminary NRA for Nine Elms Reach for river transport at Battersea as prepared by Marico



HALCROW / TRANSPORT FOR LONDON

NORTHERN LINE EXTENSION - PRELIMINARY NAVIGATION RISK ASSESSMENT REPORT FOR NINE ELMS REACH - ACTIVITY 137



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MARINE AND RISK CONSULTANTS LTD

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Halcrow / Transport for London

Northern Line Extension - Preliminary Navigation Risk Assessment Report for Nine Elms Reach- Activity 137

Prepared for: Halcrow / Transport for London

Elms House
43 Brook Green
LONDON
W6 7EF

Author(s): Paul Fuller, Andrew Rawson, David Foster

Checked By: Ed Rogers

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Marine and Risk Consultants Ltd
Marico Marine
Bramshaw
Lyndhurst
SO43 7JB
Hampshire
United Kingdom

19/08/2013

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ABBREVIATIONS

Term	Definition
AIS	Automatic Identification System
ALARP	As Low as Reasonably Practicable
BPS	Battersea Power Station
BPSD	Battersea Power Station Development
BPSJ	Battersea Power Station Jetty
CCTV	Closed Circuit Television
D&B	Design and Build
HW	High Water
ICW	In Collision With
IMO	International Maritime Organisation
ITT	Invitation to Tender
kt	Knot (unit of speed equal to nautical mile per hour , approximately 1.15 mph)
LW	Low Water
m	Metre
Marico Marine	Marine and Risk Consultants Ltd
MCA	Maritime and Coast Guard Agency
ML	Most Likely
NLE	Northern Line Extension
nm	Nautical Mile
NRA	Navigation Risk Assessment
PAM	Possible Additional Mitigation
PEC	Pilotage Exemption Certificate

PLA	Port of London Authority
PWC	Personal Water Craft
RIB	Ridged Inflatable Boat
SMS	Safety Management System
STCW	Standards of Training Certification and Watchkeeping
TfL	Transport for London
TTT	Thames Tideway Tunnel
VHF	Very High Frequency (radio communication)
VTS	Vessel Traffic Service
WC	Worst Credible
WPSA	Westminster Passenger Service Association
WRWA	Western Riverside Waste Authority

EXECUTIVE SUMMARY

0.1 Transport for London (TfL) proposes to export excavated material from the Northern Line Extension project via the former Battersea Power Station Jetty to a downstream disposal site, utilising for the purposes of this NRA a system of towed barges. However, on appointment, the contractor will be free to determine the mode of marine transport to suit his method of working.

0.2 This report documents the findings of a Preliminary Navigation Risk Assessment within the Nine Elms reach area to identify any significant navigation risk associated with the proposed barge operations.

0.3 A Navigation Risk Assessment is not usually undertaken at this stage in the design process; however it has been decided to carry out a preliminary assessment at this time to provide more confidence that the barge proposal is deliverable.

0.4 The methodology employed in this study follows the internationally adopted Formal Safety Assessment approach to risk management, currently utilised by the Port of London Authority. The study relied on analysis of data, liaison and consultation with Port of London Authority and other key stakeholders in Nine Elms Reach, and the expert judgement of industry professionals.

0.5 The results show that for the baseline case no hazards were deemed “High Risk”, and by introducing additional mitigation measures, all hazards can be assessed as “Low Risk”.

0.6 In order to ensure that navigation related hazards remain “Low Risk” this report recommends that:

- 0.6.1 Marine safety issues are directly addressed in the “Design and Build” contractor requirements;
- 0.6.2 Marine expertise is utilised to vet contractor proposals.

0.7 The assessment demonstrates that, within Nine Elms Reach, there is no reason why the proposed strategy for removing excavated material should not be implemented.

0.8 This risk assessment reflects the level of development of the design in the application for a Transport and Works Act Order, that is, an outline design. It is

recommended that TfL require its Contractors to prepare detailed Navigational Risk Assessments and method statements before relevant barge movements commence, working closely with the PLA and other relevant stakeholders. These NRAs should follow the relevant guidance from the PLA and should consider the following issues:

- 0.8.1 **Barge scheduling**: Covering the whole export of the excavated material operation from Battersea to the final disposal site including the passage through Central London in relation to other planned projects and events that are relevant and to include the development of appropriate management measures;
- 0.8.2 **Nine Elms Reach coordination**: Consider establishing an overall coordination organisation / group for the Nine Elms Reach;
- 0.8.3 **Interface with Thames Tideway Tunnel (TTT)**: Develop a contingency strategy to cover the possibility that the Northern Line Extension removal of excavated material operation over runs into the Thames Tideway Tunnel excavated material removal operations.

1 INTRODUCTION

1.1 BACKGROUND

1.1.1 Transport for London (TfL) proposes to export excavated material from the Northern Line Extension (NLE) project via the former Battersea Power Station Jetty (BPSJ) to a downstream disposal site (yet to be determined, but put to beneficial use following the principle of Wallasea Island). In July 2013, Halcrow (on behalf of TfL) appointed Marine and Risk Consultants (Marico Marine) to undertake a preliminary Navigation Risk Assessment (NRA) for Nine Elms Reach for the proposed removal of excavated material operation.

1.1.2 This preliminary assessment aims to ensure that there are no critical navigation risks associated with the proposed export of the excavated material by the NLE project, and that the additional river traffic generated will not be in conflict with other river traffic or fixed installations.

1.1.3 Since the contractor's methods of working will not be known and the disposal site not yet selected until after the contractor has been appointed, the geographical limit of the assessment is Nine Elms Reach on the River Thames, which is bounded by Victoria Railway Bridge and Vauxhall Bridge (see **Figure 1**). This assessment does not therefore consider wider navigational issues outside Nine Elms Reach.

1.2 PROJECT OVERVIEW

1.2.1 TfL intends to remove uncontaminated excavated material from construction of running tunnels and overrun tunnels, Battersea station and crossover boxes, by means of a conveyor belt from the construction site to the BPSJ thence by water transport to a suitable disposal site further downstream. Excavated material from Battersea Power Station Development (BPSD) excavations may also be exported by river from the BPSJ concurrent with NLE exports. Information provided by BPSD indicates that quantities to be removed from the BPSD site are small in comparison to those from the NLE, and the proposed NLE barge operation has therefore included the transport of these additional quantities.

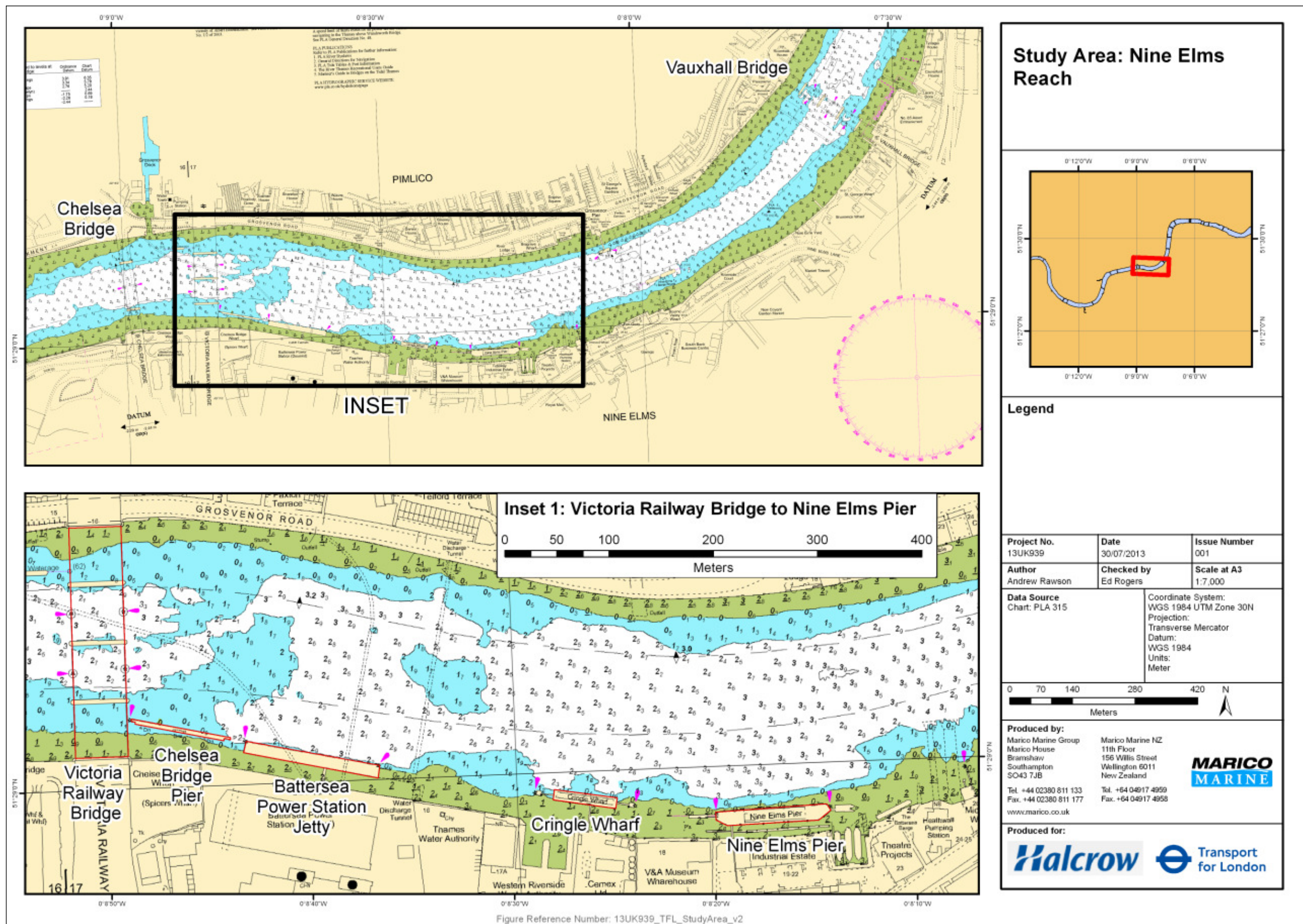


Figure 1: Extract from PLA Chart 315 showing the study area (top) and wharfs close to Battersea Power Station Jetty.

1.3 ASSUMPTIONS

1.3.1 At this stage of the project the details of the marine removal of excavated material methodology and operation have yet to be developed and will become the responsibility of the Design and Build (D&B) contractor when they are appointed.

1.3.2 Since the downstream site for the disposal of excavated material is yet to be determined pending the appointment of a contractor, (the current assumption is for it to be put to beneficial use following the principle of Wallasea Island), this initial assessment is confined to the Nine Elms Reach area only and the following assumptions were provided by Halcrow at the start of the study:

- 1.3.2.1 Based on available information from Thames Tideway Tunnel (TTT), NLE removal of excavated material operation from BPSJ will be completed before the start of the TTT export of excavated material from their proposed Kirtling Street jetty;
- 1.3.2.2 The NLE removal of excavated material operation from BPSJ includes material excavated from the BPSD site for the duration of the NLE excavation works;
- 1.3.2.3 The contractor will use barges of a capacity of about 1,000 tonnes (although the contractor will be free to determine his own mode of marine transport) ;
- 1.3.2.4 Up to two barges could be loaded over a tidal cycle;
- 1.3.2.5 Sufficient conveyor capacity will be provided to allow two barges to be loaded per tide;
- 1.3.2.6 Barges may be berthed two deep on BPSJ but will not encroach into Port of London Authority` (PLA) Authorised Channel; and
- 1.3.2.7 At peak periods it is expected that up to 20,000 tonnes of excavated material will be produced per week and loaded into barges from the two berths on BPSJ.

2 NINE ELMS REACH TRAFFIC PROFILE

2.0.1 This section provides background information on operations in Nine Elms Reach pertinent to this project.

2.1 BARGE OPERATIONS

2.1.1 Removal of Excavated Material

2.1.1.1 The controllability of a tug and tow is, to a certain extent, determined by the configuration of the tow, the size of the tow, and the environmental conditions encountered by the tow. Typical tow configurations may be described as (see

Figure 2):

- 2.1.1.1.1 Stern tow;
- 2.1.1.1.2 Hip tow; and
- 2.1.1.1.3 Push tow.

2.1.1.2 Current barge operations in Nine Elms Reach are largely tidally constrained due to the height of tide, the tidal stream and the type of towage configuration currently utilised. The towing configurations, shown in **Figure 2**, give different levels of control over the barges being towed and offer different levels of utility to towage operators. In general the larger the tow the more control and power is required. Currently there are no restrictions on the towing of laden barges with the tidal flow. However as manoeuvrability is more difficult the operation is generally avoided where possible (see **Section 2.1.3**).

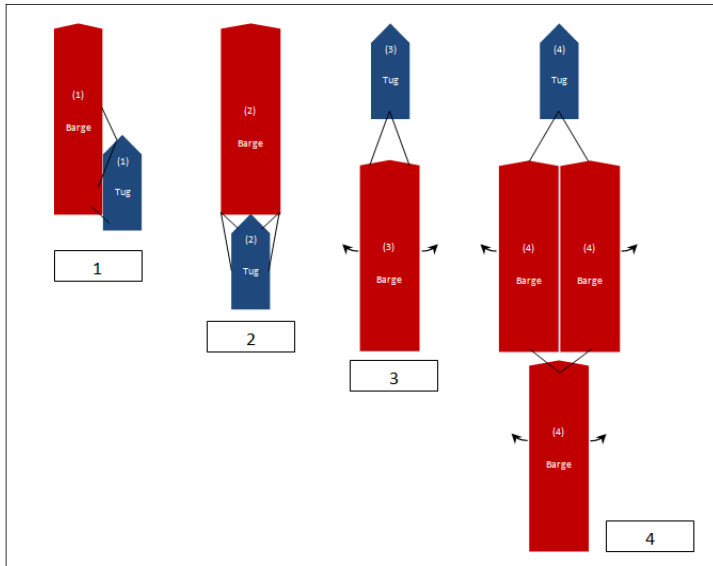


Figure 2: Tow configurations 1 – Hip / Alongside tow, 2 – Push Tow, 3 – Stern Tow (1 barge), and 4 – Stern Tow (3 barges – stern barge articulated).

2.1.1.3 GPS Marine (a marine contractor who operates barges on the River Thames) are currently undertaking trials using push towage for large barges, similar to the size that the NLE removal of excavated material operation would necessitate, to assess the ease of operating with ebb and flood tidal flows. If the push towage trials are successful then the PLA may encourage more use of this method, to transit with, as well as against the tide through the confined reaches between Vauxhall Bridge and Tower Bridge. This could have a significant benefit to operators, who utilise this method, as it opens the operational windows which were previously tidally limited.

2.1.2 Height of Tide

2.1.2.1 The height of the tide is fundamental to passage planning on the tidal Thames.

2.1.2.2 There has to be sufficient height of tide for tugs and tows to navigate over the shallow areas on passage from downstream to Battersea. The shallowest part of the River Thames, up to Battersea, is located near Westminster Bridge, where tug and tows have to pass water depths of approximately 1.5m below chart datum.

2.1.2.3 Another tidal constraint is related to air draught for passing under bridges in central London. Air draught is the clearance between the highest point on the vessel and the underside of the bridge span. At high tide the air draught available under certain bridges is much reduced and at such times, some vessels are not able to pass safely underneath them.

2.1.2.4 The tidal height and the vessel's dimensions (water draught and air draught) have to be considered jointly to determine an arrival time at and a departure time from BPSJ to safely navigate through central London.

2.1.3 Tidal Stream

2.1.3.1 Navigating accurately in the same direction as the tidal stream is considerably more challenging than against it. This is due to higher than expected speed over the ground, compared to that "felt" as the vessel navigates through the water. Vessels navigating against the current however, have a relatively lower speed over the ground, which means they are easier to handle (e.g. they are able to control their speed by "stemming the current").

2.1.3.2 Thus the manoeuvrability of a vessel navigating with the current is significantly less than one transiting against the current. The most demanding stretch of river to navigate is in central London where there are many bridges, the highest density of other traffic, and high tide flows. Some vessels, including tug and tows, may adjust the time for arrival/departure at berths to minimise these issues.

2.1.3.3 This concern is of considerable more importance when navigating fully laden barges, as the consequence of a contact with a fixed structure (e.g. a bridge or pier) is greatly magnified.

2.1.3.4 There are no significant tidal eddies in Nine Elms Reach.

2.2 BATTERSEA POWER STATION JETTY

2.2.1 BPSJ was built around 1930 for the purpose of unloading coal from small coasters for the power station. The jetty is 130m in length and 11m wide and constructed from reinforced concrete. Battersea Power Station (BPS) closed in 1983 and the jetty has remained largely unused since then apart from when remedial works were undertaken in 2004.

2.3 NAVIGATION AUTHORITY

2.3.0.1 The PLA is the navigation authority for Nine Elms Reach, and is both the Statutory and Competent Harbour Authority in the area.

2.3.1 Regulations

2.3.1.1 The Port of London Authority has a comprehensive and mature set of regulations covering all aspects of navigation on the tidal Thames including:

- 2.3.1.1.1 The Port of London Act;
- 2.3.1.1.2 Port of London River Byelaws;
- 2.3.1.1.3 General Directions;
- 2.3.1.1.4 Pilotage Directions;
- 2.3.1.1.5 Permanent Notices to Mariners;
- 2.3.1.1.6 Notices to Mariners; and
- 2.3.1.1.7 Various codes of practice (including craft towage).

2.3.1.2 All of the above regulations are reviewed regularly and are easily available in either paper format or on the PLA website.

2.3.2 Pilotage

2.3.2.1 The pilotage requirements for vessels navigating within the assessment area are set out in the PLA Pilotage Directions.

2.3.2.2 In general terms, to the west of Margaret Ness, vessels over 40m length overall are required to take a pilot or hold a valid Pilot Exemption Certificate (PEC)¹

2.3.2.3 Local commercial intra port vessels are subject to separate regulations based on the Marine and Coastguard Agency (MCA) Boatmasters legislation².

2.3.3 Vessel Traffic Service

2.3.3.1 The PLA provides Vessel Traffic Services (VTS) from the outer Thames Estuary to Teddington Lock with full radar coverage from the estuary up river as far as Blackwall Reach and Automatic Identification System (AIS) coverage throughout the port limits.

2.3.3.2 The 15 radars feed two VTS Control Centres; one in Gravesend covering the estuary and the lower river. The second centre at Woolwich covers the upriver section of the port.

2.3.3.3 Nine Elms Reach lies in the sector controlled by the Woolwich VTS Centre; however it is outside the area covered by radar but it can still be monitored by AIS. Closed Circuit Television (CCTV) coverage is available to the PLA VTS centre through its co-location with HM Coastguard who can link into the Metropolitan Police CCTV system. However the CCTV coverage and accessibility for Nine Elms Reach is not sufficient for VTS officers to make any reliable judgement on navigational issues.

¹ PLA Pilotage Directions 2010, Direction 4(3)

² The Merchant Shipping (Inland Waterways and Limited Coastal Operations) (Boatmasters' Qualifications and Hours of Work) Regulations 2006 & PLA Thames Byelaws



Figure 3: PLA VTS Centre at Woolwich

2.3.4 Speed Limit

2.3.4.1 There is a 12 knot (kt) speed limit between Wandsworth Bridge and Margaret Ness³ with exemptions given to particular groups of vessels (e.g. Fast Ferries, Emergency Services etc.).

2.3.4.2 Nine Elms Reach lies within the 12kt speed limit area although Fast Ferries navigate through the reach, in places, at speeds up to 25kt in accordance with their laid down navigation passage plans.

2.4 NINE ELMS REACH VESSEL TRAFFIC

2.4.1 The traffic profile in Nine Elms Reach is made up of passenger vessels, freight vessels including tug and tows, and recreational craft. Analysis of available traffic Automatic Identification System (AIS)⁴ data from 2011 indicates that during winter months the reach is less busy than during summer months (see **Figure 4** and **Table 1**). This is largely due to the seasonal nature of passenger vessel activity coinciding

³ Port of London Thames Byelaws 2012 Byelaw 16.3 and 16.4

⁴ Automatic Identification Systems transmit navigational data from vessels required to do so by IMO SOLAS resolution and/or Thames AIS Carriage requirements. It does not necessarily cover recreational craft that are not mandated to carry the equipment.

with the summer tourist season. Typically traffic navigates on the correct side (starboard) of the river whilst transiting past Battersea Power Station jetty. The Victoria Railway Bridge arches help to keep vessels to the starboard side of the channel.

2.4.2 The majority of traffic passing through the reach in the analysis period, in 2011, was passenger traffic following a diurnal pattern; with peak numbers transiting in the morning and evening (see **Figure 5**). This is likely to be associated with commuter services and early evening sight-seeing / dinner cruises.

Transits per Day	Vessel Type				
	Passenger	Port Tender	Tug	Other	Total
Average Winter (8 days data)	18.6	3.9	5.6	1.4	29.5
Average Summer (14 days data)	44.2	3.9	3.3	1.5	52.9
Winter and Summer (22 days data)	34.9	3.9	4.1	1.5	44.4

Table 1: Analysis of 2011 AIS data from Nine Elms Reach Gate (see Figure 4)

2.4.3 The traffic profile during the early hours of the morning (00:00 - 05:00) hours is markedly different, with extremely low transit numbers. Therefore the use of night time hours for removal of excavated material operations would be unlikely to impact any other vessel traffic moving on Nine Elms Reach.

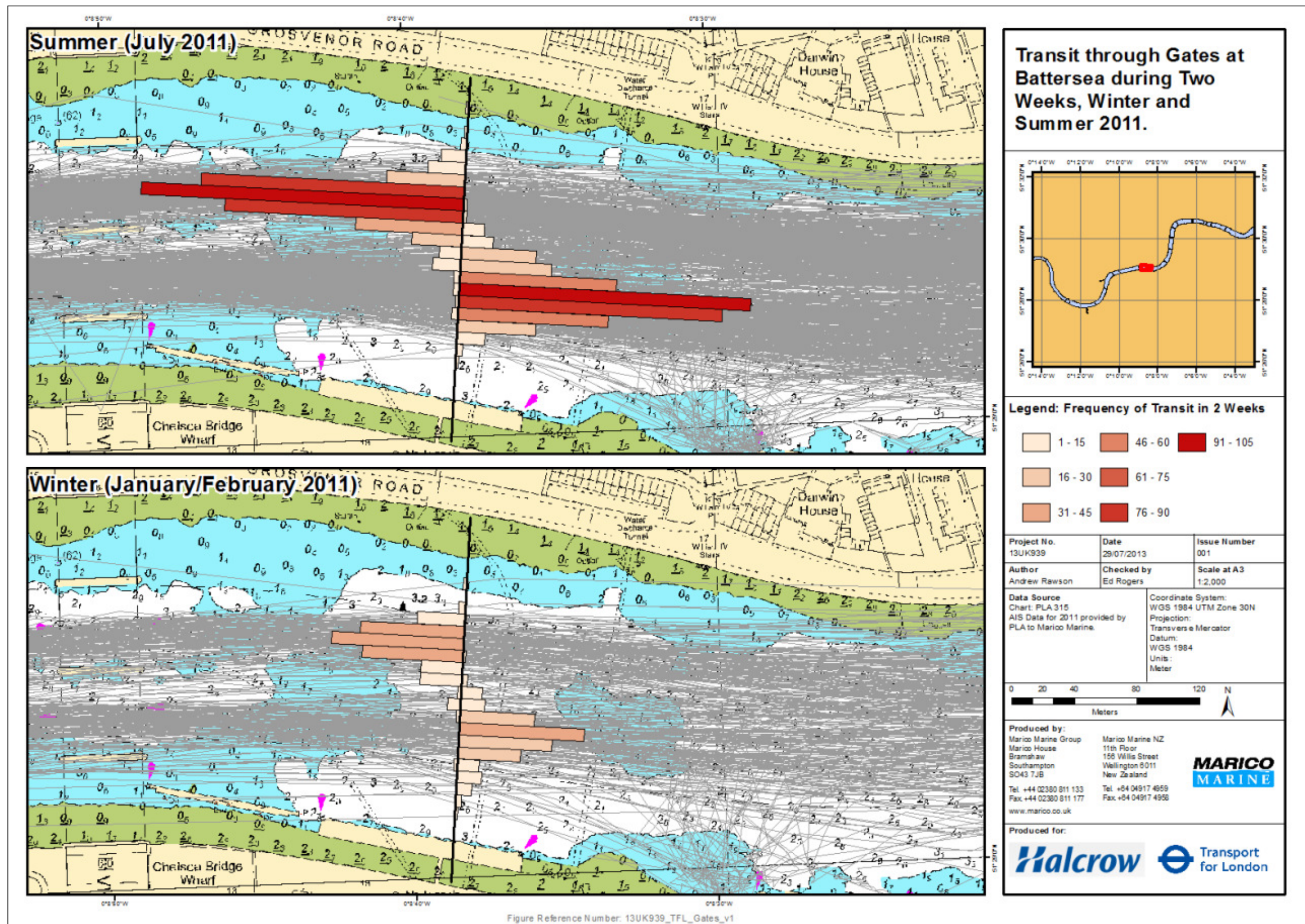


Figure 4: Nine Elms Reach Vessel Tracks – 2011 AIS data.

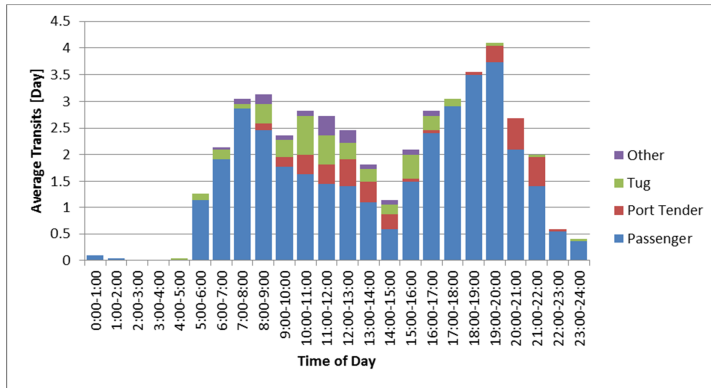


Figure 5: Distribution of vessel transit at Gate by time of day (2011 AIS data).

2.5 COMMERCIAL VESSEL TRAFFIC

2.5.0.1 There are two commercially active berths in Nine Elms Reach:

- 2.5.0.1.1 Cringle Wharf; and
- 2.5.0.1.2 Cringle Dock.

2.5.1 Cringle Wharf - Cemex

2.5.1.1 Cringle Wharf is operated by Cemex and is mainly used to import aggregate to supply a ready mixed concrete plant on the site behind the wharf. The berth currently handles motorised barges and, on average, handles one or two vessels per day.

2.5.1.2 Typically vessels arrive 2 or 3 hours before high water and sail around 2 hours after high water.

2.5.1.3 It is anticipated that usage of Cringle Wharf may increase to meet the aggregate demands of the works in the area (e.g. BPSD, NLE, US Embassy and TTT).

2.5.1.4 A second berth, on the river wall on the inside of the jetty, was used to import cement in the past, however cement is currently delivered by road transport.

2.5.2 Cringle Dock – Cory Environmental

2.5.2.1 The Western Riverside Waste Authority (WRWA) is located at Cringle Dock where a recycling plant handles waste from the London Boroughs of Hammersmith and Fulham, Lambeth, Wandsworth; and the Royal Borough of Kensington and Chelsea. Cringle Dock is operated by Cory Environmental Ltd and exports containerised waste from Battersea to the Riverside Resource Recovery facility downstream at Belvedere.

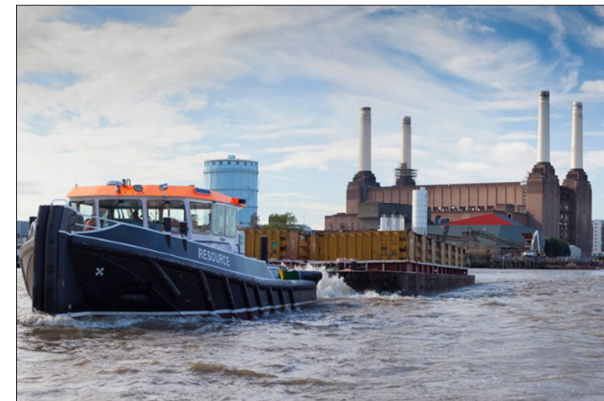


Figure 6: Cory Tug and Tow in Nine Elms Reach

2.5.2.2 On average Cringle handles four to six “Cringle” class barges per day, normally using the day time tidal windows, six days a week. The operation is typically undertaken utilising stern tows of up to three barges per tug (see Figure 2 – Towage configuration 4 and Figure 7). “WRWA” class barges are also taken to the Cory Environmental Ltd facility upstream at Wandsworth.

2.5.2.3 The dimensions of Cory Environmental barges using Nine Elms Reach are given in Table 2.

Class	Number in fleet	Length (metres)	Beam (metres)	Draught (metres)
Cringle	24	33.5	7.48	3.00
WRWA	12	45.72	7.9	3.02

Table 2: Cory Environmental barges using Nine Elms Reach

2.5.2.4 Tug and tows typically arrive with empty barges 2-3 hours before high water and depart with loaded barges 1 hour before high water. Occasionally, fully laden barges have to be towed down river on the ebb tide particularly during spring tides when there is insufficient clearance under the bridges in central London (at the top of the tide).

2.5.2.5 Cory berth the newly arrived empty barges on the river wall immediately upstream of Cringle Dock, in close proximity to the BPS river wall. The empty barges are then winched into the WRWA facility once the loaded barges have been taken away.

2.5.2.6 As can be seen from the swept path of tows approaching the dock (given in **Figure 7**) with the flood tide, the tugs swing into the dock and the empty barges are taken down by the tide prior to being winched into the dock.

2.5.3 Middle Wharf

2.5.3.1 Middle Wharf, downstream of Nine Elms Pier, was used to import small quantities of aggregates but is now no longer in operation. It is understood that some of the cargo handling infrastructure has been demolished.

2.6 THAMES CLIPPERS – PASSENGER SERVICES

2.6.1 Thames Clippers provide a commuter service to the west of central London and call at St George's Pier en route to Putney. The current timetable is limited to 0530 – 1030 and 1630 – 1930 on week days, however there are plans to expand the service to cover the full day and into the weekends.

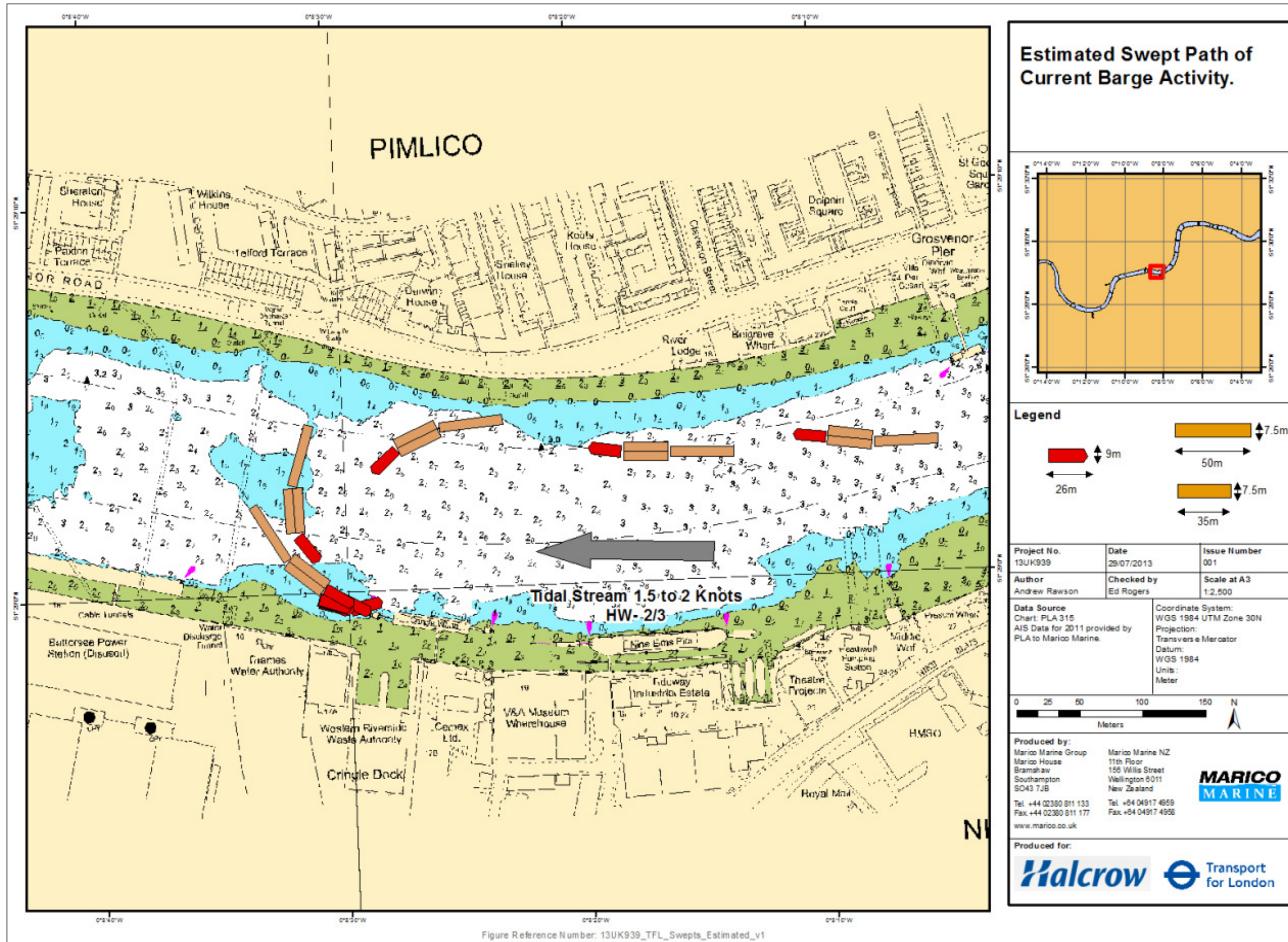


Figure 7: Swept path plot of Cory Environmental barge approaching Cringle Dock (Tug position from AIS, barge positions estimated).

2.6.2 Approximately six High Speed Passenger vessels currently pass through Nine Elms Reach each hour when the service is running.



Figure 8: KPMG Thames Clipper

2.6.3 High Speed Passenger vessels are permitted to travel up to 25kt but their passage plan includes sections where lesser speeds are required such as passing through bridge arches and where wash presents a significant risk (e.g. passing Cringle Dock).

2.6.4 St George's Wharf Pier, immediately upstream of Vauxhall Bridge on the south shore is, at present, the only operational passenger pier in Nine Elms Reach.

2.6.5 Thames Clippers expect to increase the frequency of their service to the west and also to add Battersea to their scheduled service and call at the pier adjacent to BPSJ (currently the lay-by pontoon).

2.6.6 It is envisaged that the downstream end of the pontoon, immediately upstream of the BPSJ, will, in addition to handling commuters, be used to transport prospective customers and possibly construction workers to and from the BPSD.



Figure 9: St Georges Wharf Pier

2.7 RECREATIONAL TRAFFIC

2.7.0.1 There is some recreational activity in Nine Elms Reach as described below.

2.7.1 Westminster Boating Base

2.7.1.1 Westminster Boating Base, on the north shore, is a busy community based water activity centre offering mainly dinghy sailing and kayaking (see **Figure 10**). The centre is active five days a week during the day time and the early evening and specialises in training young people and novices.

2.7.2 Nine Elms Pier

2.7.2.1 The Nine Elms Pier is occupied by a number of permanently moored residential house boats.

2.7.3 Other Users

2.7.3.1 Nine Elms Reach is used by other recreational motor vessels varying from RIBs and narrow boats to Dutch barges and motor cruisers en route to and from the Upper Thames and Brentford Lock.

2.7.3.2 The area is also used by some kayaks, canoes, rowing boats and small power boats.

Watersports at Westminster Boating Base

Weekly Session Schedule						
		Novice Young People	Experienced Young People	Novice Adult	Experienced Adult	Experienced = RYA Level 2 holders or BCU One Star / Paddlepower Passport holders
S SAILING						
K KAYAKING & CANOEING						
Monday	Adult 6.15-9pm Youth 5.45-9pm	S	S K	K	S K	
Tuesday	4.45-8pm	S K	S K		S	
Wednesday	4.45-8pm	S K	S K	K	S K	
Thursday	5.45-9pm		S K		S K	
Sunday	10am-1pm & 2-5pm		S K		S K	

The above programme begins on 1st April 2013. Evening weekday Sailing ends 30th September and evening kayaking 31st October 2013

Figure 10: Westminster Boating Base Timetable

2.7.3.3 The level of activity depends on the time of year, day of the week, time of the day, the weather and state of the tide.

2.7.3.4 Personal Water Craft (PWCs) are not permitted to operate in the area.

2.8 THROUGH TRAFFIC

2.8.1 Other commercial traffic passing through Nine Elms Reach includes:

- 2.8.1.1 Tugs and tows en route to the Riverside Waste Transfer Station at Wandsworth. Approximately one Cory tug and tow round trip per day (Monday to Saturday);
- 2.8.1.2 GPS Marine tug and tows carrying aggregate en route to Pier Wharf. One or two tug and tows per day. GPS tend to push the loaded barges upstream with the tidal stream and tow the empty barges downstream;
- 2.8.1.3 Small commuter passenger vessel services;
- 2.8.1.4 Sightseeing and party passenger vessels, operated mainly by Westminster Passenger Service Association (WPSA), providing services to Kew and Hampton Court. The time table depends on the time of year, in high season about 3 to 4 vessels pass both ways through the Reach each day;

- 2.8.1.5 Tugs and tows servicing construction work upstream of Nine Elms Reach. (e.g. the S Walsh and Son muck-away operation from the Lots Road development); and
- 2.8.1.6 Port of London Authority, Emergency Services, Thames Water, Environment Agency, Port Health etc. craft.

2.9 FUTURE DEVELOPMENT WITHIN NINE ELMS REACH

2.9.1 Thames Tideway Tunnel (Kirtling Street)

2.9.1.1 The TTT project comprises tunnels to store and transfer discharges from combined sewer overflows from West to East London for treatment at Beckton Sewage Treatment Works. As part of these works TTT is currently proposing to construct a shaft to drive tunnels from a site in Kirtling Street and export "tunnelling spoil" from a temporary jetty to be located immediately downstream of the Cringle Wharf (Cemex Jetty). The location of the proposed TTT jetty is shown in Figure 11.

2.9.1.2 Under the current construction plans and programme the operation of the Kirtling Street jetty is *not* expected to coincide with the NLE removal of excavated material operation.

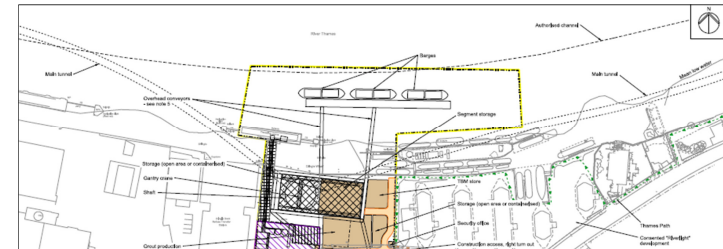


Figure 11: Illustrative Drawing of the Thames Tideway Tunnel Kirtling Street Jetty⁵

2.9.1.3 At the time of writing this report, it is understood that TTT excavated material exports, and therefore exports by barge, are expected to commence in September 2017 and continue until February 2020. TTT plan to construct their jetty between

⁵ Thames Tideway Tunnel Doc Ref 7.20.04

mid July and the end of September 2017 at the same time as they excavate the shaft to the launch chamber for the tunnel boring machine (TBM).

2.9.1.4 NLE expects to complete spoil removal by June 2017.

2.9.2 Nine Elms Marina

2.9.2.1 Plans for the re-development of Nine Elms Pier have been in progress for some time. However, if the proposed development, which lies outside the navigable channel, goes ahead it is unlikely pose an impact to passing traffic.

3 CONSULTATION

3.1 Consultation with stakeholders was streamlined due to the preliminary nature of the assessment. The following, face-to-face stakeholder consultations meetings were held:

- **3.1.1 Port of London Authority** – 19th July 2013, 14:00-15:30:
 - 3.1.1.1 Capt. Terry Lawrence - Harbour Master Upper;
 - 3.1.1.2 Mark Townen – Deputy Harbour Master Upper;
 - 3.1.1.3 David Foster – Marico Marine;
 - 3.1.1.4 Dr Ed Rogers – Marico Marine; and
 - 3.1.1.5 Mike Fidler – Halcrow.
- **3.1.2 Cory Environmental Ltd**– 22nd July 2013, 10:30-12:00:
 - 3.1.2.1 Neil Caborn – General Manager;
 - 3.1.2.2 Peter Hammond – Lighterage Controller;
 - 3.1.2.3 David Foster – Marico Marine; and
 - 3.1.2.4 Mike Fidler – Halcrow.
- **3.1.3 KPMG Thames Clippers** – 22nd July 2013, 12:00-13:30:
 - 3.1.3.1 Derek Mann –Safety Executive;
 - 3.1.3.2 Mark Thomson – Head of Fleet Operations;
 - 3.1.3.3 David Foster – Marico Marine; and
 - 3.1.3.4 Mike Fidler – Halcrow.

3.2 Consultation was conducted through telephone conference call with:

- **3.2.1 Thames Tideway Tunnel** – 24th July 2013:
 - 3.2.1.1 James Spikesley - Thames Tideway Tunnel;
 - 3.2.1.2 Alex Seibicke - Thames Tideway Tunnel;
 - 3.2.1.3 David Foster – Marico Marine;
 - 3.2.1.4 Dr Ed Rogers – Marico Marine; and
 - 3.2.1.4 Mike Fidler – Halcrow.

3.3 Consultation was also conducted via email with:

- **3.3.1 Westminster Boating Base** – Received 28th July 2013:
 - 3.3.1.1 Kevin Burke - Chief Instructor.

3.4 The information and issues brought up at the stakeholder meetings are included in the assessment of risk in this study. Details of meetings held with stakeholders are given in **Annex A**.

3.5 Overall no significant issues or concerns were raised, with most of the stakeholders that were consulted being enthusiastic about utilising the river for freight transportation.

3.6 BPSDC were not consulted as part of the NRA but their input has previously been obtained in consultation with Halcrow and export of their excavated material is included within the combined NLE/BPSDC rate of export of excavated material from BPSJ

4 NAVIGATION RISK ASSESSMENT

4.1 METHODOLOGY

4.1.1 The NRA methodology, used for this assessment, has been specifically developed for navigational use in ports/harbours. It is fundamentally based on concepts of the “Most Likely” (ML) and “Worst Credible” (WC) scenarios that reflect the range of outcomes arising from a navigation hazard (see **Figure 12**). This approach fits the available marine incident data, as data shows a high frequency of minor events, separated from a much lower frequency of worst credible events.

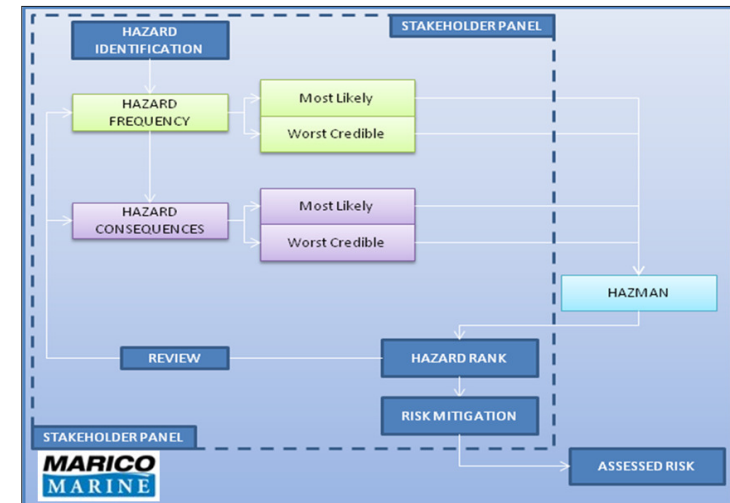


Figure 12 : MARICO hazard identification and risk assessment process

4.1.2 The NRA process is based on the Formal Safety Assessment methodology as adopted by the International Maritime Organisation (IMO) and follows the requirements of the Port Marine Safety Code. The NRA used the proprietary Marico Marine “Hazman II®” programme to undertake the risk assessment process. The software is currently used by the PLA to manage their navigation risk assessment requirements mandated by the Port Marine Safety Code.

4.1.3 IMO guidelines define a hazard as “something with the potential to cause harm, loss or injury”, the realisation of which results in an accident. The potential for a hazard to be realised can be combined with an estimate or known consequence of outcome. This combination is termed “risk”. Risk is therefore a measure of the frequency and consequence of a particular hazard and in order to compare risk levels a matrix is used.

4.1.4 At the low end of the scale, frequency is extremely remote, consequence insignificant and risk can be said to be negligible. At the high end, where hazards are defined as frequent and the consequence catastrophic, then risk is termed intolerable. Between the two is an area defined “As Low As Reasonably Practicable” (ALARP). The IMO guidelines allow the selection of definitions of frequency and consequence to be made by the organisation carrying out the NRA. This is important, as it allows risk to be applied in a qualitative and comparative way. To identify high risk levels using a quantitative mathematical approach would require a large volume of casualty data, which is not generally available.

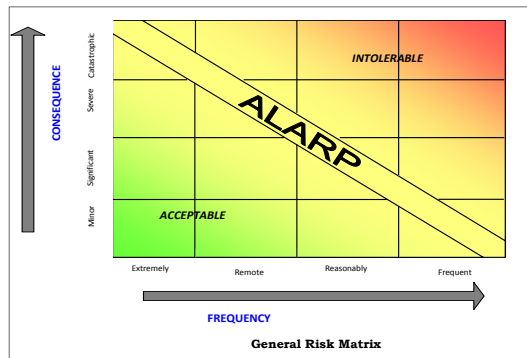


Figure 13: Frequency/Consequence Chart

4.1.5 ALARP can be defined as “Tolerable”, if the reduction of the risk is impracticable, or if the cost of such reduction would obviously be highly disproportionate to the improvement. It can also be defined as “Tolerable”, if the cost of reducing the risk is greater than any improvement gained. This is shown pictorially in **Figure 13**.

4.2 INCIDENT CATEGORIES

4.2.1 In order to ensure that all hazards associated with the Project were identified (and allocated a Hazard Reference number), a matrix of generic hazards was used, which focused on the risk exposure in Nine Elms Reach (see **Table 3**).

Hazard Ref.	Category	Hazard Title
1	Collision	NLE/BPSD Tug and Tow “In Collision With” (ICW) Freight Vessel
2	Collision	NLE Tug and Tow ICW High Speed Passenger Vessel
3	Collision	NLE Tug and Tow ICW Passenger Vessel
4	Collision	NLE Tug and Tow ICW Recreational Vessel
5	Contact with fixed object.	NLE Tug and Tow
6	Grounding	NLE Tug and Tow grounding
7	Mooring Breakout	NLE Tug and/or Tow break out from BPS Jetty or barge mooring buoy
8	Personal Injury	NLE Tug and Tow operatives
9	Contact, Grounding or Collision	Other Freight Vessel as a result of NLE Tug and Tow Operations
10	Contact, Grounding or Collision	High Speed Passenger Vessel as a result of NLE Tug and Tow Operations
11	Contact, Grounding or Collision	Passenger Vessel as a result of NLE Tug and Tow Operations
12	Contact, Grounding or Collision	Recreational Vessel as a result of NLE Tug and Tow Operations

Table 3: Initial Hazard Identification Matrix

4.3 RISK MATRIX CRITERIA

4.3.1 Frequency

4.3.1.1 In this study, each hazard was reviewed with respect to cause and effect, with frequency of occurrence derived for notional “most likely” and “worst credible” hazard events based on **Table 4**.

Scale	Description	Definition	Operational Interpretation
F5	Frequent	An event occurring in the range once a week to once an operating year.	One or more times in 1 year
F4	Likely	An event occurring in the range once a year to once every 10 operating years.	One or more times in 10 years 1 - 9 years
F3	Possible	An event occurring in the range once every 10 operating years to once in 100 operating years.	One or more times in 100 years 10 – 99 years
F2	Unlikely	An event occurring in the range less than once in 100 operating years.	One or more times in 1,000 years 100 – 999 years
F1	Remote	Considered to occur less than once in 1,000 operating years (e.g. it may have occurred at a similar site, elsewhere in the world).	Less than once in 1,000 years >1,000 years

Table 4: Hazard Frequency Ranges

4.3.2 Consequence

4.3.2.1 Consequence (or impact of risk realisation) was assessed in four key categories:

- 4.3.2.1.1 **People** Personal injury, fatality etc.;
- 4.3.2.1.2 **Property** Port and third party;
- 4.3.2.1.3 **Environment** Oil pollution etc.; and
- 4.3.2.1.4 **Stakeholder/ Business** Reputation, financial loss, public perception, etc.

4.3.2.2 Consequence is assessed against “most likely” and “worst credible” outcomes. It should be noted that in terms of property, the risk assessment process by necessity considers that the loss of a large commercial vessel is of wider implication than the loss of a private leisure cruiser. This assessment criterion is not intended to undervalue damage suffered by the leisure user, whose personal loss may be very significant in relative terms, however, it is recognised that the loss of a

commercial vessel often has a wider implication in terms of business and negative media exposure.

4.3.2.3 The rating applied is such that the consequences are of broadly equivalent value across the categories (see **Table 5**).

Cat.	People	Property	Environment	Business
C1	Negligible Possible very minor injury (e.g. bruising)	Negligible Costs <10k	Negligible No effect of note. Tier1 may be declared but criteria not necessarily met. Costs <10k	Negligible Costs <10k
C2	Minor (single minor injury)	Minor Minor damage Costs 10k – 100k	Minor Tier 1 – Tier 2 criteria reached. Small operational (oil) spill with little effect on environmental amenity Costs 10K–100k	Minor Bad local publicity and/or short-term loss of revenue Costs 10k – 100k
C3	Moderate Multiple minor or single major injury	Moderate Moderate damage Costs 100k - 1M	Moderate Tier 2 spill criteria reached but capable of being limited to immediate area within site Costs 100k -1M	Moderate Bad widespread publicity Temporary suspension of operations or prolonged restrictions Costs 100k - 1M
C4	Major Multiple major injuries or single fatality	Major Major damage Costs 1M -10M	Major Tier 3 criteria reached with pollution requiring national support. Chemical spillage or small gas release Costs 1M - 10M	Major National publicity, Temporary closure Costs 1M -10M
C5	Catastrophic Multiple fatalities	Catastrophic Catastrophic damage Costs >10M	Catastrophic Tier 3 oil spill criteria reached. International support required. Widespread shoreline contamination. Serious chemical or gas release. Significant threat to environmental amenity. Costs >10M	Catastrophic International media publicity. Operations and revenue seriously disrupted for more than two days. Ensuing loss of revenue. Costs >10M

Table 5: Consequence Categories (Costs in £) ⁶

4.4 PROJECT RISK MATRIX

4.4.1 Navigation hazards were identified by the project team, and scored for “frequency” (see **Table 4**) and “consequence” (see **Table 5**), in terms of a “most likely” (ML) and “worst credible” (WC) outcome, with results documented in a “Hazard Log” (see **Annex B** for project hazard log showing the input values for this risk assessment).

⁶ Tiered oil spill response levels were adopted by the International Maritime Organisation International Convention on Oil Pollution Preparedness, Response and Co-operation, 1990.

Consequences	Cat 5	5.1	5.9	7.0	8.3	10.0
	Cat 4	4.1	4.9	5.9	7.4	9.4
	Cat 3	2.9	3.5	4.4	5.9	8.3
	Cat 2	1.5	1.8	2.4	3.5	5.9
	Cat 1	0	0	0	0	0
Frequency Scale	>1,000 years [F1]	100-1,000 years [F2]	10-100 years [F3]	1 to 10 years [F4]	Yearly [F5]	

Table 6: Project Risk Matrix

4.5 RISK TREATMENT CRITERIA

4.5.1 Risk scores are calculated for each hazard under the “most likely” and “worst credible” scenarios for each of the consequence criteria (people, property, environment and business) based on the scores in the hazard log, using a risk matrix (see **Table 6**). This generates eight individual risk scores per hazard which are documented in the “Ranked Hazard List”. The individual risk scores for each consequence category are then combined, using a proprietary algorithm in Hazman II, to derive an overall risk score. The overall baseline risk scores are used to create a ranked hazard list (see **Annex C**).

4.5.2 All risk scores, whether individual related to a hazard consequence category, or overall combined for an individual hazard are scored on a scale of 0 (low risk) to 10 (high risk) (see **Table 7** for more details).

MATRIX OUTCOME	Risk Definition	Action Taken
0 & 1	Negligible Risk	A level where operational safety is unaffected.
2 & 3	Low risk	A level where operational safety is assumed.
4, 5 and 6	As Low As Reasonably Practicable (ALARP)	A level defined by study at which risk control in place is reviewed. It should be kept under review in the ensuing Safety Management System.
7 & 8	Significant Risk	A level where existing risk control is automatically reviewed and suggestions made where additional risk control could be applied if appropriate.

		Significant risk can occur in the average case or in individual categories. New risk controls identified should be introduced in a timescale of two years.
9 & 10	High Risk	A level requiring immediate mitigation.

Table 7: Risk Bands.

4.6 REDUCING RISK

4.6.1 It is possible to reduce the risk of a hazard occurring by implementing risk controls. Risk controls are generally considered as mitigation as they are designed to reduce either the consequences or likelihood of a hazard occurring.

It is possible to estimate a risk controls' effectiveness, by determining the extent to which it reduces, the likelihood of a hazard occurring, or the magnitude of a hazards' consequences. This is beneficial in determining the merits (either absolute or relative) of implementing risk controls, which can also lead on to effective cost benefit analysis.

4.6.2 There are two assessments of risk required for this project;

4.6.2.1 **Baseline Risk:** The assessed risk score of the NLE removal of excavated material project which includes all current risk controls in place; and

4.6.2.2 **Residual Risk:** The baseline risk score with additional mitigation measures in place (e.g. Possible Additional Mitigation (PAM) measures) that were not included when the risk assessment was undertaken.

Risk Reduction	Percentage Reduction
None	0%
Low	10%
Medium	20%
High	30%

Table 8: Risk Reduction Levels

4.6.3 The effectiveness of PAM risk controls is assessed against a nominal scale, which applies differing percentage reductions, based on their estimated

effectiveness (see **Table 8**). The percentage reduction is then made to either / or both, the likelihood or consequence values, essentially entailing a further calculation using the risk matrix, and a “residual” risk score is calculated using proprietary Hazman II software.

4.6.4 As an example, take a hazard with a “property” score equivalent to £100,000. A PAM risk control judged to reduce the consequence of this hazard by 20% will generate a residual “property” value, equivalent to £80,000. The same reduction is applied to the other consequence categories (e.g. people, environment and business) for the most likely and the worst credible scenarios, and the risk matrix used to determine the residual risk scores. The combined risk score is calculated the same as for baseline risk.

4.6.5 It is therefore possible to determine the reduction in risk score from the difference between the baseline and residual risk, enabling an assessment total risk reduction for each hazard.

4.6.6 The application of additional mitigation measures is assessed using a compound calculation. From the example above, a further risk control could be applied at 20%, which would reduce the “property” cost, from £80,000 to £64,000. A third risk control, with 10% effectiveness, would reduce the same property cost from £64,000 to £57,600, and so on. The residual risk score, with all these risk control measures in place, would therefore utilise the £57,600 “property” value in the calculation of risk.

4.6.7 It should be noted that as risk by definition is a non-dimensional number (being a combination of likeliness and consequence), a 50% reduction in frequency of hazard occurrence will not result in a 50% reduction in risk, because no similar reduction in consequences have been applied. A further complexity is added by the nonlinearity of the risk matrix (which is in part due to societal aversion to large scale consequence hazards); thus risk reduction is not uniform over either frequency or consequence ranges.

4.6.8 Also, it is often very difficult to determine the exact effectiveness of risk controls in a dynamic and changing system such as a port, and, as such, a significant degree of subjectivity is commonly used. However, given that a standardised framework is

applied across all hazards, then the resulting scores can be used to judge the relative and absolute merits of implementing additional risk controls.

5 RISK ASSESSMENT RESULTS

5.0.1 The risk assessment results are presented in terms of:

- 5.0.1.1 “Baseline” risk of NLE removal of excavated material operations – Risk assessed with standard risk controls in place (e.g. existing PLA risk control measures); and
- 5.0.1.2 “Residual” risk of NLE removal of excavated material operations – Risk assessed with the standard risk controls in place and also “Possible Additional Mitigation” risk controls in place which are identified as part of this assessment.

5.1 BASELINE RISK ASSESSMENT RESULTS

5.1.1 The results of the baseline risk assessment (i.e. inherent risk with no additional mitigation in place) is summarised in **Table 9**. Overall no hazards were identified as either “high” or “significant risk”, which reflects the nature of the project being a standard marine operation on the River Thames. This is due to the many risk controls, put in place by the PLA amongst others, to control and mitigate similar activities (which are included in the base line assessment of risk – see **Annex B - Hazard Log**).

5.1.2 The highest individual hazard identified scored 5.4/10, which falls into the ALARP zone on the risk matrix. This hazard is a “Collision of a removal NLE Tug and Tow with a High Speed Passenger Vessel in Nine Elms Reach”, which could have serious consequences to people and stakeholders should it occur. Further risk control measures in the form of “Possible Additional Mitigations” – PAM’s have been identified to further mitigate the risk of this hazard occurring.

Rank	Hazard Ref	Hazard Type	Title	Environment			People			Stakeholders			Baseline Risk Score
				Environment	People	Property	Environment	People	Property	Environment	People	Property	
1	2	Collision	NLE Tug and Tow ICW High Speed Passenger Vessel	0.0	5.9	3.5	3.5	3.5	2.4	7.0	5.9	7.0	5.4
2	3	Collision	NLE Tug and Tow ICW Class V Passenger Vessel	0.0	5.9	3.5	3.5	1.9	5.9	4.9	5.9	4.9	4.9
3	12	Contact, Grounding or Collision	Recreational Vessel as a result of NLE Tug and Tow Ops	0.0	5.9	5.9	3.5	0.0	5.9	4.9	4.9	4.9	4.9
4	5	Contact	NLE Tug and Tow	0.0	5.9	5.9	0.0	2.4	5.9	4.4	4.4	4.4	4.8
5	10	Contact, Grounding or Collision	High Speed Passenger Vessel as a result of NLE Tug and Tow Ops	0.0	4.4	4.4	4.4	1.9	4.9	4.9	4.9	5.9	4.5
6	11	Contact, Grounding or Collision	Passenger Vessel as a result of NLE Tug and Tow Ops	0.0	4.4	4.4	4.4	1.9	4.9	4.9	4.9	5.9	4.5
7	1	Collision	NLE Tug and Tow ICW Freight Vessel	0.0	3.5	3.5	0.0	2.4	7.0	5.9	5.9	4.4	4.4
8	7	Breakout	NLE Tug and/or Tow break	0.0	0.0	0.0	5.9	2.4	2.4	5.9	4.4	4.4	4.3
9	4	Collision	NLE Tug and Tow/ ICW Recreational Vessel	0.0	3.5	3.5	3.5	0.0	5.9	4.4	5.9	4.4	4.0
10	8	Personal Injury	NLE Tug and Tow Operatives	0.0	5.9	0.0	0.0	0.0	5.9	0.0	4.4	4.4	4.0
11	9	Contact, Grounding or Collision	Freight Vessel as a result of NLE Tug and Tow Ops	0.0	3.5	3.5	0.0	1.9	4.9	4.9	4.9	4.9	3.6
12	6	Grounding	NLE Tug and Tow	0.0	0.0	0.0	0.0	2.4	4.4	4.4	4.4	2.4	2.0

Table 9: Baseline Risk Assessment Summary Table (see Ranked Hazard List in Annex C for full details).

5.2 ADDITIONAL MITIGATION

5.2.0.1 The PLA already has comprehensive and robust risk control systems in place to mitigate risk from freight traffic navigating within Nine Elms Reach. These controls ensure that the risks associated with hazards identified in the proposed NLE removal of excavated material operation are currently within or below the ALARP band.

5.2.0.2 The adoption of additional mitigation measures listed in Table 10 should further reduce the risks associated with the NLE removal of excavated material operation.

PAM No.	Possible Additional Risk Control Measures	Hazard Ref.
1	<p>Additional Fendering (over and above that already existing) on BPSJ.</p> <p>The outer face of the BPSJ will be subjected to considerable wear and tear over the life of the removal of excavated material operation. The provision of additional fendering should help reduce the consequence of contact damage.</p> <p>Action: Inclusion in ITT by TfL. Construction by D & B Contractor.</p>	5.
2	<p>Collar barges for lay-by berths. (Barges moored fore and after in the river against which either empty or loaded barges may lie when not required or there is insufficient room at BPSJ).</p> <p>Although the detail of the removal of excavated material operation is not known, it is highly likely that additional berths will be required in Nine Elms Reach to enable the delivery of empty barges and the removal of loaded barges over a single high water period.</p> <p>PLA Harbour Master (Upper) is provisionally examining a possible location for the collar barges immediately opposite BPSJ on the north side of the river.</p> <p>The provision of collar barges should improve the efficiency and safety of the NLE removal of excavated material operation.</p> <p>Action: D & B contractor's option depending on selected method of working.</p>	1, 2, 3, 4, 9, 10, 11, 12.
3	Local recreational stakeholder engagement to ensure all aspects	4, 12.

	<p>of the project is communicated effectively to recreational users.</p> <p>Communicating with the varied cross section of recreational users, many of whom only very occasionally navigate through Nine Elm Reach (e.g.. Narrow boaters and motor cruisers en route to and from the Upper Thames), is a constant challenge for the PLA.</p> <p>The PLA should do it its upmost to warn recreational users of the additional work and traffic in Nine Elms Reach. Many channels of communication already exist including: consultative forums, public meetings, liaison groups and the PLA website.</p> <p>Action: Joint PLA/TfL/D&B contractor.</p>	
4	<p>Local Vessel Traffic Control only if TTT operations concurrent.</p> <p>Currently the NLE removal of excavated material operation is scheduled to complete prior the start of the TTT removal of excavated material operation from Kirtling Street.</p> <p>The Harbour Master (Upper) is content that the current PLA traffic control measures that are already in place are sufficient to control the increase of traffic associated with the NLE.</p> <p>If the NLE and TTT removal of excavated material operations were to overlap consideration should be given to introducing a local traffic control system to coordinate the movements in Nine Elms Reach.</p> <p>Action: PLA at the cost of the contractor.</p>	1, 2, 3, 4, 5, 6, 7, 9, 10, 11 & 12
5	<p>Marine contractors to undertake detailed NRA.</p> <p>This is a preliminary navigation risk assessment based on outline information supplied by Halcrow and obtained from stakeholders as part of this study.</p> <p>Once the marine contractor has been appointed and the detailed methodology, including the passage plan, has been devised, the whole operation will require a full navigation risk assessment covering all aspects of the process in detail.</p> <p>Once the detailed NRA has been completed then the operational procedures can be developed.</p> <p>Action: TfL to include in ITT. D & B contractor to undertake NRA.</p>	All.
6	<p>Notice to Mariners covering NLE removal of excavated material Operations.</p> <p>The issue of Notices to Mariners is the standard method of</p>	1, 2, 3, 4, 9, 10, 11, 12.

	<p>promulgating navigational information to all river users.</p> <p>Issuing a Notice to Mariners prior to the start of the NLE removal of excavated material should draw the attention of river users to the increase of traffic and change of operations in Nine Elms Reach.</p> <p>Action: Issued by PLA in conjunction with information from D&B contractor.</p>	
7	<p>TfL Sub-contractor Risk Assessment.</p> <p>The appointment of a reputable marine contractor who is capable of delivering a safe, professional and fully auditable removal of excavated material operation is vital if the marine safety in central London and downstream is to be maintained.</p> <p>TfL's selection of a suitable marine contractor is key to a safe operation.</p> <p>Action: TfL.</p>	All.
8	<p>Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard.</p> <p>See PAM 7 above.</p> <p>The PLA are introducing the Thames Freight Standard; the standard covers the three basic requirements of a safe operation:</p> <p>The vessels' fitness for purpose;</p> <p>The Master and crew's competence; and</p> <p>The company's safety management systems.</p> <p>The Thames Freight Standard should assist TfL in selecting a suitable marine contractor.</p> <p>Action: D & B contractor.</p>	All.
9	<p>Inbound tugs and tows on the flood tide pass through Victoria Railway and Chelsea Bridge prior to swinging and making their approach to BPSJ.</p> <p>See Section 2.2 The danger of swinging a vessel or tug and tow immediately upstream of an object is that if the manoeuvre is misjudged or there is a mechanical breakdown the vessel or tug and tow is set down onto the object.</p> <p>If tugs and tows were to swing off BPSJ on a flood tide there is a risk of them being set down onto the Victoria Railway Bridge.</p> <p>To avoid this contact risk it is recommended that inbound tugs and</p>	5.

<p>tows on the flood tide pass through Victoria Railway and Chelsea Bridge prior to swinging and then make their approach to BPSJ (This manoeuvre is indicated in Inset 2 of Figure 14).</p> <p>Action: D & B contractor.</p>

Table 10: Possible Additional Mitigation Risk Controls

5.2.1 Possible Mitigation 9 – Tug Berthing Manoeuvres

5.2.1.1 For the NLE removal of excavated material operations, 1,000 tonne barges are envisaged. Indicative swept path plots for such tug and tow berthing onto the jetty are given in **Figure 14**. Typical arrival times for barge operations in the Nine Elms Reach are likely to be around 2-3 hours before high water (see below for more details). At that time tug and tows berthing onto BPSJ are at risk of being "set" upstream towards the Victoria Railway Bridge on the flood tide.

5.2.1.2 To mitigate this risk it is possible to execute the 180 degree turn upstream of the Victoria Rail and Chelsea bridges, where there are less obstacles to be swept onto should a machinery failure or error of judgement occur, and then approach the jetty stemming the tide.

5.3 RESIDUAL RISK

5.3.1 Mitigation has been identified which can be utilised to further reduce the risk of the identified hazards. The effectiveness of these risk controls has been assessed on a purely qualitative basis. The risk effectiveness identified for each measure is given in **Table 11** with risk reduction levels given in Table 8.

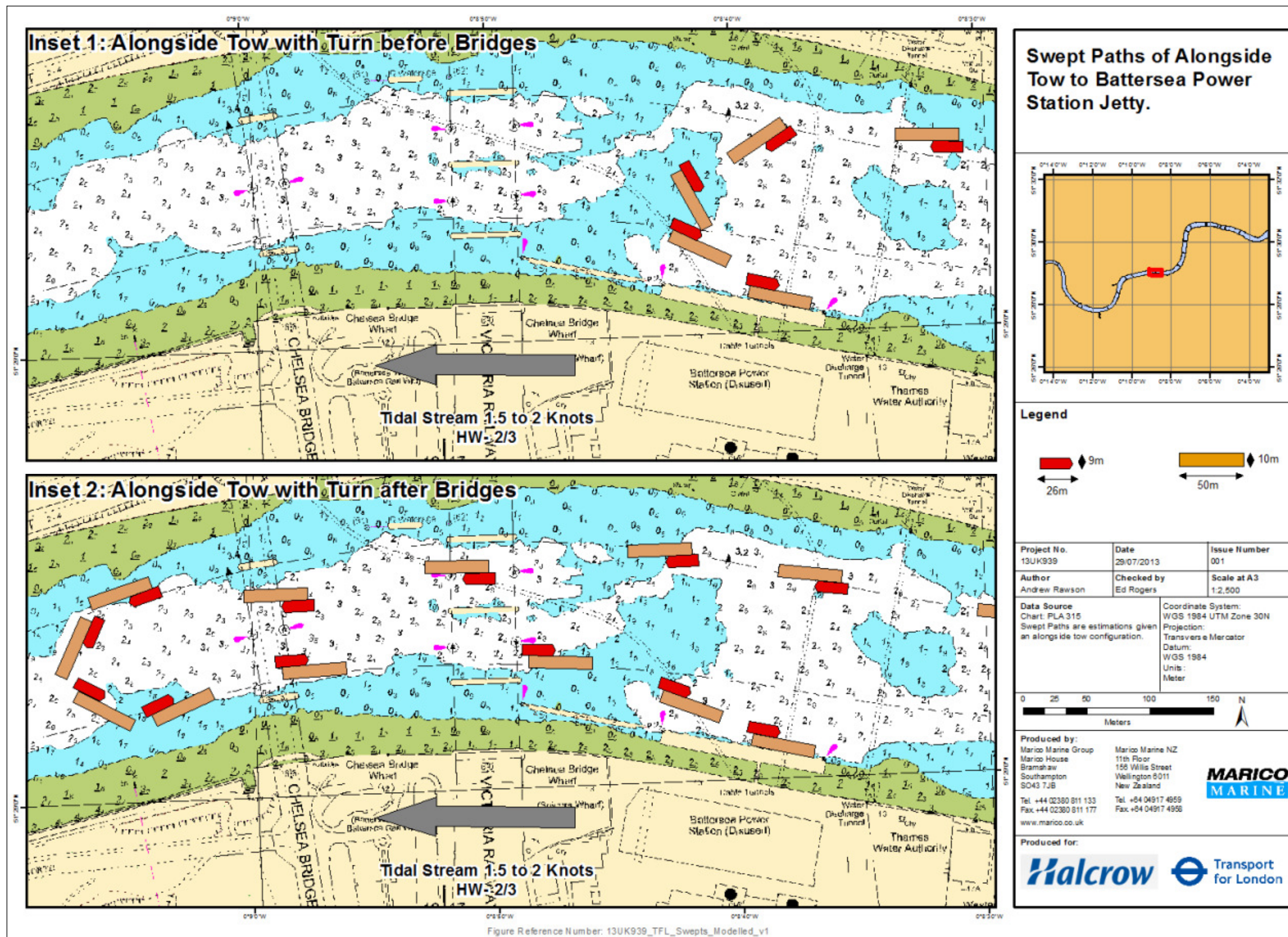


Figure 14: Swept Path plot estimating 1000t tug and tow berthing options at Battersea Power Station Jetty.

5.3.2 It should be noted that since the TTT development is not expected to commence before the completion of the NLE removal of excavated material project the Local Traffic Control PAM was scored with zero risk reduction effectiveness for frequency and consequence reduction.

5.3.3 Further effectiveness of these risk controls is possible with detailed quantitative analysis.

Ref.	Possible Additional Mitigation	Frequen- cy Effective- ness	Conseq- uence Effectiv- eness
PAM_1	Additional Fendering on BPSJ.	None	Low
PAM_2	Collar barges for lay-by barges.	Medium	None
PAM_3	Local recreational stakeholder engagement to ensure all aspects of the project is communicated effectively to recreational users.	Medium	None
PAM_4	Local Vessel Traffic Control only if TTT operations concurrent.*	NA	NA ⁷
PAM_5	Marine Contractors to undertake detailed NRA.	High	High
PAM_6	Notice to Mariners covering NLE removal of excavated material operations.	Medium	Low
PAM_7	TfL Sub-contractor Risk Assessment.	Medium	Low
PAM_8	Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard.	High	Low
PAM_9	Inbound tugs and tows on the flood tide pass through Victoria Railway and Chelsea Bridge prior to swinging and making their approach to BPSJ.	Medium	Medium

Table 11: Risk Reduction Effectiveness Scores

5.3.4 The results of the residual risk assessment (presented as final ranked risk scores), which includes the risk reduction effectiveness noted in Table 11, are detailed in Table 12. The subjective nature of this preliminary risk assessment should be noted in conjunction with the uniform and qualitative nature of the residual risk assessment methodology. However, the analysis indicates that should all PAM's be implemented (with the exception of Local Traffic Control), then risk for all

⁷ Only applicable if the NLE and TTT muck-away operations coincide (see text above table).

navigation hazards in Nine Elms Reach related to the NLE removal of excavated material operation could be mitigated to below ALARP into the "Low Risk" category. As a result there is no reason why the proposed strategy for removing excavated material should not be implemented.

5.3.5 It should be noted however, that even if a hazard is assessed to be low risk, there remains a possibility, no matter how small, that it could be realised.

Hazard Ref.	Hazard Type	Title	Baseline Risk Rank	Baseline Risk Score	Residual Risk Rank	Residual Risk Score	Total Risk Reduction
2	Collision	NLE Tug and Tow ICW High Speed Passenger Vessel	1	5.4	1	3.7	1.77
3	Collision	NLE Tug and Tow ICW Class V Passenger Vessel	2	4.9	4	3.2	1.77
12	Contact, Grounding or Collision	Recreational Vessel as a result of NLE Tug and Tow Ops	3	4.9	2	3.4	1.51
5	Contact	NLE Tug and Tow	4	4.8	9	2.4	2.34
10	Contact, Grounding or Collision	High Speed Passenger Vessel as a result of NLE Tug and Tow Ops	5	4.5	5	3.0	1.47
11	Contact, Grounding or Collision	Passenger Vessel as a result of NLE Tug and Tow Ops	6	4.5	5	3.0	1.47
1	Collision	NLE Tug and Tow ICW Freight Vessel	7	4.4	8	2.6	1.76
7	Breakout	NLE Tug and/or Tow break	8	4.3	3	3.2	1.09
4	Collision	NLE Tug and Tow ICW Recreational Vessel	9	4.0	10	1.9	2.11
8	Personal Injury	NLE Tug and Tow	10	4.0	7	2.8	1.2
9	Contact, Grounding or Collision	Freight Vessel as a result of NLE Tug and Tow Ops	11	3.6	11	1.9	1.66
6	Grounding	NLE Tug and Tow	12	2.0	12	1.2	0.74

Table 12: Residual Risk Summary Results

6 CONCLUSIONS

6.1 This Preliminary Navigation Risk Assessment describes the effect of the planned NLE removal of excavated material by river in the Nine Elms Reach area, and is based on the assumption that the work will be completed before the start of the TTT removal of excavated material operation from the proposed Kirtling Street facility (see Section 1.3).

6.2 No critical navigational risks associated with the additional river traffic generated by the NLE removal of excavated material operations have been identified in Nine Elms Reach, nor will the additional river traffic conflict significantly with other river users or fixed installations.

6.3 The PLA's regulations, Codes of Practice and safe systems of work, already provide a robust regulatory and operational framework, upon which a safe NLE removal of excavated material operation can be managed.

6.4 The decision on which PAM measures should be implemented lies with TfL or the Design & Build contractor in conjunction with the PLA, who have ultimate responsibility for navigation safety in Nine Elms Reach. Should the additional risk mitigation measures listed in Section 5.2 be implemented, then the risks from all the navigation hazards in Nine Elms Reach related to the NLE removal of excavated material operation could be mitigated to the "Low Risk" category and there is no reason why the proposed strategy for removing excavated material should not be implemented. It should, however, be noted that even if a hazard is assessed to be low risk, there remains a possibility, no matter how small, that it could occur.

6.5 The key to a safe NLE removal of excavated material operation lies in the competence of the marine contractor selected as part of the "Design and Build" contract. The implementation of Thames Freight Standard should assist in the selection of a suitable marine contractor.

7 RECOMMENDATIONS

7.1 REMOVAL OF EXCAVATED MATERIAL RECOMMENDATIONS

7.1.1 It is recommended that operational consent be given to the proposed NLE removal of excavated material operation and that the additional mitigation measures listed in **Section 5.2** be considered by TfL or the Design & Build contractor.

7.1.2 It is further recommended that:

- 7.1.2.1 The marine safety issues involved in the removal of excavated material are addressed fully in the Invitation to Tender (ITT) for the contract for the Marine Contractor;
- 7.1.2.2 A marine expert is appointed to the team vetting the Marine Contractor proposals received in response to the ITT; and
- 7.1.2.3 Once a marine (sub) contractor has been appointed and the method statement and passage plan has been determined, a comprehensive Navigation Risk Assessment should be conducted on the whole NLE removal of excavated material operation (from Battersea, through central London, to the final disposal destination) (see **Section 5.2** PAM 5).

7.2 CONTINGENCY PLANNING

7.2.1 As stated in **Section 1.3**, limited parameters, appropriate to the stage of the project, were set for this Preliminary Navigation Risk Assessment.

7.2.2 It is therefore recommended that the following issues should be addressed by TfL or the Design & Build contractor in the NRA to be produced after contract award when details of the contractor's proposals for handling excavated material and the disposal site become known:

- 7.2.2.1 Conduct a study into the effect of additional levels of barge traffic in central London (Lambeth Bridge to Wapping Ness) in line with similar studies undertaken by TTT (See notes of TTT consultation (**Annex A**)) including assessment of future traffic levels;
- 7.2.2.2 Develop a contingency strategy to cover the possibility that the NLE removal of excavated material operation over-runs into the TTT;
- 7.2.2.3 Assess the utility of conducting, or assisting in, a study into the in-combination and cumulative effects of all the removal of excavated

material and construction operations taking place adjacent to the Thames in West London (TTT, BPSD, NLE, Lots Road etc.);

- 7.2.2.4 Disseminate the results of this assessment to the tenderers for the "Design and Build" contract to facilitate hazard identification and further develop detailed risk assessment; and
- 7.2.2.5 Consider establishing an overall coordination organisation (PLA, Cory, Cemex, Thames Clippers, TTT, NLE, etc.) for Nine Elms Reach prior to the start of the TTT Kirtling Street jetty construction.

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Annex A Meeting Notes

Meeting Note

Project	Northern Line Extension - Preliminary Navigation Risk Assessment - Activity 137
Organisation	Port of London Authority
Time / Date	19 th July 14:00-15:30
Subject	Stakeholder Consultation Navigation
Venue	PLA, Bakers Hall.
Attendees	Capt Terry Lawrence - Harbour Master Upper; Mark Towens – Deputy Harbour Master Upper; David Foster – Marico Marine; Dr Ed Rogers – Marico Marine; and Mike Fidler – Halcrow.

- Notes**
- River bus - initially just for clients then possibly Thames clipper service western loop – (see KPMG Thames Clippers meeting note below)
 - Options for brow to BPS jetty or straight to shore on barge mooring for northern bank;
 - TTT mornings to the north of authorised channel;
 - There is a proposal to put foot bridge / bicycle bridge near Grosvenor wharf;
 - Wandsworth waste (see Cory Environmental meeting note below);
 - Swedish Wharf – tendered;
 - Removal of excavated material at Lots Road - 1 to 2 barges a day
 - 54m vessel SWS Thurrock or tug and tow
 - Cement berth and Gabriela (cement barge) no longer working
 - Cringle Wharf - Cemex max 1 per day - capacity is increasing
 - Westminster boating base kayaking dinghy sailing and motor boat sailing busy most days
 - Rarely do rowing or canoeing occur here
 - Barges towing through Battersea
 - PLA by-laws no longer applicable now based on nav. risk assessment

- on a case by case basis.
- Trials using pushing tug -operating in Nine Elms Reach is a passage plan
- No heavy barges with tide behind
- Motorised barge run on ebb tide
- Hip or push barges may require flying bridge
- Active review and evaluation of risk assessment by PLA HM upper.
 - Sail up to any time after high water (HW) possible
 - Risk mitigation barge roads on north side
 - Ebb tide barge traffic - risk assessment and evaluation
 - Motorised or pushed more feasible for ebb tide operations
 - Anchoring systems for vessels -stern anchors for vessels greater than 50m
 - Charing Cross CCTV camera only (coastguard have coverage only but not great for navigation)
- VTS control of barge operations on the reach as a suitable mitigation measure? PLA view – adequate capacity at Thames Barrier VTS and masters managing themselves e.g. 10 min calling.
- Thames training alliance - Fast track apprentice scheme -2 years BML qualified, possibly using merchant seaman but at the moment there is no funding.
- Additional mitigation measures;
 - Thames Freight Standards - technical standards for vessel and operator code of practice for Thames - to be implemented shortly;
 - Workboat/tug on station to render assistance would be good idea; and
 - TTT included in tender compliance requirements for quality approach and hence Thames Freight Standards includes SMS requirements. – PLA are keen for TfL to have personnel standards.

Meeting Note

Project	Northern Line Extension - Preliminary Navigation Risk Assessment - Activity 137
Organisation	Cory Environmental Ltd
Time / Date	22 nd July 10.30-12.00;
Subject	Stakeholder Consultation Navigation
Venue	Charlton Barge Works
Attendees	Neil Caborn – General Manager; Peter Hammond – Lighterage Controller; David Foster – Marico Marine; and Mike Fidler – Halcrow

Notes

Cory Movements

- 6 day a week service (increased from 5).
- Usually use daytime tidal slot.
- Nine Elms:
 - 4-6 barges/day
 - ETA HW-3 to -2
 - ETD HW -1 (but can be delayed of being “bridged” in Central London then sail on ebb tide when height of tide acceptable.
- Wandsworth:
 - 3 barges/day
 - Same windows approx.
- Use ebb tide fairly regularly ... stated in Cory Risk Assessment and passage plan.

New Tugs draught 2.5m - require >HOT 2.0m at Westminster.

Cemex Movements:

- ETA HW -2
- ETD HW+2
- Little interference between operations.

Middle Wharf not operational some plant demolished.

Pier Wharf – GPS – 1 or 2 big barges /day.

Lots Road – Walsh – 1 (350t) barge /day – unlikely to be a long contract.

Thames Freight Standard – Corys are contributors to the project and very on side.

St George Pier etc – Clipper service to Putney does not affect the Cory operation (including wash) at present.

Proposed additional Passenger Pier by BPSJ – do not foresee major interference with Clipper v Cory operation ... well clear of Cringle Dock.

PH advise inbound Tug and tow on flood tide to transit Victoria Rail before chucking round and approaching BPSJ to avoid chance of being set onto Victoria Rail.

Cory are not considering pushing in their current operation.

Cory use river wall immediately upstream of Cringle Dock as a lay-by berth for barges during the ETA/ETD process ... inside line of BPSJ outer face. Do not have formal agreement with riparian owner.

1000t barges 10mx50m approx. depending on swim design.

Westminster Boating Base – rarely cause problems to tugs and tows – appears that WBB is well organised and the students are well controlled on the water.

Meeting Note

Project Northern Line Extension - Preliminary Navigation Risk Assessment - Activity 137

Organisation KPMG Thames Clipper

Subject Stakeholder Consultation Navigation

Venue O2 Dome

Attendees Derek Mann –Safety Executive;
Mark Thomson – Head of Fleet Operations;
David Foster – Marico Marine; and
Mike Fidler – Halcrow.

Notes

Expanding services to the west:

- Currently St George Pier, Cadogan Pier, Wandsworth and Putney loop only a weekday commuter service 0530 – 1030 and 1630 – 2000. 6 vessels/hour through Nine Elms Reach.
- Examining adding an hourly service off peak + weekends.

Speed limit 12kt to Wandsworth then 8kt further upstream with dispensation for fast ferries:

- Very detailed passage plan including “ease-downs” past Cringle Dock and Wharf plus through bridges.
- Possible permitted maximum in Nine Elms Reach <25kt.

Proposed additional passenger pier immediately upstream of BPSJ:

- . Insufficient information currently available

WPS provide services to Kew and Hampton Court – at peak about 3 to 4 round trips/day in full season.

Need for “clear eye” through Victoria Railway Bridge ... included in passage plan.

Discussions of merits and disadvantages of tow v push.

GPS – large barges to Pier Wharf. Push up/tow down.

S Walsh and Son – Muck-away from Lots Road.

Cemex now being supplied by motorised barges (Polla Rose and Yarra (?) Rose).

Local Traffic Control:

- Not required if NLE is the only additional traffic.
- May be required if NLE and TTT traffic at the same time.

Agree that NLE muck-away will most likely require additional lay-by moorings – collar barges rather than single buoys to avoid barges possibly lying across the river at slack water or in strong winds.

Shifting barges to and from BPSJ to the collar barges will add more barge traffic in area (cannot comment at this stage until marine contractor’s methodology becomes available - DF).

Overall Clipper have few concerns with NLE muck-away project provided it does not coincide with TTT traffic.

Meeting Note

Project Northern Line Extension - Preliminary Navigation Risk Assessment - Activity 137

Organisation Thames Tideway Tunnel

Subject Stakeholder Consultation Navigation

Venue Teleconference – Marico Offices

Attendees James Spikesley - Thames Tideway Tunnel
Alex Seibicke - Thames Tideway Tunnel
Ed Rogers – Marico Marine
David Foster – Marico Marine; and
Mike Fidler – Halcrow

Notes

- Ed explained the scope of the project and that we were commissioned by TfL to carry out NRA between Victoria Bridge and Vauxhall Bridge.
- The NLE NRA can be expected to be similar to the TTT NRA.
- Mike Fidler confirmed that a liaison group to consider potential synergy between TTT and NLE projects has been established.
- Ed explained at peak times it was expected to have 4,000 tons removal of excavated material per day and 1,000 ton barges in use at Battersea jetty.
- Timescale for Northern line extension and Kirtling Street jetty crucial for NRA and will have consequences if both are to run concurrently. Mid 2016 to end 2016 expected to be peak time for removal of excavated material for NLE.
- Kirtling Street jetty expected to start construction late 2016.
- Northern line extension expected to be finished end of 2017.
- All mitigation measures mentioned in preliminary NRA for Kirtling Street will be considered and then refined following a further risk assessment.
- Tunnel construction will be divided into three geographical areas (east, central, west) under three separate contractors.
- There will be an overall traffic strategy to deal with the cumulative effects and maximum requirements of the river. The main points are contained in a presentation re peak requirements. This has already

been issued to the PLA but Marico do not currently have a copy.

- For TTT, Cringle Dock and Cemex Jetty likely to be the main hazards in terms of consequence.

Annex B Hazard Logs

Colour coding in cells relates to incident category.

Text coloured red relates to possible Thames Tideway Tunnel impacts.

ML – Most likely Scenario

WC – Worst Credible Scenario

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Hazard ID	Incident Category	Hazard Title	Hazard Detail	Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely					Worst Credible					Mitigation in Place	Possible Additional Mitigation
							People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency		
From Table 3							See Table 5					See Table 5						
1	Collision	Collision:- NLE Tug and Tow ICW Freight Vessel	NLE Tug and Tow ICW a freight vessel. ML - overtaking collision with low speed impact or slow speed collision brought about by vessels manoeuvring in close proximity (e.g. vessels manoeuvring on/off Cringle Wharf, Cringle Dock or Kirtling Street TTT jetty) WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries. Minor damage to both vessels. Negligible pollution. Small delay to ops. Local unwelcome publicity	Multiple deaths on both vessels. Major damage to both vessels. Tier 1 Pollution. Vessel sinks blocking navigation or damages bridge. National adverse publicity for TFL & PLA.	2	2	1	1	4	5	4	2	4	3	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights). PLA pilotage for some vessels. VTS (including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges.
2	Collision	Collision:- NLE Tug and Tow ICW High Speed Passenger Vessel	NLE Tug and Tow ICW a high speed passenger vessel. ML - overtaking collision with low speed impact. WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with TTT and passenger vessel bound for Battersea passenger jetty.	Multiple Minor injuries. Minor damage to both vessels. Negligible pollution. Regional unwelcome publicity.	Multiple deaths on vessels particularly the passenger vessel. Major damage to both vessels. Tier 1 Pollution. Vessel sinks blocking navigation or damages bridge. International adverse publicity for TFL & PLA.	3	2	1	2	4	5	4	2	5	3	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights) PLA pilotage for some vessels. VTS (Including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges.
3	Collision	Collision:- NLE Tug and Tow ICW Class V Passenger Vessel	NLE Tug and Tow ICW a Class V Passenger Vessel. ML - overtaking collision with low speed impact. WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with TTT and passenger vessel bound for Battersea passenger jetty.	Multiple Minor injuries. Minor damage to both vessels. Negligible pollution. Regional unwelcome publicity.	Multiple deaths on vessels particularly the passenger vessel. Major damage to both vessels. Tier 1 Pollution. Vessel sinks blocking navigation or damages bridge. International adverse publicity for Tfl & PLA.	3	2	1	2	4	5	4	2	5	2	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights) PLA pilotage for some vessels. VTS (Including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges.
4	Collision	Collision:- NLE Tug and Tow ICW Recreational Vessel	NLE Tug and Tow ICW a recreational vessel. ML - overtaking collision with low speed impact. WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Unlit recreational craft. Recreational vessel lack of experience of navigating in Central London. Recreational vessel taking additional risks during an event. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger	Minor injuries on recreational vessel. Minor damage to recreational vessel. Negligible pollution. Local unwelcome publicity.	Death or major injury on recreational vessel. Major damage to recreational vessel - minor damage to tug/tow. Minimal pollution. Vessel sinks blocking navigation or damages bridge. National adverse publicity for TFL & PLA.	2	2	1	2	4	4	3	1	4	3	Masters qualifications (STCW, BML, and RYA). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning - Freight only. PLA Recreational Guide. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights) PLA pilotage for some vessels. VTS (Including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges. Local recreational stakeholder engagement to ensure all aspects of the project are communicated effectively to recreational users.

Hazard ID	Incident Category	Hazard Title	Hazard Detail	Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely				Worst Credible				Mitigation in Place	Possible Additional Mitigation		
							People	Property	Environment	Business	Frequency	People	Property	Environment			Business	Frequency
From Table 3							See Table 5				See Table 5							
				vessel bound for Battersea passenger jetty.														
5	Contact	Contact:- NLE Tug and Tow	NLE Tug and Tow Contact onto BPSJ or other fixed object in Nine Elms Reach (e.g. Possible contact with TTT Kirtling Street Jetty during construction). ML - Slow speed contact/glancing blow. WC - High speed head on contact.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel (e.g. Cory Environmental operations at Cringle Dock). Towing gear failure. Unlit mooring buoy or object. Sudden change in weather conditions particularly during berthing manoeuvres. Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty.	Minor injuries to people on vessel Minor damage to vessel Minor damage jetty Negligible pollution. No adverse publicity.	Death or serious injury on vessel. Major damage to vessel. Major damage to jetty/other fixed object. Tier 1 pollution. Vessel sinks blocking navigation channel or damages bridge. Regional adverse publicity for TfL & PLA.	2	2	1	1	5	4	3	2	3	3	Masters qualifications (STCW, BML) Col Regs PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc) Notices to Mariners Thames AIS Navigation aids (e.g. navigation lights) PLA pilotage for some vessels PLA Emergency Plans Rescue Services Fixed lifesaving equipment on infrastructure (e.g. jetty).	Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. TfL Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Additional Fendering on BPSJ. Inbound tugs and tows on the flood tide pass through Victoria Railway and Chelsea Bridge prior to swinging and making their approach to BPSJ.
6	Grounding	Grounding:- NLE Tug and Tow	Grounding of NLE Tug and Tow whilst transiting Nine Elms reach or approaching BPSJ or layby barge mooring. ML - Touching the bottom during berthing or shifting barges - re-float during on same tide. WC - Powered or drift grounding at speed resulting in stranding over at least one tidal cycle.	Mechanical defect/failure. Master/Skipper error. Adverse Weather. Result of avoiding action with a 3rd party vessel. Insufficient allowance for height of tide, tidal stream and wind. Inadequate survey or dissemination of information. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty.	Negligible injuries. Negligible damage vessel. Negligible pollution. Negligible publicity.	Major injury. Moderate damage to tug. Negligible damage to barge. Tier 1 Pollution. Local adverse publicity.	1	1	1	1	4	3	3	2	2	3	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights). PLA pilotage for some vessels. VTS (including routine navigation broadcasts). PLA Emergency Plans. Rescue Services. PLA hydrographic policy and routine surveys	Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. TfL Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent.
7	Breakout	Breakout :- NLE Tug and/or Tow break	Break out of barges and or tugs from BPSJ or barge layby berth. ML - Barge partially or fully breaks out but is caught by attending/accompanying tug. WC - Barge/tug break out and set adrift in the river.	Moorings part. Excessive wash. Loss of control during barge manoeuvring on/off BPSJ. Vandalism.	Negligible Injuries. Negligible damage to barge. Negligible Pollution. Small delay to operations. Negligible Adverse Publicity.	Minor injury. Negligible damage to barge. Major damage to third party infrastructure or vessel. Minor pollution. Moderate delay to operations (NLE or 3rd Party). Adverse regional publicity for TfL & PLA.	1	1	1	2	5	2	4	2	3	3	Qualifications and professionalism of crew. Masters qualifications (STCW, BML) PLA Regulations (e.g. Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc) VTS (Including routine navigation broadcasts) PLA Emergency Plans Rescue Services Site Security	Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. TfL Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent.

Hazard ID	Incident Category	Hazard Title	Hazard Detail	Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely					Worst Credible					Mitigation in Place	Possible Additional Mitigation
							People	Property	Environment	Business	Frequency	People	Property	Environment	Business	Frequency		
From Table 3							See Table 5					See Table 5						
8	Personal Injury	Personal Injury:- NLE Tug and Tow	Personal injury of NLE tug and Tow. ML - Minor accident during marine operations. WC - Major accident during marine operations.	Injury to line handlers and vessel crews during mooring/ letting go operations including on-board tugs. Person falls from ship/ jetty/steps/ ladder into water. Crew/visitor "slips and trips" during embarkation and disembarkation. Wash from passing vessel.	Minor injury. No property loss. No pollution. Negligible operational delays. No adverse publicity.	Death or major injuries. Negligible damage to property/vessels/barges. Significant delay to operations. Negligible pollution. Regional adverse publicity.	2	1	1	1	5	4	1	1	3	3	H&S work place inspections of jetties, landing, slips etc. STCW/BML. PLA Regulations (e.g. Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Tug/workboat procedures. Provision of PPE. PLA Emergency Plans. Rescue Services.	Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment.
9	Contact, Grounding or Collision	Contact, Grounding or Collision:- Freight Vessel as a result of NLE Tug and Tow Ops	Freight vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries to people on both vessels. Minor damage to vessel or fixed infrastructure. Negligible Pollution. Minor impact on NLE or 3rd party ops. Negligible publicity.	Major injuries or single fatality to people on both vessels. Major damage to vessel or fixed infrastructure. Minor Pollution - e.g. Tier 1. Significant impact on NLE or 3rd party ops. National adverse publicity.	2	2	1	1	4	4	4	2	4	2	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights). PLA pilotage for some vessels. VTS (including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges.
10	Contact, Grounding or Collision	Contact, Grounding or Collision:- High Speed Passenger Vessel as a result of NLE Tug and Tow Ops	High Speed vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries to people on Tug and Tow. Moderate injury to people on High Speed Vessel. Moderate damage to vessel or fixed infrastructure. Negligible Pollution. Moderate impact on NLE or 3rd party ops. Regional adverse publicity.	Major injuries to people on Tug and Tow. Multiple fatalities to people on High Speed Vessel. Major damage to vessel or fixed infrastructure. Minor Pollution - e.g. Tier 1. Significant impact on NLE or 3rd party ops. International adverse publicity.	3	3	1	3	3	4	4	2	5	2	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights). PLA pilotage for some vessels. VTS (Including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges.
11	Contact, Grounding or Collision	Contact, Grounding or Collision:- Passenger Vessel as a result of NLE Tug and Tow Ops	Passenger vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries to people on Tug and Tow. Moderate injury to people on Passenger Vessel. Moderate damage to vessel or fixed infrastructure. Negligible Pollution. Moderate impact on NLE or 3rd party ops. Regional adverse publicity.	Major injuries to people on Tug and Tow. Multiple fatalities to people on Passenger Vessel. Major damage to vessel or fixed infrastructure. Minor Pollution - e.g. Tier 1. Significant impact on NLE or 3rd party ops. International adverse publicity.	3	3	1	3	3	4	4	2	5	2	Masters qualifications (STCW, BML). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights). PLA pilotage for some vessels. VTS (Including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. Tfl Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges.

Hazard ID	Incident Category	Hazard Title	Hazard Detail	Causes	Most Likely Outcome	Worst Credible Outcome	Most Likely				Worst Credible				Mitigation in Place	Possible Additional Mitigation		
							People	Property	Environment	Business	Frequency	People	Property	Environment			Business	Frequency
From Table 3							See Table 5				See Table 5							
12	Contact, Grounding or Collision	Contact, Grounding or Collision:- Recreational Vessel as a result of NLE Tug and Tow Ops	Recreational vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. - Unlit recreational craft. - Recreational vessel lack of experience of navigating in Central London. - Recreational vessel taking additional risks during an event. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Moderate injury to people on recreational vessel. Moderate damage to recreational vessel. Negligible Pollution. Minor impact on NLE or 3rd party ops. Local adverse publicity.	Multiple fatalities to people on recreational vessel. Major damage to recreational vessel. Negligible Pollution. Major impact on NLE or 3rd party ops. National adverse publicity.	3	3	1	2	4	5	4	1	4	2	Masters qualifications (STCW, BML, and RYA). Col Regs. PLA Regulations (Port of London Act, Byelaws, General Directions, Pilotage Directions, Permanent NtoM, Codes of Practice etc). Passage Planning - Freight only. PLA Recreational Guide. Notices to Mariners. "Isophase Lights". Thames AIS. Navigation aids (e.g. navigation lights) PLA pilotage for some vessels. VTS (Including routine navigation broadcasts). PLA Emergency Plans. Rescue Services.	Notice to Mariners covering NLE Removal of excavated material Ops. Use of suitably qualified and experienced contractors - e.g. follow Thames Freight Standard. Marine Contractors to undertake detailed NRA. TfL Sub-contractor Risk Assessment. Local Vessel Traffic Control only if TTT ops concurrent. Collar barges for layby barges. Local recreational stakeholder engagement to ensure all aspects of the project are communicated effectively to recreational users.

Annex C Baseline Ranked Hazard List

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Rank	Hazard Ref.	Affected Areas	Incident Category	Hazard Title	Hazard Detail	Possible Causes	Consequence Descriptions		Risk By Consequence Category								Baseline Risk Overall
							Most Likely (ML)	Worst Credible (WC)	ML				WC				
									Environment	People	Property	Business	Environment	People	Property	Business	
									See Table 6	See Table 6	Table 9						
1	2	Nine Elms Reach	Collision	Collision:- NLE Tug and Tow ICW High Speed Passenger Vessel	NLE Tug and Tow ICW a high speed passenger vessel. ML - overtaking collision with low speed impact. WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with TTT and passenger vessel bound for Battersea passenger jetty.	Multiple Minor injuries. Minor damage to both vessels. Negligible pollution. Regional unwelcome publicity.	Multiple deaths on vessels particularly the passenger vessel. Major damage to both vessels. Tier 1 Pollution. Vessel sinks blocking navigation or damages bridge – e.g. Victoria Railway Bridge. International adverse publicity for Tfl & PLA.	0.0	5.9	3.5	3.5	2.4	7.0	5.9	7.0	5.4
2	3	Nine Elms Reach	Collision	Collision:- NLE Tug and Tow ICW Class V Passenger Vessel	NLE Tug and Tow ICW a Class V Passenger Vessel. ML - overtaking collision with low speed impact. WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with TTT and passenger vessel bound for Battersea passenger jetty.	Multiple Minor injuries. Minor damage to both vessels. Negligible pollution. Regional unwelcome publicity.	Multiple deaths on vessels particularly the passenger vessel. Major damage to both vessels. Tier 1 Pollution. Vessel sinks blocking navigation or damages bridge. International adverse publicity for Tfl & PLA.	0.0	5.9	3.5	3.5	1.9	5.9	4.9	5.9	4.9
3	12	Nine Elms Reach	Contact, Grounding or Collision	Contact, Grounding or Collision:- Recreational Vessel as a result of NLE Tug and Tow Ops	Recreational vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. - Unlit recreational craft. - Recreational vessel lack of experience of navigating in Central London. - Recreational vessel taking additional risks during an event. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Moderate injury to people on recreational vessel. Moderate damage to recreational vessel. Negligible Pollution. Minor impact on NLE or 3rd party ops. Local adverse publicity.	Multiple fatalities to people on recreational vessel. Major damage to recreational vessel. Negligible Pollution. Major impact on NLE or 3rd party ops. National adverse publicity.	0.0	5.9	5.9	3.5	0.0	5.9	4.9	4.9	4.9
4	5	Nine Elms Reach	Contact	Contact:- NLE Tug and Tow	NLE Tug and Tow Contact onto BPSJ or other fixed object in Nine Elms Reach (e.g. Possible contact with TTT Kirtling Street Jetty during construction). ML - Slow speed	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel (e.g. Cory Environmental operations at Cringle Dock). Towing gear failure. Unlit mooring	Minor injuries to people on vessel Minor damage to vessel Minor damage jetty Negligible pollution. No adverse publicity.	Death or serious injury on vessel. Major damage to vessel. Major damage to jetty/other fixed object. Tier 1 pollution. Vessel sinks blocking navigation channel or damages	0.0	5.9	5.9	0.0	2.4	5.9	4.4	4.4	4.8

Rank	Hazard Ref.	Affected Areas	Incident Category	Hazard Title	Hazard Detail	Possible Causes	Consequence Descriptions		Risk By Consequence Category								Baseline Risk Overall	
							Most Likely (ML)	Worst Credible (WC)	ML				WC					
									Environment	People	Property	Business	Environment	People	Property	Business		
									See Table 6	See Table 6	Table 9							
					contact/glancing blow. WC - High speed head on contact.	buoy or object. Sudden change in weather conditions particularly during berthing manoeuvres. Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty.		bridge. Regional adverse publicity for TfL & PLA.										
5	10	Nine Elms Reach	Contact, Grounding or Collision	Contact, Grounding or Collision:- High Speed Passenger Vessel as a result of NLE Tug and Tow Ops	High Speed vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries to people on Tug and Tow. Moderate injury to people on High Speed Vessel. Moderate damage to vessel or fixed infrastructure. Negligible Pollution. Moderate impact on NLE or 3rd party ops. Regional adverse publicity.	Major injuries to people on Tug and Tow. Multiple fatalities to people on High Speed Vessel. Major damage to vessel or fixed infrastructure. Minor Pollution - e.g. Tier 1. Significant impact on NLE or 3rd party ops. International adverse publicity.	0.0	4.4	4.4	4.4	1.9	4.9	4.9	5.9	4.5	
6	11	Nine Elms Reach	Contact, Grounding or Collision	Contact, Grounding or Collision:- Passenger Vessel as a result of NLE Tug and Tow Ops	Passenger vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries to people on Tug and Tow. Moderate injury to people on Passenger Vessel. Moderate damage to vessel or fixed infrastructure. Negligible Pollution. Moderate impact on NLE or 3rd party ops. Regional adverse publicity.	Major injuries to people on Tug and Tow. Multiple fatalities to people on Passenger Vessel. Major damage to vessel or fixed infrastructure. Minor Pollution - e.g. Tier 1. Significant impact on NLE or 3rd party ops. International adverse publicity.	0.0	4.4	4.4	4.4	1.9	4.9	4.9	5.9	4.5	
7	1	Nine Elms Reach	Collision	Collision:- NLE Tug and Tow ICW Freight Vessel	NLE Tug and Tow ICW a freight vessel. ML - overtaking collision with low speed impact or slow speed collision brought about by vessels manoeuvring in close proximity (e.g. vessels manoeuvring on/off Cringle Wharf, Cringle Dock or Kirtling Street TTT jetty) WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries. Minor damage to both vessels. Negligible pollution. Small delay to ops. Local unwelcome publicity	Multiple deaths on both vessels. Major damage to both vessels. Tier 1 Pollution. Vessel sinks blocking navigation or damages bridge. National adverse publicity for TfL & PLA.	0.0	3.5	3.5	0.0	2.4	7.0	5.9	5.9	4.4	

Rank	Hazard Ref.	Affected Areas	Incident Category	Hazard Title	Hazard Detail	Possible Causes	Consequence Descriptions		Risk By Consequence Category								Baseline Risk Overall
							Most Likely (ML)	Worst Credible (WC)	ML				WC				
									Environment	People	Property	Business	Environment	People	Property	Business	
									See Table 6	See Table 6	Table 9						
8	7	Nine Elms Reach	Breakout	Breakout :- NLE Tug and/or Tow break	Break out of barges and or tugs from BPSJ or barge layby berth. ML - Barge partially or fully breaks out but is caught by attending/accompanying tug. WC - Barge/tug break out and set adrift in the river.	Moorings part. Excessive wash. Loss of control during barge manoeuvring on/off BPSJ. Vandalism.	Negligible Injuries. Negligible damage to barge. Negligible Pollution. Small delay to operations. Negligible Adverse Publicity.	Minor injury. Negligible damage to barge. Major damage to third party infrastructure of vessel. Minor pollution. Moderate delay to operations (NLE or 3rd Party). Adverse regional publicity for Tfl & PLA.	0.0	0.0	0.0	5.9	2.4	2.4	5.9	4.4	4.3
9	4	Nine Elms Reach	Collision	Collision:- NLE Tug and Tow ICW Recreational Vessel	NLE Tug and Tow ICW a recreational vessel. ML - overtaking collision with low speed impact. WC - head on collision at speed with no avoiding action taken.	Mechanical defect/failure. Master/Skipper error. Result of avoiding action with a 3rd party vessel. Towing gear failure. Unlit recreational craft. Recreational vessel lack of experience of navigating in Central London. Recreational vessel taking additional risks during an event. Adverse weather. Unplanned barrage closure affecting tidal flows. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries on recreational vessel. Minor damage to recreational vessel. Negligible pollution. Local unwelcome publicity.	Death or major injury on recreational vessel. Major damage to recreational vessel - minor damage to tug/tow. Minimal pollution. Vessel sinks blocking navigation or damages bridge. National adverse publicity for Tfl & PLA.	0.0	3.5	3.5	3.5	0.0	5.9	4.4	5.9	4.0
10	8	Nine Elms Reach	Personal Injury	Personal Injury:- NLE Tug and Tow	Personal injury of NLE tug and Tow. ML - Minor accident during marine operations. WC - Major accident during marine operations.	Injury to line handlers and vessel crews during mooring/ letting go operations including on-board tugs. Person falls from ship/ jetty/steps/ ladder into water. Crew/visitor "slips and trips" during embarkation and disembarkation. Wash from passing vessel.	Minor injury. No property loss. No pollution. Negligible operational delays. No adverse publicity.	Death or major injuries. Negligible damage to property/vessels/barges. Significant delay to operations. Negligible pollution. Regional adverse publicity.	0.0	5.9	0.0	0.0	0.0	5.9	0.0	4.4	4.0
11	9	Nine Elms Reach	Contact, Grounding or Collision	Contact, Grounding or Collision:- Freight Vessel as a result of NLE Tug and Tow Ops	Freight vessel incident following 3rd party evasive action with NLE/BPSJ Ops. ML - Slow speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge). WC - High speed collision, grounding or contact with fixed infrastructure (e.g. Victoria Railway Bridge).	Result of avoiding action, caused by; - Mechanical defect/failure. - Master/Skipper error. - Towing gear failure of tug and tow. - Sudden change in weather conditions particularly during berthing manoeuvres. - Unexpected tidal eddies, e.g. due to barrage closure. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty. Additional river traffic and vessels manoeuvring associated with delivery of TTT and passenger vessel bound for Battersea passenger jetty.	Minor injuries to people on both vessels. Minor damage to vessel or fixed infrastructure. Negligible Pollution. Minor impact on NLE or 3rd party ops. Negligible publicity.	Major injuries or single fatality to people on both vessels. Major damage to vessel or fixed infrastructure. Minor Pollution - e.g. Tier 1. Significant impact on NLE or 3rd party ops. National adverse publicity.	0.0	3.5	3.5	0.0	1.9	4.9	4.9	4.9	3.6

Rank	Hazard Ref.	Affected Areas	Incident Category	Hazard Title	Hazard Detail	Possible Causes	Consequence Descriptions		Risk By Consequence Category				Baseline Risk Overall				
							Most Likely (ML)	Worst Credible (WC)	ML		WC						
									Environment	People	Property	Business		Environment	People	Property	Business
									See Table 6	See Table 6	Table 9						
12	6	Nine Elms Reach	Grounding	Grounding:- NLE Tug and Tow	Grounding of NLE Tug and Tow whilst transiting Nine Elms reach or approaching BPSJ or layby barge mooring. ML - Touching the bottom during berthing or shifting barges - re-floats during on same tide. WC - Powered or drift grounding at speed resulting in stranding over at least one tidal cycle.	Mechanical defect/failure. Master/Skipper error. Adverse Weather. Result of avoiding action with a 3rd party vessel. Insufficient allowance for height of tide, tidal stream and wind. Inadequate survey or dissemination of information. Constriction of the navigable width and associated loss of overall space to manoeuvre by construction of Kirtling Street TTT Jetty.	Negligible injuries. Negligible damage vessel. Negligible pollution. Negligible publicity.	Major injury. Moderate damage to tug. Negligible damage to barge. Tier 1 Pollution. Local adverse publicity.	0.0	0.0	0.0	0.0	2.4	4.4	4.4	2.4	2.0

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