ENVIRONMENTAL STATEMENT: 6.3 APPENDIX 19-1: PRELIMINARY NAVIGATION RISK ASSESSMENT

DECARBONISATION

Cory Decarbonisation Project

PINS Reference: EN010128

JANUARY 2025 - Revision D

Cory Decarbonisation Project

Preliminary Navigation Risk Assessment

WSP

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EXECUTIVE SUMMARY

NASH Maritime has been instructed by WSP on behalf of Cory Environmental Holdings Limited (hereafter referred to as the Applicant) to prepare a preliminary Navigation Risk Assessment (pNRA), for the Cory Decarbonisation Project to be located at Norman Road, Belvedere in the London Borough of Bexley (LBB) (National Grid Reference/NGR 549572, 180512).

The pNRA forms an appendix to the **Environmental Statement (Document Reference 6.1)**. This pNRA documents the overall evolution of the Proposed Jetty design based on optimisation of design iterations for navigation risk. This report therefore considers design Option 2 as the starting point for the navigation risk assessment. The report then recommends Option 3 as a key engineering risk control measure to reduce navigation risk associated with the identified navigation hazards to As Low As Reasonably Practicable (ALARP). The Proposed Jetty presented in the Environmental Statement is based upon design Option 3.

The pNRA was undertaken to assess levels of navigational risk associated with the construction and operation phases of the Proposed Scheme.

The pNRA was undertaken utilising the Port of London Authority's (PLA) approved marine risk assessment methodology and the methodological approach was agreed with the PLA Harbour Master team prior to commencement.

Following a review of the Proposed Jetty operation, design, baseline navigation environment, detailed vessel traffic analysis, hazard likelihood modelling and stakeholder consultation, a preliminary risk assessment was undertaken to determine levels of inherent navigational risk.

Construction Phase

The inherent assessment of risk determined that, during the construction phase, seven hazards scored as intolerable / unacceptable, of these seven hazards, two were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) – Cargo In Collision With (ICW) Marine Works; and
- Breakout - Construction Vessel.

Five hazards were assessed as presenting 'serious' levels of risk, these were:

- Contact (Allision) - Tanker ICW Marine Works;
- Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works;
- Contact (Allision) - Construction Vessel ICW Marine Works;
- Collision - Construction Vessel ICW Cargo; and
- Collision - Third Party Vessels as a result of avoiding construction vessels.

The remaining hazards scored as 'Moderate' risk with the exception of one hazard that scored as negligible risk.

Operation Phase

The inherent assessment of risk determined that during the operation phase six hazards scored as intolerable / unacceptable. Of these six hazards, two were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside); and
- Ranging / Breakout - Project Vessel.

Four hazards were assessed as presenting “serious” levels of risk, these were:

- Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)
- Collision - Project Vessel ICW Cargo
- Collision - Project Vessel ICW Tug, Service and Other Small Vessel
- Collision - Third Party Vessels as a result of avoiding project vessels

The remaining hazards scored as ‘Moderate’ risk.

Hazards scoring in the ‘serious’ risk category and above require additional risk control measures to mitigate the risk score to acceptable levels, but it is also strongly advised that all navigation risks are reduced to ALARP. Therefore, where appropriate, additional control measures were developed to bring all construction and operation phase hazards down to ALARP.

Risk Controls

Following the inherent assessment of risk, thirteen additional controls were identified by the Applicant, some of the identified risk controls applied to both the construction and operation phases whilst some only applied to either the construction or operation phase.

Following the application of the additional risk control measures a residual assessment of navigation risk was undertaken.

For the construction phase the residual assessment of risk determined that all hazards scored as acceptable following the implementation of the additional risk controls.

For the operation phase the residual assessment of risk resulted in one hazard scoring as tolerable if deemed to be ALARP. The remaining hazards all fell within the acceptable scoring range.

The hazard considered to be tolerable if ALARP was Hazard 16 - Breakout - Project Vessel.

It should also be noted that this hazard has been scored by the NASH Maritime team, reflecting the expert qualitative judgement of the team, building on the process carried out in the development of this pNRA and the initial results of the bridge simulation study in Appendix K.

The project undertook a passing vessel mooring interaction study to support the qualitative judgment of risk associated with that hazard and to support the initial findings of the pNRA which identified Project Vessel Breakout from the Proposed Jetty during the operation phase as a credible hazard to be further investigated. It was identified that of the largest vessels currently navigating past the Proposed Jetty (Cruise vessel, Bulk Carrier and CLdN RoRo vessel), the fully loaded Bulk Carrier produced the greatest interaction forces and consequential mooring line loads. Comparatively, the Cruise vessel and CLdN RoRo vessel produced similar or lower forces and moored vessel mooring line loads. Guidance form the projects expert mariner indicated that large vessels passing at close passing distance of two times the vessel’s beam, would be anticipated typically to operate at about 6 knots, or potentially up to 8 knots in a realistic adverse scenario. The results of the passing vessel mooring interaction study generally indicated that, in combination with adverse metocean conditions:

- passing speeds of 6 knots did not exceed the industry-recommended mooring line loading limits;
- passing speeds of 8 knots generally would not exceed allowable line loading except for a loaded large Bulk Carrier passing outbound, which is not a current scenario on the waterway; and
- passing speeds of 10 knots, although rare, may exceed allowable line loading; however, would not break away from berth. Further that mitigation measures, developed through future detailed design, would suitable/appropriately contribute to optimised moorings and risk reduction.

It is also noted that the normal practice of a moored tanker and moored vessel operating procedures that the vessel will have a watch crew and the vessel's moorings will be regularly tendered to maintain, as best as possible, tensioned and even moorings. Following a review of the pNRA outcomes the following recommendations have been made:

1. The thirteen additional risk control measures identified in **Table 24** are adopted;
2. It is further recommended that the Applicant continue engagement with the PLA to review the applicability of General Direction 17.1 (b), which mandates a 60m navigation restriction around tanker vessels and oil and gas jetties, to the Proposed Scheme, (see Section 6.1 for explanation of General Direction).

pNRA update, 18-Oct-2024

Following submission of revision R04-00 of the pNRA report a Change Request (as per the change letter submitted as part of the Application on 15 August 2024) has been developed for the Proposed Scheme, to facilitate the use of a 20,000 cbm project vessel, rather than 15,000 cbm, and associated amendments to the Proposed Jetty design to account for those larger vessels.

Given the potential for these matters to alter the existing understanding of navigation risk associated with the Proposed Development (as defined in revision R04-00), it was determined that a pNRA update would be required to determine the level of impact and any resulting change in navigation risk profile.

During the time period between submission of R04-00 and this report (R05-00) the project team also undertook further work to understand the consequences of the LCO_2 release for navigation, as such the pNRA update (R05-00) also includes a summary of the findings of this work and incorporates the findings of the work in to the assessment of navigation risk.

The scope of the pNRA revision included:

- A review of the proposed scope with the PLA;
- A detailed passage planning exercise;
- An update to the passing vessel mooring interaction study;
- An update to the inherent and residual assessment of navigation risk presented in revision R04-00 of the pNRA.

The pNRA update findings are as follows:

1. The Proposed Jetty design, combined with the 20,000 cbm vessel still remains within the same Proposed Scheme envelope assessed in the pNRA revision R04-00.

2. The passage planning exercise demonstrated that it is feasible for the 20,000 cbm vessel to navigate to and from the Proposed Jetty with sufficient under keel clearance (UKC) throughout the passage, providing that the guideline arrival and departure times (relative to stage of the tidal cycle) outlined in **Section 10.3.1** and **10.3.2** are adhered to.

3. The outcomes of the revision of the passing vessel mooring interaction study did not substantially differ from those previously identified in **Section 7**. That is, in addition to the anticipated adherence to operational passing practices advised in the Port Information Guide on “speed limits” (as described in **Section 8.6.3.2**), that mooring optimisation throughout future engineering design phases (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard.

4. The preliminary LCO_2 Release Risk Assessment undertaken by WSP indicated that inherent risk would be graded as intolerable or tolerable if ALARP (when assessed against HSE societal risk factors) for persons working in the immediate vicinity of the Proposed Jetty. In the event of a LCO_2 release, this would include staff working on the Proposed Jetty, crew of the Project Vessel and Cory tug crew working near to / on moored vessels in proximity to the Proposed Jetty.

5. The primary contributor to the calculated risk in the immediate vicinity of the Proposed Jetty is rupture releases from the LCO_2 Above Ground Pipelines between the shore and the Proposed Jetty due to allision (contact) from vessels. This frequency of occurrence of this resulting in a LCO_2 release was estimated at 1/250 years. This is a conservative approximation and further detailed analysis, and modelling would be required to provide more certainty on the frequency of vessel impacts, which would need to be undertaken as part of the next stage of the NRA development process required by the Development Consent Order (DCO).

6. The preliminary LCO_2 Release Risk Assessment results indicate that additional mitigation measures are required to reduce the HSE risk associated with LCO_2 releases from the Proposed Jetty Above Ground Pipelines. A more refined assessment of the frequency of vessel contacts leading to releases, based on likely vessel movements and more specific location of contact, may also reduce the risk.

7. Based on the inherent PLA risk score for the operational phase, seven (7) hazards scored as intolerable / unacceptable, of these, two (2) were assessed as presenting ‘very serious’ levels of risk, these being:

    a. Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside); and

    b. Ranging / Breakout - Project Vessel.

8. Five (5) hazards were assessed as presenting ‘serious’ levels of risk, these were:

    a. Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside);

    b. Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside);

    c. Collision - Project Vessel ICW Cargo;

d. Collision - Project Vessel ICW Tug, Service and Other Small Vessel; and

e. Collision - Third Party Vessels as a result of avoiding project vessels.

9. The remaining hazards scored as “moderate” risk.

10. Two further additional risk controls were identified for the operational phase of the project.

a. Risk Control 14 - Detailed Design to mitigate the risks of vessel contact and breakout; and

b. Risk Control 15 – LCO_2 Emergency Response Plan.

11. The combined impact of risk controls 14 and 15 is to reduce the risks of a LCO_2 release.

12. The results of the updated residual risk assessment indicate that, should all the identified additional risk control measures (relating to the operational phase of the project) be implemented, navigation risk can be reduced to tolerable levels.

The following recommendations are made:

- The additional risk control measures identified, that are relevant to the operational phase of the project should be implemented. The identified risk control measures are listed below for completeness and detailed in **Table 25**:
  - RC01 - Relocation of the Proposed Jetty (through adoption of Option 3 provided for in the Works Plans). In R05-00, this is now further set back with the new Proposed Jetty location);
  - RC02 - Promulgation and dissemination of information;
  - RC03 - Defined Proposed Scheme limitations (construction and operation);
  - RC04 - Deconfliction of Cory operations with arrival/departure of Project Vessel;
  - RC05 - Detailed design analyses for berth and moorings;
  - RC07 - Navigation Exclusion Zone;
  - RC12 - Passing vessel mooring interaction study (subsequently undertaken and discussed in **Section 7** and updated in **Section** 10.4)
  - RC13 - Full Ship Bridge Simulations (subsequently undertaken and discussed in **Section 6** and further commented on in **Section 10.2.5**);
  - RC14 - Detailed Design to mitigate the risks of vessel contact and breakout (as described in **Section 10.8**); and
  - RC15 – LCO_2 Emergency Response Plan (as described in **Section 10.8**).
- During FEED design, risks of the product to the river are to be assessed in greater detail and mitigated through design to either tolerable or tolerable if ALARP in line with Risk Controls 14 and 15. Documents that are expected to be produced to support this include; refinements to calculated ship impact risks, a toxic gas hazard assessment, updated HAZID report and HAZOP report including risks of the product to the river, designer's risk assessment, and a Quantitative Risk Assessment. These will be provided to the PLA as a basis for informing the full NRA.

- Following completion of Detailed Design, the Navigation Risk Assessment should be reviewed to assess levels of navigation risk associated with the detailed Proposed Jetty design, both for the operational and construction phase, as secured by DCO Requirement.

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APPENDICES

ABBREVIATIONS

A glossary and abbreviations list specific to this document is presented below. The **Glossary (Document Reference 1.7)** is a complete glossary for the terms used within all the documents submitted as part of the application for a development consent order.

Abbreviation	Detail
AIS	Automatic Identification System
ALARP	As Low As Reasonably Practicable
AtoN	Aid to Navigation
cbm	Cubic meters
CCTV	Closed Circuit Television
CCS	Carbon Capture and Storage
CD	Chart Datum
CO_2	Carbon Dioxide
DCO	Development Consent Order
EfW	Energy from Waste
HMS	His Majesty's Ship
ICW	In Collision With / In Contact With
IWRAP	IALA Waterway Risk Assessment Programme
JUB	Jack Up Barge
LCO2 (or LCO_2)	Liquid Carbon Dioxide
LOA	Length Overall
m	metres
nm	nautical mile
NRA	Navigation Risk Assessment (the process or risk assessment)
OD	Ordnance Datum
PLA	Port of London Authority
pNHA	preliminary Navigation Hazard Analysis
pNRA	preliminary Navigation Risk Assessment (this document and overarching assessment)
RoRo	Roll on roll off vessel (typically ferries with cars, freights, etc)
RWL	River Works License
TSH	Trailing Suction Hopper
UKC	Under Keel Clearance
VHF	Very High Frequency
VTS	Vessel Traffic Services

1. INTRODUCTION

1.1 PREAMBLE

This preliminary Navigation Risk Assessment (pNRA) was undertaken on the basis of a previous maximum Project Vessel size and the assessment that is discussed throughout **Section 1** to **Section 9** of this report relates to this stage of the Proposed Scheme's design. Following submission of revision R04-00 of the pNRA report, a Change Request has been developed for the Proposed Scheme, as per the change letter[1] submitted as part of the Application on 15 August 2024, to facilitate the use of a larger Project Vessels and the associated amendments to the indicative Proposed Jetty design to account for those larger vessels. An update to key assessments undertaken in this pNRA for this change has been discussed in **Section 10**only.

1.2 INTRODUCTION

NASH Maritime has been instructed by WSP on behalf of Cory Environmental Holdings Limited (hereafter referred to as the Applicant) to prepare a pNRA, for the Cory Decarbonisation Project to be located at Norman Road, Belvedere in the London Borough of Bexley (LBB) (National Grid Reference/NGR 549572, 180512). The following figures are available in the **Environmental Statement (ES)**:

- **Figure 1-1: Site Boundary Location Plan (Volume 2)**; and
- **Figure 1-2: Satellite Imagery of the Site Boundary Plan (Volume 2)**.

The Applicant intends to construct and operate the Proposed Scheme to be linked with the River Thames. It comprises of the following key components, which are described below, and further detail is provided within **Chapter 2: Site and Proposed Scheme Description (Volume 1)**:

- The Carbon Capture Facility (including its associated Supporting Plant and Ancillary Infrastructure): the construction of infrastructure to capture a minimum of 95% of carbon dioxide (CO_2) emissions from Riverside 1 and 95% of CO_2 emissions from Riverside 2 once operational, which is equivalent to approximately 1.3Mt CO_2 per year. The Carbon Capture Facility will be one of the largest carbon capture projects in the UK.
- The Proposed Jetty: a new and dedicated export structure within the River Thames as required to export the CO_2 captured as part of the Carbon Capture Facility.
- The Mitigation and Enhancement Area: land identified as part of the **Outline Landscape, Biodiversity, Access and Recreation Delivery Strategy (Outline LaBARDS) (Document Reference 7.9)** to provide improved access to open land, habitat mitigation, compensation and enhancement (including forming part of the drainage system and Biodiversity Net Gain delivery proposed for the Proposed Scheme) and planting. The Mitigation and Enhancement Area provides the opportunity

[1] EN010128-000281-Notification of Change Letter PINs.pdf located at https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010128/EN010128-000281-Notification%20of%20Change%20Letter%20PINs.pdf.

to improve access to outdoor space and to extend the area managed as the Crossness Local Nature Reserve (LNR).

- Temporary Construction Compounds: areas to be used during the construction phases for activities including, but not limited to office space, warehouses, workshops, open air storage and car parking, as shown on the **Works Plans (Document Reference 2.3)**. These include the core Temporary Construction Compound, the western Temporary Construction Compound and the Proposed Jetty Temporary Construction Compound.
- Utilities Connections and Site Access Works: The undergrounding of utilities required for the Proposed Scheme in Norman Road and the creation of new, or the improvement of existing, access points to the Carbon Capture Facility from Norman Road.

Together, the Carbon Capture Facility (including its associated Supporting Plant and Ancillary Infrastructure), the Proposed Jetty, the Mitigation and Enhancement Area, the Temporary Construction Compounds and the Utilities Connections and Site Access Works are referred to as the 'Proposed Scheme'. The land upon which the Proposed Scheme is to be located is referred to as the 'Site' and the edge of this land referred to as the 'Site Boundary'. The Site Boundary represents the Order Limits for the Proposed Scheme as shown on the **Works Plans (Document Reference 2.3)**.

1.3 PURPOSE OF REPORT

The pNRA forms an appendix to the **Environmental Statement (Document Reference 6.1)**. This pNRA documents the overall evolution of the design based on optimisation of design iterations for navigation risk. This report therefore considers design Option 2 (as described in Chapter 3 of the Environmental Statement) as the starting point for the navigation risk assessment as that was the initial design proposed. The report then recommends Option 3 as a key engineering risk control measure to reduce navigation risk associated with the identified navigation hazards to As Low As Reasonably Practicable (ALARP). The Proposed Jetty presented in the Environmental Statement is based upon design Option 3 as a result of this work.

Figure 1 shows the extent of the pNRA Study Area.

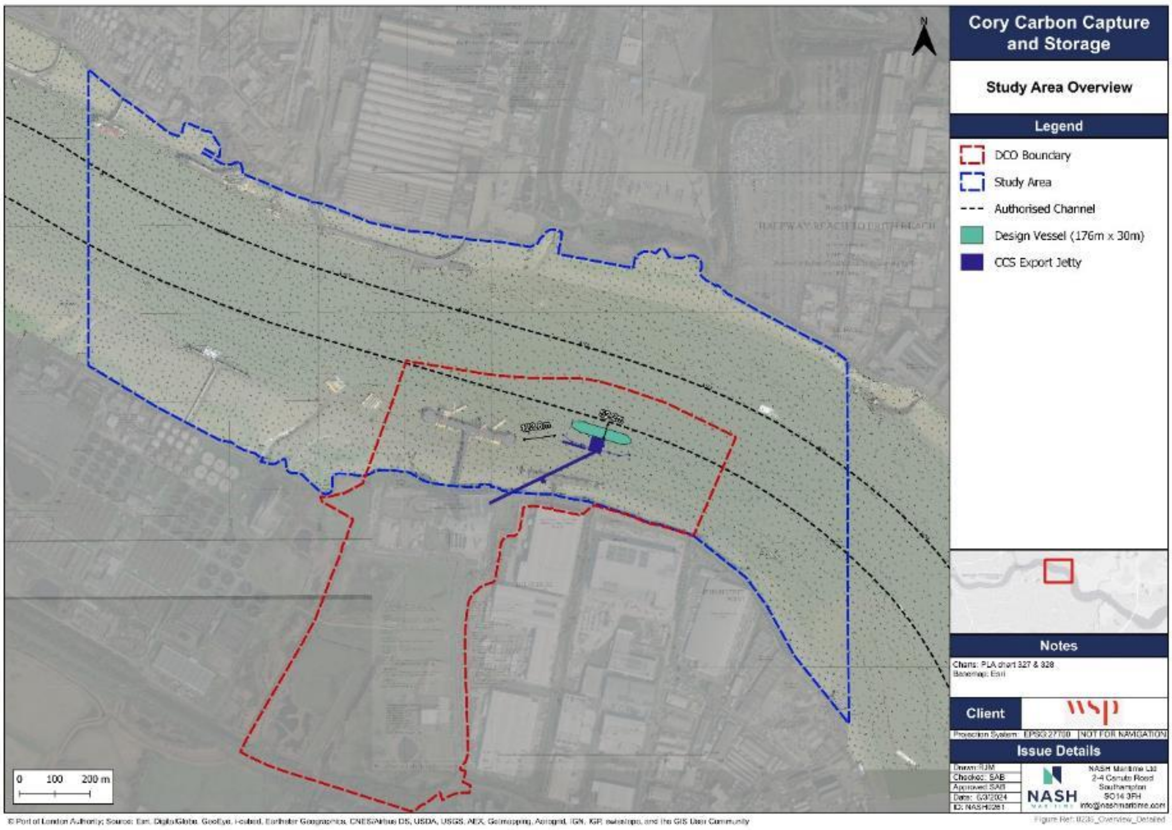


Figure 1: Proposed Jetty (Option 2) and pNRA Study Area.

1.4 PROPOSED JETTY

Engineering Plans: Indicative Equipment Layout (Document Reference 2.5) has been produced which shows one, example, way in which the Proposed Scheme, including the Proposed Jetty, could be built out within the parameters established by the **Works Plans (Document Reference 2.3)**.

A new and dedicated export structure is required to export the LCO_2. The Proposed Jetty will be located in the River Thames, approximately 130m downstream of the existing Middleton Jetty, with its front face approximately 140m from the southern bank of the River. The Proposed Jetty will comprise the following key features:

- Loading Platform;
- Breasting Dolphins;
- Mooring Dolphins;
- Access Trestle; and
- Access Catwalks.

The main function of the Loading Platform is to facilitate the loading of LCO_2 into the tanks within the vessels. The LCO_2 will be loaded through one or more manifolds located around the centre of the vessels. The loading equipment would be sized so that vessel turnaround time is less than 12 hours. To provide a level of redundancy, three marine loading arms are envisaged.

The structure will be formed of a concrete reinforced deck supported by steel piles (approximately 45 piles). In addition to quick release hooks, the topside infrastructure will likely feature the following elements: the marine loading arms and vapour return arm; elevated process pipe bridge; lighting; fire suppression systems; and space for a standard London Fire Brigade fire engine to manoeuvre. The Loading Platform will also be equipped with a gangway to allow embarkation and disembarkation of the LCO_2 vessel.

The Breasting Dolphins will be positioned either side of the Loading Platform, comprising two fender cones arranged vertically with fender panels. The fenders will be supported by steel piles. The purpose of the Breasting Dolphins is to absorb some of the loads whilst vessels are berthing.

The Mooring Dolphins will be positioned on either side of the Loading Platform, to secure vessels with mooring lines. The concrete decks will support a double-quick release hook, assisting vessel berthing, and will be supported by steel piles. The Mooring Dolphins will be positioned back from the Loading Platform to ensure mooring lines are of a suitable length and angle.

The Access Trestle will connect the Loading Platform to land and support Above Ground Pipelines and utilities, including for LCO_2, running the length of the Proposed Jetty. It may also provide access for pedestrians, emergency and maintenance vehicles. The Access Trestle will run from the northern/eastern side of the Riverside 1 building, over the England Coast Path (FP3/NCN1) and flood wall, to the rear edge of the Loading Platform. The Access Trestle comprises a deck with a concrete and tarmac roadway atop a steel frame structure, which will be supported by steel piles.

The Access Trestle for the Proposed Jetty will span over the Belvedere Power Station Jetty (disused). Design development is considering whether to retain or demolish and remove this jetty as part of the construction process of the Proposed Jetty, further detail is provided in **Chapter 2: Site and Proposed Scheme Description (Volume 1)** and in **Chapter 3: Consideration of Alternatives (Volume 1)**. In the event that the Belvedere Power Station Jetty (disused) (see **Chapter 2: Site and Proposed Scheme Description (Volume 1)**) is retained (with modifications), the proposed Access Trestle will have to be designed and constructed to accommodate it (i.e. wider pile spacing at that location). Regardless of whether the Belvedere Power Station Jetty (disused) will be retained or not the England Coast Path (FP3/NCN1) will be retained; however, overhead construction activities will be undertaken across it.

Access Catwalks will connect the Mooring Dolphins to the Loading Platform providing pedestrian access (with railings for safety).

A minimum water depth will be required alongside the berth to provide vessel access at all states of the tide. Construction dredging (Work No. 4C) will therefore be required to provide access to/from the River Thames shipping channel to the Proposed Jetty, including the creation of a berthing pocket for berthing of vessels. Maintenance dredging of this area will also be required.

To reduce the extent of dredging required, a sheet pile retaining wall equipped with a capping beam will be installed. The wall will be positioned under the Loading Platform at the edge of the berth pocket and run between the outer Mooring Dolphins towards the riverbank. The top of the capping beam will approximately be at the existing riverbed level.

It is proposed that berthing facilities for the Applicant's tugs operating at the Middleton Jetty are integrated to the Proposed Jetty. It is not safe or practicable to include these facilities on the Middleton Jetty, due to the presence of the crane that operates on it. The berthing of tugs will be facilitated via a landing pontoon that will be located at the rear of the Proposed Jetty.

The landing pontoon will provide the Applicant's marine operations with a more flexible approach and allow for safe marine operations within the vicinity of the Proposed Jetty, and in particular:

- safe access and egress for maintenance teams to carry out duties and repairs to the Proposed Jetty without requiring the operating LCO_2 berth to be vacated/out of service;
- safe access and egress for berthing crews to attend the mooring lines of the LCO_2 vessel via workboat;
- safe access and egress for pilots attending the LCO_2 vessel via river transport;
- safe low level access/egress for potential 'man overboard/rescue' from water;
- safe access for LCO_2 vessel supply, maintenance or repair requirements; and
- safe crew access/egress for operation of the Middleton Jetty (to date unavailable).

The envisaged form of construction is a proprietary pontoon restrained by steel piles for vessel access at various states of the tide. Access to the landing pontoon will be via a linkspan connected to the Loading Platform. To ensure access to the tug berth, dredging will be required at the tug berth location. Further information on dredging can be found in **Chapter 2: Site and Proposed Scheme Description (Volume 1)**.

The land side Buffer Storage Area provides sufficient buffer volume to store captured LCO_2 for several days of operation, should the Proposed Jetty be non-operational. Should the Buffer Storage reach capacity, the Carbon Capture Facility would have to be taken out of service for that period. In this situation CO_2 would be released to atmosphere in unabated flue gas from the Riverside 1 and Riverside 2 exhaust stacks, in line with current operations.

1.4.1 Design Vessels

At the time of writing the intended design vessel is not finalised. However, details of a number of indicative vessels that could be utilised to facilitate LCO_2 export operations have been provided for the basis of this assessment.

Table 1 shows the design specifications and anticipated number of vessel arrivals for design vessels with a capacity of 7,500 cbm, 12,000 and 15,000 cbm.

The vessel with a capacity of 7,500 cbm is based on a LCO_2 tanker currently under construction; it is possible that a vessel of this capacity will be utilised during the initial phase, (see **Figure 2**). The design vessel size may increase as LCO_2 production intensifies. Several LCO_2 storage providers are currently developing design vessel specifications.

This pNRA takes a precautionary approach and assumes a scenario whereby a largest design vessel (15000 cbm) will be utilised for the export operation. The project team undertook a review of LPG carriers with a capacity of 15,000 cbm to determine a suitable worst credible envelope for a Project Vessel with a capacity of 15,000 cbm. The pNRA also assumes the maximum number of vessel movements are realised (see **Table 1**).

Note, the size of the design vessel has impacts the extent to which dredging of the berthing pocket is required and influences the number of vessel movements necessary (i.e the DCO Application's dredging proposals account for a 15000 cbm vessel).

Table 1: Indicative Design Specification

Design Vessel Capacity (cbm)	Length Overall (m)	Draught (m)	Beam (m)	Arrivals per annum (Phase 1 / Phase 2)	Arrivals per week Phase 1 / Phase 2)
7,500	130	8.0	21.2	112 / 211	2.16 / 4.05
12,000	143	9.0	Not known	71 / 132	1.35 / 2.53
15,000	178	8.4	29.1	55 / 106	1.08 / 2.02

Figure 2: LCO_2 Vessel (7,500cbm³)

1.4.2 Proposed Scheme Ship Bridge Simulations

In order to inform the Proposed Jetty design, location and orientation, NASH Maritime instructed HR Wallingford to undertake ship bridge simulations, which took place between 24th and 25th April 2023. A summary of the findings of the simulations is included in this section. The full findings of the ship bridge simulations are reported in 22-NASH-0235_Cory_Decarb_Project_R01-00.

The aims and objectives of the ship bridge simulations were to inform:

- Operational limitations for berthing (a requirement endorsed by the PLA during pNHA consultation);
- Optimum alignment and positioning of the Proposed Jetty to mitigate as much as possible the effects of the tidal stream;
- Identification of ship handling issues; and

- Future baseline berthing operations, for inclusion into further studies on navigation safety.

In total 23 simulation runs were undertaken, with PLA Pilots conning the simulated vessels. Of the 23 runs undertaken one run was scored as Fail (Run 6) and one run as Marginal (Run 4). As set out in **Chapter 3: Consideration of Alternatives (Volume 1)**, following the selection of the open pile structure as the preferred jetty type, three different arrangement options were considered, which are shown on **Figure 3-5: Proposed Jetty Arrangement Alternatives (Volume 2)**. Of these, two options were considered during the simulations - Jetty Option A (which following design revisions evolved in to Option 2 and is referred to as such in sequential chapters of this report as) and Jetty Option B (which following design revisions evolved in to Option 3 and is referred to as such in sequential chapters of this report as). The jetty options utilised in the simulations are shown in **Figure 3** and **Figure 4.**

Note, these designs were preliminary options that were further refined as a result of the simulations. For the avoidance of doubt the Proposed Jetty design assessed in this pNRA report is the design shown in **Figure 1**

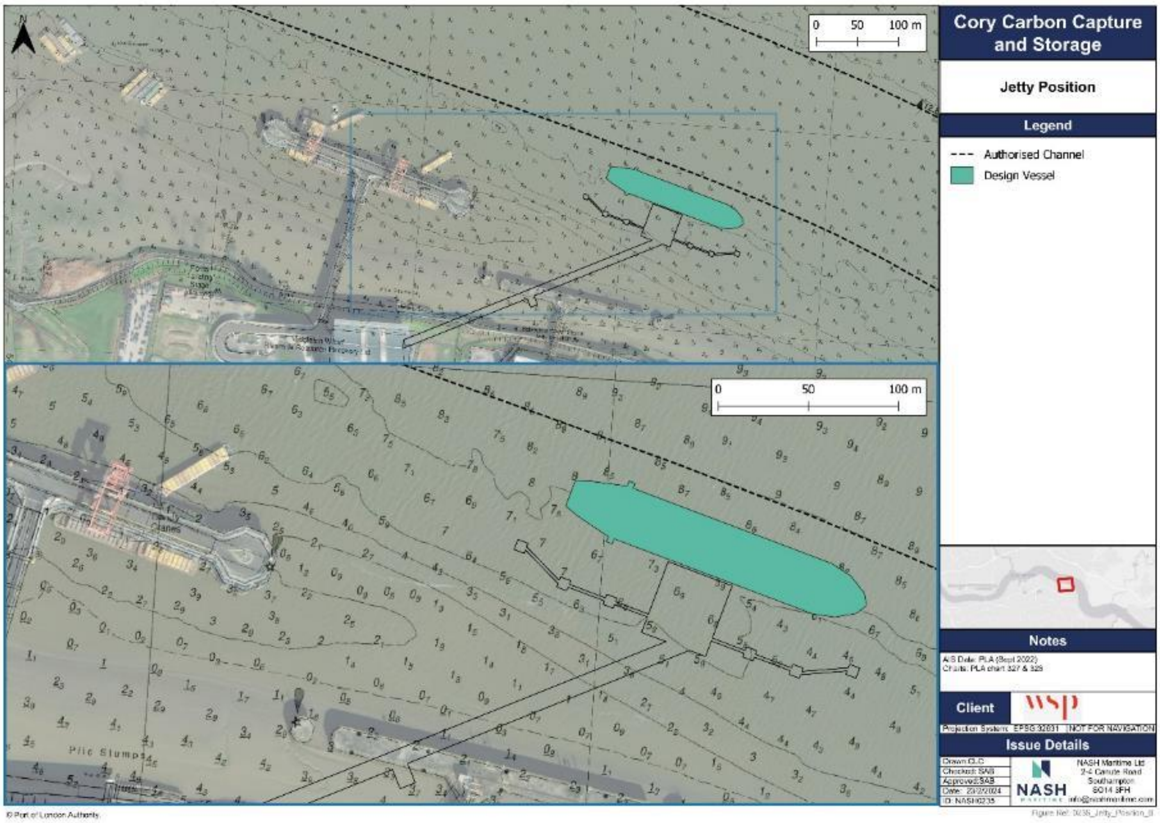


Figure 3: Jetty Option A

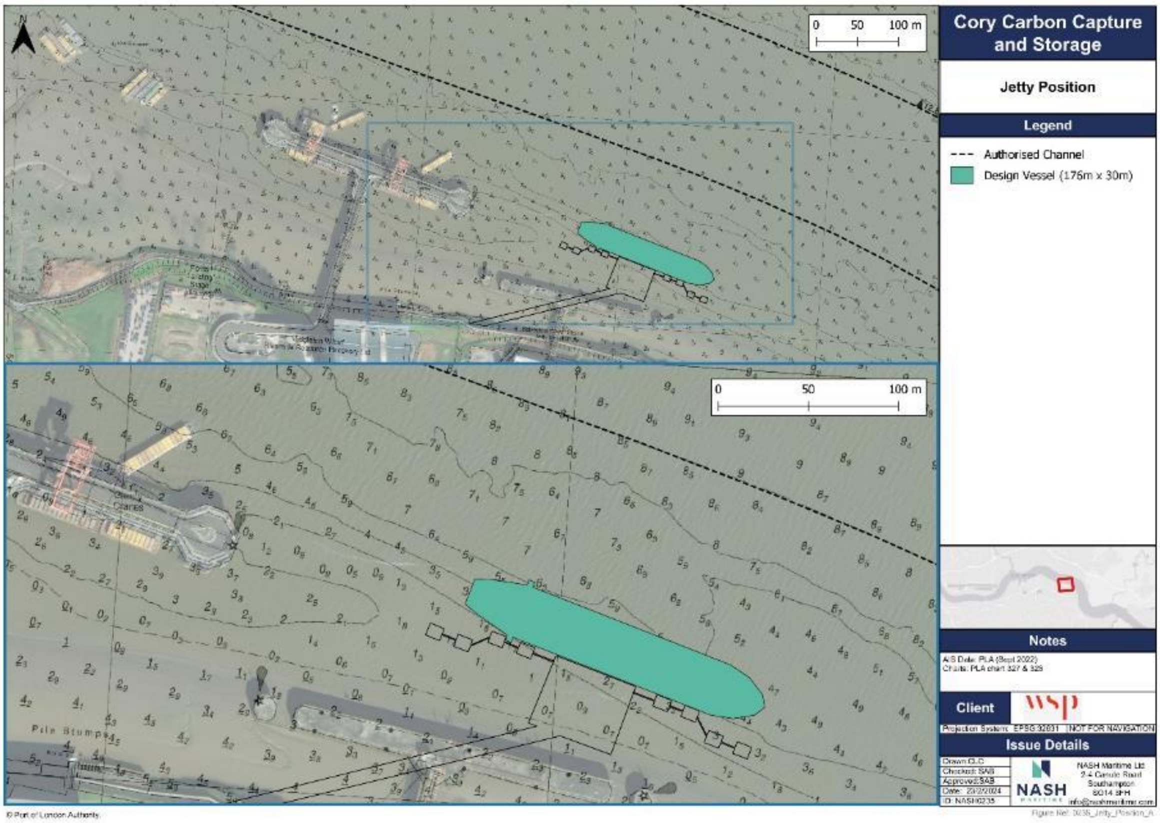


Figure 4: Jetty Option B

Figure 5 and **Figure 6** show simulator swept paths of representative arrival and departure runs to and from Jetty Option A on both flood and ebb tides. The figures give a realistic insight as to the likely navigable room required by the LCO_2 tanker and tugs when coming alongside. It can be seen that, regardless of the state of tide, it was possible for the tanker to remain within the confines of the authorised channel, indicating that there is sufficient navigable width to conduct arrival / departure manoeuvres.

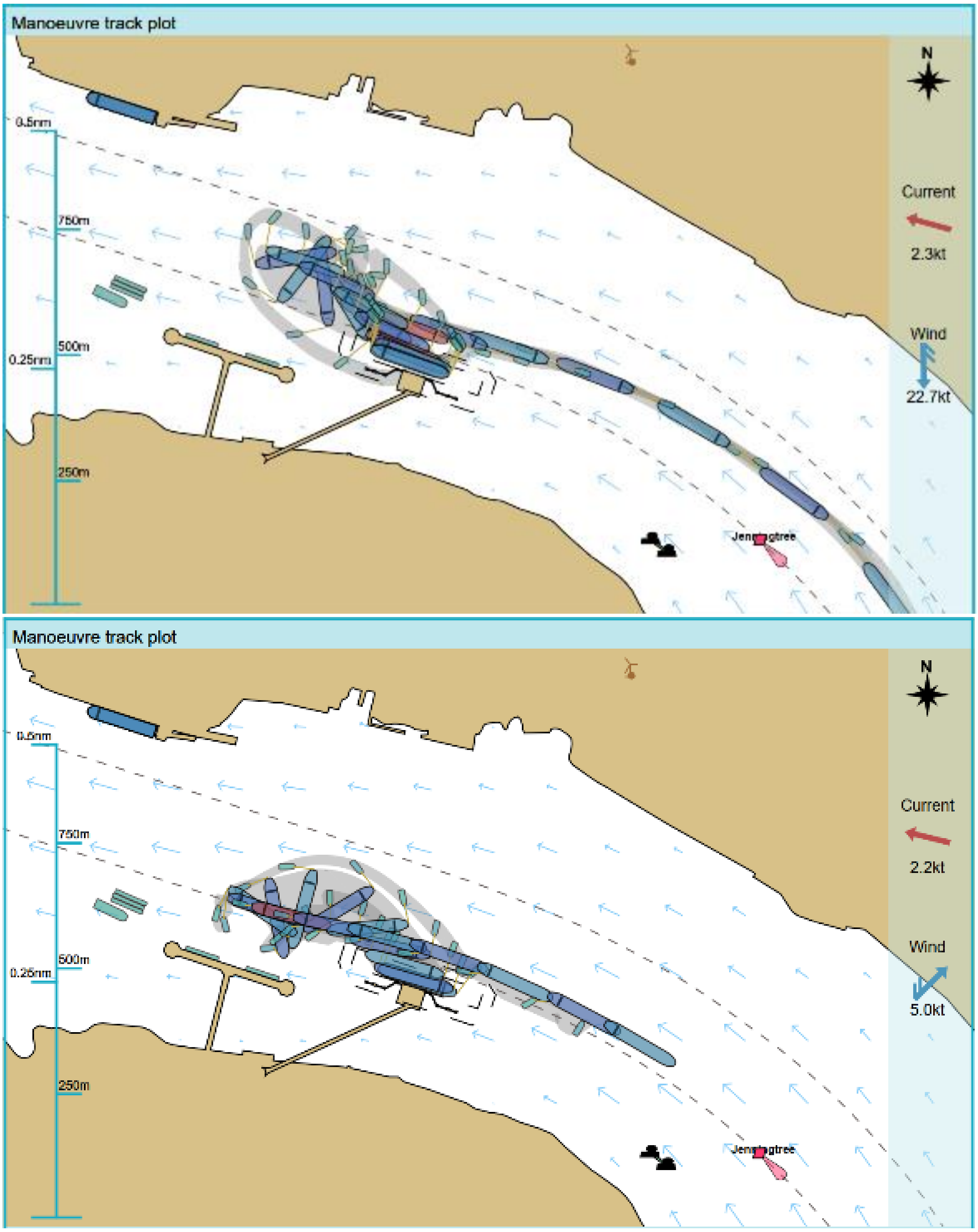


Figure 5: Representative Flood tide Arrival (top) and Departure (bottom) Manoeuvres.

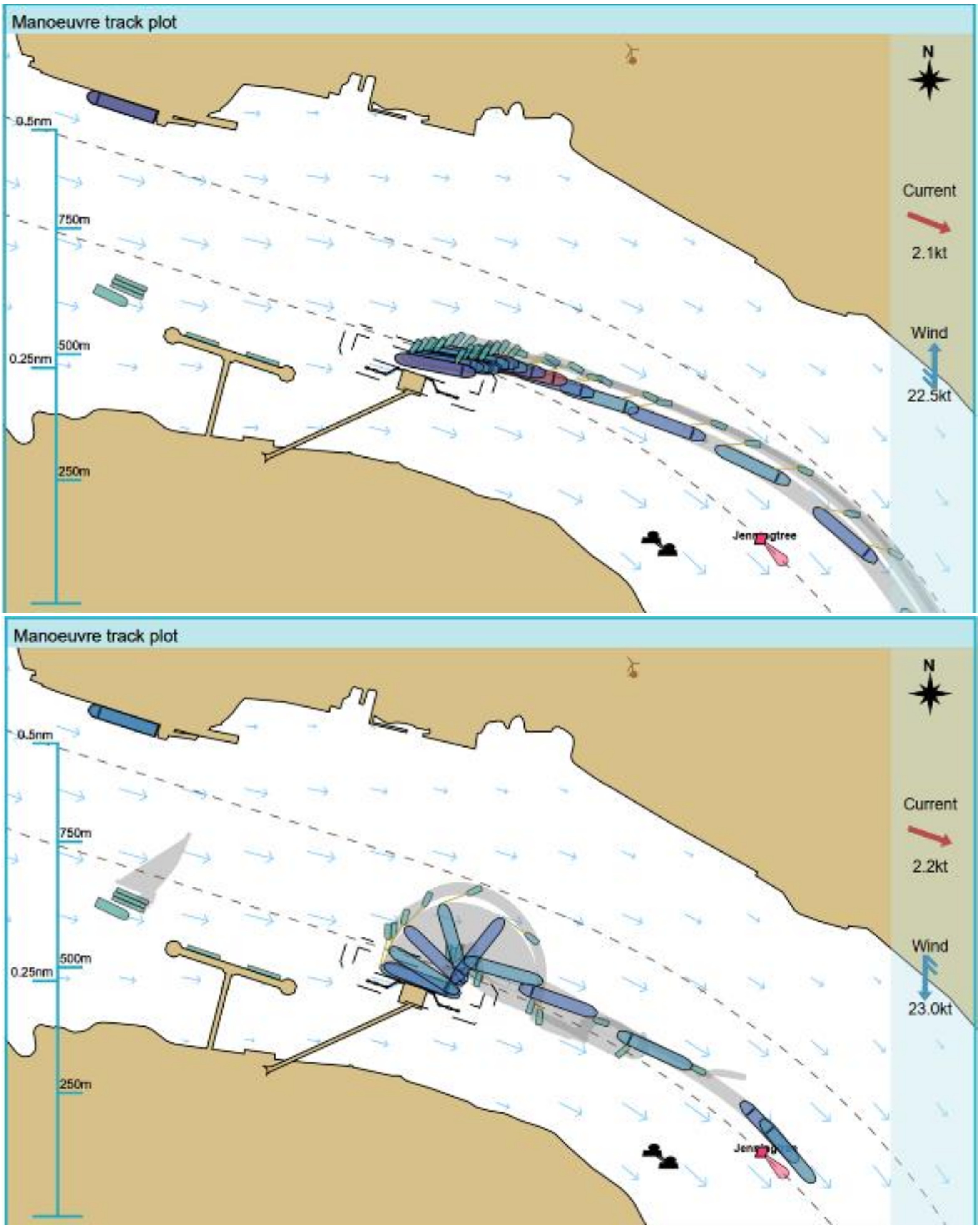


Figure 6: Representative Ebb Tide Arrival (top) and Departure (bottom) Manoeuvres.

Following a review of the simulation runs the following conclusions were made:

- It was agreed that the alignment and positioning of both Jetty Option A and Jetty Option B were satisfactory and that no further work was required to alter the alignment and positioning;
- The simulations illustrated that vessel departures will be limited to be no later than High Water HW +1.5 hours taking in to account the time to swing the vessel on an ebb

tide port side departure, the effects of the ebb tide flow and the UKC required on passage (due to limiting depth of 6.8m in Erith Reach and further to seaward);

- In nearly all instances no significant ship handling challenges were identified during the simulations, and vessels were able to swing off the berth in ebb and flood tide conditions. In certain adverse weather conditions during mid spring ebb tide departures the PLA pilots felt that departures from the berth were challenging. It was therefore concluded (especially given the limiting depth of 6.8m in Erith Reach) that mid spring ebb tide departures should be avoided;
- Simulations showed that there was adequate navigable width with the jetty in position for arriving / departing vessels to safely manoeuvre with appropriate towage in place for on and off Proposed Jetty winds up to a speed of 25 knots. Wind direction is therefore not considered to be a limiting operational factor;
- An upper wind speed limit of 20 knots, gusting 25 knots is deemed a suitable wind speed limitation. This limit was set on the basis that the jetty is situated in a relatively sheltered location and if wind speeds at the Proposed Jetty location were to reach 25 knots it would in all likelihood reach substantially higher speeds in more exposed areas further to seaward. This being the case, it is unlikely that the river passage would be commenced for reasons of ship control;
- Sight lines on approach were not felt to be an issue during simulations and therefore are unlikely to have a bearing on ship handling issues or deconfliction with opposing traffic; and

During the simulations the following additional observations were made by the PLA pilots:

- Due to the close proximity of outward passing traffic and rapidly shallowing depths inshore of the berth, draw off / interaction effect and / or suction off the berth is a possibility, particularly in the case of Jetty Option A which is the closest option to the navigation channel. The Pilots therefore recommended that a passing vessel mooring interaction study be undertaken to determine the hydrodynamic effect on moored tankers at the Proposed Jetty when large ships (of the types and sizes currently navigating in this section of the river) pass the Proposed Jetty locations, at the various relevant states of tide. If, following this study, the effect is deemed to be significant, then consideration will need to be given in the navigation risk assessment for the Proposed Jetty to require speed limitations for passing vessels in the vicinity of the Proposed Jetty when vessels are alongside;
- Due to the tidal range it was suggested a shore gangway be included within the jetty design to ensure safe access and to avoid lengthy delays to turnaround time due to time taken to rig/de-rig ship's gangway;
- Sufficient lateral offset of the dolphins should be provided to ensure that breast and stern lines can be of sufficient length to take into account the rise and fall of tide; and
- It should be ensured that mooring hooks or bollards are designed to enable springing on and off and the Proposed Jetty.

1.4.3 Proposed Jetty Construction Methodology

Several methods can be adopted for construction of the Proposed Jetty and will be determined by the appointed Contractor(s). The anticipated construction sequence is presented below:

- Sheet pile retaining wall - To reduce the extent of dredging required, a sheet pile retaining wall equipped with a capping beam will be installed. The wall will be positioned under the Loading Platform at the edge of the berth pocket and run between the outer Mooring Dolphins towards the riverbank. The top of the capping beam will be approximately at the existing riverbed level. It is anticipated that the sheet piled wall will be approximately 15m in depth.

- Piling – Piling for the Loading Platform, vertical berthing and mooring dolphin, Access Trestle and tug mooring platform are likely to be installed using a 50m crane barge, which would be capable of supporting a 300 tonne crawler crane. This would be used to lift piles from a support barge into positions where they will be installed. Piling would begin closest to the shore, moving further into the River Thames as the process progresses, with support and supply barges moored riverward of the crane barge. It is anticipated that any piles that are inclined would be installed using a jack-up barge.
- Dredging – To ensure the stability of the foreshore dredging, operations will be completed after the sheet pile retaining wall is installed. The two activities can be phased and planned to be undertaken in turns. The dredging methodology is described further in **Chapter 2: Site and Proposed Scheme Description (Volume 1).**
- Deck construction – The decks for the Loading Platform, Mooring Dolphins, and Access Trestle will be constructed after the dredging. At this stage, it is anticipated that these elements will comprise of reinforced concrete pre-cast units, topped in-situ. Pre-cast sections will be delivered to the Site by barge and craned into position, with rebar then added before an in-situ concrete is placed.
- Tug Mooring Pontoon – The pontoon body will be manufactured offsite and transported via the River Thames to the Site. It will then be lifted into place over the guide piles and final construction activities will be undertaken.
- Catwalks installation – Walkway sections will be prefabricated offsite and transported to the construction site. They can then be craned into position and secured to the Loading Platform and Mooring Dolphins.
- Installation of equipment required for the Proposed Jetty to function would be undertaken once construction of the decks is completed, the following equipment is likely to be required:
    - Marine Loading Arms;
    - Quick Release Hooks;
    - Lifesaving Equipment (emergency ladders, throw lines, safety chains etc.);
    - Operational and Navigational Lighting;
    - Fire Suppression Systems;
    - Guardrails;
    - Fences; and
    - Gates.

The construction programme is likely to last between 16 to 18 months (excluding commissioning).

It is anticipated that the following key construction vessels will be required to undertake the majority of the works:

- Crane Barge (50m x 18m) – a vessel of this size is suitable to support a 300t crawler crane;
- Supply Barge(s) (30 x 11m); and

- Jack-Up Barge (30 x 18m).

The works will also be supported by tug vessels which will be utilised to manoeuvre and position marine plant.

Indicative barge layouts are shown in **Figure 7**. The figure shows (top to bottom) anticipated barge mooring locations during the loading platform construction, berthing dolphin and mooring dolphin installation. During the construction of the loading platform, piling would likely commence at the location closest to the shore and progress riverward toward the authorised channel.

It is envisaged that the Crane Barge will be securely moored utilising a 4-point winch and anchor system, which will allow for maximum flexibility when it comes to relocating the barge and allows for adjustments to the barge's location without the use of a supporting tug vessel.

As shown in **Figure 7** it is envisaged that the marine plant footprint would be largely within the proposed capital dredged pocket.

A jack-up barge (JUB) will be required to construct the mooring dolphins as the design includes raker piles that need to be driven at an angle. The JUB will position to the east of the upstream mooring dolphin during installation to avoid, as much as possible, interference with Middleton Jetty (see bottom barge layout drawing in **Figure 7**).

Note, it has not yet been determined whether the now disused Belvedere Power Station Jetty (disused) will be removed as part of the construction works. Therefore, when considering contact hazards within the pNRA the project team assumed that the Belvedere Power Station (disused) would remain in-situ. This is a precautionary assumption and should it be later decided that the Belvedere Power Station Jetty (disused) will be removed it is likely that, in some instances, contact hazard likelihood scores may be reduced.

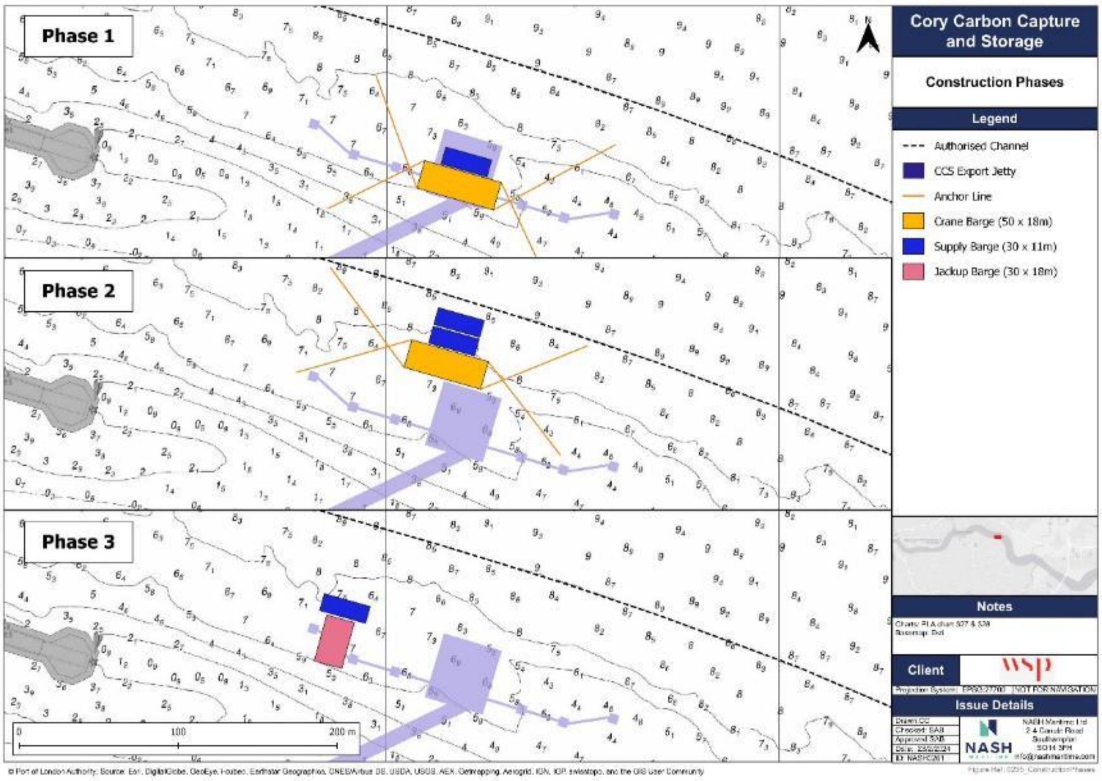


Figure 7: Indicative Barge Mooring Layouts and Anchor Spread.

1.5 STUDY EXECUTION

This pNRA report comprises the following key sections, including:

- **Section 2: Baseline Navigation Characterisation**, encompassing a qualitative review of the baseline navigational environment within the NRA Study Area;
- **Section 3: Vessel Traffic Analysis,** incorporating spatial and temporal analysis of Automatic Identification System (AIS) data, the findings of a vessel traffic survey and a commentary on the future vessel traffic baseline considered in the pNRA.
- **Section 4: Hazard Likelihood Modelling,** quantitative modelling to determine changes in the likelihood of collision, contact and grounding hazard occurrence as a result of the Proposed Scheme and associated marine operation.
- **Section 5: Stakeholder Consultation**, including a summary of key meetings undertaken with local stakeholders and the PLA.
- **Section 6: Third Party Ship Bridge Simulations**, an overview of the findings of the simulation exercises.
- **Section 7: Passing Vessel Mooring Interaction Study,** a summary of the methodology and findings of the study.
- **Section 8: Risk Assessment,** a summary of the risk assessment methodology utilised, navigational hazards identified, inherent risk assessment results, identified additional risk controls and residual risk assessment result.
- **Section 9: Conclusion and Recommendations** including a summary of the pNRA findings and recommendations.

2. BASELINE NAVIGATION CHARACTERISATION

This section gives an overview of the Study Area baseline navigational environment. The Study Area falls within Halfway Reach. The reach leads 1.5nm west-northwest from Jenningtree Point (51°30'20N, 0°08' 06E) to Crossness Light. Dagenham lies to the North of the Reach and is fronted by several jetties (Dagenham Docks). The Proposed Jetty is located approximately 500m west of Jenningtree Point on the southern bank of the River Thames.

2.1 KEY NAVIGATIONAL FEATURES

Key navigational features within the Study Area and are highlighted in **Figure 8** and described in this section. The key navigational features shown in **Figure 8** are named in **Table 2.**

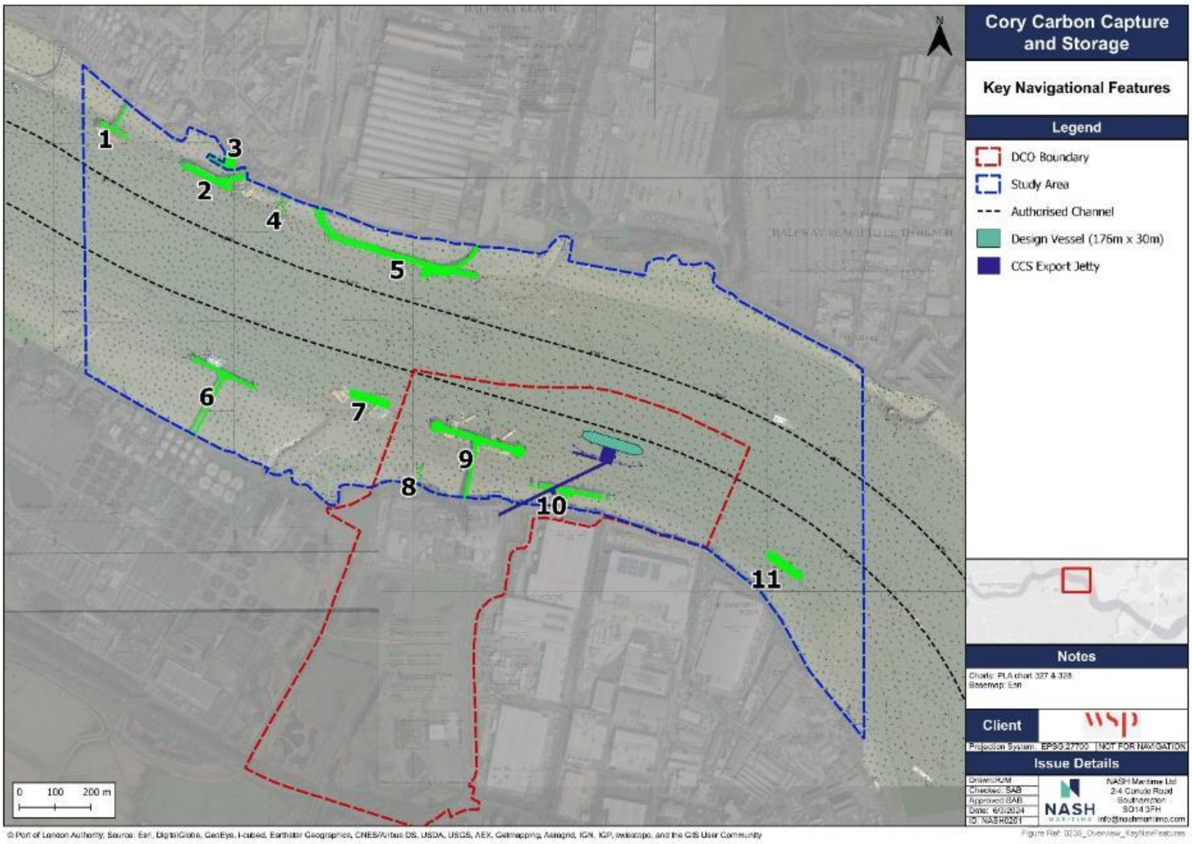


Figure 8: Key Navigational Features

Table 2: Key Navigational Features Summary

Key	Navigational Feature
1	Thunderer Jetty
2	No 4 Jetty
3	East Jetty
4	Amey's Jetty
5	Ford's Jetty

Key	Navigational Feature
6	Crossness Sewage Treatment Works Jetty
7	Cory Environmental Barge Moorings
8	Fords Landing Stage
9	Middleton Jetty
10	Belvedere Power Station Jetty (disused)
11	Thames Water Utilities Limited Barge Moorings

2.1.1 Infrastructure

- **Belvedere Power Station Jetty (disused)**
  - The Belvedere Power Station Jetty (disused), now in a state of disrepair, served as an import facility for vessels supplying fuel oil to the former Belvedere Power Station. Fuel to Belvedere, as with many other Thames power stations at that time, was transhipped black oil from Shellhaven or Coryton refineries (lower Thames Canvey Island area) or from storage at Littlebrook Power Station (immediately above what is now the M25 Dartford QE2 Bridge). The jetty lies within the intertidal zone approximately 2.1m above Chart Datum (CD) and therefore presents a limited hazard to navigation as it is only possible for vessels of shallow draught to navigate in the vicinity of the jetty near HW. In order for the Proposed Jetty to be most efficiently constructed, the Belvedere Power Station Jetty (disused) may need to be fully or partially removed, though this is not essential given the structure may remain in place, subject to detailed design.
- **Middleton Jetty**
  - The Middleton Jetty, (see **Figure 9**) serves as a transhipment facility for Cory tugs and barges delivering waste to Riverside 1 and Riverside 2 (once constructed). The tugs and barges collect waste from waste transfer stations located between Wandsworth (Smugglers Way) and Tilbury. Ash produced as a by-product is also shipped from the jetty to an IBA processing facility at the Port of Tilbury. There are around five tug and barge arrivals and departures a day. Eight barges can be moored (utilising the river and shore facing sides of the jetty) alongside the jetty at any one time. The least depth (at CD) on the river facing side of the jetty is 1.4m with the least depth on the inshore side 0.7m. Baseline vessel traffic associated with the Cory operation at the Middleton Jetty can be seen in **Figure 21**.
- **Ford's Landing Stage**
  - Fords landing stage is located inshore and west of the Middleton Jetty, the landing stage is disused and is located within the intertidal zone approximately 3.1m above CD.
- **Cory Environmental Barge Moorings**

  - The barge moorings are utilised by Cory as a temporary location to moor either full or unladen barges waiting to be transferred to the Middleton Jetty or on to waste transfer stations along the river. There are frequent vessel movements by Cory tug and barges between the barge moorings and Middleton Jetty. Cory plan to increase the number of moorings in proximity to the Middleton Jetty to accommodate the additional barges required to support the operation of Riverside 2 (under construction).
- **Crossness Sewage Treatment Works Jetty (Thames Water Utilities Ltd)**
  - Crossness Sewage Treatment Works jetty (referred to as the 'Thames Water Jetty' throughout the ES) serves as an operational base for the vessels *Thames Bubbler and Thames Vitality.* These vessels pump oxygen into the Thames at times when oxygen levels within the river decrease as a result of heavy surface / storm pipe run off. A number of smaller anti-pollution craft are also operated from the jetty.
- **Fords Jetty**
  - Ford's Jetty is located on the north side of the river (Dagenham) and is an important port facility for the Ford Motor Company's UK operation. Roll on – Roll off (Ro-Ro) cargo vessels such as *Wilhelmine* (152m Length overall (LOA)) and *Celestine* (162m LOA*)* run a continuous loop between Dagenham and Ford facilities in Vlissingen, Holland, with 290,000 vehicles making the trip across the North Sea per year.
  - Dagenham-made diesel engines are exported while completed cars are imported for sale in the UK; and
  - Charted depths alongside the berth vary between 3.5m to 5.9m.
- **Amey's Jetty**
  - Amey's Jetty is serviced by GPS Marine tug and barges operating an intra port aggregate transportation service. Arrivals and departures occur on a daily basis.
- **East Jetty**
  - Connected to the Van Dalen scrap yard and situated inshore of No 4 Jetty, for multiple cargo types.
- **No 4 Jetty:**
  - Is linked to the Hanson Packed Products site, which stores and supplies construction materials. No 4 jetty is linked to land via a bridge and also a conveyor structure. The jetty is serviced by GPS Marine tug and barges but is also used as a facility to unload Hanson Aggregates dredgers that operate in the Thames Estuary (e.g. *Arco Avon* 98.4m LOA). Dredger vessels call approx. once a week with tug and barge arrivals occurring on a more regular basis.
- **Thunderer Jetty**

- The jetty is operated by Stolthaven Terminals as a bulk liquid petrochemical storage terminal.
- **Thames Water Utilities Ltd Barge Mooring**
  - Two mooring buoys situated south of the Jenningtree channel marker and marked with a yellow light, flashing twice every five seconds.

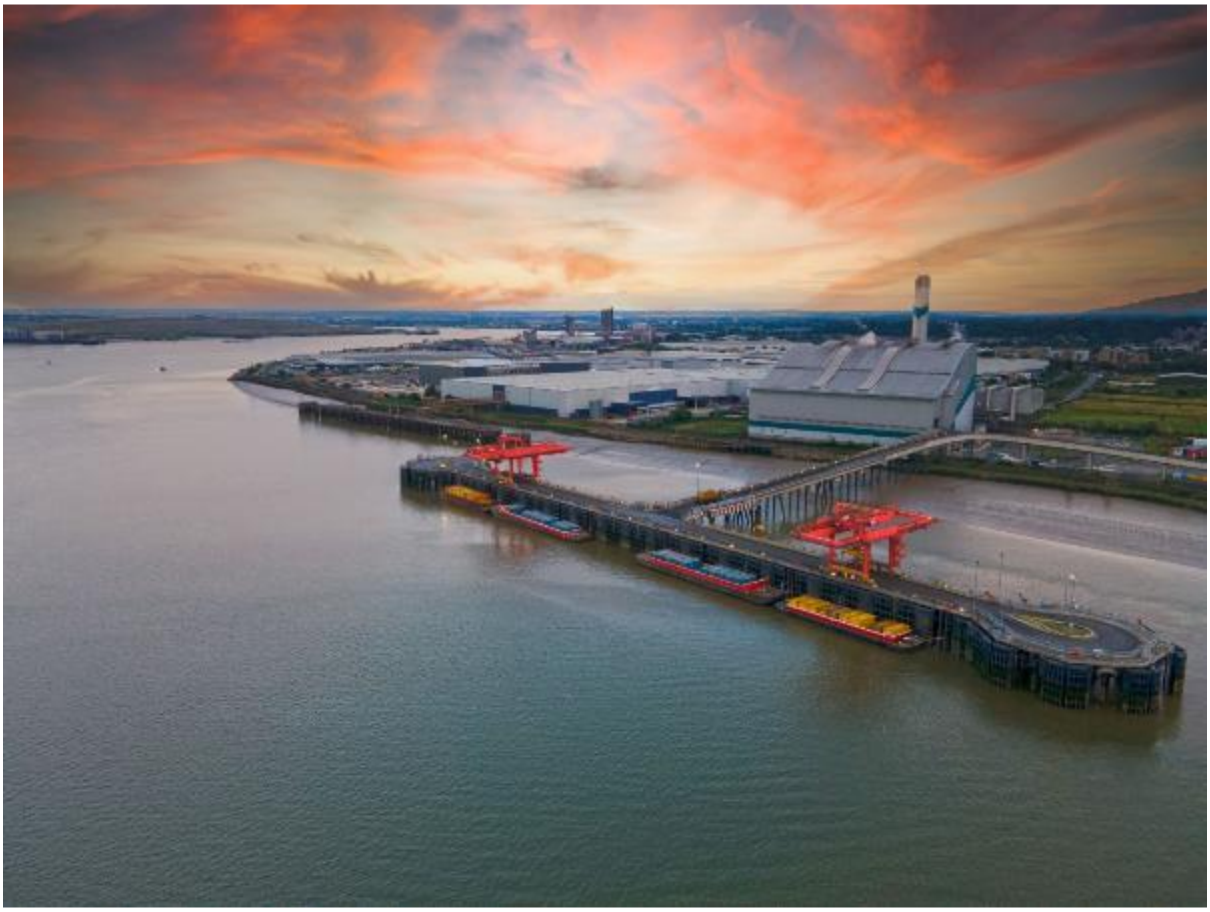


Figure 9: Middleton Jetty (near) Disused Belvedere Power Station Jetty (disused) (far)

2.1.2 Bathymetry and Charted depths

Between Crayford Ness and Dagenham depths of less than -7.0m (CD) lie on the edges of both sides of the authorised channel east-north-east and northeast of Jenningtree Point.

Figure 10 shows a visual representation of a 2022 bathymetric survey for Halfway Reach, measurements are in metres relative to CD. The area within the authorised channel is shown as the area of greatest depth with the river bed measuring more than -9m CD. Dredged pockets can be observed under and around the Middleton Jetty, Ford's Jetty and Jetty No 4.

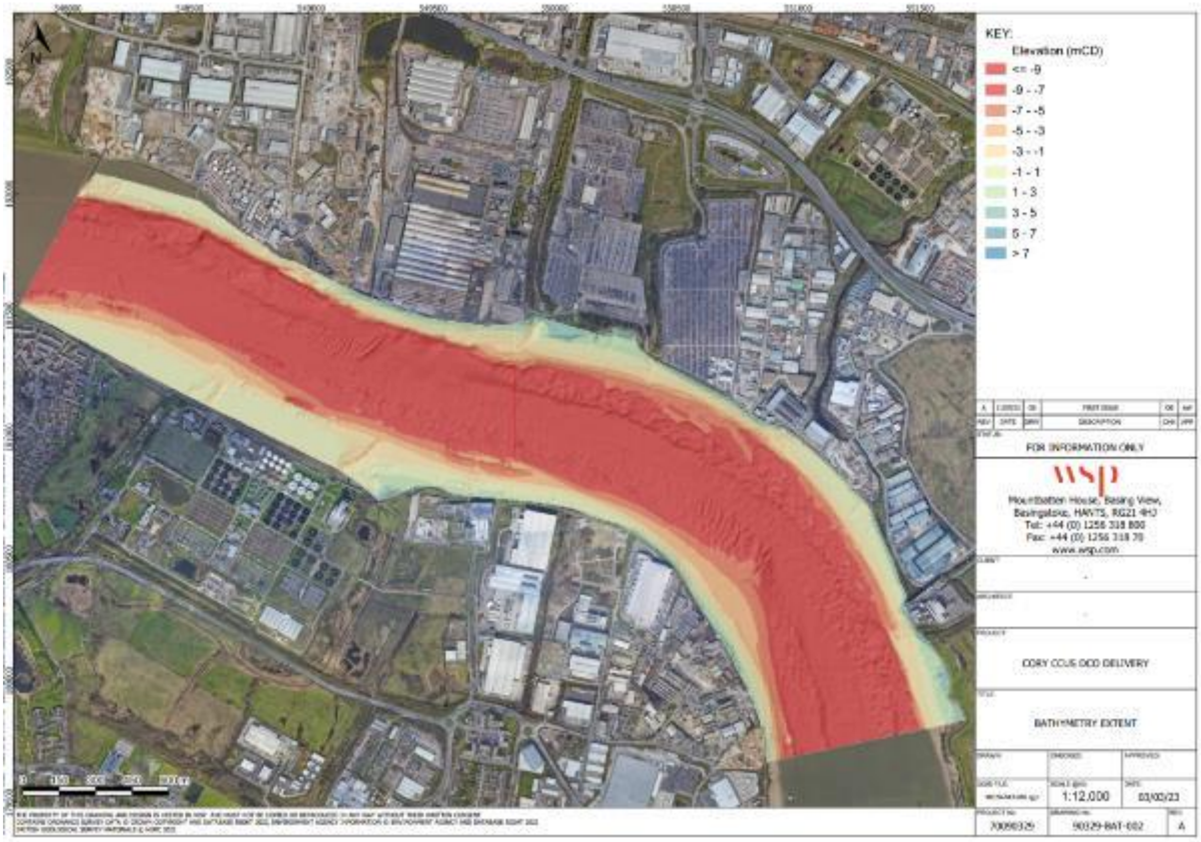


Figure 10: Bathymetric Survey (mCD)

2.1.3 Aids to Navigation (AtoN)

The below lights and AtoN alert the mariners attention to dangers within the Study Area:

- Jenningtree Port Channel Buoy: flashing red every five seconds;
- Jenningtree barge moorings: flashing yellow every two and a half seconds;
- Jetties on the north side of the river are lit by green fixed lights, one downstream and one upstream; and
- Jetties on the south side of the river are lit by red fixed lights, one downstream and one upstream.

There are several unlit barge moorings within Halfway Reach including the Cory barge mooring within the Study Area. A note on Admiralty Chart 3337 warns “Moorings and moored barges, lit and unlit, are moored frequently and may not be as charted”.

2.2 WIND

Halfway Reach is relatively exposed, with low topography along the banks of the river and therefore wind, particularly cross winds, are an important consideration for navigation in this area.

The prevailing wind is from the southwest.

Annual constant wind speeds average 2 knots with gusts averaging 6 knots.

2.3 WAVES

Locally wind generated and fetch limited waves occur within the reach. These do not affect large vessel operations although smaller craft operations can be impacted.

2.4 TIDAL CHARACTERISTICS

Tidal flow velocities can exceed 3.5 knots with the ebb (outgoing tide) although typical ebb flow rates are in the region of 2 knots. Velocities are often affected by fluvial flows from non-tidal inputs (e.g. heavy rainfall) which can significantly alter river flow velocities and water levels. The bends of the river cause tidal set, generally resulting in flows 'setting' to the outside of a bend. For this reason, flood tide rates at the location of the Proposed Jetty are relatively weak.

Although weak, the flood tidal set in the vicinity of the location of the Proposed Jetty has a northerly component which tends to push vessels attempting to moor away from the location of the Proposed Jetty, especially at the downstream end. Vessels leaving Erith Reach (the section of river to seaward of Jenningtree Point) and berthing on a flood tide, would likely stay on the north side of Halfway Reach and swing to port once safe to approach the berth.

For an ebb tide berthing, port side alongside, the set will push on to the vessels port bow when leaving Erith Reach, then as the vessel manoeuvres towards the berth the tide will push on the starboard bow. Ebb tidal flow alongside the berth is linear.

2.4.1 Tidal Heights

Table 3 shows tidal heights in Halfway Reach, the information presented in the table is taken from a PLA tide station located at Ford's Jetty, approximately 1.5nm upstream of the Proposed Jetty.

Table 3: Tidal Heights: Halfway Reach (Source: PLA)

Tidal State	Tidal height from CD (m)
Highest Recorded High Water	8.40
Mean High Water Springs	6.85
Mean High Water Neaps	5.72
Mean Low Water Neaps	1.43
Mean Low Water Springs	0.50

2.5 INCIDENT ANALYSIS

The PLA incident database was provided and reviewed to gain an understanding of historic incidents within the vicinity of the project area. Analysis of historic incident data helps the identification of:

- Hazard type;
- Hazard likelihood; and

- Hazard consequence.

All incidents that have occurred between 2010 and 2020 within Halfway Reach were extracted as part of the analysis. In total 47 unique incidents were identified. The incident types identified are summarised in **Figure 12** which presents the number of incidents by type and vessel category. The following vessel categorisation definitions apply:

- **Commercial Shipping** – Commercial seagoing vessels such as tanker, cargo and sea going passenger vessels;
- **Inland Waterways** – Commercial vessels operating within port limits, including Tug and service vessels, intra-port trade vessels and inland passenger vessels; and
- **Recreational** – Recreational vessels of all types.

Figure 11 shows the number of incident occurrences in each Thames reach. Of the 28 reaches where incident data is available Halfway Reach ranks 19th in terms of the number of incident occurrences. Vessel traffic in Halfway Reach is less dense than in many other Thames reaches. Further downstream commercial shipping is more pronounced than in Halfway Reach, whereas further upstream recreational and inland passenger vessel traffic is more prevalent.

This is reflected in an examination of incident occurrence. For example, downstream of Halfway Reach in Gravesend Reach there were 280 incidents identified, 175 of these incidents involved commercial shipping vessels. In contrast, in Barn Elms Reach, upstream of Halfway Reach, there were 82 incident occurrences, of these 51 involved recreational vessels.

Of the 47 incidents identified in Halfway Reach, 24 incidents involved commercial shipping vessels, 19 involved inland waterways vessels and 4 involved recreational vessels.

Contact incidents were the most frequently occurring incident type.

2.5.1 Notable Incidents

One incident of particular note occurred on 14-Mar-2017 when heavy contact was made between the barges *Corwen* and *Corness* as a Cory tug attempted to take both barges under tow. The incident took place during the flood tide as the tug, with the *Corness* in tow, navigated between the *Corwen* and the Middleton Jetty, the *Corwen* being secured with one bow line only. The tidal steam swung the *Corness* to the north, away from the jetty and in to the moored *Corwen*.

Note, the tidal set impacted the manoeuvre by setting the tug and barge off the berth. The Middleton Jetty is located to the west of the proposed CO_2 export jetty and further upstream of Jenningtree Point. The impact of the tidal set will be more keenly felt at the export jetty due to its proximity to the bend and alignment of the berth with the tidal stream.

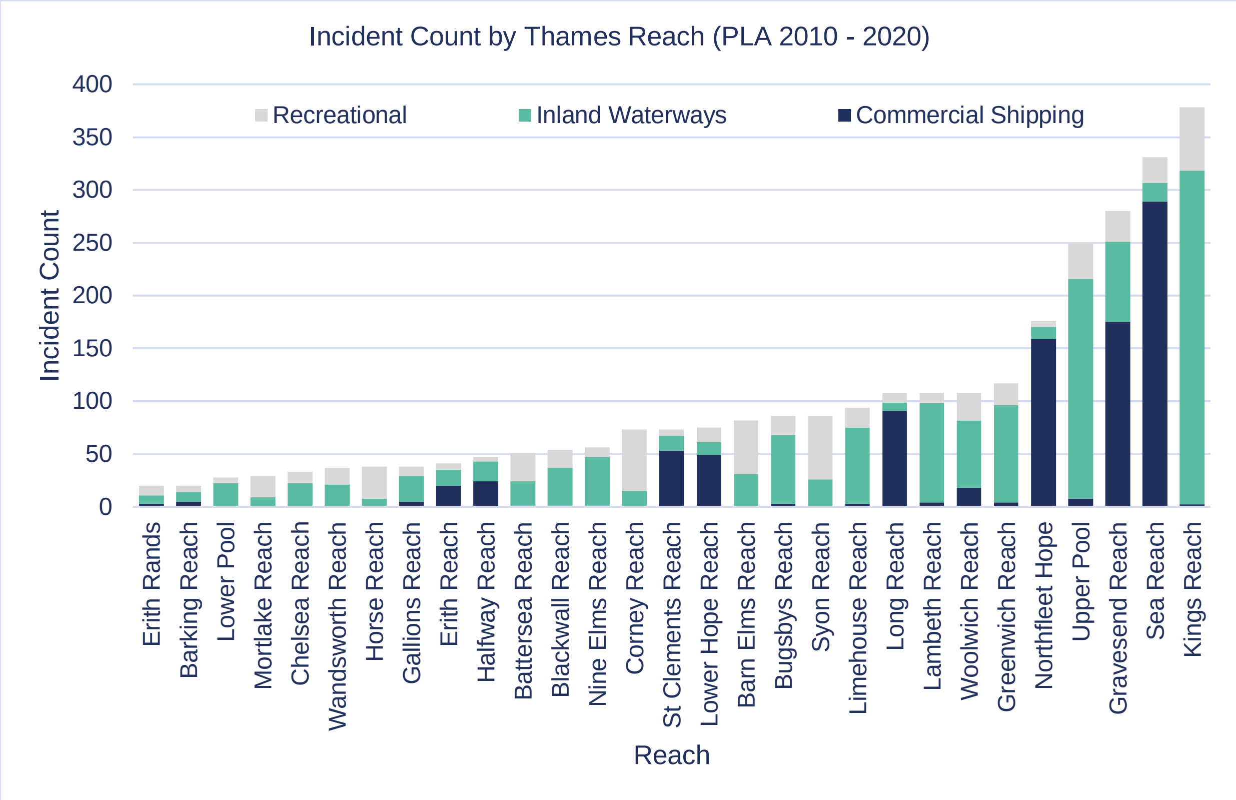


Figure 11: Incident Count by Thames Reach (PLA 2010-2020)

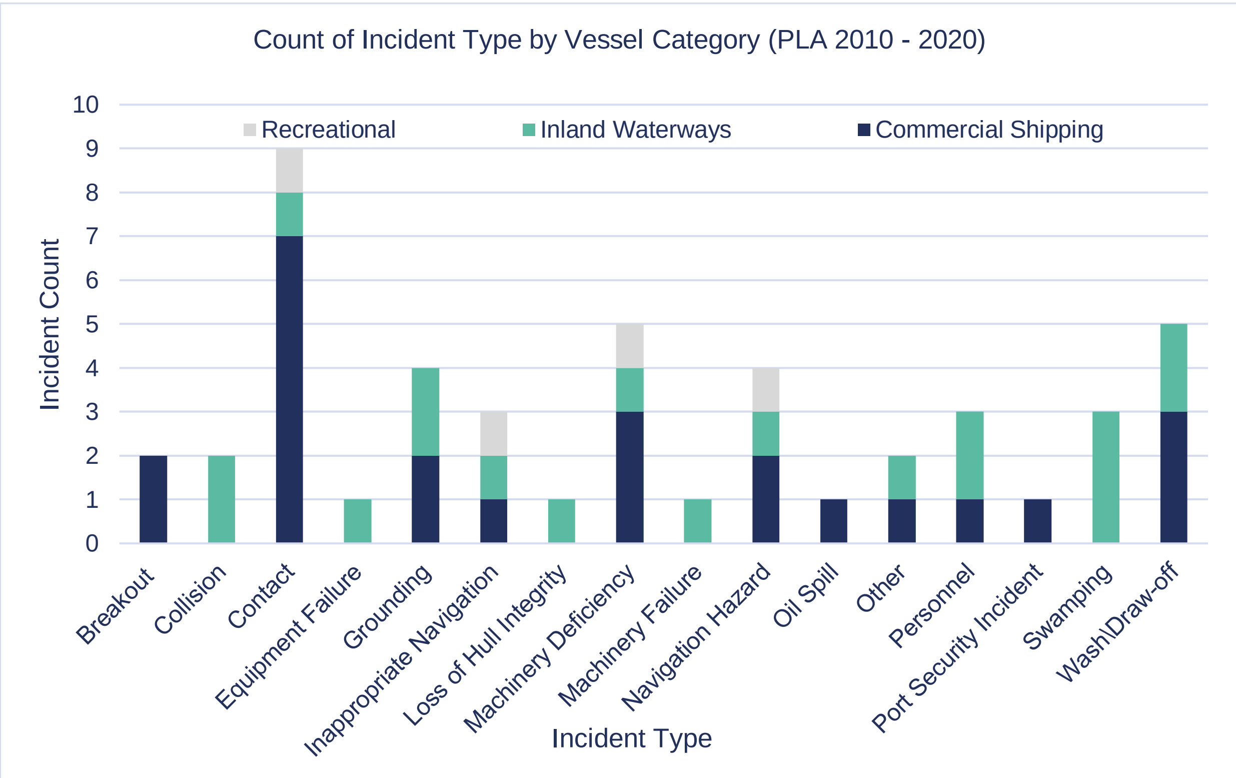


Figure 12: Count of Incident Type by Vessel Category, Halfway Reach (PLA 2010-2020)

2.6 PORT OF LONDON AUTHORITY

The PLA is the Statutory Harbour Authority (SHA) and Competent Harbour Authority (CHA) for the River Thames, responsible for "defining and enforcing the regulations needed to support and manage the safety of navigation on the 95 miles of the tidal River Thames".

The PLA Harbour Master's team is responsible for the management of navigation safety on the River Thames and implementing regulation, guidance and administering risk control measures aimed at managing navigation risk and safety within the Study Area.

The PLA publish their regulations, codes of practice and other general guidance on their website (www.pla.co.uk) which includes the following:

- Port of London Act 1968;
- Port of London Thames Byelaws 2012;
- General Directions for Navigation in the Port of London 2023; and
- Pilotage Directions 2017: Note, Pilotage is compulsory for the design vessel.
- Code of Practice for Craft Towage Operations on the Thames;
- Tideway Code: A Code of Practice for Rowing & Paddling on the Tidal Thames;
- Recreational Users Guide;
- Other codes of practice for mooring, berth operators etc; and
- The PLA also provide other measures to maintain safety of navigation which include:
    - Vessel Traffic Services including vessel traffic management and navigational assistance;
    - Promulgation of information such as Notice to Mariners and Navigation Warnings;
    - Provision and maintenance of Aids to Navigation;
    - Hydrographic Services;
    - Harbour Service Launches and patrols; and
    - Emergency preparedness and response.

3. VESSEL TRAFFIC ANALYSIS

In general, Halfway Reach sees lower vessel traffic than much of the rest of the tidal Thames, with the reaches upstream being dominated by inland passenger and recreational vessels and the reaches downstream more frequented by commercial shipping associated with Tilbury and London Gateway ports, amongst other facilities. The vessels that most commonly frequent Halfway Reach are inland non-passenger vessels, such as barges travelling to the various local wharfs and jetties, as well as commercial shipping from and to central London.

The vessel traffic activity in the project area can be classified into two major groups:

- Group 1: Powered commercial vessels which make up the larger vessels and include cargo vessels, tankers, passenger vessels, tugs and port service vessels; and
- Group 2: Recreational vessels made up of powered (e.g. cabin cruisers) and unpowered craft (e.g. rowing sculls, canoes, paddle boarders and sailing dinghies).

Analysis of group 1 (powered commercial vessels) was undertaken using Thames Automatic Identification System (AIS) transponder data (commercial vessels are mandated to transmit by VHF various vessel characteristics, such as position, speed, size and name at prescribed intervals, which can be converted to create vessel tracks).

As AIS is not required on small recreational vessels (although some larger recreational craft voluntarily carry AIS). Analysis of group 2 vessels (powered and unpowered recreational craft) is more qualitative in nature. Whilst information is available in publications, consultation with river users is necessary to ascertain detailed information on how they utilise the river. The pNRA will therefore include widespread consultation with river users.

This section provides an overview of vessel traffic in the vicinity of the proposed pier and includes:

- Analysis of Thames AIS data from Sept-2022, (September is considered a seasonally representative month in terms of vessel traffic); and
- A qualitative review of guidance documents to establish the nature of recreational vessel activity.

3.1 ALL VESSEL TRANSITS

A gate analysis plot (see **Figure 13**) shows the lateral distribution at two transects across the river Thames for all vessel carrying AIS (Sep 2022) though an upstream (west) and downstream (east) gate. The total number of east / west transits, occurring in Sep 2022 through each of the gates is summarised in **Table 4**, the monthly transit totals were multiplied to give an estimation of the number of annual east / west transits through each of the gates.

The gates positioned identify all transits of the authorised channel and do not include movements made by Cory barges between the Middleton Jetty and barge moorings.

Vessel traffic activity is generally focused within the authorised channel, the exception being those vessels transiting to the key jetties and moorings sites outside the authorised channel.

Table 4: Summary of Total Vessel Transits (Sep 2022)

Direction of Transit	Total Transits - Sep 2022	Total Annualised Transits (scaled from 1 month)
Downstream Gate		
East Transits	819	9,828
West Transits	790	9,480
Upstream Gate		
East Transits	974	11,688
West Transits	974	11,688

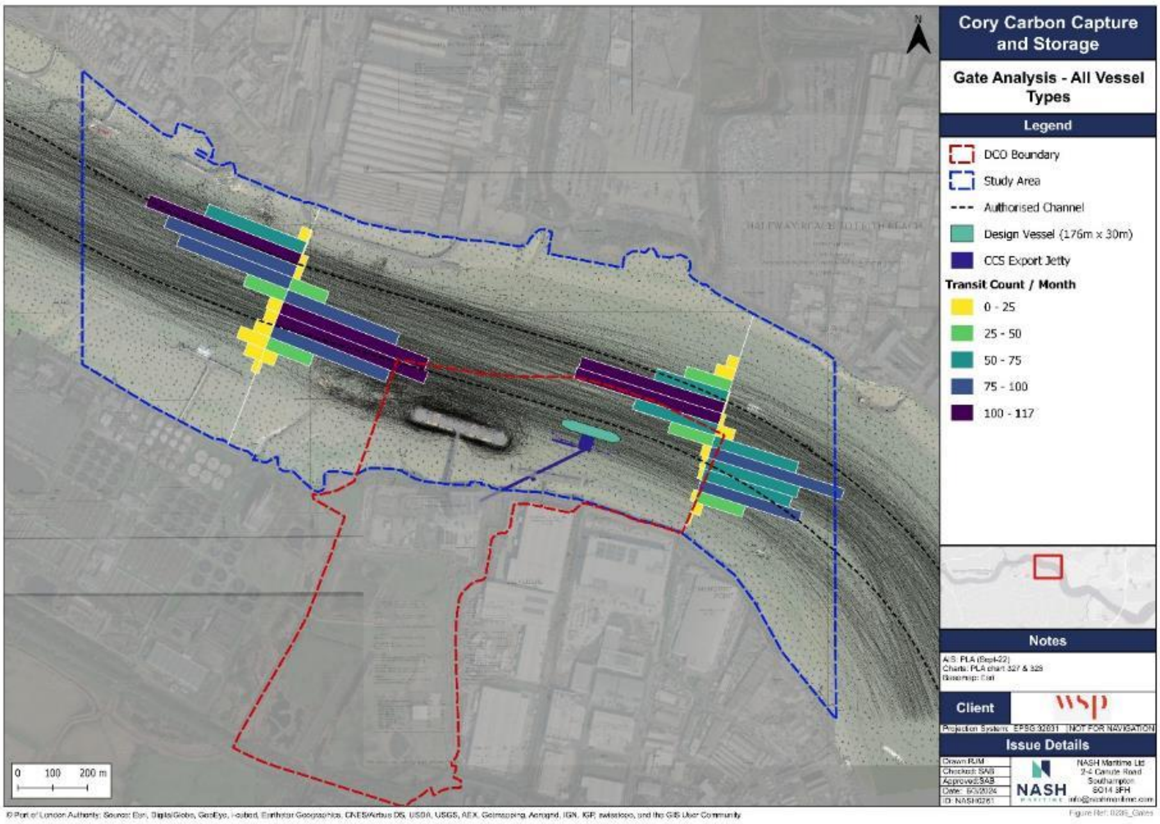


Figure 13: Gate Analysis, All Vessel Traffic (AIS Sep-2021)

Figure 14 shows a vessel traffic density plot, where it can be seen that the majority of vessel traffic activity is focused around the authorised channel and Middleton Jetty. There are a limited number of transits to the north and south of the authorised channel, likely associated with shallow draft vessels and vessels departing the channel to approach jetty and mooring locations.

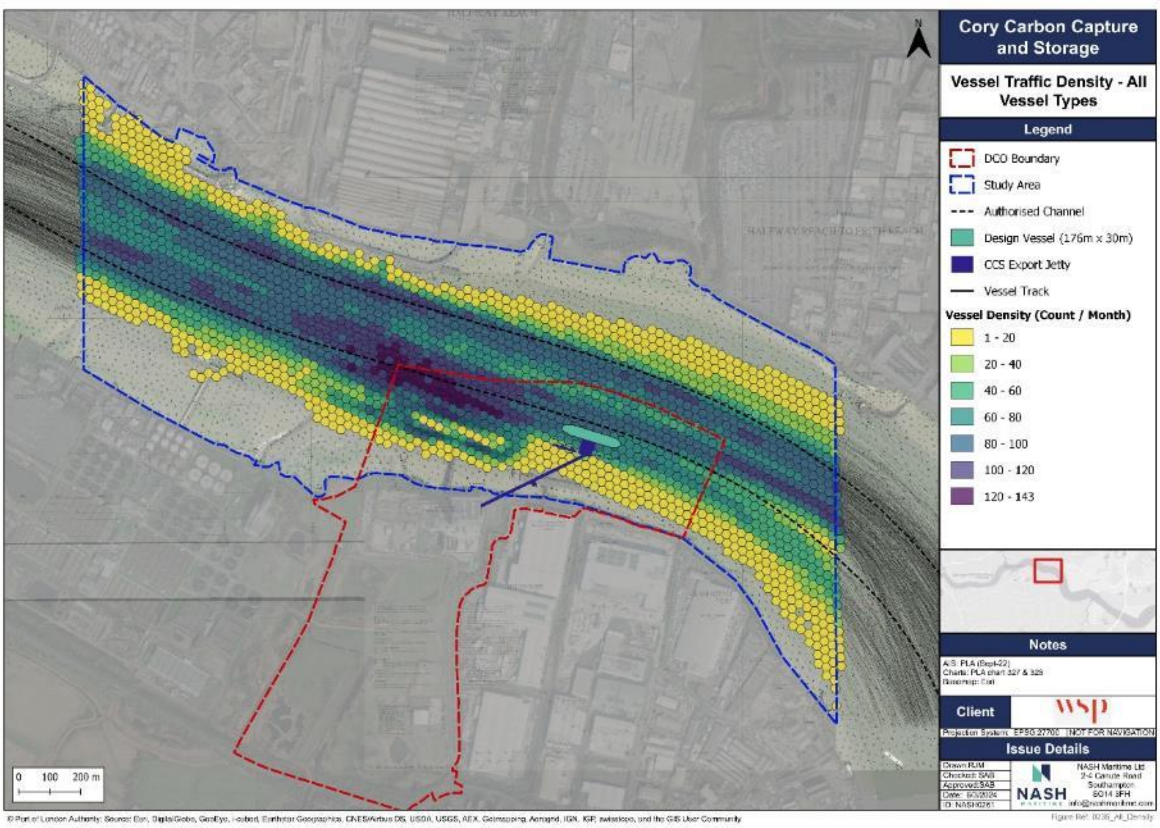


Figure 14: Vessel Traffic Density Plot, (AIS Sep-2022)

3.2 GROUP 1: VESSEL TRACK ANALYSIS

3.2.1 Commercial Vessel Tracks

Commercial vessel tracks (comprising cargo and tanker vessel tracks) are presented in **Figure 15.** On the north bank of the river, cargo vessels are shown navigating to and from Ford's Jetty and White Mountain Jetty whilst tanker vessels are observed transiting to and from the Thunderer Jetty. Ford's Jetty, on the opposite side of the river to the Proposed Jetty, is the closest facility serviced by large commercial vessels. Typically, Ro-Ro vessels such as *Wilhelmine, (***Figure 16**) operate from the Ford's Jetty, with approximately one arrival and departure each day. Arrivals and departures from Ford's Jetty are not tidally constrained **Figure 17**).

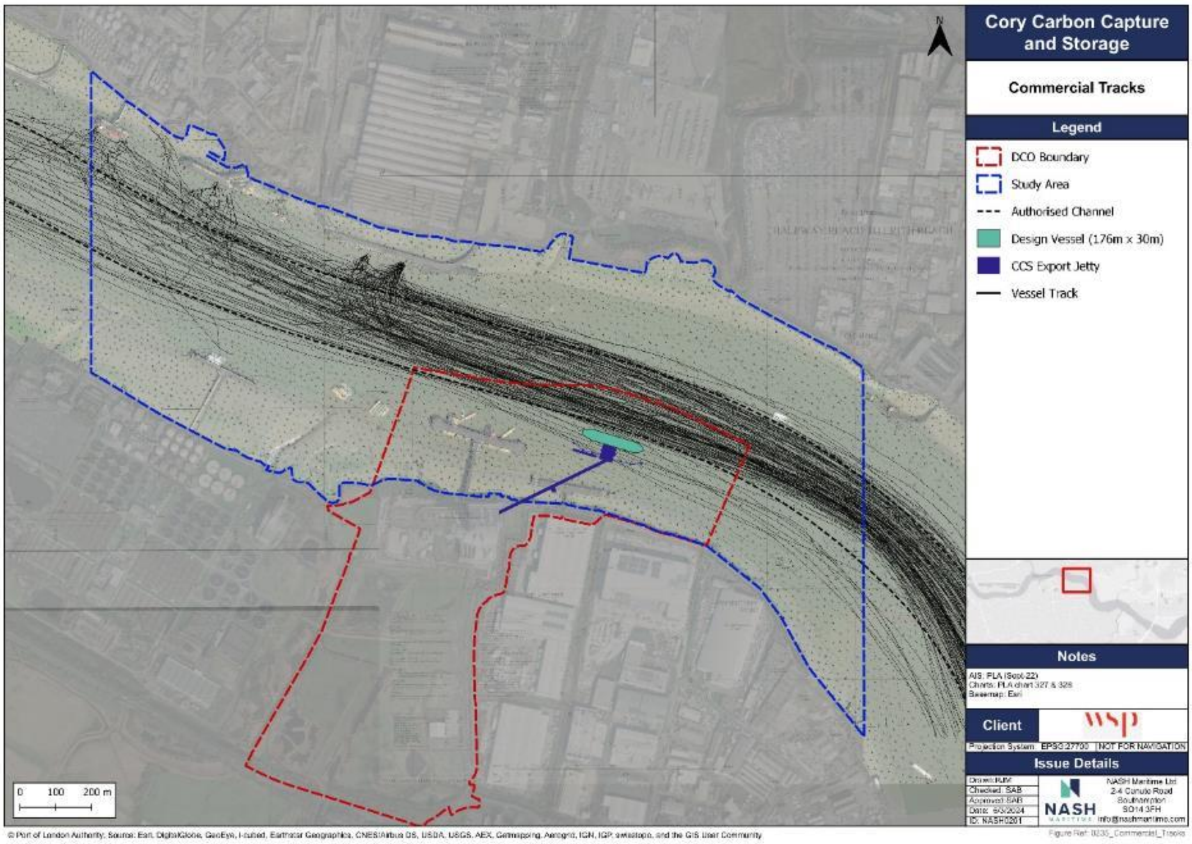


Figure 15: Commercial Vessel Tracks (AIS Sep-22)

Figure 16: *Wilhelmine*

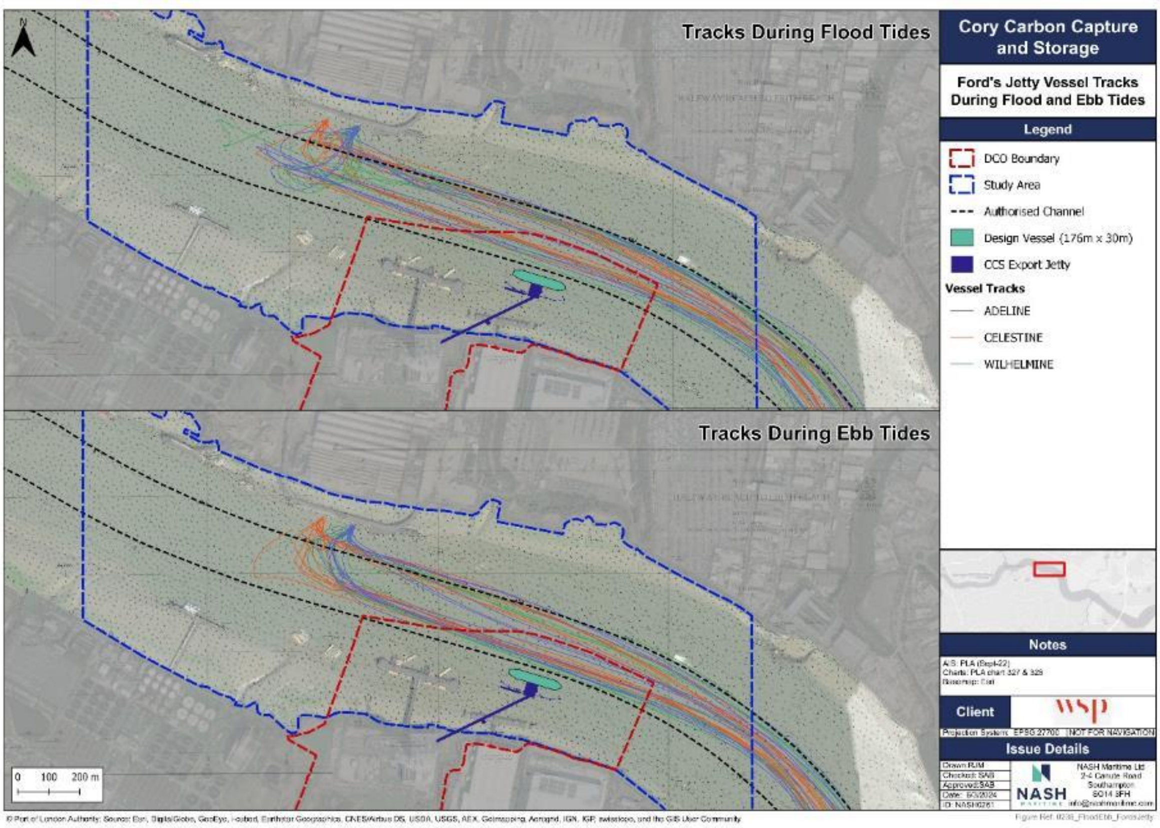


Figure 17: Arrivals and Departures, Ford's Jetty by Ebb and Flood Tide

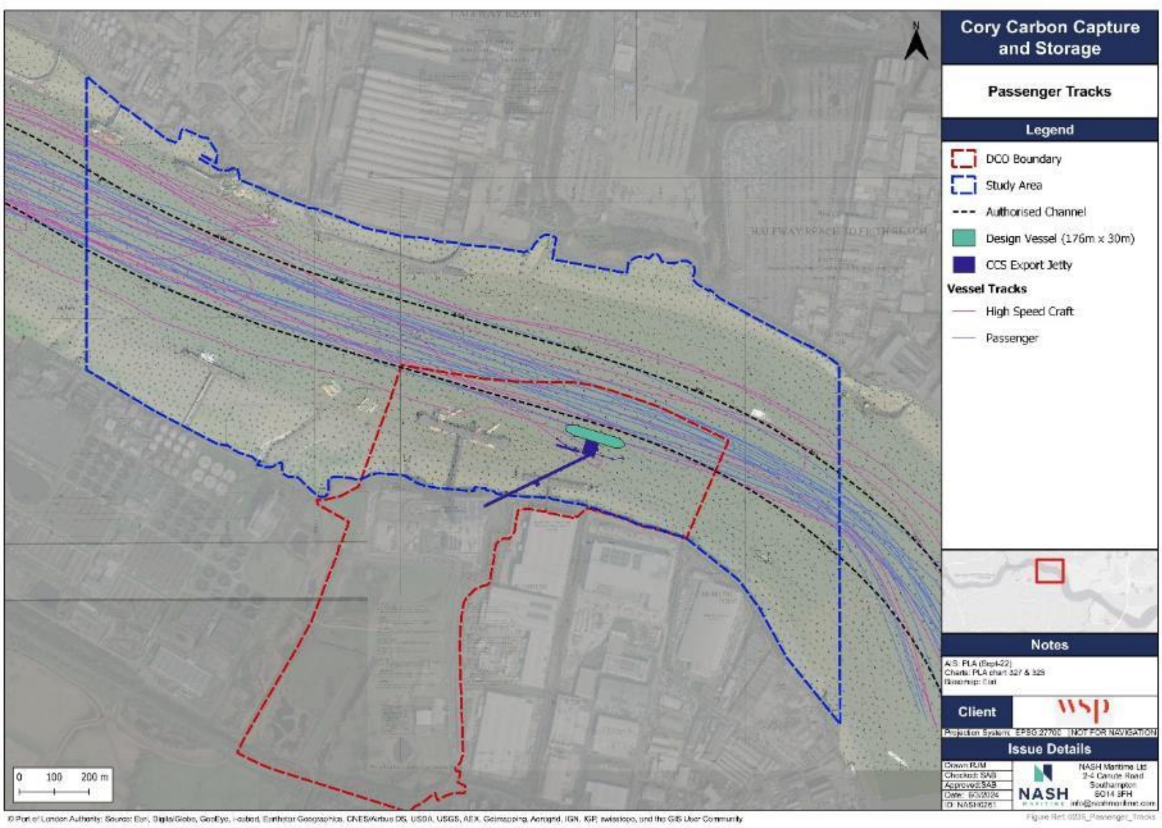


Figure 18: Passenger Vessel Tracks (AIS Sep-21)

3.2.2 Passenger and High-Speed Craft Vessel Tracks

Passenger vessel tracks are shown in **Figure 18**. Passenger vessel movements within the Study Area are limited and are mainly within the authorised channel passing clear of the Proposed Jetty. These are either sea going cruise vessels transiting to upriver berths or smaller intra port passenger vessels and High-Speed Craft operating sightseeing or regular passenger services.

3.2.3 Tug and Service Vessel Tracks

Tug and service vessel tracks are shown in **Figure 20**, and include:

- Port service vessels;
- Military and law enforcement vessels;
- Vessel engaged in dredging and underwater operations (including commercial dredging vessels);
- Tugs (including Cory tugs); and
- Other non-port service craft.

The majority of vessel tracks are within the authorised channel, notable exceptions include:

- Cory vessels transiting to and from the Middleton Jetty as well as between the jetty and barge moorings;
- GPS Marine tugs transiting to and from Amey's Jetty; and
- Commercial dredging vessels such as *Sand Falcon*, (see **Figure 19**) arriving and departing the Hanson Aggregates jetty.

Outbound tug and service vessels can be seen navigating south of the authorised channel when approaching Jenningtree Point channel marker. When tidal height allows these vessels are able to navigate within the inshore zone and in doing so pass south of the Jenningtree Point channel marker (**Figure 20**).

Figure 19: Sand Falcon

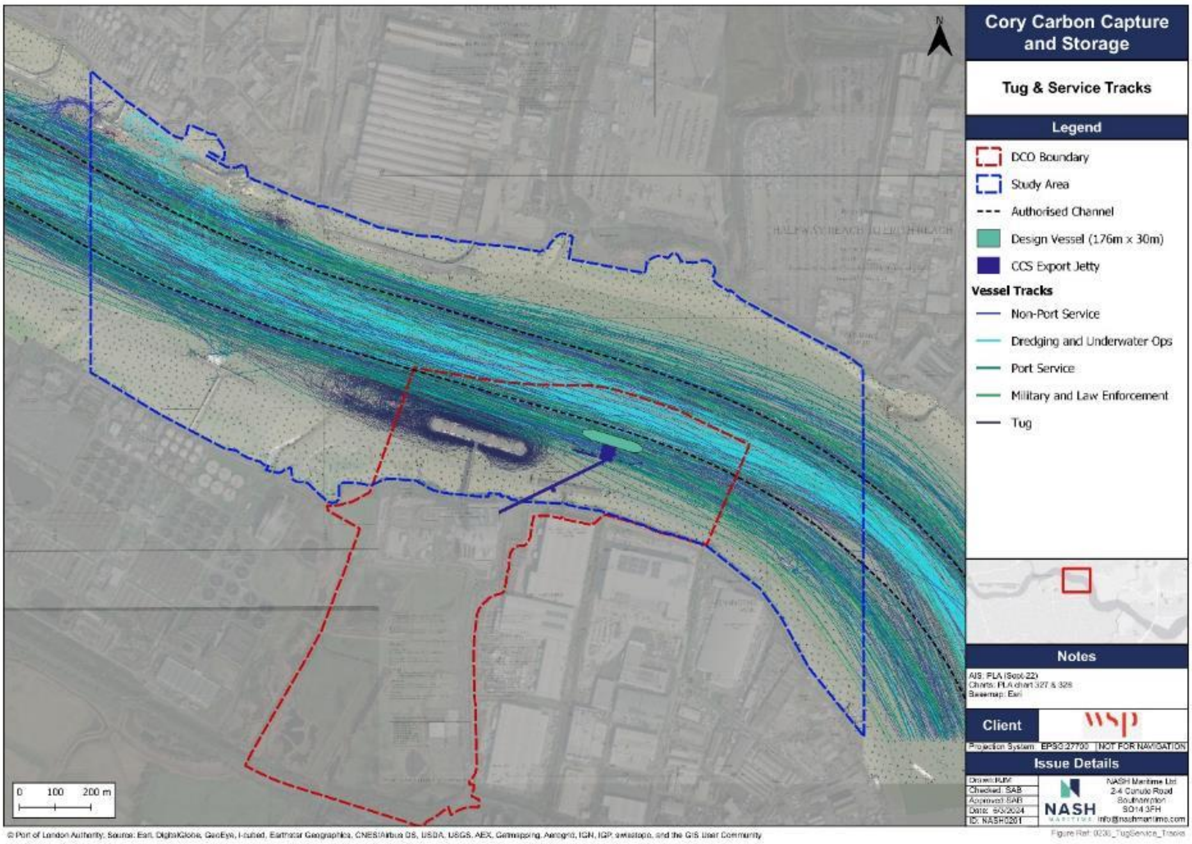


Figure 20: Tug and Service Vessel Tracks (AIS Sep-21)

3.2.4 Cory Tug Vessel Tracks

Figure 21, shows vessel tracks made by Cory tugs only; details of the tugs in the Cory fleet are summarised in **Table 5**, an image of *Resource* is shown in **Figure 22**.

Barge sizes within the fleet range from 33.5m LOA to 49.7m LOA, the tug and barge configuration depends on the route taken (length restrictions are in place in central london) and at waste transfer stations which the barges are based (some waste transfer stations are only able to accommodate the smaller barges).

Table 5: Cory Tug Fleet

Tug Name	Length (m)	Breadth (m)	Gross Tonnage
Regain	25.95	8.98	125.65
Recovery	22.65	8.00	86.69
Resource	22.65	8.00	86.69
Reclaim	22.65	8.00	86.69
Redoubt	22.65	8.00	86.69
Merit	22.98	6.12	82.66

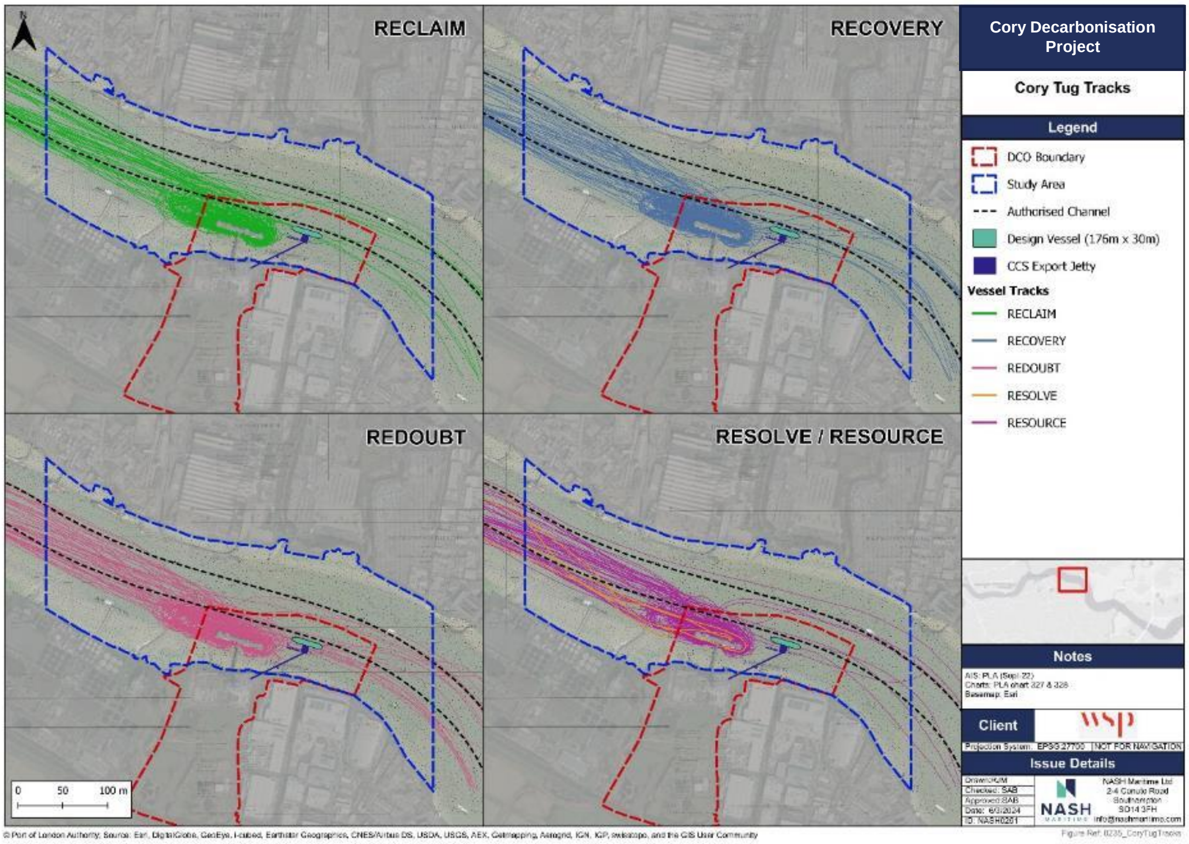


Figure 21: Vessel Tracks, Cory Tugs (PLA AIS 22)

Figure 22: ***Resource***

Figure 23 is a schematic produced to explain the daily process of arrivals and departures by Cory tugs at the Middleton Jetty.

In summary:

- There are on average ten arrivals and departures at the Middleton Jetty a day;
- Four arrivals are from an upstream direction, with one arrival from a downstream direction;
- The downstream arrival and departures represent the movement of ash barges, a biproduct of the EfW facility to a disposal facility at Tilbury Docks; and
- The upstream arrivals and departures represent the movement of waste from various waste transfer stations in central London to the Middleton Jetty.

The current Cory operation occurs over one daytime tide per day with operations taking place six days (Monday-Saturday) per week.

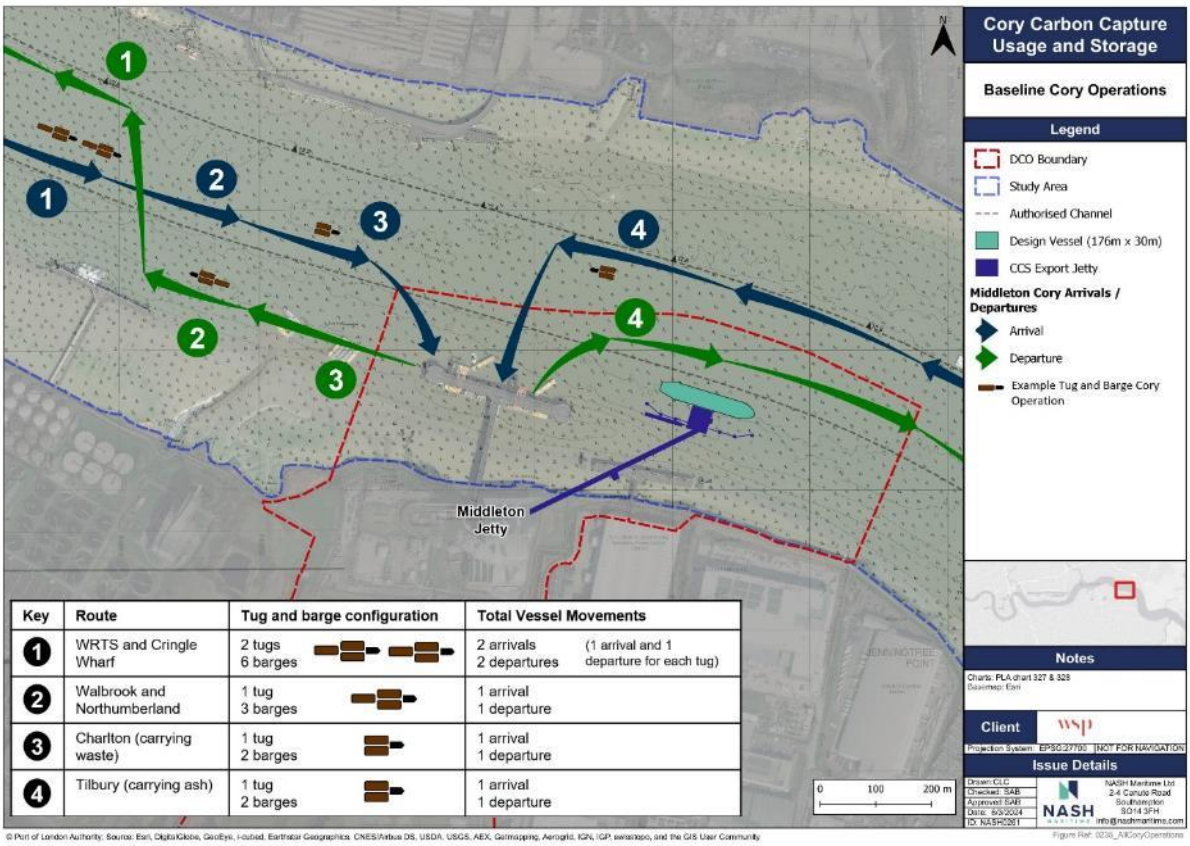


Figure 23: Baseline Cory Operation

3.3 GROUP 2: VESSEL TRAFFIC ANALYSIS

As mentioned in **Section 3,** very few recreational vessels carry AIS equipment and therefore AIS tracks likely underestimate the volume of recreational traffic passing through the Study Area. Therefore, a more qualitative approach is required.

3.3.1 Recreational Vessel Traffic Analysis

Recreational vessel tracks are shown in **Figure 24** as with most other vessel types, transits are focused within the authorised channel. However, a number of recreational vessels can be seen navigating south of the Jenningtree channel buoy (when tidal height allows) and rounding Jenningtree bend south of the Authorised Channel.

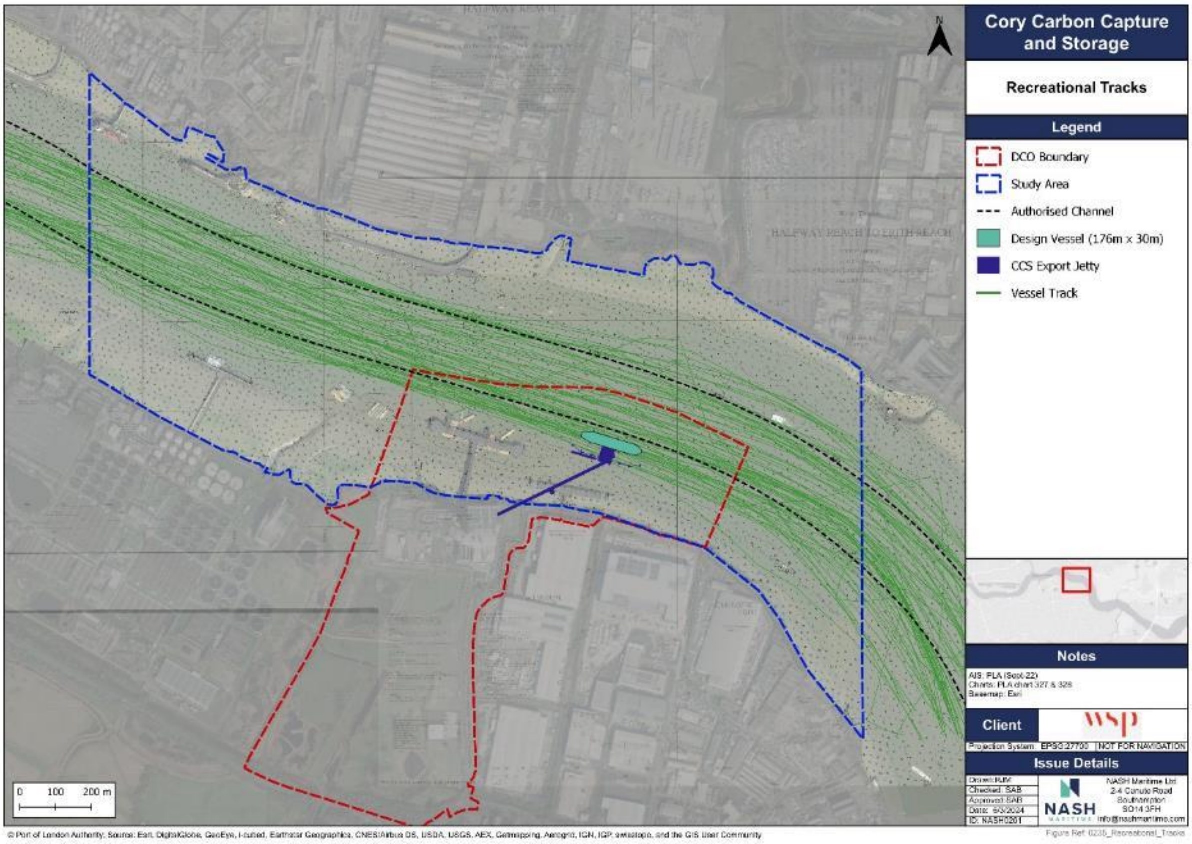


Figure 24: Recreational Vessel Tracks (AIS Sep-22)

The PLA have a number of '**key rules**' for boating on the tidal Thames which they recommend recreational users follow in order to navigate as safely as possible. These rules can be found at:[redacted] The rules cover the following themes:

- Navigating in the authorised channel e.g. 'vessels must keep as near to the starboard side of the fairway at all times, as is safe and practicable;'
- Crossing the authorised channel;
- Awareness of / interactions with other users on the river;
- Navigation regarding bridges, piers and other infrastructure on the river;
- Navigation in strong tidal conditions or poor weather conditions;
- The effect of wash and how to manage it;
- VHF marine radio;
- Moorings;
- Recommend safety equipment onboard vessels; and
- Licensing and certification.

The PLA also publishes a **Recreational Users Guide**[2] that highlights key points of interest and regulations for recreational users on the Thames. **Figure 25** shows the Halfway Reach section of the river which highlights:

2 [redacted] accessed Jul-22

- Middleton Wharf (referred to in this report as the Middleton Jetty);
- Southern Outfall (referred to in this report as Crossness Sewage Treatment Works jetty);
- Ford's jetty;
- No 4 jetty (Hanson Aggregates);
- Jenningtree port channel buoy; and
- Crossness Light.

No recreational clubs or facilities are located within the Study Area.

During consultation the PLA Harbour Master and Marine Manager confirmed that there was very limited recreational vessel activity within Halfway Reach.

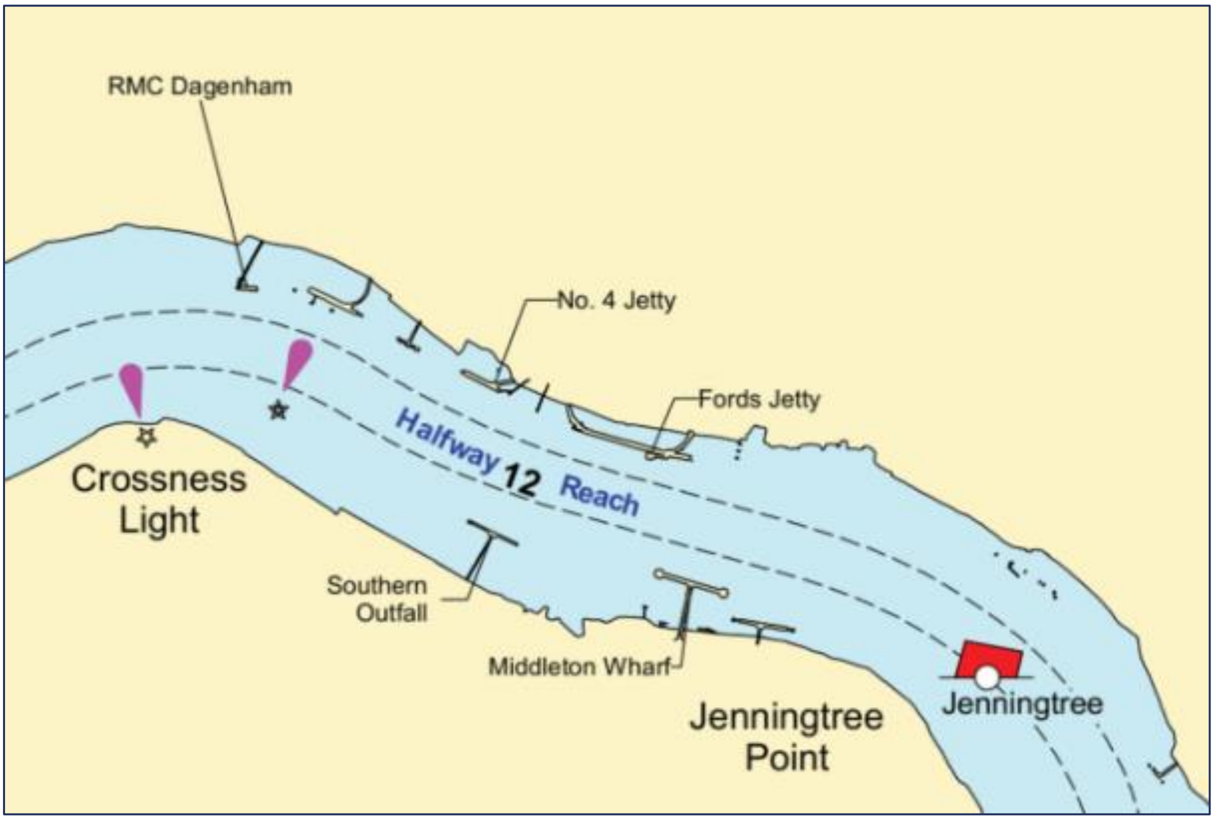


Figure 25: PLA Recreational River User Guide – Halfway Reach Section Screenshot

3.4 SWEPT PATH ANALYSIS

In order to further understand the proximity between passing commercial vessels and the Proposed Jetty, swept path analysis was undertaken. Before conducting the swept path analysis all vessel tracks identified in the September 2022 data set were filtered to only incorporate vessels that are subject to compulsory pilotage. This exercise was undertaken to ensure that only vessels that are likely to be limited in their ability to manoeuvre were considered within the analysis.

Whilst smaller shallow draught vessels navigate south of the authorised channel and would in theory collide with the Proposed Jetty if following the same course, in practice these vessels, not being limited by draught, size or ability to manoeuvre, will likely divert north avoiding the Proposed Jetty entirely. In other words, such vessels likely only navigate outside the limits of the authorised channel because there is adequate navigable width to do so, rather than there being a particular operational constraint which forces navigation in this manner.

The PLA pilotage directions 2017 state that compulsory pilotage applies:

"To the west of Sea Reach No.1 Buoy for vessels of:

a) 80 metres or more in Length Overall;

b) 50 metres or more in Length Overall which are:

i) Specified Vessels,

ii) Passenger Vessels,

iii) Vessels carrying Marine Pollutants in Bulk, or

iv) Vessels with an Operating Draught of 5 metres or more; or

c) 50 metres or more in Length Overall with an Operating Draught of 4 metres or more when Restricted Visibility exists within that part of the London Pilotage District to the West of Sea Reach No. 1 Buoy where the vessel is planning to navigate."

All cargo vessels greater than or equal to 80m LOA and all tanker vessels greater than or equal to 50m LOA were therefore extracted from the data set. The extracted tracks are presented in **Figure 26**, which shows:

- Many of the passing cargo vessel transits are associated with the Ford's Jetty Ro-Ro operation;
- Cargo vessel transits are more numerous than tanker vessel transits;
- Most tanker vessel tracks show vessels arriving and departing the Thunderer Jetty;
- The majority of transits of both cargo and tanker vessels are within the authorised channel with the exception of vessels departing the authorised channel to the north to arrive / depart Ford's Jetty or Thunderer Jetty. There are also a limited number of transits just south of the authorised channel in close proximity to the Proposed Jetty.

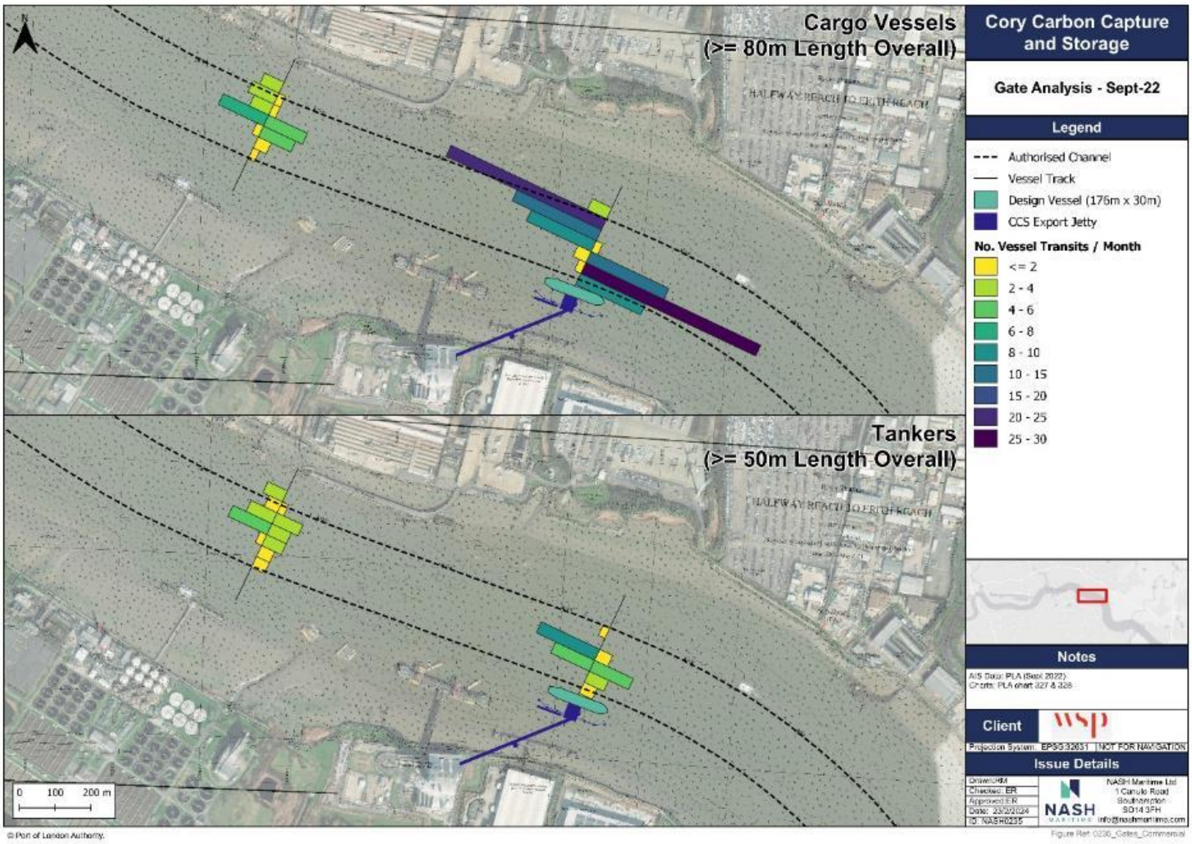


Figure 26: Gate Analysis: Commercial vessels subject to Compulsory Pilotage

3.4.1 Cargo Vessel Swept Path Analysis

Individual swept paths were created for each of the unique cargo vessel tracks identified in **Figure 26**. Examples of the individual swept paths for cargo vessels are shown in the following figures:

- **Figure 27**: Swept path Ford's Jetty Departure (*Adeline)*
- **Figure 28**: Swept Path, Ford's Jetty Departure (*Wilhelmine)*
- **Figure 29**: Swept Path Ford's Jetty Departure (*Celestine*)
- **Figure 30**: Swept Path Ford's Jetty Arrival (*Adeline*)
- **Figure 31**: Swept Path Cargo Vessel, Passing Transit, *(Chintana Naree*), (Outbound)
- **Figure 32**: Swept Path Cargo Vessel, Passing Transit, *(Eco Anglebay*), (Outbound)

The swept paths show that:

- Vessels departing from Ford's Jetty swing to port across the authorised channel before passing downriver occupying the southern limit of the channel approximately 50m north of the Proposed Jetty. During consultation CLdN Captains confirmed that the drift to the southern margin of the channel is more pronounced during a northerly wind, especially because the vessels are, at that time, still at slow speed. Outbound vessels then align to round Jenningtree bend passing north of the Jenningtree Buoy. Wilhelmine and Adeline, although smaller than Celestine, generally require more manoeuvring space because, being of single propeller configuration, they are more challenging to handle when maintaining slow speed control and when turning. During challenging wind conditions, Ford's vessels may also have one or more tugs in attendance.

- Vessels arriving at Ford's Jetty round Jenningtree bend within the central portion of the authorised channel before working north as they approach the Proposed Jetty. Vessels approaching on an ebb tide must initially remain towards the south of the authorised channel in order to avoid being set too far to the north (risking grounding). Particular attention must be given, when rounding the bend and reducing speed, to the ebb or flood tide's northerly set when combined with a strong south or south westerly wind. During consultation, see **Section 5**, CLdN Captains commented that when approaching Ford's Jetty on a strong ebb with a strong south / south westerly wind they must steer to the south of the authorised channel to avoid being set north too early, particularly on the less manoeuvrable single propeller vessels.

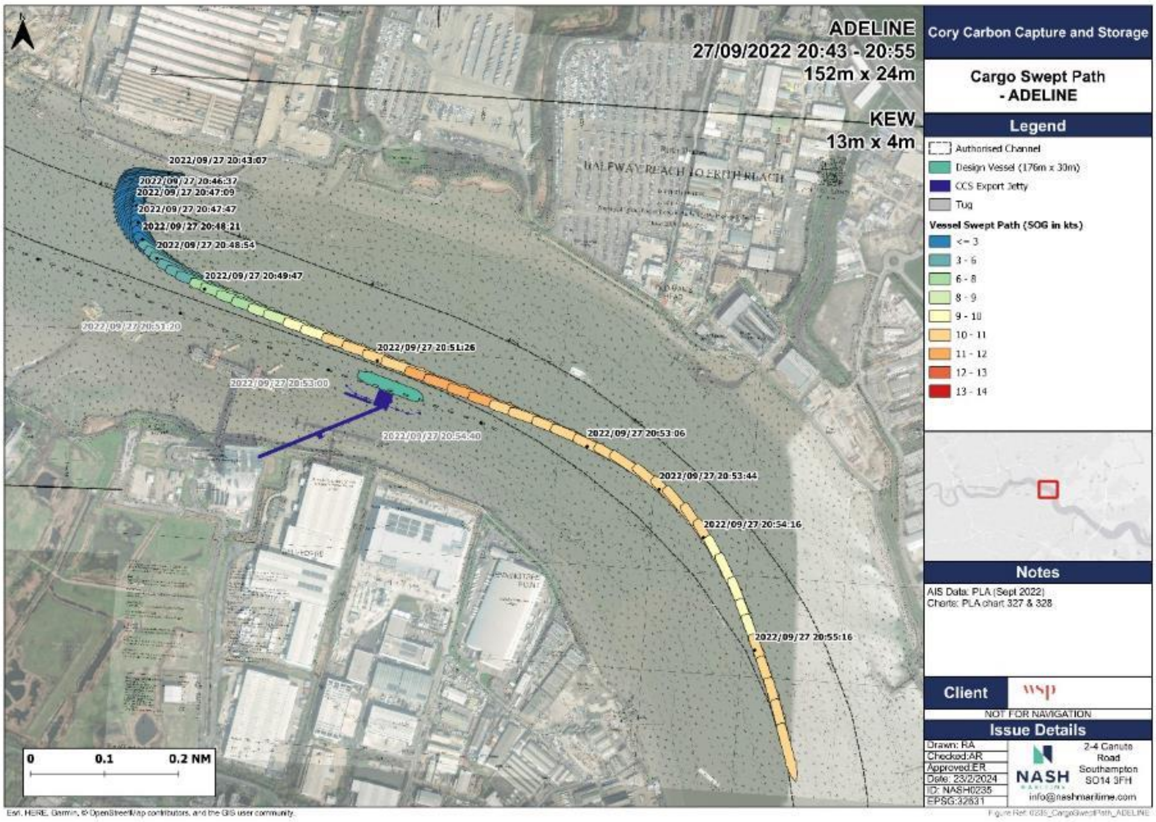


Figure 27: Swept path Ford's Jetty Departure (*Adeline)*

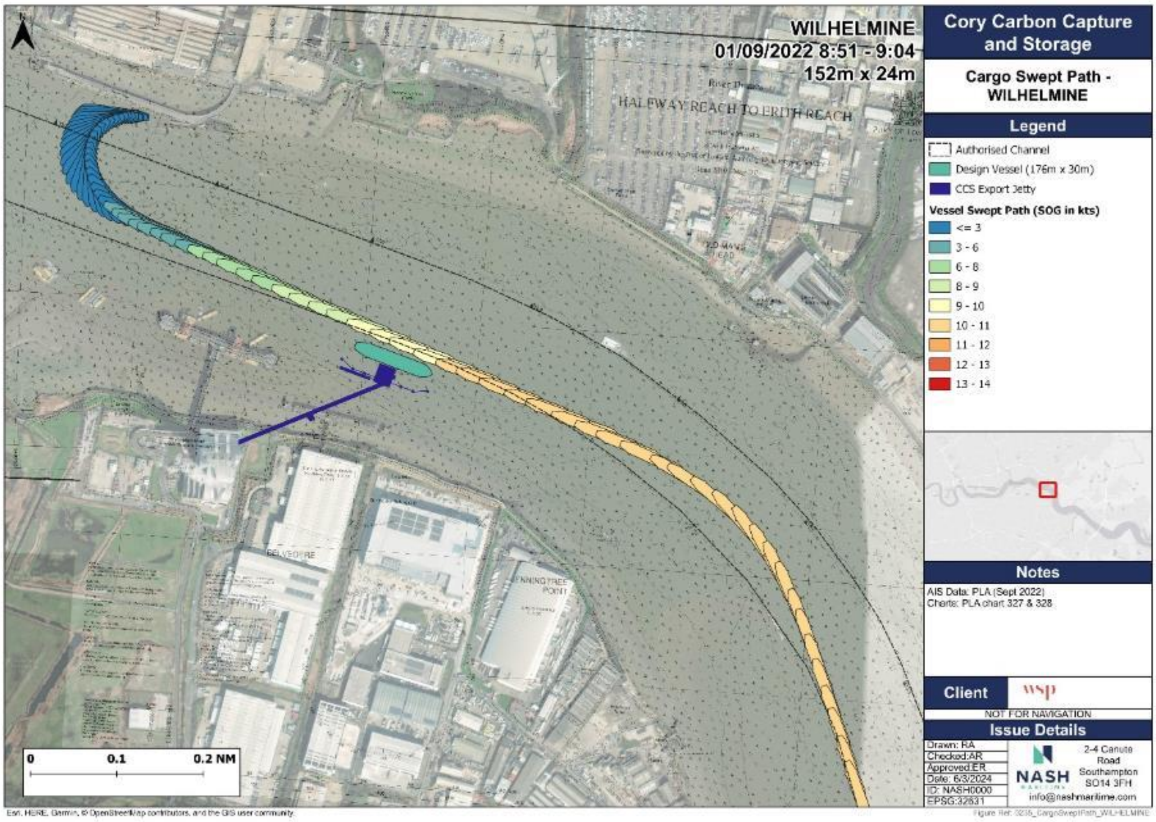


Figure 28: Swept Path, Ford's Jetty Departure (*Wilhelmine)*

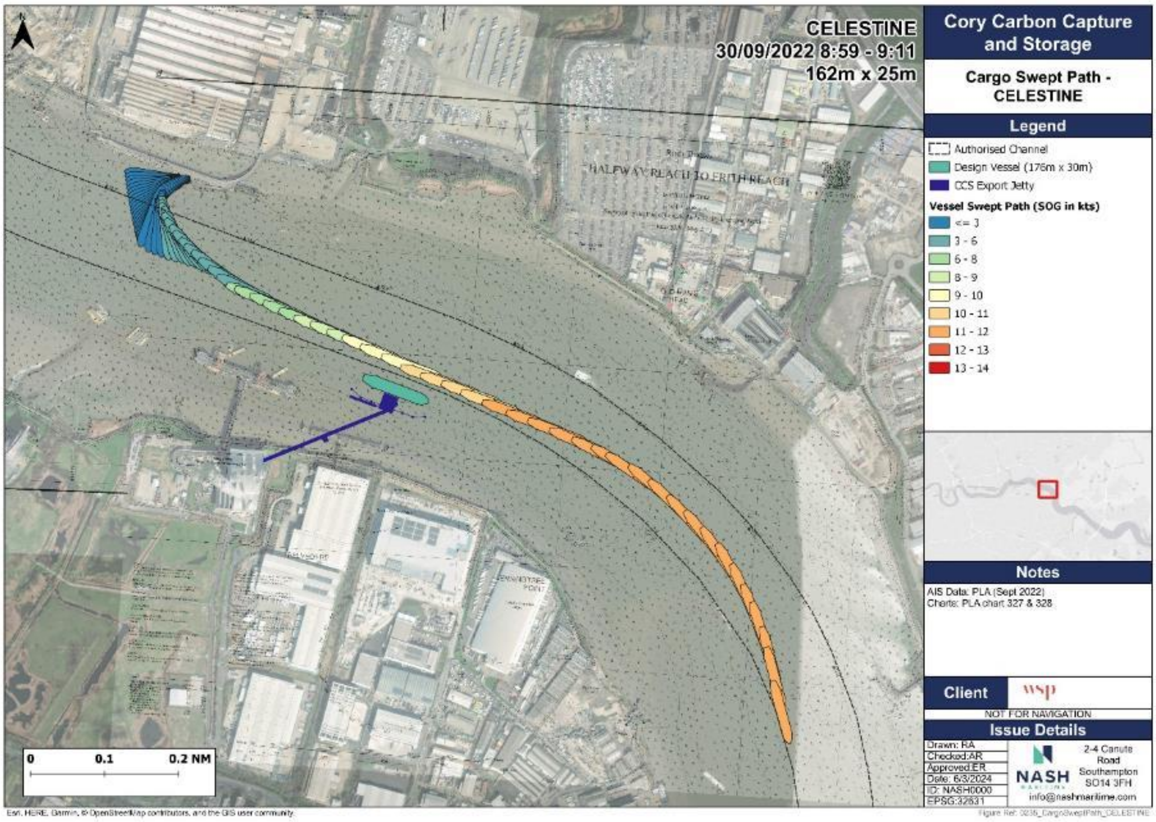


Figure 29: Swept Path Ford's Jetty Departure (*Celestine)*

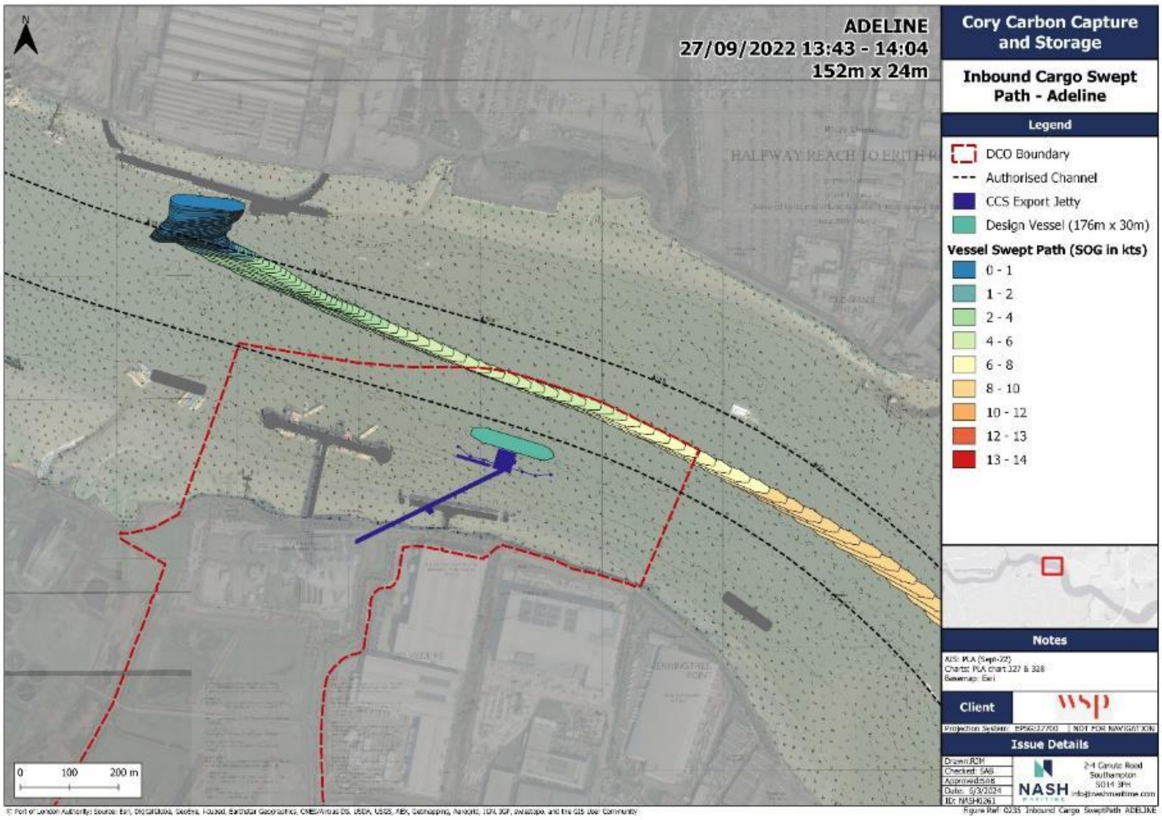


Figure 30: Swept Path Ford's Jetty Arrival (*Adeline*)

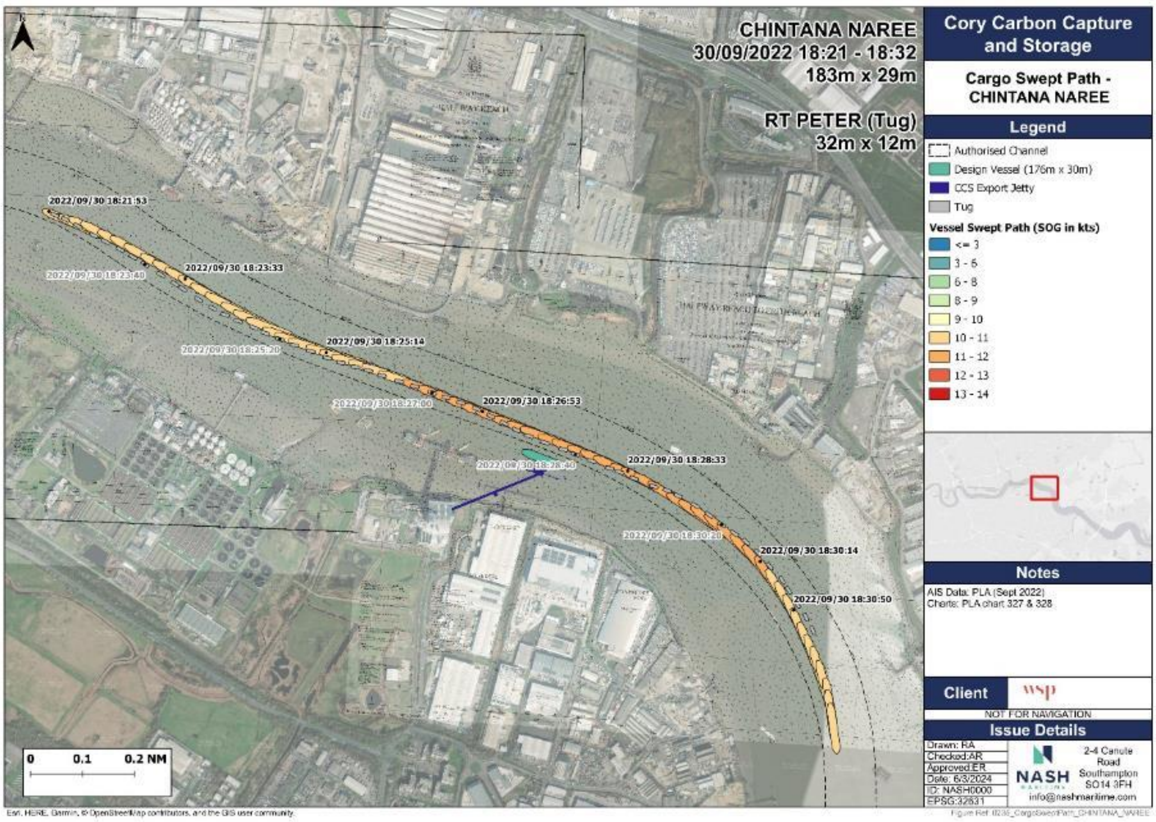


Figure 31: Swept Path Cargo Vessel, Passing Transit, (*Chintana Naree)*, (Outbound)

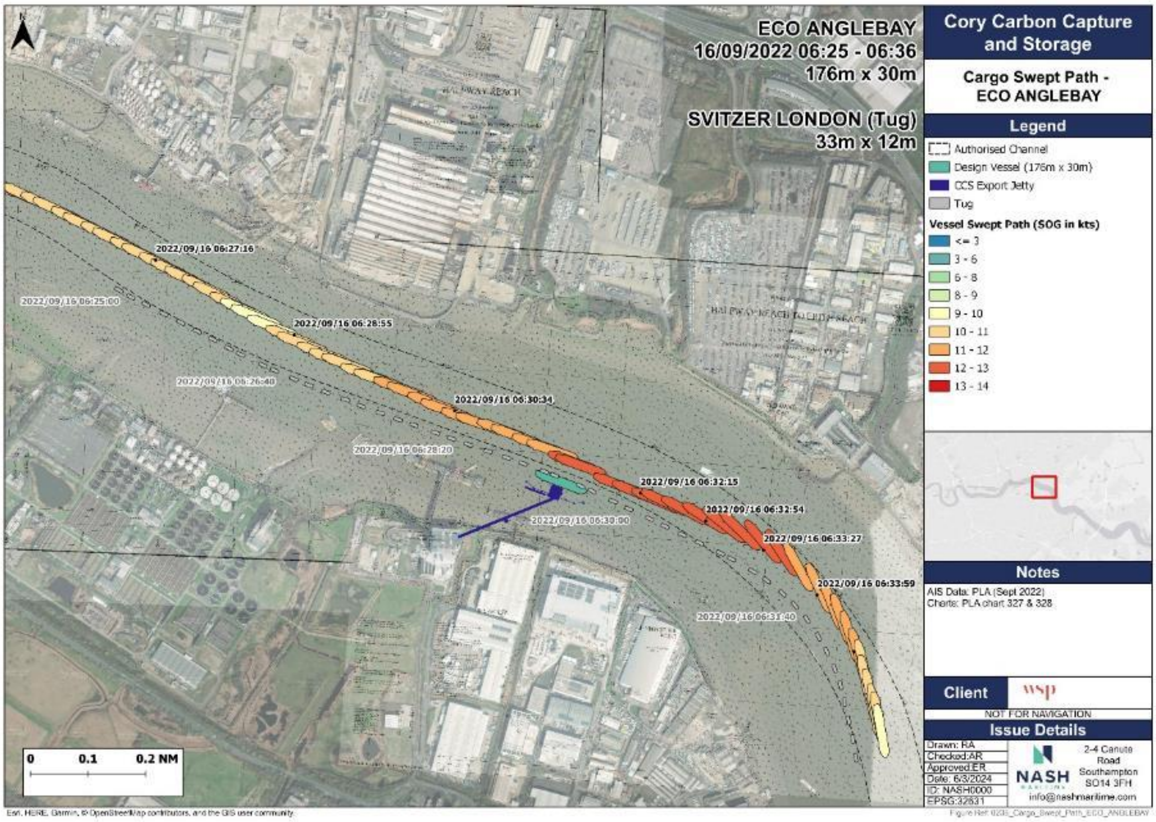


Figure 32: Swept Path Cargo Vessel, Passing Transit, (*Eco Anglebay*), (Outbound)

The individual cargo vessel swept path transits were then overlaid to create a swept path density plot, (see **Figure 33**). **Figure 33** shows the number of minutes navigated by any part of a cargo vessel within individual 10m x 10m grid cells. The most frequently transited area is around the Ford's Jetty berth as vessels manoeuvre on to and away from the berth. The areas of medium exposure show transits either side of the authorised channel as Ro-Ro vessel make passage to and from the Ford's Jetty berth. Grid cells in proximity to the Proposed Jetty were navigated by cargo vessels for less than five minutes during September 2022.

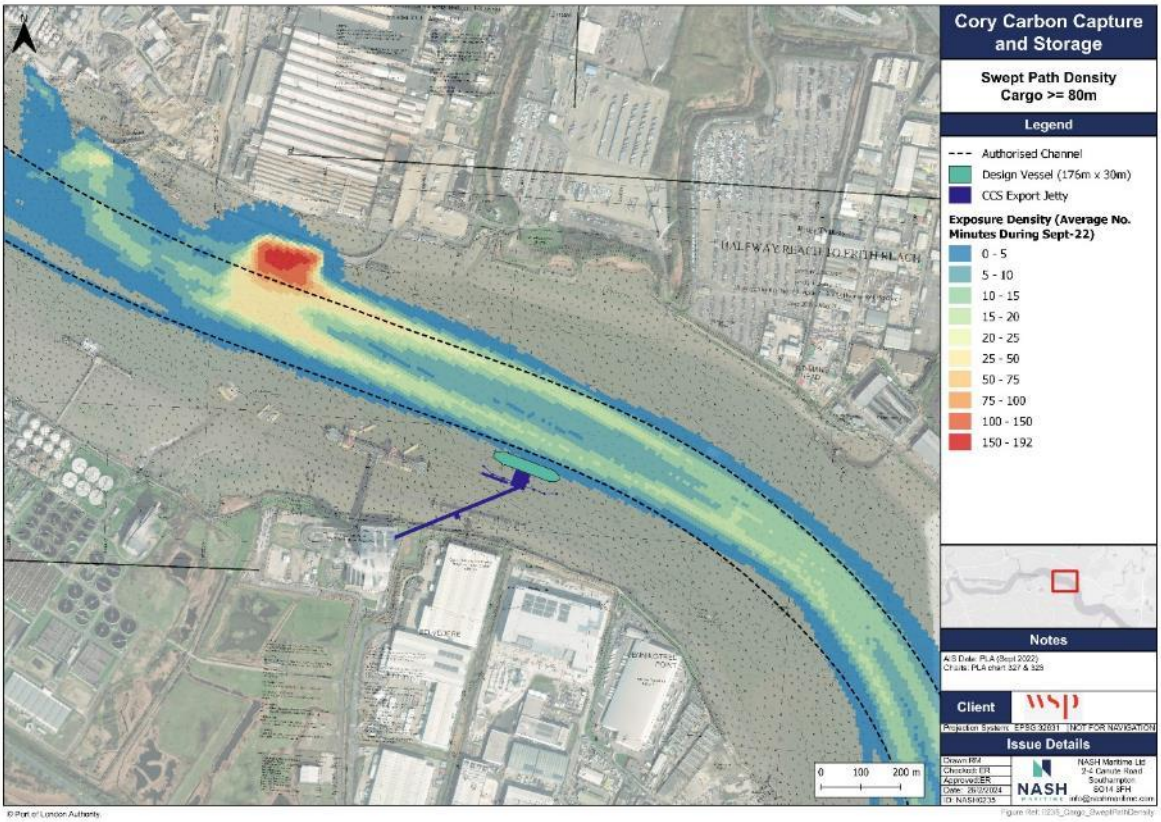


Figure 33: Cargo Swept Path Density Plot

3.4.2 Tanker Swept Path Analysis

Individual swept paths were created for each of the unique tanker tracks identified in **Figure 18**. Examples of the individual swept paths for tankers are shown in the following figures:

- **Figure 34**: Tanker Swept Path Thunderer Jetty *Arrival (Caroline Essberger)*
- **Figure 35**: Tanker Swept Path Thunderer Jetty *Departure (Preveze 1)*
- **Figure 36**: Swept Path Thunderer Jetty Departure *(Sten Moster)*
- **Figure 37**: Swept Path Thunderer Jetty Departure (*Palanca Cadiz)*

The swept paths show that, on arrival, tankers bound for the Thunderer Jetty navigate the Jenningtree bend, utilising the central portion of the channel when passing the Proposed Jetty and manoeuvring further up river. Larger vessels will also have tugs in attendance.

On departing the Thunderer Jetty vessels navigate outbound toward the southern extent of the authorised channel, passing north of the Proposed Jetty before rounding Jenningtree bend.

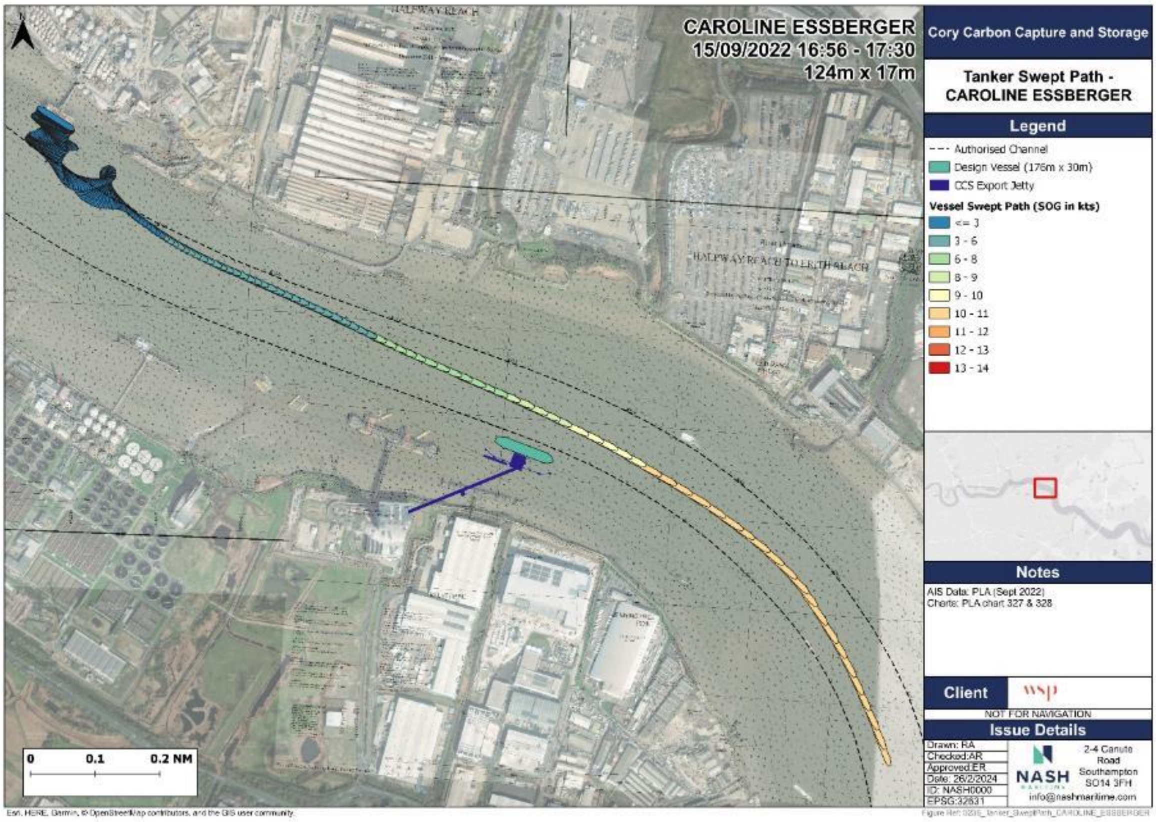


Figure 34: Tanker Swept Path Thunderer Jetty Arrival *(Caroline Essberger)*

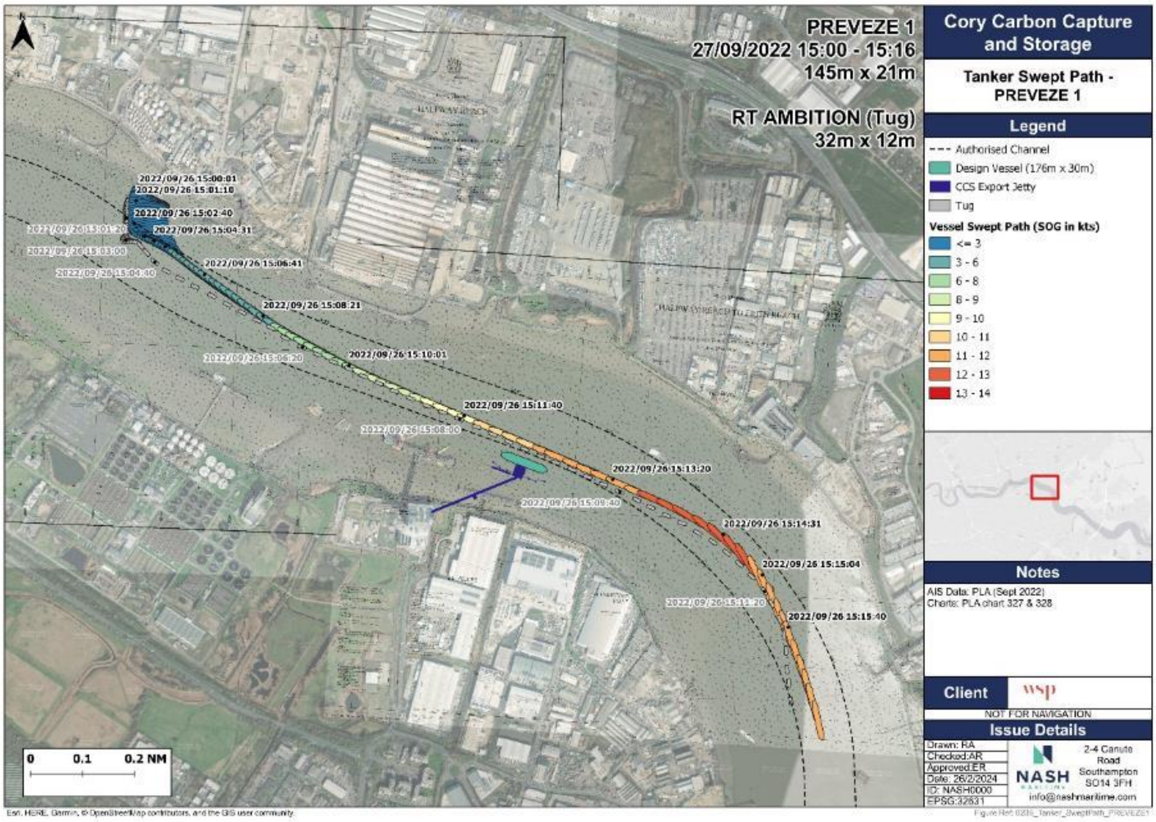


Figure 35: Tanker Swept Path Thunderer Jetty Departure *(Preveze 1)*

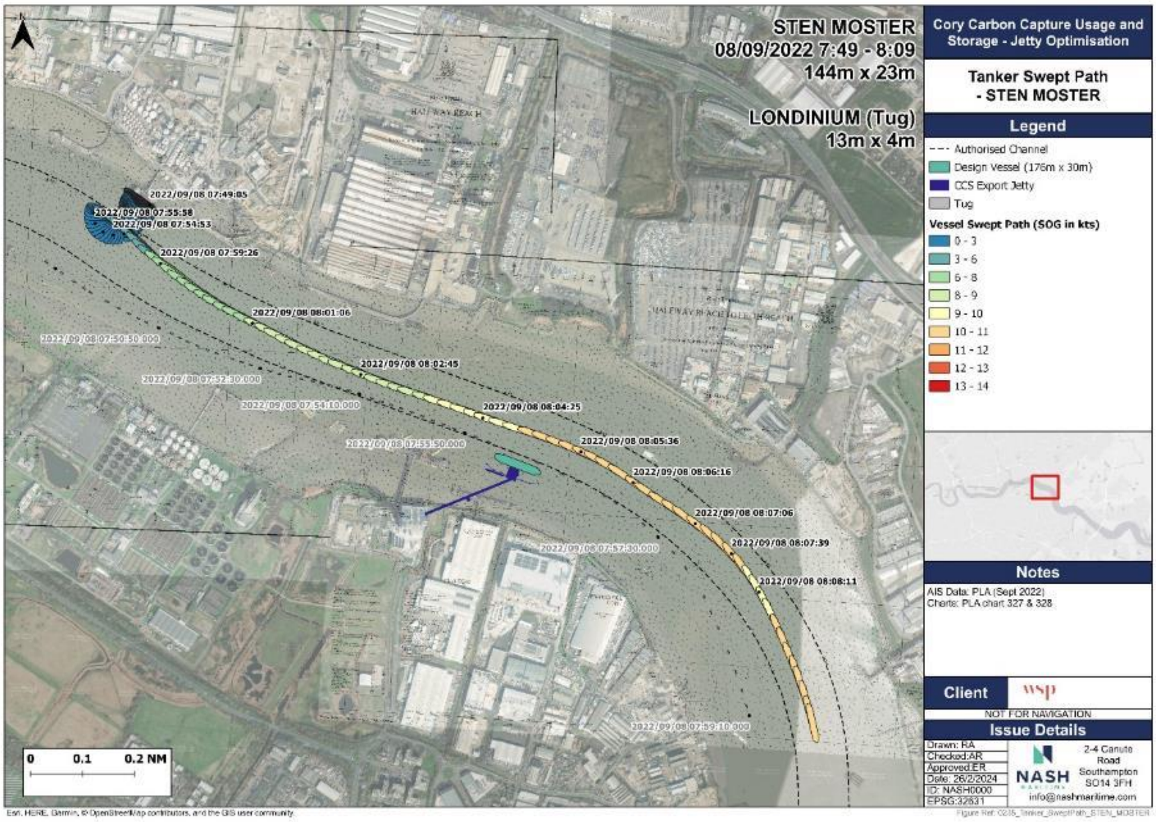


Figure 36: Swept Path Thunderer Jetty Departure *(Sten Moster)*

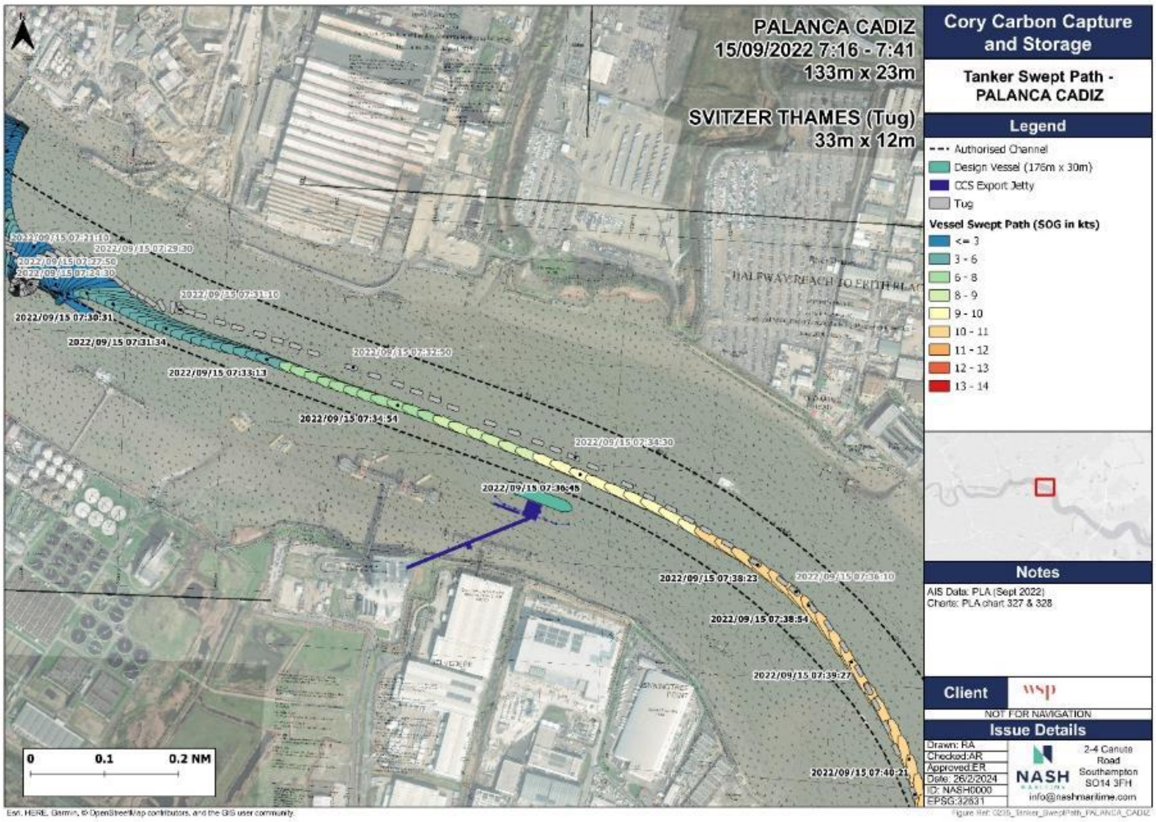


Figure 37: Swept Path Thunderer Jetty Departure (*Palanca Cadiz)*

The individual tanker swept path transits were then overlaid to create a swept path density plot, (see **Figure 38**). As for cargo vessels, **Figure 38** shows the number of minutes navigated by any part of a tanker vessel within individual 10m x 10m grid cells. Tanker vessel activity is greatest within the approaches to the Thunderer Jetty. Grid cells within the southern portion of the authorised channel and in proximity to the Thunderer Jetty were navigated by tanker vessels for less than five minutes within September 2022.

There are three distinct areas of vessel exposure south of the authorised channel, these areas show movements attributed to the coaster tanker *Distributor* (58m LOA), (see **Figure 39**). It is understood that this vessel operates with a Pilotage Exception Certificate and it is unclear as to why the vessel is shown to be navigating outside the authorised channel and south of the Jenningtree channel buoy. During consultation the PLA confirmed that the vessel should not be navigating in this manner.

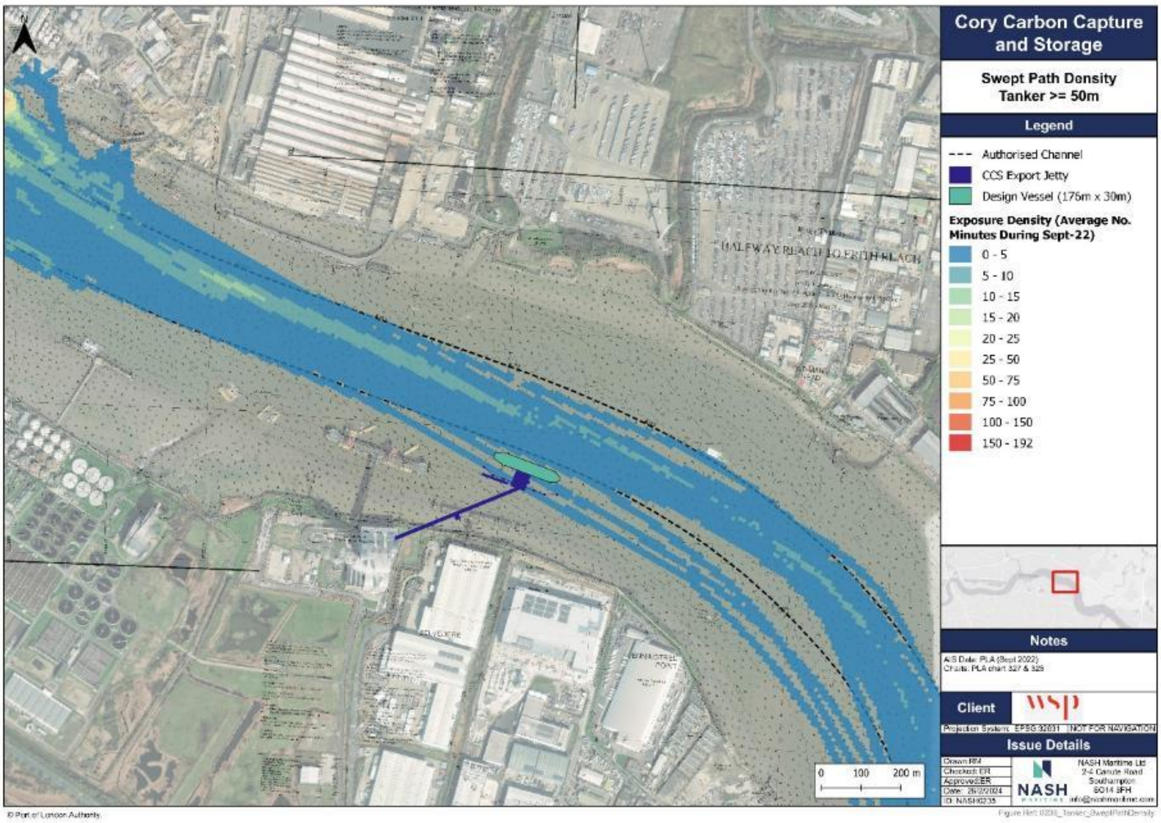


Figure 38: Tanker Swept Path Density Plot

Figure 39: ***Distributor***

3.4.3 Passenger Vessel Swept Path Analysis

In comparison to tanker and cargo vessels, sea going passenger vessel transits are comparatively infrequent. However, passenger vessels operating within Halfway Reach are subject to compulsory pilotage. A representative passenger swept path is shown in **Figure 40.** *Viking Mars* is show in **Figure 41**.

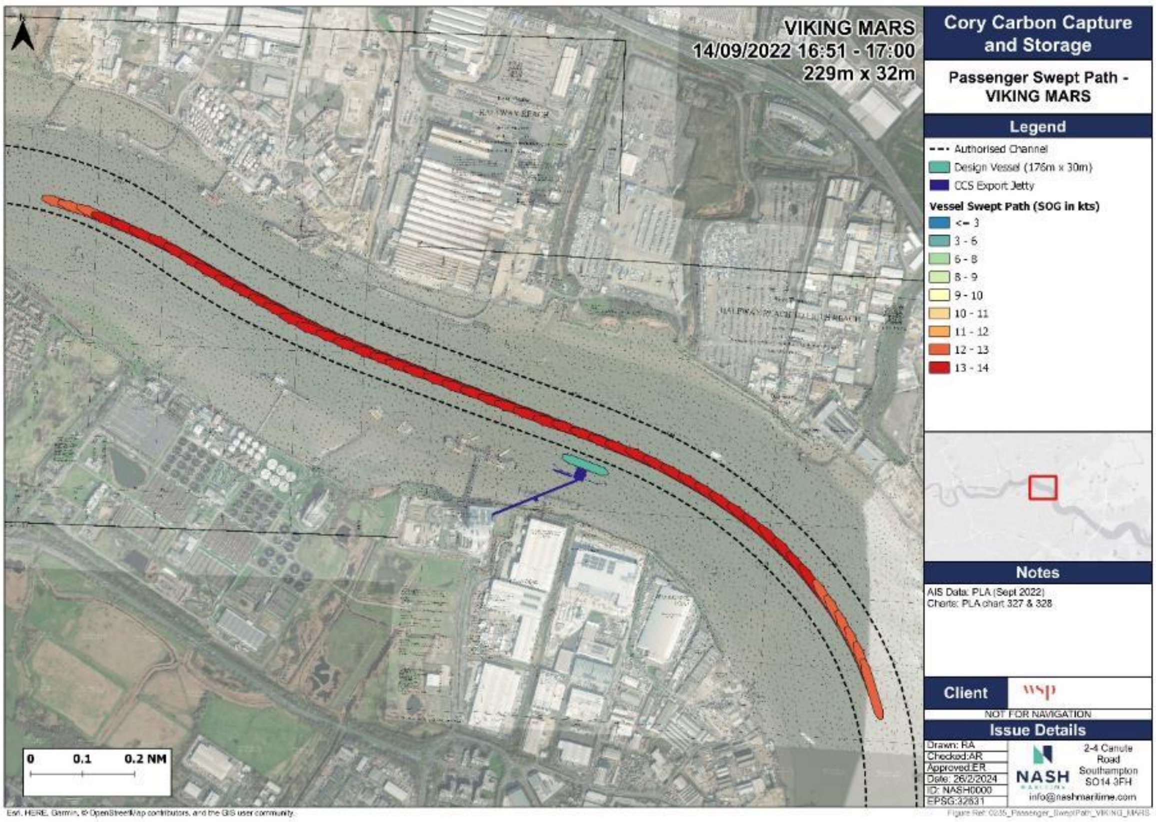


Figure 40: Swept Path, Passenger Vessel Outbound ***(Viking Mars)***

Figure 41: *Viking Mars*

3.4.4 Cory Tug and Barge Swept Path Analysis

In addition to the passing vessel swept path analysis, swept path analysis was also undertaken to examine the interaction between Cory tug and barge operations and the Proposed Jetty. Indicative swept paths were produced combining AIS tracks from the September 2022 dataset, tracks produced from AIS data collected by NASH Maritime during tripping with the Cory lighterage team and drone footage of Cory vessels navigating in the vicinity of the Middleton Jetty.

Indicative swept paths were produced showing Cory tug and barges navigating to the east and inshore of the Middleton Jetty on an ebb tide (see, **Figure 42**) and flood tide (see, **Figure 43**). The swept paths show two extreme manoeuvres, **Figure 42** shows a very tight ebb tide manoeuvre in close proximity to the Middleton Jetty whilst **Figure 43** shows a very wide flood tide manoeuvre which, with the Proposed Jetty in place, would result in the barge making contact.

Note, the flood tide indicative swept path was derived from AIS data collected by NASH Maritime whilst tripping onboard the Cory vessel *Resource*. The Tug master was instructed to undertake a worst-case scenario manoeuvre. In reality, it is highly unlikely that the Tug master would choose to swing round the eastern end of the Middleton Jetty on a strong flood tide. Instead, on a strong flood tide, rather than attempting to swing the barge around the eastern end of the Middleton Jetty (as shown in the swept paths) Cory tugs are more likely to position head to tide and crab across before falling back on to the Proposed Jetty and mooring the barge –- or alternatively navigate through the “link span” under the brow of the main Middleton jetty to remove the need for navigating around the lower end.

Following discussion with the Cory lighterage team and an experienced tug master it was agreed that a representative manoeuvre would likely (spatially) fall between the two presented examples (**Figure 42** and **Figure 43**) and would therefore mean the barges passed well clear of the Proposed Jetty structure.

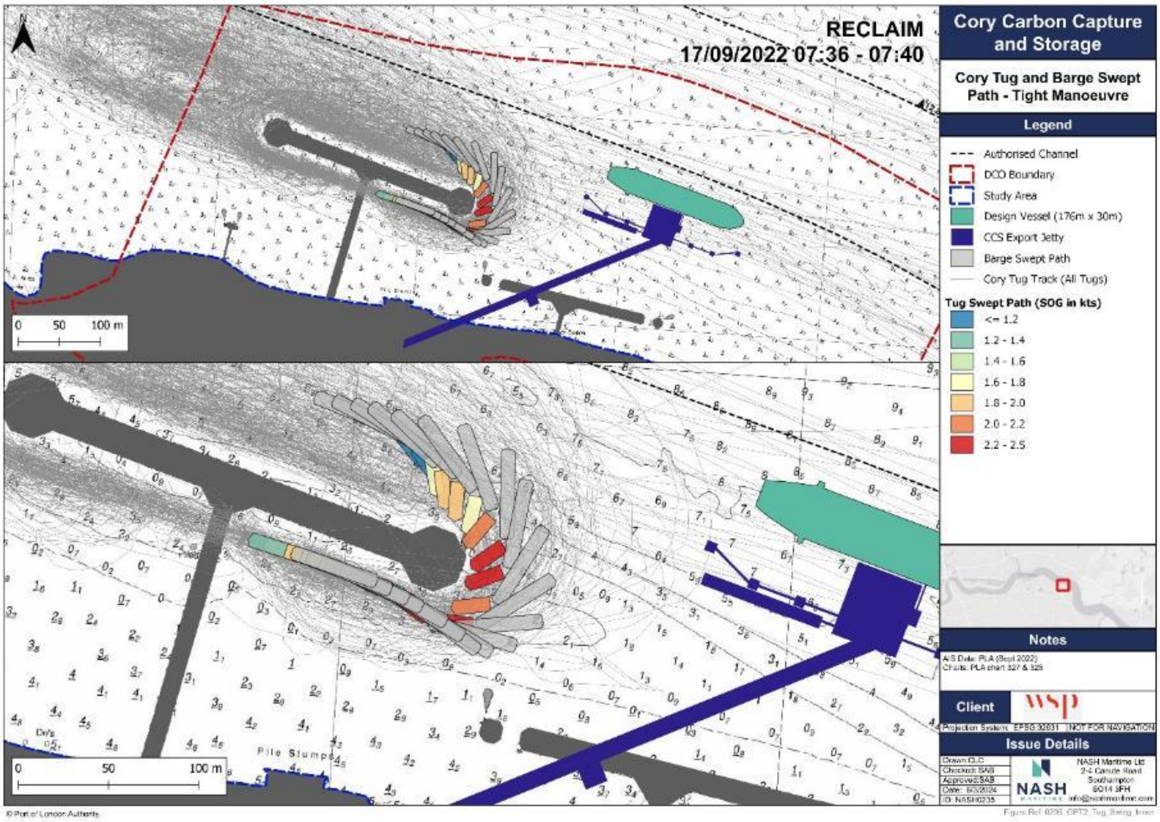


Figure 42: Cory Tug and Barge Ebb Tide Berthing

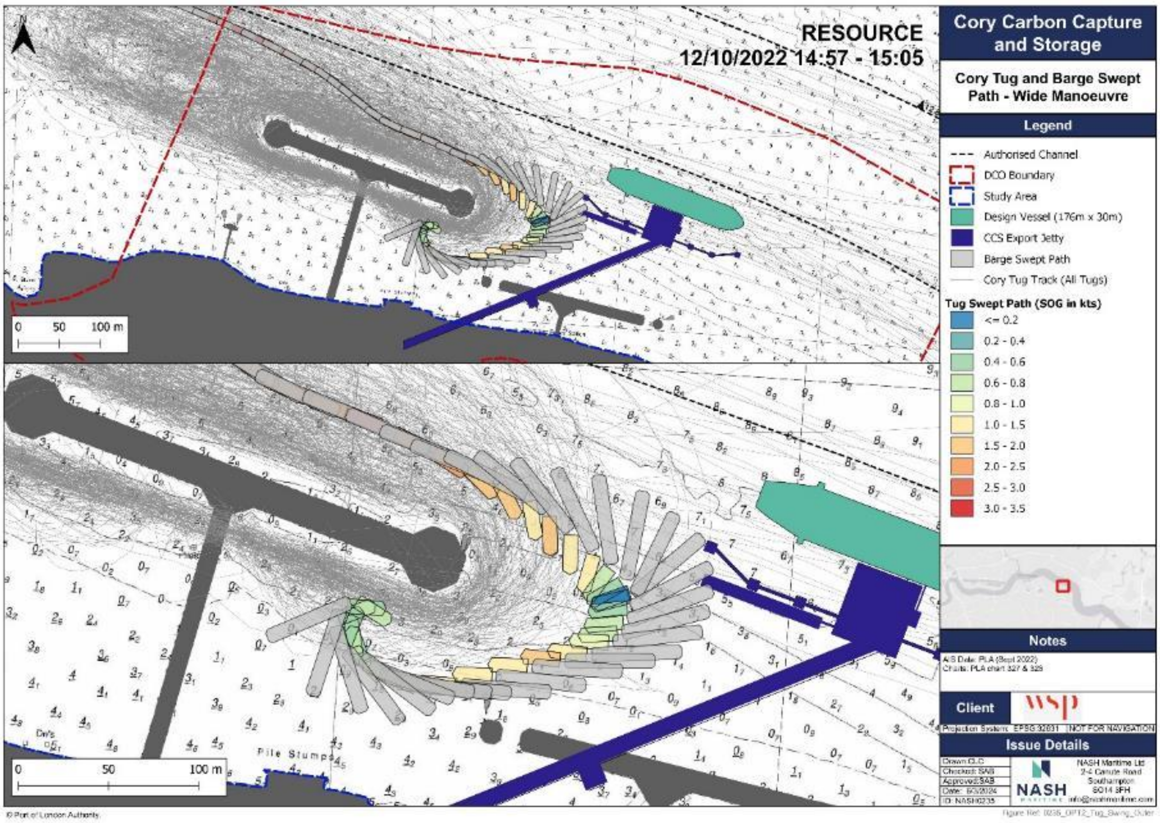


Figure 43: Cory Tug and Barge Flood Tide Berthing

3.5 VESSEL TRAFFIC SURVEY

A vessel traffic survey was conducted to better understand and quantify how Cory tug and barge manoeuvres may operate and the likely spatial requirements within the vicinity of Middleton Jetty with the Proposed Jetty in place. The survey involved placing the following equipment within the Study Area:

1) Three pellet buoys (with flashing lights) placed on the 31-Oct-23 and positioned as shown in Figure 1 to demarcate the western extent of the Proposed Jetty;

2) A high definition PTZ optical sensor (with low light image functionality) set up on the 17-Oct-23 in the position illustrated in **Figure 44**; and

3) An AIS receiver also set up on the 17-Oct-23 and located alongside the CCTV camera.

The deployed equipment allowed for the project team to collect imagery and AIS data over a one month period of all vessel movements in the vicinity of the pellet buoys.

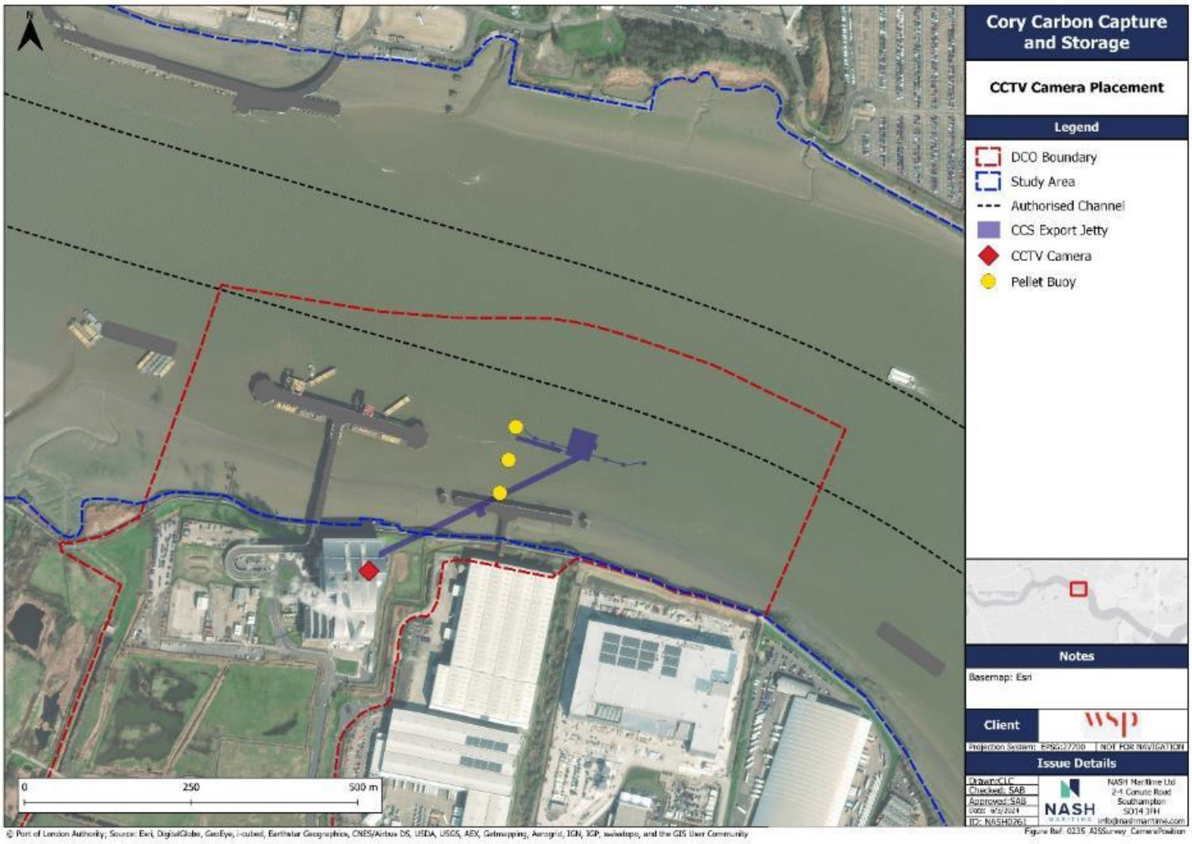


Figure 44: Camera and Pellet Buoy Positions

3.5.1 CLdN Vessel Movements

Prior to the installation of the pellet buoys (19-25 Oct), several CLdN Ro-Ro cargo vessels were recorded transiting through the Study Area on their way to / from Ford's Jetty from downriver. These tracks are shown in **Figure 45**, alongside the accompanying imagery of the vessels at the point in time indicated within the plot.

The orange, blue and purple makers show the Ro-Ro cargo vessels *Celestine*, *Adeline* and *Wilhelmine,* respectively. In all three scenarios highlighted in **Figure 45**, the vessels come within 36m of the authorised channel boundary, 58m of the design vessel and 85m of the Proposed Jetty.

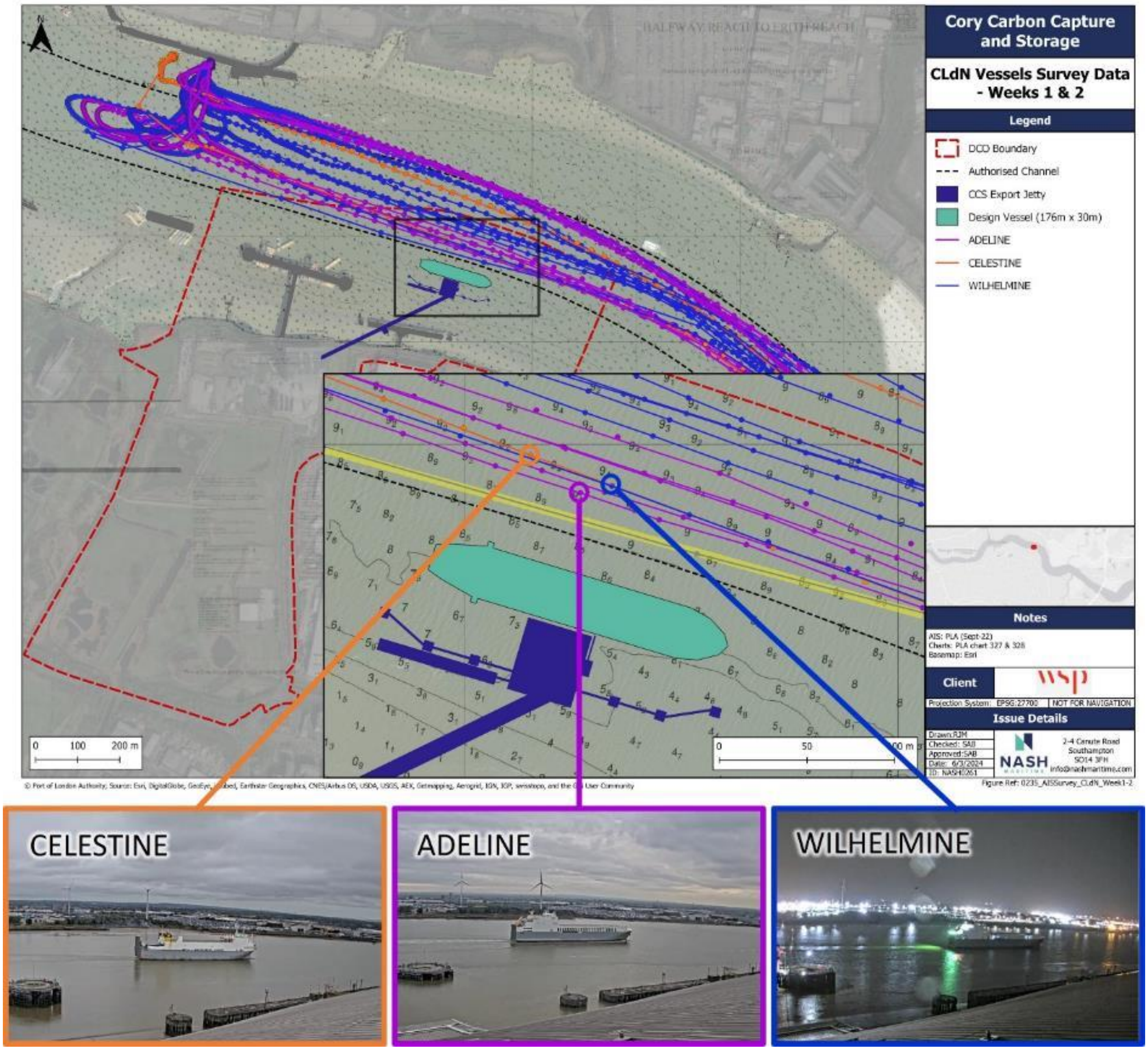


Figure 45: CLdN vessels transiting through the Study Area

The vessel track highlighted in yellow in **Figure 45** shows the vessel *Wilhelmine* on 30-Oct-23 at 22hr00 passing within 10m of the authorised channel boundary, 30m of the design vessel and 61m of the Proposed Jetty. During the week of data in which CLdN vessel transits were analysed, this was by far the closest transit to the project infrastructure. In order to further understand why the vessel *Wilhelmine* navigated in proximity to the southern boundary of the authorised channel, the CCTV footage from the time period was analysed as shown in **Figure 46**. The CCTV footage shows that *Wilhelmine* was taking action to avoid the approaching dredger *Hanson Thames* which was situated in the centre of the authorised channel. A swept path analysis shown in **Figure 47** further illustrates the encounter and shows that the vessels *Wilhelmine* and *Hanson Thames* passed within 92m of each other as they passed Middleton Jetty.

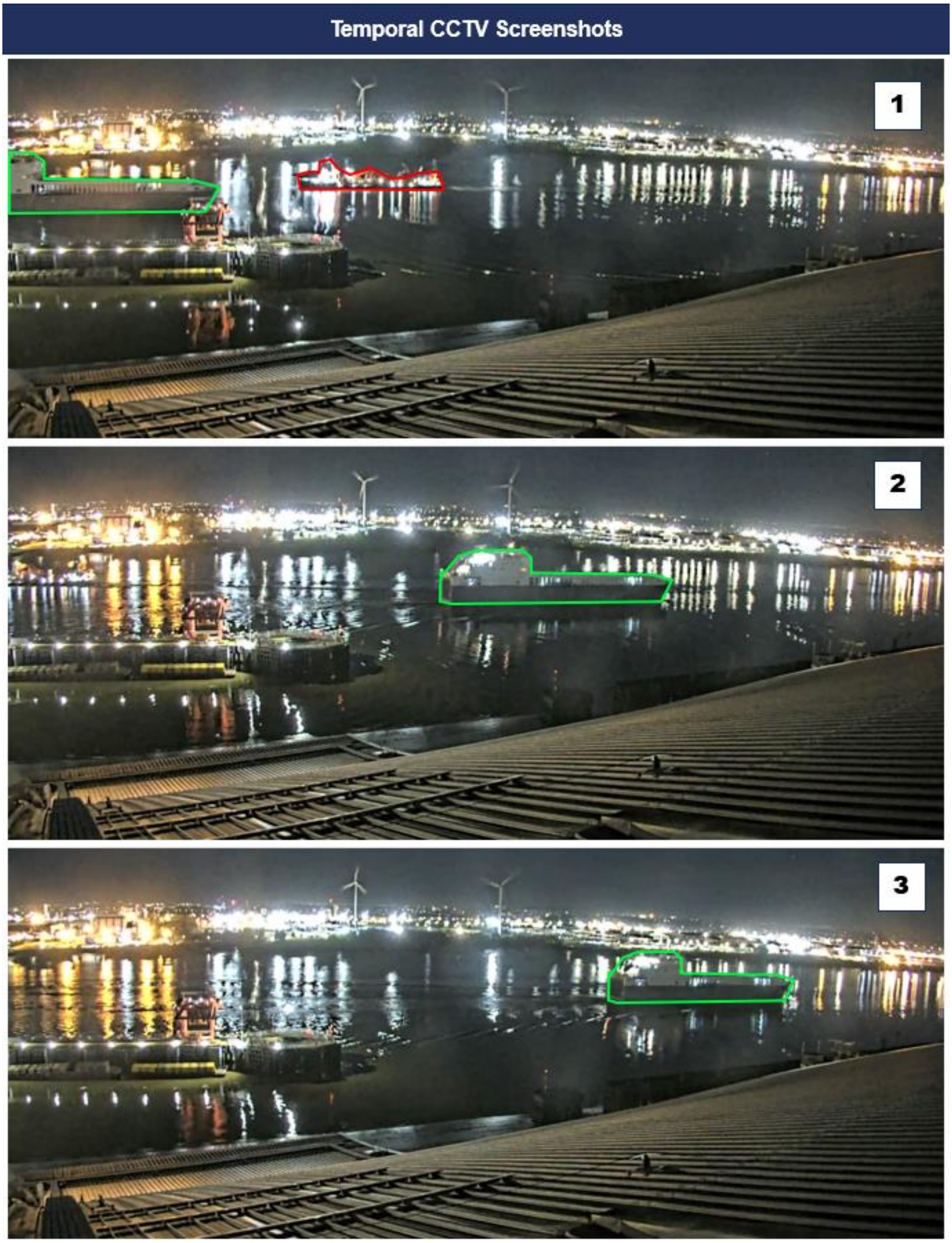


Figure 46: CCTV footage on 30-Oct-23 at approximately 22hr00, showing the dredger *Hanson Thames (outlined in red)* and the cargo vessel *Wilhelmine (outlined in green)*

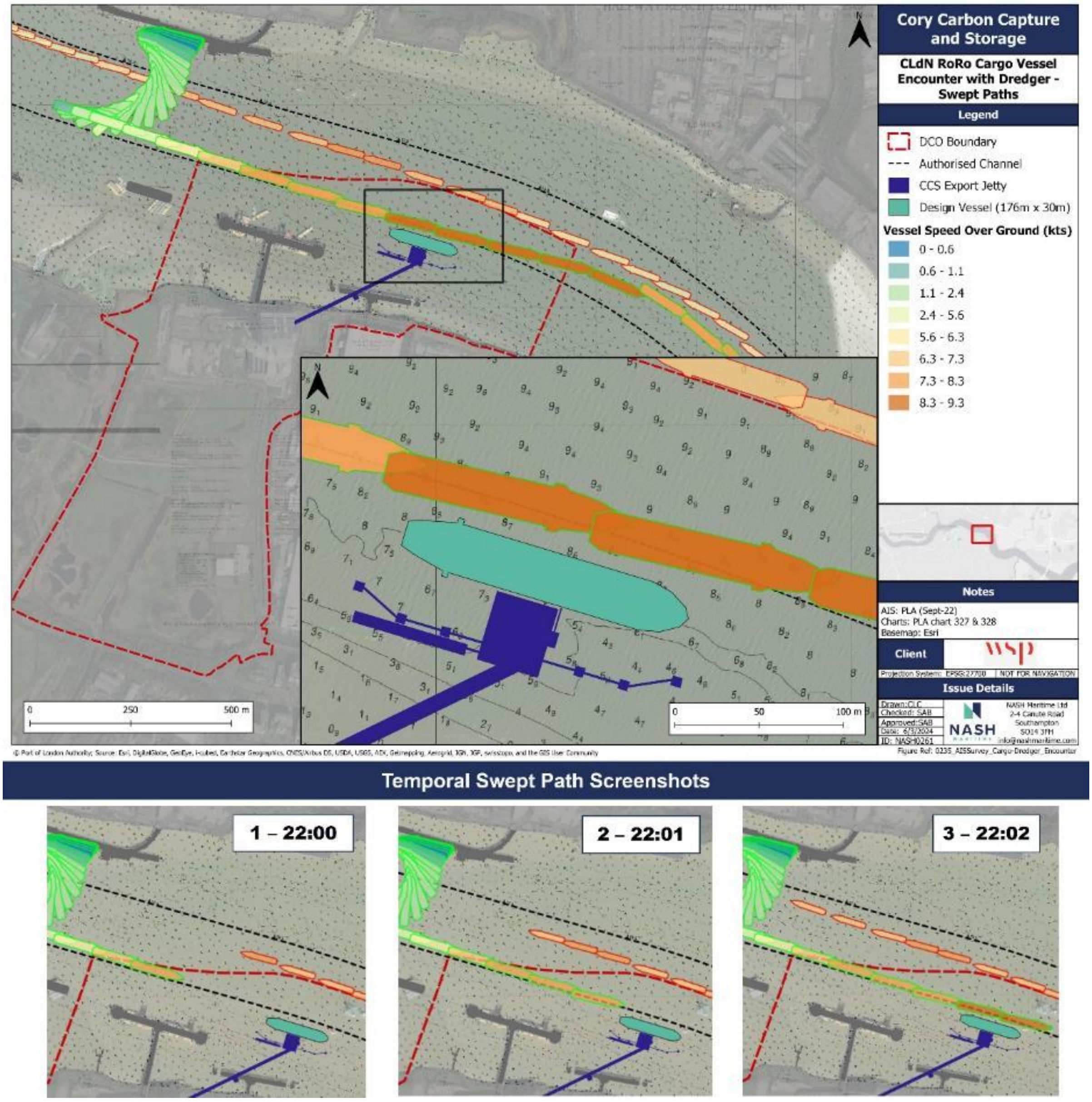


Figure 47: Swept path analysis showing the dredger *Hanson Thames* and the cargo vessel *Wilhelmine* on 30-Oct-23 at approximately 22hr00

3.5.2 Cory Tug and Barge Movements

Analysis has been undertaken for the movements to and from Middleton Jetty in order to understand how current activity may interact with the Proposed Jetty. The operations servicing barges on the southeastern side of Middleton Jetty require tugs to manoeuvre past the existing Belvedere Power Station Jetty (disused) and the location for the Proposed Jetty. To understand the water space required for these manoeuvres, the operations were monitored through AIS and camera. Generally the route taken around the Middleton Jetty to the southeastern side is dependent on the current state of tide. On an ebb tide, the tug will manoeuvre close to the Middleton Jetty as it will generally get set towards the east whereas during the flood, the vessel will get set to the west so the tug maintains a greater distance to the Middleton Jetty to offset this.

The AIS tracks recorded for the third week of the vessel traffic survey are presented in **Figure** 48 along with swept paths illustrating the manoeuvres which were closest to the Proposed Jetty location.

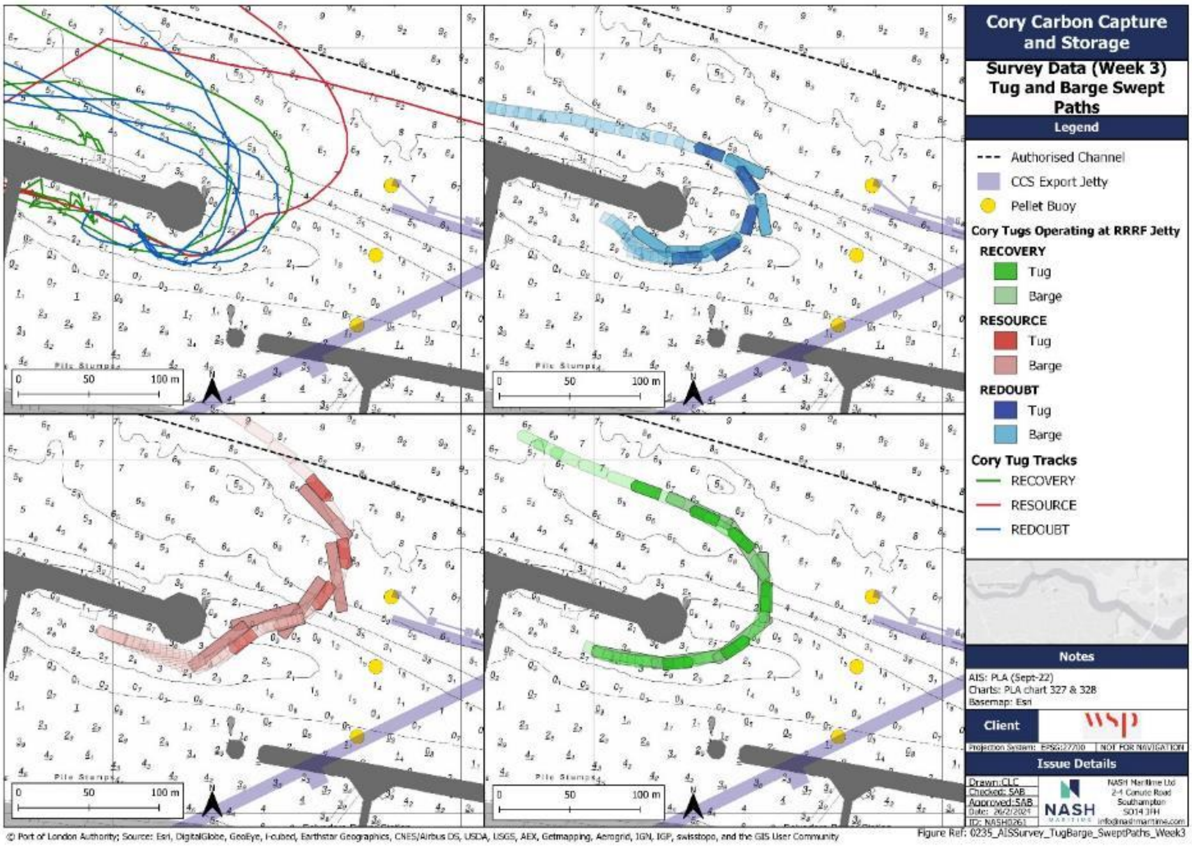


Figure 48: Cory Tug and Barge Tracks and Swept Paths

The swept paths for the Recovery and Redoubt shown in **Figure 48** are from the tugs taking a single barge from the southeastern side of Middleton Jetty. These manoeuvres are shown to pass at circa 50m from the Proposed Jetty location with limited swing from the barge due to the short tow lines and bridle configuration.

The swept path for the Resource was recorded during Storm Ciaran on 03-Nov-23 in which the tug attached the barge on the hip to allow for greater control over its movement given the increased wind conditions. The manoeuvre involved bringing a single barge to the southeastern side of the Middleton Jetty which resulted in a closest point of approximately 30m from the Proposed Jetty location which was the closest recorded.

The closest point between a tug or barge and the buoys is shown in **Figure 49**.

Following early outputs of the Cory tug and barge Vessel Traffic Survey a meeting was held via Microsoft Team with James Andrew (Head of Lighterage and Ship Repair) at Cory. The meeting took place on 09-Nov-2023 at 15:00.

During the meeting James Andrews commented that none of the manoeuvres shown in the analysis (the same analysis as is presented in this section of the report) gave any cause for concern in relation to proximity of Cory tug and barges and the installed pellet buoys.

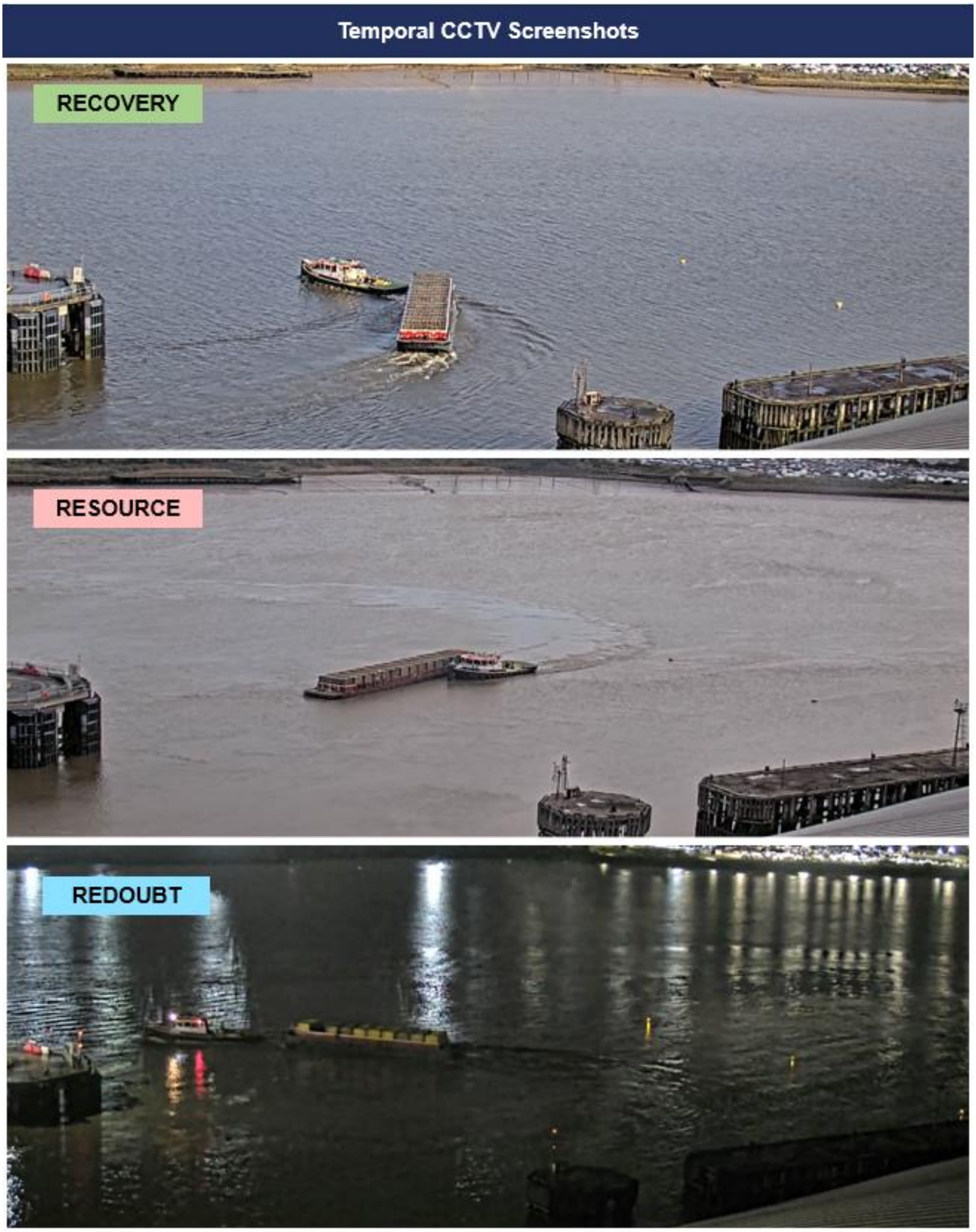


Figure 49: Tug/Barge Closest Points to Buoys

3.6 PNRA VESSEL TRAFFIC BASELINE

A detailed understanding of the baseline vessel traffic profile is crucial to informing hazard likelihood and consequence scores. In order to properly inform pNRA hazard scoring a full understanding of the future case vessel traffic profile must be understood and consideration to this should be given undertaking hazard scoring. The vessel traffic profile that informs hazard scoring in the pNRA differs to that presented in the above sections because it is derived from historic AIS data and does not account for:

- General increases in vessel traffic likely to come into fruition by 2028, (when the initial phase of the Proposed Scheme is planned to commence);
- Increases in movements by Cory tug and barges to facilitate supply to Riverside 2; and
- Increases in vessel movements resulting from the Proposed Scheme export operation.

3.6.1 General Future Increases in Vessel Traffic

The "Thames Vision 2050 (PLA, 2022)" was launched by the PLA in 2022 and includes goals to:

- Handle 60–80 million tonnes of cargo each year within the Port of London;
- Double inland waterways freight carried on the river from 2 million to 4 million tonnes per year;
- Double the number of people travelling by river to reach 20 million trips per year; and
- Increase participation in sport and recreational activities on and alongside the water.

The Port of London Economic Impact Study (Spring PLA, 2020) showed that the port handled 54 million tonnes of freight in 2019 and handled 9.8 million passenger journeys during April 2018 to March 2019 (9.2 million for April 2019 to Feb 2020; March 2020 data is not available and may be impacted by COVID-19). This study did not report on inland freight or recreational use of the river Thames.

The Thames Vision Progress Review 2016 – 2020 (PLA, 2021) noted the 2019 peak in port trade at 54 million tonnes and 3.4 million tonnes of (non-project) inland waterways freight. It also reported around 10 million passenger trips per year from 2015 to 2019 and various initiatives which had led to giving more people access to the River Thames for recreation.

The "Future Trade through the Port of London, Alternative Decarbonisation and Growth Pathways (Oxford Economics, 2021)" report published in May 2021 forecasts (under its central/base case scenario) a total of 77 million tonnes of cargo passing through the Port of London by 2050. This is driven by a big increase in inter-port trade in unitised cargo and forest products (timber for construction) offset somewhat by a decrease in liquid bulks (petroleum products) by 2050. Intra-port trade (cargo moving between terminals on the River Thames and cargo from Medway and Brightlingsea) is forecast to remain static out to 2050.

All of the Thames Vision 2050 goals and the Future Trade through the Port of London forecasts will add to the river traffic but are unlikely to materially change the type of vessels transiting the Study Area or their typical use of that area. The projected increase in vessels carrying unitised cargo and decrease in liquid bulk vessels will likely mainly impact on terminals downstream of the Study Area and will thus not impact the Proposed Scheme navigation risks.

3.6.2 Increases in Movements by Cory Tug and Barges to Facilitate Supply to Riverside 2

Figure 50 is a schematic that summarises the number of arrivals and departures at the Middleton Jetty, once Riverside 2 is operational. In order to supply both Riverside 1 and Riverside 2 the Cory marine operation will expand to include:

- 16 vessel movements per day (includes arrivals and departures);
- Six upstream arrivals and six departures;
- Two downstream arrivals and two departures;
- All tug and barge vessel movements will occur over one (daytime) tide other than Tilbury ash movement (downstream) which is over two tides.
- Six day a week operation;
- This will generate approximately 4,990 tug and barge movements per annum to Middleton Jetty; and
- There will be an increase of approximately 1,870 tug and barge movements to Middleton Jetty as opposed to the current baseline scenario outlined in **Section 3.2.4**.

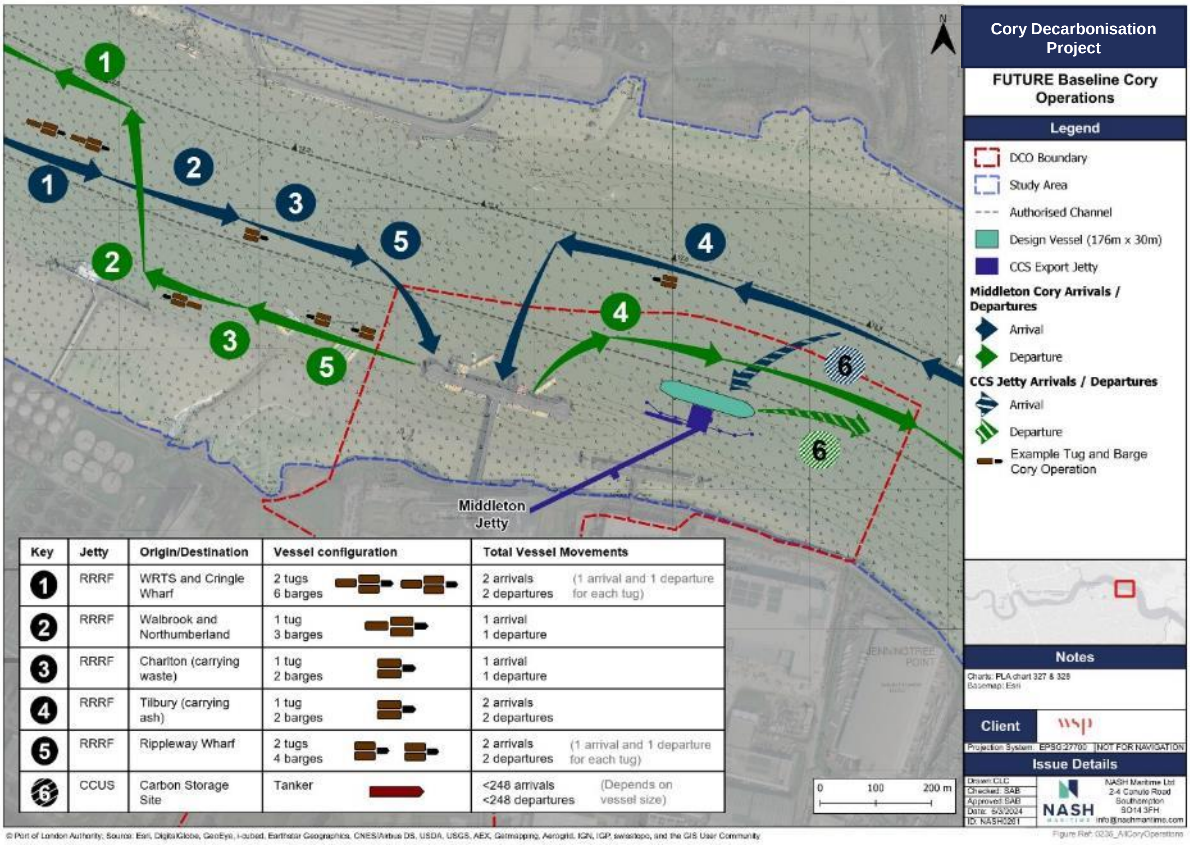


Figure 50: Future pNRA Baseline Cory Operation

The future Cory tug and barge marine operation outlined in this section has already been the subject of an pNRA, approved by the PLA. The pNRA was conducted by Marico Marine and formed an annex to the Riverside 2 ES[3]. The pNRA concluded that "*additional movements associated with the Riverside Campus would have a Negligible impact upon navigational safety on the River Thames with all hazards remaining inside ALARP with existing risk controls in place*".

The Cory marine operation outlined in this section and illustrated in **Figure 50** will form the basis for the pNRA assessment for the Proposed Jetty.

3.6.3 Increases in Vessel Movements Resulting from the Proposed Scheme

The Proposed Scheme LCO_2 export operation will result in an increase in vessel movements. The maximum estimate increase in vessel movements is likely to be 422 per annum, including arrivals and departures. This is based on utilising a vessel with a cbm^3 of 7,500 and includes arrivals and departures.

[3] https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010093/EN010093-000245-6.3%20ES%20Technical%20Appendices%20B.2%20Navigational%20Risk%20Assessment.pdf – Accessed Aug 2022

4. HAZARD LIKELIHOOD MODELLING

4.1 INTRODUCTION AND METHODOLOGY

IWRAP MKII was used to perform risk frequency analysis for collision, contact and grounding within the Study Area. The risk frequency analysis is based on a mathematical model that is based on statistical analysis of vessel routes.

The Study Area is modelled using a number of vessel routes called 'legs'. For each leg, the number and types of vessels transiting in each direction are identified from the AIS data used in the study, and a statistical distribution is assigned describing how far from the centre of the leg vessels are travelling. The model then calculates how many collisions, contacts or groundings will occur if all the vessels sail straight ahead without taking any evasive manoeuvres or actions to avoid an incident. The total number of collisions, contacts or groundings is the number of geometrical candidates multiplied by the causation factor. This method has been extensively tested and found to estimate the number of collisions and allisions close to the observed numbers all around the world, however IWRAP is a risk model and provides only a theoretical evidenced based assessment of risk.

For this study, the following data was used to inform the model:

- AIS vessel traffic data from Sep 2022 provided by the PLA;
- 1m contour bathymetry showing water depth at Mean High Water (MHW) provided by the PLA (see **Section 2.1.2** for details on the bathymetry used); and
- Infrastructure shape files of existing infrastructure within the Study Area such as jetties and moorings, and a shape file of the Proposed Jetty (used in futurecase models only).

The vessel sub-categories that were extracted from the AIS data were filtered down into the following 13 categories available for use in IWRAP:

- Cargo:
    - General Cargo;
    - Bulk carrier;
    - Container; and
    - Ro-Ro-Cargo.
- Tanker:
    - Oil Product Tanker;
    - Gas Tanker;
    - Chemical tanker; and
    - Crude Oil Tanker.
- Passenger:
    - Fast Ferry; and
    - Passenger/Cruise Ship.
- Fishing vessel;

- Recreational vessel; and
- Support ship i.e. tug and service vessels.

The risk modelling was conducted in two phases:

- **Phase 1:** Modelling of a **basecase scenario** in which existing infrastructure and vessel traffic activity is used to establish the baseline navigation risk within the Study Area.
- **Phase 2:** Modelling of a **futurecase scenario** to establish how the Proposed Jetty (in its Option 2 iteration) and its associated marine operations may change navigation risk within the Study Area. The futurecase scenario considers several additional factors compared to the basecase model. This includes:
    - The Proposed Jetty infrastructure;
    - The project tanker movements associated with the Proposed Jetty (see **Section 3.6**); and
    - Additional Cory tug movements at Middleton Jetty, as a result of Riverside 2 (see **Section 3.6**).

Due to the limitations of theoretical statistical risk modelling when applied to real world scenarios, the following caveats should be acknowledged when considering the risk modelling results for this study:

- The model is simplified compared to a real world scenario (see the IALA IWRAP Mk2 Wiki page[4] for more information);
- Vessel traffic data is annualised from 1 month of data, therefore, the seasonal, daily and hourly variation in vessel traffic is not accounted for;
- All tugs towing barges will not have the barges represented in the AIS data as they do not carry AIS equipment on board;
- The bathymetry is tidally averaged between MHWS and MHWN to get MHW, therefore, grounding results do not consider tidal variation;
- The dredged pocket (as detailed in **Section 4.1**) is not included in the bathymetry so grounding results will not account for this;
- Futurecase modelling does not include general predicted trends for vessel traffic on the Thames and therefore may not fully capture the change in vessel activity over time. Note, general increases **(Section 3.6.1)** in vessel traffic have been considered qualitatively when scoring hazard likelihood (see **Section 8**).

4.2 IWRAP MODELLING RESULTS

The following section provides a quantitative overview of the collision, contact and grounding risk modelling results from IWRAP MKII as described in **Section 4.1**. All results are summarised in **Table 6**.

IWRAP calculates the risk that a collision might occur using mathematical models. Firstly, it should be noted that it is unable to capture the full extent of existing risk controls, such as

[redacted]

pilotage and vessel scheduling which might deconflict traffic. Therefore, these modelled results are considered precautionary. Secondly, IWRAP calculates the likelihood of any incident occurring, and therefore many of these incidents are likely to be of low consequence.

Table 6: Summary of IWRAP Risk Modelling results. Likelihood score units = years between incidents (Tidal State at MHW)

Scenario	Basecase	Futurecase
Collisions		
Large commercial ICW. Large commercial	151	94
Large commercial ICW. Small Craft	55	28
Small craft ICW. Small Craft	158	53
Contacts (Powered)		
Large commercial[2]	22	13
Small craft	4.8	1.5
Contacts (Drifting)		
Large commercial[2]	88	78
Small craft	40	31
Groundings (Powered)		
Large commercial[3]	24	22
Small craft	N/A[1]	N/A[1]
Groundings (Drift)		
Large commercial[3]	219	221
Small craft	N/A[1]	N/A[1]

Notes:

Large commercial vessels include cargo, tankers and passenger ships.

Small craft include tug and service (including Cory movements) and recreational.

[1] Due to the shallow draft of small craft, grounding modelling was not undertaken.

[2] Allision modelling of large commercial vessels excludes oil tankers coming alongside the Proposed Jetty.

[3] Grounding modelling excludes oil tankers coming alongside the Proposed Jetty as the berth pocket was not included and therefore was unrepresentative.

4.2.1 Collisions

Figure 51 and **Figure 52** show the IWRAP collision risk modelling results for the basecase and futurecase scenarios.

Table 6 shows that the likelihood of collision is modelled to increase between the basecase and futurecase scenarios. **Figure 51** shows that this change in collision risk likelihood is mostly affected by the change in risk by support ships (including tug and service vessels) but also by other large commercial ships including bulk carrier and Ro-Ro cargo ships. This increase in risk is driven by an increase in the number of vessel movements and changes to the routes taken by the vessels in the futurecase scenario.

Figure 52 shows that the majority of the increase in collision risk likelihood is centred around legs to the east of the project. The presence of the Proposed Jetty has been modelled to offset traffic currently navigating inshore, towards the southern river bank, towards the authorised channel. By concentrating traffic in this way, IWRAP predicts an increase in collision risk as vessels are more likely to encounter one another. Furthermore, an additional leg has been added to accommodate project tankers (see Oil products tanker in **Figure 51**) accessing the proposed Jetty. This creates an additional merging risk as these vessels join the main flow of traffic and may collide with other passing vessels.

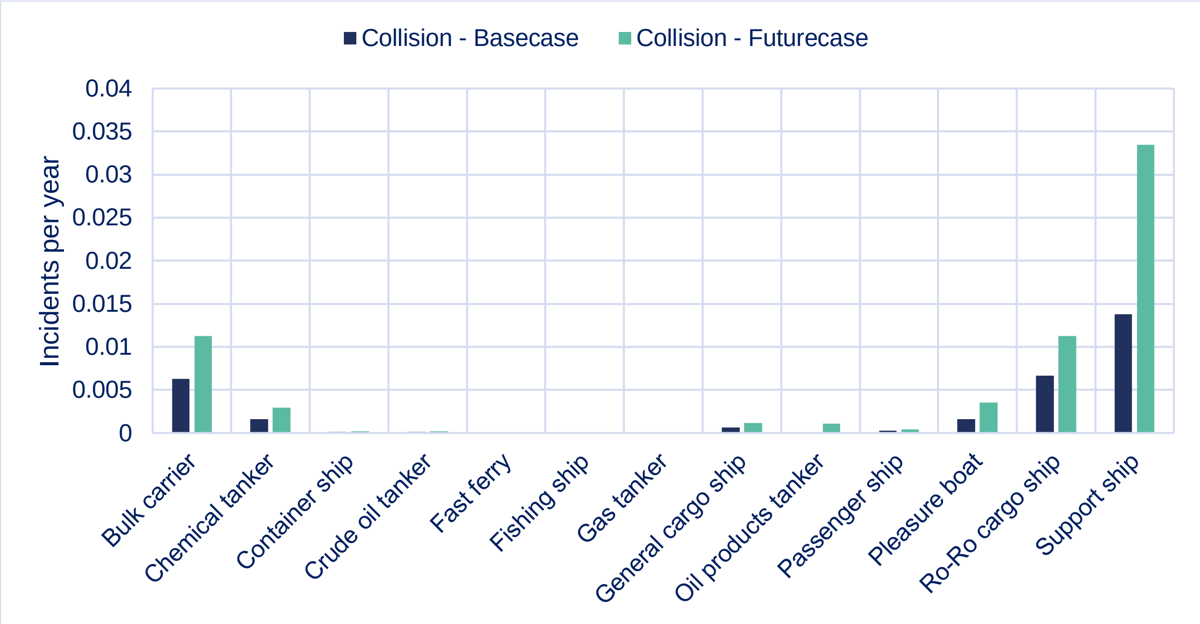


Figure 51: IWRAP Risk Modelling Results - Collision

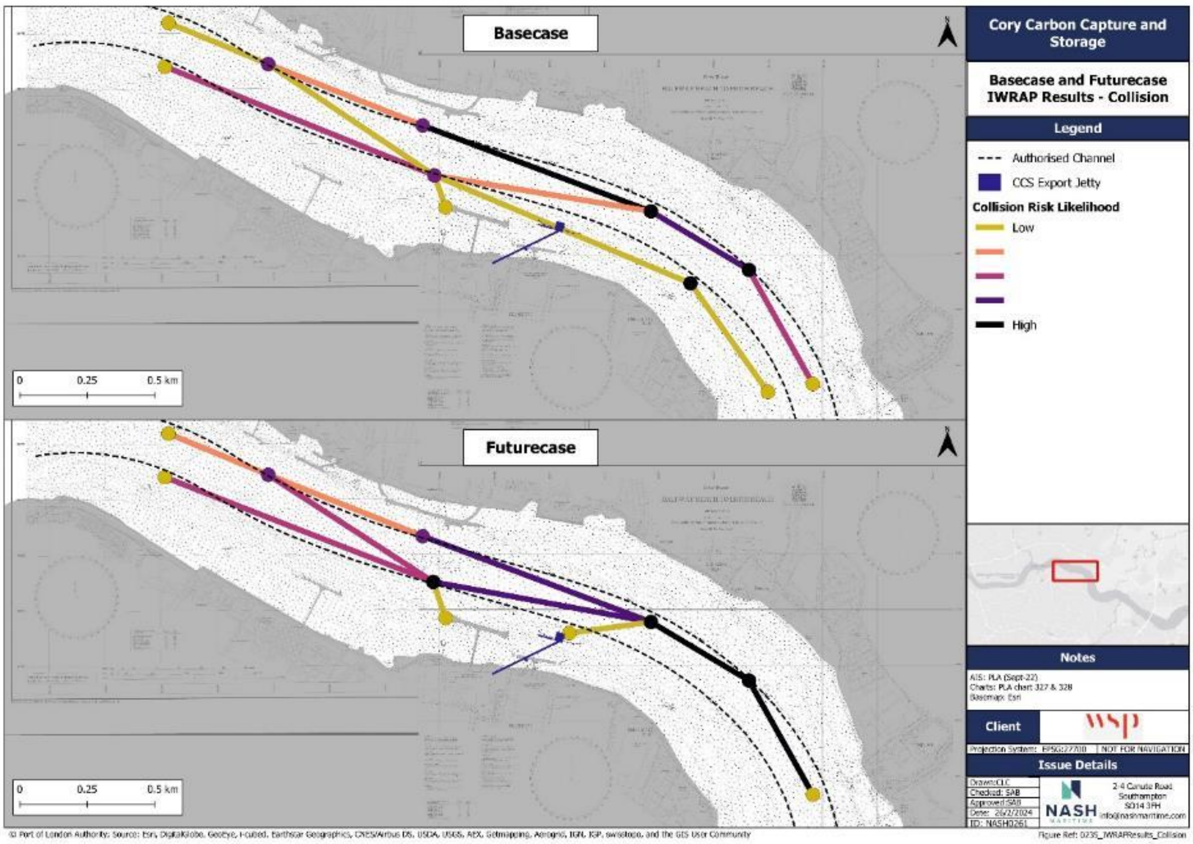


Figure 52: Collision IWRAP Results

4.2.2 Contacts

Figure 53 and **Figure 54** show the IWRAP contact risk modelling results for the basecase and futurecase scenarios.

Table 6 shows that the overall likelihood of contact increases for both powered and drifting scenarios between the basecase to the futurecase scenario. The additional infrastructure in close proximity to the authorised channel poses a hazard to passing large commercial vessels should human error or mechanical failure occur. **Figure 53** shows that support ships (tug and service vessels) predominantly drive the contact risk likelihood in both the basecase and futurecase scenarios. This is most likely because tug and service vessels are the most active vessel type in the Study Area and are modelled to come on and off the berths.

Figure 54 shows that contact is more likely to occur on structures that are closest to the authorised channel where the majority of vessel traffic transits.

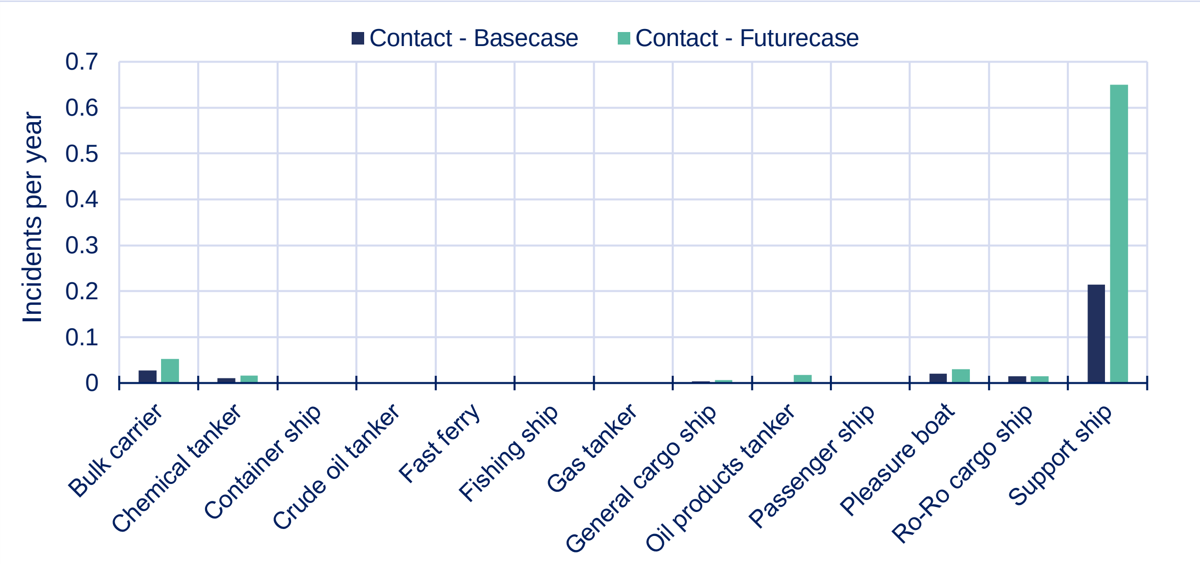


Figure 53: IWRAP Risk Modelling Results - Contact

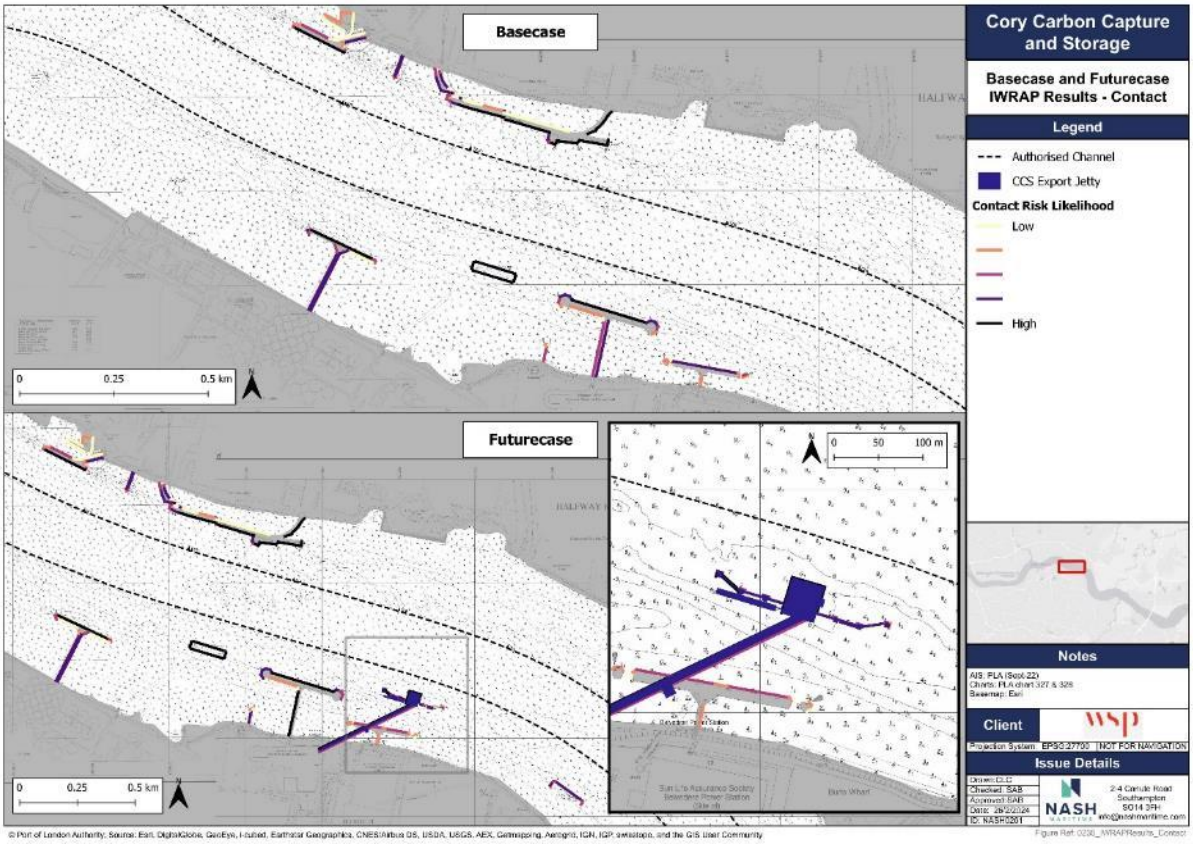


Figure 54: Contact IWRAP Results

4.2.3 Groundings

Figure 55 and **Figure 56** show the IWRAP grounding risk modelling results for the basecase and futurecase scenarios. **Table 6** shows that there is a negligible change in the overall likelihood of grounding for passing vessels as there is a minimal impact on the routes and bathymetry in the Study Area.

Figure 55 shows that the increase in grounding is heavily influenced by the project tankers (labelled as oil product tankers in **Figure 55**) that will be accessing the Proposed Jetty. It must be noted (as detailed in **Section 4.1**) that the IWRAP model does not include the dredged pocket that is included in the Proposed Scheme (see **Section 1.4.3**) and therefore has been excluded from the results in **Table 6**. Therefore, the grounding likelihood calculated for the futurecase scenario, is not fully representative of the Proposed Jetty design and highly precautionary. The dredged pocket will increase depth alongside the Proposed Jetty and dramatically reduce the likelihood of a grounding incident.

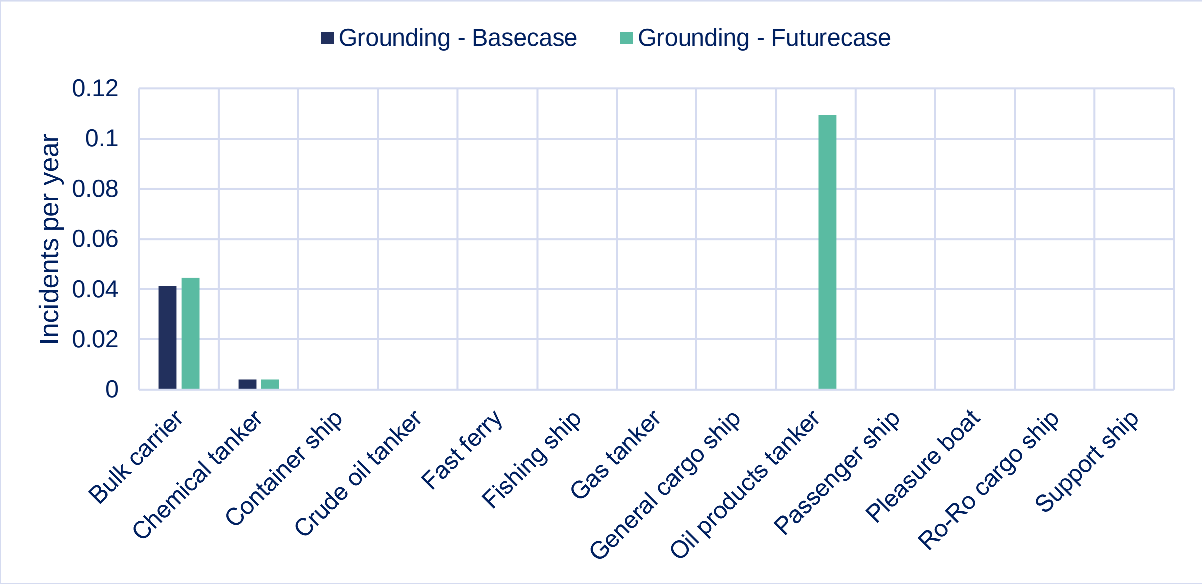


Figure 55: IWRAP Risk Modelling Results - Grounding

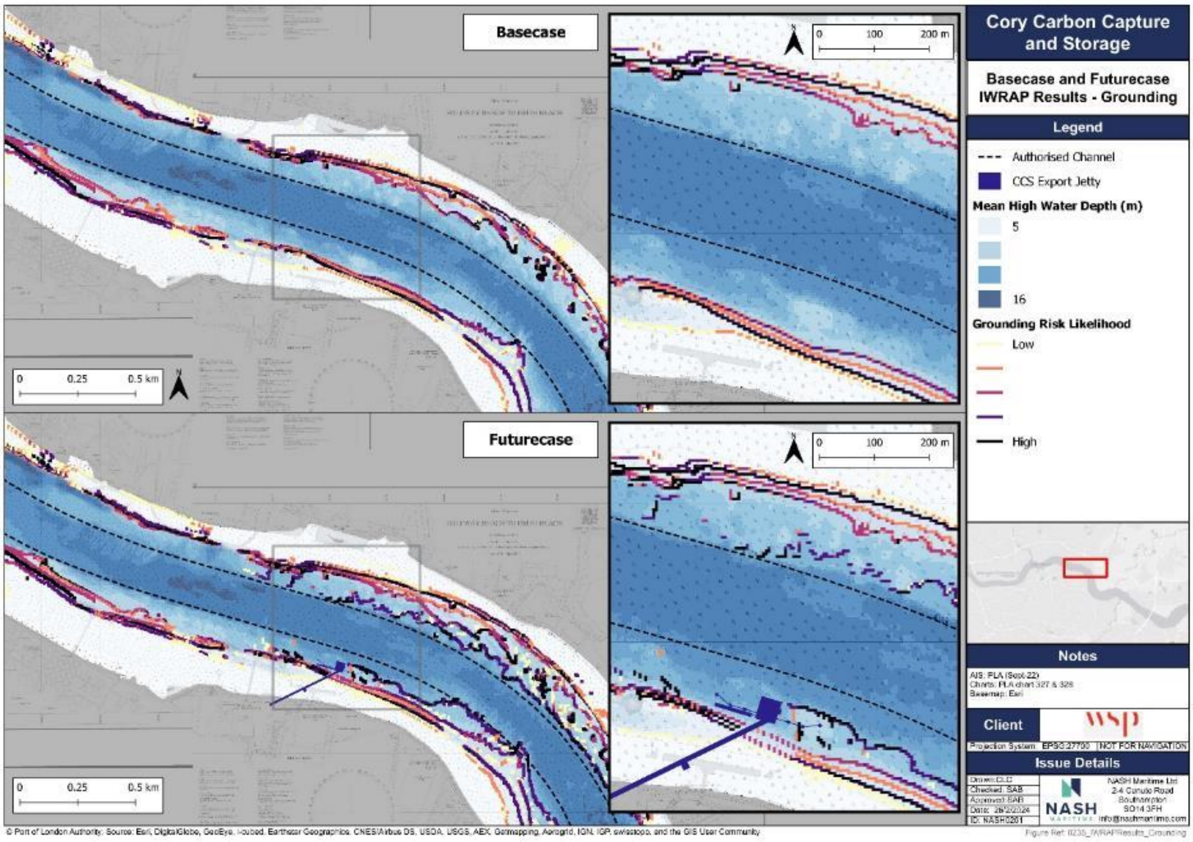


Figure 56: Grounding IWRAP Results

4.3 HAZARD LIKELIHOOD MODELLING FINDINGS

The findings of the hazard likelihood modelling are summarised below:

- The likelihood of collision is modelled to increase between the basecase and futurecase scenarios. This increase in risk is predominately associated with support ships, Ro-Ro and bulk cargo vessels and is driven by an increase in the number of vessel movements and changes to the routes taken by the vessels in the futurecase scenario.
- The overall likelihood of contact increases for both powered and drifting scenarios between the basecase to the futurecase scenario. The additional infrastructure (Proposed Jetty) is in close proximity to the authorised channel and poses a hazard to passing large commercial vessels should human error or mechanical failure occur.
- Support ships (tug and service vessels) predominantly drive the contact risk likelihood in both the basecase and futurecase scenarios.
- Grounding risk modelling results for the basecase and futurecase scenarios show that there is a negligible change in the overall likelihood of grounding for passing (third party) vessels as there is a minimal impact on the routes and bathymetry in the Study Area.

The results of the hazard likelihood modelling were considered when informing the hazard likelihood scores within the NRA, as detailed in **Section 7**.

5. STAKEHOLDER CONSULTATION

The elicitation of key stakeholder and regulator knowledge and opinion is essential to the risk assessment process. The purpose of stakeholder and regulator consultation is primarily to identify any key navigation issues/hazards and potential risk control mitigation measures for consideration in the risk assessment process.

This section summarises the key consultation meetings undertaken to inform this pNRA and includes consultation meetings facilitated by the NASH Maritime (and / or WSP) that were conducted during early stages of the Proposed Jetty design development and during a preliminary Navigation Hazard Analysis (pNHA) conducted by NASH Maritime. The earlier consultation meetings include references to:

- Proposed Jetty design iterations that were considered during early-stage design development;
- Simulation studies conducted by NASH Maritime (as reported in **Section 1.4.2**; and
- References to the pNHA conducted by NASH Maritime in order identify design critical navigational issues.

The inclusion of minutes from meetings undertaken prior to the commencement of the formal pNRA process is deemed necessary because the findings of these meetings are crucial to developing a full understanding of the navigation environment within Study Area, Cory's existing and future tug and barge operation, decisions taken that informed the early-stage design process and PLA oversight of the design and pNRA process.

Meeting minutes and presentations for meetings reported in this section can be found in **Appendix A.**

5.1 CONSULTATION PRIOR TO FORMAL PNRA COMMENCEMENT.

The following consultation meetings took place prior to the commencement of the pNRA. Note, two pNHA documents were produced by NASH Maritime, the first (referred to below as the initial pNHA) was superseded by a second document (referred to in this sections as the pNHA) the requirement for which was necessitated as a result of a change in the Proposed Jetty location and the need to include the findings of the ship bridge simulations, (see **Section 1.4.2**).

5.1.1 PLA Scope Consultation (Initial pNHA)

An introductory meeting, hosted by WSP was held with the PLA. The purpose of the meeting was to review the components of the NRA scope (encompassing the pNHA, ship bridge simulations and pNRA) and methodology in order to incorporate regulator feedback.

The meeting was held on 22-Jul 2022 between 10am and 11am and was attended by:

- **PLA**
  - Lucy Owens (LO) – Deputy Director of Planning and Development;
  - Michael Atkins (MA) - Senior Planning Officer; and
  - Darren Knight (DK) - Deputy Harbour Master.

- **Cory**
  - Ross Brown (RB) – Project Lead, Carbon Capture and Storage; and
  - James Andrews (JA) – Head of Lighterage and Ship Repair.
- **WSP**
  - Jonathan Pierre (JP) – Associate Director; and
  - Jane Templeton (JT) – Principal Engineer, Maritime.
- **Hendeca**
  - Kirsten Berry (KB) – Consultant working on behalf of Cory.
- **NASH Maritime Ltd**
  - Ed Rogers (ER) – Project Director;
  - Nigel Bassett (NB) – Master Mariner and Subject Matter Expert;
  - Sam Anderson-Brown (SAB) - Principal Consultant; and
  - Adam Fitzpatrick (AF) – Senior Consultant.

Key points of discussion, relating to the NRA scope (as defined above), are summarised below:

- NRA should give due consideration to future vessel traffic baseline resulting from increased passenger vessel traffic in proximity to the Proposed Jetty.
- It was suggested that Lydia Hutchinson (PLA Marine Manager) and David Allsop (Assistant Harbour Master) should be included in future consultation meetings[5].
- There were no further comments on the NRA scope which was felt to be appropriate to the assessment.

5.1.2 Cory Consultation (Initial pNHA)

A consultation meeting was held on 02-Aug-22 between 12:30 and 13:30 to discuss current and future baseline Cory lighterage operations. The specific aims of the consultation meeting were to:

- Validate understanding of the current Cory lighterage operations at the Middleton Jetty and more broadly between Tilbury and the Western Riverside Transfer Site.
- Refine understanding of the uplift in tug and barge movements required to support the increase in supply of refuse material to the Middleton Jetty once Riverside 2 is operational.
- Identify any navigational issues associated with interaction between the lighterage operation at the Middleton Jetty (giving due consideration to the increased vessel movements required to support Riverside 2) and the Proposed Scheme.

The meeting was attended by:

- **Cory:**

    - James Andrews (JA) – Head of Lighterage and Boat Maintenance.
- **WSP:**
    - Jane Templeton (JT) – Principal Engineer, Maritime.

NASH Maritime Ltd:

- Sam Anderson-Brown (SAB) – Principal Consultant; and
- Adam Fitzpatrick (AF) – Senior Consultant.

A summary of the key discussion points is outlined below:

- JA suggested some minor amendments to vessel movement schematics produced by NASH.
- JA explained that the positioning of the Proposed Jetty means that additional barge moorings which are being consulted on with the PLA can now no longer be installed directly downstream from the Middleton Jetty. Additional barge moorings are required and will need to be positioned either upstream of the existing barge moorings and in line with the Thames Water jetty or to the north of the authorised channel. Positioning of the additional barge moorings will bring differing operational and navigational risk challenges. JA would prefer the moorings were located upstream of the existing moorings. JA to keep SAB informed of progress regarding installation of additional barge moorings.
- Adequate navigable width will be required between the berthed tanker / Proposed Jetty and the Middleton Jetty to enable Cory tugs to manoeuvre barges on to the inshore side of Middleton Jetty. JA anticipates that adequate navigable width would be no less than 125m. NASH to produce scale drawing to review navigable width and report findings back.
- JA noted that there would potentially be logistical challenges in servicing the additional barges at Middleton Jetty with the available mooring space, infrastructure and equipment.

5.1.3 Formal pNHA Consultation (Initial pNHA)

A consultation meeting we held with the PLA on 09-Aug-2022 between 11:00 and 12:00 via videoconference. The stated aims of the meeting were to:

- Validate the baseline navigational environment;
- Review the identified preliminary hazards and key navigational issues; and
- Discuss next steps including ship bridge simulations and the preliminary Navigation Risk Assessment.

The meeting was attended by:

- **PLA:**
    - Lydia Hutchinson (LH) – Marine Manager; and
    - Adam Layer (AL) - Harbour Master.

- **Cory:**
  - Ross Brown (RB) – Project Lead, Carbon Capture and Storage; and
  - James Andrews (JA) – Head of Lighterage and Boat Maintenance.
- **WSP:**
  - Jane Templeton (JT) – Principal Engineer, Maritime
- **NASH Maritime Ltd:**
  - Sam Anderson-Brown (SAB) - Principal Consultant; and
  - Adam Fitzpatrick (AF) Senior Consultant.

The following key points were discussed:

- SAB noted that the pNRA will take a precautionary approach regarding the design vessels, with the largest vessel and maximum number of vessels moves used to inform pNRA assumptions;
- SAB commented that the project design vessel will likely be tidally restricted and asked whether there are any other tidally restricted vessels arriving / departing berths or on passage through Halfway Reach. AL to provide data for this;
- AL and LH agreed that the baseline characterisation presented was representative of current river activity;
- LH asked about the AIS data being used as some of the slides in the section indicated 2018 data was used. SAB explained that the information presented on the slides in question was taken directly from the NRA for Riverside 2, hence the reference to 2018 data. Analysis for the pNHA has been undertaken using 2021 data. AL commented that there has been a significant increase in activity in 2022 so the most recent data should be used where possible;
- SAB presented the preliminary hazards to vessel navigation associated with the CCS project which comprise 16 hazards in the following 4 categories:
  - Collision;
  - Contact;
  - Grounding; and
  - Breakout.
- SAB noted that the limited line of visibility at Jenningtree Point was a potential issue and the tidal set may affect berthing at the location of the Proposed Jetty. AL agreed;
- LH said that the interactions with passenger vessels in the area given the future increase in movements is potentially significant. SAB asked whether traffic risk modelling will be required. LH confirmed that it will, and the PLA would expect to see this in the pNRA. LH and AL confirmed that no other significant impacts or hazards in addition to those identified and outlined in the presentation were envisaged at this stage; and

- SAB discussed the ship bridge simulations that will be conducted to test the viability of the jetty and any ship handling issues that may arise. SAB asked AL whether the PLA simulator could be used. AL said that the PLA simulator may not be appropriate for this, given current limitations / capability. SAB and AL to discuss further.
- SAB introduced the scope for the pNRA to support the DCO application and asked about other stakeholder consultees for the area. LH noted Ford's Jetty Ro-Ro berth regularly have vessels swinging in the area, GPS Marine regularly transit and that a River Pilot should be consulted. LH to confirm if any further stakeholders need to be consulted.
- SAB agreed to carryout high-level consultation with Erith Yacht Club to ascertain the geographic boundary of the clubs sailing area[6].

5.1.4 Consultation Regarding the use of the PLA Simulator (Initial pNHA)

As per an action to further discuss the option for the project to utilise the PLA simulator (see **Section 5.1.2**) a call between Sam Anderson – Brown (SAB), Principal Consultant, NASH Maritime Ltd and Adam Layer (AL) Harbour Master, PLA was arranged. The call took place via video conference, the key discussion points are summarised below:

- PLA simulator does not have the capability to model new infrastructure;
- It is unlikely that the PLA simulator will be able to model a number of design vessels and or differing metocean conditions;
- PLA do not want to offer the simulator for consultancy work at this time because of limited capability;
- Support from external provider has been withdrawn so PLA lack the ability to model various design vessels;
- PLA river pilots could be made available for simulations); and
- PLA would like to understand operational limitations for berthing, this will form a key risk control and should be explored in detail.

5.1.5 pNHA Findings Workshop (Initial PLA)

A pNHA consultation meeting we held with the PLA on 22-Sep 2022 between 16:00 and 17:00 via videoconference. The aim of the workshop was to present the key findings of the pNHA report and to give the PLA a chance to comment on the findings prior to issue of the pNHA report.

The workshop was attended by:

- **PLA:**
    - Lydia Hutchinson (LH) – Marine Manager; and

[6] Following further discussion with the PLA and amongst the NASH Project it was determined that consultation at this stage would be premature. Erith Yacht Club will be consulted in full as part of the pNRA consultation exercise.

  - Adam Layer (AL) - Harbour Master.
- **WSP:**
  - Jane Templeton (JT) – Principal Engineer, Maritime
- **NASH Maritime Ltd**:
  - Sam Anderson-Brown (SAB) - Principal Consultant;
  - Adam Fitzpatrick (AF) - Senior Consultant; and
  - Nigel Bassett (NB) – Associate Principal Consultant.

The key discussion points are summarised below:

- LH and AL observed that they felt the key navigational issues had been identified.
- AL commented that he saw the definition of appropriate operational limitations as a key risk control measure.
- In relation to the recommendation that navigational modelling be undertaken AL said that the project team needs to show that the project and its operations do not significantly affect safety of navigation and, given the key issues that have been identified, he did not see how this could be achieved without ship bridge simulation.

5.1.6 PLA Consultation (pNHA revision)

A pNHA consultation meeting we held with the PLA on 29-Mar-2023 between 15:00 and 16:00 via videoconference. The meeting had three stated aims and objectives, namely to:

- Recap the findings of the initial pNHA, including the preliminary hazard identification exercise;
- Discuss the Proposed Jetty revised layout; and
- Discuss the next steps for navigation safety work including the ship bridge simulations and scope of the pNRA.

The workshop was attended by:

- **Cory Environmental:**
  - Richard Wilkinson (RW) – Project Director
- **PLA:**
  - Lydia Hutchinson (LH) – Marine Manager
  - Adam Layer (AL) - Harbour Master.
- **WSP:**
  - Jane Templeton (JT) – Principal Engineer (Maritime)
- **NASH Maritime Ltd:**
  - Ed Rogers (ER) - Director
  - Sam Anderson-Brown (SAB) - Principal Consultant;

The key discussion points are summarised below:

- SAB outlined the key drivers for the change in jetty location:
    - Original location was closer to the shore and dredging would have been required in the intertidal zone with serious environmental consequences, which the project team are aiming to avoid;
    - Interaction between the existing Cory tug and barge operation and the LCO_2 tanker operation. Project team consulted with Cory Tug master and conducted swept path analysis which showed the proposed revised location is preferred as the offset between the existing Middleton Jetty and Proposed Jetty gives adequate navigable width for barge movements (particularly on a strong flood tide);
    - Greater clarity on design vessel and subsequent dredging requirements; and
    - Aiming to futureproof the structure for potential hydrogen bunkering facilities in the future.
- SAB explained that NASH are revising the pNHA to take account any perceived changes in navigational risk profile resulting for the change in jetty location.
- NASH summarised key findings from the preliminary hazard analysis. PLA confirmed this was an accurate summary of previous works.
- The Proposed Jetty design was presented and analysis was shown illustrating passing cargo and tanker transits in proximity to the revised Proposed Jetty. This analysis was developed to understand spatially how much sea room passing vessels need to navigate, rather than just looking at vessel tracks:
- NASH noted that passing transits in close proximity to the Proposed Jetty are largely associated with the Ford's Jetty Ro-Ro operation. It was also noted that vessels associated with this operation passed the Proposed Jetty location at relative low speed.
- It was agreed that consultation with the vessel operator should be expedited to understand the full impact of the Proposed Jetty location on the Ford's Jetty Ro-Ro operation.
- An examination of passing cargo and passenger swept paths as well as a review of swept paths showing tanker vessel arrivals / departures at Thunderer Jetty revealed that vessels are passing to the north of the Proposed Jetty location, well within the authorised channel.
- The bunker barge *Distributor* was the exception to this as was noted navigating well outside (south) of the authorised channel.
- PLA stated they are currently not unhappy with the proposals, subject to further consultation to understand what is causing Ford's Jetty vessels to transit at the edge of the Authorised channel.
- It was noted by the PLA that the structure is on the south side of the river, therefore approaching vessels have long line of sight to see the infrastructure. It is likely that

traffic will habituate to take in to account the location of the Proposed Jetty once in situ as there is adequate navigational width in this location.

- PLA further noted that only vessels with a PEC are navigating the southern limit of the authorised channel. Those vessels that have a PLA pilot onboard pass well north. It may be an option to test the PEC holders with ship simulation to assess impact of infrastructure.
- The scope of the ship bridge simulations was discussed and the PLA noted that the specification was sufficiently broad.

5.1.7 Cory Consultation (pNHA Revision)

A pNHA consultation meeting was held with the James Andrew's (Head of Lighterage and Ship Repair) at Cory Environmental on 19-Apr-2023 between 13:00 and 13:30 via videoconference. The purpose of the meeting was to understand the possible impact of each Proposed Jetty design iteration on the existing Cory lighterage operation at Belvedere. Note, at the time of this meeting (Apr -23) the Cory lighterage team had already been consulted by WSP and had input into the design development process. The lighterage team had therefore already confirmed they were comfortable with the design iteration presented to the PLA on 29-Mar-23. However, for the purposes of the pNHA it was considered important to fully examine any navigational considerations arising from the various design iterations and any associated impact these may have on the Cory Lighterage team.

Two design iterations were presented in the meeting:

- **Option 2**: Located approx. 50m south of the Authorised Channel (this is the option presented in this pNHA and discussed during consultation with the PLA); and
- **Option 3**: Located approx. 80m south of the Authorised Channel.

The meeting was attended by:

- **Cory Environmental**:
  - James Andrews – (JA) – Head of Lighterage and Ship Repair.
- **NASH Maritime Ltd**:
  - Sam Anderson-Brown (SAB) - Principal Consultant.

The key discussion points are summarised below:

- SAB explained that the purpose of the meeting was to understand the possible variances in impact of two design iterations on the existing Cory lighterage operation at Belvedere.
- JA felt that neither Proposed Jetty design would have an adverse impact on Cory's existing lighterage operation and that the lighterage team would be able to continue their operation should either option be taken forward. JA based his judgement on his own first-hand experience of operating in the area and knowledge of previous incidents and existing operational obstructions.

- JA mentioned that the western dolphin of the now disused Belvedere Power Station Jetty (disused) is located in closer proximity to the Middleton Jetty than the proposed access brows for both Proposed Jetty designs, this dolphin has never been hit by a Cory tug and barge. Equally, the navigable width between the western end of the Middleton Jetty and the existing Cory barge moorings is less than the proposed navigable width between the Middleton Jetty and Proposed Jetty.
- JA suggested that several pellet buoys be put down to simulate the location of the Proposed Jetty and brow and to enable further decision making on the extent to which the Proposed Jetty location would constitute a contact hazard.

5.1.8 Additional Consultation with the Cory Lighterage team

Further to the consultation meeting conducted on 19-Apr-23, (see Section 5.1.7). James Andrews and Tom Jones (TJ (Cory Tugmaster)) attended ship bridge simulations, at HR Wallingford on 24 and 25 Apr 2023. The purpose of the simulations was to model the arrival of the LCO_2 tanker at the Proposed Jetty location.

JA and TJ were present to comment on the impact of the tanker approach / departure on Cory's lighterage operation. However, as part of the simulations there was also an opportunity (facilitated by HR Wallingford) for TJ to undertake simulation runs utilising a Cory tug vessel model with the Middleton Jetty and Option 2 / Option 3 of the Proposed Jetty design modelled. TJ undertook runs to the shore side downstream berth.

Following the simulation runs undertaken by TJ and a review of the plots SAB had previously provided to JA, TJ concluded that that neither Jetty design would have an adverse impact on Cory's existing lighterage operation and that the lighterage team would be able to continue their operation should either option be taken forward.

As a precautionary measure TJ concluded that the placement of pellet buoys (as previously suggested by JA) would be a worthwhile exercise and would prove that the positioning of the Proposed Jetty (Option 2 or Option 3) would have no impact on the existing lighterage operation.

5.2 PNRA CONSULTATION

The following consultation meetings took as part of the pNRA process.

5.2.1 PNRA Initiation Meeting with PLA

A pNRA initiation meeting was held on 22-Aug 23 with the PLA representatives, the purpose of the meeting was to discuss the pNRA scope and to ensure that the PLA had an opportunity to influence the scope of the assessment to ensure that specific navigational concerns were addressed.

The meeting took place between 15:00 and 16:00 and was attended by:

- **PLA**
    - Adam Layer (AL) - Harbour Master

    - Lydia Hutchinson (LH) - Marine Manager
- **WSP**
    - Jo Evans (JE) - Technical Director (Maritime)
- **NASH Maritime**
    - Sam Anderson Brown (SAB)
    - Claire Conning (CC)
    - Adam Fitzpatrick (AF)

The key discussion points are summarised below, full minutes of the meeting can be viewed in **Appendix B**:

- SAB summarised the key recommendations from the PNHA and sims, these were:
    - Consultation with the Ford's Jetty vessel operator should be expedited to understand the full impact of the proposed jetty location on the Ford's Jetty Ro-Ro operation.
    - Cory tug and barge trials should be undertaken to confirm maximum footprint of required operations. Trials will be undertaken through placement of pellet buoys to define the Proposed Jetty infrastructure and data collected from the trials should be included in the pNRA.
- SAB asked whether the Sep 22 AIS dataset used for the PNHA meets the PLA's requirements for the pNRA. AL and LH confirmed that the data is acceptable.
- SAB presented the scheme and PNHA Study Area and asked whether it is appropriate for the pNRA.
- AL and LH confirmed that there have not been significant changes to marine traffic in the area, so the Study Area is still valid.
- SAB presented identified stakeholders for consultation. Noting commercial operators as:
    - CLdN (Ford's Jetty);
    - Hansons; and
    - Vessels using Thunderer Jetty.
- SAB asked if there are other commercial consultees and whether the PLA could provide appropriate points of contact.
- AL and LH will discuss whether additional consultees should be contacted and provide points of contact where available.
- SAB asked whether the PLA felt there was anything else that should be included in the NRA scope.
- AL stated that he felt the current scope was suitable.

5.2.2 pNRA Stakeholder Consultation

Invitations to participate in stakeholder consultation were sent to the following organisation by the PLA:

- Hanson Aggregates;
- CLdN (operator of Ford's Jetty vessels); and
- Stolthaven (operators of Thunderer Jetty).

NASH Maritime also contacted the following organisations directly:

- GPS Marine;
- Erith Yacht Club; and.
- Erith Rowing Club.

Stakeholders were advised that the purpose of stakeholder consultation was inform the pNRA and define hazards and appropriate risk control measures to reduce risk associated with the Proposed Jetty and marine operations.

Stakeholders were asked for their views on the following:

- New navigation-related hazards that could emerge during the construction and operation of Proposed Jetty (e.g. collision, contact, breakout, grounding);
- Likelihood and the potential consequence of hazards (i.e. risks) to people, property, business and the environment; and
- Views on suitable means to mitigate any identified risks (e.g. risk controls such as buoyage and markings, procedures, communication.

Stakeholders were invited to submit written representations and / or to attend a consultation meeting with the NASH Maritime team.

5.2.2.1 Erith Rowing Club

The following written response was received from Erith Rowing Club's Club Captain:

- *"The location and operations of this proposal, potentially appear to be hazardous for navigating this section of the river, however the impact on Erith Rowing Club would be somewhat negligible.*
- *This is due to the fact the majority of our river outings are carried out in the opposite direction, towards the Dartford crossing.*
- *The only factor that may have an impact is any increase in traffic due to the operations of the new jetty."*

A copy of the original email correspondence can be viewed in **Appendix C.**

5.2.2.2 Hanson Aggregates

The following written response was received from a Hanson Aggregates Captain:

- *"When I leave Ameys and there is an inward bound v/, I usual navigate right up to the channel edge to leave adequate space for the inbound ship in the vicinity of the Jenningtree l/b (usually from around Middletons down to the Jenningtree l/b). Conversely when arriving and meeting another v/l in this area I would navigate to the northern edge and expect the outbound v/l to navigate to the southern edge."*
- *"The maximum width of the navigable channel there is only 1 cable as it is. So, impeding into an already tight area would result in passing another v/l at even closer pinch point."*
- *"There are some large v/l's that navigate in this part of the river – not just small coastal v/l's, you can have 180m tankers (for Thunderer jetty), large passenger v/l's (for tower bridge & HMS Belfast) and large sugar boats (for Silvertown) some drawing 9 – 10m draught, all transiting this area."*

A copy of the original email correspondence can be viewed in **Appendix D.**

5.2.2.3 CLdN

Consultation Meeting 1 of 2

An initial consultation meeting was held with CLdN Principal Operations Manager, Matthew Booth on 05-Oct-2023 between 11:00 and 12:00.

The meeting was attended by:

- **CLdN**
  - Matthew Booth (MB) Principal Operations Manager
- **WSP**
  - Jonathan Pierre (JP) - Technical Director (Maritime)
  - Jo Evans (JE) - Technical Director (Maritime)
- **NASH Maritime**
  - Sam Anderson-Brown (SAB) - Principal Consultant
  - Clarie Conning (CC) - Maritime Consultant
  - Nigel Bassett (NB) - Associate Principal Consultant

The key discussion points are summarised below, full meeting minutes and a copy of the accompanying PPT presentation used to inform discussion can be viewed in **Appendix E:**

- SAB presented a series of plots derived from Sep 2022 Thames AIS data and asked MB to consider whether the plots showed a realistic overview of day-to-day vessel movements within the Study Area.
- MB explained that the plots looked to be representative of his understanding of vessel movements in the Study Area although MB noted that being relatively new in to post he has not had the opportunity to visit the Site.

- MB asked if two tugs were utilised to assist larger vessels during simulated berthing / unberthing operations. NB explained that two tugs were used for the larger 15,000cbm^3 vessel but not for the smaller 7,500cbm^3 vessel.
- MB confirmed that CLdN service is timetabled and not subject to tidal restrictions.
- MB commented that he felt CLdN vessels navigated to the south of the authorised channel on an outbound transit because there was the available navigable width to do so. MB was not aware of a specific operational issue / set of circumstances that would require the vessels to navigate in such a manner.
- MB stated he would need to consult with CLdN Captains before making any substantial comment on this.
- SAB confirmed it would be good to understand the Captains' views on a number of issues, as summarised below:
    - It was noted that on departure CLdN vessels swing off the berth and then utilise the southern extent of the authorised channel. SAB explained that the project is keen to understand if there are operational limitations that mean vessels are restricted to manoeuvring in this manner. SAB noted that the current assumption is that there are no particular restrictions and that the Captains' are simply utilising the available navigable width.
    - SAB explained that should the jetty be constructed it is felt that (given the ample navigable width available in this location) CLdN vessels would be able to navigate further north, thus keeping clear of the Proposed Jetty and tanker moored alongside. SAB noted it would be good to understand the Captains' views on this.
    - Given the proximity of the moored tanker vessel to the authorised channel, the project would like to understand if the Captains have concerns regarding draw off. Would it be possible to reduce speed when passing the Proposed Jetty and to navigate far enough to the north to mitigate any draw off concerns?
- MB agreed that he would put these specific questions to CLdN Captains.
- MB made the following closing comments:
    - MB asked if there were any historic incidents involving the Ford's Jetty operation. NB responded that he believed there had been come incidents of Ro-Ro vessels contacting the now disused Belvedere Power Station Jetty (disused). JE and SAB confirmed they had heard of two anecdotal incidents.
    - MB stated that his gut feel was the jetty was too close to the authorised channel but that he would consult with the CLdN Captains' before making further comment.
    - MB confirmed he would provide operational parameters for Ford's Jetty.

<u>Written Responses</u>

Following the meeting with Matthew Booth on 05-Oct-2023 written responses to the questions outlined at the meeting were received from three CLdN Captains. These written responses can be viewed in **Appendix F**.

Consultation Meeting 2 of 2

Following receipt of the written correspondence from the CLdN Captain's a further consultation meeting was arranged to discuss the points raised. This meeting took place on 18-Oct-2023 and was attended by:

- **CLdN**
  - Captain Matthew Booth (MB) Principal Operations Manager
  - Captain Vincent Veys (VV) – CLdN Vessel Captain *(Wilhelmine)*
- **NASH Maritime**
  - Sam Anderson-Brown (SAB) - Principal Consultant
  - Nigel Bassett (NB) - Associate Principal Consultant

The key discussion points are summarised below, full meeting minutes and a copy of the accompanying PPT presentation used to inform discussion can be viewed in **Appendix G:**

- VV made the following comments:
  - It is crucial that CLdN vessels are able to utilise the full width of the fairway when navigating to and from Ford's Jetty; any encroachment of the project footprint into the fairway as a result of any exclusion zone around the Proposed Jetty would not be acceptable.
  - This is because when inbound on a flood tide with a strong south westerly wind CLdN vessels, having rounded Jenningtree bend, must remain close to the southern limit of the fairway to avoid being set to the north, bearing in mind their likely swept path and the fact that they are reducing speed at this time. This is particularly important with the CLdN single propeller vessels given the difficulty of maintaining directional stability on these vessels in a beam wind, when reducing speed. If an exclusion zone is present, meaning vessels cannot navigate in this manner, then there would be a risk of setting too far north into shallow water and being set too close to the jetty on the approach. The issue is primarily with inbound transits not outbound.
  - Conflict with tug and barge traffic being pushed north into fairway as a result of jetty position is not an issue as transits past the Proposed Jetty take little time, tug and barges can give way and transits are relatively infrequent.
  - Jenningtree is not an appropriate location for vessels to pass due to narrow fairway and bend. Movements between CLdN and other vessels are therefore deconflicted in this area, additional tanker movements would be deconflicted in the same way through VTS and ship to ship communications.
  - Does not see congestion as a major issue, CLdN vessels are not tidally restricted and are not operating to a critical timetable. They can therefore hold position alongside if necessary until it is safe to proceed outbound.

  - Transits by large vessels as far upriver as Jenningtree are relatively infrequent, but apart from the Jenningtree area VV is happy to pass vessels of all sizes anywhere.
  - CLdN Captains are PEC holders so no demand for PLA pilots.
  - There are ample opportunities to pass prior to Jenningtree if necessary.
- SAB presented an alternate design option (Option 3) that gave an additional 20m clearance between the north extent of the tanker for the Proposed Scheme and fairway and asked VV to comment on the design from a navigation risk perspective.
- VV stated:
  - The alternate design is clearly preferable as it allows full use of the fairway and allows for a greater margin for error.
  - Fundamental for CLdN is that ability to navigate within the fairway is not impeded for reasons previously outlined.
- NB explained that the there would be no requirement for a cargo related navigational exclusion zone around the berth as LCO_2 is not a flammable cargo and that it is therefore unlikely that there would be any formal restriction to existing navigable width arising from either Proposed Jetty design.
- MB and VV confirmed that their view was that detailed simulation work is necessary when final designs are known in advance of any acceptance from CLdN.

5.2.2.4 GPS Consultation Meeting

A consultation meeting was held with Graeme Faulkner (Owner of GPS Marine) on 04 October-2023 between 15:30 and 17:00. The meeting was attended by:

- **GPS**
  - Graeme Faulkner (GF)
- **WSP**
  - Jo Evans (JE) - Technical Director (Maritime)
- **NASH Maritime**
  - Sam Anderson-Brown (SAB) - Principal Consultant
  - Claire Conning (CC) – Maritime Consultant

The key discussion points are summarised below, full meeting minutes and a copy of the accompanying PPT presentation used to inform discussion can be viewed in **Appendix G**:

- GF asked how close the design vessel would be to the authorised channel, SAB explained that the vessel would be approx. 20m from the authorised channel when moored alongside Option 2.
- SAB presented a series of plots derived from Sep 2022 Thames AIS data and asked GF to consider whether the plots showed a realistic overview of day-to-day vessel movements within the Study Area.

- GF confirmed that the plots showed an accurate overview of the baseline vessel traffic environment within the Study Area.
- Referring to slide 11, GF commented that his key concern related to the positioning of the jetty, explaining that when muck away barges are outbound on an ebb tide (one tug could be towing two barges weighing up to 1500t each) it is necessary for them to navigate south of the authorised channel when approaching Jenningtree bend to avoid being set toward the north side of the river as they round the bend. On a young ebb tide, tug and tows are likely to pass inside the Jenningtree marker, as the tide strengthens they will aim to pass just north of the marker when rounding the bend.
- GF stated that in his opinion the current position of the Jetty would mean that when moored the tanker would block the route south of the authorised channel and prevent tug and tows from aligning correctly to safely navigate Jenningtree bend. The risk being the tug and tows are set to the north side of the river and potentially risk grounding or colliding with inbound vessels.
- SAB asked GF how movements between outbound tugs and inbound vessels are currently deconflicted in the Jenningtree bend area. GF explained that communication between masters and VTS works well, GF had no knowledge of any collision incidents between inbound vessels and tug and tows in the area.
- GF further clarified that inbound vessels (e.g. CLdN vessels on route to Ford's Jetty) would need to give way to an outbound tug and tow navigating with the ebb tide.
- GF explained that the increased number of vessels movements within the Study Area was not a concern as this is a relatively quiet section of the river.
- SAB presented a high-level overview of the construction sequence and approximate construction works area.
- GF commented that as well as a 4-point mooring system construction barges would also need to utilise spud anchors to remain in place.
- GF considered contact with construction barges to be the most significant navigational risk and felt the impact of draw off could be mitigated by ease downs in the area. (Note, temporary ease downs may be acceptable during construction works but a permanent ease down for operation phase will be unacceptable to PLA).
- SAB presented a list of identified hazards:
    - GF made the following comments:
    - Identified hazards appear to cover key navigational issues and points of concern, GF did not feel there was anything obvious missing.
    - GF did not feel that draw off would be a substantial concern during operational phase but felt this would be an issue during construction.
    - GF's main concern is the positioning of the jetty and the resulting potential for contact hazard occurrence.
- SAB asked if there were any additional risk control measures that could be put in place to alleviate GF concerns in relation to contact occurrence. GF commented that the only

way to address this concern would be to move the jetty south so that when moored the project tanker is clear of the tug and tow route south of the authorised channel.

- GF explained that if this design change could be made then there were no other significant navigational issues that could not otherwise be mitigated.

5.2.3 pNRA Consultation Workshop with PLA

A Consultation Workshop meeting was held with Lydia Hutchinson, PLA Marine Manager on 07-Nov-23 between 13:00 and 14:30, the objectives of the meeting are outlined below:

- Review and explore key themes and outcomes of stakeholder consultation exercise alongside additional analysis;
- Seek feedback on:
    - Inherent risk assessment results;
    - Additional risk control measures; and
    - Residual risk assessment results.

The meeting was attended by:

- **PLA**
    - Lydia Hutchinson (LH) – Marine Manager.
- **WSP**
    - Jo Evans (JE) – Technical Director (Maritime)
- **NASH Maritime**
    - Sam Anderson-Brown (SAB) - Principal Consultant
    - Claire Conning (CC) – Maritime Consultant

The key discussion points are summarised below, full meeting minutes and a copy of the accompanying PowerPoint presentation used to inform discussion can be viewed in **Appendix I**:

- LH (in reference to tanker arrival and departures) commented that PLA pilots had considered flood arrivals and ebb departures during strong stream to be higher risk manoeuvres and that pilotage restrictions may apply.
- SAB commented that arrivals were likely to be around HW – 1 and departures no later than HW + 1.5, therefore the strongest tidal stream should be avoided.
- SAB commented that CLdN has stated that full ship bridge simulations would be required before they (CLdN) could make any further comment on acceptability of the jetty. LH said that the PLA supports the CLdN position and the requirement for full ship bridge simulations to be undertaken to further inform the Proposed Jetty location and impact on third party users e.g. CLdN, Hanson etc.

- SAB explained that although CLdN did not consider interaction between their vessels and project vessel to be an issue the project team felt draw off effect could still be a concern. Reason for this difference of opinion relates to vessel speed. CLdN have stated that their vessels passed the Proposed Jetty location at low speed (approx. 6 knots) whereas AIS data shows vessels passing at up to 12 knots and on the southern limit of the authorised channel.
- **Inherent Risk Assessment**
  - LH commented that she felt all relevant hazards for construction and operation phase had been identified.
  - LH queried score for Haz ID 11 - Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works and stated that due to Hazard likelihood she felt there was a case for this hazard to score as higher than ‘moderate’. SAB explained that although likelihood had been scored high, consequence was thought to be less significant than other identified contact hazards. SAB committed to reviewing hazard scoring.
  - LH felt that allocated hazard scores were appropriate and highlighted key areas of concern namely issues associated with proximity of the Proposed Jetty to passing vessel traffic within the authorised channel.
- **Additional Risk Controls**
  - SAB asked whether LH felt a navigation exclusion zone could be appropriate during the construction phase. LH commented that exclusion zone would work, vessels would have to deviate around Marine Works anyway so formalising this requirement would be sensible. LH suggested only implementing exclusion zone during certain phases of construction, e.g. exclusion zone may not be required during access trestle installation (which is situated within intertidal zone).
  - **Consider Relocation of Jetty (Preliminary Design Revision) –** SAB explained that the Proposed Jetty location in close proximity to the authorised channel gave rise to key concerns relating to vessel interaction and resulting draw off effect in combination with concerns in relation to contact hazard occurrence. This results in high levels of baseline risk and it is therefore recommended that consideration be given to the relocation of the Proposed Jetty. SAB explained that NASH had scored ranging / breakout and contact hazards conservatively as the Proposed Scheme has not yet undertaken work to fully understand the impact of draw off and / or impacts to third party vessel manoeuvres (critically CLdN). A key recommendation of the pNRA is therefore to undertake a passing vessel mooring interaction study and Full Ship Bridge Simulations for third party operators (both included as additional risk controls).
  - LH supported the recommendation to undertake passing vessel mooring interaction study and Full Ship Bridge Simulations to further inform the navigation risk assessment.

- LH confirmed that the PLA would expect to see this work undertaken within a future NRA update as the evidence base for the pNRA and likelihood / consequence scores allocated was not sufficient to confirm whether the Proposed Jetty location posed an unacceptable level of navigation risk.

- **Residual Risk Assessment**
  - LH felt that allocated hazard scores were appropriate (given work has not yet been undertaken to consider impact of draw off and impacts on third party vessel manoeuvres).
  - SAB reiterated that scoring was conservative and following additional work (passing vessel mooring interaction study and full ship bridge simulations for third party operations) likelihood and consequence scores for ranging / breakout and contact hazards could be revisited (and potentially reduced). This will in turn inform decision making as to the location of the Proposed Jetty.
  - SAB explained that if passing vessel mooring interaction study and simulations indicated that baseline level of risk associated with ranging / breakout and contact hazards fell within acceptable level of risk then requirement to consider relocation of Proposed Jetty could be redundant.

6. THIRD PARTY SHIP BRIDGE SIMULATIONS

Further to the Project Simulations completed in April 2023 and the comments from stakeholders referenced in section 5, further simulations were undertaken during January 2024 with third parties in order to:

1. Assess the impact (if any) of the Proposed Jetty design options on existing CLdN vessels navigating to and from Fords Jetty;
2. Assess the impact (if any) of the Proposed Jetty design options on passing vessel transits, particularly passing distance and speed;
3. Further understand how (if at all) the jetty influences the positioning of vessels within the authorised channel when transiting Halfway Reach and Jenningtree bend; and,
4. Gather any additional feedback and comments from attendees.

Simulations for CLdN vessel arrivals and departures for the Proposed Jetty design options (Option 2 and Option 3) were undertaken on 29th and 30th Jan 2024. The 31st Jan 2024 was dedicated to passing vessel simulations.

The simulations were attended by key stakeholder representatives of the following organisations:

- PLA;
- CLdN;
- Heidelberg Materials (formerly Hanson);
- WSP;
- NASH Maritime; and
- HR Wallingford.

The individuals that represented each of the above organisations are summarised in **Table 7.**

Table 7: Summary of Third Party Simulation Attendees

Name	Organisation	On the Day Role	Job Title	Dates Attending
Gillian Watson	HR Wallingford	Project oversight	Principal Engineer, Ships and Dredging	29th / 30th / 31st
Henry Cruickshank	HR Wallingford	Project Manager	Engineer, Ships and Dredging (HRW Project Manager)	29th / 30th / 31st
Jess Skinner	HR Wallingford	Simulation Operator	Simulation Operator	29th / 30th / 31st
Capt Matthew Booth	CLdN	Principal Operations Manager	Principal Operation Manager	29th / 30th / 31st

Name	Organisation	On the Day Role	Job Title	Dates Attending
Capt Vincent Veys	CLdN	CLdN Simulator Capt	Captain	29th / 30th /31st
Lyn Kindlen - Funnell	Port of London Authority	Observer	Harbour Master	29th / 30th / 31st
Lydia Hutchinson	Port of London Authority	Observer	Marine Manager	30th / 31st
Capt Neil Jephcote	Port of London Authority	Simulator Pilot	PLA Pilot	31st
Capt Michele Pulizzi	Port of London Authority	Simulator Pilot	PLA Pilot	31st
David Thomas	Heidelberg Materials	Observer	Marine Operations Manager/ DPA	31st
Jo Evans	WSP	Observer	Technical Director, Maritime	29th / 30th / 31st
Thomas Proctor	WSP	Observer	Assistant Maritime Engineer	29th / 30th (tbc)
Margaret Radziwonowska	WSP	Observer	Associate Director	30th
Will Treasure	WSP	Observer	Graduate	30th
Yalin Gulen	WSP	Observer	Graduate	30th
Capt Nigel Bassett	NASH Maritime Ltd	Observer	Principal Associate Consultant	29th / 30th / 31st
Sam Anderson – Brown	NASH Maritime Ltd	Observer	Principal Consultant	29th / 30th /
Amber Hutchinson	NASH Maritime Ltd	Observer	Graduate Maritime Consultant	31st
Brocque Preece	NASH Maritime Ltd	Observer	Principal Consultant	31st
Marco Slerca	NASH Maritime Ltd	Observer	Graduate Maritime Consultant	31st
Eleanor Scott	NASH Maritime Ltd	Observer	Graduate Maritime Consultant	30th Jan

Simulation Terms of References were prepared including objectives of the sessions, proposed run plan and vessel models and shared with the attending third party organisations prior to the simulations taking place. Through this, agreement was sought and obtained with all third parties as to the scenarios that would be assessed and the ship models that would be utilised. The ship models used are summarised in **Table 8.**

All simulations were undertaken with a representative tanker moored alongside each Proposed Jetty design option.

Table 8: Simulation Ship Models

Characteristic	Unit	Celestine	City of Westminster		185m x 32m Bulker		239m x 31m Cruise Vessel
Ship type		***Freight Ferry***	***TSH Dredger***		***Bulker***		***Cruise Ship***
Length overall	m	162.5	99.9		185.0		239.0
Length between perpendiculars	m	150.0	95.8		180.0		207.5
Beam overall	m	25.4	17.7		32.2		30.8
Distance bridge to stern	m	139.5	83.0		32.7		205.1
Modelled conditions		One loading condition	**Laden**	**Ballast**	**Laden**	**Ballast**	One loading condition
Draught forward	m	6.5	6.3	4.0	11.0	8.0	6.5
Draught aft	m	6.5	6.3	4.5	11.0	8.0	6.5
Block coefficient		0.71	0.82	0.82	0.81	0.80	0.70
Displacement	t	18,000	9,000	6,000	52,900	38,000	29,600
Main engine type		Medium speed diesel	2x Wartsila 6L26		Slow speed diesel		4 x MAN 9L32 44CR
Engine power (total)	kW	9,840	3,600		10,000		15,500
No. of propellers, type		2 x CPP (inward)	2 x CPP (outward)		1 x FFP (right-handed)		2 x Azipod
Bow thrusters	t	22	9		none		37
Stern thrusters	t	none	none		none		none
Rudder type		Semi-balanced	Standard		Standard		None
Max rudder angle	°	35	45		35		0

A full simulation findings report has been developed by HR Wallingford . HR Wallingford have also issued a run summary document and Summary Conclusions report which have informed the this pNRA, both documents can be viewed in **Appendix K**.

Note, the commentary provided by HR Wallingford within the Run Summary document in **Appendix K** relates purely to the assessment criteria set out within the simulation Terms of Reference. **Table 9** sets out the relevant commentary in terms of the conclusions in respect of navigation safety following the simulation.

Table 9: Navigational Safety Criteria

#	Criteria	Description	Assessment
1	**Ship Control**	Was full control of the vessel maintained, giving due consideration to vessel moored alongside, the prevailing conditions and ship characteristics?	**Success**: Ship remains under full control for duration of simulation.
			Marginal: Whilst ship remained under control, it was considered at the limits of acceptable seamanship.
			Fail: Ship lost control and could not be manoeuvred acceptably.

2	**Clearances from Infrastructure and passing vessels**	Was sufficient navigable room maintained from fixed objects to reduce the risk of allision or contact and/or collision, given the prevailing conditions and ship characteristics?	**Success**: Passing distances from fixed objects where tolerable
			Marginal: Ship navigated closer to fixed hazards than acceptable but maintained sufficient control to continue to navigate safely (contact not made)
			Fail: Ship came within unacceptably close proximity to a fixed hazard or made contact
3	**Suitability of Under Keel Clearance**	Was suitable under keel clearance to avoid grounding maintained, given the prevailing conditions and ship characteristics?	**Success**: Ship retained substantial under keel clearance throughout the passage (>1m).
			Marginal: Under keel clearance thresholds were breached but safe navigation could be maintained.
			Fail: Ship either grounded or had unacceptable under keel clearance.

The following conclusions were reached following the simulations:

- The location of the Proposed Jetty (Option 2 and Option 3) results in reduced navigable width to the south of the authorised channel. When rounding Jenningtree bend, this creates no significant challenge for one way traffic but will mean that when two large vessels that are restricted to utilising the authorised channel wish to pass in the area this would need to take place to the west of the Proposed Jetty. This presents a slight change in the way vessels restricted to the authorised channel currently navigate as at present the outbound vessel will likely position itself close north of the location of the Proposed Jetty.
- It is understood through discussion with the PLA Pilots and CLdN Captains that vessels do not look to pass in the area of the navigable channel when rounding Jenningtree bend.
- Existing operations can safely continue with Option 2, any large vessel passing transits would need to occur upstream of the Proposed Jetty location.
- Existing operations can safely continue with Option 3, with Option 3 providing increased navigable width and therefore a greater passing distance from vessels moored at the Proposed Jetty (when compared to Option 2).
- The PLA indicated during simulations that they would look to enforce a 60m navigation exclusion zone whilst the vessel is moored alongside (General Direction 17.1 (b)), with 60m also being agreed by HR Wallingford, NASH Maritime, CLdN and (after simulations) the PLA as an appropriate minimum passing distance to be used as a

basis for the simulation conclusions outlined above (60m being approximately 2 x beam of both the proposed design vessel and the largest likely passing vessels).

- The PLA queried whether LCO_2 presented any additional hazards to the river, and whether views had been sought from the Marine Coastguard Agency as well as the Health and Safety Executive (HSE).

6.1 PLA CLARIFICATION RELATING TO APPLICATION OF PLA GENERAL DIRECTION 17.1 (B)

Following the simulations NASH Maritime sought clarification from the PLA as to whether General Direction 17.1 (b) would be applicable, this not having previously (before the third party simulations) been raised by the PLA as an issue during consultation.

General Direction 17.1 (Navigational Restrictions and Exclusion Zones) states:

> *17.1 No Vessel is to:*
>
> *a) enter any Exclusion Zone shown on PLA charts or established in the Thames from time to time by the PLA;*
>
> *b)* ***approach within 60 metres of any Berthed tanker, or oil or gas jetty in the Thames;***
>
> *c) approach within 50 metres of any wind turbine tower unless for the purposes of construction or maintenance;*
>
> *d) transit through a bridge arch or span of the Thames Barrier which is closed to Navigation; or*
>
> *e) pass or overtake a ULCS between Knock John 1 and Knock John 4, except in an emergency or with the permission of the Harbourmaster.*

At a meeting on 22-Feb-2024, the PLA Harbour Master (Lyn Kindlen-Funnel) and Marine Manager (Lydia Hutchinson) confirmed:

- The 60m exclusion zone would apply to the LCO_2 tanker when moored alongside the Proposed Jetty due to it being classed as a 'tanker' and would apply from the outboard side of the vessel;
- The exclusion zone would not apply to the Proposed Jetty alone as the terminal is not an oil or gas jetty. The PLA explained that the exclusion zone applies to tankers hence their interpretation that the exclusion zone would apply only when a tanker is berthed;
- The exclusion zone would only apply to passing (through) traffic, I.e. Cory tugs manoeuvring for or moored at the pontoon on the inshore side of the Proposed Jetty or manoeuvring for Middleton Jetty will not be expected to comply with the exclusion zone.
- It was acknowledged that the original intention of the General Direction was to mitigate the risk posed by sources of ignition associated with hydrocarbon tankers and berths. It was agreed that the wording of the General Direction required an update as it was not immediately clear as to how it applied to the Proposed Scheme. LCO_2 is not flammable and is not currently regulated by the HSE.
- The PLA agreed that the applicability of the General Direction to the berthed LCO_2 tanker could be revisited pending the provision of gas dispersion modelling providing

further context as to the nature, extent and effects of a LCO_2 release. Until such a time that evidence is provided to reduce or remove the exclusion zone, the PLA would enforce a 60m exclusion zone on a precautionary basis.

- The PLA commented that although this exclusion zone would encroach on the authorised channel, the distance (Option 3) was relatively small and likely to be insignificant to vessels transiting past the Proposed Jetty.
- It was agreed the simulations had demonstrated that vessels could safely navigate well clear of the proposed exclusion zone extent in accordance with the General Direction.

7. PASSING VESSEL MOORING INTERACTION STUDY

7.1 PURPOSE AND BACKGROUND

A passing vessel mooring interaction study was commissioned following identification of Project Vessel breakout, in earlier stages of the NRA process, from the Proposed Jetty because of passing vessel interaction as a potential hazard. This assessment was undertaken to support and facilitate an informed judgement on the level of navigational risk associated with this hazard.

The purpose was not to undertake mooring design analysis, which would form part of the Proposed Jetty detailed design during the Front End Engineering Design (FEED) stage, at which point a detailed dynamic mooring analysis would be undertaken to define the mooring system design, equipment selection and inform structural requirements of the berth and Proposed Jetty.

7.2 PARAMETERS USED

The information used to inform the assessment has been based on internal expertise, initial NRA findings, navigation simulation findings and stakeholder discussions at simulations and with the PLA (see **Section 5** and **Section 6**).

The key findings of these were:

- The key largest vessels operating in the vicinity of the Proposed Jetty are: Bulk Carrier, Cruise and CLdN RoRo (vessel details shown in **Table 10**).
- A realistic typical close passing distance can be considered to be approximately 2.0 x the passing vessel's beam; around 60m for these key largest vessels . This distance is within the same order of magnitude as the potential implementation of a 60m exclusion zone for a moored project vessel (being defined as a tanker within PLA General Directions, see **Section 6.1**).
- Vessels would transit towards the starboard side of the navigation channel (north on inbound transit, south for outbound transit). Therefore, a vessel passing by the Proposed Jetty inbound would adversely be located approximately on the channel centreline and vessel's passing outbound would be located closer to the Proposed Jetty and moored vessel (as per the previous point).
- Inbound and outbound vessels typically avoid passing one another in the vicinity of the Jenningtree Bend; therefore, vessels passing the Proposed Jetty would rarely be passing another vessel at this location. This is particularly so in adverse weather such as higher winds.
- Based on mariner guidance, large vessels and particularly those with deep draft, would be anticipated to typically operate at 6 knots, or up to 8 knots as an exception, when passing a berthed tanker at the Proposed Jetty and on approach to a river bend.

The assessment uses dedicated software for generating passing vessel pressure-induced interaction forces, ROPES, coupled with dedicated mooring analysis software widely using in the maritime industry, Optimoor.

The assessment objective was to assess the passing vessel forces, moored vessel response and potential for breakout. Therefore, mooring line loading has been used to assess mooring capability. Elements subject to future detailed design phases of the terminal, such as fender and marine loading arm selection, would be within the control of the project detailed design and would therefore be designed appropriately at that time and considered as part of the updated NRA required by the DCO Requirement.

7.3 VESSELS

The assumptions used for a proxy moored tanker in this assessment as shown in the tables below, which have been based on industry guidance through PIANC [7] and OCIMF [8] publications. No design vessel exists for this size of LCO_2 carrier and therefore these values are estimated based on the exemplar vessels in the indicative design specification from **Section 1.4.1** and PIANC industry guidance. These assumed parameters are shown in **Table** 10. The passing vessels assumed in the assessment were as shown in **Table 11**.

Table 10: Assumed Project Vessels' Parameters

Project Vessel	Assumed value
Length overall	178 m
Beam	29.1 m
Draft (loaded)	8.4 m
Capacity	15,000 m^3
Mooring line type	Polypropylene
Maximum Breaking Load (MBL)	58 tonnes
Number of mooring winches (lines)	12 in use (up to 16 available)
Line pre-tension	10% MBL

Table 11: Passing Vessels' Parameters

Parameter	Cruise Vessel	CLdN RoRo	Bulk Carrier
Vessel	Similar to simulations	Similar to simulations	Similar to simulations
Length overall	239 m	162 m	186 m
Beam	30.8 m	25 m	32.2 m
Draft (loaded)	6.5 m	6.5 m	10.1 m
Draft (light)	-	-	6.5 m

7.4 METOCEAN CONDITIONS

Metocean conditions were applied to assess a conservative, yet realistic, scenario. This would be more akin to a typical adverse scenario that could be applied to support judgement of risk in this application to support the pNRA.

[7] Permanent International Association of Navigation Congresses (PIANC) MarCom WG 235, Ship Dimensions and Data for Design of Marine Infrastructure.

[8] Oil Companies International Marine Forum (OCIMF) Mooring Equipment Guidelines 4th revision (MEG4).

7.4.1 Wind

Winds are predominately from the southwest (**Section 2.2**), being beam on, pushing the vessel off berth. A conservative wind speed of 31.8kn (30-sec gust) was applied which approximately represents the top 1% of yearly average historical winds. This is substantially higher than the 25 knots gust wind speeds deemed the upper limit for CO_2 vessel movements and it therefore considered to be a low likelihood occurrence and highly conservative for the mooring interaction study undertaken.

7.4.2 Tide Height

Tide height applied was low water, resulting in minimum UKC for passing vessels and moored vessel, which results in highest passing vessel interaction forces. The CLdN RoRo and Cruise vessels are not inhibited by UKC restrictions and therefore low water (0m tide height) was applied. The Bulker is constrained by the controlling depth further downstream in Erith Reach and a tide height of 3.0m in the location of the Proposed Jetty was applied.

7.4.3 Current

Current speeds are described in **Section 2.4**. Typical currents are 2.0 knots but are noted to also be influenced by non-tidal river fluvial flow. The tidal set is towards the outside of the river bend and the tidal flow at the Proposed Jetty are relatively weak.

Transits with and against the tidal flow were considered. Conservatively, an adverse “typical” scenario was assessed by applying peak spring ebb and flood tidal flow of 3.0 knots within the channel when generating passing vessel interaction forces. This current speed was observed in the HRW tidal flow modelling and as applied within the third party bridge simulations. Current applied at the berth was also conservative and applied a maximum typical current speed of 2.9 knots.

7.5 FINDINGS

Assessment of the breakaway hazard used an applied mooring line limiting criteria derived from industry mooring equipment guidelines for tankers and gas carriers, OCIMF MEG4, and based on the limiting maximum threshold of 50% of the mooring line design breaking strength and a ceiling of 60% representing the winch brake slip as all lines were assumed to be on winches. The other nominal mooring limitations that typically form part of berth design (such as fender selection and allowable movements at berth) would not have a material influence on the breakaway hazard and therefore did not form part of this assessment. These would be further considered as part of the berth’s detailed design phase and NRA post-consent.

A summary of the findings for each vessel is shown in **Table 12**:

Table 12: Assessment Findings.

Passing Vessel	Speed through water	2.0 x Beam or 60m (adverse scenario for outbound transit)	Mid-channel (adverse scenario for inbound transits)
6 knots passing speed			
CLdN RoRo	6 knots	Below line limit	Below line limit

Passing Vessel	Speed through water	2.0 x Beam or 60m (adverse scenario for outbound transit)	Mid-channel (adverse scenario for inbound transits)
Cruise Vessel	6 knots	Below line limit	Below line limit
Bulk Carrier (Light)	6 knots	Below line limit	Below line limit
Bulk Carrier (Loaded)		Below line limit	Below line limit
8 knots passing speed			
CLdN RoRo	8 knots	Below line limit	Below line limit
Cruise Vessel	8 knots	Below line limit	Below line limit
Bulk Carrier (Light)	8 knots	Below line limit	Below limit but not a current scenario
Bulk Carrier (Loaded)		Exceeded limit (56% MBL) but not a current scenario	Below line limit
10 knots passing speed			
CLdN RoRo	10 knots	Exceeded line limit (>60% MBL winch brake)	Below line limit
Cruise Vessel	10 knots	Exceeded line limit (>60% MBL winch brake)	Exceeded line limit (57% MBL)
Bulk Carrier (Light)	10 knots	Exceeded line limit (>60% MBL winch brake)	Exceeded limit (>60% MBL) but not a current scenario
Bulk Carrier (Loaded)		Exceeded limit (>60% MBL) but not a current scenario	Exceeded line limit (>60% MBL winch brake)

Key results can be summarised as:

- Of the three largest vessel types on the river at this location, the worst for generating vessel interaction forces is a deep draft (loaded) large Bulk Carrier, followed by the large Cruise Ship.
- Typically, a vessel passing the same direction as the current flow generated higher mooring line loads than against the current (i.e. outbound with ebb current, or inbound with flood current).
- All vessels passing at 6 knots at a close passing distance of 2x the vessel's beam did not exceed the recommended maximum mooring line load limit (as per OCIMF industry guidance being 50% of the mooring line design breaking strength).
- None of the vessels passing at 6 knots, 8 knots or 10 knots caused the moored vessel to breakout or drift free of the berth. At higher speeds, some mooring line loads exceed winch brake setting (as per OCIMF industry guidance being 60% of the mooring line design breaking strength); however, were not overwhelmed by prevailing adverse wind and current and remained alongside the berth after the passing vessel had passed.
- For the worst vessel – the large Bulk Carrier – the scenario of the loaded Bulk Carrier heading outbound does not currently occur due to the nature of bulk cargo sugar ship operations in this section of the river.
- Similar trends were also observed for Cruise vessels and CLdN RoRo vessels which did not exceed recommended line loading limits at 8 knots but for the Cruise vessel started to exceed recommended line loading limits at higher speeds of 10 knots.

Indicative sensitivity assessments were undertaken on scenarios in which line loading exceeded recommended maximum limits. These included additional mooring lines (additional two forward and two aft) and/or higher line strength (up 20% to 70 tonnes MBL). These sensitivity assessments indicated:

- Either a higher line strength or additional lines were sufficient to keep all 8 knot close passing scenarios within recommended line loading limits.
- A combination of both additional lines and higher line strength were sufficient to keep all 10 knot close passing scenarios within recommended line loading limits.

Therefore, in most-likely scenarios, such as 6 knots close passing up to 8 knots at greater passing distances in adverse conditions, the moored vessel did not exceed recommended line loading limits. For worst credible scenarios, such as 10 knots close passing in adverse conditions, then mooring optimisation through detailed design (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard.

It should also be noted that the Port of London - Port Information Guide, dated April 2024, states in relation to transiting vessel speed limits (bold emphasis added):

> *Speed Limits*
>
> *2. Except in an emergency, the master of a power-driven vessel must, at all times when underway on the Thames, ensure that the vessel is navigated at a speed and in a manner such that **any wash or draw-off created by the vessel must not compromise**: a) **the safety of others using** the Thames, the foreshore, adjacent piers, moorings, **berths, jetties** or other facilities; or b) the integrity of the foreshore.*

8. RISK ASSESSMENT

The following section outlines the identification and assessment of navigation hazards associated with Proposed Jetty Option 2 and the associated marine operation utilising the PLA's standard risk assessment methodology for river developments. This section includes:

- A summary of the key definitions used to describe components of the risk assessment process;
- An overview of the PLA standard risk assessment methodology;
- A summary of the identified hazard causes and their impact within the NRA Study Area;
- A summary of the identified hazards;
- The findings of the inherent assessment of risk;
- An overview of the proposed additional risk controls; and
- The findings of the residual risk assessment.

8.1 DEFINITIONS

The following pNRA definitions apply:

- **Hazard** - an unwanted event resulting in adverse consequences;
- **Likelihood** - a determination of how likely a hazard is to occur;
- **Consequence** - the magnitude of adverse outcomes should a hazard occur;
- **Risk** – a non-dimensional measure of hazard frequency and consequence based on a qualitative risk matrix;
- **Embedded risk control measures** – a risk control measure that is already in place;
- **Additional risk control measures** – a risk control measure that is put in place specifically for the project scheme under consideration;
- **Inherent Assessment of Navigation Risk** – an assessment of hazard risk with the project / scheme / development in place including existing risk control or mitigation measures.
- **Residual Assessment of Navigation Risk** – an assessment of hazard risk with the project / scheme / development in place including embedded (existing) risk control or mitigation measures, and additional project / scheme / development risk control or mitigation measures.

8.2 METHODOLOGY

The PLA risk assessment methodology requires that navigation hazards be identified and assessed in relation to hazard likelihood and hazard consequence to generate a hazard risk score:

$$Navigation\ Risk = likelihood\ of\ hazard\ occurence\ \times severity\ of\ hazard\ occurence$$

The assessment of navigation risk is made for two risk scenarios – '*inherent*' and '*residual*' assessment.

The inherent and residual assessment enables the determination of hazard risk reduction brought about by either an additional individual risk control or in most cases a suite of related risk control measures.

In order to determine hazard likelihood assessments, the PLA use a likelihood classification table to allocate likelihood scores to hazards – see **Table 13**.

Hazard consequence classifications are as shown in **Table 14** and relate in broad terms to hazard impact to:

- People;
- Environment;
- Property;
- Reputation; and
- Port Impact.

Table 13: Hazard Likelihood Classifications

Hazard Likelihood Classifications	
Rare:	Very unusual - not common or frequent.
Unlikely:	Not probable or likely to happen.
Possible:	Not certain – might or might not happen.
Likely:	Will probably happen or is expected.
Almost Certain:	More than likely / in all likelihood.

Table 14: PLA Hazard Severity Classifications

Consequence Classifications	People	Environment	Property	Reputation	Port Impact
Minor:	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. Guidance: up to approx. £5,000.

Consequence Classifications	People	Environment	Property	Reputation	Port Impact
Moderate:	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. Guidance approx. between £5,000 and £50,000.
Serious:	-Major / life changing injuries.	-Limited impact on environment and port operation with short term or long-term effects.	-Vessel / Equipment / structure un-operational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. Guidance approx. between £50,000 and £250,000.
Very Serious:	-Single Fatality.	-Significant impact on environment and Port operation with short term or long-term effects	-Vessel / Equipment / Structure un-operational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Very Serious cost implications for Port. Guidance approx. between £250,000 and £500,000.
Severe:	-Multiple fatalities.	-Serious long-term impact on environment and / or permanent damage.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. Guidance approx. over £500,000.

A risk matrix is then used to combine the likelihood and consequence scores for each hazard to generate an inherent assessment of risk.

Based on the evaluation of the impact of the development each hazard is scored using the matrix as defined in **Table 15**.

Table 15: PLA's Risk Score Matrix

Likelihood	**Almost Certain**	5	10	15	20	25
	Likely	4	8	12	16	20
	Possible	3	6	9	12	15
	Unlikely	2	4	6	8	10
	Rare	1	2	3	4	5
Risk Score Matrix		**Minor**	**Moderate**	**Serious**	**Very Serious**	**Severe**
		Severity				

8.2.1 Acceptability

The PLA methodology does not state the acceptability of risk scores. However, it is assumed that risk scored at 'Moderate' and 'Minor' would be deemed acceptable, which puts the acceptability threshold at risk scores lower than 9.0 / 25 (see **Table 16** for PLA risk score classifications). Where inherent hazard risk scores are greater than 9.0 / 25 (Serious, Very Serious or Severe), risk controls are identified and allocated to hazards. Hazard risk scores are then recalculated using the same method as above and a residual assessment of risk determined. Where inherent hazard risk scores are deemed acceptable, applicable additional risk controls are still applied to demonstrate the conceivable reduction in hazard risk.

Table 16: PLA Hazard Risk Score Classifications

Total Risk Score	
Minor	1-3.9
Moderate	4-8.9
Serious	9-14.9
Very Serious	15-19.9
Severe	20-25

8.3 HAZARD CAUSES

Hazard causes may individually, or combine, to result in a hazard occurrence. For example, the combination of adverse weather conditions and a loss of situational awareness by the master of a vessel could lead to a hazard occurrence e.g. grounding contact, collision etc.

Table 17 summarises the key hazard causes identified. The table also provides a commentary outlining the context to each cause and in the case of highly relevant hazards, additional commentary as to the effects of specific causes within the NRA Study Area.

Table 17: Identified Hazard Causes.

ID	Cause Name	Commentary
1	Action of the tidal stream	The tidal stream sets strongly to the north on an ebb tide within the Study Area and can significantly impact vessels rounding Jenningtree bend. The ebb tide in particular can cause issues for inbound vessels arriving at Ford's Jetty (CLdN and outbound vessels (Tug and tows). In both instances vessels risk being swept to the north of the authorised channel. The effects of the north tidal set are exacerbated when combined with strong SW and / or S wind.
2	Adverse weather conditions	Strong SW and S winds combined with the ebb north tidal set push vessels north.
3	Avoidance of another vessel	Additional Cory vessels movements resulting from the requirement to service Riverside 2 combined with the introduction of vessel movements for the Proposed Scheme will lead to an increase in vessel traffic within the NRA Study Area and therefore the likelihood that a vessel is required to take avoiding action is increased.
4	Communications failure	Failure in communication either between vessels (ship to ship) or between a vessel and PLA VTS.
5	Displacement of small vessels into authorised channel	The Proposed Jetty will obstruct the inshore route currently utilised by GPS, Cory and other small craft tug and tows (when height of tide allows). This will increase the number of vessel movements within the authorised channel and therefore the number of vessel interactions, this may in turn increase the likelihood of a collision hazard occurrence.
6	Human error	Captain / Pilot / Tug Master / Jetty operative error.
7	Increased vessel activity within Study Area	Increased vessel activity – see ID 3.
8	Interaction with passing vessel	Due to the close proximity of outward passing traffic and rapidly shallowing depths inshore of the berth draw off / interaction damage and / or suction of the project vessels (off the Proposed Jetty) is a possibility.
9	Mechanical defect / failure	Failure of equipment leads to vessel being restricted in its ability to manoeuvre / un-operational.
10	Misjudged manoeuvre	Specific mariner error during manoeuvre e.g. Project Vessel or CLdN vessel swinging of berth.
11	Reduced visibility	Fog / snow or heavy rainfall leading to reduced visibility increases the likelihood of a collision, contact or grounding hazard occurrence.
12	Reduced width of navigable water	Resulting from encroachment of Proposed Jetty into the navigable inshore zone south of authorised channel.
13	Towage failure	Parting of tow line, tug breakdown etc.
14	Vessel wash	Excessive wash due to proximity of the Proposed Jetty to the authorised channel leading to ranging of project vessel

ID	Cause Name	Commentary
15	Excessive vessel speed	Excessive speed not related to interaction but leading to reduced thinking / reaction time.

8.4 HAZARD IDENTIFICATION

The findings of the baseline navigation environment review, vessel traffic analysis, hazard likelihood modelling, Third party ship bridge simulations and stakeholder consultation exercises were combined to to identify hazard types associated with the Proposed Jetty and marine operation. This resulted in four hazard types being identified which are summarised in **Table 18**.

Table 18: Summary of Hazard Types

Hazard #	Hazard Types	Definition
1	**Collision**	Collision between two vessels underway (also includes striking of an anchored vessel).
2	**Contact (Allision)**	Vessel makes contact with Fixed or Floating Object (FFO) (e.g. quay, pile, shoreline, buoy, moored vessel).
3	**Ranging / Breakout**	Vessel moves from securely moored position, may result in damage to non-vessel objects.
4	**Grounding**	Vessel makes contact with shore or riverbed.

8.4.1 Vessel Categories

A review of the baseline vessel traffic analysis was also undertaken to define vessel type categorisations. The following vessel categories were identified:

Table 19: Summary of Identified Vessel Categories

Vessel #	Vessel Types / Receptors	Description
1	**Cargo**	Vessels carrying cargo such as containers, dry bulk cargo, vehicles, aggregates, commercial dredgers. Including vessels for **CLdN** and **Hansons**.
2	**Tanker**	Liquid bulk vessels e.g. bunker vessels, product & chemical tankers. Activity predominantly associated with **Stolthaven Thunderer Jetty.**
3	**Passenger**	HSC, cruise, sail training vessels and Class V vessels.
4	**Tug, Service and Other Small Vessel**	Tugs (including with tow), maintenance dredgers, workboats, port service, law enforcement and survey vessels not associated with the construction activities. This includes **Cory** vessels operating

Vessel #	Vessel Types / Receptors	Description
		at **Middleton Jetty** and **GPS** vessels operating to and from **Amey's Jetty.**
5	**Recreational Vessel**	Powered or unpowered recreational vessels.
6	**Construction Vessel**	All vessels engaged in construction activities for the Proposed Jetty including Jack up barges, tug and tow, dredger and workboats.
7	**Project Vessel**	LCO_2 tanker servicing the Proposed Jetty.

8.4.2 Contact Scenarios

A number of contact (allision / impact) scenarios were identified for vessels navigating within the Study Area. Separate contact scenarios are considered because the severity of a contact occurrence not only depends on the vessel type(s) involved but the nature of the infrastructure contacted. For example, a contact hazard occurrence between a cargo vessel and the Middelton Jetty may result in significant damage to property but will likely have minimal consequences for the environment. In contrast a contact occurrence between a tanker and the Proposed Jetty will not only result in significant damage to property but may also have catastrophic environmental impacts (release of tanker product and LCO_2). The magnitude of risk is therefore influenced by the type of vessel and the nature of the infrastructure contacted. The contact scenarios are summarised in **Table 20**.

Table 20: Summary of Identified Contact Scenarios

Contact Scenarios	Detail
Proposed Jetty (or a vessel moored alongside)	The operational Proposed Jetty post construction or a vessel moored alongside.
Marine Works	The Proposed Jetty whilst under construction including associated construction craft whilst moored at the site (e.g. JUB, Crane Barge).
Third Party Infrastructure	All other fixed and floating infrastructure in the Study Area (Middleton Jetty and Belvedere Power Station Jetty (disused)).

8.4.3 Identified Hazards

The identified hazard types, vessel types and contact scenarios were then combined to create a list of potential navigation hazards. The project team reviewed each hazard iteration to check whether the occurrence of each identified hazard was credible. Those hazards that were not deemed credible were removed from the final identified hazard lists:

- See **Table 21** for identified construction phase hazards; and
- **Table 22** for identified operation phase hazards.

Table 21: Identified Construction Phase Hazards

Haz Id #:	Hazard Type	Hazard Title
1	Collision	Collision - Construction Vessel ICW Cargo
2	Collision	Collision - Construction Vessel ICW Tanker
3	Collision	Collision - Construction Vessel ICW Passenger
4	Collision	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel
5	Collision	Collision - Construction Vessel ICW Recreational Vessel
6	Collision	Collision - Construction Vessel ICW Construction Vessel
7	Collision	Collision - Third Party Vessels as a result of avoiding project/construction vessels
8	Contact (Allision)	Contact (Allision) - Cargo ICW Marine Works
9	Contact (Allision)	Contact (Allision) - Tanker ICW Marine Works
10	Contact (Allision)	Contact (Allision) - Passenger ICW Marine Works
11	Contact (Allision)	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works
12	Contact (Allision)	Contact (Allision) - Recreational Vessel ICW Marine Works
13	Contact (Allision)	Contact (Allision) - Construction Vessel ICW Marine Works
14	Contact (Allision)	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure
15	Grounding	Grounding - Cargo
16	Grounding	Grounding - Construction Vessel
17	Ranging / Breakout	Ranging / Breakout - Construction Vessel

Table 22: Identified Operation Phase Hazards

Haz Id #:	Hazard Type	Hazard Title
1	Collision	Collision - Project Vessel ICW Cargo
2	Collision	Collision - Project Vessel ICW Tanker
3	Collision	Collision - Project Vessel ICW Passenger
4	Collision	Collision - Project Vessel ICW Tug, Service and Other Small Vessel
5	Collision	Collision - Project Vessel ICW Recreational Vessel

Haz Id #:	Hazard Type	Hazard Title
6	Collision	Collision - Third Party Vessels as a result of avoiding project/construction vessels
7	Contact (Allision)	Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside)
8	Contact (Allision)	Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)
9	Contact (Allision)	Contact (Allision) - Passenger ICW Proposed Jetty (or a vessel moored alongside)
10	Contact (Allision)	Contact (Allision) - Tug, Service and Other Small Vessel ICW Proposed Jetty (or a vessel moored alongside)
11	Contact (Allision)	Contact (Allision) - Recreational Vessel ICW Proposed Jetty (or a vessel moored alongside)
12	Contact (Allision)	Contact (Allision) - Project Vessel ICW Proposed Jetty (or a vessel moored alongside)
13	Contact (Allision)	Contact (Allision) - Project Vessel ICW Third Party Infrastructure
14	Grounding	Grounding - Cargo
15	Grounding	Grounding - Project Vessel
16	Ranging / Breakout	Ranging / Breakout - Project Vessel

8.5 INHERENT ASSESSMENT OF RISK

The results of the pNRA are contained in full in the '*Risk Assessment Logs*' and can be viewed in **Appendix J.** The logs are based on the PLA template and consider hazard risk in terms of:

- Hazard ID;
- Inherent Hazard Risk Rank (based on inherent risk score);
- Residual Hazard Risk Rank ((based on residual risk score);
- Hazard Causes;
- Hazard severity (broken down into '*Most Likely*' and '*Reasonable Worst Credible*');
- Inherent Risk Assessment (no Proposed Scheme risk controls in place);
- Hazard Likelihood Score;
- Hazard Consequence Score;
- Hazard Risk Score;
- Additional risk control measures – Proposed Scheme risk control or mitigation measures;
- Residual Risk (additional risk controls in place);

- Hazard Likelihood Score.
- Hazard Consequence Score.
- Hazard Risk Score.

In allocating hazard likelihood and consequence scores the following were considered:

- The findings of the baseline navigational environment and Vessel Traffic Analysis;
- Outcomes of stakeholder consultation;
- Simulation findings;
- Hazard likelihood modelling findings;
- Changes in vessel traffic (i.e. increases in vessel traffic frequency) profile resulting from general vessel traffic trends (non-Proposed Scheme related).

The above inputs were combined with the expert knowledge of the project team in order to allocate appropriate hazard scores.

8.5.1 Construction Phase

The results of the inherent assessment of risk for the construction phase are contained in **Table 23** which relates to an assessment of risk without additional control measures but includes PLA embedded risk control measures, (see **Section 2.6**).

Based on the PLA risk score seven (7) hazards scored as intolerable / unacceptable, of these seven hazards, two were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) - Cargo ICW Marine Works; and
- Ranging / Breakout - Construction Vessel.

Five hazards were assessed as presenting 'serious' levels of risk, these were:

- Contact (Allision) - Tanker ICW Marine Works;
- Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works;
- Contact (Allision) - Construction Vessel ICW Marine Works;
- Collision - Construction Vessel ICW Cargo; and
- Collision - Third Party Vessels as a result of avoiding construction vessels.

The remaining hazards scored as 'moderate' risk with the exception of one hazard that scores as 'negligible' risk.

Hazards scoring in the 'serious' risk category and above require additional risk control measures to mitigate the risk score to acceptable levels, but it is also strongly advised that all hazards are reduced to ALARP. Therefore, where appropriate, additional control measures have been utilised to bring all construction phase related hazards down to ALARP.

The highest scoring hazard is Hazard 8 - Contact (Allision) - Cargo ICW Marine Works, the positioning of the Proposed Jetty in such close proximity to the authorised channel necessitates the requirement for construction vessels undertaking the Marine Works to be positioned close to the authorised channel. When departing Ford's Jetty, CLdN vessels navigate on the southern boundary of the authorised channel. A contact hazard occurrence between a cargo vessel and the Marine Works is thought likely because of the proximity in which CLdN vessels will navigate to the Marine Works. This hazard also scores highly when consideration is given to the consequences of such a hazard occurrence. Crucially, in both a most likely and worst credible scenario the consequences of this hazard occurrence are deemed to be severe because a contact between a large CldN vessel and (relatively) small Marine Works vessel could well lead to significant damage to the Marine Works vessel and fatalities amongst construction workers.

The next highest scoring hazard (also falling within the ‘very serious’ scoring category) is Hazard 17 – Ranging / Breakout - Construction Vessel. The combination of a high hazard likelihood and consequences scores in both a most likely and worst case scenario result in a relative high risk score for this hazard. The proximity of proposed barge mooring layouts to large passing vessels (and the resulting draw off effect), impact of the north tide set and proposed mooring spread result in a high hazard likelihood. Breakout of a construction vessel could cause fatalities and serious damage to property in a worst credible scenario, for example if the crane barge breaks out during lifting operations this could lead to capsize and / or loss of the lifted load.

The third, fourth and fifth highest scoring hazards (falling within the ‘serious’ risk category) are all contact hazards between various vessel types and the Marine Works. Contact hazards scored highly in general because of the proximity of the Marine Works to the authorised channel. Consequence scores for each the contact hazard iterations very depending on vessel size. For example, the consequences of a large tanker vessel contacting the Marine Works are thought to be of greater severity than a contact hazard involving a construction vessel. This is because a tanker could well sink a construction vessel involved in the Marine Works, whereas a smaller construction vessel is less likely to cause such severe damage.

Two hazards score joint sixth highest and are the final two hazards that are considered to have intolerable levels of risk. The hazards are:

- Hazard 1: Collision - Construction Vessel ICW Cargo; and
- Hazard 7: Collision - Third Party Vessels as a result of avoiding construction vessels.

These two collision hazards scoring highly predominately because of high likelihood scores resulting from the proximity of the Marine Works to passing vessel transits, frequency of transits by Cargo vessel types (and proximity to the Marine Works) and the fact that the current location of the Proposed Jetty will displace smaller craft north into the authorised channel.

Table 23: Inherent Risk Assessment Results

Haz ID	Inherent Risk Rank	Hazard Name	Score
8	1	Contact (Allision) - Cargo ICW Marine Works	16.0
17	2	Ranging / Breakout - Construction Vessel	15.0
9	3	Contact (Allision) - Tanker ICW Marine Works	12.0
11	4	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works	10.0
13	4	Contact (Allision) - Construction Vessel ICW Marine Works	10.0
1	6	Collision - Construction Vessel ICW Cargo	9.0

Haz ID	Inherent Risk Rank	Hazard Name	Score
7	6	Collision - Third Party Vessels as a result of avoiding construction vessels	9.0
6	8	Collision - Construction Vessel ICW Construction Vessel	8.0
10	8	Contact (Allision) - Passenger ICW Marine Works	8.0
12	8	Contact (Allision) - Recreational Vessel ICW Marine Works	8.0
2	11	Collision - Construction Vessel ICW Tanker	6.0
3	11	Collision - Construction Vessel ICW Passenger	6.0
4	11	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel	6.0
5	11	Collision - Construction Vessel ICW Recreational Vessel	6.0
14	11	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure	6.0
15	11	Grounding - Cargo	6.0
16	17	Grounding - Construction Vessel	3.0

8.5.2 Operation Phase

The results of the inherent assessment of risk for the construction phase are contained in **Table 24** which relates to an assessment of risk without additional control measures but includes PLA embedded risk control measures (see **Section 2.6**).

Based on the PLA risk score six (6) hazards scored as intolerable / unacceptable, of these six hazards, two were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside); and
- Ranging / Breakout - Project Vessel.

Four hazards were assessed as presenting 'serious' levels of risk, these were:

- Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)
- Collision - Project Vessel ICW Cargo
- Collision - Project Vessel ICW Tug, Service and Other Small Vessel
- Collision - Third Party Vessels as a result of avoiding project vessels

The remaining hazards scored as "moderate" risk.

Hazards scoring in the 'serious' risk category and above require additional risk control measures to mitigate the risk score to acceptable levels, but it is also strongly advised that all hazards are reduced to ALARP. Therefore, where appropriate, additional control measures have been utilised to bring all operation phase hazards down to as low as reasonably practical.

As with the hazards assessed in the construction phase the two highest scoring hazards (falling within the 'very serious' category area assessed as a contact hazard involving cargo vessels and the Proposed Jetty and a ranging / breakout hazard. Again, frequency of cargo vessel movements and proximity of the Proposed Jetty to the authorised channel (and consequently passing vessel traffic) combine to result in high likelihood and consequence scores for these hazards.

In the operational case a contact between a passing cargo vessels (most likely a CLdN vessel) and the Proposed Jetty would also include the Project Vessel when moored alongside. In a worst case scenario such a hazard occurrence could result in the loss of one or even both vessels, a release of CO_2 potentially resulting in fatalities as well as environmental damage and significant damage to the Proposed Jetty.

Hazard 8 – Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside) is the third highest scoring hazard. As with a contact between a cargo vessel and the Proposed Jetty the consequences of such a hazard occurrence are judged to be severe. However, in comparison to cargo vessels movements by tanker vessels within the Study Area are relatively infrequent, this results in a lower likelihood score and therefore this hazard overall risk score is deemed to be lower in comparison.

Collision hazard occurrences involving the project vessel, cargo vessels, tug and services vessels score highly because of the frequent transits of such vessels within the Study Area and the high potential consequences of vessels of these types colliding.

Table 24: Residual Risk Assessment Results

Haz ID	Inherent Risk Rank	Hazard Name	Score
7	1	Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside)	16.0
16	2	Ranging / Breakout - Project Vessel	15.0
8	3	Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)	12.0
1	4	Collision - Project Vessel ICW Cargo	9.0
4	4	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0
6	4	Collision - Third Party Vessels as a result of avoiding project vessels	9.0
9	7	Contact (Allision) - Passenger ICW Proposed Jetty (or a vessel moored alongside)	8.0
10	7	Contact (Allision) - Tug, Service and Other Small Vessel ICW Proposed Jetty (or a vessel moored alongside)	8.0
12	7	Contact (Allision) - Project Vessel ICW Proposed Jetty (or a vessel moored alongside)	8.0
3	7	Collision - Project Vessel ICW Passenger	8.0
14	11	Grounding - Cargo	6.0
15	11	Grounding - Project Vessel	6.0
2	11	Collision - Project Vessel ICW Tanker	6.0
5	11	Collision - Project Vessel ICW Recreational Vessel	6.0
11	11	Contact (Allision) - Recreational Vessel ICW Proposed Jetty (or a vessel moored alongside)	6.0
13	16	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	4.0

8.6 ADDITIONAL RISK CONTROLS

Following completion of the inherent risk assessment the project team conducted a thorough review of the embedded risk control measures. Drawing on the expertise of the project team, additional risk control measures, as detailed in **Table 25** were identified. These are over and above the embedded risk control measures mandated by the PLA and could be used to reduce hazard risk.

In total 13 additional risk control measures were identified, some of the identified risk controls apply to both the construction and operation phases whilst some only apply to either the construction or operation phase.

Table 25: Summary of Proposed Additional Risk Controls

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
1	**Relocation of Jetty (Option 3)**	Relocate Proposed Jetty 30m south of current location (see **Figure 57**), results in: • 75m between mid-point of Proposed Jetty platform and southern limit of authorised channel (as opposed to 50) • 45m between north extent of moored Project Vessel and southern limit of authorised channel (as opposed to 20m) • 150m between north extent of moored Project Vessel and centre of authorised channel (as opposed to 120m)	Yes	Yes
2	**Promulgation and dissemination of information**	Information relating to project construction and operation phases to be shared as widely as possible through NtM, VTS broadcasts, updates to guidance documents, emails to key stakeholders and through social media platforms: Construction phase: • Planned vessel movements (arrivals and departures of materials barges) • Sequencing of construction works and proposed Marine Works mooring configurations to be shared with VTS and marine stakeholders (e.g. CLdN). • Requirement for speed reduction and minimum passing distance to Marine Works. Operational phase: • Updates to navigational publications (charts, port guidance documents e.g. PLA Port Information Guide)	Yes	Yes

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
3	**Defined Proposed Scheme limitations (Construction and Operation)**	Operational restrictions during construction and operation phases should include (but may not be limited to) limiting parameters for: • Wind; • Height of tide • Tidal stream; and • Visibility. • Minimum available UKC at which arrivals and departures can occur. • Tug assistance required. • Tidal state e.g. ebb and flood arrivals and departures Operation: Recognising that the Proposed Jetty design, positioning and design vessel specifications are subject to an element of change, then defining the boundaries of the detailed operational parameters at this stage of the study is limited. However, some limitations can be confirmed. For example, simulations have confirmed that departures be limited to be no later than HW +1.5 hours taking in to account the time to swing the vessel on an ebb tide port side departure, the effects of the Ebb tide flow and the UKC required on passage (due to limiting depth of 6.8m in Erith Reach and further to seaward).	Yes	Yes
4	**Deconfliction of Cory operations with arrival/departure of project vessel**	Cory tug and barge operation at downstream end of Middelton Jetty to cease during project vessel arrival / departure.	No	Yes
5	**Detailed design analyses for berth and moorings**	Detailed design for the mooring system specification, equipment selection and structural requirements of the berth and Proposed Jetty should accommodate and mitigate the likelihood and consequences of the project vessel ranging, therefore providing information for future operational considerations such as visiting vessel requirements, defined mooring plans and mooring procedures. In addition, design development should continue into the detailed design phase to ensure vessel breakout is minimised to ALARP.	No	Yes

Additional Risk Controls				
			Application	
RC ID	**Risk Control Name**	**Risk Control Description**	**Construction Phase**	**Operation Phase**
6	**Minimum passing distance and Speed Reduction**	Enforcement of a minimum passing distance from Marine Works (50m) to vessels passing within the authorised channel in addition to a requested maximum Speed Reduction (less than 6kts). Requirements to proceed with caution or at slow speed will be made in accordance with the procedure set out in the Port of London Authority's Port Information Guide, under 'London VTS,' 'Section 4'. Masters of passing vessels should have due regard for the effects of their wash including the possibility of rebound from the river wall and the combined effect of wash from other vessels.	Yes	No
7	**Navigation Exclusion Zone**	**Construction** A navigation exclusion to all vessels other than those engaged in the construction works and Cory vessels navigating to and from Middleton Jetty should be enforced to minimise risk associated with contact and collision hazard occurrence. **Operation** PLA General Direction 17.1.(b) states *"No vessel is to: approach within 60 metres of any Berthed tanker, oil or gas jetty in the Thames"*. The PLA have confirmed this direction would apply in the case of a berthed LCO_2 tanker although it not to the Proposed Jetty itself when unoccupied (it not being an oil or gas jetty), nor to Cory tugs that are proposed to moor on the inshore pontoon[9].	Yes	Yes

[9] Although the PLA's General Directions are considered an embedded risk control measure the requirement for a 60m exclusion zone for the berthed LCO_2 tanker has on this occasion been treated as an additional risk control measure because the applicability of General Direction 17.1(b) to the Proposed Scheme is not clear and it has therefore been necessary to seek additional guidance from the PLA as to the applicability of this General Direction clause. It is understood that the intention of the original General Direction wording was to mitigate the risk associated with hydrocarbon vessels and terminals because of concerns relating to flammability. However, as explained in **Section 6.1**, further analysis of LCO_2 release may contribute to a relaxation or removal of the applicability of this General Direction on a case-by-case basis once the effects are further investigated. As the final applicability of this General Direction remains unclear, it has been assumed to be in effect when considering this pNRA; however, has been treated as an additional risk control for the purposes of risk assessment, risk control effectiveness. and the residual assessment of risk.

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
8	**Standby Tug**	Standby tug to be present on site throughout construction phase to provide assistance in the event of a construction vessel breakout. The standby tug should be manned and ready to respond when construction activity is taking place on Site.	Yes	No
9	**Safety boat**	Based on a PLA supplied specification a Safety Boat would be: • Focused on the alerting of Category 1 and Category 2 responders in event of persons or objects falling into the river from the works / operation. • To provide a recovery response for falling persons. • Not to provide local control navigation. • In full communication with work's contractors and the appropriate PLA VTS Control Centre. • To alert works contractors of impending breach of non-intrusion area by errant craft. • Generally sited downstream of the protected works or moored downstream of the protected works with an agreed response time from notification to deployment. • Shallow draught, low freeboard (for rescue of recreational craft and persons) and equipped with basis safety equipment. • Crewed by two persons with the minimum qualifications of RYA Safety Boat Certificate for the helmsman/person in charge and the second person being RYA Power Boat Level 2 or International Certificate of Competence (ICC).	Yes	No
10	**Marine works and construction vessel mooring configurations**	• Give due consideration to Marine Works Marine Works mooring layouts to minimise risk of breakout resulting from vessel interaction. • Optimise construction sequencing to ensure maximum distance between southern extent of authorised channel and Marine Works. • Deploy and utilise spud legs in addition to mooring anchor spread.	Yes	No
11	**Lighting of marine works and construction vessels**	Lighting of Marine Works before permanent AtoN are installed	Yes	No

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
12	**Passing vessel mooring interaction study**	Due to the close proximity of outward passing traffic and rapidly shallowing depths inshore of the berth draw off / interaction damage and / or suction off berth is a possibility. It is therefore recommended that a passing vessel mooring interaction study is undertaken to determine the hydrodynamic effect of close passing large ships on moored project vessels.	No	Yes
13	**Third Party Bridge Simulations**[10]	PEC holders (CLdN/Heidelberg Materials) to participate in Full Ship Bridge Simulations to assist in familiarisation with project operational navigational environment and in form evidence-based decision making in relation to jetty location and design.	No	Yes

[10] Note, Full Ship Bridge Simulations (Risk control ID #13) and passing vessel mooring interaction study (Risk control ID # 12) have at the time of writing been conducted. However, these additional risk controls are included within the table in order to ensure that the process of optimising the Proposed Jetty layout for navigational risk purposes is properly documented.

8.6.1 Risk Control ID 1 - Relocation of Proposed Jetty (Option 3)

The Proposed Jetty should be relocated south further away from passing vessels navigating within the authorised channel. This proposal (Option 3) is made following the outcomes of the inherent assessment of risk and third-party ship bridge simulations whereby high risk scores arise as a result of the Proposed Jetty (Option 2) location in proximity to the authorised channel.

Moving the Proposed Jetty south would have the following impacts which will likely contribute to a reduction in navigation risk:

- Increased navigable width for CLdN vessels arriving and departing Ford's Jetty;
- Increased distance between large passing vessels and the Marine Works / Proposed Jetty; and
- Retention of the navigable water south of the authorised channel.

Figure 57 shows Option 3 which is the reccomended Proposed Jetty design, this design shows the Proposed Jetty approximately 30m further south of the limit of the authorised channel than Option 2.

Note, the residual risk assessment scores presented in **Section 8.7** assume Option 3 is adopted as an additional risk control measure.

During the operation phase the PLA would apply a 60m exclusion zone for vessels passing the berthed tanker while the Proposed Jetty is occupied. As well as reducing navigation risk as outlned above, adopting Option 3 as the Proposed Jetty design will minimise the extent to which the 60m exclusion zone will encroach on the authorised channel (see **Figure 58**). At the maximum extent (assuming Option 3 is adopted with the largest design vessel at berth) the exlusion zone will encroach 22m in to the authorised channel at its closest point. This encroachment is deemed to be acceptableby by the PLA following the third party simulations undertaken by the project (Risk Contol ID # 13) which demonstated that CLdN and other transiting vessels are able to navigate well in excess of 60m from the berthed tanker when alongside the Proposed Jetty.

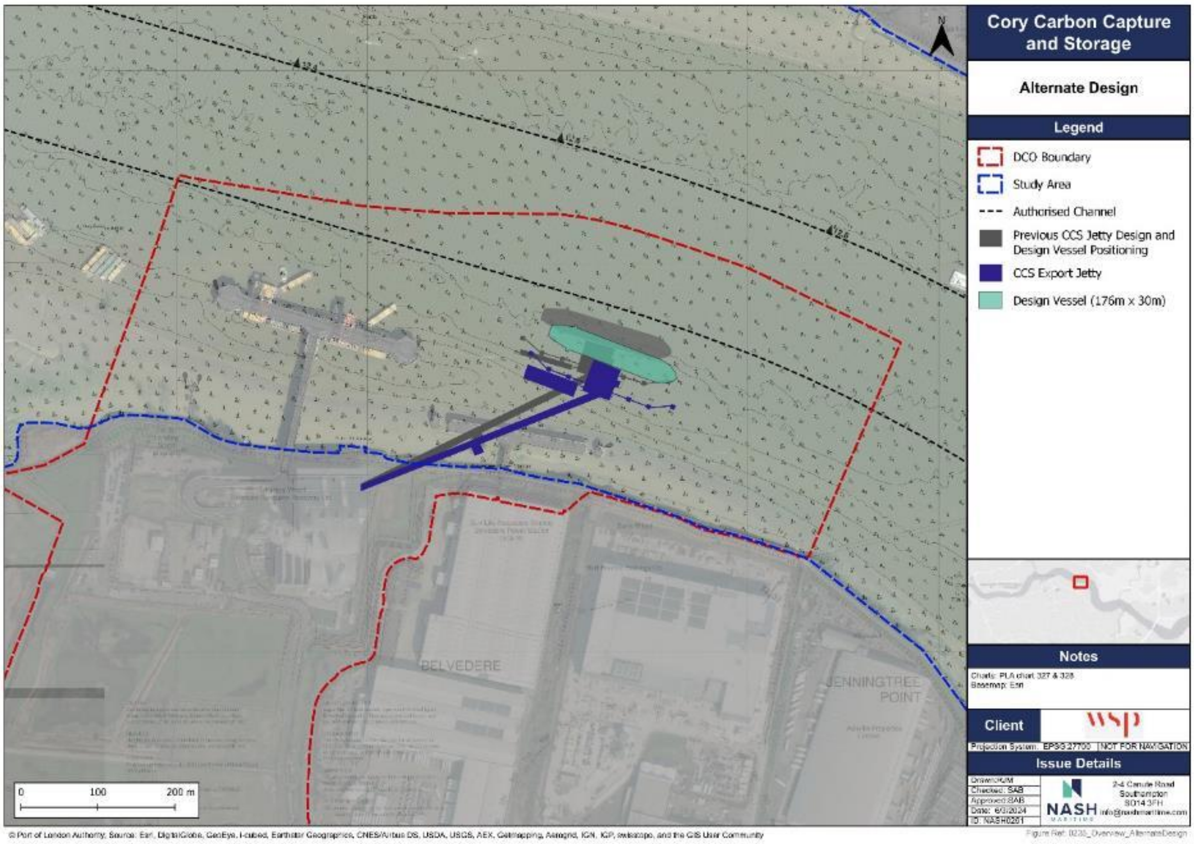


Figure 57: Option 3

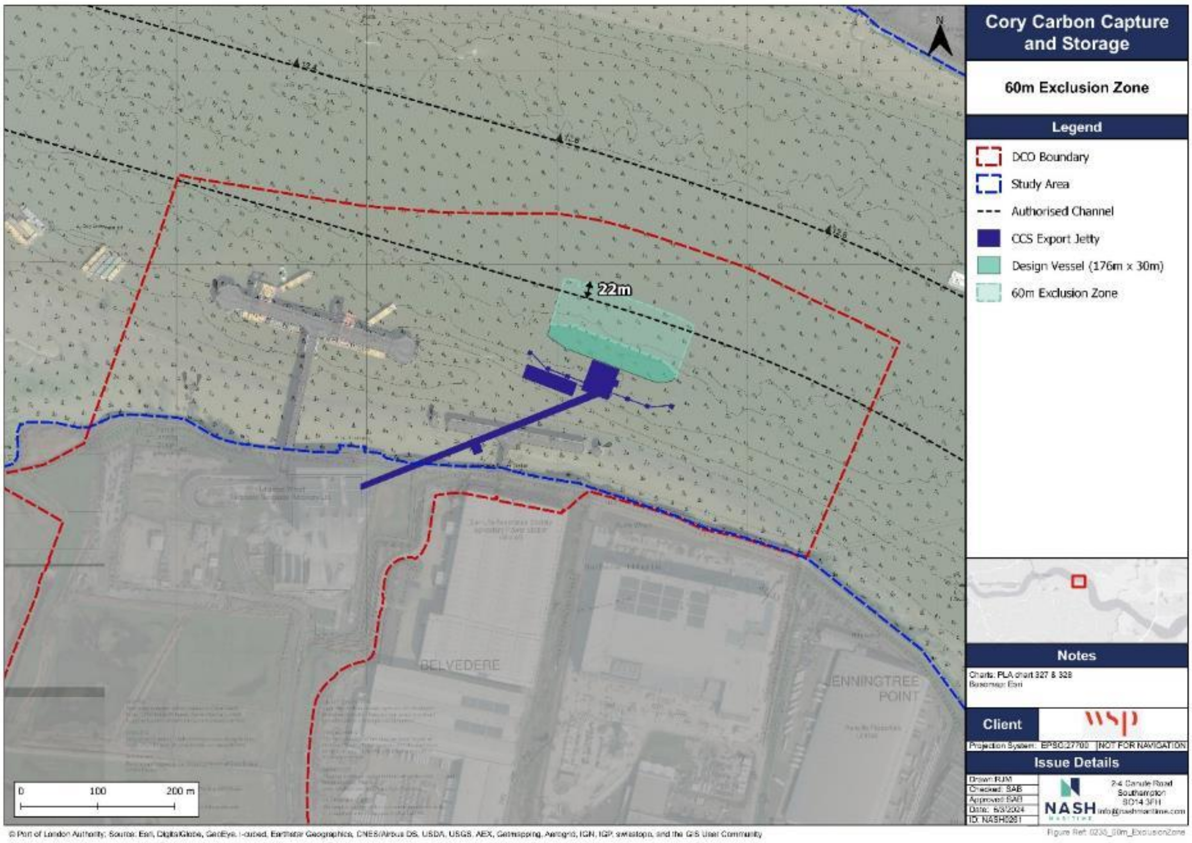


Figure 58: Extent of Navigation Exclusion Zone (with largest design vessel at berth)

8.6.2 Risk Control ID 6 - Minimum passing distance and speed reduction

Risk control ID 6 (construction phase only) recommends the enforcement of a minimum passing distance from Marine Works (50m) to vessels passing within the authorised channel in addition to a requested maximum speed seduction (to less than 6kts).

Figure 59 shows the extent of the proposed 50m minimum passing distance around the jetty infrastructure relative to the original Proposed Jetty design Option 2 (left hand image) and Proposed Jetty design Option 3 (right hand image). Note, the purpose of this risk control is to mitigate navigation risk associated with passing vessel traffic, therefore it is not proposed that the minimum passing distance will apply to Cory vessels conducting operations at the Middleton Jetty.

Note, the residual risk assessment scores presented in **Section 8.7** assume that Option 3 is taken forward.

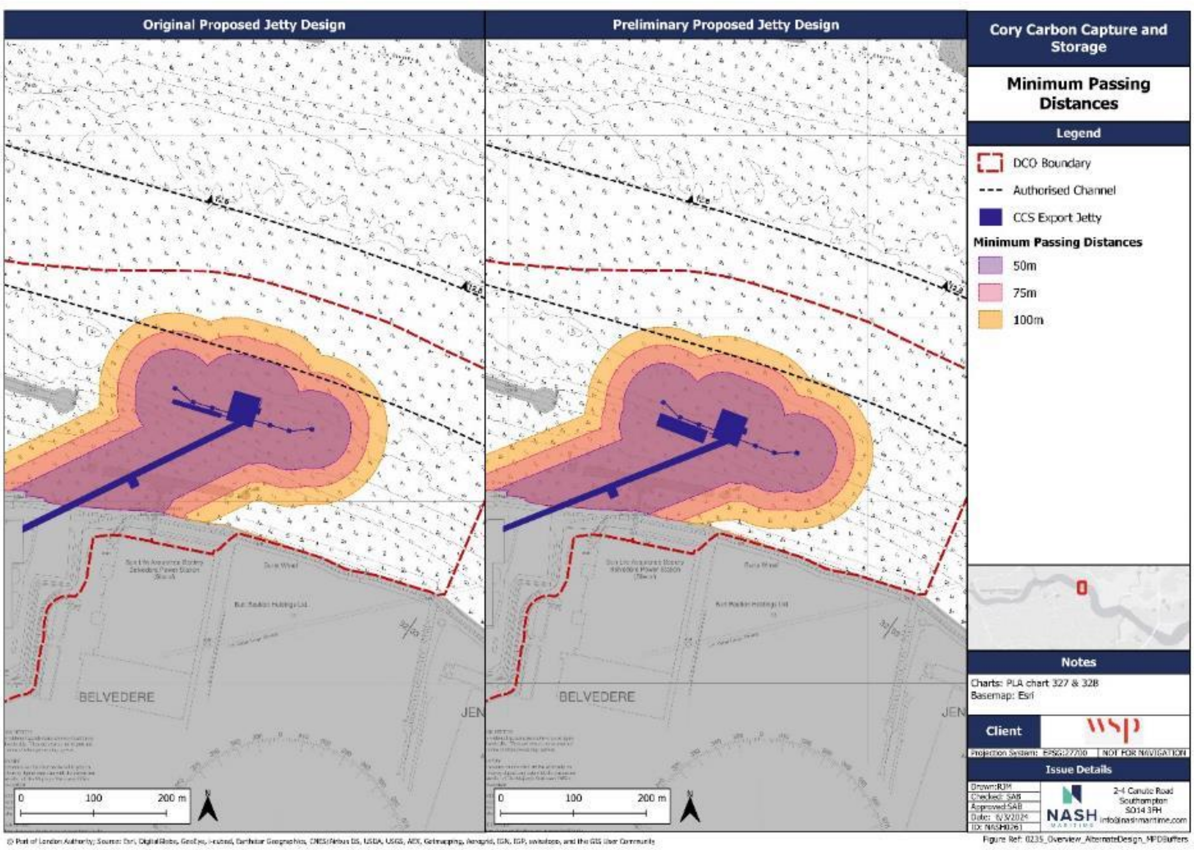


Figure 59: Minimum Passing Distances

8.6.3 Proposed Risk Controls Not Taken Forward

In addition to the risk control measures identified in **Table 25** two risk controls were identified that were not taken forward following consultation with the PLA, these two risk controls are summarised in the remainder of this section.

8.6.3.1 One way vessel movements

The project team proposed that in order to ensure vessels maintain 60m from the Proposed Jetty (Option 3) at all times then a General Direction enforcing one way navigation off Jenningtree bend should be developed. Following discussion with the PLA this risk control was not taken forward because:

- Existing operators avoid passing in this location as confirmed by CLdN, Heidelberg Materials and the PLA pilots;
- Ship to Ship communications are felt by the PLA to be an adequate method of deconfliction;
- General Direction 17.5 (e) gives London VTS the authority to enforce one way traffic at any location with the PLA SHA. In other words VTS have the power to enforce one way traffic around Jenningtree bend at any time that is deemed necessary by VTS.

"Vessels may be subject to one-way traffic management procedures as follows:

a) When Reporting Vessels are navigating between Black Deep No. 9 Buoy and Knock John No. 7 Buoy;

b) When Reporting Vessels are navigating between the West Oaze Buoy and Sea Reach No. 3 Buoys;

c) When Reporting Vessels are navigating in the Princes Channel Deep Water Route, depending on traffic density;

d) When Reporting Vessels are navigating in Barking Creek; and

e) Any other time deemed necessary by London VTS."

8.6.3.2 Area specific speed ease down (operation phase)

In order to mitigate the impact of draw off resulting from passing vessel interaction the project team proposed that a speed ease down be introduced during the operation phase.

The PLA have advised that rather than introducing a specific speed ease down they would instead rely on Byelaw 57 to ensure vessels passed the Proposed Jetty at an appropriate speed and manner.

The wording of the byelaw is included below for fullness:

"57. WASH AND DRAW-OFF

Except in an emergency, the master of a power-driven vessel must, at all times when underway on the Thames, ensure that the vessel is navigated at a speed and in a manner such that any wash or draw-off created by the vessel must not compromise:

a) the safety of others using the Thames, the foreshore, adjacent piers, moorings, berths, jetties or other facilities; or

b) the integrity of the foreshore."

8.6.4 Risk Control Application

This risk controls outlined in **Table 25** were applied variously to the identified hazards to reduce the levels of risk identified during the inherent assessment of risk.

The application of the additional risk controls to the construction and operation phase hazards is summarised in **Table 26** and **Table 27,** respectively.

Table 26: Summary of Application of Additional Construction Phase Risk Controls to Construction Phase Hazards

Haz ID	Hazard Name	Additional Risk Controls
1	Collision - Construction Vessel ICW Cargo	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat
2	Collision - Construction Vessel ICW Tanker	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat
3	Collision - Construction Vessel ICW Passenger	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat
4	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat

Haz ID	Hazard Name	Additional Risk Controls
5	Collision - Construction Vessel ICW Recreational Vessel	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat
6	Collision - Construction Vessel ICW Construction Vessel	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat
7	Collision - Third Party Vessels as a result of avoiding construction vessels	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug
8	Contact (Allision) - Cargo ICW Marine Works	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels
9	Contact (Allision) - Tanker ICW Marine Works	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine Works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels
10	Contact (Allision) - Passenger ICW Marine Works	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels

Haz ID	Hazard Name	Additional Risk Controls
11	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels
12	Contact (Allision) - Recreational Vessel ICW Marine Works	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels
13	Contact (Allision) - Construction Vessel ICW Marine Works	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels
14	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of Marine Works and construction vessels
15	Grounding - Cargo	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information
16	Grounding - Construction Vessel	3. Defined Proposed Scheme limitations (Construction and Operation) 8. Standby tug

Haz ID	Hazard Name	Additional Risk Controls
17	Breakout - Construction Vessel	1. Relocation of Proposed Jetty (Option 3) 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 8. Standby tug 9. Safety boat 10. Marine works and construction vessel mooring configurations

Table 27: Summary of Application of Additional Operation Phase Risk Controls to Operation Phase Hazards.

Haz ID	Hazard Name	Additional Risk Controls
1	Collision - Project Vessel ICW Cargo	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
2	Collision - Project Vessel ICW Tanker	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
3	Collision - Project Vessel ICW Passenger	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
4	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel 13. Full ship bridge simulations
5	Collision - Project Vessel ICW Recreational Vessel	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
6	Collision - Third Party Vessels as a result of avoiding project vessels	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
7	Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside)	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. PLA Navigation Exclusion Zone 13. Full ship bridge simulations
8	Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. PLA Navigation Exclusion Zone 13. Full ship bridge simulations
9	Contact (Allision) - Passenger ICW Proposed Jetty (or a vessel moored alongside)	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. PLA Navigation Exclusion Zone

Haz ID	Hazard Name	Additional Risk Controls
10	Contact (Allision) - Tug, Service and Other Small Vessel ICW Proposed Jetty (or a vessel moored alongside)	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. PLA Navigation Exclusion Zone
11	Contact (Allision) - Recreational Vessel ICW Proposed Jetty (or a vessel moored alongside)	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. PLA Navigation Exclusion Zone
12	Contact (Allision) - Project Vessel ICW Proposed Jetty (or a vessel moored alongside)	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation)
13	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	1. Relocation of Jetty (Option 3) 2. Promulgation and dissemination of information 13. Full ship bridge simulations
14	Grounding - Cargo	2. Promulgation and dissemination of information 13. Full ship bridge simulations
15	Grounding - Project Vessel	3. Defined Proposed Scheme limitations (construction and operation phase) 4. Deconfliction of Cory operations with arrival/departure of Project vessel
16	Breakout - Project Vessel	1. Relocation of Jetty (Option 3) 3. Defined Proposed Scheme limitations (Construction and Operation) 5. Detailed design analyses for berth and moorings 7. PLA Navigation Exclusion Zone 12. Passing vessel mooring interaction study

8.7 RESIDUAL ASSESSMENT OF RISK

The risk control measures identified in **Section 8.6** were applied to the identified hazards, the findings of the residual assessment of risk are presented in **Table 28** for the construction phase and **Table 29** for the operation phase.

The tables show the following for each hazard:

- Haz ID,
- Inherent Risk Ranks;
- Residual Risk Rank,
- Hazard Name;
- Inherent Risk Score: and
- Residual Risk Score.

8.7.1 Construction Phase

For the construction phase the residual assessment of risk resulted in all hazards scoring as ‘acceptable’.

The impact of the proposed risk controls on the identified hazard types during the construction phase is outlined in the remainder of this section.

8.7.1.1 Contact

Contact hazards are mitigated by the below highlighted risk controls.

Applicable risk controls:

1. **Relocation of Proposed Jetty (Option 3)** - The relocation of the Proposed Jetty creates more navigable width for third party vessels and decreases the likelihood of a contact hazard occurrence between all third-party vessels and the Marine Works

2. **Promulgation and dissemination of information** - The promulgation and dissemination of information relating to the construction works to third parties reduces the likelihood of contact occurrences by raising awareness of the Marine Works.

3. **Defined Proposed Scheme limitations (construction and operation**) - Defined operational limitations during the construction stage reduce the likelihood of a construction vessel making contact with the Marine Works by ensuring that works do not take place in adverse weather / tidal conditions.

6. **Minimum passing distance and speed reduction** - The introduction of a minimum passing distance further creates spatial separation between the Marine Works and passing vessels.

7. **Navigation exclusion zone** - The introduction of a navigation exclusion zone creates spatial separation between the Marine Works and vessels navigating within the inshore zone.

9. **Safety boat –** The addition of a safety boat reduces the consequences of a contact hazard by increasing the likelihood that Man Overboard casualties are recovered speedily and without serious injury and / or fatalities.

10. **Marine works and construction vessel mooring configurations** - optimising barge mooring locations to ensure maximum spatial separation wherever possible between passing vessels and the Marine Works reduces the likelihood of contact incident occurrence.

11. **Lighting of Marine Works and construction vessels** - lighting of the Marine Works and construction vessels at night ensures that they are visible to passing vessels.

Contact hazards are mitigated by the above highlighted risk controls.

8.7.1.2 Collision Hazards

Collision hazards are mitigated by the below additional risk controls measures:

Applicable risk controls:

1. **Relocation of Proposed Jetty (Option 3)** - The relocation of the Proposed Jetty increases navigable width reducing congestion in proximity to the Marie Works and therefore the likelihood of a collision hazard occurrence.

2. **Promulgation and dissemination of information** - The promulgation and dissemination of information relating to the construction works to third parties reduces the likelihood of collision occurrences by raising awareness of the Marine Works.

3. **Defined Proposed Scheme limitations (Construction and Operation)** - Defined operational limitations during the construction stage reduce the likelihood of a construction vessel being involved in a collision occurrence by ensuring that works do not take place in adverse weather / tidal conditions.

6. **Minimum passing distance and speed reduction** - The introduction of a minimum passing distance creates spatial separation between construction vessels and passing vessels.

7. **Navigation exclusion zone** - The introduction of a navigation exclusion zone creates spatial separation between construction vessels and vessels navigating within the inshore zone.

8. **Standby tug** - The provision of a standby tug ensures construction vessels that may have broken down or slipped mooring lines can be recovered and securely moored in a safe location thus reducing the likelihood of a collision hazard occurrence.

9. **Safety boat** - The addition of a safety boat reduces the consequences of a collision hazard by increasing the likelihood that Man Overboard casualties are recovered speedily and without serious injury and / or fatalities.

8.7.1.3 Ranging / Breakout

Ranging / breakout hazards are mitigated by the below additional risk controls measures:

Applicable risk controls:

1. **Relocation of Proposed Jetty (Option 3)** - Relocating the Proposed Jetty further from the authorised channel reduces the potential draw off impacts that result from interaction with large passing vessels. This leads to a reduction in the likelihood of a ranging / breakout hazard occurrence.

3. **Defined Proposed Scheme limitations (Construction and Operation)** - Defined operational limitations during the construction stage reduce the likelihood of a construction vessel being involved in ranging / breakout incident by ensuring that works do not take place in adverse weather / tidal conditions. For example, breakout hazard occurrence would be more significant in periods of strong wind, particularly if a south or south westerly wind is combined with a strong ebb tide.

6. **Minimum passing distance and speed reduction** - The introduction of a minimum passing distance creates spatial separation between construction vessels and passing vessels, combined with a speed reduction this will decrease the draw off effect that results from interaction with large passing vessels.

8. **Standby tug** - The consequences of a breakout occurrence can be mitigated by the provision of a standby tug that can intercept any construction vessel that breakout from a moored location.

9. **Safety boat** - The addition of a safety boat reduces the consequences of a ranging / breakout hazard by increasing the likelihood that Man Overboard casualties are recovered speedily and without serious injury and / or fatalities.

10. **Marine works and construction vessel mooring configurations** - optimising barge mooring locations to ensure maximum spatial separation wherever possible between passing vessels and the Marine Works reduces the likely draw off effect associated with interaction between the Marine Works and large passing vessels.

8.7.1.4 Grounding

Grounding hazards are mitigated by the below additional risk controls:

Applicable risk controls:

1. **Relocation of Proposed Jetty (Option 3) –** Relocating the Proposed Jetty ensures that CLdN vessels are able to utilise the full authorised channel without being impeded by the Marine Works. This is critically when a CLdN vessel is approaching Ford's Jetty when working against a southerly wind and strong ebb tide. If CLdN vessels are not able to navigate far enough south when approaching (because of the location of the Proposed Jetty) then they risk being set north by the combined effect of the wind and tide and grounding to the north of the authorised channel.

2. **Promulgation and dissemination of information -** The promulgation and dissemination of information relating to the construction works to third parties reduces the likelihood of grounding occurrences by raising awareness of the Marine Works.

3. **Defined Proposed Scheme limitations (Construction and Operation)** - Defined operational limitations during the construction phase reduce the likelihood of a construction vessel being involved in grounding incident by ensuring that works do not take place in adverse weather / tidal conditions.

8. **Standby tug -** The provision of a standby tug ensures construction vessels that may have broken down or slipped mooring lines can be recovered and securely moored in a safe location thus reducing the likelihood of a grounding hazard occurrence. The standby tug can also assist construction vessels that may have run aground thus reducing the consequence of a grounding hazard occurrence.

Table 28: Construction Phase Residual Risk Assessment Results

Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Risk Score	Residual Risk Score
8	1	1	Contact (Allision) - Cargo ICW Marine Works	16.0	8.0
9	3	1	Contact (Allision) - Tanker ICW Marine Works	12.0	8.0
11	4	1	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works	10.0	8.0
13	4	1	Contact (Allision) - Construction Vessel ICW Marine Works	10.0	8.0
17	2	1	Breakout - Construction Vessel	15.0	8.0
1	6	6	Collision - Construction Vessel ICW Cargo	9.0	6.0
2	11	6	Collision - Construction Vessel ICW Tanker	6.0	6.0
3	11	6	Collision - Construction Vessel ICW Passenger	6.0	6.0
6	8	6	Collision - Construction Vessel ICW Construction Vessel	8.0	6.0
7	6	6	Collision - Third Party Vessels as a result of avoiding construction vessels	9.0	6.0
10	8	6	Contact (Allision) - Passenger ICW Marine Works	8.0	6.0
12	8	6	Contact (Allision) - Recreational Vessel ICW Marine Works	8.0	6.0
4	11	13	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel	6.0	4.0
5	11	13	Collision - Construction Vessel ICW Recreational Vessel	6.0	4.0
14	11	13	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure	6.0	4.0
15	11	13	Grounding - Cargo	6.0	4.0
16	17	17	Grounding - Construction Vessel	3.0	3.0

8.7.2 Operation Phase

For the operation phase the residual assessment of risk resulted in one hazard scoring tolerable if ALARP. The remaining hazards all scored as acceptable.

The impact of the proposed risk controls on the identified hazard types during the operation phase is outlined in the remainder of this section.

8.7.2.1 Contact

Contact hazards are mitigated by the below highlighted risk controls.

Applicable risk controls:

1. **Relocation of Jetty (Option 3)** - The relocation of the Proposed Jetty creates more navigable width for third party vessels and decreases the likelihood of a contact hazard occurrence between all third-party vessels and the Proposed Jetty (and or project vessel moored alongside).

2. **Promulgation and dissemination of information** - The promulgation and dissemination of information relating to the Proposed Jetty to third parties reduces the likelihood of contact occurrences by raising awareness of the Jetty location.

3. **Defined Proposed Scheme limitations (construction and operation**) - Defined operational limitations during the operation phase reduce the likelihood of the project vessel making contact with the Proposed Jetty by ensuring that operations do not take place in adverse weather / tidal conditions.

7. **Navigation exclusion zone –** The introduction of a navigation exclusion zone (60m from a berthed tanker's hull side) creates spatial separation between passing vessels and the berthed tanker. Exclusion zone applies only when a tanker is berthed.

13. **Full ship bridge simulations** - Contact by third party operators with the Marine works is reduced by the undertaking of full ship bridge simulation for key third party operators such as CLdN and Hanson Aggregates as simulations allow vessel Captains to familiarise themselves with the more restrictive manoeuvring requirements that result from the location of the Marine Works. Note, simulations with third parties have been undertaken as per this risk control requirement . The findings of the simulations are reported in **Section 6** and inform the pNRA findings.

8.7.2.2 Collision Hazards

Applicable risk controls:

1. **Relocation of Jetty (Option 3)** - The relocation of the Proposed Jetty increases navigable width reducing congestion in proximity to the Proposed Jetty and therefore the likelihood of a collision hazard occurrence.

2. **Promulgation and dissemination of information** - The promulgation and dissemination of information relating to the Proposed Jetty and associated marine operation to third parties reduces the likelihood of collision occurrences by raising awareness.

3. **Defined Proposed Scheme limitations (construction and operation)** - Defined operational limitations during the operation stage reduce the likelihood of the project vessel being involved in a collision occurrence by ensuring that operations do not take place in adverse weather / tidal conditions.

4. **Deconfliction of Cory operations with arrival/departure of Project vessel –** A stoppage in Cory tug and tow movements whilst the project vessel arrives / departs the berth reduces the likelihood of a collision.

13. **Full ship bridge simulations** - – The Likelihood of collisions involving third party operators with the Project Vessels is reduced by the undertaking of full ship bridge simulation for key third party operators such as CLdN and Hanson Aggregates as simulations allow vessel Captains to familiarise themselves with the more restrictive manoeuvring requirements that result from the location of the Proposed Jetty and the likely arrival and departure manoeuvres undertaken by the project vessel. Note, simulations with third parties have been undertaken as per this risk control requirement. The findings of the simulations are reported in **Section 6** and inform the pNRA findings.

8.7.2.3 Ranging / Breakout

Ranging / breakout hazards are mitigated by the below additional risk controls measures:

Applicable risk controls:

1. **Relocation of Jetty (Option 3)** - Relocating the Proposed Jetty further from the authorised channel reduces the potential draw off impacts that result from interaction with large passing vessels. This leads to a reduction in the likelihood of a ranging / breakout hazard occurrence.

3. **Defined Proposed Scheme limitations (construction and operation)** - Defined operational limitations during the operation phase reduce the likelihood of the project vessel being involved in a ranging / breakout incident by ensuring that mooring operations do not take place in adverse weather / tidal conditions. For example, breakout hazard occurrence would be more significant in periods of strong wind, particularly if a south or south westerly wind is combined with a strong ebb tide.

5. **Detailed design analyses for berth and moorings** - The detailed design stages for terminal, positioning and mooring equipment specification to be undertaken as part of future design phases should be designed to analyse and mitigate the potential occurrence and resulting impacts of the project vessel ranging. This risk control reduces the consequences of a ranging/ breakout hazard occurrence and provides information for future development of operational procedures.

7. **Navigation exclusion zone** - The introduction of a navigation exclusion zone (60m from berthed tanker) as appropriate (see **section 6.1**) creates spatial separation between passing vessels and the berthed tanker mitigating the effects of draw off and subsequent breakout / ranging by reducing passing interaction forces.

12. **Passing vessel mooring interaction study** - analysis should be undertaken to ensure that the impacts of draw off resulting from interaction with large passing vessels is fully understood. This should in turn inform the detailed design of the Proposed Jetty which should be positioned to mitigate as much as possible the impact of draw off. Note, the passing vessel mooring interaction study has been undertaken as per this risk control requirement. The findings of the study are reported in **Section 7** and inform the pNRA findings.

8.7.2.4 Grounding

Grounding hazards are mitigated by the below additional risk controls:

Applicable risk controls:

2. **Promulgation and dissemination of information** - The promulgation and dissemination of information relating to the Proposed Jetty and associated marine operation to third parties reduces the likelihood of grounding hazard occurrences by raising awareness.

3 **Defined Proposed Scheme limitations (construction and operation)** - Defined operational limitations during the construction phase reduce the likelihood of a project vessel being involved in a grounding incident by ensuring that works do not take place in adverse weather / tidal conditions.

4. **Deconfliction of Cory operations with arrival/departure of Project vessel** - A stoppage in Cory tug and tow movements whilst the project vessel arrives / departs the berth reduces the likelihood of a grounding incident as a result of the tanker having to take avoiding action to avoid a cory tug and barge.

13. **Full ship bridge simulations -** The Likelihood of grounding incidents involving third party operators is reduced by the undertaking of full ship bridge simulation for key third party operators such as CLdN and Hanson Aggregates as simulations allow vessel Captains to familiarise themselves with the more restrictive manoeuvring requirements that result from the location of the Proposed Jetty and the likely arrival and departure manoeuvres undertaken by the project vessel. Note, simulations with third parties have been undertaken as per this risk control requirement . The findings of the simulations are reported in **Section 6** and inform the pNRA findings.

Table 29: Operation Phase Residual Risk Assessment Results.

Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Risk Score	Residual Risk Score
16	2	1	Breakout - Project Vessel	15.0	12.0
7	1	2	Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside)	16.0	8.0
1	4	3	Collision - Project Vessel ICW Cargo	9.0	6.0
4	4	3	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0	6.0
6	4	3	Collision - Third Party Vessels as a result of avoiding project vessels	9.0	6.0
8	3	3	Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)	12.0	6.0
9	7	3	Contact (Allision) - Passenger ICW Proposed Jetty (or a vessel moored alongside)	8.0	6.0

Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Risk Score	Residual Risk Score
10	7	3	Contact (Allision) - Tug, Service and Other Small Vessel ICW Proposed Jetty (or a vessel moored alongside)	8.0	6.0
12	7	3	Contact (Allision) - Project Vessel ICW Proposed Jetty (or a vessel moored alongside)	8.0	6.0
14	11	3	Grounding - Cargo	6.0	6.0
15	11	3	Grounding - Project Vessel	6.0	6.0
3	7	12	Collision - Project Vessel ICW Passenger	8.0	4.0
13	16	12	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	4.0	4.0
2	11	14	Collision - Project Vessel ICW Tanker	6.0	3.0
5	11	14	Collision - Project Vessel ICW Recreational Vessel	6.0	3.0
11	11	14	Contact (Allision) - Recreational Vessel ICW Proposed Jetty (or a vessel moored alongside)	6.0	3.0

9. CONCLUSIONS AND RECOMMENDATIONS

9.1 CONCLUSIONS

This NRA has been undertaken to assess levels of navigational risk associated with the construction and operation elements of the Proposed Scheme. Following a review of the proposed operation and Proposed Jetty design, baseline navigation environment, detailed vessel traffic analysis, hazard likelihood modelling and stakeholder consultation a risk assessment was undertaken to determine levels of inherent navigational risk.

The inherent assessment of risk determined that during the construction phase seven hazards scored as intolerable / unacceptable, of these seven hazards, two were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) - Cargo ICW Marine Works; and
- Breakout - Construction Vessel.

Five hazards were assessed as presenting 'serious' levels of risk, these were:

- Contact (Allision) - Tanker ICW Marine Works;
- Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works;
- Contact (Allision) - Construction Vessel ICW Marine Works;
- Collision - Construction Vessel ICW Cargo; and
- Collision - Third Party Vessels as a result of avoiding construction vessels.

The remaining hazards scored as 'Moderate' risk with the exception of one hazard that scores as negligible risk.

The inherent assessment of risk determined that during the operation phase six hazards scored as intolerable / unacceptable, of these six hazards, two were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside); and
- Ranging / Breakout - Project Vessel.

Four hazards were assessed as presenting "serious" levels of risk, these were:

- Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)
- Collision - Project Vessel ICW Cargo
- Collision - Project Vessel ICW Tug, Service and Other Small Vessel
- Collision - Third Party Vessels as a result of avoiding project vessels

The remaining hazards scored as "Moderate" risk.

Hazards scoring in the "Serious" risk category and above require additional risk control measures to mitigate the risk score to acceptable levels, but it is also strongly advised that all hazards are reduced to ALARP. Therefore, where appropriate, additional control measures were developed to bring all construction and operation phase hazards down to ALARP.

Following the inherent assessment of risk 13 additional controls were identified by the project team, some of the identified risk controls applied both the construction and operation phases whilst some only applied to either the construction or operation phase.

Following the application of the additional risk control measures a residual assessment of navigation risk was undertaken.

For the construction phase the residual assessment of risk determined that all hazards scored as acceptable following the implementation of the additional risk controls.

For the operation phase the residual assessment of risk resulted in one hazard scoring as tolerable if deemed to be ALARP. The remaining hazards all fell within the acceptable scoring range.

The hazard considered to be tolerable if ALARP was Hazard 16 - Breakout - Project Vessel.

It should also be noted that this hazard has been scored by the NASH Maritime team and this reflects the expert qualitative judgement of the team, building on the process carried out in the development of this pNRA and the initial results of the bridge simulation study in **Appendix K**. The project undertook a passing vessel mooring interaction study to further understand the potential impacts of draw off on vessels berthed alongside the Proposed Jetty.

The passing vessel mooring interaction study was undertaken to support the judgment of risk associated with a Project Vessel breakout from the Proposed Jetty during the operation phase hazard. It was identified that of the largest vessels currently navigating past the Proposed Jetty (Cruise vessel, Bulk Carrier and CLdN RoRo vessel), the fully loaded Bulk Carrier produced the greatest interaction forces and therefore resulting moored vessel mooring line loads. Comparatively, the Cruise vessel and CLdN RoRo vessel produced similar or lower forces and moored vessel mooring line loads. Guidance form the projects expert mariner indicated that large vessels passing at close passing distance of two times the vessel's beam would be anticipated to typically operate at about 6 knots, or potentially up to 8 knots in an realistic adverse scenario. The results of the assessment generally indicated that, in combination with adverse metocean conditions:

- Passing speeds of 6 knots did not exceed the industry-recommended mooring line loading limits;
- Passing speeds of 8 knots generally would not exceed allowable line loading except for a loaded large Bulk Carrier passing outbound which is not a current scenario on the waterway.
- Passing speeds of 10 knots, although rare, may exceed allowable line loading; however, would not break away from berth and risk mitigation through future detailed design would contribute to optimised moorings and risk reduction.
- It is also noted that the normal practice of a moored tanker and moored vessel operating procedures that the vessel will have a watch crew and the vessel's moorings will be regularly tendered to maintain, as best as possible, tensioned and even moorings.

9.2 RECOMMENDATIONS

Following a review of the pNRA outcomes the following recommendations have been made:

1. The thirteen additional risk control measures identified in **Table 25** are adopted; and

2. It is further recommended that the project continue engagement with the PLA to review the applicability of General Direction 17.1 (b), which mandates a 60m navigation restriction around tanker vessels and oil and gas jetties, to the Proposed Scheme, (see **Section 6.1** for explanation of General Direction).

10. PNRA UPDATE

The following section documents the findings of a pNRA update undertaken following the submission of revision R04-00 of the pNRA report on 24-Sep-2024 and includes the following key sections:

- **10.1 Requirement for NRA Revision**, an overview of the need for an updated pNRA due to a non-material change to the Proposed Development;
- **10.2 pNRA Update Scope**, an overview of the scope items included in this pNRA update;
- **10.3 Passage Planning**, a summary of the findings of the passage planning scope item undertaken to inform the pNRA;
- **10.4 Passing Vessel Mooring Interaction Study**, a summary of the findings of the updated passing vessel mooring interaction study;
- **10.5 Preliminary LCO2 release Risk Assessment,** a summary of the preliminary Risk Assessment undertaken by the WSP Process Safety team to inform an understanding of the consequences to navigation from a LCO_2 release;
- **10.6 Key findings,** an overview of the key findings from **Sections 10.3, 10.4** and **10.5** and a qualitative view on how these findings impact the navigational risk profile;
- **10.7 Updated Inherent Risk Assessment,** presentation of the updated inherent assessment of risk;
- **10.8 Additional Risk Controls,** a review of the risk controls developed during R04-00 and presentation of new risk controls required as a result of the non-material change outlined in **Section 10.1**; and
- **10.9 Updated Residual Risk Assessment,** presentation of the updated residual assessment of risk.
- **10.10 pNRA Updated Conclusions and Recommendations**, a summary of the conclusions and recommendations following the pNRA update.

10.1 REQUIREMENT FOR NRA REVISION

Following submission of revision R04-00 of the pNRA report, a Change Request has been developed for the Proposed Scheme, to facilitate the use of a 20,000 cbm vessel. This change has led to the Applicant considering that the Proposed Jetty, and associated dredging, should now be designed to facilitate a maximum vessel size of approximately 20,000 cbm, rather than the maximum 15,000 cbm previously considered in the application documentation (including revision R04-00 of the pNRA).

Two key changes were identified that could alter the current navigation risk profile as articulated in R04-00 for the operational phase of the project. The two identified changes are:

- Changes in the proposed design vessel envelope (see **Section 10.1.1**); and,
- Changes in the Proposed Jetty design (see **Section 10.1.2**).

Given the potential for these matters to alter the existing understanding of navigation risk associated with the Proposed Development (as defined in revision R04-00), it was determined that a pNRA update would be required to determine the level of impact and any resulting change in navigation risk profile in the operational phase (the change was considered to have minimal influence to the pNRA assessments previously made for the construction or decommissioning phases).

10.1.1 Changes in the Proposed Design Vessel Envelope

Revision R04-00 of the pNRA took a precautionary approach when considering previous 15,000 cbm vessels (see **Section 1.4.1)** as at the time of submission of R04-00 the intended design vessel dimensions had not been finalised. However, details of several indicative vessels that could be utilised to facilitate LCO_2 export operations where provided (see **Table 1**). Revision R04-00 assumed a reasonable worst-case scenario whereby the largest design vessel would be utilised to undertake the LCO_2 export operation and that the maximum number of vessel movements were realised. The project team also undertook a review of LPG carriers with a capacity of 15,000 cbm to determine a suitable worst credible dimensions envelope for a project vessel with a capacity of 15,000 cbm.

Following submission of the pNRA revison R04-00 it was confirmed that a vessel with a 20,000 cbm capacity was under consideration as the export vessel for the Proposed Scheme. The indicative measurement parameters for this vessel exceed the LOA and laden draught for the worst credible envelope vessel considered in R04-00 and therefore there is a requirement for the findings of R04-00 to be revisited, taking in to account any additional risk posed by utilising a vessel with a more significant laden draught and greater LOA.

The indicative vessel parameters for the 20,000 cbm vessel considered in this pNRA update are summarised in **Table 30.** Note, the 20,000 cbm indicative design vessel dimensions are based on two LCO_2 vessels currently on order in the market.

Although it is anticipated that the use of larger vessels will mean less vessel movements are required, as a precautionary approach, this pNRA update takes the same approach to vessel movement numbers as R04-00 and assumes the highest number of vessel arrivals are realised (in the order of four arrivals per week).

Table 30: 20,000 cbm Vessel Parameters

Vessel Parameter	20,000 cbm vessel measurement (m)
LOA	180
LBP (Length Between Perpendiculars)	177
Beam	26.4
Ballast Draft	7.0
Laden / Scanting Draft	9.9

10.1.2 Change to Proposed Jetty

Following submission of revision R04-00, and in anticipation of the navigational risk process following on-going discussions with the PRA, the indicative design of the Proposed Jetty was further refined to ensure that any impact to the authorised channel was mitigated as fully as possible. This resulted in the maximum extent of the Proposed Jetty being moved 5m south towards the riverbank. Furthermore, two new breasting dolphins will be required to facilitate the berthing of the larger vessel. **Figure 60** shows the Option 3 Proposed Jetty Design overlaid with the new indicative Proposed Jetty design.

In addition, the draught of the proposed 20,000 cbm vessel is larger than the draught of the vessel adopted in R04-00, therefore it requires a deeper berth pocket. It is proposed that the berth pocket for the indicative 20,000 cbm vessel is dredged to -11.0m CD, this dredge level would provide 1.1m of under keel clearance which corresponds to approximately 10% of the indicative laden vessel draft.

10.1.3 Combined Effect to Navigable Width

Figure 60 shows the new indicative Proposed Jetty design (blue) overlaid on the Option 3 Proposed Jetty design (white outline). The figure also shows the 20,000 cbm tanker moored alongside the new Proposed Jetty Design along with the PLA proposed 60m exclusion zone extending out into the authorised channel by 13.7m at the greatest extent. The proposed dredged pocket is indicated by the red solid line.

Figure 61 shows the new Proposed Jetty design with the 20,000 cbm vessel moored alongside. When moored alongside the distance between the northern extremity of the project vessel and the limit of the authorised channel would be 50.5m (as illustrated in **Figure 61**).

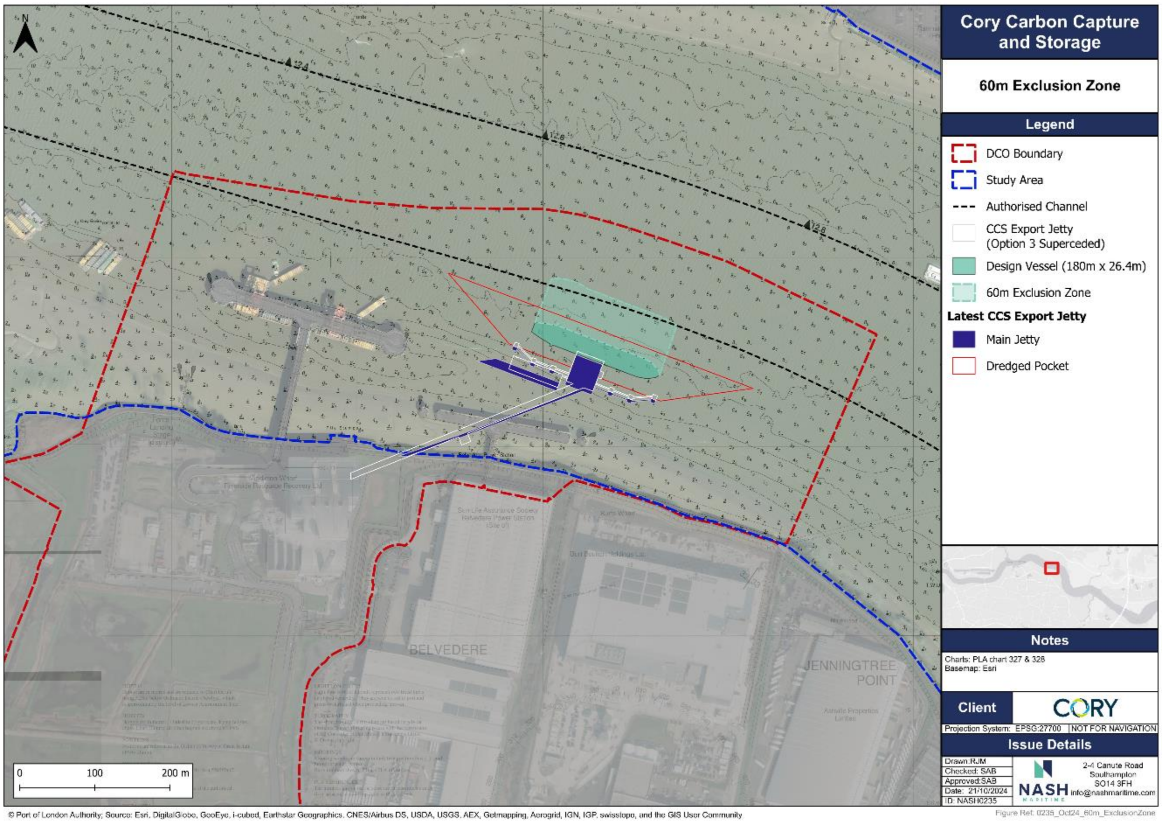


Figure 60: New Proposed Jetty Design Overlaid on Option 3.

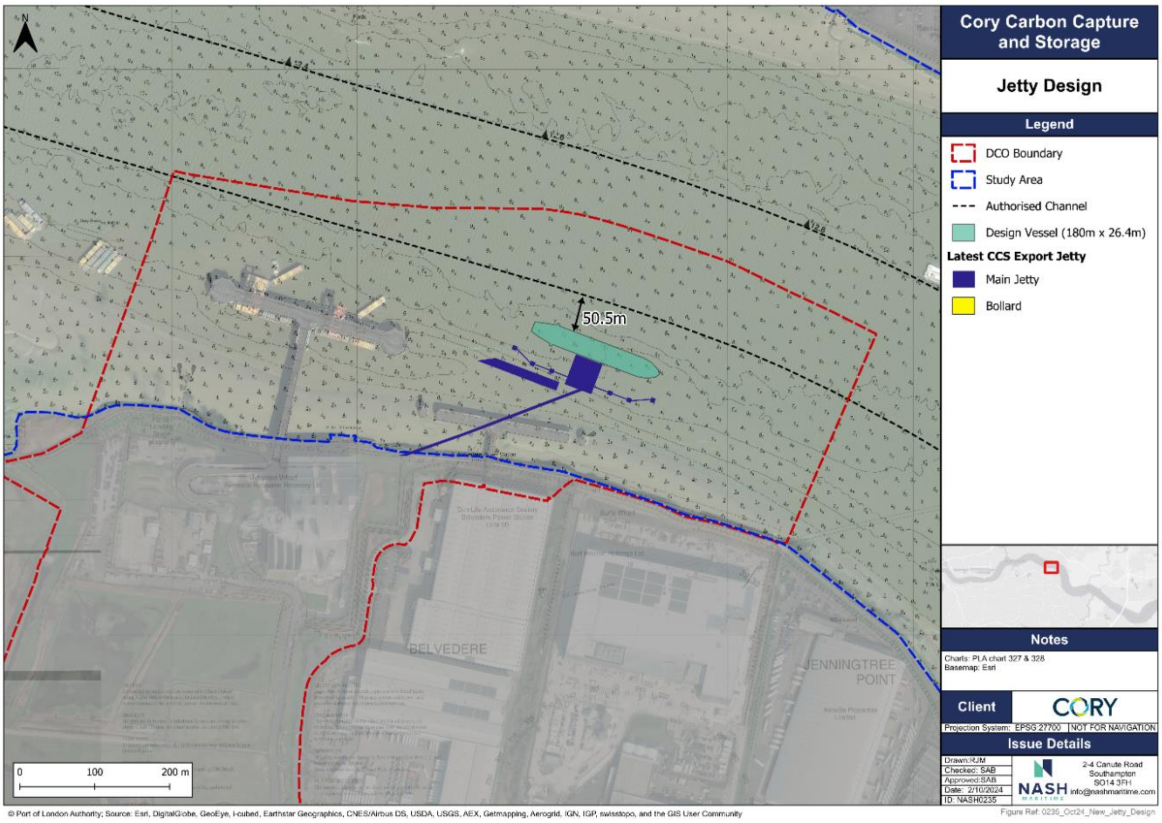


Figure 61: New Proposed Jetty Design with 20,000 cbm Vessel Alongside.

10.2 PNRA UPDATE SCOPE

The following scope items were undertaken to identify any increase in navigation risk that resulted from the nonmaterial changes outlined in **Section 10.1.**

10.2.1 Consultation to Inform pNRA Update Scope

Prior to the finalisation of the pNRA update scope, consultation was undertaken with the PLA and CLdN.

A meeting with PLA representatives took place on 21-Aug-2024 between 15:00 and 16:00 via Microsoft Teams. The meeting was attended by the following individuals:

- **PLA:**
  - Lydia Hutchinson (LH), Marine Manager; and
  - Lucy Owen (LO), Deputy Director of Planning and Development.
- **NASH Maritime Ltd:**
  - Sam Anderson-Brown (SAB, Principal Consultant;
  - Brocque Preece (BP), Principal Consultant; and
  - Nigel Bassett (NB), Principal Consultant.

- **WSP:**
  - Jo Evans (JE), Technical Director (Maritime).

The objectives of the meeting were to:

- Provide an update to the PLA on the latest revision of the pNRA (PLA had not seen the pNRA revision R04-00 at the time of the meeting);
- Explain the Change Request and that it that may alter navigational risk profile as defined in existing pNRA (R04-00); and
- Discuss proposed pNRA Update scope to ensure any potential variations in navigation risk profile for the Change are sufficiently captured and assessed.

Full minutes of the meeting can be viewed in **Appendix L** along with the slide deck that was presented at the meeting.

The following key points were discussed:

- Due to minimal increase in project vessel size, further simulations will not be undertaken.
- Discussion as to whether 0.9m increase in vessel draught would materially impact ship handling issues when vessel was arriving / departing berth. LH to discuss with PLA pilots as to whether simulation of project vessel arrivals and departures with a modelled draught increase of 0.9m would be necessary.
- SAB agreed that option to undertake project vessel sims would be kept as an option until PLA pilots had confirmed requirement.
- **Post meeting note,** following a discussion between LH and the PLA pilots it was confirmed that further simulations would not be required by the PLA.
- NB commented that increase in vessel draught would likely reduce tidal operational window, hence the scope therefore included an additional passage planning assessment task.
- LH agreed this was crucial to provide a holistic view of navigational safety – the task therefore included a meeting between NB and PLA pilot(s).

A telephone call between Matthew Booth, CLdN Principal Operations Manager and Nigel Bassett took place on 09-Sep-2024 between 14:00 and 14:30. It was agreed on this call that given the minimal increase in vessel size, that further ship simulations would not be required.

An email confirming this conversation was sent by Nigel Bassett on 14-Sep-2024, the content of which was agreed by Matthew Booth on 16-Sep-2024.

10.2.2 Passage Planning

Given the extensive Thames tidal range and the deeper laden draught of the 20,000 cbm vessel (9.9m) it was deemed necessary to undertake a passage planning exercise to determine the feasibility of navigating a vessel of this draught as far up the river as Halfway Reach.

The limiting depth on the passage between Halfway Reach and Sea Reach is 6.5m in Erith Reach. It was previously determined (see **Section 1.4.2**) that vessel departures would be limited to no later than High Water + 1.5 hours. Given the increase in draught associated with the 20,000 cbm vessel (additional 0.9m) it is likely that the limitation on departures will be more restrictive and there may also be an increase in the likelihood of a grounding hazard occurrence (the findings of the passage planning task are presented in **Section 10.3)**. The objectives of the passage planning exercise was therefore to:

- Ascertain the feasibility of navigating the 20,000 cbm vessel between Halfway and Sea Reach (when in laden condition); and
- Determine the likely tidal windows in which the passage could safely take place whilst maintaining adequate water depth.

10.2.3 Passing Vessel Mooring Interaction

The passing vessel mooring interaction study undertaken to inform revision R04-00, (see **Section 7**) concluded that in most-likely scenarios, such as 6 knots close passing up to 8 knots at greater passing distances in adverse conditions, the moored vessel did not exceed recommended line loading limits. For worst credible scenarios, such as 10 knots close passing in adverse conditions, then mooring optimisation through detailed design (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard.

It was therefore determined that the risk of Project Vessel breakout could be limited to ALARP and, in line with the PLA risk assessment methodology, could be considered tolerable.

The increase in draught and LOA of the 20,000 cbm vessel has the potential to increase the passing vessel interaction effects. Therefore, a revision of the passing vessel mooring interaction study was included as part of the scope for this pNRA update to determine whether there is an increase in the likelihood of a project vessel breakout. The findings of the updated passing vessel mooring interaction study are reported in **Section 10.4.**

10.2.4 Preliminary LCO2 Release Risk Assessment

Following the submission of revision R04-00, the WSP Process Safety team undertook further work to understand the consequences of a potential LCO_2 release. NASH Maritime reviewed and provided some input to this work in order that potential consequences to navigation could be considered.

The findings of the preliminary Risk Assessment undertaken are reported in **Section 10.5** and have been fed into the assessment of navigation risk documented in this pNRA update.

10.2.5 Navigation Simulations

As reported above, discussions occurred between WSP, NASH Maritime and third parties, including the PLA and CLdN, as to the requirement for further navigations simulations. It was determined following consultation that further navigation simulations would not be required primarily because:

- The 0.9m increase in project vessel loaded draught would not materially affect vessel handling on departure (this was confirmed with PLA pilots); and
- The minimal increase in LOA would have no material effect on third-party vessel arrival and departure manoeuvres.

10.3 PASSAGE PLANING

This section presents a qualitative commentary of the typical passage planning requirements for a 20,000 cbm Project Vessel arriving and departing the Proposed Jetty. The passage planning requirements were developed by Captain Nigel Bassett (NASH Maritime Pilotage SME) and further refined in a workshop undertaken with PLA Pilots, Captain Neil Jephcote and Captain Michele Pulizzi, on 27-Sep-2024.

10.3.1 Inward transits (arrivals), assuming ballast draught 7.0 metres.

Irrespective of port of origin, vessels drawing 7.5m draught and under are encouraged to enter the Port of London using the North East Spit pilot station and the Princes Channel. From sea, the controlling depth for the inward passage is initially in the Princes Channel at Princes Shoal, with a maximum datum of 7.8m centre channel (shelving towards the boundaries). The optimal passage timings for a Project Vessel would therefore be to board a pilot at NE spit around LW then, even at spring tides, there would be sufficient rise over Princes Shoal to cross, making an earliest ETA Gravesend of LW + 2 hours and an ETA to swing off the Proposed Jetty of LW +3 hours Allowing 0.9m standard UKC allowance on a flood tide, this would allow adequate rise over both the 7.8m Princes Shoal and the 6.5m shoal in Erith Reach, then adequate water close to the north of the channel margin during the swing for the Proposed Jetty.

Arriving on a flood tide, Project Vessels will be required to berth starboard side alongside. Subject to minor variation, spring or neap tides make little difference to the preferred arrival time given the rise of tide required for Erith Reach being approximately half tide, which is broadly similar in height during any stage of the lunar cycle.

Starboard side berthing would always be preferred to avoid a more onerous departure procedure, involving a swing, when loaded.

However, for a vessel arriving late on the tide, and berthing after HW on an ebb tide, port side berthing would be required. Latest arrival time at the berth would vary according to neap or spring flow rate, but is likely to be HW+2 hours, mindful of the controlling depth in Erith Reach and to allow the standard 1.4m UKC on a falling tide.

10.3.2 Outward transit (departures), assuming loaded brackish water draught of 10.0m

Outward transits are time constrained over the HW period, between the controlling depths of 6.5m in Erith Reach and 9.2m at Divers Shoal, Gravesend Reach.

Initial controlling depth is the 6.5m patch off Coldharbour Jetty in Erith Reach which, assuming a 10.0m brackish water draught and 0.9m UKC, would require a 4.4m rise of tide. Therefore, a Standard Operating Procedure of lifting off the berth 1 hour before HW would be suitable for head out (starboard side alongside) departures subject to slight variation, in consultation with pilots, depending on tidal regime on any particular day. For head-in departures requiring a swing off the berth, an earlier departure of HW -1h 15m would be appropriate.

The latest time for departure if a swing was required would be HW (berthed head in, port side to the jetty) allowing time to proceed up river to swing, or HW +45m to depart head out (starboard side to the jetty, no swing required).

This latest time is due to the increasing strength of ebb tide at Jenningtree Point, and the passage time required to Gravesend Reach on a large heavily loaded tanker, to affect the pilot change and the need to pass Diver's Shoal with adequate UK prior to the tide dropping away.

Consideration also needs to be given to potential time delay during slow down to effect pilot change at Gravesend.

Diver's Shoal is a large area situated at the eastern end of Gravesend Reach over which the controlling depth, if maintaining a position centre channel, is 9.2m. Mid ebb tide height (either spring or ebb) at Diver's Shoal is approximately 3.0m which would give a water depth of 12.2m, but on a rapidly falling tide. Even with an unobstructed run from the berth to Gravesend, the allowance of 1.5 hours to transit this section of river for a loaded Project Vessel would be prudent (heavy ship, slow speed control on bends etc), therefore allowing 1.4m UKC (pilots' standard minimum allowance on a falling tide) plus a nominal allowance of 0.5m for squat it can be seen that a ship clearing the Proposed Jetty at HW +1 hour (as cut off) should therefore clear Diver's Shoal at HW +2.5 hours with adequate margin. Note, that if an inward ship forces an outward ship to more towards the southern margin of the channel in the Divers Shoal area, the River shallows to 8.5m closer to the southern margin, therefore forward planning to be able to command the centre of the River is desired and becomes more essential as the ebb runs away.

Having cleared Diver's Shoal, there are no further critical depths outbound, assuming the ship transits north to a discharge port, via the Sunk pilot station.

10.3.3 Passage planning summary

The passage planning exercise demonstrated that it is feasible for the 20,000 cbm Project Vessel to navigate to and from the Proposed Jetty with sufficient UKC throughout the passage, providing that the guideline arrival and departure times (relative to stage of the tidal cycle) outlined in **Section 10.3.1** and **10.3.2** are adhered to.

10.4 PASSING VESSEL MOORING INTERACTION STUDY

The passing vessel mooring interaction study undertaken and discussed in **Section 7** was reassessed using the increased design vessel size, using the same combination of ROPES and Optimoor software to assess passing vessel forces and mooring responses, respectively.

Although the overall length and beam physical dimensions of the larger 20,000 cbm LCO_2 vessel remained similar to the previous 15,000 cbm LCO_2 vessel (as shown in **Table 30**), the deeper draft contributed to a smaller UKC, which increases the passing vessel interaction forces. The updated dredged depth of the berthing pocket, combined with the deepest draft and lowest water, was reviewed as the worst case minimum UKC condition.

Similar to the previous assessment undertaken and discussed in **Section 7**, the analysis was undertaken for the purpose of the assessment of risk of the breakaway hazard identified during the risk assessment process, and not for the purposes of mooring design. The detailed design mooring analysis would be undertaken during later stages of the design of the Proposed Scheme, post-consent.

10.4.1 Vessels

Based on the same PIANC and OCIMF guidance documents it was concluded that the relatively modest increase in physical size of the LCO_2 design vessel was unlikely to lead to notable increases to the baseline assumptions on the vessel's mooring equipment. Therefore, the mooring line size, strength, material and number of lines / winches remained the same as described in **Section 7.3**.

All passing vessels remained the same, that is: Cruise Vessel, CLdN RoRo vessel and loaded and ballast Bulk Carrier.

10.4.2 Metocean conditions

Metocean conditions remained conservatively adverse as described in **Section 7.4**.

10.4.3 Findings of 20,000m^3 LCO_2 Design Vessel

A summary of the findings for the fully laden 20,000 cbm LCO_2 vessel is shown in **Table 31**. The same conservative scenario was applied of combined lowest tide, fully laden moored LCO_2 vessel, being passed by each of the large passing vessels.

Table 31: Assessment Findings

Passing Vessel	Speed through water	2.0 x Beam or 60m (adverse scenario for outbound transit)	Mid-channel (adverse scenario for inbound transits)
6 knots passing speed			
CLdN RoRo	6 knots	Below line limit	Below line limit
Cruise Vessel	6 knots	Below line limit	Below line limit
Bulk Carrier (Light)	6 knots	Below line limit	Below line limit
Bulk Carrier (Loaded)		Below line limit	Below line limit
8 knots passing speed			
CLdN RoRo	8 knots	Below line limit	Below line limit
Cruise Vessel	8 knots	Exceeded line limit (51% MBL)	Below line limit
Bulk Carrier (Light)	8 knots	Exceeded line limit (55% MBL)	Below limit but not a current scenario
Bulk Carrier (Loaded)		Below limit but not a current scenario	Below line limit
10 knots passing speed			
CLdN RoRo	10 knots	Exceeded line limit (>60% MBL winch brake)	Below line limit
Cruise Vessel	10 knots	Exceeded line limit (>60% MBL winch brake)	Below line limit
Bulk Carrier (Light)	10 knots	Exceeded line limit (>60% MBL winch brake)	Exceeded limit (>53% MBL) but not a current scenario
Bulk Carrier (Loaded)		Exceeded limit (>60% MBL) but not a current scenario	Exceeded line limit (>59% MBL)

Key results can be summarised as:

- Similar to the previous assessment in **Section 7**, all vessels passing at 6 knots at a close passing distance of 2x the vessel's beam did not exceed the recommended maximum mooring line load limit (as per OCIMF industry guidance being 50% of the mooring line design breaking strength).
- For passing speeds of 8 knots, results showed marginally higher mooring line loads than the previous assessment in **Section 7**, resulting in marginal exceedance of the recommended mooring line load limit for close passing scenarios on the CLdN RoRo passing at 2x the beam (50m) but remined below the limit when passing at 60m (exclusion zone); and for the Cruise and Bulk Carrier vessels. No exceedance was recorded for these vessels passing at 8 knots mid-channel.
- Indicative sensitivity assessments were again undertaken on the passing scenarios in which line loading had exceeded recommended maximum limits (additional mooring lines two forward and two aft, or 20% higher line strength). The results indicated:
  - For exceedances from these large passing vessels passing at 8 knots at close passing distances, the application of more lines or greater line strength reduced the mooring line load below the recommended line load limit.
  - Similarly, for exceedances from large passing vessels passing at 10 knots mid-channel, application of more lines or combination of more line at greater line strength reduced the mooring line load below the recommended line load limit.
  - The scenario of large passing vessels passing at 10 knots at close passing distances of 2.0 x Beam still exceeded recommended mooring line load limits; however, this scenario is not considered to be a practice that would adhere to the Port of London - Port Information Guide, dated April 2024, in relation to passing speed limits (as described in **Section 8.6.3.2** and copied again below):

    Speed Limits

    2. Except in an emergency, the master of a power-driven vessel must, at all times when underway on the Thames, ensure that the vessel is navigated at a speed and in a manner such that any wash or draw-off created by the vessel must not compromise: a) the safety of others using the Thames, the foreshore, adjacent piers, moorings, berths, jetties or other facilities; or b) the integrity of the foreshore.

The outcomes of the revision of the passing vessel mooring interaction study therefore do not differ from those previously identified in **Section 7**. That is, in addition to the anticipated adherence to operational passing practices advised in the Port Information Guide on "speed limits" (as above), that mooring optimisation throughout future engineering design phases (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard. Mooring optimisation at future detailed design stages could also be used to assist in informing the PLA following these design phases and would be reported in the updated NRA submitted pursuant to DCO Requirement.

10.5 PRELIMINARY LCO2 RELEASE RISK ASSESSMENT

The WSP Process Safety team undertook a preliminary LCO_2 Release Risk Assessment to develop a further understanding of the likelihood and consequence of a LCO_2 release from the Above Ground Storage Tanks, Carbon Capture Plant(s), Above Ground Pipelines and marine loading arm.

Several navigational incidents were considered (in a worst-case scenario) to have the potential to cause a LCO_2 release from either the Above Ground Pipelines (on the Proposed Jetty) or marine loading arm, including:

- Breakout of the Project Vessel leading to emergency disconnect from the marine loading arm;
- Contact with the Proposed Jetty supporting the Above Ground Pipelines or loading manifold by a third-party vessel or Project Vessel; and
- Contact with the Proposed Jetty by Cory tugs.

A release of LCO_2 from the Project Vessel because of either contact or collision was not deemed to be a credible scenario given the vessel's double hull design and the high forces and direct angle of impact that would be required to damage the vessel to the extent that ruptured the inner cargo tanks for a release of product to occur.

The preliminary LCO_2 Release Risk Assessment considered the Location Specific Individual Risk (LISR) that individual passing vessels, members of the public and workers would be exposed to should a credible LCO_2 release occur.

The preliminary LCO_2 Release Risk Assessment results indicated that inherent risk is intolerable or tolerable if ALARP (when assessed against HSE risk tolerability criteria) for persons working in the immediate vicinity of the Proposed Jetty. In the event of a LCO_2 release, this would include staff working on the Proposed Jetty, crew of the Project Vessel and Cory tug crew working near to / on moored vessels in proximity to the Proposed Jetty.

The primary contributor to the calculated risk in the immediate vicinity of the Proposed Jetty is rupture LCO_2 releases from the Above Ground Pipelines between the shore and the Proposed Jetty due to allision (contact) from vessels. This frequency of occurrence of this resulting in a LCO_2 release was estimated at 1/250 years. Similarly, rupture releases from the marine loading arms due to third-party vessel contact with the Project Vessel are a significant contributor to the calculated risk at the Proposed Jetty. The frequency of occurrence of this scenario resulting in a LCO_2 release was estimated to be 1/100 years. These are conservative approximations and further detailed analysis, and modelling, would be required to provide more certainty on the frequency of vessel impacts.

On this basis, the preliminary LCO_2 Release Risk Assessment results indicate that additional mitigation measures are required to reduce the HSE risk associated with LCO_2 releases from the Above Ground Pipelines (on the Proposed Jetty). A more refined assessment of the frequency of vessel impacts leading to releases may also reduce the risk.

It is therefore recommended that additional mitigations should be put in place to minimise the likelihood and/or consequences of a LCO_2 release to reduce the risk of a release from the Above Ground Pipelines (on the Proposed Jetty) to As Low As Reasonably Practicable (ALARP) (and below intolerable levels). For example, risk reduction can be achieved during further detailed design phases, as listed in **Section 10.8** and **Table 33** (and reported on in the updated NRA submitted pursuant to DCO Requirement) to ensure that large-scale LCO_2 release scenarios can be minimised through process systems design, Proposed Jetty design and terminal procedures. These may be further explored during the Proposed Jetty detailed design phases and may include measures such as reducing potential containment loss size with additional emergency shutoffs, increasing the Proposed Jetty impact resistance or increasing isolation/flexibility between Above Ground Pipelines and the Proposed Jetty, or written procedures for vessels operating and mooring requirements at the Proposed Jetty or tug berth.

The preliminary LCO_2 Release Risk Assessment also considered how long it would take for a LCO_2 release to disperse. This is demonstrated by calculating the "duration of cloud" (the time for the concentration of CO_2 to fall below the equivalent to 1% fatality probability dose for a 30-minute period) in differing release scenarios. In a worst-case scenario, whereby a full-bore rupture of the export Above Ground Pipelines occurred, and the isolation valves failed (this is considered extremely unlikely) then it would take approximately 30 mins for the gas cloud to disperse. In the more likely event that the release was isolated then the cloud would disperse in approximately 6 minutes time. It should be noted that the effects the cloud has on visibility (e.g. how long the cloud will impede vision) cannot be determined at this stage.

Given the rapid rates of dispersal, it is felt that a release would have limited impact on navigating vessels. Relatively simple control measures to ensure that in the event of a CO_2 release vessels are warned to keep clear of the area / vacate the area for a short period of time would further mitigate risks to passing vessels, this could be done by VHF communications from London VTS or direct from the terminal operator and visual signals.

10.6 KEY FINDINGS

The key findings of the passage planning exercise, passing vessel mooring interaction study and preliminary LCO_2 Release Risk Assessment are summarised below:

- The passage planning exercise demonstrated that it is feasible for the 20,000 cbm Project Vessel to navigate to and from the Proposed Jetty with sufficient UKC throughout the passage, providing that the guideline arrival and departure times (relative to stage of the tidal cycle) outlined in **Section 10.3.1** and **10.3.2** are adhered to. It is therefore concluded that the increased draught of the 20,000 cbm would not have any material impact on the likelihood of a grounding of the Project Vessel.
- Passing vessel mooring interaction revision:
    - Similar to the previous assessment in **Section 7**, all vessels passing at 6 knots at a close passing distance of 2x the vessel's beam did not exceed the recommended maximum mooring line load limit.
    - For passing speeds of 8 knots, results showed marginally higher mooring line loads than the previous assessment in **Section 7**, resulting in exceedance of the recommended mooring line load limit for close passing scenarios on the CLdN RoRo passing at 2x the beam (50m) but remined below the limit passing at 60m (exclusion zone); and for the Cruise and Bulk Carrier vessels. No exceedance was recorded for these vessels passing at 8 knots mid-channel.

  - The outcomes of the revision of the passing vessel mooring interaction study do not differ from those previously identified in **Section 7**. That is, in addition to the anticipated adherence to operational passing practices advised in the Port Information Guide on “speed limits” (as described in **Section 8.6.3.2**), that mooring optimisation throughout future engineering design phases (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard.

- The preliminary LCO_2 Release Risk Assessment results indicated that inherent risk is intolerable or tolerable if ALARP (when assessed against HSE societal risk factors) for persons working in the immediate vicinity of the Proposed Jetty, prior to the introduction to risk mitigation measures. In the event of a LCO_2 release, this would include staff working on the Proposed Jetty, crew of the Project Vessel and Cory tug crew working near to / on moored vessels in proximity to the Proposed Jetty.
- The primary contributor to the calculated risk in the immediate vicinity of the Proposed Jetty is rupture releases from the Above Ground Pipelines between the shore to the Proposed Jetty due to allision (contact) from vessels. This frequency of occurrence of this resulting in a LCO_2 release was estimated at 1/250 years. This is a conservative approximation and further detailed analysis, and modelling would be required to provide more certainty on the frequency of vessel impacts.
- The preliminary LCO_2 Release Risk Assessment results indicate that additional mitigation measures (please refer to **Section 10.8** for details) are required to reduce the HSE risk associated with LCO_2 releases from the Above Ground Pipelines (on the Proposed Jetty). A more refined assessment of the frequency of vessel impacts leading to releases may also reduce the risk.

10.7 UPDATED INHERENT RISK ASSESSMENT

Following the completion of the passage planning exercise, passing vessel mooring interaction study revision and preliminary Risk Assessment, the project team reviewed the inherent assessment of risk for the operation phase of the Proposed Scheme (see **Section 8.5.2**) to determine any changes in inherent navigation hazard risk scoring.

It was concluded that navigation risk profile was not impacted by the Change. However, the findings of the preliminary LCO_2 Release Risk Assessment have enhanced the project teams’ understanding of the consequences (to people) of a CO_2 release, a full review of the consequence scores for each hazard occurrence was therefore undertaken.

All hazard scores allocated in the R04-00 revision inherent assessment of risk remained the same other than Hazard 10 - Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside).

The consequence score for this hazard was increased from a score of 2 to 3 to reflect the possibility that in a worst-case scenario hazard occurrence those working on Cory Tugs, the Project Vessel or Proposed Jetty could be subject to asphyxiation as a result of a CO_2 release and that there is therefore a possibility of fatalities occurring. This results in Hazard 10 scoring as "Serious Risk – Tolerable if ALARP", whereas the hazard has previously been assessed as "Medium Risk".

The revised inherent risk assessment results are presented in **Table 32** (the full hazard log can be viewed in **Appendix M**).

Based on the inherent PLA risk scores, seven (7) hazards scored as intolerable / unacceptable, of these, two (2) were assessed as presenting 'very serious' levels of risk, these being:

- Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside); and
- Ranging / Breakout - Project Vessel.

Five (5) hazards were assessed as presenting 'serious' levels of risk, these were:

- Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside);
- Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside);
- Collision - Project Vessel ICW Cargo;
- Collision - Project Vessel ICW Tug, Service and Other Small Vessel; and
- Collision - Third Party Vessels as a result of avoiding project vessels.

The remaining hazards scored as "moderate" risk.

Table 32: Revised Inherent Risk Assessment.

Haz ID	Hazard Name	Inherent Risk Score
7	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	16.0
16	Breakout - Project Vessel	15.0
8	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	12.0
10	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	12.0
1	Collision - Project Vessel ICW Cargo	9.0
4	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0
6	Collision - Third Party Vessels as a result of avoiding project vessels	9.0
3	Collision - Project Vessel ICW Passenger	8.0
9	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	8.0
12	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	8.0
2	Collision - Project Vessel ICW Tanker	6.0
5	Collision - Project Vessel ICW Recreational Vessel	6.0

Haz ID	Hazard Name	Inherent Risk Score
11	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	6.0
14	Grounding - Cargo	6.0
15	Grounding - Project Vessel	6.0
13	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	4.0

10.8 UPDATED ADDITIONAL RISK CONTROLS

The risk controls relevant to the operational phase of the Proposed Scheme and outlined in **Section 8.6** of this document all variously apply to this pNRA update with the following amendments and further proposed additional risk controls:

- **Additional Risk Control 1** (RC01 in **Table 25**) – the starting point for the pNRA is that the original Option 2 design forms the basis of the scenario that is assessed in the inherent assessment of risk, this control recommends the adoption of Jetty Option 3 as a key control measure to mitigate the likelihood of contact hazard occurrence. With the further revisions discussed in **Section 10.1**. The available navigable width is increased and therefore the effectiveness of this risk control is enhanced.
- An additional risk control is proposed and used to reduce risk in this pNRA update. **Risk Control 14 "Detailed Design to mitigate the risks of vessel contact and breakout"**. This would include further detailed risk analysis for LCO_2 release consequences to ensure detailed design of the Proposed Jetty, its LCO_2 systems design and integrity of the Above Ground Pipelines will minimise risk. This is likely to include ensuring impact resilience from vessel contact and thus reduce the risks of a LCO_2 release as well as the requirement to mitigate the extent of any LCO_2 resulting from breakout of the Project Vessel.
- A further additional risk control is proposed and used to reduce risk in the pNRA update. **Risk Control 15 "LCO_2 Emergency Response Plan"**- an LCO_2 Emergency Response Plan should be developed giving specific guidance as to actions that should be taken to mitigate risks to navigation in the event of a CO_2 release. This should include communication procedures with passing vessels and London VTS to ensure adequate warning is given in the event of a CO_2 release. This control measure should also outline intended evacuation procedures for Cory vessels, Proposed Jetty staff and Project Vessel crew.

The combined impact of risk controls 14 and 15 (as identified above) is to reduce the likelihood of a CO_2 release (Risk Control 14) and to mitigate the risks of a release should such an occurrence materialise (Risk Control 15).

10.9 UPDATED RESIDUAL RISK ASSESSMENT

The risk control measures relevant to the operational phase of the project (identified in **Section 8.6**) and the new additional risk controls outlined in **Section 10.8** were applied to the identified hazards to reduce navigation risk, (see **Table 33**) the findings of the residual assessment of risk are presented in **Table 34.**

The results of the updated residual risk assessment indicate that one hazard, Breakout of a Project Vessel, scores as 'serious risk' but can be reduced to ALARP with the identified additional risk controls and is therefore considered tolerable. All other hazards scores as either 'moderate risk or 'minor risk' and navigation risk for these hazards is therefore considered acceptable.

Table 33: Application of Additional Risk Control Measures.

Haz ID	Hazard Name	Additional Risk Controls
1	Collision - Project Vessel ICW Cargo	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
2	Collision - Project Vessel ICW Tanker	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations
3	Collision - Project Vessel ICW Passenger	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
4	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
5	Collision - Project Vessel ICW Recreational Vessel	1. Relocation of Proposed Jetty (New Design)) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations
6	Collision - Third Party Vessels as a result of avoiding project vessels	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations

Haz ID	Hazard Name	Additional Risk Controls
		(Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations
7	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan
8	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan
9	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan
10	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel 7. Navigation Exclusion Zone 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan
11	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 7. Navigation Exclusion Zone 3. Defined Proposed Scheme limitations (Construction and Operation) 14. Detailed Design to the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan

Haz ID	Hazard Name	Additional Risk Controls
12	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan
13	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	1. Relocation of Proposed Jetty (New Design) 2. Promulgation and dissemination of information 13. Full ship bridge simulations 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. Emergency Response Plan
14	Grounding - Cargo	2. Promulgation and dissemination of information 13. Full ship bridge simulations
15	Grounding - Project Vessel	3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel
16	Breakout - Project Vessel	1. Relocation of Proposed Jetty (New Design) 3. Defined Proposed Scheme limitations (Construction and Operation) 5. Positioning of berth infrastructure 7. Navigation Exclusion Zone 12. Passing vessel mooring interaction study 14. Detailed Design to mitigate the risks of vessel contact and breakout 15. LCO2 Emergency Response Plan

Table 34: Updated Residual Risk Assessment Results.

Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Risk Score	Residual Risk Score
16	2	1	Breakout - Project Vessel	15.0	12.0
10	3	2	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	12.0	8.0
1	5	3	Collision - Project Vessel ICW Cargo	9.0	6.0
4	5	3	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0	6.0
6	5	3	Collision - Third Party Vessels as a result of avoiding project vessels	9.0	6.0

7	1	3	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	16.0	6.0
8	3	3	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	12.0	6.0
9	8	3	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	8.0	6.0
12	8	3	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	8.0	6.0
14	11	3	Grounding - Cargo	6.0	6.0
15	11	3	Grounding - Project Vessel	6.0	6.0
3	8	12	Collision - Project Vessel ICW Passenger	8.0	4.0
13	16	12	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	4.0	4.0
2	11	14	Collision - Project Vessel ICW Tanker	6.0	3.0
5	11	14	Collision - Project Vessel ICW Recreational Vessel	6.0	3.0
11	11	14	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	6.0	3.0

10.10 PNRA UPDATED CONCLUSIONS AND RECOMMENDATIONS

This pNRA revision was undertaken following the Change to the vessel size. Further work was also undertaken by WSP to quantify the societal risk of a CO_2 release.

The scope of the pNRA revision included:

- A review of the proposed scope with the PLA;
- A detailed passage planning exercise;
- An update to the passing vessel mooring interaction study; and
- An update to the inherent and residual assessment of navigation risk presented in revision R04-00 of the pNRA.

The pNRA update findings are as follows:

1. The new Proposed Jetty design, combined with the 20,000 cbm vessel (remains within the same project envelope assessed in R04-00).
2. The passage planning exercise demonstrated that it is feasible for the 20,000 cbm project vessel to navigate to and from the Proposed Jetty with sufficient UKC throughout the passage, providing that the guideline arrival and departure times (relative to stage of the tidal cycle) outlined in **Section 10.3.1** and **10.3.2** are adhered to.
3. The outcomes of the revision of the passing vessel mooring interaction study do not differ substantially from those previously identified in **Section 7**. That is, in addition to the anticipated adherence to operational passing practices advised in the Port Information Guide on “speed limits” (as described in **Section 8.6.3.2**), that mooring

optimisation throughout future engineering design phases (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard.

4. The preliminary LCO_2 Release Risk Assessment undertaken by WSP indicated that inherent risk would be graded as intolerable or tolerable if ALARP (when assessed against HSE societal risk factors) for persons working in the immediate vicinity of the Proposed Jetty, prior to the implementation of additional mitigation measures. In the event of a LCO_2 release, this would include staff working on the Proposed Jetty, crew of the Project vessel and Cory tug crew working near to / on moored vessels in proximity to the Proposed Jetty.

5. The primary contributor to the calculated risk in the immediate vicinity of the Proposed Jetty is rupture LCO_2 releases from the Above Ground Pipelines between the shore and the Proposed Jetty due to allision (contact) from vessels. This frequency of occurrence of this resulting in a LCO_2 release was estimated at 1/250 years. This is a conservative approximation and further detailed analysis, and modelling would be required to provide more certainty on the frequency of vessel impacts.

6. The preliminary Risk Assessment results indicate that additional mitigation measures are required to reduce the HSE risk associated with LCO_2 releases from the Above Ground Pipelines (on the Proposed Jetty). A more refined assessment of the frequency of vessel contacts leading to releases, based on likely vessel movements and more specific location of contact, may also reduce the risk.

7. Based on the inherent PLA risk score seven (7) hazards scored as intolerable / unacceptable, of these, two (2) were assessed as presenting ‘very serious’ levels of risk, these being:

    a. Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside); and

    b. Ranging / Breakout - Project Vessel.

8. Five (5) hazards were assessed as presenting ‘serious’ levels of risk, these were:

    a. Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside);

    b. Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside);

    c. Collision - Project Vessel ICW Cargo;

    d. Collision - Project Vessel ICW Tug, Service and Other Small Vessel; and

    e. Collision - Third Party Vessels as a result of avoiding project vessels.

9. The remaining hazards scored as “moderate” risk.

10. Two further additional risk controls (relevant to the operational phase of the project) were identified:

    a. Risk Control 14 - Detailed Design to mitigate the risks of vessel contact and breakout; and

b. Risk Control 15 – Emergency Response Plan.

11. The combined impact of risk controls 14 and 15) is to reduce the risks of a CO_2 release.

12. The results of the updated residual risk assessment indicate that, should all the identified additional risk control measures (relevant to the operational phase of the project) be implemented, then navigation risk can be reduced to ALARP and therefore tolerable levels in line with the PLA risk assessment methodology.

10.11 RECOMMENDATONS

The following recommendations are made:

- The additional risk control measures identified, that are relevant to the operational phase of the project, should be implemented. The identified risk control measures are listed below for completeness and detailed in **Table 25**:
    - RC01 - Relocation of Proposed Jetty (through adoption of Option 3. Now further set back with the new Proposed Jetty location as shown in the Works Plans (Rev P04) submitted alongside this report);
    - RC02 - Promulgation and dissemination of information;
    - RC03 - Defined Proposed Scheme limitations (Construction and Operation);
    - RC04 - Deconfliction of Cory operations with arrival/departure of Project Vessel;
    - RC05 - Detailed design analyses for berth and moorings;
    - RC07 - Navigation Exclusion Zone;
    - RC12 - Passing vessel mooring interaction study (subsequently undertaken and discussed in **Section 7** and updated in **Section** 10.4);
    - RC13 - Full Ship Bridge Simulations (subsequently undertaken and discussed in **Section 6** and further commented on in **Section 10.2.5**);
    - RC14 - Detailed Design to mitigate the risks of vessel contact and breakout (as described in **Section 10.8**); and
    - RC15 - LCO2 Emergency Response Plan (as described in **Section 10.8**).
- During FEED design, risks of the product to the river are to be assessed in greater detail and mitigated through design to either tolerable or tolerable if ALARP in line with Risk Controls 14 and 15. Documents that are expected to be produced to support this include; refinements to calculated ship impact risks, a toxic gas hazard assessment, updated HAZID report and HAZOP report including risks of the product to the river, designer's risk assessment, and a Quantitative Risk Assessment. These will be provided to the PLA as a basis for informing the full NRA.
- Following completion of Detailed Design a Navigation Risk Assessment should be undertaken to assess levels of navigation risk associated with the detailed Proposed

Jetty Design, both for the operational and construction phase. This Navigation Risk Assessment should consider the assessment undertaken within this pNRA.

Appendix A
Meeting Minutes of Consultation Meetings Undertaken Prior to pNRA Commencment

AGENDA & MEETING NOTES

PROJECT NUMBER	70090329	**MEETING DATE**	22 July 2022
PROJECT NAME	Cory CCUS DCO	**VENUE**	Virtual – Microsoft Teams
CLIENT	Cory	**RECORDED BY**	JT
MEETING SUBJECT	Various		

PRESENT	PLA: Lucy Owen, Michael Atkins, Darren Knight WSP: Luke Jiggins, Jonathan Pierre, Jane Templeton Cory: James Andrews, Kirsten Berry Nash: Ed Rogers, Sam Anderson-Brown, Adam Fitpatrick, Nigel Bassett
APOLOGIES	Chris Girdham Ross Brwn
DISTRIBUTION	As above plus: Click to type
CONFIDENTIALITY	**Internal**

ITEM	SUBJECT	ACTION
1		
1.1	All parties talked through Cory's decarbonisation plan: Heat, waste, electricity & transport	
1.2	Riverside 2 targeted date for operation is 2026. Currently discharged all but one condition on DCO. Construction to start early next year, and a number of integrated programmes going on to contribute to decarbonisation programme.	
1.3	Discussion on the potential for producing hydrogen from EfW facilities; feasibility discussions ongoing.	
2		
2.1		
2.1.1	Discussion around Carbon Capture: 1.5Mt per annum for export, split into the 2 phases for the development. Reasons for 2 phases: lessons learnt, and financial spreading investment profile. Unsure at this stage whether the existing facility or new facility would be used in the process first.	
2.1.2	Description of the capture process at a high level.	
2.2		

2.2.1	Discussion around Northern lights storage, currently space is quite limited so they have phase 2 and phase 3 planned for expansion.	
2.2.2	Discussions are also taking place with UK based storage sites, but all currently at different level of process, related to everything with BEIS. Need to make sure that the storage sites will be ready for when Cory is ready to export, so PLA noted that we're keeping all the options open. Cory also considering the implications that storage location may have for funding.	
2.2.3	Discussion around the capacities of the site and other projects looking to use those sites. PLA: Do you have timescales for when we have to commit to the sites? WSP: Yes, discussion we're having with Northern Lights etc. Their initial capacity only 2M per annum. Trying to understand phasing, how they're planning to expand etc., at some point need to enter into contract.	
2.3		
2.3.1	Aim for negative CO_2 emissions on everything done, so storing Hydrogen prior to usage. WSP right at the start of the feasibility study so don't have a lot of information, but all linked to decarbonisation plan.	WSP to engage with PLA regarding 'Hydrogen Highway' WSP to research market, appetite, who is doing what?
2.3.2	Focus of hydrogen is on mobility	
2.3.3	Talks of looking at bigger vessels and technology not really there so targeting smaller vessels.	
2.4		
2.4.1	Discussion around the access trestle and pipework passing over the Thames Path.	
2.4.2	Layout of jetty structure decided on bathymetry and Cory operations, amongst other things	
2.4.3	PLA requests drawings be provided on PLA charts	WSP to overlay all future drawings onto a PLA chart and share with the PLA.
2.5		
2.5.1	Discussion around vessel calls, 2-3 vessels per week for 10k cubic metre vessel	

2.5.2	PLA requested to know the dredging requirements	WSP to provide the PLA with indicative dredging volumes for range of vessel sizes
2.5.3	PLA asked WSP to confirm distance to Navigation Channel	WSP to confirm distance to navigation channel to PLA
2.5.4	PLA asked whether jetty's sole use is for carbon capture. WSP responded yes, currently focus is to have this jetty for sole CO_2 export	
3		
3.1	Future plans to include Thames Clippers transiting the area, confirmed by PLA. Clippers acquiring pier at Gravesend.	
3.2	Lydia Hutchinson should be involved in the project/consultation at this stage.	NASH to include Lydia Hutchinson in project meetings
3.3	PLA request Cory/WSP ensure futureproofing for commercial vessels	PLA request Cory/WSP ensure futureproofing for commercial vessels
3.4	PLA confirmed they don't know exactly what's happening with London Resort. Going to resubmit by the end of the year. Large vessel numbers compared to what currently happens. Keep David Allsop in the loop too.	David Allsop to be added to periodical emails and/or meetings by NASH
4		
4.1	Project currently heading down DCO route - s.14 of 2008 Planning Act forms extension of existing facility, plus volumes associated with carbon and hydrogen. s.35 Act - s.35 application being drafted in parallel with optioneering process. To be submitted to PINS	
4.2	Project sits wholly within London Borough of Bexley - sought initial support already and feedback is broadly supportive	
4.3	PLA asked if the project would have/use 1 or 2 DCOs? Cory: Currently working this through but frontrunner at the moment is one DCO to cover both. S.35 should've been in by now but held it back to make sure we get the right strategy.	

4.4	Discussion of Feedback from REP2: Need to identify ways Cory and PLA can work better together and speed things up. Big thing is what to do about 66-73 of PLA act. If we can keep those clauses in the DCO that would be great so we don't end up with Protective Provisions that need negotiation. PLA Act not being disapplied.	
4.5	WSP to organise another catch up with PLA and Cory to discuss lessons learnt etc. (Luke Jiggins).	Luke Jiggins (WSP) to organise another meeting with the PLA and Cory on DCO lessons learned.

NEXT MEETING

An invitation will be issued if an additional meeting is required.

CCUS NRA / RIPPLEWAY WHARF NRA

Project Title	CCUS NRA / Rippleway Wharf NRA
Project Number	22-NASH-0235
Meeting subject / purpose	Lighterage Consultation
Revision	R01-00
Date of meeting	02-Aug-2022
Start time	12:30:mm GMT
Finish time	13::45 GMT
Client	WSP / Cory
Location	Meeting Location

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R01-00	02-Aug-2022	Issued to attendees for comment	SAB
R02-00	09-Aug-2022	JA comments incorporated	SAB

ATTENDEES

Organisation	Attendee	Role	Initial
NASH Maritime	Sam Anderson-Brown Adam Fitzpatrick	Principal Consultant Senior Consultant	SAB AF
Cory	James Andrews	Head of Lighterage and Ship Repair	JA
WSP	Jane Templeton	Principal Engineer	JT

AGENDA

1. Introductions
2. Scope of work (SAB)
3. Baseline operation (SAB)
4. Future baseline (increased capacity for Riverside 2) (SAB)
5. CCUS export operation (SAB)
6. Rippleway Wharf marine operation (AF)
7. Rippleway Wharf tug and barge trials (AF)
8. AOB

NOTES OF MEETING

1	Introductions	Action
1.1	Introductions made.	
2	**Scope of work**	
2.1	SAB presented the current NRA scope of works for both the CCUS and Rippleway Wharf NRAs	
3	**Baseline operation**	
3.1	SAB presented a schematic illustrating NASH's current understanding of the baseline (current as of today) operation. JA made the following comments outlined in 3.2 and 3.3.	
3.2	There should be 3 barges coming from Walbrook and Northumberland Wharfs.	
3.3	Tugs starts at Charlton and heads to Middelton Jetty with two loaded waste barges, services Middelton Jetty, Leaves to Tilbury with loaded ash, returns from Tilbury with empty ash barges, services Middelton Jetty and then returns to Charlton with empty waste barges.	
4	Future baseline operation	
4.0	SAB presented a schematic illustrating NASH's current understanding of the future baseline operation (required to increase tonnage for Riverside 2). JA made the following comments outlined in 4.1, 4.2, 4.3, 4.4 and 4.5.	
4.1	Arrivals / departures from WRTS, Cringle Wharf, Northumberland Wharf and Walbrook Wharf remain the same as baseline operation (totalling 3 tugs and 9 barges).	
4.2	2 tugs and 4 barges will arrive from Rippleway Wharf resulting in two additional arrivals and two additional departures.	
4.3	A second ash barge movement will be required between Middelton Jetty and Tilbury, resulting in 3 arrivals and 3 departures from the Middelton Jetty (1 additional arrival and 1 additional departure in comparison to the Baseline operation). This would result in ash movements on two tides a day.	
4.4	JA noted that there would potentially be logistical challenges in servicing the additional barges at Middelton Jetty with the available mooring space, infrastructure and equipment.	
4.5	There should be 2 ash barges per passage between Middelton Jetty and Tilbury	
4.6	No waste transfer operation from Tilbury.	
4.7	SAB to update schematics for JA review.	SAB
5	CCUS export operation	
5.1	JA explained that the positioning of the proposed CCUS Jetty means that additional barge moorings which are being consulted on with the PLA can now no longer be installed directly downstream from the Middelton Jetty. Additional barge moorings are required and will need to be positioned either upstream of the existing barge moorings and in line with the Thames Water jetty or to the north of the Authorised Channel. Positioning of the additional barge moorings will bring differing operational and navigational risk challenges. JA would prefer the moorings were located upstream of the existing moorings. JA to keep SAB informed of progress regarding installation of additional barge moorings.	JA
5.2	Adequate navigable width will be required between the berthed tanker / CCUS Jetty and the Middelton Jetty to enable Cory tugs to manoeuvre barges on to the inshore	SAB

	side of the Jetty. JA anticipates that adequate navigable width would be no less than 125m. NASH to produce scale drawing to review navigable width and report findings back.	
5.3	JA had no other navigation risk related concerns.	
6	Rippleway Wharf marine operation	
6.1	AF outlined marine operation as per NASH understanding	
6.2	JA commented that it was likely 2 tugs towing two barges each would be utilised. • Tug towing two empty barges enters Barking Creek • Empty barges are loaded • Tug exits Barking Creek and proceeds to Middelton Jetty. • Second tug repeats operation with remaining barges. • Gallions moorings remains as a fallback should only one tug be utilised. • One hour either side of HW on the lowest neap tide of the year was requested to provide enough time for operations and for potential 3rd party vessel moves. • Closure of Barking Creek flood barrier was raised as a potential issue for operations.	
7	Rippleway Wharf tug and barge trials	
7.1	AF outlined plan for trials: • To be undertaken to understand how the tugs will manoeuvre barges into Rippleway Wharf and the timing of operations Plan for trials: • HW on a spring tide • Use drone footage and AIS to record passage • Board at Charlton to include passage past Belvedere • Invitation extended to the PLA	
7.2	JA happy with proposed trials and PLA inclusion but suggested that trials be undertaken on either 12 or 13 Sep to better coincide with tug and staff availability. (*AF reviewed NRA programme post meeting and confirmed 13 Sep fitted within current schedule)*	AF
7.3	JA noted capacity on tug was limited to 12 persons so PLA launch may be required	AF
8	AOB	
8.1	Agreed that JA would provide copies of generic passage pan and also third-party risk assessment.	

MEETING ACTIONS

Number	Owner	Action	Status
1	SAB	Update schematics as per discussion and issue to JA for validation prior to further consultation.	03-Aug-2022
2	JA	To confirm status of additional mooring application and likely timescales / Site	08-Aug-2022

3	SAB	SAB to arrange for scale drawing illustrating current navigable width between Middelton Jetty and CCS jetty to be prepared for review.	12-Aug-2022
4	AF	Confirm feasibility of conducting trials during Sep -22	Complete
5	AF	Confirm trial arrangements, interface with PLA etc.	31-Aug-2022

CCUS PRELIMINARY NAVIGATION HAZARD ANALYSIS

Project Title	CCUS Preliminary Navigation Hazard Analysis
Project Number	22-NASH-0235
Meeting subject / purpose	PLA Consultation
Revision	R01-00
Date of meeting	09-Aug-2022
Start time	11:00 BST
Finish time	12:00 BST
Client	WSP / Cory
Location	Microsoft Teams

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R01-00	10-Aug-2022	Issued to attendees for comment	SAB

ATTENDEES

Organisation	Attendee	Role	Initial
NASH Maritime	Sam Anderson-Brown Adam Fitzpatrick	Principal Consultant Senior Consultant	SAB AF
PLA	Adam Layer Lydia Hutchinson	Harbour Master Marine Manager	AL LH
Cory	Ross Brown James Andrews	Project Manager Head of Lighterage and Ship Repair	RB JA
WSP	Jane Templeton	Principal Engineer	JT

AGENDA

1. Introductions;
2. Meeting aims and objectives;
3. Scope of work;
4. Project overview;
5. Baseline navigation characterisation;
6. Vessel traffic analysis;
7. Preliminary navigation hazards and key navigational issues;

8. Task 3: Ship bridge simulations;
9. Task: 4 Preliminary Navigation Risk Assessment;
10. Next steps; and
11. AOB.

NOTES OF MEETING

1	Introductions	Action
1.1	Introductions between attendees.	
2	**Meeting Aims and Objectives**	
2.1	SAB presented the aims and objectives for the meeting.	
3	**Scope of Work**	
3.1	SAB presented the work that will be undertaken to inform the NRA.	
4	**Project Overview**	
4.1	SAB gave a description of the proposed jetty location and the design vessels currently under consideration. The two vessels represent the largest and smallest currently under consideration	
4.2	SAB noted that the Preliminary Navigation Risk Assessment (PNRA) will take a precautionary approach regarding the design vessels, with the largest vessel and maximum number of vessel moves used to inform PNRA assumptions.	
5	**Baseline Navigation Characterisation**	
5.1	SAB presented the following: • Key navigational features, including potential additional Cory barge moorings – it was noted that the navigation risk profile would differ depending on the location of the barge moorings; • Summary of the NRA completed for the Riverside 2 DCO; • Incident count by vessel per reach; and • Baseline risk controls.	
5.2	AL and LH agreed that the baseline characterisation was representative of current river activity.	
6	**Vessel Traffic Analysis**	
6.1	The vessel traffic analysis focused on the following areas: • Vessel traffic density; • Largest vessels identified transiting the area; • Vessels using the jetties in the study area; • Passenger vessel tracks; • Tug and service vessel tracks; • Recreational vessel tracks; • Current Cory operations; and • Future Cory operations.	
6.2	LH asked about the AIS data being used as some of the slides in the section indicated 2018 data was used. SAB explained that the information presented on	

	the slides in question was taken directly from the NRA for Riverside 2, hence the reference to 2018 data. Analysis for the PNHA has been undertaken using 2021 data. AL commented that there has been a significant increase in activity in 2022 so the most recent data should be used where possible.	
6.3	SAB highlighted that the NRA for Riverside 2 concluded that additional barge operations for Cory would have a negligible impact on vessel navigation on the Thames.	
6.4	SAB commented that the project design vessel will likely be tidally restricted and asked whether there are any other tidally restricted vessels arriving / departing berths or on passage through Halfway Reach. AL to provide data for this.	AL
6.5	LH noted that there is a trend toward increased cruise ship activity through the study area and that a predicted increase in UBTC activity would need to be considered.	
6.6	SAB noted that there is limited recreational activity in the study area and no yacht clubs located within Halfway Reach. SAB asked if there were any recreational stakeholders that should be consulted during the PNRA. LH said that the Erith Yacht Club is the closest but they may not sail in the study area. SAB agreed to carryout high level consultation with Erith Yacht club to ascertain the geographic boundary of the clubs sailing area.	
7	**Preliminary Navigation Hazards and Key Navigational Issues**	
7.1	SAB presented the hazards to vessel navigation associated with the CCUS project which comprise 16 hazards in the following 4 categories: • Collision; • Contact; • Grounding; and • Breakout.	
7.2	SAB noted that the limited visibility at Jenningtree Point was a potential issue and the tidal set may affect berthing at the proposed jetty location. AL agreed.	
7.3	SAB asked whether there were any other hazards or key issues that need consideration. Responses provided in 7.4 and 7.5.	
7.4	LH said that the interactions with passenger vessels in the area given the future increase in movements is potentially significant. SAB asked whether traffic risk modelling will be required. LH confirmed that it will and the PLA would expect to see this in the PNRA.	
7.5	JA noted that there may be impacts related to the maintenance dredging operations at the Middelton Jetty berth interacting with tanker movements.	
7.6	LH and AL confirmed that no other significant impacts were envisaged at this stage.	
8	**Bridge Simulations**	
8.1	SAB discussed the ship bridge simulations that will be conducted to test the viability of the jetty and any ship handling issues that may arise. SAB asked AL whether the PLA simulator could be used. AL said that the PLA simulator may not be appropriate for this, given current limitations / capability. SAB and AL to discuss further.	SAB / AL
9	**Preliminary Navigation Risk Assessment**	
9.1	SAB introduced the scope for the PNRA to support the DCO application and asked about other stakeholder consultees for the area. LH noted Ford's RoRo berth regularly have vessels swinging in the area, GPS Marine regularly transit and that	LH

	a River Pilot should be consulted. LH to confirm if any further stakeholders need to be consulted with.	
9.2	SAB asked whether a commercial shipping assessment would be required as part of this process. AL and LH commented that given the level of certainty around future operations, it would be difficult to appropriately assess and this would provide limited value. LH confirmed that the PLA would ne expect to see such an assessment included in the PNRA.	
9.3	LH confirmed that the proposed PNRA scope was suitable.	
10	**Next Steps**	
10.1	SAB listed the steps that will be taken to complete the PNHA.	
11	**AOB**	
11.1	JA asked whether the masters for LCO_2 tanker will be likely to attain PECs. AL confirmed that with the proposed 496 movements per year, it is likely they would and that the River Pilots would otherwise by limited by available resource.	

MEETING ACTIONS

Number	Owner	Action	Status
1	AL	Provide information on tidally restricted vessels transiting Halfway Reach.	Ongoing
2	SAB AL	Discuss the potential to use the PLA simulator for the bridge simulations.	Ongoing
3	LH	Advise on appropriate commercial stakeholders to be consulted during PNRA.	Ongoing
4	SAB	Undertake high level consultation with Erith Yacht club to ascertain the geographic boundary of the clubs sailing area.	To be programmed in to PNRA programme.

CORY CCUS NRA

Project Title	Cory CCUS NRA
Project Number	22-NASH-0235
Meeting subject / purpose	PLA pNHA findings
Revision	R01-00
Date of meeting	22-Sep-2022
Start time	16:00 BST
Finish time	17:00 BST
Client	WSP / Cory
Location	Microsoft Teams

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R01-00	27-Sep-2022	Issued to attendees for comment	SAB

ATTENDEES

Organisation	Attendee	Role	Initial
NASH Maritime	Sam Anderson-Brown Nigel Bassett Adam Fitzpatrick	Principal Consultant Associate Consultant Senior Consultant	SAB NB AF
PLA	Adam Layer Lydia Hutchinson	Harbour Master Marine Manager	AL LH
WSP	Jane Templeton	Associate	JT

AGENDA

- Scope of work
- Project overview
    - Concept jetty design
    - Marine operation
- Preliminary navigation hazards
- Key navigational issues
- Preliminary risk controls
- Study recommendations

- Task 4: Preliminary Navigation Risk Assessment
- Next steps
- AOB

NOTES OF MEETING

1	**Scope of Work**	
1.1	SAB presented the work that will be undertaken to inform the NRA.	
2	**Project Overview**	
2.1	SAB provided a recap of the project including the current jetty design and an overview of the proposed operations.	
3	**Preliminary Navigation Hazards**	
3.1	SAB described the process used to identify the navigation hazards associated with the project and presented a list of hazards.	
4	**Key Navigational Issues**	
4.1	SAB gave an overview of the key navigational issues that have been identified, these are: • Impact of the tidal stream • Sight lines • Positioning of additional Cory barge moorings • The future increase in vessel traffic • The proximity of the CCUS jetty to the Middelton Jetty • Tidal restrictions to operations	
4.2	LH and AL observed that they felt the key navigational issues had been identified.	
5	**Preliminary Risk Controls**	
5.1	SAB outlined the preliminary risk control measures identified; these are: • Operational limitations • Deconfliction of operations • Location and alignment of the CCUS jetty • Positioning of berthing infrastructure • Positioning of the additional Cory barge moorings to lessen the impact on project vessel movements	
5.2	AL commented that he saw the definition of appropriate operational limitations as a key risk control measure.	
5.3	AL is in the process of collating data on tidally restricted vessels and will provide this to NASH in due course.	
6	**Study Recommendations**	
6.1	SAB summarised the study recommendations (see slide 25 and 26) of the accompanying presentation.	
6.2	In relation to the recommendation that navigational modelling be undertaken AL said that the project team needs to show that the project and its operations do not significantly affect safety of navigation and, given the key issues that have been identified, he didn't see how this could be achieved without ship bridge simulation.	

6.2	NB commented that he was of the opinion that Ship Bridge Simulations would be the only means of accurately determining the best swing location when berthing on a flood tide given the close proximity of the Middleton Jetty. AL concurred with this and reiterated that given the variables of the berth it's difficult to envisage how other forms of navigational modelling would produce satisfactory outputs.	
7	**Preliminary Navigation Risk Assessment**	
7.1	SAB recapped the scope of the pNRA (see slide 28 and 29)	
8.	**Next steps**	
8.1	SAB outlined next steps (see slide 30)	

MEETING MINUTES

PROJECT NUMBER	70090329	**MEETING DATE**	29 March 2023
PROJECT NAME	Cory Decarbonisation Project	**VENUE**	MS Teams
CLIENT	Cory	**RECORDED BY**	JT
MEETING SUBJECT	PLA Consultation		

PRESENT	Sam Anderson Brown & Ed Rogers (NASH), Richard Wilkinson (Cory), Lydia Hutchinson & Adam Layer (PLA), Jane Templeton (WSP)
APOLOGIES	James Andrews (Cory)
DISTRIBUTION	As above plus: Click to type
CONFIDENTIALITY	**Confidential**

ITEM	SUBJECT
1	NASH outlined the navigation scope of work both in terms of work done, and what is yet to be completed.
2	NASH outlined the key drivers for change in jetty location as: - Original location was closer to the shore and dredging would have been required in the intertidal zone with serious environmental consequences, which the project team are aiming to avoid. - Interaction between the existing Cory tug and barge operation and the CO2 tanker operation. Project team consulted with Cory Tugmaster and conducted swept path analysis proposed revised location is preferred as the offset between the existing Middelton Jetty facility and proposed CO2 jetty gives adequate navigable width for the barge movements (particularly on a strong flood tide). - Greater clarity on design vessel and subsequent dredging requirements. - Aiming to futureproof the structure for potential hydrogen bunkering facilities in the future
3	NASH is currently revisiting preliminary Navigation Hazard Analysis; once complete, the next step is to go through ship simulations and NRA.
4	NASH summarised key findings from the preliminary hazard analysis. PLA confirmed this was an accurate summary of previous works.
5	Regarding the updated jetty location: - Width between authorised channel and outside point of vessel is 20m

- WSPnoted : Jetty head and dolphin positions/dimensions are still under review during the design; these are likely to shrink down to some extent
- NASH presented AIS tracks and indicative swept paths showing Cory's existing barge movements with the proposed new jetty location.
  - Flood tide option was performed with no infrastructure in place so the tugmaster somewhat exaggerated this manoeuvre
  - Does show a difference between the flood and ebb tide manoeuvres
  - Distance between the two structures considered acceptable by Cory, subject to reviewing the final infrastructure location on a chart showing new moorings upstream of the existing jetty too. WSP to prepare once the jetty dimensions are finalised.
- Discussed putting pellet buoys down to simulate location of proposed jetty and to enable Cory tugmaster's to make an informed decision on the extent to which the proposed jetty location would constitute a contact hazard.

NASH presented detailed swept path analysis plots (including swept path density plots) for passing cargo and tanker transits. These were developed to understand spatially how much room passing vessels need, rather than just looking at vessel tracks:

- NASH noted that passing transits in close proximity to the proposed jetty are largely associated with the Ford's Jetty Ro-Ro operation. It was also noted that vessels associated with this operation passed the proposed jetty location at relative low speed.
- On initial review it is unclear as to why these vessels navigate in such close proximity to the southern limit of the authorised channel (and therefore in close proximity to the proposed jetty location).
- NASH asked PLA whether they have any insight into why the vessels would be navigating in this manner.
- PLA commented that the vessels may be aligning for Jenningtree bend, relative low speeds may also be due to third party traffic in the area
  - If vessels have more headway, they'll be less affected by tide
  - If vessels are still building speed, they'll be more affected by tide
- It was agreed that consultation with the vessel operator should be expedited to understand the full impact of the proposed jetty location on the Ford's Jetty Ro-Ro operation.
- An examination of passing cargo and passenger swept paths as well as a review of sweptpaths showing tanker vessel arrivals / departures at Thunderer jetty revealed that vessels are passing to the north of the proposed jetty location, well within the authorised channel.
- The bunker barge *Distributor* was the exception to this as was noted navigating well outside (south) of the authorised channel.

	Further consideration is needed to establish what will impact be with infrastructure in place. NASH noted that this will be part of the formal pNRA process and can be brought forward in the programme. NASH to undertake further swept path analysis on a tidal basis during pNRA analysis as per PLA request. PLA considering being on board on a tanker to Thunderer Jetty to observe movements PLA stated they are currently not unhappy with the proposals, subject to further consultation to understand what is causing vessels to transit at the edge of the channel. It was noted by the PLA that the structure is on the south side of the river, therefore approaching vessels have long line of sight to see the infrastructure. It is likely that traffic will habituate to take in to account the location of the jetty once in situ as there is adequate navigational width in this location. PLA further noted that only vessels with a PEC are navigating the southern limit of the authorised channel. Those vessels that have a PLA pilot onboard pass well north. It may be an option to test the PEC holders with ship simulation to assess impact of infrastructure.
6 :	**Ship Bridge Simulations** PLA noted that the specification is sufficiently broad; it is expected the pilots will learn a lot from trying to achieve the specified aims and had no further comments to add. Simulations to be held on 24th and 25th April. LH to attend from PLA with 2no. PLA pilots (TBC).

Next meeting: TBC following ship simulations.

CORY DECARBONISATION PROJECT: PNHA REVIEW

Project Title	Cory Decarbonisation Project: PNHA Review
Project Number	0235
Meeting subject / purpose	Cory Lighterage Consultation
Revision	R01-00
Date of meeting	19-Apr-2023
Start time	13:00 GMT
Finish time	13:30 GMT
Client	WSP / Cory Environmental
Location	Meeting Location

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R01-00	19-Apr-2023	Issued to attendees for comment	SAB

ATTENDEES

Organisation	Attendee	Role	Initial
NASH Maritime	Sam Anderson-Brown	Principal Consultant	SAB
Cory Environmental	James Andrews	Head of Lighterage and Ship Repair	JA

NOTES OF MEETING

1	Meeting Purpose	Action
1.1	SAB explained that since the last consultation meeting with the Cory Lighterage team (02-Aug-2022) the jetty design had been further developed and two design iterations were being considered. SAB went on to clarify that the purpose of the meeting was to understand the possible impact of each design on the existing Cory lighterage operation at Belvedere.	
2	**Design Options**	
2.1	SAB presented the two design options, Option 2 (closest to the Authorised Channel) and Option 3 (in line with the existing Middelton Jetty facility nearest to the shore)	
2.2	SAB presented a number of indicative swept paths showing Cory vessels navigating to the downstream shoreside berth of the Middelton Jetty. These swept paths had been overlaid with the Option 2 and 3 Jetty designs to illustrate the potential spatial impact on the swept paths arising from each Jetty design. JA commented that the swept paths showed two extremes, one being a very tight (ebb tide) manoeuvre in close proximity to the Middelton Jetty and the other being a very wide (flood tide) manoeuvre, which in a real-world scenario would result in	

	the barge making contact with the most westerly jetty dolphin. JA emphasised that in all reality a representative manoeuvre would likely (spatially) fall between the two presented examples and would therefore mean the barges passed well clear of both pier structures JA added that on a strong flood tide, rather than attempting to swing the barge around the eastern end of the Middelton Jetty (as shown in the swept paths) Cory tugs were more likely to position head to tide and crab across before falling back on to the Jetty and mooring the barge — or alternatively navigate through the "link span" under the brow of the main Middelton Jetty to remove the need for navigating around the lower end.	
2.3	JA made the following comments in relation to each Jetty Option: Option 2: • Gave a greater offset between Middelton Jetty and proposed jetty, allowing for Cory Tug vessels to go head to tide with ease when manoeuvring barges to the downstream shoreside berth. • Positioning of brow is closer to Middelton Jetty berth giving (relative) more concern over contact than with Option 3. • Although there is a greater offset, extreme eastern end of Middelton Jetty is slightly closer to most westerly jetty dolphin. SAB confirmed this. Option 3: • Reduced offset between Middelton Jetty and proposed jetty, making head to flood tide manoeuvre more challenging (in relative terms) • Positioning of brow is further away from Middelton Jetty berth giving (relative) less concern over contact than with Option 2. • Extreme eastern end of Middelton Jetty is slightly further from most westerly jetty dolphin.	
2.4	JA felt that neither Jetty design would have an adverse impact on Cory's existing lighterage operation and that the lighterage team would be able to continue their operation should either option be taken forward. JA based his judgement on his own first-hand experience of operating in the area and knowledge of previous incidents and existing operational obstructions. JA mentioned that the western dolphin of the now disused Belvedere power station jetty (to be demolished as part of this proposal) is located in closer proximity to the Middelton Jetty than the proposed access brows for both proposed jetty options, this dolphin has never been hit by a Cory tug and barge. Equally, the navigable width between the western end of the Middelton Jetty and the existing Cory barge moorings is less than the proposed navigable width between the Middelton Jetty and proposed jetty. JA suggested that several pellet buoys be put down to simulate the location of the proposed jetty and brow and to enable further decision making on the extent to which the proposed jetty location would constitute a contact hazard**.**	
2.5	JA asked SAB to provide plots presented so that he could undertake consultation with Tug master's within the lighterage team	
3	**Additional Consultation and informal simulations**	
3.1	Further to the consultation meeting conducted on 19-Apr-23 (see Section 1 and 2 of this document). James Andrews and Tom Jones (TJ (Cory Tugmaster)) attended Ship Bridge Simulations, at HR Wallingford on 24 and 25 Apr. The purpose of the simulations was to model the arrival of the CO_2 tanker at the proposed Jetty location. JA and TJ were present to comment on the impact of the tanker approach / departure on Cory's lighterage operation. However, as part of the simulations there	

	was also an opportunity (facilitated by HR Wallingford) for TJ to undertake simulation runs utilising a Cory Tug ship model with the Middelton Jetty and Option 2 / Option 3 of the proposed Jetty design modelled. TJ undertook runs to the shore side downstream berth.	
3.2	Following the simulation runs undertaken by TJ and a review of the plots SAB had previously provided to JA, TJ concluded that that neither Jetty design would have an adverse impact on Cory's existing lighterage operation and that the lighterage team would be able to continue their operation should either option be taken forward. As a precautionary measure TJ concluded that the placement of pellet buoys (as previously suggested by JA) would be a worthwhile exercise and would prove that the positioning of proposed jetty (Option 2 or 3) would have no impact on the existing lighterage operation.	

Appendix B
PLA pNRA Project Initiation Meeting Minutes

CORY CARBON CAPTURE AND STORAGE

Project Title	Cory Carbon Capture and Storage
Project Number	22-NASH-0235
Meeting subject / purpose	NRA initiation meeting
Revision	R02-00
Date of meeting	22-Aug-2023
Start time	15:00 BST
Finish time	16:00 BST
Client	WSP / Cory
Location	Microsoft Teams

DOCUMENT CONTROL

Revision	Date of Issue	Description	Approved
R02-00	22-Aug-2023	Issued to attendees for comment	SAB

ATTENDEES

Organisation	Attendee	Role	Initial
PLA	Adam Layer Lydia Hutchinson	Harbour Master Marine Manager	AL LH
WSP	Jo Evans	Project Engineer	JE
NASH Maritime	Sam Anderson-Brown Claire Conning Adam Fitzpatrick	Principal Consultant Maritime Consultant Senior Consultant	SAB CC AF

AGENDA

1. Introductions
2. Shipping and navigation tasks
3. Key PNHA and sims recommendations
4. pNRA scope
    - Task 1 - Project Management
    - Task 2 - Analysis
    - Task 3 - Thames Traffic Risk Modelling
    - Task 4 - Stakeholder Consultation

- Task 5 - Risk Assessment
- Task 6 - Reporting

5. AOB

NOTES OF MEETING

1	Introductions	Action
1.1	Introductions between attendees SAB explained that the meeting was an opportunity to discuss the pNRA scope and to ensure that the PLA had an opportunity to influence the scope of the assessment to ensure that specific navigational concerns were addressed.	
2	**Shipping and navigation tasks**	
2.1	SAB provided a summary of the tasks that have been completed to date, these are: • Site optioneering • Preliminary Navigation Hazard Analysis • Jetty optimisation • Revise Preliminary Navigation Hazard Analysis • Ship Bridge Simulations	

2.2	• SAB highlighted two key elements that inform / are included in the pNRA scope and were previously identified during consultation with the PLA:
	  ◦ The pNRA will assume a worst-case scenario in terms of vessel size and number of vessel movements, (assuming further work to refine the project vessel is not undertaken)
	  ◦ Quantitative risk modelling should be undertaken as part of the pNRA scope to determine any changes in future collision hazard occurrence likelihood, resulting principally from an increase in passenger traffic within Halfway Reach.	

3	**Key pNHA and sims recommendations**	
3.1	SAB summarised the key recommendations from the PNHA and sims, these were: • Consultation with the Ford's jetty vessel operator should be expedited (possibly prior to undertaking the pNRA) to understand the full impact of the proposed jetty location on the Ford's jetty Ro-Ro operation. • Cory tug and barge trials should be undertaken to confirm maximum footprint of required operations. Trials will be undertaken through placement of pellet buoys to define CCS infrastructure and data collected from the trials should be included in the pNRA	
4	**pNRA scope**	
4.1	SAB presented the stages of the pNRA, the following presents the key areas of discussion.	
4.2	SAB asked whether the Sep-22 AIS dataset used for the PNHA meets the PLA's requirements for the pNRA. AL and LH confirmed that the data is acceptable.	
4.3	SAB presented the scheme and PNHA study area and asked whether it is appropriate for the pNRA.	

	AL and LH confirmed that there has not been significant changes to marine traffic in the area, so the study area is still valid.	
4.4	SAB presented the updated marine operation for the project noting: • The dredge pocket will be 10.5m below CD (previous design was 10.2m below CD) • The vessel sizes and movement numbers have been updated, the project will likely use a mixture of vessels. The smallest vessels resulting in the highest number of movements and the largest vessels will be considered in the pNRA to represent a worst case scenario. • Quantitative collision risk modelling will be undertaken as part of the pNRA. The future traffic profile needs to be agreed to allow for accurate results.	
4.5	SAB noted that during previous consultation with the PLA, increased passenger vessel movements through the study area were expected. He asked whether there was any further information available on this. AL said that he would confirm with Lucy Owen and Michael Atkins regarding projects that may influence the future traffic profile.	1
4.6	SAB presented the anticipated increase in activity for Cory based on its future operations.	
4.7	SAB presented identified stakeholders for consultation. Noting commercial operators as: • Cobelfret (Ford's Jetty) • Hansons • Vessels using Thunderer Jetty SAB asked if there are other commercial consultees and whether the PLA could provide appropriate points of contact. AL and LH will discuss whether additional consultees should be contacted and provide points of contact where available.	2
4.8	SAB asked whether there are any recreational stakeholders that should be consulted on the project. AL noted that Greenwich Yacht Club operate in the area. JE suggested inclusion of Erith Yacht Club and the Erith Causeway Rowing Club.	
4.9	SAB asked whether the PLA risk assessment methodology should be used. LH confirmed that it should.	
4.10	JE noted that the WSP technical safety team are undertaking an assessment of the potential release of product which can be used to inform consequence scoring in the pNRA. AL asked whether it would be considered a COMAH site. JE said that the HSE doesn't currently consider liquid CO2 as a COMAH product, however this is subject to continuous review. She suggested potential mitigations including an exclusion zone or landside controls such as emergency shut off valves. LH asked whether the design closest to the authorised channel is being considered and whether an exclusion zone would extend into it. SAB confirmed that it is the design currently being considered and that any exclusion zone would be considered against the vessel traffic in the area.	
4.11	LH asked whether the simulation report will be provided to the PLA for review. JE confirmed that the report can be provided to the PLA as a draft. SAB to issue.	3
4.12	SAB asked whether the PLA felt there was anything else that should be included in the NRA scope.	

	AL stated that he felt the current scope was suitable.	
5	**AOB**	
5.1	AL asked about the current status of the project and the timeline for application. He noted that there is currently a disconnect with different topics for the assessment. Post meeting note; EIA assessment will commence in mid-October and the DCO will be submitted in March 2024. AL commented the Harbourmaster team had concerns that other departments within the PLA where not being kept up to speed when it came to project developments and that a communication flow with all elements of the PLA was necessary.	

MEETING ACTIONS

Number	Owner	Action
1	AL	Provide information on the future traffic profile.
2	AL and LH	Confirm the stakeholders that should be consulted with and provide a point of contact where available.
3	SAB	Issue draft simulation report to the PLA

Appendix C
Email Correspondence with Erith Rowing Club

Sam Anderson-Brown

From:	[redacted]
Sent:	03 October 2023 08:26
To:	Sam Anderson-Brown
Cc:	[redacted]
Subject:	Re: Invitation to provide feedback to inform Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation
Attachments:	image001.jpg

Morning Sam

Thank you for your email regarding the CCS Jetty.

The location and operations of this proposal, potentially appear to be hazardous for navigating this section of the river, however the impact on Erith Rowing Club would be somewhat negligible.

This is due to the fact the majority of our river outings are carried out in the opposite direction, towards the Dartford crossing.

The only factor that may have an impact is any increase in traffic due to the operations of the new jetty.

I hope this is of some use.

Regards

[redacted]
Erith Rowing Club (Captain)

On Mon, 2 Oct 2023 at 11:24, Sam Anderson-Brown [redacted] wrote:

> Good morning,
>
> I wondered if Erith Rowing Club had any comment in relation to the below proposals or whether representatives of the club would like to join a consultation meeting.
>
> Kind regards,
>
> Sam
>
> **Sam Anderson-Brown | Principal Consultant**
>
> t: [redacted]

From: Sam Anderson-Brown
Sent: Tuesday, September 19, 2023 11:59 AM
To: [redacted]
Subject: Invitation to provide feedback to inform Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation

Good afternoon,

Invitation to provide feedback to inform Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation

On behalf of Cory Environmental Limited, NASH Maritime is undertaking a Navigation Risk Assessment (NRA) for the Cory Carbon Capture and Storage Project (CCS). The CCS project includes new infrastructure, in the form of a jetty, and an associated marine operation that together facilitate the export of Liquid Carbon Dioxide (LCO2) from the proposed Carbon Capture and Storage (CCS) facility at Cory's Riverside Campus, on the river Thames in London.

We are therefore writing to advise you of the proposals and, as key marine stakeholder, invite your input and feedback as part of the NRA process.

I attached a PPT slide pack giving key information relating to:

- Project Overview – slide 3
- CCS Jetty Location – slide 5
- Marine Operation - slides 6 to 10
- Consultation Objectives – slides 11 and 12.

We would be grateful if you could attend a workshop meeting to discuss the project.

The purpose of stakeholder consultation is to inform the NRA and define hazards and appropriate risk control measures to reduce risk associated with the marine aspects of the proposed CCS project. We are therefore keen to hear your views on the following:

- New navigation-related hazards that could emerge during the construction, operation and decommissioning of CCS project (e.g. collision, contact, breakout, grounding)
- Likelihood and the potential consequence of hazards (i.e. risks) to people, property, business and the environment.
- Views on suitable means to mitigate any identified risks (e.g. risk controls such as buoyage and markings, procedures, communication).

Workshop meetings will be held utilising Microsoft Teams, current available dates for workshop meetings are:

- 22nd September;
- 2nd October;
- 3rd October;
- 5th October; and
- 6th October.

If you would like to attend a consultation workshop then please advise as to your preferred availability responding directly to [redacted] Depending on availability of other stakeholders we may seek to combine stakeholder meetings at a mutually convenient time.

Alternatively, If you intend to provide a written submission, please provide as much detail as you can so we can ensure that your views are taken into account during the assessment. Should you require any further information then please do not hesitate to contact us. Please submit any written submissions by 6th October.

Kind regards,

Sam

Sam Anderson-Brown | Principal Consultant

[redacted]

Appendix D
Email Correspondence with Hanson Aggregates

Sam Anderson-Brown

From: [redacted]
Sent: 09 October 2023 13:57
To: Sam Anderson-Brown
Cc: [redacted]
Subject: Cory Belvedere CCS

Importance: High

Hi Sam

We've received some late feedback from Hanson on the CCS project at Jenningtree (as below). I had sent on your powerpoint to them so this comment is based on that.

He has said it is ok to pass on his email address to you directly if you wish to discuss further;
[redacted]

Thanks

[redacted]

[redacted]

Port of London Authority
[redacted]

Follow us at @LondonPortAuth

From: [redacted]
Sent: 09 October 2023 13:28
To: [redacted]
Subject: FW: New jetty near Jenningtree Point

This message originated from outside your organisation

[redacted]
Apologies abut I finally got some feedback.
Appreciate it's a few days late.
Regards
[redacted]

From: [redacted]
Sent: Monday, October 9, 2023 13:14
Subject: RE: New jetty near Jenningtree Point

Good afternoon [redacted],

In my opinion I think that the new berth is too close to edge of the navigable channel.
When I leave Ameys and there is an inward bound v/, I usual navigate right up to the channel edge to leave adequate space for the inbound ship in the vicinity of the Jenningtree l/b (usually from around Middletons down to the Jenningtree l/b). Conversely when arriving and meeting another v/l in this area I would navigate to the northern edge and expect the outbound v/l to navigate to the southern edge.
The maximum width of the navigable channel there is only 1 cable as it is. So, impeding into an already tight area would result in passing another v/l at even closer pinch point.
There are some large v/l's that navigate in this part of the river – not just small coastal v/l's, you can have 180m tankers(for Thunderer jetty), large passenger v/l's(for tower bridge & HMS Belfast) and large sugar boats(for silvertown) some drawing 9 – 10m draught, all transiting this area.

[redacted]

[redacted].

Appendix E
CLdN Consultation Meeting 1 – PPT Presentation and Meeting Minutes

Cory Carbon Capture and Storage (CCS) Project

Subject: Preliminary Navigation Risk Assessment | Stakeholder consultation

Client: WSP / Cory

Revision: R01-00

NASH MARITIME

Agenda

- Introductions
- Project overview
- Consultation objectives
- CCS Jetty location
- Navigational environment
- Marine operation
- Construction phase overview
- CLdN operation
- Identified hazards

Project Overview

- NASH Maritime are undertaking a Navigation Risk Assessment (NRA) for a planned jetty and associated marine operation that together facilitate the export of Liquid Carbon Dioxide (LCO2) from the proposed Carbon Capture and Storage (CCS) facility at Riverside Campus, on the river Thames in London
- Since 2011 Cory has operated an Energy from Waste (EfW) facility known as Riverside 1, situated at Norman Road in Belvedere. In addition to Riverside 1, Cory has permission to construct and operate an additional EfW facility, known as Riverside 2, immediately adjacent to Riverside 1 and due for completion in 2026. The site occupied by the two EfW facilities is known as the Riverside Campus
- Riverside 2 will process up to 655,000 tonnes of waste per annum in addition to the 782,000 tonnes per annum processed by Riverside 1(in 2021). The Riverside Campus will maximise the use of Cory's existing river infrastructure including its operational jetty, tugs and barges, and will necessitate an increase in Cory freight operations on the river Thames
- The Cory Decarbonisation Project will involve the installation of technology to capture a minimum 95% of the emissions from the Riverside Campus. The project intends to use marine shipment to transport LCO2 to an offshore subsea storage site

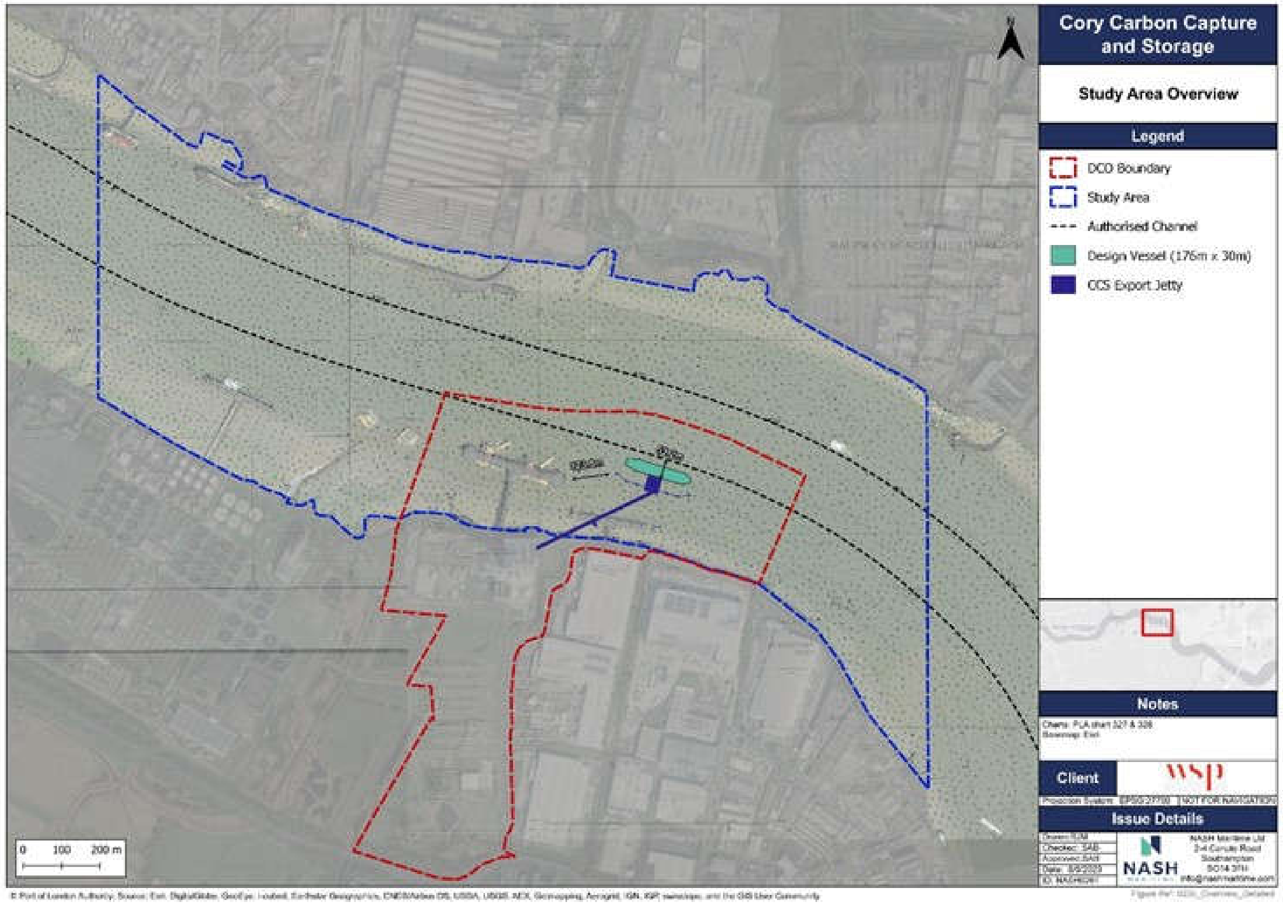
Consultation Objectives

- The purpose of stakeholder consultation is to inform the NRA and define hazards and appropriate risk control measures to reduce risk associated with the marine aspects of the proposed CCS project. We are therefore keen to hear your views on the following:
  - The identified navigational environment
  - New navigation-related hazards that could emerge during the construction, operation and decommissioning of CCS project (e.g. collision, contact, breakout, grounding)
  - Likelihood and the potential consequence of hazards (i.e. risks) to people, property, business and the environment
  - Views on suitable means to mitigate any identified the risks (e.g. risk controls such as buoyage and markings, procedures, communication)

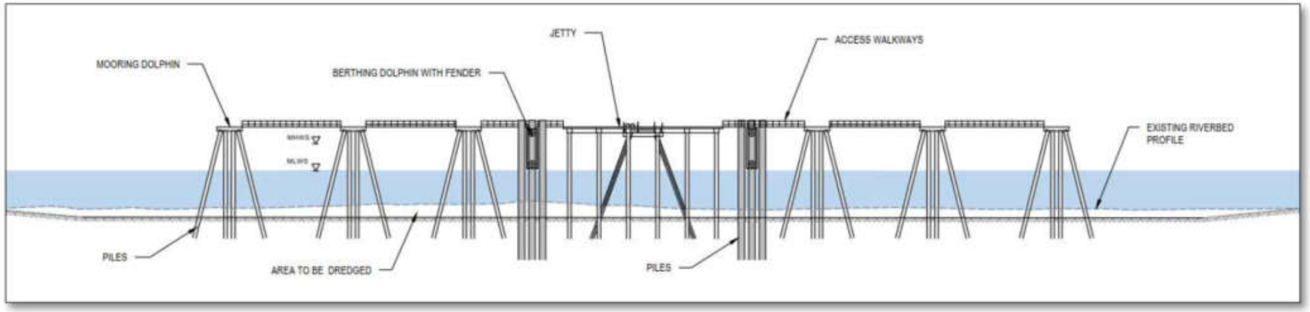
CCS Jetty Location

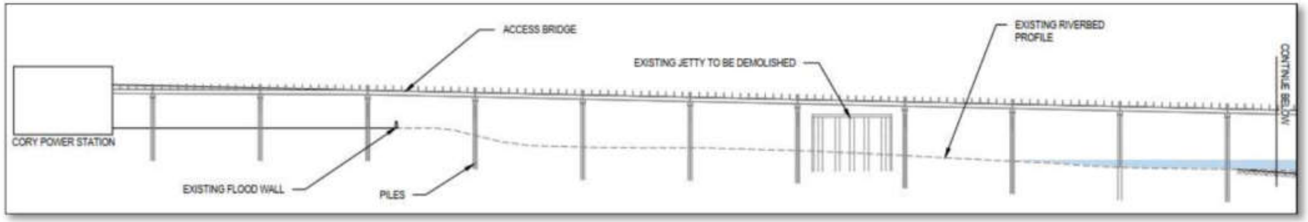
CCS Jetty Location

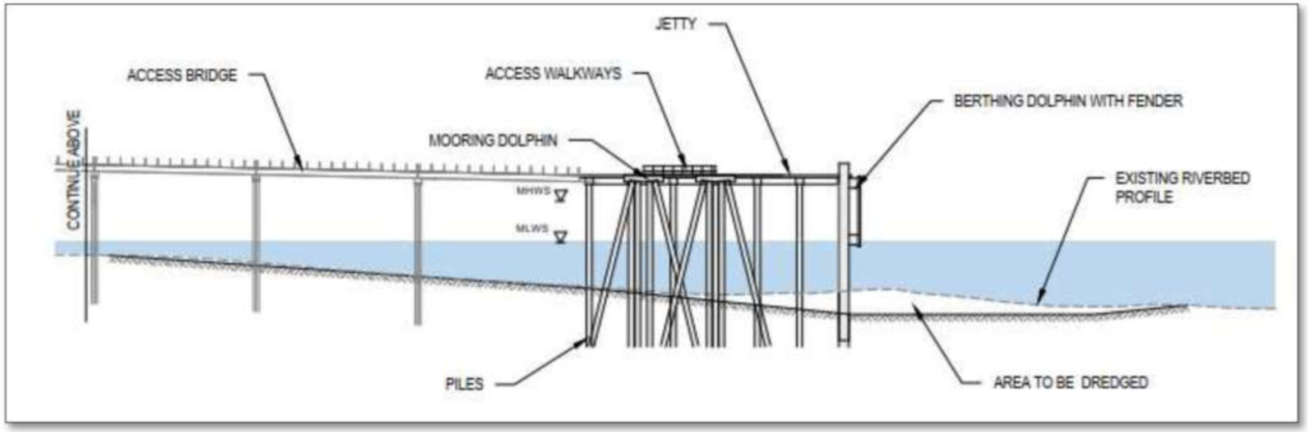
- The CCS jetty will consist of a main loading platform, connected to land by an access trestle
- Dredging of a berthed pocket will be necessary to accommodate LCO2 tankers alongside at all states of tide. The volume of material to be dredged will depend on the design vessel draught, which is yet to be determined, however it is estimated the pocket will need to be dredged to 10.5 m below Chart Datum (CD) alongside the berth to allow berthing at all states of tide.



Preliminary Jetty Design



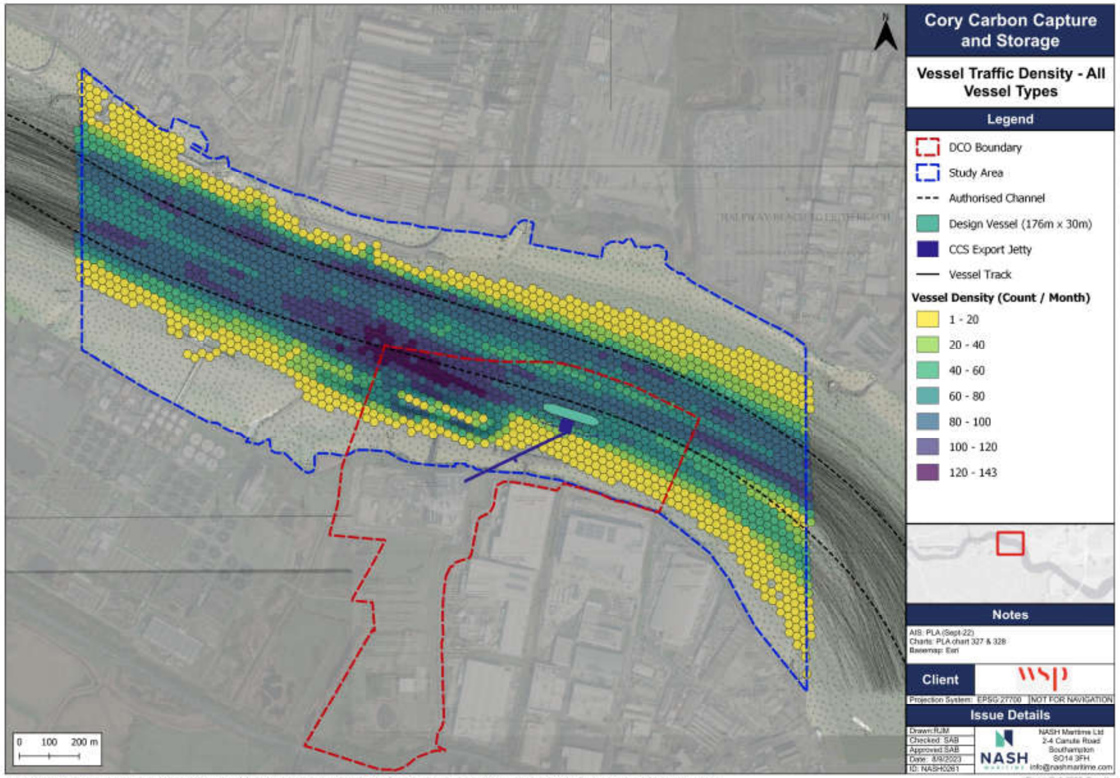


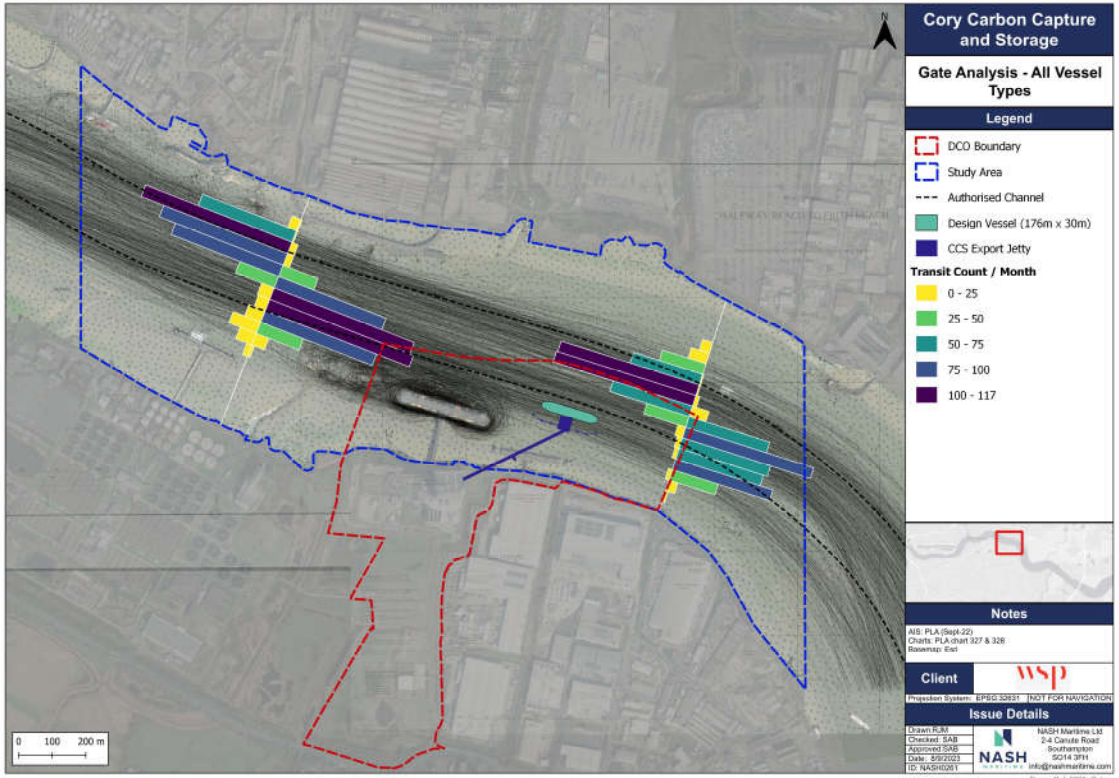


Navigational Environment

Vessel Traffic Overview

NASH MARITIME





Commercial Tracks (Cargo / Tanker)

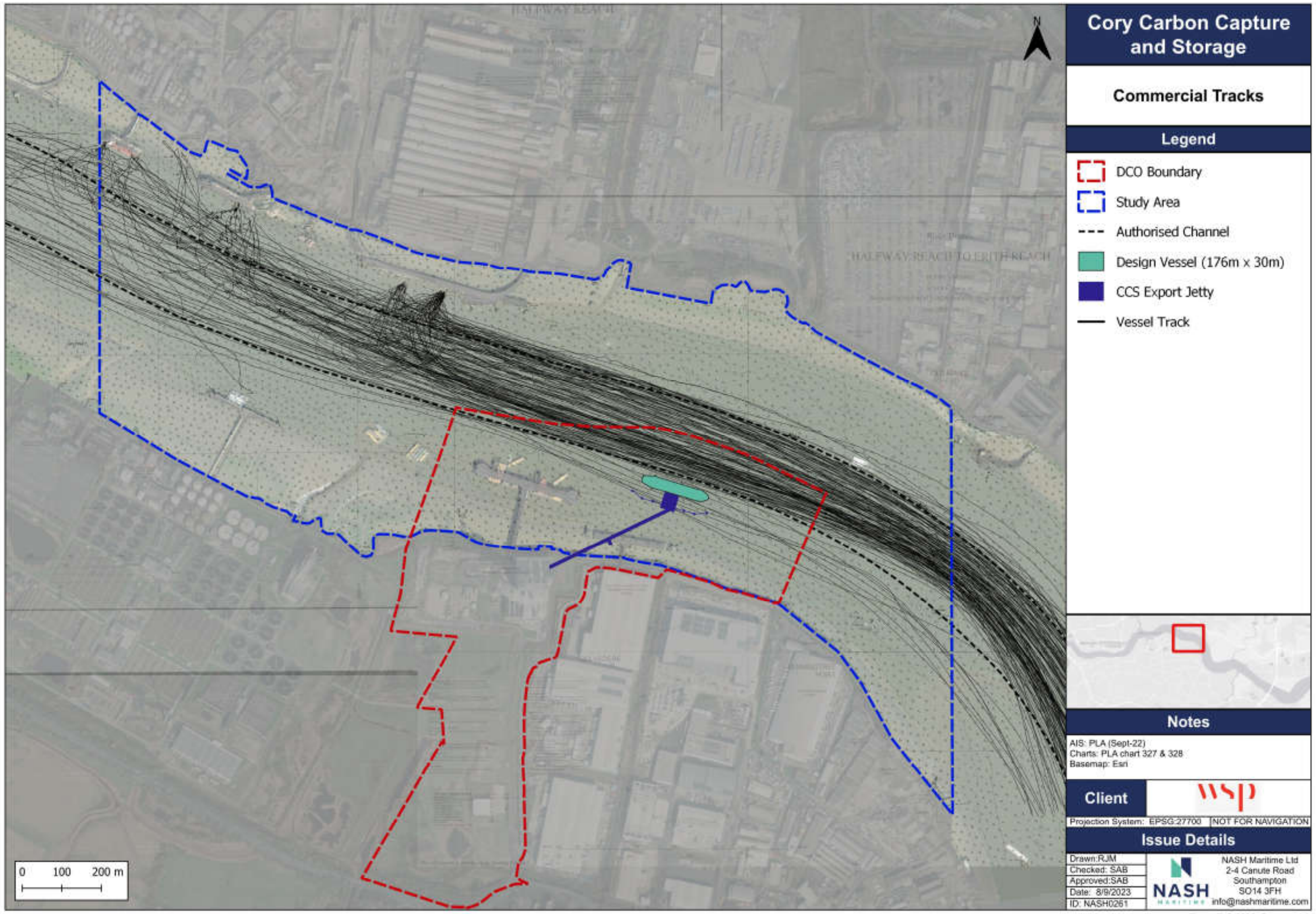


Figure Ref: 0235_Commercial

Tug and Service Tracks

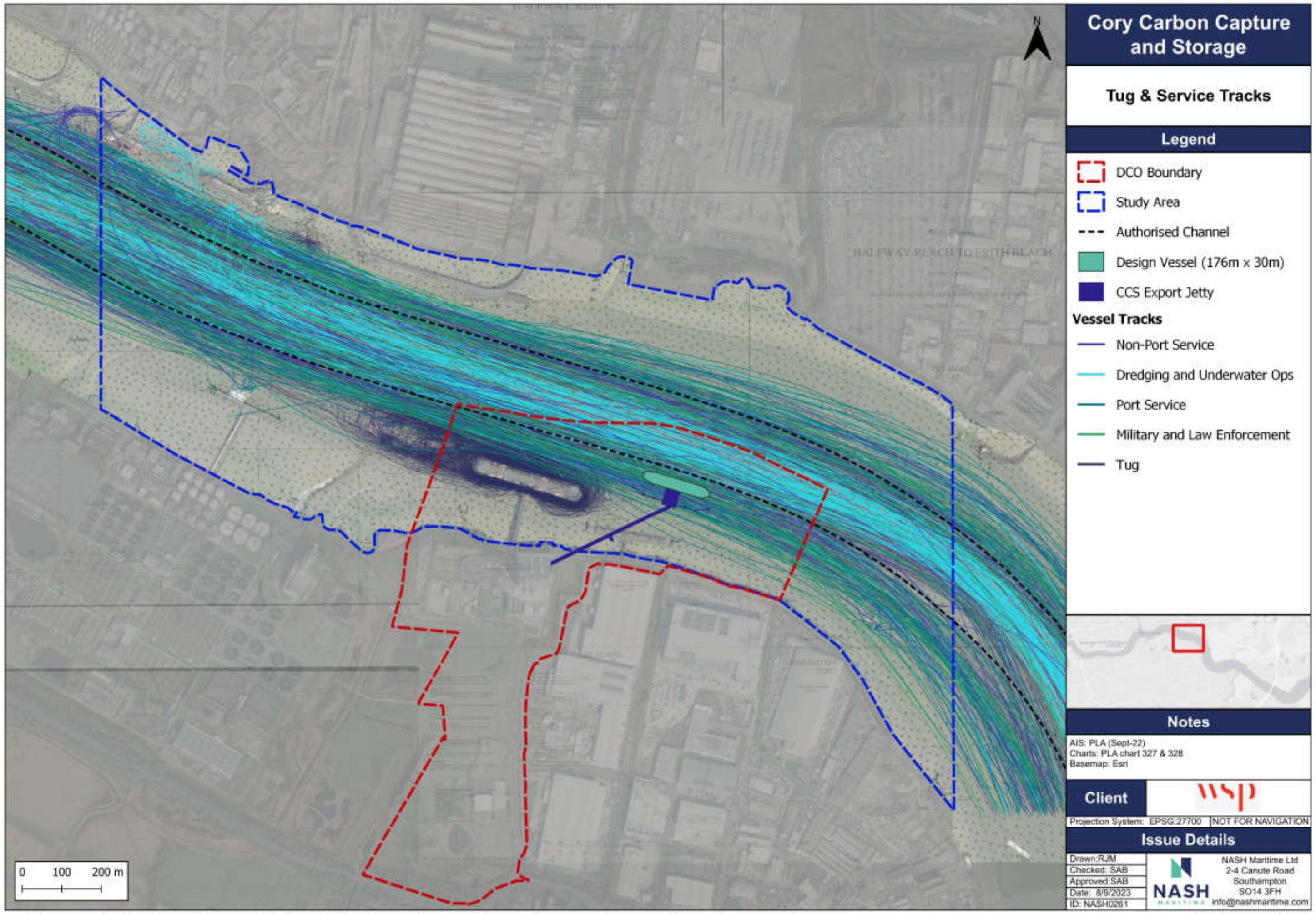


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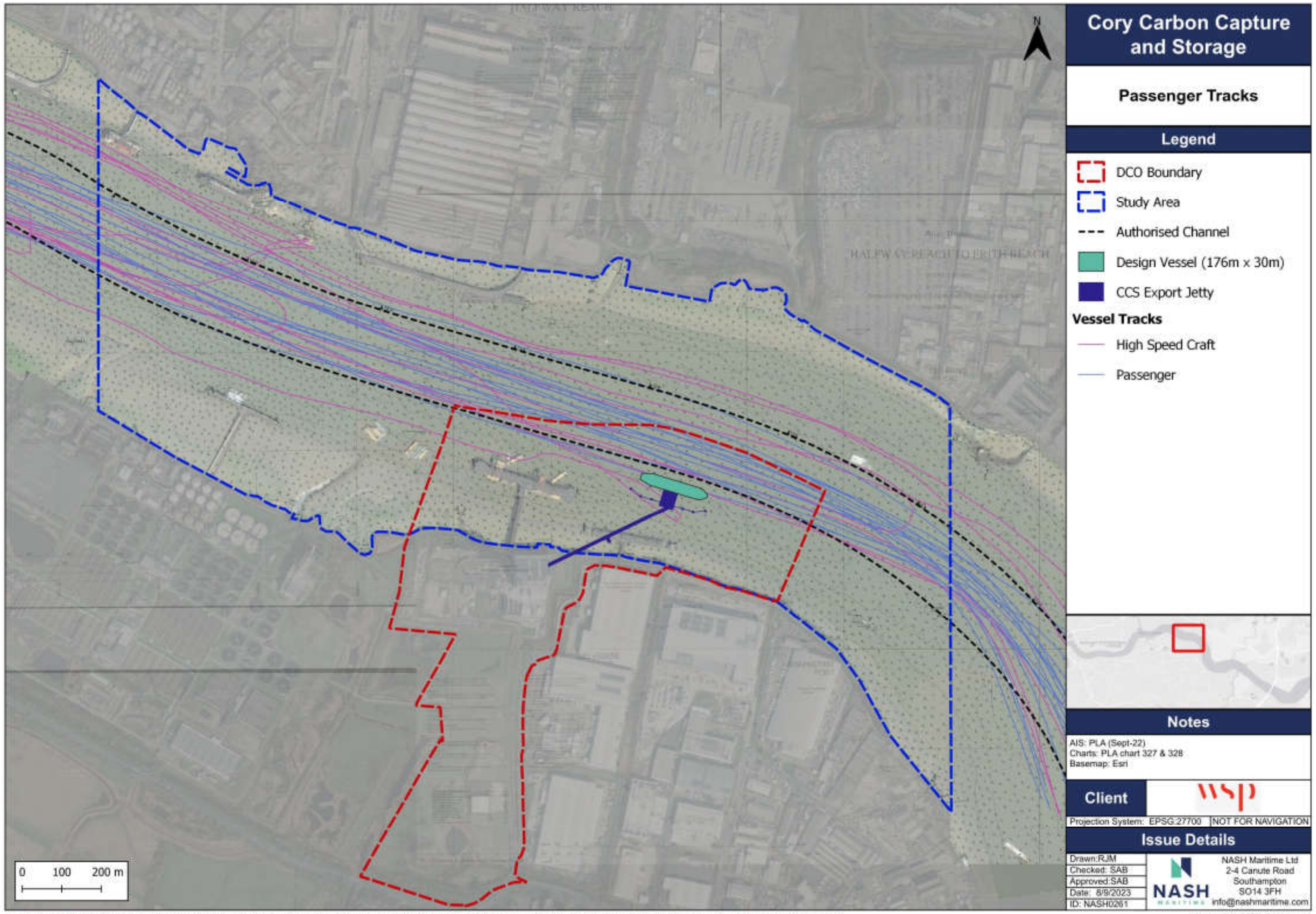
Figure Ref: 0235_TugService

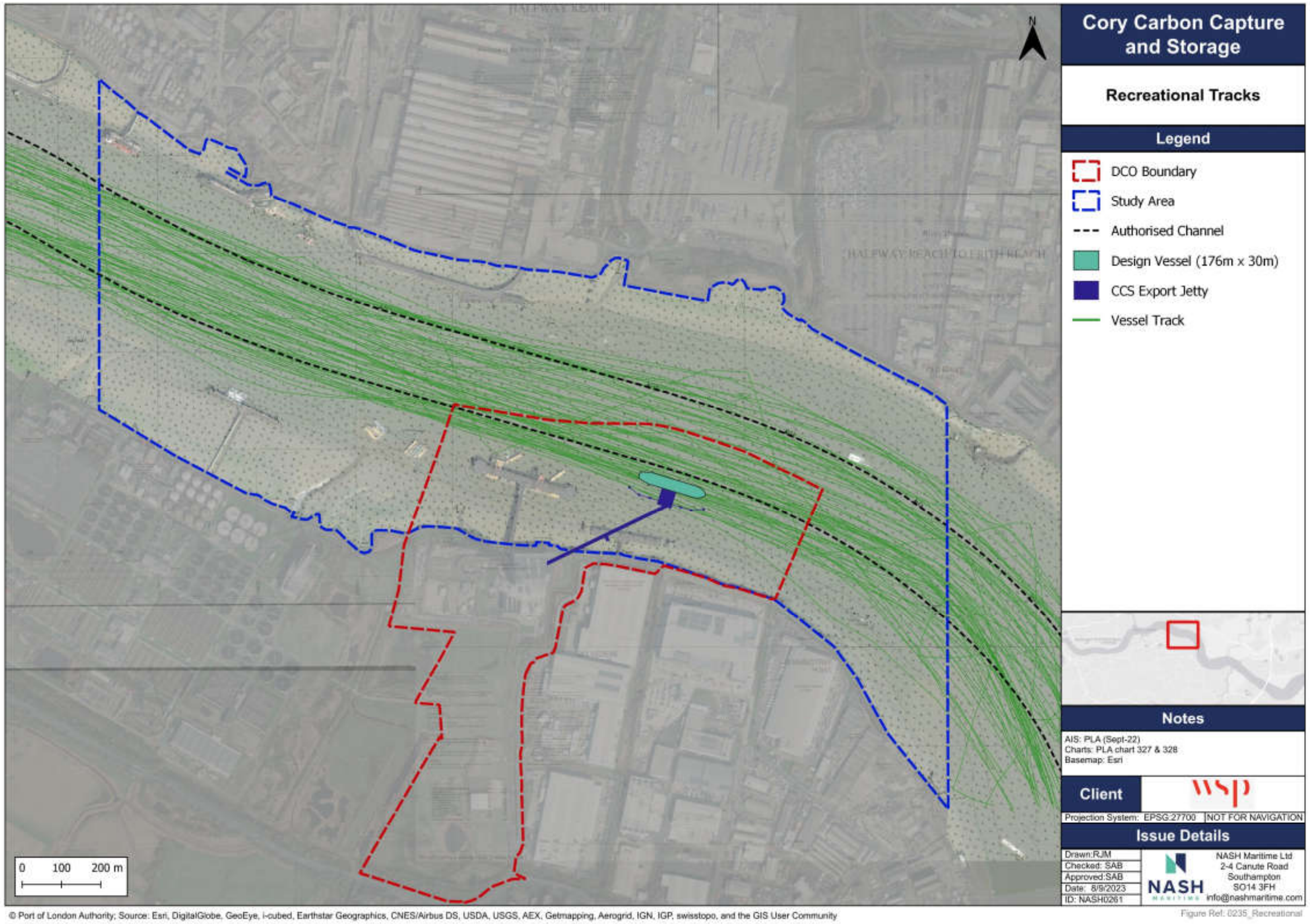
Passenger Tracks



© Port of London Authority; Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

Figure Ref: 0235_Passenger

Recreational Tracks



Marine Operation

Design Vessels

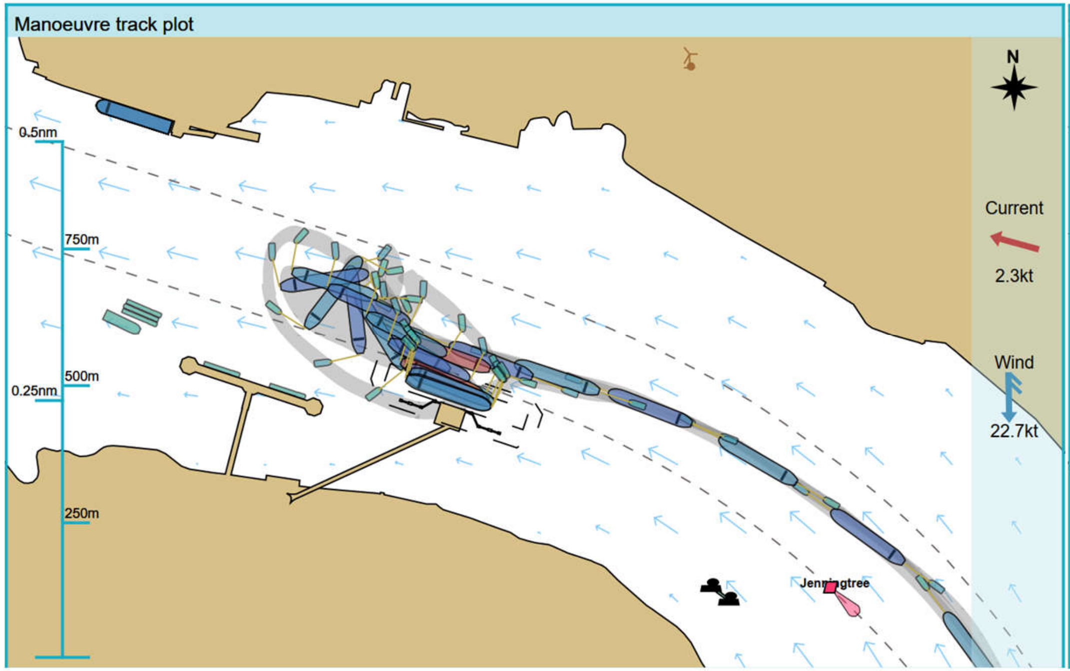
- Several project vessels are currently under consideration, all of which could be utilised to facilitate LCO2 export operations
- The table to the right shows the design specifications and anticipated number of vessel arrivals for design vessels with a capacity of 7500 cbm³ through to15000 cbm³
- The vessel with a capacity of 7500 cbm³ is based on a LCO2 tanker, it is possible that a vessel of this capacity will be utilised during the initial phase. The design vessel size may increase as CO2 production intensifies. Several CO2 storage providers are currently developing design vessel specifications, a vessel of 15000 cbm³ would likely be the largest vessel that may operate from the CCS jetty
- pNRA assumes largest vessel and maximum vessel movements

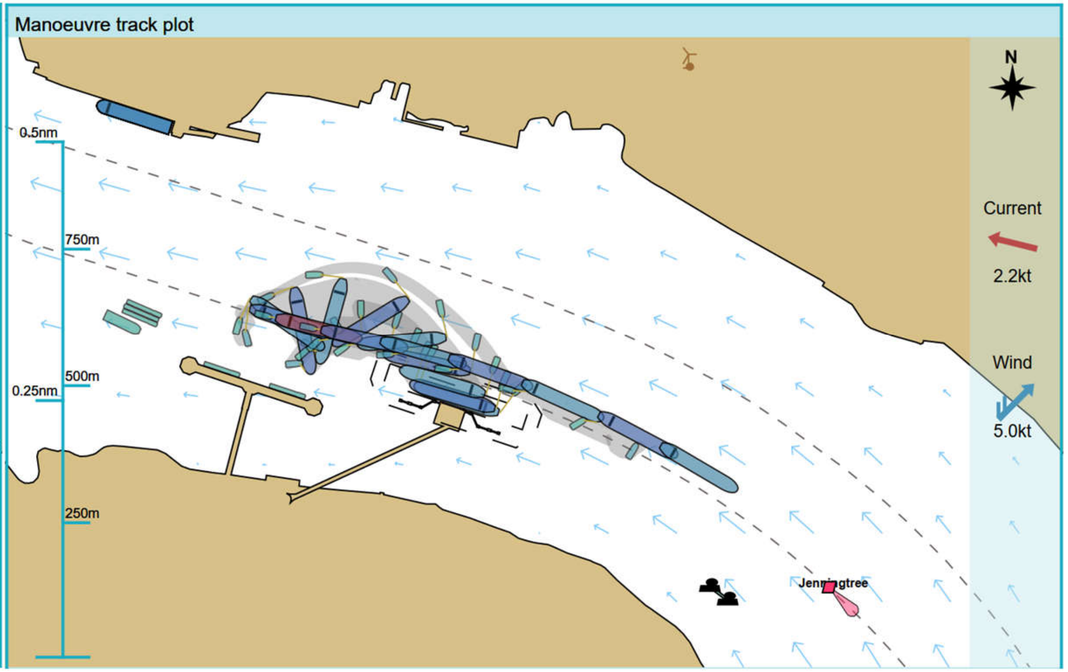
Design Vessel Capacity (cbm³)	Length Overall (m)	Draught (m)	Arrivals per annum (Phase 1 / Phase 2)	Arrivals per week Phase 1 / Phase 2)
7500	130	8.0	112 / 211	2.16 / 4.05
12000	143	9.0	71 / 132	1.35 / 2.53
15000	178	8.4	55 / 106	1.08 / 2.02

Marine Operation

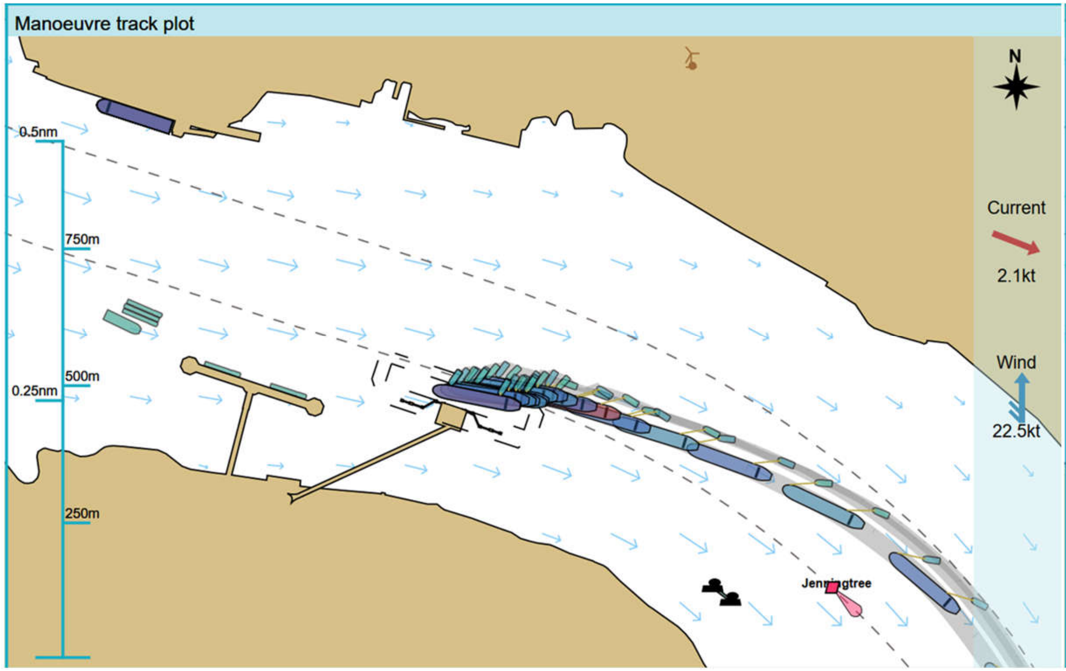
- Simulations were undertaken, using a variety of design vessels, to inform the jetty design and location.
- It is anticipated that tankers will arrive at berth at approximately HW – 1 hour.
- Departure manoeuvres will take place no later the HW + 1.5 hours.

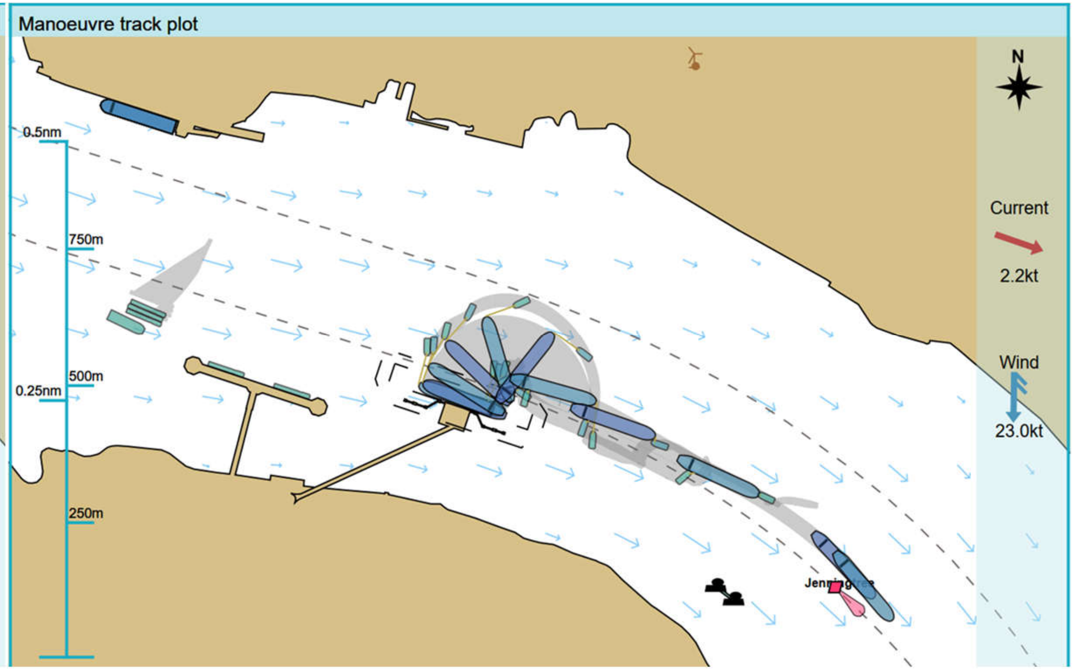
Flood Arrival (left) and Departure (right)



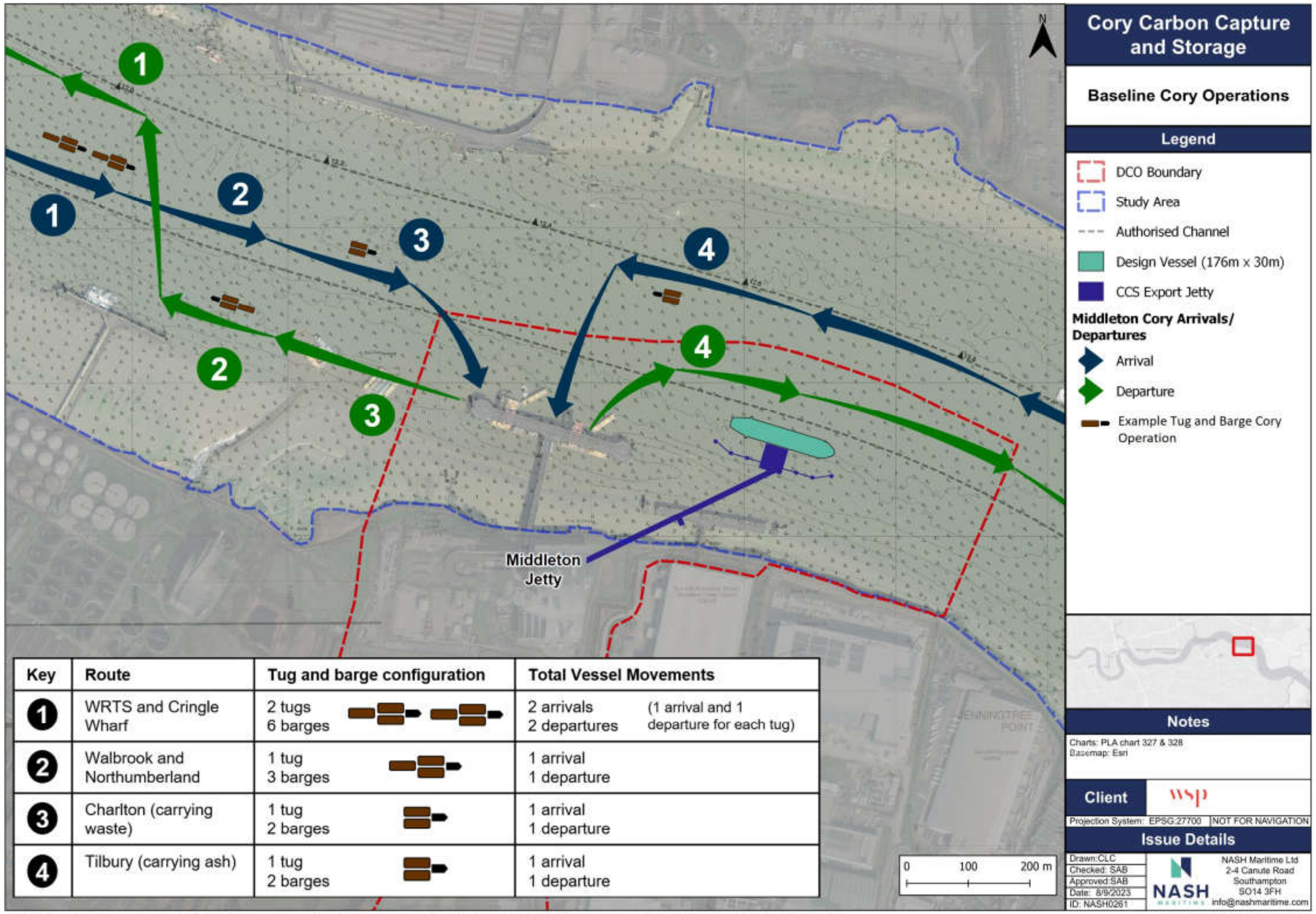


Ebb Arrival (left) and Departure (right)





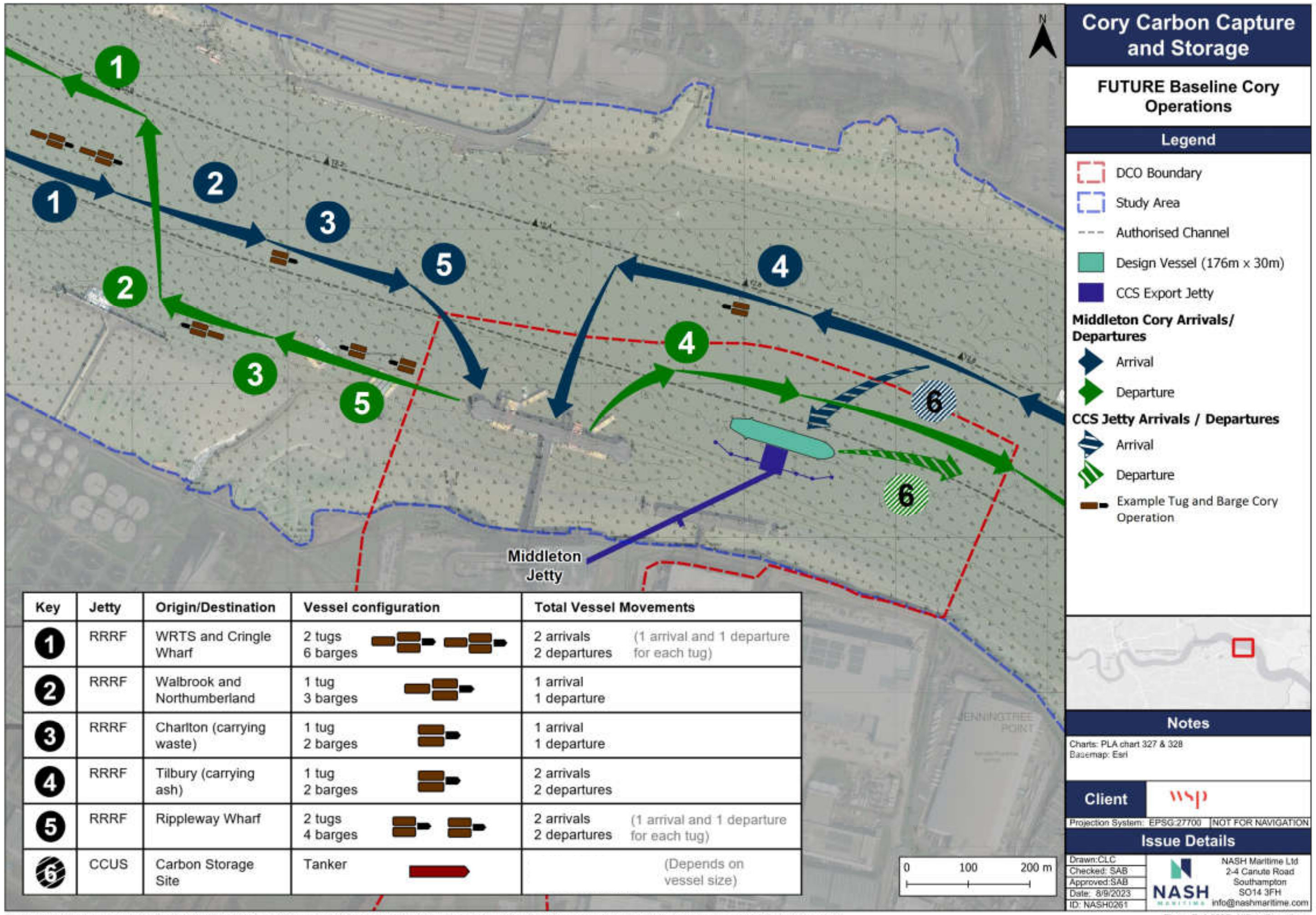
Cory Baseline Operation



Key	Route	Tug and barge configuration	Total Vessel Movements	
1	WRTS and Cringle Wharf	2 tugs 6 barges	2 arrivals 2 departures	(1 arrival and 1 departure for each tug)
2	Walbrook and Northumberland	1 tug 3 barges	1 arrival 1 departure	
3	Charlton (carrying waste)	1 tug 2 barges	1 arrival 1 departure	
4	Tilbury (carrying ash)	1 tug 2 barges	1 arrival 1 departure	

Figure Ref: 0235_AllCoryOperations

Cory Future Baseline Operation

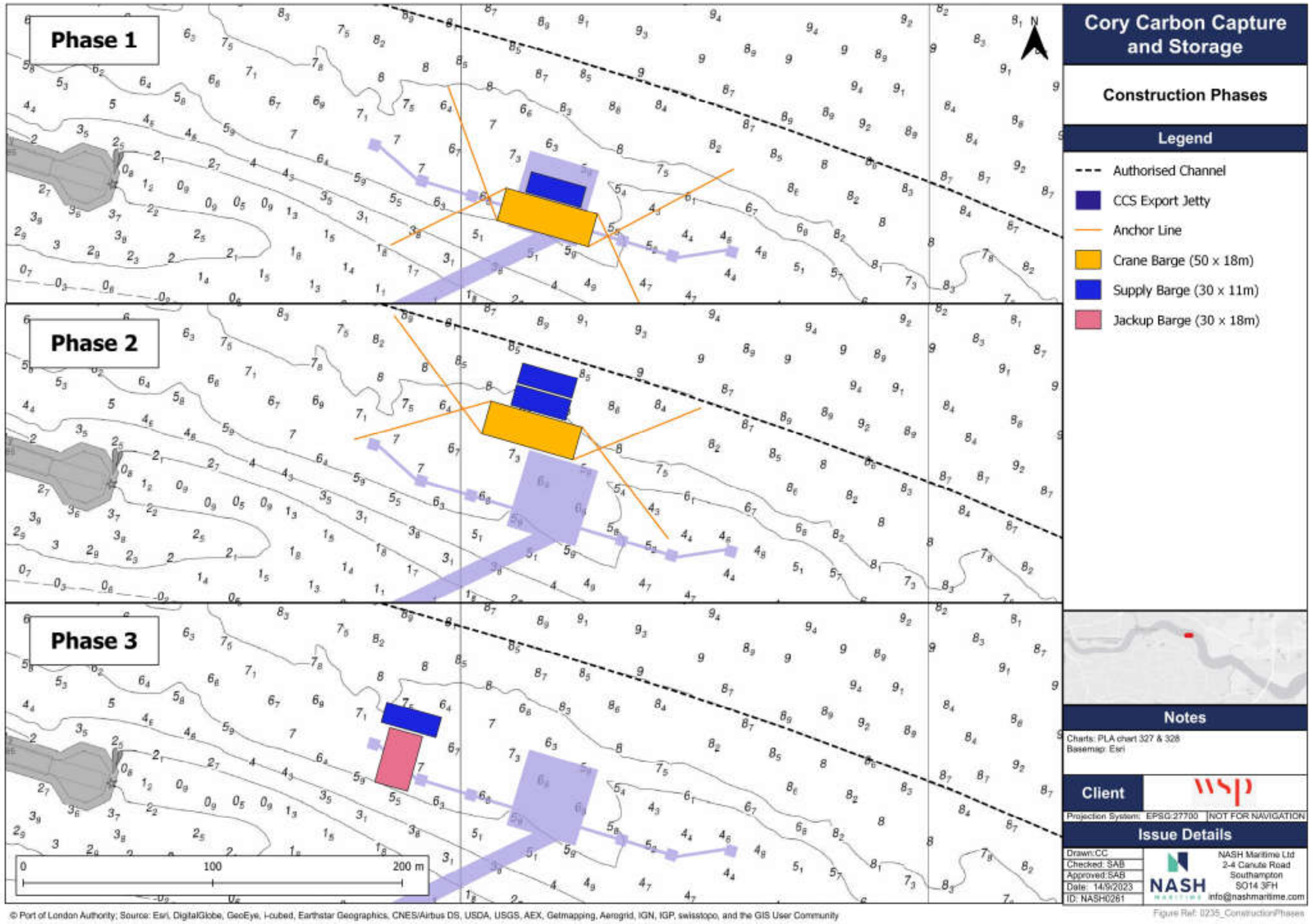


Key	Jetty	Origin/Destination	Vessel configuration	Total Vessel Movements
1	RRRF	WRTS and Cringle Wharf	2 tugs 6 barges	2 arrivals 2 departures (1 arrival and 1 departure for each tug)
2	RRRF	Walbrook and Northumberland	1 tug 3 barges	1 arrival 1 departure
3	RRRF	Charlton (carrying waste)	1 tug 2 barges	1 arrival 1 departure
4	RRRF	Tilbury (carrying ash)	1 tug 2 barges	2 arrivals 2 departures
5	RRRF	Rippleway Wharf	2 tugs 4 barges	2 arrivals 2 departures (1 arrival and 1 departure for each tug)
6	CCUS	Carbon Storage Site	Tanker	(Depends on vessel size)

Construction

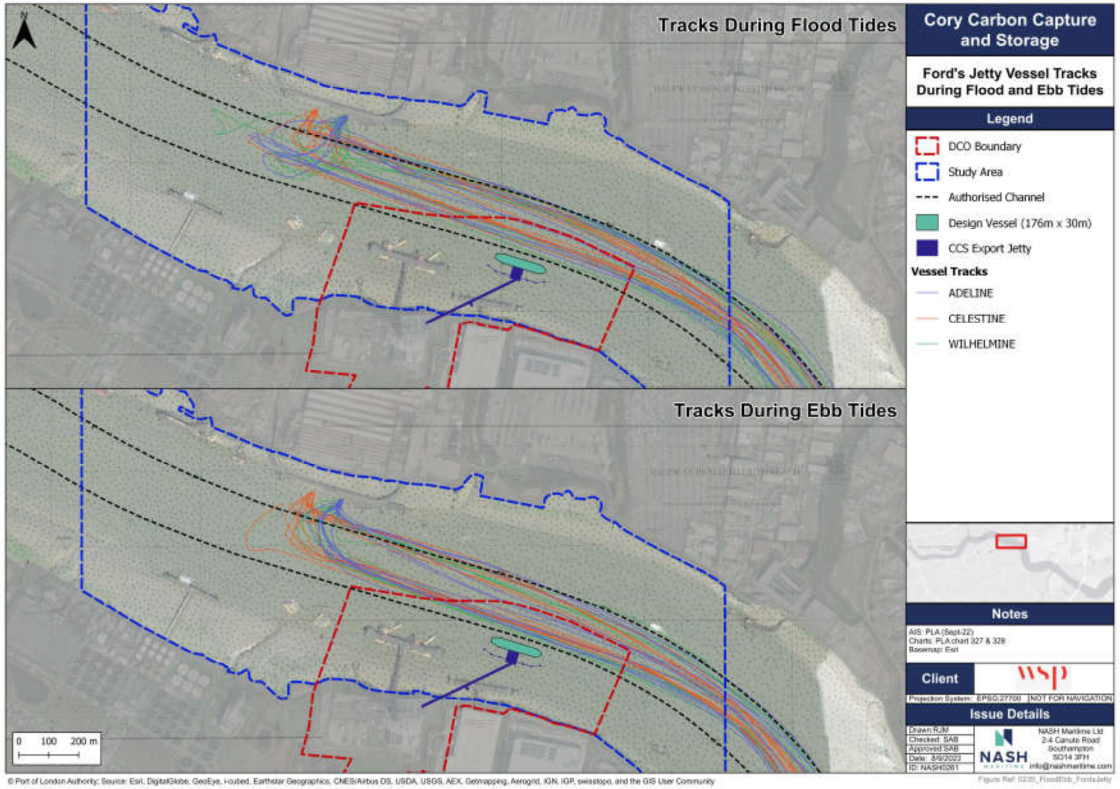
Construction overview

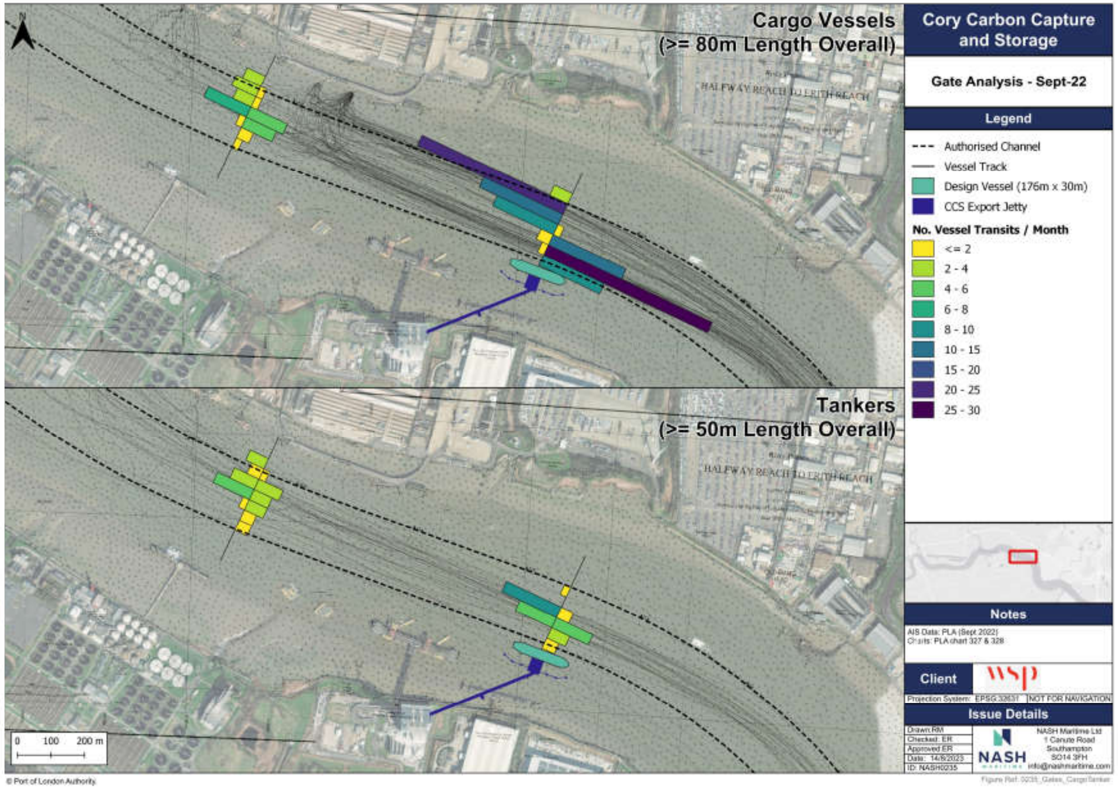
- Construction stages
  - Dredging (likely backhoe)
  - Access trestle
  - Loading platform construction
  - Berthing dolphin construction
  - Mooring dolphin construction
- Construction plant:
  - Crane Barge (50m x 18m)
  - Supply Barge (30 x 11m)
  - Jack-Up-Barge (30m x 18m)



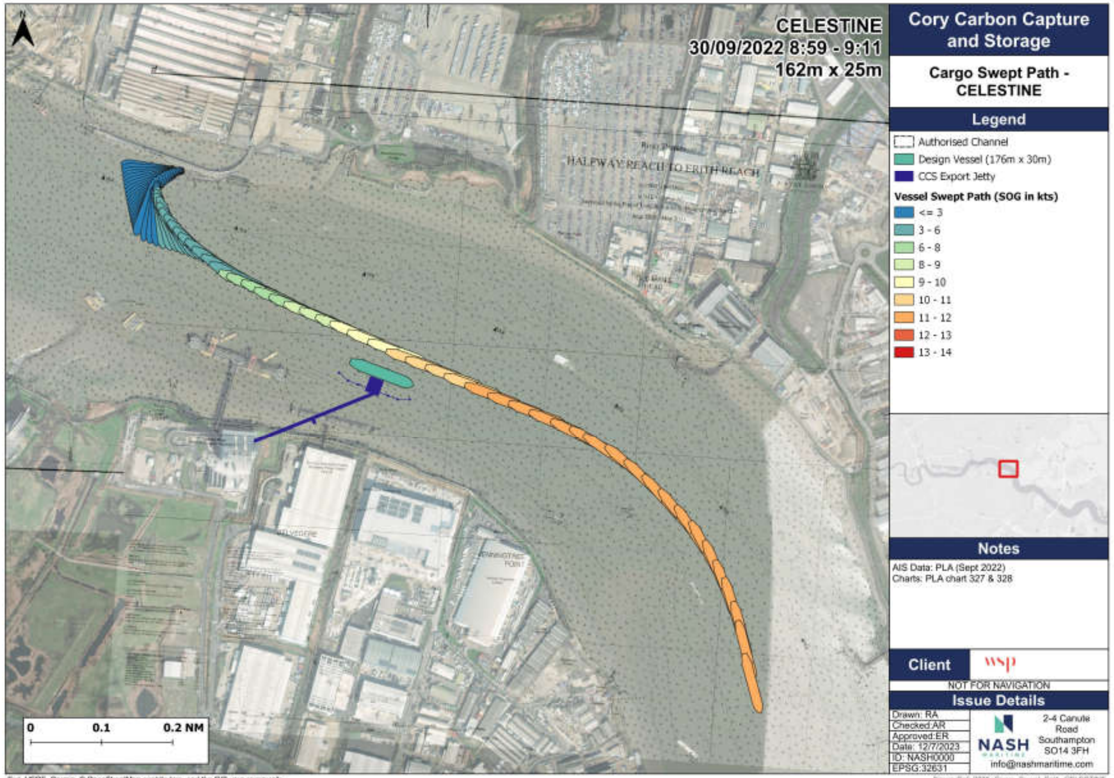
CLdN Operation

CLdN Operation (1)





CLdN Operation (2)



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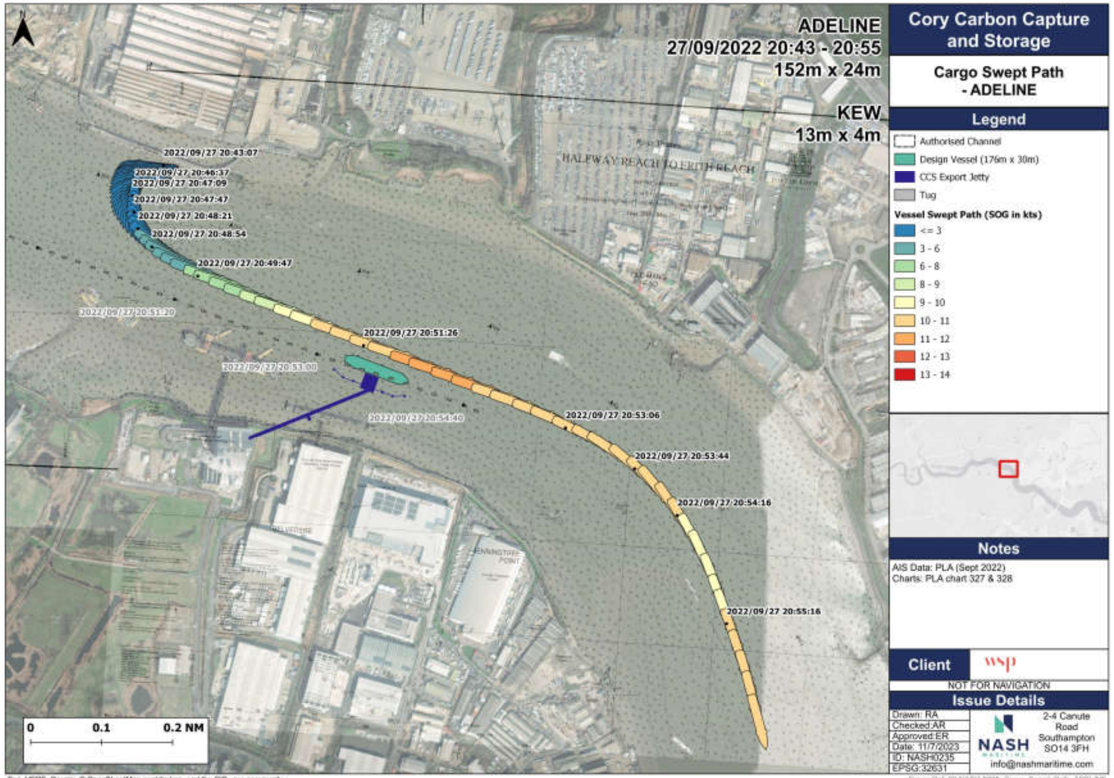

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Identified Hazards

Identified Hazards

	Operation Phase	Construction Phase
Collision	Project vessel in collision with commercial (cargo / tanker) vessel	Construction vessel in collision with commercial (cargo / tanker) vessel
	Project vessel in collision with passenger vessel	Construction vessel in collision with passenger vessel
	Project vessel in collision with recreational vessel	Construction vessel in collision with recreational vessel
	Project vessel in collision with tug and service vessel	Construction vessel in collision with tug and service vessel
	Project vessel in collision with cory tug and barge	Construction vessel in collision with cory tug and barge
	Collision between third party vessels resulting from action taken to avoid project vessel	Collision between third party vessels resulting from action taken to avoid construction vessel
Contact	Project vessel contacts CCS Jetty	Construction vessel contacts CCS Jetty
	Project vessel contacts existing infrastructure (e.g., RRRF jetty)	Construction vessel contacts existing infrastructure (e.g., RRRF jetty)
	Cory tug and barge contacts CCS jetty	Cory tug and barge contacts CCS jetty
	Third party vessel contacts CCS jetty	Third party vessel contacts CCS jetty
Grounding	Project vessel grounds	Construction vessel grounds
	Cory tug and barge grounds	Cory tug and barge grounds
	Third party vessel grounds	Third party vessel grounds
Breakout	Project vessel breakout	Construction vessel breakout
	Cory tug and barge breakout	Cory tug and barge breakout
	Third party vessel breakout	Third party vessel breakout

CCS – PNRA CONSULTATION

Project Title	Cory Carbon Capture and Storage pNRA
Project Number	22_NASH_0235
Meeting subject / purpose	Stakeholder Consultation
Revision	R01-00
Date of meeting	05-Oct-2023
Start time	11:00 BST
Finish time	12:30 BST
Client	Cory / WSP
Location	MS Teams

These minutes should be issued alongside and read in conjunction with PPT ref: 22_NASH_0235-CCS_pNRA_Consultation_CLdN_R01-00 – references to the slide(s) containing pertinent supplementary information are included within the minutes below.

ATTENDEES

Organisation	Attendee	Role	Initial
CLdN	Matthew Booth	Principal Operations Manager	MB
NASH Maritime	Sam Anderson-Brown	Principal Consultant	SAB
NASH Maritime	Clarie Conning	Maritime Consultant	CC
NASH Maritime	Nigel Bassett	Associate Principal Consultant	NB
WSP	Jonathan Pierre	Technical Director (Maritime)	JP
WSP	Jo Evans	Technical Director (Maritime)	JE

NOTES OF MEETING

1	**Introductions**	**Action**
1.1	SAB welcomed all to the meeting and brief introductions were held.	
2	**Agenda**	
2.1	SAB outlined the agenda for the meeting (see slide 2)	
3	**Project Overview**	
3.1	SAB gave an overview of the project and explained the context for the consultation meeting, (see slide 3)	
4	**Consultation Objectives**	
4.1	SAB presented an overview of the consultation meeting objectives, (see slide 4 for further detail).	
5	**CCS Jetty Location and Preliminary Design (slides 5 to 7)**	

5.1	SAB presented an overview of the current proposed jetty location. MB asked for clarification as to the NRA study area, SAB explained that the study area was wider than the DCO area (NRA study area shown by blue broken line in plot on slide 6).	
6	**Navigational Environment (slides 8 to 13)**	
6.1	SAB presented a series of plots derived from Sept 2022 Thames AIS data and asked MB to consider whether the plots showed a realistic overview of day to day vessel movements within the Study Area. MB explained that the plots looked to be representative of his understanding of vessel movements in the Study Area although MB noted that being relatively new in to post he has not had the opportunity to visit site.	
7	**Marine Operation (slides 14 to 19)**	
7.1	SAB presented an overview of the marine operation (see slides 14 to 19), this included: • A summary of potential design vessels and associated movement scenarios; • Vessel swept path plots showing exemplar tanker arrival and departure manoeuvres on an ebb and flood tide; • A summary of future vessel movements associated with the Middleton Jetty and CCS Jetty.	
7.2	MB asked if two tugs were utilised to assist larger vessels during simulated berthing / unberthing operations. NB explained that when two tugs were used for the larger 1500cbm^3 vessel but not for the smaller 7500cbm^3 vessel.	
8	Construction	
8.1	SAB presented a high level overview of the construction sequence and approximate construction works area, (see slide 21). MB had no specific comments.	
9	CLdN Operation (slides 23-25)	
9.1	SAB presented plots showing the following: • Ebb and flood tide arrivals at Ford's Jetty; • Gate analysis of vessels subject to pilotage within the study area; • Sweptpaths of CLdN vessels departing Ford's Jetty. MB confirmed that CLdN service is timetabled and not subject to tidal restrictions. MB commented that he felt CLdN vessels navigated to the south of the authorised channel on an outbound transit because there was the available navigable width to do so. MB was not aware of a specific operational issue / set of circumstances that would require the vessels to navigate in such a manner. MB stated he would need to consult with CLdN Captains before making any substantial comment on this.	MBto consult with CLdN Captains in relation to outbound transits.
9.2	SAB confirmed it would be good to understand the Captains views on a number of issues, as summarised below: • It was noted that on departure CLdN vessels swing off the berth and then utilise the southern extent of the authorised channel. SAB explained that the project is keen to understand if there are operational limitations that mean vessels are restricted to manoeuvring in this manner. SAB noted that the current assumption is that there are no particular restrictions and that the Captains are simply utilising the available navigable width.	

	• SAB explained that should the jetty be installed it is felt that (given the ample navigable width available in this location) CLdN vessels would be able to navigate further north, thus keeping clear of the jetty and tanker moored alongside. SAB noted it would be good to understand the Captains views on this. • Given the proximity of the moored tanker vessel to the authorised channel, the project would like to understand if the Captains have concerns regarding draw off. Would it be possible to reduce speed when passing the proposed jetty and to navigate far enough to the north to mitigate any draw off concerns? MB agreed that he would put these specific questions to CLdN Captains.	
10	Identified Hazards	
10.1	SAB presented a list of identified hazards, (see slide 27). MB felt these wee appropriate.	
10.1	MB made the following closing comments: • MB asked if there were any historic incidents involving the Ford's Jetty operation. NB responded that he believed there had been come incidents of Ro-Ro vessels contacting the Belvedere Power Station Jetty. JE and SAB confirmed they had heard of two anecdotal incidents. • MB stated that his gut feel was the jetty was too close to the authorised channel but that he would consult with the CLdN Captains before making further comment. • MB confirmed he would provide operational parameters for Ford's Jetty.	

Appendix F
Email Correspondence with CLdN

Sam Anderson-Brown

From: [redacted]
Sent: 08 October 2023 19:34
To: [redacted]
Subject: Feedback RE: Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation

Dear [redacted]

Pls find underneath initial feedback in green re CCS Jetty;

You kindly agreed to discuss the content of the slides with some of CLdN Captains, we are particularly keen to get their perspective on the following:

- **We note from AIS analysis that on departure CLdN vessels swing off the berth and then utilise the southern extent of the authorised channel. We are keen to understand if there are operational limitations that mean vessels are restricted to manoeuvring in this manner. Our current assumption is that there are no particular restrictions and that the Captains are simply utilising the available navigable width.**

Due to the size of CLdN vessels calling at Dagenham (up to 165m) in combination with the limited size of the authorised channel (180m), departing vessels on ebb and flood tide require full channel width in order to complete manoeuvres safely.
Provided graphics, to which reference is made, are a representation of the vessels AIS ground tracks (conning position). No clear picture is given on the swept path during manoeuvring/sailing.
Swept path, drift at various speed tide and wind conditions in relation to the proposed CCCS jetty to be established by simulation or real live recordings.

- **Should the jetty be installed we believe (given the ample navigable width available in this location) that CLdN vessels would be able to navigate further north, thus keeping clear of the jetty and tanker moored alongside. I'm keen to understand if this is a view shared by CLdN Captains.**

CLdN vessels tend to sail as close as possible to the southern edge of the fairway when reducing speed compensating for drift due to wind and tide.
E.g. arrival on a following tide in combination with sw-ly wind results in a considerable drift (swept path) towards northern side of the fairway requiring vessels to aim for the southern edge. Likewise, on departure (indicated on CLdN 1/2), CLdN vessels sail near the southern edge in order to round safely Jenningtree point.
To be established by all stakeholders what a safe practical distance from the new Jetty+vessel is to be considered.

- **Finally, given the proximity of the moored tanker vessel to the authorised channel, we would like to understand if the Captains have concerns regarding draw off. Would it be possible to reduce speed when passing the proposed jetty and to navigate far enough to the north to mitigate any draw off concerns?**

The position of the proposed jetty does not allow for sufficient

At Jenningtree point, due to direction of tidal current, vessels experience a strong offset to the northern edge of the fairway. (very) Slow speed with sw-ly wind increases the danger of grounding on the opposite side.
Risk regarding draw off to be established in conjunction with safe passing distance (safe zone).

- ***Marine Operation;*** ***berthing HW-1 hour and departing not later than HW +1.5 hours.***

Due to the combination of the proposed size of Tankers (176m x 30m), CLdN vessels and fairway limitations, vessels require a clear run (one way traffic) in and out from Crayfordness up to the berth and vice versa.
How will this be established ? Where can vessels pass each other safely (Long reach?).
How/where can a vessel wait on a following tide when another vessel is departing or arriving at the berth ?
24 h Stand by tug available in this area ?

<u>Conclusion ;</u>

- ***Full width of the fairway to be available without restriction.***
- ***Safe zone to be established/agreed around berthed tanker not extending into the fairway.***
- ***Procedures to be established/agreed for clear run berth-Crayfordness/Crayfordness-berth.***
- ***Barges and small craft being able to sail outside authorized channel required to do so or give way.***
- ***Simulation to be done testing above with stakeholders in various wind and tidal conditions.***

Best regards,

[redacted]

(For urgent communications requiring immediate attention, plse contact by voice call or VSAT)

From: [redacted]
Sent: Friday, 6 October, 2023 11:03
To: [redacted]
Subject: Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation
Importance: High

Good morning Captains

Please see attached presentation and questions raised below.

I was at a project meeting yesterday and raised several points in respect to speed and proximity we currently pass the proposed site but now require your own input as PEC holders.

Consider also construction phase and any limitations of slow speed passing / tug use etc…

The presentation also talks of an increase in barge traffic to the Cory jetty and the fact that in future small craft will need to navigate within the main channel to pass around the jetty.

The request for feedback is tight so if you could consider it and get something to me over the weekend please. The project teams main questions are as per the email below, if you could address them all separately and add any points of your own.

It might be I visit one of the vessels next week and we involve you in the discussion via Teams with the project team.

Regards
[redacted]

[redacted]
[redacted]er

CLdN RoRo Agencies Ltd,
Long Reach House, London Road, Purfleet Essex, RM19 1PD
United Kingdom
[redacted]

[redacted]

From:
Sent: Thursday, October 5, 2023 5:06 PM
To: BOOTH, Matthew [redacted]
Cc:
Subject: RE: Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation

Hi Matthew,

Thanks again for your time this morning, it was a really useful discussion. As promised, please find the slides we went through attached.

You kindly agreed to discuss the content of the slides with some of CLdN Captains, we are particularly keen to get their perspective on the following:

- We note from AIS analysis that on departure CLdN vessels swing off the berth and then utilise the southern extent of the authorised channel. We are keen to understand if there are operational limitations that mean vessels are restricted to manoeuvring in this manner. Our current assumption is that there are no particular restrictions and that the Captains are simply utilising the available navigable width.
- Should the jetty be installed we believe (given the ample navigable width available in this location) that CLdN vessels would be able to navigate further north, thus keeping clear of the jetty and tanker moored alongside. I'm keen to understand if this is a view shared by CLdN Captains.
- Finally, given the proximity of the moored tanker vessel to the authorised channel, we would like to understand if the Captains have concerns regarding draw off. Would it be possible to reduce speed when passing the proposed jetty and to navigate far enough to the north to mitigate any draw off concerns?

As mentioned we have a rather tight deadline for providing feedback so if your able to come back to us next week with any feedback that would be much appreciated.

Nigel and I can be available for a call next week if required.

Kind regards,

Sam Anderson-Brown

From: [redacted]
Sent: 09 October 2023 07:20
To: [redacted]
Subject: RE: Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation

Good morning.

For sure this new berth will make our life much more complicate in future.
Please find below some of my concerns:

- First of all - it is a position of new jetty. It is almost at the S edge of main fairway. All traffic from Middleton jetty and all small crafts traffic which before use S edge of Halfway Reach will now goes to the main fairway impeding safe passage of sea going vessels.
- Of cause manoeuvring at Ford's will be revised with presence of new jetty. With S-ly and SW-ly winds usually we do approach from the middle of fairway, often from opposite side due to high drift at slow speed. If vessel will be alongside at new jetty use of southern part of fairway becomes more dangerous. During strong N-ly, NE-ly winds on departure vessel swings sometimes quite close to Middleton jetty. New jetty will be much closer to fairway than Middleton. And space for manoeuvring will be significantly reduced. This is just a few but not the all possible scenarios when something can goes wrong.
- Schedule concerns. Each of three vessels doing 3-4 arrivals/departures per week. Understand that at new jetty we can expect 2 ships per week? In case of meeting in Area 4 when CLdN vessel and LCO2 tanker both inbound it will be not possible to overtake that tanker and follow ship's schedule. Arrival/departure LCO2 tanker will dictate arrival/departure time of CLdN vessels at Ford's.
- For sure with vessel alongside at new jetty in doubtful weather condition we will require tug/tugs more often both for arrivals and departures.

Kind regards,
[redacted]

(For urgent communications requiring immediate attention, please contact by voice call or SAT-C.)

From: B[redacted]
Sent: 06 October 2023 11:03
To: [redacted]
Subject: Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation
Importance: High

Good morning Captains

Please see attached presentation and questions raised below.

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Consider also construction phase and any limitations of slow speed passing / tug use etc…

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It might be I visit one of the vessels next week and we involve you in the discussion via Teams with the project team.

[redacted]

[redacted]

CLdN

[redacted]

[redacted]

From:
Sent: Thursday, October 5, 2023 5:06 PM
To: BOOTH, Matthew [redacted]
Cc:
Subject: RE: Navigation Risk Assessment (NRA) for CCS Jetty and Marine Export Operation

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You kindly agreed to discuss the content of the slides with some of CLdN Captains, we are particularly keen to get their perspective on the following:

- We note from AIS analysis that on departure CLdN vessels swing off the berth and then utilise the southern extent of the authorised channel. We are keen to understand if there are operational limitations that mean vessels are restricted to manoeuvring in this manner. Our current assumption is that there are no particular restrictions and that the Captains are simply utilising the available navigable width.
- Should the jetty be installed we believe (given the ample navigable width available in this location) that CLdN vessels would be able to navigate further north, thus keeping clear of the jetty and tanker moored alongside. I'm keen to understand if this is a view shared by CLdN Captains.
- Finally, given the proximity of the moored tanker vessel to the authorised channel, we would like to understand if the Captains have concerns regarding draw off. Would it be possible to reduce speed when passing the proposed jetty and to navigate far enough to the north to mitigate any draw off concerns?

As mentioned we have a rather tight deadline for providing feedback so if your able to come back to us next week with any feedback that would be much appreciated.

Nigel and I can be available for a call next week if required.

Kind regards,

Sam Anderson-Brown

From: [redacted]
Sent: 09 October 2023 07:52
To: [redacted]
Subject: NRA for CCS Jetty and Marine Export Operation

Good morning Matthew,

My apologies for the late and concise reply but could not find the time over the weekend.

First of all, I would like to express my thanks for being involved in this NRA consulting process, although a bit late I have to admit. This being said, I remain at your disposal should you wish to discuss this further and/or wish for a more detailed explanation.

Anyway, to answer your questions regarding the reason why we are utilizing the full width of the fairway when departing from Fords the answer is pretty straight forward, the fairway is 185m wide (1 cable) and the distance from Fords jetty to southern hedge of the authorized channel about 290m, with vessels up to 162m in length, that does not leave much room for leeway. Considering the limited manoeuvrability power of the Cobelfret vessels plying this route, we need to use the current and the wind to their maximum extent and to do that, room is needed.

Regarding your second question about the possibility of navigating further north, I am afraid that might be a struggle as the fairway is rather narrow, the depth of water outside the Main fairway pretty shallow and the prevailing winds being usually from a S'ly or SW'ly direction. As long as we can use the full width of the fairway and navigate in the middle, that should not be an issue but could be if an exclusion zone is imposed when vessels are alongside or during the construction phase. Actually, at this stage, that is where my main concern lies ... the construction phase!

Coming to the point of draw off and the need to reduce the speed when passing, in my view, that's not an issue since we are not talking about a transit speed, on arrival, vessels are reducing speed to berth at Fords and on departure, vessels are gradually increasing speed. The CldN vessel's speed in this area should not be a concern.

As said earlier, this feedback is a bit concise but do not hesitate to contact me should you need it.

Best regards,

[redacted]

Appendix G
CLdN Consultation Meeting 2 – PPT Presentation and Meeting Minutes

CCS – PNRA CONSULTATION

Project Title	Cory Carbon Capture and Storage pNRA
Project Number	22_NASH_0235
Meeting subject / purpose	Stakeholder Consultation
Revision	R01-00
Date of meeting	18-Oct-2023
Start time	11:00 BST
Finish time	12:00 BST
Client	Cory / WSP
Location	MS Teams

ATTENDEES

Organisation	Attendee	Role	Initial
CLdN	Capt Matthew Booth	Principal Operations Manager	MB
CLdN	Capt Vincent Veys	CLdN Vessel Captain	VV
NASH Maritime	Sam Anderson-Brown	Principal Consultant	SAB
NASH Maritime	Capt Nigel Bassett	Associate Principal Consultant	NB

NOTES OF MEETING

1	**Introductions**	**Action**
1.1	SAB welcomed all to the meeting and brief introductions were held.	
2	**Purpose**	
2.1	SAB explained that the purpose of the meeting was to discuss written feedback received from CLdN Captains to ensure a full understanding of navigational issues raised.	
3	**Impact of Jetty on Navigable Width**	
3.1	VV made the following comments: - It is crucial that CLdN vessels are able to utilise the full width of the fairway when navigating to and from Ford's Jetty; any encroachment of the project footprint into the fairway as a result of an exclusion zone around the jetty would not be acceptable. - This is because when inbound on a flood tide with a strong south westerly wind CLdN vessels, having rounded Jenningtree bend, must remain close to the southern limit of the fairway to avoid being set to the north, bearing in mind their likely swept path and the fact that they are reducing speed at this time. This is particularly important with the CLdN single propeller vessels given the difficulty of maintaining directional stability on these vessels in a beam wind, when reducing speed. If an exclusion zone is present meaning vessels cannot navigate in this manner, then there would be a risk of setting too far north into shallow water and being too close to the jetty on the approach. Issue is primarily with inbound transits not outbound.	

	- Conflict with tug and barge traffic being pushed north into fairway as a result of jetty position is not an issue as transits past the proposed CCS berth take little time, tug and barges can give way and transits are relatively infrequent. - Jenningtree is not an appropriate location for vessels to pass due to narrow fairway and bend. Movements between CLdN and other vessels are therefore deconflicted in this area, additional tanker movements would be deconflicted in the same way through VTS and ship to ship communications.	
4	**Congestion resulting from CCS tanker operation**	
4.1	VV made the following comments: - Doesn't see congestion as a major issue, CLdN vessels are not tidally restricted and are not operating to a critical timetable. They can therefore hold position if necessary. - Transits by large vessels as far upriver as Jenningtree are relatively infrequent, but apart from the Jenningtree area VV is happy to pass vessels of all sizes anywhere. - CLdN Captains are PEC holders so no demand for pilotage - There are ample opportunities to pass prior to Jenningtree if necessary.	
5	**Draw off resulting for CLdN manoeuvres**	
5.1	VV does not see draw off as a major issue as on arrival, vessels are reducing speed to berth at Ford's and on departure, vessels are gradually increasing speed. The CldN vessel's speed in this area should not be a concern.	
6	**Alternate Design Option**	
6.1	SAB presented an alternate design option that gave an additional 20m clearance between the north extent of the CCS tanker and fairway and asked VV to comment on the design from a navigation risk perspective. VV stated: - The alternate design is clearly preferable as it allows full use of the fairway and allows for a greater margin for error. - Fundamental for CLdN is that ability to navigate within the fairway is not impeded for reasons previously outlined. NB explained that the Projects' view was that there would be no requirement for a cargo related navigational exclusion zone around the berth as Carbon Dioxide is not a flammable cargo and that it is therefore unlikely that there would be any formal restriction to existing navigable width arising from either jetty design.	
6.2	MB and VV confirmed that their view was that detailed simulation work is necessary, when final designs are known, in advance of any acceptance from CLdN.	

Appendix H
GPS Consultation Meeting Minutes – PPT Presentation and Meeting Minutes

Cory Carbon Capture and Storage (CCS) Project

Subject: Preliminary Navigation Risk Assessment | Stakeholder consultation

Client: WSP / Cory

Revision: R01-00

NASH MARITIME

Agenda

- Introductions
- Project overview
- Consultation objectives
- CCS Jetty location
- Navigational environment
- CCS Marine operation
- Construction phase overview
- Identified hazards

Project Overview

- NASH Maritime are undertaking a Navigation Risk Assessment (NRA) for a planned jetty and associated marine operation that together facilitate the export of Liquid Carbon Dioxide (LCO2) from the proposed Carbon Capture and Storage (CCS) facility at Riverside Campus, on the river Thames in London
- Since 2011 Cory has operated an Energy from Waste (EfW) facility known as Riverside 1, situated at Norman Road in Belvedere. In addition to Riverside 1, Cory has permission to construct and operate an additional EfW facility, known as Riverside 2, immediately adjacent to Riverside 1 and due for completion in 2026. The site occupied by the two EfW facilities is known as the Riverside Campus
- Riverside 2 will process up to 655,000 tonnes of waste per annum in addition to the 782,000 tonnes per annum processed by Riverside 1(in 2021). The Riverside Campus will maximise the use of Cory's existing river infrastructure including its operational jetty, tugs and barges, and will necessitate an increase in Cory freight operations on the river Thames
- The Cory Decarbonisation Project will involve the installation of technology to capture a minimum 95% of the emissions from the Riverside Campus. The project intends to use marine shipment to transport LCO2 to an offshore subsea storage site

Consultation Objectives

- The purpose of stakeholder consultation is to inform the NRA and define hazards and appropriate risk control measures to reduce risk associated with the marine aspects of the proposed CCS project. We are therefore keen to hear your views on the following:
  - The identified navigational environment
  - New navigation-related hazards that could emerge during the construction, operation and decommissioning of CCS project (e.g. collision, contact, breakout, grounding)
  - Likelihood and the potential consequence of hazards (i.e. risks) to people, property, business and the environment
  - Views on suitable means to mitigate any identified the risks (e.g. risk controls such as buoyage and markings, procedures, communication)

CCS Jetty Location

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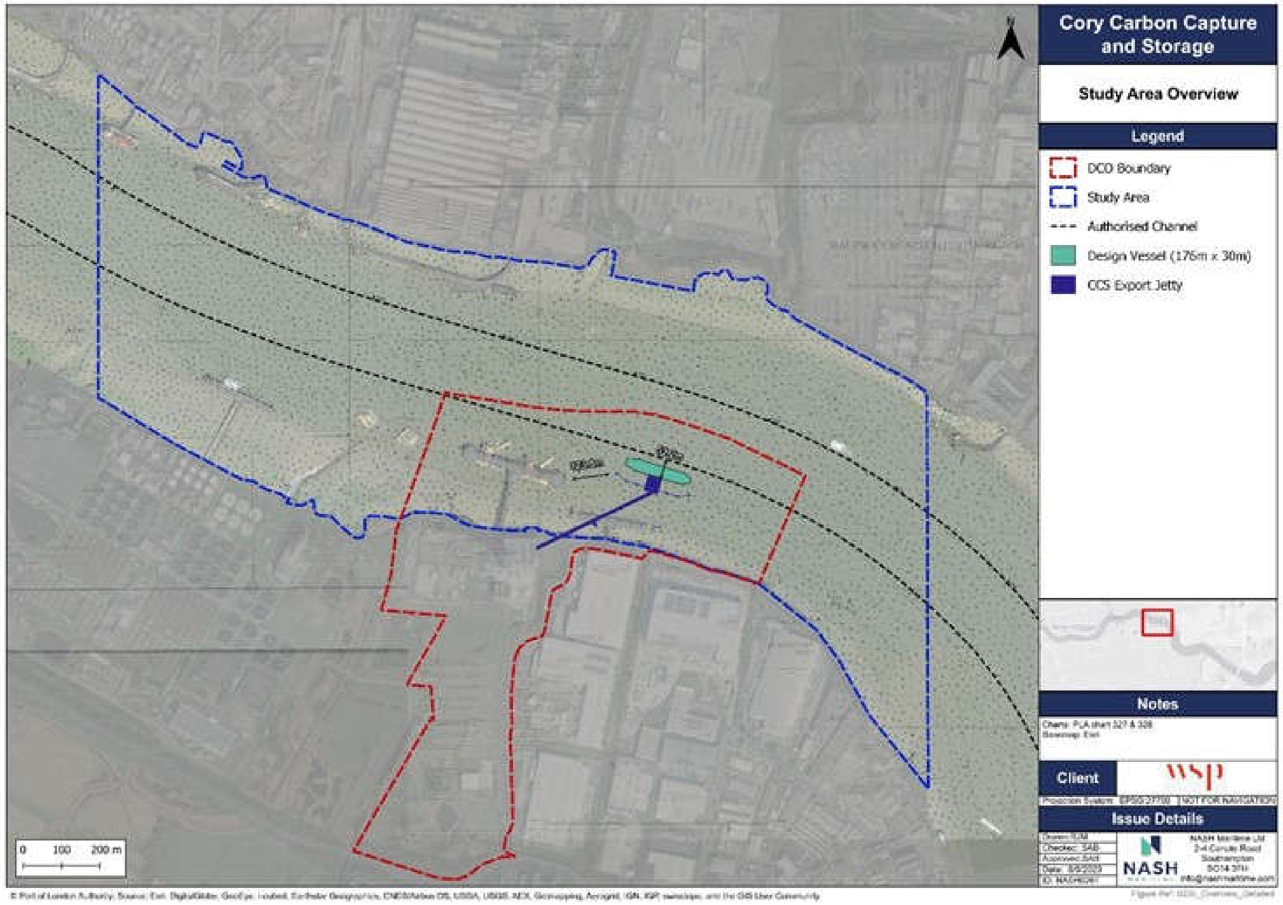
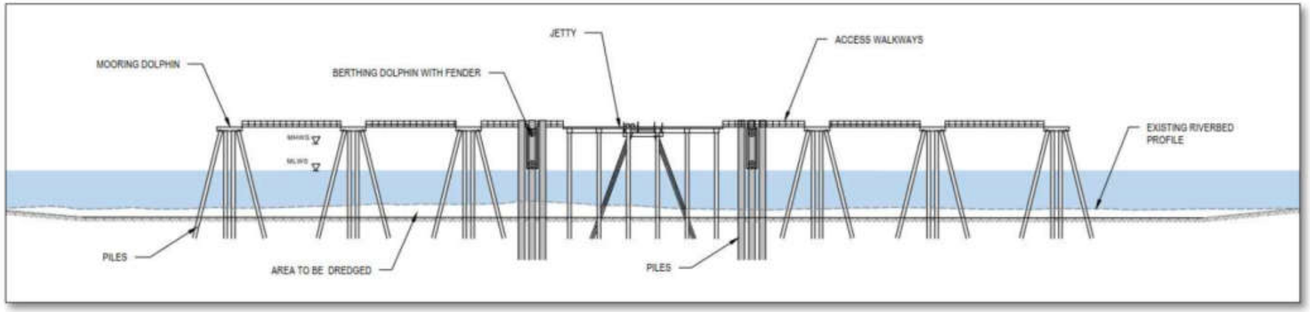
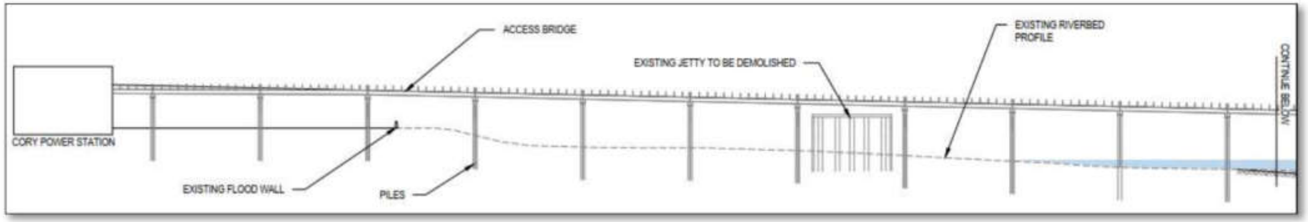
CCS Jetty Location

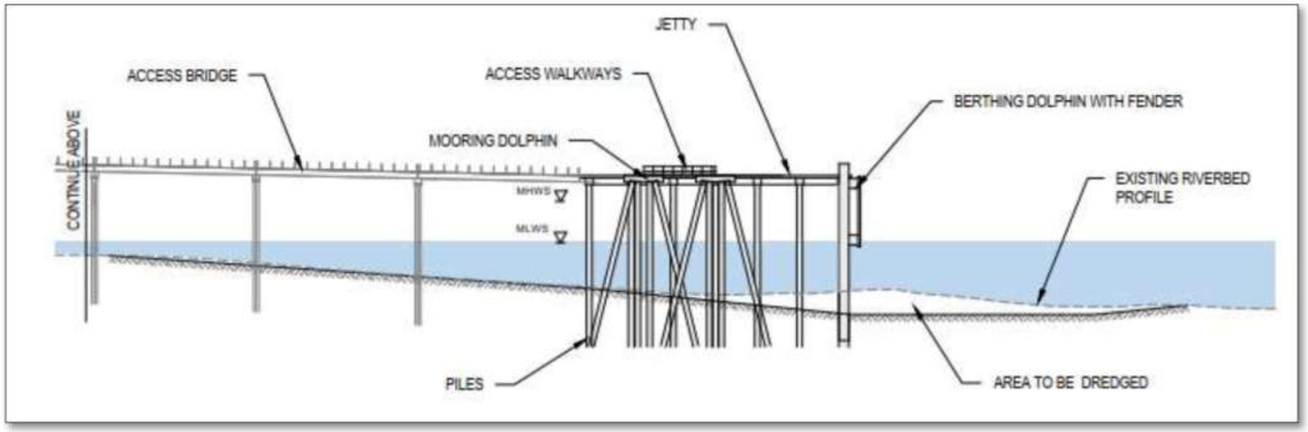
- The CCS jetty will consist of a main loading platform, connected to land by an access trestle
- Dredging of a berthed pocket will be necessary to accommodate LCO2 tankers alongside at all states of tide. The volume of material to be dredged will depend on the design vessel draught, which is yet to be determined, however it is estimated the pocket will need to be dredged to 10.5 m below Chart Datum (CD) alongside the berth to allow berthing at all states of tide.



Preliminary Jetty Design







Navigational Environment

Vessel Traffic Overview

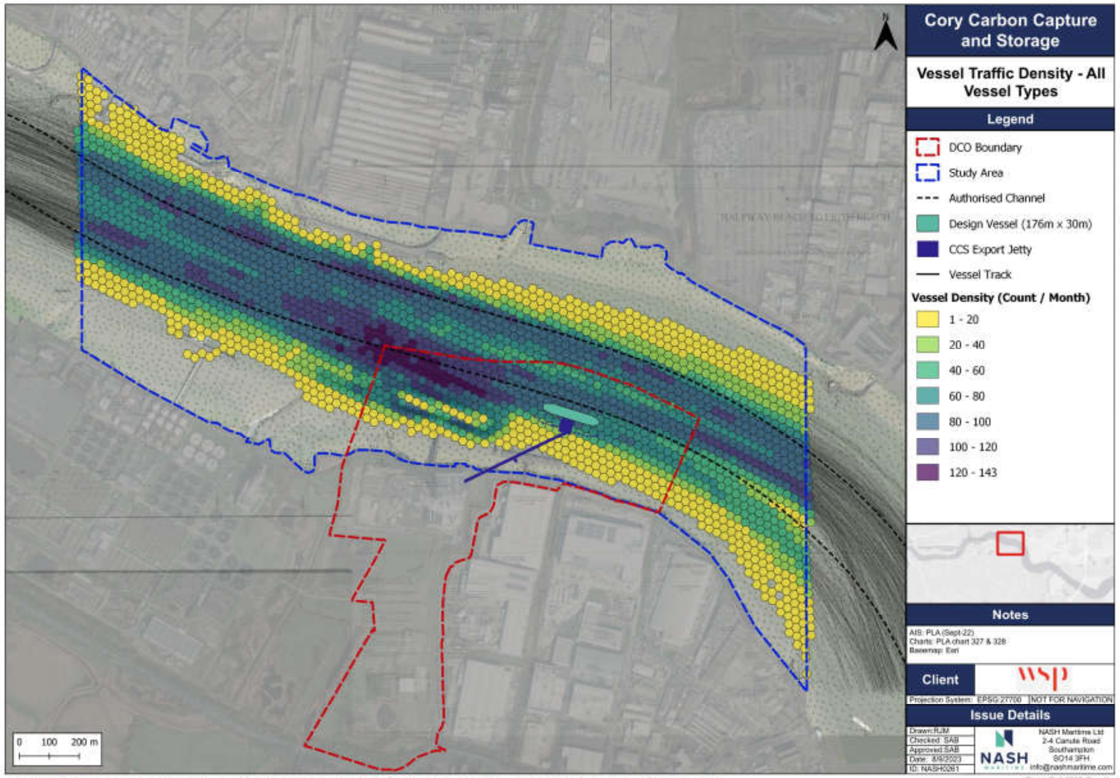


Figure Ref: 0235_Density

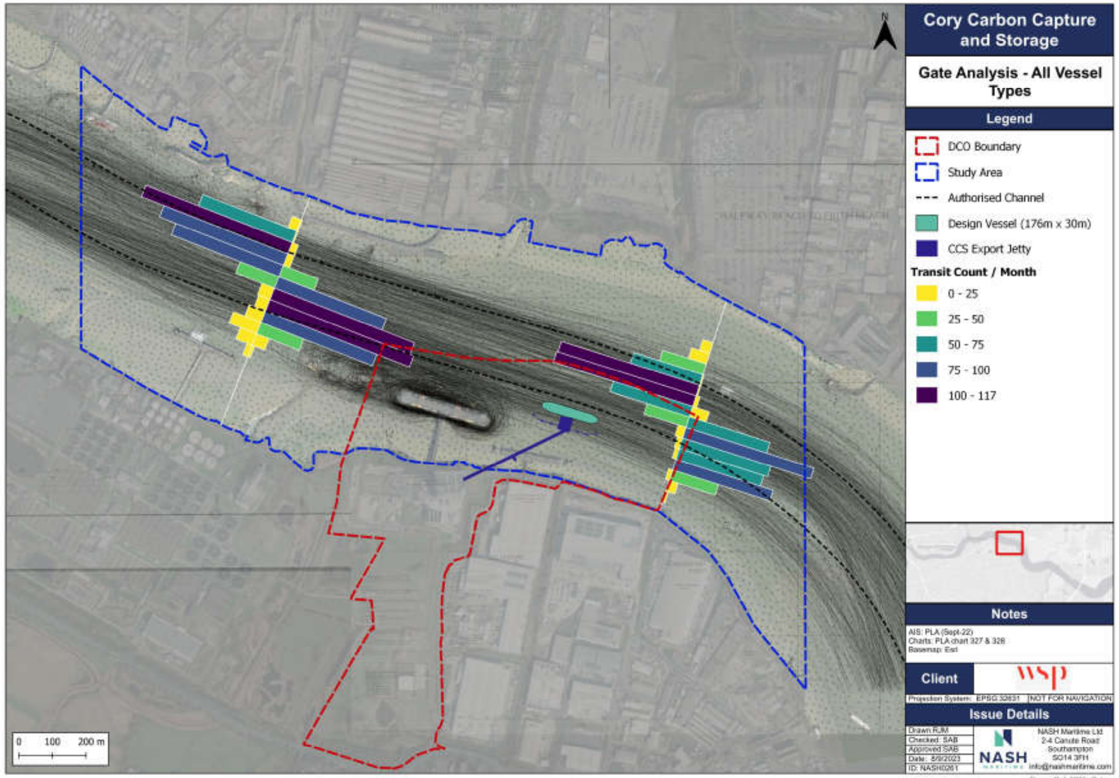
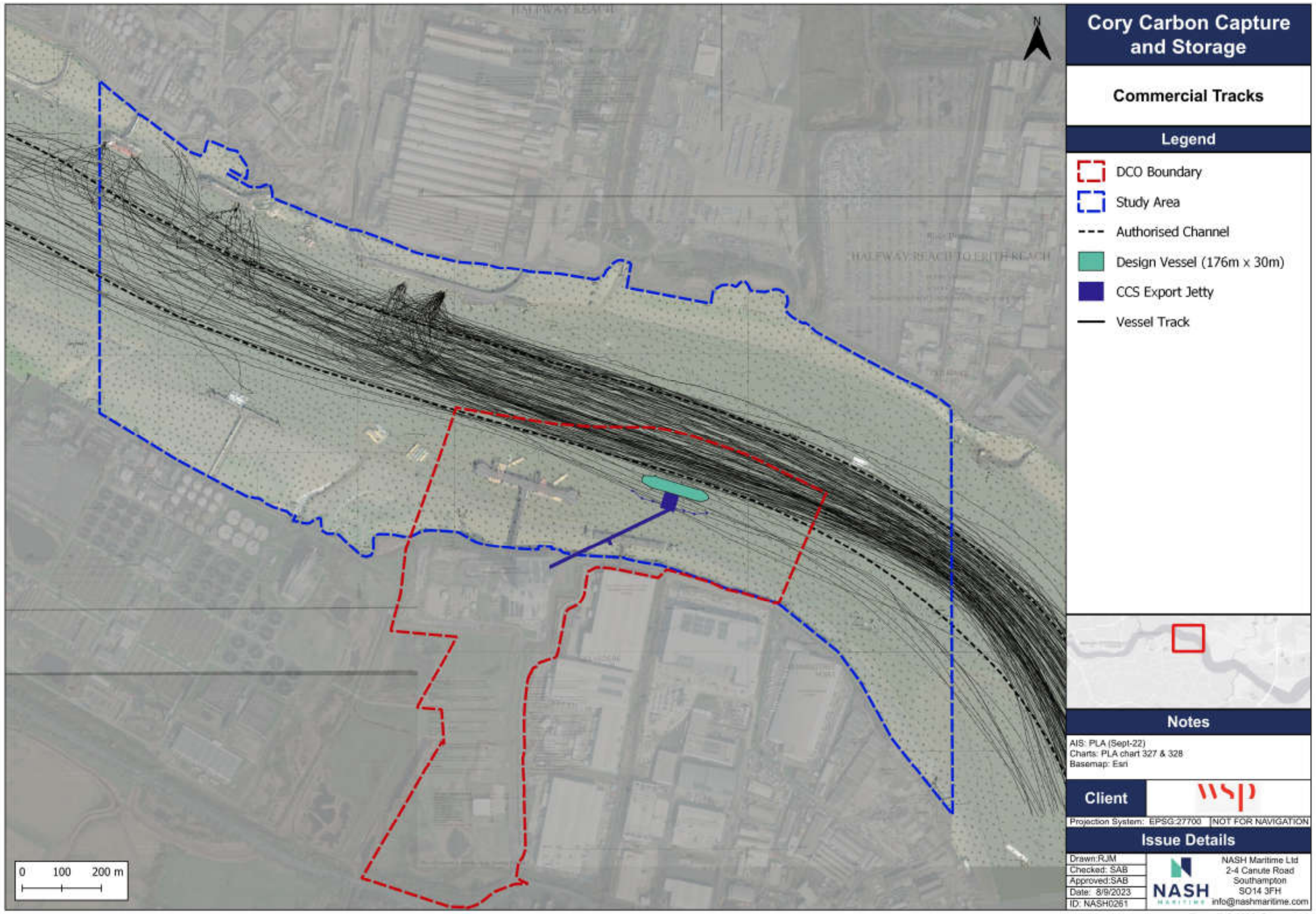


Figure Ref: 0235_Gates

Commercial Tracks (Cargo / Tanker)



Tug and Service Tracks

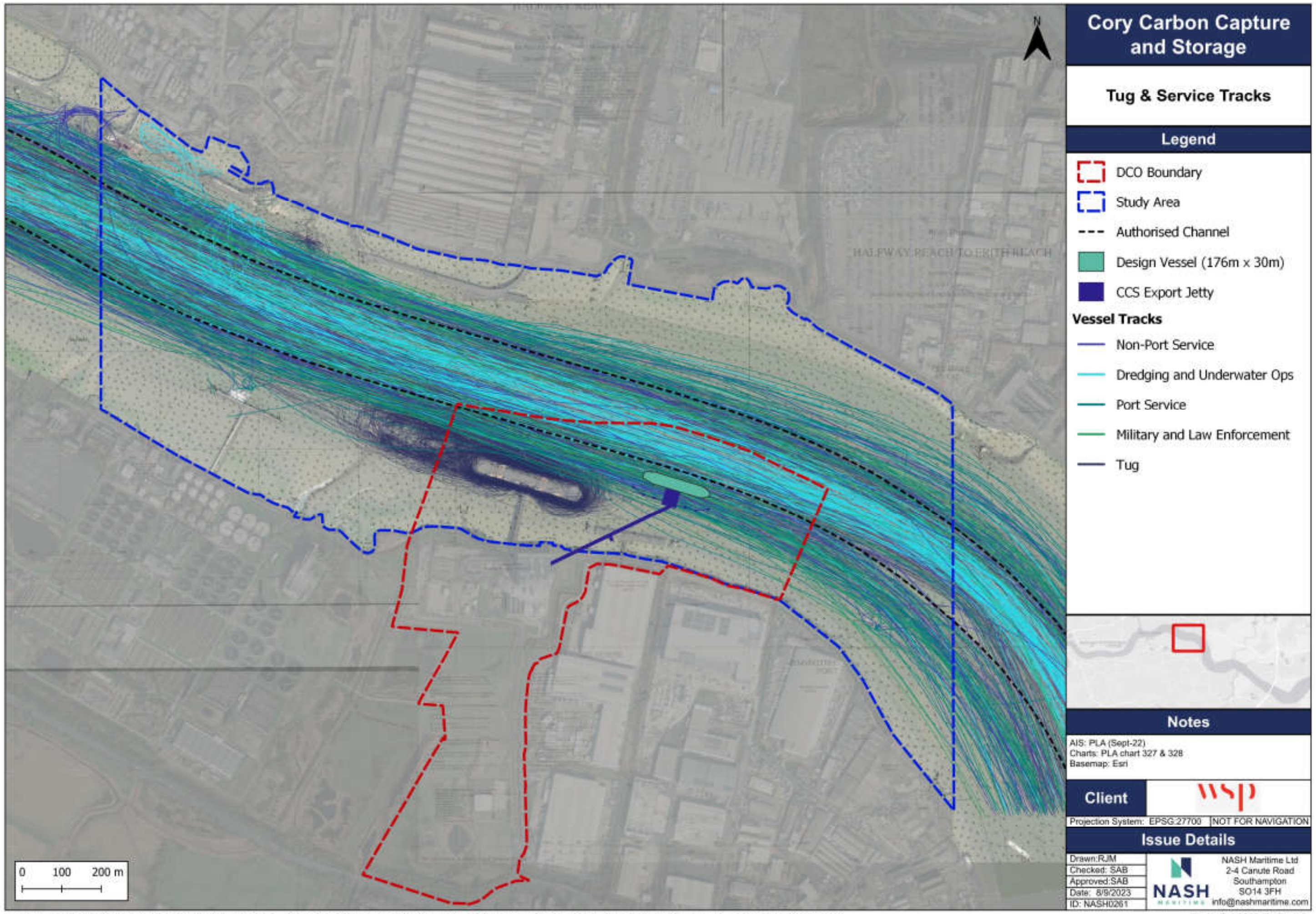


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Figure Ref: 0235_TugService

Passenger Tracks

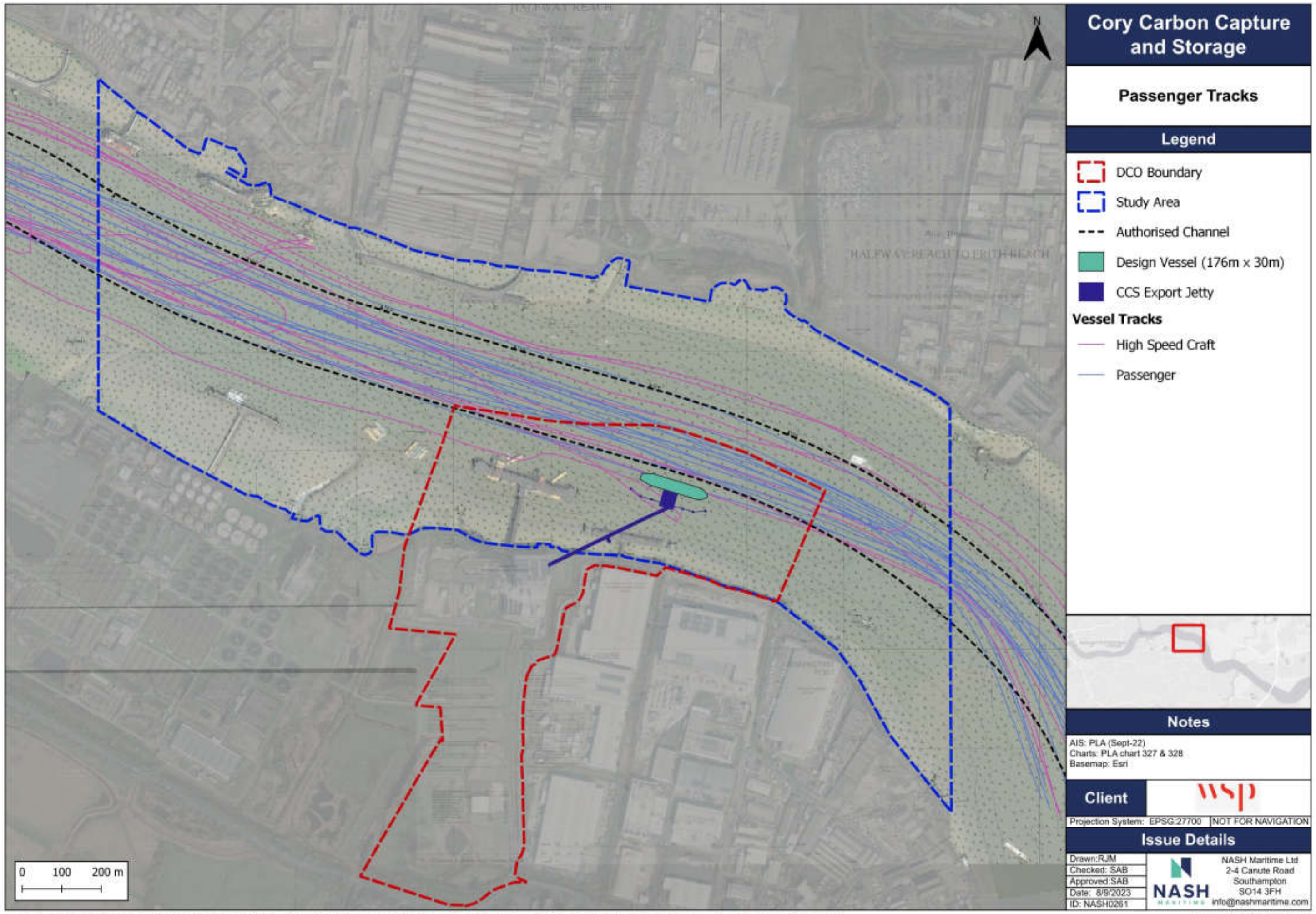

Figure Ref: 0235_Passenger

Recreational Tracks

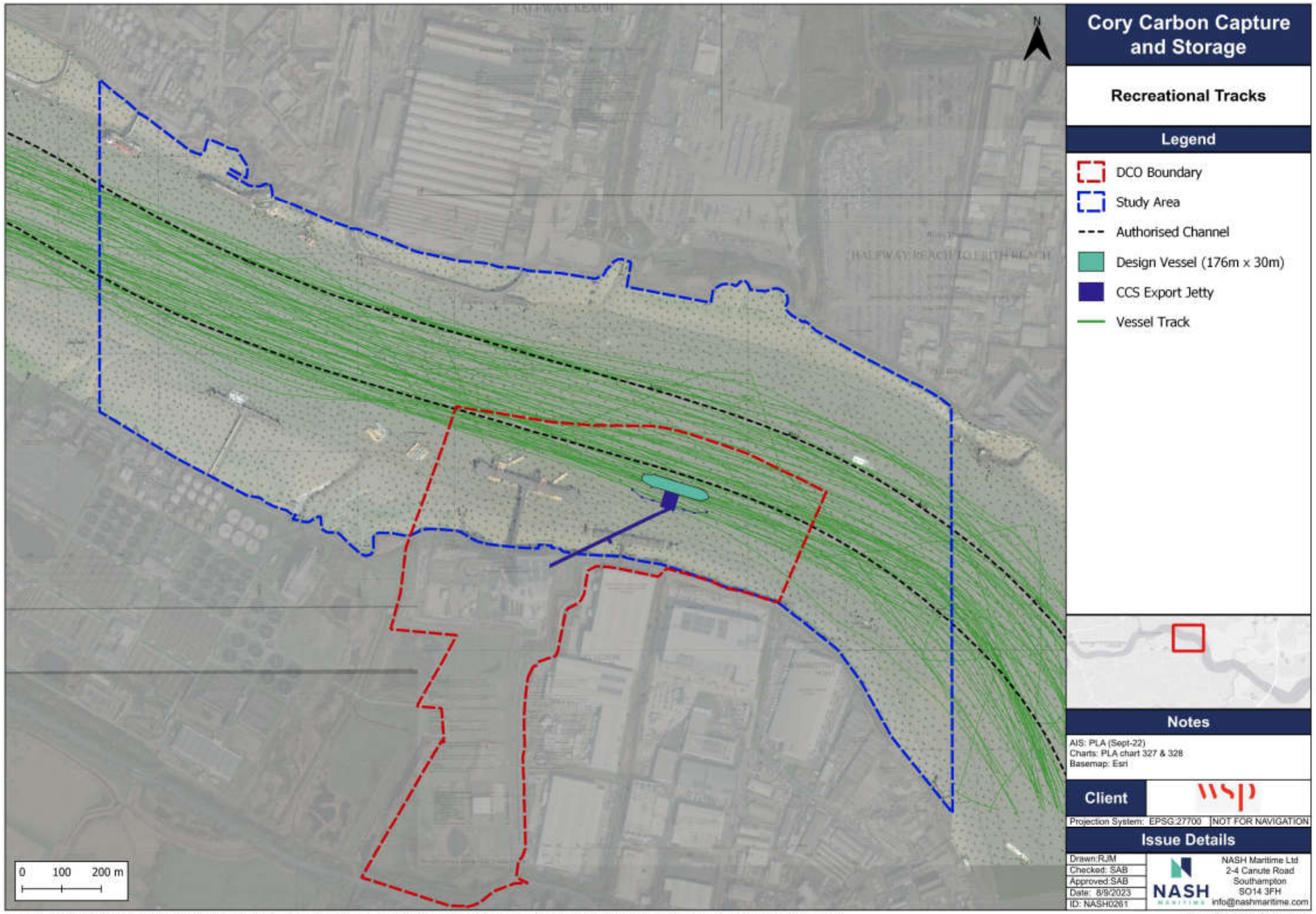

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Figure Ref: 0235_Recreational

Marine Operation

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Design Vessels

- Several project vessels are currently under consideration, all of which could be utilised to facilitate LCO2 export operations
- The table to the right shows the design specifications and anticipated number of vessel arrivals for design vessels with a capacity of 7500 cbm^3 through to15000 cbm^3
- The vessel with a capacity of 7500 cbm^3 is based on a LCO2 tanker, it is possible that a vessel of this capacity will be utilised during the initial phase. The design vessel size may increase as CO2 production intensifies. Several CO2 storage providers are currently developing design vessel specifications, a vessel of 15000 cbm^3 would likely be the largest vessel that may operate from the CCS jetty
- pNRA assumes largest vessel and maximum vessel movements

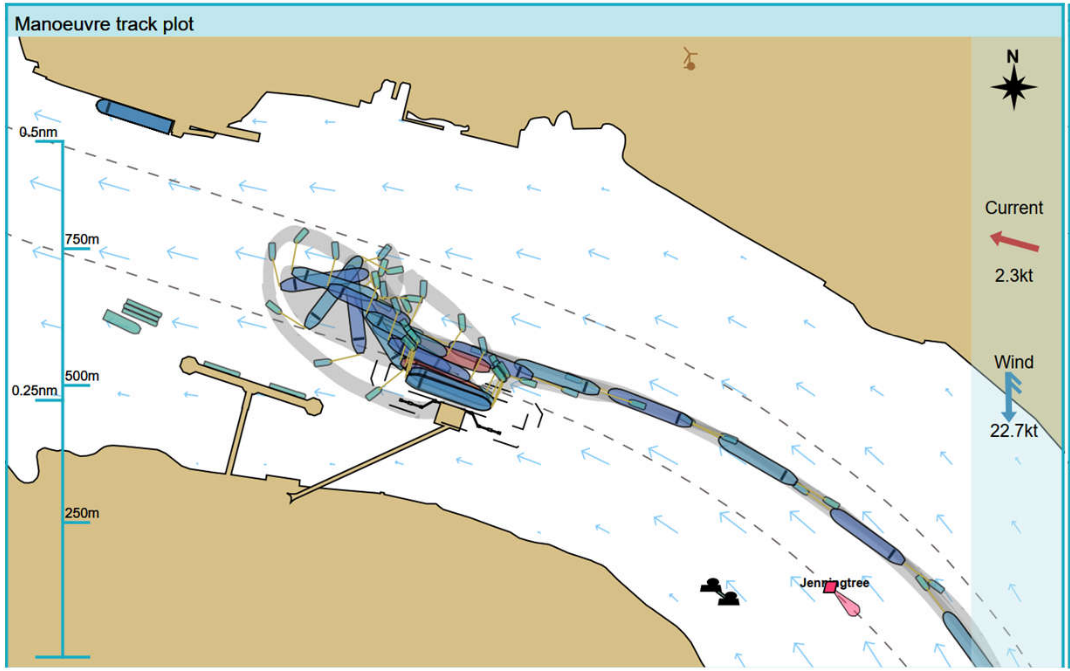
Design Vessel Capacity (cbm^3)	Length Overall (m)	Draught (m)	Arrivals per annum	Arrivals per week
			(Phase 1 / Phase 2)	Phase 1 / Phase 2)
7500	130	8.0	112 / 211	2.16 / 4.05
12000	143	9.0	71 / 132	1.35 / 2.53
15000	178	8.4	55 / 106	1.08 / 2.02

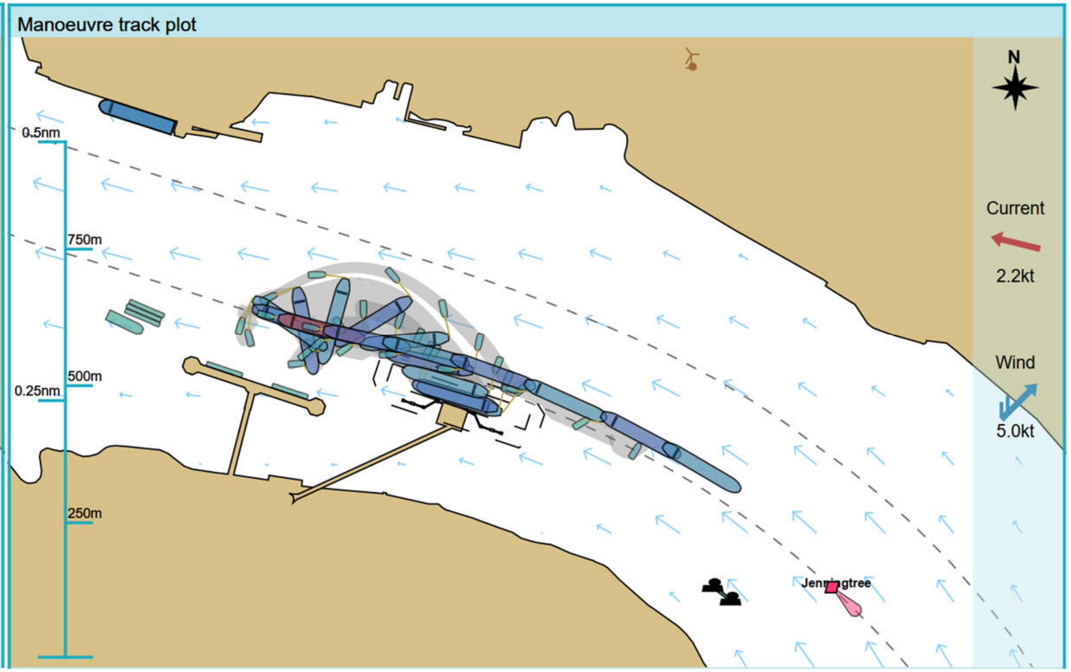
Marine Operation

NASH MARITIME

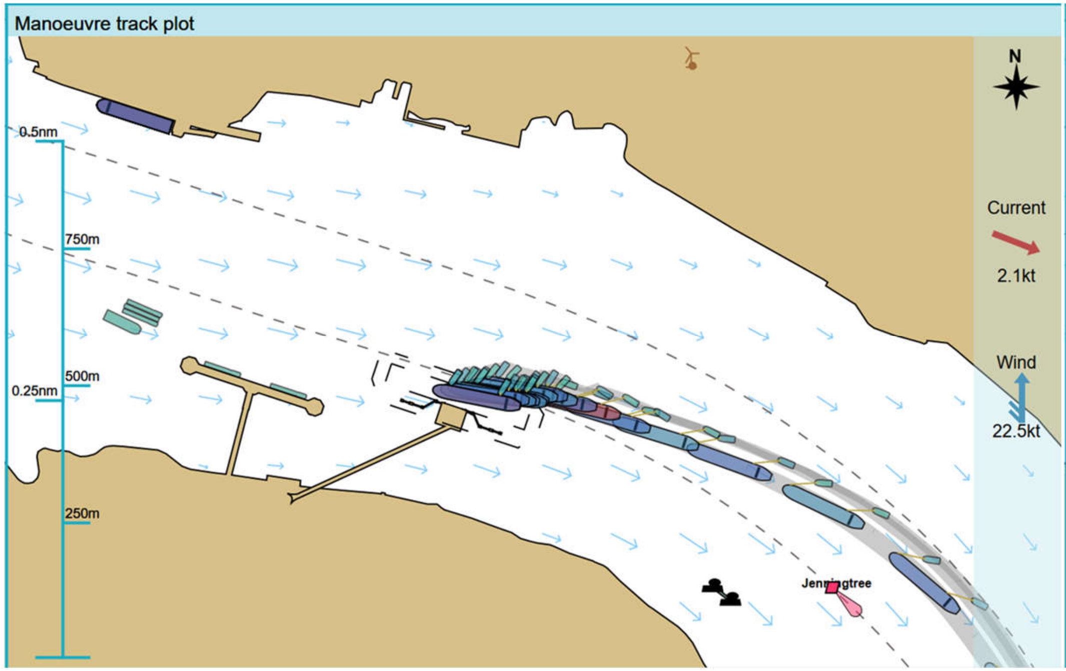
- Simulations were undertaken, using a variety of design vessels, to inform the jetty design and location.
- It is anticipated that tankers will arrive at berth at approximately HW – 1 hour.
- Departure manoeuvres will take place no later the HW + 1.5 hours.

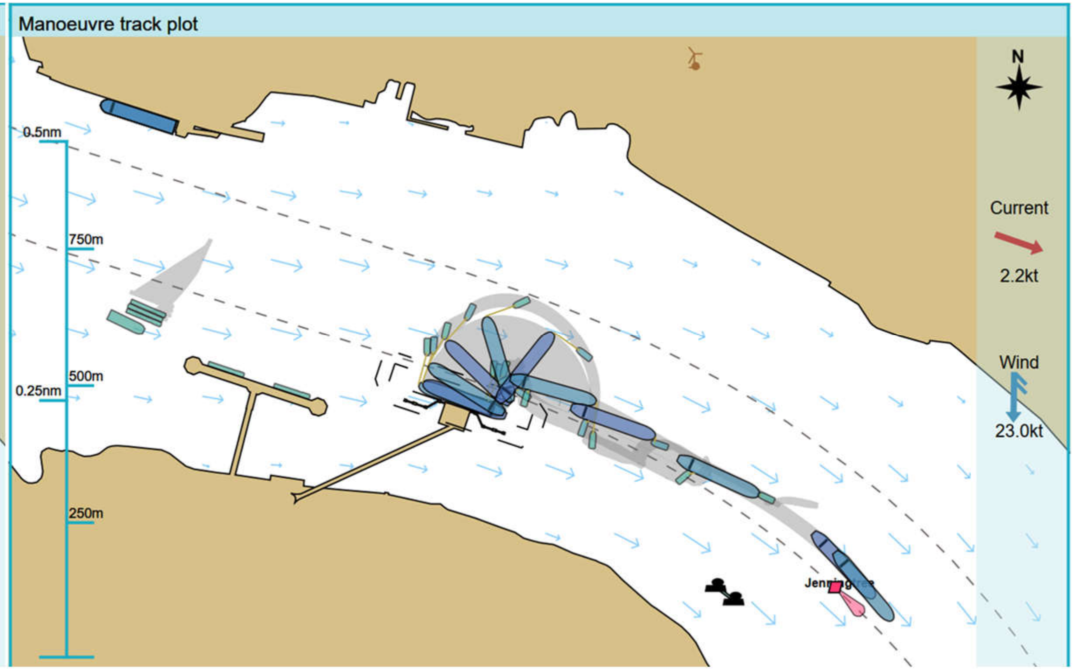
Flood Arrival (left) and Departure (right)



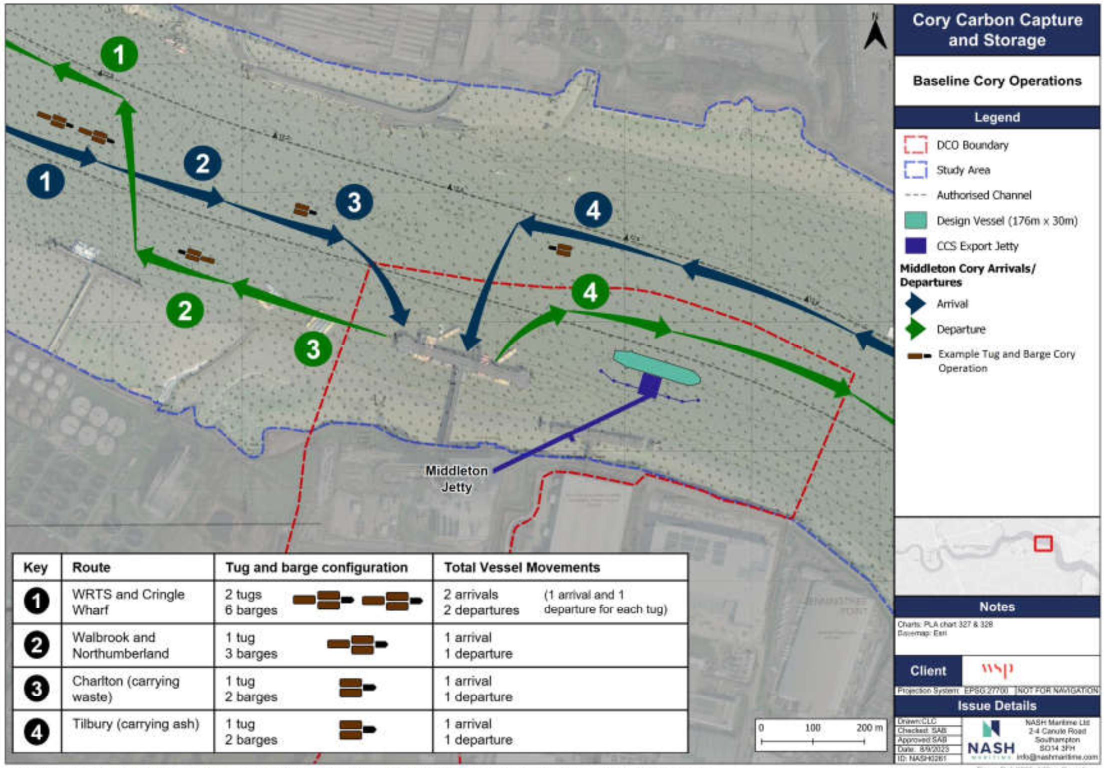


Ebb Arrival (left) and Departure (right)

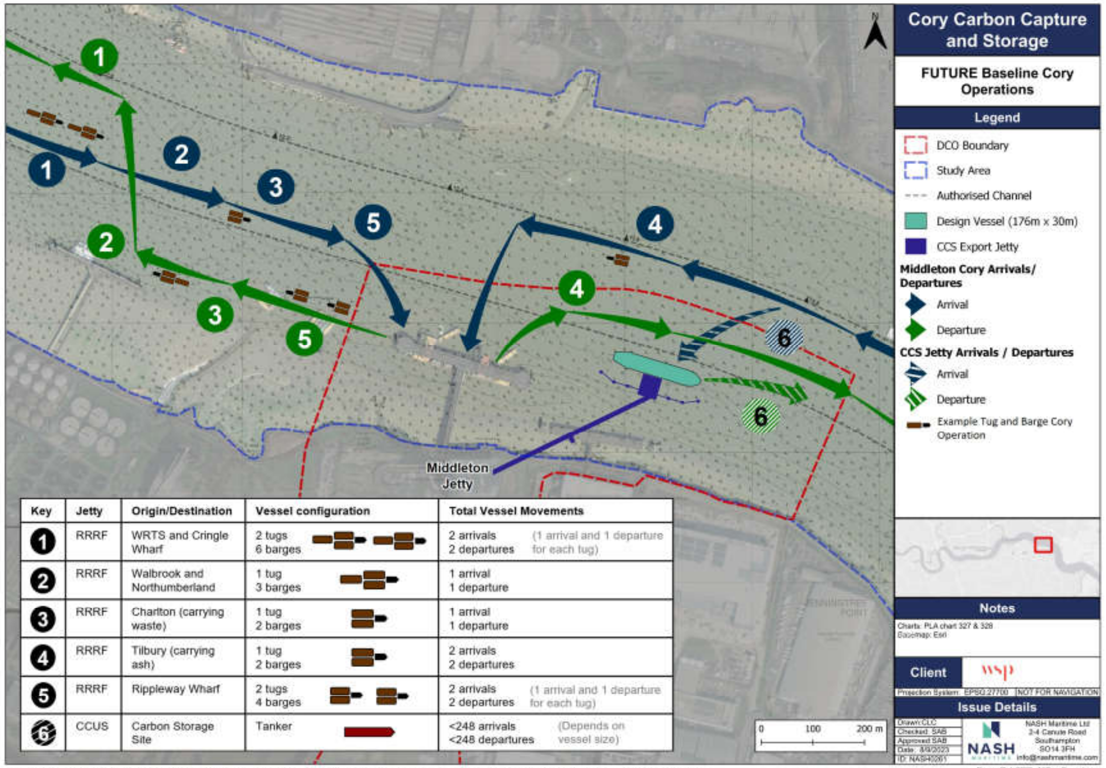




Cory Baseline and Future Operation



Key	Route	Tug and barge configuration	Total Vessel Movements
1	WRTS and Cringle Wharf	2 tugs 6 barges	2 arrivals 2 departures (1 arrival and 1 departure for each tug)
2	Walbrook and Northumberland	1 tug 3 barges	1 arrival 1 departure
3	Charlton (carrying waste)	1 tug 2 barges	1 arrival 1 departure
4	Tilbury (carrying ash)	1 tug 2 barges	1 arrival 1 departure



Key	Jetty	Origin/Destination	Vessel configuration	Total Vessel Movements
1	RRRF	WRTS and Cringle Wharf	2 tugs 6 barges	2 arrivals 2 departures (1 arrival and 1 departure for each tug)
2	RRRF	Walbrook and Northumberland	1 tug 3 barges	1 arrival 1 departure
3	RRRF	Charlton (carrying waste)	1 tug 2 barges	1 arrival 1 departure
4	RRRF	Tilbury (carrying ash)	1 tug 2 barges	2 arrivals 2 departures
5	RRRF	Rippleway Wharf	2 tugs 4 barges	2 arrivals 2 departures (1 arrival and 1 departure for each tug)
6	CCUS	Carbon Storage Site	Tanker	<248 arrivals <248 departures (Depends on vessel size)

Construction

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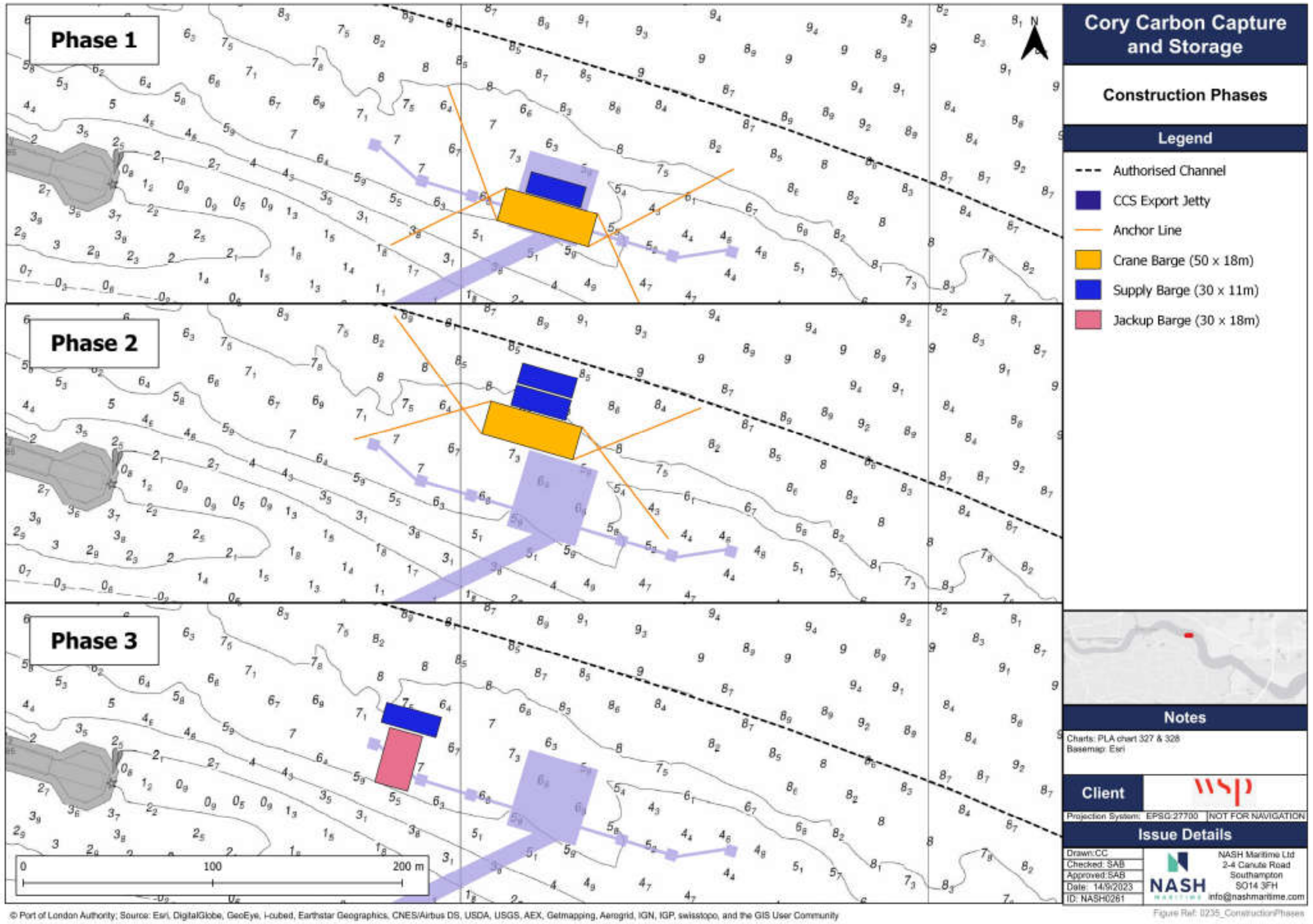
Construction overview

- Construction stages
  - Dredging (likely backhoe)
  - Access trestle
  - Loading platform construction
  - Berthing dolphin construction
  - Mooring dolphin construction
- Construction plant:
  - Crane Barge (50m x 18m)
  - Supply Barge (30 x 11m)
  - Jack-Up-Barge (30m x 18m)



Identified Hazards

Identified Hazards

	Operation Phase	Construction Phase
Collision	Project vessel in collision with commercial (cargo / tanker) vessel	Construction vessel in collision with commercial (cargo / tanker) vessel
	Project vessel in collision with passenger vessel	Construction vessel in collision with passenger vessel
	Project vessel in collision with recreational vessel	Construction vessel in collision with recreational vessel
	Project vessel in collision with tug and service vessel	Construction vessel in collision with tug and service vessel
	Project vessel in collision with cory tug and barge	Construction vessel in collision with cory tug and barge
	Collision between third party vessels resulting from action taken to avoid project vessel	Collision between third party vessels resulting from action taken to avoid construction vessel
Contact	Project vessel contacts CCS Jetty	Construction vessel contacts CCS Jetty
	Project vessel contacts existing infrastructure (e.g., RRRF jetty)	Construction vessel contacts existing infrastructure (e.g., RRRF jetty)
	Cory tug and barge contacts CCS jetty	Cory tug and barge contacts CCS jetty
	Third party vessel contacts CCS jetty	Third party vessel contacts CCS jetty
Grounding	Project vessel grounds	Construction vessel grounds
	Cory tug and barge grounds	Cory tug and barge grounds
	Third party vessel grounds	Third party vessel grounds
Breakout	Project vessel breakout	Construction vessel breakout
	Cory tug and barge breakout	Cory tug and barge breakout
	Third party vessel breakout	Third party vessel breakout

CCS – PNRA CONSULTATION

Project Title	Cory Carbon Capture and Storage pNRA
Project Number	22_NASH_0235
Meeting subject / purpose	Stakeholder Consultation
Revision	R01-00
Date of meeting	04-Oct-2023
Start time	15:30 BST
Finish time	17:00 BST
Client	Cory / WSP
Location	MS Teams

These minutes should be issued alongside and read in conjunction with PPT ref: 22_NASH_0235-CCS_pNRA_Consultation_GPS_R01-00 – references to the slide(s) containing pertinent supplementary information are included within the minutes below.

ATTENDEES

Organisation	Attendee	Role	Initial
GPS	Graeme Faulkner	Company Director	GF
NASH Maritime	Sam Anderson-Brown	Principal Consultant	SAB
NASH Maritime	Clarie Conning	Maritime Consultant	CC
WSP	Jo Evans	Technical Director (Maritime)	JE

NOTES OF MEETING

1	**Introductions**	**Action**
1.1	SAB welcomed all to the meeting and brief introductions were held.	
2	**Agenda**	
2.1	SAB outlined the agenda for the meeting (see slide 2)	
3	**Project Overview**	
3.1	SAB gave an overview of the project and explained the context for the consultation meeting, (see slide 3)	
4	**Consultation Objectives**	
4.1	SAB presented an overview of the consultation meeting objectives, (see slide 4 for further detail).	
5	**CCS Jetty Location and Preliminary Design (slides 5 to 7)**	
5.1	SAB presented an overview of the current proposed jetty location.	

	GF asked how close the design vessel would be to the authorised channel, SAB explained that the vessel would be approx. 20m from the authorised channel when moored alongside.	
6	**Navigational Environment (slides 8 to 13)**	
6.1	SAB presented a series of plots derived from Sept 2022 Thames AIS data and asked GF to consider whether the plots showed a realistic overview of day to day vessel movements within the Study Area. GF confirmed that the plots showed an accurate overview of the baseline vessel traffic environment within the Study Area	
6.2	Referring to slide 11, GF commented that his key concern related to the positioning of the jetty, explaining that when muck away barges are outbound on an ebb tide (1 tug could be towing two barges weighing up to 1500t each) it is necessary for them to navigate south of the authorised channel when approaching Jenningtree bend to avoid being set toward the north side of the river as they round the bend. On a young ebb tide, tug and tows are likely to pass inside the Jenningtree marker, as the tide strengthens they will aim to pass just north of the marker when rounding the bend. GF stated that in his opinion the current position of the Jetty would mean that when moored the tanker would block the route south of the authorised channel and prevent tug and tows from aligning correctly to safely navigate Jenningtree bend. The risk being the tug and tows are set to the north side of the river and potentially risk grounding or colliding with inbound vessels. SAB asked GF how movements between outbound tugs and inbound vessels are currently deconflicted in the Jenningtree bend area. GF explained that communication between masters and VTS works well, GF had no knowledge of any collision incidents between inbound vessels and tug and tows in the area. GF further clarified that inbound vessels (e.g. CLdN vessels on route to Ford's Jetty) would need to give way to an outbound tug and tow navigating with the ebb tide.	
7	**Marine Operation (slides 14 to 19)**	
7.1	SAB presented an overview of the marine operation (see slides 14 to 19), this included: • A summary of potential design vessels and associated movement scenarios; • Vessel swept path plots showing exemplar tanker arrival and departure manoeuvres on an ebb and flood tide; • A summary of future vessel movements associated with the Middleton Jetty and CCS Jetty.	
7.2	GF explained that the increased number of vessels movements within the study area was not a concern as this is a relatively quiet section of the river.	
8	Construction	
8.1	SAB presented a high level overview of the construction sequence and approximate construction works area, (see slide 21) GF commented that as well as a 4 point mooring system construction barges would also need to utilise spud anchors to remain in place. GF considered contact with construction barges to be the most significant navigational risk and felt the impact of draw off could be mitigated by ease downs in the area. (Note, temporary ease downs may be acceptable during construction works but a permanent ease down for operation phase will be unacceptable to PLA).	
9	Identified Hazards	

9.1	SAB presented a list of identified hazards, (see slide 23). GF made the following comments: • Identified hazards appear to cover key navigational issues and points of concern, GF did not feel there was anything obvious missing. • GF did not feel that draw off would be a substantial concern during operational phase but felt this would be an issue during construction. • GF's main concern is the positioning of the jetty and the resulting potential for contact hazard occurrence. SAB asked if there were any additional risk control measures that could be put in place to alleviate GF concerns in relation to contact occurrence. GF commented that the only way to address this concern would be to move the jetty south so that when moored the project tanker is clear of the tug and tow route south of the authorised channel. GF explained that if this design change could be made then there were no other significant navigational issues that could not otherwise be mitigated.	
9.2	GF made the following closing comments: • Visibility in Halfway Reach / Erith Rands area can often be worse during periods of fog than in other reaches. • GF recalled two incidents a number of years ago when Ro-Ro vessels operating from Ford's jetty had made contact with the now disused Belvedere Power Station Jetty.	

Appendix I
PLA pNRA Consultation Workshop – PPT Presentation and Meeting Minutes

Cory CCS Project

pNRA PLA Workshop

WSP / Cory

07-Nov-2023

NASH MARITIME

Agenda

- Introductions
- Objectives
- Project overview
  - Jetty location
  - Design vessels
  - Marine operation
  - Construction
- pNRA
  - Consultation findings and additional analysis
  - Hazard likelihood modelling
  - Risk Assessment
    - Baseline risk assessment
    - Additional risk controls
    - Residual risk assessment

Objectives

- Review and explore key themes and outcomes of stakeholder consultation exercise alongside additional analysis;
- Seek feedback on:
  - Inherent risk assessment results;
  - Proposed and discuss additional risk control measures; and
  - Residual risk assessment results.

Project overview

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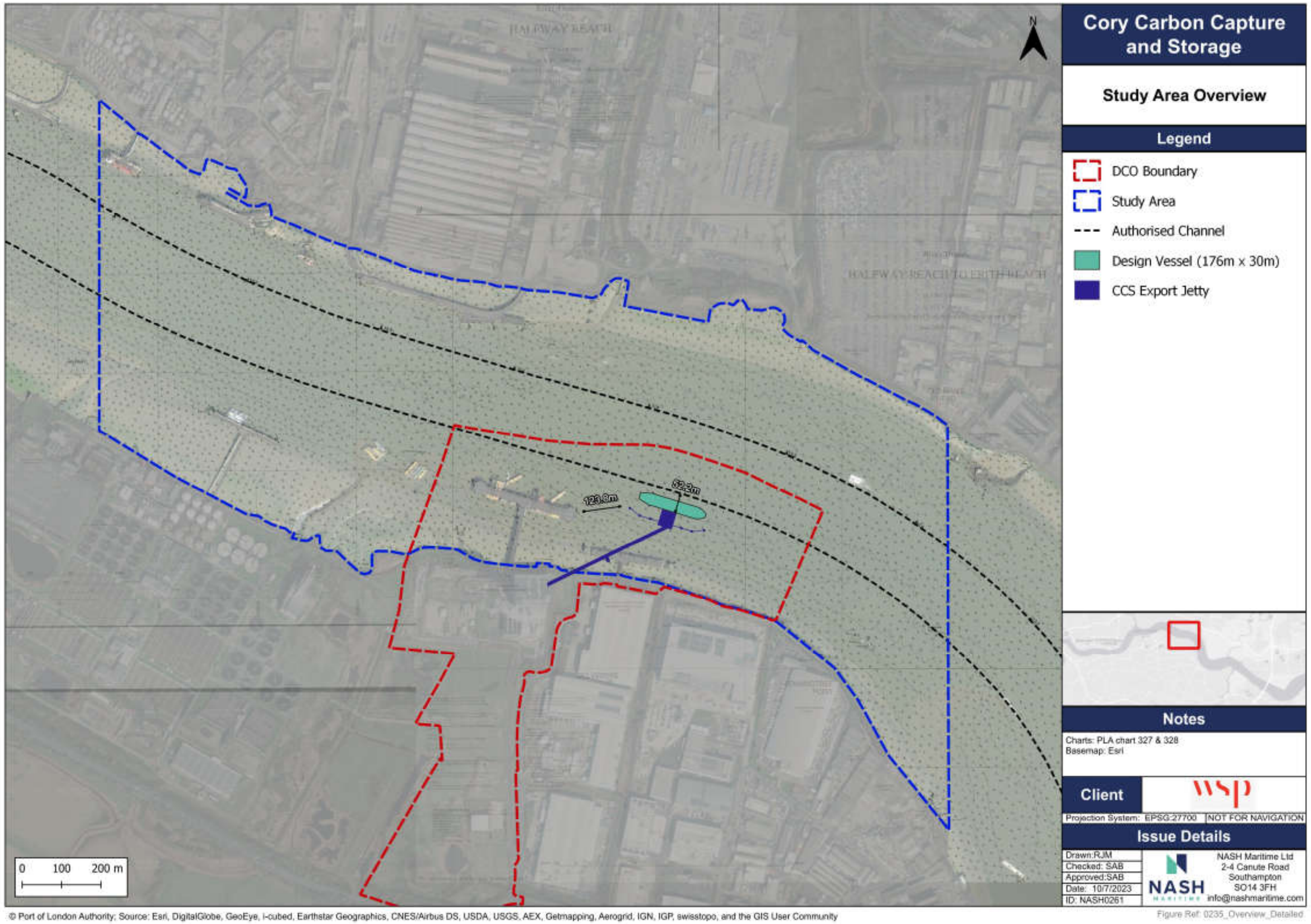
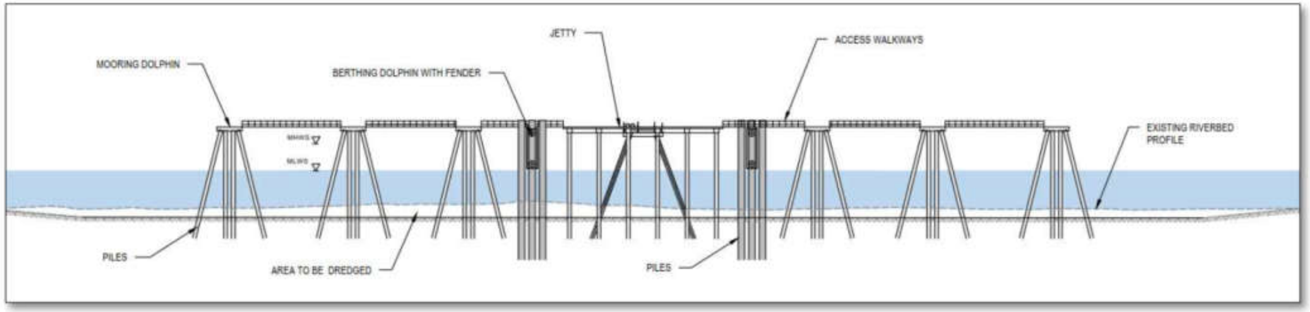
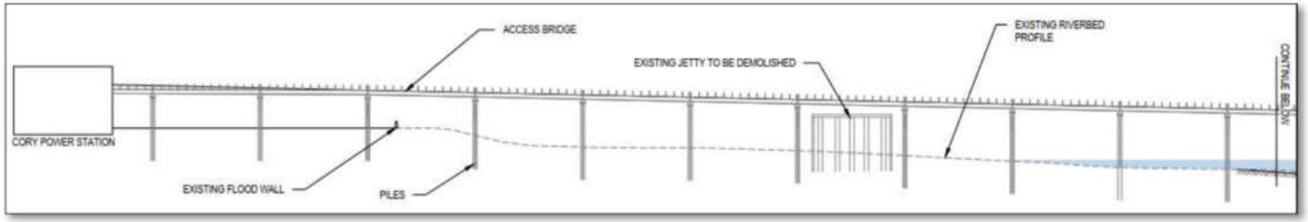
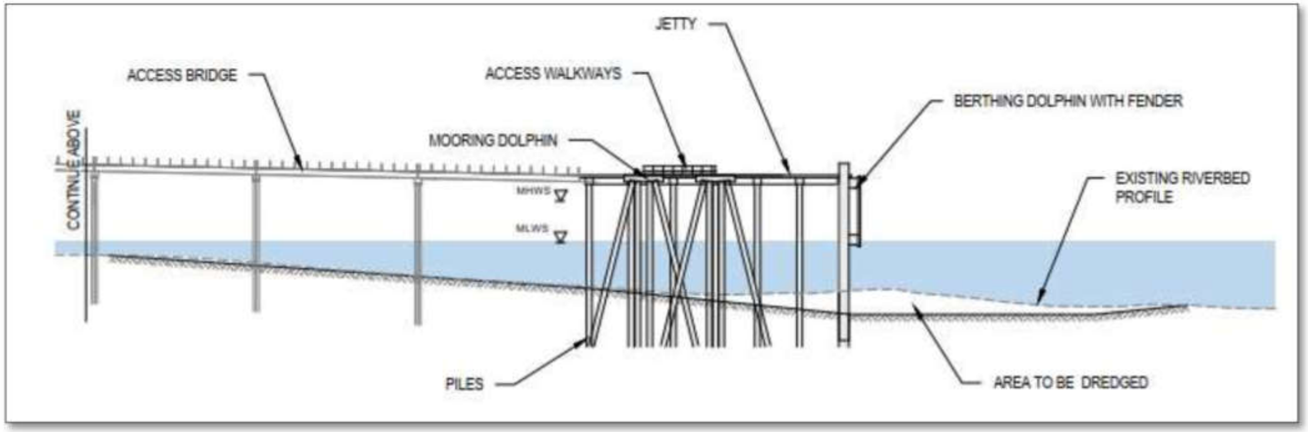
CCS Jetty Location



Preliminary Jetty Design







Design vessels

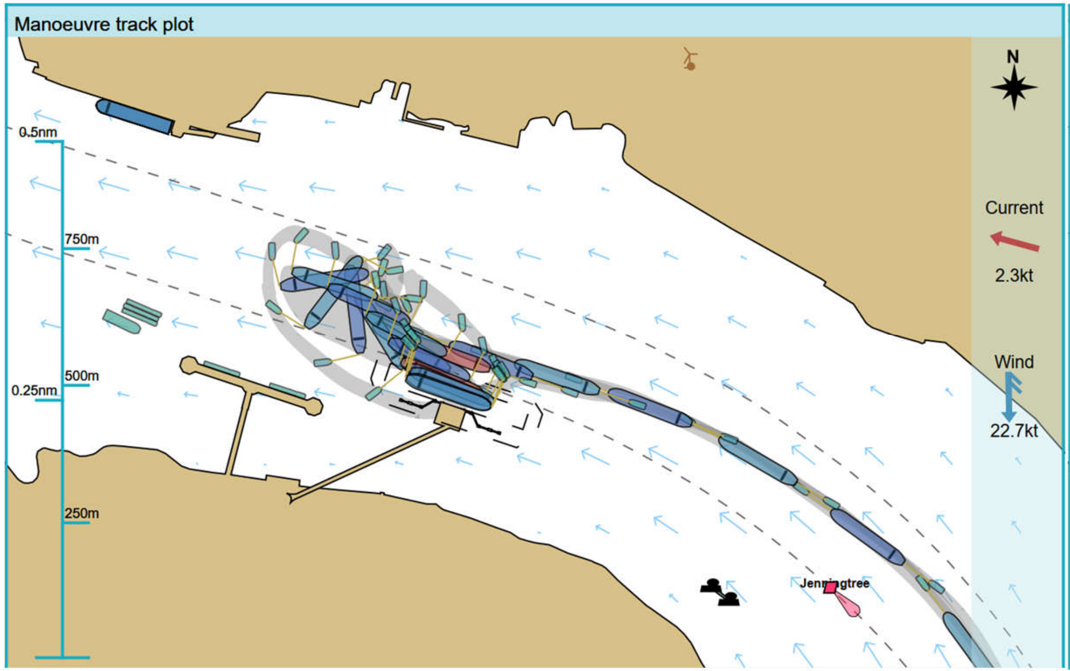
- Marine shipment of liquid Carbon Dioxide
- Number of vessel arrivals is contingent on vessel size
- Berthing pocket will be dredged to 10.5m below CD enabling vessel to remain alongside throughout tidal cycle

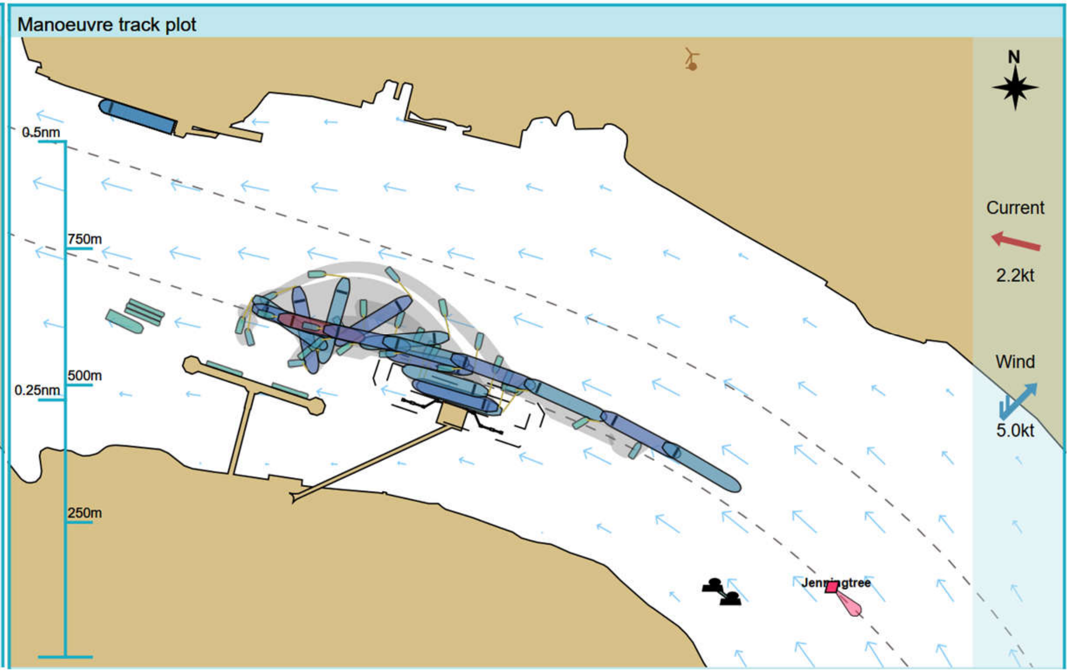
Design Vessel Capacity (cbm³)	Length Overall (m)	Draught (m)	Arrivals per annum (Phase 1 / Phase 2)	Arrivals per week Phase 1 / Phase 2)
7500	130	8.0	112 / 211	2.16 / 4.05
12000	143	9.0	71 / 132	1.35 / 2.53
15000	*178*	*8.4*	55 / 106	1.08 / 2.02

Marine Operation

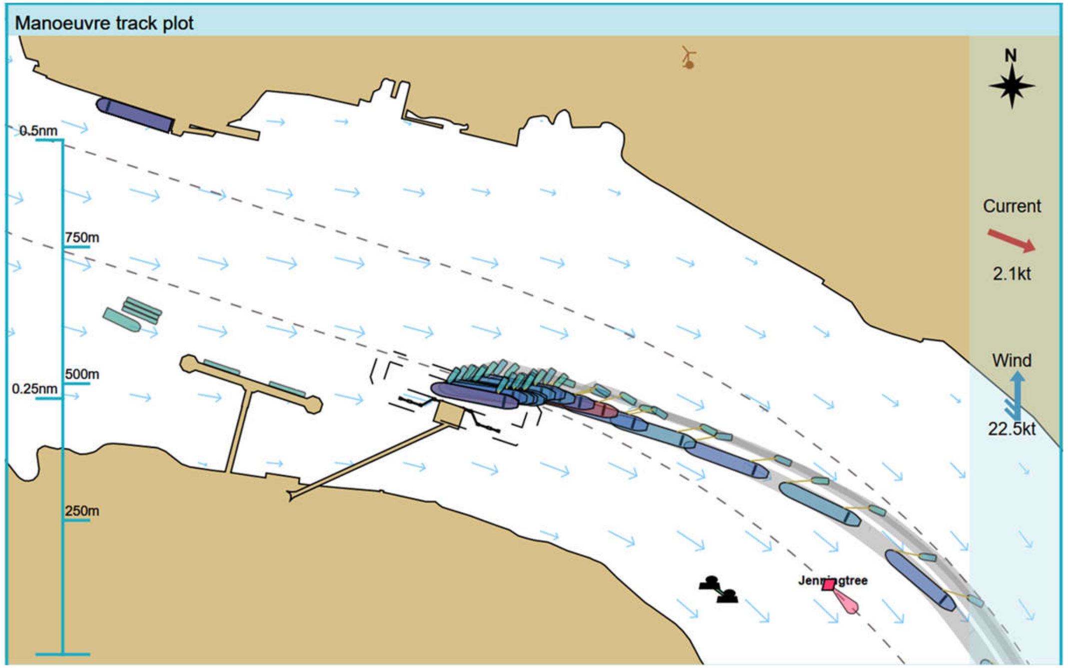
- Simulations were undertaken, using a variety of design vessels, to inform the jetty design and location.
- It is anticipated that tankers will arrive at berth at approximately HW – 1 hour.
- Departure manoeuvres will take place no later the HW + 1.5 hours.

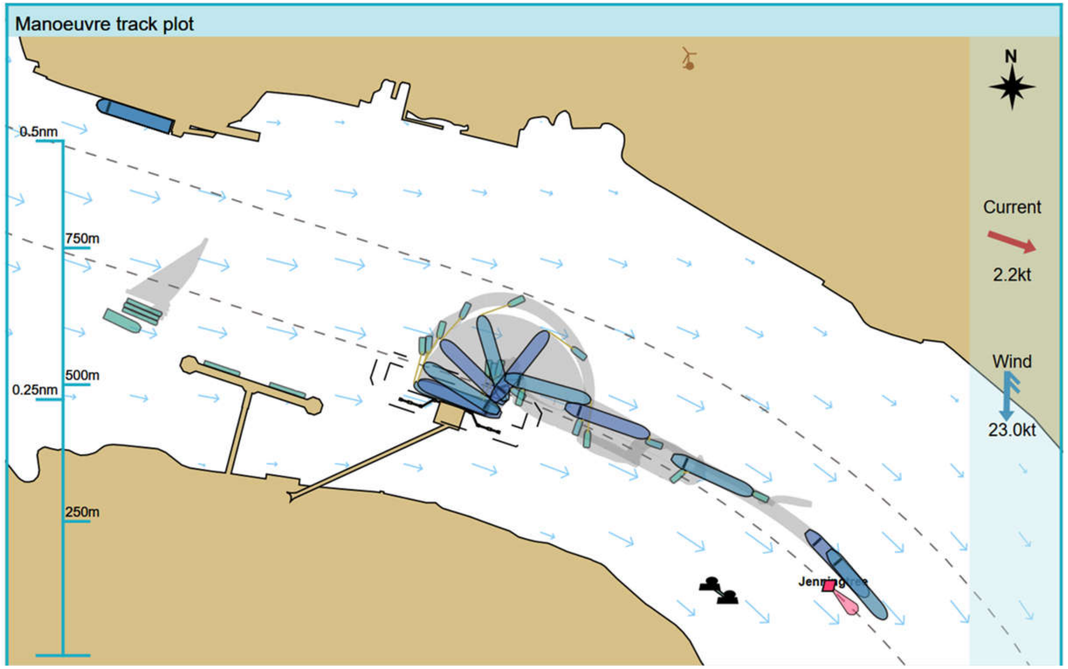
Flood Arrival (left) and Departure (right)





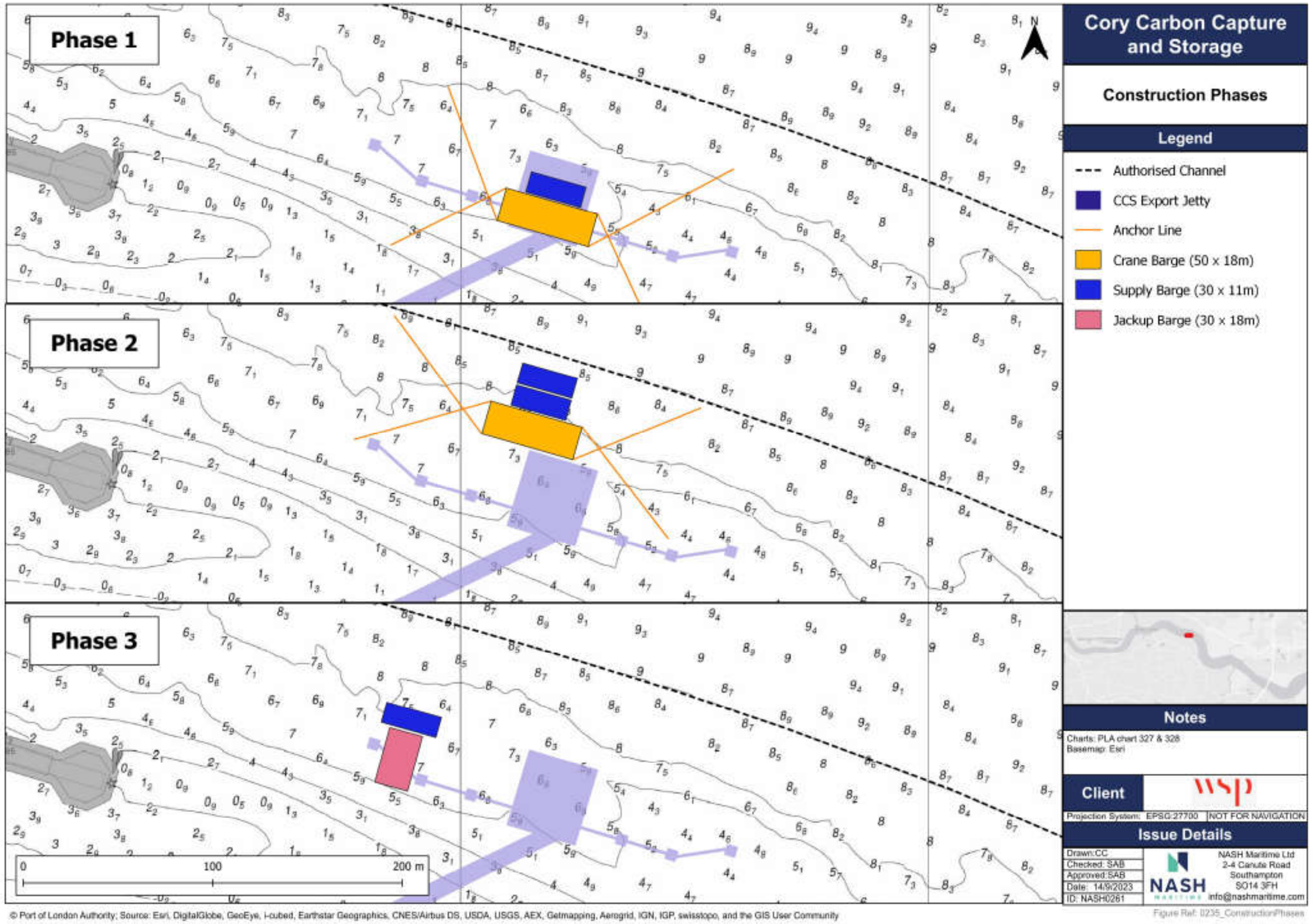
Ebb Arrival (left) and Departure (right)





Construction overview

- Construction stages
  - Dredging (likely backhoe)
  - Access trestle
  - Loading platform construction
  - Berthing dolphin construction
  - Mooring dolphin construction
- Construction plant:
  - Crane Barge (50m x 18m)
  - Supply Barge (30 x 11m)
  - Jack-Up-Barge (30m x 18m)



Consultation

Recreational

- Erith Rowing Club
- Club Captain:
  - *"The location and operations of this proposal, potentially appear to be hazardous for navigating this section of the river, however the impact on Erith Rowing Club would be somewhat negligible.*
  - *This is due to the fact the majority of our river outings are carried out in the opposite direction, towards the Dartford crossing.*
  - *The only factor that may have an impact is any increase in traffic due to the operations of the new jetty."*

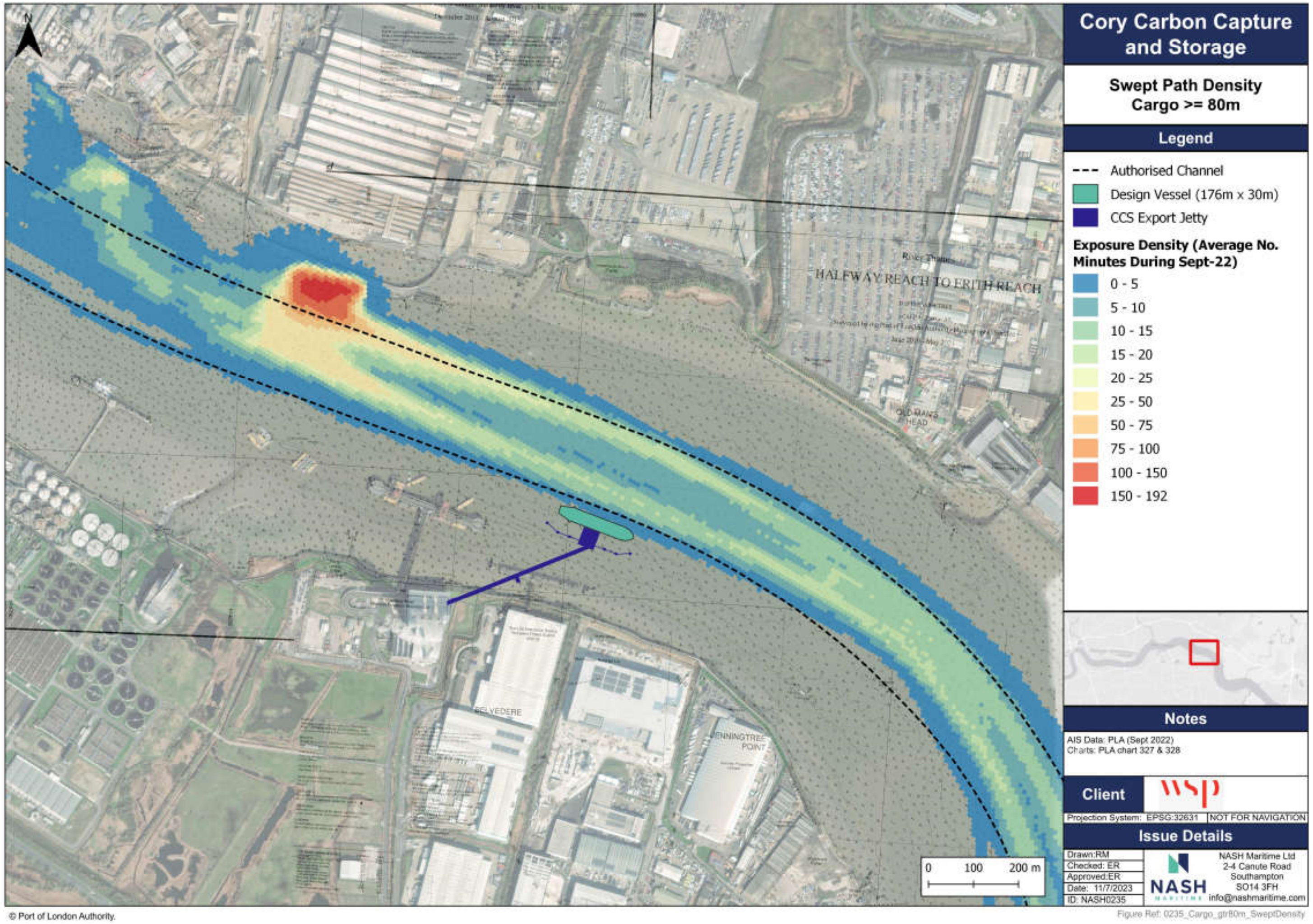
Hanson Aggregates

- Written feedback received
- Hanson Captain of the opinion the Jetty is positioned too close to the authorised channel.
  - *"When I leave Ameys and there is an inward bound v/, I usual navigate right up to the channel edge to leave adequate space for the inbound ship in the vicinity of the Jenningtree l/b (usually from around Middletons down to the Jenningtree l/b). Conversely when arriving and meeting another v/l in this area I would navigate to the northern edge and expect the outbound v/l to navigate to the southern edge."*
  - *"The maximum width of the navigable channel there is only 1 cable as it is. So, impeding into an already tight area would result in passing another v/l at even closer pinch point."*
  - *"There are some large v/l's that navigate in this part of the river – not just small coastal v/l's, you can have 180m tankers (for Thunderer jetty), large passenger v/l's (for tower bridge & HMS Belfast) and large sugar boats (for Silvertown) some drawing 9 – 10m draught, all transiting this area."*

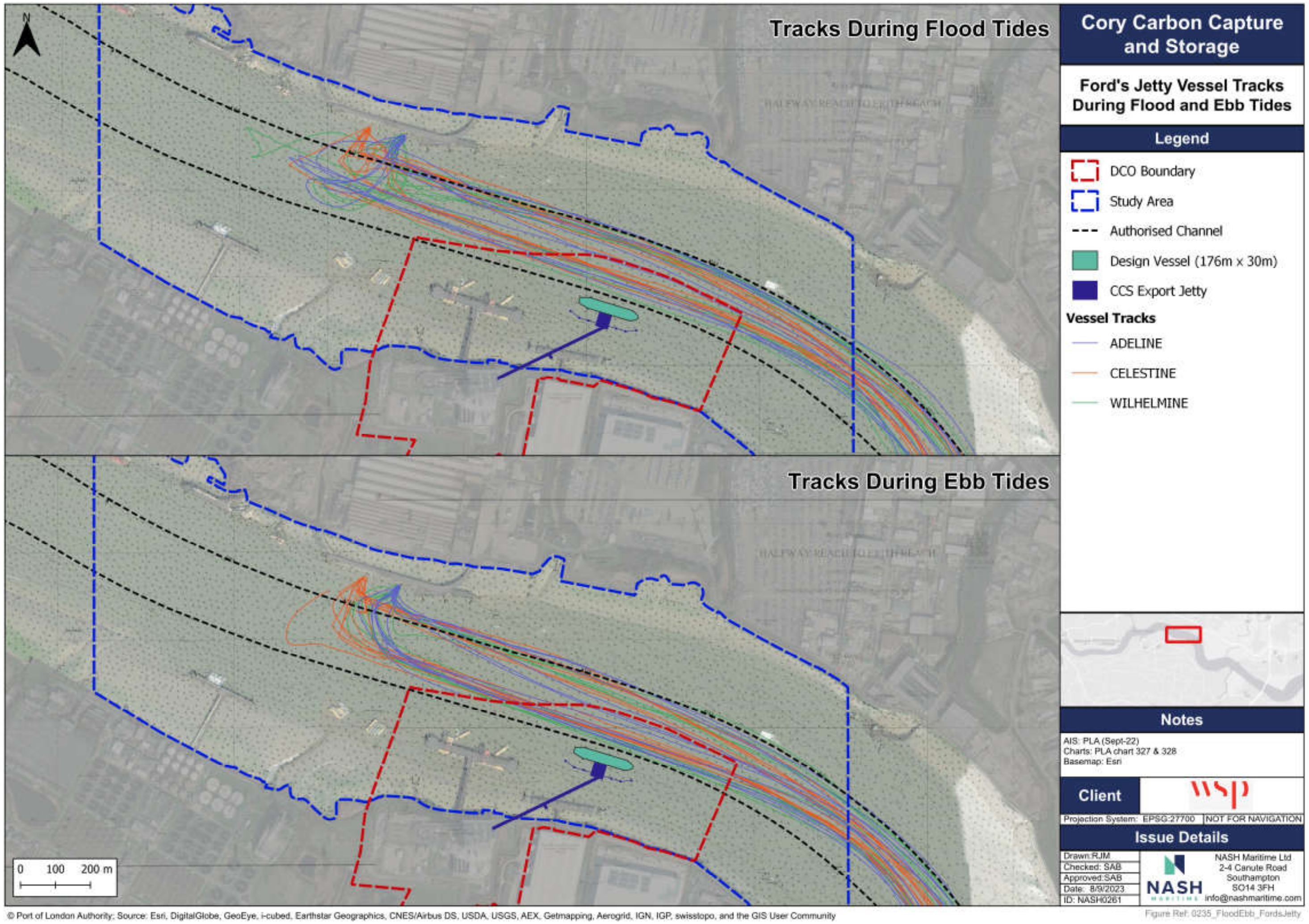
CLdN

- Written feedback received
- 2 x consultation meetings
- Consultation summary
  - CLdN stated that their vessels require the full width of the authorised channel:
    - In S / SW winds, CLdN vessels approach from middle / south of AC due to risk of drifting at low speed.
    - Limited manoeuvrability of the single screw Cobelfret vessels - need to use the current and the wind to their maximum extent and to do that, therefore max width is needed.
    - N winds when leaving berth - vessels pushed towards project which is now much closer to authorised channel.
  - CLdN initially concerned regarding congestion over high water period.
  - CLdN believe passing speed and CLdN vessel interaction with project vessel is not an issue (CLdN vessels are operating at low speed on arrival / departure).
  - CLdN initially concerned about displacement of inshore traffic in to authorised channel
  - CLdN position is that detailed simulation work is necessary when final designs are known in advance of any acceptance of design by CLdN.

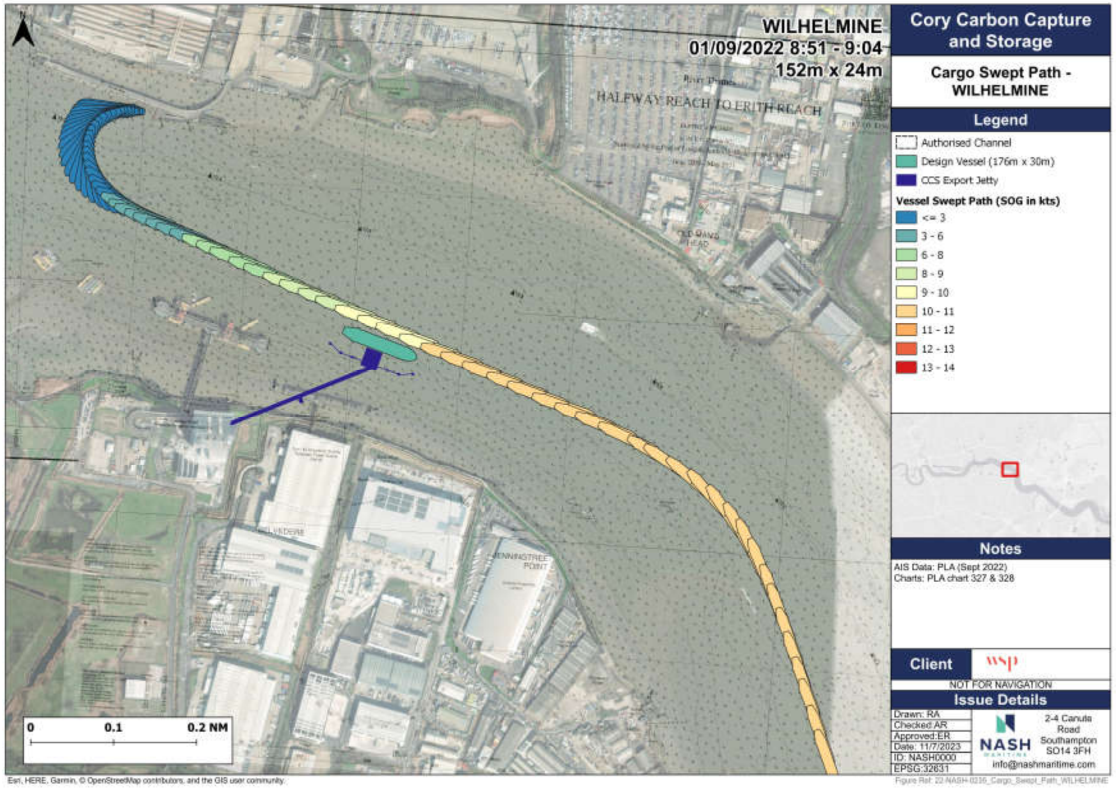
CLdN vessels

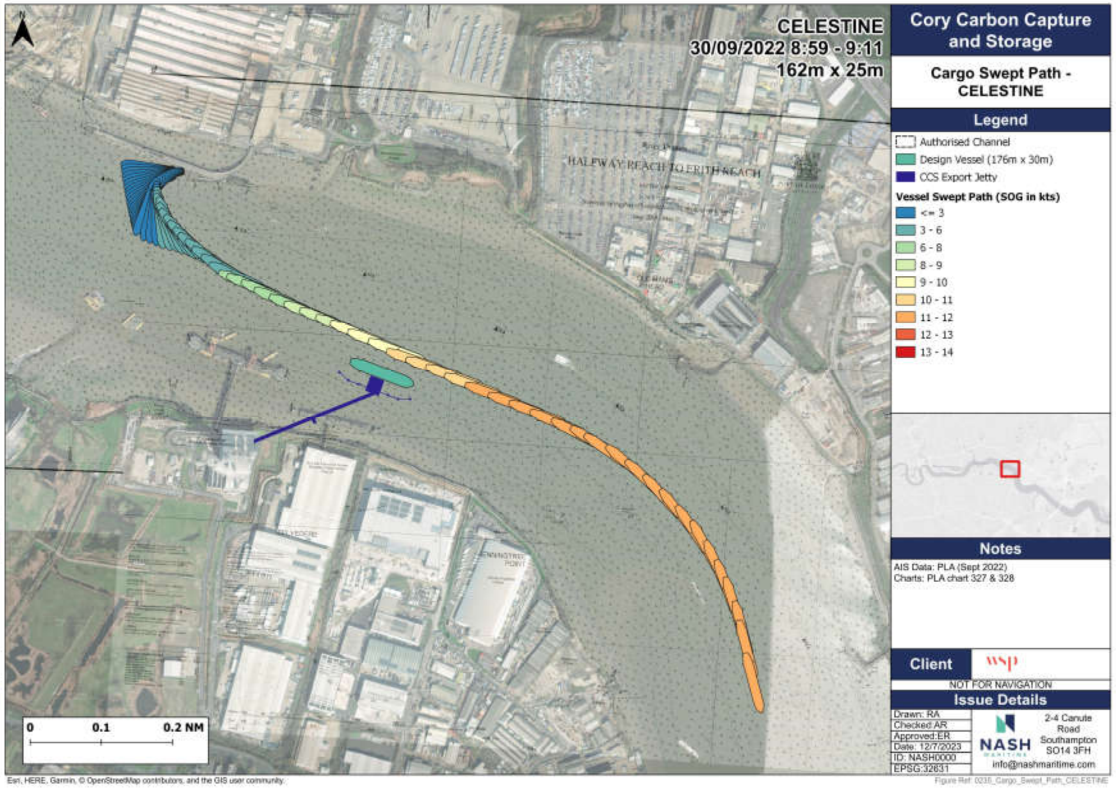


CLdN vessels over different tidal states



Outbound CLdN swept paths





Inbound CLdN swept paths

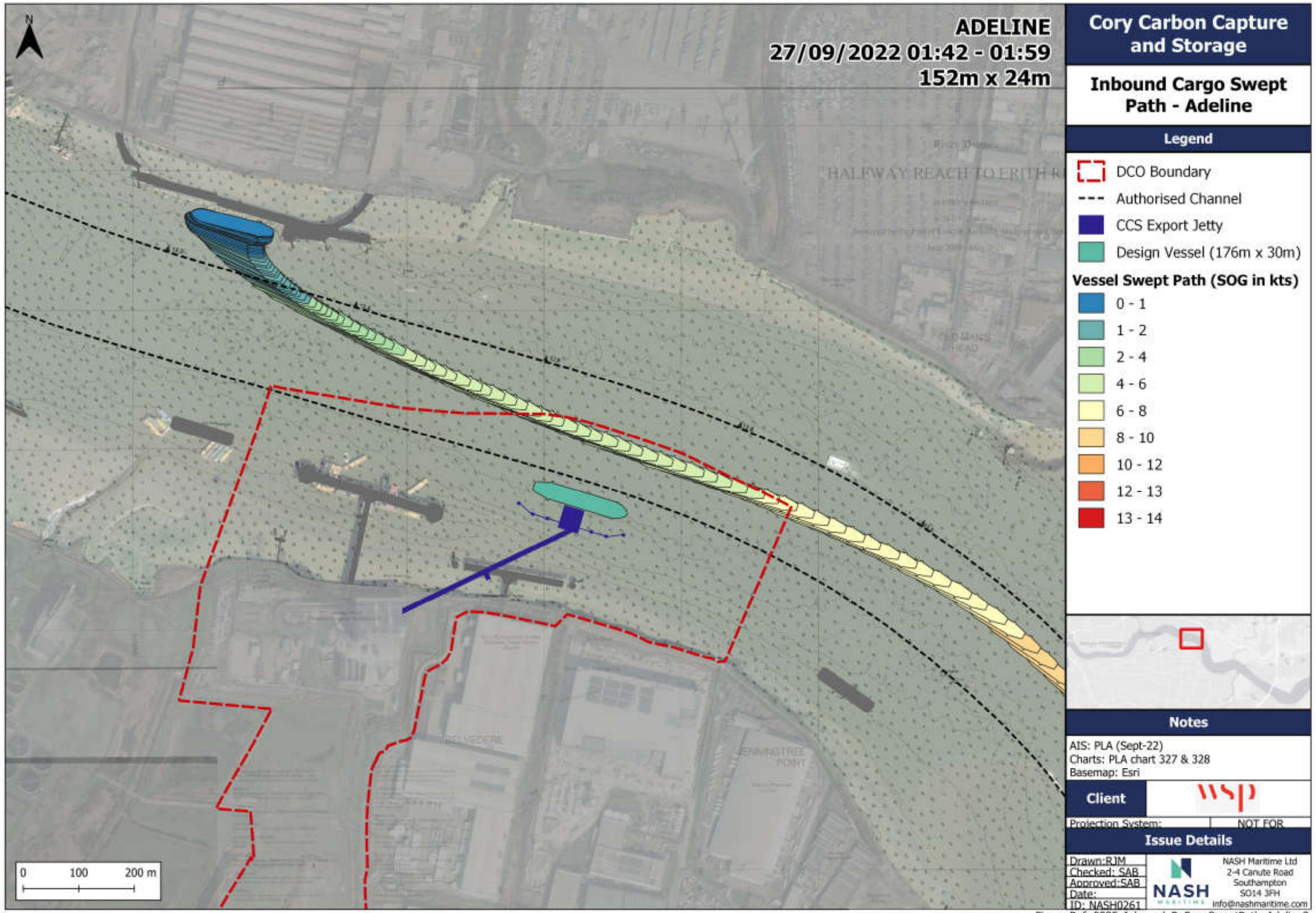


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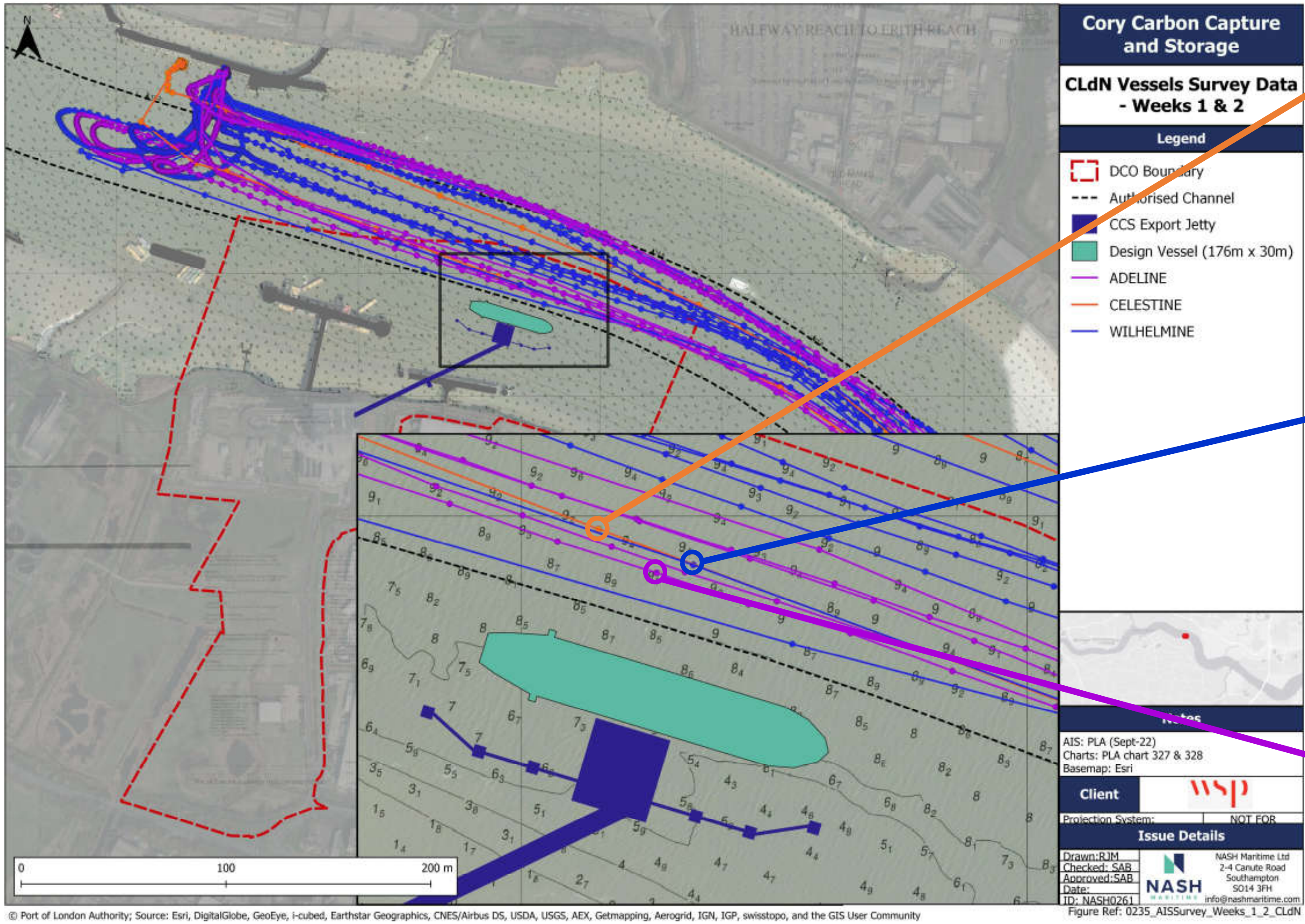
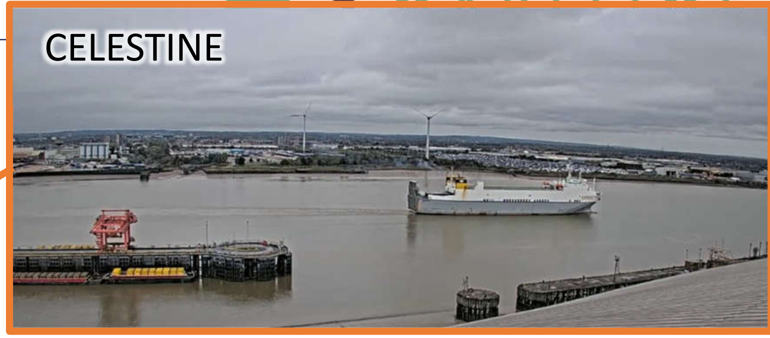
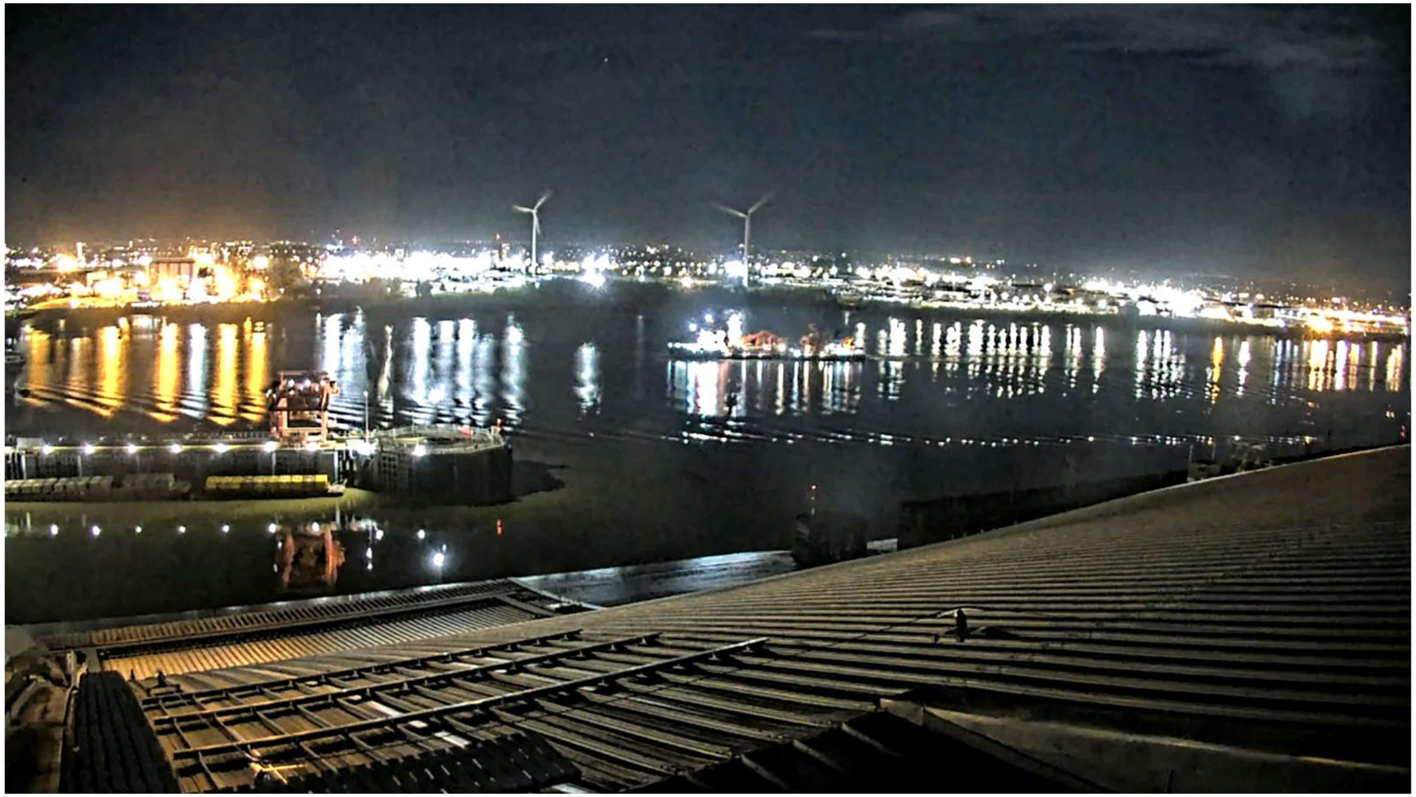
Figure Ref: 0235_Inbound_RoRos_SweptPath_Adeline3

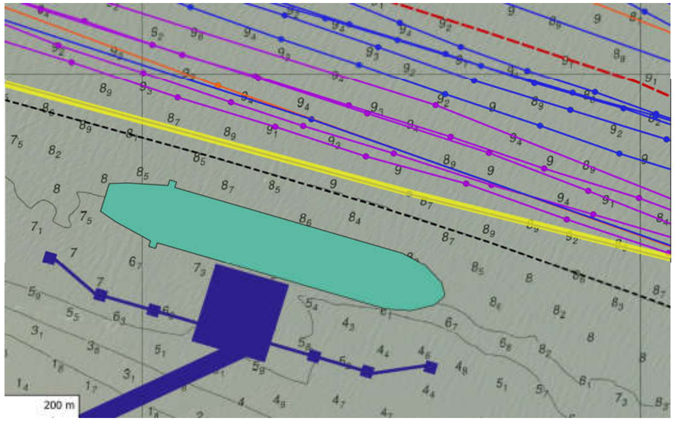
CLdN Manoeuvres



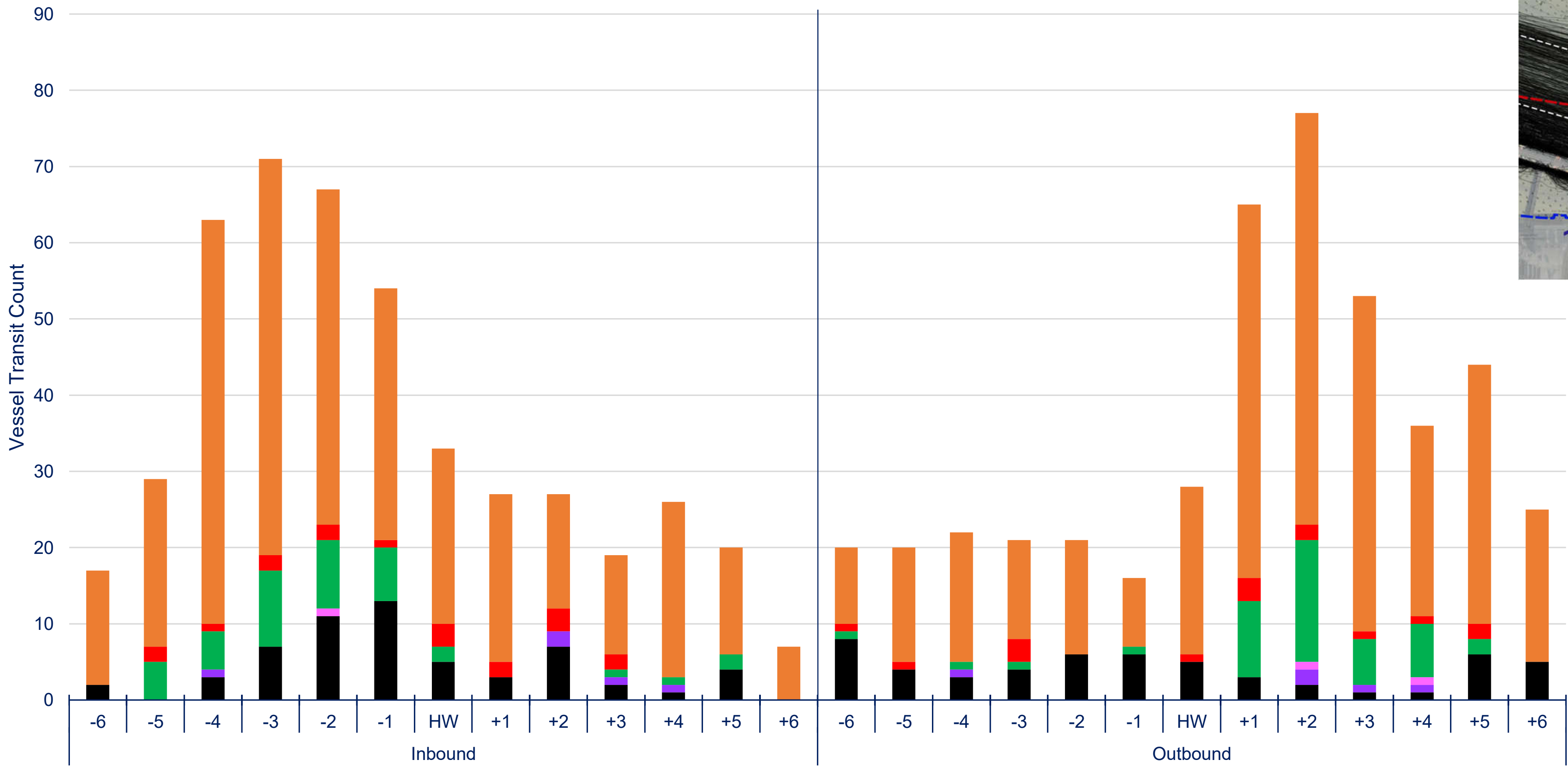


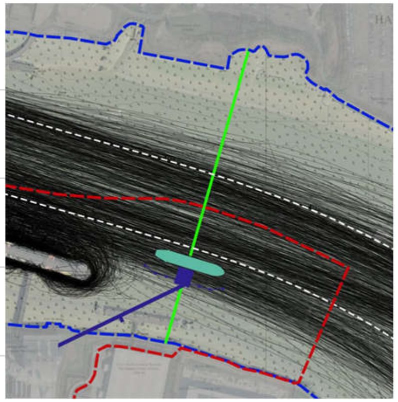
Video example: Whilhelmine





Tidal analysis





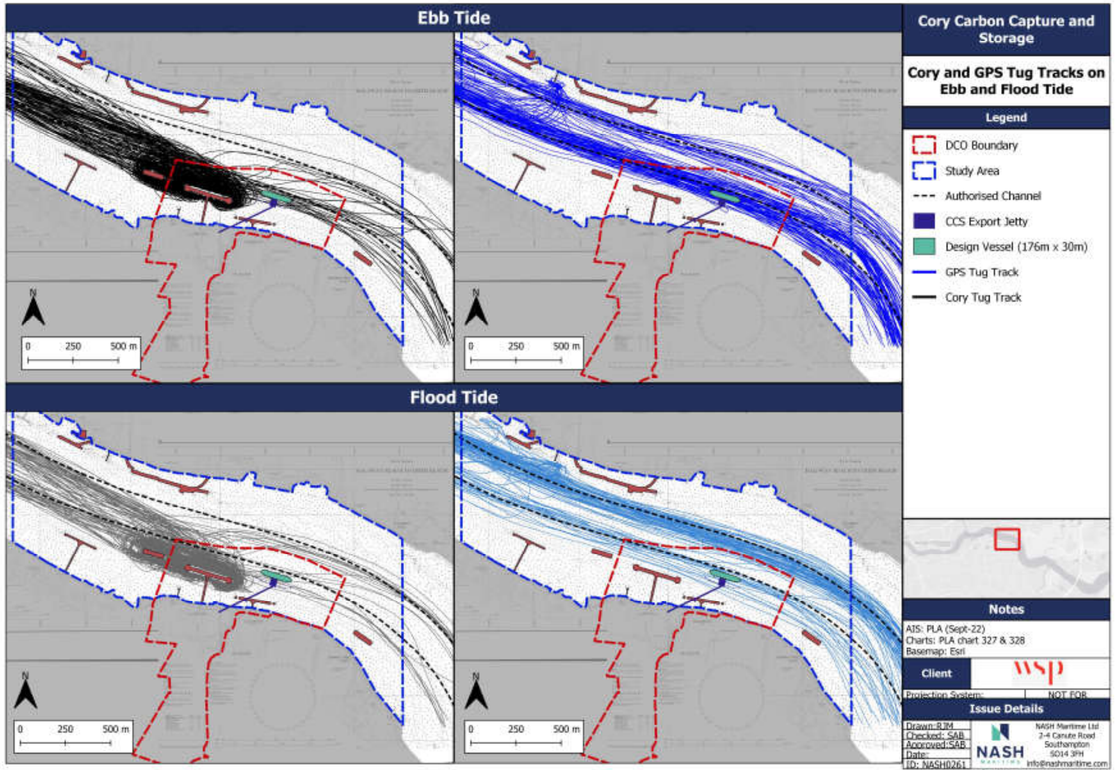
GPS

- Consultation meeting:
  - GPS commented that key concern related to the positioning of the jetty, explaining that when muck away barges are outbound on an ebb tide (1 tug could be towing two barges weighing up to 1500t each) it is necessary for them to navigate south of the authorised channel when approaching Jenningtree bend to avoid being set toward the north side of the river as they round the bend. On a young ebb tide, tug and tows are likely to pass inside the Jenningtree marker, as the tide strengthens, they will aim to pass just north of the marker when rounding the bend.

  - GPS of the view that position of the Jetty would mean that when moored the tanker would block the route south of the authorised channel and prevent tug and tows from aligning correctly to safely navigate Jenningtree bend. The risk being the tug and tows are set to the north side of the river and potentially risk grounding or colliding with inbound vessels.

Cory tug and barge tracks

NASH
MARITIME



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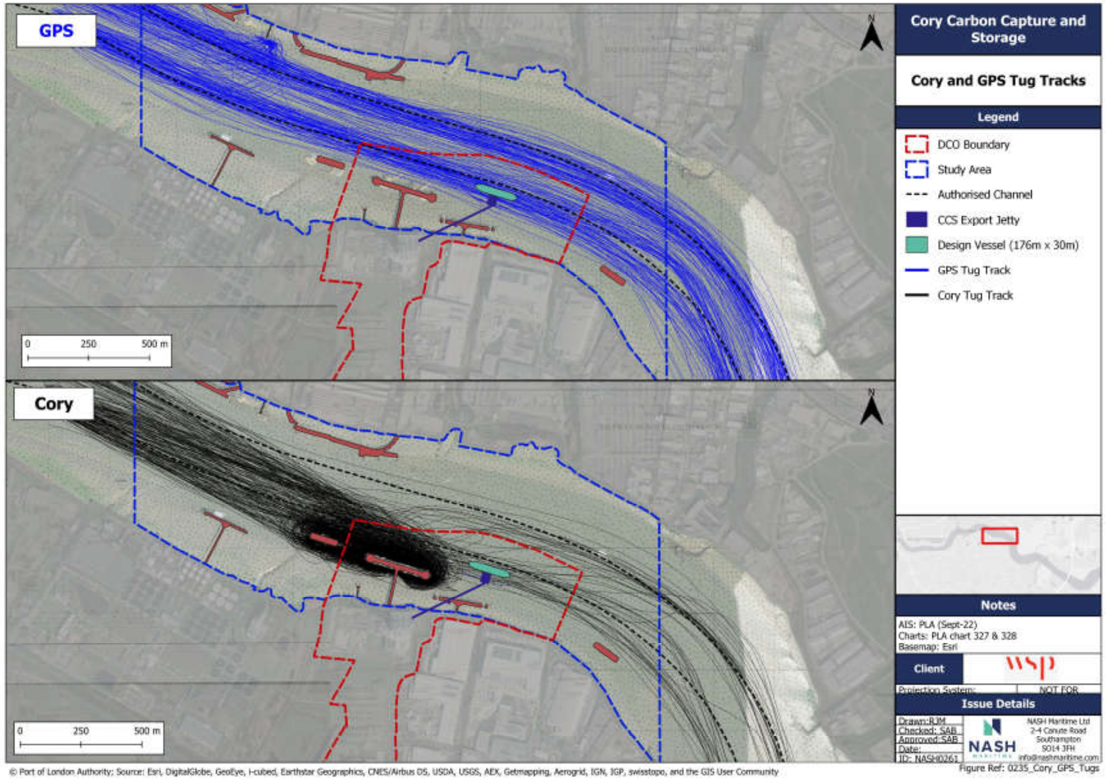

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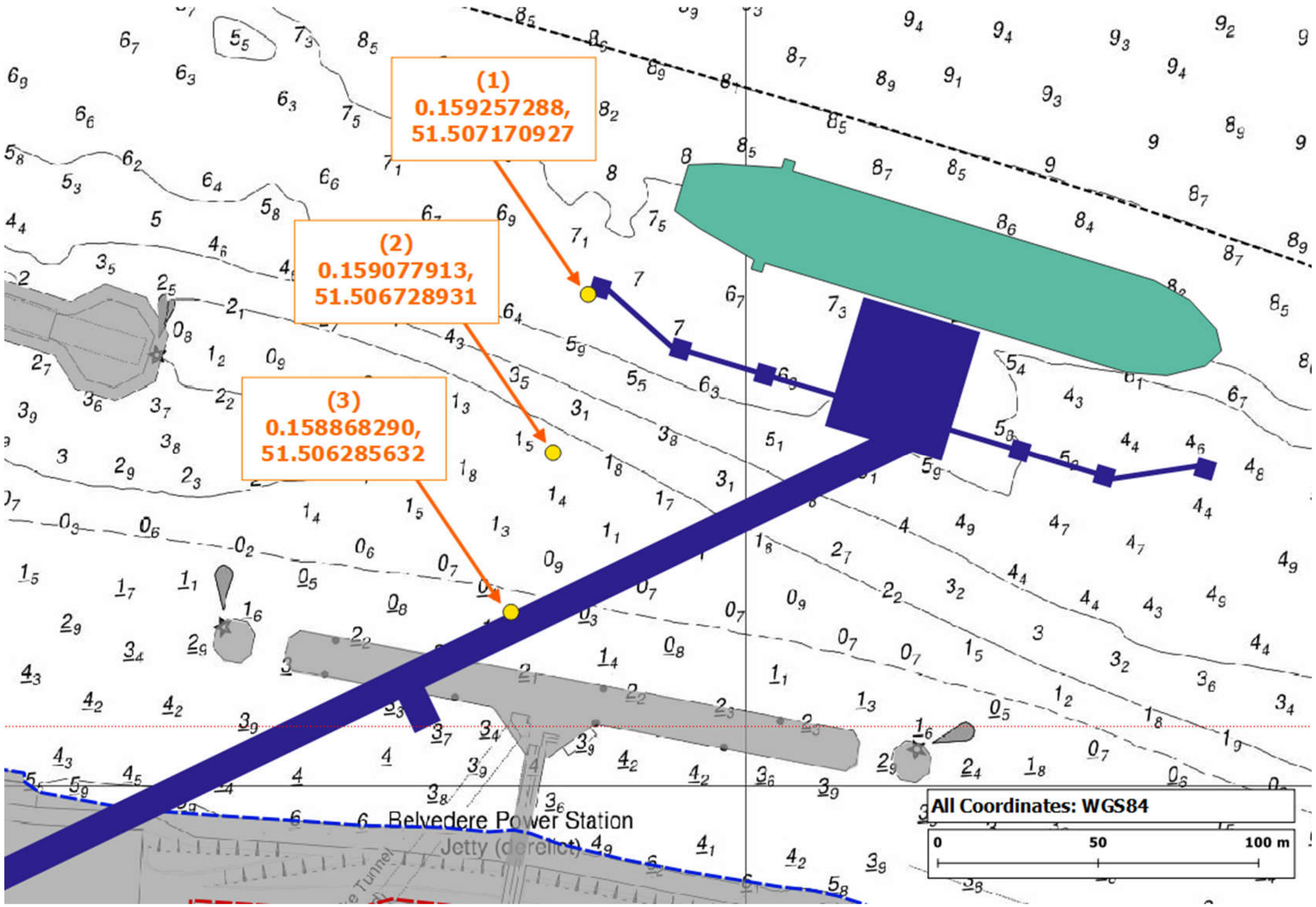
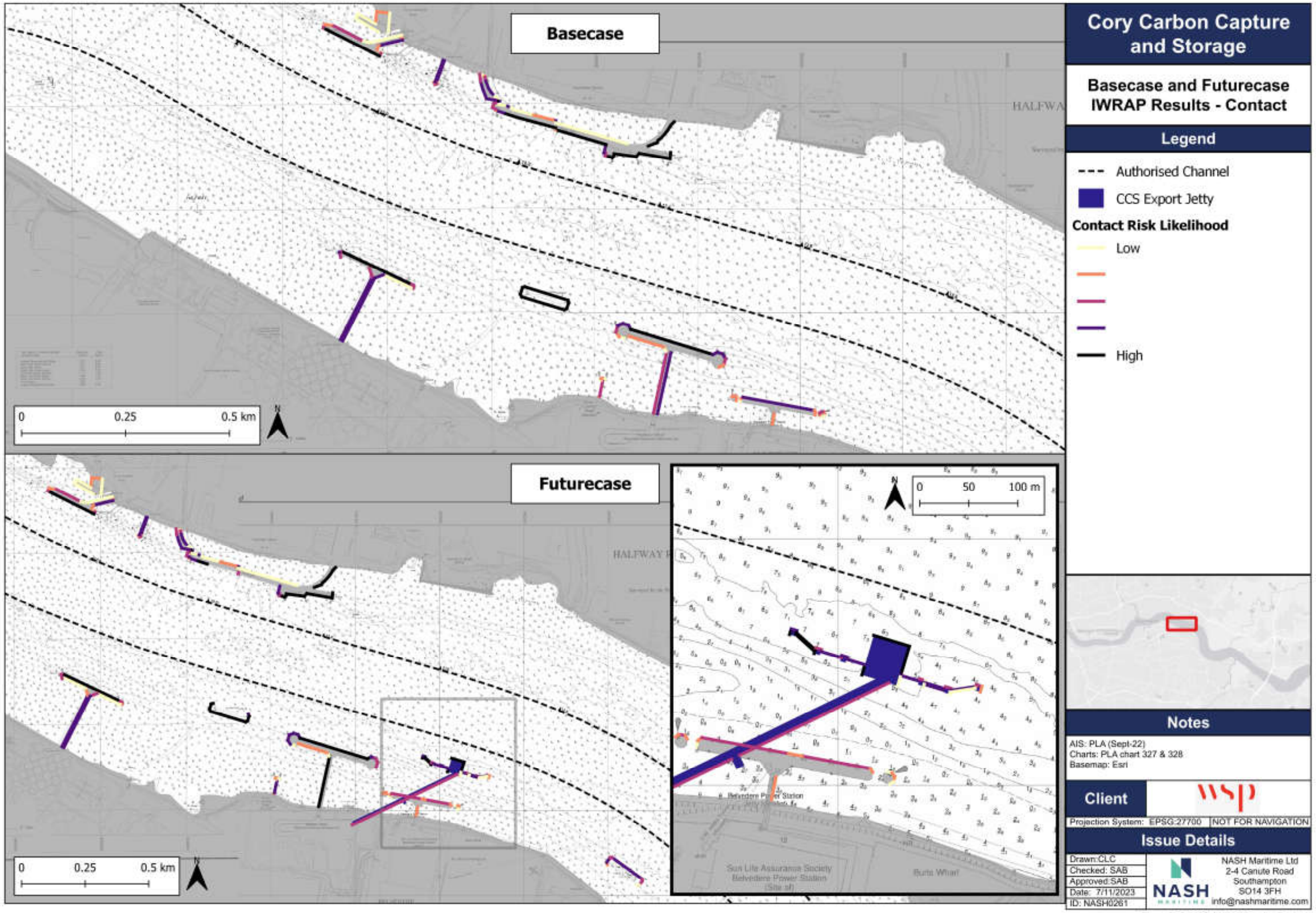
Pellet Buoy Placement



Hazard likelihood modelling

Contact

	Basecase	Futurecase
Powered Allision	3.9	1.34
Drifting Allision	27.4	22.3
Total Allisions	3.4	1.3



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Collision

	Basecase	Futurecase
Overtaking	134	101
HeadOn	231	109
Crossing	217	481
Merging	598	31.8
Bend	76.8	76.9
Total Collisions	32.1	15.2

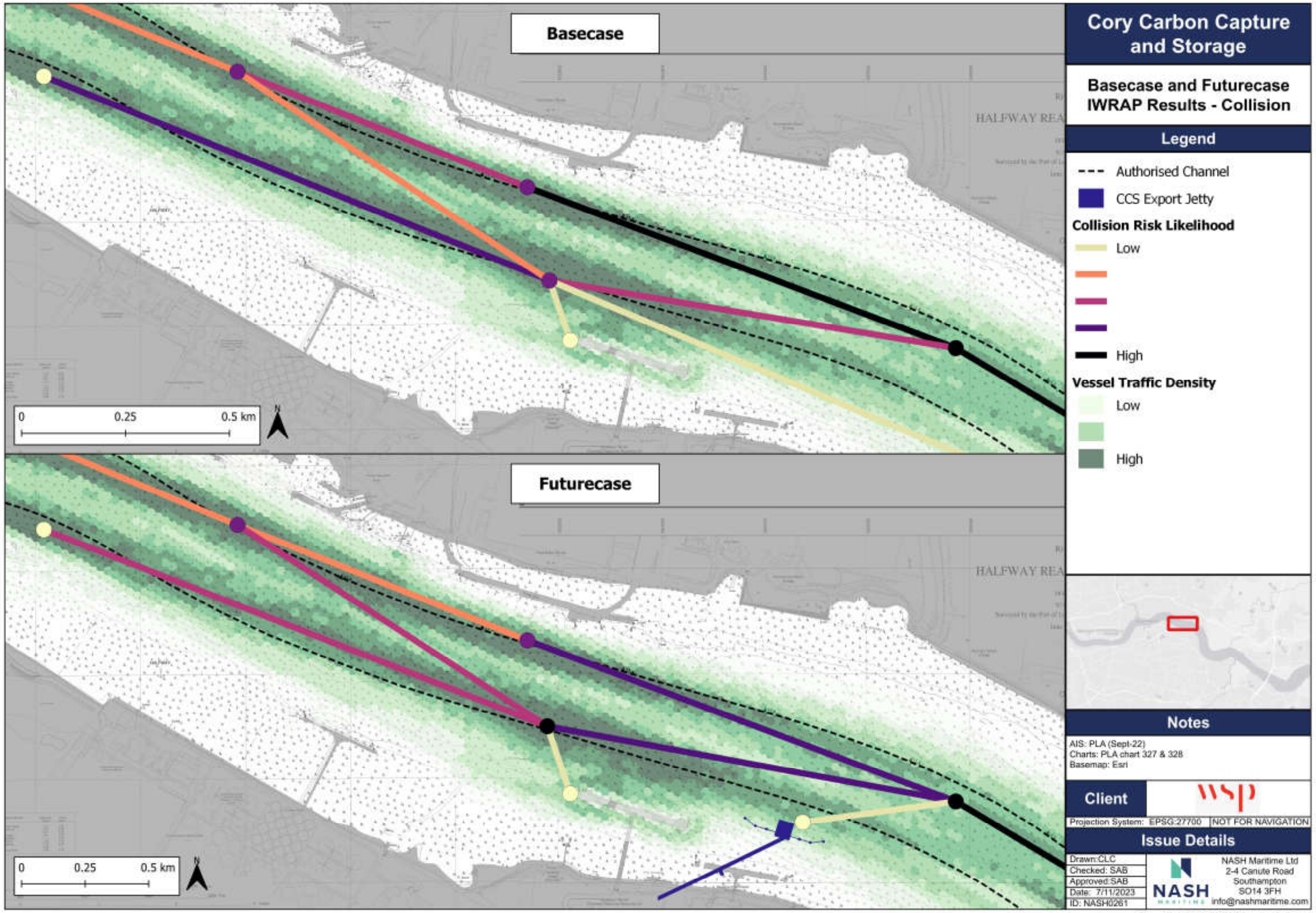

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Figure Ref: 0235_IWRAPResults_Collision

Grounding

	Basecase	Futurecase
Powered Grounding	24.4	6.6
Drifting Grounding	219	176
Total Groundings	21.9	6.31

(Tidal state = MHW)

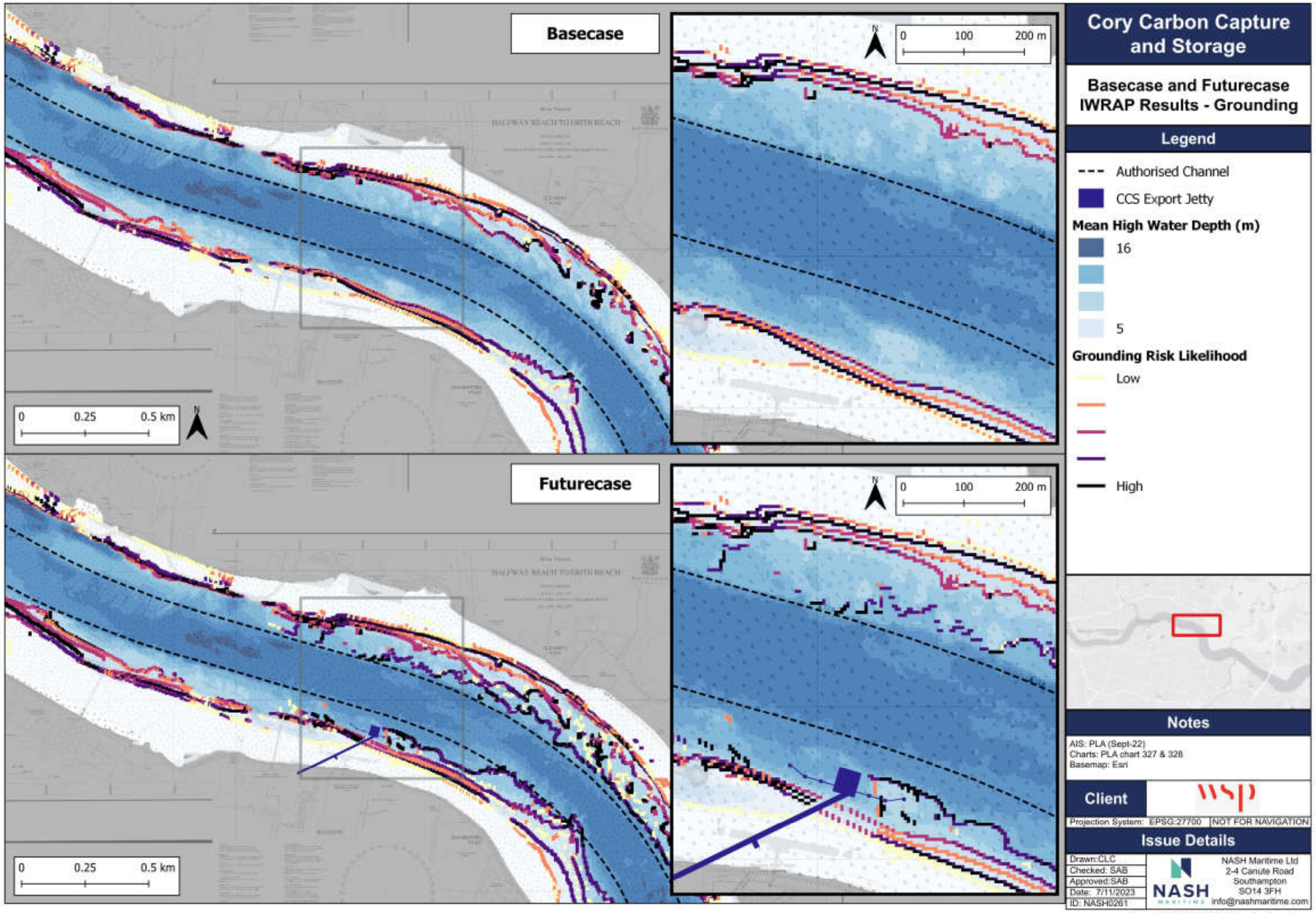


Figure Ref: 0235_IWRAPResults_Grounding

Risk Assessment

Navigation Risk Assessment

- Construction and operation
- Incorporate analysis, consultation and expert judgement/local knowledge
- ID hazards, establish risk assessment matrix
- Score baseline risk
- ID risk controls
- Score risk control effectiveness (frequency/likelihood)
- Update and finalise risk assessment matrix and logs to amended PLA methodology

Risk Scoring Matrix					
Almost Certain	5	10	15	20	25
Likely	4	8	12	16	20
Possible	3	6	9	12	15
Unlikely	2	4	6	8	10
Rare	1	2	3	4	5
Likelihood	Minor	Moderate	Serious	Very Serious	Severe

Hazard types

Hazard #	Hazard Types	Definition
1	**Collision**	Collision between two vessel underway (also includes striking of an anchored vessel).
2	**Contact (Allision)**	Vessel makes contact with Fixed or Floating Object (FFO) (e.g. quay, pile, shoreline, buoy, moored vessel).
3	**Ranging / Breakout**	Vessel moves from securely moored position, may result in damage to non-vessel objects.
4	**Grounding**	Vessel makes contact with shore or river bed

Identified vessel types

Vessel #	Vessel Types	Description
1	**Cargo**	Vessels carrying cargo such as containers, dry bulk cargo, vehicles, aggregates, commercial dredgers. Including vessels for **CLdN and Hansons.**
2	**Tanker**	Liquid bulk vessels e.g bunker vessels, product & chemical tankers. Activity predominantly associated with **Stolthaven Thunderer Jetty.**
3	**Passenger**	HSC, cruise, sail training vessels and Class V vessels.
4	**Tug, Service and Other Small Vessel**	Tugs (including with tow), maintenance dredgers, workboats, port service, law enforcement and survey vessels not associated with the construction activities. This includes **Cory** vessels operating at **Middleton Jetty** and **GPS** vessels operating to and from **Amey's Jetty.**
5	**Recreational Vessel**	Powered or unpowered recreational vessels
6	**Construction Vessel**	All vessels engaged in construction activities for the CCS Jetty including Jack up barges, tug and tow, dredger, workboats.
7	**Project Vessel**	LCO2 tanker servicing the CCS Jetty.

Contact scenarios

Contact Scenarios	Detail
CCS Jetty (or a vessel moored alongside)	The operational jetty post construction or a vessel moored alongside.
Marine Works	The CCS jetty whilst under construction including associated construction craft whilst moored at the site (e.g. Jack Up Barge, Crane Barge)
Third Party Infrastructure	All other fixed and floating infrastructure in the study area (**Middleton** and **Belvedere** Jetties).

Hazard causes

ID	Cause Name	Commentary
1	Action of the tidal stream	Strong tidal set to North of Jenningtree
2	Adverse weather conditions	Strong SW and S winds combined with tidal set push vessels North
3	Avoidance of another vessel	Additional Cory tug and barge vessel movements resulting from Riverside 2, tanker required to cross authorised channel on arrival / departure at CCS Jetty
4	Communications failure	Ship to ship or VTS
5	Displacement of small vessels into authorised channel	CCS Jetty will obstruct the inshore route currently utilised by GPS, Cory and other small craft (when height of tide allows)
6	Human error	Captain / Pilot / Tug Master / Jetty operative error
7	Increased vessel activity within study area	Increased vessel activity see ID 3
8	Interaction with passing vessel	Draw-off of Project Vessel when moored alongside CCS Jetty by large vessels passing. Results from speed of passing vessel and proximity of transit.
9	Mechanical defect / failure	Failure of equipment leads to vessel being restricted in its ability to manoeuvre / non-operational.
10	Misjudged manoeuvre	Specific mariner error during manoeuvre e.g. Project Vessel or CLdN vessel swinging of berth.
11	Reduced visibility	Resulting from fog / snow or heavy rainfall
12	Reduced width of navigable water	Resulting from encroachment of CCS jetty into navigable inshore zone south of authorised channel.
13	Towage failure	Parting of tow line, tug breakdown etc.
14	Vessel wash	Excessive wash leading to ranging of project vessel
15	Excessive vessel speed	Excessive speed not related to interaction but leading to reduced thinking / reaction time.

Identified hazards construction

Hazard Id #:	Hazard Type	Hazard Title
1	Collision	Collision - Construction Vessel ICW Cargo
2	Collision	Collision - Construction Vessel ICW Tanker
3	Collision	Collision - Construction Vessel ICW Passenger
4	Collision	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel
5	Collision	Collision - Construction Vessel ICW Recreational Vessel
6	Collision	Collision - Construction Vessel ICW Construction Vessel
7	Collision	Collision - Third Party Vessels as a result of avoiding project/construction vessels
8	Contact (Allision)	Contact (Allision) - Cargo ICW Marine Works
9	Contact (Allision)	Contact (Allision) - Tanker ICW Marine Works
10	Contact (Allision)	Contact (Allision) - Passenger ICW Marine Works
11	Contact (Allision)	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works
12	Contact (Allision)	Contact (Allision) - Recreational Vessel ICW Marine Works
13	Contact (Allision)	Contact (Allision) - Construction Vessel ICW Marine Works
14	Contact (Allision)	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure
15	Grounding	Grounding - Cargo
16	Grounding	Grounding - Construction Vessel
17	Ranging/Breakout	Breakout - Construction Vessel

Identified hazards operation

Hazard Id #:	Hazard Type	Hazard Title
1	Collision	Collision - Project Vessel ICW Cargo
2	Collision	Collision - Project Vessel ICW Tanker
3	Collision	Collision - Project Vessel ICW Passenger
4	Collision	Collision - Project Vessel ICW Tug, Service and Other Small Vessel
5	Collision	Collision - Project Vessel ICW Recreational Vessel
6	Collision	Collision - Third Party Vessels as a result of avoiding project/construction vessels
7	Contact (Allision)	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)
8	Contact (Allision)	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)
9	Contact (Allision)	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)
10	Contact (Allision)	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)
11	Contact (Allision)	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)
12	Contact (Allision)	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)
13	Contact (Allision)	Contact (Allision) - Project Vessel ICW Third Party Infrastructure
14	Grounding	Grounding - Cargo
15	Grounding	Grounding - Project Vessel
16	Ranging/Breakout	Breakout - Project Vessel

Embedded risk controls

Embedded Risk Controls (RCs)	
RC ID	**Risk control**
1	Aids to navigation
2	Availability of latest hydrographic information
3	Berthing procedures
4	Byelaws
5	General Directions - General Directions for Navigation in the Port of London - September 2023
6	Monitoring of met ocean conditions
7	Oil spill contingency plans
8	Passage planning including abort points and passing areas
9	Pilotage
10	Port Facility Emergency Plan
11	Towage
12	Vessel reporting requirements
13	Berthing simulation study
14	Vessel Traffic Services
15	Weather limits
16	Construction RAMS
17	International/National legislation
18	Promulgation of information – e.g. Notices to Mariners, Navigation Warning.

Inherent Risk Assessment (construction)

Haz ID	Inherent Risk Rank	Hazard Name	Score
8	1	Contact (Allision) - Cargo ICW Marine Works	16.0
17	2	Breakout - Construction Vessel	15.0
9	3	Contact (Allision) - Tanker ICW Marine Works	12.0
13	4	Contact (Allision) - Construction Vessel ICW Marine Works	10.0
1	5	Collision - Construction Vessel ICW Cargo	9.0
7	5	Collision - Third Party Vessels as a result of avoiding construction vessels	9.0
6	7	Collision - Construction Vessel ICW Construction Vessel	8.0
10	7	Contact (Allision) - Passenger ICW Marine Works	8.0
11	7	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works	8.0
12	7	Contact (Allision) - Recreational Vessel ICW Marine Works	8.0
2	11	Collision - Construction Vessel ICW Tanker	6.0
3	11	Collision - Construction Vessel ICW Passenger	6.0
4	11	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel	6.0
5	11	Collision - Construction Vessel ICW Recreational Vessel	6.0
14	11	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure	6.0
15	11	Grounding - Cargo	6.0
16	17	Grounding - Construction Vessel	3.0

Inherent Risk Assessment (operation)

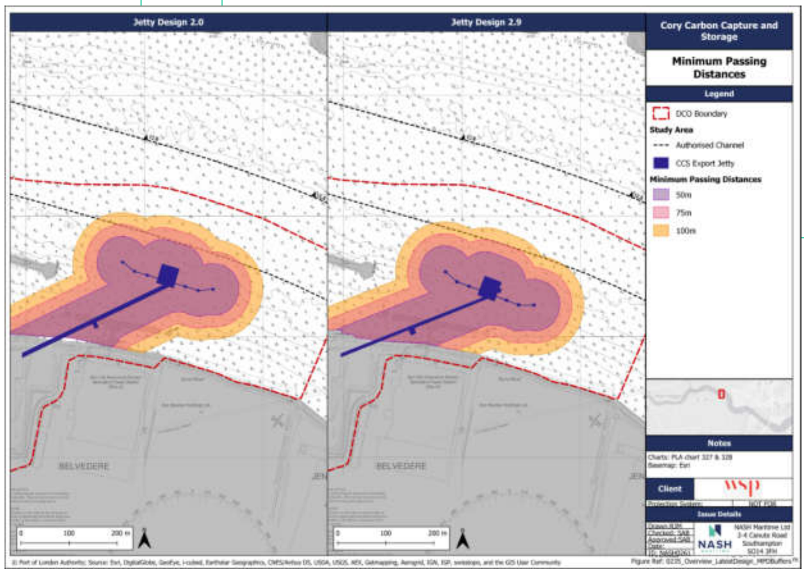
Haz ID	Inherent Risk Rank	Hazard Name	Score
7	1	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	16.0
16	2	Ranging / Breakout - Project Vessel	15.0
8	3	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	12.0
1	4	Collision - Project Vessel ICW Cargo	9.0
4	4	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0
6	4	Collision - Third Party Vessels as a result of avoiding project vessels	9.0
3	7	Collision - Project Vessel ICW Passenger	8.0
9	7	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	8.0
10	7	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	8.0
12	7	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	8.0
2	11	Collision - Project Vessel ICW Tanker	6.0
5	11	Collision - Project Vessel ICW Recreational Vessel	6.0
11	11	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	6.0
14	11	Grounding - Cargo	6.0
15	11	Grounding - Project Vessel	6.0
13	16	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	4.0

Additional risk controls (1 of 4)

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
1	**Promulgation and dissemination of information**	Information relating to project construction and operation phases to be shared as widely as possible through NtM, VTS broadcasts, updates to guidance documents, emails to key stakeholders and through social media platforms: **Construction phase:** • Planned vessel movements (arrivals and departures of materials barges) • Sequencing of construction works and proposed marine works mooring configurations to be shared with VTS and marine stakeholders (e.g. CLdN). • Requirement for speed reduction and minimum passing distance to marine works. **Operational phase:** • Updates to navigational publications (charts, port guidance documents e.g. PLA Port Information Guide)	Yes	Yes
2	**Standby tug**	Standby tug to be available during construction works to mitigate consequences of breakout.	Yes	No
3	**Defined project operational limitations**	Operational restrictions should include (but may not be limited to) limiting parameters for: • Wind; • Height of tide • Tidal stream; and • Visibility. • Minimum available UKC at which arrivals and departures can occur. • Tug assistance required. • Tidal state e.g. ebb and flood arrivals and departures	Yes	Yes
4	**Deconfliction of Cory operations with arrival/departure of Project vessel**	Cory tug and barge operation in and around Middelton Jetty to cease during project vessel arrival / departure.	No	Yes

Additional risk controls (2 of 4)

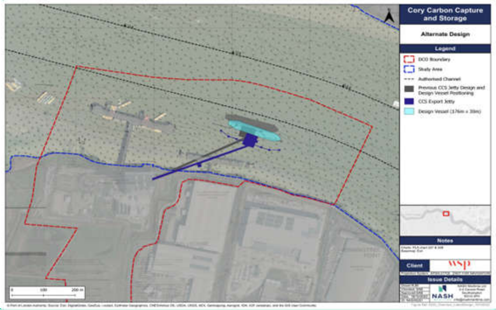
Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
5	**Positioning of berth infrastructure**	Berth infrastructure including, fenders, number and position of bollards, gangway and shore connections (especially LCO2 hard arm) should be designed to mitigate the likelihood and consequences of the project vessel ranging.	No	Yes
6	**Minimum passing distance and Speed Reduction (*Also consider navigation exclusion zone around Marine Works)***	Enforcement of a minimum passing distance from Marine Works (50m) to vessels passing within the authorised channel in addition to a requested maximum Speed Reduction (less than 6kts). Requirements to proceed with caution or at slow speed will be made in accordance with the procedure set out in the Port of London Authority's Port Information Guide, under 'London VTS', 'Section 4'. Masters of passing vessels should have due regard for the effects of their wash including the possibility of rebound from the river wall and the combined effect of wash from other vessels.	Yes	No



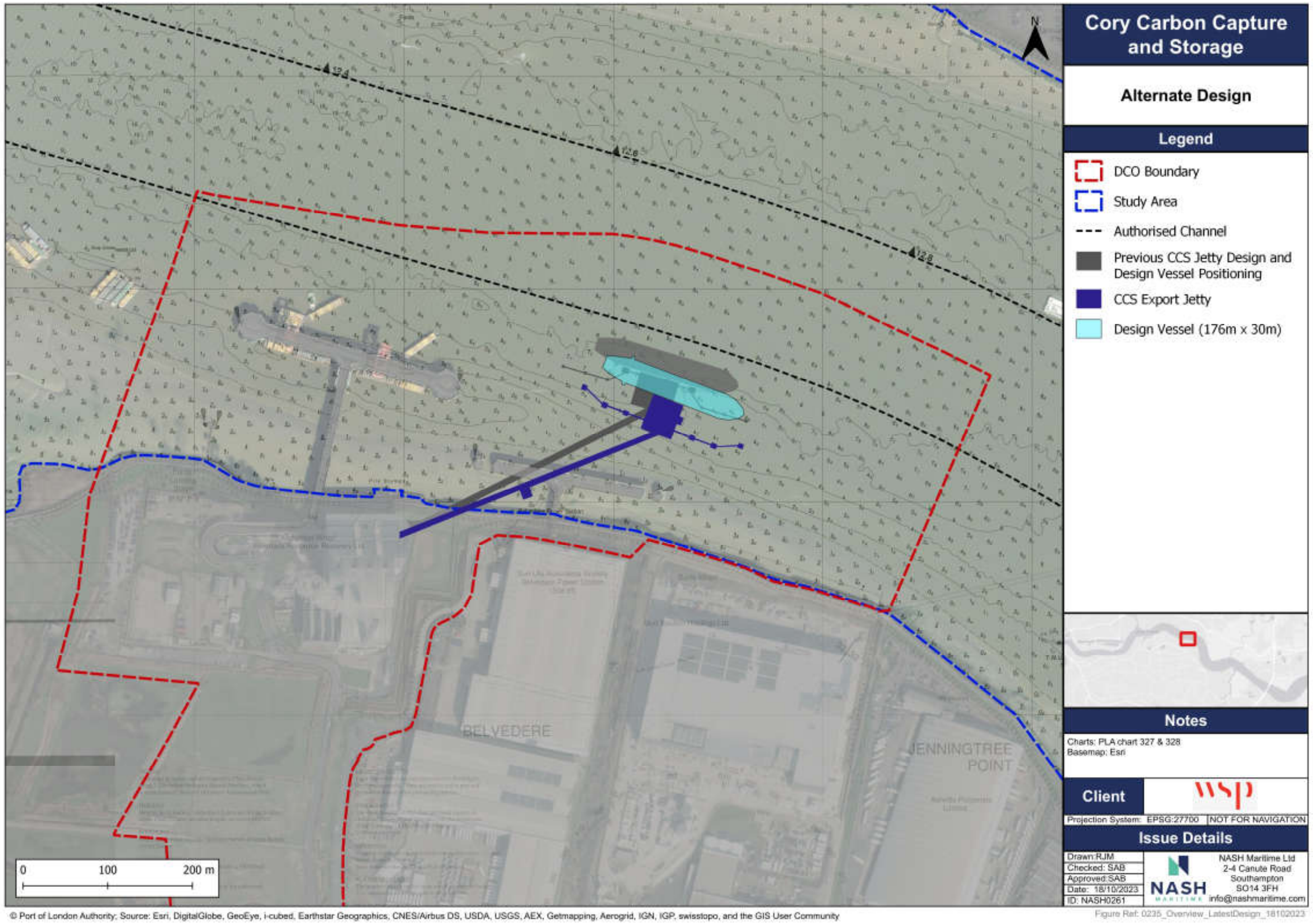
Additional risk controls (3 of 4)

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
7	**Safety boat**	Based on a PLA supplied specification a Safety Boat would be: • Focused on the alerting of Category 1 and Category 2 responders in event of persons or objects falling into the river from the works / operation. • To provide a recovery response for falling persons. • Not to provide local control navigation. • In full communication with work's contractors and the appropriate PLA VTS Control Centre. • To alert works contractors of impending breach of non-intrusion area by errant craft. • Generally sited downstream of the protected works or moored downstream of the protected works with an agreed response time from notification to deployment. • Shallow draught, low freeboard (for rescue of recreational craft and persons) and equipped with basis safety equipment. • Crewed by 2 persons with the minimum qualifications of RYA Safety Boat Certificate for the helmsman/person in charge and the second person being RYA Power Boat Level 2 or International Certificate of Competence (ICC).	Yes	No
8	**Lighting of marine works and construction vessels**	Lighting of marine works before permanent AtoN are installed	Yes	No
9	**Dynamic Mooring analysis**	A Dynamic Mooring Analysis should be conducted considering the local environmental conditions and the effect of passing vessels.	No	Yes
10	**Full Ship Bridge Simulations**	PLA and local PEC holders to participate in Full Ship Bridge Simulations to assist in familiarisation with project operational navigational environment and inform evidence-based decision making in relation to jetty location and design.	No	Yes

Additional risk controls (4 of 4)

Additional Risk Controls				
			Application	
RC ID	Risk Control Name	Risk Control Description	Construction Phase	Operation Phase
11	**Marine works and construction vessel mooring configurations**	Give due consideration to marine works mooring layouts to minimise risk of breakout resulting from vessel interaction. Optimise construction sequencing to ensure maximum distance between southern extent of authorised channel and marine works. Deploy and utilise spud legs in addition to mooring anchor spread.	Yes	No
12	**Consider Relocation of Jetty (Preliminary Design Revision)** 	Relocate jetty south of current location. **Note**, the design shown is a preliminary revision and is subject to the findings of Risk Control ID # 8 and 9 as well as further design work by WSP. The Preliminary Design Revision • 75m between mid-point of main jetty platform and southern limit of authorised channel (as opposed to 50) • 45m between north extent of moored Project Vessel and southern limit of authorised channel (as opposed to 20m) • 150m between north extent of moored Project Vessel and centre of authorised channel (as opposed to 120m) •	Yes	Yes

Option 2.9



Cory Carbon Capture and Storage
Alternate Design
Legend
DCO Boundary
Study Area
Authorised Channel
Previous CCS Jetty Design and Design Vessel Positioning
CCS Export Jetty
Design Vessel (176m x 30m)
Notes
Charts: PLA chart 327 & 328
Basemap: Esri
Client
Projection System: EPSG:27700
NOT FOR NAVIGATION
Issue Details
Drawn: RJM
Checked: SAB
Approved: SAB
Date: 18/10/2023
ID: NASH0261
NASH Maritime Ltd
2-4 Canute Road
Southampton
SO14 3FH
info@nashmaritime.com
BELVEDERE
JENNINGTREE POINT
0
100
200 m
© Port of London Authority; Source: Esri, DigitalGlobe, GeoEye, i-cubed, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community
Figure Ref: 0235_Overview_LatestDesign_18102023

Residual Risk Assessment (Construction)

Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Calculated Risk Score	Residual Calculated Risk Score
17	2	1	Ranging / Breakout - Construction Vessel	15.0	9.0
8	1	2	Contact (Allision) - Cargo ICW Marine Works	16.0	8.0
9	3	2	Contact (Allision) - Tanker ICW Marine Works	12.0	8.0
13	4	2	Contact (Allision) - Construction Vessel ICW Marine Works	10.0	8.0
1	5	5	Collision - Construction Vessel ICW Cargo	9.0	6.0
7	5	5	Collision - Third Party Vessels as a result of avoiding construction vessels	9.0	6.0
6	7	5	Collision - Construction Vessel ICW Construction Vessel	8.0	6.0
10	7	5	Contact (Allision) - Passenger ICW Marine Works	8.0	6.0
11	7	5	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works	8.0	6.0
12	7	5	Contact (Allision) - Recreational Vessel ICW Marine Works	8.0	6.0
2	11	5	Collision - Construction Vessel ICW Tanker	6.0	6.0
3	11	5	Collision - Construction Vessel ICW Passenger	6.0	6.0
4	11	13	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel	6.0	4.0
5	11	13	Collision - Construction Vessel ICW Recreational Vessel	6.0	4.0
14	11	13	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure	6.0	4.0
15	11	13	Grounding - Cargo	6.0	4.0
16	17	17	Grounding - Construction Vessel	3.0	3.0

Residual Risk Assessment (Operation)

Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Calculated Risk Score	Residual Calculated Risk Score
16	2	1	Breakout - Project Vessel	16.0	12.0
7	1	2	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	15.0	9.0
8	3	3	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	12.0	6.0
1	4	3	Collision - Project Vessel ICW Cargo	9.0	6.0
4	4	3	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0	6.0
6	4	3	Collision - Third Party Vessels as a result of avoiding project vessels	9.0	6.0
3	7	12	Collision - Project Vessel ICW Passenger	8.0	4.0
9	7	3	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	8.0	6.0
10	7	3	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	8.0	6.0
12	7	3	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	8.0	6.0
2	11	14	Collision - Project Vessel ICW Tanker	6.0	3.0
5	11	14	Collision - Project Vessel ICW Recreational Vessel	6.0	3.0
11	11	14	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	6.0	3.0
14	11	3	Grounding - Cargo	6.0	6.0
15	11	3	Grounding - Project Vessel	6.0	6.0
13	16	12	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	4.0	4.0

CCS – PNRA CONSULTATION

Project Title	Cory Carbon Capture and Storage pNRA
Project Number	22_NASH_0235
Meeting subject / purpose	Stakeholder Consultation
Revision	R01-00
Date of meeting	09-Nov-2023
Start time	13:00 BST
Finish time	14:30 BST
Client	Cory / WSP
Location	MS Teams

These minutes should be issued alongside and read in conjunction with PPT ref: 22_NASH_0235-CCS_pNRA_Workshop_PLA_R01-00 – references to the slide(s) containing pertinent supplementary information are included within the minutes below.

ATTENDEES

Organisation	Attendee	Role	Initial
PLA	Lydia Hutchinson	Marine Manager	LH
NASH Maritime	Sam Anderson-Brown	Principal Consultant	SAB
NASH Maritime	Clarie Conning	Maritime Consultant	CC
NASH Maritime	Adam Fitzpatrick	Senior Consultant	AF
WSP	Jo Evans	Technical Director (Maritime)	JE

NOTES OF MEETING

1	Introductions	Action
1.1	SAB welcomed all to the meeting and brief introductions were held.	
2	**Agenda (slide 2) and Meeting Objectives (slide 3)**	
2.1	SAB outlined the agenda for the meeting (see slide 2)	

2.2	SAB explained outlined the meeting objectives as follows:
	• Review and explore key themes and outcomes of stakeholder consultation exercise alongside additional analysis;
	• Seek feedback on:
	    • Inherent risk assessment results;
	    • Proposed additional risk control measures; and
	    • Residual risk assessment results.	

3	**Project Overview (slides 4 to 11)**	
3.1	SAB gave an overview of the project including the proposed jetty design, marine operation and high level construction methodology (slides 4 to 11)	
3.2	LH (in reference to tanker arrival and departures) commented that PLA pilots had considered flood arrivals and ebb departures during strong stream to be higher risk manoeuvres and that pilotage restrictions may apply. SAB commented that arrivals were likely to be around HW – 1 and departures no later than HW + 1.5, therefore the strongest tidal stream should be avoided.	
3.3	In reference to the construction stage LH commented that she would anticipate the project making use of spud anchors as well as anchor mooring spread to securely moor construction barges and would want to see robust, evidence based justification for the current methodology given high tidal streams in the area.	
4	**Consultation review and additional analysis (12 to 25)**	
4.1	SAB presented an overview of the consultation outcomes.	
4.2	In relation to tug and service craft navigating north or south of Jenningtree channel marker LH commented that tow configuration could well have a bearing on routeing undertaken, as well as tidal stream and height.	
4.3	SAB commented that CLdN has stated that full ship bridge simulations would be required before they (CLdN) could make any further comment on acceptability of the jetty location. LH said that the PLA supports the CLdN position and the requirement for full ship bridge simulations to be undertaken to further inform jetty location and impact on third party users e.g. CLdN, Hanson etc.	
4.4	SAB explained that although CLdN did not consider interaction between their vessels and project vessel to be an issue the NASH project team felt draw off effect could still be a concern. Reason for this difference of opinion relates to vessel speed. CLdN have stated that their vessels passed the jetty location at low speed (approx. 6 knots) whereas AIS data shows vessels passing at up to 12 knots and on the southern limit of the authorised channel.	
5	**Hazard likelihood Modelling (slides 26 to 29)**	
5.1	SAB presented an overview of the modelling results and explained that IWRAP mk II produced conservative results as it did not take in to account numerous embedded risk control measures that are implemented in a port environment e.g. pilotage.	
5.2	SAB highlighted that increase in collision likelihood in the future case model is predominately associated with additional vessel movements by tug and service craft with the introduction of the project vessel having little influence.	
5.3	LH commented that contact / allision increase was as expected due to increase in vessel traffic and addition of jetty.	
6	**Risk Assessment (Slides 30 – 47)**	
6.1	SAB presented an overview of the Risk Assessment task including: - Hazard identification; - Inherent risk assessment; - Proposed additional risk controls; and - Residual risk controls.	
6.2	**Hazard identification (slides 32 - 38)** - LH commented that she felt all relevant hazards for construction and operation phase had been identified.	

6.3	**Inherent risk assessment (slides 40 - 41)** - LH queried score for Haz ID 11 - Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works and stated that due to Hazard likelihood she felt there was a case for this hazard to score as higher than "moderate". SAB explained that although likelihood had been scored high, consequence was thought to be less significant than other identified contact hazards. SAB committed to reviewing hazard scoring. - LH felt that allocated hazard scores were appropriate and highlighted key areas of concern namely issues associated with proximity of jetty to passing vessel traffic within the authorised channel.	
6.4	**Additional Risk Controls (slides 41 to 45)** - SAB asked whether LH felt a navigation exclusion zone could be appropriate during construction works. LH commented that exclusion zone would work, vessels would have to deviate around marine works anyway so formalising this requirement would be sensible. LH suggested only implementing exclusion zone during certain phases of construction, e.g. exclusion zone may not be required during access trestle installation (which is situated within intertidal zone). - **Consider Relocation of Jetty (Preliminary Design Revision) –** SAB explained that current jetty location in close proximity to the authorised channel gave rise to key concerns relating to vessel interaction and resulting draw off effect in combination with concerns in relation to contact hazard occurrence. This results in high levels of baseline risk and it is therefore recommended that consideration be given to the relocation of the jetty (preliminary design revision included on slide 45). SAB explained that NASH project team had scored ranging / breakout and contact hazards conservatively as the project has not yet undertaken work to fully understand the impact of draw off and / or impacts to third party vessel manoeuvres (critically CLdN). A key recommendation of the pNRA is therefore to undertake a dynamic mooring analysis and Full Ship Bridge Simulations for third party operators (both included as additional risk controls. - LH supported the recommendation to undertake dynamic mooring analysis and Full Ship Bridge Simulations to further inform the navigation risk assessment. - LH confirmed that the PLA would expect to see this work undertaken within a future NRA update as the evidence base for the pNRA and likelihood / consequence scores allocated was not sufficient to confirm whether the current jetty location posed an unacceptable level of navigation risk.	
	Residual Risk Assessment (slides 46 to 47) - LH felt that allocated hazard scores were appropriate (given work has not yet been undertaken to consider impact of draw off and impacts on third party vessel manoeuvres). - SAB reiterated that scoring was conservative and following additional work (dynamic mooring analysis and full ship bridge simulations for third party operations) likelihood and consequence scores for ranging / breakout and contact hazards could be revisited (and potentially reduced). This will in turn inform decision making as to the location of the proposed jetty. - SAB explained that if dynamic mooring analysis and simulations indicated that baseline level of risk associated with ranging / breakout and contact hazards fell within acceptable level of risk then requirement to consider relocation of jetty could be redundant.	

Appendix J
Hazard Logs

MARINE RISK ASSESSMENT FORM

Assessment Title	Cory Carbon Capture Construction
Assessment Date	11/10/2023
Version	R01-00

Average Inherent	8.5
Average Residual	5.9

Hazard ID	Inherent Ri	Residual Ri	Hazard Description	Hazard type	Cause	Consequence – Most likely – Ppl	Most likely – Env	Most likely – Prop	Most likely – Rep	Most likely – Imp	Worst Credible – Ppl	Worst Credible – Env	Worst Credible – Prop	Worst Credible – Rep	Worst Credible – Imp	Inherent Risk – Likelihoo	Inherent Risk – Severity	Inherent Risk – Score	Additional Risk Control Measures	Residual Risk – Likelihoo	Residual Risk – Severity	Residual Risk – Score
1	6	6	Collision - Construction Vessel ICW Cargo	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat	2	3	6
2	11	6	Collision - Construction Vessel ICW Tanker	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat	2	3	6
3	11	6	Collision - Construction Vessel ICW Passenger	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Moderate injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat	2	3	6
4	11	13	Collision - Construction Vessel ICW Tug, Service and Other Small Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat	2	2	4
5	11	13	Collision - Construction Vessel ICW Recreational Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat	2	2	4
6	8	6	Collision - Construction Vessel ICW Construction Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	4	2	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat	3	2	6

7	6	6	Collision - Third Party Vessels as a result of avoiding construction vessels	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug	2	3	6
8	1	1	Contact (Allision) - Cargo ICW Marine Works	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Single Fatality.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-National news coverage with significant potential for reputational damage	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	4	4	16	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	2	4	8
9	3	1	Contact (Allision) - Tanker ICW Marine Works	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Single Fatality.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-National news coverage with significant potential for reputational damage	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	4	12	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	2	4	8
10	8	6	Contact (Allision) - Passenger ICW Marine Works	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Single Fatality.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-National news coverage with significant potential for reputational damage	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	4	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	2	3	6
11	4	1	Contact (Allision) - Tug, Service and Other Small Vessel ICW Marine Works	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	5	2	10	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	4	2	8
12	8	6	Contact (Allision) - Recreational Vessel ICW Marine Works	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	4	2	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	3	2	6
13	4	1	Contact (Allision) - Construction Vessel ICW Marine Works	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	5	2	10	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	4	2	8

14	11	13	Contact (Allision) - Construction Vessel ICW Third Party Infrastructure	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 7. Navigation exclusion zone 8. Standby tug 9. Safety boat 10. Marine works and construction vessel mooring configurations 11. Lighting of marine works and construction vessels	2	2	4
15	11	13	Grounding - Cargo	Grounding	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information	2	2	4
16	17	17	Grounding - Construction Vessel	Grounding	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / structure unoperational and in need of repairs.	-Little or no risk to company image.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	3	1	3	3. Defined Proposed Scheme limitations (Construction and Operation) 8. Standby tug	3	1	3
17	2	1	Breakout - Construction Vessel	Breakout	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash	-Minor or No injuries.	-Minor impact on environment and port operation with no lasting effects	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Minor impact on environment and port operation with no lasting effects	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	5	3	15	1. Relocation of Proposed Jetty (Option 3) 3. Defined Proposed Scheme limitations (Construction and Operation) 6. Minimum passing distance and speed reduction 8. Standby tug 9. Safety boat 10. Marine works and construction vessel mooring configurations	4	2	8

MARINE RISK ASSESSMENT FORM

Assessment Title	Cory Carbon Capture
Assessment Date	11/10/2023
Version	R01-00

Average Inherent	**8.5**
Average Residual	**5.7**

Hazard ID	Inherent Risk	Residual Risk	Hazard Description	Hazard type	Cause	Consequence – Most likely: Ppl	Most likely: Env	Most likely: Prop	Most likely: Rep	Most likely: Imp	Worst Credible: Ppl	Worst Credible: Env	Worst Credible: Prop	Worst Credible: Rep	Worst Credible: Imp	Inherent Risk: Likelihood	Inherent Risk: Severity	Inherent Risk: Score	Additional Risk Control Measures	Residual Risk: Likelihood	Residual Risk: Severity	Residual Risk: Score
1	4	3	Collision - Project Vessel ICW Cargo	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Major / life changing injuries.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	2	3	6
2	11	14	Collision - Project Vessel ICW Tanker	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Major / life changing injuries.	-Serious long-term impact on environment and / or permanent damage.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations	1	3	3
3	7	12	Collision - Project Vessel ICW Passenger	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Moderate injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	4	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	1	4	4
4	4	3	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	2	3	6
5	11	14	Collision - Project Vessel ICW Recreational Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	1	3	3
6	4	3	Collision - Third Party Vessels as a result of avoiding project vessels	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations	2	3	6

7	1	2	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	4	4	16	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations	2	4	8
8	3	3	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	4	12	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations	2	3	6
9	7	3	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Moderate injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	4	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone	2	3	6
10	7	3	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	4	2	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel 7. Navigation Exclusion Zone	3	2	6
11	11	14	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 7. Navigation Exclusion Zone 3. Defined Proposed Scheme limitations (Construction and Operation)	1	3	3
12	7	3	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	4	2	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel	3	2	6
13	16	12	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	2	2	4	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 13. Full ship bridge simulations	2	2	4

MARINE RISK ASSESSMENT FORM

14	11	3	Grounding - Cargo	Grounding	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	2. Promulgation and dissemination of information 13. Full ship bridge simulations	3	2	6
15	11	3	Grounding - Project Vessel	Grounding	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel	3	2	6
16	2	1	Breakout - Project Vessel	Breakout	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	5	3	15	1. Relocation of Proposed Jetty (Option 3) 3. Defined Proposed Scheme limitations (Construction and Operation) 5. Positioning of berth infrastructure 7. Navigation Exclusion Zone 12. Dynamic Mooring analysis	4	3	12

Appendix K
HR Wallingford third party Simulation Run List and summary conclusions

hr wallingford

Run	Pilot [1]	Manoeuvre	Layout option	Vessel and draught (T)	Traffic	Tug positioning [2]	Tidal condition [3]	Wind direction and speed (knots, from)	Outcome	Comments
Day 1 – 29th January 2024										
01	VV	Inbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW - 1 (flood)	SW (225°N) 15 knots	N/A – familiarisation manoeuvre	A familiarisation manoeuvre for the Captain to become familiar with the simulator controls and the manoeuvring model. The vessel transited past the proposed jetty position at a passing distance of 198m with a speed of 6.2 knots through the water.
02	VV	Inbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW - 5 (flood)	SW (225°N) 25 knots	N/A – familiarisation manoeuvre	An increase in wind conditions when compared to Run 01. Another familiarisation manoeuvre for the Captain to become familiar with the simulator controls and the manoeuvring model. The vessel transited past the proposed jetty position at a passing distance of 180m with a speed of 6.6 knots through the water
03	VV	Inbound	2	162m RoRo 'Celestine' ' (T = 6.5m)	None	None	HW - 5 (flood)	SW (225°N) 25 knots	N/A – familiarisation manoeuvre	A familiarisation manoeuvre for the Captain to becoming familiar with the simulator controls and the manoeuvring model. The vessel transited past the proposed jetty position with an acceptable passing distance (143m) with a speed of 7.1 knots through the water.
04	VV	Inbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW + 3 (peak ebb)	NE (045°N) 15 knots	Successful	A successful manoeuvre, with no cause for concern. With the vessel heading into the flow condition the vessel can be manoeuvred under full control. The vessel transited past the proposed jetty position with a passing distance of 151m with a speed of 8.7 knots through the water.
05	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW + 3 (peak ebb)	NE (045°N) 20 knots	Successful	A straight forward manoeuvre, with no cause for concern. The vessel transited past the proposed jetty position with a passing distance 127m with a speed of 9.0 knots through the water. It was noted that if a minimum passing distance of 60m is required, the vessel remained >60m away from the proposed jetty position.
06	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	100m dredger - inbound	None	HW - 3 (peak flood)	NE (045°N) 25 knots	Marginal – vessels passing speed and distance was unacceptable	A departure manoeuvre, the vessel is manoeuvred off the berth and holds position upstream of the proposed jetty position, whilst the dredger transits past the jetty position. It was discussed that it would be challenging for the vessel to hold its position upstream, if the tide was ebbing, due to the difficulty in stemming the tide, and the vessel would remain alongside until the vessel has transited past the proposed jetty position. The ship 'Celestine', passed the moored ship at a speed of 10.7 knots through the water with a minimum passing distance of 58m to the beam of the moored vessel. It was noted that the vessel was passing to fast given the passing distance of <60m.
07	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	100m dredger inbound	None	HW - 3 (peak flood)	NE (045°N) 25 knots	Failure – vessel came within close proximity to the jetty, at an unacceptable passing speed.	A departure manoeuvre, with the vessel holding position upstream, whilst the inbound vessel transited past the proposed jetty position. The vessels passed adjacent to the proposed jetty location. The ship 'Celestine' came within close proximity to the proposed jetty (<10m) and at a speed of 9.1 knots through the water. It was noted that the vessel could have either held its position upstream of the proposed jetty position for longer, or remained alongside the berth, such that the vessels would not have passed adjacent to the proposed jetty position.
08	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	100m dredger inbound	None	HW - 3 (peak flood)	NE (045°N) 25 knots	Successful	A successful manoeuvre with no cause for concern. The vessel held its position upstream of the proposed jetty position, such that the passing location of the inbound and outbound vessel was upstream of the proposed jetty position. The ship 'Celestine' positioned towards the centreline of the channel, allowing for a passing distance of 65m passing the moored vessel alongside the proposed terminal at a speed of 5.3 knots through the water

09	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	2 x 75t BP ASD tugs Tug 1 – Centre lead forward Tug 2 – Port quarter	HW + 3 (peak flood)	NE (045°N) 35 knots	Marginal – vessels passing speed and distance was unacceptable, The remaining manoeuvre was considered a Failure as the vessel contacted the Jenningtree Buoy.	The vessel transited past the proposed jetty with a passing distance of 41m with a speed of 8.0 knots through the water. After the vessel had transited past the proposed jetty position, the wind set the vessel south, such that it contacted the Jenningtree Buoy.
10	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	2 x 75t BP ASD tugs Tug 1 – Centre lead forward Tug 2 – Port quarter	HW + 3 (peak flood)	NE (045°N) 35 knots	Successful	A refinement swing manoeuvre off the berth when compared to Run 09, which provided an improvement to the overall manoeuvre, such that the vessel was able to remain at an acceptable clearance from the proposed jetty. The tugs were able to assist the vessel during the swinging manoeuvre and did not impact safe navigation of the vessel. The vessel transited past the proposed jetty position with a passing distance of 109m with a speed of 8.4 knots through the water.
Day 2 – 30th January 2024										
11	VV	Inbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW + 3 (peak ebb)	SW (225°N) 25 knots	Successful	A successful manoeuvre with no cause for concern. The vessel is set to the north of the channel by the prevailing south westerly wind condition, and is able to remain at a safe distance and speed from the proposed terminal. The vessel transited past the proposed jetty position with a passing distance of 143m with a speed of 6.1 knots through the water.
12	VV	Inbound	2	162m RoRo 'Celestine' (T = 6.5m)	None	1 x 75t BP ASD tug Tug 1 – In attendance, port side	HW – 3 (peak flood)	NE (045°N) 25 knots	Successful	A successful manoeuvre, with no cause for concern. It was demonstrated that there is sufficient available manoeuvring area for a supporting tug and vessel to manoeuvre past the jetty with speeds and distances remaining acceptable throughout. The vessel transited past the proposed jetty position with a passing distance of 105m with a speed of 9.0 knots through the water.
13	VV	Outbound	3	162m RoRo 'Celestine' (T = 6.5m)	100m dredger inbound	None	HW – 3 (peak flood)	NE (045°N) 25 knots	Successful	The vessel departed the berth and held position upstream of the proposed jetty position, stemming the tide until the dredger was just downstream of the proposed jetty. The ship 'Celestine' then began its outbound transit, passing the jetty at 5.8 knots through the water and at a distance of 73m. It was noted that the increase in available manoeuvring area with Option 3 (when compared to Option 2) is preferred.
14	VV	Inbound	3	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW – 3 (peak flood)	NE (045°N) 35 knots	Successful	A successful manoeuvre with no cause for concern. The vessel remained on the northern side of the channel throughout, with a passing distance of 150m and at a speed of 8.7 knots from the proposed jetty.
15	VV	Inbound	3	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW – 3 (peak flood)	SW (225°N) 15 knots	Successful	A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 160m and a speed through the water of 7.9 knots.
16	MB	Inbound	3	162m RoRo 'Celestine' (T = 6.5m)	None	None	HW – 3 (peak flood)	SW (225°N) 25 knots	Successful	A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 96m and a speed through the water of 7.1 knots.
17	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	100m dredger inbound	2 x 75t BP ASD tugs Tug 1 – Centre lead forward Tug 2 – Port quarter	HW – 3 (peak flood)	SW (225°N) 30 knots	Successful	A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 87m and a speed through the water of 5.5 knots.
18	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	100m dredger inbound	None	HW – 3 (peak flood)	SW (225°N) 10 knots	Marginal – vessels passing speed and distance was unacceptable	A manoeuvre to identify whether vessels can pass adjacent to the proposed jetty position jetty position. Although from a navigational point of view the manoeuvre was successful, the passing speed and distance were considered

										unacceptable and need to be confirmed by a passing ship analysis study. It was noted that the manoeuvre could have been improved, if the outbound vessel held its position upstream, to avoid passing adjacent to the proposed jetty position. The vessel transited past the proposed jetty position with a passing distance of 46m with a speed of 6.5 knots through the water
19	VV	Outbound	3	162m RoRo 'Celestine' (T = 6.5m)	None	2 x 75t BP ASD tugs Tug 1 – Centre lead forward Tug 2 – Port quarter	HW + 3 (peak ebb)	NE (045°N) 35 knots	Successful	Two tugs were used to assist the swing off the berth but were let go before the vessel transited past the proposed jetty position. A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 120m and a speed through the water of 7.3 knots.
20	VV	Inbound	3	162m RoRo 'Celestine' (T = 6.5m)	None	2 x 75t BP ASD tugs Tug 1 – Port shoulder Tug 2 – Centre lead aft	HW – 3 (peak flood)	SW (225°N) 30 knots	Successful	A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 85m and a speed through the water of 8.2 knots.
21	VV	Outbound	2	162m RoRo 'Celestine' (T = 6.5m)	100m dredger and Thames Clipper inbound	None	HW – 3 (peak flood)	SW (225°N) 30 knots	Successful	An outbound manoeuvre with an inbound dredger and Thames Clipper. The two inbound vessels remained at a safe distance to the outbound vessel, as it held its position upstream of the proposed jetty position. A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 76m and a speed through the water of 6.0 knots.
Day 3 – 31st January 2024										
22	NJ	Inbound	2	100m dredger 'City of Westminster'	None	None	HW – 3 (peak flood)	SW (225°N) 15 knots	Successful	Familiarisation manoeuvre for the Port of London Authority Pilots to become familiar with the simulator controls and the manoeuvring model. A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 201m and a speed through the water of 10.9 knots.
23	MP	Outbound	2	100m dredger 'City of Westminster'	None	None	HW + 3 (peak ebb)	SW (225°N) 25 knots	Marginal – vessels passing speed and distance was unacceptable	A departure manoeuvre, with the vessel beginning its transit adjacent to the Stolthaven terminal. The vessel transited towards the south of the river, passing the moored vessel on the jetty at a speed of 11.0 knots through the water and at a minimum distance of 52m.
24	NJ	Outbound	3	100m dredger 'City of Westminster'	None	None	HW + 3 (peak ebb)	SW (225°N) 25 knots	Successful	A successful manoeuvre with no cause for concern. The vessel passed the proposed jetty at a minimum passing distance of 85m and a speed through the water of 13.0 knots.
25	MP	Outbound	3	100m dredger 'City of Westminster'	100m dredger inbound	None	HW + 3 (peak ebb)	SW (225°N) 25 knots	Successful	A departure manoeuvre where the vessels pass downstream of Jenningtree Buoy. It was noted that although it is achievable to have vessels pass in this location, it would be favourable for vessels to pass upstream of the proposed jetty position. The vessel passed the proposed jetty at a minimum passing distance of 125m and a speed through the water of 13.0 knots.
26	NJ	Inbound	2	185m bulker (T = 11.0m)	None	None	HW - 1 (flood)	SW (225°N) 15 knots	Successful	A successful manoeuvre with no cause for concern. The vessel transited past the proposed jetty at a passing distance of 154m with a passing speed of 11.0 through the water.
27	MP	Outbound	2	185m bulker (T = 8.0m)	None	None	HW - 1 (flood)	SW (225°N) 15 knots	Marginal – vessels passing speed and distance was unacceptable	The outbound vessel passed within 51m to the moored vessel at the proposed jetty and a speed of 12.8 knots through the water. The Pilot noted that there was potential for the manoeuvre to be refined, to improve the passing distance to moored vessel at the proposed jetty (see Run 28).
28	NJ	Inbound	2	185m bulker (T = 11.0m)	None	None	HW + 1 (ebb)	SW (225°N) 15 knots	Successful	A repeat of Run 28, with a refined starting position and departure strategy, such that the outbound vessel remains towards the centre

										of the channel. The vessel passed the proposed jetty at a minimum passing distance of 69m and a speed through the water of 10.0 knots.
29	MP	Inbound	2	239m cruise vessel (T = 6.45)	None	None	HW - 3 (peak flood)	NE (045°N) 15 knots	Successful	Straight forward manoeuvre with no cause for concern. The vessel transited past the terminal in the centre of the channel with an approximate passing distance of 100m at a speed through the water of 13.0 knots. A safe and sufficient manoeuvre, but with an extra 20-30m of available manoeuvring area with option 3 this would be preferable.
30	NJ	Outbound	2	239m cruise vessel (T = 6.45)	None	None	HW + 1 (ebb)	NE (045°N) 20 knots	Successful	A successful manoeuvre with no cause for concern. The vessel remained at a passing distance 99m with a passing speed of 12.7 knots, through the water.
31	MP	Outbound	3	239m cruise vessel (T = 6.45)	100m dredger inbound	None	HW + 1 (ebb)	NE (045°N) 20 knots	Marginal - vessels passing speed and distance was unacceptable	The vessel passed the moored vessel at an unacceptable passing distance of 50m with a speed of 13.8 knots through the water.
32	NJ	Outbound	3	185m bulker (T = 8.0m)	None	2 x 75tBP ASD tugs In attendance	HW - 1 (flood)	SW (225°N) 20 knots	Successful	A departure manoeuvre to determine the minimum passing speed whilst maintaining a passing distance of greater than 60m. The vessel transited past the moored vessel at the jetty with a separation of 137m, with a speed of just over 4.0 knots through the water, with the assisting tugs also remaining at a passing distance to the proposed jetty position.
33	MP	Outbound	3	185m bulker (T = 8.0m)	None	2 x 75tBP ASD tugs In attendance	HW + 1 (ebb)	NE (045°N) 20 knots	Successful	A departure manoeuvre to determine the minimum passing speed whilst maintaining a passing distance that can be achieved. The vessel transited past the moored vessel at the jetty, with a speed of 6.0 knots through the water, at a distance of approximately 130m.

[1]: Pilots VV - Captain Vincent Veys (CLdN), NJ - Captain Neil Jephcote (PLA), MP - Captain Michele Pulizzi (PLA)

[2]: All tugs were centrally controlled by the simulator operator based on the commands of the pilot.

[3]: The tidal position was taken from the centre of the channel, adjacent to the berth.

[4]: For all simulation runs, a 162m x 26m tanker was moored starboard side to the proposed jetty.

Appendix L
pNRA Update Meeting (PLA) – Meeting Minutes and Presentation

CCS – PNRA CONSULTATION

Project Title	Cory Carbon Capture and Storage pNRA
Project Number	22_NASH_0235
Meeting subject / purpose	PLA Update
Revision	R01-00
Date of meeting	21-Aug-2024
Start time	15:00 BST
Finish time	16:00 BST
Client	Cory / WSP
Location	MS Teams

These minutes should be issued alongside and read in conjunction with PPT ref: – 22-NASH-0235_PLA_Update_Aug-2024_R01-00 references to the slide(s) containing pertinent supplementary information are included within the minutes below.

ATTENDEES

Organisation	Attendee	Role	Initial
PLA	Lydia Hutchinson	Marine Manager	LH
PLA	Lucy Owen	Deputy Director of Planning and Development	LO
NASH Maritime	Sam Anderson-Brown	Principal Consultant	SAB
NASH Maritime	Brocque Preece	Principal Consultant	BP
NASH Maritime	Nigel Bassett	Principal Consultant	NB
WSP	Jo Evans	Technical Director (Maritime)	JE

NOTES OF MEETING

1	Introductions	Action
1.1	SAB welcomed all to the meeting and brief introductions were held.	
2	**Agenda (slide 2)**	
2.1	SAB outlined the agenda for the meeting: • NRA status update. • Variations to proposed scheme. • Proposed NRA scope.	
2.2	SAB outlined meeting objectives: • Provide update to PLA on latest revision of pNRA (PLA have not seen this document). • Explain variation to proposed scheme that will impact current pNRA.	

	• Discuss proposed pNRA updated scope to ensure any variations in navigation risk profile are sufficiently captured.	
3	**Third Party Nav Sims – Outcomes summary (slide 3)**	
3.1	SAB gave an overview of the Third Party Nav Sim findings – see summary in slide 3.	
3.2	The location of the Proposed Jetty (Option 2 and Option 3) results in reduced navigable width to the south of the authorised channel. When rounding Jenningtree bend, this creates no significant challenge for one way traffic but will mean that when two large vessels that are restricted to utilising the authorised channel wish to pass in the area this would need to take place to the west of the Proposed Jetty. This presents a slight change in the way vessels restricted to the authorised channel currently navigate as at present the outbound vessel will likely position itself close north of the location of the Proposed Jetty. It is not felt that this will result in any significant change in navigation risk profile as it is possible for outbound vessels to hold station to the west of the Jetty and stem the tide, this was proved during the simulations. It is understood through discussion with the PLA Pilots and CLdN Captains that vessels do not look to pass in the area of the navigable channel when rounding Jenningtree bend. Given current levels of vessel traffic the requirement for a large outbound vessel to hold station to the west of the Proposed Jetty whilst a large inbound vessel navigates past the Proposed Jetty location is thought to be a relatively rare occurrence (possibly around once a week).	
3.3	LH asked if 60m exclusion zone would intrude into navigation channel when tanker was moored alongside. SAB confirmed that exclusion zone would impede approx. 15m.	
3.4	LO asked about commercial impacts of Proposed Jetty on operations e.g. CLdN. SAB explained that CLdN had confirmed during sims that minor delays to departures (or holding station to west of Proposed Jetty) whilst project vessel manoeuvred on to berth would have little to no impact on their operations.	
4	**Passing vessel mooring interaction study (slide 4)**	
4.1	BP presented a summary of the passing vessel mooring interaction study, see slide 4 and items 4.2 to 4.16 below.	
4.2	The passing vessel mooring interaction study was commissioned following identification of Project Vessel breakout from the Proposed Jetty as a result of passing vessel interaction as a potential hazard.	
4.3	The purpose was to inform the risk assessment and not to undertake mooring design analysis, which would form part of the Proposed Jetty detailed design, at which point a detailed dynamic mooring analysis would be undertaken to define the mooring system design, equipment selection and inform structural requirements of the berth and Proposed Jetty.	
4.4	The key largest vessels operating in the vicinity of the Proposed Jetty were: Bulk carrier, Cruise vessel and CLdN RoRo vessels – the same as identified for the Nav Sim studies.	
4.5	A realistic typical close passing distance (based on mariner guidance and discussion during Nav Sims) can be considered to be approximately 2.0 x the passing vessel's beam, which for these key largest vessels being around 60m. This also approximately aligns with potential implementation of a 60m exclusion zone to be applied to a project vessel whilst moored.	
4.6	Based on mariner guidance, large vessels and particularly those with deep draft, would be anticipated to typically operate at 6 knots, or up to 8 knots as an	

	exception, when passing a berthed tanker at the Proposed Jetty and on approach to a river bend.	
4.7	The assessment objective was to assess the passing vessel forces, moored vessel response and potential for breakout. Therefore, mooring line loading has been used to provide an indication of mooring capability. Elements subject to future detailed design phases of the terminal, such as fender and marine loading arm selection, would be within the control of the project design and would therefore be designed appropriately at that time.	
4.8	Of the three largest vessel types on the river at this location, the worst for generating vessel interaction forces is a deep draft (loaded) large Bulk Carrier, followed by the large Cruise Ship	
4.9	All vessels passing at 6 knots at a close passing distance of 2x the vessel's beam line did not exceed the recommended maximum mooring line load limit (as per OCIMF industry guidance being 50% of the mooring line breaking strength).	
4.10	None of the vessels passing at 6 knots, 8 knots or 10 knots caused the moored vessel to breakout and drift completely free of the berth in the mooring simulations. At higher speeds, some mooring line loads exceed winch brake setting, however, were not overwhelmed by the applied prevailing adverse wind and current and remained alongside the berth.	
4.11	For the worst vessel – the large Bulk Carrier – the scenario of the loaded Bulk Carrier heading outbound does not currently occur due to the nature of bulk cargo sugar ship operations in this section of the river being in ballast outbound.	
4.12	Similar trends were also observed for Cruise vessels and CLdN RoRo vessels which did not exceed recommended line loading limits at 8 knots but for the Cruise vessel started to exceed recommended line loading limits at higher speeds of 10 knots. Note, passing the Proposed Jetty at 6 knots as opposed to 10 knots is likely to reduce overall transit time by approx. 4 minutes and therefore will not cause any considerable delays to transit times.	
4.13	In most-likely scenarios, such as 6 knots close passing up to 8 knots at greater passing distances in adverse conditions, the moored vessel did not exceed recommended line loading limits. For worst credible scenarios, such as 10 knots close passing in adverse conditions, then mooring optimisation through detailed design (which would also support operational considerations such as terminal-specific vessel requirements, defined mooring plans and mooring procedures) would contribute to risk reduction of the Project Vessel breakout hazard.	
4.14	LH asked how many additional lines would be required in a worst credible scenario would be required to reduce risk to acceptable levels? BP to confirm and explained that this would need to be further considered during detailed design and berth specification. UPDATE: A sensitivity was checked with two additional lines forward and two additional lines aft (from 12 to 16 total). It was also noted that the current berth layout already allowed for these additional lines; however, detailed berth design and optimisation would be further assessed during later detailed design stages and refinement would be made at that time. Additional sensitivity assessment for stronger mooring lines (and combination of both more lines and stronger lines) also indicated similar beneficial outcomes to overall potential breakout hazard mitigation.	
4.15	NB discussed the PLA byelaws which state: "Except in an emergency, the master of a power-driven vessel must, at all times when underway on the Thames, ensure that the vessel is navigated at a speed and in a manner such that any wash or draw-off created by the vessel must not compromise: a) the	

	safety of others using the Thames, the foreshore, adjacent piers, moorings, berths, jetties or other facilities; or b) the integrity of the foreshore." LH commented that there is also a responsibility on the project to ensure risks of breakout are mitigated to ALARP through detailed design. JE and SAB confirmed agreement of this point.	
5	**PNRA Outcomes (Slide 5)**	
5.1	See slide 6	
5.2	SAB explained that proposed risk controls mitigated navigation risk to ALARP and that therefore the impact of the Proposed Jetty and associated marine operation is considered tolerable.	
5.3	SAB noted that third party sims and passing vessel mooring interaction study had not changed pNRA outcomes (when compared to version seen by PLA) but NASH now had greater confidence in risk scores allocated.	
6	**Variation to proposed scheme (Slide 6)**	

6.1	- Change in design vessel
	  o LOA – 2m increase
	  o Beam - 1.4m increase
	  o Draught – 0.9m increase
	- Change in Proposed Jetty Design
	  o 5m south of Jetty Option 3
	- All changes were remining within the existing defined boundary.	

7	**NRA update scope (Slide 7)**	
7.1	SAB gave an overview of the proposed pNRA update scope.	
7.2	Due to minimal increase in project vessel size, further will not be undertaken.	
7.3	Discussion as to whether 0.9m increase in vessel draught would materially impact ship handling issues when vessel was arriving / departing berth. LH to discuss with PLA pilots as to whether simulation of project vessel arrivals and departures with a modelled draught increase of 0.9m would be necessary. SAB agreed that option to undertake project vessel sims would be kept as an option until PLA pilots had confirmed requirement.	LH to confirm Pilot acceptance
7.4	Additional task for NASH to review WSP landslide Quantitative Risk Assessment (QRA) to consider likely consequences of a CO2 release on shipping and navigation.	
7.5	NB commented that increase in vessel draught would likely limit tidal operational window, scope therefore includes an additional passage planning task. LH agreed this was crucial to holistic view of navigational safety – task will include a meeting between NB and PLA pilot(s).	LH to confirm Pilot availability
7.6	LO commented on the essential requirement to provide regular updates to PLA and third-party operators including CLdN and Heidelberg Materials (formerly Hanson Aggregates).	
7.7	Discussion as to how recommendations in NRA would translate in to DCO, in the context that the NRA recommends locating the jetty at a certain distance from the channel but the Order limits would allow something else. JE to give this consideration and discuss with WSP team.	

NASH
MARITIME

Cory Decarbonisation Project: PLA Update
Aug 2024

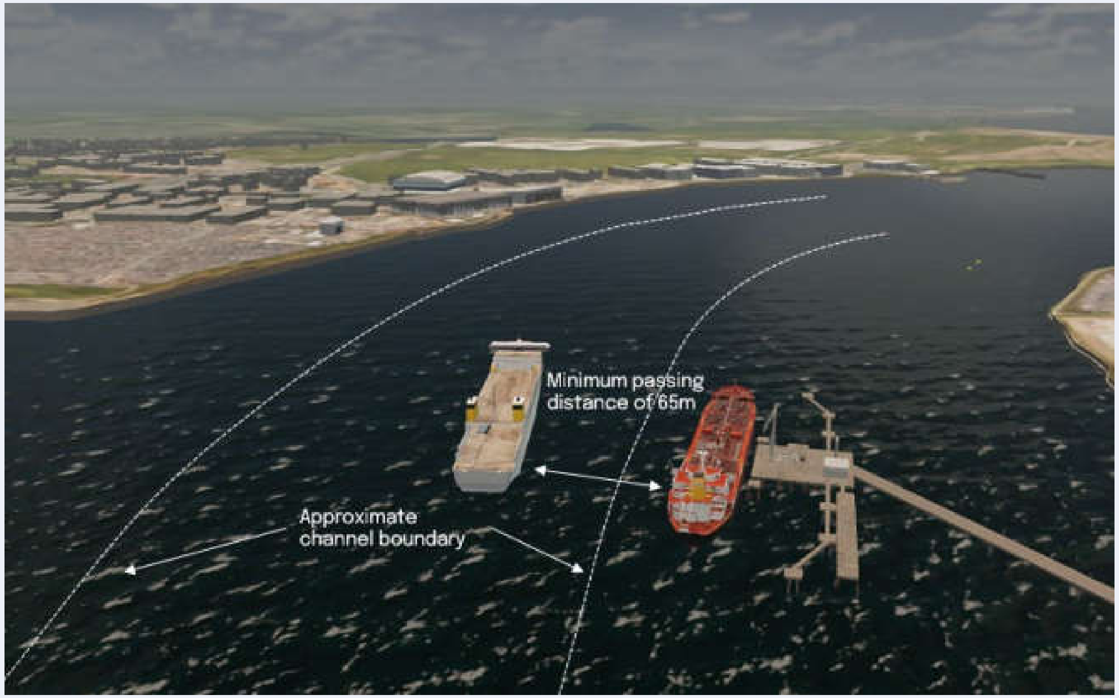
Cory Decarbonisation Project

Agenda

- NRA status update
- Variations to proposed scheme
- Proposed NRA scope

Third Party Nav Sims – Outcomes summary

- The location of the Proposed Jetty (Option 2 and Option 3) results in reduced navigable width to the south of the authorised channel.
  - No significant challenge for one way traffic.
  - Two-way traffic will need to pass west of Proposed Jetty.
  - Presents a slight change to how vessels restricted by draught currently operate.
- Existing operations can safely continue.
- 60m passing distance maintained in the most adverse conditions.



Passing vessel mooring interaction study

Passing Vessel	Speed through water	2.0 x Beam or 60m (adverse scenario for outbound transit)	Mid channel (adverse scenario for inbound transits)
6 knots passing speed			
CLdN RoRo	6 knots	Below line limit	Below line limit
Cruise Vessel	6 knots	Below line limit	Below line limit
Bulk Carrier (Light)	6 knots	Below line limit	Below line limit
Bulk Carrier (Loaded)		Below line limit	Below line limit
8 knots passing speed			
CLdN RoRo	8 knots	Below line limit	Below line limit
Cruise Vessel	8 knots	Below line limit	Below line limit
Bulk Carrier (Light)	8 knots	Below line limit	Below limit but not a current scenario
Bulk Carrier (Loaded)		Exceeded limit but not a current scenario	Below line limit
10 knots passing speed			
CLdN RoRo	10 knots	Exceeded line limit	Below line limit
Cruise Vessel	10 knots	Exceeded line limit	Exceeded line limit
Bulk Carrier (Light)	10 knots	Exceeded line limit	Exceeded limit but not a current scenario
Bulk Carrier (Loaded)		Exceeded limit but not a current scenario	Exceeded line limit

Cory Decarbonisation Project

Risk Assessment Outcomes

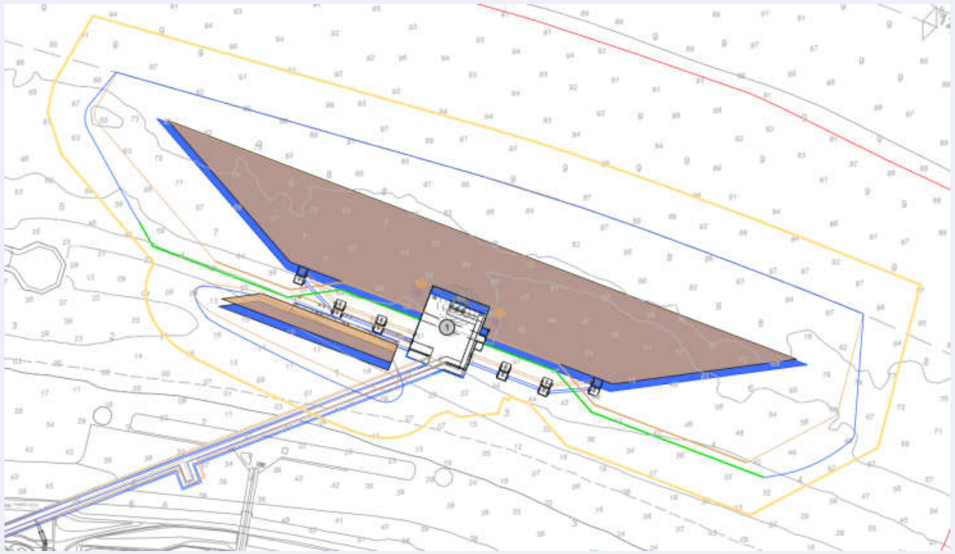
Haz ID	Inherent Risk Rank	Residual Risk Rank	Hazard Name	Inherent Risk Score	Residual Risk Score
16	2	1	Breakout - Project Vessel	15.0	12.0
7	1	2	Contact (Allision) - Cargo ICW Proposed Jetty (or a vessel moored alongside)	16.0	8.0
1	4	3	Collision - Project Vessel ICW Cargo	9.0	6.0
4	4	3	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	9.0	6.0
6	4	3	Collision - Third Party Vessels as a result of avoiding project vessels	9.0	6.0
8	3	3	Contact (Allision) - Tanker ICW Proposed Jetty (or a vessel moored alongside)	12.0	6.0

- Risk Controls
  - Relocation of Jetty (Option 3)
  - Promulgation and dissemination of information
  - Defined proposed scheme limitations (ebb tide departure)
  - Deconfliction between Cory and project vessel operations
  - Detailed design analysis for berth and moorings
  - Navigation exclusion zone
  - Passing vessel mooring interaction study
  - Third party ship bridge simulations

Variations to proposed scheme

- Change in design vessel
  - LOA – 2m increase
  - Beam - 1.4m increase
  - Draught – 0.9m increase
- Change in Proposed Jetty Design
  - 5m south of Jetty Option 3

Vessel Parameter	Capacity (m^3)			
	7,500	12,000	15,000	20,000
LOA (m)	130	150	178	180
LBP (m)	127.8	-	-	177
Beam (m)	21.2	21.6	25	26.4
Ballast Draft (m)	7.5	8.5	-	7.0
Laden/ Scantling Draft (m)	8.0	9.0	8.4	9.9
Moulded Depth (m)	11.00	-	-	15.5



Cory Decarbonisation Project

NRA update scope

- Simulations are not recommended.
  - Worst case scenario assessed.
  - Simulations address spatial concerns.
  - Model vessel would likely be the same.
  - It is not anticipated that additional 0.9m draught would substantially impact ship handling.
- Tasks
  - Review WSP QRA outputs from navigation perspective
  - Undertake revised passing vessel mooring interaction study
  - Undertake detailed passage planning (input of PLA pilot required)
  - Risk assessment
  - Update to existing NRA report
  - Update meetings with PLA and CLdN

Appendix M
pNRA Update Hazard Log

MARINE RISK ASSESSMENT FORM

Assessment Title	Cory Carbon Capture
Assessment Date	14/10/2024
Version	R01-00

Average Inherent	**8.8**
Average Residual	**5.7**

Hazard ID	Inherent Ris	Residual Ris	Hazard Description	Hazard type	Cause	Consequence										Inherent Risk			Additional Risk Control Measures	Residual Risk		
						Most likely					Worst Credible											
						Ppl	Env	Prop	Rep	Imp	Ppl	Env	Prop	Rep	Imp	Likelihoo	Severity	Score		Likelihoo	Severity	Score
1	5	3	Collision - Project Vessel ICW Cargo	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Major / life changing injuries.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	2	3	6
2	11	14	Collision - Project Vessel ICW Tanker	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Major / life changing injuries.	-Serious long-term impact on environment and / or permanent damage.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations	1	3	3
3	8	12	Collision - Project Vessel ICW Passenger	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Moderate injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Local news coverage and control measures required to manage publicity.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	4	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	1	4	4
4	5	3	Collision - Project Vessel ICW Tug, Service and Other Small Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	2	3	6
5	11	14	Collision - Project Vessel ICW Recreational Vessel	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 13. Full ship bridge simulations	1	3	3
6	5	3	Collision - Third Party Vessels as a result of avoiding project vessels	Collision	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	3	9	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations	2	3	6

7	1	3	Contact (Allision) - Cargo ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	4	4	16	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	2	3	6
8	3	3	Contact (Allision) - Tanker ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	3	4	12	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 13. Full ship bridge simulations 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	2	3	6
9	8	3	Contact (Allision) - Passenger ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Moderate injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-International news coverage with severe potential for reputational damage.	-Severe cost implications for Port. *Guidance approx. over £500,000*	2	4	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 7. Navigation Exclusion Zone 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	2	3	6
10	3	2	Contact (Allision) - Tug, Service and Other Small Vessel ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Multiple fatalities.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	4	3	12	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel 7. Navigation Exclusion Zone 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	4	2	8
11	11	14	Contact (Allision) - Recreational Vessel ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Single Fatality.	-Limited impact on environment and port operation with short term or long term effects.	-Vessel / equipment / structure unsalvageable. -Serious long-term impact on port operational effectiveness.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	2	3	6	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 7. Navigation Exclusion Zone 3. Defined Proposed Scheme limitations (Construction and Operation) 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	1	3	3
12	8	3	Contact (Allision) - Project Vessel ICW CCS Jetty (or a vessel moored alongside)	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	4	2	8	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	3	2	6
13	16	12	Contact (Allision) - Project Vessel ICW Third Party Infrastructure	Contact (Allision)	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / equipment / structure incurs minor damage but remains in service / safe to use. Some adjustments to working / operational methods may be required.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Moderate cost implications for Port. *Guidance approx. between £5000 & £50,000*	2	2	4	1. Relocation of Proposed Jetty (Option 3) 2. Promulgation and dissemination of information 13. Full ship bridge simulations 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	2	2	4

MARINE RISK ASSESSMENT FORM

14	11	3	Grounding - Cargo	Grounding	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	2. Promulgation and dissemination of information 13. Full ship bridge simulations	3	2	6
15	11	3	Grounding - Project Vessel	Grounding	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Insignificant or no damage to vessel / equipment / structure.	-Little or no risk to company image.	-Insignificant port costs. *Guidance: up to approx. £5000*	-Moderate injuries.	-Minor impact on environment and port operation with no lasting effects	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	3	2	6	3. Defined Proposed Scheme limitations (Construction and Operation) 4. Deconfliction of Cory operations with arrival/departure of Project vessel	3	2	6
16	2	1	Breakout - Project Vessel	Breakout	Action of the tidal stream Adverse weather conditions Avoidance of another vessel Communications failure Displacement of small vessels Human error Increased vessel activity Interaction with passing vessel Master / Pilot error Mechanical defect / failure Misjudged manoeuvre Reduced visibility Reduction in navigable water Towage failure Vessel wash Excessive vessel speed	-Minor or No injuries.	-Insignificant impact on environment and port operation.	-Vessel / Equipment / structure unoperational and in need of repairs.	-Regional news coverage with potential for reputational damage.	-Serious cost implications for Port. *Guidance approx. between £50,000 & £250,000*	-Multiple fatalities.	-Significant impact on environment and Port operation with short term or long term effects	-Vessel / Equipment / Structure unoperational and in need of extensive repairs / dry docking.	-National news coverage with significant potential for reputational damage	-Severe cost implications for Port. *Guidance approx. over £500,000*	5	3	15	1. Relocation of Proposed Jetty (Option 3) 3. Defined Proposed Scheme limitations (Construction and Operation) 5. Positioning of berth infrastructure 7. Navigation Exclusion Zone 12. Passing vessel mooring interaction study 14. Detailed Design to mitigate consequences of vessel contact and breakaway 15. Emergency Response Plan	4	3	12

NASH
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