Port of London Authority:
Maintenance Dredge Protocol and
Water Framework Directive
Baseline Document

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Summary:-

The Port of London Authority who are the Harbour Authority for the Thames Estuary, has commissioned ABP Marine Environmental Research Ltd (ABPmer) to compile this Maintenance Dredge Protocol (MDP) Baseline document. The aim of the MDP is to collate relevant information into a Baseline Document to assist operators and regulators seeking, or giving approval, for maintenance dredging activities that could potentially affect European designated sites. This Baseline Document:

- Provides third parties wishing to carry out maintenance dredging within the study area with the relevant baseline information;
- Provides the information needed to inform the preparation of Water Framework Directive (WFD) assessments in accordance with the Environment Agency's 'Clearing the Waters' guidance; and
- Provides information to assist competent authorities in identifying 'likely significant effect' in respect of future maintenance dredging applications or proposals.

The Thames Estuary is one of the largest estuaries on the east coast of England, approximately 83 km in length to the normal tidal limit (NTL) at Teddington Weir, narrowing in width from around 2 km at the mouth to about 85 m at the NTL. The Thames Estuary and surrounding area are of high nature conservation importance with large areas of the estuary and the adjacent coastline having been designated as nationally and internationally protected sites. These sites include Special Protection Areas (SPAs), Ramsar Sites and Special Areas of Conservation (SAC), namely:

- Outer Thames Estuary SPA;
- Margate and Long Sands SCI;
- Essex Estuaries SAC;
- Foulness (Mid-Essex Coast Phase 5) SPA and Ramsar;
- Benfleet and Southend Marshes SPA and Ramsar;
- Medway Estuary and Marshes SPA and Ramsar; and
- Thames Estuary and Marshes SPA and Ramsar.

Maintaining safe port access for commercial and recreational maritime transport is an important function for all Harbour Authorities and is a requirement of the Department for Transport (DfT) Port Marine Safety Code. Maintenance dredging is undertaken to remove recently deposited sediment from access channels and berth pockets. Within the Thames Estuary, maintenance dredging to maintain and improve navigation channels has taken place since at least 1857.

The maintenance dredging within the Thames Estuary (up to the NTL at Teddington) is carried out under the management and direction of the PLA, which has a responsibility to maintain depths within navigation channels. Whilst the PLA has a responsibility to maintain the navigational fairways, the maintenance dredging of non-harbour authority berths and approaches is the responsibility of third party organisations under the regulation of the PLA. The majority of dredging within the Thames, by volume and frequency, are undertaken using water injection dredging (WID).Other areas are maintained using trailer suction hopper dredging, plough dredging and backhoe excavator dredging.. Maintenance dredging (by the PLA and third party berth operators) occurs throughout the Thames Estuary; by volume the outer part of the Inner Estuary sees the most frequent maintenance dredge activity.

However, the recently developed DP World London Gateway port facility and its access channel will provide maintenance requirements focused on the outer Estuary.

This Baseline Document provides a summary that is applicable at the time of publication, the MDP guidance identifies that Baseline Documents should not require substantial revisions unless major changes are proposed or significant new information becomes available. A number of proposed and consented schemes are anticipated within the Thames Estuary and these are described within Appendix A of this document which assesses the effects of maintenance dredging on designated sites as per the requirements of the Conservation Assessment Protocol for maintenance dredging. Where necessary, reference has been made to expected changes. After developments have occurred, following the Department for Food and Rural Affairs (Defra) MDP guidance, it remains the obligation of the scheme promoter to fund the update of the Baseline Document.

If this document is to be used to assist in the assessment of maintenance dredging, it is essential that the most up to date copy is available, and used by, competent authorities and operators. This Baseline Document has been updated as a result of the completion of the DP World London Gateway, which became operational in 2013, plus the changes in the MMO licensing process for navigational dredging which came into force in April 2014. In addition, new conservation designations (Marine Conservation Zones) have been included to capture updated condition status reports for designated sites.

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List of Abbreviations

AA	Appropriate Assessment
ABPmer	ABP Marine Environmental Research Ltd.
AL	Action Level
As	Arsenic
AWB	Artificial Waterbody
CD	Chart Datum
Cd	Cadmium
Cefas	Centre for Environment, Fisheries and Aquaculture Science
CHA	Competent Harbour Authority
CHaMP	Coastal Habitat Management Plan
CPA	Coast Protection Act
Cr	Chromium
cSAC	candidate Special Area of Conservation
Cu	Copper
DBT	Dibutyl tin
DCLG	Department for Communities and Local Government
DDT	Dichlorodiphenyltrichloroethane
Defra	Department for the Environment, Food and Rural Affairs
DfT	Department for Transport
DSIS	Dredging Spatial Information System
EA	Environment Agency
EIA	Environmental Impact Assessment
EMS	European Marine Site
EQS	Environmental Quality Standard
FEPA	Food and Environment Protection Act
GIS	Geographical Information System
HDM	Hydro-dynamic dredging method
Hg	Mercury
HMWB	Heavily Modified Water Body
IECS	Institute of Estuarine and Coastal Studies
JNCC	Joint Nature Conservation Committee
KEIFCA	Kent and Essex Sea Fisheries Committee
LOD	Limits of detection
LSE	Likely significant effect
MAC	Medway Approach Channel
MCZ	Marine Conservation Zone
MDP	Maintenance Dredge Protocol
MHW	Mean High Water
MLW	Mean Low Water
MMO	Marine Management Organisation
MOD	Ministry of Defence
MPA	Marine protected Area
N2K	Natura 2000
NDPB	non-departmental public body
Ni	Nickel
NPPC	National Planning Policy Framework
NTL	Normal Tidal Limit
NVZ	Nitrate vulnerable zone
PAH	Polyaromatic hydrocarbons
Pb	Lead
PCB	Polychlorinated biphenyls
PLA	Port of London Authority

PSA	Public Service Agreement
pSAC	possible SACs
pSPA	potential SPAs
RBMP	River Basin Management Plans
rMCZ	Recommended Marine Conservation Zone
RSPB	Royal Society for the Protection of Birds
SAC	Special Area of Conservation
SCI	Site of Community Importance
SHA	Statutory Harbour Authority
SPA	Special Protection Area
SSC	Suspended Sediment Concentration
SSSI	Site of Special Scientific Interest
TBT	Tributyl tin
TPH	Total petroleum hydrocarbons
TSHD	Trailer suction hopper dredging
UKHO	United Kingdom Hydrographic Office
UWWTD	Urban Waste Water Treatment Directive
VTS	Vessel traffic Survey
WFD	Water Framework Directive
WID	Water Injection Dredging
Zn	Zinc

Units

mm	Millimetre
m	Metre
km	Kilometres
M	Million
Mg	milligram
kg	Kilogram
ppm	parts per million
%	Percent
T	tonnes
Yr	year
l	Litre
Yd	Yard

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1. Introduction

1.1 Background

The Thames Estuary is one of the largest estuaries on the east coast of England, a classic macrotidal funnel-shaped estuary, approximately 82.5 km in length to the Normal Tidal Limit (NTL) at Teddington Weir, narrowing in width from around 2.1 km at the mouth to *circa* 85 m.

The estuary has been heavily reclaimed and modified over time by anthropogenic influences which have had significant impacts on the coastal processes and morphodynamics of the Thames Estuary by changing the geographical distribution of sediment sources and sinks (see Section 5.2.4). The area covered by the floodplain deposits of the Thames Estuary has been progressively protected and developed since the 12th century. The Industrial Revolution led to the construction of major docks and a rapid expansion of industrial development. The closure of the London docks in the late 1950s, and the transfer of these facilities downstream to Tilbury, led to further extension of industrial developments on saltmarshes previously used for agriculture. The Thames Estuary provides a number of port facilities (e.g. Tilbury and London Gateway) along with numerous oil and gas terminals, ferry terminals, wharfs, jetties, and piers (see Sections 5 and 6). In addition to commercial activity, the Estuary is also used by recreational clubs and individuals for leisure activities, although some watersports are restricted to certain areas of the river for the purposes of safety.

Maintenance dredging within the Thames Estuary (up to the NTL at Teddington) is carried out under the management and direction of the Port of London Authority (PLA), which has a responsibility to maintain depths within the navigation channels. Berth operators are responsible for the maintenance of their berths and approaches under the regulation of the PLA (see Section 2). Maintenance dredging (by the PLA and third party berth operators) occurs throughout the Thames Estuary (see Figures 6.2 to 6.7), however most of the maintenance dredging currently occurs in the outer region of the Inner Estuary, although in the near future additional maintenance dredging will be under taken in the Outer Thames in relation to the approach channel for the recently developed DP World London Gateway.

1.2 Objectives

This Baseline Document has been prepared in order to comply with the requirements of the Conservation Assessment Protocol for maintenance dredging, with respect to 'The Conservation of Habitats and Species Regulations 2010'. It is the Government's view, supported by rulings in the European Court of Justice, that maintenance dredging should be considered as a 'plan or project' for the purposes of the EC Habitats Directive (92/43/EEC), and assessed in accordance with Article 6(3) of that Directive (Defra, 2007). A requirement therefore exists to ensure that maintenance dredging operations with the potential to affect Natura 2000 (N2K) sites are considered in a wider sediment management context. The aim of the protocol is to collate relevant information into a Baseline Document to make the process of assessing the effect of maintenance dredging more explicit for all parties.

To fulfil this obligation the PLA, has commissioned ABP Marine Environmental Research Ltd (ABPmer) to compile a Baseline Document following the guidance provided in the Department for Food and Rural Affairs (Defra) Maintenance Dredging

and The Habitats Regulations 1994 'A Conservation Assessment Protocol for England'. This baseline provides all parties wishing to carry out maintenance dredging within the PLA Statutory Harbour Area with the relevant information to support maintenance dredge licence applications and the information needed to inform the preparation of Water Framework Directive (WFD) assessments in accordance with the Environment Agency's 'Clearing the Waters' guidance.

In addition to the requirements of the Habitat Regulations, this Baseline Document also addresses requirements under the EU Water Framework Directive (WFD) (2000/60EC) and the EU Environmental Quality Standards Directive (EQS) (2008/105/EC) in respect of maintenance dredging and disposal. The lead authority for overseeing the implementation of the WFD within England and Wales is the Environment Agency.

Production of a Baseline Document is voluntary but without it individual maintenance dredge proposals (in this instance from third party berth operators within the Thames Estuary; see Section 2) may require more extensive and time-consuming information gathering and consultation. The Baseline Document therefore aims to provide an agreed basis for the licensing authority to consider maintenance dredge applications. The presumption, in assessing any potential consequences of dredging activity, is that maintenance dredging will continue in line with established practice. To establish existing maintenance dredge activities, this baseline has drawn on existing and readily available information, including the PLA's Dredging Spatial Information System (DSIS) (described in Section 4) and presents the current and historical patterns of dredging in relation to the conservation status of the designated sites. This Baseline Document has been updated (April 2014) to take account of new baseline data, changes to existing dredging campaigns and new dredging campaigns since the previous baseline and assessment was published in 2009 (PLA, 2009).

The objectives of this Baseline Document are as follows:

- To synthesize relevant existing information about the environmental status of the study area and, in particular, what is known about the potential extent of impacts of previous maintenance dredging activities undertaken by PLA and others;
- To provide the data necessary to allow any maintenance dredging proposals for the River Thames to be assessed in accordance with Article 6(3) of the Habitat Directive and in line with the Conservation Assessment Protocol on Maintenance Dredging and the Habitats Regulations 1994 (the 'Maintenance Dredge Protocol' (MDP)); and
- To assist competent authorities in identifying 'likely significant effect' in respect of future maintenance dredging applications or proposals (see Appendix A).

It should be noted that the MDP recommends that as sites change over time, whether as a result of natural or anthropogenic change, the Baseline Document will need to evolve. As such, in the future this document will require updating as more information becomes available and if circumstances and requirements change.

1.3 Study Area

The PLA is the Harbour Authority for the Thames Estuary from the seaward approaches in the Outer Thames to the NTL at Teddington, and the study area is

commensurate with the extremities of the PLA's Statutory Harbour Authority Area (see Figure 1.1). The study area includes the approach channel to the Medway Estuary, however, whilst referenced and identified within this document, historical and current maintenance dredging has been described in an MDP compliant Baseline Document specific to the Medway Estuary (Peel Ports, 2012) and hence will not be described in detail in this document.

1.4 Report Structure

This MDP compliant Baseline Document is structured into the following sections:

Section 1: Introduction (this section);
Section 2: Details the legislation context behind the MDP and the Marine Navigation Dredging Framework under the Habitats Directive and the WFD;
Section 3: Summarises general licence conditions for third parties undertaking maintenance dredging in the Thames Estuary;
Section 4: Describes the PLA Maintenance Dredge Framework;
Section 5 Outlines relevant coastal, estuarine and morphological processes for the Thames Estuary;
Section 6: Details the history of dredging within the study area, followed by current dredging and disposal practices;
Section 7: Contains information relating to sediment quality and presents an overall assessment of sediment quality from previous licence applications;
Section 8: Outlines the study area nature designations, the interest features from these designations and also the WFD water bodies and their current status; and
Section 9: Summarises data gaps identified during the data collation stages of this study and makes recommendations relating to information for future iterations of the Baseline Document.

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2. Legislation

Marine navigation dredging (both capital and maintenance dredging) and disposal are highly regulated activities due to their potential to negatively affect the environment if they are not carefully considered and controlled. Dredging activities are primarily licensed under application to the Marine Management Organisation (MMO), an executive non-departmental public body (NDPB) established and given powers under the Marine and Coastal Access Act 2009. Also, where powers to dredge in Harbour Areas are conferred by Acts of Parliament, local works or dredge licences issued by the Harbour Authority may permit dredging (and other activities) within the scope of the special Act under which they are issued. The following section details the legislative context in which this Baseline Document has been drafted.

2.1 National Legislation

Dredge and disposal operations are regulated by the MMO, using powers conferred primarily through the 'Marine and Coastal Access Act' 2009. This Act has established a single Marine Licence, which came into effect on 6 April 2011. Prior to this date, dredge and disposal operations were regulated by two separate Parliamentary Acts; the first being the Coast Protection Act (CPA) 1949 as amended by Section 36 of the Merchant Shipping Act 1988. The second Act regulated disposal of dredged material at sea, and was termed the 'Food and Environment Protection Act (FEPA) 1985 (as amended)'. The FEPA licence provided the basic environmental control for sea disposal of dredged material and regulated beneficial use.

Under the 'Marine and Coastal Access Act' 2009, all dredging and disposal activities require a marine licence unless they qualify for an exemption from licensing control by virtue of the 'Marine Licensing (Exempted Activities) Order' 2011 and the 'Marine Licensing (Exempted Activities) (Amendment) Order' 2013. Under the 'Marine Licensing (Exempted Activities) (Amendment) Order' 2013, which came into force on 6 April 2013, the following dredging activities are exempt from licensing:

- Certain dredging activities carried out by, or on behalf of, a Harbour Authority, which involves the relocation of sediments inside surface waters, including for the purpose of managing waters and waterways. The activity must be authorised by a local Act or harbour order and the authority must demonstrate to the MMO's satisfaction that the sediments are non-hazardous; and
- Small-scale navigational dredging (removing under 500 m^3 dredge material per campaign and under 1,500 m^3 per annum; referred to as '*de minimus*' dredging) carried out for navigational purposes in an area that has been dredged at least once in the preceding 10 years.

From 6 April 2014, any maintenance dredging activity which does not fall into the above categories will require a licence from the MMO. An 'accelerated' licensing process, designed to license relatively small-scale ongoing dredging activities with limited consultation, will be available for dredging activity which fulfils the following criteria:

- Dredge campaigns between 500 to 3,000 m^3 per campaign and less than 10,000 m^3 per annum;
- Dredging is ongoing and has been carried out in the same way for at least 3 years;

- Campaigns are separated by at least one month;
- Evidence on the quality of sediment is provided; and
- The project is assessed as part of an MDP Baseline Document or another form of assessment agreed with Natural England of likely impacts.

All other maintenance dredging activity (i.e. removing volumes above 3,000 m^3 per campaign and over 10,000 m^3 per annum), capital dredging activities and those associated with environmental impact assessment (EIA) will require a Marine Licence from the MMO obtained through the standard marine licensing process. Information required to support such licence applications should include:

- Dredging methodology;
- Pre-dredge survey showing the boundary of dredge area, dredge depths, existing bed levels, side slopes;
- Dredging history;
- Current or previous licences and associated conditions, including from the local harbour authority (in this instance the PLA), Coastal Protection Act, consent under Environment Agency (EA) byelaws or a marine licence;
- Physical and chemical characteristics of the dredged material, including physical nature (i.e. silt, sand, gravel etc.) and chemical quality (i.e. in relation to pollutants); and
- Information on progress regarding achieving other consents if necessary (e.g. from the landowner or local harbour authority).

Further details of the licensing process for maintenance dredging is described on the MMO website (MMO, 2014).

2.2 Marine Navigation Dredging Under the Habitats Regulations

Under Regulation 61 of the Habitat Regulations all competent authorities are required to carry out an AA if the proposed works are within or adjacent to a designated European Marine Site (EMS) and if they are likely to have a 'significant effect' on the site, either alone or in combination with other 'plans and projects'. The UK Government considers that maintenance dredging proposals, which could potentially affect an EMS, need assessing in accordance with Article 6(3) of the Habitats Directive (Defra, 2007). In effect this means that ongoing maintenance dredging should be considered as a relevant 'plan or project' and requires its effects on the EMS to be considered according to a specified procedural framework that may result in a requirement for an AA prior to any consent being granted.

The MDP is intended to use readily available data to complete a Baseline Document (this document) and, drawing upon existing information, to describe the current and historical patterns of dredging in relation to the conservation status of the EMS. Completion of the protocol is voluntary; however those estuaries with completed Baseline Documents may use these in support of maintenance dredge applications. The licensing authority will use Baseline Documents as a reference point to provide a basis against which maintenance dredging applications can be assessed. It is anticipated that this strategy will streamline the consenting procedure.

2.3 Marine Navigation Dredging Under the Water Framework Directive

The EU Water Framework Directive (WFD) (2000/60/EC), which came into force on 22 December 2000, is implemented in the national water regulations of the Member

States. The Directive establishes a new approach to the protection, improvement and sustainable use of Europe's rivers, lakes, estuaries, coastal waters and groundwater. The Directive applies to all surface waters out to 1 nautical mile (nm) seaward of the baseline for territorial waters and to ground waters. For management purposes, surface and ground waters are divided into a number of discrete units termed 'water bodies'. Water bodies relevant to this study have been presented in Figure 8.3.

The WFD is implemented in England and Wales through the 'Water Environment (Water Framework Directive) (England and Wales) Regulations 2003' (commonly termed the Water Framework Regulations). The WFD introduces new broader ecological objectives, designed to protect and where necessary, restore the structure and function of aquatic ecosystems themselves and thereby safeguarding the sustainable use of water resources (UK TAG, 2009).

Under the Regulations, the Environment Agency is the competent authority for implementation of the Directive in England and Wales. Programmes of measures have been developed through a process of river basin management planning and are set out in a number of regionally based River Basin Management Plans (RBMPs) formally published in December 2009. To help those undertaking navigational dredging and disposal activities to comply with the requirements of the WFD in transitional (estuary) and coastal water bodies, the Environment Agency has published the 'Clearing the Waters' guidance (Environment Agency, 2012).

Under the new maintenance dredging licensing regime described in Section 2.1, third parties applying to the MMO for a Marine Licence will be required to undertake a WFD assessment (this will not apply where a Marine Licence is not required, e.g. for *de minimus* dredging; see Section 2.1).

2.4 Local Harbour Powers

The PLA is the Statutory Harbour Authority on the River Thames and as such has powers to carry out maintenance dredging for navigational purposes under Section 60 of the 'Port of London Act 1968 (as amended)', which states:

"(1) The Port Authority may cleanse, scour, cut, deepen, widen, dredge and improve the bed and banks of the Thames, and may take up and remove material therefrom.

(2) Any material so taken up and removed shall (in so far as it is not the property of the Port Authority before being taken up) become the property of the Port Authority on taking up and may be used, sold, deposited or otherwise disposed of as the Port Authority think fit:

Provided that no such material shall be deposited below the level of mean *high water springs seaward of the Yantlet line except in such position as the Board of Trade may approve, and subject to such restrictions and conditions as they may impose."*

These powers enable the PLA to carry out maintenance dredging in the statutory harbour area with exemption from the licensing provisions and licensing control which would normally be required in order to dredge material from below mean low water (see Section 2.1). Consent is still required from the MMO in the form of a Marine Licence in order to deposit any dredging at sea.

Further legislative requirements apply when works are of a sufficient nature or scale or are within a 'sensitive' area for nature conservation. The Marine Works (Environmental Impact Assessment) Regulations 2007 provide a requirement to carry out an EIA prior to granting consent where a plan or project is deemed likely to give rise to 'significant effects'.

Before any dredging work is undertaken by third parties on the tidal Thames it is a statutory requirement that a licence for such works is granted and the PLA has the powers to grant such a dredging licence under Section 73 of the of the Port of London Act 1968 (as amended) which relates to the Licensing of dredging and states:

"(l) Subject to section 74 (Crown property) of this Act, the Port Authority may upon such terms as they think fit, including conditions as to variation and revocation of the licence, grant to a person a licence to cleanse, scour, cut, deepen, widen, dredge or take up or remove material from the bed and banks of the Thames.

(2) A licence under this section may be given under the hand of a duly authorised officer of the Port Authority.

(3) A person who cleanses, scours, cuts, deepens, widens, dredges or takes up or removes material from the bed or banks of the Thames and who cannot show that he is acting under and in accordance with a subsisting licence granted under this section shall, without prejudice to any other remedy or proceeding against him, be guilty of an offence and liable to a fine not exceeding [level 4 on the standard scale].

(4) The issue of a licence under this section shall not confer statutory authority for the carrying out of the work covered by the licence.

(5) In the exercise of the powers conferred by a dredging licence the holder of the licence shall not damage or injuriously affect:
(a) any submarine cable placed or maintained by the Postmaster General; or
(b) any undertakers work (as defined in section 195 (For protection of statutory undertakers) of this Act); or, without the consent of the Postmaster General or the undertakers concerned, as the case may be, interfere with or adversely affect the operation of any such submarine cable or undertakers work.

(6) A dredging licence shall not be required under this section by a river authority or drainage authority in exercise of their functions under the Land Drainage Act, 1930, the Land Drainage Act, 1961, or the Water Resources Act 1963."

As indicated in Section 73 of the Port of London Authority Act 1968 (as amended) above, dredging works are defined as including any operation to cleanse, scour, cut, deepen, widen, dredge or take up or remove material from the bed and banks of the Thames. Dredge methods including bed levelling, backhoe, ploughing, hydro dynamic, trailer suction hopper and Water Injection Dredging (WID) fall within this definition.

Maintenance dredging licences are normally issued to third parties by the PLA for a period of 12 months. However, a three year dredging licence may be issued where a dredge site can be shown to be stable in terms of the dredging requirement, dredging methodology and chemical quality and where no adverse environmental effects have been observed. General licence and monitoring conditions for third parties licensed to undertake maintenance dredging under Section 73 of the Port of London Act 1968 (as amended) are described in Section 3.

3. Licence and Monitoring Information

One and three year licences issued to third parties for maintenance dredging under Section 73 of the Port of London Act 1968 (as amended), contain a set of general conditions which are described in Schedule 3 of the Licence issued to the third party licensee. The general conditions relating specifically to pre and post dredging requirements and dredging activity (for both one and three year licences) are summarised below (note, miscellaneous general conditions have not been included). Text shown in [ ] may not apply to all licences and/or will have licence specific information added.

Requirements prior to commencement and on completion of a dredging campaign:

- To ensure that the Licensee's contractor undertaking the dredging campaigns completes and returns a 'Contractor's Acknowledgement' form to the PLA at least ten working days prior to the first dredging campaign;
- At least 5 working days in advance of the first dredging campaign, supply a method statement to the PLA which includes details of the obligations in this licence. The method statement must be approved by the PLA prior to dredging commencing and will set out how all dredging campaigns under this licence are to be undertaken;
- For each separate dredging campaign, in compliance with PLA specifications, undertake a pre-dredge bathymetric survey and post-dredge no later than one week after the dredging campaign has been completed (the extent of the bathymetric survey area must be agreed with the PLA prior to dredging commencing);
- To provide the PLA with the results of all surveys undertaken prior to and on completion of dredging campaigns;
- To inform the PLA's Environment Manager in writing of the completion of each separate dredging campaign carried out under this Licence within 24 hours of completion;
- [Obtain the prior written consent of the Environment Agency for any proposed works or structures either affecting or within 9 metres of the tidal or fluvial flood defence under the terms of the Water Resources Act 1991 and the Land Drainage Byelaws. A copy of this consent must be forwarded to the PLA's Environment Department before dredging commences];
- [Before each separate dredging campaign and survey and again at the end of each dredging campaign and survey to inform London Vessel Traffic Services ("VTS") and to contact VTS at any other time requested by VTS];
- To provide a post dredge report within one month after each dredging campaign in compliance with PLA specifications; and
- To provide a report within one week after each dredging campaign which details the dates and times dredged.

Requirements of how the dredge is to be undertaken:

- To carry out the dredging to the PLA's satisfaction and in accordance with the method statement approved by the PLA;
- To undertake no more than [two/three/four] dredging campaigns during the duration of this Licence and to remove no more than [xm^3] of material during each separate dredging campaign and no more than [xm^3] of material in total;
- The depth of the dredge is not to exceed [xm] below chart datum;

- To comply with the requirements of the PLA's harbourmaster as to the mooring placing marking and working of vessels used in connection with dredging;
- To inform London VTS at least 30 minutes before and on completion of dredging in order that a suitable warning and 'proceed with caution' in accordance with Permanent Notice to Mariners 4/08 can be included on the routine half hourly navigation broadcast; and
- Vessels engaged in dredging operations are to be licensed appropriately and the masters thereof properly certificated; licences and certificates must be available on board and available for inspection by the harbour master or his appointed Deputies. If not available for inspection, work may be stopped until such time as correct certification and licenses are demonstrated to be in place.

In addition there are conditions related specifically to certain dredge methods and these are shown below:

- WID - to undertake dredging on the ebb phase of the tide only; and
- Dispersive methods are restricted (not to be carried out) above Tilbury during the months of June to August inclusive, to prevent elevated water quality issues during months of high water temperatures and low oxygen levels[1].

For the three year licences, the PLA reserves the right to impose additional controls or to require changes to the dredging methodology where this is considered necessary in the light of monitoring or sampling licence requirements. Furthermore, if there are any changes to the Licensee's dredging requirements or the sensitivity of the environment in the area to be dredged or its vicinity, the PLA reserves the right to review and if necessary vary the terms of the Licence. Additional general conditions that apply for three year licences are:

- To supply the PLA on each anniversary of the date of the licence, for the duration of the licence, the start and end dates of each dredging campaign and the quantity of material removed during each dredging campaign carried out in that year; and
- In relation to investigations and sampling - to undertake further sediment sampling during the duration of the Licence if required by the PLA because a pollution event has occurred, or there is an indication one has occurred involving a discharge or a possible discharge of polluting oil noxious liquid substances or harmful substances or goods either in the area to be dredged or in the vicinity of a dredge area, and to provide the results of the sediment sampling to the PLA as soon as possible thereafter.

[1] This condition does not apply to dredging undertaken at Vopak London Terminal (Jetties 1,2 and 3) due to restrictions (specific licence conditions) which already apply at this site to minimise overwintering bird disturbance.

4. Port of London Authority Maintenance Dredge Framework

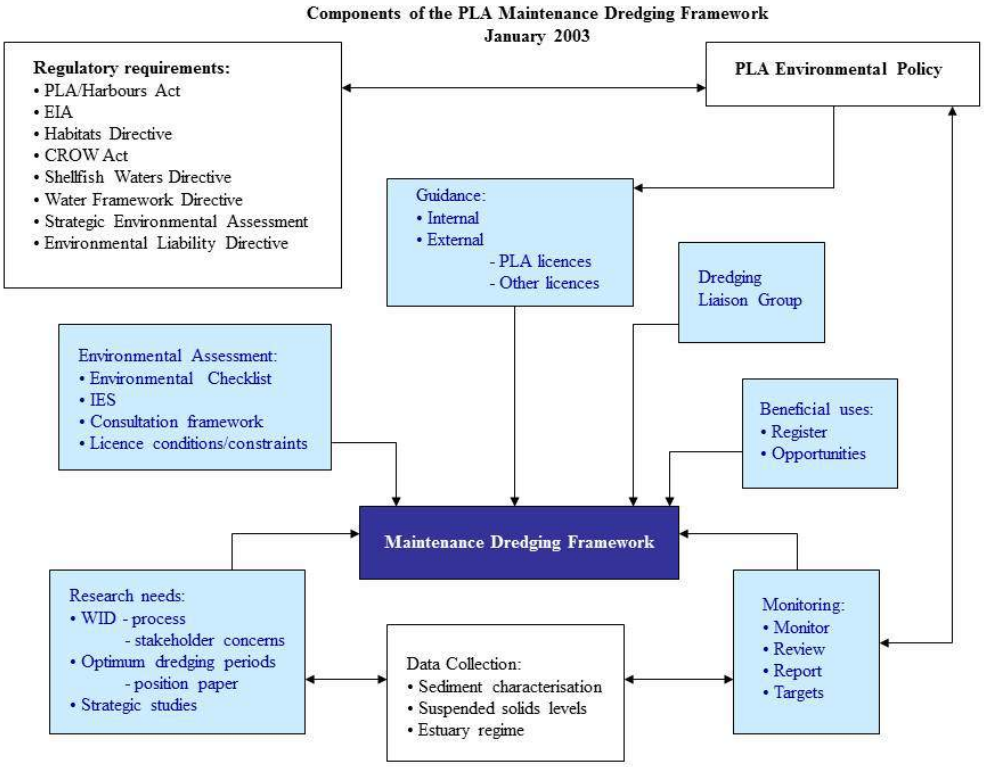
In 2003 the PLA established a Maintenance Dredging Framework for the Thames in partnership with members of the Dredging Liaison Group (a Thames Estuary Partnership Action Group). The framework provides for the co-ordinated assessment and management of dredging operations on the tidal Thames, including consideration of any likely impacts on designated conservation sites, by bringing together stakeholders as partners in the decision-making process for dredging licence applications. Stakeholder partners include, the Environment Agency, Natural England, the Royal Society for the Protection of Birds (RSPB), Kent and Essex Sea Fisheries Committee (KEIFCA) and four dredging companies, with the Thames Estuary Partnership providing administrative support and a neutral forum for discussion. An important consideration in developing the framework was the need to understand the estuary at a strategic (i.e. 'whole estuary') level, enabling decisions to be made in full awareness of strategic as well as site-specific issues. The Framework structure is shown in Image 4.1 below.

The 'Maintenance Dredging Framework' comprises an ongoing and continually evolving collection of initiatives, including:

- Dredging Spatial Information System (DSIS);
- Environmental impact assessment and appraisal procedures;
- A beneficial uses register;
- Information for berth owners and operators;
- Consultation mechanisms;
- Data collection and monitoring; and
- Collaborative research.

A key component of the Framework was the development of the Geographical Information System (GIS) Dredging Spatial Information System (DSIS). The DSIS facilitates the sharing of information and produces a baseline of relevant environmental data for the tidal Thames. DSIS is available to members of the Dredging Liaison Group via a secure connection on the PLA's website. Much of the current and historic dredging information and sediment contamination summary information presented in Sections 6 and 7 have been sourced through DSIS, supplemented by stakeholder and third party operator liaison where required.

This report will provide an updated Baseline Document to inform several components of the Maintenance Dredging Framework (e.g. updated regulatory requirements). It is recommended that the Framework, which provides a functional approach to forward planning of maintenance dredging campaigns in the Thames, is revised to ensure it provides guidance on the recent changes to the maintenance dredging licence regime (i.e. the need for third parties to obtain a Marine Licence from the MMO in addition to the current requirement for a licence from the PLA; see Section 2.1) and subsequent sediment contamination sampling and testing regimes as part of the additional MMO licensing process to ensure the licensing process for third party berth operators is as streamlined as possible.



(Source: PLA, 2013)

Image 4.1 PLA Maintenance Dredging Framework for the Thames Estuary

5. Coastal and Estuarine Processes and Morphology

5.1 Overview

The Thames Estuary is one of the largest estuaries on the east coast of England, a classic macrotidal funnel-shaped estuary that has been heavily reclaimed and modified over time by anthropogenic influences. The estuary is approximately 82.5 km in length to the normal tidal limit (NTL) at Teddington Weir, narrowing in width from around 2.1 km at the mouth to *circa* 85 m. Table 5.1 provides a summary of the physical parameters of the Thames Estuary, as taken from the Futurecoast Study (Defra, 2002).

Parameter		Thames Estuary
Total area	(ha)	20,000
Intertidal area	(ha)	13,510
Marsh area	(ha)	0
Shoreline	(km)	232
Channel length	(km)	82.5
Mean river flow	(cumec)	92.5
Maximum river flow	(cumec)	572.7
Cross sectional area	(m^2)	58,062
Mouth width	(m)	2,100
(Source: Defra, 2002)		

Table 5.1 Key estuary parameters for the Thames Estuary

The following sections of this document provide a summary of the past evolution of the Thames Estuary (both from a geological and anthropogenic perspective) and the present day baseline hydrodynamic and sediment regimes. In order to present this review, a number of key information sources have been utilised, these include the Greater Thames CHaMP, the Thames Estuary 2100 project, PLA monitoring studies and a variety of technical/ research papers and reports.

5.2 Past Evolution

5.2.1 Geological Evolution

The Thames Estuary lies towards the southern edge of the London Basin bounded by upland areas to the south (North Downs) and north (Chiltern Hills) composed of Cretaceous Chalk. It was not until the Late Cretaceous (around 65 million years ago) that a major rise in sea level across Europe led to a significant deepening of the sea and without the influence of sediments brought in from nearby landmasses a very pure marine limestone was deposited in the warm sea. This is the Chalk, which may constitute up to 98% calcium carbonate, and forms the sub-crop of sections of the middle part of the Inner Thames (Erith downstream to Tilbury and parts of Woolwich and Gallions Reaches) (Sumbler, 1996). Elsewhere the Chalk is covered by Tertiary muds and sands (Balson and D'Olier, 1989; British Geological Survey, 1997).

A fall in sea level allowed the emergence of large areas of land and a considerable thickness of Chalk was eroded away. However, around 60 million years ago, sea level rose again and a shallow sea invaded the area depositing a series of Tertiary muds and sands reflecting changes in sea level and the transgression and regression of this sea (Sumbler, 1996). The oldest Tertiary sediments beneath the

Thames Estuary belong to the Thanet Sand Formation and Lambeth Group. The bulk of the Thanet Sand consists of shallow marine silty sand with the main outcrops in south-east London (e.g. Howland, 1991) and north Kent. The Lambeth Group comprises sands (the Upnor Formation) deposited in a shallow sea and the overlying Woolwich Formation, comprising a varied assortment of sediments including clays and sands deposited in brackish, estuarine or coastal lagoon environments.

Following a rise in sea level, shallow marine conditions were again established in the Thames area, and the Harwich Formation was deposited, made up of several distinct units of mud and sand. Sea level continued to rise during the Eocene (55 to 35 million years ago) leading to the deposition of the thick bluish-brown London Clay which is the most widespread and best known of the Tertiary deposits of the London Basin and underlies much of Greater London and the Thames.

The Tertiary units are overlain by a complex suite of sediments deposited during the glacial and interglacial phases of the Quaternary, including those of the Holocene (last 10,000 years). Between the Anglian glaciation and the Devensian glaciation (the last Ice Age) the River Thames and its tributaries became established in their modern valleys and formed wide expanses of river terrace sands and gravels (Bridgland, 1994). These are mainly remnants of floodplains, representing phases in the gradual downcutting of the river during the Pleistocene; the highest terrace being the oldest and the lowest the youngest. This gently terraced landform is now almost completely obscured by urban development. The last major phase of terrace formation was during the Devensian glaciation when the River Thames was graded to a level at least 25 m below present sea level. The Late Devensian River Thames appears to have followed a braided course, crossing a wide floodplain until the early Holocene when it gradually developed into a single channel river (Wilkinson and Sidell, 2000). The deposits are now covered by estuarine alluvium, deposited as sea level rose during the Holocene interglacial (10,000 years ago to present).

Following the melting of the ice sheet at the end of the Devensian glaciation there has been a significant rise in sea level. The Thames Estuary was flooded around 8,000 years ago and complex sequences of marine/brackish sediments intercalated with freshwater peats were deposited on the youngest terrace sands and gravels (Devoy, 1977, 1979, 2000; Marsland, 1986). The Holocene sediments cover the floodplain approximating to the area that has been flooded by high water spring tides, including that presently protected by flood defences; they occur on both sides of the estuary and occupy an overall width of 3 to 10 km (Royal Haskoning, 2004).

The width of the Thames Estuary floodplain deposits is partially controlled by the position and strength of the Cretaceous and Tertiary sub-crops. The most significant change occurs at Tilbury where relatively soft Tertiary deposits downstream are replaced by relatively hard Chalk upstream, resulting in greater confinement of the river upstream. As a consequence the width of the floodplain deposits narrows rapidly from 10 km in the Coryton area to 3 km at Tilbury-Gravesend. The thickness of the deposits increases downstream, reaching a maximum of about 35 m at the eastern end of Canvey Island (Marsland, 1986).

5.2.2 Holocene Evolution

Devoy (1977, 1979) proposed two Holocene relative sea level curves from the estuary, one for Tilbury and one from sites to the west of Tilbury. Although the curves from both areas followed the same trend, the Tilbury curve plotted *circa* 1.5 to 3 m

below the west of Tilbury curve. Various reasons have been put forward for this anomaly, including the possibility of differential subsidence on an east-west axis (Devoy, 1979). However, a reinterpretation of the data (Haggart, 1995; Long, 1995), removed the need for eastward trending subsidence.

The most recent model proposed for the Holocene evolution of the Thames Estuary (Long, 2000; Long *et al*., 2000) describes sedimentation within a three-stage sequence based on estuarine development:

- **Stage 1:** The early Holocene rapid rise in relative sea level and flooding of the estuary between 8,000 and *circa* 6,000 years ago (Wilkinson and Sidell, 2000) leading to the widespread deposition of the silt and clay;
- **Stage 2:** A major expansion of peat-forming communities between *circa* 6,000 and 3,500 years ago. Beginning in the lower estuary, the initial formation replaced estuarine mudflat and saltmarsh sedimentation. Further west in London, the rising water table allowed peats to form on top of Devensian terrace sands and gravels. Peat accumulation had a significant impact on the geometry of the estuary, reducing the spatial extent of intertidal environments. At Cross Ness, the intertidal area narrowed by 4 km. It is likely that the reason for initiation of peat formation at this time is a reduction in the rate of relative sea level rise between *circa* 6,000 and 4,000 years ago. In the Thames Estuary the slow-down in sea level rise would have encouraged the expansion of saltmarsh and then freshwater communities across areas of former intertidal mudflat; and
- **Stage 3:** Between 4,000 and 3,000 years ago the peats of the lower estuary were inundated with later inundation of middle and upper estuary areas (2,500 years ago at Silvertown) (Wilkinson *et al*., 2000). By *circa* 2,500 to 2,000 years ago almost all of the once extensive peat forming communities throughout the estuary downstream of Woolwich had been replaced by intertidal conditions. Hence, the tidal Thames expanded and was once again flanked by extensive mudflats and saltmarshes that continued to develop, with only occasional still stand phases until *circa* 150 years ago when much of the previously intertidal area was land-claimed for docks and associated installations.

5.2.3 Historic Relative Sea level Change and Ground Motion

The most recent relative sea level curve (Wilkinson and Sidell, 2000) shows that there is a general rise of sea level through time, with an initial rapid rise of 3.5 mm per year, slowing down around *circa* 6,000 years ago to 0.7 mm per year. This is supported by a wider analysis of land level and sea level change around Britain (Shennan and Horton, 2002), which calculated a late Holocene (last 4,000 years) relative sea level rise of 0.74 mm per year for the Thames, 0.85 mm per year for Essex and 0.67 mm per year for Kent. This can be compared with those for 20th century sea level changes published by Woodworth *et al.* (1999) using tide gauges. They showed relative sea level rises of 1.22 ± 0.24 mm per year at Southend-on-Sea, 1.58 ± 0.91 mm per year at Tilbury and 2.14 ± 0.15 mm per year at Sheerness. Overall, these figures suggest an additional rate of relative sea level change in the 20th century of around 1.0 mm per year, as compared to the Late Holocene. This is in general agreement with the view that global sea levels have increased by 100 to 200 mm over the last century.

Shennan and Horton (2002) suggest, however, that some deficiencies may be inherent in the 20th century dataset. These include the unequal distribution of measurements and the considerable amount of inter-annual (typically decadal) variability present in all tide gauge records. Littlewood and Crossman (2003) also questioned the degree of accuracy of the tide gauge data based on concerns that they may not have remained at the same level relative to Ordnance Datum throughout their period of deployment. They indicated that the gauges were levelled to Ordnance Datum over 40 years ago, and since that time differential ground subsidence may have caused their perceived level to be different to their actual level. Monitoring using GPS at the tide gauge locations at Richmond, Tower Pier, Silvertown, Erith, Tilbury and Southend-on-Sea has shown that between March 1997 and July 1999, the movement of ground levels at these locations was statistically insignificant.

5.2.4 Anthropogenic Influences

Historically, people have placed considerable demands on the Thames Estuary. Little control and poor recording of these activities have meant that it is difficult to relate morphological changes to the estuary with any particular impact (Royal Haskoning, 2004). As a result, large capital or maintenance dredging programmes, the discharge of pollutants and the construction of riverside developments have been subject to increasing legislation since the 1960s/70s to ensure that their impact on the hydrodynamic and morphological regimes of the estuary are deemed acceptable. Examples of substantial anthropogenic influences on the Thames Estuary are provided in the subsequent sections.

5.2.4.1 Land-claim and industrial development

The area covered by the floodplain deposits of the Thames Estuary has been progressively protected and developed since the 12th century. The Industrial Revolution led to the construction of major docks and a rapid expansion of industrial development. The closure of the London docks since the late 1950s and the transfer of these facilities downstream to Tilbury led to further extension of industrial developments on saltmarshes previously used for agriculture. A large proportion of the saltmarshes have been land-claimed behind embankments which stretch along most of the estuary shore.

The progressive land-claim of saltmarsh has meant that most of the enclosed areas now lie below the level of high water. This is due to the consolidation of the saltmarsh sediments after they were drained. The enclosed marshes cannot accrete as their supply of sediment has been cut off. Land-claim and development have had significant impacts on the coastal processes and morphodynamics of the Thames Estuary by changing the geographical distribution of sediment sources and sinks. New source areas may be activated and existing areas starved due to lack of replenishment. A few examples of how previous developments have impacted on the process regime are described below. It should be noted that the recent construction works at the DP World London Gateway development, which began in February 2010 and comprised the reclamation of approximately 92 ha of land from the river and raising of around 80 ha of existing land, are described further in Section 6.3.2.

Construction of West Thurrock Oil Jetty

Kendrick (1984) examined the impact on the estuary of the construction of West Thurrock oil jetty. The construction of the first jetty in 1873 caused a local 80 m

seaward movement of the low water mark, whilst a second jetty built further downstream in 1966 caused further deposition and the advancement of the low tide mark by around 50 m at the new jetty; due to reduced tidal current velocities near the bank. Prior to construction, sediment brought into the area on the flood tide was deposited around high water slack, but then re-entrained into the flow on the ebb tide, maintaining a balance. Once jetty construction was completed the reduction in current velocities provided a longer period for deposition, and the ebb current was less efficient in re-entraining sediment.

Construction of Woolwich Ferry Terminals

Kendrick (1984) found that cofferdams used in the construction of the Woolwich ferry terminals (starting in 1964) created eddies in the current flow, particularly on the north bank, reducing current velocities leading to increased sediment deposition. Bed levels during construction were raised by over 3 m in places. Former bed levels were not re-established following the removal of the cofferdams because the silt had become compacted during construction and the large number of piles supporting the terminals continued to impede flow post–construction. The zone of deposition extended beyond the terminals along the adjacent banks. Kendrick (1984) attributed this to a secular increase in tidal penetration causing the gradual upstream movement of the zone of main deposition (the Mud Reaches), which increased the quantity of suspended sediment in the area as a whole. There is a possibility that the process may have been enhanced by the cessation of dredging in the downstream Barking Reach between 1963 and 1966, allowing more suspended sediment to arrive in Woolwich Reach on the flood tide.

Construction of Rainham Creek Dam

To prevent tidal surges flooding the low lying Hornchurch and Rainham Marshes flanking Rainham Creek, a sheet pile dam was constructed in 1978/79 spanning the mouth of the creek (about 100 m wide). An alternative outlet for the creek (Ingrebourne River) was provided by sluices further up-river. The result was extensive siltation to the previous location of the low water channel in front of the dam (Kendrick, 1984).

Diver Shoal Groynes

A comparison of 1970 and 1998 bathymetric charts indicate that large amounts of accretion (in the order of 1 million m^3) occurred in the area now occupied by the Diver Shoal groynes along the northern shore of Gravesend Reach (HR Wallingford, 2002a, f). It was concluded that this accumulation, as anticipated, was almost completely due to the construction of the Diver Shoal groynes which took place between 1995 and1998.

5.2.4.2 Dredging and disposal

The PLA has a statutory duty to provide and maintain designated depths of water in the navigable channels, jetties and berths of the Thames Estuary. As a result of sedimentation it is therefore necessary to periodically undertake maintenance dredging. The importance of London as a port has resulted in a history of dredging, although, as elsewhere, few accurate records of dates of dredging and quantities removed exist. The records that do exist are difficult to use in a quantitative fashion because the units are not always compatible or the dredge volumes are approximations only. A description of the historic dredging that has taken place in the Thames Estuary is provided in more detail within Section 6.1.

Dredging within the estuary can potentially affect hydrodynamic and sediment processes in a number of ways, for example, deepening of the main channel may increase the proportion of total tidal discharge along the channel, thus reducing velocities across the adjacent areas. Furthermore, dredging may create an artificial sink for sediment which may modify the fine sediment regime, thereby reducing supply to other nearby areas (Royal Haskoning, 2004).

5.2.4.3 Operation of the Thames Barrier

The Thames Barrier is one of the largest movable flood defences in the world, providing protection to 125 km^2 of central London from tidal and fluvial flooding. Prior to 2014 the Thames Barrier had been closed no more than 24 times per year since 1982, however, as a result of prolonged stormy weather across the UK the barrier was closed in excess of 50 times between December 2013 and March 2014.

Whilst the Thames Barrier provides invaluable flood protection to London, its operation can influence hydrodynamics and sediment transport along the length of the estuary, although the type and magnitude of the influence is presently unclear. For example, Prandle (1975) simulated deployment of the Thames Barrier during the 1953 storm surge, and found that the amplitude of the reflected wave at Southend-on-Sea was negligible. However, Littlewood and Crossman (2003) identified that the closure of the Thames Barrier for prevention of fluvial flooding (without a surge component) could result in a reflected wave that may raise high water levels downstream of the barrier by around 0.5 m, depending upon the time of closure. In contrast, a small negative wave (depression of water level) is generally recorded propagating upriver. As the future barrier operations are likely to increase in response to climate change, the potential influence of the barrier on the local morphology is also expected to increase (Royal Haskoning, 2004). Due to a lack of data, the impacts of the Barrier on the Greater Thames Estuary (e.g. the Medway), are not currently fully understood.

5.3 Hydrodynamic Regime

5.3.1 Tidal Levels

The Thames Estuary is macrotidal with a mean spring tide range of 5.2 m at Sheerness gradually increasing upstream to 5.9 m at Tilbury and 6.6 m at London Bridge (United Kingdom Hydrographic Office (UKHO), 2013); see Table 5.2. The increasing tidal range upstream is due to the funnelling effect of the estuary, which has gradually been magnified by the extent of intertidal reclamation in recent history.

Tidal Level		Southend-on-Sea	Tilbury	London Bridge (Tower Pier)
		m(CD)	m(CD)	m(CD)
Highest Astronomical Tide	HAT	6.40	7.10	7.70
Mean High Water Springs	MHWS	5.90	6.40	7.10
Mean High Water Neaps	MHWN	4.70	5.40	5.90
Mean Sea Level	MSL	3.02	3.36	3.67
Mean Low Water Neaps	MLWN	1.40	1.40	1.30
Mean Low Water Springs	MLWS	0.50	0.50	0.50
Lowest Astronomical Tide	LAT	-	-0.10	-0.20
Spring Tidal Range (MHWS – MLWS)		5.40	5.90	6.60
Neap Tidal Range (MHWN – MLWN)		3.30	4.00	4.60
(Source: UKHO, 2013)				

Table 5.2 Tidal levels for the Thames Estuary

The Thames Estuary has historically experienced an increase in the elevation of high water levels. Rossiter (1969) and Bowen (1972) showed that between 1934 and 1966/69 there were increases in mean high water (MHW) and mean low water (MLW) at both Southend-on-Sea and Tower Bridge (Table 5.3). It was also found that other water level increases were superimposed on the 18.6 year (lunar) oscillation.

Source	Water Level	Southend-on-Sea (mm/yr)	Tower Bridge (mm/yr)
Rossiter (1969)	MHW	3.63	7.75
	MLW	2.49	0.92
Bowen (1972)	MHW	3.51	6.80
	MLW	2.50	0.43

Table 5.3 Rate of increases of mean high water (MHW) and mean low water (MLW) at Southend-on-Sea and Tower Bridge

Overall, the data shows that an increase in tidal range has taken place, which itself increased steadily with distance upstream from Southend-on-Sea. An increase in tidal range of around 1.0 to 1.1 mm/yr is described for Southend-on-Sea and 6.4 to 6.8 mm/yr for Tower Bridge, between 1934 and 1969. The increase in tidal range is probably due to a combination of anthropogenic and natural causes (Royal Haskoning, 2004). Bowen (1972) considered that a large part of the observed increase in tidal range is likely to be due to the effects of embanking the estuary. Before construction of flood defences much of the water entering the Thames spread laterally to cover mudflats and saltmarshes. Flood defences have caused a loss of this water storage volume at high tide levels, thus increasing the height of high water contained within the banks through morphological effects. Other contributory artificial causes may include the historic dredging of deeper shipping channels, the damming of tidal creeks and changes to estuary morphology caused by waterside developments. Natural causes also have an influence on tidal range, but the main drivers are difficult to ascertain. The predominant causes of the observed increase in tidal range appear to be (although not definitively) anthropogenic in nature; for this reason a simple extrapolation of the observed rates into the future would not be appropriate (Littlewood and Crossman, 2003).

5.3.2 Extreme Water Levels (including Storm Surges)

The primary driver of flood risk along most of the Thames Estuary is the tidal water level enhanced by a non-tidal (storm) surge component. The incidence and magnitude of these surges depend on the air pressure and the severity of winds in the North Sea. Positive surges in the North Sea are generated by low air pressure combined with strong northerly winds. If the surge component peaks at the same time as high water (particularly spring tides) there will be an increased risk of flooding, unless the flood defences are able to cope with the increased elevation. Predicted tide levels in the Thames Estuary have been raised by as much as 2.5 m at high water, and up to 4 m on the rising tide by surges (Trafford, 1981; Horner, 1984). On the 1st February 1953, the surge increased the rising tide and high tide levels at Tower Bridge by 2.9 m and 1.9 m respectively (Trafford, 1981). As noted in Section 5.2.4.3, prolonged stormy weather across the UK resulted in the Thames Tidal Barrier being closed to protect against flooding in excess of 50 times over a four month period (December 2013 to March 2014).

5.3.3 Tidal Currents

Tidal currents in the Thames Estuary generally show an increasing degree of asymmetry in an upstream direction, i.e. the length of the flood tide shortens in comparison to the ebb (with the exception of Sheerness and Southend-on-Sea). IECS (1993) suggested that the ebb dominance found at Sheerness resulted from the large tidal prism held in the Medway Estuary confluencing with the Thames Estuary over the ebb tide through a constricted mouth at Sheerness. Between Southend-on-Sea and Gravesend, maximum ebb current velocities are typically in excess of the flood. In contrast, upstream of Gravesend the flood current velocities are in excess of the ebb, where the tidal velocities reflect the increasing influence of the flood tide (Thorn and Burt, 1978). Using historical current velocity data measured in Halfway Reach in 1968 and 1969, Thorn and Burt (1978) identified that current velocities (at all depths) rose sharply after low water slack after which they decreased steadily to a smaller peak just before high water. During both the flood and the ebb tides, velocities generally increased with height above the bed.

Tidal current dominance has important implications for sediment transport in the Thames Estuary. Other things being equal, flood-dominance will tend to favour net movement of sediment into the estuary, whereas ebb-dominance will favour net export of sediment. However, this general scenario is complicated by the presence of upstream-directed density currents (see Section 5.3.5) which enhance the flood tidal currents, and if increased river flows occur, these will enhance the ebb tidal currents (especially in the upper reaches). In addition, it has been shown by HR Wallingford (2002e) that the flow regime of the Thames Estuary downstream of Gravesend Reach has three-dimensionality. 3D modelling demonstrates that, although secondary currents are weak in comparison to the main tidal current flows, the flow field has a complex vertical structure in both lateral and longitudinal directions (HR Wallingford, 2002d). Greater detail is now available from ADCP measurements carried out in parts of the estuary by the PLA to support the investigation of various developments in the Thames Estuary. These datasets provide full river-width current velocity distributions at intervals through the tidal cycle and support this view of a complex flow field (Littlewood and Crossman, 2003).

5.3.4 Waves

HR Wallingford (2002b) modelled the wave regime of the Thames Estuary in Lower Gravesend Reach, Lower Hope Reach and Sea Reach. They found that wind action is the main wave generation process in this part of the Thames Estuary as waves generated offshore were dissipated over the Outer Estuary banks and wide intertidal flats. They modelled waves generated by winds from the east and those from 205°, representing waves generated locally from the south across Lower Hope Reach. They found relatively short wave periods, and since the fetch is longest for winds from the south-east and east, these winds generally result in the highest wave conditions in this part of the Thames Estuary. However, a lot of energy is dissipated by the extensive offshore bank and channel system before the waves reach Sea Reach leading to relatively small overall wave heights (HR Wallingford, 2004). Significant wave heights were predicted to be slightly greater than 1.5 m at Coryton for 1 in 50 year winds from all directions and under 0.7 m for 10 in 1 year winds (at all water levels), with the wave climate typically decreasing in an upstream direction. Another method of wave generation in the estuary is that created by the passage of vessels. Although individually of less energy than wind-generated waves, they may

present the largest waves in more sheltered locations. Furthermore, the passage of large vessels may also influence flow direction.

5.3.5 Freshwater Flows, Salinity and Mixing

The main freshwater input to the Thames Estuary is at Teddington, with a mean flow rate of circa 90 m^3/s (IECS, 1993). The highest flow rate measured over this long record is estimated at 1,059 m^3/s in 1989, with other major fluvial events occurring in 1947 (714 m^3/s), 2003 (461 m^3/s) (Littlewood and Crossman, 2003) and February 2014 (502 m^3/s). Tributary inputs to the main fluvial flows at Teddington are relatively small (*circa* 10 to 15% of the total flow). Average freshwater inputs to the Thames are considerably smaller than the tidal discharge within the estuary, with HR Wallingford (2002d) reporting tidal discharges of up to 15,000 m^3/s on both flood and ebb tides (in Lower Hope Reach) based on ADCP measurements in July 2001. Crooks (1994) analysed water level records over the previous 100 years for locks upstream of Teddington, and found that there was a greater number of above average peaks before 1940 than after 1940. This work concluded that channel dredging in the upper parts of the Thames and flood prevention schemes have resulted in localised decline in peak flood levels and event duration (particularly since dredging of the main fresh watercourses took place in the 1930s and 1940s); this may have influenced sediment supply to the estuarine parts of the system.

The relationship between tidal range and river discharge enables all estuaries to be classified between highly stratified estuaries at one end and well mixed estuaries at the other. The Thames Estuary is generally a well-mixed estuary; this means that river flow is small compared with the volume of the tide, and the whole water mass migrates up and down the estuary with the flood and ebb tides. A longitudinal salinity gradient also exists and mixing takes place at the interface between the river water and sea water; saline water is mixed upwards (being denser and thus freshwater moves above the saline water) and freshwater is mixed downwards. This mixing causes a weak density current to flow (in addition to the tidal currents), which is a natural mechanism for maintaining a balance of fresh and saline water. This current flows upstream and is an important agent for the transportation of suspended sediment into the Thames Estuary. The near bed residual flows result in the formation of a null point where there is no net movement of water at the bed in either direction. During summer freshwater discharges, the null point is generally located along the Gallions, Barking and Halfway Reaches but variations such as freshwater input will cause the location of the null point to move up or down-estuary (Royal Haskoning, 2004).

As part of the London Gateway development, DP World undertook salinity monitoring along Lower Hope Reach and Sea Reach for a period of five years, the results of which are shown in Image 5.1 for a number of locations; see Image 5.2 for positions. The monitoring included pre-dredge (blue) and a subsequent four year period when capital dredging was ongoing. The monitoring results clearly illustrate a seasonal pattern in salinity at all locations, which is typically less in the winter months (i.e. November to January), increasing through the spring and summer (with maximum salinity around August). This pattern is driven by the relationship between fresh and saline water volumes, i.e. the additional input of freshwater during periods of increased rainfall (typically winter) will lower the salinity within the reaches of the Thames. This pattern does, however, vary significantly along the Thames as the saline water becomes increasing dominant in a downstream direction away from freshwater sources (e.g. Teddington). The monitoring data in Image 5.1 would also

tend to suggest that the London Gateway development had no significant effect on salinity within this section of the Thames Estuary, i.e. all changes are within natural variability over the five-year dataset.

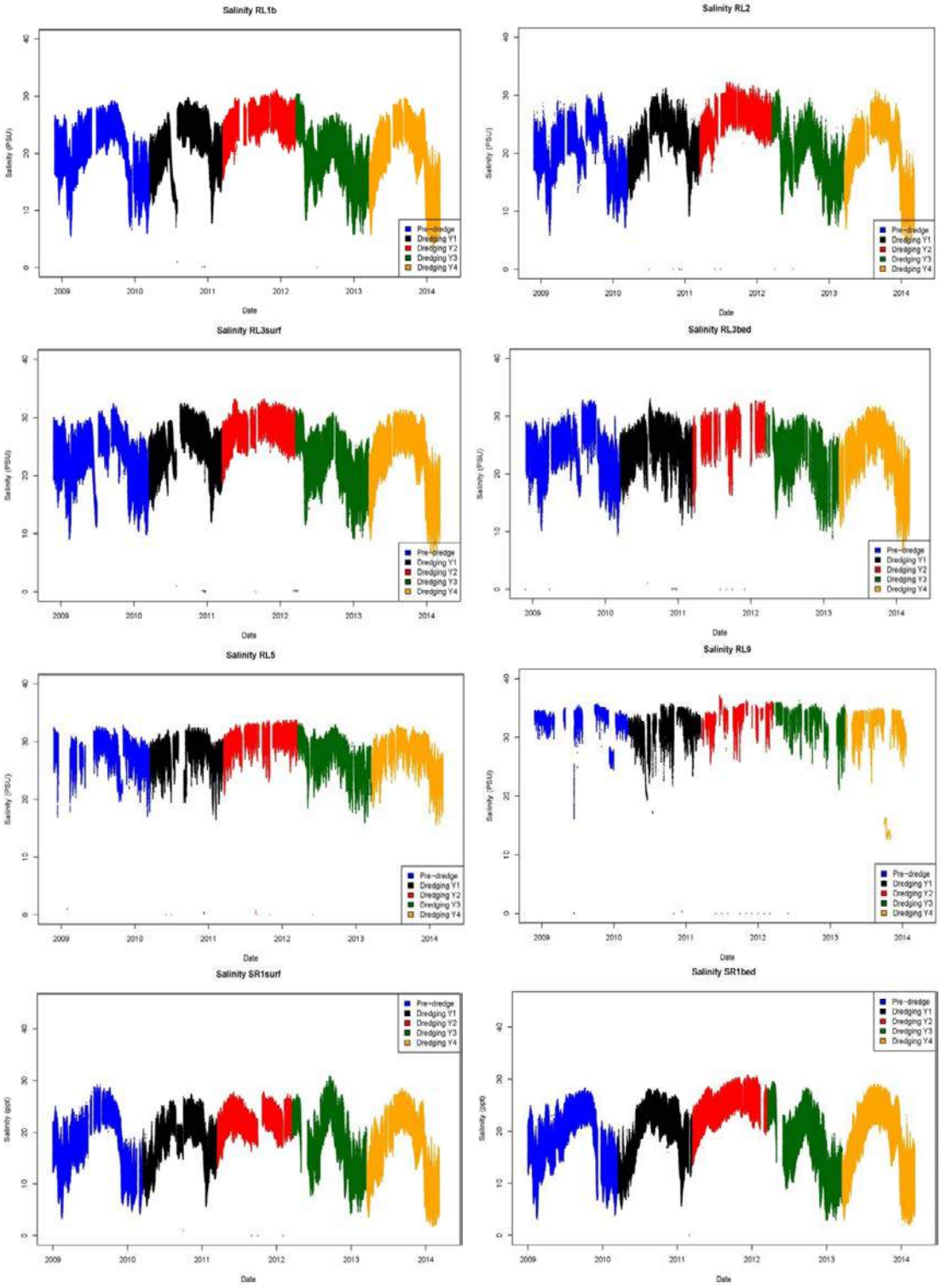


Image 5.1 London Gateway salinity monitoring (2009 – 2014)

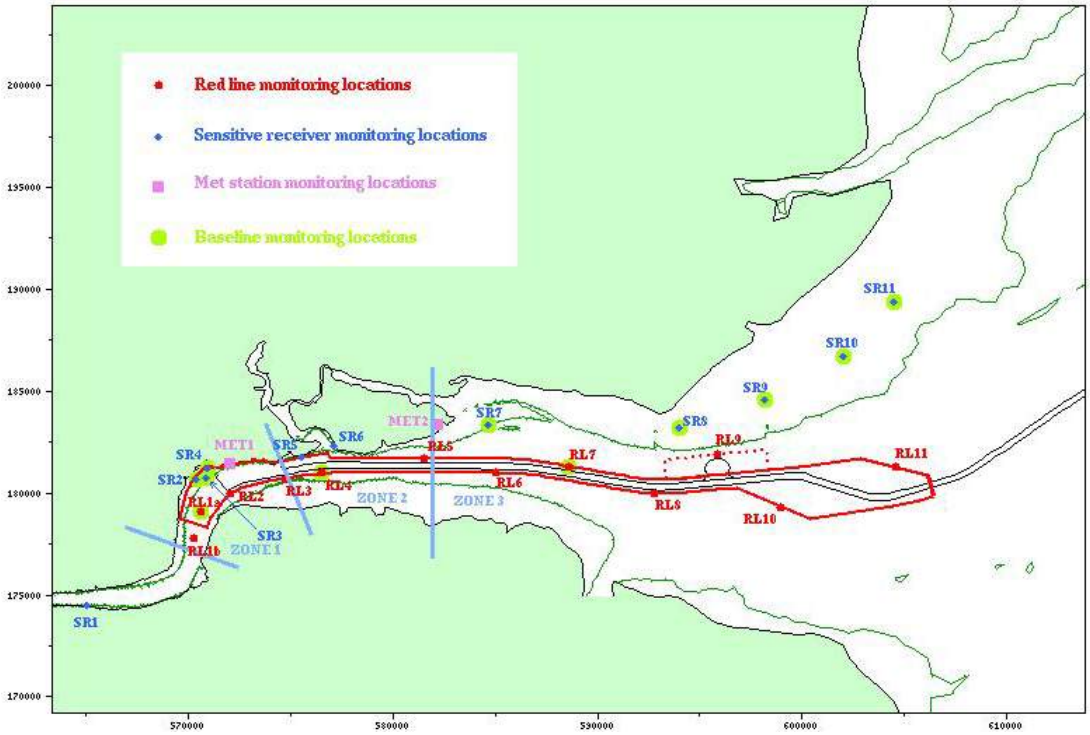


Image 5.2 London Gateway monitoring locations

5.4 Sediment Regime

5.4.1 Nature of Seabed Sediments

The characteristics of the bed sediments of the Inner Thames Estuary vary across and along the estuary. British Geological Survey (1997) and HR Wallingford, 2002d, e, 2004) showed that between Erith and Canvey Island the main subtidal channel generally comprises sand and gravel. To the east of Canvey Island, these sediments are replaced by mainly sand. The Outer Thames Estuary intertidal flats are characterised by sediment with high sand content due to the winnowing action of waves generated locally and those that propagate into the estuary from the North Sea. Mean sediment particle size becomes markedly smaller up-river into the Inner Thames Estuary. Mucking Flats are typified by mud whereas Blyth Sands/Yantlet Flats are muddy towards the high water mark becoming sandy towards the low water mark with a transition zone between the two (British Geological Survey, 1997; HR Wallingford, 2002d, e). A thin strip of coarser sediment (gravel and conglomerates) is generally found at the base of the flood defences backing the intertidal flats. Information on bed characteristics upstream of Erith is limited.

5.4.2 Sediment Transport

5.4.2.1 Influence of turbidity maximum

Littlewood and Crossman (2003) divided the Inner Thames Estuary into four suspended sediment zones on spring tides (they suggested that little sediment is in suspension on neap tides). From Teddington to Lower Pool the suspended load is low, there is little deposition on the bed and banks of the river, and much of the sediment passes through downstream. The second zone, downstream to Erith

Reach, includes the turbidity maximum which forms around the null point in Gallions, Barking and Halfway Reaches. This is a zone where large concentrations of suspended sediment accumulate (collectively known as the 'Mud Reaches') which coincides with the limit of saline water intrusion (Inglis and Allen, 1957). Turbulence and the high concentrations of sediment in this zone encourage flocculation, and deposition occurs. The exact position of the turbidity maximum is sensitive to tidal range, changes of sea level, and the seasonal variability of the freshwater flow and saline tidal flow (Kendrick, 1972; Littlewood and Crossman, 2003). During periods of higher river discharge (winter flows), the saline water is pushed seawards and sediments are flushed out of the Mud Reaches and stored downriver in the Gravesend Reach area. During periods of lower river discharge (summer flows), there is a gradual upriver migration of the saline water, modifying residual flows and sediments gather and settle back in the Mud Reaches. Littlewood and Crossman (2003) suggested that the upriver migration of sediment is a slow process (months) because the forces are weak. However, the first freshwater flow of sufficient strength will rapidly move the 'summer' load back to the position it occupied before. They suggested that the downriver movement takes the form of a high suspended sediment concentration close to the bed and in the deeper parts of the channel, with only a small percentage at higher levels in the water column; as mentioned previously in Section 5.3.5, these density currents are important for the transportation of suspended sediment in the Thames Estuary. Inglis and Allen (1957) observed that a sustained increase in river flow of around 1 to 2 weeks caused the Barking Reaches channel to deepen by over 0.5 m in the shoal areas. They suggested three reasons for the change:

- The silt-laden water in the Mud Reaches is pushed downstream and replaced by relatively clear water which encourages re-suspension of the bed and hence scour;
- The high river flow appreciably increases the ebb discharge and thus physically scour the bed; and
- The almost fresh upland water acts as a dispersing or deflocculating agent on the uppermost layers of consolidated mud thus reducing the effective particle size and bonding of particles and making them more readily transportable.

5.4.2.2 Suspended sediment transport

Once the suspended sediment enters the Inner Estuary system, material movement and accumulation is complex. Using measurements taken in 1953, Inglis and Allen (1957) showed a striking drop in suspended sediment concentration upstream of the Mud Reaches with concentrations in Upper Pool and Bugsby's Reach consistently below 200 ppm. The concentrations rise to a peak near the upper end of the Mud Reaches and gradually decrease seawards. They also described higher concentrations of suspended sediment on the ebb than on the flood. This may be a result of the differential resuspension of sediment after low water slack and high water slack. On low water slack sediment settles out to form a high concentration (100,000 to 150,000 ppm) fluid mud layer close to the bed. Some of the sediment at the base of this mud layer consolidates under its own weight raising the bed level, effectively removing it from re-suspension. At high water slack some suspended sediment again settles out but it is brought back into suspension by the ebb current. More thorough mixing takes place during the ebb, with consequently higher concentrations in the middle to surface layers.

As a result of suspended sediment monitoring, Thorn and Burt (1978) were able to propose several longitudinal areas of the estuary which act as temporary sediment stores releasing and accumulating sediment on a semi-diurnal and spring tide cycle. On the flood tide, sediment deposited on the previous low slack water is re-entrained and moved upstream in a series of 'jumps' corresponding to the 16 km tidal excursion and is then re-deposited at high slack water. On the following ebb tide almost all of this sediment is re-entrained and moved downstream once more where it is deposited close to the original source area at low slack water. Thus the temporary storage areas in the lower estuary supply sediment only on the flood and receive it again only on the ebb, whereas storage areas in the middle estuary, between Gravesend Reach and Blackwall Reach, both receive and supply during flood and ebb. In contrast, the most landward temporary store, in the Syon Reach, receives only on the flood and supplies only on the ebb.

A programme of water sampling at discrete points in the estuary downstream of Gravesend Reach was undertaken in July 2001 by HR Wallingford (2002e). They found a marked concentration gradient with spring tide near-bed levels up to 2,000 mg/l in Lower Hope Reach decreasing to 1000 mg/l at Coryton to less than 100 mg/l at Southend-on-Sea. A similar pattern emerged from the neap tide measurements with highs of up to 500 mg/l in Lower Hope Reach and lows of less than 100 mg/l at Southend-on-Sea. They also showed vertical layers on both spring and neap tides; at high water bed concentrations were an order of magnitude greater than mid-depth concentrations and at other states of the tide were several times higher.

More recently, suspended sediment concentrations (SSCs) were monitored along Sea Reach between January and December 2009 as part of the London Gateway baseline surveys (prior to the capital dredging and reclamation works). The monitoring further identified a clear reduction in near-bed concentrations in a seaward direction during both summer and winter months, with peak spring SSCs of *circa* 1,400 mg/l within the main channel adjacent to the Oikos Terminal (Hole Haven); neap tide concentrations show a similar pattern but of lesser magnitude. A summary of the monitoring results (spring tide only) are provided in Table 5.4.

Location	Depth	Jan 2009 Average	Jan 2009 Peak	July 2009 Average	July 2009 Peak
Lower Hope Point (51°29.10N, 000°27.25E)	Near Surface (1.0 m below)	201	986	93	422
Hole Haven (51°30.00N, 000°,33.89E)	Near Bed (1.0 m above)	254	1,223	402	1,393
Shoebury Ness (51°30.06N, 000°49.01E)	Near Bed (1.0 m above)	54	485	34	151

Table 5.4 Summary of spring tide SSCs (mg/l) along Sea Reach

In addition to this baseline monitoring, SSCs were also measured for a variety of locations for a four-year period (2010 to 2014) during the required capital dredging for the London Gateway development. The results from this monitoring, which includes the 2009 baseline (blue), is provided in Image 5.3; the monitoring positions are identified in Image 5.2. The monitoring results indicate that near-surface SSCs typically range between 200 and 1,000 mg/l, whilst near bed concentrations can vary between 500 and 3,000 mg/l (see SR1 and RL3 bed plots). At monitoring position RL9 (i.e. along the outer section of Sea Reach) there is a clear reduction in SSC, which is attributed to the lesser influence of the muddy/turbid Thames Estuary. In general, the impact of the capital dredging is difficult to identify in the plots due to the large natural variability in SSC evident within the five-year dataset.

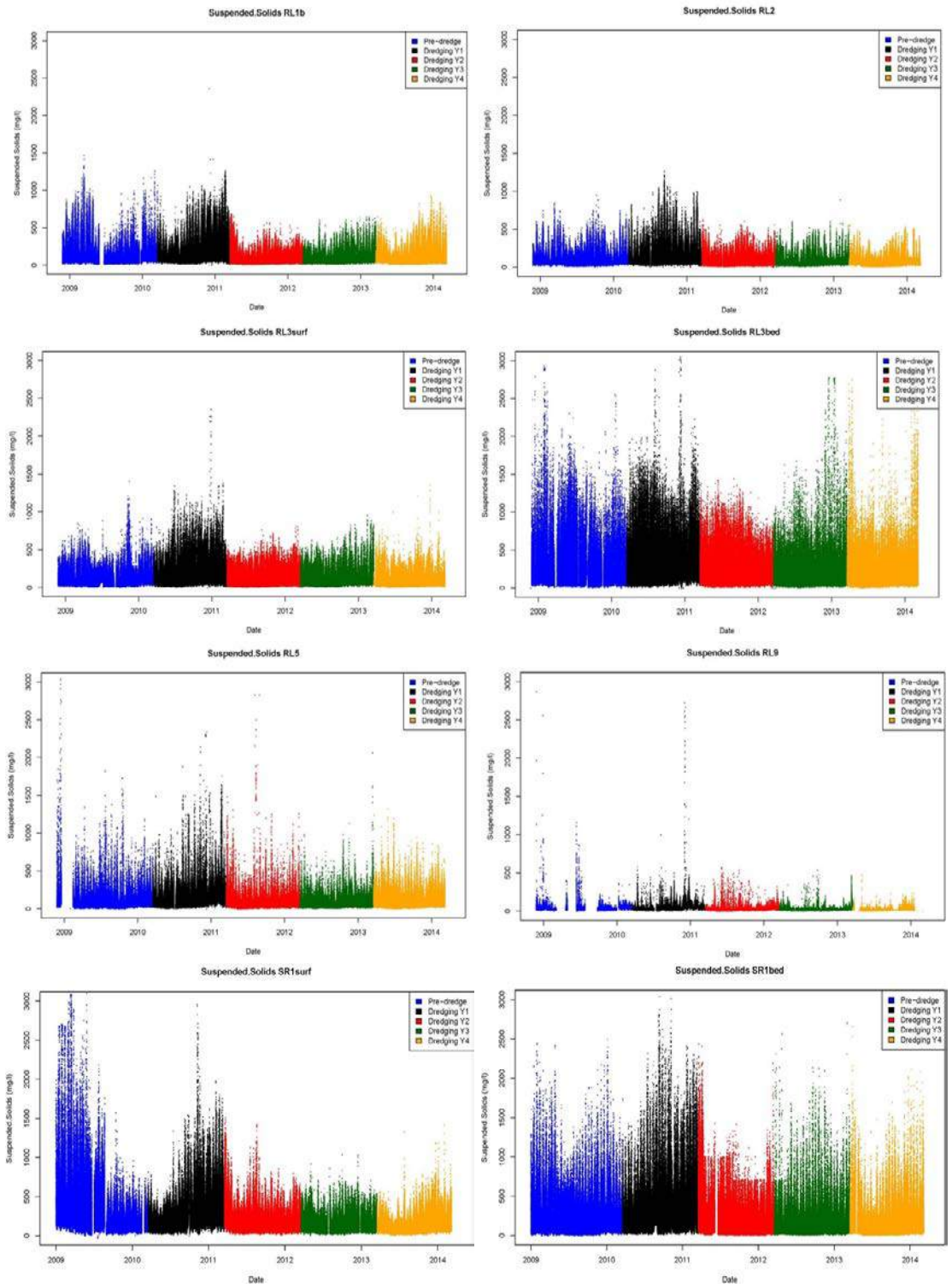


Image 5.3 London Gateway SSC monitoring (2009 – 2014)

HR Wallingford (2002c) modelled fine sand transport (median diameter 0.1 mm) in the estuary downstream of Gravesend and found a net spring and neap tide sediment flux out of the estuary (i.e. export of sediment). Tidal currents transported a majority of the sediment with negligible wave influence. These results support the

general conclusions that the estuary is ebb-dominated downstream of Gravesend and wave heights are relatively small and have less influence on the sediment movements.

It has been recognised that single point measurements in the estuary may not provide information on the full complexity of suspended sediment distribution. For example, the presence of wide meanders influences suspended sediment transport. The interaction of these meanders (and the secondary currents set up by them) with the adjacent intertidal mudflats gives rise to a complex suspended sediment regime with large fluxes of sediment moving on and off the mudflats, with subsequent morphological change (HR Wallingford, 2004, Royal Haskoning, 2004). Bed sediments can also change across the section from the outer to inner part of the meander, for example, the meander separating Gravesend Reach and Lower Hope Reach results in secondary currents that move near-bed sediment towards the inside of the meander increasing suspended sediment concentrations relative to the outside of the meander (HR Wallingford, 2002e).

5.4.2.3 Bedload transport

On the south shore of the Outer Thames Estuary, longshore sediment transport is inclined to the west under the action of north-easterly waves although this is largely interrupted at the Isle of Sheppey by the River Swale and at the Isle of Grain by the outflow of the River Medway (Welsby and Motyka, 1987). The net transport of sediment decreases in magnitude upstream in the estuary and is generally less than 5,000 m^3 per year (Scott Wilson, 1998). Scott Wilson (1998) argued that Kentish Flats and Whitstable Flats (intertidal areas) attenuate the wave energy that would otherwise reach the Isle of Sheppey, and they may therefore influence the relatively low rates of sediment transport along this shoreline. These results indicate that movement of sediment as bedload is very small in comparison to the loads of suspended sediment that are carried into and out of the estuary.

5.4.3 Sediment Budget

The definition of sediment budgets for estuaries is challenging, particularly for large estuaries such as the Thames. One of the most suitable and widely adopted approaches to developing an understanding involves defining the key elements of the sediment budget within the area under consideration, and identifying the key controls on sedimentary processes. This approach is often qualitative due to the inherent problems associated with quantifying a sediment budget. The degree of confidence that can be placed in the results and outputs of this approach depends on the quality and quantity of information available (ABPmer, 2008).

The sediment budget can broadly be divided into sources, pathways and sinks.

- **Sediment sources:** These can be considered as inputs to the sediment budget and are important to the sustainability of sedimentary features in the area. Sediment sources can be provided via a number of mechanisms such as: shoreline sources (sea cliff recession, beach erosion, etc.); erosion of the local seabed; fluvial input via estuaries; and offshore marine sources.
- **Sediment transfers:** There are two mechanisms of sediment transport:
  - Bed-load transport – this process refers to all sedimentary grains that move, roll or bounce (saltation) along the seabed as they are transported

by currents. This mode of transport is principally related to coarser material (sands and gravels); and

- Suspended-load transport – this process refers to particles of sediment that are carried above the seabed by currents and are supported in the water without recourse to saltation. These two mechanisms of transport could be controlled by different processes and hence require separate consideration.

- **Sediment sinks:** These can be considered to be outputs of sediment from the local sediment system. Sinks of sediment may include; sand banks; areas of beach accumulation; deposition within estuaries; deposition on tidal flats; and offshore losses.

Drawing together an extensive set of contemporary literature and source data (i.e. published research, consultancy reports and technical documents), the Greater Thames CHaMP (ABPmer, 2008) provides the most up-to-date estimate of the sediment budget within the Thames Estuary (although predominantly downstream of Tilbury). A summary of this sediment budget, specifically including the sediment sources, pathways and sinks, is provided in the subsequent sections.

5.4.3.1 Sediment sources

Thames River

Previous estimates of the fluvial input of fine sediment from the Thames River have varied greatly. As detailed previously in the PLA's 2009 Dredge Conservation Assessment (DCA) (PLA, 2009), IECS (1995), estimate a sediment contribution of about 28,000 tonnes/yr, whilst in contrast, Odd and Murphy (1992) estimate a somewhat larger input of approximately 700,000 tonnes/yr. More recently, HR Wallingford (2006a) estimated the fluvial sediment input from the River Thames as being 150,000 tonnes/yr; determined from a detailed analysis of suspended sediment data at Teddington Weir as part of a sediment budget covering Shellhaven to Teddington. This sediment discharge therefore represents the most recent attempt at quantifying the input of sediment from the Thames River. In addition to this, approximately 20,000 tonnes/yr of sediment is also supplied from other tributaries into the Thames (HR Wallingford, 2006a). Taking into consideration other factors that may influence the input of sediment into the estuary upstream of Tilbury (e.g. morphological changes, sewage and dredging), the Greater Thames CHaMP calculates a total fluvial sediment contribution of *circa* 141,600 tonnes/yr.

Eroding Saltmarsh

Burd (1992) calculated that between 1973 and 1988, 980,000 m^2 of saltmarsh was eroded in the Inner Thames Estuary (between Higham Marshes and Shoeburyness). Assuming that the surface of the saltmarsh is elevated 1 m above the level of the mudflat, and the erosion rate has continued to the present day then 65,000 tonnes of eroded saltmarsh is yielded every year. Not included in these sediment yield estimates is any possible contribution from the saltmarshes between Shoeburyness and Foulness Point. Van Der Wal and Pye (2004) found that sequential maps indicate little change in the marsh coverage between 1877 and 1921, and since 1921 some marshes have eroded but during the last decade some marsh growth has been observed locally.

Intertidal Mudflats

Intertidal mudflats experienced a net increase in volume between 1820 and 1988, however, the northern bank experienced erosion between 1940 and 1988 (ABPmer, 2008). Assuming that this horizontal erosion on the lower mudflat is occurring at the same time as vertical accretion on the inner mudflats, IECS (1995) calculated a sediment yield of approximately 50,000 tonnes/yr.

London Clay Cliffs

The northern coast of the Isle of Sheppey is characterised by a 7 km stretch of eroding London Clay cliffs between Minster and Leysdown. Historical analysis by Nicholls *et al.* (2000) showed that these cliffs receded at an average rate of 1m/yr between 1867 and 1998, with a maximum recession rate of 1.9 $\pm$ 0.08 m/yr. Based upon these recession rates, the sediment yield from the cliffs amounted to around 660,000 to 740,000 tonnes/yr between 1867 and 1897, falling to approximately 450,000 to 500,000 tonnes/yr between 1897 and 1998. Based on the available information, it is believed that the London Clay cliffs presently supply at least 450,000 tonnes/yr of fine-grained sediment to the Thames Estuary system (Nicholls *et al.*, 2000).

London Clay Platform

London Clay platforms are situated 5 km offshore from Leysdown-on-Sea and also extend eastwards across the Kentish Flats. A significant source of sediment could also be supplied by these platforms, as was found to be the case within a similar silty, clay rich substrate environment off the Holderness Coast in Yorkshire (Balson *et al.*, 1998), although the volume of this sediment cannot be quantified.

5.4.3.2 Sediment sinks

Accreting Saltmarsh

In addition to the horizontal recession of the saltmarshes within the Inner Thames Estuary (see Section 5.4.3.1), vertical accretion of these saltmarshes has also been recorded. Assuming a vertical accretion of 3 mm/yr and the 1988 saltmarsh area of 3.2 Mm^2, Royal Haskoning (2004) calculated a sediment volume increase of *circa* 31,000 tonnes/yr. Once again, this does not include the saltmarshes between Shoeburyness and Foulness Point which have undergone vertical accretion locally in recent years.

Intertidal Mudflat

Between 1820 and 1988, the mudflats within the Thames Estuary (downstream of Tilbury) both decreased and increased in area on the north and south bank, respectively, resulting in an overall increase in mudflat area (IECS, 1995) i.e. the intertidal mudflats represented a sink as well as a source. Assuming that the mudflats had kept pace with sea level rise, IECS (1995) estimated that the accreting area of mudflat had gained around 98,600 m^3/yr. On this basis, Royal Haskoning (2004) determined that this sink amounts to 98,600 tonnes/yr (assuming a dry density of 1,000 kg/m^3 for soft silts).

Subtidal

HR Wallingford (2006b) demonstrated that the subtidal volume of water (below chart datum) in the Thames Estuary between Broadness and Southend decreased (i.e. sediment accreted) during the periods 1910 to 1925 and 1970 to 1995. These increases in sediment volume equate to *circa* 202,353 tonnes/yr (ABPmer, 2008).

Outer Estuary Sand Banks

Sand banks in the Outer Thames Estuary, namely Kentish Knock, Long Sand, Sunk Sand, East and West Barrow and the Northeast Middle are potential sinks for fine to medium sands (HR Wallingford *et al*., 2002). Both Long Sand and Sunk Sand have extended to the northeast during the last 150 years, by approximately 1.5 and 5.0 km respectively, whilst also experiencing deposition at their south-western ends. This being said, it has not been possible to quantify the volumetric changes of the sand banks (ABPmer, 2008).

Dredging

IECS (1995) and Royal Haskoning (2004) determined that maintenance dredging within the Thames Estuary since 1961 amounted to approximately 225,000 m3/yr. As a large proportion of this material was disposed to land, thus removing it from the system, dredging constituted as a sink. Royal Haskoning (2004) determined that this sediment volume equates to approximately 113,000 tonnes/yr. It should be emphasised, however, that in more recent years the dominant dredge methodology within the Thames Estuary has been WID, which actively retains the sediment within the marine system. As such, dredging is now expected to be a lesser sink than that calculated in the Greater Thames CHaMP.

5.4.3.3 Transfers

Marine Suspended Sediment

It is difficult to quantify marine suspended sediment in the Thames Estuary as the suspended sediment dynamics in this area are poorly understood (ABPmer, 2008). This is largely because the net sediment movement during each tidal cycle is relatively small in comparison to the large amount of sediment in the residual water volume (IECS, 1995). Royal Haskoning (2004) gave an estimate of 10 million m^3/yr of available suspended sediment within the Greater Thames embayment (defined as the area west of North Foreland to Walton on the Naze). This figure was calculated using average suspended sediment concentrations provided by CEFAS, which indicated that the average sediment volume at any one time is *circa* 1 million m^3 (ABPmer, 2008). However, the amount of sediment available from this potential supply cannot be quantified with any certainty.

A landward residual of fine sediment was first proposed by Inglis and Kestner (1957; unlisted reference cited in PLA, 2009), this was to make up the deficit found in their sediment budget amounting to some 276,000 tonnes/yr. This source of sediment was identified as the sludge and dredged sediment, which was placed at Black and Barrow Deep. The approach of balancing the sediment budget using the marine source was also used by IECS (1995). In contrast, HR Wallingford (2006a) formulated a sediment budget for the estuary upstream of Shellhaven and found that when morphological changes where allowed for within the calculation the

discrepancy was reduced to 27,000 tonnes/yr, reducing the significance of the marine sediment source. As such, HR Wallingford (2006a) question the presence of a significant source of sediment being brought into the Thames seaward of Southend, this was because no strong evidence was found for a residual current which can carry sediment landwards from the outer estuary. If a landward residual is present then an input of sediment from the cliffs on the Isle of Sheppey is a more likely source of material, although there is no evidence that this material is transported landward into the estuary. This suggests that although the existence of a landward residual current cannot be ruled out altogether, the amount of material supplied from the marine sediment source could be lower than previously thought (HR Wallingford, 2006a).

5.4.3.4 Sediment budget summary

A summary of the available sediment budget data for the Thames Estuary is provided in Table 5.4. The outcome of this sediment budget analysis suggests that the estuary has had a sufficient supply of sediment throughout the last 100 years to enable accretion, i.e. an accretional morphological behaviour. The sediment budget indicates that in order to maintain this accretionary behaviour the supply of sediment from either the Isle of Sheppey cliffs or from offshore, distal marine sources needs to be included (ABPmer, 2008). This in turn suggests that although, as noted by HR Wallingford (2006a), there is a lack of evidence for a sediment transport mechanism, some sediment from either the London Clay cliffs or offshore (or both) is probably being deposited in the Outer Thames and made available for further transport within the Thames, although it is likely that this supply becomes less important upstream of Shellhaven.

Dynamic Status	Element	Description	Rate of Sediment Load (tonnes/yr)	Total (tonnes/yr)
Sources	Rivers	Sediment supply from Thames upstream of study area	141,600	706,600
	Saltmarsh (not including Foulness)	Erosion (horizontal)	65,000	
	Mudflat	Erosion	50,000	
	Cliff	Erosion	450,000	
	London clay platform	Erosion	Not quantified	
Sinks	Saltmarsh (not including Foulness)	Accretion (vertical)	31,000	444,953
	Mudflat	Accretion	98,600	
	Subtidal	Accretion	202,353	
	Outer estuary sand banks	Accretion	Not quantified	
	Dredging	Removal of material from system	113,000	
Transfers	Water body	Suspended sediment	1,000,000	1,000,000
(Source: ABPmer, 2008)				

Table 5.5 Summary of Thames Estuary sediment budget

Importantly, a recent analysis of LiDAR data between 2008 and 2014 for the Lower and Outer Thames Estuary has identified that continued accretion has generally

taken place across the intertidal mudflats and saltmarshes. More specifically, there has been an approximate vertical increase of approximately 1.0 to 1.5 m across Mucking Flats, whilst elsewhere there are clear areas of vertical accretion in the order of 0.2 to 1.0 m (e.g. Blyth Sands, Hole Haven and Yantlet Flats).

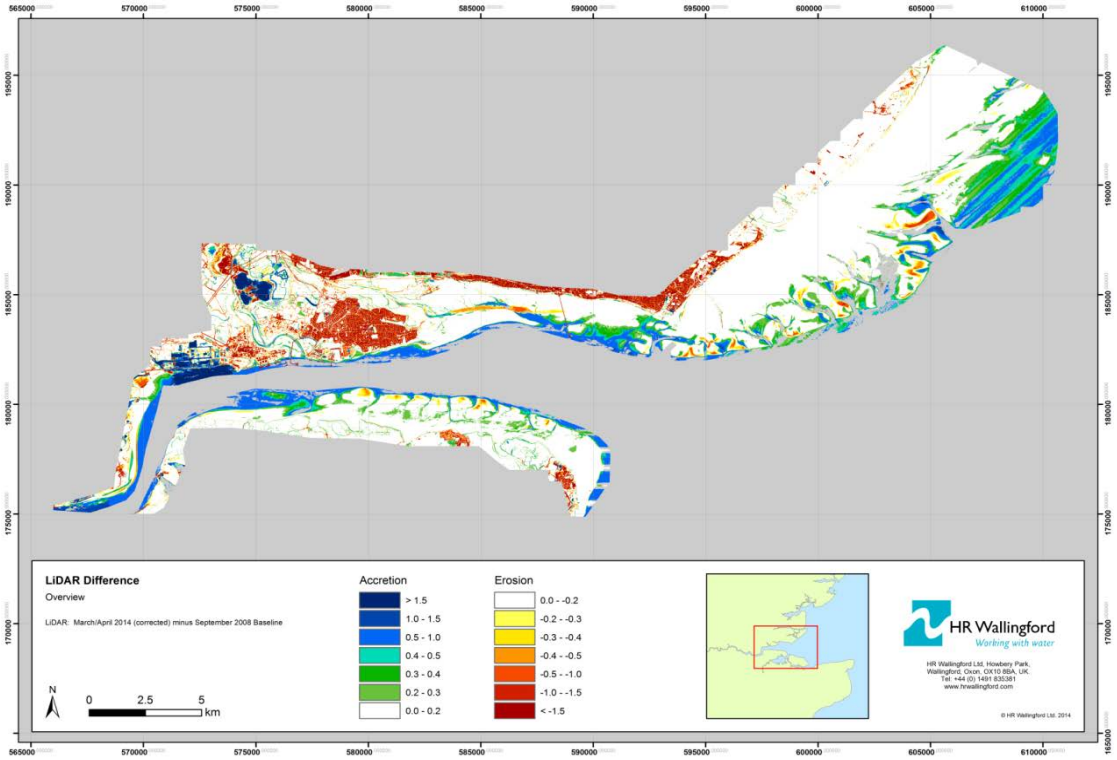


Image 5.4 London Gateway LiDAR comparison (2008 – 2014)

5.4.4 Future Morphological Development

An important question with respect to the future morphological development of the Thames Estuary is whether accretion on the intertidal areas will be able to keep pace with potential accelerated sea level rise. This is presently a difficult question to answer in the absence of a definitive sediment budget, although several attempts, using different methods, have been made to look at the estuary response based on the available data.

IECS (1993) suggested that under an accelerated rate of sea level rise, a net loss of intertidal surface area would be likely, although vertical accretion may continue on some intertidal surfaces. They envisaged that this net loss would result in a narrowing of the foreshore, leading to reduced attenuation of wave and tidal energy. It was also suggested that the response of the Thames Estuary to sea level rise over the next 100 years would be to roll-over in a landward direction. This means that the entire estuary sediment system would transgress landward with sea level rise causing the pattern of sediment entrainment, transport and deposition to also migrate upstream. To achieve this transgressive movement the estuary must redistribute sediment landward but must also receive sediment inputs from marine sources equivalent to the rate of sea level rise as the system elevates with the tidal frame. Posford Haskoning (2002) predicted that for the Thames Estuary this landward migration rate would be around 12.5 m/yr assuming an accelerated sea level rise of 6 mm per year (medium-high scenario).

A combination of process based modelling and historical trend analysis (HR Wallingford, 2002a-f) showed that long term changes observed between 1970 and 1998 could be accounted for by the intertidal processes of accretion at high water and erosion under wave and tidal action as predicted by the sediment transport models. They found that on average Mucking Flats increased in volume by about 30,000 m^3/yr but slightly reduced in area (less than 1000 m^2/yr) (HR Wallingford, 2002a). Mucking Flats was observed to be rising at average rates of between 7 and 26 mm/yr. They also found that (western) Blyth Sands reduced in volume by about 40,000 m^3/yr but increased in area by about 9,000 m^2/yr. The upper parts of the intertidal area were lowering by about 12 mm/yr. Overall, in the period 1970 to 1998 these intertidal areas underwent net accretion of about 400,000 m^3 and the elevations adjacent to the mudflats accreted or eroded at rates substantially greater than observed rates of sea level rise (around 2 mm/yr).

If in the medium term, the intertidal areas downstream of Gravesend continued to respond in the same way they have been observed to change between 1970 and 1998, then in ten years' time Mucking Flats would be expected to rise in level by between 70 and 260 mm but reduce in area by about 10,000 m^2. The upper parts of Blyth Sands would reduce in level by 120 mm and the lower parts would accrete by 80 mm because of an increase in area due to a lower intertidal accretion of about 90,000 m^3. HR Wallingford (2002a-f) did not propose extrapolation of these rates of change beyond a ten year period and they found no evidence of net erosion of the intertidal areas of the estuary between Gravesend and Canvey Island (IECS, 1993).

The HR Wallingford results may simply reflect the change in the system from one where (historically) dynamic equilibrium has been reached to one of transition in relation to rising sea levels where the roll-over of the estuary inland has commenced. However, the roll-over method operates on the basis of potential sediment movement allowing the estuary to adjust to the new tidal frame. The difficulty with applying roll-over to the Thames Estuary is the likelihood that sediment movement will be laterally constrained by flood defences and other developments and the transgression may have 'nowhere to go' upstream because this boundary of the estuary is constrained by Teddington Weir and development.

The findings of HR Wallingford (2002a) are based upon historical trend analysis and are in broad agreement with process model predictions. Their predictions do not apply to the entire estuary and there is limited historical data on the changes in the downstream intertidal areas. Collectively these studies provide a basis for prediction that needs to be proven or disproven once better information on sediment and historical trend analysis data becomes available.

6. Dredging Information

The following sections describe historic and current dredge activities carried out on the Thames Estuary. Details are provided on the dredge quantities, dredge techniques and on the status of existing dredge disposal sites. This chapter contains separate sections which provide information on dredging carried out by PLA and information on third party (non-PLA) organisations that have carried out maintenance dredging within the last 10 years. Where information on dredge methods, volumes and times is known, this has been included.

6.1 Historic Dredging

The Thames River and estuary has provided a national gateway port since the Roman Period. Encroachment through reclamation and wharf construction ensured access was maintained, although by the early 19th Century some dredging works had commenced principally to lower shoals on the main channels and to provide a source of ballast. From 1857, when the Thames Conservators were reconstituted, dredging activity in the Thames increased to maintain and improve the main navigation, ensuring passage of new classes of commercial shipping, which were both wider and deeper drafted. Between 1878 and 1908, some 6 million yd^3 [4,587,000 m^3] of solid material was dredged from the tideway by the Thames Conservancy to improve navigation (HR Wallingford, 2008; unlisted reference cited in PLA, 2009). These works also included capital dredging in 1908 (approx.) to develop the Yantlet Channel as the main shipping channel in Lower Sea Reach, with the dredge material being deposited in the adjacent Leigh Channel. Further works were also undertaken during a second capital dredging campaign concluded by 1928, during which some 37 million yd^3 [28.3 million m^3] were excavated. These campaigns included the capital dredging of the navigational channel between Tilbury and Gallions Reach to a depth of 30 feet [9.1 m] below chart datum, and the navigation channel between Gallions Reach and Upper Pool to a depth of 19 to 20 feet [5.8 to 6.1 m] below chart datum.

Since 1928, dredging in the Thames has been primarily associated with maintaining depths. The main navigation channel created by 1928 was largely self-maintaining, but annual dredging returns for the River and docks for the periods 1928 to 1956 are fairly consistent, averaging 2,660,000 hopper tonnes [1,860,000 m^3] per annum; this data was extracted from HR Wallingford (2007) and corroborated by IECS (1993). Much of this material, along with sewage sludge from London's main sewage works at Barking and Cross Ness, was disposed of in the Outer Estuary (Black Deep and Barrow Deep). In addition, some of this material was disposed at Lower Hope Reach in front of north Mucking Flats. HR Wallingford (2002f) reported that a total of around 580,000 m^3/yr of material is estimated to have been disposed of in Lower Hope Reach between 1941 and 1967. It has been estimated that approximately 50% of the dredge material between 1928 and 1956 originated from the Mud, Gravesend and other Reaches along the estuary (HR Wallingford, 2007).

Following a review of the dredging requirements of the River in the 1950s, the PLA implemented a significant change of policy for the dredging objectives and disposal practice. This resulted, from 1967, in a considerable annual reduction in the dredging commitment particularly within the Mud Reaches (HR Wallingford, 2007). This included a significant reduction in maintenance dredging at Diver Shoal and Gravesend Reach from 1965, with ongoing dredging limited to local activities related

to new jetties or deepening of existing riverside facilities (Kendrick, 1984); these reductions does not appear to have impacted significantly on the navigable depth in the River. It should also be noted that in the preceding years (1962 to 1966), significant capital dredging was undertaken, which included the relocation of the navigation channel in Lower Gravesend Reach (relocated 500 feet south - 1964/1965) and Knock John Channel (deterioration of North Edinburgh Channel, new channel created through Black Deep - 1966) in response to recommendations by the then Hydraulics Research Station.

Historically, dredge arisings have been predominantly disposed of in the Outer Estuary, seaward of Southend-on-Sea. However, two onshore placement sites also operate at Rainham and Cliffe. Rainham was operational pre-1949 but was further developed following the suggestion by Inglis and Allen (1957) that the disposed sediment at Black Deep was re-entrained and transported back into the estuary, adding to the rate of deposition in primary sources (Thorn and Burt, 1978). The Black Deep disposal site was changed in 1961 (and still ongoing) to Rainham Marshes, situated mid-way between London Docklands and Tilbury, which had the effect of removing the dredged sediment from the system. Initially comprising two large lagoons, the Rainham site was extended with the addition of 7 new lagoons, commencing operations in January 1968. Cliffe was originally licensed to receive dredge materials (having formerly operated as clay pits) in 1960. With Rainham originally anticipated to be full by 1982, Westminster Dredging expanded their interest in the Cliffe disposal site in 1972 to provide capacity for 20 years of maintenance operations.

6.2 Current Dredge Practice

6.2.1 Overview

As described in Section 2, maintenance dredging within the Thames Estuary (up to the NTL at Teddington) is carried out under the management and direction of the PLA, which has a responsibility to maintain depths within the navigation channels. A Maintenance Dredging Framework, established by the PLA in partnership with members of the Dredging Liaison Group (a Thames Estuary Partnership Action Group), provides for the co-ordinated management of dredging operations on the tidal Thames (see Section 4). Berth operators are responsible for the maintenance of their berths and approaches under the regulation of the PLA and in accordance with the Maintenance Dredging Framework.

The following sections cover the maintenance dredging carried out by PLA, who have powers to carry out maintenance dredging for navigational purposes under Section 73 of the 'Port of London Act 1968' (see Section 2.4), but also dredging undertaken within the Thames Estuary by third party (non-PLA) operators. Data and information on dredging operations in the Thames were obtained through consultation with the PLA, document review and, most importantly, from DSIS, developed through the Maintenance Dredging Framework (described in Section 2). A description of the various dredging techniques currently implemented within the Thames is provided within Section 6.2.2, whilst current disposal sites (both land and sea) are described in Section 6.2.3. Detailed information of site specific dredging operations, both PLA and third party, is provided in Section 6.3.

6.2.2 Dredging Methods

6.2.2.1 Water Injection Dredging

The majority of dredged sites within the Thames, by volume and frequency, are undertaken using WID, rather than more conventional excavation processes. The technique involves the injection of high volumes of water at low pressure into the recently deposited seabed sediments. This re-fluidises the silts and fine sands, which then flow by gravity or current from the dredge site. The water is injected at low pressures, ensuring the sediment material is re-energised as a density current at the bed, rather than being re-suspended into the full water column. To be effective, the technique requires a flow gradient away from the dredge site, so material is transported to locations from which it is subsequently re-distributed by natural currents. The technique therefore promotes relocation of material based on local dispersion rather than removal to licensed marine or land (terrestrial) disposal sites. Retention of sediments within the natural estuarine system is widely considered to be a potentially significant environmental benefit of the technique. In order to minimise the environmental effects, dredging is required to be undertaken on an ebb tide to provide maximum dispersion and minimise sedimentation on the designated conservation sites. Where adjacent facilities are dredged (e.g. Coryton), the sequence in which berths are dredged is managed, when possible, to work downstream, thereby avoiding deposition within recently maintained areas.

Re-deposition rates vary depending on the grading of the dredged materials. Sand material will be re-deposited within close proximity of the dredge site whereas fine silts may remain in suspension for a period of days following dredging.

6.2.2.2 Hydro-dynamic Dredging

The Hydro-dynamic Dredging Method (HDM) utilises a high pressure/high volume dredging technique to maintain water depths through sediment dispersion. The HDM can be specifically designed to monitor and control turbidity in the water column, thus reducing the potential risk to the surrounding environment (GPS Marine, 2011).

6.2.2.3 Trailer Suction Hopper Dredging

WID and HDM are not suitable for all locations and sediment materials. Consequently, a number of areas are maintained using conventional trailing suction hopper dredging (TSHD) equipment. TSHD uses suction to raise loosened material from the bed through a pipe connected to a centrifugal pump. Suction alone is normally sufficient for naturally loose material, such as recently deposed material within deepened areas such as the approach channel or berthing areas. TSHD is most efficient when working with fine substrates such as mud, silt, sand and loose gravel as the material can be easily held in suspension. Coarser materials can also be dredged using this method, but with a greater demand on pump power and with greater wear on pumps and pipes. Material dredged by TSHD is then disposed at licensed sites (see Section 6.2.3).

6.2.2.4 Plough dredging (bed levelling)

Plough dredging utilises a tug equipped with a plough unit, e.g. a steel box suspended on cables/chains. The plough is lowered to a predetermined depth and is

used to drag sediment along the seabed. Ploughing is typically used in confined areas due to the small size and manoeuvrability of the vessel, moving material from inaccessible areas such as dock entrances, corners or complicated areas of bathymetry to areas accessible by TSHD or WID vessels. As with WID, ploughing should not typically lead to significant re-suspension of sediment, but if the sediment ploughed is soft, it may be sufficiently disturbed to rise into suspension. Ploughing equipment has also been deployed in the Thames to level sand waves in the channel bed, but without significant success.

6.2.2.5 Backhoe excavator dredging

A backhoe dredger is a hydraulic excavator equipped with a half-open shell. This shell is filled as it moves towards the machine. Typically, dredged material is loaded in barges and subsequently disposed of either in landfill or licensed sea disposal sites. This machine is mainly used in harbours and other shallow waters. The advantages of backhoe dredging are:

- Its ability to dredge a wide range of materials, including those which contain boulders, debris; difficult materials, such as stiff clays and weak rocks;
- The ability to work in confined spaces;
- Its accurate control of position and depth; and
- The minimum disturbance and dilution of the material being dredged.

6.2.3 Disposal Sites and Beneficial Use

As detailed previously, maintenance dredging within the Thames Estuary is predominantly achieved through WID. As a result of this process the dredged sediments do not require disposal, but are rather dispersed locally in the water column, therefore promoting relocation of material rather than removal to licensed marine or land disposal sites. In the instances where disposal is required from dredge locations in the study area, i.e. through TSHD or backhoe dredging, land disposal facilities within the Thames Estuary at Rainham Marshes and Cliffe Pools are most commonly used. In addition to these sites, a land disposal facility at Hoo Island on the Medway Estuary and marine disposal sites at South Falls (TH060) and Inner Gabbard (TH052) have also been used (see Figure 6.1).

6.2.3.1 Rainham Marshes

Rainham Marshes become operational pre-1949 and initially comprised two large lagoons, before it was extended with the addition of 7 new lagoons from 1968 onwards. Rainham now comprises a series of 9 linked lagoons, and currently has a capacity of approximately 1.5 million m^3. The original two lagoons have since been incorporated into the household waste landfill operations facility. The site, situated to the south of Rainham Town Centre (see Figure 6.1), is owned by Defence Estates (the Ministry of Defence) and leased to the RSPB who manage the Inner Thames Marshes SSSI (PLA, 2006).

This site is a receptor for material arising from maintenance dredging operations, as well being a habitat within the Inner Thames Marshes SSSI. An Operational Plan was prepared in 2006 (PLA, 2006) to provide an agreed procedure for the operational disposal of dredged material to the Silt Lagoons. The plan has been produced in consultation with the PLA, Westminster Dredging, the RSPB, Natural England and the Environment Agency. The Plan supports the ongoing operation of the site to

minimise disturbance to wildlife and maximise opportunities for creating productive habitats during pumping operations.

The Waste Management Licence allows for a maximum annual reception capacity of 350,000 tonnes of deposited material (solids), excluding the water used to carry the material to the lagoons. The dredged material deposited at Rainham is used beneficially to create and maintain the habitats within the silt lagoons. The ongoing operation of the site is an intrinsic element of the maintenance dredging strategy for the Thames, as well as continuing the management regime of the SSSI itself. The operations do not directly impact on the European sites and the discharge from the lagoons occurs outside the study area.

6.2.3.2 Cliffe Pools

Cliffe Pools has operated as a dredging disposal site since 1960. It is located to the east of Gravesend, in Kent (see Figure 6.1), and forms the western end of the Thames Estuary and Marshes Special Protection Area (SPA). Since 2001, the site has been owned by RSPB. In 2002, RSPB entered into a management contract for the lagoons with Westminster Dredging, and this arrangement is ongoing. The site is a receptor for selected material arising from maintenance dredging operations in the Thames. The deposited materials are used to manage and enhance the existing saline lagoon areas to reduce depths, provide beaches, and create islands which function as breeding and roosting sites.

A Management Plan has been produced for the site which covers the period 2008 to 2013 (RSPB, 2008). The Plan includes an objective to enhance the existing saline lagoons and brackish pools. This will be achieved primarily through prioritised disposal of dredgings to reduce water depth and create islands to increase numbers of breeding, wintering and passage water birds and maintain their current non-avian value and maintain favourable SSSI and SPA status. In 2004, Westminster Dredging obtained a Pollution Prevention Control Licence for the site (although Government has since removed the requirement for PPC at such sites).

The site has a potential capacity of 850,000 m^3, with an annual ceiling of 150,000 m^3. The site operates in support of dredging activity in the Thames, equating to quarterly periods of approximately 3 weeks duration. During these periods, the site is operational for up to 24 hours each day, with a daily ceiling of 10,000 m^3 excluding the water used to flush material into the site from the discharging vessel. Water, from dredging and precipitation, is discharged from the site via a series of sluices leading to Cliffe Creek. These are operated by Westminster Dredging during operational periods and by RSPB during non-operational phases. The PLA are not aware of any water quality issues associated with this activity.

6.2.3.3 Hoo Island

The Hoo Island disposal facility is operated by Peel Ports Medway within the Medway Estuary (see Figure 6.1), and is designed to receive and handle dredged material associated with navigational maintenance dredging. In addition, the site also accepts material from terrestrial sources for engineering purposes, i.e. for maintaining internal bunds.

6.2.3.4 Marine disposal sites

There are a number of licensed open and closed marine disposal sites within the Thames Estuary and further offshore. Of these, South Falls (TH070) and Inner Gabbard (TH052) are the sites which have been used for maintenance dredging disposal in recent years; see Figure 6.1 for locations.

Defra records show that the volume of dredging material disposed in the South Falls site fluctuates from nothing to around 0.34 million tonnes annually, calculated over a 27 year period between 1986 and 2012. The data provided by Defra does not specify the source of the material, therefore, it is not possible to state that the deposited quantities arise from any one given source or geographic area. Defra records also show that the volume of maintenance dredgings disposed in the Inner Gabbard site fluctuated from around 0.7 million tonnes to approximately 3.33 million tonnes annually over a 15 year period from its opening in 1998 to 2012. It should also be highlighted that a further sand placement site has been recently characterised in the North Edinburgh Channel (TH080), see Figure 6.1.

6.3 Dredge Volumes, Frequencies and Duration of Current Dredging Operations

6.3.1 PLA Dredging

As described in Section 6.2.1, the PLA has a conservancy obligation under the Port Marine Safety Code to maintain and improve navigation within the Thames Estuary. In order to achieve this, PLA consider a wide range of measures from moving navigation aids and recommended routes to maintenance and capital dredging as trading or other factors demand. The PLA carry out regular hydrographic surveys and provide charted information informing mariners of navigable depths, where reduced depths within navigation channels are identified, maintenance dredging can be used to restore access windows.

Maintenance dredging by the PLA is undertaken using a variety of techniques, which largely depend on the location of the dredge area (e.g. accessibility and water depth) and the material type requiring dredging. Table 6.1 provides a summary of the potential maintenance dredging activities that may be undertaken by the PLA, with the dredge areas listed from the outermost location in the Outer Thames (Black Deep) to the most upstream dredge location (Richmond Shoal); the location of the dredge areas are provided in Figures 6.2 to 6.7. This summary has been compiled through a review of historical dredging activities and in anticipation of potential future maintenance in the outer estuary.

Table 6.2 provides a record of PLA maintenance dredge volumes for a 10 year period between 2004 and 2013. During this period the most frequently maintained areas were Diver and Tilburyness Shoals (both shown in Figure 6.4). The information collated in Table 6.1 and 6.2 is based on data from DSIS; although where incomplete records existed further consultation was undertaken with the PLA to fill the data gaps. It should also be highlighted that significant improvements in the data recording process in recent years will help to reduce data gaps in future iterations of the Baseline Document.

Dredge Location	Current Maximum Dredge Depth (m below CD)	Predominant Dredge Methodology*	Maximum Potential Dredge Volume (m^3 per Campaign)	Predominant Sediment Type	Dredge Area Size (km^2)	Last Dredged
Black Deep	16.8	TSHD	50,000	Sand	6.07	-
Knock John	15.3	TSHD/WID	50,000	Sand	3.85	2009
Oaze Deep	15.3	TSHD	10,000	Sand	5.86	-
West Oaze	14.8	TSHD	100,000	Sand	1.71	-
Holehaven Shoal**	11.0	WID/Plough	2,500	Sand/Silt	<0.01	2008
Lower Hope Shoal	9.5	TSHD	2,500	Sand/Gravel	1.27	1997
Coalhouse Shoal	9.5	Plough/TSHD	20,000	Sand/Gravel	0.39	2006
Diver Shoal	9.5	WID/Plough	78,500	Silt/Sand/Gravel	0.75	2012
Royal Terrace Pier	2.3	WID	1,000	Silt	<0.01	2007
Tilburyness Shoal	9.1	WID/Plough/TSHD	20,000	Sand/Gravel	0.07	2013
Broadness Shoal	7.3	WID/Plough	1,050	Sand/Gravel	0.03	2007
Crayfordness Shoal	7.5	WID/Plough	1,000	Sand/Gravel	0.03	-
Jenningtree Shoal	7.3	WID/Plough	8,300	Sand/Gravel	0.05	2008
Barking Shoal	5.8	WID/Plough	3,300	Sand/Gravel	0.05	2012
Barking Creek	+1.0	WID	2,300	Silt	<0.01	2012
Gallions Shoal	6.0	WID/Plough	800	Sand/Gravel	0.06	2007
Hookness Shoal	5.8	WID/Plough	6,300	Sand/Gravel	0.05	2008
Blackwall Shoal	5.1	WID/Plough	1,500	Sand/Gravel	0.05	2008
Saundersness Shoal	5.0	TSHD	27,000	Sand/Gravel	0.08	2003
Limekiln Dock	+5.0	Plough/Backhoe	1,200	Gravel	<0.01	-
Battersea Shoal	2.3	Backhoe/WID	2,200	Gravel	0.02	2009
Kew Shoal	1.3	Backhoe	1,000	Gravel	0.03	2005
Richmond Shoal	1.3	Backhoe	1,000	Gravel	<0.01	1999

* Predominant dredge methodologies adopted historically (or expected to be adopted for future dredging).
** Holehaven shoal has been historically dredged by the PLA, however, this area will now be maintained by London Gateway in the future.

Table 6.1 Summary of PLA dredging within the Thames Estuary

Dredge Location	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Black Deep	0	0	0	0	0	0	0	0	0	0
Knock John	0	0	0	0	0	856	0	0	0	0
Oaze Deep	0	0	0	0	0	0	0	0	0	0
West Oaze	0	0	0	0	0	0	0	0	0	0
Holehaven Shoal*	N/A	N/A	100	2,500	475	0	0	0	0	0
Lower Hope Shoal	0	0	0	0	0	0	0	0	0	0
Coalhouse Shoal	0	0	130	0	0	0	0	0	0	0
Diver Shoal	0	0	3,555	N/A	1,200	0	79,168	3,880	4,136	0
Royal Terrace Pier	0	0	0	1,880	0	0	0	0	0	0
Tilburyness Shoal	1,000	3,000	2,569	4,010	1,100	0	2,082	508	0	1,016
Broadness Shoal	0	0	N/A	N/A	0	0	0	0	0	0
Crayfordness Shoal	0	0	0	0	0	0	0	0	0	0
Jenningtree Shoal	0	0	8,235	0	1,142	0	0	0	0	0
Barking Shoal	0	0	0	0	0	0	0	0	114	0
Barking Creek	0	0	0	0	0	0	0	0	N/A	0
Gallions Shoal	0	0	0	800	0	0	0	0	0	0
Hookness Shoal	0	0	6,280	0	2,000	0	0	0	0	0
Blackwall Shoal	0	0	0	0	1,200	0	0	0	0	0
Saundersness Shoal	0	0	0	0	0	0	0	0	0	0
Limekiln Dock	0	0	0	0	0	0	0	0	0	0
Battersea Shoal	0	0	N/A	0	2,000	2,200	0	0	0	0
Kew Shoal	0	1,000	0	0	0	0	0	0	0	0
Richmond Shoal	0	0	0	0	0	0	0	0	0	0

Notes: It should be recognised that volumes presented in this table do not necessarily include all dredge events, but rather recorded volumes available in DSIS.
N/A denotes that dredging was undertaken but the total volume is unknown.
** Holehaven shoal has been historically dredged by the PLA, however, this area will now be maintained by London Gateway in the future.

Table 6.2 Recorded PLA maintenance dredging volumes (m³) for the period 2004 to 2013

6.3.2 Third Party Dredging

The Thames Estuary provides numerous docks, wharves, jetties, pontoons and slipways which are used by a range of commercial and recreational estuary users. Many of these facilities require regular maintenance dredging to remove recently deposited material to ensure safe navigation and appropriate access. Whilst the PLA has a responsibility to maintain the main navigational fairways, the maintenance dredging of non-harbour authority berths and approaches is the responsibility of third party organisations (under the regulation of the PLA), referred to in this text as 'third party dredging'.

The following sections detail the activities of organisations that have been identified as undertaking third party dredging within the Thames Estuary during the period 2004 to 2013, or planning to undertake on-going maintenance dredging activities in the near future (i.e. London Gateway). The information is based on data from DSIS, although where incomplete records existed further consultation was undertaken with the PLA to fill the data gaps where information was available. In particular, more detailed information of specific maintenance dredging activities by third parties has been provided where possible, predominantly for those organisations that are currently licensed by the PLA to undertake maintenance dredging within the Thames. Significant improvements in the data recording process in recent years will help to reduce data gaps in future iterations of the Baseline Document.

6.3.2.1 London Gateway

Organisation:	DP World
Dredge location:	See Figures 6.2 and 6.3
Current max. dredge depth:	17.0 m below CD (Berths 1, 2 & 3), 14.5 m below CD (manoeuvring area, Yantlet Channel and future berth), 16.5 m below CD (majority of outer navigation channel), 15.0 m below CD (Knock John Channel).
Dredging frequency:	Up to 4 times per year (under consideration)
Material type:	Silt/sand
Dredging technique:	WID/TSHD

Description: Construction works at the London Gateway began in February 2010, comprising the reclamation of approximately 92 ha of land from the river and raising of around 80 ha of existing land. As part of the development, substantial capital dredging of the berth pockets, manoeuvring area and approach channels was achieved primarily using TSHD, with some use of a cutter suction dredger and ploughing. In total, the capital dredge amounted to approximately 31.35 Mm^3, of which around 2.5 Mm^3 was disposed at the licensed South Falls (TH070) disposal ground, whilst the remainder of the dredge material was used in land works (i.e. the construction of the reclamation) or for beneficial use (pers. comms. HR Wallingford, 2014). At the time of writing (April 2014) no maintenance dredging has been required since completion of the capital dredge campaign however the potential future maintenance dredging requirements have been estimated. It is considered that up to 1.94 Mm^3/yr of muds and sands will require dredging as a combined total from the berths and manoeuvring area., It is also estimated that up to 250,000 m^3/yr may require dredging from the navigation channel, mostly within Sea Reach (pers. comms. HR Wallingford, 2014). These volumes are estimated on the basis that depths created during the capital dredge are to be maintained. Whilst the specific

frequency and timing of the maintenance dredging is not yet finalised, it is presently being considered that dredging will be undertaken up to 4 times per year (i.e. every 3 months). Furthermore, it is expected that maintenance dredging will be achieved through a combination of WID and TSHD (pers. comms. HR Wallingford, 2014).

6.3.2.2 Medway Approach Channel

Organisation: Peel Ports Medway
Dredge location: See Figure 6.2
Current max. dredge depth: 12.5m below CD
Dredging frequency: 12 to 18 months
Campaign duration: Typically no longer than 2 to 3 weeks
Material type: Silt/sand
Dredging technique: TSHD (Dredging International (UK) Ltd)

Description: The Medway Approach Channel (MAC) is located within the PLA Statutory Harbour Area, but is under the administration of the Medway Ports Authority. Whilst dredging of the MAC is licensed by PLA, details and assessment of these specific dredging and disposal works is covered separately in 'The Medway Approaches, Medway Estuary and The Swale MDP and WFD Baseline Document' (Peel Ports, 2012) and other related documentation. For context, however, maintenance dredging is required to provide safe navigation along the approach channel into the Medway Estuary. This dredging has been undertaken by TSHD over the last 10 years, with disposal at the licensed South Falls (TH070) and Inner Gabbard (TH052) disposal sites.

Location	2004	2005	2006	2007	2008
Medway Approach Channel	83,525	151,960	0	158,725	0
	2009	**2010**	**2011**	**2012**	**2013**
	112,286	116,236	0	104,656	130,368
(Source: DSIS, 2014; Peel Ports, 2012)					

Table 6.3 Dredging volumes (m^3) for the Medway Approach Channel

6.3.2.3 Oikos Terminal (Holehaven Jetty)

Organisation: Oikos
Dredge location: See Figure 6.3
Current max. dredge depth: 12.5 m below CD (main berth box), 4 m below CD (behind jetty), 13.5 m below CD (escape channel)
Dredging frequency: Every 3 months
Campaign duration: Approximately 15 hours
Material type: Silt/fine sand
Dredging technique: WID (Van Oord)

Description: The Oikos jetty has been dredged regularly since construction in order to permit all tide operations. Between 2004 and 2013, the majority of dredging was achieved using WID except for smaller TSHD campaigns of 15,000 m^3 in 2006 (disposal to Rainham Marshes) and 9,500 m^3 in 2007 (disposal to Cliffe Pools). In order to facilitate the effective removal of silt and sand from the jetty berth during WID, PLA licensed Oikos to dredge an 'escape channel' from the berth to deeper water. Dredging of the escape channel was undertaken during 2007 and 2008 by WID, with dredge volumes of 12,350 and 51,840 m^3 respectively. Whilst the escape

channel has not been re-dredged since this time, maintenance of the channel is likely to be required in the future.

Location	2004	2005	2006	2007	2008
Oikos Terminal (Main Box Berth, Behind Jetty and Escape Channel)	34,950	36,925	53,830	61,378	116,848

Table 1.4 Dredging volumes (m³) for Oikos Terminal

6.3.2.4 Thames Oilport

Organisation: Morzine Ltd
Dredge location: See Figure 6.3
Current max. dredge depth: 10.6 m below CD (jetty 1), 5.1 m and 7.0 m below CD (jetty 2), 13.4 m below CD (jetty 3), 14.0 m below CD (jetty 4), 13.1 m CD (jetty 5), 11 m below CD (patch), 1.0m below CD (behind jetty 1)
Dredging frequency: Every 3 months
Campaign duration: Up to 50 hours
Material type: Silt and fine/medium sand
Dredging technique: WID (Van Oord)

Description: Thames Oilport established in 2012 as a joint venture between Royal Vopak, Greenergy and Shell. The site comprises a range of jetty structures serving differing vessel profiles, all of which have been dredged regularly since their construction in order to accommodate large vessels. Maintenance dredging over the last 10 years has been typically achieved by WID, however, in 2011 the PLA granted a licence variation for a one off dredge using a TSHD. This dredge was required to remove coarser materials and debris from within the berth pockets (unachievable by WID), with a total volume of 93,382 m^3 dredged and subsequently disposed at the London Gateway site.

Location	2004	2005	2006	2007	2008
Thames Oilport (All Locations, i.e. Jetties 1, 2, 3, 4, 5 and Patch)	152,225	208,025	112,260	104,840	62,058
	2009	**2010**	**2011**	**2012**	**2013**
	46,629	20,010	122,583	22,748	40,721
(Source: DSIS, 2014)					

Table 1.5 Dredging volumes (m³) for Thames Oilport

6.3.2.5 S Jetty Shellhaven

Organisation: Shell
Dredge location: See Figure 6.3
Current max. dredge depth: 16.0 m below CD
Dredging frequency: Every 3 to 4 months
Material type: Very fine sand/silt
Dredging technique: Van Oord (WID)

Description: The Shellhaven S Jetty was constructed in 2011 to replace the last of the old refinery operational jetties. The refinery at Shellhaven closed in December 1999, but the site continued to supply Aviation fuel by pipe and road using parts of

the old infrastructure (including the Bravo Jetty, which required regular maintenance dredging until 2009 (see Section 6.3.2.21 for volumes)). For future operation of the S Jetty, it is envisaged that dredging will need to be undertaken approximately 3 to 4 times per year using WID.

Location	2004	2005	2006	2007	2008
S Jetty Shellhaven	0	0	0	0	0
	2009	**2010**	**2011**	**2012**	**2013**
	0	0	0	0	8,597
(Source: DSIS, 2014)					

Table 1.6 Dredging volumes (m³) for S Jetty Shellhaven

6.3.2.6 Tilbury Power Station

Organisation: RWE npower
Dredge location: See Figure 6.4
Current max. dredge depth: 13.8 m below CD (upper berth), 7.2 m below CD (lower berth)
Dredging frequency: Every 4 to 6 months (when required)
Material type: Silt (some sand and gravel)
Dredging technique: Plough/TSHD/Backhoe (Westminster)

Description: Whilst the power station is not presently licensed by the PLA to undertake dredging, historically there has been a regular need to maintain berth depths. In the past dredging has been predominantly required within the upper berth, although some dredging of the lower berth was achieved in 2009 (60 m^3 by TSHD and disposal to Cliffe Pools), 2010 (1,334 m^3 by plough) and 2011 (134 m^3 by plough). In addition to the dredging of the upper and lower berths, approximately 6,000 m^3 was dredged by backhoe from the power station intakes during 2005, with this sediment pumped to the Cliff Pools licensed land disposal site.

Location	2004	2005	2006	2007	2008
Tilbury Power Station	120,000	8,000	16,500	15,860	12,540
	2009	**2010**	**2011**	**2012**	**2013**
	2,822	13,593	1,697	0	0
(Source: DSIS, 2014)					

Table 1.7 Dredging volumes (m³) for Tilbury Power Station

6.3.2.7 Customs Pier

Organisation: UK Border Agency
Dredge location: See Figure 6.4
Current max. dredge depth: 3.0 m below CD
Dredging frequency: Every 6 to 12 months
Material type: Silt
Dredging technique: WID (Van Oord)

Description: In order to permit all tide operations for vessels, the berth pocket has been dredged regularly since the construction of the jetty. Maintenance dredging at Customs Pier is achieved through WID approximately every 6 to 12 months, with an average volume of *circa* 5,730 m^3/yr.

Location	2004	2005	2006	2007	2008
Customs Pier	4,500	7,450	1,250	8,560	6,827
	2009	**2010**	**2011**	**2012**	**2013**
	5,646	3,694	2,601	6,999	9,774
(Source: DSIS, 2014)					

Table 1.8 Dredging volumes (m³) for Customs Pier

6.3.2.8 Tilbury Bellmouth

Organisation: Port of Tilbury Ltd
Dredge location: See Figure 6.4
Current max. dredge depth: 7.0 m below CD (restricted area), 8.5 m below CD (remaining area)
Dredging frequency: Every 3 months
Material type: Silt
Dredging technique: WID (Van Oord)

Description: Dredging is required to maintain access to the Port of Tilbury through the lock for all vessels at all states of the tide. The lock entrance is a natural silt trap consequently, dredging has been necessary throughout the operational life of the dock system. Over the past decade, dredging has been achieved by WID on the ebb tide with no obvious impact on the adjacent river berths. Maintaining access to the lock entrance meant depths needed to be managed to facilitate access by all ships, however the sediment quality was not of an acceptable standard for dispersion across the whole dredge area. Therefore depths were reduced in the areas of poorer sediment quality to minimise impacts, with targeted dredging to facilitate the use of the lock.

Location	2004	2005	2006	2007	2008
Port of Tilbury Bellmouth (Lock Entrance)	42,000	61,500	36,200	51,781	53,791
	2009	**2010**	**2011**	**2012**	**2013**
	40,539	20,205	20,890	50,950	55,256
(Source: DSIS, 2014)					

Table 1.9 Dredging volumes (m³) for Port of Tilbury Bellmouth

6.3.2.9 Northfleet Hope Container Terminal

Organisation: Port of Tilbury Ltd
Dredge location: See Figure 6.4
Current max. dredge depth: 13.8 m below CD
Dredging frequency: Every 2 to 3 years
Material type: Silt/sand
Dredging technique: WID (Van Oord)

Description: The Northfleet Hope Container Terminal berth is largely self-maintaining, however, occasional dredging is required to maintain operational depths. Dredging was undertaken on two occasions (in 2007 and 2011) over the last 10 years, predominantly achieved by TSHD (with disposal at Cliffe Pools) with some plough dredging. Any future maintenance dredging (i.e. post 2013) undertaken at this location will be achieved by WID.

Location	2004	2005	2006	2007	2008
Port of Tilbury (Northfleet Hope Container Terminal)	0	0	0	3,076	0
	2009	**2010**	**2011**	**2012**	**2013**
	0	0	3,220	0	0
(Source: DSIS, 2014)					

Table 1.10 Dredging volumes (m³) for Northfleet Hope Container Terminal

6.3.2.10 Robins Wharf (Northfleet)

Organisation: ARMAC Shipping Ltd
Dredge location: See Figure 6.4
Current max. dredge depth: 3.0 m below CD
Dredging frequency: Annually
Material type: Silt
Dredging technique: WID (Van Oord)

Description: Dredging is undertaken in the Robins Wharf jetty berth pocket to allow receipt and unloading of aggregate vessels. Over a 10 year period between 2004 and 2013, dredging has been achieved through WID approximately annually.

Location	2004	2005	2006	2007	2008
Robins Wharf	1,000	5,000	0	1,415	3,222
	2009	**2010**	**2011**	**2012**	**2013**
	1,794	2,359	1,140	0	2,293
(Source: DSIS, 2014)					

Table 1.11 Dredging volumes (m³) for Robins Wharf

6.3.2.11 Vopak London Terminal

Organisation: Vopak
Dredge location: See Figure 6.4
Current max. dredge depth: 10.5 m below CD (jetties 1 & 2), 7.9 m below CD (jetty 3)
Dredging frequency: Every 6 months (when required)
Material type: Silt
Dredging technique: WID (Van Oord)

Description: When maintenance dredging is required at the Vopak London Terminal, this is typically achieved through WID, albeit 3,000 m^3 of sediment was removed through ploughing in 2006. The greatest need for dredging at the terminal is within the deeper jetty 1 and 2 berth pockets, with the shallower jetty 3 having only required dredging more recently in 2009, 2010 and 2013 (207 m^3).

Location	2004	2005	2006	2007	2008
Vopak Jetties 1, 2 & 3	0	0	3,000	3,854	3,176
	2009	**2010**	**2011**	**2012**	**2013**
	10,072	4,658	0	0	6,457
(Source: DSIS, 2014)					

Table 1.12 Dredging volumes (m³) for Vopak Jetties 1, 2 & 3

6.3.2.12 Jurgens Jetty

Organisation: Pura Foods Ltd
Dredge location: See Figure 6.4
Current max. dredge depth: 3.6 m below CD (inner jetty), 9.6 m below CD (outer jetty)
Dredging frequency: Every 12 months
Material type: Silt
Dredging technique: WID (Van Oord)

Description: Dredging of silt from within the inner and outer jetty berth pockets at Riverside Wharf is achieved through WID approximately every 12 months. In addition to this, approximately 100 m^3 of sediment was dredged (dispersed) in 2008 when compressed air was blown through the cofferdam airlines.

Location	2004	2005	2006	2007	2008
Riverside Wharf	0	0	0	0	8,854
	2009	**2010**	**2011**	**2012**	**2013**
	4,090	0	4,000	9,367	4,585
(Source: DSIS, 2014)					

Table 1.13 Dredging volumes (m^3) for Jurgens Jetty

6.3.2.13 Purfleet Deep Wharf

Organisation: C. Ro Ports Ltd
Dredge location: See Figure 6.4
Current max. dredge depth: 8.0 m below CD (upper/lower berths), 7.8 m below CD (lower berth approach), 3.0 m below CD (pontoon area) and 1.0 m below CD (inner area).
Dredging frequency: Every 3 to 6 months
Material type: Silt/very coarse sand
Dredging technique: WID (Van Oord)

Description: Dredging of the berths and approaches at Purfleet Deep Wharf is undertaken by WID in order to maintain required navigational depths. This dredging has been typically undertaken 3 to 4 times per year since 2001 to predominantly remove very coarse sand (and silt), albeit with no recorded dredging activity between 2004 and 2006. Since 2008, the dredging requirement at Purfleet Deep Wharf has been on average 9,560 m^3/yr.

Location	2004	2005	2006	2007	2008
Purfleet Deep Wharf	0	0	0	N/A	18,723
	2009	**2010**	**2011**	**2012**	**2013**
	8,217	7,224	6,723	9,976	6,500
(Source: DSIS, 2014)					

Table 1.14 Dredging volumes (m^3) for Purfleet Deep Wharf

6.3.2.14 Middleton Wharf

Organisation: Riverside Resource Recovery Ltd
Dredge location: See Figure 6.5
Current max. dredge depth: 2.9 m below CD (inner jetty), 4.3 m below CD (outer jetty)
Dredging frequency: Every 6 to 12 months
Material type: Silt
Dredging technique: WID (Van Oord)

Description: Maintenance dredging at the Middleton Wharf has been required since 2013, in which two WID campaigns to remove silts from the inner and outer jetty berth pockets were achieved (only dredge volumes from the 2nd campaign have been documented).

Location	2004	2005	2006	2007	2008
Middleton Wharf	0	0	0	0	0
	2009	**2010**	**2011**	**2012**	**2013**
	0	0	0	0	10,603
(Source: DSIS, 2014)					

Table 1.15 Dredging volumes (m³) for Middleton Wharf

6.3.2.15 King George V Lock

Organisation: RoDMA
Dredge location: See Figure 6.5
Current max. dredge depth: 4.0 m below CD
Dredging frequency: Every 3 months
Material type: Silt
Dredging technique: WID (Van Oord), Plough (Howard Beer)

Description: Maintenance dredging is undertaken within the lock entrance approximately every 3 months in order to maintain access to the enclosed King George V Dock. Between 2004 and 2007, dredging was achieved through ploughing, whilst in more recent years WID has been preferred.

Location	2004	2005	2006	2007	2008
King George V Lock Entrance	3,075	5,400	1,500	4,000	18,102
	2009	**2010**	**2011**	**2012**	**2013**
	36,229	25,017	19,905	26,454	18,457
(Source: DSIS, 2014)					

Table 1.16 Dredging volumes (m³) for King George V Lock Entrance

6.3.2.16 Thames Refinery

Organisation: Tate & Lyle Sugars
Dredge location: See Figure 6.5
Current max. dredge depth: 10.0 m below CD (outer jetty) and 2.0 m below CD (inner jetty)
Dredging frequency: Every 3 to 6 months (when required)
Material type: Silt
Dredging technique: WID (Van Oord)

Description: Dredging is periodically undertaken at the Thames Refinery in order to maintain depths within the jetty berths, predominantly the outer jetty, allowing vessels to unload cargoes of raw sugar cane. Over a 10 year period between 2004 and 2013, dredging has been achieved approximately every other year through WID, typically with 3 to 4 campaigns per annum.

Location	2004	2005	2006	2007	2008
Thames Refinery (Outer and Inner Jetties)	0	0	30,395	12,688	13,729
	2009	**2010**	**2011**	**2012**	**2013**
	12,959	0	0	0	9,320
(Source: DSIS, 2014)					

Table 1.17 Dredging volumes (m³) for Thames Refinery

6.3.2.17 Murphy's Wharf Jetty

Organisation: Day Aggregates
Dredge location: See Figure 6.6
Current max. dredge depth: 0.3 m below CD
Dredging frequency: Every 1 to 3 years
Material type: Silt
Dredging technique: Various, most recently HDM

Description: Relatively infrequent dredging has been undertaken at Murphy's Wharf Jetty between 2004 and 2013. During this period, dredging has been achieved using backhoe in 2004 (with disposal at Hoo Island) and ploughing in 2007 and 2009. More recently, however, dredging was achieved by the Hydro Dynamic Dredging Method (HDM) in 2013.

Location	2004	2005	2006	2007	2008
Murphy's Wharf Jetty	3,500	0	0	500	0
	2009	**2010**	**2011**	**2012**	**2013**
	N/A	0	0	0	1,036
(Source: DSIS, 2014)					

Table 1.18 Dredging volumes (m³) for Murphy's Wharf

6.3.2.18 West India Docks

Organisation: Canal and River Trust
Dredge location: See Figure 6.6
Current max. dredge depth: 4.7 m below CD (Lock Entrance)
Dredging frequency: Every 6 months
Material type: Silt
Dredging technique: WID (Van Oord)

Description: The lock entrance to the West India Docks is dredged approximately twice per year to in order to maintain ship access to the docks, e.g. South Dock regularly plays host to medium-sized military vessels visiting London. Prior to 2007, dredging was achieved through ploughing, whilst WID has been the preferred technique in recent years (i.e. between 2007 and 2013).

Location	2004	2005	2006	2007	2008
West India Dock (Lock Entrance)	3,000	3,000	12,700	18,857	13,980
	2009	**2010**	**2011**	**2012**	**2013**
	14,671	14,561	15,381	15,426	14,715
(Source: DSIS, 2014)					

Table 1.19 Dredging volumes (m³) for West India Dock

6.3.2.19 Nelson Pier (Hilton Pier)

Organisation: KPMG Thames Clippers
Dredge location: See Figure 6.6
Current max. dredge depth: 1.5 m below CD
Dredging frequency: Every 6 months
Material type: Silt/sand
Dredging technique: WID (Van Oord), Backhoe (G.P.S. Marine), Plough (Westminster)

Description: Maintenance dredging between 2004 and 2013 has been undertaken approximately biannually using a variety of dredge techniques, i.e. WID, plough and backhoe dredging (with disposal to Hoo Island). In more recent years, dredging has been achieved using WID.

Location	2004	2005	2006	2007	2008
Nelson Pier	2,400	4,900	2,700	4,230	1,674
	2009	**2010**	**2011**	**2012**	**2013**
	1,032	1,327	2,301	2,757	1,445
(Source: DSIS, 2014)					

Table 1.20 Dredging volumes (m³) for Nelson Pier

6.3.2.20 Other third party dredging activities

In addition to the third party dredging activities detailed in the previous sections, Table 6.22 identifies other third party dredging that has taken place within the Thames Estuary between 2004 and 2013 (the majority of which are not currently licensed by the PLA); see Figures 6.2 to 6.6 for locations. These activities have been achieved by a variety of techniques, particularly WID, ploughing and backhoe (with disposal to licensed land sites). In addition to these activities, applications for future maintenance dredging are also in progress with the PLA for the following locations:

- Erith Oil Works Adm Inner (1.1 m below CD);
- Plantation Wharf (2.0 m below CD);
- Thunderer Jetty (11.0 m below CD);
- Walbrook and Smugglers Wharf (2.0 m above CD); and
- Alpha Jetty (to remove spilt material).

It is important to note that given the generally small volumes of maintenance dredging that have been historically required at many of the locations detailed in Table 6.22, a number of these third party activities may be considered exempt from the Marine Licencing process; i.e. where maintenance dredging does not exceed more than 500 m^3 per campaign, and no more than 1,500 m^3 per year. This being said, third party dredging within the Thames Estuary would still be subject to regulation by the PLA in accordance with the Maintenance Dredging Framework.

Dredge Location	Maximum Dredge Depth (m below CD)	Maintenance Dredge Volumes (m^3)									
		2004	2005	2006	2007	2008	2009	2010	2011	2012	2013
Tilbury Landing Stage	-	0	0	0	0	0	0	0	0	0	500
Civil & Marine Jetty Upper	6.7	0	0	0	0	790	0	0	0	0	20
Dagenham Jetty – Ford	6.0	8,752	0	0	0	5,048	0	0	3,834	0	0
Purfleet Fuels Terminal	-	0	N/A	0	0	0	0	0	0	0	0
Riverside Wharf Charlton	-	0	<100	<100	0	451	0	0	0	0	0
DePass Wharf	-	0	0	0	0	0	0	0	0	0	0
Savoy Pier	-	0	0	<500	0	0	0	0	0	0	0
Waterloo Police Pier	-	0	0	N/A	0	0	0	0	0	0	0
Putney Pier	-	0	0	500	0	0	0	0	0	0	0
Coryton Construction Jetty	-	10,800	0	5,600	0	0	0	0	0	0	0
Thames Barrier	-	0	0	1,000	0	0	0	0	0	0	0
Wapping Police Station	-	0	0	0	150	0	114	0	0	0	0
Grosvenor Dock	-	0	0	0	0	1,500	0	0	0	0	0
Debden Wharf	-	0	0	0	0	7,000	0	0	0	0	0
Alexander Wharf	-	0	0	0	1,425	0	0	0	0	0	0
Pitsea Reclamation Jetty	-	0	0	0	0	10,750	0	0	0	0	0
Calor Gas (Canvey)	12.0	0	0	0	0	0	7,231	0	0	0	0
Smallgains Creek	-	0	0	0	N/A	0	0	0	0	0	0
Comleys Wharf	-	0	0	0	0	350	0	0	0	0	0
Riverside South	-	0	0	0	0	0	600	0	0	0	0
Point Pleasant Marina	1.5	0	0	0	0	0	N/A	0	0	0	0
Bay Wharf	-	0	0	0	0	0	0	0	N/A	0	0
White Mountain Jetty	+1.0	0	0	0	0	0	2,310	0	0	0	3,485
Bow Creek & Channelsea River	+2.5	0	0	0	0	0	0	3,162	0	0	0
Hanson Jetty 4 & Barge Berth*	7.8 (Hanson) 4.8 (Ameys)	0	0	0	0	0	0	0	0	0	N/A
Mucking Jetty	-	0	0	0	0	0	0	950	0	0	0
Denton Jetty	5.6	500	6,250	900	0	0	0	0	0	N/A	0
Northfleet Jetty	3.4	0	0	0	0	0	0	0	N/A	0	0
Black Friars Jetty	2.0	0	0	0	0	0	0	0	N/A	0	0
St Georges Pier	1.0	0	0	0	0	0	0	0	0	N/A	0
Bravo Jetty Shellhaven**	16.0	40,000	65,950	29,675	31,691	15,954	32,634	0	0	0	0
Beckton Outfall***	4.9	-	-	-	-	-	-	-	-	-	N/A

Notes: N/A denotes dredging has taken place but the volume is unknown. * Dredge required to remove spilt material. ** Bravo Jetty removed in 2010 to make space for London Gateway reclamation. *** Capital dredge, no maintenance dredge anticipated (PLA, pers. com. April 2014)

Table 1.21 Dredging volumes (m^3) for other third party dredging activities

7. Sediment Quality

7.1 Overview

This section describes the chemical characteristics of sediments within the study area. Data on sediment quality within the Thames Estuary has been obtained from both the PLA through the DSIS database and from third party organisations. The PLA require sediment at dredging areas to be analysed on up to a three year cycle as part of the dredging licensing process.

In addition to meeting the requirements of the PLA, sediment sampling and analysis is also required by the MMO in support of the Marine Licensing process for dredging and disposal in the Thames Estuary. On receiving a Marine Licence application, Cefas is instructed by the MMO as licensing authority, to carry out a sediment analysis in order to assess the nature and degree of any chemical contamination present. Cefas do not routinely test for the whole range of contaminants, as this is determined on a case-by-case basis depending on a number of factors. However, the chemical characteristics of the sediments are described in terms of a range of chemical parameters, listed below:

- Heavy metals (arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc) and other metals (aluminium, boron, iron, manganese, selenium, silver and vanadium);
- Organotins (Tributyl tin (TBT) and Dibutyl tin (DBT));
- Total petroleum hydrocarbons (TPH);
- Polyaromatic hydrocarbons (PAHs) (USEPA 16);
- Polychlorinated biphenyls (PCBs) including 25 congeners;
- Ammonia; and
- Sulphide.

The results of geochemical analysis undertaken by Cefas are used in conjunction with other assessment methods (for example bioassays) as well as historical data and expert knowledge of a site, to make a decision regarding the fate of the dredged material following disposal or disturbance. Action Levels (AL) are used as part of a ‘weight of evidence’ approach to assessing dredged material and its suitability for disposal to sea (it should be noted that the same action levels are used by the PLA for sediment quality assessment for dredging). Cefas ALs are not statutory contaminant concentrations for dredged material and therefore do not constitute ‘pass/fail’ thresholds, but are used as guidance in conjunction with other assessment criteria, as mentioned previously. This allows variation in local hydrodynamics, sedimentary patterns and material types to be taken in account along with the background geology, as well as recent trends, natural variability and existing ecology of the specific system. Thus, dredged sediment with a certain geochemical signature may be regarded as contaminated marine sediments in one water body but not in another (ABPmer, 2010). The Cefas ALs are presented below in Table 7.1.

Contaminant/ Compound	Action Level 1 mg/kg Dry Weight (ppm)	Action Level 2 Mg/kg Dry Weight (ppm)
Arsenic (As)	20	100
Cadmium (Cd)	0.4	5
Chromium (Cr)	40	400
Copper (Cu)	40	400
Mercury (Hg)	0.3	3
Nickel (Ni)	20	200
Lead (Pb)	50	500
Zinc (Zn)	130	800
Organotins (TBT, DBT, MBT)	0.1	1
Polychlorinated Biphenyls (PCBs), Sum of ICES 7	0.01	None
Polychlorinated Biphenyls (PCBs), Sum of 25 Congeners	0.02	0.2
Polyaromatic Hydrocarbons (PAH), Total Hydrocarbons (THC)	100	None
* Dichlorodiphenyltrichloroethane (DDT)	*0.001	None
*Dieldrin	*0.005	None
* Provisional Action Levels for these compounds are subject to further investigation		

Table 7.1 Cefas guideline action levels for dredged material

7.2 Sediment Quality within the Study Area

Sediment quality data for both PLA and third party dredging within the Thames Estuary are provided in Appendix B. Where possible, the most recent surface sediment quality data was presented for each dredge location. A summary of sediment quality in the estuary is provided below.

7.2.1 Metals

The data collated indicates that the vast majority of metal concentrations within both PLA and third party dredge locations fall below Cefas AL 1. This being said, AL 1 is exceeded for a variety of metals throughout the estuary, although this does not appear to be location specific i.e. increased concentrations are found in both the inner and outer estuary, thus suggesting these concentrations are near 'background' for the Thames. Cefas AL 2 was only exceeded in a single sediment sample, specifically for Cadmium and Mercury. The absence of elevated metals elsewhere at this location (both recently (2012) and more historically) would suggest that any contamination source would have been relatively localised (e.g. a small piece of scrap metal) and unlikely to have any adverse environmental effect on the estuary.

7.2.2 Organotins

As was the case for metals, organotin (i.e. TBT and DBT) concentrations within the Thames Estuary largely fall below Cefas AL1. This being said, the sediment quality data provided in Appendix B does identify that concentrations of both TBT and DBT have exceeded AL1 in more than one sediment sample within the Thames Refinery berth pockets, although these exceedances are predominantly marginal.

7.2.3 Polychlorinated Biphenyls (PCBs)

The majority of sediment samples analysed in the Thames Estuary for both PLA and third party dredging did not register a PCB concentration, i.e. the concentrations were below the limits of detection (LOD) in most instances. As such, the sum of the ICES 7 congeners (i.e. PCB 25, 52, 101, 118, 138, 153 and 180) was typically below Cefas

AL 1. In instances where AL 1 was exceeded, a number of these are due to inadequate LOD, whereby the concentrations of PCBs are actually likely to still be below Cefas AL 1. Of all sediment samples analysed and presented in Appendix B, only 2 are clearly shown to have concentrations greater than AL 1, both of which are in the Thames Refinery inner berth pocket.

7.2.4 Polyaromatic Hydrocarbons (PAHs)

Cefas ALs do not presently consider PAH concentrations individually, but rather as total hydrocarbons (TCH). The data collated for both PLA and third party dredging indicates that at no location does TCH exceed Cefas AL 1, with concentrations generally only being a very small fraction of this limit. It is also worth indicating that individual PAH concentrations are predominantly below 0.1 mg/kg, and therefore below the LOD on a substantial number of occasions.

7.2.5 Summary

The sediment quality throughout the study area exhibits a varied degree of contamination for a variety of substances. Analysis of sediment quality data for both PLA and third party dredging activities have indicated that contamination levels are typically below Cefas ALs, although a number of samples do exceed Cefas AL 1 for certain substances (most commonly heavy metals). Only a single analysed sediment sample from within the Thames exceeded Cefas AL 2 thresholds, although any potential contamination is considered to be very localised and unlikely to have any adverse environmental effect on the estuary (at waterbody level).

8. Environmental Information

8.1 Conservation and Designation Status

The nature conservation importance of the Thames Estuary and the surrounding area is recognised through a number of protected sites which are shown in Figures 8.1 and 8.2 (although it should be noted that the Figure 8.1 does not show the full seaward/northern extent of the Outer Thames Estuary SPA and the Margate and Longsands Site of Community Importance[2] (SCI)). The following sections provide further information on designated sites including Special Protection Areas (SPAs), Ramsar Sites, Special Areas of Conservation (SAC), European Marine Sites and Marine Conservation Zones (MCZ)/ recommended MCZs (rMCZs) within 5km of maintenance dredge areas and/or disposal sites identified within this Baseline Document.

8.1.1 Special Protection Area

The EC Directive on the Conservation of Wild Birds (the Birds Directive[3]) requires all member states to identify areas to be given special protection for the rare or vulnerable species listed in Annex 1 of the Directive (Article 4.1), for regularly occurring migratory species (Article 4.2) and for the protection of wetlands, especially wetlands of International importance. An overview of the reasons for designating the SPAs that occur within the study area) is included within Table 8.1.

Site	SPA Qualifying Feature		
	Article 4.1	Article 4.2	Sub-Features
Outer Thames Estuary	✓	-	Shallow coastal waters and areas in the vicinity of sub-tidal sandbanks
Foulness (Mid-Essex Coast Phase 5)	✓	✓	Shell, Sand and Gravel Shores, Intertidal Mudflats and Sandflats, Atlantic Salt Meadows, Saltmarsh, Boulder and Cobble Shores and Shallow Coastal Waters.
Benfleet and Southend Marshes	-	✓	Intertidal Mudflat and Sandflat Communities, Saltmarsh Communities, Eelgrass Beds (*Zostera* beds) and Shell banks
Medway Estuary & Marshes	✓	✓	Shallow Inshore Waters, Mudflats, Saltmarsh and Shingle Beaches
Thames Estuary and Marshes	✓	✓	Intertidal Mudflats, Intertidal Saltmarsh and Intertidal Shingle.

Table 8.1 SPAs within the study area

The bird species qualifying under the Birds Directive using the marine component of the SPA at the time of classification can be found in Appendix C.

[2] Explanation of site status: Candidate Special Areas of Conservation (cSAC) are sites that have been submitted to the European Commission (EC), but not yet formally adopted; Sites of Community Importance (SCI) are sites that have been adopted by the EC but not yet formally designated by the government of each country; Special Areas of Conservation (SAC) are sites that have been adopted by the EC and formally designated by the government of each country in whose territory the site lies.

[3] Council Directive 79/409/EEC on the conservation of wild birds.

8.1.2 Ramsar Sites

Under the 1971 Ramsar Convention on Wetlands of International Importance, it is a requirement of signatory states to protect wetland sites of International importance, including those that are important waterfowl habitats (JNCC, 2014a). An overview of the reasons for designating the Ramsar sites that occur within the study area is included within Table 8.2

Site	Ramsar Qualifying Criteria				
	Criterion 1	Criterion 2	Criterion 3	Criterion 5	Criterion 6
Foulness (Mid-Essex Coast Phase 5)	Extent and diversity of saltmarsh habitat.	Site supports number of nationally rare and nationally scarce plant species and British Red Data Book invertebrates	Site contains extensive saltmarsh habitat with areas supporting saltmarsh plant communities	82,148 waterfowl (5 yr peak mean 98/99-02/03)	Peak spring/autumn counts of common redshank. Peak winter counts of Dark Bellied Brent goose, Oystercatcher, Grey Plover, Red Knot and Bar tailed godwit.
Benfleet and Southend Marshes	-	-	-	32,867 waterfowl (5 yr peak mean 98/99-02/03)	Spring/autumn peak counts of Dark-bellied brent goose. Winter peak counts; Grey plover and Red knot. Future considerations of peak winter counts for Dunlin.
Medway Estuary & Marshes	-	Supports a number of species of rare plants and animals.. At least 12 British Red Data Book Species of wetland invertebrates and non wetland species.	-	47,637 waterfowl (5 yr peak mean 98/99-02/03)	Peak spring/autumn counts of Grey Plover, Common Redshank. Peak winter counts of Dark-bellied brent goose, Common Shelduck, Northern Pintail, Ringed Plover, Red Knot, Dunlin. Future considerations of spring/autumn counts of Black-tailed godwit.
Thames Estuary and Marshes	-	Supports one endangered plant species and at least 14 nationally scarce plants of wetland habitats. Also supports >20 British Red Data book invertebrates	-	45,118 waterfowl (5yr peak mean 98/99-02-03)	Species with peak counts in spring autumn; Ringed Plover, Black-tailed godwit. Peak counts in winter; Grey plover, Red knot, Dunlin and common Redshank.
(Source: JNCC 2008a, b, c & d)					

Table 8.2 Ramsar sites within the study area

8.1.3 Special Areas of Conservation

The EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive[4]) requires the establishment of a network of important high quality conservation sites that will make a significant contribution to conserving the 169 habitat types and 623 species identified in Annexes I and II of the Habitats Directive. An overview of the reasons for designating the SAC and Site of Community Importance (SCI) (a site that has been adopted by the European Commission but not yet formally designated by the government of the country containing the site) that occur within the study area is included within Table 8.3.

Site	SAC Qualifying Features	
	Annex 1 Habitats	Annex II Species
Margate and Long Sands SCI	Sandbanks which are slightly covered by sea water all the time[1]	
Essex Estuaries SAC	Estuaries[1], Mudflats and sandflats not covered by seawater at low tide[1], *Salicornia* and other annuals colonizing mud and sand[1], *Spartina* swards (*Spartinion maritimae*)[1], Atlantic salt meadows (*Glauco-puccinellietalia maritimae*)[1], Mediterreanean and thermo-Atlantic halophilous scrubs (*Sarcocornetea fruticosi*)[1] and Sandbanks which are slightly covered by sea water all the time[2].	
[1] Priority feature [2] Present as a qualifying features, but not a primary reason for selection of this site		
(Source: JNCC, 2014b and c)		

Table 8.3 SAC and SCI within the study area

8.1.4 European Marine Sites

EMS is the collective term for SACs and SPAs that are covered by tidal water (continuously or intermittently) and protect some of Britain's most special marine and coastal habitats and species of European importance. In accordance with Government advice in both England and Wales, Ramsar sites must be given the same consideration as European sites when considering plans and projects which might affect them. European Marine Sites form part of the Marine Protected Area (MPA) network (Natural England, 2014a).

The following EMS and corresponding international designations which are described above are located in the study area:

- Essex Estuaries European Marine Site, comprising:
  - Essex Estuaries SAC; and
  - Foulness SPA.
- Benfleet and Southend Marshes European Marine Site, comprising:
  - Benfleet and Southend Marshes SPA.
- Swale and Medway European Marine Site, comprising:
  - Medway Estuary & Marshes SPA.
- Thames Estuary European Marine Site, comprising:
  - Thames Estuary and Marshes SPA.

[4] Council Directive 92/43/EEC on the conservation of natural habitats and wild fauna

8.1.5 Compensation Sites

The March 2012 National Planning Policy Framework (NPPC), which sets out the Government's planning policies for England confirms (in Paragraph 118) that: 'sites identified, or required, as compensatory measures for adverse effects on European sites' should be given the same protection as European sites (DCLG, 2012, p28). On this basis, all completed managed realignment or recharge sites that have been created for compensatory purposes were identified. These are included in Figure 8.1 and are as follows.

- London Gateway Wildlife Reserve (Stanford Le Hope Wharf);
- Barking Creek – Barking Barrier;
- Barking Creek – A13; and
- Millennium Terraces.

The qualifying interest features of the compensatory sites that occur in the study area are not known, however it is considered that these will support features already designated by other European/Ramsar sites (in particular coastal habitats and supporting species and foraging and migratory birds).

8.1.6 Marine Conservation Zones

The UK has signed up to international agreements that aim to establish an 'ecologically coherent network of MPAs' by the end of 2012. This network will be made up of current MPAs as well as a new type of MPA called an MCZ. Within the south east region, the development of recommendations for MCZs has been coordinated by the Balanced Seas Regional MCZ Project (Balanced Seas, 2011).

In November 2013 Defra designated 27 new Marine Conservation Zones (MCZs), one of which falls within the vicinity of the maintenance dredge operations. This site is:

- Medway Estuary MCZ.

In February 2014, Defra announced that work on a second tranche of MCZs is currently underway with the aim of holding public consultation in early 2015 and designating sites by the end of that year (Defra, 2014). For the second tranche, 37 sites from the Regional MCZ Project recommendations have been identified as suitable candidates for consideration. Of these there is one recommended MCZ (rMCZ) which falls within the vicinity of maintenance dredge operations, this site is:

- The Swale Estuary rMCZ.

Although this rMCZ is beyond 5km from any dredge location, it is considered to be hydromorphologically linked to the Medway Estuary and hence has been described within this Baseline Document (see Table 8.4). However, this site has not been formally designated at this point.

The Balanced Seas Regional Project also proposed the Thames Estuary as an rMCZ. Although the Thames Estuary rMCZ has been noted and described within this Baseline Document (see Table 8.4) this site was not put forward to be considered for designation in the first or second tranche of MCZs. Furthermore, in the Defra MCZ

consultation in 2012 (Defra, 2012, Annex A.3), the following statement was made regarding the Thames Estuary rMCZ:

"For the Thames Estuary recommended MCZ there is a strong indication of a potentially significant unquantified socio-economic implications associated with the development in the estuary. Therefore, despite this site being highlighted by the [Statutory Nature Conservation Bodies] SNCBs as a site at higher risk, further work will be required to better understand these implications prior to this site being considered for designation".

The features and draft conservation objectives that were developed by Natural England and Joint Nature Conservation Committee (JNCC) (Balanced Seas, 2011) for the designated MCZ and rMCZs described above are outlined in Table 8.4. The draft conservation objective 'maintain' means that in general the current levels of activity in the area are considered acceptable, but they will be monitored and restrictions may have to be introduced if necessary. 'Recover' means that restrictions on certain activities may be necessary to allow the feature to recover to favourable condition. It does not necessarily mean that an activity will be prohibited, as other mitigation measures might be appropriate (e.g. change in fishing gear type, reduction in intensity, seasonal restrictions etc.).

Figure 8.2 shows the locations of the nearby MCZ and rMCZs described above. It is important to note that at present the rMCZ locations represent recommendations made to Natural England and the JNCC by the regional project coordinators, and that the boundaries and existence of such areas will be subject to public consultation and could potentially change.

MCZ	Feature Type	Feature Name	Draft Conservation Objectives
The Swale Estuary rMCZ	Broad-scale habitats	A1.3 Low energy intertidal rock	Maintain
		A3.3 Low energy Infralittoral rock	Maintain
		A5.2 Subtidal sand	Maintain
		A5.3 Subtidal mud	Maintain
		A5.4 Subtidal mixed sediments	Maintain
	Habitat FOCI	Blue Mussel Beds	Recover
		Peat and clay exposures	Maintain
		Ross worm reefs (*Sabellaria spinulosa*)	Recover
		Sheltered muddy gravels	Maintain
		Subtidal sands and gravels	Maintain
	Species FOCI	European eel (*Anguilla anguilla*)	Maintain
		Native oyster (*Ostrea edulis*)	Maintain
Medway Estuary MCZ	Broad-scale habitats	A1.3 Low energy intertidal rock	Maintain
		A2.2 Intertidal sand/Muddy sand	Maintain
		A2.4 Intertidal mixed sediments	Maintain
		A5.1 Subtidal coarse sediment	Maintain
		A5.2 Subtidal sand	Maintain
		A5.3 Subtidal mud	Maintain
	Habitat FOCI	Estuarine rocky habitats	Maintain
		Peat and clay exposures	Maintain
	Species FOCI Low mobility	Tentacled Lagoon Worm (*Alkmaria romijni*)	Maintain
Thames Estuary rMCZ	Broad-scale habitats	Intertidal sand/muddy sand	Maintain
		Intertidal mixed sediments	Maintain
		Subtidal coarse sediments	Maintain
		Subtidal sand	Maintain
		Subtidal mud	Maintain
	Habitat FOCI	Sheltered muddy gravels	Recover
	Species FOCI	Tentacled lagoon worm (*Alkmaria romijni*)	Recover
		European eel (*Anguilla anguilla*)	Maintain
		Smelt (*Osmerus eperlanus*)	Maintain

Table 8.4 Features and conservation objectives for MCZ and rMCZs in the study area

8.1.7 Location of maintenance dredge sites in relation to European/ Ramsar sites

Table 8.5 identifies all PLA and third party dredge locations which are situated less than 10 km from their nearest European/Ramsar site. For each of these dredge locations, the nearest European/Ramsar site is located down-estuary from the dredge site, except where dredge sites are located within a European/Ramsar site. Consideration of any potential direct or indirect impacts of maintenance dredge activities on the features of the designated sites within the SHA is provided in Appendix A.

Dredge Location	Nearest European/ Ramsar Site	Distance (km)
PLA dredge sites		
Black Deep	Outer Thames Estuary SPA	within
Knock John	Outer Thames Estuary SPA	within
Oaze Deep	Outer Thames Estuary SPA	within
West Oaze	Outer Thames Estuary SPA	within
Holehaven Shoal	Thames Estuary & Marshes SPA & Ramsar	0.9
Lower Hope Shoal	Thames Estuary & Marshes SPA & Ramsar	0.3
Coalhouse Shoal	Thames Estuary & Marshes SPA & Ramsar	0.4
Diver Shoal	Thames Estuary & Marshes SPA & Ramsar	0.4
Royal Terrace Pier	Thames Estuary & Marshes SPA & Ramsar	2.9

Dredge Location	Nearest European/ Ramsar Site	Distance (km)
Tilburyness Shoal	Thames Estuary & Marshes SPA & Ramsar	4.7
Broadness Shoal	Thames Estuary & Marshes SPA & Ramsar	8.1
Third party dredge sites		
London Gateway	Outer Thames Estuary SPA	within
Medway Approach Channel	Outer Thames Estuary SPA	within
Smallgains Creek	Benfleet & Southend Marshes SPA	within
Calor Gas (Canvey)	Thames Estuary & Marshes SPA & Ramsar	1.2
Oikos Terminal (Holehaven Jetty)	Thames Estuary & Marshes SPA & Ramsar	1.4
Thames Oilport	Thames Estuary & Marshes SPA & Ramsar	1.4
Coryton Construction Jetty	Thames Estuary & Marshes SPA	1.4
Pitsea Reclamation Jetty	Thames Estuary & Marshes SPA & Ramsar	5.2
S Jetty Shellhaven	Thames Estuary & Marshes SPA & Ramsar	1.4
Mucking Jetty	Thames Estuary & Marshes SPA & Ramsar	within
Alpha Jetty	Thames Estuary & Marshes SPA & Ramsar	0.03
Denton Jetty	Thames Estuary & Marshes SPA & Ramsar	1.4
Tilbury Power Station	Thames Estuary & Marshes SPA & Ramsar	2.0
Customs Pier	Thames Estuary & Marshes SPA & Ramsar	2.8
Tilbury Landing Stage	Thames Estuary & Marshes SPA & Ramsar	5.8
Tilbury Bellmouth	Thames Estuary & Marshes SPA & Ramsar	5.8
Robins Wharf (Northfleet)	Thames Estuary & Marshes SPA & Ramsar	6.2
Northfleet Hope Container Terminal	Thames Estuary & Marshes SPA & Ramsar	6.1
Northfleet Jetty	Thames Estuary & Marshes SPA & Ramsar	6.2

Table 8.5 Distance between dredge locations and European/ Ramsar sites

8.2 Regulation 35 Advice

Natural England has statutory responsibility to advise relevant authorities as to the conservation objectives for EMS and operations, which may cause deterioration or disturbance of natural habitats and species. This advice is provided under Regulation 35[5] of the Conservation of Habitats and Species Regulations 2010 (referred to as the Habitats Regulations within this Baseline Document). The role of the conservation objectives is to define the nature conservation aspirations for the features of interest, thereby representing the aims and requirements of the Habitats and Birds Directives in relation to the site. The following sections summarise the relevant favourable condition attributes for which targets have been set for each of the relevant sub-features.

8.2.1 SPA Sub-features

The Regulation 35 advice that has previously been issued recognises that bird populations change, therefore the advice focuses on the condition of the habitat to support birds rather than the bird numbers themselves. In this respect the ecologically important sub-features associated with the bird features have been identified (see Table 8.1). The maintenance of the favourable condition of these habitats is considered fundamental in the maintenance of the European/Ramsar sites.

The conservation objectives for the relevant sub-features that have been identified within the SPAs of the Essex Estuaries EMS, Benfleet and Southend Mashes EMS,

5 This advice was formerly provided under Regulation 33(2) of the Conservation (Natural Habitats, &c.) Regulations, 1994. The 2010 update of the 1994 Habitats Regulations has changed the regulation advice section number. Within the context of this report, reference is made to Regulation 35 advice only.

Swale and Medway EMS and Thames Estuary EMS (See Section 8.1.4) is to maintain the sub-features (habitats) in favourable condition. Details of how to recognise favourable condition are summarised in the respective Regulation 35 Advice (English Nature, 2000, 2001a, b, c). The favourable condition attributes for which targets have been set for each of the relevant sub-features has been summarised below for each of the SPAs.

Relevant sub-features and the favourable condition attributes for the Foulness SPA (Figure 8.1) can be summarised as:

- Shell, sand and gravel shores – extent and distribution of habitat, vegetation cover/density;
- Shallow coastal waters - food availability;
- Intertidal mudflats and sandflats - extent and distribution of habitat, food availability; and
- Saltmarsh - extent and distribution of habitat.

Relevant sub-features and the favourable condition attributes for the Benfleet and Southend Marshes SPA (Figure 8.1) can be summarised as:

- Shell Banks - extent and distribution of habitat, food availability;
- Saltmarsh - extent and distribution of habitat, vegetation characteristics, food availability;
- Intertidal Sandflat and Mudflat communities - extent and distribution of habitat, food availability; and
- Eelgrass Beds - extent and distribution of habitat, food availability.

Relevant sub-features and the favourable condition attributes for the Medway Estuary and Marshes SPA (Figure 8.1) can be summarised as:

- Shingle Beaches – vegetation cover/density;
- Shallow Coastal Waters – food availability;
- Intertidal Mudflats – food availability; and
- Intertidal Saltmarsh – food availability and vegetation characteristics.

The favourable condition attributes for the Thames Estuary and Marshes SPA (Figure 8.1) can be summarised as:

- Intertidal Mudflats - extent and distribution of habitat, food availability;
- Intertidal Saltmarsh- extent and distribution of habitat, vegetation characteristics, food availability; and
- Intertidal Shingle - extent and distribution of habitat.

Birds can also be affected by disturbance, particularly changes in noise, movement and lines of sight so the Directive requires measures to avoid such forms of significant disturbance.

8.2.2 Ramsar Subfeatures

There are no specific conservation objectives for the features identified within the citations for the Ramsar sites. Given the high degree of overlap with the sub-features

cited in the corresponding SPAs, no specific additional consideration has been given to the qualifying Ramsar features.

8.2.3 SAC Subfeatures

The Margate and Long Sands SCI does not form part of an EMS, but does have its own Natural England advice under Regulation 35 (Natural England, 2013). The conservation objectives for the Margate and Long Sands SCI interest features is to maintain each in favourable condition at all times. The favourable condition attributes for which targets have been set for each of the interest features of the Margate and Long Sands SCI are summarised as follows:

- Dynamic sand communities – extent of sandbanks, topography of sandbanks, sediment character, distribution of sub-features and biotopes, species composition and population; and
- Gravelly muddy sand communities - extent of sandbanks, topography of sandbanks, sediment character, distribution of sub-features and biotopes, species composition and population.

The conservation objectives for the Essex Estuaries SAC interest features is to maintain each in favourable condition subject to natural change. Detail of how to recognise favourable condition is summarised in the respective Regulation 33 Advice (English Nature, 2000). The current favourable condition status has not yet been defined specifically for the SAC, however, condition assessments for two SSSIs (Benfleet and Southend SSSI and Foulness SSSI) which partially geographically overlap with the Essex Estuary SAC (see Figure 8.1 and 8.2) have been undertaken by Natural England (Natural England, 2014b). A detailed breakdown of the condition assessment of these SSSIs can be found in Appendix D and a summary is presented in Table 8.5 (see Section 8.2.4 below).

The favourable condition attributes for which targets have been set for each of the interest features of the Essex Estuaries SAC are summarised as follows:

- *Salicornia* and other annuals colonising mud and sand – algal mat cover and distribution and extent of Glasswort/annual Seablite community and Sea aster community, distribution and extent of English cordgrass *Spartina anglica* community;
- *Spartina* swards - distribution and extent of small and smooth cordgrass communities;
- Atlantic salt meadows – distribution and extent, species composition;
- Mediterranean saltmarsh scrub – distribution and extent of shrubby seablite and rock sea lavender community;
- Estuary – extent, morphological equilibrium, temperature and salinity;
- Rock; subtidal mud; subtidal muddy sand; subtidal mixed sediment communities – Relative distribution of sub-features, sediment character, extent, range and distribution of communities; and
- Intertidal mudflats and sandflats – extent, topography, sediment character and nutrient enrichment, macroalgal mats. Extent, range and distribution of mud and muddy sands communities along with presence of characteristic species and (e.g. *Zostera noltii*) biotopes (e.g. LMS). Sand and gravel –

sediment character, range and distribution of sand and gravel communities (e.g. LGS).

8.2.4 Favourable Condition Status

The current favourable condition status has not yet been defined specifically for all the European/Ramsar sites, however, a condition assessment of the respective SSSIs which cover virtually the same geographic extent as the European/Ramsar sites (Figure 8.2) that have been screened into the assessment has been undertaken by Natural England (Natural England, 2014b). A detailed breakdown of the condition assessment of the respective SSSIs can be found in Appendix D and a summary of these results is presented in Table 8.5.

The majority of units (average of 51% of the area) are described as in a favourable condition and an average of 31% of the area unfavourable but recovering. Primarily the main habitats in the units which were not considered to be meeting Public Service Agreement (PSA) targets were neutral grassland – lowland and littoral sediment. Typical reasons for this classification included coastal squeeze, litter and the presence of competitor species.

SSSI	Area (ha)	Summary of Site Description and Reason for Notification	Area Meeting PSA* Target	% Area Favourable	% Area Unfavourable Recovering	% Area Unfavourable No Change	% Area Unfavourable Declining	% Area Destroyed / Part Destroyed
Foulness (Mid-Essex Coast Phase 5)	10,702	Comprises extensive intertidal sand-silt flats, saltmarsh, beaches, grazing marshes, rough grass and scrubland. The flats are of national and international importance as winter feeding grounds for nine species of wildfowl and wader, with the islands, creeks and grazing land forming an integral part as sheltered feeding and roosting sites. The shell banks support nationally important breeding colonies of Little Terns, Common Terns and Sandwich Terns. The complex matrix of habitats also supports nationally important numbers of breeding Avocets along with plants and invertebrates. Numerous species are locally restricted in their distribution and nationally uncommon or rare.	97.29%	72.61%	24.68%	0.02%	2.70%	0.00%
Sheppey Cliffs & Foreshore	301.50	Geological interest - This coastal section is one of the best known Palaeogene sites in Britain. The cliff and foreshore section between Warden and Minster comprise Eocene London Clay, capped by Pleistocene sediments except between East End and Cliff Farm where the cliff intersects an outlier of the Eocene Virginia Water Formation. This is the only extant section of the upper part of the London Clay and is geographically the most extensive section of this Formation in Britain. Some of the most detailed studies of Palaeogene stratigraphy have been produced for this section. Five informal divisions (AÐE) have been recognised for the London Clay of which divisions C, D & E are exposed. The stratigraphical and palaeoenvironmental significance of the site is a reflection of its extremely well preserved fossil fauna and flora; Ecological interest - The cliffs are of botanical interest in that they support a good population of the nationally rare plant dragons teeth *Tetragonolobus maritimus*. A number of other uncommon species have also been recorded, including the nationally scarce plant Bithynian Vetch *Vicia bithynica*.	100%	100%	0.00%	0.00%	0.00%	0.00%

SSSI	Area (ha)	Summary of Site Description and Reason for Notification	Area Meeting PSA* Target	% Area Favourable	% Area Unfavourable Recovering	% Area Unfavourable No Change	% Area Unfavourable Declining	% Area Destroyed / Part Destroyed
Benfleet & Southend Marshes	2099.69	Comprises an extensive series of salt marshes, mudflats, scrub and grassland which support a diverse flora and fauna. The south-facing slopes of the downs, composed of London Clay capped by sand, represent the line of former river cliffs with several re-entrant valleys. At their foot lies reclaimed marshland, with its associated dyke system, based on alluvium. Outside the sea walls there are extensive salt marshes and mud-flats, on which wintering wildfowl and waders reach both nationally and internationally important numbers. Nationally uncommon plants occur in all of the habitats and parts of the area are of outstanding importance for scarce invertebrates.	92.26%	0.87%	91.39%	7.74%	0.00%	0.00%
Medway Estuary & Marshes	6,840.14	The Medway Estuary and Marshes form the largest area of intertidal habitats which have been identified as of value for nature conservation in Kent and are representative of the estuarine habitats found on the North Kent coast. A complex of mudflats and saltmarsh is present with in places grazing marsh behind the sea walls which is intersected by dykes and fleets. The area holds internationally important populations of wintering and passage birds and is also of importance for its breeding birds. An outstanding assemblage of plant species also occurs on the site.	99.28%	0.00%	99.28%	0.24%	0.00%	0.48%
Holehaven Creek	273.87	The intertidal mudflats and saltmarsh habitats of Holehaven Creek support a nationally important number of black-tailed godwit *Limosa limosa islandica*. This species also regularly occurs in numbers of international importance. The creek provides suitable conditions for black-tailed godwit, including an abundance of food in the mudflats (polychaete worms and bivalve molluscs), large areas of saltmarsh (e.g. Lower Horse) for high tide roosts and minimal levels of disturbance. These sheltered inner estuary conditions are rare within the Thames Estuary.	100%	100%	0.00%	0.00%	0.00%	0.00%
South Thames Estuary &	5449.14	The South Thames Estuary and Marshes SSSI from Gravesend to the eastern end of the Isle of Grain forms	97.63%	95.28%	2.35%	0.59%	1.79%	0.00%

SSSI	Area (ha)	Summary of Site Description and Reason for Notification	Area Meeting PSA* Target	% Area Favourable	% Area Unfavourable Recovering	% Area Unfavourable No Change	% Area Unfavourable Declining	% Area Destroyed / Part Destroyed
Marshes		a major component of the Greater Thames Estuary. The site consists of an extensive mosaic of grazing marsh, saltmarsh, mudflats and shingle characteristic of the estuarine habitats of the north Kent marshes. Freshwater pools and some areas of woodland provide additional variety and complement the estuarine habitats. The site supports outstanding numbers of waterfowl with total counts regularly exceeding 20,000. Many species regularly occur in nationally important1 numbers and some species regularly use the site in internationally important numbers. The breeding bird community is also of particular interest. The diverse habitats within the site support a number of nationally rare and scarce invertebrate species and an assemblage of nationally scarce plants.						
Mucking Flats & Marshes	311.56	Mucking Flats and Marshes comprise an extensive stretch of Thames mudflats and saltmarsh, together with sea wall grassland. Wintering wildfowl and waders reach both nationally and internationally important numbers on the mudflats, roosting and feeding on adjacent saltmarsh and disused silt lagoons. The saltmarsh has a high invertebrate interest, which includes the rare spider *Baryphyma duffeyi*, as well as many notable and local species.	100.00%	94.13%	5.87%	0.00%	0.00%	0.00%
West Thurrock Lagoon & Marshes	66.08	West Thurrock Lagoon and Marshes is one of the most important sites for wintering waders and wildfowl on the Inner Thames Estuary. The combination of extensive intertidal mudflats together with a large and secure high tide roost, attracts waders in nationally important numbers, with significant populations of other bird species. The adjacent Stone Ness saltmarsh is noted for the size and character of its high marsh plant community.	0.00%	0.00%	0.00%	33.31%	66.69%	0.00%
Inner Thames Marshes	479.3	The Inner Thames Marshes form the largest remaining expanse of wetland bordering the upper reaches of the Thames Estuary. The site is of particular note for its diverse ornithological interest and especially for the	60.17%	42.37%	17.80%	5.73%	31.36%	2.74%

SSSI	Area (ha)	Summary of Site Description and Reason for Notification	Area Meeting PSA* Target	% Area Favourable	% Area Unfavourable Recovering	% Area Unfavourable No Change	% Area Unfavourable Declining	% Area Destroyed / Part Destroyed
		variety of breeding birds and the numbers of wintering wildfowl, waders, finches and birds of prey, with wintering teal populations reaching levels of international importance. The Marshes also support a wide range of wetland plants and insects with a restricted distribution in the London area, including some that are nationally rare or scarce.						
Ingrebourne Marshes	47.8	The Ingrebourne Valley supports the largest and one of the most diverse coherent areas of freshwater marshland in Greater London. The variety of habitat includes extensive areas of reed sweet-grass *Glyceria maxima* and common reed *Phragmites australis* swamp; wet neutral grassland, and tall fen. Nowhere else in London do these habitats occur on such a large scale or in such intimate juxtaposition. These habitats also support a rich assemblage of associated invertebrates and breeding birds.	59.84%	59.84%	0.00%	4.59%	35.57%	0.00%
Syon Park	21.5	Syon Park is the only known area of tall grass washland along the Thames in Greater London; it contains several invertebrate species with a restricted distribution, both locally and nationally.	100%	0.00%	100%	0.00%	0.00%	0.00%
* PSA = Public Service Agreement target								

Table 8.6 Favourable condition status of SSSIs

8.3 Water Framework Directive Baseline Information

Under the WFD, coasts, estuaries, rivers and man-made docks and canals are divided up into a series of water bodies. The WFD sets new ecological as well as chemical targets (objectives) for each water body. These objectives are derived from pristine natural conditions. However, as other factors can affect the ability of a water body to meet its ecological targets, objectives are also set under the WFD in respect of:

- Changes in parameters such as hydrology (tidal flows) or geomorphology (bed forms), for example caused by dredging, embanking for flood defence (etc): these are known as 'hydromorphological' objectives; and
- Changes in parameters such as dissolved oxygen, salinity or nutrients: these 'physico chemical' changes can also determine whether or not a water body can achieve 'Good Ecological Status' (or Potential).

Compliance with chemical status objectives is assessed in relation to quality standards for a specified list of 'priority' and 'priority hazardous' substances laid down by the European Union (EU) Environmental Quality Standards Directive (EQS). The Directive sets objectives, amongst other things, for the reduction or cessation of discharges, emissions and losses of these substances.

The objective for all water bodies is to reach 'Good Ecological Status' and 'Good Chemical Status' by 2015, unless alternative arrangements (i.e. exemptions) can be justified. Each water body has a hydromorphological designation which states how modified a water body is from its natural state (Environment Agency, 2009a, 2009b, 2009c). Water bodies are either undesignated or designated as Heavily Modified Water Bodies (HMWB) or Artificial Water Bodies (AWB). HMWBs are defined as bodies of water which as a result of physical alteration by human activities, such as flood protection, port/harbour use, commercial fin and shellfisheries and resource extraction, are substantially changed in character and cannot therefore meet good ecological status, whereas AWB are artificially created. The default target for HMWBs and AWB under the WFD is to achieve good ecological potential (a status which recognises the importance of their human use whilst making sure ecology is protected as far as possible) and good surface water chemical status by 2015 or 2027. The target for water bodies with no designation is as for the HMWB sites; however the bodies should also have good ecological status. Ecological potential and status are measured on a scale of high, good, moderate, poor and bad, while chemical status is measured as good or fail.

8.3.1 Study Area Water Bodies

The current status of water bodies in the study area have been assessed under the WFD classification, and are given in a number of River Basin Management Plans (RBMP). These include the Thames RBMP, Anglian RBMP and South East RBMP (Environment Agency, 2009a, 2009b, 2009c). Within the study area, a number of water bodies are considered to have a potential hydromorphological link with maintenance dredging activities, these include five coastal, five transitional and one canal water body (detailed in Table 8.6 and shown in Figure 8.3). It should also be noted that a number of other water bodies (particularly rivers) are located in relatively close proximity to the identified maintenance dredging activities (at an estuary scale), however, it is considered that there is no potential for hydromorphological interaction

(or such interaction is significantly restricted) between these water bodies and the activities. This assumption is based upon the presence of a NTL, existing man-made structures (e.g. sluices, weirs, culverts and flapped gravity outfalls etc.) which will restrict tidal interaction, or the dredging methodology adopted is unlikely to lead to a direct interaction (i.e. WID on the ebb tide away from an upstream water body). In these instances, the water bodies have been excluded from Table 8.6.

Water Body Name	Map Code	Water Body Reference	Water Body Type	Hydromorphological Designation
Anglian River Basin District				
Essex	C5	GB650503520001	Coastal	HMWB
South East River Basin District				
Kent North	C9	GB650704510000	Coastal	HMWB
Thames Coastal South	C8	GB640604640000	Coastal	HMWB
Whitstable Bay	C12	GB640604290000	Coastal	HMWB
Thames River Basin District				
Swale	T10	GB530604011500	Transitional	HMWB
Thames Coastal North	C1	GB640603690000	Coastal	HMWB
Thames Lower	T5	GB530603911401	Transitional	HMWB
Medway	T8	GB530604002300	Transitional	HMWB
Thames Middle	T2	GB530603911402	Transitional	HMWB
Thames Upper	T1	GB530603911403	Transitional	HMWB
River Lee Navigation, tidal section	Ca14	GB70610068	Canal	HMWB
HMWB = Heavily Modified Water Body				
(Source: Environment Agency, 2009a, 2009b, 2009c)				

Table 8.7 Coastal, transitional and canal water bodies with potential hydromorphological linking to maintenance dredging activities within the Thames Estuary

8.3.2 Current Status of Water Bodies

Table 8.7 summarises the current overall potential and objective status for the coastal, transitional and fluvial water bodies that are scoped in for WFD Assessment, highlighting the WFD parameters which are currently at 'moderate' status or below. The current overall potential for the identified water bodies are 'moderate' or 'poor' with the objective for all identified water bodies to achieve 'good' status by 2027. Further information regarding the status of all relevant water bodies in the study area, together with their objectives and relevant protected area information, can be found in Appendix D.

Water Body Name	Water Body Size (km^2)	Water Body Reference	Current Overall Potential	Status Objective (Overall)	WFD Parameters Currently at 'Moderate' Status Or Below
Essex	1195.91	GB650503520001	Moderate	Good by 2027	1) Mitigation measures for flood coastal erosion protection
Kent North	450.01	GB650704510000	Moderate	Good by 2027	1) Dissolved Inorganic Nitrogen 2) Mitigation measures for flood and coastal erosion protection
Thames Coastal South	77.08	GB640604640000	Poor	Good by 2027	1) Phytoplankton 2) Dissolved Inorganic

Water Body Name	Water Body Size (km^2)	Water Body Reference	Current Overall Potential	Status Objective (Overall)	WFD Parameters Currently at 'Moderate' Status Or Below
					Nitrogen 3) Mitigation measures for flood and coastal erosion protection
Whitstable Bay	25.73	GB640604290000	Moderate	Good by 2027	1) Dissolved Inorganic Nitrogen 2) Mitigation measures for flood and coastal erosion protection
Swale	29.06	GB530604011500	Moderate	Good by 2027	1) Dissolved Inorganic Nitrogen 2) Tidal regime - Freshwater flow 3) Mitigation measures for flood and coastal erosion protection 4) Tributyltin Compounds
Thames Coastal North	42.68	GB640603690000	Moderate	Good by 2027	1) Phytoplankton 2) Mitigation measures for flood and coastal erosion protection
Thames Lower	201.04	GB530603911401	Moderate	Good by 2027	1) Invertebrates 2) Dissolved Inorganic Nitrogen 3) Mitigation measures for flood and coastal erosion protection 4) Benzo (ghi) perelyene and indeno (123-cd) pyrene 5) Tributyltin Compounds
Medway	56.57	GB530604002300	Moderate	Good by 2027	1) Dissolved Inorganic Nitrogen 2) Mitigation measures for flood and coastal erosion protection, and for ports and harbours
Thames Middle	44.21	GB530603911402	Moderate	Good by 2027	1) Invertebrates 2) Dissolved Inorganic Nitrogen 3) Dissolved Oxygen 4) Tidal regime - Freshwater flow 5) Mitigation measures for flood and coastal erosion protection 6) Benzo (ghi) perelyene and indeno (123-cd) pyrene 7) Tributyltin Compounds
Thames Upper	201.04	GB530603911403	Moderate	Good by 2027	1) Invertebrates 2) Dissolved Inorganic Nitrogen 3) Mitigation measures for flood and coastal erosion protection 4) Benzo (ghi) perelyene and indeno (123-cd) pyrene 5) Tributyltin Compounds
River Lee Navigation, tidal section	-	GB70610068	Moderate	Good by 2027	None Identified. Current Status and Status Objectives are based on Expert Judgement.
(Source: Environment Agency, 2009a, 2009b, 2009c); - = information not sourced					

Table 8.8 Summary of water body status

8.3.3 Water Quality – Bathing Waters Directive

In March 2006 the revised Bathing Water Directive (2006/7/EC) entered into force, in which it aims to protect the environment and public health, and maintain amenity use of designated bathing waters (fresh and saline) by reducing the risk of pollution. It requires popular bathing waters to be 'designated' and monitored for water quality, particularly for human waste from sewage treatment works or agricultural waste. Water samples are taken from bathing waters in England and Wales, approximately once a week during the bathing season (15 May to 30 September).

The mandatory standards used by the European Commission to determine compliance for Bathing Waters within the Directive are the microbiological parameters - total and faecal coliforms, and three physico-chemical parameters - surface active substances, mineral oils and phenols. Cases of non-compliance with the physico-chemical parameters are extremely rare so compliance in the UK each year is normally determined by the extent of pollution by total and faecal coliform bacteria.

To comply with these standards, bathing waters must not exceed values of 10,000 total coliforms per 100ml and 2000 faecal coliforms per 100ml in 95% of samples. The revised Directive has updated the way in which water quality is measured, focusing on fewer microbiological indicators, and setting different standards for inland and coastal bathing sites:

- Tighter microbiological standards - to be met by 2015;
- Two microbiological parameters - Intestinal enterococci and *Escherichia coli*; and
- Water quality classification based on 3 or 4 years monitoring data, using 95 or 90 percentiles. This monitoring began in 2012.

Four new classification categories will be introduced (not formally adopted at the time of writing):

- Excellent - approximately twice as stringent as the current guideline standard;
- Good - similar to the current guideline standard;
- Sufficient - tighter than the current mandatory standard; and
- Poor - normally non-compliant water.

Until the revised bathing water is fully adopted, bathing waters are assessed as to whether they comply with the standards of the current Bathing Water Directive (76/160/EEC):

- **Higher** means the bathing water meets the criteria for the stricter UK guideline standards of the Directive - approximately twice as stringent as the current guideline standard;
- **Minimum** means that at least 95% of the samples meet the mandatory standards of the Directive;
- **Fail** means that fewer than 95% of the samples meet the required mandatory standards of the Directive; and
- **Not** sampled indicates that the bathing water was closed during the bathing season.

During the 2013 bathing season there were a total of 618 identified and monitored bathing waters across the UK. Almost all of these (98.8%) met the minimum standards required by the current European Bathing Waters Directive. Approximately 82.4% meet the stricter UK guideline standards of the Bathing Waters Directive.

There are four bathing waters located within 2 km of maintenance dredging areas. However, a further four bathing waters located just beyond 2 km from the dredge areas have also been scoped in for assessment due to their relatively close proximity and potential for hydromorphological interaction with dredge activities (Figure 8.4). The water quality classification for these bathing water sites during the period 2009 to 2013 can be found in Table 8.8. All sites were classified as meeting 'minimum' or 'higher' bathing water standards during this period.

Bathing Water	2009	2010	2011	2012	2013
Sheerness	Minimum	Higher	Minimum	Higher	Higher
Shoeburyness	Higher	Higher	Higher	Higher	Higher
Southend - Thorpe Bay	Minimum	Higher	Higher	Higher	Higher
Southend - Jubilee Beach	Minimum	Higher	Minimum	Minimum	Minimum
Southend - Three Shells	Minimum	Higher	Higher	Minimum	Higher
Southend - Westcliff Bay	Higher	Higher	Higher	Minimum	Higher
Southend - Chalkwell Beach	Minimum	Higher	Minimum	Minimum	Higher
Southend - Leigh Bell Wharf	Minimum	Minimum	Minimum	Minimum	Minimum
(Source: Environment Agency, 2014)					

Table 8.9 Bathing water quality classifications: 2009 to 2013

Water quality classification predictions for bathing waters in England and Wales under the revised and more stringent Bathing Water Directive have been assessed by the Environment Agency using 2010 to 2013 monitoring data (Environment Agency, 2013). These predictions are shown in Table 8.9. Two of the bathing waters are classed as 'Excellent', three as 'Good' and three as 'Sufficient'.

Bathing Water	2013 Revised BWD Classification (2010-2013 Data)
Sheerness	Excellent
Shoeburyness	Good
Southend - Thorpe Bay	Good
Southend - Jubilee Beach	Sufficient
Southend - Three Shells	Good
Southend - Westcliff Bay	Excellent
Southend - Chalkwell Beach	Sufficient
Southend - Leigh Bell Wharf	Sufficient
(Source: Environment Agency, 2013)	

Table 8.10 Bathing water quality classifications: 2009 to 2013

8.3.4 Water Quality – Shellfish Waters Directive

The original Shellfish Waters Directive, which was adopted in October 1979, was repealed by the amended Shellfish Waters Directive (2006/113/EC) and adopted on 12 December 2006. The aim of the Directive is to ensure a suitable environment for the growth of shell fisheries and to promote water of good quality to reduce the risk of food poisoning. The Directive requires mandatory compliance with imperative standards for parameters including dissolved oxygen and suspended solids. The Directive requires that dissolved oxygen, measured as the percentage of saturation, should exceed 70% (as a mean), and individual measurements may not be less than

60% unless there are no harmful consequences on the development of shellfish colonies. These standards are absolute and compliance with them is an obligation for the UK.

The Directive also requires that a discharge affecting shellfish waters must not cause the suspended solid content of the water to exceed by more than 30% the content of waters not so affected. The Directive also has mandatory standards for metals and other contaminants. It was expected that the Shellfish Waters Directive would be repealed in 2013 under the EU WFD. However, when this occurs, the WFD must provide at least the same level of protection to shellfish waters (which the WFD classifies as protected areas) as the Shellfish Waters Directive does.

In 2012, there were 98 shellfish waters within England and a total of 242 in the UK. The closest Shellfish Waters to the study area, and within 2 km of dredging activities are listed in Table 8.10 and shown in Figure 8.4. Compliance by these shellfish waters has been assessed by the Environment Agency using monitoring data.

The objective is to achieve 'imperative standards' and endeavouring to respect the guideline standards of the Shellfish Waters Directive. The last available information is from 2012. In 2012, all four shellfish waters associated with the study area passed the imperative standards showing that water quality in these areas was good. However one of the four sites (Southend) achieved a 'Guideline Fail'. Sites failing on coliform guideline standards usually do so because shellfish accumulate bacteria from water as they filter it to feed. Human and animal waste is generally the source of coliform; control measures to manage source inputs typically include reducing inputs from sewage treatment and better management of farm derived waste.

Shellfish Water Site	Location	2012
Outer Thames	Thames	Guideline Pass / Imperative Pass
Foulness	Anglian	Guideline Pass / Imperative Pass
Sheppey Cliffs and Foreshore	Southern	Guideline Pass / Imperative Pass
Southend	Thames	Guideline Fail / Imperative pass
(Source: Environment Agency, 2012)		

Table 8.11 Environment Agency monitoring of Shellfish Waters for 2012

8.3.5 Water Quality – Freshwater Fish Directive

The Freshwater Fish Directive (78/659/EEC) was adopted in 1978 and is concerned with the protection and improvement of fresh waters in order to support fish life. The Directive sets water quality standards and monitoring requirements for ensuring the protection of coarse and game fisheries, and requires the designation of appropriate rivers and lakes into two categories of water: those suitable for salmonids (i.e. mainly salmon and trout but also grayling) and those suitable for cyprinids (including carp, tench, bream, roach, chub and minnows). The Directive sets out 14 physical and chemical parameters for which 'imperative' and/or the more rigorous 'guideline' standards are given for the two categories of designation. Failures of the guidelines are typically caused by low dissolved oxygen concentrations, variations in pH and raised concentrations of total ammonia. These are typically associated with effluent discharges from waste water treatment works, low river flows, algal blooms and farm run-off.

A number of 'river' waterbodies that open into the Thames Estuary are designated under the Freshwater Fish Directive due to the presence of either salmonid or cyprinid species. However, as noted in Section 8.3.1, the river waterbodies located in relatively close proximity to the maintenance dredging activities (at an estuary scale) have not been included in this Baseline Document as it was considered that there is no potential, or significantly restricted potential, for hydromorphological interaction between these water bodies and the dredging activities (see Section 8.3.1 for assumptions on which this is based) and hence will not be described further with respect to the Freshwater Fish Directive.

Of the coastal and transitional WFD waterbodies identified in Section 8.3.1, the Medway, Thames Middle and Thames Upper waterbodies are designated under the Freshwater Fish Directive, as shown in the 'Protected Area Designation' section of the RBMP Water Body status information (see Appendix E). However, a search of available data has not provided any information in relation to the compliance status of the aforementioned waterbodies against the Freshwater Fish Directive standards.

8.3.6 Water Quality – Other Directives

There are further EU Directives that impose objectives relevant to the regulation of surface water quality, such as The Urban Waste Water Treatment Directive (UWWTD) (91/271/EEC) and the Nitrates Directive (91/676/EEC).

The UWWTD aims to protect the environment from the adverse effects of the collection, treatment and discharge of urban waste water. The Directive covers statutory water and sewerage companies, since they own and operate the public sewerage system and the urban waste water treatment works. Discharges from certain industrial sectors such as food and drink processing plants can have a similar polluting effect to untreated sewage, and are also covered by the Directive. There are no designated sensitive eutrophic areas which are considered to have a potential hydromorphological link to the maintenance dredge activities.

The Nitrates Directive aims to reduce water pollution by nitrate (nitrogen is one of the nutrients that can affect plant growth) from agricultural sources and to prevent such pollution occurring in the future. Surface waters have to be identified if too much nitrogen has caused a change in plant growth which affects existing plants and animals and the use of the water. There is one Nitrate Vulnerable Zone (NVZ) within 2 km of the maintenance dredging activities. This area has the potential to provide increased concentration of nitrate into the Thames Estuary.

8.3.7 Directive Overlap

The WFD makes clear that, in the case of protected areas (i.e. where the presence of a protected area introduces different targets to a particular water body), the more stringent objective applies. There is no indication from the RBMP that any of the WFD objectives would be more stringent than those of the Birds and Habitats Directives.

9. Summary of Data Gaps and Recommendations

The following data gaps/limitations were identified during the update of the Baseline Document.

- Historically some data gaps were identified in relation to PLA and third party maintenance dredge volumes on DSIS. As such, it should be recognised that the maintenance dredge volumes presented in this Baseline Document do not necessarily include all historical dredge events, but rather the recorded volumes available in DSIS. However, it can be highlighted that significant improvements in the data recording process in recent years will help to reduce such data gaps in future iterations of the Baseline Documents.
- At the time of writing, no maintenance dredging had been undertaken at DP World London Gateway port. As such no records of actual maintenance dredge volumes were available and the information provided in this Baseline Document regarding potential future maintenance dredge requirements were informed by the capital dredge Environmental Statement and consultation with DP World London Gateway (i.e. in relation to predicted material type, dredge volume, and methodology).
- Information on the water body size (km^2) of the River Lee Navigation tidal section was not readily available.
- No information was found in relation to the compliance status of the identified coastal and transitional WFD waterbodies against the Freshwater Fish Directive standards. However, the Freshwater Fish Directive is due to be repealed by the Water Framework Directive.

As described in Section 1, the MDP recommends that Baseline Documents evolve over time to account for natural or anthropogenic changes in the study area. This evolution should incorporate new information as it becomes available and to assess the maintenance dredging regime against the latest guidance. Potential information identified for incorporation in further iterations of this baseline include:

- Future revisions of the Environment Agency guidance on maintenance dredging and compliance with the WFD. At the time of writing, revisions were being undertaken by the Environment Agency and were due to be consulted on at end 2014 and/or the start 2015 (PLA, pers. com.). However, until the new guidance has been adopted by the Environment Agency, the current guidance (in 'Clearing the Waters') applies to any WFD assessments undertaken by third parties in the study area.
- Any changes in the status of the WFD Waterbodies identified and described in this Baseline Document may need to be updated when the River Basin Management Plans are next revised (2015).

In addition, the following recommendation is made in relation to the PLA Maintenance Dredging Framework:

- The Framework is revised to provide suitable guidance on the additional MMO licensing process, thus ensuring that future third party dredging applications are as efficient as possible.

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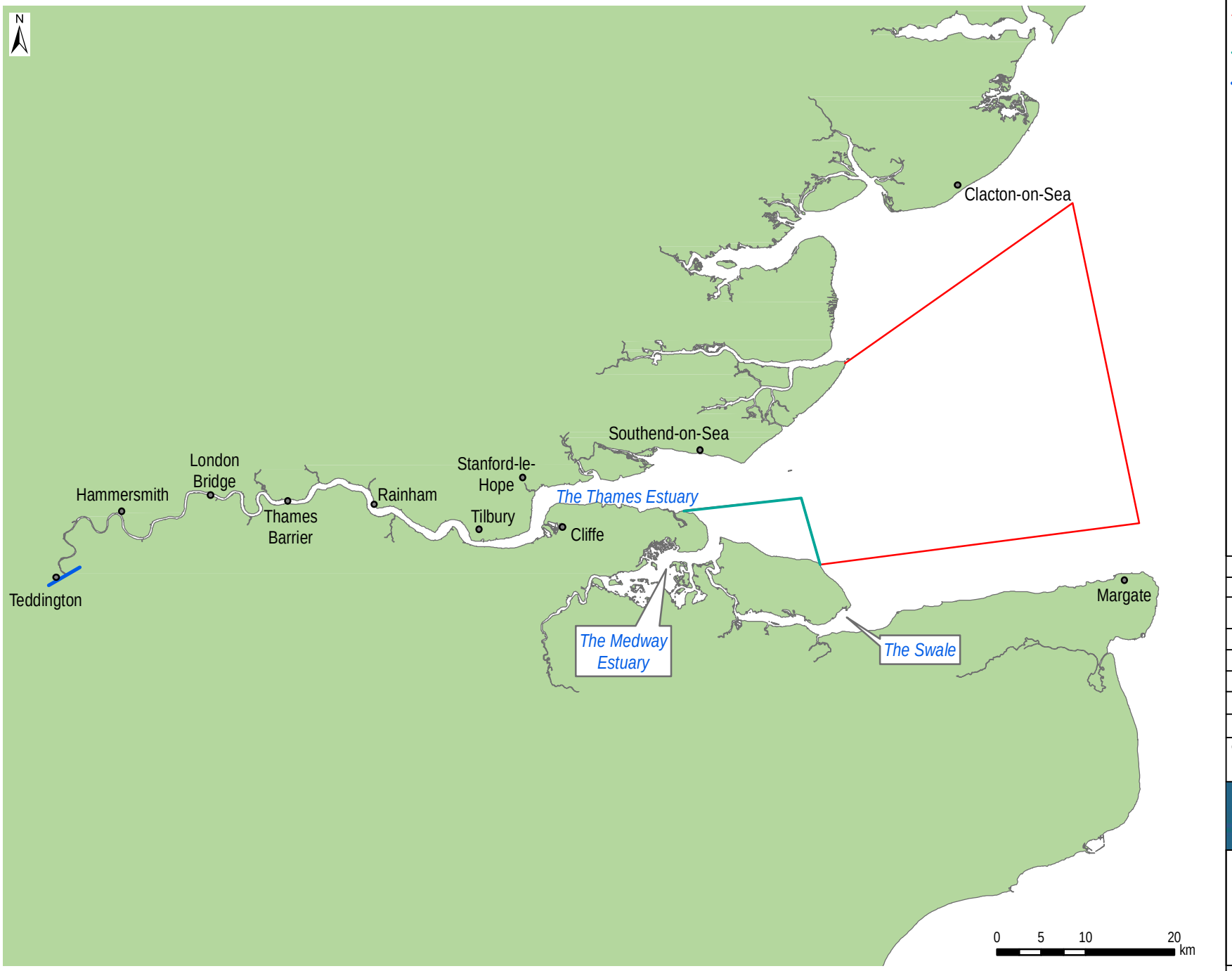
Figures



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

Normal Tidal Limit

Date	By	Size	Version
Apr 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:600,000	
QA		DLW	
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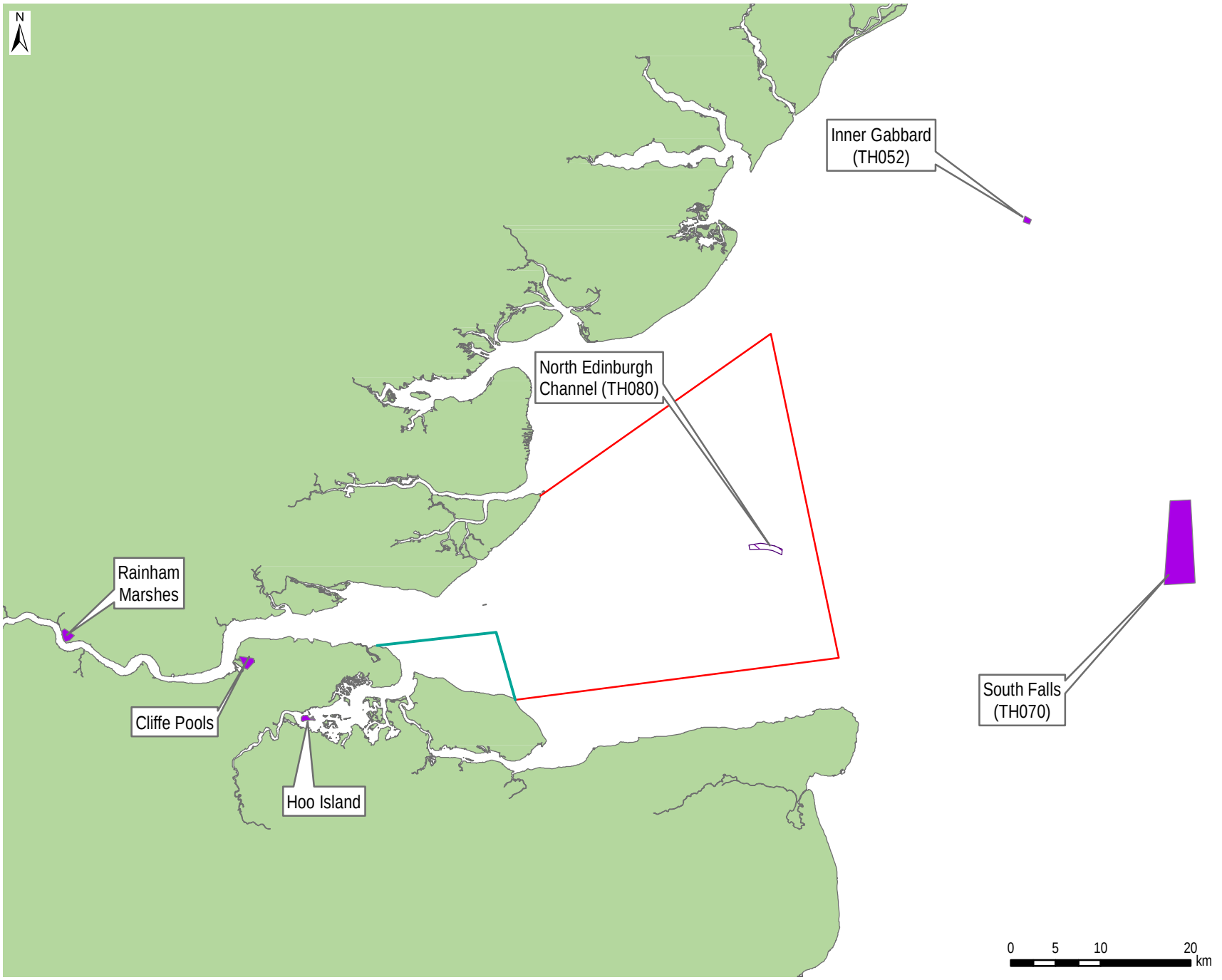
Study Area

Figure 1.1



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

Disposal Sites Used up to 2013

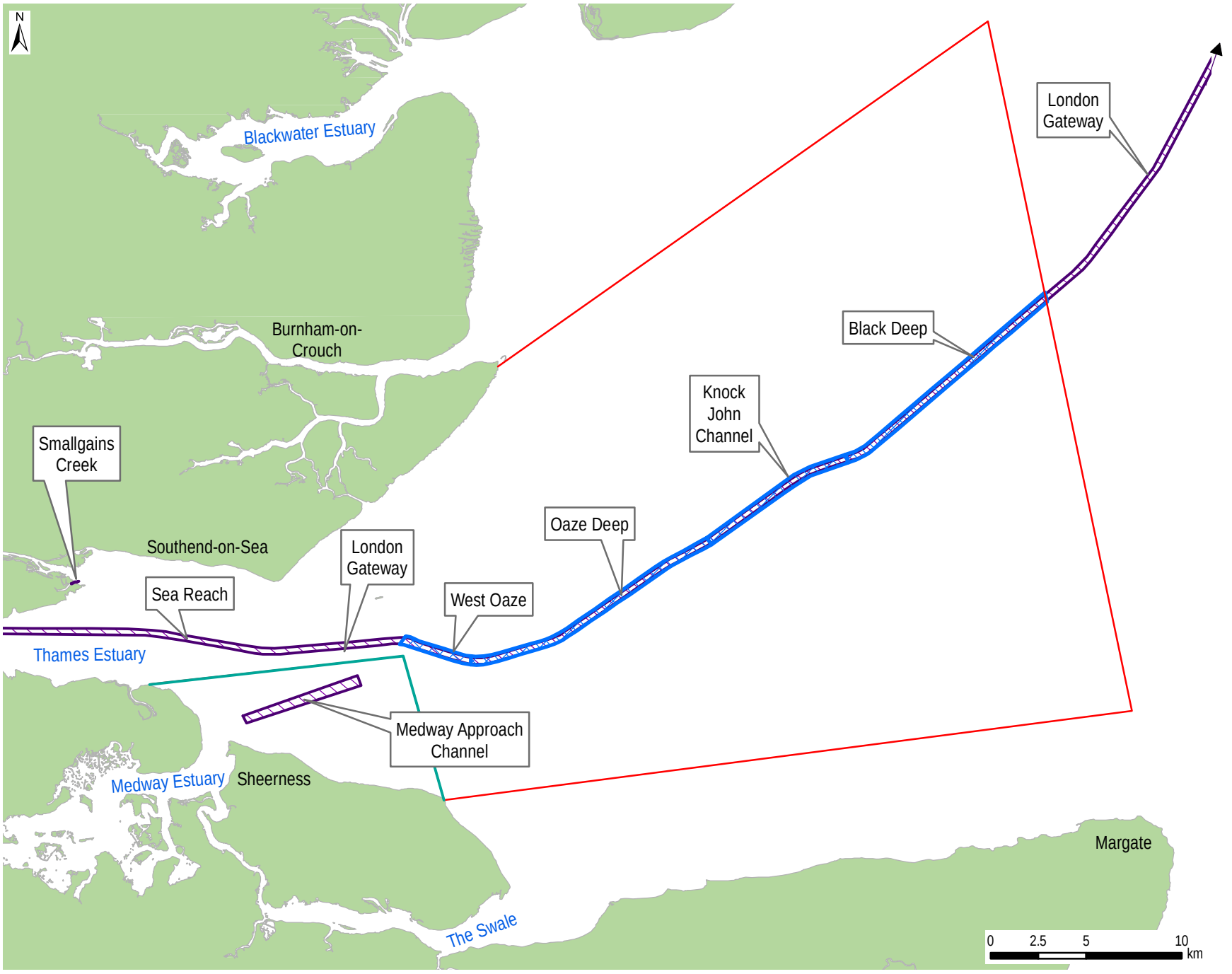
Recently Characterized Disposal Site (Unused to Date)

Date	By	Size	Version
May 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:600,000	
QA		DLW	
4223 Fig_6_1_Disposal_areas.mxd			
Produced by ABPmer			

ABP mer marine environmental research

Disposal Sites Used by PLA and Third Parties in the Study Area

Figure 6.1



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

PLA Dredge Areas

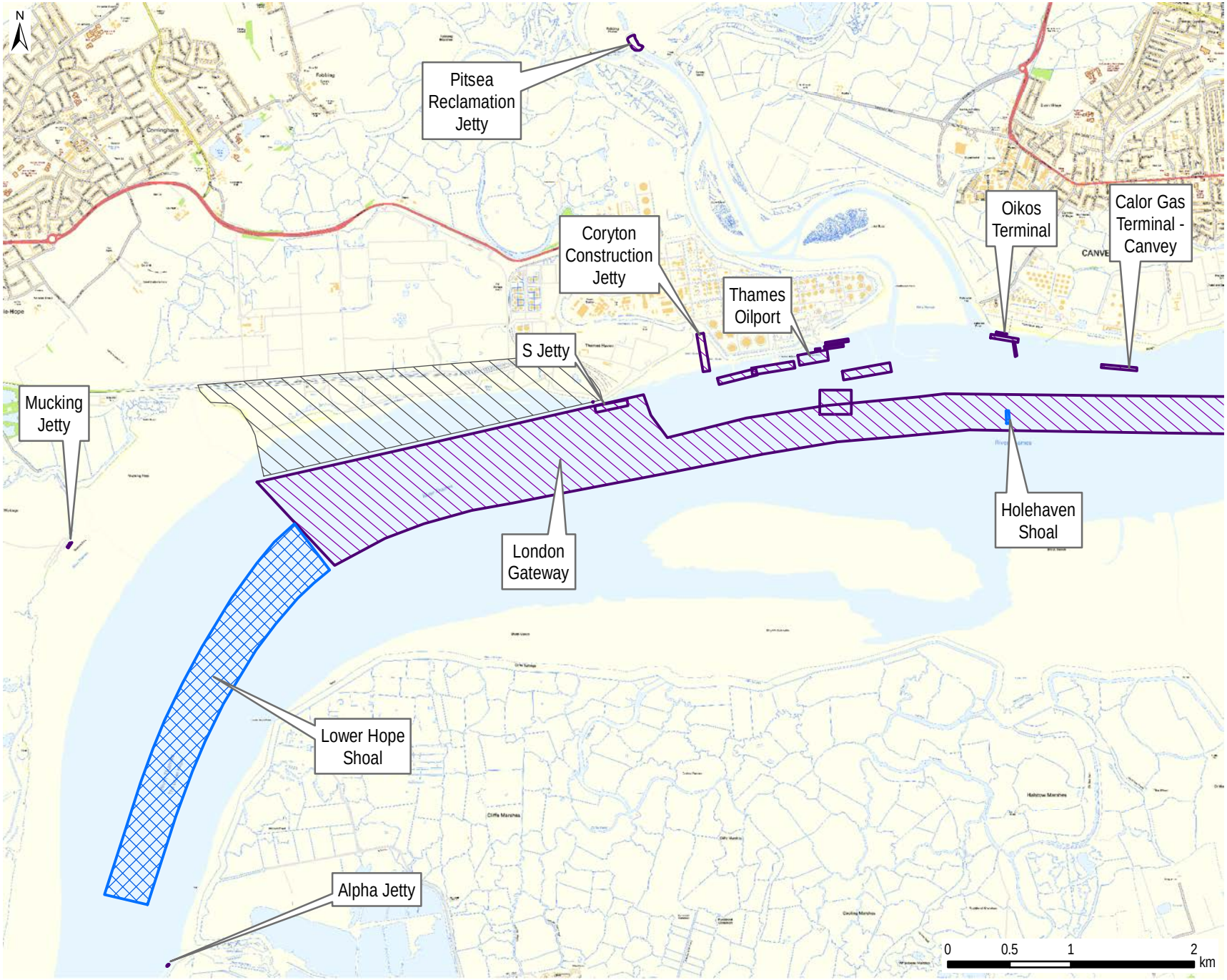
Third Party Dredge Areas

Date	By	Size	Version
May 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:280,000	
QA		DLW	
4223 Fig_6_2_Dredge_Areas.mxd			
Produced by ABPmer			

ABP mer marine environmental research

Dredge Locations (1)

Figure 6.2



PLA Dredge Areas

Third Party Dredge Areas

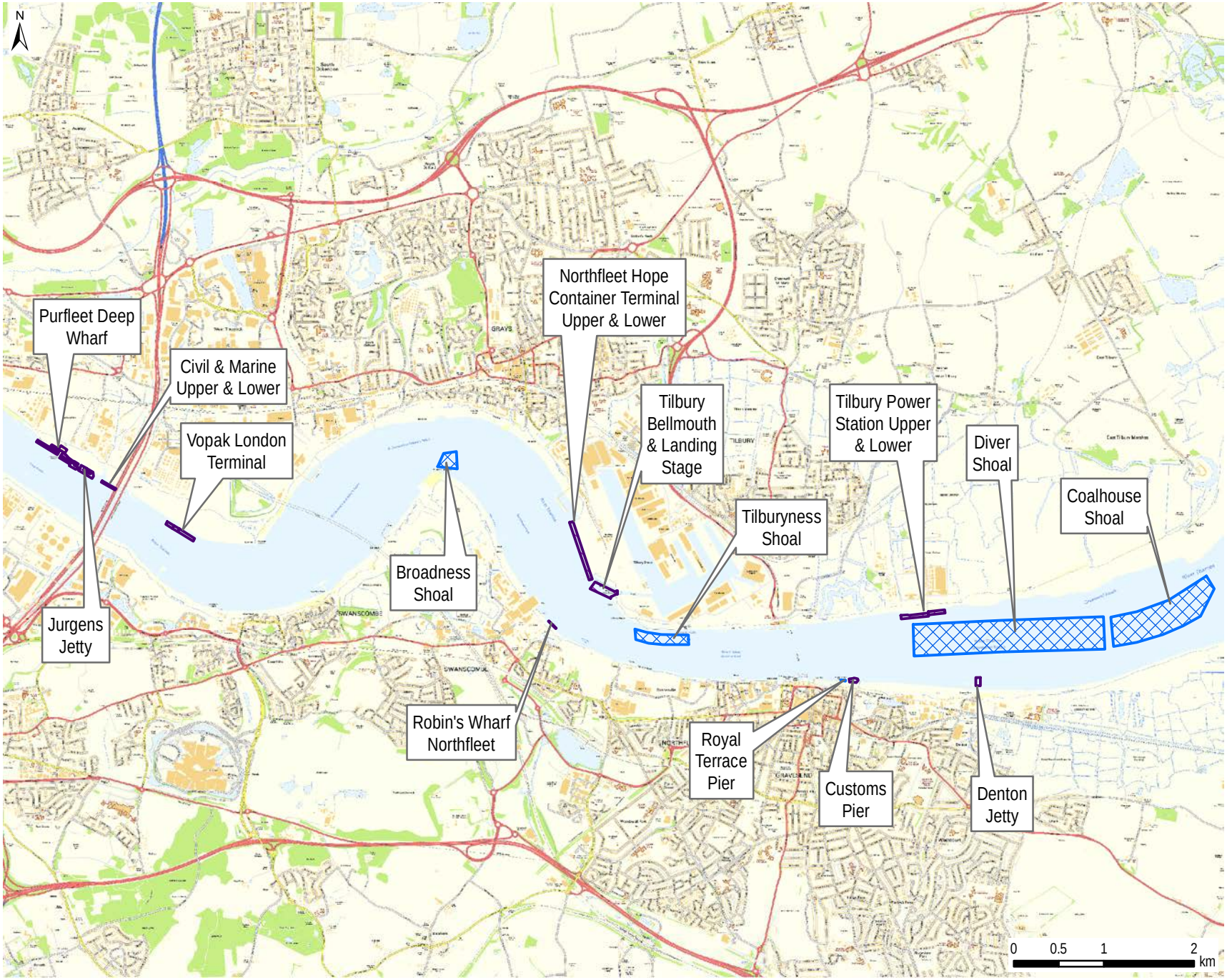
London Gateway Reclamation

Date	By	Size	Version
Apr 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:43,956	
QA		DLW	
4223 Fig_6_3_Dredge_Areas.mxd			
Produced by ABPmer			

ABP mer marine environmental research

Dredge Locations (2)

Figure 6.3



PLA Dredge Areas

Third Party Dredge Areas

Date	By	Size	Version
Apr 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:60,000	
QA		DLW	
4223 Fig_6_4_Dredge_Areas.mxd			
Produced by ABPmer			

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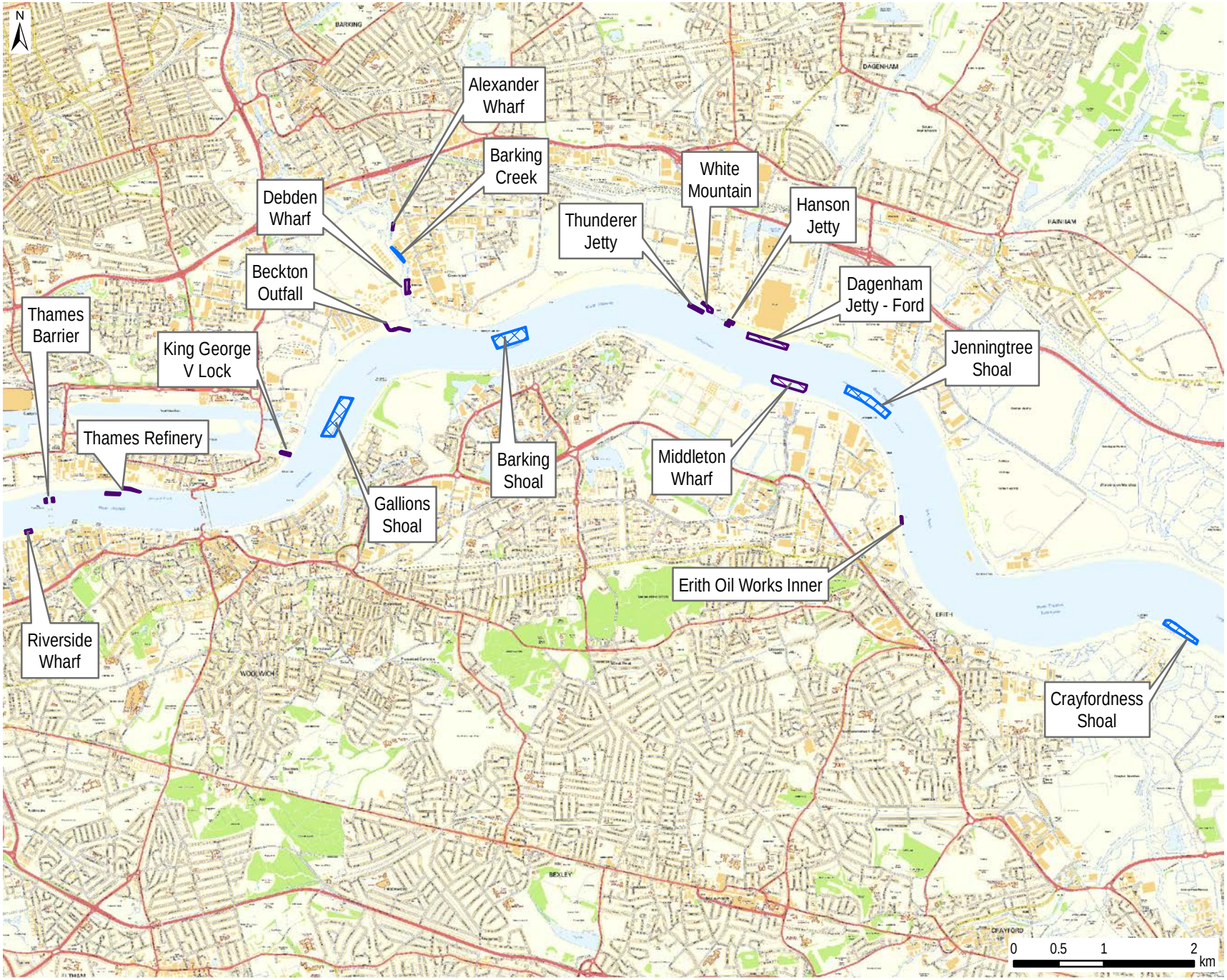
marine environmental research

Dredge Locations (3)

Figure 6.4



PLA Dredge Areas

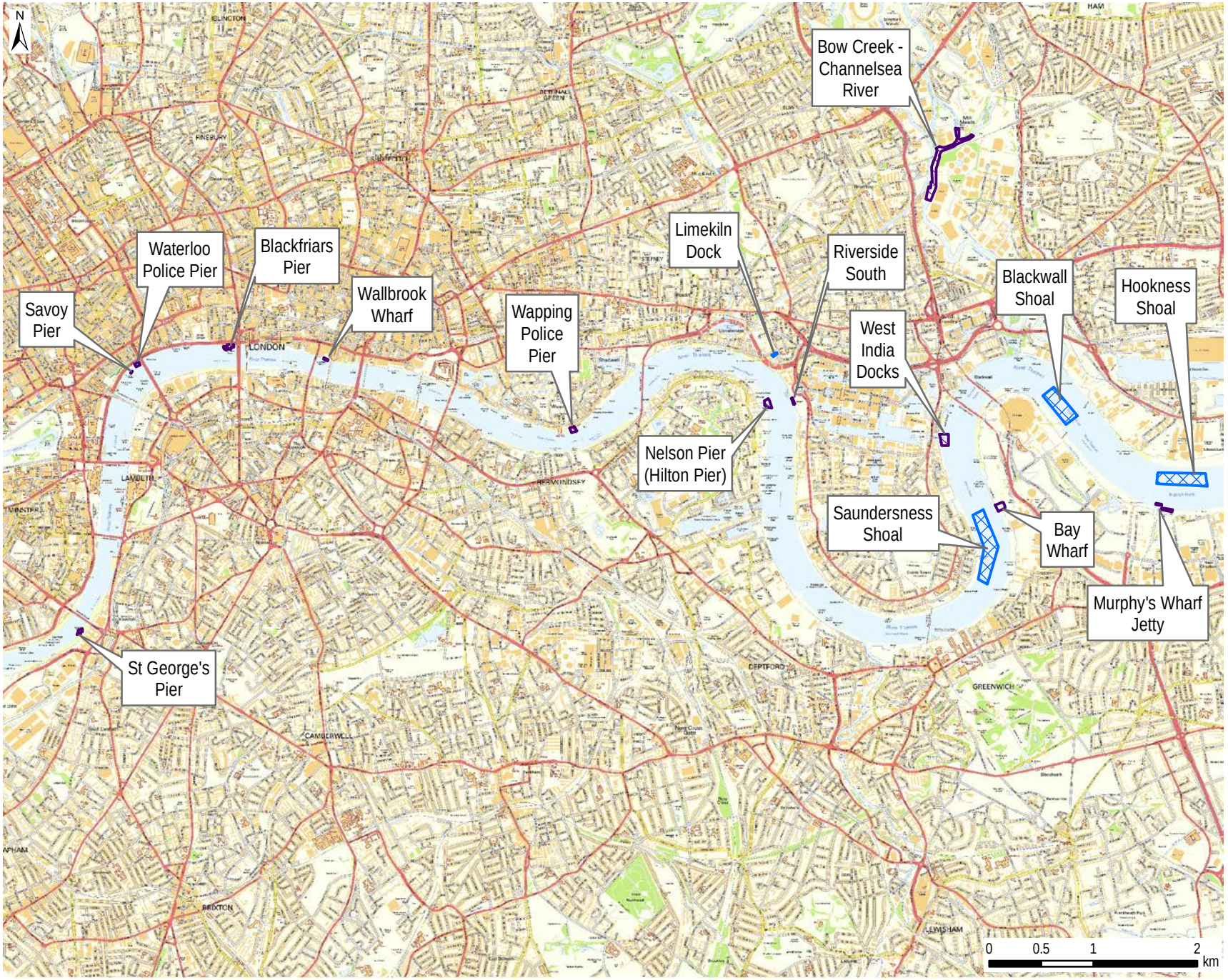
Third Party Dredge Areas

Date	By	Size	Version
May 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:60,000	
QA		DLW	
4223 Fig_6_5_Dredge_Areas.mxd			
Produced by ABPmer			

ABP mer
marine environmental research

Dredge Locations (4)

Figure 6.5



PLA Dredge Areas

Third Party Dredge Areas

Date	By	Size	Version
Apr 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:52,000	
QA		DLW	
4223 Fig_6_6_Dredge_Areas.mxd			
Produced by ABPmer			

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marine environmental research

Dredge Locations (5)

Figure 6.6

PLA Dredge Areas

Third Party Dredge Areas

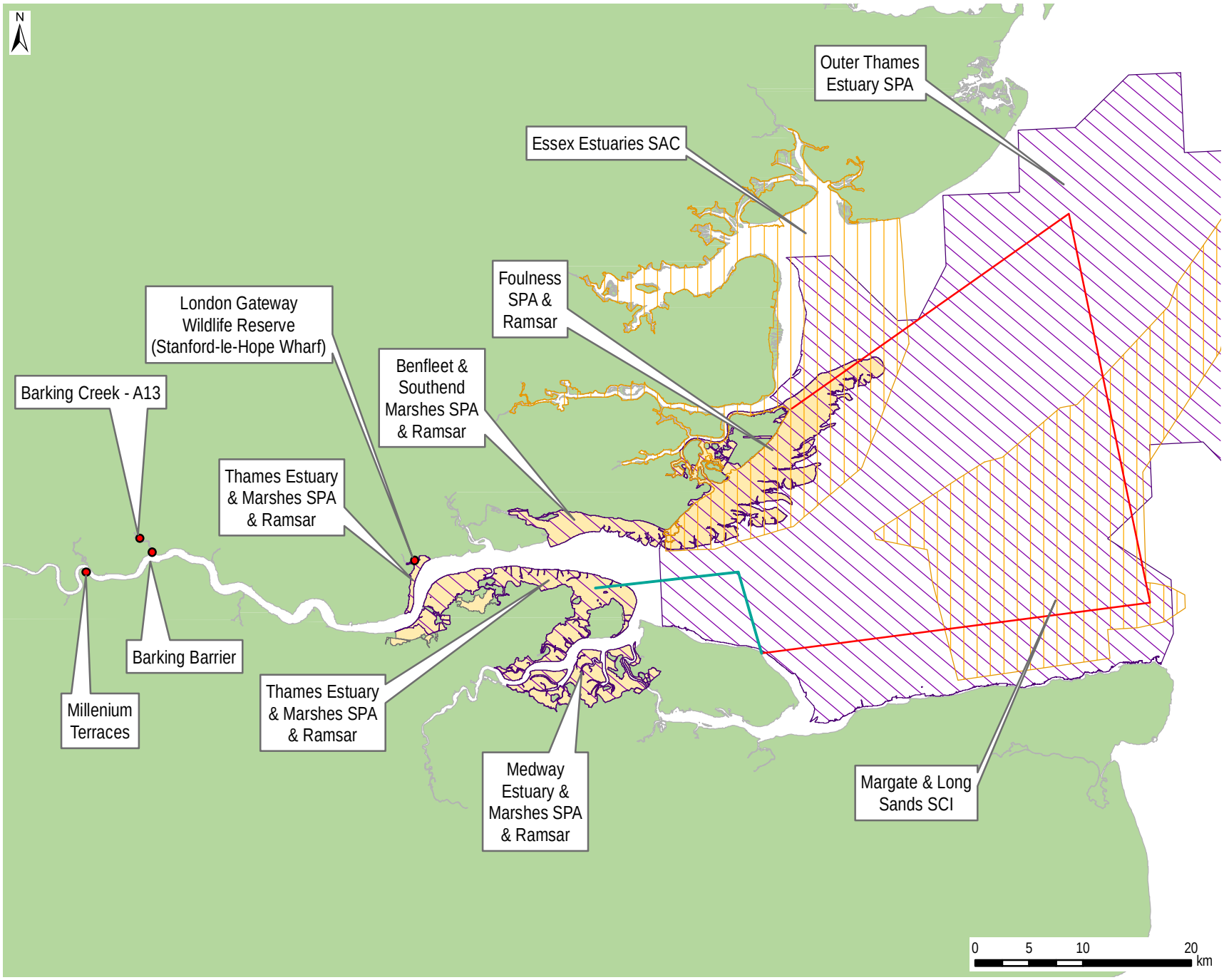
Normal Tidal Limit

Date	By	Size	Version
Apr 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:60,000	
QA		DLW	
4223 Fig_6_7_Dredge_Areas.mxd			
Produced by ABPmer			

ABP mer
marine environmental research

Dredge Locations (6)

Figure 6.7



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

Special Areas of Conservation and Site of Community Importance

Special Protected Areas

Ramsar

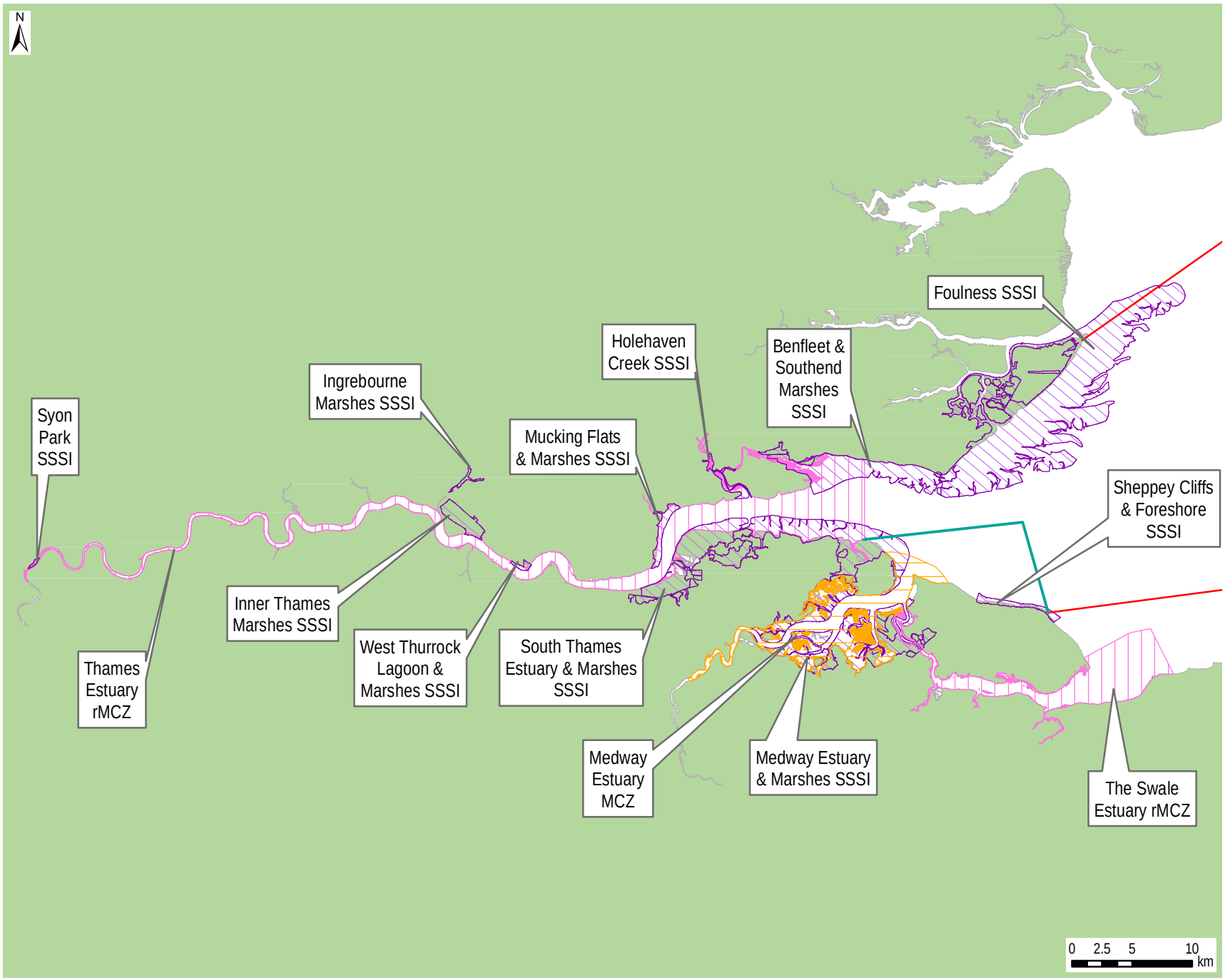
Compensation Sites

Date	By	Size	Version
Jun 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:500,000	
QA		DLW	
4223 Fig_8_1_Int_Designations.mxd			
Produced by ABPmer			

ABP mer marine environmental research

International Designations

Figure 8.1



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

Sites of Special Scientific Interest

Marine Conservation Zone

Recommended Marine Conservation Zone *

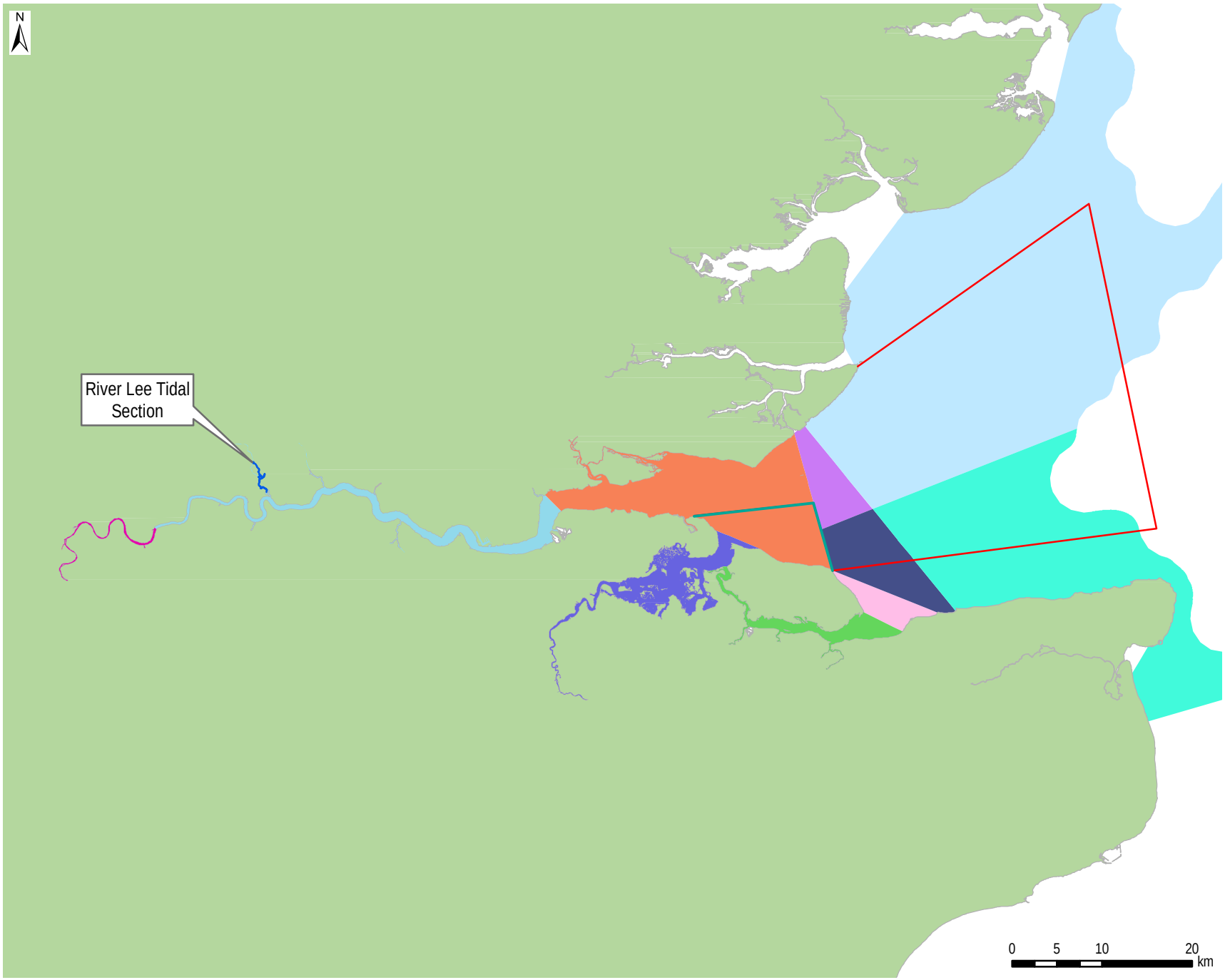
*Note - The Swale Estuary rMCZ is under consideration for the second tranche of MCZs (see section 8.1.6)

Date	By	Size	Version
Aug 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:450,000	
QA		DLW	
4223 Fig_8_2_Nat_Designations.mxd			
Produced by ABPmer			

ABP mer marine environmental research

National Designations

Figure 8.2

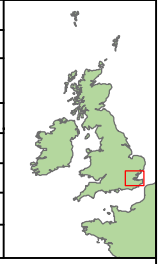


Statutory Harbour Authority Boundary
Medway Approach Area
Canal Water Bodies

Coastal Water Bodies
- Essex
- Kent North
- Thames Coastal North
- Thames Coastal South
- Whitstable Bay

Transitional Water Bodies
- Swale
- Thames Lower
- Medway
- Thames Middle
- Thames Upper

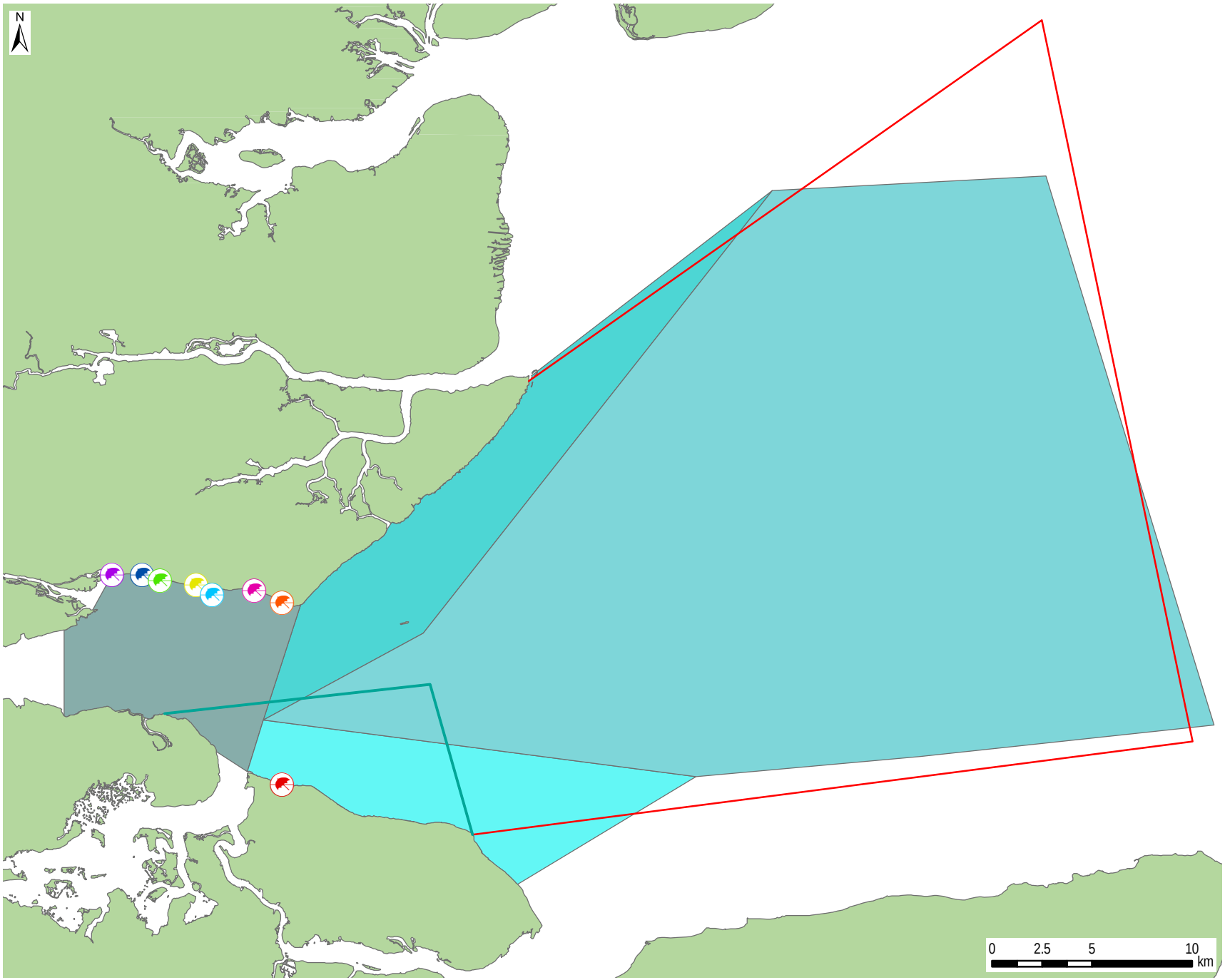
Date	By	Size	Version
May 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:600,000	
QA		DLW	
4223 Fig_8_3_Waterbodies.mxd			
Produced by ABPmer			



ABP mer
marine environmental research

Water Bodies with a Potential Hydromorphological Link to Dredge Activities in the Study Area

Figure 8.3



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

Bathing Waters

- Sheerness
- Shoeburyness
- Southend - Thorpe Bay
- Southend - Jubilee Beach
- Southend - Three Shells
- Southend - Westcliff Bay
- Southend - Chalkwell Beach
- Southend - Leigh Bell Wharf

Shellfish Waters

- Outer Thames
- Foulness
- Sheppey
- Southend

Date	By	Size	Version
May 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:270,000	
QA		DLW	
4223 Fig_8_4_Bathing_Shellfish_Waters			
Produced by ABPmer			

ABP mer marine environmental research

Designated Bathing Waters and Shellfish Waters

Figure 8.4

Appendices

Appendix A

Information for an Approriate Assessment

A.1 Context

The Habitats Regulations[1] implement the EC Habitats[2] and Birds Directives[3] in UK waters and require that an Appropriate Assessment (AA) be undertaken where a plan or project is not directly connected with, or necessary for the management of designated European sites or offshore European sites and where the possibility of a likely significant effect (LSE) on these sites cannot be excluded, either alone or in-combination with other plans or projects.

These sites include the following which comprise the Natura 2000 network:

- Special Areas of Conservation (SACs) designated under the EC Directive on the Conservation of Natural Habitats and of Wild Fauna and Flora (the Habitats Directive) for their habitats and/or species of European importance; and
- Special Protection Areas (SPAs) classified under the EC Directive on the Conservation of Wild Birds (the Birds Directive) for rare, vulnerable and regularly occurring migratory bird species and internationally important wetlands.
- Sites that are proposed for designation and inclusion in the Natura 2000 network and those sites that are currently in the process of being classified i.e. potential SPAs (pSPAs), candidate and possible SACs (cSACs and pSACs) and Sites of Community Importance (SCIs)[4].
- Listed or proposed Ramsar Sites (listed under the Ramsar Convention on Wetlands of International Importance); and
- Sites identified, or required, as compensatory measures for adverse effects on European sites, pSPAs, pSACs, and listed or proposed Ramsar sites.

These sites are collectively referred to throughout this report as European/Ramsar sites.

It is the Government's view, supported by rulings in the European Court of Justice, that maintenance dredging should be considered as a 'plan or project' for the

[1] The following principal instruments (jointly referred to as the "Habitats Regulations") transpose the EC Habitats Directive into UK law: the Conservation of Habitats and Species Regulations 2010 (as amended); the Conservation (Natural Habitats, &c) Regulations 1994 (as amended); the Offshore Marine Conservation (Natural Habitats) Regulations 2007 (as amended).
[2] Council Directive 92/43/EEC on the conservation of natural habitats and wild fauna.
[3] Council Directive 79/409/EEC on the conservation of wild birds.
[4] Explanation of site status: Candidate Special Areas of Conservation (cSAC) are sites that have been submitted to the European Commission (EC), but not yet formally adopted; Sites of Community Importance (SCI) are sites that have been adopted by the EC but not yet formally designated by the government of each country; Special Areas of Conservation (SAC) are sites that have been adopted by the EC and formally designated by the government of each country in whose territory the site lies.

purposes of the EC Habitats Directive (92/43/EEC), and assessed in accordance with Article 6(3) of that Directive (Defra, 2007). This Appendix presents the relevant information to allow the lead Competent Authority (the PLA) taking appropriate advice from Natural England, to record the AA. The Appendix is informed by the information presented in the main report.

A.2 Designated Sites Screened into the Appropriate Assessment

A.2.1 European/Ramsar Sites

The international nature conservation importance of the Thames Estuary and the surrounding area is recognised through designation of a number of sites for nature conservation importance (Figure A.1). Section 8 of the main report identifies the European/Ramsar sites where the possibility of a LSE cannot be excluded, either as a result of maintenance dredge operations alone or in-combination with other plans or projects, and have therefore been screened into the AA. These are labelled on Figure A.1 and are as follows:

- Outer Thames Estuary SPA;
- Margate and Long Sands SCI;
- Essex Estuaries SAC;
- Foulness (Mid-Essex Coast Phase 5) SPA and Ramsar;
- Benfleet and Southend Marshes SPA and Ramsar;
- Medway Estuary and Marshes SPA and Ramsar; and
- Thames Estuary and Marshes SPA and Ramsar.

European Marine Sites (EMS) is the collective term for SACs and SPAs that are covered by tidal water (continuously or intermittently). The following EMS and corresponding international designations are located in the study area:

- Essex Estuaries European Marine Site, comprising:
    - Essex Estuaries SAC; and
    - Foulness SPA.
- Benfleet and Southend Marshes European Marine Site, comprising:
    - Benfleet and Southend Marshes SPA.
- Swale and Medway European Marine Site, comprising:
    - Medway Estuary & Marshes SPA.
- Thames Estuary European Marine Site, comprising:
    - Thames Estuary and Marshes SPA

Natural England has statutory responsibility to advise relevant authorities as to the conservation objectives for EMS and operations which may cause deterioration or disturbance of natural habitats and species. This advice is provided under Regulation 35 of the Conservation of Habitats and Species Regulations 2010 (referred to as the Habitats Regulations within this document).

The role of the conservation objectives for a EMS is to define the nature conservation objectives for the features of interest, thereby representing the aims and requirements of the Habitats and Birds Directives in relation to the site. A detailed breakdown of the qualifying interest features and the associated conservation objectives for the European/Ramsar sites listed above can be found in Section 8 of the main report.

The March 2012 National Planning Policy Framework, which sets out the Government's planning policies for England confirms (in Paragraph 118) that "*sites identified, or required, as compensatory measures for adverse effects on European sites*" should be given the same protection as European sites (DCLG, 2012, p28). On this basis, all completed managed realignment or recharge sites that have been created for compensatory purposes were identified. These are included on Figure A.1 and are as follows:

- London Gateway Wildlife Reserve (Stanford-le-Hope Wharf);
- Barking Creek – Barking Barrier;
- Barking Creek – A13; and
- Millennium Terraces.

The qualifying interest features of the compensatory sites that occur in the study area are not known. It has been assumed that these will support features already designated by other European/Ramsar sites already screened into the AA (in particular coastal habitats and supporting species, and foraging and migratory birds). The assessment therefore does not include any specific further consideration of these sites.

A.2.2 Marine Conservation Zones

The UK has signed up to international agreements that aim to establish an 'ecologically coherent network of Marine Protected Areas (MPAs)' by the end of 2012. This network will be made up of current MPAs as well as a new type of MPA called a Marine Conservation Zone (MCZ). Within the south east region, the development of recommendations for MCZ was coordinated by the Balanced Seas Regional MCZ Project (Balanced Seas, 2011).

In November 2013 Defra designated 27 new MCZs, one of which falls within the vicinity of the maintenance dredge operations, the Medway Estuary MCZ (Figure A.1).

In February 2014, Defra initiated that work on a second tranche of MCZs with the aim of holding a public consultation in early 2015 and designating sites by the end of that year (Defra, 2014). For the second tranche, 37 sites from the Regional MCZ Project recommendations have been identified as suitable candidates for consideration. Of these, the Swale Estuary recommended MCZ (rMCZ) has been put forward for consideration in the second tranche of MCZs (Figure A.1). Although site is more than 5km from dredging activities it is considered to be hydromorphologically linked to the

Medway Estuary. Although this site has not been formally designated, it has been screened into the assessment on a precautionary basis and treated as though it is fully designated.

The Balanced Seas Regional MCZ Project also proposed the Thames Estuary as a rMCZ but "requiring further consideration" prior to being considered for designation. Given that this site was not put forward to be considered for designation in the first or second tranche of MCZs, this site will not be considered further as part of the assessment. Should the site be brought forward for consideration at some point in the future, this would require the AA to be revisited.

The features and draft conservation objectives that were developed by Natural England and Joint Nature Conservation Committee (JNCC) advisors (Balanced Seas, 2011) for the Medway Estuary MCZ and The Swale Estuary rMCZ are outlined in Table 8.4 of the main report. A conservation objective set to 'maintain' means that the stated levels of activity currently occurring on the feature are considered acceptable, but features will be monitored and restrictions may have to be introduced if the condition declines. A conservation objective to 'recover' means that restrictions may be necessary on the activity causing the pressure, in order to allow the feature to recover to favourable condition. It does not necessarily mean that an activity will be prohibited, as other mitigation measures might be appropriate (e.g. change in fishing gear type, reduction in intensity, seasonal restrictions etc.).

It should be noted that the location of rMCZs, the features proposed for designation and the conservation objectives for the specified features, may change prior to or following public consultation in 2015.

A.3 Potential Impacts on Interest Features

This section provides a review of the potential impacts of the PLA's and third party maintenance dredge operations alone (Sections A.3.1 to A.3.2) and in-combination with other relevant plans and projects (Section A.3.4), on the qualifying interest features of designated sites that have been screened into the assessment. This assessment has been carried out in the context of the nature of the maintenance dredging activities, and the geographical locations of both the works and the interest features. It is also based on existing knowledge and evidence with no new analysis undertaken.

The historic maintenance dredging regime (between 2004 and 2013) is described in detail in Section 6 of the main report. As described in Section 6, maintenance dredging by the PLA and third parties occurs throughout the SHA, although most of the maintenance dredging currently occurs in the outer region of the Inner Estuary (see Figures A.2.1 and A.2.2). Dredging methods used include water injection dredging (WID), trailer suction hopper dredging (TSHD), plough dredging (bed levelling) and backhoe excavator dredging. Dredging of the approaches in the Outer Thames is typically achieved using TSHD (with some WID) as the sediment predominantly comprises fine to coarse sands (and other coarser material i.e. gravel and debris), whilst dredging of more muddy sediments (silt) and fine sands within the outer Inner Estuary is predominantly carried out using WID and ploughing. Upstream of Tower Bridge the sediment is more gravelly and the predominant maintenance dredge method is backhoe excavator dredging.

The predominant dredge method, sediment type and recorded dredge volumes between 2004 and 2013 at each PLA and third party maintenance dredge area are described in Section 6.3 of the main report (where this information was available). The locations of the PLA's and third party maintenance dredge operations in the context of the designated sites that have been screened into the AA are shown on Figures A.2.1 and A.2.2. Three dredge locations directly overlap with designated sites:

- The Outer Thames Estuary main navigation approach channel;
- Smallgains Creek; and
- Mucking Flats

The disposal of any maintenance dredge arisings from PLA and third party maintenance dredge operations occurs mainly on land (e.g. Rainham Marshes and Cliffe Pools) and to less of an extent at marine licenced disposal sites (e.g. South Falls and the Inner Gabbard). Figure A.3 provides a map of disposal locations, used for the disposal of maintenance dredge material from sites within the SHA, up to and including 2013, and Section 6.2.3 of the main report provides further information on current disposal sites and beneficial use. The land disposal sites are outside of the marine environment and there is no impact pathway linking these disposal operations

to the qualifying interest features. There is therefore no potential for LSE and these operations are not considered further as part of the assessment. The marine disposal sites are located offshore and beyond 5km from any protected sites. There is therefore unlikely to be a potential for LSE and marine disposal operations are not considered further in the assessment.

A.3.1 Direct Impacts on Interest Features

In general terms, depending on the nature, scale, timing, duration and magnitude of effect, the potential direct impacts of maintenance dredging on the qualifying interest features of the designated sites could include:

- Change in habitat and loss of benthic organisms within the footprint of the dredged areas;
- Disturbance of sediment during the dredging process resulting in the creation of sediment plumes causing an increase in turbidity, suspended sediment concentrations, organic matter and ultimately smothering;
- The potential remobilisation of contaminated sediments associated with suspended sediment as a result of dredging activity, which could impact on water quality; and
- Potential for disturbance caused by interruption of possible lines of sight and noise during the dredging process.

Each of these potential impact pathways are assessed in turn in the following sections.

A.3.1.1 Change in Habitat and Loss of Benthic Organisms

The direct removal of sediment and benthos as a result of maintenance dredging within the boundary of the designated sites occurs along the main navigation channel in the Outer Thames Estuary, and also in two small discrete areas: Smallgains Creek and Mucking Jetty on the north bank of the Thames Estuary (Figure A.2.1 and A.2.2 respectively). The designated sites and features with which these dredge areas overlap are shown below (see Section 8.1 of the main report and Appendix B for full details of the designated site features):

The maintenance dredging in the main navigation channel overlaps with the Outer Thames Estuary SPA and runs adjacent to the Margate and Long Sands SCI, the features of which are as follows:

- The Outer Thames Estuary SPA is designated for the Red-throated diver (*Gavia stellata*) supported by habitats including shallow coastal waters and areas in the vicinity of sub-tidal sandbanks.
- The qualifying feature of the Margate and Long Sands SCI is sandbanks which are slightly covered by sea water all the time

The Smallgains Creek dredge area overlaps with the Benfleet and Southend Marshes SPA and Ramsar site which are designated for waterfowl and are supported by a range of intertidal habitats including intertidal mudflat and sandflat communities, saltmarsh Communities, eelgrass Beds (*Zostera* beds) and shell banks

Mucking Jetty dredge area overlaps with the Thames Estuary and Marshes SPA and Ramsar site, which are designated for a number of waterfowl and are supported by a range of intertidal habitats, including intertidal mudflat and sandflat communities.

The seabed of the Outer Thames Estuary is predominantly fine and medium sands but with considerable amounts of gravel or shell in the deeper areas, e.g. north and east of the Isle of Sheppey, where much of the coarser material is oyster and other shell material (London Array Ltd, 2005). The indicative subtidal habitats that occur in the wider study area can be obtained from the predictive habitat maps produced as part of the EUSeaMap project (JNCC, 2010). The subtidal seabed habitats at the maintenance dredge areas that overlap with designated sites are predicted to comprise a mosaic of subtidal sand, coarse and mixed sediments.

The typical invertebrate assemblage changes throughout the estuary, which is largely a function of the range in salinity and physical condition, including substrate type. The subtidal benthic environment in the Outer Thames Estuary is generally dominated by nemerteans, polychaetes (*Nephtys* spp., *Magelona johnstoni*, *Spiophanes bombyx*), oligochaetes (*Tubificoides spp*.), amphipods (*Bathyporeia elegans*) and bivalves (*Abra alba*, *Venus* spp.) and are characteristic of the benthic environments of this bio-geographic region (ABPmer, 2007; Dong Energy, 2007; GREP, 2002; London Array Ltd, 2005; MALSF, 2009; TEDA, 2010; Vattenfall, 2011). In addition, the Ross worm (*Sabellaria spinulosa*), which in its reef form is a UK Biodiversity Action Plan (BAP) habitat, has been found to be present in small numbers in the Black Deep area of the navigation channel in the Outer Thames Estuary (London Gateway, 2004).

Species richness and diversity generally correlates with sediment type with few species and low abundance found within the fine sand or gravelly sand substrates dominating the Outer Thames Estuary, whilst the muddy, gravelly sites generally located further inshore are relatively species rich. Maintenance dredging in the main navigation channel in the Outer Thames Estuary occurs rarely given that the system is largely self-scouring. The last time this part of the channel was maintenance dredged was in 2009 where 856m^3 was removed from the seabed. Prior to this, no known maintenance dredging had occurred since 2004 (see Section 6.3 in the main report). The development of the London Gateway port facility has involved deepening parts of the approach channel in the Outer Thames. No maintenance dredging has yet been required since the completion of the capital dredge in 2013 and the Environmental Statement did not predict any requirement for maintenance dredging in the Outer Thames given the self-scouring nature of the channel, although this will need to be reviewed on an ongoing basis. Over the last ten years, Smallgains Creek was only maintenance dredged in 2007, although the volume that was dredged is not known (the Appropriate Assessment for this maintenance dredge reported that the 'recommended scenario' was that 4,000m^3 was dredged using WID; see PLA, 2009, Appendix A 'Island Yacht Club Appropriate Assessment'). Over this same period, Mucking Jetty was maintenance dredged in 2010 by backhoe and a total of 950m^3 was removed comprising mainly silts. The future maintenance dredge requirements for these sites are not known.

Following dredging, benthic communities are expected to be able to recover (or adapt) given the low frequency and small scale nature of the disturbance. Furthermore, maintenance dredging will not expose a different type of sediment to that which is currently present and therefore the nature of marine communities that will re-colonise the area would be similar to the communities that were present

before. Re-colonisation of the seabed would take place by recruitment of larvae and the migration of adult individuals into the affected area from adjacent areas. Estimates of the rate of recover are strongly linked to the lifecycles of the characterising species present. Estuarine muds which are more predominant at the inshore intertidal dredge locations are likely to recover within six to eight months of maintenance dredging whereas subtidal sands and gravels in the main navigation channel of the Outer Thames Estuary could take around two to three years to recover.

Overall, the sensitivity of the habitats and associated benthic communities is considered to be low. The exposure to change is negligible given the very low frequency and small magnitude of the disturbance. The potential impact of dredging causing a loss of benthic organisms within the dredged area is therefore considered to be insignificant.

A.3.1.2 Disturbance of Sediment and Smothering

Maintenance dredging creates temporary sediment plumes which in turn can increase turbidity and the concentration of suspended organic matter. The scale of any changes in suspended sediment concentrations will vary in space and time depending on the tidal state, range of tide and material type, as well as location, rates and methods of maintenance dredging.

The sediment plumes that are generated by maintenance dredging undertaken by PLA and third parties are likely to overlap with a number of the designated sites that have been screened into the assessment (see Section A.2.1), in particular the Outer Thames Estuary SPA, Margate and Longsands SCI, Benfleet and Southend Marshes SPA and Ramsar site and the Thames Estuary and Marshes SPA and Ramsar.

Dredging of more muddy sediments (silt) and fine sands within the Inner Estuary is predominantly carried out using Water Injection Dredging (WID) and plough dredging. Dredging of the approaches in the Outer Thames is typically achieved using trailing suction hopper dredging (TSHD) with limited use of WID as the sediments predominantly comprise fine to coarse sands (and other coarser material, i.e. gravel and debris).

WID involves the injection of high volumes of water at low pressure into recently deposited seabed sediments. This re-fluidises the silts and fine sands, which then flow by gravity or current from the dredge site. The water is injected at low pressures, ensuring the sediment material is re-energised as a density current at the bed, rather than being re-suspended into the full water column. To be effective, the technique requires a flow gradient away from the dredge site, so material is transported to locations from which it is subsequently re-distributed by natural currents. The technique therefore promotes relocation of material based on local dispersion rather than removal to licensed marine or land (terrestrial) disposal sites. Retention of sediments within the natural estuarine system is widely considered to be a potentially significant environmental benefit of the technique. In order to minimise the environmental effects, dredging is required to be undertaken on an ebb tide to provide maximum dispersion and minimise sedimentation on the designated conservation sites. Where adjacent facilities are dredged, the sequence in which berths are dredged is managed, when possible, to work downstream, thereby avoiding deposition within recently maintained areas.

Similar to WID, ploughing should not typically lead to significant re-suspension of sediment in to the upper water column, but if the sediment ploughed is soft it may be sufficiently disturbed to raise smaller sediment fractions into suspension. The amount of suspended sediment that is released into the water column by a small/medium size TSHD is relatively small per load.

Further information on the full range of maintenance dredging methods that are used on the Thames Estuary is included in Section 6.2.2 of the main report.

Numerical modelling undertaken for the London Gateway capital dredge scheme[5] identified that for silt dredging the greatest increases in suspended sediment concentrations (SSC) are predicted to occur within about 200m of the dredger perpendicular to tidal flow and about 3km in the direction of tidal flow (London Gateway, 2004). Whilst the sediment plume is predicted to extend beyond this, i.e. potentially up to an extent of 10 to 15km in some areas, the increases in suspended sediment concentrations are generally lower than baseline variations and therefore unlikely to have a significant effect on protected sites at these distances. In contrast, sand (mainly dredged within the approaches and navigation channel) will drop out of suspension in much greater proximity to the dredger and is therefore considered to have an extent of impact considerably less than 5km.

Sediment modelling has also been undertaken as part of the Smallgains Creek maintenance dredge application to identify whether there would be an impact on the sensitive seagrass beds in Benfleet and Southend Marshes SPA and Ramsar (PLA, 2009). This demonstrated that, using WID, peak levels of up to 200mg/l above background levels may occur for up to 20 minutes before gradually decaying to normal background levels (no distances over which this peak increase occurs is provided in the report). The modelling also indicated that approximately 25% of the seagrass beds may be affected by an increase in suspended sediment levels of up to 100mg/l, which is comparable to the maximum levels that are experienced at the site during the range of normal conditions, including storm events (see PLA, 2009 Appendix A). .

During maintenance dredging, the material that is suspended into the water column disperses and re-settles onto other areas. Sand material will be re-deposited within close proximity to the dredge site whereas fine silts may remain in suspension for a period of days following dredging. Furthermore, any material that settles is very short-lived, most likely only occurring during slack water periods and being re-dispersed as tidal currents increase. In other words, these periods of deposition are transient and the scale of any exposure is considered to be within the existing natural variability of the system.

Intertidal and subtidal estuarine habitats and associated benthic communities are naturally adapted to fluctuating conditions and the resuspension and deposition of sediments on a daily basis (through tidal action), lunar cycles (due to the differing influences of spring and neap tides) and on a seasonal basis (due to storm activity and conditions of extreme waves). The sensitivity of the benthic community to the predicted scale of change is therefore considered to be low. These habitats have been historically exposed to changes in suspended sediments and sedimentation as

[5] This information has been referred to as it provides useful information on sediment plumes and hence hydromorphological linking in the Outer Thames Estuary, however, it is important to note that this modelling was undertaken for a large capital dredge and therefore lower SSCs would be expected for any future maintenance dredge campaigns in this location.

a result of ongoing maintenance dredging for over two centuries in some places. Overall, given the low level of exposure and the low sensitivity of interest features, the impact of this temporary disturbance is considered to be minor and unlikely to change the overall favourable condition status of interest features.

An increase in suspended sediments may reduce visibility and affect the feeding success of the Red-Throated Diver, which is a feature of the Outer Thames Estuary SPA, as they forage visually. The effects of suspended sediment plumes are considered temporary, lasting no longer than a few hours. The worst case footprints of the plume from TSHD are localised around the dredged area. In addition only a very small proportion of this foraging area will be affected by maintenance dredge activities. Therefore Red-Throated Divers are not considered to be significantly affected due to their ability to forage over extensive areas and any effects would be very temporary and localised in nature.

A.3.1.3 The Potential Remobilisation of Contaminated Sediments

The sediments that are maintenance dredged within the Thames Estuary (both within and outwith European/Ramsar sites) exhibit a varied degree of contamination across a range of chemical parameters including heavy metals and organotins. In general, a review of sediment quality data has indicated that contamination levels are typically below Cefas Action Levels (ALs)[6], although a number of samples do exceed Cefas AL 1 for certain substances (most commonly heavy metals). Only a single analysed sediment sample from within the Thames (at the Thames Refinery dredge site, upstream from European/Ramsar sites) exceeded Cefas AL 2 thresholds, specifically for cadmium and mercury, although any potential contamination is considered to be very localised and the dredge site is located 29.7km upstream from the nearest European/Ramsar site (Thames Estuary and Marshes SPA and Ramsar). More detailed information on the sediment quality of material licensed for maintenance dredging is provided within Section 7 of the main report.

In general, contaminant levels in dredged material below AL 1 are considered of no concern with respect to their potential to cause pollution, and are unlikely to influence the decision to issue a licence. These ALs are not absolute 'pass/fail' levels, but are used as guidance in conjunction with other assessment criteria. Where contamination levels in sediment samples exceeded AL 1, these concentrations would have been taken into account by the licensing authority. The successful receipt of marine licences for maintenance dredging and/or disposal at sea indicates that observed contamination slightly above Cefas ALs 1 and 2 is not thought to present an unacceptable risk to the marine environment in terms of further pollution.

It is not expected that water quality and prey species for birds will be adversely affected by the re-suspension of sediments and associated contaminants through existing maintenance dredging activities undertaken by PLA and third parties. Generally, any contamination that has been detected occurs at isolated locations and therefore only a small amount of contaminated material will be redistributed and

[6] Historically, Canadian guideline standards (and Dutch Standards) have been used as comparison standards for Contaminated Marine Sediment management in England and Wales because Cefas Action Levels were not publically available. However, given that Cefas Action Levels are now publically available, and these are the threshold levels which regulators use to determine licence applications for disposal of dredge material at sea, the current Baseline Document only presents the sediment contamination data in relation to Cefas Action levels.

deposited during dredging. The PLA has developed guidelines on the number of samples required which is dependent upon the quantity of sediment to be dredged. This provides a mechanism for modifying or preventing dredging if the sediments are significantly contaminated. Furthermore, there is strict legislation and water quality assessments in place that must be adhered to in order to obtain a dredging licence. If any contaminant concentrations are deemed too high then dredging and disposal of that material is restricted. It is therefore considered unlikely that maintenance dredging has to date had an adverse effect on the integrity of the EMS through remobilisation of contaminated sediments. Subject to the existing maintenance dredging testing and licensing regime remaining in place, it is unlikely that an impact would occur in the future.

A.3.1.4 Potential for Disturbance Caused by Interruption of Possible Line of Sight and Noise

A list of the bird species associated with the relevant SPAs can be found in Appendix B. Noise levels generated by the dredgers are no greater than noise generated by other vessels that routinely use the estuary throughout the year. The noise from the TSHD is continuous and, therefore, in general, birds are considered to rapidly become habituated (Hill et al., 1997) (although see also information on the Red throated diver below). With regard to disturbance from movement, waterbirds are already accustomed to high levels of commercial and recreational activity in the estuary, and, therefore, the slow and relative infrequent movements of the vessels involved in the dredging process are unlikely to cause significant additional disturbance. Dredging is not labour intensive on the deck of a vessel, and so the disturbance from human movement is considered negligible. Furthermore, machinery and vehicle movements are better tolerated than people at the source of the disturbance (Hill et al., 1997; IECS, 1999). In addition, the counts of birds, which were deemed to warrant designation, occurred at a time when maintenance dredging was already ongoing. The overall potential for disturbance effects on birds using the estuary and wider area is considered to be insignificant.

It should be noted that the Red-throated diver *Gavia stellata*, which is a feature of the Outer Thames Estuary SPA, is highly sensitive to non-physical disturbance by noise and visual presence during the winter (Garthe and Huppop 2004). Disturbance can cause these birds to reduce or cease feeding in a given area or to be displaced (JNCC, 2013). Disturbance and displacement effects may arise from shipping (including recreational boating) and boat movements associated with activities such as marine aggregate extraction and fishing activities (Cook and Burton 2010). As such, maintenance dredging of the main approach channel within the Outer Thames Estuary SPA has the potential to disturb Red-throated divers. As previously noted, the London Gateway port development Environmental Statement did not predict any requirement for maintenance dredging in the outer part of the Estuary given its self-scouring nature (although this will need to be reviewed on an ongoing basis). Furthermore, as the main approach channel is already frequently used by shipping, and shipping channels are already known to be avoided by Red-throated divers, any additional vessel movements associated with any such future maintenance dredge requirements would not be expected to result in any increase in disturbance to this species.

A.3.1.5 Summary of Direct Impacts

The frequency and scale of disturbance as a result of PLA and third party maintenance dredging is considered to be very low. Furthermore qualifying features of European/Ramsar sites (e.g. benthic communities, birds) have been historically exposed to this disturbance for over two centuries in some places and therefore impacts related to this disturbance are already reflected in the sites. In summary, none of the direct impacts related to the continuation of maintenance dredging at the existing levels are likely to change the condition of the qualifying interest features that have been identified in the relevant citations for each of the respective European/Ramsar sites. In addition, there are no likely direct impacts that would lead to a deterioration in the condition of the features recognised within the designated MCZ and rMCZ screened into the assessment.

A.3.2 Indirect Impacts on Interest Features

The potential indirect impacts of maintenance dredging operations of the estuary are limited to changes in the sediment supply and any associated effects on the designated sites and interest features.

As detailed within Sections 6.3.1 and 6.3.2 of the main report, maintenance dredging undertaken by both the PLA and third parties has been predominantly achieved by WID and ploughing in recent years. Through these methods of dredging, sediment is typically retained in the estuary and dispersed locally in the water column, therefore promoting relocation of material and contributing to local sediment supply, rather than removal to licensed marine or land disposal sites. In the instances where disposal is required, i.e. through TSHD or backhoe dredging, land disposal facilities within the Thames Estuary at Rainham Marshes and Cliffe Pools are most commonly used. For further information on the full range of dredging and disposal methods used by PLA and third party users, see Section 6.2 of the main report.

Maintenance dredge arisings that are disposed of onshore at Rainham Marshes and Cliffe Pools and at marine disposal sites (e.g. South Falls) results in a removal of sediment from the marine system creating an artificial sediment sink in sediment budget terms which in turn can modify the sediment regime and reduce supply to other nearby areas.

Drawing together an extensive set of contemporary literature and source data (i.e. published research, consultancy reports and technical documents), the Greater Thames Coastal Habitat Management Plan (CHaMP) (ABPmer, 2008) provides the most up-to-date estimate of the sediment budget within the Thames Estuary. The outcome of this sediment budget analysis suggested that the estuary has had a sufficient supply of sediment throughout the last 100 years to enable accretion, i.e. an accretional morphological behaviour.

As part of the Greater Thames CHaMP sediment budget analysis, it was assumed that approximately 113,000 tonnes/yr, equivalent to *circa* 225,000 m^3/yr, of sediment is removed from the system and disposed to land (or offshore disposal sites) through maintenance dredging. A comparison of these values, with those more accurately derived as part of this MDP Baseline Document, would suggest that the maximum volumes of sediment removed from the system in recent years are in the order of 20,000 m^3/yr. This has been calculated through the summation of maintenance dredge volumes disposed to both land and sea by PLA and third parties over the last 10 years (see Section 6 for dredge volumes). As such, there is much greater potential for an accretional behaviour within the Thames Estuary than previously

calculated; assuming other aspects of the sediment budget analysis remains constant.

In the future, with the inclusion of predicted maintenance dredging for DP World London Gateway, this volume may be potentially increased by a further 250,000 m^3/yr (see Section 6.3.2.1). This conservatively assumes that all dredging is undertaken by TSHD and disposed at the licensed offshore disposal sites (outside of the estuary system), although a considerable amount of dredging may realistically be achieved through WID. Taking into account this considerable change in future dredging requirements, the sediment budget analysis for the estuary is still expected to remain positive with potential for ongoing accretion.

There is currently no evidence that the existing maintenance dredging activity is detrimentally affecting the habitat interest features in Thames Estuary. This is supported by the condition statement assessment of the respective Sites of Special Scientific Interest (SSSI) Units, which predominantly class the estuary as in favourable (average of 51% of the area) and unfavourable but recovering (average of 31% of the area) condition. Primarily the main habitats in the units which were not considered to be meeting Public Service Agreement (PSA) targets were neutral grassland – lowland and littoral sediment. Typical reasons for not meeting targets included coastal squeeze, litter and the presence of competitor species. Please refer to Section 8.2.4 in the main report for further information.

In the Outer Thames, it is not expected that maintenance dredging will be required and hence it would not be anticipated that it would affect sediment transport in relation to the offshore sandbanks associated with the Outer Thames Estuary SPA and Margate and Longsands SCI.

In summary, given the physical processes operating in the estuary and the nature of maintenance dredging, the potential indirect impacts associated with maintenance dredging are considered insignificant and these interest features will therefore not be adversely affected.

A.3.2.1 Summary of Indirect Impacts

In summary, none of the potential indirect impacts identified as a result of the continuation of maintenance dredging by PLA and third parties at the existing levels and frequency are likely to change the condition of the qualifying interest features that have been identified in the relevant citations for each of the respective European/Ramsar sites. In addition, there are no likely indirect impacts that would deteriorate the condition of the features recognised within the designated MCZ and rMCZ screened into the assessment.

A.3.3 Mitigation Measures

Through the collation of material to support the AA there has been no identification of a need for new mitigation measures to be introduced. However, it should be noted that existing licence conditions include constraints on dredging and disposal, and such conditions thus form an important part of the baseline against which the potential effects have been assessed. These conditions are described in Section 3 of the main report and include, but are not limited to, the following for certain dredge methods:

- Water Injection Dredging - to undertake dredging on the ebb phase of the tide only; and
- Dispersive methods are restricted (not to be carried out) above Tilbury Bridge during the months of June to August inclusive, to avoid water quality issues during months of high water temperatures and low oxygen levels (exceptions to this condition, due to other seasonal site specific licence conditions are noted in Section 3 of the main report).

Additional general conditions that apply for three year licences are:

- To supply the PLA on each anniversary of the date of the licence, for the duration of the licence, the start and end dates of each dredging campaign and the quantity of material removed during each dredging campaign carried out in that year; and
- In relation to investigations and sampling - to undertake further sediment sampling during the duration of the Licence if required by the PLA because a pollution event has occurred, or there is an indication one has occurred involving a discharge or a possible discharge of polluting oil, noxious liquid substances or harmful substances or goods either in the area to be dredged or in the vicinity of a dredge area, and to provide the results of the sediment sampling to the PLA as soon as possible thereafter.

A.3.4 In-combination Effects

Section 6 of the main report provides information on PLA and third party maintenance dredge operations which are ongoing and classified as 'maintenance' at the time of publication. This section summarises any known and publicised 'plans or projects' which could have implications for maintenance dredging within the study area if constructed in the future. After publication of the baseline, any new proposed plans or projects which might give rise to an in-combination effect with respect to maintenance dredging should be assessed against the existing maintenance dredging regime described in this Baseline Document. The Maintenance Dredge Protocol (MDP) (Defra, 2007, p6) states that; "the onus will also be on the developer [of a future project] to resource the updating of the Baseline Document" in respect of the new plan or project which affect the context, assessment or detail within the Baseline Document and, as a result, this assessment.

Where such developments entail reclamation, dredging or the construction of infrastructure in tidal waters, potential impacts would be considered through an Environmental Impact Assessment (EIA) that would be required to support an application for development permission. Where the development has the potential to affect a European/Ramsar site, the requirements of the Habitats Regulations would also need to be complied with. In such cases these developments will require their own mitigation/compensation, prior to considering the future effects on maintenance dredging, which is the focus of this AA.

This in-combination assessment has focussed on the potential for in-combination effects of maintenance dredging to arise with other plans and projects predominantly within the Inner Thames Estuary component of the SHA. This is due to the fact that, to date, maintenance dredging of the main navigation channel in the Outer Thames has only be undertaken sporadically, and required very small volumes to be dredged, given that the system in this area is largely self-scouring (see Section A.3.1.1 above and Table 6.2 in the main report). Furthermore, it has been predicted that future maintenance dredge requirements for the approach channel to the new London Gateway facility will mainly be required within Sea Reach (see Figure 6.2 in the main report). As such, it was considered unlikely that in-combination effects of maintenance dredging with plans or projects in the Outer Thames Estuary (e.g. with marine aggregate extraction from active/exploratory areas or offshore wind farm development) would occur. Hence, the following text summarises known consented and unconsented plans and projects predominantly within the Inner Thames Estuary.

Thames Airport: A review is currently being undertaken to consider the options available to Transport for London to upgrade London airports. One of the options being reviewed is the opportunity to develop an airport on the Thames Estuary (the Inner Thames Estuary Option), which would overlap with the Thames Estuary and Marshes SPA and Ramsar site and to a much smaller degree with the Medway Estuary and Marshes Ramsar site (Transport for London, 2014). If such an airport were to be developed within the region, there could potentially be a significant adverse in-combination effect.

TE2100: This is an Environment Agency project to create a long-term flood risk management strategy for the tidal Thames. The TE2100 area includes the Thames Estuary, its tidal tributaries and floodplain from Teddington downstream to a line between Shoeburyness and Sheerness. The Plan describes a programme of flood management measures for the Thames Estuary which includes:

- A vision for tidal flood risk management for London and the Thames Estuary which seeks to optimise sustainable solutions with multifunctional benefits;
- An action plan and investment programme of strategic flood management options covering the short, medium and long term; and
- A clear explanation of how the Plan is adaptable to the uncertainty of a changing future environment - including the changing climate and varying socio-economic scenarios that may develop over the next 100 years.

The Plan provides a strategic framework through to the end of the century together with the strategic direction for flood risk management for all parts of the Plan area. It also provides guidance on the flood risk management activities that will be required over the short, medium and long term. The plan predicted that overall there will be a net loss of intertidal area throughout the TE2100 study area as a whole over the next 100 years due to coastal squeeze and identified the need to create intertidal habitat to offset these predicted losses (i.e. compensatory habitat) (Environment Agency, 2012). The implications of the Plan for maintenance dredging are unknown at this

stage but it seems unlikely based on what is currently known that a significant adverse in-combination effect would be anticipated.

Medway Approaches, Medway Estuary and The Swale Maintenance Dredging: The Medway Estuary lies on the south side of the outer Thames Estuary in Kent. It forms a single tidal system with The Swale and joins with the Thames Estuary between the Isle of Grain and Sheerness. Shipping approaching the Medway Estuary does so through an approach channel that lies within the Thames Estuary. Maintaining safe port access for commercial and recreational maritime transport is an important function for the Harbour Authority. The volume of maintenance dredging carried out by Peel Ports Medway and third party users across the Medway and The Swale estuaries averages approximately 156,100m³ annually.

Peel Ports Medway has provided the information deemed necessary to inform an AA of the maintenance dredging undertaken by or on behalf of the Authority and all known third party users in the Medway Estuary, its Approaches and The Swale (Peel Ports, 2012b). The report concluded that none of the impacts arising from ongoing maintenance dredging and disposal are likely to change the condition of the qualifying interest features for each of the internationally designated sites. A firm conclusion could not be reached with respect to dredging in some of the third party maintenance dredge sites due to a lack of site-specific sediment analysis. However, available evidence suggests that the risks will be low (i.e. there is no evidence of contamination above the background signature levels either at other maintenance dredge locations or in the wider receiving environment, and there is no evidence of any sediment-related water quality problems according to Water Framework Directive (WFD) monitoring outcomes). Overall, the potential for significant adverse in-combination effects with the maintenance dredging operations in the Thames Estuary are therefore considered unlikely.

Enderby Wharf: Planning permission has been secured for the regeneration of Enderby Wharf (London Borough of Greenwich, approximately 36km upstream of the nearest European Marine Site (Thames Estuary and Marshes SPA), although closer to three of the compensation sites.) for a mix of uses including townhouses, apartments and hotel accommodation. As part of this development there is a requirement to provide a cruise liner and river bus terminal. Vessels will berth against a pontoon secured to large diameter piles and it will be necessary to create a dredge pocket for the vessels to be accommodated during low water periods[7]. It has been proposed that the berth pocket will be dredged to a depth of 8m below CD, requiring a capital dredge to remove material in the order of 50,000m^3. However, the subsequent maintenance dredge requirements are unclear (PLA, pers. comm., May 2014) and therefore it is not possible at this stage to assess the potential in-combination effects with current maintenance dredge operations.

[7] Information from MMO Marine Case Management System – Public Register: Marine Licence Application_2013_00021-Marine Borehole site Investigation-Methodology – Issue 1-3.pdf

Tideway Tunnel: The Thames Tideway Tunnel is a major new storm water drainage project that will help tackle the problem of overflows from the capital's Victorian sewers and will protect the River Thames from increasing pollution for at least the next 100 years. Starting in west London, the proposed route for the main tunnel follows the River Thames to Limehouse (approximately 41km upstream from the nearest European Marine Site (Thames Estuary and Marshes SPA), although closer to three of the compensation sites), where it then continues north east to a pumping station near Stratford. The six-month public examination of the application to build the tunnel ended in March, 2014. The Planning Inspectorate is now considering the application before making a recommendation to the Government. A decision is expected in September 2014. Details of any future maintenance dredge requirements as part of this application are unknown and therefore it is not possible at this stage to assess the potential in-combination effects with current maintenance dredge operations.

Garden Bridge: The Garden Bridge will be a public garden planted on a new footbridge that will link the South Bank to Temple station and the Strand (approximately 49km upstream from the nearest European Marine Site (Thames Estuary and Marshes SPA), although closer to three of the compensation sites). The structure will widen and narrow across its span to create a dynamic crossing experience for London's pedestrians. The project will only proceed if the Garden Bridge Trust is able to raise sufficient funding to build the new bridge and maintain it in the future. An EIA will be prepared to support future applications for the various permissions that would be needed to build the bridge. Given that the design of the bridge is unknown it is not possible to assess the potential hydromorphological effects to the estuary and the potential changes in future maintenance dredge requirements at this stage. The scale of any changes, however, are likely to be localised and unlikely to result in a significant adverse in-combination effect.

A.4 Application of the Habitats Directive

For the purposes of this document and application of the Maintenance Dredging Protocol, the Habitats Regulations are applied as follows:

- Regulation 61 (1)

Under Regulation 61 (1) a competent authority, before deciding to undertake, or give any consent, permission or other authorisation for, a plan or project which either:

- is likely to have a significant effect on a European site or a European offshore marine site (either alone or in combination with other plans or projects), and
- is not directly connected with or necessary to the management of that site,

must make an AA of the implications for that site in view of that site's conservation objectives.

For the purposes of the Regulation 61 (1), the volumes that are maintenance dredged from the Thames Estuary are sufficient to conclude that there could be a 'likely significant effect'. As a consequence, Regulation 61 (2) and those following are applied.

- Regulation 61 (2)

Under Regulation 61 (2) a person applying for any such consent, permission or other authorisation must provide such information as the competent authority may reasonably require for the purposes of the assessment or to enable them to determine whether an AA is required.

In this document PLA provides the information deemed necessary to inform an AA of its maintenance dredging commitments within their SHA area on the Thames Estuary.

- Regulation 61 (3 and 4)

Under Regulation 61 (3) the competent authority must for the purposes of the assessment consult the appropriate nature conservation body and have regard to any representations made by that body within such reasonable time as the authority specifies.

Under Regulation 61 (4) they must also, if they consider it appropriate, take the opinion of the general public, and if they do so, they must take such steps for that purpose as they consider appropriate.

The Port of London Authority can be considered a Competent Authority responsible for undertaking the AA according to these regulations.

A.4.1 Outcome of the Assessment

In the preparation of this report, it is concluded that maintenance dredging will not result in an adverse effect on the integrity of any of the following European/Ramsar sites:

- Outer Thames Estuary SPA;
- Margate and Long Sands SCI;
- Essex Estuaries SAC;
- Foulness (Mid-Essex Coast Phase 5) SPA and Ramsar;
- Benfleet and Southend Marshes SPA and Ramsar;
- Medway Estuary and Marshes SPA and Ramsar;
- Thames Estuary and Marshes SPA and Ramsar; and
- Compensatory sites.

Designated MCZs and rMCZs put forward for consideration in tranche 2 of the process in the study area have also been assessed. Although rMCZs put forward for consideration in tranche 2 have not been formally designated, they have been

brought into the assessment on a precautionary basis and treated as though they were fully designated sites. The assessment has concluded that maintenance dredging will not result in a significant adverse effect on any of the following sites:

- Medway Estuary MCZ; and
- The Swale Estuary rMCZ.

The reasons for the above conclusions are outlined below.

Direct Impacts: The frequency and scale of disturbance as a result of PLA and third party maintenance dredging is considered to be very low. Furthermore, qualifying features of European/Ramsar sites (e.g. benthic communities, birds) have been historically exposed to this disturbance for over two centuries in some places and are therefore considered to be accustomed to these changes. In summary, none of the direct impacts related to the continuation of maintenance dredging at the existing levels are likely to deteriorate the condition of features of European/Ramsar sites and MCZ/rMCZs put forward in tranche 2.

Indirect Impacts: The majority of maintenance dredging within the Thames Estuary is undertaken by WID which does not require disposal, but results in sediment being retained in the estuary. This method of dredging is considered to be beneficial in sediment budget terms, given that it results in the relocation of material and contributes to local sediment supply. Maintenance dredge arisings that are disposed of onshore or further offshore, on the other hand, result in an artificial sediment sink. However, an analysis of the sediment budget indicates that sediment sources are exceeding sediment sinks in the estuary and thus the estuary is exhibiting net accretional behaviour. Given the physical processes operating in the estuary and the nature of maintenance dredging, the potential indirect impacts associated with maintenance dredging are considered insignificant and these interest features will therefore not be adversely affected. No indirect impacts are expected in the Outer Thames as no significant maintenance dredging is likely to be required.

In-combination Effects: Although the details of some of the other plans or projects in the study area are currently unknown, based on currently available information, the in-combination assessment indicates that there is unlikely to be any significant adverse in-combination effects.

A.4.2 Summary

In summary, none of the potential impacts arising from ongoing maintenance dredging are assessed as being significant. They are not therefore likely to change the condition of the designated features that have been identified in the relevant citations for each of the European/Ramsar sites that have been screened into the assessment. In addition, there are no likely impacts that would deteriorate the condition of the features recognised within the designated MCZ and rMCZ put forward for consideration in tranche 2 that have been screened into the assessment.

It should be noted that this assessment has been based on previous and current levels of maintenance dredging within the study area. If maintenance dredge locations, volumes (outside existing variability) or techniques from existing operations (as at May 2014) are required to change in the future, this would require an additional assessment in the context of the designated features. It is noted that there are several consented projects (not yet undertaken) and unconsented projects which

could change the maintenance dredging commitment on the estuary. An update of this assessment, following an update to the MDP Baseline Document, will therefore be required once such developments have been implemented.

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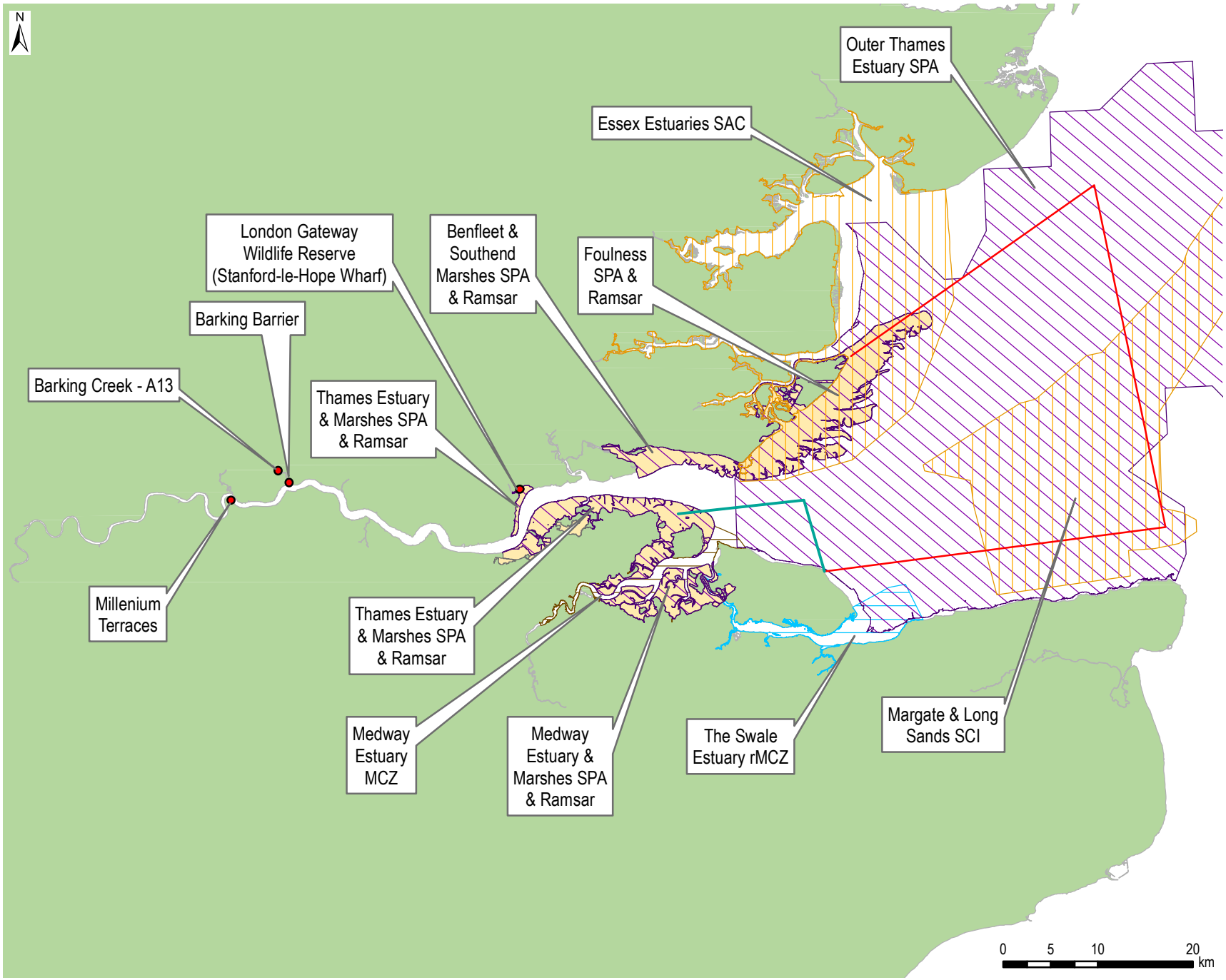

- Port of London Statutory Harbour Authority Boundary
- Medway Approach Area
- Compensation Sites
- Special Areas of Conservation and Site of Community Importance
- Special Protected Areas
- Ramsar
- Marine Conservation Zone
- Recommended Marine Conservation Zone (under consideration for the second tranche of MCZs)

Note - The full seaward/northern extent of the Outer Thames Estuary SPA & Margate & Long Sands SCI are not shown

Date	By	Size	Version
Aug 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:570,000	
QA		DLW	
4223 IAA_Fig_A.1_Designations.mxd			
Produced by ABPmer			

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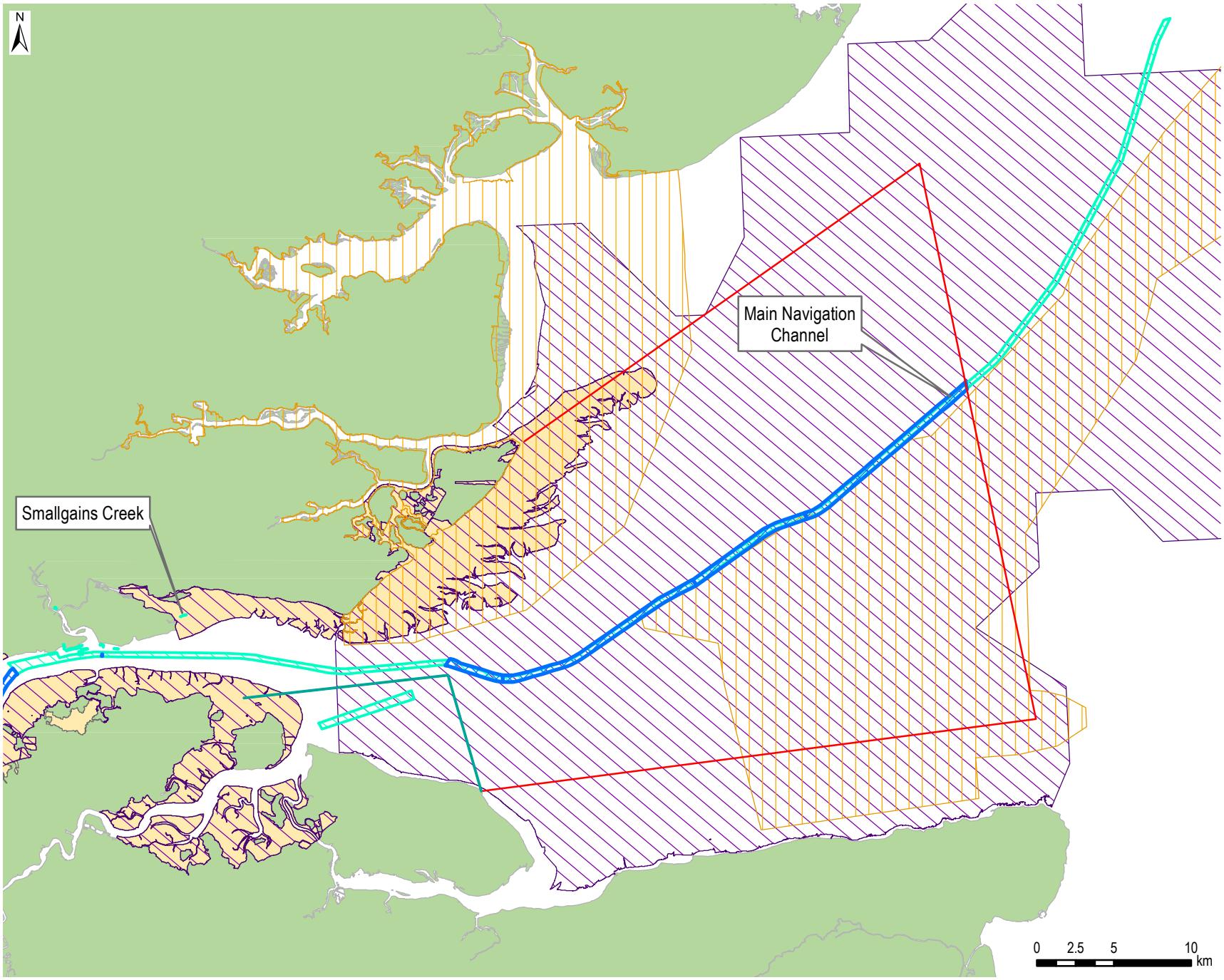
Designated Sites Screened into Appropriate Assessment

Figure A.1



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

PLA Dredge Areas

Third Party Dredge Areas

Special Areas of Conservation and Site of Community Importance

Special Protected Areas

Ramsar

Dredge areas that overlap with designated sites are labelled in this figure

Date	By	Size	Version
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Projection		Transverse Mercator	
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QA		DLW	
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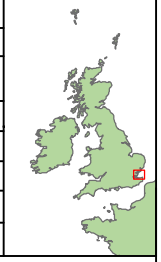

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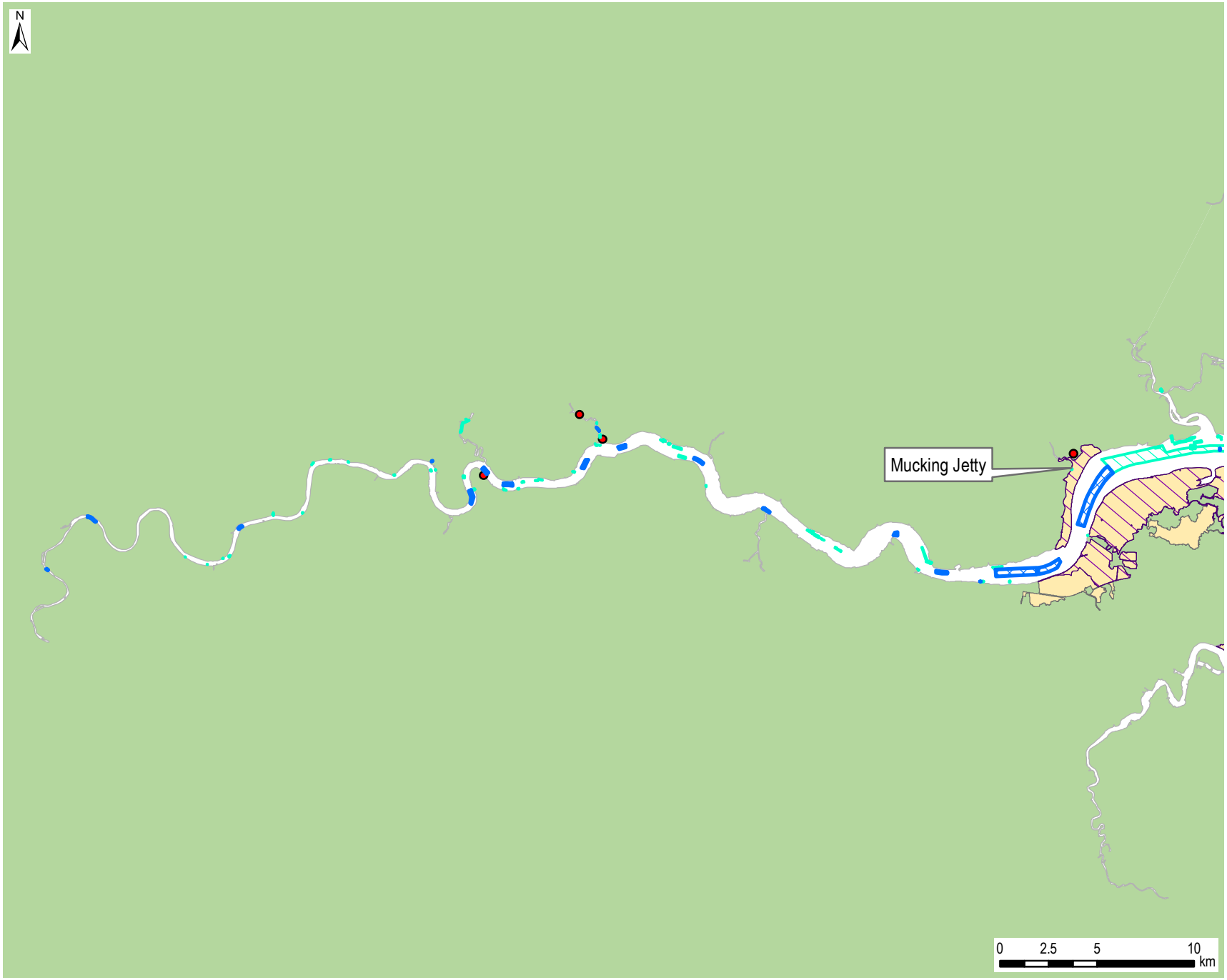
Designated Sites and Maintenance Dredge Sites (1)

Figure A.2.1



Port of London Statutory Harbour Authority Boundary
Medway Approach Area
PLA Dredge Areas
Third Party Dredge Areas
Compensation Sites
Special Protected Areas
Ramsar

Dredge areas that overlap with designated sites are labelled in this figure

Date	By	Size	Version
Oct 14	NMW	A4	1
Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:279,000	
QA		DLW	
4223 IAA_Fig_A.2.2_Desig_Dredge.mxd			
Produced by ABPmer			

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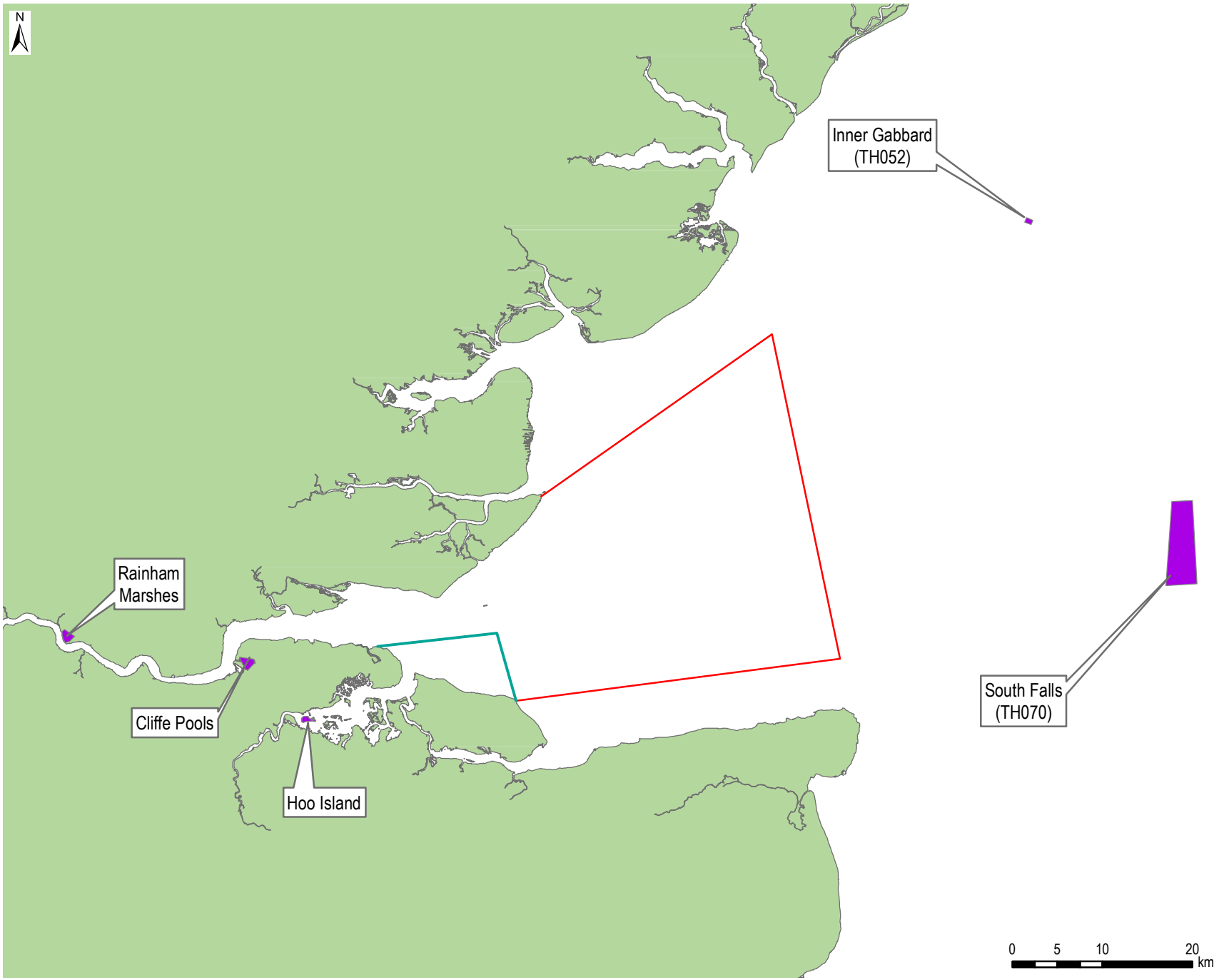
Designated Sites and Maintenance Dredge Sites (2)

Figure A.2.2



Port of London Statutory Harbour Authority Boundary

Medway Approach Area

Disposal Sites Used up to 2013

Date	By	Size	Version
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Coordinate System		British National Grid	
Projection		Transverse Mercator	
Scale		1:600,000	
QA		DLW	
4223 IAA_Fig_A.3_Disposal_Areas.mxd			
Produced by ABPmer			

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Disposal Sites Used by PLA and Third Parties in the Study Area

Figure A.3

Appendix B

Sediment Quality Data

B. Sediment Quality Data

Sediment quality data has been collated for both PLA (Section A.1) and third party (Section A.2) dredging activity locations. Where sediment quality data is available, the most recent sample results have been provided. Historical sediment quality data has not been included, however, this is available for many locations through DSIS.

B.1 PLA Sediment Contamination Results

Tables A1-60 show the sediment contamination results for PLA dredge sites for which information was available. No information was available for the following PLA dredge sites:

- Black Deep;
- Oaze Deep;
- West Oaze; and
- Crayfordness Shoal.

B.1.1 Knock John

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
534	20/12/2007	0	45	0.6	<10	8.5	<0.6	<4	25	29	<0.1	<0.1
535	20/12/2007	0	64	0.8	<10	6.4	<0.6	<4	20	36	<0.1	<0.1

Table B1. Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
534	20/12/2007	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
535	20/12/2007	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B2. Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
534	20/12/2007	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
535	20/12/2007	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
534	20/12/2007	0	<0.1	0.28	<0.1	<0.1	<0.1	0.26	0.19	-
535	20/12/2007	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B3 . Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.2 Sea Reach

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1089	07/04/2011	0	73	<0.1	33	<5	<0.1	28	55	57	<0.01	<0.01
1090	07/04/2011	0	31	<0.1	27	<5	<0.1	24	31	31	<0.01	<0.01
1091	07/04/2011	0	14	<0.1	42	9.6	<0.1	29	39	35	<0.01	<0.01
1093	07/04/2011	0	47	<0.1	30	<5	<0.1	23	43	53	<0.01	<0.01

Table B4 . Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1089	07/04/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1090	07/04/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1091	07/04/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1093	07/04/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B5. Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1089	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1090	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1091	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1093	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1089	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
1090	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
1091	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
1093	07/04/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2

Table B6 . Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.3 Holehaven Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1014	04/12/2009	0	57	<0.1	9.5	<5	<0.1	10	40	72	<0.1	<0.1
858	06/10/2008	0	30	<0.5	<10	5.6	<0.1	4.9	35	63	<0.1	<0.1
859	06/10/2008	0	37	<0.5	<10	<5	<0.1	4.7	34	60	<0.1	<0.1

Table B7 . Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1014	04/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
858	06/10/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
859	06/10/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B8. Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1014	04/12/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
858	06/10/2008	0	<0.1	<0.1	0.87	0.41	1.8	1.1	0.35	1.7
859	06/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1014	04/12/2009	0	<0.1	0.16	<0.1	<0.1	<0.1	<0.1	0.13	<2
858	06/10/2008	0	<0.1	5.8	0.11	0.35	<0.1	2.7	4.4	21.03
859	06/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B9. Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.4 Lower Hope Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
601	30/01/2008	0	4.8	<0.5	<10	11	<0.1	8	22	22	<0.1	<0.1
602	30/01/2008	0	5.2	<0.5	<10	12	<0.1	7.4	58	32	<0.1	<0.1

Table B10 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
601	30/01/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
602	30/01/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B11 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
601	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
602	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
601	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
602	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B12 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.5 Coalhouse Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
590	29/01/2008	0	8.8	<0.5	14	9.7	0.17	7.9	32	54	<0.1	<0.1
591	29/01/2008	0	17	<0.5	18	16	0.15	14	29	68	<0.1	<0.1

Table B13 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
590	29/01/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
591	29/01/2008	0	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-

Table B14 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
590	29/01/2008	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
591	29/01/2008	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
590	29/01/2008	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-
591	29/01/2008	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	-

Table B15 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.6 Diver Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1197	28/11/2011	0	8.8	<0.1	8.9	5.1	<0.1	8.3	25	55	<0.01	<0.01
1198	28/11/2011	0	7.2	<0.1	8.6	5	<0.1	5.5	34	30	<0.01	<0.01

Table B16 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1197	28/11/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1198	28/11/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B17 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1197	28/11/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1198	28/11/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1197	28/11/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
1198	28/11/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2

Table B18 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.7 Royal Terrace Pier

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
517	01/12/2004	0	12	0.5	59	39	0.4	18	66	120	-	-

Table B19 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
517	01/12/2004	0	-	-	-	-	-	-	-	-

Table B20 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
517	01/12/2004	0	<0.1	0.12	0.14	0.44	0.38	0.48	0.38	0.36
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
517	01/12/2004	0	<0.1	0.74	<0.1	0.3	<0.1	0.3	0.64	4.8

Table B21 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.8 Tilburyness Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1069	08/02/2011	0	12	<0.1	<5	6.3	<0.1	7.8	11	57	<0.1	<0.1
854	07/10/2008	0	6.7	<0.5	11	12	0.6	9.4	28	43	<0.1	<0.1
855	07/10/2008	0	9.5	<0.5	15	9.7	0.6	13	21	39	<0.1	<0.1

Table B22 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1069	08/02/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
854	07/10/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
855	07/10/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B23 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1069	08/02/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
854	07/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
855	07/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1069	08/02/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2
854	07/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
855	07/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B24 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.9 Broadness Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
605	30/01/2008	0	8.2	<0.5	<10	5.2	<0.1	6.5	19	31	<0.1	<0.1
606	30/01/2008	0	6.7	<0.5	<10	5.4	<0.1	4.9	18	25	<0.1	<0.1

Table B25 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
605	30/01/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
606	30/01/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B26 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
605	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
606	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
605	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
606	30/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B27 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.10 Jenningtree Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1012	02/12/2009	0	12	0.15	36	23	0.1	38	42	68	<0.0001	<0.0001
1013	02/12/2009	0	6.9	0.16	18	35	0.19	8.3	130	41	<0.0001	<0.0001

Table B28 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1012	02/12/2009	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-
1013	02/12/2009	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-

Table B29 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1012	02/12/2009	0	1.7	0.18	2.4	4.1	4.6	7.9	3.7	5.5
1013	02/12/2009	0	0.36	0.11	1.2	1.5	2.2	2.8	1.4	2.5
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1012	02/12/2009	0	1.4	9.1	1.1	4.6	6	6.3	6.5	71
1013	02/12/2009	0	0.75	4.7	0.56	1.7	0.77	2.9	3.4	29

Table B30 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.11 Barking Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1151	21/09/2012	0	6.3	0.16	12	30	0.12	16	50	61	<0.01	<0.01
596	31/01/2008	0	11	0.5	10	34	0.22	9	60	65	<0.1	<0.1

Table B31 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1151	21/09/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
596	31/01/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B32 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1151	21/09/2012	0	1.2	0.69	2.3	3.6	5.5	5	3	6.1
596	31/01/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1151	21/09/2012	0	0.65	12	0.94	3.2	1.5	9	8.6	68
596	31/01/2008	0	<0.1	0.14	<0.1	<0.1	<0.1	0.11	0.11	-

Table B33 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.12 Barking Creek

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1219	02/05/2012	0	11	0.11	30	36	0.42	22	58	110	<0.01	<0.01
1220	02/05/2012	0	2.6	<0.1	10	12	0.18	6.2	22	41	<0.01	<0.01
1221	02/05/2012	0	5	<0.1	16	19	0.31	10	34	61	<0.01	<0.01

Table B34 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1219	02/05/2012	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-
1220	02/05/2012	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-
1221	02/05/2012	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-

Table B35 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1219	02/05/2012	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1220	02/05/2012	0	1.3	1.2	2.4	<0.1	<0.1	<0.1	<0.1	<0.1
1221	02/05/2012	0	1.1	1.1	2	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1219	02/05/2012	0	<0.1	0.67	<0.1	<0.1	<0.1	2.5	0.55	3.7
1220	02/05/2012	0	<0.1	1.4	7.3	<0.1	1.1	8.4	1.3	24
1221	02/05/2012	0	<0.1	1.5	6.1	<0.1	0.95	7.2	1.2	21

Table B36 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.13Gallions Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1021	08/12/2009	0	7.0	0.22	16	49	0.42	7.9	110	72	<0.0001	<0.0001
1022	08/12/2009	0	7.6	0.18	16	34	0.38	8.8	86	66	<0.0001	<0.0001

Table B37 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1021	08/12/2009	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-
1022	08/12/2009	0	0.01	0.01	0.01	0.01	0.01	0.01	0.01	-

Table B38 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1021	08/12/2009	0	<0.1	<0.1	0.22	0.49	0.62	0.81	0.43	0.65
1022	08/12/2009	0	<0.1	<0.1	0.16	0.19	0.45	0.67	0.35	0.51
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1021	08/12/2009	0	0.24	1.3	<0.1	0.45	<0.1	0.72	1.1	7.7
1022	08/12/2009	0	0.26	0.87	<0.1	0.4	<0.1	0.55	0.79	5.9

Table B39 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.14Hookness Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1195	12/02/2013	0	21	0.19	18	21	0.62	17	98	130	<0.01	<0.01
1196	12/02/2013	0	11	0.16	14	35	0.18	12	69	54	<0.01	<0.01

Table B40 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1195	12/02/2013	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-
1196	12/02/2013	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-

Table B41 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1195	12/02/2013	0	0.49	0.6	0.7	0.53	1.2	1.1	0.45	1.1
1196	12/02/2013	0	0.36	0.18	1.6	1.2	2.8	2.6	1.4	2.8
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1195	12/02/2013	0	0.18	2.5	0.29	0.64	0.93	1.7	2.1	15
1196	12/02/2013	0	0.38	6	0.28	1.5	0.28	2.8	4.6	31

Table B42 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.15Blackwall Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1017	08/12/2009	0	8.7	<0.1	17	22	0.2	13	120	63	<0.0001	<0.0001
1018	08/12/2009	0	9.4	<0.1	61	8.2	0.1	15	230	61	<0.0001	<0.0001

Table B43 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1017	08/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1018	08/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B44 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1017	08/12/2009	0	0.13	<0.1	0.34	0.48	1.0	1.5	0.78	1.2
1018	08/12/2009	0	<0.1	<0.1	<0.1	0.25	0.24	0.43	0.2	0.31
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1017	08/12/2009	0	0.32	2.4	0.21	0.81	<0.1	1.2	2.0	14
1018	08/12/2009	0	0.31	0.43	<0.1	0.23	<0.1	0.22	0.3	3.4

Table B45 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.16 Saundersness Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1023	08/12/2009	0	9.5	<0.1	17	16	0.18	17	280	95	<0.0001	<0.0001
1024	08/12/2009	0	9.1	0.26	20	32	0.29	15	180	140	<0.0001	<0.0001

Table B46 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1023	08/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1024	08/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B47 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1023	08/12/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	0.11	0.14
1024	08/12/2009	0	0.21	<0.1	0.22	0.39	0.52	0.74	0.39	0.6
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1023	08/12/2009	0	0.15	0.2	<0.1	0.13	<0.1	0.17	0.19	<2.0
1024	08/12/2009	0	0.33	1.2	0.12	0.37	<0.1	0.67	0.92	7.6

Table B48 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.17 Limekiln Dock

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1241	19/04/2013	0	12	<0.1	14	17	0.99	13	43	72	<0.01	<0.01
1242	19/04/2013	0	9.4	<0.1	11	20	1.2	10	66	46	<0.01	<0.01
1243	19/04/2013	0	5.8	<0.1	19	8.4	0.42	13	13	24	<0.01	<0.01

Table B49 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1241	19/04/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1242	19/04/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1243	19/04/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B50 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1241	19/04/2013	0	0.11	<0.1	0.27	<0.1	<0.1	<0.1	0.16	<0.1
1242	19/04/2013	0	<0.1	<0.1	<0.1	<0.1	0.26	<0.1	<0.1	0.24
1243	19/04/2013	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1241	19/04/2013	0	<0.1	0.16	0.17	<0.1	<0.1	0.16	<0.1	<2
1242	19/04/2013	0	<0.1	0.46	<0.1	<0.1	<0.1	<0.1	0.38	<2
1243	19/04/2013	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<2

Table B51 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.18 Battersea Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
856	02/10/2008	0	11	0.6	20	32	<0.1	20	99	150	<0.1	<0.1
857	02/10/2008	0	18	0.6	27	56	<0.1	24	75	220	<0.1	<0.1

Table B52 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
856	02/10/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
857	02/10/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B53 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
856	02/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
857	02/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
856	02/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
857	02/10/2008	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B54 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.19Kew Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1015	01/12/2009	0	14	0.15	17	18	0.23	13	63	98	<0.0001	<0.0001
1016	01/12/2009	0	11	0.18	18	7.7	0.1	15	80	76	<0.0001	<0.0001

Table B55 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1015	01/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1016	01/12/2009	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B56 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1015	01/12/2009	0	<0.1	<0.1	0.12	0.32	0.55	0.68	0.3	0.65
1016	01/12/2009	0	<0.1	<0.1	<0.1	0.23	0.24	0.37	0.25	0.36
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1015	01/12/2009	0	<0.1	0.94	<0.1	0.35	<0.1	0.4	0.74	6.0
1016	01/12/2009	0	0.19	0.39	<0.1	0.27	<0.1	0.23	0.33	3.5

Table B57 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.1.20 Richmond Shoal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
609	05/02/2008	0	7.3	0.8	27	18	0.6	23	21	58	<0.1	<0.1

Table B58 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
609	05/02/2008	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B59 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
609	**05/02/2008**	**0**	**<0.1**	**<0.1**	**0.29**	**0.41**	**0.77**	**0.5**	**0.27**	**0.82**
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
609	**05/02/2008**	**0**	**<0.1**	**2.7**	**0.14**	**0.24**	**<0.1**	**1.5**	**2.2**	**10.55**

Table B60 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2 Third Party Sediment Contamination Results

B.2.1 London Gateway

The sediment quality data presented below for the London Gateway was sampled and analysed prior to the initiation of the capital dredging works. The surface sediment samples analysed were largely collected from the intertidal areas within the lower Inner Thames and Outer Thames (e.g. Mucking Flats, Yantley Flats, Chapman Sands and Maplin Sands) rather than within the proposed dredge pockets themselves. As such, the data provides a baseline of surface sediment quality in this region, rather than actual sediment quality of the material dredged. It should also be noted that samples were collected and analysed from the same locations during the capital dredging works, however, the results from this are not presented here.

Sample ID	Location (x)	Location (y)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
SQ1	565954.82	174815.56	9	0.16	22	14	-	12	43	64	-	-
SQ2	569731.92	176962.31	7	0.19	26	17	-	11	32	71	-	-
SQ3	570157.28	179833.62	8	0.13	23	14	-	10	33	60	-	-
SQ4	570914.65	180731.01	6	0.12	27	15	-	12	31	65	-	-
SQ5	573204.43	180140.63	7	0.11	23	12	-	10	26	59	-	-
SQ6	574796.73	179304.55	11	0.19	45	37	-	21	52	113	-	-
SQ7	576808.91	182064.49	6	0.10	19	6	-	7	14	38	-	-
SQ8	578802.83	180019.08	8	0.16	18	11	-	7	31	54	-	-
SQ9	580515.62	182343.32	6	0.10	21	9	-	9	19	47	-	-
SQ10	581961.54	179147.75	6	0.16	22	11	-	10	23	56	-	-
SQ11	584692.98	183365.64	6	0.07	10	2	-	4	8	24	-	-
SQ12	586483.56	184730.03	5	0.09	12	3	-	5	9	28	-	-
SQ13	587935.45	178956.86	6	0.08	17	6	-	8	14	39	-	-
SQ14	590642.39	183399.99	6	0.10	12	5	-	4	8	25	-	-
SQ15	594188.92	183608.63	6	0.03	10	2	-	4	7	22	-	-
SQ16	597867.54	185476.65	5	0.03	10	2	-	4	6	21	-	-
SQ17	599990.09	175946.23	9	0.09	19	7	-	10	15	47	-	-
SQ18	601157.89	187443.44	5	0.02	11	2	-	4	5	18	-	-
SQ19	603679.44	189195.97	6	0.03	10	2	-	4	6	20	-	-
Note: Sample locations presented in British National Grid (BNG)												

Table B61 Metal and Tin Results (mg/kg)

Sample ID	Location (x)	Location (y)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
SQ1	565954.82	174815.56	-	-	0.398	-	0.769	0.856	0.571	0.707
SQ2	569731.92	176962.31	-	-	0.120	-	0.316	0.399	0.265	0.319
SQ3	570157.28	179833.62	-	-	0.064	-	0.161	0.292	0.211	0.170
SQ4	570914.65	180731.01	-	-	0.038	-	0.091	0.144	0.119	0.095
SQ5	573204.43	180140.63	-	-	0.035	-	0.090	0.122	0.099	0.092
SQ6	574796.73	179304.55	-	-	0.074	-	0.199	0.293	0.233	0.204
SQ7	576808.91	182064.49	-	-	0.021	-	0.070	0.076	0.057	0.073
SQ8	578802.83	180019.08	-	-	0.085	-	0.228	0.412	0.279	0.241
SQ9	580515.62	182343.32	-	-	0.022	-	0.057	0.082	0.067	0.060
SQ10	581961.54	179147.75	-	-	0.038	-	0.099	0.137	0.104	0.100
SQ11	584692.98	183365.64	-	-	0.003	-	0.006	0.007	0.013	0.007
SQ12	586483.56	184730.03	-	-	0.013	-	0.018	0.020	0.020	0.019
SQ13	587935.45	178956.86	-	-	0.027	-	0.068	0.084	0.065	0.072
SQ14	590642.39	183399.99	-	-	0.003	-	0.004	0.004	0.010	0.004
SQ15	594188.92	183608.63	-	-	0.002	-	0.002	0.002	0.010	0.003
SQ16	597867.54	185476.65	-	-	0.002	-	0.003	0.003	0.010	0.004
SQ17	599990.09	175946.23	-	-	0.012	-	0.028	0.038	0.032	0.029
SQ18	601157.89	187443.44	-	-	0.002	-	0.003	0.002	0.010	0.003
SQ19	603679.44	189195.97	-	-	0.002	-	0.003	0.004	0.010	0.005

Sample ID	Location (x)	Location (y)	DBENZAH	FLUORAN	FLUOREN	INDPYR	NAPTH	PHENANT	PYRENE	THC
SQ1	565954.82	174815.56	-	1.486	-	0.564	0.354	1.005	1.228	-
SQ2	569731.92	176962.31	-	0.594	-	0.306	0.160	0.335	0.511	-
SQ3	570157.28	179833.62	-	0.274	-	0.235	0.097	0.144	0.337	-
SQ4	570914.65	180731.01	-	0.173	-	0.134	0.092	0.111	0.168	-
SQ5	573204.43	180140.63	-	0.182	-	0.113	0.080	0.112	0.159	-
SQ6	574796.73	179304.55	-	0.359	-	0.263	0.126	0.204	0.329	-
SQ7	576808.91	182064.49	-	0.118	-	0.066	0.052	0.074	0.107	-
SQ8	578802.83	180019.08	-	0.619	-	0.312	0.101	0.220	0.483	-
SQ9	580515.62	182343.32	-	0.113	-	0.075	0.076	0.072	0.105	-
SQ10	581961.54	179147.75	-	0.192	-	0.117	0.087	0.120	0.179	-
SQ11	584692.98	183365.64	-	0.009	-	0.013	0.034	0.012	0.009	-
SQ12	586483.56	184730.03	-	0.036	-	0.023	0.053	0.049	0.041	-
SQ13	587935.45	178956.86	-	0.127	-	0.076	0.072	0.095	0.118	-
SQ14	590642.39	183399.99	-	0.005	-	0.010	0.034	0.011	0.005	-
SQ15	594188.92	183608.63	-	0.003	-	0.010	0.043	0.010	0.003	-
SQ16	597867.54	185476.65	-	0.004	-	0.011	0.051	0.010	0.004	-
SQ17	599990.09	175946.23	-	0.051	-	0.034	0.047	0.046	0.051	-
SQ18	601157.89	187443.44	-	0.004	-	0.010	0.065	0.010	0.004	-
SQ19	603679.44	189195.97	-	0.006	-	0.010	0.038	0.010	0.006	-

Note: Sample locations presented in British National Grid (BNG)

Table B62 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.2 Medway Approach Channel

Sediment quality data analysed separately in 'The Medway Approaches, Medway Estuary and The Swale MDP and WFD Baseline Document' (Peel Ports, 2012).

B.2.3 Oikos Terminal (Holehaven Wharf)

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1210	11/02/2012	0	9.37	0.241	18.6	12.50	<0.14	11.00	22.8	56.1	<0.005	<0.005
1211	11/02/2012	0	11.80	0.335	21.1	18.50	<0.14	12.20	32.3	72.2	0.0096	0.013
1212	11/02/2012	0	8.55	0.184	13.2	7.23	<0.14	7.32	15.5	40.1	0.011	<0.005
1213	11/02/2012	0	9.00	0.242	14.5	10.30	<0.14	8.02	20.3	49.3	<0.005	<0.005

Table B63 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1210	11/02/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1211	11/02/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1212	11/02/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1213	11/02/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021

Table B64 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1210	11/02/2012	0	<0.008	<0.012	<0.016	0.0574	0.0659	0.0873	0.0959	0.0533
1211	11/02/2012	0	0.0248	0.0794	0.0975	0.21	0.267	0.388	0.311	0.247
1212	11/02/2012	0	<0.008	<0.012	<0.016	0.0372	0.0463	0.0523	0.0549	0.0333
1213	11/02/2012	0	0.0212	0.0321	0.0459	0.11	0.155	0.191	0.155	0.149
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1210	11/02/2012	0	<0.023	0.108	0.01	0.067	0.0362	0.0599	0.107	0.871
1211	11/02/2012	0	0.0666	0.502	0.0364	0.235	0.085	0.225	0.507	3.76
1212	11/02/2012	0	<0.023	0.0667	0.01	0.0398	0.032	0.0375	0.0637	0.536
1213	11/02/2012	0	<0.023	0.276	0.0203	0.116	0.0476	0.127	0.254	1.94

Table B65 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.4 Thames Oilport

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1116	31/08/2011	0	14.5	0.3	32.6	27.4	0.14	20.5	45.9	109	<0.02	<0.02
1117	31/08/2011	0	14.6	0.288	34.1	25.9	0.14	21.6	40.8	101	<0.02	<0.02
1099	10/02/2011	0	8.82	0.156	10.90	5.54	<0.14	5.84	12.60	34.3	<0.02	<0.02
1100	10/02/2011	0	11.60	0.198	13.40	7.25	<0.14	7.64	14.70	42.4	<0.02	<0.02
1101	10/02/2011	0	6.70	0.102	7.98	1.90	<0.14	3.21	7.12	23.3	<0.02	<0.02
1102	10/02/2011	0	13.20	0.286	23.50	15.60	0.163	13.80	27.10	67.3	<0.02	<0.02
1103	10/02/2011	0	9.88	0.206	15.80	8.59	<0.14	8.93	15.70	43.7	<0.02	<0.02
1104	10/02/2011	0	8.43	0.120	10.20	3.56	<0.14	5.20	9.10	28.3	<0.02	<0.02

Table B66 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1116	31/08/2011	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1117	31/08/2011	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021

Table B67 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1116	31/08/2011	0	<0.008	0.0463	0.0491	0.357	0.199	0.267	0.237	0.121
1117	31/08/2011	0	0.0178	0.0352	0.0502	0.371	0.149	0.283	0.247	0.129
1099	10/02/2011	0	<0.008	0.0141	0.0243	0.048	0.0943	0.0995	0.0702	0.0866
1100	10/02/2011	0	0.0327	<0.012	0.048	0.0953	0.166	0.174	0.119	0.146
1101	10/02/2011	0	<0.008	<0.012	<0.016	<0.014	<0.014	<0.015	<0.024	<0.01
1102	10/02/2011	0	<0.008	0.0227	<0.016	0.0894	0.118	0.148	0.142	0.118
1103	10/02/2011	0	0.0145	0.017	<0.016	0.0599	0.0901	0.107	0.0992	0.0792
1104	10/02/2011	0	<0.008	<0.012	<0.016	<0.014	<0.014	0.0256	<0.024	0.0233
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1116	31/08/2011	0	<0.023	0.235	<0.01	0.191	0.0582	0.128	0.222	2.24
1117	31/08/2011	0	0.0485	0.279	0.0251	0.197	0.0566	0.145	0.258	2.43
1099	10/02/2011	0	<0.023	0.197	<0.01	0.058	<0.009	0.0779	0.157	1.05
1100	10/02/2011	0	<0.023	0.26	0.0228	0.0957	0.0181	0.181	0.219	1.76
1101	10/02/2011	0	<0.023	<0.017	<0.01	<0.018	<0.009	<0.015	<0.015	<0.118
1102	10/02/2011	0	<0.023	0.176	<0.01	0.115	0.035	0.097	0.161	1.39
1103	10/02/2011	0	<0.023	0.146	0.0169	0.0785	0.0267	0.094	0.126	1.09
1104	10/02/2011	0	<0.023	<0.017	<0.01	<0.018	<0.009	<0.015	0.0233	<0.118

Table B68 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.5 S Jetty Shellhaven

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1137	17/05/2012	0	19	<0.1	6.7	12	0.14	6.8	21	75	<0.01	<0.01
1138	17/05/2012	0	19	<0.1	<5	9.5	0.12	5	17	63	<0.01	<0.01
1139	17/05/2012	0	20	<0.1	<5	<5	<0.1	<5	11	40	<0.01	<0.01

Table B69 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1137	17/05/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1138	17/05/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1139	17/05/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B70 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1137	17/05/2012	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1138	17/05/2012	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1139	17/05/2012	0	0.87	0.51	1.6	1.7	2.9	2.8	1.3	3.6
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1137	17/05/2012	0	<0.1	0.26	<0.1	<0.1	<0.1	<0.1	0.15	<2
1138	17/05/2012	0	<0.1	0.45	<0.1	<0.1	<0.1	0.17	0.25	<2
1139	17/05/2012	0	0.18	6.8	0.45	1.3	0.24	6.1	5.2	39

Table B71 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.6 Tilbury Power Station

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1140	26/04/2012	0	10	<0.1	25	20	0.2	10	37	78	<0.01	<0.01
1141	26/04/2012	0	15	<0.1	37	32	0.41	17	60	110	<0.01	<0.01

Table B72 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1140	26/04/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1141	26/04/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B73 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1140	26/04/2012	0	<0.1	<0.1	0.14	<0.1	0.33	<0.1	0.15	0.29
1141	26/04/2012	0	<0.1	<0.1	0.15	0.36	0.26	0.19	0.83	0.22
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1140	26/04/2012	0	<0.1	0.81	<0.1	0.15	<0.1	0.43	0.64	2.9
1141	26/04/2012	0	<0.1	0.47	<0.1	0.74	<0.1	0.26	0.28	3.95

Table B74 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.7 Customs Pier

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1094	27/07/2011	0	15	<0.1	33	27	0.45	17	51	94	<0.01	<0.01
1095	27/07/2011	0	14	<0.1	35	32	0.48	19	56	110	<0.01	<0.01

Table B75 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1094	27/07/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1095	27/07/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B76 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1094	27/07/2011	0	<0.1	<0.1	<0.1	0.12	0.17	0.3	0.13	0.21
1095	27/07/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1094	27/07/2011	0	<0.1	0.34	<0.1	0.13	<0.1	0.22	<0.1	<2
1095	27/07/2011	0	<0.1	0.24	<0.1	<0.1	<0.1	0.12	0.17	<2

Table B77 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.8 Tilbury Bellmouth

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1096	27/07/2011	0	13	<0.1	32	28	0.4	17	50	94	<0.01	<0.01
1097	28/07/2011	0	14	<0.1	34	31	0.42	19	54	100	<0.01	<0.01
1098	29/07/2011	0	17	<0.1	37	34	0.53	20	62	120	<0.01	<0.01

Table B78 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1096	27/07/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1097	28/07/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1098	29/07/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B79 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1096	27/07/2011	0	<0.1	<0.1	<0.1	<0.1	0.12	<0.1	<0.1	<0.1
1097	28/07/2011	0	<0.1	<0.1	<0.1	<0.1	<0.1	0.11	0.37	<0.1
1098	29/07/2011	0	<0.1	<0.1	<0.1	0.2	<0.1	<0.1	<0.1	0.13
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1096	27/07/2011	0	<0.1	0.3	<0.1	0.13	<0.1	<0.1	0.2	<2
1097	28/07/2011	0	<0.1	0.7	<0.1	0.13	<0.1	0.57	0.55	3
1098	29/07/2011	0	<0.1	0.37	<0.1	<0.1	<0.1	0.18	0.23	<2

Table B80 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.9 Northfleet Hope Container Terminal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1156	08/10/2012	0	7.7	<0.1	17	15	0.22	15	28	69	<0.01	<0.01
1157	08/10/2012	0	12	<0.1	28	27	0.32	22	38	84	<0.01	<0.01
1158	08/10/2012	0	28	0.11	57	46	0.48	40	77	140	<0.01	<0.01
1155	27/09/2012	0	13	<0.1	42	43	0.46	24	75	110	<0.01	<0.01

Table B81 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1156	08/10/2012	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1157	08/10/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1158	08/10/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1155	27/09/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B82 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1156	08/10/2012	0	<0.1	<0.1	<0.1	0.14	0.2	0.4	<0.1	0.24
1157	08/10/2012	0	<0.1	<0.1	<0.1	0.25	0.21	0.27	<0.1	0.17
1158	08/10/2012	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
1155	27/09/2012	0	0.42	0.31	1.4	1.2	2.6	2.2	1.2	2.7
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1156	08/10/2012	0	0.1	0.31	0.1	0.1	0.1	0.12	0.36	2
1157	08/10/2012	0	0.1	0.31	0.1	0.1	0.1	0.17	0.21	2
1158	08/10/2012	0	0.1	0.1	0.1	0.1	0.1	0.1	0.1	2
1155	27/09/2012	0	0.23	5	0.44	1.7	0.1	3.2	3.7	28

Table B83 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.10 Robins Wharf (Northfleet)

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1150	15/10/2012	0	45	0.25	79	69	0.93	58	130	220	<0.01	<0.01
946	24/06/2009	0	10	0.5	32	32	<0.6	16	60	110	<0.1	<0.1
947	24/06/2009	0	10	0.5	34	34	<0.6	17	64	120	<0.1	<0.1
948	24/06/2009	0	10	0.5	37	37	<0.6	18	72	130	<0.1	<0.1

Table B84 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1150	15/10/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
946	24/06/2009	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
947	24/06/2009	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-
948	24/06/2009	0	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	<0.002	-

Table B85 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1150	15/10/2012	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
946	24/06/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.18
947	24/06/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.11
948	24/06/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.19
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1150	15/10/2012	0	<0.1	0.14	<0.1	<0.1	<0.1	<0.1	0.11	<2
946	24/06/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
947	24/06/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-
948	24/06/2009	0	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-

Table B86 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.11 Vopak London Terminal

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1162	02/05/2013	0	11	<0.1	26	33	<0.1	15	40	100	<0.01	<0.01
1163	02/05/2013	0	8.2	<0.1	14	18	<0.1	8.4	27	65	<0.01	<0.01
1164	02/05/2013	0	8.4	<0.1	16	21	<0.1	9.6	28	64	<0.01	<0.01
1165	02/05/2013	0	10	<0.1	16	20	<0.1	10	33	70	<0.01	<0.01
1166	02/05/2013	0	9.1	<0.1	15	20	<0.1	9	27	67	<0.01	<0.01

Table B87 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1162	02/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1163	02/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1164	02/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1165	02/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1166	02/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B88 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1162	02/05/2013	0	0.38	0.17	0.23	0.43	0.53	0.86	1.2	0.47
1163	02/05/2013	0	0.19	<0.1	<0.1	0.5	0.6	0.9	1.0	0.71
1164	02/05/2013	0	0.25	0.13	<0.1	0.44	0.32	0.46	0.57	0.4
1165	02/05/2013	0	0.28	<0.1	0.13	0.38	0.5	0.95	1.0	0.59
1166	02/05/2013	0	0.20	<0.1	0.14	0.53	0.53	0.8	0.85	0.63
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1162	02/05/2013	0	<0.1	1.10	<0.1	0.51	<0.1	0.4	0.81	8.3
1163	02/05/2013	0	0.17	1.10	<0.1	0.69	<0.1	0.38	0.67	8.4
1164	02/05/2013	0	<0.1	0.73	<0.1	0.39	<0.1	0.22	0.33	5.1
1165	02/05/2013	0	<0.1	0.87	<0.1	0.54	<0.1	0.3	0.79	7.5
1166	02/05/2013	0	0.15	0.92	0.13	0.59	<0.1	0.35	0.71	7.5

Table B89 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.12 Jurgens Wharf

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1152	26/09/2012	0	5.9	<0.1	13	14	0.2	7.6	28	44	<0.01	<0.01
1153	26/09/2012	0	3.7	<0.1	14	10	0.12	8.9	16	27	<0.01	<0.01
1154	26/09/2012	0	17	<0.1	26	15	0.16	16	22	35	<0.01	<0.01

Table B91 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1152	26/09/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1153	26/09/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1154	26/09/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B92 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1152	26/09/2012	0	<0.1	<0.1	<0.1	0.43	0.46	0.57	0.42	0.45
1153	26/09/2012	0	0.72	0.27	2.8	1.2	2.3	1.6	1.1	2.4
1154	26/09/2012	0	0.17	<0.1	0.15	0.23	0.17	0.34	<0.1	0.21
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1152	26/09/2012	0	<0.1	0.85	<0.1	0.44	<0.1	0.43	0.63	5.45
1153	26/09/2012	0	0.44	6.1	1.5	1.0	0.25	5.6	4.6	33.78
1154	26/09/2012	0	<0.1	0.44	<0.1	<0.1	<0.1	0.32	0.37	2.7

Table B93 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.13Purfleet Deep Wharf

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1181	26/09/2012	0	7.3	<0.1	19	25	0.23	11	36	57	<0.01	<0.01
1182	26/09/2012	0	5.5	<0.1	17	18	0.21	9.2	32	52	<0.01	<0.01
1183	03/12/2012	0	22	0.19	35	44	0.47	27	89	140	<0.01	<0.01
1184	03/12/2012	0	14	0.12	22	25	0.23	18	61	80	<0.01	<0.01
1185	03/12/2012	0	16	0.19	24	32	0.33	18	76	94	<0.01	<0.01

Table B94 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1181	26/09/2012	0	-	-	-	-	0.001	0.001	0.001	-
1182	26/09/2012	0	-	-	-	-	0.001	0.001	0.001	-
1183	03/12/2012	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-
1184	03/12/2012	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-
1185	03/12/2012	0	0.001	0.001	0.001	0.001	0.001	0.001	0.001	-

Table B95 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1181	26/09/2012	0	0.28	0.11	0.45	0.59	0.88	0.8	1.0	0.87
1182	26/09/2012	0	<0.1	<0.1	0.27	0.42	0.7	0.7	0.69	0.67
1183	03/12/2012	0	<0.1	<0.1	0.17	0.36	0.8	0.58	0.32	0.63
1184	03/12/2012	0	<0.1	<0.1	<0.1	0.12	0.18	0.11	<0.1	0.19
1185	03/12/2012	0	<0.1	<0.1	0.17	0.26	0.65	0.3	0.2	0.46
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1181	26/09/2012	0	0.14	1.7	0.33	0.91	<0.1	1.2	1.2	11

1182	26/09/2012	0	<0.1	1.3	<0.1	0.64	<0.1	0.74	0.97	7.9
1183	03/12/2012	0	0.14	0.84	<0.1	0.6	<0.1	0.4	0.51	5.9
1184	03/12/2012	0	<0.1	0.26	<0.1	<0.1	<0.1	<0.1	0.16	<2
1185	03/12/2012	0	<0.1	0.61	<0.1	0.33	<0.1	0.29	0.55	4.3

Table B96 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.14Middleton Wharf

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1249	06/08/2013	0	15	0.39	36	44	0.69	25	60	140	<0.01	<0.01
1250	06/08/2013	0	12	0.36	23	52	0.44	16	43	120	<0.01	<0.01
1251	06/08/2013	0	8.5	0.26	16	43	0.34	10	32	79	<0.01	<0.01

Table B97 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1249	06/08/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1250	06/08/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1251	06/08/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B98 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1249	06/08/2013	0	0.29	0.11	0.28	0.32	0.21	0.47	1.0	0.32
1250	06/08/2013	0	0.45	<0.1	0.6	1.2	1.4	1.4	1.5	1.6
1251	06/08/2013	0	<0.1	<0.1	0.46	0.79	1.1	1.3	0.57	1.2
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1249	06/08/2013	0	0.56	0.8	<0.1	2.0	<0.1	0.46	0.6	8.5
1250	06/08/2013	0	1.2	2.6	0.13	3.1	0.26	1.3	2.0	21
1251	06/08/2013	0	0.39	1.9	<0.1	1.0	<0.1	1.1	1.5	13

Table B99 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.15King George V Lock

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1124	08/12/2011	0	8.8	<0.1	27	33	0.50	16	58	98	<0.01	<0.01
1125	08/12/2011	0	6.8	<0.1	20	24	0.40	12	48	72	<0.01	<0.01
1126	08/12/2011	0	10	<0.1	29	34	0.55	17	63	110	<0.01	<0.01

Table B100 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1124	08/12/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1125	08/12/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-
1126	08/12/2011	0	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-

Table B101 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1124	08/12/2011	0	<0.1	<0.1	0.12	0.15	3.50	0.27	0.46	0.87
1125	08/12/2011	0	<0.1	<0.1	0.28	0.31	0.75	0.54	0.52	1.10
1126	08/12/2011	0	<0.1	<0.1	0.17	0.42	0.13	0.61	0.45	0.12
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1124	08/12/2011	0	0.12	0.89	<0.1	0.5	<0.1	0.56	0.77	8.4
1125	08/12/2011	0	<0.1	0.85	<0.1	0.73	<0.1	0.53	0.63	6.7
1126	08/12/2011	0	<0.1	1.4	<0.1	0.43	<0.1	0.4	0.53	5.1

Table B102 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.16 Thames Refinery

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1172	02/11/2012	0	9.35	0.747	22.7	29.2	0.293	12.6	49.8	101	0.22	0.015
1173	02/11/2012	0	10.20	0.844	24.9	38.8	0.387	14.3	73.9	122	0.21	0.02
1174	02/11/2012	0	9.42	0.856	27.6	35.9	0.296	15.3	61.8	123	0.12	<0.01
1175	02/11/2012	0	9.83	0.799	24.0	33.1	0.296	13.5	58.9	109	0.19	0.017
1176	03/11/2012	0	8.07	0.828	19.5	30.5	0.284	11.8	51.0	100	0.013	0.021
1177	03/11/2012	0	8.90	0.872	23.0	36.8	0.313	13.0	68.4	111	0.30	0.023
1178	03/11/2012	0	9.61	0.864	23.9	37.4	0.232	14.0	60.2	108	0.19	0.037
1179	03/11/2012	0	13.90	2.350	62.3	71.6	1.550	32.9	122.0	258	0.38	0.160
1180	03/11/2012	0	24.80	6.390	121.0	155.0	4.920	48.3	208.0	624	0.57	0.40

Table B103 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1172	02/11/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1173	02/11/2012	0	<0.003	<0.003	<0.003	<0.003	0.00467	0.00344	<0.003	<0.021
1174	02/11/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1175	02/11/2012	0	0.0031	<0.003	<0.003	<0.003	0.00325	<0.003	<0.003	<0.021
1176	03/11/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1177	03/11/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1178	03/11/2012	0	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.021
1179	03/11/2012	0	0.0106	0.00714	0.00652	0.00394	0.00888	0.00771	0.00453	0.0493
1180	03/11/2012	0	0.177	0.0736	0.0539	0.0377	0.0571	0.0382	0.0241	0.462

Table B104 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1172	02/11/2012	0	0.125	0.137	0.378	0.539	0.996	1.16	0.715	0.875
1173	02/11/2012	0	0.198	0.118	0.358	0.666	1.29	1.46	0.865	1.01
1174	02/11/2012	0	0.0676	0.0839	0.201	0.339	0.663	0.801	0.538	0.551
1175	02/11/2012	0	0.378	0.171	0.891	1.11	2.88	2.93	1.59	2.17
1176	03/11/2012	0	0.276	0.0767	0.384	0.687	1.26	1.75	1.28	1.1
1177	03/11/2012	0	0.0929	0.065	0.257	0.539	1.05	1.15	0.667	0.984
1178	03/11/2012	0	0.209	0.0848	0.439	0.701	1.43	1.59	0.939	1.32
1179	03/11/2012	0	0.0674	0.111	0.184	0.412	0.538	0.88	0.622	0.519
1180	03/11/2012	0	0.361	0.312	0.682	0.914	1.65	2.39	1.64	1.45
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1172	02/11/2012	0	0.161	1.71	0.125	0.593	0.126	0.899	1.44	11
1173	02/11/2012	0	0.222	2.61	0.193	0.73	0.0906	1.36	2.05	14.7
1174	02/11/2012	0	0.121	1.34	0.0818	0.457	0.0791	0.657	1.09	7.88
1175	02/11/2012	0	0.399	5.76	0.37	1.37	0.261	2.9	4.55	30.6
1176	03/11/2012	0	0.289	2.62	0.192	1.07	0.171	1.5	2.16	16.3
1177	03/11/2012	0	0.19	2.23	0.0955	0.595	0.132	0.83	1.81	11.8
1178	03/11/2012	0	0.268	3.04	0.189	0.81	0.161	1.68	2.42	16.9
1179	03/11/2012	0	0.16	1.21	<0.1	0.542	0.14	0.487	1.09	7.88
1180	03/11/2012	0	0.33	3.96	0.394	1.35	0.343	1.86	3.45	24

Table B105 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.17 Murphy's Wharf Jetty

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1186	24/05/2013	0	10	<0.1	14	13	0.16	9.7	28	48	<0.01	<0.01
1187	24/05/2013	0	11	0.14	30	37	0.49	18	72	110	<0.01	<0.01

Table B106 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1186	24/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1187	24/05/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B107 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1186	24/05/2013	0	<0.1	<0.1	<0.1	0.19	0.36	0.35	1.0	0.43
1187	24/05/2013	0	0.4	0.13	0.8	1.4	1.8	0.95	2.6	2.3
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1186	24/05/2013	0	0.13	0.6	<0.1	0.62	<0.1	0.35	0.59	5.1
1187	24/05/2013	0	0.41	4.4	0.36	2.3	0.36	2.6	3.7	27

Table B108 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.18West India Docks

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1192	26/01/2013	0	19	0.55	42	67	0.85	29	100	200	<0.01	<0.01
1193	26/01/2013	0	17	0.32	41	55	0.61	26	90	160	<0.01	<0.01
1194	26/01/2013	0	12	0.28	17	54	0.26	19	100	210	<0.01	<0.01

Table B109 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1192	26/01/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1193	26/01/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1194	26/01/2013	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B110 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1192	26/01/2013	0	0.31	0.44	0.25	1.3	0.72	1.4	<0.1	0.79
1193	26/01/2013	0	0.31	0.32	0.29	1.0	0.68	0.39	<0.1	0.67
1194	26/01/2013	0	0.41	0.16	0.38	0.3	0.38	0.36	<0.1	0.56
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1192	26/01/2013	0	<0.1	3.0	0.17	<0.1	0.13	0.46	1.1	12.0
1193	26/01/2013	0	<0.1	1.9	0.15	<0.1	<0.1	0.47	1.4	8.9
1194	26/01/2013	0	<0.1	0.91	<0.1	<0.1	0.31	0.54	0.71	5.5

Table B111 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

B.2.19 Nelson Pier (Hilton Pier)

Sample ID	Date Sampled	Depth (m)	Arsenic	Cadmium	Chromium	Copper	Mercury	Nickel	Lead	Zinc	DBT	TBT
1131	19/04/2012	0	14	0.17	39	47	0.60	22	98	140	<0.01	<0.01
1132	19/04/2012	0	11	0.20	36	46	0.55	21	92	150	<0.01	<0.01
1133	19/04/2012	0	15	0.31	46	61	0.73	26	110	180	<0.01	<0.01

Table B112 Metal and Tin Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	PCB 28	PCB 52	PCB 101	PCB 118	PCB 138	PCB 153	PCB 180	PCB Total 7
1131	19/04/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1132	19/04/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-
1133	19/04/2012	0	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	-

Table B113 Polychlorinated Biphenyl (PCB) Results (mg/kg)

Sample ID	Date Sampled	Depth (m)	ACENAPH	ACENAPT	ANTHRAC	BKF	BAA	BAP	BENZGHI	CHRYSEN
1131	19/04/2012	0	<0.1	<0.1	0.20	<0.1	0.32	<0.1	0.43	0.35
1132	19/04/2012	0	<0.1	<0.1	<0.1	<0.1	0.25	<0.1	<0.1	0.23
1133	19/04/2012	0	<0.1	<0.1	0.76	0.51	0.29	<0.1	<0.1	0.36
Sample ID	**Date Sampled**	**Depth (m)**	**DBENZAH**	**FLUORAN**	**FLUOREN**	**INDPYR**	**NAPTH**	**PHENANT**	**PYRENE**	**THC**
1131	19/04/2012	0	0.15	0.56	<0.1	0.91	<0.1	0.35	0.34	3.8
1132	19/04/2012	0	<0.1	0.50	<0.1	1.40	<0.1	0.30	0.25	3.0
1133	19/04/2012	0	0.15	0.79	<0.1	1.40	<0.1	0.50	0.35	5.6

Table B114 Polycyclic Aromatic Hydrocarbon (PAH) Results (mg/kg)

Appendix C

SPA Site Bird Species

C. SPA Site Bird Species

C.1 Introduction

Appendix C shows the bird species qualifying under the Birds Directive using the marine component of SPA sites at the time of classification.

Article 4.1				
Red Throated Diver	*Gavia stellata*		Overwintering	
(Source: Natural England and JNCC, 2013)				

Table C1 Outer Thames Estuary SPA

Article 4.1				
Pied Avocet	*Recurvirostra avosetta*	Breeding		
Little Tern	*Sterna albifrons*	Breeding		
Common Tern	*Sterna hirundo*	Breeding		
Sandwich Tern	*Sterna sandvicensis*	Breeding		
Hen Harrier	*Circus cyaneus*		Overwintering	
Bar-tailed Godwit	*Limosa lapponica*		Overwintering	
Golden Plover	Pluvialis apricaria		Overwintering	
Article 4.2				
Ringed Plover	*Charadrius hiaticula*	Breeding		
Brant Goose	*Branta bernicla bernicla*		Overwintering	
Red Knot	*Calidris canutus*		Overwintering	
Oyster Catcher	*Haematopus ostralegus*		Overwintering	
Grey Plover	*Pluvialis squatarola*		Overwintering	
Redshank	*Tringa totanus*		Overwintering	
Internationally important waterbird assemblage				
(Source: Natural England, 2014a)				

Table C2 Foulness (Mid-Essex Coast Phase 5) SPA

Article 4.2				
Brant Goose	*Branta bernicla bernicla*		Overwintering	
Dunlin	*Calidris alpina*		Overwintering	
Red Knot	*Calidris canutus*		Overwintering	
Ringed Plover	*Charadrius hiaticula*		Overwintering	
Grey Plover	*Pluvialis squatarola*		Overwintering	
Internationally important waterbird assemblage				
(Source: Natural England, 2014b)				

Table C3 Benfleet and Southend Marshes SPA

Article 4.1				
Pied Avocet	*Recurvirostra avosetta*	Breeding	Overwintering	
Little Tern	*Sterna albifrons*	Breeding		
Article 4.2				
Northern Pintail	*Anas acuta*		Overwintering	
Brant Goose	*Branta bernicla bernicla*		Overwintering	
Dunlin	*Calidris alpina alpina*		Overwintering	
Red Knot	*Calidris canutus*		Overwintering	
Ringed Plover	*Charadrius hiaticula*		Overwintering	
Black tailed godwit*	*Limosa limosa islandica*		Overwintering	
Grey Plover	*Pluvialis squatarola*		Overwintering	
Shelduck	*Tadorna tadorna*		Overwintering	
Redshank	*Tringa totanus*		Overwintering	
Internationally important water bird and breeding assemblages				
* Additional Qualifying Feature identified by the 2001 UK SPA Review and included above as listed as such in the source document. (Source: Natural England, undated)				

Table C4 Medway Estuary and Marshes SPA

Article 4.1				
Pied Avocet	*Recurvirostra avosetta*		Overwintering	
Hen Harrier	*Circus cyaneus*		Overwintering	
Article 4.2				
Dunlin	*Calidris alpina*		Overwintering	
Red Knot	*Calidris canutus*		Overwintering	
Black-tailed Godwit	*Limosa limosa islandica*		Overwintering	
Grey Plover	*Pluvialis squatarola*		Overwintering	
Redshank	*Tringa totanus*		Overwintering	
Ringed Plover	*Charadrius hiaticula*		Overwintering	
Internationally important waterbird assenblage				
(Source: Natural England,, 2014c)				

Table C5 Thames Estuary and Marshes SPA

C.2 References

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Appendix D

Favourable Conditions Status

D. Favourable Conditions Status for Sites of Scientific Interest

References within Appendix D have been transcribed from Natural England's conditions of SSSI units: Website accessed on 26/03/14: http://www.sssi.naturalengland.org.uk

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	6.21	Neutral grassland – lowland	22 Mar 2013	Favourable	Mosaic of sandy and brackish grassland. Notable plants of coastal grassland assemblage including Poa bulbosa, Vulpia fasciculata and brackish grassland/wetland species Parapholis incurva, Puccinellia rupestris. Also species characteristic of sandy grassland includes Glaucium flavum, Carex arenaria and Ammophila arenaria. Rabbit grazing maintains a sufficiently short sward with disturbed bare ground in core areas allowing sand dune communities and lichen heath to be maintained. Undesirable species such as Poa annua, Plantago major is no more than occasional in core areas and open with no significant encroachment from rank grassland or scrub. Site supports an interesting mosaic with transitions between dry free-draining sandy areas and winter wet low lying brackish hollows. Management restricts access so no visible signs of vehicle damage.	
2	1195.2	Littoral Sediment	16 Mar 2010	Unfavourable recovering	Overall, unit regarded as unfavourable recovering (see direction on file) but watching brief appropriate. Estuary: extent of outer coast habitats likely to have decreased due to coastal squeeze, Salinity & Water quality not regarded as inappropriate (EA ROC 2008). Intertidal mud/sand flats likely to have decreased in extent, range of biotopes and eelgrass bed extent sustained. SD2 strandline zones present with appropriate plant assemblage including notables Cynodon dactylon, Cakile maritime. No observed unconsented development encroachment. Non-breeding birds: favourable with caution for Dark Bellied Brent Geese, Curlew, Dunlin, Shelduck (see file notes). Additional vascular plants include Zostera noltii.	
3	7788.56	Littoral Sediment	25 Oct 2010	Favourable	This unit comprises a large expanse of open coast mud & sandflats (with eelgrass beds in places) providing significant feeding and loafing areas for overwintering waterfowl. The mud extent is regarded by this snapshot assessment, as currently keeping pace with sea level rise (albeit, probably being fed by sediment from eroding saltmarsh areas), however adverse erosion trends are suspected (see file note and high risk category). Furthermore, the eelgrass beds are currently assessed as stable and the overwintering waterfowl meet population thresholds at a site level.	
4	88.08	Neutral grassland – lowland	21 Mar 2013	Unfavourable recovering	Areas of tussocky grassland, short turf, bare ground, scattered / dense scrub, ditches and sea wall grassland with delph. Scrub cover currently above 25% target and in places shading-out ditches. The grassland,	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					ditches (including delph) with some good core areas but sub-optimal for structural diversity (for inverts & plants). Recent consented works in accordance with MSER and IRMP have positively increased diversity of habitat mosaic and ongoing restoration maintenance in accordance with IRMP principles should maintain unit recovery.	
5	42.99	Littoral sediment	17 Sep 2010	Unfavourable recovering	This area of creek provides intertidal areas that support birds (overwintering), and important habitats for notable invertebrate & plant assemblages. At a unit level, the extent & quality of intertidal mudflats and the saltmarsh structure & habitat composition is regarded as favourable but at a SSSI level the condition is regarded as unfavourable recovering (see file note). The saltmarsh supports notable plants species such as Inula crithmoides. There is no field evidence to indicate that significant erosion has occurred to this unit's saltmarsh, probably due to its relatively sheltered location. The overwintering waterfowl meet population threshold at a site level, and site observation indicates the area contributes suitable roosting and loafing habitat for waders and wildfowl. Overall, the unit is regarded as unfavourable recovering.	
6	42.10	Neutral grassland – lowland	22 Mar 2013	Unfavourable recovering	Area of grassland, with scattered scrub and ditches, Fleet and sea wall. Grassland and sea wall dominated by a tussocky sward with short grass and bare ground largely restricted to mown trampled paths and vehicle tracks. Ditches and Fleet collectively contribute favourable range of transitional vegetation for notable invertebrates. Recommend targeted grassland management to increase the overall structural diversity of the grassland, sea wall and the ditch profile through the IRMP to achieve favourable condition status	
7	13.43	Neutral grassland – lowland	24 Dec 2012	Unfavourable recovering	Unfavourable recovering if unit considered in isolation. Short and longer grassland in discrete areas rather than being part of a mosaic (although broadly acceptable habitat contribution when considered in combination with the adjacent units). Grassland structural quality (excessive leaf litter and lack of mosaic – short grass/bare ground/tussocky etc) with post-cut short grass available for o/w Brent Geese. Ditch water levels seasonally low with sub-optimal bank profiles and limited structural diversity. Sea wall (landward face with berm) and grassland have inadequate cover of short sward and bare ground (ideally created by grazing) to be addressed via Management plan (IRMP). Recommend targeted grassland management to increase structural diversity and ditch profile enhancement to achieve favourable status.	
8	73.15	Neutral grassland-lowland	24 Dec 2012	Unfavourable recovering	Unfavourable recovering at a SSSI Unit level. The areas of short & longer grassland broadly contribute an acceptable range of habitats when considered in combination with the adjacent units however due to operational requirements they are in discrete areas rather than being part of	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					an integrated mosaic. Ditch water levels seasonally low with sub-optimal bank profiles and limited structural diversity. Sea wall (landward face with berm) and grassland have inadequate cover of short sward and bare ground (ideally created by grazing) to be addressed via management plan (IRMP). Recommend targeted grassland management through IRMP to increase the overall structural diversity of the grassland, sea wall and the ditch profile through to achieve favourable condition status.	
9	46.16	Improved grassland	24 Dec 2012	Unfavourable recovering	Unfavourable recovering at a SSSI Unit level. The areas of short & longer grassland broadly contribute an acceptable range of habitats for plant and botanical interest (including legumes, yellow composites, wild carrot, strawberry clover, knapweed and bedstraws), however due to operational requirements they are in discrete areas rather than being part of an integrated mosaic. Ditch water levels seasonally low with sub-optimal bank profiles and limited structural diversity. Sea wall (landward face with berm) and grassland have inadequate cover of short sward and bare ground (ideally created by grazing) to be addressed via management plan (IRMP). Recommend targeted grassland management through IRMP to increase the overall structural diversity of the grassland, sea wall and the ditch profile to achieve favourable condition status.	
10	33.12	Neutral grassland-lowland	24 Dec 2012	Unfavourable recovering	Unfavourable recovering at a SSSI Unit level due to sub-optimal sward in eastern field and sea wall area and low water levels. The mosaic of habitats within the grazed western area (with ant hills, bare ground, short & longer tussocks) coupled with unmanaged rough grassland of eastern field broadly contribute an acceptable range of habitats, with some notable plants (yellow wort, common centaury, strawberry clover, ladies bedstraw, yellow composites, red bartsia, narrow leaved birdsfoot trefoil, wild carrot). Also unusual umbellifer Longleaf Falcaria vulgaris). Ditch water levels seasonally low and would benefit from water level management & targeted management within eastern field. Scarce Emerald damselfy Lestes dryas seen in Sea Club rush ditches. Sea wall (landward face with berm) and eastern field grassland have inadequate cover of short sward and bare ground (ideally created by grazing) to be addressed via IRMP. Recommend targeted grassland management through IRMP to increase the overall structural diversity of the eastern grassland, sea wall and water level management of the ditches through the IRMP (with consideration of Agri-Envt Scheme) to achieve favourable condition status.	
11	32.29	Neutral grassland – lowland	24 Dec 2012	Unfavourable recovering	Overall unfavourable recovering at a SSSI Unit level. The areas of regularly mown short & longer unmanaged grassland broadly contribute beneficial invertebrate habitats, particularly when considered in combination with the adjacent units however due to operational requirements they are in discrete areas rather than being part of an integrated mosaic. Ditch water levels	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					seasonally low with sub-optimal bank profiles and limited structural diversity. Areas of grassland with excessive scrub cover and dominance of rank tussocky grassland. Sea wall (landward face with berm) and grassland also have sub-optimal cover of short sward and integrated areas of bare ground (ideally created by grazing) to be addressed via management plan (IRMP). Recommend targeted scrub, grassland and rotational ditch management through IRMP to increase the overall structural diversity of the grassland, sea wall and the ditch profile to achieve favourable condition status.	
12	16.22	Improved grassland	24 Dec 2012	Unfavourable recovering	Unfavourable recovering if unit viewed in isolation with higher proportion of ranker grassland than desirable. Grazing Marsh grassland has limited structural & floristic diversity and ditches sub-optimal for channel & successional stage diversity. The areas of longer unmanaged grassland with connecting ditches contribute some invertebrate habitats if considered in combination with the adjacent units however they are currently in discrete areas rather than being part of an integrated mosaic. Annual Beard Grass (Polypogon monspeliensis) recorded from pond edge on unit boundary. Overall, the area has the potential to better contribute habitat for overwintering Brent geese and notable grazing marsh plants. Recommend targeted scrub, grassland & rotational ditch management through the management plan (IRMP) to increase the overall structural diversity of the grassland, sea wall and the ditch profile to achieve favourable condition status.	
13	6.8	Coastal lagoon	31 Mar 2009	Favourable	Borderline favourable if viewed within mosaic of adjacent units. Provides discrete areas of short and ranker grassland rather than integrates as a mosaic but acceptable within the units 11-13 complex. Recommend site visit in summer for ditch plants and consideration of targeted sea wall management programme & lagoon management.	
14	141.09	Littoral sediment	14 Jan 2010	Unfavourable recovering	"This unit is encompassed within the Essex Estuaries complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." Mike Burke, Target Delivery Manager, Protected Areas	
15	14.23	Coastal Lagoon	30 Mar 2009	Favourable	Borderline favourable for brackish lagoon area. Recommend management and enhancement work to improve for avocet and introduce targeted sea wall management for sea wall plant assemblage.	
16	12.40	Neutral grassland – lowland	17 Mar 2013	Favourable	Good mosaic of grassland with ditches, low-ways and decoy pond that overall are assessed as Borderline favourable. Includes northern fields cut for hay and southern fields grazed that collectively provide adequate quality	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					of habitat for overwintering waterfowl (eg, Brent Geese, Teal) and notable character plants and invertebrates. The southern fields provide some topographical variation with winter wet conditions and saline intrusion at southern end. The northern fields would benefit further from an aftermath graze	
17	25.66	Littoral Sediment	27 Aug 2010	Unfavourable recovering	The unit supports intertidal habitats with overwintering bird, invertebrate and plant assemblage interest. At a SSSI level, evidence indicates that the extent of saltmarsh habitats is likely to have decreased as a result of coastal squeeze however the recent regional initiatives and direction states: "This unit is encompassed within the essex estuary complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." At the unit level there was mimimal field evidence to indicate significant erosion processes (see file note). The structure and composition of saltmarsh regarded as favourable (see file note) including notable plants such as Inula crithmoides and suitable surfaces/features for the invertebrate assemblage. Overwintering waterfowl favourable. Sea wall condition is regarded as sub-optimal (see file note) however, the proposed management in accordance with the agreed IRMP is regarded as appropriate to help re-establish appropriate sea wall habitat conditions.	
18	295.24	Neutral grassland – lowland	17 Mar 2013	Unfavourable declining	Coastal grazing marsh with low-ways, ditches and sea wall corridor. Grazing within the main fenced-off grassland area has ceased since 2010 due to operational H&S reasons. Overall, unit assessed as unfavourable due to over-dominance of rough grassland with limited structural diversity and unsuitable habitat for overwintering grazing wildfowl, notable vascular plants and invertebrate assemblage. The ditches and delphs are favourable. The sea wall area outside the operational fenced area is currently regarded as unfavourable recovering due to management being undertaken in accordance with a recent management agreement with tenant managers.	Dominance of rough grassland which is unsuitable for grazing wildfowl

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
19	60.55	Littoral Sediment	27 Aug 2010	Unfavourable recovering	The unit supports intertidal habitats with overwintering bird, invertebrate and plant assemblage interest. At a SSSI level, evidence indicates that the extent of saltmarsh habitats is likely to have decreased as a result of coastal squeeze however the recent regional initiatives and direction states: "This unit is encompassed within the essex estuary complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." At the unit level, the structure and composition of saltmarsh is regarded as favourable (see file note) including notable plants such as Inula crithmoides and suitable surfaces/features for the invertebrate assemblage. Overwintering waterfowl favourable. Sea wall condition is regarded as sub-optimal (see file note) however, the proposed management in accordance with the agreed IRMP is regarded as appropriate to help re-establish appropriate sea wall habitat conditions. In addition to this the track on the landward side of the Creek adjacent to the sea wall (Mostly in Unit 18) supports a good community of pioneer saltmarsh plants. Collectively this corridor provides an interesting transition from mud, pioneer/low-mid marsh/mid-upper, and sea wall grassland and landward track supporting additional pioneer saltmarsh species.	
20	19.70	Neutral grassland-lowland	17 Mar 2010	Unfavourable recovering	Creek as part of Estuary a) Extent - No known or observed changes; (b) Habitat distribution – inner Creek; (c) Salinity – no changes observed or suspected. No field evidence to indicate that water quality and specifically organic carbon content is in excess of an appropriate environmental baseline. Saltmarsh – Preliminary assessment indicates that the extent of mud/sandflat habitats within this inner Creek are not likely to have decreased as a result of coastal squeeze. There is limited saltmarsh on discrete islands or lining Creek margins and where seen, the characteristics are as follows: Physical structure – creeks and pans present. Vegetation zonation – Low-mid marsh dominates but some areas of Pioneer interspersed and Mid-Upper Marsh largely confined to sea wall and sea wall toe. No Inula crithmoides identified but niche is available. Sward height – average growth up to 30cm, with higher Spartina clumps c45cm Positive Species – Pioneer : Salicornia, Low-mid marsh: Puccinellia maritima, Atriplex portulacoides, Upper marsh/embankment: Elytrigia atherica (locfreq). Negative species – Spartina present (not able to distinguish as S.townsendii but precautionary note). Saltmarsh not extensive so not regarded as significant high tide roost area therefore non-mandatory attributes not assessed. Site observation suggests no concerns. The	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					satmarsh grades into areas of less saline habitat dominated by Sea Club rush. Saltmarsh broadly favourable in habitat terms for plant assemblage invertebrate assemblage (see feil notes) but requires summer validation. Regarded as favourable for overwintering waterfowl at SSSI level.	
21	23.36	Littoral Sediment	09 Mar 2010	Favourable	Creek as part of Estuary a) Extent - No known or observed changes; (b) Habitat distribution – inner Creek; (c) Salinity – no changes observed or suspected. No field evidence to indicate that water quality and specifically organic carbon content is in excess of an appropriate environmental baseline. Saltmarsh – Preliminary assessment indicates that the extent of mud/sandflat habitats within this inner Creek are not likely to have decreased as a result of coastal squeeze. There is limited saltmarsh on discrete islands or lining Creek margins and where seen, the characteristics are as follows: Physical structure – creeks and pans present. Vegetation zonation – Low-mid marsh dominates but some areas of Pioneer interspersed and Mid-Upper Marsh largely confined to sea wall and sea wall toe. No Inula crithmoides identified but niche is available. Sward height – average growth up to 30cm, with higher Spartina clumps c45cm Positive Species – Pioneer : Salicornia, Low-mid marsh: Puccinellia maritima, Atriplex portulacoides, Upper marsh/embankment: Elytrigia atherica (locfreq). Negative species – Spartina present (not able to distinguish as S.townsendii but precautionary note). Saltmarsh not extensive so not regarded as significant high tide roost area therefore non-mandatory attributes not assessed. Site observation suggests no concerns. The satmarsh grades into areas of less saline habitat dominated by Sea Club rush. Saltmarsh broadly favourable in habitat terms for plant assemblage invertebrate assemblage (see feil notes) but requires summer validation. Regarded as favourable for overwintering waterfowl at SSSI level.	
22	28.01	Littoral Sediment	14 Jan 2010	Unfavourable recovering	“This unit is encompassed within the Essex Estuaries complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as ‘recovering’ up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in ‘recovering’ status.” Mike Burke, Target Delivery Manager, Protected Areas	
23	41.86	Littoral Sediment	30 Mar 2009	Favourable	favourable – but validation required through summer survey of botanical interest (notably sea wall and saltmarsh)	
24	25.61	Littoral Sediment	25 Mar 2010	Unfavourable recovering	Unit includes Creek intertidal, sea wall grassland and adjacent borrowdyke at northern end. Overwintering birds regarded as favourable at a site level. The Creek contributes more sheltered intertidal habitats within Estuary complex -Creek extent, intertidal habitat mosaic, salinity, water quality all regarded as favourable (see file note). Saltmarsh habitat structure (rills &	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					pans), vegetation composition and habitat qualities (successional stages, invertebrate surfaces, flowering etc) all favourable, however evidence to date indicates that saltmarsh likely to have reduced in extent so saltmarsh regarded as unfavourable but recovering. (accounting for regional direction see file note). Sea Wall and associated borrodwyke favourable. Sea wall vegetation managed (cut/grazed) with predominantly short sward rich in legumes, fine leaved grasses and habitats for Suite 14 vascular plant assemblage. Lower berm adjacent to borrowdyke provides interesting supplementary habitat for sea wall species including those requiring brackish intrusion. Borrowdyke - over 1metre water depth, water quality 90% clear with some algae in patches probably as a result of run-off from adjacent arable. Vegetation dominated by Scirpus, with occasional Aster and Elytrygia dominated bankssides.	
25	12.39	Neutral grassland-lowland	07 Jan 2013	Favourable	Grazing marsh with ditches - overall favourable. Grassland supports a mixed sward of short, longer grass through to tussocky overwintering areas at field margins. Reasonable mix of flowering pasture plants including legumes and compositae and low-lying areas including upper berms also support brackish intrusion plants. such as Salicornia, Spergularia etc. Ditches and low-ways provide a variety of water depths/seasonal waterlogging & successional stages from open water-early/mid - late stages. Mostly open ditches, with characteristic plants including Scirpus, Halimione, Aster, Salicornia, Spartina and good diversity notably in northern & eastern side, with some notable plants including Annual Beard Grass. Overall scrub cover is acceptable, although eastern boundary ditch is heavily scrub-lined (providing screening of perimeter fence) and would benefit from some targeted management.	
26	4.8	Littoral Sediment	17 Sep 2010	Unfavourable recovering	The unit supports intertidal habitats with overwintering bird, invertebrate and plant assemblage interest. At a SSSI level, evidence indicates that the extent of saltmarsh habitats is likely to have decreased as a result of coastal squeeze however the recent regional initiatives and direction states: “This unit is encompassed within the essex estuary complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as ‘recovering’ up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in ‘recovering’ status.” At the unit level there was minimal field evidence to indicate significant erosion processes (see file note). The structure and composition of saltmarsh is regarded as favourable (see file note) including notable plants such as Inula crithmoides and Puccinellia maritima and suitable surfaces/features for the invertebrate assemblage. Overwintering waterfowl favourable (see file note).	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
27	26.89	Neutral grassland-lowland	20 Mar 2013	Favourable	Good mosaic of grazing marsh with adequate structural diversity and topographical variety including low-ways and anthills, ditches, brackish fleet and reedbed. Waterbodies with good water levels and quality with a variety of marginal vegetation showing transitions from saline (sea aster), brackish (scirpus), reed (phragmites). 200 Dark Bellied Brent geese utilising short-grazed wet grassland and Fleet adds additional interest of overwintering waterfowl such as shelduck, teal and oystercatcher.	
28	152.79	Littoral Sediment	27 Aug 2010	Unfavourable recovering	The unit supports intertidal habitats with overwintering bird, invertebrate and plant assemblage interest. At a SSSI level, evidence indicates that the extent of saltmarsh habitats is likely to have decreased as a result of coastal squeeze however the recent regional initiatives and direction states: "This unit is encompassed within the essex estuary complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." At the unit level there was mimimal field evidence to indicate significant erosion processes (see file note) and larger blocks within the Creek provide suitable opportunities for high tide roosts. The structure and composition of saltmarsh regarded as favourable (see file note) including notable plants such as Inula crithmoides and suitable surfaces/features for the invertebrate assemblage. Overwintering waterfowl favourable. Sea wall condition - key areas of botanical interest support suitable Suite 14 habitats in the landward S-W facing grassland slopes /berms of the western side of Barlinghall Creek sea wall (adjacent to the landfill site) with species such as Trifolium squamosum, Carex divisa & Puccinellia spp. present. The proposed management in accordance with the agreed IRMP is regarded as appropriate to increase extent of favourable sea wall grassland conditions (see file note).	
29	6.16	Littoral Sediment	27 Aug 2010	Unfavourable recovering	The unit supports intertidal habitats with overwintering bird, invertebrate and plant assemblage interest. At a SSSI level, evidence indicates that the extent of saltmarsh habitats is likely to have decreased as a result of coastal squeeze however the recent regional initiatives and direction states: "This unit is encompassed within the essex estuary complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." At the unit level there was minimal field evidence to indicate significant erosion processes (see file	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					note). The structure and composition of saltmarsh is regarded as favourable (see file note) including notable plants such as Triglochin maritima, Limonium spp, Puccinellia maritima, Limonium spp, Cochlearia, Armeria and Artemisia maritima and suitable surfaces/features for the invertebrate assemblage. Overwintering waterfowl favourable (see file note).	
30	14.89	Neutral grassland-lowland	20 Mar 2013	Favourable	Overall favourable when set within the context of the surrounding SSSI units. Grazing marsh with saline ditches, low-ways, sea wall and delph supporting a range of habitats for character invertebrate and notable plants. Livestock mainly free-roaming cattle with some enclosed horse pasture that collectively provides varied grazing intensity. The botanical interest of the sea walls would benefit from a slightly higher grazing pressure to create localised poached areas and reduce vegetation thatch. The delph and ditches are typical of the saline and silt-rich character for the area and the low-ways provide added interest.	
31	150.59	Littoral Sediment	31 Mar 2010	Unfavourable recovering	"This unit is encompassed within the Essex Estuaries complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." Mike Burke, Target Delivery Manager, Protected Areas. Saltmarsh gain of 0.4 ha (4,000 m2 / 0.99 acres) has occurred between 1994 and 2007- based on a remote sensing contract undertaken by IECS for Natural England comparing ortho-rectified aerial photographs. This condition assessment has only assessed the extent attribute. Ground truthing may be required to assess other attributes. Two units out of 35 have been assessed so far by the Natural England RO. Saltmarsh change shows a downward trend with a net loss of 3.38 ha (33,800 square metres/8.35 acres) over the reporting period. Reporting on arbitrary units, without a full account of the pattern of losses or gains throughout the whole estuary does not allow for a fuller understanding of the morphological changes taking place in the estuary.	
32	59.02	Supralittoral Sediment	31 Mar 2010	Unfavourable recovering	"This unit is encompassed within the Essex Estuaries complex. Sufficient habitat re-creation has commenced within the estuary complex for this unit to be assessed as 'recovering' up until Dec 2010. Beyond Dec 2010 further additional habitat recreation will need to be delivered through Shoreline Management Plans and/or regional coastal habitat recreation programmes for this unit to remain in 'recovering' status." Mike Burke, Target Delivery Manager, Protected Areas. Saltmarsh loss of 3.78 ha (37,800 m2 / 9.34 acres) has occurred between 1994 and 2007- based on a remote sensing contract undertaken by IECS for Natural England comparing ortho-rectified	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					aerial photographs. This unit includes Foulness Point at the north-eastern tip of Foulness Island. Erosion here has been significant with 10 percent loss from the 1994 baseline. This condition assessment has only assessed the extent attribute. Ground truthing may be required to assess other attributes. Two units out of 35 have been assessed so far by the Natural England RO. Saltmarsh change shows a downward trend with a net loss of 3.38 ha (33,800 square metres/8.35 acres) over the reporting period. Reporting on arbitrary units, without a full account of the pattern of losses or gains throughout the whole estuary does not allow for a fuller understanding of the morphological changes taking place in the estuary.	
33	444.5	Littoral Sediment	18 Mar 2010	Unfavourable recovering	Overall, regarded as unfavourable recovering (see regional direction). Estuaries: evidence indicates extent of outer coast intertidal habitats decreased due to coastal squeeze. water quality acceptable (EA ROC 2008). Saltmarsh structure and zonation acceptable. Site surveys and NVC survey (2003) indicate range of saltmarsh communities present including Atlantic salt meadow, Mediterranean & thermoatlkantic halophilous scrub, Salicornia and other annuals colonising mud/sand. Notable species recorded on site include Inula crithmoides, Suaeda vera. Atriplex still present in core site. Recommend further targeted surveys for Spartina, Puccinellia, Salicornia. Non-breeding birds regarded as favourable at site level, albeit with caution expressed for Dark Bellied Brent Geese, Curlew, Dunlin, Shelduck (see file notes)	
35	2.09	Supralittoral Sediment	22 Mar 2010	Unfavourable no change	Unit provides off-shore habitat for notable breeding birds, such as terns. Overall, unit currently regarded as unfavourable (see file notes). Extent of intertidal habitat regarded as unfavourable recovering, consistent with regional direction (see file notes). Most recent breeding bird surveys indicate that tern numbers are unfavourable (see file notes). Further investigation is required to update breeding bird survey, with specific effort focused on this SSSI unit, to identify any potential reasons if unfavourable breeding bird figures confirmed and suggest appropriate actions to remedy via implenentation of IRMP and SMP / EA Regional Habitat Creation Programme.	Bird numbers unfavourable, reason may the extent of the intertidal habitat

Table D1 Foulness (Mid-Essex Coast Phase 5)

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	120.72	Earth Heritage	13 Oct 2006	Favourable	Plenty of evidence of active processes occurring on site and no significant evidence of unconsented activity.	
2	182.93	Earth Heritage	13 Oct 2006	Favourable	Geology clearly visible and good evidence of active processes occurring. Small amount of fly-tipping present at one location but not significant enough to affect the condition of the site.	
3	0.00	Supralittoral Sediment	13 Oct 2006	Favourable	Viewed the area from the beach during the site visit. Records of the plant supplied by local naturalist earlier in the year showing a large healthy population.	

Table D2 Sheppey Cliffs and Foreshore

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
4	50.7	Neutral grassland – lowland	27 Aug 2012	Unfavourable recovering	Condition Monitored during site visit in July 2012. No decrease in grassland & waterbody extent (aerials & visits). Mosaic of grassland habitats with anthills (short sward/tussock-longer sward/scrub edge) provide >3 surfaces for invertebrate assemblage and overall habitat mosaic is broadly favourable ; <5% scrub cover in core grassland, 5% cover bare ground (largely confined to poached gateways/crossings) & adequate poaching within turf with mosses present >10% occupancy of samples. Litter cover 5-10% & seed heads mostly in tussocky, least grazed areas in scrub edge transitions; c30% flowering of short growing herbs (includes strawberry clover, hairy buttercup) & scattered taller herbs (eg. thistles, ragwort). Ditches - overall, unfavourable recovering. Adequate water levels (average >0.5m depth), no sig water discoloration, algae abundant c60% cover, no alien weeds seen; limited variation in ditch profiles (c.50% broadly trapezoidal) but cattle poaching positively increasing the sloping edge habitat and the ponds with variable sloping edges. Mix of successional stages in waterbodies (c20% early, 60% mid, 20% late), with water crowfoot, sea club rush and no observed fish, <10% waterbody areas shaded. Sea wall maintaining a mosaic of taller herb rich areas (c40cm incl narrow leaved trefoil, wild carrot), short sward (<15cm) and 10% bare ground adjacent to brackish ditches and scrub <5% cover - overall habitat regarded as favourable. Sea barley and Sea clover present and although not recorded during visits suitable habitat is being maintained by grazing along sea wall for Bupleurum tenuissimum, Chenopodium chenopodioides.	
5	74.05	Broadleaved, mixed and yew	27 Aug 2012	Unfavourable recovering	Condition Assessed during visit in July 2012. Overall - unfavourable recovering. No decrease in extent of core grassland areas (aerial & visit) &	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		woodland - lowland			evidence of increased extent through ongoing consented scrub removal/grassland restoration work. Grassland areas support a mosaic of short turf/longer tussocky sward/scrub edge habitat providing > 3 surfaces in 30% of samples for invertebrate assemblage; 10-20% cover of scrub in core grassland areas (ongoing reduction required); <10% cover of bare ground in grassland unit (adequate within turf and higher proportion on steep slopes near paths & recently scrub cleared areas);moss c5-10% occupancy of samples; 20% occupancy of >1cm litter cover & overwintering seeds; c40-50% flowering within core areas (up to 80% cover in some green hay areas). Populations and suitable habitat maintained for Deptford Pink, Hairy Vetchling & Hartwort, and although not seen on site appropriate habitats have been maintained on site for Bithynian vetch & Slender tare. [Scrub clearance areas should also provide additional habitat for the latter].	
6	193.71	Littoral sediment	25 Mar 2013	Unfavourable recovering	This CSM snapshot assessment needs to be considered within the context of the intertidal SSSI units. The mosaic of intertidal habitats consists of open water, mud/sandflat, saltmarsh and eelgrass beds that collectively provide core feeding habitat, roosting and loafing habitat for the overwintering waterfowl. Population counts for the waterfowl assemblage currently exceeds minimum thresholds for all species except grey plover (3% below FCT threshold) for this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide roosts, eelgrass sustainability) NE will continue to encourage further research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore & offshore activities. The structural and habitat attributes of the saltmarsh are regarded as favourable for notable plants and invertebrate assemblage.	
7	141.91	Littoral sediment	25 Mar 2013	Unfavourable no change	This CSM snapshot assessment needs to be considered within the context of the intertidal SSSI units. The mosaic of intertidal habitats consists of open water, mud/sandflat, saltmarsh and eelgrass beds that collectively	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					provide core feeding habitat, roosting and loafing habitat for the overwintering waterfowl. Population counts for the o/w waterfowl assemblage currently exceeds minimum thresholds for all species except grey plover (3% below FCT threshold) for this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide roosts, eelgrass sustainability) NE will continue to encourage further research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore & offshore activities. The structural and habitat attributes of the saltmarsh are regarded as favourable for notable plants and invertebrate assemblage.	
8	19.14	Littoral Sediment	25 Mar 2013	Unfavourable recovering	This CSM snapshot assessment needs to be considered within the context of the intertidal SSSI units. The mosaic of intertidal habitats consists of open water, mud/sandflat, saltmarsh and eelgrass beds that collectively provide core feeding habitat, roosting and loafing habitat for the overwintering waterfowl. Population counts for the waterfowl assemblage currently exceeds minimum thresholds for all species except grey plover (3% below FCT threshold) for this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide roosts, eelgrass sustainability) NE will continue to encourage further	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore & offshore activities. The structural and habitat attributes of the saltmarsh are regarded as favourable for notable plants and invertebrate assemblage.	
9	20.76	Broadleaved, mixed and yew woodland – lowland	03 Mar 2013	Favourable	Favourable - Site habitat mosaics of dry neutral grassland and brackish wetlands provide good opportunities for invertebrates. Grassland: appropriate range and proportion of preferred features and surfaces (bare ground/short grass/taller herb). Scrub cover below 10% in key grassland areas. Appropriate representation of bare ground (5%), ungrazed leaf litter (20% in core grassland areas but ranges up to 80%), overwintering seed heads (80%) and diversity of nectar sources (herbs & scrub). Wetlands: all water bodies with standing water, appropriate water clarity, no observed pest herbs (although some previous records) with marginal vegetation of Phragmites/Scirpus, wetlands c50% sloping, shallow edges. The wetlands include ditches, scrape and more expansive 'lagoon -dyke' displaying a range of successional stages from open to vegetation choked. Most wetlands open with limited shading by scrub.	
10	41.71	Littoral Sediment	25 Mar 2013	Unfavourable no change	This CSM snapshot assessment needs to be considered within the context of the intertidal SSSI units. The mosaic of intertidal habitats consists of open water, mud/sandflat, saltmarsh and eelgrass beds that collectively provide core feeding habitat, roosting and loafing habitat for the overwintering waterfowl. Population counts for the o/w waterfowl assemblage currently exceeds minimum thresholds for all species except grey plover (3% below FCT threshold) for this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide roosts, eelgrass sustainability) NE will continue to encourage further research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore &	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					offshore activities. The structural and habitat attributes of the saltmarsh are regarded as favourable for notable plants and invertebrate assemblage.	
11	201.23	Littoral Sediment	25 Mar 2013	Unfavourable recovering	CSM provides a snapshot assessment of this unit's contribution towards SSSI targets. This extensive area of intertidal mud/sandflats and eelgrass beds provide core feeding habitat for overwintering waterfowl and supports the nationally scarce Zostera noltii. Population counts for all of the o/w waterfowl, except grey plover (3% below FCT thresholds), and mapped extent of eelgrass currently exceeds minimum thresholds for this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide roosts at seaward edge, eelgrass sustainability) NE will continue to encourage further research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore & offshore activities.	
12	437.14	Littoral Sediment	25 Mar 2013	Unfavourable recovering	CSM provides a snapshot assessment of this unit's contribution towards SSSI targets. This extensive area of intertidal mud/sandflats provide core feeding habitat for overwintering waterfowl. Population counts for the o/w waterfowl currently exceeds minimum thresholds for all of the listed species except grey plover (3% below) for this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					roosts, eelgrass sustainability) NE will continue to encourage further research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore & offshore activities.	
13	1193.33	Littoral Sediment	25 Mar 2013	Unfavourable recovering	CSM provides a snapshot assessment of this unit's contribution towards SSSI targets. This extensive area of intertidal mud/sandflats provide core feeding habitat for overwintering waterfowl. Population counts for the o/w waterfowl currently exceeds minimum thresholds for all listed species except grey plover (3% below FCT threshold) this reporting cycle. NE is mindful of adverse background environmental trends of which some are known, (eg – fluctuating bird populations, decreasing extent of SSSI high tide roosts at seaward edge, predicted rates of mud/sandflat loss in the longer term) and others currently unquantified (eg, reduced duration of exposed habitat, implications of reduced bird roost provision & eelgrass bed extent within SSSI) and these remain as ongoing concerns to NE. Addressing coastal habitat losses requires an ongoing commitment by Southend on Sea BC and Castle Point BC to work with the EA within a strategic framework such as Thames Estuary 2100 & Essex SMP. With respect to other trends where there is currently insufficient information (eg, sediment budget, impact of reduced exposure periods on waterfowl, decreasing extent of high tide roosts, eelgrass sustainability) NE will continue to encourage further research to inform SSSI management & future CSM monitoring. Furthermore continued vigilance through regulatory & management measures is necessary to minimise disturbance effects of onshore & offshore activities.	

Table D3 Benfleet and Southend Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	72.97	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
21	11.57	Neutral grassland – lowland	07 Sep 2010	Unfavourable no change	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	Reason unclear
23	51.33	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
27	78.93	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
30	52.24	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
31	36.92	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
32	17.21	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
33	90.11	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
34	130.55	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
35	16.43	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
39	7.96	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
40	50.87	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
41	13.51	Neutral	07 Sep 2010	Unfavourable	This assessment was based on bird data alone and has not taken into account	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		grassland – lowland		recovering	habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
42	36.51	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
43	9.85	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
48	16.97	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
49	28.29	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					current research are available; in the meantime the site remains recovering but at risk.	
54	26.49	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
55	38.52	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
56	40.49	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose,	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
57	34.20	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
58	2.59	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
74	22.17	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
75	6.36	Neutral grassland – lowland	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
76	1.12	Fen, marsh and swamp -	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		lowland			Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
99	20.91	Fen, , marsh and swamp – lowland	01 Apr 2011	Unfavourable recovering	HLS agreement live from 1st April 2011. covering ditch and reedbed restoration.	
100	2163.43	Littoral Sediment	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin, Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
101	1647.77	Littoral Sediment	07 Sep 2010	Unfavourable recovering	This assessment was based on bird data alone and has not taken into account habitat features. Data supplied by BTO (WeBs counts for 2003 to 2008) in the Medway Estuary and Marshes indicates that the criterion for a number of wintering and breeding birds (population should be maintained above 50% of that at designation) is not met. These birds are Little Tern, Dark-bellied Brent Goose, Shelduck, Wigeon, Teal, Great Crested Grebe, Ringed Plover, Grey Plover, Dunlin,	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					Curlew and Redshank. Wintering and breeding bird numbers have declined significantly at this site for reasons which are not clear. Management is in place to maintain the habitat required to support the assemblage of wintering and breeding birds through stewardship schemes, ditch management, the consenting process and the Local Development Framework process. Drawing from previous condition assessments, habitat quality is thought to be good and not the cause of declines. As it is currently unclear as to why bird declines are occurring, a number of reasons are being investigated including disturbance, bird movements within the region and internationally. Further consideration on condition will be given when the results of current research are available; in the meantime the site remains recovering but at risk.	
106	22.56	Coastal Lagoon	27 Feb 2009	Destroyed	This area of mudflats was lost to planning development (car park) which is part of Sheerness Docks. The special interest feature has been irretrievably lost.	Development of a car park has destroyed the habitat

Table D4 Medway Estuary and Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	100.45	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
2	16.57	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
3	48.53	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
4	40.80	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
5	7.45	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
6	8.09	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
7	33.46	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
8	13.28	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly <10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	
9	4.19	Littoral Sediment	12 Dec 2011	Favourable	The five year peak mean (2010/11 partial count) is 1594 so above 870 FCT threshold. Black-tailed godwits observed feeding in shallow waters of Creek in units 1 and 4. The key saltmarsh areas have not significantly changed in extent. Saltmarsh structure and composition on Upper and Lower Horse regarded as suitable for high tide roost [Mosaic of short vegetation mostly	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					<10cm, allowing unrestricted views over 200 metres during non-breeding season. Vegetation includes Halimione (a -dom) Puccinellia (a-dom), Spergularia media (o), Aster tripolium (o), Suaeda maritima (r), Salicornia spp. (o), Triglochin maritime (r), Juncus maritima (r), Spartina spp (o)]. No evidence during site visit of adverse water quality or significant disturbance – and currently satisfied that both are subject to regular monitoring and regulation by RSPB, EA, PLA, NE.	

Table D5 Holehaven Creek

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
6	81.31	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
7	84.34	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
8	27.76	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks and occasional scrub along the ditches. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
9	69.45	Neutral grassland – lowland	26 Oct 2010	Favourable	The unit supports low-lying semi-improved grassland of value in providing roosting habitat for overwintering birds. There is good sward height, and well managed ditches with a good range of vegetation successional stages. Current management appears to be appropriate to maintain the grassland in suitable condition for the wintering bird assemblage.	
10	86.11	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					club rush. Sward generally short with areas of taller tussocks and occasional scrub along the ditches. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
11	59.48	Neutral grassland – lowland	26 Oct 2010	Unfavourable recovering	This unit supports low-lying semi-improved grassland of value in providing roosting habitat for overwintering birds. There is also a network of ditches which provide habitat diversity. Work continues to restore the ditch system with internal ditches of the unit in need of further work. Patches of scrub are present which reduce the value of the grassland for roosting wildfowl. The grassland has a mix of suitable sward height. Both cattle and sheep were present during the site visit. Current management appears to be appropriate to maintain the grassland in suitable condition for the breeding bird assemblage. The majority of this unit is currently under an ELS/HLS agri-environment agreement which supports appropriate management to improve habitat conditions.	
12	37.28	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks and occasional taller herbaceous vegetation. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
13	83.91	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks and occasional scrub along the ditches. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
14	76.70	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
15	47.88	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
16	46.23	Neutral grassland - lowland	19 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains which also support emergent vegetation including common reed and sea	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					club rush. Sward generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus. Larger margins of common reed adjacent to Long Hope Fleet with wider areas (up to 20m) of open standing/flowing water used by 100's of widgeon in the winter months. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
17	2.28	Neutral grassland - lowland	19 Feb 2009	Favourable	Large margins of common reed adjacent to areas of open standing/flowing water used by 100's of widgeon in the winter months. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
18	4.37	Neutral grassland - lowland	12 Feb 2009	Favourable	Area of natural creek with emergent vegetation adjacent, mainly of common reed but also taller herbaceous vegetation with occasional scrub where narrow. Water body of variable width providing all year round standing open water not subject to tides. No negative indicators.	
19	24.56	Neutral grassland - lowland	12 Feb 2009	Favourable	Area of natural creek with emergent vegetation adjacent, mainly of common reed but also taller herbaceous vegetation with occasional scrub where narrow. Water body of variable width providing all year round standing open water not subject to tides. Narrow area of grazed grassland adjacent. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
20	15.54	Neutral grassland - lowland	12 Feb 2009	Favourable	Cattle grazing giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and sea club rush. Occasional scattered scrub and brambles but less than 5 %. Unit assessed for value as breeding and over wintering bird habitat.	
21	39.27	Neutral grassland - lowland	12 Feb 2009	Favourable	Unit includes an area of the seawall which is a close grazed earth bank with a level area between it and the main carrier. Also includes a larger area of grazing of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and sea club rush. Unit assessed for value as breeding and over wintering bird habitat.	
22	16.09	Neutral grassland - lowland	12 Feb 2009	Favourable	Area of natural creek with emergent vegetation adjacent, mainly of common reed but also taller herbaceous vegetation but no scrub. Water body of variable width providing all year round standing open water not subject to tides.	
24	52.50	Neutral grassland - lowland	12 Feb 2009	Favourable	Cattle grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					water in the many ditches and drains with marginal emergent vegetation including common reed, sea club rush and reed mace. Signs of recent ditch reprofiling with the spoil levelled to create a low bund which was effectively increasing surface water. No scrub but an ungrazed area of about 2ha of common reeds at one end adjacent to a firing range installation. Unit assessed for value as breeding and over wintering bird habitat.	
25	72.15	Neutral grassland - lowland	12 Feb 2009	Favourable	Horses grazing parts at time of survey with supplementary feed and poached areas mainly beneath power lines and less than 5%. Also sheep grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and reed mace. Scrub was occasional on the landward side of the unit under the power lines, less than 5%. Unit assessed for value as breeding and over wintering bird habitat. Many birds on the unit including Shelduck, geese, Lapwing, Curlew, Avocet and flocks of Starlings.	
26	74.24	Neutral grassland - lowland	12 Feb 2009	Favourable	Cattle grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and reed mace. Scrub was more than occasional (between 5% and 10%) but this is deliberate to provide refuge for Great Crested Newts known to be on this unit. Unit assessed for value as breeding and over wintering bird habitat. Many birds on the unit including Shelduck, geese, Lapwing, Curlew, Avocet and flocks of Starlings.	
27	72.35	Neutral grassland - lowland	12 Feb 2009	Favourable	Cattle grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and reed mace. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
28	61.67	Neutral grassland - lowland	12 Feb 2009	Favourable	Sheep grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and reed mace. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
29	63.75	Neutral grassland -	12 Feb 2009	Favourable	Sheep grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		lowland			vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and reed mace. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
31	81.49	Neutral grassland - lowland	19 Mar 2009	Favourable	Uneven area of grassland generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus. With large areas of ephemeral standing water at the time of survey also more permanent water in the ditches and larger water bodies which support emergent vegetation including common reed and sea club rush. 100s of ducks and waders of several species large and small. Areas of scrub on the edge of the unit backing onto the houses < 5%. A small part of the unit was horse grazed at the time of survey with a more evenly short sward and areas of poaching < 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
32	86.54	Neutral grassland - lowland	19 Mar 2009	Favourable	Uneven area of grassland generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus. With large areas of ephemeral standing water at the time of survey also more permanent water in the ditches and larger water bodies which support emergent vegetation including common reed and sea club rush. 100s of ducks and waders of several species large and small. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
34	91.26	Neutral grassland - lowland	19 Mar 2009	Favourable	Uneven area of grassland generally sparsely grazed with most of the unit taller tussocks with occasional taller herbaceous vegetation and Juncus. Large areas of ephemeral standing water at the time of survey also more permanent water in the ditches and larger water bodies which support emergent vegetation including common reed and sea club rush. Despite the possibility that this unit was ungrazed in 2008/09, taken as a whole the site is verging on overgrazed so this unit provides a sheltered area of cover away from any access and as such is contributing to the overall habitat. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
35	49.97	Neutral grassland - lowland	19 Mar 2009	Favourable	Cattle grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and sea club rush. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
36	93.48	Neutral grassland -	19 Mar 2009	Favourable	Cattle grazing at time of survey giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		lowland			vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and sea club rush. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
37	75.24	Neutral grassland - lowland	19 Mar 2009	Favourable	Uneven area of grassland generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus, dryer areas with ant hills. With large areas of ephemeral standing water at the time of survey also more permanent water in the ditches and larger water bodies which support emergent vegetation including common reed and sea club rush. 100s of ducks of several species large and small, waders, geese and swans at time of survey, lapwing displaying. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
38	29.48	Neutral grassland - lowland	19 Mar 2009	Favourable	Large (> 10m) margins of common reed bordering areas of open standing water. Adjacent grassland generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
39	147.66	Neutral grassland - lowland	19 Mar 2009	Favourable	Grazed grassland generally short with areas of taller tussocks, occasional taller herbaceous vegetation and Juncus, dryer areas with ant hills. Large areas of ephemeral standing water at the time of survey also more permanent water in the ditches and larger water bodies which support emergent vegetation including common reed and sea club rush. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
40	17.39	Neutral grassland - lowland	12 Feb 2009	Favourable	Close grazed turf on level ground with areas of ephemeral standing water at the time of survey. More permanent water in drains and ditches, emergent aquatic vegetation including Phragmites and Reedmace. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
41	31.09	Neutral grassland – lowland	13 Mar 2009	Unfavourable no change	The unit has been subject to damage by being regularly ploughed. The habitat is not meeting objectives for the breeding and wintering bird features.	Area disturbed due to farming practises
42	35.67	Neutral grassland - lowland	12 Feb 2009	Favourable	A grazed area of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent and floating vegetation including common reed and reed mace. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
43	19.77	Neutral grassland -	12 Feb 2009	Favourable	A grazed area of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		lowland			more permanent areas of water in the many ditches and drains with marginal emergent and floating vegetation including common reed and reed mace. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
44	14.44	Boundary and linear features	12 Feb 2009	Favourable	Sheep grazed giving rise to areas of short turf interspersed with taller tussocks. Scrub is dominant at one end of the unit and forms an effective screen of an industrial site from the rest of the grazing marsh. Unit assessed for value as breeding and over wintering bird habitat.	
45	40.01	Neutral grassland - lowland	12 Feb 2009	Favourable	The majority of the unit is grazed (>70 %) creating short turf with occasional Juncus and large areas of ephemeral standing water at the time of survey. Parts of the unit, which is on the edge of this large site, is unfenced and ungrazed with high levels of public access. This has allowed areas of common reed to dominate with tall grasses, Juncus and tall herbaceous vegetation as well as rabbit grazed areas of scattered scrub on dryer ground. As operational features for this unit is shown as 'grazing marsh without breeding waders' the extent of common reed and scrub is adding an additional habitat on the edge of the site and creating a buffer for the more sensitive nesting areas for breeding waders. Unit assessed for value as breeding and over wintering bird habitat.	
46	12.88	Neutral grassland - lowland	12 Feb 2009	Favourable	Close grazed turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation on uneven ground with areas of ephemeral standing water at the time of survey. More permanent water in drains and ditches, emergent aquatic vegetation including Phragmites and Reedmace. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
47	55.87	Neutral grassland - lowland	12 Feb 2009	Favourable	Sheep grazed giving rise to areas of short turf interspersed with taller tussocks, juncus and areas of tall herbaceous vegetation. Lots of ephemeral standing water and more permanent areas of water in the many ditches and drains with marginal emergent vegetation including common reed and reed mace. Scrub was occasional, less than 5%. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
48	23.42	Standing open water and canals	12 Feb 2009	Favourable	Standing open water surrounded by ungrazed grassland, common reed and scrub with little emergent vegetation as the banks are not shallow or shelving. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
49	71.81	Standing open water and canals	12 Feb 2009	Favourable	Standing open water surrounded by ungrazed grassland, common reed and scrub with little emergent vegetation as the banks are not shallow or shelving. There are no signs that this is due to recent changes as site is flooded quarry, may be to do with high water levels at the time of survey. Unit assessed for value as breeding and over wintering bird habitat.	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
50	23.73	Standing open water and canals	12 Feb 2009	Favourable	Large area of open standing water with some recent improvements to extend the areas of bank for fishing access. No emergent or floating aquatic vegetation as the ex quarry workings are very steep sided. Some scrub on the cliff top but very little area beyond the open water within this unit. No negative indicators.	
51	34.06	Standing open water and canals	12 Feb 2009	Favourable	Large area of open standing water, no emergent or floating aquatic vegetation as the ex quarry workings are very steep sided. Some scrub on the cliff top and the areas beyond the open water within this unit. No negative indicators.	
52	21.38	Coastal Lagoon	12 Feb 2009	Favourable	Large waterbody with a convoluted shoreline in places. Also includes small areas of uneven ungrazed grassland with taller herbaceous vegetation, patches of common reed and strips of scrub between the separate lagoons. No signs of the previous problems with unauthorised vehicle access and burning of cars and dumping of other rubbish. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
53	70.65	Coastal Lagoon	12 Feb 2009	Favourable	Large waterbody with a convoluted shoreline in places. Also includes surrounding areas of uneven ungrazed grassland with taller herbaceous vegetation, patches of common reed and strips of scrub between the separate lagoons. No signs of the previous problems with unauthorised vehicle access and burning of cars and dumping of other rubbish. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
54	69.04	Coastal Lagoon	12 Feb 2009	Favourable	Large waterbody with many islands and a convoluted shoreline. These grass covered with areas of taller herbaceous vegetation further from the waters edge. Also includes surrounding areas of uneven ungrazed grassland with taller herbaceous vegetation, patches of common reed and occasional scrub. Good numbers of birds present during the visit – geese, teal, shoveler, pochard, lapwing etc. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
56	64.63	Coastal Lagoon	12 Feb 2009	Unfavourable recovering	Unit mainly uneven ungrazed grassland with taller herbaceous vegetation and patches of common reed with large amounts of scrub. Scrub removal was being carried out at the time of survey and cattle grazing had recently been introduced to part of the unit and was also being carried out at the time of survey. The main feature of the unit is the lagoons which have several islands and a convoluted shore line with emergent vegetation in places. Also recently created perimeter ditch and other permanent water bodies have good emergent vegetation and open water habitat. Unit assessed for value as breeding and over wintering bird habitat.	
57	35.46	Neutral grassland-lowland	12 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains some of which support emergent vegetation including common reed and	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					sea club rush. Sward generally short with areas of taller tussocks. Occasional scrub along the ditches, major reprofiling of ditches was being carried out, spoil remains on site adjacent to watercourses.. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
58	32.10	Neutral grassland-lowland	12 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permanent water in the ditches and drains some of which support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks. Occasional scrub along the ditches, major reprofiling of ditches was being carried out, spoil remains on site adjacent to watercourses.. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
59	56.15	Neutral grassland-lowland	12 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permenant water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks. Occasional scrub along the ditches, evidence that scrub removal was being carried out. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
60	43.91	Neutral grassland-lowland	12 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permenant water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks and occasional scrub. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
61	53.87	Neutral grassland-lowland	12 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permenant water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks and occasional scrub. No negative indicators. Unit assessed for value as breeding and over wintering bird habitat.	
62	49.48	Neutral grassland-lowland	12 Feb 2009	Favourable	Uneven area of grazed grassland with large areas of ephemeral standing water at the time of survey. More permenant water in the ditches and drains which also support emergent vegetation including common reed and sea club rush. Sward generally short with areas of taller tussocks and occasional scrub. Unit assessed for value as breeding and over wintering bird habitat. No negative indicators.	
64	19.95	Neutral grassland-	12 Feb 2009	Favourable	Close grazed grass bank and level strip between sea wall and main carrier. Short sward with occasional taller tussocks, water course with emergent	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
		lowland			bankside vegetation, common reed, Juncus and sea club rush. Unit assessed for value as breeding and over wintering bird habitat. No negative indicators.	
100	13.35	Littoral Sediment	19 Mar 2009	Unfavourable declining	Areas of saltmarsh scattered along the coast between the mudflats and the sea wall, hence the Unfavourable declining condition due to coastal squeeze.	Coastal squeeze
101	81.17	Littoral Sediment	12 Feb 2009	Unfavourable declining	Several small areas of saltmarsh scattered along the coast between the mudflats and the sea wall, hence the Unfavourable declining condition due to coastal squeeze.	Coastal squeeze
102	69.09	Littoral Sediment	12 Feb 2009	Favourable	Large areas of tidal mudflat running some of the length of this large site. Numbers of waterfowl feeding at the time of survey including teal and shoveler. Unit assessed for value as breeding and over wintering bird habitat.	
103	2374.24	Littoral Sediment	12 Feb 2009	Favourable	Large areas of tidal mudflat running the majority of the length of this large site. Thousands of birds feeding at low tide at time of survey including Shelduck, Dunlin, curlew, oyster catcher and lapwing. Unit assessed for value as breeding and over wintering bird habitat.	

Table D6 South Thames Estuary and Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	18.37	Coastal Lagoon	06 Aug 2012	Unfavourable recovering	Mosaic of free-draining, brackish grassland with scattered scrub and wetland habitats (ditches low-lying areas). Habitat structure for invertebrates associated with free-draining & brackish grassland / wetland – overall, borderline favourable due to appropriate scrub cover & bare substrate with early successional grassland habitat. Habitat surfaces include bare ground (includes lichen heath-type), short sward (eg. Festuca, Lotus, Trifolium spp., & Common Spotted orchids), longer grasses (eg. Arrhenatherum, Elytrigia), taller herbs (eg. Cirsium, Chamaerion), and young scrub (eg. Hawthorn, willow). Many preferred surfaces including exposed silty substrate, localised surface disturbance, tussocky areas, flower-rich areas, scrub edge habitat. 10 % scrub cover. Maximum of 5% bare areas & pioneer mossy habitat in grassland. Up to 50% leaf litter cover in unit. > 15% seed heads allowed to over-winter. Sward height c30cm average and over 40% able to flower in season with ample representation by asteracea, legumes & rosacea. Habitat structure for W211/314 invertebrate assemblage associated with brackish wetland – overall	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					currently unfavourable principally due to lack of early successional habitat but HLS work in accordance with Management Plan should address this. Core wetland habitat on site is restricted to a few marshy areas, ponds & ditches. Water levels above 0.5metres in core low-lying areas in winter period but not summer period. No undesirable water discoloration, no algal dominance or aggressive non-natives recorded. Wetland habitats have naturally grading profiles and preferred structural layers within the unit include bay layer, herb layer and low & high emergent layers. The wetland habitats predominantly support mid-late successional stages and less than 10% of the resource is shaded.	
2	112.46	Littoral sediment	30 Nov 2009	Favourable	Overwintering birds meeting thresholds for all species (see File Note). Saltmarsh providing suitable habitat for invertebrate assemblage (see File Note)	
3	87.85	Littoral Sediment	30 Nov 2009	Favourable	Overwintering birds meeting thresholds for all species (see File Note). Saltmarsh providing suitable habitat for invertebrate assemblage (see File Note)	
4	94.03	Littoral Sediment	30 Nov 2009	Favourable	Overwintering birds meeting thresholds for all species (see File Note). Saltmarsh providing suitable habitat for invertebrate assemblage (see File Note)	

Table D7 Mucking Flats and Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	22.15	Coastal Lagoon	29 Mar 2010	Unfavourable no change	Dunlin and redshank wintering numbers below threshold. The lagoon currently has a mosaic of habitats including some seasonally wet shorter saltmarsh/grassland, longer tussocky rush grassland, scrub and some seasonal open water. Site still subject to physical disturbance.	Number of bird features below threshold and site physically disturbed
2	44.35	Littoral Sediment	29 Mar 2010	Unfavourable declining	Dunlin and redshank wintering numbers below threshold. Intertidal mudflats and saltmarsh regarded to be suffering from steepening as a result of coastal squeeze. Stoneness also regarded as being subject to erosion causing a net loss of extent. Stoneness still being used as a roost (dunlin, redshank) but with numbers generally below SSSI desirable thresholds. Intertidal areas totally constrained by Thames defences.	Coastal squeeze

Table D8 West Thurrock Lagoon and Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	27.93	Neutral grassland-lowland	22 Dec 2009	Unfavourable recovering	Unit has been entered into an HLS agreement with the London Borough of Havering.	
2	152.38	Littoral Sediment	27 Oct 2010	Unfavourable declining	The unit is no longer providing suitable conditions for wading birds, as silt deposition has ceased and as a result the land is drying out. The habitat is now rough grassland which may support raptors and invertebrates in particular, but does not support the interest features of the SSSI.	Change of habitat at the site
4	7.71	Neutral grassland – lowland	30 Sep 2011	Part destroyed	The unit remains Part Destroyed by the construction of the A13 flyover. However the remaining habitat has good potential to support wetland plant species and associated fauna. Although there is not currently formal conservation management on the unit, a combination of informal horse and cattle grazing has limited scrub encroachment and ruderal vegetation growth. Ditches require desilting (this is underway) but are relatively rich in aquatic plant species. The landowner is keen to explore conservation management of the unit and discussions will focus on grazing regime and water level management.	Construction of a road
5	27.86	Littoral Sediment	27 Oct 2010	Unfavourable no change	There is evidence of habitat loss through coastal erosion processes since the site was notified. There has been no further loss of extent of saltmarsh since the last condition assessment. However the extent has not increased (recovered) and there is not currently a remedy underway.	Coastal erosion
6	9.89	Littoral Sediment	06 Apr 2005	Favourable	This area is not managed but provides a valuable area of rough grassland habitat thus adding to the habitat mosaic within the site	
7	85.40	Neutral grassland-lowland	27 Oct 2010	Favourable	Carex divisa is locally abundant through the majority of the unit. Brackish water crow-foot was also identified in a small number of ditches. The breeding bird assemblage is considered over the SSSI as a whole and has been assessed as favourable (the site is supporting good populations). The site is managed under a grazing regime which is maintaining suitable habitat conditions for breeding and wintering waders. The ditch network on the unit is being managed in rotation, giving a range from open (recently cleared) to choked (mature vegetation growth) water channels. This provides an excellent variety of habitats and surfaces for wetland invertebrates, including open water column, sumberged aquatic plants, and good structure of marginal and emergent plants.	
8	14.64	Neutral grassland-lowland	22 Sep 2009	Favourable	Units 8 and 9 have been well managed by the RSPB and continue to improve. The habitats within this unit are in good condition as a result of the grazing regime. There is good structural diversity across the ditch network and a range of open water and marginal habitats. Bird numbers are favourable across the site for both breeding bird assesmblage and wintering Teal. Most notified vascular plant species were present and doing	

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					well, including a large population of Carex Divisa. Although Ranunculus baudotii was not found appropriate habitat conditions are in place so the feature is assessed as favourable.	
9	95.92	Neutral grassland-lowland	22 Sep 2009	Favourable		
10	5.59	Neutral grassland-lowland	10 Nov 2009	Destroyed	Area destroyed when A13 constructed.	Road construction
11	58.54	Neutral grassland-lowland	22 Dec 2009	Unfavourable recovering	The unit has now been entered into an HLS agreement with the remainder of the RSPB land holding on the SSSI.	

Table D9 Inner Thames Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
1	9.33	Neutral grassland-lowland	05 Aug 2009	Unfavourable declining	Unit passes on breeding bird assemblage and invertebrate proxy habitat assessment. However, the Glyceria maxima beds are unfavourable due to: - dense litter cover - presence of Himalayan balsam - presence of negative indicator species - woody species covering >10% of area There is currently little active habitat management in this unit.	Litter and presence of competitor species
3	6.7	Fen, marsh and swamp – lowland	15 Sep 2009	Favourable	This unit passes for all of the SSSI notified features; breeding birds, invertebrates and Reedbed habitat.	
4	8.78	Fen, marsh and swamp – lowland	13 Oct 2010	Unfavourable declining	The unit consists of a private angling lake surrounded by reed sweet grass and reed swamp communities. There is good surface diversity for invertebrates. Himalayan balsam is becoming a problem in some areas. This requires management and the site would benefit from grazing to reduce the buildup of litter and open up the sward.	Litter and presence of competitor species
5	5.55	Fen, marsh and swamp – lowland	06 Aug 2009	Favourable	Unit assessed as favourable for breeding birds, invertebrate proxy habitat assessment, S4 reedbed and S5 Glyceria maxima swamp. Areas of open water with patches of Glyceria and Phragmites. Habitats fairly open with little encroachment. Crassula helmsii present in one area and should be monitored.	
6	5.23	Fen, marsh and swamp – lowland	06 Aug 2009	Unfavourable declining	Breeding bird assemblage assessed as favourable (whole SSSI assessment). Reedbed is very dense and unmanaged, assessed as unfavourable due to: - dense litter cover - high cover of undesirable species	Litter and presence of competitor species

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
					(nettles within reedbed) The invertebrate assemblage proxy habitat assessment is unfavourable due to a lack of structural diversity within the unit (i.e. dense reeds of similar age with no structural variation).	
7	7.15	Neutral grassland-lowland	05 Aug 2009	Favourable	The unit has been assessed as favourable for: S4 Phragmites australis reedbed S5 Glyceria maxima swamp Breeding bird assemblage Invertebrate proxy habitat assessment The area north of the footpath is in very good condition with a range of fen and neutral grassland habitats. The area south of the path is slightly overgrazed in places but still passes the requirements for habitat composition and positive indicators.	
8	7.56	Fen, marsh and swamp – lowland	16 Sep 2009	Favourable	This unit has passed all of the Common Standards Monitoring targets for the notified features of interest; breeding bird assemblage; Invertebrate habitat assessment and Glyceria maxima and Reed bed habitat assessment.	
9	3.01	Fen, marsh and swamp – lowland	16 Sep 2009	Unfavourable no change	This unit passes on breeding bird assemblage and invertebrate proxy habitat assessment. However, the Glyceria maxima beds and Reedbeds are unfavourable due to: - dense litter cover; presence of Himalayan balsam; presence of negative indicator species – Typha and Phragmities are invading the Glyceria bed and Typha is invading areas of reed. There are also areas of nettle within the Glyceria bed.	Litter and presence of competitor species
10	2.52	Fen, marsh and swamp – lowland	13 Oct 2010	Favourable	This unit is an undisturbed area in the interior of the SSSI. It features tall fen vegetation (reed and reed sweet grass swamp) communities with a permanently raised water level. The unit provides good blocks of fen habitat with no encroachment from scrub.	
11	9.78	Fen, marsh and swamp – lowland	13 Oct 2010	Favourable	This unit is an undisturbed area in the interior of the SSSI. It features tall fen vegetation (reed and reed sweet grass swamp) communities with a permanently raised water level. The unit provides good blocks of fen habitat with limited encroachment from scrub.	

Table D10 Ingrebourne Marshes

Unit Number	Unit Area (ha)	Main Habitat	Latest Assessment Date	Assessment Description	Condition Assessment Comment	Reason for Adverse Condition
4	22.07	Fen, marsh and swamp - lowland	13 Aug 2009	Unfavourable recovering	Areas of fen and swamp are in favourable condition: - Good structural diversity due to grazing. - Positive indicator species present (Glyceria maxima dominant). - Invasive species rare Areas of woodland in unfavourable condition due to present of Impatiens glandulifera over >10% area. Good structural diversity and deadwood within wood. Invertebrate assemblage proxy habitat assessment favourable	

Table D11 Syon Park

Appendix E

Water Framework Directive - Water Body Status

Waterbody Category and Map Code.:	Coastal - C5	**Surveillance site:** No
Waterbody ID and Name:	GB650503520001 Essex	
National Grid Reference:	TM 26122 07726	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2015	
Justification if overall objective is not good status by 2015:	Technically infeasible	
Protected Area Designation:	Bathing Water Directive, Natura 2000 (Habitats and/or Birds Directive), Nitrates Directive, Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Coastal Protection, Flood Protection	
Downstream Waterbody ID:		

Ecological Potential

Current Status (and certainty that status is less than good) Moderate

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Invertebrates	Good	Good	
Phytoplankton	High	High	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Good	Good	
Dissolved Oxygen	High	High	
Copper	High	High	
Iron	High	High	
Un-ionised ammonia	High	High	
Zinc	High	High	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Managed realignment of flood defence	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Good

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Cadmium And Its Compounds	High	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Nickel And Its Compounds	High	High	

Waterbody Category and Map Code.:	Coastal - C9	**Surveillance site:** No
Waterbody ID and Name:	GB650704510000	Kent North
National Grid Reference:	TR 26905 71993	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2015	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Bathing Water Directive, Natura 2000 (Habitats and/or Birds Directive), Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Coastal Protection	
Downstream Waterbody ID:		

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Invertebrates	Good	Good	
Phytoplankton	Good	Good	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1o)
Dissolved Oxygen	High	High	
2,4-dichlorophenol	High	High	
2,4-dichlorophenoxyacetic acid	High	High	
Arsenic	High	High	
Copper	High	High	
Dimethoate	High	High	
Iron	High	High	
Linuron	High	High	
Mecoprop	High	High	
Permethrin	High	High	
Toluene	High	High	
Zinc	High	High	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Manage disturbance	**In Place**
Site selection (dredged material disposal) (e.g. avoid sensitive sites)	**In Place**
Sediment management	**In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good) Good

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
1,2-dichloroethane	High	High	
Atrazine	High	High	
Benzene	High	High	
Cadmium And Its Compounds	High	High	
Hexachlorobenzene	High	High	
Hexachlorobutadiene	High	High	
Hexachlorocyclohexane	High	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Napthalene	High	High	
Nickel And Its Compounds	High	High	
Pentachlorophenol	High	High	
Simazine	High	High	
Tributyltin Compounds	High	High	
Trichlorobenzenes	High	High	
Trichloromethane	High	High	
Trifluralin	High	High	
Aldrin, Dieldrin, Endrin & Isodrin	High	High	
Carbon Tetrachloride	High	High	
para - para DDT	High	High	
Tetrachloroethylene	High	High	
Trichloroethylene	High	High	

Waterbody Category and Map Code.:	Coastal - C8	**Surveillance site:** No
Waterbody ID and Name:	GB640604640000	Thames Coastal South
National Grid Reference:	TR 06455 73526	
Current Overall Potential	Poor	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2015	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Coastal Protection	
Downstream Waterbody ID:		

Ecological Potential

Current Status (and certainty that status is less than good)	Poor (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Phytoplankton	Poor (Uncertain)	Moderate	Disproportionately expensive (N1a)

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1a)
Dissolved Oxygen	High	High	
Copper	High	High	
Iron	High	High	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Operational and structural changes to locks, sluices, weirs, beach control, etc	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Preserve and, where possible, restore historic aquatic habitats	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Good

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Cadmium And Its Compounds	High	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Nickel And Its Compounds	High	High	

Waterbody Category and Map Code.:	Coastal - C12	**Surveillance site:** Yes
Waterbody ID and Name:	GB640604290000	Whitstable Bay
National Grid Reference:	TR 07666 69102	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Bathing Water Directive, Natura 2000 (Habitats and/or Birds Directive), Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Coastal Protection	
Downstream Waterbody ID:		

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Invertebrates	Good	Good	
Phytoplankton	Good	Good	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1o)
Dissolved Oxygen	High	High	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Manage disturbance	**In Place**
Site selection (dredged material disposal) (e.g. avoid sensitive sites)	**In Place**
Sediment management	**In Place**
Indirect / offsite mitigation (offsetting measures)	**Not In Place**
Operational and structural changes to locks, sluices, weirs, beach control, etc	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Bank rehabilitation / reprofiling	**Not In Place**
Preserve and, where possible, restore historic aquatic habitats	**Not In Place**
Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	**Not In Place**
Remove obsolete structure	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Does not require assessment

Waterbody Category and Map Code.:	Transitional - T10	**Surveillance site:** No
Waterbody ID and Name:	GB530604011500 SWALE	
National Grid Reference:	TR 05475 67221	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2027	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Bathing Water Directive, Natura 2000 (Habitats and/or Birds Directive), Nitrates Directive, Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Flood Protection	
Downstream Waterbody ID:	GB640604290000	

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Macroalgae	Moderate (Uncertain)	Good	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1e)
Dissolved Oxygen	High	High	
Arsenic	High	High	
Copper	High	High	
Dimethoate	High	High	
Iron	High	High	
Zinc	High	High	

Supporting conditions

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Tidal Regime - Freshwater Flow	Does not Support Good (Very Certain)	Does not Support Good	Disproportionately expensive (HT3a)

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Bank rehabilitation / reprofiling	**Not In Place**
Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good) Fail (Very Certain)

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
1,2-dichloroethane	High	High	
Cadmium And Its Compounds	High	High	
Hexachlorobenzene	High	High	
Hexachlorobutadiene	High	High	
Hexachlorocyclohexane	High	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Nickel And Its Compounds	High	High	
Pentachlorophenol	High	High	
Tributyltin Compounds	Moderate (Very Certain)	Moderate	Technically infeasible (C2a)
Trichlorobenzenes	High	High	
Trichloromethane	High	High	
Aldrin, Dieldrin, Endrin & Isodrin	High	High	
Carbon Tetrachloride	High	High	
para - para DDT	High	High	
Tetrachloroethylene	High	High	
Trichloroethylene	High	High	

Waterbody Category and Map Code.:	Coastal - C1	**Surveillance site:** No
Waterbody ID and Name:	GB640603690000	Thames Coastal North
National Grid Reference:	TR 02100 81123	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Natura 2000 (Habitats and/or Birds Directive), Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Flood Protection, ShellFisheries	
Downstream Waterbody ID:		

Ecological Potential

Current Status (and certainty that status is less than good) Moderate (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Phytoplankton	Moderate (Uncertain)	Moderate	Disproportionately expensive (B1a)

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Oxygen	High	High	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Disproportionately expensive (M2b), Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Indirect / offsite mitigation (offsetting measures)	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Bank rehabilitation / reprofiling	**Not In Place**
Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	**Not In Place**

Chemical Status	
Current Status (and certainty that status is less than good)	Does not require assessment

Waterbody Category and Map Code.:	Transitional - T5	**Surveillance site:** Yes
Waterbody ID and Name:	GB530603911401	THAMES LOWER
National Grid Reference:	TQ 85340 80133	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2027	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Bathing Water Directive, Natura 2000 (Habitats and/or Birds Directive), Nitrates Directive, Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Flood Protection, Navigation	
Downstream Waterbody ID:	GB640603690000	

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Quite Certain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Invertebrates	Moderate (Uncertain)	Moderate	Not Required (MS)
Macroalgae	High	High	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1o)
Dissolved Oxygen	High	High	
2,4-dichlorophenol	High	High	
2,4-dichlorophenoxyacetic acid	High	High	
Arsenic	High	High	
Copper	Moderate (Quite Certain)	High	
Dimethoate	High	High	
Iron	High	High	
Linuron	High	High	
Mecoprop	High	High	
Permethrin	High	High	
Toluene	High	High	
Un-ionised ammonia	High	High	
Zinc	High	High	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Manage disturbance	**In Place**
Site selection (dredged material disposal) (e.g. avoid sensitive sites)	**In Place**
Alter timing of dredging / disposal	**In Place**
Reduce impact of dredging	**In Place**
Prepare a dredging / disposal strategy	**In Place**
Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works)	**In Place**
Sediment management	**Not In Place**
Operational and structural changes to locks, sluices, weirs, beach control, etc	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works.	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Bank rehabilitation / reprofiling	**Not In Place**
Increase in-channel morphological diversity	**Not In Place**
Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	**Not In Place**
Remove obsolete structure	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Fail (Quite Certain)

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
1,2-dichloroethane	High	High	
Atrazine	High	High	
Benzene	High	High	
Benzo (a) and (k) fluoranthene	High	High	
Benzo (ghi) perelyene and indeno (123-cd) pyrene	Moderate (Uncertain)	Moderate	Technically infeasible (C2a)
Benzo(a)pyrene	High	High	
Cadmium And Its Compounds	High	High	
Diuron	High	High	
Fluoranthene	High	High	
Hexachlorobenzene	High	High	
Hexachlorobutadiene	High	High	
Hexachlorocyclohexane	High	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Napthalene	High	High	
Nickel And Its Compounds	High	High	
Pentachlorophenol	High	High	
Simazine	High	High	
Tributyltin Compounds	Moderate (Quite Certain)	Moderate	Technically infeasible (C2a)
Trichlorobenzenes	High	High	
Trichloromethane	High	High	
Trifluralin	High	High	
Aldrin, Dieldrin, Endrin & Isodrin	High	High	
Carbon Tetrachloride	High	High	
para - para DDT	High	High	
Tetrachloroethylene	High	High	
Trichloroethylene	High	High	

Waterbody Category and Map Code.:	Transitional - T8	**Surveillance site:** Yes
Waterbody ID and Name:	GB530604002300 MEDWAY	
National Grid Reference:	TQ 82213 70920	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2015	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Bathing Water Directive, Freshwater Fish Directive, Natura 2000 (Habitats and/or Birds Directive), Nitrates Directive, Shellfish Water Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Flood Protection, Navigation	
Downstream Waterbody ID:	GB530603911401	

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Invertebrates	Moderate (Uncertain)	Good	
Macroalgae	Moderate (Uncertain)	Good	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1e)
Dissolved Oxygen	High	High	
2,4-dichlorophenol	High	High	
2,4-dichlorophenoxyacetic acid	High	High	
Arsenic	High	High	
Copper	High	High	
Dimethoate	High	High	
Iron	High	High	
Linuron	High	High	
Mecoprop	High	High	
Permethrin	High	High	
Toluene	High	High	

Supporting conditions

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Tidal Regime - Freshwater Flow	Supports Good	Supports Good	

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3e, M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Vessel Management	**In Place**
Site selection (dredged material disposal) (e.g. avoid sensitive sites)	**In Place**
Sediment management	**In Place**
Alter timing of dredging / disposal	**In Place**
Reduce impact of dredging	**In Place**
Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works)	**In Place**
Structures or other mechanisms in place and managed to enable fish to access waters upstream and downstream of the impounding works.	**In Place**
Indirect / offsite mitigation (offsetting measures)	**Not In Place**
Prepare a dredging / disposal strategy	**Not In Place**
Operational and structural changes to locks, sluices, weirs, beach control, etc	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Removal of hard bank reinforcement / revetment, or replacement with soft engineering solution	**Not In Place**
Remove obsolete structure	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Fail (Quite Certain)

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
1,2-dichloroethane	High	High	
Atrazine	High	High	
Benzene	High	High	
Cadmium And Its Compounds	High	High	
Hexachlorobenzene	High	High	
Hexachlorobutadiene	High	High	
Hexachlorocyclohexane	Moderate (Quite Certain)	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Nickel And Its Compounds	High	High	
Pentachlorophenol	High	High	
Simazine	High	High	
Tributyltin Compounds	High	High	
Trichlorobenzenes	High	High	
Trichloromethane	High	High	
Trifluralin	High	High	
Aldrin, Dieldrin, Endrin & Isodrin	High	High	
Carbon Tetrachloride	High	High	
para - para DDT	High	High	
Tetrachloroethylene	High	High	
Trichloroethylene	High	High	

Waterbody Category and Map Code.:	Transitional - T2	**Surveillance site:** Yes
Waterbody ID and Name:	GB530603911402	THAMES MIDDLE
National Grid Reference:	TQ 32950 80508	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2027	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Freshwater Fish Directive, Natura 2000 (Habitats and/or Birds Directive), Nitrates Directive, Urban Waste Water Treatment Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Coastal Protection, Flood Protection, Navigation	
Downstream Waterbody ID:	GB530603911401	

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Biological elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Invertebrates	Moderate (Uncertain)	Moderate	Not Required (MS)
Macroalgae	High	High	

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Inorganic Nitrogen	Moderate (Uncertain)	Moderate	Disproportionately expensive (N1o)
Dissolved Oxygen	Moderate (Uncertain)	Moderate	Disproportionately expensive (DO1a)
2,4-dichlorophenol	High	High	
2,4-dichlorophenoxyacetic acid	High	High	
Arsenic	High	High	
Copper	High	High	
Dimethoate	High	High	
Iron	High	High	
Linuron	High	High	
Mecoprop	High	High	
Permethrin	High	High	
Toluene	High	High	
Un-ionised ammonia	High	High	
Zinc	High	High	

Supporting conditions

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Tidal Regime - Freshwater Flow	Does not Support Good (Uncertain)	Does not Support Good	Disproportionately expensive (HT1a)

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Vessel Management	**In Place**
Modify vessel design	**In Place**
Manage disturbance	**In Place**
Site selection (dredged material disposal) (e.g. avoid sensitive sites)	**In Place**
Sediment management	**In Place**
Alter timing of dredging / disposal	**In Place**
Reduce sediment resuspension	**In Place**
Reduce impact of dredging	**In Place**
Prepare a dredging / disposal strategy	**In Place**
Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works)	**In Place**
Indirect / offsite mitigation (offsetting measures)	**Not In Place**
Operational and structural changes to locks, sluices, weirs, beach control, etc	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Remove obsolete structure	**Not In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Fail (Very Certain)

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
1,2-dichloroethane	High	High	
Atrazine	High	High	
Benzene	High	High	
Benzo (a) and (k) fluoranthene	High	High	
Benzo (ghi) perelyene and indeno (123-cd) pyrene	Moderate (Quite Certain)	Moderate	Technically infeasible (C2a)
Benzo(a)pyrene	High	High	
Cadmium And Its Compounds	High	High	
Diuron	Moderate (Uncertain)	High	
Fluoranthene	High	High	
Hexachlorobenzene	High	High	
Hexachlorobutadiene	High	High	
Hexachlorocyclohexane	High	High	
Lead And Its Compounds	High	High	
Mercury And Its Compounds	High	High	
Napthalene	High	High	
Nickel And Its Compounds	High	High	
Pentachlorophenol	High	High	
Simazine	High	High	
Tributyltin Compounds	Moderate (Very Certain)	Moderate	Technically infeasible (C2a)
Trichlorobenzenes	High	High	
Trichloromethane	High	High	
Trifluralin	High	High	
Aldrin, Dieldrin, Endrin & Isodrin	High	High	
Carbon Tetrachloride	High	High	
DDT Total	High	High	
para - para DDT	High	High	
Tetrachloroethylene	High	High	
Trichloroethylene	High	High	

Waterbody Category and Map Code.:	Transitional - T1	**Surveillance site:** Yes
Waterbody ID and Name:	GB530603911403 THAMES UPPER	
National Grid Reference:	TQ 21488 76502	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027, Good Chemical Status by 2015	
Justification if overall objective is not good status by 2015:	Technically infeasible	
Protected Area Designation:	Freshwater Fish Directive, Nitrates Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Coastal Protection, Flood Protection	
Downstream Waterbody ID:	GB530603911402	

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate

Supporting elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Dissolved Oxygen	Good	Good	
Un-ionised ammonia	High	High	

Supporting conditions

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Tidal Regime - Freshwater Flow	Does not Support Good (Uncertain)	Does not Support Good	Disproportionately expensive (HT1a)

Ecological Potential Assessment

Element	Current status	Predicted Status by 2015	Justification for not achieving good status by 2015
Mitigation Measures Assessment	Moderate	Moderate	Technically infeasible (M3f)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Operational and structural changes to locks, sluices, weirs, beach control, etc	**Not In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**Not In Place**
Managed realignment of flood defence	**Not In Place**
Remove obsolete structure	**Not In Place**

Waterbody Category and Map Code.:	Canal - Ca14	**Surveillance site:** No
Waterbody ID and Name:	GB70610068	River Lee Navigation, tidal section
National Grid Reference:	TQ 38604 81753	
Current Overall Potential	Moderate	
Status Objective (Overall):	Good by 2027	(For Protected Area Objectives see Annex D)
Status Objective(s):	Good Ecological Potential by 2027	
Justification if overall objective is not good status by 2015:	Disproportionately expensive, Technically infeasible	
Protected Area Designation:	Nitrates Directive	
SSSI (Non-N2K) related:	No	
Hydromorphological Designation:	Heavily Modified	
Reason for Designation:	Flood Protection, Navigation, Urbanisation	
Downstream Waterbody ID:		

Note: Current Status and Status Objectives for this water body are based on Expert Judgement

Ecological Potential

Current Status (and certainty that status is less than good)	Moderate (Uncertain)

Mitigation Measures that have defined Ecological Potential

Mitigation Measure	Status
Appropriate techniques (invasive species)	**In Place**
Appropriate timing (vegetation control)	**In Place**
Appropriate vegetation control technique	**In Place**
Selective vegetation control regime	**In Place**
Manage disturbance	**In Place**
Site selection (dredged material disposal) (e.g. avoid sensitive sites)	**In Place**
Sediment management	**In Place**
Alter timing of dredging / disposal	**In Place**
Reduce sediment resuspension	**In Place**
Reduce impact of dredging	**In Place**
Prepare a dredging / disposal strategy	**In Place**
Avoid the need to dredge (e.g. minimise under-keel clearance; use fluid mud navigation; flow manipulation or training works)	**In Place**
Preserve and where possible enhance ecological value of marginal aquatic habitat, banks and riparian zone	**In Place**

Chemical Status

Current Status (and certainty that status is less than good)	Does not require assessment

Chemical Status

Current Status (and certainty that status is less than good)	Good

Chemical elements

Element	Current status (and certainty of less than good)	Predicted Status by 2015	Justification for not achieving good status by 2015
Cadmium And Its Compounds	High	High	
Mercury And Its Compounds	High	High	