PLANNING ACT 2008
INFRASTRUCTURE PLANNING (EXAMINATION PROCEDURE)
RULES 2010

PROPOSED PORT TERMINAL AT FORMER TILBURY POWER STATION

TILBURY2

TR030003

UPDATE HABITAT REGULATIONS ASSESSMENT (HRA) STAGE 2 REPORT - CLEAN

TILBURY2 DOCUMENT REF:
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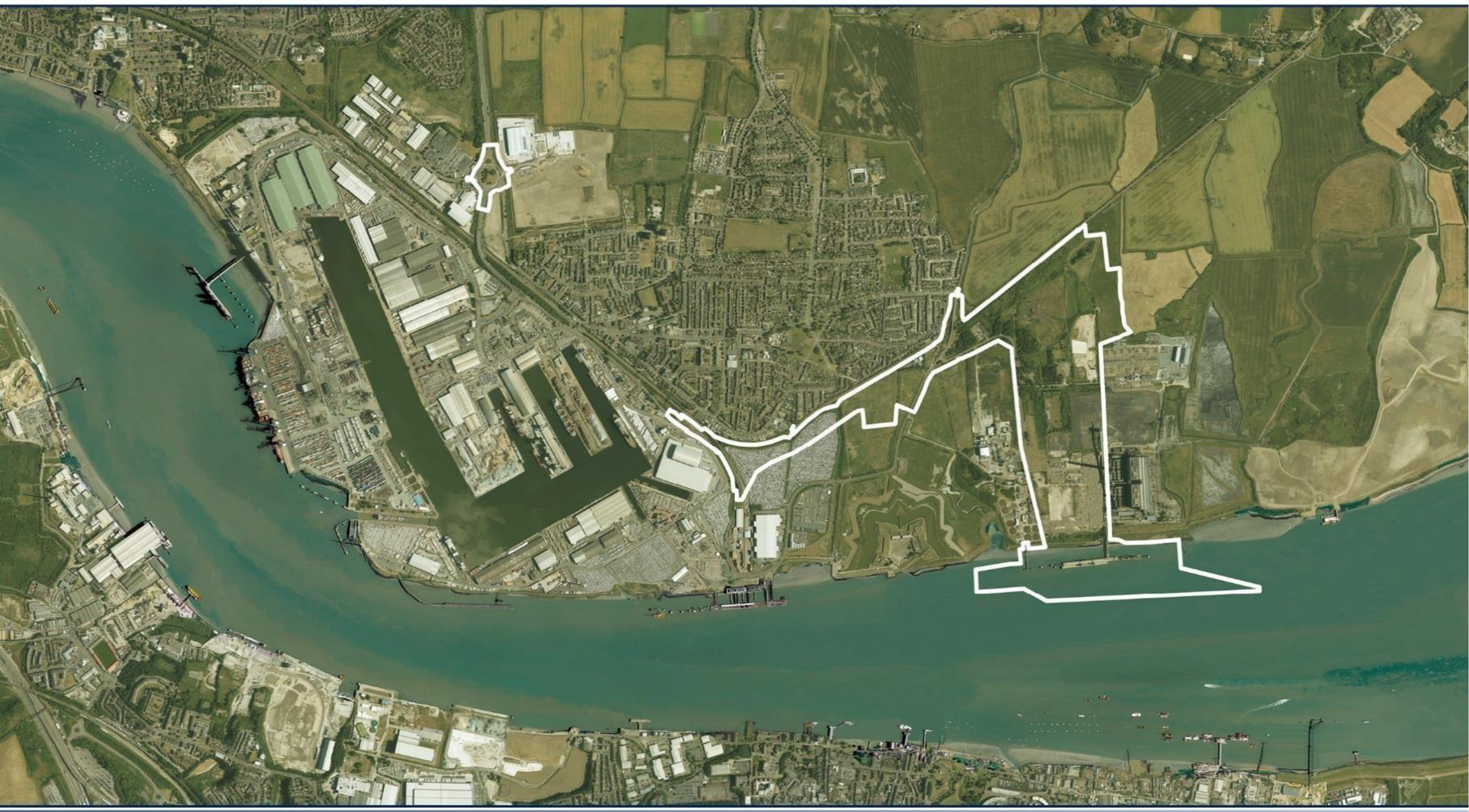

TILBURY2

CONTENTS

FIGURES

APPENDICES

APPENDIX 7	Air Quality Consultants Report: ‘Update: Tilbury2 Air Quality Impacts on Designated Ecological Sites (May 2018)
APPENDIX 8	HR Wallingford Report: ‘Port of Tilbury Expansion – Hydrodynamic and Sediment Study (October 2017)’
APPENDIX 9	The ‘Bird Note’: ‘Proposed Port Terminal at Former Tilbury Power Station: Tilbury2 - Note on Winter Bird Use of the Intertidal Area (April 2018)’
APPENDIX 10	Figures 1-7: Number and distribution of SPA citation species during wintering bird surveys in 2016/17 and 2017/18, showing overlapping Tilbury2 and Tilbury Energy Centre (TEC) Order Limits.
APPENDIX 11	Stage 2 Integrity Matrices

1 INTRODUCTION

1.1 Status and Purpose of this Document

1.1.1 This document ('HRA report') aims to provide relevant technical information to enable competent authorities to discharge their functions under Regulations 7 (competent authorities) and 63 (requirement to carry out an appropriate assessment) of the Conservation of Habitats and Species Regulations 2017 (The Habitats Regulations) in connection with the consenting process for the Tilbury2 project.

1.1.2 The Tilbury2 project is a Nationally Significant Infrastructure Project (NSIP) and consequently the competent authority is the Secretary of State for Transport.

1.1.3 Under the provisions of the UK Habitats Regulations and the parent European Habitats Directive[1], the Secretary of State is required to carry out an appropriate assessment if there are deemed to be 'Likely Significant Effects' (LSE) on a site or sites expressly protected under the terms of the Directive ('European Sites'), when considered alone or in conjunction with other projects and where those LSE arise from a plan or project not directly connected with or necessary to the management of that site or sites.

1.1.4 European Sites are Special Protection Areas (SPAs) and Special Areas of Conservation (SACs) designated pursuant to the Birds and Habitats Directives respectively, but as a matter of both established and emerging UK policy[2,3] also extend to include sites designated pursuant to the 1971 Ramsar Convention on Wetlands of International Importance (Ramsar Sites).

1.1.5 The HRA report appended to the Tilbury2 ES document reference 6.2, 10.O [APP-060) described how the potential for LSE on candidate or confirmed/designated European/Ramsar Sites to arise was assessed in accordance with prevailing guidance and how by means of the Stage 1 screening process (Stage 1 assessment), the Applicant concluded that there are no LSE arising for any European/Ramsar Sites.

1.1.6 However, during subsequent consultation with the Statutory Nature Conservation Body (i.e. Natural England) as part of the pre-Examination and Examination processes, Natural England has stated the view that *"consistent with the precautionary principle, a likely significant effect cannot be ruled out, and that consequently HRA assessment should proceed to the Appropriate Assessment stage"* (see Appendix 1). Therefore in order to address Natural England's recommendation, the Applicant has revisited the HRA process to give consideration as to whether any potential effects could adversely affect the integrity of the two overlapping designations agreed to require assessment (the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar Site) in view of their conservation objectives (a 'Stage 2' assessment). That information is presented within this revised HRA report in accordance with the requirements of the Stage 2 (Appropriate Assessment) process.

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[1] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora (as codified) (the 'Habitats Directive')

[2] Paragraph 118 of the NPPF: Department for Communities and Local Government (March 2012). *National Planning Policy Framework*.

[3] Paragraph 174 of the consultation draft NPPF: Ministry of Housing, Communities and Local Government (March 2018). *National Planning Policy Framework: draft text for consultation.*

1.1.7 The opportunity is also taken to address the outcome of a recent judgement in the Court of Justice of the European Union (*People Over Wind and Sweetman v Coillte Teoranta*; C-323/17) which indicated that measures intended to avoid/reduce the harmful effects of a proposed project should not be taken into account by competent authorities at Stage 1 (screening) when judging whether a proposed plan or project is likely to have a significant effect on a European/Ramsar site.

1.1.8 This updated HRA report including Stage 2 assessment concludes, on the basis of objective information, that the project will not adversely affect the integrity of any European/Ramsar Site, alone or in combination with other known plans or projects. Evidence in support of that conclusion is presented in order to assist the competent authority.

1.1.9 This document has been prepared in accordance with procedural advice prepared by The Planning Inspectorate (PINS)[4] in relation to the Planning Act 2008 (as amended) process, recent (May 2018) guidance issued by PINS in the wake of the 'People Over Wind/Sweetman' case[5] and version 1.1 (December 2017) of Natural England's Operational Standard for HRA[6]. Other guidance has been drawn upon where relevant, and as cited and listed in the references.

[4] The Planning Inspectorate (November 2017) Advice Note 10: Habitats Regulations Assessment relevant to nationally significant infrastructure projects (version 8). Accessed 14.05.2018.

[5] The Planning Inspectorate (09 May 2018) PINS Note 05/2018 Consideration of avoidance and reduction measures in Habitats Regulations Assessment: *People over Wind, Peter Sweetman v Coillte Teoranta* [accessed May 2018]

[6] Natural England (2017) Habitats Regulations Assessment Operational Standard 01.12.2017. V1.1. [Accessed 14.05.2018].

2 METHODOLOGY

2.1 Guidance and Common Standards Followed

2.1.1 The assessment process followed the stepwise procedure set out in PINS advice note 10, whilst also drawing on Natural England's Operational Standards for HRA[7], the procedural guidance in The Habitats Regulations Handbook[8], EC Guidance and guidance for ecological impact assessment more generally (e.g.) as published by the European Commission[9] and the Chartered Institute of Ecology and Environmental Management[10, 11].

2.2 Assessment Process

2.2.1 The assessment process works sequentially through the following stages:

Stage 1 (screening)

2.2.2 This considers the scope for Likely Significant Effects (LSE) to occur based on a broad scale risk analysis taking into account factors such as the spatial relationship between impact sources and designated sites (and functionally linked habitats and species), the magnitude of changes predicted in atmospheric, coastal/estuarine, freshwater and hydromorphological systems (drawing on outputs from other specialist studies) and whether there are physical or other relationships between source and receptor that could provide an impact vector. Stage 1 screening for likely significant effects considers the project both alone and in-combination with other projects. Decommissioning is not considered in the case of Tilbury2 as there is no deemed end-life for the Tilbury2 development. If it can be confidently predicted on the basis of objective information that there are no likely significant effects, then the output of Stage 1 takes the form of a 'No Significant Effects Report' (NSER) and subsequent HRA stages are not required.

2.2.3 The April 2018 judgment of the Court of Justice of the European Union in *People over Wind & Sweetman*[12] ruled that it is not permissible to take account of measures intended to avoid or reduce the harmful effects of the plan or project on a European site at the Stage 1 screening stage thus contradicting established case law in England and Wales that established that such measures could be taken into account at screening stage. The approach adopted in this HRA report is that such measures can only be taken into account as part of Stage 2 appropriate assessment.

Stage 2 (appropriate assessment)

2.2.4 If Stage 1 identifies Likely Significant Effects, an assessment of the implications of the project for the site(s)'s conservation objectives is carried out. Conservation objectives for European/Ramsar Sites are defined and published by Natural England. In this case the relevant document

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[7] Natural England (2016) Habitats Regulations Assessment Operational Standard 01.12.2017. V1.1.

[8] Tyldesley D & Chapman C, (2013) *The Habitats Regulations Assessment Handbook* (May 2018 edition) UK: DTA publications Ltd.

[9] European Commission (2011) Guidance for the Implementation of the Birds and Habitats Directives in Estuaries and Coastal Zones (with particular attention to port development and dredging). Accessed October 2017 via https://ec.europa.eu/transport/sites/transport/files/modes/maritime/.../guidance_doc.pdf

[10] CIEEM (2016) Guidelines for Ecological Impact Assessment in the UK and Ireland: Terrestrial, Freshwater and Coastal, 2nd edition. Chartered Institute of Ecology and Environmental Management, Winchester.

[11] CIEEM (2010) Guidelines for Ecological Impact Assessment in Britain and Ireland: Marine and Coastal. Chartered Institute of Ecology and Environmental Management, Winchester

[12] CJEU 12th April 2018 People Over Wind and Sweetman v Coillte Teoranta (C-323/17)

("European Site Conservation Objectives for Thames Estuary and Marshes Special Protection Area Site Code: UK9012021") has not changed since 2014 (see Appendix 3). The assessment takes the form of a Stage 2 HRA Report and should include sufficient information to enable an Appropriate Assessment (AA) to be undertaken by the competent authority.

2.2.5 HRA Stages 3 and 4 are required if Stage 2 concludes that the project will adversely affect the integrity of the site(s), or when adverse effects on integrity cannot be ruled out.

Stage 3: Assessment of alternative solutions

2.2.6 Stage 3 requires consideration of alternatives, which may include siting the project in an alternative location or design changes to eliminate the source of LSE.

Stage 4: Assessment where no alternative solutions are possible and adverse impacts remain

2.2.7 Stage 4 is engaged where alternative solutions to avoid LSE are not possible and is concerned with assessing whether the project is justified by 'Imperative Reasons of Overriding Public Interest' (IROPI) and, if so, what compensatory measures can be put in place in relation to the affected habitat.

3 DESCRIPTION OF THE PROJECT

3.1 Location and Context

3.1.1 A plan of the proposed Order Limits for the Tilbury2 project is provided in Figure 4.1 of the Environmental Statement (also attached to this HRA report for ease of reference). The proposed Order Limits do not engage directly with any European/Ramsar Site or other statutory nature conservation designation. The relationship between the proposed Order Limits and relevant European/Ramsar Sites and SSSIs is shown at Figure 1 of this report. Figure 1 demonstrates that the nearest part of any European/Ramsar Site (Thames Estuary and Marshes Ramsar Site) is approximately 1.5km distant and to the south-east.

3.1.2 The land bound by the proposed Order Limits comprises four areas, summarised as follows:

- the main site of the new port facility on land formerly forming part of the now decommissioned Tilbury Power Station ("the main site" or "Tilbury2 site");
- sections of the adjoining tidal Thames required for the construction of expanded berthing capacity, a linkspan bridge and associated dredging ("the marine area");
- an infrastructure corridor connecting the existing Port to the Tilbury2 site and accommodating the routes of a new link road between Ferry Road and Fort Road and an adjoining rail spur ("the infrastructure corridor"); and
- a small, disjunct area of land around the A1089 roundabout to the north of the existing Port ("the ASDA roundabout") where small-scale highway improvements will be required.

3.2 Need

3.2.1 The need for the proposals in relation to the exhaustion of current capacity at the existing Port of Tilbury and the economic benefits of expansion both locally and nationally are set out in the Environmental Assessment (ES) at chapters 3 (Port of Tilbury – Existing and Future) and 5 (Description of the Proposals) and in the accompanying Outline Business Case submission document (reference 7.1 [AS-016]); and further expanded upon in the CMAT Position Statement (document reference POTLL/T2/EX/49, Appendix B [REP1-016]). The need is also considered within the Planning Policy Compliance Statement (document reference PoTLL/T2/EX/65 [REP3-005]). Alternatives for the proposals as a whole and in terms of location are considered in ES chapter 6 and its appended Masterplanning Statement (document reference 6.2, 5.A [APP-034]) and Surface Access Options report.

3.2.2 In essence, it is argued that there is an overwhelming need for the proposals to avoid constraining the existing Port's ability to meet throughput increases and the needs of its tenants. Whilst it is difficult to forecast the behaviour of individual tenants if expansion cannot be achieved at Tilbury2, the Port of Tilbury London Limited (PoTLL) are strongly of the view that relocation to other ports, with a consequential damage to PoTLL's investment plans and economic contribution, is highly likely, with knock on effects on the local and regional economy. This is explored further in the Outline Business Case.

3.3 **Design Process**

3.3.1 The design of the project has been driven primarily by operational requirements to make best use of the available land. This has been to achieve the capacity objectives outlined above and to respond to the site constraints and opportunities in terms of existing marine and land-based infrastructure and the practical, spatial and operational demands of the primary uses proposed. This process is explored further in the Masterplanning Statement and Surface Access Options report.

3.3.2 As set out in those documents, terrestrial and marine ecology considerations have been a key consideration at all stages of the design process, and the need to avoid generating off-site impacts that could transmit to European/Ramsar Sites downstream has been a significant driver in the design of marine infrastructure and in the adoption of restrictions imposed on project-related activities such as capital and maintenance dredging through the Development Consent Order (DCO), Deemed Marine Licence (DML), and the Construction Environmental Management Plan (CEMP; reference PoTLL/T2/EX/71 [REP3-011]).

3.4 **Summary Project Description**

3.4.1 A full project description is contained within Chapter 5 of the ES. A brief summary is given below focussing on the elements of most relevance to the consideration of effects with the potential to engage with the nearby European/Ramsar Site/s:

Jetty/Marine Works

3.4.2 The existing jetty, formerly used for receipt of coal for the power station, will be retained but will require modification and extension at both its upstream and downstream arms to increase berthing capacity. This will require in-channel works including piling. Capital and maintenance dredging will be required to create expanded berth pockets and to maintain the approach channel. Dredge pockets will be created and maintained around the improved jetty for the life of the terminal. In relation to the downstream arm comprising the Construction Materials and Aggregates Terminal ("CMAT") jetty, the depth of pocket will be circa 15m and will cater for the largest likely bulk aggregate vessels to visit the site in the future (c. 100,000 tonnes). A sheet pile wall will be installed to run along the northern edge of the dredge pocket. The 'roll on roll off' (RoRo) berthing pocket (next to the western end of the existing jetty and around its westward extension) will require less dredging in order to create a depth of circa 7.88m. The immediately adjoining approaches to the berth pockets will also need dredging and are included within the Order Limits. A link-span bridge on piles will connect the western arm of the jetty to the landside area of the Ro-Ro terminal. The jetty will also need to be lit.

Ro-Ro Terminal – landside facilities

3.4.3 The southern part of the Tilbury2 site (land south of the existing Substation Road) will be developed to accommodate RoRo associated storage areas and access to the RoRo jetty over an area of approximately 20ha.

Construction Materials and Aggregates Terminal – landside facilities

3.4.4 The northern part of the Tilbury2 site (land north of Substation Road) will be developed to accommodate a CMAT, which will comprise a number of permanent uses and structures associated with the receipt and processing of marine aggregates via a conveyor connection to the expanded jetty.

Processing Facilities

3.4.5 This CMAT area is envisaged to include a mixing plant that will include the use of a mechanical mixer; moulding; pressure removal of water, and the robotised stacking of products once completed. Manufactured products may also be cured in a heated area of the plant. A ready-mix concrete batching plant fed from the aggregate storage yard described above and an asphalt manufacturing plant is also envisaged.

Highway and Rail Access Provision

3.4.6 In order to fully utilise the new RoRo terminal and CMAT, a surface access strategy has been devised comprising new and improved road and rail links in the infrastructure corridor extending westwards from the Tilbury2 site (i.e. moving away from the nearest European/Ramsar Site) and connecting in to existing highway and rail networks at the eastern edge of the current Port.

3.5 Avoidance Measures Embedded in Project Design

3.5.1 The application for a DCO and DML for the project is accompanied by an ES (document reference 6.1 [APP-031]) which describes embedded avoidance measures to limit the spatial influence of environmental effects, including those from noise and vibration (Chapter 17), dust and emissions (Chapter 18) and ground and surface water pollution (Chapters 15 and 16). Also accompanying the ES is a Construction Environmental Management Plan (CEMP) (document reference PoTLL/T2/EX/71 [REP3-011]), Operational Management Plan (OMP) (document 6.10 [APP-165]), a Lighting Strategy (ES Appendix 9.J [APP-044] and key figure reproduced within this document) and a Drainage Strategy (ES Appendix 16.E [APP-090]). These collectively detail the avoidance measures that have been embedded within the design (such as the surface water drainage scheme for the Tilbury2 site and the Infrastructure Corridor) or committed to as a means to reduce environmental effects local to the project site (for example planted landscape screening, noise attenuation fencing and cowling/shields on site lighting). Such embedded avoidance measures are taken into account in this HRA report. The DCO/DML, CEMP and OMP provide mechanisms for ensuring the delivery of these measures as an integral part of the scheme.

3.6 Consultation

3.6.1 The pre-application procedures set out within the Planning Act 2008 (as amended) have been followed, as detailed within Chapter 1 of the ES and in the Consultation Report (CR) (document 5.1 [APP-021]). PINS on behalf of the Secretary of State and relevant statutory bodies including Natural England, the Environment Agency, the Marine Management Organisation, the Port of London Authority and the relevant Local Planning Authorities have all been involved in and have contributed to the pre-application statutory (Section 42) consultation, but consultation and direct engagement has continued beyond that to include submission of drafts of relevant documents. In respect of the HRA process, this has included discussions with the Statutory Nature Conservation Body (SNCB), Natural England, to set the scope of coverage of the HRA (in terms of the European/Ramsar Sites needing to be considered) and submission of advance drafts of the HRA report for the purposes of seeking an agreed position on the likelihood or otherwise of significant effects on any European/Ramsar Site occurring.

3.6.2 Natural England's comments have been received during the course of meetings and direct correspondence, and more formally via the exchange of written representations, including in particular the following representations which include specific reference to the Applicant's Stage 1 HRA report (main letters, excluding some lengthy annexes, reproduced at Appendix 1):

- Natural England letter setting out its Section 42 Statutory Consultation Response (dated 28 July 2017. Reference: 218441 Tilbury2 Port Expansion (Thurrock));

- Natural England Discretionary Advice Service (DAS) letter relating to HRA matters (dated 25 October 2017. Reference: DAS 11835 209261 Port of Tilbury 2 HRA);

- Natural England letter setting out its Relevant Representations (dated 08 January 2018. Reference: 11835/227719 [RR-025]);

- Natural England letter setting out its Written Representations for Deadline 1 (dated 20 March 2018. Reference: 236858 Tilbury2 Written Reps [REP1-074]);

- Natural England letter setting out its Written Representations & Written Submission of Oral Case for Deadline 3 (dated 30 April 2018. Reference: Tilbury 2 Deadline 3 Response [REP3-042];

3.6.3 The Applicant has had regard to Natural England's representations and this Stage 2 assessment has been undertaken primarily to address the SNCB's residual comments and recommendations as detailed in the Relevant Representations and the Written Representations issued at Deadlines 1 and 3, and in order to address the recent CJEU judgment in *People over Wind & Sweetman*.

4 RELEVANT EUROPEAN AND/OR RAMSAR SITES

4.1 **Models and assumptions used to define maximum zones of influence for specific effects arising from the project**

4.1.1 The maximum zone of influence for air and water quality effects arising from the Tilbury2 project has been defined by reference to the outputs of bespoke modelling studies conducted as part of the Environmental Impact Assessment, involving (*inter alia*) application of the following tools:

- Atmospheric Dispersion Modelling System (ADMS) 'ADMS-Roads' model (version 4.0). Cambridge Environmental Research Consultants (see ES Chapter 18)[13] to model land-based vehicular emissions generated by the project;

- Atmospheric Dispersion Modelling System (ADMS) 'ADMS-5' model (industrial installations). Cambridge Environmental Research Consultants (see Appendix 6 and 7 of this HRA report) to model emissions from shipping traffic in the operational phase; and

- Hydrodynamic modelling tool TELEMAC-3D (see Appendix 8 of this HRA report, section 2.1) to assist with modelling sediment dispersal and deposition plumes and related effects.

4.1.2 In respect of effects on cited fauna from lighting, noise and disturbance from movement or human sources, a maximum zone of influence has been defined with the assistance of the following tool:

- Waterbird Disturbance Mitigation Toolkit (Institute of Estuarine & Coastal Studies (IECS) University of Hull, 2013) (TIDE toolkit).[14]

4.1.3 The 'zone of influence' of disturbance to birds is defined by reference to the maximum response distances of the relevant species, and for noise, by the predicted decibel outputs of the most disturbing activities (i.e. piling) so is 'worst case' in its application. Some of the species using the envelope will be more resistant to disturbance than others, by reference to established studies as cited in TIDE, and for these species the envelope of potentially disturbing effects may be smaller than allowed for. For all bird species considered, the zone of influence for noise and human bird disturbance is wider than for disturbance from lighting. Thus, the approach taken in this HRA report is 'worst case'.

4.1.4 Where such tools or the outputs from quantitative studies are not available, for example in the consideration of potential lighting effects on Ramsar-cited invertebrate or plant taxa in functionally linked habitats close to the Tilbury2 site, professional judgment has been applied taking subjective or objective account of factors such as intervening distance, rates of attenuation and dilution, prevailing tidal and atmospheric processes, and factors such as the existing substantially industrialised nature of the Thames estuary (influencing, amongst other things, individual species' habituation and sensitivity), including in relation to recent industrial activity on the Tilbury 2 site itself.

[13] See ES (document reference 6.1 [APP-031]) Chapter 18 e.g. para 18.122
[14] Accessed October 2017 and May 2018 from http://www.tide-toolbox.eu/tidetools/waterbird_disturbance_mitigation_toolkit/

4.2 **European and/or Ramsar Sites within range of potential impact sources**

4.2.1 Based on the potential maximum range at which identified effects have the potential to be significant, taking account of the modelled outputs and assessments, the need to consider the potential for likely significant effects has been identified solely in respect of the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar Site.

4.2.2 The intention to limit Habitats Regulations Assessment to these two overlapping and largely coterminous designations was set out in scoping discussions and correspondence with statutory and non-statutory agencies at the outset of the project and referenced in the Preliminary Environmental Information report (PEIR) issued as part of the pre-application process. In particular, paragraph 10.146 states:

"*All other European nature conservation designations are located at least 9km from the Site, at which distance they are considered to be beyond the range of potential significant effects. No other designations have emerged through the scoping process, and therefore no other European nature conservation designations are given any further consideration in this PEIR*"

4.2.3 In responding to the statutory section 42 consultation, Natural England included the following statement in their letter of 28 July 2017 (Appendix 1):

"*Natural England acknowledges the list of sites presented in 'Table 10.23 Statutory nature conservation designations within 5km of the Site' and agrees the sites selected in the following paragraphs as being most likely to be impacted is appropriate.*"

4.2.4 In accordance with this agreed position with the Statutory Nature Conservation Body, the two European and/or Ramsar Sites considered in this assessment are the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar Site. There has been no change to this position arising from ongoing consultation and engagement with NE.

4.3 **Qualifying Features – Thames Estuary and Marshes SPA**

4.3.1 The qualifying features for the Thames Estuary and Marshes SPA are attached at Appendix 2 and are as follows:

Wintering populations of European importance of the following Annex I species:

- Avocet *Recurvirostra avosetta*; and
- Hen harrier *Circus cyaneus*.

Regular use by 1% or more of the biogeographical populations of the following regularly occurring migratory species (other than those listed on Annex I):

- Ringed plover *Charadrius hiaticula* (passage);
- Grey plover *Pluvialis squatarola* (winter);
- Dunlin *Calidris alpina alpina* (winter);
- Knot *Calidris canutus islandica* (winter);
- Black-tailed godwit *Limosa limosa islandica* (winter); and
- Redshank *Tringa totanus totanus* (winter).

The site also qualifies by regularly supporting over 20,000 waterfowl generally.

4.3.2 The European Site Conservation Objectives for the SPA are attached at Appendix 3 and are as follows:

> "*With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features'...), and subject to natural change;*
>
> - *Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;*
> - *The extent and distribution of the habitats of the qualifying features;*
> - *The structure and function of the habitats of the qualifying features;*
> - *The supporting processes on which the habitats of the qualifying features rely;*
> - *The population of each of the qualifying features; and,*
> - *The distribution of the qualifying features within the site*."

4.4 Qualifying Features – Thames Estuary and Marshes Ramsar Site

4.4.1 Of the nine criteria for the selection of Wetlands of International Importance pursuant to the Convention, the Thames Estuary and Marshes Ramsar Site qualifies under Criterion 2 for supporting rare plants and invertebrates as follows:

4.4.2 The Ramsar Site supports the endangered plant species least lettuce *Lactuca saligna*; and at least 14 nationally scarce plants of wetland habitats (annual beard grass *Polypogon monspeliensis*, Borrer's saltmarsh-grass *Puccinellia fasciculata*, bulbous foxtail *Alopecurus bulbosus*, clustered clover *Trifolium glomeratum*, divided sedge *Carex divisa*, dwarf eelgrass *Zostera noltii*, golden samphire *Inula crithmoides*, narrow-leaved eelgrass *Zostera angustifolia*, one-flowered glasswort *Salicornia pusilla*, saltmarsh goosefoot *Chenopodium chenopodioides*, sea barley *Hordeum marinum*, sea clover *Trifolium squamosum*, slender hare's-ear *Bupleurum tenuissimum*, and stiff saltmarsh-grass *Puccinellia rupestris*).

4.4.3 The site supports the endangered weevil species *Bagous longitarsis*; eleven vulnerable species (the groundbug *Henestaris halophilus*, a weevil *Bagous cylindrus*, a ground beetle *Polystichus connexus*, a cranefly *Erioptera bivittata*, a cranefly *Limnophila pictipennis*, a horse fly *Hybomitra expollicata*, a hoverfly *Lejops vittata*, a dancefly *Poecilobothrus ducalis*, a snail-killing fly *Pteromicra leucopeza*, a solitary wasp *Philanthus triangulum* and a damselfly *Lestes dryas*) and fifteen rare species (a ground beetle *Anisodactylus poeciloides*, the water beetles *Aulacochthebius exaratus*, *Berosus fulvus*, *Cercyon bifenestratus*, *Hydrochus elongatus*, *Hydrochus ignicollis*, *Ochthebius exaratus* and *Hydrophilus piceus*, a malachite beetle *Malachius vulneratus*, a rove beetle *Philonthus punctus,* a fungus beetle *Telmatophilus brevicollis*, a fly *Campsicnemus magius*, a horsefly *Haematopota bigoti*, a soldier fly *Stratiomys longicornis* and a spider *Baryphyma duffeyi*.)

4.4.4 In addition, the site qualifies under Criterion 5 for supporting internationally important assemblages of waterfowl (5 year peak mean 1998/99-2002/03 of 45118 waterfowl) and under Criterion 6 for internationally important numbers of the following species:

- Ringed plover *Charadrius hiaticula;*
- Black-tailed godwit *Limosa limosa islandica;*
- Grey plover *Pluvialis squatarola;*
- Knot *Calidris canutus islandica;*
- Dunlin *Calidris alpina alpina;* and
- Redshank *Tringa totanus totanus*.

4.4.5 The Ramsar information sheet is attached at Appendix 4.

4.5 **Functionally linked features**

4.5.1 In addition to populations of species occurring within the boundaries of the Thames Estuary and Marshes SPA and Ramsar Site, there is a need to consider 'functionally linked' populations occurring beyond the designation boundaries[15]. The need to broaden impact assessments out to consider functionally linked features is an established principle in Habitats Regulations Assessment.

4.5.2 In this case, the main consideration is cited species making use of (predominantly intertidal) habitats that are closer to the Tilbury2 site than the designated SPA/Ramsar boundaries, and thereby at higher risk of exposure to identified potentially significant impacts emanating from the project site.

4.5.3 In respect of SPA/Ramsar cited bird species, some of which use intertidal areas close to Tilbury2 for feeding, the assumption can readily be made that such birds will to a greater or lesser extent form part of or at least interchange with the nationally or internationally significant numbers that underpin the SPA/Ramsar designations and thence significant effects on them (for example from displacement) even outside the designated area could give rise to indirect significant effects within the designated sites, potentially up to and including threats to the continued sustainability of, or restoration of, favourable conservation status of, the key populations and thus site integrity. A considerable volume of bird survey information is available in order to inform the assessment of overwintering birds and use of intertidal habitats outside of the boundaries of the SPA/Ramsar Site. This is presented within Chapter 10 of the ES [APP-031] and further expanded upon in the 'Bird Note' presented at Appendix 9 to this report.

4.5.4 In respect of populations of cited plant and invertebrate species relevant to the Ramsar Site but outwith the designation boundary and closer to the Tilbury2 site, interrelationship with the Ramsar Site populations cannot be assumed so readily. However, the restricted distribution of such species and their specialist habitat requirements indicate that the health of populations outside of the designated site is very likely to have at least some degree of functional linkage to the health of the populations within it (for example in performing a role in genetic flow and exchange). These extra-boundary populations thus also fall to be considered in the HRA process.

[15] "the term 'functional linkage' refers to the role or 'function' that land or sea **beyond the boundary** of a European site might fulfil in terms of supporting the populations for which the site was designated or classified" C Chapman & D Tyldesley (June 2015). *Functional linkage: how areas that are functionally linked to European sites have been considered when they may be affected by plans and projects – a review of authoritative decisions*. Natural England Research Report NECR207.

5 POTENTIAL IMPACT SOURCES – TILBURY2

5.1 Impacts arising from the Tilbury2 project that have the potential to give rise to effects within the Thames Estuary and Marshes European/Ramsar Site

Direct and indirect effects from disturbance, noise and lighting emanating from the Tilbury2 site

5.1.1 The Thames Estuary and Marshes SPA and Ramsar Site have overlapping boundaries which are coterminous for the section of the Site to the east of the Order Limits (see Figure 1). The distance between the Tilbury2 site and the nearest part of both the SPA and Ramsar site (foreshore adjoining Eastcourt/Shorne Marshes on the opposite (southern) side of the Thames, also recognised as the South Thames Estuary and Marshes SSSI) is just under 1.5km. Here, the boundaries of the Thames Estuary and Marshes Ramsar Site encompass a greater extent of land than the SPA boundaries do. This is because the Ramsar Site incorporates several landward elements that the SPA does not, within the area of the Shorne Marshes. The nearest near-shore component (Mucking Flats and Marshes SSSI, north of Coalhouse Fort) is just over 2.4km distant. For these near-shore areas, the boundaries for both the SPA and Ramsar are the same.

5.1.2 Through application of the tools and judgments described in section 4.1, these intervening distances obviate the potential for direct effects on the designated site, which are consequently scoped out, and they also substantially reduce the scope for indirect effects. In particular the attenuating effect of these intervening distances on potential impact sources such as disturbance caused by human movement and activity, noise and lighting originating within the Tilbury2 site, is significant and alone allows the scope for significant indirect effects from these sources to impact on receptors within the European/Ramsar Site boundaries to be ruled out.

5.1.3 Taking this into account, the following potential impact sources are considered to be of most relevance to the HRA process in respect of the Tilbury2 project:

Air quality

5.1.4 Emissions from road and non-road traffic and shipping in and around the Tilbury2 site will disperse towards the European/Ramsar Site by virtue of the prevailing westerly and south-westerly wind direction. Increased shipping traffic generated by the expanded port, once operational, may also bring emissions sources closer to the European/Ramsar Site via shipping lanes.

Sediment circulation and deposition patterns

5.1.5 The construction of new and/or expanded marine structures and associated capital and maintenance dredging has the potential to interfere with coastal and estuarine processes, including patterns of sediment circulation, accretion and deposition. Where such processes underpin the morphology, extent and condition of habitats within the European/Ramsar Site such as mudflat and saltmarsh, and functionally linked examples of such habitats outside which are important for cited bird species and other taxa, there is the potential for any changes to give rise to a significant effect.

Water and/or sediment quality

5.1.6 The construction of new and/or expanded marine structures and associated capital and maintenance dredging has the potential to influence water quality within the Thames, both in terms of suspended sediment loads and through the risk of mobilising any contaminants currently bound in sediments. Redistribution of contaminants in this way could result in contamination affecting habitats within the European/Ramsar Site and functionally-linked habitats outside it, via sediment transport and re-deposition or could increase the bioavailability (e.g. to aquatic organisms) of contaminants, causing potential effects on cited interest features further up the food chain (biomagnification) or even via direct toxicity.

Disturbance – shipping

5.1.7 Increased shipping traffic and/or any significant operational changes (eg, changes in size, type, movement or duration of associated waterborne vessels) generated by the expanded port, once operational, will generate additional movements along shipping lanes proximal to the European/Ramsar Site and functionally linked habitats outside it and could exacerbate any current disturbing effect that shipping traffic has on cited fauna such as birds.

Disturbance - noise and lighting

5.1.8 The attenuating effect of distance means that there is assessed to be no scope for significant disturbance effects from these sources to act directly on the European/Ramsar Site in respect of noise generation or lighting emissions from the site itself. There is assessed to be greater potential for noise and lighting associated with increased and potential operational changes to shipping traffic along shipping lanes proximal to the European/Ramsar Site to affect cited fauna such as birds.

Invasive Non-Native Species

5.1.9 Construction works and Port operations (in particular shipping) have the capacity to introduce or encourage the spread of Invasive Non-Native Species (INNS) that could potentially impact on the European and Ramsar Site features and the habitats within and outside the designated area that support them.

Construction waste and pollutants

5.1.10 The construction activities within the development footprint have the capacity to introduce or mobilise environmental contaminants via a range of activities (e.g. elevated construction dust; increased quantity and affected quality of surface water run-off; use or application of non-biodegradable toxic chemicals, etc.). This could potentially impact on the Thames Estuary and Marshes SPA and Ramsar site either via onward mobilisation or by affecting functionally linked land.

Operational waste and pollutants

5.1.11 The Port operations have the capacity to increase and alter water discharges to the Thames which may potentially impact on the functionally-linked habitat. They also have the capacity to introduce or mobilise contaminants via a range of activities (e.g. surface run-off from increased vehicle movement, operational spillages) which could affect water and sediment quality in the

Thames and have knock-on effects on the downstream European/Ramsar Site or functionally linked habitats.

5.2 Impacts with the potential to give rise to effects solely on functionally linked features

5.2.1 The marine elements of the Tilbury2 project site include representations of intertidal habitats including saltmarsh, mudflat and shingle/cobble beach that are a continuation of habitats present within and integral to the European/Ramsar Site. The potential for impacts on these to have implications for the European/Ramsar Site lies mainly in the scope for impacts on associated fauna and flora that represent an integral part and/or extension of the populations for which the European/Ramsar Site is designated. Principal amongst these are wading birds and waterfowl, where they use these habitats closer to the Tilbury2 site (i.e. birds using functionally-linked habitats that are closer to the Tilbury2 site than the habitats of the Thames Estuary & Marshes SPA and Ramsar site), but also the populations of cited insect and plant taxa which may form part of or an important outlier to local metapopulations that are important for reasons such as genetic exchange and/or providing a failsafe against localised extinctions.

5.2.2 Taking the above into account, the following potential impact sources are considered to be of most relevance to assessing whether LSE on the European/Ramsar Site are possible via effects limited to functionally linked habitats or species:

Habitat loss /damage

5.2.3 The predicted temporary loss of 0.035ha of intertidal habitat[16] (comprising saltmarsh, mudflat, and shingle/cobble beach habitat) and losses of 3.5ha of coastal and floodplain grazing marsh[17] would (either alone or in-combination with other plans or projects) fractionally denude the local extent of potential functionally-linked habitat. This could give rise to implications for population carrying capacity (e.g. of intertidal birds and/or Criterion 2 Ramsar species) and/or pressure on the surviving examples within the European/Ramsar Site. The potential effects fall to be screened or otherwise assessed on that basis.

Air quality – dust and vehicle emissions (non-shipping)

5.2.4 Atmospheric pollution from road and non-road traffic and shipping in and around the Tilbury2 site could impinge on functionally linked habitat resources through deposition and interference with the nutrient balance of (e.g.) upper saltmarsh and coastal grazing marsh. Factors such as tidal wash are likely to militate against deposition on mudflats or regularly inundated habitat features.

5.2.5 The study area for the air quality assessment is defined at paragraph 18.51-18.64 of the ES, summarised in Table 1 below, and illustrated in the following figures (also reproduced within this HRA report):

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[16] For further detail, see the Applicant's response to the Examining Authority's First Written Question 1.11.7 [REP1-016], available from: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR030003/TR030003-000675-PoTLL_Response%20to%20the%20Examining%20Authority's%20First%20Written%20Questions.pdf

[17] For further detail refer to tabulated response to FWQ 1.2.10 provided within at pages 23-25 of the Applicant's Deadline 2 submission document [REP2-007], available from: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR030003/TR030003-000705-The%20Applicant%20Written%20responses.pdf

- ES Figure 18.1 [APP-155] – Potential construction dust impacts;
- ES Figure 18.2 [APP-156] – Potential traffic impacts; and
- ES Figure 18.4 [APP-158] – Potential operational dust and odour impacts.

Table 1 – Air quality study areas for ecological receptors

Element of Air Quality Assessment	Maximum extent of study area
Construction dust (ES paragraphs 18.52-18.54)	50m from the Site Boundary 50m either side of haul routes up to 500m from the Site access. Set in accordance with IAQM Construction Dust Guidance (2014)[18].
Operational dust (ES paragraph 18.55)	For dust soiling and human health impacts, the area considered is up to 400m from the Site Boundary. Set in accordance with IAQM Mineral Dust Guidance (2016)[19]. Paragraph 18.57 of the ES provides justification for why the effects of operational dust were not considered between 400m and 1km from the site boundary in light of the low background PM_{10} concentrations
Road traffic emissions (construction and operation) (ES paragraphs 18.58 and 18.59).	200m either side of the centreline of an 'affected' road where 'affected' is defined by the EPUK / IAQM change criteria. The distance is based on industry best practice as cited in DMRB (2007) guidance[20].
Rail (ES paragraphs 18.60 to 18.62)	200m either side from the centreline of the railway. Paragraph 18.144 of the ES confirms inclusion of rail emissions alongside road traffic emissions in the ADMS dispersion model.
Shipping (HRA Appendix 6 and 7. For HRA purposes, this air quality modelling supersedes the study areas defined at ES	Includes full extent of Thames Estuary and Marshes SPA and Ramsar Site. HRA Appendix 6 and 7 ('Air Quality Impacts on Designated Ecological Sites' reports) describe modelling of air quality changes in relation to shipping emissions over the full extent of the European Sites, which was undertaken specifically for the HRA on a precautionary basis.[21]

[18] IAQM (February 2014). *IAQM Guidance on the Assessment of Dust from Demolition and Construction*, Institute of Air Quality Management, London. Available from: www.iaqm.co.uk/text/guidance/construction-dust-2014.pdf

[19] IAQM (May 2016). *IAQM Guidance on the Assessment of Mineral Dust Impacts for Planning.* Institute of Air Quality Management, London. Available from: http://www.iaqm.co.uk/text/guidance/mineralsguidance_2016.pdf

[20] Highways England (2007). *Design Manual for Roads and Bridges. Volume 11, Section 3, Part 1 'Air Quality' (HA 2017/07*). Available from http://www.standardsforhighways.co.uk/ha/standards/dmrb/vol11/section3/ha20707.pdf

[21] Note that the modelling of the full extent of the SPA/ Ramsar site supersedes the need to define more limited study areas, such as the 250m and 1km study areas applied within the ES, which were based upon Defra guidance in respect of human receptors [Originally published 2016 but now superseded by: *Defra (February 2018). Local Air Quality Management Technical Guidance LAQM.TG16.* Available from: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf]. That guidance is designed to help local authorities screen the need to assess an increase in shipping activity related to a port extension. It recommends that the following study areas be considered: locations within 250m of shipping berths/main areas of manoeuvring if there are more than 5,000 large ship movements per year; or locations within 1km of the port/shipping area if there are more than 15,000 large ship movements per year. For Tilbury2, large ship movements are calculated to be fewer than 2,000 per year (paragraph 14.25 of Chapter 14 of the ES), and thus shipping movements fall well below the two thresholds in the guidance. Both the 250m and 1km study areas were applied within the ES during screening, with the SPA/Ramsar Site being screened out initially due to being >1km from the port, and due to it being more than 250m from the shipping lane. However, these study areas have ultimately been superseded by the modelling assessments presented at Appendix 6 and 7, which model air quality changes over the full extent of the SPA and Ramsar Site arising from the additional shipping movements.

Element of Air Quality Assessment	Maximum extent of study area
paragraphs 18.63 to 18.64 and 18.149 to 19.150).	

Air quality – shipping emissions

5.2.6 The study area for the air quality assessment is defined by reference to Appendix 6 and 7, which considered shipping emissions in relation to the entire SPA and Ramsar Site. This supersedes the study area boundaries as defined within the ES at paragraph 18.63 (see Table 1 above). Appendix 6 provides details of how potential impacts from increased exhaust emissions from shipping have been modelled and assessed on the basis of predicted increases in shipping movements arising from the Tilbury2 project. An update note is provided at Appendix 7 presenting refined outputs from corrections to the model. In summary, the emissions from the additional ship movements along the Thames were determined by reference to vessel types and these were then used as input to a dispersion model to calculate contributions to concentrations and deposition rates across the SPA and SSSIs (thus also covering the Ramsar site). The increased shipping movements, as set out in Table A1.1 in Appendix A1 Modelling Methodology of Appendix 6 to the HRA report, comprise 40 additional annual movements for CMAT aggregate vessels represented by the JS Amazon vessel, and 1,452 movements a year for RoRo vessels represented by the M/V Bore Sea.

Sediment circulation and deposition patterns

5.2.7 The construction of new and/or expanded marine structures and associated capital and maintenance dredging has the potential to interfere with coastal and estuarine processes, including patterns of sediment circulation, accretion and deposition close to the Tilbury2 site where it could affect the morphology, extent and condition of intertidal habitat including saltmarsh, mudflat and shingle/cobble beach habitats that are functionally linked to the European/Ramsar Site.

Water and sediment quality

5.2.8 The construction of new and/or expanded marine structures and associated capital and maintenance dredging has the potential to influence water quality local to the works, both in terms of suspended sediment loads (albeit within a system characterised by high levels of suspended sediment) or more particularly through the risk of mobilising any contaminants currently bound in benthic sediments. Mobilisation and redistribution of contaminants in this way could result in contamination of intertidal habitats proximal to the Tilbury2 site or could increase the bioavailability (e.g. to aquatic organisms) of contaminants, causing potential effects on cited interest features further up the food chain (biomagnification) or even via direct toxicity.

Disturbance - shipping

5.2.9 Shipping activity concentrated around the jetty area may have a disturbing affect on the bird species that feed on nearby intertidal habitats, and where such species form part of the wider populations underpinning the European/Ramsar Site, there is a potential vector for indirect significant effects.

Disturbance - noise and lighting

5.2.10 Noise and lighting associated with the construction and operation of marine structures, and to a lesser extent the landward elements of the Tilbury2 site, may have a disturbing affect on bird species using nearby intertidal habitats (as set out in Table 2 below), and where such species form part of the wider populations underpinning the European/Ramsar Site, there is a potential vector for indirect significant effects.

Disturbance – visual/human activity

5.2.11 Disturbance triggered by human presence and/or movement associated with the construction and operation of marine structures, and to a lesser extent the landward elements of the Tilbury2 site, may have a disturbing affect on bird species feeding on nearby intertidal habitats (as set out in Table 2 below), and where such species form part of the wider populations underpinning the European/Ramsar Site, there is a potential vector for indirect significant effects.

Table 2. Sensitivity of SPA citation species to disturbance[22]

SPA Citation Species	Species Sensitivity	Noise/Construction Disturbance	Human Disturbance
Avocet *Recurvirostra avosetta*	Moderate sensitivity likely, but high sensitivity assumed for precautionary reasons in absence of empirical data.	Limited data available, but considered likely to be moderately sensitive to noise stimuli. The most conservative data from the species below are therefore used to define likely threshold effects distances.	Limited data available, but considered tolerant of moderate visual disturbance. The most conservative data from the species below are therefore used to define likely threshold effects distances.
Black-tailed godwit *Limosa limosa islandica*	Moderate sensitivity	Moderately sensitive to noise stimuli. From a 100m distance, 110-115dB at source is likely to create a high level disturbance impact.	Limited data available, but considered tolerant of moderate visual disturbance.
Dunlin *Calidris alpina alpina*	Low sensitivity	Dunlin are not particularly sensitive and a noise level of 72dB at the bird is considered acceptable (caution above 60dB). A source noise threshold of 102-107dB can be applied at c.50m (caution above 92dB).	Will allow approach as close as 50-90m before flushing when confronted with a lone walker on mudflat. Dunlin are very tolerant of moderate/high level visual disturbance.
Grey plover *Pluvialis squatarol*	Moderate sensitivity	Given the limited data available, a precautionary approach is taken in setting likely response thresholds. From a 150m distance, 115-120dB at source is likely to create a high level disturbance impact; from 500m distance it would be 125-130dB.	Will allow approach as close as 50-100m before flushing when confronted with a lone walker on mudflat. Tolerant of moderate and high-level visual disturbance.
Hen harrier *Circus cyaneus*	Moderate-high sensitivity to noise; Low sensitivity to	The various studies of disturbance on hen harrier (and conspecifics) suggest safe stand-off distances	As with noise/construction disturbance, albeit safe human disturbance stand-

[22] As set out at para 4.1.2 above, zone of influence is defined by reference to the Waterbird Disturbance Mitigation Toolkit (Institute of Estuarine & Coastal Studies (IECS) University of Hull, 2013) (TIDE toolkit)

SPA Citation Species	Species Sensitivity	Noise/Construction Disturbance	Human Disturbance
	human/visual disturbance	from construction activity to be anything between 60 and 600m, although some of these studies relate to breeding activity during which the species is typically more sensitive.	off distances likely to be >60m.
Knot *Calidris canutus islandica*	High sensitivity to noise; Tolerant of visual disturbance	Knot are resilient to works activity in general but sensitive to noise stimuli. A noise level of 70dB at the bird is considered acceptable (caution above 55dB). A source noise threshold of 100-105dB can applied at c.50m (caution above 87-92dB).	Birds react to walkers at <75m when roosting. Knot are tolerant of moderate/high level visual disturbance.
Redshank *Tringa totanus totanus*	High sensitivity to noise; Tolerant of visual disturbance	Redshank are resilient to works activity in general but sensitive to noise stimuli. A noise level of 70dB at the bird is considered acceptable (caution above 55dB). A source noise threshold of 100-105dB can applied at c.50m (caution above 87-92dB).	Will allow approach as close as 70-115m before flushing when confronted with a lone walker on mudflat.
Ringed plover *Charadrius hiaticula*	Low sensitivity; extremely tolerant with habituation	Ringed plover appear not to be sensitive to noise stimuli and habituate rapidly. A noise level of 75dB at the bird is considered acceptable (caution above 60dB). A source noise threshold of 107-112dB can applied at c.50m (caution above 93-98dB).	Will allow approach as close as 30-50m before flushing when confronted with a lone walker on mudflat. Very tolerant of moderate/high level visual disturbance.

5.3 Summary of potential impacts including maximum extents

5.3.1 Impacts from noise, lighting, dust and human disturbance associated with construction and operational activities within the proposed Order Limits are assessed to all fall within a maximum zone of influence of 300m from the proposed DCO boundary. The maximum range of influence of some of these effects (e.g. dust deposition, lighting) will be significantly less than 300m. At the outer edges of this 300m envelope, effects from lighting, dust and visual disturbance are likely to be nil, undetectable or at least well below significance thresholds. The main potential impact source at that distance is construction phase noise, particularly related to piling activity. The adoption of 300m is a therefore a worst case approach.

5.3.2 Impacts with the potential to be significant beyond the 300m zone of influence drawn around the proposed Order Limits are restricted to air quality from shipping, noise/lighting/movement disturbance associated with increased shipping traffic along the Thames navigable channel and sediment mobilisation and redeposition from the proposed marine works and dredging (with associated water quality implications). The maximum extent used for these other potential impacts was derived from the technical studies submitted with the ES. For clarity, further information is provided at Table 3 below:

Table 3: Maximum precautionary extent of potential significant impact envelope for effects where distance not already specified in HRA

Impact source	Outer extent of potential significant impact envelope	Application document reference
Air quality changes	>5km from navigable channel	ES Chapter 18 [APP-031] paras 18.63, 18.64, 18.149, 18.150 set out guidance from Defra[23,24] in respect of establishing study areas: • 250m from shipping berths/main areas of manoeuvring if there are more than 5,000 large ship movements per year; or • 1km from the port/shipping area if there are more than 15,000 large ship movements per year. This guidance specifically relates to human receptors, but it was considered reasonable to apply it in the absence of more specific guidance. Given that the large shipping movements associated with Tilbury2 are below the cited levels, the potential for impacts on the SPA/Ramsar Site was screened out in the ES. Subsequent precautionary modelling of air quality changes over the entirety of the SPA/Ramsar Site is presented at Appendix 6 and 7 of this report and demonstrates that application of the above thresholds was appropriate.
Noise/lighting/movement disturbance associated with increased shipping traffic along the Thames navigable channel	300m from navigable channel	TIDE toolkit (conservative application of 300m as generic response threshold radius for wading birds)
Sediment mobilisation and re-deposition from the proposed marine works and dredging.	40km	Appendix 8 of this report [APP-089] Figures 4.10 and 4.15

5.4 Impacts from decommissioning

[23] Defra (February 2018). *Local Air Quality Management Technical Guidance LAQM.TG16*. Available from: https://laqm.defra.gov.uk/documents/LAQM-TG16-February-18-v1.pdf

[24] Now superseded: Defra (2016). *Local Air Quality Management Technical Guidance LAQM.TG16*.

5.4.1 The Tilbury2 project is for a permanent form of development and no decommissioning is envisaged. Potential impacts arising from decommissioning have not therefore been considered in this HRA report.

6 OTHER PROJECTS WITH THE POTENTIAL TO GIVE RISE TO IN-COMBINATION EFFECTS WITHIN THE EUROPEAN/RAMSAR SITE OR ON FUNCTIONALLY LINKED FEATURES

6.1 Projects considered

6.1.1 Table 2.2 of the Environmental Statement lists future consented or planned development projects that were considered in the assessment of cumulative effects as part of the production of the ES and in the Stage 1 HRA report. The location of these relative to both the Tilbury2 site and the Thames Estuary and Marshes SPA/Ramsar is indicated on Figure 2.1 of the ES (reproduced in this HRA report for ease of reference). Paragraphs 2.40 to 2.45 of the ES describe how these were identified, and paragraphs 2.47-2.63 explain how certain other projects were excluded from consideration, taking account of PINS guidance and because they were at such a nascent stage.

6.1.2 Subsequent to the submission of the ES and Stage 1 HRA documents in October 2017, additional information has become available for two NSIPs that were previously excluded from consideration: the Lower Thames Crossing (LTC)[25] and Tilbury Energy Centre (TEC)[26]; albeit this information is still considered insufficiently detailed to enable a quantitative in-combination assessment with Tilbury2 to be undertaken. Nevertheless, in so far as the information available allows, a high level, qualitative and proportionate consideration of the qualitative cumulative effects of the Tilbury2 proposals with both of these projects has been undertaken, including limited quantitative extrapolation where our own and published data allows us to use this to inform the qualitative assessment. This is set out in a 'Qualitative Cumulative Effects Assessment' of Tilbury2 with TEC and LTC, dated April 2018 (document reference PoTLL/T2/EX/92 [REP3-027]).

6.1.3 Both LTC and TEC, and the projects defined on Table 2.2 of the ES, when acting in concert with the Tilbury2 development, have the potential to give rise to additive or synergistic effects on the Thames Estuary environment, including the Thames Estuary and Marshes SPA/Ramsar Site. Additive or synergistic effects could arise from additional shipping movements (and related disturbance and air quality impacts), from individually low magnitude additive or synergistic effects on estuarine processes such as sediment circulation (e.g. arising from refurbishment of multiple marine structures and associated capital and maintenance dredging), with consequences for intertidal habitats within or functionally related to the European/Ramsar Site designations and related risks from mobilisation of polluted sediments. Further consideration of potential in-combination effects of Tilbury2 with TEC and LTC is given in the 'Qualitative Cumulative Effects Assessment' document [REP3-027], and in the sections that follow below:

6.2 Tilbury Energy Centre (TEC)

6.2.1 The Tilbury Energy Centre will provide energy from three sources: a 2,500MW Combined Cycle Gas Turbine (CCGT) plant, a 299MW peaking plant, and a 100MW energy storage facility. A 3km pipeline will connect to the site. The project also reserves land to construct and operate carbon

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[25] Highways England, (November 2017). L*ower Thames Crossing: Scheme Number HE540039. Environmental Impact Assessment Scoping Report.* [Accessed from: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/TR010032/TR010032-000006-LTC%20EIA%20Scoping%20Report.pdf]

[26] RWE, (April 2018)*. Environmental Impact Assessment Scoping Report – Tilbury Energy Centre. Submitted to the Planning Inspectorate under Regulation 10 of The Infrastructure Planning (Environmental Impact Assessment) Regulations 2017.* [Accessed from: https://infrastructure.planninginspectorate.gov.uk/wp-content/ipc/uploads/projects/EN010089/EN010089-000018-TBEC%20-%20Scoping%20Report.pdf]

capture facilities should the technology become available in the future. Site location and block layout information has been appended to Figure 2.1. It is anticipated that TEC construction would commence at the earliest in 2021 with operation commencing in 2025.

6.2.2 No Habitats Regulations Assessment (HRA) information for the TEC project has been made available at this stage; however, RWE confirm in their Scoping Report that a Stage 1 Screening will be undertaken.

6.2.3 To inform the current high-level qualitative assessment set out below, the existing baseline data[27] used to inform the Tilbury2 assessment has been reviewed and considered. Potential impacts of the TEC on statutory designations such as the Thames Estuary and Marshes SPA and Ramsar Site may include the following:

Air Quality

6.2.4 The impacts of the generating station on NOx concentrations and nitrogen deposition at SACs, SPAs, Ramsar Sites and SSSIs within 10km of the central CCGT stack will be modelled and assessed by RWE as part of the Stage 1 Screening exercise. Increased NOx emissions, leading to changes in air quality, and resulting in potentially significant increases in nitrogen deposition on European/Ramsar Site habitats (e.g. saltmarsh), could potentially breach the critical load threshold for those habitat types or prevent recovery in the context of otherwise improving trends. For habitats comprising special interest features of the Ramsar Site, there could be a decline in habitat condition/quality, or if the effect were severe then possibly a loss of noteworthy flora and a transition of the vegetation communities to different habitat-types. Knock-on effects for the SPA/Ramsar Site could arise from a related reduction in quality/suitability of wader-foraging habitat for qualifying species.

Disturbance

6.2.5 The Scoping Report for TEC does not specifically state that disturbance to SPA/Ramsar-cited wading bird species using intertidal habitats and possible high-tide roosts will be considered as part of the Stage 1 Screening exercise. However, it is considered that there is potential for disturbance impacts to arise during construction of the off-shore cooling water infrastructure (with any associated dredging and piling activity) and during construction of the 3km on-shore pipeline (both within the SPA and outside of it within land that is potentially functionally-connected (i.e. used by SPA/Ramsar Site species for feeding or high-tide roosting).

6.2.6 Therefore, the quantitative data available for bird use intertidal habitats within and in proximity to the proposed DCO Limits (i.e. that provided by the baseline information reported on at ES Chapter 10 (in particular Table 10.41) and further expanded upon in the technical 'Bird Note' (Appendix 9 to this HRA report, in particular Table 5)) has been interrogated further to come to a quantitative assessment of potential disturbance impacts from Tilbury2 in-combination with the TEC project.

6.2.7 Appendix 10 presents the mapped number and distribution of SPA citation species recorded during the wintering bird surveys in 2016/17 and 2017/18, overlain by the Order Limits for both the Tilbury2 and Tilbury Energy Centre projects.

[27] In respect of SPA bird species, this includes data provided in the Tilbury2 ES paragraphs 10.269 – 10.285 [APP-031], and the subsequent 'Note of Wintering Birds' (Appendix 7 to the Applicant's Response to Relevant Representations [AS-049]).

Table 4. Winter bird citation species counts in the 300m envelopes surrounding the Tilbury2 and TEC Order Limits compared with the Thames Estuary and Marshes SPA counts

SPA qualifying period	Species	Number of individuals listed on SPA sheet	Number of individuals (peak mean 04/05 to 08/09)	Peak count within combined 300m envelopes	No. of visits encountered in survey area (out of 17 visits)	Percentage of peak number of individuals found within the Tilbury2/TEC 300m envelopes taken together (based on recent peak mean of 2004/05-2008/09)
Oct-Mar	Avocet	283	1395	11	6	0.79
Oct-Mar	Black-tailed godwit	1699	5311	3	2	0.06
Oct-Mar	Dunlin	29646	37251	20	2	0.05
Oct-Mar	Grey plover	2593	5673	2	2	0.04
Oct-Mar	Hen harrier	7	0	0	0	0.00
Oct-Mar	Knot	4848	42871	0	0	0.00
Oct-Mar	Redshank	3251	4313	19	9	0.44
Passage	*Ringed plover**	*1324*	*1186*	0	0	*0.00*

* passage period only [28]

6.2.8 The data indicate that peak numbers using intertidal habitat within 300m from the proposed Order Limits at any one time remain in all recorded cases less than 1% of the SPA/Ramsar Site population and thus remain below significance levels (i.e. the peak count of birds present within the combined ZoI is equivalent to <1% of recent peak mean counts for citation species within the SPA boundaries).

Loss of Functionally-linked Habitat

6.2.9 Potential temporary losses of functionally linked habitat could arise as a consequence of the TEC project, dependent on the nature and scale of the works within intertidal habitats (related to any cooling water infrastructure), and potentially along the route of the 3km pipeline depending on the extent to which such land is used by SPA/Ramsar Site bird species (the LTC Part One Appropriate Assessment (AA)[29] refers to a high tide roost in this area);

Other Impacts on Functionally-linked Habitat

6.2.10 Potential construction phase effects will include displacement/removal of benthos; changes to suspended solids levels in the water column during dredging and potential smothering of benthos; release of chemicals in bottom sediments to the water column during dredging; changes to the hydrodynamics resulting from temporary structures leading to potential scour or deposition. During operation, discharge of heated cooling water at the outfall and the associated thermal plume could result in positive or negative changes to benthos populations, distributions and availabilities to SPA/Ramsar Site bird species.

[28] Taken to be May, August and September, as informed by: Frost, T.M., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hall, C., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Balmer, D.E. (2017). *Waterbirds in the UK 2015/16: The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT*. British Trust for Ornithology, Thetford.

[29] Highways England (January 2016). *Lower Thames Crossing. Pre-Consultation Scheme Assessment Report. Volume 6: Environmental Appraisa*l. (Ref: HA540039-HHJ-ZZZ-REP-ZZZ-010)

6.3 Lower Thames Crossing (LTC)

6.3.1 The Lower Thames Crossing (LTC) is a proposed new crossing of the River Thames east of London which would connect Kent and Essex. It would comprise a bored tunnel under the river, with a 31km link road connecting the A2 East of Gravesend in Kent with the M25 via Junction 29 (site location information has been appended to Figure 2.1). The construction period is anticipated to be approximately 5 years circa 2021-2026.

6.3.2 As set out above, LTC construction would not commence until after the currently estimated first operation of Tilbury2, and therefore in-combination effects are considered only in respect of the operational phase of the Tilbury2 project.

6.3.3 Potential impacts of the LTC on the Thames Estuary and Marshes SPA and Ramsar Site were considered under a Part One Appropriate Assessment (AA) [30]. Whilst there will be no direct loss of habitat from the SPA/Ramsar Site as a result of the crossing being via a bored tunnel, other potential construction/operation impacts identified (in the absence of mitigation) include:

- Disturbance to SPA/Ramsar cited species during construction (particularly waders using intertidal habitats);
- Disturbance impacts during operation (assessed in the Part One AA as likely to be minimal);
- Loss of functional habitat on north side of river (potential high tide roost using functionally linked land near the tunnel portal); and
- Potential for hydrogeological changes to affect ecology.

6.3.4 Other potential impacts in respect of the SPA/Ramsar Site not specifically identified in the Part One AA (although subsequently raised by Natural England (LTC Scoping Report, para 6.3.3)) include changes in air quality arising from increased local traffic flows and the potential for nitrogen deposition within 200m of the route alignment, to bring about a change in the vegetation composition of habitats within the Ramsar Site/SPA.

6.3.5 On the basis of the information available from the LTC project, the impacts with greatest potential to generate a significant in-combination effect in the absence of appropriate mitigation measures as part of the LTC, are likely to be:

Air Quality

6.3.6 Air quality impacts arising from additional traffic emissions associated with the LTC resulting in potentially significant increases in nitrogen deposition on European/Ramsar Site habitats (e.g. saltmarsh), potentially breaching the critical load threshold for those habitat types or preventing recovery in the context of otherwise improving trends. For habitats comprising special interest features of the Ramsar Site, there could be a resulting decline in condition/quality, or if the effect were severe then possibly loss of noteworthy flora and a transition of the vegetation communities to different habitat-types. Knock-on effects for the SPA/Ramsar Site could result from a related reduction in quality/suitability of wader foraging habitat for qualifying species.

---

[30] Highways England (January 2016). *Lower Thames Crossing. Pre-Consultation Scheme Assessment Report. Volume 6: Environmental Appraisa*l. (Ref: HA540039-HHJ-ZZZ-REP-ZZZ-010)

Disturbance

6.3.7 LTC construction phase disturbance of wading bird interest features of the SPA/Ramsar Site, especially in respect of functionally linked land to the west of the SPA which could combine with operational-phase effects from Tilbury2.

7 ASSESSMENT

7.1 Stage 1 Screening Matrices

7.1.1 Appendix 5 (5a and 5b) contains the completed Stage 1 screening matrices for the Thames Estuary and Marshes SPA and Ramsar Site, adopting the format set out in PINS Advice Note 10.[31]

7.1.2 The disparate sources of potentially significant effects have been compressed into a number of broad categories in line with the approach recommended in Advice Note 10.

7.1.3 For each qualifying feature and potentially significant effect, evidence supporting the conclusions indicated in the matrix (either 'likely significant effect **cannot** be excluded' – denoted by a "✓" or likely significant effect **can** be excluded – denoted by a "x" in the matrix) is provided in footnotes a-k of the matrix. That **informa**tion is not replicated here.

7.2 Conclusions of Stage 1 assessment

7.2.1 The Applicant's Stage 1 assessment concluded that there are no likely significant effects on the SPA or Ramsar Site arising as a consequence of the project, either independently, or considered cumulatively with effects arising from other known or planned projects (excluding TEC and LTC).

7.2.2 However, in view of the recent Court of Justice of the European Union (CJEU) on the interpretation of the Habitats Directive in the case of *People Over Wind and Sweetman vs Coillte Teoranta* which concluded that:

"Article 6(3) of the Habitats Directive must be interpreted as meaning that, in order to determine whether it is necessary to carry out, subsequently, an appropriate assessment of the implications, for a site concerned, of a plan or project, it is not appropriate (emphasis added), at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site";

and in view of Natural England's position *"that we cannot rule out that significant effects are likely, possibly alone, but also in-combination"*[32], the Applicant has undertaken to provide further information consistent with a Stage 2 level of Habitats Regulations Assessment (Appropriate Assessment), as set out below.

7.3 Stage 2 Integrity Matrices

7.3.1 Appendix 11 contains the completed Stage 2 integrity matrices for the Thames Estuary and Marshes SPA and Ramsar Site, adopting the format set out in PINS Advice Note 10.

7.3.2 For each qualifying feature and potential adverse effect on integrity, evidence supporting the conclusions indicated in the matrix (either 'adverse effect on integrity **cannot** be excluded' – denoted by a "✓" or adverse effect on integrity **can** be excluded – denoted by a "x" in the matrix) is provided in footnotes a-c of that matrix. That information is not replicated here

[31] The Planning Inspectorate (November 2017). Advice Note 10: Habitats Regulations Assessment relevant to nationally significant infrastructure projects (version 8).
[32] Natural England (30 April 2018). Tilbury2 Deadline 3 Post-hearing Submission.(Document reference REP-042).

7.4 **Conclusions of Stage 2 Appropriate Assessment**

7.4.1 The Stage 2 assessment has concluded on the basis of objective information, that the project will not adversely affect the integrity of the European/Ramsar site, alone or in combination with other plans or projects. The reasons for this conclusion are summarised in section 7 overleaf.

7.5 **Stage 3 & 4 assessments**

7.5.1 As the potential for an adverse effect on the integrity of the site has been ascertained at Stage 2, there is no need to progress to Stages 3 and 4 of the HRA process.

7.6 **Further Consultation**

7.6.1 Natural England have responded to the Stage 1 HRA report and further consultation and discussion with them is continuing through the Statement of Common Ground process with the objective of reaching a position of agreement on the conclusions reached in this Stage 2 report.

8 OVERALL CONCLUSIONS

8.1 Potential for Likely Significant Effects on the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar Site

8.1.1 The Stage 1 assessment process has been able to exclude the possibility of significant effects on either the Thames Estuary and Marshes SPA or the Thames Estuary and Marshes Ramsar Site, from the following possible sources:

- Disturbance (whether from lighting, human disturbance, noise or shipping traffic) to any qualifying interest bird species using habitats within the SPA and/or Ramsar Site designation boundaries (construction or operational phase);

- Disturbance to hen harrier or knot using functionally linked habitats in either the construction or operational phase;

- Any operational phase disturbance to qualifying interest bird species using habitats within the SPA and/or Ramsar Site designation boundaries, or functionally linked habitat outside the designation boundaries.

8.1.2 However, for the following potential effects, the possibility of these being significant either cannot be excluded beyond reasonable scientific doubt, or a precautionary approach has been taken to considering their likelihood after consultation with Natural England:

- Damage to habitats within the SPA and/or Ramsar Site due to temporary or permanent minor changes in estuarine processes, temporary changes in water quality, temporary or permanent changes in air pollution (construction or operational phase), construction/operational waste and pollutants, and the possibility of heightened risk of introduction of invasive non-native species (INNS);

- Direct loss or damage to functionally linked habitats outside the SPA and Ramsar Site and more proximal to the Tilbury2 site from the same sources, with possible consequences for bird populations associated with the SPA, and bird, flora and invertebrate fauna associated with the Ramsar Site;

- Disturbance or damage to habitats within the SPA and/or Ramsar Site or to functionally linked habitats outside the designation boundaries from in-combination effects arising from Tilbury2 alongside other consented or planned projects.

8.2 Consequences for integrity of the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar Site

8.2.1 The Stage 2 ‘appropriate assessment’ process has considered the possibility of adverse effects on the integrity of the Thames Estuary and Marshes SPA and/or the Thames Estuary and Marshes Ramsar Site, either alone or in combination with other projects, from the likely significant effects that could not be ruled out at Stage 1.

8.2.2 For the reasons given in section 7 of this report, it is concluded that the competent authority can be sufficiently certain on the basis of the evidence and reasons given in this report that adverse effects from the Tilbury2 project will not occur on the integrity of either the Thames Estuary and

Marshes SPA and/or the Thames Estuary and Marshes Ramsar Site, either alone or in combination with other projects.

8.3 Secured mitigation and monitoring measures

8.3.1 For ease of reference, the mitigation measures relied upon in the Stage 2 appropriate assessment process, and as described in section 7 of this report, are set out in Table 5 below, with cross-referencing to where these measures are secured in the DCO/DML. The key enforceable documents secured by the DCO are:

- Operational Management Plan (OMP) (document reference PoTLL/T2/EX40 [REP1-008]); and
- Construction Environmental Management Plan (CEMP) (document reference PoTLL/T2/EX71 [REP3-011]).

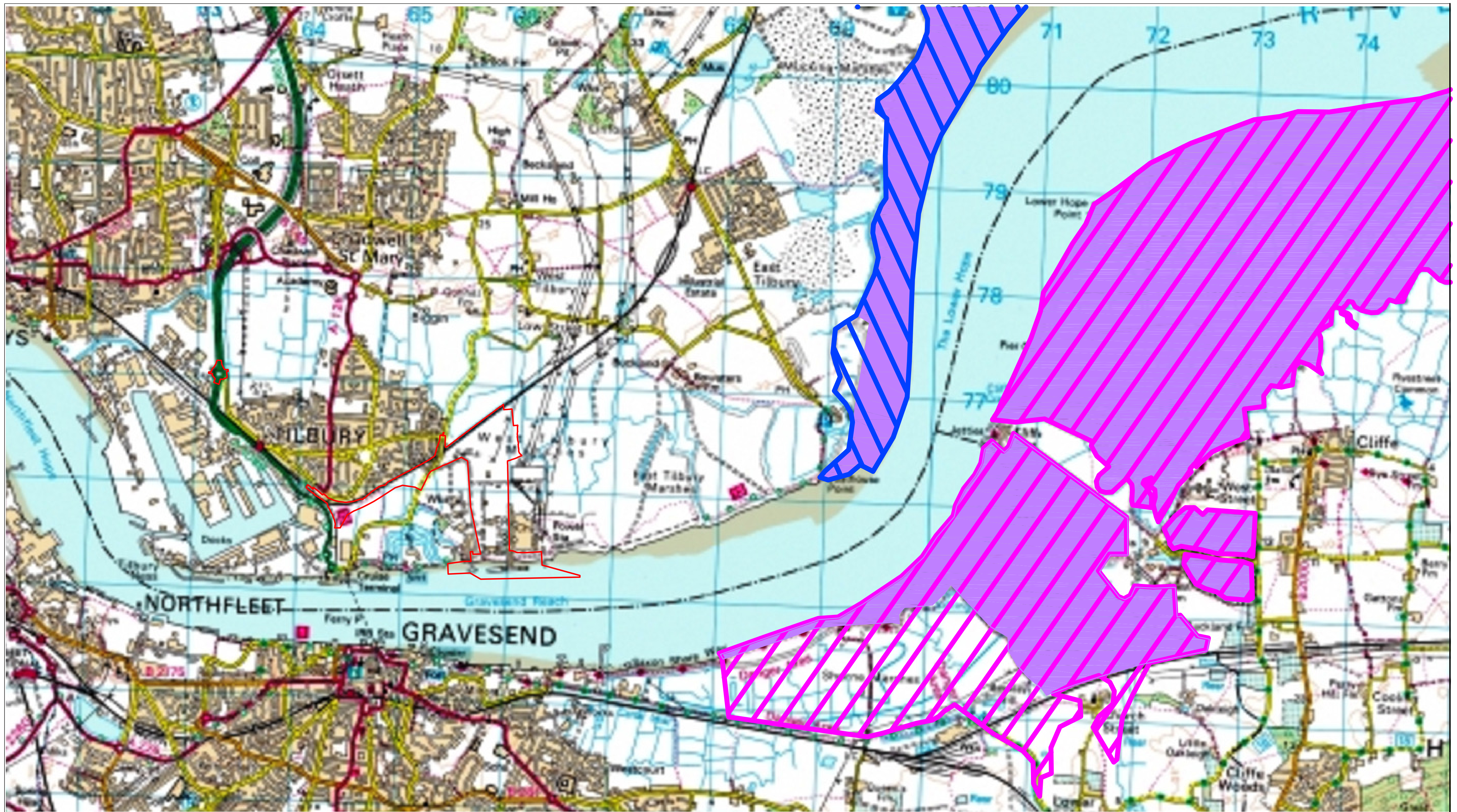
Table 5. Embedded mitigation and monitoring measures

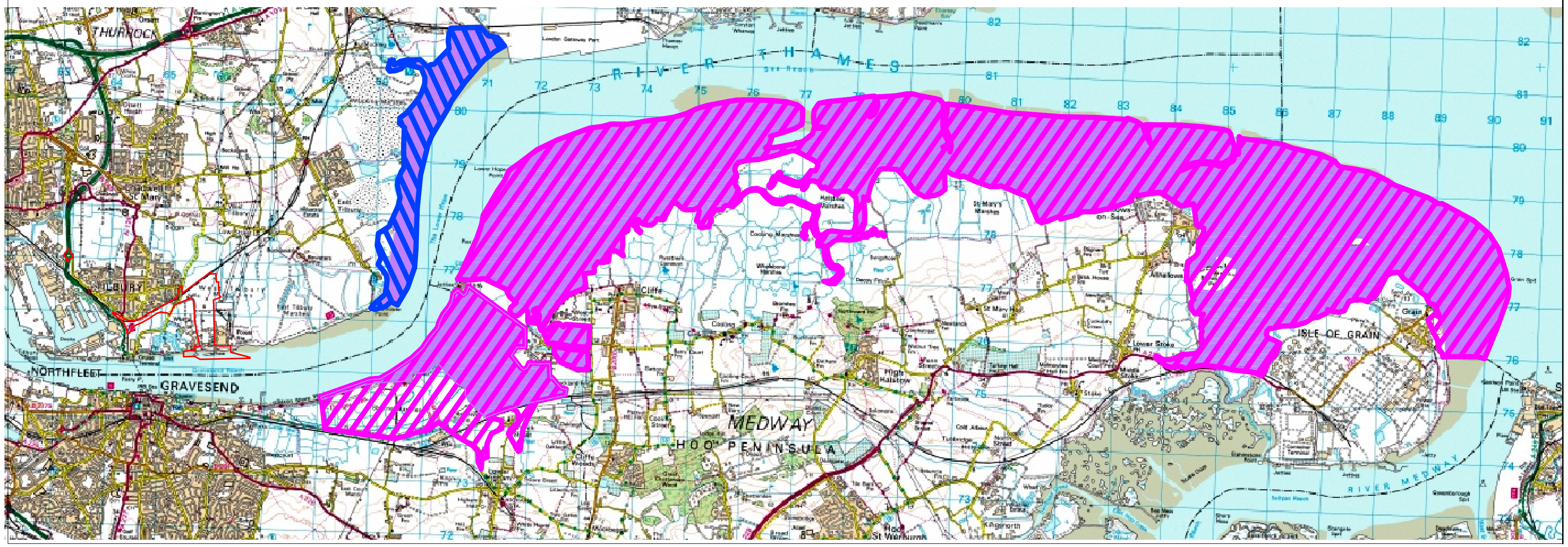
Mitigation/monitoring measure	Where these measures are secured in the DCO/DML
Cowling/shields on site and jetty lighting to ensure the envelope of potentially significant effects accords with the maximum zone of influence assumed in the HRA.	DCO Requirement for final lighting strategy to be approved by Thurrock Council, and to be in accordance with Preliminary Lighting Strategy (document reference 6.2, 9.J [APP-044] - key figure from which is reproduced within this HRA report; CEMP (Chapters 5, 6, and 7).
Embedded mitigation to reduce the spatial influence of effects from noise and vibration (ES Chapter 17, Document Reference 6.1 [APP-031]) and ensure the envelope of potentially significant effects accords with the maximum zone of influence assumed in the HRA.	OMP (Section 6), CEMP (Chapter 10), and noise barriers (secured through DCO requirement).
Embedded mitigation to reduce the spatial influence of effects from dust and emissions (ES Chapter 18) and ensure the envelope of potentially significant effects accords with the maximum zone of influence assumed in the HRA.	OMP (Section 7), CEMP (Chapter 11)
Embedded mitigation to reduce the spatial influence of effects from surface water pollution (ES Chapters 15 and 16) and ensure the envelope of potentially significant effects accords with the maximum zone of influence assumed in the HRA.	Drainage Strategy (document reference 6.2, 16.E [APP-090]) and CEMP (Chapter 9).
Embedded mitigation to reduce the spatial influence of benthic sediment mobilisation and re-deposition and ensure the envelope of potentially significant effects accords with the maximum zone of influence assumed in the HRA.	CEMP (Chapter 7), Operation of the DML conditions on construction and maintenance dredging
Sampling of sediments to reduce the spatial influence of potential contaminants during **maintenance** dredging.	Operation of the DML conditions on maintenance dredging.

8.3.2 Although not required for mitigation purposes, additional reassurance is to be provided by the Applicant on the issue of construction phase disturbance (e.g. from piling) in the form of a Bird Monitoring and Action Plan (BMAP). The BMAP is not relied up on in reaching the conclusions set out in this HRA report, although it is intended that the BMAP will form an Appendix to the HRA documentation once submitted.

8.3.3 The BMAP will detail the Applicant's commitment to continue wintering and passage bird surveys (covering the months September – April) throughout the key noise-generating phases of the Tilbury2 construction period. The BMAP will also provide details of a traffic-light system of alerts, which would be triggered if bird numbers in the monitored areas and periods fall below defined threshold levels. These threshold levels would be derived from relevant recent and historical datasets (i.e. the datasets referenced in the 'Bird Note' at Appendix 9 of this HRA report). In the event that specified alerts are triggered (for example consistently suppressed bird numbers are indicated by the ongoing monitoring), a system of escalating responses would be initiated. These could include a period of more intense monitoring and rapid notification of key stakeholders in order that the basis for the trigger threshold can be discussed, and extraneous explanatory factors considered (e.g. any climatic conditions such as severe winter weather that may have caused localised distribution shifts noted elsewhere in the estuary but are unrelated to the project). Ultimately, the Applicant would undertake to temporarily cease any disturbing activities that the monitoring results and consultation process indicate are clearly implicated in significant effects that have the potential to adversely affect the integrity of the Thames Estuary and Marshes SPA and/or the Thames Estuary and Marshes Ramsar Site, either alone or in combination with other projects.

FIGURE 1





ORDER LIMITS

THAMES ESTUARY & MARSHES SPA/RAMSAR SITE

SOUTH THAMES ESTUARY & MARSHES SSSI

MUCKING FLATS & MARSHES SSSI

REV	DATE	DESCRIPTION

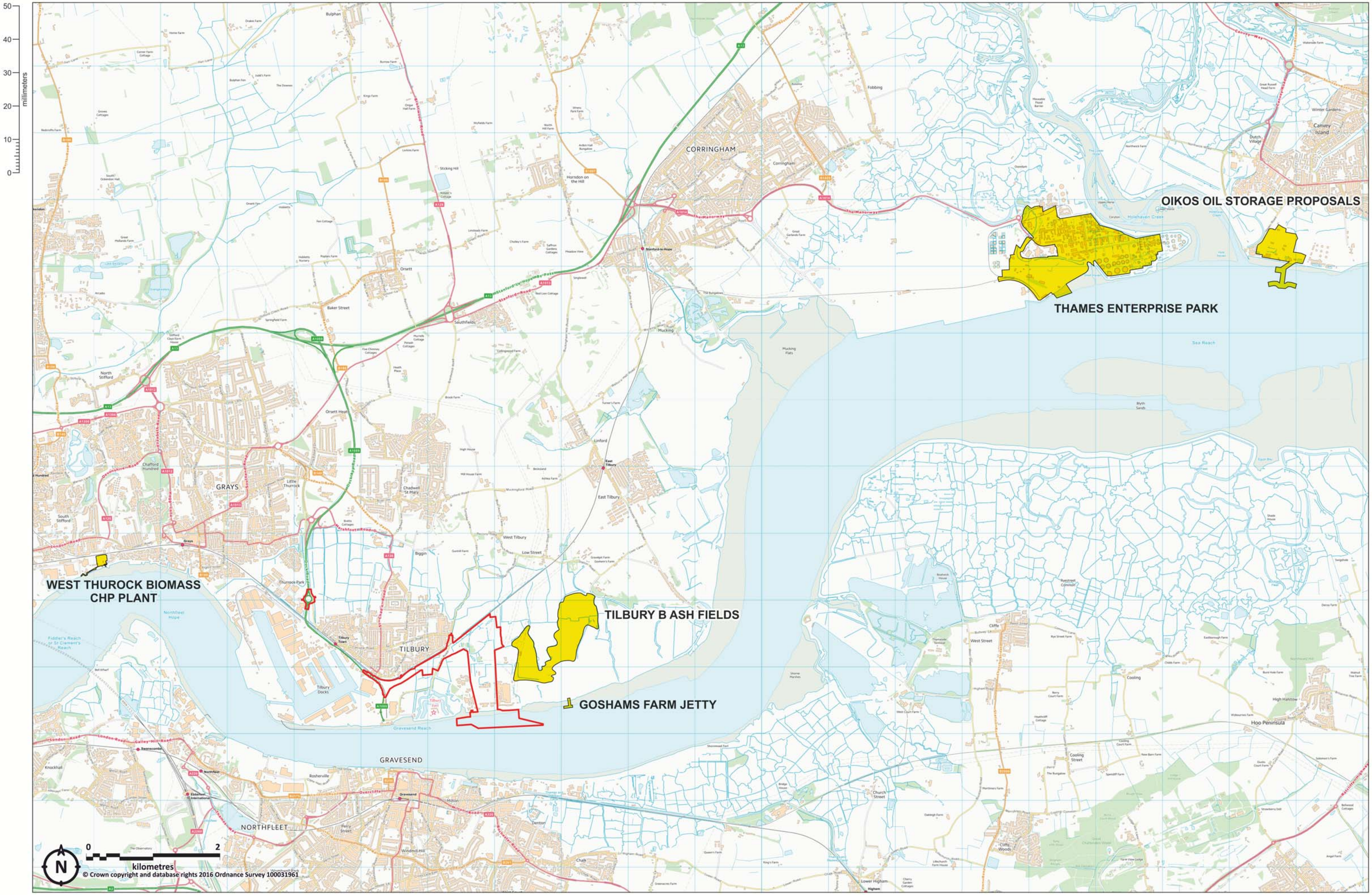
DRAWING TITLE

SITE LOCATION RELATIVE TO EUROPEAN SITES

SCALE: NOT TO SCALE	DRAWN: BC	FIG. 1	
DATE: SEPT 2017	CHECKED: DW		

TILBURY2

ES FIGURE 2.1



REV	DATE	DESCRIPTION
B	09-17	Order Limit boundary amendments
A	08-17	Thurrock Biomass CHP Facility added

DRAWING TITLE
Cumulative developments

SCALE	1:50000 @ A3	DRAWN	HNA
DATE	MAY 2017	CHECKED	HNA

FIG. 2.1

TILBURY2

Figure 4 - Temporary and permanent land take associated with the proposed TEC

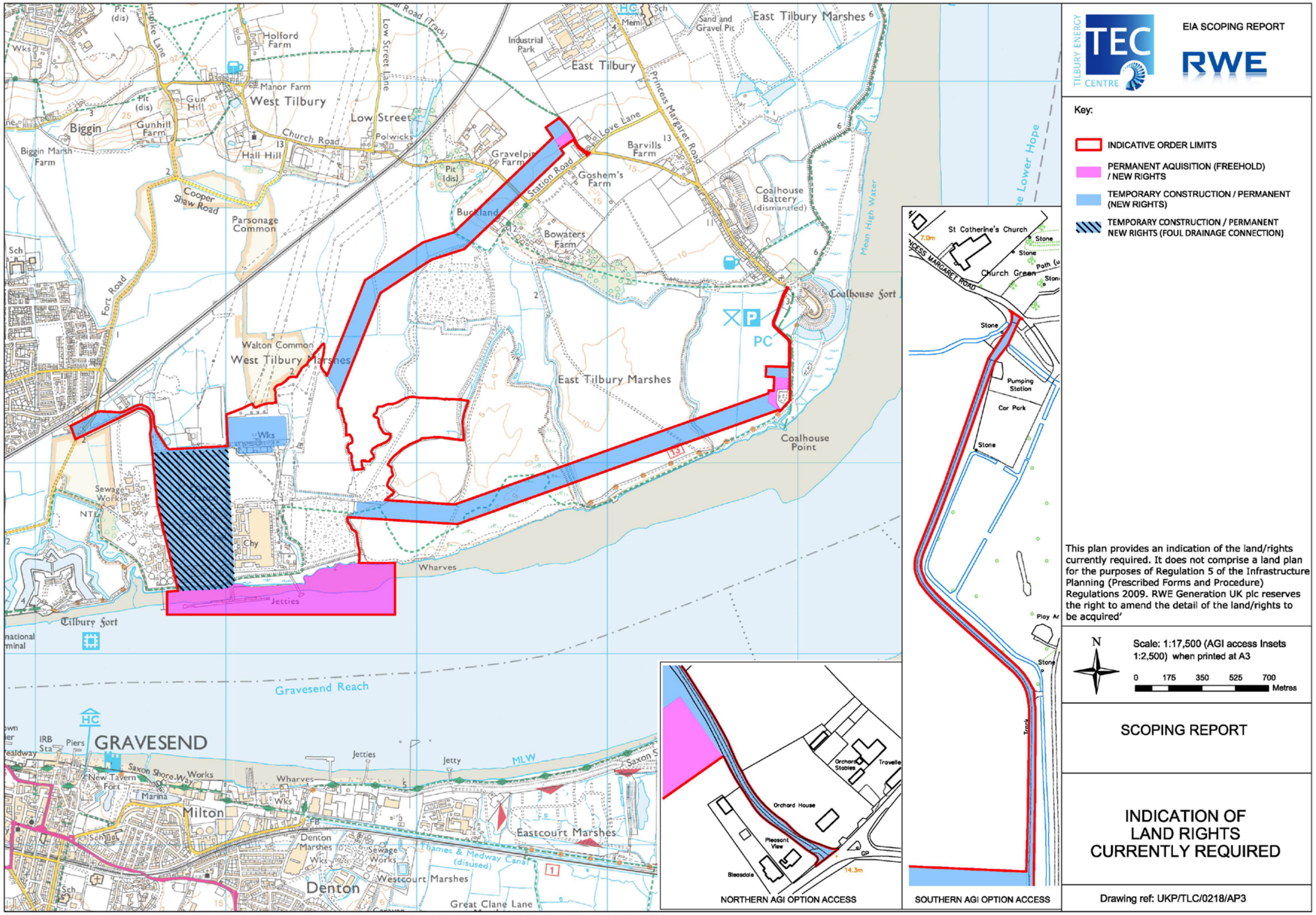
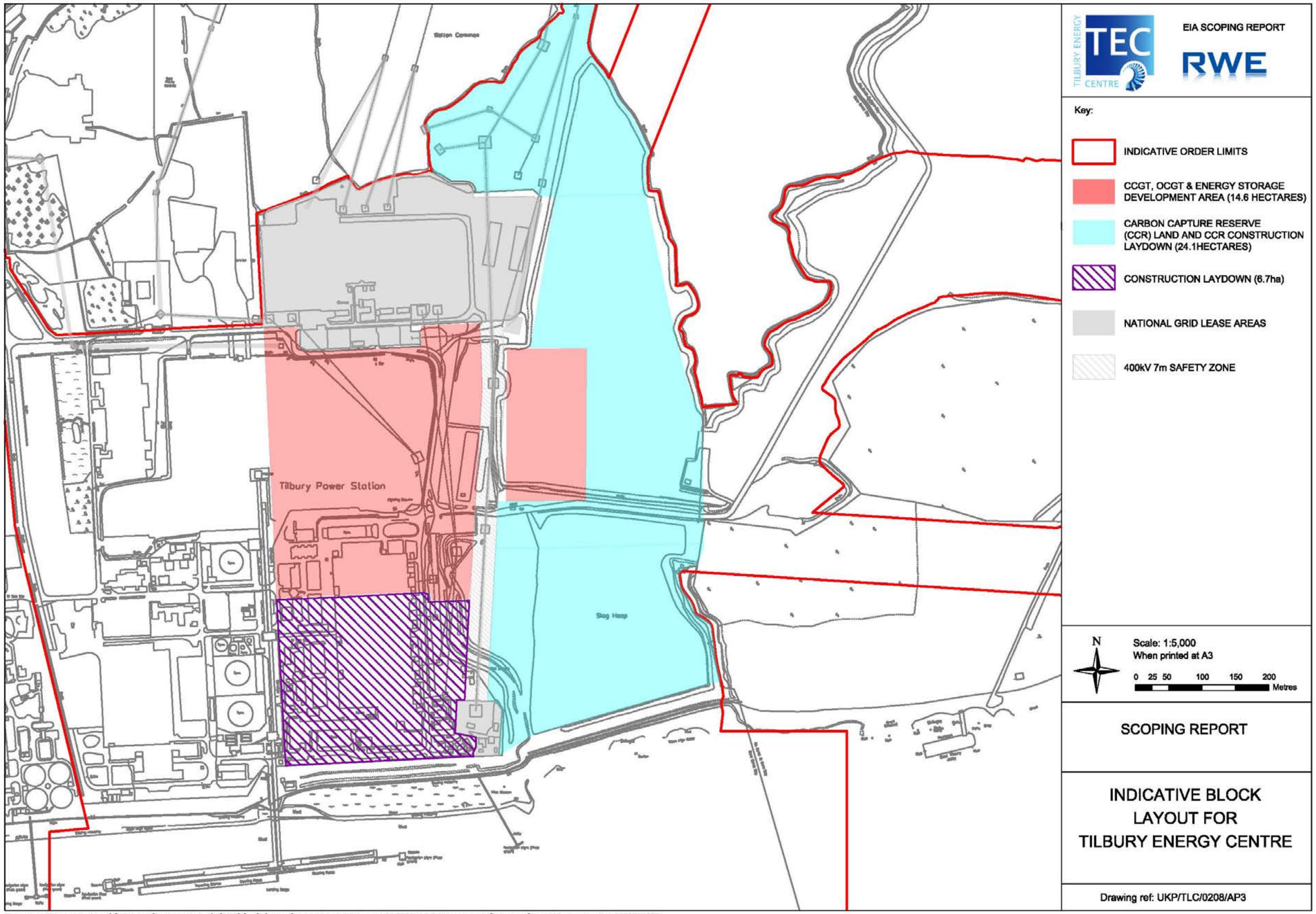
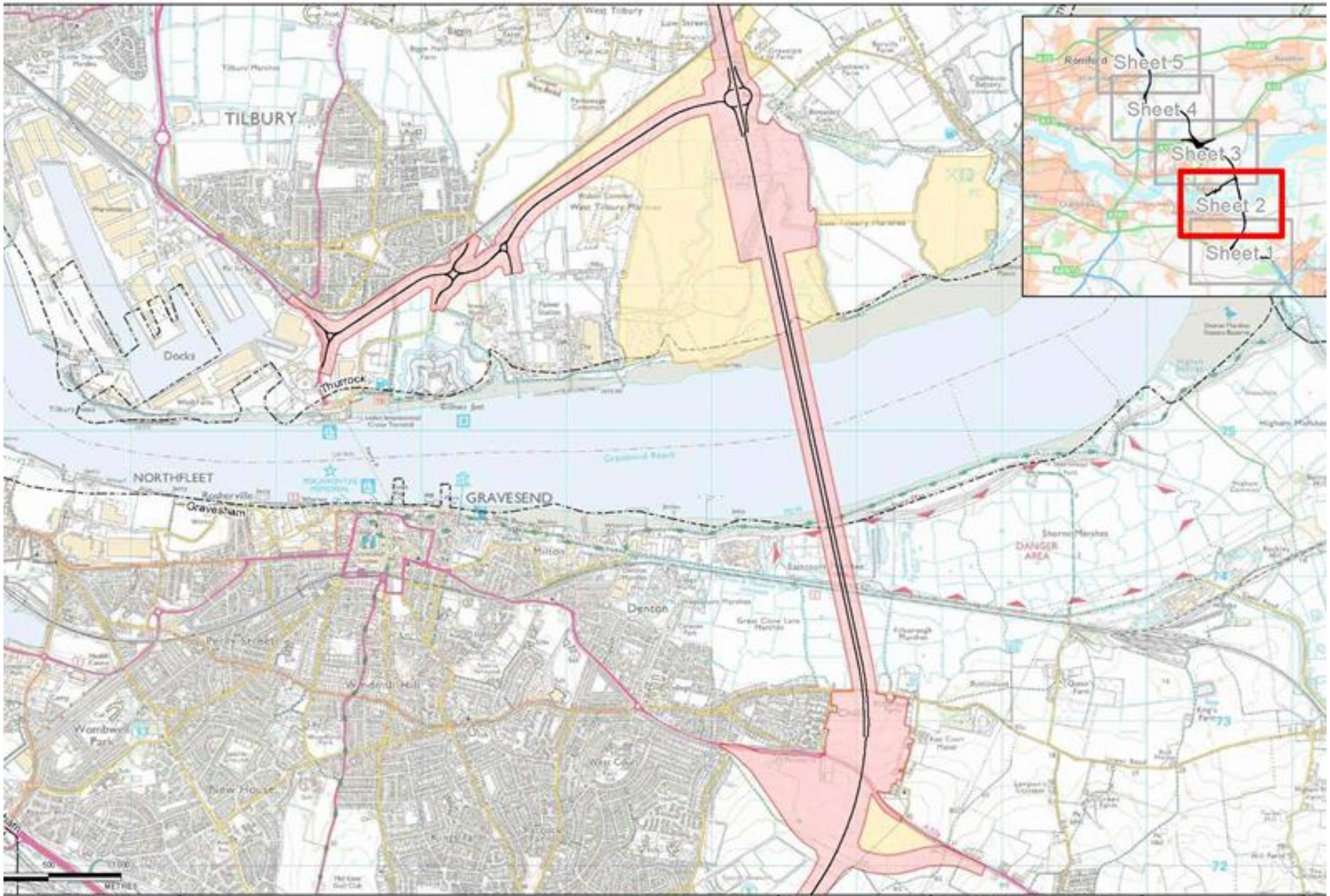


Figure 5 - Indicative block layout for the TEC (CCGT, OCGT, energy storage/batteries, CCR and construction laydown)





LTC Route Alignment

Permanent Land Requirement

Temporary Land Requirement

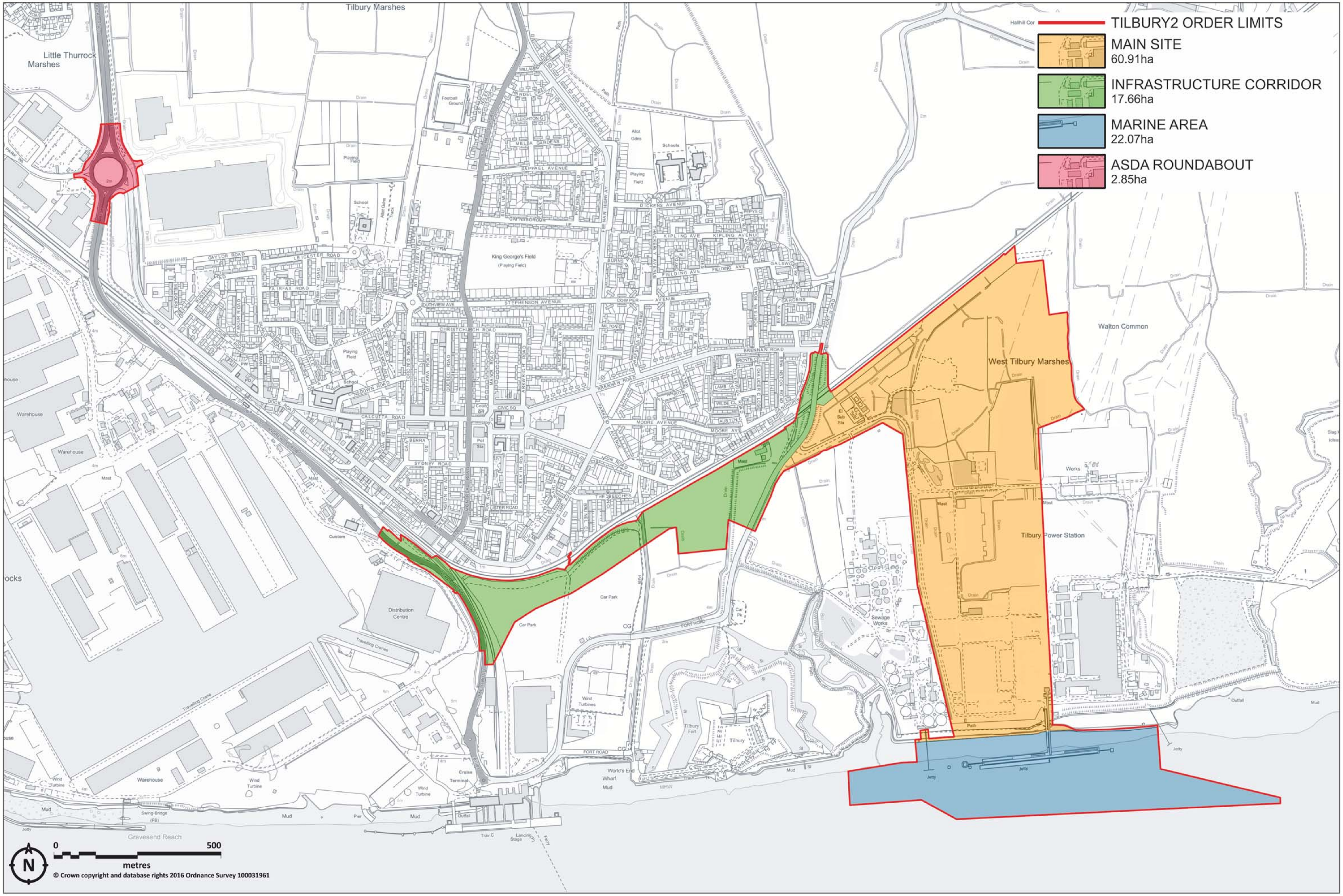
Lower Thames Crossing

LOWER THAMES CROSSING DEVELOPMENT PHASE

Figure 2.1
Application Site Location Plan
Sheet 2 of 5

S2

ES FIGURE 4.1



REV	DATE	DESCRIPTION
A	09-17	Order Limit boundary amendments

DRAWING TITLE
Site areas

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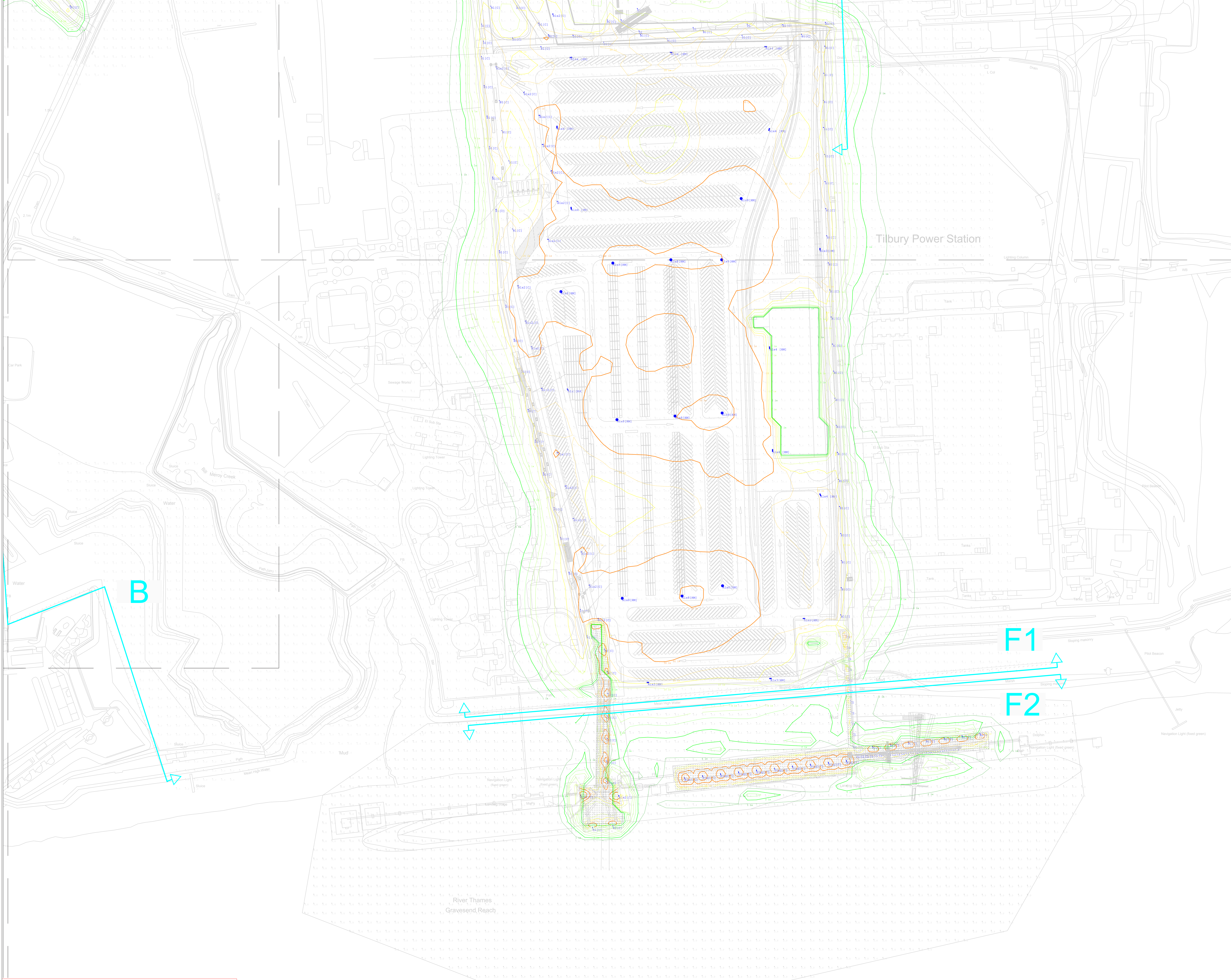
DATE	CHECKED
MAY 2017	HNA

FIG. 4.1

TILBURY2

ES FIGURE EXTRACTED FROM ES APPENDIX 9J

DO NOT SCALE



Millimetres
100
10
0

NOTES:

1. PRELIMINARY LIGHTING STRATEGY - DESIGN SHOWN FOR ILLUSTRATIVE PURPOSES ONLY
2. ALL LUMINAIRE LOCATIONS AND TYPES ARE INDICATIVE AND SUBJECT TO DESIGN DEVELOPMENT.
3. NO COMPLIANCE IS IMPLIED THROUGH PRELIMINARY LIGHTING STRATEGY
4. ALL LUMINAIRE LOCATIONS ARE APPROXIMATE FOR THE PURPOSE OF ASSESSMENT.
5. NO EXISTING OBSTRUCTIONS OR ADDITIONAL MITIGATION IS INCLUDED WITHIN THE CALCULATION.
6. REFER TO LIGHTING REPORT FOR GENERIC LUMINAIRE INFORMATION

ISOLINES KEY

1 lux
2 lux
3 lux
4 lux
5 lux
10 lux
15 lux
20 lux
30 lux
50 lux
75 lux
100 lux

MAINTAINED ILLUMINANCE
Maintenance Factor (MF) = 0.7

SHEETS KEY

1
2
3

RECEPTOR LOCATION
within the calculation.

Rev.	Date	Description	By	Chk'd	App'd

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Indicative External Lighting Layout
Sheet 3 0f 3

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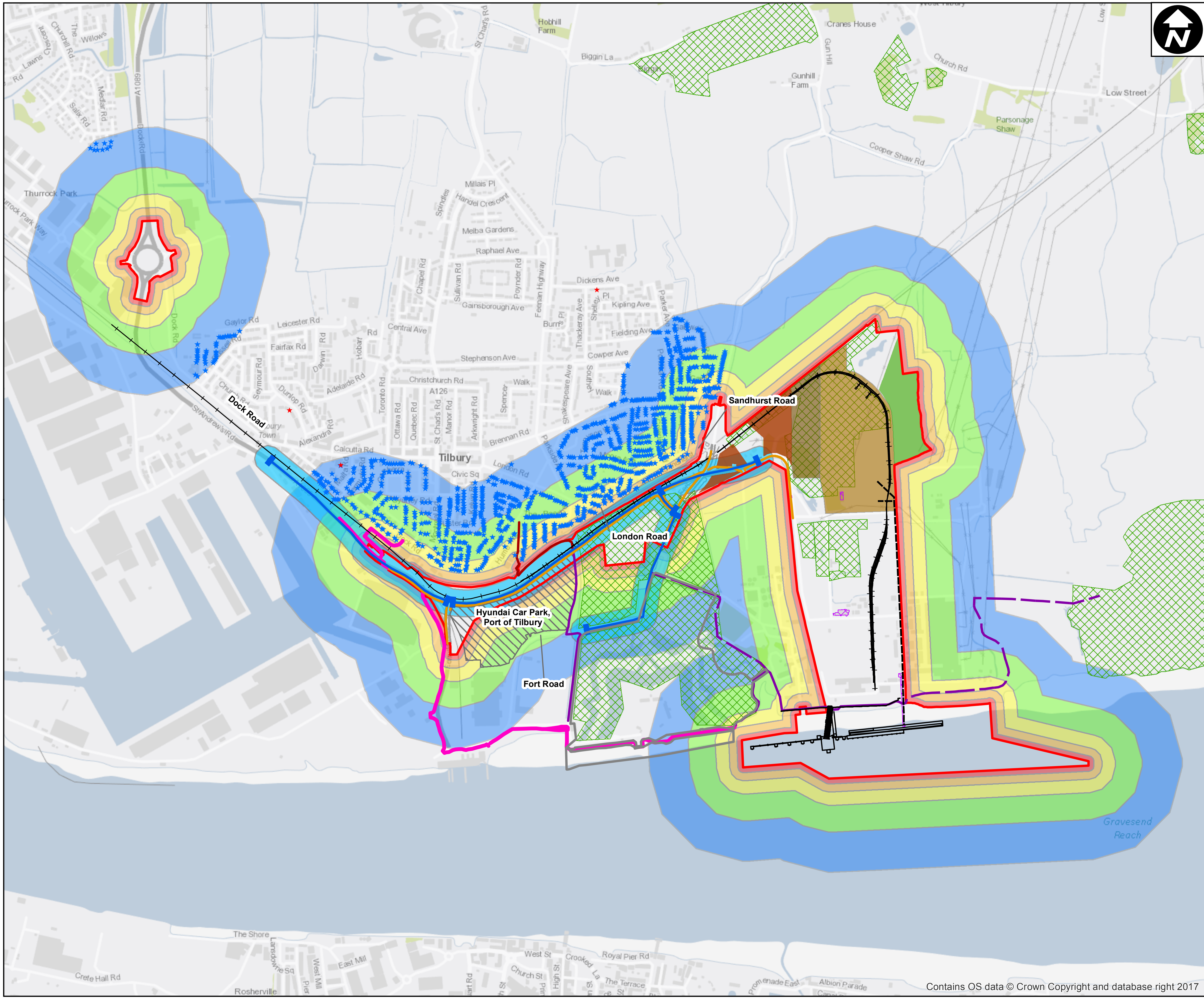
1:2000	LC	LC	GD	DM
Original Size	Date	Date	Date	Date
A1	07/09/17	07/09/17	08/09/17	19/09/17

Drawing Number: 5153187-ATK-ZZ-XX-SK-ZZ-1086
Revision: P02

ES FIGURE 18.1



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- Existing Footpath
- Proposed New Shared Surface
- Thames Estuary Path
- Shared Cycle and Pedestrian Facility
- Trackout
- Conveyor
- Demolished Buildings
- General Storage
- Ecology Compensation Region
- Aggregate Storage Region
- Construction Materials and Aggregates Terminal
- Local Wildlife Site
- Tilbury Fort
- Car Park
- Haul Route 50m Buffer
- Order Limits 20m Buffer
- Order Limits 50m Buffer
- Order Limits 100m Buffer
- Order Limits 200m Buffer
- Order Limits 350m Buffer

Meters
0 100 200 300 400 500

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CONSTRUCTION DUST ASSESSMENT STUDY AREA

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A3	1:13,000	FLD Date 24/10/17	RR Date 24/10/17	SH Date 24/10/17

Drawing Number	Rev
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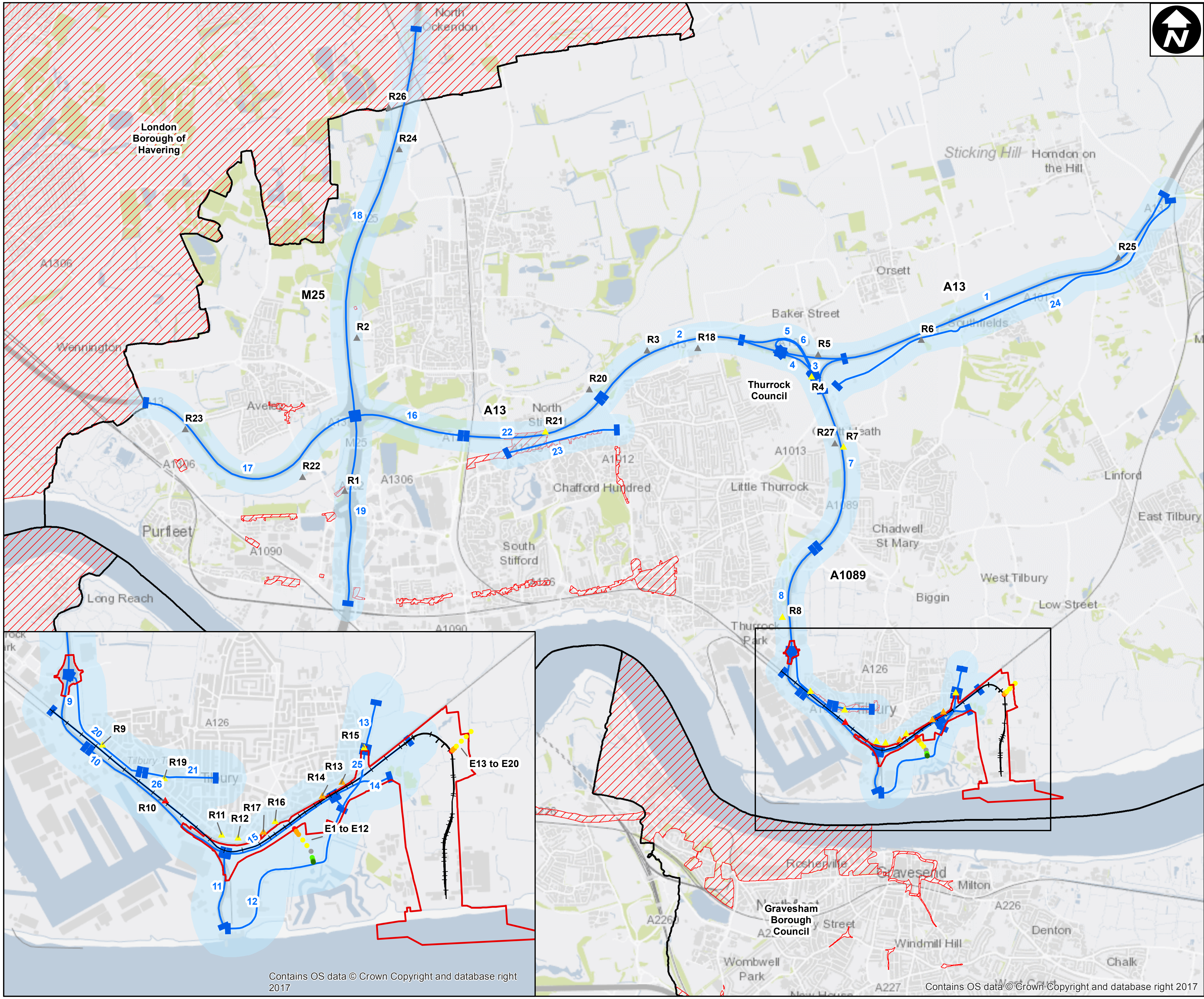
ES FIGURE 18.2



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- Order Limits

Modelled change in annual mean NO_2

- Large decrease (<-4 μg/m³)
- Medium decrease (<-2 to -4 μg/m³)
- Small decrease (<-0.4 to -2 μg/m³)
- Imperceptible change (≥-0.4 to ≤0.4 μg/m³)
- Small increase (>0.4 to 2 μg/m³)
- Medium increase (>2 to 4 μg/m³)
- Large increase (>4 μg/m³)

Modelled change in annual mean NO_x

- Large decrease (<-4 μg/m³)
- Medium decrease (<-2 to -4 μg/m³)
- Small decrease (<-0.4 to -2 μg/m³)
- Imperceptible change (≥-0.4 to ≤0.4 μg/m³)
- Small increase (>0.4 to 2 μg/m³)
- Medium increase (>2 to 4 μg/m³)
- Large increase (>4 μg/m³)
- Modelled Road
- Modelled Rail
- Road
- 200m Buffer
- Local Authority Boundary
- Air Quality Management Area

Meters

0 500 1,000 1,500 2,000

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TRAFFIC EMISSIONS ASSESSMENT STUDY AREA

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A3	1:25,000	FLD	RR	SH
		Date 13/10/17	Date 13/10/17	Date 13/10/17

Drawing Number	Rev
Figure 18.2	00

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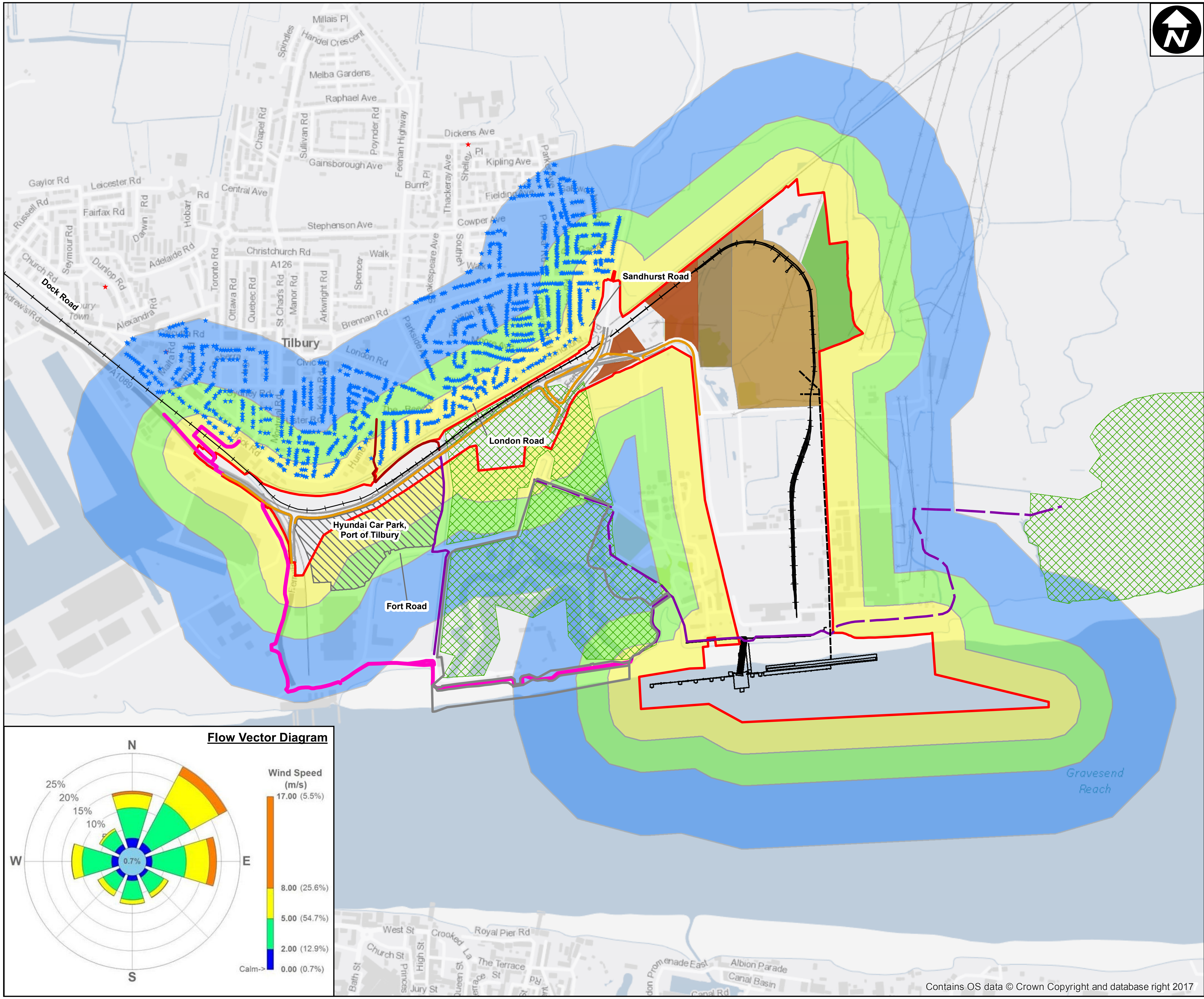
ES FIGURE 18.4



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- Conveyor
- General Storage
- Ecology Compensation Region
- Aggregate Storage Region
- Construction Materials and Aggregates Terminal
- Car Park
- Local Wildlife Site
- Tilbury Fort
- Order Limits 100m Buffer
- Order Limts 200m Buffer
- Order Limits 400m Buffer

Meters
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Drawing Number: Figure 18.4
Rev: 00

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APPENDIX 1

Date: 28 July 2017
Our ref: 218441 Tilbury2 Port Expansion (Thurrock)
Your ref:

Customer Services
Hornbeam House
Crewe Business Park
Electra Way
Crewe
Cheshire
CW1 6GJ

T 0300 060 3900

Peter Ward,
TILBURY2 Project, Port of Tilbury,
Leslie Ford House, TILBURY,
RM18 7EH
By email only: T2consultation@potll.com

Dear Mr Ward

Consultation: Expansion of the Port of Tilbury – "Tilbury2". Statutory Consultation on a Proposed Application for Development. Section 42 Planning Act 2008.
Location: Former Tilbury Power Station, Thurrock

Thank you for your consultation on the above dated the 16th June 2017 which was received by Natural England on the same date via email.

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

We understand that you are consulting us in line with paragraph 67 of the Planning Act 2008 "Guidance on pre-application consultation", and that further consultation may be required in line with paragraph 85, particularly when the draft Environmental Statement has been prepared. We also appreciate that this consultation under S42 of the Planning Act 2008 also encompasses consultation on the preliminary environmental information, and that some overlap exists between these various requirements. Natural England welcomes both formal and informal pre application consultation and refers you to our annex C to the NID advice note 11.

Natural England has previously provided advice on this proposal through our Discretionary Advice Service (DAS) at a meeting on the 22nd March 2017 (our ref: 11835/209261) and through our response to the Environmental Impact Assessment Scoping Consultation dated the 25th April 2017 (our ref: 211894).

Natural England remains concerned that *"there is likely to be a net negative residual effect on the local and wider ecological resource during construction"* as stated in paragraph 10.292 of the Preliminary Environmental Information Report (PEIR) and that "*in an optimistic scenario" the aspiration is for* "something close to a net neutral effect on local and regional biodiversity in perhaps ten or 15 years."

Paragraph 3.3.3 of National Planning Statement (NPS) for Ports requires that new development should *"preserve, protect <u>and where possible improve</u> marine and terrestrial biodiversity"* and *"provide high standards of protection for the natural environment."* We advise that this paragraphs 10.292 and 10.293 should be seeking to achieve an aspiration of net environmental gain.

Nationally and Internationally Designated Sites
Natural England acknowledges the list of sites presented in *'Table 10.23 Statutory nature conservation designations within 5km of the Site'* and agrees the sites selected in the following paragraphs as being most likely to impacted is appropriate.

It is noted in paragraph 10.7 that a *"shadow Habitats Regulation Assessment (HRA) document will* *be produced to accompany the Environmental Statement with sufficient information to enable the relevant competent authority/s to assess the likelihood of any potential effects on European Sites being significant."* HRA should be considered an iterative process which should be carried out at the earliest available opportunity so that its findings can be used to inform site design.

Natural England notes that further assessment is required regarding indirect impacts on Nationally and Internationally designated sites with full consideration of effects alone and 'in combination' with other plans and/or projects. We agree that this assessment will need to consider the impacts of net increases in shipping patterns and potential cumulatively significant changes to estuarine processes that support the condition of intertidal habitats. It should also consider impacts on mobile species especially given that the Thames Estuary and Marshes Special Protection Area (SPA) feature birds have been identified using the intertidal mudflats within the application site boundary and adjacent areas. Further to this we advise that a full survey season for over-wintering birds needs to include September through to the end March. We would expect to see the full overwintering bird report with the Environmental Statement so that it can be properly assessed.

Invertebrates
Natural England was directly provided with the "Land Adjacent to Tilbury Power Station, Essex: Invertebrate Survey Report (November 2016)" on the 20th July 2017 and notes that it is still not available on the website for general public viewing.

The report confirms the findings of earlier reports; that the site is of high intrinsic importance to invertebrate ecology and forms an integral part of the "*wider area of interest that has become known as the East Thames Corridor, within which there is an outstanding community of invertebrates that is of profound national value*." The number and diversity of rare invertebrate species is considerable and I refer to section 5.8 of the 2008 report, which states '*It is unequivocally clear that Tilbury Power Station supports an invertebrate assemblage that is outstandingly significant at a national (British Isles) level; almost no other site in Britain that has been afforded an equivalent level of appropriate survey supports such a high number of UK Biodiversity Action Plan specie*s' The significance of the Thames Terrace Invertebrates is recognised within Natural England's Thames Estuary and Marshes Focus Area.

Natural England notes from paragraph 10.281 and our previous DAS meeting that the applicant is keen to identify an offsite solution to compensate for the loss of these high value ecological areas. Whilst Natural England acknowledges that creative solutions may be necessary to achieve sustainable development solutions, we advise that it is important to follow the sequential processes of EIA and IEEM principles to adequately assess the environmental assets and the significance of the impacts on these assets, considering alternatives, avoidance, mitigation and compensation for residual impacts. This would be consistent with paragraph 3.3.3 of the NPS for Ports, which states that new port infrastructure should preserve and protect biodiversity and provide high standards of environmental protection.

Paragraph 5.1.14 also advises that the decision-maker should give due consideration to local designations even if they should not be used in themselves to refuse development. Natural England is not yet satisfied of the need to destroy these significant environmental assets.

Details of mitigation measures and compensation sites are not yet available. We are aware that the applicant wishes to discuss these with us and will be engaging further in the near future.

Protected Species and biodiversity
Planning Policy Statement 9 – '*Biodiversity and Geological Conservation'* sets out the key principles of national planning policy. These include the principle that planning decisions should aim to maintain and enhance, restore or add to biodiversity and that opportunities for the incorporation of beneficial biodiversity within the design of development should be promoted. The companion 'Guide to Good Practice', published by the Government in 2006, reinforces these principles. It emphasises how "*The design, layout and landscaping of new developments offer enormous opportunities to add to, or enhance, biodiversity.*" It recognises that "*major new areas of biodiversity habitat alongside development*" can be provided. It also points out that "*Major development due to its scale and*

demand on resources can have both the greatest impact on and provide the greatest benefits to biodiversity".

The terrestrial land within the site is shown to provide a mosaic of habitats supporting a number of rare and declining birds, including turtledove, nightingale and cetti's warbler and protected species including water vole and reptiles. In addition to this, the application site supports a significant number of nationally scare or near threatened vascular plants, that collectively may be regarded as an outstanding vascular plant assemblage.

Natural England considers that the project should include all aspects of its mitigation, compensation and enhancement proposals for biodiversity, irrespective of the requirements of the international and national wildlife legislation which may also apply in this case. The site layout plans appear to show the development proceeding without having secured and integrated all counter-acting measures for habitat and species protection and lacking proposals for enhancement.

The area subject to development, even as a busy industrial port, can offer opportunities for conservation and enhancement which, together with land provided to offset the effects on habitats and species on the site, can help to maintain and improve green corridors, networks and habitat links to the wider environment. Substantial areas will need to be secured and incorporated into the master planning for the development site to offset the potential harm to wildlife species and habitats. Natural England advises that this development should be brought forward with all aspects of its proposals fully considered and thoroughly integrated, as part of the iterative processes of good design and environmental assessment.

Natural England also understands letters of no impediment will be sought for species licencing with regard to protected species. Our licencing team is aware and will engage further through our Discretionary Advice Service.

Protected Landscapes – North Kent Downs Area of Outstanding Natural Beauty (AONB)
The proposed development is for a site approximately 4.6km from a nationally designated landscape namely North Kent Downs AONB. Natural England advises that the relevant AONB Conservation Board should be consulted. Their knowledge of the site and its wider landscape setting, together with the aims and objectives of the AONB's statutory management plan, will be a valuable contribution to the planning decision.

Marine Ecology
Paragraph 11.2 advises that *"ongoing maintenance dredging will be required."* Proposed methodology, quantity and frequency of maintenance should be provided so that impacts of this may be properly assessed. Regarding 11.3, where it is stated that *"the fate of dredging materials is yet to be determined,"* Natural England would encourage the beneficial re-use of sediments. The quantity of dredge material anticipated should also be provided.

Paragraph 11.5 – Natural England welcomes the proposed data collection and surveys for the marine environment which will provide evidence to support conclusions made. Natural England will be able to provide further comments once the Environmental Statement has been updated following the survey results.

Table 11.1: Marine and Coastal Access Act - Natural England welcomes the inclusion of the Thames Estuary recommended Marine Conservation Zone (rMCZ) and the separate Marine Conservation Zone (MCZ) assessment provided particularly the information on smelt as a migratory feature of the rMCZ. We note that the applicants have used information as provided in the Thames Estuary rMCZ factsheet available on the Wildlife Trust website. For your information the former Thames Estuary rMCZ has now been split into two separate sites; the first (Upper) stretches from Richmond Bridge to Battersea Bridge and the second (Lower) stretches from The Queen Elizabeth II Bridge to Columbia Wharf/Grays respectively.

The Upper Thames Estuary rMCZ is proposed as it is an important area for Smelt (Osmerus eperlanus). The boundary of the lower site, Swanscombe rMCZ, has been determined to fit more closely around records of the tentacled lagoon-worm (Alkmaria romijni) for which there is currently considered to be a gap in the ecological network.

This information is in draft status only and forms part of our scientific advice on the sites that are under consideration for Tranche 3. Defra will make decisions regarding which sites and which features will go forward to a public consultation. These sites are not currently a material consideration, but the sites and features that are put forward to consultation will become a material consideration at that stage.

The Thames Estuary rMCZ was last consulted on in 2012/13 https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/82726/mcz-annex-a3-121213.pdf.

Please note that the last consultation does not necessarily reflect what will be put forward should the site go to public consultation as part of tranche 3. The features last consulted on are listed below:

Broad scale habitats -
- Intertidal sand and muddy sand
- Intertidal mixed sediment
- Subtidal coarse sediment
- Subtidal sand
- Subtidal mud

Habitat Features of Conservation Importance (FOCI) -
- Sheltered muddy gravels

Species FOCI (low mobility) -
- Tentacled lagoon worm (Alkmaria romijini). N.B. intertidal mud is a supporting habitat of this species.

Species FOCI (high mobility) -
- European eel (Anguilla Anguilla) NB- eel is no longer considered a suitable feature for designation within an MCZ
- Smelt (Osmerus eperlanus)

Paragraph 11.35 - Natural England welcomes the proposed survey work for tentacled lagoon to understand whether this protected species is present in the vicinity of the works. We advise that the applicants should demonstrate within the Environmental Statement that the impacts of the proposal are considered for tentacled lagoon worm under both aspects of legislation which protects this species.

Tentacled lagoon worm is a species listed under schedule 5 (9a) of the Wildlife and Countryside Act 1981 (as amended) and protection concerns the habitat of the species, any act that causes habitat disturbance would be considered an offence under this legislation.

The applicant must ensure to be compliant with the legislation when carrying out the proposed works. The Marine and Coastal Access Act (2009) concerns the population of the species and therefore the applicants must demonstrate that the conservation objectives for the population of the worm are not hindered by the proposal. We note that this has been provided within the MCZ assessment in Appendix 11A.

Paragraph 11.27 – Natural England welcomes the proposed additional benthic survey work which will provide evidence to support conclusions made. Natural England will be able to provide further comments once the Environmental Statement has been updated following the survey results.

Table 11.17 – Nustar Jetty. The dredge has been included within the table of cumulative impacts

however the jetty extension has not been included. (Marine Management Organisation application reference MLA/2017/00110).

Hydrology, Air Quality, Noise and Vibration
We would expect the Environmental Statement to consider the impacts of hydrological change, surface water runoff and contaminates on nearby designated sites, SPA and SSSI mobile species that utilise the site and/or surrounding area and on biodiversity retained on site. This should also be considered through the Habitats Regulations Assessment where appropriate.

If you have any queries relating to the advice in this letter please contact me on 020 802 61025

Yours sincerely,

Mr Jamie Melvin
Planning Lead Adviser - West Anglia

Date: 25 October 2017
Our ref: DAS 11835 209261 Port of Tilbury 2 HRA
Your ref:

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NATURAL ENGLAND

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Dear Mr Woodfield

Discretionary Advice Service (Charged Advice)
DAS 11835 209261
Development proposal and location: Tilbury2: Proposed Port Terminal at Former Tilbury Power Station

Thank you for your consultation on the above dated 10th October 2017. .

This advice is being provided as part of Natural England's Discretionary Advice Service. Bioscan (UK) Ltd has asked Natural England to provide advice upon:

- Tilbury2: Habitats Regulations Assessment Report

This advice is provided in accordance with the Quotation and Agreement dated 11th July 2017.

The following advice is based upon the information within the following documents:

- Tilbury2: Habitats Regulations Assessment Report (Ref: E1862/HRA/V1)
- Environmental Statement Chapter 10 (20.10.17)
- Construction Environmental Management Plan
- Operational Management Plan

Please note that Natural England only received the final draft of the Habitats Regulations Assessment (HRA) on 10th October 2017 and the relevant chapter of the Environmental Statement (ES) late on the afternoon of 20th October 2017.

Protected sites
Natural England is currently not satisfied, on the basis of the information which has so far been provided, that it can conclude that the proposed plan or project will have no significant effect on the Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar, either alone or in combination with other plans or projects.

We are pleased to see that surveys have been carried out in September and October of 2017, thus completing an overwintering season in conjunction with the 2016 data. We would, however, have expected the application to be supported by a number of years of full data and consider that this limitation may have contributed to bird numbers identified being low. Paragraph 1.277 of the ES gives limited detail relating to survey work prior to 2016. Any further data available should be presented within the ES to corroborate the findings of the most recent surveys.

With regards to functionally linked land, Natural England notes that *'several of the bird species* *underpinning the European Site designations make use of intertidal habitats in closer proximity to the Tilbury2 site than the European Site itself.'* From the information provided Natural England has been unable to ascertain which areas SPA birds are using, which species or in what numbers. We note that it is considered that there is *'relatively low'* usage of intertidal habitats within the area of *'potential disturbance'* identified, but would expect to see consideration of what the habitat is being used for and potential impacts on the species concerned. It is worth bearing in mind that whilst some key species are identified in the SPA conservation objectives, water bird assemblage is also a qualifying feature.

In Combination Effects

Natural England is currently not satisfied, on the basis of the information which has so far been provided, that it can be concluded that the proposed plan or project will have no significant effect on the Thames Estuary and Marshes Special Protection Area (SPA) and Ramsar in combination with other plans or projects.

The Planning Inspectorate advises that the following should be considered (please note this list is not exhaustive):

- projects that are under construction;
- permitted application(s) not yet implemented;
- submitted application(s) not yet determined;
- all refusals subject to appeal procedures not yet determined;
- projects on the National Infrastructure's programme of projects; and
- projects identified in the relevant development plan (and emerging development plans - with appropriate weight being given as they move closer to adoption) recognising that much information on any relevant proposals will be limited and the degree of uncertainty which may be present.[1]

At a minimum, this includes Tilbury Energy Centre which is included on the National Infrastructure's programme of projects but omitted from the list of applications considered in the ES. Given the scale of development that is known to be coming forward on this and neighbouring sites, Natural England advises that it is extremely important that in combination effects are properly assessed.

There is no established legal definition of what constitutes a plan or project for the purposes of the HRA. Natural England therefore advises that it would be prudent to include all known projects to ensure compliance with the Conservation of Habitats and Species Regulations 2010. Natural England advocates a co-ordinated approach to the avoidance and mitigation of ecological impacts in this area and will be working with key local partners and stakeholders to promote this.

We would strongly recommend that the project overall seeks to deliver a net gain for biodiversity. In that regard, we advise that the plans for overall mitigation of wider impacts on wildlife, and their enhancement, are provided alongside measures to address the specific impacts on designated wildlife features.

Natural England would be keen to discuss the HRA further once we have had the opportunity to fully consider the documentation provided and considers that it is appropriate for now to include it as a matter under discussion in the Statement of Common Ground.

As the Discretionary Advice Service is a new service, we would appreciate your feedback to help shape this service. We have attached a feedback form to this letter and would welcome any comments you might have about our service.

☒ The advice provided in this letter has been through Natural England's Quality Assurance process

[1] https://infrastructure.planninginspectorate.gov.uk/wp-content/uploads/2015/06/Advice-note-10v4.pdf

The advice provided within the Discretionary Advice Service is the professional advice of the Natural England adviser named below. It is the best advice that can be given based on the information provided so far. Its quality and detail is dependent upon the quality and depth of the information which has been provided. It does not constitute a statutory response or decision, which will be made by Natural England acting corporately in its role as statutory consultee to the competent authority after an application has been submitted. The advice given is therefore not binding in any way and is provided without prejudice to the consideration of any statutory consultation response or decision which may be made by Natural England in due course. The final judgement on any proposals by Natural England is reserved until an application is made and will be made on the information then available, including any modifications to the proposal made after receipt of discretionary advice. All pre-application advice is subject to review and revision in the light of changes in relevant considerations, including changes in relation to the facts, scientific knowledge/evidence, policy, guidance or law. Natural England will not accept any liability for the accuracy, adequacy or completeness of, nor will any express or implied warranty be given for, the advice. This exclusion does not extend to any fraudulent misrepresentation made by or on behalf of Natural England.

Yours sincerely,

Jamie Melvin
Planning Lead Adviser – West Anglia

Cc commercialservices@naturalengland.org.uk

Date: 08 January 2018
Our ref: 11835/227719
Your ref: TR030003

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Rob Ranger - The Planning Inspectorate,
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By email only: tilbury2@pins.gsi.gov.uk

Dear Mr Ranger,

NSIP Reference Name / Code: Tilbury2
User Code: TR030003

Thank you for your consultation on the above dated the 29th of November 2017 which was received by Natural England on the 4th of December 2017.

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

NATURAL ENGLAND'S RELEVANT REPRESENTATIONS

Natural England's advice in these relevant representations is based on information submitted by Port of Tilbury in support of its application for a Development Consent Order ('DCO') in relation to the proposed port terminal at Former Tilbury Power Station ('Tilbury2').

Natural England has been working closely with Port of Tilbury to provide advice and comments since the 6th February 2017. Natural England has also been working with the Environment Agency and Thurrock Council to provide coordinated advice. Whilst this has been helpful to aid our understanding of the project, it has not enabled all issues to be satisfactorily resolved ahead of submission of the project. We remain committed to working with the project team to progress outstanding items over the period of the Examination.

These Relevant Representations contain a summary of what Natural England considers to be the priority nature conservation impacts and opportunities in the context of Tilbury and wider South Essex area in relation to the DCO application and we indicate the principal submissions that we wish to make at this point. We will develop these points further as appropriate during the Examination process.

We may have further or additional points to make, particularly if further information about the project becomes available. It is not an exhaustive representation on all matters related to biodiversity, and any matters upon which we have not commented should not be taken to mean that there are no other impacts, rather that these are not the focus for our engagement. Other parties may wish to make comments on these points.

Natural England's main issues raised by this application are:

<u>Terrestrial Invertebrates</u>
The 2017 invertebrate report which underpins the Environmental Statement identifies that the area that will be lost to development is *'of high conservation importance for invertebrates in a national context'.* Ten species listed under section 41 of the Natural Environment and Rural Communities Act 2006 (a list of the living organisms and types of habitat which in the Secretary of State's opinion are of principal importance for the purpose of conserving biodiversity, for which steps should be taken as appear to the Secretary of State to be reasonably practicable to further the conservation of the living organisms and types of habitat included) were identified in the 2016 and 2017 surveys. These were as follows:

- Planthopper *Ribautodelphax imitans*
- Sea Aster Bee *Colletes halophilus*
- Five-banded Weevil-wasp *Cerceris quinquefasciata*
- Brown-banded Carder-bee *Bombus humilis*
- Shrill Carder-bee *Bombus sylvarum*
- Picture-winged Fly *Dorycera graminum*
- Wall butterfly *Lasiommata megera*
- Small Heath butterfly *Coenonympha pamphilus*
- Garden Tiger moth *Arctia caja*
- Cinnabar moth *Tyria jacobaeae*

A further five were recorded in or near to the survey area in 2007:

- Saltmarsh Shortspur beetle *Anisodactylus*
- Hornet Robberfly *Asilus crabroniformis*
- Red-shanked Carder-bee *Bombus ruderarius*
- Black-headed Mason-wasp *Odynerus melanocephalus*
- Four-banded Weevil-wasp *Cerceris quadricincta*

The ES chapter 10 Ecology at paragraph 10.295 summarises the headline findings, including 159 "key species" (of a total of 1,397), of which 31 were rare species (having rare or threatened conservation status). **In our opinion, the overall assemblage could be considered to be of sufficient quality to meet the designation requirements of a Site of Special Scientific Interest (SSSI)**.

It is important to note therefore, that although the habitats and species affected by the proposed development receive some recognition in nature conservation terms (NERC s41, LoWS), that our specialist assessment of the survey data collected indicates the overall invertebrate assemblage to be significant in a national context. Indeed, the Lytag LoWS in particular is regarded as almost unique in England and, whilst as a brownfield habitat it is man-made, would be very difficult to re-create with confidence on a compensation site should it be lost to development.

Natural England has unfortunately not been able to agree a Statement of Common Ground with the applicant prior to submission of the DCO, and although it remains our intention to reach agreement on as many outstanding issues as possible, the very tight submission date and volume of consultation material to review has meant that we are not yet in a position to do so. We therefore have some concerns for example that some statements within the ES which indicate where a common ground position has been achieved may be premature (for example, paragraphs 10.298 – 10.301).

The Environmental Statement agrees that the site is *'clearly of very high value'* and recognises the requirement to mitigate the impacts of the proposals on terrestrial ecology. In this respect, the application relies heavily on an Ecological Mitigation and Compensation Plan which *'will be discussed with stakeholders'* (paragraph 10.318). Note that whilst we have held some high level discussions with the applicant around mitigation principles, Natural England has not seen any part of this document and remain unsighted on any mitigation proposals (including those for off-site compensation). Details relating to specific parcels of off-site compensation land and specific habitat creation and management proposals have not been made available to us to date (which we understand are subject to a non-disclosure agreement).

Consequently, we have not been able to provide any specific comments on the suitability of the mitigation and compensation package for losses to terrestrial invertebrates which are regarded to be of national importance. This has significantly hampered our ability to provide meaningful pre-application advice on this aspect of the proposed development.

The Environmental Statement relies heavily on the provision of off-site compensation in order to form its conclusions over impacts to ecological receptors, not least terrestrial invertebrates. Paragraph 10.316 and onwards describes this feature as "embedded mitigation", and it is not yet known whether this will form a single or multiple sites. Summary paragraph 10.386 and Table 10.52 "Terrestrial Ecology: Residual Effect Summary Table" present residual significance of effects. **Natural England advises that it is not yet possible to comment with any degree of confidence on whether the off-site compensation measures required can deliver the stated outcomes.** As it stands, Natural England does not consider that the project represents sustainable development with respect to terrestrial ecology, the principle interest of which is the invertebrate assemblage of national importance. In our opinion, the ES should be regarded as incomplete.

<u>Environmental Impact Assessment – Cumulative Assessment</u>
Natural England is aware that significant major infrastructure development is proposed for this area, most prominently the Lower Thames Crossing and Tilbury Energy Centre Nationally Significant Infrastructure Projects ('NSIP') developments. We understand that the applicants for the Tilbury2 project do not consider that there is a need to consider cumulative impacts for these two specific projects due to temporal separation and the absence of detail relating to proposed development. However, we consider that, in keeping with the Planning Inspectorate's Advice Note 17, an EIA cumulative effect assessment would be appropriate with these two additional projects beyond those listed currently in the ES. Given the potential combined level of impact on similar high value ecological features (including for brownfield invertebrate ecology) Natural England considers that there is a need for a joint strategy for mitigation.

In our view, the PINS Advice Note 17 has not been given due regard as a key guiding reference and advice note. Whilst we recognise that it does not strictly form part of NSIP Policy, it has been produced by PINS as an Advice note for the benefit of all parties, and in our view reflects the spirit of EIA cumulative assessment process, which should be applied in view of the known scale of multiple NSIP development in the Tilbury area, affecting similar terrestrial ecological receptors. Consistent with that advice note, the Lower Thames Crossing is already a "Tier 2" project, and the Tilbury Energy Centre is we understand shortly to also become a "Tier 2" project, for which EIA cumulative impact assessment is recommended. Whilst much of the Advice Note is relevant, we particularly highlight paragraph 3.4.12 "where possible, applicants should consider opportunities to develop holistic mitigation strategies in collaboration with other developers identified in the CEA".

Overall Natural England is concerned that the EIA cumulative assessment should be fit for purpose in the context and the spirit of the future outcomes of multiple strategic development projects in the Tilbury area in terms of the future of biodiversity in this part of the Thames Estuary. The assessment of known major infrastructure projects in isolation from each other does not assist stakeholders in providing advice that seeks a co-ordinated outcome for common impacts, and in ensuring that decision makers meet their duties and obligations towards nature conservation. As such, the consideration of projects on a strictly sequential basis does not best serve this purpose. In our view, sufficient detail may be available (either in the public domain or currently held by relevant projects) to inform a cumulative impact assessment. In discussion with stakeholders, we understand that the Environment Agency, Thurrock Council, and the Marine Management Organisation are of a similar view, with respect to their own remits.

Habitats Regulations Assessment in-combination
The application boundary lies within the zone of influence of habitats providing a supporting function to wintering and passage birds using the Thames Estuary and Marshes Special Protection Area (SPA). Whilst overwintering bird surveys show only relatively low levels of use of intertidal areas within and adjacent to the development, we note that only one year's worth of data has currently been provided (although we understand that the applicant intends to continue surveys for a second year). Our knowledge of the area affected suggests that the intertidal area does provide some valuable function as supporting habitat for the Special Protection Area particularly in extreme weather events. We also consider that recent mild winter weather at the time of the survey may have led to under-recording of bird numbers and species.

There is some evidence that current construction works approximately 800m downstream from the proposal in association with the Goshem's Farm works (17/00224/FUL) are already causing disturbance to the waterbird assemblage in that part of the estuary and we understand that this is being investigated. In this context, we note the proposed construction of the Lower Thames Crossing and other projects in a similar area may extend a level of disruption to the ecological function of the area for some years to come, and on this basis, we have concerns regarding that the Habitats Regulations Assessment in-combination conclusion has indicated "no likely significant effect", as its screening conclusion. We do not yet consider that this conclusion is sufficiently precautionary, however in our view we suggest that the project in combination with other Plans and projects may be able to avoid an adverse effect on the integrity of the European site with appropriate mitigation and monitoring measures deployed consistent with best practise.

Applying the precautionary principle we recommend that the Habitats Regulations Assessment screening is updated to reflect our concern and that the applicant makes a commitment to maintain annual bird surveys between 01 September to 31 March during the construction and operational phases. Where an impact is noted Natural England should be contacted so that appropriate mitigation measure can be implemented within agreed timeframes. In discussion with the applicant, we are expecting additional assessment information to inform our views on the above conclusion, and so we can advise that discussions will continue with the view to agreeing this matter in due course.

Marine Interests
Natural England is satisfied that the project is unlikely to have a significant impact on either the Medway Estuary Marine Conservation Zone or the Upper Thames recommended Marine Conservation Zone. We are pleased to see that impacts on migratory smelt have been considered within the assessment, however the mitigation for timing of the works to avoid likely fish migration periods should be clarified. As discussed within the document, smelt migrate upstream to spawning grounds in early spring (February-April) and the mitigation suggested is for no water injection dredging between June and August. We would like to understand what species this mitigation measure is aimed at and whether any additional restrictions are required for migratory smelt.

Natural England notes that regular maintenance dredging will be required at Tilbury 2 and we encourage the inclusion of this information into the next revision of the Port of London Authority Maintenance Dredge Baseline Document. Inclusion within this document will ensure that the cumulative impacts from dredging activities are assessed, particular with regards to other large scale dredging operations such as those at London Gateway.

Licensable Protected Species

Natural England has undertaken a high level review of the proposed mitigation strategies for those protected species where licensable activities are proposed. On the basis of the information provided to us to date, we do not consider there to be any fundamental reasons why licences (where required) would not be granted subject to the submission of detailed mitigation strategies and application details consistent with those earlier strategies. We have expressed this view to the applicant in our letter dated 14th December 2017.

Summary

Natural England's overall position at this stage is that in relation to issues within its remit there remain critical issues with respect to nature conservation that remain outstanding at this point in the NSIP application process. Whilst we will continue to work with the applicant towards resolving these issues, we currently are of the opinion that that the project cannot be regarded as a sustainable development prospect in the absence of the key mitigation details described above. In our opinion these matters must be resolved satisfactorily as part of the Examination process by Port of Tilbury and the Examining Authority as part of the examination and consenting process before development consent can be granted.

Jonathan Bustard
Casework Manager
Natural England
8th January 2018

Date: 20 March 2018
Our ref: 236858 Tilbury2 Written Reps
Your ref: TR030003

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Dear Sir/Madam,

NSIP Reference Name / Code: Tilbury2
User Code: TR030003

Thank you for your consultation on the above dated the 26th of February 2018.

Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

Written Representation
PART I: Summary of Natural England's advice.
PART II: Annexes including Natural England's evidence and answers to the Examining Authority's first written questions

Contents

PART 1 INTRODUCTION

1.1. Purpose and structure of these representations

1.1.1. These Written Representations are submitted in pursuance of rule 10(1) of the Infrastructure Planning (Examination Procedure) Rules 2010 ('ExPR') in relation to an application under the Planning Act 2008 for a Development Consent Order ('DCO') for Tilbury2: the proposed port terminal at the former Tilbury Power Station ('the Project') submitted by Port of Tilbury London Limited ('the Applicant') to the Secretary of State.

1.1.2. Natural England has already provided a summary of its principal concerns in its Relevant Representations, submitted to the Planning Inspectorate on the 8th of January 2018. This document comprises an updated detailed statement of Natural England's views, as they have developed in view of the common ground discussions that have taken place with the Applicant to date. These are structured as follows:

a. Section 2 describes the conservation designations, features and interests that may be affected by the Project and need to be considered.

b. Section 3 comprises Natural England's submissions in respect of the issues that concern it. This submission cross-refers to, and is supported by, the evidence contained in the Annexes.

c. Section 4 is a dedicated section answering the Examining Authority's written questions which were asked on the 27th of February 2018, cross-referenced to the rest of this document.

d. Section 5 provides a summary of Natural England's case.

e. The Annexes contain evidence referred to in the main body of these Representations.

1.1.3. A number of abbreviations and acronyms will be used in these Representations. These will be introduced where they first appear in the text but for ease of reference, a list of abbreviations is provided in Annex A.

2. SUMMARY

2.1. Summary and update on the Statement of Common Ground

The Examining Authority will be aware of Natural England's principal concerns regarding the Tilbury2 Nationally Significant Infrastructure Project ('NSIP') as set out in our Relevant Representation dated 8th January 2018. These are broadly as follows:

- Impacts to terrestrial invertebrates of national significance
- Impacts to the Thames Estuary & Marshes SPA and Ramsar site, and component Mucking Flats & Marshes Site of Special Scientific Interest SSSI
- Absence of EIA cumulative & HRA in-combination assessments.
- Impacts to licensable protected species
- Impacts on marine interests

In summary of our position, Natural England remains of the view that the development, as currently submitted to the Examining Authority, does not represent sustainable development as required by the National Policy Statement for Ports, and subsidiary policy including the National Planning Policy Framework (including the current consultation draft). Our main concern relates to the proposed direct impact on large areas supporting terrestrial invertebrates and their habitats which are regarded by both ourselves and the developer to be of national nature conservation importance, and for which an agreed package of mitigation and compensation has yet to be submitted to the Examination for consultation. Natural England's view is that parts of the proposed development site hold unique habitats which arguably are irreplaceable (in particular the Lytag site), and for which we will consider designation as a Site of Special Scientific Interest (SSSI), consistent with our duties as statutory nature conservation adviser to the Government.

We also have remaining concerns regarding indirect impacts to non-breeding birds using habitats at the foreshore which have a functional linkage to the Thames Estuary & Marshes Special Protection Area (SPA) and Ramsar site. At the time of writing, we are expecting additional bird survey data for February and March 2018 to be submitted, and will review this in due course. In our view, the Habitats Regulations Assessment should be updated to include assessment of a fuller range of impact pathways than have currently been included. Additional comments are supplied with respect to other nature conservation features, including lichens, vascular plants, and licensable protected species.

For both of these concerns, we consider that EIA cumulative and HRA in-combination assessments are required with relevant projects, in order to adequately assess impacts. Please note, however, that Natural England is in ongoing active dialogue with the applicant over all outstanding matters, and whilst in our view significant progress is still required at this site to address these concerns, we anticipate further conversations to make progress on these matters. In our view, further work is needed on the scheme to demonstrate compliance with the mitigation hierarchy, of which avoidance of impacts (in this case to nationally important invertebrate assemblages) is of greatest relevance. As it stands however, Natural England cannot yet support the proposal as an example of sustainable development.

3. CONSERVATION DESIGNATIONS, FEATURES AND INTERESTS THAT COULD BE AFFECTED BY THE PROPOSED PROJECT

The following is a brief summary of the interest features of the relevant designated areas of concern in this matter. Designation citations and maps are included in Annexes B and C.

3.1. International conservation designations

Thames Estuary and Marshes Special Area of Protection (‘SPA’) - Site area: 4802.47 hectares

The detailed citation informationcan be found in Annex C.

Qualifying Features:
A082 *Circus cyaneus*; Hen harrier (Non-breeding)
A132 *Recurvirostra avosetta*; Pied avocet (Non-breeding)
A137 *Charadrius hiaticula*; Ringed plover (Non-breeding)
A141 *Pluvialis squatarola*; Grey plover (Non-breeding)
A143 *Calidris canutus*; Red knot (Non-breeding)
A149 *Calidris alpina alpina*; Dunlin (Non-breeding)
A156 *Limosa limosa islandica*; Black-tailed godwit (Non-breeding)
A162 *Tringa totanus*; Common redshank (Non-breeding)
Waterbird assemblage

Thames Estuary and Marshes Ramsar
The qualifying features of the Thames Estuary and Marshes Ramsar are also qualifying species of the Thames Estuary and Marshes SPA. Therefore our advice relating to the SPA is equally applicable to the Ramsar.

3.2. National conservation designations

Mucking Flats and Marshes Site of Special Scientific Interest (‘SSSI’) – Site Area: 312.7149 hectares

Mucking Flats and Marshes comprise of an extensive stretch of the Thames mudflats and saltmarsh, together with seawall grassland. The saltmarsh is dominated by sea couch and sea purslane, and to seaward has patches of the nationally scarce golden samphire. Other nationally scarce plants present are Borrer`s saltmarsh grass, sea barley and slender hare`sear. The sea wall is dominated by sea couch, cocks foot, wild carrot and prickly ox tongue. The saltmarsh has a high invertabrate interest, which includes the rare spider *Baryphyma duffeyi*. The mudflats form the largest intertidal feeding area for wintering wildfowl and waders west of Canvey Island on the north bank of the Thames. Ringed plover occur in internationally important numbers, with nationally important numbers of Avocet, Black tailed godwit, Dunlin, Grey plover and Shelduck. Part of this SSSI is within the Thames Estuary and Marshes Special Protection Area and Ramsar site.

Notified Features
- Aggregations of non-breeding birds - Black-tailed Godwit, *Limosa limosa islandica*
- Aggregations of non-breeding birds - Dunlin, *Calidris alpina alpina*
- Aggregations of non-breeding birds - Grey Plover, *Pluvialis squatarola*
- Aggregations of non-breeding birds - Redshank, *Tringa totanus*
- Aggregations of non-breeding birds - Ringed Plover, *Charadrius hiaticula*
- Aggregations of non-breeding birds - Shelduck, *Tadorna tadorna*
- Invertebrate assemblage

3.3. European Protected Species

The Conservation of Habitats and Species Regulations 2017: Schedule 2 Species – European Protected Species of Animals. EC Habitats Directive (Council Directive 92/43/EEC) Annex 2/4 species.

Bats, Typical (all species) *Vespertilionidae*

3.4. Nationally Protected Species

Water Vole – Schedule 5 species under the Wildlife and Countryside Act 1992 (as amended)
Badgers – The Protection of Badgers Act 1992 (as amended)

3.5. Non-designated interests and features of concern

The invertebrate assemblage of the Tilbury 2 site is agreed with the applicant to be measureable as of national importance on the basis of the 2007, 2016 and 2017 datasets and by reference to the geographic terms of reference set out by the Chartered Institute of Ecology and Ecological Management ('CIEEM') in the 2016 Ecological Impact Assessment ('EIA') Guidelines.

The 2017 invertebrate report which underpins the Environmental Statement ('ES') identifies that the area that will be lost to development is *'of high conservation importance for invertebrates in a national context'.* Ten species listed under section 41 of the Natural Environment and Rural Communities Act 2006 (a list of the living organisms and types of habitat which in the Secretary of State's opinion are of principal importance for the purpose of conserving biodiversity, for which steps should be taken as appear to the Secretary of State to be reasonably practicable to further the conservation of the living organisms and types of habitat included) were identified in the 2016 and 2017 surveys. These were as follows:

- Planthopper *Ribautodelphax imitans*
- Sea Aster Bee *Colletes halophilus*
- Five-banded Weevil-wasp *Cerceris quinquefasciata*
- Brown-banded Carder-bee *Bombus humilis*
- Shrill Carder-bee *Bombus sylvarum*
- Picture-winged Fly *Dorycera graminum*
- Wall butterfly *Lasiommata megera*
- Small Heath butterfly *Coenonympha pamphilus*
- Garden Tiger moth *Arctia caja*
- Cinnabar moth *Tyria jacobaeae*

A further five were recorded in or near to the survey area in 2007:

- Saltmarsh Shortspur beetle *Anisodactylus poeciloides*
- Hornet Robberfly *Asilus crabroniformis*
- Red-shanked Carder-bee *Bombus ruderarius*
- Black-headed Mason-wasp *Odynerus melanocephalus*
- Four-banded Weevil-wasp *Cerceris quadricincta*

The ES chapter 10 Ecology at paragraph 10.295 summarises the headline findings, including 159 "key species" (of a total of 1,397), of which 31 were rare species (having rare or threatened conservation status). Natural England's specialist assessment of the invertebrate interest at the Tilbury2 proposed development site is that the **overall assemblage could be considered to be of sufficient quality to meet the designation requirements of a SSSI**. In particular, we regard the Lytag site, and the broader invertebrate survey area referred to as "The Rest" to represent the highest quality areas. However, it should be noted that other parts within the red-line boundary also represent areas of elevated importance, such that their relative quality compared to the Lytag and "The Rest" should not be over-looked.

In addition to the above listed individual species of conservation priority (s41 species), several have historically been found on the site but not re-found in recent surveys (including notably *Scybalicus oblongiusculus* which although not re-found there is no particular reason it will have become extinct on this site).

Natural England is aware that there are two Local Wildlife Sites within the site boundary and open mosaic priority habitats listed under section 41 of the Natural Environment and Rural Communitees Act 2006. Natural England does not hold locally specific information on local sites and recommends further information is obtained from appropriate bodies such as the local records centre, wildlife trust, geoconservation groups or recording societies (e.g. http://www.essexwtrecords.org.uk/).

4. NATURAL ENGLAND'S CONCERNS AND ADVICE

4.1. The principal issue

4.1.1. Natural England identified the following main issues in its Relevant Representations:

a. Potential impacts upon terrestrial invertebrates
b. Potential impacts on internationally designated sites and their qualifying species
c. The Habitats Regulations Assessment ('HRA') in combination assessment and the Environmental Impact Assessment ('EIA') cumulative assessment
d. Potential impacts upon lichen communities
e. Potential impacts upon licensable protected species
f. Potential impacts upon marine interests
g. Planning policy: National Planning Policy Framework ('NPPF') consultation draft

These issues will be discussed in corresponding sections below along with any updates on the progress or resolution of issues.

4.2. a. Potential impacts on terrestrial invertebrates

In our Relevant Representation, Natural England provided summary data on the invertebrate species and assemblages of note that would be directly impacted by the proposed development.

<u>*Description of the Value of Component Parts of the Site*</u>
Overall, with respect to the survey areas from the 2017 invertebrate report (in particular figure 3 of this report illustrating the subsites within the wider survey area), the Lytag site is the most important single area, but "The Rest" is of broadly equivalent value (i.e. nationally important), followed by the Tilbury corridor, and finally the Tilbury Centre areas. The associated habitats of importance to invertebrates are grassland communities, in particular F111 ("bare sand and chalk" assemblage within the "short sward and bare ground" habitats of the "open habitats" broad biotope) and F112 ("open short sward" within the same habitat category as F111). More specifically, and mindful of the datasets which span ~10 years, our view is that the Lytag site has retained its overall value, albeit with some limited decline in condition.

The Lytag site still supports impressive fauna, and as part of the brownfield network mapped out by Buglife in the past (see later reference), adds a valuable contribution. The role of brownfield in supporting a number of bumblebees is well known, and the populations of *Bombus humilis* and *B. sylvarum,* as well as the more "common" *Bombus* species add up to an important pollinator group. The presence of a number of s41 taxa on these brownfields further adds to the site's credentials.

"The Rest" is of a very good standard. It holds a good fauna with a good conservation status spread, and the grassland fidelity index is comparable with Lytag. In assemblage terms, it is the key resource on the site. The Rest is substantially larger and spatially less well defined, and consequently it is unclear how extensive it really is, and what resources it can bring to the overall site. The invertebrate survey reports do not state how much survey effort was placed where and when, so there is only limited value in comparing survey areas, however if The Rest is added to Lytag, the combined invertebrate resource becomes impressive, and could be even better with some bespoke management.

The Tilbury Corridor sampling area indicates a wetland bias which is something that is scarce across the wider site. The most recent data shows that this area remains important for invertebrates, and whilst this continued to demonstrate that the wetland interest is only of generic quality, the brownfield resource it holds moves it into third place with respect to its assemblage representation.

The Tilbury Centre seems to have suffered disproportionally between the survey periods, and these losses may be a function of its relatively small size or nature of the habitat it holds, but could equally well point to contributory losses from elsewhere on the site. Since none of these sites are at all isolated for many taxa, localised habitat degradation may well have impacts elsewhere on the site. Without management it looks like this site will decline further.

Background to Invertebrate Interest of the Thames Gateway
It is important that the Examining Authority views this nationally important biodiversity interest in some geographic and historical context. For some years, the importance of the Thames Estuary to invertebrate assemblages has been recognised with conservation efforts and research directed accordingly.

In summary, environmental conditions combine here to form favourable conditions for invertebrate communities of elevated importance, including being one of the driest parts of the country, with frequent soil water deficit in the months of May through to August. In summer these areas are also among the warmest parts of the country with high levels of sunshine. The predominant southerly aspect rising from the northern Thames shoreline, the presence of relict “Thames terrace” grasslands with a free-draining substrate, and a conglomeration of formerly developed brownfield sites with highly variable habitats provide many suitable habitats in which invertebrate assemblages can flourish. These include sites with artificial substrates such as sands, gravels, dredging, pulverished fuel ash (‘PFA’), former quarries, former railway sidings, as well as remnants of more natural habitats such as grazing marsh, and coastal borrow-dykes.

The very nature of the substrate deposits on many of these sites (such as exposed sand in quarries, PFA dumps, tailings, river dredgings, composite industrial debris) mean that vegetation finds it hard to establish and so the habitat is dominated by low vegetation and much “bare” ground. It is the range and transitions between the two that give so many opportunities for invertebrates, in additional to the increased opportunities for nest or burrow construction, shelter, and exposure to large amounts of warming sunlight.

Such conditions are now very rare in “natural” situations and only found on the better managed heathlands and chalk grasslands, as well as soft rock and slumping earth cliffs. As such, the open mosaic habitats that develop on brownfields have an important role to play in the conservation of a range of rare species and a number of important invertebrate assemblages.
In recognition of this conservation potential, and combined with growing re-development pressures, a partnership project between English Nature and Buglife

known as *All of a Buzz in the Thames Gateway*[1] undertook survey work and produced alert maps of sites to indicate high value invertebrate sites to ensure local planning authorities would alert developers to this important interest, which sought to ensure that they were effectively assessed and mitigated. Many of these sites were however lost to development, and the continued regeneration of strategic areas of the Thames Estuary has exacerbated the cumulative impacts to this priority biodiversity resource at a landscape scale.

Throughout this time, research was progressing and additional data collected which enabled the conservation community to place sites of elevated importance more accurately within local, regional, and national contexts. Natural England has developed invertebrate assemblage analysis tools to interrogate site quality to a much finer degree of precision, and to more accurately compare site with site. We now understand much better the unique contribution that several of these sites make to the overall resource of the Thames Gateway, such that it should not be thought that one brownfield invertebrate site is much the same as the next. Sites can now be shown to be statistically distinct from one another, and placed in a more refined context.

Our analysis for the Tilbury2 NSIP has involved the analytical tool Pantheon[2], a database tool developed by Natural England and the Centre for Ecology & Hydrology to analyse invertebrate sample data. The analyses supported by Pantheon improve our understanding of the resources and structures used by invertebrates within the sample locations and aid their conservation.

Users import lists of invertebrates (called “samples”) into Pantheon, which then matches the species to the preferred name in the UK Species inventory[3] before analysing the sample, attaching associated habitats and resources[4], assemblage types[5] (adapted from the ISIS, habitat fidelity scores[6] and other information against them. The analysis then displays a lot of this data as numerical scores[7]. This information can be used to determine site quality by revealing whether the species list is indicative of good quality habitat, inform on species ecology and assist in management decisions by revealing the key ecological resources. Pantheon also helps to establish a shared terminology for describing invertebrate interest which will greatly augment invertebrate nature conservation.

Furthermore, in recent months, Natural England has become aware of several other NSIP projects at various stages of development, including the Tilbury Energy Centre (currently at pre-application stage), the Lower Thames Crossing (‘LTC’) (currently at EIA scoping stage), and a further NSIP project immediately proximal to the Tilbury2 site (also at pre-application stage). The cumulative effect of these projects presents a significant threat to the remaining invertebrate resource of the Tilbury area, and which, in our view, would benefit from a holistic approach to development via a strategic solution, which initially would be well served by appropriate EIA cumulative impact assessment (see below).

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[1] https://www.buglife.org.uk/campaigns-and-our-work/habitat-projects/all-buzz-thames-gateway
[2] http://www.brc.ac.uk/pantheon/
[3] http://www.nhm.ac.uk/our-science/data/uk-species.html

[4] http://www.brc.ac.uk/pantheon/content/habitats-and-resources
[5] http://www.brc.ac.uk/pantheon/content/isis
[6] http://www.brc.ac.uk/pantheon/content/habitat-scores
[7] http://www.brc.ac.uk/pantheon/content/scoring-systems

In this context, the data presented within the applicant's Environmental Impact Assessment, which has been analysed by Natural England, has identified the assemblage on this site as being of national significance, and both Natural England and the developer are in agreement over the significance (in EIA terms) of this resource. The Examining Authority should therefore be aware that, consistent with its duties, Natural England must consider such a site for notification as a Site of Special Scientific Interest (SSSI). We have advised the applicant that, in view of the data arising from the submission of this project, Natural England is required to consider SSSI notification for parts of the proposed development site. We regard the invertebrate assemblage of the Tilbury2 site (and its subsections as described above) as being demonstrably distinct from other sites in the Thames Estuary, and therefore within scope for SSSI notification in its own right. The guidelines for the selection of biological SSSIs are available on the Joint Nature Conservation Commitee ('JNCC') website[8], however please note that these are subject to revision, with the updated version expected shortly (current timeframe March 2018).

Progress with the Invertebrate Mitigation / Compensation Package
As reported in our Relevant Representations, Natural England has engaged with the applicant in several meetings around the nature conservations aspects of the project, however we have been unable to meaningfully advise either them or the Examining Authority on the adequacies of invertebrate mitigation, as no details have been made available to us of the off-site compensation proposals (albeit we understand that several options have been or are being pursued). In view of the lack of progress in this regard, and mindful of the above SSSI qualities of the area, we have recently met with the developer at a senior level to discuss our concerns on Friday 16th March 2018, with a view to working with them to consider a development proposal which could be regarded as sustainable development (consistent with the requirements of both National Policy Statement ('NPS') for Ports and the NPPF.

The minutes of that meeting will be available to the Examining Authority in due course, however Natural England has advised the applicant that in our view, revisions should be made to the project to enable an improved scheme with demonstrable adherence to the mitigation hierarchy required by EIA and endorsed by the CIEEM[9]– of avoidance as a first principal, then mitigation, and compensation only as a last resort. Whilst we recognise the objective of the applicant to maximise economic profitability of their proposal, we are not yet satisfied that efforts to avoid the highest quality areas of the development site are proportionate to the nationally significant nature conservation interests found within it.

At the meeting, the developer updated us on progress with a variety of off-site compensation options, and whilst one of these appears to have a higher certainty of delivery than we have seen to date (a site near Paglesham), we have advised that this location is both unsuitable and inappropriate for brownfield invertebrate compensation (noting initially both proximity concerns – at ~30km from the donor site – and lacking an appropriate environmental context), and note that it would be largely used for reptile translocation and coastal grazing marsh compensation. We understand that a number of other options are being actively pursued by the applicant, and we are willing to discuss these further with them as required, however at the time of submitting these Written Representations, we remain of the

[8] http://jncc.defra.gov.uk/page-2303
[9]https://www.cieem.net/data/files/Website_Downloads/Guidelines_for_Ecological_Impact_Assessment_2015.pdf

view that no appropriate conservation outcome for terrestrial invertebrates has yet been presented to us or the Examining Authority which lends confidence in both ecological and procedural deliverability (including long-term in-perpetuity monitoring and management arrangements). We would however acknowledge a tone of open dialogue and look forward to progressing discussions on a number of options as the examination progresses.

In terms of possible SSSI notification therefore, Natural England advises the Examining Authority and the developer that we will continue to consider this as one of a number of options available to us, in seeking to achievely a sustainable development solution in this location.

b. Potential impacts on internationally designated sites and their qualifying species

Natural England agrees with the HRA that Thames Estuary and Marshes SPA and Ramsar are, in our opinion, the only internationally designated sites that are likely to be affected by the proposal.

It is our advice that a likely significant effect cannot be ruled out either alone or in combination at this stage.

The following detailed comments relate to the submitted 'ES Appendix 10.O: Habitat Regulations Asessment (HRA) Report. Document Ref: 6.2 10.O.'

Paragraph 4.5.2 states:

'4.5.2 - In respect of [cited species of] birds making use of (predominantly intertidal) habitats for feeding that are closer to the Tilbury 2 site than the designated SPA/Ramsar boundaries], the assumption can readily be made that such species will to a greater or lesser extent form part of or at least interchange with the nationally or internationally significant numbers that underpin the SPA/Ramsar designations and thence significant effects on them (for example from displacement) even outside the designated area could give rise to indirect significant effects within the designated sites, potentially up to and including threats to the continued sustainability of the key populations and thus site integrity.'

Natural England is broadly happy with the above statement subject to the interpretation of '*including threats to the continued sustainability of the key populations and site integrity*' adequately assessing whether the affected area is necessary to maintain <u>or restore</u> favourable conservation status (see Annex D - David Tyldesley & Associates et al 2016, notably page 9), which states:

'Supporting habitat in areas beyond the boundary of a SAC[10] or SPA which are connected with or 'functionally linked' to the life and reproduction of a population for which a site has been designated or classified should be taken into account in a Habitats Regulations Assessment. However, that assessment will need to determine how critical the area may be to the population of the qualifying species and whether the area is necessary to maintain or restore the favourable conservation status of the species. Effects which would not be acceptable within the boundary of a European site may or may not be acceptable if they occur on functionally linked land or sea.'

[10] Special Area of Conservation (see Annex A: List of Abbreviations under SAC)

For the avoidance of doubt Natural England is also broadly satisfied with section 4.5.3 of the HRA which states:

'4.5.3 - In respect of populations of cited plant and invertebrate species relevant to the Ramsar Site but outwith the designation boundary and closer to the Tilbury 2 site, interrelationship with the Ramsar Site populations cannot be assumed so readily. However, the restricted distribution of such species and their specialist habitat requirements indicate that the health of populations outside of the designated site is very likely to have at least some degree of functional linkage to the health of the populations within it (for example in performing a role in genetic flow and exchange). These extra-boundary populations thus also fall to be considered in the HRA process.'

With reference to Chapter 5 of the HRA, Natural England sets out our advice about potential impacts in two sections. Section 1 lists relevant potential impacts that do not appear to have been covered within the HRA. Section 2 lists potential impacts that have been included within the HRA, but require additional advice from Natural England to ensure the HRA adequately meets the Habitats Regulations requirements for the Thames Estuary & Marshes SPA and Ramsar site.

<u>Section 1 - Additional potential impacts</u>

Invasive Non-Native Species – Construction works and Port operations have the capacity to introduce invasive non-native species that could potentially impact on Thames Estuary and Marshes SPA and Ramsar site features and the habitats that support them. Natural England acknowledges there is information within the ES but advises this should also be addressed within Section 5 of the HRA to specifically address the Habitats Regulations requirements.

Construction Waste and Pollutants – The construction activities within the development footprint have the capacity to introduce or mobilise environmental contaminants via a range of activities (eg, elevated construction dust; increased quantity and affected quality of surface water run-off; use or application of non-biodegradable toxic chemicals, etc) to potentially impact on the Thames Estuary and Marshes SPA and Ramsar site. Natural England acknowledges the information within the ES and the Construction Environment Management Plan ('CEMP'), however we recommend the potential impacts to the SPA and Ramsar site features and proposed mitigation are separately addressed within the HRA to ensure the CEMP has an appropriate framework of reference to demonstrate compliance with the Habitats Regulations.

Operational Waste and Pollutants – The Port operations enabled have the capacity to increase and alter water discharges to the Thames which may potentially impact on the functionally-linked habitat. They also have the capacity to introduce or mobilise contaminants via a range of activities (eg, surface run-off from increased vehicle movement, operational spillages). Natural England acknowledges the information within the ES and the Operational Management Plan ('OMP'), however we advise the potential impacts to the SPA and Ramsar site features and proposed mitigation are separately addressed within the HRA to ensure the OMP has an appropriate framework of reference to demonstrate compliance with the Habitats Regulations.

<u>Section 2 - Points of detail about potential impacts listed within HRA with reference to paragraphs</u>

Natural England broadly welcomes the following sections of Chapter 5 but there are points of detail within the descriptions of potential impacts that require our additional advice to ensure the HRA adequately meets the Habitats Regulations requirements for the Thames Estuary & Marshes SPA and Ramsar site. These are set out below with reference to the relevant section of the HRA.

Natural England advises that reference to *'the European Site'* in Chapter 5 should be interpreted as Thames Estuary & Marshes SPA and Ramsar site.

Water and/or sediment quality
'5.1.5 - The construction of new and/or expanded marine structures and associated capital and maintenance dredging has the potential to influence water quality within the Thames, both in terms of suspended sediment loads and through the risk of mobilising any contaminants currently bound in sediments. Redistribution of contaminants in this way could result in contamination affecting habitats within the European Site' ***and Functionally-linked habitats*** *'via sediment transport and re-deposition or could increase the bioavailability (e.g. to aquatic organisms) of contaminants, causing potential effects on cited interest features further up the food chain (biomagnification) or even via direct toxicity.'*

Natural England considers that this section requires additional text (as illustrated in bold above) to confirm the need to consider impacts on Functionally-Linked habitats.

Disturbance – shipping
'5.1.6 - Increased shipping traffic' ***and/or any significant operational changes (eg, changes in size, type, movement or duration of associated waterborne vessels)*** *'generated by the expanded port, once operational, will generate additional movements along shipping lanes proximal to the European Site and could exacerbate any current disturbing effect that shipping traffic has on cited fauna such as birds.'*

Natural England advises that the proposed development is not only likely to increase shipping traffic in this area but also alter current shipping operations in the river as described in the additional bold text above.

Disturbance - noise and lighting
'5.1.7 - The attenuating effect of distance means that there is assessed to be no scope for significant disturbance effects from these sources to act directly on the European Site in respect of noise generation or lighting emissions from the site itself. There is assessed to be greater potential for noise and lighting associated with increased' **and potential operational changes to** *'shipping traffic along shipping lanes proximal to the European Site to affect cited fauna such as birds.'*

Natural England advises that the proposed development is not only likely to increase shipping traffic in this area but also alter shipping operations in the river at this location, as described in the additional text proposed for section 5.1.6 above.

Impacts with the potential to give rise to effects on functionally linked features
'5.2.1 - The marine elements of the Tilbury2 project site include representations of' ***intertidal habitats including*** '*saltmarsh*, ~~*and*~~ *mudflat'* ***and shingle/cobble beach*** *'that are a continuation of habitats present within and integral to the European Site. The potential for impacts on these to have implications for the European Site lies mainly in the scope for impacts on associated fauna and flora that represent an*

integral part and/or extension of the populations for which the European Site is designated. Principal amongst these are wading birds and waterfowl, where they use these habitats closer to the Tilbury2 site, but also the populations of cited insect and plant taxa which may form part of or an important outlier to local metapopulations that are important for reasons such as genetic exchange and/or providing a failsafe against localised extinctions.'

Natural England is content with this text providing the statement '*where they use these habitats closer to the Tilbury2 site*' is interpreted as 'birds using functionally-linked habitats that are closer to the Tilbury2 site than the habitats of the Thames Estuary & Marshes SPA and Ramsar site'. For the avoidance of doubt, no firm conclusions can be made at this stage about the relationship between the likely scale of potential impact(s) and proximity to the Port of Tilbury2 site. This is important because the range of potential impacts identified include hydrodynamic processes, sediment regimes and involve intertidal habitats of different character and habitat importance. Furthermore, these effects can be cumulative and synergistic and need to be considered 'in combination' with other relevant plans and projects.

'5.2.3 – Habitat Loss: Any loss of' ***intertidal habitat (e.g**. 'saltmarsh*, ~~*or intertidal*~~ *mudflat'* ***and shingle/cobble beach*** *'habitat'****)*** *'would denude the local extent within and around the European Site'* ***(including functionally-linked habitat)*** '*and may have implications for carrying capacity and/or pressure on the surviving examples within the European Site*.'

'*5.2.5 - The construction of new and/or expanded marine structures and associated capital and maintenance dredging has the potential to interfere with coastal and estuarine processes, including patterns of sediment circulation, accretion and deposition close to the Tilbury2 site where it could affect the morphology, extent and condition of'* ***intertidal habitat including*** *'saltmarsh,* ~~*and*~~ *mudflat'* ***and shingle/cobble beach*** *'habitats that are functionally linked to the European Site.'*

Natural England advises that the main extent of intertidal habitat within the Thames Estuary SPA and Ramsar site is mud/sandflat and saltmarsh, but there is also intertidal shingle/cobble beach habitat that are an important sub-feature within the supporting intertidal habitat mosaic. Additional text is suggested above in bold text.

References to 'local' 'proximal' and 'nearby' in paragraphs 5.2.3 – 5.2.9 should not be interpreted at this stage as only relevant to areas a short distance away from the Tilbury2 site, because no firm conclusions can be made yet about the relationship between the likely scale of potential impact(s) and proximity to the Tilbury2 site. The 'zone of disturbance to birds' caused by human movement (referred to in paragraph 5.2.9) and the relevant distance involved are likely to differ between bird species. The HRA should be able to refer to research on bird disturbance that provides a relevant framework of reference for assessing likely zone of influence.

The 'zone of influence' of lighting and the relevant distance involved will differ from those relevant for noise and human bird disturbance. The HRA refers to Embedded Mitigation in Section 3.5.1, which is noted however there is no specific consideration of the effect on SPA and Ramsar site feature birds, either alone and/or in combination with other plans and projects to demonstrate clearly that this will be adequate to avoid a likely significant effect on SPA and Ramsar site feature birds. Site specific tailoring of framework best practice should occur accounting for the significant disturbance experienced by the recent Gosham's Jetty works.

References to ‘and around the European Site’ should be interpreted as ‘including functionally-linked habitat’

The application for a Development Consent Order (‘DCO’) and Deemed Marine License (‘DML’) for the project is accompanied by an ES (Volume 6 of the application documents) which describes embedded mitigation to reduce the spatial influence of effects from noise and vibration (Chapter 17), dust and emissions (Chapter 18) and ground and surface water pollution (Chapters 15 and 16). Also accompanying the ES is a CEMP (document 6.9), OMP (document 6.10), a Lighting Strategy (ES Appendix 9.J) and a Drainage Strategy (ES Appendix 16.E). These collectively detail the mitigation measures that have been embedded within the design (such as the surface water drainage scheme for the Tilbury2 site and the Infrastructure Corridor) or committed to as a means to reduce effects local to the project site (for example planted landscape screening, noise attenuation fencing and cowling/shields on site lighting). Such embedded mitigation is taken into account in this HRA report. The DCO/DML, CEMP and OMP provide mechanisms for ensuring the delivery of these measures.

<u>The HRA Assessment of Potential Impacts requires an assessment of likely significant effects alone and in combination with other plans and projects.</u>

Natural England notes the text in section 5.3.1 of the HRA which states:

5.3.1 - *Table 2.2 of the Environmental Statement lists future consented or planned development projects that have been considered in the assessment of cumulative effects. The location of these relative to both the Tilbury2 site and the Thames Estuary and Marshes SPA/Ramsar is indicated on Figure 2.1 of the ES. Paragraphs 2.40 to 2.45 of the ES describe how these have been identified, and paragraphs 2.47-2.63 explain how certain other projects (for example the Lower Thames Crossing) have been excluded from consideration taking account of PINS guidance and because they are such a nascent stage.*

The relevant excerpts from the ES are included in Annex 2:

Natural England also has concerns relating to what has been excluded from the in combination assessment for the purposes of HRA. Specifically Natural England disagrees with the applicants view that the LTC and the Tilbury Energy Centre (‘TEC’) should be excluded from the in combination assessment. This will be discussed further under 3.2.d.

c. The Habitats Regulations in combination assessment and the Environmental Impact Assessment cumulative assessment

Natural England disagrees with the applicant’s decision to exclude the proposed LTC development from the list of in combination plans and projects within the HRA for the following reasons:

- The proposed LTC has been published for consultation with an approved location and route corridor; crossing-type and development timetable.
- The information available to Natural England and PINS indicates that the LTC will have a potential impact on the intertidal area of the Thames Estuary at a location near to the proposed Tilbury2 development. The intertidal area within the likely corridor of development is identified by Natural England and both Tilbury2 and LTC developments as containing

habitats that are functionally-linked to the Thames Estuary and Marshes SPA and Ramsar site.

- Both LTC and Tilbury2 are large NSIPs and the timescales of potential impacts are likely to either overlap and/or occur in successive years with implications for the Thames & Estuary Marshes SPA and Ramsar site features including the capacity to achieve favourable condition status.

Natural England also questions the applicant's decision to exclude RWE's proposed redevelopment of the Tilbury Power Station site (the TEC) from the EIA, and also the HRA. With reference to the intended timetables of the RWE application and the information available (within current and previous submissions) Natural England is concerned that these two proximal developments will have a significant impact (cumulative and in combination) on nationally important nature conservation assets (terrestrial and intertidal habitats) and, it is unclear how a suitable mitigation and compensation package will be achievable without both parties working together in a strategically appropriate way, guided by an overarching and/or linked EIA.

This is particularly relevant to the notable assemblages of invertebrates and vascular plants, where matters important to delivering conservation solutions (ie, piecemeal loss of supporting habitat extent and quality; 'irreplaceability' of Lytag habitat and 'in situ' conservation) are likely to constrain the capacity of each developer to achieve adequate mitigation and compensation packages. For matters relevant to SPA and Ramsar site non-breeding bird features these should also be covered by the HRA for completeness in accordance with the principles set out in the HRA including Chapter 5, accounting for our additional advice relevant to this section.

With respect to the TEC NSIP, Natural England notes a recent public consultation event (26^{th} February to 26^{th} March 2018) which will contain important project information, and our understanding is that RWE expect to submit their EIA Scoping report by the end of March 2018. This can be expected to provide substantial additional project detail and ecological survey information to inform a cumulative environmental assessment. We understand that should this be the case, it would be relevant for Tilbury2 to make a cumulative environmental assessment proportionate to the information available, and Natural England would welcome this approach.

With respect to Cumulative Envionmental Assessment ('CEA') for invertebrates, we are particularly concerned that, noting the importance of the wider power station site as a significant node for inverterbates both within the Tilbury area and its strategic location within the Thames Estuary, that the effect of multiple large scale developments may compromise important meta-populations whose viability may become compromised or at least left in a more vulnerable future state should large sections of their habitat resource be re-located some distance off-site. We would be pleased to work with both developers to scope out an approach to CEA for invertebrates should that opportunity arise.

d. Potential impacts upon lichen communities

Natural England broadly concurs with the conclusion drawn in paragraph 10.191 of the ES which states:

'Despite the changes in the composition of the lichen communities present on the open habitats, the communities remain diverse and of interest for their extent and unusual brownfield context. By comparison with other sites (within the UK and more widely in Europe), the lichen assemblages at the Site can collectively be considered of at least Regional importance, with the most important component being the Lytag Brownfield site.'

We consider that the lichen communities may be more easily replicable than the invertebrate interest however the ES defers to the EMCP for details regarding mitigation and compensation. Natural England was only presented with this document on the 16th of March 2018. It currently contains no details relating to the proposed offsite compensation site and is therefore incomplete.

e. Licensable Protected Species
Natural England has prepared a Letter of No Impediment ('LONI') relating to bat species dated the 18th of March 2018 and water voles and badgers on the 20th March 2018. Please note that the letters contain caveats which Natural England advises must be observed. All three are included here in Annex F.

f. Marine Interests
In our Relevant Representation response Natural England indicated that we were broadly satisfied that the project is unlikely to have a significant impact on either the Medway Estuary Marine Conservation Zone or the Upper Thames recommended Marine Conservation Zone. There has been no further correspondence regarding marine interests so we refer you to our previous response.

g. Planning Policy: NPPF consultation draft
Natural England also notes the consultation draft changes to the National Planning Policy Framework, which should be regarded as a material consideration. This draft represents a sea change in environmental net gain, and is aligned with the government's 25 year environment plan. We regard this draft to clearly demonstrate a direction of travel in planning policy (including we anticipate for future revisions to National Policy Statements), and Natural England would anticipate that decisions on NSIP projects would seek to be mindful of these 25 year environmental ambitions (noting the lifetime of this particular NSIP).

In addition to relevant policy extracts from the extant NPPF, we wish to highlight the following:

Paragraph 117 regarding the need to make *'as much use as possible of previously developed or 'brownfield' land,* ***except where this would conflict with other policies in this Framework, including causing harm to habitats of high environmental value.'*** Note that the wording here is similar to paragraph 111 of the current NPPF.

Draft paragraph 168
'Planning policies and decisions should contribute to and enhance the natural and local environment by:
a) Protecting and enhancing valued landscapes, sites of geological value and soils (in a manner commensurate with their statutory status ***or identified quality****)*
b) …
c) …

d) *Minimising impacts and providing net gains for biodiversity, including by **establishing coherent ecological networks that are more resilient to current and future pressures'***

Paragraph 172 deals with habitats and biodiversity, calling on plans to:
'b) promote the conservation, restoration and re-creation of priority habitats, ecological networks and the protection and recovery of priority species, and identify and pursue opportunities for securing measurable net gains for biodiversity'

Paragraph 173 reinforces the avoid, mitigate, compensate hierarchy:

'When determining planning applications, local planning authorities should apply the following principles:
*a) If significant harm to biodiversity resulting from a development cannot be avoided (through locating on an alternative site with less harmful impacts), adequately mitigated, or **as a last resort**, compensated for, then planning permission should be refused.*
b) …
*c) Development resulting in the loss or deterioration of **irreplaceable habitats** should be refused, unless there are wholly exceptional reasons'*

Note in the above extracts bold text is our emphasis.

4.3. Conclusions

4.3.1. The intertidal habitat is contiguous with, and proximal to the Thames Estuary and Marshes SPA, Ramsar and SSSI. Natural England is not yet satisfied that a likely significant effect can be ruled out either alone or in combination at this stage and advises that further mitigation measures may be required to ensure compliance with the Habitats Regulations. We advise that the following impacts need to be considered in the HRA document.

- Invasive Non-Native Species
- Construction Waste and Pollutants
- Operational Waste and Pollutants

We also advise that the HRA requires further consideration of:

- Impacts of dredging on the European site and functionally linked land
- Impacts of increased shipping traffic and operational changes on the European site and functionally linked land
- Impacts of noise, dust, pollutants and lighting on SPA birds using the European site and functionally linked land both during the construction and operational stage.
- In combination effects with both the LTC and Tilbury Energy Centre

The proposed development site contains a unique open mosaic s41 habitat, a nationally significant invertebrate assemblage and a lichen community of at least regional importance all of which are likely to be lost to development as it is currently submitted. Our key concerns are that:

- The application as proposed will lead to the loss of an almost unique priority habitat[11] and a national significant invertebrate assemblage.
- Natural England considers that the habitats present would be extremely difficult to recreate with confidence on a compensation site.
- Natural England rejects the assertion that successional issues have lead to the terminal decline of the invertebrate interest. We consider the current population to be of extremely high conservational value and advise that basic management could improve it yet further.
- We are concerned that insufficient consideration has been given to the mitigation heirachy, particularly to the requirement to avoid in first instance
- We remain unsighted on a version of the EMCP with confirmed locations for off-site compensation (notwithstanding our concerns that this could be effective)
- We have concerns relating to what has been excluded from EIA cumulative assessment (see 3.2.d above).

Paragraph 9.195 of the ES states that:

‘The overall effect is predicted to [be] significant adverse at various geographical scales up to national level, albeit reducing in time towards a position of neutrality

[11] Open mosaic habitat on previously developed land as listed under section 41 of the Natural Environment and Rural Communities Act 2006

with (depending on the scale and success of the off-site compensation) the possibility of net gain over the longer term.'

Natural England agrees that the potential effect on nationally significant terrestrial ecology is likely to be significantly adverse at a national scale. *'Reducing in time towards a position of neutrality'* and *'depending on the scale and success of the off-site compensation'* do not suggest to us that there is a high degree of confidence in the mitigation compensation measures particularly in the short term. In the absence of the EMCP it is impossible to comment further on whether the stated aims can be achieved and we remain of the view that the ES should be regarded as being incomplete.

We take this position because it is not only the case that the information has not been provided, but that we understand from the developer that the off-site compensation location(s) have changed from what was originally proposed, and so the ES has been written with a different site(s) in mind, with the assumption that an alternative site(s) can deliver the same stated outcomes. In the absence of detail, Natural England cannot conclude that this is the case, and neither that residual effects anticipated by the ES can be adequately addressed by the alternative site(s).

We are however broadly satisfied that the project is unlikely to have a significant impact on either the Medway Estuary Marine Conservation Zone or the Upper Thames recommended Marine Conservation Zone.

Natural England has prepared a Letter of No Impediment ('LONI') relating to bat species dated the 18th of March 2018 and water voles and badgers on the 20th March 2018.

4.4. The questions received

In its Rule 8 letter dated the 27th of March 2018, the Examining Authority asked Natural England a number of questions. These are set out, along with the answers, in the table provided at Annex G. The table cross-refers to passages in these Written Representations and their Annexes. We have also provided additional comments on other questions raised by the Examining Authority where we have considered it appropriate for us to do so.

ANNEX F – First Written Questions

1.1 **Air Quality**
Although not mentioned, the lichen interest of the site may be adversely impacted by changes in air quality. Lichens are generally highly sensitive to air pollutants both directly (bioaccumulation) and through alteration of the pH of their substrates. Details of future pollutants and proximity to lichen hotspots would need to be known before potential impacts could be assessed.
1.2.2. **ES paragraph 6.38 considers that, *"…some areas of some ecological value, particularly those reliant on open mosaic habitat, are likely to deteriorate in value if left in an undeveloped condition in the future, as natural succession leads to the intrusion of more substantial vegetation; and that any loss in biodiversity will be compensated, it is considered that development of the northern part of the site is appropriate.*"** **Is the statement that some areas of ecological value, particularly those reliant on open mosaic habitat, are likely to deteriorate in value if left in an undeveloped condition in the future, correct?**
The above statement is partially true in the absence of management but it is hard to conclude either way. This stems from the question making the assumption that brownfield habitats behave consistently and that they therefore respond in a semi-linear predictable fashion, as do most other broad habitat types. However, brownfields, and especially those of the Thames Gateway with its long and varied industrial use, are anything but the same. When one considers that they can be composed of Thames river dredgings, brick building demolition layers, pulverised fuel ash/ lytag (with a pH when new of >9), metal-working slags, coal wastes, engineering wastes with heavy metals, fuel oil tips, fly-tipped material, and a whole range of other materials, in either uniform or mixed component heaps, of varying ages, aspects, depths, extents, inclines and degrees of wetness, then the notion of brownfield as an entity is clearly unsustainable. The "Lytag" label for one of the application site survey areas is just that, a label, and in no way should be seen to suggest the importance of lytag as a product over the other substrate mixes, the combinations of which seem the key driver to maximising species diversity on these sites. The response of vegetation to these substrate mixes is thus varied. Some core principles might be salvaged from this argument: the often high levels of drainage can make plant growth difficult; the presence of toxic heavy metals residues in the soil can make growth difficult; pH generally drops over time, from calcareous through neutral to slightly acidic, and German brownfield studies (referenced below) notes that brick rubble sites did differ from others. The reduction of the calcareous grassland indicator invertebrates at Tilbury from higher fidelity classes to more moderate ones could be a reflection of a drop in substrate pH, and perhaps a shift in floral community. The changes in the sand & chalk assemblages figures would be more credible if the sampling effort was more standardised,. So it is hard to call if the drop in assemblage species is a sampling artefact, or some sort of succesional shift, and if it is a shift, what sort. Bierdermann et al (2009)[30], writing from a botanical community perspective, suggested that "optimal management should consist of shifts between strong disturbances and secondary succession", and that this might take place every 3-7 years. Some site management of the existing interest features would likely be beneficial. But other sites are left unmanaged for many decades and remain in good condition. From a lichen perspective the most important aspect of the 'open mosaic habitat' for the interest at Tilbury, is the open unshaded ground. Without management or grazing, the open habitat will in time become increasingly vegetated and the lichen interest of open ground will decline. In addition

[30] Schadek,U; Strauss, B; Biedermann, R & Kleyer, M. (2009). Plant species richness, vegetation structure and soil resources of urban brownfield sites linked to successional age. Urban Ecosyst (2009) 12:115–126.

succession will lead to an increase in the organic content of the soil which will also affect the ground-dwelling lichen communities (a change in species composition and abundance likely).
1.2.3. **Do you consider that the Applicant has addressed the need (within the NPS for Ports, paragraph 5.1.8) to aim to avoid significant harm to biodiversity and geological conservation interests, including through mitigation and consideration of reasonable alternatives?**
Paragraph 5.1.8 of the National Policy Statement for ports advises that compensation and mitigation measures should be sought where significant harm to biodiversity and geodiversity conservation interests **cannot be avoided**. Whilst Natural England acknowledges the argument put forward in paragraph 5.24 of ES Appendix 5.A: Masterplanning Statement. Document Ref: 6.2 5.A we are not yet satisfied that at least some areas of high conservational value could not be retained. The high value of the Lytag LoWS has been known for some time and this should have been taken account of at the design stage (we are not aware that design iteration is detectable within the ES). As proposed that site and related interest will be lost to the proposed CMAT facility. Paragraph 6.36 of the Environmental Statement states that: *'The CMAT is more easily located away from the jetty itself as the process of moving aggregate from self-discharging vessels by conveyor is not distance sensitive.'* Given that moving aggregate is not considered distance sensitive Natural England advises that further consideration should be given to avoidance rather than proceeding to compensation. It is appropropriate, however, to note that Natural England is not in a position to comment on whether alternative layouts are feasible from an operational perspective, nevertheless our overall impression of the treatment of avoidance of impacts in the ES is that the design of the facility has been driven by a desire to maximise the economic profitability of the project. It is not clear to us whether a scaled-down version of the development, avoiding the highest quality biodiversity areas, has been considered, and at what point economic viability becomes a limiting factor. We would encourage the Examining Authority to fully explore this point, such that a clear audit around the mitigation hierarchy (with a focus on avoidance as a first principle) is available, and that adjustments have been made consistent with this principle. From a marine perspective the development site is outside the boundary of the Thames Estuary recommended Marine Conservation Zone (rMCZ) and this site is currently not a material consideration in terms of designated sites. The applicants have ensured best practice by providing consideration of this site within the Environmental Assessment and provided a shadow MCZ assessment. Species associated with the rMCZ have been considered within the assessment and mitigation for mobile species such as smelt (a recommended feature) have been considered. However, we note that clarification around the mitigation is still required (reference to 1.2.30). Overall, it is NE's opinion that regarding marine matters the applicant has considered and demonstrated paragraph 5.1.8 of the NPS for Ports.

1.2.6. **Open Mosaic Habitat on Previously Developed Land** **a) Have there ever been any habitat translocation trials for Lytag habitat substrates (or similar)?** **b) If so, were they successful? Please provide summary details.** **c) Is the Applicant proposing to undertake habitat translocation trials, for the open mosaic habitat types that would be lost, prior to the commencement of the Proposed Development? if so please provide details?** **d) In your view, would a large scale habitat translocation project be likely to succeed for the Lytag habitat (and other artificial habitat substrate here), in terms of it being suited to the diverse assemblages of insects, plants, lichens and other biodiversity interests that would be directly impacted by the development?** **e) How would this large scale habitat translocation project be funded and managed?**
In answer to a) and b), not as such. Peter Shaw[31] has run a long term succesional study of the Drax pfa from 6 mounds that were created for the experiment, these being a mixture of pfa and FGD gypsum, though this was from the research perspective of tracking botanical community change. Wilson (2017)has been working on restoration of a part pfa site in Calderdale, West Yorkshire, though the habitat differed in that the restoration target communities were more wetland focused than traditional brownfield. So, more about the impacts of re-wetting. Work on various green/ brown roofs are deemed inappropriate in both scale, and environmental variables achieved to be of much use here. There have been adoptions of pfa sites as nature reserves (e.g. King's meadow, Nottinghamshire) but these are not translocations, neither are the many planning applications to create new pfa dump sites. We have requested Bioscan's own survey data from the nearby Area 1 ash disposal mound within RWE's remaining landholding which seems to be the best monitored re-creation , and will provide comment on it in due course, noting it would be good to go through as it is one of the few examples. Its success would seem likely to hang on proximity of the fauna resident on Lytag and The Rest. **Habitat translocation trials of similar substrates with specific regard to Lichen** <u>Woolmer Link Road, Hampshire</u> Ecological Planning & Research translocated a U1a grassland on loose sand (Woolmer Link Road). Alaska Contracting made a special implement to move it in one action. The receptor site remained lichen-rich for a few years but there was no follow-up grazing and lacked rabbits. The vegetation became rank and it was then burned. An adjacent U1c was easily translocated as loose topsoil; the result was apparently better than the original. A project report may be available. <u>Blashford Lakes lichen heath, Hampshire</u> This site comprises spoil of pure washed sand that was excavated from a pit during the construction of a water works. It was not part of a mitigation plan. The area was seeded with commercial grass which died and then a type of U1a developed over 20 to 30 years under intense rabbit grazing. Reports on the lichen interest may be available. <u>Chances of success at the Lytag</u> Based on the information provided, it seems highly likely that the Lytag habitat can be re-created elsewhere. Of key importance for lichens are: 1) the low nutrient status of the soil, 2) a lack of existing shading vegetation, and 3) grazing in place and of sufficient intensity to maintain the open plagioclimax.

[31] Shaw P.J.A. 2009. Succession on the PFA/Gypsum Trial Mounds at Drax Power Station: The First Fifteen Years. Journal of Practical Ecology and Conservation Vol. 8 (2):7-19.

Translocation of ground-dwelling lichen species has variable success rate depending on species group – e.g. reindeer lichens (Cladonia sub-genus Cladina) appear to translocate well; others less so. Translocation of early successional lichen habitat is possible, and species recovery may be enhanced through various techniques.[32] **Overall** Whilst there is some evidence that certain species of lichen can be successfully translocated the translocation of invertebrates is generally regarded as highly experimental and we advise that caution required. It is considered likely that you could create something in the form of a new brownfield, but it would be hard to re-create what has formed naturally and in response to the conditions that exist. The number of site variables are enormous- degrees of pfa leaching, slope, substrate mixes, and differential exposures of those mixes, degrees of openness and shading, odd substrates that are very patchy, not obvious but influential (heavy metal mixes suppressing plant growth) ect.
1.2.18. **Water Voles Is NE satisfied that water voles from the Proposed Development areas could be translocated to the area referred to in FWQ 1.2.17? Would they be able to provide a Letter of No Impediment for this translocation work?**
A Letter of No Impediment was issued on the 20th of March 2018 and is attached here in Annex F.
1.2.22. **Bats Is NE able to provide a Letter of No Impediment for the loss of the bat roost in building B7?**

[32] **Lichen species/habitat translocation bibliography - Key papers**

Brooker, R. W., Brewer, M. J., Britton, A. J., Eastwood, A., Ellis, C., Gimona, A., . . . Genney, D. R. (2018). Tiny niches and translocations: The challenge of identifying suitable recipient sites for small and immobile species. Journal of Applied Ecology, 55(2), 621-630. 10.1111/1365-2664.13008

Duncan, S.J. 2015. Woodland caribou alpine range restoration: An application for lichen transplants. Ecol. Restor. 33: 22–29.

Enns, K. 1998. Forage Lichen Enhancement in the Itcha – Ilgachuz Caribou Range. British Columbia Ministry of Environment Lands and Parks, Fish and Wildlife Branch. Williams Lake, B.C.

Gilbert, O. L. 2001. Species recovery programme: the Breckland rarities and Teloschistes flavicans. In: A. FLETCHER, P.A. WOLSELEY, & R. WOODS, eds. Lichen Habitat Management. British Lichen Society.

Hugron, S., M. Poulin and L. Rochefort. 2013. Organic matter amendment enhances establishment of reintroduced bryophytes and lichens in borrow pits located in boreal forest highlands. Boreal Envir. Res. 18: 317–328.

Rapai, S.B., R.T. McMullin and S.G. Newmaster. 2016. Restoring Terrestrial Lichen Communities on the Detour Lake Mine Property. Progress Report December 2016.

Rapai, S. B., McColl, D., & McMullin, R. T. (2017). Examining the role of terrestrial lichen transplants in restoring woodland caribou winter habitat. The Forestry Chronicle, 93(3), 204-212.

Roturier, S., S. Backlund, M. Sunden and U. Bergsten. 2007. Influence of ground substrate on establishment of reindeer lichen after artificial dispersal. Silva Fenn. 41: 269–280.

Roturier, S., Ollier, S., Nutti, L. E., Bergsten, U., & Winsa, H. (2017). Restoration of reindeer lichen pastures after forest fire in northern Sweden: Seven years of results. Ecological Engineering, 108, 143-151.

Scheidegger, C., & Werth, S. (2009). Conservation strategies for lichens: insights from population biology. Fungal biology reviews, 23(3), 55-66.

Waite, N. (2017) Calaminarian Grassland Management Guide, Northumberland Wildlife Trust, UK.

White, G., & Gilbert, J. (Eds.). (2003). Habitat Creation Handbook for the Minerals Industry: Editors Graham White and Jo Gilbert. RSPB.

A Letter of No Impediment was issued on the 18th of March 2018 and is attached here in Annex F.
1.5.1. **Has the Applicant submitted a copy of the Construction Method Statement to the Examination? If not, why not?**
NE would welcome sight of the Construction Method Statement to fully understand each phase of works and the methods to be employed. It would also be useful to secure appropriate mitigation measures within the method statement, for example timing of the dredge activity both seasonal and tidal.
1.5.2. **Where in the ES (or supporting documents) are there details of the months of the year that piling in the marine environment would take place and are there any months when piling in the marine environment would not be undertaken?**
Mitigation for the piling activity should be clearly identified, including type of piling, and seasonal restrictions. The seasonal restrictions have been referenced to reduce impact to fish within the ES, also refer to 1.2.30 (1st written questions) which replicates NE's query we still would like clarification on with regards to restriction of dredge activity in June to August. Also please refer to NE comments under 1.11.10 (additional mitigation required) whereby NE advise careful programme timing is required to reduce noise impact to overwintering birds.
1.5.3. **Please provide details of the locations, size of areas that would be subject to the various types of piling, together with the duration of piling in each location.**
Natural England would welcome sight of this information.
1.9.23. **The ES [APP-031], paragraph 11.147 provides mitigation for the tentacle lagoon worm and fish receptors by restricting dredging to the ebb tide only. Would this be secured through the method statements for construction works (DML condition 6) and maintenance dredging (DML condition 14)? If not, how would this be secured?**
NE have not reviewed the conditions DML condition 6 and DML condition 14 in the DML so are unable to provide further comment here. However, we would like to add that we have provided pre application advice (teleconference 4/9/2017) to the applicants alongside the MMO and EA and agreed that there is relatively low risk of tentacled lagoon worm colonising near to Tilbury. It was advised that appropriate mitigation to ensure that sediment smothering was reduced via dredging operation and therefore the dredge activity should be carried out on an ebb tide. We would recommend that this is secured within the method statement, but also as a condition on the DML/DCO.
1.11.5. **For the avoidance of doubt, please can NE confirm agreement that:** **a) The correct European sites and qualifying features have been identified in the Applicant's HRA report [APP-060]; and** **b) Section 5 of the HRA report has identified all relevant potential impacts from the Proposed Development upon these sites?**
a) Sites and Qualifying Features Natural England confirms that, in our opinion, Thames Estuary and Marshes SPA and Ramsar are the only internationally designated sites that are likely to be affected by the proposal. The Thames Estuary & Marshes SPA features listed in the HRA are correctly in accordance with the SPA Conservation Objectives and SPA Citation available on our website at http://publications.naturalengland.org.uk/publication/4698344811134976 The Thames Estuary & Marshes Ramsar site features listed in the HRA are correctly in accordance with Ramsar site citation available on the JNCC website at http://jncc.defra.gov.uk/pdf/RIS/UK11069.pdf.

The HRA rightly picks up the discrepancy that black-tailed godwits are listed as an ‘overwintering’ species in the SPA Citation but with peaks counts in Spring/ Autumn on the Ramsar site Citation. It should be noted that the SPA Citation is dated 2000, the Ramsar site criteria sheet is dated 2008 and the SPA Conservation Objectives are dated 2014. The SPA Citation and Classification in 2000 was based on the 5 Yr Peak Mean 1993/4 – 1997/8 which includes counts during September and October, regarded at the time as broadly within the overwintering period for this species. The SPA Conservation Objectives clarify this matter by referring to the Black-tailed godwit population as non-breeding population.

b) Potential Impacts

Natural England advises that the following need to be considered to satisfy the requirements of HRA:

- **Invasive Non-Native Species**
- **Construction Waste and Pollutants**
- **Operational Waste and Pollutants**

We acknowledge that these issues are identified and discussed within the ES and elsewhere but should be specifically addressed within the HRA to ensure that supporting documents have an appropriate framework of reference and to demonstrate compliance with the Habitats Regulations. Please also note our detailed comments relating to HRA is paragraph 3.2.a above.

Q1.11.8.
Please can NE confirm whether they are in agreement with the Applicant’s conclusion that the Proposed Development (alone) would not result in any Likely Significant Effects (LSE) on the Thames Estuary and Marshes SPA and Ramsar site?

After consideration of the detailed submissions for this proposed development, Natural England cannot yet discount a likely significant effect alone. A few examples are provided for reference rather than a complete list of detailed points of disagreement.

i) The ecological value/ importance of the ‘functionally-linked’ habitat has been undervalued within the HRA and EIA. This is mainly because the environmental baseline is based on a snapshot assessment during a sub-optimal period rather than the ‘broader longer-term’ context. Natural England raised this risk during initial consultation but the applicants have been working to a demanding timetable that restricted the duration of site-based surveys. The baseline should seek to define the potential value of this functionally-linked habitat, noting it as an intertidal habitat that is contiguous with, and proximal to the Thames Estuary and Marshes SPA and Ramsar site. For example, Natural England is aware of at least two surveys since 2007/08 (which are referenced within a Tilbury2 file note submitted to us by Bioscan on the 9th of February 2018) that indicate that the BioScan survey area supports SPA bird features in numbers of national and international significance, well above the ‘low numbers’ referred to within the assessments.

ii) The proposed zones of influence are not clearly set out within the HRA (or linked EIA) assessments to enable robust impact assessments to be made that adequately address reasonably precautionary concerns. For example, the necessary dredging activities are likely to mobilise and disperse sediment (including significant concentrations of environmental pollutants) to effect a considerable area (distance and extent) of functionally-linked habitat. Whilst noting comments about background levels and modelled outputs, the predicted deposition quantity and quality on the functionally-linked habitat (and potentially parts of the Mucking Flats & Marshes SSSI part of the Thames Estuary & Marshes SPA and Ramsar site) requires validation monitoring. In addition to this, we note further submissions about dredging are necessary, with requirements for approval. These will need to address concerns about the likely effects of dredging on the quality of intertidal habitats, the invertebrate prey they support and the SPA features that feed on them.

iii) Natural England does not agree that all the 'zones of influence' are sufficiently precautionary. For example, the HRA and ES regards a 300m distance as adequate to avoid significant disturbance to birds of the SPA and Ramsar site assemblage. The referenced toolkit places the ES noise levels from piling at this distance in a category of 'moderate – high' rather than adopting a distance generally regarded as 'low' impact. In addition to this, this toolkit also advises that 'site-based' information is necessary to ensure distances applied are project specific for impact assessment. Recent experience of piling activity at the adjacent Gosham Farm Jetty and the resultant bird displacement suggests that birds of the SPA assemblage are displaced in significant numbers from a distance beyond 300 metres.

iv) The estimated scale of influence for the various potential impacts appear to be sequentially downgraded without transparently addressing uncertainties. For example, Noise is described at 7.1.1 as exceeding a 55dB level at 300m distance from the application site but this potential impact to the SPA and Ramsar site feature birds is dismissed as insignificant, possibly because of a combination of (i) and (iii) above. The mitigation measures presented within the ES are not regarded as adequate to address bird disturbance within the 300m zone or beyond it to a zone agreed as low impact. Similarly, the sediments in the intertidal area of the application site have been shown to contain significant elevated levels of contaminants but the likely impacts of dredging (pollution, disturbance etc) have been discounted without site-based validation (or adoption of a precautionary position with commitments to undertake follow-up ground truth monitoring) and an assumption that likely significant effects alone (and in combination) can be avoided by further permissions (currently not obtained) which require further information (see 7.15 of HRA).

The development plans mainly within the terrestrial area, (but also including some intertidal areas) have the capacity to impact on habitats that support a number of Thames Estuary and Marshes Ramsar site listed invertebrates and plants. The mitigation plans are not currently regarded as adequate to address the predicted scale of loss in extent and quality of the habitat mosaic and no compensation plans have been submitted yet for our consideration.

Q.1.7.1
There are legal requirements within legislation to undertake a cumulative assessment for EIA and an in-combination assessment for HRA. There is also a requirement within the NPS for Ports to consider cumulative impacts. The PINS post-acceptance s51 advice noted that a scoping report for Lower Thames Crossing (LTC) had been produced at that time and so, in accordance with PINS Advice Note 17, a cumulative effects assessment should be provided for the Proposed Development with the LTC. The assessment should be proportionate to the information available to the Applicant and could be at a high level using assumptions about the traffic levels on opening of the LTC and using traffic growth projections used in other projects, if applicable.
Please provide an updated Chapter 20 of the ES [APP-031], together with any relevant appendices and plans which screens in the Lower Thames Crossing, using the worst case scenarios. This should consider as a minimum, combined and cumulative impacts from traffic and transport, impacts upon air quality and noise.

Natural England disagrees with the applicant's decision to exclude the proposed Lower Thames Crossing development from the list of in combination plans and projects within the HRA for the following reasons:

The proposed Lower Thames Crossing has been published for consultation with an approved location and route corridor; crossing-type and development timetable.

The information available to Natural England and PINS indicates that the LTC will have a potential impact on the intertidal area of the Thames Estuary at a location near (X km east) to the proposed Tilbury Port2 development). The intertidal area within the likely corridor of development is identified by

Natural England and both Tilbury Port2 and LTC developments as containing habitats that are functionally-linked to the Thames Estuary and Marshes SPA and Ramsar site. Both LTC and Tilbury2 are large nationally significant projects and the timescales of potential impacts are likely to either overlap and/or occur in successive years with implications for the Thames & Estuary Marshes SPA and Ramsar site features including the capacity to achieve favourable condition status. Natural England also questions the applicant's decision to exclude RWE's proposed redevelopment of the Tilbury Power Station site from the EIA, and also the HRA. With reference to the intended timetables of the RWE application and the information available (within current and previous submissions) Natural England is concerned that these two proximal developments will have a significant impact (cumulative and in combination) on nationally important nature conservation assets (terrestrial and intertidal habitats) and, it is unclear how a suitable mitigation and compensation package will be achievable without both parties working together in a strategically appropriate way, guided by an overarching and/or linked EIA. This is particularly relevant to the notable assemblages of invertebrates and vascular plants, where matters important to delivering conservation solutions (ie, piecemeal loss of supporting habitat extent and quality; 'irreplaceability' of Lytag habitat and 'in situ' conservation) are likely to constrain the capacity of each developer to achieve adequate mitigation and compensation packages. For matters relevant to SPA and Ramsar site non-breeding bird features these should also be covered by the HRA for completeness in accordance with the principles set out in the HRA including Chapter 5, accounting for our additional advice relevant to this section.
1.11.10. **Please can NE indicate whether additional mitigation measures (above and beyond those proposed in the HRA report) are likely to be required?**
Additional Mitigation measures are likely to be required for the following operations to ensure this proposed development (alone) can avoid a likely significant effect on Thames Estuary & Marshes SPA and Ramsar site. Natural England provides the following advice towards this aim but cannot pre-judge the adequacy of these mitigation measures without all the relevant information being made available for our consideration. Noise generation by piling within the river is likely to significantly disturb birds of the SPA and Ramsar site assemblage without additional mitigation. For example, the design and methodology will require careful programme timing to avoid the sensitive September – end March period. Surface water pollution needs to be effectively managed to avoid impacting on intertidal habitats supporting SPA and Ramsar site features. This requires additional mitigation measures to comply with best practice, in accordance with advice from the Environment Agency within the written representations. Dredging operations are likely to significantly impact on birds of the SPA and Ramsar site assemblage without additional mitigation. For example, the design and methodology will require careful programme timing to avoid disturbing these birds during the sensitive September – end March period. Dredging operations are likely to significantly impact on the functionally-linked intertidal habitats that support birds of the SPA and Ramsar site assemblage without additional mitigation. For example, the appropriate design and methodology (yet to be defined, agreed and permitted) will require careful programme timing to avoid increasing the presence of contaminated sediments to invertebrate prey and birds foraging during the Autumn – end March period (includes ringed plover autumn passage). In addition to this, monitoring will be necessary to ensure compliance with an approved best-practice methodology; validate the predictions from modelling; assess the scale & extent of any additional mitigation that may be required by the applicants (to deliver via a robust permission-linked mechanism) that is related to unforeseen impacts on the functionally-linked and SPA habitats.

The Port operations enabled have the capacity to increase and alter water discharges to the Thames which may potentially impact on the functionally-linked habitat. They also have the capacity to introduce or mobilise contaminants via a range of activities (eg, surface run-off from increased vehicle movement, operational spillages). Natural England acknowledges the information within the ES and the Operational Management Plan (OMP), however we advise the potential impacts to the SPA and Ramsar site features and proposed mitigation need to be separately addressed within the HRA to ensure the OMP has an appropriate framework of reference to demonstrate compliance with the Habitats Regulations.

Construction Waste and Pollutants – The construction activities within the development footprint have the capacity to introduce or mobilise environmental contaminants via a range of activities (eg, elevated construction dust; increased quantity and affected quality of surface water run-off; use or application of non-biodegradable toxic chemicals, etc) to potentially impact on the Thames Estuary and Marshes SPA and Ramsar site. Natural England acknowledges the information within the ES and the Construction Environment Management Plan (CEMP), however we recommend the potential impacts to the SPA and Ramsar site features and proposed mitigation are separately addressed within the HRA to ensure the CEMP has an appropriate framework of reference to demonstrate compliance with the Habitats Regulations.

Invasive Non-Native Species – Construction works and Port operations have the capacity to introduce invasive non-native species that could potentially impact on Thames Estuary and Marshes SPA and Ramsar site features and the habitats that support them. Natural England acknowledges there is information within the Environmental Statement but advises this should also be addressed within Section 5 of the HRA to specifically address the Habitats Regulations requirements.
The development plans mainly within the terrestrial area, (but also including some intertidal areas) have the capacity to impact on functionally linked habitats that support a number of Thames Estuary and Marshes Ramsar site listed invertebrates and plants. The mitigation plans are not currently regarded as adequate to address the predicted scale of loss in extent and quality of the habitat mosaic and no compensation plans have been submitted yet for our consideration.

1.19.22.
Do the EA, MMO and NE agree with the Applicant's statements in ES [APP-031] paragraphs 16.87, 16.88 and 16.91, in relation to WFD matters, that the Proposed Development would be unlikely to cause any deterioration in water body status in the Thames Lower and Middle water body, nor would it cause a deterioration in critical habitats?

Natural England broadly align with the Environment Agency's advice in their January 2018 representations, subject to further information and assessment where necessary to ensure proposals comply with Habitats Regulations requirements for the proposed development alone and in combination. From a HRA perspective, Natural England's concerns focus on the quality and extent of functionally-linked and SPA, Ramsar site habitats (mainly but not exclusively intertidal).

2.11.
Phasing of Mitigation/compensatory habitat How would the provision of mitigational/compensatory habitat be phased, so that habitat areas off-site are created and fit for purpose, before existing habitat would be destroyed?

There would appear to be a number of key drivers here:

- Proximity, given that parts of the fauna have low mobility
- Point to achievement of resource provision
- Maintenance of source populations

Proximity. Clearly the closer any new site is to existing brownfield sites of quality, the greater the chance of faunal establishment. The nature and quality of intercepting barriers should be minimised.

Date: 30 April 2018
Our ref: Tilbury 2 Deadline 3 Response
Your ref: TR030003

Customer Services
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Tilbury2 Project Team,
The Planning Inspectorate,
Temple Quay House,
2 The Square,
Bristol, BS1 6PN
By email only: tilbury2@pins.gsi.gov.uk

Dear Sir/Madam,

NSIP Reference Name / Code: Tilbury2
User Code: TR030003

Thank you for your consultation on the above dated the 26th of February 2018.
Natural England is a non-departmental public body. Our statutory purpose is to ensure that the natural environment is conserved, enhanced, and managed for the benefit of present and future generations, thereby contributing to sustainable development.

Written Submission of Oral Case & Post-Hearing Submissions

Further to oral representations made on the 18th April 2018 at the Issue Specific Hearings ('ISH'), Natural England provides the following written submission:

Cumulative & Combined Impacts

***7.3* Does Natural England accept the Applicant's reasoning set out in section 2 of its Response to Relevant Representations [AS-049] for excluding the LTC and TEC from assessment of in-combination effects?**

Natural England assumes the question is to be understood to include both in-combination (HRA) effects and cumulative effects (EIA). Natural England does not accept the reasoning presented by the Applicant. We also note that the question has been superseded by additional information and submissions since the Relevant Representations, and we have sought to take these into account in providing our answer.

With respect to the Tilbury Energy Centre (TEC), we note that the Planning Inspectorate are now in receipt of the EIA scoping report prepared by RWE for their NSIP project. Whilst Natural England has not yet had opportunity to review this report, we regard it to present significant additional project information to enable a more detailed Cumulative Environmental Assessment with Tilbury2.

We suggest that this report should be viewed alongside as much additional information as may be available for the TEC project, including the public consultation (February – March 2018), and further to this Natural England understands that additional ecological survey information is likely to be available from the RWE project team which may not yet be publically available. Natural England has requested of RWE that any relevant data should be made available for the purposes of CEA, especially with respect to terrestrial invertebrates (but also with respect to HRA issues). We understand that a dialogue exists between the PoTLL and RWE, and would hope that exchange of data could be arranged. We also note that considerable ecological information already exists in the public domain for former development proposals at the wider Tilbury Power Station site. This information should also be used as alongside any more recent information to inform the CEA.

Whilst Natural England acknowledges the desire of the PoTLL to be helpful to the Examination in producing CEA assessments for TEC and LTC (despite their own disagreement that this is required), we note that this is consistent with the Planning Inspectorate's own Advice Note 17 at paragraph 3.4.3 where "an assessment should be provided for all Tier 1 and Tier 2 'other development', where possible".

The submission of RWE's EIA scoping report for their TEC project promotes TEC to a "Tier 2" project, with reference to table 3 of Advice Note 17. We also note that paragraph 3.4.9 of Advice Note 17 advises on the question of "Assessment Cut-off-Date" that "the Examining Authority may request additional information during the examination in relation to effects arising" if other development comes forward following the stated cut-off period. As this is now the case, the need for CEA is entirely consistent with the Planning Inspectorate's advice notes on this matter.

To this end we note that a Cumulative Effects Assessment has been prepared (ahead of the submission of the TEC EIA scoping report) and submitted as Appendix C to the PoTLL "Response to Written Representations". Natural England has not yet reviewed this version of the CEA with TEC, but will endeavour to do so as soon as possible.

Natural England considers CEA with TEC to be particularly important because of the close ecological relationship which exists between the two projects. Clearly they are both similar in character as holding brownfield habitats and there is likely to be interchange of mobile species between them and a shared overall habitat resource. The assessment of impacts arising for both of the proposed NSIPs having close associations and essentially comprising a single overall node for terrestrial invertebrates in this area of the Thames Estuary lends itself appropriately to CEA. Indeed we note that Thurrock Council's draft local wildlife sites review includes additional areas within both the Tilbury2 red-line boundary and wider Tilbury Power Station complex which supports the notion that the overall ecological resource affected by Tilbury2 is beyond that which sits strictly within the red-line boundary.

It is important to note that many of the species of concern operate at a meta-population level (broadly defined as populations which operate as smaller sub-groups which interact between each other. This strategy is more stable in the long term as it allows flexibility in the variable use of resources, and recolonization in the event of localised extinctions). Hence the availability of resources in the long-term within range of linked populations is critical to the success of conservation efforts.

Natural England is concerned that the loss of a significant proportion of this overall resource may compromise the viability and longer-term functionality of remnant populations. In particular we are concerned regarding the spatial scale of impacts across both projects for both individual species and group of species which have minimum habitat and population sizes to ensure long-term viability. We are also concerned regarding the temporal availability of habitats, noting the need for construction lay-down areas, and whether sufficient resource exists at any given point in time, noting the lengthy construction periods required. CEA would assist by providing information on habitats likely to be affected – whether permanent or temporary, known or indicative, best or worst case – and undertake appropriate impact assessment.

With respect to the Lower Thames Crossing, much of the above also applies, although we note that LTC is less closely associated with Tilbury2 than TEC, with the exception of the transport corridor containing the "Tilbury link road".

Natural England's advice on the HRA in-combination assessment is expanded in answers to later questions, however in summary, we cannot yet rule out the likelihood of the significant effects of Tilbury2 in-combination with TEC and / or LTC.

Biodiversity, Ecology & Natural Environment

2.1 Why does Natural England (NE) consider the habitats on the proposed development site “arguably ... irreplaceable (in particular the Lytag site)” [REP1-074], and Buglife the site “unique and irreplaceable” [REP1-030] in their respective WRs? Is it the characteristics of the Lytag and PFA products themselves or the nature of the ground conditions on which they have been placed which gives rise to these circumstances?

Brownfield loss is most acute nowadays in that it tends not to be recreated, especially when the end use is housing. Whilst the substrates are post-industrial, and hence “artificial” this does not diminish their value or the value of the faunas that develop on them. In many respects, this makes them a scientifically interesting case of faunas that are otherwise naturally very limited to habitats such as eroding soft-rock cliffs.

Whilst the Thames gateway is seen as a hot-spot from brownfield habitats, the losses to that resource have been, and continue to be significant. The 2013 Buglife report on brownfield showed that 51% (n=198) of Thames brownfields had either been damaged, lost, or were threatened with conversion. Within Essex the report showed that of 38 High value sites, only 23 were intact at the time of writing (2013), seven were partially destroyed, four destroyed, and four had extant planning permission granted on them. It is unclear how many of the latter sites have moved on in the intervening years. The cluster of high quality sites in and immediately around the application site demonstrate its value as there will be faunal exchanges, and again emphasise the importance of a landscape scale resource here. With the sort of trajectory of losses, it is quite possible for the hot spot to turn fully cold.

The named areas at the Tilbury application site are artefacts of sampling and analysis convenience. The fauna shows a reasonable degree of mobility, such that the lytag area will be benefiting from a wider range of substrate mixes than just the pulverised fuel ash (pfa) that was deposited across it. It is the range of substrate types and mixes, all randomly arrived at, that makes the site significant. Even within the pfa, it is likely that there is substrate variation. As the species are selecting micro-habitats that meet their particular and individual needs, having as diverse matrix of substrate and substrate conformation does allow a rich fauna to form. On the lytag, it is the deposition of the pfa, and the proximity of that pfa to other substrates and other substrates mixes, depths, and slopes, that supports such an important fauna.

2.2 Do NE, Buglife, the Applicant and the Environment Agency (EA) all agree the status of the Lytag Local Wildlife Site (LoWS) is of high quality and of national importance, which is at risk of declining due to successional processes if left unmanaged?

Almost all habitats in the UK benefit from some management, and some intervention within any brownfield site would increase the range of substrate variability and hence opportunities for invertebrates. Since many invertebrates operate on choice of micro-habitat parameters, increasing those options can only benefit the fauna. The lytag site data does have a scrub signal within the assemblages identified through the various surveys, and it does remain true that the early successional faunas have a requirement for open and hot substrates, and that shading does diminish the substrate mix. Whether the trajectory on the lytag is towards one of inevitable woodland is not clear, and if it is over what time frame. If such a trend is real, it is very easily reversible. Randomised relatively small-scale disturbance would benefit any such system, but most especially in the context of this happening within a rich brownfield ecosystem, since re-colonisation opportunities are greatly enhanced when proximity is a major factor.

2.3 Are EA, NE, Buglife (and Marine Management Organisation (MMO) if appropriate) content with the proposals for offsite compensation set out in the draft Ecological Mitigation and Compensation Plan (EMCP) submitted at Deadline 2? [REP2-009]

Natural England notes the submission of the most recent version of the EMCP (issued for purposes of deadline 2). This also follows a meeting held with the PoTLL on Friday 16th March, a minute of which has recently been agreed and should be made available to PoTLL. We note the amendments proposed to the scheme of off-site compensation, in particular the new off-site compensation proposed at

Paglesham. We understand that this site is proposed for compensation for losses of coastal grazing marsh habitats, and reptile populations. Natural England has not made specific representations on either of these ecological receptors, and it may be that other interested parties will have comments to make on the suitability of this location for the stated purposes. We would however invite the PoTLL to consider the compatibility of the Paglesham compensation site with the Essex and south Suffolk Shoreline Management Plan, to ensure there are no conflicts arising with the long-term aspirations for coastal management in this area. The SMP can be located at this link.

Importantly however, the EMCP scheme of off-site compensation does not yet make provision for terrestrial invertebrates and brownfield compensation, and as such it should be regarded as incomplete (this is noted at paragraph 9.33). Natural England's opinion is that the Paglesham site is not appropriate for off-site invertebrate compensation because it lacks any meaningful connectivity with the development site and so fails largely on proximity grounds. We also note however that in our view it also lacks an appropriate ecological context and is devoid of any equivalent urban brownfield habitats.

We understand that the PoTLL are actively pursuing other options for terrestrial invertebrate compensation, and are willing to assist them in advising on site suitability. During the course of the hearing, reasons of commercial sensitivity were raised as limiting the ability of the PoTLL to provide specific details on the location of compensation sites, and the PoTLL drew the Examining Authority's attention to our apparent unwillingness to enter an non-disclosure agreement (NDA) with them and prospective landowners. Natural England considers the use of NDA to be both inappropriate and unnecessary. Any decision not to enter an NDA should not be viewed that we are unwilling to provide assistance to the Port in providing advice on the relative suitability of compensation sites.

In addition, we are in receipt of an email from PoTLL ecologists (dated 17th April 2018) seeking to reach agreement with us on a range of ecological criteria which may help in appropriate site selection for compensation sites. We will respond to this email shortly.

Further to the above, we note that the questions arising on matters related to biodiversity and nature conservation are concentrated around the adequacy of mitigation and compensation measures required. As we have sought to emphasise both to the PoTLL and the Examining Authority throughout our representations on this proposed development, Natural England emphasises the importance of following the "mitigation hierarchy" which seeks to avoid impacts as a first principle, and we urge the Examining Authority to give due regard to avoidance of impacts, in the context of a project design which (in view of the answers provided to the Examining Authority's questions) appears to have been driven to maximise commercial advantage, rather than for any particular operational limitation.

2.5 What is the position concerning the additional wintering bird survey data for February and March 2018 referred to in NE's WR [REP1-074] concerning land functionally linked to SPAs? In light of this information, does NE still consider that annual bird surveys are required (between 01 September to 31 March during the construction and operational phases)?

Natural England's view is that notwithstanding the February and March supplementary data supplied, the annual bird surveys proposed remain appropriate. We remain of the view that we cannot rule out that significant effects are likely, possibly alone, but also in-combination. The reason for this view is that additional survey data exists (other than that surveyed by the PoTLL) which indicates that the area of foreshore contiguous with the Thames Estuary & Marshes SPA has supported significant numbers of over-wintering (and / or passage) bird species and that more recent activities in the area of the foreshore (linked to the Goshem's Farm development) are thought to have caused a reduction in bird usage of the area in proximity of the Tilbury2 project. These factors place the PoTLL's data in a wider context, such that Natural England cannot rule out that the disturbance of birds in this area and their inability to feed / roost effectively could be regarded as a significant and likely effect.

On this basis, an Appropriate Assessment would be required in advance of any permission granted, with further surveys and/or desk based studies, as necessary. Should the Examining Authority be minded to grant permission without an appropriate assessment, Natural England would not regard ongoing surveys as mitigation. We advise that monitoring surveys would be necessary to assess the scale and significance of the construction activities and operational activities, both alone and in combination with other plans or projects. There would also need to be a linked and robust mechanism to deliver an adequate scale and type of mitigation and impact-offsetting (identified by survey results) in a suitably timely and appropriate way. In this context, we believe additional survey work to inform an Appropriate Assessment enables a rigorous assessment of the in-combination issues to ensure the mitigation and mechanisms can be part of any permission granted.

The Examining Authority will be aware that the submitted HRA has been supplemented by additional survey and analysis which has been provided to Natural England, in the form of a “Bird Note”. The most recent version of this note is dated April 2018, and was submitted on 9th April. Natural England wishes to submit a fuller response to this report (see below), within the answer provided to this question, although for avoidance of doubt we did not set out this detail during the hearing session.

In our Written Representations Natural England has drawn attention to the following contextual remarks around the “low” bird numbers reported in the ES and used to inform the HRA, as follows (with emphasis added):-

> “We are pleased to see that surveys have been carried out in September and October of 2017, thus completing an overwintering season in conjunction with the 2016 data. We would, however, have expected the application to be supported by a number of years of full data and **consider that this *limitation may have contributed to bird numbers identified being low***. *Paragraph 1.277 of the ES gives limited detail relating to survey work prior to 2016. Any further data available should be presented within the ES to corroborate the findings of the most recent surveys. With regards to functionally linked land, Natural England notes that ‘several of the bird species underpinning the European Site designations make use of intertidal habitats in closer proximity to the Tilbury2 site than the European Site itself.’ From the information provided Natural England has been unable to ascertain which areas SPA birds are using, which species or in what numbers.* ***We note that it is considered that there is ‘relatively low’ usage of intertidal habitats within the area of ‘potential disturbance’ identified,*** *but would expect to see consideration of what the habitat is being used for and potential impacts on the species concerned. It is worth bearing in mind that whilst some key species are identified in the SPA conservation objectives, water bird assemblage is also a qualifying feature."*

Natural England requested that any “*further data available should be presented ... to corroborate the findings of the most recent surveys*”.

<u>Assessment of “Bird Note”</u>
Natural England notes the WeBS Low Tide Counts undertaken for the relevant sector during 1998-99, and how this information may assist when considering the value of the feeding habitat for non-breeding waterbirds of the SSSI, SPA assemblage. In particular we note the excerpts from Musgrove which state: *Many of the individual species were widespread but showed concentrations in one or more areas. Such species included […]* ***Dunlin (especially East Tilbury*** *[…]).* ***Avocets were highly concentrated on the East Tilbury shoreline, with most of the Black-tailed Godwits also here*** *and along the North Kent shore.* ***Ringed Plovers were in their highest densities at*** *Thamesmead,* ***West Thurrock to Coalhouse*** *and […].”*

We note that the BioScan survey methodology during 2016/17 does not cover the full non-breeding survey season and that low tide counts were not undertaken during the January & February 2017 period, which may be expected to be among the higher count months. The Low Tide and High Tide counts during the 2017/18 season including February 2018 and March 2018 are therefore welcomed.
The assertion from Bioscan in Section 4 of the T2 Note that a wider area may have been the context for our precautionary position is partially correct. It is important for the applicant’s consultants to recognise (consistent with points made at the outset) that these inner Thames areas are particularly important during severe weather & prolonged freezing conditions and a ‘snapshot assessment’ may not adequately cover this important aspect and value of the site. This is particularly important for this development noting the weather during the survey period until late February 2018 has been mild and the March 2018 date chosen was also mild temperature and weather. In addition to this, the extra survey

information undertaken by Atkins for the river area around Goshams Jetty provides additional non-breeding bird surveys for 2016/2017. These surveys help to fill some gaps in counts for the January – February 2017 period. For example, during January 2017, we note BioScan recorded 11 avocets at high tide in the IT4 sector and Atkins recorded 8 avocets at low tide in the E6 sector of the Tilbury Port 2 study area. The Atkins surveys also recorded 27 ringed plovers in the IT7 zone during Low tide (November 2016), which is geographically closer to the development zone than the maximum record of 44 ringed plovers recorded in the IT8 zone in October 2017 by the BioScan study. In summary, these counts are either within or sufficiently close to the application area to warrant detailed consideration.
In this respect, whilst we acknowledge these figures are low numbers, it is important to recognise that these bird species have relatively low significance population thresholds at a national and international level, for example:

- Avocet - 11 individuals represents approximately 14.7% of a Nationally Important non-breeding population and 1.5% of an internationally important population.
- Ringed Plover – 27 individuals represents approximately 7.9% of a Nationally Important non-breeding population and 3.7% of an internationally important population.

The effect on these species should therefore be considered in more detail within the context of the SPA and the nearby constituent Mucking Flats & Marshes SSSI.

- Avocet – 11 individuals represents approximately 3.9% of the Thames Estuary & Marshes SPA population at classification
- Ringed Plover – 27 individuals represents approximately 2% of the Thames Estuary & Marshes SPA population and 20% of the Mucking Flats & Marshes SSSI population at SPA classification.

The survey counts within or close to the development area for these two species should not be regarded as insignificant and therefore the potential impact of the proposed development needs to be assessed in more detail, to meet EIA and HRA requirements.

To assist with this assessment Natural England can advise as follows:

i. The potential disturbance to waterfowl of the SPA, SSSI assemblage caused by noise (notably piling) may be more significant than appreciated for the Goshem's Farm jetty application noting the concerns expressed and complaints we received about the bird disturbance it caused. This experience offers a helpful site-based observation.

ii. Based on the data available (including consideration of the White Young Green report 2012) the importance of non-breeding bird interest within BioScan's '300m impact zone' is regarded to be more significant than indicated within the T2 Note and therefore should not be regarded as supporting insignificant value at the outset of HRA and EIA assessment. The area of intertidal immediately to the east of the Tilbury Power Station supports noteworthy habitat for non-breeding birds and provides diversity to the mud/sandflat and saltmarsh mosaic through patches of shingle and typically winter-warmer conditions around an Outfall. To the west, the mouth of Bill Meroy Creek may also be regarded as supporting SPA bird interest. On this basis, the 300 metre zone should not be immediately dismissed within any HRA or EIA assessment as an area that does not contribute either significant bird interest or notable supporting habitats for a SPA. Consistent with the iterative approach required, our evaluation has raised a number of questions arising from the WYG report, and therefore the robustness of the linked conclusions within the BioScan T2 Note. Noting the requirements of the precautionary principle (see Infrastructure Planning Commission Advice Note 10) this has implications for the content and conclusions within the ES and HRA.

Please note, it is possible that more data exists within the referenced White Young Green reports that would assist with helping to better define the area and boundaries of significant interest and non-significant interest. In the absence of this, it is only reasonably possible to conclude that (a) the density of notable birds (SPA feature and notable assemblage birds) generally appears to be higher within the central - eastern third of the survey area if compared with the western third closest to and within the application area (red-line boundary), (b) the western third is used by notable birds (SPA feature and notable assemblage birds) in numbers that may be regarded as a significant proportion of the nearby SPA and SSSI, (c) the application area (ie red line boundary on Map attached) is also used by some of the listed notable birds (SPA feature and notable assemblage birds) in potentially significant numbers.

i. With reference to the White Young Green report (2012) and Mr Larkin's (Essex Birdwatching Society) counts (2014 -17), the area east of the '300m impact zone' clearly supports notable non-breeding bird interest.

ii. Natural England is keen to understand what 'zone of impact' is being proposed for the Construction and Operational Noise and how this is being justified. For reasons set out above, accounting for site-based experience, the proposed '300 metre zone' may not be sufficient to adequately safeguard the non-breeding birds. In addition to this, the 300m distance is also unlikely to be relevant for a number of development effects (eg, alterations to hydrodynamics & sediment regime, risk of pollution by displacing contaminated sediment, changes to port vessels etc) which may all have an impact on the foraging bird population across a wider area of relevance. In this context, the likely impact/effect of these different aspects needs to be assessed accounting for their respective geographical zones and scales of influence (alone, in combination and cumulatively). An evaluation of the relative scale and significance of the effect/impact on the key feature birds (SPA, SSSI, notable) and the supporting intertidal habitats can then be made.

iii. Natural England is keen to ensure an appropriate and robust nature conservation value for non-breeding birds is attached to the whole intertidal area from application site to the Coalhouse Point area. Consistent with advice provided at the outset, this needs to be based on a broader context (ie, accounting for the value of its location proximal to existing designated sites; the 'relative warmth' it provides during severe weather periods and anthropogenic influences). This response seeks to help the applicant address these points to comply with best practice to meet EIA and HRA requirements and enable an exemplar sustainable development solution to be achieved. Consistent with this, Natural England regards it appropriate that the Lower Thames Crossing and other relevant geographically overlapping projects are included within the HRA assessments as 'in combination' plans and projects to ensure they collectively ensure this area of Tilbury achieves a strategically meaningful regeneration to deliver and secure significant nature conservation assets.

The Bird Note appears to acknowledge in its conclusions that the contextual data referred to above (WeBS low tide counts, Atkins Goshem's Jetty surveys, and Mr. Larkin's Essex Birdwatching Society data) have indicated some changes in bird numbers using the foreshore area in recent years, however it does not regard these changes as sufficient to warrant changes to the assessment process (with reference to paragraph 6). Natural England does not agree with this conclusion, and regards that consistent with the precautionary principle, a likely significant effect cannot be ruled out, and that consequently HRA assessment should proceed to the Appropriate Assessment stage.

We also wish to draw the Examining Authority's attention to a recent ruling by the Court of Justice of the European Union (the CJEU) on the interpretation of the Habitats Directive in the case of People Over Wind and Sweetman vs Coillte Teoranta. Whilst we are still considering the implications of this ruling, the central conclusion is that:

> *"Article 6(3) of the Habitats Directive must be interpreted as meaning that, in order to determine whether it is necessary to carry out, subsequently, an appropriate assessment of the implications, for a site concerned, of a plan or project, it is not appropriate* (emphasis added)*, at the screening stage, to take account of the measures intended to avoid or reduce the harmful effects of the plan or project on that site."*

We recommend that the competent authority takes this recent judgement into account when considering the impacts of the project upon European sites, however we note that the ruling signals a presumption in favour of Appropriate Assessment, and that mitigation measures require further scrutiny. The applicant may wish to seek their own legal opinion on the implications of this ruling for their shadow HRA, however consistent with that ruling, and in view of our current position that we cannot exclude a likely significant effect, we respectfully suggest that the HRA proceed to the Appropriate Assessment stage.

2.7 Can the Applicant explain how the functionally-linked habitat has been valued in the Environmental Impact Assessment (EIA) [APP-031] and the Habitats Regulations Assessment (HRA) [APP-060] report?

Natural England notes that this question is addressed to the Applicant, and did not provide a response at the hearing session. We noted that the Applicant regarded functionally-linked habitat as being intrinsically less valuable than the SPA itself, nevertheless it is appropriate for us to point out the case law establishes that functionally-linked land should receive equivalent protection.

2.10 Further to its assessment in its WR [REP1-074] of the site as a potential Site of Special Scientific Interest (SSSI), what progress has NE made in considering the site for SSSI notification?

In our Written Representations, we advised that “the overall assemblage could be considered to be of sufficient quality to meet the designation requirements of a SSSI” and that “consistent with its duties, Natural England must consider such a site for notification”.

It remains the case that we are considering the suitability of the site to put forward for designation, consistent with our statutory duty and designations strategy. This remains an option available to us, however we have discussed this with the PoTLL in a meeting on Friday 16th March. Paragraph 17 of the meeting minute discusses this option – where we outlined that the option around SSSI designation is weighed up against alternative outcomes – and these alternative option are the subject of live discussions with the PoTLL. We advise however that discussions on such alternative options have not progressed to a point at which we can remove SSSI notification from the options available to us. Specifically, to the best of our knowledge, Natural England is aware only of additional *off-site* options being explored, and with reference to paragraph 12 of the meeting minute, we have not been advised of any plans to adjust layout arrangements within the Order Limits.

We can update the Examining Authority however that since the Issue Specific Hearing on 18th April, Natural England has discussed the option of SSSI designation on our national High Risk Casework Panel. We can now advise PoTLL and the Examining Authority that Natural England will be adding the site to our SSSI designations’ pipeline, consistent with the requirements of our designations’ strategy. This means that it will be put forward for consideration by Natural England’s Senior Leadership Team for formal notification in due course.

11.1 What are the Applicant’s intentions for the revised version of the HRA report to be submitted for Deadline 3 in the light of NE’s statement in its WR [REP1-074] about further work required to cover for example functionally-linked habitat, Invasive Non-Natural Species (INNS), waste and pollutants, dredging, noise, dust and in-combination effects?

Although the question is directed to the Applicant, Natural England welcomes the intentions for the HRA to be updated in response to our earlier statements in our Written Representations. We will be pleased to review this in due course, noting that additional comments are provided within this submission, such that a further revision may be appropriate. We also note the intention of the Examining Authority to undertake its own assessment consistent with its duties as the competent authority (Report on the Implications for European Sites).

11.3 What further mitigation measures to ensure compliance with the Habitats Regulations does NE have in mind, pursuant to its WR [REP1-074] and response to FWQ?

In answering this question, some mitigation measures are proposed elsewhere in the submission that in the HRA, and we recommend that these are captured within the HRA in order to establish a clear audit trail. In other situations, such as dredging, the methodology has been suggested as an option but not confirmed, and we have outstanding concerns around the uncertainties of sediment movement, pollution & scale of impact on birds/supporting habitats. Notwithstanding this, we have sought to provide some extended advice and be helpful where we can.

Noise generation by piling within the river is likely to significantly disturb birds of the SPA and Ramsar site assemblage without additional mitigation. For example, the design and methodology will require careful programme timing to avoid the sensitive September – end March period. Based on recent experience at Goshem's Jetty, this will need to be strictly adhered to, to avoid significant disturbance to SPA feature birds.

Surface water pollution needs to be effectively managed to avoid impacting on intertidal habitats supporting SPA and Ramsar site features. This requires additional mitigation measures to comply with best practice, in accordance with advice from the Environment Agency within the written representations. This refers to and would align with the concerns expressed and requirements of the EA set out in the Written Reps (see attached EA reps – Section 11) to meet WFD and Pollution Prevention Guidelines.

Dredging operations are likely to significantly impact on birds of the SPA and Ramsar site assemblage <u>if undertaken without additional mitigation</u>. For example, the design and methodology will require careful programme timing to avoid disturbing these birds during the sensitive September – end March period. Dredging operations are also likely to significantly impact on the functionally-linked intertidal habitats that support birds of the SPA and Ramsar site assemblage if undertaken <u>without additional mitigation.</u> For example, the appropriate design and methodology (<u>yet to be defined, agreed and permitted</u>) will require careful programme timing to avoid increasing the presence of contaminated sediments to invertebrate prey and birds foraging during the Autumn – end March period (includes ringed plover autumn passage). Without more information about the required dredging methodology and reliant on a precautionary position we can advise that any initial dredging should not be undertaken during the ten month period of July – April to allow for sediment to settle and be allowed to disperse, before overwintering and Autumn passage visit the area in significant numbers. A suitable sediment monitoring programme will be necessary to ground truth the sediment movement, accretion and contamination levels to SPA supporting habitats arising from this initial dredging to inform any maintenance dredging programme going forward. This is best provided by way of interim reports with monitoring data and assessment for regulator's approval in consultation with Natural England. The monitoring report & assessment will also identify the scale and type of any additional mitigation and impact-offsetting that will be necessary to meet a robustly timetabled delivery programme. Monitoring will be necessary to ensure compliance with an approved best-practice methodology; validate the predictions from modelling; assess the scale & extent of any additional mitigation that may be required by the applicants (to deliver via a robust permission-linked mechanism) that is related to unforeseen impacts on the functionally-linked and SPA habitats.

Water Discharges - The Port operations that would be enabled by grant of planning permission have the capacity to increase and alter water discharges to the Thames which may potentially impact on the functionally-linked habitat. They also have the capacity to introduce or mobilise contaminants via a range of activities (eg, surface run-off from increased vehicle movement, operational spillages). Natural England acknowledges the information within the ES and the Operational Management Plan (OMP), however we advise the potential impacts to the SPA and Ramsar site features and proposed mitigation need to be separately addressed within the HRA to ensure the OMP has an appropriate framework of reference to demonstrate compliance with the Habitats Regulations. The information is not clearly set out within the HRA to enable Natural England to assess the likely significance of this effect. Once received we can consider this.

Construction Waste and Pollutants – The construction activities within the development footprint have the capacity to introduce or mobilise environmental contaminants via a range of activities (eg, elevated construction dust; increased quantity and affected quality of surface water run-off; use or application of non-biodegradable toxic chemicals, etc) to potentially impact on the Thames Estuary and Marshes SPA and Ramsar site. Natural England acknowledges the disparate information within the ES and the Construction Environment Management Plan (CEMP), however we recommend the potential impacts to the SPA and Ramsar site features and proposed mitigation need to be separately addressed within the

HRA to ensure the CEMP has an appropriate framework of reference to demonstrate compliance with the Habitats Regulations. The information is not clearly set out within the HRA to enable Natural England to assess the likely significance of this effect. Once received we can consider this.

Invasive Non-Native Species - Construction works and Port operations have the capacity to introduce invasive non-native species that could potentially impact on Thames Estuary and Marshes SPA and Ramsar site features and the habitats that support them. Natural England acknowledges there is information within the Environmental Statement but advises this should also be addressed within Section 5 of the HRA to specifically address the Habitats Regulations requirements. The information is not clearly set out within the HRA to enable Natural England to assess the likely significance of this effect. It should include the full list of likely species and measures to eradicate, monitor and implement operational management measures as necessary.

Direct Impact of development - The development plans mainly within the terrestrial area, (but also including some intertidal areas) have the capacity to impact on functionally linked habitats that support a number of Thames Estuary and Marshes Ramsar site listed invertebrates and plants. The mitigation plans are not currently regarded as adequate to address the predicted scale of loss in extent and quality of the habitat mosaic and no compensation plans have been submitted yet for our consideration. The scale of loss to these Ramsar site features and full details of the mitigation and compensation package has not been clearly set out within the ES to enable Natural England to assess the likely significance of this impact. Our current precautionary position is that the development will have a significant impact without adequate mitigation and compensation.

Outstanding Matters

Natural England understands that additional responses have been requested of us in order to meet deadline 3. These include response to queries raised in the “Response to Written Representations, Local Impact Reports and Interested Parties’ Responses to First Written Questions” (document reference PoTLL/T2/EX/60. This response raises several items that require additional work by Natural England, and we therefore are unable to response in time for deadline 3. With apologies, we intend to submit our further comments on these matters as soon as possible, to assist the Examination. Several of these items are linked to the Statement of Common Ground between the PoTLL and ourselves, and consequently we have been unable to progress the SoCG in the time available. Please be assured that we are endeavouring to progress our responses in a timely manner, as far as possible.

Otherwise this will involve stochastic expansions of low mobility taxa set against a diminishing resource of those same taxon donor pools. Ideally, a new site would sit adjacent, and work phased to allow colonisation of parts of the new site from the old.

Resource provision. We understand, from the analysis of associations, that key components need to be in place. Looking at Mark Telfer's lytag site data from the 2016-17 dataset, shows a conservation status species dependency on a range of other animals groups (top weighting attached to aphids, bees, snails, wasps) , and then to generic classes of flowers and grasses, and "trees", with more precision with plant genera such as clovers or birds-foot trefoils or a wider groups of brassica species. To support the full lytag fauna one would thus have to have viable and large establishment of these supporting species resources before the ecosystem had achieved some conservation maturity. It is understood that topographic and substrate variation are key to building any new habitat.

Maintenance of source populations.
We are hindered by the Tilbury data offering up no real abundance data (it presents species presence only) so we cannot establish how much of the conservation status rarity profile of the site is founded on just one example, or might better reflect local populations. Given that the taxa of particular interest are either Rare or Nationally Scarce, their founder populations can similarly be scarce. If the source populations are destroyed before the colonisation and maturity are established, there remains an uncertainty over how much faunal resource will be available. Historical colonisation will have heavily traded on current population presence, and whilst new sites, if demonstrably good, could feed newer sites, this does depend more on their proximity, and the resource provision.

Clearly, if one was going to do this in a logical manner, one would create a new site with appropriate materials from lower grade interest areas of the donor site, let it mature a bit, and let animals close by colonise. The more population centres one has the more resilient the fauna, as each brownfield site will be different and ought to support variants of a brownfield fauna.

APPENDIX 2

EC Directive 79/409 on the Conservation of Wild Birds: Special Protection Area

Name: Thames Estuary and Marshes

Unitary Authority/County: Essex County Council, Gravesham Borough Council, Kent County Council, Medway Council, and Thurrock Borough Council.

Consultation proposal: Mucking Flats and Marshes SSSI and South Thames Estuary and Marshes SSSIs have been recommended as a Special Protection Area because of the site's European ornithological interest.

The Thames Estuary and Marshes Special Protection Area is a wetland of European importance comprising a mosaic of intertidal habitats, saltmarsh, coastal grazing marshes, saline lagoons and chalk pits. The site provides wintering and breeding habitats for important assemblages of wetland bird species, particularly wildfowl and waders as well as supporting migratory birds on passage. The site forms part of the wider Thames Estuary together with other classified SPAs in both Essex and Kent.

Boundary of SPA: The SPA boundary is within or coincident with the above SSSI boundaries. See SPA map for further detail.

Size of SPA: The SPA covers an area of 4,838.94 ha.

European ornithological importance of the SPA: Thames Estuary and Marshes SPA is of European importance because:

a) the site qualifies under **article 4.1** of the Directive (79/409/EEC) as it is used regularly by 1% or more of the GB populations of the following species listed on Annex I, in any season:

Annex I species	5 year peak mean 1993/94 - 1997/98	% GB population
Avocet *Recurvirostra avosetta*	283 individuals - wintering	28.3% GB
Hen Harrier *Circus cyaneus*	7 individuals - wintering	1.0% GB

b) the site qualifies under **article 4.2** of the Directive (79/409/EEC) as it is used regularly by 1% or more of the biogeographical populations of the following regularly occurring migratory species (other than those listed on Annex I), in any season:

Species	5 year peak mean 1993/94 - 1997/98	% of population
Ringed Plover *Charadrius hiaticula*	1,324 individuals - passage	2.6% Europe/ Northern Africa (win)
Grey Plover *Pluvialis squatarola*	2,593 individuals - wintering	1.7% Eastern Atlantic (wintering)
Dunlin *Calidris alpina alpina*	29,646 individuals - wintering	2.1% N Siberia/Europe/ W Africa
Knot *Calidris canutus islandica*	4,848 individuals - wintering	1.4% NE Can/Grl/ Iceland/NW Eur
Black-tailed Godwit *Limosa limosa islandica*	1,699 individuals - wintering	2.4% Iceland (breeding)
Redshank *Tringa totanus totanus*	3,251 individuals - wintering	2.2% Eastern Atlantic (wintering)

c) the site qualifies under **article 4.2** of the Directive (79/409/EEC) as it is used regularly by over 20,000 waterfowl in any season:

Period	**Season**	**Population**
1993/94 - 1997/98	Wintering	75,019

Non-qualifying species of interest

Other Annex 1 species which regularly occur on the site in non-qualifying numbers are breeding Common Tern *Sterna hirundo*, and passage and wintering Bewick's Swan *Cygnus columbianus bewickii*, Golden Plover *Pluvialis apricaria*, Ruff *Philomachus pugnax*, Short-eared Owl *Asio flammeus* and Kingfisher *Alcedo atthis*.

The site also supports nationally important populations of Shelduck *Tadorna tadorna*, Teal *Anas crecca*, Pintail *Anas acuta*, Gadwall *Anas strepera*, Shoveler *Anas clypeata*, Tufted Duck *Aythya fuligula* and Pochard *Aythya ferina*.

Status of SPA

The Thames Estuary and Marshes SPA was classified on 31 March 2000.

APPENDIX 3

European Site Conservation Objectives for Thames Estuary and Marshes Special Protection Area Site Code: UK9012021

With regard to the SPA and the individual species and/or assemblage of species for which the site has been classified (the 'Qualifying Features' listed below), and subject to natural change;

Ensure that the integrity of the site is maintained or restored as appropriate, and ensure that the site contributes to achieving the aims of the Wild Birds Directive, by maintaining or restoring;

- **The extent and distribution of the habitats of the qualifying features**
- **The structure and function of the habitats of the qualifying features**
- **The supporting processes on which the habitats of the qualifying features rely**
- **The population of each of the qualifying features, and,**
- **The distribution of the qualifying features within the site.**

This document should be read in conjunction with the accompanying *Supplementary Advice* document, which provides more detailed advice and information to enable the application and achievement of the Objectives set out above.

Qualifying Features:

A082 *Circus cyaneus*; Hen harrier (Non-breeding)

A132 *Recurvirostra avosetta*; Pied avocet (Non-breeding)

A137 *Charadrius hiaticula*; Ringed plover (Non-breeding)

A141 *Pluvialis squatarola*; Grey plover (Non-breeding)

A143 *Calidris canutus*; Red knot (Non-breeding)

A149 *Calidris alpina alpina*; Dunlin (Non-breeding)

A156 *Limosa limosa islandica*; Black-tailed godwit (Non-breeding)

A162 *Tringa totanus*; Common redshank (Non-breeding)

Waterbird assemblage

This is a European Marine Site

This SPA is a part of the Thames Estuary and Marshes European Marine Site (EMS). These Conservation Objectives should be used in conjunction with the Regulation 35 Conservation Advice document for the EMS. For further details about this please visit the Natural England website at: http://www.naturalengland.org.uk/ourwork/marine/protectandmanage/mpa/europeansites.aspx or contact Natural England's enquiry service at enquiries@naturalengland.org.uk or by phone on 0845 600 3078.

Explanatory Notes: European Site Conservation Objectives

These Conservation Objectives are those referred to in the Conservation of Habitats and Species Regulations 2010 (the "Habitats Regulations") and Article 6(3) of the Habitats Directive. They must be considered when a competent authority is required to make a 'Habitats Regulations Assessment' including an Appropriate Assessment, under the relevant parts of this legislation.

These Conservation Objectives and the accompanying Supplementary Advice (where this is available) will also provide a framework to inform the management of the European Site under the provisions of Articles 4(1) and 4(2) of the Wild Birds Directive, and the prevention of deterioration of habitats and significant disturbance of its qualifying features required under Article 6(2) of the Habitats Directive.

These Conservation Objectives are set for each bird feature for a Special Protection Area (SPA). Where the objectives are met, the site will be considered to exhibit a high degree of integrity and to be contributing to achieving the aims of the Wild Birds Directive.

Publication date: 30 June 2014 (Version 2). This document updates and replaces an earlier version dated 29 May 2012 to reflect Natural England's Strategic Standard on European Site Conservation Objectives 2014. Previous references to additional features identified in the 2001 UK SPA Review have also been removed.

APPENDIX 4

Information Sheet on Ramsar Wetlands (RIS)

Categories approved by Recommendation 4.7 (1990), as amended by Resolution VIII.13 of the 8th Conference of the Contracting Parties (2002) and Resolutions IX.1 Annex B, IX.6, IX.21 and IX. 22 of the 9th Conference of the Contracting Parties (2005).

Notes for compilers:

1. The RIS should be completed in accordance with the attached *Explanatory Notes and Guidelines for completing the Information Sheet on Ramsar Wetlands*. Compilers are strongly advised to read this guidance before filling in the RIS.

2. Further information and guidance in support of Ramsar site designations are provided in the *Strategic Framework for the future development of the List of Wetlands of International Importance* (Ramsar Wise Use Handbook 7, 2nd edition, as amended by COP9 Resolution IX.1 Annex B). A 3rd edition of the Handbook, incorporating these amendments, is in preparation and will be available in 2006.

3. Once completed, the RIS (and accompanying map(s)) should be submitted to the Ramsar Secretariat. Compilers should provide an electronic (MS Word) copy of the RIS and, where possible, digital copies of all maps.

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1. Name and address of the compiler of this form:

FOR OFFICE USE ONLY.

DD	MM	YY

Designation date

Site Reference Number

Joint Nature Conservation Committee
Monkstone House
City Road
Peterborough
Cambridgeshire PE1 1JY
UK
Telephone/Fax: +44 (0)1733 – 562 626 / +44 (0)1733 – 555 948
Email: RIS@JNCC.gov.uk

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2. Date this sheet was completed/updated:

Designated: 31 March 2000

3. Country:

UK (England)

4. Name of the Ramsar site:

Thames Estuary and Marshes

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5. Designation of new Ramsar site or update of existing site:

This RIS is for: Updated information on an existing Ramsar site

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6. For RIS updates only, changes to the site since its designation or earlier update:

a) Site boundary and area:

** Important note: If the boundary and/or area of the designated site is being restricted/reduced, the Contracting Party should have followed the procedures established by the Conference of the Parties in the Annex to COP9 Resolution IX.6 and provided a report in line with paragraph 28 of that Annex, prior to the submission of an updated RIS.

b) Describe briefly any major changes to the ecological character of the Ramsar site, including in the application of the Criteria, since the previous RIS for the site:

7. Map of site included:

Refer to Annex III of the *Explanatory Notes and Guidelines*, for detailed guidance on provision of suitable maps, including digital maps.

a) A map of the site, with clearly delineated boundaries, is included as:

i) **hard copy** (required for inclusion of site in the Ramsar List): *yes* ✓ -or- *no* □;
ii**) an electronic format** (e.g. a JPEG or ArcView image) Yes
iii) **a GIS file providing geo-referenced site boundary vectors and attribute tables** *yes* ✓ -or- *no* □;

b) Describe briefly the type of boundary delineation applied:
e.g. the boundary is the same as an existing protected area (nature reserve, national park etc.), or follows a catchment boundary, or follows a geopolitical boundary such as a local government jurisdiction, follows physical boundaries such as roads, follows the shoreline of a waterbody, etc.

The site boundary is the same as, or falls within, an existing protected area.

For precise boundary details, please refer to paper map provided at designation

8. Geographical coordinates (latitude/longitude):

51 29 08 N 00 35 47 E

9. General location:

Include in which part of the country and which large administrative region(s), and the location of the nearest large town.

Nearest town/city: Gravesend

Contains part of the north coast of Kent and part of the southern coast of Essex, straddling the Thames estuary.

Administrative region: Essex; Kent; Medway; Thurrock

10. Elevation (average and/or max. & min.) (metres): 11. Area (hectares): 5588.59

Min.	-2
Max.	20
Mean	1

12. General overview of the site:

Provide a short paragraph giving a summary description of the principal ecological characteristics and importance of the wetland.

A complex of brackish, floodplain grazing marsh ditches, saline lagoons and intertidal saltmarsh and mudflat. These habitats together support internationally important numbers of wintering waterfowl. The saltmarsh and grazing marsh are of international importance for their diverse assemblages of wetland plants and invertebrates.

13. Ramsar Criteria:

Circle or underline each Criterion applied to the designation of the Ramsar site. See Annex II of the *Explanatory Notes and Guidelines* for the Criteria and guidelines for their application (adopted by Resolution VII.11).

2, 5, 6

14. Justification for the application of each Criterion listed in 13 above:

Provide justification for each Criterion in turn, clearly identifying to which Criterion the justification applies (see Annex II for guidance on acceptable forms of justification).

Ramsar criterion 2

The site supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. The site also supports more than 20 British Red Data Book invertebrates.

Ramsar criterion 5

Assemblages of international importance:

Species with peak counts in winter:
45118 waterfowl (5 year peak mean 1998/99-2002/2003)

Ramsar criterion 6 – species/populations occurring at levels of international importance.

Qualifying Species/populations (as identified at designation):

Species with peak counts in spring/autumn:

Ringed plover , *Charadrius hiaticula*, Europe/Northwest Africa	595 individuals, representing an average of 1.8% of the GB population (5 year peak mean 1998/9-2002/3)
Black-tailed godwit , *Limosa limosa islandica*, Iceland/W Europe	1640 individuals, representing an average of 4.6% of the population (5 year peak mean 1998/9-2002/3)

Species with peak counts in winter:

Grey plover , *Pluvialis squatarola*, E Atlantic/W Africa -wintering	1643 individuals, representing an average of 3.1% of the GB population (5 year peak mean 1998/9-2002/3)
Red knot , *Calidris canutus islandica*, W & Southern Africa (wintering)	7279 individuals, representing an average of 1.6% of the population (5 year peak mean 1998/9-2002/3)
Dunlin , *Calidris alpina alpina*, W Siberia/W Europe	15171 individuals, representing an average of 1.1% of the population (5 year peak mean 1998/9-2002/3)
Common redshank , *Tringa totanus totanus*,	1178 individuals, representing an average of 1% of the GB population (5 year peak mean 1998/9-2002/3)

Contemporary data and information on waterbird trends at this site and their regional (sub-national) and national contexts can be found in the Wetland Bird Survey report, which is updated annually. See www.bto.org/survey/webs/webs-alerts-index.htm.
Details of bird species occuring at levels of National importance are given in Section 22

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15. **Biogeography** (required when Criteria 1 and/or 3 and /or certain applications of Criterion 2 are applied to the designation)**:**

Name the relevant biogeographic region that includes the Ramsar site, and identify the biogeographic regionalisation system that has been applied.

a) biogeographic region:
Atlantic

b) biogeographic regionalisation scheme (include reference citation):
Council Directive 92/43/EEC

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16. Physical features of the site:

Describe, as appropriate, the geology, geomorphology; origins - natural or artificial; hydrology; soil type; water quality; water depth, water permanence; fluctuations in water level; tidal variations; downstream area; general climate, etc.

Soil & geology	alluvium, mud, shingle
Geomorphology and landscape	coastal, floodplain, intertidal sediments (including sandflat/mudflat), estuary
Nutrient status	eutrophic
pH	no information
Salinity	brackish / mixosaline, fresh, saline / euhaline
Soil	no information
Water permanence	usually permanent, usually seasonal / intermittent
Summary of main climatic features	Annual averages (Greenwich, 1971–2000) (www.metoffice.com/climate/uk/averages/19712000/sites/greenwich.html) Max. daily temperature: 14.8° C Min. daily temperature: 7.2° C Days of air frost: 29.1 Rainfall: 583.6 mm Hrs. of sunshine: 1461.0

General description of the Physical Features:

The marshes extend for about 15 km along the south side of the Thames estuary and also include intertidal areas on the north side of the estuary. To the south of the river, much of the area is brackish grazing marsh, although some of this has been converted to arable use. At Cliffe, there are flooded clay and chalk pits, some of which have been infilled with dredgings. Outside the sea-wall, there is a small extent of saltmarsh and broad intertidal mudflats.

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17. Physical features of the catchment area:

Describe the surface area, general geology and geomorphological features, general soil types, general land use, and climate (including climate type).

The marshes extend for about 15 km along the south side of the Thames estuary and also include intertidal areas on the north side of the estuary. To the south of the river, much of the area is brackish grazing marsh, although some of this has been converted to arable use. At Cliffe, there are flooded clay and chalk pits, some of which have been infilled with dredgings. Outside the sea-wall, there is a small extent of saltmarsh and broad intertidal mudflats.

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18. Hydrological values:

Describe the functions and values of the wetland in groundwater recharge, flood control, sediment trapping, shoreline stabilization, etc.

Shoreline stabilisation and dissipation of erosive forces, Sediment trapping, Flood water storage / desynchronisation of flood peaks, Maintenance of water quality (removal of nutrients)

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19. Wetland types:

Marine/coastal wetland

Code	Name	% Area
G	Tidal flats	49.6
4	Seasonally flooded agricultural land	38.6
Q	Saline / brackish lakes: permanent	4.2
Ss	Saline / brackish marshes: seasonal / intermittent	3.2
Other	Other	1.6
H	Salt marshes	1.3
E	Sand / shingle shores (including dune systems)	0.8
O	Freshwater lakes: permanent	0.7

20. General ecological features:

Provide further description, as appropriate, of the main habitats, vegetation types, plant and animal communities present in the Ramsar site, and the ecosystem services of the site and the benefits derived from them.

The intertidal flats are mostly fine, silty sediment, though in parts they are sandy. The saltmarsh shows a transition from pioneer communities containing *Zostera* to saltmarsh dominated by, for example, *Atriplex portulacoides*. The grazing marsh grassland is mesotrophic and generally species-poor. It does, however, contain scattered rarities, mostly annuals characteristic of bare ground. Where the grassland is seasonally inundated and the marshes are brackish the plant communities are intermediate between those of mesotrophic grassland and those of saltmarsh. The grazing marsh ditches contain a range of flora of brackish and fresh water. The aquatic flora is a mosaic of successional stages resulting from periodic clearance of drainage channels. The dominant emergent plants are *Phragmites communis* and *Bolboschoenus maritimus*. The saline lagoons have a diverse molluscan and crustacean fauna. Dominant plants in the lagoons include *Ulva* and *Chaetomorpha*.

Ecosystem services

21. Noteworthy flora:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Nationally important species occurring on the site:

Higher plants:

The site supports a population of the endangered least lettuce *Lactuca saligna*, and also supports several nationally scarce plants, including bulbous foxtail *Alopecurus bulbosus*, slender hare's-ear *Bupleurum tenuissimum*, divided sedge *Carex divisa*, saltmarsh goosefoot *Chenopodium chenopodioides*, sea barley *Hordeum marinum*, golden samphire *Inula crithmoides*, annual beard grass *Polypogon monspeliensis*, Borrer's saltmarsh-grass *Puccinellia fasciculata*, stiff saltmarsh-grass *P. rupestris*, one-flowered glasswort *Salicornia pusilla*, clustered clover *Trifolium glomeratum*, sea clover *T. squamosum*, narrow-leaved eelgrass *Zostera angustifolia* and dwarf eelgrass *Z. noltei*.

22. Noteworthy fauna:

Provide additional information on particular species and why they are noteworthy (expanding as necessary on information provided in **12**. Justification for the application of the Criteria) indicating, e.g. which species/communities are unique, rare, endangered or biogeographically important, etc., including count data. *Do not include here taxonomic lists of species present – these may be supplied as supplementary information to the RIS.*

Birds

Species currently occurring at levels of national importance:

Species with peak counts in spring/autumn:

Little grebe , *Tachybaptus ruficollis ruficollis*, Europe to E Urals, NW Africa	251 individuals, representing an average of 3.2% of the GB population (5 year peak mean 1998/9-2002/3)
Little egret , *Egretta garzetta*, West Mediterranean	54 individuals, representing an average of 3.2% of the GB population (5 year peak mean 1998/9-2002/3)
Ruff , *Philomachus pugnax*, Europe/W Africa	23 individuals, representing an average of 3.2% of the GB population (5 year peak mean 1998/9-2002/3)
Common greenshank , *Tringa nebularia*, Europe/W Africa	38 individuals, representing an average of 6.3% of the GB population (5 year peak mean 1998/9-2002/3)

Species with peak counts in winter:

Common shelduck , *Tadorna tadorna*, NW Europe	1238 individuals, representing an average of 1.5% of the GB population (5 year peak mean 1998/9-2002/3)
Gadwall , *Anas strepera strepera*, NW Europe	359 individuals, representing an average of 2% of the GB population (5 year peak mean 1998/9-2002/3)
Northern shoveler , *Anas clypeata*, NW & C Europe	288 individuals, representing an average of 1.9% of the GB population (5 year peak mean 1998/9-2002/3)
Water rail , *Rallus aquaticus*, Europe	6 individuals, representing an average of 1.3% of the GB population (5 year peak mean 1998/9-2002/3)
Pied avocet , *Recurvirostra avosetta*, Europe/Northwest Africa	607 individuals, representing an average of 17.8% of the GB population (5 year peak mean 1998/9-2002/3)
Spotted redshank , *Tringa erythropus*, Europe/W Africa	6 individuals, representing an average of 4.4% of the GB population (5 year peak mean 1998/9-2002/3)

Species Information

Nationally important species occurring on the site:

Invertebrates:

The endangered species *Bagous longitarsis* occurs on the site.

The following vulnerable species occur on the site: a groundbug *Henestaris halophilus*, a weevil *Bagous cylindrus*, a ground beetle *Polystichus connexus*, a cranefly *Erioptera bivittata*, a cranefly *Limnophila pictipennis*, a horse fly *Hybomitra expollicata*, a hoverfly *Lejops vittata*, a dancefly *Poecilobothrus ducalis*, a snail-killing fly *Pteromicra leucopeza*, a solitary wasp *Philanthus triangulum* and a damselfly *Lestes dryas*.

The following rare species occur on the site: a ground beetle *Anisodactylus poeciloides*, the water beetles *Aulacochthebius exaratus, Berosus fulvus, Cercyon bifenestratus, Hydrochus elongatus, H. ignicollis, Ochthebius exaratus* and *Hydrophilus piceus*, a beetle *Malachius vulneratus*, a rove beetle *Philonthus punctus*, a fungus beetle *Telmatophilus brevicollis*, a fly *Campsicnemus magius*, a horsefly *Haematopota bigoti*, a soldier fly *Stratiomys longicornis* and a spider *Baryphyma duffeyi*.

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23. Social and cultural values:

Describe if the site has any general social and/or cultural values e.g. fisheries production, forestry, religious importance, archaeological sites, social relations with the wetland, etc. Distinguish between historical/archaeological/religious significance and current socio-economic values.

Aesthetic
Archaeological/historical site
Environmental education/ interpretation
Fisheries production
Livestock grazing
Non-consumptive recreation
Scientific research
Sport fishing
Sport hunting
Tourism
Transportation/navigation

b) Is the site considered of international importance for holding, in addition to relevant ecological values, examples of significant cultural values, whether material or non-material, linked to its origin, conservation and/or ecological functioning? No

If Yes, describe this importance under one or more of the following categories:

i) sites which provide a model of wetland wise use, demonstrating the application of traditional knowledge and methods of management and use that maintain the ecological character of the wetland:

ii) sites which have exceptional cultural traditions or records of former civilizations that have influenced the ecological character of the wetland:

iii) sites where the ecological character of the wetland depends on the interaction with local communities or indigenous peoples:

iv) sites where relevant non-material values such as sacred sites are present and their existence is strongly linked with the maintenance of the ecological character of the wetland:

24. Land tenure/ownership:

Ownership category	On-site	Off-site
Non-governmental organisation (NGO)	+	+
Local authority, municipality etc.	+	+
Private	+	+
Public/communal	+	

25. Current land (including water) use:

Activity	On-site	Off-site
Nature conservation	+	+
Tourism	+	+
Recreation	+	+
Current scientific research	+	+
Fishing: commercial	+	
Fishing: recreational/sport	+	
Gathering of shellfish	+	
Bait collection	+	
Arable agriculture (unspecified)		+
Permanent arable agriculture		+
Livestock watering hole/pond	+	+
Grazing (unspecified)	+	+
Permanent pastoral agriculture	+	+
Hunting: recreational/sport	+	
Industrial water supply		+
Industry		+
Sewage treatment/disposal	+	+
Harbour/port	+	+
Flood control	+	
Transport route	+	+
Urban development		+
Military activities	+	

26. Factors (past, present or potential) adversely affecting the site's ecological character, including changes in land (including water) use and development projects:

Explanation of reporting category:

1. *Those factors that are still operating, but it is unclear if they are under control, as there is a lag in showing the management or regulatory regime to be successful.*
2. *Those factors that are not currently being managed, or where the regulatory regime appears to have been ineffective so far.*

NA = Not Applicable because no factors have been reported.

Adverse Factor Category	Reporting Category	Description of the problem (Newly reported Factors only)	On-Site	Off-Site	Major Impact?
Dredging	1		+	+	+
Erosion	2		+		+
Eutrophication	2	Studies by the Environment Agency indicate that the waters in the Thames estuary are hyper-nutrified for nitrogen and phosphorus.	+	+	+
General disturbance from human activities	1		+		+

For category 2 factors only.
What measures have been taken / are planned / regulatory processes invoked, to mitigate the effect of these factors?
Erosion - The North Kent Coastal Habitat Management Plan (CHaMP) has been produced. The Environment Agency is producing a Flood Defence Strategy for the Thames (Thames 2100) and decisions on future flood risk management will need to take into account the effects on features within the designated sites.
Studies of sediment transport and hydrodynamics within Thames estuary. Investigation of beneficial use of dredgings for mudflat recharge and creation of compensatory habitat.

Eutrophication - Water quality and sources of nutrient inputs are subject to further investigation by the Environment Agency as part of the Agency's review of consents under the Habitats Regulations. Stage 3 of the Review of Consents (appropriate assessment) is scheduled for completion by March 2006, at which point any consented discharges having an adverse effect on site integrity will be identified.

Is the site subject to adverse ecological change? YES

27. Conservation measures taken:

List national category and legal status of protected areas, including boundary relationships with the Ramsar site; management practices; whether an officially approved management plan exists and whether it is being implemented.

Conservation measure	On-site	Off-site
Site/ Area of Special Scientific Interest (SSSI/ASSI)	+	
Special Protection Area (SPA)	+	

Land owned by a non-governmental organisation for nature conservation	+	+
Management agreement	+	
Site management statement/plan implemented	+	
Environmentally Sensitive Area (ESA)	+	+

b) Describe any other current management practices:
The management of Ramsar sites in the UK is determined by either a formal management plan or through other management planning processes, and is overseen by the relevant statutory conservation agency. Details of the precise management practises are given in these documents.

28. Conservation measures proposed but not yet implemented:

e.g. management plan in preparation; official proposal as a legally protected area, etc.

No information available

29. Current scientific research and facilities:

e.g. details of current research projects, including biodiversity monitoring; existence of a field research station, etc.

Numbers of migratory and wintering wildfowl and waders are monitored annually as part of the national Wetland Birds Survey (WeBS) organised by the British Trust for Ornithology, Wildfowl and Wetlands Trust, the Royal Society for the Protection of Birds and the Joint Nature Conservation Committee.
Numbers of breeding waders have been monitored through the BTO/RSPB/English Nature/Defra survey Breeding Waders of Wet Meadows (2002).
Botanical surveys of vegetation of sea wall embankments and grazing marsh ditches have been carried out.
The distribution and extent of saltmarsh habitat has been mapped - North Kent Marshes Saltmarsh Survey (2002) (Blair-Myres 2003)
The RSPB monitors various species groups on its reserves within the site

30. Current communications, education and public awareness (CEPA) activities related to or benefiting the site:

e.g. visitor centre, observation hides and nature trails, information booklets, facilities for school visits, etc.

The RSPB manages a network of reserves within and adjacent to the site, which are promoted locally through existing community initiatives, and more widely through publications and via the internet. The site forms part of proposals for a north Kent ‘Regional Park’, being promoted to balance development in Kent Thameside (part of the Thames Gateway growth area). The Management Guidance for the Thames Estuary aims to increase awareness of conservation and is promoted by the Thames Estuary Partnership. The Thames Estuary Partnership has also produced the Tidal Thames Habitat Action Plan to raise awareness of and address biodiversity issues.

31. Current recreation and tourism:

State if the wetland is used for recreation/tourism; indicate type(s) and their frequency/intensity.

Yachting, angling, wildfowling, jet-skiing, water-skiing and birdwatching. Bird watching occurs throughout the year and wildfowling is restricted to the period September to February. The remaining activities occur year-round but are more prevalent in the summer months. Disturbance from these activities is a current issue but is being addressed through further research, negotiation and information dissemination.

32. Jurisdiction:

Include territorial, e.g. state/region, and functional/sectoral, e.g. Dept. of Agriculture/Dept. of Environment, etc.

Head, Natura 2000 and Ramsar Team, Department for Environment, Food and Rural Affairs, European Wildlife Division, Zone 1/07, Temple Quay House, 2 The Square, Temple Quay, Bristol, BS1 6EB

33. Management authority:

Provide the name and address of the local office(s) of the agency(ies) or organisation(s) directly responsible for managing the wetland. Wherever possible provide also the title and/or name of the person or persons in this office with responsibility for the wetland.

Site Designations Manager, English Nature, Sites and Surveillance Team, Northminster House, Northminster Road, Peterborough, PE1 1UA, UK

34. Bibliographical references:

Scientific/technical references only. If biogeographic regionalisation scheme applied (see **15** above), list full reference citation for the scheme.

Site-relevant references

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APPENDIX 5

Appendix 5: Stage 1 Screening Matrices

Potential Effects

Potential effects upon the European site(s)* which are considered within the submitted HRA report are provided in the table overleaf:

* As defined in Advice Note 10.

Effects considered within the Stage 1 screening matrices

Designation	Effects described in submission information	Presented in screening matrices as
Thames Estuary and Marshes SPA	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area) • **Disturbance (from shipping)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area)	• 1) Disturbance (within SPA)
	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (using functionally linked habitats outside designation boundary) • **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (using functionally linked habitats outside designation boundary) • **Disturbance (from shipping)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species	• 2) Disturbance (outside SPA)

Designation	Effects described in submission information	Presented in screening matrices as
	(using functionally linked habitats outside designation boundary)	
	• Damage (negative changes) to habitats used by cited bird species from changes to **sediment circulation or deposition patterns** (within designated area) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality** including from dust, **construction waste and pollutants,** and exhaust emissions (within designated area) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)**	• 3) Habitat damage (within SPA)

Designation	Effects described in submission information	Presented in screening matrices as
	(within designated area)	
	• **Direct loss of and damage** to intertidal habitats used by cited bird species during construction, e.g. of proposed outfall (functionally linked habitats outside designation boundary) • Damage to or loss of habitats used by cited bird species from changes to **sediment circulation or deposition patterns** (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality**, including from dust, **construction waste and pollutants,** and exhaust emissions (functionally linked habitats outside	• 4) Habitat loss or damage (Functionally Linked Habitats – FLH - outside SPA)

Designation	Effects described in submission information	Presented in screening matrices as
	designation boundary) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)** (functionally linked habitats outside designation boundary)	
	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area and using functionally linked habitats outside designation boundary) • **Disturbance (from shipping)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area and using functionally linked habitats outside designation boundary) • **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (using functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats	• In Combination Effects

Designation	**Effects described in submission information**	**Presented in screening matrices as**
	used by cited bird species from changes to **sediment circulation or deposition patterns** (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality** including from dust, **construction waste and pollutants,** and exhaust emissions (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)**	

Designation	Effects described in submission information	Presented in screening matrices as
	(within designated area and functionally linked habitats outside designation boundary) • **Direct loss of and damage** to intertidal habitats used by cited bird species during construction (functionally linked habitats outside designation boundary)	
Thames Estuary and Marshes Ramsar Site	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area) • **Disturbance (from shipping)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area)	• 1) Disturbance (within Ramsar Site)
	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (using functionally linked habitats outside designation boundary) • **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress	• 2) Disturbance (outside Ramsar Site)

Designation	Effects described in submission information	Presented in screening matrices as
	responses amongst cited bird species (using functionally linked habitats outside designation boundary) • **Disturbance (from shipping)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (using functionally linked habitats outside designation boundary)	
	• Damage (negative changes) to habitats used by cited species from changes to **sediment circulation or deposition patterns** (within designated area) • Damage (negative changes) to habitats used by cited species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area) • Damage (negative changes) to habitats used by cited species from changes in **air quality** including from dust, **construction waste and pollutants,** and exhaust emissions (within	• 3) Habitat damage (within Ramsar Site)

Designation	Effects described in submission information	Presented in screening matrices as
	designated area) • Damage (negative changes) to habitats used by cited species from introduction or proliferation of **invasive non-native species (INNS)** (within designated area)	
	• **Direct loss of and damage** to intertidal habitats during construction, e.g. of proposed outfall, and to grazing marsh habitats from construction of the infrastructure corridor (functionally linked habitats outside designation boundary) • Damage to or loss of habitats used by cited species from changes to **sediment circulation or deposition patterns** (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (functionally linked habitats outside designation boundary)	• 4) Habitat loss or damage (FLH outside Ramsar Site)

Designation	Effects described in submission information	Presented in screening matrices as
	• Damage (negative changes) to habitats used by cited bird species from changes in **air quality** including from dust, **construction waste and pollutants,** and exhaust emissions (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from introduction or proliferation of **invasive non-native species (INNS)** (functionally linked habitats outside designation boundary)	
	• Local (Ramsar and wider) population level impacts to Criterion 2 plant/invertebrate species from direct **habitat loss and damage** to intertidal habitats during construction, e.g. of proposed outfall, and to grazing marsh habitats from construction of the infrastructure corridor • Damage or loss of Criterion 2 plant/invertebrate species from habitat changes arising from changes in **air quality** (including via **construction waste and pollutants**) • Damage or loss of Criterion 2 plant/invertebrate species from habitat changes arising from changes in	• 5) Damage or loss (non-bird Ramsar species)

Designation	Effects described in submission information	Presented in screening matrices as
	sediment circulation and deposition patterns • Damage or loss of Criterion 2 plant/invertebrate species from changes in **water and sediment quality** (including via **construction /operational waste and pollutants**) • Physiological stress or behavioural responses in Criterion 2 plant/invertebrate species caused by **lighting** • Damage or loss of Criterion 2 plant/invertebrate species from introduction or proliferation of **invasive non-native species (INNS)**	
	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area and using functionally linked habitats outside designation boundary) • **Disturbance (from shipping)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (within designated area and using functionally linked habitats outside designation boundary)	• In Combination Effects

Designation	Effects described in submission information	Presented in screening matrices as
	• **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (using functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes to **sediment circulation or deposition patterns** (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes in **air quality** including from dust, **construction waste and pollutants,** and exhaust emissions (within	

Designation	Effects described in submission information	Presented in screening matrices as
	designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from introduction or proliferation of **invasive non-native species (INNS)** (within designated area and functionally linked habitats outside designation boundary) • **Direct loss of and damage** to habitats used by cited species during construction (functionally linked habitats outside designation boundary)	

STAGE 1: SCREENING MATRICES

The European sites included within the screening assessment are:

THAMES ESTUARY AND MARSHES SPA (REF: UK9012021) (Matrix 1)

THAMES ESTUARY AND MARSHES RAMSAR SITE (REF: UK11069) (Matrix 2)

Evidence for, or against, likely significant effects on the European site(s) and its qualifying feature(s) is detailed within the footnotes that follow the screening matrices. Where a significant effect cannot be excluded, that potential impact source is carried forward to Stage 2 assessment

Matrix Key:

✓ = Likely significant effect **cannot** be excluded
✗ = Likely significant effect **can** be excluded

C = construction
O = operation
D = decommissioning

HRA Screening Matrix 1: Thames Estuary and Marshes SPA

Name of European site and designation: ***Thames Estuary and Marshes SPA***															
EU Code: ***UK9012021***															
Distance to NSIP: c.*1.5km*															
European site features	**Likely effects of NSIP**														
Effect	*1) Disturbance (within SPA)*			*2) Disturbance (outside SPA)*			*3) Habitat Damage (within SPA)*			*4) Habitat Loss or Damage (Functionally Linked Habitats outside SPA)*			*In combination effects*		
Stage of Development	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*
Article 4.1 qualifying feature: Avocet (winter)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.1 qualifying feature: Hen Harrier (winter)	**×a**	**×b**		**×d**	**×d**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.2 qualifying feature: Ringed Plover (passage)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.2 qualifying feature: Grey Plover (winter)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.2 qualifying feature: Knot (winter)	**×a**	**×b**		**×e**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	

Article 4.2 qualifying feature: Dunlin (winter)	**✕a**	**✕b**		**✓c**	**✕f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.2 qualifying feature: Black-tailed Godwit (winter)	**✕a**	**✕b**		**✓c**	**✕f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.2 qualifying feature: Redshank (winter)	**✕a**	**✕b**		**✓c**	**✕f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	
Article 4.2 qualifying feature: Total waterfowl (winter)	**✕a**	**✕b**		**✓c**	**✕f**		**✓g**	**✓g**		**✓h**	**✓h**		**✓k**	**✓k**	

HRA Screening Matrix 2: Thames Estuary and Marshes Ramsar Site

Name of European site and designation: ***Thames Estuary and Marshes Ramsar Site***																		
Ramsar Code: ***7UK141***																		
Distance to NSIP: c.*1.5km*																		
Ramsar qualifying features	**Likely effects of NSIP**																	
Effect	*1) Disturbance (within Ramsar Site)*			*2) Disturbance (outside Ramsar Site)*			*3) Habitat Damage (within Ramsar Site)*			*4) Habitat Loss or Damage (Functionally Linked Habitats outside Ramsar Site)*			*5) Damage or loss (non-bird species)*			*In combination effects*		
Stage of Development	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*
Criterion 2 qualifying feature (nationally rare and scarce plant and invertebrate species)	**×i**	**×i**		**×i**	**×i**		**✓g**	**✓g**		**✓h**	**✓h**		**✓j**	**✓j**		**✓k**	**✓k**	
Criterion 5 qualifying feature: Total waterfowl (winter)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	
Criterion 6 qualifying feature: Ringed Plover (passage)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	
Criterion 6 qualifying feature: Black Tailed Godwit (passage)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	
Criterion 6 qualifying feature: Grey Plover	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	

(winter)																		
Criterion 6 qualifying feature: Knot (winter)	**×a**	**×b**		**×e**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	
Criterion 6 qualifying feature: Dunlin (winter)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	
Criterion 6 qualifying feature: Redshank (winter)	**×a**	**×b**		**✓c**	**×f**		**✓g**	**✓g**		**✓h**	**✓h**		**×i**	**×i**		**✓k**	**✓k**	

Evidence supporting conclusions (note that the same supporting evidence may be referred to for both the SPA and Ramsar Site as their extents and boundaries are largely coterminous):

a. The distance between the Tilbury2 site and the nearest part of the SPA/Ramsar (foreshore adjoining Eastcourt/Shorne Marshes on the opposite (southern) side of the Thames) is just under 1.5km. The nearest near-shore component (Mucking Flats) is just over 2.4km. These areas are, furthermore, the westernmost extremity of both the SPA and Ramsar Site, which cover 4,838.94 and 5,588.59 ha respectively extending eastward from these points up to 24km distant at Grain. The vast majority of both the SPA and Ramsar Site is therefore >3km removed from the Tilbury2 site. Such distances alone militate against any likely significant effect on qualifying bird species using the SPA/Ramsar Site from visual disturbance emanating from the construction site, or from lighting (on the basis of the information and lux modelling provided in ES Appendix 9.J, in particular the Indicative Lighting Layouts at Appendix B [APP-044], the key figure from which is reproduced within this HRA report). The potential magnitude of change in noise generation as compared to the baseline position is assessed in ES Chapter 17 and the outputs of that assessment are considered in terms of implications for ecological receptors in ES Chapter 10. Peak or mean (i.e. 24hr) noise in excess of 55dB is not predicted to be experienced at distances in excess of 300m from the site for most construction or operational activities, with the exception of construction-phase jetty piling and dredging and pavement construction. The foremost of these could see noise levels of 63dB at 300m from source with the latter having the potential to slightly exceed the 55dB level at 300m (ES Chapter 17 Table 17.30 [APP-031]). These data indicate that noise levels during construction would not be sufficient to elicit any behavioural responses in birds at just under 1.5km (the nearest point of the SPA/Ramsar Site). Additional shipping movements during construction will be minimal (and lower than those considered for the operational phase under footnote ‘b’ below) and no assessment thresholds for shipping movements would be exceeded. Whilst construction phase movements will include additional barge movements to Mucking landfill and its jetty (carrying translocated brownfield substrates) and this will involve shipping traffic within the SPA/Ramsar Site, these additional barge movements will be accommodated within the normal and ongoing delivery pattern of restoration materials to Mucking jetty and will not represent an uplift on disturbance at that location due to the combined and absolute limitations of berthing capacity and tidal restrictions at that site. Thus there is assessed to be no likely significant effect on the SPA or Ramsar Site from the limited shipping activity associated with the construction phase. In consequence, there is no likely significant effect on cited SPA or Ramsar bird species using the designated areas and no need to progress this part of the assessment to Stage 2.

b. In the operational phase, the mitigating effect of distance similarly rules out a likely significant effect (LSE) on qualifying bird species within the SPA/Ramsar Site from lighting (based on the operational lighting design and predicted Lux contours reported in the Preliminary Lighting Strategy and Impact Assessment at Appendix 9.J of the ES [APP-044] – noting that DCO will require the final lighting strategy to be in general accordance with this Preliminary Lighting Strategy) or visual disturbance emanating from the site. Noise levels generated within the site during operation are unlikely to exceed the peaks associated with construction-phase piling and can therefore also be ruled out as having the potential to give rise to a LSE on the SPA/Ramsar Site. Some increase in potential for LSE from disturbance during operation is associated with the predicted uplift in shipping traffic generated by the operational port (i.e. an increase of 1,792 vessel movements per annum over the existing 17,092 movements, see ES Navigation chapter, paras 14.18-14.25 [APP-031]), as these increased vessel movements will occur along a broad (c.24km) interface with the SPA and Ramsar Site, albeit that the navigable channel is typically >200m from the SPA/Ramsar Site boundary. Increased Tilbury2 port-related shipping movements along the Thames bring with them some scope for increased disturbance from noise, lighting and related visual disturbance caused by the movement of vessels *per se*. However, because the majority of vessels will be large, with a corresponding large draught, such potential impact sources will be along predictable mid-channel paths, relatively remote (e.g. >200m) from designated intertidal habitats and will be experienced by avian receptors against a backdrop of existing regular traffic of large, distant vessels. The additional shipping movements from Tilbury2 alone are therefore assessed to represent an imperceptible increase in disturbance in the context of existing levels of habituation. In consequence, there is assessed to be no likely significant effect on cited SPA or Ramsar bird species using the designated areas and no need to progress to Stage 2 appropriate assessment in respect of this potential impact source. In-combination effects are considered under ‘k’ below.

c. Avocet, ringed plover, grey plover, black-tailed godwit and redshank (Birds Directive Article 4.1 and 4.2 qualifying species; and Ramsar Criteria 5 and 6 species) all make use of intertidal habitats in closer proximity to the Tilbury2 site than the SPA/Ramsar Ste itself. The individual birds involved will in most cases be part of the local wintering or passage population that forms the qualifying feature. Quantitative data on the numbers using intertidal habitats within and in proximity to the proposed DCO limits is provided by the baseline information reported on at ES Chapter 10 (in particular Table 10.41) and further expanded upon in the technical 'Bird Note' (Appendix 9 to this HRA report, in particular Table 5). The data indicate that peak numbers using intertidal habitat within 300m from the proposed Order Limits at any one time remains in all recorded cases than 1% of the SPA/Ramsar Site population (Appendix 9 to this HRA report, Table 7). 300m is taken as a rational outer extent of impact envelope for significant construction-phase disturbance taking into account literature on response distances amongst the bird species concerned (see Table 2 within the main body of this HRA report) and outputs from the impact studies reported in the ES (in particular noise – Chapter 17, Table 17.30 [APP-031]). Due to the sub-significant levels of use of intertidal habitats within this 300m envelope by SPA/Ramsar Site species in the baseline state, even if significant temporary construction phase disturbance effects could occur on receptors within it that are functionally linked to the SPA/Ramsar Site, the result (up to and including temporary displacement) is assessed as not likely to give rise to a significant effect on the qualifying features. However Natural England are of the view that a significant effect cannot be excluded, in large part due to sources of external bias in the long-term dataset (especially the suggestion that activity associated with the marine infrastructure improvement works at Goshems Farm jetty and related activities during 2016 and 2017), and for precautionary reasons therefore**, disturbance to cited bird species using functionally linked habitats is progressed to Stage 2 appropriate assessment**.

d. Hen harrier is not likely to make any significant use of habitats that are potentially affected by construction phase disturbance effects (either within or outside the SPA), and the baseline surveys have not recorded any use of the Tilbury2 site by this species more generally (ES Chapter 10 [APP-031]; noting that the single record made by Mr Larkin at Table 3 of the Bird Note at Appendix 9 to this HRA report relates to an individual somewhere along the foreshore between Tilbury and Coalhouse "flying over to Kent"). In consequence, there is assessed to be no scope for likely significant effect on the SPA through this receptor and no need to progress to Stage 2 appropriate assessment in respect of effects on this qualifying feature.

e. Knot has not been recorded using functionally linked intertidal habitats within potential range of construction-phase disturbance effects in either the baseline surveys reported on at ES Chapter 10 (in particular Table 10.41 [APP-031]) or to any meaningful level in the expanded dataset reported in the technical 'Bird Note' (Appendix 9 to this HRA report). As such, while small-scale transient use of the 300m envelope around the Tilbury2 DCO boundary by knot cannot be discounted, there is assessed to be no scope for likely significant effect and no need to progress to Stage 2 appropriate assessment in respect of this qualifying feature.

f. The scope for significant disturbance effects on populations of SPA and Ramsar Site qualifying bird species using areas outside the respective designation boundaries is somewhat greater during the operational phase by virtue of the predicted uplift in vessel traffic along the river. However, the envelope of potentially significant disturbance effects during the operational phase is substantially smaller than in the construction phase and it captures far less habitat with a potential functional linkage to the SPA and Ramsar Site. In addition, the same factors militating against LSE apply when putting this uplift into context as discussed for birds using areas within the respective designations (under (b) above) and, when considered with the sensitivity of each bird species to disturbance by reference to the TIDE toolkit (for which, refer to Table 2 of this HRA report), and the far lower (and sub-significant) numbers of individuals present closer to the application site, there are assessed to be <u>no likely significant effects</u> arising and no need to progress to Stage 2 appropriate assessment in respect of this potential impact.

g. Based on the outputs of impact assessments reported on within the appendices to ES [APP-031] Chapters 11 (marine ecology) and 16 (water resources and flood risk – including the Water Framework Directive Assessment at Appendix 16.C [APP-088] and the Hydrodynamic Modelling Study at Appendix 16.D to the ES [APP-089], and as Appendix 8 of this HRA report), there is assessed to be no scope for significant changes to baseline sediment circulation (erosion and deposition) regimes within the SPA/Ramsar Site boundary arising as a consequence of marine works and dredging, during either the construction or operational phase. However, one of the two <u>capital</u> dredging scenarios assessed (namely dispersal dredging by water injection (WID)), and the favoured method of <u>maintenance</u> dredging (also WID) have the potential to give rise to very minor, highly localised and temporary increases in sediment deposition within the intertidal areas of the SPA/Ramsar Site (see Appendix 8). Note that for maintenance dredging, whilst other methods could be used, these would also be subject to the relevant controls. Natural England consider that on the basis of the conclusions of the objective technical study, a significant effect cannot therefore be excluded beyond all reasonable scientific doubt, and **therefore the potential effects arising from minor changes in sediment circulation patterns is progressed to Stage 2 appropriate assessment**.

In respect of water quality, localised elevated concentrations of PAHs including perylene, pyrene and fluoranthene and of metals including Arsenic, Chromium and Nickel have been found in samples of sediment around the existing Tilbury2 jetty and (in particular) the approach channel to it (ES Appendix 11.C [APP-088]). This is not unusual for Thames Estuary sediments. The contaminants of concern in this case generally have low solubility and where mobilised will mostly remain adsorbed onto sediment particles. This reduces the potential for contamination of the water column, but could pose a risk to sediment dwelling organisms were these substances to be re-deposited at high concentrations. The risk to marine and estuarine biota is generally assessed in ES Chapter 11 [APP-031]. Risk to higher trophic orders, including SPA and Ramsar

Site cited fauna is mainly possible through these substances becoming directly bio-available in re-distributed sediments and or from biomagnification through the food chain, although the risks from biomagnification in the case of PAHs are ameliorated due to the greater capacity of higher organisms to metabolise PAHs. An assessment of the risks of significantly contaminated sediments around the Tilbury2 jetty being redistributed onto intertidal habitats within or otherwise functionally linked to the SPA and Ramsar Site is reported at Appendix 8 to this HRA report, section 6, focusing on the PAH perylene. It assesses its risk to the marine environment and the likelihood of its dispersion based on its solubility between the sediments, water and biota. This assessment indicates that perylene mobilised during dredging operations has a very low risk of becoming available to SPA/Ramsar cited species, with in particular a very low risk of significant deposition onto intertidal areas both proximal to the Tilbury2 jetty and within the SPA/Ramsar Site further afield. Other contaminants adsorbed to sediments will follow a similar dispersion pathway and therefore the risk of significant effects from mobilisation of other PAHs and metals observed at elevated levels in the samples is assumed to be equivalent or less than for perylene. However, because a significant effect cannot be excluded **this potential impact source is progressed to Stage 2 appropriate assessment**.

In respect of air quality, emissions of NOx and SO_2 from the proposed increase in vessel traffic on the Thames arising from the operation of Tilbury2 have been modelled against baseline (background) levels, as set out in Appendix 6 and 7 of this HRA report. The results indicate that increases in atmospheric levels and/or deposition loads of both NOx and SO_2 on habitats within the SPA/Ramsar Site boundary will not be significant (in both peak and mean scenarios resulting in all instances in increases of less than 1% compared with critical levels/loads) and will not result in accepted critical loads for saltmarsh, mudflat or coastal grazing marsh habitat being exceeded. Consequently there is assessed to be no likely significant effect on critical levels or critical loads for NOx and SO2 within the SPA and Ramsar Site, although as there is no equivalent assessment for functionally linked habitats and the predicted change to the 24 hour mean is approaching the 1% significance threshold a precautionary approach is taken (specifically in respect of scarce plant species constituting Ramsar qualifying features) and **therefore this potential impact source is progressed to Stage 2 appropriate assessment.**

In respect of invasive non-native species (INNS), the main risk is assessed to be the increase in shipping traffic being likely to elevate the risk of introducing foreign marine or estuarine organisms. Marine organism accumulations on the hulls of ocean-going vessels could detach from the ship while it is moored or transiting on the Thames. INNS could also be present in ballast water discharged by such vessels, if this occurs while the ship is in the river. The level of risk is difficult to quantify, and has to be viewed in the context of the Thames already being one of the world's busiest inshore waters for international shipping. It will depend on the port of origin of vessels and adherence to INNS managing and mitigation measures. The risk of significant effect cannot however be excluded and therefore this potential impact source is **progressed to Stage 2 appropriate assessment.**

h. For effects arising from direct loss of or damage to functionally linked habitat, see references to functionally linked habitats under ‘g’ above and to functionally linked populations of Criterion 2 species under ‘j’ below. The risk of significant effects cannot be excluded and therefore for precautionary reasons this potential impact source is **progressed to Stage 2 appropriate assessment.**

i. Not applicable.

j. In both the construction and operational phases, the effect of distance rules out a likely significant effect on Criterion 2 invertebrate and plant species within the Ramsar Site from lighting (based on the lighting design and predicted Lux contours reported in ES Appendix 9.J [APP-044] including the key Indicative Lighting Strategy figure as reproduced within this HRA report) and from dust deposition impacts. Impacts to such species (within or outside the Ramsar boundary) could however occur in both the construction and operational phases from the introduction of invasive non-native species (INNS), or by habitat changes triggered by exceedance of critical loads for atmospheric pollutants or (in respect of cited plant and invertebrate species associated with intertidal habitats) from changes in sediment circulation systems and deposition patterns or from localised or wider water quality or sediment quality changes within the Thames system (see under ‘g’ above).

Of the fifteen nationally rare or scarce plant species cited in the Ramsar Information Sheet, only three have been recorded on the Tilbury2 site. For these species, direct habitat loss outside the Ramsar Site boundary and within the Order Limits may result in losses of small numbers of individuals e.g. divided sedge *Carex divisa* and annual beard grass *Polypogon monspeliensis* within the infrastructure corridor and golden samphire *Inula crithmoides* at the proposed Thames outfall. However, these losses will be at a *de minimis* level, with any potential for effects at the population-level being limited by virtue of the small number of plants involved and the continued presence of these species in other nearby habitat outside of the Ramsar Site. Of the twenty-seven Ramsar-cited invertebrate species, at least seven have previously been recorded within or in the immediate environs of the Tilbury2 site (ES Chapter 10). As a consequence of direct habitat loss there is a credible risk of losses of individuals of Criterion 2 invertebrate species that have been recorded within the Order Limits (e.g. the water beetle *Aulacochthebius (=Ochthebius) exaratus*) but the potential for effects at the population-level is considered low, and by extension the risk of significant indirect effects on the Ramsar Site populations is considered very low. Outside the Ramsar Site boundary and in intertidal habitats close to the jetty, lighting impacts could affect functionally linked populations of Criterion 2 species, potentially initiating physiological responses that could affect species lifecycles, life strategies and the long-term viability of populations. However only one of these (golden samphire) in intertidal habitats is potentially at risk of lighting effects (further details in Chapter 10 of the ES [APP-031]). The location where this species grows will have been subject to light spill effects from past operational phases of the jetty (when the power station was active) and there is no evidence that this influenced the distribution or vigour of the colony, or (within scientific literature) that this species is sensitive to light pollution generally. Ramsar-cited invertebrate species are similarly not assessed to be at risk of significant impacts from lighting, noise, dust and other emissions given their co-existence with the operational power station and its jetty in the past. In respect of the 3.5ha losses of coastal and floodplain grazing marsh, which typically encompasses poorer quality grassland habitat, a combination of on-site and geographically relevant off-site compensation is proposed to ensure no net loss of priority Thames Estuary grazing marsh habitats and associated ditch systems as reported on in Chapter 10 of the ES (and subsequently the EMCP [PoTLL/T2/EX/165]. As grazing marsh habitats are of value or potential value to species such as *Lestes dryas*, *Stratiomys longicornis*, *Haematopota bigoti, Aulacochthebius exaratus* and *Anisodactylus poeciloides* this further obviates the scope for any effect on the Ramsar populations by virtue of any functional linkage that may exist. For saltmarsh species such as *Malachius vulneratus*, the near-complete retention of coastal saltmarsh habitats and the low scope for any change to their supporting processes should further ensure no significant effect from habitat loss generally. Note that this conclusion is reached on the basis that the habitat losses relate to poorer quality examples of grazing marsh, and *de minimis* loss of saltmarsh habitat, i.e. without reliance on the compensatory provision proposed in pursuit of 'no net loss' of priority habitat.

In large part due to uncertainty as to physiological responses and the degree of any (likely tenuous) functional linkage to Ramsar Site populations, the scope for likely significant effects on cited Ramsar plant and invertebrate species cannot therefore be excluded and **for precautionary reasons are thus taken forward to Stage 2 appropriate assessment**.

k. Cumulative (additive or synergistic) effects are possible for most of the potential impact sources arising from Tilbury2 when considered in-combination with other projects. The extent to which these have the potential to give rise to significant effects on the SPA and Ramsar Site, directly or via functionally linked features, varies, but significant effects cannot be excluded in particular for disturbance (from shipping), disturbance to functionally linked habitat used by cited bird species, cumulative effects on air quality, cumulative effects on sediment circulation processes and water quality and additive risks from invasive non-native species. **Consequently, in-combination effects are progressed to Stage 2 appropriate assessment.**

APPENDIX 6

Air Quality Impacts on Designated Ecological Sites:

Tilbury 2 Dock, Thurrock

October 2017

Experts in air quality
management & assessment

Document Control

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1 Introduction

1.1 This note presents the results of the assessment of potential air quality impacts on designated ecological sites associated with the proposed Tilbury 2 Dock at the Port of Tilbury. The emissions from additional ship movements generated by the proposed new dock could impact on designated sites adjacent to the Thames.

1.2 The pollutants of concern associated with shipping emissions are nitrogen oxides (NOx) and sulphur dioxide. Detailed modelling inputs are presented in Appendix A1.

1.3 Impacts from the additional vessel movements have been determined for a grid of receptor points covering nearby ecological receptors within the wider study area. These include the South Thames Estuary and Marshes Site of Special Scientific Interest (SSSI) and Mucking Flats and Marshes SSSI. These two designated sites are components of the larger Thames Estuary and Marshes Special Protection Area (SPA). Impacts on those areas of the SPA within the constituent SSSIs have been assessed.

1.4 The potential impacts from the proposed dock considered in this assessment are those associated with the additional shipping contributions to:

- annual mean NOx concentrations;
- 24-hour mean NOx concentrations;
- annual mean sulphur dioxide concentrations;
- annual mean nitrogen deposition fluxes; and
- annual mean acid deposition fluxes.

1.5 Contributions to levels of nitrogen and acid deposition have been combined with baseline deposition levels and compared against the Critical Loads applicable to the ecological sites listed above. Additionally, the contributions to the annual mean and maximum 24-hour mean NOx concentrations have been combined with baseline concentrations and compared against the annual mean and 24-hour mean Critical Levels (respectively 30 $\mu g/m^3$ and 75 $\mu g/m^3$). The contribution to the annual mean sulphur dioxide concentrations, combined with baseline concentrations, has been compared against the annual mean Critical Level (20 $\mu g/m^3$).

1.6 The Critical Loads and Critical Levels considered in this assessment for each ecological site assessed are presented in Table 1 and Table 2 below. Critical Loads are expressed as ranges. In Table 1, this range has been extended to include the maximum and minimum Critical Loads for any habitat within each site.

Table 1: Vegetation and Ecosystem Critical Loads [a]

Ecological Site	Designation	Critical Load (kg N/ha/yr) [b]	NMax Critical Load (keq/ha/yr)
Thames Estuary & Marshes	SPA	8 - 30	0.743 – 5.710
South Thames Estuary & Marshes	SSSI	8 - 30	0.733 – 5.710
Mucking Flats & Marshes	SSSI	8 - 30	4.558 – 5.710

[a] Critical Loads for nutrient nitrogen deposition and acid deposition taken from (APIS, 2017).

[b] A range of Critical Loads is presented to address the different ecological features present at each designated site. The lower end of the ranges corresponds to lower-bound of the Critical Load range for acid type coastal stable dune grasslands, and is not representative of the entirety of each designated site.

Table 2: Vegetation and Ecosystem Critical Levels [a]

Pollutant	Time Period	Critical Level
NOx (expressed as NO_2)	Annual Mean [a,b]	30 µg/m^3
	24-Hour Mean [a,c]	75 µg/m^3
Sulphur Dioxide	Annual and Winter Mean [a,b]	20 µg/m^3

[a] The Critical Levels are defined by the World Health Organisation (WHO, 2000).

[b] Away from major sources, this Critical Level is set as an objective (Defra, 2007) and a limit value (Directive 2008/50/EC of the European Parliament and of the Council, 2008).

[c] This critical level is not an objective and thus does not have the same legal standing.

1.7 Background nitrogen and acid deposition fluxes, and background NOx and SO_2 concentrations at the designated sites have been taken from the APIS website (APIS, 2017) and are presented in Table 3. Background nutrient nitrogen deposition rates potentially[1] exceed the Critical Load in all three designated sites. Background acid nitrogen deposition rates are potentially exceeding the Critical Load in the Thames Estuary and Marshes SPA and the South Thames Estuary and Marshes SSSI. All three sites have annual mean NOx concentrations in excess of the Critical Level, but there are no exceedances of the Critical Level for annual mean SO_2.

[1] Assuming the lowest end of the Critical Load range applies.

Table 3: Background Deposition Fluxes and Annual Mean Concentrations

Ecological Site	Nutrient Nitrogen Deposition (kgN/ha/yr)	Acid Nitrogen Deposition (keq/ha/yr)	NOx Concentration ($\mu g/m^3$)	SO_2 Concentration ($\mu g/m^3$)
Thames Estuary & Marshes	9.5 – 16.0	0.66 – 1.20	18.3 – 35.3	0.3 – 1.1
South Thames Estuary & Marshes	5.2 – 14.8	0.35 – 1.08	17.1 – 35.3	0.3 – 1.1
Mucking Flats & Marshes	8.1 – 16.0	0.56 – 1.16	27.3 – 33.7	0.5 – 0.8

2 Impact Assessment

2.1 Air quality impacts on the three designated ecological sites, expressed as both the maximum and minimum additional shipping contribution (i.e. the maximum and minimum impacts anywhere within each modelled ecological site), are presented in Table 4, Table 5, Table 6, Table 7, Table 8 and Table 9 below. The additional shipping emissions would lead to extremely small changes in concentrations and deposition fluxes. The changes are so small that they would not change the concentrations and deposition fluxes when they are rounded to the level precision presented by APIS.

Table 4: Predicted Maximum Pollutant Concentrations at Thames Estuary and Marshes SPA (µg/m^3)

Pollutant/Averaging Period	Maximum Additional Shipping Contribution	Background Level	Total Background and Process Contribution [a]	% Change Relative to Background Level	% Change Relative to Critical Level/Load
Annual Mean NOx (µg/m^3)	0.00048	18.3 – 35.3	18.3 – 35.3	0.001 – 0.003	0.002
24-Hour Mean NOx (µg/m^3)	0.0076	N/A	N/A	N/A	0.01
Annual Mean Sulphur Dioxide (µg/m^3)	0.000017	0.3 - 1.1	0.3 – 1.1	0.002 – 0.006	0.00009
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.000048	9.5 – 16.0	9.5 – 16.0	0.0003 – 0.0005	0.0002 – 0.0006
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0000055	0.66 – 1.20	0.66 – 1.20	0.0005 – 0.0008	0.0001 – 0.0007

[a] Adding the maximum shipping contribution to the range in background levels.

Table 5: Predicted Minimum Pollutant Concentrations at Thames Estuary and Marshes SPA (µg/m^3)

Pollutant/Averaging Period	Minimum Additional Shipping Contribution	Background Level	Total Background and Process Contribution [a]	% Change Relative to Background Level	% Change Relative to Critical Level/Load
Annual Mean NOx (µg/m^3)	0.00019	18.3 – 35.3	18.3 – 35.3	0.0005 – 0.001	0.0006
24-Hour Mean NOx (µg/m^3)	0.0014	N/A	N/A	N/A	0.002
Annual Mean Sulphur Dioxide (µg/m^3)	0.0000068	0.3-1.1	0.3 – 1.1	0.0006 – 0.002	0.00003
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.000019	9.5 – 16.0	9.5 – 16.0	0.0001 – 0.0002	0.00006 – 0.0002
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0000022	0.66 – 1.20	0.66 – 1.20	0.0002 – 0.0003	0.00004 – 0.0003

[a] Adding the minimum shipping contribution to the range in background levels.

Table 6: Predicted Maximum Pollutant Concentrations at South Thames Estuary and Marshes SSSI (µg/m^3)

Pollutant/Averaging Period	Maximum Additional Shipping Contribution	Background Level	Total Background and Process Contribution [a]	Contribution as % of Background Level	% of Critical Level
Annual Mean Nitrogen Oxides (µg/m^3)	0.00048	17.1 – 35.3	17.1 – 35.3	0.001 – 0.003	0.002
24-Hour Mean Nitrogen Oxides (µg/m^3)	0.0076	N/A	N/A	N/A	0.01
Annual Mean Sulphur Dioxide (µg/m^3)	0.000017	0.3 – 1.1	0.3 – 1.1	0.002 – 0.006	0.00008
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.000048	5.2 – 14.8	5.2 – 14.8	0.0003 – 0.0009	0.0002 – 0.0006
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0000055	0.35 – 1.08	0.35 – 1.08	0.0005 – 0.002	0.0001 – 0.0007

[a] Adding the maximum shipping contribution to the range in background levels.

Table 7: Predicted Minimum Pollutant Concentrations at South Thames Estuary and Marshes SSSI (μg/m³)

Pollutant/Averaging Period	Minimum Additional Shipping Contribution	Background Level	Total Background and Process Contribution [a]	Contribution as % of Background Level	% of Critical Level
Annual Mean Nitrogen Oxides (μg/m³)	0.00019	17.1 – 35.3	17.1 – 35.3	0.0005 – 0.001	0.0006
24-Hour Mean Nitrogen Oxides (μg/m³)	0.0014	N/A	N/A	N/A	0.002
Annual Mean Sulphur Dioxide (μg/m³)	0.0000068	0.3 – 1.1	0.3 – 1.1	0.0006 – 0.002	0.00003
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.000019	5.2 – 14.8	5.2 – 14.8	0.0001 – 0.0004	0.00006 – 0.0002
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0000022	0.35 – 1.08	0.35 – 1.08	0.0002 – 0.0006	0.00004 – 0.0003

[a] Adding the minimum shipping contribution to the range in background levels.

Table 8: Predicted Maximum Pollutant Concentrations at Mucking Flats and Marshes SSSI (µg/m^3)

Pollutant/Averaging Period	Maximum Additional Shipping Contribution	Background Level	Total Background and Process Contribution [a]	Contribution as % of Background Level	% of Critical Level
Annual Mean Nitrogen Oxides (µg/m^3)	0.00038	27.3 – 33.7	27.3 – 33.7	0.001	0.001
24-Hour Mean Nitrogen Oxides (µg/m^3)	0.0041	N/A	N/A	N/A	0.005
Annual Mean Sulphur Dioxide (µg/m^3)	0.000013	0.5 – 0.8	0.5 – 0.8	0.002 – 0.003	0.00007
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.000038	8.1 – 16.0	8.1 – 16.0	0.0002 – 0.0005	0.0001 – 0.0005
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0000043	0.56 – 1.16	0.56 – 1.16	0.0004 – 0.0008	0.00008 – 0.00009

[a] Adding the maximum shipping contribution to the range in background levels.

Table 9: Predicted Minimum Pollutant Concentrations at Mucking Flats and Marshes SSSI ($\mu g/m^3$)

Pollutant/Averaging Period	Minimum Additional Shipping Contribution	Background Level	Total Background and Process Contribution	Contribution as % of Background Level	% of Critical Level
Annual Mean Nitrogen Oxides ($\mu g/m^3$)	0.00033	27.3 – 33.7	27.3 – 33.7	0.001	0.001
24-Hour Mean Nitrogen Oxides ($\mu g/m^3$)	0.0027	N/A	N/A	N/A	0.004
Annual Mean Sulphur Dioxide ($\mu g/m^3$)	0.000012	0.5 – 0.8	0.5 – 0.8	0.001 – 0.002	0.00006
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.000034	8.1 – 16.0	8.1 – 16.0	0.0002 – 0.0004	0.0001 – 0.0004
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0000038	0.56 – 1.16	0.56 – 1.16	0.0003 – 0.0007	0.00007 – 0.00008

[a] Adding the minimum shipping contribution to the range in background levels.

3 References

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4 Appendices

A1 Modelling Methodology

A1.1 The impacts of emissions from the development-generated vessel movements have been predicted using the ADMS-5 dispersion model. ADMS-5 is a new generation model that incorporates a state-of-the-art understanding of the dispersion processes within the atmospheric boundary layer. The model has been run to predict the contribution of the proposed shipping emissions to annual mean concentrations of nitrogen oxides and sulphur dioxide, and the maximum 24-hour mean concentrations of nitrogen oxides.

A1.2 Concentrations have been predicted across a nested Cartesian grid of receptors covering the entirety of the SSSIs, as well as the wider study area. Receptors have been spaced 200 m apart outside of the designated habitats and 100 m apart within the designated ecological site boundaries.

A1.3 Hourly sequential meteorological data from Gravesend for 2013, 2014 and 2016 have been used in the model. The Gravesend meteorological station is deemed to be the nearest monitoring station representative of meteorological conditions in the vicinity of the proposed development site; both the development site and the Gravesend meteorological monitoring station are located at near-estuarine locations in the southeast of England where they will be influenced by the effects of estuarine meteorology.

A1.4 Information on additional vessel movements and fleet composition associated with Tilbury 2 Dock has been provided by Port of Tilbury London Ltd. Specifications for the new development-generated vessels have been taken from technical datasheets for similar existing vessels, which have been identified by Port of Tilbury London Ltd. Vessel technical details are presented in Table A1.1 below. Using these details, nitrogen oxides and sulphur dioxide emissions rates have been calculated following the methodology established by Entec (2010). This approach assigns emissions factors to vessels based on engine speed and fuel type, and calculates an emission rate according to engine power and distance travelled. The total emission rates for all vessels included in this assessment are presented in Table A1.2. Table A1.2 also defines other model inputs used in the assessment. Exhaust temperature and efflux velocity have been taken from a report by CONservation of Clean Air and Water in Europe (CONCAWE, 1994). Source height has been determined from vessel technical drawings. Figure A1.1 shows the shipping lane included within the model and defines the study area.

Table A1.1: Vessel Specifications

Parameter	Value
CMAT Aggregates Vessels – e.g. JS AMAZON	
Annual Vessel Movements	40
Main Engine	Doonan MAN B&W 5S60ME-C8-TII
Main Engine Rotations Per Minute	91
Main Engine Power (kW)	8,300
Main Engine Fuel	MGO
Auxiliary Engine	3 x CME-MAN, 5L23/30H
Auxiliary Engine Rotations Per Minute	720
Auxiliary Engine Power (kW)	615
Auxiliary Engine Fuel	MGO
Vessel Average Speed (kph)	19.6
RoRo Vessels – e.g. M/V Bore Sea	
Annual Vessel Movements	1,452
Main Engine	Wärtsilä 12V46F-CR
Main Engine Rotations Per Minute	600
Main Engine Power (kW)	12,000
Main Engine Fuel	MGO
Auxiliary Engine	2 x Caterpillar 3508B
Auxiliary Engine Rotations Per Minute	1,500
Auxiliary Engine Power (kW)	1,270
Auxiliary Engine Fuel	MDO
Vessel Average Speed (kph)	27.0

Table A1.2: Model Inputs

Parameter	Value
Total Nitrogen Oxides Emission Rate (g/m/s)	0.00019
Total Sulphur Dioxide Emission Rate (g/m/s)	0.0000069
Exhaust Temperature (°C)	280
Efflux Velocity (m/s)	30
Source Height (m)	40.5

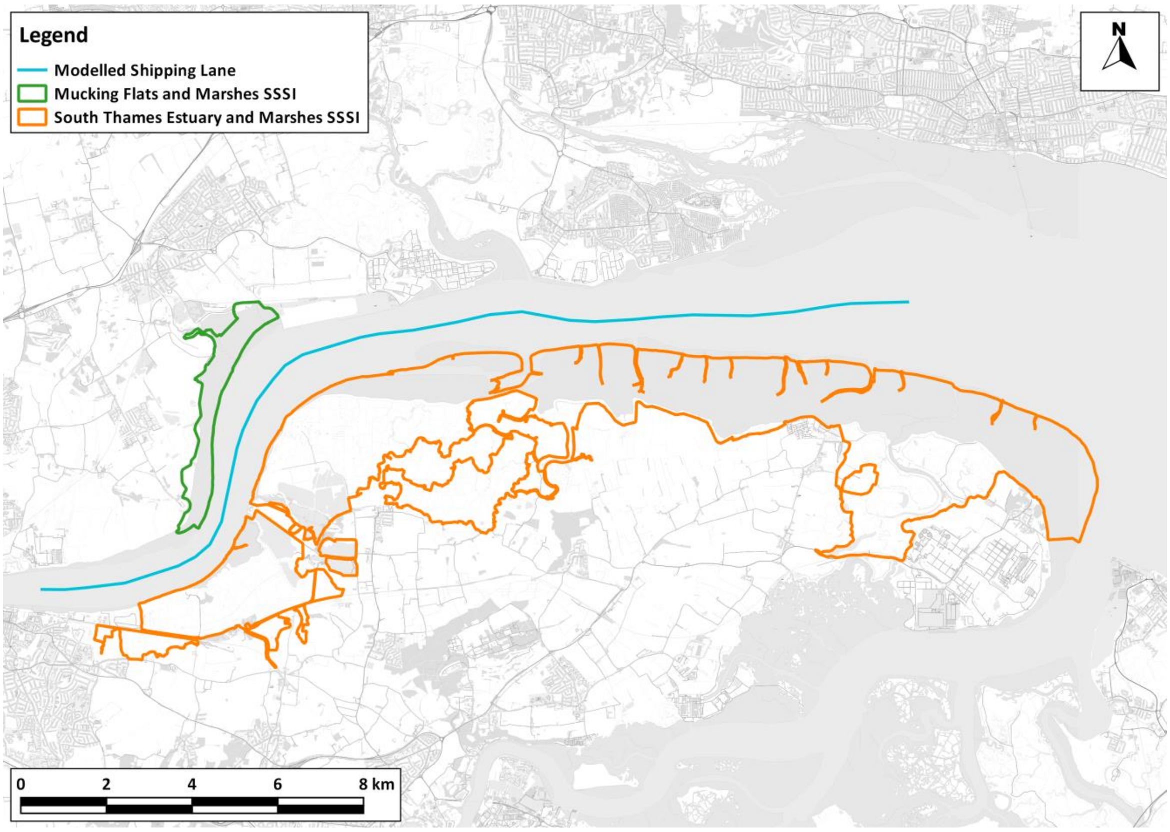

Figure A1.1: Modelled Shipping Lane and SSSI boundaries

Deposition Rates

A1.5 Deposition has not been included within the dispersion model because the principal depositing component of concern is nitrogen dioxide and this is calculated from nitrogen oxides outside of the model. Instead, deposition has been calculated from the predicted ambient concentrations using the deposition velocities set out in Table A1.3. Deposition velocities refer to a height above ground, typically 1 or 2 m, although in practice the precise height makes little difference and here they have been applied to concentrations predicted at a height of 1.5 m above ground. The velocities are applied simply by multiplying a concentration (µg/m^3) by the velocity (m/s) to predict a deposition flux (µg/m^2/s). Subsequent calculations required to present the data as kg/ha/yr of nitrogen or sulphur and as keq/ha/yr for acidity follow basic chemical and mathematical rules[2].

[2] For example, 1 kg N/ha/yr = 0.071 keq/ha/yr

Table A1.3: Deposition Velocities Used in This Assessment

Pollutant	Deposition Velocity (m/s)	Reference
Nitrogen Dioxide	0.0015 m/s (Grassland)	AQTAG06 (Environment Agency, 2011)
Sulphur Dioxide	0.012 m/s (Grassland)	AQTAG06 (Environment Agency, 2011)

A1.6 Wet deposition has been discounted. Wet deposition of the emitted pollutants this close to the emission source will be restricted to wash-out, or below cloud scavenging. For this to occur, rain droplets must come into contact with the gas molecules before they hit the ground. Falling raindrops displace the air around them, effectively pushing gasses away. The low solubility of nitrogen dioxide means that any scavenging of this gas will be a negligible factor. While wash-out of sulphur dioxide might be more significant, the very low sulphur oxide emission rates mean that discounting wet deposition is highly unlikely to affect the outcomes of the assessment.

A2 Professional Experience

Prof. Duncan Laxen, BSc (Hons) MSc PhD MIEnvSc FIAQM

Prof Laxen is the Managing Director of Air Quality Consultants, a company which he founded in 1993. He has over forty years' experience in environmental sciences and has been a member of Defra's Air Quality Expert Group and the Department of Health's Committee on the Medical Effects of Air Pollution. He has been involved in major studies of air quality, including nitrogen dioxide, lead, dust, acid rain, PM_{10}, $PM_{2.5}$ and ozone and was responsible for setting up the UK's urban air quality monitoring network. Prof Laxen has been responsible for appraisals of all local authorities' air quality Review & Assessment reports and for providing guidance and support to local authorities carrying out their local air quality management duties. He has carried out air quality assessments for power stations; road schemes; ports; airports; railways; mineral and landfill sites; and residential/commercial developments. He has also been involved in numerous investigations into industrial emissions; ambient air quality; indoor air quality; nuisance dust and transport emissions. Prof Laxen has prepared specialist reviews on air quality topics and contributed to the development of air quality management in the UK. He has been an expert witness at numerous Public Inquiries, published over 70 scientific papers and given numerous presentations at conferences. He is a Fellow of the Institute of Air Quality Management.

Dr Ben Marner, BSc (Hons) PhD CSci MIEnvSc MIAQM

Dr Marner is a Technical Director with AQC and has seventeen years' experience in the field of air quality. He has been responsible for air quality and greenhouse gas assessments of road schemes, rail schemes, airports, power stations, waste incinerators, commercial developments and residential developments in the UK and abroad. He has been an expert witness at several public inquiries, where he has presented evidence on health-related air quality impacts, the impacts of air quality on sensitive ecosystems, and greenhouse gas impacts. He has extensive experience of using detailed dispersion models, as well as contributing to the development of modelling best practices. Dr Marner has arranged and overseen air quality monitoring surveys, as well as contributing to Defra guidance on harmonising monitoring methods. He has been responsible for air quality review and assessments on behalf of numerous local authorities. He has also developed methods to predict nitrogen deposition fluxes on behalf of the Environment Agency, provided support and advice to the UK Government's air quality review and assessment helpdesk, Transport Scotland, Transport for London, and numerous local authorities. He is a Member of the Institute of Air Quality Management and a Chartered Scientist.

Penny Wilson, BSc (Hons) CSci MIEnvSc MIAQM

Ms Wilson is an Associate Director with AQC, with more than seventeen years' relevant experience in the field of air quality. She has been responsible for air quality assessments of a wide range of development projects, covering retail, housing, roads, ports, railways and airports. She has also prepared air quality review and assessment reports and air quality action plans for local authorities and appraised local authority assessments and air quality grant applications on behalf of the UK governments. Ms Wilson has arranged air quality and dust monitoring programmes and carried out dust and odour assessments. She has provided expert witness services for planning appeals and is Member of the Institute of Air Quality Management and a Chartered Scientist.

Marko Ristic-Smith, BA (Hons) MSc DIC AMIEnvSc AMIAQM

Mr Ristic-Smith is an Assistant Consultant with AQC, having joined the company in September 2016. He is gaining experience of air quality assessments for a range of developments using air quality monitoring and modelling techniques. Prior to joining AQC he completed his MSc in Environmental Technology, with his thesis examining the air quality and health impacts of transport policy scenarios in London. He is an Associate Member of the Institute of Air Quality Management.

Full CVs are available at www.aqconsultants.co.uk.

APPENDIX 7

Air Quality
CONSULTANTS

Update:
Tilbury 2, Air Quality Impacts on Designated Ecological Sites

May 2018

Experts in air quality
management & assessment

Document Control

Client	Port of Tilbury London Ltd.	Principal Contact	Peter Ward

Job Number	J2900

Report Prepared By:	Dr Ben Marner and Dr Kate Wilkins

Document Status and Review Schedule

Report No.	Date	Status	Reviewed by
J2900A/4/F1	18 May 2018	Final	Prof. Duncan Laxen (Associate)

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1 Introduction

1.1 In October 2017, Air Quality Consultants Ltd. (AQC) prepared a report on "*Air Quality Impacts on Designated Ecological Sites: Tilbury 2 Dock, Thurrock*" - Report No: J2900A/3/F4 ('the 2017 report'). This report was included as Appendix 6 to the ES Appendix 10.O: Habitat Regulations Assessment (HRA) Report, Document Ref 6.2 10.O (Ref: TR030003-000242) ("the HRA"), and referred to in paras 4.1.1, 7.1.6, 7.2.4, 7.3.1 and Appendix 5 para g. The 2017 report set out the predicted changes in nitrogen oxides (NOx) concentrations and nutrient and acid deposition fluxes at European designated ecological sites as a result of shipping emissions associated with the Project. It showed that these incremental changes were extremely small. The HRA made clear that the impact of increases in atmospheric pollutant concentrations and/or nutrient and acid deposition on habitats within the Thames Estuary and Marshes Special Protection Area (SPA)/Ramsar Sites will be negligible (para 7.1.6), and no likely significant effect is predicted (para 7.2.4). The sites are shown in Figure 1.

1.2 Recent work by AQC during the update to the HRA has identified that aspects of the model setup that supported the 2017 report have led to the concentrations and deposition rates being underestimated. This update explains the issue that has been identified with the modelling and sets out updated numbers. The updated numbers do not materially change the conclusions of the HRA.

2 Details

2.1 The modelled concentrations in the 2017 report were made using the ADMS-5 dispersion model developed by CERC and one of the models accepted by regulatory agencies and local authorities in the UK. This advanced dispersion model combines the emissions from the ships' engines with assumptions regarding 'release conditions', together with measured hour-by-hour meteorological data, to generate estimates of ground-level concentrations, from which deposition fluxes are calculated. The 'release conditions' of relevance relate to the speed at which exhaust gas exits from the ship engine flues, and the temperature of that gas. These factors combine to give the emission plume a buoyancy, which causes it to rise and thus disperse (and dilute) more readily.

2.2 There are no known dispersion models which have the capability to model emissions from moving ships, i.e. emissions from a moving point source, and so it is common practice to model emissions as arising from a line source with a uniform emission rate (for example, in the case of a road, emissions are assumed to be emitted from a uniform source with a width equivalent to the roadway, rather than simulating the movement of each vehicle along the road). In the case of the emissions from the vessel movements in the Thames associated with the Project, the emissions were modelled in 2017 as a line source, following the approximate centre of the shipping lane. This line was assigned a nominal width of 38 m, based on the width of a typical vessel.

2.3 Recent work undertaken by AQC has identified an issue with the way that that the ADMS-5 model treats the buoyancy from line sources. In effect, the model equates the buoyancy of the release with the width of the line. The effect of this is that the thermal buoyancy of the emissions will have been over-estimated in the 2017 modelling. This, in turn, means that the change in concentrations and deposition caused by the additional vessel movements associated with the Project will have been under-predicted.

2.4 AQC has worked with the developers of the ADMS-5 model to investigate this issue. While there is still no way to simulate moving point sources with absolute certainty, it is considered that equating the width of the emission source with the diameter of a typical exhaust stack provides a pragmatic solution. This will restrict the amount of thermal buoyancy to an area that would be directly above the stack at the point/time of release. The 2017 model has thus been re-run using a source width of 1 m, which is considered to provide a reasonable worst-case estimate (– a greater assumed width would give rise to lower concentrations). This is consistent with information provided by P&O that the Bore Sea RoRo vessel used in the model assessment for the 2017 report, has a single exhaust of 1.3m diameter (some vessels would have multiple flues which would be likely to have a similar or greater effective stack diameter).

2.5 The remodelling has used the same input data as set out in the 2017 report, but with the width of the line source reduced from 38m to 1m.

3 Results

3.1 Table A1.1 to Table A1.6 in Appendix A1 of this report present the revised modelling results in the same format as used in the 2017 report. The maximum modelled impacts are presented in Table 1 to Table 3 for the designated areas of interest (Thames Estuary and Marshes SPA and Ramsar, South Thames SSSI and Mucking Flats SSSI – see Figure 1), and shown in Figure 2 to Figure 6 below. The results show that the additional contributions to pollutant concentrations and deposition fluxes caused by emissions from ships associated with Tilbury 2 are, while larger than presented in the 2017 report, still extremely small. In particular, even at the point of maximum impact on the shoreline of the Thames (as shown in the Figures), the increments are below 1% of the long-term critical levels and loads, and below 10% of the short-term critical level for nitrogen oxides. These are criteria which are often used to discount such impacts as insignificant. Moving away from the point of maximum impact, the changes become smaller still, for instance the lowest modelled NOx increment at Thames Estuary and Marshes is an order of magnitude lower (see Figure 2)

4 Comment from Ecology Specialist

4.1 The author of the HRA has reviewed these results and provided the following comments:

"The revised model outputs increase the contribution predicted to be made by shipping emissions to maximum pollutant concentrations and deposition rates within the Thames Estuary and Marshes SPA. By the measure of % change relative to relevant critical levels/loads, this merits a slight upward revision of the assessment of potential for likely significant effects on affected habitats. However, this is a revision that might be characterised as a shift from barely perceptible to minimal, within a spectrum remaining within the compass of the descriptor 'negligible'. Importantly, in HRA terms, the overriding conclusion remains unchanged – i.e. that the revised outputs remain sub-significant, all constituting a less than 1% change relative to critical level/load for any of the modelled pollutants. Therefore, while the changes need to be brought to the attention of the relevant agencies, they are not considered to materially change the conclusions of the HRA".

Table 1: Maximum Modelled Increments to Concentrations and Deposition Fluxes at the Thames Estuary and Marshes SPA

Pollutant/Averaging Period	Critical level/load	Maximum Additional Shipping Contribution [a]	Background Level [b]	Total Background and Shipping Contribution [b]	% Change Relative to Critical Level/Load
Annual Mean NOx ($\mu g/m^3$)	30	0.14	25.0	25.1	0.5%
24-Hour Mean NOx ($\mu g/m^3$)	75	0.55	N/A	N/A	0.7%
Annual Mean Sulphur Dioxide ($\mu g/m^3$)	20	0.005	0.500	0.505	0.02%
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	8-30	0.014	12.46	12.47	0.05% - 0.2% [c]
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.743 – 5.710	0.002	1.010	1.012	0.03% - 0.2% [c]

[a] This is the entire contribution from additional shipping movements associated with Tilbury 2. It is not the change from the values in the 2017 report.

[b] At point of maximum shipping contribution.

[c] Expressed as a percentage of the maximum and minimum critical loads within the SPA (as shown in Table 1of the 2017 report).

Table 2: Maximum Modelled Increments to Concentrations and Deposition Fluxes at the South Thames SSSI

Pollutant/Averaging Period	Critical level/load	Maximum Additional Shipping Contribution [a]	Background Level [b]	Total Background and Shipping Contribution [b]	% Change Relative to Critical Level/Load
Annual Mean NOx ($\mu g/m^3$)	30	0.14	25.0	25.1	0.5%
24-Hour Mean NOx ($\mu g/m^3$)	75	0.47	N/A	N/A	0.6%
Annual Mean Sulphur Dioxide ($\mu g/m^3$)	20	0.005	0.500	0.505	0.02%
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	8-30	0.014	12.46	12.47	0.05% - 0.2% [c]
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.733 – 5.710	0.002	1.010	1.012	0.03% - 0.2% [c]

[a] This is the entire contribution from ships associated with Tilbury 2. It is not the change from the values in the 2017 report.

[b] At point of maximum shipping contribution.

[c] Expressed as a percentage of the maximum and minimum critical loads within the SPA (as shown in Table 1of the 2017 report).

Table 3: Maximum Modelled Increment to Concentrations and Deposition Fluxes at Mucking Flats SSSI

Pollutant/Averaging Period	Critical level/load	Maximum Additional Shipping Contribution [a]	Background Level [b]	Total Background and Shipping Contribution [b]	% Change Relative to Critical Level/Load
Annual Mean NOx ($\mu g/m^3$)	30	0.12	33.7	33.8	0.4%
24-Hour Mean NOx ($\mu g/m^3$)	75	0.55	N/A	N/A	0.7%
Annual Mean Sulphur Dioxide ($\mu g/m^3$)	20	0.004	0.590	0.594	0.02%
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	8-30	0.012	13.72	13.73	0.04% - 0.2% [c]
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	4.558 – 5.710	0.001	0.580	0.581	0.02% - 0.03% [c]

[a] This is the maximum modelled increment and represents the total contribution from ships associated with Tilbury 2. It is not the change from the values in the 2017 report.

[b] At point of maximum shipping contribution.

[c] Expressed as a percentage of the maximum and minimum critical loads within the SPA (as shown in Table 1of the 2017 report).

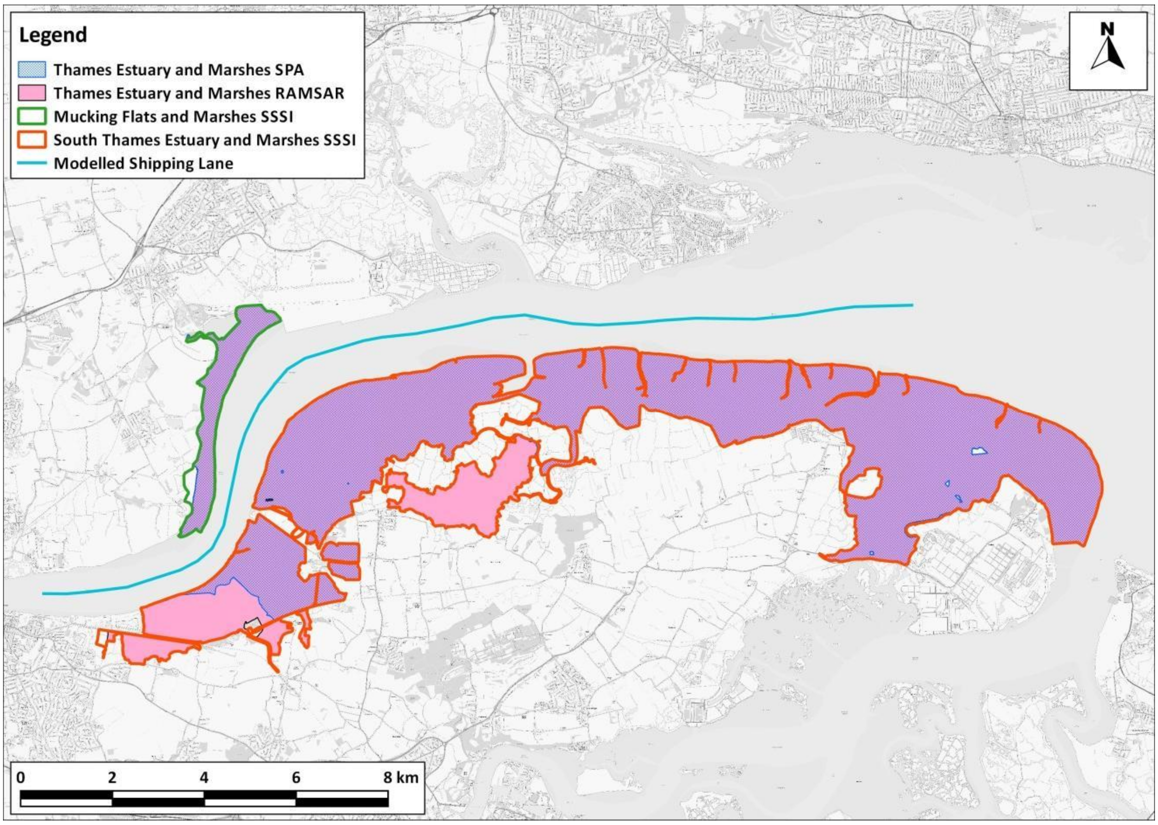


Figure 1: Locations of the Thames Estuary and Marshes SPA and Ramsar Sites, and the South Thames Estuary and Marshes SSSI and Mucking Flats and Marshes SSSI

Figure 2: Incremental Change in Annual Mean NOx Concentrations Across the Protected Habitats as a Result of Tilbury 2 Additional Vessel Movements (mg/m^3)

Figure 3: Incremental Change in 24-hour NOx Concentrations Across the Protected Habitats as a Result of Tilbury 2 Additional Vessel Movements ($\mu g/m^3$)

Figure 4: Incremental Change in Annual Mean Sulphur Dioxide Concentrations Across the Protected Habitats as a Result of Tilbury 2 Additional Vessel Movements (mg/m³)

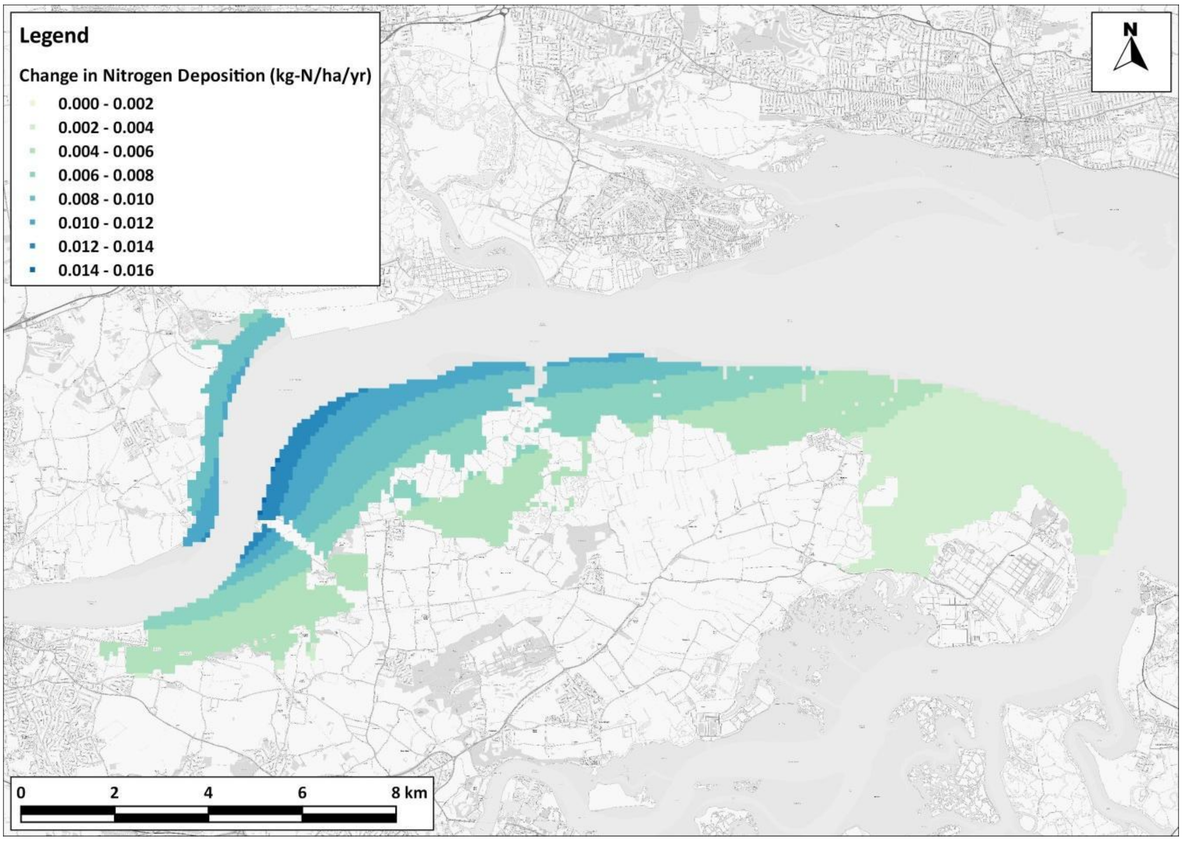


Figure 5: Incremental Change in Nutrient Nitrogen Deposition Across the Protected Habitats as a Result of Tilbury 2 Additional Vessel Movements (kg-N/ha/yr)

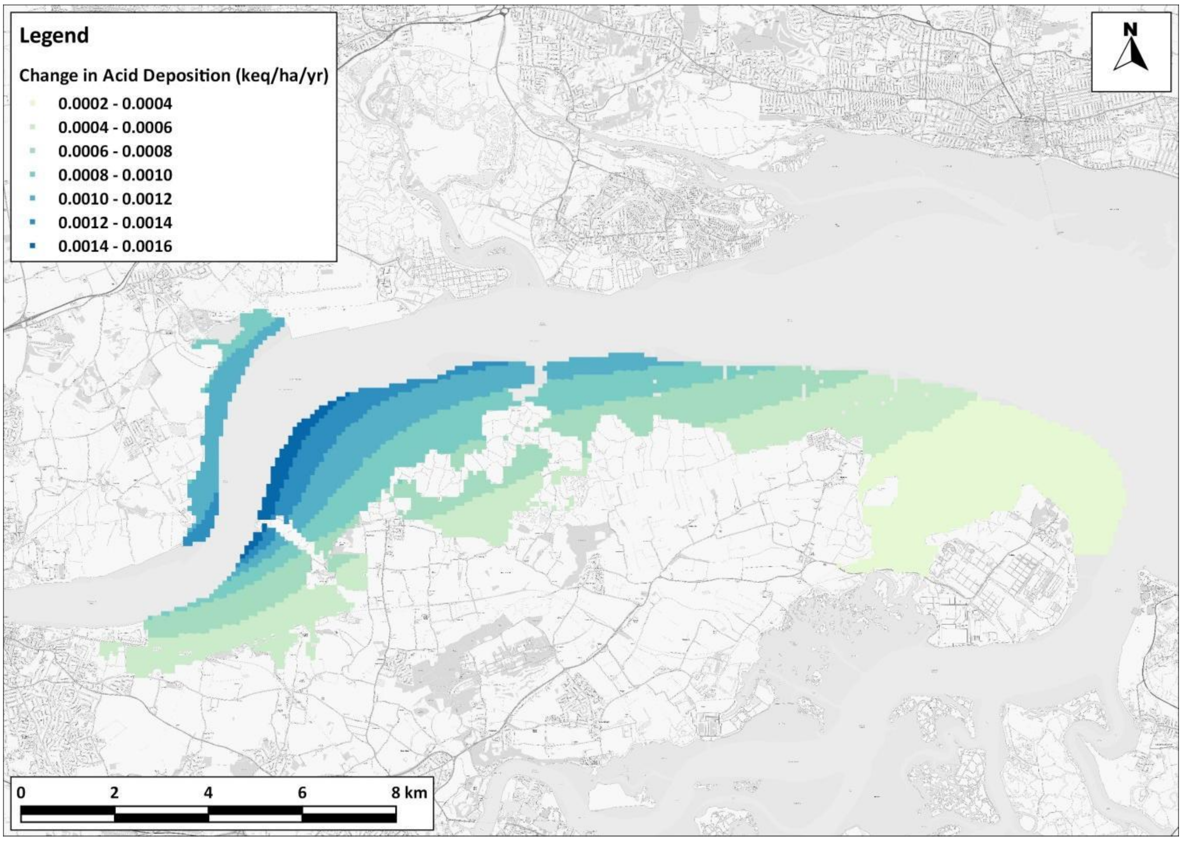


Figure 6: Incremental Change in Acid Deposition Across the Protected Habitats as a Result of Tilbury 2 Additional Vessel Movements (keq/ha/yr)

A1 Updated Tables (in Format of the 2017 Report)

Table A1.1: Maximum Modelled Pollutant Concentrations at the Thames Estuary and Marshes SPA (µg/m^3)

Pollutant/Averaging Period	Maximum Additional Shipping Contribution	Background Level [a]	Total Background and Shipping Contribution [b]	% Change Relative to Background Level	% Change Relative to Critical Level/Load
Annual Mean NOx (µg/m^3)	0.140	18.3 – 35.3	18.4 – 35.4	0.40 - 0.77	0.468
24-Hour Mean NOx (µg/m^3)	0.550	N/A	N/A	N/A	0.734
Annual Mean Sulphur Dioxide (µg/m^3)	0.00499	0.3 - 1.1	0.3 – 1.1	0.45 - 1.66	0.025
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.0142	9.5 – 16.0	9.5 – 16.0	0.09 - 0.15	0.047 – 0.177
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0016	0.66 – 1.20	0.66 – 1.20	0.13 - 0.24	0.028 – 0.215

[a] Range of values across the SPA.

[b] Adding the minimum shipping contribution to the range in background levels.

Table A1.2: Minimum Modelled Pollutant Concentrations at the Thames Estuary and Marshes SPA (µg/m^3)

Pollutant/Averaging Period	Minimum Additional Shipping Contribution	Background Level [a]	Total Background and Shipping Contribution [b]	% Change Relative to Background Level	% Change Relative to Critical Level/Load
Annual Mean NOx (µg/m^3)	0.0197	18.3 – 35.3	18.3 – 35.3	0.06 - 0.11	0.066
24-Hour Mean NOx (µg/m^3)	0.170	N/A	N/A	N/A	0.226
Annual Mean Sulphur Dioxide (µg/m^3)	0.0007	0.3 - 1.1	0.3 – 1.1	0.06 - 0.23	0.004
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.00199	9.5 – 16.0	9.5 – 16.0	0.01 - 0.02	0.007 – 0.025
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.00022	0.66 – 1.20	0.66 – 1.20	0.02 - 0.03	0.004 – 0.030

[a] Range of values across the SPA.

[b] Adding the minimum shipping contribution to the range in background levels.

Table A1.3: Maximum Modelled Pollutant Concentrations at the South Thames Estuary and Marshes SSSI (μg/m³)

Pollutant/Averaging Period	Maximum Additional Shipping Contribution	Background Level [a]	Total Background and Shipping Contribution [b]	Contribution as % of Background Level	% of Critical Level/Load
Annual Mean Nitrogen Oxides (μg/m³)	0.140	17.1 – 35.3	17.2 – 35.4	0.40 – 0.82	0.468
24-Hour Mean Nitrogen Oxides (μg/m³)	0.472	N/A	N/A	N/A	0.629
Annual Mean Sulphur Dioxide (μg/m³)	0.00499	0.3 – 1.1	0.3 – 1.1	0.45 – 1.66	0.025
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.0142	5.2 – 14.8	5.2 – 14.8	0.10 – 0.27	0.047 – 0.177
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.0016	0.35 – 1.08	0.35 – 1.08	0.15 – 0.46	0.028 – 0.035

[a] Range of values across the SSSI.

[b] Adding the minimum shipping contribution to the range in background levels.

Table A1.4: Minimum Modelled Pollutant Concentrations at the South Thames Estuary and Marshes SSSI (μg/m³)

Pollutant/Averaging Period	Minimum Additional Shipping Contribution	Background Level [a]	Total Background and Shipping Contribution [b]	Contribution as % of Background Level	% of Critical Level/Load
Annual Mean Nitrogen Oxides (μg/m³)	0.0197	17.1 – 35.3	17.1 – 35.3	0.06 – 0.12	0.066
24-Hour Mean Nitrogen Oxides (μg/m³)	0.170	N/A	N/A	N/A	0.226
Annual Mean Sulphur Dioxide (μg/m³)	0.0007	0.3 – 1.1	0.3 – 1.1	0.06 – 0.23	0.004
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.00199	5.2 – 14.8	5.2 – 14.8	0.01 – 0.04	0.007 – 0.025
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.00022	0.35 – 1.08	0.35 – 1.08	0.02 – 0.06	0.004 – 0.005

[a] Range of values across the SSSI.

[b] Adding the minimum shipping contribution to the range in background levels.

Table A1.5: Maximum Modelled Pollutant Concentrations at the Mucking Flats and Marshes SSSI (µg/m^3)

Pollutant/Averaging Period	Maximum Additional Shipping Contribution	Background Level [a]	Total Background and Shipping Contribution [b]	Contribution as % of Background Level	% of Critical Level/Load
Annual Mean Nitrogen Oxides (µg/m^3)	0.120	27.3 – 33.7	27.4 – 33.8	0.36 – 0.44	0.399
24-Hour Mean Nitrogen Oxides (µg/m^3)	0.550	N/A	N/A	N/A	0.734
Annual Mean Sulphur Dioxide (µg/m^3)	0.00426	0.5 – 0.8	0.5 – 0.8	0.53 – 0.85	0.021
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.0121	8.1 – 16.0	8.1 – 16.0	0.08 – 0.15	0.040 – 0.151
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.00137	0.56 – 1.16	0.56 – 1.16	0.12 – 0.24	0.024 – 0.030

a Range of values across the SSSI.

b Adding the minimum shipping contribution to the range in background levels.

Table A1.6: Minimum Modelled Pollutant Concentrations at the Mucking Flats and Marshes SSSI (µg/m^3)

Pollutant/Averaging Period	Minimum Additional Shipping Contribution	Background Level [a]	Total Background and Shipping Contribution [b]	Contribution as % of Background Level	% of Critical Level/Load
Annual Mean Nitrogen Oxides (µg/m^3)	0.071	27.3 – 33.7	27.4 – 33.8	0.21 – 0.26	0.238
24-Hour Mean Nitrogen Oxides (µg/m^3)	0.356	N/A	N/A	N/A	0.475
Annual Mean Sulphur Dioxide (µg/m^3)	0.00254	0.5 – 0.8	0.5 – 0.8	0.32 – 0.51	0.013
Annual Mean Nutrient Nitrogen Deposition Rate (kg-N/ha/yr)	0.0072	8.1 – 16.0	8.1 – 16.0	0.05 – 0.09	0.024 – 0.090
Annual Mean Acid Nitrogen Deposition Rate (keq/ha/yr)	0.00081	0.56 – 1.16	0.56 – 1.16	0.07 – 0.14	0.014 – 0.018

a Range of values across the SSSI.

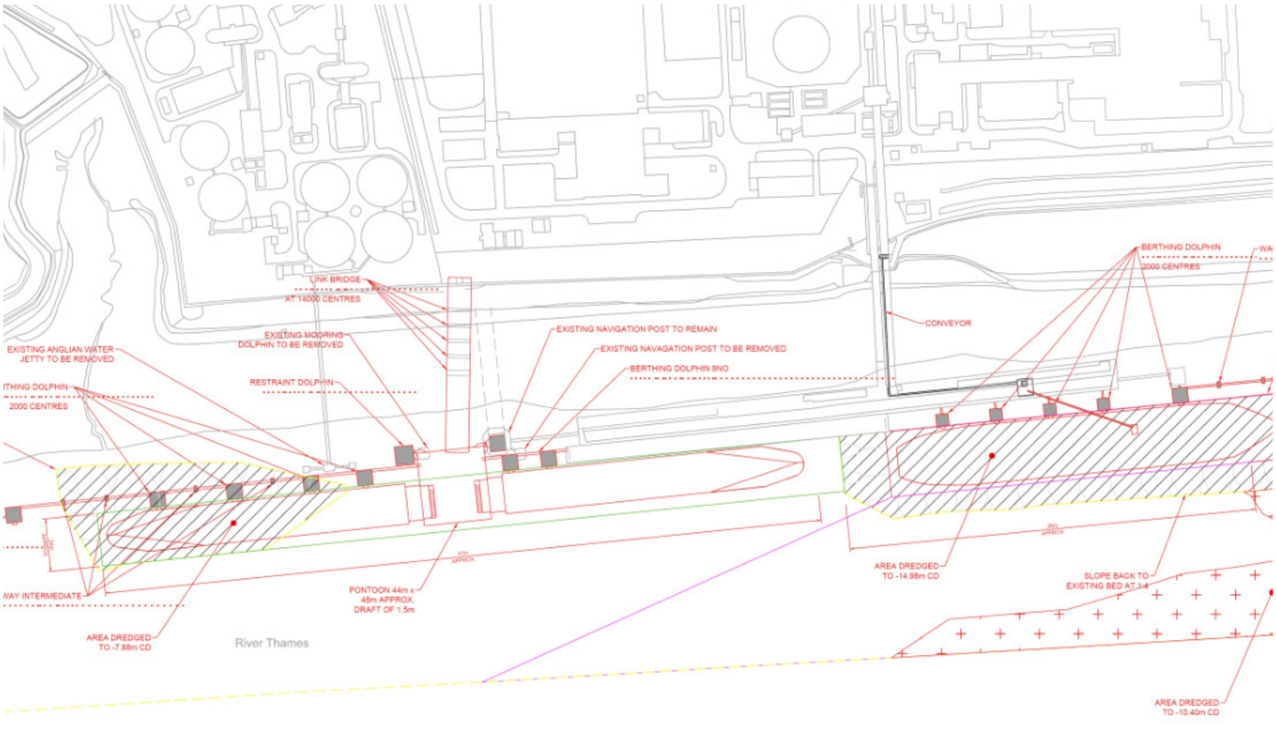
b Adding the minimum shipping contribution to the range in background levels.

APPENDIX 8

HR Wallingford
Working with water

Port of Tilbury Expansion

Hydrodynamic and sediment study



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Summary

An expansion of the riverside facilities at the Port of Tilbury is proposed, including a new dredged bulk handling berth at the existing power station jetty and two dredged RO-RO berths served from a new pontoon and link span bridge.

The development is of a nature that will interact with the hydrodynamic and sedimentological regime of the area to some degree, and this may in turn have various implications for navigational and environmental issues. A modelling study has been undertaken to investigate the effects of the proposed development on the physical processes of the estuary regime. The conclusions are as follows:

Hydrodynamics

The data obtained from this study provide sufficient evidence to suggest that the introduction of the proposed works will only have a comparatively local impact upon the flow conditions and will not affect the overall hydrodynamic regime of the Thames Estuary.

Sedimentation

The proposed development will have a minor and local effect on the sediment regime of the Thames Estuary. Dredging the berth pocket to depths several metres below the natural regime depth in an area which is known to be sensitive to sedimentation has been shown to lead to the dredged areas being subject to ingress of sediment. The predicted infill rates for the dredged berth pockets are up to 100,000 m^3 annually with the bulk of the material fine silty sediment. Whilst this total, which is close to the capital dredging, volume is likely to be reduced, for example, by vessel occupancy at the berths, regular maintenance dredging should be expected, in particular at the eastern end of the bulk berth. The site appears suitable for the use of water injection/agitation dredging to maintain the fine silty material; however a need for occasional removal of sandy material accumulating in the berth pockets is also present.

Additionally, dredging of the berth pocket to the proposed depth may challenge the integrity of adjacent side slopes (dredged or intertidal). Knowledge of the strength and the material composition of the bed sediments is required so that this issue can be appropriately addressed. Short term additional infill in the dredged areas may occur early in the lifetime of the project.

Waves

The conclusion is that the impact of the proposed structures and dredging on the wave climate will be small with negligible implications for morphology. This is because:

1. The wave climate typically comprises small, short period, waves. Short period waves as experienced at the site do not typically lead to significant enhancements to sediment transport in water depths greater than 4 m.
2. The structures are mostly open piled and spread out and present less of an obstacle than the existing power station jetty.

Construction effects

The capital dredging methodology had not been finalised at the time of these studies and so sediment release from two practicable options were assessed, namely use of a back hoe dredger, and water injection dredging (WID). These cases describe the effect of a range of sediment release scenarios from a low rate associated with backhoe to a high rate associated with WID.

Due to the extremely low sediment release rate from back hoe dredging compared to the ambient suspended sediment concentrations in the area any effect of the sediment released by the dredging is considered negligible.

The use of WID in the capital dredge would be limited to the finer silty material found in the upper stratum of the material to be dredged. A precautionary approach to modelling the plume from WID operations has shown an area 15 km either side of the dredging which will experience an increase in maximum suspended sediment concentration greater than 20 mg/l. Maximum increases of greater magnitude, up to 200 mg/l, are limited to an area within 2 km of the dredge. The time series results show that these increases are very transient. The effect of the dredging in raising the average suspended sediment concentration is limited to the immediate area of the dredge. The duration of this effect may be up to 5-7 weeks depending on how much of the material can be removed by WID and if the WID is continuous or ebb tide only (as is typical in the Thames).

A consequence of the WID methodology is that the sediment plume is predicted to mostly be confined to the subtidal areas with limited increase in suspended sediment concentration or sediment accumulation on the intertidal areas. Accumulation depths of the order of 1-2 mm are predicted widely in the subtidal channel due to 2 weeks of WID. Larger accumulation depths, greater than 10 mm, can occur in small areas however only areas of channel with a consistent pattern of accumulation greater than 10mm are within 5 km of the dredge site.

The simulations have shown that the landward extent of any influence of the dredging can be significantly limited by dredging being restricted to the ebb tide.

Comparison with the latest fine sediment budget of the Thames (Baugh et al, 2013) shows that the total mass released by the dredging (assuming WID is undertaken) is in the variability identified in the annual sediment budget and therefore the dredging will not change the fine sediment budget of the Thames budget outside natural variability.

Elevated concentrations of perylene have been found in the sediment to be dredged. A review of the available information on the properties of perylene has shown it has extremely low solubility and therefore it is unlikely to result in a water quality impact. An assessment of the dispersion of perylene adsorbed onto the sediment released during the dredge has, in general, shown very low concentrations attached to sediment in the water column and therefore a very low risk of contamination depositing on the intertidal areas.

Maintenance dredging effects

The modelling and results for WID presented for the construction effects section assume a high fine sediment content in the material dredged as would be expected for maintenance dredging and therefore the predicted effects of maintenance dredging can be anticipated as similar to those for the capital dredging as production rates and dredge volumes will be similar.

Elsewhere on the tidal Thames WID is typically undertaken from an hour before high water to 4 hours after high water to minimise the landward extent of any effect. Assuming 2 tides of dredging with 5 hours of dredging undertaken in each suggests a sediment removal rate of slightly over 2,000 m^3 per day. In this scenario the maintenance could be done in four, 2 week dredging campaigns as modelled.

Contents

Figures

Tables

1. Introduction

An expansion of the riverside facilities at the Port of Tilbury is proposed, including a new dredged bulk handling berth at the existing power station jetty and two dredged RO-RO berths served from a new pontoon and link span bridge.

The development is of a nature that will interact with the hydrodynamic and sedimentological regime of the area to some degree, and this may in turn have various implications for navigational and environmental issues. The main hydraulic aspects that are likely to be of interest are:

- Flow conditions (speed, direction) at the berths and the effects of the works on hydrodynamics in the authorised channel;
- Infill within the new or existing dredged areas, requiring maintenance dredging;
- Potential changes to erosion or accretion at the intertidal foreshore (including environmentally designated areas), nearby berths and other riparian activities;
- Sediment release from dredging and consequential effects on ecology due to increased turbidity and deposition.

A hydrodynamic study is therefore required to determine the footprint and magnitude of any substantive impacts of the development upon the hydrodynamic and sedimentological regimes of the area. The study is to provide information to support an Environmental Impact Assessment.

The studies supporting the EIA are described in four further sections; Section 2 describes the establishment and results of a tidal flow modelling exercise. The implications of the changed hydrodynamics on sedimentation are covered by Section 3. The assessment of fine sediment release during the capital dredge is provided by Section 4. The studies are summarised with conclusions and recommendations provided in Section 5.

2. Hydrodynamic modelling

2.1. Choice of model

A requirement of this study was to obtain knowledge of the local tidal flow regime via a hydrodynamic assessment for both existing and proposed scenario. Knowledge of the flow environment was obtained based on the numerical flow model of the whole Thames Estuary set up by HR Wallingford on behalf of the Environment Agency (EA) and the Port of London Authority (PLA) to assist them with their regulatory responsibilities. To provide a more detailed study, the model was run in 3D mode to show the vertical variation in magnitude of currents.

The Thames Base numerical model has previously been used to investigate the hydrodynamic regime around developments in many areas along the tidal River Thames as well as investigating the estuarine hydrodynamic and sediment transport processes themselves. The modelling tool used for the Thames Base model was TELEMAC-3D. TELEMAC-3D, developed by EDF-LNHE solves the 3D Navier-Stokes flow equations making the hydrostatic pressure assumption (i.e. no significant vertical flow accelerations) using a finite element triangular grid. This triangular grid allows the model mesh resolution to continually vary in space resulting in good representation of existing and proposed features.

2.2. Calibration and validation

The model was initially established and successively validated against a wide set of tidal level, current and total discharge data in 2001 (HR Wallingford, 2004). The model was subsequently validated against the estuary-wide survey undertaken in late 2004 as part of the EA's TE2100 studies (HR Wallingford, 2006a). A further bathymetric update and validation exercise was undertaken for the PLA in 2009 (HR Wallingford, 2009).

For both the calibration and validation exercises the model accuracy has been assessed based on the Mean Absolute Error (MAE) which gives a view of the average 'goodness of fit' of the simulated hydrodynamics compared with those observed. The MAE for the model representation of the tide curve is in the range 3-4% of the tide range and the MAE of the total water discharge has been calculated as in the range 6-12% of the peak discharge.

For the purposes of assessing the modelled currents, a level of accuracy of 12% based on the maximum MAE for tidal discharge would provide a precautionary view of the uncertainty. For example maximum currents could be in the range 1.05-1.35 m/s for a predicted maximum current of 1.2 m/s.

2.3. Bathymetry

The bathymetry database of the Thames Base numerical model was developed from the bathymetric data published by the Port of London Authority (PLA). All depths were reduced to a common flat datum of Ordnance Datum Newlyn (OD(N)) from the PLA Chart Datum which constantly changes to reflect the local lowest tide levels. At the study site OD(N) is 3.12 m above Chart Datum.

Additional bathymetry data at the site was provided by the client. These data were reduced to OD(N) and included in the model bathymetry.

2.4. Model mesh

The model uses a triangular grid which allows the model mesh resolution to continually vary in space resulting in good representation of features such as the various bridge piers, vessels, structures and the river wall. A model mesh size as fine as 5-10 m was used to ensure the proposed works were accurately represented in the model.

The model mesh and bathymetry close to area of interest are illustrated by Figure 2.1.

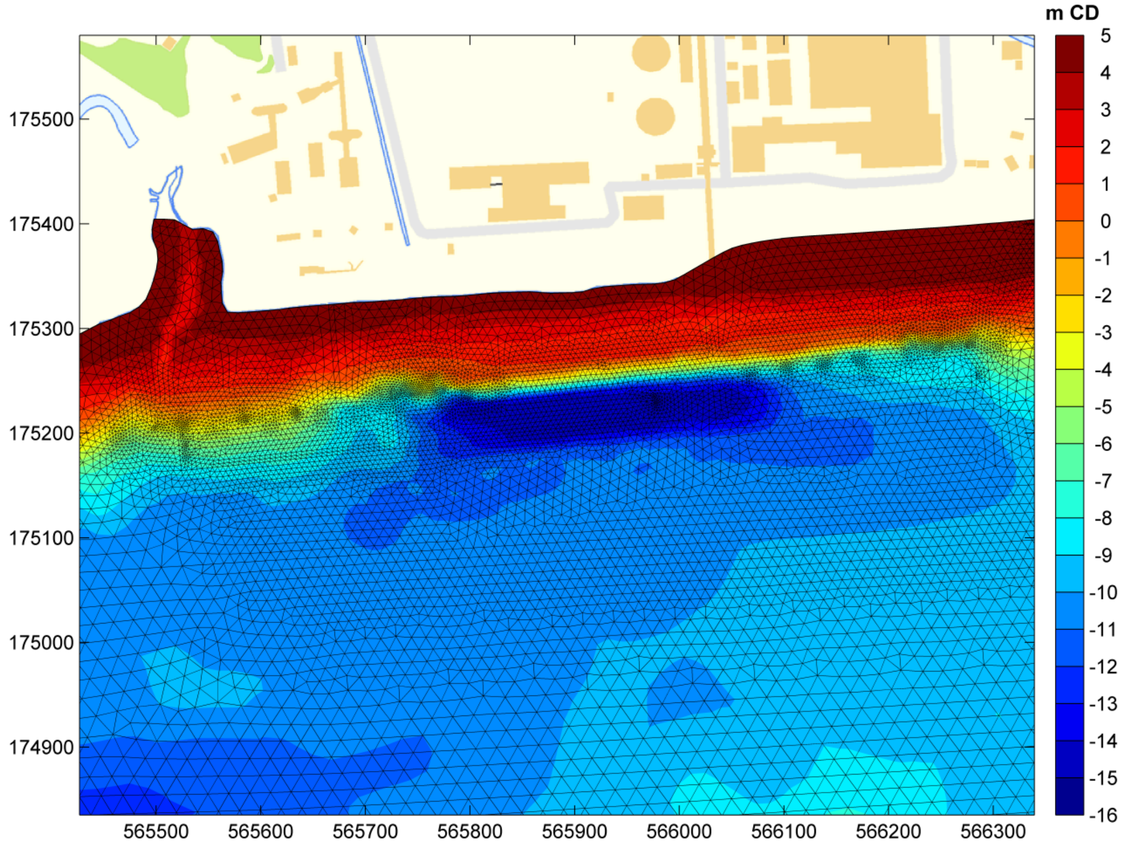

Figure 2.1: Model mesh and bathymetry in area of proposed works

Background image contains OS data © Crown copyright (2016)

2.5. Boundary conditions

The simulations required the imposition of landward and seaward boundary conditions. The model domain covers the whole length of the tidal Thames Estuary so the tidal elevation at Southend-on-Sea and water discharge at Teddington Weir defined the seaward and landward boundary conditions, respectively.

Data for the seaward tidal elevation boundary came from those observed at the Port of London Authority's tide gauge on Southend Pier. The freshwater flow data for the landward boundary was calculated from the gauged flow at Kingston (http://nrfa.ceh.ac.uk/data/station/meanflow/39001).

For the simulated period the tidal boundary conditions were taken from the tide gauge record at Southend-on-Sea for the spring tide 28-29 September 2004. The imposed river input was the annual mean fluvial input (65 m^3/s) at Kingston imposed for the flow over Teddington Weir.

2.6. Piled structures and vessels

The influence of piles on the flow is included in the model by adding extra turbulent drag within each model cell within the piled region using the following equation:

$$F_{u,v} = -0.5 * N * D * C_D * U_{norm} \qquad \text{(Eq. 1)}$$

Where:

$F_{u,v}$ = drag in the X and Y direction

N = total number of piles in the jetty

D = diameter of the piles (m)

C_D = a drag coefficient related to the shape of the pile; for square piles C_D = 2.0 (Mutlu Sumer and Fredsøe, 2006)

U_{norm} = depth averaged current flow speed (m/s).

F_u and F_v are then included implicitly within the hydrodynamic momentum equations used by the model.

Details of the existing and proposed piled structures were assessed from photographs of the site and drawings supplied by the client.

The floating RO-RO pontoon and vessels were included in the model by applying additional pressure to the free surface of the 3D hydrodynamic model, depressing the water surface to a level equivalent to the hull of each vessel.

2.7. Model parameters

- The model time step was 1.0 s due to the high currents and small grid size anticipated;
- Bed friction was calculated throughout the model domain using Nikuradse's law with a coefficient of 0.003;
- The model stored the hydrodynamic results (water level, water depth, current magnitude in the East-West and North-South directions) every 900 seconds (15 mins);
- No effect of wind or other meteorological forcing was included in the model as the currents of up to 2 m/s are tidally dominated, any additional effect of wind would be extremely minor.

2.8. Layout of proposed works simulated

The proposed works as supplied by client are shown in Figure 2.2 and how they were represented in the model is shown in Figure 2.4. The works comprise:

- Removal of Anglian Water jetty and two dolphins;
- Installation of fourteen new dolphins and associated walkway supports;
- Dredged pockets and access area.

Figure 2.4 shows the depth of dredging proposed. Up to 4 m of dredging is required to bring the western berth to the target depth; about 7 m of dredging is required to bring the eastern end of the berth area adjacent to the existing jetty to the target depth. Additionally up to 2 m of dredging would be needed to provide the dredged approaches.

Estimates of the dredged volumes required to achieve the target depths are:

- Western RO-RO berth pockets: 16,000 m^3;
- Eastern bulk berth pocket: 72,000 m^3;
- Dredged approaches: 25,000 m^3.

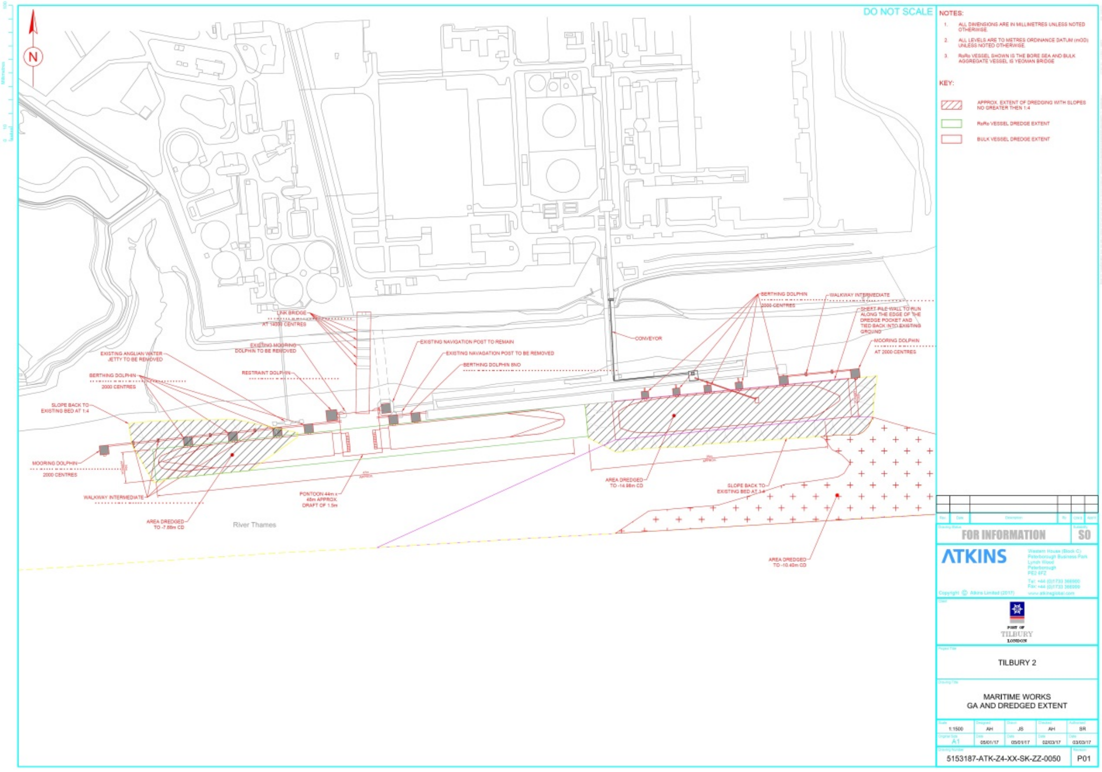

Figure 2.2: Proposed berth development at Port of Tilbury

Source 5153187-ATK-Z4-XX-SK-ZZ-0050 Plan for HR Wallingford.dwg supplied by Atkins

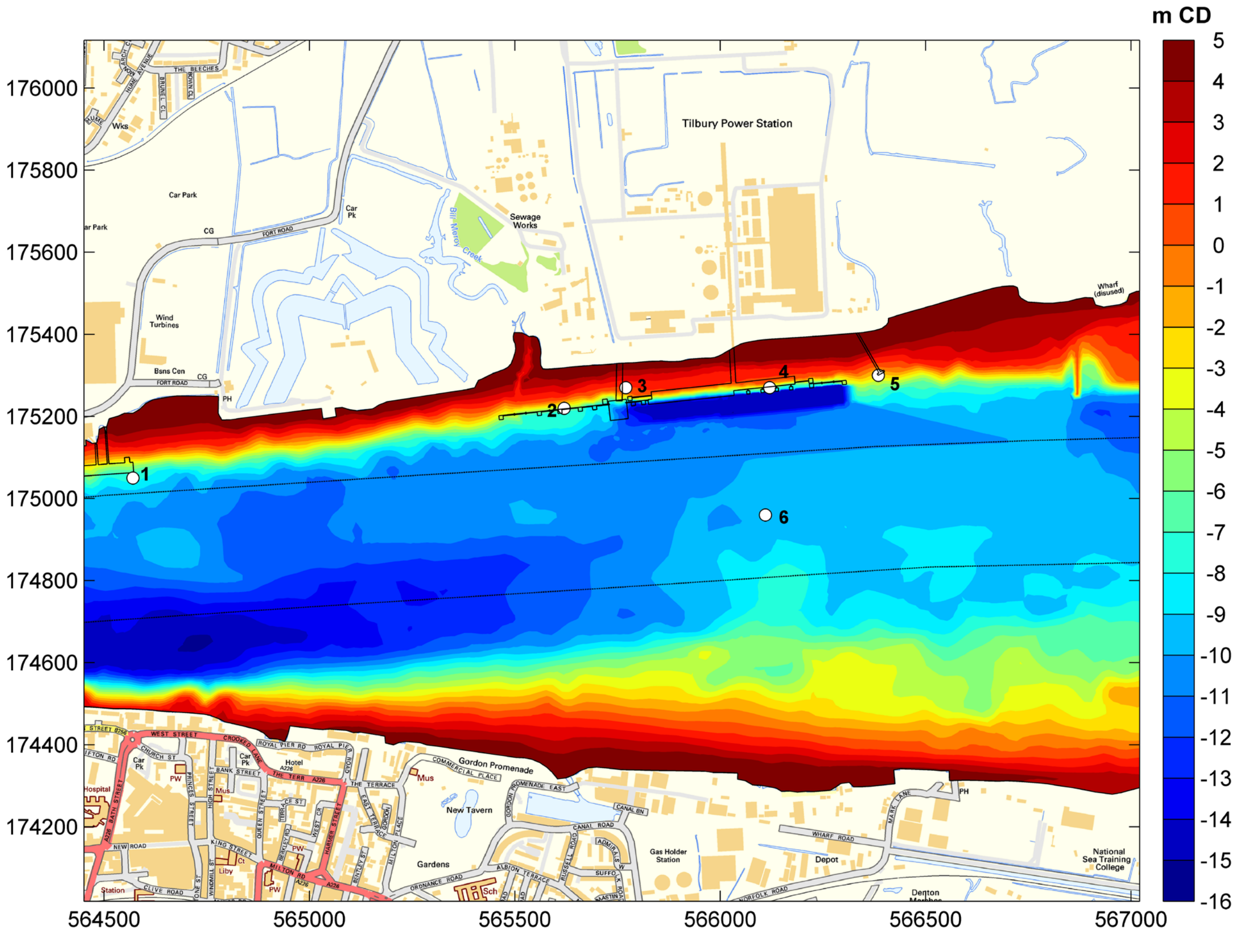

Figure 2.3: Location of time series data points overlaid on proposed layout

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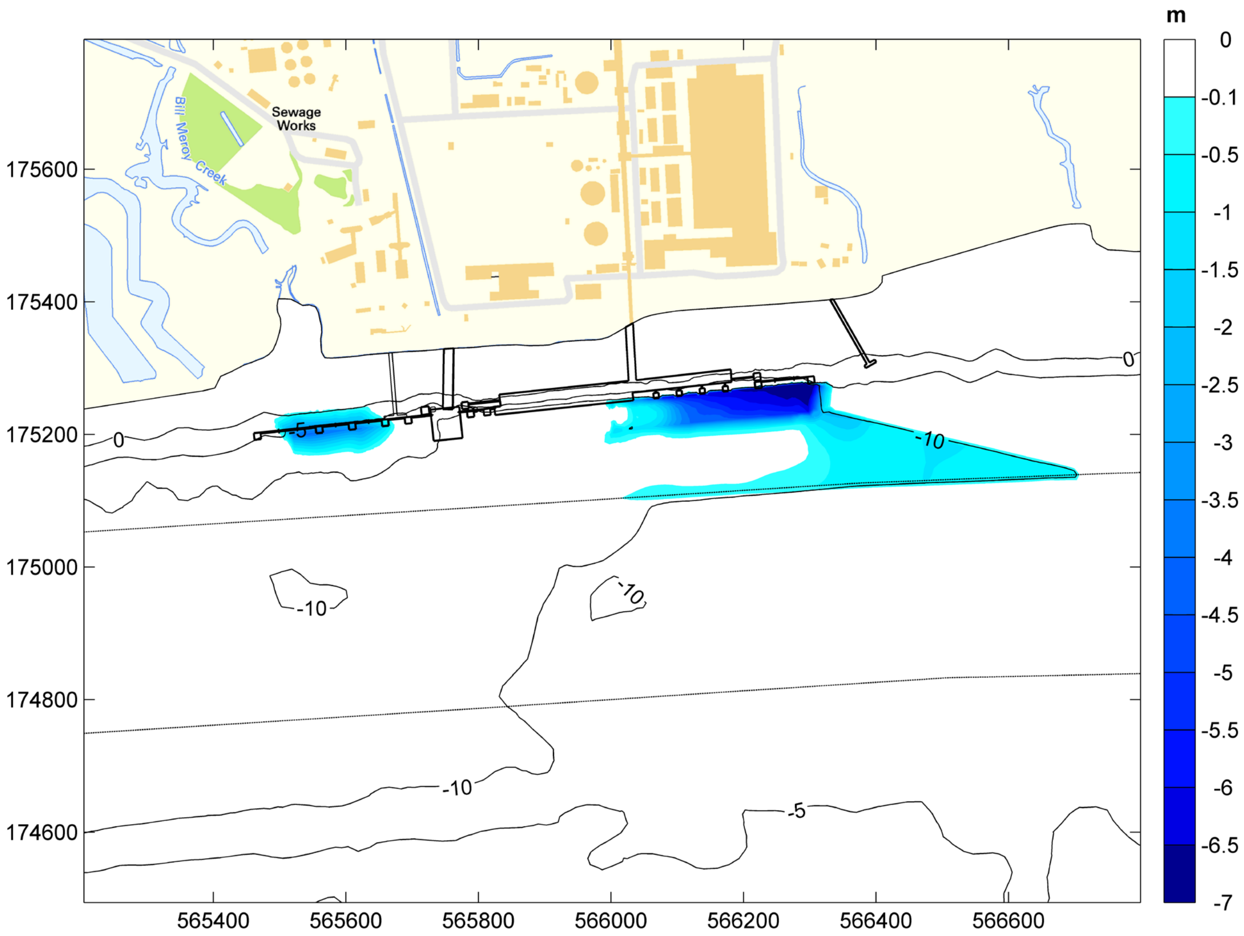

Figure 2.4: Depth of capital dredging proposed

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2.9. Description of model outputs provided

The simulations are presented in four ways to help assessment of the near and mid field hydrodynamic impacts of the works.

2.9.1. Spatial plots of current speed for baseline conditions

These figures show the model results for the baseline (pre-development) case at the times of peak ebb and flood tide flow speeds. These results provide the values against which the effects of the proposed works on flow magnitude are compared.

The times of peak ebb and peak flood tides are chosen to be representative of the largest ebb or flood tide currents at the site to provide a precautionary view of the effects of the works on current speeds.

It should be noted that tidal variations within each tide and during tides of different range or sediment characteristics may not reflect the maximum impact upon the movement of sediment in the vicinity of the proposed works. This is separately covered in Section 3.

2.9.2. Spatial plots of current speed difference

These figures present snapshots of the simulated difference in speed magnitude at the time of peak ebb and flood tides when comparing the works scenario to the baseline conditions. Yellow through to red colours indicate increases in flow speed, while green through to blue colours indicate decreases in flow speed. Any changes less than 0.1 m/s are not plotted as they are considered insignificant compared to the peak currents or the natural through-tide variability that occur in the area. These figures can show the overall effect on the flow via plotting the depth-averaged result or show the effect of the works on near surface or near bed currents.

2.9.3. Time series plots of current speed and direction

These plots are included to demonstrate if the effects of the works on peak currents shown in the above figures are representative of the whole tidal period, by providing additional information throughout the tide. A series of points covering the area around the proposed works have been chosen to characterise the effects. At each point, the baseline current speed and direction are overlaid with the results for the works scenario. The locations of the six points defined are shown in Figure 2.5. The points reflect the different areas of interest for potential effects; intertidal areas, channel, nearby jetties.

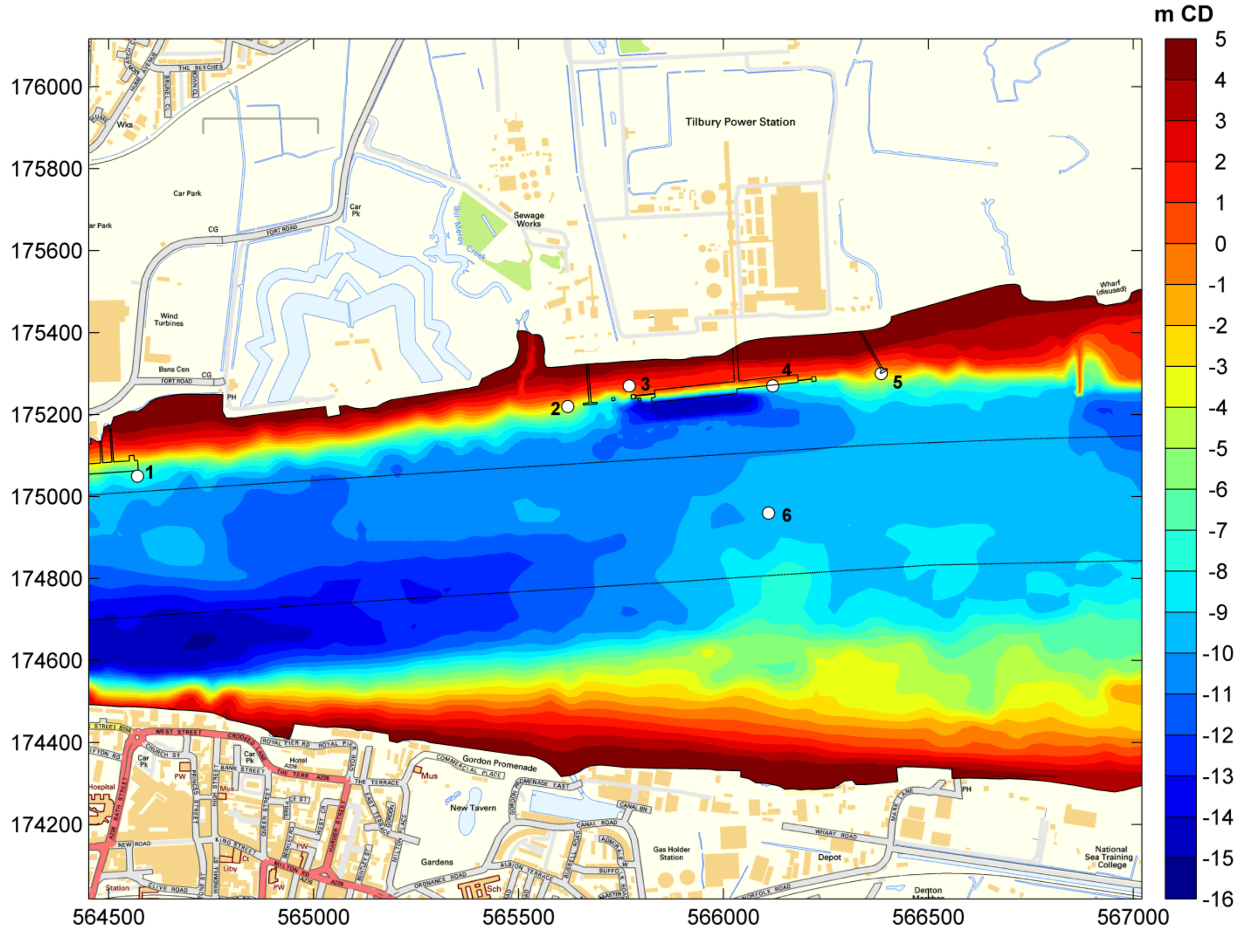

Figure 2.5: Locations of time series data points on baseline layout

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2.9.4. Tabulation of peak current speed magnitude

The maximum current speeds for each of the time history points are tabulated. These tables confirm the effects plotted at the times of largest ebb and flood tide current are representative of the effect of the works on maximum current speeds.

2.10. Model results

2.10.1. Baseline conditions

The baseline conditions for current magnitude at times of peak ebb and flood tide currents are plotted in Figure 2.6 to Figure 2.11. The first two plots show the results for both tidal phases (ebb and flood tides) for the spring tide and mean daily flow using depth averaged velocities. The next plots show predicted currents near the bed and near the surface.

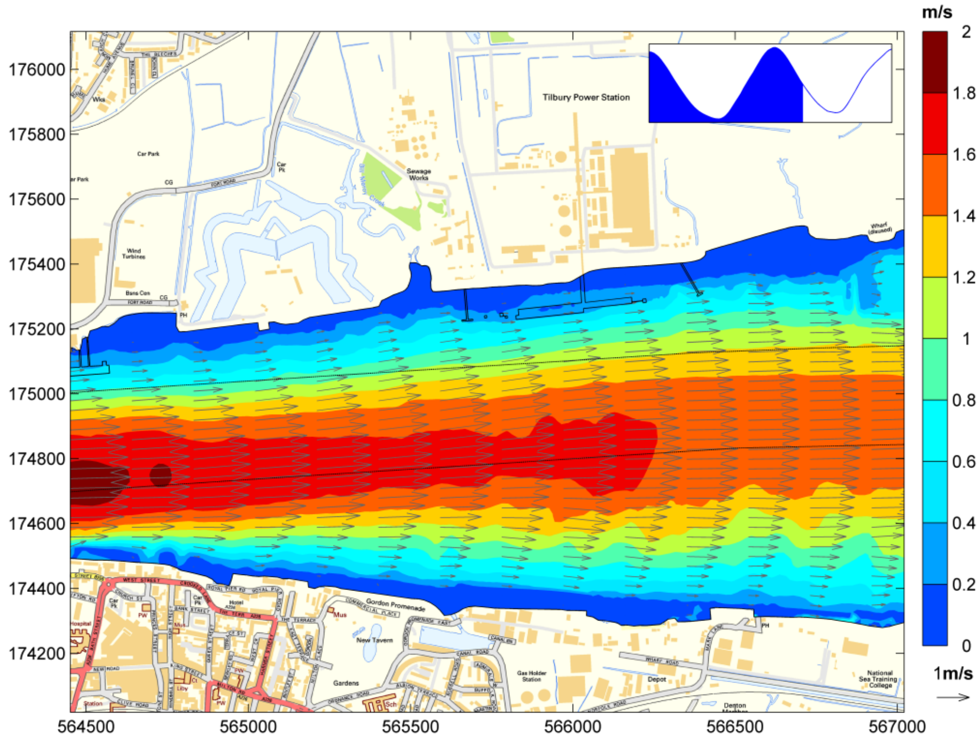

Figure 2.6: Depth averaged current speed magnitude at time of peak ebb tide, baseline conditions

Background image contains OS data © Crown copyright (2016)

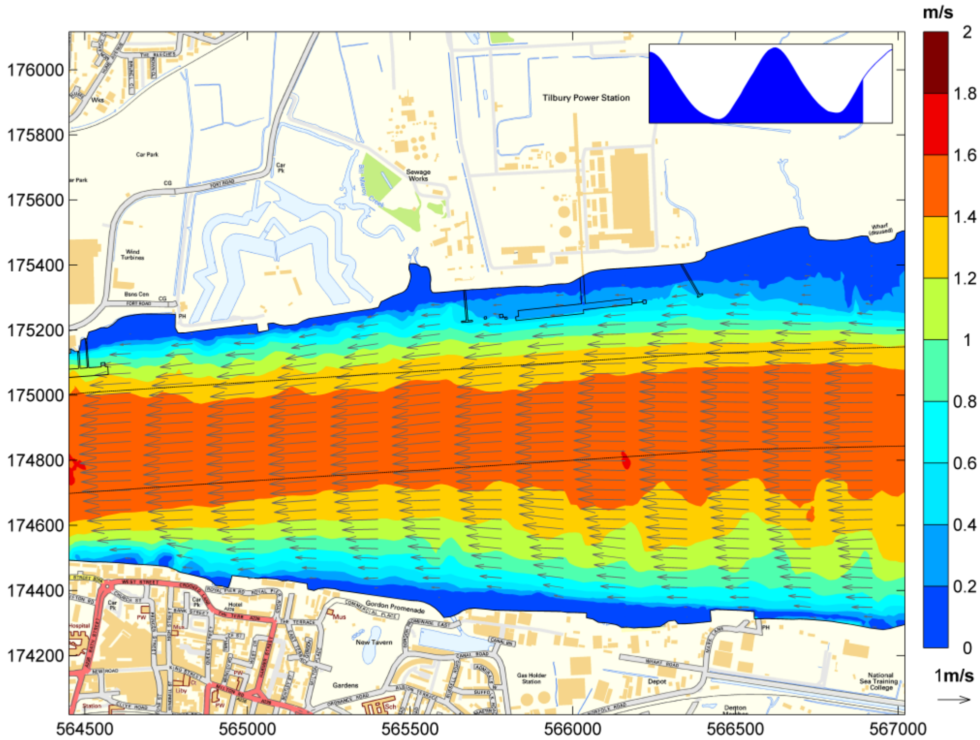

Figure 2.7: Depth averaged current speed magnitude at time of peak flood tide, baseline conditions

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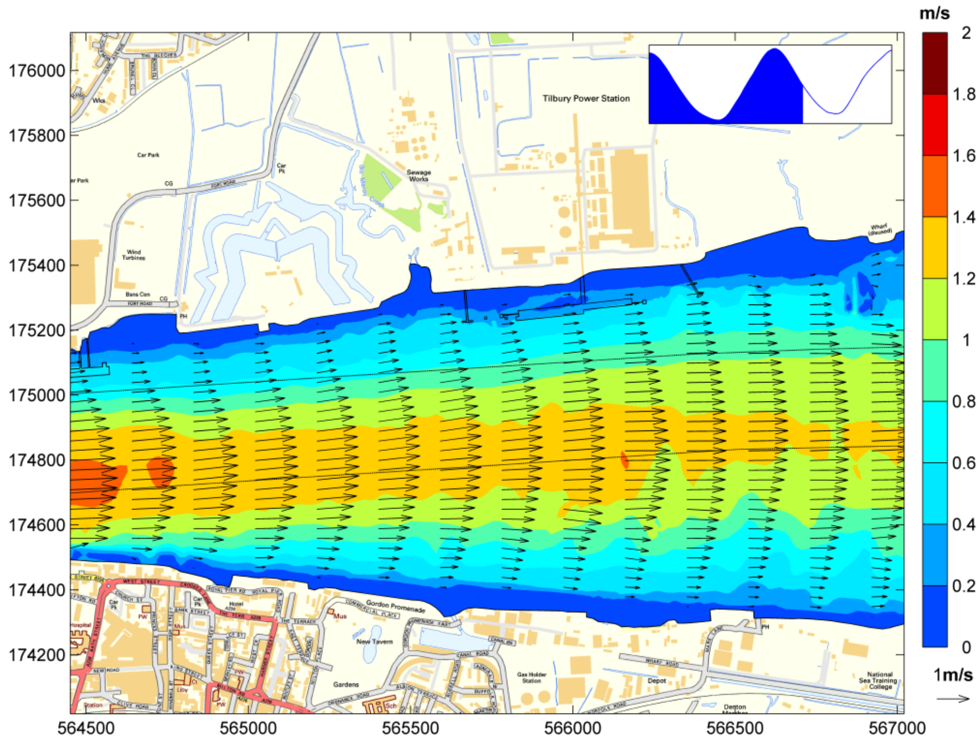

Figure 2.8: Current speed magnitude at time of peak ebb tide, near bed, baseline conditions

Background image contains OS data © Crown copyright (2016)

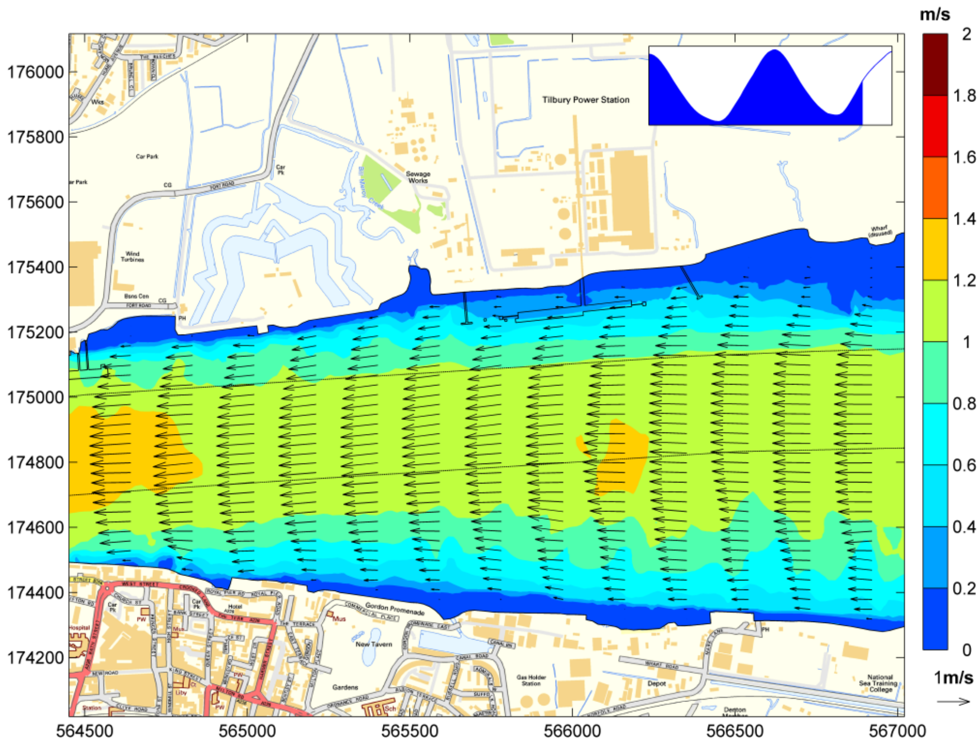

Figure 2.9: Current speed magnitude at time of peak flood tide, near bed, baseline conditions

Background image contains OS data © Crown copyright (2016)

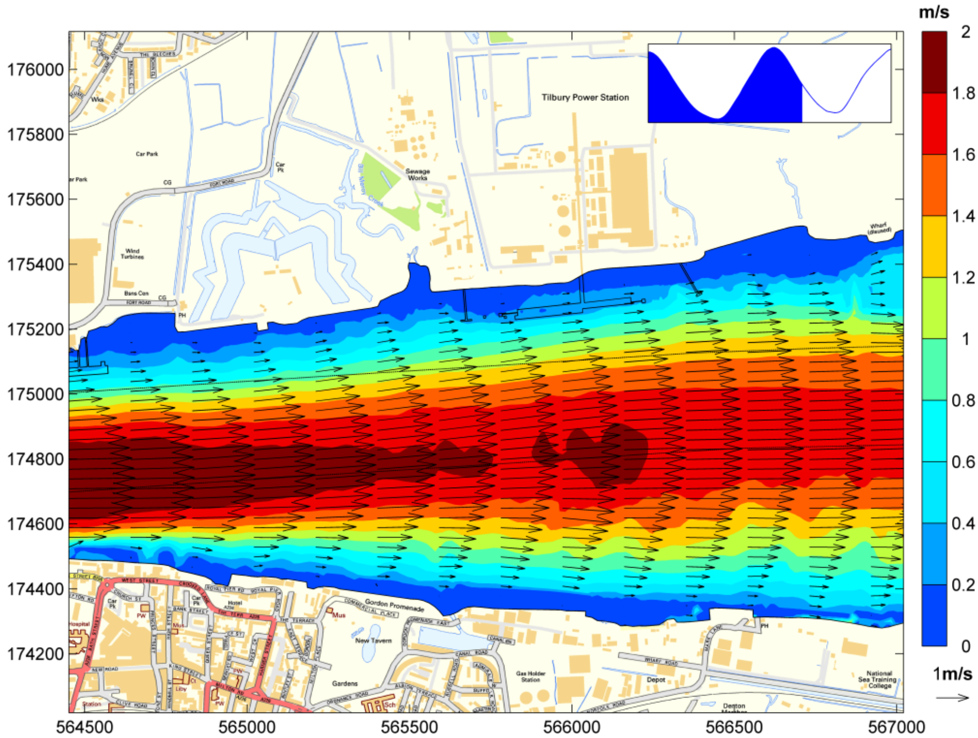

Figure 2.10: Current speed magnitude at time of peak ebb tide, near surface, baseline conditions

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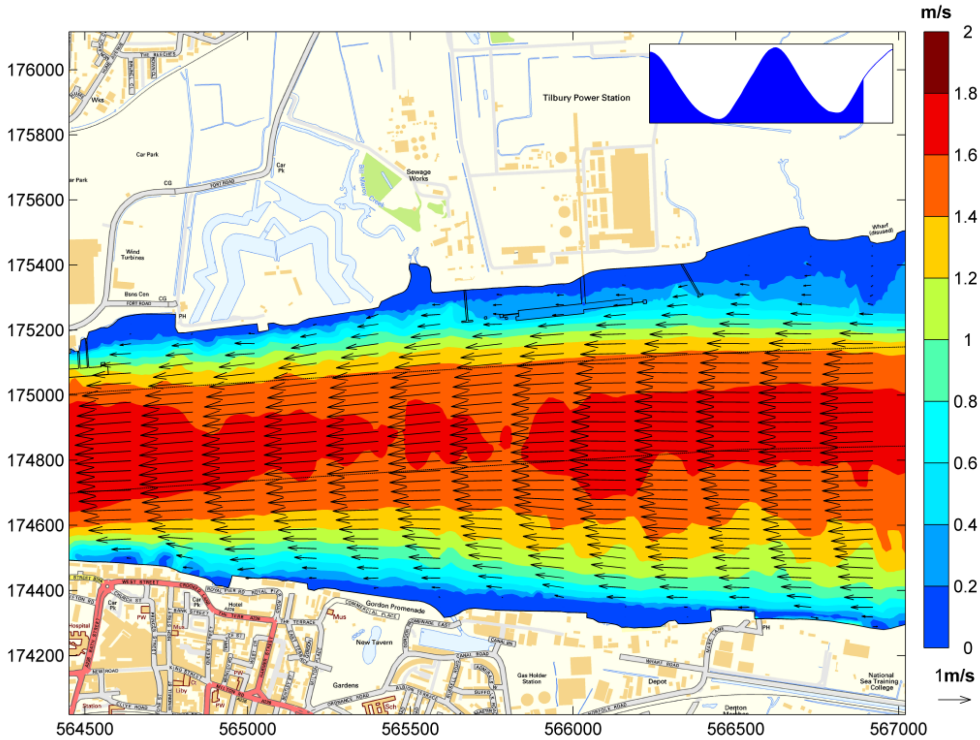

Figure 2.11: Current speed magnitude at time of peak flood tide, near surface, baseline conditions

Background image contains OS data © Crown copyright (2016)

2.10.2. Proposed works results

Current magnitude and direction

The current magnitude at times of peak ebb and flood tide currents with the project in place are plotted in Figure 2.12 to Figure 2.17. As for the baseline current presentation, the first two plots show the depth averaged velocities and the subsequent plots show predicted currents near the bed and near the surface.

Change to current magnitude

The effects of the proposed works on hydrodynamics are shown in Figure 2.18 to Figure 2.23. The plots show the change to the magnitude of currents associated with the proposed works compared to baseline conditions. The first two plots (Figure 2.18 and Figure 2.19) are for depth averaged results then equivalent results are provided for near bed and near surface currents.

The effects of the works on current magnitude are very localised to the works themselves and are distributed similarly in the water column i.e. similar amounts of change are shown for the depth averaged currents and those near the bed and near the surface.

Speed decreases are shown in the areas of dredging due to the increased water depth. The largest magnitude of change is approximately 0.2 m/s shown at the eastern end of the bulk berth dredging. The rest of the predicted speed reductions are in the range 0.1-0.2 m/s. A very small area of speed increase in the range 0.1-0.2 m/s is shown to the north of the proposed RO-RO pontoon due to the partial blockage to the flow afforded by the pontoon.

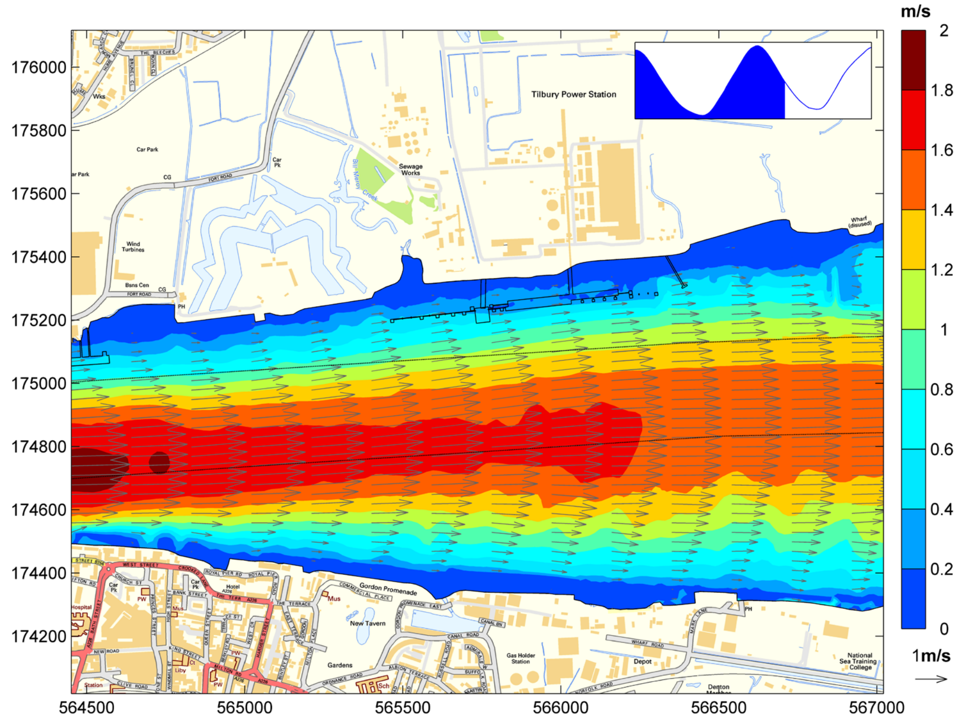

Figure 2.12: Depth averaged current speed magnitude at time of peak ebb tide, post-development conditions

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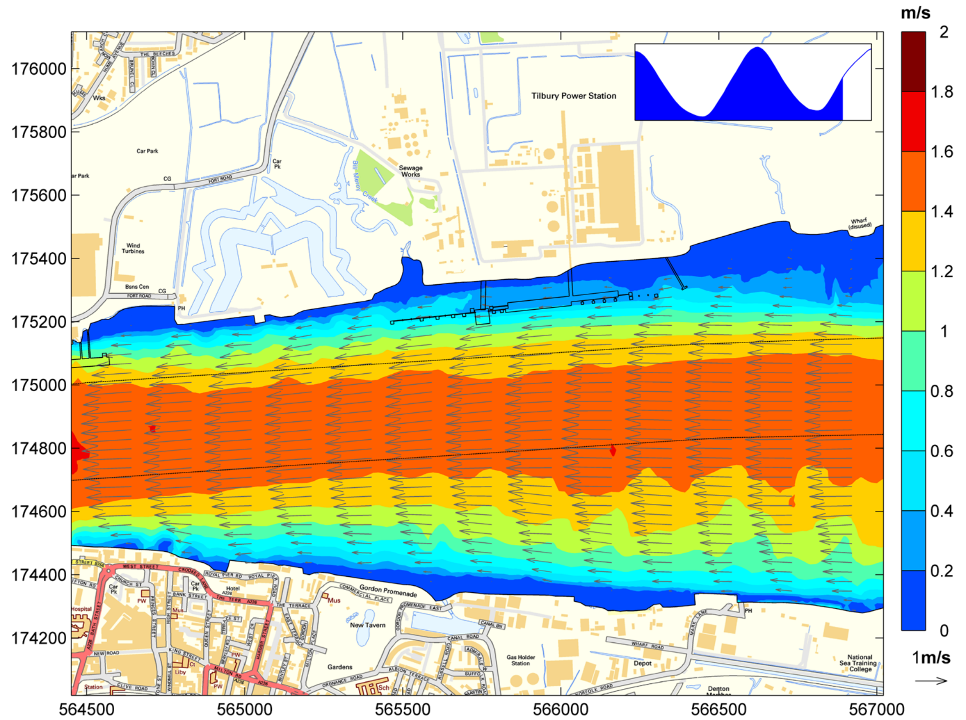

Figure 2.13: Depth averaged current speed magnitude at time of peak flood tide, post-development conditions

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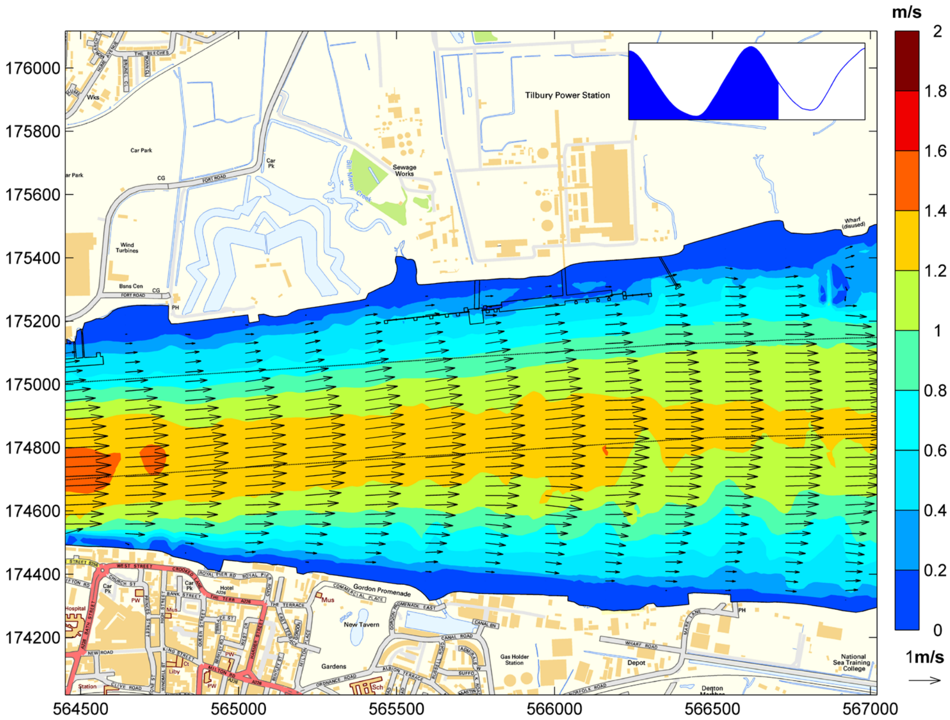

Figure 2.14: Current speed magnitude at time of peak ebb tide, near bed, post-development conditions

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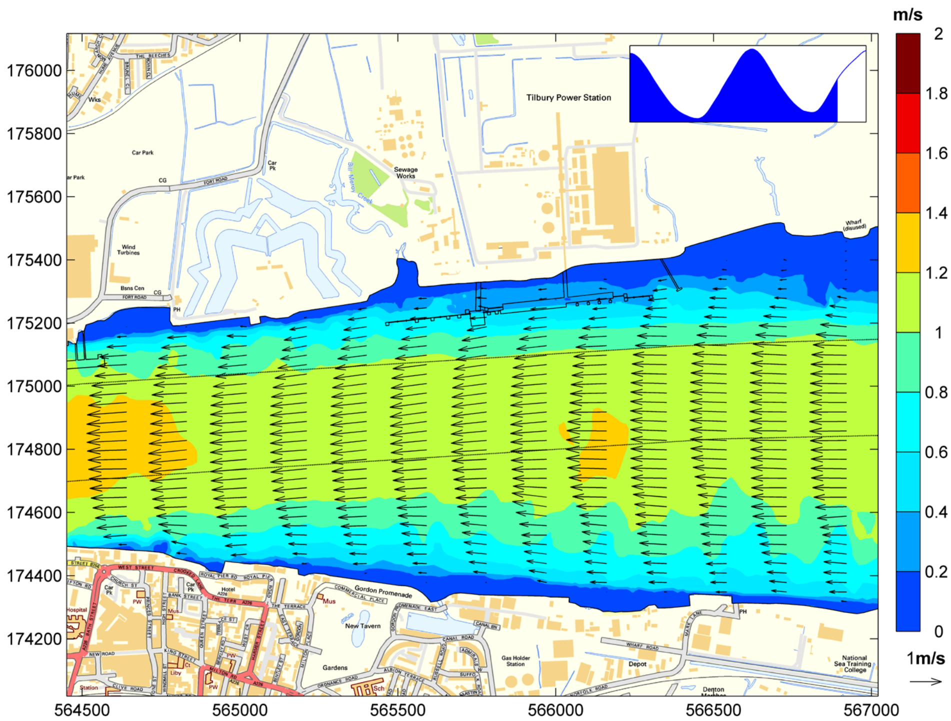

Figure 2.15: Current speed magnitude at time of peak flood tide, near bed, post-development conditions

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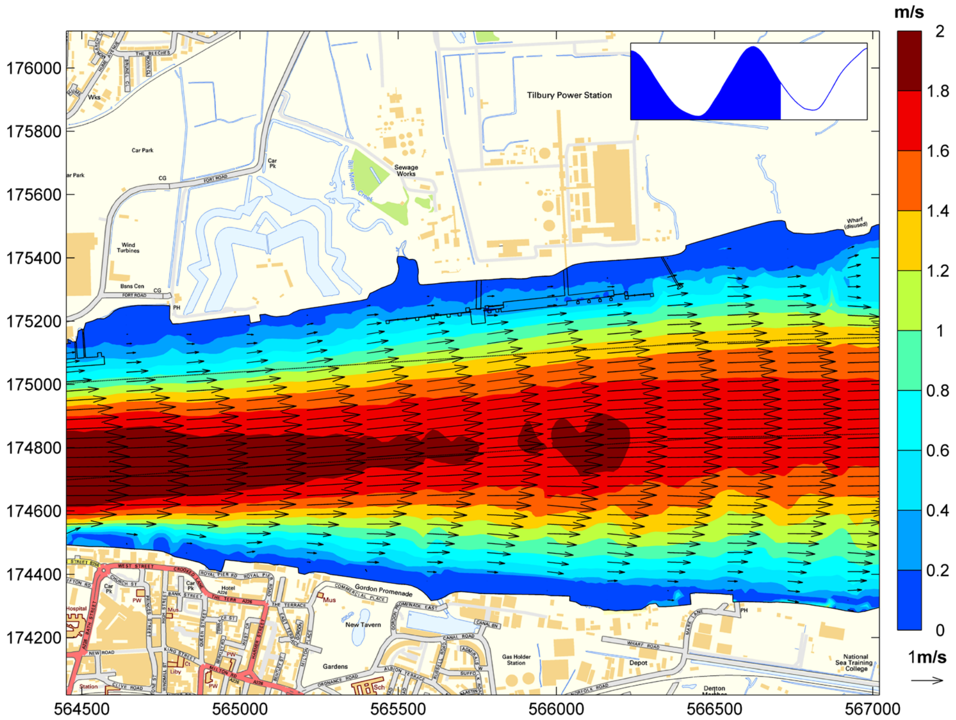

Figure 2.16: Current speed magnitude at time of peak ebb tide, near surface, post-development conditions

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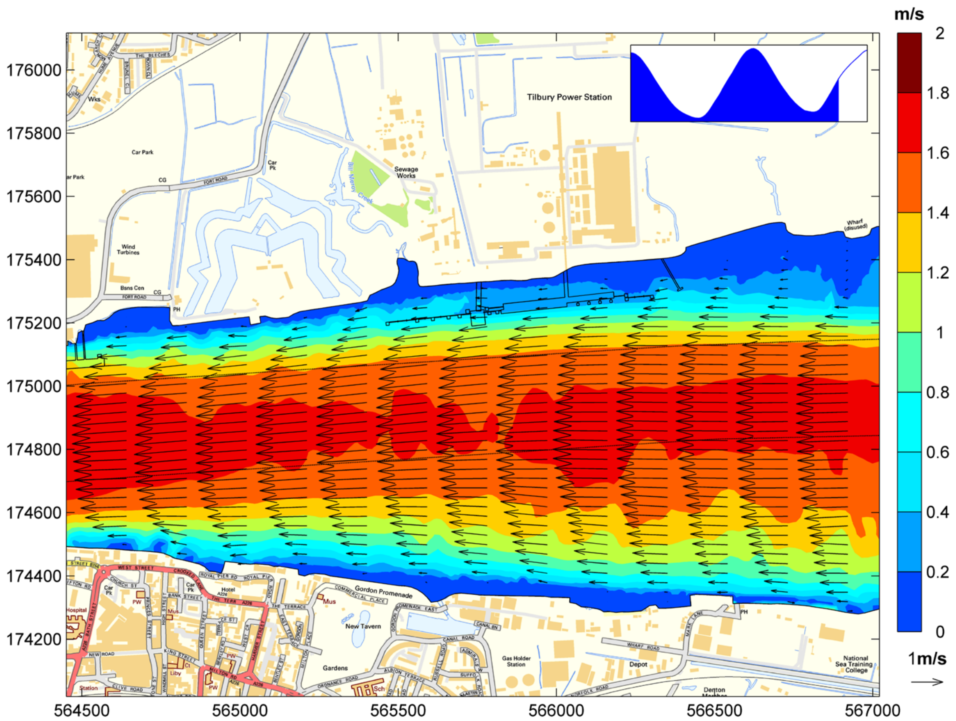

Figure 2.17: Current speed magnitude at time of peak flood tide, near surface, post-development conditions

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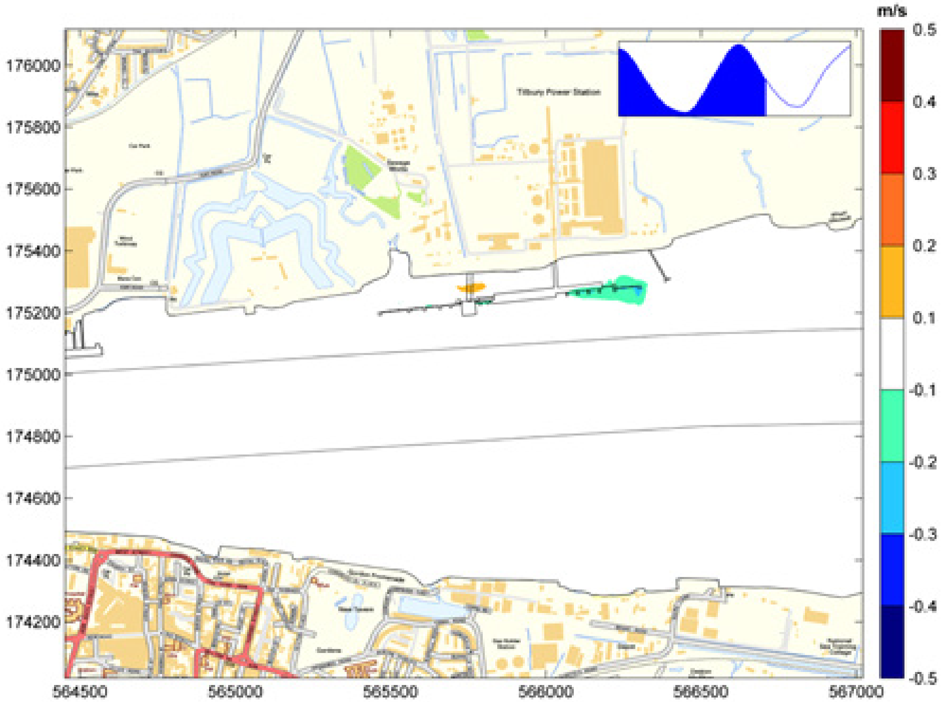

Figure 2.18: Difference in depth averaged current speed magnitude - proposed works compared to baseline, peak ebb tide

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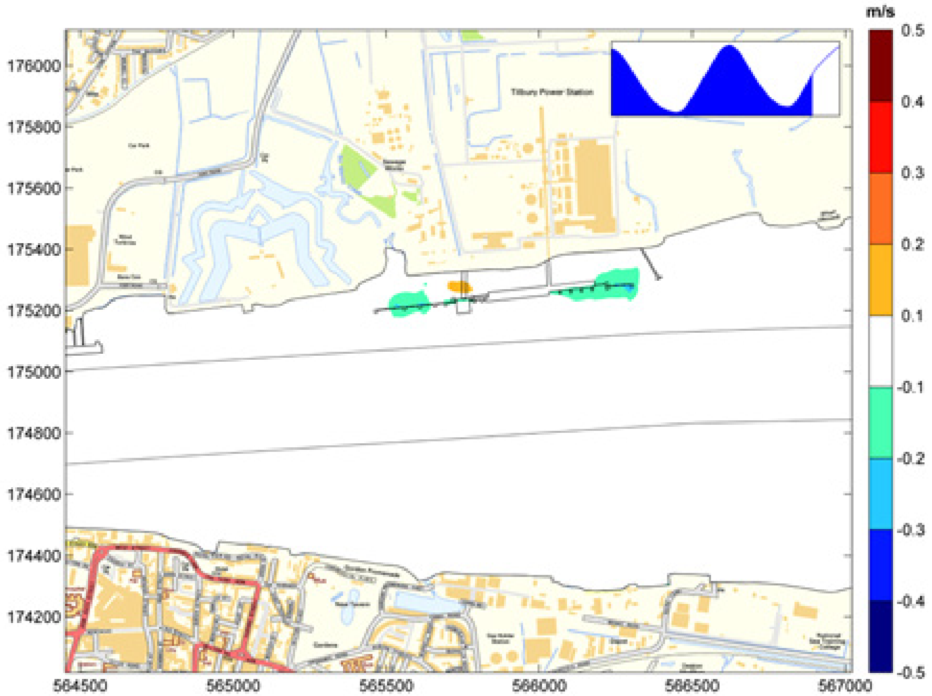

Figure 2.19: Difference in depth averaged current speed magnitude – proposed works compared to baseline, peak flood tide

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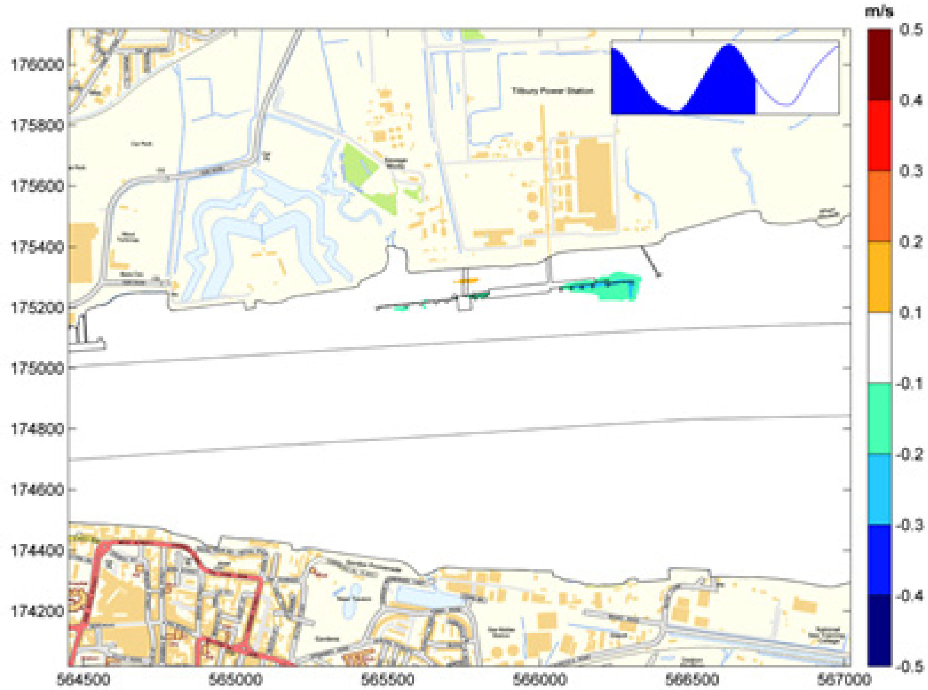

Figure 2.20: Difference in current speed magnitude - proposed works compared to baseline, near bed, peak ebb tide

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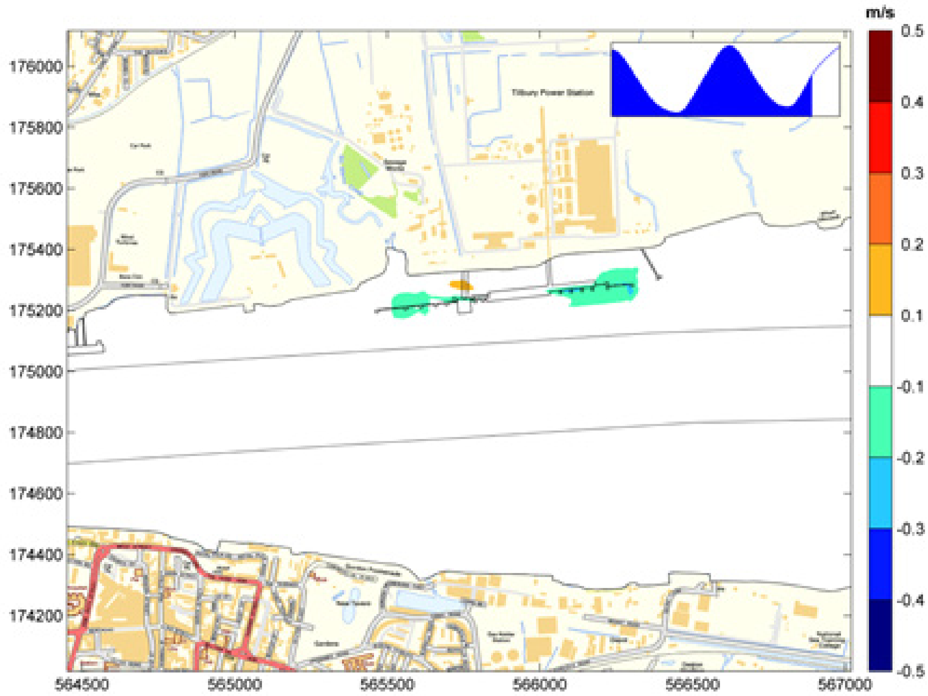

Figure 2.21: Difference in current speed magnitude - proposed works compared to baseline, near bed, peak flood tide

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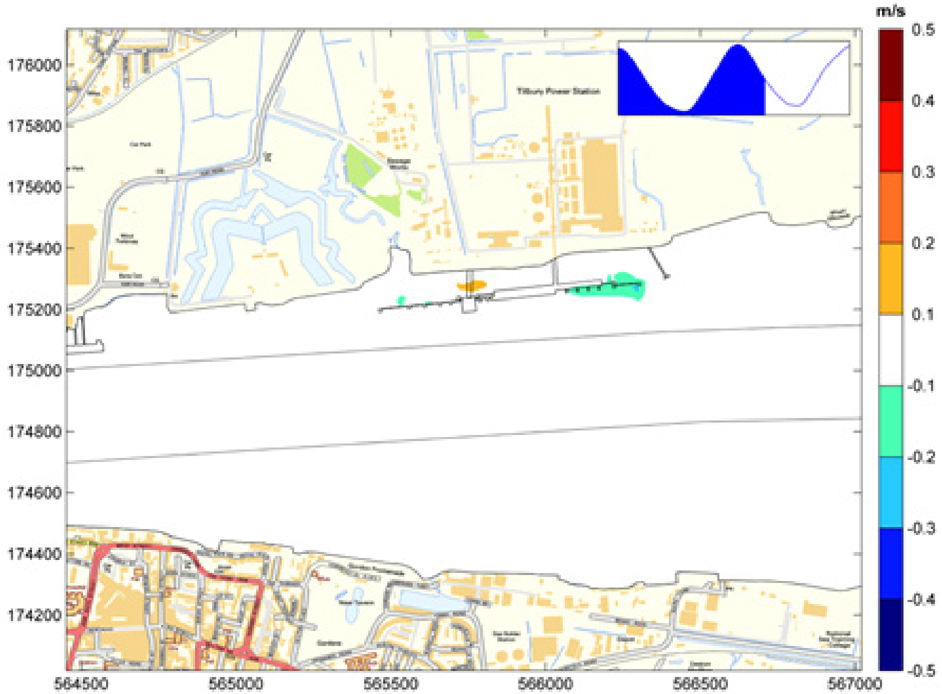

Figure 2.22 Difference in current speed magnitude - proposed works compared to baseline, near surface, peak ebb tide

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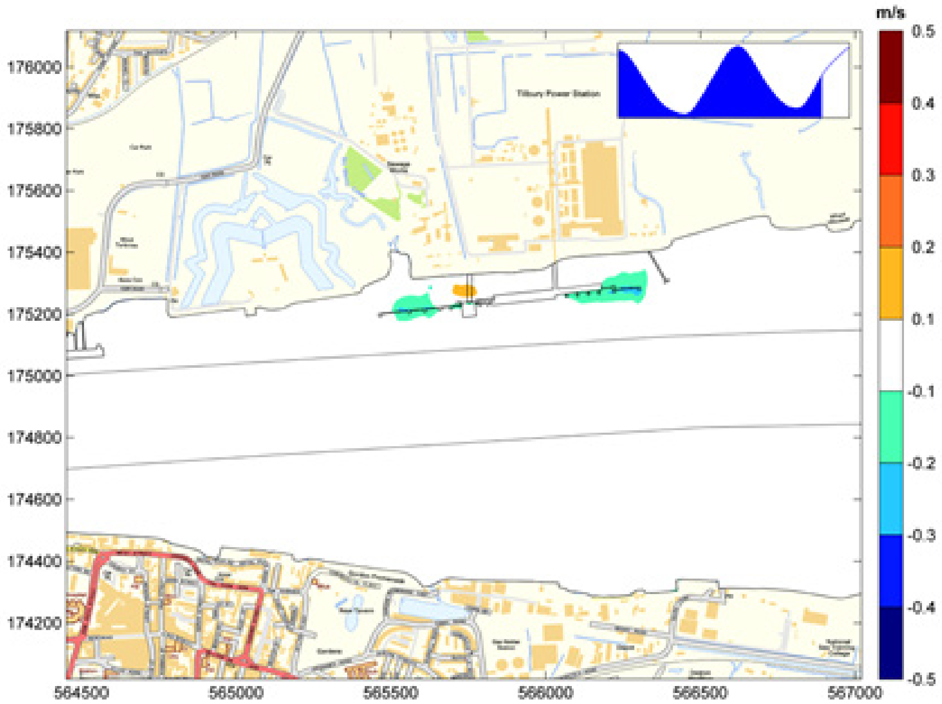

Figure 2.23: Difference in current speed magnitude - proposed works compared to baseline, near surface, peak flood tide

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Sensitivity to moored vessels

The predictions above indicate the effect of the dredging, RO-RO pontoon and piles alone to be extremely small and localised. To fully demonstrate the effect of the operational berths on the local hydrodynamics the effect of the presence of moored vessels was simulated. Three vessels of the type anticipated at the site were included in the model; a 180 m LOA RO-RO vessel with max draft of 6.5 m, a 195 m LOA RO-RO vessel with max draft of 7.4 m and a 250 m LOA bulk carrier with a max draft of 15.0 m.

Figure 2.24 and Figure 2.25 show the depth average current speed magnitude at the times of peak ebb and flood tides with the vessels in place. The predicted currents are compared with the baseline currents in Figure 2.26 (ebb tide) and Figure 2.27 (flood tide). The presence of the vessels, particularly the bulk carrier, provides additional blockage to the flow resulting in speed reductions in line with the vessels. The area of speed reduction extends some 500m from the development.

As the flow passes around the vessel hulls some speed increases are shown to the north of the ships. The largest predicted speed increase is associated with the bulk carrier during flood tide when speed increases in the range 0.2–0.3 m/s are predicted resulting in currents of 0.6-0.8 m/s.

No effect on current speed magnitude is shown in the authorised channel.

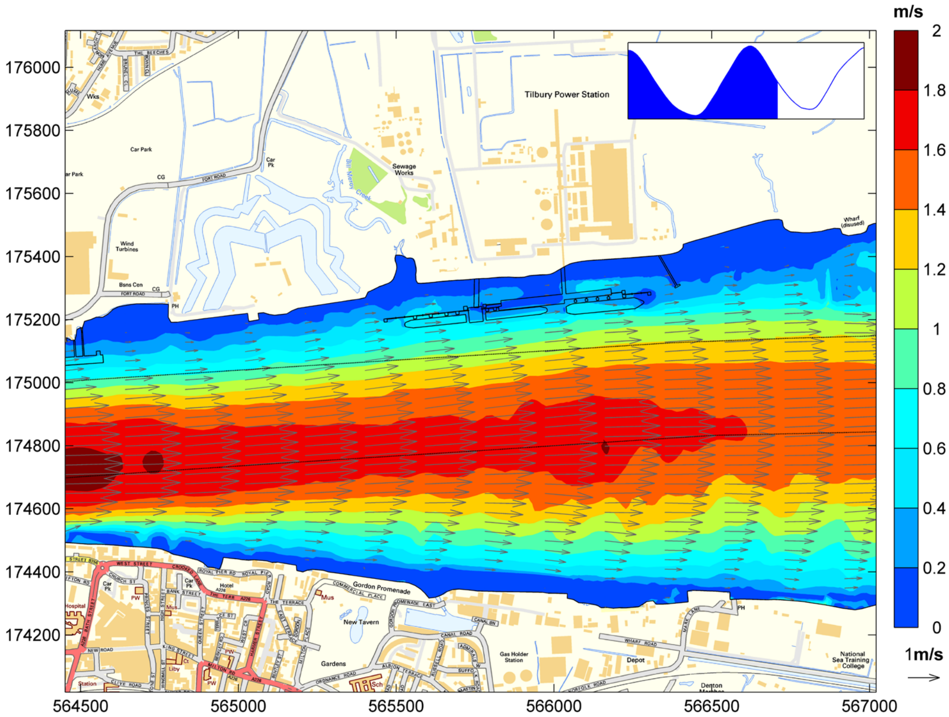

Figure 2.24: Depth-averaged peak current speed magnitude - proposed works and vessels compared to baseline, peak ebb tide

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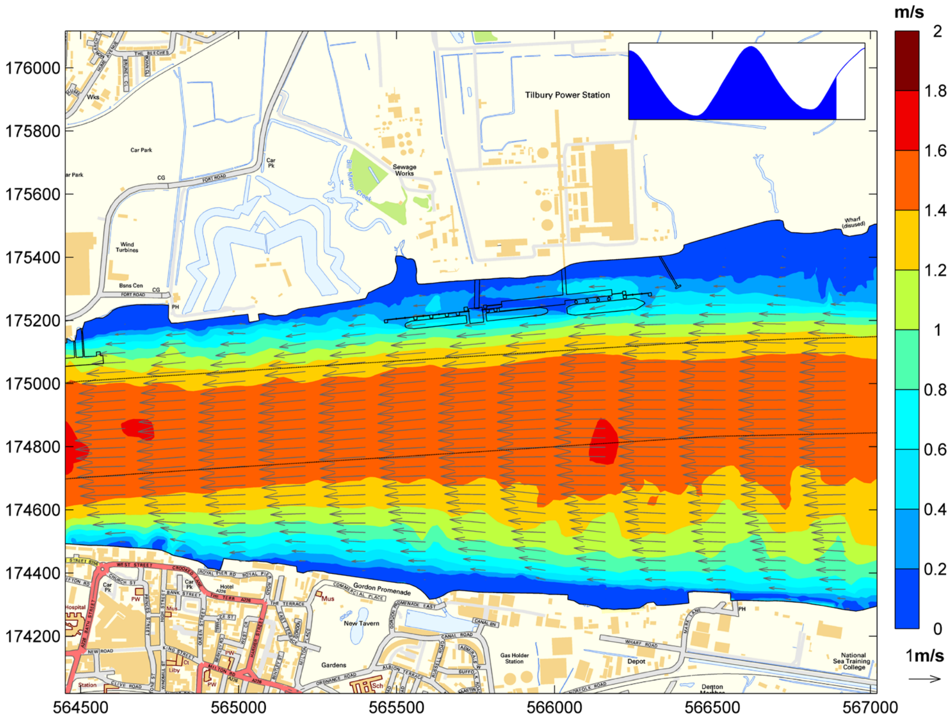

Figure 2.25: Depth-averaged peak current speed magnitude - proposed works and vessels compared to baseline, peak flood tide

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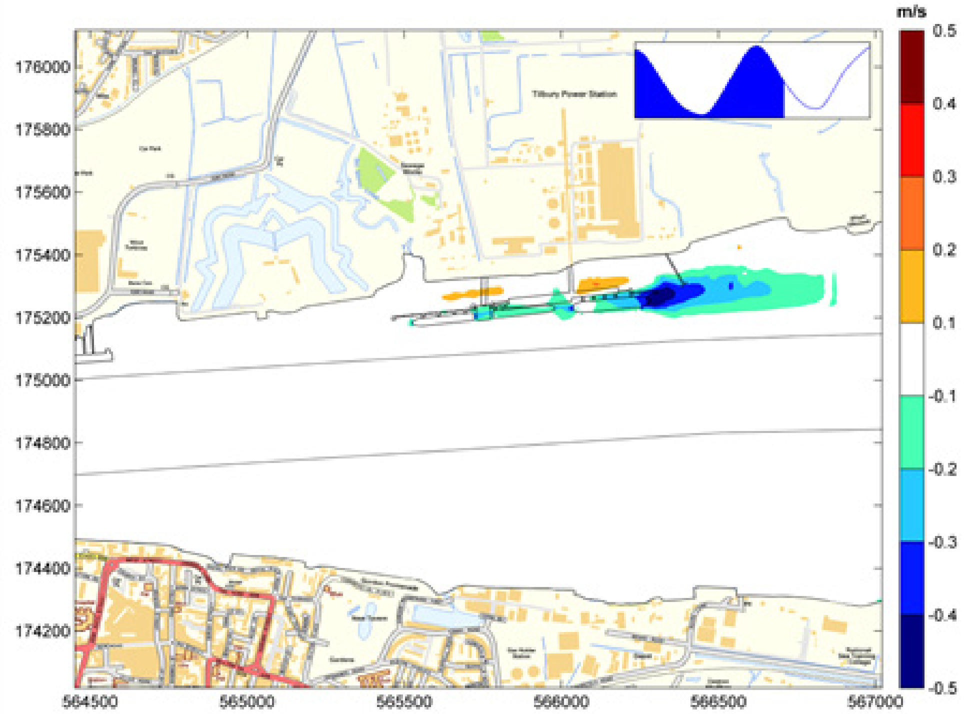

Figure 2.26: Difference in depth-averaged peak current speed magnitude - proposed works and vessels compared to baseline (no vessels), peak ebb tide

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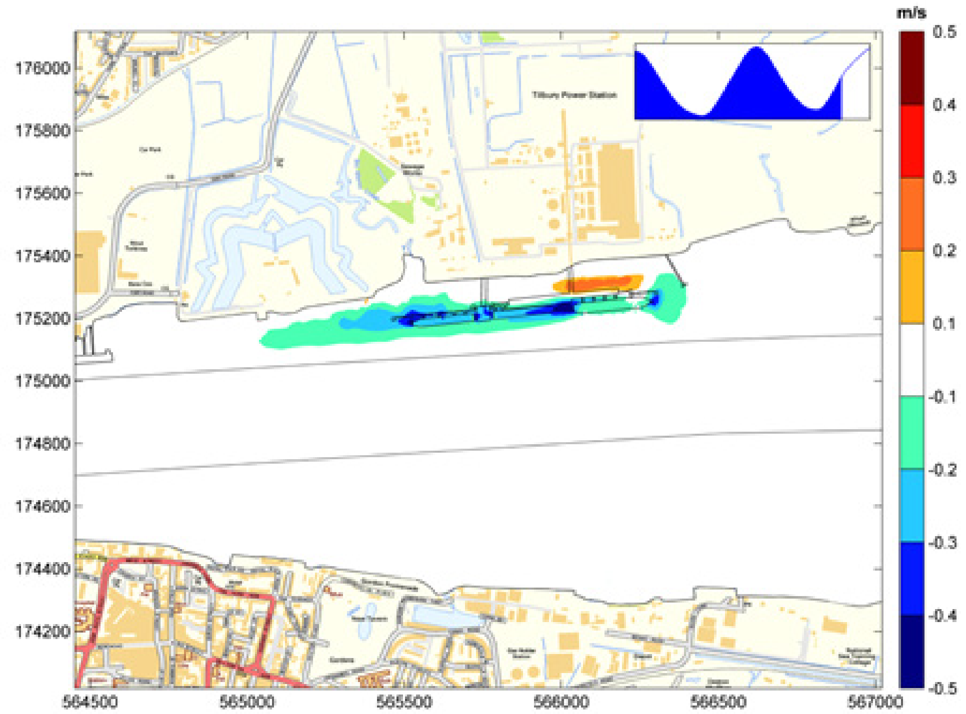

Figure 2.27: Difference in depth-averaged peak current speed magnitude - proposed works and vessels compared to baseline (no vessels), peak flood tide

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3. Sedimentation

Dredging the berth pocket to depths several metres below the natural regime depth in an area which is known to be sensitive to sedimentation is likely to lead to the dredged areas being subject to ingress of sediment. The flow modelling described above has been used to drive models of non-cohesive (sandy) and fine cohesive (muddy) sediment transport.

3.1. Available data

3.1.1. Suspended sediment concentration

Suspended sediment data were collected by water sampling at four locations near the power station jetty in July 2002 (HR Wallingford, 2002a). Example results for total suspended sediment concentration are shown in Figure 3.1. Of this total, generally approximately 10% was sand (although with some samples of more than 30% sand found, including one at mid-depth).

Fine sediment concentrations of up to 1,600 mg/l (near bed) and 1,300 mg/l (mid depth) were observed. Average suspended sand concentrations of 80 mg/l (near bed) and 30 mg/l (mid depth) indicate a highly dynamic location.

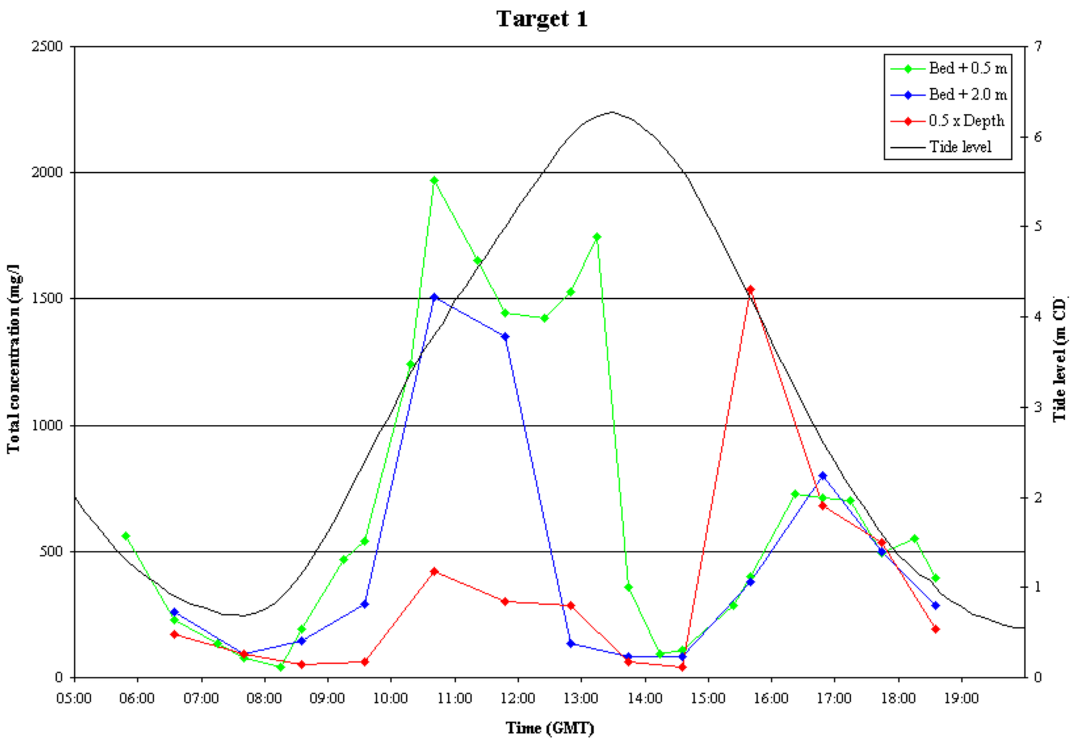

Figure 3.1: Suspended fine sediment concentration observed near the Power Station Jetty in July 2002

Source: HR Wallingford (2002a)

The view of a dynamic sedimentary environmental is confirmed by measurements of total sediment flux made in Gravesend Reach in September 2004. Spring tide observations showed approximately 65,000 Tonnes of sediment passing through the section during each tidal phase. This total fell to approximately 20,000 Tonnes during neap tides. Figure 3.2 shows the instantaneous discharge and sediment flux at the section in Gravesend Reach. Maximum sediment fluxes of 6,000 kg/s are shown for both the ebb and flood tidal phases.

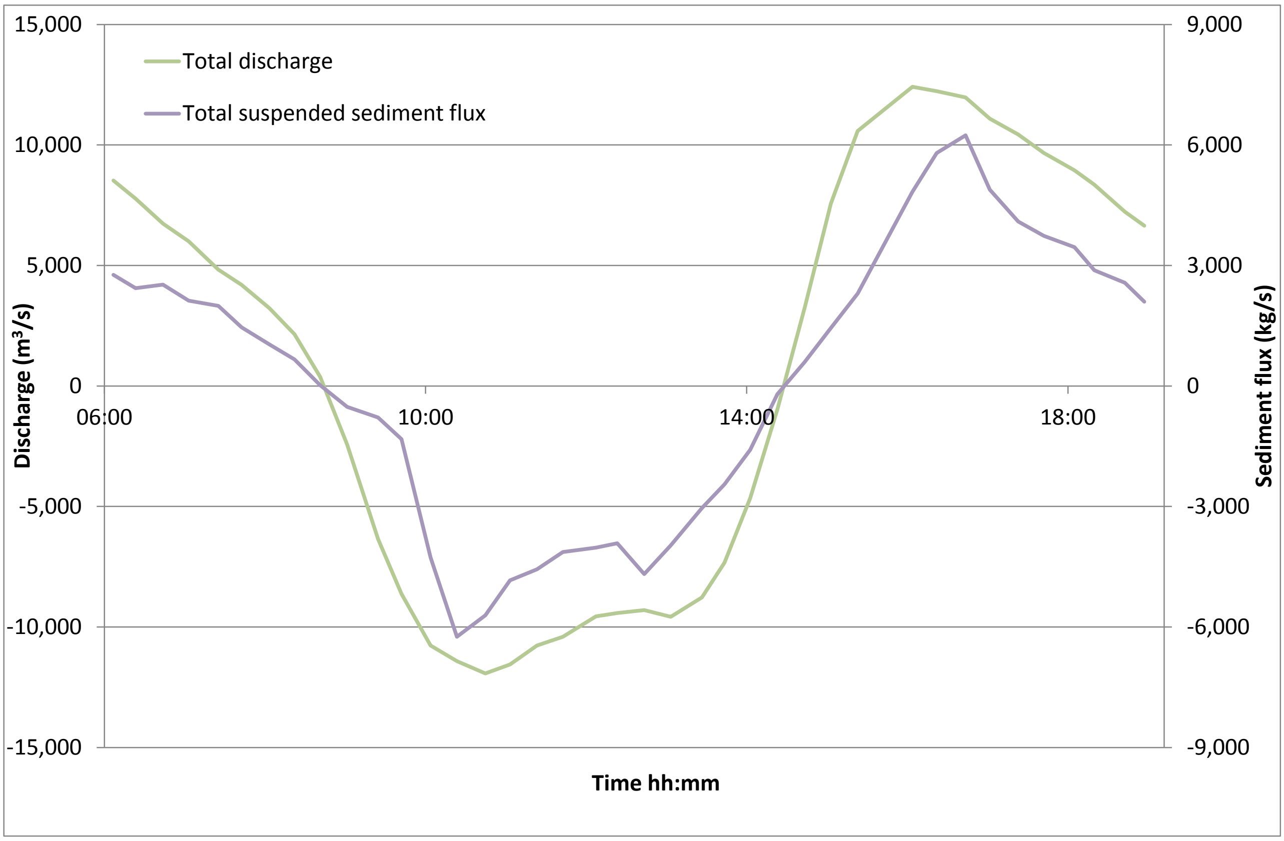

Figure 3.2: Total spring tide water discharge and sediment flux measured in Gravesend Reach, September 2004

Source: HR Wallingford (2006b)

3.1.2. Bed composition

A programme of geotechnical data collection was undertaken at the existing coal jetty in 2002 (Norwest Holst, 2002). This programme included 12 boreholes with particle size analysis undertaken for a selection of the locations and bed depths. Data for the upper 10 m of the boreholes is summarised in Table 3.1. The location of the boreholes is shown in Figure 3.3 which is taken directly from Norwest Holst (2002).

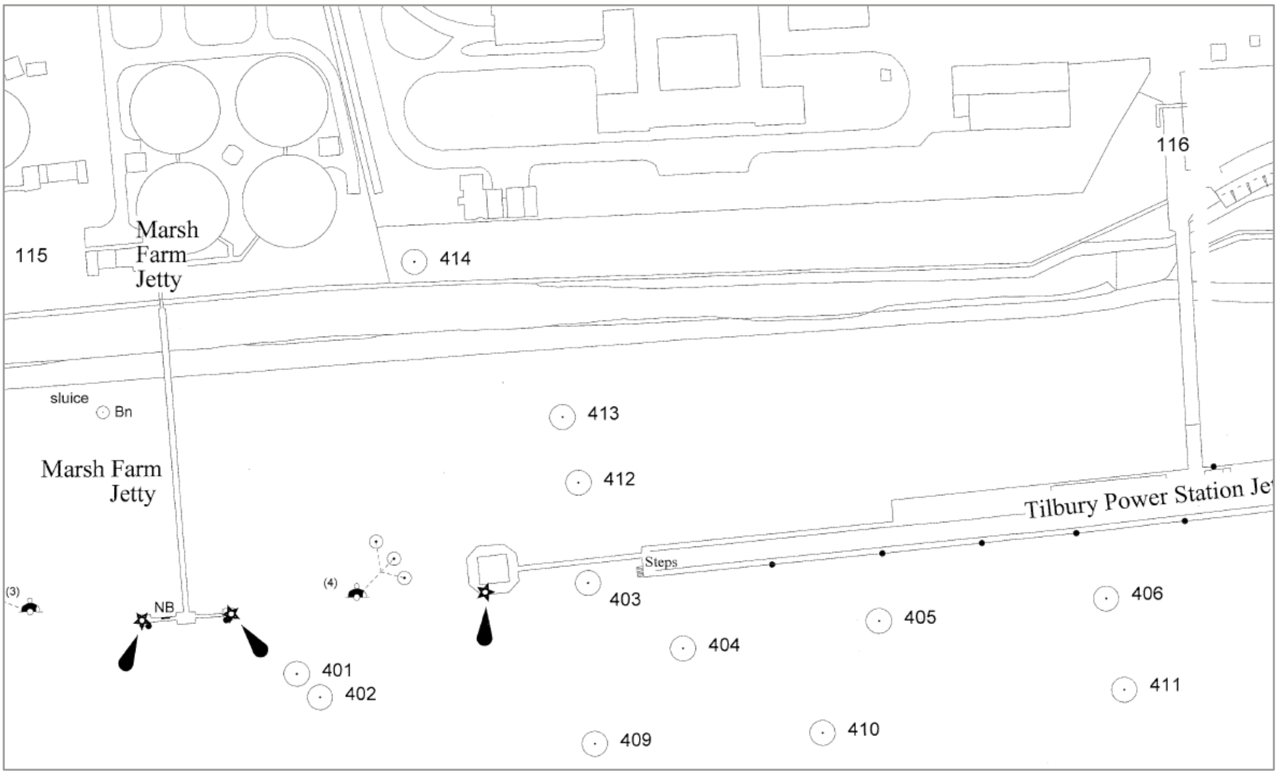

Figure 3.3: Location of 2002 boreholes

Source: Norwest Holst (2002)

The data on surficial sediments is in line with the observations of sediment transport rates indicating a dominance of fine silt or clay. Below this alluvial layer the material is a mix of sand and gravel in the boreholes south of the existing jetty line (i.e. in the areas of potential dredging for the berth pocket) and silt or peat for the boreholes to the north of the present jetty line.

Table 3.1: Sediment descriptions from 2002 boreholes

Borehole	Sediment description	depth of sediment base (m below river bed)	Sediment description	depth of sediment base (m below river bed)	Sediment description	depth of sediment base (m below river bed)
BH401	Grey organic SILT	2.4	fine to medium SAND	3.2	TERRACE GRAVEL (8-36% sand)	9.5
BH402	very soft grey organic CLAY	3	clayey fine to coarse gravel	3.5	Fine to coarse GRAVEL	8
BH403	Organic SILT	6	TERRACE GRAVEL (3-12% sand)	8.8		

Borehole	Sediment description	depth of sediment base (m below river bed)	Sediment description	depth of sediment base (m below river bed)	Sediment description	depth of sediment base (m below river bed)
BH404	Slightly organic SILT	3.4	sandy GRAVEL (27-35% sand)	5	TERRACE GRAVEL	6.8
BH405	Slightly organic SILT	3.2	sandy GRAVEL (8-13% sand)	4.5	TERRACE GRAVEL (12-22%sand)	9.5
BH406	Organic SILT	1.3	Sandy CLAY	3.8	TERRACE GRAVEL (20-29%sand)	6.3
BH409	Coarse SAND and GRAVEL (46% sand)	1.1	GRAVEL (7-13% sand)	5.5	GRAVEL	6.3
BH410	Slightly organic CLAY	0.4	Gravelly SAND (43% sand)	0.7	GRAVEL (29-20% sand)	5.8
BH411	Sandy SILT (4% sand)	0.8	fine to coarse SAND	1.3	GRAVEL (0-53% sand)	4
BH412	sandy CLAY	4.2	organic SILT	5.2	silty PEAT	6.8
BH413	Organic SILT	6	clayey PEAT	8.35	CLAY	9.1
BH414	MADE GROUND	0.55	Sandy SILT	4.2	organic SILT	6

Source: Norwest Holst (2002)

3.1.3. Sedimentation rate

The primary source of sedimentation data is the PLA's Maintenance Dredge Protocol Baseline Document. Three releases of this document reveal considerable variation in historic dredging rates at the Tilbury Power Station Jetty, most likely due to the changing operational needs of the jetty.

The 2007 document (Royal Haskoning, 2007) describes maintenance dredging of soft silt at the jetty by Trailer Suction Hopper Dredger with an annual average dredge quantity of 40,000 m^3.

In 2009 Royal Haskoning undertook a similar review of dredging activities in the Thames Estuary for a dredging conservation assessment (Royal Haskoning, 2009). This document reported small scale use of plough dredging at the power station jetty to clear material from under the structure. An average dredge quantity of 11,100 m^3 of sandy silt is stated with the maximum permitted licensed dredge quantity of 20,000 m^3.

The 2014 MDP document (ABPmer, 2014) describes and tabulates annual dredging at the Tilbury Power Station although the site is not presently licensed by the PLA. Maintenance dredging has predominantly been required within the upper (western) berth (declared depth -13.8 mCD) although some irregular dredging of the lower (eastern) berth (declared depth -7.2 mCD) has been undertaken with a maximum volume of 1,334 m^3 removed by plough dredging. Additionally, during the period 2004-2013 approximately 6,000 m^3 was dredged by backhoe from the power station intakes during 2005.

Table 3.2 summarises the annual dredged volumes from ABPmer (2014). It can be seen that the dredged volumes vary greatly due to operational requirements of the power station eventually falling to zero before the power station was closed in 2013. The highest infill rate of 120,000 m^3 in 2004 corresponds to a period of capital dredging and reconstruction of the berth to accommodate deeper draft vessels. It is not known if the reported volume includes any of the capital dredging volume or if it represents the short term increase in infill typically experienced by newly deepened berths due to sediment disturbance during the dredge and while the surrounding seabed reaches equilibrium.

Table 3.2: Reported maintenance dredging volumes at Tilbury Power Station

	2004	2005	2006	2007	2008
Annual dredged volumes (m^3)	120,000	8,000	16,500	15,860	12,540
	2009	**2010**	**2011**	**2012**	**2013**
	2,822	13,593	1,697	0	0

Source: ABPmer, 2014

Due to the high degree of variability in the quoted dredging data it is not straightforward to propose a calibration target for the sedimentation model. If the 2004 value of 120,000 m^3 is excluded due to the potential effects of a capital dredge at that time, the infill has been somewhere in the range 10,000 – 40,000 m^3/year although this is likely to be strongly linked to the operational needs of the berth as well as variation in vessel occupancy.

3.2. Sand transport modelling

3.2.1. Methodology

For this element of the study the integrated sediment transport model SISYPHE (part of the TELEMAC system) was employed to simulate non-cohesive (sandy) sediment transport by tidal flows.

SISYPHE is the state-of-the-art sediment transport model used at HR Wallingford. The main factors controlling sand transport which can be included in the model are: advection by currents, settlement under gravity, wave stirring, turbulent diffusion in all directions and exchange of sediment between the flow and the bed.

Like TELEMAC-3D, SISYPHE uses an unstructured triangular model mesh. This mesh allows complex coastlines and seabed features to be modelled accurately with user defined levels of detail applicable in a particular area of interest. Larger model mesh elements are used to remove the model's imposed boundary conditions away from the area of interest.

For this study SISYPHE was run taking the flow results from the TELEMAC-3D simulation. At this location larger swell waves will not occur and wave conditions are limited to locally wind generated waves with consequential less effect of sediment transport except in shallow areas or intertidal areas. Without the inclusion of waves the potential for sediment accretion in shallow areas is likely to be slightly over estimated.

The sediment size used was a fine to medium sand of median grain size 0.1 mm. This value is consistent with the sediment size used for projects nearby, for example at London Gateway Port (HR Wallingford, 2002b).

By default SISYPHE assumes sand is available everywhere on the river bed to provide a sediment source for the material transported. However in areas of the channel the currents are too high to allow significant accumulations of sand. Therefore to take account of this factor the model was run in two stages, the first stage was to generate more realistic initial conditions. The model was initially run for spring tide conditions assuming sand deposits were available everywhere and then the resultant of areas of potential sand accumulation identified by the simulation were used to define the initial conditions for areas of sand availability in the main model runs. In effect this method excluded the availability of sand from the channel areas. There remains some uncertainty in the availability of sand in the area however this approach is considered acceptable to provide comparative results for the purposes of demonstrating the effect of the development on sand transport.

3.2.2. Results

The model was run for a spring-neap cycle (approx. 14.5 days) and the results multiplied to give estimates of annual infill rates.

Figure 3.4 and Figure 3.5 show the predicted annual sand infill for the baseline and developed case, respectively. For each plot the extent of the proposed dredging are marked to enable comparison. Neither case shows sand accumulation in the approaches to the berths. Some accumulation adjacent to the Divers Shoal groynes are shown in both cases, however as it is understood that this area now has broadly stable bed levels following the morphological response to the groynes, this accumulation of material may be removed by local wind generated waves.

There is no maintenance dredging undertaken in the existing berths so there is no data to confirm the sand accumulation predicted in the berth areas under baseline conditions. With the development in place additional sandy infill is predicted in the dredged berth areas, particularly at the eastern end of the bulk berth (Figure 3.5). This is the area of deepest dredging so largest infill would be expected here.

The difference in sandy infill due to the development is plotted in Figure 3.6. No change other than in the berth pockets is predicted. The effect of the development on infill appears to be concentrated in the bulk berth pocket, particularly at the eastern end of the berth pocket where annual infill rates of more than 0.3 m are shown.

Some additional sedimentation may occur to the north of the berth line due to reduction in wave conditions but wave effects are not simulated to confirm this possibility.

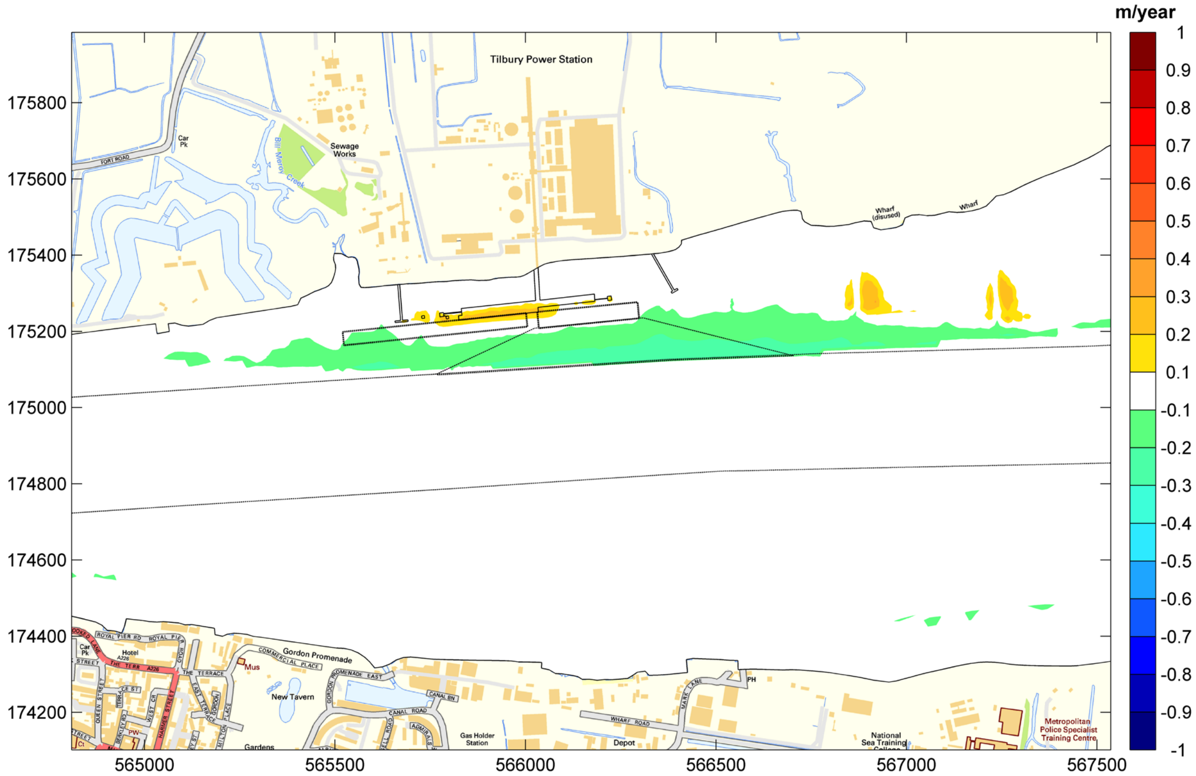

Figure 3.4: Predicted annual sand infill – baseline conditions

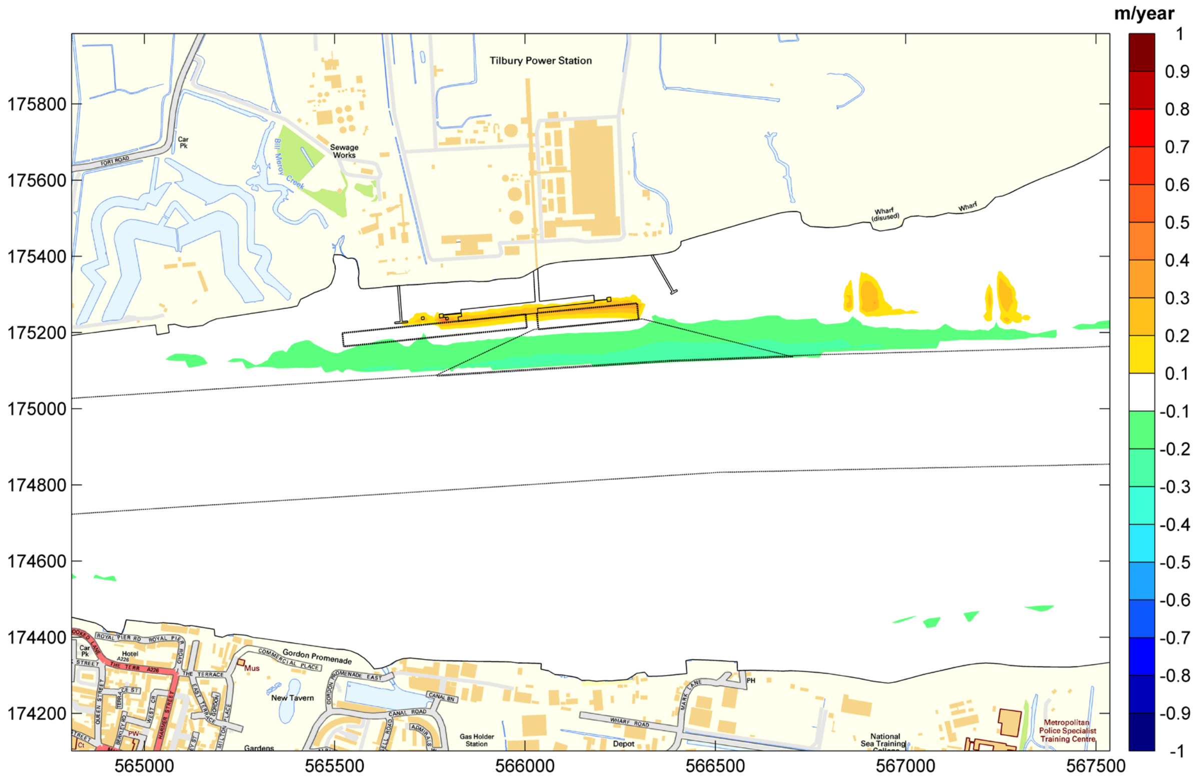

Figure 3.5: Predicted annual sand infill – post development conditions

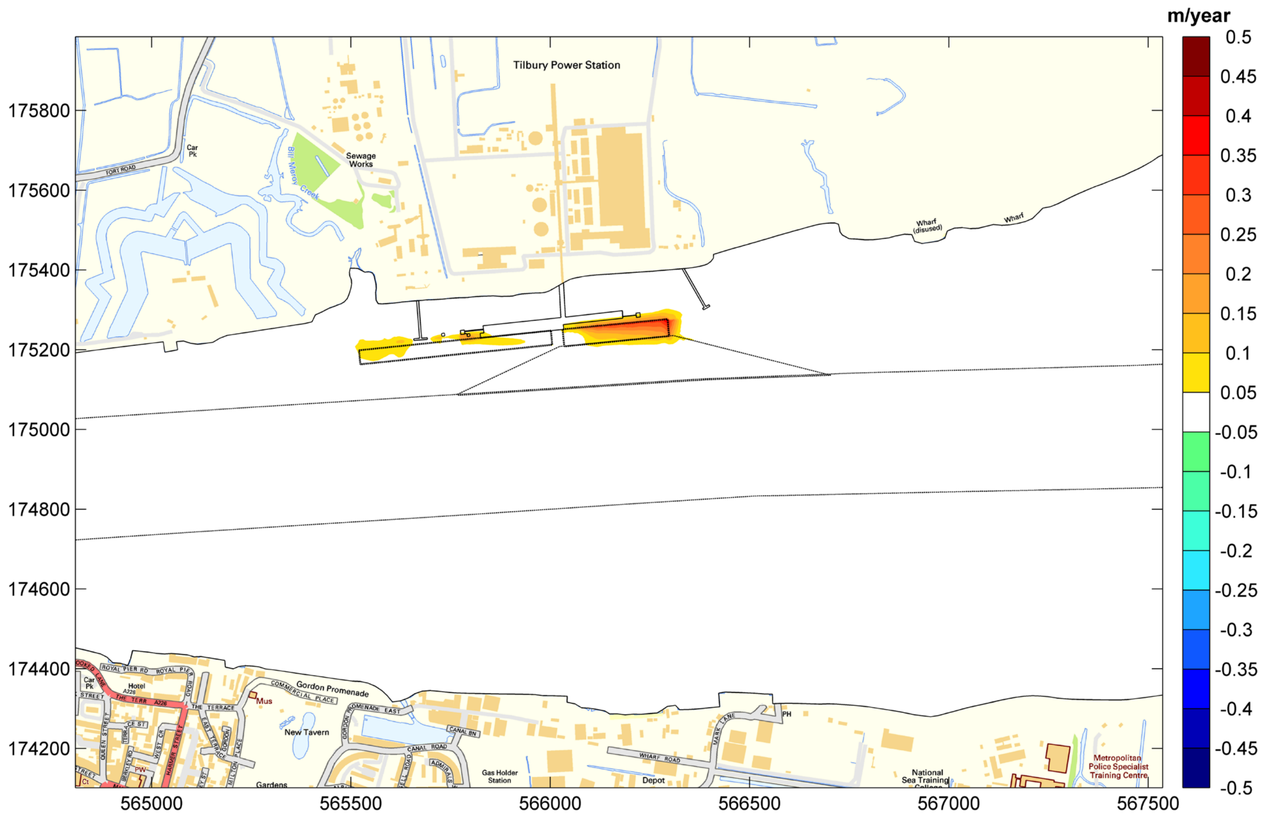

Figure 3.6: Change to predicted annual sand infill due to the development

The volume of infill has been integrated in the areas around the western RO-RO, the Eastern RO-RO and the bulk berth. The area of integration included the berths and the surrounding side slopes as sediment on the side slopes may also migrate into the berth area.

The predicted annual sandy infill rates are shown in Table 3.3. As the infill predicted for the baseline case cannot be straightforwardly validated by comparison with data in this area there is some uncertainty in the predicted infill for the developed case. However, the low rate of sandy accumulation is in line with the evidence that infill is predominantly silty with a small contribution of sand. The uncertainty in potential sandy accumulation is represented by the range between the predicted infill total and the difference in predicted infill total due to the works.

Table 3.3: Predicted annual infill of sandy sediment (m^3/year)

Site	Baseline	Developed case	Difference
West RO-RO	330	450	120
East RO-RO	1,890	2,340	450
Bulk cargo berth	1,150	3,590	2,440
Total	3,370	6,380	3,010

In summary between approximately 3,000 and 6,400 m^3/year of sandy infill is predicted with between 50% and 80% of this total anticipated to be within the bulk cargo berth pocket. This is a medium term prediction after any initial effects of the dredging itself have been removed.

An example of the temporal variation in sandy infill for the bulk berth is provided by Figure 3.7. As might be expected sand transport and consequential infill is strongly tidally dominated with significant bed changes only predicted during spring tides.

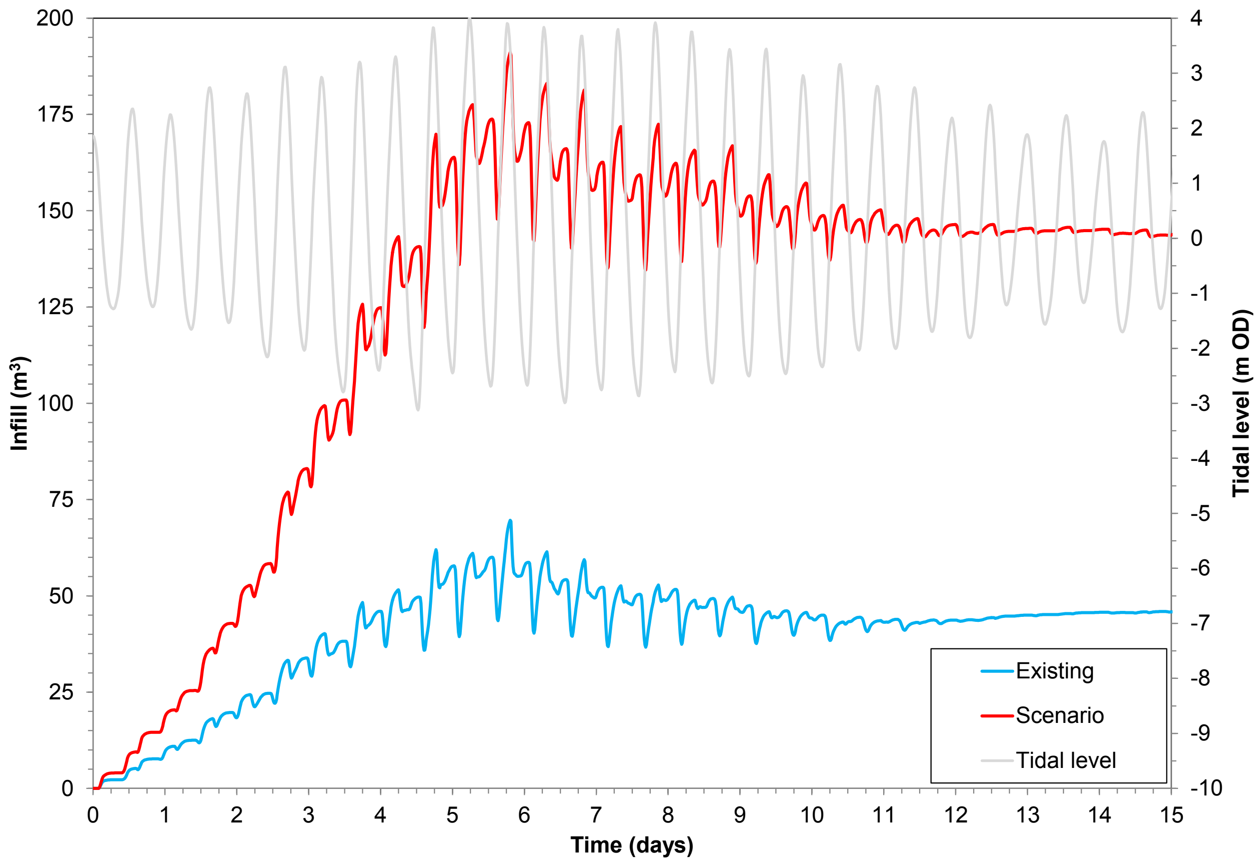

Figure 3.7: Time series of predicted cumulative sand infill volume for proposed bulk berth

3.3. Mud transport modelling

3.3.1. Methodology

To simulate fine cohesive (muddy) sediment transport, the TELEMAC-3D modelling was repeated including the transport of fine sediments. Coupling of TELEMAC-3D with mud transport is required in areas of high suspended sediment concentration such as within Gravesend Reach. In these conditions the suspended sediment concentration is high enough to influence the hydrodynamics via changes to density.

HR Wallingford has been applying TELEMAC-3D coupled with fine sediment transport in the Thames at various time since a model was established in 2005 for the Environment Agency's TE2100 programme. The model was calibrated against the sediment flux data at a series of transects between Southend-on-Sea and central London such as that shown in Figure 3.2. The calibration of the model is reported in Baugh and Littlewood (2005). At the study location waves are anticipated to be a secondary effect, mainly on intertidal areas as the waves will be locally generated wind waves, without the wave height or period to produce significant forces on the seabed. Therefore waves were not included in the modelling.

Initial conditions for the simulations were required for fine sediment both in suspension and on the bed. The imposed initial conditions comprised a variation in depth averaged suspended sediment concentration ranging from 30 mg/l at Southend-on-Sea to a maximum of more than 500 mg/l near Crossness (approximately the estuarine turbidity maximum) then decreasing back below 100 mg/l in the upper Tideway. This distribution of fine sediment was enhanced by an initial 0.1 m layer of mud on the channel bed in the area from Gravesend to Woolwich. This bed material was intended to quickly erode and provide additional suspended sediment concentration in the muddiest reaches.

3.3.2. Results

The model was run for a 3 day spin up period to remove the influence of the initial conditions and then for a spring-neap cycle (approx. 14.5 days). The predicted infill was calculated over the spring-neap period.

As a validation check the suspended sediment concentration was extracted at the observed location plotted in Figure 3.1. The model's reproduction of the data as shown in Figure 3.8 is not exact as it simulated a different set of tidal and river flow conditions however the most significant features of near bed suspended sediment concentration peaking above 1,500 mg/l and dropping to peaks of below 500 mg/l at mid-depth are shown in both the observations and simulated results.

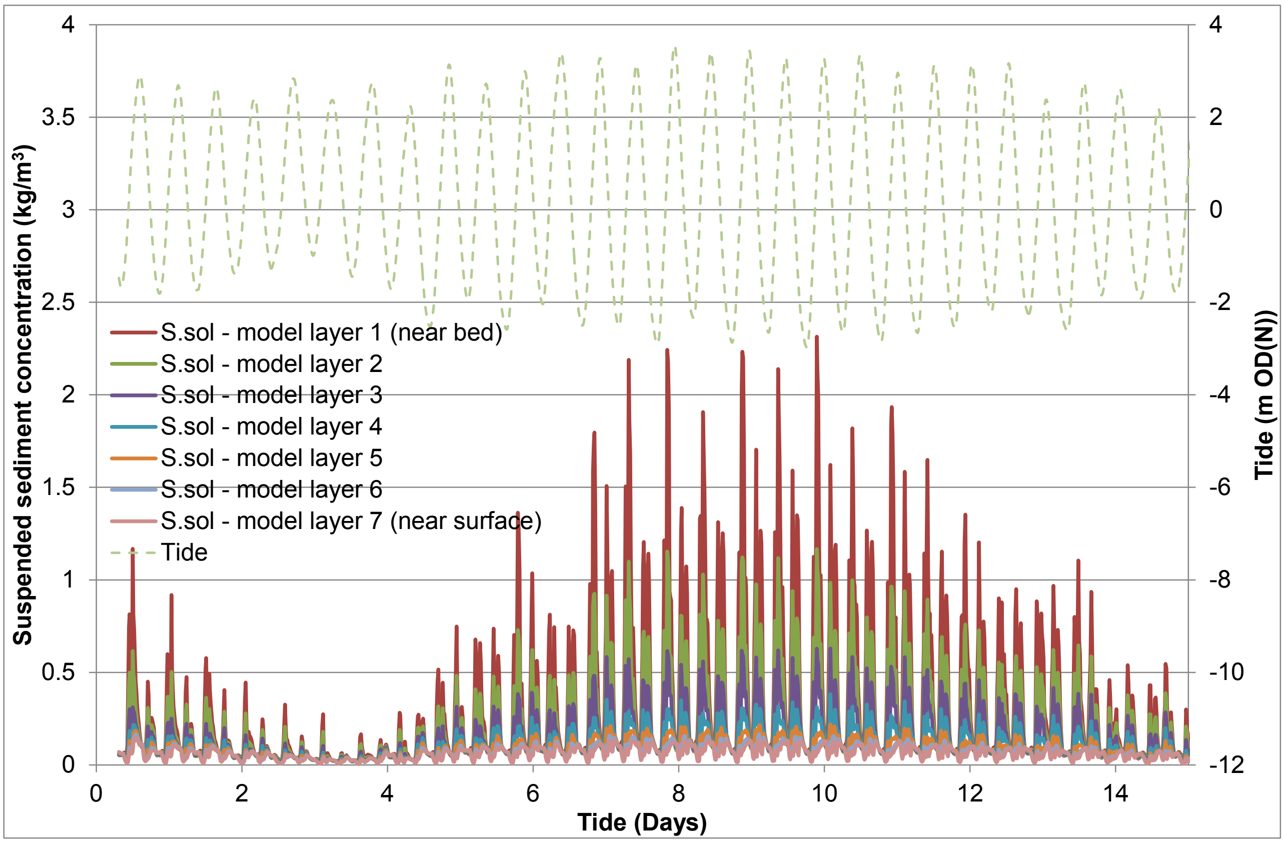

Figure 3.8: Simulated suspended sediment concentration near the Power Station Jetty

Figure 3.9 and Figure 3.10 show the predicted fine sediment infill for the baseline and developed case over a spring–neap cycle, respectively. For each plot the extent of the proposed dredging is marked to enable comparison. The bed density used for calculating the depth of fine sediment accumulation is 750 kg/m^3 (a dry density for consolidated sediment. At the early stages of deposition, before consolidation, lower densities will occur down to 300 kg/m^3, which would make apparent depths of sediment accumulation greater.

Neither simulation shows fine sediment accumulation in the approaches to the berths due to the high currents. Some accumulation is shown adjacent to the Divers Shoal groynes. As for the sand transport modelling it is understood that this area now has broadly stable bed levels following the morphological response to the groynes so this accumulation of material is most likely removed by local wind generated waves.

The evidence for maintenance dredging undertaken in the existing berths presents high level of variation in annual infill rates which makes it difficult to confirm the mud accumulation predicted in the existing berth area under baseline conditions. However, if compared with the baseline dredging rate in the range 10,000-40,000 m^3/year the model prediction of infill in the upper (western) berth is 87,300 m^3/year. This includes infill below the declared depth of the berth which would not require dredging. Excluding infill in the deeper areas the integrated sedimentation predicted by the model in the ends of the berth area which would require dredging is 32,700 m^3/year, i.e. within the range of reported dredging rate, although at the high end of the annual dredging rates reported since 2005.

Overall, comparing the modelled sedimentation rates with the reported dredging rate suggests that the model over predicts infill rates in the existing dredged areas. The difference is most likely due to reduction in the rate of accumulation due to morphological change, resuspension of sediment by local turbulence or disturbance due to vessel motions.

With the development in place (Figure 3.10) some muddy infill is predicted in the RO-RO berth areas as was shown for baseline conditions with a new area of significant infill predicted at the eastern end of the bulk berth. This is the area of deepest dredging, up to 6m below the present bed level so notable infill would be expected here.

The difference in muddy infill due to the development is plotted in Figure 3.11. The effect of the development on infill appears to be concentrated in the bulk berth pocket, particularly at the eastern end of the berth pocket where infill rates of more than 0.3 m are shown in the berth pocket over the spring neap cycle simulated. Greater depths of accumulation are shown on the side slopes to the east of the berth pocket. In time these accumulations on the side slopes would be likely to act as an additional source of sediment to the berth pocket and therefore are included in the calculation of total annual infill.

Some additional sedimentation may occur to the north of the berth line due to reduction in wave conditions but wave effects are not simulated here so this effect cannot be quantified.

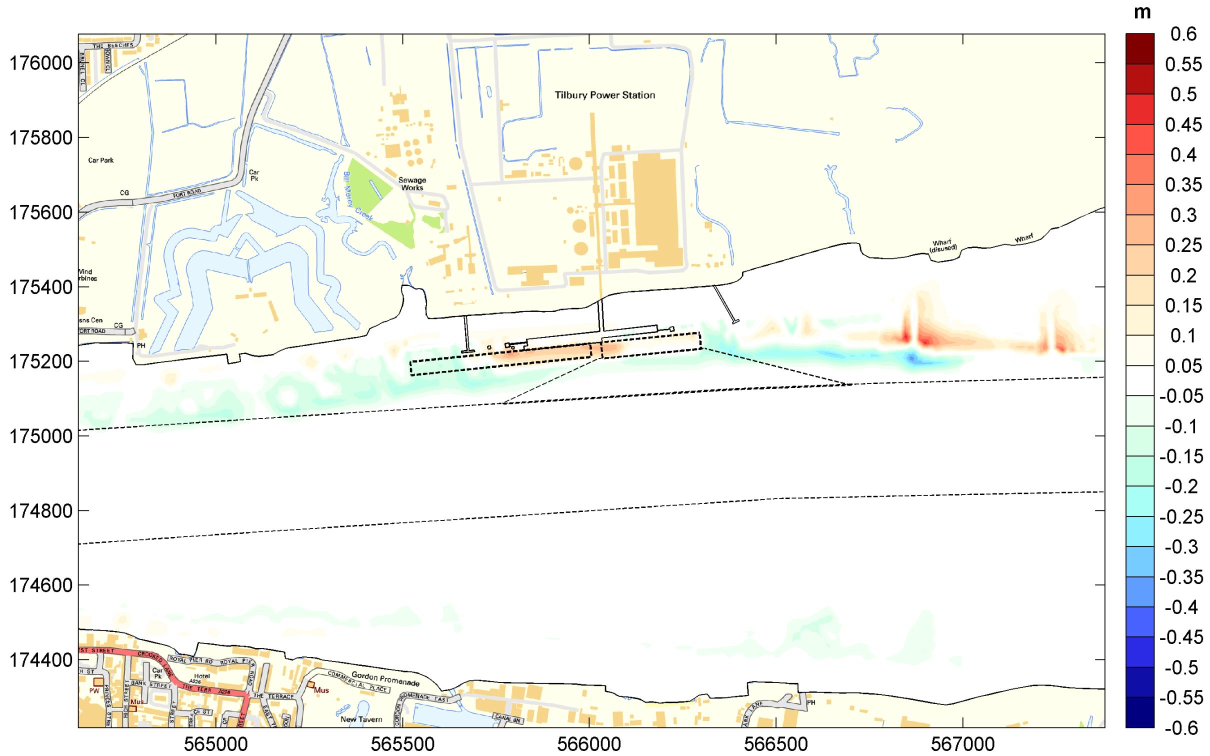

Figure 3.9: Predicted mud infill over a spring-neap cycle – baseline conditions

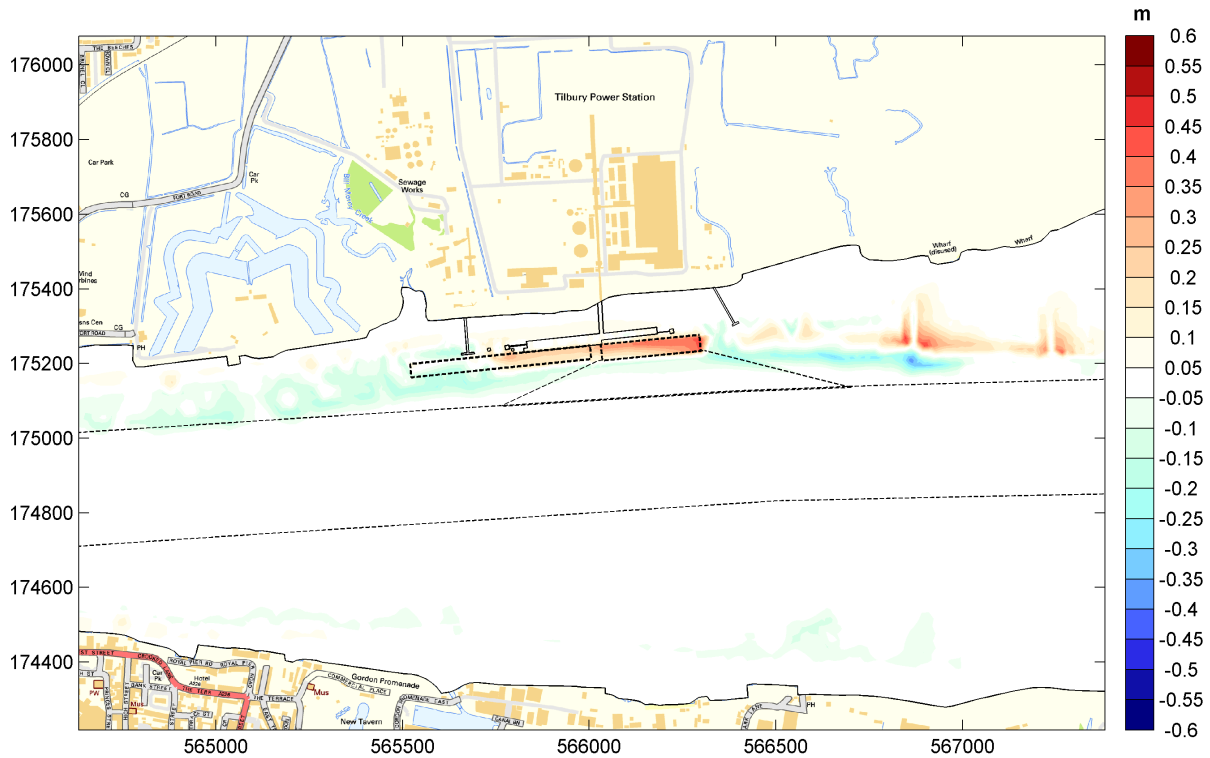

Figure 3.10: Predicted mud infill over a spring-neap cycle – post development conditions

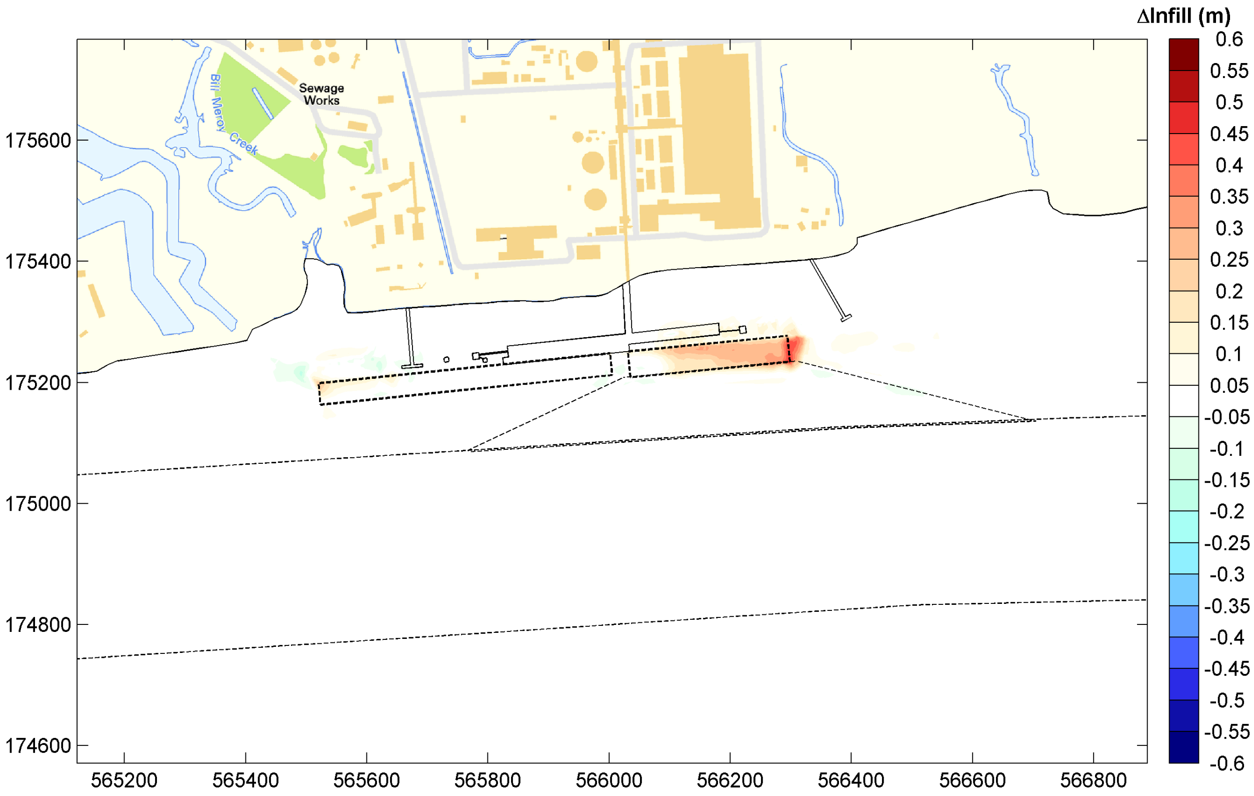

Figure 3.11: Change to predicted mud infill over a spring-neap cycle due to the development

The volume of infill has been integrated in the areas around the western RO-RO, the eastern RO-RO and the bulk berth. An example of the temporal variation in muddy infill for the bulk berth is provided by Figure 3.12. As might be expected fine sediment infill is strongly tidally dominated with greater bed changes occurring for spring tides. The results suggest the area has broadly stable bed levels under baseline conditions but the dredging of the eastern half of the berth results in additional muddy infill. This is a medium term prediction after any initial effects of the dredging itself such as increased in suspended sediment concentration or side slope adjustment have been removed.

The predicted annual fine sediment infill rates are shown in Table 3.4 assuming the berths are regularly maintained at their target depths. As the infill predicted for the baseline case cannot be straightforwardly validated by comparison with data in this area there is some uncertainty in the predicted infill for the developed case. Assuming the bed levels are presently broadly stable the additional infill resulting from the dredging provides the best estimate of fine sediment accretion rates with the development in place.

It is clear the main area of additional fine sediment infill is at the eastern end of the bulk berth pocket where the change of bed depth is greatest. Neither of the RO-RO berths experiences an increase in infill although the risk of some muddy accumulation cannot be discounted, in particular from the western end of the landward RO-RO berth.

In terms of annual maintenance dredging for fine sediment without making any allowance for vessel effects a total volume of up to 97,500 m^3/year of fine sediment may accumulate in the dredged area. As discussed for the existing case the sedimentation total is likely to be an over prediction to some extent, indeed the total is similar to the capital dredge volume, however regular maintenance dredging will be required. The total appears large but for context maintenance dredging of the bell mouth to Tilbury Dock occurs approximately every 3 months with an annual average dredge quantity of 85,000 m^3 (ABPmer, 2014).

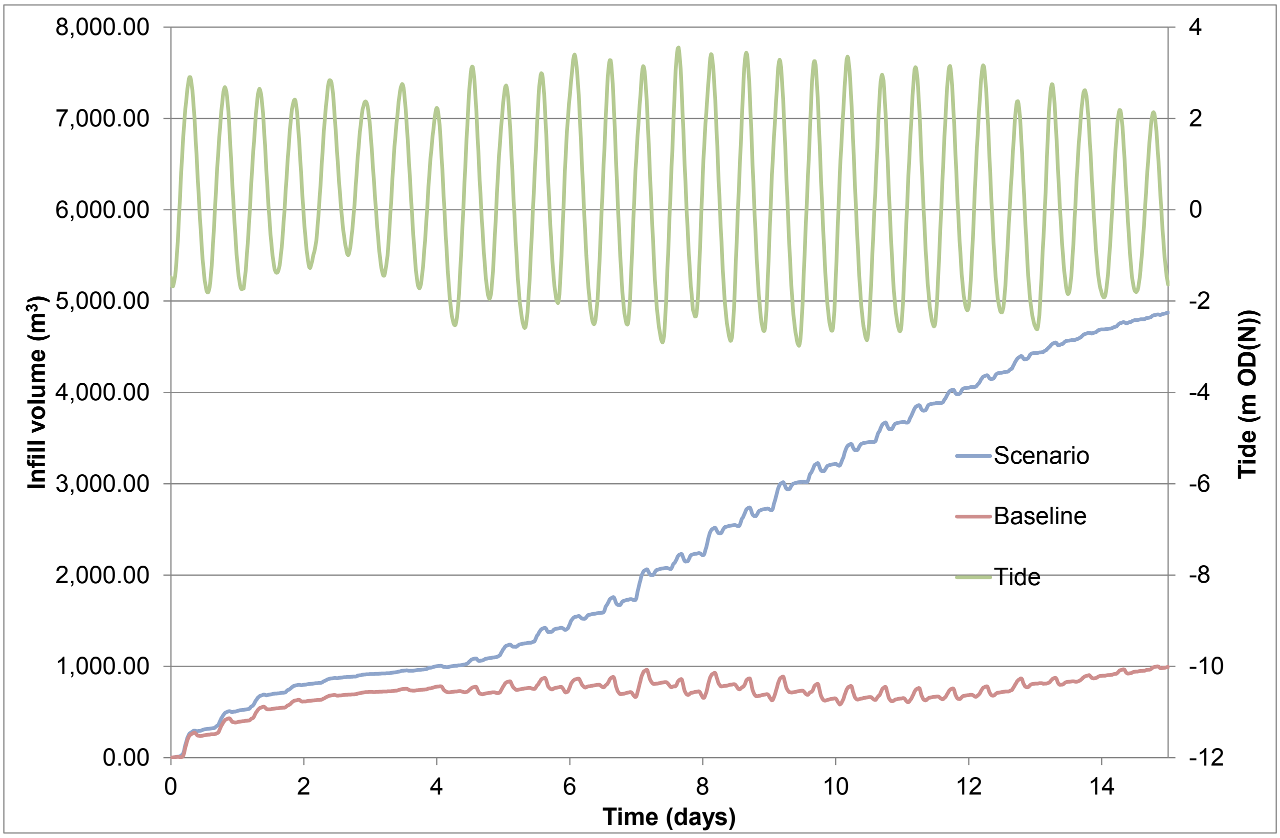

Figure 3.12: Time series of predicted mud infill for proposed Bulk berth

Table 3.4: Predicted annual infill of muddy sediment (m^3/spring - neap)

Site	Baseline	Developed case	Difference
West RO-RO	0	0	0
East RO-RO	2,700	2,400	-300
Bulk cargo berth	1,000	4,900	3,900
Total	3,700	7,300	3,600

4. Dredging plume assessment

4.1. Modelling methodology

The dispersion of the plumes of sediment arising from the proposed dredging was simulated using the HR SEDPLUME model. The model uses the hydrodynamic output from the TELEMAC-3D model and the assumption of a logarithmic velocity profile through the water column to track the 3 dimensional movements of sediment particles. Dispersal in the direction of flow is provided by the shear action of differential speeds through the water column while turbulent dispersion is modelled using a random walk technique. The deposition and resuspension of particles are modelled by establishing critical shear stresses for erosion and deposition. Erosion of deposited material occurs when the bed shear stress exceeds the critical shear stress for erosion while deposition of suspended material occurs when the bed shear stress falls below the critical shear stress for deposition.

Note that the dispersion modelling undertaken does not represent background concentrations but simulates the increase of suspended sediment concentrations above background caused by dredging plumes.

4.2. Dredging methodology

The capital dredging methodology has not been finalised as yet so sediment release from two practicable options have been studied – use of a back hoe dredger and water injection dredging (WID). These cases describe the effect of a range of sediment release scenarios from a low rate associated with backhoe to a high rate associated with WID.

WID is also a commonly used maintenance dredging method on the tidal Thames and given the potential sedimentation rates predicted in Section 3 simulations of WID are useful for considering the potential impacts of maintenance dredging.

4.2.1. Backhoe dredger

The relatively small volume of capital dredging required (~100,000 m^3) and the anticipated mix of bed material as shown by the borehole data suggests that a backhoe dredger could be used working continuously loading material into a fleet of barges. The losses from a backhoe occur as the bucket 'digs' into the riverbed and as the bucket is raised through and above the water column and deposits the material in a barge. Based on experience elsewhere a sediment loss rate of 1 kg/s is considered a reasonable worst case. Typical production rates for backhoe dredgers are 10,000-20,000 m^3/week assuming a 130 hour working week. This suggests the dredge could be completed within 10 weeks (approximately 5 spring-neap cycles).

In the simulation the release point is simulated as remaining in the same place throughout the entire simulation. In reality there would be some relocation of the dredge plant and barges as the work progressed over the footprint of the dredge area. As sediment may be released at any point in the dredge process the sediment is released in the model equally throughout the water column.

The simulation continues for 15 days to cover both spring and neap tide conditions with dredging taking place continuously from the start of the modelling for 14 days.

4.2.2. Water injection dredger

The overlying soft silts and sands found in the boreholes could be removed by water injection dredging (WID). WID uses a technique whereby large amounts of water are injected at low pressure into surface sediments on the seabed via a series of nozzles on a horizontal bar which is lowered to the bed. The small jets on the bar generate a high density sediment layer on the seabed, normally up to 1 m deep, with the highest density part of the layer being around 0.5 m above the bed. The dense fluidised layer acts as a fluid and flows over the bed through the action of gravity in the direction of the bed slope. The aim of this type of dredging is not to resuspend sediment within the water column but rather to move sediments from one area to another. Some resuspension of fine sediment fractions can occur using this technique if some sediment escapes from the dense near-bed layer (e.g. due to strong tidal currents or a pronounced bed gradient) but on the whole dispersion of sediment into the overlying waters and into the far-field tend to be small and more gradual than in more conventional dredging techniques (e.g. trailing suction hopper dredger). However, it is possible that the WID operation can bring lager proportions of the sediment into suspension; it is this more conservative case that has been modelled.

In all six WID simulations were undertaken – three dredging scenarios, each for silt and sand, as summarised in Table 4.1. These scenarios cover the range of possible operational plans but it should be noted that the approach to WID elsewhere on the Thames favours ebb only dredging. During the dredging the release point is modelled as moving continuously over the path shown in Figure 4.1.

Table 4.1: Summary of WID simulations undertaken

Scenario No.	Dredging programme
1	Dredging continuously – neap to spring to neap tides
2	Dredging during ebb tide only – neap to spring to neap tides. Rate of sediment release as Scenario 1.
3	Dredging continuously – spring tides. Total sediment released per tide as Scenario 2.

Scenarios 1 and 2 runs represent WID for 14 days starting on neap tides the going through spring tides before returning to neaps. As such the whole range of tidal conditions is included in the simulations which allows the maximum likely footprint (spring tides) and maximum excess suspended sediment concentration (neap tides) to be shown. Scenario 3 was undertaken for a sensitivity test for ebb-only dredging. In this case, although the dredging was continuous, the total sediment released was the same as for the ebb dredging Scenario 2. Comparing Scenario 2 and Scenario 3 allows the effect of ebb only dredging to be demonstrated.

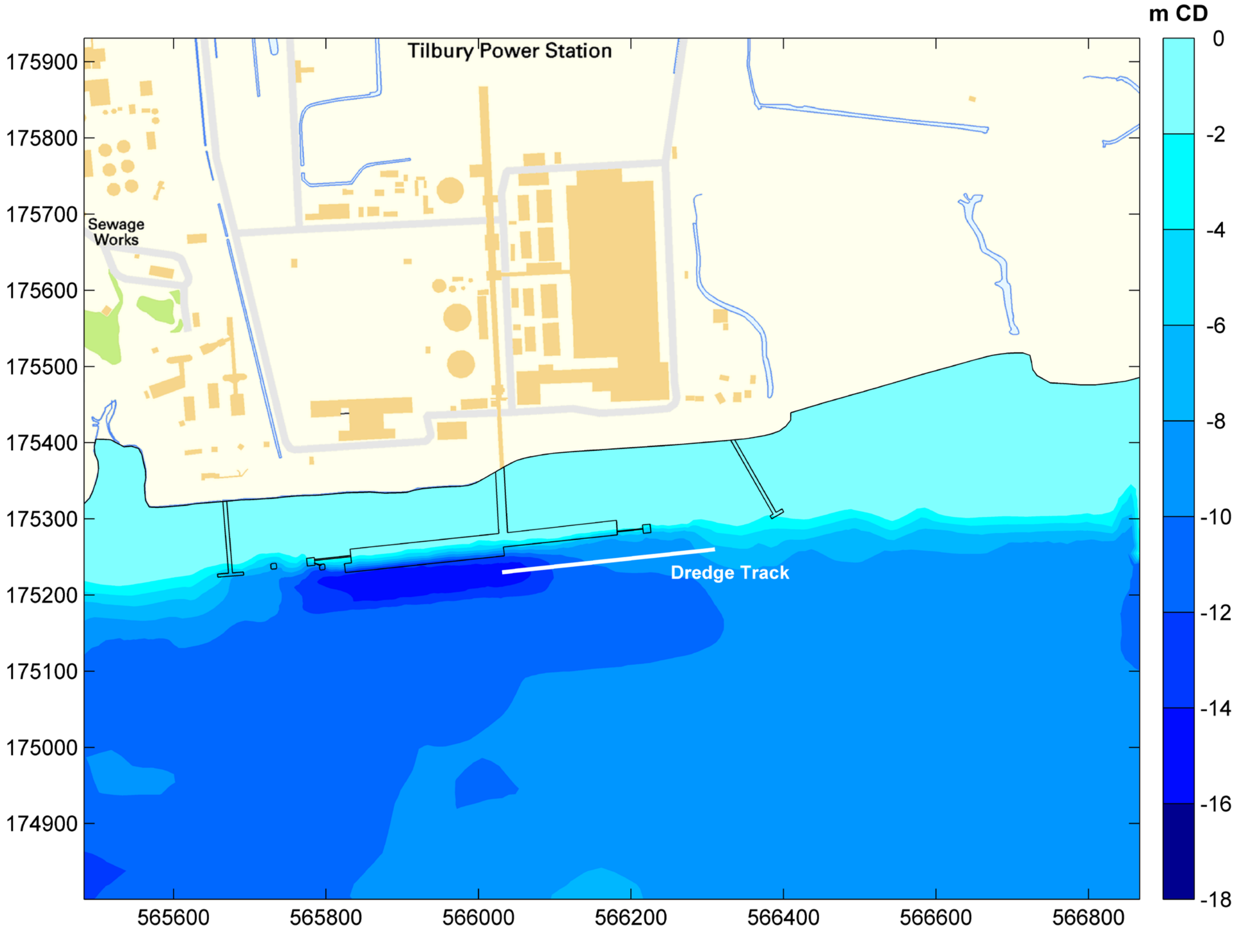

Figure 4.1: Location and path of simulated dredging

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A typical sediment release rate for WID of 113 kg/s was used based on HR Wallingford's experience of similar WID operations. This corresponds to release rates for the silt, very fine sand and fine sand fractions as follows: silt: 51 kg/s; very fine sand (63-90 µm): 31 kg/s; and fine sand (90-125 µm): 31 kg/s. As a conservative assumption for significant mixing of the near bed dense layer into the water column the sediment was released into the bottom 10 metres of the water column.

For the continuous dredging scenarios the dredging simulated corresponds to the removal of 4,000-5,500 m^3 of sediment from the dredged area per day. This rate of dredging is up to two times greater compared to that for the back hoe simulated.

For clays and gravels found under the silts, which would not be dredgeable by WID, the capital dredge could revert to back hoe or use another method any of which would have a lower sediment release rate than the WID modelled.

4.3. Sediment properties

The sediment parameters used in the simulations are summarised in Table 4.2.

Table 4.2: Sediment parameter settings

Parameter	Value
Critical shear stress for deposition of sediment	0.1 N/m^2
Critical shear stress for erosion of silt/clay	0.2 N/m^2
Critical shear stress for erosion of sand	When sand deposits it forms part of the background sand transport and ceases to be part of the sediment plume.
Erosion constant for silt/clay - M_e $[\frac{\partial m}{\partial t} = M_e(\tau - \tau_e)]$	0.002 $kg/N/m^2/s$
Settling velocity of fine sediment fraction	1 mm/s
Settling velocity of sand fractions	As Soulsby (1997)
Dry sediment density of deposited silt/clay	500 kg/m^3
Dry sediment density of deposited sand fractions	1600 kg/m^3

4.4. Results for backhoe dredging

The results for the dispersal of fine material arising from the backhoe dredging are shown in Figures 4.1 to 4.8. The plots that show the peak (depth averaged) concentration above background or deposition that occurred at any time during the simulation. These plots thus convey the footprint of influence of the dredging but they do not represent a particular point in time as can be seen from the time series plots of concentration Figures 4.2 to 4.5 the length of time that any one place is affected by maximum concentrations is relatively small. Figure 4.1 shows the depth averaged concentration never exceeds 20mg/l which compared to the ambient concentrations of up to thousands of mg/l makes the increase seem insignificant. This negligible effect is further emphasized in the averaged plot Figure 4.6 which shows no increase.

Figures 4.7 to 4.8 show the deposition which is predicted to occur due the dredging. The peak plot shows the envelope, whereas the net plot (Figure 4.8) shows the areas where material will settle and remain under the flow conditions simulated. It shows a vast quantity of the material released by the dredging is deposited within 1.5 km of the dredge; outside of this area deposition thickness is rarely above 1mm.

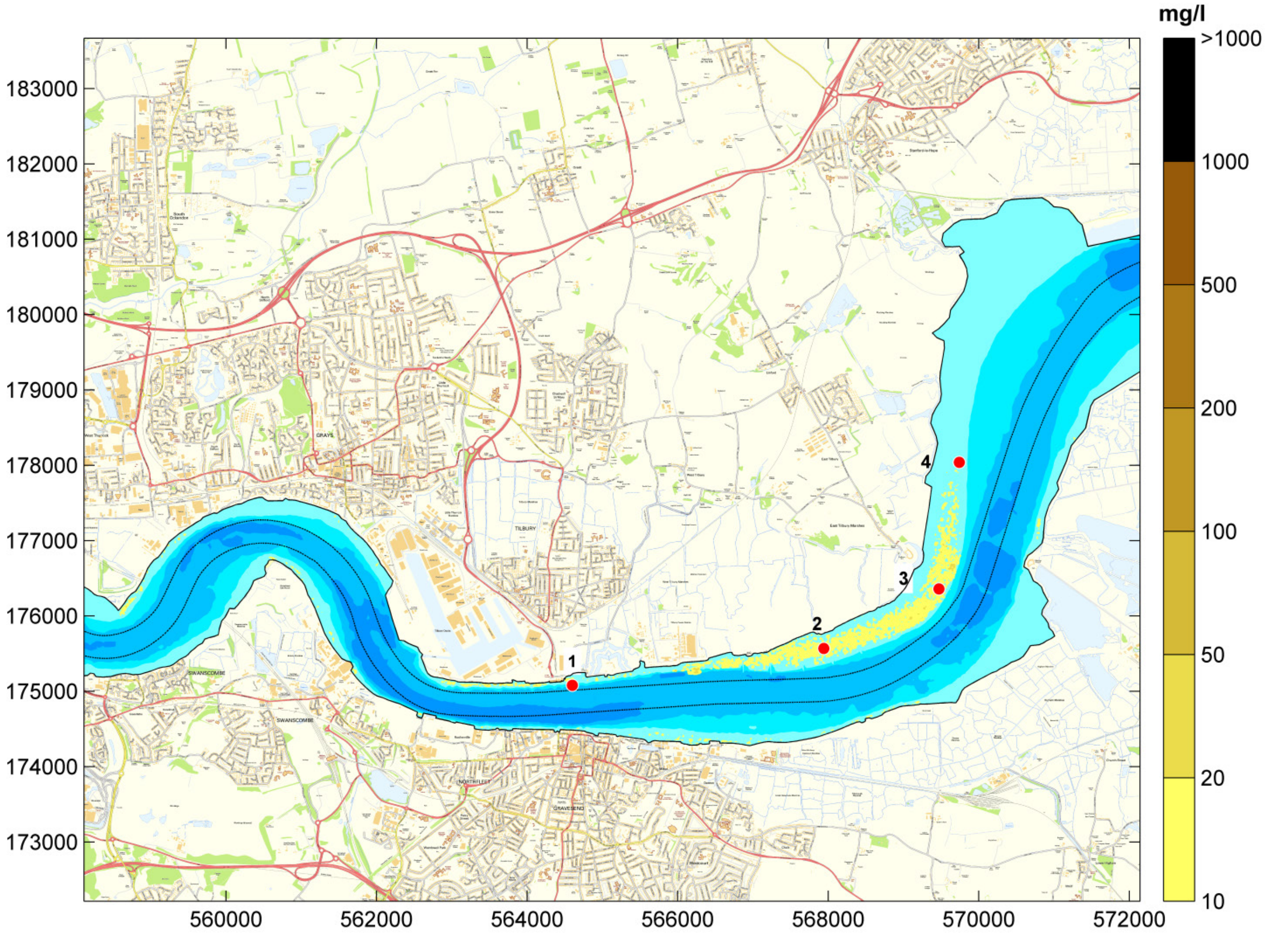

Figure 4.2: Maximum increase in depth average suspended sediment concentration during 14 days of backhoe dredging

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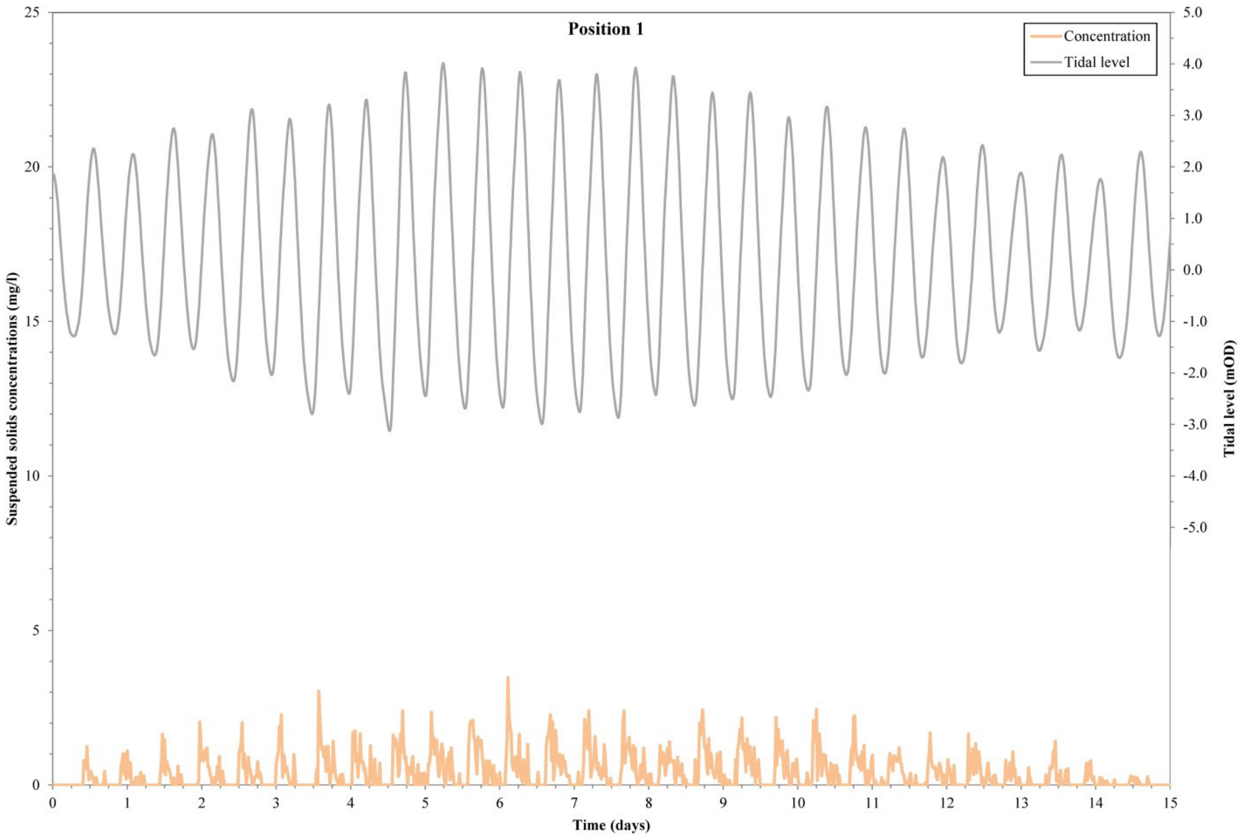

Figure 4.3: Time series of concentration over 14 days of backhoe dredging – location 1

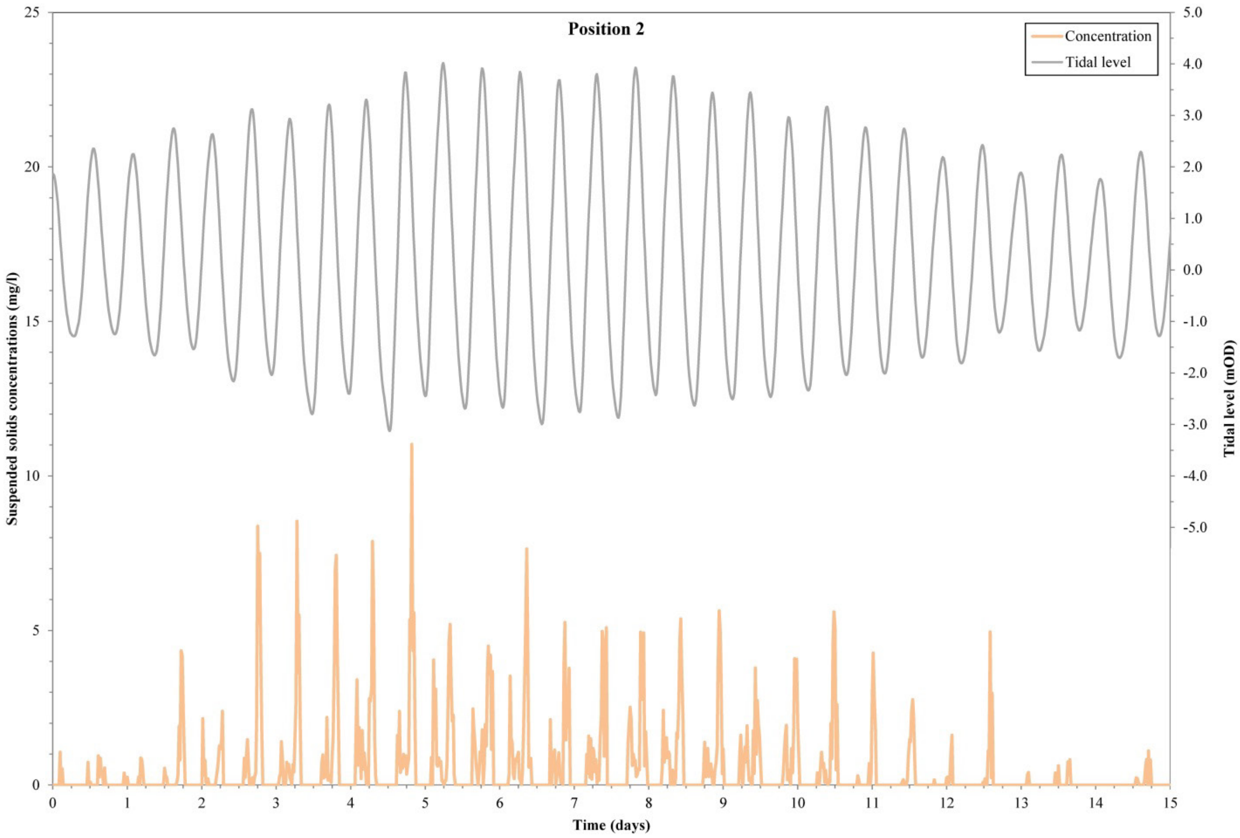

Figure 4.4: Time series of concentration over 14 days of backhoe dredging – location 2

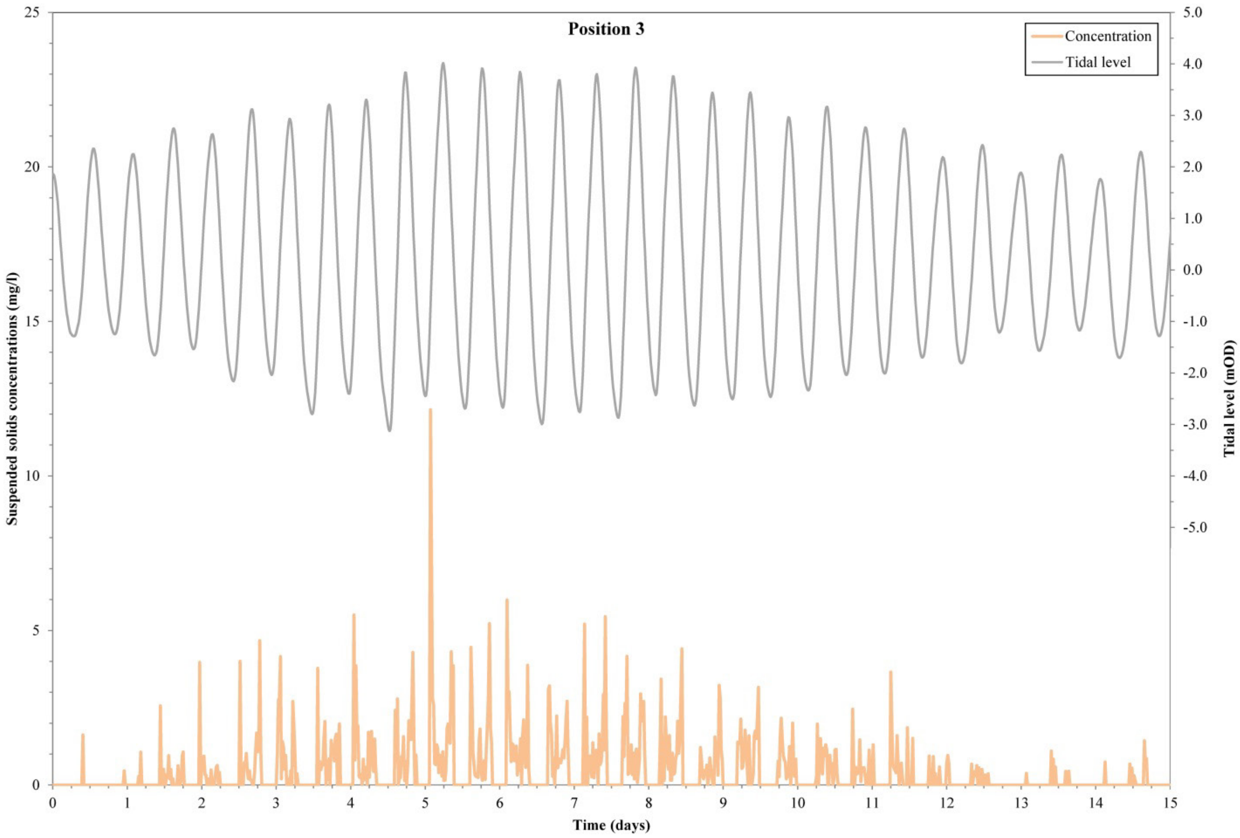

Figure 4.5: Time series of concentration over 14 days of backhoe dredging – location 3

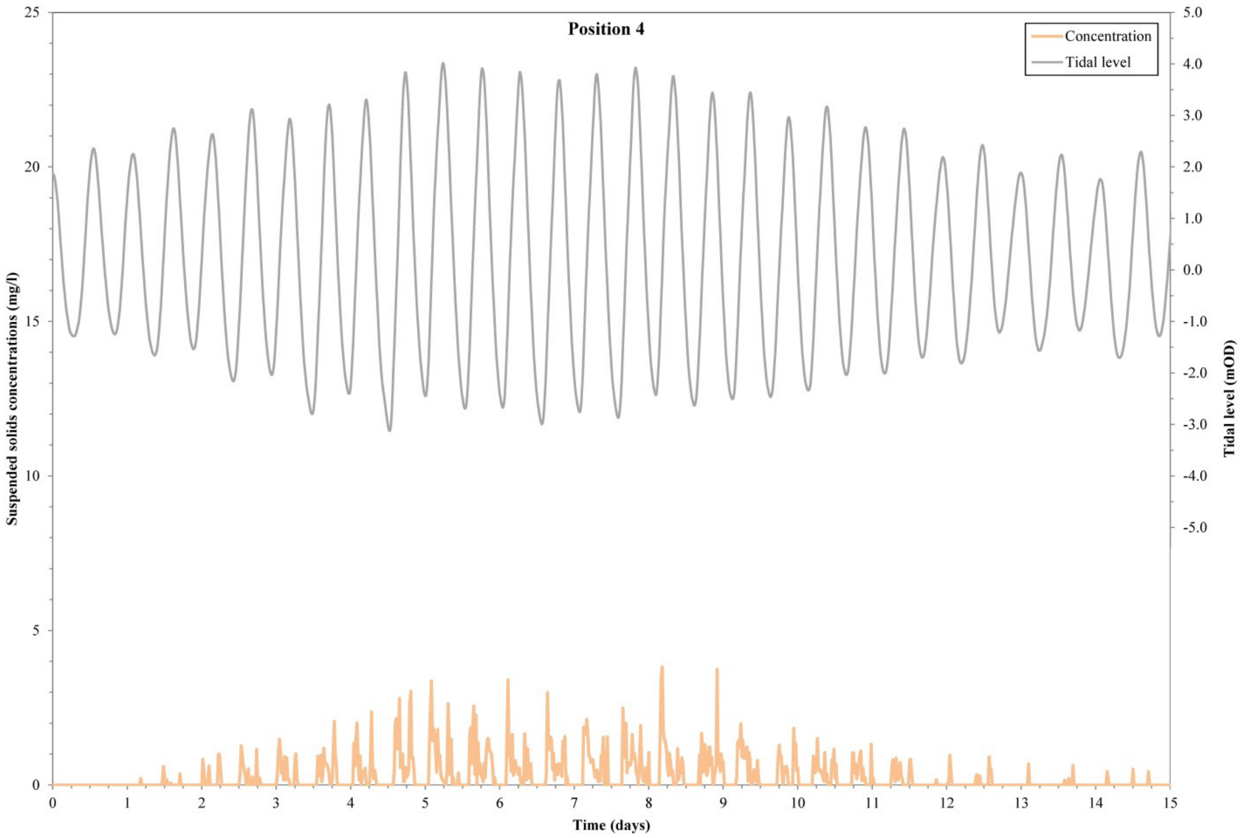

Figure 4.6: Time series of concentration over 14 days of backhoe dredging – location 4

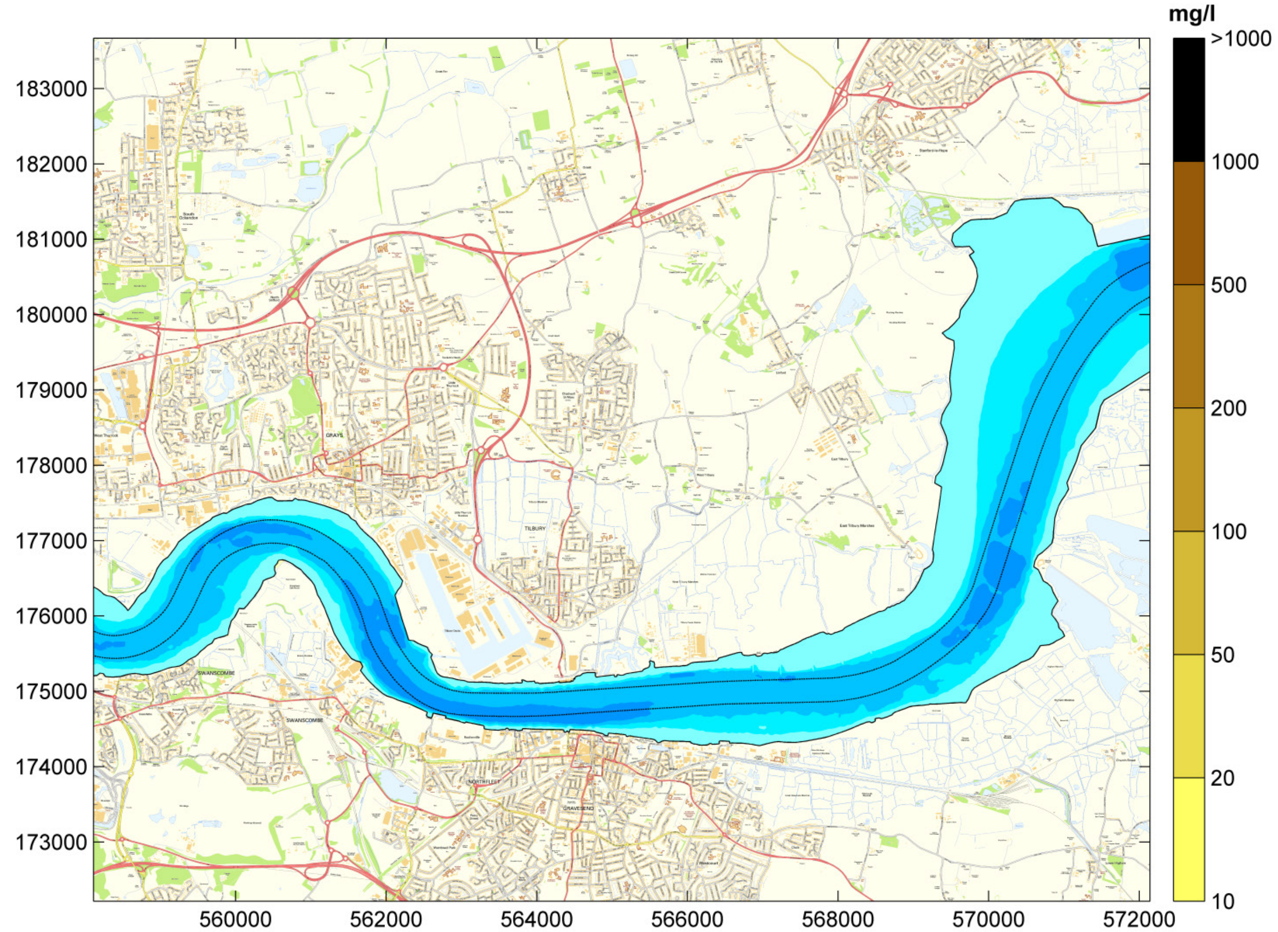

Figure 4.7: Average increase in depth average suspended sediment concentration during 14 days of backhoe dredging

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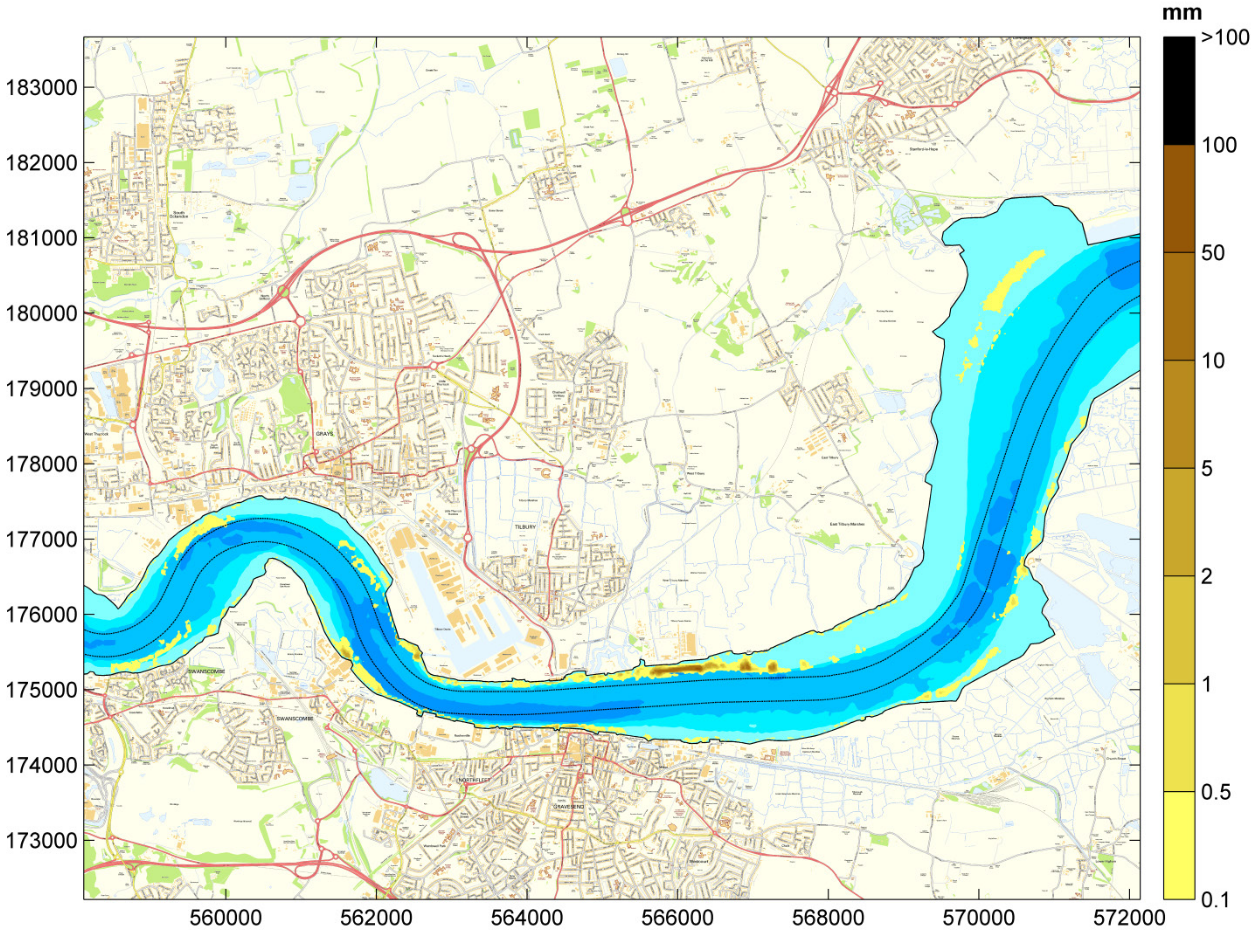

Figure 4.8: Maximum deposition depth of the released sediment during 14 days of backhoe dredging

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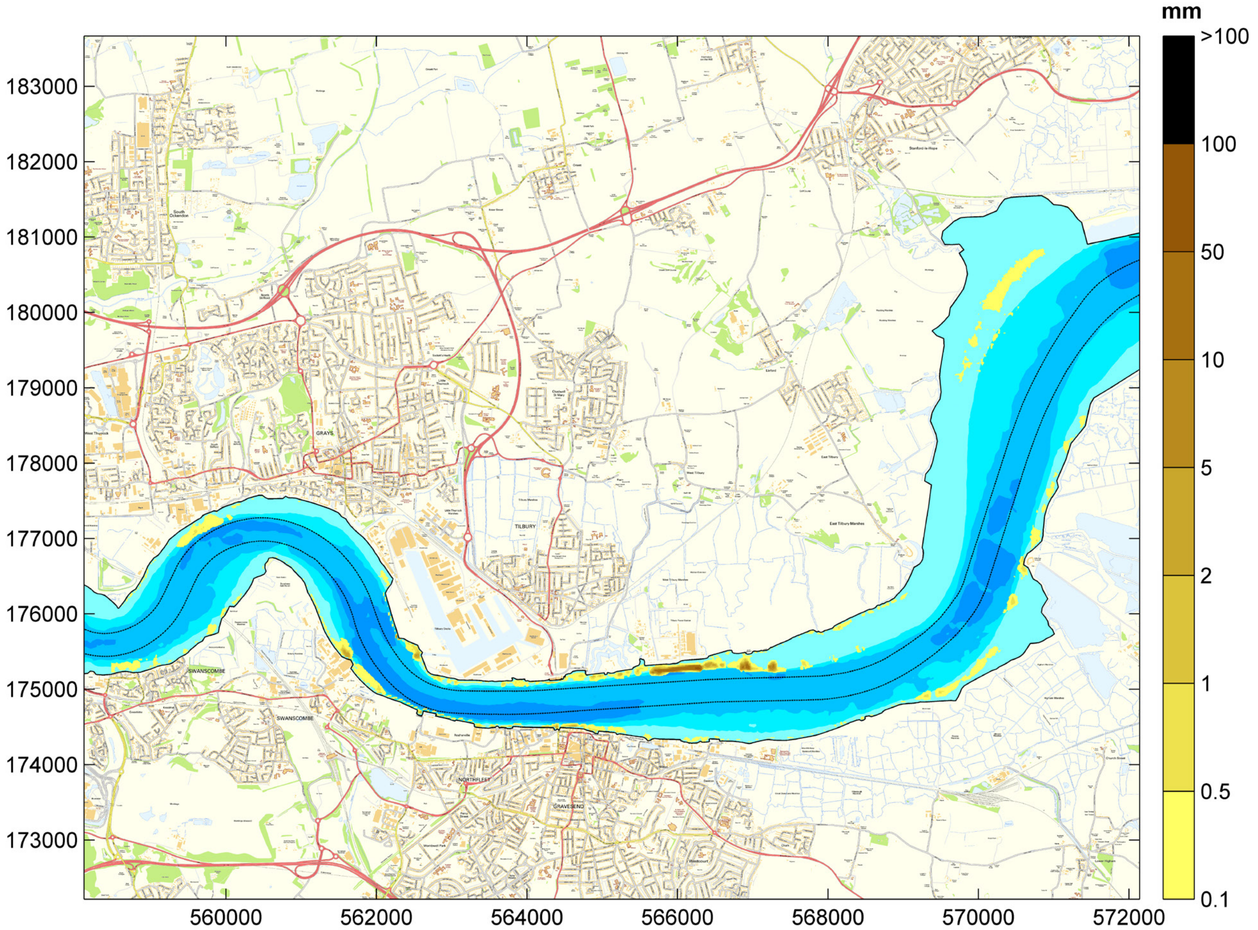

Figure 4.9: Nett accumulation of the released sediment at the end of 14 days of backhoe dredging

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4.5. Results for water injection dredging

4.5.1. Scenario 1 – continuous WID

The results for the dispersal of fine material arising from the continuous WID dredging are shown in Figures 4.10 to 4.17.

Figure 4.10 shows the peak (depth averaged) concentration above background that occurred at any time during the simulation. These plots thus convey the footprint of influence of the dredging but they do not represent a particular point in time as can be seen from the time series plots of concentration, Figures 4.11 to 4.14, the length of time that any one place is affected by the maximum concentration as shown by Figure 4.10 is relatively small. A view of the impact of the dredge on suspended sediment concentration taking into account the temporal variation is available by calculating the average increase in suspended sediment concentration during the dredge (Figure 4.15). This plot shows that whilst a large area, up to 20 km either side of the dredge site, may experience episodic increases in suspended sediment concentration the area with consistent elevation in suspended sediment concentration is much smaller, confined to within 2 km of the dredge site.

Figures 4.16 to 4.17 show the deposition above background which is predicted to occur due to the dredging. The peak plot indicates an overall envelope of effect, whereas the net plot (Figure 4.17) shows the areas where material will settle and remain under the flow conditions simulated. It should be noted that the peak deposition plot (Figure 4.16) includes temporary slack water deposition which is exchanged between the bed and the water column at every slack water.

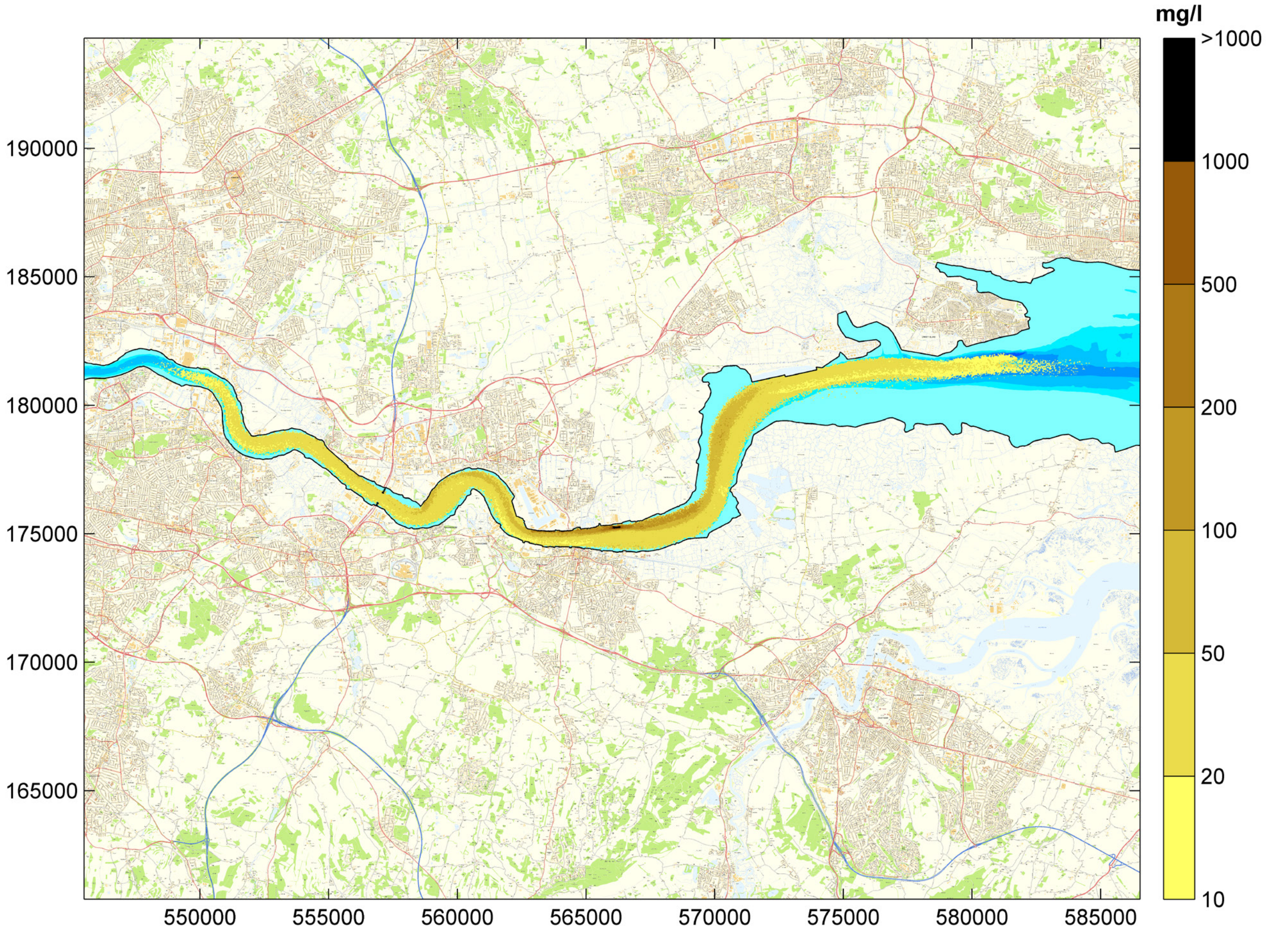

Figure 4.10: Maximum increase in depth averaged suspended sediment concentration during 14 days of WID – Scenario 1

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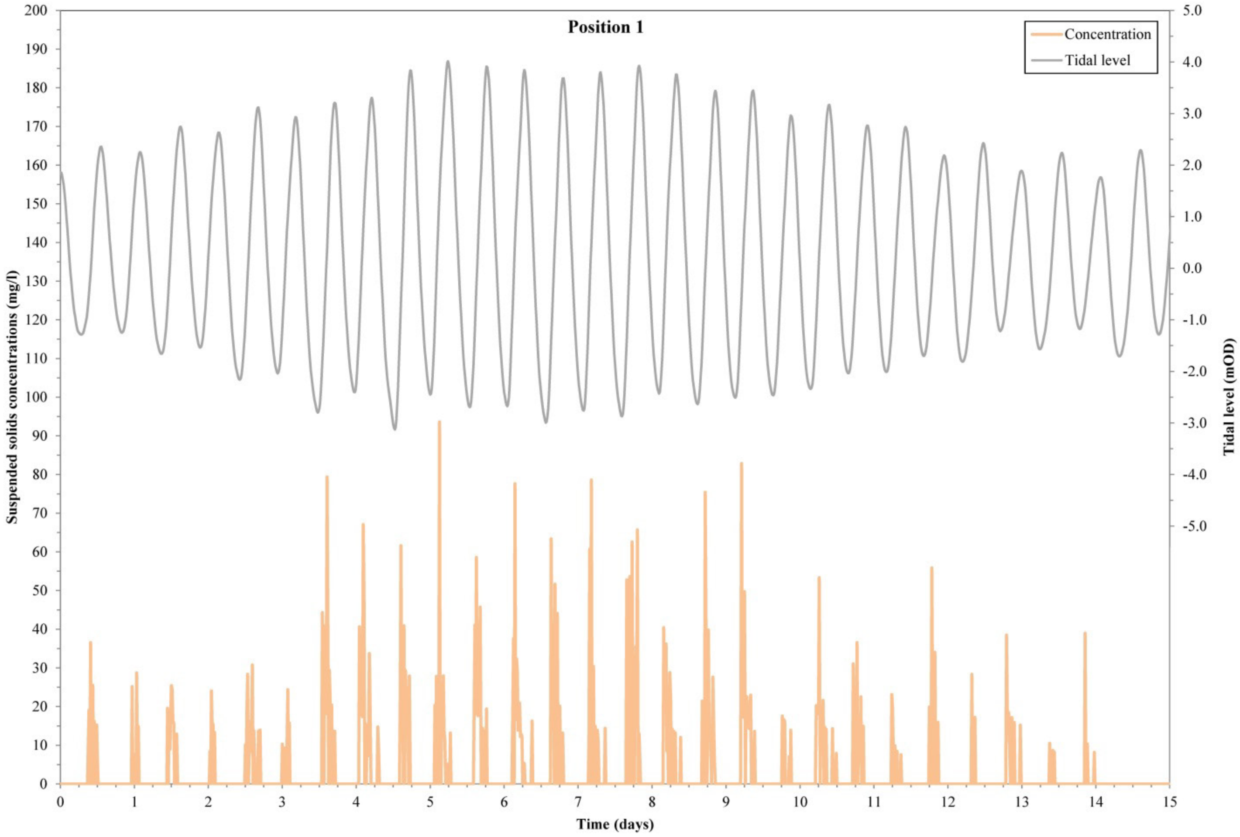

Figure 4.11: Time series of concentration over 14 days of WID – location 1 – Scenario 1

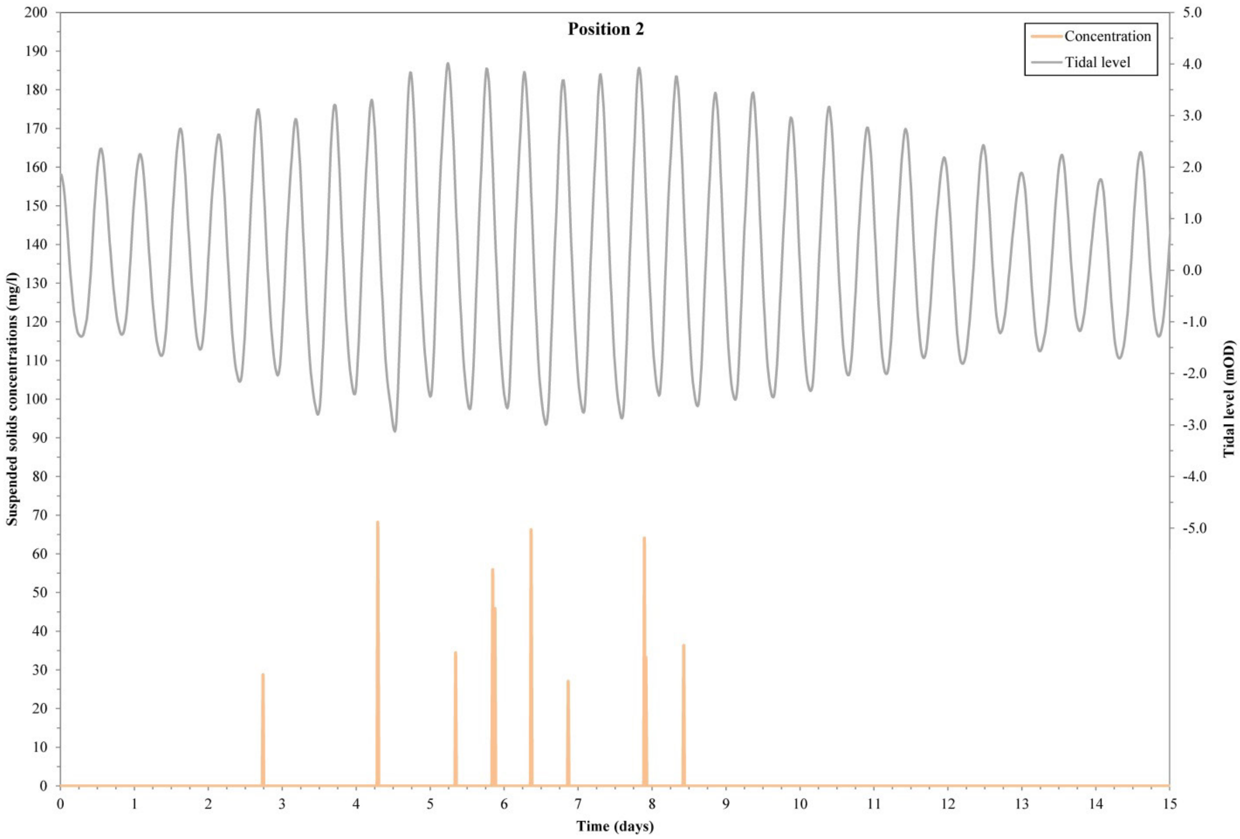

Figure 4.12: Time series of concentration over 14 days of WID – location 2 – Scenario 1

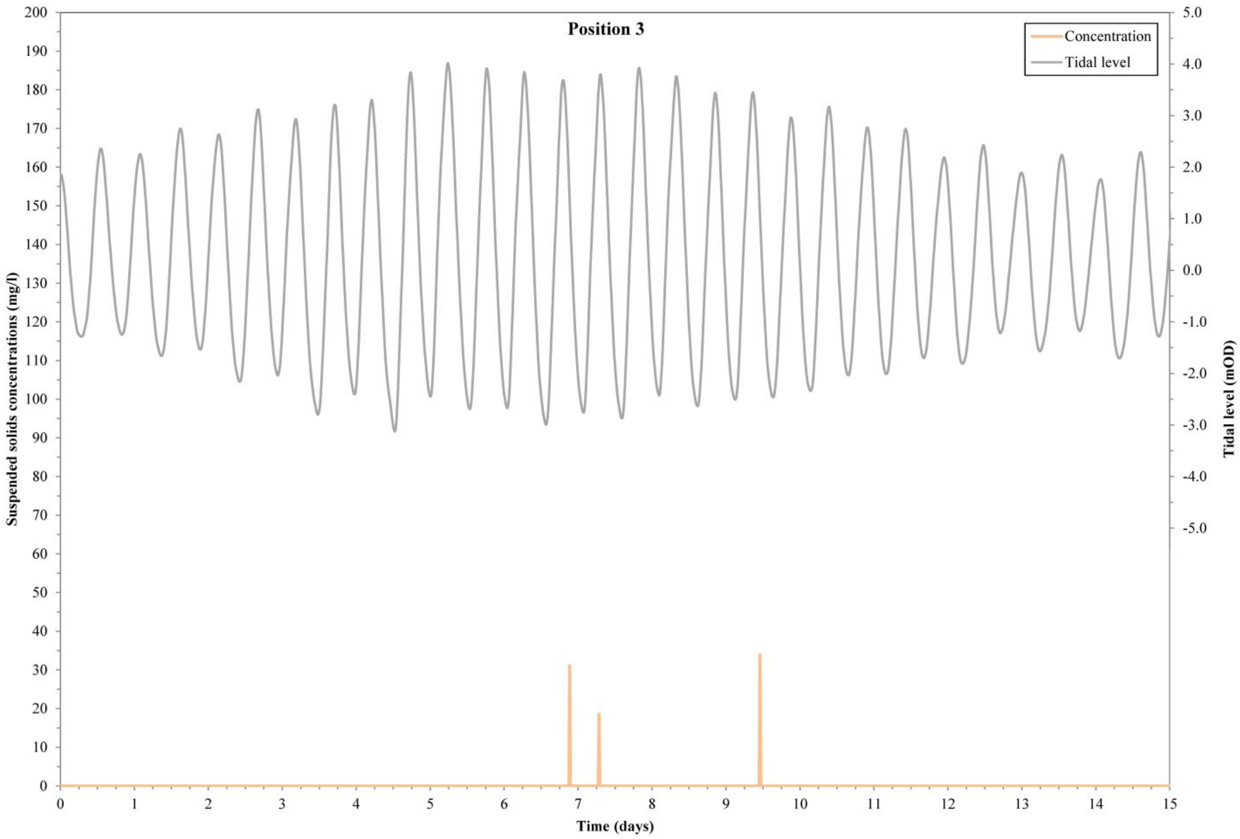

Figure 4.13: Time series of concentration over 14 days of WID – location 3 – Scenario 1

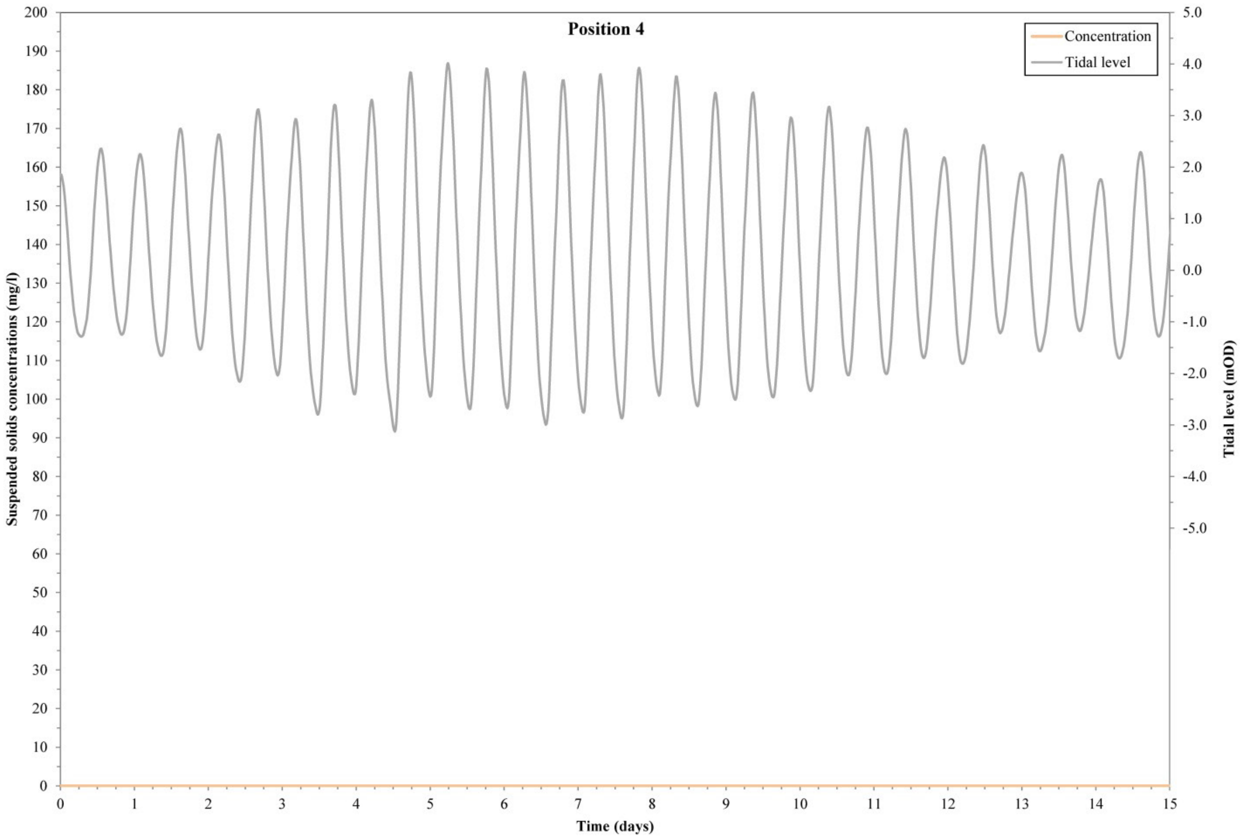

Figure 4.14: Time series of concentration over 14 days of WID – location 4 – Scenario 1

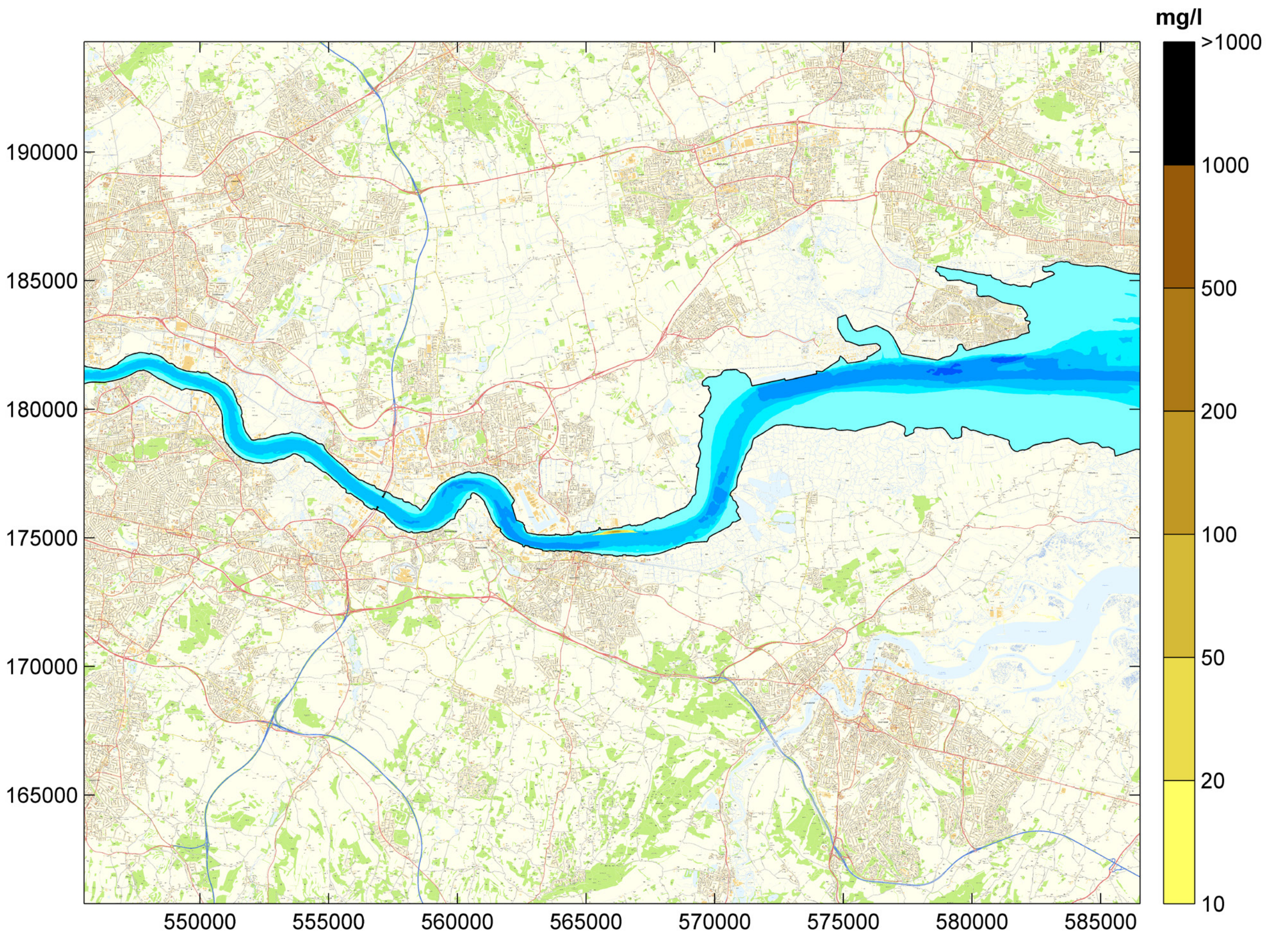

Figure 4.15: Average increase in depth average suspended sediment concentration during 14 days of WID – Scenario 1

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Figure 4.16: Maximum deposition depth of the released sediment during 14 days of WID – Scenario 1

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Figure 4.17: Nett accumulation of the released sediment at the end of 14 days of WID – Scenario 1

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4.5.2. Scenario 2 – ebb tide only WID

The results for the dispersal of fine sediment arising from the ebb tide only WID are shown in Figures 4.18 to 4.25.

Figure 4.18 shows the peak (depth averaged) concentration above background that occurred at any time during the simulation. This plot thus conveys an overall footprint of influence of the dredging but it does not represent a particular point in time. As can be seen from the time series plots of concentration, Figures 4.19 to 4.22, the length of time that any one place is affected by maximum concentrations may be relatively small. Figure 4.23 shows the average increase in suspended sediment concentration.

Figures 4.24 to 4.25 show the increase in deposition above background conditions which is predicted to occur due the dredging . The peak plot shows the overall envelope of anywhere that may experience an increase in deposition however temporary, whereas the net deposition plot (Figure 4.25) shows the areas where material will settle and remain under the flow conditions simulated.

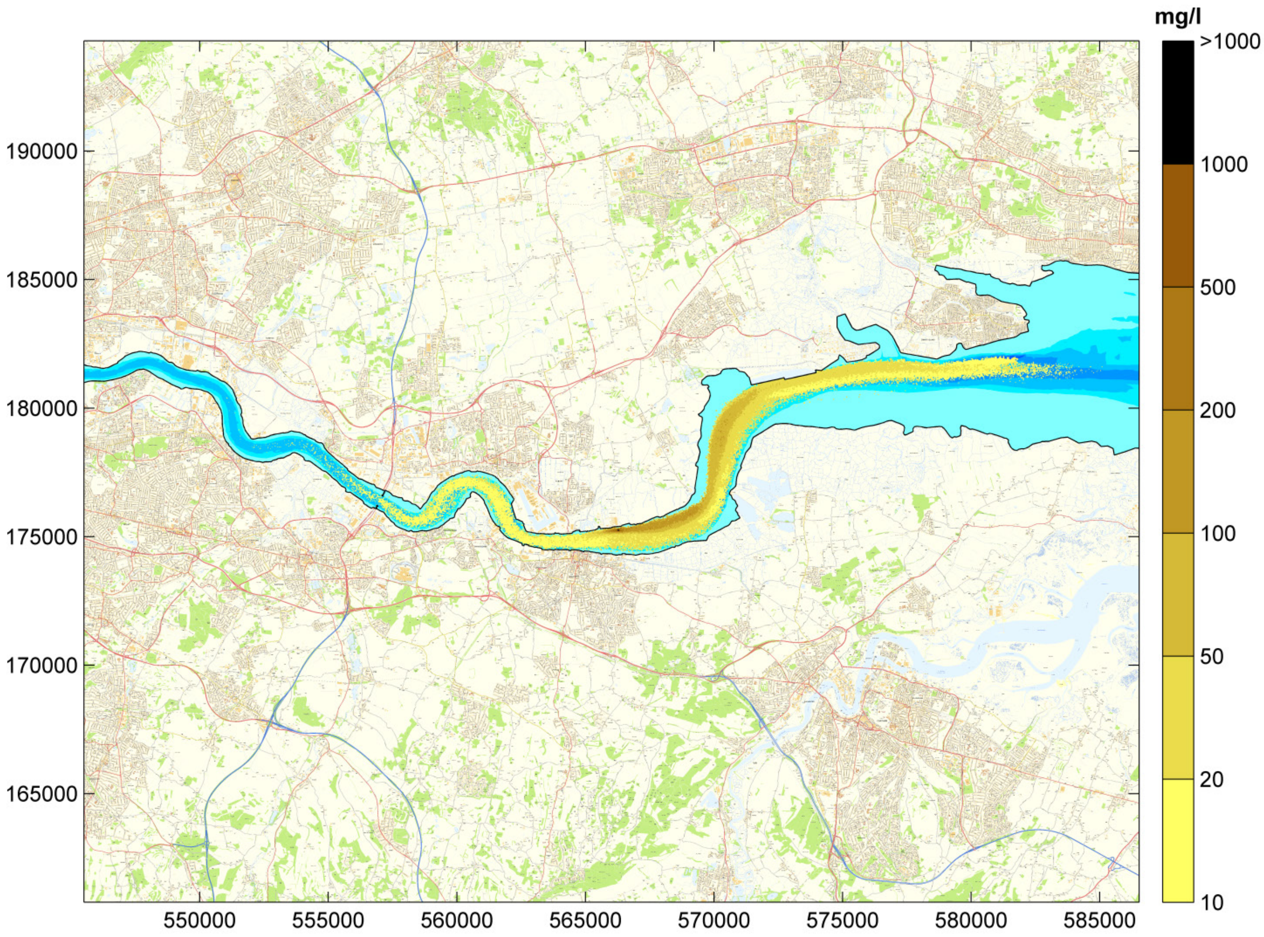

Figure 4.18: Maximum increase in depth average suspended sediment concentration during 14 days of WID – Scenario 2

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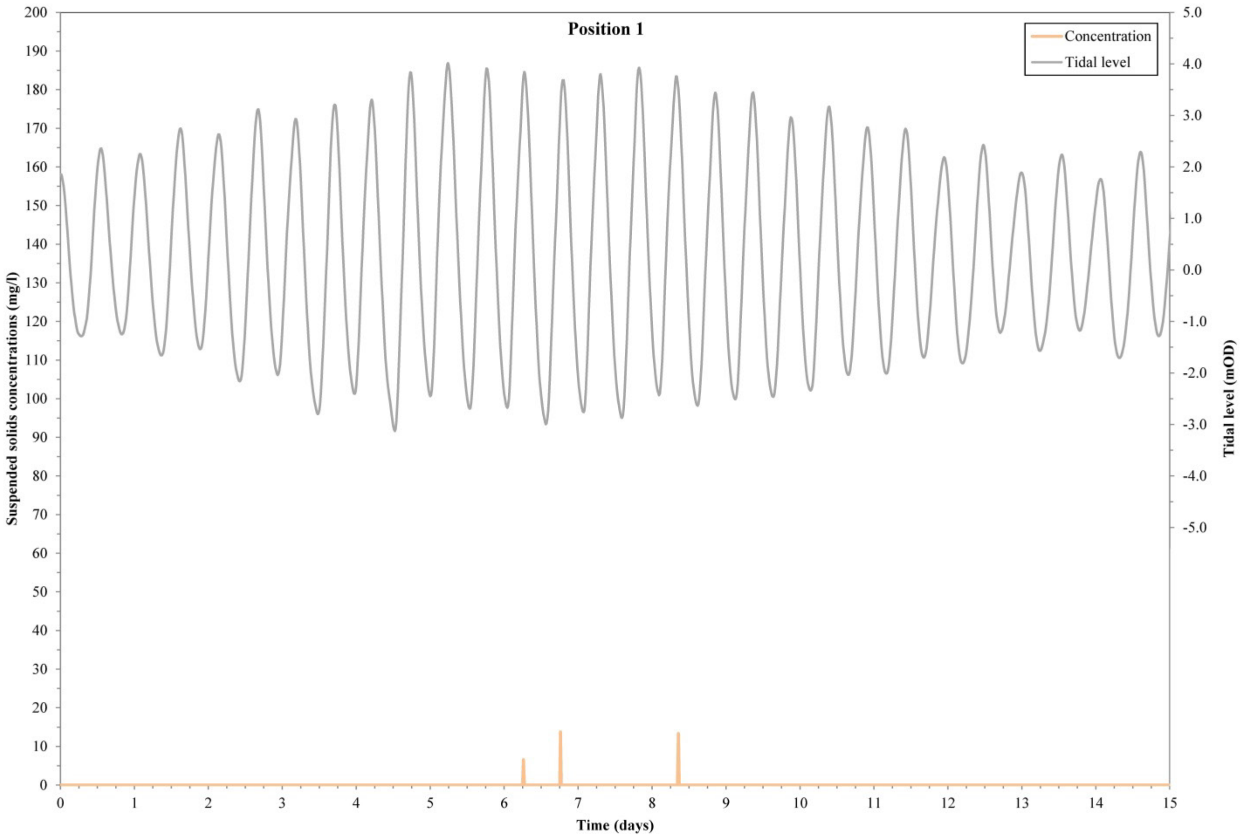

Figure 4.19: Time series of concentration over 14 days of WID – location 1 – Scenario 2

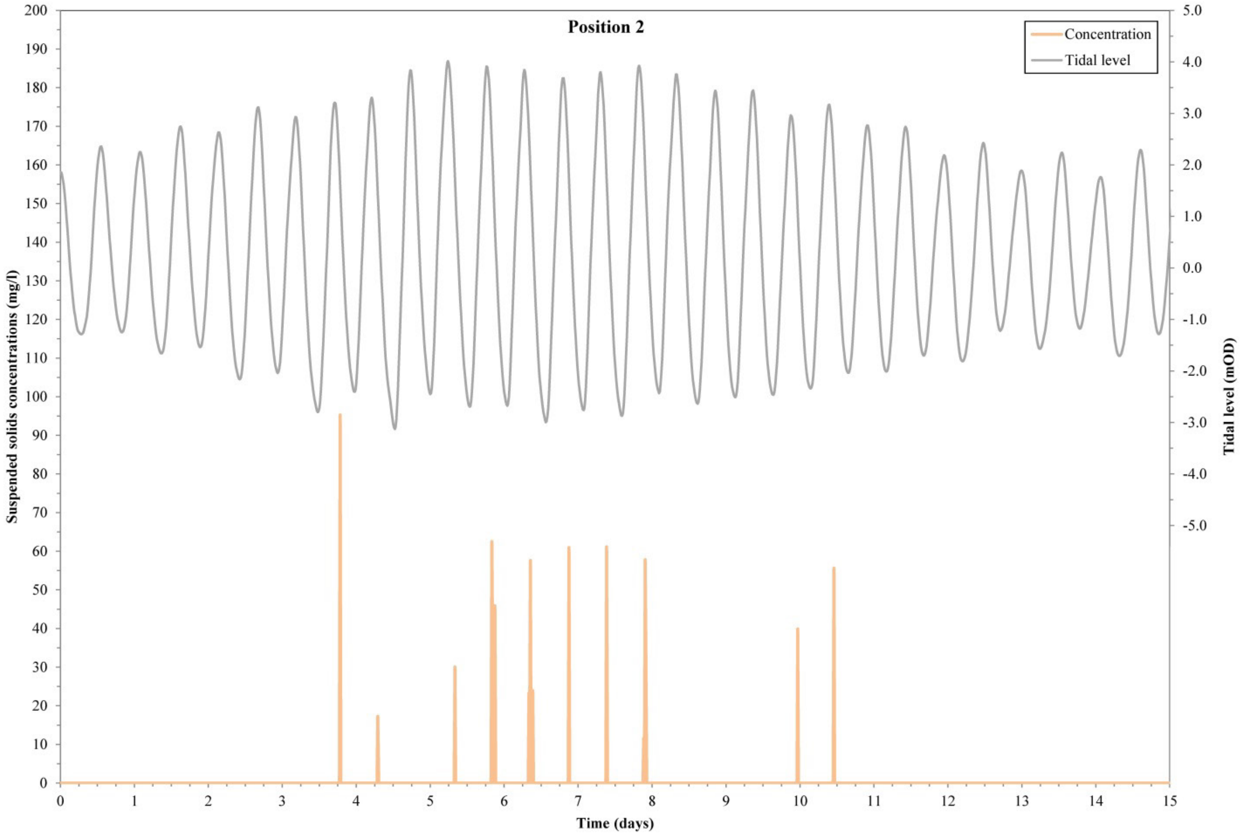

Figure 4.20: Time series of concentration over 14 days of WID – location 2 – Scenario 2

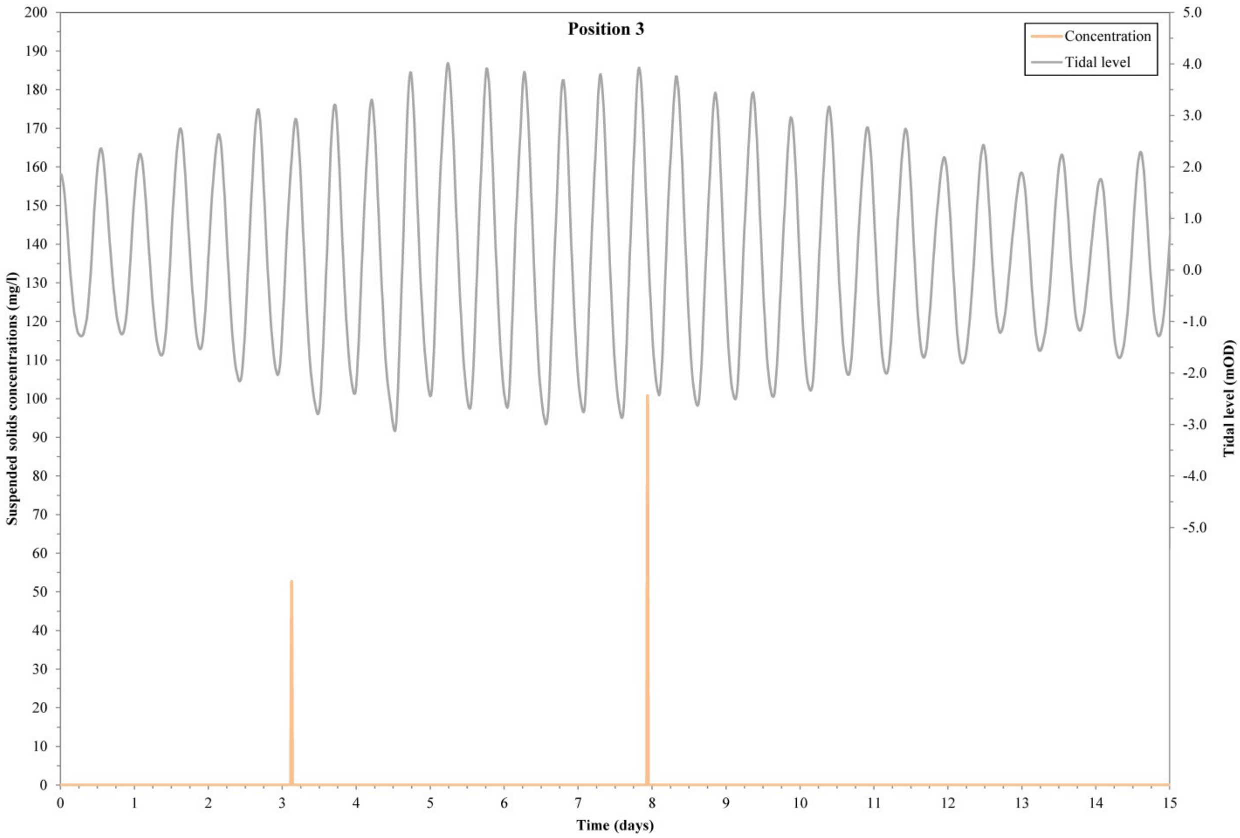

Figure 4.21: Time series of concentration over 14 days of WID – location 3 – Scenario 2

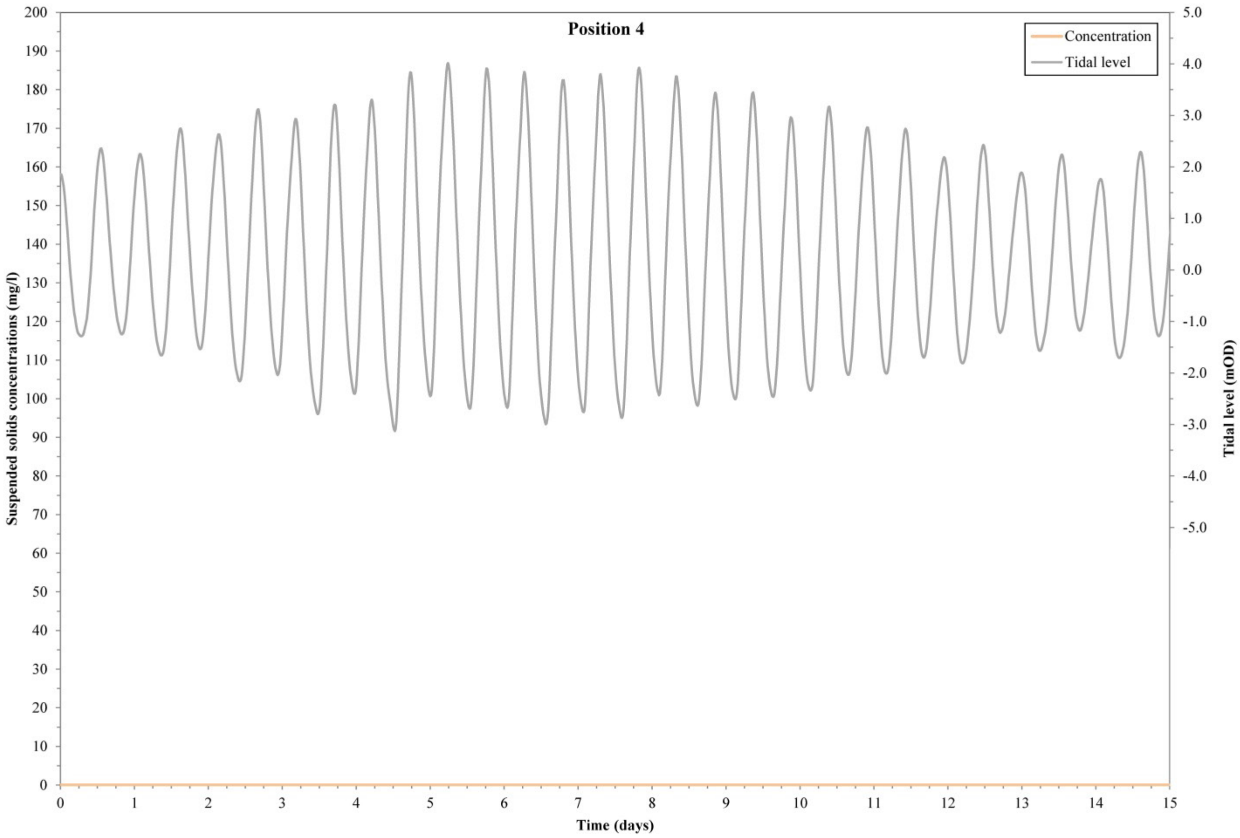

Figure 4.22: Time series of concentration over 14 days of WID – location 4 – Scenario 2

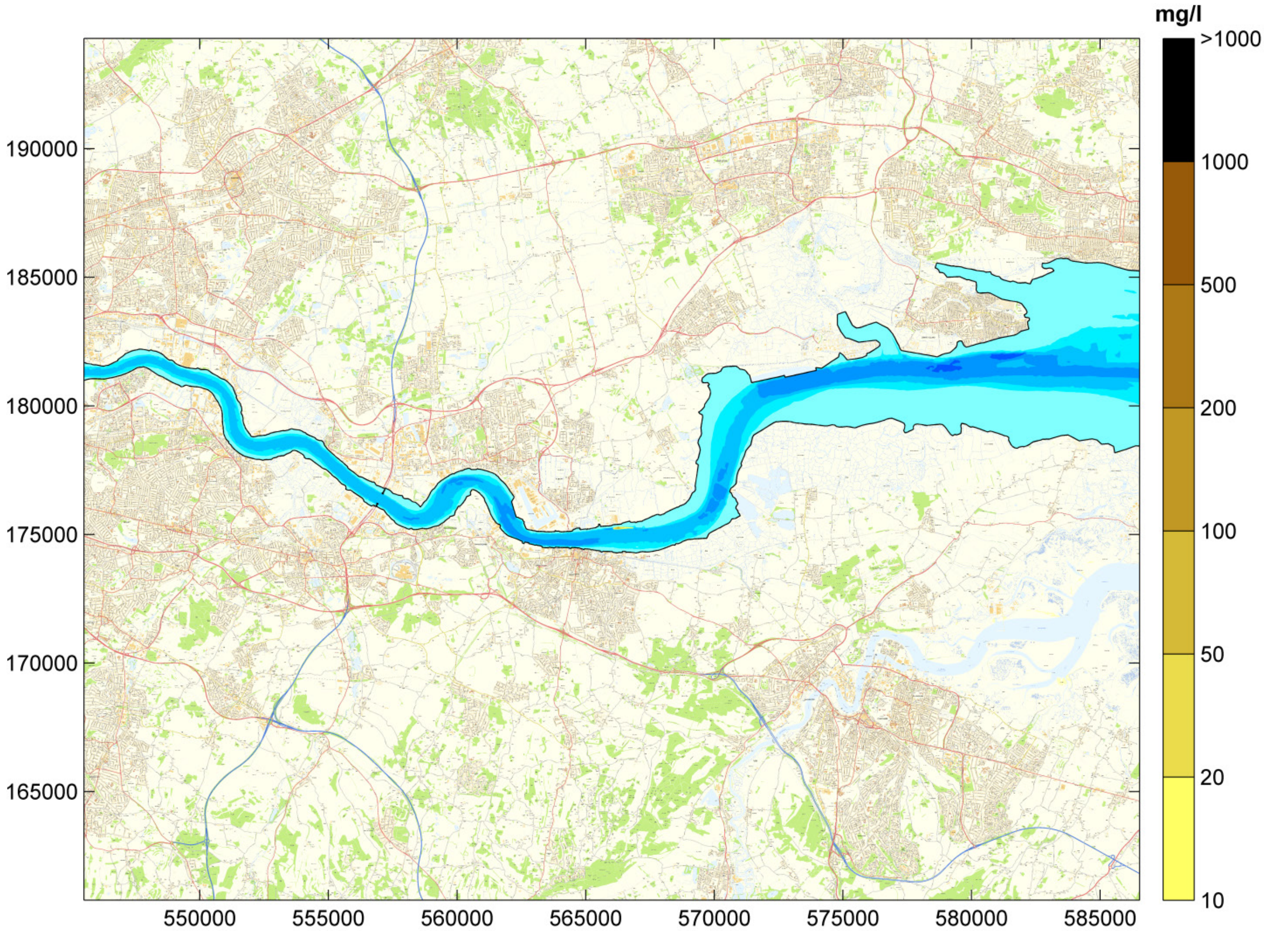

Figure 4.23: Average increase in depth average suspended sediment concentration during 14 days of WID – Scenario 2

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Figure 4.24: Maximum deposition depth of the released sediment during 14 days of WID – Scenario 2

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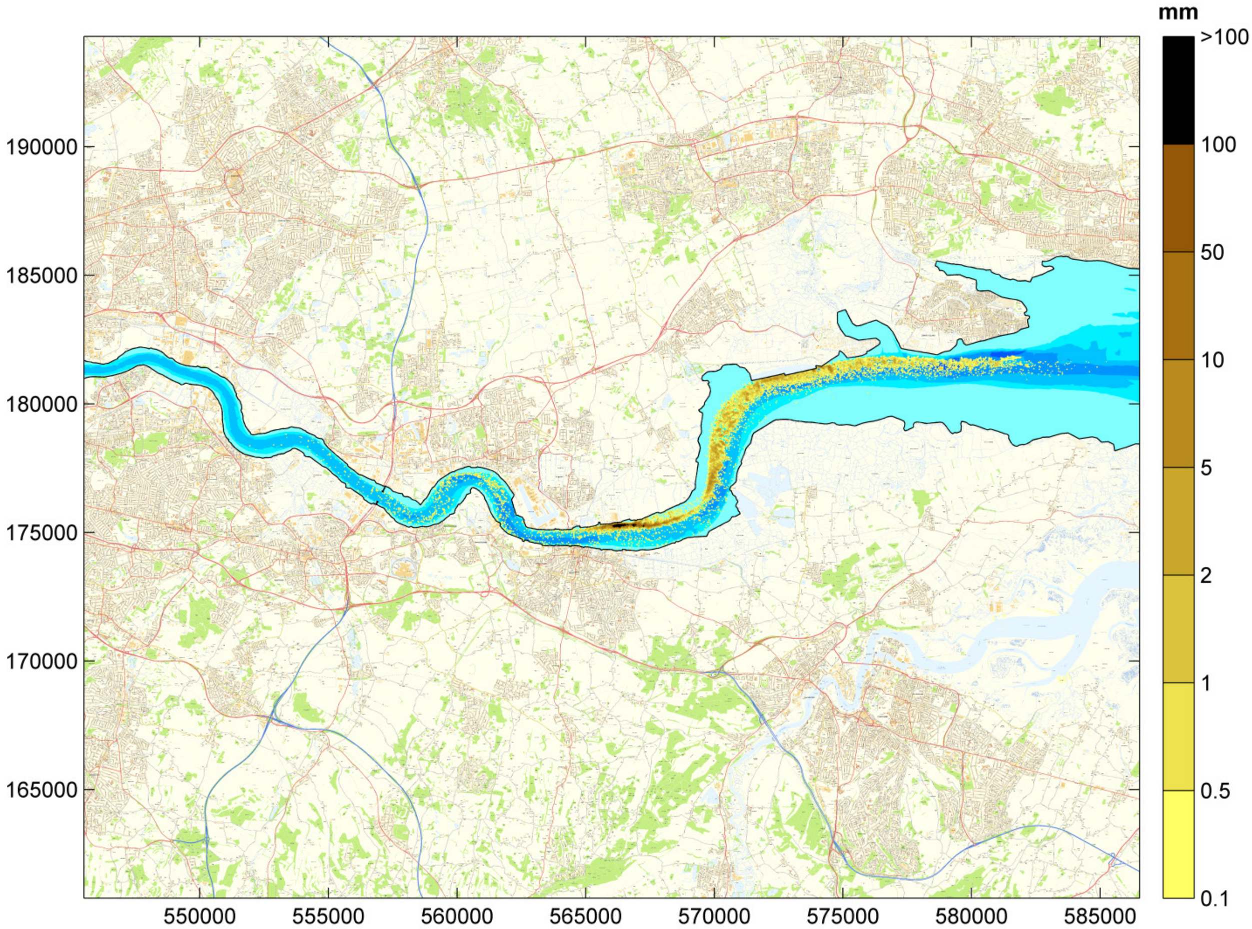

Figure 4.25: Nett accumulation of the released sediment at the end of 14 days of WID – Scenario 2

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4.5.3. Scenario 3 – continuous WID during spring tides only

The results for the dispersal of fine material arising from continuous WID dredging during 5 days of spring tides are shown in Figures 4.26 to 4.33. The plots that show the increase in (depth averaged) suspended sediment concentration or depth of sediment deposition, above background conditions, that occurred during the simulation.

For this simulation the rate of release was increased so that the total sediment mass of sediment released was the same as the for the same period in the ebb only WID scenario 2. This provides a good comparison of the effect of releasing sediment on the ebb tide only compared to continuous release.

Figure 4.26 shows the maximum increase in suspended sediment concentration above background. This plot conveys the footprint of influence of the dredging but does not represent a particular point in time as can be seen from the time series plots of concentration Figures 4.27 to 4.30 the length of time that any one place is affected by maximum concentrations can be small. Figure 4.27 to Figure 4.30 also include the Scenario 2 results to enable a comparison.

The duration of elevations in suspended sediment is taken into account by plotting the average increase in suspended sediment concentration (Figure 4.31). This shows that whilst much of the area experiences the sediment plume episodically only a small area in the immediate vicinity of the dredging experiences a consistent increase of the concentration of suspended sediment in the water column.

Figures 4.32 to 4.33 show the deposition which is predicted to occur due the dredging. The peak deposition plot (Figure 4.32) shows the maximum envelope of deposition, including temporary slack water deposits, whereas the net deposition plot (Figure 4.33) shows the areas where material will settle and remain under the flow conditions simulated.

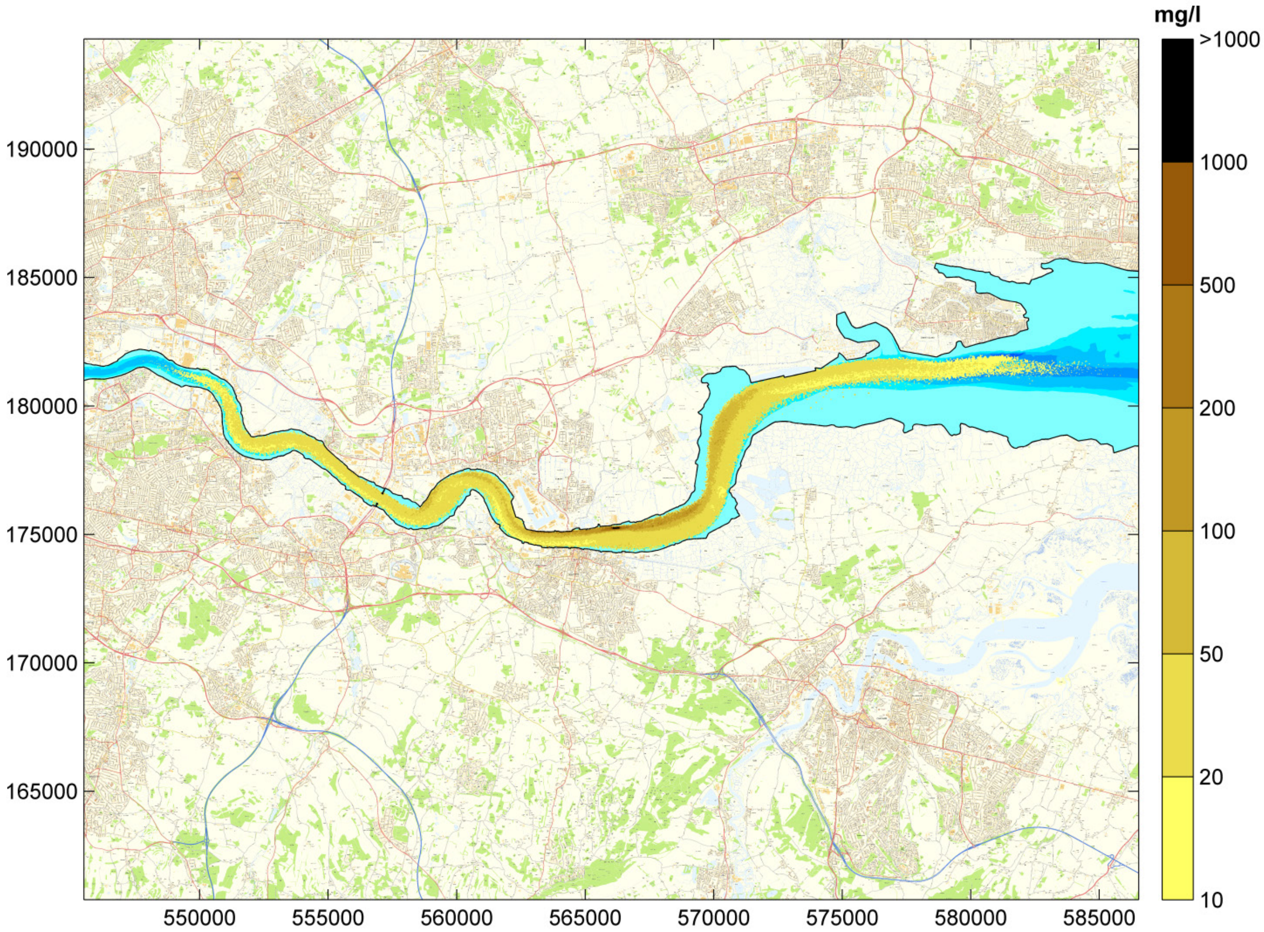

Figure 4.26: Maximum increase in depth average suspended sediment concentration during 5 days of WID – Scenario 3

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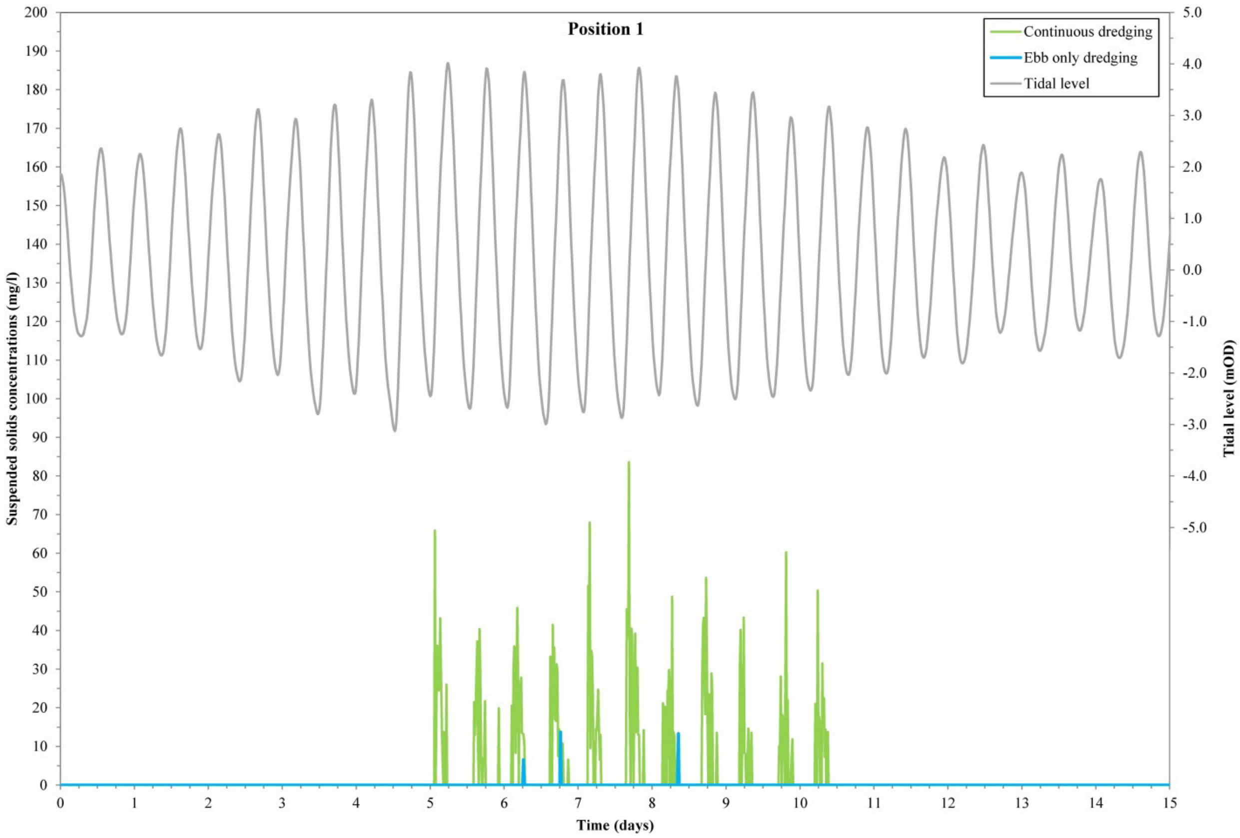

Figure 4.27: Time series of concentration during WID – location 1 – Scenario 2 (14 days ebb only) & 3 (5 days continuous)

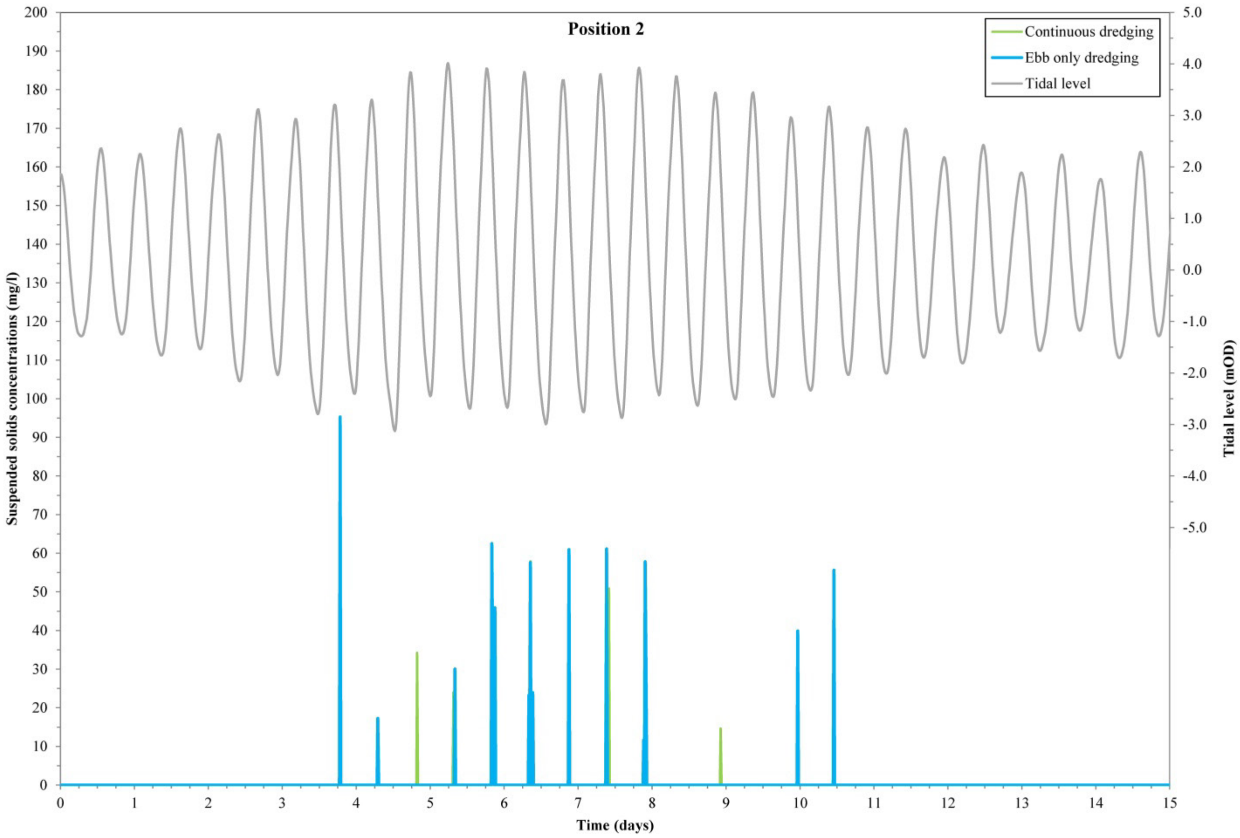

Figure 4.28: Time series of concentration during WID – location 2 – Scenario 2 (14 days ebb only) & 3 (5 days continuous)

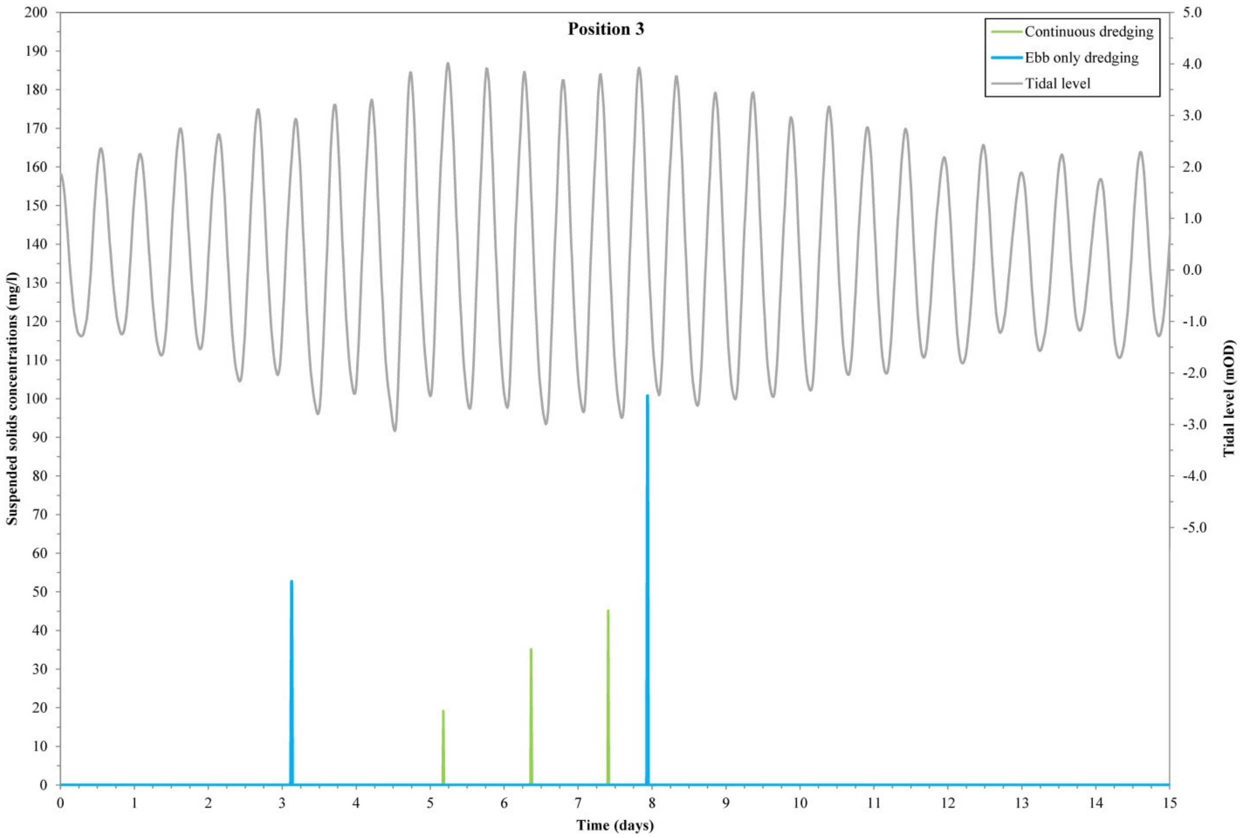

Figure 4.29: Time series of concentration during WID – location 3 – Scenario 2 (14 days ebb only) & 3 (5 days continuous)

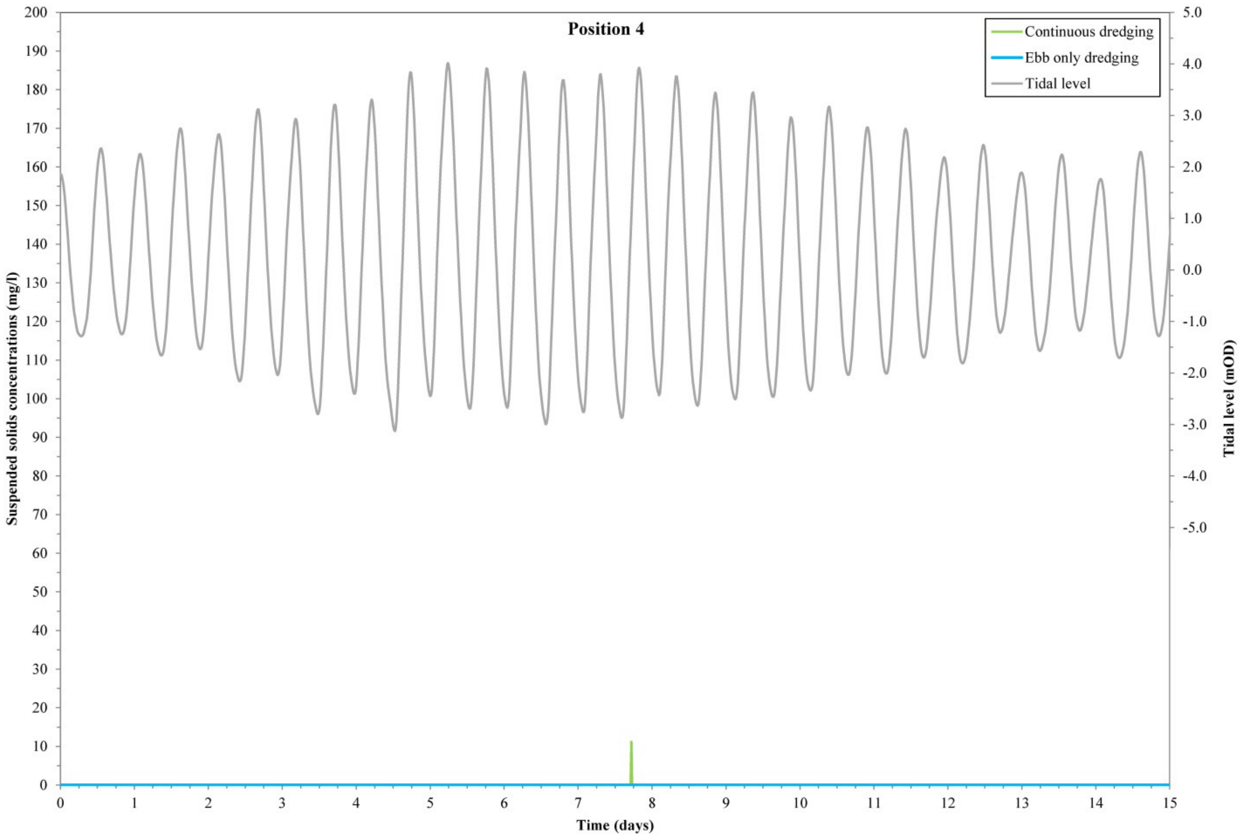

Figure 4.30: Time series of concentration during WID – location 4 – Scenario 2 (14 days ebb only) & 3 (5 days continuous)

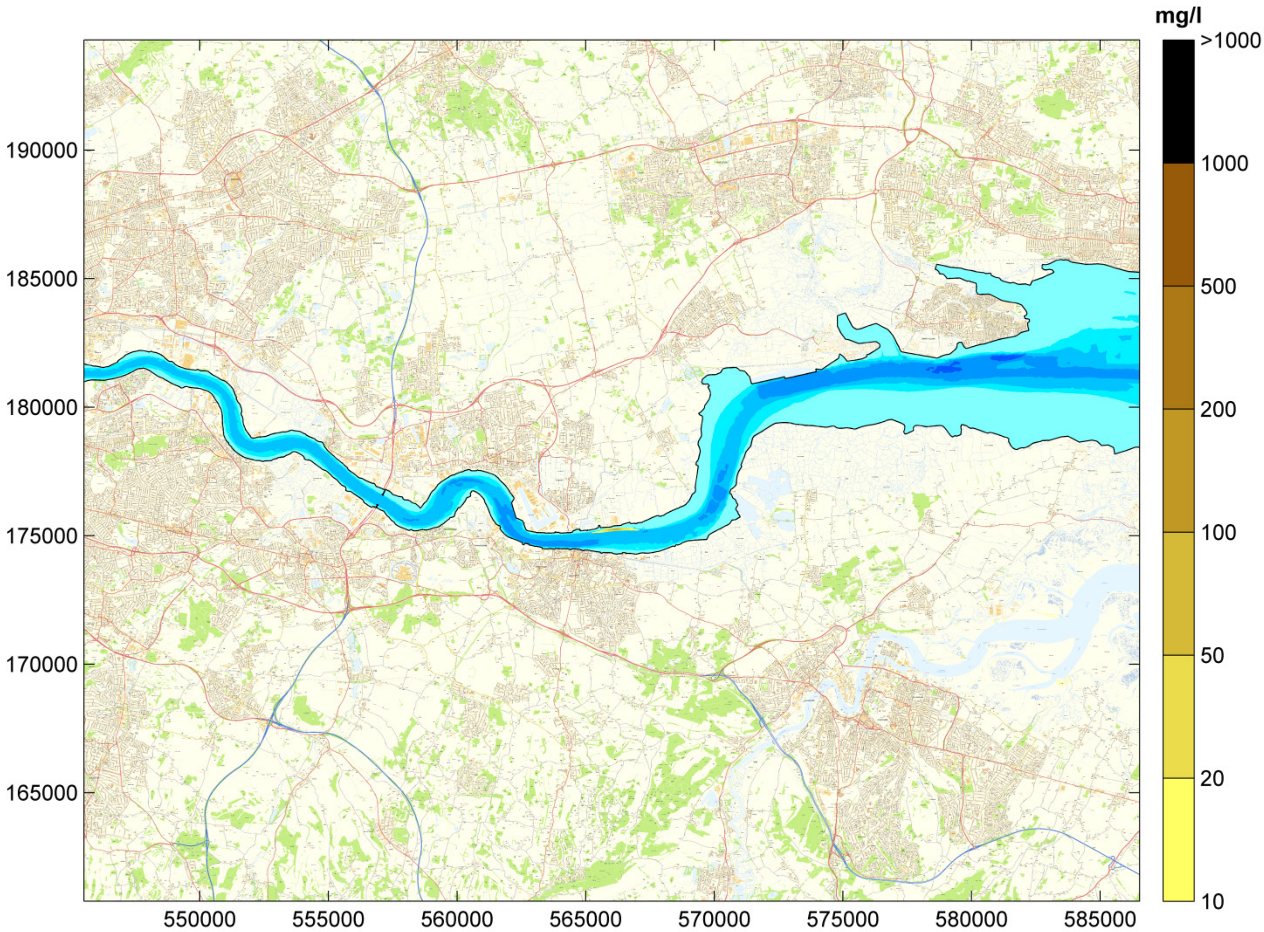

Figure 4.31: Average increase in depth average suspended sediment concentration during 5 days of WID – Scenario 3

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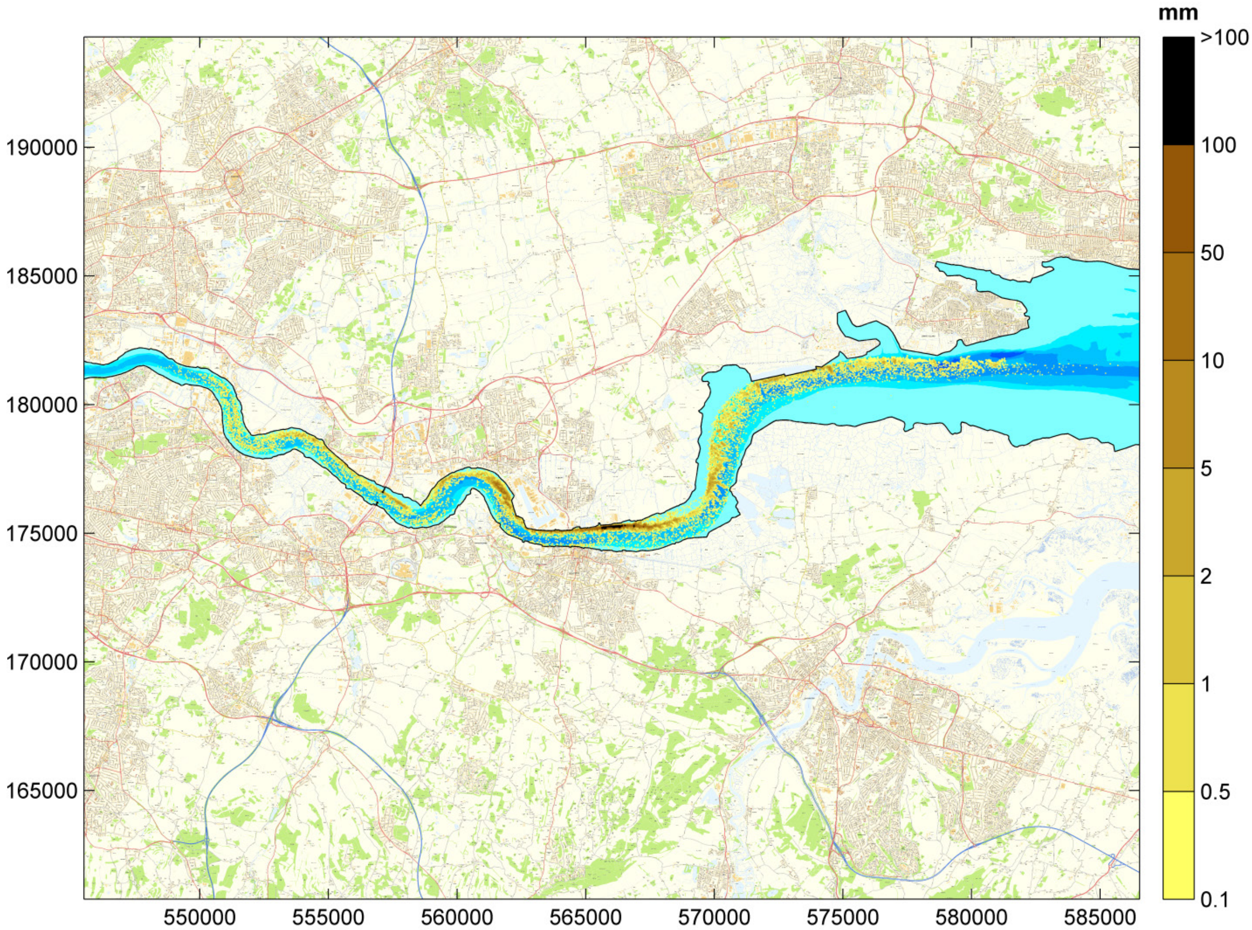

Figure 4.32: Maximum deposition depth of the released sediment during 5 days of dredging – Scenario 3

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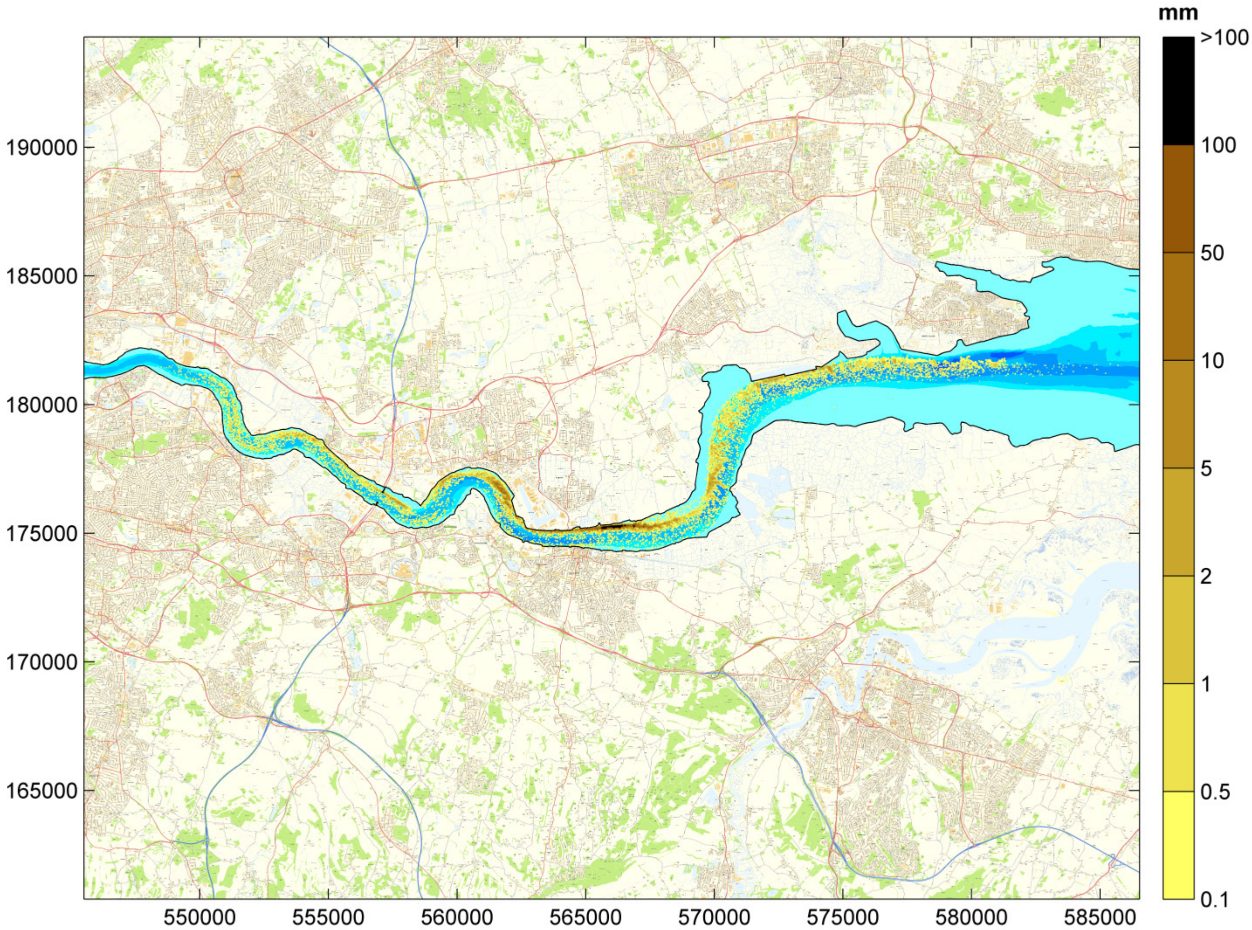

Figure 4.33: Nett accumulation of the released sediment at the end of 5 days of dredging – Scenario 3

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5. Waves

The site is sheltered from the outer Thames Estuary and southern North Sea and so waves at the site are due to generation by local winds in the reach of the Thames Estuary. The generation area is quite small, the fetch to the east is approximately 5 km and to the west is 4 km. As a consequence, the wave climate is characterised by small short period waves.

5.1. Wave climate and extreme wave conditions

The wave climate close to the site was investigated for the EA's Thames Estuary 2100 study (HR Wallingford 2005). The reporting location N9 from HR Wallingford (2005) is very close to the proposed site and the wave conditions presented for N9 are representative of those at the proposed development.

The climate is presented in Table 5.1 for significant wave height against direction and Table 5.2 for significant wave height against wave period. Extreme wave conditions for relevant direction sectors are listed in Table 5.3.

The wave climate is dominated by waves propagating either down the estuary from the west or up the estuary from the east. The most common directions are from the west and southwest which is the direction of the prevailing winds. The largest waves come from the east however as this is the longer fetch and the estuary gradually widens eastward of the site.

Wave heights are small, as expected for an enclosed location, with significant wave height of 0.6 m for a 100 year return period. Wave heights were predicted to be less than 0.2 m approximately 92% of the time. Wave periods are also short, as is typical of waves generated within a restricted fetch and mean wave periods do not exceed 2.5 s.

5.2. Impact of proposed structures on waves

The proposed works include new dolphins with associated walkways and a pontoon. The Anglian Water jetty is proposed to be removed. The dolphins will be supported on piles.

The dolphins and piles are of a similar scale to the wavelengths of the short period waves so will scatter and dissipate some wave energy but this effect will be localised. However, the dolphins are spaced out and the existing piled power station presents a larger and denser obstacle. The proposed structures will not focus wave energy so the relatively small impact on the wave climate will not impact the river bank.

The conclusion is that the impact of the proposed structures on the wave climate will be small, primarily because:

- The wave climate is typically comprised of only small, short period waves.
- The structures are mostly open piled and spread out and present less of an obstacle than the existing power station jetty.

5.3. Impact of the proposed dredging on waves

Dredged areas are proposed at the bulk handling berth and the western RO-RO berth. The pockets are proposed to be dredged to -15 mCD at the bulk handling berth, and -7.9 mCD at the RO-RO berths. Based on the differences described in Section 2.8 and shown in Figure 2.4, the minimum pre-dredge depths in these areas are approximately -8.0 mCD and -3.9 mCD.

The wave climate shows very short period waves with 99.9% with a mean period approximately 2 s or less. Short period waves do not “feel” the seabed unless the water depth is less than 4 m and the wave speed is only reduced by 3% in 2 m of water. Therefore, the effect of the dredging on waves can be considered to negligible.

Table 5.1: Wave climate at site: Significant wave height against wave direction. Data in parts per thousand.

Wave height (m)			Wave direction (°N)											
			0	30	60	90	120	150	180	210	240	270	300	330
H1	H2	P(Hs>H1)	30	60	90	120	150	180	210	240	270	300	330	360
0.0	0.1	0.94309	0	0	9610	3714	2707	1523	1519	3862	19691	90	0	0
0.1	0.2	0.51591	0	0	4856	6747	1596	1745	2884	9803	15886	0	0	0
0.2	0.3	0.08075	0	0	694	1282	343	221	549	2677	1377	0	0	0
0.3	0.4	0.00932	0	0	118	347	11	6	108	156	127	0	0	0
0.4	0.5	0.00061	0	0	13	41	0	0	1	2	4	0	0	0
Total per thousand for each direction			0	0	153	121	47	35	51	165	371	1	0	0

Source: HR Wallingford (2005)

Table 5.2: Wave climate at site: Significant wave height against mean zero-crossing wave period. Data in parts per thousand.

Wave height (m)			Mean zero-crossing wave period (s)					
			0.0	0.5	1.0	1.5	2.0	2.5
H1	H2	P(Hs>H1)	0.5	1.0	1.5	2.0	2.5	3.0
0.0	0.1	0.94309	0	6399	34780	1539	0	0
0.1	0.2	0.51591	0	0	39178	4333	7	0
0.2	0.3	0.08075	0	0	3781	3345	17	0
0.3	0.4	0.00932	0	0	0	846	25	0
0.4	0.5	0.00061	0	0	0	55	5	0
Total per thousand for each wave period			0	64	777	101	1	0

Source: HR Wallingford (2005)

Table 5.3: Extreme significant wave heights and associated mean wave periods.

Return period (years)	Wave direction sector (°N)						
	60	90	120	150	180	210	240
	90	120	150	180	210	240	270
0.1	0.32 *(1.83s)*	0.38 *(1.76s)*	0.31 *(1.51s)*	0.26 *(1.36s)*	0.31 *(1.44s)*	0.35 *(1.58s)*	0.37 *(1.70s)*
1	0.38 *(1.95s)*	0.47 *(1.92s)*	0.38 *(1.64s)*	0.32 *(1.47s)*	0.37 *(1.53s)*	0.42 *(1.69s)*	0.43 *(1.81s)*
10	0.45 *(2.08s)*	0.55 *(2.03s)*	0.45 *(1.74s)*	0.38 *(1.55s)*	0.42 *(1.61s)*	0.48 *(1.78s)*	0.49 *(1.90s)*
100	0.49 *(2.15s)*	0.61 *(2.13s)*	0.51 *(1.83s)*	0.42 *(1.62s)*	0.47 *(1.68s)*	0.54 *(1.86s)*	0.55 *(1.98s)*
1000	0.53 *(2.21s)*	0.68 *(2.21s)*	0.57 *(1.90s)*	0.47 *(1.69s)*	0.51 *(1.74s)*	0.59 *(1.93s)*	0.61 *(1.99s)*

Key: (s) Corresponding mean wave period for extreme wave height

Source: HR Wallingford (2005)

6. Water and sediment quality

6.1. Introduction

Elevated perylene concentrations (up to a maximum of 2250 µg/Kg (ppb)) have been detected in sediments at Tilbury on the river Thames, London.

Perylene is a Polyaromatic Hydrocarbon (PAH) with five benzene rings, $C_{20}H_{12}$. There are a number of PAHs. These compounds are widespread in the environment. They occur in sediments and aquatic systems from both natural and man-made (anthropogenic) sources and estuary systems can have background concentrations of these contaminants arising from their natural occurrence. The actual concentrations they occur at are of importance as this will affect their potential toxicity. In addition, individual PAHs behave differently, have varying solubility's and toxicities and therefore pose different risks.

There is a lot of information available on the PAHs in general and some PAHS are much more documented then others. Typically the standard PAHs that are regulated for under the Water Framework Directive (WFD) and the 16 PAHs regulated in the USA by its environmental protection agency (EPA) are more frequently reported. Perylene is not one of these PAHs and is therefore less commonly monitored. The amount of relevant information specific to this contaminant is limited.

This review focuses on perylene and the limited information available. The review outlines the risks associated with the presence of perylene in the marine environment and the likelihood of its dispersion based on its solubility between the sediments, water and biota.

6.2. Review of relevant information

6.2.1. Occurrence and sources of Perylene

The predominance of perylene over other PAHs in the marine environment has been reported in qualitative studies and quantitative studies (Venkatesan, 1988). It has a number of proposed and some proven natural sources (diatoms and diagenetic processes of sediment and sedimentary rock, fungal and insect pigments). Perylene has possibly two major natural sources, both marine and terrigenous. It also has some anthropogenic sources related local effluent and atmospheric dry deposition. Perylene is only a minor component in petroleum, crude oil and coals, relative to other PAHs. However the combustion of fuels is more important as an anthropogenic source. For example, Perylene occurs in significant amounts relative to other PAH in emissions from (i) coke production, (ii) heat generation sources employing coal and various firing methods, (iii) catalyst regeneration flue gas from oil refineries if discharged uncleaned, (iv) stack gases of municipal incinerators, (v) combustion of kerosene and (vi) coal tar (Venkatesan, 1988).

It is obvious from the available data that perylene is widespread in organic rich soils and sediments. Perylene precursors are present in terrestrial as well as aquatic and marine organic detritus. To date, the precursors of perylene have not been identified, although a precursor-product relationship has been suggested for the transformation of perylene-quinone pigments of fungi and insects (Thomson, 1976, 1979). It is probably unrealistic to believe that fungal and insect pigments can be the sole source of perylene precursor to generate perylene levels as high as 4000 ppb (µg/Kg) in the sediments (Venkatesa, 1988). A credible diagenetic origin is also hypothesised by Opuene *et. al.,* (2007).

High perylene concentrations are observed in diatomaceous sediments in marine and lacustrine environments, indicating diatoms as potential precursors of perylene. However, the available data are not informative enough to determine (a) the precise role of diatoms in the adsorption or entrapment of perylene which is probably later diagenetically released or (b) whether perylene is produced from diatoms by bacterial alteration.

Venkatesa (1988) reports favourable environments for the formation and/or preservation of perylene are (a) anoxic marine environments and terrigenous peaty (bog) deposits and lakes which have fast sedimentation rates, (b) aquatic or marine regions with high biological productivity (especially rich in diatoms) such as in upwelling zones, estuaries or lakes and (c) trenches with old and dysaerobic (limited oxygen available) or anaerobic (lacking oxygen) bottom waters.

When perylene is detected in sediments, it is reported to be more prevalent and at higher concentrations at depth and in anoxic (oxygen depleted) sediments compared to oxic (measurable oxygen) surface sediments. Indeed, perylene is considered to be a paleoenvironment marker for early sedimentary anoxia (Tan and Heit, 1981, among others).

Most information in the literature exists, however, for freshwater systems but Venkatesan (1988) references background concentrations in marine sediments of 10ppb (µg/Kg) and concentrations of up to 2 to 4ppm (mg/Kg, or 2000 to 4000 µg/Kg) in the Yarra River Estuary in Melbourne, Australia (Bagg et al, 1981). Amounts as high as 2-4 ppm have been detected in Saanich inlet, Canada (Aizenshtat, 1973) and the Yarra River estuary, Australia (Bagg et al., 1981).

6.2.2. Occurrence and sources of perylene at Tilbury

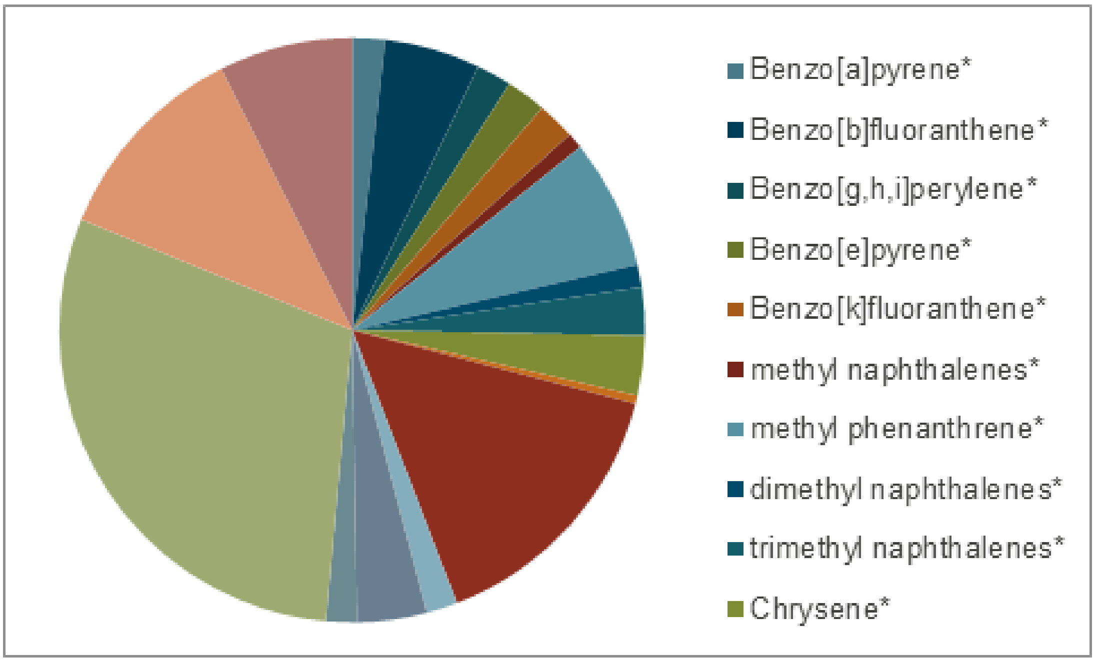

Figure 6.1: Area i) High total hydrocarbon, some perylene (2017-MO-BH01_0.00-0.50)

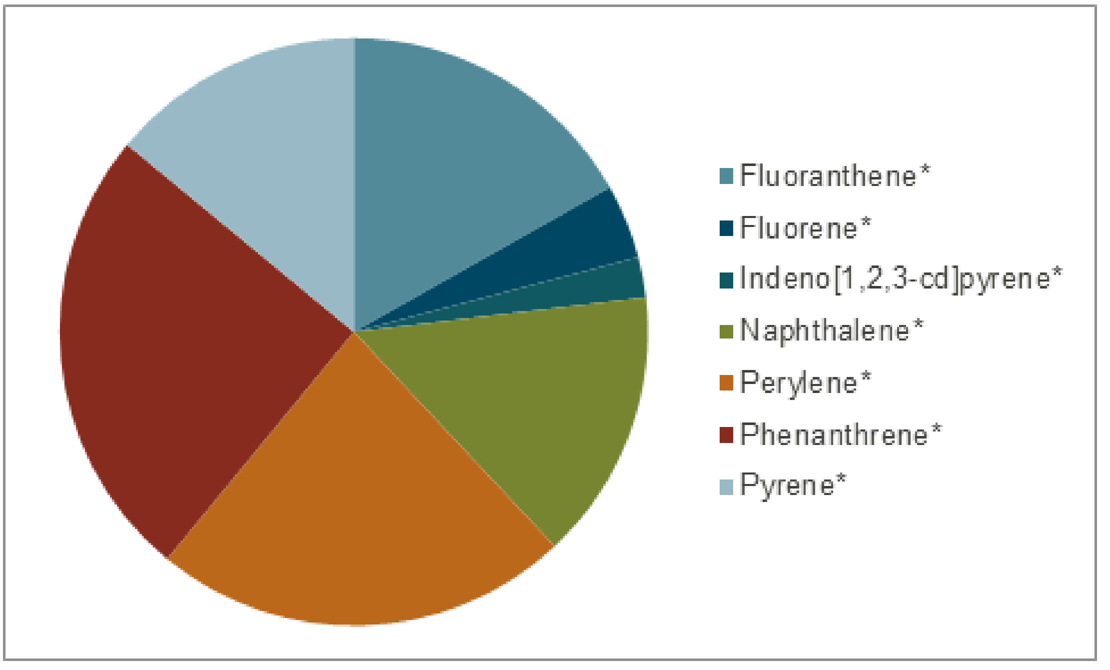

Figure 6.2: Area i) High total hydrocarbon, perylene dominates (217-MO-RBS08_0.00-0.30)

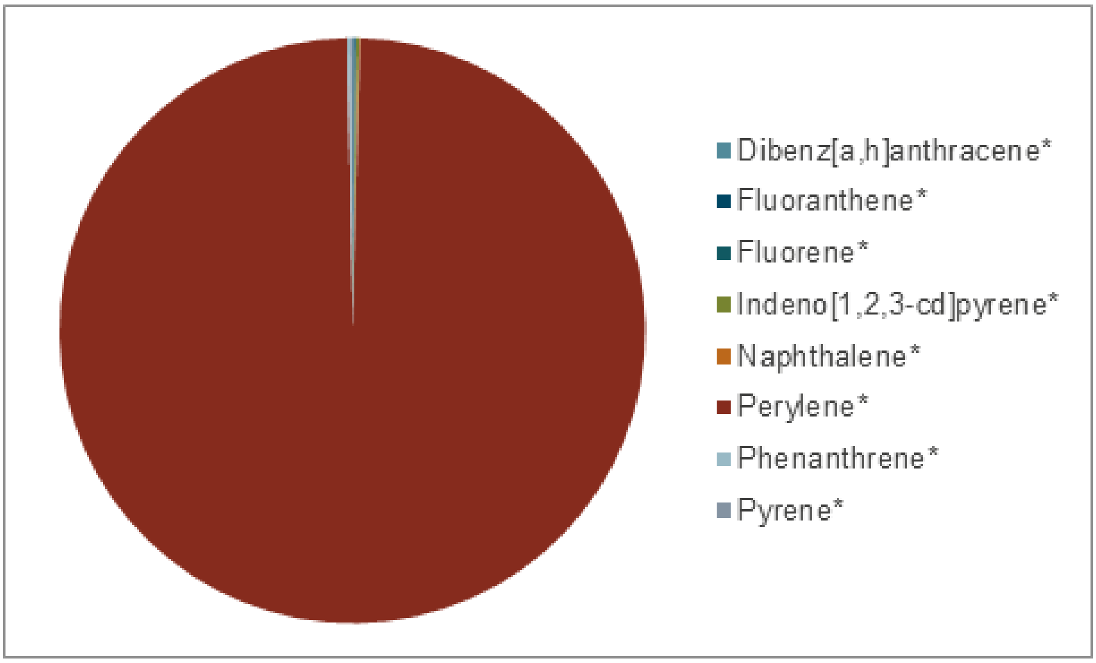

Figure 6.3: Area i) Highest perylene recorded (2017-MO-BH03_3)

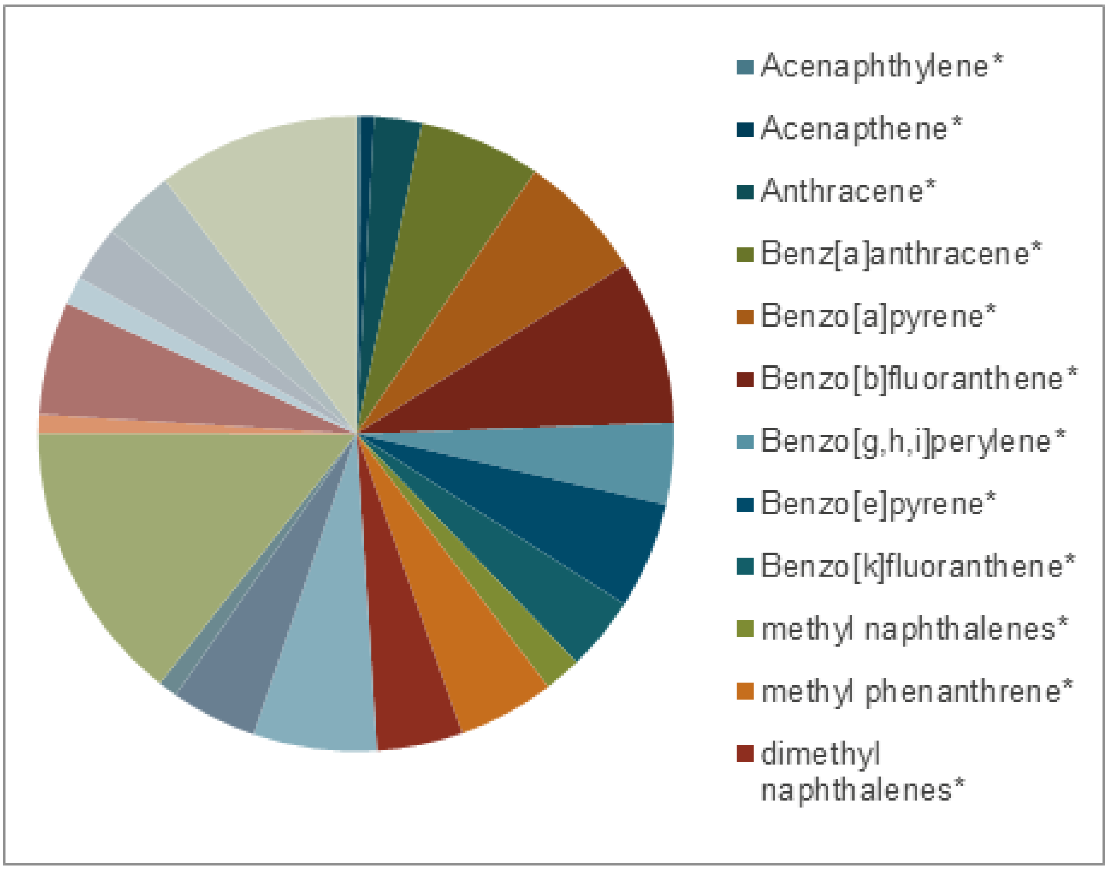

Figure 6.4: Area ii) High total hydrocarbon and PAHs (217-MO-RBS08_0.00-0.30)

The Pie charts above for two samples from area ii that recorded high total hydrocarbons shows the percentage of individual PAHs present. It can be seen that Benzo[b]fluoranthene, Fluoranthene and Pyrene, but not perylene dominate the percentage of PAHs found at one site. Whereas another sample from area ii shows perylene dominate alongside with phenathrene and naphthalene and fluorene dominate the percentage of PAHs found at this site.

However, the Pie chart at the location in area ii, where the maximum perylene concentration of 2250 µg/Kg (ppb) was reported clearly shows this contaminant masks any other PAH present. It is worth noting that at this site the total hydrocarbon concentration was not high.

It seems that the samples with high total hydrocarbons present are not necessarily the same as those with high perylene.

Indeed the Pie chart for a sample from area ii which had high total hydrocarbon concentrations and a number of PAHs present at elevated concentrations shows that perylene at this location is not high. This may indicate that there are different sources of PAHs in the area sampled and it is worth considering this locally contaminated area separately from the perylene assessment.

It is known that certain ratios of different PAHs can be indicative of a major pyrolitic contribution (e.g. fossil fuels such as coal). If the following ratios of individual PAH concentrations at different locations across the sample areas are calculated the following can be reported;

1. Phenanthrene/Anthracene <10 indicates a pyrolitic source (value of 1.5 and 8.2, for Area i (2017-MO-RBS02_0) and ii (217-MO-RBS08_0.00-0.30) respectively);
2. Fluoranthene/pyrene >1 indicates a pyrolitic source (value of 1.4 and 1.2, for Area i and ii respectively);
3. Benzo(a)anthracene/ Chrysene >0.9 indicates a pyrolitic source (value of 1.4 and 0.7, for Area i and ii respectively).

These ratios have been used in the literature as indicators of the source of PAHs and do not clearly support coal as likely to be responsible for contamination of perylene across this site but may show that locally in one part of area ii coal may be responsible for the number of PAHs detected. This supports that more than one source of PAHs is likely to be occurring in the area.

However, more evidence is not available and the source of perylene at Tilbury is not known, to date and it is not possible from the literature and information available to comment further.

6.2.3. Physical properties of Perylene including solubility

Existing data

Some information for perylene has been found from research journals and chemical data sheets available on the internet. These are given below in context with other PAHs which are monitored more frequently.

PAHs have 2-6 molecule rings and molecular weights of 128-278 g/mol. The molecular weight of perylene is 252g/mol making it one of the heavier and larger PAHs. It has 5 molecule rings.

This review is interested in the risk of perylene entering the water phase and its behaviour between the sediment, water and biota. Solubility and vapour pressure characteristics of PAHs are the major physico-chemical factors that control their distribution between the soluble and particulate components of the atmosphere, hydrosphere and biosphere. Solubility values range from highly insoluble (benzo[g,h,i]perylene is 0.003 mg/L) to slightly soluble (naphthalene at 31 mg/L). The solubility of perylene at 20-25 deg C (mg/L) is reported as 0.000131 mg/L, meaning it is highly insoluble.

PAH vapour pressures range from highly volatile (naphthalene) to relatively non-volatile (benzo[g,h,i]perylene).

The PAHs range from moderately to highly lipophilic having logarithmic octanol-water partition coefficients (log Kow) of 3.37 -6.75. A range of values for perylene are 6.031 (calculated using 2 carbon model), 6.135 (freshwater), 6.25 to 6.704. Perylene is highly lipophilic.

Sorption coefficient for perylene (Log L/Kg) Koc 6.59.

Adsorption and sequestration to sediments

Approaches to modelling PAH adsorption and sequestration in marine sediments exist (Brion and Peletier, 2005) but do not offer information for perylene. In many reports and papers perylene is not included as it is not as regulated as other PAHs, as mentioned previously.

6.2.4. Persistence in the marine environment

Perylene has high persistence in the marine environment in anoxic sediments. Perylene has natural origins, and may be involved in part of the diagenetic processes occurring.

6.2.5. Bioconcentration and bioaccumulation

The perylene Log BCF is reported as 1.196-4.36 and the likelihood of bioaccumulation as low. This value may warrant further investigated as both the Kow and Koc values given above would indicate a potential to bioaccumulate/ bioconcentrate, as lipophilic compounds generally do bioaccumulate. It is suggested that perylene might be metabolise by some biota and not bioaccumulate as a result.

6.2.6. 2.5 Potential toxicity information

Relevant data

Humans

It is understood that Perylene is not a designated hazardous substance under UK legislation.

Perylene is considered a hazardous substance elsewhere.

Chemwatch hazard rating – acute and chronic toxicity is moderate.

Biota - water concentrations

Some toxicity information is given of for perylene from the USA, albeit for a freshwater system is:

Toxicity Fish: LC50(96)1.1-5 µg/L

Toxicity invertebrate: LC50 (96)0.39-7033 µg/L

It is reported that uptake by plants occurs for more soluble PAHs, while the uptake by invertebrates is higher for lower solubility PAHs. Perylene is a lower solubility PAH.

Research with a variety of aquatic species has shown that while polycyclic aromatic hydrocarbons (PAHs) are generally not acutely toxic in conventional laboratory tests, many are extremely toxic in the presence of sunlight. Evidence suggests perylene is one of them.

Oris and Giesy (1987) found some differences in photo-induced toxicity between fish larvae and zooplankton. While all of the PAHs that were toxic to fish were toxic to *D. magna,* three of the chemicals that were not toxic to fish (benzo[e]pyrene, perylene, and dibenzo [a, h] anthracene) were toxic to *D. magna.*

QSARs for Polycyclic Aromatic Hydrocarbons, including perylene, to *Daphnia magna* are reported (Mekenyan *et. al.,* 1993).

A paper looking at the concentrations of perylene from 2µg/L to 110mg/L in water reported that even small concentrations can have deleterious effects on reproduction (Cunha *et. al.,* 2008 paper).

Biota - sediment concentrations

Longworthy *et. al*., (1998) shows that the structure of the microbial community in sediments can be altered due to the occurrence of perylene.

Equilibrium partitioning sediment benchmarks (ESBs) are derived by the USEPA for the protection of benthic organisms and are based on the bioavailable concentrations of contaminants in sediments. When a chemical exceeds the ESB an adverse biological effect may occur. There is no ESB for perylene in the UK. The UK have an alternative system involving Environmental Quality Standard (EQS). However, there is no EQS value for perylene in the UK.

Partition coefficients and interstitial water

Interstitial water concentrations become important and possibly better indicators of potential risk then their Equilibrium partitioning sediment benchmarks (ESBs). Partition coefficients always have an error of uncertainty. And finding a coefficient which represents the system under investigation is difficult. Sediment type, organic content, lipid content and ionic strength all play a role and will vary from location to location, over depth in sediments and if disturbed over time.

6.3. Discussion on relevance to Tilbury Docks

The concentrations of perylene recorded in the project sediments from Tilbury are high and are widespread throughout the sample area. However, marine sediment concentrations of this magnitude have been reported at other locations. It is also known that perylene exists in sediments from other parts of the Thames at these orders of magnitude.

The source of the perylene in the sediments at Tilbury is not known from the information available. However, one location in area ii displayed elevated concentrations for a number of PAHs that may be localised contamination from coal. The perylene concentrations at that location are not elevated and the widespread contamination by perylene across the sampled area does not seem to be associated with this PAH “hot spot” and will, therefore, be considered separately.

Perylene is insoluble and lipophilic supported by its Kow and Koc values. Perylene will remain largely on the sediments and mostly in the silt, clay, organic particulates and lipid factions. The concentrations of perylene in the sediments are significantly higher, orders of magnitude higher, than in water. The distribution and transport of perylene is therefore likely to follow the sediment transport as it is attached to the carbons in the sediments.

When dredging and disturbing the sediments, it is important to understand whether perylene will enter the water at levels of significance. It is noted that dredging, however, can change the physico-chemical properties of the sediment and anoxic (oxygen lacking) sediments may become oxic (oxygen available). The behaviour of perylene when the sediments become oxic is uncertain but unlike some metal contaminants, no evidence exists to show that perylene would enter the water column because of this change in sediment conditions. It is expected that the perylene will remain on the sediments due to its physical properties as mentioned above.

From the information available, and the partition coefficients found in the literature and reported, on dredging, perylene will be primarily transported and distributed with the sediments and follow the dredging plume. It is therefore considered that, when assessing any disturbance of the Tilbury sediments, it is appropriate to adopt the concept that the perylene remains on the sediment and is not likely to enter the water. Any perylene present in the water column will remain attached to the suspended sediments. Perylene loads can then be calculated alongside any sedimentation loading rather than undertaking uncertain, and for this contaminant unnecessary, partition coefficient modelling.

There is no EQS value for perylene in the UK. EQS values exist in the UK and Europe for other 5 to 6 ring PAHs, including benzo[g,h,i]perylene. (PAH 5-6 rings dossier, 2011). How these may be of use to determine the relevance of the perylene concentrations from the information available is not known. The EQS in water for benzo [g, h, i] perylene is 8.2×10^{-4} µg/l as a maximum allowable concentration (MAC) and benzopyrene is often used “as a marker” to establish compliance with the benzo[g,h,i]perylene annual average (AA), and the benzopyrene AA is 1.7×10^{-4}µg/L. The water data given, reported many samples as <0.01 µg/L. This means that the limits of detection for many of the results are too high to establish whether, if any AA threshold value similar to benzopyrene was used, perylene has breached (or not) at that specific point in time for that sample.

This assessment comes down to a very difficult and complex chemical argument about how much perylene, if any, dissociates from the sediments and enters the water column when the material is disturbed, how long it remains there, and whether it does more damage in the aqueous phase than it does bound to the sediment. It is likely that as perylene concentrations are widespread in the sediments the water column will always be at risk, with or without dredging, due to tidal action, currents and wave action. However, no regulations exist for the UK for perylene to inform this assessment.

No data on toxicity of perylene is available that is specifically for this marine environment. However some toxicity information of relevance to the aquatic system is given for perylene above. It is noted that acute toxicity test on perylene in the laboratory have shown no toxicity while similar concentrations in the environment have shown some toxicity in the presence of sunlight. The significance of any potential photo-induced toxicity is not known but it is unlikely to be of concern as the penetration of sunlight through the water column to the sediment bed is expected to be low.

In conclusion, this report assesses the available information and presents where we are in our understanding of the risk, if any, of perylene in the sediments sampled. Given that 1) the perylene detected in these sediment samples is reported at concentrations of the same order of magnitude in other marine sediment (noting the one sample with very high concentrations of perylene alongside other PAHs); 2) the view presented from the literature that the source of perylene can be both natural and anthropogenic but for this location is unknown; 3) the physical properties of perylene determine it is likely to remain on the sediment; and 4) no toxic effects from perylene have been reported for this system to date; then, on the balance of evidence, the risks to the water column and associated biota are likely to be very low.

6.4. Model results

The sediment release modelling has been used to demonstrate the effect of the resuspension of perylene bound to the fine sediment dredged. As described above it is assumed the contaminant stays adsorbed onto the sediment – a worst case assumption for sediment quality. Figure 6.5 shows the maximum concentration of perylene attached to sediment suspended in the water column. In this case the average observed concentration of perylene of 400 µg/kg has been combined with the ebb tide WID sediment release case to provide a likely worst case for perylene in the water column. The value used is the average of all the samples, including the single high value of more than 2,000 µg/kg – without this value the mean value would be approximately 350 µg/kg. As the sample with the highest perylene value included other PAHs with high values it is intended that this material be removed by other means with less sediment dispersion (e.g. backhoe) and taken to a licensed contaminated sediment treatment site.

Use of the maximum concentration provides a view of the full footprint of potential effect. For reference the edge of the intertidal areas is indicated on the plot. Other than in the immediate vicinity of the dredge no concentration of perylene greater than 0.05 µg/l is shown on the intertidal areas. This is a consequence of the WID operation which introduces the sediment into the lower half of the water column with less risk of material getting onto intertidal areas.

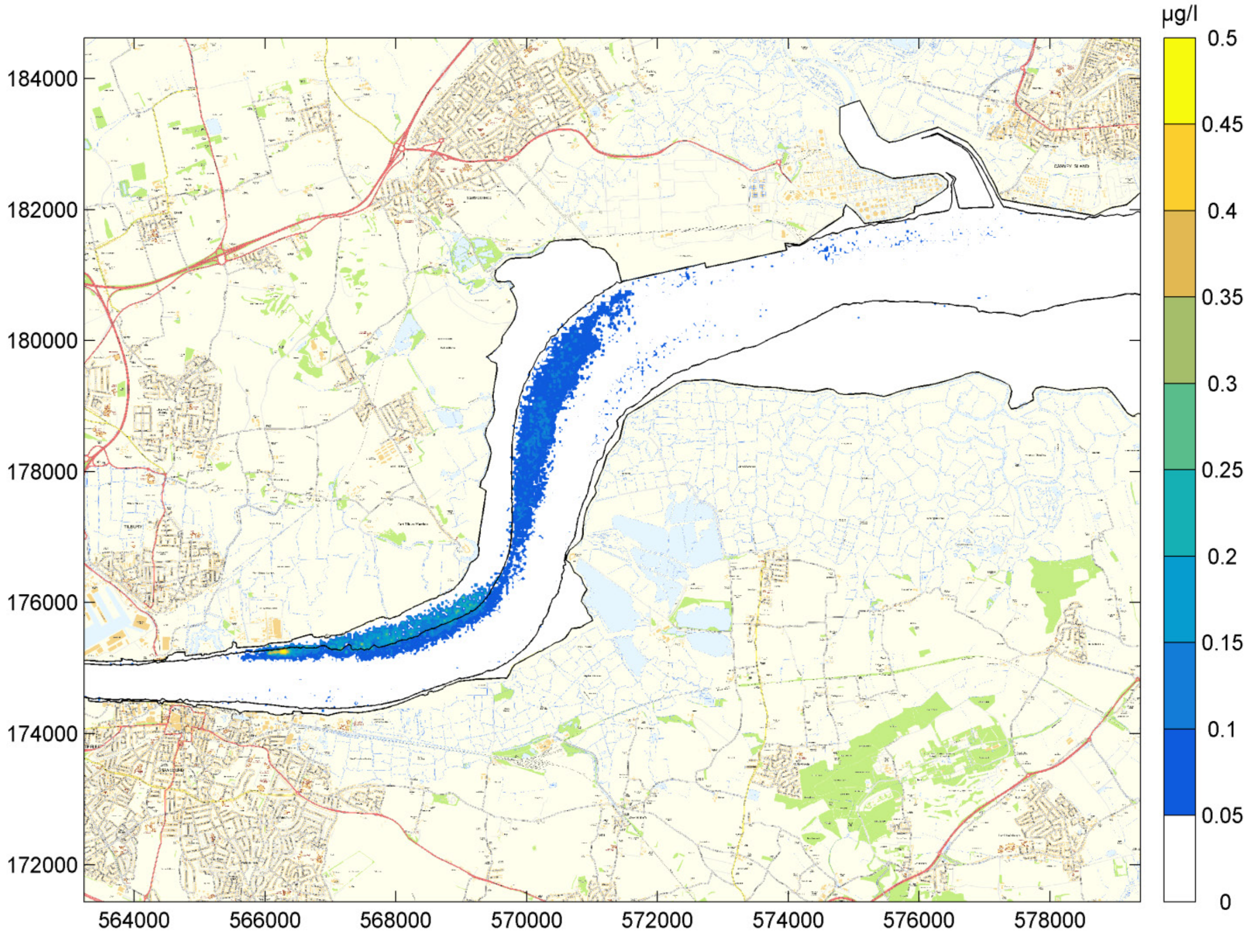

Figure 6.5: Maximum concentration of perylene in the water column for the material dredged by WID

7. Assessment and conclusions

7.1. Hydrodynamics

The data obtained from this study provides sufficient evidence to suggest that the introduction of the proposed works will only have a comparatively local impact upon the flow conditions and that they will not affect the overall hydrodynamic regime of the Thames Estuary. However, locally the predicted changes to the magnitude of the flow strength in the vicinity of the proposed works are likely to affect the distribution of bed sediments and the potential for zones of accretion to occur especially in the berthing areas.

7.2. Sedimentation

The proposed development will have a minor and local effect on the sediment regime of the Thames Estuary. Dredging the berth pocket to depths several metres below the natural regime depth in an area which is known to be sensitive to sedimentation has been shown to lead to the dredged areas being subject to ingress of sediment. The predicted infill rates for the dredged berth pockets are up to 100,000 m^3 annually with the bulk of the material fine silty sediment. Whilst this total is a maximum assuming the berth is maintained at its target depth and is likely to be reduced by vessel occupancy, regular maintenance dredging should be expected, in particular at the eastern end of the bulk berth. Although the site appears suitable for the use of water injection/agitation dredging to maintain the fine silty material (see below) a need for occasional removal of sandy material accumulating in the berth pockets is also present.

Additionally, dredging of the berth to the proposed depth may challenge the integrity of adjacent side slopes (dredged or intertidal) – the proposed piling will help but this will have to be carefully designed to minimise adverse impacts. Knowledge of the strength of and the material composition of the bed sediments is required so that this issue can be further addressed.

7.3. Construction effects

The relatively small volume of capital dredging required (~100,000 m^3) and the anticipated mix of bed material as shown by the borehole data suggests that a backhoe dredger could be used working continuously loading material into a fleet of barges assuming a backhoe of sufficient reach is available.

Alternatively the overlying soft silts and finer sands found in the boreholes could be removed by water injection dredging (WID) with any stronger or coarser sediment found at depth removed by backhoe.

The releases of sediment from both backhoe dredging and WID have been considered to demonstrate the potential effects of a range of dredging methodologies. Sediment release from methods such as use of a cutter suction dredger (loading into barges) or trailer hopper dredger would be in the range between the two methods modelled.

7.3.1. Backhoe

Due to the extremely low sediment release rate of this dredging method compared to the high ambient suspended sediment concentrations in the area any effect of the sediment released by the dredging is considered negligible.

7.3.2. WID

The worst case simulation of continuous WID showed an area 15 km either side of the dredging which will experience an increase in maximum suspended sediment concentration greater than 20 mg/l. Maximum increases of greater magnitude, up to 200 mg/l, are limited to an area within 2 km of the dredge. The time series results show that these increases are very transient. The effect of the dredging in raising the average suspended sediment concentration is limited to the immediate area of the dredge.

A consequence of the WID methodology is that the sediment plume is mostly confined to the subtidal areas with limited increase in suspended sediment concentration or sediment accumulation on the intertidal areas. Accumulation depths of the order of 1-2 mm are predicted widely in the subtidal channel due to 2 weeks of WID. Larger accumulation depths, greater than 10 mm can occur in small areas however only areas of channel with a consistent pattern of accumulation greater than 10mm are within 5 km of the dredge site.

The simulations have shown that the landward extent of any influence of the dredging can be significantly limited by dredging being restricted to the ebb tide.

7.3.3. Comparison with estuarine sediment budget

The dredging is taking place within a dynamic estuarine sediment regime. Baugh et al (2013) report a reappraisal of the fine sediment regime of the Thames Estuary undertaken with reference to new observations of suspended sediment concentrations and collated morphological change data. The inclusion of morphological change into the fine sediment budget removed the discrepancy between sediment inputs and outputs to the Thames Estuary that was hitherto assumed to be proof of large amounts of sediment coming into the Thames from marine sources. The sediment budget is tabulated below.

Table 7.1: Estimated average sediment budget over the period 1970 to 1990, landward of Shell haven

Contributing factor	Mass (Tons dry solids / year)
Inputs	
Fluvial input (Thames + tributaries)	170,000
Sewage effluent	42,000 (est. average over the period)
Storm sewage	13,000
Sewage sludge	0
Industrial discharges	3,000
Morphological change (erosion +ve)	-120,000
Total inputs	**108,000**
Outputs	
Maintenance Dredging (net placed outside system)	95,000
Decomposition of sewage	24,000
Total outputs	119,000
Net difference	**-11,000 +/- 70,000**

Source: Baugh et al (2013)

The material to be dredged is a mix of surficial fine sediment overlying sand and gravel making up a total volume of up to 113,000 m^3. The exact proportion of fine sediment to be removed during the dredging is not finalised so for the purpose of this assessment it is assumed half of the material to be dredged is fine sediment (56,500 m^3) with a typical dry density of 0.75 T/m^3. In this case the total sediment mass either released by the WID dredging or removed from the system by backhoe dredging is approximately 40,000 Tons. By comparison with the table above it can be seen that this total mass released into the water column in the area landward of Shell haven by the use of WID or potentially removed from the system by backhoe dredging is within the variability identified in the annual sediment budget of +/-70,000 Tons/year and therefore the dredging will not change the fine sediment budget of the Thames Estuary outside observed natural variability.

7.4. Water and sediment quality

A review of the properties of perylene has shown it has extremely low solubility and is therefore unlikely to result in a water quality impact. An assessment of the dispersion of perylene adsorbed onto the sediment released during the dredge has, in general, shown very low concentrations and very low risk of contamination depositing on to the intertidal areas.

7.5. Maintenance dredging effects

The sedimentation study has shown a risk of fine sediment accumulation in the dredged berths. WID is a suitable method for maintain the berth depth. It is also preferable environmentally as it avoids the removal of sediment from the estuary system. The modelling and results for WID presented for the construction effects section assume a high fine sediment content in the material dredged as would be expected for maintenance dredging and therefore the predicted effects of maintenance dredging can be anticipated as similar to those for the capital dredging. The dredge rate assumed a removal of up to 5,000 m^3 per day of sediment so the predicted infill could be removed in 20 days or three, one week campaigns.

It is more likely that dredging by WID will be limited to ebb only. Elsewhere on the tidal Thames WID is undertaken from an hour before high water to 4 hours after high water to minimise the landward extent of any effect. Assuming 2 tides of dredging with 5 hours of dredging undertaken in each suggests a sediment removal rate of slightly over 2,000 m^3 per day. In this scenario the maintenance could be done in four, 2 week dredging campaigns as modelled.

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Appendix

A. Time series results for baseline and scenario

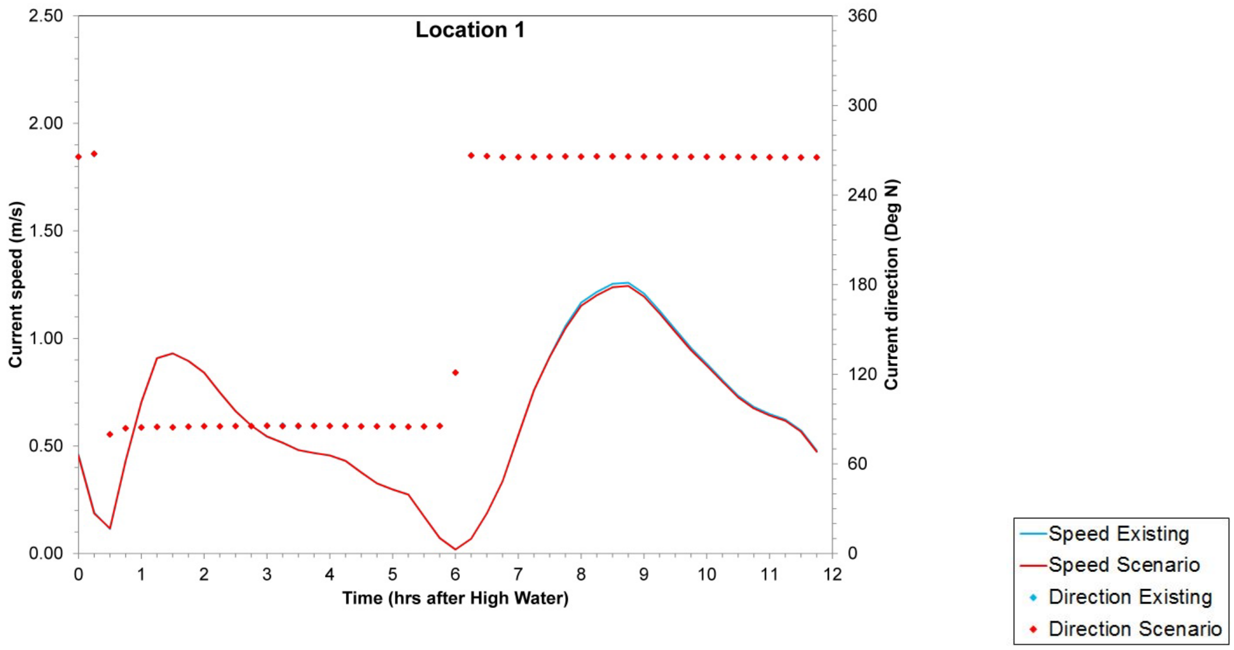

Figure A.1: Time history at Point 1

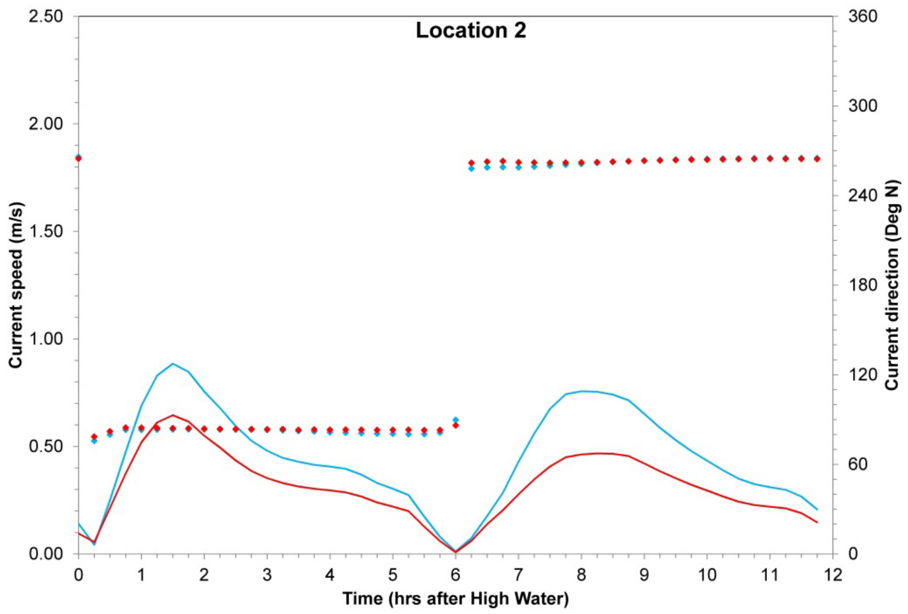

Figure A.2: Time history at Point 2

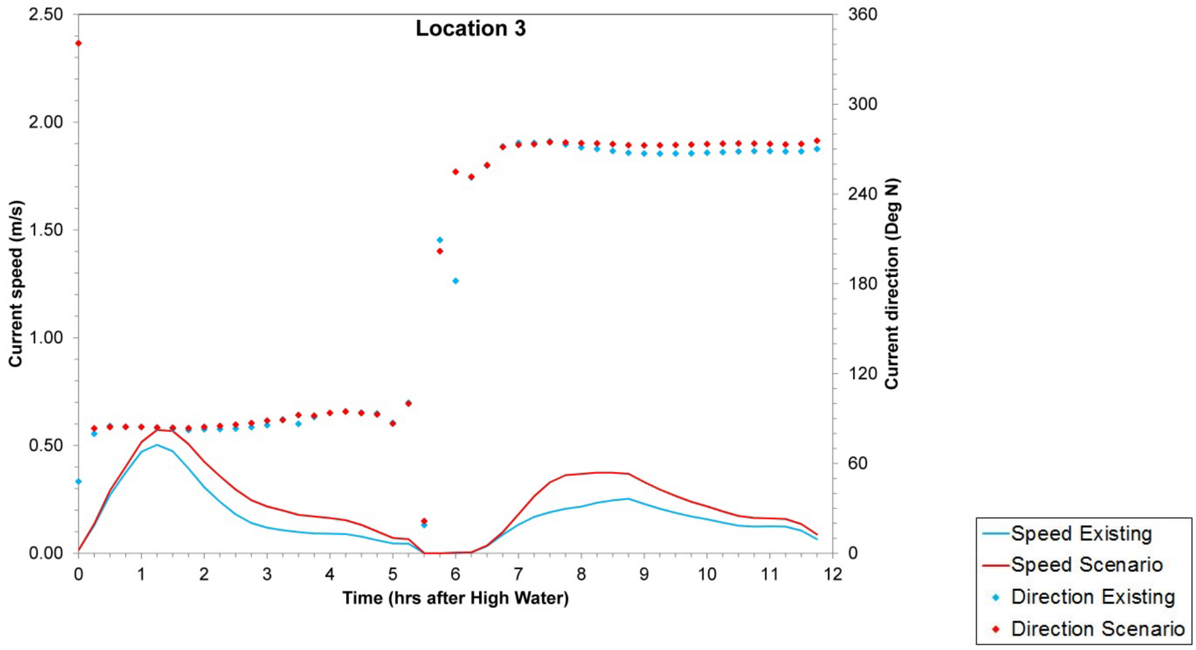

Figure A.3: Time history at Point 3

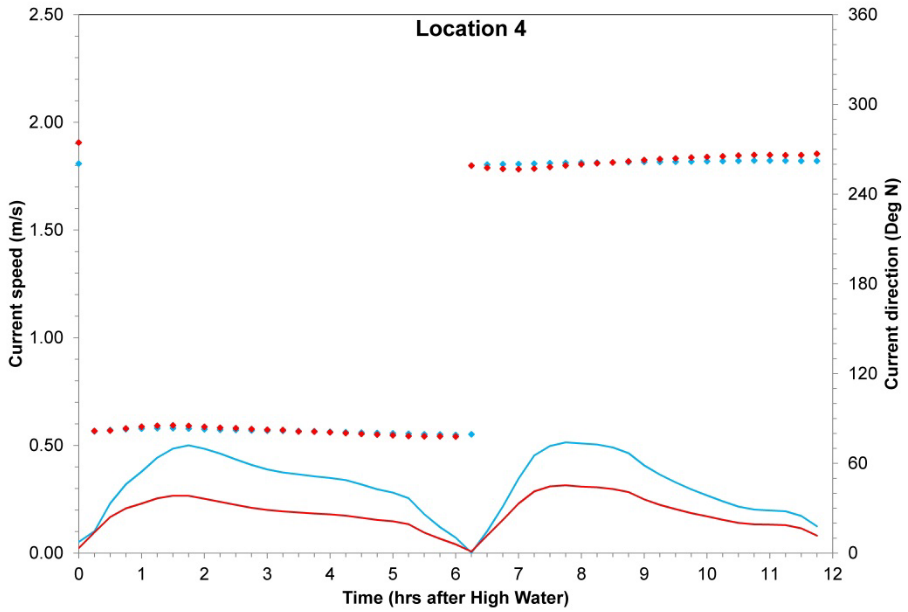

Figure A.4: Time history at Point 4

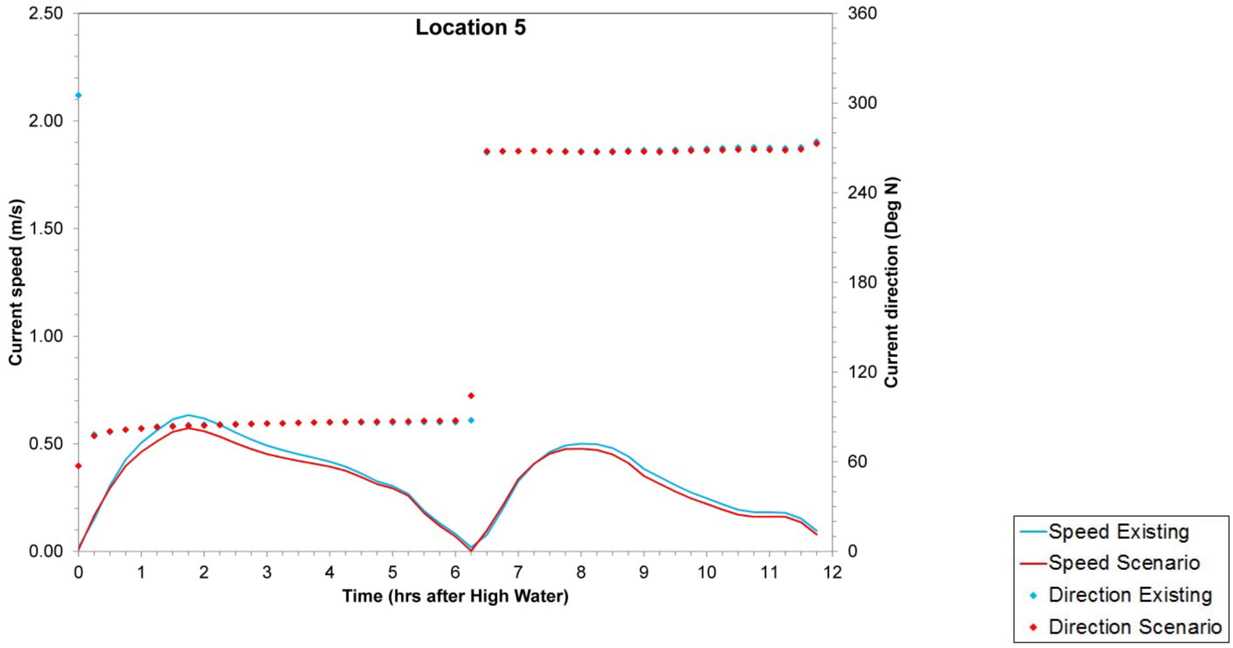

Figure A.5: Time history at Point 5

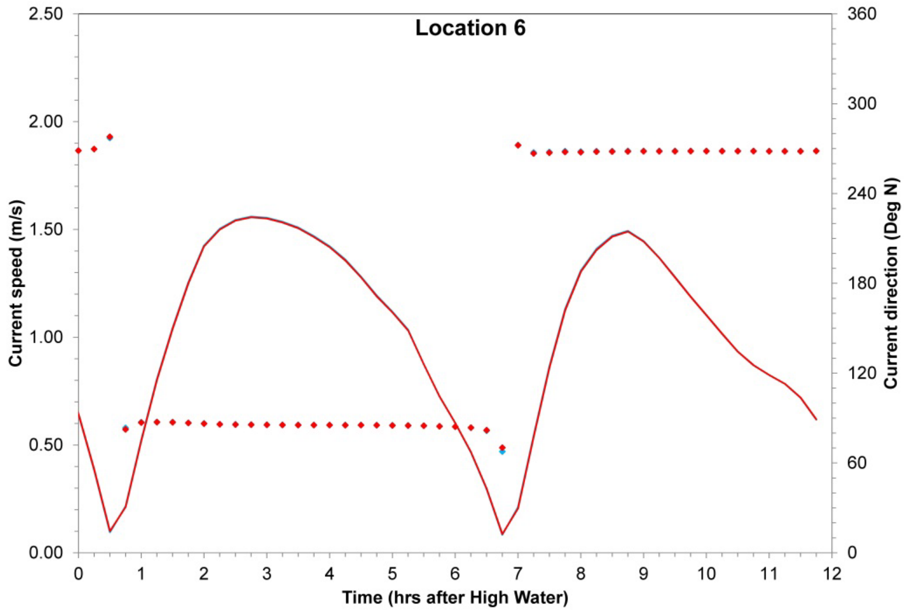

Figure A.6: Time history at Point 6

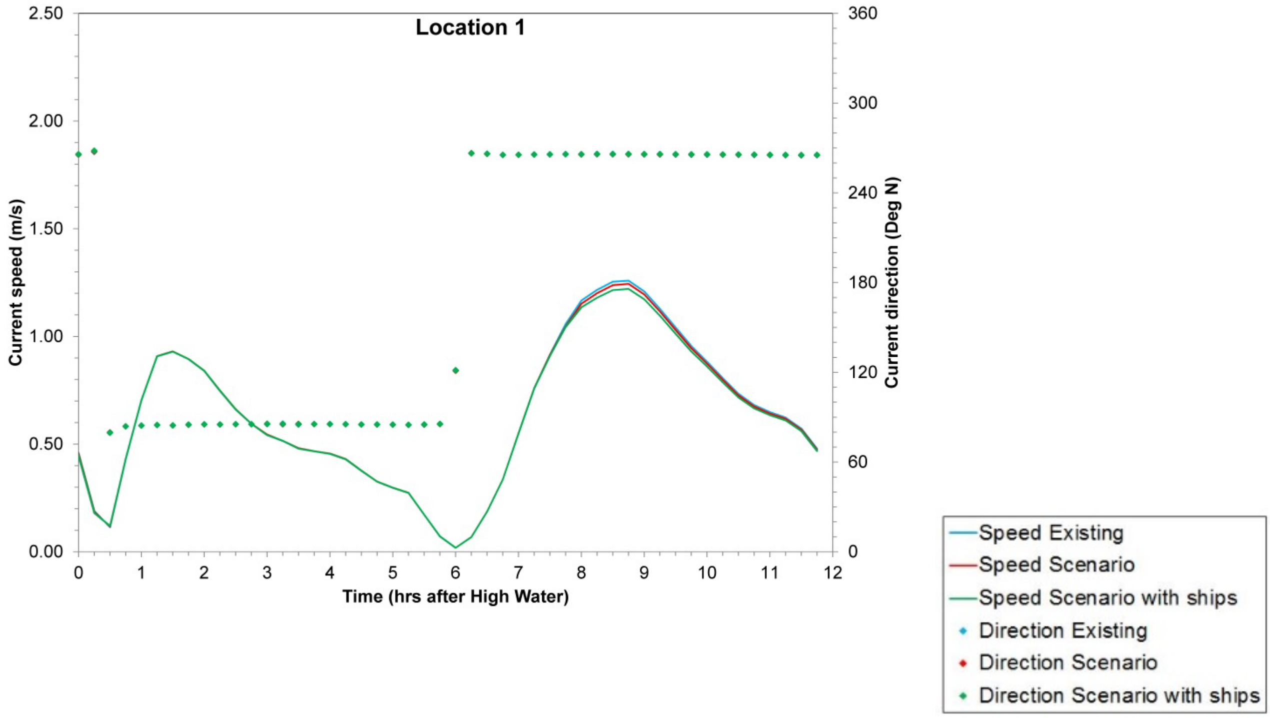

Figure A.7: Time history at Point 1, sensitivity test with vessels

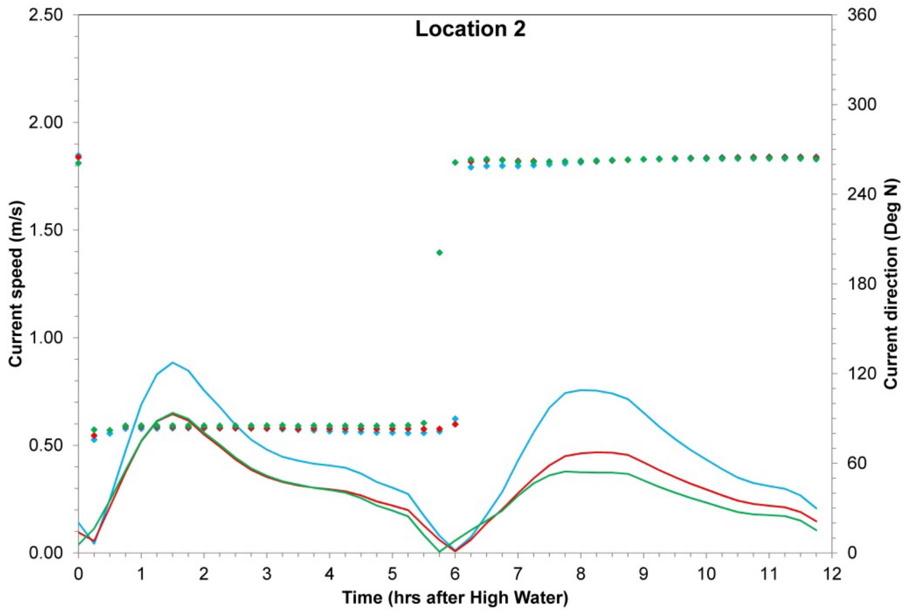

Figure A.8: Time history at Point 2, sensitivity test with vessels

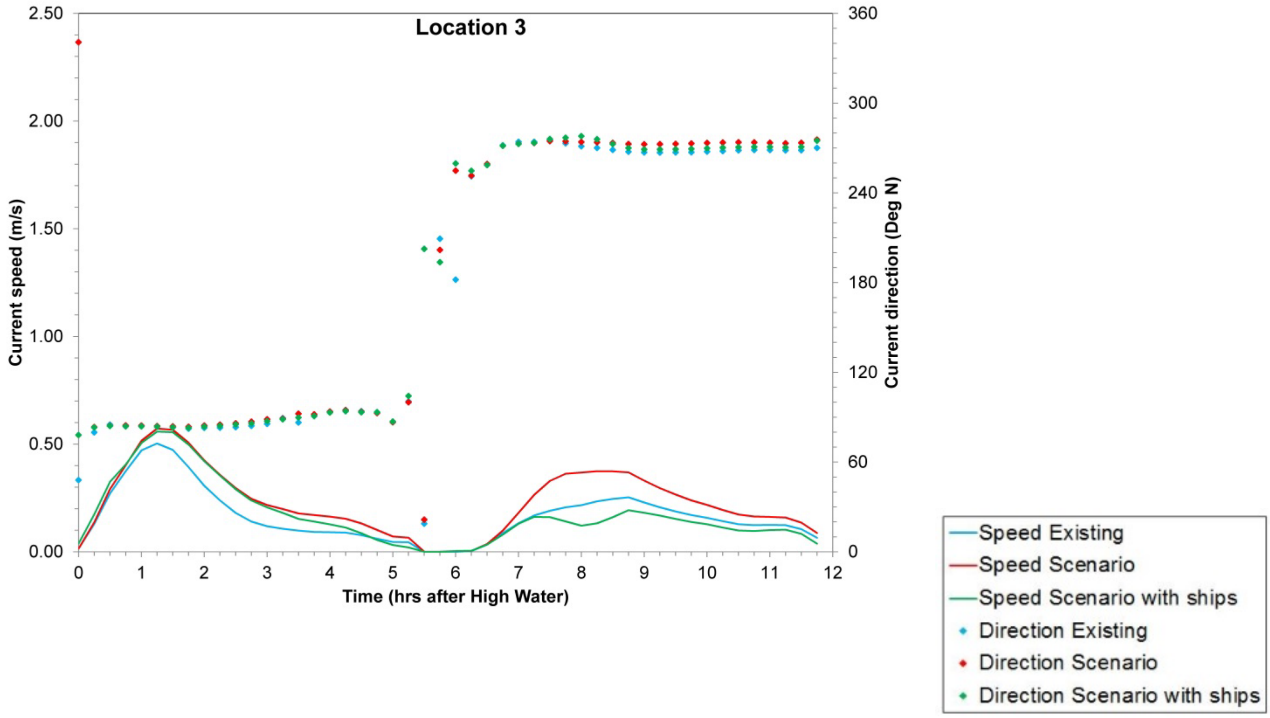

Figure A.9: Time history at Point 3, sensitivity test with vessels

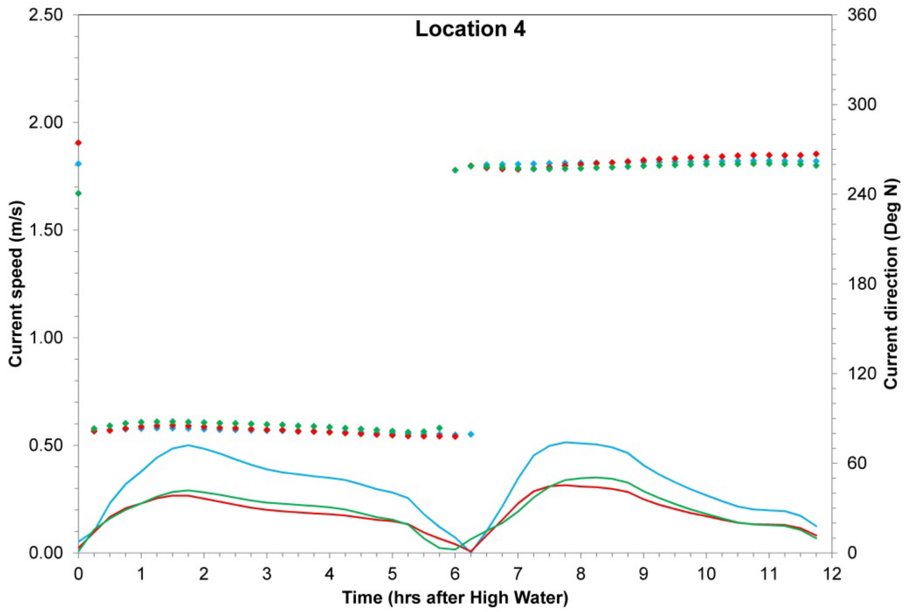

Figure A.10: Time history at Point 4, sensitivity test with vessels

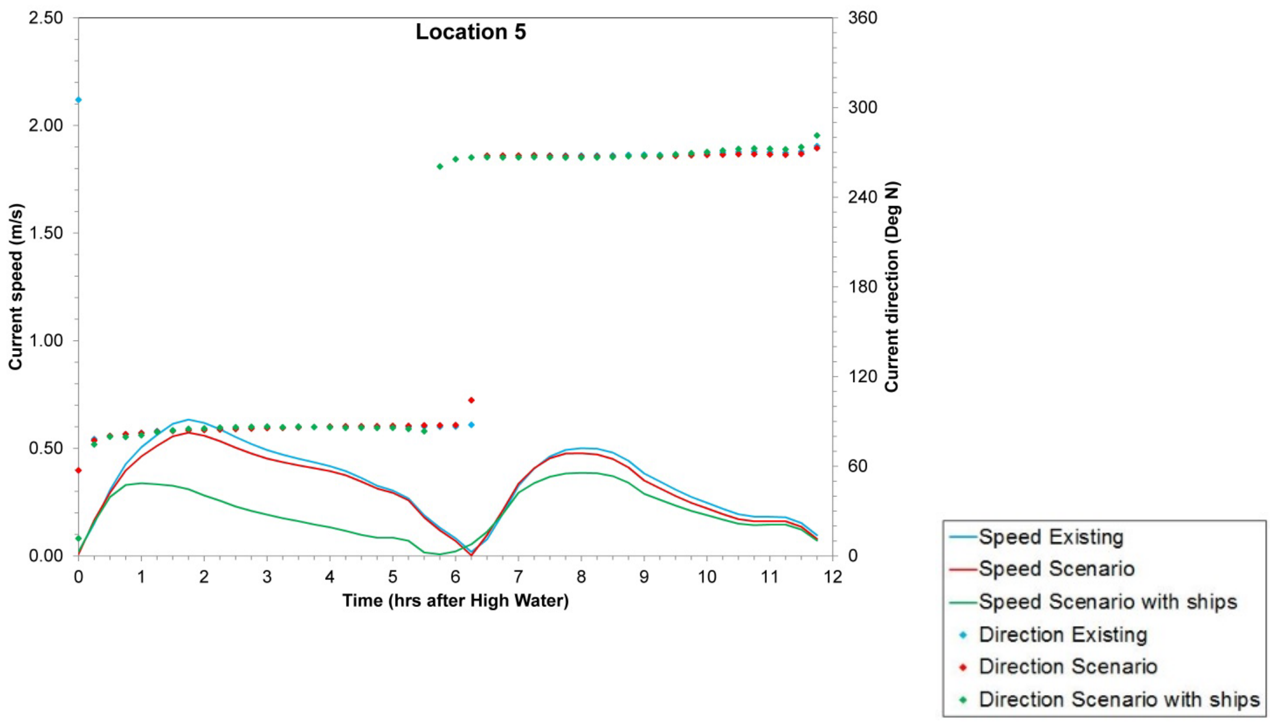

Figure A.11: Time history at Point 5, sensitivity test with vessels

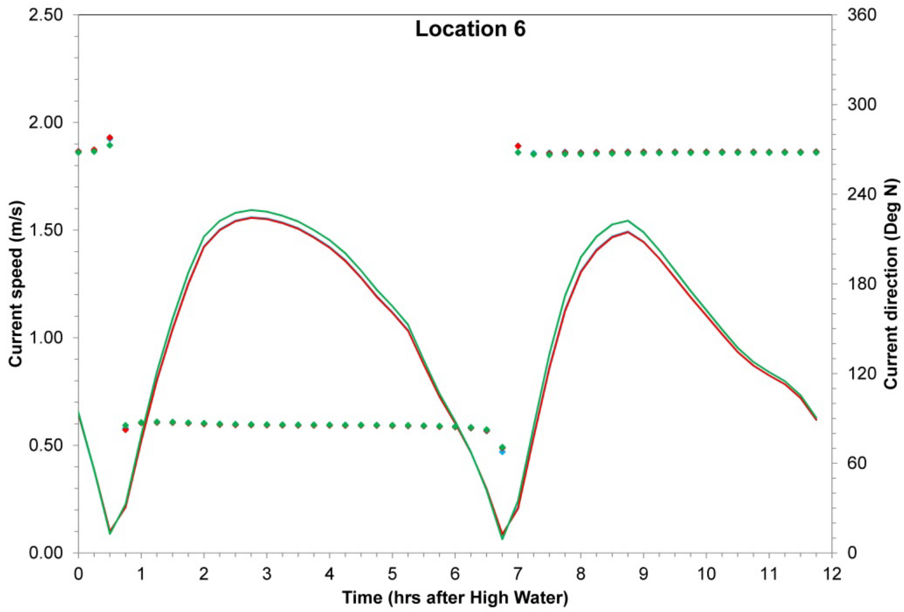

Figure A.12:Time history at Point 6, sensitivity test with vessels

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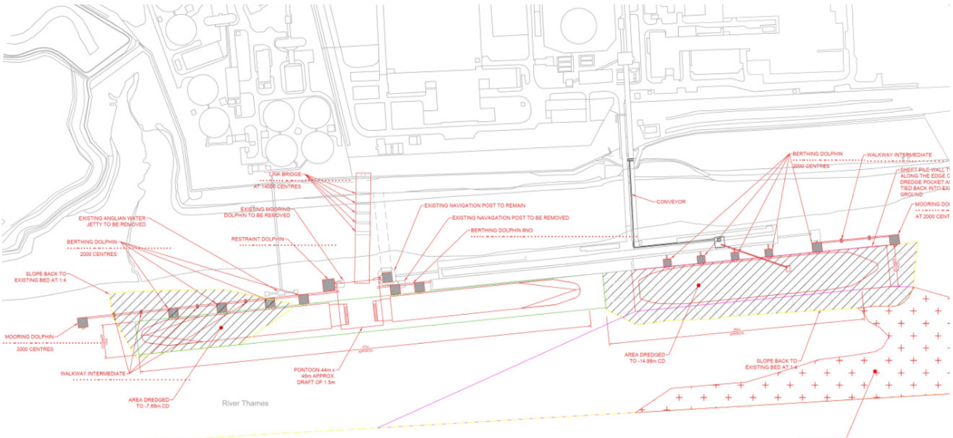

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APPENDIX 9

PROPOSED PORT TERMINAL AT FORMER TILBUY POWER STATION: TILBURY2
NOTE ON WINTER BIRD USE OF THE INTERTIDAL AREA
April 2018

Background and purpose of note

1. Port of Tilbury London Limited (PoTLL) has submitted an application for a new port terminal on the north bank of the River Thames, on part of the site of the former Tilbury Power Station. The Development Consent Order (DCO) application was accepted for examination by the Planning Inspectorate on 21 November 2017[1,2]. The project is known as "Tilbury2" and will require improvements and extensions to the existing jetty including creation of a new RoRo berth, with associated dredging of berth pockets around the extended jetty and dredging of the approaches to the berth pockets.

2. To provide supporting information for the DCO application, monthly wintering bird surveys of the intertidal area within the vicinity of the jetty were carried out between November 2016 and March 2017, with additional surveys in September and October 2017, as reported in the Environmental Statement (ES) submitted with the application.

3. On 25 October 2017, Natural England issued an email under its Discretionary Advice Service (DAS), which stated [emphasis added by Bioscan]:

   *"We are pleased to see that surveys have been carried out in September and October of 2017, thus completing an overwintering season in conjunction with the 2016 data. We would, however, have expected the application to be supported by a number of years of full data and **consider that this limitation may have contributed to bird numbers identified being low**. Paragraph 1.277 of the ES gives limited detail relating to survey work prior to 2016. Any further data available should be presented within the ES to corroborate the findings of the most recent surveys.*
   *With regards to functionally linked land, Natural England notes that 'several of the bird species underpinning the European Site designations make use of intertidal habitats in closer proximity to the Tilbury2 site than the European Site itself.' From the information provided Natural England has been unable to ascertain which areas SPA birds are using, which species or in what numbers. **We note that it is considered that there is 'relatively low' usage of intertidal habitats within the area of 'potential disturbance' identified,** but would expect to see consideration of what the habitat is being used for and potential impacts on the species concerned. It is worth bearing in mind that whilst some key species are identified in the SPA conservation objectives, water bird assemblage is also a qualifying feature."*

4. Initially, no explanation was provided by Natural England as to the source of this query, nor any alternative evidence that informed their view that the low bird numbers recorded by Bioscan for the intertidal area adjacent to the proposed Tilbury2 site may be atypical. However, during a subsequent discussion at a meeting held at Port of Tilbury on 11 December 2017, it became apparent that the background data that had led to these comments, covered a much wider area extending from the Tilbury2 site to Coalhouse Fort. Bioscan's own studies had noted significantly greater concentrations of intertidal bird species downstream of the Tilbury2 site and adjacent to Coalhouse Fort, and it was conjectured in discussion with Natural England on 11

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[1] The DCO application documents are available via the Planning Inspectorate website https://infrastructure.planninginspectorate.gov.uk/projects/south-east/tilbury2/
[2] Thurrock Borough Council scoping application reference: 16/01194/SCO.

December that the counts presented in the ES may have been viewed in the context of the higher numbers around Coalhouse Fort, leading to an incorrect supposition that the ES data for the zone of influence around the proposed DCO boundary was anomalous or unrepresentative.

5. It was agreed on the 11 December 2017 that Bioscan would produce a note providing additional context to the information presented in the ES. Natural England requested that any "*further data available should be presented ... to corroborate the findings of the most recent surveys*". This note duly provides details of wintering bird survey work which has been undertaken monthly between November 2017 and March 2018 (i.e. following on from the Environmental Statement submission). This is presented in the context of the Bioscan's previous intertidal wintering bird surveys (2016/17 and 2017), with further third-party and historic data being provided as part of this package of evidence in order to demonstrate that the level of bird use of this area is representatively portrayed and robustly assessed within the DCO application supporting documents (i.e. within Chapter 10 of the Environmental Statement, document reference 6.1; and ES Appendix 10.O Habitats Regulations Assessment (HRA) Report, document reference 6.2 10.O).

6. This note provides supporting evidence which is for clarification purposes and is not required for the assessment of likely significant effects. This supporting information includes the results of on-going monitoring which corroborates the findings of the most recent surveys provided in the ES. Such on-going monitoring is good practice. The information in this note does not constitute "further information" pursuant to Regulation 17 of the Infrastructure Planning (Environmental Impact Assessment) Regulations 2009. It is evidence which supports our existing conclusions and it is not necessary in order to make the initial ES adequate; the data requested by Natural England was to corroborate the findings of the most recent surveys and that is what this note achieves. Those affected by the information presented have therefore already had an adequate opportunity to comment on it.

Sites Designated for Bird Interest

7. The specific portion of intertidal area along the River Thames adjoining the Tilbury2 site and extending upstream and downstream for over two kilometres is not designated as a Site of Special Scientific Interest (SSSI), Special Protection Area (SPA) or Ramsar Site. The nearest European nature conservation designation is the Thames Estuary and Marshes SPA and Ramsar Site, which is located approximately 2km to the south-east at its closest point (which is on the far side of the River Thames). A portion of the SPA is on the same side of the Thames as the site and is located at its closest point approximately 2.6km to the east.

8. The qualifying features for the Thames Estuary and Marshes SPA are as follows:

   Wintering populations of European importance of the following Annex I species:

   - Avocet *Recurvirostra avosetta*; and
   - Hen harrier *Circus cyaneus*.

Regular use by 1% or more of the biogeographical populations of the following regularly occurring migratory species (other than those listed on Annex I):

- Ringed plover *Charadrius hiaticula* (passage);
- Grey plover *Pluvialis squatarola* (winter);
- Dunlin *Calidris alpina alpina* (winter);
- Knot *Calidris canutus islandica* (winter);
- Black-tailed godwit *Limosa limosa islandica* (winter); and
- Redshank *Tringa totanus totanus* (winter).

9. The site also qualifies under Article 4.2 as a wetland of international importance by regularly supporting at least 20,000 waterfowl. Over winter, the area is cited as regularly supporting 75,019 individual waterfowl (five-year peak mean to 21/03/2000) including: redshank, black-tailed godwit, dunlin, lapwing *Vanellus vanellus*, grey plover, shoveler *Anas clypeata*, pintail *Anas acuta*, gadwall *Anas strepera*, shelduck *Tadorna tadorna*, white-fronted goose *Anser albifrons*, little grebe *Tachybaptus ruficollis*, ringed plover, avocet and whimbrel *Numenius phaeopus*.

10. The Thames Estuary & Marshes is also designated as a wetland of international importance under the Ramsar criteria (The Thames Estuary & Marshes Ramsar Site). In relation to birds, the site qualifies under criterion 3 due to it supporting a wintering bird assemblage of international importance (5 year peak mean, 1998/99 – 2002/03, of 45,118 waterfowl) and under criterion 6 due to it supporting populations of qualifying bird species at levels of international importance (specifically migratory ringed plover and black-tailed godwit; and wintering grey plover, knot, dunlin and redshank).

11. The South Thames Estuary and Marshes SSSI is designated on the basis of its coastal wetland habitats and the rare/scarce plants and invertebrates they support, as well as the internationally important populations of certain bird species (as cited under the SPA and Ramsar designations), and nationally important numbers of certain other bird species. Such older data is provided as supporting explanatory and reference material only.

Bird use of the affected areas: historical and third party data

12. Some of the data described in the following paragraphs is of significant age and of questionable relevance to the current baseline position, hence much of these older data were not reported in the ES. Nevertheless, for completeness and to consider whether longer term trends have any relevance to Natural England's query, it is included below for completeness.

13. **Estuarine Waterbirds at Low Tide: the WeBS Low Tide Counts 1992-93 to 1998-99**. Over the winters of 1992/93 to 1998/99 a study of the bird use of the estuarine systems at low tide of the UK was undertaken (Musgrove *at al.*, 2003)[3]. In respect of the Thames Estuary this covered two winters: 1993-94 and 1998-99. The inner Thames between Barking and Tilbury was covered during the 1993-94 winter only; however, greater coverage of the estuary was achieved in

[3] Musgrove, A.J., Langston, R.H.W., Baker, H. & Ward, R. M. (eds) (2003) Estuarine Waterbirds at Low Tide: the WeBS Low Tide Counts 1992-93 to 1998-99. WSG/BTO/WWT/RSPB/JNCC, Thetford.

1998-99, as shown at Inset Figure 1 below. In respect of the Tilbury2 site, a low-tide recording compartment runs between the Tilbury jetty access eastward to Coalhouse Point, as indicated by the red arrow in Inset Figure 1 below (with the intertidal area between the jetty and 'London International Cruise Terminal' in Tilbury apparently omitted).

Inset Figure 1: extract from Musgrove *at al.* (2003) showing survey compartments

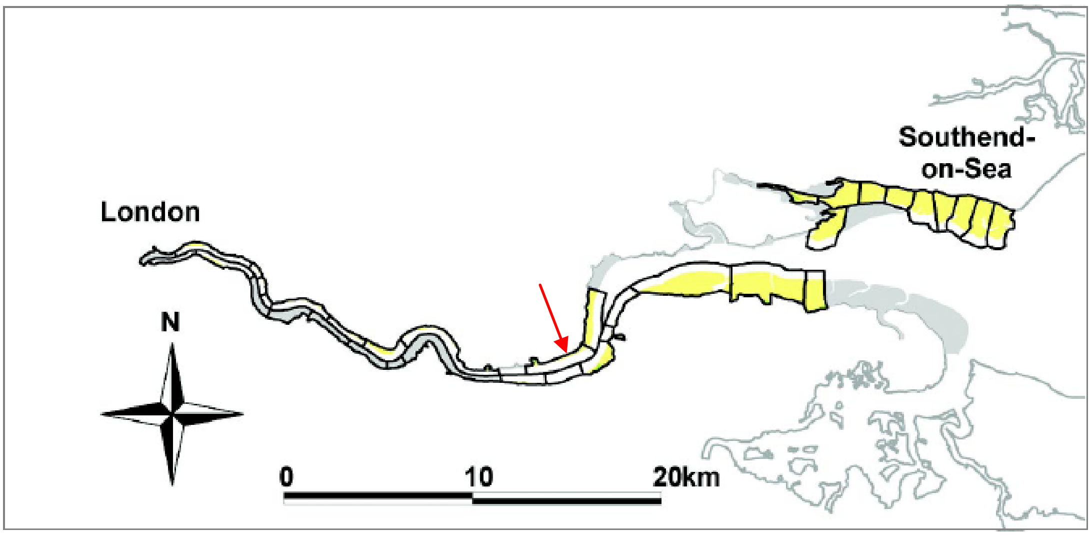


Figure 4.23.1: **LTC sections at the Thames Estuary, winters 1993–94 and 1998–99**

14. In contrast with the British Trust for Ornithology's (BTO's) standard methodologies for undertaking Wetland Bird Surveys (WeBS) core counts, which cover inland waterbodies and coastal areas at high tide (therefore aiming to survey high-tide bird roosts); the Musgrove *at al*. study aimed to cover the low tide period of estuaries to assess their importance for feeding birds. The published results of the Musgrove *at al.* study included a summary of the bird use at low tide of each of the main estuaries in the UK. The following is an extract in respect of the Thames Estuary [emphasis added by Bioscan to highlight references most pertinent to the Tilbury2 site]:

"Due to the incomplete coverage achieved, care must be taken when attempting to interpret the maps. With this in mind, the totals and weighted totals maps pick out the shore north of ***Coalhouse Fort (off East Tilbury Marshes)*** *as well as Higham Creek, Hadleigh Ray, Southend Flats and on the south shore from Egypt Bay eastwards.* ***High densities were also recorded on the inner Thames, although much smaller numbers of birds were involved due to the narrower shores here.*** *Many of the individual species were widespread but showed concentrations in one or more areas. Such species included* […] ***Dunlin (especially East Tilbury*** […]*).* ***Avocets were highly concentrated on the East Tilbury shoreline, with most of the Black-tailed Godwits also here*** *and along the North Kent shore.* ***Ringed Plovers were in their highest densities at*** *Thamesmead,* ***West Thurrock to Coalhouse*** *and* […]*."*

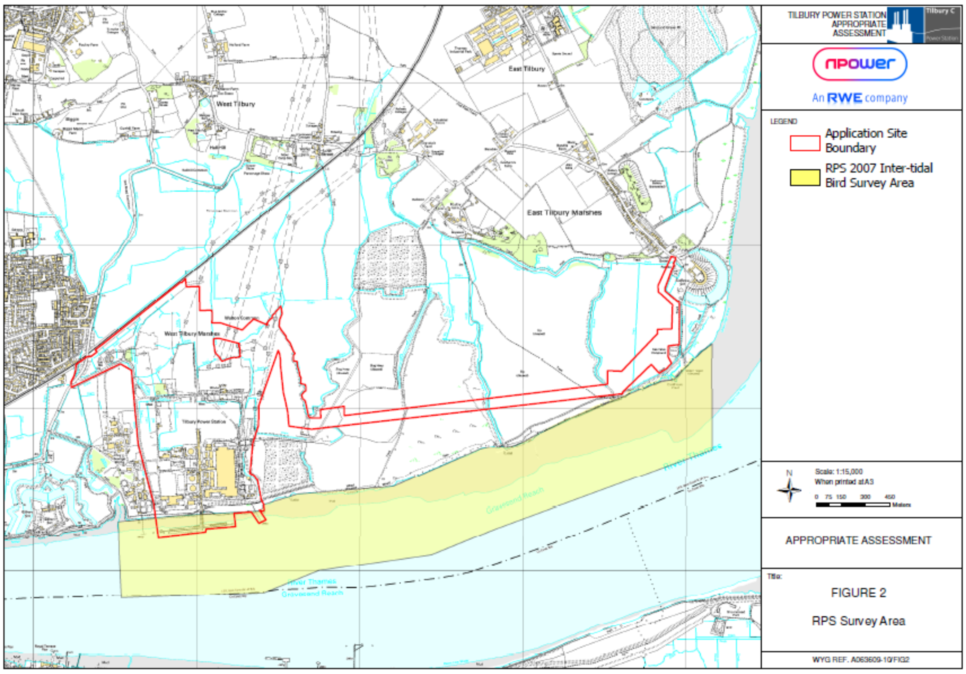
15. For each estuary system a series of dot-density maps were provided to show an indicative distribution of the various species surveyed in the Thames Estuary. In respect of the compartments adjacent to the Tilbury2 site (i.e. between the Tilbury jetty access eastward to Coalhouse Point – see Inset Figure 1 above with relevant compartment indicated by a red arrow), the dot-density maps show concentrations of lapwing, dunlin, shelduck, ringed plover, grey plover and redshank. However, as the dot-density maps present the distributions as an even coverage of birds within the compartment, when in fact the data was collected from a

coastal stretch >3km long which includes the Tilbury2 survey area and >1km beyond this to the east incorporating Coalhouse Point, the mapping is of limited value. Given this, and the time which has elapsed since the data was gathered (some of which is approaching 20 years in age), the degree to which this data can be relied upon to inform the current assessment is limited.

16. **Surveys to inform development proposals at Tilbury Power Station (2007-2008).** Targeted bird surveys of the intertidal area within the vicinity of the Tilbury2 site were conducted by RPS on behalf of RWE between January 2007 and May 2008 and documented in interim reports[4,5,6,7,8] with WYG providing a summary of all the RPS results (WYG, 2012)[9]. These records were further summarised within Table 10.39 of the Tilbury2 ES.

17. The RPS wintering bird surveys comprised intertidal surveys from January to March 2007 (low tide only), and September 2007 to March 2008 (two counts at low tide and two at high tide). Nocturnal intertidal surveys were also conducted and these comprised monthly visits between November 2007 and March 2008. The nocturnal surveys commenced after dusk and three hours prior to low tide and finished one hour after low tide. The area surveyed covered the intertidal section of the River Thames from Bill Meroy Creek to just north of Coalhouse Point (see Inset Figure 2 below), therefore encompassing the whole of the Tilbury2 DCO boundary and overlapping with the study area for the present ES. Table 1 below provides a summary of the results from these surveys, and the survey area is shown in Inset Figure 2 below.

Inset Figure 2: extract from WYG (2012) showing intertidal bird survey area



4 RPS (July 2007) 'Tilbury Power Station: Intertidal Ornithological Survey Report. January-March 2007'

5 RPS (February 2008) 'Tilbury Power Station: Intertidal Ornithological Survey Report. August-October 2007'

6 RPS (March 2008) 'Tilbury Power Station: Intertidal & Terrestrial Ornithological Survey Report. November-December 2007'

7 RPS (June 2008) 'Tilbury Power Station: Intertidal & Terrestrial Ornithological Survey Report. November-March 2008'

8 RPS (June 2008) 'Tilbury Power Station: Intertidal Ornithological Survey Report. April-May2008'

9 WYG (August, 2012). 'Tilbury B Biomass Phase 2 Project: Information for Appropriate Assessment (Assessment of Potential Impacts on the Thames Estuary and Marshes Special Protection Area and Ramsar Site)'. Produced in respect of RWE's [now shelved] biomass conversion project (planning reference: 12/00890/OUT).

Table 1: Summary of results of intertidal wintering bird survey (RPS, 2012[10]; and Atkins, 2017[11]).

Month	Jan-2007 (Diurnal survey)	Feb-07 (Diurnal survey)	Mar-07 (Diurnal survey)	Sep-2007 (Diurnal survey)	Oct-2007 (Diurnal survey)	Nov-2007 (Nocturnal survey)	Nov-2007 (Diurnal survey)	Dec-2007 (Diurnal survey)	Jan-2008 (Nocturnal survey)	Jan-2008 (Dirunal survey)	Feb-2008 (Nocturnal survey)	Feb-2008 (Diurnal survey)	Mar-2008 (Nocturnal survey)	Mar-2008 (Diurnal survey)	2016-17- Max count (High tide)	2016-17- Max count (Low tide)	Max count SPA species within Bioscan survey area (Atkins 2016-17 data)*	Number of visits SPA species encountered within Bioscan survey area (Atkins 2016-17 data)*
Source	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	RPS	Atkins	Atkins	Atkins	Atkins
Avocet	2	0	8	26	50	7	68	7	2	450	3	2	0	12	900	10	11	2
Bar-tailed Godwit	1	0	0	21	48	0	36	2	0	5	0	5	0	5	0	0	-	-
Black-headed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	200	368	-	-
Black-tailed Godwit	16	6	0	105	1479	11	247	26	8	13	6	15	2	7	13	3	7	2
Brent goose	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1	-	-
Canada goose	0	0	0	26	80	0	0	0	0	0	0	0	0	0	0	0	-	-
Common gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5	2	-	-
Common sandpiper	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	-	-
Common scoter	0	0	0	0	0	0	0	0	0	0	0	0	0	0	27	0	-	-
Cormorant	8	3	4	6	13	0	5	9	0	3	0	4	0	6	3	2	-	-
Curlew	36	20	3	5	40	11	38	27	22	54	27	37	9	4	20	52	-	-
Dark-bellied Brent Goose	0	0	0	0	58	0	0	0	0	0	0	4	0	0	0	0	-	-
Dunlin	2,119	1,560	1	54	649	667	1,407	1,402	51	306	452	3,201	81	602	590	486	200	2
Gadwall	2	0	0	0	0	0	0	0	0	2	0	0	0	0	40	40	-	-
Great Crested Grebe	0	0	0	2	0	0	0	0	0	0	0	1	0	0	0	0	-	-
Great black-backed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3	9	-	-
Green sandpiper	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	-	-
Grey heron	0	0	0	0	3	0	0	0	0	0	0	0	0	0	1	2	-	-
Grey Plover	30	12	4	7	23	25	22	28	10	21	75	28	6	26	18	23	10	1
Greylag goose	0	0	0	4	42	0	0	1	0	0	0	0	0	0	0	0	-	-
Herring gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	7	14	-	-
Knot	0	0	0	0	4	0	0	0	0	18	0	77	0	0	0	0	-	-
Lapwing	39	4	12	1	11	6	86	12	6	64	10	53	0	26	0	7	-	-
Lesser black-backed gull	0	0	0	0	0	0	0	0	0	0	0	0	0	0	9	5	-	-
Little egret	0	0	0	5	4	0	6	2	0	1	0	2	0	2	1	2	-	-
Little Grebe	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0	-	-
Little Stint	0	0	0	2	9	0	0	0	0	0	0	0	0	0	0	0	-	-
Mallard	43	15	9	48	65	1	69	61	0	61	0	47	2	36	138	68	-	-
Oystercatcher	0	4	12	1	0	0	0	0	0	1	2	11	3	11	2	3	-	-
Pintail	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	-	-
Redshank	97	1	0	27	21	75	25	68	19	23	11	9	148	25	9	30	8	4
Ringed Plover	112	135	24	124	112	12	56	87	17	78	1	86	2	54	0	40	27	2
Ruff	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	-	-
Shag	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	-	-
Shelduck	127	157	50	30	104	21	2	93	61	123	2	227	92	120	200	106	56	3
Shoveler	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0	0	-	-
Shoveler	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	0	-	-
Teal	5	5	5	13	8	1	24	25	0	56	13	148	64	163	317	435	-	-
Tufted Duck	0	1	0	0	0	0	0	0	0	1	0	1	0	0	0	0	-	-
Turnstone	8	8	0	0	0	0	1	0	0	6	0	2	0	1	5	2	-	-
Whimbrel	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	-	-
Wigeon	0	0	0	2	8	0	0	0	0	0	0	0	0	0	7	0	-	-

* Numbers taken from maps provided in Atkins (2017) report.

[10] WYG (August, 2012). 'Tilbury B Biomass Phase 2 Project: Information for Appropriate Assessment (Assessment of Potential Impacts on the Thames Estuary and Marshes Special Protection Area and Ramsar Site)'. Produced in respect of RWE's [now shelved] biomass conversion project (planning reference: 12/00890/OUT).

[11] Atkins Ltd (March 2017). 'Thames Tideway FLO JV: Winter Bird Survey Report - final'. Produced in respect of the Goshem's Farm jetty proposals (planning reference: 17/00224/FUL).

18. The report (WYG, 2012) indicates, in respect of the results of the 2007/8 diurnal intertidal surveys, that the waterbird assemblage was concentrated outside of Bioscan's survey area, towards the east:

"By day, the majority of the survey area waterbird assemblage extensively utilised the eastern mudflats, east of an old pipeline/breakwater [taken to be at TQ 67852 75750, equating to the eastern limit of Bioscan's intertidal survey area] *and to a lesser extent the central area. Teal and pied avocet distribution was divided between two areas, the sewage outfall to the west of the power station and the intertidal flats adjacent to the SPA. A discrete concentration of black-tailed godwits also utilised the former area*."

19. The report (WYG, 2012) does state that higher counts were recorded during the 2007/8 nocturnal intertidal surveys, although it acknowledges that there were limitations to undertaking surveys at night due to reduced visibility, despite using night-imagery equipment:

"By night, waterbirds were generally spread more evenly throughout the survey area than during the day. In general, greater numbers of grey plover, dunlin, Eurasian curlew and common redshank foraged on the intertidal flat adjacent to the power station at night than during the day."

20. The report then states in the evaluation section that relatively low numbers of waterbirds were recorded in the vicinity of the power station itself during the 2007/8 surveys:

"In general, the zone within 500m of the Development Site boundary [the former power station]*, or the Maximum Zone of Potential Disturbance due to construction works relating to the Tilbury B Biomass Phase 2 Project, held relatively low numbers of waterbirds in comparison with the intertidal survey area as a whole although, due to use of the area around the sewage outflow pipe to the west of the power station, some species were recorded in similar numbers to those recorded from the wider zone of potential disturbance."*

"A large proportion of the species present within 500m of the Development Site were recorded in numbers which represented an insignificant proportion (i.e. <5%) of the SPA population. Mallard, great cormorant, common sandpiper, ruff and black-tailed godwit were the only species recorded within 500m of power station site in significant proportions (i.e. >5%) of the Thames Estuary & Marshes SPA population, although counts of great cormorant, common sandpiper and ruff are too small to be considered significant whilst mallard numbers are likely to be augmented by non-SPA birds and are, therefore, also not considered significant in SPA terms."

"Black-tailed godwit was present in significant numbers. Black-tailed godwit distribution within 500m of the Development Site was concentrated at the tributary mouth [presumed to mean Bill Meroy Creek] *to the west of the existing Tilbury B station, approximately 300m to the east* [presumed typo for 'west'] *of the jetty. As for the Maximum Potential Disturbance Zone, the peak count of black-tailed godwit within 500m of the Development Site occurred in October consisting of 760 individuals which represents 37.2% of the autumn Thames Estuary and Marshes SPA 5 year autumn mean peak (2002/3-2006/7). The winter peak in November of 53 individuals also represents a significant proportion (7.4%) of the winter SPA population. Further analysis of the data for black-tailed godwits (Tables 2-5) shows that August to November are the months where the highest numbers of birds are present within 500m of the Development Site with relatively low numbers (<5% of the SPA population) present at other times."*

21. The above supporting material is essentially consistent with what is reported in the Tilbury2 ES and accompanying HRA report (with the exception of findings in respect of black-tailed godwit). The WYG (2012) report then goes on to summarise the 2007/8 survey findings, drawing a conclusion which is otherwise consistent with the findings of the Tilbury2 ES:

"On the basis of six diurnal surveys between November and March 2007/08 and single nocturnal surveys in December 2007 and January 2008, the terrestrial habitat adjacent to the intertidal areas of the wider study area are considered to be of negligible importance to wintering waterbirds."

22. **Essex Birdwatching Society records (2014-2017)**. Pre-existing records received from the Essex Field Club and KMBRC were reviewed as part of the desk-study that informed the DCO ES. In order to address Natural England's request that *"Any further data available should be presented ... to corroborate the findings of the most recent surveys"*, a further more recent review of the Essex Birdwatching Society's website[12] has been conducted to understand if there were further records available for the intertidal area within the vicinity of the Tilbury2 site. The review revealed a relatively large volume of records for this area, with the majority of these submitted by one recorder (Mr Larkin). Mr Larkin was contacted and kindly gave permission for these records to be referred to in this document. The records span from early 2014 to December 2017. In considering the wintering bird use of the wider area, records from the East Tilbury/Coalhouse Fort area were also reviewed.

23. The following two tables provide a summary of Mr Larkin's records of the SPA species (plus two other species which are regularly found in this area, curlew and shelduck) over the winter period. The records presented within Table 3 show those which encompass the c.3km long Bioscan survey area and extend >1km beyond to the east (i.e. covering, in total, a stretch of Thames shore from the London International Cruise Terminal eastward to just before Coalhouse Point – as shown at Figure 10.12). Those presented separately within Table 4 are Mr Larkin's records from around the East Tilbury/Coalhouse Fort area.

24. The below Tables 3 and 4 indicate that there were fewer total records from the East Tilbury/Coalhouse Fort area for most species, although this appears to be due to there being fewer visits to this area in comparison with the intertidal area adjacent to the Tilbury2 site, but that the counts for the majority of the species are higher and in some cases significantly higher for the East Tilbury/Coalhouse Fort area (Table 4) when compared with the intertidal area near the Tilbury2 site (Table 3). Redshank is the only citation species in the tables above for which counts are comparable or higher within the vicinity of the Tilbury2 site as compared with the East Tilbury/Coalhouse Fort intertidal area. For assemblage species, only lapwing and gadwall counts have been higher within Table 3 (nearer the Tilbury 2 site), and for the latter species this is because it preferentially forages in proximity to the sewage outfall.

Table 3: Summary of Mr Larkin's 2014-2017 winter records from the Cruise Terminal eastward to before Coalhouse Point (encompassing Bioscan's c.3km long intertidal survey area and >1km beyond to the east).

SPA citation species	Number of records	Average	Maximum count	Minimum count
Avocet *Recurvirostra avosetta*	66	12.8	119	1
Black-tailed godwit *Limosa limosa*	63	30.7	178	1
Dunlin *Calidris alpina*	30	148	928	1
Grey plover *Pluvialis squatarola*	10	7.8	16	1

[12] The Essex Birdwatching Society. http://www.ebws.org.uk/ebs/default.asp

SPA citation species	Number of records	Average	Maximum count	Minimum count
Hen harrier *Circus cyaneus*	1	1	1	1
Knot *Calidris canutus*	0	0	0	0
Redshank *Tringa totanus*	59	17.8	80	1
Ringed plover *Charadrius hiaticula**	18	32.9	246	1
Assemblage species				
Lapwing *Vanellus vanellus*	34	47.6	199	4
Shoveler *Anas clypeata*	4	7.0	11	2
Gadwall *Anas strepera*	39	14.7	77	1
Little grebe *Tachybaptus ruficollis*	43	13.2	29	1
Shelduck *Tadorna tadorna*	60	9.7	43	1

* Passage period only [13]

No records for pintail, whimbrel, white-fronted goose

Table 4: Summary of Mr Larkin's 2014-2017 winter records from the East Tilbury/Coalhouse Fort area (outside and to the east of Bioscan's survey area).

SPA citation species	Number of records	Average	Maximum count	Minimum count
Avocet *Recurvirostra avosetta*	12	1200.4	3113	294
Black-tailed godwit *Limosa limosa*	24	456.8	2025	21
Dunlin *Calidris alpina*	20	729.5	4160	50
Grey plover *Pluvialis squatarola*	32	117.7	203	13
Hen harrier *Circus cyaneus*	2	1	1	1
Knot *Calidris canutus*	12	21	164	1
Redshank *Tringa totanus*	5	23.6	38	4
Ringed plover *Charadrius hiaticula**	18	100.4	378	1
Assemblage species				
Lapwing *Vanellus vanellus*	6	57.2	95	17
Shoveler *Anas clypeata*	10	6.5	24	1
Pintail *Anas acuta*	2	1.5	2	1
Gadwall *Anas strepera*	5	11.8	18	5
Little grebe *Tachybaptus ruficollis*	24	18.7	31	7
Whimbrel *Numenius phaeopus*	3	1	1	1
Shelduck *Tadorna tadorna*	10	250.3	474	61

* Passage period only

No records for white-fronted goose

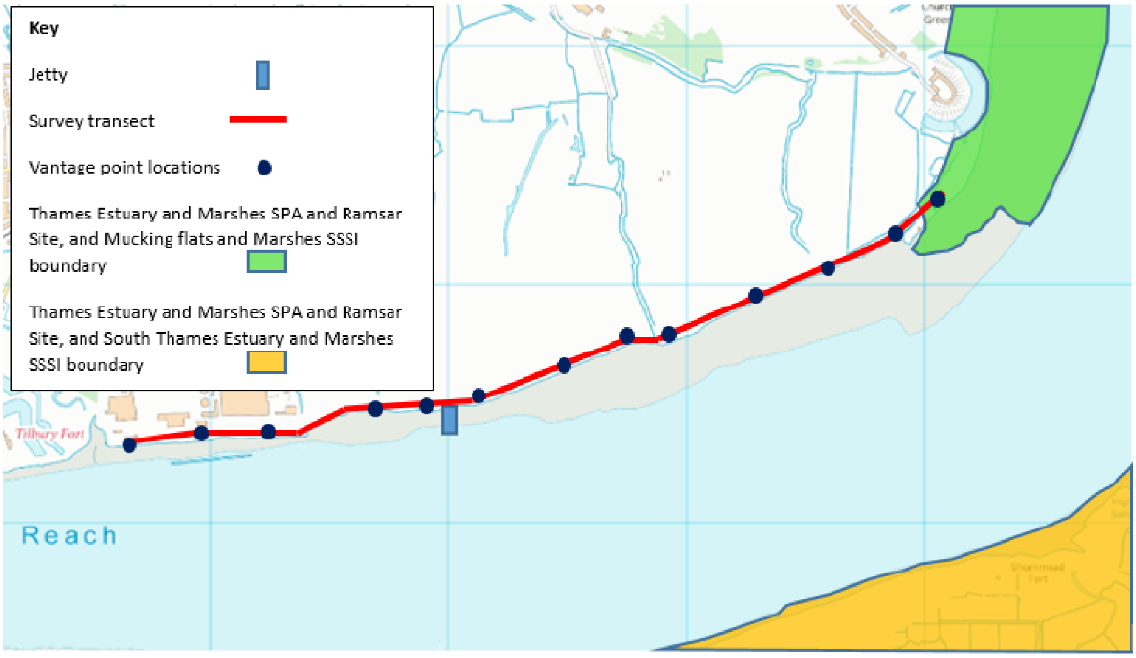
25. Detailed analysis of Mr Larkin's data appears to show a decline in the numbers of black-tailed godwit, ringed plover, avocet, and possibly lapwing and redshank, since late 2016 along the intertidal area (between the London International Cruise Terminal and Coalhouse Point). There does not appear to be a particular pattern for dunlin, but this could be due to lower number of records for this species. A review of Mr Larkin's data from the Coalhouse Fort area does not

[13] Taken to be May, August and September, as informed by: Frost, T.M., Austin, G.E., Calbrade, N.A., Mellan, H.J., Hall, C., Hearn, R.D., Stroud, D.A., Wotton, S.R. & Balmer, D.E. (2017). *Waterbirds in the UK 2015/16: The Wetland Bird Survey. BTO, RSPB and JNCC, in association with WWT*. British Trust for Ornithology, Thetford.

appear to show the same pattern, although it should be noted fewer visits were made to this area in comparison with the area within the vicinity of the Tilbury2 site.

26. **Surveys to inform development proposals at Goshem's Farm (2016-2017).** Targeted bird surveys of the intertidal area within the vicinity of the Tilbury2 site were conducted by Atkins on behalf of Ferrovial Agroman UK Ltd and Laing O'Rourke between November 2016 and February 2017 (Atkins, 2017)[14]. A wintering bird survey was undertaken of the intertidal area between Coalhouse Fort (TQ 69364 76784) to the mud flats at the eastern boundary of Tilbury Power Station (TQ 65760 75341). The surveys comprised four spring high tide surveys (November 2016, December 2016, January 2017 and February 2017), and four spring low tide surveys (November 2016, December 2016, January 2017 and February 2017). The results from the survey were provided in a report which also included summary maps of the distribution of the SPA species. The survey route is shown in Inset Figure 3 and a summary of the results is provided in Table 1 above.

Inset Figure 3: extract from Atkins (2017) showing intertidal bird survey transect



27. The Atkins report states in the discussion section:
"As can be seen from the distribution maps in Appendix C, qualifying species were recorded in low numbers throughout the survey area, with the largest counts being concentrated around Coalhouse Fort. This is within the Thames Estuary and Marshes SPA, Thames Estuary and Marshes Ramsar site and Mucking Flats and Marshes SSSI sites, and is approximately 2km from the proposed [Goshem's Farm] *jetty.... These surveys indicate that the mud flats approximately 2km to the east of the proposed* [Goshem's Farm] *jetty support higher concentrations of wetland birds than the rest of the survey area."*

28. In summary the findings were consistent with Bioscan's over the same period, and similarly reflect the position reported by WYG in 2012, with low numbers of birds being found in proximity to the Tilbury2 site, as against greater numbers closer to Coalhouse Fort.

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[14] Atkins Ltd (March 2017). 'Thames Tideway FLO JV: Winter Bird Survey Report - final'. Produced in respect of the Goshem's Farm jetty proposals (planning reference: 17/00224/FUL).

Bird use of the affected areas: Bioscan wintering bird data

29. Since November 2016, wintering bird surveys following the British Trust for Ornithology's (BTO) Wetland Bird Survey (WeBS) methodology have been carried out by Bioscan on the intertidal area between Tilbury Cruise Terminal (grid reference TQ 64516 75191) to a ditch outfall (TQ 67852 75750) approximately 1.1km south-west of Coalhouse Point (known in this report as the Bioscan survey area). The survey area encompasses a 3.4km stretch of coastline which includes the proposed DCO limits and the predicted zone of influence for noise, lighting and other effects around them, as reported in the ES.

30. A review of the BTO WeBS website for the ES found that this area does not appear to be covered by existing WeBS core counts (i.e. high tide count) and does not have any survey compartments. Nevertheless, part of this intertidal area is covered by a low-tide count compartment which appears to have been last counted over the winter of 1998/99. This compartment runs between the Tilbury jetty access eastward to Coalhouse Point.

31. Prior to the commencement of the surveys the intertidal area was divided into compartments based on the characteristics of the survey area and the nature and extent of the proposed development in order to collect relevant bird use data. The compartments were drawn onto large scale maps of the survey area, with the map then used to plot the approximate locations of all wildfowl and waders recorded during each survey. Once a survey was complete the numbers of individuals of each species was tallied for each compartment, with an overall bird count then calculated. Figure 10.12 provides the survey area and the extent of the compartments (with these extending down to low water mark in respect of the low tide counts).

32. Five monthly surveys were conducted between November 2016 and March 2017, with six further monthly surveys conducted thus far over the winter of 2017/18 (i.e. September, October, November and December 2017, and January and February 2018). In order to understand the bird use of the survey area during different tidal states the November 2016, December 2016, March 2017, September 2017 and October 2017 visits were undertaken during low tide; and the January and February 2017 visits were undertaken at high tide. From November 2017 to March 2018, both the high and low tide periods were covered during each visit.

33. In addition to the counts of the intertidal area, counts for waterfowl and waders were also undertaken of the moat around Tilbury Fort and of the area of grazed grazing marsh fields on common land to the north of the Fort in order to inform baseline conditions and impact assessments for the proposed new access road connecting Tilbury2 to the existing port.

34. Table 5 below provides a summary of the combined number of each species encountered during each survey of the intertidal area, in the moat of Tilbury Fort and in the fields to the north of the Fort (see Appendix 1 for details of the species and numbers encountered within each survey compartment). Figures 1-7 provide the location and numbers of the SPA birds (and curlew) encountered during the surveys, with the figures also showing the site boundary drawn with a 300m buffer.

Table 5: Number of individuals recorded during each survey within the Bioscan survey area

Date	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017	19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018	
Count type	**Low tide**	**Low tide**	**High tide**	**High tide**	**Low tide**	**Low tide**	**Low tide**	**Low tide**	**High tide**	**Low tide**	**High tide**	**Low tide**	**High tide**	**Low tide**	**High tide**	**Low tide**	**High tide**	**Peak count**
Avocet	1	0	12	0	0	0	0	1	0	0	0	4	0	9	4	5	0	12
Black-headed gull	189	95	176	297	308	473	247	296	304	152	88	244	90	77	49	325	84	473
Black-tailed godwit	0	0	0	0	0	4	0	6	0	0	0	0	0	1	0	3	0	6
Canada goose	0	0	3	2	0	0	0	0	0	0	0	3	6	2	6	0	2	6
Common gull	0	4	3	4	0	0	0	1	0	1	0	0	0	0	0	1	0	4
Common sandpiper	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
Coot	0	0	4	2	0	0	0	0	0	0	0	0	0	0	0	0	0	4
Cormorant	0	0	1	2	0	1	2	1	1	0	2	0	0	1	0	0	2	2
Curlew	19	32	11	2	21	0	2	24	0	14	0	21	0	2	0	12	0	32
Dunlin	13	0	58	0	0	33	3	1	0	0	0	0	0	0	0	1	0	58
Gadwall	0	14	59	40	0	0	0	0	0	2	2	71	47	11	8	16	16	71
Great Black-Backed gull	0	1	1	0	0	0	3	0	1	2	2	2	0	0	0	0	0	3
Grey heron	0	0	0	0	0	1	1	1	1	2	1	2	0	1	1	0	0	2
Grey plover	8	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	8
Herring gull	0	0	0	1	2	1	0	3	0	0	0	0	0	0	0	1	0	3
Kingfisher	0	0	0	0	0	0	0	0	1	1	1	0	0	0	0	0	0	1
Lapwing	15	163	32	0	0	0	0	4	0	9	1	2	0	95	0	0	0	163
Lesser Black-Backed gull	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
Little egret	0	2	0	0	0	6	0	3	1	1	1	0	0	0	0	0	0	6

Date	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018	Peak count
Count type	Low tide	Low tide	High tide	High tide	Low tide		Low tide	Low tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	Low tide	High tide	
Little grebe	18	24	15	14	8		20	8	19	3	14	9	15	11	12	5	3	0	24
Little gull	0	0	0	0	0		1	0	0	0	0	0	0	0	0	0	0	0	1
Mallard	134	53	81	90	35		75	72	77	77	42	56	46	85	40	57	26	57	134
Moorhen	1	0	0	0	1		0	0	0	0	0	0	0	0	1	0	0	0	1
Mute swan	4	2	3	0	2		0	0	0	0	0	0	0	0	2	2	3	1	4
Oystercatcher	0	0	0	2	6		2	0	0	0	0	0	0	0	2	2	11	0	6
Pochard	0	0	0	0	0		0	0	1	0	2	2	59	2	80	3	0	0	80
Redshank	16	29	29	5	0		1	1	18	0	26	27	14	1	20	12	6	1	29
Ringed plover	5	0	0	0	0		10	44	0	0	0	0	0	0	0	0	3	0	44
Ruff	0	0	0	0	0		0	0	0	0	0	1	0	0	0	0	0	0	1
Shelduck	4	0	13	1	15		0	4	6	0	7	10	32	26	24	11	13	8	32
Shoveler	0	0	12	0	0		0	0	0	0	0	0	0	0	1	0	2	0	12
Snipe	0	0	1	0	0		0	0	1	0	0	0	0	0	0	0	0	0	1
Teal	125	194	204	171	47		2	0	56	23	89	75	84	34	228	109	133	89	228
Tufted duck	0	0	0	0	0		0	0	0	0	0	0	1	0	0	0	0	0	1
Turnstone	0	8	1	0	0		0	0	0	0	0	0	0	0	0	0	0	0	8

35. The data set out in Table 5 above indicates that the survey area receives moderate levels of regular use by black-headed gull, gadwall, lapwing, little grebe, mallard, redshank and teal.

36. During the December 2017, January, February and March 2018 visits, surveys of the intertidal area to the east of Coalhouse Fort (outside the area surveyed for the ES) were conducted in order to understand relative bird use of this more distant downstream area. These counts were undertaken during a rising tide from one of the few slightly elevated positions to the east of the Fort; however, due to the low-lying nature of the area and the presence of saltmarsh vegetation between the observer and the intertidal mudflats, a small proportion of the mudflats beyond is obscured. Therefore, the numbers presented in Table 6 below from this area are considered to be minimum counts.

Table 6: Number of individuals recorded within the intertidal area east of Coalhouse Fort during the December 2017, January and February 2018 visits

Species	04/12/2017	19/01/2018	14/02/2018	22/03/2018
Avocet *Recurvirostra avosetta*	1160	714	707	670
Bar-tailed godwit *Limosa lapponica*	3	0	3	12
Black-tailed godwit *Limosa limosa*	0	20	1	852
Cormorant *Phalacrocorax carbo*	4	0	0	0
Curlew *Numenius arquata*	62	68	34	38
Dunlin *Calidris alpina*	c.4200	c.4800	c.4300	c.2600
Gadwall *Anas strepera*	0	2	0	0
Great black-backed gull *Larus marinus*	2	0	0	0
Grey plover *Pluvialis squatarola*	110	139	226	230
Knot *Calidris canutus*	0	0	0	45
Mute swan *Cygnus olar*	0	0	0	2
Oystercatcher *Haematopus ostralegus*	1	2	5	12
Redshank *Tringa totanus*	25	0	3	1
Shelduck *Tadorna tadorna*	210	10	38	12
Teal *Anas crecca*	0	21	50	358

37. Table 6 indicates that the numbers of key species using the intertidal areas around Coalhouse Fort and some 2km or more downstream of the Tilbury2 site are significantly higher than those found within the Bioscan survey area adopted for the EIA studies. By comparison, numbers of most SPA/Ramsar species using the intertidal habitats within the proposed DCO limits, within the wider 300m zone of influence around that, or even within 2km, are far lower than those that use the mudflats near and downstream of Coalhouse Point.

38. To put this further into context, and facilitate consideration of the levels of use of the Bioscan survey area by the species cited for the nearby Thames Estuary and Marshes SPA, Table 7 below provides the numbers on the citation sheet, more recent published counts for the SPA, and the maximum number found during the surveys. By reference to the SPA citation species, avocet, black-tailed godwit, dunlin, grey plover and redshank have been recorded within the survey area; although the numbers found are relatively low in the context of the designation, and all counts represent less than 1% of the recent peak mean figures for the SPA (see Table 7).

Table 7: Comparison of winter bird counts in the Bioscan survey area with the Thames Estuary and Marshes SPA counts

SPA qualifying period	Species	Number of individuals listed on SPA sheet	Number of individuals (peak mean 04/05 to 08/09) [15]	Peak count in Bioscan survey area	No. of visits encountered in Bioscan survey area (out of 17 visits)	Percentage of peak number of individuals found within survey area (based on recent peak mean of 2004/05-2008/09)
Oct-Mar	Avocet	283	1395	12	7	0.86
Oct-Mar	Black-tailed godwit	1699	5311	6	4	0.11
Oct-Mar	Dunlin	29646	37251	58	6	0.16
Oct-Mar	Grey plover	2593	5673	8	2	0.14
Oct-Mar	Hen harrier	7	0	0	0	0
Oct-Mar	Knot	4848	42871	0	0	0
Oct-Mar	Redshank	3251	4313	29	15	0.67
Passage	Ringed plover	1324	1186	10*	1*	0.84

* On passage only

39. In terms of use patterns within the survey area, the duck species (gadwall, mallard and teal) tend to be found within the vicinity of the Anglian Water sewage outfall (TQ 6564 7531). Teal tend to sit adjacent to the outfall at low tide, and then feed in the mud around high tide. Gadwall tend to swim and feed in the water within the vicinity of the outfall both at low and high tide. Mallard behaviour appears similar to gadwall but can be more spread out along the adjoining intertidal area. Black-headed gull are generally found in association with the outfall and inside the sewage works, whilst little grebe are exclusively found within Tilbury Fort moat. Low numbers of lapwing have been found along the intertidal areas with higher numbers found resting adjacent to Tilbury Fort moat. Redshank are generally found scattered and feeding in the mud along the whole foreshore area; however, small flocks (no more than 11 individuals) have been found within the vicinity of the sewage outfall.

Summary of all survey data

40. The wintering bird surveys of the intertidal within the vicinity of Tilbury2 conducted during the 1998-99 Low Tide Count, and by Mr Larkin, RPS, Atkins and Bioscan all show broadly consistent results. Higher aggregations of waders and wildfowl are recorded outside and to the east of Bioscan's survey area, closer to Coalhouse Point.

41. Analysis of Mr Larkin's data does indicate that there has been some decline in the numbers of black-tailed godwit, ringed plover, avocet, and possibly lapwing and redshank, since late 2016 for the intertidal area between the London International Cruise Terminal and Coalhouse Point. The same pattern was not found for the intertidal areas to the east of Coalhouse Point. The period during which lower numbers were recorded corresponds with the 2016-2018 period during which Bioscan and Atkins undertook survey work of this intertidal stretch and also recorded low counts. As such, whilst Bioscan's findings are validated by these concurrent studies, the results do appear to show that the intertidal area is currently experiencing a period

[15] Liley, D, (20 June 2011). 'What do we know about the birds and habitats of the North Kent Marshes? Baseline data collation and analysis'. Natural England Commissioned Report NECR082).

of lower waterbird numbers than the previous baseline. It is conjectured that this is could be due to the recent activities at Goshem's Farm.

42. The RPS data indicate that higher numbers of black-tailed godwit used this area over 10 years ago, but in view of the run of data since then showing significantly lower numbers (rarely exceeding 70 individuals), this strongly suggests either that 2007 was an unusual year for that species, or that there was a sudden decline afterwards that has continued.

43. In summary the data from these sources indicates sporadic to occasional use by low numbers of SPA species between London International Cruise Terminal and Coalhouse Point; and significantly higher numbers along the intertidal area within the vicinity of Coalhouse Fort (approximately 3km to the east of the Tilbury2 site boundary). This is fully consistent with the position presented in the ES and upon which the impact assessments in the ES and the associated HRA report are based.

Appendix 1.

Bioscan wintering bird surveys 2016-2018: raw data by compartment.

Appendix 1. Bioscan survey data: species and numbers within each survey compartment.

Species by compartment (see Figure 10.12)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Tidal state	LT	LT	HT	HT	LT		LT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT
IT1																		
Avocet			1															
Black-headed gull	10	5	4	210	42		66	27	5		3		20		8		54	
Black-tailed godwit									3								1	
Common gull			1	4														
Curlew			8	2	1						2							
Dunlin			36															
Herring Gull				1	2													
Lapwing			7						1				2					
Lesser black-backed gull	1																	
Mute swan			3															
Oystercatcher					2												2	
Redshank	2	2	7	5					7		3		2		1		6	
Shelduck															2			
Teal			2															
Notes			#	$												&		
IT2																		
Black-headed gull	4	1					14	3							11			
Curlew	1																	
Lapwing	13										8							
Oystercatcher																	2	
Redshank	2	5									6				6			
Teal			1															
Turnstone		4																
Notes					NB													
IT3																		
Black-headed gull		3						5										
Curlew	5										1							
Gadwall			2															
Lapwing		9							3		1							
Mallard			5															
Oystercatcher							1											
Redshank	2	3							2		2		1					
Teal		3	14															
Turnstone		4																
Notes					NB													

Species by compartment (see Figure 10.12)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Tidal state	LT	LT	HT	HT	LT		LT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT
IT4																		
Avocet	1		11						1				1		3	4		
Black-headed gull	12	8	30		13			3							16		12	
Common gull																	1	
Cormorant																		2
Curlew		1																
Dunlin			19															
Gadwall			23	40														
Grey heron										1								
Mallard			3	4			14			7						3		
Redshank	1	7	12						2									
Shelduck	4		1		5			4	6		6		2		6	2	5	
Teal		14	101	126	16					8						20	28	31
Notes																		
IT5																		
Black-headed gull							62		4									
Black-tailed godwit									3									
Cormorant								1										
Dunlin									1									
Gadwall			20								2		2				3	
Herring gull							1											
Mallard	72	4			2		36	66	36						13		2	
Oystercatcher																	2	
Redshank	7	7					1	1	6		11		7		9			
Teal	49	7	27		5				10		41		41		32		17	
IT6																		
Black-headed gull	9			74	29		56	48	4						6		70	
Common sandpiper							1											
Curlew		2	2						1									
Gadwall			9										53					
Herring gull																	1	
Little egret									2									
Little gull							1											
Mallard	20	14	50	31	2						14		35		9		17	34
Oystercatcher				1	1										2	2	1	
Redshank		1	7						1									
Shelduck																		2
Teal	1	1	13	4	4						6		4				4	1

Species by compartment (see Figure 10.12)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Tidal state	LT	LT	HT	HT	LT		LT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT
IT7																		
Avocet													3		6		5	
Black-headed gull	54	3			118		70	90	74		24		46		12		106	
Black-tailed godwit																	1	
Common gull		1																
Cormorant				1														
Curlew	1	1	1		3			1	11		7				1			
Dunlin			1															
Grey plover			2															
Mallard			10	28	10													14
Mute swan																	2	
Oystercatcher																	2	
Shelduck			9		1								6		2		6	
Teal		5	8	22	4													2
Turnstone			1															
IT8																		
Black-headed gull	38	3			62		20	31	6		12		123		12			
Black-tailed godwit							4								1			
Common gull		3							1									
Curlew	12	28			17			1	12		4		21		1		12	
Dunlin	13						33	3									1	
Great black-backed gull		1						3					2					
Grey heron							1											
Grey plover	8																	
Herring gull									3									
Little egret		2							1		1							
Mallard		2		2											2		1	
Oystercatcher					3												2	
Redshank	2	4	1										2		1			
Ringed plover	5						10	44									3	
Shelduck					9								24		14		2	
Teal		85			2								12		150		62	
E1																		
No birds recorded																		
E2																		
Black-headed gull													30					

Species by compartment (see Figure 10.12)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Tidal state	LT	LT	HT	HT	LT		LT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT
E3																		
Black-headed gull											5							
Teal											1							
E4																		
Grey heron												1						
Mallard											2	2						
Shelduck												7						
Teal											3	5						
E5																		
Black-headed gull	22						55		53							25		
Gadwall		8										2	14	47	11	8	13	16
Mallard	38	6					5		22	5	11	2			8	13	2	4
Shelduck																2		
Teal	59	40							16	14	26	51	22	34	14	83	14	40
E6																		
Black-headed gull							44											
Gadwall													2					
Mallard										52		47		79		30		
Shelduck																2		
Teal										1		9						
E7																		
Black-headed gull		18																
Mallard		4								6						3		
Shelduck												2				1		
E8																		
Cormorant												1						
Shelduck														24				
J1																		
Black-headed gull		35	5							124	78	74						12
Common gull			1								1							
Cormorant			1					1		1								
Great black-backed gull			1							1	2	2						

Species by compartment (see Figure 10.12)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Tidal state	LT	LT	HT	HT	LT		LT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT
J2																		
Common gull			1															
Mallard		3					20	6										
J2a																		
Cormorant				1			1		1			1						
Mallard			12	14	10				6	7	10	4	9	6				
Oystercatcher				1														
J3																		
Black-headed gull			1				69											
M1																		
Black-headed gull			21		4						9	14						
Canada goose													3	6				
Coot			4	2														
Cormorant															1			
Gadwall		6	2															
Grey heron									1		1			2	1	1		
Kingfisher							1			1		1						
Lapwing												1						
Little egret							1											
Little Grebe	18	24	13	14	8		20	8	19	3	14	9	15	11	12	5	3	
Mallard		7							13		5		2		2	4	2	
Mute swan		2																
Oystercatcher							1											
Pochard			2						1		2	2	59	2	80	3		
Redshank			1								3	4	1			12		
Shelduck														2				
Teal		2					2		30		12	10	5		21			
Tufted duck													1					
M2																		
Black-headed gull		4		4							1					24	23	22
Canada goose			3	2											2	6		2
Dunlin			2															
Gadwall			3															
Grey heron								1			1							
Kingfisher											1							
Lapwing	2	154	16												95			

Species by compartment (see Figure 10.12)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2018	19/01/2018	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Tidal state	LT	LT	HT	HT	LT		LT	LT	LT	HT	LT	HT	LT	HT	LT	HT	LT	HT
Little egret							4			1								
Mallard	4	9	1	6	7							1			6	2	2	2
Moorhen	1														1			
Mute swan	4				2										2	2	1	
Pied wagtail				1														
Redshank											1	23		1	2			1
Ruff												1						
Shelduck			3	1							1	1				4		4
Shoveler			12												1		2	
Teal	16	37	38	19	12											6	8	12
F1																		
Lapwing			6															
F2																		
Mallard		4																
F3																		
Lapwing			3															
Mallard				5												2		3
Mute swan																		1
Shelduck																		2
Snipe									1									
Teal																		3
F4																		
No birds																		
F5																		
Black-headed gull					10													
Little egret							1					1						
Little grebe			2															
Mallard					4													
Redshank													1		1			
Teal					4										11			
Snipe			1															
Sewage Works																		
Black-headed gull	40	15	115	9	30		17	40	150	180	20		25		12		50	50
Moorhen					1													

Species (Non-WeBS)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2017	19/01/2017	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Along footpath																		
Blackbird			1										p				p	
Blue tit							p											
Carrion crow									p				p					
Collared dove			1	1	1													
Dunnock		p	3		1		p		p		p				p			
Feral pigeon		p	3				p	p							p			
Goldfinch	p	p		2			p								p			
Great spotted woodpecker									p									
Greenfinch															p			
Grey Wagtail	p	p	1							p	p		p	p				
Kestrel			1				2	1								1		
Linnet	p		25	8	1		62	24	6							p	10	P
Long-tailed tit													p					
Magpie				2			p		p									
Meadow pipit	p	p		2	1			10	p		p			p				
Mistle thrush										1								
Pied wagtail	p	p					p	3	p		p			p	p			
Robin				1			p			p	p		p		p		p	
Song thrush		p	1										p					
Starling		p					p		p						p			
Stonechat	2	1					2	2		1	1			1		1		
Swallow							p											
Wren			2	1	1			1		p			p				p	
Fields (F1-F5)																		
Blackbird			1										p					
Carrion crow			1									p						
Chaffinch														p				
Dunnock			1				1											
Goldfinch							p							p				
Great Tit	2																	
Kestrel																		
Linnet	c.5	p					3					45			p			
Magpie	3	p	3	7	11			4	p			p		p		p		
Meadow pipit							14					p	p		p	p		p
Mistle thrush								1										
Pied wagtail	c.3				3				p				p					p

Species (Non-WeBS)	18/11/2016	16/12/2016	26/01/2017	22/02/2017	16/03/2017		19/09/2017	10/10/2017	08/11/2017	08/11/2017	04/12/2017	04/12/2017	19/01/2017	19/01/2017	14/02/2018	14/02/2018	22/03/2018	22/03/2018
Skylark		1																
Song thrush			1															
Sparrowhawk	1																	
Starling				35			330		p					p				
Woodpigeon			196	233	4									p	p	p		p
Yellow wagtail							2											

KEY

IT= Inter-tidal

E= Estuary

F= Field

M= Moat

J= Jetty/Pier

NB = no birds

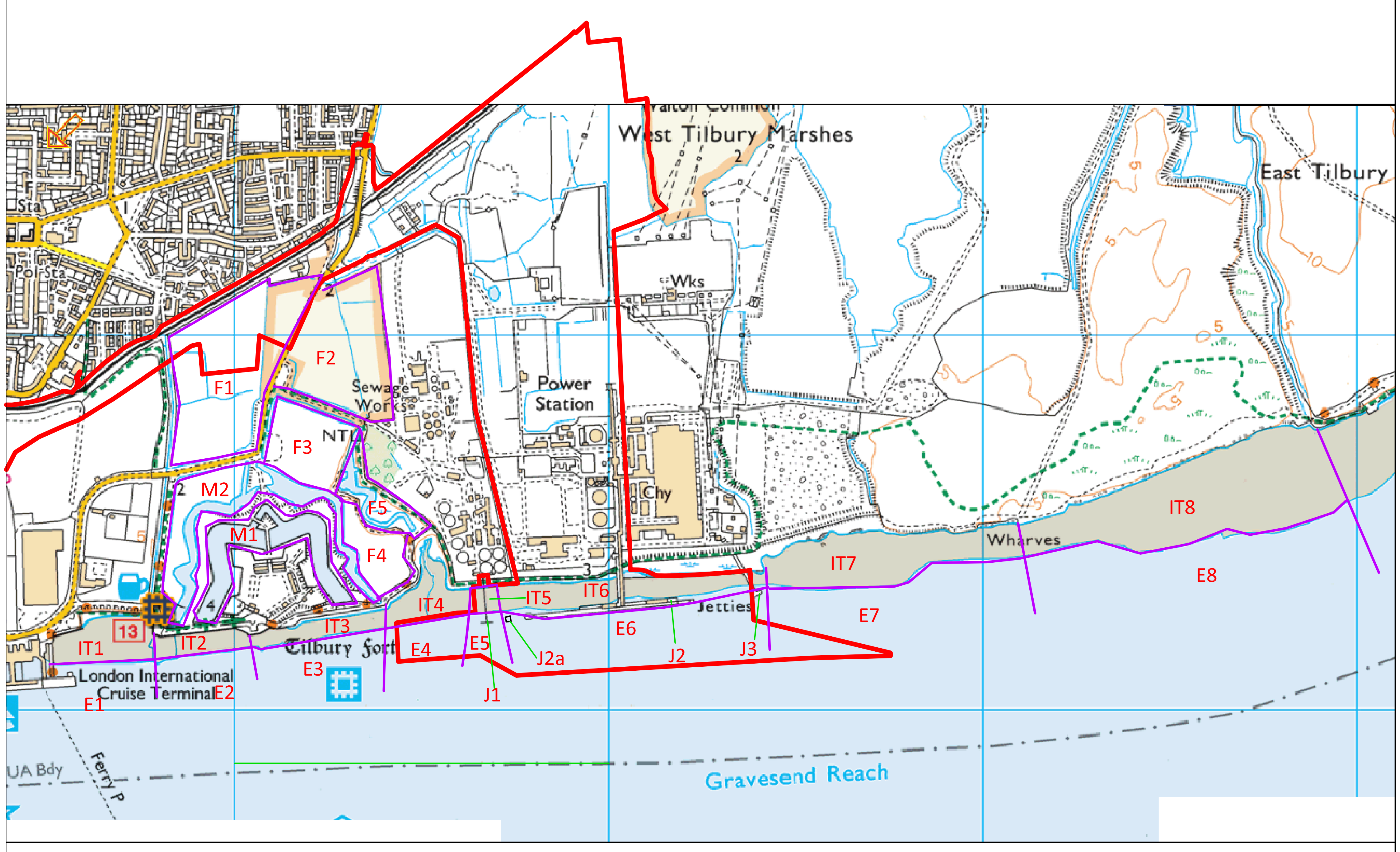
All birds except swans on the only small area of remaining exposed mud- near to fort car park

$ All birds on the only small area of remaining exposed mud- near to fort car park

& Birds in upper slither of exposed mud of Bill Meroy creek which was not inundated despite being high tide.

Figure 10.12.

Bioscan wintering bird survey compartments (2016-2018).



ORDER LIMITS

BIRD SURVEY COMPARTMENT BOUNDARIES (WITH REFERENCE CODE*)

* IT= INTER-TIDAL
E= ESTUARY
J= JETTY
F= FIELD
M= MOAT

REV	DATE	DESCRIPTION

DRAWING TITLE

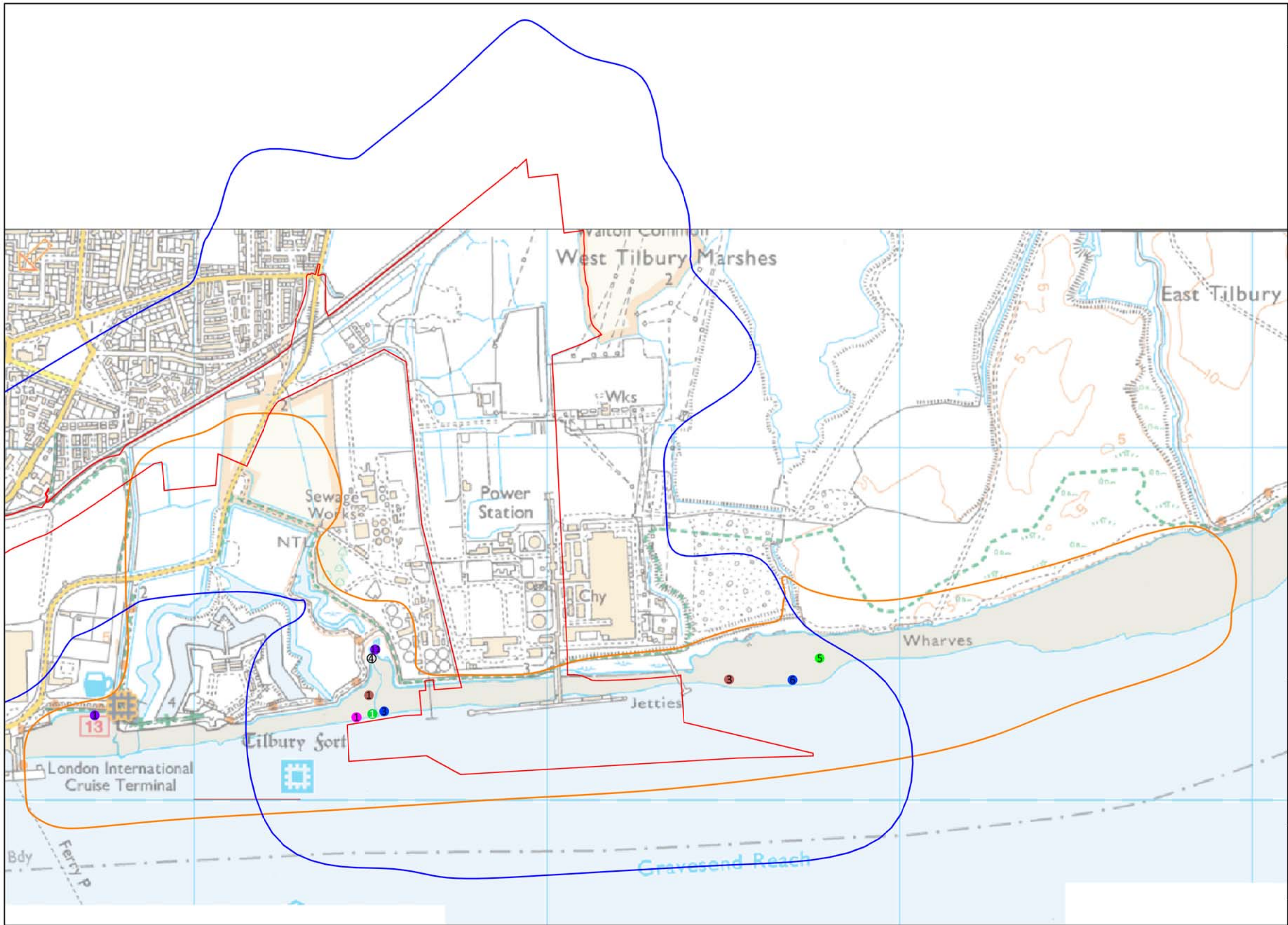
WINTERING BIRD SURVEY COMPARTMENTS 2016/17

SCALE	DRAWN	
1:12500 @ A3	BC	FIG. 10.12
DATE OCT 2017	CHECKED RR	

TILBURY2

Figures 1-7.

Bioscan wintering bird survey data by species (2016-2018).



Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- January 2017 visit (high tide)
- November 2017 visit (low tide)
- January 2018 visit (low tide)
- February 2018 visit (low tide)
- February 2018 visit (high tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title
Numbers and distribution of avocet during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 1	A	E1862

Drawn	Date
BC	March 2018

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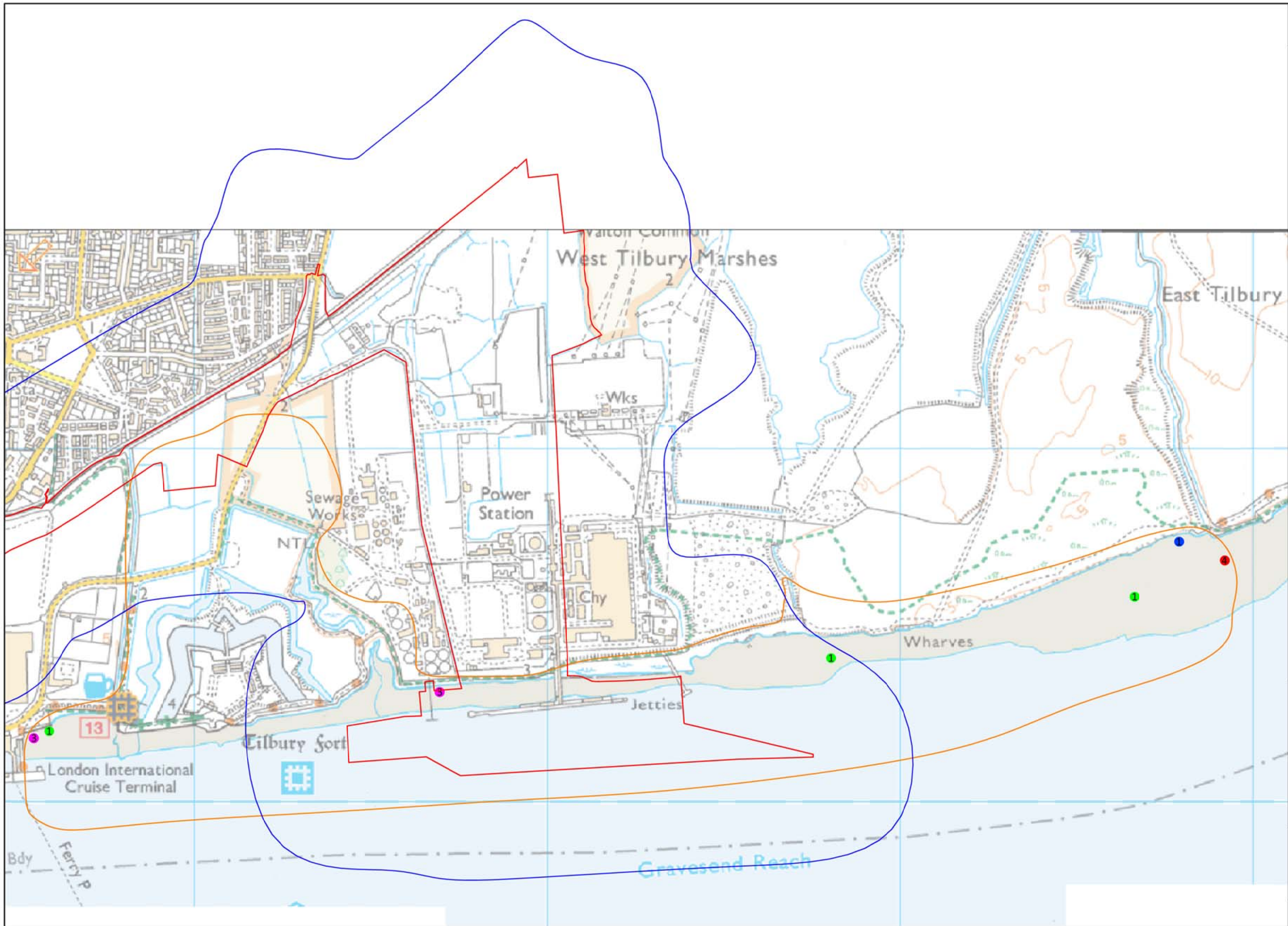

Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- September 2017 visit (low tide)
- November 2017 visit (low tide)
- February 2018 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title

Numbers and distribution of black-tailed godwit during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 2	A	E1862
Drawn	**Date**	
BC	March 2018	

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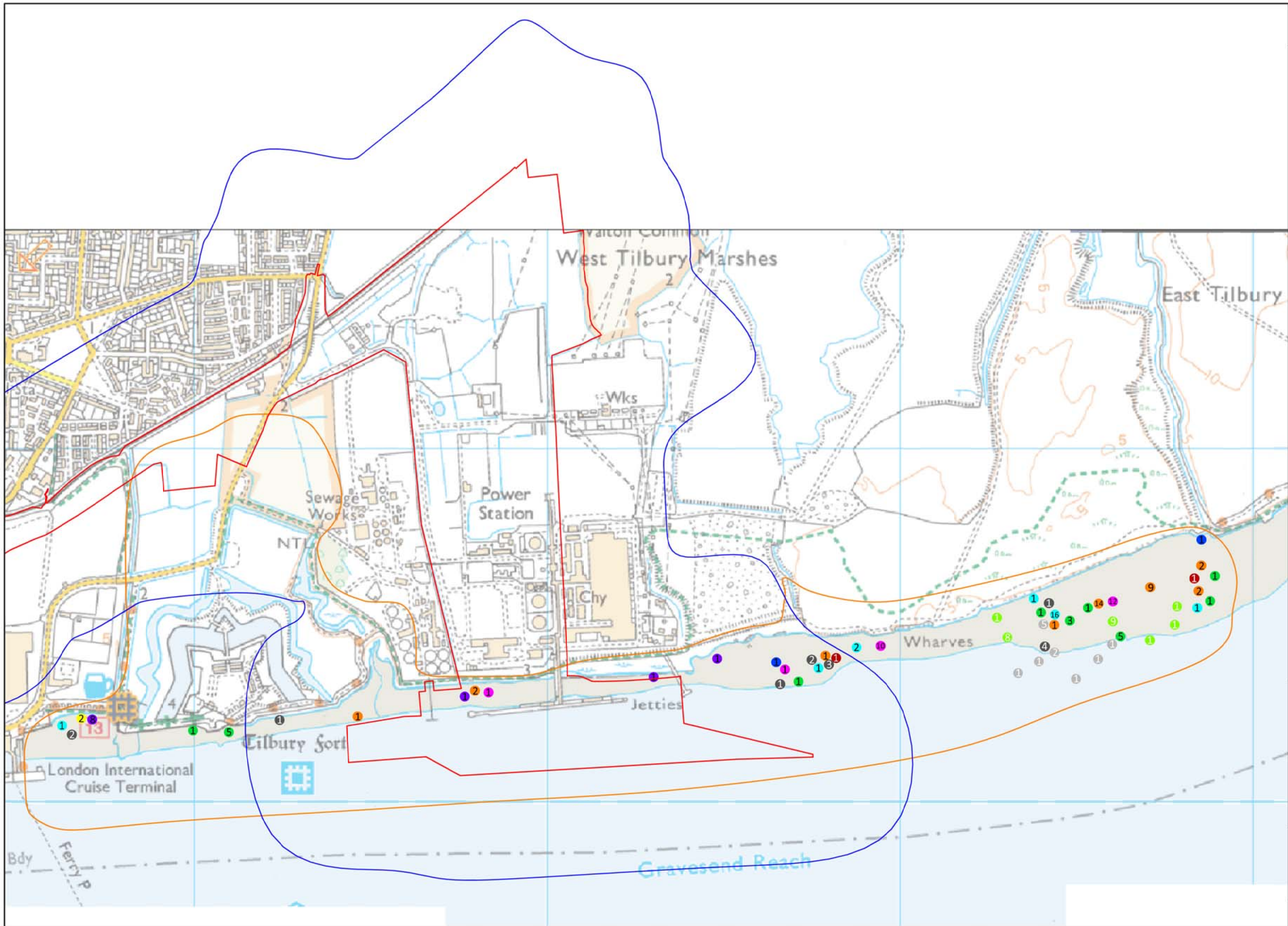

Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- December 2016 visit (low tide)
- January 2017 visit (high tide)
- February 2017 visit (high tide)
- March 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- December 2017 visit (low tide)
- January 2018 visit (low tide)
- February 2018 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title

Numbers and distribution of curlew during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 3	A	E1862

Drawn	Date
BC	March 2018

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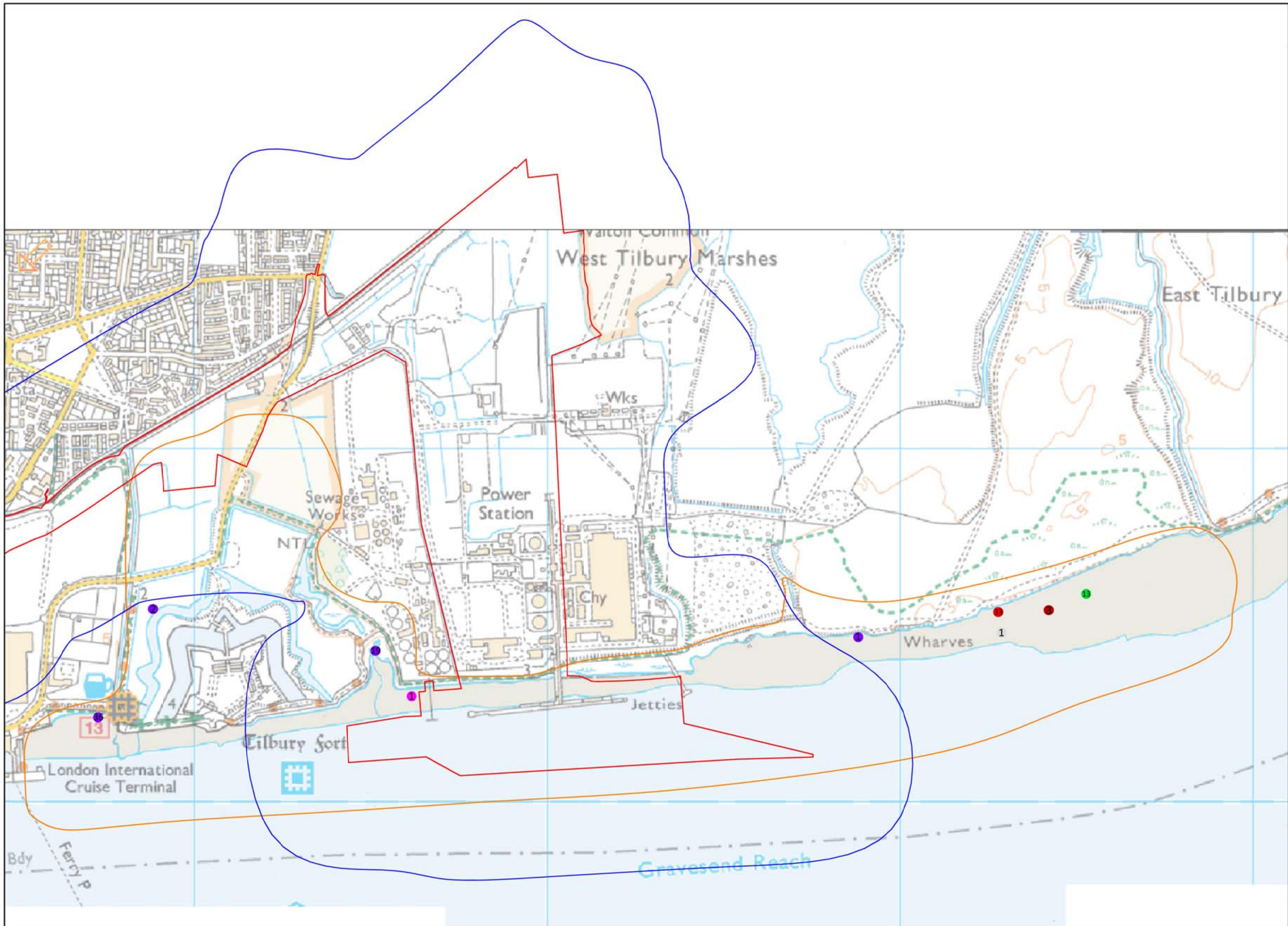

Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- January 2017 visit (high tide)
- September 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- March 2017 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title

Numbers and distribution of dunlin during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 4	A	E1862
Drawn	**Date**	
BC	March 2018	

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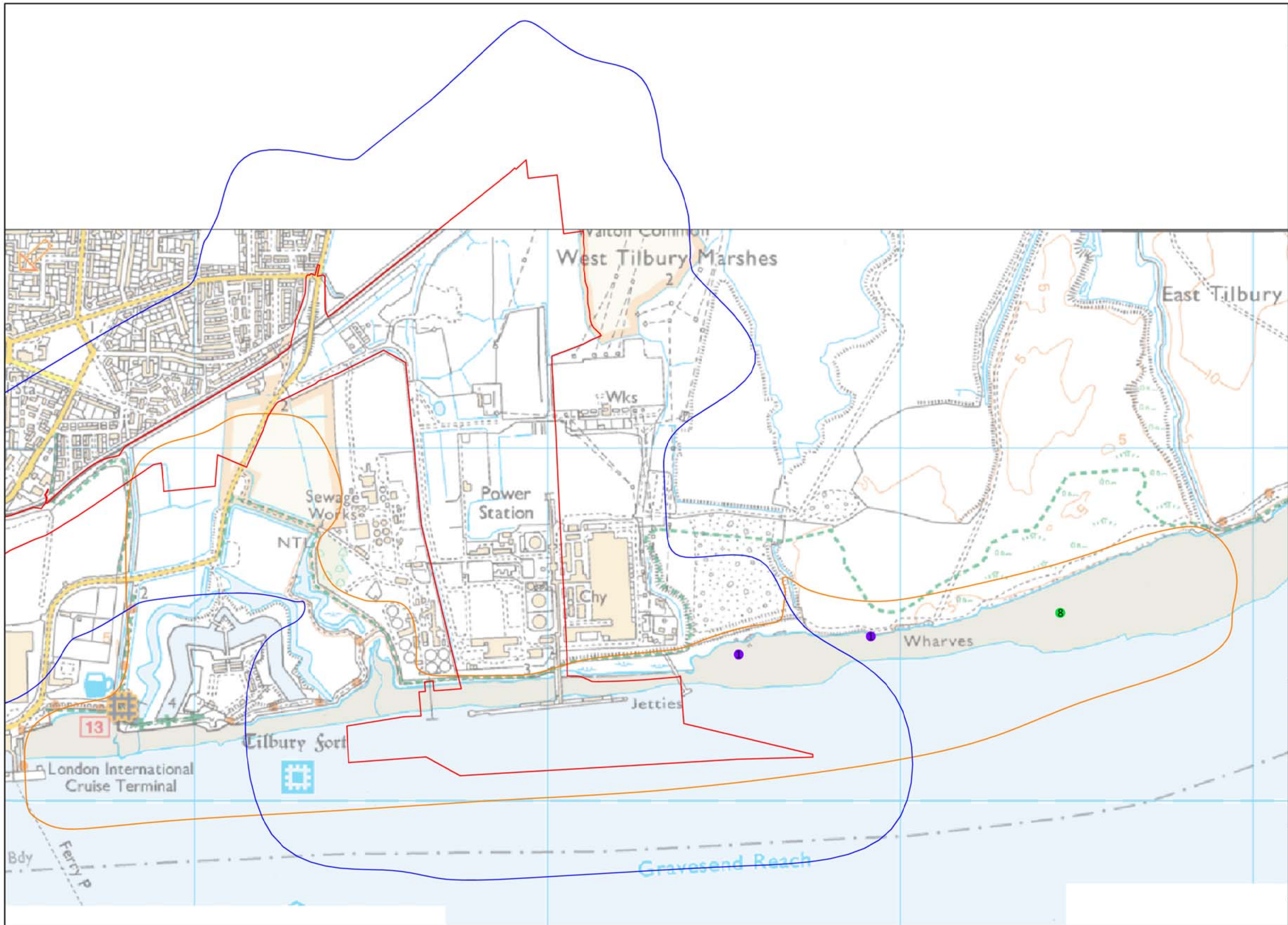

Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- January 2017 visit (high tide)

DO NOT SCALE

Title

Numbers and distribution of grey plover during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 5	A	E1862

Drawn	Date
BC	March 2018

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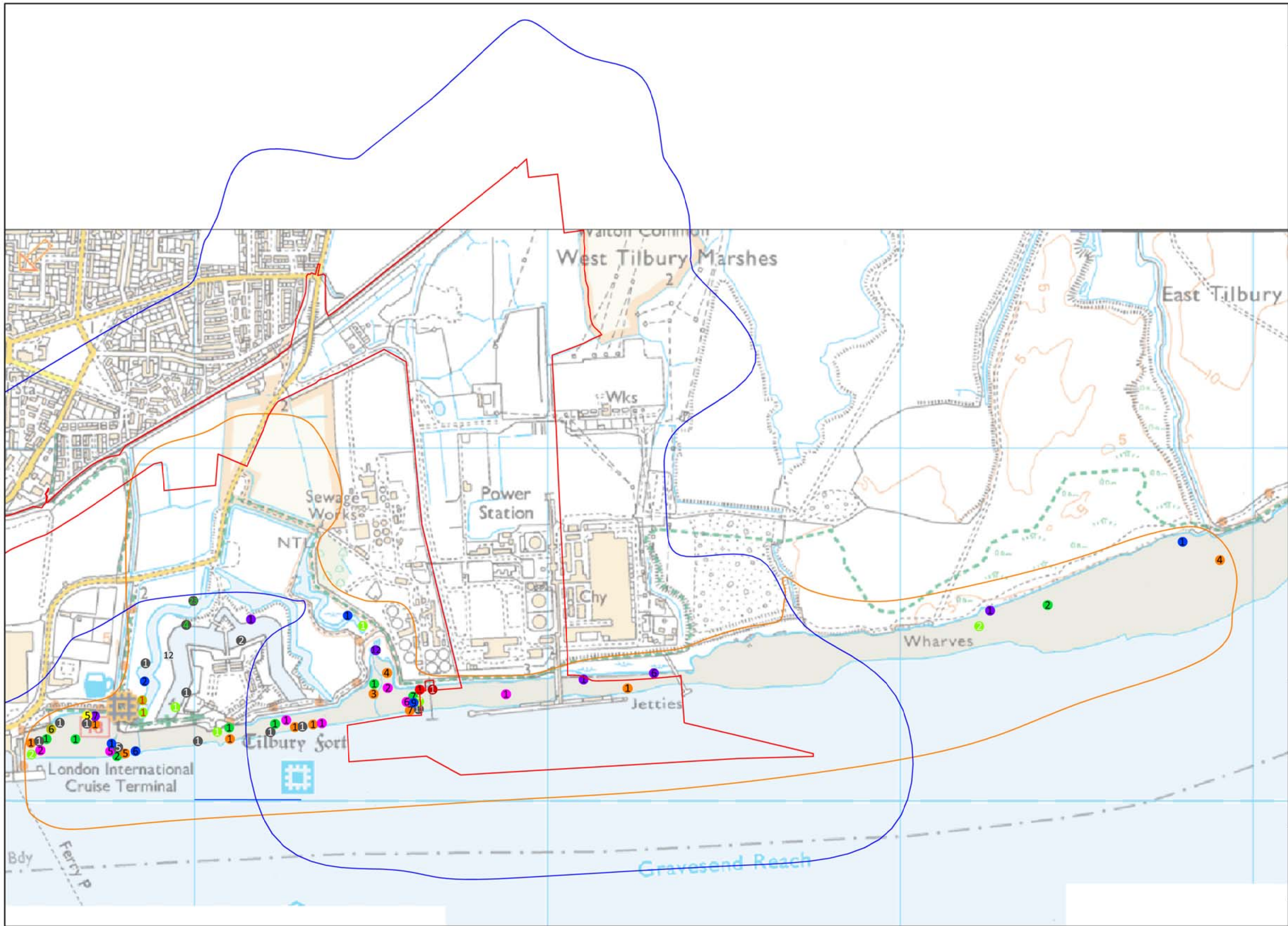

Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- December 2016 visit (low tide)
- January 2017 visit (high tide)
- February 2017 visit (high tide)
- September 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- December 2017 visit (low tide)
- December 2017 visit (high tide)
- January 2018 visit (low tide)
- January 2018 visit (high tide)
- February 2018 visit (low tide)
- February 2018 visit (high tide)
- March 2018 visit (low tide)
- March 2018 visit (high tide)
- 1 Number in circle relates to the number of individuals found at the location

DO NOT SCALE

Title

Numbers and distribution of redshank during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 6	A	E1862

Drawn	Date
BC	March 2018

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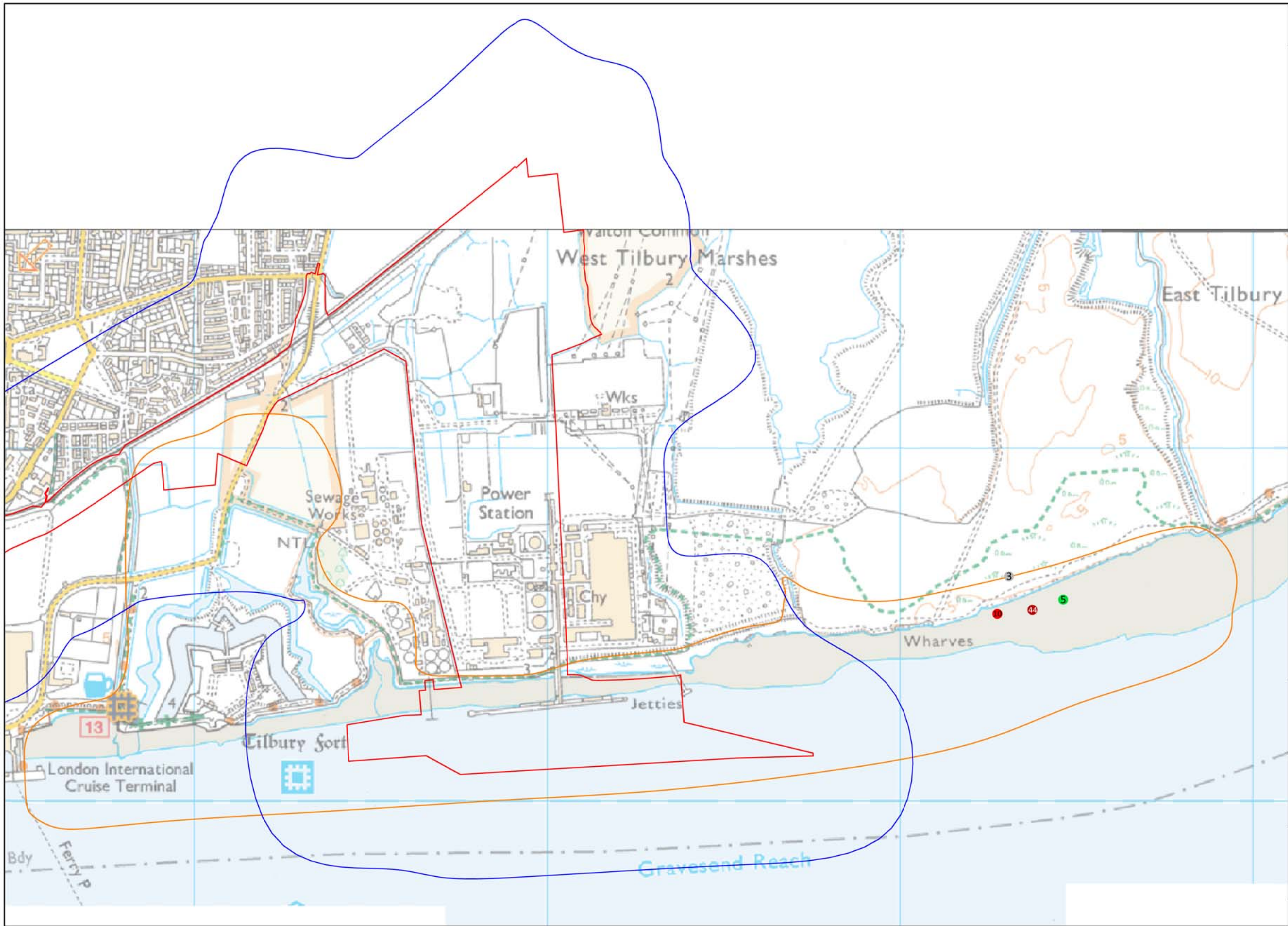

Key

- Application Site
- Approximate extent of survey area
- 300m buffer from site boundary
- November 2016 visit (low tide)
- September 2017 visit (low tide)
- October 2017 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

Title
Numbers and distribution of ringed plover during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 7	A	E1862
Drawn	**Date**	
BC	March 2018	

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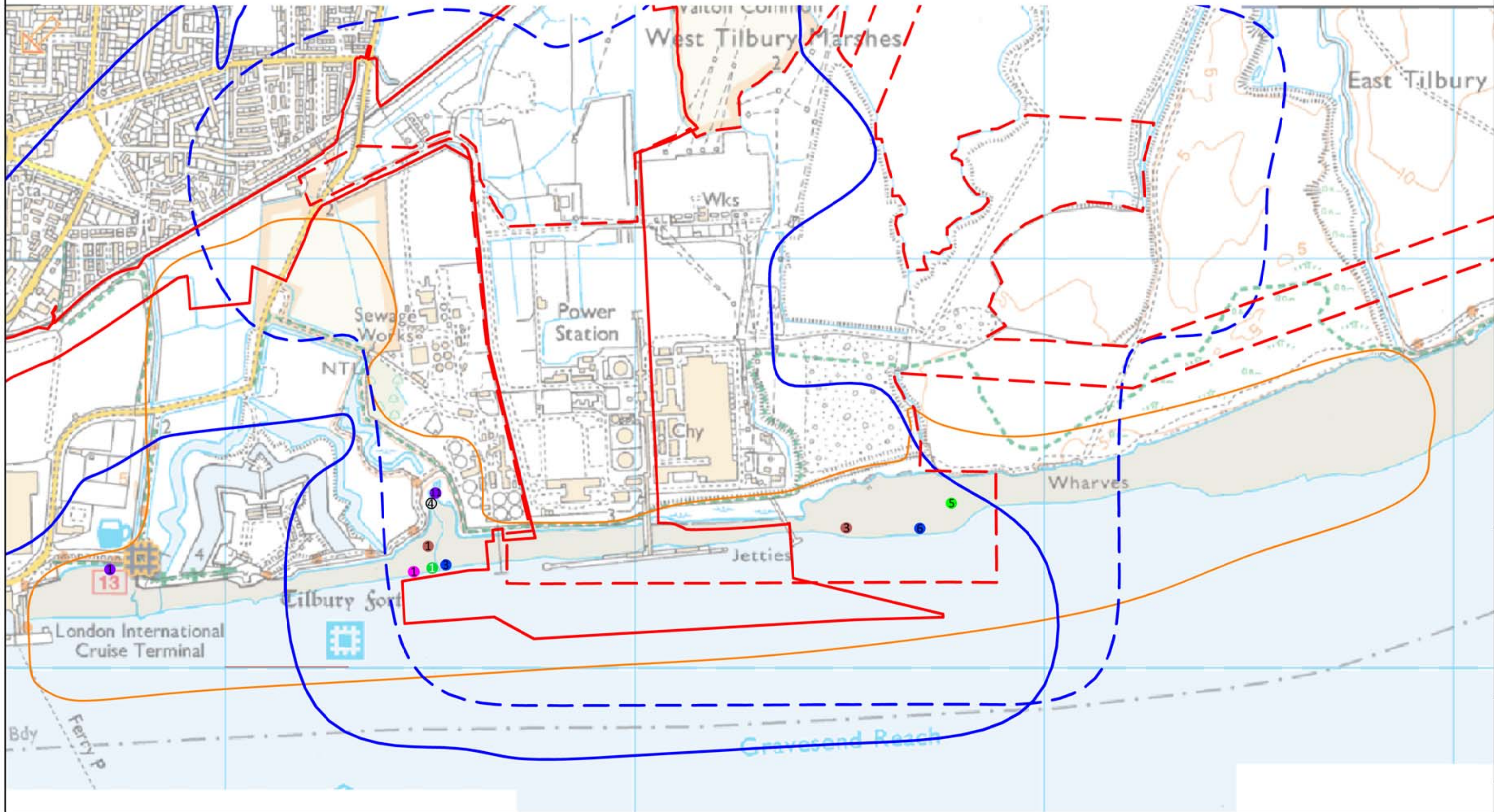
APPENDIX 10



Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
- 300m buffer from TEC Order Limits*
- 1 November 2016 visit (low tide)
- 1 January 2017 visit (high tide)
- 1 November 2017 visit (low tide)
- 1 January 2018 visit (low tide)
- 1 February 2018 visit (low tide)
- 1 February 2018 visit (high tide)
- 1 March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

DO NOT SCALE

Title

Numbers and distribution of avocet during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 1	A	E1862
Drawn	**Date**	
BC	May 2018	

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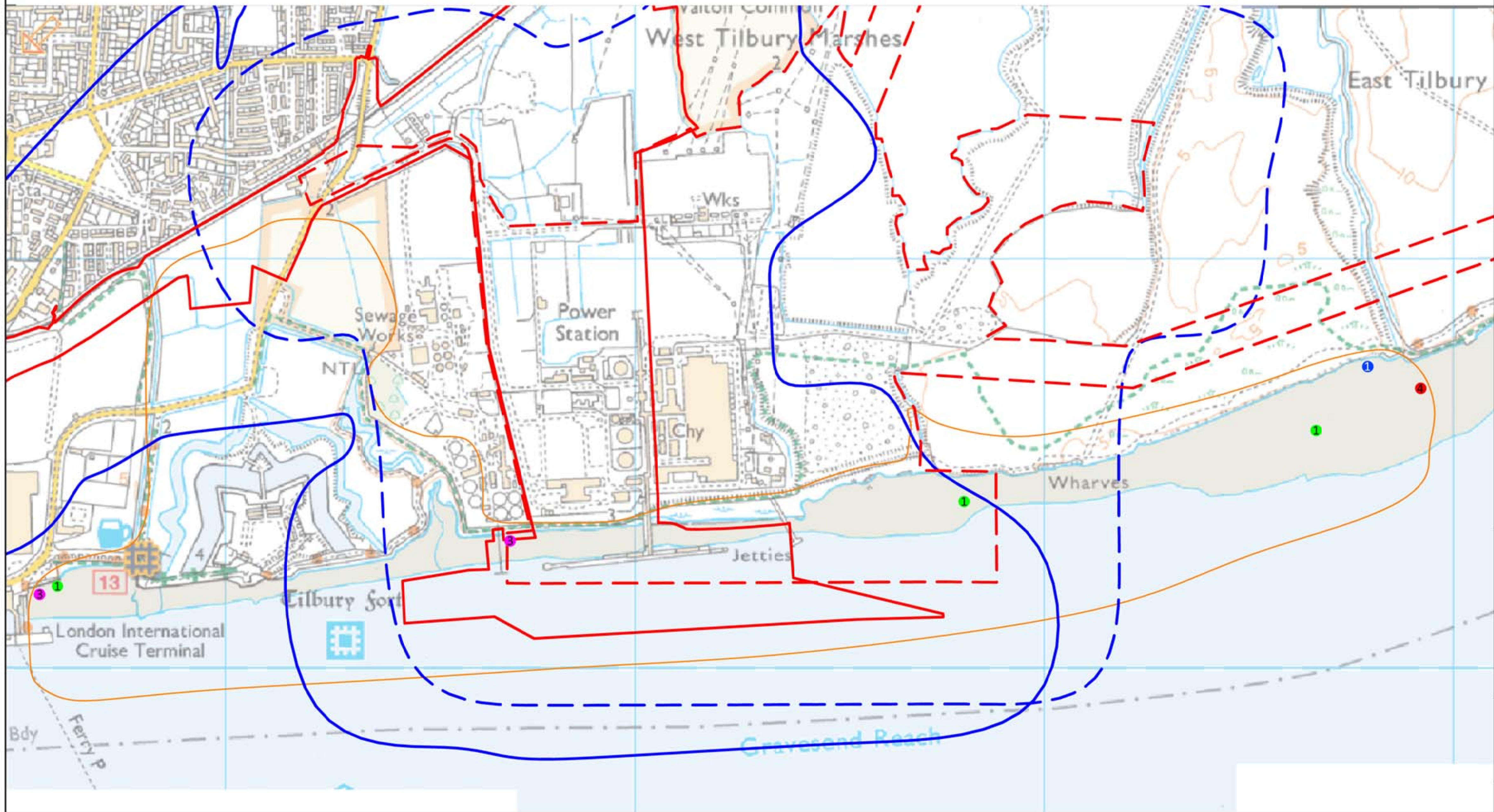

Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
- 300m buffer from TEC Order Limits*
- September 2017 visit (low tide)
- November 2017 visit (low tide)
- February 2018 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

DO NOT SCALE

Title
Numbers and distribution of black-tailed godwit during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 2	A	E1862
Drawn	**Date**	
BC	May 2018	

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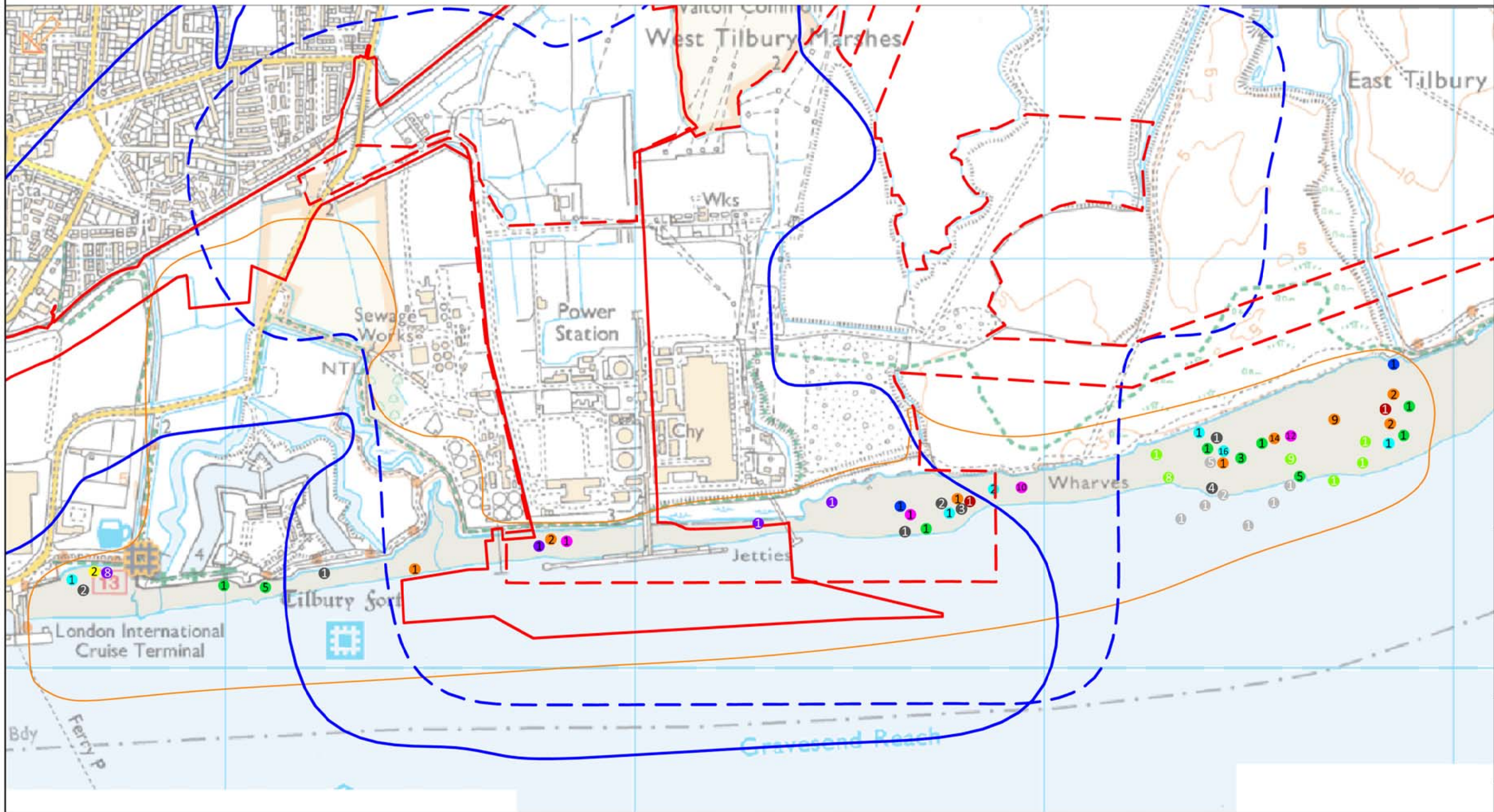

Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
- 300m buffer from TEC Order Limits*
- November 2016 visit (low tide)
- December 2016 visit (low tide)
- January 2017 visit (high tide)
- February 2017 visit (high tide)
- March 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- December 2017 visit (low tide)
- January 2018 visit (low tide)
- February 2018 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

DO NOT SCALE

Title

Numbers and distribution of curlew during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 3	A	E1862

Drawn	Date
BC	May 2018

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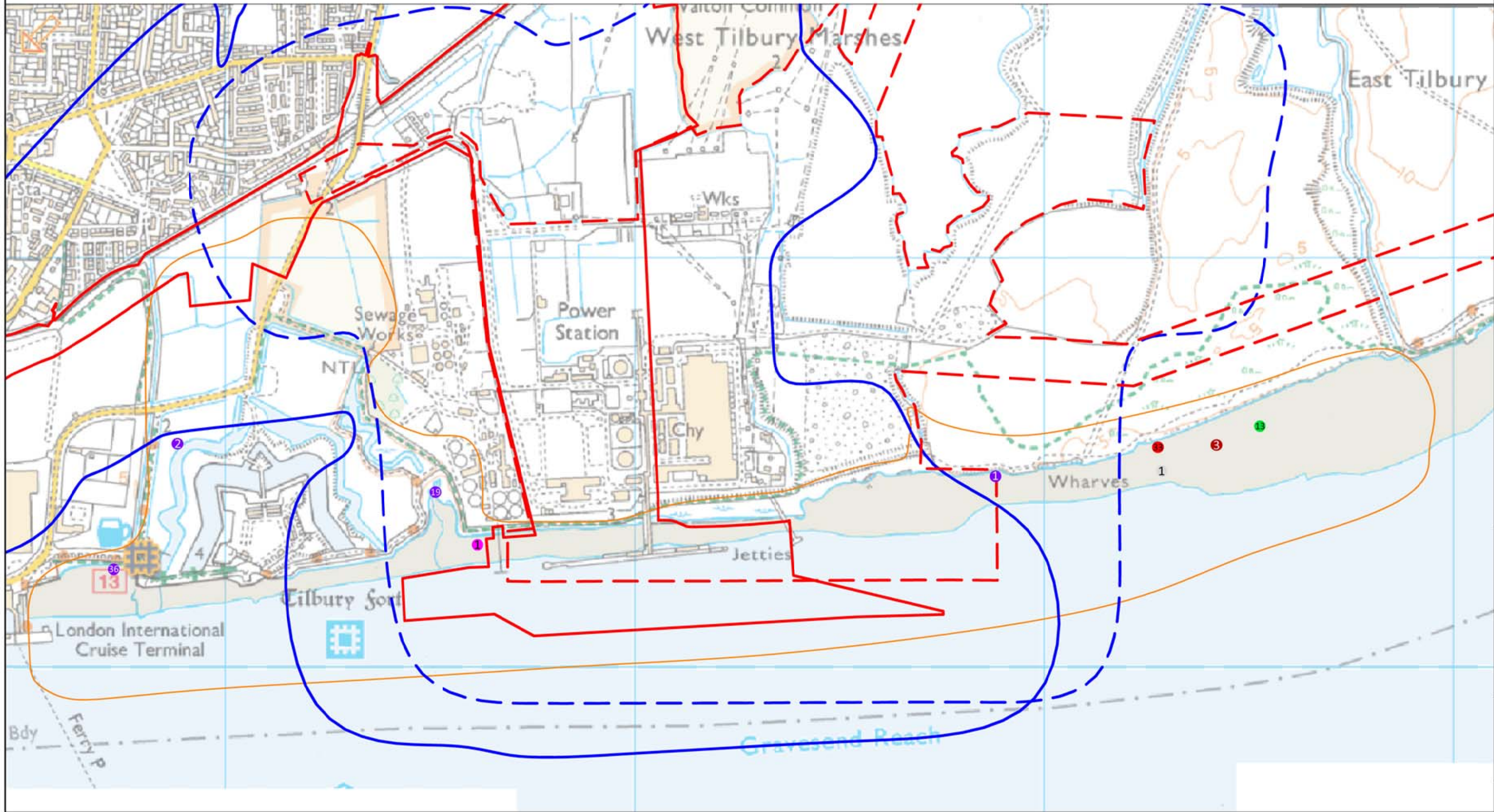

Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
- 300m buffer from TEC Order Limits*
- November 2016 visit (low tide)
- January 2017 visit (high tide)
- September 2017 visit (low tide)
- October 2017 visit (low tide)
- November 2017 visit (low tide)
- March 2017 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

DO NOT SCALE

Title

Numbers and distribution of dunlin during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 4	A	E1862

Drawn	Date
BC	May 2018

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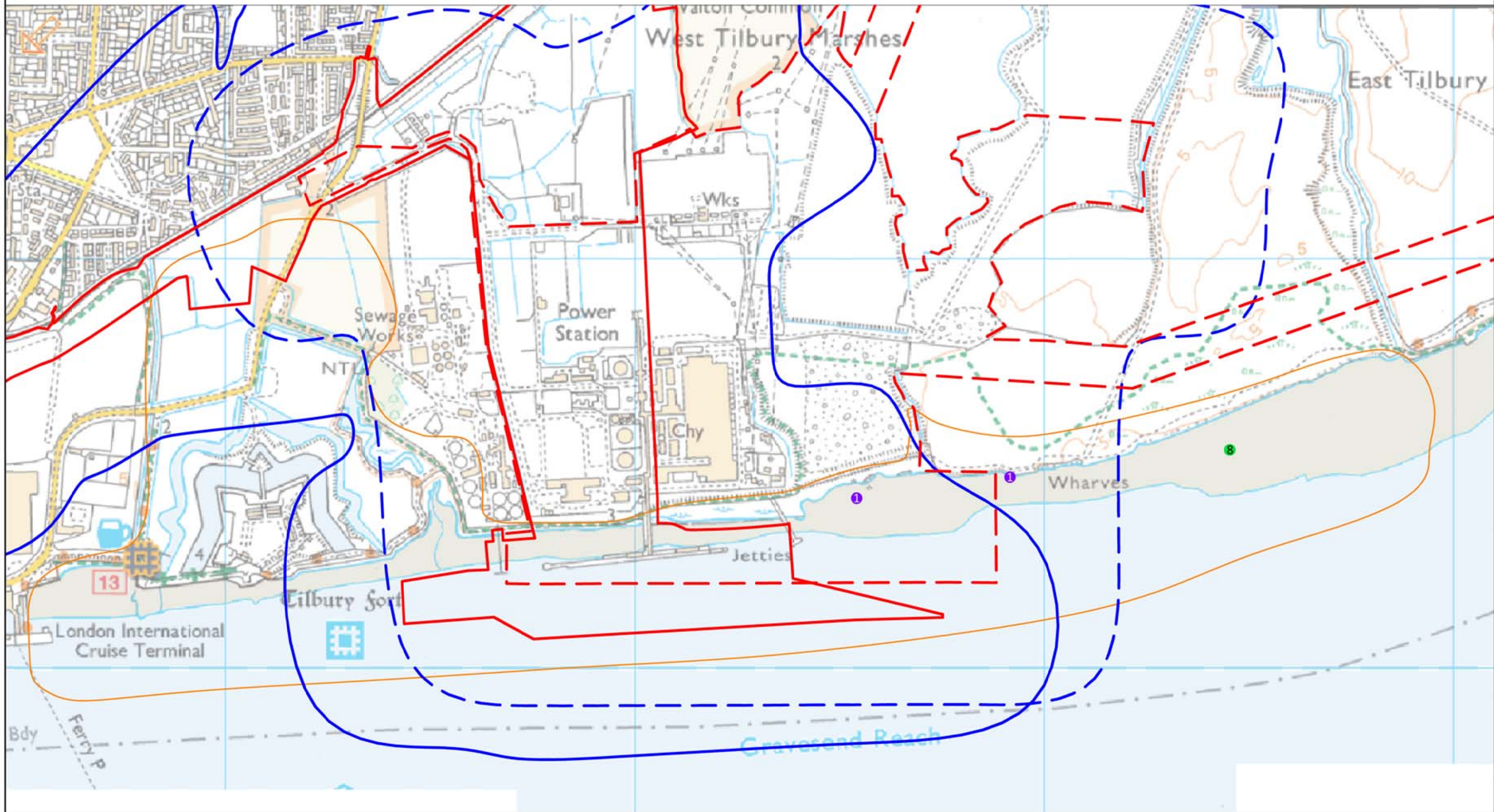

Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
- 300m buffer from TEC Order Limits*
- November 2016 visit (low tide)
- January 2017 visit (high tide)

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

DO NOT SCALE

Title

Numbers and distribution of grey plover during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 5	A	E1862
Drawn	**Date**	
BC	May 2018	

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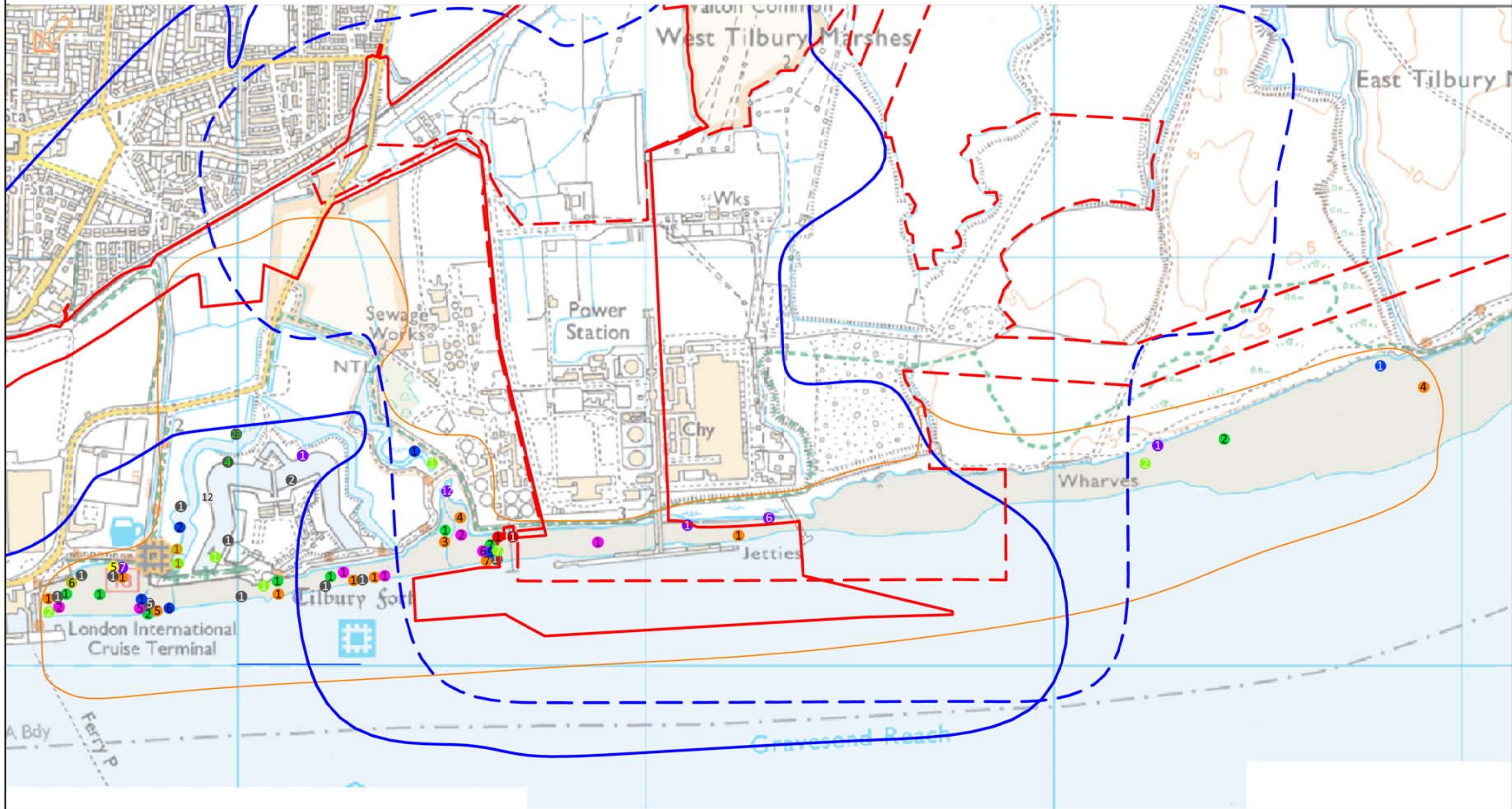

Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
- 300m buffer from TEC Order Limits*
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- March 2018 visit (low tide)
- March 2018 visit (high tide)
- 1 Number in circle relates to the number of individuals found at the location

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

Title

Numbers and distribution of redshank during wintering bird surveys in 2016/17 and 2017/18

Project	Client
Tilbury2	Port of Tilbury

Drawing No.	Revision	Project No.
Figure 6	A	E1862

Drawn	Date
BC	May 2018

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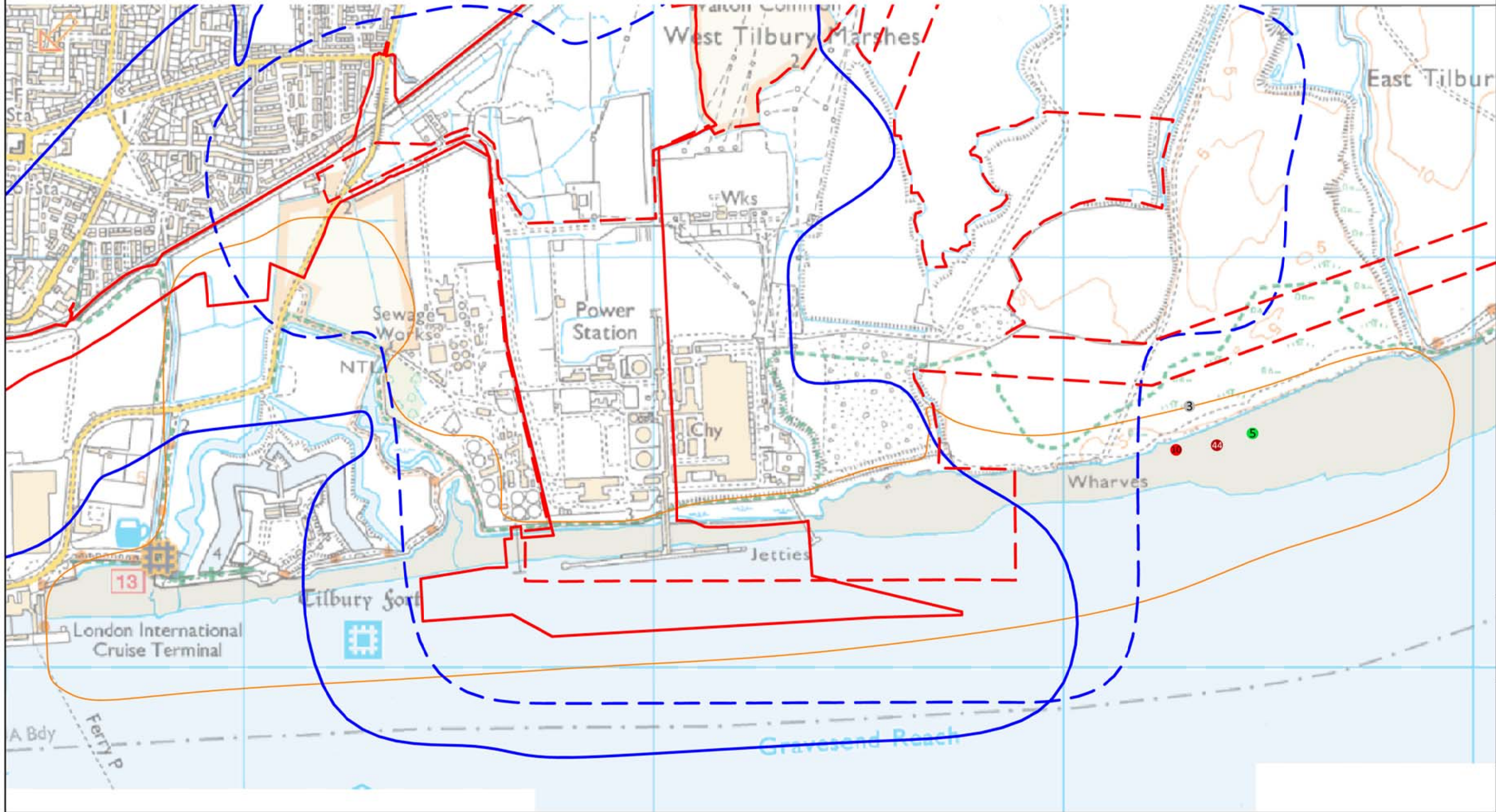

Key

- Tilbury2 Order Limits
- Tilbury Energy Centre (TEC) Order Limits
- Approximate extent of Tilbury2 survey area
- 300m buffer from Tilbury2 Order Limits
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- November 2016 visit (low tide)
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- October 2017 visit (low tide)
- March 2018 visit (low tide)
- 1 Number in circle relates to the number of individuals found at the location

* Encompasses all construction works except for the proposed pipeline. Pipeline construction will be temporary and involves excavation works likely to generate noise levels that fall well short of significant at 300m.

DO NOT SCALE

Title
Numbers and distribution of ringed plover during wintering bird surveys in 2016/17 and 2017/18

Project	Client	
Tilbury2	Port of Tilbury	
Drawing No.	**Revision**	**Project No.**
Figure 7	A	E1862
Drawn	**Date**	
BC	May 2018	

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APPENDIX 11

Appendix 11: Stage 2 Integrity Matrices

Potential Effects

Likely significant effects arising from the Tilbury2 project that have been identified from Stage 1 screening to have the potential to give rise to adverse effects on the integrity of the Thames Estuary and Marshes SPA and the Thames Estuary and Marshes Ramsar Site (alone or in-combination with other projects), are summarised in the table overleaf:

Potential adverse effects considered within the integrity matrices (excludes effects screened out at Stage 1 as not likely to be significant)

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
Thames Estuary and Marshes SPA	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2) • **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2)	• 2) Disturbance (to bird species using Functionally Linked Habitats – FLH – outside SPA)
	• Damage (negative changes) to habitats used by cited bird species from changes to **sediment circulation or deposition patterns** (within designated area) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**;	• 3) Habitat damage (within SPA)

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality,** including from dust, **construction waste and pollutants,** and exhaust emissions (within designated area) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)** (within designated area)	
	• **Direct loss of and damage** to habitats used by cited bird species during construction (functionally linked habitats outside designation boundary) • Damage to or loss of habitats used by cited bird species from changes to **sediment circulation or deposition patterns** (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface	• 4) Habitat loss or damage (Functionally Linked Habitats – FLH - outside SPA)

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants;** or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality,** including from dust, **construction waste and pollutants,** and exhaust emissions (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)** (functionally linked habitats outside designation boundary)	
	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2) • **Disturbance (human movement and activity)** giving rise to	• In Combination Effects

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2) • Damage (negative changes) to habitats used by cited bird species from changes to **sediment circulation or deposition patterns** (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality,** including from dust, **construction waste and pollutants,** and exhaust emissions (within designated area and	

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)** (within designated area and functionally linked habitats outside designation boundary) • **Direct loss of and damage to** habitats used by cited bird species during construction (functionally linked habitats outside designation boundary)	
Thames Estuary and Marshes Ramsar Site	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2) • **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2)	• 2) Disturbance (outside Ramsar Site)
	• Damage (negative changes) to habitats used by cited bird species from	• 3) Habitat damage (within Ramsar Site)

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	changes to **sediment circulation or deposition patterns** (within designated area) • Damage (negative changes) to habitats used by cited bird species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (within designated area) • Damage (negative changes) to habitats used by cited bird species from changes in **air quality,** including from dust, **construction waste and pollutants,** and exhaust emissions (within designated area) • Damage (negative changes) to habitats used by cited bird species from introduction or proliferation of **invasive non-native species (INNS)** (within designated area)	
	• **Direct loss of and damage** to habitats during construction (functionally linked habitats outside	• 4) Habitat loss or damage (FLH outside Ramsar Site)

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	designation boundary) • Damage to or loss of habitats used by cited species from changes to **sediment circulation or deposition patterns** (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential associated knock-on risk of bioaccumulation (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes in **air quality,** including from dust, **construction waste and pollutants,** and exhaust emissions (functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from introduction or proliferation of **invasive non-native species (INNS)** (functionally linked habitats outside designation	

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	boundary)	
	• Local (Ramsar and wider) population level impacts to Criterion 2 plant/invertebrate species from direct **habitat loss and damage** to habitats during construction (functionally linked habitats outside designation boundary) • Damage or loss of Criterion 2 plant/invertebrate species from habitat changes arising from changes in **air quality** (including via **construction waste and pollutants**) • Damage or loss of Criterion 2 plant/invertebrate species from habitat changes arising from changes in **sediment circulation and deposition patterns** • Damage or loss of Criterion 2 plant/invertebrate species from changes in **water and sediment quality** (including via **construction /operational waste and pollutants**) • Physiological stress or behavioural responses in Criterion 2 plant/invertebrate species caused by **lighting**. • Damage or loss of Criterion 2 plant/invertebrate species from introduction or proliferation of	• 5) Damage or loss (non-bird Ramsar species)

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	invasive non-native species (INNS)	
	• **Disturbance (noise and lighting)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2) • **Disturbance (human movement and activity)** giving rise to displacement, other behavioural changes or physiological stress responses amongst cited bird species (functionally linked habitats close to Tilbury2) • Damage (negative changes) to habitats used by cited species from changes to **sediment circulation or deposition patterns** (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes to **water and/or sediment quality** (either from surface or groundwater discharges from Tilbury2 site including **construction / operational waste and pollutants**; or from disruption of contaminated Thames sediments), with potential	• In Combination Effects

Designation	Effects described in Stage 1 screening assessment	Presented in integrity matrices as
	associated knock-on risk of bioaccumulation (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from changes in **air quality,** including from dust, **construction waste and pollutants,** and exhaust emissions (within designated area and functionally linked habitats outside designation boundary) • Damage (negative changes) to habitats used by cited species from introduction or proliferation of **invasive non-native species (INNS)** (within designated area and functionally linked habitats outside designation boundary) • **Direct loss of and damage to** habitats used by cited species during construction (functionally linked habitats outside designation boundary)	

STAGE 2: EFFECTS ON INTEGRITY

The Stage 1 (screening) assessment and consultation with NE has determined that it cannot be ascertained that Likely Significant Effects will not occur on the following sites from certain potential impact sources:

THAMES ESTUARY AND MARSHES SPA (REF: UK9012021) (Matrix 1)

THAMES ESTUARY AND MARSHES RAMSAR SITE (REF: UK11069) (Matrix 2)

These sites have therefore been subject to further assessment in order to establish if the Tilbury2 NSIP could have an adverse effect on their integrity. Evidence for the conclusions reached on integrity is detailed within the footnotes to the matrices below.

Matrix Key

✓ **=** Adverse effect on integrity **cannot** be excluded
✕ **=** Adverse effect on integrity **can** be excluded

C = construction
O = operation
D = decommissioning

Cells filled with grey tone denote effects screened out at Stage 1 as not likely to be significant for the reasons and justifications given in the Stage 1 screening matrices (Appendix 5).

HRA Integrity Matrix 1: Thames Estuary and Marshes SPA

Name of European site and designation: ***Thames Estuary and Marshes SPA***															
EU Code: ***UK9012021***															
Distance to Tilbury2: c.*1.5km*															
European site features	**Adverse effect on integrity**														
Effect	*1) Disturbance (within SPA)*			*2) Disturbance (outside SPA)*			*3) Habitat Damage (within SPA)*			*4) Habitat Loss or Damage (Functionally Linked Habitats outside SPA)*			*In combination effects*		
Stage of Development	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*
Article 4.1 qualifying feature: Avocet (winter)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.1 qualifying feature: Hen Harrier (winter)							**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.2 qualifying feature: Ringed Plover (passage)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.2 qualifying feature: Grey Plover (winter)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	

Article 4.2 qualifying feature: Knot (winter)							**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.2 qualifying feature: Dunlin (winter)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.2 qualifying feature: Black-tailed Godwit (winter)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.2 qualifying feature: Redshank (winter)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Article 4.2 qualifying feature: Total waterfowl (winter)				**×a**			**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	

HRA Integrity Matrix 2: Thames Estuary and Marshes Ramsar Site

Name of European site and designation: ***Thames Estuary and Marshes Ramsar Site***																		
Ramsar Code: ***7UK141***																		
Distance to NSIP: c.*1.5km*																		
Ramsar qualifying features	**Adverse effect on integrity**																	
Effect	*1) Disturbance (within Ramsar Site)*			*2) Disturbance (outside Ramsar Site)*			*3) Habitat Damage (within Ramsar Site)*			*4) Habitat Loss or Damage (Functionally Linked Habitats outside Ramsar Site)*			*5) Damage or loss (non-bird species)*			*In combination effects*		
Stage of Development	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*	*C*	*O*	*D*
Criterion 2 qualifying feature (nationally rare and scarce plant and invertebrate species)							**×b**	**×b**		**×b**	**×b**		**×b**	**×b**		**×c**	**×c**	
Criterion 5 qualifying feature: Total waterfowl (winter)				**×a**			**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	
Criterion 6 qualifying feature: Ringed Plover (passage)				**×a**			**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	
Criterion 6 qualifying feature: Black Tailed Godwit (passage)				**×a**			**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	

Criterion 6 qualifying feature: Grey Plover (winter)				**×a**			**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	
Criterion 6 qualifying feature: Knot (winter)							**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	
Criterion 6 qualifying feature: Dunlin (winter)				**×a**			**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	
Criterion 6 qualifying feature: Redshank (winter)				**×a**			**×b**	**×b**		**×b**	**×b**					**×c**	**×c**	

Evidence supporting conclusions (note that the same supporting evidence may be referred to for both the SPA and Ramsar Site as their extents and boundaries are largely coterminous, and the evidence is grouped under 'disturbance', 'damage' and 'in-combination effects'):

<u>Disturbance effects (to qualifying features using functionally linked habitats)</u>

a. Avocet, ringed plover, grey plover, black-tailed godwit and redshank (Birds Directive Article 4.1 and 4.2 qualifying species and Ramsar Criteria 5 and 6 species) all make use of intertidal habitats in closer proximity to the Tilbury2 site than the SPA/Ramsar Ste itself. The individual birds involved will in most cases be part of the local wintering or passage population that forms the qualifying feature. Quantitative data on the numbers using intertidal habitats within and in proximity to the proposed DCO limits is provided by the baseline information reported on at ES Chapter 10 (in particular Table 10.41) and further expanded upon in the technical 'Bird Note' (Appendix 9 to this HRA report, in particular Table 5). The data indicate that peak numbers using intertidal habitat within 300m from the proposed Order Limits at any one time remain in all recorded cases less than 1% of the SPA/Ramsar Site population (Appendix 9 to this HRA report, Table 7). 300m is taken as a rational outer extent of impact envelope for significant construction-phase disturbance (whether arising from noise, lighting or human movement and activity) taking into account literature on response distances amongst the bird species concerned (see Table 2 within the main body of this of HRA report) and outputs from the impact studies reported in the ES (in particular noise – Chapter 17, Table 17.30 [APP-031]). Noise impacts are considered to have the potential for the most spatially expansive effects of all these potential sources and therefore the envelope is set by reference to worst case noise impacts (i.e. during piling, which is assumed for assessment purposes to be constant, thus building in further precaution). Due to the sub-significant levels of use of intertidal habitats within this 300m envelope by SPA/Ramsar Site species in the baseline state, even if significant temporary construction phase disturbance effects could occur on receptors within it, the result (up to and including temporary displacement) is assessed as not likely to give rise to a significant effect on the qualifying features. However Natural England are of the view that a significant effect cannot be excluded, and therefore this potential impact source is assessed in the context of the integrity of the SPA/Ramsar Site. In considering the scope for adverse effects on integrity, key considerations are the likely extremely temporary duration of any displacement effect (the principal risk being piling which will be time-limited both within the 24 hour period and in terms of overall duration), the extent of functionally linked habitat available to temporarily displaced birds and the worst-case approach that has been taken to the assessment (i.e. assuming that all birds could be displaced from the 300m zone of significant noise impacts). Taking these factors into account, it is extremely unlikely that displacement due to disturbance emanating from the Tilbury2 site could have consequences for the SPA or Ramsar Site populations, or indeed significant physiological consequences for any individual birds or collective assemblages of individuals or mixed species agglomerations. **There is thus concluded to be no credible threat to the integrity of the SPA or Ramsar Site from this potential impact source and no need to progress to Stage 3 or 4 of the HRA process.** Although it does not constitute mitigation and is not presented as such, the Applicant has agreed to undertake monitoring of bird use of the intertidal habitats proximal to the Tilbury2 site for the duration of the construction phase. The details are presented in a Bird Monitoring and Action Plan (BMAP) which includes details of a traffic-light alert system triggered if bird numbers in the monitored areas fall below defined threshold levels, these to be derived from historical datasets (i.e. datasets referenced in the 'Bird Note' at Appendix 9 of this HRA report, including the baseline surveys for the ES). If an alert level is reached, consultation processes will be triggered, which will involve liaison with the statutory authority to ascertain whether any responsive action such as a temporary cessation of potentially disturbing activities is appropriate. This document will follow and when submitted will form an appendix to the HRA documentation, but is not relied upon for the assessment itself.

Damage to habitats and species (within and outside the SPA/Ramsar Site)

b. Taking account of mitigation measures to limit the spatial influence of construction-phase activity and reduce the potential for damage, direct losses of saltmarsh and intertidal mud habitats that may be used by Criterion 2 Ramsar species and which, if so, may thereby have a functional linkage to the Ramsar Site, will be minimal (0.035ha). Reinstatement and restoration measures will also render such impacts at least partly temporary, further reducing the potential for a significant effect. The scope for adverse effects on integrity is therefore vanishingly small even without regard to the compensatory provision that is proposed to ensure no net loss of priority habitat. Taking that compensatory provision into account, there is assessed to be greater likelihood of net beneficial consequences for Criterion 2 species than net negative, and in all scenarios, no scope for adverse effects on integrity.

Taking account of construction and operational restrictions contained within the Construction Environmental Management Plan (CEMP) [REP3-011] and/or volunteered through the Deemed Marine Licence/Development Consent Order, there is assessed to be no scope for significant changes to baseline sediment circulation (erosion and deposition) regimes within the SPA/Ramsar Site boundary arising as a consequence of marine works and dredging, during either the construction or operational phase. Of the two capital dredging scenarios assessed (namely backhoe dredge and disposal, and dispersal dredging by water injection (WID)), the latter has the potential to give rise to very minor, highly localised and temporary increases in sediment deposition within the intertidal areas of the SPA/Ramsar Site (ES Appendix 16.D [APP-089] and Appendix 8 to this HRA report). The favoured method of maintenance dredging is proposed to be by means of Water Injection Dredging (WID) limited to ebb tide periods outside of the months of June to August through operation of the DML conditions. Note that for maintenance dredging, whilst other methods could be used, these would also be subject to the relevant controls. The sediment plumes from all these dredging scenarios have been modelled and increases in subtidal deposition are predicted to be localised, and generally low in magnitude (<2mm) for each capital or maintenance dredging event (ES Appendix 16.D and Appendix 8 of this HRA report). The modelling study concludes that the proposed reliance on WID for most dredging operations means that displaced sediments will mostly disperse and redeposit within the sub-tidal zone, with very limited potential for increases in deposition on the intertidal areas. The study further concludes that the resulting variations experienced in the Thames sediment budget will be within the range of annual fluctuations in this part of the Thames (ES Appendix 16.D and Appendix 8 of this HRA report, section 7.3.3). On the basis of such conclusions, significant effects on sediment circulation regimes both within the downstream SPA and Ramsar Site, and on functionally linked intertidal habitats outside those designations, are not anticipated. Consequently, no risk to the quality and availability of intertidal habitats for cited SPA or Ramsar Site species is predicted, and **there is consequently no risk of adverse effect on the integrity of the European and/or Ramsar Site and no need to progress to Stage 3 or 4 of the HRA process.**

Localised elevated concentrations of PAHs including perylene, pyrene and fluoranthene and of metals including Arsenic, Chromium and Nickel have been found in samples of sediment around the existing Tilbury2 jetty and (in particular) the approach channel to it (ES Appendix 11.C [APP-088]). This is not unusual for Thames Estuary sediments. The contaminants of concern in this case generally have low solubility and where mobilised will mostly remain adsorbed onto sediment particles. This reduces the potential for contamination of the water column, but could pose a risk to sediment dwelling organisms were these substances to be re-deposited at high concentrations. The risk to marine and estuarine biota generally is assessed in ES Chapter 11 [APP-031]. Risk to higher trophic orders, including SPA and Ramsar Site cited fauna within those designations or using functionally linked habitats outside them, is mainly possible through these substances becoming directly bio-available in re-distributed sediments and or from biomagnification through the food chain, although the risks from biomagnification in the case of PAHs are ameliorated due to the greater capacity of higher organisms to metabolise PAHs. An assessment of the risks of significantly contaminated sediments around the Tilbury2 jetty being redistributed onto intertidal habitats associated with the SPA and Ramsar Site is reported at ES Appendix 16.D, section 6 (Appendix 8 of this report), focusing on the PAH perylene. It assesses its risk to the marine environment and the likelihood of its dispersion based on its solubility between the sediments, water and biota. The assessment indicates that perylene mobilised during dredging operations has a very low risk of becoming available to SPA/Ramsar cited species, with in particular a very low risk of significant deposition onto intertidal areas both proximal to the Tilbury2 jetty and within the SPA/Ramsar Site further afield. Other contaminants adsorbed to sediments will follow a similar dispersion pathway and therefore the risk of significant effects from mobilisation of other PAHs and metals observed at elevated levels in the samples is assumed to be equivalent or less than for perylene. Notwithstanding this low risk, restrictions adopted through the DML/DCO for the project and/or attached to future related consents will further obviate the scope for significant effects, through the adoption of non-dispersive capital dredging methods (e.g. backhoe dredging) for areas of the approach channel that are confirmed (e.g. by existing or future further surveys) to be appreciably contaminated with PAHs or other contaminants. The disposal of arisings from such operations will be to an appropriate licensed contaminated sediment treatment site to be defined in line with the relevant consenting procedures. **Such measures are assessed to obviate the scope for adverse effects on the integrity of the SPA/Ramsar Site (via its qualifying features) from mobilisation of contaminated sediments associated with dredging activities, such that there is no need to progress to Stage 3 or 4 of the HRA process.**

In respect of air quality, emissions of NOx and SO_2 from the proposed increase in vessel traffic on the Thames arising from the operation of Tilbury2 have been modelled and the increments of concentrations and deposition compared against critical levels and critical loads for vegetation, as set out in Appendices 6 and 7 of this HRA report. The results indicate that increases in atmospheric levels and/or deposition loads of both NOx and SO_2 on habitats *within* the SPA/Ramsar Site boundary will not be significant (in all instances increases of less than 1% of the critical level at the most affected location within the SPA/Ramsar Site (see Figures 2 to 5 in Appendix 7 of the HRA). For nitrogen and acid deposition, the maximum increment at any location within the SPA/Ramsar Site is just 0.2% of the most stringent critical load applied (i.e. 8 kg N/ha/yr listed as the lowest value for sand dunes, a habitat that is indicated to be present by on-line tools but which is actually scarce or absent in the SPA/Ramsar Site). Accepted critical loads for the broad habitats which encompass the vast majority of the SPA/Ramsar Site, including those used by qualifying bird species (e.g. saltmarsh, mudflat and coastal grazing marsh, for which cited critical load values are 20-30 kg N/ha/yr) are not at risk of being exceeded. There is no equivalent assessment for functionally linked habitats but similar conclusions can be drawn based on the geographical relationship between these and shipping lanes. While a significant change in deposition of atmospheric pollutants onto functionally linked habitats, cannot be ruled out, this needs to be viewed in the context of an improving background trend (ES Appendix 18.B.3 [APP-095]), and in the context of the precautionary approach adopted (worst case location and most stringent critical load) as well as an improving background trend (as demonstrated in ES Appendix 18.B.3 [APP-095]), and in the context of critical loads being exceeded for such habitats in many locations within and outside the designated areas in the baseline state. Whilst it is conceivable that the contribution made by shipping emissions from Tilbury2 alone could marginally retard the otherwise positive trend of improvement, at least in the short-medium term, there is no evidence or scientific rationale to suggest that such effects could be significant in terms of the integrity of the designated sites. Thus, there is assessed to be **no adverse effect on the integrity of the European and/or Ramsar Site and no need to progress to Stage 3 or 4 of the HRA process.** A very high certainty can be attached to this conclusion in respect of the SPA, albeit a slightly lower level of certainty is applicable to the assessment of adverse effects on the integrity of the Ramsar Site, due to the latter's inclusion of scarce plant species likely to have a degree of sensitivity to habitat changes attendant with eutrophication.

In respect of invasive non-native species (INNS), the principal mechanism for managing the risk of INNS from ships is the adherence to IMO regulations, particularly the Ballast Water Convention. The UK Government has committed to comply with the Ballast Water Convention which requires all ships involve in international trade to manage their ballast water to specified standards since September 2017. To mitigate against potential introduction of (marine) INNS, the port can liaise with the PLA/Harbour Authorities/ Thames Vision INNS Working Group, and ban cleaning of the hull of the vessels on site. The introduction of INNS through other elements of operation can be mitigated through the implementation of the check-clean-dry protocol. Provisions to manage the risk of INNS are set out within the CEMP, sections 6 and 7 [REP3-011], and within the LEMP [REP1-010]. With these measures in place the risk of introducing INNS by Port operations is unlikely to be significant and **no adverse effect on the integrity of the European and/or Ramsar Site is predicted, with no consequent need to progress to Stage 3 or 4 of the HRA process**. Such residual risk as remains has to be viewed in the context of the Thames already being one of the world's busiest inshore waters for international shipping.

In-combination effects

c. While the potential for cumulative disturbance effects to arise during operation from increased shipping movements generated by Tilbury2 added to future increments from other known consented or planned projects (as set out in ES

Chapter 20 [APP-031], and in the CEA [REP3-027]), these are predicted not to give rise to any credible threat to site integrity on the basis of available data on such movements, even when considered cumulatively. The main reasons are that because the majority of vessels will be large, with a corresponding large draught, such potential impact sources will be along predictable mid-channel paths, relatively remote (e.g. >200m) from designated intertidal habitats and will be experienced by avian receptors against a backdrop of existing regular traffic of large, distant vessels. The additional shipping movements from Tilbury2 alone are therefore assessed to represent an imperceptible increase in disturbance in the context of existing levels of habituation. Whilst a tipping point could theoretically be reached with unbridled future increase in river traffic, the requirements of navigational safety and the practical limitations of the river's morphology are assessed as likely to militate against large vessel traffic ever achieving a level where it poses a disturbance threat to bird use of intertidal habitats within or functionally linked to the SPA or Ramsar Site. This is in large part due to the requirement for larger vessels to remain within the maintained navigable channel in the central part of the river most remote from such habitats. This assessment stands with the additional consideration given to the Tilbury Energy Centre (TEC) and Lower Thames Crossing (LTC) projects, neither of which will give rise to significant additional shipping traffic.

The risk of in-combination effects from displacement of birds from intertidal habitats due to additive disturbance impacts is significantly ameliorated by the relatively limited number of projects that are likely to have overlapping construction phases (by reference to the Qualitative Cumulative Effects Assessment of Tilbury2 with TEC and LTC [REP3-027], anticipated construction periods are 2019 - early 2021 for Tilbury2, mid-2021 - 2025 for TEC, and 2021 - 2026 for LTC), the lower number of these likely to involve particularly disturbing activities such as piling and the limited zone of influence of noise impacts, relative to the amount of intertidal habitat available.

It cannot be ruled out that the Stage 1 screening threshold for LSE may be exceeded when emissions from increased shipping traffic from Tilbury2 are considered in-combination with those of other plans or projects (including combined cycle gas turbine emissions from Tilbury Energy Centre, and road traffic emissions from Lower Thames Crossing), however these developments are not anticipated to open for five years after Tilbury2, over which time there are anticipated to continue to be general improvements in air quality in the area (ES Appendix 18.B.3). In respect of the avian qualifying interest features of the SPA and Ramsar Site, the effect on critical levels for their habitats is in all cases negligible. The scope for impact is higher with regard to critical load exceedances affecting Ramsar-cited flora and the scope for indirect effects on qualifying features through attendant habitat change. Due to the locations of the various sources under consideration (shipping, road traffic, stack emissions), there is limited potential for the emissions to combine to an extent that would exceed critical loads in the qualifying interest species' key habitats of saltmarsh, mudflat or coastal grazing marsh within the SPA/Ramsar Site (i.e. limited potential for any likely significant effect). Therefore, in the context of improving baseline concentrations (as demonstrated in ES Appendix 18.B.3 [APP-095]) and deposition rates along the estuary, and the reduction in the contribution from shipping emissions with increasing distance inland, the cumulative effect of uplifts in vessel traffic from Tilbury2 in-combination with emissions from other proposed projects is not considered to pose a credible risk of adverse effects on integrity.

Cumulative (additive or synergistic) low magnitude effects on estuarine processes (including sediment circulation) that support intertidal habitats and related designations, and on water and sediment quality within designated areas or associated with functionally linked habitats, are also possible from refurbishment of marine structures and/or capital and maintenance dredging associated with other projects. However the potential influence on estuarine processes of the Tilbury2 project has been shown to be negligible and therefore significant in-combination effects are not likely regardless of the magnitude of effects arising elsewhere. Similarly, the adoption of measures to prevent significant mobilisation of polluted sediments, and the controls imposed by dredging regulators as a matter of standard practice, and the ability of Port of London Authority (PLA) to control other dredging in the estuary through marine licensing, leaves a negligible potential contribution to any cumulative water quality effects arising from other marine works projects and dredging activities, such that adverse in-combination effects are unlikely. Additive risks from invasive non-native species (INNS) are militated against by adherence to IMO regulations, particularly the Ballast Water Convention, and can be further mitigated against via liaison with the PLA/Harbour Authorities/ Thames Vision INNS Working Group, as described at ‘b’ above. In the absence of further information from the TEC or LTC projects (and assuming that further information does not identify any higher risk pathways for introduction of INNS from these sources) there is assessed to be no prospect of an adverse effect on the integrity of the SPA or Ramsar Site.

There are thus concluded to be no credible risks of significant in-combination effects having adverse consequences for the integrity of the European/Ramsar Site.

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