REPORT

Goodwin Sands Aggregate Dredging Scheme Marine Licence Application

Response to MMO Clarification Requests, December 2016

Client: Dover Harbour Board

Reference: I&BPB1552R001F0.1

Revision: 0.1/Final

Date: 10 August 2017

Royal HaskoningDHV
Enhancing Society Together

HASKONINGDHV UK LTD.

Rightwell House
Rightwell East
Bretton
Peterborough
PE3 8DW
Industry & Buildings
VAT registration number: 792428892

+44 1733 334455 **T**
+44 1733 262243 **F**
info.exeter@uk.rhdhv.com **E**
royalhaskoningdhv.com **W**

Document title:	Goodwin Sands Aggregate Dredging Scheme Marine Licence Application
Document short title:	MLA/2016/00227
Reference:	I&BPB1552R001F0.1
Revision:	0.1/Final
Date:	10 August 2017
Project name:	Goodwin Sands MLA
Project number:	PB1552
Author(s):	Royal HaskoningDHV

Classification
Project related

MANAGEMENT SYSTEM CERTIFICATION DNV·GL ISO 9001 = ISO 14001 OHSAS 18001

Disclaimer

Royal HaskoningDHV

Table of Contents

Table of Tables

Table of Figures

Royal HaskoningDHV

Appendices

Appendix 1 November 2016 Heritage Meeting Minutes

Appendix 2 Archaeological Review of Geophysical Data (Wessex Archaeology, 2017)

Appendix 3 Annex to Archaeological Review of Geophysical Data (Wessex Archaeology, 2017)

1 Introduction

Following submission of the Further Environmental Information Report (FEIR) (Royal HaskoningDHV (RHDHV), 2016a) in September 2016 and a second round of public consultation, the Marine Management Organisation (MMO) has requested further clarifications from Dover Harbour Board (DHB) to enable it to reach a decision on the Goodwin Sands Aggregate Dredging Scheme Marine Licence Application (MLA) (reference number MLA/2016/00227).

This report sets out the comments and observations raised by the MMO in December 2016 and provides a response to each, including additional points where relevant. Significant additional work has been undertaken since January 2017 to inform the approach to the proposed aggregate extraction from the Goodwin Sands and an update is provided on this. The clarifications provided on the six areas raised by the MMO (consideration of alternatives, socio-economics, marine mammals, heritage, nature conservation, and fisheries/shellfisheries) are set within the context of the project update and build upon this as appropriate.

This document also seeks to acknowledge the additional comments from the MMO and its Primary Advisors. For ease of reference, the comments and queries raised in the MMO's letter of the 20th December 2016 are provided within the body of this report.

2 Project Update

The MLA to extract material from the Goodwin Sands is being made in order to provide infill for the reclamation works for the Dover Western Docks Revival (DWDR) Scheme. Since DHB received comments from the MMO in December 2016, a considerable amount of extra work has been carried out to inform and refine the construction details of the DWDR Scheme and the associated resource sought from the Goodwin Sands. In January 2017, in order to meet the commercial demands of this project and to progress the marine civil engineering aspects of the DWDR Scheme, DHB mobilised its appointed contractor VolkerStevin BoskalisWestminster (VSBW) as the main contractor for Stages 1 and 2.

In April 2017 DHB commissioned Clinton Marine Survey to carry out the following surveys of the proposed dredge footprint[1] and an additional 250m buffer zone around the extent of this footprint (see **Figure 6-4**):

- Marine magnetometer (line spacing of approximately 7m, towed about 3m above the seabed)
- Sidescan sonar (range of 50m with a line spacing of 50m)
- Multibeam echosounder (line spacing of 50m)
- Sub-bottom profiler (line spacing of approximately 7m)

Wessex Archaeology was commissioned to undertake an archaeological review of the high resolution geophysical data obtained from these surveys. This review identified a total of 314 sites of potential archaeological interest within the exploration and proposed dredge area. Of these, none were identified as A1 (anthropogenic origin of archaeological interest); 305 were classified as A2 (uncertain origin of potential archaeological interest) and 9 were discriminated as O2 (uncertain origin of possible archaeological interest but outside the vertical footprint of the proposed works). In addition, one UKHO record (7006) with no corresponding geophysical anomalies has been identified within the survey area.

In light of the interpretation provided by Wessex Archaeology, DHB has significantly refined the proposed dredge footprint to avoid most of the 305 anomalies and therefore minimise the risk of potential disturbance as far as possible (see **Figure 2-1**). Precautionary exclusion zones (PEZ) or buffers of 25m have also been placed around the 23 anomalies that now remain within the refined dredge footprint in order to ensure they too are avoided. A more detailed summary of the interpreted geophysical data is provided in **Section 6** of this report and full details on the archaeological interpretation of the raw data is provided as a supporting document to this submission[2].

In addition to the further archaeological investigations, DHB has analysed the 2017 bathymetric data to confirm that sufficient dredge resource (i.e. the thickness of sand present above the maximum dredge depth of -1.95m) is available across the proposed dredge footprint. This is based on the proposed dredging methodology which, in order to maximise productivity while minimising potential impacts on environmental receptors, will involve extracting material evenly across the dredge footprint with an average depth of approximately 1m. As confirmed in the FEIR (RHDHV, 2016a) DHB will maintain a minimum average sediment layer of 1m above bedrock. In reviewing these data in light of the dredge footprint that has been refined to avoid archaeological anomalies, it is evident that more than sufficient resource would still be available to meet the requirements of the DWDR scheme. **Table 2-1** provides a high level calculation of the available resource as confirmed through this analysis.

[1] Referred to in the Goodwin Sands Environmental Statement (ES) and FEIR as the 'proposed dredge footprint/Primary Impact Zone (PIZ)' and amended to allow for seal exclusion zones
[2] Goodwin Sands Archaeological review of Geophysical Data (2017), Wessex Archaeology

Table 2-1 Calculated dredge resource within the originally proposed and refined dredge footprints

Dredge footprint	Area (million m^2)	Available volume (assuming removal of 1m material across the dredge area) (million m^3)
Originally proposed dredge footprint	3.23	3.23
Refined dredge footprint (with 50m PEZ removed)	2.36	2.36

Extracting material to a relatively shallow depth across the dredge footprint will help to ensure that material extracted from the Goodwin Sands for the DWDR project is more likely to comprise deposits which the bathymetric data indicates have recently accumulated; this should further minimise the risk to unknown archaeological artefacts. Taken together with the additional mitigation introduced through the refined dredge footprint it is considered that the potential for previously unidentified *in situ* wrecks and aircraft to be present within the target aggregate is low. Information on further heritage matters as raised in the MMO's response of December 2016 is provided in **Section 6** of this report. **Figure 2-1** provides an illustration of the proposed dredge footprint as it has evolved over time, including the reduced dredge footprint identified in light of the results of the archaeological surveys. It should be noted that the eastern boundary of the dredge footprint has also been updated in light of the 2017 bathymetric data to reflect the changing 6.1m depth contour (i.e. to avoid intertidal areas).

Although DHB has confirmed that sufficient resource for the whole project can be secured from the Goodwin Sands refined dredge footprint, the requirement for a third round of public consultation of the Goodwin Sands MLA has resulted in the determination of the MLA being later than originally envisaged in the project planning. In order to avoid delays to the programme, DHB has been obliged to instruct VSBW to source material for the preliminary stages of reclamation, scheduled to commence in September 2017, from an alternative licenced marine aggregate site. VSBW has duly secured delivery of c. 500,000m^3 of material for the first reclamation campaign from Licence Area 501 (Thames Estuary). In light of this, the MLA has been updated to reflect the lower volume of material now required from the Goodwin Sands, as detailed in **Table 2-2**.

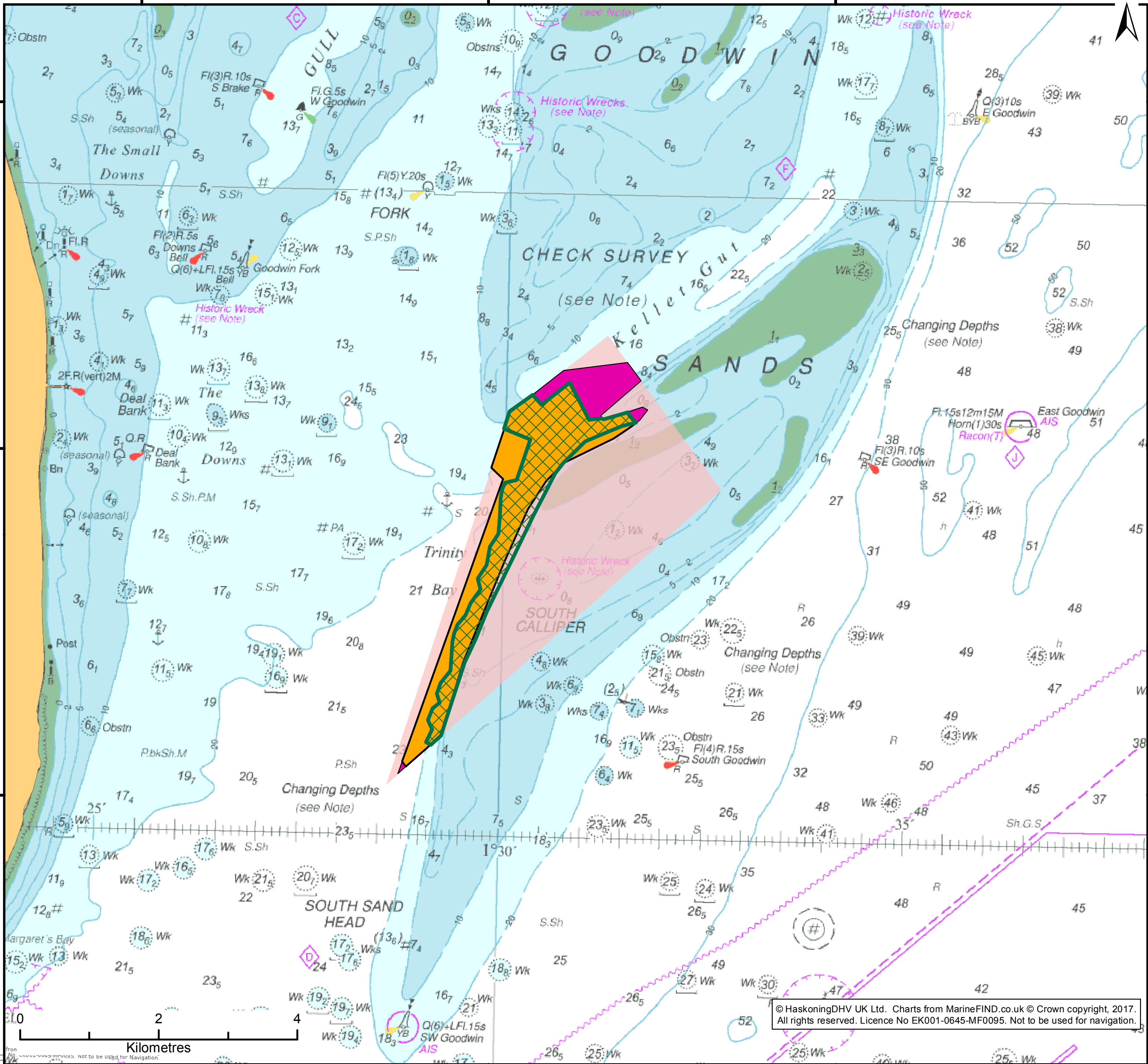
The steps described above have been taken to ensure the overall project programme can be maintained, however it has resulted in significant additional cost and delays to the programme and sourcing all of the reclamation material required to deliver the DWDR Scheme from site 501 is not considered a viable option. The preferred option for sourcing the reclamation material for all stages of the DWDR Scheme remains the Goodwin Sands.

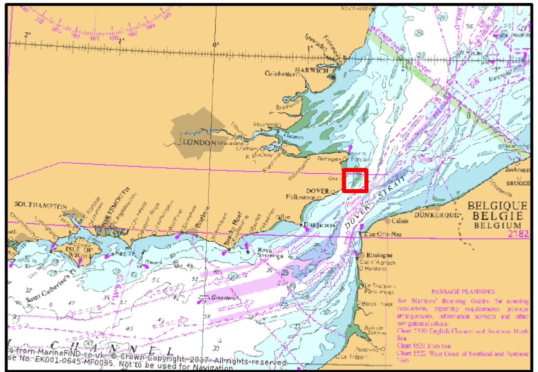
The changes to the overall construction programme have also necessitated an update to the indicative dredging programme as detailed in Table 2.1 on page 17 of the Goodwin Sands Aggregate Extraction Environmental Statement (hereafter referred to as the ES (RHDHV, 2016b); see **Table 2-2**.

Table 2-2 Updates to indicative dredge programme and volumes for the Goodwin Sands MLA

Details as per the Goodwin Sands ES (RHDHV, 2016)		Updated dredge details (2017)	
Estimated dredge timings	Estimated dredge volume (m^3)	Estimated dredge timings	Estimated dredge volume (m^3)
September – December 2017	2,500,000	Mid-November 2017 – Mid-April 2018	800,000
May – August 2018		June 2019 – September 2019	1,200,000
April – July 2019			

All other aspects of the dredging methodology remain as described in the ES. The updated dredging programme comprises two stages instead of three and, whilst the first stage is longer than the stages previously identified, dredging is likely to be discontinuous during this period and there is a much greater period of time between successive campaigns. In terms of potential effects therefore the updated dredge programme is not considered to be significantly different to that described in the ES and the outcomes of the EIA are considered to remain unchanged. Furthermore, as the updated dredge volume is anticipated to be 500,000m^3 lower than that identified in the original MLA, any impacts arising from the dredging activities can be considered to be the same or lower than those assessed in the Goodwin Sands ES (RHDHV, 2016b).





Legend:

- Refined Dredge Footprint (2017)
- Revised to avoid subtidal coarse sediment (2017 see Section 5)
- Originally Proposed Dredge Area / PIZ (2016 ES)
- Exploration Area

Client:	Project:
Dover Harbour Board	MMO Response December 2016

Title: Dredge Footprint Evolution

Figure: 2.1 | Drawing No: PB2107/ARCH/001

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	06/12/2016	JE	VC	A4	1:80,000
02	02/08/2017	NJ	VC	A4	1:80,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV
Enhancing Society Together

PORT OF DOVER
DWDR

3 Consideration of Alternatives

MMO Comment

Comment No.	Comment
1.1	*Further clarification and justification as to why aggregate material cannot be obtained from a combination of licensed aggregate sites must be provided.*
1.2	*Further information must also be provided to demonstrate the suitability and feasibility of all the 16 aggregate sites within 65km to 170km of Dover Harbour and not just the 4 sites shown in Table 1 in page 4.*
1.3	*The MMO is aware that consideration is being given to the use of recycled material from terrestrial developments in Dover. Details of the location of the recycled material and the amount of material to be obtained must be provided.*
1.4	*The CO_2 conversion factor used in the alternatives section is different to the conversion factor on the BMAPA website: http://www.bmapa.org/documents/BMAPA_Ninth_Annual_SD_Report_2015.pdf Clarification is required on whether the correct conversion factor has been used. If it has not, then the revised figures must be presented.*

3.1 Introduction

As part of the MLA, the Goodwin Sands ES (RHDHV, 2016b) considered a number of licensed marine aggregate sites within 200km of the Port of Dover (herein referred to as the Port) as alternative sources of reclamation material (see below and **Figure 3-1**); these are listed as 16 sites in Table 1 on page 4 of the FEIR. It should be noted that within that table, an additional site described as 'Greenwich Light East/EEC North/EEC South' is also included and is an erroneous duplication. The following list correctly describes the 15 sites considered as potential alternatives to the Goodwin Sands:

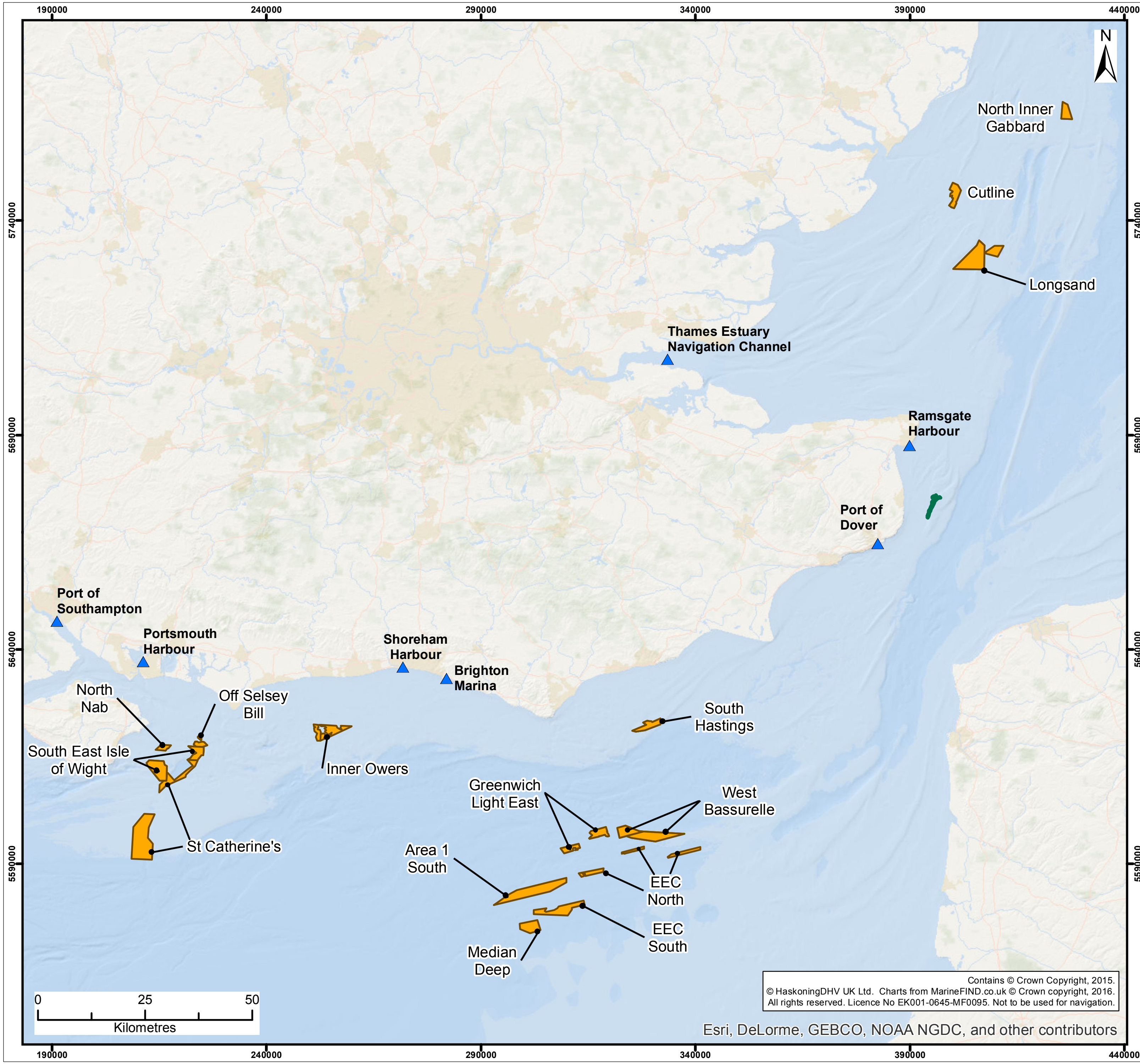
- South Hastings
- Longsand
- Cutline
- West Bassurelle
- Greenwich Light East
- EEC North
- EEC South
- Area 1 South
- North Inner Gabbard
- Median Deep
- Inner Owners
- Off Selsey Bill
- South East Isle of Wight
- St Catherine's
- North Nab

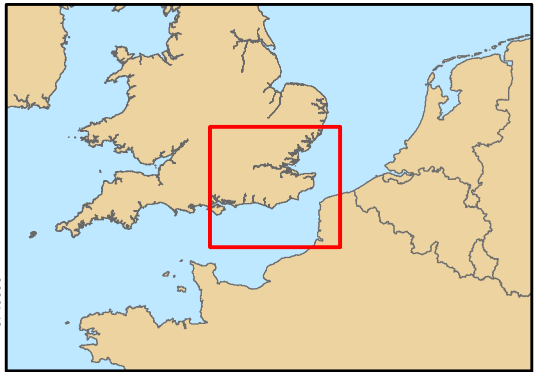
Schedule 3 of the Marine Works Environmental Impact Assessment Regulations 2007 (the EIA Regulations) states that any Environmental Statement must include "*An outline of the main alternatives* *studied by the applicant and an indication of the main reasons for the applicant's choice, taking into account the environmental effects of those alternatives and the project as proposed.*" The conclusion of this process as presented in the ES was that the Goodwin Sands was the most suitable site from which to obtain sandy material required for the development of the DWDR scheme. Further information on the relative suitability of the alternative sites considered in this process is provided below.

The impacts of extraction at the 15 alternative marine aggregate extraction sites could potentially differ from those identified for the Goodwin Sands in relation to the following factors:

- Nature and scale of extraction activities;
- The magnitude of environmental changes; and
- The specific sensitivities and values of the environmental receptors at and around the sites.

However, given the inherent similarities in aggregate extraction techniques across all marine aggregate sites, it is reasonable to conclude that the nature of the impacts assessed for the proposed extraction at the Goodwin Sands will be broadly similar to those assessed for the alternative aggregate sites. In granting the aggregate extraction licences for the alternative sources of marine aggregates, the consenting authority (the MMO) would have required the applicant to undertake the necessary assessment of impacts (e.g. EIA, Habitats Regulations Assessment (HRA) etc.). As such, in coming to a decision, the MMO (or its predecessor) must have judged the extraction activities to be environmentally acceptable (taking into account mitigation measures). It can therefore be concluded that the process of extracting aggregate from the 15 marine aggregate sites considered as potential alternative sources of fill material for the DWDR Scheme will result in broadly comparable environmental effects. The assessment of the suitability of alternative sources therefore focusses on differentiating factors linked to the relative sustainability of each option. The following sections provide an overview of these factors and provides specific context for the Goodwin Sands MLA.





Legend:

- Refined Dredge Footprint (2017)
- Licensed Aggregate Sites
- Maintenance Dredging Areas

Client:	Project:
Dover Harbour Board	MMO Response December 2016

Title:

Licenced Marine Aggregate Dredging Areas and Maintenance Dredging Locations

Figure:	3.1	Drawing No:	PB2107/ES/055		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	25/02/2016	JE	DC	A4	1:1,250,000
02	03/08/2017	NJ	CP	A4	1:1,250,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV
Enhancing Society Together

PORT OF DOVER
DWDR

3.2 Factors for Consideration

3.2.1 Sailing Distance

In considering the alternative sources of aggregate that could be available to support the DWDR Scheme, a review of the licensed marine aggregate sites within reasonable sailing distance was undertaken. From discussion with a number of dredging contractors, it is evident that sailing distances greater than 100km are rarely considered practical due to implications for plant size and productivity i.e. to remain economically viable, travelling greater distances necessitates the use of proportionately larger dredgers.

Larger dredgers have increased capacities and more powerful suction pumps so can move more material in one go and this can, ordinarily, provide economies of scale to help mitigate the increased costs associated with having to travel greater distances. There are, however, other issues to consider, including the operating draft of the vessels relative to the depth of water at both the dredging site and the discharge site, and the ability of the construction site to receive a given volume of material at a given time. For example, the most economical way of transporting material from an extraction site further afield would be to use a dredger such as the Prins der Nederlanden or the Oranje, having a hopper capacity in the region of 16,000m^3, and a loaded draught of 12m. However, the available depth of water in the approach to the DWDR site limits the draft of vessels to 9m, meaning that large dredgers of this type cannot be used to capacity. Furthermore, the later stages of construction demand the careful and controlled discharge of material into the works which a larger dredger cannot achieve. Consequently, DHB is prevented from fully mitigating the effects of distance by using larger dredgers and would be required to use less efficient smaller dredgers.

In summary, a greater distance necessitates either the use of larger dredgers or a higher level of activity using a smaller dredger. Both of these scenarios increase the financial cost of the project. In addition, larger dredgers are technically unsuitable for the later stages of the reclamation works as a result of site engineering constraints associated with construction. For this reason, Goodwin Sands, which offers the shortest sailing distance of all potential sites and can be accessed by the optimum size of dredger to complete the necessary works at the Port, is the preferred option. Further discussions of the economic considerations relevant to the application are set out in **Section 3.2.4.**

3.2.2 Energy Consumption

In addition to the consideration of sailing distance for sourcing aggregate from licensed extraction areas for the DWDR Scheme, the environmental impacts linked to increased energy consumption are also relevant. As discussed in the Goodwin Sands ES (RHDHV, 2016b) and the FEIR (RHDHV, 2016a), transporting aggregate greater distances would impact air quality due to increased vessel emissions. Furthermore, sourcing aggregate from greater distances may result in additional noise and visual impacts as a result of an extended construction programme for the DWDR Scheme.

When considering the specific matter of emissions, calculations have been carried out to assess the relative levels of carbon dioxide (CO_2) emissions that would be generated per 'round trip' (i.e. a return trip from the Port to the aggregate extraction site) for each of the 15 licensed sites within 200km of the Port. Based on the conversion factors released each year by the Department for Energy and Climate Change (DECC), these calculations clearly indicate that the greater the distance travelled, the greater the levels of CO_2 emissions (see Table 3-1). For example, the CO_2 emissions associated with obtaining aggregate from Extraction Area EEC South are almost nine times higher than those arising from obtaining aggregate from the Goodwin Sands. It should be noted that the information presented in **Table 3-1** is based on a straight line route between each extraction site and the Port; depending on the draught of the dredging vessel, it may not always be possible to follow straight line routes due to the presence of naturally occurring seabed features. Should a straight line route not be possible the distance travelled would be greater and the CO_2 emissions accordingly higher. Since the energy consumption for extracting, producing and processing aggregates is similar between sites, it can be concluded that the environmental sustainability with respect to CO_2 emissions of alternative marine based sources is less acceptable than the use of aggregates from Goodwin Sands.

Table 3-1 Vessel CO_2 emissions from marine aggregate extraction sites within 200km of the Port

Site Name	Sailing Distance from the Port (km)	Vessel CO_2 Emissions (kg per return trip)[3]
Goodwin Sands	12	62,058,020
South Hastings	65	336,147,611
Longsand	68	351,662,116
Cutline	81	418,891,638
West Bassurelle	81	418,891,638
Greenwich Light East	91	470,606,655
EEC North	81	418,891,638
EEC South	107	553,350,683
Area 1 South	106	548,179,181
North Inner Gabbard	109	563,693,686
Median Deep	118	610,237,201
Inner Owners	129	667,123,720
Off Selsey Bill	163	842,954,778
South East Isle of Wight	165	853,297,782
St Catherine's	167	863,640,785
North Nab	170	879,155,290

In response to comment 1.4 in its letter of the 16^{th} December 2016 and as discussed with the MMO (David Morris, pers. comm., 16/02/17), the Ninth Annual Sustainable Development Report (British Marine Aggregate Producers Association (BMAPA), 2015) references the 2008 Department for Food, Environment and Rural Affairs (Defra) Guidelines to Greenhouse Gas Conversion Factors for Company Reporting). The CO_2 conversion factor used in the FEIR (RHDHV, 2016a) and the calculations used to arrive at the figures provided in **Table 3-1** above is the 2016 factor for Marine Gas Oil which is the latest conversion factor produced by the DECC and therefore the most accurate and relevant conversion factor to use in this instance.

3.2.3 Suitability and Availability of Material

One of the key considerations when reviewing alternative aggregate sources is the suitability of the extracted material for use in the reclamation of land in the DWDR Scheme. The design of the scheme has been developed with sand as the planned reclamation material in line with that available from the

[3] CO_2 emissions calculated based on the Department for Business, Energy and Industrial Strategy Green House Gas Reporting 2016 Conversion Factors: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016

Goodwin Sands. The engineering properties of material from the Goodwin Sands are well known due to their previous historical use within Dover Harbour and other UK based projects (see Table 3-2).

Table 3-2 Summary of historical use of infill material previously dredged from the Goodwin Sands

Area	Name	Client	Use	Year	Volume (m^3)
293/1	South Goodwin	DHB	Construction of hoverport in Western Docks	1976	860,000
304	South Goodwin	DHB	Eastern Docks Development Phase 3	1978–1979	4,380,000
342	Goodwin Sands	DHB	Land Reclamation at Eastern Docks	1984-1998, 1998	
352	North Goodwin	Port of Ramsgate	Land reclamation	1986, 1990	Unknown
365	North Goodwin	Channel Tunnel	Construction	1990–1998: Channel Tunnel Terminal[4]	~ 4,000,000

During the design phase of the DWDR Scheme, it was prudent to use material for which engineering parameters were known, to provide assurance that the engineering performance requirements of the reclaim would be achieved and avoid the likely variance in using material from unknown sites. Whilst utilisation of larger/mixed aggregate is possible, deviation from the material properties assumed during the planning and design phase would require updates to the structural calculations and detailed design.

All of the later elements of the DWDR Scheme construction programme depend on delivery of the reclamation material ‘on-time’. Updating the calculations to accommodate a material with different engineering properties has implications on the project programme and therefore cost. It is noted that other reclamation projects within the UK have made use of a range of infill material types; however these choices would have been dictated by consideration of factors such as proximity to source as well as cost. For example, for the Liverpool 2 port expansion, a mix of gravel/pebbles/cobbles were used as infill for part of the scheme as this material was located only a few hundred metres from the reclamation site.

In addition to the suitability of the material, its availability (in terms of volume and timing) is also an important factor. The various marine aggregate sites under consideration are licensed to different commercial operators, with differing conditions on their extraction licences linked to, for example, maximum extraction volumes, access windows and seasonality. Furthermore, the majority of the licensed capacity at each site tends to be committed to existing customers within the construction industry. Some licensed operators do, however, allow within their annual extraction volumes a percentage of ‘spare capacity’ which is available to purchase on the open market. Consultation with the relevant aggregate companies has provided information on the available spare capacity at some sites within 100km of Dover Harbour and within the timeframes that DHB wishes to deliver the reclaim activities for the DWDR scheme.

[4] *Boskalis Westminster, 2015*

Table 3-3 provides a summary of the types of aggregate material available from all 15 sites considered, together with an overview of availability. It is noteworthy that very few of the alternative extraction sites yield sand rich material, with most containing a significant percentage of gravel. In addition, there appear to be some limitations on sourcing the required volume of material from the nearer alternative sites within the timeframes required by the DWDR construction programme. DHB has investigated the potential of sourcing material from a combination of licensed aggregate sites however whilst this is a technical possibility, it is not considered to be a viable option in light of the additional costs involved (largely for the reasons already described above). Drawing on multiple sources to supply material for a discrete aspect of the construction works may also introduce a requirement for blending which would represent further delay and cost to the Scheme.

In summary, in making its application for the use of Goodwin Sands, DHB has considered the suitability of material that may be sourced from alternative marine aggregate extraction sites. While material *is* available from other locations, the geotechnical properties vary from those built into the engineering design of the DWDR Scheme. Although it would be possible to make use of alternative material types this would introduce delays to the project programme, would increase the overall project costs and could represent an inefficient use of construction quality aggregate. Furthermore, it appears that availability is limited from alternative marine aggregate sources within the timeframes of the DWDR construction programme. For these reasons Goodwin Sands, which offers the closest source of geotechnically suitable material that is available to meet the programmed reclaim dates, is the preferred option.

3.2.4 Economics

In addition to the environmental, engineering and logistical aspects it is appropriate that economics is a key factor when considering the suitability of alternative marine aggregate sources for the DWDR Scheme. Schedule 3 of the EIA Regulations focuses on the environmental effects of alternatives and in the case of Goodwin Sands the EIA is linked to the marine licensing process. The purpose of the licensing process is to permit licensable activities in a way that is compliant with the law and government's policy outcomes. Central to the licensing process is the activity under consideration which the applicant has chosen to put forward. If carrying out that activity in an alternative manner makes it non-viable from an economic point of view, then the whole purpose of the licensing process falls away. Costs associated with sourcing material from alternative aggregate extraction sites is therefore a relevant factor that needs to be considered.

The costs associated with sourcing material from different aggregate extraction sites are based on four main factors:

- The cost of the material itself (which includes a percentage profit to the licence holder, which is determined on a case by case basis);
- The aggregate levy (assuming the aggregate being used is considered primary aggregate);
- Royalties payable to The Crown Estate (as the mineral owner), and
- The cost of transporting and placing the material (the approach to which is limited by the maximum available draught at the DWDR site of 9m).

Whilst some of these factors are fixed (e.g. the aggregate tax levy is currently set at £2/tonne), some are case specific and subject to market forces. In view of these uncertainties, DHB has compared the transportation costs of obtaining reclamation material from the different sites to the transportation costs of extraction from the Goodwin Sands. As some of this information is considered by DHB to be commercially sensitive, for the purposes of this report the results of this assessment are provided in relative terms using the following scale:

- Transportation costs of <1.5 times greater than that incurred if using the Goodwin Sands are considered to be 'Higher'
- Transportation costs of 1.5-2 times greater than that incurred if using the Goodwin Sands are considered to be 'Much Higher'
- Transportation costs of >2 times greater than that incurred if using the Goodwin Sands are considered to be 'Very High'
- Transportation costs of >3 times greater than that incurred if using the Goodwin Sands are considered to be 'Extremely High'

The results of this analysis demonstrate that, taking into account the cost of the material, aggregate tax levy, royalties and transportation costs, sourcing infill from any of the 15 alternative sites is substantially more expensive than obtaining material from the Goodwin Sands. Using the scale described above, the costs of extracting from all the alternative sites are either 'Very High' or 'Extremely High' relative to extracting material from the Goodwin Sands. This information is provided for each of the 15 alternative sites in **Table 3-3**. The relative cost of extraction from Area 501 (which has been secured for the first stage of reclamation as set out above) is also included for completeness.

It is evident from the assessment of the relative cost of aggregate extraction that sourcing the fill material from alternative sites has considerable cost implications for DHB and, as a result, has the potential to threaten the delivery of the later stages of the DWDR Scheme. Much of the difference in relative costs is a factor of the increasing sailing distances from Dover. As alternative areas become further away from Dover, the rate for each alternative area goes up directly in proportion to the increased sailing distance. This is because whilst the weekly costs of running the vessel remain almost the same, the dredge cycle time increase and therefore the number of loads delivered each week decreases i.e. productivity decreases.

Table 3-3 Summary of all factors taken into consideration of the suitability and feasibility of the 15 marine aggregate extraction sites within 200km of the Port; Area 501 (confirmed as the source for the initial reclaim campaign) is included for completeness

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
Goodwin Sands	n/a	DHB	Subject to MLA for 2,500,000m^3 (approx. 6,016,325.66 tonnes)	4-25	12	62,058,020	Sand	n/a	£4.6M (for 1.2Mm^3 sand)	Geographically closest & most economically viable; No other current extraction demands on this site; Design material; Sufficient tonnage available.
South Hastings-	460	CMX	2,000,000	21	65	336,147,611	Coarse Sediment (sand and gravel shingle)	Multiple licence holders; Timing restrictions on access to site.	Very High	Geographically next closest; Geotechnically suitable material; Licence holders have indicated insufficient spare capacity to meet DWDR programme
	460	TM	1,000,000							
	460	HN	2,000,000							
Longsand	508	BA	1,500,000	18-24	68	351,662,116	Sand and	Multiple licence	Very High	Geotechnically suitable as

[5] CO_2 emissions calculated based on the Department for Business, Energy and Industrial Strategy Green House Gas Reporting 2016 Conversion Factors: https://www.gov.uk/government/publications/greenhouse-gas-reporting-conversion-factors-2016
[6] Where <1.5x greater is considered to be 'Slightly Higher''; 1.5-2x greater is considered to be 'High'; 2 – 2.5x greater is considered to be 'Very High'

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
	509/3	TM	1,500,000				Coarse / Mixed Sediment Estimated 55% gravel	holders; Timing restrictions on access to site; Existing commercial commitments for supplying aggregate licensed for extraction.		infill (would require updated calculations); Licence holders have indicated some availability within annual extraction limits at 508 (400,000m^3 per annum); heavy commitments into the London market within the DWDR timeframe.
	510/1	CMX	1,300,000							
	510/2	CMX								
Thames Estuary	501	WG	2,000,000	40-45	81	209,445,819	Sand/coarse mixed sediment	None	Very High	Geotechnically suitable material; No restrictions Volume available for Sept 2017 start; selected for DWDR Stage 1 reclaim
Cutline	447	TM	500,000	15	81	418,891,638	Coarse Sediment	Multiple licence holders	n/a	This site is no longer available due to expiration of Marine Licence.
		HN	1,000,000							
		CMX	1,000,000							
West Bassurelle	458	CMX	5,000,000	35-40	81	418,891,638	Coarse Sediment (gravelly sand)	Multiple licence holders;	Very High	Geotechnically suitable as infill (would require updated calculations); Licence holders have only

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
		TM	5,000,000							indicated some availability within annual extraction limits
	464	CMX	5,000,000							
		TM	5,000,000							
Greenwich Light East/ EEC North/ EEC South	473	HN	8,666,667	42	91	470,606,655	Coarse Sediment	Multiple licence holders; extraction limitations in Dec/Jan; limitations on dredger positioning in adjacent areas	Very High	Geotechnically suitable as infill (would require updated calculations);; Licence holders have only indicated some availability within annual extraction limits Increased sailing distance leads to increased CO_2 emissions as well as disproportionately more
	474	HN			81	418,891,638				
	475	HN			81	553,350,683		No dredging between 1st Dec and 31st Jan		

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
	473	CMX	1,333,333		91	470,606,655		Extraction limitations in Dec/Jan; limitations on dredging activity in adjacent areas	Very High	cost and risk of programme delay/ Sailing distance too high to be considered as a cost effective alternative.
Area 1 South	478	DM	3,000,000	41	106	548,179,181	Coarse Sediment	Restrictions on dredge locations in Dec/Jan; limitations on dredger numbers	Very High	Sailing distance too high to be considered as a cost effective alternative. Increased water depth in this location would dictate use of particular dredging fleet; a dredger equipped to dredge from this depth would likely not be suitable for direct discharge of the material into the reclaim areas within Dover Harbour.
North Inner Gabbard	498	BA	350,000	27	109	563,693,686	Coarse / Mixed Sediment	Multiple licence holders;	Very High	Sailing distance too high to be considered as a cost effective alternative. Increased water depth in this location would dictate use of particular dredging

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
	498	VD	350,000							fleet; a dredger equipped to dredge from this depth would likely not be suitable for direct discharge of the material into the reclaim areas within Dover Harbour.
Median Deep	461	VD	5,000,000	35	118	610,237,201	Coarse Sediment	Timing restrictions on access to site;	Very High	Sailing distance too high to be considered as a cost effective alternative. Increased water depth in this location would dictate use of particular dredging fleet; a dredger equipped to dredge from this depth would likely not be suitable for direct discharge of the material into the reclaim areas within Dover Harbour.
Inner Owners	396/1	TM	1,000,000	10.3-25.0	129	667,123,720	Coarse Sediment	Multiple sites in close proximity to each other and multiple	Very High	Sailing distance too high to be considered as a cost effective alternative.
	396/2	TM								

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
	435/1	HN	1,000,000		129		Sand and Gravel	licence holders;		
	435/2	HN								
	488	TM	500,000	5.8 – 20.2	129		Sand and Gravel			
	453	CMX	500,000		129		Sand and Gravel			
Off Selsey Bill	395/1	KB	1,500,000	12-29	163	842,954,778	Sand and Gravel	Multiple licence holders;	Extremely High	Sailing distance too high to be considered as a cost effective alternative.
	395/2	KB								
	395/1	TM	1,000,000							
	395/2	TM								
South East Isle of Wight	340	VD	1,000,000	20-37	165	853,297,782	Coarse Sediment	Multiple licence holders; extraction limited annually; busy shipping area; navigational	Extremely High	Sailing distance too high to be considered as a cost effective alternative. Increased water depth in this location would dictate use of particular dredging fleet; a dredger equipped
	340	CMX	1,000,000							

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
								features		to dredge from this depth would likely not be suitable for direct discharge of the material into the reclaim areas within Dover Harbour.
	351	VD	1,500,000	14-41						
	351	TM	1,500,000							
St Catherine's	451	WG	2,500,000	23-47	167	863,640,785	Coarse Sediment	Site restrictions linked to archaeological artefacts; the max extraction limits are divided into different zones within the site	Extremely High	Sailing distance too high to be considered as a cost effective alternative. Increased water depth in this location would dictate use of particular dredging fleet; a dredger equipped to dredge from this depth would likely not be suitable for direct discharge of the material into the reclaim areas within Dover Harbour.
North Nab	372/1	HN	500,000	18	170	879,155,290	Coarse Sediment	Limitations on number of dredgers active at the same time; onboard screening not permitted;	Extremely High	Sailing distance too high to be considered as a cost effective alternative.

Site Name	TCE Ref	Licence Holder	Extraction Volume Limit (tonnes per annum)	Site Depth (m)	Sailing Distance	Energy Consumption	Suitability and Availability of Material		Economics	Main Drivers
					Sailing Distance (km)	CO_2 Emissions (kg per return trip)[5]	Type of material	Licence constraints	Transportation costs relative to Goodwin Sands[6]	
								specified transit routes for certain sites within the licensed area		

Abbreviations

RMA – Resource Management Association
BA – Britannia Aggregates Ltd.
TM – Tarmac Marine Ltd.
CMX – CEMEX UK Marine Ltd.
HN – Hanson Aggregates Marine Ltd.
DM – DEME Building Materials Ltd.
VD – Volker Dredging Ltd.
KB – Kendall Bros. (Portsmouth) Ltd.
WG – Westminster Gravels Ltd.

3.3 Recycled Material

A fundamental part of the consideration of alternatives under the EIA Regulations relates to the availability of secondary aggregate or recycled material. DHB has sought to maximise the utilisation of recycled material in the DWDR Scheme and to date has identified 49,780m^3 of secondary material that is planned for use as infill, hard-standing or piling mats; a further ~7,000m^3 of recycled rock will also be utilised in the new areas of rock armour. A summary of these materials, their sources and their potential use is provided in **Table 3-4**. Other sources of material have been considered but have proved unsuitable, and details of these are included in **Table 3-4** for completeness. DHB intends to continue to review the availability of local recycled materials throughout the lifetime of the DWDR Scheme and will seek to make use of any suitable secondary aggregate as appropriate.

Table 3-4 Potential sources of recycled material for use in the DWDR Scheme

Provider	Material Type	Source	Possible Use	Approximate Amount of Recycled Material
Ling Demolition	Crushed demolition materials (concrete)	Hover Port	Infill material, hard standings, piling mats	24,400m^3
Grahams/Dover Demolition Services	Crushed demolition materials (concrete)	Prince of Wales Pier	Infill material, hard standings, piling mats	12,900m^3
Costain	Crushed demolition materials (concrete)	Dover railway	Rock armour	600m^3
Costain	Rocks	Dover railway	Rock armour	2,600 tonnes
Port of Dover	Crushed demolition material (concrete)	Eastern Docks multi-storey carpark	Infill material, hard standings, piling mats	3,000m^3 predicted in 2017
Volker Stevin	Crushed demolition materials (concrete)	Dunkirk Jetty	Infill material, hard standings, piling mats	5,480m^3 predicted in 2017
Dover District Council	Crushed demolition materials (concrete)	Burlington House	Infill material, hard standings, piling mats	2,000m^3
Jacksons	Tarmac/Asphalt	A20 roadworks	Infill material, hard standings, piling mats	2,000m^3
Potential sources of recycled material considered unsuitable for use in the DWDR Scheme				
DDS Demolition working for Homes and Communities Agency	Crushed demolition materials (concrete)	Connaught Barracks	Material reserved for re-use by the Homes and Communities Agency in the Connaught Barracks housing development	
Colliery Shale	Unburnt colliery shale	Former Tilmanstone Colliery in Kent	Material likely to be contaminated and not suitable for use in the marine environment; chemical properties likely to render it unsuitable for engineering use*	

* Sample analysis indicated high levels of oxidisable sulphides and water-soluble sulphate in excess of the allowable figures within the 'Manual for Contract Highway Works (Series 600- Earthworks); this material is unlikely to be considered suitable for deposition within 500mm of steel structures, reinforced concrete or cement-bound granular material (Hyder Consulting Ltd, 2014)

3.4 Consideration of Alternatives - Summary

As outlined in the preceding sections, a combination of factors have been taken into consideration by DHB when choosing the Goodwin Sands as the preferred site from which to obtain reclamation material for the DWDR Scheme.

The Goodwin Sands Aggregate Dredging ES (RHDHV, 2016b) considered 15 licensed marine aggregate sites within 200km of the Port as alternative sources of infill material for the DWDR Scheme. This report has further investigated these 15 sites as well as a newly licensed extraction site which became available in the summer of 2017 (see below). A summary of their key characteristics from a suitability perspective drawing on the factors described above is provided in **Table 3-3**.

DHB has also committed to maximise the utilisation of recycled material and to date has identified almost 50,000m^3 which will be used in the Scheme. More details on the sources of this secondary material are provided in **Table 3-4**.

As described above, to safeguard the construction programme, VSBW have on behalf of DHB secured material for the first reclamation campaign from Area 501, the availability of which only became a licensed option for consideration in the summer of 2017. Taking these steps has resulted in significant additional cost and delays to the programme and sourcing all of the reclamation material required to deliver the DWDR Scheme from this site is not considered a viable option.

As demonstrated by the further clarification provided in this section, the conclusion of the consideration of alternatives process remains as presented in the Goodwin Sands ES (RHDHV, 2016b) and the preferred option for sourcing the reclamation material for all stages of the DWDR Scheme remains the Goodwin Sands.

4 Social and Economic

MMO Comment

Comment No.	*Comment*
2.1	*Further consideration of the social and economic benefits of the proposed aggregate dredge project and the wider scheme are required.*
2.2	*Further consideration of the social economic impacts and benefits of the proposed project and wide scheme on other users of the Goodwin Sands is required.*

The full DWDR scheme will not only bring major regeneration to the Port's Western Docks but the Waterfront development has been identified as a strategic allocation in Dover District Council's Local Development Framework Core Strategy. The infill material that is required from the Goodwin Sands will be used for the reclamation of land is fundamental to this regeneration. The Scheme is anticipated to deliver benefits at both the local and national scales.

Direct Benefits

Reclamation of areas within the Western Docks will create space for the construction of new berths and cargo handling facilities which will be relocated from the Eastern Docks, in turn creating space needed there to meet increasing international trade demands and customer requirements. The marina and waterfront development will provide a significant addition to the leisure and amenity offering of Dover by creating the opportunity for the provision of retail units, bars, cafes and restaurants. Furthermore, the new marina will provide enhanced berthing facilities with improved access at the Western Docks for boat users. The second stage of reclamation in the Western Docks will create space and opportunity for further port-centric commercial development, associated with trade logistics and distribution. The additional commercial outlets resulting from the regeneration of the Western Docks will lead to job creation which will benefit the local community.

It is anticipated that approximately 600 jobs will be created once the DWDR Scheme is fully operational and will therefore deliver benefits through the increase of local employment opportunities. The majority of this employment is anticipated to be based in the port centric areas and the opportunity for retail units, bars, cafes and restaurants that will be developed as part of the marina curve and waterfront development (known as Stage 3 of the DWDR Scheme). There is a significant risk that should infill material from the Goodwin Sands be unavailable, the key elements of Stage 3 described above will not be delivered therefore posing a risk to projected local benefits and job creation. Oxera has calculated this risk to be up to £0.5bn of lost local economic benefit.

To further understand the impact of the DWDR Scheme on the local and national economy, DHB commissioned Oxera to undertake a detailed analysis of the economic impact of the scheme. This analysis concluded the DWDR Scheme is estimated to have a local economic impact up to £765m Gross Value Added (GVA)[7] and a national economic impact GVA of up to £233m (Oxera, 2017).

[7] Definition of GVA from Office of National Statistics (ONS) (2017) – ''Regional gross value added using production (GVA(P)) and income (GVA(I)) approaches. Regional gross value added is the value generated by any unit engaged in the production of goods and services. GVA per head is a useful way of comparing regions of different sizes.''

A key message of this study highlighted that in the absence of the DWDR Scheme, the existing cargo terminal in the Eastern Docks would be closed in 2020[8], as a result of the existing berths being unable to accommodate the industry's future requirements, and the Port would then be unable to receive bulk cargo (Oxera, 2017). Following closure of the existing cargo terminal the intention is for the current employees to transfer across to the regenerated Western Docks thereby ensuring job security.

On a wider scale, closure of the existing facilities in the absence of the DWDR scheme would result in vessels associated with the port's existing business having to travel further to alternative ports, with a consequent increase in journey time, fuel cost, and emissions. Conversely, construction of DWDR will also create enhanced facilities able to provide a more accessible and economical destination for potential new port business.

Indirect Benefits

As well as the economic benefits described above, investigations carried out to inform the proposed dredge of the Goodwin Sands has also delivered some wider benefits. The additional desk-based work undertaken for the proposed scheme, including the mapping and interrogation of the historic admiralty charts, together with the accumulation of archaeologically interpreted geophysical data and data on the changing geomorphology of the South Calliper Sands, has contributed significantly to a greater understanding of the offshore archaeological potential of the Goodwin Sands.

In particular, the commitment by DHB to extending monitoring surveys to include the locations of the *Admiral Gardner*, *Northumberland* and *Restoration* Protected Wreck Sites will provide useful additional data to inform the management of these sites by Historic England and the licensees of the sites.

Although the risk of encountering archaeological material is anticipated to be low, as with other offshore projects, in the event of unexpected discoveries, the data and records produced in mitigating their effects can also be regarded as a significant potential contribution to understanding the archaeological resource of the area This positive effect will be demonstrated by the completion of studies to professional archaeological standards and the publication of results in accordance with the draft WSI.

Other Users of the Goodwin Sands

The Goodwin Sands ES (RHDHV, 2016b) investigated the potential impacts of the proposed dredge on other users within the dredge area itself, the transit route and inside Dover Harbour. The key receptors which relate to user groups can be categorised as follows:

- Commercial and recreational fishing
- Navigation – commercial, recreational and fishing vessels
- Energy providers – subsea cables
- Recreational divers

A number of impacts were identified in the ES for each of these receptors and these are summarised in **Table 4-1**. The socio-economic implications of these impacts e.g. potential loss of earnings from loss of access to fishing grounds were considered as part of the EIA process and fed into the conclusions about the residual impact. Full detail on the impact assessment carried out for these receptors is available in Sections 12, 13 and 15 of the Goodwin Sands Aggregate Extraction ES (RHDHV, 2016b).

[8] Due to the inability of the existing cargo berths to accommodate the larger vessels coming into service and the increasing demand on operational space from the ro-ro operations.

Table 4-1 Summary of impacts on other users of Goodwin Sands

Receptor	Potential Impact	Mitigation	Residual Impact
Commercial & Recreational Fisheries	Displacement from transit route; temporary loss of access to fishing grounds; potential damage to fishing gear from seabed debris uncovered by dredging; indirect impacts to ancillary and supporting fishing industry	Fishing Liaison Plan and engagement between DHB and a Fisheries Liaison Officer (FLO); Best practice as in Marine Aggregate Extraction and the Fishing Industry- Operational Code of Practice prepared by BMAPA, MMO and TCE (2015).	Minor adverse/ Negligible
Navigation	Increase in collision risk (vessel to vessel/ vessel to structure) and grounding risk	Standard mitigation measures e.g. Notices to Mariners; update of Port Navigation Risk Assessment and Marine Safety Code	As Low As Reasonably Possible
Energy Providers e.g. subsea cables	Exposure of subsea cables due to changes in sediment erosion/accretion as a result of dredging	None required	No impact
Recreational Divers	Reduced visibility at dive sites due to sediment plumes resulting from dredging	As for navigation for dive boats; avoidance of affected dive sites during and for a few days following dredge activities	Minor adverse (to reflect the inherent safety risks with diving)

The ES provides particular detail on the potential economic impacts on the commercial fishing sector. The sensitivity of fishing to a loss or restriction to access can be informed by the baseline data on fishing activity and intensity. Data obtained from the Kent and Essex Inshore Fisheries and Conservation Authority (KEIFCA) indicate that the proposed dredge area is used mostly by local fishers operating vessels less than 10m long out of ports within the study area, and using a mix of potting, netting and line methods. While the true level of fishing activity and intensity is unclear, an estimate of the value of the proposed dredge area as a fishing resource (based on 7 questionnaire returns) shows that the majority of the originally proposed dredge area is low in value (£8-£487 per 0.25 sq. km per year) when compared with the adjacent areas that are generally valued between £1,597 and £4,790.10 per 0.25 sq. km per year. The total estimated value (maximum) of the originally proposed dredge area, based on figures obtained from MacAlister, Elliot & Partners Ltd (2015) is £18,842. The annual turnover of the wider study area is estimated to be worth £835,000.

In terms of receptor sensitivity, there is no information to suggest that the originally proposed dredge area is of particular importance (in comparison to the wider study area) to any single fishing type or target species. It is generally lower in value than the surrounding area, and is not uniquely important during a specific time of the year. Therefore, if it is assumed that the potential annual turnover for the originally proposed dredge area of £18,842 is spread evenly throughout the year, this would equate to £1,570 per month. Based on the original dredge programme of three dredge periods of four months, the commercial fishers would have restricted access equating to £6,280 in 2017, 2018 and 2019. In combination, over the programme for the proposed dredge (2017-2019), the commercial fishers would therefore have had no or restricted access equating to £18,840 of fishery resource out of an estimated total of £2,505,000 fishery resource (i.e. £835,000 x 3 years), which represents 0.75% of the fishery resource.

As described in the Project Update above, the programme has been updated to include only two dredge periods, one of 5 months in 2017/18 and one of 4 months in 2019 and the dredge footprint has been reduced to avoid potential archaeological anomalies. Updating the figures in light of these changes indicates that the potential impact on commercial fishing activity would either remain as assessed, or be slightly lower (in light of the reduced dredge footprint). It is also worth noting that the lower number of dredge periods will reduce the overall level of disturbance to the fishers who make use of the areas impacted by the proposed dredge activity.

Given the large amount of available area for each type of fishing in the area surrounding the proposed dredge area, and the relatively low value per square km of the proposed dredge area it is considered that local fishing activity has a low sensitivity to being displaced from the proposed dredge area. The magnitude of the lost and/or restricted access is considered low given the low value of the displaced resource (i.e. 0.75% of the estimated turnover within the study area during the entire dredging programme), the limited time of displacement (i.e. two periods of four months over 2017-2018), and the availability and accessibility of higher value fishery areas adjacent to the proposed dredge area.

As indicated in the Goodwin Sands ES (RHDHV, 2016b), DHB has committed to developing a Fishing Liaison Plan and engaging with the fishing community through a Fisheries Liaison Officer (FLO). This will ensure that discussions around the socio-economic factors of relevance to fishers using the Goodwin Sands will continue.

5 Marine Mammals

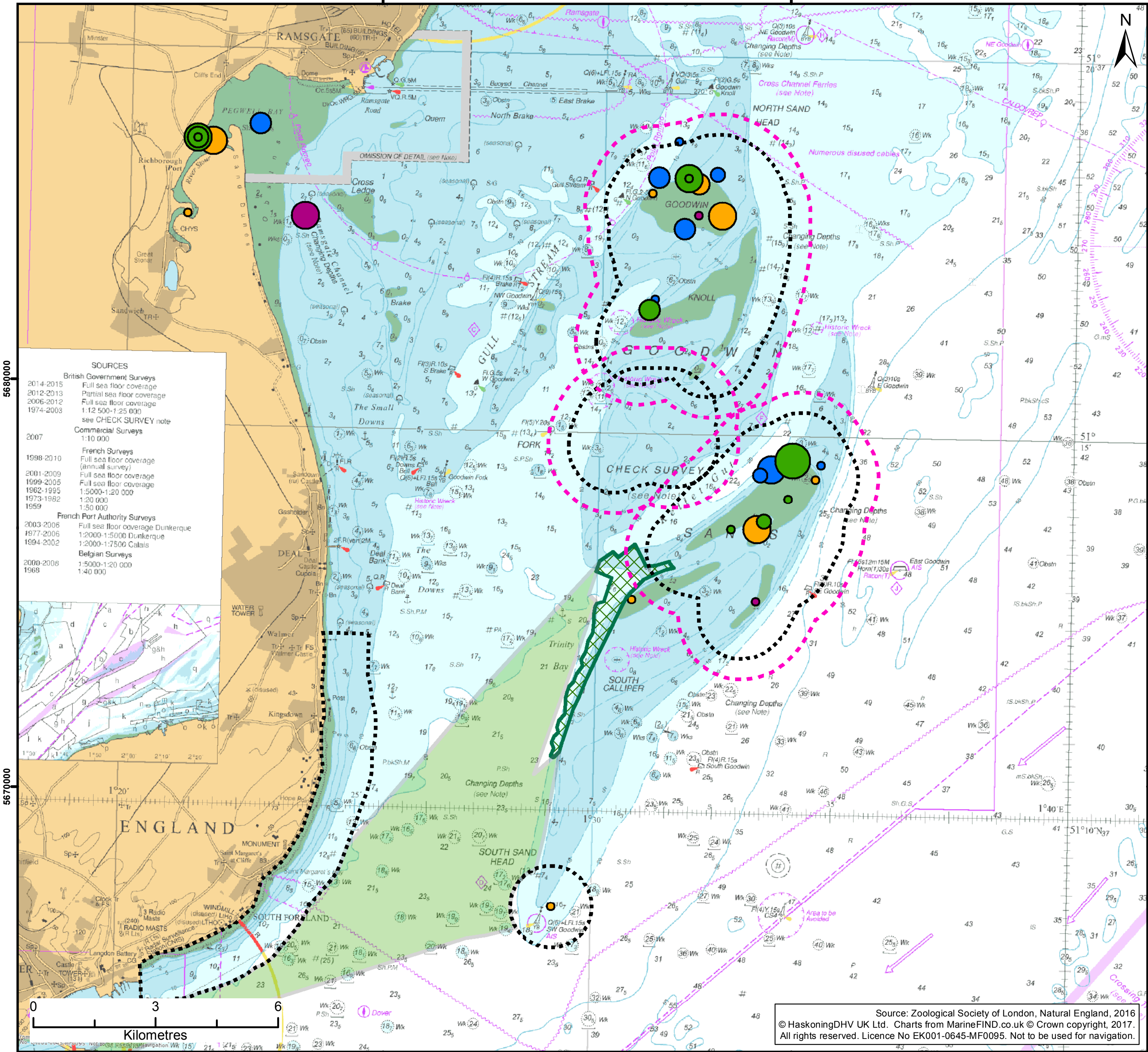
MMO Comment

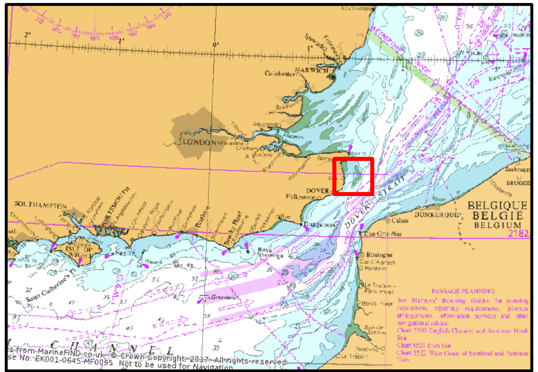
Comment No.	Comment
3.1	*Figure 7.1 in the Further Environmental Information document only refers to harbour seals. The buffer should also apply to grey seals as well.*

As detailed in the FEIR (RHDHV, 2016a), grey seals and grey seal pups were not present on coastal sand banks, including the Goodwin Sands, during the peak grey seal breeding season (December) in the Zoological Society of London's (ZSL) survey of the Greater Thames Estuary (Barker, 2015). During the breeding season, grey seals must haul-out above the high water mark and would not use the temporary exposed sand banks at Goodwin Sands for breeding sites. Therefore, the main periods of sensitivity for seals at known seal haul-out sites at Goodwin Sands are during the harbour seal breeding and moult period.

It is proposed that dredger(s) would avoid known seal haul-out sites at Goodwin Sands (based on data presented in Figure 10.7 and 10.9 of the Goodwin Sands ES (RHDHV, 2016b) by maintaining a distance of 1km between the dredger(s) and the exposed sandbanks concerned. In addition, during sensitive times of the year (June to July for the harbour seal breeding season and August for the harbour seal moult period) the dredger(s) would avoid known seal haul-out sites at Goodwin Sands by maintaining a minimum distance of 1.5km between the dredger(s) and the exposed sand banks concerned.

Based on the above, we would like to clarify with the MMO that the 1km buffer applies to areas that both grey and harbour seals could use as haul-out sites, whilst the 1.5km buffer provides additional protection to harbour seals during the months of June, July and August due to the potential for increased sensitivity during the harbour seal breeding and moult period. For further clarity on this point, **Figure 5-1** presents the indicative exclusion zones for harbour seals in relation to exposed sand at known harbour seal haul-out sites and **Figure 5-2** present the indicative exclusion zones for grey seals in relation to exposed sand at known grey seal haul-out sites.





Legend:

- Vessel Transit Route
- Indicative 1km exclusion zone around known seal haul out sites (when exposed, year round) based on approximate LAT level
- Indicative 1.5km exclusion zone around known seal haul out sites (when exposed, June, July and August only) based on approximate LAT level
- Refined Dredge Footprint (2017)

Harbour Seal count

- <5
- 5-15
- 15-25
- 25-50
- >50

- 2015 Survey
- 2014 Survey
- 2013 Survey
- 2012 Survey

Client:	Project:
Dover Harbour Board	MMO Response December 2016

Title:

Indicative Exclusion Zones for Harbour Seal Haul Out Sites

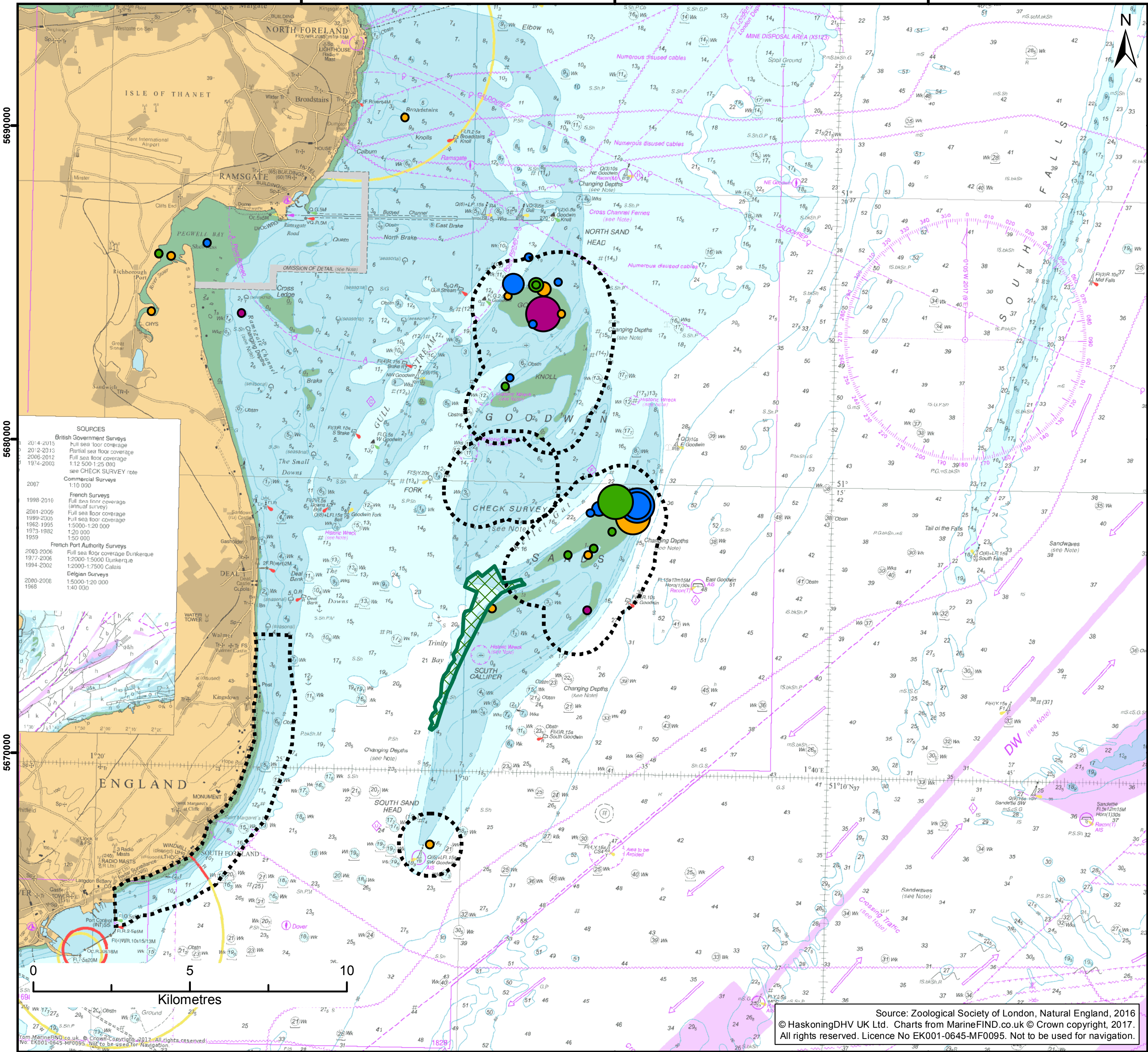
Figure:	5.1	Drawing No:	PB2107/ES/059

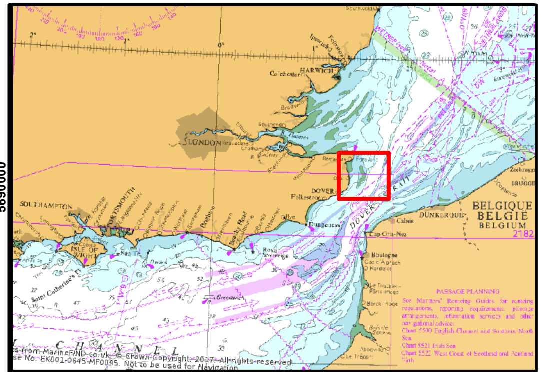
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	08/09/2016	JE	DC	A4	1:134,423
02	02/08/2017	NJ	DC	A4	1:134,423

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV
Enhancing Society Together

PORT OF DOVER
DWDR





Legend:

- 1km Exclusion Zone around known haul out sites (when exposed, year round) based on approximate LAT level
- Refined Dredge Footprint (2017)

Grey Seal Count

- <5
- 5-15
- 15-25
- 25-50
- >50

- 2015 Survey
- 2013 Survey
- 2014 Survey
- 2012 Survey

Client:	Project:
Dover Harbour Board	MMO Response December 2016

Title:

Indicative Exclusion Zones for Grey Seal Haul Out Sites

Figure: 5.2	Drawing No: PB2107/MMO/002				
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	24/02/2017	JE	JM	A4	1:175,000
02	02/08/2017	NJ	JM	A4	1:175,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV
Enhancing Society Together

PORT OF DOVER
DWDR

6 Heritage

Update on Further Work

As part of further clarifications sought by the MMO in response to the FEIR (RHDHV, 2016a), Historic England requested that, in order to understand the risk of unknown archaeological remains, a magnetometer survey of the entire proposed dredge area be undertaken. They also requested that the data from the survey be assessed and interpreted by a suitably qualified marine archaeologist to assess the potential for buried ferromagnetic archaeological remains, which may include aircraft engines, and shipwreck structures and fixtures.

In December 2016, Wessex Archaeology produced a recommended scope for the magnetometer survey which was agreed in consultation with Historic England. In April 2017, DHB contracted Clinton Marine Survey (Clinton) to undertake the survey and the data were acquired during April and May 2017. In addition to the magnetometer survey, at the request of DHB and to further inform detailed understanding of the archaeological potential of the proposed dredge area, high resolution sidescan sonar, multibeam bathymetry and sub-bottom profiler data were also acquired during the campaign.

All data were acquired from within a survey area, agreed with Historic England, comprising the originally proposed dredge area plus a 250m buffer. The buffer was included to ensure that any geophysical anomalies of potential archaeological interest on the margins of the proposed dredge area would also be captured while also allowing for direct comparison with the 2015 geophysical data coverage and to provide contextual geophysical data in the area immediately surrounding the impact area. The survey area is illustrated in **Figure 6-5**.

The raw data were provided to Wessex Archaeology by Clinton in order to undertake a specialist archaeological assessment. Following an initial review, all data were considered to be suitable for archaeological assessment. The data were processed and interpreted by Wessex Archaeology and, using desk-based sources of information and the results of previous data assessment, were correlated with existing anomalies, previously identified to inform the Goodwin Sands ES (RHDHV, 2016b) and FEIR (RHDHV, 2016a).

The results of the assessment were provided to DHB via a draft illustrated technical report which was forwarded to Historic England on 14th July 2017. A meeting to discuss the results of the assessment with Historic England and the MMO was held in Dover on 18th July 2017. In summary, the assessment demonstrated the presence of:

- 0 anomalies of anthropogenic origin of archaeological interest;
- 305 anomalies of uncertain origin of possible archaeological interest (concentrated along the western edge of the overall survey area where sand coverage is lower);
- 1 historic record of possible archaeological interest with no corresponding geophysical anomaly (7006 as recorded in the ES); this record relates to a very small contact observed on the seabed in geophysical data, last observed in 1997. A subsequent survey in 2010 did not locate the anomaly and any material was presumed to be buried. Based on the record and the current data assessment, Wessex Archaeology concluded that there is no evidence of any material at this location on the surface or buried. and
- 9 anomalies of uncertain origin of possible archaeological interest but outside of the vertical footprint (below 2.5m depth).

On the basis of these results, DHB modified the dredge footprint such that all anomalies of possible archaeological interest identified by Wessex Archaeology would be avoided. On this basis, further investigation of the individual anomalies was not deemed necessary, particularly considering the difficulties that shallow water depths, strong tidal currents and reduced visibility would pose for Remote Operated Vehicles (ROV) attempting further investigation.

During the consultation meeting held on 18th July, DHB's preferred approach to avoid potential impacts was discussed in detail with Historic England and the MMO. It was agreed that a 25m buffer would be placed around the extents of all of the 305 anomalies as seen in the geophysical data and that those falling wholly or partially within the proposed dredge area would be formalised as Precautionary Exclusion Zones (PEZs). A 25m buffer is included (rather than a recommendation to avoid the physical footprint of the anomaly alone) in order to allow for any positional inaccuracy and to ensure that the anomaly, and any associated debris would be encapsulated by the PEZ. Adherence to both Archaeological Exclusion Zones (AEZs) and PEZs will be monitored using the vessels dredge control system. This information, combined with post-dredge geophysical data, will inform the preparation of post-dredge monitoring reports which will be submitted to the MMO and Historic England in order to demonstrate adherence to this avoidance strategy during dredging in accordance with the draft WSI.

The approach to avoiding anomalies of possible archaeological interest using PEZs was set out in the draft Written Scheme of Investigation (WSI) prepared by Royal HaskoningDHV in October 2016. PEZs preclude dredging from taking place within their boundaries, thereby avoiding significant impacts to assets contained within. PEZs differ from AEZs only in that they represent a precautionary avoidance strategy for anomalies of possible archaeological interest, rather than a formal archaeological strategy through the application of AEZs around a wreck, or aircraft crash sites for example.

During the consultation meeting on the 18th July 2017, the requirement to retain the existing AEZs recommended in the ES and draft WSI (50m around 7006 and 100m around the recorded location of *Britannia*) was also discussed. These were recommended for removal on the basis that nothing was seen at the recorded locations in the acquired high resolution data (nor in repeated surveys by the UKHO or the 2015 data), and that the original descriptions of both do not provide substantiated information to confirm that archaeological material has ever been physically recorded at these locations. A single magnetic anomaly is located within the proposed dredge area within the 100m Britannia AEZ and this will be avoided via a PEZ. Historic England agreed that there was no archaeological reason to retain the AEZs and these have been removed from the archaeological mitigation strategy.

The overall mitigation strategy to prevent impact to material of potential archaeological significance has been developed in consultation with Historic England and was previously outlined in the draft WSI. In summary, the mitigation strategy comprises:

- avoidance of known heritage assets and geophysical anomalies through the application of AEZs and PEZs;
- the archaeological assessment of geophysical data acquired during pre- and post-dredge monitoring surveys;
- the application of a Protocol for Archaeological Discoveries (PAD) to address unexpected discoveries of material during dredging;
- on-board monitoring via a specially trained archaeological observer to support the implementation of the PAD; and
- monitoring to support the implementation of the PAD during discharge of material in Dover.

The draft WSI will be updated to include details of the additional PEZs, to ensure that any conditions of consent are adequately accounted for and to provide details of additional consultation carried out to inform agreement of the mitigation strategy with Historic England and the MMO. In combination with the additional information provided, and the consequent modifications to the dredge area, the effective implementation of measures set out in the draft WSI will result in a low risk of significant impact to both known and potential heritage assets.

The following responses to comments raised in the MMO's letter of December 2016 should be considered within the context of this heritage update.

MMO Comment

Comment No.	*Comment*
4.1	*The MMO welcome the use of previous published hydrographic (navigation) chart information to assess potential. However, in order to assess effectiveness of using historic navigation charts to assess risk, the following information must be provided in support of the assessment:* *- An explanation of the methodology used to undertake the assessment and geo-reference the charts;* *- An assessment of the accuracy of each of the original charts with regards to geo-referencing, and how this has been considered in any interpretation;* *- Information on how the original soundings achieved and the degree of confidence in each chart, due to the potential inaccuracies or differing methods in acquiring such information.* *- Assessment of how differences in sediment accretion or loss compare with the most recent geophysical bathymetric data obtained in 2015.*

The use of previous published hydrographic (navigation) chart information to assess potential has subsequently been supported by the archaeological assessment of newly acquired geophysical survey data (Wessex Archaeology, 2017) as described above. While the responses provided below relate directly to the specific questions asked by the MMO, consideration of the results of this recent assessment, and of further consultation with Historic England and the MMO, is included where appropriate.

An explanation of the methodology used to undertake the assessment and geo-reference the charts

Historic admiralty charts were provided by the United Kingdom Hydrographic Office (UKHO) as high resolution .tiff image files. These files were subsequently georeferenced by the RHDHV GIS Data Officer using ESRI's ArcGIS software (v 10.3). Georeferencing was based on common areas throughout the charts with due consideration to the dynamic nature of coastlines and features. The 2013, present day chart was provided as a georeferenced WMS (Web Map Service) through MarineFIND.co.uk.

An assessment of the accuracy of each of the original charts with regards to geo-referencing, and how this has been considered in any interpretation

In order to consider the accuracy of each of the original charts and the georeferencing, each of the charts was compared to ESRI aerial imagery at three static points along the coastline: Walmer Castle, Deal pier and Ramsgate harbour lighthouse. The distance of these static points in comparison to the aerial imagery was recorded for each of the charts (**Table 6-1**).

Table 6-1 Actuary Check for Historic Admiralty Charts

Chart	Distance from Location on ESRI Aerial Imagery (m)			
	Walmer Castle	Deal Pier	Ramsgate Harbour Lighthouse	Average
1846	30	-	105	45.00
1865	32	75	108	71.67
1915	150	68	4	74.00
1937	60	60	23	47.67
1961	62	80	10	50.67
1973	26	5	3	11.33
1982	57	37	4	32.67
1999	75	78	41	64.67
Average	**61.5**	**57.57**	**37.25**	**52.11**
2013	10	10	17	**12.33**

The lowest discrepancy, at only 3m, occurs on the 1973 chart for Ramsgate Harbour Lighthouse. The largest discrepancy is 150m for the position of Walmer Castle on the 1915 chart, although the same chart shows a discrepancy of only 4m for the Ramsgate Harbour lighthouse. The results show that there is no overall trend for each chart and no overall trend which indicates greater accuracy on charts of a later date, for example. The lowest average discrepancy occurs on the 1973 chart (11.33m) while the 1982 and 1999 charts both show a higher average discrepancy (32.67m and 64.67m). This indicates that the overall accuracy of positioning is affected by both the accuracy of the original chart as well as the way in which the software manipulates each image file in the process of georeferencing.

Information on how the original soundings achieved and the degree of confidence in each chart, due to the potential inaccuracies or differing methods in acquiring such information.

There is no definitively quantifiable measure for the degree of confidence in each chart although sources of data for each chart are recorded on the charts themselves (**Figure 6-1**). There are seven series available for chart 1828 (A to G) and it was ensured that one from each series (two from series G) were included to represent each phase of survey, data acquisition and charting. This information shows that the charts from 1846, 1865, 1937, 1961, 1999 and 2013 were all based upon survey data acquired either the same year or one or two years previously. The 1915 chart was based upon survey data from 1896, the 1973 chart on data acquired between 1959 and 1967 and the 1982 chart on data acquired between 1974 and 1981. This may suggest that these three charts may be less accurate in terms of the time lapse between surveys and the production of the chart, particularly considering the dynamic environment of Goodwin Sands. In addition, only partial sea floor coverage is noted in the area of the proposed dredge with regard to the 2012 to 2013 data for the 2013 chart. As specified on each of the historic charts the datum for each of the soundings are as follows:

- 1846, 1865 and 1915: soundings in feet reduced to "28ft 3 inches below coping of the pier near the crane in the East Gully", Ramsgate;
- 1937, 1961: soundings in fathoms reduced to the level of mean low water springs at Dover and Ramsgate;
- 1973, 1982, 1999 and 2013: soundings in metres, "reduced to Chart Datum which is approximately the level of Lowest Astronomical Tide".

Any direct link between the date of a survey and its dependability is based upon an assumption that the accuracy and completeness of the work improves as the instruments and surveying techniques have evolved and improved over time (Pielou, 1984: 124). During the 1930s, the use of an echosounder allowed for a continuous profile to be recorded, rather than spot depths obtained by traditional hand-lead and line and, following World War II, technological developments such as electronic positioning systems produced for air navigation were also employed by surveyors (Haslam and Pielou, 1985). Side-scan sonar, specifically designed for surveying, was introduced and first used in 1971.

However, 'leadline', as opposed to sonar surveys, should not necessarily be assumed to be less accurate and Pielou (1984) states that an 'adequate comprehensive survey' is judged by a chart maker on a wide variety of factors. He further states that the manner in which 'a mariner evaluates each chart for his particular route is largely a matter of personal knowledge, experience and judgement'. It is concluded, therefore, that any degree of confidence is necessarily based upon professional judgement rather than any kind of quantifiable measure.

Based on the recorded discrepancies in **Table 6-1**, the average error across the georeferenced .tiffs is +/- 52m. Using the same method, the accuracy of the 2013 chart is significantly higher at +/- 12m.

This error should be taken into account in any activity which attempts to map zones of potential across the study area. However, as the interpretations presented in the FEIR (RHDHV, 2016a) are based upon overall patterns of geomorphological change across the study area over time, the current interpretation is not considered to be affected by this average error.

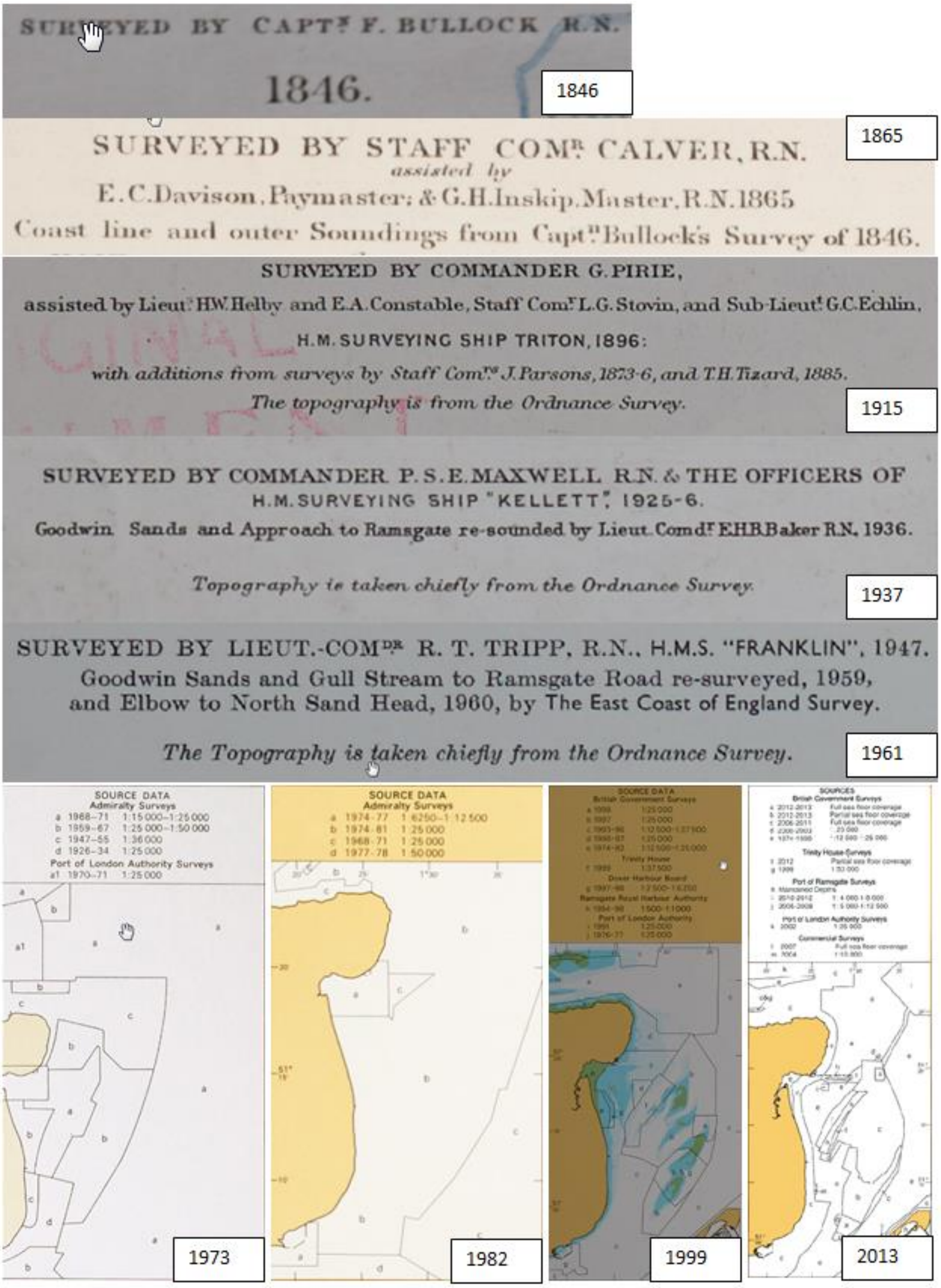


Figure 6-1 Data sources from historic admiralty charts

Assessment of how differences in sediment accretion or loss compare with the most recent geophysical bathymetric data obtained in 2015.

A general pattern of sediment accretion has been observed in the comparison of historic admiralty charts. A recent accumulation of sediments westwards has also been indicated by a historic study of geomorphological changes to Goodwin Sands undertaken by HR Wallingford in 2008, previously referenced in the ES (refer to Section 6). Bathymetric data from 1986-1988, 1995-1998 and 2006 were compared to identify any changes in the bank morphology during this period. The data showed that between 1995-8 and 2006 there was an increase in bank levels over most of the area within a lowering on the eastern side of the bank. Similarly, the UKHO's own assessment of data acquired in 2009 and 2012 also show this accumulation. The 2009 report states that between 2003 and 2009:

The most dramatic changes to the bank complex have occurred in this area, in particular to South Calliper. Depths have increased by over 20 metres on the eastern side, exposing several large wrecks, while on the western side over 20 metres of sediment has built up, with the bank encroaching into Trinity Bay by up to 1,000 metres (UKHO, 2009: 5).

The 2012 UKHO survey showed that the area of large scale migration on the western side had seen no further migration since the 2009 survey (UKHO, 2012). To the south of this, the UKHO report that the bank has extended to the west by up to 344 metres at the 10 metre contour level (Figure 6-2).

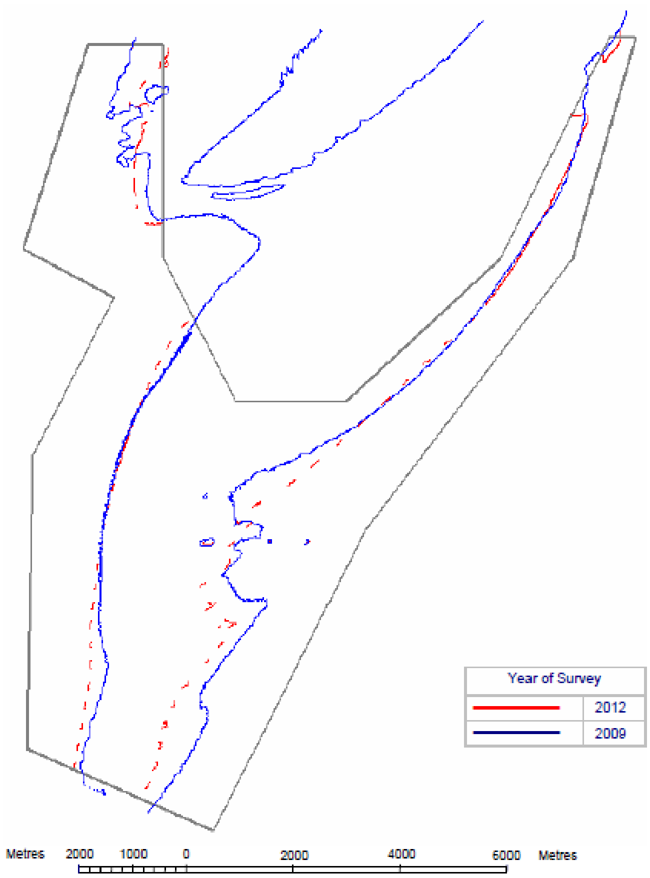


Figure 6-2 Composite diagram of the 10m contour from the 2009 and 2012 surveys (UKHO, 2012: Annex B)

In order to best demonstrate how the differences in sediment accretion or loss compare with the most recent geophysical bathymetric data obtained in 2015, UKHO bathymetric data was downloaded from the INSPIRE portal and MEDIN Bathymetry Data Archive Centre.[9]

UKHO data from 2009 represents the best overlap with the 2015 data acquired by DHB for the proposed dredge area, and hence the best comparison in how water depths had changed over the six year period. A graphical comparison between the datasets showing where sand is accumulating and reducing is shown in **Figure 6-3**.

Figure 6-3 illustrates the accumulation of sand (coloured blue) across the main part of the bank and up to 4.5m in the southern part of the northern section of the proposed dredge area. A lowering of sand of 2 to 3m is shown within parts of the northern area (coloured red). As shown in the FEIR (RHDHV, 2016a), however, within the centre of this northern area the historic admiralty charts show a decrease in water depths from c. 19.5m in 1961, to 16.8m in 1973, 13.5m in 1982/1999 and 8.5m in 2013. This indicates an increase in sand of over 10m between 1961 and 2013.

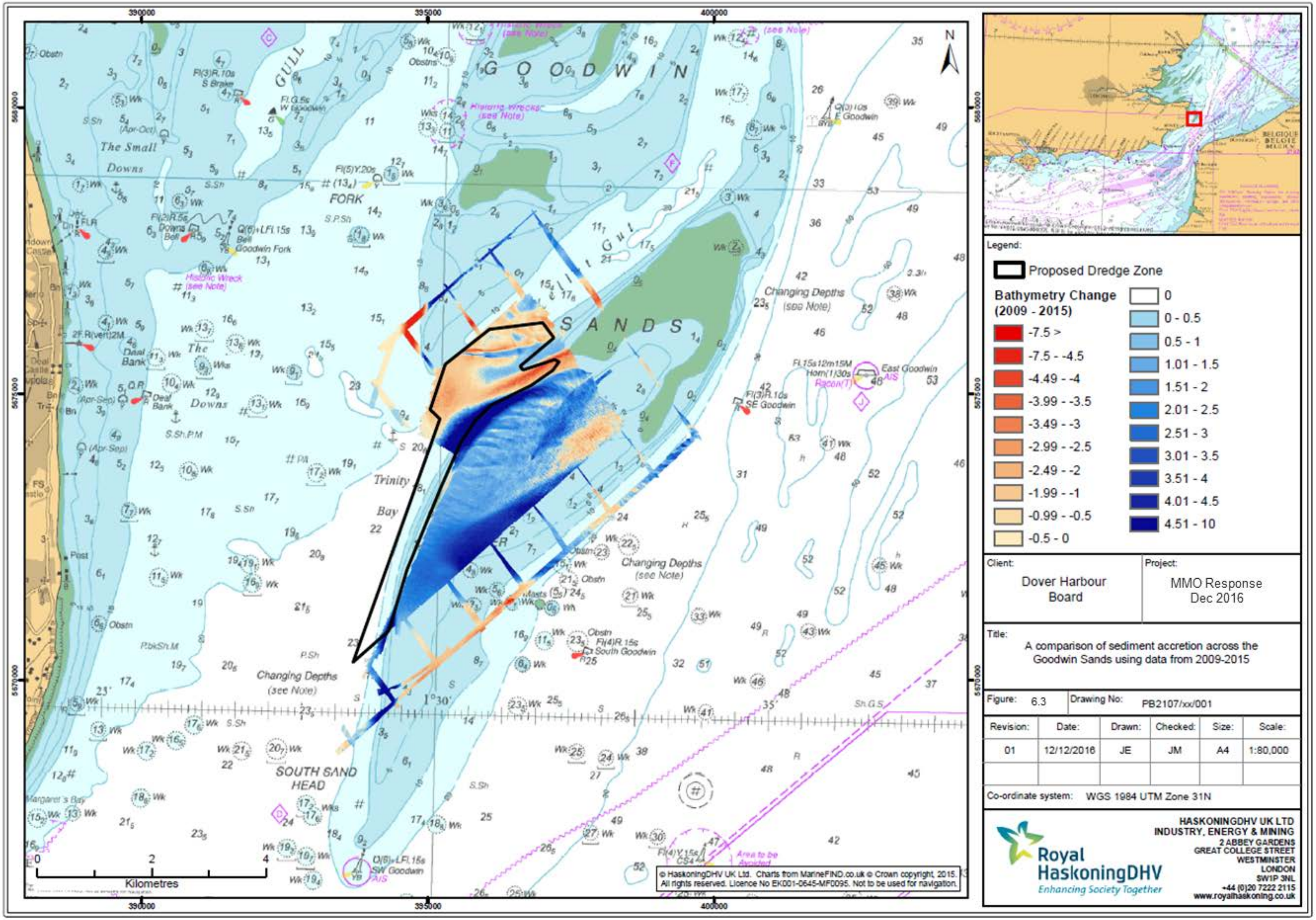
Water depths at two randomly selected spot locations, within the central area of the northern section of the proposed dredge area, were taken from the 2009 bathymetry data and compared to the 2015 dataset. The first location shows a depth of 10.99m in 2009 and 11.98 in 2015 representing a lowering of sand of c. 0.99m. The second shows a depth of 10.68m in 2009 and 11.94m in 2015, a lowering of c. 1.26m. These depths fit with the pattern of sand accumulation within the northern section up to c. 2013 and then a lowering in sand levels to 2015, as shown also by **Figure 6-3**. The sand levels remain, however, significantly higher than they were in 1961 (11.98m/11.94m compared to 19.5m in 1961), potentially up to c. 7.5m and by at least the proposed maximum dredge depth of -1.95m CD..

A further spot height was taken at the south eastern corner of the proposed dredge zone. This showed a decrease in water depths, and increase in sand levels of 6.26m between 2009 and 2015 (13.48m depth to 7.22m).

The above information was presented to Historic England, the MMO and representatives from the Joint Casualty and Compassionate Centre (JCCC) as part of the Heritage and Archaeology Consultation Meeting held on 30th November 2016. The minutes for this meeting, and a consultation note prepared in advance of the meeting to inform discussions, are appended to this document.

Subsequently, further bathymetric data have been acquired by Clinton Marine Survey from a survey area defined by a 250m buffer zone around the extent of the originally proposed dredge area, as described above. The results of this survey have informed the further development of the proposed mitigation for the scheme originally set out in the previously submitted draft Written Scheme of Investigation (WSI) (RHDHV, 2016c).

[9] *Available at: http://aws2.caris.com/ukho/mapViewer/map.action*



GOODWIN
SANDS
The Small Downs
The Downs
GULL
FORK
Trinity Bay
SOUTH SAND HEAD
Changing Depths (see Note)
Historic Wrecks (see Note)
Legend:
Proposed Dredge Zone
Bathymetry Change (2009 - 2015)
-7.5 >
-7.5 - -4.5
-4.49 - -4
-3.99 - -3.5
-3.49 - -3
-2.99 - -2.5
-2.49 - -2
-1.99 - -1
-0.99 - -0.5
-0.5 - 0
0
0 - 0.5
0.5 - 1
1.01 - 1.5
1.51 - 2
2.01 - 2.5
2.51 - 3
3.01 - 3.5
3.51 - 4
4.01 - 4.5
4.51 - 10
Client:
Dover Harbour Board
Project:
MMO Response Dec 2016
Title:
A comparison of sediment accretion across the Goodwin Sands using data from 2009-2015
Figure: 6.3
Drawing No: PB2107/xx/001
Revision: 01
Date: 12/12/2016
Drawn: JE
Checked: JM
Size: A4
Scale: 1:80,000
Co-ordinate system: WGS 1984 UTM Zone 31N
HASKONINGDHV UK LTD
INDUSTRY, ENERGY & MINING
2 ABBEY GARDENS
GREAT COLLEGE STREET
WESTMINSTER
LONDON
SW1P 3NL
+44 (0)20 7222 2115
www.royalhaskoning.co.uk
Royal HaskoningDHV
Enhancing Society Together
0 2 4
Kilometres
390000
395000
400000
5670000
5675000
5680000

The subsequent data were assessed by Wessex Archaeology and the results of this work included further assessment of sediment changes between 2015 and 2017 as demonstrated by the data. This was achieved by creating a surface difference digital terrain model from the data acquired in 2017 and the data acquired previously in 2015 (Wessex Archaeology, 2017, reproduced in **Figure 6-4**). Both accretion and erosion have occurred across the survey areas between 2015 and 2017. To the east of the proposed dredge area the edge of the central and southern portion of the sandbank has moved in excess of 70 m to the east, while the northern edge of the bank has shifted westwards into the proposed dredge area. The model shows that sand has accreted by up to 10m in parts of the northern area while erosion by up to 4m has taken place in the central eastern part of the proposed dredge area. Overall the figures illustrate movement of approximately 10 million m^3 of material over the past 18 months – 2 years.

These changes in bank morphology within a two year period, as demonstrated by the 2015 and 2017 bathymetric data, are clearly indicative of the high mobility of the sand. As previously discussed within the September 2016 FEIR and the draft WSI, the active bedforms and highly mobile sediments of the Goodwin Sands have frequently resulted in the covering and complete burial of wreck material. Wrecks encapsulated within the sand are often very well preserved. As the bedforms move, however, wreck material can once again become uncovered and exposed to erosion and biological degradation. As part of this covering and uncovering, the abrasive nature of the mobile sands themselves can have an erosive effect, negatively influencing the longer term preservation of materials, particularly organic materials such as wood.

Exposed wreck material, and material with only shallow coverage that regularly covers and uncovers, is at greater risk from erosion, biological decay and physical damage. Exposed sites are also at greater risk from treasure hunters and illegal salvage. The high mobility of surficial bedforms within the proposed dredge area thus reduces the potential for material to be preserved intact within the top 1.9m representing the maximum target dredge depth, with dredging anticipated to less than 1m depth across the proposed area in practice. Wrecks preserved under several metres of sand are protected to a far greater extent, although biological decay can still be possible albeit at a reduced rate. Therefore, there is greater preservation potential beneath these target depths, as shown by the exposure of a far greater number of anomalies along the western edge where sand cover is currently minimal.

In the west of the area and the majority of the north of the area, there has been considerably less movement of sediment, typically less than 1m erosion, indicating little change to the site conditions of many of the anomalies identified in this area, between the execution of the 2015 and 2017 surveys. The revised dredging footprint proposed by DHB avoids the western edge of the bank where sand cover is low as well as avoiding the anomalies identified in the recent geophysical data. Taken together with the proposed approach to dredging i.e. extracting material evenly across the dredge footprint with an average depth of approximately 1m (not exceeding -1.95m dredge depth), this should result in a low risk of material of archaeological significance being present (including potential aircraft remains).

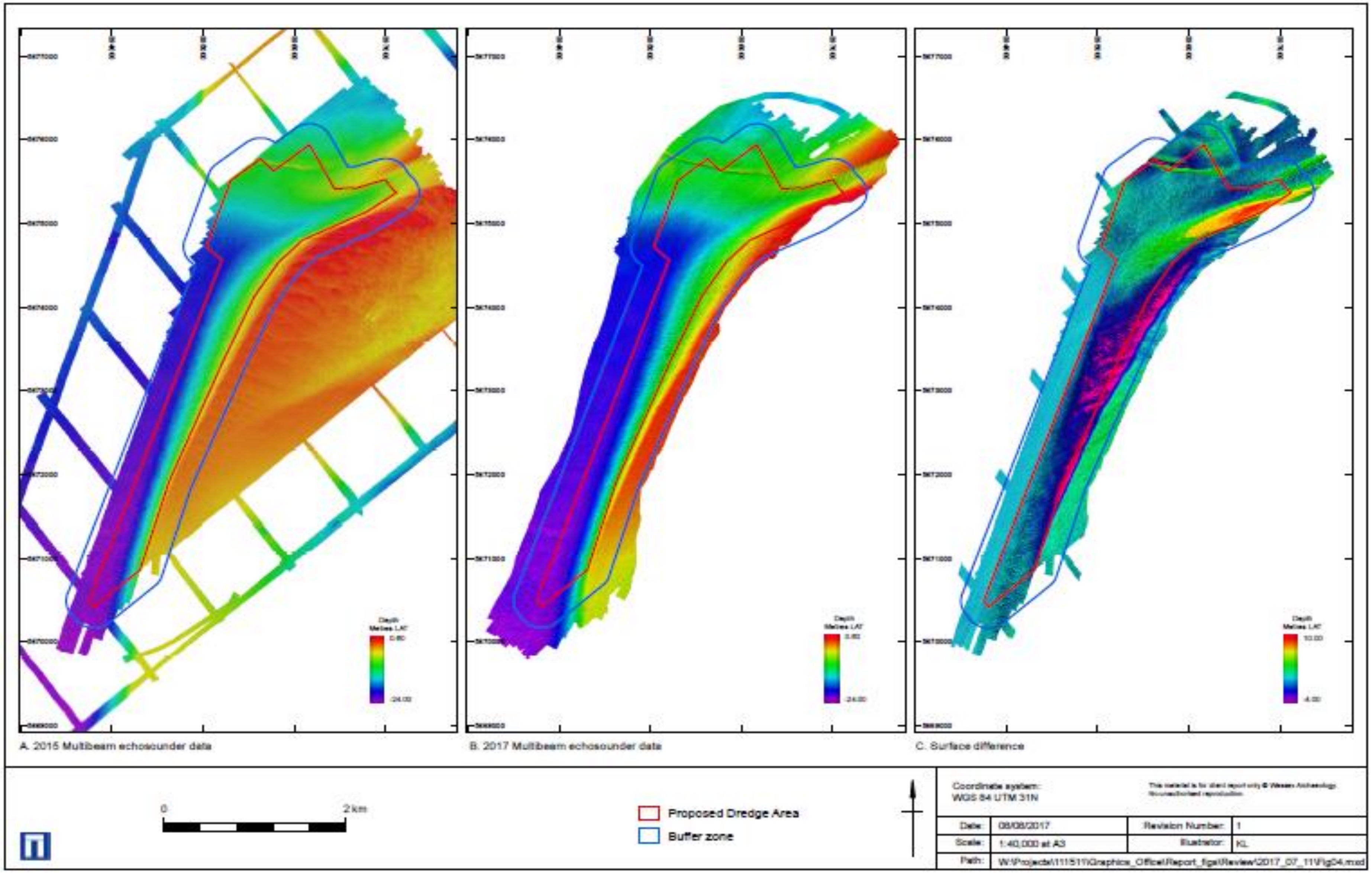


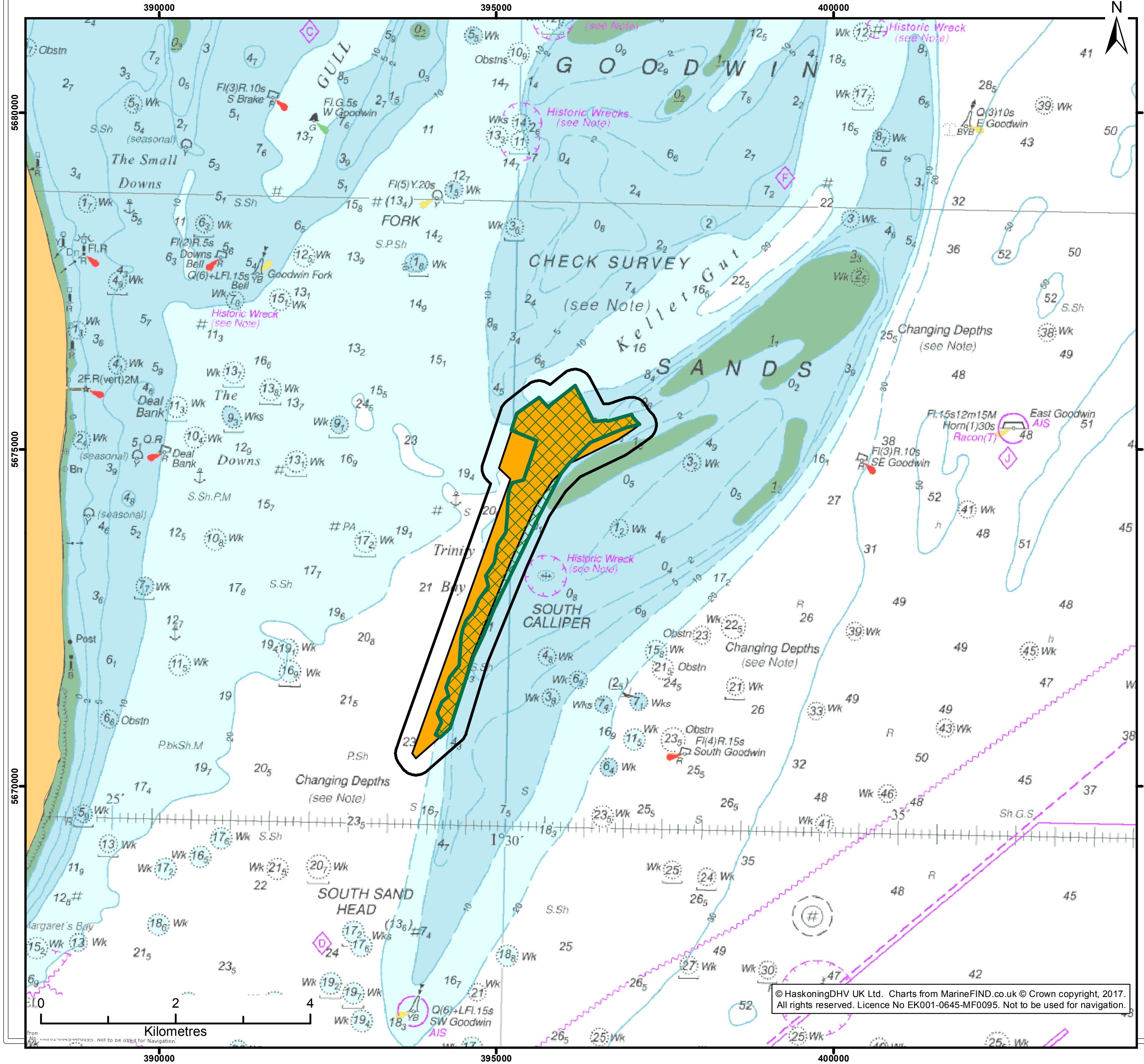
Figure 6-4 Comparison of 2015 and 2017bathymetric data (obtained by DHB, Figure taken from Wessex Archaeology, 2017)

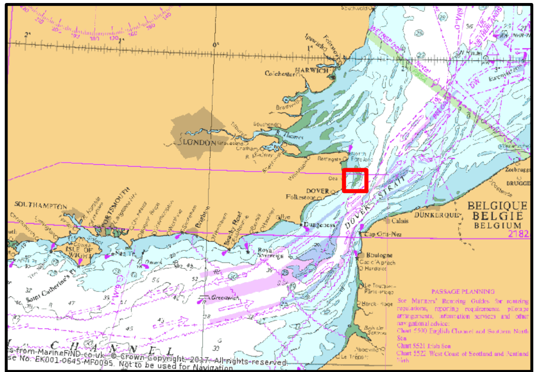
Comment No.	Comment
4.2	*The hydrographic charts submitted to demonstrate the recent accumulation of sediment on the Goodwins Sands, are not sufficient on their own, to conclude the potential impact to unknown heritage impacts as 'low'. There is still a substantial risk that dredging activities could encounter unknown archaeological remains close to the surface of the seabed.* *To understand the risk of unknown archaeological remains a magnetometer survey of the entire proposed dredge area must be undertaken. The data from the survey must be assessed and interpreted by a suitably qualified marine archaeologist to assess the potential for buried ferromagnetic archaeological remains, which may include aircraft engines, and shipwreck structures and fixtures. Also, by comparing the magnetometer data with desk-based sources of information and other current survey data it will be possible to correlate identified features (buried or exposed) against existing anomalies.*

As explained in the heritage update provided above, in December 2016, Wessex Archaeology produced a recommended scope for the magnetometer survey which was agreed in consultation with Historic England. In April 2017, DHB contracted Clinton Marine Survey (Clinton) to undertake the survey and the data were acquired during April and May 2017. In addition to the magnetometer survey, at the request of DHB and to further inform detailed understanding of the archaeological potential of the proposed dredge area, high resolution sidescan sonar, multibeam bathymetry and sub-bottom profiler data were also acquired during the campaign. All data were acquired from within a survey area, agreed with Historic England, comprising the proposed dredge area plus a 250m buffer. The buffer was included to ensure that any geophysical anomalies of potential archaeological interest on the margins of the proposed dredge area would also be captured while also allowing for direct comparison with the 2015 geophysical data coverage and to provide contextual geophysical data in the area immediately surrounding the impact area. The survey area covered by Clinton is illustrated in **Figure 6-5** together with the dredge footprint (as originally proposed and as revised to avoid subtidal coarse sediments, see **Section 7** of this report).

A summary of the findings of the additional survey work is provided in the heritage update provided at the beginning of **Section 6** and the full survey report produced by Wessex Archaeology has been submitted to the MMO with this report.

As part of its commission, Clinton provided a report containing the unfiltered survey data and this appears to present a higher number of anomalies than the assessment carried out by Wessex Archaeology. A total of 771 contacts were detected by Clinton which demonstrated the same distribution pattern as Wessex Archaeology's interpretation. The higher number of contacts recorded by Clinton stems from their inclusion of natural features (e.g. boulders) which were discounted as being of no archaeological interest by Wessex Archaeology. Furthermore, Clinton included the total number of contacts from each survey technique, as opposed to the archaeological interpretation where contacts relating to the same feature were grouped as one anomaly. A comparison between the archaeological interpretation provided by Wessex Archaeology and that provided by Clinton is included as an annex to the archaeological review of geophysical data report produced by Wessex Archaeology (2017).





Legend:

- Refined Dredge Footprint (2017)
- Revised to avoid subtidal coarse sediment (2017 see Section 5)
- Magnetometer Survey Area (including 250m buffer)

Client:	Project:
Dover Harbour Board	MMO Response December 2016

Title:

Magnetometer Survey Area

Figure:	6.5	Drawing No:	PB2107/ARCH/004.4

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	06/12/2016	JE	VC	A4	1:80,000
02	10/08/2017	NJ	VC	A4	1:80,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV
Enhancing Society Together

PORT OF DOVER
DWDR

Comment No.	Comment
4.3	*A marine archaeological excavation is planned on the designated protected shipwreck site of the Rooswijk during the summer months of May and July 2017, with the possibility of additional archaeological work occurring after this period. It must be confirmed that the programme of archaeological investigation directed at the Rooswijk will not be compromised*

The Rooswijk is located over 6km to the north east of the proposed dredge area outside the potential zone of influence identified during sediment dispersion modelling undertaken to inform the Goodwin Sands Aggregate Dredge Scheme ES. Consultation will be maintained with Historic England to ensure that any potential overlap in the duration of any future activities associated within this programme of work can be effectively managed once the final programme for dredging is available.

Comment No.	Comment
4.4	*It should be noted that it is possible that the proposed dredge area may contain dumped stores and ammunition compromised.*

This is noted and will be addressed through the application of an Unexploded Ordnance (UXO) policy which forms standard practice for offshore dredging operations. In the event that UXO is encountered then measures put in place by DHB or its dredging contractors in the interests of human safety will take precedence. It is recognised, however, that historic ordnance may still be of archaeological interest and would be reported under the Protocol for Archaeological Discoveries, as set out in the draft Written Scheme of Investigation (RHDHV, 2016c), once UXO policy has been satisfied.

Summary

Extensive additional work has been carried out to inform the approach to dredging at the Goodwin Sands with reference to the maritime heritage. The overall mitigation strategy has been updated accordingly and can be summarised as follows:

- Avoidance of known heritage assets and geophysical anomalies through the application of AEZs and PEZs and a refined dredge footprint;
- The archaeological assessment of geophysical data acquired during pre and post-dredge monitoring surveys;
- The application of a Protocol for Archaeological Discoveries (PAD) to address unexpected discoveries of material during dredging;
- On-board monitoring via a specially trained archaeological observer to support the implementation of the PAD, and
- Monitoring to support the implementation of the PAD during discharge of material at the construction site.

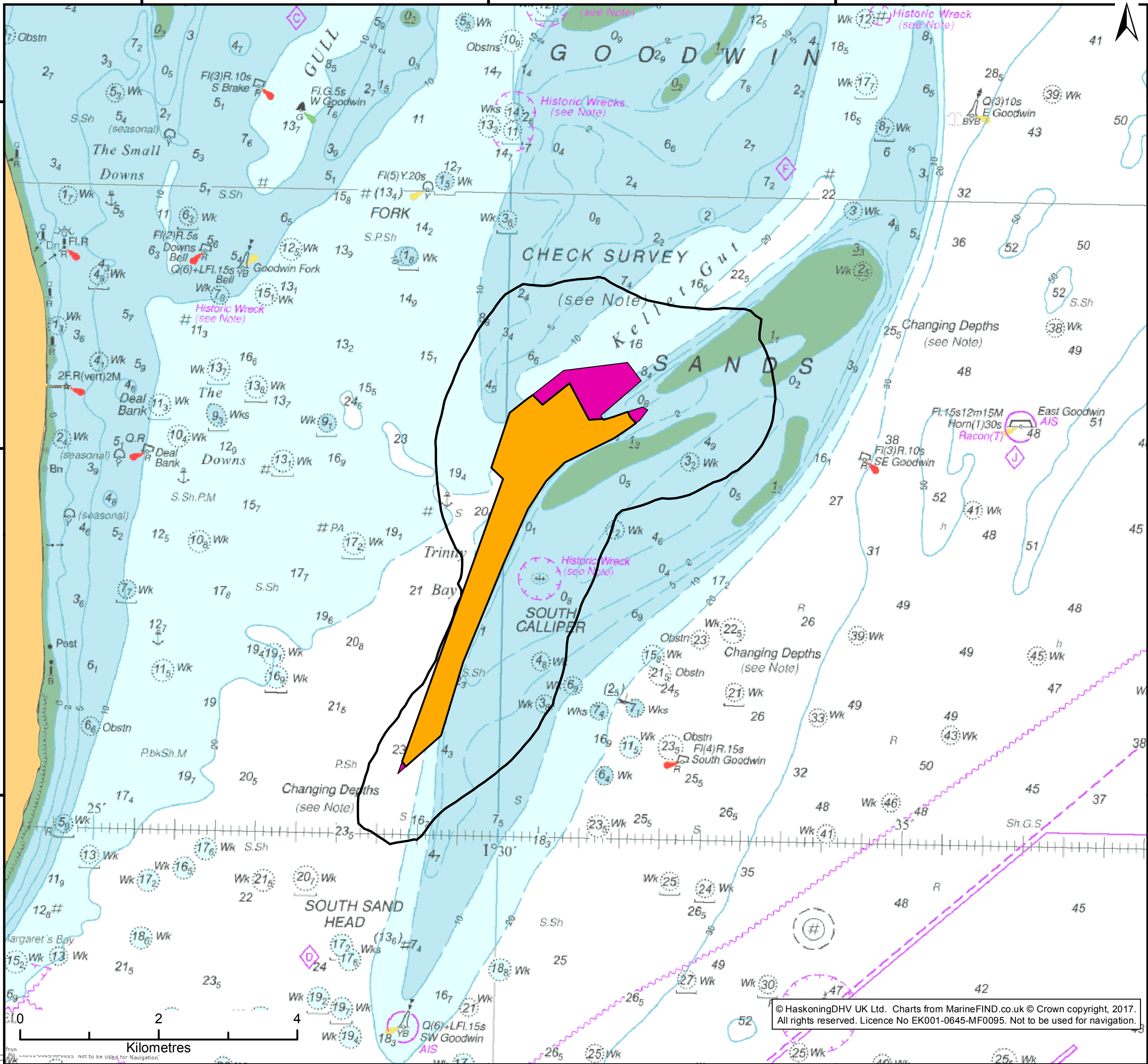
This approach has been developed in consultation with Historic England and is outlined in the draft WSI. Taken together with the proposed dredging methodology, i.e. extracting material evenly across the dredge footprint with an average depth of ~1m (not exceeding -1.95m dredge depth), this should result in a low risk of material of archaeological significance being present.

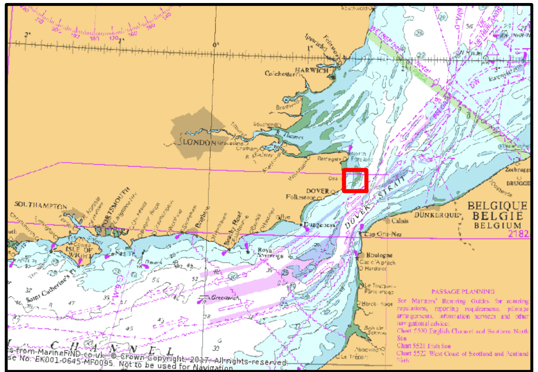
7 Nature Conservation

MMO Comment

Comment No.	Comment
6.1	*Subtidal coarse sediment (infralittoral and circalittoral) is an interest feature of the Goodwin Sands recommended Marine Conservation Zone (rMCZ) and has an increased sensitivity to abrasion and therefore a longer recovery period. It is also important as sub-prime habitat for sandeels. Dredging therefore must be excluded from the north eastern corner of the proposed dredging area and this must be incorporated into proposed plans.*

In response to this, the originally proposed dredge area has been revised and excludes the areas in the north eastern corner; **Figure 7-1** illustrates the revised dredge area**.** It should be noted that the dredge footprint has subsequently been further refined to avoid potential archaeological anomalies (see Project Update and **Section 6** of this report).





Legend:

- Revised to avoid subtidal coarse sediment (2017)
- Originally Proposed Dredge Area / PIZ (2016 ES)
- Secondary Impact Zone

Client: Dover Harbour Board

Project: MMO Response December 2016

Title: Revision to Dredge Footprint To avoid subtidal coarse sediments

Figure: 7.1

Drawing No: PB2107/ARCH/005

Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	06/12/2016	JE	VC	A4	1:80,000
02	02/08/2017	NJ	VC	A4	1:80,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV Enhancing Society Together

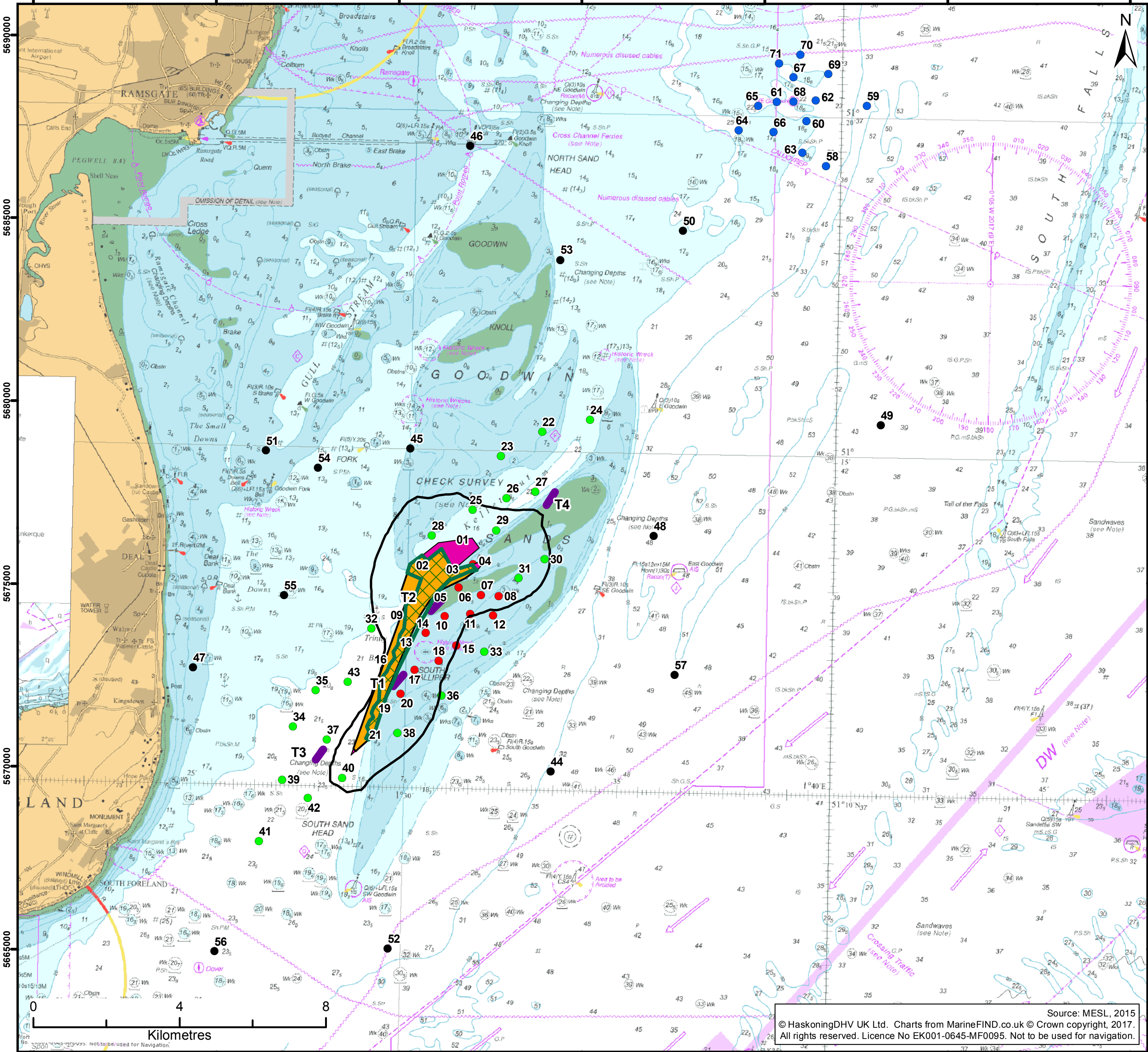
PORT OF DOVER

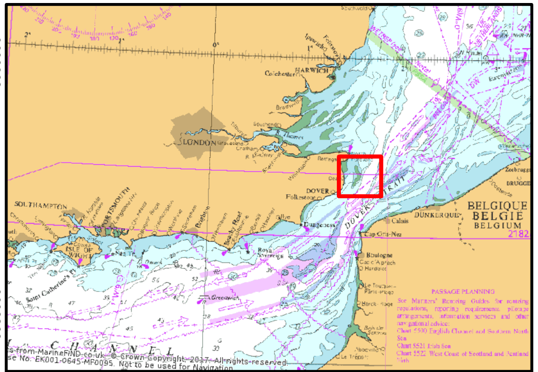
DWDR

8 Fisheries and Shellfisheries

Comment No.	***Comment***
7.1	*An additional chart must be provided that clearly displays the original and current Primary Impact Zone (PIZ) and Secondary Impact Zone (SIZ) with the benthic trawl and benthic grab locations overlain so that a comparison can be made between species recorded in each zone*

Figure 8-1 illustrates the original and current PIZ, the SIZ and location of the benthic trawl and grab samples. It should be noted that the dredge footprint has subsequently been further refined to avoid potential archaeological anomalies (see Project Update and **Section 6** of this report) and this refined footprint has been included on **Figure 8-1** for completeness.





Legend:

- Refined Dredge Footprint (2017)
- Revised to avoid subtidal coarse sediment (2017 see Section 5)
- Originally Proposed Dredge Area / PIZ (2016 ES)
- Secondary Impact Zone

Sampling Stations

- PIZ (as defined in ES 2016)
- SIZ (as defined in ES 2016)
- Context
- Reference
- Trawl Location

Client:	Project:
Dover Harbour Board	MMO Response December 2016

Title:

Location of Original and Current PIZ, SIZ, and Benthic Trawl and Grab Locations

Figure:	8.1	Drawing No:	PB2107/MMO/003		
Revision:	Date:	Drawn:	Checked:	Size:	Scale:
01	24/02/2017	JE	JM	A4	1:150,000
02	02/08/2017	NJ	JM	A4	1:150,000

Co-ordinate system: WGS 1984 UTM Zone 31N

Royal HaskoningDHV
Enhancing Society Together

PORT OF DOVER
DWDR

9 Summary

Following the public consultation period subsequent to the submission of the FEIR (RHDHV, 2016a), the MMO has requested further clarifications to inform the decision making process in relation to the Goodwin Sands MLA. These clarification requests related to six areas including the consideration of alternatives, socio-economics, marine mammals, heritage, nature conservation and fisheries/shellfisheries and responses to each of these are provided in this report.

Significant additional work has been undertaken by DHB since December 2016 and the clarifications contained within this report are set within the context of the associated project updates. The proposed approach to dredging at the Goodwin Sands has been refined in light of the additional work in order to minimise the potential environmental effects as far as reasonably possible, particularly in relation to heritage. There have also been changes to the indicative dredging programme and overall volumes for extraction.

The requirement for a third round of public consultation in relation to the Goodwin Sands MLA has resulted in determination of the MLA being later than originally envisaged within the project programme. As with all large schemes, the ‘investment windows’ during which the necessary funds are available is linked to a range of complex factors and are, therefore, limited. Delays in the project programme can result in key milestones being missed and this can have knock-on implications for the investment targets for the wider project. To secure the viability of the DWDR scheme, it is therefore imperative that DHB keeps to the current project programme and this has been a key driver when assessing potential alternative aggregate sources.

To safeguard the construction programme, VSBW on behalf of DHB has secured material for the first stage of reclamation from Area 501, the availability of which only became a licensed option for consideration in the summer of 2017. Whilst this demonstrates the willingness of DHB to source material from alternative and already-licensed marine aggregate areas, Goodwin Sands remains the most environmentally sound and economically viable option for delivering the remainder of Stage 2 and Stage 3 of the DWDR Scheme. Should it become necessary to source all the required reclamation material from alternative sources, the delivery of later stages of the DWDR Scheme could be affected.

10 References

Barker, J. (2015). Greater Thames Estuary Seal Surveys Report. UK & Europe Conservation Programme Report, Zoological Society of London. Available online at: https://www.zsl.org/sites/default/files/media/2015-07/2015_July_Greater%20Thames%20Estuary%20Seal%20Survey%20Report.pdf.

Newell, R.C., Seiderer, L.J., Simpson, N.M. & Robinson, J.E. 2002. Impact of Marine Aggregate Dredging and Overboard Screening on Benthic Biological Resources in the Central North Sea: Production Licence Area 408, Coal Pit. Marine Ecological Surveys Limited Technical Report No ER1/4/02 to the British Marine Aggregate Producers Association. 72 pp.

Haslam, D. W. and Pielou, F. A. (1985). Present State of Hydrographic Surveying of the North Sea and English Channel. International Hydrographic Review, Monaco, LXII (1), January 1985. Available at URL: https://journals.lib.unb.ca/index.php/ihr/article/download/23477/27251 [Accessed 17/11/2016]

Historic England (2002). Military Aircraft Crash Sites. Available online: https://content.historicengland.org.uk/images-books/publications/military-aircraft-crash-sites/milaircsites.pdf/

Hyder Consulting Ltd (2014). Letter from Tim Buckingham-Jones of Hyder to Simon Greenhalgh of DHB

MacAlister Elliott and Partners Ltd, (2015). Preliminary Investigations into Fishing Activity on the Goodwin Sands

Pielou, F. A. (1984). Source data diagrams and their use on British admiralty charts. International Hydrographic Review, Monaco, LXI (2), July 1984. Available at URL: https://journals.lib.unb.ca/index.php/ihr/article/viewFile/23500/27273 [Accessed 17/11/2016]

Royal HaskoningDHV (2016a). Goodwin Sands Aggregate Dredging Scheme Marine Licence Application: Further Environmental Information. September 2016.

Royal HaskoningDHV (2016b). Goodwin Sands Aggregate Dredging: Environmental Statement. Volume II EIA Outcome. May 2016.

Royal HaskoningDHV (2016c). Goodwin Sands Aggregate Dredging: Archaeological Written Scheme of Investigation (Draft). Report ref: I&B/PB2107/304514/R001/D01.

UKHO (2009) Goodwin Sands, Assessment on the Analysis of Routine Resurvey Areas GS1, GS2, GS3 and GS4 from the 2009 survey. Available at URL:
[Accessed 17/11/2016]

UKHO (2012) Goodwin Sands, South Calliper, Summary Assessment on the Analysis of Routine Resurvey Area GS4 from the 2012 Survey. Available at URL:
[Accessed 17/11/2016]

Wessex Archaeology (2008). Aircraft Crash Sites at Sea. Available online: http://blogs.wessexarch.co.uk/aircraftcrashsitesatsea/files/2008/03/aircraft_crash-sites_at_sea_report.pdf

Wessex Archaeology (2017). Goodwin Sands, Archaeological Review of Geophysical Data (2017). Report ref: Ref: 111511.02.

Appendix 1 November 2016 Heritage Meeting Minutes

Appendix 2 Archaeological Review of Geophysical Data (Wessex Archaeology, 2017)

Appendix 3 Annex to Archaeological Review of Geophysical Data (Wessex Archaeology, 2017)