Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.08**

Heathwall Pumping Station

APFP Regulations 2009: Regulation **5(2)(q)**

Hard copy available in

Box **57** Folder **B**
January 2013

Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Navigational Issues and Preliminary Risk Assessment: Heathwall Pumping Station

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Main Report

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1 Executive summary

1.1 Purpose

1.1.1 This report documents the activities and assessments undertaken to identify the navigational issues, risks and mitigation measures for the proposed permanent and temporary structures at the site known as Heathwall Pumping Station (PS) as part of the Thames Tideway Tunnel project.

1.1.2 It was developed through liaison and consultation with Port of London Authority (PLA) and the other key stakeholders. It is intended to support the application for development consent and identify the navigational issues at the site and how these are to be managed. The process was used to inform the design of the permanent and temporary works and a number of measures to address navigational hazards have been embedded into the design.

1.1.3 The preliminary risk assessment follows the methodology proposed by the PLA rather than the methodology detailed within the PLA Safety Management System. The risk assessment reflects the level of development of the design in the application for development consent, that is, an outline design. The Contractor would be required to prepare detailed risk assessments and method statements and submit these to the PLA for approval before commencing any works in the river at this site.

1.1.4 The assessment was divided into four distinct project phases to assess hazards and develop risk reduction measures commensurate with the risk posed by different operations associated with the project. These phases were specific to this assessment and comprise:

a. Phase A: construction of cofferdam

b. Phase B: construction of drop shaft/culvert/connection tunnel

c. Phase C: removal of cofferdam

d. Phase D: permanent works site.

1.2 Issues to be addressed

1.2.1 The proposed Heathwall PS site lies adjacent to Middle Wharf and Nine Elms Pier on the south bank of the River Thames in the Nine Elms Reach area of the river (PLA Chart 315).

1.2.2 During the risk assessment process a number of issues have been identified for this site:

a. interaction with existing river traffic:

i freight

ii commercial

iii leisure.

b. proximity to the authorised channel

c. relocation of the ‘Battersea Barge’ floating restaurant.

1.3 Interaction with existing river traffic

1.3.1 It is anticipated that there would be a maximum of two x 350t barges per day accessing this site, taking cofferdam materials in and out and drop shaft excavated material away. This section of the river sees large numbers of freight movements due to the sites proximity to Cory Environmental Ltd’s Cringle Dock facility and delivery of aggregates to Cemex’s facility. The cumulative impact of barge movements to/from the proposed project site at Kirtling Street was also taken in to account.

1.3.2 Timetabled passenger services, scheduled and unscheduled sightseeing tours and recreational river users all operate within the study area and were taken into consideration when compiling this assessment.

1.4 Proximity to authorised channel

1.4.1 The Limits of land to be acquired or used (LLAU) at Heathwall PS would extend in to the river and encompasses the existing South West Storm Relief (SWSR) outfall culvert. The LLAU would not encroach into the authorised channel however its northern most boundary would lie within 2m of it.

1.4.2 The cofferdam would be set back a minimum of 65m from the authorised channel. At these distances from the authorised channel, the impact on passing vessels is anticipated to be negligible.

1.5 Relocation of Battersea Barge floating restaurant

1.5.1 Located adjacent to the Heathwall PS site is a large barge (approximately 40m length overall (LOA)), known as the Battersea Barge floating restaurant. The project proposes to temporarily relocate the barge during the course of the works at Heathwall PS. It is proposed that the barge would be moved approximately 7m upstream, during the construction period, so that it is clear of the work site, and then moved back to its current location in the permanent case.

2 Site overview

2.1 Purpose of this report

2.1.1 The purpose of this report is to provide information on the navigational issues, risk assessment and mitigation measures associated with the proposed Heathwall Pumping Station site. The report informs the *Transport Assessment and Environmental Statement* and the PLA approval process.

2.2 Introduction

2.2.1 The Thames Tideway Tunnel project (the 'project') comprises tunnels to store and transfer discharges from combined sewer overflows (CSOs) from West to East London for treatment at Beckton Sewage Treatment Works. The primary objective of the project is to control CSO discharges in order to meet the requirements of the EU Urban Waste Water Treatment Directive (91/271/EEC) (UWWTD) and the related UK Urban Waste Water Treatment Regulations.

2.2.2 The project comprises the following elements:

a. a main tunnel from Acton Storm Tanks to Abbey Mills Pumping Station requiring five main tunnel sites (one of the sites would also intercept flows from one CSO)

b. control of 18 CSOs by diverting intercepted flows into the main tunnel requiring 16 CSO sites; two long connection tunnels (Frogmore connection tunnel and Greenwich connect tunnel) and 11 short connection tunnels

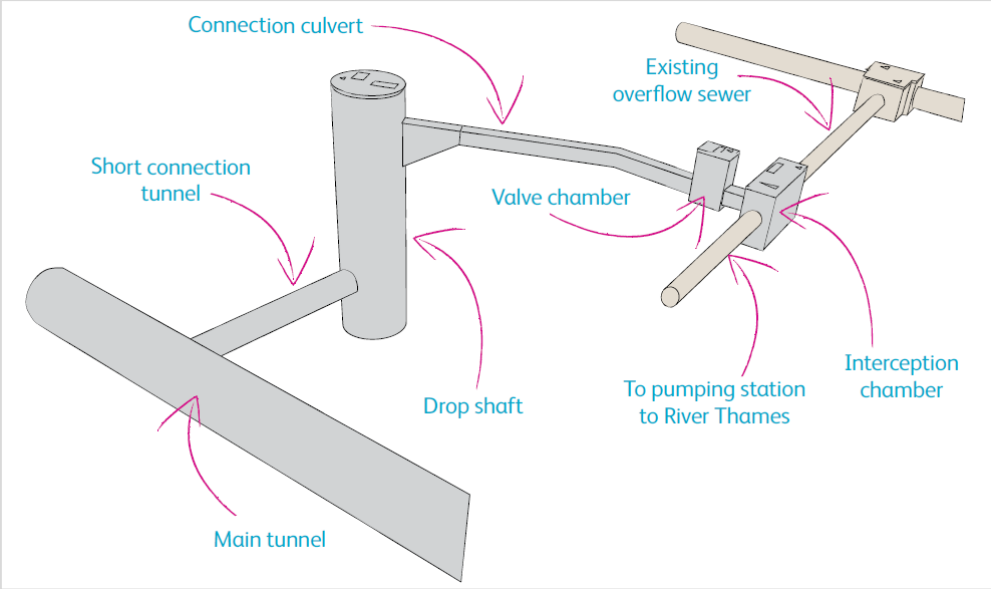
c. control of two CSOs by locally modifying the sewerage system requiring two system modification sites

d. works to drain down the system at Beckton Sewage Treatment Works.

2.2.3 The main tunnel would connect to the Lee Tunnel at Abbey Mills Pumping Station. All the flows from the Thames Tideway Tunnel and the Lee Tunnel would be transferred to Beckton Sewage Treatment Works via the Lee Tunnel.

2.2.4 The Heathwall Pumping Station CSO site would be required to intercept the Heathwall Pumping Station CSO and the South West Storm Relief CSO and to connect both flows to the main tunnel. The proposed structures at this site are illustrated in Figure 2.1.

Figure 2.1 CSO site structures (below-ground)



2.2.5 It is proposed that the permanent site and in-river structure at the Heathwall Pumping Station site would accommodate:

a. a CSO drop shaft – 16m internal diameter, approximately 46m deep
b. an interception shaft in the foreshore – 10m internal diameter, approximately 19m deep
c. connections to the Heathwall Pumping Station CSO and South West Storm Relief CSO outfalls
d. connection culverts and valve chambers
e. air management structures
f. a new section of river wall.

2.2.6 A cofferdam would be constructed, which would include the following areas to enable construction of the permanent in-river structure:

a. excavated material storage and handling facilities
b. cranes
c. maintenance workshop and storage
d. internal site roads
e. site support and welfare

2.3 Limits of land to be acquired or used

2.3.1 The proposed limits of land to be acquired or used (LLAU) for this site centres around the existing Middle Wharf structure and Heathwall Pumping Station.

2.3.2 The LLAU encompasses the maximum working area required during construction. A cofferdam would be constructed within this area during the

construction phases. The permanent river wall works would take place within the cofferdam.

2.3.3 The LLAU would be used intermittently, depending on the progress, method and phasing of construction.

2.3.4 Appendix A details the various design, construction and site layout drawings, and the LLAU.

2.4 Project phases

2.4.1 This assessment was divided into four distinct project construction phases to assess hazards and develop risk reduction measures commensurate with the risk posed by different operations associated with the project. These phases were identified for use during the navigation risk assessment and comprise:

a. Phase A: construction of cofferdam

b. Phase B: construction of drop shaft/culvert/connections

c. Phase C: removal of cofferdam

d. Phase D: permanent works site

2.5 Construction methodology

2.5.1 All works would be undertaken in accordance with the project's *Code of Construction Practice (CoCP)*.

2.5.2 The code sets out a series of objectives and measures to protect the environment and limit disturbance from construction activities as far as reasonably practicable. The topics covered by the *COCP* include but are not limited to; working hours, traffic management, noise and vibration, air quality, waste management, recycling, ecology, archaeology and settlement.

2.5.3 The methodologies, layouts and plant requirements outlined in this document are for illustrative purposes only and may be varied by subsequent design and build construction contractors.

2.6 Phase A: Site set-up and construction of cofferdam

2.6.1 The Battersea Barge would be relocated approximately 7m upstream by relocating the mooring piles and extending the existing barge grid so that it is clear of the works.

2.6.2 The cofferdam would be constructed by installing a sheet piled wall. It is currently envisaged that the cofferdam would be designed as a twin walled cofferdam to accommodate the various loading conditions including external tidal loading and internal plant/construction loading.

2.6.3 It is intended to use the river to access and service the cofferdam construction activities, and a jack-up or spud leg barge would be mobilised at the site. A jack-up barge is a hydraulically operated self-elevating platform, which provides a stable platform from which marine piling works

can be undertaken. The barge would be equipped with a crawler crane for off-loading and pitching the sheets for the sheet piled wall, a silent piling hammer, a small welfare cabin, a rescue boat and generated power.

2.6.4 A campshed would be constructed in the foreshore adjacent to the eastern wall of the cofferdam.

2.7 Phase B: Drop shaft and associated works construction

2.7.1 The CSO drop shaft would be constructed with precast segmental lining using caissons and underpinning.

2.7.2 An attendant excavator would load the excavation material into a dumper, which would deposit excavated material into the excavated material muck bin. A long reach excavator would load the excavated material into a barge moored alongside the cofferdam wall.

2.8 Phase C: Connection tunnel construction

2.8.1 To connect the drop shaft to the main tunnel, a connection tunnel would be constructed, using Sprayed Concrete Lining (SCL) techniques.

2.8.2 Upon completion of tunnelling works an in-situ concrete lining would be constructed.

2.8.3 A smaller tunnel would be constructed at a higher level between the drop shaft and intervention shaft. This would be constructed using the same techniques as the connection tunnel.

2.8.4 Interception and valve chamber structures would be constructed to intercept and divert flows from the existing sewer to the drop shaft. Due to the ground conditions, secant piles would be used for primary ground support for the main chambers.

2.8.5 Excavated material would be brought to the surface in skips and the majority would be transferred to barges for disposal.

2.9 Phase D: Cofferdam removal

2.9.1 On completion of the CSO drop shaft and connection chambers, the permanent river wall would be constructed. The area between the cofferdam and permanent river wall would be excavated.

2.9.2 Concrete blinding would be installed and then the permanent river wall constructed.

2.9.3 Only once the permanent river wall is in place would the cofferdam on the riverside be removed in order to maintain flood protection. The cofferdam piled wall would then be dismantled by jack-up barge.

3 Study aim and area

3.1 Introduction

3.1.1 The aim of this assessment is to identify and assess navigational hazards project-specific to construction activities at the Heathwall PS site and to assess how the proposed phases of the project would likely impact on existing river users.

3.1.2 This assessment considers all river users and the hazards that the project's activities could pose to navigation on the River Thames.

3.1.3 In compiling this assessment, the project undertook extensive consultation with the PLA and current river users, along with observations of current river operations.

3.1.4 In order to consider the navigation impact on the wider river community, the scope of this assessment comprised an area between Vauxhall Bridge and Victoria Rail Bridge. This study area captures the majority of vessel types likely to transit this section of the river and pass the worksite.

3.1.5 The proposed development site is located close to a house boat community at Nine Elms Pier and Tideway Dock and an operating floating restaurant (Battersea Barge). The site is also near to Cory Environmental Ltd's Cringle Dock facility, Cory in river moorings (Nine Elms Barge Roads) and Kirtling Wharf, currently used by Cemex as a concrete batching works.

3.1.6 The potential effect of additional barge movements in this area was considered within this assessment.

3.1.7 The project proposes to use barges during construction phase A, B and C, to bring in and take away the material used to fill the cofferdam and to supply construction materials.

3.2 General navigation

3.2.1 Safety is the responsibility of all river users; however, overall responsibility for facilitating the safety of navigation on the River Thames rests with the PLA.

3.2.2 As part of its activities in maintaining navigational safety, the PLA produces Notices to Mariners (NTMs), which provide essential, up-to-date information and advice to those navigating within the Port of London. NTMs can range from information on special events, notifications of works (eg, the Network Rail works on Blackfriars Bridge), and notification of new and updated navigation rules and regulations. A full list of extant NTMs is available on the PLA website, http://www.pla.co.uk/notice2mariners/index.cfm/site/navigation.

3.2.3 The River Thames becomes tidal downriver of Teddington Lock, with a tidal range of between five and seven metres at different locations.

3.2.4 On the flood tide, the tidal current flows up-river (ie, predominantly east to west) whereas on the ebb tide, the tidal current flows downriver (ie, predominantly west to east).

3.3 The authorised channel

3.3.1 The authorised channel is marked on both Admiralty and PLA charts as a pair of pecked lines that define where the majority of commercial vessels generally navigate. However, vessels cannot always be expected to navigate 'within' the authorised channel.

3.3.2 The authorised channel in the Heathwall PS area varies between 65m and 85m width. Directly adjacent to the work site the authorised channel is 65m wide. At peak times, when freight operators are operating in the area, the authorised channel would be busier then at other times of the day, but still experiences much lower usage than the Central Pool of London, between London Bridge and Tower Bridge.

3.3.3 The document General Directions for Navigation in the Port of London 2011 states the following:

> *"36. REQUIREMENT TO USE THE AUTHORISED CHANNEL*
>
> *(1) This Direction applies only to vessels navigating between the Margaretness Limit and Putney Bridge.*
>
> *"(2) Except in an emergency or for the purposes of overtaking, or with the permission of the Harbourmaster, or when manoeuvring to or from piers, wharves, anchorages or other berths, all Reporting Vessels and vessels of 13.7 metres or more in Length Overall shall normally navigate only in the authorised channel as identified on PLA charts.*
>
> *"(3) Where there is sufficient room, vessels less than 13.7 metres in Length Overall should normally navigate outside the authorised channel unless constrained by their draught or otherwise restricted in ability to manoeuvre, or in an emergency".*

3.4 Tide set

3.4.1 During consultation for this and other sites associated with the project, the project determined that the 'tide set' in this area of the River Thames should be taken into consideration when assessing navigational hazards.

3.4.2 The term 'tide set 'is used to describe the movement of water into the bight or outside edge of a bend of a river. In a tidal river like the River Thames, which is embanked in the central area, it also leads to an increase in velocity.

3.4.3 Every vessel is affected by tide set in varying degrees. Smaller, faster-moving craft are affected less than larger, slow-moving vessels such as tugs and tows, which have to make course and steering adjustments to counteract the impact of tide set.

3.4.4 The embankments of the River Thames deflect the water flow towards the outside of the next bend. This effect manifests itself particularly in the section of the river that contains the various bridges.

3.4.5 The tide set in and around Heathwall is assessed as ‘Moderate South’ on both the flood and ebb tides.

3.5 Existing river users

3.5.1 There are a number of freight operators that provide regular freight services within the study area. At present, Cory Environmental Ltd operate a daily (currently weekday) waste transfer service, transporting containerised waste from Wandsworth, Cringle Dock and Walbrook Wharf waste transfer stations to landfill; and in the future it will also transport waste to their incinerator plant at Belvedere. Cory typically operates a service consisting of up to three tugs with up to four barges (per tug) on inward and outward bound journies to their Cringle Dock facility.

3.5.2 Freight operators deliver aggregates to Cemex’s Nine Elms goods yard several times per week with barges in the region of 800 to 1200 tonnes capacity.

3.5.3 Additional freight operators that can be expected to operate within the study area include; Bennett’s Barges, GPS Marine, JJ Prior and Livett’s Launches.

3.5.4 Timetabled passenger services, sightseeing tours and party boat tours all operate within the study area.

3.5.5 Complete Pleasure Boats operate a Putney to Blackfriars river bus service that passes through the Heathwall area. This service is typically only running during AM/PM peak times.

3.5.6 Westminster Passenger Services Association runs a river tours service from Hampton Court through to Westminster.

3.5.7 Thames Clippers have extended their Tate to Tate and Service West operations to incorporate the new St George Wharf pier. The service runs every 40 minutes, seven days a week from St George Wharf to central London (Bankside Pier). There are also plans to extend Thames Clipper services upriver as far as Putney Pier and to include a new pier at Plantation Wharf.

3.5.8 Private hire cruise vessels transit past the Heathwall site on occasion. While it is not feasible to state exact figures for these vessels, it is assumed that vessels from the following companies operate in the study area[1]:

a. Thames Cruises
b. Capital Pleasure Boats
c. Westminster Party Boats,
d. London Party Boats,
e. Thames Executive charters,
f. Crown River Cruises and Viscount Cruises.

[1] List provides details of the majority of unscheduled service operators and is not considered to be exhaustive.

3.5.9 It is estimated that during peak operating periods you might expect to see up to seven charter vessels passing Heathwall heading eastbound during any given day, and approximately the same number passing westbound.

3.5.10 The PLA is actively encouraging the use of the tidal Thames for recreational boat users, with a dedicated website www.boatingonthethames.co.uk *'Making the most of the Thames'* that provides advice, guidance and safety information to a wide variety of leisure users.

3.5.11 Recreational traffic on the Thames that can be expected to be in transit within the study area includes narrow boats, motor yachts, RIBs, speed boats, rowing boats, kayaks and sailing yachts.

3.5.12 The Westminster Boating Base, an independent charity that teaches dinghy sailing, power boating, kayaking and canoeing is located on the north bank of the river, approximately 275m from the western end of the Nine Elms Pier.

3.5.13 Westminster Boating Base tends to hold events on most days of the week from April through to September, with activities over a typical week as indicated below.

Table 3.1 Westminster Boating Base

Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	Sunday
14:00 - Kayaking	11:30 - Powerboat	13:00 - Kayaking	13:00 - Kayaking		10:00 - BCU Course	10:00 - Kayaking
17:45 - Kayaking	13:00 - Kayaking -	14:00 - Kayaking	17:45 - Sailing		10:00 - Power boat	10:00 - Sailing
17:45 - Sailing	14:00 - Sailing	16:45 - Kayaking	17:45 - Slalom League Race 1		10:00 - Sailing	14:00 - Kayaking
	16:45 - Kayaking	16:45 - Sailing				
	16:45 - Sailing					

3.6 Existing vessel traffic movements

3.6.1 The majority of freight movements can be expected to pass through the study area around 2 hours before high water (HW), which provides them with a sufficient operating window to deliver the empty barges and remove full barges from the site before heading downstream to their final destination around 1 hour before the HW mark.

3.6.2 Cory's current passage plan requires that tugs depart Cringle Dock one hour before HW on the spring tides and 30 minutes before HW on the neap tides in order to clear the bridges in the Central Pool area of London.

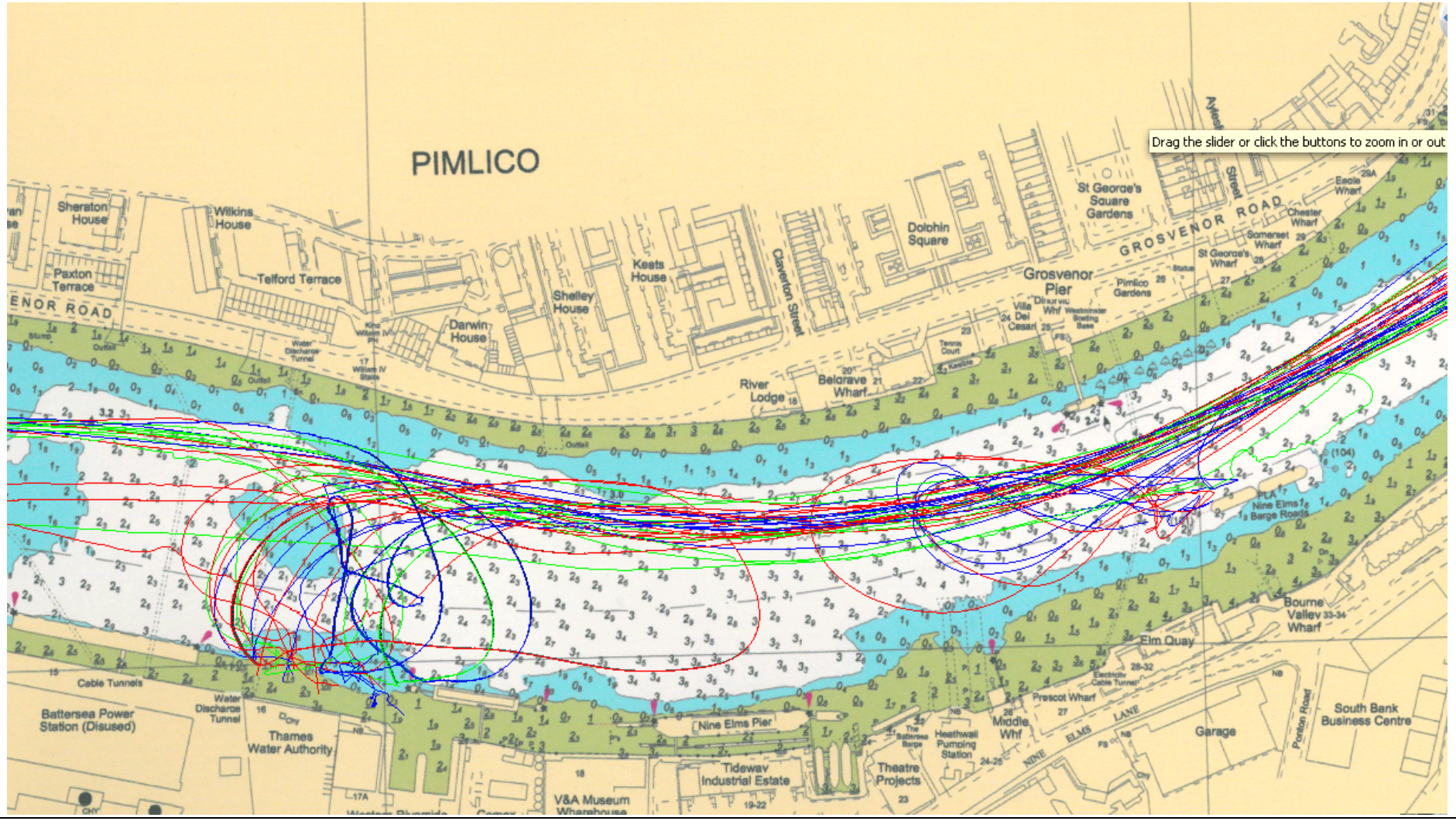
3.6.3 Figure 3.2 shows inbound Cory barge movements to the Cringle Dock facility.

3.6.4 The Thames is used by tourists as a means of sightseeing and consequently traffic levels are seasonal with the greatest tourist traffic being around lunchtime in the summer months.

3.6.5 Charter vessels also have an element of seasonality with some increases around the Christmas party season.

Figure 3.1 Nine Elms

Figure 3.2 GPS tracks of Cory Environment Ltd traffic in the Nine Elms area



4 Summary of navigational issues

4.1 Interaction with existing river traffic

4.1.1 It is anticipated that a maximum of two 350 tonne barges per day would access this site. This is in addition to the proposed peak of four 1000 tonne barges (two per tide) expected to access the Kirtling Street site.

4.1.2 Cory operates a daily tug and barge operation to their Cringle Dock waste transfer facility. Due to the tidal range at Cringle Dock and the configuration of the dock, barge movements at the site are centred on a period when there is sufficient water to allow barges to float into and out of the dock, typically 1 - 2 hours prior to high water.

4.1.3 Cory operates in a relatively tight operating window and any delays are likely to affect their ability to operate.

4.1.4 Cory regularly use the PLA Nine Elms Barge Roads mooring, located approximately 200m downriver of Middle Wharf, to lay-up barges.

4.1.5 It is proposed that a Berthing Co-ordinator be appointed for the Kirtling Street and the Heathwall PS sites. The Berthing Co-ordinator would be responsible for liaising and communicating with all operators in the local area to assure safe operations between project and other vessels.

4.2 Proximity to authorised channel

4.2.1 The Limit of Land to be Acquired or Used (LLAU) at Heathwall extends to the southern boundary of the authorised channel to allow for the need to carry out work to the existing outfall, which discharges below low water near the edge of the authorised channel. The most of the construction period, the working area would be set back at least 65m from the authorised channel, as shown on the Zones of Foreshore Working drawing in Appendix A.

4.2.2 The proximity of the LLAU to the authorised channel at this location has been identified as a potential navigational hazard to existing river users.

4.3 Relocation of the Battersea Barge

4.3.1 In order to have sufficient room to construct the cofferdam at Heathwall it would be necessary to relocate the floating restaurant Battersea Barge approximately 7m upstream.

4.3.2 The barge would remain in this position for the duration of the construction period (phase A, B and C) and would then be relocated back to its current position at the end of the construction phase (phase D).

Figure 4.1 Battersea Barge

5 Stakeholder consultation

5.1 Consultation meetings

5.1.1 Over the development of the site, the project team were continuously engaged with Cory Environmental as a stakeholder with regard to river operations and the impact upon their operations close to this location. Further meetings with representatives from Cory are scheduled.

5.1.2 AIS data has been provided by Cory Environmental Ltd and were collected by the project in order to allow for detailed analysis of typical tug and tow tracks within the study area.

5.1.3 On-going consultation and dialogue with Cory Environmental Ltd is expected throughout the planning, construction and operational phases of the project.

5.1.4 Discussions have also been held with owners of the Battersea Barge about the need to relocate the vessel.

5.2 Observation notes

5.2.1 Observations and analyses of Cory tug and tow operations in the vicinity of the site were conducted. Full details of the analyses are contained with Annex B – Freight track and AIS analysis.

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6 Risk assessment

6.1 Risk assessment: Methodology

6.1.1 For each of the identified hazards, the associated risk was assessed and classified. The following definitions were applied for the purposes of this report:

a. Hazard: eg, an object, activity or phenomenon that can cause an adverse effect.

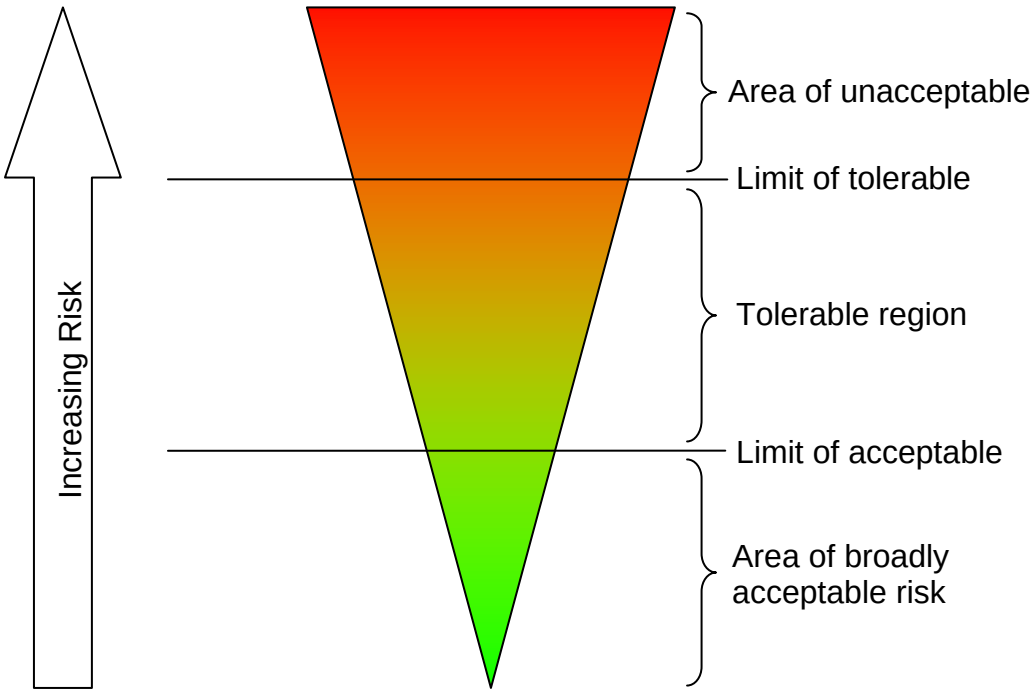
b. Risk: a relative measure of harm or loss, derived from the combination of the severity of a particular consequence together with the probability of the consequence occurring.

c. Consequence: a particular scenario (expressed as harm to people, damage to the environment, an operational impact and/or negative media attention) that results from a hazardous situation.

d. Probability: the chance of a particular hazard consequence occurring, measured as a frequency (per year).

6.1.2 The assessment used the principle of reducing navigational risks to a level that is As Low As Reasonably Practicable (ALARP).ALARP is part of the Health and Safety at Work Act 1974 and involves assessing the acceptability of a risk against the difficulty, time and expense needed to control it. The ALARP concept is illustrated in Figure 6.1.

Figure 6.1 The ALARP Principle



6.1.3 At the lower end of the ALARP triangle, risks are small due to either low probability or insignificant consequences. These risks can generally be accepted provided that common safeguards are implemented. Moving up

the ALARP triangle to the tolerable region, risks increase in magnitude due to either an increase in probability or an increase in severity of consequences. Risks in the tolerable region can be accepted provided that risk controls are implemented that demonstrate that the risk is reduced to a level deemed to be ALARP; where any further risk reduction would be disproportionate in terms of cost, time and resources required to implement it compared to the benefit it would introduce. At the top of the ALARP triangle is a region of unacceptable risk that cannot be accepted without risk controls to reduce the risk to a tolerable and ALARP level.

6.1.4 This risk assessment was undertaken on a qualitative basis, using the engineering and operational judgement of representatives from the project team and representatives from river users and operators. Hazard consequences were considered based on most likely outcomes.

6.2 Risk assessment: Criteria

6.2.1 When commencing the assessment of the risk posed by the project's activities, the project's marine consultant recommended using the risk assessment criteria and methodology within the existing PLA Safety Management System (SMS). The rationale behind this recommendation was to provide the project team and the PLA with a consistent assessment score that could be transferred across into the PLA's existing SMS and enable an appreciation of the increase in risk resulting from the project's temporary and permanent works.

6.2.2 Consultation with the PLA highlighted the PLA's desire to use an alternative risk terminology, and an alternative assessment matrix and risk classification scorecard. These changes have now been incorporated as requested.

6.2.3 This section details the risk criteria used throughout this assessment. The assessment process identifies four distinct areas of risk and the probable consequences associated with each hazard assessed in terms of harm or loss to:

a. people (life)

b. environment

c. operational impact

d. media attention.

6.2.4 Table 6.1 details the 'probability' criteria used to assess how likely each hazard is to occur in terms of average frequency in the PLAs jurisdiction.

Table 6.1 Probability Criteria

	Frequency	Score
Rare	Has not occurred in the in the last ten years	1
Unlikely	Has not occurred in the in the last three years	2
Possible	Has not occurred in the in the last year	3
Likely	Has occurred in the in the last year	4
Almost certain	Occurs several times per year	5

6.2.5 Table 6.2 details the severity criteria applied to the safety- related consequences of each hazard.

Table 6.2 Severity Criteria: People	Level
First aid case / Medical treatment case	1
Restricted work case	2
Lost Time Injury / Moderate permanent partial disability injury	3
Single Fatality / Severe permanent partial disability	4
Multiple fatalities	5

6.2.6 Table 6.3 details the severity criteria applied to the environmental loss related consequences of each hazard.

Table 6.3 Severity Criteria: Environment	Level
Low impact with no lasting effect	1
Temporary effect / Minor effect to small area	2
Short to medium term impact	3
Medium to long term effect / large area affected	4
Long term impact / severe impact on sensitive area	5

6.2.7 Table 6.4 details the severity criteria applied to the property loss/damage related consequences of each hazard.

Table 6.4 Severity Criteria: Operational Impact	Level
Insignificant or no damage to vessel / equipment	1
Minor or superficial damage to vessel / equipment	2
Moderate damage to vessel / equipment requiring immediate repairs	3
Major damage to vessel / equipment and detention	4
Very serious damage to vessel or equipment possible criminal proceedings	5

6.2.8 Table 6.4 details the severity criteria applied to negative media attention/coverage consequences of each hazard.

Table 6.5 Severity Criteria: Media Attention	Level
No Coverage	1
Local coverage	2
Regional coverage	3
National coverage	4
International coverage	5

6.3 Risk matrix

6.3.1 The risk matrix in Table 6.6 was used to provide a risk score, combining severity of a particular consequence with the likelihood (probability) of the consequence occurring.

Table 6.6 Risk assessment matrix

Likelihood	Rare	**1**	**2**	**3**	**4**	**5**
	Unlikely	**2**	**4**	**6**	**8**	**10**
	Possible	**3**	**6**	**9**	**12**	**15**
	Likely	**4**	**8**	**12**	**16**	**20**
	Almost certain	**5**	**10**	**15**	**20**	**25**
	Severity	Level 1	Level 2	Level 3	Level 4	Level 5

6.3.2 The risk score in Table 6.7 indicates the magnitude and acceptability of the risk in accordance with the ALARP principle. The PLA method applies this to both individual and average risk.

Table 6.7 Risk classification

Score	Classification	Definition
1 to 2	**Slight**	No action is required.
3 to 4	**Minor**	No additional controls are required, monitoring is required to ensure no changes in circumstances.
5 to 9	**Moderate**	Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.
10 to 14	**High**	Efforts should be made to reduce risk to ALARP level. Job can only be performed after authorisation from Harbour Master and after further additional controls required under the circumstances.
15 to 25	**Extreme**	Intolerable risk. Job is not authorised.

6.4 Hazard identification

6.4.1 A hazard can be defined as 'the potential for an adverse consequence', and may be associated with a situation that could cause harm to people, damage to the environment, an operational impact or negative media attention.

6.4.2 In order to facilitate a comprehensive overview of potential maritime hazards, various river users and operators were consulted throughout the risk assessment process, including:

a. Thames Clippers;

b. Cory Environmental Limited;

c. City Cruises;

d. Livett's Launches;

e. Bennett's Barges;

f. London Duck Tours;

g. Metropolitan Police Marine Policing Unit;

h. Royal National Lifeboat Institute (RNLI).

6.4.3 The project also made several site visits to HR Wallingford's physical model during the risk assessment process. This provided Captain David Phillips (at the time, PLA Harbour Master (Upper)), freight (Cory Environmental) and commercial (Thames Clippers) operators with the opportunity to understand the impact of the proposed developments on the river flow patterns and to visualise the scale of the temporary and permanent work at various locations. However, the site at Heathwall was not included in this physical model.

6.5 Mitigation strategy

6.5.1 Throughout the assessment process, it was evident that potential hazards presented by the project would require mitigation measures throughout the project lifecycle.

6.5.2 The following section will identify and detail the navigational issues and proposed mitigation measures.

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7 Navigational issues and mitigation measures

7.1 General

7.1.1 It is acknowledged that mitigation measures may themselves introduce further hazards that also require mitigation. Where appropriate, these have been considered.

7.1.2 Mitigation measures were developed with an emphasis on measures that are within the project's control (e.g. design of in-river structures).

7.1.3 For the purpose of this assessment, mitigation measures (risk control options) were classified as three types;

a. Design: measures that can be implemented by the project at the design stage.

b. Physical: measures that the project can implement during the construction and operational phases.

c. Operational: measures that the project can implement in conjunction with the PLA at all stages of the project.

7.1.4 Of course, some proposed mitigation measures would be beyond the project's control, such as emergency plans, operating procedures and NtMs.

7.2 Interaction with existing river traffic: Freight

7.2.1 The Heathwall Pumping Station site is close to a number of facilities that rely on barge movements to conduct their daily operations, namely Cringle Dock and Kirtling Wharf.

7.2.2 Cory Environmental Ltd operate a daily tug and barge service to Cringle Dock waste transfer facility. Due to the tidal range at Cringle Dock and the configuration of the dock, barge movements at the site are centred on a period when there is sufficient water to allow barges to float into and out of the dock, typically 1 - 2 hours prior to high water.

7.2.3 Cory operates in a relatively tight operating window and any delays are likely to affect their ability to operate.

7.2.4 Aggregates are delivered several times per week to the Cemex Wharf (referred to as Kirtling Wharf in the GLA's consultation on safeguarded wharves, also historically known as Cringle Wharf). Barges to this facility are approximately 800-1200 tonnes in size and delivered several times per week. As the construction work increases in the Nine Elms area, it is likely that the demand for concrete would increase and there may be more frequent barge deliveries to Kirtling Wharf as a result.

7.2.5 The interaction of the project's barge movements with existing freight operations in this area has been highlighted as a potential navigational hazard.

Actions required

7.2.6 A number of actions, specific to the issue, have been commenced or completed in order to assist the project to provide a robust and evidence-based assessment to the PLA. These actions include:

a. collate AIS data to allow detailed assessment and site specific drawings to be produced and overlaid, showing the extent of the interaction

b. undertake observations of Cory and Cemex operations at this site

c. maintain dialogue with Cory operations manager

d. maintain dialogue with Cemex

Mitigation of issues: Design

7.2.7 Designing the project has been an iterative process, influenced by the ongoing navigational risk assessment process. Measures to eliminate or reduce navigational hazards identified in early risk assessments were embedded into the design of the temporary and permanent works to eliminate or reduce navigational hazards. This assessment therefore assesses the residual risk assuming the effective implementation of these measures. The embedded measures include:

a. The design and in-river footprint of the temporary and permanent works site has been minimised so that intrusion into the river is kept as small as possible, whilst incorporating the necessary works, and is set back from the authorised channel. This reduces the extent that work sites extend into the river and therefore may reduce the likely impact on existing river users.

b. Barge size to be used at this site has been optimised in order to minimise the number of barge movements to and from the site.

7.2.8 The following sections set out the proposed mitigation measures to address the residual risks.

Mitigation of issues: Physical

a. analysis of AIS data and photographs of existing operations at the site

b. assessment and understanding of operating procedures to ensure minimum disruption/interaction with existing users

c. meetings with Cory to receive their views and input into interaction issues and possible working relationships.

Mitigation of issues: River operations

a. scheduling of barge movements, passage planning and publication of planned operations.

b. Berthing Co-ordinator: Would communicate with all commercial operators in the area in order to facilitate safe berthing and departures from berths in close proximity to the project's operations. The berthing co-ordination would co-ordinate vessel activities so that the freight operators in the area are aware of each others movements and can

schedule departures and arrivals accordingly. The PLA would retain overall responsibility for safety on the river.

c. Notice to Mariners to inform operators and river users of planned operations in this area

7.3 Proximity to the authorised channel

7.3.1 The LLAU at Heathwall Pumping Station extends to the southern boundary of the authorised channel although the temporary cofferdam and permanent works would be set back at least 65m from the authorised channel and therefore reduce the likelihood of an incident.

7.3.2 The LLAU needs to extend around the existing CSO outfalls (which discharge below the low water line, a short distance from the authorised channel) to allow work to be carried out on them. This work would be short term in nature and is therefore excluded from this assessment. The Contractor would be required to prepare and agree detailed navigational risk assessments before commencing these works. For most of the duration of the construction period, the working area would be at least 45m from the authorised channel.

7.3.3 The proximity to the authorised channel at this location has been identified as a potential navigational hazard to existing river users.

Actions required

7.3.4 A number of actions, specific to the issue, have been commenced or completed in order to assist the project to provide a robust and evidence-based assessment to the PLA. These actions include:

a. conduct analysis of vessel movements through this area

b. identify typical river traffic that uses this section of the river and their frequency

c. observe and record Cory barge tracks

d. consult with Cory to understand their operations and areas of concern.

Mitigation of issues: Design

7.3.5 The following measures are embedded in the designs and this assessment therefore only assesses the residual risk assuming the effective implementation of these measures:

a. The design and in river footprint of the temporary and permanent works site has been minimised so that intrusion into the river is minimal and set back from the authorised channel.

b. Constraints have been placed on the working areas within the river to minimise the duration and extent of obstructions in the river.

7.3.6 The following sections set out the proposed mitigation measures to address the residual risks.

Mitigation of issues: Physical

a. assessment and understanding of operating procedures to ensure minimum disruption/interaction with existing users.

Mitigation of issues: River operations

b. scheduling of barge movements / passage planning

7.4 Relocation of the Battersea Barge restaurant

7.4.1 In order to ensure that the project would have sufficient working area to construct and operate the cofferdam and the temporary works site, the project proposes to temporarily relocate the Battersea Barge restaurant which is currently moored in within the LLAU.

7.4.2 The vessel would be moved approximately 7m upstream, which is expected to require the installation of two new mooring piles and an extension of the existing barge grid.

7.4.3 The Contractor would produce a full method statement and risk assessment for the relocation works prior to the works commencing.

7.4.4 It is proposed that the method statement and risk assessment would include all stages of the relocation and would provide sufficient level of detail to demonstrate to the satisfaction of the PLA that the operation can be conducted safely and with minimum impact on existing river users.

8 General navigational hazards

8.1.1 In addition to the 'navigation issues' considered within this report, navigational hazards associated with day-to-day river operations were also identified. These hazards relate to the interaction of the project-related marine traffic with existing river users.

8.1.2 'Worst Credible' consequences and the probability of the consequences were considered in the assessment. As a result, in some cases the Worst Credible score was lower than the 'Most Likely' score. This is explained by the probability that a 'moderate injury', for example, is higher than the probability of a 'single fatality'.

8.1.3 Full hazard details contained in Annex A through to Annex G.

8.2 Project phases A to C: Most likely

Table 8.1 Most likely hazard log summary

				Score			
Hazard Id	**Hazard title**	**Hazard description**	**Phase**	**People**	**Environment**	**Operational**	**Media**
1	Increase in flow	Changes to the hydrodynamics of the river may affect passing vessels.	A	6	6	6	6
			B	6	6	6	6
			C	6	6	6	6
2	Contact - High Speed Passenger Vessel with worksite	A High Speed Passenger Vessel comes into contact with the project's work site at Heathwall PS.	A	6	4	4	4
			B	9	6	6	6
			C	6	4	4	4
3	Contact - Class V passenger vessel with worksite	A Class V passenger vessel comes into contact with the project's worksite at Heathwall PS.	A	6	4	4	4
			B	9	6	6	6
			C	6	4	4	4
4	Contact - private leisure vessel with worksite	Private leisure vessels, including narrow boats, comes into contact with the project's worksite at Heathwall PS.	A	6	2	6	4
			B	9	3	9	6
			C	6	2	6	4

5	Contact - commercial freight with worksite	Commercial freight comes into contact with the project's worksite at Heathwall PS.	A	6	4	6	4
			B	6	4	6	4
			C	6	4	6	4
6	Contact - tug and tow with worksite	A tug and tow comes into contact with the project's worksite at Heathwall PS.	A	6	4	6	4
			B	6	4	6	4
			C	6	4	6	4
7	Grounding - all vessels due to 'Squat Effect'	At periods of low water, vessels may be affected by the 'Squat Effect', causing them to be closer to the river bed than expected.	A	4	4	4	4
			B	4	4	4	4
			C	4	4	4	4
8	Mooring breakout	A vessel involved in the project's activities breaks free temporary/layup moorings.	A	6	4	6	4
			B	9	6	9	6
			C	6	4	6	4
9	Collision - High Speed Passenger Vessel (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Heathwall PS.	A	6	4	6	6
			B	N/A	N/A	N/A	N/A
			C	6	4	6	6
10	Collision - Class V passenger vessel (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Heathwall PS.	A	6	4	6	6
			B	N/A	N/A	N/A	N/A
			C	6	4	6	6
11	Collision - Class V passenger vessel (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Heathwall PS.	A	9	6	9	9
			B	N/A	N/A	N/A	N/A
			C	9	6	9	9

12	Collision with commercial freight operator (Construction/ Deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a commercial freight operator in the vicinity of Heathwall PS.	A	9	6	6	9
			B	N/A	N/A	N/A	N/A
			C	9	6	6	9
13	Collision - tug and tow (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a tug and tow in the vicinity of Heathwall PS.	A	9	6	6	9
			B	N/A	N/A	N/A	N/A
			C	9	6	6	9
14	Contact - house boat at Nine Elms Pier or Nine Elms Marina complex (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities makes contact with a house boat at Nine Elms Pier or Nine Elms Marina complex during the construction/ deconstruction of the project's cofferdam.	A	6	4	6	8
			B	N/A	N/A	N/A	N/A
			C				
15	Collision - High Speed Passenger Vessel (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	6	4	6	6
			C	N/A	N/A	N/A	N/A
16	Collision - Class V passenger vessel (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a Class V passenger vessel in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	6	4	6	6
			C	N/A	N/A	N/A	N/A
17	Collision -	A vessel conducting	A	N/A	N/A	N/A	N/A

	private leisure vessel (delivery/ material removal)	the project's delivery/ material removal activities collides with a private leisure vessel in the vicinity of Heathwall PS.	B	9	6	9	9
			C	N/A	N/A	N/A	N/A
18	Collision - commercial freight operator (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a commercial freight operator in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	9	9	6	9
			C	N/A	N/A	N/A	N/A
19	Collision - tug and tow (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a tug and tow in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	9	9	6	9
			C	N/A	N/A	N/A	N/A
20	Contact - House Boat at Nine Elms Pier or Nine Elms Marina complex (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities makes contact with a house boat at Nine Elms Pier or Nine Elms Marina complex.	A	N/A	N/A	N/A	N/A
			B	6	4	6	8
			C	N/A	N/A	N/A	N/A

8.3 Project phases A to C: Worst credible

Table 8.2 Worst credible hazard log summary

				Score			
Hazard Id	**Hazard title**	**Hazard description**	**Phase**	**People**	**Environment**	**Operational**	**Media**
1	Increase in flow	Changes to the hydrodynamics of the river may affect passing vessels.	A	8	6	8	6
			B	8	6	8	6
			C	8	6	8	6
2	Contact - High	A High Speed	A	10	6	8	10

	Speed Passenger Vessel with worksite	Passenger Vessel comes into contact with the project's worksite at Heathwall PS.	B	10	6	8	10
			C	10	6	8	10
3	Contact - Class V passenger vessel with worksite	A Class V passenger vessel comes into contact with the project's worksite at Heathwall PS.	A	10	6	8	10
			B	10	6	8	10
			C	10	6	8	10
4	Contact - private leisure vessel with worksite	Private leisure vessels, including narrow boats, comes into contact with the project's worksite at Heathwall PS.	A	10	4	8	8
			B	10	4	8	8
			C	10	4	8	8
5	Contact - commercial freight with worksite	Commercial freight comes into contact with the project's worksite at Heathwall PS.	A	8	6	8	8
			B	8	6	8	8
			C	8	6	8	8
6	Contact - tug and tow with worksite	A tug and tow comes into contact with the project's worksite at Heathwall PS.	A	8	6	8	8
			B	8	6	8	8
			C	8	6	8	8
7	Grounding - all vessels due to 'Squat Effect'	At periods of low water, vessels may be affected by the 'Squat Effect', causing them to be closer to the river bed than expected.	A	6	4	6	6
			B	6	4	6	6
			C	6	4	6	6
8	Mooring breakout	A vessel involved in the project's activities breaks free from temporary/layup moorings.	A	6	4	6	4
			B	6	4	6	4
			C	6	4	6	4
9	Collision - High Speed	A vessel conducting the project's	A	10	4	10	10
			B	N/A	N/A	N/A	N/A

	Passenger Vessel (construction/ deconstruction)	construction/ deconstruction activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Heathwall PS.	C	10	4	10	10
10	Collision - Class V passenger vessel (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Heathwall PS.	A	10	4	10	10
			B	N/A	N/A	N/A	N/A
			C	10	4	10	10
11	Collision - Class V passenger vessel (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a Class V passenger vessel in the vicinity of Heathwall PS.	A	10	4	10	10
			B	N/A	N/A	N/A	N/A
			C	10	4	10	10
12	Collision - commercial freight operator (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a commercial freight operator in the vicinity of Heathwall PS.	A	8	6	8	8
			B	N/A	N/A	N/A	N/A
			C	8	6	8	8
13	Collision - tug and tow (construction/ deconstruction)	A vessel conducting the project's construction/ deconstruction activities collides with a tug and tow in the vicinity of Heathwall PS.	A	8	6	8	8
			B	N/A	N/A	N/A	N/A
			C	8	6	8	8
14	Contact - house boat at Nine	A vessel conducting the project's	A	8	4	8	8
			B	N/A	N/A	N/A	N/A

	Elms Pier or Nine Elms Marina complex (construction/ deconstruction)	construction/ deconstruction activities makes contact with a house boat at Nine Elms Pier or Nine Elms Marina complex during the construction/ deconstruction of the cofferdam.	C	8	4	8	8
15	Collision - High Speed Passenger Vessel (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a High Speed Passenger Vessel (eg, Thames Clipper) in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	10	6	8	10
			C	N/A	N/A	N/A	N/A
16	Collision - Class V passenger vessel (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a Class V passenger vessel in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	10	6	8	10
			C	N/A	N/A	N/A	N/A
17	Collision - private leisure vessel (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a private leisure vessel in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	10	4	8	8
			C	N/A	N/A	N/A	N/A
18	Collision - commercial freight operator (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities collides with a commercial freight operator in the vicinity of Heathwall PS.	A	N/A	N/A	N/A	N/A
			B	8	6	8	8
			C	N/A	N/A	N/A	N/A
19	Collision - tug	A vessel conducting	A	N/A	N/A	N/A	N/A

	and tow (delivery/ material removal)	the project's delivery/ material removal activities collides with a tug and tow in the vicinity of Heathwall PS.	B	8	6	8	8
			C	N/A	N/A	N/A	N/A
20	Contact - House boat at Nine Elms Pier or Nine Elms Marina complex (delivery/ material removal)	A vessel conducting the project's delivery/ material removal activities makes contact with a house boat at Nine Elms Pier or Nine Elms Marina complex.	A	N/A	N/A	N/A	N/A
			B	6	4	6	8
			C	N/A	N/A	N/A	N/A

9 Mitigation measures

9.1 Existing mitigation

9.1.1 Existing safeguards (measures that manage the risk) in the form of control measures and relevant PLA guidance, are set out in Table 9.1 together with any additional controls deemed desirable or necessary to reduce risk to a level that is ALARP. The risk is assessed whilst taking account of the impact of these various safeguards and controls.

Table 9.1 Existing safeguards

• Boat Masters License	• Vessel Master Experience
• MCA - MGN 199 (M) Dangers of Interaction	• Permanent/Temporary Notice to Mariners
• Aids to Navigation	• Passage Planning
• Safe Systems of Work	• Tug Operator Procedures
• Contractors Risk Assessment	• BML Local Knowledge Endorsement
• River Bylaws	• General Directions
• VTS Qualification	• VHF Communications
• Bridge Special Signal Lights	• Ship Towage Code of Practice
• VTS Navigational Broadcast	• Emergency Plans and Procedures
• Thames AIS	• Oil Spill Contingency Plan
• PLA Bridge Guide	• Maintenance / Inspection Routines
• Admiralty Charts	• COLREGs
• Tide Gauges	• Qualified Crew
• Tide Tables	• Barge Operators daily check lists
• Accurate Tidal Information	• High Speed Craft Code

9.1.2 The above list is not exhaustive but was used to highlight the measures that are most relevant to the project's operations.

9.2 Proposed mitigation

9.2.1 The proposed risk reduction/mitigation measures were divided into three categories: design, physical and river operations. This is to provide the PLA with assurance that the measures proposed throughout this assessment have regard to the project's responsibility to reduce risk rather than focussing on local authorities' and existing river users' responsibilities.

9.3 Design

9.3.1 The following measures are embedded in the designs and this assessment therefore only assesses the residual risk assuming the effective implementation of these measures:

a. The design and in-river footprint of the temporary and permanent works site has been minimised so that intrusion into the river is kept as small as possible while incorporating the necessary works and is set back from the authorised channel as far as practical. This reduces the extent that works sites extend into the river and therefore reduces the likely impact on existing river users.

b. Barge size to be used at this site has been optimised in order to minimise the number of barge movements to and from the site.

c. Constraints have been placed on the working areas within the river to minimise the duration and extent of obstructions in the river.

9.3.2 The following sections identify proposed mitigation to address the residual risks.

9.4 Physical

a. assessment and understanding of operating procedures of local operators to ensure minimum disruption/interaction with existing users

b. consultation and meetings with Cory Environmental Ltd to receive their views/input into interaction issues and possible working relationships.

9.5 River operations

a. scheduling of barge movements / passage planning and publication of planned operations.

b. appoint Berthing Co-ordinator to liaise and be in communication with all operators in the local area and be on hand to deal with potential areas of concern / conflict.

Table 9.2 Mitigation measures within the project's control

Procedural	Informational	Qualifications / Personnel	Guidance / Publications	Site Specific
Safe Systems of Work	Sound Warnings	Berth Master (term to be defined)	Temporary Notice to Mariners	Grab Chains
Contractors Risk Assessment	Light Warnings	Qualifications / Competence of on site personnel	Permanent Notice to Mariners	Fendering
Site Working Practises	Anemometer at site			Impact Protection - Temporary Works
Scheduling of barge movements to assist with existing river events				Impact Protection - Permanent Works
				New Tide Gauges / Markers

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10 Conclusion

10.1 Assessment

10.1.1 This *Navigational Issues and Preliminary Risk Assessment* assessed the potential impact of the proposed works at Heathwall Pumping Station on existing users.

10.1.2 The project's approach to this assessment comprised stakeholder engagement, analysis of Automatic Identification System (AIS) data, observation of current river operations including a desktop review of hazards, and development of potential mitigation measures.

10.1.3 The risk assessment criteria, assessment matrix, terminology and risk classification were provided by the PLA. The assessment also follows the Formal Safety Assessment (FSA) methodology:

a. stakeholder consultation

b. identification of hazards

c. hazard analysis.

10.1.4 The permanent in river works at this location extends approximately 25m from the river wall, which is no further out than the existing Middle Wharf jetty. Therefore it was determined that the structure would be highly unlikely to present an additional hazard to navigation.

10.2 Stakeholder engagement

10.2.1 The project actively engaged and continues to engage with Cory Environmental Ltd as a stakeholder with regard to river operations and impact upon their operations at this location and the adjacent Kirtling Street site. Cory provided the project with an understanding of their operations at this site and views on potential hazards and mitigations.

10.2.2 AIS data has been provided by Cory Environmental Ltd in order to allow for detailed analysis of typical tug and tow tracks within the study area.

10.2.3 On-going consultation and dialogue with Cory Environmental Ltd and Cemex is expected throughout the planning, construction and operational phases of the project.

10.2.4 Discussions have also been held with owners of the Battersea Barge about the need to relocate the vessel.

10.2.5 A number of issues were identified throughout the risk assessment process, including:

a. Interaction with existing river users

b. Changes in river flow

10.3 Risk analysis

10.3.1 Hazards at various stages of the project were assessed and scored using the risk matrix and scorecard provided by the PLA in terms of 'Most Likely' and 'Worst Credible' scenarios.

10.3.2 Annexes A to F provide full details of the hazards identified and the overall scores. The analysis is summarised below in Table 10.1 and Table 10.2:

Table 10.1 Hazard overview: Most Likely

Most Likely	Phase A	Phase B	Phase C
Extreme: Intolerable risk. Job is not authorised	0	0	0
High: Efforts should be made to reduce risk ALARP level. Job can only be performed after authorisation from Harbour Master and after further additional controls required under the circumstances.	0	0	0
Moderate: Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.	35	44	35
Minor: No additional controls are required, monitoring is required to ensure no changes in circumstances.	20	12	20
Slight: No action is required.	1	0	1

Table 10.2 Hazard overview: Worst Credible

Worst Credible	Phase A	Phase B	Phase C
Extreme: Intolerable risk. Job is not authorised	0	0	0
High: Efforts should be made to reduce risk ALARP level. Job can only be performed after authorisation from Harbour Master and after further additional controls required under the circumstances.	14	5	14
Moderate: Efforts should be made to reduce risk to ALARP level. Job can be performed under direct supervision of Senior Officer.	34	45	35
Minor: No additional controls are required, monitoring is required to ensure no changes in circumstances.	8	6	8
Slight: No action is required.	0	0	0

10.3.3 Most of the hazards (within the Most Likely assessment) fell within the 'moderate risk' category, requiring effort to be made to reduce the risk to ALARP level.

10.3.4 For ‘Worst Credible’ scenarios, the majority of pre mitigation hazards fell within the ‘high risk’ category, indicating that the work could only be performed after authorisation from the Harbour Master.

10.4 Overall

10.4.1 The navigational issues were summarised as follows:

a. Interaction with existing river users

b. Changes in river flow

10.4.2 This report sought to provide an independent, evidence-based assessment of current river operations and the likely impact that project operations would have on existing river users.

The overall responsibility for safety on the River Thames lies with the Port of London Authority, which needs to determine whether the issues and hazards set out in this report present a ‘tolerable’ navigational risk.

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11 Recommendations

11.1.1 The project recommends implementing the mitigations set out in Section 8 Additionally, the below should be given consideration:

11.1.2 **Berthing Co-ordinator:**

11.1.3 The project recommends appointing a Berthing Co-ordinator to communicate with all commercial operators in order to facilitate safe berthing and departures from berths in close proximity to project operations. The co-ordinator would co-ordinate departures so that all freight operators, including project barges, could depart on time without adversely impacting on navigation on the tidal Thames.

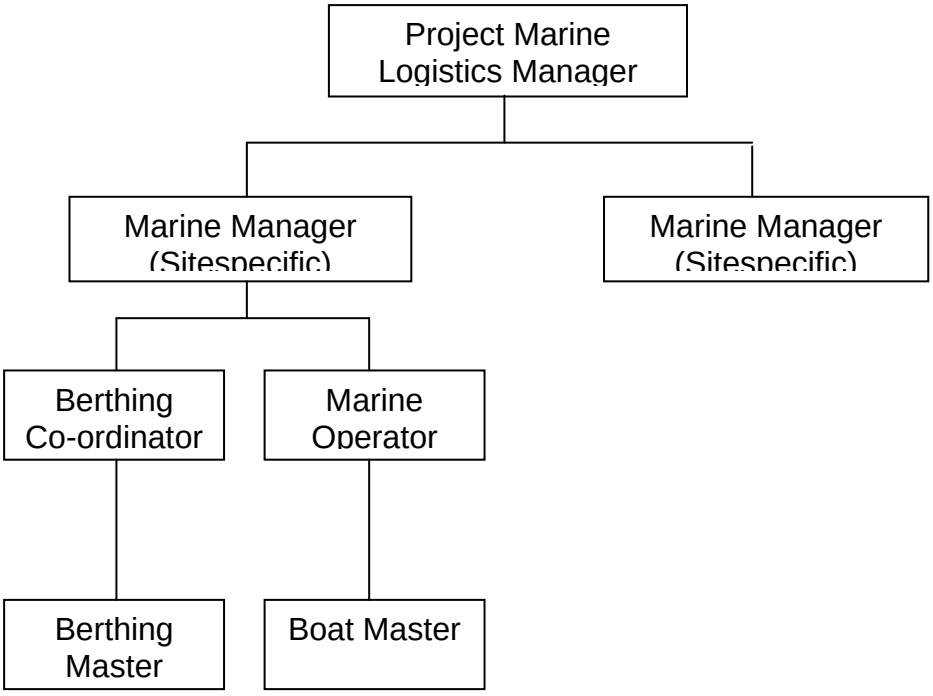
11.1.4 The project recommends considering the designated Berthing Co-ordinator's authority and responsibilities. One responsibility of the Berth Co-ordinator would be to liaise regularly with the PLA and local stakeholders. Clear lines of delegation and responsibilities would need to be established prior to commencing project works to ensure that potential conflict of interest issues would be managed and to prevent confusion to mariners and authorities regarding various traffic control systems.

11.1.5 It is recommended that the Berthing Co-ordinator appointed for the site at Kirtling Street is also responsible for the Heathwall PS site.

11.1.6 Overall safety on the river is the PLA's responsibility: the Thames Barrier Navigation Centre assists the PLA by managing and directing traffic from Crayfordness to Teddington Lock.

11.1.7 **Continued communication**: The project should continue to maintain communication and liaison with the freight, passenger and leisure users in order to disseminate information relevant to the project.

Figure 11.1Potential Marine Logistics Hierarchy



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Abbreviations

AIS	Automatic Identification System
ALARP	As low as reasonably practicable
CSO	Combined sewer overflow
LLAU	Limits of land to be acquired or used
NtM	Notice to Mariners
PLA	Port of London Authority

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Appendices

List of appendices in order

Project drawings

Freight tracks and AIS analysis

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.08**

Heathwall Pumping Station

Appendix A

APFP Regulations 2009: Regulation **5(2)(q)**

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Appendix A: Project drawings

Drawing title	Phase
Construction phases - Site setup shaft construction & tunnelling	Phase A
Construction phases - Construction of other structures	Phase B
Construction phases - Site demobilisation	Phase C
Permanent works layout	Phase D
River foreshore zones of working	

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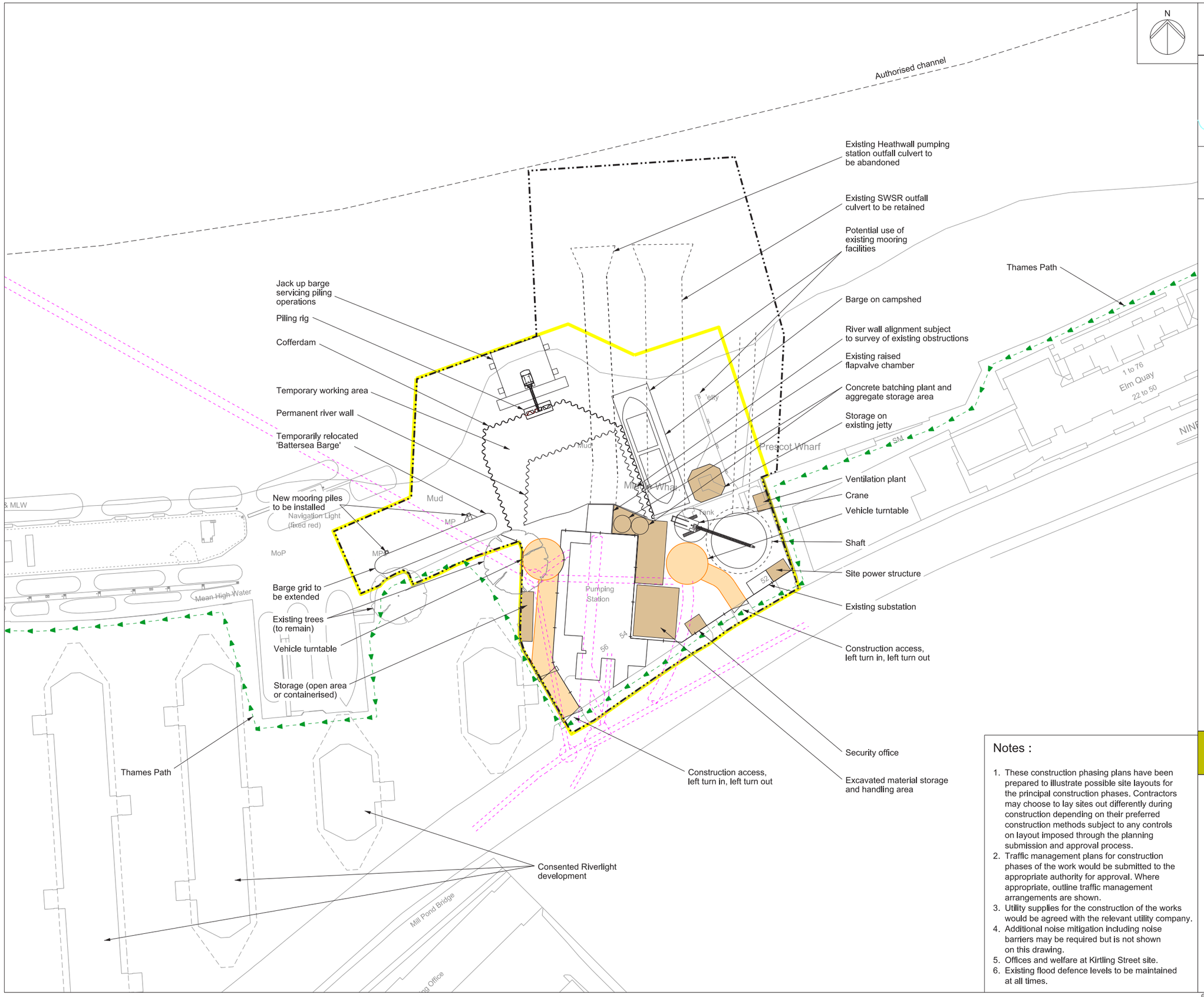


Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Access / haul route
- Existing sewers
- Sheet piles

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

Notes :

1. These construction phasing plans have been prepared to illustrate possible site layouts for the principal construction phases. Contractors may choose to lay sites out differently during construction depending on their preferred construction methods subject to any controls on layout imposed through the planning submission and approval process.
2. Traffic management plans for construction phases of the work would be submitted to the appropriate authority for approval. Where appropriate, outline traffic management arrangements are shown.
3. Utility supplies for the construction of the works would be agreed with the relevant utility company.
4. Additional noise mitigation including noise barriers may be required but is not shown on this drawing.
5. Offices and welfare at Kirtling Street site.
6. Existing flood defence levels to be maintained at all times.

ILLUSTRATIVE

Location

Heathwall Pumping Station
London Borough of Wandsworth

Document Information

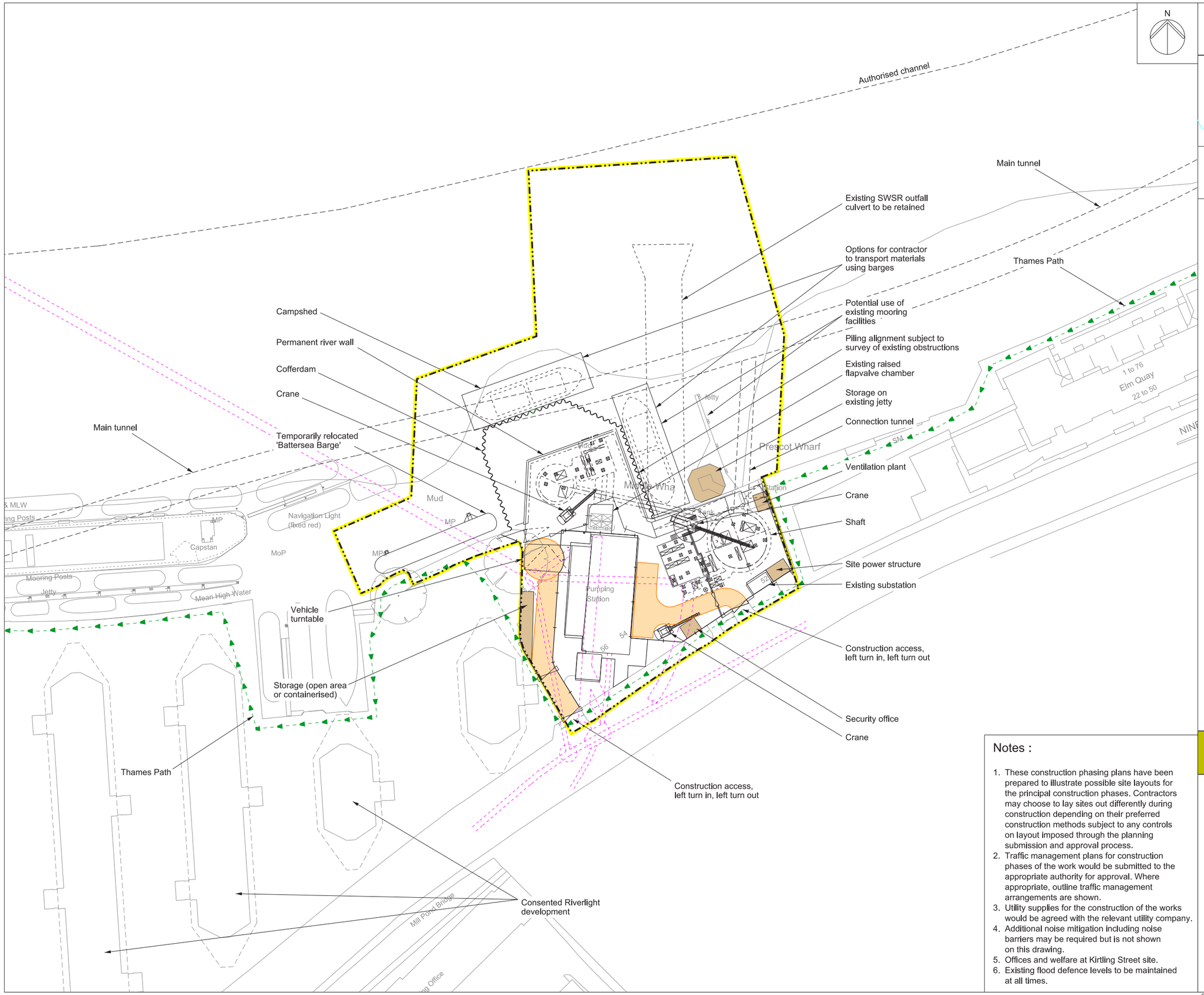
Application for Development Consent

Construction phases - phase 1
Site setup shaft construction & tunnelling
Book of plans - section 16

DCO-PP-14X-HEAPS-160014
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water



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Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Access / haul route
- Existing sewers
- Sheet piles

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

Notes :

1. These construction phasing plans have been prepared to illustrate possible site layouts for the principal construction phases. Contractors may choose to lay sites out differently during construction depending on their preferred construction methods subject to any controls on layout imposed through the planning submission and approval process.
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5. Offices and welfare at Kirtling Street site.
6. Existing flood defence levels to be maintained at all times.

ILLUSTRATIVE

Location
Heathwall PumpIng Statlon
London Borough of Wandsworth

Document Information
Application for Development Consent

Construction phases - phase 2
Construction of other structures
Book of plans - section 16

DCO-PP-14X-HEAPS-160015
January 2013

Thames Tideway Tunnel
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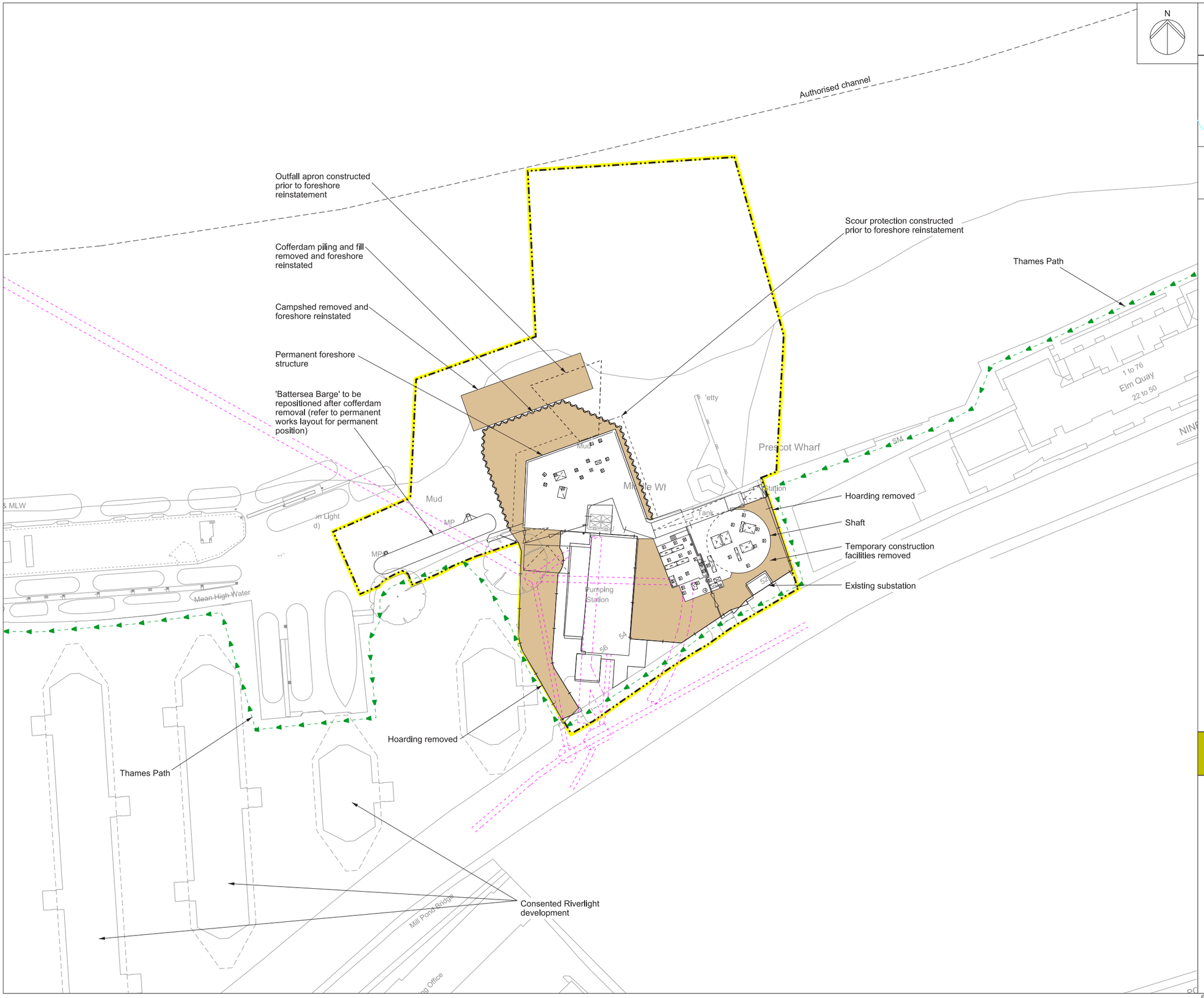
Thames Water



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Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Hoarding
- Maximum extent of working area
- Existing public right of way
- Site access
- Existing sewers
- Sheet piles

10m 0 40m

Scale 1:500 at A1
1:1000 if reproduced at A3

ILLUSTRATIVE

Location

Heathwall Pumping Station
London Borough of Wandsworth

Document Information

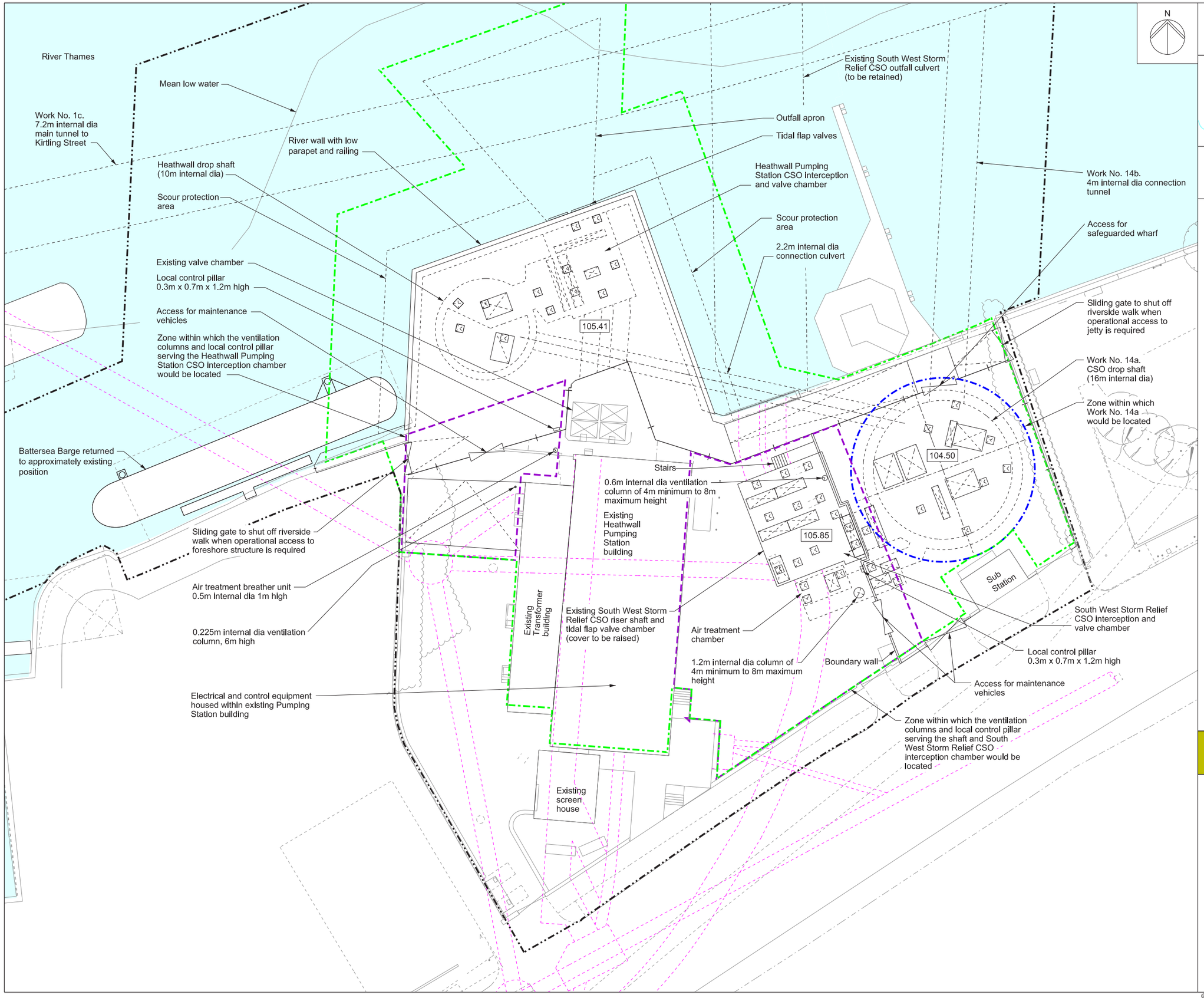
Application for Development Consent

Construction phases - phase 3
Site demobilisation
Book of plans - section 16

DCO-PP-14X-HEAPS-160016
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water



Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

- Limits of land to be acquired or used (LLAU)
- Existing sewers
- Proposed access cover
- 104.50 — Proposed level (shown in metres above tunnel datum)
- Zone within which all permanent site structures would be located
- Zone within which the shaft would be located
- Zone within which permanent above ground structures would be located

Notes:

1. All dimensions and levels are approximate.
2. Any discrepancy between the location of structures and the parameters marked on the drawings are due to differences between the Ordnance Survey base and topographical survey base, both of which have been used in the preparation of this drawing.
3. This drawing shows permanent site structures only. Landscaping hard works and soft works are shown on the Proposed landscape plan and/or Proposed site features plan.

10m 0 10m

Scale 1:200 at A1
1:400 if reproduced at A3

ILLUSTRATIVE

Location
Heathwall Pumping Station
London Borough of Wandsworth

Document Information
Application for Development Consent
Permanent works layout

Book of plans - section 16
DCO-PP-14X-HEAPS-160007
January 2013

Thames Tideway Tunnel
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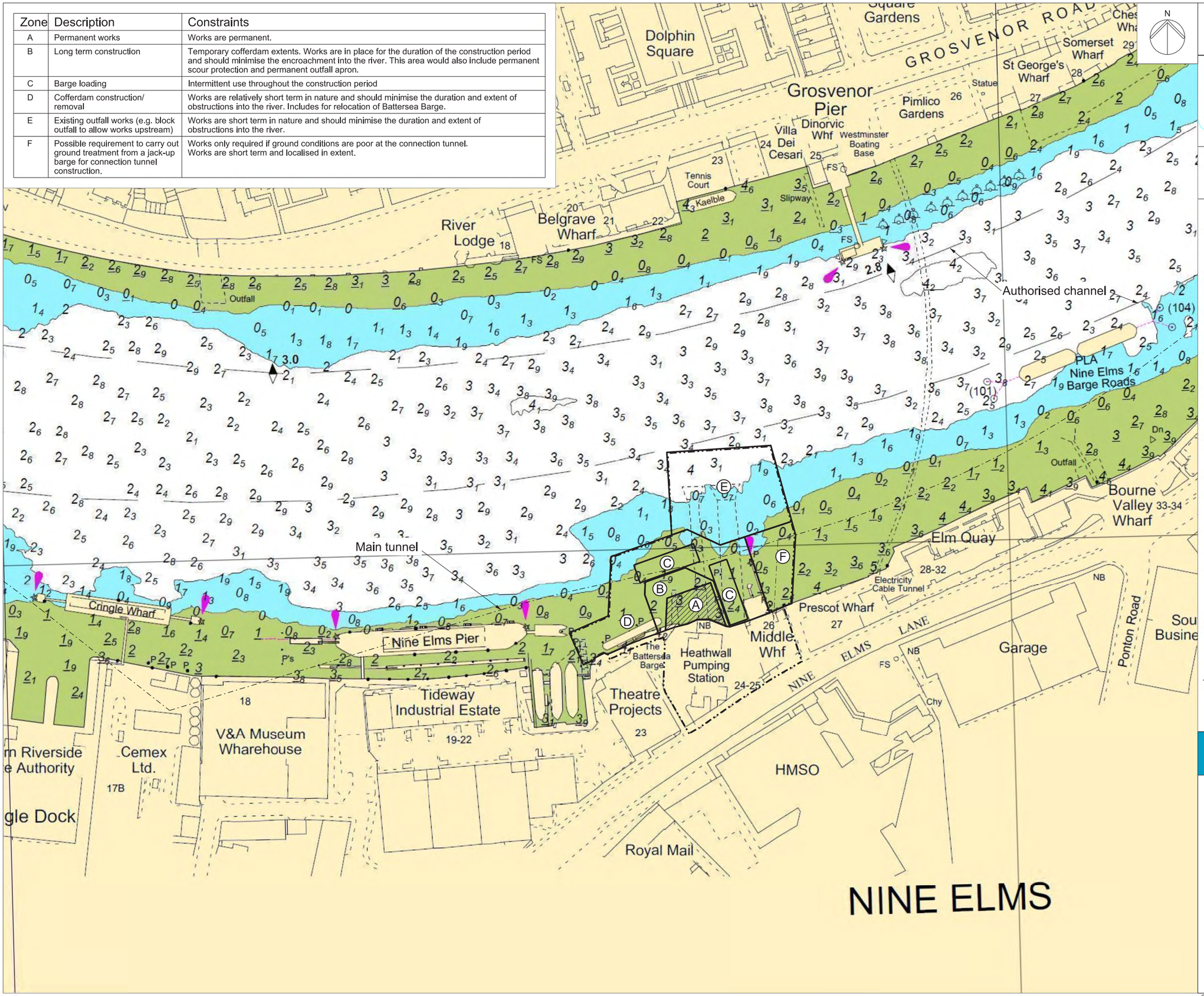
Thames Water

Zone	Description	Constraints
A	Permanent works	Works are permanent.
B	Long term construction	Temporary cofferdam extents. Works are in place for the duration of the construction period and should minimise the encroachment into the river. This area would also include permanent scour protection and permanent outfall apron.
C	Barge loading	Intermittent use throughout the construction period
D	Cofferdam construction/ removal	Works are relatively short term in nature and should minimise the duration and extent of obstructions into the river. Includes for relocation of Battersea Barge.
E	Existing outfall works (e.g. block outfall to allow works upstream)	Works are short term in nature and should minimise the duration and extent of obstructions into the river.
F	Possible requirement to carry out ground treatment from a jack-up barge for connection tunnel construction.	Works only required if ground conditions are poor at the connection tunnel. Works are short term and localised in extent.



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Keyplan:

Coordinates are to be Ordance Survey Datum OSGB36. All levels are in metres and relate to the Tunnel Datum which is 100 metres below Ordnance Datum Newlyn.

Key:

Limits of land to be acquired or used (LLAU)

Notes:

1. All levels are in metres and relate to chart datum.
2. Background information shown on this drawing is taken from:

   River Thames - Nine Elms Reach

   Port of London Authority Hydrographic Service

   H.O. Ref. No....113-315-030....Date....23/12/2010

10m 0 100m

Scale 1:1000 at A1
1:2000 if reproduced at A3

FOR INFORMATION

Location
Heathwall Pumping Station
London Borough of Wandsworth

Document Information
Application for Development Consent
River foreshore zones of working

DCO-PP-14X-HEAPS-160018
January 2013

Thames Tideway Tunnel
Creating a cleaner, healthier River Thames

Thames Water

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Thames Tideway Tunnel
Thames Water Utilities Limited

Application for Development Consent

Application Reference Number: WWO10001

Navigational Issues and Preliminary Risk Assessment

Doc Ref: **7.20.08**

Heathwall Pumping Station

Appendix B

APFP Regulations 2009: Regulation **5(2)(q)**

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Thames Tideway Tunnel

Creating a cleaner, healthier River Thames

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Appendix B – Freight tracks and AIS analysis

B.1 Introduction

B.1.1 The project proposes to use the existing Heathwall Pumping Station and adjacent Middle Wharf for construction work and to accommodate permanent structures required to operate the main tunnel. The site would be used to connect two existing CSOs, known as Heathwall Pumping Station CSO and South West Storm Relief, to the main tunnel. These sites are referred to collectively within this report as Heathwall Pumping Station (PS).

B.1.2 In order for this assessment to take into consideration the navigation impact on the wider river community, an area between Vauxhall Bridge and Victoria Rail Bridge was considered. It is proposed that this study area captures the majority of vessel types likely to transit this section of the river.

B.1.3 A review of Global Positioning System (GPS) track information of inbound freight movements passing through this section of the river was undertaken. The track data was captured in November 2011 and provided by Cory Environmental Ltd. The transponder was sited on the starboard rear quarter of the rearmost rank of barges, enabling analysis of vessel track data for the entire duration of the journey.

B.2 Summary

B.2.1 C.2.10 Cory environmental supplied the project with a set of GPS data showing the movements of their tugs and barges. The data covered 14 days in November 2011, a total of 35 tug movements. This data was analysed and visualised to inform various sections of this report. Included below in Figure B.1 is a GIS output of all tracks overlaid over a chart of the Heathwall PS area.

B.2.2 By individually investigating each of the tracks supplied it has been possible to speculate on the potential impacts of the various phases of development.

B.2.3 Due to the similarities between the vast majority of tracks through this area, only six individual images have been produced for this report. These six (highlighted yellow in Table B.1) represent a good cross section of possible routes taken by Cory Environmental Ltd.

B.2.4 Table B.1 has the following headings:

a. Date – Date the GPS data was collected
b. Colour – colour system assigned by Cory tugs to enable identification of individual tugs
c. Tug – The name of the tug in question
d. Head Rank Port – The name of the barge being towed in the port position
e. Head Rank stb'd - the name of the barge being towed in the starboard position
f. Second rank – the name of the barge being towed in the rear position (where applicable)
g. Time entering chart area – approximate time at which the tug entered the displayed chart area
h. Wind Direction - Approximate Wind Direction
i. Wind Speed - Wind speed in m/s
j. High tide – time at which high tide was (taken from the PLA 2011 tide times booklet)
k. Tidal height – projected height of tide at Tower Bridge (taken from the PLA 2011 tide times booklet)
l. Notes/Comments – any pertinent notes or comments on this specific track data
m. Figure – reference in this document for the image of the GPS tracks.

Table B.1 Cory track data

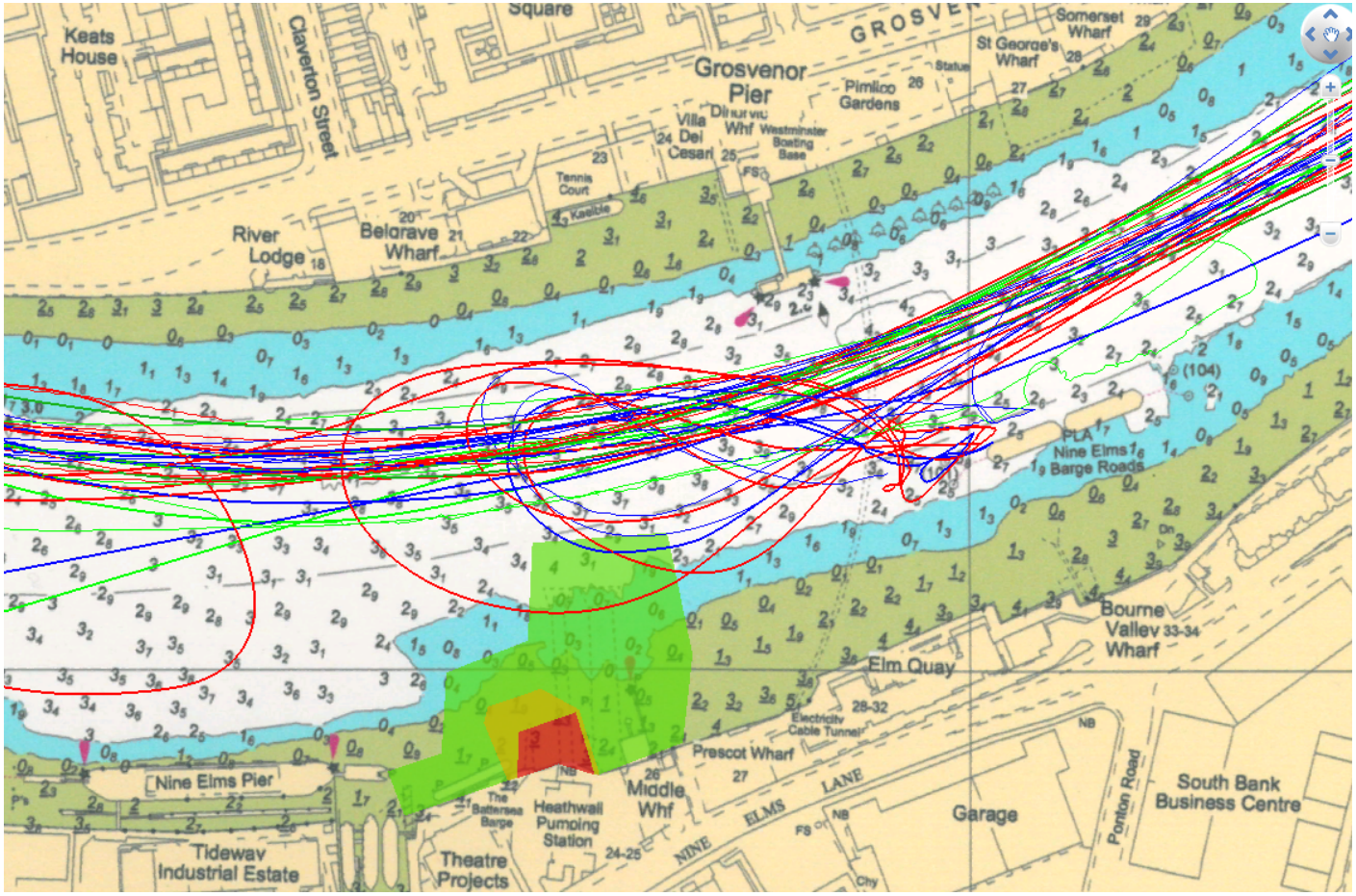
Date	Colour	Tug	Head rank port	Head rank stb'd	Second rank	Time entering chart area	Wind direction	Wind Speed (m/s)	High tide at	Tidal height (m)	Notes / Comments	Figure
07/11/11	Red	Resource	Cringle	Cringle		07:58	NE	3	11:21	6.2		
07/11/11	Blue	Reclaim	Cringle	Cringle	Walbrook		NE	3	11:21	6.2		
07/11/11	Green	Recovery	Cringle	Wangas		07:32	NE	3	11:21	6.2		
08/11/11	Red	Reclaim	Cringle	Cringle	Cringle	09:15	SE	9	12:10	6.5		Figure B.2
08/11/11	Blue	Regain	Cringle	Cringle		08:55	SE	8	12:10	6.5		
08/11/11	Green	Resource	Cringle	Cringle	Wangas	08:49	SE	8	12:10	6.5		
09/11/11	Red	Resource	Cringle	Walbrook		10:26	SE	3	12:51	6.7		
09/11/11	Blue	Recovery	Cringle	Wangas	Wangas	10:07	SE	3	12:51	6.7		
09/11/11	Green	Redoubt	Cringle	Cringle	Wangas	10:15	SE	5	12:51	6.7		
10/11/11	Red	Resource	Cringle	Cringle	Wangas	10:14	E	3	13:27	6.8		
10/11/11	Blue	Regain	Cringle	Cringle	Wangas	09:55	E	4	13:27	6.8		Figure B.3
11/11/11	Red	Reclaim	Cringle	Cringle	Wangas	11:23	E	4	14:00	6.9		
11/11/11	Blue	Recovery	Walbrook	Cringle		11:54	SE	4	14:00	6.9		
11/11/11	Green	Resource	Cringle	Cringle	Wangas	11:07	SE	4	14:00	6.9		
14/11/11	Red	Resource	Wangas	Cringle		12:27	E	4	15:39	6.9		
14/11/11	Blue	Recovery	Walbrook	Cringle		12:37	E	4	15:39	6.9		
14/11/11	Green	Regain	Wangas	Cringle		12:41	E	4	15:39	6.9		

Date	Colour	Tug	Head rank port	Head rank stb'd	Second rank	Time entering chart area	Wind direction	Wind Speed (m/s)	High tide at	Tidal height (m)	Notes / Comments	Figure
15/11/11	Green	Reclaim	Cringle	Cringle			NE	4	16:16	6.8	Not in this study area	
16/11/11	Red	Redoubt	Walbrook	Cringle		14:56	SE	3	16:55	6.7		
16/11/11	Blue	Reclaim	Cringle	Cringle	Cringle	13:27	E	3	16:55	6.7		
16/11/11	Green	Recovery	Cringle	Wangas	Cringle		E	3	16:55	6.7		
17/11/11	Red	Redoubt	Cringle	Cringle	Cringle	14:58	SW	5	17:40	6.6		
17/11/11	Blue	Reclaim	Wangas	Wangas		14:38	SW	5	17:40	6.6		
18/11/11	Red	Regain	Cringle	Wangas	Cringle	14:12	S	5	18:33	6.4		
18/11/11	Blue	Recovery	Cringle	Cringle		15:38	S	4	18:33	6.4		
22/11/11	Red	Regain	Wangas	Wangas		07:19	E	2	10:34	6.5		
22/11/11	Blue	Recovery	Cringle	Cringle	Cringle	07:23	E	2	10:34	6.5		Figure B.4
22/11/11	Green	Reclaim	Cringle	Cringle		07:30	E	2	10:34	6.5		
23/11/11	Red	Reclaim	Wangas	Wangas		09:16	SW	2	11:35	6.8		
23/11/11	Blue	Redoubt	Cringle	Walbrook		09:21	SW	2	11:35	6.8		
23/11/11	Green	Regain	Transponder on tug			09:18	SW	2	11:35	6.8		
24/11/11	Red	Resource	Wangas	Wangas		09:41	SW	4	12:31	7.1		Figure B.5
24/11/11	Blue	Reclaim	Cringle	Cringle	Cringle	09:43	SW	4	12:31	7.1		
24/11/11	Green	Recovery	Cringle	Cringle	Cringle	09:28	SW	4	12:31	7.1		
25/11/11	Red	Resource	Walbrook	Cringle		11:50	W	10	13:22	7.2		Figure B.6

Date	Colour	Tug	Head rank port	Head rank stb'd	Second rank	Time entering chart area	Wind direction	Wind Speed (m/s)	High tide at	Tidal height (m)	Notes / Comments	Figure
25/11/11	Blue	Recovery	Wangas	Wangas		11:38	W	10	13:22	7.2		
25/11/11	Green	Redoubt	Cringle	Cringle	Cringle	11:34	W	10	13:22	7.2		

All Cory Tracks

Figure B.1 All Cory Tracks



Cory Individual Tracks

Figure B.2 08/11/2011 - Red Track image

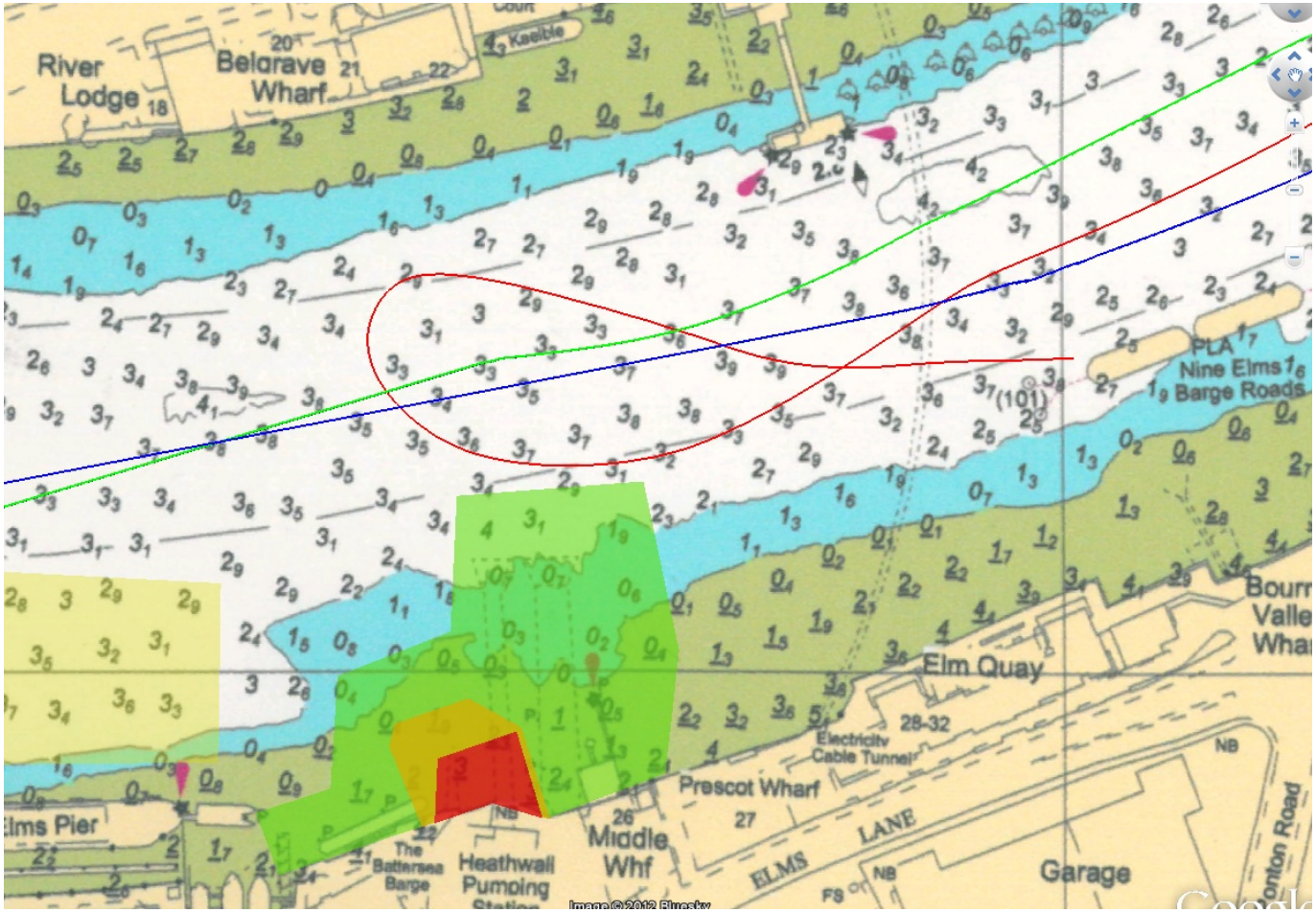


Figure B.3 22/11/2011 - Blue Track image

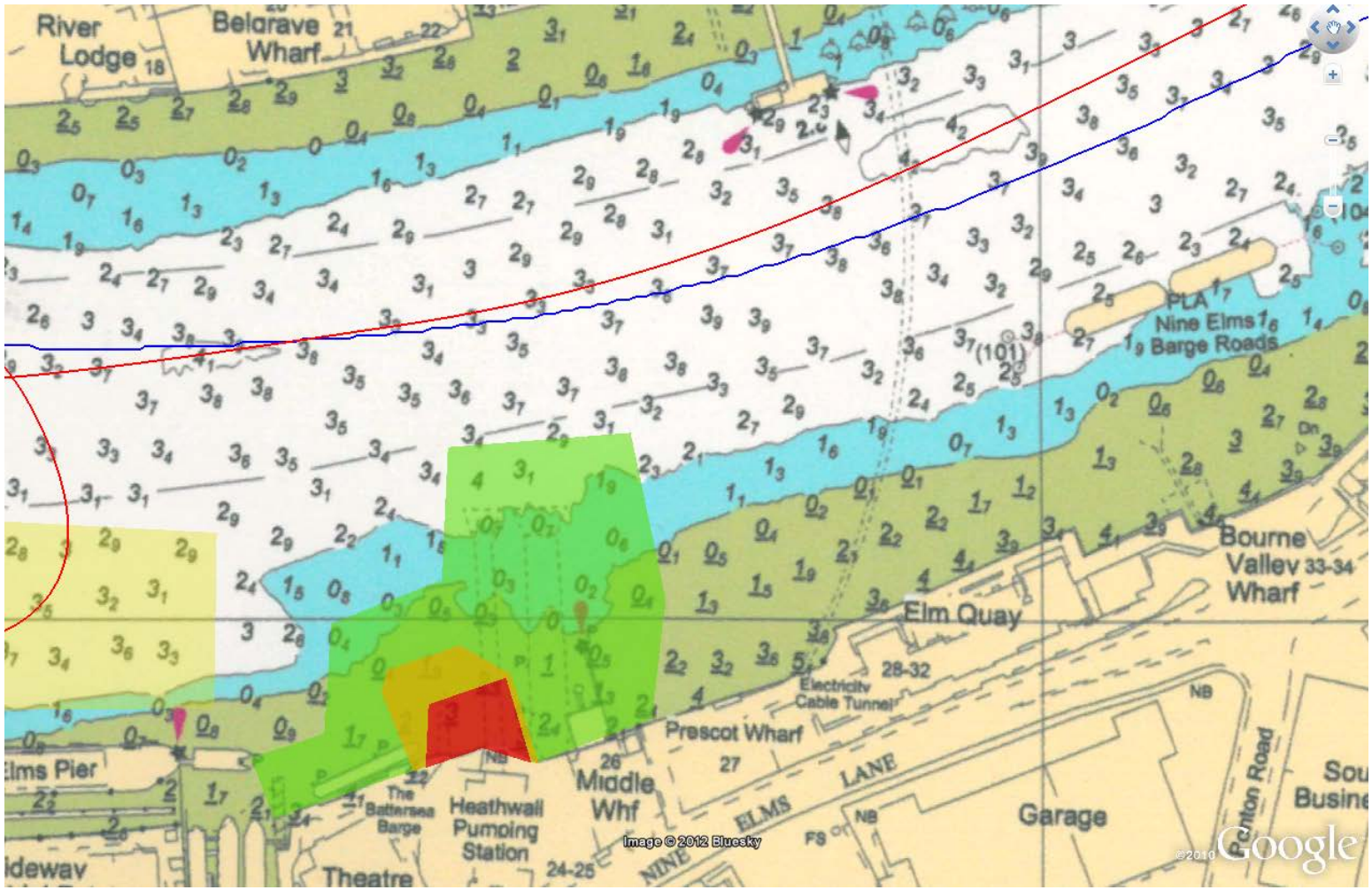


Figure B.4 22/11/2011 - Blue Track image

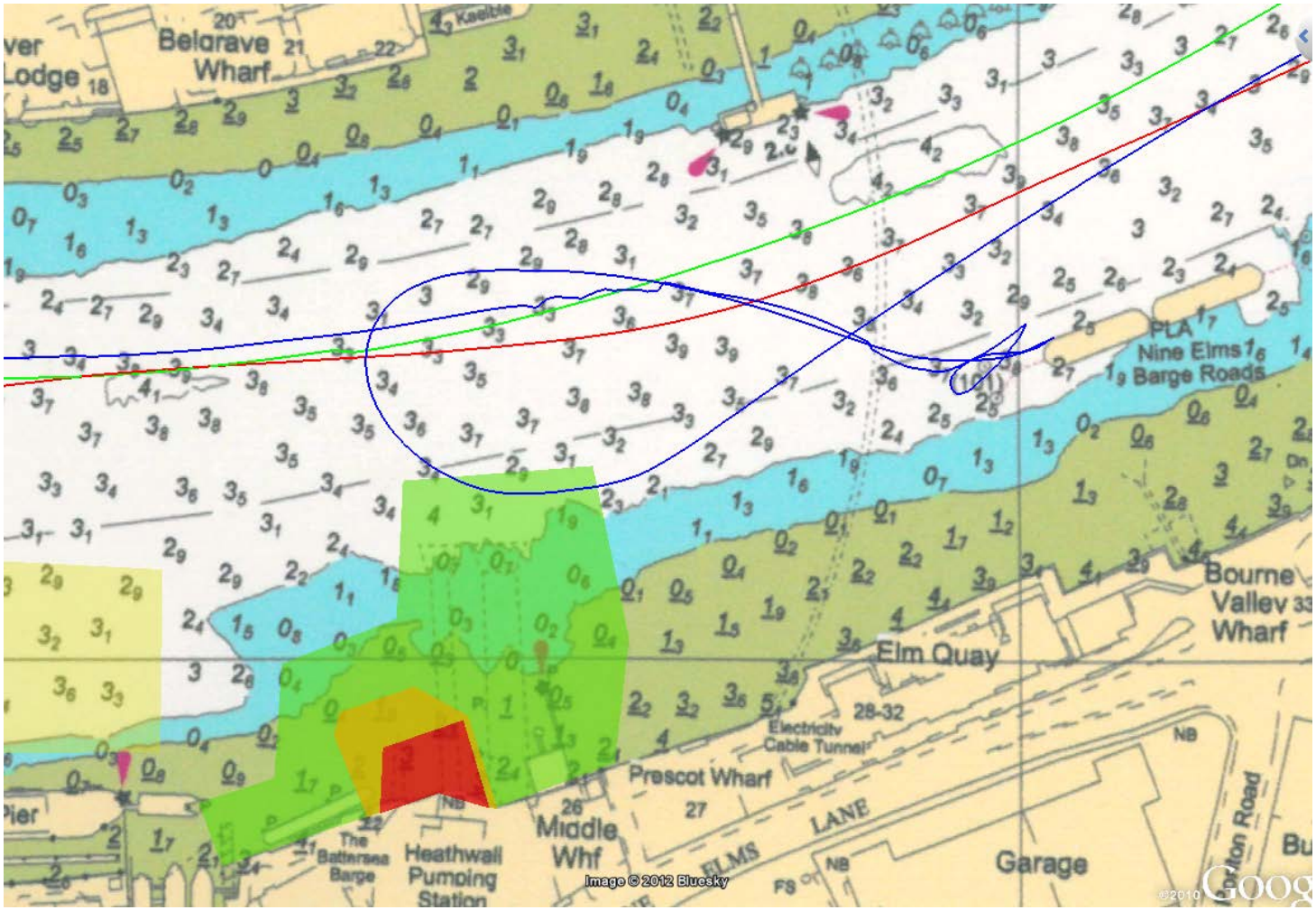


Figure B.5 24/11/2011 - Red Track image

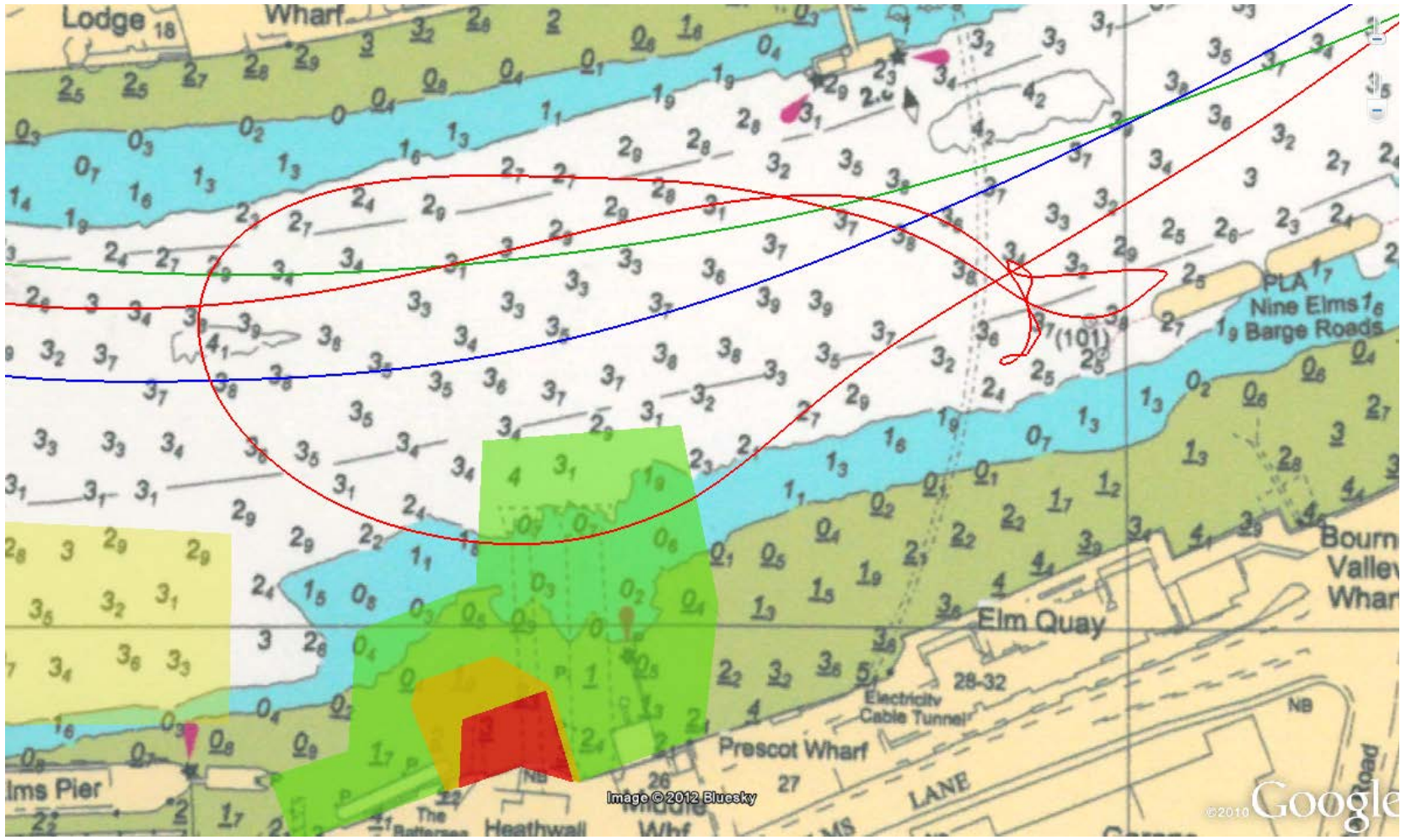
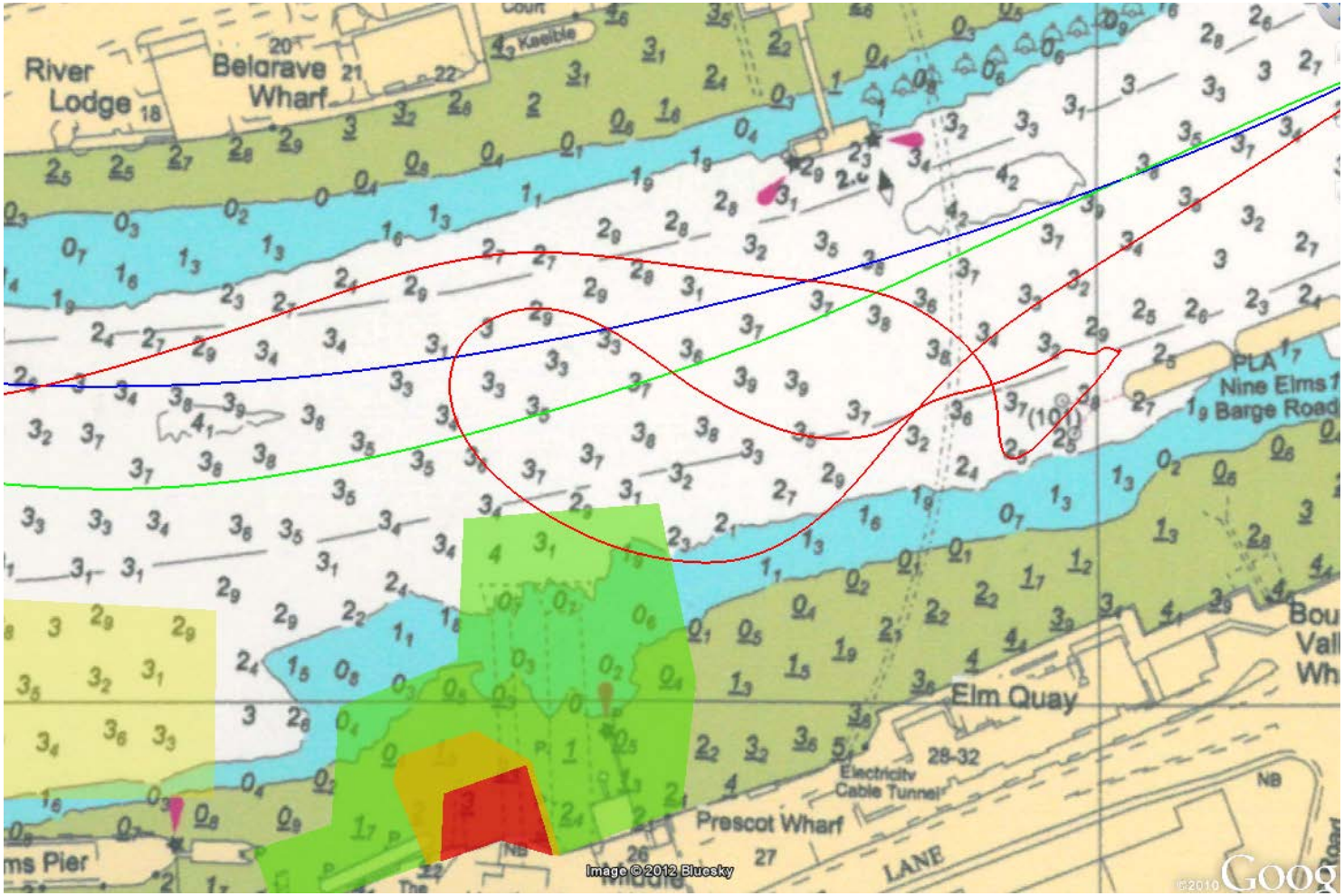


Figure B.6 25/11/2011 - Red Track image



Thames Water Utilities Limited
Clearwater Court, Vastern Road, Reading RG1 8DB

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